Program Environmental Impact Report

on

Gravel Removal from the Lower Mad River

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Volume II Appendices

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SCH 92083049

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April, 1993

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Humboldt County Planning and Building Department
Planning Division
3015 H Street
Eureka, CA 95501

Program Environmental Impact Report
on
Gravel Removal from the Lower Mad River

Volume II
Appendices

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PROPOSED FINAL

PROGRAM ENVIRONMENTAL IMPACT REPORT

ON

Gravel Removal from the Lower Mad River

BOARD OF SUPERVISORS
HEARING COPY

SCH # 92083049

MAY, 1994

Prepared for:

Humboldt County Planning and Building Department
Planning Division
3015 H Street
Eureka, CA 95501

PROGRAM ENVIRONMENTAL IMPACT REPORT

ON

GRAVEL REMOVAL FROM THE LOWER MAD RIVER

Humboldt County, California
SCH #92083049

Humboldt County
Board of Supervisors

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ATTACHMENTS AVAILABLE SEPARATELY

Attachment 2 Lower Mad River Annual Gravel Replenishment and Harvest Models 1962-1993.

Attachment 3 1993 MOA Extension Reports; Scientific Committee Gravel Extraction Recommendation Report; and a final wildlife report, Wildlife Report for Lower Mad River, Humboldt County prepared by Mad River Biologists and dated September 2, 1993.

0.1 PEIR PROLOGUE

The first draft of this PEIR on Gravel Removal from the Lower Mad River was submitted to the State Clearing House in April 1993 (SCH No. 92083049). That document consisted of two parts. Volume I was the draft. Volume II was a set of appendices (A through N).

In September 1993 a Proposed Final PEIR was circulated. The proposed Final PEIR had three attachments.

Attachment 1 was titled Aggregate Resources Management Plan.
Attachment 2 is Lower Mad River Annual Gravel Replenishment and Harvest Models 1962-1993.
Attachment 3 is titled: 1993 MOA Extension Reports; Scientific Committee Gravel Extraction Recommendation Report; and a final wildlife report, Wildlife Report for Lower Mad River, Humboldt County prepared by Mad River Biologists and dated September 2, 1993.

The changes brought about by the responses to the Proposed Final PEIR led to a recirculated Draft PEIR, submitted to the State Clearing House in February 1994.

Attachment 1 was not incorporated. To the extent that the previous appendices and Attachments 2 and 3 are not inconsistent with this PEIR they are incorporated herein. They are referenced herein as Appendices A through N and as Attachments one through three.

Mr. William Davis, attorney for the gravel operators has collected a package of letters describing the economic benefits of Mad River aggregate resources. These letters were attached to the recirculated draft as Appendix O.

Pursuant to CEQA 15132, this proposed final PEIR contains the following:

1. Revisions to the recirculated draft PEIR.
2. Comments and responses to the recirculated draft PEIR.

This proposed final PEIR, without revision marks and strikeouts has been prepared for the Board of Supervisors for certification. After certification, additional copies without revisions and strikeouts will be printed for distribution and sale.

Comments regarding this document should be submitted to the Humboldt County Planning and Building Department, Thomas D. Conlon, Director, 3015 H Street, Eureka, CA 95501. Phone: (707)445-7541. FAX: (707)445-7446.

1.0 PROJECT DESCRIPTION

1.1 Type of Document

This Environmental Impact Report (EIR) is being prepared pursuant to the California Environmental Quality Act (CEQA [Public Resources Code Section 21000 et. seq.]) and the State CEQA Guidelines (14 California Administrative Code Section 15000 et. seq.). This EIR is a Program EIR (PEIR) pursuant to Section 15168 of the CEQA Guidelines and will evaluate the cumulative impacts of gravel extraction and of channel degradation, whatever the cause, on the natural resources, public utilities, and structures in and along the lower Mad River. This EIR also presents and evaluates several project alternatives including a preferred alternative. The preferred alternative is a plan to develop, implement, and monitor flexible, comprehensive, environmentally-sound mining strategies and reclamation standards that will provide a moderate rate of recovery from past degradation at critical sites while attempting to provide for continued commercial extraction of Mad River riverrun sand and gravel and while protecting significant riverine resource values. The preferred alternative is introduced in Section 1.4 and described more thoroughly in Section 6.

A PEIR is a public document used to: analyze the environmental effects of a proposed project; ascertain ways to reduce or avoid possible environmental degradation; and identify alternatives to the project which would reduce or avoid the significant adverse effects of the proposed project. The Draft PEIR must also disclose significant adverse environmental impacts that cannot be avoided, growth-inducing impacts, effects not found to be significant, and significant cumulative impacts of all past, present and reasonably anticipated future projects.

Because this PEIR is structured around a cumulative analysis, cumulative impacts are discussed within each subsection of Section 5.0, Impacts and Mitigation Measures. Therefore, there is no separate "Cumulative Impacts" section as described in the CEQA Guidelines, Section 15130.

1.2 PEIR Purpose and Scope

The preparation of this PEIR is the result of a 1992 Memorandum of Agreement (MOA) between the following Mad River gravel operators: Eureka Sand & Gravel; Mad River Sand & Gravel; and Redwood Empire Aggregates, and the following agencies: Humboldt County Board of Supervisors; California Resources Agency; Board of Mining and Geology; Department of Conservation; Department of Fish and Game; and State Lands Commission. See Appendix K and Attachment 3 for the MOA and related documents.

According to the MOA "The County shall prepare, or cause to be prepared under contract to it, a programmatic EIR to evaluate the cumulative effects of gravel extraction operations on the natural resources of the Mad River from Swasey [Sic] Dam downstream to the railroad bridge which is downstream of the Highway 101 Bridge." From this we further interpreted that the initial purpose of the PEIR was to evaluate the cumulative effects of instream gravel extraction operations and channel degradation, regardless of the causes, on the natural resources, public utilities and structures of the lower Mad River.

Mitigation measures and feasible alternatives as a means of minimizing or avoiding potential adverse effects of the project are also addressed. Cumulative impacts are discussed within each subsection of Section 5, Impacts and Mitigation Measures.

1.3 Intended Use of this PEIR

This PEIR will identify the known and anticipated significant adverse environmental impacts on the riverine environment that have resulted from Mad River channel degradation and Mad River gravel extraction operations. It will also identify certain cumulative effects that are the result of gravel extraction in combination with other activities.

The project is the development of an enforceable instream mining regulatory program that will operate under the authority of SMARA and any existing or future County procedures and ordinances. The purpose of the project is to enhance and protect the aggregate extraction-related environmental riverine resources of the Mad River corridor.

The preferred project alternative is the development and implementation of a flexible Mad River aggregate management program, monitoring program, and reclamation plan that will use coordinated extraction prescriptions and reclamation standards which will allow a moderate rate of recovery (aggradation) at critical sites while protecting or enhancing other river resource values. The environmental effects of implementing the preferred project alternative are also evaluated.

The PEIR will review and evaluate the potential environmental impacts of the preferred alternative project which includes:

1. The development of a coordinated adaptive mining and management plan to limit the potential adverse impacts of gravel extraction
2. The development of an adaptive river resource monitoring program to monitor the impacts of gravel extraction under the adaptive management plan
3. The development of a process to annually review compliance and enforce instream mining reclamation plans
4. The development of proposed mitigation measures to limit the potential adverse impacts of the preferred project alternative
5. The establishment of a Mad River Scientific Design and Review Committee (SDRC) which will act as an agent for the County. The duties of the SDRC are described in Section 6.
6. The development of a procedure to review and guide the management program and the activities of the SDRC. Some people believe this should be the role of the Humboldt County Board of Supervisors. Others believe that a separate committee should be established.

The PEIR will serve as a reference for Humboldt County, the SDRC, the California Department of Fish and Game, and others, as described in Section 3.1 and Appendix I.

The PEIR may serve as a foundation for future environmental documents necessary for the review and approval of County, State, or Federal permits regarding current, future, new, or expanded, mining operations. This PEIR does not address all of the issues that an application for a conditional use would raise. Such operations that are currently not permitted will have to submit site-specific supplemental EIRs or other appropriate environmental documents.

The PEIR and preferred project alternative are limited in scope as described in Sections 1.2 and 1.8. Minor annual changes in appropriate adaptive mining, monitoring, and reclamation plans as considered herein will be made to provide adequate environmental protection and as

authorized in the adaptive mining plan and in SMARA, will not require annual CEQA reviews. Significant changes in the above may require CEQA review. The preferred project alternative will be implemented during the 1994 extraction season. After the fifth extraction season under this project (1998), the entire project will be thoroughly evaluated by the SDRC. The five-year findings of the SDRC shall be reviewed at a public hearing during which, recommendations for modifying the management plan, monitoring program and reclamation plan review process will be considered.

1.4 The Project

Because most of the historical extraction sites on the lower Mad River have approved reclamation plans and are operating under either conditional use permits or vested rights there was some initial confusion among planning staff and other participants as to what the "project" was. The question: "What is the project?" was repeated many times while this PEIR was in its early stages. Initially there was no clear answer. As the evaluation progressed it became clear that significant adverse impacts had occurred in the project reach and that there was the potential for additional impacts if the gravel industry followed its historical pattern of extracting more gravel than was being recruited in the lower Mad River.

After examining a series of alternatives the project eventually became the development of an enforceable instream mining regulatory program that will operate under the authority of SMARA and any existing or future County procedures and ordinances.

The preferred alternative includes continuing the commercial extraction of riverrun sand and gravel, in limited quantities, from up to 10 specific sites located along the lower Mad River between the Blue Lake hatchery weir and the U.S. Highway 101 bridges in a manner that will provide a moderate rate of recovery for the past adverse impacts of channel degradation and will eliminate or minimize the adverse impacts of future mining activities. The preferred project alternative includes the formation of a Scientific Design and Review Committee (SDRC) and a flexible, site specific adaptive management and resource monitoring and protection plan which develops, implements, and monitors comprehensive environmentally-sound mining strategies and reclamation standards for limited commercial extraction of riverrun materials from the lower Mad River. The preferred project alternative includes a continuing relative-resource monitoring program from which adaptations to the management plan and reclamation plans can be made as needed.

The adaptive management plan, flexible mining strategies, and reclamation standards require monitoring of the project area, including the gravel bars and related resources in their environs, as needed, to estimate sand and gravel recruitment and replenishment, to monitor related river resource conditions and trends, to verify compliance, to determine the impact of past mining, and to evaluate future proposed annual mining strategies. The combined monitoring, and annual evaluations will lead to appropriate, coordinated, annual, flexible, environmentally-sound, adaptive mining and reclamation strategies which may vary from year to year and site to site. Under this alternative and existing permits the location, method, and level of extraction will be developed annually and approved through a consultative process between the operators, and a Scientific Design and Review Committee (SDRC), acting as an agent for the lead agency (County). A mechanism for review of the SDRC management prescriptions and activities by responsible state and federal trustee agencies and the public is included.

The preferred project alternative is limited in scope. It applies only to the 10 specific sites described herein, to the extraction of river-run sand and gravel, and the direct and indirect impacts of the same. No new or expanded processing sites are included.

This alternative is not an overall Aggregate Resource Management Plan. Such a project should be a County-wide project of much greater scope. This preferred project alternative is not a River Corridor Management Plan. If projects such as these are proposed in the future, tiered, supplemental, or other appropriate environmental documents will be required.

There are up to ten sites considered under this PEIR, which are authorized (or proposed) to extract gravel; see Table 1.4-1. Two sites operate under authorization of Conditional Use Permits, six sites have recognized vested rights, and two sites are unauthorized. The two non-permitted sites are not a part of this project. They are considered here because CEQA requires that the PEIR consider the possibility of future related projects. It is anticipated that agents for the two unauthorized sites will seek to confirm vested rights or obtain conditional use permits. However, this PEIR does not address all of the issues that an application for a conditional use might. raise.

The preferred project alternative will be implemented by developing an adaptive management plan, an adaptive monitoring program, and, as needed, revised reclamation plans for those eight project sites that are currently permitted and have approved reclamation plans. Project sites that do not currently have approved entitlement or reclamation plans will be required to comply with these project standards as a condition of gaining approval of any existing or future applications for vested rights, conditional use permits, or approval of reclamation plans.

The Mad River and its environs are a dynamic system, constantly changing. Changes in the river ecosystem will continue and the processes of aggradation and degradation will continue to occur and reoccur whether gravel extraction continues or not. Because of the dynamic nature of the river system, it is not possible to forecast with precision how the river environment will change. This precludes the possibility of a fixed formula-based management and monitoring program. An objective of this preferred alternative management plan is to develop over time a dynamic set of adaptive mining and reclamation strategies that will respond to changes in the environment and in our understanding of the environment, and to changes in technology.

The impacts and mitigation measures identified in this PEIR will be the basis for establishing site-specific appropriate adaptive mining strategies during State-mandated annual SMARA reviews of project reclamation plans and during other reviews of the project by the SDRC. The SMARA reclamation plan reviews and other reviews are necessary to assure that the prescribed scope, method, type and intensity of mining operations for each year have been and remain appropriate for the actual riverine resource conditions and trends observed in the Mad River environment. The SDRC will modify the adaptive mining strategy, monitoring program and reclamation plans as needed in order to monitor and protect the riverine environmental resources of the lower Mad River while attempting to sustain a viable Mad River gravel industry.

Table 1.4-1 Sites under Review

Operator and Name of bar	Site No.	Max. c.y	Authorization (Date approved)
Mad River Sand & Gravel Guynup bar	1	200,000	Conditional Use Permit (12/30/76) Reclamation plan approved for 200,000 (11/18/88)
Hum County Public Works Emmerson bar	2	2,000*	Conditional Use Permit and reclamation plan for 2,000 (4/4/88)
Redwood Empire Aggregates Emmerson bar	2	50,000	Vested right for 50,000 (6/19/92) Reclamation plan for 50,000 (7/28/92)
Redwood Empire Aggregates Blue Lake bar	3	100,000*	Vested right for 50,000 (6/16/92) Reclamation plan for 100,000 (7/29/92)
Eureka Sand & Gravel Christie bar	4	150,000*	Conditional Use Permit and reclamation plan for 50,000 (3/7/86) Application on file for additional 100,000 c.y.
Redwood Empire Aggregates Johnson bar	5	30,000	Vested right for 30,000 (4/15/93) Reclamation plan for 30,000 (7/29/92)
Mercer Fraser Essex bar	6	40,000	Vested right and reclamation plan for 40,000 (11/3/88)
Arcata ReadiMix Johnson-Spini bar	7	80,000	Vested right and reclamation plan for 80,000 (5/18/89)
Redwood Empire Aggregates Graham bar	8	100,000*	Vested right for 95,000 (4/15/93) Reclamation plan for 100,000 (7/29/92)
Zabel Trucking Simpson-Zabel bar	9	40,000*	unauthorized
Simpson Timber Company upper Simpson bar	10	25,000*	unauthorized
Total		**817,000 c.y.**	

*Note: these volumes are different from those in the Notice of Preparation. The volumes in Table 1.4-1 represent the maximum anticipated entitlement and not the reasonably anticipated future extraction project. Actual annual extraction will be determined from recruitment, replenishment, condition, and trend monitoring data. See Sections 1.5 and 1.6 for discussion on production and entitlement.

Table 1.4-2. Distribution of "extraction sites" and "open space" in the project reach. Distances are in river miles. [a/]

Reach of River	"Open Space"	Extraction Sites	Total Miles	Percent "Open"
Mouth to Boat Ramp	3.2	.0	3.2	100
Boat Ramp to Hwy. 101	2.4	.0	2.4	100
Hwy. 101 to Graham Bar	0.5	.0	0.5	100
Graham Bar to Hwy. 299	.0	1.7	1.7	0
Hwy. 299 to Essex Bar	.8	.0	.8	100
Essex Bar	.0	.4	.4	0
Essex Bar to Railroad Br	.8	.0	.8	100
Railroad Br to Blue Lake Br	.6	2.4	3.0	20
Blue Lake Br to Hatchery Weir	.1	1.6	1.7	6
Sub-Total Miles	8.4	6.1	14.5	
Sub-Total Percentages	*58*	*42*	*100*	58
Hatchery Weir to Sweasey Dam	5.1	.0	5.1	100
Total Miles	**13.5**	**6.1**	**19.6**	
Total Percentages	***69***	***31***	***100***	**69**

[a/] An extraction site reach is a reach with one or more bank attached to an extraction site. An open reach is a reach where neither bank is attached to an extraction site. Refer to Table 4.6-1 for location of structures in project reach.

The process of adopting annual adaptive management strategies includes periodic and annual reviews that will evaluate the success of previous extraction prescriptions; monitor the dynamic character (condition and trend) of Mad River resources, and restrict the scope, method, type and intensity of annual extraction operations, as needed, to protect river resources. The term river resources is understood to include related community infrastructure as well as related physical and biological resources.

1.5 Past Project Aggregate Production

According to the Mad River sand and gravel operators past Mad River production levels varied in response to local construction needs as well as to major highway construction projects which required road base, asphalt paving, concrete bridges, interchanges, overpasses, and related items. Large projects occurring between the 1950's and 1970's include the Highway 101 Arcata-Eureka freeway (8 miles built in the 1950's) and Arcata to Big Lagoon freeway (27 miles built in the 1960's); Highway 299 freeway from Highway 101 to Berry Summit (35 miles built in the late 1960's, early 1970's) and Highway 255 (Samoa Boulevard) from Arcata to the Coast Guard Station (11 miles built in the 1960's).

Other projects that required substantial amounts of Mad River material include the Arcata Airport (1940's, approximately 300,000 cubic yards), and base and paving material for most mill yards in the Arcata-Eureka area. For example, the Simpson Samoa Pulp Mill required 90,000 cubic yards of material for base and concrete in the 60's. Most of the concrete buildings in Eureka built in the 60's obtained materials from the Mad River. The County Courthouse, alone, required 40,000 cubic yards of concrete. The development of Humboldt State University's concrete buildings, base and paving utilized material from the Mad River. In 1972, 5,000 dolos were constructed for the jetties. Half of the 212,000 tons of material came from the Mad River.

Gravel extraction practices during those times included the use of a dragline during winter months. As material was removed, it was replenished by winter flows, allowing for large stockpiles to be developed in winter for summer construction projects. This practice ceased in the early 1970's when the California Department of Fish & Game restricted gravel extraction to other methods. Production levels were decreased and, at the same time, most of the large highway construction projects were completed. Local construction needs of Mad River aggregate remained high through the 1970's and into the 1980's. Several large floods contributed gravel recruitment and replenishment to meet the demands during that time. The recent droughts in the mid 1970-s and late 1980's caused a significant reduction in gravel recruitment. The combined effects of high extraction and low recruitment produced localized channel degradation problems throughout much of the lower Mad River extraction area and may have contributed to the northward migration of the river mouth (Borgeld et al., 1993). Other factors are also suspected of contributing to the northward migration of the river mouth (Borgeld et al., 1993).

Theoretically, the presently permitted and proposed operations could potentially extract up to 817,000 cubic yards per year (Table 1.4-1). However, that level of extraction could not be sustained without serious environmental consequences and recent extraction has been much less than this. The best available data (Lehre, Klein, and Trush, 1993) documents the 41-year period from 1952 through 1992. Excluding 1992 when the extraction level was limited by prescriptions provided by the Scientific Design and Review Committee, the lowest annual

extraction rate was approximately 161,000 cubic yards (1953); the highest was approximately 771,000 cubic yards (1970); and, the average was approximately 358,000 cubic yards. During the last 33 years (1960-1992) the approximate average annual extraction level was 425,000 cubic yards. During the last 10 years (1982-1991) the approximate average annual extraction rate was 286,000 cubic yards. In 1992, the Scientific Design and Review Committee prescribed approximately 153,000 cubic yards. The 1993 Scientific Design and Review Committee prescribed approximately 122,000 cubic yards of extraction. As of this writing the actual 1993 extraction has not been verified.

Table 1.5-1 Examples of average annual sand and gravel extraction volumes from the lower Mad River.

Period	Number of years	Approximate Average annual extraction (cubic yards)
1952 - 1991	41	358,000
1960 - 1992	33	425,000
1982 - 1991	10	286,000
1992	1	153,000
1993	1	122,000

1.6 Project Entitlement versus Future Extraction Levels

There has been some concern that the industry will remain unregulated and attempt to extract the full 817,000 cubic yards found in the various existing and proposed entitlement; and that such a level of extraction would lead to serious environmental consequences. Under current river conditions an average annual extraction level of 817,000 cubic yards is clearly unacceptable. During the 10-year 1982 through 1991 period the average annual extraction level was 286,000 cubic yards. In 1992 and 1993 the extraction levels dropped due to the prescriptions of a scientific committee, operating under the memorandum of agreement which is described elsewhere in this PEIR. Refer to Appendix K and Attachment 3 for the MOA.

The preferred project alternative expands on the MOA and provides a flexible environmental review and adaptive management strategy which will limit future levels of extraction in an attempt to both protect the environment and sustain the industry. Under this program large entitlement will not be extracted unless the SDRC prescribes them.

Although the sum total of the entitlement is large, the large individual entitlement provide river management flexibility and reduce the possibility that a site-specific, scientifically derived, environmentally sound river management decision to extract gravel will be limited by a lack of entitlement. Large entitlement also increase project flexibility should conditions change and channel aggradation becomes a problem throughout the project reach or at specific sites within the project reach.

1.7 Methods of Extraction

This PEIR focus on instream gravel mining. Gravel that is in terraces outside the banks of the river is not instream gravel. The extraction of gravel in terraces, beyond the banks of the river is called terrace mining. Terrace mining is an alternative to instream mining and is considered as an alternative elsewhere in this PEIR. See the section on alternatives to the project.

Instream gravel is gravel that is located between the banks of a river. Channel confinement, bar morphology, and discharge level determines how much of the instream gravel is above or below the water level at any one point of time. During the low-flow summer months the maximum amount of gravel bar is exposed and dry for the longest period of time.

The effects of instream gravel extraction vary with the season of operation, the length of operation, the location in the project reach, the location on the gravel bar, the extraction methodology, the amount of gravel removed, the amount vegetation that is destroyed, the shape of the residual bar, and the skill of the operator.

A variety of methods have been used to extract gravel from the Mad River. The primary methods of gravel extraction used in the last 40 years include:

1 excavation of pits spanning the entire channel width, sometimes to elevations well below the river's thalweg,

2 excavation of pits occupying most of the active channel width to below the elevation of the groundwater table, while leaving or constructing a berm separating the low-flow channel from the pit,

3 skimming of bar surfaces adjacent to the low-flow channel down to the elevation of the groundwater table,

4 excavation of a deep trench adjacent to the low-flow channel but separated from the low-flow channel by a residual berm,

5 skimming of bar surfaces to elevations above the groundwater table at various slop gradients sloping toward the low-flow channel edge, and

6 excavation of a pit to elevations either above or below the groundwater table on the outer areas of bar or low terrace surfaces well away from the low flow channel.

Of these methods, only the last three have been used in recent years. Several types of heavy equipment have been used to extract gravel, depending on the type of excavation. Dragline cranes were best suited to excavation of pits which were dug to below the water surface over large areas. Skimming is usually accomplished with scrapers, bulldozers, or front-end loaders. Trenching is accomplished using a large backhoe or excavator.

There have been no studies done to document specific geomorphic effects of instream gravel mining on the Mad River. However, the response of the river to the various types of extraction can be generalized in terms of the basic conceptual models of river behavior. For a more extensive discussion of effects of instream mining, the reader is referred to Collins and Dunne (1990). They present an overview of the spectrum of effects instream mining may have on a river channel, methods to assess those effects, and several case studies. Here, we discuss several of the most prevalent effects likely to have occurred on the lower Mad River.

Pits within the active channel: Pits encompassing or adjacent to the low flow channel which are excavated to depths below the thalweg elevation are likely to have the most profound effects on channel processes and form. This configuration creates a large basin which causes abrupt decreases in water velocity, not unlike a reservoir behind a dam when viewed in the short term. When flows sufficient to transport sediment from upstream reaches occur, these pits are likely to be completely inundated. They will function as very efficient traps for virtually

all bedload transported until gravel deposition in the pit restores the bed to a high enough elevation to allow transport past the pit to downstream reaches.

In addition to trapping bedload sediment which is transported from upstream reaches, pits within the active channel cause rapid scour of the bed through upstream migration of the knickpoint created by the upstream lip of the pit. A knickpoint may migrate a long distance upstream of a deep pit, depending on river slope, sediment supply, flood magnitude, and other factors. This process may also occur downstream of the pit, but probably to a lesser degree. Excessive bed scour presents a danger to nearby bridges, levees, and other facilities having foundations within the active channel. It also adversely affects aquatic habitat by altering hydraulic geometry and destabilizing riffles and other bedforms. In the Mad River, pit excavations occurring in some years were sufficiently numerous and near each other that it is very likely bed scour propagating upstream from one reached up to and combined with bed scour migrating downstream from another. This represents one type of cumulative effect on river morphology when the combined effects from multiple operations exceed some threshold.

As the pit refills with new sediment, it may exhibit a morphology which is discontinuous with adjacent channel bedforms. During the intermediate stages of refilling with gravel, transitional bedforms such as mid-channel bars may be deposited, or a lateral or point bar may develop which is out of phase with similar features up- and downstream of the pit.

Trenches within the active channel: Trenching adjacent to the low-flow channel is likely to have effects similar to those resulting from pits. They function as very efficient bedload traps and promote bed scour, even in low-flow years. Trenches tend to capture the thalweg, thereby realigning segments of the river and producing a geomorphically discontinuous planform. Incomplete capture of the thalweg results in multiple channels, or braiding.

Typically, trenches were dug just to the inside of the low-flow channel (which includes the thalweg) on meander bends. Being so close to the thalweg, they readily capture the thalweg during moderate stormflows. This results in an artificial shortening of the channel length, decreased radius of curvature, and increased slope of the thalweg relative to the unaltered planform. Consequently, the channel is temporarily destabilized while it adjusts to the new conditions.

If trenches are excavated on the outer (away from the low-flow channel) edges of bars and are sufficiently close to the head of the bar, there can be a high risk of a meander being cutoff during a high flow event if the knickpoint at the upstream end of the trench migrates headward and captures the thalweg at the upstream end of the bar.

Bar skimming: Bar skimming down to the groundwater elevation on a level, planar surface virtually eliminates the confining effect which bars have on the inner channel. As with trenching and pit excavation, this method of gravel extraction can result in bed scour, braiding, and channel realignment. A more recent method of bar skimming is to slope bar surfaces at even or compound gradients toward the low-flow channel edge. Excavated grades are above the groundwater elevation, and so pose a lesser risk of creating an undesirable hydraulic geometry by maintaining a higher degree of confinement of the inner channel. Low-flow channel confinement can be further enhanced by maintaining a vertical buffer between the skimmed surface and the water surface.

Off-channel pits: During the 1992 extraction season, two relatively small pits were excavated on high bar/low terrace surfaces which were judged to be inundated about once every five years on average. The rationale for selecting this type of feature was that it would be far enough removed from geomorphically active areas in low to moderate flow years to have little effect on the already impacted areas in the river corridor, but with the occurrence of flows of sufficient magnitude to cause widespread geomorphic changes, the effects of these pits would be obliterated as the channel reworks the bar surface features.

These pits were several acres in size and were located away from the upper end of the bar to avoid the risk of knickpoint migration causing development of a meander cutoff. Design of these pits incorporated features to enhance their value to the riparian ecosystem. Pit bottom depths were below the groundwater table and sideslopes were very gentle (as low as 10%) so that a spectrum of terrestrial and aquatic plants could colonize the pit margins. The planform of the pits was designed to follow existing vegetation patterns, resulting in an irregular shape bounded by existing vegetation. Consequently, for the life-span of these pits (5-25 years, most likely), they will be less detrimental to the riparian ecosystem than extractions closer to the low-flow thalweg, and less detrimental to the landscape than pits excavated on higher terraces, which would become relatively permanent features.

In a river reach such as the lower Mad, which has all the appearances of a sediment-deprived system, pits located on high bar/low terrace areas may provide a relatively low impact means of sustaining a gravel industry through times of low recruitment. It must be stressed, however, that there is a limit to the extent to which these pits may be utilized. Although presently undefined and perhaps undefinable, this limit may be indexed in a gross sense as some percentage of the surface area of an individual feature which can be safely mined without elevating the risk of meander cutoff during low to moderate flood flows, or creating a large bedload trap which might deprive downstream areas of gravel in a moderate to large flood event.

For the lower Mad River as a whole, historic air photos clearly show that geomorphic continuity has been chronically disrupted for many years. The more intrusive types of mining methods (1-4, above) led to the development of a haphazard, chaotic morphology which is evident in the air photo record for many years and is likely to persist until large floods rework the active channel.

1.8 Project Location and Geographic Scope

The project is located in Humboldt County on the north coast of California approximately 275 miles north of San Francisco, California and 75 miles south of Crescent City, California. The mouth of the Mad River (river mile 0), is located at about latitude 40°58'30" North, longitude 124°07'30" West (approximately the same latitude as Salt Lake City, Utah; Lincoln, Nebraska; and New York City, New York).

The lower end of the project is located between the City of Arcata and the community of McKinleyville, approximately 10 miles north of the City of Eureka, the County Seat. The middle reach is just south of the City of Blue Lake. The upper reach, near the former Sweasey Dam, is privately-owned timber land. Other communities that are near the project area are: Korbel, Glendale, and the West End Road area. See Maps 1.2-3 and 1.2-4 and Appendix A, Individual Site Details for specific locations of the mining operations covered under this PEIR.

The geographic scope of the project is bank to bank along the Mad River from the former Sweasey Dam site, river mile 19.6, to the Hammond Trail Bridge, river mile 3.6. Those portions and percentages of the project reach that are "occupied by extraction sites" are shown in Table 1.4-2. As defined in Table 1.4-2, 69 percent of the project reach is "open space" and 31 percent has at least one bank in an extraction site. The PEIR and management plan assume no extraction sites upstream from the Mad River Hatchery weir nor downstream from Highway 101. The upper project area from the Sweasey Dam site to the hatchery weir is of interest as it is the major immediate source of aggregate recruitment for the lower project extraction area, located between the hatchery weir and the Highway 101 Bridge. The lower project area between the Highway 101 bridge and Hammond Trail bridge, and the reach downstream of the Hammond Bridge are of interest because some project impacts can be expected to migrate downstream. Bank to bank is understood to refer to bank-full channel capacity and is understood to be a dynamic channel feature which will change location over time. The project also includes the adjacent upland aggregate processing sites but considers no expansion of these sites. See Maps 1.2-1 and 1.2-2.

1.9 Economic Benefits of the Project

The County retained Dr. John Grobey to gather and analyze information on the economic benefits of gravel mining in Humboldt County. The following paragraph is adapted from Dr. Grobey's report. See Appendix M for Dr. Grobey's complete report.

Gravel mining operations have had, and will continue to have substantial effects on the Humboldt County economy. Mining provides an input of vital and perhaps indispensable importance to a number of key activities in the construction industry. Construction sand and gravel provide the necessary ingredient in foundation construction and other stabilization requirements in road construction, maintenance, and repair. Concrete blocks and bricks, asphaltic concrete aggregates and other bituminous mixtures cannot be prepared without these inputs. Other important uses include fill materials, snow and ice control, and railroad-grade ballast. The importance of these uses is out of proportion to the modest market values and regional cash flows generated by this sector of the economy. Questions about the economic significance of this industry may be addressed by asking what would happen to the economy if gravel mining were brought to a complete halt. It is hard to imagine what substitute material might be used, or where it could be obtained as cheaply. Many economic activities would simply cease. Refer to Appendix O, incorporated herein, for additional information on the economic benefits of gravel extraction operations.

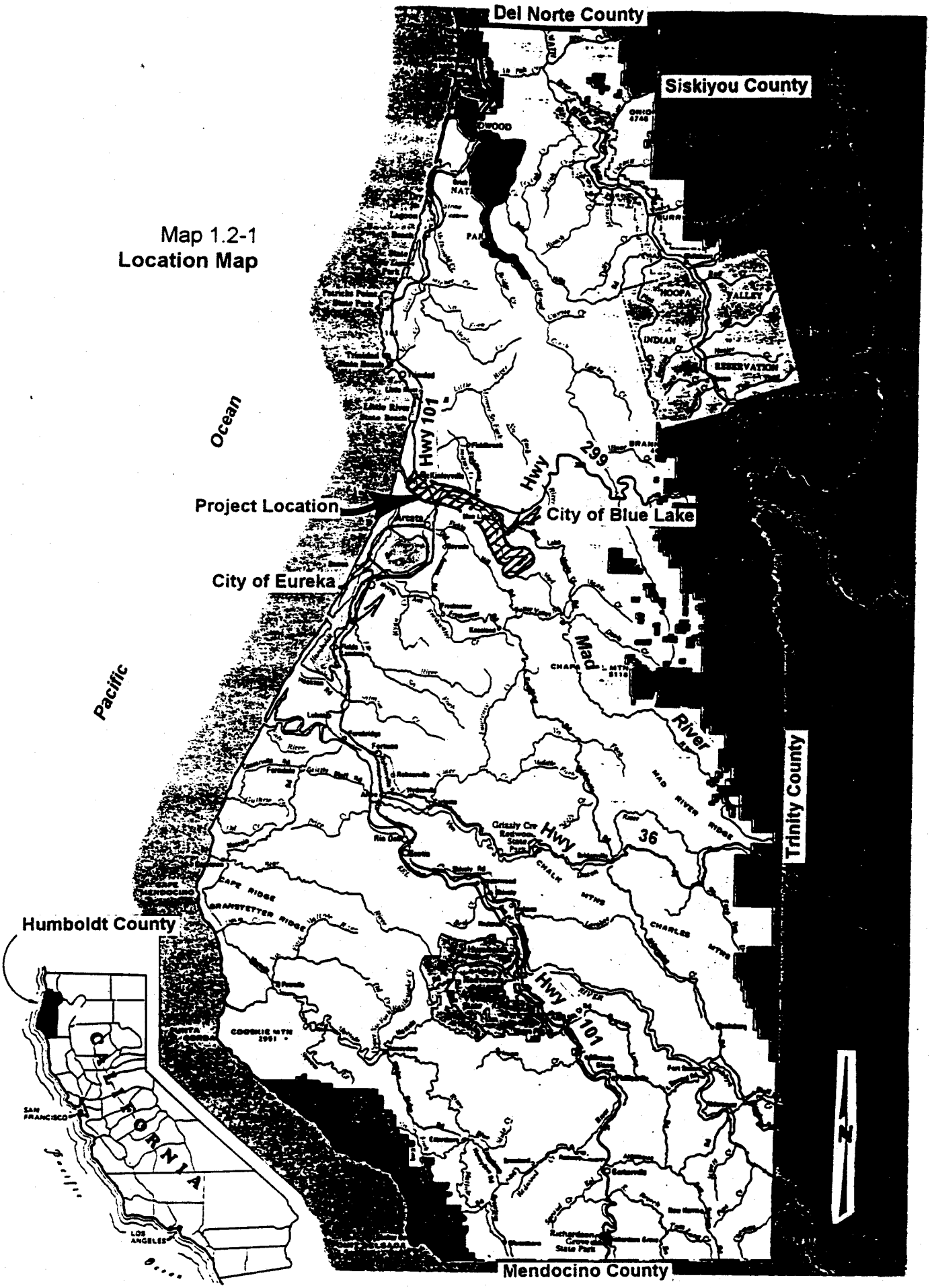
1.10 Other Projects and Related Factors in the Extraction Area

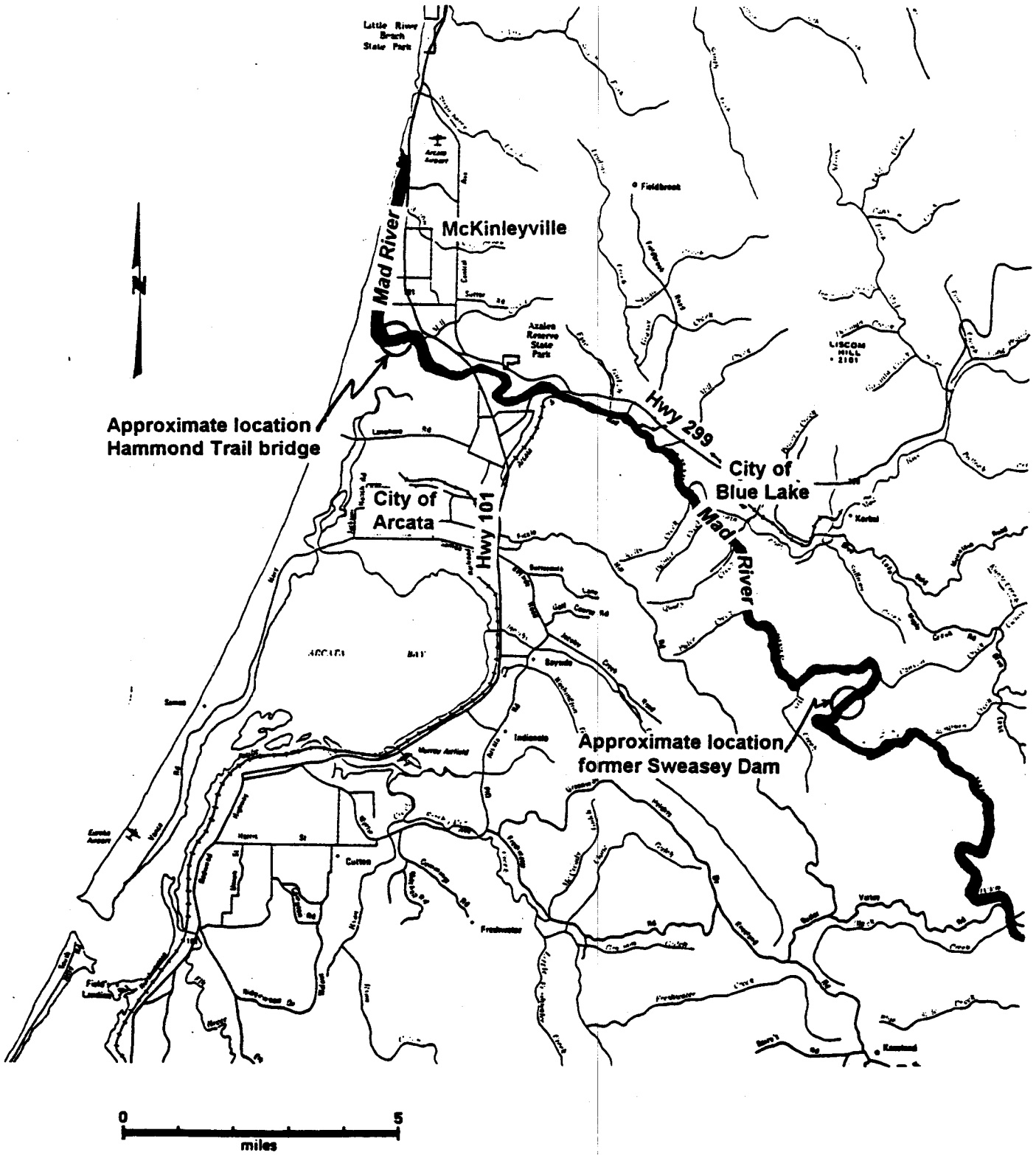
The lower Mad River is a complex dynamic ecosystem. In addition to gravel extraction and processing, there are a variety of other projects and related factors influencing the resources of the lower Mad River area. Some of these are included in the public structures list (Table 4.6-1). The PEIR recognizes that the impacts of these projects and factors continue and that they are varied and cumulative. A few examples are listed below. Concentrations of sea lions and seals at the mouth of the river, the rock cascade located just upstream from Highway 299, anglers and poachers, and the weir at the fish hatchery all impede the migration of anadromous fish. Structures in the river, such as bridge piers and Ranney wells increase local channel scour. Levees and rip-rap alter channel scour patterns, limit the extent of riparian vegetation, and redirect the hydraulic forces of the river towards other banks. Highways; HBMWD facilities; streambank protection rip rap; bridges; and adjacent residential, industrial,

and agricultural areas impact river esthetic qualities. Sewage effluent and other organic matter sources influence river dissolved oxygen concentrations. Water diversions reduce streamflow and produce indirect effects on stream temperature and dissolved oxygen concentrations.

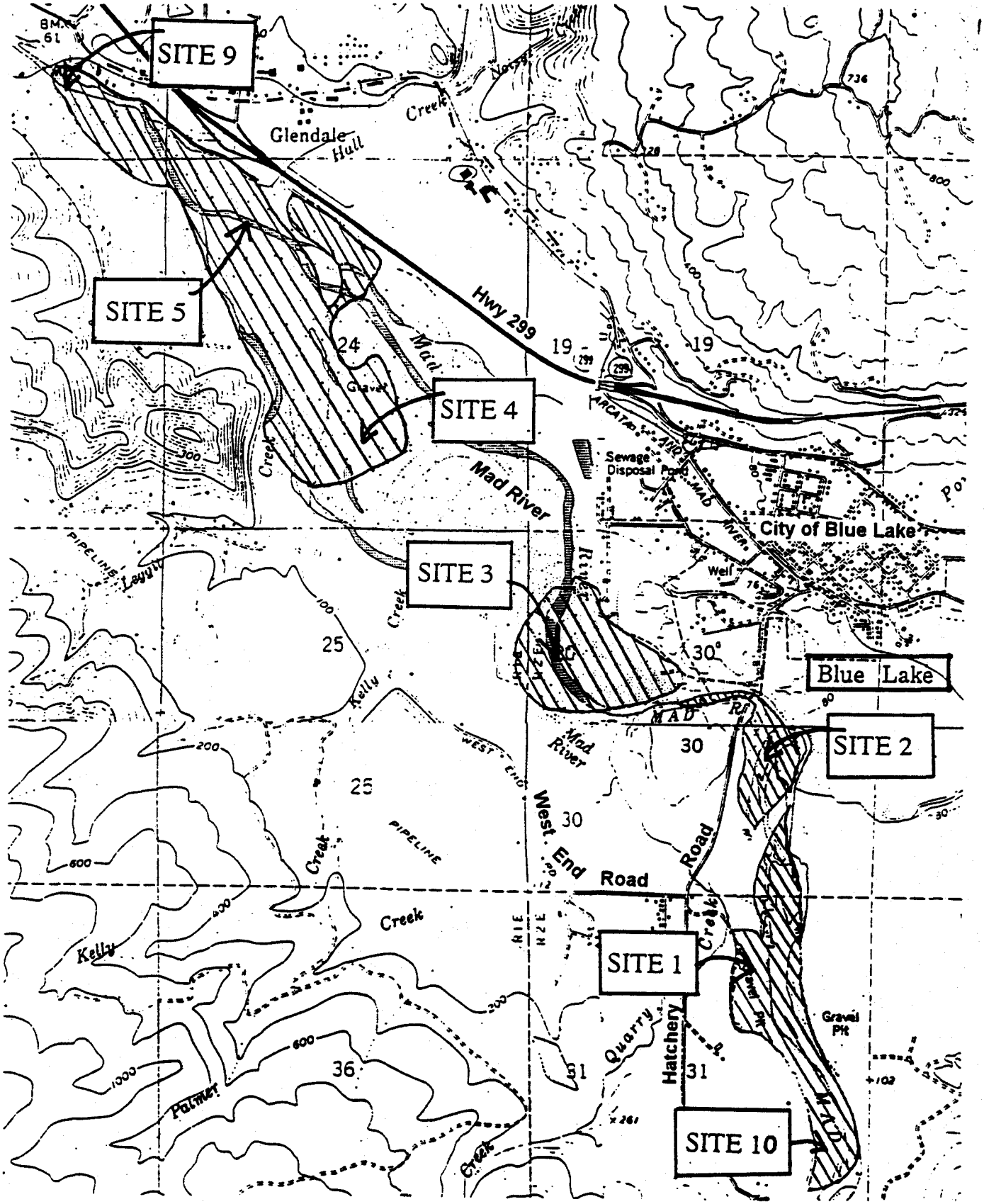
These projects and related factors and others cumulatively influence various Mad River resources, many of which are also influenced by gravel extraction and processing in the lower Mad River area.

Map 1.2-1
Location Map



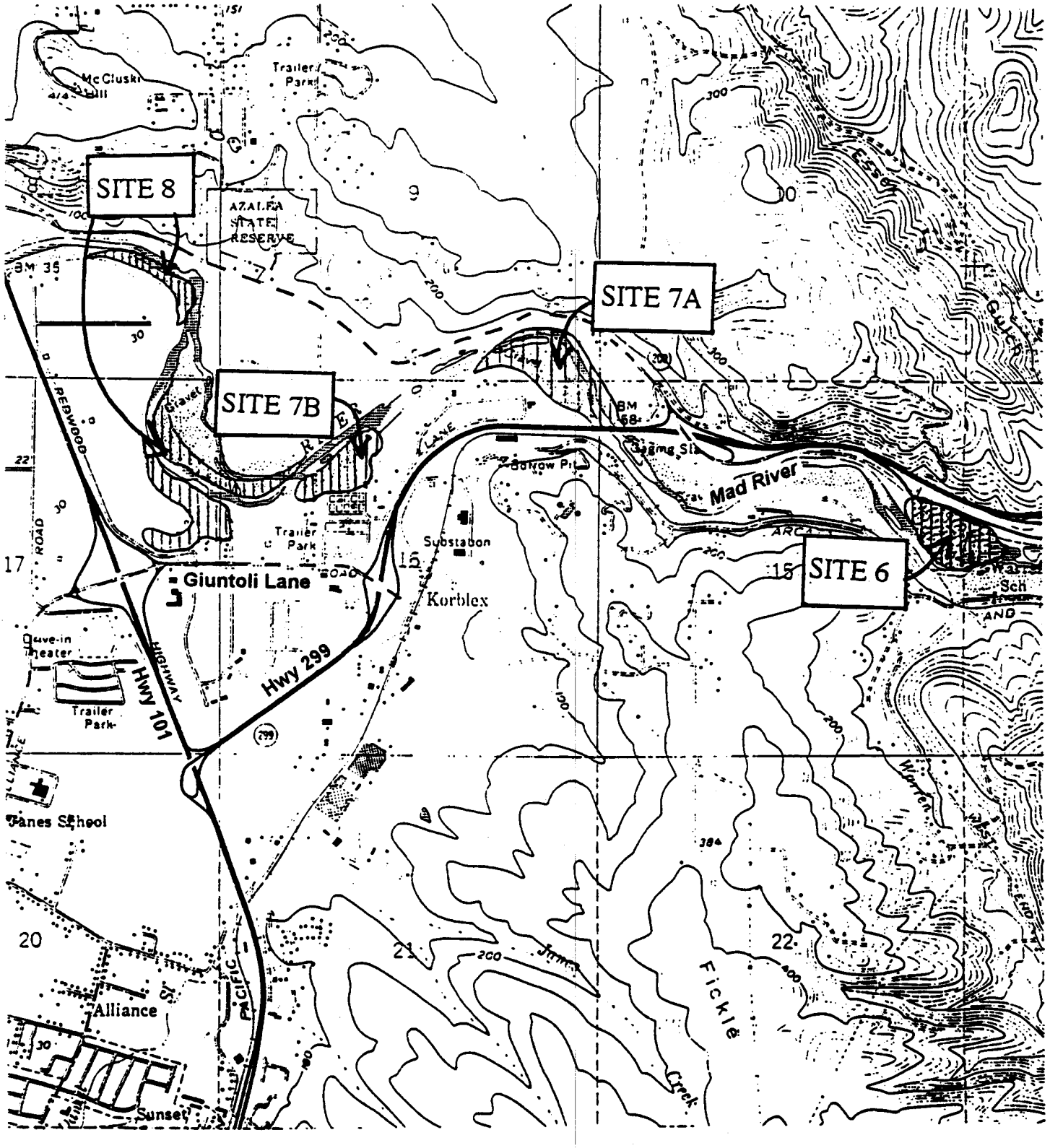


Map 1.2-2
Regional Map



Map 1.2-3
Vicinity Map
1 of 2

(adapted from: James Roscoe Consultants Report, Appendix G)



Map 1.2-4
Vicinity Map
2 of 2

(adapted from: James Roscoe Consultants Report, Appendix G)

2.0 SUMMARY

2.1 Identified Potential Significant Effects

For the purposes of CEQA, impacts identified herein are either 'significant'(S), 'significant and unavoidable' (SU), 'less than significant' (LS), or 'potentially significant' (PS). No differentiation has been made as to the degree of significance or insignificance.

Although Planners do distinguish degrees of significance and/or insignificance when evaluating land use decisions, CEQA does not require such a comparison, therefore this PEIR does not identify the scale of relative significance or insignificance of an identified impact.

Table 2.1-1 summarizes the effects and identifies the related mitigation measures. A more detailed list of the effects is found in Section 2.2. A detailed list of mitigation measures is shown in Section 2.3. Refer to Section 5 for a more complete discussion of both effects and mitigation measures.

Note in Table 2.1-1 that certain significant adverse impacts are mentioned more than once. For example Morph-1 includes those significant effects found under the Public Utility and Structures listing (PU&S). Likewise, Noise-10 and Rec-3 are similar, if not identical.

Impacts resulting from excessive bed degradation in certain reaches of the lower Mad River are one of the principal adverse effects caused by excessive gravel extraction. Other factors also contribute to bed degradation and these include low rainfall and runoff, reduced rates of erosion, and localized channel scour to name a few. However, managing and limiting gravel extraction is the most direct means of reducing most of the channel degradation in the lower Mad River.

It is understood that gravel extraction in excess of net recruitment, causes degradation and the greater this excess is the greater the potential resulting impacts will be and/or the sooner they will occur. If extraction is below net recruitment, aggradation will reduce or eliminate the impacts caused by excessive degradation.

Regardless of the volume extracted, gravel extraction methods can produce adverse impacts on channel morphology and on the aquatic and adjacent environments. However, these impacts can usually be mitigated during the annual extraction design and review phases.

Table 2.1-1 - Summary of Environmental Effects.

Impacts	Signif w/o mitigat.	Mitigation Measures	Signif after mitigat.
Morph-1 Bed degradation, impact on structures (See PU&S impacts)	S	Mit 1, 2	S
Morph-2 Bed degradation, impact on aquatic habitat	PS	Mit 1	LS
Morph-3 Bed degradation, impact on groundwater	PS	Mit 1, 3	LS
Morph-4 Bed degradation, impact on bank stability	PS	Mit 1, 3	LS
Morph-5 Bed degradation, impact on channel capacity	LS	Mit 1	LS

Morph-6 Extraction impacts on river resources	PS	Mit 1	LS
H2OQlty-1 Turbidity during high flows	LS	None required	LS
H2OQlty-2 Summer bridge placement, impact turbidity	LS	Mit 4	LS
H2OQlty-3 Skimming reduces channel confinement	PS	Mit 1	LS
H2OQlty-4 Petroleum product leaks	PS	Mit 5	LS
GndH2O-1 Aggradation raises water table	PS	Mit 1	LS
GndH2O-2 Degradation lowers water table	PS	Mit 1	LS
GndH2O-3 Degradation impacts HBMWD reach	PS	Mit 1	LS
Fish-1 Extraction reduces channel confinement, may create low water barrier	PS	Mit 1	LS
Fish-2 Degradation impacts migration at tributaries	PS	Mit 1	LS
Fish-3 Extraction may impact spawning	PS	Mit 1, 6	LS
Fish-4 Summer bridge may impact juvenile migration	PS	Mit 4	LS
Fish-5 Trenching impact on riffles	PS	Mit 1	LS
Fish-6 Extraction impact on woody debris and diversity	PS	Mit 1	LS
Wild-1 Loss of wildlife habitat	S	Mit 1, 7, 8, 9	S
Wild-2 Noise on wildlife	PS	Mit 1, 7, 10	PS
Wild-3 Dust coating vegetation	PS	Mit 1, 7, 11, 12	LS
Wild-4 Habitat of various species of concern	PS	Mit 1,7	LS
Wild-5 Northern Red-legged frog	PS	Mit 1, 7	LS
Wild-6 Yellow-legged frog	PS	Mit 1, 7	LS
Wild-7 Northwestern Pond Turtle	PS	Mit 1, 7	LS
Veg-1 Cumulative impacts on riparian vegetation	S	Mit 1, 8, 9	S
Veg-2 Loss of vegetation may impact bank stability	PS	Mit 1, 3, 8, 9	LS
Veg-3 Cumulative impacts on successional development of gravel bars, terraces and vegetation	S	Mit 1	S
Air-1 Exhaust emissions	LS	None required	LS
Air-2 Generation of dust	PS	Mit 11, 12	LS
View-1 Cumulative visual impacts near Blue Lake and Hatchery Road	S	Mit-24	S
View-2 West End Road visual impacts	LS	None required	LS
View-3 Cumulative visual impacts near Highway 299 & Giuntoli Lane	S	Mit 24	S
View-4 Cumulative visual impacts along Highway 299 between Arcata and Blue Lake	S	Mit 24	S
View-5 Visual impacts along North Bank Road	LS	None required	LS
View-6 Cumulative visual impacts along river	SU	Mit 13, 24	SU
Traffic-1 City of Blue Lake	PS	Mit 14, 15	PS
Noise-1 Mad River Sand & Gravel	LS	None required	LS
Noise-2 Emmerson Bar	LS	None required	LS

Noise-3 Blue Lake Bar	LS	None required	LS
Noise-4 Eureka Sand & Gravel processing site & Christie Bar	LS	None required	LS
Noise-5 Johnson-Zabel Bar	LS	None required	LS
Noise-6 Essex Bar	LS	None required	LS
Noise-7 Arcata ReadiMix processing site	SU	Mit 10	SU
Noise-8 REA processing site	SU	Mit 10	SU
Noise-9 Eureka Ready Mix impact on Glendale Trailer Park	LS	None required	LS
Noise-10 Impact on river users	SU	Mit 10, 16	SU
PU&S-1 Degradation impact at Mad River Fish Hatchery weir	PS	Mit 1, 2	LS
PU&S-2 Degradation impacts at RSP adjacent to fish hatchery	PS	Mit 1, 2	LS
PU&S-3 Blue Lake bridge	PS	Mit 1, 2	LS
PU&S-4 Blue Lake right bank levee	PS	Mit 1, 2	LS
PU&S-5 Blue Lake sewage treatment ponds & levee	PS	Mit 1, 2	LS
PU&S-6 Highway 299 Mill Creek bridge	PS	Mit 1, 2	LS
PU&S-7 North Coast Railroad Authority bridge	PS	Mit 1, 2	PS
PU&S-8 Glendale Drive bridge at Lindsay Creek	PS	Mit 1, 2	LS
PU&S-9 Highway 299 bridge at Lindsay Creek	PS	Mit 1, 2	LS
PU&S-10 Railroad trestle at Warren Creek	PS	Mit 1, 2	LS
PU&S-11 Warren Creek road bridge	PS	Mit 1, 2	LS
PU&S-12 Structures in the HBMWD reach	PS	Mit 1, 2	LS
PU&S-13 Upper HBMWD pipe crossing	PS	Mit 1, 2	LS
PU&S-14 Lower HBMWD pipe crossing	PS	Mit 1, 2	LS
PU&S-15 U.S. Geological stream gaging station	LS	None required	LS
PU&S-16 Highway 299 bridges	S	Mit 1, 2	S
PU&S-17 PG&E upper gas line crossing attached to Highway 299 bridge	S	Mit 1, Mit 2	S
PU&S-18 Degradation impacts on Highway 101 bridges	PS	Mit 1, 2	LS
PU&S-19 Degradation impacts on Hammond Trail bridge	PS	Mit 1, 2	LS
PU&S-20 Degradation impacts on Mad River Beach Road RSP and boat ramp	PS	Mit 1, 2	LS
PU&S-21 Degradation impacts on Clam Beach Mad River RSP	PS	Mit 1, 2	LS
Arch-1 Archaeological sites	PS	Mit 17, 18	LS
Rec-1 Trench hazards	PS	Mit 19, 20, 21	PS
Rec-2 Summer bridge- portaging	LS	None required	LS
Rec-3 Summer bridge boating hazards	PS	Mit 22, 23	PS
Rec-4 Noise impacts on river users (See Noise-10)	SU	Mit 10, 16	SU

2.2 List of Effects

See Section 5 for more detailed discussion on effects.

Morph-1: Gravel extraction, droughts, streambank levees, bridge piers, other instream structures, and other factors cumulatively contribute to channel degradation. The primary Mad River channel morphology concerns at this time are associated with channel degradation and the effects that cumulative channel degradation has had on certain structures. However, excessive channel aggradation has created a host of river management problems in the past and these problems could reoccur in the future. Extraction rates in excess of average net recruitment will encourage the riverbed to continue degrading. Bed degradation can expose or undermine bridge supports, pipe lines and other structures jeopardizing structural integrity. Caltrans has indicated that the Highway 299 bridge supports have been weakened by degradation and that modifications have been tentatively scheduled for 1995-96. Said changes should strengthen the integrity of the Highway 299 bridge supports and help reduce the significance of channel degradation at this location. See Section 5.12 for more information on public utilities and structures.

No extraction or extraction rates below average net recruitment can lead to channel aggradation. Channel aggradation at Caltrans bridge sites and at other specific sites is needed to reduce the cumulative effects of past degradation and would be beneficial. However, excessive channel aggradation can create significant localized adverse effects. (S/S)

Morph-2: Excessive channel aggradation and degradation produce various negative impacts on the aquatic habitat. Gravel extraction in excess of replenishment causes the bed to degrade at the extraction site and upstream and downstream of the extraction site, and can produce significant negative impacts on the aquatic habitat. Gravel replenishment is presently needed at some sites to restore degraded conditions. However, excessive gravel aggradation will lead to adverse impacts on the aquatic habitat. See Section 5.5 for additional information on the aquatic habitat. (PS/LS)

Morph-3: Excessive channel aggradation and degradation produce various negative impacts on the groundwater regime which can lead to other impacts, both beneficial and adverse. Gravel extraction in excess of replenishment causes the bed to degrade at the extraction site and upstream and downstream of the extraction site, and can produce a significant lowering of the water table in the vicinity of the channel. Lowering the water table can improve drainage, reduce aquifer storage capacity, increase the depth to groundwater, and drain wet sites resulting in a change of riparian or wetland vegetation habitat. The changes in riparian or wetland vegetation habitat, could be significant and could lead to changes in channel morphology through bank erosion. See Section 5.4 for more information on groundwater. See Section 5.7 for more information on vegetation. (PS/LS)

Morph-4: Excessive channel aggradation and degradation produce various negative impacts on channel bank stability. Excessive aggradation creates a shallow, wide channel which can increase bank erosion and cause the channel to encroach on adjacent properties. Gravel extraction in excess of replenishment can reduce aggradation rates and cause the bed to degrade at the extraction site and upstream and downstream of the extraction site and reduce the adverse impacts of excessive aggradation. Rapid excess bed degradation can induce bank

collapse and erosion by increasing the heights of banks, and by reducing the water table, which in turn reduces bank stabilizing vegetation. Bank erosion brought on by excessive channel aggradation and degradation has the potential to be significant. (PS/LS)

Morph-5: Excessive channel aggradation produces negative impacts on channel flood carrying capacity. Channel aggradation reduces channel capacity and increases the risk of overbank flooding. Bed degradation, what ever the cause, has the potential of increasing the channel flood carrying capacity and reduces the risk of overbank flooding. Gravel extraction in excess of replenishment causes the bed to degrade at the extraction site and upstream and downstream of the extraction site. Increased flood capacity is a beneficial result of bed degradation, whatever the cause. Decreased flood capacity is an adverse effect of channel aggradation. Channel aggradation is not currently a problem. Therefore, impacts on flood carrying capacity are not currently significant. (LS/LS)

Morph-6: Regardless of the rate of extraction, relative to bedload recruitment and replenishment, site-specific variables in extraction location and methodology can produce adverse impacts on channel morphology and related river resources. (PS/LS)

H20Qlty-1: During extraction, mining equipment inadvertently pulverizes gravel bar surface materials and leaves a fine dust residue on some heavily disturbed gravel bars. When the river rises in the fall, the fine dust particles, along with other sediment are picked up by the river. Depending upon flow conditions this may, or may not, produce a short term measurable increase in turbidity. High flows on the Mad River are already quite turbid before they enter the project area and the added turbidity, when present, is not likely to be noticed and is considered less than significant. (LS/LS)

H20Qlty-2: Placement and removal of summer bridges or other summer crossings can cause a short term increase in turbidity, at a time when the river is generally free of turbidity. Because the potential increase in turbidity is slight, short lived, and isolated the impact is insignificant. (LS/LS)

H20Qlty-3: Skimming as an extraction method has the potential to create a broad, shallow channel increasing the surface area of the flowing river, and potentially increasing channel braiding and water temperatures. Generally the native fish species of the Mad River prefer cool water. Increased water temperatures could potentially have a significant adverse effect on these native fish species. (PS/LS)

H20Qlty-4: During gravel extraction petroleum products may spill or leak on to the gravel bar. When the river rises these contaminants could adversely impact water quality. (PS/LS)

GndH2O-1: When extraction volumes are below net recruitment channel aggradation can occur. Aggradation raises the water table. A higher water table means less depth or opportunity for percolation of leach fields and percolation ponds. Aggradation has the potential to significantly impact the effectiveness of septic tank leach fields and the Blue Lake Sewage Treatment percolation ponds. (PS/LS)

GndH2O-2: If extraction volumes exceed the recruitment rate channel degradation could occur through the Blue Lake Valley reach. This, in turn, would cause the water table in the Blue Lake aquifer to drop, and produce changes in dependent riparian plant communities located on

adjacent upper level terraces and in adjacent riparian forests, phreatophytic vegetation and wetland habitat. The drop in the water table has the potential to be a significant adverse environmental impact within the Blue Lake valley reach. See Section 5.7 for more discussion on vegetation. (PS/LS)

GndH2O-3: The water reaching the HBMWD intakes is naturally filtered by passing through the sand and gravel of the riverbed. Deeper sand and gravel means more filtration. If extraction volumes exceed net recruitment channel degradation will continue in the HBMWD Gorge. Channel bed degradation produces a concurrent reduction in natural filtration. In the absence of widespread channel degradation, localized scour around the mid-channel Ranney wells will produce similar results. Reduced natural filtration forces the HBMWD to incur additional water treatment costs. This has a potentially significant economic impact. See Section 5.12 for more information on HBMWD water supplies. (PS/LS)

Fish-1: Certain extraction methods and standards have the potential to create a broad, shallow channel. If the channel is too shallow, adult and juvenile fish migration through the excavated area may be adversely impacted during semi-low flows (PS/LS)

Fish-2: Channel degradation has the potential to create physical topographic barriers at the mouths of tributaries and adversely influence fish migration into and out of these tributaries, particularly when flows are low to marginal. Barriers to anadromous fish migration into and out of tributaries could be a significant impact. (PS/LS)

Fish-3: Gravel extraction has the potential to adversely alter the morphology of spawning sites and the composition of spawning gravel in the Mad River extraction area. There is debate on this issue and it could be a significant impact. However, the CDFG has stated that they believe that gravel extraction can continue without impacting spawning habitat. (PS/LS)

Fish-4: The installation and removal of summer bridges or other summer crossings has the potential to significantly impact juvenile fish migration. (PS/LS)

Fish-5: Trenches can be strategically located in a variety of sites. Trenches can also be deep or shallow, wide or narrow, and short or long. The effects of trenches can vary. Trenching has the potential for improving fish passage in aggraded reaches. This is a beneficial impact of trenching. Trenching also has the potential to reduce or eliminate riffles which are important for rearing juvenile steelhead and as habitat for benthic macroinvertebrates. This loss or reduction of riffles has a potential to be significant. (PS/LS)

Fish-6: Gravel mining can reduce aquatic habitat diversity and the retention of large woody debris, both of which are necessary in order to maintain quality summer rearing habitat and holding areas for migrating adult and juvenile fish. The loss of habitat diversity and woody debris can be a significant impact. (PS/LS)

Wild-1: Gravel extraction, aggregate stockpile and processing sites, industrial development, agricultural development, residential development, highway development, and streambank levees have cumulatively reduced the Mad River riparian corridor wildlife habitat to a fraction of what it once was. Gravel extraction operations and gravel stockpiles can significantly reduce or modify the habitat of certain wildlife species. These potential changes could be significant adverse impacts. The preferred alternative will not increase this loss of wildlife habitat. On the

contrary certain vegetation mitigation measures may actually increase the availability of significant wildlife habitat. Regardless, the cumulative adverse impacts on wildlife habitat will remain significant. (S/S)

Wild-2: Wildlife can be affected by excessive noise resulting from mechanical equipment. Operational noise can be reduced if the exhaust systems of all internal combustion engines owned or maintained by the operators are kept in good repair and as manufactured. While many species can become acclimatized to predictable and/or constant noise, others will be displaced, at least temporarily. When operations cease, the wildlife can return. This may be considered a short term effect and less than significant. However, if rare or threatened species are displaced by excessive noise the effect would be significant. Monitoring for noise-reduction compliance and for the presence of rare, threatened, or endangered species subject to noise disturbance is needed. For more information on noise see Section 5.11. (PS/PS)

Wild-3: Dust resulting from the project can coat riparian vegetation inhibiting both plant growth and insect use of plants, both of which consequently affect wildlife use of the habitat. This has a potential of being a significant impact. (PS/LS)

Wild-4: Gravel extraction operations could impact the habitat of various bird and mammal Species of Special Concern, Threatened species, or Endangered species. These impacts could be significant. (PS/LS)

Wild-5: Gravel extraction operations could impact the Northern Red-legged Frog, a Species of Special Concern in California and a Category 2 Candidate for Federal Listing. Disturbance of breeding or habitat areas could be significant. (PS/LS)

Wild-6: Gravel extraction operations could impact the Foothill Yellow-legged Frog, a Species of Special Concern in California and a Category 2 Candidate for Federal Listing. Disturbance of breeding or habitat areas could be significant. (PS/LS)

Wild-7: Northwestern Pond Turtles were not observed in the project areas during the 1993 wildlife survey. However, gravel extraction operations could impact the Northwestern Pond Turtle, a Species of Special Concern in California and a Category 2 Candidate for Federal Listing. Disturbance of breeding or habitat areas could be significant. (PS/LS)

Veg-1: Consultants to this project have stated time and again that protecting all stages of riparian forests is the single most important element in ensuring good wildlife populations in the project area. Much of the natural riparian habitat originally present in the Mad River corridor has already been destroyed by agricultural conversion, the construction of levees, the development of roads, highways residential areas, and industrial areas and other causes. This loss of riparian habitat is cumulative and has been significant. Any further removal of significant riparian habitat, whether for gravel extraction or other purposes, has the potential to produce additional significant adverse impacts, primarily due to the potential loss of wildlife habitat. (S/S)

Veg-2: The indiscriminate removal of riparian vegetation, whether for gravel extraction or other purposes has the potential to produce significant adverse impacts due to the loss of bank stability. Loss of bank stability has both favorable and unfavorable impacts. If banks are

unstable the river may tend to meander. When a river meanders it recruits sediment from terraces and produces less downcutting. (PS/LS)

Veg-3: The repeated removal of gravel in certain locations will alter the successional development of gravel bars, terraces, and vegetation at those locations. Continued excavation in any one area precludes the natural evolution of terraces and subsequent development of riparian vegetation. The low-lying herbaceous and early scrub habitats would be the most affected. The localized long-term effects would include: A) the loss of early stage scrub; B) the maturation of the later stage scrub and forest; C) a decline in vegetative diversity; D) a decline in wildlife habitat values; and E) a likely decline in wildlife diversity. These impacts are cumulative and significant. (S/S)

Air-1: Gravel extraction operations involve the use of gasoline or diesel-powered equipment that emit exhaust emissions. The air emissions are regulated by the NCUAQMD. There is no evidence that exhaust emission resulting from the project cause significant impacts. (LS/LS)

Air-2: The project may involve the generation of dust. Dust emissions are regulated by the NCUAQMD. Some operations coupled with dry weather and heavy winds can emit fugitive dust in excess of adopted standards. This would be a significant impact. (PS/LS)

View-1: In the vicinity of Hatchery Road Bridge there are a variety of industrial-type land uses that may be perceived as adverse visual impacts. The primary access to the river at Blue Lake is via the Hatchery Road bridge and levee. Both the Emmerson bar (Site No. 2) and Blue Lake bar (Site No. 3) extraction areas are visible from the bridge and levee. No other views of the river are available along Hatchery Road. Further south along Hatchery Road, the Mad River Sand & Gravel processing site (Site No. 1) can be seen in the distance, approximately 650 feet off the road. With the exception of the stockpiles and processing site this is primarily a rural agricultural setting and some people may feel that the processing site is in conflict with the setting. The reclamation plan and use permit allow for additional processing facilities at this site. With the exception of the processing plant and site the visual impacts resulting from the project in this view setting will be less than significant. However, the cumulative visual impact of this processing site, in combination with other aggregate processing sites and other industrial uses in the Mad River corridor is a significant adverse impact (S/S)

View-2: From Blue Lake to Arcata along West End Road, views are mostly screened by dense stands of riparian vegetation. Blue Lake and Christie bar (Site No. 3 and 4) stockpiles and extraction activity can be seen along a limited stretch of the road directly opposite the operations.

West End Road closely parallels the river. When the summer foliage has fallen from the trees, Essex bar (Site No. 6) can be viewed. Along West End Road, between the Water District buildings and Highway 299 the river can be viewed through the trees. These visual impacts are considered less than significant.

The project will create no significant change in visual effects at this view location. Therefore these visual impacts will remain less than significant. (LS/LS)

View-3: No views of the river are available from Giuntoli Lane. However, the Redwood Empire Aggregates processing site (Site No. 8) is highly visible from both Giuntoli Lane and Highway

101. The Arcata ReadiMix processing plant and stockpiles (Site No. 7B) are visible from Giuntoli Lane, Boyd Road, and Highway 299. These sites, along with other industrial uses in the area are considered individually and cumulatively significant adverse visual impacts. These two aggregate processing sites are zoned and planned for industrial use and visual effects are existing. The project will create no additional adverse visual effects at this view location. However, the cumulative visual impact of these processing sites, in combination with other industrial uses in the Mad River corridor is a significant adverse impact. Therefore the visual impacts resulting will remain significant. (S/S)

View-4: While driving westbound on Highway 299 down the Lord Ellis Summit there are distant views of the Mad River and the Blue Lake, Christie and Johnson bars (Site No. 3, 4 and 5).

Further west along Highway 299, Eureka Sand & Gravel's (Site No. 4) processing and stockpile yard is highly visible. Some evergreen plantings occur within the Caltrans right-of-way, but most of the processing and stockpile yard is exposed.

The Glendale Road underpass offers a view of the upstream end of Johnson bar (Site No. 5) and the Eureka Sand & Gravel's Christie bar (Site No. 4).

Eastbound Highway 299 passes several pump stations, the Water District buildings and utility yard, and Mercer Fraser's Essex bar, processing and stockpile yard (Site No. 6) are visible. Only short glimpses of the river are possible along this stretch. The streambank is lined with cottonwoods, willows and alders with conifer trees planted both within the Caltrans right-of-way and growing naturally on adjacent land. Adjacent to the Essex Lane underpass, the railroad bridge and the river can be seen. The river is then hidden by the adjacent streambank and dense vegetation.

The only other view of the river is from the Highway 299 bridge. The Water District buildings or the Johnson-Spini bar (Site No. 7A) can be seen from the bridge, depending on the direction one is driving. Gravel extraction is visible from westbound 299 when it occurs on the Johnson-Spini bar (Site No. 7A).

Along the length of Hwy. 299 views from the highway are diverse, and range from natural landscapes to heavy industrial use. Hwy. 299 also passes through the Cities of Arcata and Redding. Diverse views are normal and expected. Visual effects of gravel operations in this description are existing and vary from slight to highly visible and offensive to some individuals. The Eureka Ready Mix processing site is highly visible from Highway 299 and contributes to the cumulative adverse visual impacts of this project. The project will create no additional adverse visual effects in this view shed. However, the cumulative visual impact of this processing site, in combination with other industrial uses in the Mad River corridor is a significant adverse impact. Therefore the visual impacts resulting from the project will remain significant. (S/S)

View-5: As Northbank Road passes the Johnson-Spini and Arcata ReadiMix bars, and the Graham bar (Site Nos. 7A, 7B and 8), the gravel extraction operations are hardly noticeable because of the curvature and narrowness of North Bank Road. The Johnson-Spini bar (Site No. 7A) and Highway 299 bridge are visible from pull-offs along Northbank Road

The visual effects in this description are existing and would likely be considered as minor by most individuals. The project will create no significant change in the visual effects described here. Therefore the visual impacts will less than significant. (LS/LS)

View-6: Gravel extraction and processing activity can be viewed from the river and river bars. The cumulative viewshed impacts resulting from extraction include extraction sites, summer bridge crossings, haul roads, processing sites and stockpiles. These impacts will vary with the season and throughout the river. Some of these cumulative visual impacts may be considered significant and unavoidable. (SU/SU)

Traffic-1: Extraction operations use the existing Truck Route through the City of Blue Lake. The City of Blue Lake responded to the Notice of Preparation that the City has concerns that the project will add to an existing traffic, access, maintenance and safety problem within the City of Blue Lake.

The truck route through the City of Blue Lake is developed to acceptable industrial road standards. Traffic generated by the project is only a small portion of the total traffic using the Blue Lake truck route. The extraction/processing projects are ongoing and the preferred alternative does not significantly increase the level of truck traffic within the City. However, the cumulative impact of the project traffic in combination with other traffic that may be increasing could potentially be significant. If so, it is unavoidable. (PS/PS)

Noise-1: The closest residence to the Mad River Sand & Gravel processing operation (Site No. 1) is a house owned by the operator approximately 650' southwest of the processing plant which would be subjected to exterior noise levels of 66 dBA. This noise level is Normally Unacceptable for low density residential and normally acceptable for industrial and agriculture (Table 5.11-1). Because the house is located in an agricultural and industrial setting the noise is considered normally acceptable and insignificant.

Residences directly west of the processing site are approximately 900' from the processing plant. During operations, these residences would receive exterior noise levels of approximately 63 to 65 dBA. These levels are considered Conditionally Acceptable for low density residential (Table 5.11-1). Conventional construction, with closed windows will normally suffice. Both the operation and the residences are existing and owned by the operator.

The existing noise levels are judged insignificant with respect to the residences. The project will not increase existing noise impacts. Therefore the impact at this location is less than significant. (LS/LS)

Noise-2: The closest residences to the Emmerson bar (Site No. 2) are located approximately 1,100' to the northwest and 1,200' to the south. There are also approximately 20 houses off West End Road within 2,000' of the extraction and stockpiling area. The noise levels received at these residences from extraction activities and gravel transport would be less than 55 dBA. This level is Clearly Acceptable (Table 5.11-1) and is considered less than significant.

The project will not increase existing noise impacts at this site. Therefore the impact at this location is less than significant. (LS/LS)

Noise-3: The closest residences to the Blue Lake bar (Site No. 3) are two houses owned by REA, 100' and 400' from the truck yard and 800' to 1,000' from the gravel bar. These residences would receive noise levels of 54 dBA and 55 dBA from extraction activities (Clearly Acceptable). Processing does not occur at this site; but, if it did these two residences would receive 62 dBA (Conditionally Acceptable) and 74 dBA (Clearly Unacceptable) from processing.

The project will not increase existing noise impacts at this site. Therefore the impact at this location is less than significant. (LS/LS)

Noise-4: The closest residence to the Eureka Sand and Gravel processing site (Site No. 4) is approximately 1,600' to the north, and would be affected by traffic on Highway 299, as well as the processing plant. The noise levels received by residences from processing would be less than 60 dBA and Normally Acceptable for low density residential (Table 5.11-1).

The project will not increase existing noise impacts at this site. Therefore the impact at this location remains less than significant. (LS/LS)

Noise-5: Extraction equipment at Johnson bar (Site No. 5), would produce noise levels of less than 55 dBA at Warren Creek Road residences, approximately 1,200'-1,800' southwest of the site. This is Clearly Acceptable (Table 5.11-1) and less than significant.

The project will not increase the current existing noise impacts at this site. Therefore the impact at this location is less than significant. (LS/LS)

Noise-6: The nearest occupied structure to Essex bar (Site No. 6), is approximately 450' to the south; it would receive exterior noise levels of 62-65 dBA. This is Conditionally Acceptable for low density residential (Table 5.11-1). Conventional Construction with closed windows will normally suffice.

The project will not increase existing noise impacts at this site. Therefore the impact at this location is less than significant. (LS/LS)

Noise-7: The Arcata ReadiMix (Site No. 7) site has processing equipment, a cement batch plant, front end loaders, dump trucks and mixers. Developed in 1951, the site is located within an industrial area. It is also located adjacent to and directly north of the Town and Country Trailer Park, built in 1955. In previous years, there were some complaints about noise generated by early morning operations.

Noise levels, measured adjacent to the trailer park range from 55 dBA (Clearly Acceptable), with no equipment running, to 80 dBA (Clearly Unacceptable for high density residential and Conditionally Acceptable to Normally Unacceptable for industrial areas), when a gravel truck passes within 75 feet. The average noise level measured at the trailer park, for a one hour period is 63 dBA (Conditionally Acceptable for high density residential and Clearly Acceptable for industrial). When the cement batch plant operates (10 minutes for one load), noise levels increase to 73.5 dBA (Clearly Unacceptable for high density residential and Normally Acceptable for industrial). Noise levels generated by this operation could be considered an unavoidable significant effect of an existing use, particularly with reference to the adjacent high-density residential use.

The project will not increase the existing noise impacts at this site. However, the existing noise at this site is significant and unavoidable. (SU/SU)

Noise-8: The existing facility at Graham bar is located in an industrial and commercial area. The nearest occupied structure to Graham bar (Site No. 8), is a residence, approximately 200'-300' south of the processing equipment. Noise levels at the residence would be 65 dBA (Conditionally Acceptable for high density residential) for the processing plant, and 67-74 dBA (Normally Acceptable for industrial) for Giuntoli Lane traffic. The nearest residence to the east is approximately 500' away, receiving noise levels of 67 dBA (Conditionally Acceptable for high density residential and Normally Acceptable for industrial).

Residences west and north were 1,400' and 1,800' respectively; noise levels would be reduced to less than 55 dBA at each residence (Clearly Acceptable for low density residential).

The noises generated by Highway 101 and Giuntoli Lane at this site are high but Normally Acceptable for industrial areas (Table 5.11-1). The combined highway and processing noises are at least conditionally acceptable for this zoning and therefore not significant. The project will not increase existing noise impacts at this site. Therefore, the noise impact at this location would be less than significant. (LS/LS)

Noise-9: Glendale Trailer Park, approximately 400 feet to the north of the Johnson-Zabel bar (Site No. 9), is the nearest residential area with about 35 trailers. These trailers are subjected to noise from Highway 299. Extraction could generate noise levels of 60-62 dBA in the trailer park. This is considered Conditionally Acceptable for both low and high density residential (Table 5.11-1). With conventional construction and closed windows, this is considered acceptable and less than significant.

The project will not increase existing noise impacts. Therefore the impact in this location is less than significant. (LS/LS)

Noise-10: River and river bar users are impacted by noise generated by the existing operations and by noise from adjacent roadways. During extraction, noise levels reach 67-74 dBA at 100'. This is considered Normally Acceptable to Normally Unacceptable for water recreation uses (Table 5.11-1) but may not be acceptable to river recreationists and fishermen.

The primary impact from noise would occur from extraction activities which occur outside the main fishing periods and this will help reduce the significance of the impact. While some people may be intrigued by gravel operations and not mind the noise, others perceive it as a significant impact. With current technology, this impact is unavoidable.

The project will not increase existing noise impacts along the river. However, the existing noise impacts at the river are sometimes significant and unavoidable. (SU/SU)

PU&S-1: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Mad River Fish Hatchery weir. This could be a significant impact. (PS/LS)

PU&S-2: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the RSP along the left bank, adjacent to the fish hatchery (river mile 14.5). This could be a significant impact. (PS/LS)

PU&S-3: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Blue Lake bridge (river mile 12.8). This could be a significant impact. (PS/LS)

PU&S-4: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Blue Lake right bank levee (river mile 12.8-13). This could be a significant impact. (PS/LS)

PU&S-5: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Blue Lake sewage treatment ponds and levee (river mile 11.7). This could be a significant impact. (PS/LS)

PU&S-6: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Highway 299 Mill Creek bridge (river mile 10.5). This could be a significant impact. (PS/LS)

PU&S-7: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the North Coast Railroad Authority bridge (river mile 9.8). A 16-inch water line is attached to the railroad bridge. It takes water to the north side of the river to service the community of Fieldbrook and the city of Blue Lake. The loss of this bridge would be a significant impact. (PS/PS)

PU&S-8: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Glendale Drive bridge over Lindsay Creek (river mile 9.8). This could be a significant impact. (PS/LS)

PU&S-9: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Highway 299 bridge over Lindsay Creek (river mile 9.8). This could be a significant impact. (PS/LS)

PU&S-10: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Gravel extraction in volumes exceeding replenishment has the potential to cause bed degradation. Continued bed degradation could jeopardize the integrity of the Railroad trestle over Warren Creek (river mile 9). This could be a significant impact. (PS/LS)

PU&S-11: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Gravel extraction in volumes exceeding replenishment has the potential to cause bed degradation. Continued bed degradation could jeopardize the integrity of the Warren Creek Road bridge (river mile 9). This could be a significant impact. (PS/LS)

PU&S-12: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the structures in the HBMWD reach (river mile 7.8 - 9.5). This could be a significant impact. (PS/LS)

PU&S-13: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the upper HBMWD water pipe crossing (river mile 8.7). This could be a significant impact. (PS/LS)

PU&S-14: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the lower HBMWD water pipe crossing (river mile 7.8). This could be a significant impact. (PS/LS)

PU&S-15: Changes in bed level require periodic calibration of the U. S. Geological stream gaging station (river mile 7.8). This is not a significant impact. (LS/LS)

PU&S-16: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Highway 299 bridges (river mile 7.8). This could be a significant impact. (S/S)

PU&S-17: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Highway 299 bridge. The PG&E upper gas line crossing (river mile 7.8) is connected to this bridge. As long as the bridge integrity is intact, there will be no related impacts to the PG&E pipeline. As discussed in PU&S-16, impacts to Hwy. 299 bridge could be a significant, therefore the impacts to the pipeline could be significant. (S/S)

PU&S-18: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Highway 101 bridges (river mile 5.6). This could be a significant impact. (PS/LS)

PU&S-19: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Hammond Trail bridge (river mile 3.9). This could be a significant impact. (PS/LS)

PU&S-20: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could

jeopardize the integrity of the Mad River Beach Road RSP (river mile 3.3 - 3.4). This could be a significant impact. (PS/LS)

PU&S-21: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Clam Beach Mad River RSP (river mile 0). This could be a significant impact. (PS/LS)

Arch-1: Two prehistoric archaeological sites are recorded on river terraces above proposed gravel extraction areas in the project area. The sites have been given the trinomials CA-HUM-930 and CA-HUM-931 by the Sonoma State University, Northwest Regional Information Center. The locations are not being disclosed in order to protect the sites. At least one of these sites may be at risk due to streambank erosion. If bed degradation, or other factors, cause bank failure in the area of the identified archeological resources, these resources could be significantly impacted. (PS/LS)

Rec-1: Trenches can be hazardous to recreational users of the river bars and are considered a potential significant impact. (PS/PS)

Rec-2: Summer bridge crossings could impact recreational users of the river. If the crossings are low, Kayakers and tubers will need to portage. This is considered less than significant. No mitigation is proposed for this. See Rec-3 for a related impact. (LS/LS)

Rec-3: Low summer bridge crossings could present hazards to river users, especially kayakers and inner tubers. These can be especially dangerous if the water rises and is used by boaters before the bridges are removed. (PS/PS)

Rec-4: Noise can have an adverse impact on recreational users. Refer to Noise Impact-10 for discussion of this subject. (SU/SU)

2.3 List of Mitigations

This project has been unusual from the start. Mitigation number one, described below, is no exception. Mitigation number one is actually the implementation of the preferred alternative which is designed to provide mitigation for past and future effects of gravel extraction on the lower Mad River. See Section 5 for more details on mitigation measures.

Mit-1: Implementing the preferred alternative helps to alleviate past aggregate mining impacts and is mitigation number one. This mitigation regulates the Mad River gravel industry in order to substantially reduce or eliminate cumulative and future adverse impacts. The SDRC will review all input, from operators, as well as others and apply information gained to the annual review, planning, and reporting procedures. After reviewing all available data and evaluating river resource reclamation, conditions, and trends the Mad River SDRC will prescribe variable annual site-specific extraction locations, extraction volumes, and extraction methods. The Mad River gravel operators may then extract sand and gravel at these specified locations using these specified standards and volume limitations. Under present conditions the approximate total annual volume prescribed shall be below the approximate average annual net recruitment rate as determined by the Mad River SDRC. In time, this mitigation measure will substantially reduce or eliminate the present cumulative impacts of bed degradation. This mitigation measure may also help sustain a viable Mad River Sand and Gravel industry. Therefore, if

localized or extensive channel aggradation becomes a problem in the future, it is possible that this mitigation measure may be able to help reduce the significance of the potential adverse impacts associated with excessive channel aggradation. The potential success of this mitigation measure is dependent upon the combined expertise of the Mad River SDRC, the ability of the SDRC to reasonably monitor, judge, and apply flexible mining strategies to a dynamic river system, and on future hydrologic and geologic processes. This mitigation, Mit-1, will reappear many times throughout this document and shall be used to reduce, minimize, or eliminate many of the actual or potential adverse impacts that are identified in this PEIR.

Mit-2: In order for the SDRC to fully implement the preferred alternative monitoring, information will be needed from other concerned agencies. Caltrans, the California Department of Fish & Game, Humboldt County Public Works Department, the NorthCoast Railroad Authority, Humboldt Bay Municipal Water District, or any other agency responsible for the integrity of structures along the Mad River, shall monitor their facilities and advise the SDRC as to the structural integrity of said facilities and as to potential risks that may be created by changes in channel aggradation and degradation or any other changes in channel morphology. The SDRC will utilize this information while evaluating instream reclamation and while planning future extractions. See Section 5.12 for more information on structures and utilities in the Mad River project area.

Mit-3: The SDRC will monitor river banks in the project area and, where and when feasible will initiate bank-stabilizing revegetation practices at sites where bank erosion is excessive and where revegetation may reduce the erosion rate. This is one form of revegetation that will be used as mitigation for eroding streambanks and when extraction operations disturb significant plant communities.

Mit-4: The SDRC shall consult with operators regarding the best design and placement of summer crossings. All summer bridges and other crossings shall be installed and removed in accordance with adopted regulations of the CDFG and, if required, the USACOE. This mitigation measure assures that installation and removal is executed under authorization of appropriate state and federal agency permits or agreements. These agencies have the capability of requiring conditions of approval on permits or agreements that will maintain water quality impacts, resulting from summer bridge installation and removal, at a level of insignificance.

Mit-5: The CDFG shall incorporate oil and grease clean up requirements in their 1603 agreement. Operators shall inspect their extraction sites daily when extracting and shall immediately remove all petroleum-contaminated gravel from the river bar. This mitigation measure should maintain the identified impact at a level of insignificance.

Mit-6: The Scientific Design and Review Committee and the California Department of Fish & Game will monitor fish spawning activity in the Mad River extraction area in an attempt to determine the significance and success of spawning activity and how that activity might be influenced by gravel extraction. The Scientific Design and Review Committee will meet and confer with the California Department of Fish & Game and with additional experts, as needed to develop annual mining prescriptions that will allow extraction to continue without impacting spawning habitat.

Mit-7: For at least the first five years of this project wildlife monitoring surveys similar to those conducted in the project area and at site specific extraction operations during 1993 will be continued. The SDRC will consider comments from the California Department of Fish and Game, the wildlife surveys, and impacts to wildlife when developing annual mining strategies at affected sites. The need for continuing wildlife surveys after the first five years will be considered during the five-year comprehensive review.

Mit-8: No new haul roads shall be constructed through established riparian forest under this project. Abandoned haul roads, and trails, will be revegetated.

Mit-9: Gravel stockpiles shall be maintained in historic locations in a manner to assure no encroachment into significant wildlife habitat. No new stock pile locations shall be established in riparian forests under this project. Abandoned stockpile sites will be revegetated.

Mit-10: The exhaust systems of all internal combustion engines owned or maintained by the operators shall be kept in good repair and as manufactured.

Mit-11: All non-paved haul roads will be watered at least twice a day when being used during the extraction season. In addition all extraction and processing areas shall be watered as required by the NCUAQMD or as necessary to reduce the level of fugitive dust to acceptable air quality standards.

Mit-12: All operational traffic shall observe a maximum speed limit on unpaved roads of 20 m.p.h. This will reduce dust by approximately 65-80% (RSE, 1993).

Mit-13: In order to improve visual qualities for some recreational river users operators will minimize the amount of time that idle equipment is stored on gravel bars during the extraction season.

Mit-14: The City of Blue Lake will regulate traffic within its boundaries.

Mit-15: The City of Blue Lake has asked that gravel operators operating out of Blue Lake Bar, Emmerson Bar, and Guynup Bar to regularly advise and remind their drivers to drive through Blue Lake at reduced speed and in such a manner as to minimize noise and road wear.

Mit-16: Although most approved reclamation plans provide for longer hours of operation, gravel bar extraction operations will normally occur between the hours of 7:30 a.m. and 5:30 p.m. Monday through Friday. This helps reduce conflicts for early morning, and evening anglers, and weekend recreational users. However, if environmental or other circumstances create a shorter than normal extraction season it may sometimes be necessary to extend the operating hours in order to complete the permitted extraction within the allowable time.

Mit-17: There are two recorded archeological sites located near one of the potential operating sites. The SDRC shall examine these sites and become familiar with the potential bank erosion problem during 1994 and at least once per year in following years. If problems exist now the SDRC may be able to propose solutions. The SDRC will also be able to consider related potential impacts during site specific planning if gravel extraction is proposed on nearby gravel bars.

Mit-18: Although only two sites were found, the Mad River basin is known to contain significant archaeological resources, therefore, should concentrations of archaeological materials be encountered during operations, all ground-disturbing work in that vicinity shall be halted. Work near the archaeological finds shall not be resumed until a qualified archaeologist has evaluated the materials and offered recommendations for further action.

Mit-19: A public safety plan, including signs posted adjacent to trench areas, shall be prepared by the operator and submitted to HCPD, for review and approval as part of the annual review process. Extraction design shall consider the length of the trench in relationship to recreational uses and access. This measure will assure that proper warning is given recreational users of the river bar.

Mit-20: Stockpiles adjacent to trenches shall contain breaks between piles to facilitate egress from trenches.

Mit-21: One of the long-walls of the trench shall be graded/excavated at such an angle as to facilitate emergency escape.

Mit-22: A public safety plan, including signs posted warning of summer bridge crossings, shall be prepared by the operator and submitted for review and approval as part of the annual review process.

Mit-23: Summer bridges shall be removed according to schedule and shall not be allowed to remain in channel during high flows.

Mit-24: The revised reclamation plans will recognize the need to mitigate for barren bars. The SDRC will strive to locate reasonable sites where revegetation or other forms of mitigation can be used to compensate for visual, vegetation, and terrace forming qualities that have been lost due to extraction-induced barren bars. Such mitigation can be in the form of revegetation or improved site protection obtainable by restricting inappropriate river bar access.

2.4 Areas of Controversy and Issues to be Resolved

The following areas of controversy and or issues to be resolved were identified at the EIR scoping meeting, through the comments to the NOP, or during the environmental analysis. A summary table of comments received on the NOP is found in Appendix K.

Bed Degradation

The bed of the Mad River has degraded. There are differences of opinion as to the accuracy of some information that was used to document the degradation, the extent and location of degradation, the effects of said degradation, and the influences that gravel extraction has had on bed degradation. Some of these differences remain, even at the conclusion of the EIR process. The SDRC may have to review this material further.

NEPA/DEIS

The Army Corps has responded that if there are enough elements requiring Army Corps Section 404 or Section 10 permits, there may be justification for preparation of a Draft Environmental Impact Statement pursuant to NEPA.

Alternatives
Several respondents expressed that less environmentally damaging alternatives should be analyzed. The EIR does analyze a variety of alternatives in Section 7. Some respondents feel that the analysis of alternatives is incomplete while staff believes it to be adequate.

Habitat Restoration
The project could affect significant flora and fauna habitat. Areas of controversy include the degree of responsibility of surface mining operations to mitigate, enhance, or restore the degraded habitats. Some revegetation mitigations are included in the preferred alternative and this will help with habitat restoration.

Mitigation/Monitoring
Several responses to the NOP requested that the PEIR include a mitigation/monitoring program. An area of controversy was the identification of an agency or agencies to monitor each of the proposed mitigation measures. Monitoring and mitigation monitoring is described in Sections 6.14 and 6.15.

Structural Integrity
Much concern has been expressed regarding the structural integrity of existing bridges, RSP structures and bank slopes. Had the engineers who designed the threatened structures in the Mad River had better understanding of fluvial processes, more funding, and better technology we might be better able to adapt to a degrading river. It is likely that engineers did the best that they could with the resources that they had and it is possible that they knew retrofitting and the cost for retrofitting would occur in the future.

Traffic
Caltrans has requested an analysis of existing traffic conditions, cumulative impacts, access routes, the anticipated number of truck trips per day, and the alternative of rail transport to road transport. The City of Blue Lake expressed concern regarding traffic through the City. These issues have been discussed in the EIR.

Land Use
One respondent requested that all land uses within the project scope be identified and that each land use be followed by a discussion of compatibility with surrounding uses. Staff believes that such an effort would be appropriate for a Mad River Corridor Management Plan but not for this EIR.

Recruitment Rate/Replenishment Rate/Sediment Budget
Controversy exists over the rate of gravel recruitment. Issues to be resolved are the rates of recruitment and replenishment; and the amount of material that should be allowed to be extracted. Sediment transport, gravel recruitment, and gravel replenishment are highly variable processes which require annual monitoring. The preferred alternative will include adequate monitoring to accommodate this variability.

Water
The U.S. Fish and Wildlife Service expressed concern regarding environmental impacts associated with processing water and groundwater pumping. The discharge of processing water is regulated by Water Quality Control. There has been no evidence introduced regarding adverse effects of ground water pumping in this project area.

Sovereign/Trust Lands
The SLC has responded that the project area includes sovereign and trust lands held in fee ownership by the State of California. Issues to be resolved include the actual presence and location of these lands and the State's sovereign interest in the lands.

Public Access/Use
The SLC has expressed concern that the project not affect existing public access or use of the area. It does not appear that existing public access or use of the project area will be limited by this project.

Summer Bridges
The SLC is concerned that all summer bridge crossings be constructed or placed with sufficient clearance above the water elevation to allow safe passage under the structure. This issue is discussed in the EIR.

Groundwater Storage and Recharge
The Department of Conservation has requested an analysis of the potential impacts on groundwater storage and recharge from bed degradation. This issue has been discussed in the EIR.

Reclamation Plans
The Department of Conservation has responded that all reclamation plans for the existing operations should conform to the mitigation measures that are adopted for the project. Reclamation plans will be revised to conform with the mitigation measures that are adopted for this project.

Spawning Area
There is controversy over the quality of spawning habitat in the lower Mad River, particularly from the Mad River Fish Hatchery down to the Blue Lake Bridge. The SDRC will consult and work with the CDFG to resolve this issue.

Annual CEQA reviews
Some individuals believe that the annual planing decisions of the SDRC are discretionary decisions that will require annual CEQA reviews. Others believe that the discretionary powers of the SDRC are very much limited by the controlling parameters of the EIR and management plan and that annual CEQA reviews should not be required. Refer to Section 6.10 and comment 11-3 for further discussion on this issue.

Technical Advisory or Oversight Committee
Some individuals believe that a special committee should be established to review the activity of the SDRC and to perhaps do other things such as appointing committee members and establishing operating budgets. If such a committee were to be established it might include representatives from various state regulatory and trust agencies. Other people believe that an additional committee would be unnecessarily burdensome and that these roles can easily be assumed by the Board of Supervisors or otherwise incorporated into standard County planning channels. This is a policy decision that will have to be determined by the Board of Supervisors.

Consulting Activities of SDRC Members

Some people are concerned that committee members may have a conflict of interest if they consult to the gravel industry outside the umbrella of the SDRC and want to prohibit such activity. Others would allow such activity but recognize the need to monitor it. This latter group believe that reporting gravel industry consulting earnings as was done by members of the MOA scientific committee will suffice. See further discussion on this subject in Section 6.7 and in comment and response number 9-1. This is not a major environmental issue; but it will require a policy decision from the Board of Supervisors.

3.0 AGENCIES/ABBREVIATIONS/GLOSSARY

3.1 Agencies/Approvals

Agency	Approval/Review
Department of Fish and Game	1601/1603 Stream Alteration Agreement
State Lands Commission	Public Trust Issues
Mining and Geology Board	Mineral Resource Policy
Reclamation Program	Reclamation Plan Review
Office of Mine Reporting and Reclamation Compliance	Financial Assurance Review
Humboldt County Planning Department	Permits, Vested Rights Reclamation Plans, exemptions
California Department of Transportation	Encroachment Permit
North Coast Regional Water Quality Control Board	Water Quality Control
California Coastal Commission	Coastal Development permits
U.S. Army Corps of Engineers	404 and Section 10 permits
National Marine Fisheries Service	Fishery issues
U.S. Fish and Wildlife Service	Fishery and wildlife issues
U.S. Environmental Protection Agency	Environmental review of USACOE issued permits
Resources Agency	Mediator

[Note: For a more detailed discussion of Agencies and Permits, see Appendix I]

3.2 Abbreviations and Acronyms

ADT ..... Average Daily Traffic
APCD ..... Air Pollution Control District
AQMD..... Air Quality Management District
CalTrans..... California Department of Transportation
CARB ..... California Air Resources Board
CCR..... California Code of Regulations
CDF ..... California Department of Forestry
CDFG ..... California Department of Fish and Game
CDMG..... California Division of Mines and Geology
CEC..... California Energy Resources Conservation and Development Commission
CEQA ..... California Environmental Quality Act
cfs..... cubic feet per second
CNPS ..... California Natural Plant Society
DEH..... Department of Environmental Health
DO..... Dissolved Oxygen
DWR..... Division of Water Rights

EIR ..... Environmental Impact Report
EIS..... Environmental Impact Statement
EPA ..... Environmental Protection Agency
F ..... Fahrenheit
Fed/OSHA ..... Federal Occupational Safety and Health Administration
FEMA ..... Federal Emergency Management Agency
HBMWD ..... Humboldt Bay Municipal Water District
HCPD ..... Humboldt County Planning and Building Department
HCPWD..... Humboldt County Public Works Department
LCP ..... Local Coastal Plan
LOS ..... Level of Service
MCSD..... McKinleyville Community Services District
MGD..... Million Gallons per Day
MSL..... Mean Sea Level
NEPA..... National Environmental Protection Act
NCUAQMD .... North Coast Unified Air Quality Management District
NMFS ..... National Marine Fisheries Service
NOP..... Notice of Preparation
NTU ..... Nephelometric Turbidity Unit
PEIR..... Program Environmental Impact Report
PG&E ..... Pacific Gas & Electric
ppm ..... parts per million
psi..... Pounds per Square Inch
RSE..... Rising Sun Enterprises
RSP..... Rock Slope Protection
RWQCB ..... Regional Water Quality Control Board
SDRC ..... Scientific Design & Review Committee
SLC ..... State Lands Commission
SMARA..... Surface Mining and Reclamation Act
TSP ..... Total suspended particulates
ug ..... micrograms
U.S. ..... United States
USACOE ..... United States Army Corps of Engineers
USFWS ..... United States Fish and Wildlife Service
USGS ..... United States Geological Survey
VMS..... Visual Management System

Throughout the PEIR, reference may be made to the Blue Lake Bridge, Hatchery Road Bridge or Hatchery Bridge. These are referring to the same bridge structure at river mile 12.8.

Throughout the PEIR, reference may be made to the Railroad Bridge, the Arcata and Mad River Railroad Bridge, the Northcoast Railroad Bridge or the Annie and Mary Railroad Bridge. These all refer to the same bridge structure at river mile 9.8.

Throughout the PEIR, reference is made to Eureka Sand & Gravel; this company is also known as Eureka Ready Mix.

3.3 Glossary

Aggradation - The process of building up a surface by deposition. Aggradation reduces channel capacity by raising the elevation of streambeds and flood plains. Aggradation also restores elevation to previously degraded surfaces. Excessively aggraded rivers tend to braid and have reduced pool habitat.

Anadromous fish - A fish species which matures in the ocean and ascends streams to spawn. Examples are salmon and steelhead.

Baseline conditions/environment - The natural state of the environment before it is disturbed.

Bedload - The sediment in a stream channel that mainly moves by traction or saltation, sliding, or rolling on or very near the bottom of the stream.

Bedload transport volume - The volume of bedload material moving past a given point over some time period.

Braided river - A river containing two or more interconnecting branching and recombining channels separated by unvegetated gravel bars, sparsely vegetated islands, and occasionally, heavily vegetated islands. Shallow braided rivers create poor fish habitat.

Channel - A natural or artificial waterway of perceptible extent which periodically or continuously contains moving water. It has a definite bed and banks which serve to confine water.

Channel morphology - The physical shape, size and characteristics of a stream channel resulting from scour and deposition and produced by hydraulic factors such as velocity, turbulence, flow, and flow frequency.

Degradation - The general lowering or downcutting of the land or channel by erosive processes. Degradation increases channel capacity by removing sediments from the channel system.

Dynamic equilibrium - A dynamic condition where the amount of water and sediment entering a particular reach stream is equal to the amount that leaves the stream by natural processes at the lower end of the reach. The stream and its channel will change in response to changes that take place in the watershed; but the stream will constantly adjust in an attempt to maintain dynamic equilibrium.

Gravel - Fragments of rock larger and coarser than sand, worn by the action of air or water, 2 mm to 64 mm in size.

Groundwater - All subsurface water that is below the water table.

Groundwater recharge - Replenishment of groundwater by precipitation, runoff or by artificial methods.

Headward erosion - Channel bed erosion that develops at a zone of steepened gradient called a "knickpoint" and migrates upstream. In areas of gravel mining, headward erosion often begins where the stream flows into a pit or trench.

Impact - In this report, the unqualified use of the word 'impact' refers to an adverse environmental impact.

In-Stream mining - Excavation of sand and gravel aggregate from stream bed deposits found within the bankfull channel.

Lower Mad River project extraction area- the reach between the hatchery weir and the Highway 101 Bridge.

Monitoring - The collection of environmental, scientific, or engineering data by either continuous or periodic sampling methods.

Net recruitment - Net recruitment is recruitment into the project reach minus bed load transport out of the project reach.

Recruitment - New aggregate bedload material transported into the lower Mad River project extraction area from above the hatchery weir, from tributary sources below the hatchery weir and from upland sources.

Replenishment - The deposition of bedload aggregate material at individual gravel bars in the lower Mad River project extraction area. Replenishment may be the result of

recruitment or the redistribution of sediments that were already present in the lower Mad River project extraction area. Sand - Inorganic particles between 0.062 mm and 2.0 mm in diameter.

Scour - The local removal of sediment from streambeds by the action of flowing water.

Significant impact - A substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project.

Spawning - The act of laying and fertilizing eggs by fish, mollusks, and amphibians.

Thalweg - The deepest point or a generally downstream trending line connecting the deepest points of an active stream channel.

Turbidity - Turbidity is an optical property that refers to the amount of light that is scattered or absorbed by a fluid. Turbidity in the Mad River is usually due to the presence of suspended sediment or plankton.

4.0 ENVIRONMENTAL SETTING

4.1 Location

The Mad River drainage basin covers approximately 500 square miles (see Map 4.1-1). The basin is elongate in a northwesterly trend with a length of about 80 miles and an average width of about 6 miles. The Mad River headwaters rise in the southern portion of Trinity County, California in the Six Rivers National Forest and flows northwesterly to the Pacific Ocean just north of Arcata and Humboldt Bay. At the time of early settlement, flood events occurring every 2-5 years would spill over into Humboldt Bay. Subsequently much of the delta region has been diked and converted to agriculture while the channel has been confined within levees. Consequently, spill over into Humboldt Bay occurs much less frequently, perhaps on the average, once every 20 years (Scalici 1993). During recent history the mouth has oscillated North and South throughout approximately 0.9 miles of coastline. Between 1970 and 1992 the mouth migrated northward about 3.4 miles. The northward migration has been checked by a CalTrans rock slope bank protection project near U.S. Highway 101 and the south end of Clam Beach.

4.2 Climate

The climate of the region is mediterranean. Winters are cool and wet with 75 percent of the annual precipitation occurring between November and March. Average annual precipitation varies from around 40 inches near the coast to over 80 inches at the higher elevations with an overall basin average of about 64 inches. Oceanic influences keep the coastal regions cool during the summer and these influences often move inland along the valley bottom. Hot, dry summers typify the upper inland reaches of the basin.

4.3 Vegetation

Vegetation in the basin varies with disturbance, climate, geology, soils, proximity to the coast, elevation, slope angle and slope aspect. On a broad scale some of the more dominate vegetation associations are: coastal redwood forest, mixed conifer forest, true fir forest, oak-woodland, and natural grassland.

The project area is confined to the lower reaches of the Mad River channel and the vegetation habitat types found here are influenced by streamflow and river morphology. Starting from the summertime low-water wetted channel and moving upland there is a "typical" vertical gradient of riparian vegetation which illustrates a progression of successional stages. This progression can be described as follows.

> Low-Water Channel ⇨ Sparse Herbaceous Vegetation ⇨ Low Density Woody Vegetation (early successional scrub) ⇨ Dense Woody Vegetation (late successional scrub) ⇨ Developing Riparian Forest ⇨ Riparian Forest ⇨ Upper Level Terrace

The progression of vegetation is correlated with soil development processes and terrace elevation. Sparse herbaceous vegetation is found on fresh sediment deposits at the lowest elevations, the early successional scrub on the lower (most recently formed) terraces, the late successional scrub on the moderate-elevation terraces, and the developing riparian forest and riparian forest on the higher terraces where the soil development is greatest. Ponds and backwaters are found infrequently within both the scrub and forest vegetation types.

The deposition of silt and fines, which provide a medium for vegetation development is important to the evolution of river terraces. As early vegetation becomes established, the velocity of water is slowed, encouraging the deposition of additional sediment and nutrients to

add to the developing soil. This process continues as the terrace evolves, allowing for the establishment of woody scrub species and, eventually, tree species. Remnant channels and backwater areas occur throughout the study area, and interrupt the "typical" vegetative progression. These create linear stands of scrub vegetation of differing ages and, occasionally, young forest vegetation. Some backwaters and ponds persist long enough to allow for the growth of emergent wetland vegetation, which provides a small but notable component of the riparian vegetation complex.

An inquiry was made to the Natural Diversity Data Base with regard to the presence of rare, threatened and/or endangered plant species within the project area. There are no records of any such species within the study area. Additionally, a review of the Inventory of Rare and Endangered Vascular Plant Species (CNPS, 1988) and the California Department of Fish and Game's Special Plant List (CDF, 1991) did not reveal any species which would be expected within the habitats found in the study area. No rare, threatened and/or endangered plant species have been found in or near the project area. However, the North Coast Chapter of the California Native Plant Society has expressed an interest in having the North Coast Black Cottonwood Riparian Forest listed with the California Natural Diversity Data Base as an endangered habitat type (Keeler-Wolf, 1993).

Riparian vegetation produces a rich and diverse habitat. Riparian vegetation forms a transition zone between aquatic and terrestrial communities and provides habitat values that enrich both.

When European settlers first came to this area the Arcata Bottoms and Blue Lake Valley bottoms contained extensive stands of riparian vegetation and the Arcata Bottoms contained an extensive network of sloughs and associated wetlands. Early settlers cleared timber and brush from the low lying alluvial flats and developed pasture and farm land. The Swamp Land Grant Act encouraged settlers to drain "worthless swamp land" located near the mouth of the Mad River to create pasture and farm land. Settlers filled in sloughs, built levees, dikes, channels, and tide gates to separate the natural flood plain from its river ecosystem in order to protect the developing farmland and community infrastructure from flooding.

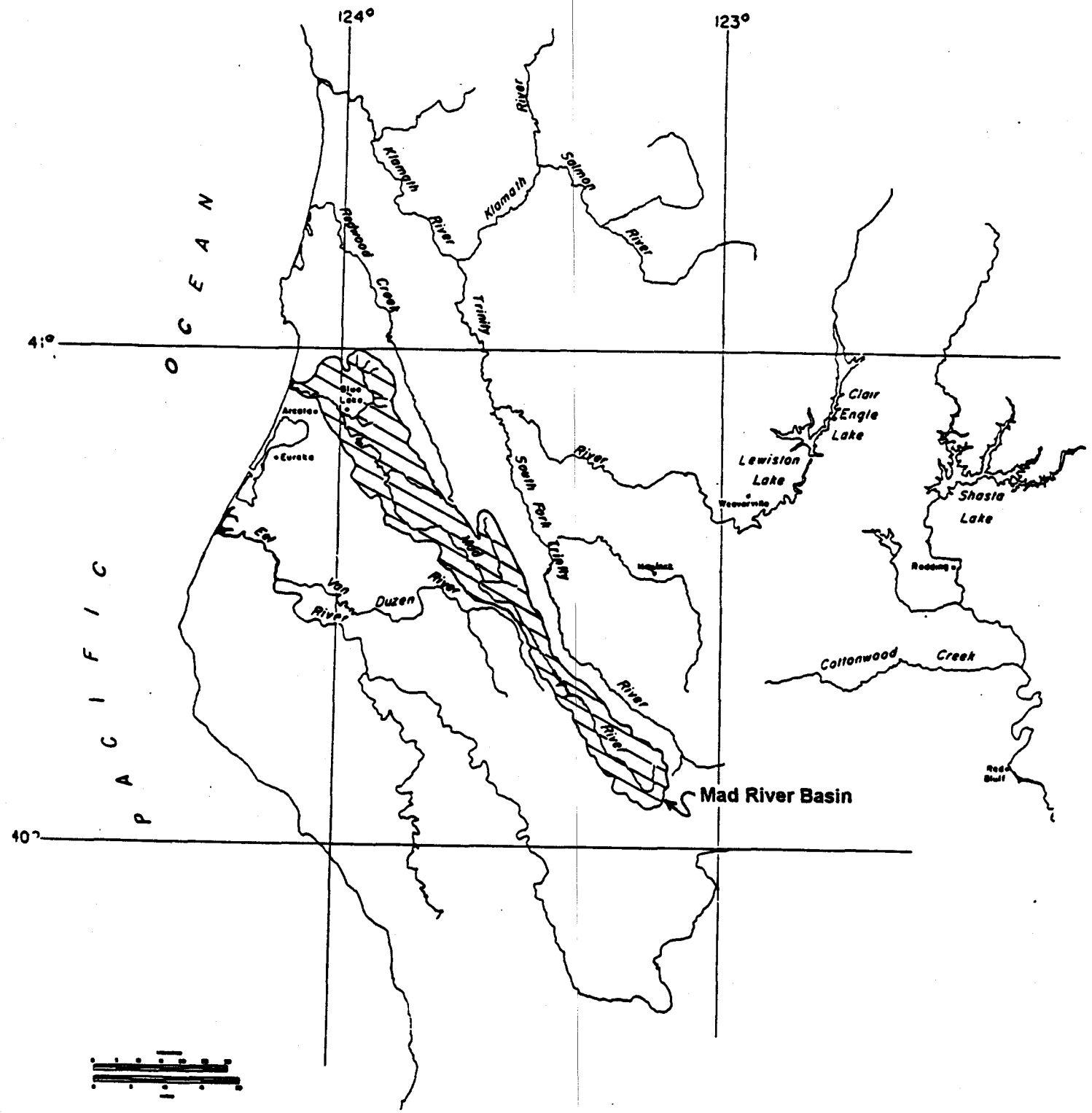
Today much of the remaining riparian vegetation community is confined to a narrow corridor adjacent to the Mad River. A significant portion of this vegetation is found on parcels attached to the 10 extraction sites (Table 4.3-1). For additional discussion on vegetation, see Section 5.7. Additional information on vegetation may be found in Appendix H (Karen Theiss and Associates, 1993) and is incorporated herein by reference.

Table 4.3-1 summarizes the 1993 land use and vegetation classification found on the parcels of the 10 potential lower Mad River gravel extraction sites. Riparian vegetation occupies 42.3 percent of the total parcel area. Approximately 20 percent is used for agriculture. Approximately 25 percent is potential gravel extraction area and approximately 5 percent is dedicated to gravel stockpiles or processing sites.

Table 4.3-1 Land and vegetation classifications of parcels connected to Mad River gravel extraction sites. Interpreted by Rising Sun Enterprises from July 1993 aerial photographs. Area is in acres.

Bar	Total Parcel	Agric uses	Processing or Stockpile	Gravel Bar	River	Scrub Veg	Riparian Veg
Guynup	160	82	10	27	10	13	18
Emmerson	120	0	4	30.5	11.5	20	54
Blue Lake	320	83	4	45	15	99	74
Christie	250	20	10	105	25	30	60
Johnson	39	0	0	14.4	3.3	19.3	2
Essex	17	0	9	3.3	2.2	.3	2.2
Johnson-Spini	97	22.3	11	31.2	13.5	0	19
Graham	140	37	13	22	7	1	60
Zable Simpson	50	3.3	0	16.8	5.3	1.2	23.4
Upper Simpson	40	0	0	9.5	6.5	5.5	18.5
Total acres	1233	247.6	61	304.7	99.3	189.3	331.1
Percent area	100	20.1	4.9	24.7	8.1	15.4	26.9

Table Footnotes:
Emmerson Bar includes parcel area south of flood levee.
Johnson-Spini Bar includes parcel area south of North Bank Road.
Upper Simpson Bar includes parcel area west of right bank.



Map 4.1-1
Watershed Map
Mad River Basin

(adapted from: DWR, June 1982 "Mad River Watershed Erosion Investigation")

4.4 Wildlife and Fisheries

The distribution and density of wildlife within the Mad River watershed basin is diverse, and is closely related to the land use and vegetation pattern in the area. The upper watershed which is sparsely inhabited by humans, has the greatest variety and concentration of species, which can include the mountain lion, black bear, deer, coyote, gray fox, porcupine, possum, rabbit, striped skunk, chipmunk and squirrel. The lower watershed, although more developed and populated, still has a diverse range of wildlife. The species mentioned above may occur in the lower watershed project area, but more rarely. Further discussion of wildlife can be found in Section 5.6. Additional information on wildlife can be found in Appendix D and Attachment 3 (Mad River Biologists, 1993a, 1993b) and incorporated herein by reference.

Fisheries common to the watershed include the cutthroat trout, coho salmon, steelhead trout and chinook salmon (see Table 5.5-1). Further discussion of fisheries can be found in Section 5.5. Additional information on fisheries may be found in Appendix F (Institute for River Ecosystems, 1993) and incorporated herein by reference.

4.5 Highways

There are three major highways within the Mad River watershed. U.S. Highway 101, the main north-south highway along the U.S. Pacific Coast, cuts across the western end of the basin and near the lower end of the project area. State Highway 299 is a west-east route that connects with U.S. 101 near the lower end of the basin and project area. Highway 299 crosses the project area and parallels it for several miles. State Highway 36 is another west-east route which intersects U.S. 101 further south and provides access into the upper reaches of the watershed outside the project area.

4.6 Public Utilities and Structures

The following public utilities and significant structures are located in or near the project area and might possibly be impacted by the project (does not include gravel processing sites). The approximate river mile locations are shown. Additional detail regarding these structures is described in Section 5.12.

4.7 Topography

The Mad River basin is characterized by mature topography in the northern and southern regions, and youthful topography in the middle portion. The coastal delta region and the southern interior valleys are essentially flat. The rest of the basin is rugged topography with steep V-shaped canyons. Elevations in the basin range from sea level to slightly more than 6,000 feet (see Map 4.7-1). From the headwaters the main channel descends with an average gradient of 16 feet per mile for about 40 miles and then drops rapidly at 61 feet per mile for 30 miles before emerging onto the lower valley where the gradient drops to approximately 12 feet per mile for the remaining 55 miles (see Figure 4.7-1).

Table 4.6-1 - Public Structures and Utilities within the Project Area

Structure	River Mile
Former Sweasey Dam Site	19.6
Mad River Fish Hatchery	14.5
Weir	
Left Bank RSP	
Blue Lake Hatchery Road Bridge	12.8
Blue Lake Right Bank Levee and RSP	12.8 - 13
Blue Lake Sewage Treatment Ponds	11.7
Right Bank RSP	
Highway 299 Mill Creek Bridge	10.5
North Coast Railroad Authority Bridge	9.8
Glendale Drive Bridge over Lindsay Creek	9.8
Highway 299 Bridge over Lindsay Creek	9.8
Railroad Trestle over Warren Creek	9
Warren Creek Road Bridge	9
Diversion Structures in the HBMWD Reach	7.8 - 9.5
Five Ranney-Type Wells and Collectors	
One Surface Water Diversion (Pump Station Six)	
Upper HBMWD Water Pipe Crossing	8.7
Lower HBMWD Water Pipe Crossing	7.8
U. S. Geological Survey Stream Gaging Station	7.8
Highway 299 Eastbound (Right) Bridge	7.8
Highway 299 Westbound (Left) Bridge	7.8
PG&E Upper Gas Line Crossing	7.8
Sewage Effluent Pipe Crossing	7.8
MCSD Water Pipe Crossing	7.25
Highway 101 Northbound (Right) Bridge	5.6
Highway 101 Southbound (Left) Bridge	5.6
PG&E Lower Gas Line Crossing	5.6
Hammond Trail Bridge	3.9
McKinleyville Community Sewage Treatment Plant	2.1
Mad River Beach Road Left Bank RSP	3.3 - 3.4
Humboldt County Boat Ramp	3.2
Clam Beach Mad River Mouth RSP Site	0

4.8 Geology

The Mad River Basin lies within the northern coast range province. The geology of the watershed is complex and variable having some areas that are high sediment producers and others that produce much less sediment.

The basin is underlain by three principal rock formations that occur in northwest trending bands and are aligned with the general trend of the river. These formations range in age from pre-Cretaceous (dinosaur era) to Pliocene (early mammal era) in age and are separated by major faults. The rock formations become progressively younger from east to west in the basin. The oldest rocks, Kerr Ranch Schist are exposed in a one to five mile wide zone that borders the extreme east-northeast side of the basin. This zone separates the Klamath Mountains province to the east from the northern coast province on the west.

Most of the basin is underlain by late Jurassic to late Cretaceous rocks of the Franciscan formation. These rocks are predominantly sandstones and shales with lesser amounts of altered volcanic rocks (greenstones), cherts, conglomerates, and serpentine. Of the various rocks in the Franciscan formation, the sandstones and greenstones are the best quality for use as aggregate construction material. The Franciscan complex of rocks can be further divided into a number of subgroups. Generally, these rocks have been strongly folded, faulted,

crushed, and sheared during several episodes of crustal disturbances in the geologic past. This intense alteration has produced a variety of rock units that are subject to rapid weathering, slope instability, and other factors that facilitate rapid erosion (see Map 4.8-1). The most erosive rock unit of the Franciscan assemblage is the melange unit which is the major source of sediment transported by the Mad River.

The dominate erosion processes vary between the various subgroups of the Franciscan assemblage. Some of the more important erosion processes observed throughout the Franciscan assemblage in the Mad River include: soil creep, shallow debris slides, fluvial incision, and slump-earthflow. Some landforms creep slowly downslope and continuously feed coarse and fine sediment into the Mad River Channel. Debris slides are common where the river cuts through the toe of oversteepened perennial slide zones. Large active slump-earthflows originating in the Franciscan melange are among the most important erosion processes in the Mad River basin. These large features often originate near the basin perimeter and extend downslope to tributary valleys or to the main channel. Fluvial incision feeds earthflow debris and other slope derived material to the main channel and is clearly an important process. The combined effects of high precipitation and unstable geology place the Mad River basin and other Northcoast rivers among the highest recorded sediment producers per unit area in the world (Table 4.8-1). The high sediment yields produced locally are the product of moderately high sediment concentrations and very high stream flow.

The youngest rocks in the basin are unconsolidated marine sediments belonging to the Falor formation of the recent Pliocene era. These rocks may have formed from deposits accumulating under a shallow sea which extended into an ancestral Mad River Valley. Subsequent uplift and faulting lifted the Falor formation to its present position in the north central portion of the basin. The clays and soft sands in this formation often become saturated and unstable, resulting in rotational slumping.

Late Quaternary fluvial terraces are found along several stretches of the Mad River. These are indicative of major geologic cycles of channel aggradation followed by channel incision and degradation over perhaps 40,000 years. Soil development found in terrace profiles and elevation above the present stream channel help differentiate these deposits from one another and from more recently deposited alluvium.

Recent alluvium contains mixtures of boulders, gravel, sand, silt, and clay that has accumulated in the tributaries and main stem of the Mad River. These alluvial deposits vary in width and depth throughout the basin and the project area. At the hatchery the canyon opens up into a broad alluvial flood plain through which the river flows for about four miles. At moderately low flows of 1,000 to 4,000 cfs these alluvial deposits move readily as the channel shifts course and meanders downstream.

The North Fork of the Mad River enters through this flood plain about two miles downstream from the hatchery. Near Essex the river cuts through a low ridge and enters a narrow canyon. The HBMWD surface water diversion and Ranney wells are located in this canyon. When the river leaves this canyon, it is more or less confined and prevented from meandering greatly through a broad coastal flood plain before reaching the Pacific Ocean. In recent years the river mouth has migrated north and encroached on Clam Beach. In 1992, recognizing that the northward migration of the river was threatening U.S. Highway 101, CalTrans placed a large rock rip rap revetment at the south end of Clam Beach to halt the northward migration and divert the river away from the highway. The northward migration of the river has greatly expanded the volume of the Mad River Estuary.

4.9 Hydrology

The river has a 43-year (through 1990 water year) average annual flow of 1,071,000 acre feet which is equivalent to about 41 inches of runoff which can be compared to a basin-wide average annual precipitation of 64 inches. The range in annual runoff varies from 109,000 acre feet (4 inches), recorded in the 1977 water year to 1,789,000 acre feet (69 inches) recorded in 1983. During the recent 20 year period (1971-1990) the average annual runoff was 951,000 acre feet (37 inches) and during the more recent 10 year period (1981-1990) the average annual runoff dropped to 527,000 acre feet (20 inches) which is about half of the long term average. These recent "drought-like" conditions reduced sediment recruitment into the lower Mad River project extraction area and contributed to channel degradation processes. See Section 5.3 for further discussion on Hydrology and Section 5.4 for discussion on groundwater. Also refer to Appendix F (Institute for River Ecosystems, 1993) incorporated herein by reference.

Table 4.8-1 - Approximate Long-term Average Sediment Yield of Selected Major Watersheds.

Watershed	tons per mi^2 per year
Columbia	15
Potomac	25
North America	40
Mississippi	45
Missouri	70
World-wide average	75
Smith River	450
Eel River (Scotia)	1,000
Mad River (Arcata)	5,000
Mattole	10,000

4.10 Sediment Yield

The combined effects of high precipitation and unstable geology place the Mad River basin and other Northcoast rivers among the highest recorded sediment producers per unit area in the world (Table 4.8-1). The high sediment yields produced locally are the product of moderately high sediment concentrations and very high stream flow. In the Mad River most of the sediment is suspended load rather than bedload. The exact proportion of bedload to suspended load or bedload to total load varies with time and varies throughout the watershed. Generally, the bedload/total load ratio gets smaller as you move downstream. See Section 5.2 for further discussion on bedload recruitment. Also refer to Appendix F (Institute for River Ecosystems, 1993) incorporated herein by reference.

4.11 Project Conformance with General and Local Coastal Plans

General

The general plan is a long-range statement of public policy for the use of public and private lands within the unincorporated areas of Humboldt County. These public policies establish a generalized pattern of land use for a twenty-year period, which is the foundation of more detailed implementation.

As represented by the general plan, the pattern of land use attempts to balance the economic and social needs of the public with the inherent characteristics of the land, plant and animal life, and air and water conditions.

The Humboldt County General Plan is organized into two volumes. Volume I, the Framework Plan, establishes goals, policies and standards for county wide issues, and the development of the rural areas of the County. The plan also establishes the boundaries of the community planning areas. Volume II contains a number of individual plans for specific geographic areas as identified in Volume I. These include the Local Coastal Plans (LCP) for the Coastal Zone, and the Community Plans for the non-coastal areas of the County.

LCPs, in response to Coastal Act requirements, tend to be much more detailed than the Framework or Community Plans. The policies of the LCPs address development and resource protection issues typically not included in the Framework or Community Plans.

The project area is governed by several LCPs and non-coastal Community Plans. The County has not updated all of the community plans as delineated in Volume I. Therefore, it is sometimes necessary to rely on "old" plans, as is required for a large portion of the project area. When the County is required to utilize old plans or when there is an inconsistency between existing and historic uses with the plan, the Framework Plan, Volume I specifies that the following guidelines be observed: common sense; consideration of existing and historic uses; the physical conditions of the geographic area; and consideration of errors, oversights or omissions.

The land use plans for the project area, from upstream to downstream, are listed below:

Blue Lake Community Plan (Northern Humboldt General Plan
Arcata Community Plan
McKinleyville LCP
Humboldt Bay Area LCP

Blue Lake Community Plan

The Blue Lake Community Plan is part of the old Northern Humboldt County General Plan adopted by the Board of Supervisors in approximately 1967.

The Northern Humboldt Plan's section on mining states:

"Sand and Gravel have been the leading (mineral) products in Humboldt County. Mineral reserves have been largely untapped. Manganese, iron, lime, clay, coal, copper, bornite, chalcolite and chalcopyrite are reported to exist. The dollar value of the output is relatively small at this time, but with new encouragement, this section of the economy can be really developed."

The plan further states that mining is not shown on the land use map "since mining is related to extractions from under the ground". There is very little in the old Northern Humboldt General

Plan regarding mining, therefore, in order to make a conformance finding with the plan, common sense and some reliance on the Framework Plan is required.

The Framework Plan sets *goals* for mineral and energy resources:

1. To assure the long-term availability of adequate supplies of mineral resources, to protect mineral resource areas from incompatible land uses and to minimize adverse environmental impacts.

2. To move toward self-sufficiency in energy use, with maximum reliance on local renewable resources for local energy needs.

The *policies* for mineral and energy resources include:

1. Maintain and update maps of the County's identified mineral deposits.
2. Plan future development such that it will not interfere with the utilization of identified mineral deposits.
3. Ensure that adverse environmental effects are prevented or mitigated to the fullest extent feasible and that mined lands are reclaimed to a usable condition which are readily adaptable for alternative land uses under the General Plan.
4. Encourage the production and conservation of minerals, while preserving to the maximum extent feasible, the values relating to recreation, watershed, wildlife, range and forage, science, and aesthetic enjoyment.
5. Ensure elimination of residual hazards to the public health and safety.
6. Prevent the disruption of community character in siting and planning mineral resource extraction operations.
7. Require mineral haul routes to avoid incompatible areas such as landslides, highly erodible soils, residential areas, and schools, if feasible.
8. Permit conditions for mineral extraction operations should address allowable dust and noise levels, hours of operation, fencing, traffic, access, setbacks and other means to reduce conflicts with adjacent development.
9. Extraction of instream sand and gravel is not to exceed average annual replenishment level (annual bedload), except when the bedload left from a previous flood is greater than the average annual replenishment or if the projects emphasize fishery enhancement, flood control or bank protection.
10. Bank Protection shall be permitted to: 1) maintain necessary public or private roads; 2) protect principal structures in danger from erosion; and 3) protect lands designated Agriculture-Exclusive from erosion.
11. Evaluate significant water diversion projects which would reduce the replenishment rate of gravel in streams as to the impact they would have on local mineral supply in Humboldt County.
12. The operation of borrow pits on Resource Production Lands (timber, agriculture) for non-commercial purposes is considered a principal use necessary to maintain the primary use of the land.
13. The subdivision to create parcels, which are for the primary purpose of providing road and construction materials, shall be consistent with this plan.

Arcata Community Plan

The Arcata Community Plan was adopted by the Board of Supervisors in approximately 1966. The plan apparently has no discussion on mining. Therefore, refer to the previous discussion of the Blue Lake Community Plan.

McKinleyville Local Coastal Plan

The McKinleyville LCP was adopted by the Board of Supervisors on December 16, 1980, and certified by the State Coastal Commission on January 7, 1982. The LCP, Section 3.41(J) states:

"For surface mining projects within the Coastal Zone, the following conditions apply to all operations whether they are covered by the County Surface Mining and Reclamation Ordinance No. 1373 or not:

a. Removal shall be from unvegetated bars.

b. Disturbance of banks shall be avoided or minimized.

c. Excavations shall not leave holes or pits which could adversely affect aquatic life.

d. Sediment settling ponds shall be used for fine silt trapment when a crusher is used at the gravel site.

e. In order to minimize adverse impacts to migrating anadromous fish, the Department of Fish and Game's guideline for removal of gravel only from May to November each year, except for emergency purposes, shall apply.

f. River crossings, or drainage crossing on the gravel bar, should use temporary culverts or removable bridges to minimize impacts to water quality.

g. Sand and gravel projects emphasizing flood control or bank protection shall be encouraged."

Humboldt Bay Area Local Coastal Plan

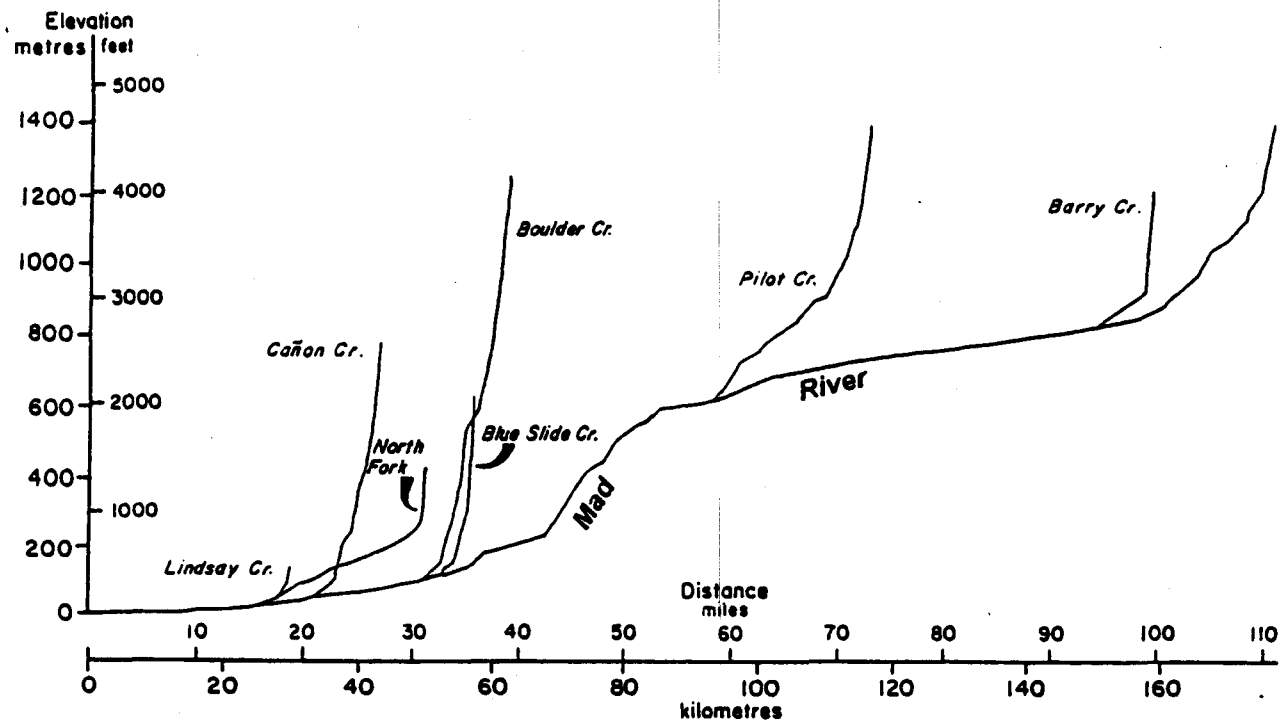
The Humboldt Bay Area LCP was adopted by the Board of Supervisors on November 29, 1983, and certified by the State Coastal Commission on October 14, 1982. The LCP, Section 3.14(B)(10) states:

"For surface mining projects within the Coastal Zone, the following conditions apply to all operations whether they are covered by the County Surface Mining and Reclamation Ordinance No. 1373 or not:

1. Removal shall be from unvegetated dunes which pose a safety hazard or threaten existing development or agricultural, and shall be consistent with Section 3.30B(10) (Beach and Dunes); or shall be from unvegetated river bars, or from industrially designated areas.

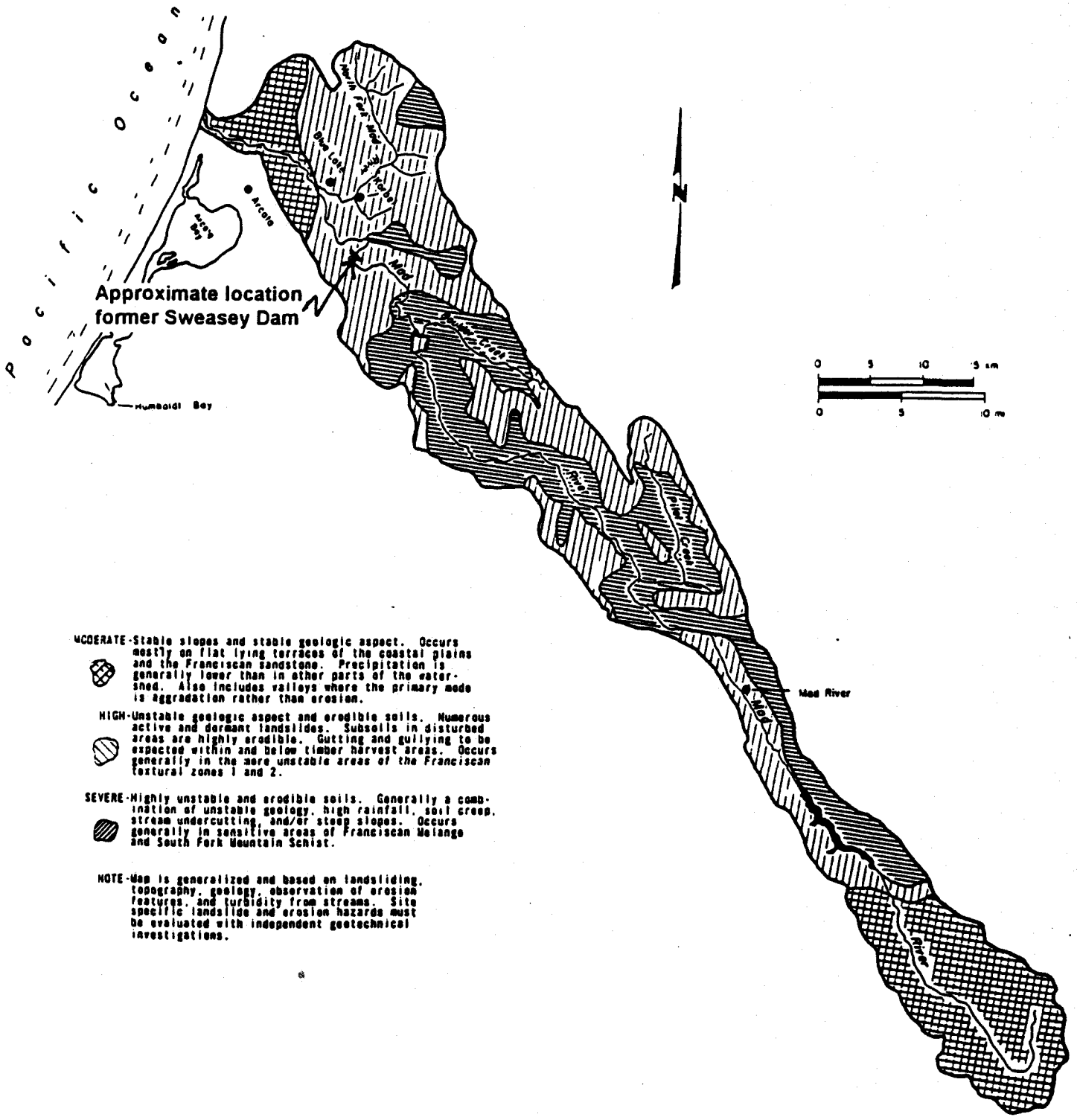
(Note: items 2-7 are the same as items b-g above)

8. Sand and gravel operations shall not remove sediments essential to the maintenance of areas used for public recreation or which protect uplands planned for commercial, residential or industrial use from erosion."



(adapted from: DWR, June 1982 "Mad River Watershed Erosion Investigation")

Figure 4.7-1
Stream Profiles
Mad River Basin



Map 4.8-1
General Stability Map
Mad River Basin

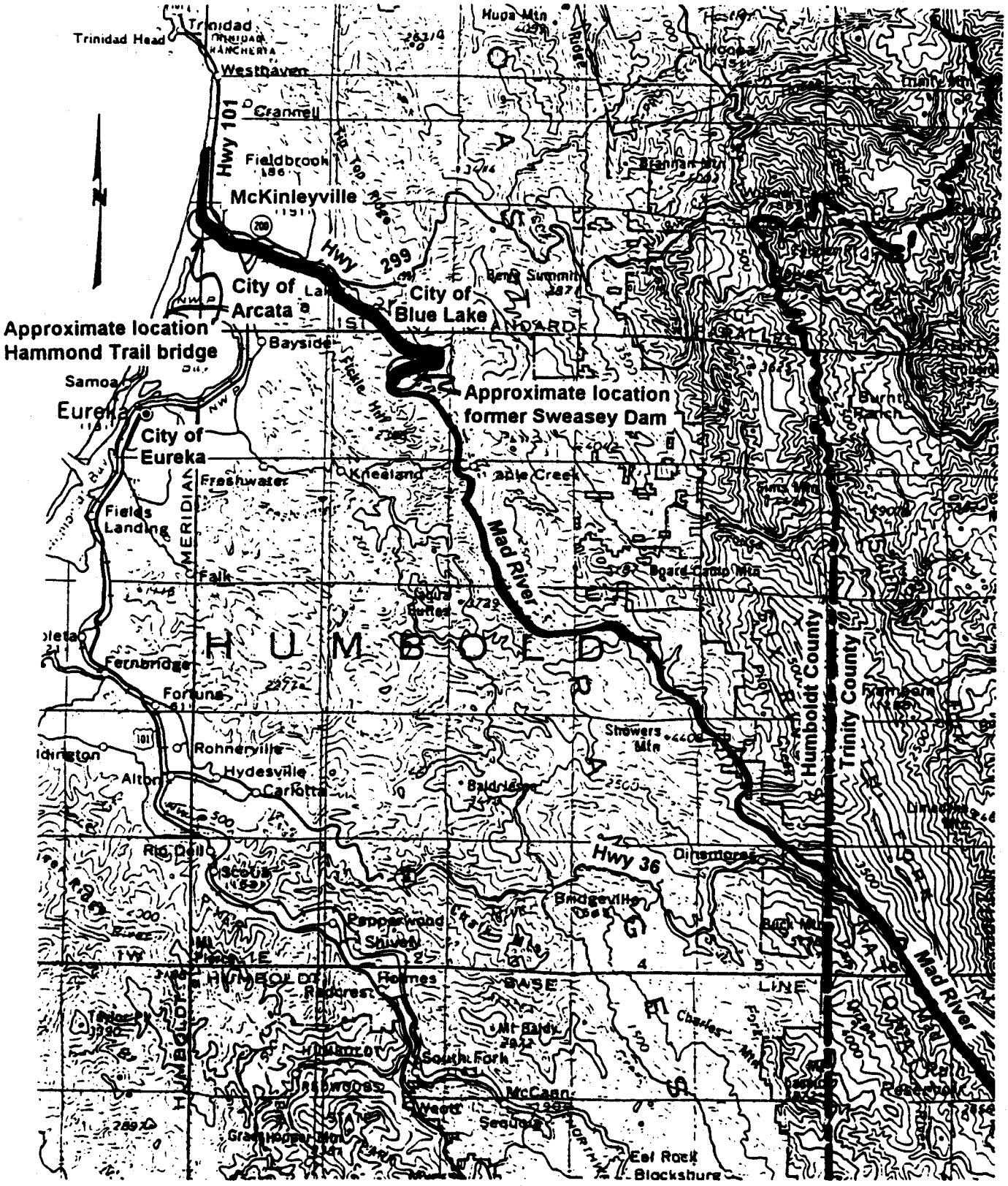
(adapted from: DWR, June 1982 "Mad River Watershed Erosion Investigation")

Conclusion

This Program Environmental Impact Report identifies existing and potential significant environmental impacts resulting from channel degradation and the extraction of sand and gravel from the Mad River. The PEIR also recognizes that excessive channel aggradation can cause significant adverse impacts to wildlife habitat and aquatic habitat, and can increase flood hazards by reducing channel capacity. One way to reduce the threat of these impacts is to maintain a viable gravel extraction industry. The recommended alternative and suggested mitigation measures will ensure conformance with the goals of the Framework Plan, i.e. the long-term supply of aggregate mineral resources in the Mad River, protection of Mad River mineral resource areas from incompatible land uses, and minimization of identified significant adverse environmental impacts.

The recommended alternative, an adaptive management plan and monitoring program will ensure conformance with the policies of the Framework Plan, by assuring that future extraction operations will not significantly affect established riparian vegetation or adversely affect aquatic life. The adaptive management plan will limit and design future extraction operations to minimize impacts to migrating anadromous fish, public utilities, and structures. Surface mining in and along the Mad River will be conducted in compliance with all applicable local, state and federal regulations. The placement and use of summer bridge crossings is governed by CDFG 1603 agreements and USACOE permits to reduce the risk that summer channel crossings will adversely affect water quality and other river resource values.

In short, the preferred alternative will ensure that gravel extraction on the Mad River conforms with the intent and purpose of the established goals and polices of the local coastal and general plans. In addition, as a result of this PEIR it is expected that the Board of Supervisors will set site specific goals and policies for surface mining activities within the geographic scope of this PEIR. Without the preferred alternative gravel extraction in the lower Mad River would not be in conformance with the goals and policies of the Framework Plan.



Map 4.7-1
Topographic Map
Mad River Watershed and Vicinity

5.0 IMPACTS AND MITIGATION MEASURES

For the purposes of CEQA, impacts identified herein are either 'significant'(S), 'significant and unavoidable' (SU), 'less than significant' (LS), or 'potentially significant' (PS). No differentiation has been made as to the degree of significance or insignificance.

5.1 Channel Morphology/Gravel Recruitment

The County retained Humboldt State University's Institute for River Ecosystems, and M & M Consultants to gather and analyze information on the effects of historic gravel extraction on the geomorphic character of the project area. The reports are included herein by reference. Portions of the following section were adapted from the Institute report. See Appendix F for the complete Institute for River Ecosystems report, and Appendix C for the complete M & M Consultants report.

River bed morphology is constantly changing regardless of gravel extraction. A goal of the adaptive management plan is to maintain a degree of dynamic equilibrium in structure and diversity, while the channel adjusts to natural and man-induced changes in stream power and sediment supply. Another goal of the adaptive management plan is to establish a program to monitor gravel extraction, gravel recruitment, gravel replenishment, bed morphology, fish passage, fish habitat, vegetation, and other riverine resources, to see that a degree of dynamic equilibrium, and where needed, rehabilitation is established and maintained, while allowing appropriate amounts of gravel to be extracted from appropriate reaches.

If the Mad River channel continues to degrade, the surrounding water table will decline which will induce changes in the riparian plant community; which may, in turn, induce changes in channel morphology. However, plant communities and channel morphology are not static features and there will always be change taking place. The adaptive management plan and monitoring program is not established to prevent change in the riparian plant community and channel, but to assure that extraction-induced changes in channel morphology and vegetation do not create irreversible adverse impacts on the processes of channel development and community succession, nor eliminate representations of specific successional communities.

If gravel extraction is expanded to permitted levels, or sustained at levels that exceed net recruitment there will be little control regarding adverse channel changes induced by gravel extraction. The preferred adaptive management plan includes periodic and annual reviews of mining reclamation plans, extraction levels, recruitment levels, individual bar replenishment, other changes and trends in channel morphology, and changes and trends in related resource areas. Using the information obtained during the reclamation plan compliance reviews and during the monitoring program the SDRC will limit and guide the operators in establishing the appropriate quantity, location, and methods of extraction.

Aggregate recruitment is the transport of sand and gravel into the project reach from upstream by bedload transport. In the case of sand, some suspended load may also be recruited as the channel gradient decreases in the lower reaches, or as storm runoff declines. During high flows some bedload material is transported out of the project reach, i.e., it is recruited into a downstream reach. Net recruitment to the project reach would be the amount coming in minus the amount going out as bed load transport into lower reaches.

Replenishment is the amount of bedload material that is deposited in the project reach. During any given year and depending, in part, where the bar is located in the project reach, replenishment may be the result of material that was recently recruited; it may also be the

result of redistributing material that was previously stored upstream in the project reach; or, it may be a combination of both new material and redistributed material.

Recruitment and replenishment are typically expressed in tons or cubic yards per year. For a given river reach, in general terms, if the average annual extraction rate is less than average annual net recruitment, then channel aggradation will occur. If this aggradaton is focused in site-specific areas where current degradation is a concern, then restoration of bed elevation or rehabilitation will occur. If this aggradation occurs where aggradation problems exist, then the aggradation problems will worsen. Both excessive channel aggradation and excessive channel degradation generally lead to a host of related environmental problems.

If the average annual extraction is more or less equal to average annual net recruitment, then a condition of sustained yield could exist. Under sustained yield deposition and scour will occur locally but in a spatially-averaged sense the channel may remain more or less in dynamic equilibrium.

If the average annual extraction rate exceeds net recruitment then the sand and gravel resource is being 'mined'. Long-term mining generally leads to excessive channel degradation and a host of related potential environmental problems.

In reference to channel equilibrium, it is important to recognize that changes in channel aggradation and degradation will naturally occur in the absence of gravel extraction. Such changes are driven by the availability of sediment and stream power. Stream power is the ability of a stream to do work and is a function of discharge, slope, and hydraulic geometry; and these factors are functions of precipitation, watershed condition, and channel morphology. Precipitation patterns vary continuously and produce obvious changes in runoff and sediment load. Watershed condition influences streamflow-precipitation-erosion relationships and the availability of sediment. Erosion rates and sediment availability are influenced by geology, precipitation, topography, vegetation, land use, earthquakes, streamflow, and channel morphology. Sediment scour and sediment deposition produce changes in channel morphology and channel gradient. These processes are all interrelated in a complex series of actions and reactions and it is difficult to precisely predict the effects of changing any of the interrelated factors.

Since European settlers moved into this region, there have been obvious changes in Mad River watershed conditions. Early logging, ranching, road building, and other human activities increased sediment availability and the channel aggraded significantly. Prior to the mid 1980's, almost every report written on the Mad River discussed problems associated with flooding and channel aggradation. According to the Department of Water Resources 1982 investigation on Mad River Erosion:

"Aggradation of the riverbed has caused historical changes in the channel, raising the height of peak stormflows and resulting in damage to roads, bridges, agricultural land, fisheries, and dam and diversion facilities." (DWR, 1982)

Sweasey Dam was constructed in 1938 to supply water for the city of Eureka. A sediment flushing valve was installed with the intended purpose of allowing sediment transport into downstream reaches. This valve became inoperable in 1941 and the dam reservoir capacity began to diminish rapidly as sediment began filling the reservoir. The reservoir was completely filled during the 1964 flood and thereafter sediment rolled over the dam spillway (Hollingworth, 1993). If 3000 acre-feet of sediment filled the reservoir between 1938 and 1964 the average annual bedload transport rate would have been approximately 186,000 cubic yards per year.

The destruction of Sweasey Dam in 1970 released nearly five million cubic yards of sediment into the upper project area which contributed to existing channel aggradation problems. Large landslides in the reach between Sweasey Dam and the fish hatchery contributed additional sediment. According to the River Institute report approximately 15.5 million cubic yards of gravel was extracted from the lower project area between 1952 and 1992. The gravel mining industry and those who view the growth of the County infrastructure as a positive factor benefitted from this erosion, aggradation, and extraction. Today, there is a great deal of concern over channel degradation.

The lower project area has since experienced channel degradation and this is one of the major concerns that generated this PEIR. Some of the sediment that was released into the upper reaches of the project area when Sweasey Dam was destroyed in 1970 may still be stored in the channel. But, some of that sediment wave has passed through or has been extracted from the lower reaches of the project area.

In recent years there have been improvements in timber harvesting and road building practices which should logically result in less erosion, less sediment, and more channel degradation. Hillslope disturbances, related erosion, and sediment production associated with past improvements of Highway 299 have decreased. In recent years the Mad River has experienced droughts and seen a reduction in high water. For example, the average annual runoff at Arcata during the last 10 years is half of the long-term recorded average annual runoff. Recent low-water years have produced less-than-average sediment transport and recruitment.

It is obvious, from the data presented herein, that gravel extraction has exceeded net recruitment in the project area. It is sometimes recommended that, in order to have sustained yield gravel extraction, average annual extraction should equal average annual net recruitment. Dr. Andre Lehre (Lehre, et al. 1993) has used a variety of methods to estimate long-term average annual Mad River gravel recruitment near the middle of the project area, in the vicinity of Blue Lake. Lehre, Klein, and others (Lehre, et al. 1993) have compared recruitment estimates with extraction estimates and with changes in channel storage in a budget-like analysis (Gravel Recruitment - Gravel Extraction = Change in Gravel Storage) and the estimates seem to balance fairly well. However, according to the Department of Conservation, Office of Governmental and Environmental Services, these measurements "... show that the bed was enlarged by a factor of only about one-half and about one-sixth of the offtake rate (minus the transport rate) in the hatchery to 299 reach and the 299 to 101 reach, respectively. The lack of a commensurate response of the bed dimensions to the mined volume seems to indicate that the volume deficit manifested downstream of 101. The enlargement of the Mad River estuary may be a result of this change" (from Mined-Land Reclamation Project staff of the Department of Conservation's Division of Mines and Geology, response to Draft PEIR, dated June 11, 1993).

Lehre recommends that a reasonable long term average gravel recruitment estimate for planning purposes is 150,000 to 200,000 cubic yards per year and these numbers agree well with the 186,000 cubic yards described above for the 1938-1964 period when Sweasey Dam reservoir filled with sediment.

According to the Mined-Land Reclamation Project staff of the Department of Conservation's Division of Mines and Geology (response to Draft PEIR, dated June 11, 1993) the "long term average bedload sediment yield, of 100,000 to 150,000 cubic yards of sand and gravel per year, is a useful parameter to plan extraction activities on the Mad River. A corroborative line of

evidence is the in-filling rate for Sweasy [sic] dam. According to Brown (WRI 26-75, 1975), over 2,000 acre-feet of sediment was released from the impoundment at its debouchment in 1970. This yields an average capture rate of about 100,000 cubic yards per year. We have no more specific documentation that describes the extent of filling of Sweasy Dam. However, if the entire storage capacity of Sweasy Dam had been filled with sand and gravel (about 3,000 acre-feet), an average transport figure of 150,000 cubic yards would be demonstrated. These values are in close agreement to the high and low long term averages cited in the Draft PEIR."

Relative to these estimates, the industry and the community have been borrowing gravel from the river and now must consider paying back some of this debt. If, in the long run, gravel extraction equals replenishment in the vicinity of Blue Lake, then the river below Blue Lake will be starved for gravel and the community will remain in debt to the river. Consequently, extraction should be less than net recruitment and replenishment in the upper or middle project area in order to allow necessary sand and gravel to migrate downstream and provide recovery to threatened resources in the lower project area.

Under current conditions, the SDRC shall use their reasoned judgment and available monitoring data to maintain extraction below net recruitment. Mine reclamation, bedload transport, recruitment, and replenishment along with river resource conditions and trends will be monitored and evaluated annually to help guide the SDRC in establishing site specific allowable extraction levels. In addition to overall river resource conditions and trends and average annual net recruitment into the project area reach, site specific entitlement, current bar morphology and instream habitat needs are just some of the factors that must be evaluated before developing annual site specific extraction prescriptions. The SDRC must recognize that river conditions can change and that the potential exists for aggradation problems to reoccur in the future. If aggradation becomes a problem it may be necessary to temporarily raise extraction levels to equal or exceed net recruitment.

Impact Statements and Mitigation Measures

Impact

Morph-1: Gravel extraction, droughts, streambank levees, bridge piers, other instream structures, and other factors cumulatively contribute to channel degradation. The primary Mad River channel morphology concerns at this time are associated with channel degradation and the effects that cumulative channel degradation has had on certain structures. However, excessive channel aggradation has created a host of river management problems in the past and these problems could reoccur in the future. Extraction rates in excess of average net recruitment will encourage the riverbed to continue degrading. Bed degradation can expose or undermine bridge supports, pipe lines and other structures jeopardizing structural integrity. Caltrans has indicated that the Highway 299 bridge supports have been weakened by degradation and that modifications have been tentatively scheduled for 1995-96. Said changes should strengthen the integrity of the Highway 299 bridge supports and help reduce the significance of channel degradation at this location. See Section 5.12 for more information on public utilities and structures.

No extraction or extraction rates below average net recruitment can lead to channel aggradation and excessive channel aggradation can create significant localized adverse effects. However, channel aggradation at Caltrans bridge sites and at other specific sites is needed to reduce the cumulative effects of past degradation and would be beneficial. (S/S)

Mitigation Measures

Mit-1: Implementing the preferred alternative helps to alleviate past aggregate mining impacts and is mitigation number one. This mitigation regulates the Mad River gravel industry in order to substantially reduce or eliminate cumulative and future adverse impacts. The SDRC will review all input, from operators, as well as others and apply information gained to the annual review, planning, and reporting procedures. After reviewing all available data and evaluating river resource reclamation, conditions, and trends the Mad River SDRC will prescribe variable annual site-specific extraction locations, extraction volumes, and extraction methods. The Mad River gravel operators may then extract sand and gravel at these specified locations using these specified standards and volume limitations. Under present conditions the approximate total annual volume prescribed shall be below the approximate average annual net recruitment rate as determined by the Mad River SDRC. In time, this mitigation measure will substantially reduce or eliminate the present cumulative impacts of bed degradation. This mitigation measure may also help sustain a viable Mad River Sand and Gravel industry. Therefore, if localized or extensive channel aggradation becomes a problem in the future, it is possible that this mitigation measure may be able to help reduce the significance of the potential adverse impacts associated with excessive channel aggradation. The potential success of this mitigation measure is dependent upon the combined expertise of the Mad River SDRC, the ability of the SDRC to reasonably monitor, judge, and apply flexible mining strategies to a dynamic river system, and on future hydrologic and geologic processes. This mitigation, Mit-1, will reappear many times throughout this document and shall be used to reduce, minimize, or eliminate many of the actual or potential adverse impacts that are identified in this PEIR.

Monitoring

Monitoring shall be performed by the SDRC and others as described in more detail below and in the adaptive management plan and adaptive monitoring program.

Mit-2: In order for the SDRC to fully implement the preferred alternative monitoring, information will be needed from other concerned agencies. Caltrans, the California Department of Fish & Game, Humboldt County Public Works Department, the North Coast Railroad Authority, Humboldt Bay Municipal Water District, or any other agency responsible for the integrity of structures along the Mad River, shall monitor their facilities and advise the SDRC as to the structural integrity of said facilities and as to potential risks that may be created by changes in channel aggradation and degradation or any other changes in channel morphology. The SDRC will utilize this information while evaluating instream reclamation and while planning future extractions. See Section 5.12 for more information on structures and utilities in the Mad River project area.

Monitoring

Humboldt County/Scientific Design and Review Committee
California Department of Fish & Game
Humboldt County Public Works Department
Caltrans
North Coast Railroad Authority
Humboldt Bay Municipal Water District

Significance after Mitigation

Significant. After mitigation measures Mit-1 and Mit-2 are implemented, it is not known how long it will take for the river to aggrade sufficiently and restore structural integrity to the subject structures. Therefore, there is an unknown period during which the subject structures

may be at risk due to bed degradation. Because of the time involved, the impacts of channel degradation will remain temporarily significant during mitigation.

Impact
Morph-2: Excessive channel aggradation and degradation produce various negative impacts on the aquatic habitat. Gravel extraction in excess of replenishment causes the bed to degrade at the extraction site and upstream and downstream of the extraction site, and can produce significant negative impacts on the aquatic habitat. Gravel replenishment is presently needed at some sites to restore degraded conditions. However, excessive gravel aggradation will lead to adverse impacts on the aquatic habitat. See Section 5.5 for additional information on the aquatic habitat. (PS/LS)

Mitigation Measure
Mit-1: In time this mitigation measure should reduce the cumulative impacts of bed degradation on the aquatic habitat to a level of insignificance. This mitigation measure will also reduce future potential adverse impacts of excessive channel aggradation to a level of insignificance. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee

Significance after Mitigation
Less than significant

Impact
Morph-3: Excessive channel aggradation and degradation produce various negative impacts on the groundwater regime which can lead to other impacts, both beneficial and adverse. Gravel extraction in excess of replenishment causes the bed to degrade at the extraction site and upstream and downstream of the extraction site, and can produce a significant lowering of the water table in the vicinity of the channel. Lowering the water table can improve drainage, reduce aquifer storage capacity, increase the depth to groundwater, and drain wet sites resulting in a change of riparian or wetland vegetation habitat. The changes in riparian or wetland vegetation habitat, could be significant and could lead to changes in channel morphology through bank erosion. See Section 5.4 for more information on groundwater. See Section 5.7 for more information on vegetation. (PS/LS)

Mitigation Measure
Mit-1: The regulation provided by this mitigation measure will reduce the cumulative impacts of bed degradation on the ground water, vegetation , and bank erosion regime to a level of insignificance. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Mit-3: The SDRC will monitor river banks in the project area and, where and when feasible will initiate bank-stabilizing revegetation practices at sites where bank erosion is excessive and where revegetation may reduce the erosion rate. This is one form of revegetation that will be used as mitigation for eroding streambanks and when extraction operations disturb significant plant communities.

Monitoring
Humboldt County/Scientific Design and Review Committee

Significance after Mitigation
Less than significant

Impact
Morph-4: Excessive channel aggradation and degradation produce various negative impacts on channel bank stability. Excessive aggradation creates a shallow, wide channel which can increase bank erosion and cause the channel to encroach on adjacent properties. Gravel extraction in excess of replenishment can reduce aggradation rates and cause the bed to degrade at the extraction site and upstream and downstream of the extraction site and reduce the adverse impacts of excessive aggradation. Rapid excess bed degradation can induce bank collapse and erosion by increasing the heights of banks, and by reducing the water table, which in turn reduces bank stabilizing vegetation. Bank erosion brought on by excessive channel aggradation and degradation has the potential to be significant. (PS/LS)

Mitigation Measure
Mit-1: The regulation provided by this mitigation measure will reduce the cumulative impacts of bed degradation on vegetation , and bank erosion to a level that is not excessive and therefore not significant. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Mit-3: The SDRC will monitor river banks in the project area and, where and when feasible will initiate bank-stabilizing revegetation practices at sites where bank erosion is excessive and where revegetation may reduce the erosion rate. This is one form of revegetation that will be used as mitigation for eroding streambanks and when extraction operations disturb significant plant communities.

Monitoring
Humboldt County/Scientific Design and Review Committee

Significance after Mitigation
Less than significant

Impact
Morph-5: Excessive channel aggradation produces negative impacts on channel flood carrying capacity. Channel aggradation reduces channel capacity and increases the risk of overbank flooding. Bed degradation, what ever the cause, has the potential of increasing the channel flood carrying capacity and reduces the risk of overbank flooding. Gravel extraction in excess of replenishment causes the bed to degrade at the extraction site and upstream and downstream of the extraction site. Increased flood capacity is a beneficial result of bed degradation, whatever the cause. Decreased flood capacity is an adverse effect of channel aggradation. Channel aggradation is not currently a problem. Therefore, impacts on flood carrying capacity are not currently significant. (LS/LS)

Mitigation Measure
Although no mitigation is required, implementation of the flexible management plan and Mit-1 requires the project to monitor these processes and adjust allowable extraction rates in an attempt to maintain a degree of dynamic equilibrium in channel morphology. This has the potential of reducing possible channel aggradation and the adverse impacts of moderate flooding. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee

Significance after Mitigation
Not Significant

Impact
Morph-6: Regardless of the rate of extraction, relative to bedload recruitment and replenishment, site-specific variables in extraction location and methodology can produce adverse impacts on channel morphology and related river resources. (PS/LS)

Mitigation Measure
Mit-1: The reasoned judgments and prescriptions of the SDRC will be used to reduce the site-specific cumulative impacts resulting from extraction methodology to a level of insignificance. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation
Less than significant

5.2 Water Quality

Only those water quality parameters that are likely to be influenced by gravel extraction and related activity, are discussed here. The County retained Humboldt State University's Institute for River Ecosystems to gather and analyze information on the effects of historic gravel extraction on the water quality of the project area. Portions of the following section were adapted from the Institute report, see Appendix F for the complete Institute for River Ecosystems report.

Turbidity

Turbidity is an optical property of water. When sunlight enters a column of clear water most of it will be transmitted directly through the column, or depending on the solar angle, much of it will be reflected. But, if the water is turbid, meaning it contains suspended or colloidal organic and inorganic matter, then very little will be reflected; much of the light will be scattered and absorbed by the solids and less will be transmitted. During the winter months suspended sediment is the main cause of turbidity in the Mad River. The main source of this sediment is the youthful Franciscan topography in the middle reaches of the basin.

On occasion, turbidity has its advantages. For example, the Mad River Fish Hatchery waits for the water level and turbidity to rise before releasing young fish into the river. The turbid water helps hide the newly released and concentrated fish from predators.

However, high turbidity is usually considered a water quality problem. Turbidity increases the cost of water treatment and shortens the life of pumping facilities. Water clarity, the opposite of turbidity, is generally desirable.

Stream productivity will be increased if sunlight can be transmitted to the gravel substrate. This is where much of the photosynthetic primary productivity of a stream takes place. If the water is turbid, little light reaches the stream bottom, and productivity declines.

Salmonids feed by sight, excessive turbidity will interfere with their feeding. Abnormal levels of turbidity during the summer season will limit the growth of juvenile fish. Turbidity also limits sports fishing.

Turbidity may cause water temperature to increase because the solids causing the turbidity will absorb incoming solar radiation. In addition, turbidity causes the ambient water temperature to increase through conduction and long-wave radiation.

During low-flow periods the main source of turbidity in the Mad River is suspended phytoplankton. During the summer months unregulated gravel mining operations and other activities that disturb the live channel could cause an undesirable significant increase in low-flow turbidity. Brown (1973) reported occasional noticeable levels of turbidity in the project area during low flow portions of the 1969, 1970 and 1971 water years. Although he did not offer any evidence to support his interpretations, he stated that the turbidity was probably "related to gravel operations and other activities". In all cases, the increases in turbidity subsided within 24 hours. The potential for regulated modern gravel extraction techniques to produce significant levels of low-flow summer turbidity is greatly reduced when compared to extraction techniques of the late 1960's and early 1970's.

Two sets of water samples were collected by HCPD staff and analyzed for turbidity at the North Coast Laboratories Ltd. during the 1992-93 water year.

The first set of samples were collected following the 1992 extraction season, while the river was rising on October 28, 1992. One sample was collected above the Mad River Fish Hatchery and one sample was collected below U.S. 101. The results indicated practically no turbidity, with 0.050 NTU above the hatchery, and 0.052 NTU at the 101 bridge.

Samples were also collected on January 20, 1993 while the river was at high flow. The January 20th results were:

Above the Hatchery	780 NTU
Blue Lake Bridge	200 NTU
Highway 299 Bridge	540 NTU
Highway 101 Bridge	570 NTU

It is difficult to interpret these few samples because there is no indication of discharge in the main channel; nor is there any information on turbidity and discharge in the various tributaries that enter the river between sample stations. During the 1969-1971 period, Brown (1973) observed turbidity readings in excess of 1000 NTU's. So we can assume that the 1992-93 samples were not exceptionally high.

With the exception of installing and removing summer bridges, modern gravel extraction does not encroach on the live channel and is unlikely to cause any increase in low-flow turbidity due to suspended sediment. During summer bridge installation and removal there may be a short term unavoidable small increase in stream turbidity. When properly applied the CDFG 1603 process reduces this impact to an insignificant level.

When the river rises it will pick up available sediment until it reaches its sediment carrying capacity. Fine dust particles left on bar surfaces after extraction operations will eventually be picked up and carried downriver. When this occurs the water is already quite turbid and the addition of this extraction-related suspended sediment has no significant adverse effect on water quality.

During regulated trenching operations a wall, or buffer, of gravel separates the trench from the channel. Thus, trenching should not contribute to low-flow turbidity. Gravel will be temporarily stockpiled adjacent to trenches to allow water drainage. This also allows the drainage of fine sediments. If stockpiles are properly placed, the fine sediments remain on the gravel bar rather than draining towards the live channel. Dredging raises the turbidity of trench water and this fine sediment settles on the bottom of the trench. When high flows occur, the trench wall collapses and the trench water and fine sediment on the bar and in the trench is connected to the live channel. When this occurs the water is usually already quite turbid from other sources and the addition of this extraction-related sediment has no significant adverse effect on water quality.

Gravel processing yards generate a considerable amount of fine material from crushing and sorting operations. These fines are collected in sediment settling ponds. Sediment settling ponds are required by the Regional Water Quality Control Board, and as part of the surface mining reclamation plans. The use of settling ponds reduces water quality impacts from processing yard run-off to a level of insignificance.

Temperature

Water temperature in the lower Mad River is not a problem during the high flow winter months, when incoming solar radiation is limited. Warm water could become a problem in the summer months, particularly during low-flow years. During low-water summer months the available

water is heated by incoming solar radiation. The potential for adverse effects of warm water may be greatest downstream from the HBMWD diversions where the volume of water has been significantly reduced. The water district is required to maintain the river above certain low flows levels. But, excessively low flows have been recorded below the district diversions during recent drought years.

The native fish of the Mad River are cold-water species. The optimum water temperatures for these fish vary between species and with age. Temperatures of 54° to 57°F tend to be preferred and fish will attempt to avoid water with temperatures in excess of 59°F. Non-optimum temperatures are not necessarily lethal. Salmonids will survive short durations in very cold (33°F) and very warm (75°F) water. Although salmonids prefer cool water, the swimming stamina of salmonids is reduced in cold water. Swimming stamina is greatest in temperatures of 65-75°F, and lowest at 32-40°F. Optimum swimming ability of juveniles is around 68°F.

As water temperature increases the metabolic activity and oxygen consumption of fish will rise. Unfortunately, the available dissolved oxygen level in water declines as the temperature rises.

Temperature increases can also favor the productivity of algae, and excessive algal production can create unfavorable habitat. Increased algal levels can increase oxygen levels through photosynthesis during the daylight, but respiration and decomposition dominates after the sun goes down and can be responsible for low levels of oxygen during the night.

The most crucial temperature dependent period for salmonids is while the embryo's are in the redds. During this period, cool water with a high concentration of dissolved oxygen is required. For the most part, nest sites are occupied during the high-flow cooler months, when water temperatures are relatively low in the lower Mad River.

Young juvenile fish using the lower Mad River for a nursery, are apt to encounter undesirable warm water. However, the enlarged estuary, which developed when the mouth of the Mad moved north, will help alleviate this potential problem. The enlarged tidal prism creates more volume and possibly more favorable summer habitat; adults and good-sized juveniles can usually migrate to more favorable sites when temperatures begin to rise.

Excavated instream ponds which occur on terraces away from the low flow channel, would not have any effect on the water temperature in the low-flow channel.

Trench mining would tend to provide cooler water at the channel bottom. This water is not available to fish until the barriers are removed at the end of gravel extraction season. Trench mining could also increase water surface area, thus causing a slight insignificant increase in water temperature.

The main potential effects on water temperature caused by gravel operations, result from changes in channel morphology Gravel skimming creates a less confined, wider channel. If the water level rises during the summer months it will spread out in a wide shallow channel instead of being confined in a relatively deep narrow channel. The greater water surface area absorbs more incoming short wave solar radiation, and the water temperature rises. Furthermore, the incoming summer solar radiation penetrates the relatively clear, shallow water and warms the gravel substrate. To the extent that the gravel substrate is warmed the maximum water temperature is reduced. However long-wave radiation from the warm gravel helps sustain warm temperatures into the evening hours. When skimming operations maintain a one-foot or greater vertical buffer above the low-flow water level the summer channel is more readily confined and the impacts on summer water temperature are reduced.

Dissolved Oxygen

Dissolved oxygen (DO) is necessary to support aquatic fauna. Aquatic species have varying dissolved oxygen requirements. Some require much greater levels of DO than others. Tolerance to low DO concentration also varies with stage of development. Salmonid eggs, in the nest, are particularly sensitive to low DO levels. The optimum level for DO in redds is about 7 - 9 mg/l. Severe losses in salmonid redds may occur when the DO concentration drops below 5 mg/l.

As water temperature increases, the solubility of DO decreases. Consequently, if all other factors are kept equal, there is less available DO when the water temperature is warm, than when it is cool. Furthermore algae tend to proliferate when temperature increases; and this proliferation can lower DO concentrations to critical levels, particularly at night when there is no photosynthetic activity.

The amount of dissolved oxygen in the water contributes to the swimming ability of salmonids. Changes in dissolved oxygen concentrations from 7 mg/l to 3 mg/l can reduce sustained swimming speeds by 500 percent.

Gravel extraction can cause the channel to become wide and shallow which causes the water temperature to rise and thereby reduce the DO concentration. Deoxygenated stream water regains oxygen through photosynthetic processes, and through gaseous exchange with the atmosphere. Rapid oxygen recovery can occur when the surface of the stream is turbulent. When extraction indirectly raises the water temperature, and reduces the presence of turbulent riffle flow, it will reduce the DO concentration. This reduction in DO could be significant in some reaches, particularly in low-flow years. The SDRC will monitor DO concentrations in the lower Mad River to determine current conditions.

Petroleum Products

The use of motorized vehicles on gravel bars introduces the possibility of contamination by petroleum products. The CDFG sometimes incorporates oil and grease clean up requirements in their 1603 agreement. Operators should remove all contaminated gravel from the river bar, so the petroleum products will not contaminate the water when the river rises.

Impact Statements and Mitigation Measures

Impact

H20Qlty-1: During extraction, mining equipment inadvertently pulverizes gravel bar surface materials and leaves a fine dust residue on some heavily disturbed gravel bars. When the river rises in the fall, the fine dust particles, along with other sediment are picked up by the river. Depending upon flow conditions this may, or may not, produce a short term measurable increase in turbidity. High flows on the Mad River are already quite turbid before they enter the project area and the added turbidity, when present, is not likely to be noticed and is considered less than significant. (LS/LS)

Mitigation Measures

Since no significant impact was identified, no mitigation is required.

Monitoring

None required.

Impact

H20Qlty-2: Placement and removal of summer bridges or other summer crossings can cause a short term increase in turbidity, at a time when the river is generally free of turbidity. Because the potential increase in turbidity is slight, short lived, and isolated the impact is insignificant. (LS/LS)

Mitigation Measures

Although no mitigation is required, implementation of the following permit measure(s) may be required

Mit-4: The SDRC shall consult with operators regarding the best design and placement of summer crossings. All summer bridges and other crossings shall be installed and removed in accordance with adopted regulations of the CDFG and, if required, the USACOE. This mitigation measure assures that installation and removal is executed under authorization of appropriate state and federal agency permits or agreements. These agencies have the capability of requiring conditions of approval on permits or agreements that will maintain water quality impacts, resulting from summer bridge installation and removal, at a level of insignificance.

Monitoring

Humboldt County/Scientific Design and Review Committee
California Department of Fish & Game, and possibly the
U.S. Army Corps of Engineers

Significance after Mitigation

Less than significant

Impact

H20Qlty-3: Skimming as an extraction method has the potential to create a broad, shallow channel increasing the surface area of the flowing river, and potentially increasing channel braiding and water temperatures. Generally the native fish species of the Mad River prefer cool water. Increased water temperatures could potentially have a significant adverse effect on these native fish species. (PS/LS)

Mitigation Measures
Mit-1: The SDRC will implement site-specific extraction prescriptions that will maintain this identified impact at a level of insignificance. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee

Significance after Mitigation
Less than significant

Impact
H20Qlty-4: During gravel extraction petroleum products may spill or leak on to the gravel bar. When the river rises these contaminants could adversely impact water quality. (PS/LS)

Mitigation Measures
Mit-5: The CDFG shall incorporate oil and grease clean up requirements in their 1603 agreement. Operators shall inspect their extraction sites daily when extracting and shall immediately remove all petroleum-contaminated gravel from the river bar. This mitigation measure will maintain the identified impact at a level of insignificance.

Monitoring
California Department of Fish and Game
Water Quality Control Board
Humboldt County/Scientific Design and Review Committee

Significance after Mitigation
Less than significant

5.3 Hydrology

The County retained Humboldt State University's Institute for River Ecosystems to gather and analyze information on the effects of historic gravel extraction on the hydrology of the project area. Portions of the following section were adapted from the Institute report. See Appendix F for the complete report.

The climate of the region is mediterranean. Winters are cool and wet with 75 percent of the annual precipitation occurring between November and March. Oceanic influences keep the coastal regions cool during the summer and these influences often move inland along the valley bottom. Hot, dry summers typify the upper inland reaches of the basin. Average annual precipitation varies from around 40 inches near the coast, to over 80 inches at the higher elevations with an overall basin average of about 64 inches (see Map 5.3-2).

For the purposes of this section 'hydrology' means the flow and flood characteristics of the Mad River. The Mad River streamflow has been constantly measured at the Arcata Station located 100 feet upstream from Highway 299 since August 1950 (for gage station locations, see Map 5.3-1). Streamflow was also measured at this site from 1910 through 1911. Water is diverted to the HBMWD at Essex, 0.1 mile upstream from the gaging station.

The long-term average daily discharge at Arcata is 1,478 cfs. The recorded instantaneous river flow at Mad River in Arcata varies from 0.1 cfs recorded on August 29, 1977 to 81,000 cfs on December 22, 1964.

The river has a 43-year (through 1990 water year) average annual flow of 1,071,000 acre feet which is equivalent to about 41 inches of runoff. The range in annual runoff varies from 109,000 acre feet (4 inches), recorded in the 1977 water year to 1,789,000 acre feet (69 inches) recorded in 1983. During the last 20 years (1971-1990) the average annual runoff was 951,000 acre feet (37 inches) and during the last 10 years (1981-1990) the average annual runoff has dropped to 527,000 acre feet (20 inches) which is about half of the long term average.

The HBMWD diverts about 55,000,000 gallons per day from the river, which is equivalent to about 85 cfs or 62,000 acre feet per year (USGS, 1990; DWR 1982). Other diversions, elsewhere on the river amount to about 4,000,000 gallons per day, which is equivalent to about 6 cfs or 4,500 acre feet per year.

Ruth reservoir, located about 68 miles upstream has been storing and distributing Mad River flow since July 1961. Ruth reservoir has a capacity of 48,030 acre feet. At Ruth Dam the required minimum flow released to the river is 5 cfs. Below Essex the HBMWD must maintain the natural flow or the flows outlined below -whichever is less.

Date	Discharge (cfs)
Oct 01 - Oct 10	30
Oct 16 - Oct 31	50
Nov 01 - Jne 30	75
Jul 01 - Jul 30	50
Aug 01 - Aug 30	40
Sep 01 - Sep 30	30

The erosion rates above Ruth reservoir are relatively low and the water district reports that very little sediment has been retained by the reservoir. Thus, Ruth is probably not preventing a

significant amount of sediment from reaching the lower river. Depending upon storm patterns Ruth can have a significant impact in reducing early flood peaks. But, in normal years, the reservoir will fill after the first few storms and water will flow over the spillway for most of the remaining winter. During this spillway overflow period, Ruth would have less of an impact on flood peaks at Blue Lake or Arcata.

Flood frequency analyses use a variety of statistical methods (notably, the USGS method and the Log Pearson Type III method), and the results may differ somewhat. Furthermore, the data set changes with the completion of each new water year. Using the 32-year data set (through 1979) in DWR (1982) and the 44-year data set analyzed by students at Humboldt State University, the following generalizations on flood frequency can be stated. At Arcata maximum annual peak flows may exceed approximately 20,000 cfs every 1.5 years. Every other year the maximum annual peak flow may exceed approximately 26,000 cfs. Peak flows of the magnitude observed in 1964, about 80,000 cfs, may have approximately a 50-year return period. Statistically speaking, it is realistic to expect a 1964-sized event to occur during the next decade (Coughlan, 1984). When such an event does occur it will likely produce significant aggradation in the lower river and initiate a series of erosional features that will deposit significant quantities of sediment into the channel system.

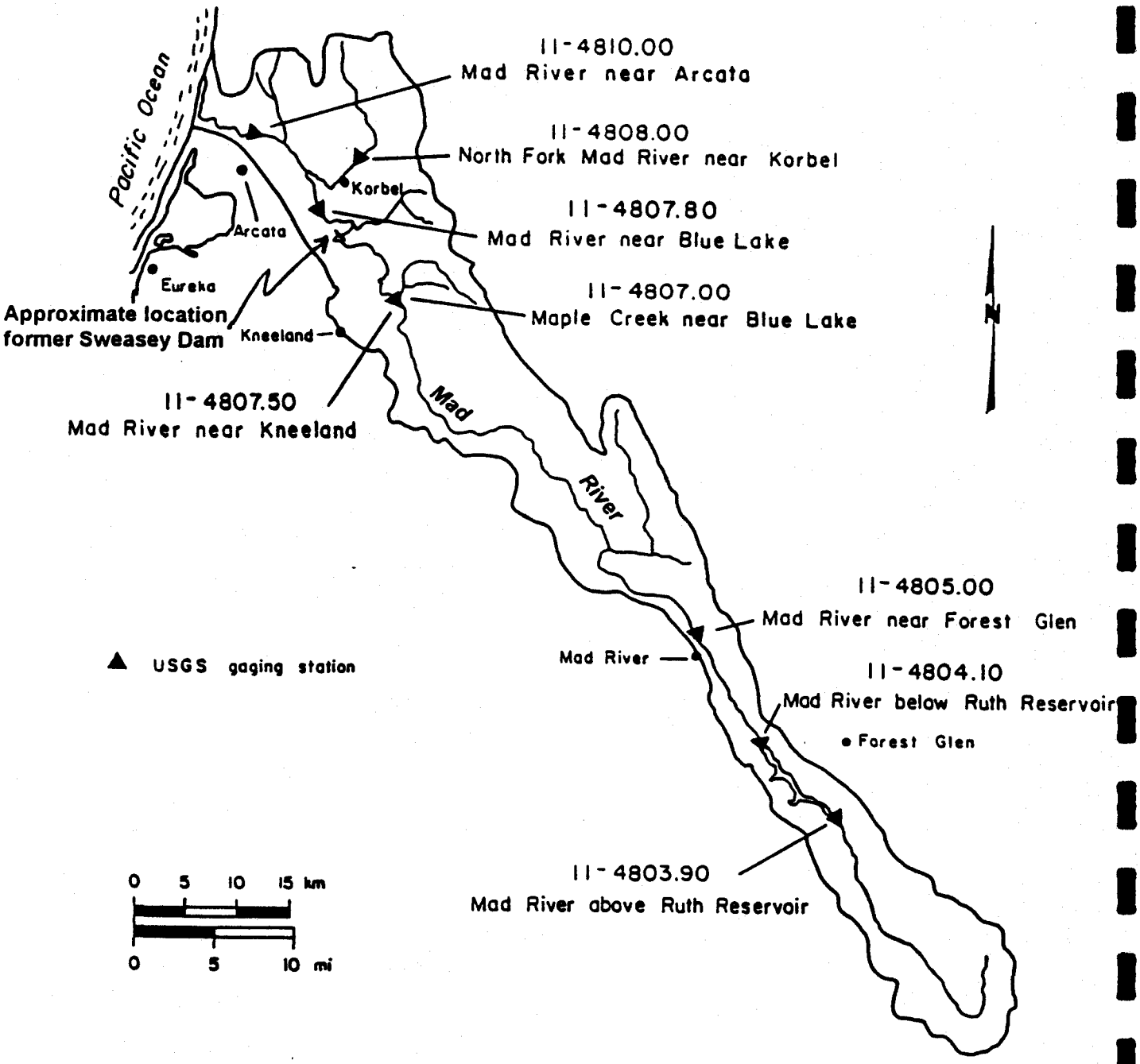
The Mad River will continue to flow, and flood, regardless of gravel extraction activity (for channel locations see Maps 5.3-3 and 5.3-4). Although gravel extraction, channel aggradation, and channel degradation do not directly influence flood frequency and drought frequency these processes can influence the impacts of flood waters and they can also influence the presence or absence of surface water during low-flow periods as well as the pattern of flow during low-flow periods.

While preparing this PEIR it became obvious that many people believe that channel degradation has a primarily negative impact on the environment. However, there are hydrologic situations where channel degradation can be more favorable than channel aggradation. And, there are also obvious situations where the opposite may be true. Some effects of aggradation and degradation on surface water hydrology are summarized below. Although the processes of channel aggradation and degradation do not influence flood frequency or drought frequency, channel aggradation reduces channel capacity and can increase the damage caused by moderate floods. Along the same lines, channel degradation increases channel capacity and can reduce the damages caused by moderate floods.

In alluvial systems streamflow occurs as surface flow in the open channel above the channel bottom and as subsurface flow within the alluvium below the channel bottom . Runoff from the watershed includes the water found in both the surface and subsurface flow. For a given low-level of runoff, aggradation increases subsurface flow and reduces the presence of surface water. For the same level of runoff, degradation reduces the subsurface flow and increases the surface flow. Thus, during low-flow conditions much of the water in an aggraded stream may infiltrate into the alluvium producing a low volume of surface water. In fact, the aggraded channel may be dry in certain reaches. It is normal for aggraded channels to eventually degrade as the stream attempts to restore and maintain dynamic equilibrium. As an aggraded channel degrades, the proportion of the total runoff that appears as surface flow increases and the proportion that is subsurface flow decreases. Thus, a reach of channel that may have been "dry" while in an aggraded condition may be "wet" after the channel has degraded. From a fisheries standpoint, as well as from a variety of other viewpoints, a wet degraded reach is preferable to a dry aggraded reach.

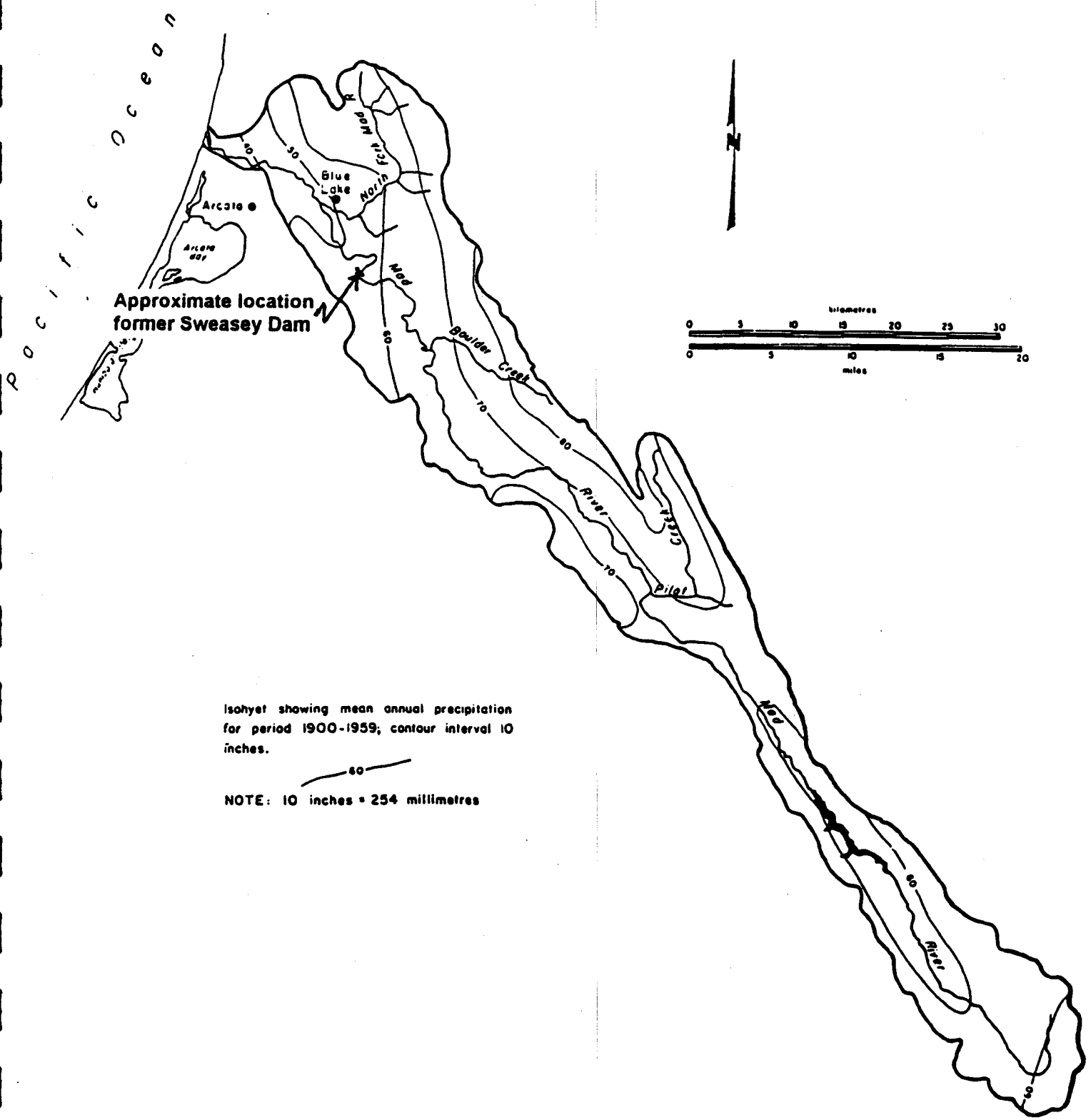
Generally speaking, during some moderately low-flow conditions an aggraded reach is likely to have a shallow braided condition which would be unfavorable from a water quality and fisheries viewpoint. Conversely, a similar degraded reach would be more likely to have a narrow well confined channel which could well be more favorable habitat.

On the basis of the above discussion, channel degradation resulting from gravel extraction or from any other cause does not result in any significant adverse impacts on the hydrology of the Mad River, therefore no impacts on hydrology are identified.



Map 5.3-1
Gage Station Locations
Mad River Basin

(adapted from: DWR, June 1982 "Mad River Watershed Erosion Investigation")



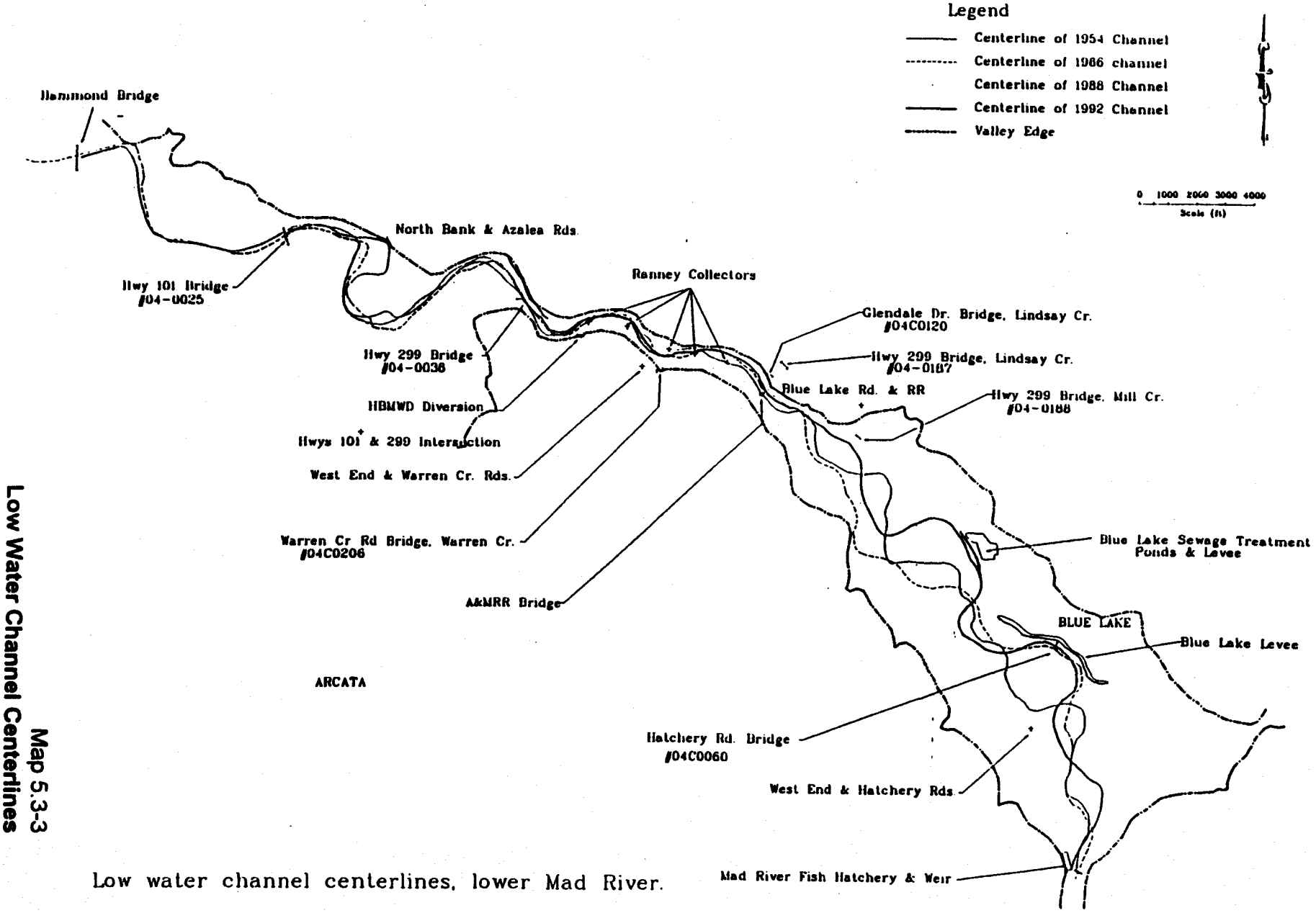
Isohyet showing mean annual precipitation for period 1900-1959; contour interval 10 inches.

60

NOTE: 10 inches = 254 millimetres

(adapted from: DWR, June 1982 "Mad River Watershed Erosion Investigation")

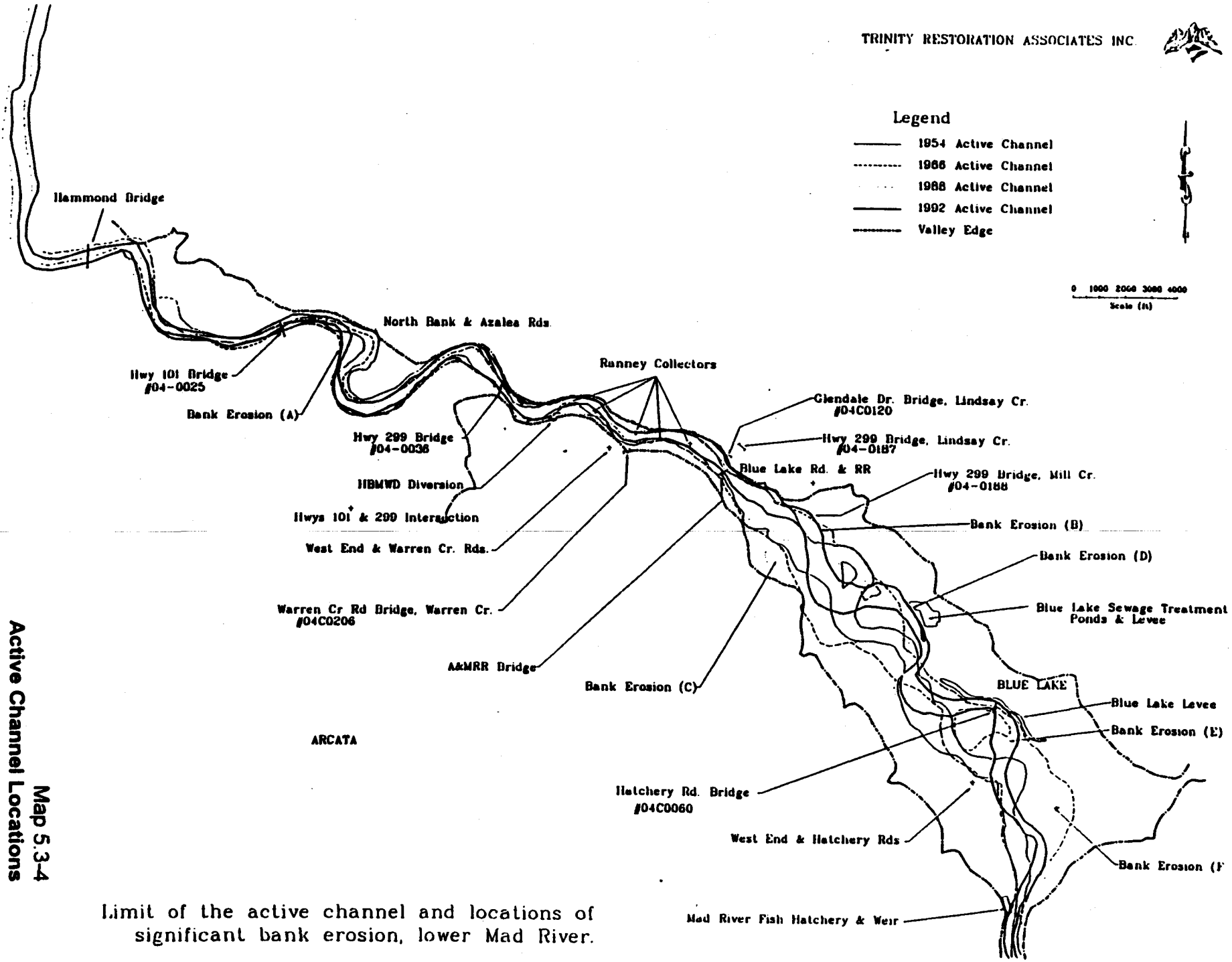
Map 5.3-2
Isohyetal Map
Mad River Basin



Low water channel centerlines, lower Mad River.

Map 5.3-3
Low Water Channel Centerlines
1954-1992

(adapted from: River Institute Consultants Report, Appendix F)



(adapted from: River Institute Consultants Report, Appendix F)

Map 5.3-4
Active Channel Locations 1954-1992

Limit of the active channel and locations of significant bank erosion, lower Mad River.

5.4 Groundwater Recharge and Water Supplies

The County retained Humboldt State University's Institute for River Ecosystems to gather and analyze information on the effects of historic gravel extraction on the geomorphic character, groundwater conditions, and fisheries habitat of the project area. Portions of the following section were adapted from the Institute report. See Appendix F for the complete report.

The project area has been divided into four geomorphic units for discussion of groundwater supplies. First, is the upper project area, which is termed the Mad River Gorge and is located between the Sweasey Dam site and the Mad River Hatchery. The Mad River Gorge is a relatively narrow bedrock gorge aggraded with gravel alluvium. Below the hatchery, the river flows through the Blue Lake Valley which is occupied by a deep, productive, unconfined alluvial aquifer, see Photos 5.4-1, 5.4-2, and 5.4-3.

This Blue Lake valley extends almost to the Arcata & Mad River Railroad Bridge. The third unit, the HBMWD Gorge, lies approximately between the Mad River Railroad bridge and the Highway 299 bridges, see Photo 5.4-4. Here the river again flows through a narrow bedrock gorge that is choked with alluvium. The fourth unit is the Mad River Floodplain located below the Highway 299 bridges.

Periodic changes in channel aggradation and degradation influence the water table in adjacent unconfined alluvial aquifers as well as the extent of the phreatophytic vegetation tapping the water of these aquifers. Other factors being equal, aggradation raises the water table and would allow an expansion of phreatophytic vegetation, riparian habitat, and wetland habitat into adjacent agricultural, residential and industrial areas. Channel degradation lifts river terraces above the river, lowers the water table and produces a corresponding migration of phreatophytic vegetation, riparian habitat, and wetland habitat towards the river thalweg.

The Mad River Gorge

The Mad River gorge is locally significant but is not an important water bearing aquifer. This narrow reach is aggraded with gravel alluvium and bounded by steep hillslopes. Periodic high flows keep the alluvium free of significant woody riparian vegetation and the steep hillslopes cause riparian vegetation to quickly give way to upland vegetation. Channel degradation in this reach is somewhat limited by the Mad River Hatchery weir which establishes an artificial control point in the river's longitudinal profile. As long as the integrity of the hatchery weir is maintained, gravel extraction and changes in channel morphology below the hatchery will not impact the limited groundwater regime in this upper gorge. On the other hand, channel aggradation in this reach reduces adjacent stream bank and hillslope stability which, in turn, increases the supply of sediments to the lower reaches of the project area.

Blue Lake Valley

The Blue Lake Valley is underlain by the Blue Lake aquifer which is a potentially significant source of water. It covers approximately 2,200 acres and has a saturated volume of 55,000 acre feet or more. With a specific yield of about 25 percent, it could yield about 14,000 acre feet (4,600,000,000 gallons) of water (Winzler and Kelly, 1962). The HBMWD has considered tapping this aquifer as a supplemental water supply; and one of their initial studies preliminarily concludes that with proper river management including conjunctive use this aquifer might supply up to 20 MGD (Willis and Chu, 1981).

At different river stages this aquifer is either being recharged with seepage from the Mad River or is supplying water to the river. When the water in the river is high, relative to the adjacent groundwater, river water will seep into the channel banks and recharge the aquifer. When the

river is low, relative to the adjacent groundwater, the groundwater will seep into the channel and help sustain the flow of the river.

Seasonal changes in river stage produce short-term seasonal changes in the water table. Because this alluvium is relatively permeable, the impacts of these seasonal changes on the water table extend quite some distance from the channel banks. When aggradation causes the water table to rise, it can modify existing vegetation patterns, and have an adverse impact on septic tank leach fields and the Blue Lake Sewage Treatment percolation ponds. When degradation occurs, the water table will decline which can modify existing vegetation patterns, reduce the potential aquifer yield, and improves percolation opportunities for leach fields and percolation ponds.

Although this reach has been degrading, it still has many features of an aggraded channel. The summer low-flow channel meanders back and forth across a wide unstable high flow channel. Normally, frequent high flows remove most of the ephemeral in-channel vegetation. In many areas, the low-flow water surface has little adjacent vegetation and therefore little shade cover. Because of the ephemeral nature of this vegetation, minor changes in the water table, due to fluctuations in the water surface or channel profile, will have little impact on riparian vegetation in this exposed channel. Significant channel degradation can produce water table changes that would impact vegetation on adjacent upper level terraces and in adjacent riparian forests.

If extraction volume reaches permitted or proposed levels, or is sustained at recent levels, it is safe to assume that channel degradation will continue, the water table will fall, and significant changes will occur in dependent riparian plant communities. If extraction volumes are below the replenishment rate channel profile adjustments will occur, but significant rates of degradation in this reach would not be expected. Therefore, there would be little long-term change in the water table and no significant impact on adjacent vegetation.

HBMWD Gorge

The valley narrows dramatically below the Railroad Bridge as it passes into an alluvium-filled bedrock gorge. The restricted volume of alluvium reduces the groundwater storage capacity in the gorge. In 1962, the HBMWD installed three Ranney-type wells in this reach. Two additional Ranney wells were installed in 1965 as part of an overall system expansion. The wells tap subsurface flow and surface water that is pulled down into the riverbed alluvium by pumping. The relatively rapid increase in well-water turbidity during winter storms shows that this connection between surface water and groundwater is quite efficient. Some of these wells penetrate the river bed alluvium to depths of 90 feet and have perforated radial intake pipes located 50 to 80 feet below the riverbed. Channel scour and degradation has reduced the depth of overlying alluvium by 4 to 8 feet since the collectors were installed in 1962. See Section 5.12, Public Utilities and Structures for more information on this subject.

The general bed lowering throughout the HBMWD reach has adversely impacted the district. The water reaching the HBMWD intakes is naturally filtered by passing through the sands and gravels of the riverbed; all other things being equal, the greater the thickness of sand and gravel the water must travel through, the more filtration will occur. It is possible, that by reducing the vertical distance between the channel bottom and the well intake pipes, degradation has reduced the natural filtration effectiveness provided by the riverbed alluvium and increased the cost of water treatment which must be supplied by the water district.

If extraction occurs at permitted or proposed levels, or is sustained at recent levels, it is clear that continued bed lowering in this reach must eventually affect the quality of water pumped

from the wells (if it has not already done so), leading to increased treatment costs, as well as increased costs for the maintenance of the pump stations.

If average extraction rates are below net recruitment, the bed should stabilize at or near its current elevation and no additional treatment or maintenance costs should be necessary.

Mad River Floodplain

When the river leaves the HBMWD Gorge it flows through the Mad River Floodplain and merges with the floodplain of the Arcata Bottoms before reaching the ocean-dune environment. The extensive alluvial deposits in this area make it a principal aquifer with an estimated summer storage capacity of 4,500 acre feet.

In the vicinity of the Highway 101 bridges, the river bed has degraded 17 feet since 1929 on the upstream span, and 8 feet since 1957 on the downstream span. Since 1972 there has been very little change at this site. Channel degradation in this reach has resulted in a lower water table in the adjacent aquifer. Because the alluvium in this aquifer is quite permeable, the extent of this effect should be widespread.

The bed elevation through the lower portions of this reach is near sea level and significant additional degradation is not expected, regardless of upstream gravel extraction rates. Given current gravel extraction regulations and standards, a small amount of additional degradation is possible, particularly near existing gravel extraction sites in the upper portion of this reach. Because the potential for degradation in the upper reach is small, the water table-related impacts on adjacent riparian vegetation and groundwater supplies would be minimal.

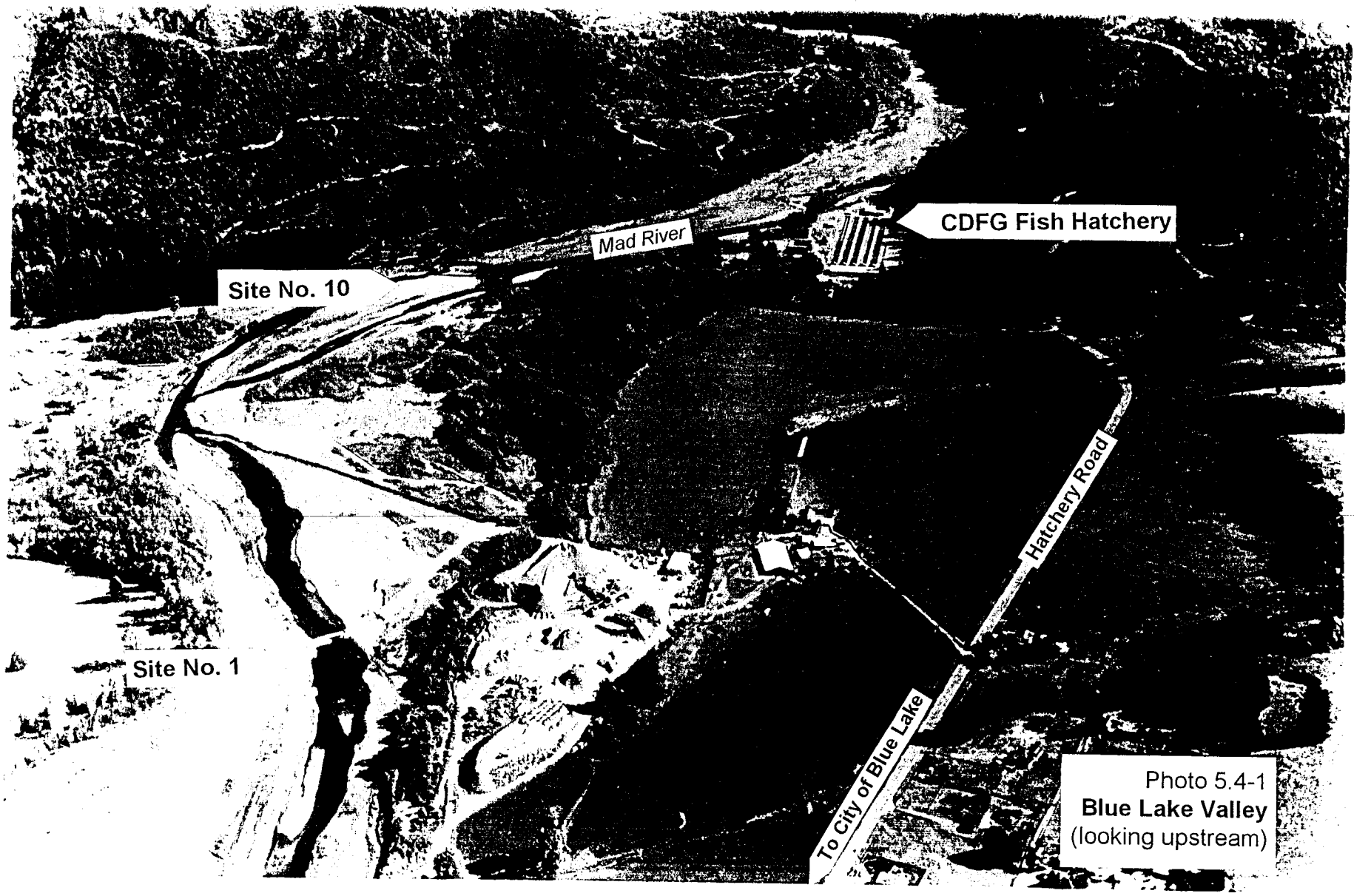


Photo 5.4-1
Blue Lake Valley
(looking upstream)

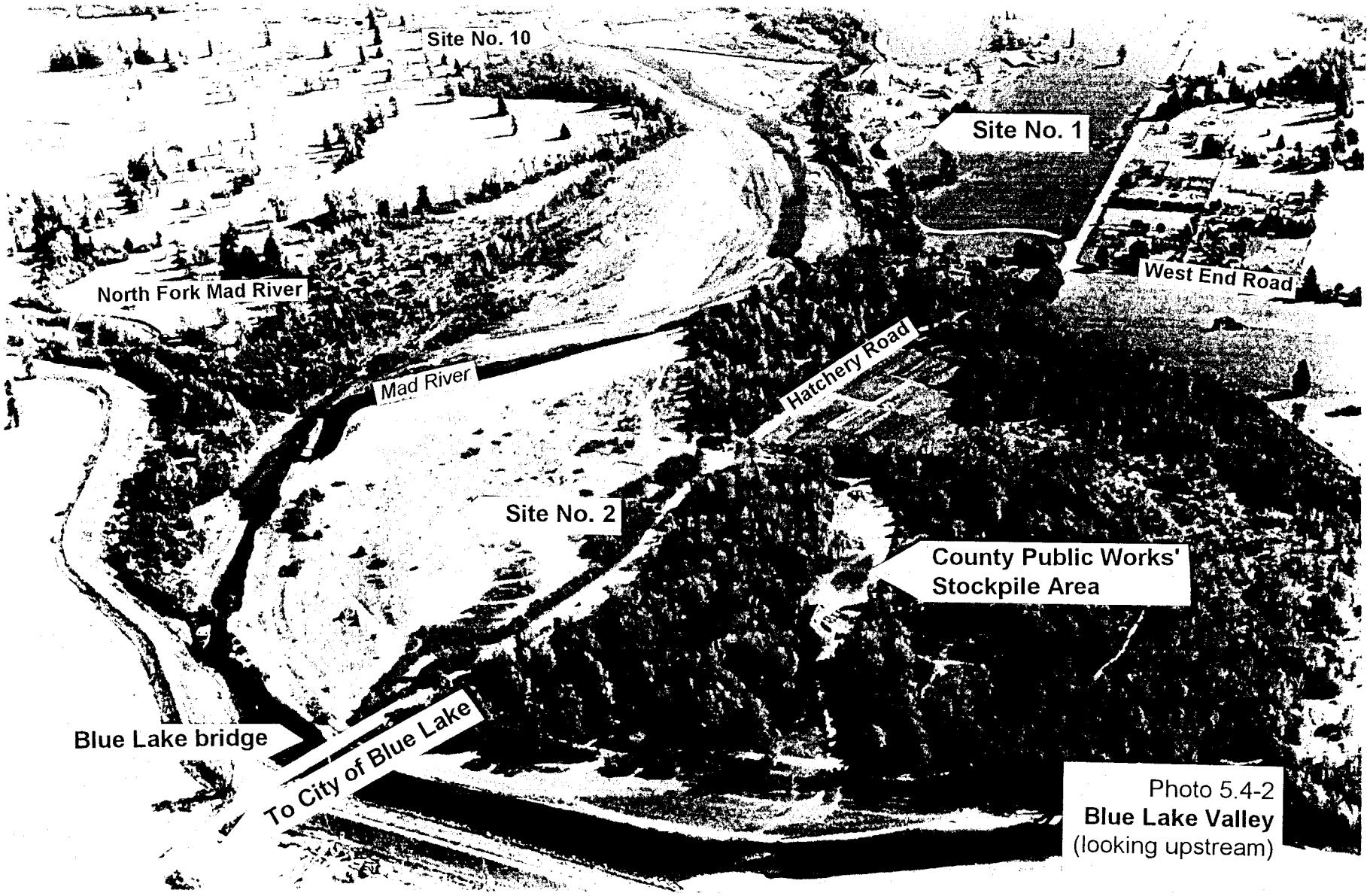


Photo 5.4-2
Blue Lake Valley
(looking upstream)



Photo 5.4-3
Blue Lake Valley
(looking upstream)

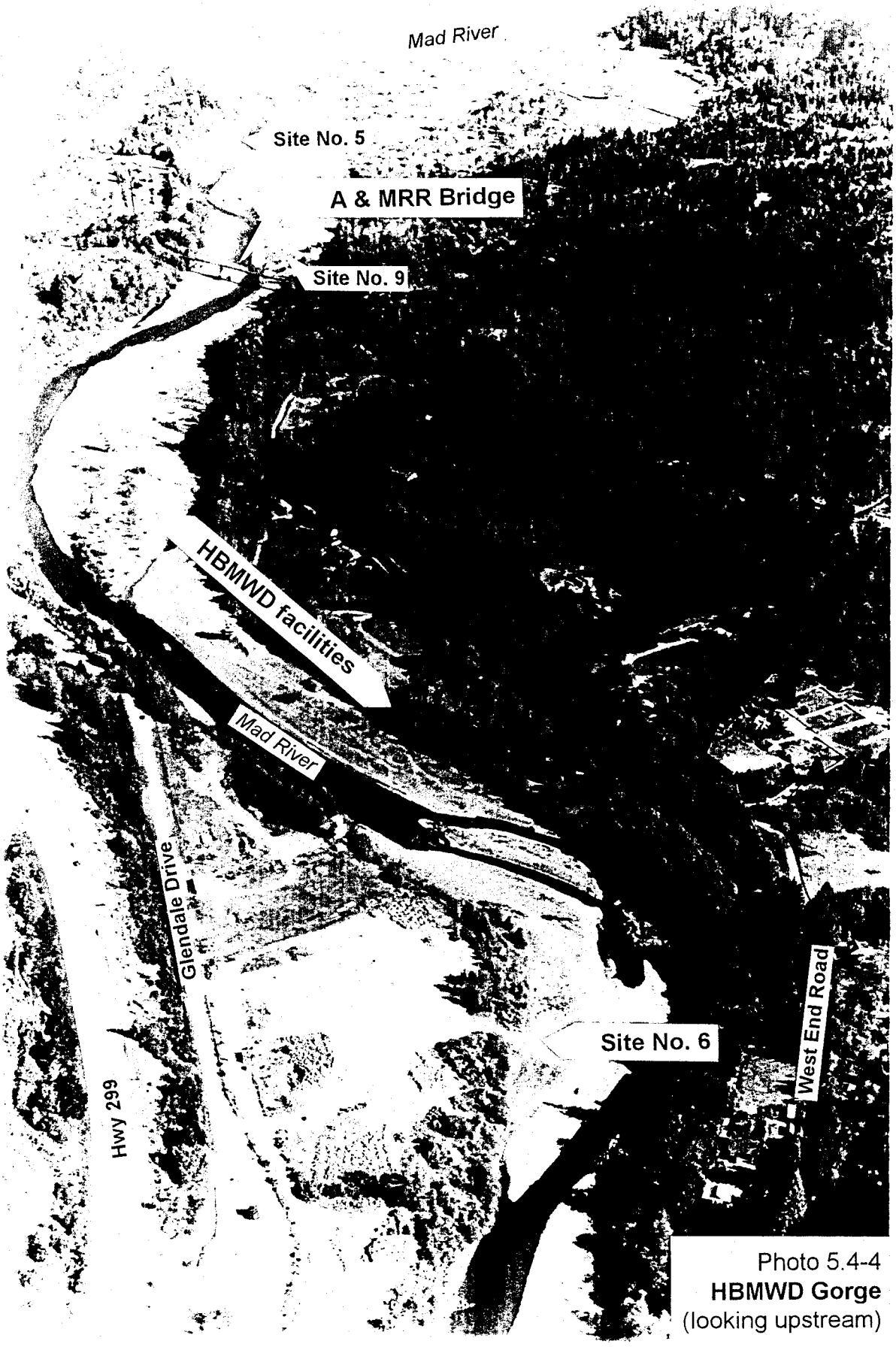


Photo 5.4-4
HBMWD Gorge
(looking upstream)

Impact Statements and Mitigation Measures

Impact
GndH2O-1: When extraction volumes are below net recruitment channel aggradation can occur. Aggradation raises the water table. A higher water table means less depth or opportunity for percolation of leach fields and percolation ponds. Aggradation has the potential to significantly impact the effectiveness of septic tank leach fields and the Blue Lake Sewage Treatment percolation ponds. (PS/LS)

Mitigation Measures
Mit-1: This mitigation measure will reduce the cumulative impacts of bed degradation and aggradation on water table fluctuations to a level of insignificance. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee
City of Blue Lake
Humboldt County Department of Environmental Health

Significance after Mitigation
Less than significant

Impact
GndH2O-2: If extraction volumes exceed the recruitment rate channel degradation could occur through the Blue Lake Valley reach. This, in turn, would cause the water table in the Blue Lake aquifer to drop, and produce changes in dependent riparian plant communities located on adjacent upper level terraces and in adjacent riparian forests, phreatophytic vegetation and wetland habitat. The drop in the water table has the potential to be a significant adverse environmental impact within the Blue Lake valley reach. See Section 5.7 for more discussion on vegetation. (PS/LS)

Mitigation Measures
Mit-1: This mitigation measure will reduce the cumulative impacts of bed degradation and aggradation on water table fluctuations to a level that is not excessive and therefore not significant. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Scientific Design and Review Committee

Significance after Mitigation
Less than significant

Impact
GndH2O-3: The water reaching the HBMWD intakes is naturally filtered by passing through the sand and gravel of the riverbed. Deeper sand and gravel means more filtration. If extraction volumes exceed net recruitment channel degradation will continue in the HBMWD Gorge. Channel bed degradation produces a concurrent reduction in natural filtration. In the absence of widespread channel degradation, localized scour around the mid-channel Ranney

wells will produce similar results. Reduced natural filtration forces the HBMWD to incur additional water treatment costs. This has a potentially significant economic impact. See Section 5.12 for more information on HBMWD water supplies. (PS/LS)

Mitigation Measures

Mit-1: In time, this mitigation measure will reduce the cumulative impacts of bed channel degradation to a level of insignificance. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring

Scientific Design and Review Committee
Humboldt Bay Municipal Water District

Significance after Mitigation

Less than significant

5.5 Fisheries and Habitat

The County retained the Humboldt State University Institute for River Ecosystems to gather and analyze information on the effects of historic gravel extraction on the geomorphic character and fisheries habitat of the project area. Portions of the following section were adapted from the Institute report. See Appendix F for the complete report.

The main fishery resources of the lower Mad River are the five runs of anadromous salmonid species: fall chinook salmon, coho salmon, winter steelhead, summer steelhead, and coastal cutthroat trout. According to the American Fisheries Society, the fall chinook race and the coastal cutthroat trout are threatened by a moderate risk of extinction and the summer steelhead is threatened by a high risk of extinction, (Nehlsen, et al., 1991). No other fish of special concern has been identified in the Mad River. Some of the common species found in the lower Mad River are listed in Table 5.5-1.

Table 5.5-1 Common fish species found in the lower Mad River.

Chinook salmon	Coho salmon
Steelhead/Rainbow trout	Coastal Cutthroat
Threespine stickleback	Riffle sculpin
Coastrange sculpin	Staghorn sculpin
Shiner surfperch	Sacramento sucker
Eulachon	Pacific lamprey

The fisheries aspect of this PEIR will concentrate on the anadromous fish populations because they appear to be the most sensitive to the riverine conditions which are influenced by gravel extraction. The PEIR considerations are influenced by the Mad River Fish Hatchery, the species involved, adult migratory needs, spawning habitat concerns, summer habitat needs, and juvenile migration patterns. Beyond gravel extraction, there are other factors influencing salmonids in the Mad River which may be beyond the scope of this PEIR. These include, but are not limited to fish-eating birds, concentrations of seals and sea lions at the mouth of the river, and poachers. Although we have no hard data we believe sea mammals and poachers take a significant portion of the adult anadromous fish resource, particularly in low flow years. Fish-eating birds devour large quantities of juvenile fish.

The Mad River Fish Hatchery is presently raising and releasing yearling chinook salmon, yearling coho salmon, and yearling steelhead trout. Occasionally they also release catchable trout. In the past chinook fingerlings were also released. In terms of releasing fish, the PEIR is only concerned with their Mad River releases. Releases of yearlings or catchables in other waters are beyond the scope of this PEIR.

The Mad River Hatchery releases fish at various times. Generally their yearling chinook are released in October through December, after the water level and turbidity have risen. Yearling steelhead and coho are released during springtime high water, generally March and April. In the past the hatchery has attempted to stock the upper Mad River, but that program created a variety of management problems. Today, the Mad River fish are released at the hatchery.

Sweasey Dam was constructed in 1938 to supply water for the city of Eureka. It was filled with water in November and a fish ladder was opened in December. Water would spill over the top of the structure onto a fish ladder which ran parallel to the dam face. A sediment flushing valve was installed with the intended purpose of allowing sediment transport into downstream reaches. This valve became inoperable in 1941 and the dam reservoir capacity began to diminish rapidly as sediment began filling the reservoir. The reservoir was completely filled

during the 1964 flood and thereafter sediment and debris rolled over the dam spillway and crushed the fish ladder. The dam served as a complete barrier to anadromous fish runs from 1964 until its demolition in July of 1970 (Hollingworth, 1993).

Anadromous fish spawning takes place in the main channel and in several main tributaries. Downstream from the Mad River Hatchery, the main spawning tributaries are Warren Creek, Lindsay Creek, Mill Creek, and the North Fork of the Mad River. Lindsay Creek appears to be extremely important for both coastal cutthroat and coho salmon.

Fish encounter a variety of barriers during their migrations. In theory, each partial barrier encountered by migrating fish, whether they be flow barriers, water quality barriers or physical barriers causes delays and reduces the individual fish's energy reserves. Where the migratory path is long, these barriers cumulatively reduce the number of fish that are capable of completing the migration.

On the main stem a 25-foot waterfall near Bug Creek, about 24 miles above the former Sweasey Dam site was modified in 1980 by blasting and is no longer a migration barrier to steelhead. A steep cascade about five miles upstream on the North Fork of the Mad River prevents salmon migration and limits steelhead migration. A boulder cascade at the mouth of Mill Creek, installed to protect the Highway 299 bridge, may be creating a partial barrier to Mill Creek. A rock cascade beneath the Highway 299 bridge on the main stem is a low-flow barrier. The pool below this barrier is a holding area that is often fished illegally.

Continued channel degradation in the lower Mad River could adversely influence fish migration into and out of adjacent tributaries, particularly when flows are low to marginal. Normally fish migrate during the fall, winter, and spring when flows are higher. In drought years fish often attempt to migrate at less optimum flows.

Partial barriers such as these, located relatively close to the ocean, are important but are of less concern than barriers located far upstream, because the fish's energy reserves should remain relatively high during relatively short upstream migrations.

Some spawning takes place in the project area, mostly above Essex bar (Site No. 6), particularly during low-flow years when access to tributaries and the upper river is limited. According to CDFG (response to Draft PEIR, dated June 11, 1993) anecdotal information indicates spawning below the hatchery bridge every year. The magnitude and success of this spawning is unknown. The Mad River was surveyed in 1992 during drought conditions. Salmonids were observed spawning in tributaries and mainstem of Mad River in all areas surveyed from Canon Creek to Hatchery Bridge. On November 17th, 1993 the CDFG observed chinook salmon redds a short distance below Highway 299 and in the Essex reach. On November 23, 1993 the CDFG observed 14 redds between the railroad bridge and the hatchery road bridge. Consequently, portions of the project area have been used for both fish spawning and gravel extraction.

Gravel extraction has the potential to adversely alter the morphology of spawning sites and the composition of spawning gravel. However, when properly regulated gravel extraction should be able to continue without impacting the spawning habitat. A qualitative survey by Dr. Trush found that many pool tails on both mined and undisturbed reaches in the project area had sufficient water depth and a proper range of water velocities to support favorable spawning environment (Lehre, et al. 1993). No data were presented regarding the composition or quality of spawning gravel in mined and unmined reaches.

Spawning in the project reach is strongly influenced by hatchery management practices. When ocean escapement is high, more fish return to the hatchery than are needed for hatchery egg production. Excess fish are left in the river. Usually there are hundreds of excess fish and infrequently, the rejected or excess fish number in the thousands. Fisheries biologists, and others suspect that hatchery fish and the progeny of excess hatchery fish compete with, and adversely affect, desirable wild juvenile stock. While some of the hatchery excess fish will spawn downstream from the hatchery some may move upriver to spawn. The hatchery uses groundwater in its operations; and one of the reasons the fish tend to concentrate downriver may have to do with the scent of the groundwater released into the river at the hatchery.

There is debate over the quality of spawning habitat and the success of spawning below the hatchery. It has been suggested that spawning in this reach may have little chance of success due to the unstable nature of the alluvial river bed. Although more studies are needed, preliminary flow analysis indicates that, in this reach, the average daily flow in January is near 2,500 cfs and average daily flows of 3,000 cfs or more can occur, on about 30 to 60 days during the spawning season. Flows of that magnitude might effectively scour out, and severely limit salmonid redds in the unstable alluvium found in this reach. Furthermore, flows of that magnitude would introduce fine sediments to the redds which could infiltrate the redds and limit emergence of juveniles. Thus, spawning in this aggraded reach may be rather futile and the main beneficial fisheries use of the lower project area (below the hatchery) may be for adult migration up stream to more favorable spawning areas and juvenile migration downstream to the estuary and the ocean.

CDFG has stated (response to Draft PEIR, dated June 11, 1993) that they believe that most successful salmonid spawning occurs in the tributaries because of scour (in the main stem) during storm events. The following quote is from the same letter. "However, anecdotal information by anglers indicates that salmon spawn below the hatchery bridge. These mainstem spawners are at risk of egg loss, depending on the individual redd site. Many Central Valley rivers subject to annual scour produce large natural populations. It is difficult to dismiss any potential salmon or steelhead production area in light of the declining resources today. We believe that gravel extraction can continue without impacting spawning habitat."

This is a potential area of controversy. While some claim that this area is prime spawning ground and that gravel extraction should be limited or prohibited in this reach, others claim that spawning in this reach is abnormally high because of hatchery management practices. There is also the belief that spawning in this reach is generally unsuccessful due to the unstable nature of the channel bottom. If the spawning of excess hatchery fish is successful, the progeny would compete with preferred wild native fish at various juvenile stages during rearing and migration.

Information from CDFG (response to Draft PEIR, dated June 11, 1993) indicated that the Mad River Hatchery is scheduled to be without funding beyond fiscal year 1994-95. We are not aware of any environmental analysis on the possible effects of closing the hatchery. Obviously, after a few years, only naturally produced fish will return to spawn if the hatchery is closed. The closing of the hatchery may prove to be advantageous to the Mad River fisheries because wild fish populations are more apt to have or generate the genetic diversity needed to allow fish populations to survive droughts and other habitat disasters.

It is clear that the effects of gravel extraction on spawning habitat and spawning success in the lower Mad River are uncertain. Further study of channel scour and spawning success may be

needed to resolve the issue. Regardless, The CDFG has stated that they believe that gravel extraction can continue without impacting spawning habitat.

Chinook salmon enter the river from late August through mid-February, but more typically from late October through mid-January. Naturally spawned chinook emerge from the gravel in late March through early May. Downstream migration begins in April, peaks in early to mid-June and tapers off in late July. Some late juveniles may remain in the river through mid-summer. Most downstream migration in the Mad River may take place at night. Normal summer-time gravel extraction operations, as mitigated in recent years, would not impact these juveniles. However these juveniles could be at risk when heavy equipment enters the stream during the installation of summer bridges.

Most native coho migrate upstream during the daylight and the activity usually peaks in December. The peak migration period for introduced coho stock is earlier and may be more apt to be limited by low flows. The life cycle of Mad River coho is probably similar to coho in other northcoast streams. After residing in fresh water for a year, juvenile coho migrate seaward during the spring. The migration may extend into July. As with chinook, most downward migration takes place during the hours of darkness.

Normally, steelhead spawn further upriver and further up tributaries than salmon. Winter steelhead migrate upstream over a lengthy period, from late fall through March. Summer steelhead enter the river from April through late June and generally hold up in the lower river until fall rains cause the river to rise. Young steelhead spend one to four years in fresh water before migrating to the ocean in the spring.

Because coho and steelhead juveniles reside in the river during the summer, the quality of the low-flow season summer habitat is important for these two species. Coho generally migrate out after one year while steelhead may spend one to several years in the river before migrating to the ocean. If summer habitat is adequate, the two species will generally segregate with the coho preferring deep, dark pools, with woody debris and the steelhead preferring riffles. When habitat is limiting, the larger more aggressive steelhead tend to dominate at the expense of the juvenile coho and younger steelhead fish.

Early reports indicate that Lindsay Creek is an important coastal cutthroat trout stream. There is little direct information on Mad River coastal cutthroat trout. Consequently, most of the information has been derived from generalized discussions in Meehan ed. (1991). The project area is near the southern extremity of the species range and the American Fisheries Society has indicated that the species is facing a moderate risk of extinction in California coastal streams. The general reasons for their decline seem to be competition from introduced species, habitat degradation, and over-fishing. Cutthroat trout spawn in the late spring or summer and their progeny emerge in late summer. Juveniles tend to remain in their natal stream, or its vicinity, for two or more years before migrating to the ocean in the spring. In the ocean, the adults do not travel far. They remain in the ocean only for the summer before migrating back in the late summer or winter. They overwinter in the stream before spawning in the summer or returning to the ocean without spawning. Like steelhead, cutthroat trout have the potential to spawn in subsequent years.

It is apparent that there is some anadromous fish use the project area throughout the year, with the least amount of activity coinciding with the low-flow summer period. This is one of the reasons that CDFG generally prefers to restrict gravel extraction to the period from June 1 through September 30. To start earlier may place unnecessary risk on downstream migrating smolts. To extend the season beyond the normal closure date increases the risk of high water

closing an operation before the gravel bar is bedded down for the winter. In certain site specific cases and with appropriate mitigation, the CDFG has extended the operating window beyond the normal season.

Downstream from the project area, changes at the mouth of the river may be improving anadromous fish habitat. In recent years, the mouth of the Mad River has migrated to the north, significantly enlarging the estuary. This additional estuary habitat enhances conditions for early arriving adults that hold up in the river and wait for rising water. It also provides more habitat in which juvenile fish could reside while making the transition to an ocean environment. However, there is apparently no information avaialble to indicate the degree to which this enlarged estuary is being utilized by fish populations.

Unregulated gravel extraction can damage fish habitat and other riverine resources and thus interupt recognized beneficial uses of the Mad River channel. It is the responsibility of Humboldt County, the CDFG, and other agencies to advise and regulate the industry to minimize the potential risks to these resources, while allowing the operators to remove a safe volume of gravel from appropriate locations by appropriate methods.

The National Marine Fisheries Service is responsible for preserving and enhancing marine, estuarine, and anadromous fish resources and the habitats that support these resources. They have listed the following potential effects of gravel extraction that are of concern to them. Most of these concerns are described and discussed in Collins and Dunne (1990). These concerns are addressed more specifically in Section 5.1 of this PEIR, Channel Morphology/Gravel Recruitment.

1. Extraction of bed material in excess of replenishment by transport from upstream causes the bed to degrade upstream and downstream of the extraction site.
2. Degradation can deplete the entire depth of gravelly bed material, exposing other substrates that may underlie the gravel, which could in turn affect the quality of aquatic habitat. One example would be the loss of benthic macro invertebrate habitat if gravel beds eroded down to underlying bedrock. On the other hand aggradation of fine sediment (sand) can produce the same effect.
3. Rapid bed degradation may induce bank collapse and erosion by increasing the heights of banks.
4. Degradation may change the morphology of the riverbed, which constitutes one aspect of the aquatic habitat.
5. Lowering of the water table can change the riparian plant community.
6. The reduction in size or height of bars can cause adjacent banks to erode more rapidly or to stabilize, depending on how much gravel is removed, the distribution of removal, and on the geometry of the particular site.
7. Removal of gravel from bars may cause downstream bars to erode if they subsequently receive less bed material than they contribute to downstream transport.

In summary, if extraction volumes are expanded to permitted levels, or sustained at recent levels channel degradation will continue more or less at its present rate; and there will be little control regarding the adverse channel degradation changes which are induced by gravel extraction.

If average extraction levels are below the net recruitment rate, aggradation will occur. After some adjustment the present river grade line would be raised slightly in some places and more or less maintained in others.

River bed morphology is constantly changing regardless of gravel extraction. The goal is to maintain some sort of equilibrium in structure and diversity while the channel adjusts to changes in stream power, sediment supply, and sediment export. The recommended management plan with its annual review will monitor gravel extraction, gravel recruitment, bed morphology, fish passage, fish habitat, and other riverine resources to see that a degree of dynamic equilibrium is established and maintained in the aquatic habitat resources while allowing appropriate amounts of gravel to be extracted from appropriate reaches. These monitoring measures will help guide the SDRC and operators in establishing the appropriate quantity, location, and methods of extraction.

Impact Statements and Mitigation Measures

Impact
Fish-1: Certain extraction methods and standards have the potential to create a broad, shallow channel. If the channel is too shallow, adult and juvenile fish migration through the excavated area may be adversely impacted during semi-low flows (PS/LS)

Mitigation Measures
Mit-1: This mitigation measure will assure that future extraction operations are planned and executed in a manner that will not significantly impact fish migration. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation
Less than significant

Impact
Fish-2: Channel degradation has the potential to create physical topographic barriers at the mouths of tributaries and adversely influence fish migration into and out of these tributaries, particularly when flows are low to marginal. Barriers to anadromous fish migration into and out of tributaries could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1: This mitigation measure will monitor, limit, and regulate gravel extraction to minimize the risk that extraction-induced bed degradation will inhibit fish migration at the adjacent tributaries. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation

Less than significant

Impact

Fish-3: Gravel extraction has the potential to adversely alter the morphology of spawning sites and the composition of spawning gravel in the Mad River extraction area. There is debate on this issue and it could be a significant impact. However, the CDFG has stated that they believe that gravel extraction can continue without impacting spawning habitat. (PS/LS)

Mitigation Measures

Mit-1: This mitigation measure will monitor and regulate gravel extraction to minimize the risk that extraction-induced changes in gravel composition and channel morphology will inhibit fish spawning. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Mit-6: The Scientific Design and Review Committee and the California Department of Fish & Game will monitor fish spawning activity in the Mad River extraction area in an attempt to determine the significance and success of spawning activity and how that activity might be influenced by gravel extraction. The Scientific Design and Review Committee will meet and confer with the California Department of Fish & Game and with additional experts to develop annual mining prescriptions that will allow extraction to continue without impacting spawning habitat.

Monitoring

Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation

Less than significant. There is evidence that extraction methodology and amounts can be limited to allow extraction to continue without significantly impacting spawning habitat.

Impact

Fish-4: The installation and removal of summer bridges or other summer crossings has the potential to significantly impact juvenile fish migration. (PS/LS)

Mitigation Measures

Mit-4: The SDRC shall consult with operators regarding the best design and placement of summer crossings. All summer crossings shall be installed and removed in accordance with adopted regulations of the CDFG and, if required, the USACOE. This mitigation measure assures that installation and removal is executed under authorization of appropriate state and federal agency permits or agreements. These agencies have the capability of requiring conditions of approval on permits or agreements that will reduce impacts resulting from summer bridge installation and removal, to a level of insignificance.

Monitoring

Scientific Design and Review Committee
California Department of Fish & Game, and possibly the
U.S. Army Corps of Engineers

Significance after Mitigation

Less than significant

Impact

Fish-5: Trenches can be strategically located in a variety of sites. Trenches can also be deep or shallow, wide or narrow, and short or long. The effects of trenches can vary. Trenching has the potential for improving fish passage in aggraded reaches. This is a beneficial impact of trenching. Trenching also has the potential to reduce or eliminate riffles which are important for rearing juvenile steelhead and as habitat for benthic macroinvertebrates. This loss or reduction of riffles has a potential to be significant. (PS/LS)

Mitigation Measures

Mit-1: This mitigation measure will monitor and regulate gravel extraction methods. The regulation will protect the river from significant extraction-induced changes in riffle habitat. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring

Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation

Less than significant

Impact

Fish-6: Gravel mining can reduce aquatic habitat diversity and the retention of large woody debris, both of which are necessary in order to maintain quality summer rearing habitat and holding areas for migrating adult and juvenile fish. The loss of habitat diversity and woody debris can be a significant impact. (PS/LS)

Mitigation Measures

Mit-1: The implementation of this mitigation measure will include monitoring aquatic habitat diversity, condition, and trend as well as the presence and significance of large woody debris. Information gained during this monitoring will be used while developing site-specific extraction prescriptions that will minimize adverse impacts on these factors and, where possible, enhance these river resource conditions. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring

Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation

Less than significant

5.6 Wildlife and Habitat

The County retained the Mad River Biologists to gather and analyze information on the effects of historic gravel extraction on the wildlife and wildlife habitat of the project area. A preliminary report dated March 10, 1993 is included as Appendix D. The final report, dated September 2, 1993 is included as Attachment 3. Portions of the following section were adapted from these Mad River Biologists' reports which are incorporated herein by this reference.

Introduction

This section describes the wildlife habitats of the study area and the wildlife species that are expected in each habitat. The potential significant effects of instream mining on the non-fish, vertebrate wildlife species, i.e. amphibians, reptiles, birds and mammals, are also discussed, as are corresponding mitigation measures.

Special attention is given to those species considered endangered, threatened, or of special concern by the U.S. Fish and Wildlife Service and the California Department of Fish and Game.

Habitats

Refer to "Vegetation" Sections 4.3 and 5.7 for additional discussion on riparian scrub, developing riparian forests and mature riparian forests.

Riparian

Riparian habitat as a whole, in all of its successional stages (riparian scrub, developing riparian forest, and mature riparian forest) is a significant resource. Significant stands of developing and well-developed riparian vegetation exist along the Mad River in the study area. The riparian forest provides habitat for nearly all of the reptiles, amphibians, birds and mammals listed in Table 5.6-1. Even those that do not use this habitat for feeding, nesting or cover, depend, to some extent, on the productivity of this habitat. Furthermore, the aquatic habitats (both riverine and pond) adjacent to the riparian forests receive organic matter (in the form of plant and animal material) from the riparian forest and owe much of their physical structure to the influence of the riparian forests.

Gravel mining operations have three potential effects on wildlife and riparian habitat. The first is the actual removal of riparian habitat, due to the construction of roads, stock piles, or processing sites. At this time, there are no new roads, stock piles or processing sites proposed in the riparian habitat adjacent to gravel operations on the Mad River.

The second potential effect, is the direct effect of noise and dust from the mechanical operations. The noise and movement of equipment have an immediate effect on wildlife. While many species can become acclimatized to predictable and/or constant noise, others will be displaced.

The consequences of dust coating riparian vegetation is also of concern, as a layer of dust can inhibit both plant growth and insect use of plants, both of which consequently affect wildlife use of the habitat, by either directly or indirectly affecting food availability.

The third potential effect of gravel mining would result from changes in the river channel dimensions and location as a result of mining activity. These changes could alter the health and distribution of the riparian habitats. In particular, the early successional stages could be altered on a regular basis, reducing the extent of later successional stages.

Riverine

The river itself is an important habitat to the fish and aquatic invertebrates of the Mad River system. The health of the river affects species that depend on the fish and aquatic invertebrates for food, such as Double-crested Cormorant, Bald Eagle, Osprey, Common Merganser, and Dipper. See the "Fisheries and Habitat" section for a more complete discussion of gravel mining's effect on fish habitat. In addition, water quality concerns, such as spilled petroleum products, waste water, and other by-products of the mining operation, could have consequences for wildlife. See the "Water Quality" section.

Gravel Bars

The gravel bar is the habitat most directly affected by mining operations. Gravel bars provide feeding habitat for birds such as the Spotted Sandpiper and Killdeer, other shorebirds, and various larger birds such as the Bald Eagle and Turkey Vulture. Gravel bars also provide roosting sites for gulls and mergansers.

The earliest successional stages of the riparian forests begin on the gravel bars, where they are subject to high water. Mining methods and the amount of gravel extracted from a gravel bar play a large role in determining the impact of mining operations on the wildlife habitat value of gravel bars.

Temporary Pools and Backwaters

Temporary pools and backwaters include the seasonal and temporary quiet waters that develop along the river's course which can include the shallow ponds that are flooded at high water and then disappear as the season progresses, or backwaters and low sites within the river bed that stay wet all year long because of available groundwater. These ponds are considered temporary because their structure and distribution can change dramatically during high flow events. During the past few drought years, many of these ponds have developed healthy stands of emergent aquatic vegetation and have become the breeding site for amphibians. Ponds are one of the most important habitats for the Red-legged Frog and the Western Pond Turtle. In addition, Foothill Yellow-legged Frog, Bullfrog and other amphibians can use this habitat extensively.

Freshwater Marshes and Ponds (including pits)

Various freshwater marsh and pond habitats occur adjacent to the river channel. These are distinguished from the above classification by their more-or-less permanent nature. As a consequence of their permanent nature, the aquatic vegetation is often well-developed, resulting in a more complex habitat structure that provides homes for a variety of wildlife.

These ponds are maintained, in part, because they intercept the water table. Channel degradation can cause the water table to lower and reduce pond storage volume. Some of these ponds are natural, while others have come about as a consequence of mining activity. There is potential for creating wildlife habitat using these ponds.

Species Accounts

Table 5.6-1 Species of Special Concern

Northern Red-legged Frog	*Rana aurora aurora*	CA2, SC
Foothill Yellow-legged Frog	*Rana boylii*	CA2, SC
Bullfrog	*Rana catesbeiana*	I, HA
Northwestern Pond Turtle	*Clemmys marmorata marmorata*	CA2, SC
Double-crested Cormorant	*Phalacrocorax auritus*	SC
Bald Eagle	*Haliaeetus leucocephalus*	CE, FE, CP
Northern Spotted Owl	*Strix occidentalis caurina*	FT
Sharp-shinned Hawk	*Accipiter striatus*	SC
Cooper's Hawk	*Accipiter cooperi*	SC
Merlin	*Falco columbarius*	SC
American Peregrine Falcon	*Falco peregrinus anatum*	CE, FE, CP
Marbled Murrelet	*Brachyramphus marmoratus*	CE, FT
Willow Flycatcher	*Empidonax trailii*	CE
Black-capped Chickadee	*Parus atricapillus*	SC
California Yellow Warbler	*Dendroica petechia brewsteri*	SC
Yellow-breasted Chat	*Icteria virens*	
White-footed Vole	*Arborimus albipes*	CA2, SC

FT	Federally Threatened Species
FE	Listed as Endangered by the Federal Government
SC	California Species of Special Concern
CE	Listed as Endangered by the State of California
CP	California Protected Species
CT	Listed as Threatened by the State of California
CA2	Category 2 Candidate for listing by the Federal Government (existing information indicates listing may be warranted, but necessary biological data are lacking)
I	Introduced
HA	Harvested Species

Northern Red-legged Frog (*Rana aurora aurora*)
The Northern Red-legged Frog is typically found in ponded areas along the coast and cascade ranges from northern California to southern British Columbia. Here on the north coast of California, it is widespread in ponds and along rivers where there is quiet water and emergent aquatic vegetation providing cover. When not breeding, this species wanders widely in damp woods, including riparian and coniferous forests. Breeding takes place in late winter and early spring. Red-legged frogs have a weak voice and are vocally inconspicuous. Egg masses consisting of up to 2-3,000 eggs are deposited in water up to 6" deep. Most young are completely transformed into adults by mid-summer, or earlier. The diet of Red-legged Frogs consists primarily of insects captured near water.

The Northern Red-legged Frog is considered a Species of Special Concern in California and is a Category 2 Candidate for Federal Listing. The main reasons for concern in California are the declining habitat and predation by the introduced Bullfrog.

Red-legged Frogs have been found in freshwater marshes and ponds outside the Mad River project area. One adult was found in a pond at the Blue Lake Bar during the Spring 1993 survey. Locally, the Red-legged Frog is not as common along the rivers as the Foothill Yellow-legged Frog. Along the Eel River, Red-legged Frogs were found in temporary pools and backwaters where emergent aquatic vegetation had developed to provide sufficient cover. This

emergent vegetation has probably developed more extensively during the last few drought years.

Foothill Yellow-legged Frog (*Rana boylii*)
The Foothill Yellow-legged Frog is found in coastal and foothill habitats throughout northern California. Its preferred habitat is along streams and rivers, especially where riffles are present. When disturbed, the Yellow-legged Frog escapes into the water and hides in vegetation, or in the nooks and crannies on the bottom of the water body. The Foothill Yellow-legged Frog is less likely to use the riparian forests and other adjacent habitats than other frogs. Breeding takes place later in the spring, when high water flows have subsided. Up to 1,000 eggs, laid in a mass, are attached to rocks in shallow, flowing water. During the summer, the larvae transform into frogs .

The Foothill Yellow-legged Frog is considered a Species of Special Concern in California and is a Category 2 Candidate for Federal Listing. The main reasons for concern in California are declining habitat and predation by the introduced Bullfrog.

Along the north coast, Yellow-legged Frogs are found in most rivers and large streams. This species seems to prefer more sunny areas than the Red-legged Frog. It has been found downstream to the Water District park to the edge of the coastal fog zone. In inland portions of the Eel River, the Yellow-legged Frog has been replaced by the introduced Bullfrog.

During field surveys, Yellow-legged Frogs were found in small ponds, edgewaters, and larger ponds adjacent to the river. No Yellow-legged Frogs were found in the river.

Bullfrog (*Rana catesbeiana*)
The Bullfrog has been introduced in California and is found in almost all aquatic habitats, except the high mountains and deserts. It prefers permanent waters, especially with well-developed vegetation and muddy bottoms. It is highly aquatic and rarely ventures from water. The breeding season depends on the particular site and varies from February to July. Anywhere from 10-20,000 eggs are laid in a mass. Larvae may not transform into adults until the second year of life. The Bullfrog has a varied diet that includes insects and other invertebrates, fish, small reptiles, birds, small mammals and other amphibians. Its habit of eating other frogs has caused a decline in both Red-legged and Yellow-legged Frogs in the west and its presence is a significant part of the reason that the latter two species are of special concern.

The Bullfrog is a Harvest Species in California that is managed by California Fish and Game.

Bullfrogs are widespread and becoming more common along the north coast. The Bullfrog was not detected in the study area during the spring 1993 field season.

Northwestern Pond Turtle (*Clemmys marmorata marmorata*)
The Northwestern Pond Turtle is California's only native aquatic turtle and is widely distributed west of the Sierra-Cascade Mountains. Pond Turtles are found in and near water, especially slow moving or quiet waters, such as ponds, small lakes, reservoirs, quiet streams and rivers. They can be found basking on rocks, logs or on the bank along aquatic vegetation. Places to bask seem to be an important component of their habitat needs. Females lay a clutch of 5-11 eggs between April and August in a small hole in a dirt bank, sometimes at a distance from her home water. The diet of Pond Turtles consists of aquatic plants, fish, invertebrates and carrion.

The Northwestern Pond Turtle is considered a Species of Special Concern in California and is a Category 2 Candidate for Federal Listing.

Along the north coast of California, the Pond Turtle is sparsely distributed, mainly at ponds in the interior. It is found downstream at least to the Blue Lake bridge. This species, like the Yellow-legged Frog, seems to prefer sunny areas, and so it may avoid the coastal fog belt.

Double-crested Cormorant (*Phalacrocorax auritus*)
The Double-crested Cormorant is a widely distributed species throughout North America. It is the only cormorant to occur regularly in freshwater habitats. Breeding takes place in colonies on islands (especially in ocean environments) or in stands of large trees, often in riparian areas. The Cormorant's diet consists mainly of fish and invertebrates, especially crustaceans.

The Double-crested Cormorant is a Species of Special Concern in California.
In the study area, Double-crested Cormorants are common along the Mad River throughout the year. There are no known nesting areas in the study area; the nearest nesting sites are on the abandoned Arcata Wharf in Humboldt Bay and along sea stacks in and around Trinidad Harbor, north of the Mad River mouth.

Bald Eagle (*Haliaeetus leucocephalus*)
The Bald Eagle is found throughout North America and California. Concentrations of Bald Eagles are found where their preferred food is concentrated, i.e. in major waterfowl wintering areas, and along major salmon streams and rivers with adjacent snags for perching. Nesting takes place in large stick nests, often high in a tree, living or dead. Eggs can be laid as early as January, incubation is 30-45 days, and the young take their first flight approximately two and one-half months after hatching. Their food consists largely of fish, either caught themselves or stolen from Ospreys. Bald Eagles also feed upon a wide variety of small mammals, aquatic birds and carrion.

The Bald Eagle is listed as endangered both in California and the United States. It is a California Protected Species.

Bald Eagles are rare in Humboldt County. Three nests are known in the county, one is above Korbel near the project area. Scattered sightings of Bald Eagles along the coastal portion of the Humboldt Bay area may refer to this pair and its offspring, or an occasional outside visitor. At present, there are no gravel operations in the immediate vicinity (within 1.25 miles) of the known Bald Eagle nest. However, the entire Mad River extraction area is habitat for the eagles located near Korbel.

Northern Spotted Owl (*Strix occidentalis caurina*)
The Northern Spotted Owl is an uncommon and reportedly declining species found in old growth forests in the Pacific Northwest. Its habitat is in old-growth or older second growth forests.

The Northern Spotted Owl is a Federally Threatened Species.

Near the study area, Spotted Owls are common in suitable habitat. None are known in habitat adjacent to the present gravel operations.

None of the present gravel mining operations would impact Spotted Owls as suitable habitat is lacking within 0.25 miles of the operations.

Sharp-shinned Hawk (*Accipiter striatus*)
The Sharp-shinned Hawk is found throughout North America in a wide variety of forest and scrub habitats, where it preys primarily on small birds. Populations in North America have declined due to pesticide residues, habitat destruction and the general decline of songbird populations, its major prey.

The Sharp-shinned Hawk is a Species of Special Concern in California. Locally, the Sharp-shinned Hawk is an uncommon winter resident and rare summer breeder. No Sharp-shinned Hawks were observed in the project area during these surveys, but they are regularly encountered during the wintertime.

Cooper's Hawk (*Accipiter cooperi*)
The Cooper's Hawk is found throughout North America in a wide variety of forested and scrub habitats, where it preys primarily on song birds. Populations in North America have declined due to pesticide residues, habitat destruction and the general decline of songbird populations, its major pry.

The Cooper's Hawk is a Species of Special Concern in California. Locally, the Cooper's Hawk is an uncommon winter resident and rare summer breeder. No Cooper's Hawks were observed during the spring and summer 1993 surveys.

Merlin (*Falco columbarius*)
The Merlin is found throughout North America in a wide variety of open habitats, where it preys primarily on shorebirds and song birds. Populations in North America have declined due to pesticide residues and habitat destruction.

The Merlin is a Species of Special Concern in California.

Locally, the Merlin is an uncommon winter resident that occasionally hunts along the lower stretches of the Mad River, where it preys on Pine Siskins and other small birds.

American Peregrine Falcon (*Falco peregrinus anatum*)
The Peregrine Falcon is found throughout North American aquatic habitats, where it preys primarily on shorebirds and ducks. Populations in North America have declined due to pesticide residues, nest disturbances (including the illegal removal of chicks for falconry) and habitat destruction. There seems to be some recent recovery of the species.

The Peregrine Falcon is an Endangered Species in California and the United States and is a California Protected Species.

Locally, the Peregrine Falcon is an uncommon winter resident and rare summer breeder. It is fairly common in the lower reaches of the Mad River, below the 299 bridge, where it hunts for shorebirds along the river and in the adjacent fields.

Marbled Murrelet (*Brachyramphus marmoratus*)
The Marbled Murrelet is an uncommon and reportedly declining marine bird that depends on old growth forests for their nesting sites.

The Marbled Murrelet is a California Endangered and Federal Threatened species. There are no records of Marbled Murrelets in the study area or anywhere along the mad River drainage

(Paton and Ralph, 1990). Suitable habitat does not occur within 0.25 miles of any present operation.

Willow Flycatcher (*Empidonax trailii*)
The Willow Flycatcher is found throughout the northern half of the continental United States. Its preferred habitat is wet meadow and montane riparian habitats dominated by willow thickets. The Willow Flycatcher breeds almost exclusively in dense willow thickets, using the lower branches for feeding and singing perches. This species' nests are parasitized by the Brown-headed Cowbird, a significant part of the reason for its California listing.

The Willow Flycatcher is a California Endangered Species.

The Willow Flycatcher is not yet known to nest in Humboldt County, although singing males exhibiting territorial behavior have been noted along the Eel River, near Dyerville.
Intensive searching showed no Willow Flycatchers in the project area during the 1993 surveys.

Black-capped Chickadee (*Parus atricapillus*)
The Black-capped Chickadee is possibly the most abundant and best-known chickadee in North America. In California, it is found almost exclusively in willow/cottonwood habitats along the north coast south to the vicinity of Ferndale.

The Black-capped Chickadee is a Species of Special Concern in California

It has become fairly common in suitable habitat along the Mad River, from the Mad River County Park upstream to at least the Blue Lake bridge.

California Yellow Warbler (*Dendroica petechia brewsteri*)
Found throughout North America, the Yellow Warbler has been declining as a breeding bird in California due to habitat destruction and parasitization by the Brown-headed Cowbird. Its breeding habitat is in riparian deciduous forests of almost any size.

The Yellow Warbler is a Species of Special Concern in California.

In Humboldt County the Yellow Warbler is a fairly common breeder in riparian habitats including the riparian forests downstream from the Blue Lake bridge.

Yellow-breasted Chat (*Icteria virens*)
This bird is found throughout North America but has been declining as a breeding bird in California due to habitat destruction. Its breeding habitat is in riparian deciduous forests of moderate or larger size.

The Yellow-breasted Chat is a Species of Special Concern in California. In Humboldt County it is an uncommon breeder in riparian habitats including the Mad River riparian forests downstream to at least below Azalea Park.

White-footed Vole (*Arborimus albipes*)
The White-footed Vole is found along the coastal regions of Oregon and extreme northern California. Its preferred habitat is humid coastal forests of Redwood, Douglas-fir and riparian

species. White-footed Voles feed principally on the leaves of green plants; red alder seems to be preferred in some areas.

The White-footed Vole is a Species of Special Concern in California and is a Category 2 Candidate for Federal Listing.

Locally, this species is not well known, but seems to prefer riparian vegetation along small streams within the coastal coniferous forests, but it is not expected to be found in the Cottonwood/willow type of riparian forests of the study area.

Impact Statements and Mitigation Measures

Impact

Wild-1: Gravel extraction, aggregate stockpile and processing sites, industrial development, agricultural development, residential develoment, highway development and, streambank levees have cumulatively reduced the Mad River riparian corridor wildlife habitat to a fraction of what it once was. Gravel extraction operations and gravel stockpiles can significantly reduce or modify the habitat of certain wildlife species. These potential changes could be significant adverse impacts. The preferred alternative will not increase this loss of wildlife habitat. On the contrary certain vegetation mitigation measures may actually increase the avaiability of significant wildlife habitat. Regardless, the cumulative adverse impacts on wildlife habitat will remain significant. (S/S)

Mitigation Measures

Mit-7: For at least the first five years of this project wildlife monitoring surveys similar to those conducted in the project area and at site specific extraction operations during 1993 will be continued. The SDRC will consider comments from the California Department of Fish and Game, the wildlife surveys, and impacts to wildlife when developing annual mining stratagies at affected sites. The need for continuing wildlife surveys after the first five years will will be considered during the five-year comprehensive review.

Mit-1: Wildlife survey and other monitoring information will be used to limit and design gravel extraction to minimize the risk producing significant gravel extraction-induced changes in wildlife habitat. Significance as related to impacts regarding wildlife will be determined by the SDRC, during annual wildlife surveys and in consultation with the CDFG and other experts. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Mit-8: No new haul roads shall be constructed through established riparian forest under this project. Abandoned haul roads, trails, will be revegetated.

Mit-9: Gravel stockpiles shall be maintained in historic locations in a manner to assure no encroachment into significant wildlife habitat. No new stock pile locations shall be established in riparian forests under this project. Abandoned stockpile sites will be revegetated.

Monitoring

Scientific Design and Review Committee
Humboldt County Planning Department
California Department of Fish & Game

Significance after Mitigation

Significant. The cumulative adverse wildlife habitat impacts will remain significant.

Impact

Wild-2: Wildlife can be affected by excessive noise resulting from mechanical equipment. Operational noise can be reduced if the exhaust systems of all internal combustion engines owned or maintained by the operators are kept in good repair and as manufactured. While many species can become acclimatized to predictable and/or constant noise, others will be displaced, at least temporarily. When operations cease, the wildlife can return. This may be considered a short term effect and less than significant. However, if rare or threatened species are displaced by excessive noise the effect would be significant. Monitoring for noise-reduction compliance and for the presence of rare, threatened, or endangered species subject to noise disturbance is needed. For more information on noise see Section 5.11. (PS/PS)

Mitigation Measures

Mit-10: The exhaust systems of all internal combustion engines owned or maintained by the operators shall be kept in good repair and as manufactured.

Mit-7: Annual pre-extraction wildlife surveys will occur. If rare or threatened species are observed near extraction areas, extraction prescriptions will be modified to accomaodate the noted individuals. The SDRC will consider comments from the California Department of Fish and Game, the wildlife surveys, and impacts to wildlife when developing annual mining stratagies at affected sites. The need for continuing wildlife surveys after the first five years will will be considered during the five-year comprehensive review.

Mit-1: Monitoring information will be used to design and regulate gravel extraction to minimize the risk of producing significant gravel extraction-induced impacts to wildlife habitat. Significance as related to impacts regarding wildlife will be determined by the SDRC, during annual wildlife surveys and in consultation with the CDFG and other experts. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring

Humboldt County/Scientific Design and Review Committee
California Department of Fish and Game

Significance after Mitigation

Less than significant

Impact

Wild-3: Dust resulting from the project can coat riparian vegetation inhibiting both plant growth and insect use of plants, both of which consequently affect wildlife use of the habitat. This has a potential of being a significant impact. (PS/LS)

Mitigation Measures

Mit-11: All non-paved haul roads will be watered at least twice a day when being used during the extraction season. In addition all extraction and processing areas shall be watered as required by the NCUAQMD or as necessary to reduce the level of fugitive dust to acceptable air quality standards.

Mit-12: All operational traffic shall observe a maximum speed limit on unpaved roads of 20 m.p.h. This will reduce dust by approximately 65-80% (RSE, 1993).

Mit-7: Annual pre-extraction wildlife surveys will occur. If rare or threatened species are observed near extraction areas, extraction prescriptions will be modified to accomaodate the noted individuals. The SDRC will consider comments from the California Department of Fish and Game, the wildlife surveys, and impacts to wildlife when developing annual mining stratagies at affected sites. The need for continuing wildlife surveys after the first five years will will be considered during the five-year comprehensive review.

Mit-1: Monitoring information will be used to limit and design gravel extraction to minimize the risk producing significant gravel extraction-induced impacts to wildlife habitat. Significance as related to impacts regarding wildlife will be determined by the SDRC, during annual wildlife surveys and in consultation with the CDFG and other experts. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee
NCUAQMD.

Significance after Mitigation
Less than significant

Impact
Wild-4: Gravel extraction operations could impact the habitat of various bird and mammal Species of Special Concern, Threatened species, or Endangered species. These impacts could be significant. (PS/LS)

Mitigation Measures
Mit-7: Annual pre-extraction wildlife surveys will occur. If rare or threatened species are observed near extraction areas, extraction prescriptions will be modified to accomaodate the noted individuals. The SDRC will consider comments from the California Department of Fish and Game, the wildlife surveys, and impacts to wildlife when developing annual mining stratagies at affected sites. The need for continuing wildlife surveys after the first five years will will be considered during the five-year comprehensive review.

Mit-1: Monitoring information will be used to limit and design gravel extraction to minimize the risk of producing significant gravel extraction-induced changes in wildlife habitat. Significance as related to impacts regarding wildlife will be determined by the SDRC, during annual wildlife surveys and in consultation with the CDFG and other experts. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation
Less than significant

Impact
Wild-5: Gravel extraction operations could impact the Northern Red-legged Frog, a Species of Special Concern in California and a Category 2 Candidate for Federal Listing. Disturbance of breeding or habitat areas could be significant. (PS/LS)

Mitigation Measures
Mit-7: Annual pre-extraction wildlife surveys will occur. If rare or threatened species are observed near extraction areas, extraction prescriptions will be modified to accomaodate the noted individuals. The SDRC will consider comments from the California Department of Fish and Game, the wildlife surveys, and impacts to wildlife when developing annual mining stratagies at affected sites. The need for continuing wildlife surveys after the first five years will will be considered during the five-year comprehensive review.

Mit-1: Monitoring information will be used to limit and design gravel extraction to minimize the risk of producing potential impacts on Northern Red-legged Frog breeding ponds to a level of insignificance. Significance as related to impacts regarding wildlife will be determined by the SDRC, during annual wildlife surveys and in consultation with the CDFG and other experts. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation
Less than significant

Impact
Wild-6: Gravel extraction operations could impact the Foothill Yellow-legged Frog, a Species of Special Concern in California and a Category 2 Candidate for Federal Listing. Disturbance of breeding or habitat areas could be significant. (PS/LS)

Mitigation Measures
Mit-7: Annual pre-extraction wildlife surveys will occur. If rare or threatened species are observed near extraction areas, extraction prescriptions will be modified to accomaodate the noted individuals. The SDRC will consider comments from the California Department of Fish and Game, the wildlife surveys, and impacts to wildlife when developing annual mining stratagies at affected sites. The need for continuing wildlife surveys after the first five years will will be considered during the five-year comprehensive review.

Mit-1: Monitoring information will be used to limit and design gravel extraction to minimize the risk of producing gravel extraction-induced impacts on Yellow-legged Frog habitat to a level of insignificance. Significance as related to impacts regarding wildlife will be determined by the SDRC, during annual wildlife surveys and in consultation with the CDFG and other experts. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation
Less than significant

Impact

Wild-7: Northwestern Pond Turtles were not observed in the project areas during the 1993 wildlife survey. However, gravel extraction operations could impact the Northwestern Pond Turtle, a Species of Special Concern in California and a Category 2 Candidate for Federal Listing. Disturbance of breeding or habitat areas could be significant. (PS/LS)

Mitigation Measures
Mit-7: Annual pre-extraction wildlife surveys will occur. If rare or threatened species are observed near extraction areas, extraction prescriptions will be modified to accomaodate the noted individuals. The SDRC will consider comments from the California Department of Fish and Game, the wildlife surveys, and impacts to wildlife when developing annual mining stratagies at affected sites. The need for continuing wildlife surveys after the first five years will will be considered during the five-year comprehensive review.

Mit-1: Monitoring information will be used to limit and design gravel extraction to minimize the risk of producing adverse impacts on Northwestern Pond Turtles. Significance as related to impacts regarding wildlife will be determined by the SDRC, during annual wildlife surveys and in consultation with the CDFG and other experts. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Monitoring
Humboldt County/Scientific Design and Review Committee
California Department of Fish & Game

Significance after Mitigation
Less than significant

5.7 Vegetation

The County retained Karen Theiss and Associates to gather and analyze information on the effects of historic gravel extraction on the vegetation of the project area. Portions of the following section were adapted from Karen Theiss' report. See Appendix H for the complete report.

Overview
Where gravel extraction affects botanical habitats, the direct impact is the removal of vegetation resulting in an overall decline in botanical presence and diversity. A reduction in vegetative cover will result in a decrease in wildlife habitat value with an expected decline in the numbers of individuals and species present. With respect to current conditions and values, the removal of gravel bar habitat would result in the least overall degree of direct impact, while the removal of riparian forest would result in the greatest overall degree of impact on both botanical and wildlife values. See Section 4.3 for more information on vegetation.

Removal of isolated patches of moderate to late stage scrub vegetation and young forest stands from the gravel bar, and early scrub habitats would preclude the development and expansion of these vegetation units over time. These "islands" of more developed vegetation serve to enhance habitat values for wildlife; their removal would result in an overall decline in habitat value. These islands of vegetation may act as traps to 'grab' sand and gravel as it is transported downstream. Over time, the cycle of capturing of more material and the growth of additional vegetation causes the islands to develop as distinct habitat areas. A side effect of the development of vegetation islands is a braided river channel.

Continued excavation in any one area precludes the natural evolution of terraces and subsequent development of riparian vegetation. The low-lying herbaceous and early scrub

habitats would be the most affected. The localized long-term effects would include: A) the loss of early stage scrub; B) the maturation of the later stage scrub and forest; C) a decline in vegetative diversity; D) a decline in wildlife habitat values; and E) a likely decline in wildlife diversity.

Other factors adversely affect the development of a natural meandering pattern and the evolution of point bars into river terraces. These include Highway 299 with its bank protection, certain bridges, and levees and RSP all of which limit the natural tendency of the river to meander across its floodplain.

Revegetation techniques can be used to mitigate for habitat that is disturbed by gravel extraction. Salvage of existing woody plant material may be possible. Salvaged material needs to be properly stored and maintained (e.g., adequate water supply, protection from desiccation). While it may not always be possible to salvage plant material, plant material that is lost may be replaced in strategic locations by using cuttings and seedlings. Reclamation also offers an opportunity for habitat diversification, if desired. An example would be the creation of small ponds which allow for the establishment and support of particular species such as the California Red-legged Frog and the Northern Yellow-legged Frog.

Avoidance can be employed in those areas of continuous, well established vegetation, from moderate scrub to mature forest. At any one particular site, at least some of the early successional scrub should be avoided in order to allow for diversity of age class and attendant habitat value. Isolated stands of moderate age scrub and young forest within the gravel bar habitat should be considered on a case by case basis to evaluate their contribution to the overall habitat value. Those patches with a high probability for surviving the forces of high water flows should be avoided.

A natural riverine system is highly dynamic and routinely experiences changes in the location of the channel and the area of wetted surface over time. Depending on the nature and extent of relocation, bank erosion may occur on either side of the stream bed. Bank erosion, whether on low terraces vegetated with riparian scrub or on high terraces with mature riparian forest, results in loss of vegetation, habitat diversity, and a decline in overall habitat value. In a natural system, erosion on one side of a meander is generally accompanied by deposition on the opposite side, with development of vegetation over time. The natural replenishment of the riparian vegetation is thus closely correlated with hydrologic processes. The alteration of natural hydraulic forces by instream gravel extraction can affect riparian vegetation by accelerating the rate of erosion and/or precluding the deposition of materials (and subsequent establishment of vegetation) over time. These changes can occur both upstream and downstream of active mining areas, as well as directly at the extraction sites.

Instream gravel extraction, in excess of net recruitment and replenishment will cause stream bed degradation which, in turn, results in a lowering of the water table. Many riparian species thrive where they do because of their specific water requirements. A significant lowering of the water table will alter the density and diversity of plant species growing in any specific location. Young shoots of arroyo willow, for instance, tend to colonize close to the water's edge in order to take advantage of the proximity of the water table. A lowering of the water table due to degradation of the low-water wetted channel changes the location where new colonization of these species will occur and stresses existing young stands.

Methodology

The use of aerial photography and field investigations conducted by Karen Theiss in February, 1993, indicate the presence of four distinct habitat types: gravel bar, riparian scrub, mature

riparian forest, and ponds and backwaters. Ponds and backwaters are infrequent within the scrub and forest vegetation types. The investigative work of Mad River Biologists adds an additional habitat type: developing riparian forest.

Arbitrary cover class designations are used within the report as follow:

sparse ..... <10% cover
low..... 10%-30% cover
moderate..... 30%-70% cover
dense ..... 70%-90% cover
very dense..... >90% cover

Starting at the gravels alongside the channel, a cross section of riparian vegetation correlates to terrace elevation and depth of sediment deposits: from sparse herbaceous vegetation at the lowest elevations; to low-density woody vegetation (early successional scrub) on the lower terraces; to dense woody vegetation (late successional scrub) on the moderate-elevation terraces; to riparian forest on the higher terraces. Of importance to the development of vegetation in terrace evolution is the deposition of silt and fines, which provide a medium for vegetation development. As early vegetation establishes, additional sediment is trapped and nutrients are added to the developing soil. This process continues as the terrace evolves, allowing for the establishment of woody scrub species and, eventually, tree species.

Remnant channels and backwaters occur throughout the study area, and interrupt the vegetative progression. These create linear stands of differing ages of scrub vegetation and, occasionally, young forest vegetation. Some backwaters and ponds persist long enough to allow for the development of emergent wetland vegetation, which provides a small but notable component of the riparian vegetation complex.

Riparian vegetation provides a high degree of potential wildlife habitat value The dynamic nature of riverine systems results in the establishment of different zones of vegetation, each with its own special characteristics. Even within a single habitat type, early successional stages offer different habitat values than do later, more mature stages.

Gravel Bar

The gravel bar habitat encompasses an area that is seasonally inundated and scoured by normal winter flows. The substrate is comprised of varying amounts of cobbles, pebbles, and gravel, with minor amounts of silt and sand. Large woody debris (tree trunks and root wads) has accumulated at a number of spots within this habitat type.

Gravel bars support annual forbs and grasses during spring and summer months. During the winter months this ephemeral vegetation is washed away and these areas are generally devoid of perennial woody vegetation. In some areas, large woody debris provides localized protection for vegetative growth. The diversity and density of this vegetation is variable and depends on site-specific characteristics, including period and length of inundation, availability of moisture during summer months, insolation, substrate qualities, scour, deposition, and mechanical disturbance.

Drought conditions, such as in the recent past, lead to reduced winter flows and a lowering of the water table which may allow sparse woody vegetation, primarily arroyo willow (*Salix lasiolepis*) or coyote brush (*Baccharis pilularis* var. *consanguinea*), to establish in some areas which might not otherwise support these species. These areas of young woody vegetation are often linear patches running parallel to the direction of high winter flow. As these patches

mature, they trap sediment and debris, resulting in the formation of hummocks of differing vegetation within the gravel bar habitat.

Riparian Scrub

Riparian scrub extends transversely from the lowest terraces bordering the gravel bar to the uppermost terraces, supporting riparian forest. The substrate is comprised of coarse fragments (cobbles, pebbles, and gravel) overlain with fine deposits (sand and silt) which increase in depth from the lower to upper terraces. Woody debris has accumulated in some of the lower areas, and appears to be generally smaller than that found on the gravel bars. This debris is often trapped against existing vegetative stands.

Vegetation varies within the habitat, in terms of diversity, density, and spatial distribution. The greatest vegetative diversity is found within the early successional stages on the lower terraces, which are characterized by extensive herbaceous cover and sparse young woody vegetation (coyote brush and/or arroyo willow). Late successional vegetation is located at slightly higher elevations and is generally underlain with a deeper layer of fine deposits and a more developed soil. The later stages are characterized by a decrease in herbaceous cover, an increase in shrub density and cover, a deepening of fine deposits, and an increase in elevation. Young red alder (*Alnus rubra*) and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) may be found sparingly at the upper edges of mature scrub vegetation.

It appears that the combined influences of the recent drought, along with channel degradation, may have allowed the early stages of the riparian scrub to encroach further onto the gravel bar than would occur during "normal" hydrologic years. Recent low winter flows have deposited fine sediments at lower elevations in areas that are usually subject to annual scouring. The accumulation of these sediments has, in turn, allowed for encroachment of herbaceous and woody species, and expanded the spatial extent of the scrub habitat and its associated potential wildlife value.

Riparian Forest

This habitat is located on higher terraces and is usually the farthest from the river channel. On alluvial terraces, the substrate is characterized by deep silt and sand deposits overlying coarse material. River-borne woody debris is sparse to absent within this habitat. On native slopes (e.g., between Glendale and Essex, and upriver of the fish hatchery), the substrate is comprised of native material, with occasional rocky outcrops.

Depending on historic river channel locations, flood activity, and land use practices, single-aged or mixed-aged stands of vegetation may exist within the riparian forest. Within the study area, the riparian forest is typified by moderately dense to dense canopy cover with black cottonwood, red alder, and yellow willow (*Salix lasiandra*) being dominant. In more mesic areas, associated canopy species include California bay (*Umbellaria californica*) and cascara sagrada (*Rhamnus purshiana*), with occasional Sitka spruce (*Picea sitchensis*) and coast redwood (*Sequoia sempervirens*). By virtue of its spatial location, the riparian forest is protected from frequent periodic inundation, which, in turn, has allowed the canopy species to develop and mature.

The shrub layer is present in low to moderate cover classes. Characteristic species include coyote brush, salmonberry (*Rubus spectabilis*), and red elderberry (*Sambucus racemosa* ssp. *pubens* var. *arborescens*), with California blackberry (*Rubus vitifolius*) and Himalaya berry (*Rubus discolor*) being more evident along the edges and in disturbed areas. The herb layer generally exhibits low cover values, with sword fern (*Polystichum munitum*) and bracken fern (*Pteridium aquilinum* var. *pubescens*) being typical.

The relative species composition of the riparian forest varies within the study area. In some stands, cottonwood is the dominant species, with red alder being a moderate to very minor component. Other stands are dominated by red alder, with cottonwood being a minor to absent component. Yellow willow was noted primarily in the vicinity of Graham Bar, associated with both cottonwood and red alder. The age class of forest vegetation also varies within the study area. The young forest complex adjacent to Graham Bar has developed within the last 25 years. Examples of older stands include those just downstream of Hatchery Bridge, as well as those adjacent to agricultural fields in the Blue Lake area. Isolated mature cottonwood in adjacent agricultural fields are most likely remnants from a more extensive forest which existed prior to clearing for agriculture.

Ponds and Backwaters

Isolated backwaters and ponds within the scrub habitat are subject to inundation and accumulate silt deposits. A number of these ponds and backwaters persist for a period sufficient to support a different flora, with the vegetation characterized by hydrophytic species. Slough sedge (*Carex obnupta*), broadleaf cattail (*Typha latifolia*), and horsetail (*Equisetum laevigatum*) are the most common. Adjacent vegetation is variable, from sparse to very dense shrubs and young trees. The location of these backwaters and ponds change periodically, depending on the annual flow characteristics of the river.

Sensitive Plant Species and Plant Communities

An inquiry was made to the Natural Diversity Data Base with regard to the presence of rare, threatened and/or endangered plant species within the project area. There are no records of any such species within the study area. Additionally, a review of the 'Inventory of Rare and Endangered Vascular Plant Species' (CNPS, 1988) and the California Department of Fish and Game's Special Plant List (CDFG, 1991) did not reveal any species which would be expected within the habitats found in the study area. As of this writing, no rare, threatened and/or endangered plant species have been found in or near the project area. However, the North Coast Chapter of the California Native Plant Society has expressed an interest in having the North Coast Black Cottonwood Riparian Forest listed with the California Natural Diversity Data Base as an endangered habitat type (Keeler-Wolf, 1993) and remnants of this plant community are found in the Mad River riparian corridor

Wildlife Habitat Value

The wildlife habitat value of the gravel bar is low in comparison with the remaining riparian habitats due to the relative absence of cover and scarcity of food. Scattered patches of woody vegetation, which have developed within the gravel bar habitat, act to locally enhance wildlife values by providing cover and a food source for species which may not usually be found here.

The riparian scrub provides habitat for a wide variety of small and moderate-size mammals and birds. In general, the potential wildlife habitat value increases with an increase in the vegetative density, with the denser stands supporting a greater diversity of species and number of individuals.

The riparian forest provides a high degree of wildlife habitat value, due to well-developed vertical structure, extent of cover, and food availability. This habitat is utilized by a wide variety and large numbers of insects, birds, and mammals.

Persistent ponds and backwaters with emergent vegetation provide habitat for several wildlife species of concern, including the California Red-legged frog, the Northern Yellow-legged frog, and the Western Pond Turtle. The potential value of this habitat lies not so much in the

diversity of species, but in the particular special species which it supports. These ponds and backwater areas likely meet the wetlands criteria of both the California Department of Fish and Game and the US Army Corps of Engineers.

Table 5.7-1 Compiled Vegetation Species List

CANOPY SPECIES

Alnus rubra ..... red alder
Ilex aquifolium ..... English holly
Picea sitchensis ..... Sitka spruce
Populus balsamifera ssp. *trichocarpa* ..... black cottonwood
Rhamnus purshiana ..... cascara sagrada
Salix lasiolepis ..... arroyo willow
Salix lasiandra ..... yellow willow
Sequoia sempervirens ..... coast redwood
Umbellaria californica ..... California laurel

SHRUB AND VINE SPECIES

Baccharis pilularis ssp. *consanguinea* ..... coyote brush
Rubus discolor ..... Himalaya berry
Rubus spectabilis var. *spectabilis* ..... salmon berry
Rubus vitifolius ..... California blackberry
Sambucus racemosa ssp. *pubens* var. *arborescens* ..... red elderberry

HERB AND FERN SPECIES

Anaphalis margaritacea ..... pearly everlasting
Bellis perenne ..... English daisy
Bromus sp. ..... brome
Carex obnupta ..... slough sedge
Cirsium vulgare ..... bull thistle
Cortaderia selloana ..... pampas grass
Daucus carota ..... Queen Anne's lace
Dipsacus fullonum ..... teasle
Equisetum laevigatum ..... horsetail
Festuca sp. ..... fescue
Foeniculum vulgare ..... fennel
Hedera helix ..... English ivy
Holcus lanatus ..... velvet grass
Hypochoeris radicata ..... perennial cat's ear
Melilotus alba ..... sweet white clover
Plantago lanceolata ..... English plantain
Poa sp. bluegrass
Polystichum munitum ..... sword fern
Pteridium aquilinum var. *pubescens* ..... bracken fern
Raphanus sativa ..... wild radish
Scrophularia californica ..... California beeplant
Stachys sp. ..... hedge nettle
Trifolium sp. ..... clover
Typha latifolia ..... broadleaf cattail
Verbascum thapsus ..... wooly mullein
Vinca major ..... periwinkle

Site Specific Vegetation Characteristics

Guynup Bar (Site No. 1):
The Mad River Sand and Gravel - Guynup Bar (Site No. 1) includes a processing yard located on the uppermost terrace, as well as the bar itself. There is a remnant stand of riparian forest on the southeasterly side of the processing yard, which extends down slope to meet with a mature scrub stand at the bottom. The forest supports a mix of cottonwood and red alder, with some mature arroyo willow. There was standing water several feet deep along the base of this slope, with vegetation on both sides, at the time of field review, by Theiss in the winter 1992-93. This was either a remnant channel or a backwater area with potential habitat value for amphibians. A mix of forest and mature scrub continues northerly along the bank. The remainder of the area is comprised of gravel bar habitat and early to mid-successional scrub habitat.

Emmerson Bar (Site No. 2):
The Redwood Empire Aggregates - Emmerson Bar (Site No. 2) is characterized primarily by gravel bar and early successional riparian scrub. There are a few isolated patches of woody vegetation, including several stands of 20-foot arroyo willow in the gravel bar, and a patch of young cottonwood (to 25-30 feet), arroyo willow, and coyote brush in the lower reach of the riparian scrub. These patches have been able to mature sufficiently in recent years, to attain some height and begin accumulating silt and other debris at the base. The patches likely enhance the habitat value of the bar and lower terrace by providing cover and some food for wildlife.

This bar has a pond with emergent vegetation (primarily cattail) located at the northerly end of the bar, at the base of the slope. It is surrounded by a moderately dense stand of arroyo willow and red alder. This pond potentially has high habitat value for amphibians, due to its persistence and the presence of good vegetative cover. This area likely meets the wetland criteria of both the California Department of Fish and Game and the US Army Corps of Engineers.

Blue Lake bar (Site No. 3):
Much of the Redwood Empire Aggregates - Blue Lake bar (Site No. 3) is typified by gravel bar bordered with early successional riparian scrub, with patches of later successional scrub (dense arroyo willow thickets) concentrated in the northerly portion. There is a small stand of cottonwood (riparian forest) on the slope from the processing/storage yard down to the pond. In addition, there is a large patch of transitional scrub/forest to the south of the pond; this area has an approximate 20% cover by coyote brush and clumps of arroyo willow and small diameter cottonwood, 15 and 25 feet in height, respectively.

Due to the lack of riparian forest on this site, this area, particularly the woody clumps, should be avoided during extraction so as to allow for the maturation of the cottonwood and development of riparian forest. Development of riparian forest at this site, would not only diversify the on-site habitat and increase the value to wildlife, but would assist in providing a corridor for wildlife migration between forest patches upstream and downstream of this bar.

Christie Bar (Site No. 4):
Nearly all of the Eureka Sand and Gravel - Christie Bar (Site No. 4) supports the gravel bar and very early successional riparian scrub habitat types. A few patches of arroyo willow exist toward the established scrub habitat. In addition, there is a small population of mixed riparian forest and scrub on a terrace remnant toward the easterly (upstream) end of the bar. This terrace remnant is rapidly eroding. Two ponds have been excavated on the bar, one toward

the upstream side (1989) and one toward the downstream side (1992). There is a broad stand of mature scrub and patches of forest vegetation between the processing yard and the gravel bar, much of which has evolved over the last few decades.

The continued use of the existing roads between the processing and extraction areas is in order to preclude disruption of this stand. Revegetation in and around the ponds could be incorporated for mitigation should these areas not revegetate naturally.

Johnson Bar (Site No. 5):
Most of the Redwood Empire Aggregates - Johnson Bar (Site No. 5), is comprised of gravel bar habitat. There was a small linear stand of scrub willow (to 10 feet in height) noted by Karen Theiss, as well as patches of early successional scrub. There is a broad terrace above this bar to the south, which is dominated by early and mid-successional scrub vegetation, with strips of mature scrub. There were a few older backwater channels, which may persist long enough for amphibian breeding. If so, these areas should be avoided during excavation. Planting around these backwater channels for mitigation of impacts on other areas of the bar would enhance the potential wildlife value.

Essex Bar (Site No. 6):
The upper terrace of the Mercer Fraser - Essex Bar (Site No. 6) is utilized for the storage of materials from this and other bars. Vegetation in this area is quite sparse, with ruderal (weedy) herbaceous species and a few coyote brush being noted in areas not recently disturbed. There is a narrow band of mixed scrub and forest vegetation between the storage terrace and the riverside gravel bar, characterized by arroyo willow and red alder with sparse cottonwood. The gravel bar is devoid of vegetation.

Johnson-Spini bar (Site No. 7):
The Arcata ReadiMix - Johnson-Spini bar (Site No. 7) is characterized by two large gravel bars just downstream of the US Highway 299 bridge, and a very small strip of gravel bar along the southerly bank. Moderate amounts of sediment have been deposited unevenly on the bars during the past winter. There is no vegetation on either bar; the northerly bank of the this stretch of river has been lined with rip rap, and supports a moderately dense cover of arroyo willow (scrub). The southerly edge of the study area is lined with a mature forest supporting a mix of cottonwood and red alder.

Arcata ReadiMix bar (Site No. 7):
This Arcata ReadiMix - Arcata ReadiMix bar (Site No. 7) is comprised primarily of the processing plant and storage yard. There is a mature stand of mixed scrub-forest vegetation along the easterly half of the slope descending from the upper terrace to the river. At the time of field investigation by Karen Theiss, the entire area below this band of vegetation had been covered with up to several feet of sediment; no exposed gravels were noted.

Graham bar (Site No. 8):
This Redwood Empire Aggregates - Graham bar (Site No. 8) includes the Redwood Empire Aggregates processing yard and narrow bar on the south side of the river, a long narrow bar on the northerly bend on the river, and another bar on the westerly side of the downstream bend. The southerly side of the river supports a band of fairly mature forest, dominated by red alder with yellow willow and cottonwood present in lesser amounts. There is a pocket of mature scrub vegetation on the downstream bend, and sparse early scrub vegetation on the bar itself.

The northerly bar, across from the processing plant, is at the edge of a moderately- aged stand of mixed forest vegetation, which has developed within the last twenty-five years. Several low-lying areas within the forest are wet enough to support emergent vegetation. There are no stands of forest vegetation of equal or greater size downstream.

Simpson-Zabel bar (Site No. 9):
The Simpson-Zabel bar (Site No. 9) is bound by native slopes on both sides of the river, rather than alluvial terraces. The current channel is on the northerly side of the canyon. This site supports an open gravel bar habitat with early scrub vegetation being extremely sparse to absent. The banks on both sides of the river support mature arroyo willow on the lower slope and a mature red alder forest on the upper slope. At the top of both banks, the deciduous riparian forest grades into a mixed forest with cottonwood, alder, and sparse California bay (*Umbellaria californica*) and Sitka spruce (*Picea sitchensis*).

Bank erosion in this area would result in the loss of mature riparian scrub and forest habitat, and could undermine the upland forest on top of the bank. Due to the current position of the low-water wetted channel, the northerly bank is probably more exposed to erosion than is the southerly bank.

Upper Simpson bar (Site No. 10):
This Simpson Timber bar - Simpson bar (Site No. 10) is located at the upstream end of the Blue Lake Valley. It is characterized by a mid-stream gravel bar, gravel bar and early to mid-aged scrub on the easterly side, and mixed young and moderate age scrub on the westerly side. Portions of the westerly bank are being actively eroded. While mature scrub and riparian forest were not observed within the active area defined by the county, they are located adjacent to and westerly from the site.

Impact Statements and Mitigation Measures

Impact
Veg-1 Consultants to this project have stated time and again that protecting all stages of riparian forests is the single most important element in ensuring good wildlife populations in the project area. Much of the natural riparian habitat originally present in the Mad River corridor has already been destroyed by agricultural conversion, the construction of levees, the development of roads, highways residential areas, and industrial areas and other causes. This loss of riparian habitat is cumulative and has been significant. Any further removal of significant riparian habitat, whether for gravel extraction or other purposes, has the potential to produce additional significant adverse impacts, primarily due to the potential loss of wildlife habitat, and must be mitigated. (S/S)

Mitigation
Mit-1: The implementation of Mit-1 includes site specific and project area monitoring of riparian habitat characteristics and disturbances. See Table 1.4-2 for preliminary information regarding the percentages of the project-area river reaches that are subject to direct impact disturbance through excavation and the percentages that are not subject to direct excavation disturbance. These "open areas" plus areas avoided within the ownerships of extraction sites help support botanical and wildlife habitat diversity. Information obtained by monitoring disturbances and vegetation presence and diversity throughout the entire project area will be used by the SDRC while selecting specific extraction sites, while determining quantities to extract, while designing extraction methodologies, and while considering site specific mitigation

measures. Avoidance, offsite revegetation, and the devlopment of new stands of riparian habitat in conjunction with high-terrace shallow-pit minimg are just three of the alternatives that the SDRC can consider when they find significant stands of vegetation are threatened. During the monitoring and planning phases of this project the SDRC will look for opportunities to mitigate for past losses in riparina habitat. Onsite and offsite revegetation and the devlopment of new stands of riparian habitat in conjunction with high-terrace shallow-pit minimg are some of the alternatives that the SDRC will consider when changes in river morphology or other factors produce opportunities for additional vegetation mitigation. These safeguards will help reduce past cumulative effects and assure that future gravel extraction-induced disturbances to riparian vegetation will be less than significant. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Mit-8: No new haul roads shall be constructed through established riparian forest under this project. Abandoned haul roads and trails will replanted.

Mit-9: Gravel stockpiles shall be maintained in historic locations in a manner to assure no encroachment into significant wildlife habitat. No new stock pile locations shall be established in riparian forests under this project. Abandoned stockpile sites will be replanted.

Monitoring
Humboldt County/Scientific Design and Review Committee

Significance After Mitigation
Although the cumulative losses will remain significant, future losses due to gravel extraction will be less than significant

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Impact

Veg-2 The indiscriminate removal of riparian vegetation, whether for gravel extraction or other purposes has the potential to produce significant adverse impacts due to the loss of bank stability. Loss of bank stability has both favorable and unfavorable impacts. If banks are unstable the river may tend to meander. When a river meanders it recruits sediment from terraces and produces less downcutting. (PS/LS)

Mitigation
Mit-1: This mitigation measure should reduce the rate of bed degradation and the cumulative impacts of bed degradation on bank stability and erosion to a level of insignificance. This mitigation measure also has the potential to reduce the cumulative adverse impacts of excessive channel aggradation on bank erosion. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

Mit-3: The Mad River is a dynamic ecosystem that is constantly being influenced by the forces of man and nature causing bank eroson problems to occur periodically. The SDRC shall monitor river banks in the project area and shall attempt to gain access and permission to initiate bank-stabilizing revegetation practices at sites where bank erosion is considered excessive, where revegetation may reduce the erosion rate, and especially where revegetaion can be used to mitigate for current or cumulative losses in riparian habitat. No specific sites are reccomended for this treatment now. Monitoring will help identify the sites and the success of this tecnique will depend, in part, on the cooperation of land owners and the availability of funds.

Mit-8: No new haul roads shall be constructed through established riparian forest under this project. Haul roads and other access routes that are abandoned will be replanted.

Mit-9: Gravel stockpiles shall be maintained in historic locations in a manner to assure no encroachment into significant wildlife habitat. No new stock pile locations shall be established in riparian forests under this project. Abandoned stockpile sites will be replanted.

Monitoring
Humboldt County/Scientific Design and Review Committee

Significance after Mitigation
Less than significant

Impact
Veg-3: The repeated removal of gravel in certain locations will alter the successional development of gravel bars, terraces, and vegetation at those locations. Continued excavation in any one area precludes the natural evolution of terraces and subsequent development of riparian vegetation. The low-lying herbaceous and early scrub habitats would be the most affected. The localized long-term effects would include: A) the loss of early stage scrub; B) the maturation of the later stage scrub and forest; C) a decline in vegetative diversity; D) a decline in wildlife habitat values; and E) a likely decline in wildlife diversity. These impacts are cumulative and significant. (S/S)

Mitigation
Mit-1: Mit-1 will provide the SDRC with the monitoring data needed to effectively limit gravel extraction to the point where this potential impact will be less than significant. Avoidance and offsite revegetation are just two of the more site specific mitigation alternatives that the SDRC will consider and implement when they find significant terraces or stands of vegetation are threatened by repeated excavation at any one site. Refer to Section 2.3 or 5.1 for the complete text of Mit-1.

See Table 1.4-2 for preliminary information regarding the percentages of the project-area river reaches that are subject to direct impact disturbance through excavation and the percentages that are not subject to direct excavation disturbance. These "open areas" plus areas avoided within the ownerships of extraction sites may help support terrace successional processes and habitat diversity. Information obtained by monitoring disturbances, vegetation presence, and terrace development and diversity on gravel bars located throughout the entire project area will be used by the SDRC while selecting specific extraction sites, while determining quantities to extract, while designing extraction methodologies, and while considering site specific alternatives. Avoidance is an alternative to disturbance that the SDRC can consider while evaluating site-specific extraction plans. This safeguard may help limit overall gravel extraction-induced impacts gravel bar and terrace development to a point that will be less than significant.

Monitoring
Scientific Design and Review Committee

Significance after Mitigation
Although future gravel extraction related losses will be insignificant, the cumulative impacts will remain significant

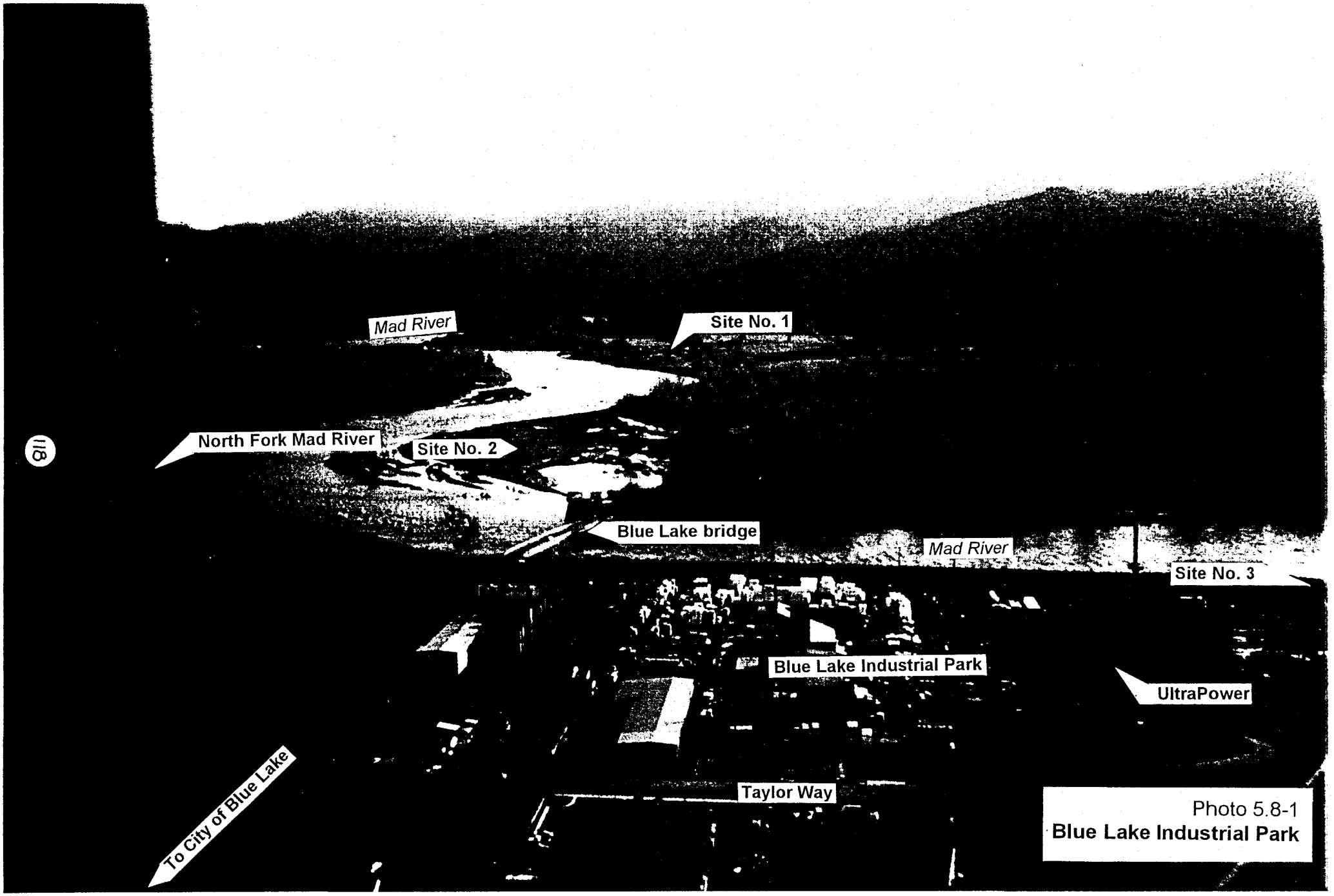


Photo 5.8-1
Blue Lake Industrial Park

5.8 Air Quality

Federal and State Regulations

The 1970 Clean Air Act gave the U.S. Environmental Protection Agency (EPA) the authority to set federal ambient air quality standards. The Act indicated the need for primary standards to protect public health, and secondary standards to protect public welfare from effects such as reduced visibility, soiling and nuisance (Sonoma County ARMP & EIR).

State ambient air quality standards were established in California in 1969, pursuant to the Mulford-Carrell Act. California air quality standards are administered by the California Air Resources Board (CARB). CARB predominantly regulates "tailpipe" emissions from vehicular sources, but has delegated authority to regulate stationary sources to the local Air Quality Management District (AQMD) and Air Pollution Control District (APCD) (Sonoma County ARMP & EIR).

Northcoast Regulations

Air pollution monitoring first began in the North Coast Air Basin (Del Norte, Humboldt, Mendocino and Trinity Counties, and part of Sonoma) in 1956 with particulate sampling in Crescent City. Air monitoring provides important data for regulating and controlling air pollution. Monitoring efforts on the North Coast have been focused on "criteria pollutants," defined as the major air pollutants from which federal and state agencies have set ambient air quality standards (Table 5.8-1). Ambient air quality standards are set limits for each criteria pollutant in the outside air, based on predicted health effects (NCUAQMD).

Table 5.8-1 Criteria Air Pollutants and Ambient Air Quality Standards

Pollutant	State Standard	Federal Standard
Ozone	0.09 ppm/hour	0.12 ppm/hour
Carbon Monoxide	20 ppm/hour average	35 ppm/hour average
Nitrogen Dioxide	0.25 ppm/hour	0.053 ppm/hour average
Sulfur Dioxide	0.25 ppm/hour	0.14 ppm/24-hour
Suspended Particulate Matter		
(PM_{10})	50 $\mu g/m^3$/24-hour average	150 $\mu g/m^3$/24-hour average
Sulfate	25 $\mu g/m^3$/24-hour average	none
Lead	1.5 $\mu g/m^3$/30-day average	1.5 $\mu g/m^3$/90-day average
Hydrogen Sulfide	0.030 ppm/hour	none
Vinyl Chloride	0.010 ppm/24-hour average	none

Units: ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter

Data adopted from: NCUAQMD., Summary of Air Monitoring Data In The North Coast Unified Air Quality Management District, March, 1993.

The North Coast Unified Air Quality Management District (NCUAQMD) is responsible for monitoring and regulating both federal and state air quality standards for Humboldt County. The NCUAQMD operates a sophisticated air monitor at the County's Public Health Department at 6th and I Streets, Eureka, CA. Single suspended particulate matter levels are measured during a 24-hour period about 60 times per year and from those readings a yearly average is calculated. (NCUAQMD).

Suspended particulate matter is less than 10 microns or one-millionth of a meter in diameter, and thus termed PM10. Particulates are solid matter from smoke, dust, fly ash or liquid

droplets from condensing vapors which can be suspended in the air for long periods of time. PM10 has the potential to affect breathing functions, causing increased respiratory disease, lung damage and premature death. It can also damage paint, soil clothing and reduce visibility. The major sources of this pollutant include industrial processes, automobiles, wood smoke, dust from paved and unpaved roads, construction and agricultural practices (NCUAQMD).

Ambient air quality standards are levels set for air pollutants in outside air which should not be exceeded and are based on the predicted health effects of those pollutants. Exceeding state or federal air quality standards is termed "non-attainment." According to NCUAQMD, about seven readings per year exceed the state standard.

Project Area

The Mad River transects highway 101 at river mile 5.6, and highway 299 at river mile 7.8, highway 299 also parallels the river up to Blue Lake. Aside from the minor influences of vehicular emissions on air quality, the lower reach of the project area from Hammond Bridge up through the Blue Lake valley, can be affected by Louisiana-Pacific's Particleboard plant emissions.

Air quality of the Mad River basin is also affected by the emissions of UltraPower, Inc. and Calgon Carbon Corp., both located in Blue Lake's industrial zone and within 200 feet of the Mad River (see Photo 5.8-1). Similarly, Blue Lake Forest Products, located on Glendale Drive approximately one-half mile from the project area, may affect air quality during its summer operations.

This lower reach region is also periodically affected by slash burning following timber harvests on nearby Simpson land in Fieldbrook, McKinleyville, Korbel and/or Blue Lake, as well as wood stove and general domestic burning.

Regional effects of emissions are accentuated by northerly and/or westerly wind conditions. Meteorological inversion and still conditions will prevent the normal rising or flushing of surface air, thus exacerbating the above listed air quality impacts.

The particulate emissions of Louisiana-Pacific, Simpson, UltraPower, Calgon Corp. and Blue Lake Forest Products all fall under the regulations and enforcement of the North Coast Unified Air Quality Management District. Further up the project reach, towards the former Sweasey Dam, air quality improves as human-induced impacts decrease.

Ambient air quality along the flood plain is also affected by dust raised by high winds. As the active channel recedes in late spring, exposing sediment deposited along the river at high flow, dry weather and wind mobilize the fine silt. The airborne fines can limit visibility and create dusty conditions.

Air Quality Impacts

Air-suspended particulates from the use of vehicles, aggregate crushing, sorting and extraction operations required in many gravel mining operations have the potential to affect air quality.

Vehicle and site equipment exhaust emissions are generated by a variety of gasoline and/or diesel-powered equipment. Exhaust emissions include those associated with the transport of workers, machinery, and supplies to and from a site, as well as those produced on-site by the operation of the equipment. The transporting of heavy equipment and gravel from the site to

the processing yard over unpaved roads also generates dust, as do the unloading and conveying of aggregates.

Skimming operations can temporarily raise dust levels at the extraction site. Following the removal of the top layer of sediment, often referred to as the "pavement layer," the underlying fines have an increased susceptibility to becoming airborne by high wind currents. Pit mining above the water table can also have temporary air quality impacts similar to those of skimming.

Particulate emissions from concrete batch plants consist primarily of cement dust, but some sand and aggregate dust emissions do occur during operations. Batch plant operations, as well as crushing and sorting dust emissions fall under the enforcement of the North Coast Unified Air Quality Management District (see Photo 5.8-2). Sprayers for dust suppression are required for some crushing operations. The dust is then washed into sediment settling ponds, which are regulated by RWQCB.

Emissions from aggregate processing include the release of nitrogen, oxygen and carbon dioxide, which are within acceptable limits and are an insignificant impact to air quality.

Any dust that might contribute to a nuisance problem generally settles out of the atmosphere within 300 feet of the site (EPA, 1978). Particles of less than 30 microns in size stay airborne for a fairly long period of time, while particles larger than 100 microns tend to settle out of the air within 30 feet of the source.

Generally, industry standards indicate that watering the road twice a day reduces dust associated with truck traffic by 50 percent, and reducing speed limits to 15-20 m.p.h. reduces dust 65-80 percent. Furthermore, the NCUAQMD Regulation 1, Rule 430 allows enforcement of excessive amounts of fugitive dust generated in open areas such as roads, stockpiles or the extraction site.

Impact Statements and Mitigation Measures

Impact
Air-1: Gravel extraction operations involve the use of gasoline or diesel-powered equipment that emit exhaust emissions. The air emissions are regulated by the NCUAQMD. There is no evidence that exhaust emission resulting from the project cause significant impacts. (LS/LS)

Mitigation Measures
Since no significant impact was identified, no mitigation is required.

Monitoring
North Coast Unified Air Quality Management District

Impact
Air-2: The project may involve the generation of dust. Dust emissions are regulated by the NCUAQMD. Some operations coupled with dry weather and heavy winds can emit fugitive dust in excess of adopted standards. This would be a significant impact. (PS/LS)

Mitigation Measures

Mit-11: Implement mitigation measure Mit-11 (watering roads and processing areas). This will reduce dust by approximately 50% (RSE, 1993).

Mit-12: All operational traffic shall observe a maximum speed limit on unpaved roads of 20 m.p.h. This will reduce dust by approximately 65-80% (RSE, 1993).

Monitoring

Scientific Design and Review Committee
North Coast Unified Air Quality Management District

Significance after Mitigation

Less than significant. The combined measures will significantly reduce fugitive dust.



Photo 5.8-2
Processing Facilities

5.9 Viewshed

The County retained Rising Sun Enterprises to gather and analyze information on viewsheds, recreation, noise, and traffic in the project area with particular reference to gravel extraction operations; and to analyze the effect of historic gravel extraction operations on the recreational use of the project area. Portions of the following section were adapted from the Rising Sun report. See Appendix E for the complete report.

General Setting

The area between the former Sweasey Dam and the Mad River Fish Hatchery is characterized by steep forested slopes on either side of a narrow confined river channel. This area is privately owned and has restricted public access. Below the Mad River Fish Hatchery, the river flows through a valley characterized by wide river meanders, steep cut river banks and corridors of established riparian vegetation. The Mad River valley between the Mad River Fish Hatchery and the Highway 101 bridge is developed with several communities that include residential, agricultural, commercial, and industrial activities. Below the Highway 101 bridge, land use is predominantly agricultural grazing land.

Blue Lake Viewshed:

Because of streamside vegetation along Dave Powers Creek, access to and views of the river are very limited within the City of Blue Lake. Gravel bars can be seen while crossing the Hatchery Road bridge and from the top of the flood control levee, north of the river. The primary access to the river at Blue Lake is via the Hatchery Road bridge and levee. The Emmerson bar (Site No. 2) and Blue Lake bar (Site No. 3) extraction areas are both visible from the bridge and levee. No other views of the river are available along Hatchery Road. An embankment of dirt and concrete blocks which runs parallel to Hatchery Road has been constructed in an attempt to limit vehicle access to Emmerson river bar. Further south along Hatchery Road, the Mad River Sand & Gravel processing site (Site No. 1) can be seen in the distance, approximately 650 feet off the road.

The Old Meander, where the Mad River flowed until 1964, has become vegetated and portions of the adjacent land are utilized for Potters Produce vegetable growing. From Hatchery Road, an attentive eye can spot signs of the old river channel and the former bridge. Refer to the Public Utilities and Structures section for more information on this bridge and site.

From Blue Lake to Arcata along West End Road, views are mostly screened by dense stands of riparian vegetation. Blue Lake bar and Christie bar (Site No. 3 and 4) stockpiles and extraction activity can be seen along a limited stretch of the road directly opposite the operations. Warren Creek Road, off of West End Road, has views of the river from the park adjacent to Pump Station #4 to Pump Station #5. Warren Creek Road ends as a private road, with neither views nor public access to the river.

Arcata Viewshed

West End Road closely parallels the river. When the summer foliage has fallen from the trees, Essex bar (Site No. 6) can be viewed. Further west at the recreational park located adjacent to the Humboldt Bay Water District facilities, views of the river can be obtained by a walk through the park. Along West End Road, between the Water District buildings and Highway 299, the river can be viewed through the trees.

No views of the river are available from Giuntoli Lane, although Redwood Empire Aggregates (Site No. 8) and Arcata ReadiMix processing plants and stockpiles (Site No. 7B) are visible.

Highway 299 Viewshed

While driving westbound on 299 down the Lord Ellis Summit, there are distant views of the Mad River, and the Blue Lake, Christie and Johnson bars (Site No.s 3, 4 and 5).

Eureka Sand & Gravel's (Site No. 4) processing and stockpile yard is highly visible from Highway 299. Some evergreen plantings exist within the CalTrans right-of-way, but most of the processing and stockpile yard is exposed.

The Glendale Road underpass offers a view of the upstream end of Johnson bar (Site No. 5) and the Eureka Sand & Gravel's Christie bar (Site No. 4).

Eastbound Highway 299 passes several pump stations, the Water District buildings and utility yard, and Mercer Fraser's Essex bar, processing and stockpile yard (Site No. 6) are visible. Only short glimpses of the river are possible along this stretch. The streambank is lined with cottonwoods, willows and alders with conifer trees planted both within the CalTrans right-of-way and growing naturally on adjacent land. Adjacent to the Essex Lane underpass, the railroad bridge and the river can be seen. The river is then hidden by the adjacent streambank and dense vegetation.

The only other view of the river is from the Highway 299 bridge. The Water District buildings or the Johnson-Spini bar (Site No. 7A) can be seen from the bridge, depending on the direction one is driving. Gravel extraction is visible from westbound 299 when it occurs on the Johnson-Spini bar (Site No. 7A).

Northbank Road Viewshed

Northbank Road runs along the north bank of the Mad River and links Highway 299 with northbound Highway 101. Views from North Bank Road consist primarily of grazing land and streambank riparian vegetation, with only occasional glimpses of the river.

As Northbank Road passes the Johnson-Spini and Arcata ReadiMix bars, and the Graham bar (Site No. 7A, 7B and 8), the gravel extraction operations are hardly noticeable because of the curvature and narrowness of North Bank Road. The Johnson-Spini bar (Site No. 7A) and Highway 299 bridge are visible from pull-offs along Northbank Road.

Highway 101 Bridge Viewshed

There are currently no views of mining operations from the Highway 101 bridge. Historical or future views would be minimal.

River Viewshed

The viewshed from the Mad River is affected by gravel extraction and processing activities in the area between the Mad River Fish Hatchery and Highway 101. Gravel extraction and processing activity can be viewed from the river itself or from limited roads that lie close to the processing plants.

Consider floating down the river from the hatchery weir to the County boat ramp (a distance of 11.3 miles). During 6.1 miles (54 percent of the reach) one or both of the banks would be connected to one of the ten sites where gravel extraction is permitted or proposed. During the rest of the trip (5.2 miles or 46 percent of the reach) neither bank would be connected to an existing or proposed extraction site. If you subtracted out the two unauthorized sites the open reach would total 5.9 miles (52 percent of the float trip) and the extraction reaches would total 5.4 miles (48 percent of the trip).

Refer to Table 1.4-2 for more details on open river reaches and river reaches connected to extraction sites. River alignment, river banks, and vegetation will influence the actual view while in each reach. Part of the time, while in an open reach and approaching an extraction reach extraction areas and processing areas may be visible. And, part of the time while in an extraction reach no extraction areas or processing sites would be visible. Other factors such as highways, bridges, levees, and water district facilities would influence the view as well.

During the winter months there would be less vegetative screening due to the deciduous nature of much of the riparian vegetation. Also during the winter months there would no extraction activity on the bars and there would be no summer bridges across the river. Noise from the turbulent water would likely mask most sounds from adjacent highways and processing sites. Finally, boaters would likely be moving faster and concentrating on the water more so than during the summer months.

A trip in the summer would be different. The trip would be slower and there would be more time to look around. There would also be more of a tendency to pause and relax at selected sites. There would be more vegetative screening as the deciduous trees would be leafed out. Summer bridges may be present and extraction equipment may be present at some locations in the extraction reaches. Although the river will be quieter it will still mask much of the noise from adjacent highways and processing sites.

Each operator is unique in the way they extract their gravel resource and two examples are discussed below to expand the reader's perspective. In terms of extraction equipment consider the Christie Bar and assume 35,000 cubic yards were to be extracted in a single season. These operators sometimes prefer to operate a single scraper and remove about 700 cubic yards per 8-hour day. Thus, they would operate on the bar about 50 days during a single extraction season which is usually no longer than 120 days. You would also have to further recognize that the scraper would spend half of its time traveling back and forth between the extraction site and the processing and storage site. Thus during any 8-hour day the scraper would be on the bar and most visible from the river for about four hours per day or 200 hours for the entire 50 days.

A single operator has most of the rights at both the Emmerson Bar and the Blue Lake Bar. This operator would typically prefer to operate on one bar at a time. Accordingly, the visual impact and other impacts associated with extraction would be spatially spread out.

As a side note several consultants on this project have commented that the use of motorcycles and off-road vehicles on the Blue Lake Bar and in the adjacent riparian forest during a typical summer weekend have a great impact from a noise and visual perspective and that these impacts far outweigh those that are associated with gravel extraction anywhere along the river.

Overview

The Mad River viewshed is affected by gravel extraction and processing activities found in the reach between the Mad River Fish Hatchery and Highway 101. Gravel extraction and processing activity can be viewed from the river itself or from limited roads that lie close to the processing plants. For the most part, views of the extraction sites afforded from public roads are screened during the extraction season by dense streamside vegetation and steep streambanks.

Project viewshed impacts readily seen by river users include extraction operations, summer bridge crossings, haul roads and some stockpiles. Processing sites and stockpiles are less visible to river users.

Although processing sites and stockpiles are less visible to river users they are highly visible from public roads. The two sites that are most visible outside of urban areas are the Essex (Site No. 6) and Eureka Sand & Gravel (Site No. 4) operations. The Redwood Empire Aggregate (Site No. 8) and Arcata ReadiMix (Site No. 7) adjacent to Giuntoli Lane are within an industrial and commercial area and are highly visible. The Mad River Sand & Gravel (Site No. 1) processing plant is visible but not close to local traffic or residences on Hatchery Road.

Introduction to the Analysis

The California Environmental Quality Act (CEQA) Guidelines state that the significant effects on the environment include substantial, or potentially substantial, adverse changes in scenic quality or in objects having aesthetic significance. Under CEQA Guidelines Section 15382, a project will normally have a significant effect on the environment if it will have a "substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project..."

Analysis of aesthetic impacts, according to the CEQA Guidelines, requires identification of important public views of the project site and evaluation of two types of potential adverse effects:

1. the effects of the proposed project on the availability of the important public views;

2. the effects of the proposed project on the scenic quality of the project site or on objects having aesthetic significance.

The first type of adverse effect consists of obstruction of important views, and the second type of adverse effect consists of impairment of important public views. Impairment of important public views can result from: 1) the introduction into an existing view of a visual feature that is "aesthetically offensive" in itself; 2) the degradation of a visual feature that has aesthetic significance; or 3) the introduction into an existing view, objects or activities which exhibit a high degree of visual contrast in comparison with the existing objects and activities of the site.

Important public views of the project are available from fixed vantage points (viewsheds) and in sequences of views along roadways (visual corridors). The major viewsheds and visual corridors within the project area are identified above.

Visual elements of the project were evaluated in relation to the past and existing visual characteristics of individual sites and of the project extraction and processing area as a whole. It should be noted that the visual impacts resulting from extraction, processing and stockpile areas are existing and have been present for many years. Although visual impacts resulting from extraction operations have occurred for many decades, each year the specific amount of extraction as well as the design and location of extraction may vary. As such their may be slight annual variations in certain perceived impacts. The visual impacts of stockpile areas will change with time as stock piles grow during the summer months and shrink during the post extraction season.

Many of these visual impacts are offensive to some individuals. However, the preferred alternative will cause no significant change in the gravel extraction and processing induced visual impacts. Although there will be no significant change in these impacts as a result of the project they will remain offensive to some and not so to others.

Impact Statements and Mitigation Measures

Impact

View-1: In the vicinity of Hatchery Road Bridge there are a variety of industial-type land uses that may be perceived as adverse visual impacts. The primary access to the river at Blue Lake is via the Hatchery Road bridge and levee. Both the Emmerson bar (Site No. 2) and Blue Lake bar (Site No. 3) extraction areas are visible from the bridge and levee. No other views of the river are available along Hatchery Road. Further south along Hatchery Road, the Mad River Sand & Gravel processing site (Site No. 1) can be seen in the distance, approximately 650 feet off the road. With the exception of the stockpiles and processing site this is primarily a rural agricultural setting and some people may feel that the processing site is in conflict with the setting. The reclamation plan and use permit allow for additional processing facilities at this site. With the exception of the processing plant and site the visual impacts resulting from the project in this view setting will be less than significant. However, the cumulative visual impact of this procesing site, in combination with other aggregate processing sites and other industrial uses in the Mad River corridor is a significant adverse impact (S/S)

Mitigation Measures

Mit-24: The visual impact of this processing site can be signifcantly reduced by planting a vegetatin screen between the site and Hatchery Road. The amended reclamation plan at this site will incorporate successful vegetation plans for this mitigation. Planting will take place during the winter of 1994-95. However, the cumulative visual impacts in this view setting will remain significant.

Monitoring

Humboldt County and the SDRC will confirm the planting and monitor for survival, growth, and eventual visual screening.

Impact

View-2: From Blue Lake to Arcata along West End Road, views are mostly screened by dense stands of riparian vegetation. Blue Lake and Christie bar (Site No. 3 and 4) stockpiles and extraction activity can be seen along a limited stretch of the road directly opposite the operations.

West End Road closely parallels the river. When the summer foliage has fallen from the trees, Essex bar (Site No. 6) can be viewed. Along West End Road, between the Water District buildings and Highway 299 the river can be viewed through the trees. These visual impacts are consided less than significant.

The project will create no significant change in visual effects at this view location. Therefore these visual impacts will remain less than significant. (LS/LS)

Mitigation Measures

Since no significant impact was identified, no mitigation is necessary.

Monitoring

None required

Impact

View-3: No views of the river are available from Giuntoli Lane. However, the Redwood Empire Aggregates processing site (Site No. 8) is highly visible from both Giuntoli Lane and Highway 101. The Arcata ReadiMix processing plant and stockpiles (Site No. 7B) are visible from Giuntoli Lane, Boyd Road, and Highway 299. These sites, along with other industrial uses in the area are considered individually and cumulatively significant adverse visual impacts. These two aggregate processing sites are zoned and planned for industrial use and visual effects are existing. The project will create no additional adverse visual effects at this view location. However, the cumulative visual impact of these procesing sites, in combination with other industrial uses in the Mad River corridor is a significant adverse impact. Therefore the visual impacts resulting will remain significant. (S/S)

Mitigation Measures

Mit-24: The visual impacts of these processing sites can be signifcantly reduced by planting vegetation screens between the sites and roadways. The amended reclamation plans at these sites will incorporate successful vegetation plans for this mitigation. Planting will take place during the winter of 1994-95. However, the cumulative visual impacts in this view setting will remain significant.

Monitoring

Humboldt County and the SDRC will confirm the planting and monitor for survival, growth, and eventual visual screening.

Impact

View-4: While driving westbound on Highway 299 down the Lord Ellis Summit there are distant views of the Mad River and the Blue Lake, Christie and Johnson bars (Site No. 3, 4 and 5).

Further west along Highway 299, Eureka Sand & Gravel's (Site No. 4) processing and stockpile yard is highly visible. Some evergreen plantings occur within the Caltrans right-of-way, but most of the processing and stockpile yard is exposed.

The Glendale Road underpass offers a view of the upstream end of Johnson bar (Site No. 5) and the Eureka Sand & Gravel's Christie bar (Site No. 4).

Eastbound Highway 299 passes several pump stations, the Water District buildings and utility yard, and Mercer Fraser's Essex bar, processing and stockpile yard (Site No. 6) are visible. Only short glimpses of the river are possible along this stretch. The streambank is lined with cottonwoods, willows and alders with conifer trees planted both within the Caltrans right-of-way and growing naturally on adjacent land. Adjacent to the Essex Lane underpass, the railroad bridge and the river can be seen. The river is then hidden by the adjacent streambank and dense vegetation.

The only other view of the river is from the Highway 299 bridge. The Water District buildings or the Johnson-Spini bar (Site No. 7A) can be seen from the bridge, depending on the direction one is driving. Gravel extraction is visible from westbound 299 when it occurs on the Johnson-Spini bar (Site No. 7A).

Along the length of Hwy 299 views from the highway are diverse, and range from natural landscapes to heavy industrial use. Hwy 299 also passes through the Cities of Arcata and Redding. Diverse views are normal and expected. Visual effects of gravel operations in this description are existing and vary from slight to highly visible and offensive to some individuals.

The Eureka Readimix processing site is highly visible from Highway 299 and contributes to the cumulative adverse visual impacts of this project. The project will create no additional adverse visual effects in this view shed. However, the cumulative visual impact of this procesing site, in combination with other industrial uses in the Mad River corridor is a significant adverse impact. Therefore the visual impacts resulting from the project will remain significant. (S/S)

Mitigation Measures
Mit-24: The visual impacts of this processing site can be signifcantly reduced by planting vegetation screens between the sites and roadways. Such a planting may encroach on the Caltrans right-of-way and if so, permission from Caltrans would be required. The amended reclamation plan at this site will address this issue and incorporate successful vegetation plans for this mitigation, if possible. If planting is possible, it will take place during the winter of 1994-95. However, the cumulative visual impacts in this view setting will remain significant.

Monitoring
Humboldt County and the SDRC will confirm the planting and monitor for survival, growth, and eventual visual screening.

Impact
View-5: As Northbank Road passes the Johnson-Spini and Arcata ReadiMix bars, and the Graham bar (Site No.s 7A, 7B and 8), the gravel extraction operations are hardly noticeable because of the curvature and narrowness of North Bank Road. The Johnson-Spini bar (Site No. 7A) and Highway 299 bridge are visible from pull-offs along Northbank Road

The visual effects in this description are existing and would likely be considered as minor by most individuals. The project will create no significant change in the visual effects described here. Therefore the visual impacts will less than significant. (LS/LS)

Mitigation Measures
Since no significant impact was identified, no mitigation is necessary.

Monitoring
None required

Impact
View-6: Gravel extraction and processing activity can be viewed from the river and river bars. The cumulative viewshed impacts resulting from extraction include extraction sites, summer bridge crossings, haul roads, processing sites and stockpiles. These impacts will vary with the season and throughout the river. Some of these cumulative visual impacts may be considered significant and unavoidable. . (SU/SU)

Mitigation Measures
Mit-13: In order to improve visual qualities for recreational river users operators will minimize the amount of time that idle equipment is stored on gravel bars during the extraction season.

Mit-24: The revised reclamation plans will recognize the need to mitigate for barren bars. The SDRC will strive to locate reasonable sites where revegetation or other forms of mitigation

mitigation can be used to compensate for visual, vegetation, and terrace forming qualities that have been lost due to extraction-induced barren bars. Such mitigation can be in the form of revegetation or improved site protection obtainable by restricting inapproprite river bar access.

Monitoring
Humboldt County/Scientific Design and Review Committee

Significance after Mitigation
Significant

5.10 Traffic

The County retained Rising Sun Enterprises (RSE) to gather and analyze information on viewsheds, recreation, noise and traffic resulting from Mad River gravel extraction operations. Portions of the following section were adapted from the Rising Sun report. See Appendix E for the complete report.

Overview

This section discusses the adequacy of existing transportation systems to accommodate vehicular traffic generated by the surface mining operations covered under this PEIR.

Traffic load on existing transportation systems varies by operation and by season. During the 'dry' season, more traffic is generated for longer periods of time. The dry season coincides with long days, the majority of construction and the extraction phase of surface mining operations in the County. With the exception of drought years, little extraction and construction occurs in Humboldt County during the winter, or wet season.

Traffic resulting from the surface mining operations include:

1. Transporting equipment to and from extraction sites;
2. Transporting raw material to stockpile areas;
3. Transporting stockpiled material to processing yards;
4. Transporting raw material to job sites;
5. Transporting processed material to job sites;
6. Employee private vehicles.

Each operation covered by this PEIR has private access to either a city or county-owned and maintained road. On the basis of the CalTrans' Highway Design Manual, all of the surface mining operation private access road intersections with city or county roads have adequate sight stopping distance. For roads with 35 m.p.h. traffic, approximately 250' of visual clearance in each direction is required.

Table 5.10-1 shows approximate volumes of material extracted at the various sites during 1990-1991. The average daily traffic (ADT) is based on: the volume extracted; a five day work week; four-month extraction period; eight-month processing and transporting period; and assumes a 15-yard dump truck is used for transporting raw material.

The actual number of trips per day is determined by the job, the number of vehicles employed, the destination, and the product being transported. When the length of extraction season is shortened, the intensity of activity is increased, resulting in a period of higher traffic volumes.

Traffic count information was obtained for intersections on city, county and state roads and, where available, percentage of traffic that consisted of trucks. Those figures are noted in Table 5.10-2. Because these operations are existing, the listed ADT totals have incorporated the traffic generated by these projects.

The service area for most of these operations range from Eureka to Orick, and east to Willow Creek, for an approximate 50-mile radius. There is the possibility that rail traffic could be used to reduce the amount of truck traffic. Because of the short haul and the need to unload and load aggregate, it is not likely that the railroad could be effectively used to transport Mad River gravel from extraction sites to stock piles or processing sites. Also, because of the current shortage of extractable Mad River aggregate, it is unlikely that the rail road could be used to export Mad River gravel to another market area. Because of the current shortage of

extractable Mad River aggregate there may be a possibility of using the rail road to import aggregate into the some Mad River processing plants.

There are two apparent logical sites where the imported gravel could be taken off of the rail road cars and stockpiled for distribution to processing sites. The first is an old mill site near the west end of West End Road, approximately across the freeway from Boyd Road. The second site is in the Glendale area where the tracks cross the entrance to the Eureka Sand and Gravel processing site (Christie Bar). It is possible that Eel River gravel could be economically transferred by rail to either of these sites in order to meet Mad River gravel market demands. This is a business decision which would have to be based on the economics of the potential rail use.

Table 5.10-1 - Approximate Traffic Generation

Site No.	Site	Cubic yds per year	Extraction Year	Processing ADT[a/]	ADT
1	MRS&G	85,000	1991	0	35
2	REA (Emmerson)	28,950	1991	24	12
3	REA (Blue Lake)	82,750	1991	69	35
4	ES&G	50,000	1990	0	21
5	REA (Johnson)	29,700	1990	25	13[b/]
9	Zabel-Simpson	62,300	1990	52	0
6	Essex	3,500	1990	3	0
7	Arcata ReadiMix	84,950	1990	70	35
8	REA (Graham)	36,000	1990	118[c/]	15
	Total	463,150		361	166

a/ These figures represent one-way trips. Figures should be doubled to account for return trips.

b/ This amount represents exports from the Giuntoli site as a result of importation from this site.

c/ This amount includes importation of materials from the other three REA sites.

Table 5.10-2 - Existing Traffic Levels [a/]

Site/Road Segment	ADT[b]	Peak Hour	Percent Trucks
REA Giuntoli			
Hwy 299 at Hwy 101	9,700	1,050	15
Giuntoli west of Valley West Blvd	12,200		
Janes Road west of Hwy 101	8,500		
Giuntoli east of Valley East Blvd.	6,200		
Arcata ReadiMix			
Boyd Road	2,200		
Hwy 299 at Giuntoli	9,800	1,100	14.5
Hwy 299 at North Bank Road	10,600	1,150	11.7
Essex			
Hwy 299 at Essex Lane	10,600	1,150	
Simpson/Johnson/Eureka Sand & Gravel			
Glendale Drive near E&O Market	1,700		
Hwy 299 at Glendale Drive	8,500	940	
Blue Lake/Emmerson/Mad River Sand & Gravel			
Hwy 299 at Blue Lake Blvd	3,550	500	18
Blue Lake Blvd. west of Greenwood	5,600		
Greenwood Ave. south of Blue Lake Blvd.	4,000		
Taylor Way north of hatchery Road	775		
Hatchery Road north of West End Road	750		
West End Road west of Hatchery Road	175		

a/ CalTrans Information, 1991; City of Arcata information, 1990-91
County of Humboldt Information, 1992.
b/ Figures represent totals in both directions.

Individual Sites

Note: Unless otherwise indicated, all truck trips represent one-way trips. Figures should be doubled to account for round trips.

Site No. 1 Mad River Sand and Gravel - Guynup Bar

Traffic from Mad River Sand & Gravel is, for the most part, limited to transportation of sorted and/or washed materials. On an average, in the summer months the operation produces 25-30 loads per day. For a large job, as many as 100 loads per day may leave the site. During the winter months, activity is reduced. Some days the gate remains shut and no loads are exported. No traffic or access conflicts were noted by RSE (1993).

Site No. 2 Redwood Empire Aggregate - Emmerson Bar

Use of the Emmerson bar is limited to the extraction season. Trucks leaving Emmerson bar access Hatchery Road and either proceed through the City of Blue Lake or to the stockpile area at the Nicholls Trucking facility at Site No. 3 - Blue Lake bar.

During the 1992 season, an estimated 24,344 cubic yards were extracted between September 8th and September 24th for a total of 697 loads, and an average of 50 loads per day. Approximately 50 percent of the 697 loads was stockpiled at Nicholls Trucking. No traffic or access conflicts were noted by RSE (1993).

Site No. 3 Redwood Empire Aggregates - Blue Lake Bar
During the 1992 season, an estimated 47,256 cubic yards were extracted from the Blue Lake bar. Extraction on the Blue Lake bar occurred over 23 days between August 11th and September 5th, with a total of 1,352 loads, for an average of 59 loads per day. Approximately 50 percent of the 1,352 loads were stockpiled at the adjacent Nicholls Trucking.

Traffic associated with the Blue Lake bar occurs primarily during the extraction season when material is exported to the REA Giuntoli processing site. Some of the material is stockpiled at the Nicholls Trucking facility for transportation during less active periods of the year. In the 1992 winter season, only one truck was used to haul stockpiled gravel to the Giuntoli site. Traffic from the Blue Lake bar accesses Taylor Way through the City of Blue Lake Industrial Park, which currently has a high percentage of chip and lumber truck traffic. No traffic or access conflicts were noted by RSE (1993).

Site No. 4 Eureka Sand and Gravel - Christie Bar
Vehicles must cross under 299 on a private access road to reach the Eureka Sand & Gravel operation, which lies on the south side of Highway 299. This private road intersects Glendale Drive which accesses Highway 299 a short distance to the west. During the summer construction season, an average of 35-50 truck loads per day leave the site. This is reduced to an average of five truck loads per day during winter or wet periods. Of the total loads, approximately half are aggregate materials, with the other half readymix concrete.

Site No. 5 Redwood Empire Aggregates - Johnson Bar
Trucks use the same access road for the Johnson bar as for the Simpson-Zabel bar (Site No. 9). Transport loads during the 1991 extraction season were estimated at 100 per day. Very little activity, if any, occurs during the non-extraction season at the Simpson-Zabel and Johnson bar locations. No traffic or access conflicts were noted by RSE (1993) from this project site.

Site No. 6 Mercer Fraser - Essex Bar
Essex yard extraction levels have been reduced in recent years because of the drought and market conditions. Site access is by Glendale Drive from Highway 299 at the Essex Road interchange. In addition to gravel bar material, this site has historically been used for storage of other aggregate/rip rap materials, which creates importation and exportation traffic. No traffic or access conflicts were noted by RSE, 1993, at this project site.

Site No. 7A and 7B Arcata ReadiMix - Johnson-Spini Bar & Arcata ReadiMix Bar
During summer months, there are approximately 50-60 loads per day leaving the processing site, with a maximum of 110 loads per day. In addition approximately 100 loads per day are transported from Site No. 7A, the Johnson-Spini bar, along Boyd Road to the processing site. During winter months, trips leaving the processing site are reduced to an average of 20 loads per day.

In addition to material transported to the site from the Johnson-Spini bar, Arcata ReadiMix also imports gravel from their extraction operation on the Eel River. The Boyd Road/Giuntoli Lane and the private access road/Boyd Road intersections operate at acceptable Levels Of Service (LOS). Access to both Highway 101 or Highway 299 from Boyd Road is easy. No traffic or access conflicts were noted by RSE (1993) at this project site.

Site No. 8 Redwood Empire Aggregate - Graham Bar
During the extraction season, Redwood Empire Aggregate's (REA) Giuntoli processing site receives gravel from the Johnson, Blue Lake and Emmerson bars, as well as Graham bar. In

addition, during winter months, there is importation from the stockpile at Site No. 3 - Blue Lake bar and Nicholls Trucking yard stockpiles. Exportation of materials from the Giuntoli site averages about 50 loads per day during the summer months, with maximum loads approximating 120 per day. In addition, approximately 30-50 customers a day bring their private vehicles to be loaded with various aggregate materials. During winter months, the number of loads is reduced to an average of approximately 12 per day. Access onto Giuntoli Lane is at the intersections of Giuntoli Lane with Valley East or Valley West Boulevards, both a short distance from Highway 299 or Highway 101. All intersections are qualitatively operating at an acceptable LOS. No traffic or access conflicts were noted from this project site by RSE (1993).

Site No. 9 Simpson - Simpson-Zabel Bar
The Simpson Zabel bar is used solely for extraction. As material is extracted, it is loaded onto trucks and removed from the site, usually to construction sites. Therefore, traffic is limited to extraction months. The number of trucks leaving this site is limited to both the number of trucks available and the ability of the front-end loader to fill the trucks. A substantial amount of material was removed between April to October in 1990 which resulted in approximately 10-15 trucks per hour or 110-130 loads per day from the Simpson Zabel bar.

The access drive is steep and narrow and may cause hazards for two-way traffic; however, radio communication generally prevents this from occurring. Trucks leaving the site can access Highway 299 by turning left or right on Glendale Drive. Traffic must cross the railroad tracks; however, trains, which currently run in the evening or late at night, are not a source of traffic conflict. No traffic or access conflicts were noted by RSE, 1993, at this project site.

Site No. 10 Simpson Timber - Simpson Bar
This operation involves extraction only; no stockpiling or processing occurs on-site. Access to this site is from a private road that intersects Hatchery Road, approximately 3/4 mile south of West End Road. This bar has not been mined in recent years. No traffic or access conflicts are anticipated at this project site.

Analysis
All sites reviewed have adequate access to public roads and sufficient sight stopping distance clearance. All intersections function adequately during winter observations made in the study period. The proportion of Highway 101 and 299 truck traffic to total traffic is consistent with that of other areas, at approximately 13-18 percent. Gravel truck traffic represents a small percentage of the total truck traffic.

Operations are located close to suitable transportation routes and are dispersed so that there is minimal concentration of traffic. However, one area of conflict does exist on the truck route through the City of Blue Lake (see Map 5.10-1). Aggregate materials or products from the Blue Lake bar, Emmerson bar and Mad River Sand & Gravel processing site are all transported from Hatchery Road to Railroad Avenue to Greenwood Avenue to Blue Lake Boulevard. This route passes developed residential areas, offices, a church, a public library and an elementary school.

When material is removed from the sites for large construction projects, such as in the 1960's and 1970's with the construction of Highway 299, high levels of truck traffic passed through the town of Blue Lake. This also occurred in 1990 and 1991 when trenching was implemented, which removed large volumes of material. If the 197,000 total cubic yards extracted in 1991 were transported in an eight-month period, five days per week with 15-yard dump trucks,

approximately 82 truck trips (one way) per day would occur. With round trips this would amount to 16-20 trucks per hour.

UltraPower, Inc., in the City of Blue Lake Industrial Park generates a substantial amount of chip truck traffic. A 1988 Conditional Use Permit Amendment estimated that this operation requires approximately 34 one-way truck trips per day, year-around. Other industrial uses in the industrial park also generate truck traffic. Furthermore, in recent years, Simpson Timber Company has conducted timber activities on the west side of the Mad River where logs were transported along Hatchery Road through the City of Blue Lake. When all truck traffic occurs at the same time, it can create significant traffic impacts for the City of Blue Lake.

The City's 1986 General Plan Circulation Element noted that Blue Lake's truck traffic was 6.5 percent of total traffic, which was barely lower than Highway 101's truck traffic through Eureka at 7-8 percent. At that time it was estimated that 33 percent of the 6.5 percent truck traffic originated from outside the City of Blue Lake. A separate truck route was considered, but postponed until truck traffic makes up 30-40 percent of the total traffic.

In 1986, Greenwood Avenue carried 370 vehicles per hour during peak hour traffic (8:00 - 9:00 a.m.). Based on the City's 1986 General Plan Circulation Element, approximately 1,200-1,300 vehicles per hour would be a high level of traffic for Greenwood Avenue. Total traffic levels have increased on Greenwood Avenue from 3,764 vehicles per day in 1985 to 4,000 per day in 1992. Comparing the percent truck traffic with traffic volume would indicate 245 per day in 1985. Extrapolating this to 1992 volumes would indicate 260 truck-trips per day on Greenwood Avenue.

The percentage of truck traffic through town is an important factor in road maintenance. Based on the CalTrans Highway Design Manual, the load of one three-axle truck is equivalent to 1,840 passenger car trips in relation to street degradation. This has less of an impact when streets are constructed to handle truck traffic, as has the City of Blue Lake truck route.

The Industrial Park Environmental Impact Report recognized that the increased traffic volumes and accompanying degradation of city streets from the Industrial Park was a significant environmental affect which could not be avoided. It was also noted that the additional truck traffic proposed was not more than that which occurred when the MacNamara and Peepe Mill was in operation at the same location.

Mitigation measures proposed to minimize traffic impacts in the Industrial Park EIR included development and extension of Chartin Road and directing truck traffic through the less-developed western portion of town. This project has not occurred and funding is not likely to be made available.

A condition of the Industrial Park's use permit requires chip trucks to comply with the 25 m.p.h. speed limit through the City of Blue Lake. No similar mechanism exists for projects outside of the City Industrial Park, including the gravel operations. The City has recently expanded its police department, which is now equipped with radar to enforce the speed limit through town.

Blue Lake does not receive funds from property or sales tax from operations outside of the City, which could be utilized in the continued maintenance of the truck route through town. Another associated impact is the noise generated by the truck traffic. This issue and proposed mitigation measures are discussed in the "Noise" section.

The City of Blue Lake does not have the control to regulate the number or hours of truck trips for projects outside of City Limits. The Nicholls Trucking facility could be regulated for truck traffic by the City of Blue Lake as part of the use permit process, if a processing operation was further developed. The Mad River Sand & Gravel operation is outside the regulatory control of the City. Therefore, such regulations would need to be developed by the County, if found necessary.

Impact Statements and Mitigation Measures

Impact

Traffic-1: Extraction operations use the existing Truck Route through the City of Blue Lake. The City of Blue Lake responded to the Notice of Preparation that the City has concerns that the project will add to an existing traffic, access, maintenance and safety problem within the City of Blue Lake.

The truck route through the City of Blue Lake is developed to acceptable industrial road standards. Traffic generated by the project is only a small portion of the total traffic using the Blue Lake truck route. The extraction/processing projects are ongoing and the preferred alternative does not significantly increase the level of truck traffic within the City. However, the cumulative impact of the project traffic in combination with other traffic that may be increasing could potentially be significant. If so, it is unavoidable. (PS/PS)

Mitigation Measures

Mit-14: The City of Blue Lake will regulate traffic within its boundaries.

Mit-15: The City of Blue Lake has asked that gravel operators operating out of Blue Lake Bar, Emmerson Bar, and Guynup Bar to regularly advise and remind their drivers to drive through Blue Lake at reduced speed and in such a manner as to minimize noise and road wear.

Monitoring

City of Blue Lake

Significance after Mitigation

Significant. Even though the project does not significantly increase truck traffic through the City of Blue Lake, the PEIR adopts the conservative approach that even after mitigation the cumulative impact remains potentially significant.

5.11 Noise

The County retained Rising Sun Enterprises (RSE) to gather and analyze information on viewsheds, recreation, noise and traffic resulting from Mad River gravel extraction operations. Portions of the following section were adapted from the Rising Sun report. See Appendix E for the complete report.

Noise Measurement

Decibels (dB) are a numerical expression of the relative loudness of a sound. Decibels are measured by sound meters in dBA.

Noise is generally defined as unwanted sound by the receiver. Land uses considered noise-sensitive include residential, educational and health facilities, research institutions, certain recreation and entertainment facilities, and churches. Uses considered less sensitive to noise include commercial and industrial facilities, and certain noise generating recreation facilities such as playground and gymnasiums. See Table 5.11-1, Community Noise Exposure, for a index of acceptable and unacceptable noise levels for varying activities.

Setting

The Hatchery area is generally a quiet resource area. Noise measurements taken in these quiet areas, away from gravel extraction and processing activities, were approximately 43-45 dBA, rising occasionally to 48-55 dBA from the sounds of wind or rushing water. Periodic agricultural and non-gravel-related industry noises also affect this area.

The primary noise generating sources from the Mad River Fish Hatchery to Highway 101 bridge, including the developed land uses that lie adjacent to the river and within the valley slopes, are: 1) the Mad River Fish Hatchery ; 2) the Mad River Sand & Gravel processing plant; 3) Hatchery Road traffic; 4) City of Blue Lake commercial and industrial processing including UltraPower, Inc., J & S Stakes and Calgon Carbon; 5) Glendale industrial and commercial operations; 6) Glendale Drive traffic; 7) the Humboldt Municipal Water District pump stations; 8) West End Road traffic; 9) the Eureka Sand & Gravel processing plant; 10) Highway 299; 11) Giuntoli Lane's industrial and commercial activity (including REA and Arcata ReadiMix processing plants); 12) North Bank Road traffic; 13)Giuntoli Lane traffic; 14) U.S. Highway 101 traffic; 15) air traffic; and 16) train traffic.

Noise on the river includes gravel extraction equipment and occasional recreational off-road vehicles. Gravel extraction and processing involves the use of noise-generating heavy equipment, crushing and processing equipment, batch plants, and transporting trucks. Noise measurement and analysis requires the consideration of the ambient noise levels, contributions from other noise sources, distance to the nearest receptor, and the types, times and duration of noise.

Extraction, processing, and other industrial, commercial and traffic noises in this area have been ongoing since the 60's. During this time, the human populations affected by noise impacts have increased. There has been a substantial increase in residential development consisting of trailer parks and urban residential subdivisions over the past 35 years. An increase in noise impacts is not reflective of an increase of industrial activities, but is indicative of the increase in the number of residences and recreationists impacted by noise.

For the purpose of this study, noise measurements were taken by Rising Sun Enterprises, at and adjacent to the processing and extraction areas and nearby receptors. Table 5-11.2 contains a summary analysis of all the sites. Site specific noise measurements for each of the extraction and/or processing sites has been discussed.

Table 5.11-1 Community Noise Exposure Standards in Decibels; assuming single pane windows. From Humboldt County Framework Plan.

Site use	Clearly acceptable	Normally acceptable	Conditionally acceptable	Normally unacceptable	Clearly unacceptable
Low Density Residential	45-55	55-60	55-65	60-70	70-80
High Density Residential	45-55	55-60	60-70	65-70	70-80
School/Churche Libraries	45-55	55-60	55-65	65-70	70-80
Playgrounds and Parks	45-60	55-65	60-70	70-80	75-80
Water Recreation	45-60	60-70	65-75	70-80	
Commercial Retail Office	45-60	55-65	60-75	70-80	
Industrial & Agriculture	45-65	65-75	70-80	75-80	

Clearly Acceptable - The activities associated with the specified land use may be carried out with essentially no interference from the noise exposure.

Normally Acceptable - Noise should be considered in proposed land use plans, but under most circumstances conventional construction without any special noise insulation requirements is satisfactory.

Conditionally Acceptable - New construction should make analysis of noise reduction requirements and needed noise insulation features should be included in the design. Conventional construction with closed windows will normally suffice.

Normally Unacceptable - New construction should generally be discouraged. any new construction would require noise analysis, and noise insulation features should be included.

Clearly Unacceptable - New construction should generally not be undertaken.

Table 5.11-2 - Noise Analysis

Operation	Distance to Receptor (ft.)	Receptor	Approx. Noise Level (dBA)	Source of Prominent Noise
Guynup	650	1 residence	66	Processing Plant
Emmerson	1,100	1 residence	54	Truck Traffic
Blue Lake	100	1 residence (south)	74	Processing Plant
	400	1 residence (north)	62	Processing Plant
	900	Blue Lake M H Park	55	Processing Plant
Christie	1,300	1 residence (south)	52	Extraction
Johnson	100	Glendale Trlr. Pk.	68-70	Truck Traffic
	1,200	2 residences (south)	53	Extraction
Essex	450	1 residence (south)	62-65	Extraction
Johnson-Spini	100	Town & Country	74	Processing Plant
	75	RV Park	80	Truck Traffic
Graham	200	1 residence (south)	65	Processing Plant
Zabel-Simpson	100	Glendale	68-70	Truck Traffic
	400	Trailer Park	60-62	Extraction
All	100	River users	67-74	Extraction

Individual Sites

Site No. 1 Mad River Sand and Gravel, Guynup Bar

Noise measurements taken 50' from the screen plant/crusher were approximately 88 dBA. This was slightly higher than other screen plants since this material is washed and sorted at the same time. The closest residence is a house owned by the operator approximately 650'

southwest of the processing plant which would be subjected to exterior noise levels of 66 dBA. Residences on Hatchery Road at West End Road are approximately 1,700' from the processing plant and would be more affected by truck traffic leaving the site. Residences directly west of the processing site are approximately 900' from the processing plant. During operations, these residences would receive exterior noise levels of approximately 63 to 65 dBA. Noise levels of processing equipment running adjacent to the river increased from 45 to 49 dBA.

Anglers and recreationists would be subjected to noise levels from processing and extraction operations, ranging from 67-74 dBA at 100'. This may decrease by 5-10 dBA, depending on the location of equipment in relation to the river, and the recreationists.

Site No. 2 REA, Emmerson Bar
Gravel extraction and transport are the noise-generating activities at this site. Traffic-related noise is discussed under REA's Blue Lake bar (Site No. 3).

The closest residences to this site are located approximately 1,100' to the northwest and 1,200' to the south. There are also approximately 20 houses off West End Road within 2,000' of the extraction and stockpiling area. The noise levels received at these residences from extraction activities and gravel transport would be less than 55 dBA, slightly higher than ambient levels.

This bar is popular for use by anglers, during fishing season, which generally occurs in October after extraction activities are completed. Boaters and swimmers enjoy this section of the river in the summer months, and would be subjected to noise levels.

Consultants on this project have commented that the use of motorcycles and off-road vehicles on the Blue Lake Bar and in the adjacent riparian forest during a typical summer weekend have a great impact from a noise and visual perspective and that these impacts far outweigh those that are associated with gravel extraction.

Site No. 3 REA, Blue Lake Bar
Ambient noise levels at the Nicholls industrial/stockpile area, off of Taylor Way, are approximately 56-60 dBA. Major noise sources include industrial operations in the City of Blue Lake Industrial Park. Activities within the Nicholls Trucking facility would be 55-80 dBA within the industrial land area, primarily from loading equipment and truck noise. If a portable processing plant was set up at this location, it is anticipated that it would generate noise levels of 73 dBA at 100'. The closest residences are two houses owned by REA, 100' and 400' from the truck yard and 800' to 1,000' from the gravel bar. These residences would receive noise levels of 54 dBA and 55 dBA from extraction activities, and 74 dBA and 62 dBA from processing respectively. The next closest residences are within and adjacent to the Blue Lake Rancheria, approximately 1,000' from the levee and 900' from the truck yard. There are also approximately 17 trailers located at the end of Rancheria Road which would be subject to noise levels of less than 55 dBA. West End Road residences to the south of Blue Lake bar are approximately 1,200'-1,400' from the edge of the extraction area, depending on current river conditions. These residences could hear the extraction activity occurring but noise levels would be approximately 52 dBA.

This site, as well as the Emmerson and Guynup sites upstream from this location, all contribute to truck traffic onto Hatchery Road which proceeds along the Greenwood Avenue to Blue Lake Boulevard truck route. This truck route goes through a residential area with adjacent school offices, a public library, and a church.

Noise levels measured in October, 1992, 50' from the centerline of Greenwood Avenue, averaged 62 dBA over a 10 minute period. Noise levels from cars and pickup trucks range from 60 to 65 dBA. Flat bed trucks, chip trucks, dump trucks and belly dump trucks produce noise levels from 72 to 77 dBA. It was estimated by City personnel that trucks passing City Hall are less than 10% of total traffic in the winter and up to 50-66% in the summer, primarily due to gravel and logging trucks. Utilizing the above percentages, adjacent residences and the school would be subject to estimated exterior noise levels of 55-60 dBA during the winter and 61-66 dBA during the summer daytime at 100' distance. The winter noise levels are clearly acceptable; and the summer noise levels are conditionally acceptable for schools.

Gravel transporting occurs year-round, and coincides with construction jobs, which generally occur during the summer or during the dry periods in the fall or early winter. Because of summer transportation the school and the entire community will be subjected to more noise impacts during the summer.

Site No. 4 Christie Bar/Eureka Sand and Gravel Plant

Noise levels from the Eureka Sand & Gravel processing plant measured 85 dBA, 50' away from the screen. This was reduced to 65-68 dBA adjacent to Highway 299 approximately 200' north of the plant at times with no traffic. However, noise levels increased to 63 dBA when cars passed the site and 73 dBA when trucks passed the site. The closest residence to the north is approximately 1,600' from the processing site and would be affected by traffic on Highway 299, rather than the processing plant. The noise levels received by residences from processing would be less than 60 dBA.

The processing plant can be heard from the river. Ambient sound measurements taken adjacent to the river at the Glendale interchange were between 45 and 50 dBA, but increased to 59 dBA from Highway 299 traffic.

Extraction equipment on the gravel bar produces noise levels audible to residents, especially those to the south of the site. Noise levels of 80 dBA taken adjacent to the river would be reduced to 52 dBA at the closest residence approximately 1,300' to the southwest and to 48 dBA 2,100' to the southeast. The County, during the Notice of Preparation for this EIR, received a complaint about the noise from a resident to the south. The resident specified that it was not the processing plant, but the extraction activity that occurred early in the morning and during weekends in 1992. The 1992 extraction season was compressed to less than two months, requiring operators to work extended hours in the 36 days of extraction. In addition, since the operating season did not begin until July 24th, the previous year's stockpile of riverrun material had been depleted and there was an immediate need to extract and process larger volumes of gravel as quickly as possible.
These are generally short-term intermittent impacts that have occurred in the past and, unless regulated in some manner, would be expected to occur in the future depending on extraction limitations and contract needs. Nevertheless, resulting noise levels at nearby residences were within acceptable published standards.

Site No. 5 Johnson Bar

No processing occurs on-site. Warren Creek Road residences, approximately 1,200'-1,800' southwest, receive noise levels of less than 55 dBA from extraction equipment at Johnson bar. Anglers and recreationists on the river and adjacent river bar would be subjected to noise levels of 67-74 dBA at 100'.

Site No. 6 Essex Plant and Gravel Bar

Historically this site had a plant processing large amounts of gravel. The nearest occupied structures, approximately 450' to the south, would receive exterior noise levels of 62-65 dBA.

Highway 299 divides the processing site from several residences to the north. Noise levels generated by passenger cars and trucks on the freeway are higher than those of the processing and extraction operations.

Anglers and recreationists utilizing the river bar south of the site would be subjected to sound levels of 67-74 dBA during extraction periods. Although no direct public access is available, the site is adjacent to a popular swimming hole. Most access to this swimming hole is made by trespassing across the Essex site.

Site No. 7A/B Arcata ReadiMix Processing Plant and Associated Gravel Bars
The Arcata ReadiMix site has processing equipment, a cement batch plant, front end loaders, dump trucks and mixers. Developed in 1951, the site is located within an industrial area. It is also located adjacent to and directly north of the Town and Country Trailer Park, built in 1955. In previous years, there were some complaints about the noise generated at abnormally early morning operating hours.

Noise levels, measured adjacent to the trailer park ranged from 55 dBA, with no equipment running, to 80 dBA, when a gravel truck passed within 75 feet. The average noise level for a one hour period was 63 dBA. When the cement batch plant operated (10 minutes for one load), noise levels increased to 73.5 dBA.

Noise levels would not affect those residents with normal working hours who work outside the home. Those who are home during normal working hours would be affected. Furthermore, since many requests for readymix products are made for early morning deliveries, some processing occurs very early in the morning (before 7:00 a.m.). Trailer Park residents are impacted from this operation. Other noise in the area includes Highway 299 traffic and overhead air traffic, to or from the Arcata/Eureka Airport.

Anglers and recreationists utilizing the river bar to the north are subjected to noise levels of 51 to 52 dBA when mixer trucks are in high idle. Commercial air flights overhead at this location registered 55 dBA. Further upstream at the Johnson-Spini bar, no processing occurs. Operations are limited to gravel extraction. Equipment on the gravel bar would range from 67-74 dBA at 100'. This is a significant noise impact.

Site No. 8 Redwood Empire Aggregates Graham/Zanzi Bar
Historically, this site processed large volumes of gravel with its processing and asphalt batch plant. The nearest occupied structure is a residence, approximately 200'-300' south of the processing equipment. Noise measurements of 68.5 dBA were taken from the north sidewalk along Giuntoli Lane approximately 350 feet south of the processing equipment with no traffic influences. Levels increased to 73.3-79.9 dBA when traffic passed on Giuntoli Lane. Noise levels at the residence would be 65 dBA for the processing plant, and 67-74 dBA for Giuntoli Lane traffic. The nearest residence to the east is approximately 500' away, receiving noise levels of 67 dBA. Residences west and north were 1,400' and 1,800', respectively; noise levels would be reduced to less than 55 dBA at each residence (see Photo 5.11-1).

Anglers and recreationists utilizing the river bar north of the plant would be subjected to sound levels of 48 dBA during operations. The primary noise along the river bar at this location is the Highway 101 bridge traffic, which generates levels up to 52 dBA. During extraction, noise levels along the river range from 67-74 dBA at 100'.

Site No. 9 Simpson-Zabel Bar

Although, no gravel removal has occurred in recent years, there have been historic operations at this site. Presently, there is no processing or stockpiling (see Photo 5.11-2). Although Zabel Trucking plans to continue extraction at this site, no permits have been issued by the Humboldt County Planning Department.

Glendale Trailer Park, approximately 400 feet to the north, is the nearest residential area with about 35 trailers (see Photo 5.11-2). These trailers would be subjected to noise from Highway 299. Extraction could generate noise levels of 60-62 dBA in the trailer park. The primary activity affecting nearby residences would be hauling of gravel by trucks along Glendale Drive, resulting in noise levels of 68-70 dBA at 100'.

Residences located on the south side of the river off of Walnut Creek Road, within 600' of extraction equipment, would be subjected to noise levels of approximately 55-60 dBA during extraction.

Summary

While some people may be intrigued by gravel operations and not mind the noise, it would be considered a negative impact on passive recreation. Noise impacts from gravel operations are significant and unavoidable. Even if mitigation measures are proposed to regulate operating periods or noise levels from equipment, the impacts of gravel extraction processing and transporting will remain significant to both nearby residents and recreationists.

River users are the most impacted receptors as a result of gravel extraction. During extraction periods, sound levels of 67-74 dBA at 100' would be too high to permit high quality passive recreation and could be perceived as an annoyance and impact by people recreating in that area. The primary impact from noise would occur from extraction activities located adjacent to the river when anglers and recreationists are also utilizing the river's edge. Currently, most operations occur during daylight hours with the vast majority of the activity occurring weekdays during periods of dry weather. The majority of family recreational use occurs in the summertime on weekends. However, when school is out, young people are seen utilizing the river bar and river at all times, even when extraction occurs.

During processing, the Town and Country RV Park adjacent to the Arcata ReadiMix operations (and close to the REA Giuntoli site and other industrial and commercial sites), one residence south of the Essex processing site and the REA owned residence at the Nicholls Trucking facility could be adversely affected by noise levels. The Town and Country RV Park adjacent to Arcata ReadiMix, the Glendale Trailer Park to the north of the Simpson and Johnson bars and adjacent residences along the City of Blue Lake truck route could be adversely affected by the high noise levels of truck traffic. Impact would also depend on the duration and hours of the noise-generating activity.

It is anticipated that these impacts will increase, not because of increases in noise levels, but because of increased residential developments and recreational uses. It should be noted that noise impacts resulting from the existing processing and extraction operations are status quo. Although noise impacts resulting from the operations have occurred for many decades, each year the specific impacts may change.

Impact Statements and Mitigation Measures

Impact
Noise-1: The closest residence to the Mad River Sand & Gravel processing operation (Site No. 1) is a house owned by the operator approximately 650' southwest of the processing plant which would be subjected to exterior noise levels of 66 dBA. This noise level is Normally Unacceptable for low density residential and normally acceptable for industrial and agriculture (Table 5.11-1). Because the house is located in an agricultural/industrial setting the noise is considered normally acceptable and insignificant.

Residences directly west of the processing site are approximately 900' from the processing plant. During operations, these residences would receive exterior noise levels of approximately 63 to 65 dBA. These levels are considered Conditionally Acceptable for low density residential (Table 5.11-1). Conventional construction, with closed windows will normally suffice. Both the operation and the residences are existing and owned by the operator.

The existing noise levels are judged insignificant with respect to the residences. The project will not increase existing noise impacts. Therefore the impact at this location is less than significant. (LS/LS)

Mitigation Measures
Since no significant impact was identified, no mitigation is necessary.

Monitoring
None Required

Impact
Noise-2: The closest residences to the Emmerson bar (Site No. 2) are located approximately 1,100' to the northwest and 1,200' to the south. There are also approximately 20 houses off West End Road within 2,000' of the extraction and stockpiling area. The noise levels received at these residences from extraction activities and gravel transport would be less than 55 dBA. This level is Clearly Acceptable (Table 5.11-1) and is considered less than significant.

The project will not increase existing noise impacts at this site. Therefore the impact at this location is less than significant. (LS/LS)

Mitigation Measures
Since no significant impact was identified, no mitigation is necessary.

Monitoring
None required

Impact
Noise-3: The closest residences to the Blue Lake bar (Site No. 3) are two houses owned by REA, 100' and 400' from the truck yard and 800' to 1,000' from the gravel bar. These residences would receive noise levels of 54 dBA and 55 dBA from extraction activities (Clearly Acceptable). Processing does not occur at this site; but, if it did these two residences would receive 62 dBA (Conditionally Acceptable) and 74 dBA (Clearly Unacceptable) from processing.

The project will not increase existing noise impacts at this site. Therefore the impact at this location is less than significant. (LS/LS)

Mitigation Measures
Since no significant impact was identified, no mitigation is necessary.

Monitoring
None required

Impact
Noise-4 The closest residence to the Eureka Sand and Gravel processing site (Site No. 4) is approximately 1,600' to the north, and would be affected by traffic on Highway 299, as well as the processing plant. The noise levels received by residences from processing would be less than 60 dBA and Normally Acceptable for low density residential (Table 5.11-1).

The project will not increase existing noise impacts at this site. Therefore the impact at this location remains less than significant. (LS/LS)

Mitigation Measures
Since no significant impact was identified, no mitigation is necessary.

Monitoring
None required

Impact
Noise-5: Extraction equipment at Johnson bar (Site No. 5), would produce noise levels of less than 55 dBA at Warren Creek Road residences, approximately 1,200'-1,800' southwest of the site. This is Clearly Acceptable (Table 5.11-1) and less than significant.
The project will not increase the current existing noise impacts at this site. Therefore the impact at this location is less than significant. (LS/LS)

Mitigation Measures
Since no significant impact was identified, no mitigation is necessary.

Monitoring
None required

Impact
Noise-6: The nearest occupied structure to Essex bar (Site No. 6), is approximately 450' to the south; it would receive exterior noise levels of 62-65 dBA. This is Conditionally Acceptable for low density residential (Table 5.11-1). Conventional Construction with closed windows will normally suffice.

The project will not increase existing noise impacts at this site. Therefore the impact at this location is less than significant. (LS/LS)

Mitigation Measures
Since no significant impact was identified, no mitigation is necessary.

Monitoring
None required

Impact
Noise-7: The Arcata ReadiMix (Site No. 7) site has processing equipment, a cement batch plant, front end loaders, dump trucks and mixers. Developed in 1951, the site is located within an industrial area. It is also located adjacent to and directly north of the Town and Country Trailer Park, built in 1955. In previous years, there were some complaints about noise generated by early morning operations.

Noise levels, measured adjacent to the trailer park range from 55 dBA (Clearly Acceptable), with no equipment running, to 80 dBA (Clearly Unacceptable for high density residential and Conditionally Acceptable to Normally Unacceptable for industrial areas), when a gravel truck passes within 75 feet. The average noise level measured at the trailer park, for a one hour period is 63 dBA (Conditionally Acceptable for high density residential and Clearly Acceptable for industrial). When the cement batch plant operates (10 minutes for one load), noise levels increase to 73.5 dBA (Clearly Unacceptable for high density residential and Normally Acceptable for industrial). Noise levels generated by this operation could be considered an unavoidable significant effect of an existing use, particularly with reference to the adjacent high-density residential use.

The project will not increase the existing noise impacts at this site. However, the existing noise at this site is significant and unavoidable. (SU/SU)

Mitigation Measures
Mit-10: Although the project will not increase the noise impact at this site, the existing noises are significant. If the exhaust systems of all internal combustion engines owned or maintained by the operator are kept in good repair and as manufactured at least a portion of the existing noise will be minimized.

Monitoring
Cal-OSHA
Humboldt County Planning and Building Department
Humboldt County Public Works Department

Significance after Mitigation
Noise impacts at this site will remain significant even though the project impacts are less than significant.

Impact
Noise-8: The existing facility at Graham bar is located in an industrial and commercial area. The nearest occupied structure to Graham bar (Site No. 8), is a residence, approximately 200'-300' south of the processing equipment. Noise levels at the residence would be 65 dBA (Conditionally Acceptable for high density residential) for the processing plant, and 67-74 dBA (Normally Acceptable for industrial) for Giuntoli Lane traffic. The nearest residence to the east is approximately 500' away, receiving noise levels of 67 dBA (Conditionally Acceptable for high density residential and Normally Acceptable for industrial).

Residences west and north were 1,400' and 1,800' respectively; noise levels would be reduced to less than 55 dBA at each residence (Clearly Acceptable for low density residential).

The noises generated by Highway 101 and Giuntoli Lane at this site are high but Normally Acceptable for industrial areas (Table 5.11-1). The combined highway and processing noises are at least conditionally acceptable for this zoneing and therefore not significant. The project will not increase existing noise impacts at this site. Therefore, the noise impact at this location would be less than significant. (LS/LS)

Mitigation Measures
Mit-10: Although the project noise impact is insignificant the existing noises are high. If the exhaust systems of all internal combustion engines owned or maintained by the operator are kept in good repair and as manufactured at least a portion of the existing noise will be minimized.

Monitoring
Cal-OSHA
Humboldt County Planning and Building Department
Humboldt County Public Works Department

Significance after Mitigation
Less than significant.

Impact
Noise-9: Glendale Trailer Park, approximately 400 feet to the north of the Johnson-Zabel bar (Site No. 9), is the nearest residential area with about 35 trailers. These trailers are

subjected to noise from Highway 299. Extraction could generate noise levels of 60-62 dBA in the trailer park. This is considered Conditionally Acceptable for both low and high density residential (Table 5.11-1). With conventional construction and closed windows, this is considered acceptable and less than significant.

The project will not increase existing noise impacts. Therefore the impact in this location is less than significant. (LS/LS)

Mitigation Measures
Since no significant impact was identified, no mitigation is necessary.

Monitoring
None required

Impact
Noise-10: River and river bar users are impacted by noise generated by the existing operations and by noise from adjacent roadways. During extraction, noise levels reach 67-74 dBA at 100'. This is considered Normally Acceptable to Normally Unacceptable for water recreation uses (Table 5.11-1) but may not be acceptable to river recreationists and fishermen.

The primary impact from noise would occur from extraction activities which occur outside the main fishing periods and this will help reduce the significance of the impact. While some people may be intrigued by gravel operations and not mind the noise, others perceive it as a significant impact. With current technology, this impact is unavoidable.

The project will not increase existing noise impacts along the river. However, the existing noise impacts at the river are sometimes significant and unavoidable. (SU/SU)

Mitigation Measures
Mit-10: Although the project noise impact is insignificant the existing noises are sometimes significant. If the exhaust systems of all internal combustion engines owned or maintained by the operators are kept in good repair and as manufactured at least a portion of the existing noise will be minimized.

Monitoring
Cal-OSHA
Humboldt County/Scientific Design and Review Committee

Mit-16: Although most approved reclamation plans provide for longer hours of operation, gravel bar extraction operations will normally occur between the hours of 7:30 a.m. and 5:30 p.m. Monday through Friday. This helps reduce conflicts for early morning, and evening anglers, and weekend recreational users. However, if environmental or other circumstances create a shorter than normal extraction season it may sometimes be necessary to extend the operating hours in order to complete the permitted extraction within the allowable time.

Monitoring
Humboldt County Planning and Building Department

Significance after Mitigation
Extraction noise impacts on the river will sometimes be potentially significant even though the project impacts are less than significant.



Photo 5.11-1
Processing Facilities
(looking upstream)

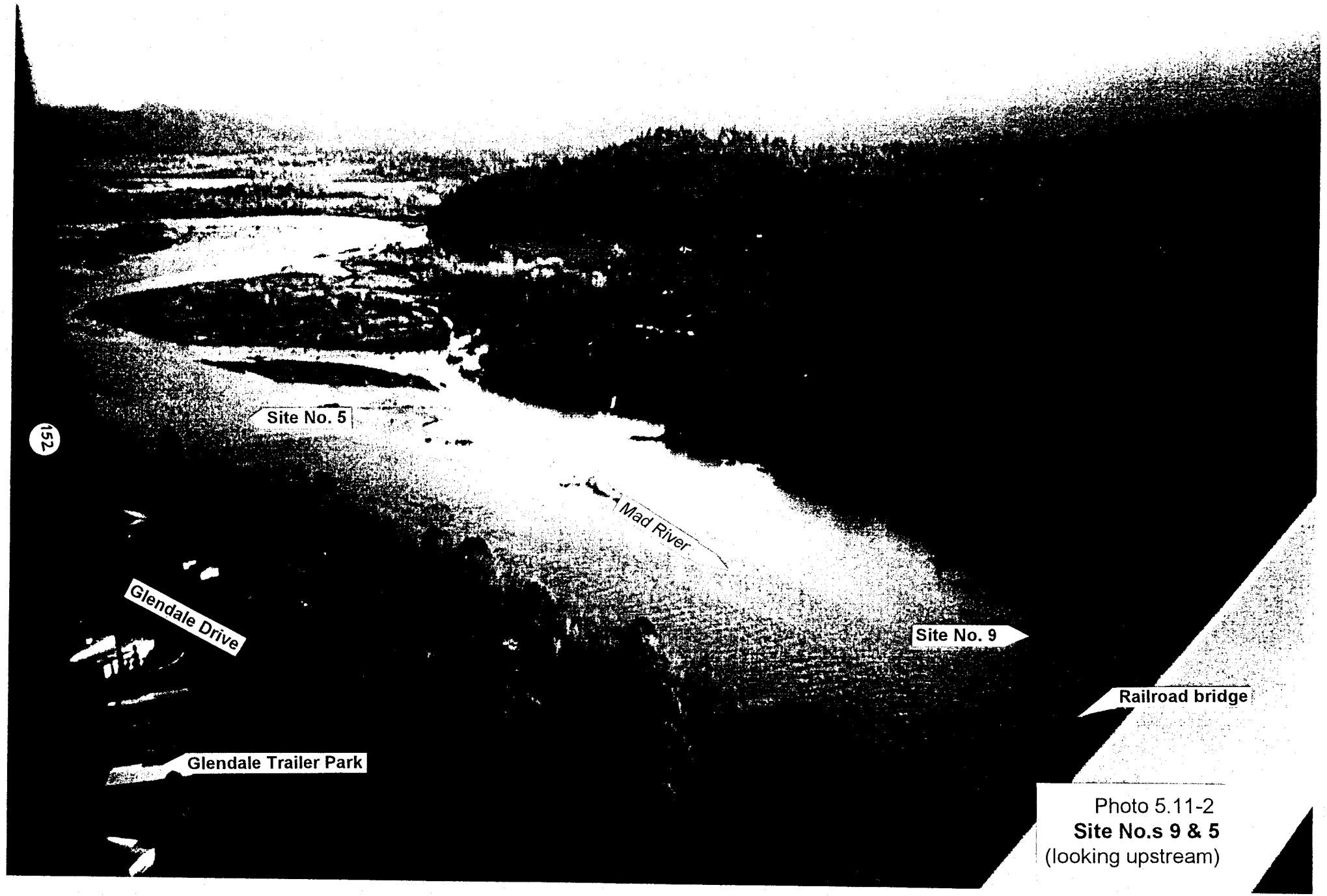


Photo 5.11-2
Site No.s 9 & 5
(looking upstream)

5.12 Public Utilities and Structures

This is a description of public utilities and significant structures in or near the project area which might possibly be impacted by the project (does not include gravel processing sites, see General Location Map 5.12-1)

Table 5.12-1 - Public Structures and Utilities within the Project Area.

Structure	River Mile	Caltrans Bridge Number	Date Built
Former Sweasey Dam Site	19.6		1938
Mad River Hatchery Weir & Left Bank RSP	14.5		
Blue Lake Hatchery Road Bridge	12.8		1982
Blue Lake Right Bank Levee & RSP	12.8-13		1965
Blue Lake Sewage Treatment Pond and Right Bank RSP	11.7		1971
Hwy 299 Mill Creek Bridge	10.5	414-188	1965
North Coast Railroad Bridge	9.8		1914
Glendale Drive Bridge at Lindsay Creek	9.8		1926
Hwy 299 Bridge at Lindsay Creek	9.8	4-187	1965
Railroad Trestle at Warren Creek	9		
Warren Creek Road Bridge	9		1927
Diversion Structures at HBMWD Five Raney-Type Wells & Collectors, One Surface Diversion	7.8-9.5		
Upper HBMWD Pipe Crossing	8.7		1960
Lower HBMWD Piipe Crossing	7.8		1960
U.S.G.S. Stream Gaging Station	7.8		1951
Hwy 299 Eastbound (Right)Bridge	7.8	436R	1948
Hwy 299 Westbound (Left) Bridge	7.8	436L	1965
PG&E Upper Gas Line Crossing	7.8		
Sewage Effluent Pipe Crossing	7.8		
MCSD Water Pipe Crossing	7.25		
Hwy 101 Northbound (Right) Bridge	5.6	4-25R	1929
Hwy 101 Southbound (Left) Bridge	5.6	4-25L	1958
PG&E Lower Gas Line Crossing	5.6		
Hammond Trail Bridge	3.9		1905
McKinleyville Community Sewage Treatment Plant	2.1		
Mad River Beach Left Bank RSP	3.3-3.4		
Humboldt County Boat Ramp	3.2		
Clam Beach Mad River Mouth RSP	0		

Former Sweasey Dam Site (19.6 miles)

The dam was built in 1938, filled with 3,000 acre feet (4,840,000 cubic yards) of sediment by 1964, and removed with dynamite in August, 1970. Portions of the dam remain keyed into the channel (see Photo 5.12-1). This marks the up-stream limit of the project area for this PEIR. Following the removal of the dam, an abnormally large sediment wave began moving downstream toward the middle and lower project area. This sediment wave helped supply the gravel industry for an undetermined period of time following 1970. Although some degradation

is now taking place at the dam site, the channel between the dam site and the Mad River Hatchery remains aggraded.

The weir at the Mad River Fish Hatchery acts as a vertical control point in the river profile. If extraction is expanded to permitted or proposed levels or sustained at recent levels, the weir at the mad River Hatchery (described below) will likely fail and the channel between the hatchery and the dam site will begin to rapidly degrade. If extraction is limited to volumes less than the average net recruitment rate, the integrity of the hatchery weir should remain intact and the river between the dam site and the weir will remain in dynamic equilibrium with its sediment supply and available stream power.

Mad River Fish Hatchery (14.5 miles)
The Mad River Fish Hatchery is located on the left bank between Blue Lake and the Sweasey Dam site (see Photos 5.12-2 - 5.12-5). The hatchery maintains a weir and fish ladder in the river. There has been some channel degradation below the weir and the river scoured under the weir during the winter of 92-93. At this time the river is too high to allow an evaluation of the situation. The Department of Fish and Game needs to evaluate, quantify, and monitor this potential problem.

Along the left bank, adjacent to the hatchery, there is some RSP (rock slope protection) against bank erosion. During installation the toe of the RSP was buried in a trench. Channel degradation can undermine the supporting toe and destroy the integrity of the RSP. The plans or cross sections for this project have not been located and the elevations along the toe are not known. The Hatchery should locate documents that will determine the foundation elevations. These elevations are needed to evaluate, quantify, and monitor this potential problem.

If extraction is expanded to permitted or proposed levels, the hatchery weir and RSP could fail. If extraction is sustained at recent levels the integrity of these two structures will be at risk and they will eventually fail. If extraction is below average net recruitment, the integrity of these structures should be secure.

Blue Lake Hatchery Road Bridge (12.8 miles)
This bridge crosses the Mad River and connects the City of Blue Lake with the West End Road area. An earlier bridge built in 1956 at this site was washed out during the flood of December 19, 1981 (see Photo 5.12-6). The current bridge was constructed in 1982. The bridge constricts the channel and increases channel scour. The increased scour, along with gravel extraction and low recruitment, has caused the bed at this site to drop about 1.6 feet between 1982 and 1991 (See Figure 5.12-1). This bridge provides access to Hatchery road and West End Road. The Blue Lake fire department and other emergency vehicles depend on this bridge and would like to see it remain open year round. However, because the south side approach to the bridge is essentially in the river bed the County Department of Public Works considers this to be a "summer bridge".

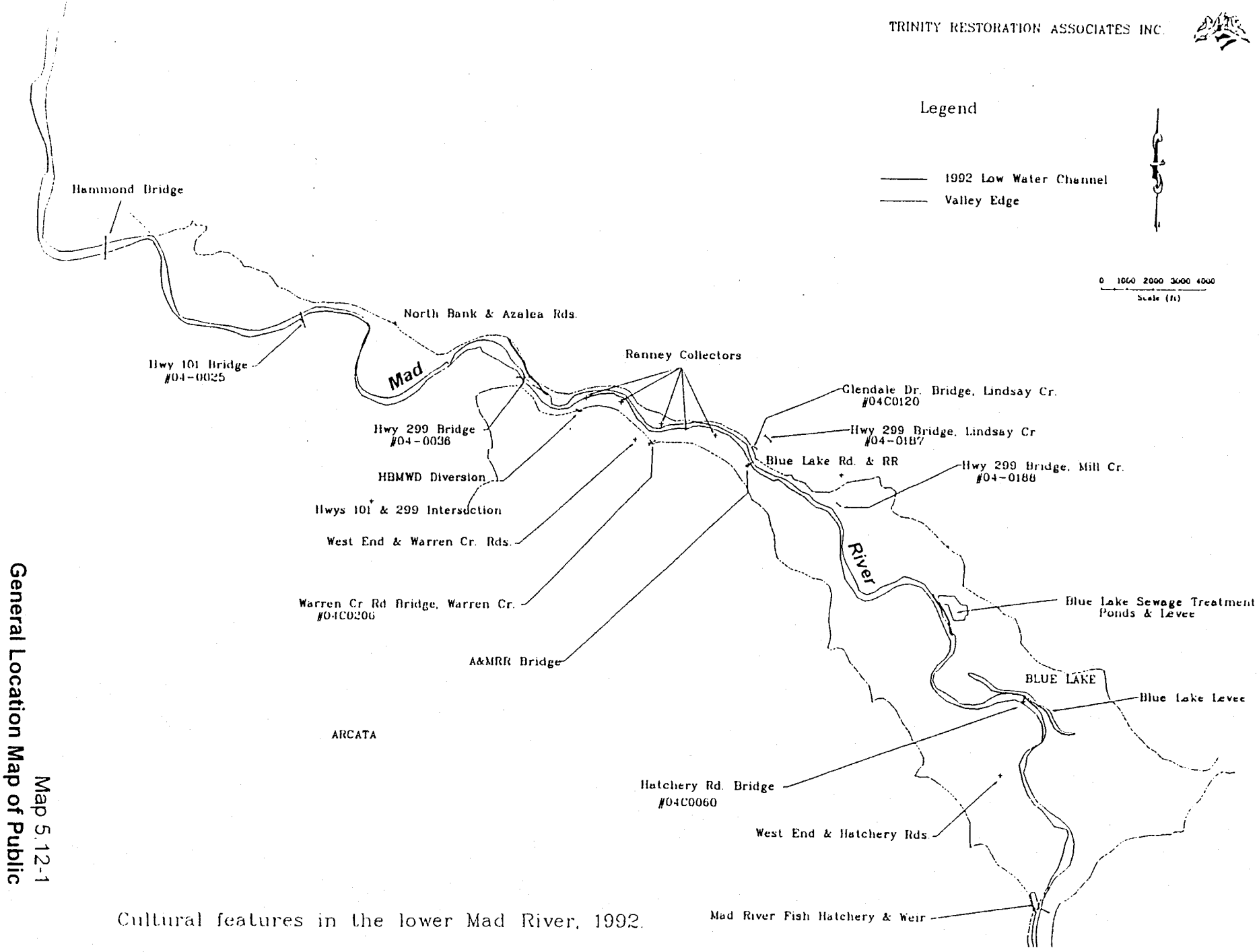
If extraction is expanded to permitted or proposed levels or sustained at recent levels it is anticipated that scour will continue at this site and the bridge will fail. If extraction is below average net recruitment, and an annual review is required, gravel extraction can be monitored and modified as needed in order to minimize the risk of bridge failure.

Blue Lake Right Bank Levee and RSP. (12.8 - 13 miles)
This right-bank levee extends from approximately one mile upstream of the Hatchery Road Bridge to about 0.5 mile downstream from the bridge (see Photo 5.12-7). The levee is

protected with RSP. During installation, the toe of RSP was buried in a trench. Channel degradation can undermine the supporting toe and destroy the integrity of the RSP.

Data from June 1965 USACOE Job Number 65-80, Maps and Cross Sections indicates that the trench bottom elevations near the lower end of the levee vary from approximately 56 to 59 feet, MSL. Near the upper end of the levee, the trench bottom elevations are approximately 71 feet MSL.

Humboldt County needs to monitor the river bed elevations in this reach in order to evaluate the risk of undermining the RSP. If extraction is expanded to permitted or proposed levels or sustained at recent levels the RSP will eventually be undermined and the integrity of the levee system will be placed at risk. Through an annual review, gravel extraction can be monitored and modified as needed in order to minimize the risk of RSP and levee failure.



Cultural features in the lower Mad River, 1992.

Map 5.12-1
General Location Map of Public Utilities and Structures

(adapted from: River Institute Consultants Report, Appendix F)

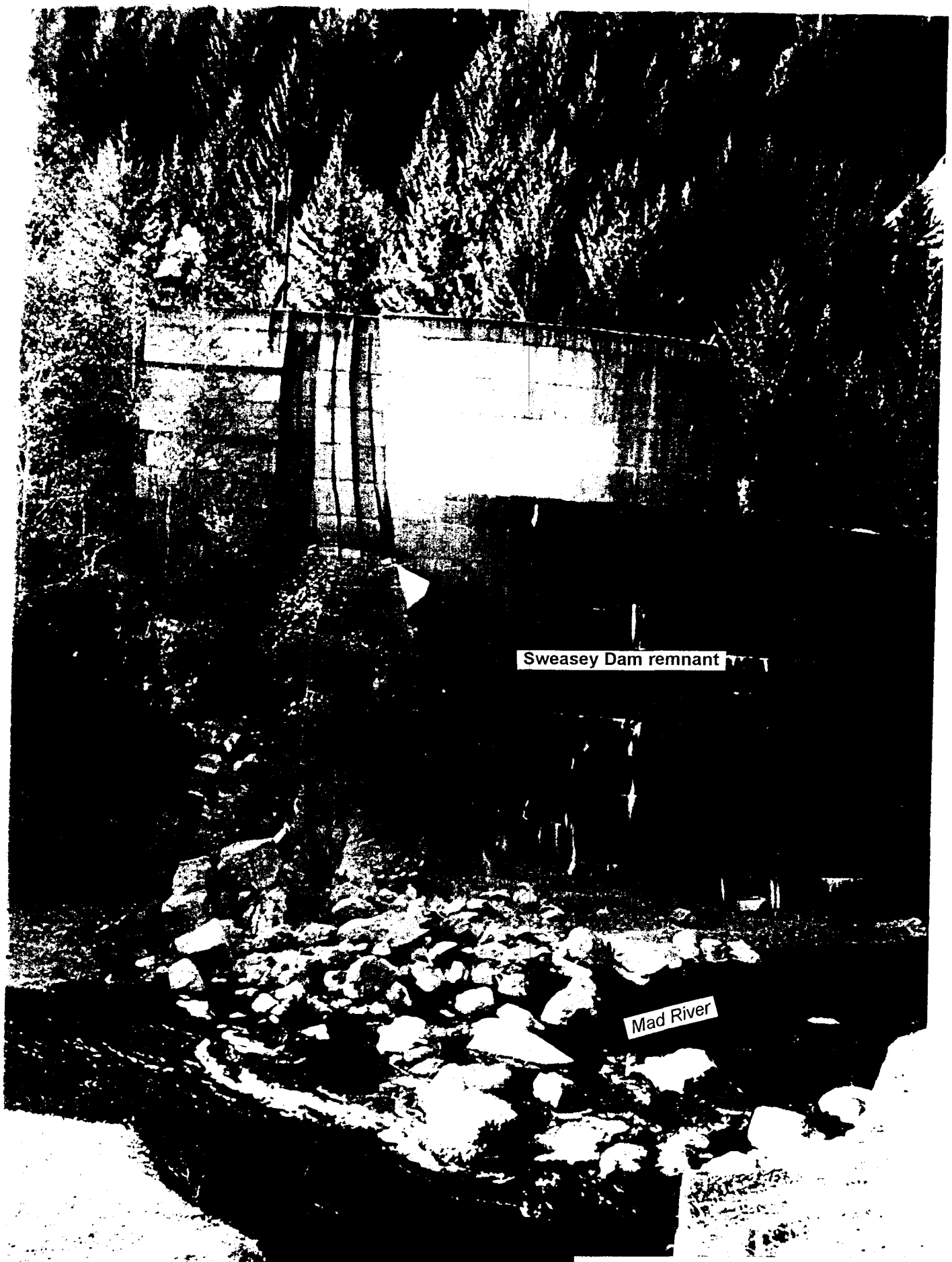
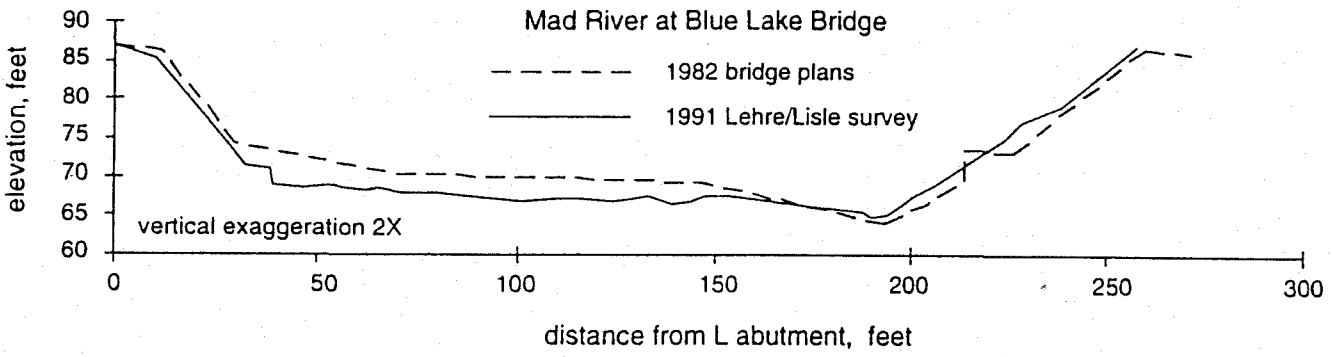


Photo 5.12-1
Former Sweasey Dam site
(looking at left bank)



Cross-sections of the Mad River at Blue Lake (Hatchery Road) Bridge

View is downstream.

Figure 5.12-1
Cross-sections of the Mad River at the Blue Lake Bridge

(adapted from: River Institute Consultants Report, Appendix F)



Photo 5.12-2
Mad River Fish Hatchery
(looking upstream)

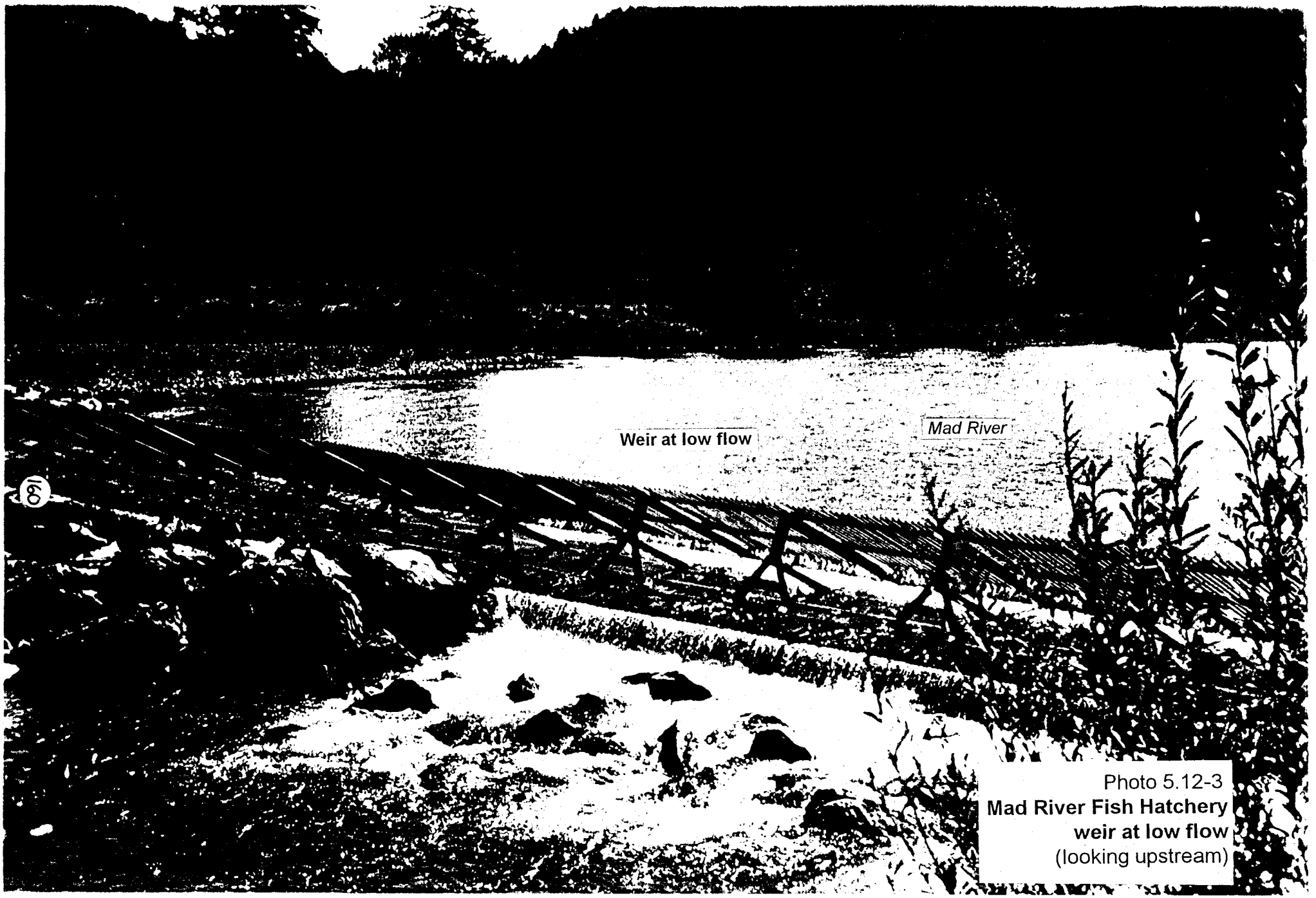


Photo 5.12-3
Mad River Fish Hatchery weir at low flow
(looking upstream)

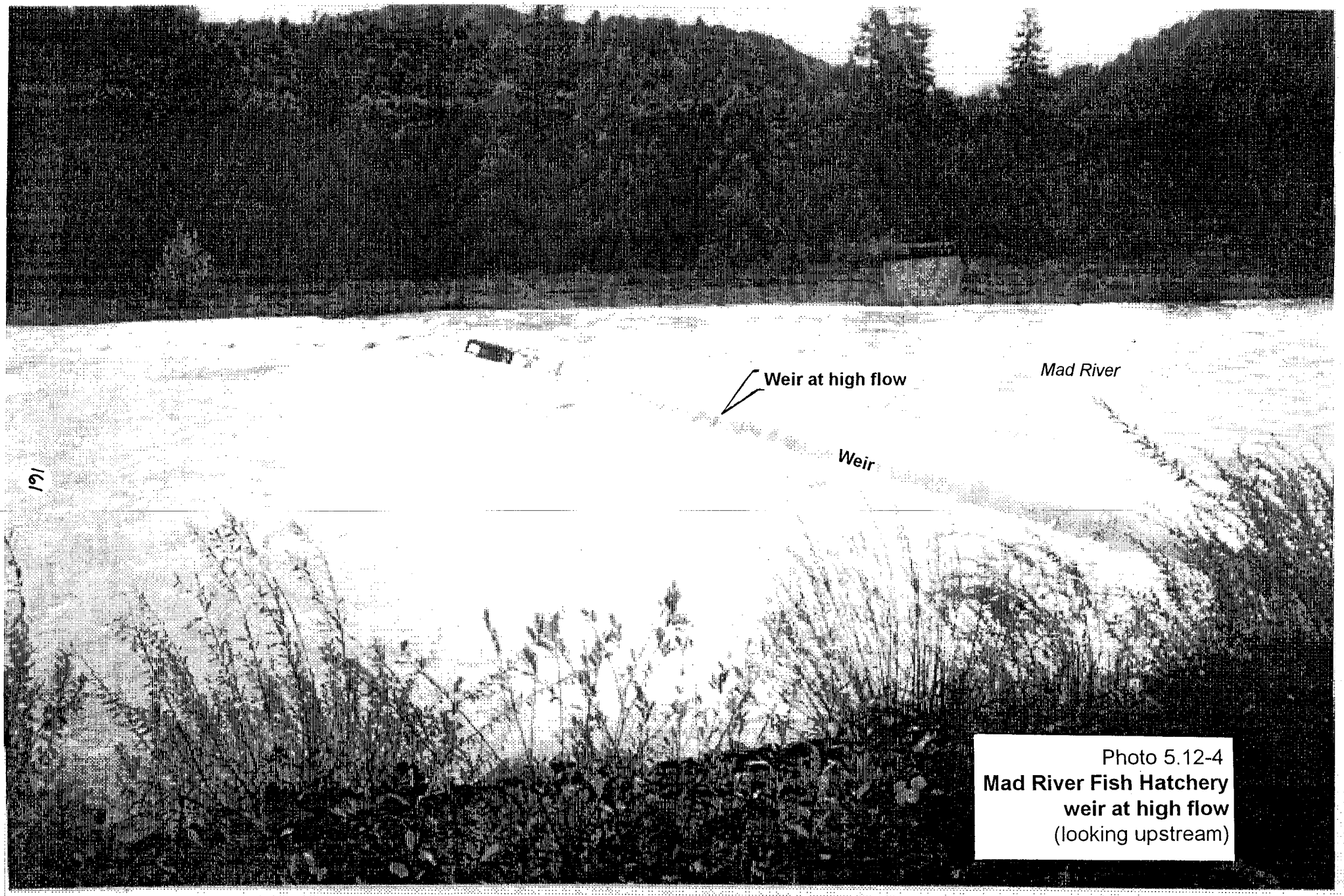


Photo 5.12-4
Mad River Fish Hatchery weir at high flow
(looking upstream)



Photo 5.12-5
Mad River Fish Hatchery
(looking downstream)

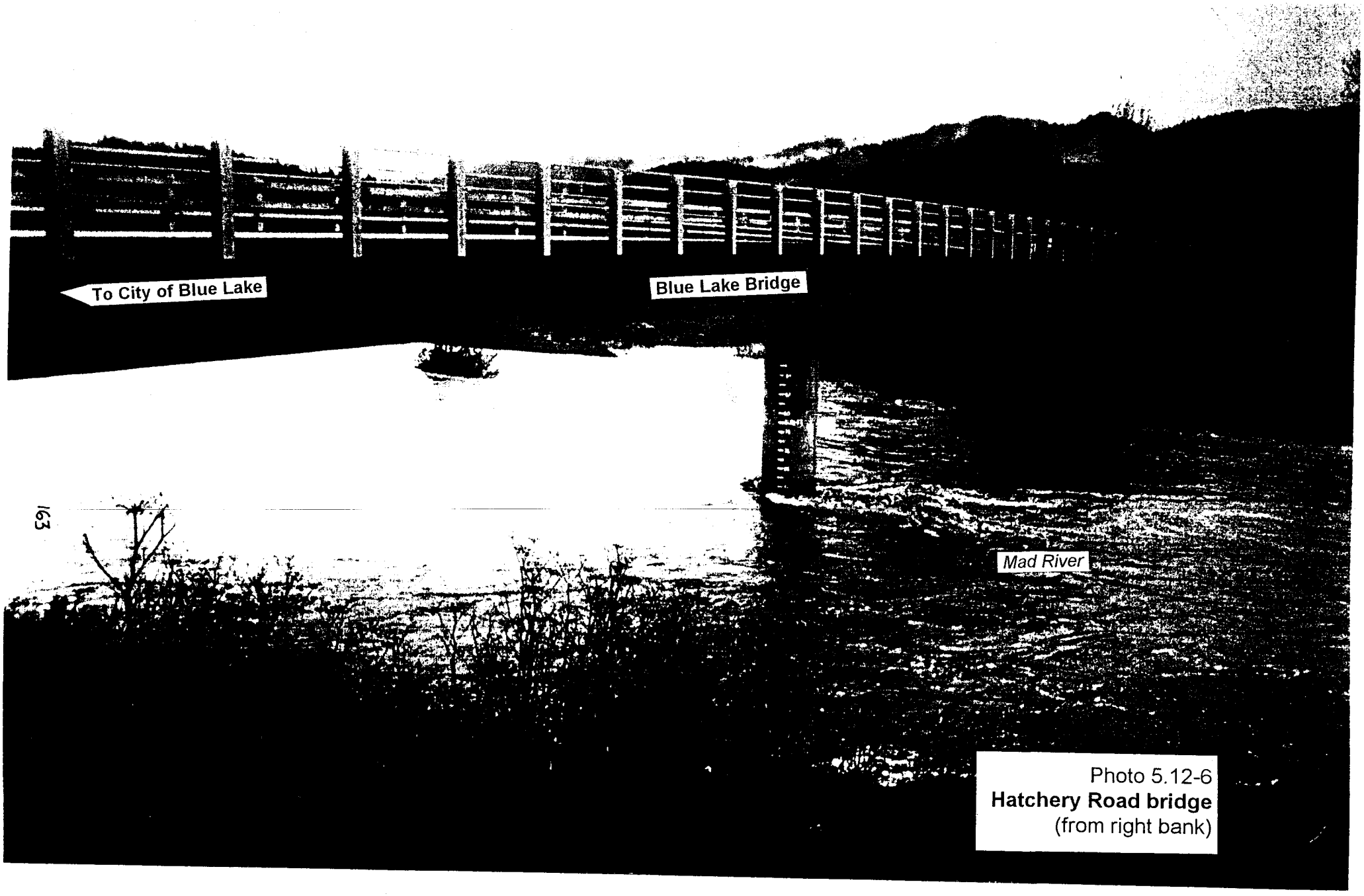


Photo 5.12-6
Hatchery Road bridge
(from right bank)

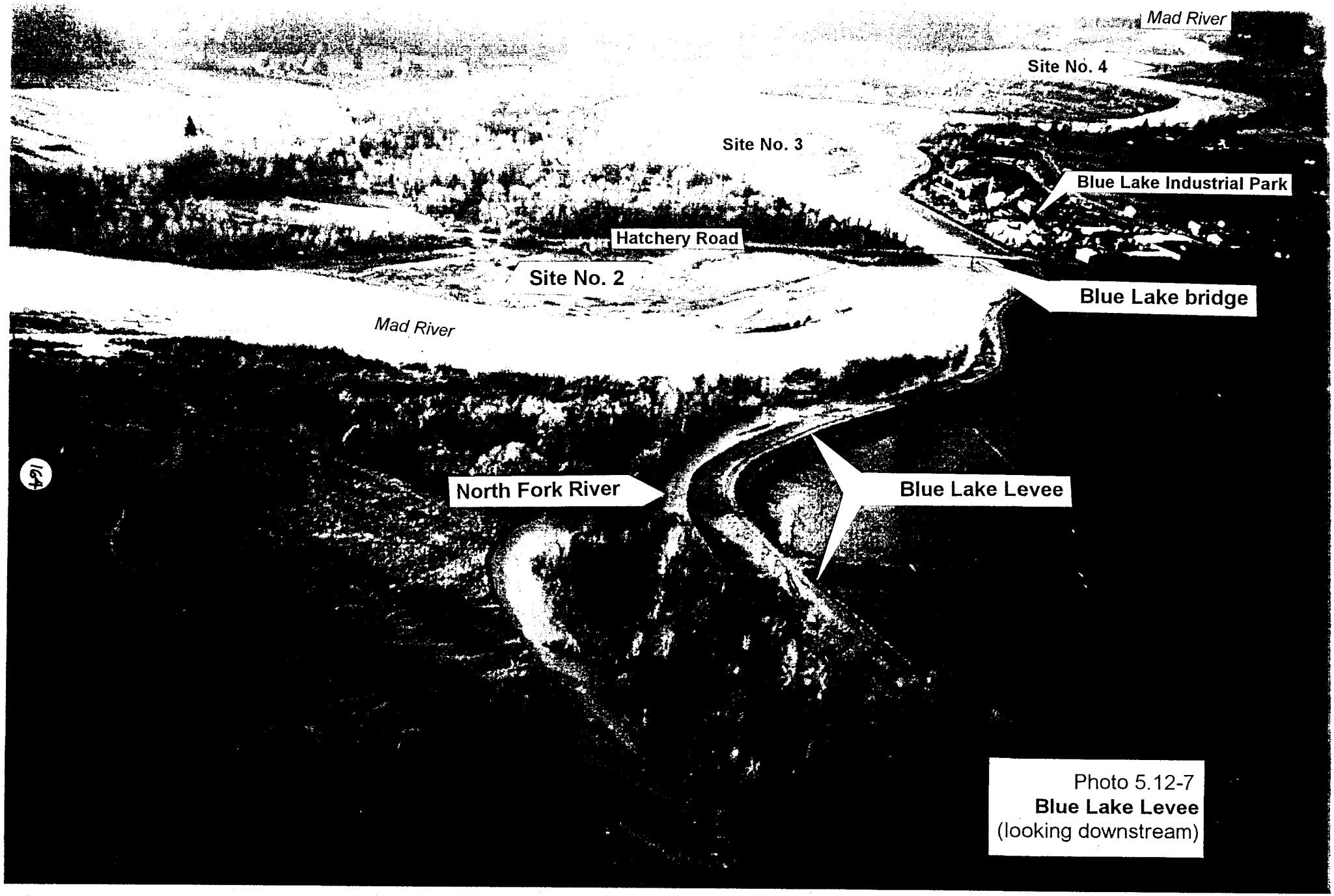


Photo 5.12-7
Blue Lake Levee
(looking downstream)

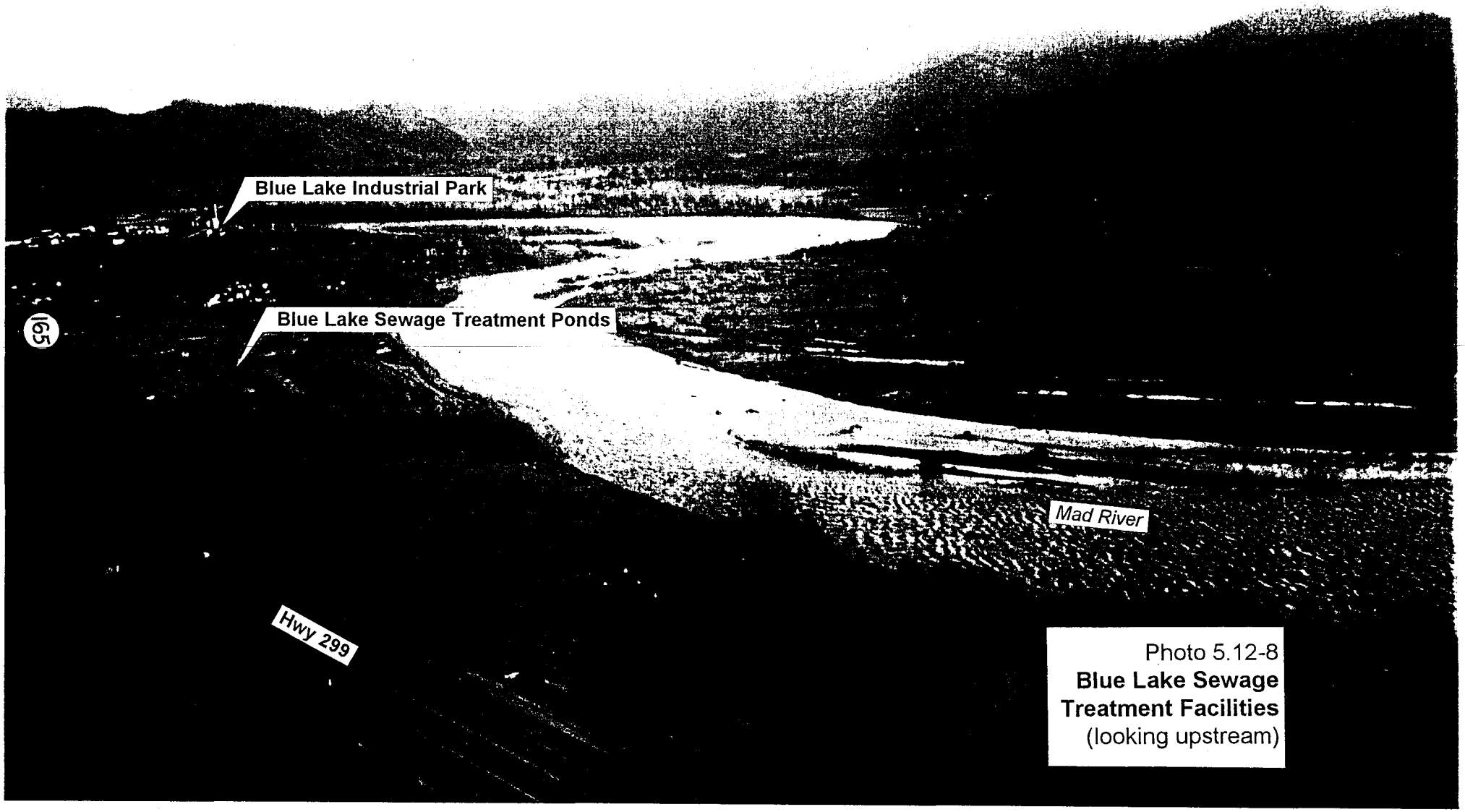


Photo 5.12-8
Blue Lake Sewage Treatment Facilities
(looking upstream)

Blue Lake Sewage Treatment Ponds (11.7 miles)
The Blue Lake sewage treatment ponds are located about 150 feet from the right channel bank (see Photo 5.12-8). Water from these ponds percolates into the aquifer. If the channel continues to degrade at this site, the surrounding water table will decline which will help maintain high percolation rates. If the channel agrades significantly at this site, the water table will rise and the percolation rate from these ponds will likely decrease.

A 1700-foot levee has been installed to protect the ponds and adjoining land from bank erosion. This levee was first built in 1971 and it has been rebuilt or repaired twice since 1971. Concerned parties need to monitor this levee and consider potential impacts when reviewing near-by gravel extraction proposals. In particular they need to direct their attention to proposals that may focus stream energy towards this site.

If the extraction is expanded to permitted or proposed levels or sustained at recent levels, the RSP will eventually be undermined and the integrity of the levee system and ponds will be placed at risk. Through an annual review, gravel extraction can be monitored and modified as needed in order to minimize the risk of RSP and levee failure.

Highway 299 Mill Creek Bridge (10.5 miles)
Mill Creek is a tributary to the Mad River and this bridge does not span the project area. However, it is located nearby and degradation in the Mad River channel could move up this tributary and undermine the bridge supports. The bridge was built in 1965 and a large rip rap sill was placed downstream to control bed degradation. No cross sections have been taken since that time. Concerned parties need to schedule new cross section measurements and monitor this bridge support. Channel degradation at the mouth of tributary streams can impair fish migration. The steep boulder cascade at the mouth of this stream may be a partial barrier.

If extraction is expanded to permitted or proposed levels or sustained at recent levels channel degradation may undermine the rip rap sill, endanger bridge supports, and impair fish passage. If extraction is below average net recruitment, channel degradation in this reach will be reduced and the integrity of these riverine resources will likely be preserved.

North Coast Railroad Authority Bridge (9.8 miles)
The Arcata and Mad River Railroad is registered as a California Historical Landmark (No. 842). The Arcata and Mad River Railroad Company contracted to have the first bridge built at this site in 1888. In 1896 a train fell through the bottom of the bridge and seven people were killed. The bridge was repaired and used until 1914 when the present steel bridge was built. According to the Arcata Union (June 25, 1914) the new bridge consists of three spans of 165 feet each with solid re-enforced concrete piers resting on a platform of 70 piles driven down to bedrock. The concrete extended down to a depth of 15 feet below low water. After the new bridge was completed the old bridge (located a few feet upstream) was demolished. A 16-inch water line is attached to the railroad bridge. It takes water to the north side of the river to service the community of Fieldbrook and the city of Blue Lake.

This bridge has in-channel supports and these supports increase local channel scour. Local channel scour and overall bed degradation have eroded the gravel bed around these bridge supports. The lowered bed appears to be threatening the integrity of the mid-channel bridge supports.

During the summer of 1992, a portion of one of the bridge supports appeared to be partially suspended above the gravel bed (see Photo 5.12-9). No evidence of pier support for the foundation was observed. An evaluation of this condition placed the bridge at risk. Further

investigations are needed to verify the extent of this problem and to look for signs of the piles that are supposed to be under the concrete supports.

It appears that some gravel replenishment occurred around these bridge supports in the winter of 1992-1993. Regardless, if extraction is expanded to permitted or proposed levels or sustained at recent levels this bridge may fail in the near future. If extraction is sustained at a level which is below net recruitment and replenishment, gravel replenishment at this site will be encouraged at this site and the integrity of the bridge may be enhanced.

Regardless of gravel extraction, localized scour around these bridge supports may continue to threaten the integrity of the bridge. There may be some engineering solutions that can be used to reduce the risk of localized scour.

Glendale Drive Bridge over Lindsay Creek (9.8 miles)
This bridge does not span the project area but it is located a short distance upstream on Lindsay Creek. This bridge was built in 1926 and about 10 feet of channel bed erosion has occurred since then. Some repairs have been made periodically and it appears that additional work is necessary now. Humboldt County needs to monitor bed elevations at this site and program appropriate repairs as needed. Fish access does not seem impaired at this tributary.

If extraction is expanded to permitted or proposed levels, average annual degradation at this site will increase along with increased risk to the bridge and fish passage. If extraction is sustained at current levels the long-term average channel degradation rate will be maintained, with increased risk to the bridge and fish passage. If extraction is below average net recruitment, channel degradation at this site will be reduced and some aggradation may occur to help minimize risk to the bridge. Fish passage into Lindsay Creek should remain unimpaired.



Photo 5.12-9
North Coast Railroad Bridge

Highway 299 Bridge over Lindsay Creek (9.8 miles)
This bridge is upstream from the Glendale Drive. It was built in 1965 and inspected in 1972. No scour problems were reported in 1972. This bridge does not span the project area but channel degradation can migrate up tributaries and it would be prudent to remeasure and evaluate bed elevations at this site in the near future.

If extraction is expanded to permitted or proposed levels or sustained at recent levels we can assume that channel bed erosion will migrate upstream and create scour problems at this bridge. If extraction is below average net recruitment, with channel monitoring and frequent review of extraction levels, the river will likely sustain the channel bed near its present position.

Railroad Trestle over Warren Creek (9 miles)
The Arcata and Mad River Railroad is registered as a California Historical Landmark (No. 842). There is two or three feet of channel scour beneath this trestle and one of the pier footings has been exposed. A large concrete slab located about 200 feet downstream from the trestle may be restricting further bed degradation at this site. This trestle does not span the project area but channel degradation can migrate up tributaries and it would be prudent to remeasure and evaluate bed elevations at this site in the near future. Fish passage into Warren Creek does not seem to be impaired.

The concrete slab may limit scour at this site for some time. Consequently, expanding the project to permitted levels or sustaining it at recent levels may not produce an immediate noticeable effect. However, it is possible that the concrete sill could become undermined which would allow channel bed erosion to migrate upstream and place the trestle and fish passage at risk.

If the extraction is below average net recruitment, the risk of channel degradation at this site will be substantially reduced. Consequently, fish passage and the integrity of the trestle supports would be maintained.

Warren Creek Road Bridge (9 miles)
This bridge was built in 1927, and is located upstream from the railroad trestle. No scour problems were noted during an investigation in 1979. This bridge does not span the project area but channel degradation can migrate up tributaries and it would be prudent to remeasure and evaluate bed elevations at this site in the near future.

The concrete slab located below the trestle may limit scour at this site also. Consequently, expanding the project to permitted levels or sustaining it at recent levels may not produce an immediate noticeable effect at this site. However, it is possible that the concrete sill could become undermined which would allow channel bed erosion to migrate upstream and place this bridge at risk. If extraction is below average net recruitment, the risk of future channel degradation at this site will be substantially reduced.

Structures in the HBMWD Reach (7.8 - 9.5 miles)
The HBMWD reach extends from just below the railroad bridge to just above the U.S. Geological Survey Mad River, Arcata stream gaging station at Highway 299. In this reach the District has five Ranney Wells, one surface water diversion structure, two underwater pipe crossings and various instream structures to provide protection against bank erosion and river bed degradation (see Photo 5.12-10). The most recent (1992) structure is a rock dike which has been placed downstream of the surface diversion (Pump Station Six) in an attempt to maintain an adequate low-flow surface water elevation at the pump inlet. Rock slope protection (RSP) was also added to the right bank just upstream from Highway 299 in 1992.

HBMWD cross sections indicate that the river bed throughout this reach has degraded an average of four to five feet since 1960 (see Figure 5.12-2). As expected, scour around at least some of the Ranney Wells has been greater than the average four to five feet. Although the recent closure of a Samoa Peninsula pulp mill may reduce the demand for water and provide some temporary relief, channel degradation in this reach has hampered the District's ability to provide an adequate quantity of water from Pump Station Six.

Channel degradation around the Ranney wells has limited the depth of gravel above the collector intakes, and consequently reduced the filtering effects of the gravel. The increased turbidity in the collected water increases the need for treatment and purification.

The dike placed in the river in 1992 may provide a temporary limit to further channel bed degradation, with or without supplemental structures. But, if extraction is expanded to permitted or proposed levels or sustained at recent levels the facilities of the HBMWD will continue to suffer the effects of channel degradation. If extraction is below average net recruitment, monitoring and adjustment of extraction levels and techniques could encourage gravel deposition in this reach with the purpose of maintaining the present grade line.

Upper HBMWD Water Pipe Crossing (8.7 miles)
The HBMWD has two 51-inch water pipe crossings buried in the Mad River Channel. Both pipe crossings are encased in concrete. The upper crossing is located just downstream from Ranney Well No. 1. The bottom of the trench (pipe invert) was at minus 6 feet MSL in 1960. At that time the stream thalweg was at approximately 24 feet. In 1992 the thalweg at this location was at 20 feet. At this time channel degradation has not created an immediate threat to this pipe crossing.

If extraction is expanded to permitted or proposed levels or sustained at recent levels scour will continue to occur and the risk of exposing this pipe will increase. If extraction is below average net recruitment, monitoring and adjustment of extraction levels and techniques could encourage gravel deposition in this reach with the purpose of maintaining the present grade line.

Lower HBMWD Water Pipe Crossing (7.8 miles)
The lower pipe crossing is just upstream from the Highway 299 bridge. This pipe also has a diameter of 51-inches and is encased in concrete. The pipe invert was laid at one foot MSL in 1960. At that time the stream thalweg was 18 feet. In 1992 the thalweg was 12 feet above MSL. At this time channel degradation has not created an immediate threat to this pipe crossing.

There is substantial large rock in the reach which limits any near-future degradation at this site, regardless of extraction or degradation rates elsewhere in the river. Therefore, none of the proposed alternatives are likely to create any immediate problems at this pipe crossing.

U. S. Geological Survey Stream Gaging Station (7.8 miles)

The U.S. Geological Survey has a stream gaging station located just above the Highway 299 bridge. This station has been monitoring streamflow continuously since 1951. An instrument shelter is located high on the right bank. The gage is a bubbler gage which requires very little instream paraphernalia. Although changes in channel aggradation and degradation at this station will not threaten this facility, constant monitoring is required to keep the station calibrated. Other than calibration problems, none of the project alternatives will have any significant impact on this installation.

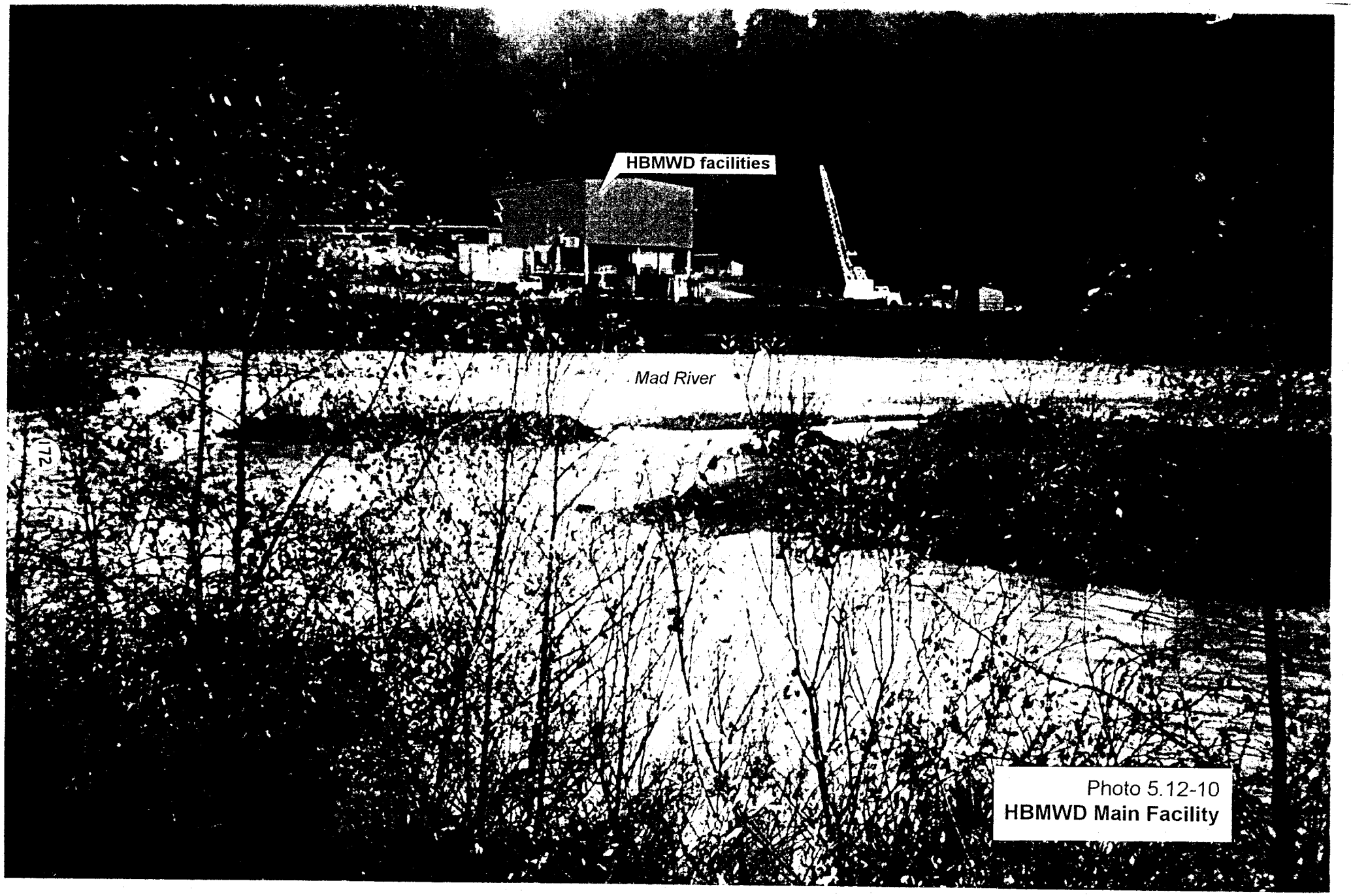
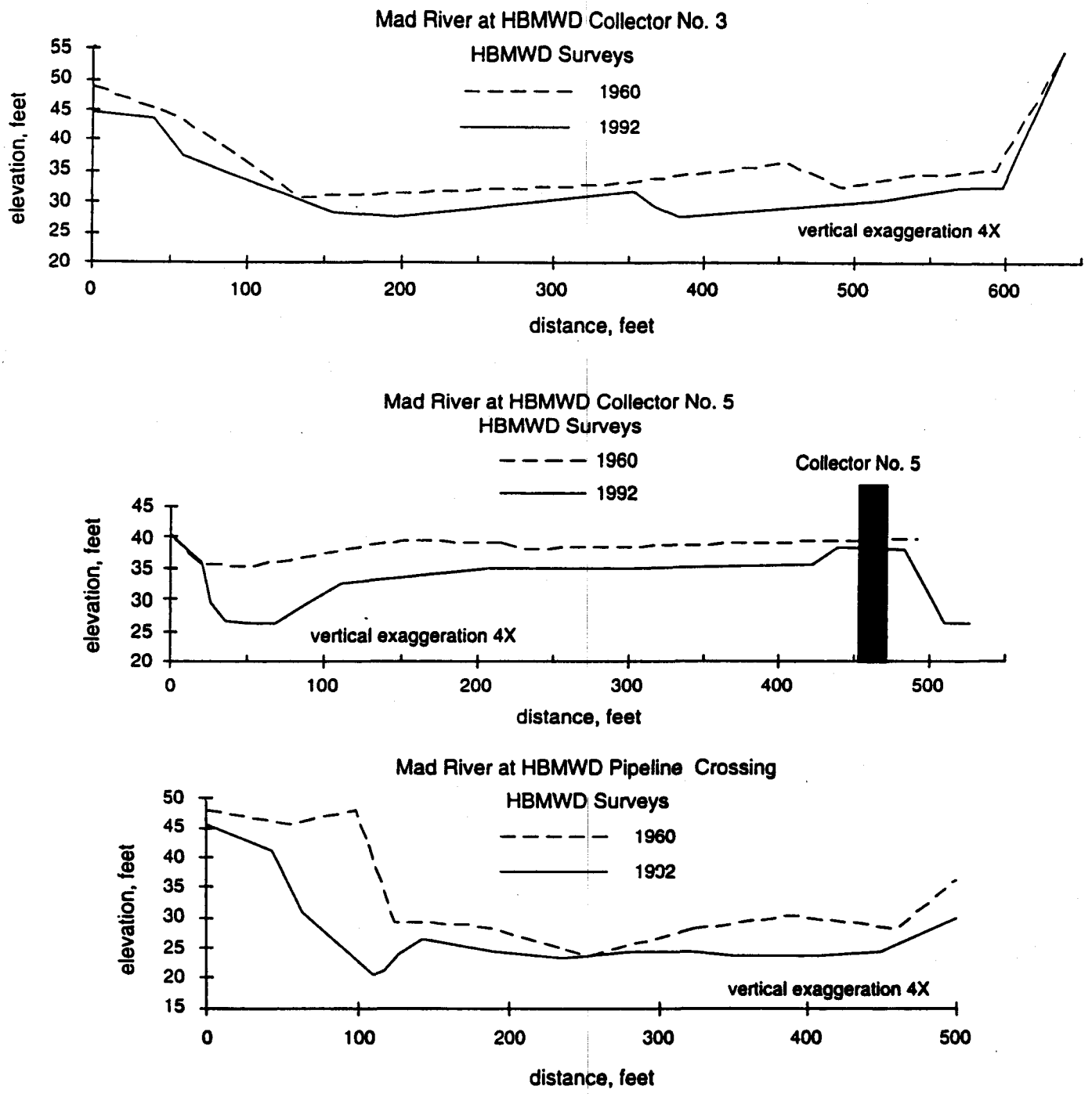


Photo 5.12-10
HBMWD Main Facility

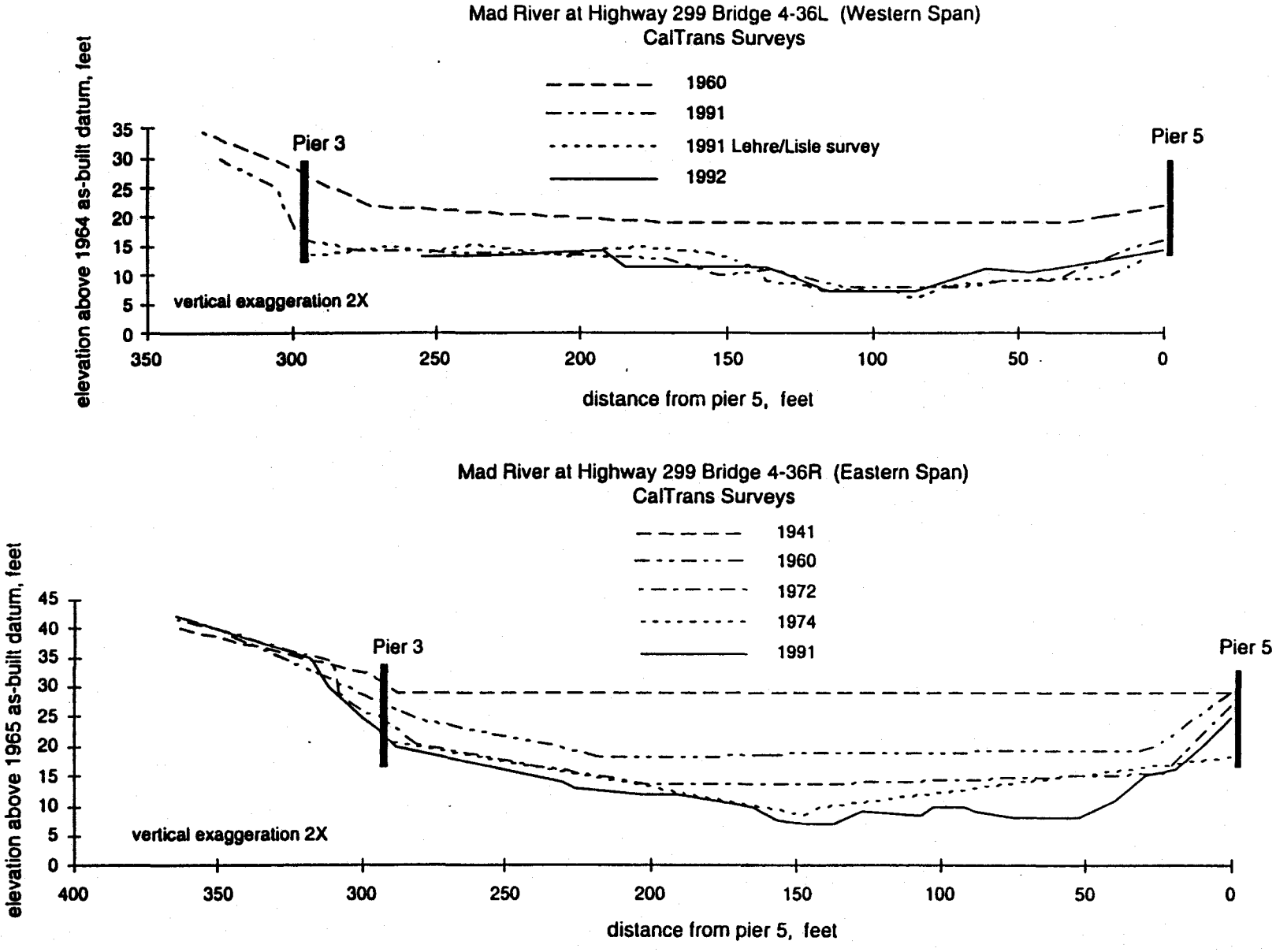


Cross-sections of the Mad River in the HBMWD reach

View is downstream.

Figure 5.12-2
Cross-sections of the Mad River in the HBMWD Reach

(adapted from: River Institute Consultants Report, Appendix F)



Cross-sections of the Mad River at Highway 299 bridge

View is downstream.

(adapted from: River Institute Consultants Report, Appendix F)

Figure 5.12-3
Cross-sections of the Mad River at the Highway 299 Bridges

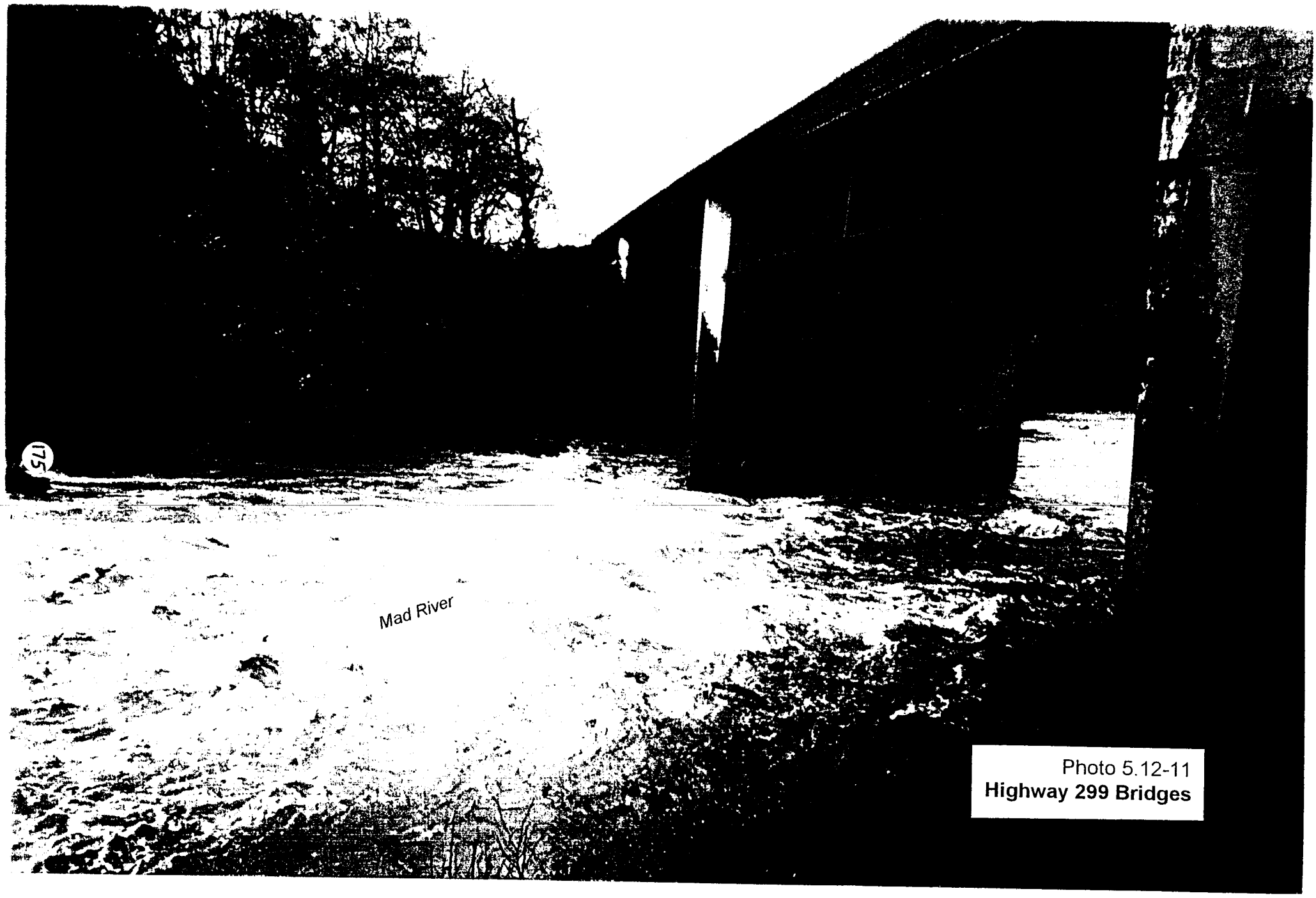


Photo 5.12-11
Highway 299 Bridges

Highway 299 Eastbound (Right) Bridge (7.8 miles)
This bridge was constructed in 1948. CalTrans' surveys at this site indicate a maximum bed lowering of 21 feet since 1941 (see Figure 5.12-3, and Photo 5.12-11). During the summer of 1992, the thalweg elevation was 3.5 feet. The footings of Pier 4 have been exposed and the concreted right bank at Pier 5 has been undercut. The underlying rock is weak and easily erodible. Channel scour during high flows may expose this underlying rock. To restore the structural integrity of this bridge the thalweg would have to be raised approximately 15 feet.

Just upstream from the bridge there are four-foot boulders and a massive bedrock outcrop in the channel. The combined effect is excessive turbulence which adds to the scour taking place at this site. Some people suspect that the boulders were placed in the channel to protect the HBMWD lower pipe crossing or to reduce upstream channel degradation. Others say the rocks are natural and have only recently been uncovered by channel degradation. As of this writing we have not resolved this issue.

Caltrans is considering protecting the existing piers, repairing the foundations, or replacing the entire bridge. It may take 10 years or more to schedule and fund the repairs or replacement. In the meantime Caltrans has requested that an aggregate management plan be initiated which will maintain or raise the level of the thalweg at this site.

If extraction is expanded to permitted or proposed levels or sustained at recent levels channel degradation at this site will continue and add to the risk of bridge failure. If extraction is below average net recruitment, sediment transport into this reach will be encouraged and the thalweg may raise somewhat.

Highway 299 Westbound (Left) Bridge (7.8 miles)
This bridge was constructed in 1965. The average elevation of the channel beneath this bridge has lowered by about 8 feet since 1960. The maximum degradation for the same period at this site is 14 feet (see Figure 5.12-3, and Photo 5.12-11).

Caltrans is planning to repair the foundations on this bridge. It may take 10 years or more to schedule and fund the repairs. In the meantime CalTrans has requested that an aggregate management plan be initiated which will maintain or raise the level of the thalweg at this site. If extraction is expanded to permitted or proposed levels or sustained at recent levels channel degradation at this site will continue and add to the risk of bridge failure. If extraction is below average net recruitment, sediment transport into this reach will be encouraged and the thalweg may raise somewhat.

Had the engineers who designed these threatened bridges had a better understanding of fluvial processes, more funding, and better technology we might be better able to adapt to a degrading river. It is likely that the engineers did the best that they could with the resources that they had; and it is possible that they knew retrofitting and the cost of retrofitting would occur in the future.

PG&E Upper Gas Line Crossing (7.8 miles)
Pacific Gas and Electric Company has a 6-inch gas line attached to the bridge crossing at Highway 299. The pipe goes under Warren Creek Road and the railroad as it approaches the river from the south just upstream from the Highway 299 bridges. The pipe then rises up to the left (west) bridge and spans the river. On the north side of the bridge the pipe turns upstream and is buried in a low terrace.

In the past, bank erosion and a gravel extraction operation located just upstream from the bridge have occasionally exposed the pipe. There is little risk of that happening again as the terrace is now overgrown with vegetation and protected with RSP. Extraction will have no effect on the gas pipe crossing as long as the integrity of the bridge is protected.

Sewage Effluent Pipe Crossing (7.8 miles)
Pressurized sewage effluent from the Glendale area is carried across the river through a pipe that is suspended from the Highway 299 bridge. Extraction will have no effect on the sewer line crossing as long as the integrity of the bridge is protected.

McKinleyville Community Services Water Pipe Crossing (7.25 miles)
The McKinleyville Community Services District has an 18-inch water line that crosses under the river. The 18-inch pipe is encased in concrete. The crossing is located a short distance downstream from the Highway 299 bridge. The pipe enters the river on the south side in the vicinity of Dutra Trucking on Giuntoli Lane. It leaves the river and approaches North Bank Road in the vicinity of Hunt's Drive. The bottom of the trench (pipe invert) is at minus 10 feet MSL. Drawings indicate that the pipe is encased in bedrock. At the time of construction the thalweg elevation was about 8 feet MSL. At this time, channel degradation has not created an immediate threat to this pipe crossing. If extraction is expanded to permitted or proposed levels or sustained at recent levels channel scour at this site will be much more likely than if the recommended project is adopted. However, because of the proximity to the coast it is unlikely that this site could degrade to a point where the pipe crossing would be at risk.

Highway 101 Northbound (Right) Bridge (5.6 miles)
This bridge spans the project area. Cross sections illustrate that the bed has degraded 17 feet at this site since 1929 and the current bed elevation is 0.0 feet, MSL (see Figure 5.12-4). Although the bridge is pile-supported the structural integrity of this bridge is threatened. A high flow event could expose eight to ten feet of the 1929 piles. CalTrans considers this bridge to be functionally obsolete and hopes to replace it within ten years.

Sediment removal at upstream sites will encourage hungry water and scour at this site, thus adding to the risk of losing this bridge. If extraction is expanded to permitted or proposed levels or sustained at recent levels channel scour will be much more likely than if extraction is below replenishment.

Highway 101 Southbound (Left) Bridge (5.6 miles)
This bridge spans the project area. Cross sections indicate that the bed has degraded 8 feet since construction in 1957. The current bed elevation is 0.0 feet, MSL. Although the bridge is pile-supported the structural integrity of this bridge is threatened (see Figure 5.12-4). A high flow event could expose eight to ten feet of the 1957 piles. CalTrans would have to widen this bridge and improve the foundation in order to meet their transportation goals. Because of the expense they plan to replace the structure rather than widening and repairing it. They hope to replace this bridge within the next ten years.

Sediment removal at upstream sites will encourage scour at this site and add to the risk of losing this bridge. If extraction is expanded to permitted or proposed levels or sustained at recent levels channel scour will be much more likely than if extraction is below average net recruitment.

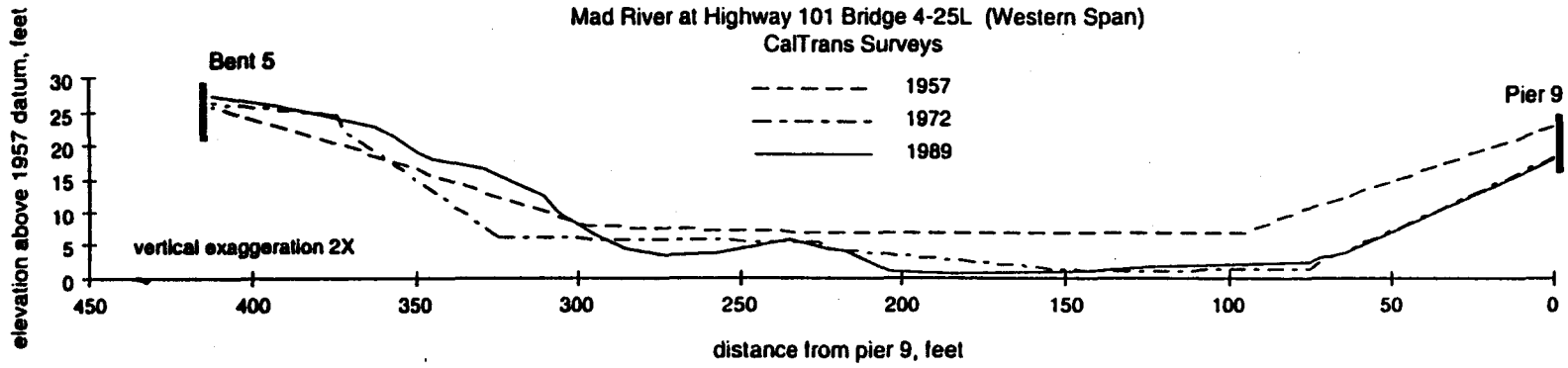
PG&E Lower Gas Line Crossing (5.6 miles)

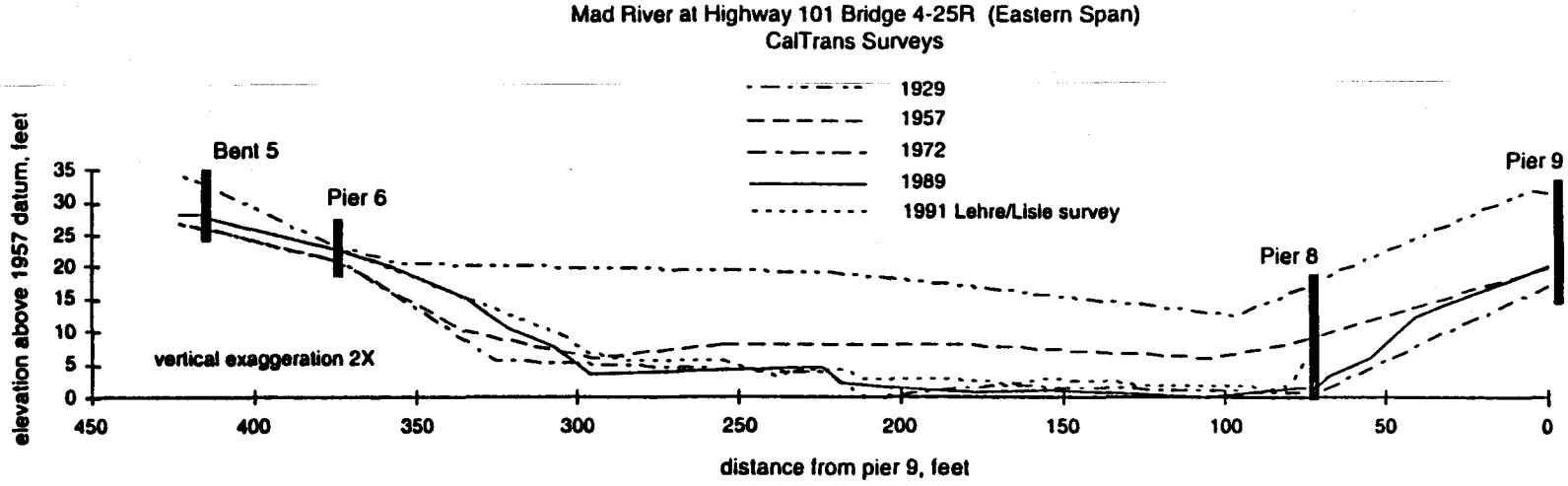
Pacific Gas and Electric Company has an 8-inch gas line crossing the river at Highway 101. The pipe is suspended from the west bridge. Extraction will have no effect on the gas pipe, as long as the integrity of the bridge is protected.

Hammond Trail Bridge (3.9 miles)
This bridge marks the downstream extent of the project area for the PEIR. There has been a bridge at this site since 1905. However, it is not known if the current bridge is the one built in 1905. The railroad has abandoned this line and the bridge now belongs to the McKinleyville Community Service District. It is presently a part of a county trail system. An 18-inch sewer effluent line goes across the bridge and is used to irrigate pastures south of the river during the summer months when the river flow is too low to allow sewage effluent to be directly discharged into the river.

At the base of the north bridge support there is a flexible pipe that is used to discharge treated sewage effluent into the river. Effluent may not be discharged into the river between May 1st and October 1st or at any other time when the streamflow is less than 200 cfs. As of this writing there is no information as to the structural integrity of this bridge.

Cross-sections used in calculation of bed degradation.





Cross-sections of the Mad River at Highway 101 bridge

View is downstream.

(adapted from: River Institute Consultants Report, Appendix F)

Figure 5.12-4
Cross-sections of the Mad River at the Highway 101 Bridges

McKinleyville Community Sewage Treatment Plant (2.1 miles)
The sewage treatment plant is located on a high terrace on the right (north) side of the river. The plant and percolation ponds are close to but outside of the project area. Extraction should have no impact on these facilities. A flexible sewage effluent discharge pipe is attached to the Hammond Trail Bridge north abutment. Because the pipe is flexible, it can adjust to the level of the river. Consequently, channel aggradation and degradation should not have an impact on the sewage outfall.

Mad River Beach Road Left Bank RSP (3.3 - 3.4 miles)
This RSP is under the jurisdiction of Humboldt County. There is no information on the elevations at the toe of this RSP.

Concerned parties need to monitor the river bed elevations in this reach in order to evaluate the risk of undermining the RSP. If extraction is expanded to permitted proposed levels, or sustained at recent levels hungry water may eventually undermine the RSP. If gravel extraction is below average net recruitment, the risk of RSP failure is minimized.

Humboldt County Boat Ramp (3.2 miles)
This ramp is under the jurisdiction of Humboldt County. There is no information on the design or construction of this ramp.

Humboldt County needs to monitor the river bed elevations in this reach in order to evaluate the risk of undermining the ramp. If extraction is expanded to permitted or proposed levels, or sustained at recent levels the ramp may eventually be undermined. If gravel extraction is below average net recruitment, the risk of ramp failure is minimized.

Clam Beach Mad River RSP Site (0 miles)
This project is designed to limit the northward migration of the river and protect the integrity of adjacent Highway 101. During high flows, suspended sand moves into and through the lower river reach. If extraction is expanded the future supply of suspended sand may be reduced and this could impact lower river resources. If an annual review is required, sand and gravel extraction can be monitored and modified as needed in order to minimize the risk of adverse impacts in this reach. Because the RSP is at a wave-dominated site it is unlikely that hungry water will create scour problems.

Impact Statements and Mitigation Measures

Impact
PU&S-1: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Mad River Fish Hatchery weir. This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and Review Committee
Mad River Fish Hatchery
California Department of Fish & Game

Significance after Mitigation
Less than significant

Impact
PU&S-2: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the RSP along the left bank, adjacent to the fish hatchery (river mile 14.5). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and Review Committee
Humboldt County Public Works Department
Mad River Fish Hatchery
California Department of Fish & Game

Significance after Mitigation
Less than significant

Impact
PU&S-3: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Blue Lake bridge (river mile 12.8). This could be a significant impact. (PS/LS)
Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and Review Committee
Humboldt County Public Works Department
City of Blue Lake

Significance after Mitigation
Less than significant

Impact
PU&S-4: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Blue Lake right bank levee (river mile 12.8-13). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Humboldt County Public Works Department
City of Blue Lake

Significance after Mitigation
Less than significant

Impact
PU&S-5: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Blue Lake sewage treatment ponds and levee (river mile 11.7). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Humboldt County Public Works Department
City of Blue Lake
Significance after Mitigation
Less than significant

Impact
PU&S-6: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Highway 299 Mill Creek bridge (river mile 10.5). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
CalTrans

Significance after Mitigation
Less than significant

Impact
PU&S-7: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the North Coast Railroad Authority bridge (river mile 9.8). A 16-inch water line is attached to the railroad bridge. It takes water to the north side of the river to service the community of Fieldbrook and the city of Blue Lake. The loss of this bridge would be a significant impact. (PS/PS)

Mitigation Measures
Mit-1 and Mit-2: In time, the combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
North Coast Railroad Authority

Significance after Mitigation
Potentially Significant. After mitigation measures Mit-1 and Mit-2 are implemented, scour around the mid-channel supports will continue to occur. Engineering features may be needed to reduce the impact of scour. It is not known how long it will take for the river to aggrade sufficiently to naturally enhance the structural integrity to the subject structure. Therefore, there is an unknown period during which the subject structure may be threatened. Because of the time involved, the impacts of channel degradation will temporarily remain potentially significant during mitigation.

Impact
PU&S-8: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Glendale Drive bridge over Lindsay Creek (river mile 9.8). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Humboldt County Public Works Department

Significance after Mitigation
Less than significant

Impact
PU&S-9: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation

could jeopardize the integrity of the Highway 299 bridge over Lindsay Creek (river mile 9.8). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
CalTrans

Significance after Mitigation
Less than significant

Impact
PU&S-10: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Gravel extraction in volumes exceeding replenishment has the potential to cause bed degradation. Continued bed degradation could jeopardize the integrity of the Railroad trestle over Warren Creek (river mile 9). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
North Coast Railroad Authority

Significance after Mitigation
Less than significant

Impact
PU&S-11: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Gravel extraction in volumes exceeding replenishment has the potential to cause bed degradation. Continued bed degradation could jeopardize the integrity of the Warren Creek Road bridge (river mile 9). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Humboldt County Public Works Department

Significance after Mitigation
Less than significant

Impact
PU&S-12: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the structures in the HBMWD reach (river mile 7.8 - 9.5). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Humboldt County Public Works Department
Humboldt Bay Municipal Water District
California Department of Fish & Game

Significance after Mitigation
Less than significant

Impact
PU&S-13: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the upper HBMWD water pipe crossing (river mile 8.7). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Humboldt County Public Works Department
Humboldt Bay Municipal Water District

Significance after Mitigation
Less than significant

Impact
PU&S-14: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the lower HBMWD water pipe crossing (river mile 7.8). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Humboldt County Public Works Department
Humboldt Bay Municipal Water District
Significance after Mitigation
Less than significant

Impact
PU&S-15: Changes in bed level require periodic calibration of the U. S. Geological stream gaging station (river mile 7.8). This is not a significant impact. (LS/LS)

Mitigation Measures
None proposed since no significant impact was identified.

Monitoring
None required

Impact
PU&S-16: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Highway 299 bridges (river mile 7.8). This could be a significant impact. (S/S)

Mitigation Measures
Mit-1 and Mit-2: In time, the combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Caltrans

Significance after Mitigation
Significant. After mitigation measures Mit-1 and Mit-2 are implemented, scour around the mid-channel supports will continue to occur. Engineering features may be needed to reduce the impact of scour. After mitigation measures Mit-1 and Mit-2 are implemented, it is not known how long it will take for the river to aggrade sufficiently to naturally restore structural integrity to the subject structures. Therefore, there is an unknown period during which the subject structures may not be structurally sound. Because of the time involved, the impacts of channel degradation will remain temporarily significant during mitigation.

Impact

PU&S-17: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Highway 299 bridge. The PG&E upper gas line crossing (river mile 7.8) is connected to this bridge. As long as the bridge integrity is intact, there will be no related impacts to the PG&E pipeline. As discussed in PU&S-16, impacts to Hwy 299 bridge could be a significant, therefore the impacts to the pipeline could be significant. (S/S)

Mitigation Measures

Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring

Scientific Design and review Committee
Humboldt County Public Works Department
CalTrans
Pacific Gas and Electric

Significance after Mitigation

Significant. After mitigation measures Mit-1 and Mit-2 are implemented, scour around the mid-channel bridge supports will continue to occur. Engineering features may be needed to reduce the impact of scour. After mitigation measures Mit-1 and Mit-2 are implemented, it is not known how long it will take for the river to aggrade sufficiently to naturally restore structural integrity to the subject structures. Therefore, there is an unknown period during which the bridge and pipe line will be at risk. Because of the time involved, the impacts of channel degradation will remain temporarily significant during mitigation.

Impact

PU&S-18: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Highway 101 bridges (river mile 5.6). This could be a significant impact. (PS/LS)

Mitigation Measures

Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring

Scientific Design and review Committee
Caltrans

Significance after Mitigation
Less than significant

Impact
PU&S-19: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Hammond Trail bridge (river mile 3.9). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Humboldt County Public Works Department

Significance after Mitigation
Less than significant

Impact
PU&S-20: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Mad River Beach Road RSP (river mile 3.3 - 3.4). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring
Scientific Design and review Committee
Humboldt County Public Works Department

Significance after Mitigation
Less than significant

Impact
PU&S-21: If the average annual gravel extraction rate exceeds average annual net recruitment and replenishment the bed will continue to degrade. Continued bed degradation could jeopardize the integrity of the Clam Beach Mad River RSP (river mile 0). This could be a significant impact. (PS/LS)

Mitigation Measures
Mit-1 and Mit-2: The combined implementation of these mitigation measure will limit gravel extraction to reduce this potential impact to a level of insignificance.

Monitoring

Scientific Design and review Committee
CalTrans

Significance after Mitigation
Less than significant

5.13 Archaeological Resources

The County retained James Roscoe to gather and analyze information on the effects of historic gravel extraction on the archaeological resources of the project area. Portions of the following section were adapted from James Roscoe's report. See Appendix G for the complete report.

The project area is located within the ethnographic territory of the Wiyot Indians. The three subgroups of the Wiyot were (1) the Patawat, who lived in the villages along the lower Mad River, (2) the Wiki on Humboldt Bay, and (3) the Wiyot along the lower Eel River. It is the name of the Eel River division which is now used in reference to the entire group.

The Wiyot population, estimated between 1,000 and 3,300, lived almost exclusively in villages along the protected shores of Humboldt Bay and near the mouths of the Eel and Mad Rivers. Ethnographic and archaeological data collected by L.L. Loud (1918) for Wiyot territory provides the best published record of prehistoric land-use of the project area.

It is probable that the abundance of fish made the project area attractive for resource procurement and settlement. Prehistoric-era archaeological remains which might be preserved in the project area include concentrations of chipped and ground stone artifacts found in poorly developed *midden and non-midden contexts*. These sites are most likely found on elevated terraces situated near rivers, creeks or springs. The gravel bars, which constitute the majority of the direct impact areas, would not have been archaeologically sensitive because any prehistoric sites or artifacts located there would have been completely destroyed or carried away by previous major floods (especially those in the 1950's and 1960's).

Pre-fieldwork research completed by James Roscoe for a Cultural Resources Study (Appendix G), included an examination of the archaeological site records, maps, and project files of the Northwest Regional Information Center of the California Archaeological Inventory. Historic maps, photographs, local newspapers, books and monographs, as well as oral history testimony were also used in the investigation.

Following the pre-fieldwork research, a mixed strategy archaeological field reconnaissance of the project area was conducted. The Chairman of the Table Bluff Rancheria was consulted regarding any specific Native American concerns for the project area, as were other local archaeologists.

Extant cultural resources were recorded on standard archaeological site record forms devised for California by the Department of Parks and Recreation. No artifacts were collected, and no subsurface testing was performed during the study.

Archaeological Sites

The Arcata and Mad River Railroad, known locally as the "Annie & Mary," is a previously recorded historic site (CA-HUM-827/H) located along the banks of the Mad River. The railroad crosses the Mad River on the North Coast Railroad Authority's Division Bridge downstream of site no. 5, at river mile 9.8. The railroad was recorded in 1987 as a historic archaeological site after being registered as California Historical Landmark No. 842 in 1970. The potential impacts to the railroad bridge and its piers from mining activities, are discussed in the "Public Utilities and Structures" section.

Two prehistoric archaeological sites were discovered and recorded on river terraces above gravel extraction areas near the Arcata and Mad River Railroad bridge (Roscoe investigation,

see Appendix G). The sites have been given the trinomials CA-HUM-930 and CA-HUM-931 by the Sonoma State University, Northwest Regional Information Center.

The precise locations of these two sites are not included in this report to preserve the confidentiality of known archaeological resources.

Impact Statements and Mitigation Measures

Impact

Arch-1: Two prehistoric archaeological sites are recorded on river terraces above proposed gravel extraction areas in the project area. The sites have been given the trinomials CA-HUM-930 and CA-HUM-931 by the Sonoma State University, Northwest Regional Information Center. The locations are not being disclosed in order to protect the sites. At least one of these sites may be at risk due to streambank erosion. If bed degradation, or other factors, cause bank failure in the area of the identified archeological resources, these resources could be significantly impacted. (PS/LS)

Mitigation Measures

Mit-17: There are two recorded archeological sites located near one of the potential operating sites. The SDRC shall examine these sites and become familiar with the potential bank erosion problem during 1994 and at least once per year in following years. If problems exist now the SDRC may be able to propose solutions. The SDRC will also be able to consider related potential impacts during site specific planning if gravel extraction is proposed on nearby gravel bars.

Monitoring

Humboldt County Scientific Design and Review Committee
Blue Lake Rancheria
Table Bluff Rancheria.

Mit-18: Although only two sites were found, the Mad River basin is known to contain significant archaeological resources, therefore, should concentrations of archaeological materials be encountered during operations, all ground-disturbing work in that vicinity shall be halted. Work near the archaeological finds shall not be resumed until a qualified archaeologist has evaluated the materials and offered recommendations for further action.

Monitoring

Scientific Design and Review Committee
Blue Lake Rancheria
Table Bluff Rancheria.
Gravel Operators
Humboldt County Planning and Building Department
California Department of Parks and Recreation

Significance after Mitigation

Less than significant

5.14 Recreation

The County retained Rising Sun Enterprises to gather and analyze information on viewsheds, recreation, noise and traffic resulting from historic gravel extraction operations; and to analyze the effect of historic gravel extraction operations on the recreational use of the project area. Portions of the following section were adapted from the Rising Sun report. See Appendix E for the complete report.

Setting

Recreational use of the Mad River and its river bars includes sports fishing, swimming, hiking, boating, horseback riding, hunting and off-road vehicle use. During low flows, off-road vehicle access is limited to controlled access at most extraction sites and to trespass at a few locations.

Designated recreational use areas include the Water District's two pump station parks and the Mad River Fish Hatchery. Handicapped fishing access is available at the Mad River Hatchery. Other public access includes the Hammond Bridge, the County Mad River Beach Park and Boat Ramp. See Map 5.14-1 for these locations. River access is made at other locations with or without the permission of landowners, see Map 5.14-2 for the general ownership within the Mad River basin.

Gravel extraction operations, as well as the effects of skimming and trenching on the bars are visible to recreational users of the river bars. Extraction is limited to 4-5 months of the year. Most operators do not operate on weekends, which is the time that most family recreational use occurs. Fishing commonly occurs in the early morning or evening hours, when processing activities rarely occur. However, anglers utilize the river at all times of the day.

Boating activities, primarily kayaking and inner tubing, occur in the summertime. Boaters traveling downstream from the Fish Hatchery to the Highway 101 bridge during the extraction season can be affected by as many as four summer bridge crossings. In addition, low flow conditions may require portages at several other places on the river, due either to channel configuration or artificial blockages such as the weirs at the Humboldt Municipal Water District and the Fish Hatchery. See Map 5.14-1 for some of these locations.

Any object in a river that water flows through rather than around is called a "strainer" by whitewater boaters and is extremely dangerous. Summer bridges or culverts that remain in the channel during high flows present a serious hazard to boaters. A flooded bridge can easily trap swimmers, boats, or people who fall out of boats.

Overview

The degree of significance of gravel induced impacts on recreation are, in part, based on the perception of the recreationalist. The PEIR takes the worst case scenario that the views, noise and dust generated by the project could be significant, or potentially significant, even though there may be equal feeling that these impacts are not significant.

Extraction Methods

During gravel extraction, certain portions of the river bar undergo an unnatural physical change. The resulting unnatural alterations may be apparent from May through October, or until the first substantial storm. As described above, extraction operations could be perceived as having an adverse affect on aesthetic values for recreation.

Operators may be required by CDFG under 1603 agreements, to stake and flag extraction areas . The placement of metal fence posts or rebar on the gravel bar may detract from the recreational experience, but would not be considered significant.

The U.S. Army Corps of Engineers has restricted the previous trenching practice of leaving stockpiles alongside a trench for several days. A nationwide permit for stockpiles below the area of high flow in an average year ("Ordinary High Water"), and for summer bridge crossings is required.

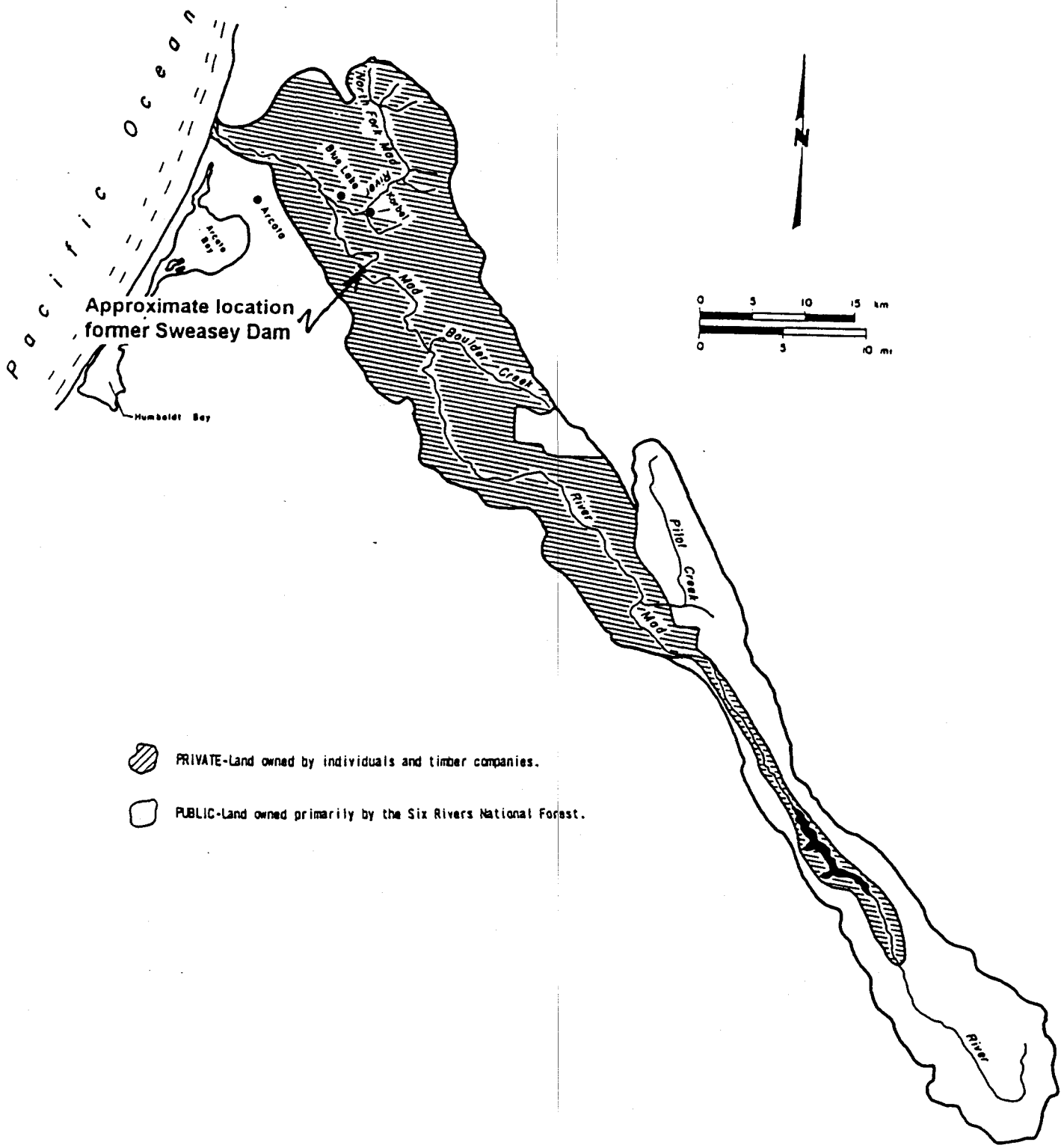
Trenches can be hazardous to recreational users of the river bars. On the Eel River, in 1991, a horse drowned in a trench. Most trenches have murky water and unstable, near vertical walls making it easy to misjudge trench and water depth. Unfortunately, many recreationists use poor judgment when trying to cross these trenches.

Beneficial Effects to Recreation

The trenches made in 1990 and 1991 are now mostly filled with gravel but, for a time, they were heavily used and preferred by bathers in the summertime, and by fish & anglers in the fall and early winter months. Gravel extraction access roads are often used by recreationalists.

The Emmerson Bar and surrounding riparian forest is heavily impacted by motorcycles and other off-road vehicle use. Bathers, anglers, and others also use this site. Often times these uses conflict with one another.

(adapted from: Rising Sun Enterprises Consultants Report, Appendix E)



Map 5.14-2
General Ownership Map
Mad River Basin

(adapted from: DWR, June 1982 "Mad River Watershed Erosion Investigation")



Photo 5.14-1
Extraction Operation

Impact Statements and Mitigation Measures

Impact
Rec-1: Trenches can be hazardous to recreational users of the river bars and are considered a potential significant impact. (PS/PS)

Mitigation Measures
Mit-19: A public safety plan, including signs posted adjacent to trench areas, shall be prepared by the operator and submitted to HCPD, for review and approval as part of the annual review process. Extraction design shall consider the length of the trench in relationship to recreational uses and access. This measure will assure that proper warning is given recreational users of the river bar.

Mit-20: Stockpiles adjacent to trenches shall contain breaks between piles to facilitate egress from trenches.

Mit-21: One of the long-walls of the trench shall be graded/excavated at such an angle as to facilitate emergency escape.

Monitoring
Scientific Design and Review Committee
Humboldt County Planning and Building Department
California Department of Parks and Recreation
State Lands Commission

Significance after Mitigation
Even with the mitigation measures, some recreational users of the gravel bar may not heed the warnings and may place themselves in danger with regard to the excavated trenches. The PEIR takes the conservative approach that even after mitigation the use of trenches remains a potentially significant impact.

Impact
Rec-2 Summer bridge crossings could impact recreational users of the river. If the crossings are low, kayakers and tubers will need to portage. This is considered less than significant. No mitigation is proposed for this impact. See Rec-3 for a related impact. (LS/LS)

Mitigation Measures:
None proposed

Monitoring:
None required

Impact
Rec-3: Low summer bridge crossings could present hazards to river users, especially kayakers and inner tubers. These can be especially dangerous if the water rises and is used by boaters before the bridges are removed. (PS/PS)

Mitigation Measures
Mit-22: A public safety plan, including signs posted warning of summer bridge crossings, shall be prepared by the operator and submitted for review and approval as part of the annual review process.

Mit-23: Summer bridges shall be removed according to schedule and shall not be allowed to remain in channel during high flows.

Monitoring
Humboldt County Planning and Building Department
California Department of Parks and Recreation
State Lands Commission

Significance after Mitigation
Even with the mitigation measures, some recreational users of the river may not heed the warnings and may place themselves in danger with regard to the summer bridges. The PEIR takes the conservative approach that even after mitigation the use of summer bridges remains a potentially significant recreational impact.

Impact
Rec-4: Noise can have an adverse impact on recreatinal users. Refer to Noise Impact-10 for discussion of this subject. (SU/SU)

Mitigation Measures
Mit-10: Although the project noise impact is insignificant the existing noises are sometimes significant. If the exhaust systems of all internal combustion engines owned or maintained by the operators are kept in good repair and as manufactured at least a portion of the existing noise will be minimized.

Monitoring
Cal-OSHA
Humboldt County/Scientific Design and Review Committee

Mit-16: Although most approved reclamation plans provide for longer hours of operation, gravel bar extraction operations will normally occur between the hours of 7:30 a.m. and 5:30 p.m. Monday through Friday. This helps reduce conflicts for early morning, and evening anglers, and weekend recreational users. However, if environmental or other circumstances create a shorter than normal extraction season it may sometimes be necessary to extend the operating hours in order to complete the permitted extraction within the allowable time.

Monitoring
Humboldt County Planning and Building Department

Significance after Mitigation
Extraction noise impacts on the river will sometimes be potentially significant even though the project impacts are less than significant.

6.0 PREFERRED ALTERNATIVE

The project is the development of an enforceable Mad River instream mining regulatory program that will operate under the authority of SMARA and any existing or future County procedures and ordinances. The purpose of the project is to enhance and protect the aggregate extraction-related environmental riverine resources of the Mad River corridor.

The prefferred project alternative is the development and implementation of a flexible Mad River aggregate management program, monitoring program, and reclamation plans using coordinated extraction prescriptions and reclamation standards which will provide for a moderate rate of recovery (aggradation) at critical sites while protecting or enhancing other river resource values. The details of this plan are presented below.

MAD RIVER ADAPTIVE GRAVEL MANAGEMENT and RESOURCE PROTECTION PLAN

6.1 Goals

The goals of this plan are:

1. to regulate aggregate resource mining on the lower Mad River in a manner that will enhance and preserve the local environment and quality of life,
2. to reduce or eliminate existing aggregate resource mining related cumulative adverse environmental impacts influencing the lower Mad River environs,
3. to encourage and support innovative mining techniques for the production of aggregate,
4. to use an annual in-stream mining reclamation program to annually reclaim, restore, and/or enhance the environmental habitat of the Mad River,
5. to encourage the joint participation of industry, agencies, residents, and interested parties in a well-defined and consistent regulatory process,
6. to provide for effective and systematic monitoring and reclamation of aggregate mining operations along the Mad River.

6.2 Objectives

The specific objectives of this plan are listed below.

1. Air Quality: To maintain the superior air quality of the Mad River valley and to assure that any adverse air quality impacts resulting from aggregate mining are reduced to a level of insignificance.
2. Archaeological: To protect sensitive archaeological sites, both known and undiscovered from adverse impacts resulting from aggregate mining operations.
3. Channel Morphology: To obtain a degree of dynamic equilibrium and channel stability in the lower Mad River channel and to assure that changes in dynamic equilibrium and channel stability resulting from aggregate mining are minimized.
4. Fisheries & Habitat: To safeguard fishery habitat and reduce any adverse agregate mining related cumulative or future impacts to a level of insignificance.
5. Groundwater: To maintain the existing quality of groundwater and groundwater supply and to assure that adverse impacts to or on groundwater that may result from aggregate mining are reduced to a level of insignificance.

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3. to encourage and support innovative mining techniques for the production of aggregate,
4. to use an annual in-stream mining reclamation program to annually reclaim, restore, and/or enhance the environmental habitat of the Mad River,
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3. Channel Morphology: To obtain a degree of dynamic equilibrium and channel stability in the lower Mad River channel and to assure that changes in dynamic equilibrium and channel stability resulting from aggregate mining are minimized.
4. Fisheries & Habitat: To safeguard fishery habitat and reduce any adverse agregate mining related cumulative or future impacts to a level of insignificance.
5. Groundwater: To maintain the existing quality of groundwater and groundwater supply and to assure that adverse impacts to or on groundwater that may result from aggregate mining are reduced to a level of insignificance.

6. Hydrology: To assure that aggregate mining does not adversely affect the flow or flood conveyance capability of the Mad River.

7. Quality of Life: To ensure a supply of aggregate material needed to maintain public health and safety, and quality of life.

8. Noise: To reduce as much as practicable, noise impacts which are caused by aggregate mining operations.

9. Public Utilities & Structures: To encourage channel aggradation at select sites inorder to regain structural integrity of all structures along the Mad River that might have suffered due to excessive channel degradation.

10. Recreation: To assure reasonably enjoyable and safe recreational experiences for all users of the river and riverine environment.

11. Traffic: To assure that aggregate and aggregate products are transported safely, and to reduce deterioration of existing transportation systems resulting from aggregate mining to a level of insignificance.

12. Vegetation: To protect significant stands of riparian vegetation from adverse impacts that might result from aggregate mining and to reduce cumulative impacts that have impacted riparian vegetation along the lower Mad River.

13. Viewshed: To protect and enhance, where possible, the aesthetic quality of the Mad River corridor.

14. Water Quality: To reduce adverse water quality impacts that may result from aggregate mining to a level of insignificance.

15. Wildlife and Habitat: To protect wildlife and wildlife habitat, and to assure that any adverse impacts on wildlife and wildlife habitat that may result from aggregate mining, are reduced to a level of insignificance.

6.3 Responsibility

It is the lead agency's responsibility, through SMARA (2711 and 2712) to recognize: that continued surface mining is essential to the economic well-being of society; and that the reclamation of mined lands is essential to prevent or minimize potential adverse effects on the environment and to protect public health and safety.

SMARA (2774b) requires that the lead agency inspect all surface mining operations at least once per year to verify compliance with SMARA. SMARA (2772g) also requires that reclamation plans specify the proposed use of mined land after it has been reclaimed and (2772h) requires the rehabilitation of affected streambed channels and streambanks to a condition that will minimize erosion and sedimentation

6.4 Instream Reclamation Concept

Reclamation, as defined in SMARA 2733, "means the combined process of land treatment that minimizes water degradation, air pollution, damage to aquatic or wildlife habitat, flooding, erosion, and other adverse effects from surface mining operations, including adverse surface effects incidental to underground mines, so that mined lands are reclaimed to a usable condition which is readily adaptable for alternate land uses and create no danger to public health or safety."

In many cases the mine site is dedicated to mining for a number of years, subject to annual erosion control and other reclamation requirements, and then reclaimed for an appropriate alternate land use. But, instream mining is different.

In the case of instream sand and gravel mining during low-flow periods, the expected and immediate proposed uses of the mined land will be those beneficial uses of a functioning stream channel, year-round during both high and low-flow periods. The combined annual activities of the operator and the hydraulic forces of the river are the forces that treat and reclaim the mined land and determine its suitability for use as year-round river habitat. Therefore, annual mining and reclamation activities must be regulated to protect the continuous low-flow and high-flow beneficial uses of the river channel. River channel beneficial uses include, but are not limited to: water conveyance, sediment transport, recreation, wildlife habitat, fish habitat, fish passage, water supply, and gravel mining. Erosion, scour, deposition, sediment transport, plant growth, aquatic food chain production, and a host of other physical and biological processes occur in the river channel environment and maintain or regulate the channel's beneficial uses. Those processes, and therefore a significant portion of the required reclamation, are dependent, in part, upon adequate gravel transport through the mined reach and replenishment at the mined site. If the channel does not have a reasonable ability to maintain itself and transport gravel then reclamation has not taken place and as per SMARA 2774.1(a) the surface mining operation(s) would not be in compliance.

6.5 Enforcement

Enforcement of the above is provided under SMARA 2774.1 and in 2774.1(f) the primary responsibility for enforcement is assigned to the lead agency. Under 2774.1(c), administrative penalties of not more than $5,000 per day be imposed by the lead agency or the State Geologist. Under special circumstances, the lead agency or the Attorney General may seek an injunction enjoining a mine that is not in compliance (Section 2774.1(d)).

6.6 Introduction To The Management Plan

This adaptive management plan will achieve reclamation by providing a degree of dynamic equilibrium between the significant biological and physical channel-forming processes operating in the lower Mad River. It will do so by using monitoring data to support professional scientific judgement in an annually iterative feedback loop which will produce incremental changes in monitoring, reclamation, and management prescriptions.

In order to assure and provide adequate annual reclamation, the plan provides for regulating the commercial extraction of riverrun sand and gravel under specified conditions from specific sites located along the lower Mad River between the Blue Lake hatchery weir and the U.S. Highway 101 bridges. It is a flexible, site and river reach specific adaptive management plan which will result in annual reclamation, environmental protection, the protection of public structures and comprehensive environmentally-sound mining and reclamation standards while providing the potential for limited continuing commercial extraction of riverrun materials from the lower Mad River.

The adaptive management plan, flexible mining strategies, and reclamation standards require monitoring of the project-area resources to estimate sand and gravel recruitment and replenishment, to monitor reclamation and all related river resource conditions and trends, to verify operator compliance, to determine the impact of past mining, and to evaluate annual mining strategies. The combined regulation, monitoring, and annual evaluations will result in appropriate, flexible, environmentally-sound mining strategies which may vary from year to

year and site to site. Under this plan the location, method, and level of extraction will be developed annually through a consultive process between the operators, and a Scientific Design and Review Committee (SDRC), acting as an agent for the lead agency (Humboldt County). A mechanism for review of the SDRC management prescriptions and activities by responsible state and federal trustee agencies and the public is included.

6.7 Scientific Design And Review Committee

The County, as lead agency, will retain the services of a three or four-member Scientific Design and Review Committee (SDRC). The composition of the SDRC, in order to provide the necessary technical expertise will, at least, include experts in the fields of fluvial hydrology, fluvial geomorphology, and fisheries. Other areas of expertise that may be needed on the SDRC include botany, engineering, forestry, watershed managment, and wildlife biology. When particular necessary areas of expertise are lacking from the SDRC, the SDRC may retain consultants to provide required input.

The SDRC, acting as an agent for the lead agency, in combination with the CDFG 1603 process, will monitor, review, guide, limit, design, and modify gravel extraction activities, reclamation activities, and mitigation activities in the lower Mad River area. According to the 1994 Mad River PEIR, these extraction activities will be limited to specific sites in the reach between the Mad River Hatchery weir and the U.S Highway 101 bridges.

Klein (1993) describes the morphology of the lower Mad River as degraded, destabilized, haphazard, and chaotic. The science of river management is not so well advanced to allow rigid formula-driven decision making to dominate the planning and monitoring process in such a destabilized river system. The members of the SDRC must have a unique blend of knowledge and experience that, collectively, will enable them to combine the science and art of river management and monitoring to develop environmentally sound flexible, site-specific, prescriptions for gravel extraction. They also must have the necessary skills to recognize when other expertise is needed and will be able to communicate with and call upon various other engineers, scientists, agency personnel, and the gravel operators for assistance and advice.

The SDRC will consult with the operators, the operators' engineers, the County Planning Department, specialists from the CDFG and other trust agencies, and other consultants in order to obtain the information and knowledge needed to carry out their assigned tasks.

Collectively, the members of the SDRC shall be, or will become, familiar with the Mad River corridor and its riverine resources, with particular emphasis on the reach between the mouth of the river and the old Sweasey Dam site. Some of the significant features of the Mad River corridor include:

1. The Mad River sand and gravel industry, including location and extent of operating sites, and the nature of operations at each site;
2. The physical aspects of channel morphology, sediment transport processes, sediment transport rates, sand and gravel recruitment, and gravel bar replenishment;
3. Biological aspects including such things as riparian vegetation extent and composition, wildlife habitat characteristics, aquatic habitat characteristics, wildlife habitat needs, fisheries habitat needs, wildlife and fisheries populations; and

4. Community infrastructure within the lower Mad River corridor, including such things as bridge crossings, utility and pipe crossings, water diversions, levees, revetments, weirs, boat ramps, and other structures that might impact or be impacted by changes in channel morphology.

Appointments to the SDRC

Appointments to the SDRC are the responsibility of the Humboldt County Board of Supervisors. The Board may form a Mad River Technical Advisory Committee (MRTAC) or other such group and delegate committee appointment and replacement responsibility as well as other responsibilities to that group.

The initial composition of the SDRC may be the four scientists who prescribed, guided and reviewed Mad River gravel extraction during 1992 and 1993 under the terms of the 1992 Mad River MOA and 1993 addendum extending the MOA for the 1993 extraction season. These individuals are:

Dr. Douglas Jager - Professor of Forestry and Watershed Management, Humboldt State University. watershed specialist, forester, and hydrologist

Mr. Randy Klein - Consulting Hydrologist and Certified Erosion and Sediment Control Specialist (CPESC)

Dr. Andre Lehre - Professor of Geology, Humboldt State University, hydrologist and sediment transport specialist

Dr. William Trush - Director of Institute for River Ecosystems, Humboldt State University, fisheries specialist and hydrologist.

Committee Member Consulting and Conflicts of Interest

The SDRC shall participate in the Mad River extraction designs and resource monitoring reviews as a team. It is understood that no member of the SDRC will consult privately regarding the extraction of instream sand and gravel from the lower Mad River extraction area. If the Mad River operators need Mad River gravel extraction related advice or other similar information they may consult with the SDRC but not with an individual member of the SDRC; or, they may go elsewhere for the advice they seek.

It is also understood that the provisions of this plan will not limit members of the SDRC from consulting on other matters near or within the lower Mad River extraction area or on gravel-related matters outside of the lower Mad River extraction area.

It is possible that individual members of the SDRC will provide gravel-related consulting services to Mad River gravel operators, various public agencies, environmental groups, or others outside of the Mad River watershed. The degree to which such consulting occurs should be monitored. Therefore, each member of the SDRC shall disclose all economic interests in and income from (including income of more than $250 from any single source) any business or other activity which is related in any way to gravel operations in Northern California. Disclosure shall be accomplished annually, during the month of January for the previous calendar year, by filing a statement of economic interest at the Office of the Humboldt County Clerk.

6.8 Concerned Contact List

The SDRC shall establish and maintain a Concerned Contact List (CCL) with specific individual contact names. Each year the SDRC shall request that the contact list representatives express

their site specific or general concerns regarding Mad River gravel extraction and Mad River resource protection.

Initially, the SDRC will request the following agencies and organizations to participate by joining the Concerned Contact List.

Individual Mad River Gravel Operators
Humboldt County Board of Supervisors
Humboldt County Planing Director
Humboldt County Department of Public Works
Humboldt Bay Municipal Water District
Humboldt County Surface Mining Advisory Committee
McKinleyville Community Services District
North Coast Railroad Authority
City of Blue Lake
Blue Lake Rancheria
Table Bluff Rancheria.
California Department of Transportation
California Department of Fish and Game
California Resources Agency
State Board of Mining and Geology
Department of Conservation
Department of Fish and Game
State Lands Commission.
Representatives of local environmental groups

These agencies and organizations shall have an opportunity to request that they not be included on the Concerned Contact List. Other agencies that may have been overlooked may request that they be added to the Concerned Contact List.

6.9 General Duties Of The SDRC

Under this plan, the duties of the SDRC include:

1. The SDRC shall select a chair person through which the operators, members of the Planning and Building Department, representatives of the Concerned Contact List, various trust agencies, and the public will contact the SDRC.

2. Each year the SDRC shall objectively through a site specific analysis, prescribe the total amount of instream sand and gravel that can be extracted during the upcoming extraction season. Because of current environmental concerns, revolving around bed degradation the SDRC shall establish a total average annual extraction rate that is less than the average annual net recruitment and will provide replenishment and aggradation at sites where excessive degradation has created adverese environmental impacts.

3. The actual amount to be extracted will be dependent upon reclamation, net recruitment, individual bar replenishment, individual bar morphology, as well as other river resource conditions and trends - all of which will be determined by a flexible monitoring program.

4. Using the above information, the SDRC will prescribe the amount, location, and method of sand and gravel extraction at each of the permitted operating sites in the lower Mad River extraction area.

5. *An attempt to develop a formula-driven method for allocating gravel to each operator during periods of low recruitment and replenishment was rejected by the operators. The operators have indicated that they will accept the extraction prescriptions of the SDRC .*

6. The SDRC shall provide a succinct statement of supporting facts and reasoning when requesting information, making recommendations, or writing extraction prescriptions.

7. The SDRC shall develop and maintain a monitoring program to obtain the information needed for making decisions regarding extraction locations, extraction levels, and extraction prescriptions. In response to the need or lack of need for specific information, the SDRC shall modify the monitoring program, with justification, to obtain the information which is needed to evaluate river physical and biological resource conditions and trends which may be influenced by gravel extraction and processing activities.

8. The SDRC shall meet with the operators, the operators' engineers, and other agents of the operators, as needed to communicate the committee's needs for planning and monitoring information. The SDRC shall guide the operators and the operators' engineers so they can provide the required information in the most timely and cost-effective manner.

6.10 Annual Extraction Planning Process

The annual extraction planning process is a time-sensitive seasonal pre-extraction process that ends with the issuance of site-specific CDFG 1603 permits. The 1603 process is exempt from certain CEQA requirements.

1. The SDRC shall continuously collect, review, and evaluate Mad River resource monitoring data from various sources. This information will be used to evaluate the effects of past management decisions and extraction operations and to plan future extraction decisions.

2. Each year, during the month of January the SDRC shall request the members of the CCL to provide succinct statements of current site specific or general Mad River gravel extraction related concerns with site specific supporting facts and reasoning if possible. These statements should be received by the SDRC by May 1st so the SDRC can consider the appropriate concerns, while reviewing the project, and while planning or making recommendations or prescriptions. Members of the CCL or others may continue to provide relevant data as they become available at other times of the year and may meet with the SDRC as is necessary to review their concerns.

3. On or before May 1st of each year the SDRC shall request the Mad River gravel operators to preliminarily inform the SDRC regarding extraction sites that they would like to operate on during the upcoming extraction season.

4. During the month of May the SDRC will meet with the operators, the operators' engineers or other agents of the operators, as needed to communicate the committee's needs for planning information. The SDRC will guide the operators and the operators' engineers so they can provide the required information in the most timely and cost-effective manner.

   Such information may include but is not limited to vegetation surveys, wildlife surveys, aquatic habitat surveys, aerial photographs, planimetric maps, topographic maps, extraction volume estimates, physical cross sections, digitized cross-sections, and digitized terrain data. This information shall be collected as soon as possible following the recession of winter flows, but not so early as to present a significant likliehood of subsequent flood events which would render certain data obsolete.

The SDRC can proceed with its job in an effective manner only when the required planning and monitoring information is provided in a timely manner and in a format which readily lends itself to review and analysis.

During the same period the SDRC shall review significant river resources and infrastructure elements, and request monitoring data from responsible agencies. Examples would be the most recent spawning surveys or cross section information at each bridge site.

5. During the spring planning period, as soon as the water level allows access to the project area, the SDRC shall visit all of the operating sites, other significant bar features, and other significant river resource features in order to obtain preliminary qualitative estimates of gravel recruitment, gravel replenishment, and other changes that may have taken place over the winter, and to consider possible extraction prescriptions.

6. As soon as possible, after the water level allows access to the project area, the operators' engineers will collect and provide the SDRC with the information needed to make site specific, environmentally sound extraction prescriptions. Item four in this annual process gives examples of the kind information that may be needed. The entire extraction reach is being managed as a unit. Therefore, the ability of the SDRC to make site specific prescriptions will be limited until they have reviewed the appropriate planning data from all potential operating sites. In the absence of data from one or more individual sites the SDRC may not be able to proceed with any site specific prescriptions at other sites or only with the most conservative site specific prescriptions at other sites.

7. If the SDRC should consider any extraction method which would excavate below the depth of the thalweg within one mile upstream or downstream of a State highway structure, Caltrans will be notified and invited to participate in and review the prescription and prescription planning process.

8. As soon as possible, after receiving all of the required data in the desired format, the SDRC shall present their prescriptions to the operators or the operators' agents. Immediately after presenting the prescriptions to the operators the SDRC will schedule a public meeting to inform interested individuals and agencies about the proposed prescriptions. After presenting the prescriptions to the operators or their agents, and the interested agencies and members of the public, the entire package of prescriptions shall be immediately forwarded to the CDFG so they may prepare individual site-specific 1603 agreements at the request of the operators. At the same time the entire package of prescriptions will be forwarded to the Humboldt County Planning Department where it will remain available for public review.

Public Review and Appeal Process

Several individuals have suggested that there should be a pre-extraction public CEQA review of the SDRC extraction plans. A lengthy review at this time is not practicable. There are pressures to reduce potential adverse impacts by restricting the extraction season to the period between June 1st and September 30th. High water sometimes delays the beginning of the extraction season. The scientific committee planning approach and increased monitoring will surely lengthen the planning process. Concerns regarding potential early storms and fish migration have caused the CDFG to request that extraction operations cease early in the fall before operators have historically quit. Extraction operations that are compressed into an excessively shortened season can produce a variety of environmental problems. For example; traffic, noise, and dust might increase while public and employee safety might decrease. To enter in to a lengthy public review at this stage would further reduce the time available to extract gravel.

A CEQA review does not seem necessary because the discretionary powers of the SDRC are limited by this plan and the 1994 PEIR. The limitations allow the SDRC to certify compliance only for those operations that are in compliance with their reclamation plans and to develop extraction prescriptions that will not cause significant adverse effects or significantly increase existing adverse exatraction-related impacts. With these parameters controlling the decision-making process, it is difficult to imagine that the four scientists could agree on a prescription package that would cause irreparable damage to the river resources during any one extraction season.

The time for thoughtful public review is between extraction seasons and not during the shortened low-flow extraction season. During this post-extraction review period the SDRC and other interested parties can evaluate river condition and trends as well as river mining and reclamation activities.

In the absence of a special review process developed by the Board of Supervisors the following public review process will be available. All prescriptions, supporting information, and reports of the SDRC shall be on file at the Humboldt County Planning Office where they will be available for public review. Members of the public or others who wish to comment on or appeal the committee's actions can do so through normal Planning Department Channels.

Verbal comments should be followed by succinct written statements of site specific Mad River gravel extraction related concerns with site specific supporting facts and reasoning, if possible. The SDRC shall respond to these inquiries, comments, and appeals. If the responses of the SDRC do not resolve the issues being reviewed, the Planning Director may schedule a public hearing before the Planning Commission, or the Board of Supervisors.

This project will be implemented during the 1994 extraction season. After the fifth extraction season under this project (1998), the entire project will be thoroughly evaluated by the SDRC. The five-year findings of the SDRC shall be reviewed at a public hearing during which, recommendations for modifying the management plan, monitoring program and reclamation plan review process will be considered.

6.11 Extraction Standards

The terminology used to describe instream extraction techniques is not always applied consistently. Terms such as skimming, scalping, grading, bar excavation, ponds, pools, pits, wet land sites, and trenches are often used and the descriptions of these techniques sometimes overlap. Over time, the SDRC may attempt to establish some common terminology and standards regarding instream extraction techniques for the Mad River project.

Various extraction methods may be used throughout this project. Site-specific prescriptions and methods will vary from location to location and year to year. The primary objective to be considered when selecting site specific methods will be to ensure reclamation, extract gravel economically, minimize potential adverse environmental impacts, and maximize potential favorable impacts.

Present river conditions indicate that the extraction designs should attempt to confine the channel, encourage gravel transport downstream through select reaches and encourage gravel deposition in other select reaches. When skimming techniques are used, the following adjustments can be made:

1. altering the finished grade,

2. using steeper finished grades near the water's edge and less steep graded slopes further away from the water,
3. maintaining a vertical buffer between the edge of the water and the graded area,
4. maintaining a horizontal buffer between the edge of the water and the graded area,
5. restricting the area to be disturbed on individual gravel bars to maintain channel confinement,
6. avoiding significant vegetation
7. mitigating for distrubed vegetation

Generally, the minimum skimming standards would include

1. at least a 1-foot vertical buffer between the water's edge and the extraction area,
2. a minimum finished grade over the skimmed area of no less than one percent towards the channel.
3. where possible, concentrate skimming in lower 2/3rds of bar in order to encourage channel stability and confinement.

As river conditions and technology change, alternative methods or standards of extraction may be developed and recommended by other public agencies, the operators, or the public. The alternative methods may be reviewed and adopted by the operators and the SDRC.

Examples of recent Mad River prescriptions can be found by reviewing the MOA Scientific Committee reports for the 1992 and 1993 extraction seasons. The 1992 report is in Appendix L and the 1993 report is attached to the September 1993 Proposed Final PEIR on Gravel Removal from the Lower Mad River.

6.12 Total Allowable Annual Extraction Level

Current conditions dictate that project extraction should be less than recruitment inorder to achieve channel aggradation in certain degraded locations.

1. The overall extraction level for the project area may be based on any of the following:
   a. actual annual net recruitment or
   b. on the long-term average annual net recruitment or
   c. on a floating average annual net recruitment with either a short, medium, or long time base for the floating average. See the report by Doug Jager attached to the September, 1993 Proposed Final PEIR on Gravel Removal from the Lower Mad River (Attachment 2) for more information and an analysis of floating averages.
   d. Extraction level may be set after monitoring river resource conditions and trends more so than by monitoring recruitment. . If the river is aggrading at critical sites, the rate of extraction may be incrementally increased. If the river is degrading excessively at critial sites extraction will have to be reduced. With this approach, a red line or red zone would be a useful tool.

      While monitoring river condition and trend a river-bed "red line or red zone" may be established for the entire project area profile, or only at site specific trouble spots. An alternative may be to have no extraction if the river bed drops below the "red line". Or, limited extraction and increased monitoring may be appropriate when the river bed approaches or drops below the "red line".
2. Site specific extraction levels may be determined by monitoring site specific gravel bar replenishment with extraction set above, equal to, or below any year's replenishment.
3. Extraction locations and amounts will be controlled by permits, reclamation standards, and excavation standards .

Extraction locations, methods, and amounts will be controlled by judiciously applying some combination of alternatives one through three. It is time for the trust agencies, gravel operators, and environmental groups to let the scientists attempt to resolve and monitor the complex issues of river management that will be encountered in the Lower Mad River Corridor. In this situation flexibility and adaptation is needed. More definitive standards may be developed in the future, as river conditions improve and as the river approaches a state of dynamic equilibrium.

6.13 Reclamation Plans

Eight operating sites in the Mad River extraction area have approved reclamation plans. These plans were developed and approved prior to completing the 1994 Mad River PEIR and prior to developing this management plan.

An important component of this management plan is the SMARA required annual review of reclamation plans. During 1994 the operators shall revise their existing reclamation plans and submit them to the SDRC for review and recommendations after which they will be forwarded to the Humboldt County Planning Department for a CEQA review and approval. Following approval by Humboldt County the ammended reclamation plans must be submitted to the Department of Conservation's Office of Mine Reclamation for final approval.

These revisions are necessary for only two reasons. The two reasons are:

1. To organize and collate various approved and amended portions of the existing plans into a usable coherent package that can be easily read, interpreted, and reviewed by the SDRC and others.
2. To bring the existing reclamation plans into conformance with the mitigation measures and reclamation standards provided herein.

Providing the revised plans conform to this PEIR and the adaptive management plan, the CEQA review of the initial reclamation plan revisions will most likely result in a negative declaration. Thereafter, the lead agency shall review the reclamation plans for compliance on an annual basis as required by SMARA.

6.14 Monitoring Requirements

Section 21081.6 of the Public Resources Code requires that all public agencies adopt a monitoring and reporting program which assures that all projects approved by a lead agency comply with the required mitigation measures. This project is ongoing and much more complex than many and additional monitoring is required on a continuous basis to provide the necessary data for annual planning, design, and feedback. Thus, we have mitigation compliance monitoring as well as the monitoring needed to support the iterative review and feedback planning process.

There are many kinds of monitoring programs and it is important to carefully consider what information you are seeking when designing a monitoring program. What is to be done with the information? How much will the monitoring cost? How much money is available for monitoring? Budgetary decisions, changing river conditions, new technology, and planning needs will all influence future monitoring.

Some examples of monitoring and what kind of information may be sought for different types of monitoring are shown below.

Implementation Monitoring. This is used to determine if activities are being conducted as planned. Did the SDRC contact the CCL members in January? Were the reclamation plans revised, reviewed and approved in 1994 as planned? Are the wildlife surveys being conducted on an annual basis as required? Are the mitigation measures being implemented? This sort of information will be included in the SDRC reports.

Baseline Monitoring. Baseline monitoring is used to establish a data base for future comparisons. Examples would include establishing the current thalweg profile or the present extent of riparian habitat. Some baseline information already exists. Karen Theiss and Associates has prepared a riparian habitat vegetation map for the Mad River corridor. Topgraphic detail has been obtained at many sites throughout the project area. However, more topographic information is needed and will be specified by the SDRC.

Trend Monitoring. Measurements are made at regular well-spaced time intervals to determine the long term trend in a particular parameter. An example would be to periodically measure the thalweg or mean bed elevation at bridge crossings and other critical sites to determine if the river is degrading or agrading at these sites.

Compliance Monitoring. Have the operators followed the prescriptions of the SDRC? Are the operators complying with the mitigation measures and the reclamation plans?

Effectiveness Monitoring. Is the project accomplishing the desired effects? Is the gravel industry surviving? Are river resources at risk? Are there fewer complaints regarding noise on the river? Has the risk of bridge failure been reduced? Are migrating fish still gaining access to the tributaries? Some of this information will be known after baseline information is resureveyed. Some resurvey information will be needed on an annual basis and other information will be obtained less frequently.

These are the kinds of questions that the monitoring program must answer. The SDRC shall carefully design and implement the monitoring program. The SDRC shall also annually review the established monitoring program and revise it as needed.

The vertical datum used for surveying, planning, and monitoring on the Mad River will be the North American Vertical Datum 1988 (NAVD 88).

A more detailed example of one proposed compliance monitoring process is described below. This monitoring will determine if the operators are following the SDRC extraction prescriptions.

The SDRC shall visit each extraction operating site and processing site at least twice during the low-flow extraction season and at least once shortly after the extraction season.

During the extraction season the SDRC shall meet with the operators, the operators' engineers or other agents of the operators, as needed, to communicate the committee's needs for post-extraction compliance monitoring information. The SDRC shall guide the operators and the operators' engineers so they can provide the required information in the most cost-effective manner.

Such information may include but not be limited to production reports, aerial photographs, planimetric maps, topographic maps, extraction volume calculations, physical cross sections, digitized cross-sections, and digitized terrain data.

It is understood that the committee can proceed with compliance monitoring in a most effective manner only when the required information is provided in a timely manner and in a format that readily lends itself to review and analysis.

Within three weeks after the end of extraction operations the operators or their agents shall submit the time-sensitive required compliance information to the SDRC. The SDRC shall review this information, inspect the sites, and file their post extraction compliance report with the operators and with the Humboldt County Planning Department within one month after receiving the required information from the operators or their agents. The post-extraction compliance reports will be available for public review at the HCPD.

Other forms of monitoring will include annual wildlife surveys to determine if sensitive species are located near extraction sites or elsewhere in the project area. The SDRC will periodically review the need for additional wildlife surveys with the CDFG and other wildlife consultants. This process is described somewhat in mitigation number seven.

Because rivers are dynamic ecosystems and river management is not a precisely predictive science, the preferred project is a flexible adaptive monitoring and management program that will be administered by a team of scientists. The project design is flexible so the project can respond to changing river conditions. Therefore, there are monitoring and design alternatives which may not be adopted initially but could be adopted during the project life. In fact, some future mining and monitoring alternatives may not be currently recognized.

6.15 Mitigation Monitoring

A periodic site inspection form will be developed. Members of the SDRC or other agents of Humboldt County will complete the inspection form and file it with the County and the SDRC after each inspection. Copies of the inspection forms will be available for public review at the Planning Department.

Mit-1 The SDRC periodic reports, and prescriptions will include succinct summaries of topographic surveys and other monitoring information that is used to evaluate reclamation and plan extraction.

Mit-2 The SDRC will request the agencies described in Mit-2 to provide periodic reports on the integrity of Mad River structures under their responsibility. Those agencies that have major concerns about threatened structures will be monitored more closely. Those agencies who have no concerns and do not wish to participate will be noted. The SDRC will provide an annual summary of data collected under this mitigation on a form that will indicate the agencies, the structures and a summary of information reported.

Action: The exact action will be determined after consultation between the SDRC and affected parties. If the risk to structures is great and gravel transport is needed to reduce the risk, the SDRC will be more conservative when developing extraction prescriptions. If conditions are improving, the SDRC will so note and may begin making incremental alterations in extraction prescriptions. If conditions are getting worse, the SDRC will so note and may respond with prescription alterations and additional monitoring.

Mit-3 The SDRC will note eroding river banks that might benefit from revegetation. These will be added to a pool of areas that may be planted as mitigation for past cumulative impacts or for current disturbances. When planting does occur, the SDRC will follow up with timely survival, growth, and analysis surveys.

Mit-4 Whenever summer bridges are used for extraction operations in the project area, the date of installation and date of removal will be recorded. Other information that will be recorded on a form to be developed will include operator, location, size of bridge, approximate volume of material in bridge approaches, approximate clearance between bridge and water surface, equipment used to install and remove bridge, water quality impacts of installation and removal, compliance with public safety plan and notices warning boaters of potential hazards. Changes observed during periodic inspections will be noted.

Mit-5 If oil and grease spills are observes during river bar inspections they will be noted on the inspection form during periodic site inspections by representatives of the SDRC or other agents of Humboldt County. If such spills are noted the operator will be informed and the area will be cleaned up. If clean-up does not take place within 48 hours, the SDRC shall notify CDFG and Water Quality Control.

Mit-6 Spawning survey information and meetings between the SDRC and the CDFG will be recorded on a form to be developed. A summary discussion of information learned and the influence that this information has on developing prescriptions will be maintained for the record.

Mit-7 Annual pre-extraction wildlife surveys will be conducted by a competent wildlife biologist acting as a consultant to the SDRC. Wildlife survey reports will be provided to the operators

and to the CDFG. They will also be maintained for the public record. When the wildlife surveys include mitigating extraction recommendations they will be so noted and the SDRC will incorporate these recommendations into the extraction planning process.

Mit-8 Haul roads and haul road conditions will be noted on the periodic site inspection form. Abandoned haul roads and trails that are revegetated will be noted. All regevetation projects will be monitored for survival.

Mit-9 Gravel pile stockpiles and disturbances caused by gravel piles will be noted on the periodic site inspection form. Abandoned stockpile sites that are revegetated will be noted. All regevetation projects will be monitored for survival.

Mit-10 Noise from equipment exhaust systems and faulty equipment will be noted on the periodic site inspection form.

Mit-11 See Mit-8.

Mit-12 Traffic activity and speed will be noted on the periodic site inspection form.

Mit-13 Idle equipment and other industrial evidence stored on gravel bars will be noted on the periodic site inspection form.

Mit-14 The City of Blue Lake is responsible for enforcing its own laws. The County will not monitor this mitigation.

Mit-17 The SDRC will periodically (at least once per year) examine these sites for evidence of excessive bank erosion or an increased risk of erosion and note the condition a form that will be developed. Bank conditioins will be recorded in the SDRC annual reports.

Mit-18 Operators are responsible for informing the workers regarding the need for protecting archaeological materials. If such material is discovered, operators will note the time of discovery and immediately notify the County Planning Department.

Mit-19 Trenching is not likely to occur in the near future. If trenches are proposed, a special trench-site inspection form will be developed to monitor this mitigation.

Mit-20 See Mit 19.

Mit 21 See Mit-19.

Mit-22 See Mit-4.

Mit-23 See Mit-4.

Mit-24 All revegetation efforts will be monitored annually for survival and growth. The revegetation inspection form will include, the location, species planted, method of planting, survival and growth.

6.16 Costs and Reimbursements

The SDRC must have an annual operating budget if it is to plan an effective resource protection monitoring program. The SDRC shall prepare a budget request and submit it for approval through the Planning Department.

The Chair of the SDRC shall periodically bill the Humboldt County Planning Department for the services of the individual SDRC members. Said services and billings shall be either of a general nature or shall be billed against specific operations.

The annual SDRC costs of operation and other incidental costs, such as necessary wildlife surveys or vegetation analyses, will be paid for by the operators through an annual assessment which will be prorated according to the amount of gravel that each operator extracts. Small, exempt operations should also share in the cost of river managment according to a fee structure which shall be established by the Board of Supervisors. Reclamation plans will be modified to specify that no mining operation will be permitted or allowed to continue unless the past year's prorated SDRC expenses have been paid or placed in an escrow account if they are being protested. Appeals and protests associated with this project will be resolved through normal Planning Department appeal procedures.

Some work of the SDRC will be of a general nature and the costs shall be spread among the operators. Some work of the SDRC will be site specific for particular operators and that cost shall be borne by the individual operator. Thus, it will be to the operator's advantage to provide the SDRC with the necessary planning information in a format that will reduce the operator's overall combined engineering and SDRC fees.

7.0 ANALYSIS OF ALTERNATIVES

Pursuant to CEQA Guidelines Section 15126 (d) this section describes and evaluates a range of reasonable alternatives to the preferred alternative project which could feasibly attain the basic objectives of the project.

The focus of this section is on alternatives that are capable of eliminating significant adverse environmental effects or reducing them to a level of insignificance. The same environmental categories as presented in Section 5.0, Impacts and Mitigation Measures, have been used to identify and compare the significant environmental impacts of the alternatives with those of the project.

Alternative 1 - The Preferred Project with a Fast Rate of Recovery.
In the preferred project the Board of Supervisors establishes a SDRC and instructs the committee to establish and use coordinated extraction prescriptions and reclamation standards that will allow a moderate rate of recovery (aggradation) at critical sites while protecting or enhancing other river resource values. The SDRC is further instructed to reasonably establish the critical sites and interprete the term "moderate recovery".

In alternative one the Board of Supervisors provides the same instructions except they plead for a fast rate of recovery and a reasoanble intrepretation of same. It is expected that the SDRC would then reduce extraction levels (from the preferered alternative level) in order to more rapidly encourage channel aggradation at selected critical sites. Reducing the extaction level accordingly would reduce but not eliminate the extraction-related adverse impacts and have little impact on the processing impacts. Choosing a fast rate of recovery could significantly reduce the viability of some components of the Mad River gravel industry. Because more aggregate would have to be imported, traffic impacts would increase.

Alternative 2 - The Preferred Project with a Low Rate of Recovery.
In the preferred project the Board of Supervisors establishes a SDRC and instructs the committee to establish and use coordinated extraction prescriptions and reclamation standards that will allow a moderate rate of recovery (aggradation) at critical sites while protecting or enhancing other river resource values. The SDRC is further instructed to reasonably select the critical sites and to interprete the term "moderate recovery".

In alternative two the Board of Supervisors provides the same instructions except they will accept a slow rate of recovery and a reasoanble intrepretation of same. It is expected that the SDRC would then increase extraction levels (from the preferered alternative level) in order to encourage a gradual rate of channel aggradation rather than a moderate rate of channel aggradation at selected critical sites.

This alternative would result in a greater risk to structures (as compared to the prefered alternative or to Alternative 1). It would also increase the extraction-related adverse impacts and have little impact on the processing impacts. Because less aggregate would have to be imported, the traffic impacts would decrease.

The wisdom of choosing between alternatives one, and two and the preferred alternative is speculative and somewhat dependent upon the whims of nature as to when the Mad River will receive the next major series of storms that will likely produce a significant influx of bedload sediment into the river system and help to shorten the recovery period.

Alternative 3 - No Project and No Further Action by the Lead Agency

Pursuant to the CEQA Guidelines, Section 15126(d)(2) the specific alternative of 'no project' must be evaluated. The intent of the 'no project' alternative is to determine the potential significant effects, should the project or an alternative to the project not be implemented or developed.

Eight of the 10 sites being considered in this PEIR and in the preferred alternative are permitted with either vested rights or conditional use permits. All eight have approved reclamation plans. Without the project or some other action by the lead agency there is little opportunity for effectively controlling gravel extraction at these eight sites and for mitigating the potential adverse impacts of gravel extraction. In the recent past, when gravel was being extracted from the lower Mad River in the absence of effective regulatory control, the gravel industry was jeopardized by lawsuits and the threat of lawsuits as the operators argued amongst themselves and as environmental groups and trust agencies argued with the operators regarding how much gravel should be extracted at various sites and by what means. Part of this problem stemmed from the fact that neither the operators, the regulatory agencies, nor the concerned environmental groups had access to the necessary expertise to develop environmentally sound extraction management limits and mitigation measures.

The no project alternative would essentially return the industry, the regulatory agencies, and the concerned environmental groups back to the chaotic conditions that existed prior to developing the 1992 MOA which began the processes of developing this PEIR and looking for a solution to the problems that kept the entire Mad River gravel industry in turmoil and threatened a variety of Mad River resources with significant potential adverse impacts. Clearly, this alternative is both undesirable and unacceptable.

Alternative 4 - Moratorium (No Extraction allowed on the Mad River)
This alternative would require the Board of Supervisors to draft and approve an ordinance that creates a moratorium prohibiting gravel extraction anywhere along the Mad River. Moratoriums are by definition temporary. Therefore, the Board of Supervisors would presumably have to specify under what conditions the moratorium would be lifted

This alternative would reduce or eliminate many of the adverse and potential adverse impacts identified in this PEIR. This alternative would increase the use of fossil fuels as the need to import aggregate into the Mad River market area would increase.

Implementation of this alternative may eliminate or reduce the ability of the industry to extract gravel during periods when channel aggradation might be a potential problem.

Some Mad River operators are known to have sources of aggregate on the Eel River and some Eel River aggregate is now being imported into the Mad River market area. However, these Eel River sites have entitlement restrictions that could logically limit their potential to competitively fulfill all of the Mad River market needs. If this alternative is chosen, at least some of the Mad River operators would have to go out of business or find competitively-priced alternate aggregate sources. These are business decisions that would have to be made on an individual basis.

Although there is debate on this issue, in order to implement this alternative the Board of Supervisors may be required to 'take' some or all of existing authorized surface mining operations along the Mad River for public use (eminent domain). If so, the County would have to pay just compensation for each site 'taken'. The actual market value is not known, however, on the bases of tax assessor information, the assessed value of the land and improvements

for the authorized sites, is approximately $1,750,000.00. The market value would likely be much higher.

Alternative 5 - Permanent Injunction (No Extraction allowed on the Mad River)
This alternative would require the Board of Supervisors to draft and approve an ordinance that would permanently prohibit gravel extraction anywhere along the Mad River.

The impacts of this alternative would be essentially the same as alternative four. The biggest difference is the Board of Supervisors would not have to draft a set of conditions under which they could lift a moratorium.

Alternative 6 - No Extraction in the Project Area
If the Board of Supervisors believed that there were better extraction sites elsewhere on the Mad River they could draft and approve an ordinance prohibiting gravel extraction in the lower Mad River extraction area defined in this PEIR as being the reach between the hatchery weir and Highway 101. Some of the project adverse impacts, particularly visual, noise, and recreational might be reduced by this alternative. The exact effects of this alternative are speculative without knowing the specifics about alternate sites and the location of processing sites.

This alternative would not prohibit extraction elsewhere on the Mad River and might be a logical alternative if there were other suitable extraction sites. At present there is no significant instream aggregate resource downstream from Highway 101. Presumably the existing operators and others could seek permits to extract gravel at sites upstream from the hatchery weir, at sites on the North Fork of the Mad River, or at sites on other river systems. However, there are precious few suitable sites for gravel extraction on other relatively near river systems that are not already under the control of other operators.

Furthermore, when a river system is degraded or degrading and this degradation is creating adverse impacts, the logical place to extract gravel is as far downstream as possible. This maximizes the "ability" of the river to "utilize" the gravel for in-river needs prior to extraction. From that perspective and under the current circumstances it would be illogical to encourage or force the Mad River operators or others to look upstream for alternate sources of aggregate.

An additional consideration would be that the quality of the aggregate resources are known to vary within the system. Upstream sites would likely produce bigger and softer rock and less sand than downstream sites. Sites that are too far downstream may have lots of sand and very little rock. Both situations would create adverse processing impacts. Additional transportation impacts would likely occur.

This alternative would reduce or eliminate some but certainly not all of the adverse and potential adverse impacts identified in this PEIR.

Alternative 7 - Alternative Offsite Sources of Riverrun Aggregate
This alternative could be thought of as a variation of any other alternative that limits Mad River gravel extraction to levels that are below the Mad River market area demand. The Mad River operators are sent in search of alternative sources of riverrun aggregate that are outside the Mad River instream gravel extraction area. These alternatives would increase the use of fossil fuels as the need to import aggregate into the Mad River market area would increase.

Riverrun aggregate can be obtained from instream sources or by mining alluvial terraces. Thus, these alternative offsite sources include instream sources in other river systems, terrace mining in alluvial terraces along the Mad River corridor, and terrace mining in other valley systems.

Terrace mining in the Mad River corridor or elsewhere in Humboldt County would eliminate or reduce instream extraction impacts. Undeveloped river terraces are often occupied by valuable agricultural land or valuable riparian vegetation. Terrace mining would produce significant changes in land use and create a whole new set of impacts that would seem to justify site specific environmental analyses. Any further analysis at this point in time, without site specific proposals would be purely speculative.

Alternative 8 - No further channel degradation
The Board of Supervisors could allow uncoordinated extraction to continue as long as no further degradation occurs in some specified reach of the river. This would be difficult to achieve as one can rarely dictate river behavior. Given the current chaotic morphology, the river profile and alignment can be expected to fluctuate significnatly as the river attempts to move towards dynamic equilibrium. Furhtermore, uncoordinated extraction could continue to upset the equilibrium. Thus, there would be little that could be done to control the aggradation and degradation processes. Degradation would likely occur in some areas; other areas might stabilize, while aggradation might be occurring elsewhere. Most of the existing adverse environemental effects would not improve and some would likely get worse with this alternative.

Clearly, a more formal approach with monitoring and incremental changes in response to river conditions is needed.

Alternative 9 - Allow extraction only when the river is not degrading
This alternative was included in the September 1993 Proposed Final PEIR. It was the essence of the proposed Aggregate Resources Managment Plan. This is not a workable alternative and the fact that it was proposed caused the industry to lose faith in the 1993 proposed final. PEIR. A large flood could produce a significnat increase in instream gravel storage i.e., aggradation, after which the stream would likely begin to degrade. This alternative allows no extraction while the river is degrading. Alternative 9 does not recognize nor provide for normal temporal variation in watershed sediment production and cyclical patterns of aggradation and degradation. Under alternative 9, if the river went into a cycle of degradation no extraction would be allowed, even though there may be large volumes of gravel stored in the channel.

Alternative 10 - Offsite Sources of Non-Riverrun Aggregate
Quarry rock can sometimes be used as a satisfactory substitute for riverrun aggregate, particularly as fill material, or base material. Hard quarry rock can also be used as an additive to normal riverrun aggregate concrete if the density of the concrete must be raised. Angular quarry rock by itself makes a poor substitute for riverrun concrete aggregate; the problems being mostly related to cost, difficulty in pouring and pumping, and ease of finish. There are a host of social and environmental problems that must be addressed when considering quarries as alternative sources. Regardless, there are many developed quarries in Humboldt County and quarry rock is already being used in the market place. This use of this alternative resource reduces the demand for instream riverrun aggregate. As the cost of riverrun aggregate continues to escalate we will see more operators experimenting with quarry products in the market place.

Known quarries or pits within Humboldt County are listed below. They are divided into three categories: Commercial Quarries, these are quarries that have County authorization to operate; Quarries operated by the County Public Works Department, these quarries generally supply material for County road base or RSP structures and are not currently used for commercial purposes; and Historic Quarries, these quarries are know to have operated in the past; however, at this time no authorization is on file with the County for current use.

Commercial Quarries

Halverson Quarry

The Halverson Quarry is operated by Robert Halverson, covers approximately 5 acres and the commodity is stone. The quarry is located in the Freshwater area in Section 16, T5N, R1E HB&M, on assessor parcel number 501-211-01.

A-21 Quarry

The A-21 Quarry is operated by Mercer Fraser, Co., covers approximately 15 acres and the commodity is stone. The quarry is located in the Crannell area in Section 20, T8N, R1E, HB&M, on assessor parcel number 513-101-14.

Trinidad Quarry

The Trinidad Quarry is operated by Mercer Fraser, Co., covers approximately 10 acres and the commodity is stone. The quarry is located in the Trinidad area in Section 24, T8N, R1W HB&M, on assessor parcel number 515-171-10.

Jacoby Creek Quarry

The Jacoby Creek Quarry is operated by Barnum Timber Co., covers approximately 15 acres and the commodity is rip rap -stone. The quarry is located in the Bayside area in Section 24, T5N, R1E HB&M, on assessor parcel numbers 404-081-01 & 404-081-02.

Monschke Quarry

The Monschke Quarry is operated by Wallan & Johnson, covers approximately 3 acres and the commodity is stone for rock slope protection. The quarry is located in the Garberville area in Section 18, T4S, R4E HB&M, on assessor parcel number 213-146-09.

Tosten Quarry

The Tosten Quarry is operated by Gordon Tosten, covers approximately 5 acres and the commodity is road rock and rip rap. The quarry is located in the Miranda area in Section 16, T3S, R3E HB&M, on assessor parcel number 212-043-01.

R. Brown and Sons Quarry

The R. Brown and Sons Quarry is operated by Roger Brown, covers approximately 1.2 acres and the commodity is rip rap. The quarry is located in the Willow Creek area in Section 1, T6N, R4E HB&M, on assessor parcel number 316-061-04.

Walsh Quarry

The Walsh Quarry is operated by Jack Walsh, covers approximately 3 acres and is located in the Fortuna area in Section 18, T3N, R1E HB&M, on assessor parcel number 311-081-05.

Ammon Quarry

The Ammon Quarry is operated by McIntosh Construction Co., covers approximately 3 acres and the commodity is stone. The quarry is located in the Willow Creek area in Section 20, T6N, R5E HB&M, on assessor parcel number 524-075-23.

Mason Quarry

The Mason Quarry is operated by Wayne Mason, covers approximately 5 acres and the commodity is rock fill material. The quarry is located in the Bald Mountain area in Section 23, T6N, R3E HB&M, on assessor parcel numbers 316-163-02 & 316-163-09.

A-370/M-200 Quarry

The A-370/M-200 Quarry is operated by Mercer Fraser, Co., covers approximately 5 acres and is located in the Crannell area in Section 27, T8N, R1E HB&M, on assessor parcel number 513-081-01.

Hindley Pit

The Hindley Pit Quarry is operated by Raymond Etter, covers approximately 4 acres and the commodity is shale. The quarry is located in the Honeydew area in Section 31, T2S, R1E & Section 36, T2S, R1W, HB&M, on assessor parcel number 107-282-04.

Grooms Rock Quarry

The Quarry is operated by Herman Grooms, covers approximately 5 acres and the commodity is shale. The quarry is located in the Big Lagoon area in Section 32, T10N, R1E HB&M, on assessor parcel number 518-052-04.

Quarries operated by the County Public Works Department

Drewry Pit

The Drewry Pit is owned by Barbara Drewry, covers approximately 2 acres and the commodity is stone. The quarry is located on assessor parcel number 216-021-07.

Monument Pit

The Monument Pit is owned by Pacific Lumber Co., covers approximately 1 acre and the commodity is stone.

Brannon Mountain Pit

The Brannon Mountain Pit is owned by Peggy Rohrback and Mike Brady, covers approximately 1 acre and the commodity is stone. The quarry is located on assessor parcel number 522-053-00.

Dyerville Pit

The Dyerville Pit is owned by James Stewart, covers approximately 1 acre and the commodity is stone. The quarry is located on assessor parcel number 216-184-01.

Hansen Pit

The Hansen Pit is owned by Hansen Degnan Properties, covers approximately 1 acre and the commodity is stone. The quarry is located on assessor parcel number 207-036-01.

Fort Seward Pit

The Fort Seward Pit is owned by Norman G. Satterlee, covers approximately 1 acre and the commodity is stone. The quarry is located on assessor parcel number 216-184-01.

Historic Quarries

Hagen Pit

This pit is located one mile east of the town of Phillipsville on Anderson Creek in Section 18, T3S, R4E, HBM.

Hooker Creek Road Pit

This pit is located in Southern Humboldt County about four miles east of Phillipsville in the eastern half of Section 36, T 3S, R3E, HBM.

Jacoby Creek Road Rock Quarry

There are a few quarry sites within the Jacoby Creek basin (see also previous Commercial Quarries, Jacoby Creek Quarry).

Pit near Willow Creek

This pit has been used by CalTrans and is located about two miles west of Willow Creek, 1/4 mile southeast on a dirt road. Probably in Section 36, T7N, R4E, HBM.

Le Perrone Pit

There is a rock pit on the east side of Le Perrone peak on U.S. Forest Service land, about 17 miles from Orleans.

Cookson Rock Quarry

This rock quarry is located east of Stover Road in Redwood Valley.

Stover Creek Rock Quarry

This quarry is located 1/4 mile beyond the Cookson Pit on the same road.

Liscom Hill Quarry

This quarry is located in Section 9, T6N, R2E, HBM.

Alternative 11 - Alternate Technology

Alternate technology could potentially reduce the need for riverrun aggregate in some products. In a sense this is similar to the previous alternative using quarry rock. This alternative does not propose that gravel extraction on the Mad River be abandoned. Under this alternative, it is expected that the demand for gravel be supplemented with cullet (glass), thereby reducing the volume of aggregate extracted.

Humboldt County has recently been named a "recycling market development zone" by the California Integrated Waste Management Board. There are 16 such zones in the state. Local businesses can qualify for low-interest loans from the California Integrated Waste Management Board to convert waste products, such as cullet, into marketable goods. In addition, enterprises that use recycled materials may qualify for tax credits worth 40 percent of the value of the recycling equipment they buy.

The following discussion is premised on the use of cullet (glass), some of the information is based on a study by Gainer and Associates.

Glasphalt

Asphalt is a brownish-black solid or semisolid mixture of bitumen's (hydrocarbons from coal or petroleum) and sand or crushed stone gravel. In 1990, 94 percent of the nation's streets were asphalt. When glass cullet is used as a partial substitute for the aggregate in the mix, it is called *glasphalt.*

One of the few advantages of using cullet in asphalt is that the mixture cools more slowly than conventional mixtures, allowing longer rolling times, while the heat facilitates paving in colder climates.

In 1970, CalTrans conducted studies using glass as a substitute for aggregate. Results were disappointing. The glasphalt surface raveled and stripped, meaning pieces of cullet began to separate from the road surface. CalTrans staff determined that needed additional studies would require a great deal of experimentation and possibly add too much expense to the cost of glasphalt.

Over the years, the use of cullet in asphalt has been unusual and sporadic. As recently as 1990, CalTrans said that speed limitation, raveling, and the cost of substituting glass prevented their department from making use of glasphalt.

Gainer and Associates state that the direct use of cullet for glasphalt may not be economical in rural plant locations where cullet may sell at $40 to $80 per ton whereas aggregate could sell at $10 ton. Only if higher priced container manufacturing markets are not available and glass would otherwise be landfilled would glasphalt be a reasonable alternative cullet use in a small-scale, rural plant. Because the cost of transporting waste glass to other markets is high, it may be economically feasible to use cullet for some local purposes.

Brick

Research conducted prior to 1973 by the U.S. Bureau of Mines, Ceramic Research Lab revealed that bricks made with 10 percent or more cullet are stronger, resist absorption of water, and fire in half the time than regular bricks made with aggregate.

Bricks made with cullet meet the specifications for similar construction materials. The Gainer and Associates study suggests that the use of cullet for such products as ceramic bricks is only practical in small scale rural plant locations and if cullet costs are considerably less than $40 per ton.

Building Blocks - Cement

Cement blocks made with an undisclosed portion of cullet were tested in 1981 and found economically feasible. Performance met specifications for similar construction materials.

Cement

Ground glass can act as a synthetic pozzuolana - a siliceous and aluminous substance that reacts chemically with calcium hydroxide at ordinary temperatures in the presence of moisture to form a cement-like material. Cullet could potentially replace cement in concrete and improve its properties (see Building Blocks - Cement).

Concrete

When cullet is added to the matrix, it is called *glascrete*. The American Society of Testing and Materials showed in 1977 that direct use of glass cullet in concrete results in the same standard of performance as conventional concrete. However, Dr. Eugene Tseng, a noted cullet products expert, cautions about glass silica expansion.

A 1977 Utah University article stated that foamed glass can be used to make lightweight concrete aggregate. The resultant product has high compressive strength (about 1000 psi) and low density which make it an ideal construction element.

Research conducted by Teledyne National Corporation in 1978 confirmed that foamed glass can be used as a substitute for sand and gravel in concrete blocks. Use of cullet improved insulation qualities and provided a strong, lightweight product.

Although the technological feasibility of using glass or foamed glass in concrete has been shown by at least three research groups and one manufacturer, the cost of cullet ($40-$80/ton) as a substitute for sand or gravel ($10/ton) may present an economic barrier to its current use.

8.0 OTHER STATUTORY CONSIDERATIONS

8.1 Growth Inducing Impacts of the Project

According to CEQA Guidelines Section 15126(g), growth-inducing impacts are the ways in which a proposed project may "foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment." Also included are projects that may "remove obstacles to population growth."

Aggregate mining operations may effect economic or population growth, or the construction of additional housing because the cost and availability of the aggregate, and aggregate products (asphalt, concrete, raw material used for base material, leach fields, railroad-grade ballast and decorative rock) affects the cost of new construction. Aggregate mining can indirectly foster economic or population growth. A lack of aggregate would have direct significant adverse effects on the construction of additional housing.

The Humboldt County Housing Element, adopted by the Board of Supervisors on December 15, 1992, identifies housing needs and sets policies and standards to achieve numerous programs that address those housing needs. It also identifies housing and population trends, as well as factors that lead to increased housing costs:

> "Although growth in the housing stock kept pace with increases in the population, there has been a substantial erosion in the affordability of housing in the ten years between 1980 and 1990. The housing stock in unincorporated areas increased by just under 3,000 units during this time period (78% of the population increase), while the average value of housing increased by $31,000 to $88,000 in 1990."
>
> "A continuation of recent trends is projected for Humboldt's population and housing...To meet the future housing needs in unincorporated areas, it is projected that close to 2,500 units will have to be constructed between January 1, 1991 and July 1, 1997."
>
> "Current national, state and local market trends will largely determine the type, quality and quantity of housing that will exist in Humboldt County. Major costs and constraints contributing to the sale price or rental cost of housing in Humboldt County include direct and indirect market costs."

Typically the single highest direct, or indirect, cost of housing development is construction which accounts for a full 60 percent of the cost of new housing:

> "Local government regulations can also significantly increase housing costs by limiting the number of available building sites and increasing development costs." Section 2815 states "The miscellaneous State fees, development standards, and permit requirements which have the most significant impact upon the costs of building materials and housing development in Humboldt County include...Mines & Geology surface mining regulation."
>
> "While litigation has not posed a serious historic threat to affordable housing in Humboldt County, recent developments in this area are frightening. Litigation can seriously delay or prohibit housing projects...As a result of litigation with the historic operation of surface mines in the county (Site No.s 2, 3, 5, 8) basic construction materials may not be available to support the construction of needed housing.

> While the County Board of Supervisors has certified that the environmental documents are adequate for these historic operations, and the County has entered into an agreement with the State Departments of Fish and Game and Mines and Geology to allow limited surface mining on these historic sites, the litigation could adversely impact these important operations."

The Housing Element breaks population growth into census divisions. Material mined from the Mad River supplies aggregate to the North Coastal (McKinleyville north) and Arcata divisions, shares the Eureka division with material mined from the Eel river, and shares the Trinity-Klamath division with material mined from the Trinity River. On the basis of the 1970-1990 population growth figures for these areas, it appears that the Mad River supplied material to 58% of the total population growth in Humboldt County.

On the basis of a projected 58% population growth and resulting need for 2,500 additional housing units by 1997, approximately 1450 housing units will require aggregate and aggregate products in the area currently served by the Mad River aggregate producers.

Because the cost of construction is typically the number one factor in determining new housing cost, and because construction relies heavily on aggregate as a building material, the cost of aggregate has a significant bearing on the cost of new housing. It appears that rate of housing construction is not affected by either an increase or decrease in aggregate cost. Rather, the data indicates that the availability of aggregate and aggregate products only affects housing prices; any cost increase resulting from an increased price for aggregate is passed on to the home buyer. Similarly, a decrease in aggregate cost is passed on to the home buyer.

The housing element also describes polices for low income housing. There are specific benefits to a developer to construct low income housing. However, in order for a developer or contractor to be induced to construct low income housing, the contractor must make a profit from the construction and sale of the housing. If the cost of aggregate rises, the cost of construction also rises, and the incentive to provide low income housing diminishes.

Property taxes and insurance are tied to the appraised value of the development. Another indirect affect that the availability and affordability of aggregate has on development is that if the cost of aggregate (construction) rises, so does the value of the development and thus the property taxes and insurance is higher.

In order for Humboldt County to maintain affordable housing, the cost of the construction materials must remain affordable. If the Mad River aggregate producers are required to haul material from other sources, the resale value of the aggregate is expected to rise, thus the cost of housing construction will also rise. The availability of affordable aggregate can be said to "remove obstacles to population growth."

Other potential environmental impacts incurred from transporting gravel from outside sources include increased use of fossil fuels; and increased traffic, wear and tear on roads and highways; deterioration of air quality and impacts occurring at the site of gravel removal.

See Appendix M, John Henry Grobey, Consultants Report, and Appendix O for additional information on economic impacts.

8.2 Short-Term vs. Long-Term

Pursuant to the CEQA Guidelines, Section 15126(e), this section discusses the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity. Unregulated or poorly regulated gravel extraction can lead to a series of cumulative and long-term effects which could adversely affect the state of the environment. These effects are mostly associated with bed degradation and can be summarized as follows:

- Extraction of bed material in excess of average replenishment causes the bed to degrade upstream and downstream of the site of removal.
- Bed degradation can undermine bridge supports, pipe lines, or other structures.
- Excessive degradation may adversely alter the aquatic habitat.
- Excessive degradation can deplete the entire depth of gravelly bed material, exposing other substrates that may underlie the gravel, which could in turn affect the quality of aquatic habitat.
- If a flood plain aquifer drains to the stream, groundwater levels can be lowered as a result of bed degradation.
- Lowering of the water table can alter riparian wildlife habitat.
- Excessive degradation can impact fish migration and spawning habitat.
- Rapid bed degradation may induce bank collapse and erosion.
- The reduction in size or height of bars can cause adjacent banks to erode more rapidly or to stabilize, depending on how much gravel is removed, the distribution of removal, and on the geometry of the particular bend.

Other impacts that may be only indirectly influenced by bed degradation or may have no connection with bed degradation include the following.

- Cumulative impacts on riparian vegetation caused in part by annual scraping of gravel bars, roads, and processing sites. These are long term cumulative impacts that impacts will be partly mitigated by this project.
- Cumulative impacts on terrace development and indirectly upon developing riparian vegetation. These are long term impacts.
- The project contributes to cumulative long term visual impacts in many areas of the Mad River corridor .
- There are significant, long-term, unavoidable noise impacts along the river during the extraction season and year-round at some processing sites.

The project is the development of a flexible management strategy which will respond to monitoring information, the development of amended reclamation plans which will conform with the PEIR and management plan, and the development of mitigating measures for extracting sand and gravel from up to 10 sites along the lower Mad River. Eight of the ten sites already have County authorization to mine sand and gravel from the Mad River (see Table 1.2-1). If this project or a suitable alternative is not adopted, the Mad River gravel industry will remain poorly regulated and without review or mitigation. If extraction is allowed to continue under those conditions, the above impacts are likely to occur. The severity of many of the impacts, and how soon they will occur, depends upon the rate of bed degradation. The impacts would be significant and may be irreversible.

The CEQA Guidelines, Section 15126(e), requires that the PEIR provide justification for implementing the project now, rather than reserving an option for further alternatives. The justification for implementing the project is to protect the Mad River environment from unregulated gravel extraction and to meet the market demand for aggregate. Reserving the project for the future is not practical in light of the preexisting authorizations for eight of the ten sites to continue mining operations.

8.3 Irreversible Environmental Changes

Pursuant to the CEQA Guidelines, Section 15126(f), this section discusses significant irreversible environmental changes which would be involved if the project is implemented.

The project is designed to protect the Mad River and its environs from the potential additional irreversible environmental impacts of an unregulated gravel extraction industry. If the project is implemented and monitored as planned it is possible that the Mad River gravel industry will survive, that certain existing impacts will be reduced, and that many future impacts will be less than significant. Some existing impacts resulting from the project will not be significantly reduced. Details on these impacts are presented in Section 5.

9.0 SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Section 15126(b). of the CEQA Guidelines requires a discussion of any significant environmental effects which cannot be avoided, e.g. which cannot be mitigated to levels of insignificance if the project is implemented.

If the project in not implemented, the existing significant adverse impacts of the permitted operations will remain unavoidable and significant. For the purposes of this discussion, it is assumed that the preferred alternative described in Section 6.0 can be implemented.

The project as mitigated, would involve the following unavoidable significant environmental impacts:

1. Aggradation and degradation are controlled, in part by the availability of stream power and a sediment supply. The unstable hillslopes of the Mad River basin seem capable of providing an adequate supply of sediment when the necessary stream power is available to provide transportation. Because stream power is not totally predictable, we are uncertain to the degree which aggradation can occur over time. Therefore, even with the requirement to limit extraction, degradation may produce unavoidable impacts at bridge sites.
2. The existing impacts on recreation and viewsheds resulting from the permitted gravel extraction operations are unavoidable. For some impacts the significance is debatable, and is based on the perception of the person(s) experiencing the impact. The project has the potential to reduce some of the viewshed and recreation impacts.
3. Noise resulting from the permitted extraction and processing operations is unavoidable. In some cases, the impact is unquestionably significant, in others the significance may be debatable. The project has the potential to reduce some of the noise impacts.
4. There has been a significant cumulative loss of riparian wildlife habitat in the Mad River corridor. Gravel extraction and processing has contributed to this impact and continues to do so. However, the preferred alternative includes some revegetation mitigation which will improve habitat but not reduce the cumulative impacts to a level of insignificance.
5. The cumulative impacts of truck traffic through the city of Blue Lake are potentially significant and unavoidable.
6. Extraction and related activities can create hazards for recreational users of the river. See Rec-1 and Rec-3.

10.0 AUTHORS/CONTRIBUTORS/ PERSONS CONSULTED

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First Draft:

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Douglas Jager, PhD, Humboldt State University, College of Natural Resources & Sciences

10.2 EIR Contributors

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Randy D. KleinConsulting Hydrologist
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James Roscoe, MAArchaeologist
Susie Van KirkConservation Chair, Sierra Club, Redwood Chapter North Group
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10.3 Persons/Organizations Consulted

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Arcata ReadiMix
Board of Realtors
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Builders Exchange
CA Dept of Fish & Game
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CA Dept of Forestry
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CalTrans
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National Marine Fisheries
NorthCoast Railroad Authority
Office of Mine Reporting
Resources Agency
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RWQCB, Northcoast Division
Redwood Empire Aggregates
State Lands Commission
Dept of Environmental Health
Trinity County Planning Dept
Don Tuttle, County Public Works
U.S. Army Corps of Engineers
Aldaron Laird, Trinity Restoration
Albert James, Table Bluff Rancheria
Allan Bramlette, HSU Archaeology Prof. CA Archaeology Inventory, NW Info. Ctr
Silvia Daniel, Blue Lake Rancheria

11.0 BIBLIOGRAPHY

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12.0 COMMENTS AND RESPONSES TO RECIRCULATED DRAFT PEIR

Pursuant to CEQA Guidelines Section 15132, the following is a lkist of persons, organizations and public agencies that commented on the recirculated Draft PEIR, SCH 92083049.

Person, Organization or Public Agency	Letter Number
Dun & Martinek William Davis	1
County of Humboldt Planning & Building Department Thomas D. Conlon	2
State of California State Lands Commission Mary Griggs	3
State of California Department of Conservation Deborah L. Herrmann	4
State of California Department of Transportation Cheryl S. Willis	5
State of California Department of Fish & Game Richard Elliott	6
Humboldt Bay Municipal Water District Royal McCarthy	7
Sierra Club Redwood Chapter North Group Susie Van Kirk	8
Redwood Region Audubon Society Lewis Klein	9
David S. Kruger	10
California Trout, Inc Fred Neighbor	11
Michael Scalici	12
Humboldt County Department of Public Works Donald Tuttle	13
Rising Sun Enterprises Robert Brown	14
Trinity Associates Aldaron Laird	15

Note: Part 2 of 2 of the Proposed Final Program Environmental Impact Report, April, 1994 (gray cover) contains copies of comments received on the Draft EIR and responses to those comments. This document is available as a separate document from County Planning and is hereby incorporated by reference.

APPENDIX O

TESTIMONIALS REGARDING GRAVEL INDUSTRY

MERCER, FRASER COMPANY
General Contractors and Engineers
SINCE 1870
P.O. BOX 1006 • (707) 443-6371
EUREKA, CALIFORNIA 95502-1006

APRIL 22, 1992

THE GRAVEL FROM THE RIVERS IN HUMBOLDT, TRINITY, DEL NORTE, AND MENDOCINO COUNTIES IS THE MOST ECONOMICAL AND PRACTICAL MATERIAL FOR USE IN ALL CONSTRUCTION FOR HOMES, ROADS, SUBDIVISIONS, AND ANY OTHER CONSTRUCTION REQUIRING CONCRETE, ASPHALT MIX, OR PLAIN RIVER GRAVEL FILL.

IF CURRENT GRAVEL OPERATIONS ARE PROHIBITED FROM OBTAINING RIVER GRAVEL IN ORDER TO CONTINUE OPERATING, AND ARE FORCED TO USE OTHER SOURCES NAMELY ROCK QUARRIES OR IMPORTED MATERIALS FROM OTHER STATES THE PRICE OF THE PRODUCT WOULD BE PROHIBITIVE, ESPECIALLY TO NEW HOME BUILDERS AND TO BUILDING CONTRACTORS WHO USE CONCRETE AND ROCK PRODUCTS.

THIS ALONE WOULD DAMAGE OUR LOCAL ECONOMY, PROBABLY BRINGING ALL CONSTRUCTION TO A STAND STILL. THIS WOULD INCLUDE HIGHWAY AND BRIDGE CONSTRUCTION. THE MINING OF RIVER GRAVEL MUST CONTINUE FOR THE SAKE OF THE ECONOMY IN OUR AREA, WITHOUT THIS RESOURCE OUR ECONOMY IS CONDEMNED TO COMPLETE FAILURE.

SINCERELY,

Frederick O Bott

FREDERICK O. BOTT,
PRESIDENT

EUREKA READY MIX CONCRETE CO., INC.

EUREKA SAND & GRAVEL

P.O. Box 3568
Eureka, CA 95502-356

Mr.William O.Davis
Dun and Martinek
Attorneys at Law
730 Seventh St.,Suite B
Eureka, CA. 95501

April 23, 1992

Dear Mr. Davis,

I am sending you this letter to answer your question on alternate gravel sources in our area . At the present time there are no other sources for gravel in our local area other than the Mad,Eel,and Van Dusen rivers. I see no reason to believe this will change in the future. There are a few rock quarries locally but they deal in large,1 foot in diameter and larger, granite rock that would not be a usable material to make the products we need.

If these rivers were to be closed to gravel extraction it would have a devastating effect on our local economy. Unable to supply area contractors with concrete,sand and gravel they need to build homes and commercial buildings, we would be forced to close down. These possible river closures would also affect asphalt plants which supply materials to paving contractors.

Sincerely,

Larry McLaughlin

Larry McLaughlin
Eureka Readymix Co.

Eureka Office (707) 443-2791 • FAX (707) 443-1368
Blue Lake Plant (707) 822-2937 • Shop (707) 822-5736 • Shop FAX (707) 822-9218
Fortuna Plant (707) 725-4417 • Crescent City Plant (707) 464-3126

R.A.O. CONSTRUCTION CO., INC.

5503 WALNUT DRIVE ■ EUREKA, CA 95501 ■ 707-443-2118

APRIL 22, 1992

TO WHOM IT MAY CONCERN:

R.A.O. CONSTRUCTION COMPANY IS CONCERNED ABOUT RECENT RUMORS THAT PERMITS WILL NOT BE ISSUED FOR ANY EXTRACTION OF GRAVEL ON THE MAD RIVER AND ONLY A FEW PERMITS ISSUED ON THE EEL RIVER.

IF THIS WERE TO INDEED HAPPEN IT WOULD BE AN ECONOMICAL DISASTER TO R.A.O. CONSTRUCTION AND MANY OTHER BUSINESSES IN THIS AREA. IF A LOCAL BUSINESS COULD NOT SUPPLY US WITH SAND, GRAVEL, CONCRETE AND ASPHALT WE WOULD BE FORCED OUT OF BUSINESS. WE EMPLOY AN AVERAGE OF TEN PEOPLE FULL TIME AND ANOTHER SIX TO EIGHT PART TIME.THESE PEOPLE WOULD ALSO BE OUT OF WORK.

WE URGE YOU TO CONSIDER THE EFFECT NOT ISSUING PERMITS WOULD HAVE ON THIS COMMUNITY.

YOURS TRULY,

Rich Olson

RICH OLSON
PRESIDENT
R.A.O. CONSTRUCTION CO., INC.

DANCO
BUILDERS

April 22, 1992

To Whom It May Concern:

We are writing this letter in response to what affect the possibility of not having any local gravel will do to our business.

We are a general contractor, building residential and commercial projects. We use gravel, and concrete in our daily business.

In the event we have to import gravel, or go to a different method of construction, it could become quite costly and the new home builder may think twice about building his home in our local area. Or the commercial builder will think twice about building a new building or remodeling an old one in our area because the cost is much too high. Why build here, when you could build in Redding, Crescent City, etc. much lower.

Gravel and Concrete are the foundations of all building projects, and without it we can have no projects, and no forward growth for our County.

Sincerely,

Dan J. Johnson

3952 Jacobs Avenue, Eureka, CA 95501 • Tel: (707) 442-5911 • Facsimile: (707) 443-1946
CONTRACTOR'S LICENSE CA #500851

KRAMER PROPERTIES, INC.
1653 MYRTLE AVENUE • EUREKA, CA 95501 • (707) 444-2919

April 23, 1992

To whom it may concern:

This letter is in regard to the availability of readimix products (concrete, sand, gravel and asphalt).

We are a development/construction company and we use concrete, sand, gravel and asphalt regularly. We employee seven (7) individuals on a full-time basis. If the above mentioned readimix products were unavailable our business would be unoperational and our employees would be unemployed.

We hope this situation can be resolved and the permits issued soon.

Sincerely,

Kurt G. Kramer
President

ARCATA READIMIX

P.O. Box 4657 Arcata, California 95521

Phone (707) 822-1795

April 23, 1992

TO WHOM IT MAY CONCERN:

Immediate action is needed on our local rivers concerning the extraction of sand and gravel materials. These natural resources must be processed for use in construction of concrete and asphalt. In an already depressed and unemployed county, we need to find a balance between man and nature. If current gravel operations are not permitted, we will have to import these materials. The cost would be prohibitive. The damage to our local economy would bring construction to a halt. We cannot afford the impact this would have on our local owned businesses and their employees. The domino effect of this would be devastating to the economy and the quality of life of residents of the North coast.

Sincerely,

Bill O'Neill

Bill O'Neill
President

RESCO
construction

April 23, 1992

To Whom it May Concern:

It has recently come to my attention that permits have not yet been issued to extract gravel from the lower Mad River bar.

If this is not corrected soon, the agencies responsible for delaying this process will be making a major policy error.

Without a stable gravel supply, our local area's ability to produce gravel for asphalt and concrete will be seriously impacted. Both of these items are already in short supply, and are both necessary for maintaining our county's infrastructure.

The lower Mad River has long been a source of gravel for these purposes, and it is necessary that this continue. I understand and believe that environmental implications must be considered and we must strive for balance and fairness in our decision making and policy decisions.

This would include the impact of not harvesting the gravel - to the businesses that harvest the gravel, the employees and families that depend upon this to put food on the table and pay rent, and the end users of the gravel.

This gravel is eventually used to supply much needed housing, concrete for medical facilities, roads, employment, and a variety of other uses that benefit our society.

All of these factors should be entered into the equation.

It is my hope that action is taken soon so that these people can get back to business, and their employees can get out of the unemployment line.

Sincerely,

Jeffrey Smith
President

GENERAL CONTRACTORS

DENIS E. COSBY CONSTRUCTION
General Building and Concrete Construction
5000 West End Road, Suite #4 • Arcata, CA 95521 • (707) 822-2112
Lic. No. 437978

May 8,1992

Department of Fish and Game
Attention: Banky Curtis

Re: Gravel Extraction on local river bars

Gentlemen:

I wish to voice my concerns on the detrimental effects that closure of local rivers to gravel extraction will have.

I first want to mention that I do have concern for ecology and the environment. If I saw neglect or destructive actions purposefully taken that would harm the rivers, I would be taking these same steps in support of closure. Instead I have witnessed well planned, enacted and supervised gravel harvesting. Steps were taken to ensure water depth maintenance, flow stability and done at a time of the year for the least amount of impact on the river habitat. How much more can a business do in good faith to stay in business. Gravel is used in all phases of construction from road and foundation fill to concrete, asphalt and landscaping needs. The pressure on builders to supply affordable housing is greater than ever, yet nothing is happening to make that realistic; lumber prices through the roof, developers impact fees and escalating land prices. Gravel prices have doubled in the last two years and the outlook for gravel prices soaring is near with acceptance of a river bar closure. It comes down to jobs again: if you can't afford to build affordable housing, you can't stay in business, no work, no jobs.

The recent turn of events regarding development and the difficulty with project approval leads me to conclude that the agenda for the Audubon Society is singular: shut down development in Humboldt County completely. A narrow view which has no consideration for the welfare of the citizen and economy of Humboldt County.

Thank you for your time,

Denis E. Cosby

Denis E. Cosby
Denis E. Cosby Construction

DEC/tm

WES GREEN LANDSCAPING AND MATERIALS
5611 HEINDON RD
ARCATA, CA 95521

(707) 822-8035

May 8, 1992

Department of Fish & Game
Banky E. Curtis
Regional Manager
601 Locust St
Redding, CA 96001

Dear Mr. Curtis:

My name is Wes Green. I am an Excavating Contractor in Arcata. I am writing this letter in regards to the permits that are pending of the extraction of the gravel on the Mad River.

My company alone uses on the average of 15 to 20 thousand yards of gravel per year. With the economy and recent disaster of the earthquake, that we have had in our area, we will be using at least that much or more this year.

I would like to ask you to please issue permits to extract the gravel form the Mad River.

Thank You,

Wes Green

DUTRA TRUCKING CO., INC.
P.O. BOX 277
ARCATA, CA 95521
(707) 822-8133

May 8, 1992

Department of Fish & Game
Banky E. Curtis
Regional Manager
601 Locust Street
Redding, CA 96001

Dear Mr. Curtis:

We are a local trucking firm in the Arcata area. This letter is being written in regards to the permits that are pending of the extraction of the gravel on the Mad River.

With the current down swing in the economy and the recent damage caused by the earthquake in our area, our area could use the jobs and revenue generated by the release of the permits.

I would like to ask you to please issue permits to extract the gravel from the Mad River.

Sincerely,

DUTRA TRUCKING CO., INC.

Jim Cyphers

JDC:tls

McKenny & Sons, Inc.
General Building Contractors

2341 Fern St. • Eureka, California 95501 • (707) 443-2244

April 22, 1992

To Whom it May Concern:

We, as building constructors, are concerned with the onslaught of new found restrictions and regulations impacting the aggregate industry. The wide spread ramifications to the construction industry go without saying. Aggregate uses range from concrete (a primary structural component), sand (used in brick and tile works), to asphalt (paved roads).

The California Environmental Quality Act (CEQA) is being skewed towards a halting of aggregate removal. This is not the intended use of CEQA. Rather the CEQA process should be used to strike a **BALANCE** with all environmental concerns. The CEQA process does not specifically have to look at the economic impacts to the aggregate industry. It does, however, need to look at the environmental impacts associated with a limited supply of materials to our infrastructure. Further, secondary economic impacts such as affordable housing, the maintenance of existing road systems for traffic flow, and the construction of new infrastructures for the health and welfare of the population (the Freshwater Water Project, etc.) have to be considered.

The process for permits should be well defined. The process provides for a balance through mitigation or a statement of overriding consideration. The proper decision makers should make those tough decisions in a timely manner. We in the construction industry need the governmental agencies to work together in harmony with the aggregate industry to obtain a timely environmentally balanced resolution to the extraction process.

Thank You,

Brendan McKenny, President
McKenny & Sons, Inc.

BILL SHEPPARD
General Contractor
Cont. Lic. # 290057
P.O. Box 56
Blue Lake, CA 95525
668-5754

April 23, 1992

As a Contractor engaged in the construction of subdivisions and in the performance of Public Works improvement projects I am very concerned with any regulations or proposed regulations that may restrict the excavation and removal of river gravels in Humboldt County.

If regulations are enacted that drastically curtail and/or prohibit gravel extraction from local rivers the cost of construction will become prohibitive and will stifle our already sluggish and tenuous economy. Our local gravel companies must be allowed to continue to extract gravels from our local rivers.We don't have any other economic choice.

YOURS TRULY

Bill Sheppard

Bill Sheppard
Owner

Appendix A

Individual Site Details

Appendix A

Summary of Mining Operations

Site No.	Operator	Bar	Code[1]	Maximum Extraction Amounts[2] (cy)	Size of Gravel Bar (acres)[3]
1	Mad River Sand & Gravel	Guynup	e,s,p	200,000	160/30
2	Humboldt County	Emmerson	e	2,000	250/33
2	REA	Emmerson	e	50,000[4]	250/33
3	REA	Blue Lake	e,s	100,000[5]	400/63
4	Eureka Sand & Gravel	Christie	e,s,p	150,000[6]	175/20
5	REA	Johnson	e	30,000[7]	36/20
6	Mercer, Fraser Co.	Essex	e,s	40,000	8/3.5
7	Arcata ReadiMix	Johnson-Spini	e,s,p	80,000	90/22
8	REA	Graham	e,s,p	100,000[8]	80/17
9	Zabel Trucking	Simpson-Zabel	e	40,000[9]	50/27
10	Simpson Timber Company	upper Simpson	e	25,000[10]	3.2/3.2
		TOTAL		**817,000 cy**	**1,252/242**

1 Code: e = extraction, s = stockpiling, p = processing
2 Extraction amounts based on vested rights, permits or foreseeable future extractions
3 Total area of site/max. area disturbed during extraction; acres disturbed each year may vary, see individual site details
4 Vested right under litigation
5 Vested right under litigation. Vested right established for 50,000, rec plan approved for 100,000
6 Permit issued for 50,000, current application on file for additional 100,000
7 Vested right determination appealed
8 Vested right determination appealed. Vested right established for 95,000, rec plan approved for 100,000
9 At time of writing, no permits or reclamation plan on file with County
10 At time of writing, no permits or reclamation plan on file with County

SITE NO. 1

Common Site Name	Guynup Bar
Humboldt County Case No.	CUP-35-91/SP-36-88
Mine I.D. No.	91-12-0012
Operator	Mad River Sand & Gravel 1206 W. 14th Street Eureka, CA 95501 (707) 443-7039
Property Owners/ Owner of Mineral Rights:	Mad River Sand & Gravel 1206 W. 14th Street Eureka, CA 95501 (707) 443-7039
Agent of Process	Rising Sun Enterprises 1864 Myrtle Avenue Eureka, CA 95501 (707) 445-2433

Project Location
Approximately 1 mile south of the City of Blue Lake, and approximately ¾ mile north of the Mad River Hatchery.
NE¼ Sec. 31, T6N, R2E, H.B.M.
Assessor Parcel Numbers 313-061-05, 313-081-23, 303-061-01.
River mile ±13.5

Access
Access to the site is from an existing driveway which intersects Hatchery Road approximately 150 feet south of the intersection of West End Road with Hatchery Road. Access to the public is restricted.

Recreational use of the river bar is limited. Access is by foot, from either upstream or downstream of the project site.

Project Description
Aggregate has been extracted from this site since approximately 1964. As with all sites covered in this PEIR, extraction amounts vary from year to year and are dependent on market demand and aggregate availability. The maximum annual extraction quantity allowed under the reclamation plan is 200,000 cubic yards.

The operation totals approximately 160 acres. During extraction, 1 to 30 acres of gravel bar may be disturbed.

The operation includes an upland processing and stockpile yard. Processing may include washing, crushing, sorting, screening and batching.

Environmental Setting

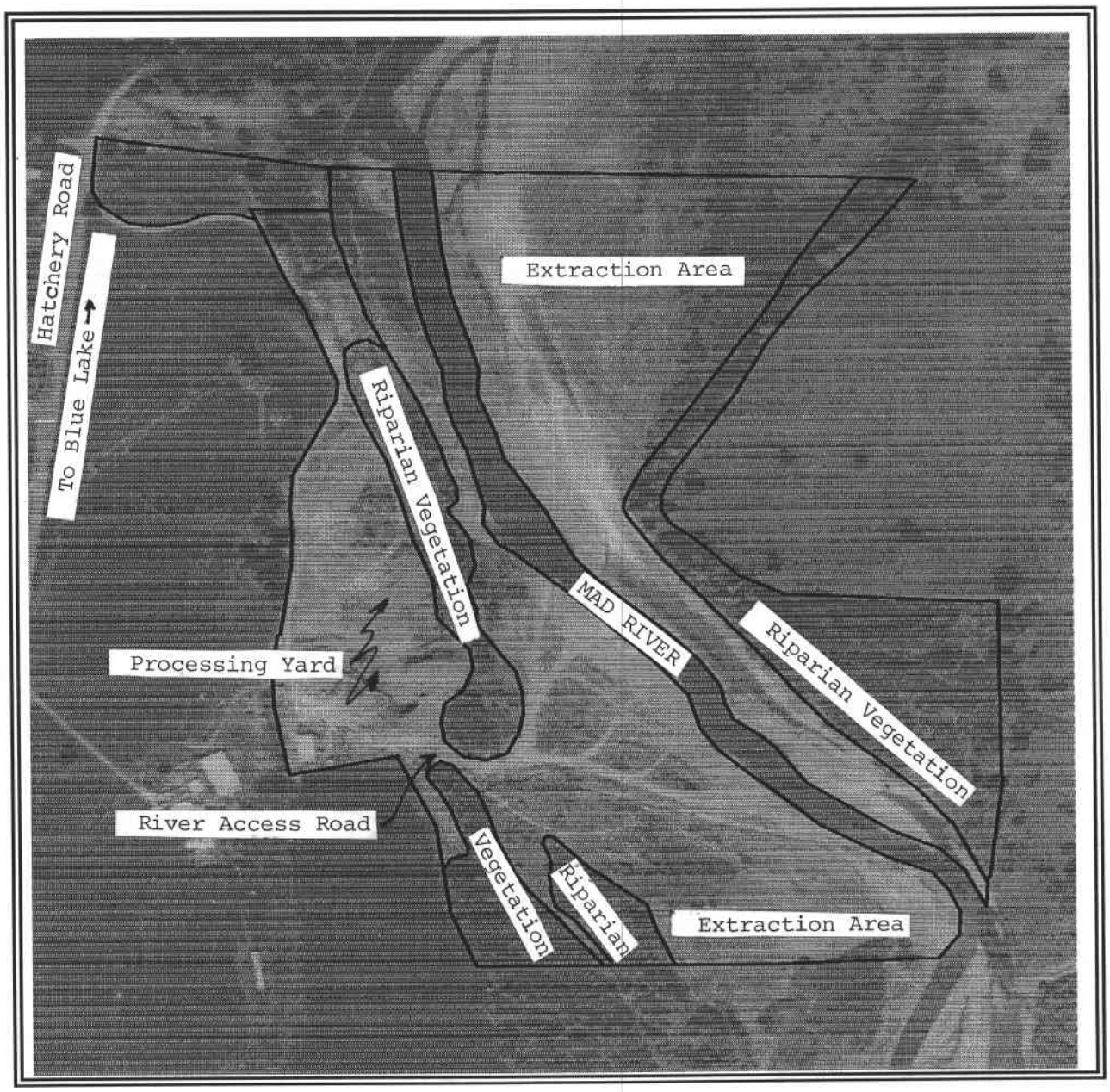
There is a remnant stand of riparian forest on the southeasterly side of the processing yard which extends down slope to meet with a mature scrub stand at the bottom. The forest supports a mix of cottonwood and red alder, with some mature arroyo willow. There has been standing water several feet deep along the base of this slope, with vegetation on both sides. This is either a remnant channel or a backwater area with potential habitat value for amphibians. A mix of forest and mature scrub continues northerly along the bank. The remainder of the area is comprised of gravel bar habitat and early to mid-successional scrub habitat.

The river flows south to north through the project area. Gravel extraction operations occur on both the east and west banks of the Mad River. Access to the gravel bars is from the south end of the processing yard. A summer flat car bridge is required to access the east bank.

The bank-to-bank width of the Mad River in this location is between 500 and 1000 feet. The bar averages 800 feet in width.

The closest residence is a house owned by the operator approximately 650 feet southwest of the processing plant. Residences on Hatchery Road and West End Road are approximately 1700 feet from the processing plant. Residences directly west of the processing site are approximately 900 feet away.

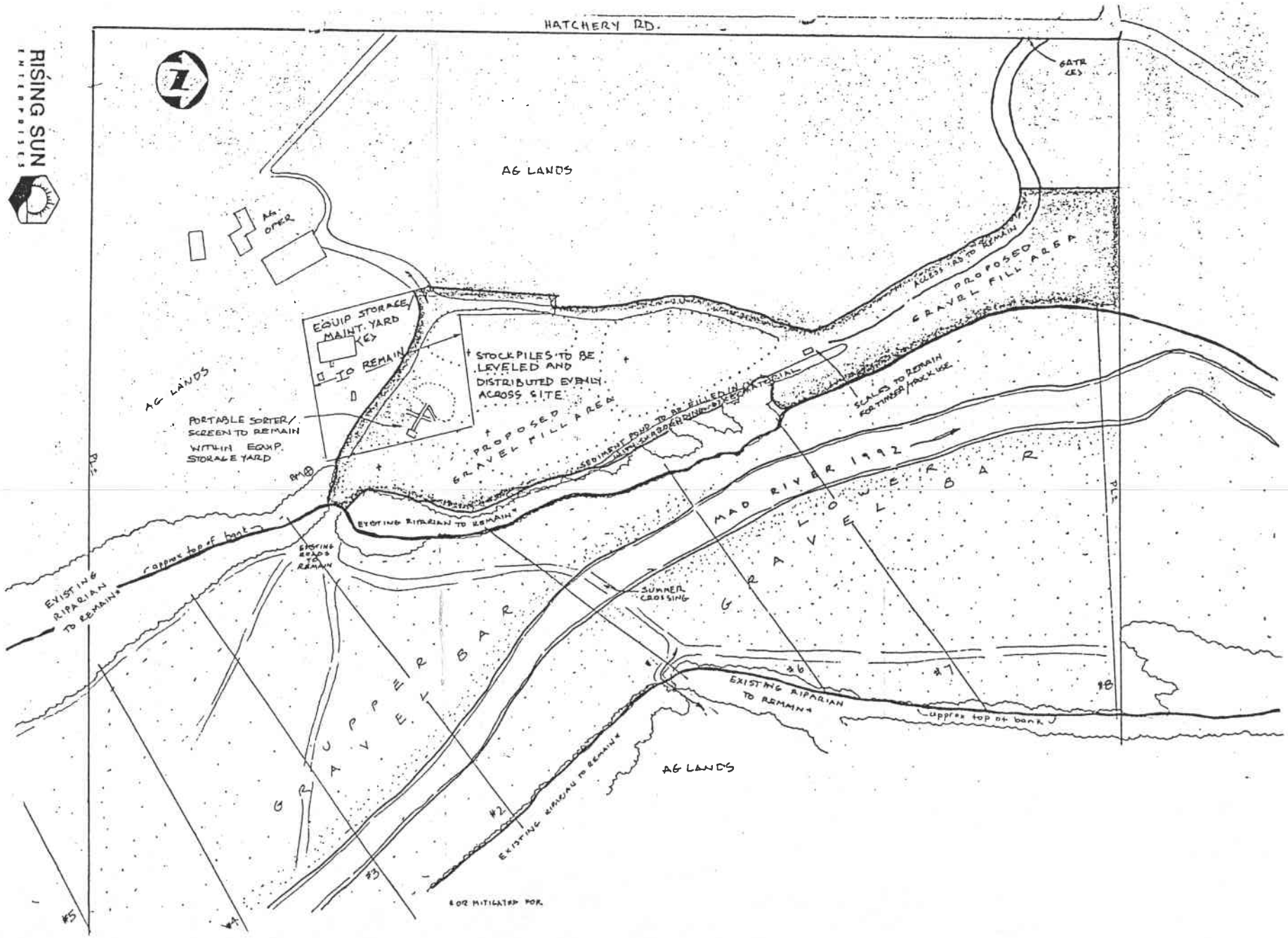
On an average, approximately 3-5 trucks transport material from the site resulting in 25-30 loads per day in the summer months. For a large job, as many as 100 loads per day may leave the site. During the winter months, activity is reduced to an average of 4 or 5 truck loads per day. Many days the gate remains shut and no loads are exported.



N

No Scale

Site Map
Site No. 1
Guynup bar



Appendix A, Site No. 1

SITE NO. 2

Common Site Name	Emmerson Bar	
Humboldt County Case No.	SMR-06-91/CUP-25-91	
Mine I.D. No.	91-12-0033	
Operator	Redwood Empire Aggregates P.O. Box 299 Arcata, CA 95521 (707) 822-4853	Public Works Dept. 1106 Second Street Eureka, CA 95501 (707) 445-7541
Property Owners/ Owner of Mineral Rights:	Emmerson & Son P.O. Box 1189K Arcata, CA 95521 (707) 443-3111	
Agent of Process	Pacific Affiliates 835 Third Street Eureka, CA 95501 (707) 445-3001	

Project Location
Approximately ½ mile south of the City of Blue Lake on the southeast side of the Hatchery Bridge. The site is approximately at the mouth of the North Fork Mad River.
SW¼ Sec. 30 & SE¼ Sec. 14, NW¼ Sec. 23, SW¼ Sec. 13, T5N, R2E, H.B.M.
Assessor Parcel Numbers 312-151-15, 19, 25-161-05.
River mile ±13.

Access
Access to the site is from an existing driveway which intersects Hatchery Road approximately 150' north of the intersection of West End Road with Hatchery Road. The access road is gated and public access is limited to foot traffic. Portions of the access road are also used for storage of materials.

This bar is popular for use by fisherpeople and other recreationists year around.

Project Description
The County has recognized a vested right for the continued commercial extraction of a maximum of 50,000 cubic yards annually at this site. The vested right determination is under litigation. The County Public Works Department has extracted additional material for non-commercial purposes.

The operation totals approximately 250 acres. During extraction, 1 to 33 acres of gravel bar may be disturbed.

Environmental Setting

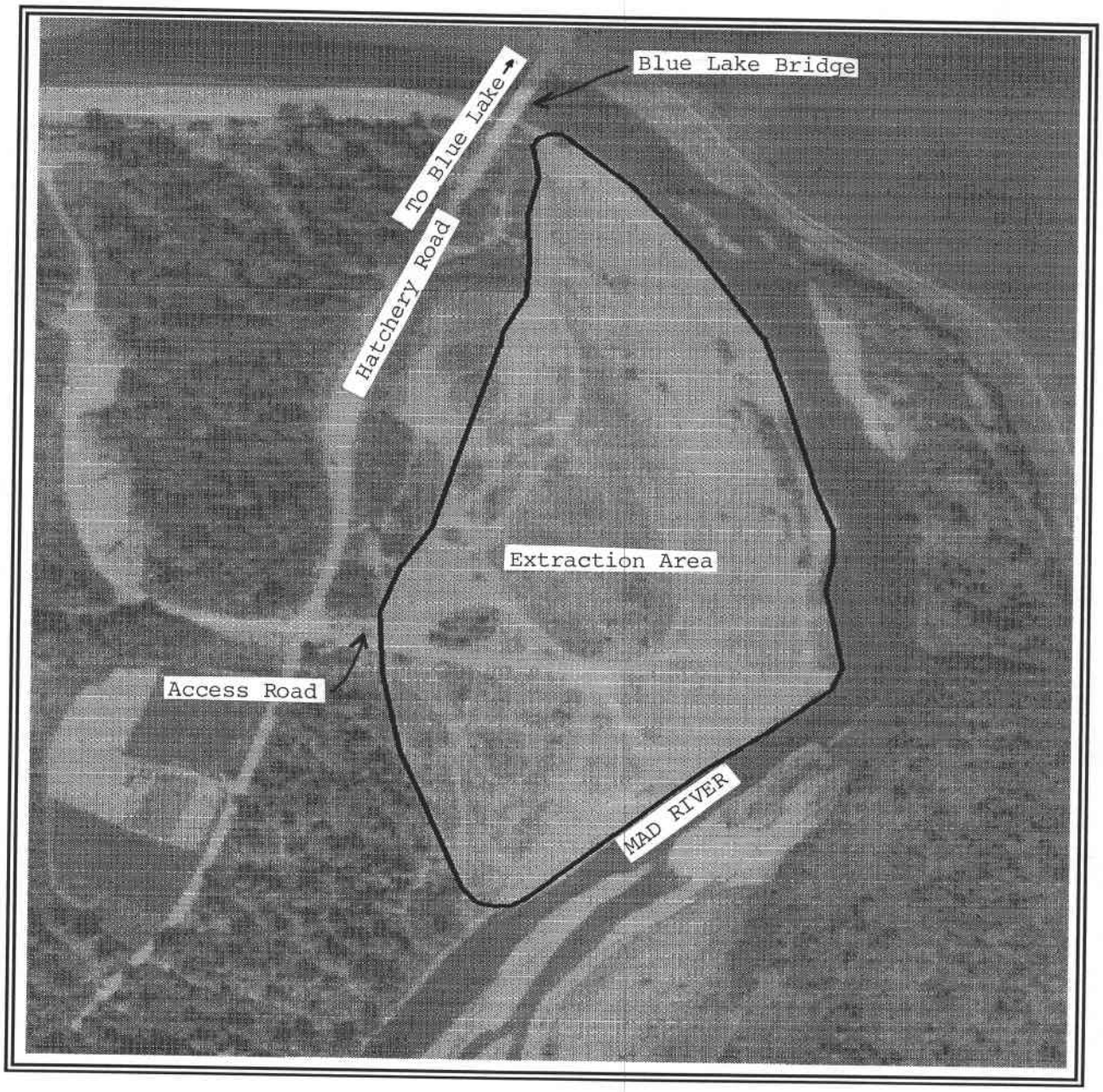
This site is characterized by gravel bar and early successional riparian scrub. There are a few isolated patches of woody vegetation, including several stands of 20-foot arroyo willow in the gravel bar and a patch of young cottonwood (to 25-30 feet), arroyo willow, and coyote brush in the lower reach of the riparian scrub. These patches have apparently been able to mature sufficiently in recent years to attain some height and begin accumulating silt and other debris at the base. The patches may enhance the habitat value of the bar and lower terrace by providing cover and some food for wildlife.

A pond with emergent vegetation (primarily cattail) is located at the northerly end of the bar, at the base of the slope. It is surrounded by a moderately dense stand of arroyo willow and red alder. This pond potentially has high habitat value for amphibians due to its persistence and the presence of good vegetative cover.

A small bar is located just downstream of Blue Lake bridge, on the south side of the channel. The lower part has been under water and the remainder has been covered with up to a foot of sediment.

Gravel extraction at this site occurs on an inside bend of the Mad River where the river changes from flowing south to north, to flowing east to west. The bank-to-bank width of the channel is between 300 and 1500 feet. The average bar width in this area is approximately 800 feet.

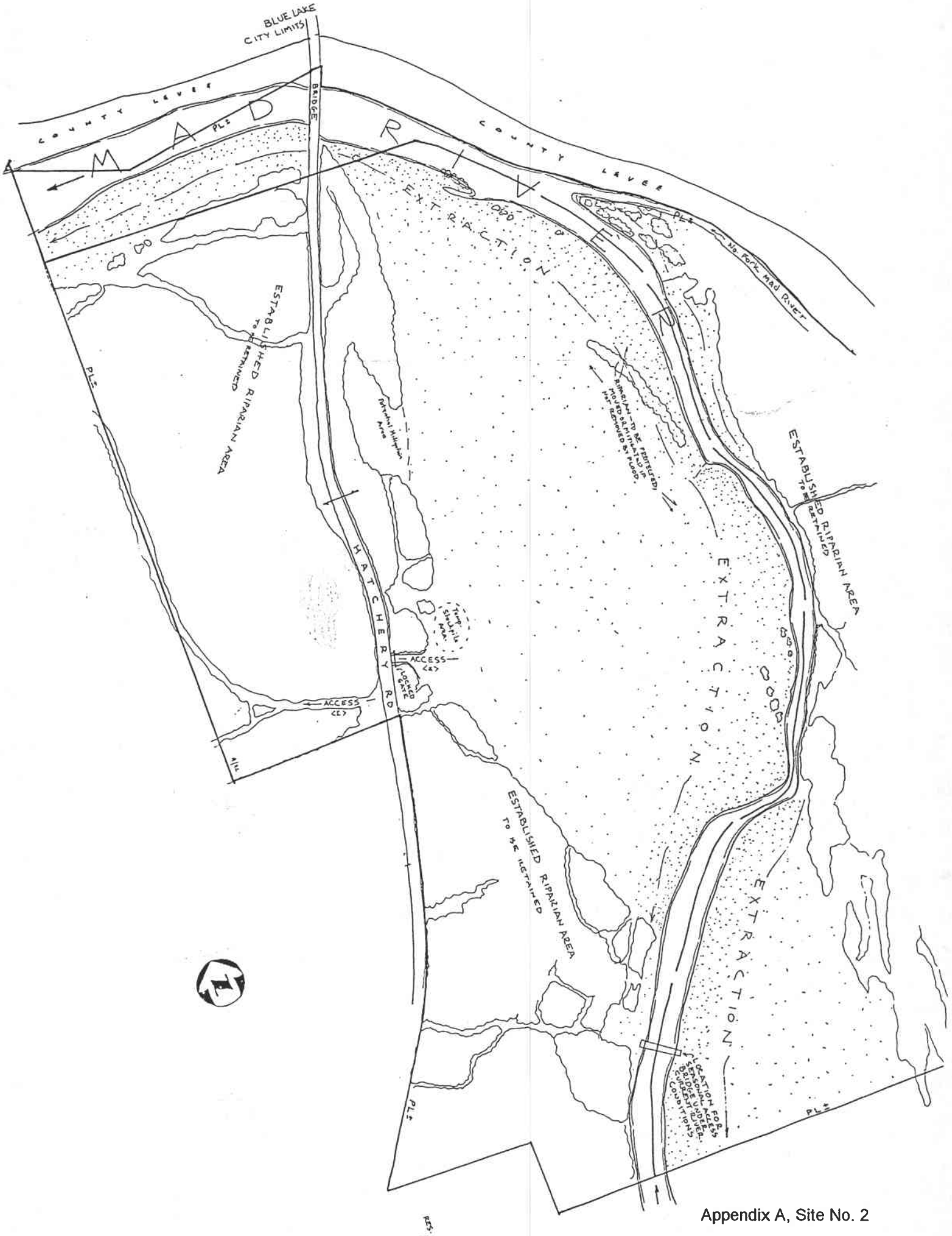
The closest residences to this site are located approximately ¼ mile to the northwest and south. There are also approximately 20 houses off West End Road within 2,000 feet of the site.



N

No Scale

Site Map
Site No. 2
Emmerson bar


BLUE LAKE CITY LIMITS
BRIDGE
COUNTY LEVEE
MAD RIVER
EXTRACTION
No. Fork Mad River
ESTABLISHED RIPARIAN AREA TO BE RETAINED
RIPARIAN TO BE REESTABLISHED PROVIDED APPROVED IMP. NOT REMOVED BY FLOOD.
POTENTIAL HABITAT AREA
HATCHERY RD
TEMP. STEELHEAD HAB.
ACCESS
LOCKED GATE
ESTABLISHED RIPARIAN AREA TO BE RETAINED
LOCATION FOR SEASONAL ACCESS BRIDGE UNDER CURRENT CONDITIONS
PLE
PL
N
Appendix A, Site No. 2

SITE NO. 3

Common Site Name	Blue Lake Bar
Humboldt County Case No.	SMR-08-91/SP-38-91
Mine I.D. No.	91-12-0032
Operator	Redwood Empire Aggregates P.O. Box 299 Arcata, CA 95521 (707) 822-4853
Property Owners/ Owner of Mineral Rights:	Redwood Empire Aggregates; CWDT, Inc.; Leavey
Agent of Process	Pacific Affiliates 835 Third Street Eureka, CA 95501 (707) 445-3001

Project Location
Approximately ½ mile southwest of the City of Blue Lake, adjacent to the Nicholls truck yard.
NW¼ Sec. 30, T6N, R2E, H.B.M.
Assessor Parcel Numbers 312-161-07; 313-231-01, 02, 03; 516-181-07, 516-191-09.
River mile ±12.5.

Access
Access to the site is from Taylor Way, through the Blue Lake Industrial Park. Taylor Way intersects with Hatchery Road approximately 700 feet north of the Blue Lake Bridge. Public access through the site is restricted.

This bar is popular for recreational use. Access is by foot from the levee below the Blue Lake Bridge. Vehicles are parked at the north end of Blue Lake Bridge.

Project Description
The County has recognized a vested right for the continued commercial extraction of a maximum of 50,000 cubic yards annually at this site. The vested right determination is under litigation. The reclamation plan is approved for the maximum annual extraction of up to 100,000 cubic yards.

The operation totals approximately 400 acres. During extraction, 1 to 63 acres of gravel bar may be disturbed. The operation includes an upland stockpile area.

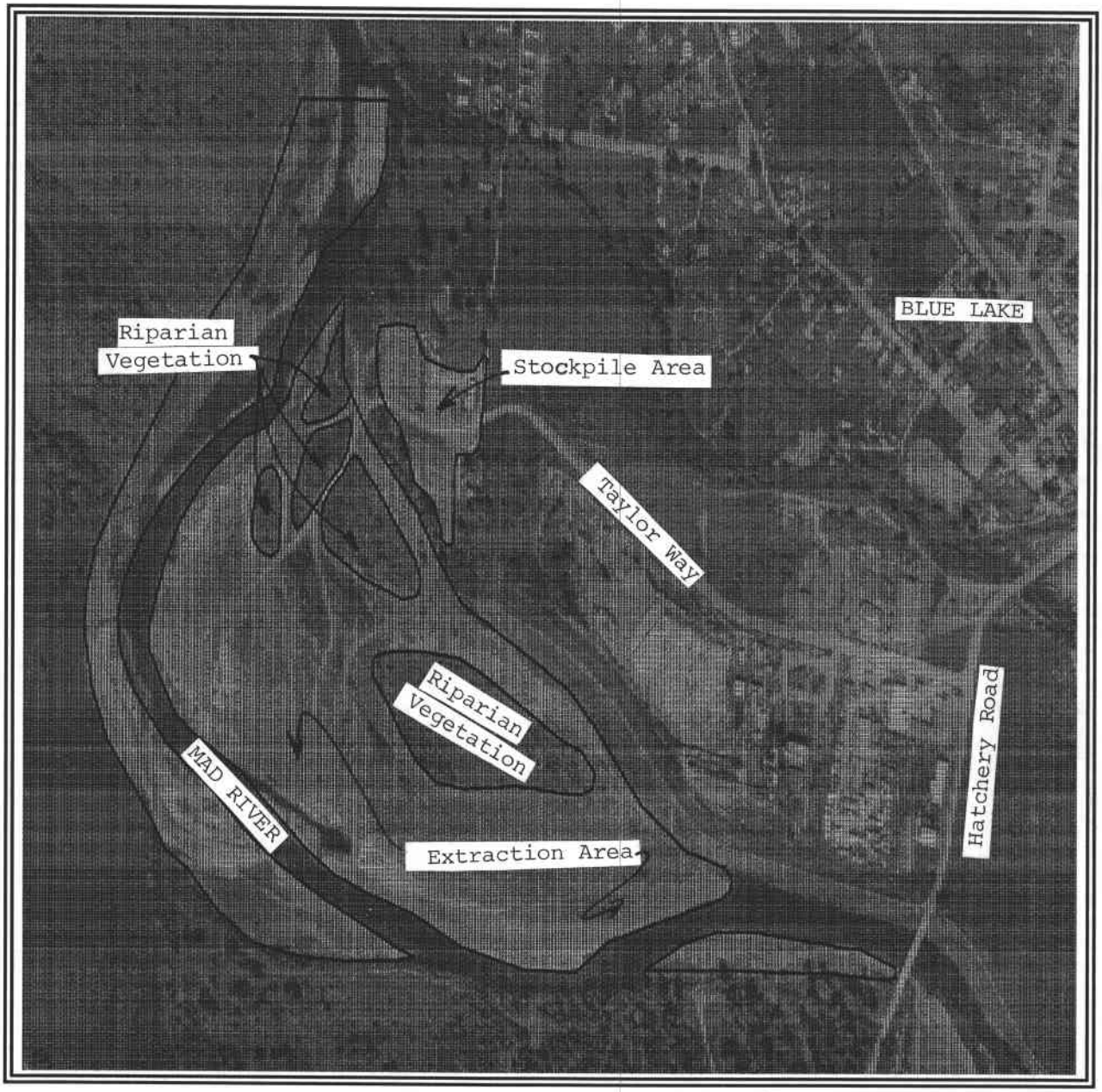
Environmental Setting
Much of this bar is typified by gravel bar bordered by early successional riparian scrub, with patches of later successional scrub (dense arroyo willow thickets) concentrated in the northerly

portion. There is a small stand of cottonwood (riparian forest) on the slope from the stockpile area down to the duck pond which was created at the end of 1992. In addition, there is a large patch of transitional scrub/forest to the south of the duck pond; this area has an approximate 20% cover by coyote brush and clumps of arroyo willow and small diameter cottonwood to 15 and 25-feet in height, respectively.

Gravel extraction occurs on an inside bend of the river where the river changes from flowing east to west, to flowing south to north. Some extraction may occur on the outside bend of the river. Access can be made by an existing road which intersects Hatchery Road approximately 1200 feet south of the Blue Lake bridge. The County Public Works Department has a stockpile adjacent to this road.

The closest residences are two houses owned by REA 100 feet and 400 feet from the truck yard, and 800 to 1000 feet from the gravel bar. The next closest residences are within and adjacent to the Blue Lake Rancheria, approximately 1000 feet from the levee and 900 feet from the truck yard. There are also approximately 17 trailers located at the end of Rancheria Road. Residences to the south on West End Road are approximately ¼ mile from the edge of the extraction area.

This site, as well as the two other sites upstream from this location, all contribute to truck traffic onto Hatchery Road which proceeds along the truck route along Greenwood Avenue to Blue Lake Boulevard. This truck traffic is required to go through a residential area with adjacent school offices, a public library and a church.



N

No Scale

Site Map
Site No. 3
Blue Lake bar


Site No. 3

SITE NO. 4

Common Site Name	Christie Bar
Humboldt County Case No.	SMR-05-91/CUP-129-85/CUP-08-88/CUP-24-91
Mine I.D. No.	91-12-0010
Operator	Eureka ReadiMix P.O. Box 3568 Eureka, CA 95502 (707) 822-2937
Property Owners/ Owner of Mineral Rights:	Phyllis M. Christie P.O. Box 187 Blue Lake, CA 95525
Agent of Process	Pacific Affiliates 835 Third Street Eureka, CA 95501 (707) 445-3001

Project Location
Approximately 1¼ miles west of the City of Blue Lake
Sec. 24, T6N, R1E, H.B.M.
Assessor Parcel Numbers 516-171-05, 06, 07; 516-181-09, 10.
River mile ±11.

Access
Access to the site is from a private road that intersects Glendale (east) Drive, approximately ¼ mile east of the intersection of Glendale Drive with Ramp Road. The private road 'T's approximately 900 feet south of Glendale Drive. Access is to the west and under Highway 299 then parallels Highway 299 for approximately 700 feet.

Public access to the gravel bar through the site is restricted. Recreational use of the gravel bar is limited. Access is from either upstream or downstream by foot or 4-wheel drive.

Project Description
The operation is currently permitted to extract a maximum of 50,000 cubic yards annually. However, Eureka Sand & Gravel has applied to increase the maximum extraction amount to 150,000 cubic yards annually.

The operation totals approximately 175 acres. During extraction, up to 20 acres of gravel bar may be disturbed. The operation includes an upland stockpile and processing yard.

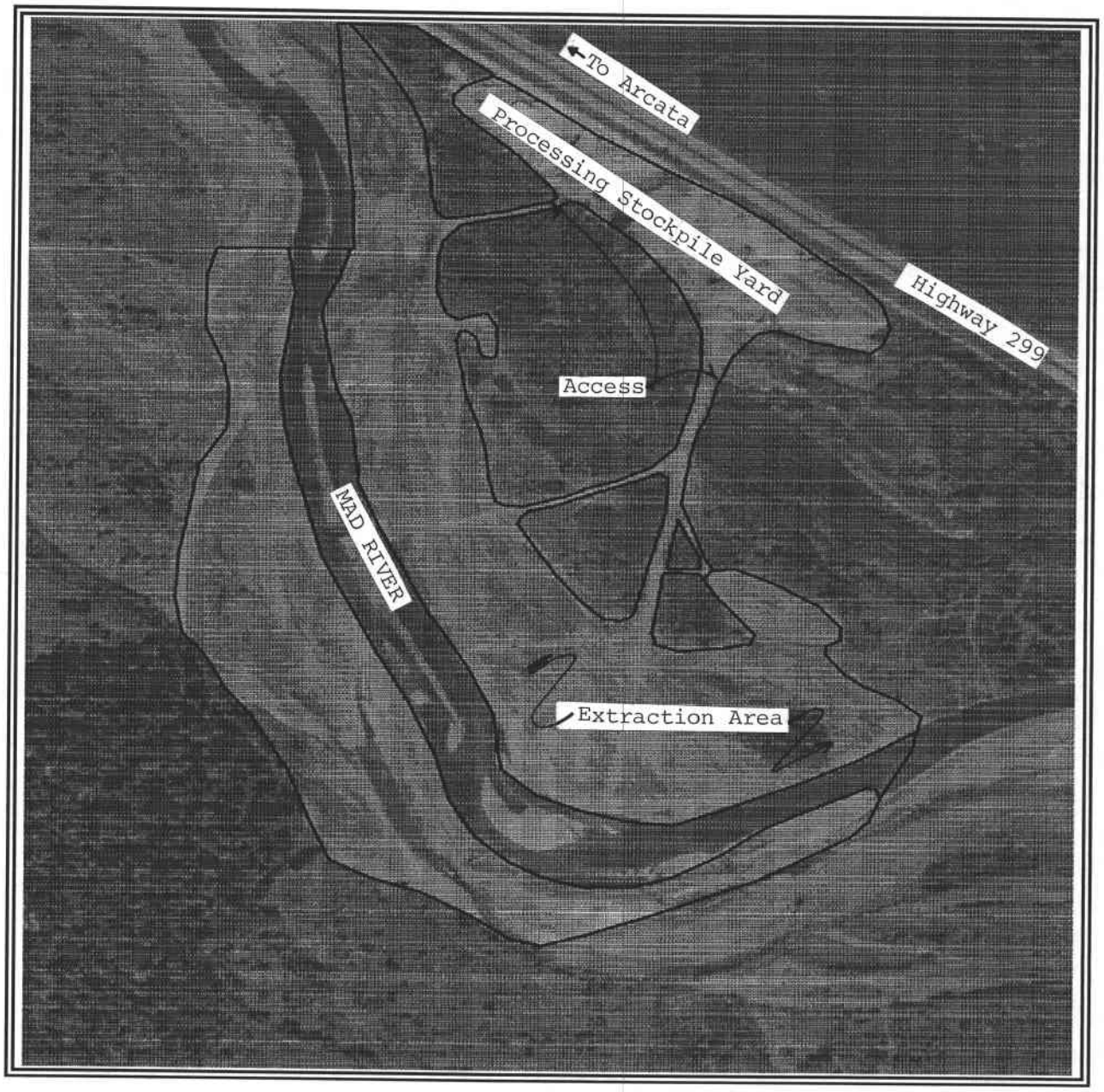
Environmental Setting
Nearly all of this site supports the gravel bar and very early successional riparian scrub habitat types. A few patches of arroyo willow are present toward the established scrub habitat. In

addition, there is a small population of mixed riparian forest and scrub on a terrace remnant toward the easterly (upstream) end of the bar. This terrace remnant appears to be rapidly eroding. Two ponds have been excavated on the bar, one toward the upstream side (1989) and one toward the downstream side (1992). There is a broad stand of mature scrub and patches of forest vegetation between the processing yard and the gravel bar, much of which has evolved over the last few decades.

Gravel extraction occurs on the north side of the river on an inside bend. The river flows southeast to northwest through the project area. Access to the gravel bar is through the east end of the processing plant.

The bank to bank width of the Mad River at this site ranges from 1400 to 2000 feet wide. The closest residence to the north is approximately 1600 feet from the processing site.

This operation has 3 dump trucks and 8 mixers. During the summer construction season, an average of 35-50 trucks per day leave the site. This is reduced to an average of 5 trucks per day during winter or wet periods. Of the total loads, approximately half are aggregate materials, with the other half ReadiMix concrete.



N

No Scale

Site Map
Site No. 4
Christie bar

SITE NO. 5

Common Site Name	Johnson Bar
Humboldt County Case No.	SMR-11-91/CUP-34-91
Mine I.D. No.	91-12-0031
Operator	Redwood Empire Aggregates P.O. Box 299 Arcata, CA 95521 (707) 822-4853
Property Owners/ Owner of Mineral Rights:	Redwood Empire Aggregates P.O. Box 299 Arcata, CA 95521 (707) 822-4853
Agent of Process	Pacific Affiliates 835 Third Street Eureka, CA 95501 (707) 445-3001

Project Location
Approximately 1½ miles west of the City of Blue Lake. The project site is located immediately downstream of the mouth of Noisy Creek and adjacent to Site No. 4.
NW¼ Sec. 24, T6N, R1E, H.B.M.
Assessor Parcel Number 516-161-02
River mile ±10.

Access
Access to the site is from a private road that intersects Glendale Drive, approximately 1000 feet east of the intersection of Larson Heights Road with Glendale Drive. Public access to the site is restricted or is made by foot or 4-wheel drive from downstream.

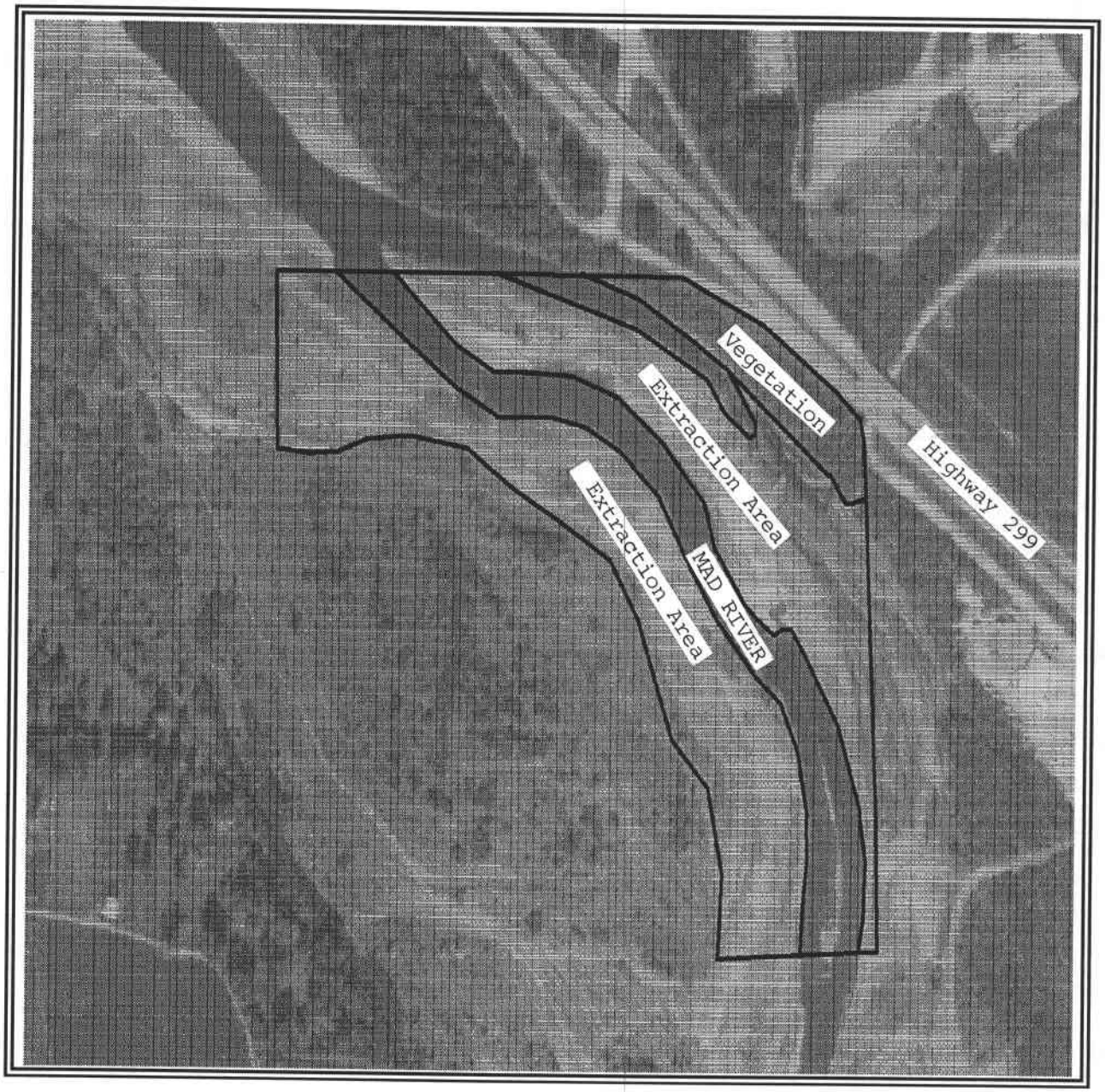
Project Description
On March 31, 1993, the County recognized a vested right for the commercial extraction of up to 30,000 cubic yards annually from the site. As of this writing, the period for filing an appeal of the determination to recognize the vested right has not been exhausted. It is expected that an appeal will be filed.

The operation totals approximately 36 acres. During extraction, 1 to 20 acres may be disturbed. There is no stockpiling or processing at this site.

Most of the Johnson Bar is comprised of gravel bar habitat. There has been a small linear stand of scrub willow (to 10 feet in height) as well as patches of early successional scrub. There is a broad terrace above this bar to the south which is dominated by early and mid successional scrub vegetation with strips of mature scrub. There were a few older backwater

channels which may persist long enough for amphibian breeding. There have been a few older backwater channels which may persist long enough for amphibian breeding.

The river flows east to west through the project site. Gravel extraction occurs on both banks of the Mad River. Access to the bars requires summer bridge crossings. Bank to Bank width at the site is approximately 600 to 1300 feet wide.



N

No Scale

Site Map
Site No. 5
Johnson bar

SITE NO. 6

Common Site Name	Essex Bar
Humboldt County Case No.	SP-26-88
Mine I.D. No.	91-12-0005
Operator	Mercer, Fraser Company P.O. Box 1006 Eureka, CA 95502 (707) 443-6371
Property Owners/ Owner of Mineral Rights:	Mercer, Fraser Company P.O. Box 1006 Eureka, CA 95502 (707) 443-6371
Agent of Process	Rising Sun Enterprises 1864 Myrtle Avenue Eureka, CA 95501 (707) 445-2433

Project Location
Approximately 2¼ miles east of the Valley West area of Arcata.
NE¼ Sec. 15, T6N, R1E, H.B.M.
Assessor Parcel Numbers 504-161-10.
River mile ±9.

Access
Access to the site is from of an existing driveway that intersects Glendale Drive, approximate 1000 feet east of the (first) Glendale Drive off ramp from eastbound Highway 299.

Public access through the site is restricted. The site is adjacent to a popular swimming hole, though no public access is available, other than walking along the river from one of the water district's pump station parks.

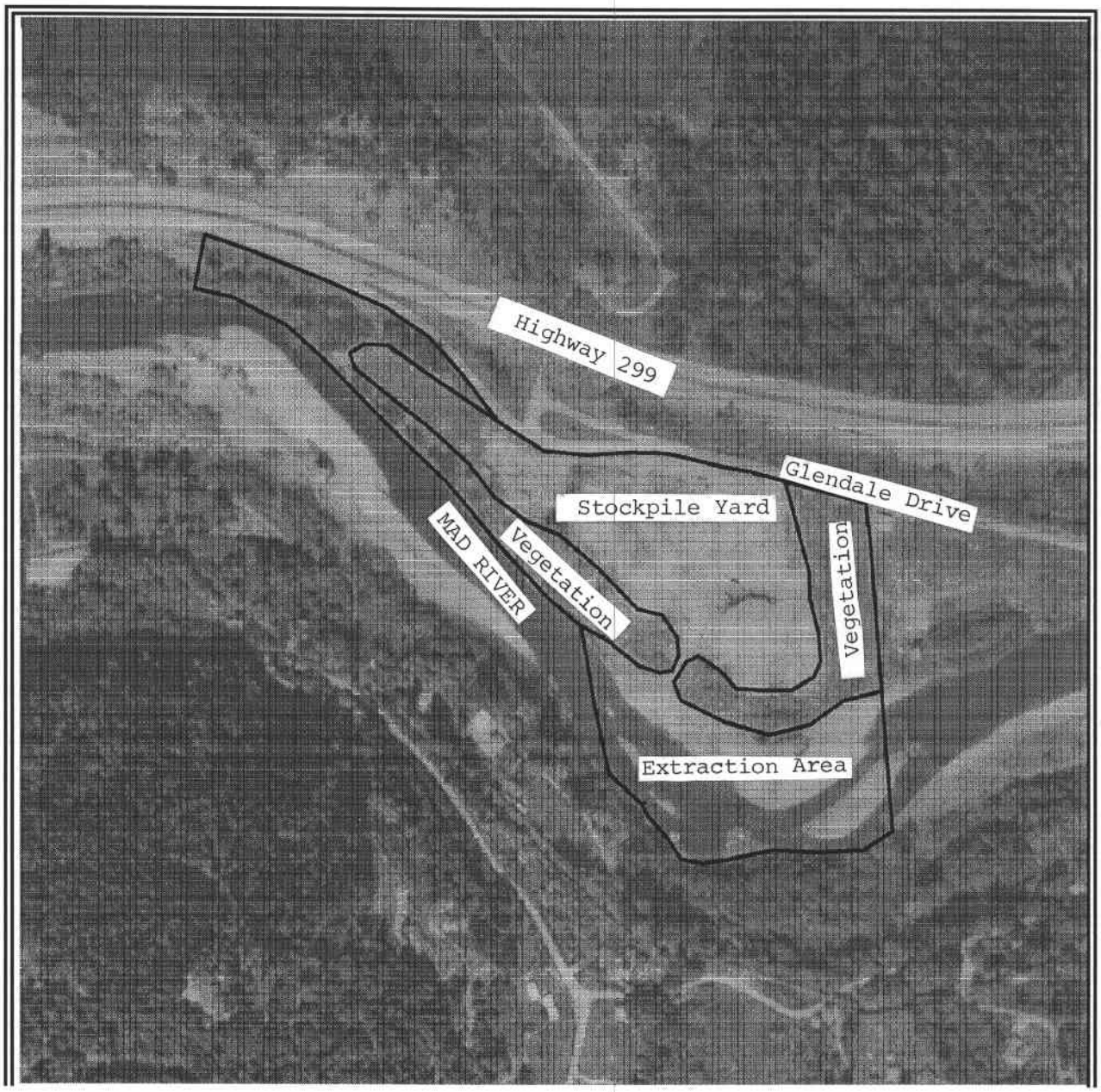
Project Description
The operation extracts a maximum of 40,000 cubic yards annually. The operation totals approximately eight acres. During extraction, 1 to 3.5 acres may be disturbed. This site historically had a processing plant running with large amounts of gravel being processed.

Environmental Setting
The upper terrace of this site is utilized for storage of materials from on and off site. Vegetation in this area is quite sparse, with ruderal (weedy) herbaceous species, and a few coyote brush being noted in areas not recently disturbed. There is a narrow band of mixed scrub and forest vegetation between the storage terrace and the riverside gravel bar,

characterized by arroyo willow and red alder with sparse cottonwood. The gravel bar has virtually no vegetation. The bar itself has been partially covered with several inches of sediment, apparently from 1993 high flows.

Extraction occurs on the north bank of the river on an inside bend. The river flows east to west through the project site. Access to the gravel bar is through the south end of an upland stockpile area.

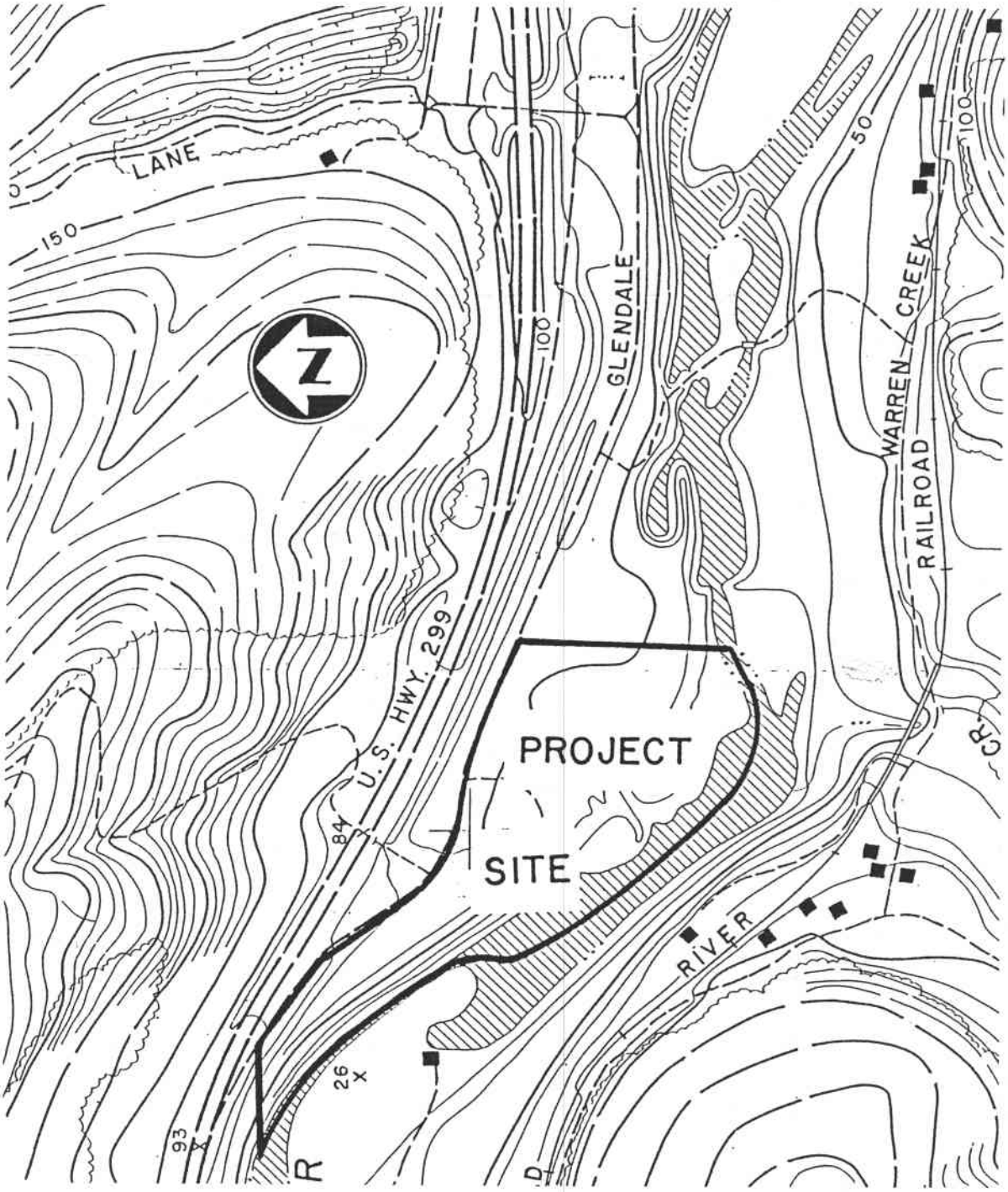
The nearest occupied structures are approximately 450' to the south. Highway 299 divides the processing site from several residences to the north. Noise levels generated by passenger cars and trucks on the freeway are higher than those contributed by the processing and extraction operations.



N

No Scale

Site Map
Site No. 6
Essex bar



RISING SUN
PLANNING/PERMITTING
ENVIRONMENTAL CONSULTING

SITE NO. 7

Common Site Name Johnson-Spini Bar (7A)
Arcata ReadiMix Bar (7B)

Humboldt County Case No. SMR-03-88/SP-91-88

Mine I.D. No. 91-12-0013

Operator Arcata ReadiMix
P.O. Box 4657
Arcata, CA 95521
(707) 822-1795

Property Owners /Owner of Mineral Rights: William O'Neill
Richard Hunt
Stan Johnson
Ben Spini

Agent of Process Rising Sun Enterprises
1864 Myrtle Avenue
Eureka, CA 95501
(707) 445-2433

Project Location
The processing yard, Site 7B, is approximately ½ east of the Valley West area of Arcata.
NW¼ & NE¼ Sec. 16, SE¼ Sec. 9, T6N, R1E, H.B.M.
Assessor Parcel Numbers(APN) are as follows:

OWNER/APN	TOTAL PARCEL AREA (acres)	AREA UTILIZED FOR PROJECT (acres)	GRAVEL BAR (acres)	PROCESSING (acres)
O'Neill				
507-381-03, 04, 05	20	20	6	14
Hunt				
507-131-18	20	1	1	0
Johnson				
507-131-83	25	11	11	0
504-181-28	5	.5	.5	0
Spini				
504-181-18, 26				
507-261-16, 9, 10	20	3.5	3.5	0
TOTAL (acres)	**90**	**36**	**22**	**14**

River mile ±7.6 (Site A), ±7 (Site B).

Access
Access to the processing yard is from a private drive that intersects Boyd Road approximately ¼ mile north of the intersection of Boyd Road with Giuntoli Lane. Access to the Johnson-Spini bar is at the end of Boyd Road, just over ½ mile from the intersection of Boyd Road with Giuntoli Lane.

Public access to Arcata ReadiMix (Site No. 7B) Johnson-Spini (Site No. 7A) bars, is restricted.

Project Description
The operation has a vested right to extract a maximum of 80,000 cubic yards annually. The operation totals 90 acres. During extraction, 1 to 22 acres may be disturbed.

The Arcata ReadiMix site consists of processing equipment and a cement batch plant. Other equipment includes front end loaders, dump trucks and mixers. Developed in 1951, the site is located within an industrial area. However, it is located adjacent to and directly north of the Town and Country Trailer Park built in 1955.

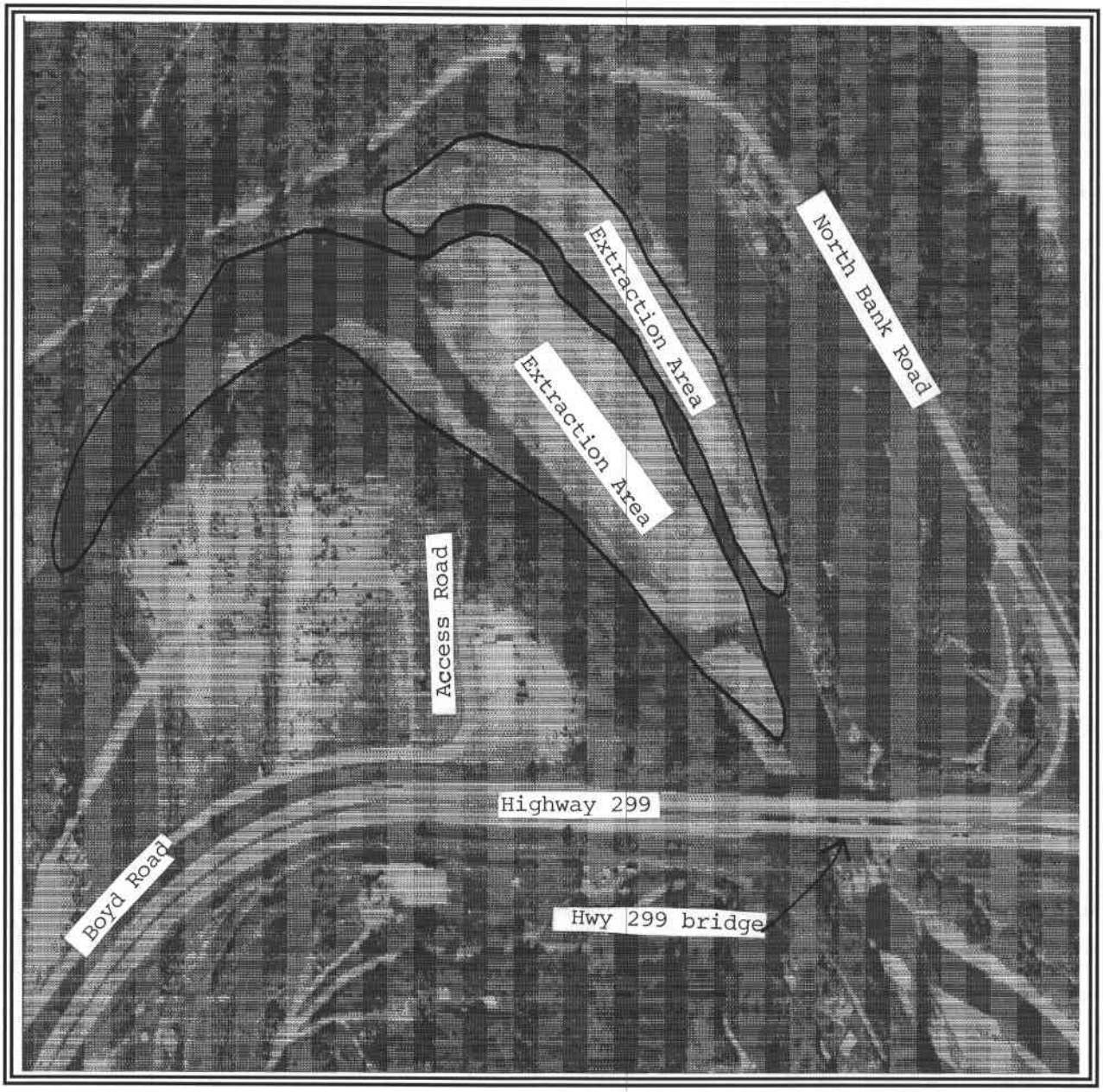
Environmental Setting
Site 7A, the Johnson-Spini bar, is characterized by two large gravel bars just downstream of the US 299 bridge, and a very small strip of gravel bar along the southerly bank. Moderate amounts of sediment have been deposited unevenly on the bars during the past winter. During a recent site visit, there was no vegetation on either bar; the northerly bank of the this stretch of river has been lined with rip rap, and supports a moderately dense cover of arroyo willow (scrub). The southerly edge of the project area is lined with a mature forest supporting a mix of cottonwood and red alder.

Site 7B is comprised primarily of the processing plant and storage yard. There is a mature stand of mixed scrub-forest vegetation along the easterly half of the slope descending from the upper terrace to the river. The entire area below this band of vegetation has been covered with up to several feet of sediment; no exposed gravel was noted.

The river makes a bend through the project area, beginning with a southeast to northwest flow and ending in a northeast to southwest flow. Access to the extraction area at site 7B is through the north end of the processing yard.

Arcata ReadiMix has 16 dump trucks and nine concrete mixers which access Boyd Road adjacent to an industrial area. Boyd Road is also utilized by the adjacent Town and Country Trailer Park. Highway access from Boyd Road is available to the south for both Highway 101 and Highway 299.

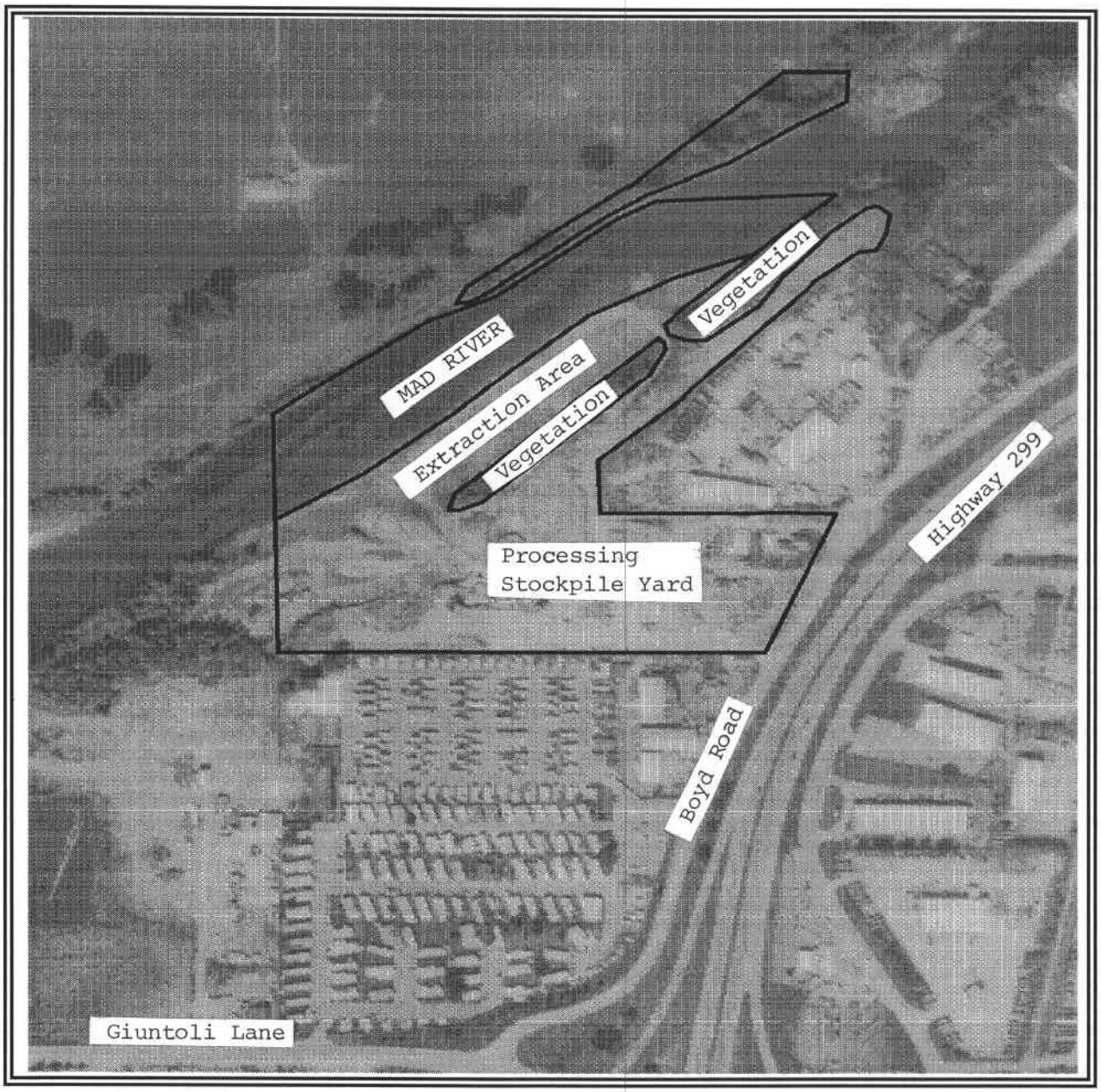
During summer months, there are approximately 50-60 loads per day leaving the processing site, with an average maximum of 110 loads. As many as an additional 100 loads per day are transported along Boyd Road to the processing site when extraction at the Johnson-Spini Bar is occurring. During winter months, trips leaving the processing site are reduced to an average of 20 loads per day. Approximately 50 percent of those loads are presently attributable to material being imported to the plant from materials extracted from the Eel River and stored at Fields Landing.



N

No Scale

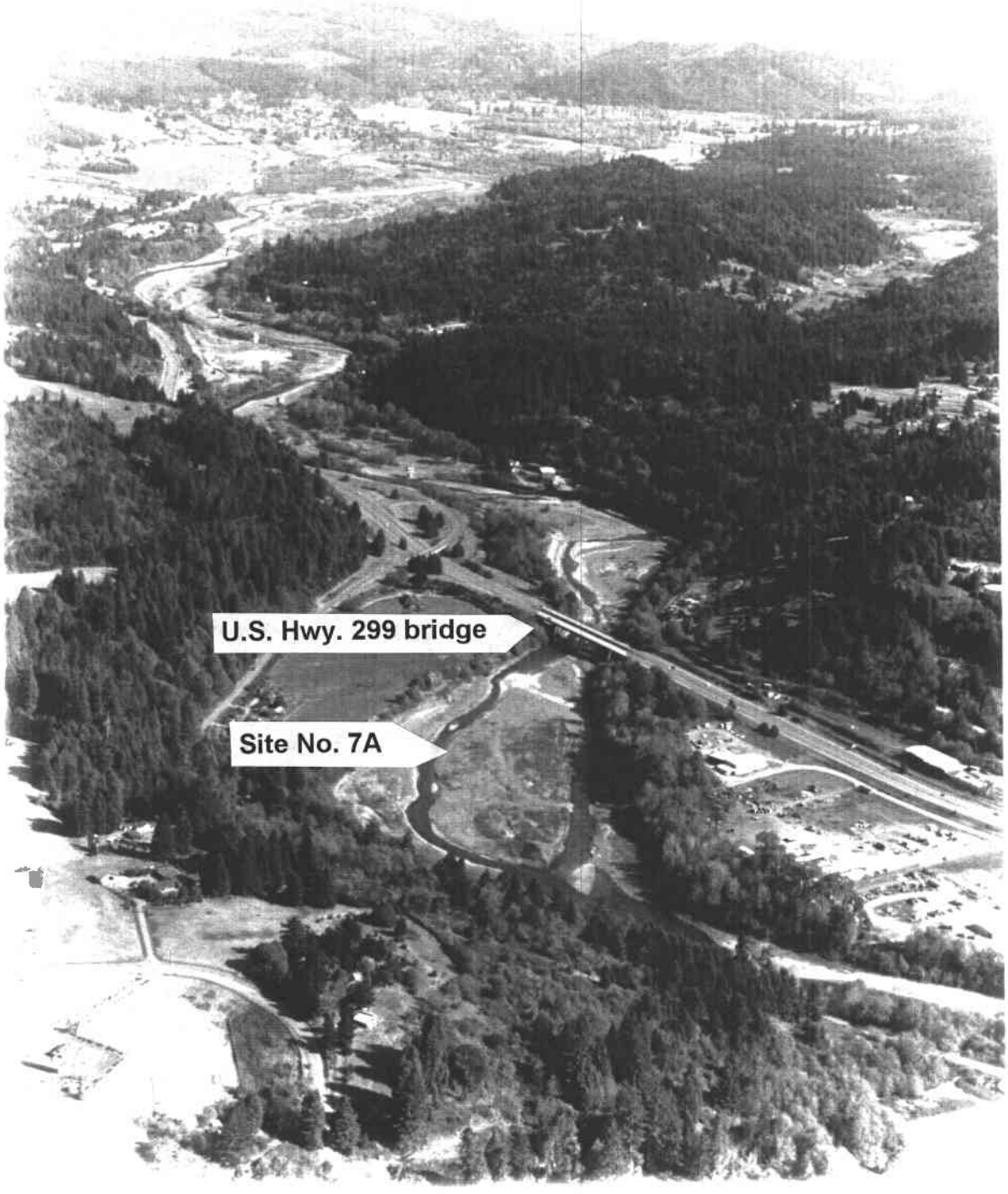
Site Map
Site No. 7A
Johnson-Spini bar

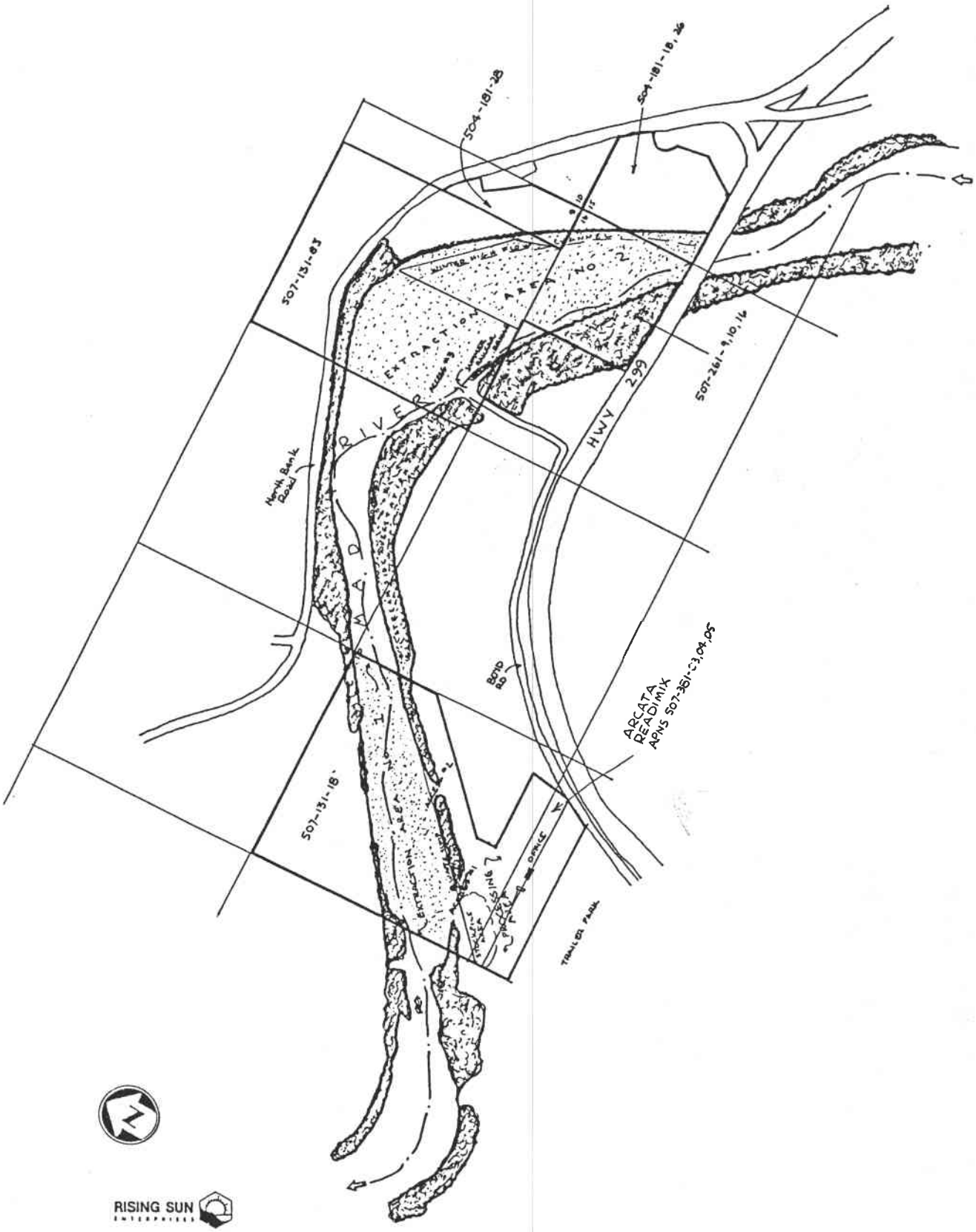


N

No Scale

Site Map
Site No. 7B
Johnson-Spini bar


U.S. Hwy. 299 bridge
Site No. 7A



Appendix A, Site No. 7

SITE NO. 8

Common Site Name	Graham-Zanzi Bar
Humboldt County Case No.	SMR-09-91/CDP-46-91/SP-39-91
Mine I.D. No.	91-12-0030
Operator	Redwood Empire Aggregates P.O. Box 299 Arcata, CA 95521 (707) 822-4853

Property Owners/Owner of Mineral Rights:

Carol & Donald Graham
1706 Giuntoli Lane
Arcata, CA 95521
(707) 822-1060

Ellen Zanzi
P.O. Box 2542
Yountville, CA 94599

REA
P.O. Box 299
Arcata, CA 95521
(707) 822-4853

Agent of Process

Pacific Affiliates
835 Third Street
Eureka, CA 95501
(707) 445-3001

Project Location
Adjacent and north of the Valley West area of Arcata.
SW¼ Sec. 8, NE¼ Sec. 17, NW¼ Sec. 16, T6N, R1E, H.B.M.
Assessor Parcel Numbers 504-141-11, 32 & 42.
The project site is located within the Coastal Zone.
River mile ±6.6 (upstream bar and processing yard), ±6 (downstream bar)

Access
Access to the processing site and the upstream extraction area is from two private driveways that intersect with Giuntoli Lane, at the intersections of Giuntoli Lane with Valley East and Valley West Boulevards. Access to the downstream extraction area is approximately 1 mile north down a private drive that begins at the intersection of Giuntoli Lane with Valley West Boulevard.

Public access through the processing yard is restricted. Public access to the downstream bar is limited.

Project Description
On March 31, 1993, the County recognized a vested right for the commercial extraction of up to 95,000 cubic yards annually from the site. As of this writing the period for filing an appeal of the determination to recognize the vested right has not been exhausted. It is expected that an appeal will be filed.

This site has historically had a processing plant, as well as an asphalt batch plant, running with large amounts of gravel being processed. The operation totals approximately 80 acres. During extraction, 1 to 17 acres may be disturbed.

Environmental Setting

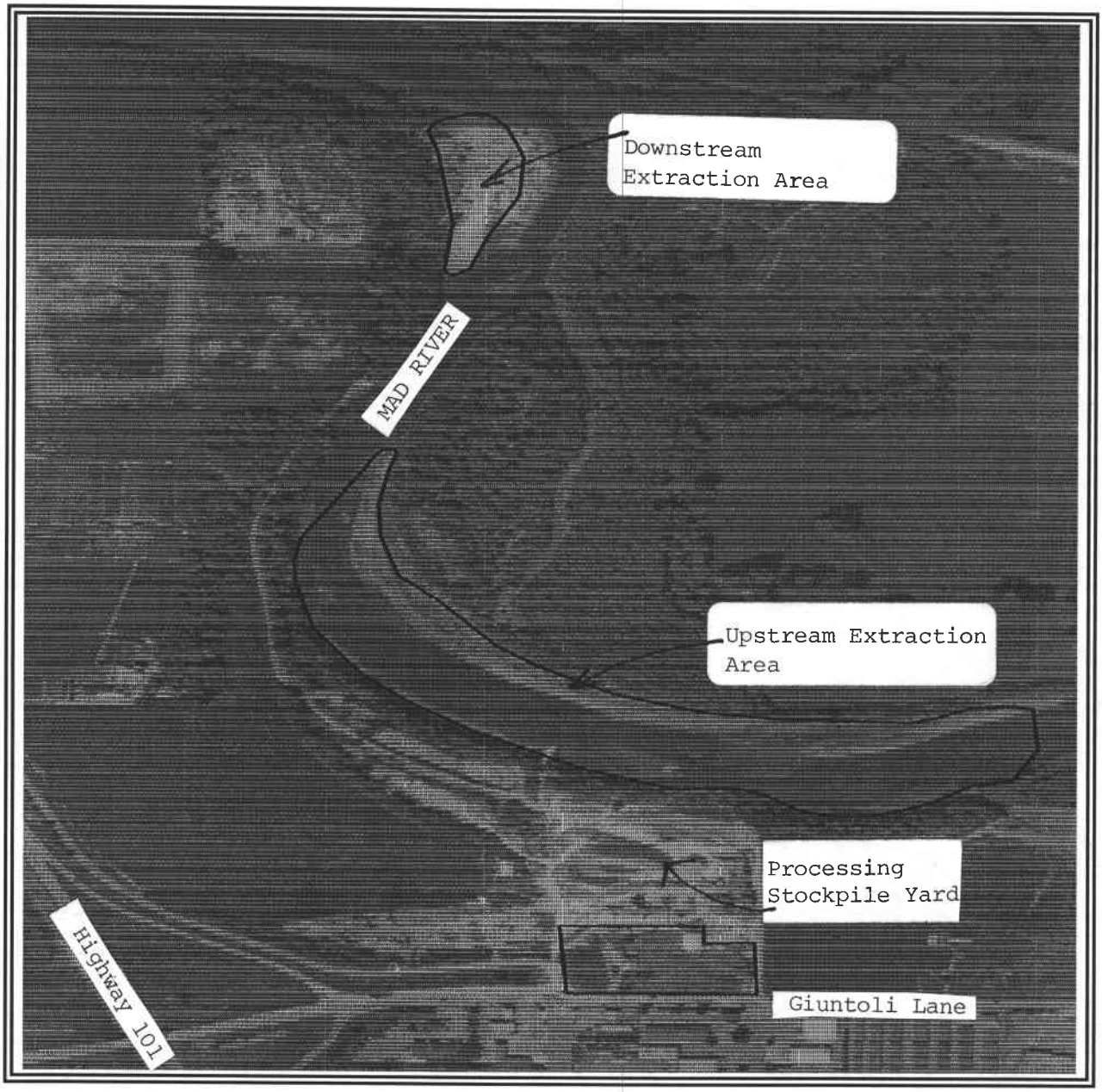
This site includes the Redwood Empire Aggregates (REA) processing yard and narrow bar on the south side of the river, a long narrow bar on the northerly bend on the river, and another bar on the westerly side of the downstream bend. The southerly side of the river supports a band of fairly mature forest, dominated by red alder with yellow willow and cottonwood present in lesser amounts. The southerly bar was covered with several feet of sediment at the time of field investigation. There is a pocket of mature scrub vegetation on the downstream bend, and sparse early scrub vegetation on the bar itself.

The northerly bar, across from the processing plant, is at the edge of a moderately aged stand of mixed forest vegetation which has developed within the last twenty-five years. Several low-lying areas within the forest are wet enough to support emergent vegetation. Thick sediment deposits with no exposed gravel have been noted on this bar. There are no stands of forest vegetation of equal or greater size downstream.

The Mad River flows south to north through the project area. Bank to bank average width is approximately 400 feet.

The nearest occupied structure is 200-300 feet south of the processing yard. The nearest residence to the east is approximately 500 feet. Residences west and north are 1,400 feet and 1,800 feet, respectively.

During the extraction season, REA receives gravel not only from its Graham bar, but also from the Johnson, Blue Lake and Emmerson gravel bars. Importation also occurs during the winter months from stockpiles in Nicholls Trucking yard in Blue Lake. REA has three dump trucks and rents others as needed. Exportation of materials from the Giuntoli site averages about 50 loads per day during the summer months with maximums approximating 120 loads per day. In addition, approximately 30-50 customers a day bring their private vehicles to be loaded with various aggregate materials. During winter months the number of loads is reduced to approximately 12 per day, on an average. Access onto Giuntoli Lane is either at Valley East or Valley West Boulevard, both a short distance to Highway 299 or Highway 101.



N

No Scale

Site Map
Site No. 8
Graham bar

SITE NO. 9

Common Site Name	Simpson-Zabel Bar
Humboldt County Case No.	none
Mine I.D. No.	none
Operator	Zabel Trucking P.O. Box 3772 Eureka, CA 95501 (707) 445-2958
Property Owners/ Owner of Mineral Rights:	Simpson Train Company P.O. Box 1169 Arcata, CA 95521 (707) 822-0371
Agent of Process	Rising Sun Enterprises 1864 Myrtle Avenue Eureka, CA 95501 (707) 445-2433

Project Location
Just upstream and east of the Railroad Bridge. Adjacent to, and downstream of Site No. 5.
SE¼ Sec. 14, NW¼ Sec. 23, SW¼ Sec. 13, T6N, R1E, H.B.M.
Assessor Parcel Numbers 504-131-02 & 04; 516-161-04.
River mile ±9.8.

Access
Access to the site is from a private road that intersects Glendale Drive, approximately 1000 feet east of the intersection of Larson Heights Road with Glendale Drive. Public access to the site is restricted, or is made by foot or 4-wheel drive from below the Railroad Bridge.

Project Description
The operation has extracted up to 40,000 cubic yards annually. At this writing no permits or reclamation plans have been approved for this site. The operation totals approximately 50 acres. During extraction, 1 to 27 acres may be disturbed.

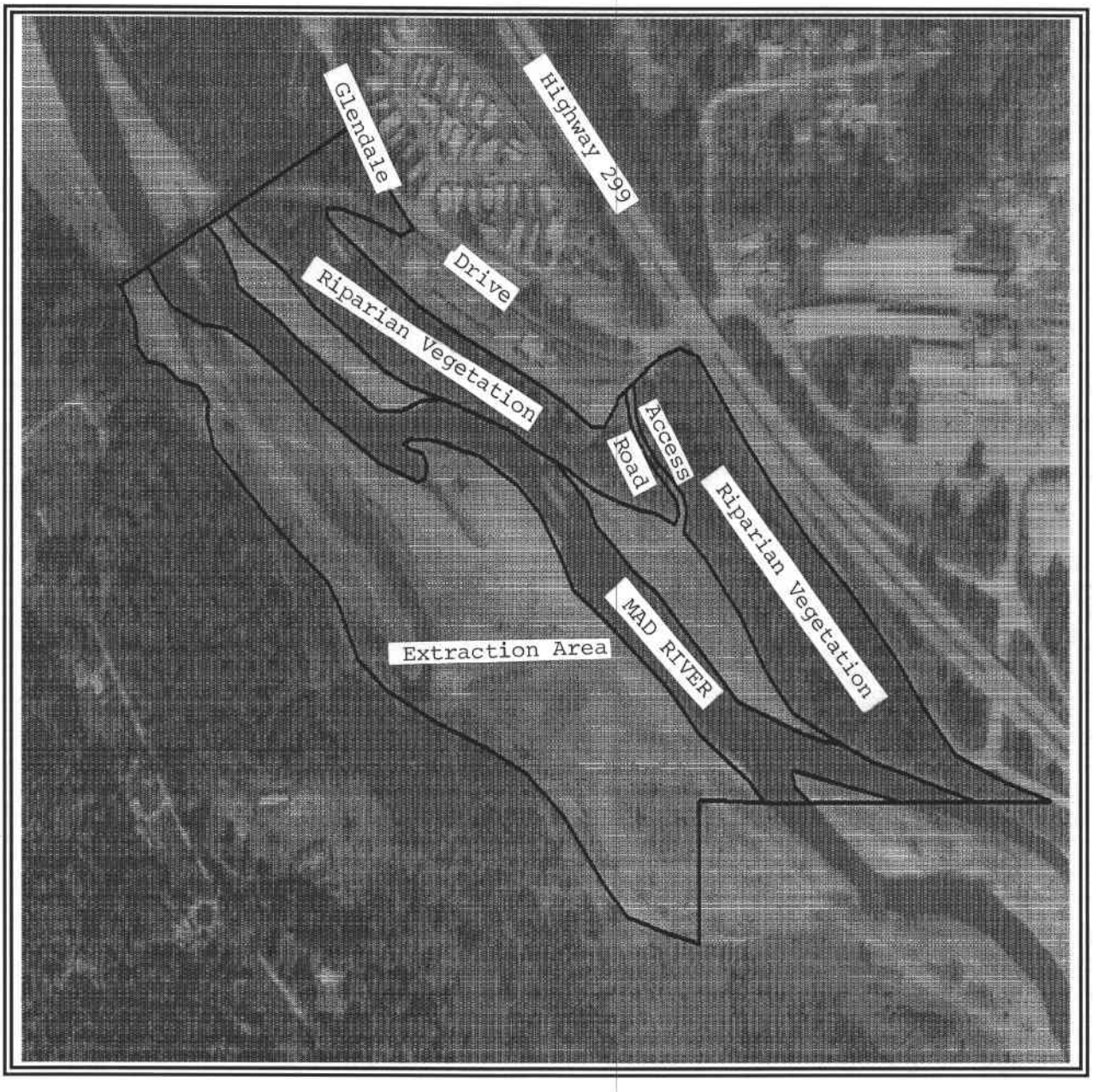
The operation involves extraction only; no stockpiles or processing occur on-site.

Environmental Setting
The Simpson-Zabel Bar is bound by native slopes rather than alluvial terraces on both sides of the river. The current channel is on the northerly side of the canyon. This site supports an open gravel bar habitat with early scrub vegetation being sparse to absent. The banks on both sides of the river support mature arroyo willow on the lower slope and a mature red alder forest on the upper slope. At the top of both banks, the deciduous riparian forest grades into a mixed forest with cottonwood, alder, and sparse California bay (*Umbellaria californica*) and Sitka spruce (*Picea sitchensis*).

Extraction may occur on both sides of the river, and a summer bridge crossing is required. The river flows east to west through the project area.

Approximately 35 trailers are the nearest residences, approximately 400 feet to the north within the Glendale trailer park area. These trailers would also be subjected to noise from Highway 299.

Other residences on the south side of the river, off of Walnut Creek Road may be within 600 feet of extraction equipment.



N

No Scale

Site Map
Site No. 9
Simpson-Zabel bar

SITE NO. 10

Common Site Name	Simpson Bar
Humboldt County Case No.	none
Mine I.D. No.	none
Operator	Simpson Timber Company
Property Owners/ Owner of Mineral Rights:	Simpson Timber Company P.O. Box 1169 Arcata, CA 95521 (707) 822-0371
Agent of Process	unknown

Project Location
Approximately ¼ mile downstream from the Mad River Hatchery.
River mile ±14.

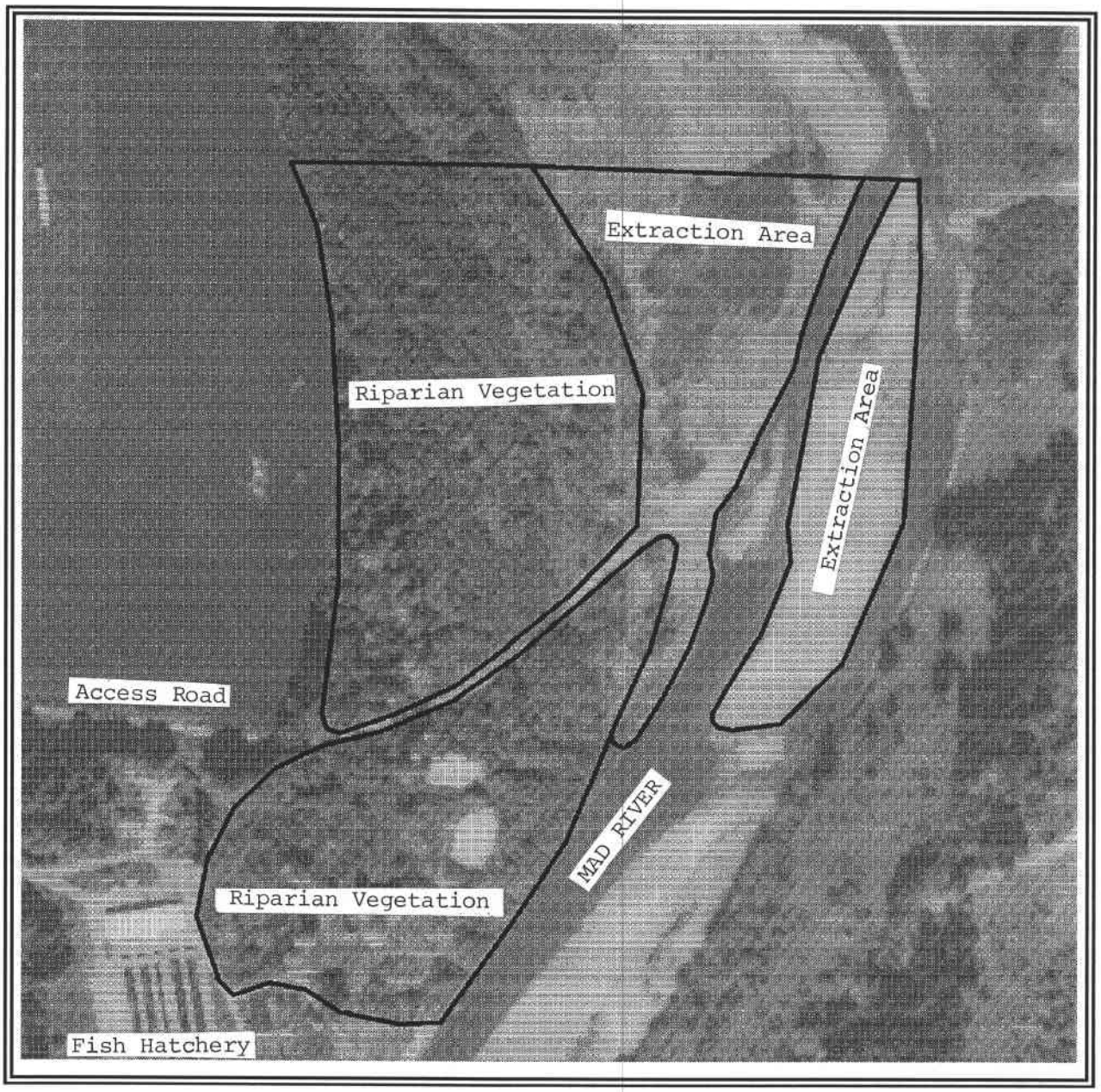
Access
Access to the site is by a private road that intersects Hatchery Road approximately ¾ mile south of the intersection of West End Road with Hatchery Road. Public access to the site is restricted.

Project Description
The site is a historic non-commercial extraction site for the Simpson Timber Company. Material extracted from the site is used to develop and maintain timber haul roads and to rock and patch the Simpson log deck. Affidavits from retired Simpson employees show upwards of 40,000 cubic yards being extracted annually. Future production levels are expected to average less than 5,000 cubic yards annually, with a maximum extraction of 25,000 cubic yards per year.

The operation totals approximately 3.2 acres. The operation involves extraction only, no stockpiles or processing occur on-site.

Environmental Setting
This site is located at the upstream end of the Blue Lake Valley. It is characterized by a mid-stream gravel bar (with gravel bar habitat), gravel bar and early to mid-aged scrub on the easterly side, and mixed young and moderate age scrub on the westerly side. Portions of the westerly bank are being actively eroded. While mature scrub and riparian forest were not observed within the active area, they are located adjacent to and westerly from the site.

Extraction may occur on both sides of the Mad River, which flows south to north through the project site.



N

No Scale

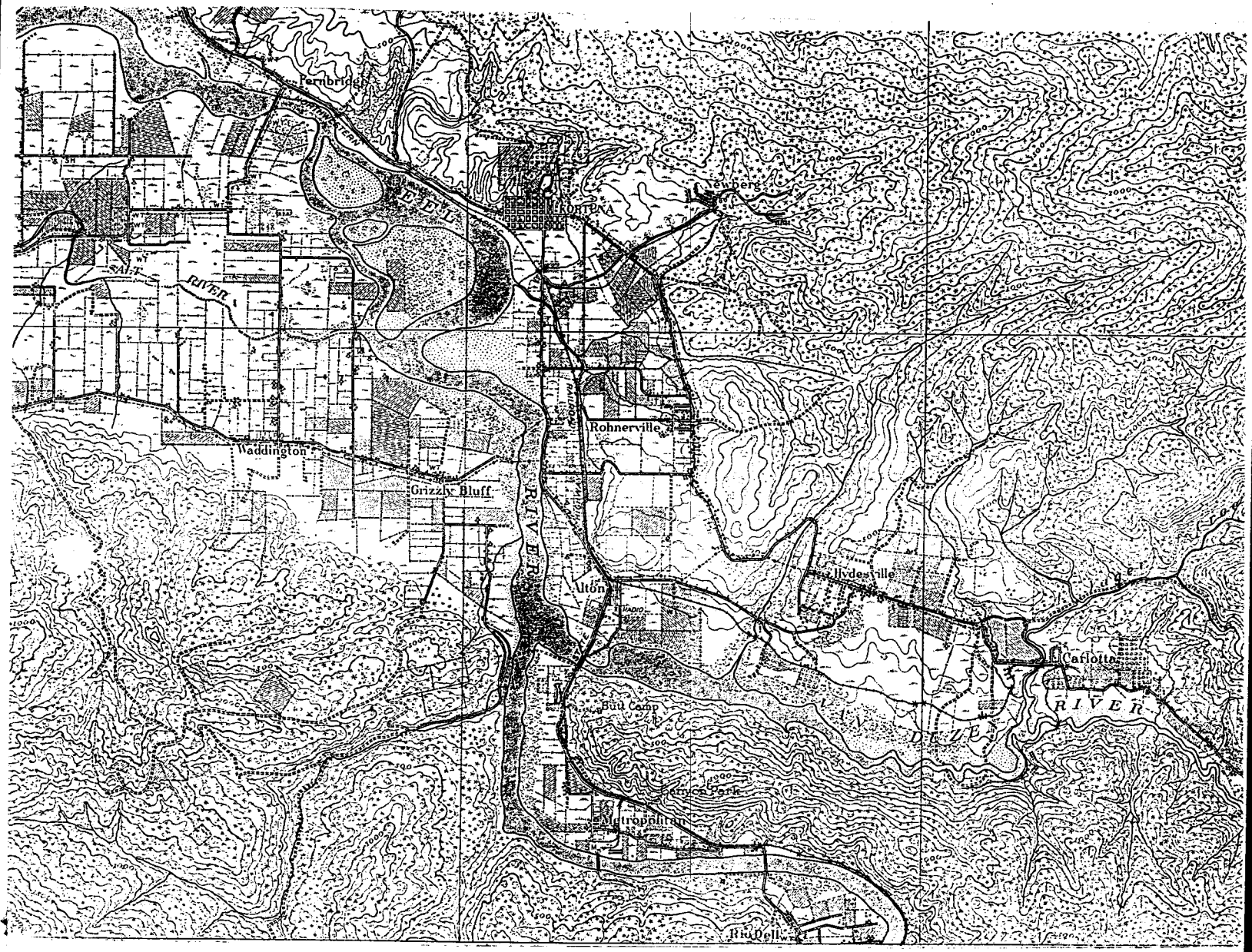
Site Map
Site No. 10
Upper Simpson bar

Appendix B

G. Mathias Kondolf
Consultants Report

AGGREGATE EXTRACTION FROM THE EEL AND MAD RIVERS, HUMBOLDT COUNTY:

GEOMORPHIC AND ENVIRONMENTAL PLANNING CONSIDERATIONS



by
G. Mathias Kondolf, Ph.D.
2241 Ward Street
Berkeley CA 94705

5 April 1993

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by
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a report submitted to the
Planning Department, County of Humboldt
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5 April 1993

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CONCLUSIONS AND RECOMMENDATIONS

1) By interrupting the continuity of sediment transport through the river system, instream gravel extraction can induce incision and other morphological changes, which can propagate miles upstream and downstream of gravel pits. Incision can occur both downstream and upstream of the gravel pit: downstream due to deprivation of sediment load, upstream from knickpoint migration.
2) The complexity of sediment transport and channel change in natural rivers is such that prediction of river behavior is plagued with a significant degree of uncertainty.
3) Computer models of sediment transport are simplifications of complex natural processes. The National Research Council (1983) concluded that the performance of all such models was so poor that their use could not be justified in flood insurance studies.
4) A thorough historical study of channel change and a sediment budget analysis should be undertaken on the Mad and Eel Rivers as a basis for understanding and predicting impacts in these channels.
5) Changes in river channel form and bed elevation should be monitored using cross sections surveyed to a common datum using standard procedures. Cross sections should be surveyed not only in extraction areas but in intervening reaches as well to provide longitudinal continuity.
6) The County should consider establishment of minimum thalweg elevations (redline) to protect bridge crossings and other resources. Incision of the thalweg below the redline would trigger a restriction or halt in extraction and any other activities that could be inducing incision under further studies indicate that extraction can be safely resumed.
7) Upland sources of aggregate (quarry and terrace gravels) should be inventoried and evaluated throughout the region.
8) Based on historical information, sediment budget analysis, and inventory of alternative sources, the County should develop a comprehensive aggregate resource management plan. A key component of the plan should be matching aggregate quality with end use requirements.
9) Although an excellent start has been made with historical and sediment budget studies completed for the EIR, the information base necessary to prepare a comprehensive aggregate resource management plan cannot be developed by June 1, so a preliminary EIR should be prepared to satisfy regulatory requirements this year. The preliminary EIR should describe the studies underway and the process by which a regional aggregate management plan will be developed and an EIR done on it in 1994.
10) The problems related to aggregate management in Humboldt County cannot be solved piecemeal. Comprehensive environmental planning is needed to examine all alternative sources and their environmental impacts, and to develop a coherent strategy to supply the county's aggregate needs while minimizing environmental impacts of extraction.

PURPOSE AND SCOPE

The purpose of this report is to provide guidance concerning geomorphic issues related to extraction of sand and gravel from the active channel beds of the Mad and Eel Rivers. Recommendations include consideration of regional approaches to management of all types of aggregate resources and methods of comparing the environmental impacts associated with extraction of each type. This guidance is presented from the perspective of an outside expert familiar with the geomorphic impacts of instream gravel mining and regulation of the activity in the State of California, the gravel requirements of spawning salmonids, and the geomorphic character of rivers of northern California in general, although not previously knowledgeable about particulars of the Mad and Eel Rivers.

This report is a written version (with citations and technical support) of the presentation made in Eureka on 17 December 1992 to a group composed of staff of the Humboldt County Planning and Public Works Departments, members of the Fish and Game Advisory Commission, staff of California Department of Fish and Game, gravel extractors, the local operators association, members of the Technical Committee, a member of the Board of Supervisors, and representatives of environmental organizations. This report applies principles of geomorphology and environmental planning, along with the author's experience with impacts of instream gravel mining elsewhere, to the situation in Humboldt County. However, specific recommendations of quantities extractable, extraction methods, location, and timing, and detailed protocols for monitoring and assessment of environmental factors in Humboldt County is beyond the scope of this report.

Since the site visit and writing of the draft version of this report, considerable historical and sediment budget analysis have been completed and reported by Andre Lehre, Randy Klein, and others as technical input to the EIR. Although I have not had an opportunity to review this material, it appears that these researchers have already completed some of the studies recommended here, although there are outstanding issues remaining that require further study (Randy Klein, personal communication 1993).

This report is organized as follows. An overview of the problem is followed by a review of river processes relevant to understanding the geomorphic issues related to instream aggregate extraction. The concept of sediment budget construction and the limitations of the existing science are reviewed, followed by a discussion of monitoring and management strategies for in-channel projects. The need for a broader, regional approach to management of aggregate demand and sources is considered, along with recommendations for the near-term strategy for Humboldt County in preparation of an EIR for extraction on the Mad River in 1993.

OVERVIEW OF THE PROBLEM

Sand and gravel are used for a large variety of construction activities including roads and highways (base material and asphalt), pipelines (bedding), septic systems (drain rock in leach fields), and concrete (aggregate mix) for highways and buildings. With the rapid population growth and consequent construction boom in California, the demand for aggregate has been strong. In 1986, the production of sand and gravel in California, primarily derived from river channels and their floodplains was estimated at 128,500,000 tons with an estimated value of nearly $500,000,000 (Sandecki 1989), nearly double the estimated production of 65,000,000 tons in 1955.

In Humboldt County, as in many other counties in the state, most aggregate has been derived from river deposits, both active channel and floodplain. This situation developed over time, with many major existing extractions having grown gradually, without, until recently, being subjected to any environmental analysis, and without a thorough planning process or analysis of cumulative effects. Although sediment budget and historical channel change studies have yet to define linkages between specific management activities and specific impacts, instream gravel extraction is implicated in degradation (downcutting) of the Mad River and consequent undermining of the Highway 299 bridge and impacts to other structures. As a result of these concerns, the County is now taking a serious look at the environmental impacts of instream aggregate extraction, in an attempt to balance the goals of aggregate supply for economic development and environmental quality in the Mad and Eel Rivers.

In California, instream gravel extraction is ineffectively regulated. Under the Surface Mine and Reclamation Act (1976, and amended), all mining operations (upland or in-channel) are required to prepare reclamation plans. The notion of reclamation is suitable for upland quarries, but, as I argue here, it is unsuitable for instream mining. Counties or cities are designated as lead agencies for approving reclamation plans and issuing special use permits or vested rights determinations. In Humboldt County, use permits are required of all mines except those operating before 15 May 1965, which may have vested rights (Sidnie Olson, Planning Department, Humboldt County, personal communication 1993). Instream mining operations must also obtain a Streambed Alteration Agreement from the Department of Fish and Game. In addition, permits for filling of waters of the United States may be required from the US Army Corps of Engineers under Section 404 of the Federal Water Pollution Control Act Amendments of 1972 and/or Section 10 of the Rivers and Harbors Act of 1899.

Despite all these requirements, the cumulative impacts of instream aggregate extraction are rarely thoroughly analyzed in any meaningful way, and an analysis of alternatives (required by the National Environmental Policy Act (NEPA), Section 404 of the Clean Water Act, and the California Environmental Quality Act (CEQA) is rarely performed.

In general, as lead agencies, county planning departments rarely have the resources or staff with expertise needed to properly address the technical issues related to instream extraction. In many counties, little monitoring has been conducted by lead agencies to assess compliance with permit conditions, and even less to document channel conditions as a means of assessing impacts. A survey of 56 county-level lead agencies in California in 1990 showed that only nine had established limits tied to hydrology or channel conditions, and only eleven required channel cross sections or aerial photography to monitor impacts (Kondolf and Matthews, in press). Moreover, county officials may be subject to political pressure or may be influenced by the needs of the county itself to extract aggregate for its operations. In many counties, illegal (unpermitted, non-vested) mines continue to operate.

The existing situation is unlikely to persist because of impacts to structures and aquatic resources. Caltrans is both a consumer of 15 percent of the state's aggregate and victim of bridge undermining by channel incision that may be related to instream mining. Mining (and other activities throughout the watershed) can produce incision that may propagate for miles, affecting distant bridges. About 150 of the state's bridges are critically threatened by scour (Cathy Crossett, Caltrans Structures Div., pers. comm. 1991). With the repair and replacement costs potentially reaching hundreds of millions of dollars, pressure is increasing for control of activities potentially responsible. Likewise, as a result of dramatic declines in anadromous salmon runs over recent decades, recent legislation requiring action to restore salmon runs, and recognition that lack of suitable spawning gravel in sites such as the Sacramento River below Keswick Dam is a major obstacle to restoration of salmon runs, pressure from fishery and environmental groups is increasing for stronger regulation of instream aggregate extraction.

This report reviews principles of river processes relevant to evaluation of impacts of instream aggregate extraction, considers the limitations in the science of sediment transport, and presents arguments for comprehensive environmental planning, in which preservation of natural resources and economic needs are balanced through intelligent, businesslike allocation of resources. This environmental planning should involve an inventory of all potential aggregate sources, evaluation of the relative quality of aggregate, and allocation to various end uses as appropriate, with environmental impacts factored into the cost of instream-produced aggregate.

REVIEW OF RIVER PROCESSES

Role of Rivers in the Landscape

As waters flow from high elevation to sea level, they sculpt

the landscape, developing complex channel networks and a variety of stream channel forms. Of the rain that falls on the land surface, over half usually goes back into the atmosphere through evaporation or transpiration by plants. The remainder (a variable fraction, typically about one-third) can run off into the stream network, either running off directly into channels or infiltrating into the groundwater and draining more slowly. Obviously the atmosphere cannot provide more water than it receives indefinitely, and this imbalance is settled by evaporation from the sea. More water evaporates from the ocean surface than falls on it as precipitation. We have already observed that more water falls on the land than evaporates from it, so there is a net transfer of moisture from the sea to land. This is due primarily to the greater availability of water for evaporation on the ocean surface and the greater tendency for precipitation over land from orographic effects.

The land area drained by a given river is termed its drainage basin or watershed, and is separated from adjacent watersheds by topographic high points termed drainage divides. Above any point in a river system, the area over which surface runoff is collected to flow past that point is the drainage area. Drainage basins can be defined at many scales, from large river basins such as the Sacramento River at Sacramento (drainage 23,500 square miles), to its tributary basins such as the Pit River (4,700 square miles) and the North Fork of Battle Creek near Manzanita Lake (6 square miles).

Drainage basins can be viewed as the fundamental landscape units because so many processes occurring upstream in the drainage basin affect downstream reaches, and some processes in downstream reaches may affect upstream reaches. For example, construction of roads in the upper drainage basin may increase rates of erosion and sediment delivery to stream channels, filling downstream channels with sediment, causing the channel to aggrade (build up its bed with sediment), as illustrated along Redwood Creek (Kelsey et al., 1981). If the level of the sea or a lake drops, the channel of a tributary stream immediately upstream may incise or degrade (erode its bed downward), and this incision may propagate upstream for miles or tens of miles, as illustrated along Rush Creek, a tributary to Mono Lake (Stine 1987).

Energy Dissipation and Sediment Transport

Energy is dissipated by rivers in a variety of ways: by transport of sediment, by turbulence from rough, irregular bed and banks, and by energy losses at bends (Figure 1). As water flows from the upper reaches of the watershed downward through the drainage network, some of the potential energy inherent in its elevation at the point of origin goes into energy of motion, with the remaining energy expended upon transport of sediment and dissipated in turbulence. The steeper the channel, the more

rapid the rate of energy dissipation (conversion of energy from potential to other forms). Steep channels typically have large rocks on the bed (with greater flow resistance and stability), with most energy losses concentrated in localized drops. These drops may be bedrock or boulder steps in step-pool reaches, or gravel-cobble riffles in pool-riffle reaches.

That rivers possess energy in excess of that required to move water to sea level is reflected in the potential for hydroelectric power generation in steep reaches of Sierra Nevada rivers. Many of these hydroelectric power projects are run-of-the-river, involving no large storage reservoirs, but simply diversion of flow from the channel into smooth canals or tunnels that convey the water at a gentle grade along the mountainside above the river. The river falls more steeply (dissipating energy in turbulence over boulders and bedrock) until the canal is 100-200 feet above river level, whence the water drops abruptly through reinforced pipes (penstocks) driving turbines in the power plant.

Much of a river's excess energy is used to move sediment. The sediment load of a river can be broken into three components: dissolved load, suspended load, and bedload. Dissolved load consists of the products of rock weathering, such as Calcium, Magnesium, and Carbonate (CO_3), carried in solution. Where chemical weathering is the dominant denudation process on the landscape, such as in humid tropical regions or landscapes underlain by soluble limestones, dissolved load can constitute most of the sediment load. Elsewhere, dissolved load is usually a minor component of total load. Suspended load, the largest component of the sediment load of most rivers, consists of mud, silt, and sand maintained in suspension by turbulence in the water column. In general, the concentration of suspended sediment decreases with height above the bed. Bedload consists of sand and gravel moved along the bed of the river by rolling, sliding, and bouncing (saltating) (Figure 2). Although gravel may move in suspension during large floods, gravel is primarily transported as bedload, so to understand processes relevant to instream gravel extraction, we are particularly interested in bedload transport.

Bedload usually constitutes a small fraction of a river's total sediment load. In low-gradient rivers, bedload might constitute 2 percent or less of total load, while in mountainous terrain, bedload may constitute 20 percent of total load (Collins and Dunne 1987).

Sediment transport is one way in which rivers dissipate excess energy. If the sediment load of a river is artificially reduced without reducing the magnitude of the flows, the flows will still possess the excess energy capable of moving sediment, and the river will tend to erode its bed and banks.

The size of sediment grains movable depends on the water velocity (a function of water depth and channel gradient) of the flow, as illustrated by Figure 3. Flow velocity determines not

only the size, but also the amount of sediment that can be moved in a river. The rate of sediment transport typically increases geometrically with flow, that is, a doubling of flow typically produces more than a doubling in sediment transport. This is illustrated by graphs relating transport of sediment in tons per day to the flow rate in the Carmel River (Figure 4). Because the rate of sediment transport is so much greater in higher flows, most sediment transport occurs during floods.

The sediment transported by rivers consists of the soil and rock fragments eroded from the watershed. The amount of sediment transported from a basin (the basin's sediment yield) can be used to compute the rate at which the landscape is lowered by erosion (the denudation rate). These processes are generally slow, with denudation rates ranging from under one-half inch per thousand years in the Appalachian Mountains to 40 inches per thousand years in the Himalayas (Leopold et al. 1964, p. 28). In general, the highest, steepest mountains are being most rapidly uplifted and are also being most rapidly eroded. For example, the Cropp River basin in the Southern Alps of New Zealand is being uplifted at approximately 0.4 inches per year and is being lowered by erosion at approximately the same rate (Griffiths and McSaveney 1983). Viewed over a longer perspective, runoff erodes the land surface and the river network carries the erosional products from each basin. The watershed can be divided into the zone of sediment production (steep, rapidly eroding headwaters), the zone of transport (through which sediment is moved more-or-less in equilibrium) and the zone of deposition (Schumm 1977)(Figure 5). The watershed can also be viewed as a sediment "factory", and the river channel as a "conveyor belt", which transports the products downstream to the ultimate depositional sites below sea level (Figure 5). Along the length of the river system, the size of sediment changes, from coarse gravel-boulder in steep upper reaches to sands and silts in low gradient reaches.

Along this "conveyor belt", sediment in the river bed may appear stable in the short term and may be replaced by new transient sediment every year or two. Gravel bars in the Eel and Mad Rivers may look much the same from year to year, but the majority of gravel particles in them may be replaced annually or biannually, as sediment moved downstream from this site is replaced by sediment carried in from upstream. The dynamic nature of river channel features may not be apparent, but is of enormous importance in understanding the effects of human activities on river channel morphology.

Just as the sediments in the channel bed are mobile on a time scale of years, so the sediments that make up the river floodplain (the valley flat adjacent to the channel) are mobile on a time scale of decades or centuries. The floodplain acts as a storage reservoir for sediments transported in the channel, alternately storing sediments (by deposition) and releasing sediment to the channel (by bank erosion). Figure 6 depicts migrations of the channel of the Carmel River since the first

surveys in 1857. The river channel migrated over a quarter of a mile in places, with most channel shifts occurring during two large floods in 1862 and 1911. The 1911 flood deposited a wide channel of sand and gravel. By 1940, the Carmel River had cut a narrow channel 12 ft deep, leaving the flood-widened bed as a terrace of alluvium flanking the new active channel. By 1960, the terrace had been subdivided for low density housing, despite the recent origin of the land.

The floodplain is a dynamic feature closely related to the channel. In fact, the channel and the floodplain are best viewed as a single unit hydrologically and geomorphically, just as the watershed is a single landscape unit. Unfortunately, the natural functions of the floodplain have frequently been ignored, with often disastrous effects.

Flood Frequency and Channel Form

Except in unusual cases below large springs (such as Fall River near Burney), flow in California rivers is exceedingly variable. This is due to the highly seasonal precipitation and variable intensity of the winter cyclonic storms. Within the year, flows range from seasonal lows (in late summer in the Coast Ranges, in winter in higher elevation Sierran snowmelt streams) to high flows (during winter storms along the coast, during spring snowmelt at higher elevations). Flows also vary from year-to-year, depending on the abundance and intensity of precipitation for the year. The typical pattern of high flows is of particular importance in shaping a stream channel, especially for rivers flowing through sediments, less so for rivers flowing through bedrock canyons. One way to statistically summarize the flood regime of a river to compute the arithmetic average of the annual peak floods, the mean annual flood or Q_{maf}. However, because year-to-year variation in flood magnitude is so great in regions with semi-arid or Mediterranean climates (such as California), this statistic is very sensitive to the sequence of years that chance to fall within the period analyzed. For example, an average over the period 1955-1986 (encompassing wet years 1955, 1965, 1982, 1983, and 1986) would be higher than an average over 1956-1991 (excluding 1955 but including the dry years of 1987-1991). Distortion of estimating frequent events can be avoided by calculation of return periods of floods based on assumed distributions, as discussed below.

The history of floods on a given river can be analyzed to develop probabilistic estimates of the likelihood of a certain sized flood occurring in a year. The flood that occurs as the annual peak flow, on an average of every two years is the "two-year flood" or "Q_2"; the flood that occurs every ten years is the "Q_{10}". The probability that these flood levels will be reached or exceeded in any given year is 50 percent and 10 percent, respectively. It is a common misconception that if a river experiences a 100-year flood one year, the probability of a

comparable flood the following year will be less. In fact, the probability of another 100-year flood the next year remains the unchanged at 1 percent.

It is intuitive that rivers with larger flows possess larger channels to convey the larger quantities of water. But how much larger must the channels be? More to the point, is there a flow to which the channel adjusts its geometry? During summer low-flows most rivers do not fill their banks, but occupy a small low-flow channel, exposing gravel bars and other such features. At extreme floods, the river flows out of its banks and spreads across its floodplain. The flow that just begins to exceed the capacity of the banks is designated as bankfull flow; in many rivers, this occurs at about the $Q_{1.5}$ to Q_2, (Leopold et al. 1964). This implies that many channels are adjusted to these frequent floods rather than to larger, but less frequent floods. However, the relative importance of less frequent floods is greater in semiarid and arid environments (Wolman and Gerson 1978).

Effects of Reservoirs

Dams and diversions have profoundly altered the character and functioning of rivers in California. To understand the nature of these changes, it is helpful to view them in terms of the independent variables that control alluvial channel geometry: flow regime and sediment load. Changes in these variables will produce adjustments in alluvial channels. The nature of these channel adjustments will depend upon the characteristics of the original and altered flow regime and sediment load. However, some general trends can be expected, as outlined in Table 1 and discussed below.

Dams disrupt the longitudinal continuity of the river system, interrupting the action of the "conveyor belt" of sediment transport. Upstream of the dam, all bedload sediment and most suspended load is deposited in the quiet water of the reservoir, while downstream, water released from the dam possesses the energy to move sediment, but no sediment load. Clearwater released from the dam is known as "hungry water", because the excess energy is typically expended on erosion of the channel bed and banks for some years following dam construction. For example, on Stony Creek (a tributary to the Sacramento River), since the closure of Black Butte Dam in 1963, the channel downstream has undercut and migrated laterally, eroding enough bedload sediment to compensate for about 20 percent of the bedload now trapped by Black Butte Dam on an annual average basis(Kondolf and Swanson 1993).

The channel erosion below dams is frequently accompanied by a change in particle size on the bed, as gravels are transported downstream, leaving a coarse lag deposit of cobbles or boulders, known as an armor layer. Development of the cobble-bed is an adjustment by the river to changed conditions because the larger

particles are less easily mobilized by the hungry water flows below the dam. However, this change in particle size can be detrimental to salmon populations, which require gravels for spawning. This problem has been observed on many rivers in the state, including the American River below Folsom and Nimbus Dams, the Sacramento River below Shasta and Keswick Dams, the Mokelumne River below Comanche Dam, and the Carmel River below Los Padres and San Clemente. In these (and other) cases, gravels suitable for spawning have been artificially placed in the channel in an attempt to recreate the lost spawning habitat.

Reservoirs typically reduce flood peaks, although this effect varies considerably depending upon reservoir size and operation; flood control reservoirs can contain larger floods than reservoirs operated solely for water supply. The larger the reservoir capacity relative to river flow, the greater the reduction in peak floods. Downstream of the reservoir, encroachment of riparian vegetation into parts of the active channel may occur in response to a reduction in annual flood scour and sediment deposition (Williams and Wolman 1984). The process of vegetation encroachment is discussed further below.

Channel narrowing has been greatest below reservoirs that are large enough to swallow the river's largest floods, such as on the Trinity River after construction of Trinity Dam in 1960. Prior to dam construction, the Q_2 was about 16,000 cfs, after dam construction only about 300 cfs. The Q_{maf} decreased from 18,500 cfs pre-dam (1911-1960) to 2,600 cfs post-dam (1964-1990)(Figure 7). As a result of this dramatic change in flood regime, the dimensions of the channel have decreased since construction of the dam by encroachment of vegetation and deposition of sediment (Pitlick 1992).

In some cases, fine sediment delivered to the river channel by tributaries accumulates in spawning gravels because there are no more natural floods to flush the river bed clean. Probably the best known example in California is the Trinity River, where accumulation of decomposed granitic sand in the river bed has led to destruction of invertebrate and salmonid spawning habitat (Fredericksen and Kamine 1980). Experimental, controlled releases are now being conducted to determine the flows required to "flush" the sand from the gravels in the Trinity River (Kondolf et al. 1993).

Effects of Aggregate Mining

Aggregate in California is derived principally from pits located in active floodplains, inactive river terrace deposits, or directly in the active channel. Other sources include hardrock quarries and mining deposits within reservoirs. Although no figures are available to specify the proportion of total production derived from various sources, it is clear that the great majority of aggregate is derived from active channels and adjacent alluvial deposits.

Aggregate derived from active river beds has the advantage of requiring little processing or transportation. Natural river processes eliminate weak materials by abrasion and attrition, so the resulting deposits are durable, rounded, well-sorted, and relatively free of interstitial fine sediment. Gravel-bedded rivers are often located near the markets for the product or along transportation routes, which reduces hauling costs. This is especially important to this industry, where the cost of the product may double with each 25 miles of transport (Randy Sater, Teichert Construction Company, Sacramento, personal communication 1991).

As noted above, the sediment in the bed of rivers is a dynamic feature, in transit through the system during floods. The flux of bedload depends on the supply of coarse sediment from the watershed and the transporting power of the river. Transport rates vary over space and time. If the sediment flux is altered, the river channel is likely to adjust to the changed conditions. Instream gravel mining, by disrupting this sediment continuum, may alter a preexisting balance between sediment supply and transporting power.

The most dramatic effects of instream mining occur when pit mining is conducted within the active channel, inducing incision both downstream and upstream. As illustrated in Figure 8, the undisturbed channel is characterized by a continuity of energy available to transport sediment (designated here by shear stress, τ, the force per unit area exerted on the channel bed) and or sediment load. Because the pit traps gravel transported from upstream, it deprives downstream reaches of sediment supply. Downstream reaches still experience the same flow and therefore the same shear stress to move sediment, so the usual result is downcutting by the hungry water. By excavating large pits, whether shallow or deep, the profile of the stream bed is altered and the channel must adjust to the locally steeper gradient upon entering the pit (Figure 8). This steeper gradient creates an excess stream power capable of eroding the bed upstream. This process is known as "headcutting" or "knickpoint migration", and the effects may translate upstream for miles. As the streambed degrades, the material remaining on the surface will coarsen as sand and finer gravels are first transported, leaving a coarse lag similar to the armor layer seen downstream of dams. In severe cases, the degradation will continue until bedrock or older substrates under the recent alluvium are uncovered.

Incision has many direct effects, notably the undermining of bridge piers and other structures (Bull and Scott 1974). The Highway 299 Bridge over the Mad River has been undermined by channel incision resulting, at least in large part, from the cumulative effects of extractions upstream and downstream. The cost of extraction-related scour to bridges through 1984 in California probably exceeded $12 million (Kondolf and Matthews, in press).

When analyzing the impacts of various factors in the watershed, it is important to look some distance upstream and downstream for causes and effects. Actions changing runoff or sediment yield in distant parts of the drainage basin may affect river processes at a downstream site. For example, Benbow Dam impounds runoff and traps all bedload from 440 square miles of the South Fork Eel River watershed, reducing runoff and sediment delivery from about 12 percent of the drainage basin of the Eel River at Fernbridge. In many other California rivers, reservoirs affect a larger percentage of the drainage area. Incision under a bridge can be caused by instream gravel mines several miles upstream, which trap bedload and reduce sediment delivery to downstream reaches.

Incision can induce channel instability and trigger bank erosion and channel migration in formerly stable reaches. The physical alteration of the stream channel may result in destruction of existing riparian vegetation and reduction of available area for seedling establishment. Loss of vegetation affects riparian and aquatic habitat by loss of temperature moderating effects of shade and cover and loss of habitat diversity. As noted above, bed coarsening results in loss of spawning gravels for salmonids. Extensive degradation may induce a decline in the alluvial water table, as the channel acts as a drainage ditch, effectively draining the banks, affecting riparian vegetation and water supply wells (Woodward-Clyde Consultants 1976).

By altering the natural channel configuration, even low-volume gravel bar skimming operations can reduce habitat diversity by producing a wide, shallow channel lacking in the pools and cover needed by fish, and potentially increased water temperatures.

Vegetation Encroachment

Along many rivers in California, the active channel is maintained by scour in annual or biannual floods. In the seasonal decline of flow following the last flood of the season (during spring in rainfall-runoff streams of the Coast Ranges, during summer in the snowmelt-runoff streams of the Sierra and Cascades), seedlings of willows and other riparian trees begin growing on exposed areas of the active bed. However, these seedlings are normally scoured by floods that occur each year or two. The seedlings offer little resistance to the forces of flood scour and are easily swept away when the bed is mobilized. Thus, the open, unvegetated active channel is maintained.

However, if flood scour does not occur for several years, the seedlings can grow to maturity. Mature willows and other woody riparian species develop dense root mats that bind the sand and gravel of channel bed. As a result, the Q_2 is incapable of dislodging the mature plants. A much larger flow, on the order of the Q_{10} may be required to dislodge mature vegetation. Flood

scour may not occur because of prolonged drought (as recently experienced from 1987-1992) or because of flow regulation by upstream reservoirs. Moreover, increased summer base flow below reservoirs may induce vegetation encroachment by irrigating the low-flow channel.

In order for vegetation encroachment to occur, the bed must be exposed (not submerged) during the germination period in late spring or summer because riparian vegetation cannot germinate under water. This factor is important because it prevents establishment of vegetation in rivers whose active channels are perennially submerged, as is commonly the case in more humid environments.

Soil moisture must be adequate during germination and growth of riparian seedlings. The water table may decline over the growing season, but the decline must be sufficiently gradual to permit root growth to keep pace. Soil moisture is determined by soil texture and water table depth. Coarse alluvial deposits (gravels and sand) retain little moisture above the water table (due to minimal capillary action); in these substrates water tables must be near the surface during the growing season for successful germination and survival. Finer-grained alluvial deposits (sand and silt) retain more moisture and permit plant growth with lower water table levels.

In wide, sand-bed channels with a shallow water table, vegetation can establish across virtually the entire active channel. Gravel-bed rivers typically have alternating bars with enough topographic relief that vegetation establishes primarily on sloping sides of the bars. One little-recognized effect of gravel bar skimming may be the potential for increased establishment of willow seedlings on skimmed surfaces. If skimming is not substantially rearranged or aggraded during the subsequent flow season, and provided riparian seedlings are not destroyed by operation of equipment, a shallower water table and therefore more favorable environment for seedling establishment may result (Figure 9).

In many channels dominated by boulders or cobbles, vegetation establishment is limited to the margins of the low-flow channel, as illustrated by the Merced River near El Portal (Figure 10). The zone in which plants can establish I have termed the "window of opportunity" (Kondolf 1988a), because above this zone, plants are desiccated in late summer, while below this zone, seedlings are periodically scoured by floods. Seedlings established above this window of opportunity are desiccated because the coarse-grained sediment cannot maintain adequate soil moisture as the water table undergoes its seasonal decline. Along the Merced River, we measured the maximum elevations of willow establishment above the baseflow level (of 1986), and found plants rarely established more than 1 m above the baseflow water elevation (which can be taken as a surrogate for the water table elevation in this coarse-grained alluvium). This finding is similar to patterns observed along Dry Creek, a gravel- and sand-

bedded stream in Sonoma County, California. McBride and Strahan (1984) contrasted first year mortality in cottonwood and willow seedlings on a site with a shallow (20-cm deep) water table in September vs a site whose water table dropped to 1 m by September. All willow and 65 percent of the cottonwood seedlings died at the site with the 1-m deep water table, while the site with the 20-cm deep water table had survival rates of 12-38 percent for willow seedlings, 94 percent for cottonwood (McBride and Strahan 1984).

Encroachment of vegetation into active channels can have impacts on flood capacity of the channel. The San Joaquin River below Friant Dam has experienced a tremendous reduction in flood regime, and riparian vegetation has invaded the active channel as a result. The USACE has initiated a study of flood hazard resulting from loss of channel capacity due to vegetation encroachment (USACE 1991). Ironically, Friant Dam was constructed in part to provide flood control, but by controlling the frequent small floods, it has allowed vegetation establishment and created a flooding problem at lower flows. Kondolf and Matthews (1990) analyzed the potential reduction in channel capacity likely to result from enlargement of a reservoir (and reduction in the Q_2) on the Carmel River.

SEDIMENT BUDGET ANALYSIS

A sediment budget is an accounting of sediment sources, rates of sediment flux through the system, losses to or gains from temporary sediment storage reservoirs (such as gravel bars or floodplains), and losses by export from the basin. The basic sediment budget equation is

$$I \pm \Delta S = O$$

where I = inputs, ΔS = change in storage, and O = output. For a given system, various components may be classified under input, storage, and output, depending upon how the system is defined.

For example, Kelsey (1980) developed a sediment budget for the Van Duzen River basin for the period 1941-1975, in which he defined five principal components of sediment input to the channel: fluvial sediment from hillslopes, debris slides and avalanches, earthflows, bank erosion in melange terrain, and bank erosion of floodplain and terrace deposits. He also measured change in storage, which was principally aggradation of the bed (mostly during the December 1964 flood), and he computed output from the river basin from suspended sediment concentration and flow data (Table 2). Kelsey's purpose was to develop a model for denudation of the Van Duzen River basin, showing the relative importance of various geomorphic processes and the relative importance of a large event, the 1964 flood.

By contrast, a sediment budget was developed for the Carmel River as a tool for management of the river downstream of San

Clemente Reservoir. For this budget there was no need to distinguish the geomorphic processes ultimately responsible for generation of sediment from the uplands. Rather, the budget established the importance of different sediment sources to the reach downstream of the dam: mainstem bank erosion, sediment yield from tributaries, and suspended sediment passing over the dam (Kondolf and Matthews 1991). In this study, based on extensive sediment sampling in 1982 and 1983, suspended and bedload sediment components were distinguished, permitting better resolution of the budget terms. The analysis showed that for the years studied, bank erosion was by far the dominant input term.

Sediment budget analysis can be helpful in analyzing potential impacts of instream gravel mining, especially in determining whether extraction rates approach or exceed annual bedload transport rates through the extraction reach. For example, Kondolf and Swanson (1993) developed a sediment budget for Stony Creek from Black Butte Dam to its confluence with the Sacramento River near Hamilton City (Figure 11). Stony Creek is a particularly good case to study because of the high natural bedload sediment yield, the magnitude of impacts of dam construction and instream mining, and the fact that the study reach (downstream of Black Butte Dam) traverses an alluvial fan so that there are no tributaries to complicate the picture. Prior to closure of Black Butte Dam in 1963, an annual average of about 100,000 m^3 (128,000 yd^3)of gravel was transported from the drainage basin to the study reach. Since closure of the dam, the reach below the dam has incised and laterally migrated, cannibalizing its earlier deposits, and regaining through bank erosion about 20 percent of its pre-dam sediment load. Using extraction volumes reported by the operators, an estimated 260,000-730,000 m^3 (330,000-930,000 yd^3) is removed annually along the entire length of Stony Creek, of which about 80-90 percent is concentrated in a 3-mile reach centered on the Highway 32 bridge. As a result of the intense mining upstream and downstream of the Highway 32 bridge, the channel degraded up to 17 ft between 1974 and 1990 under the bridge.

LIMITATIONS OF THE SCIENCE OF SEDIMENT TRANSPORT

Complexity of Natural Processes

The processes of bedload sediment transport in streams are still poorly understood. This is due, in large part, because it is generally not possible to observe the processes of bedload sediment transport directly, at least during times of greatest sediment transport. There is still basic disagreement among investigators about what goes on in streams during sediment transport. Moreover, it is difficult to measure bedload transport, especially during floods when the vast majority of sediment transport occurs. One reason sediment transport is so difficult to understand is the tremendous spatial and temporal

variability in the processes of sediment production from the watershed, sediment delivery to the channel, transportation within the channel, and deposition in and along the channel. Transport rate is a function of both the transporting energy available and the volume and grain size of available sediment. In gravel-bed rivers, the nature of bedload transport changes with increasing flow when the force per unit area applied to the bed (the bed shear stress) becomes sufficient to disrupt the coarse surface layer (the pavement), liberating finer-grained particles from below. As a result, the rate of bedload transport at a given flow may be greater on the recession limb of a flood hydrograph than the rising limb. On the rising limb, the pavement was not yet disrupted and still "protecting" the underlying fine-grained sediment, while the pavement had not yet re-formed when the river dropped back to the same flow on the recession limb.

In addition, the supply of sediment available for transport may change over the course of a flood (as fresh landslides or bank erosion contribute new material to the channel) or over a period of years. For example, on the Carmel River, massive bank erosion in 1980, 1982, and 1983 delivered large quantities of sediment to the channel. Since then, a number of bank stabilization projects have been undertaken, and sediment input from this source (the largest source term in the sediment budget) has been reduced. Sediment transport measurements in 1992 and 1993 show the rate of sediment transport at a given flow has decreased from values measured in 1982 and 1983.

Even when the sediment supply and flow can be considered to be steady, large variations in bedload transport over time have been observed (Pitlick 1988, Carey 1985). In field studies on the Trinity River in 1992 (Kondolf et al. 1993), the author collected ten sequential replicate Helley-Smith samples of bedload transport at the same station during a reservoir release held steady for a period of six days. The measured transport rates varied by over 100 percent. On sand-bedded streams, dramatic variations in transport rate are known to be associated with the passage of dunes and related bedforms. Similarly, large-scale bedforms known as "gravel waves" (about 1 m high and 1 km long) have been observed on the Waimakariri River near Christchurch, New Zealand, moving downstream at about 1 kmy^{-1} (Griffiths 1979).

On the Trinity River (and elsewhere) bedload transport rates were observed to vary substantially across the channel, with transport concentrated in zones. If these zones migrate across the channel (much as the boundaries between eddies and the main current can be observed to migrate), this would also cause bedload transport rate to vary at a point.

For these and other reasons, the relationship between sediment transport and flow is usually scattered. The sediment rating curve is usually developed as a best-fit line through often widely scattered data to predict the dependent variable

(sediment transport) from the independent variable (flow)(Figure 4). The most common practice to compute total annual sediment transport is to apply a sediment rating curve to the annual hydrograph. The inherent imprecision of the "rating curve" approach to computation of total suspended sediment transport has been discussed by Walling (1977), and Glysson (1987) documented errors of from 0 to 1,760 percent from this approach.

Limitations of Sediment Transport Models

Sediment transport models can be useful tools in analysis of river systems, but it is unrealistic to treat model predictions as anything more than attempts to represent, in a very simplified fashion, an exceedingly complex natural system that is still poorly understood. For their input values, sediment transport models must simplify river channel geometry and bed material size. For actual computation of sediment transport, the models must simulate flows in the river and use one of many conflicting sediment transport equations. Given this, the state-of-the-art in modeling sediment transport is simply not good enough to accept results of a model when those results contradict general principles of river behavior and observations on streams in the region.

Existing equations to predict sediment transport were developed (or calibrated) using imperfect field data (and data from laboratory flumes that may not reflect field conditions). The equations are unlikely to be better than the measurements upon which they were based. Given this, it is not surprising that a recent study by the National Research Council (NRC) concluded that use of these models "...cannot be justified in flood insurance studies." (NRC 1983, p.xi) The American Society of Civil Engineers compared numerous sediment transport equations with each other and with field data and concluded "...it is clear that sediment discharge formulas, at best, can be expected to give only estimates." (Vanoni 1977, p. 229-230)

Comparison of Models

A recent study by the National Research Council (NRC 1983) tested six computer models of sediment transport, including HEC-6 and FLUVIAL-11, and reported that "...greatly different sediment discharges were predicted by the models tested in this study" (p.114), and concluded that the use of these models "...cannot be justified in flood insurance studies." (p.xi) The report identified the principal deficiencies of sediment transport models as follows:

"a. Unreliable formulation of the sediment-discharge capacity of flows.

b. Inadequate formulation of the variable friction factor of erodible-bed flows, and, in particular, the dependency of friction factor on depth and velocity of flow, sediment concentration, and temperature.

> c. Inadequate understanding and formulation of the mechanics of bed coarsening and armoring, and their effects on sediment-discharge capacity, friction factor, and degradation suppression of flows.
> d. Inadequate understanding and formulation of the mechanics of bank erosion, and therefore, limited capability to incorporate this contribution into the sediment input to the flows from bank erosion and the effects of channel widening." (NRC 1983 p.xi-xii)

It is worth emphasizing that any sediment transport model is only a simplification and generalization of what are actually complex field conditions. This process of simplification and generalization involves a great many assumptions. As was illustrated by NRC study, several different competent people running the same models can produce several different results.

Problems with Sediment Transport Equations

As noted by the NRC (1983), one of the biggest problems with sediment transport models is that existing sediment transport equations (on which the models are based) are unreliable predictors of sediment transport. The American Society of Civil Engineers (ASCE) manual on Sedimentation Engineering compared the predictions of various sediment transport equations on the same data set and showed that the predictions differed up to a factor of 100. The ASCE concluded,

> Based on the material presented it is clear that sediment discharge formulas, at best, can be expected to give only estimates...
> It is very desirable to give guide lines that will enable the engineer to select an appropriate formula or relation that is suitable for use under any specific set of conditions. Unfortunately, this cannot be done except in a very general sort of way. A rough way to judge the suitability of a formula is to compare the characteristics of the flows in the problem at hand with those of the flows that gave the data for determining the formula...It must be emphasized that the foregoing method of judging the suitability of a formula is a rough one and may not give satisfactory results. For this reason it is recommended that the selection of a formula or formulas be based on checking calculated sediment discharge against any observed values of the stream under consideration or on similar ones. Finally, after reasonable checks have been made one can then make some kind of judgement of the reliability of the calculations that should be kept in mind in using them in the planning works. (Vanoni 1977, p.229-230.)

Uncertainty in Geomorphic and Sediment Transport Predictions

Some degree of uncertainty is inevitable in the study of channel change and sediment transport. This is so because: 1) numerous independent watershed variables (e.g., rainfall, rock type, land use) can combine in many different ways to produce different flow and sediment regimes, and 2) numerous dependent channel variables (e.g., width, depth, bedforms, sediment transport) can adjust in many different combinations to any given regime (the indeterminate hydraulics described by Maddock 1970). Put another way, there are too many variables to solve all the equations simultaneously.

Given the impossibility of exact prediction from science and engineering, geomorphic understanding assumes increasing importance. Although computer models are limited, there is often much historical evidence available to provide insights into the response of a river to particular types of events.

THE NEED FOR HISTORICAL STUDIES

Every river is unique. Given the complexity of natural sediment transport, the indeterminate nature of channel hydraulics, the inability of simplified models to adequately predict river behavior, and the variety of human influences upon river systems, the best guide to a river's future behavior is often gleaned from analysis of its past behavior. Moreover, a historical perspective is essential to placing the present condition in context. In California, large infrequent floods may reshape the channel, stripping the riparian zone of vegetation, transporting boulders, and eroding or depositing large quantities of sediment. The catastrophic channel changes occur suddenly, but recovery may take decades. We might develop a very different picture of the same stream depending upon whether we observe it two or twenty years following a big flood. We must know the channel's history of flood response and recovery to know what we are looking at in any given year and what changes we might expect.

For example, the Marble-Cone Fire burned large portions of the drainage basin of the Arroyo Seco (a tributary to the Salinas River south of Carmel Valley) in 1977. In 1978 and 1980, increased erosion from the burned area resulted in about six feet of aggradation in parts of the channel, but a decade later, the bed had returned to its pre-fire profile. First, it would be important to know that the basin had just burned if we were studying the Arroyo Seco in 1981. Moreover, documenting the past channel response to a perturbation such as this provides an indication of the system's resilience to future, similar events: the Arroyo Seco accommodated dramatically increased sediment loads without inducing widespread instability.

Sources of data for historical channel stability analysis

include historical aerial photographs (coverage extends back to the 1930's for most of California), old maps (commonly back to the 1850's), old engineering surveys of some river reaches (possibly back to about 1900), surveys under bridges at construction, computed bed elevations from gaging station records, narrative accounts, and geomorphic evidence (Kondolf and Sale 1985).

Geomorphic evidence would include such features as a deeply buried redwood stump encountered in an excavation along the Eel River, as reported by a participant during the author's presentation in Eureka in December 1992. If this stump were to be dated by C_{14} analysis, it might provide an excellent data point for reconstruction of the river's history. In the historical analysis, this evidence would be compared to other evidence, such as the report in 1917 that the Eel River was tidal (with a low tide depth of 2 ft) for six miles upstream from the mouth (64th US Congress 1917). However, accumulation of gravel over the stump could result from down-dropping of the land (resulting from tectonic movements) as well as an increased delivery of sediment from the watershed.

An example of temporarily increased sediment yield from a basin is the passage of hydraulic mining debris through the Yuba River around the turn of the century. Hydraulic mining was conducted by directing high-pressure jets of water onto an exposed placer deposit (gravel, sand, and silt) and running the sediment through sluices to remove the gold (Yeend 1974), washing away large portions of mountains, leaving canyon-like landscapes (e.g., Malakoff and Columbia Diggins state historic parks). The sediment washed into steep canyons and thence into the Central Valley, increasing the load of the Yuba and Feather Rivers beyond their transport capacity, resulting in extensive deposits of sediment at the foot of the Sierra Nevada. The "debris plain" of the Yuba River was particularly noteworthy, covering over 40 square miles east of Marysville. As river channels filled with sediment, rivers flooded farmland, inundating many fields with fresh deposits of hydraulic mining debris. Agricultural interests successfully halted the practice of hydraulic mining (which had begun in the 1850's) in the courts in 1884.

The passage of this wave or "slug" of sediment through the Yuba River was documented by changes in bed elevation at the stream gage at Marysville, which showed aggradation had peaked and the bed began incising by 1905 (Figure 12)(Gilbert 1917, Adler 1980). Stabilization of the bed of the Yuba River continued for decades, influenced in large part by channel training works and construction of Englebright Dam in 1940 upstream of the debris plain. The Highway 20 bridge over the Yuba River at Parks Bar was constructed in 1911, when the bed was still aggraded from the influx of the mining debris. As the channel recovered over the subsequent decades, flushing out the aggraded sediment, the bridge piers were undermined (Kondolf 1988b). An instream gravel mine immediately upstream of the

bridge may have contributed to the incision at the bridge, but the largest factor was probably gradual recovery from the hydraulic mining debris.

On Redwood Creek, repeated channel surveys documented aggradation and incision resulting from passage of a wave or "slug" of sediment, which migrated downstream about 15 miles over a decade (Varnum and Ozaki 1986).

INSTREAM MANAGEMENT STRATEGIES

A number of approaches have been employed to monitor instream extraction, based either on limits to extraction quantities or observed channel effects. One approach is to estimate the "replenishment rate" (the rate at which gravel is transported into the extraction reach from upstream), and to permit that quantity to be mined. The replenishment rate is usually expressed as an annual average, although in some cases it is estimated on a year to year basis. Because of the episodic nature of sediment transport and the enormous year-to-year variability in transport, an annual average replenishment rate is of questionable value: it will rarely correspond to the actual transport in a given year. Moreover, because of the uncertainties in sediment transport estimation and prediction, estimates of transport are prone to honest error or can be deliberately manipulated. More fundamentally, however, this approach ignores the continuity of sediment transport through the system.

The notion is that if the harvest rate does not exceed the rate at which coarse sediment is delivered from upstream, the harvesting can be sustained without impact on the channel system. However, when viewed in the larger context, this extraction site can be seen as the "upstream" from which downstream reaches derive their coarse sediment supply. If the sediment in transit through the system is rerouted out of the channel into gravel trucks, the flow of gravel is interrupted and downstream reaches are deprived of their sediment load. One effect of this is creation of hungry water downstream of extraction sites, and the river may expend its excess stream power by eroding bed and banks. Thus, channel incision and instability may result downstream of extraction sites even if the extraction rate does not exceed the "replenishment rate".

Another approach is to limit the depth of extraction, but unless this is expressed in terms of an absolute elevation, the constraint may be meaningless. Permits often specify "x feet below the channel bed" or prohibit excavation "below the water level" without defining the water level. Similarly, an approach used in Mendocino County and elsewhere has been to prohibit excavation below the thalweg, but the thalweg is redefined each year. Such approaches deal only with the excavation itself, not with resulting degradation, which can result in progressively lower bed elevations. In general, CDFG and county permits tend

to focus on the short-term impacts of extraction (gasoline spill, turbidity during operation), ignoring cumulative effects of all extractions over time, such as degradation of the river bed.

A more meaningful approach is to define limits to degradation expressed in reference to permanent benchmarks, commonly termed a "redline", as used by Ventura County on the Santa Clara River. River bed elevations can be documented by repeated aerial photography (as used by Sonoma County) or by resurvey of channel cross sections by registered engineers (as done by Lake County). These approaches provide important information for making resource decisions, but the need for a historical study cannot be overstated. For example, a river may be undergoing a long term adjustment to a major aggradational flood and would be downcutting its bed in any event. If this context were not understood, degradation observed in measured cross sections might be erroneously attributed solely to effects of extractions.

COMPREHENSIVE ENVIRONMENTAL PLANNING

The present practices and regulation of instream mining have evolved piecemeal over recent decades in reaction to problems resulting from increased extraction rates related to the state's rapid urban growth. Despite the fundamental economic importance of the aggregate, and despite the environmental impacts of its extraction from river channels, the existing situation has developed without the benefit of objective, regional planning, in which society can make businesslike decisions about the alternatives for extraction and allocation of these resources.

There has been little serious effort to step back and view these issues in the larger context of environmental impact within the entire river basin and the range of aggregate sources available in a region. Decisions about managing these resources should be based on adequate information about both the resource quality and uses, and the environmental impacts of various alternatives. Unfortunately, in many areas, the necessary data are lacking or have not been compiled in a meaningful way.

County or regional-level planning is needed to:

1) Analyze market demand for aggregate (recent history, present demand, and future projections). The demand analysis should be sufficiently sophisticated to specify the quality of product needed for each end use.

2) Inventory potential sources of aggregate regarding both quantity and quality. These sources should include all older gravel deposits, especially those outside the riparian zone, potential quarry rock sites, and recycled aggregate. In addition, production costs and transportation costs to various markets should be estimated.

3) Evaluate and quantify environmental impacts of extracting from each source. Some impacts (such as the noise level in a residential neighborhood from a quarry) may be relatively easy

to quantify. Other impacts (such as the effects of extractions on channel behavior and bridge integrity) may be more difficult. In any event, the cumulative impacts of each alternative should be evaluated to the extent possible.

Until recently (and still in many areas) environmental costs of instream gravel extraction have not been factored into production costs, making instream sources more attractive than alternatives such as dry terrace mines (which often require additional processing), quarries (from which rock must be crushed, washed, and sorted), or distant sources, such as reservoir deltas, involving greater transportation costs. Also, in many areas, competition for land from urbanization or agriculture has pushed aggregate mines into stream channels.

However, with the loss of most of California's riparian forests over the past 150 years and increasing recognition of the ecological importance of these habitats (terrestrial and aquatic), resource agencies are becoming reluctant to permit further operations without adequate environmental review.

Identification of Alternative Aggregate Sources

To identify potentially valuable mineral reserves in a region and to prevent them from being paved over and rendered inaccessible by urbanization is one goal of SMARA. Toward that end, the State Mines and Geology Board (the Board) has completed surveys of potential aggregate minerals in "production-consumption regions" in 18 counties. These have been published as "Mineral Land Classification" reports (e.g., CDMG 1982). The Board has also then designated certain reserves as "Regionally significant construction aggregate resources areas" within the production-consumption region (e.g., CDMG 1984). This designation puts certain restrictions on development of the land. For the past two years, the Board has stopped designating "regionally significant" resources to avoid the requirement to produce environmental impact documents. The Board has also shifted to producing county-level mineral assessments that include minerals other than aggregate minerals.

The Board's limited budget and staff have resulted in slow progress in classifying mineral lands in the state. Twenty counties (including Humboldt, Mendocino, Del Norte, Trinity, Siskiyou, and Shasta) have yet to have any such classification done. Figure 13 shows areas in California that have classification reports completed or in progress as of June 30, 1991. Although Humboldt County has been on a list for eventual classification study, the Board assigns highest priority to rapidly urbanizing counties in central and southern California (Mike Sandecki, CDMG, personal communication 1993).

It is possible that County officials could petition the Board to conduct a mineral land classification study of Humboldt County sooner than presently scheduled. However, normal delays would likely mean several years before such a study was complete

and available as a basis for decision making in Humboldt County. Accordingly, identification of potential upland and terrace aggregate sources will probably need to be done by the County.

The EIR for Gravel extraction from the Lower Eel River (Humboldt County 1992) dismissed alternative aggregate sources as infeasible without an adequate exposition of the supporting analysis. The County Materials Testing Lab inventoried existing pits in remote areas of the county, and found most to yield weak lithologies unsuitable for most aggregate applications, although 25 percent of the existing pits yield rock suitable as aggregate base. This was consistent with county engineers' long-term experience with behavior of materials on county roads, indicating most of the rock west of the South Fork Eel to be "soft" (Don Tuttle, Humboldt County Public Works). However, it is not clear that the population of existing pits is a representative sample of the distribution of geologic units in the county from which potential aggregate sources could be identified. In any event, it should make no difference if most of the county is underlain by incompetent lithologies so long as a few suitable quarry sites can be located and developed. Thus, while valuable experience gained by county engineers should not be discounted, a fresh look at potential sources of aggregate is needed in a comprehensive and systematic fashion.

The EIR also argued that about $1 million worth of crushing equipment would be required at a quarry and dismissed the option because, "The cost to the consumer for aggregate base or whatever gravel material would double" (Humboldt County 1992:164). The assumptions and calculations used to reach this conclusion were not presented in the EIR, but this sort of economic argument demands careful analysis and recognition that while instream aggregate sources may require less processing, they are not necessarily "free" when environmental impacts are considered. While the information collected on upland quarries thus far is useful, potential upland sources for aggregate (bedrock and terrace gravels) should be systematically inventoried as an essential element of the County's aggregate management plan.

Aggregate recycling has been identified as a potentially significant source in Sonoma County (Sonoma County 1992) and is now commercially available in some areas. In recent negotiations over highway construction, the City of Albany required Caltrans to use only recycled aggregate (Mike Brodsky, personal communication 1993). Concrete rubble suitable for recycled aggregate is likely to be more available in urban areas than in Humboldt County, but to the extent that it is available, incentives should be created to encourage its use as a resource rather than its disposal as waste.

Matching Aggregate Quality with End Use

One important aspect of a mineral resource inventory or land classification is matching aggregate quality with end use.

Sources of PCC-grade aggregate should be identified. At present, these are mostly river-derived aggregate. This product should be used, to the extent possible, only in applications requiring the PCC-grade quality. It is likely that upland quarry or terrace pit sites can be identified to produce lower grade aggregate for road bed and other uses. Increasing the efficiency of resource allocation makes sense in that it preserves the most valuable resources for the highest end uses.

In addition to compilation of economic and environmental data as a basis for decision-making, there are equity issues to be addressed. Given the competitive nature of the aggregate business, some mechanisms must be developed to insure that any increased restrictions on instream mining are phased in to avoid unfair competitive advantage to certain operators. In the long run, incorporation of true environmental costs into the price of river-produced aggregate will stimulate competition and render upland sources more attractive.

It is virtually inevitable that upland quarry sites will trigger local, probably vocal, opposition. While these concerns should be considered, they must be viewed in the larger perspective. There is a danger that institutional inertia and NIMBYism (the "Not-In-My-Backyard" opposition that develops to virtually any land-use proposal) could make it easier politically to maintain a status quo that may produce large environmental (and economic) impacts to important public resources than to make changes that would reduce overall impacts, but would shift those impacts to a small (probably vocal) segment of the public.

If the environmental effects of instream mining are too great, and if we can't locate upland quarries or pits, then we have no aggregate, and construction comes to a halt in the county. Clearly, there are choices to be made. These choices can be made wisely only in the context of all possible aggregate sources and an appreciation for the cumulative effects of their extraction. Making these choices poses a challenge not only to county government, but also to environmental and citizen advocacy groups, who cannot oppose all proposed aggregate extractions without inviting economic disaster. The regional context must be borne in mind when advocating specific, local land use decisions. It may prove necessary to accept traffic and noise impacts near an upland quarry to achieve the greater benefit of reducing instream extraction. In such cases the impacted residents can be compensated.

The management of aggregate resources in Humboldt County poses a challenge that cannot be successfully addressed piecemeal. Through comprehensive regional planning, in which economic and environmental consequences of various alternatives are recognized and quantified, an equitable, efficient, and environmentally-sound resolution can be found.

RECOMMENDATIONS FOR NEAR-TERM ACTIONS BY THE COUNTY

At present, the County is under pressure to prepare an EIR that can be approved by 1 June 1993 in order to permit extractions to resume in the Mad River this summer. Without the EIR, regulatory agencies may not issue permits for mining in the Mad River. However, the essential studies needed as a basis for comprehensively assessing environmental impacts and for reaching sensible resource allocation decisions have not yet been completed. Specifically:

1) A historical channel study is needed for the Mad River to put the present river conditions in long-term perspective. This study could possibly be completed this spring, but 9-12 months is a more reasonable time frame.

2) A sediment budget should be constructed from results of the historical study as well as reservoir sedimentation data, inventory of sediment stored in-channel and in terraces, and other quantification of sediment sources, transport, and storage. As with the historical study, 9-12 months is reasonable time frame for a sediment budget study.

3) A thorough inventory should be made of all potential aggregate sources in the region, including upland quarry and terrace sources. This study will require analysis of existing geologic maps as well as field checking and reconnaissance, testing of potential aggregate quality, and land ownership surveys. The study should not be limited to the Mad River drainage, but should include the entire market area. It is unlikely that such a study could be completed by June, although 9-12 months is probably enough time.

4) An economic analysis of alternative sources should be conducted, taking into account not only production and transportation costs, but also estimated environmental costs of indirect effects of instream extraction.

5) Based on results of the above studies, an aggregate management plan for the market area should be proposed. This plan should include a strategy for phasing in any alternative sources of aggregate, and matching aggregate quality with end use.

If it is true (as argued here) that an informed aggregate management strategy and substantiated EIR can be based only upon the results of these studies, then it would make sense to postpone the EIR until these studies can be completed. Postponing EIR preparation by one year will probably fail to satisfy the requirement of regulatory agencies that an EIR be completed this year. However, it is highly unlikely that a comprehensive aggregate resource management plan, in which environmental issues or upland alternatives are fully evaluated, can be completed by June. Thus, the dilemma.

A possible solution to the problem would be to commence the historical study and study of upland alternatives immediately, using funding available for the EIR preparation. (The historical and sediment budget analyses completed this spring by Andre

Lehre, Randy Klein, and colleagues appear to constitute an excellent beginning.) A preliminary EIR can be prepared this year, which would outline the strategy of conducting the studies, developing a rational aggregate management plan next year, and preparing the EIR based on the plan and study results. Given the environmental benefits from a plan that realistically analyzed cumulative effects and considered all alternatives, it is likely that the regulatory agencies would approve the preliminary EIR and throw their support behind the necessary studies and the comprehensive environmental planning effort to follow. These agencies should be involved in formulation of the aggregate management plan next year.

Studies of the Eel River should be coordinated with those on the Mad. The EIR on the Lower Eel River (Humboldt County 1992) represents an excellent first step at recognizing the environmental impacts and incorporating historical information in the analysis. However, a more thorough historical study is needed on the Lower Eel River, involving resurveys of historic cross sections and mapping of old channel courses from historical maps and photographs.

ACKNOWLEDGEMENTS

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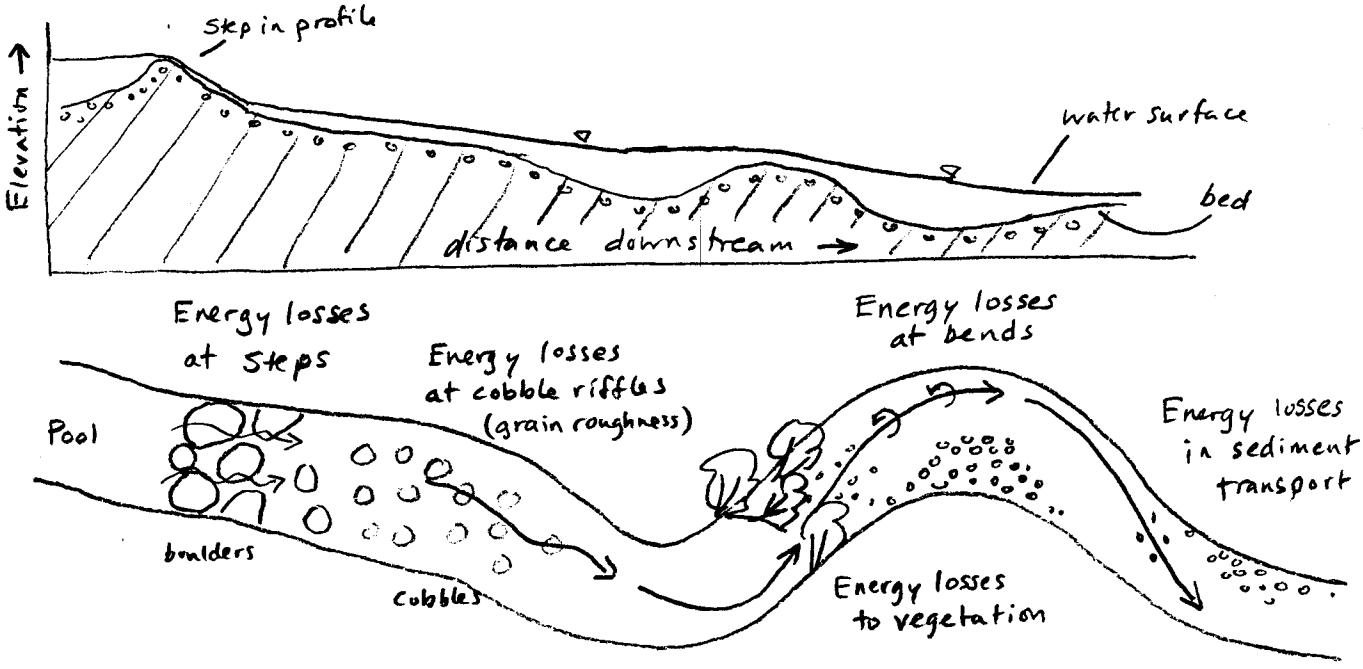


Figure 1. Diagram of energy dissipation in river channels.

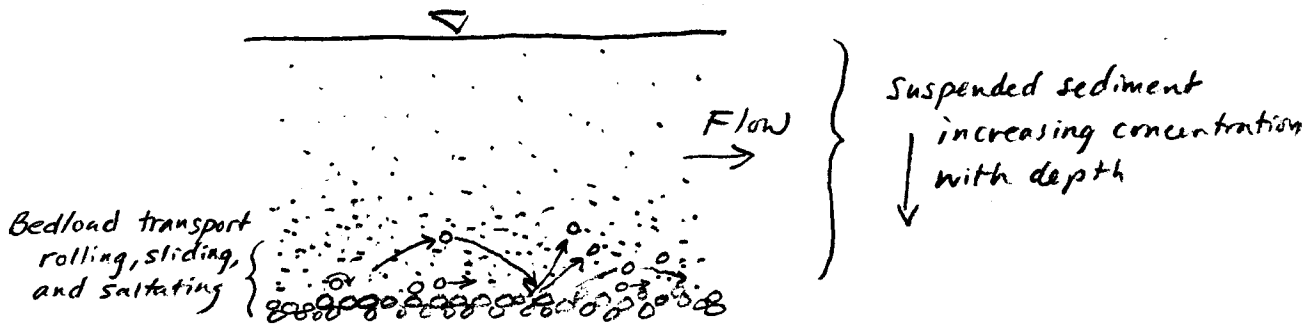


Figure 2. Suspended and bedload sediment transport in river channels.

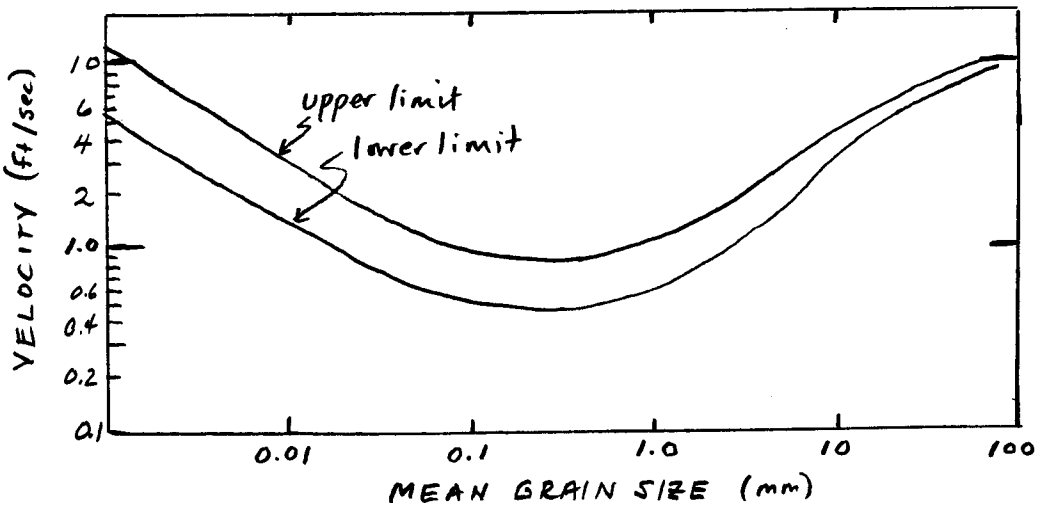


Figure 3. Relation between flow velocity and transport of uniform-sized quartz grains. (adapted from Vanoni 1977)

FIGURE 4

BEDLOAD TRANSPORT RATING CURVE
CARMEL RIVER near CARMEL

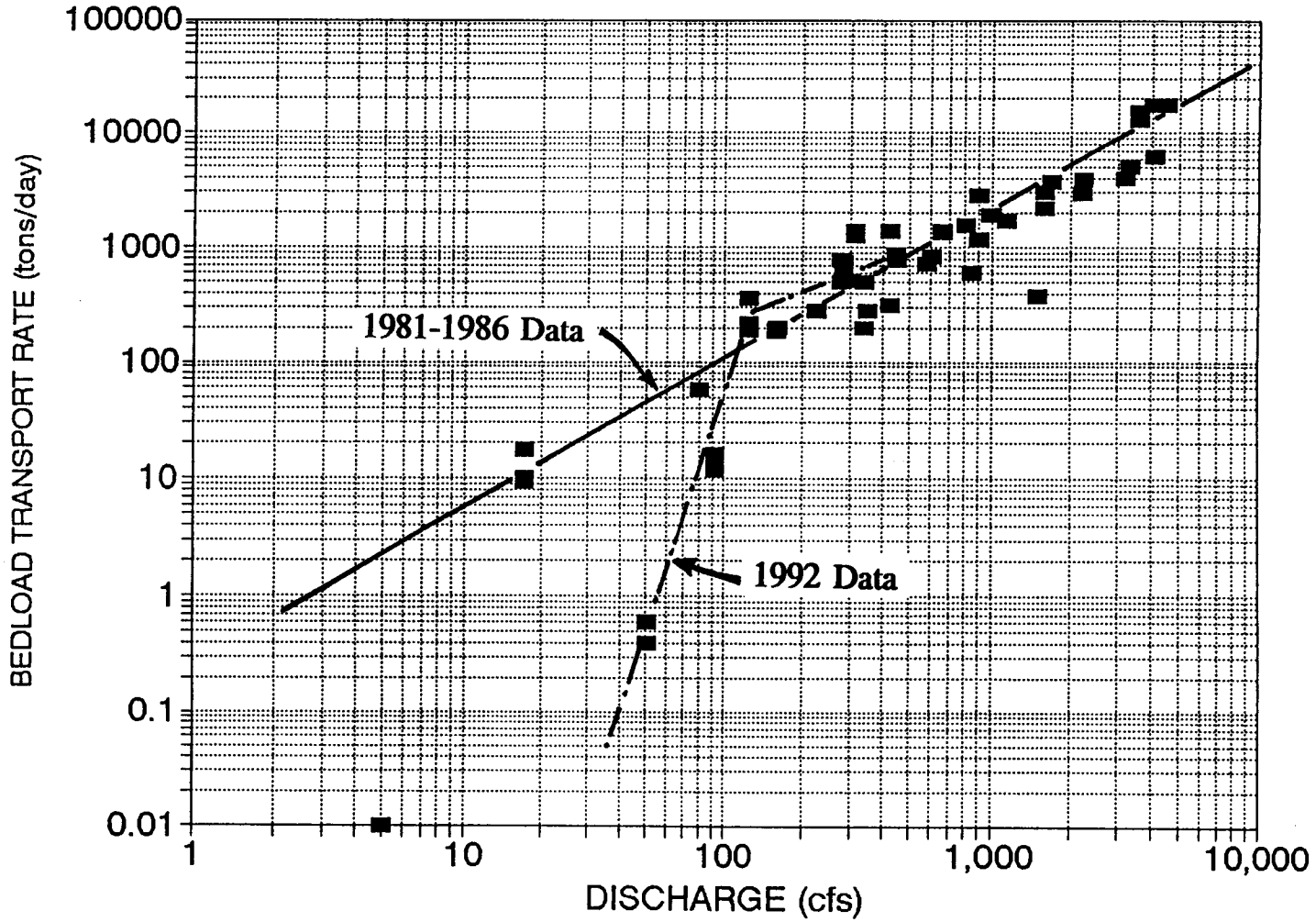


Figure 4. Relation between sampled bedload transport rate and flow in the Carmel River near Carmel. (Source: Matthews and Kondolf 1993)

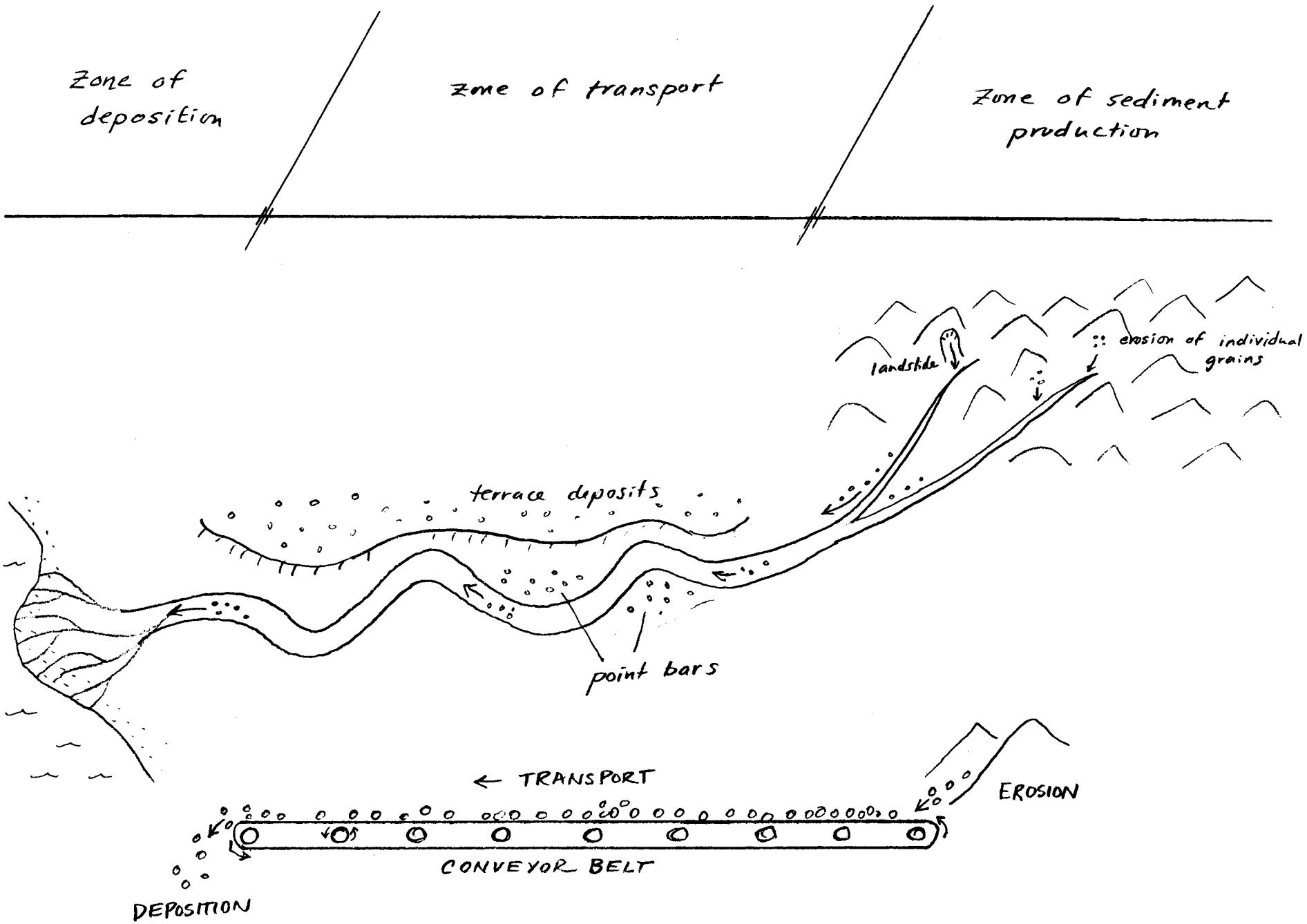


Figure 5. Diagram of zones of sediment production, transport, and deposition, and the river channel as a conveyor belt for sediment.

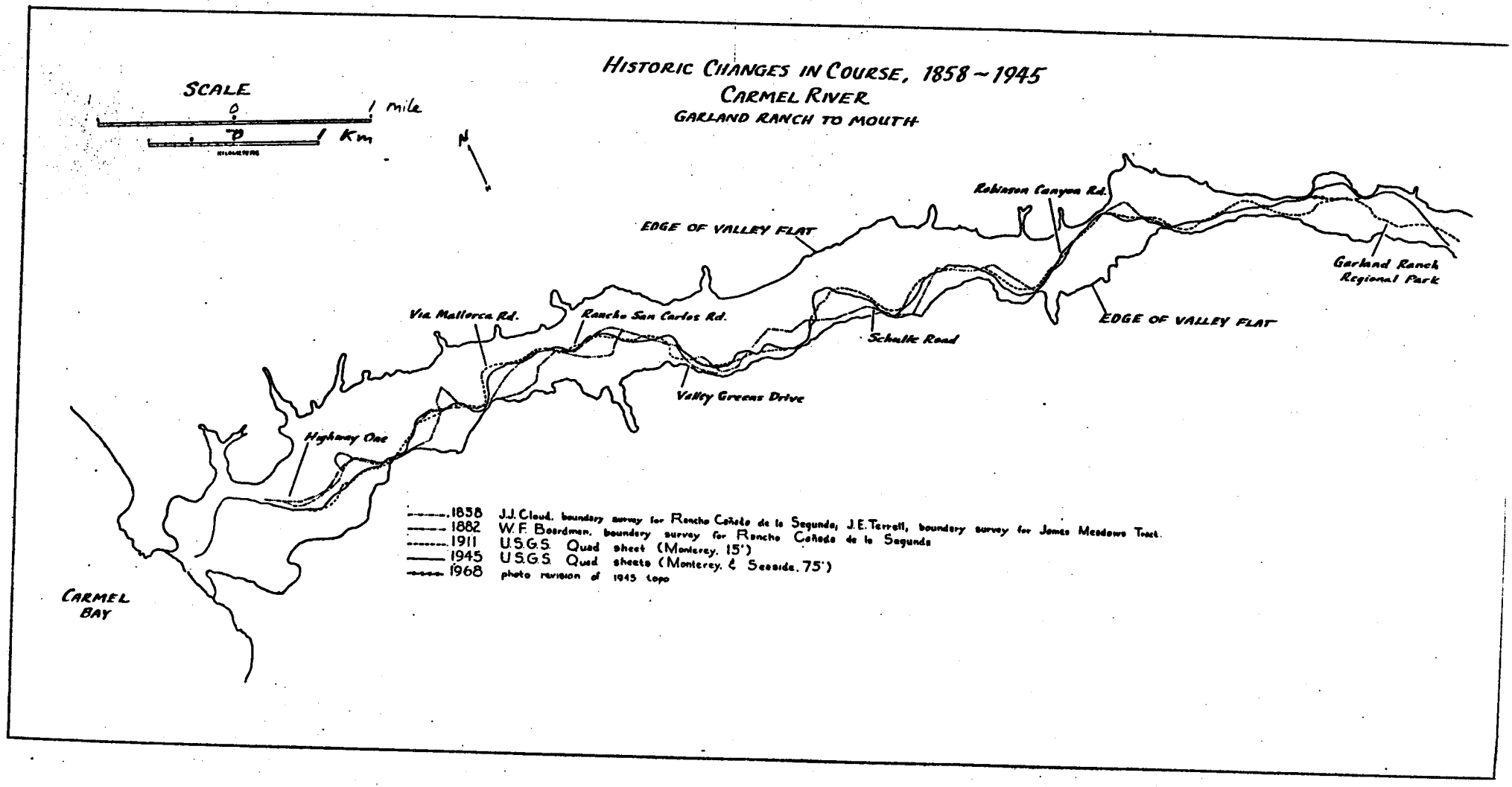


Figure 6. Channel migrations of the Carmel River, mapped from historical maps and aerial photography. (From Kondolf 1982)

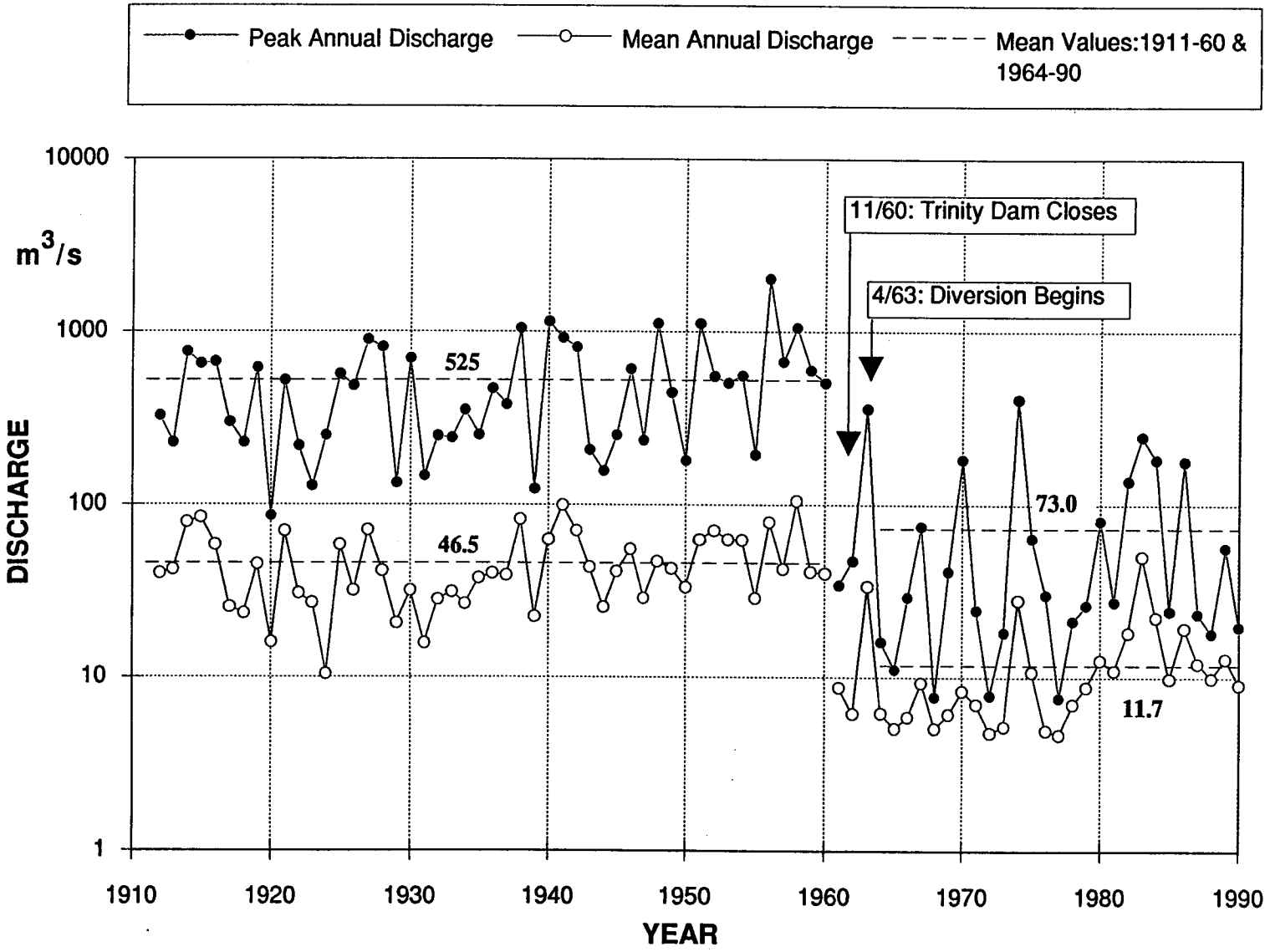


Figure 7. Annual peak and mean discharge in the Trinity River at Lewiston, 1910-1990, showing change in flow regime following closure of Trinity Dam. Ordinate is plotted in cubic meters per second (m^3s^{-1}); multiply by 35.31 to convert to cubic feet per second, cfs (ft^3s^{-1}).

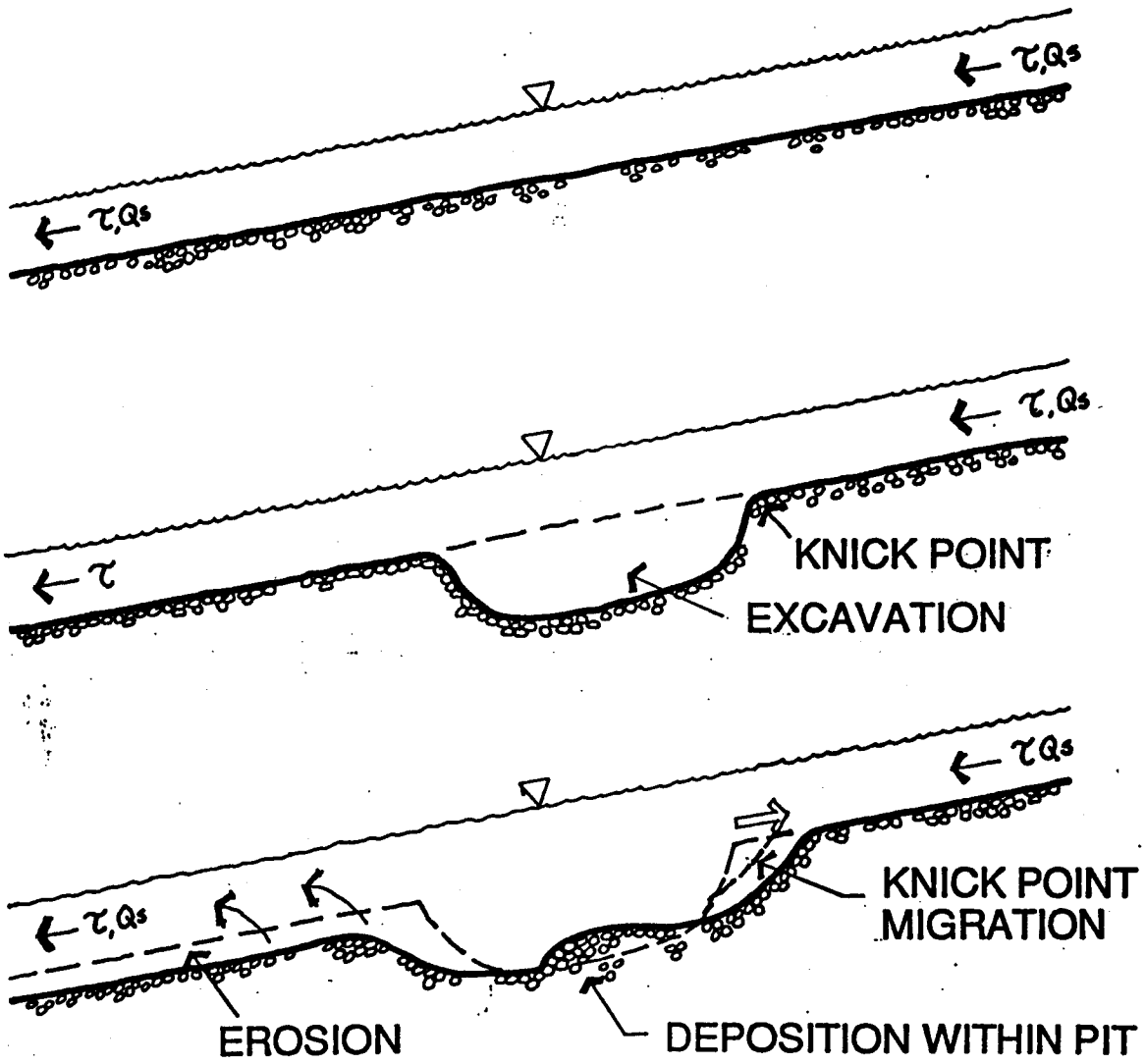


Figure 8. Effect of instream gravel pits on sediment transport and channel profile. Incision is induced upstream from knickpoint migration, downstream from erosion by hungry water.

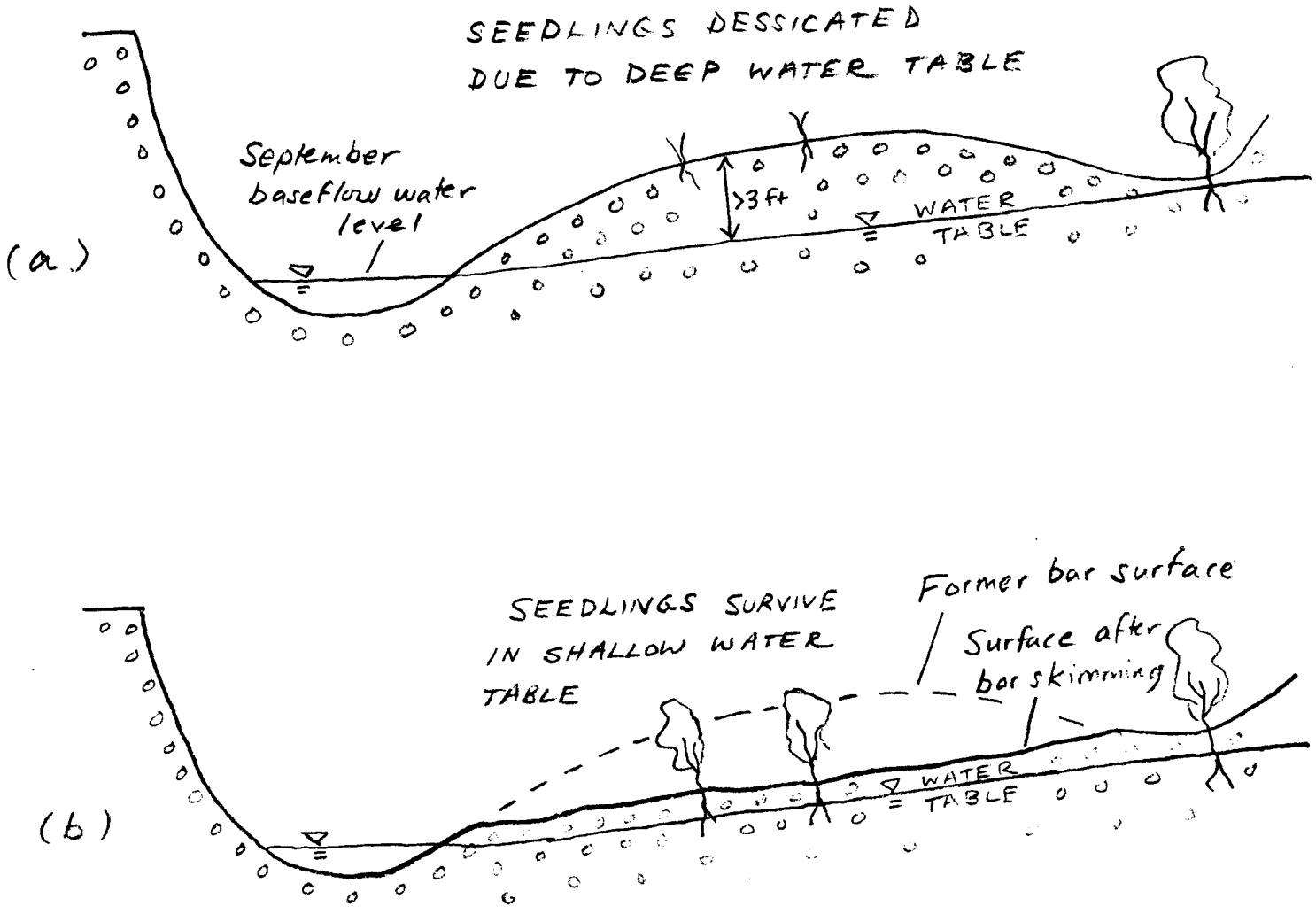


Figure 9. Diagram showing potential effect of gravel-bar skimming on establishment of willow seedlings. (a) Top of natural gravel bar is too high above late summer water table for willow survival. (b) After skimming, the surface of the gravel bar is closer to the water table, permitting survival of seedlings.

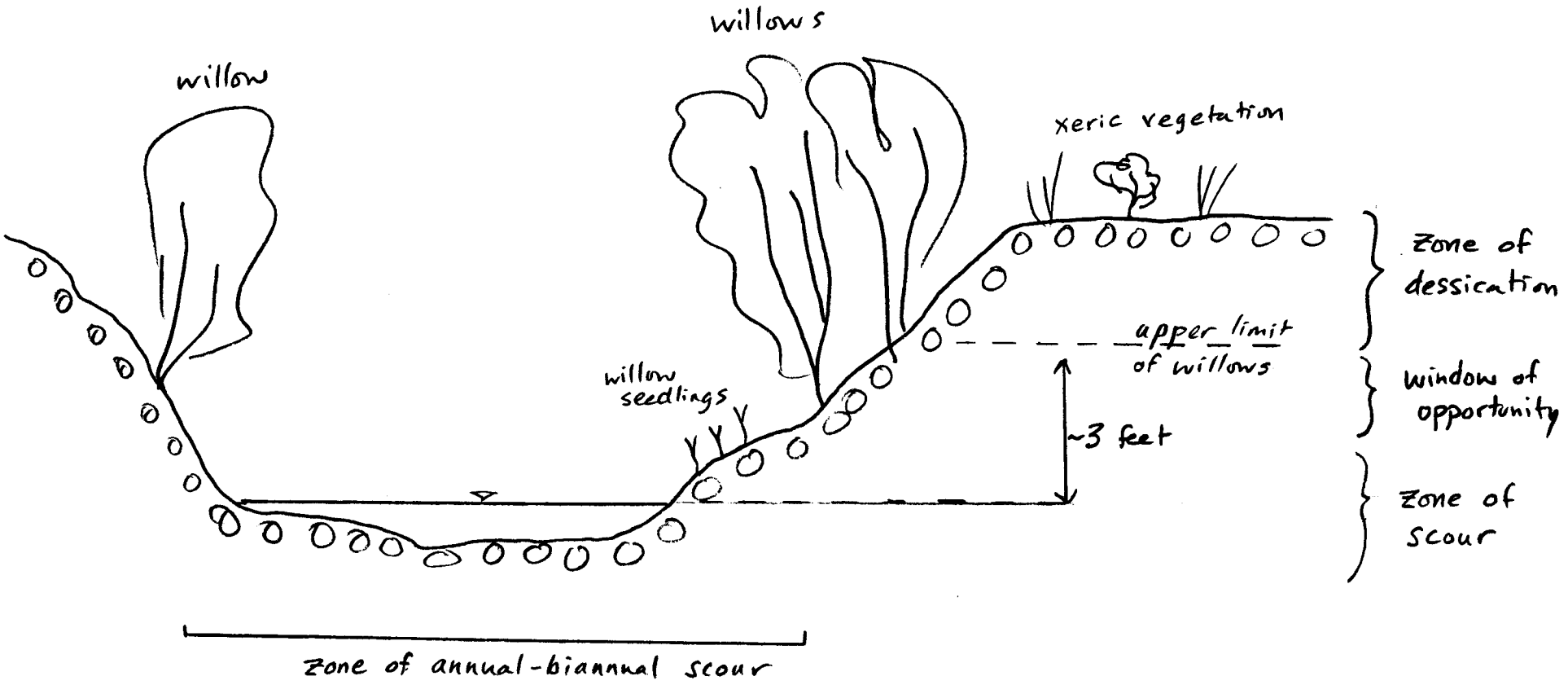


Figure 10. Diagram showing relationship between riparian vegetation establishment, height of bar surfaces above baseflow (and inferred water table level), and scour by annual or biannual floods along the Merced River at El Portal, California in the summer of 1986. (from Kondolf 1988a)

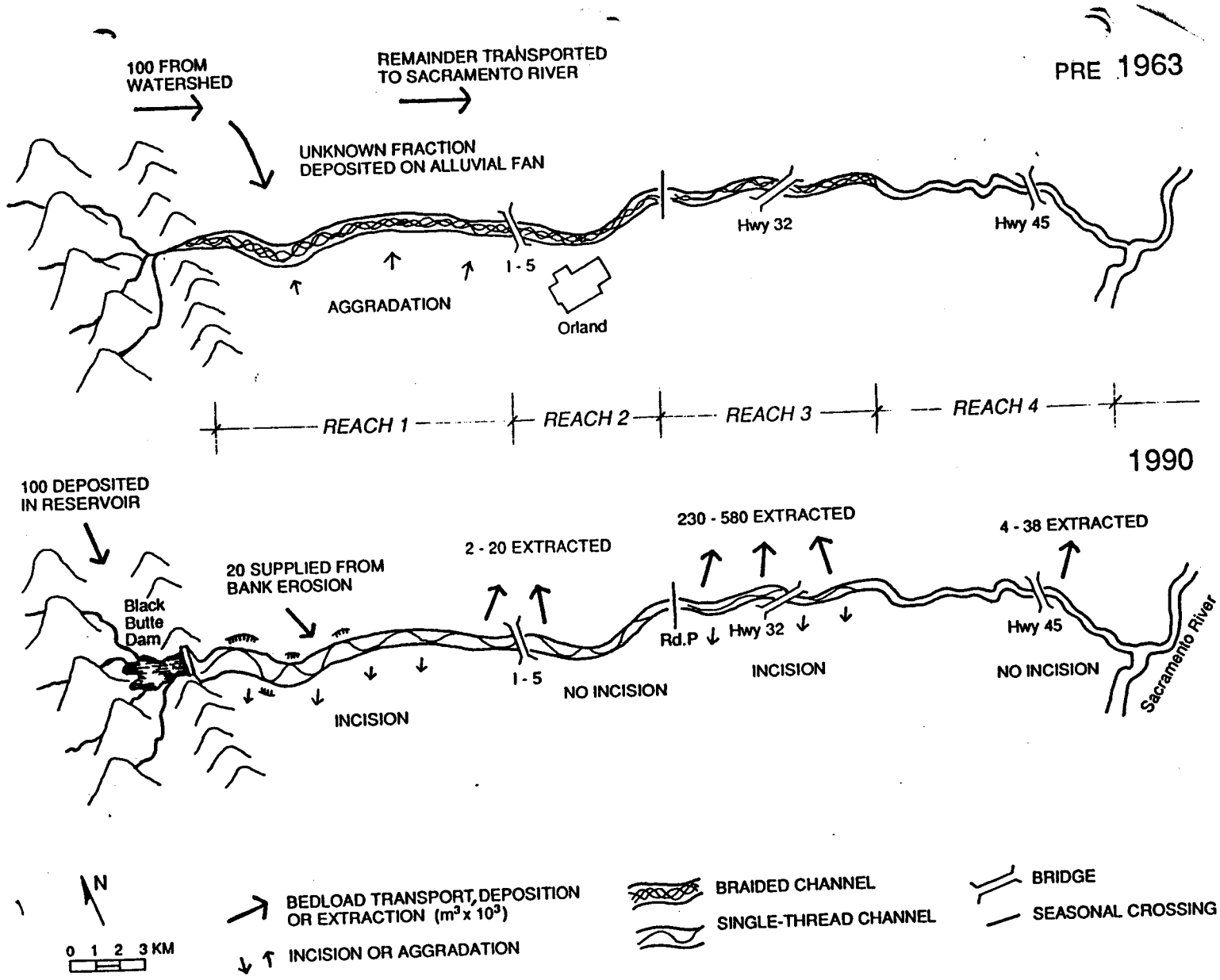


Figure 11. Sediment budget for Stony Creek below Black Butte Dam, showing pre-dam condition with supply of about 100,000 m^3yr^{-1} of gravel from the upper basin, contrasted with the post-dam situation with this supply cut off, input of about 20,000 m^3yr^{-1} from bank erosion, and extraction of large quantities of aggregate, especially near the Highway 32 bridge crossing.

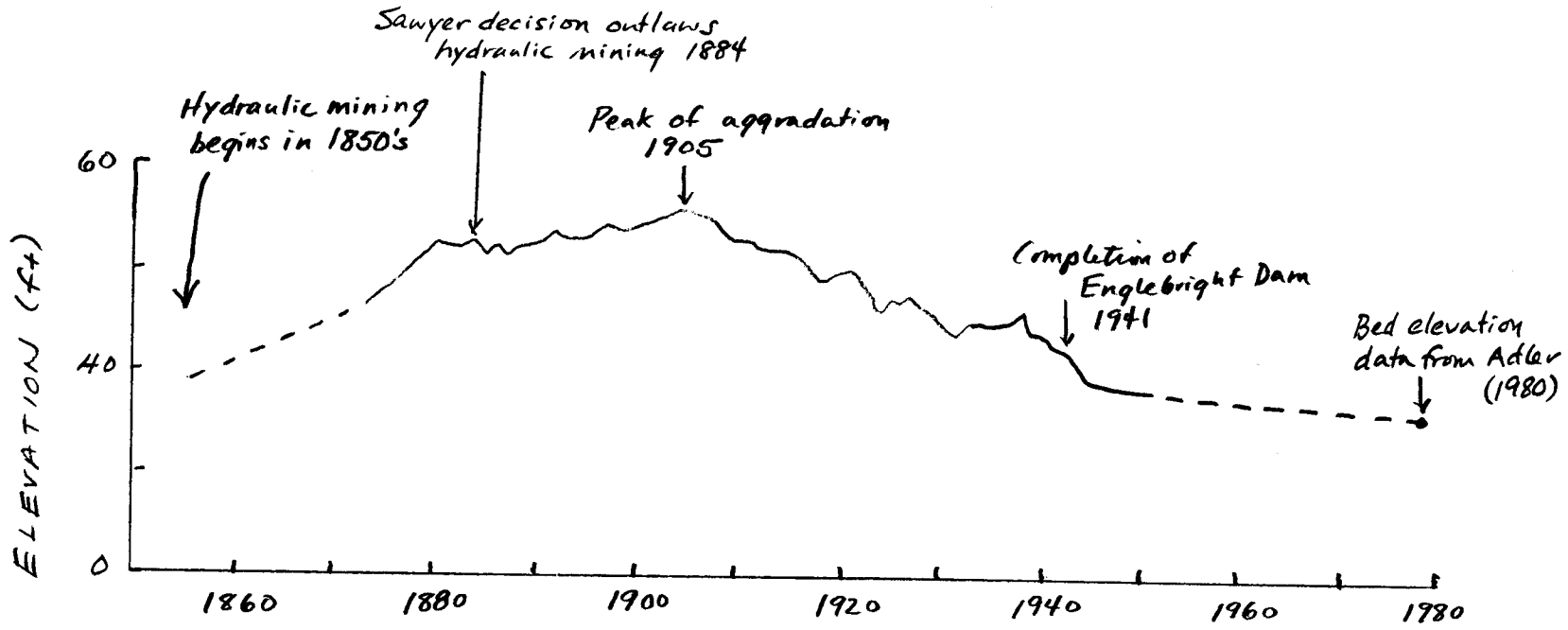


Figure 12. Change in bed elevation of the Yuba River near Marysville, 1905-1979. (adapted from Adler 1980 and Gilbert 1917)

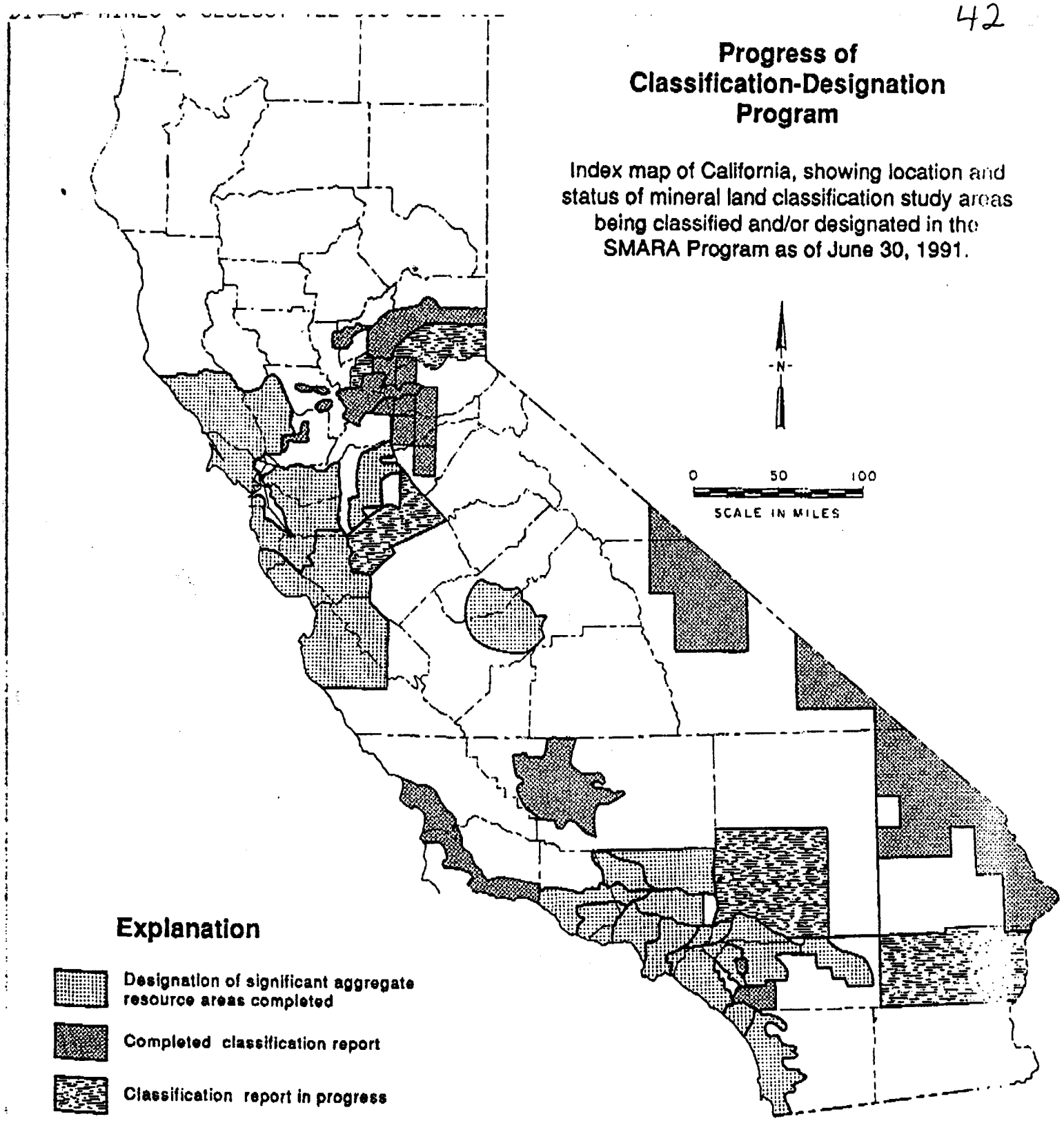


Figure 13. Map depicting areas of California for which mineral land classification studies have been completed. (source: California Division of Mines and Geology, from Mining and Geology Board Annual Report for 1992.)

Table 1. Manipulation of Independent Watershed Variables by Human activities: Some Examples

Variable	CHANGE	
	Increase	Decrease
Flow	Flow augmentation - channel enlargement (Upper Owens River)	Reduced peak flows - channel narrowing - fine sediment not flushed from bed (Trinity River)
Sediment Load	Hydraulic mining - aggradation, recovery over decades (Yuba River)	Sediment trapped by dam - incision, bank erosion downstream (Stony Creek) - loss of spawning gravels (Sacramento River)

Table 2. Sediment Budget for the Van Duzen River Basin (from Kelsey 1980)

COMPARISON OF ACTUAL COMPUTED SEDIMENT BUDGET TO HYPOTHETICAL SEDIMENT BUDGET EXCLUDING THE EFFECTS OF THE DECEMBER 1964 STORM FOR THE VAN DUZEN BASIN, 1941–1975

	Actual sediment budget (metric tons)	Hypothetical budget without 1964 storm (metric tons)
Fluvial sediment yield from hillslopes	45,509,000	38,254,000
Landsliding		
Debris slides, debris avalanches	10,630,000	1,120,200
Earthflows	2,931,000	1,834,500
Streambank erosion		
Melange bank erosion	426,000	66,100
Flood plain and fill terrace erosion	2,619,000	131,000
Aggradation	10,601,000	none
Total sediment discharge out of basin	51,036,000	41,405,000

Table 3. Sediment Budget for the Carmel River below San Clemente Dam. (from Kondolf and Matthews 1991)

Sediment Budget for Carmel River Below San Clemente Dam. 1982 and 1983

	1982			1983		
	Suspended Load	Bed Load	Total	Suspended Load	Bed Load	Total
Output	199	118	317	1120	326	1446
Inputs						
Tributaries	13	5	18	217	39	256
Bank erosion	27	64	91	210	489	699
Total	40	69	109	427	528	955
Balance[a]	159	49	208	693	(202)[b]	491
Estimated load over dam	86	...	...	430	...	...
Unexplained balance	73	...	...	263	...	...

All values in tonnes (1 tonne equals 1000 kg). Table entries represented by three dots correspond to data categories which are not applicable.

[a]Attributed to in-channel storage changes and suspended sediment passing over San Clemente Dam.

[b]Balance is negative, indicating a net sink of bed load–sized sediment into in-channel storage.

Appendix C

M & M Consultants
Consultants Report

MAD RIVER: 1850-1925

THE EFFECTS OF FLOOD EVENTS
&
LAND USE ON SEDIMENT TRANSPORT PROCESSES

Presented to:

Humboldt County Department of Planning
3015 H Street
Eureka, CA.

for Mad River Gravel EIR, 1993

Presented By:
M.J. Scalici
M & M Resource Consultants
6220 Lanphere Road
Arcata, CA. 95521

March 31, 1993

Introduction

The transport and disposition of sediment in any given segment of river channel depends on many factors. Geology, climate, vegetation and land use activities being some of the more important variables. Each variable is not mutually exclusive, and each interacts with the others. A river channel responds to changes in these variables by adjusting its morphology through time. The most rapid adjustment periods often takes place during "channel forming" events. At any given location on a stream, conditions may favor the erosion of a bank at that point, and deposition of sediment at some location downstream.

Little is known about sediment transport processes of the pre- and early sediment period on Mad River. An understanding of the geomorphic agents controlling sediment transport processes in the river, and how historic land use activites have acted as geomorphic agents is relevant when making well-informed management decisions, and will be the focus of this report.

In terms of sediment transport processes, river morphology and riparian vegetation, Mad River in the 1850's was a very different river than it is today. Many of the features that regulated the disposition of sediment through the river, such as riparian vegetation, were removed, thereby producing more rapid transport of sediments through the project reaches.

The location, spatial distribution, and nature of river meanders and locations of flood-induced bank erosion and sediment deposition provide a marker for exploring the changes in river morphology since first settlement took place. A review of the more significant events during the first 75 years of settement will be presented as outlined below:

1). A description river morphology and vegetative conditions of the floodplains at a time shortly after the first settlers arrived in the early 1850's.

2). The geomorphic resoponse of the river to flood events, and the reconstruction of the geomorphic history of the river between 1861 and 1925.

From this, the following evaluations can be made:

1). The interaction between flood events and early land use activities as explained in newspaper accounts of the time.

2). The role of land use activities on river morphology and sediment transport mechanisms .

The following three periods will be discussed separately:

a). 1850 - 1889, *Early Settlement.*
b). 1890 - 1917, *Big Floods, Aggradation and the Railoads.*
c). 1917 - 1925, *Drought and the Onset of Bed Lowering*

The Study Site

The study site includes roughly the lower 25 miles of Mad River up to, but not including, its estuary. The study site will be broken into four distinct reaches based on general geomorphic features. Figure 1 shows the project reaches which are:

Reach 1: Sweazey Dam Site to Fish Hatchery
Reach 2: Blue Lake Valley- Fish Hatchery to Lindsay Creek
Reach 3: Lindsay Creek to North Bank Road Meander
Reach 4: North Bank Road Meander to Highway 101 Bridge

A few things to keep in mind

There are a few things the reader should keep in mind when reading this report:

1). Conditions in the upper catchment and surrounding hillslopes influence the delivery of sediment to the into the project reaches. Although not the main topic of this report, this should not be ignored when considering the origin of sediments.

2). Where the river can spread laterally across its floodplain, the amount and thickness of vegetation growing on the floodplain and terraces influences the rate of sediment transport and the sizes of sediment travelling through the reach. Hydraulic roughness is a term used to equate the degree to which physical features in a river bed and on the floodplain can slow water down as it flows.

3). River and floodplain management should take into consideration pre-existing conditions of a river when making decisions affecting the balance of sediments in the river.

4). A reasonable understanding of the role of geology and land use activities as geomorphic agents and as regulators of sediment transport processes will provide for better informed management decisions.

Abbreviations used:

SBF = Susie Baker Fountain papers, Humboldt State University
AU = Arcata Union, Arcata CA.
HT = Daily Humbodlt Times, Eureka, CA.
FE = Ferndale Enterprise, Ferndale, CA.
WCS = West Coast Signal, Eureka, CA.
HDS = Humboldt Daily Standard, Eureka, CA.



Figure 1. The project reaches. See figure 2

Methods

Mapping Early Settlement Features

The U.S.Coast and Geodetic Surveys of 1854 and 1874, and photographs of the time provide a glimpse of the landscape that existed when the area was first settled in the mid-1800's. To recreate the course of Mad River and the vegetation that existed prior to significant landscape modifications, the U.S. Coast and Geodetic Survey notes (Foreman, 1874) and plat maps were obtained. Pertinent spatial information, such as the location of the river course and slough channels, vegetation breaks and marker trees, was first traced from the map onto matte acetate. These features were then manually digitized using Intergraph software to develop computer-generated maps. Section corners and quarter sections were used as control points.

Flood Events, Land Use, and Geomorphic Changes of Mad River

The geomorphic changes associated with specific flood events and the people's responses to these events were reconstructed using original newspaper accounts contained on microfiche; the Susie Baker Fountain Papers, a collection of historic papers found in the Humboldt State Library; and Haynes (1986). Land ownership was obtained using the 1898 and 1921 Belcher's maps and descriptive information contained in newspaper articles. Site specific information mapped in the fashion explained above.

Summary

Large flood events combined with land use activities that precipitated bank migration dramatically altered the ways in which course sediments were delivered to and transported through the project reaches. Early land uses involved the clearing of vegetation on the floodplains and terraces along most of the project reach. The logging boom in the 1870's drove men and mills up the river and into Blue Lake valley where old-growth redwood and other timber on the valley terraces and lower hillslopes, were cut for lumber and homesteading. Early attempts to float the logs donwstream to the canal resulted in severe bank erosion (Haynes, 1986). During the flood events of 1878, '79, and 1880, moderate to severe erosion took place along much of the project reach. This dramatically increased the volume of sediment entering the project reaches that had been previously stored in raised fluvial terraces . The channel's responses were bank migration and bed aggradation. At the same time, efforts were being undertaken to stabilize the banks and prevent channel migration at certain locations. These sites, a few floods later, tended to be targets of erosion and would often fail.

The most catastrophic flood year was 1890 when one storm after another resulted in erosion in a number of places. A late February rain-on-snow event did severe damage in Blue Lake, West End, around Valley West, and near the old canal. It was this flood that placed the confluence of the North Fork with Mad River in a mid-valley position. The net effect has been an increase in gradient of the channel and a more rapid transport of sediment through the Blue Lake valley, a situation that has persisted ever since.

By the 1890's, technologic advances and a greater demand for the export of lumber, encouraged the expansion of logging and railroading further upstream and in the tributaries, and the expansion of the city of Blue Lake. During the 1902, '03, and '07 floods, more bank erosion and landslides occurred, resulting in damage to many structures, now built closer to the river. This resulted in pulses of sediment deposition into the river throughout the early 20th century.

After 1917, few devastating floods occurred. By the early 1920's, little of the sediment once stored in the Blue Lake valley terraces remained, although logging operations higher in the catchment probably still contributed large amounts of sediments as a result of bank erosion and slides. River bars along Arcata Bottom provided copious amounts of gravel for many local projects. By the late 1920's, signs that the river bed was starting to downcut became evident, a trend which has continued to the present. Removal of sediments from the project reaches, both by nature and by human extraction at rates that exceed the rate of recruitment into them, has resulted in a "net negative" balance of sediments and the bed lowering observed today.

Geologic and Geomorphic Setting

Figure 2 shows some general geologic and geomorphic features which affect the project reaches. The delivery of sediment into the project area and its subsequent transport through it are strongly influenced by thrust faulting in the vicinity and is described below. For a technical discussion of regional tectonics, see Clarke and Carver (1991) and references.

Reach Description

Reach 1: Sweazey Dam Site to Fish Hatchery

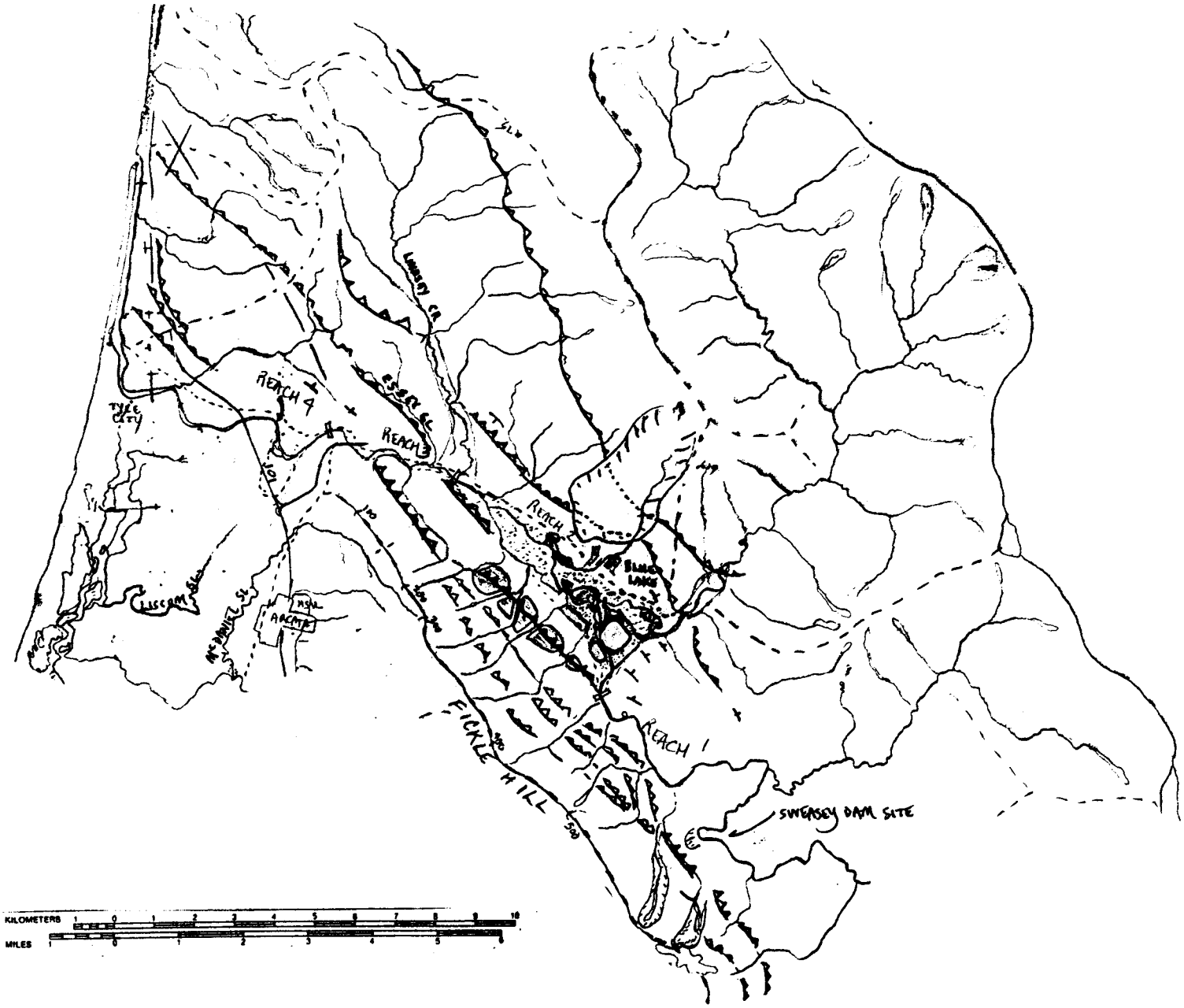
Reach 1 is a narrow canyon about 9 km long with a sinuosity of 1.6. The first 1.9 km is follows a northeast-trending ridge until it reaches the Canyon Creek meander. This meander is about 600 meters long by 400 meters wide and possesses at least 3 terraces. The river then flows west about 2.7 km contacting the Mad River fault zone where it deflects north-northwest. The river then parallels this fault boundary for the lowermost 3 km of this reach. From here, it empties out to the broad unconfined Reach 2, known as the Blue Lake valley.

Reach 2: Blue Lake Valley

Blue Lake valley is an elongated, triangular basin that has inflows; one at its southern end and one on its eastern end. The apex of the triangle is the outlet flowing northwestward. It is about 2 km wide along its southern base, narrowing to less than 1 km wide at its apex near Glendale. The delivery of sediments into the valley comes from several sources. The most relevant input of course sediments (gravels and cobbles) into the valley comes from the main stem Mad River. Its drainage area (da) is about 780 km^2 and flows into the valley from the south. The North Fork Mad River has a drainage area about 7.5 times smaller (da =105 km^2) and entered from the east. Relative to the main Mad River, the North Fork probably contributes an additional 10-15% the amount of sediment to reach 2.

The valley is sandwiched between thrust faults of the McKinleyville and Mad River fault zones. This faulting increases the quantity of sediments entering the valley. Three steep, fault-bound gulches (Quarry, Palmer and Kelly Creeks) descend from Fickle Hill contributing sediments along the western margins of the valley. Episodes of earthquake-induced slumps, earthflows, and debris torrents have occurred down these gulches that have incised uplifted fluvial terraces at their bases. Descending down the southwestern flank of Liscom Hill some

time in the recent geologic past was a large earthflow (figure 2) that probably dumped a wide mix of sediments across the northern margin of Blue Lake valley.



Earthflow

Thrust fault

Uplifted fluvial terrace

Strike and dip of bedding

Figure 2. Some general geologic and geomorphic features affecting sediment delivery into the project reaches.

On the periphery of the valley are uplifted fluvial terraces. Trenches across the McKinleyville fault near the town of Blue Lake showed late Pleistocene and Holocene river terraces that are offset due to thrust faulting (Carver, et al., 1991). Thrusted overbank floodplain sediments and scarp-derived colluvium were found representing 4 distinct events, occurring at roughly 3,000-5,000 year intervals, with the last one occurring more than 660 years ago (Carver, et al., 1991). Each event had 3 to 3.5 meters of slip on a northeast-dipping fault (Carver, et al., 1991).

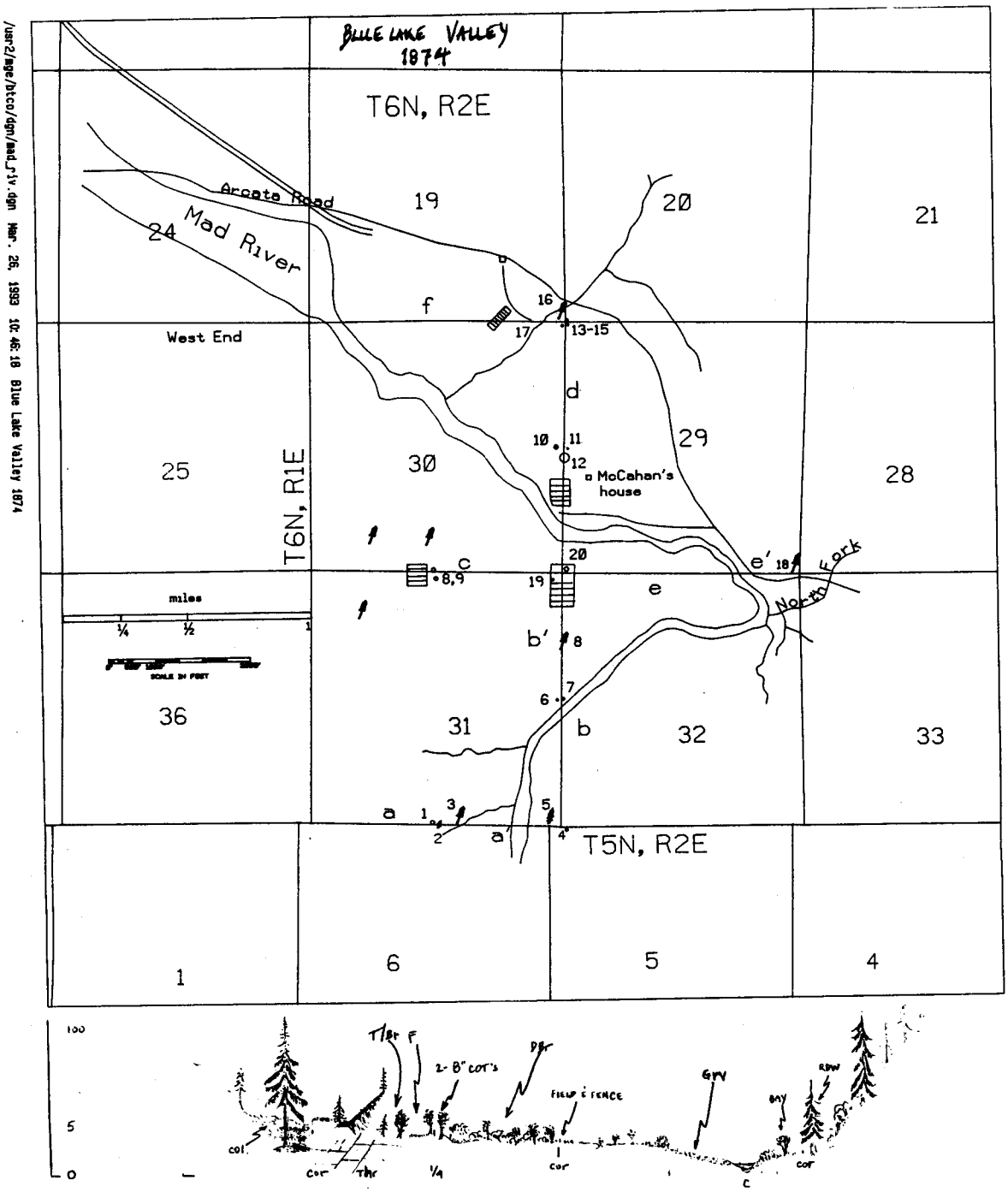
Geomorphology & Vegetation of Reach 2, 1870's

Figure 3 is reproduction of the U.S.Coast and Geodetic Survey map of Blue Lake valley, surveyed by S.W. Foreman in 1874. It shows the approximate location of the river course and the vegetation that existed at the time. Total length of the river between the east-west line between section 31, T6N-R2E and section 6 in T5N-R2E to the river's crossing of the north-south line of sections 19 and 24 was about 4 miles (6.4 km). The linear distance between these two points is 2.38 miles (3.84 km), giving a sinuousity of 1.67.* The following is the description of the valley given by Foreman in 1874:

> "Along the East boundary and in sections 29 and 34, there are small prairies good for grazing. Timber is of excellent quality being mostly redwood, pine, and oak. The latter will afford a great quantity of tanbark. Mad River runs diagonally through the township from southeast to northwest. It is a rapid stream, well adapted to floating timber to the sea."

Only the section boundaries (1 mile intervals) were surveyed and the descriptions given below will be referenced to these boundaries. In figure 3, note the course of the river as it entered the valley. The lower 1,680 feet (510 meters) flowed directly north much as it does today. Following the dip of the bedding, the river deflected northeastward toward its confluence with the North Fork around an uplifted terrace. An area of "brush and timber" grew on this uplifted terrace, which forced the river in this direction. Prior to being wiped out by flood events of the late 1800's, this terrace probably received much of the finer sediments coming down from Mad River basin. The vegetation here consisted of "redwood, cottonwood, pepperwood (bay laurel), hazel, and salmon brush". This thickly-vegetated terrace slowed the velocity of overbank flows and received deposits of fine sediments coming down from the upper parts of the basin. The soil on the line between sections 30 and 31 was considered "first rate" and the land was "generally level".

*NOTE: Sinuousity is the ratio of a length of river from one point to another to the linear distance between those two points. As will be seen later, the length of river between these two points today is about 2.46 miles (4 km) giving a sinuosity is now nearly 1.0. This is important when considering the transport of sediments through the valley.



Diagrammatic cross sectional view, west to east along the southern border of sections 25, 30, 29 and 28.

T/Br = timber & brush	Grv = gravel
Thr = Thrust fault	Rdw = redwood
D.Br = dense brush	Col = colluvium

Transect descriptions, Foreman, 1874.

a. Land steep, hill broken by tributaries of Mad River. Pine, cedar, bay, oak, fir.
a'. On river bottom. Undergrowth dense oak brush.
b. Timber redwood, cottonwood, pepperwood, pine, hazel & salmon brush.
b'. Brush and timber
c. Land level, soil 1st rate. Redwood, cottonwood, pepperwood, hazel, salmon brush.
d. Land level, soil 1st rate. Redwood, maple, pine.
e. Waste land of river bed. No timber.
e'. Timber- redwood, pepperwood.
f. Timber & brush (T/Br).

Marker trees

1	10 in. bay	10	3 in. maple
2	3 ft. pine	11	6 in. maple
3	12 ft. redwood	12	24 in. maple
4	30 in. oak	13	4 in. fir
5	36 in. cedar	14	4 in. fir
6	10 in. cottonwood	15	6 in. fir
7	10 in. cottonwood	16	16 ft. redwood
8	10 ft. redwood	17	3 ft. fir
9	2- 8 in. cottonwoods	18	8 ft. redwood

Figure 3. Blue Lake Valley, 1870's. From Foreman, 1874. The letters represent general vegetation descriptions along each surveyed transect and the numbers represent trees that the survey used as markers.

The river flowed northwestward for about 5,900 feet (1,800 m) and was joined by the North Fork at the eastern corner of the valley. On the east end of the line between sections 29 & 32, (transect *e'*) timber consisted of old-growth redwood and bay laurel. With the additional water and sediment contributed by the North Fork, the river was then deflected westward across the southern boundary of section 29. The land was "level", soil "first rate except on water land in bed of (Mad) river." (transect *e*). This area was described as "waste land of the river bed" and "contained no timber." This was apparently a site where course sediments such as gravels, would deposit and spread laterally in the valley. A road traversed the valley on the north side of the river, probably an historic Indian trail that was used by the miners accessing their claims in the Trinity mines.

The river then flowed northwestward paralleling the Mad River fault zone. Where it crossed the line between sections 29 adn 30, its active channel was 100 feet (30 meters) wide. About 650 feet (200 meters) south of the river (at the corner of sections 29, 30, 31, and 32), a 4 foot diameter bay laurel and a 30 inch diameter cottonwood stood as marker trees (veg.#'s 19 $ 20) with "no other tree in marking distance." North of the river along this line, they crossed a field and McCahan's place. Two small maples (veg.#'s 10 & 12) were the 1/4 section marker trees that grew 1,530 feet (465 m) north of the river, probably well away from . Another 420 feet (128 m) north, the survey entered brush and timber consisting of "redwood cottonwood, pepperwood, pine, and hazel and salmon brush." (transect *d*) The soil along this line was considered "first rate."

Reach 3: Lindsay Creek to North Bank Road Meander

Reach 3 cuts through a narrow, bedrock gorge, crossing at least three fractures of the Mad River fault zone. Lindsay Creek and Essex Gulch enter from the north and Warren Creek from the south, bringing mostly fine sand and silt to the river.

The survey notes are of little use here. On a north line between sections 14 & 15, T6N, R1E, the survey crossed Mad River near today's Highway 299 bridge. The channel was 225 feet (69 meters) wide. Downstream from the 299 bridge, the river deflects off the valley wall below North Bank Road and flows southwestward toward Valley West.

The course of the river through this canyon may be a geologically recent one. Although not well understood, geomorphic evidence indicates that Mad River may have flowed through Fieldbrook valley long ago. Tectonic uplift in the Fieldbrook valley and newly-formed fractures in the presently occupied canyon forced the river to find a new course through this gorge.

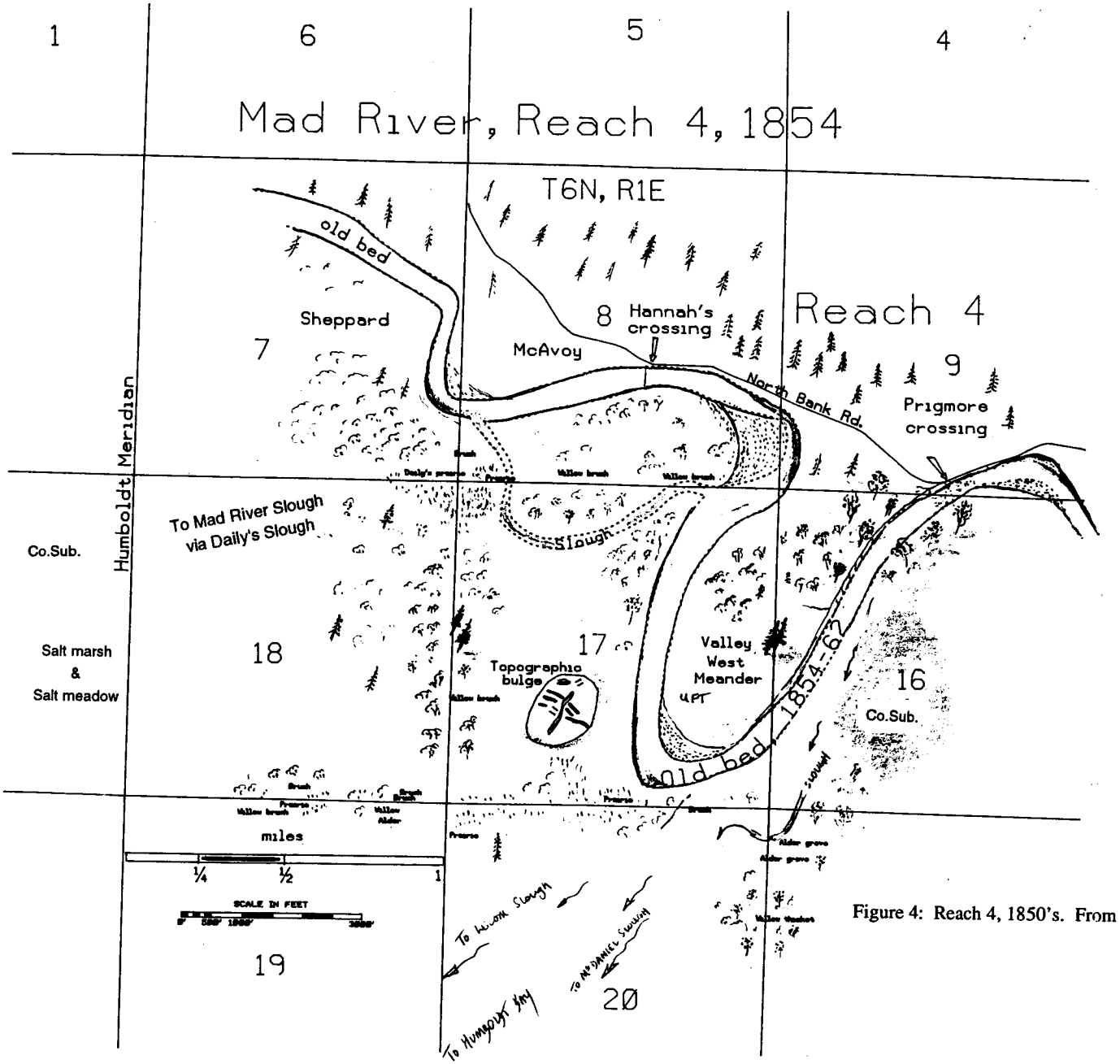
Reach 4: North Bank Road Meander to Highway 101 Bridge, Geomorphology & Vegetation, 1854

Once the river deflects southwestward off the bedrock bank below North Bank Road, it once again has a chance to spread laterally across a wide floodplain. It flows southwestward toward the Valley West Meander. When first surveyed in 1853-4, the length of channel from the North Bank Road meander to the meander was 6,530 feet (1,990 meters) (Figure 4). At the apex of this meander, distributaries would carry ordinary winter flood waters southwestward into upper Humboldt Bay, via Janes Creek and Liscom Slough. These and other distributaries are shown in Figure 4.

As a result of this lateral spreading of flood waters across the Arcata Bottom, the soil here consisted of deltaic deposits of Mad River. When the Arcata Bottom was first surveyed in 1853-54, the area between Arcata (then Uniontown) and Mad River was referred to as "the Spruce Belt." Old-growth Sitka spruce trees dominated the scene. Willow brush thickets occurred along the riparian margins of the river and a few patches of prairie could be found.

The low-lying area east and south of the Valley West meander, known as Aldergrove, was an area of earthquake-induced subsidence, while on the west side of this meander, a site of uplift occurred. This topography, shaped by large magnitude Cascadia Subduction Zone earthquakes, is the primary factor responsible for the position of this meander. The last of

which is thought to have occurred some 300 years before present (Clarke & Carver, 1992). Two 4-foot diameter Sitka spruce trees were found in the middle of the Valley West meander, a site of geologic uplift. This indicates that the river bed had not passed through this location for at least 100 years and may have even predated the 300 ybp earthquake (Scalici, 1993).



Co.Sub. = Coseismic subsidence

Arrows indicate direction of flood waters

Figure 4: Reach 4, 1850's. From U.S. Coast & Geodetic Survey, 1854.

1850 - 1889, *Early Settlement.*

The discovery of gold in the Trinity and Klamath mountains brought a rush of settlers to Northern Coastal California in the late 1840's and early 1850's. The focus of land activities along Mad River during the early settlement period was to cut the trees, clear the land for farming and establish roads and railroad lines. As early as the mid-1850's, logging was occurring in the Arcata Bottom and Blue Lake valley but was still localized. The first major enterprise was the digging of a canal in 1854. Schimps (1986) provides a good description of the Mad River Canal and the events that revolved around its operation. The intent was to float logs down the river, capture them by a boom and transport them through the canal. From there, they were to be floated to the mills on Humboldt Bay. As will be seen in the flood accounts below, this enterprise never operated as it was intended, and the floating of logs down the river caused tremendous amounts of bank erosion (Haynes, 1986).

A few ferries were operating from the river mouth to the Valley West meander. Much of the historical descriptions of the area around Blue Lake could be found in the *Blue Lake Advocate* and writings of Susie Baker Fountain.

The November 30-December 4, 1861 Flood Event

This flood event was the first major storm witnessed by the new settlers of the region The storm that generated it was probably the most severe that Norhern California has experienced since. The impact land use activities had on Mad River at the time were still quite localized and minor. Blue Lake valley was still largely undeveloped and few accounts have been found. It was this flood that allegedly formed the lake from which the town of Blue Lake was to be named (Fountain, 1955).

In December, 1861 there were 3 distinct freshets or storms in 10 days "during which time the whole country was inundated and a vast amount of damage done." (*Arcata Union*, Feb.1, 1888). The following account was published in the *Humboldt Times*:

> "The rain commenced November 30, 1861, and poured in torrents for 60 hours; by Wednesday noon the waters in Mad River were 18 inches higher than ever known before. The bottom lands north and west of Arcata were submerged; fences, bridges, across the little stream that runs through Arcata were washed away. The four bridges across the little stream that runs through Arcata (Janes Creek) were washed away and all communication cut off from the bottom, except by boat...The rain ceased on Tuesday night and by Thursday the river was again "confined to its bed," but on Thursday day the windows of heaven were again opened and the river, now truly Mad, rushed over its banks and submerged prairie. The water continued to rise

until dark Sunday at which time it was much higher than the "oldest inhabitant had ever before known." Up the river (near Blue Lake) it was 5 feet above the previous high water mark.

"At Cook's ranch, the water compelled him to leave, a huge log struck and demolished his house and nearly his whole place ruined. At Prigmore's, the water was several inches from the houses and other families down the river were obliged to leave for higher land. Mad River swept over the bottom to the bay with great force, carrying with it bridges, fences and other moveable objects with which it came in contact; the soil in many fields was washed off for several inches in depth. Near the house of Mr. Arment (Valley West) an eddy washed out a hole where the road formerly ran..." (SBF vol. 82, pg. 224).

More storms followed during that winter and the sites vulnerable to flooding became obvious to the settlers. The most susceptible site was just south of the Valley West meander. The following summer, this meander was cut off the local farmers (Haynes, 1986). This would be the first of many attempts to prevent Mad River from flowing southward through the Valley West area and into Humboldt Bay via McDaniel and Liscom Sloughs. Figure 4 shows the location of this diversion (Brk 1). Written 26 years later, the following is a description of this enterprise, which would be the first of many diversions on Mad River:

"During the following summer (1862), farmers on Arcata bottom began to consider the danger that threatened them each succeeding year, and to provide a remedy. It was found by a little simple engineering that the channel of Mad River could be turned, at a trifling expense, so as to run further north, and no time was lost in undertaking the enterprise. To old settlers here the result of that scheme is well known. By private enterprise a canal, or ditch, was cut, commencing near the crossing at the Shaw place (then the Prigmore Crossing), that diverted the water of the river from the old channel and made a new one, connecting with the old bed some miles below." (Arcata *Union*, Feb.4, 1888).

1863-1880

By 1866, farmers were busy working the rich terrace soils around Mad River. A ranch above the mouth of Warren Creek, called Skeedaddle Murphy Ranch was run by Mr. Anderson who raised potatoes. This ranch would be washed away in subsequent floods. The bed of the river at that time had a good supply of gravels and was quite shallow from there to Valley West, as evidenced by the following account:

> "The Mad River being so low in early December (1866) he was able to drive a team (of horses) down the river bar, fording the small riffles and coming out on Arcata Bottom there being no wagon road up Mad River at that time. (SBF vol. 82, pg 228).

The 1860's and 70's was a time of 'booming.' John Vance had timber land along the river along reach 3 and established a mill at Essex. The trees that were being cut along the floodplain and surrounding hills were dumped into the river where they were supposed to float down during high flows and boomed above the canal. Here they could be gathered and transported through the canal. In many of the large flood events of the 1870's and 1880's, the force of the current was so strong that the boom often failed and logs washed out along the beach (Schimps, 1986). These log brought down by the floods, resulted in tremendous bank erosion during and had major effects on reducing bank stability (Haynes, 1986).

November, 1872 Flood Event

A 5-10 year flood event occurred in November, 1872. On November 16, 1872, the *Humboldt Times* reported:

> "Heavy rains of last Monday caused a raise of waters in Mad River to such an extent as to call into requisition all the ferries on the stream. We also hear that Mad River Jas. Brown who has been logging on the other side of the Mad River, near John Hannah's place, lost 100,000 feet of logs which were swept out to sea by his boom across the river near canal breaking (SBF vol. 82, pg. 230).

The logs mentioned in the above account were probably mostly logged from Essex Gulch, lower Fieldbrook Valley and lower Blue Lake valley.

John Vance realized the futility of the canal and boom and built his mill along the north bank of Mad River at Essex and laid out a railroad for hauling the cut lumber to the Arcata wharf. In 1875, a suspension bridge was built by the Pacific Bridge Company for John Vance on Mad River at a cost of about $6,000. It connected the railroad on both sides of the river,

and by this means logs and lumber could be transported from the mill to tide water on Humboldt Bay. (Humboldt *Times*, Mar. 7, 1879)

The January-February, 1878 Flood Events

On February 2, 1878, a 10-15-year recurrence interval flood event occurred along with unusually high tides (Scalici, 1993). The headlines of the *West Coast Signal* read, "Lively times at the Mad River Boom." A log jam occurred at Vance's bridge, but they passed through eventually. "Piers at head of slough and south bank swept away, some 14 or 15 pine pilings broken off." (SBF vol. 82, pg.231). Two miles of Vance's railroad was washed out, and Hannah's ranch was again a repository for logs. (*Weekly Democratic Standard*, Feb. 2, 1878, in Haynes, 1986). The January 30th edition of the *West Coast Signal* filed this report:

> "The flood Sunday (January 27) made things unusually lively along Mad River and at the Boom. All the logs in the river and its tributaries and an immense amount of uprooted trees and drift accumulation came down in a solid body. For at time it was feared that Vance's railroad bridge would be carried away, but the jam loosened and went plunging and thundering on to the Boom just in time to save the bridge, which stood a terrible test. The scene at the Boom was exciting and grand, but the structure was equal to the emergency. It is most satisfactorily proven that the Boom can successfully withstand any pressure which a Mad river flood can bring, and the lumbermen on that stream rejoice equally with the Boom Co. Some of the piles at the head of the Slough on the south side of the river were broken, but logs were all secured. Some 5,000,000 feet of logs are now held in the Boom, sloughs and canal. (WCS, Jan.30, 1878).

Later reports disproved the boom's survival. In addition, a new channel was formed on the north side of the river downstream of today's 101 bridge. (Figure 5).

> "We learn from a gentleman who passed the Mad River Boom yesterday that the great body of water in the river has been turned into a new channel on the Dow's Prairie side (north side), and that it is cutting through Baker's field. Of course, at the present stage of the river there is some water on the canal side (south side) but how long there will be is a question. The canal is full of logs, the banks of the river are lined with them, and there are supposed to be from 150 to 200 on the beach at the mouth of the river." (WCS, Feb.6, 1878).

A letter dated February 5, at 9 p.m. stated that "at that hour the Mad River Boom was considered to be in a critical condition." The canal was full of logs, and there was "an immense lodgement of logs and driftwood pressing against the boom. The writer expressed fears of the destruction of the boom, and wrote:

"Should tonight's rain continue long enough to bring down the rest of the North Fork logs which are ready to come, nothing short of a miracle can save the boom." (WCS, Feb.6, 1878).

Another flood, this one not as great as the one mentioned above, occurred about 3 weeks later which further crippled the Boom. One of the upper piers of the boom was carried away by the flood and "some logs went to sea." (WCS, Feb.20, 1878).

The March 6 & 20, 1879 Flood Events

The March 6 flood was more severe than both the 1872 and '78 flood events. The river was "considerably higher" than at any time during the winter of 1877-8 (HT, Mar. 7, 1879), and was probably a 20-25 year event. The March 7th edition of the *Humboldt Times* reported that "without any exception, this was the most serious freshet that had ever been experienced in Humboldt County." The writer also stated that since the county had first been settled, there had been higher water, but it was at a time when it was sparsely populated and little improvements made. (HT, Mar. 7, 1879). It was apparent that the increase of people and land clearing around the river was already starting to affect the river's response to flooding.

Mell Grimmer, who operated a ferry at Vance's place, said Mad River was 8 inches higher than the 1878 flood and that "the Vance railroad bridge over Mad River was carried away." (HT, Mar. 7, 1879).

Other accounts estimated the volume of logs that were brought down by the flood. A March 8th account reads as follows,

"For the past two months the general cry has been for rain, only enough rain to cause a freshet and bring the logs down. Tuesday the logs in the main streams came down to tide water, and the rains of Tuesday night and yesterday morning caused the forks and tributaries to give up what they contained. The rivers yesterday were running bank full and loggers had all they could attend to. The number of feet of logs brought down by the freshet is estimated at forty-millions." (SBF, vol.82, pg.232).

"The rain of yesterday and the day before has caused the various rivers and streams to rise considerably. Mad River is booming, and logs were coming down lively. (SBF, vol.82, pg.232).

The March 20th flood was stated to be "the greatest rise known in that stream since the winter of 1861-62." (WCS, Mar. 21, 1879). The river's base flow was probably very high at the onset of this storm and the magnitude of this event was on the order of a 25-30-year flood (Scalici, 1993). The "rushing torrent" of this flood destroyed the remainder of Vance's railroad bridge (WCS, Mar. 21, 1879). It was estimated that 2,500 logs passed the boom and entered

Humboldt Bay. A party of loggers stated that they were a short distance up North Fork the day before and the logs had all come down as far as they went. The only reliable news obtained from upper Mad river on the 20th was contained in a dispatch from Mr. Ed Janssen to Mr. Wunderlich, sent at 4:30 p.m. It was to the effect that "some 60 logs had come out of the North Fork, and that the main river was rising rapidly." (WCS, Mar. 21, 1879).

The January, 1881 Floods

In January, 1881, two years after the severe winter of 1879, another flood occurred. This event was probably only an 8-15 year event (Scalici, 1993) and was the first to attest to erosion in Blue Lake valley. An account describing storm-induced erosion near the confluence of the North Fork and the main Mad River appeared in the newspapers.

> "Foley's farm, near the mouth of North Fork, was washed away, except a small patch of land where his house stands. The families of James McDermott and Mr. Stebbins were rescued from their dangerous quarters by L. Puter, who conveyed there in a boat to places of safety." (SBF vol. 82, pg. 234).

Once again, Hannah's place was a deposition site for a large number of logs that floated down with the flood waters.* Again, this flood was compared to the 1861 flood. However, the fact that the water was higher does not mean that the flood was a greater magnitude as the previous floods. Since the river had been severely aggraded by the input of sediments eroded from reaches 2 and 3 in this and past floods, the bed level was higher thereby giving the illusion of a great flood.

> "John Hannah's place has more the appearance of a logging camp than a productive farm. A great many logs that came down with the flood have found a resting place in his fields." (SBF vol. 82, pg. 234).

> "More water fell during a shorter period that a larger amount of damage has been done no one can doubt. At Mad River, the water was higher than at any time since '61 and some go so far as to place it higher...Much damage was done to the farm lands adjacent to the river. About 60 feet of trestle on the north side of Vance's railroad bridge was washed away, but the bridge itself, the main structure is all safe and secure. The water stood 15 inches deep in James Sinclair's yard...In many places on the farms, the water cut out small channels and in other places piled up sediment and a great deal of fencing was destroyed." (SBF vol. 82, pg.237).

*NOTE: In recent years, this site has been downcutting, and is no longer a site where significant deposition occurs. This is important to realize in light of today's extraction activities occurring in this area.

The following winter, in 1882, deep holes were reported being cut in the river bed at Hannah's crossing. The breakwater, (Brk 2 in figure 5) constructed just upstream of the crossing to prevent the river from flowing southwest to the bay, was being undermined. These scour holes formed around the breakwater pilings as later accounts suggest.

> "The crossing had always been considered very good, but lately deep holes were cut in, making the ford deep and difficult. (SBF, vol.42, pg. 180, dated December 20, 1882).

December 24-26, 1883 Rain-on-Snow Event

This flood was not very severe, probably a 2-5 year event. It was reported that "Mad River, Tuesday afternoon December 25, reached its highest mark, and in several places left its banks, covering fields, but "the current was not sufficient to create any wash or do much damage." From Vance's mill, it was reported that all bridges spanning Mad river were safe, and that the river was falling by the 26th. At the North Fork, the river had caused some little damage to the mill yard, "but nothing to speak of." Along the line of the road where "new earth had been piled in some injury had been occasioned by the water, and the track had settled in places." The current had made an eddy about the western abutment of the bridge, but prompt action had prevented trouble, and no more danger was anticipated. Every precaution (was) taken and every move made to keep the river in its channel and guide the drift on a straight course to the sea." (HT, Dec.27, 1883).

Blue Lake in 1883-87

These were heady times in vicinity of Blue Lake. The lumbering was in full swing, the mills adding the latest machinery. Minor's mill on Hall Creek was considered "one of the most substantial and best arranged in the Mad river belt" and employed 120 men in both the mill and in the woods. The town of Blue Lake was growing rapidly. A man named Scott built a new hotel and in the vicinity Blue Lake, improvements were "too numerous to mention." Mr. Chartin, the enterprising proprietor of a large hotel, store and public hall had picnic ground adjoining his place in Blue Lake. He also surveyed and platted 15 blocks of land, lying between the railroad and Scott's place, which he was to "offer for sale for residences or business purposes." (AU, Sat. Aug.7, 1886). By December, Chartin was selling lots on Mad river where it was said "the soil cannot be excelled." (AU, Dec.18, 1886).

In March, 1887, a new mill on the North Fork was completed, and turning out lumber rapidly (AU, Mar.19, 1887). The timber boom was in full swing. Quite a town was springing

up at Blue Lake and Scottsville. In April, 1887, Mr. Chartin laid off the plateau just above the hotel into town lots. (AU, April 30, 1887).

January 1888 Rain-on-Snow Flood Event

In January, 1888, Aleutian cold fronts dropped snow level down to sea level. The January 12, 1888, the *Weekly Humboldt Times* reported 2 inches of snow in Eureka with temperatures down to 26-27° for two days (SBF vol. 82, pg. 243).

During this year, moderately strong El Nino conditions prevailed (Quinn, et al. 1978). This phenomenon drives warm, subtropical moisture to northern California. On February 2, such a storm occurred generating a rain-on-snow flood. Although the resulting flood had a recurrence interval of 5 to 10-years (Scalici, 1993), it did considerable damage. By this time railroads were built along the banks of Mad River and human activities were increasingly confining the river and spreading out into the floodplains. The following account was reported on this date:

> "From Mad River, we hear that it is 20 feet above low water mark, but not rising very rapidly. About the only immediate danger that threatens is the washing away of the Webster Place, this side of Warren Creek in which event the trestle of the A & M.R. that runs through it will be damaged."

A later report showed that the Webster place, a short distance above the county bridge was washing out badly and had taken out about 400 feet of A & M.R. track (SBF vol. 82, pg. 245). Dr. Banos passed by Vance's Mad river bridge on Thursday, February.2, and informed the *Union* that the falling river was causing a cut in the breakwater above the bridge, on the north side, and that a crew was at work filling in rock from the quarry to stop the cut (AU, Feb.4, 1888). He also stated that Mad river "toyed with Vance's picnic ground to the extent of taking off a portion of that classic spot including the spruce tree against which the music stand stood, and under the generous shade of which brave men and ladies have tipped the light fantastic in days gone by." (AU, Feb.4, 1888).

1890 - 1912, *Big Floods, Aggradation and the Railoads.*

January-February, 1890 Rain-on-Snow Event

In early January, 1890, a series of storms brought record amounts of snow to the North Coast. By the second week however, the weather started turning warmer. An account from the *Weekly Humboldt Times* dated January 16 reads:

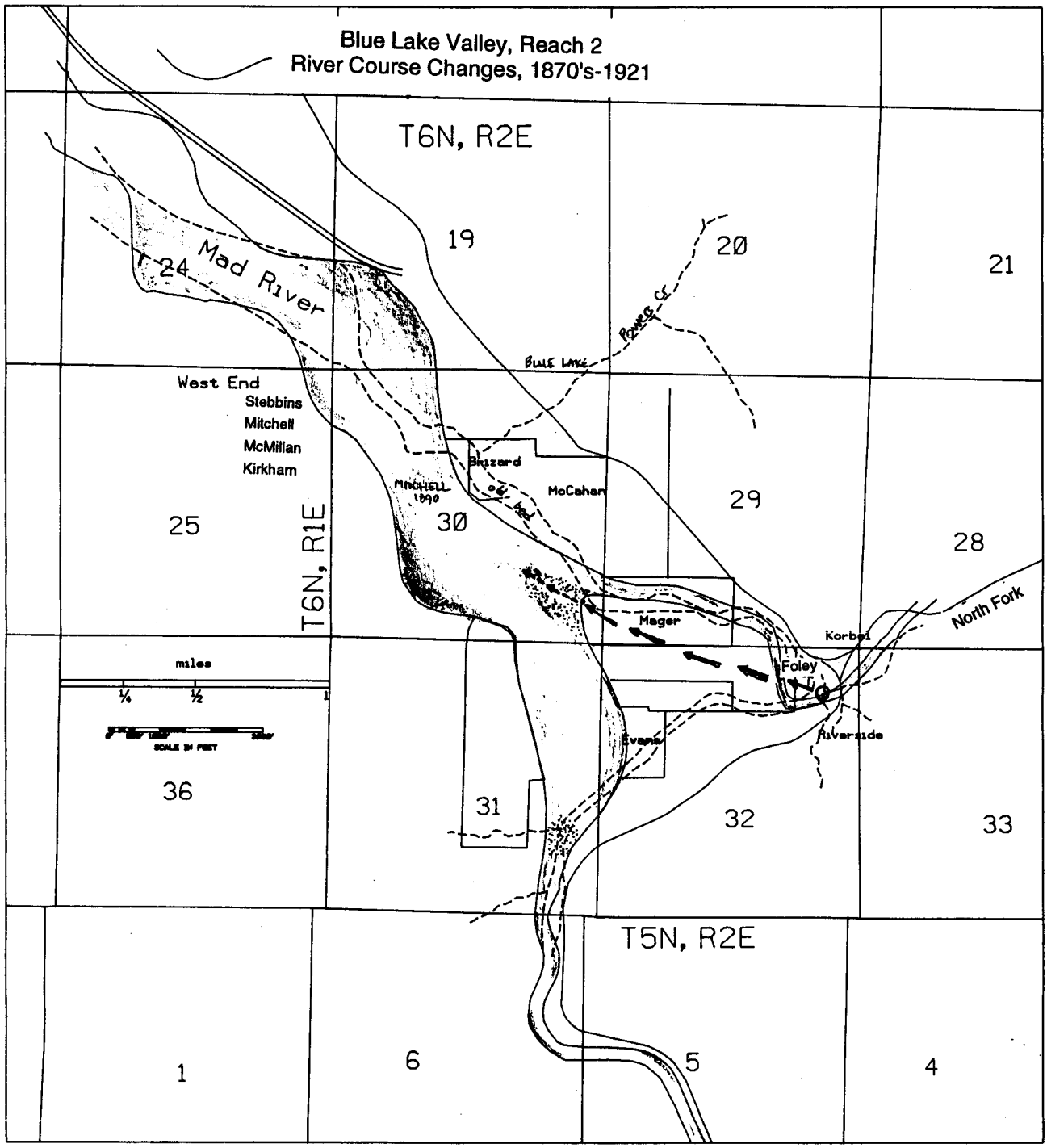
> "The deepest snow mass ever known. Warm weather and light rain yesterday, may bring a sudden melting of the snow and consequent floods and great damage. (SBF vol. 82, pg. 207).

Indeed, the people's worst fears came true. Heavy rains fell the first 3 days of February, melting the record snow and creating the greatest flood since 1861, on the order of a 40-60 year recurrence interval (Scalici, 1993). The Blue Lake valley was devastated as the river took a new course, shortened its length through the valley (Figure 5). One dated February 5 from J.H. Blake of Blue Lake to the *Times* stated that the North Fork railroad bridge had "gone out clear from bank to bank. (SBF vol. 82, pg. 181). In Blue Lake, nearly all low part of town was under water." (SBF vol. 82, pg. 208) as the high stage of the river backed up Powers Creek.

Larkin's place was covered with water from 2-4 feet deep all afternoon on February 4th, but damage there was "slight." Water began to recede about 4 a.m. and by the morning of the 5th was down 4 feet. Some 40 yards of track washed away near the Mad river railroad bridge. Some piers were injured on the same bridge and a bad slide occurred at the Webster place. (HDS, Feb.5, 1890). It was reported that the county road at the Webster place, on Mad river, between the county bridge and Warren creek was buried in the slide, "or at least so much of it as to entirely prevent teams from passing over it." (AU, Sat., Jan.18, 1890).

A February 8, account read:

> "Monday morning, after a hard and steady all-night rain, it looked serious. The creek was booming, and heavy drift logs were coming down. By hard work the bridge on Railroad Ave. was saved, and this prevented damage to the candy store, opera house, Brizards and buildings below. Mad River has been at its highest, but excepting fences down, has done no great damage this side. (Blue Lake) But West End will have a different story to tell when it gets across. The river moved that direction, cutting badly into Evan's and Kirkham's and now running right through McMillans." (SBF, vol. 82 pg.).



Arrows indicate the position of the confluence of North Fork with Mad River. A migration of 5,055 feet (1.54 km) between 1870's and 1921 took place. The 1890 flood event allegedly resulted in the most dramatic change in confluence position.

Figure 5: Reach 2, Blue Lake Valley after the 1890 flood showing the names of land owners affected by floods.

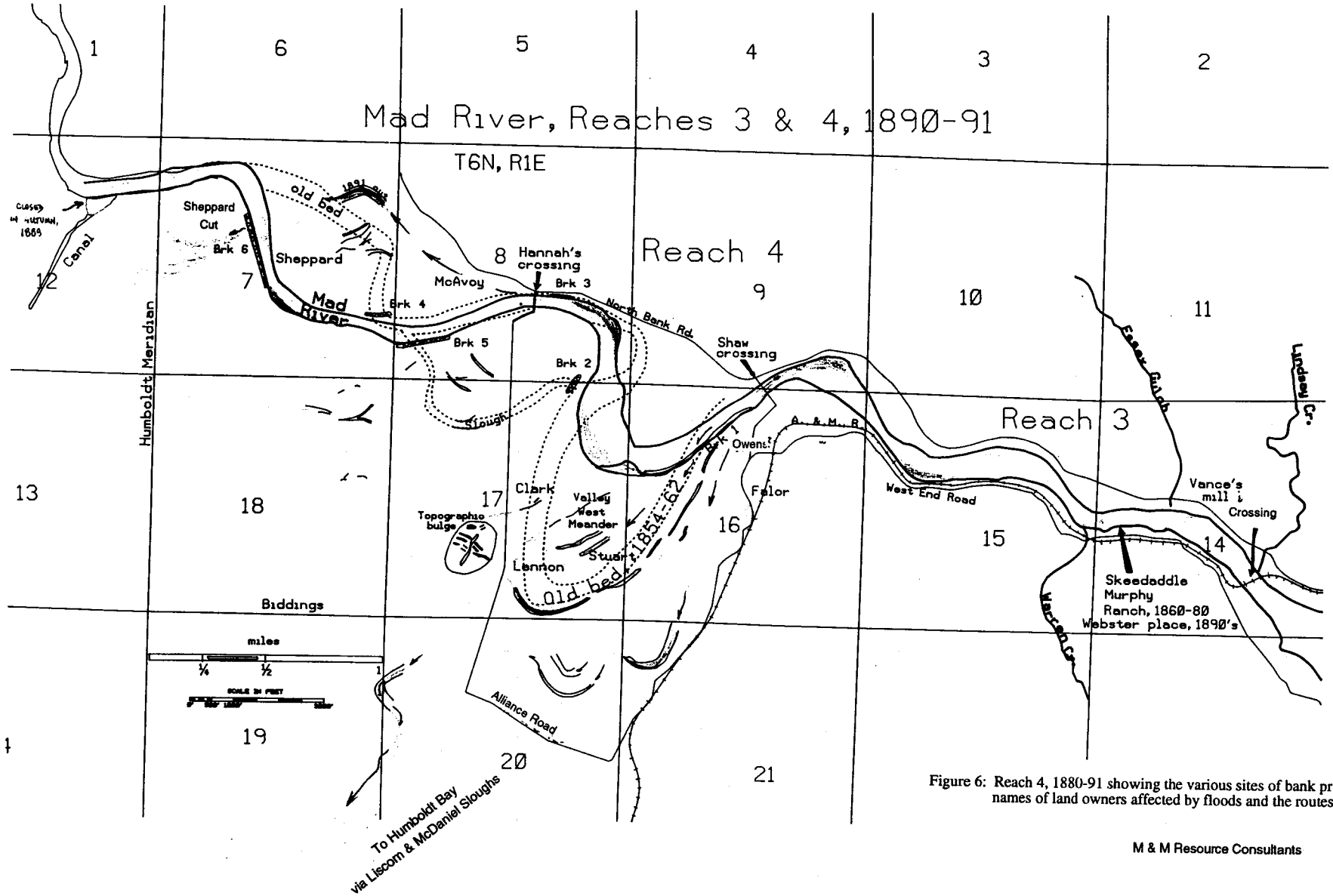


Figure 6: Reach 4, 1880-91 showing the various sites of bank protection (Brk 1-6), the names of land owners affected by floods and the routes taken by flood waters.

It wasn't until March 1 that the first wagon since the storm came across the Mad River. By March 8, the weather was trying to settle. More flooding occurred that week and an account from March 15 summarized the damage at two Blue Lake valley ranches:

> "McCahan's ranch badly washed by change in current of Mad River ...Friend McMillan puts his loss at not less than $5000. Well, 40 acres of land worth $100 an acre, and buildings, will figure up all of that. He says that, when young, he resolved not to fret about what couldn't be helped, and so he takes it cheerfully, but it does look a little rough, you must admit." (SBF, vol. 82 pg.).

This flood proved disasterous to farmers living along the south bank of Mad River, from the Shaw crossing to the head of the bay. (AU, April 5, 1890). On February 8th "the flooded district on lower Mad river," it was stated, "is a dismal looking locality." From 6 to 12 inches of sediment lodged on the fields and in backyards, gardens and houses. Fences were gone, out houses up turned, fruit trees broken down. (AU, Feb.8, 1890). A tremendous amount of the silt and sand, eroded from the bank erosion in Blue Lake valley, funneled through reach 3 and spread across Arcata Bottom.

In April, 1890, the *Arcata Union* published a very informative article about the flood damage to the south bank of Mad River describing the effects of early land use activities on flooding.

> In early years of the clearing of a portion of the bottom land adjacent to Arcata and extending back to the river, resulted in an overflow of the cleared portion, the water leaving the river at the Schuyler Clark place and passing into the bay through the Daniels's slough. Many of our older inhabitants vividly remember the occurrence, while at the present time deep gullies are to be seen through the farms traversed by the flood.
>
> Immediately after the flood above mentioned, the persons interested took steps to prevent a re-occurrence, and a ditch was dug which cut off the bend that curved toward the bay and straightened the course of the stream. The first freshet cut the ditch to accommodate the water flowing, and the river has passed through that channel ever since until this season, although it has shown a tendency to move towards the bay, cutting the soft banks on the south side each winter, and has been materially assisted in later years by some sheers, or wing dams, which have been placed on the north bank for the protection of property there.
>
> The farmers who have in later years cleared farms along the south bank of the river are now aware that there is a decided slope from the river bank towards the bay, and consequently the more the south bank cuts the greater the opportunity for the river to leave its banks. As most of the bottom land is cleared of the trees and brush, there is nothing to impede its course to the bay in such a case.

The recent high water, while an exceptionally severe freshet, has demonstrated the fact that some decided steps are necessary to protect our farmers, and most important of all considerations, our harbor, from the encroachment of the river.

A representative of the Union visited the river in early April, surveyed the flood damage and interviewed some residents who were effected. See figure 6 for the locations of the landowners mentioned in the following report.

"The Shaw crossing was first visited and a moments inspection looking down the river, showed plainly that since last fall a great piece had been cut, extending down the river as far as the eye could reach. Jerome Owens, who owns a small place near by, lost a few rods from one corner. Turning backward, and passing across the old bed of the river, very marked evidence was on every hand that the water has found its way through the old channel (through Brk 1, fig. 5). Some sand was deposited on the Falor place, but otherwise the land in the old bed is very much improved by a generous deposit of rich sediment where the soil before was nothing extra. While most of the farms and roads in this vicinity were under water for a time, no particular damage was noticed until the ranch of A. R. Stuart was reached. In conversation, Mr. Stuart stated that a portion of his land would be improved by the deposit of rich sediment, but that he would loose the clover crops for this year. His loss which will amount to about $1,000 was caused principally by the destruction of his fences, most of which are entirely gone, and the covering of two acres with course gravel. Mr. Stuart has well grounded fears for the future, as the river demonstrated a tendency to cut a channel through his place in the direction of the bay and thinks that unless steps are taken, the river will eventually go that way. He thinks that the water should be effectually shut out of the old bed, and means used to turn the force of the current to the north bank.

"Mr. P. Lennon was next seen and while he does not lament the destruction of 10 acres of grass by the deposit of sediment, he fears the ultimate destruction of his farm if steps are not taken to prevent it. He says that he and others have spent much time and money each season in caring for the river, but that they are not able to do the work necessary to properly accomplish the desired result. he wishes us to say that after his experience with the last freshet, he does not wish to be placed in a position where he will have to depend on being rescued with a boat, intimating that the boat was very tardy in making its appearance.

"On going further down the river we found W. L Dickerson and Charles Sheppard inspecting the land of the former, which had been treated to a deposit over its entire surface, consisting of rich sediment in most places, with here and there and objectionable patch of sand. Mr. Dickerson expresses grave fears for the future of all the farms in a line with his place and the bay, unless protective measures are adopted, and expresses it as his opinion that substantial work should be done in the vicinity of the Shaw crossing, just above where the old river bed leaves the main river. He and Mr. Sheppard both realize that the undertaking is one of no small magnitude, and one that will call for an outlay of considerable money, far beyond the means of the farmers directly interested. They estimate that another freshet

will destroy farms to the approximate value of $70,000, besides turning the river into the bay.

"With Mr. Sheppard we visited the spot where the water has broken through the levee (Brk 6, fig.6), constructed on the bank of the old bed a few hundred yards above where the river and old bed meet, and there we found a very deep channel which had cut for 300-400 yards at a right angle with the river and towards the bay (later to be known as the Sheppard cut).

"The gentlemen seen reside near where the river leaves its banks, and but very little drift wood was left on their land, but from them we learned that many of the farms further down were injured more or less by the loss of fences and an accumulation of logs and other drift wood. Every rise in the river hereafter will flow through the break in the levee until the damage is repaired.

"Supervisor Fernald and Road Overseer Sowash have visited the ground and made themselves familiar with the situation, and will probably move in the matter before next winter." (AU, April 5, 1890).

Expansion of Blue Lake, Summer, 1890

In June, 1890, Blue Lake was being surveyed to create the city for the logging boom families. An account from June 7 read:

"LeConte and Norton will soon survey and plat off into town lots the fine field on Greenwood Ave. in which the big tree stands and with a few houses on the side opposite the Greenwood house, that end of town will begin to put on citified acres. (SBF vol.68, pg.34).

February, 1891 Freshet, Erosion Above the County Bridge

The first rise in Mad River for the winter took place around the 18th of February. The river, though not high, made a considerable cut above the county bridge on the north side, and threatened to cut a channel around the northern end of the bridge. (AU, Feb. 21, 1891).

The February 28 edition of the Arcata Union read:

"BRIDGE DAMAGE. Considerable uneasiness is felt in this section for the safety of the county bridge over Mad river... The danger is that a channel will cut around the north end of the bridge and leave it spanning either a sand bar or shallow pool. To protect his railroad and land on the north side of the river, John Vance erected a pier a few rods above the bridge, where the river showed signs of cutting a new channel around (Brk 3, fig. 6). The rise in the river last week caused the water to work behind this pier and make considerable headway towards forming a new channel altogether. Supervisor Hill and road overseer Nellist have been at work this week, placing stone and brush in the breach, and doing all possible to confine the river to its proper channel, but what success remains to be seen, as much will surely depend upon the rise and fall of the river next month. Supervisors Mercer and Power have been on the ground this week, in consultation with Supervisor Hill, and the matter will probably come before the Board next week." (AU, Feb. 28, 1891).

April, 1891 Flood Event and Its Effects in the Blue Lake Valley

Another series of storms hit in mid-April, 1891 that did damage around Riverside Road in Blue Lake. Several giant redwoods were undermined by the rapidly migrating river resulting in considerable damage around Blue Lake. An April 18 account attests to the damage:

> "The last storm was rather severe in this part of the Mad River section (Blue Lake), and was considerably felt by all in the way of blockaded roads and railroads, trees having fallen all along the railroad, especially one big one, which fell last night at the junction of the Riverside Road. The tree fell across a little above the switch, just where the Riverside depot stood. It demolished the depot and warehouse, leaving only one side of the house on the ground. The tree measured 6 1/2 feet in diameter and buried itself about 2 1/2 feet in the ground, demolishing the track on both roads."

Summer, 1891: The Work to Repair the County Bridge

On August 15, the Board of Supervisors advertised for bids for the construction of a bulkhead on the north bank of Mad river, to protect the county bridge (Brk 3 in Figure 6). The work was to be completed by the first of November. (AU, Aug. 15, 1891). The contract was awarded to Mr. Gastman. On September 29, in company with O.H. Spring, a *Union* reporter went out to take a look at the work being done to protect the Mad river bridge. This insightful reporter stated that the cause of all this trouble with the north bank of the river "was occasioned by clearing away the timber and brush that grew along the bank, which formed a natural protection, and where the river had probably run for centuries. It was the killing of the fabled goose that laid the golden egg." (AU, Oct. 3, 1891).

On October 5th the *Union* reporter went back to look at the work on the bridge pier. Pile driving was progressing fairly and had probably been finished. The work consisted of driving piles into the bed along the north bank of the river, backfilling with gravel, adding a layer of topsoil and planting brush. There was probably some large boulders added which may have been obtained from the nearby Hannah's quarry. The work was progressing slowly but Mr. Gastman said that new methods would be adopted which he expected would allow them to make better headway. (AU, Oct. 10, 1891). The methods of hauling gravel across the river, in scrapers, had been abandoned, and an iron rail track, with cars, substituted. In mid-October the new work was still not fully in operation, but it was hoped it would be the following week, when it was thought gravel would be put in rapidly. (AU, Oct. 17, 1891). A heavy downpour on Wednesday, November 4 caused a rise in Mad river that temporarily put a stop to work on the bulkhead operations. (AU, Nov. 7, 1891). The following week, C.S. Daniels told the

Union that the brush and gravel part of the work is completed, and that the finishing touch of putting on the rock had been commenced. (AU, Nov. 14, 1891).

More Problems at Mad River County Bridge, 1893

Two years later, more problems were occurring near the bridge breakwater. A *Union* reporter visited the site in early October, 1893, and made a careful inspection of its condition.

> "About two years ago the river swerved in from the old Webster place and threatened to cut a new channel around the bridge, cutting off one end from the main land. The river made a crescent shaped cut into the land and the breakwater was built across from the two points of the crescent, making the water take its original course (Brk 4, fig. 6). The work was carefully done and seemed immovable, yet there are two weak places in it that threaten to cause trouble."
>
> "The building of the breakwater has caused the water to flow right along side of it making a deep hole along the lower side. On the upper side a small riffle flows into the hole and directly against the rock and brush forming the dam.
>
> "The rock and the brush come up within 3 feet of the spiles, but where this riffle strikes it, the breakwater has sunk down at least 6 feet for some distance. This is only a small matter, but it shows the action of the water eating under and washing out the gravel. This is about 50 feet from the up river end."
>
> "The principle break, however, is near the lower end. Here a larger current strikes in and the same effect is to be observed as in the case of the smaller riffle, only on a larger scale. Here the water seems to have washed much farther under, for the rock and brush along the inner row of spiles has sunk down 10 feet from the top. The immense weight of rock and gravel on the outer row of spiles has pushed 8 of them out of place and they slant out toward the river. The ties that bound them together on top have been washed away and the braces are cracked and split."
>
> "Directly opposite the bridge and running parallel with it about half way is a bank of gravel averaging about 10 feet high. It looks very much as if the water would flow along this bank and be deflected, striking the breakwater with re-doubled force. In the case of it striking directly in on the break it would undermine the second row of spiles and cause considerable damage. We have had two mild winters, but the coming winter may be a serious one and if a break should be made the present bridge would be cut off from the main land and be rendered useless." (AU, Oct. 7, 1893).

November Storm and Recently Exposed Buried Redwood Tree, 1893

The "biggest November storm since 1861" occurred in 1893. This storm resulted in what was probably a 5-10-year flood event and did litte damage. In December, an account of a buried 10 foot diameter redwood log was exposed in a recently eroded streambank in West End. This log may have been at least a thousand years old when it fell, and may have been buried over a thousand years. Thus, the age of the floodplain soil there may have been two to three thousandyears old before it was washed away by the rapidly migrating river.

> "Messrs William McCleod and John Farneau are making bolts for Mr. Benjamin Vaissade in the West End section have cut down a tree on the banks of that noble stream commonly known as Mad River. We are ready to concede that there is nothing specially remarkable in the circumstance that they have felled a tree. Many other men have done likewise; but this is a monarch of the forest from which depends a tale. The redwood tree 16 feet in diameter stood very close to the river. Ten feet below the stump of the tree and directly under it, the body of a redwood log 10 feet through projects from the bank, it having been exposed to view by the encroachment of the river. The 10 feet of earth between the log and the stump is all what in popular phrase is known as "madeland." As the log was there before the deposit of soil above it, and both log and soil were there before the big tree above it had ever sprouted, an interesting question is-how long has the redwood log, still sound as a dollar, been lying there?" (SBF, vol.15, pg.237)

February, 1902 Storm Event

The winter of 1902 was a wet one. In the third week of February of that year, a storm that lasted a few days brought the Mad River up to bankfull, an event with a recurrence interval of 2-5 years (Scalici, 1993). An account dated February 22 reads:

> "This section was visited by the severest rain storm of the season, which lasted for a few days. As a consequence, Mad River was bank full and up to Tuesday it threatened to do considerable damage in this valley and Arcata Bottom, but Tuesday the rain subsided some and the river began falling." (SBF vol. 82, pg. 269).

This event, although not nearly as severe as the 1893 or 1890 events, resulted in considerable damage, especially in Riverside and West End. Lumbering was in full swing and much of the land had already been cleared.

> "As it was the trestle of the Riverside Lumber Co. bridge to their bolt camp was carried away. Some land was washed away on Boyce & Mahoney's places in West End and considerable on the McCahan ranch on this side. At one time the river overflowed in an old channel back of Mr. McCahan's barn and about 9 or 10 inches was running in a current toward that low place back of the lake. Quite a current was running near Thad Smith's slaughter house into the creek, but no damage was done. In West End, the rapid current did

very little washing on the Mahan and Kelly ranches. After leaving the Kelly place, the current makes straight for the Indian rancherie on the Norton property and considerable land was washed away there. Misfortune to see his cabin go down stream together with a good deal of fencing along the river bank. Jack is now without a home and naturally feels bad over his ill luck." (SBF vol. 82, pg. 269).

Further down stream, very little damage was done. The A.&M.R. railroad bridge and the old county bridge at Vance's crossing were intact. A crew of men had to clear the drift from the pilings of the E.&K.R. bridge, some of which had been carried away. At Hannah's crossing, the new bridge stood the flood well. Some parts of the Arcata Bottom were inundated, but no damage was reported. (SBF vol. 82, pg. 269).

January, 1903 Storm Event

In January, 1903, another storm resulted in what was considered the highest flow in the past 6 or 7 years (SBF vol. 82, pg. 273). A record 5.10 in.of rain recorded at Eureka (AU, Jan.20, 1951). By this time, the lumber railroads were being laid out up North Fork, up Mad River to Canyon Creek, and Hall Creek.

On January 24, the Mad River was said to be running at bankfull (SBF vol. 82, pg.272). A report written on January 29 from Blue Lake is summarized below:

"A heavy rain of the last few days caused the creek that runs through the town to rise higher than has been known for years. Great excitement was caused yesterday (January 21) about 4 p.m. when the flume began to wash out and the banks to give way, causing the houses along the line of the flume to give way... In all, 4 buildings were damaged... The railroad bridge at Riverside went out entirely, but the county bridge at Korbel is still intact. A slide occurred just this side of Korbel causing the regular train to lay out in the storm during last night. The railroad to Canyon Creek has slides in numerous places which will take some time to repair. (WHT, Jan.29, 1903).

On the 29th the mills were all shut down on account of the water under them, but were able to start up the following morning." (WHT, Jan.29, 1903).

Winter, 1905-06: The January Flood, Janes Lagoon, and New Mad River Bridge

On December 2, the Mad River bridge being out of commission and the river was too high to ford at Shaw's crossing. (AU, Sat. Dec.2, 1905, pg.1).

An 8-15-year storm event occurred in the second week of January, 1906. Heavy rains and the melting of the snow on the high ridges was responsible for the freshet. A report on Wednesday, January 17 stated:

"The storm Monday and Monday night (January 15) was a bad one and immense quantities of rain fell, raising the streams higher than they have been for several years past. Mad River left its banks and Arcata Bottom was an inland sea on Tuesday morning. The road was entirely covered from the Higgins ranch to the county bridge and a boat was the only communication. The old bed of Mad River by the Robert Foster ranch was full of water which ran across the Bottom and emptied into the bay. Several feet of water stood in the barn of Schulyar Clark. The water came within 7 feet of the road bridge over the river at Hannah's crossing and considerable drift was coming down..."

"Reports from Korbel stated that although while the water was very high, no particular damage was reported. A bad slide occurred on the logging road on main Mad River but as no logs were being hauled at the present time, the road would not be cleared until the storm was over..."

"The O & E train only went as far as Essex on Tuesday morning, but expected to go through alright in the afternoon. No particular damage was reported there but there was too much water running over the tracks to permit a transfer. A tree had fallen across the track but was quickly removed." (AU, Jan.17, 1906).

The breakwater at the site of the 1890 Sheppard cut (Brk 6, fig. 6) also suffered damage. A report from lower Mad River on the afternoon of January 16 stated that

"the breakwater which was put in in the Glasson place was not holding out against the high water as well as was expected, and was washing out badly in places. Considerable fencing was washed out, and the drift had been floated up into the fields at several points." (AU, Jan.17, 1906).

On Arcata Bottom, the Carson Road (Humboldt Meridian line, later to become the Hammond Railroad) was washed out due to the flooding. According to Neils Lorenzen, the road formed a dyke and when the overflow from the river struck it, it backed up and could not escape into the bay. When the pressure became too great, the road bed washed out in several places. The railroad crew attempted to stem the current with brush "but were not able to do much against the rush of the waters." (AU, Jan.17, 1906).

By January 20, the waters subsided but not before extensive damage rendered the breakwater (Brk 6) useless.

"While Mad River was again out of its banks on Thursday evening (January 18), Friday morning found the water down again...It was reported Friday morning that considerable water was running down the road from the William Turner place west and travel in that vicinity was suspended for the time being. The breakwater at Glasson's also suffered damage and will have to be rebuilt. At the county bridge at Mager's, a big cut in the bank was being made by the water where the road had been cut to haul gravel up from the river bed. This place may give trouble later on, and if it cuts too deeply will threaten the south approach to the bridge."

During late summer, 1906, an irrigation project was undertaken on Janes Creek at Aldergrove. On August 25, the Arcata *Union* reported on the project.

> "A drainage ditch about 3/4 mile in length, 3 feet wide at the bottom, and varying in depth from 2 feet. The old Janes lagoon is among the bodies of water to be drained by the ditch besides the other creeks and swamps in that vicinity. The property of John Roth and N. Falk the other side of the railroad is swampy and covered with pine timber and underbrush and which will make good farming land when drained and cleared up. (This area) is under water most of the year. (AU, Aug. 25, pg.1).

By September 22, the Janes Creek Canal was completed. It was said that the successful completion of this enterprise meant much to the people owing land between Alliance Road and Mad River and it gave them all "a chance to drain their land directly into the bay."

A new bridge spanning the Mad River near Prigmore Crossing was built between 1905-06 and was completed by September 1, 1906. (AU, Sept.1, 1906).

January, 1907 Flood

Early January, 1907 brought yet another storm that resulted in considerable damage in West End and on Arcata Bottom.

> "The storm of Thursday afternoon and night (January 3) was one of the most severe we have experienced in a long time and the wind blew at a terrible rate for several hours. A number of fences in town and on the Bottom went down... and a small shed on the McMillan place south of the plaza collapsed. The records at Eureka show that 2.24 inches fell of rain during the storm. On Friday morning (Jan.4), it was reported from Mad River that the stream was at bankfull and raising rapidly with a chance that it would be out of its banks by night if any more rain fell. It was running full of logs and drift." (SBF vol. 82, pg. 273).

In an account dated February 9, 1907, 80 hours of rain was reported, and the river at Blue Lake once again changed course. (SBF vol. 82, pg. 273).

February, 1907: "A Big Storm and High Water Follows"

The recurrence interval of this flood was on the order of 15-25 years (Scalici, 1993). After raining for several days in the last week of January, a major flood occurred doing severe damage as the following account attests:

> "The storm broke into a good old fashioned one on Friday, (February 1), and on Saturday morning reports reached town that Mad river was out of its banks, and all smaller streams following out over the country. The river fell some that day and Sunday (February 3) when the flood gates of the heavens

> were seemingly thrown open wide and a down pour visited us that brought the water up to the high water mark of 1890, and Mad river poured over its banks from the old bed of Mad river at the Falor ranch, at the Shepperd place and again swept things before it at the Glasson place." (AU, Sat.Feb.9, 1907)

The water again rushed across the ranches from the Falor place to the Mad river slough but did no further damage than to take out considerable fencing. But this loss was "more than made up by the large deposits of silt spread over the pastures and fields." (AU, Sat.Feb.9, 1907)

> "The water across the road at Henry Biddings place and the ranch leased by Bert Caston, was nearly 5 feet deep, and both of these gentlemen perhaps lost more fencing than anyone else with the exception of Matt Kjer, and it was on the north boundry of this ranch west to the Glasson place where most havoc was brought by the mad rush of waters of old Mad river." (AU, Sat.Feb.9, 1907)

The damage here was all on the floodplain and not to the banks, as the rip-rap work and levee built along and on the ranches (Brk 5 & 6) "stood the ordeal with no damage to speak of." At this point Mr. Kjer had several hundred feet of new fencing washed away, and the county road was badly washed out, cut up and covered with drift at a point opposite the Canal schoolhouse. Beyond here the road was impassable "on account of a big hole washed out right in the middle of the highway." (AU, Sat.Feb.9, 1907)

On the O. & E.R.R. trains were delayed for a few hours on account of high water in Lindsay Creek, and other than a few slides in the fill along the old Vance pond site, no damage was reported. On the A. & M. R.R., no damage on the main line was reported, but on the logging road to Canyon creek a good deal of trestle would have to be rebuilt, as a section man stated to a Union man that "3 to 5 bents would have to be replaced in about one dozen trestles." (AU, Sat.Feb.9, 1907)

The storm was prolonged and severe, though not cold, and it was thought that the county was the heaviest loser, as it would "take hundreds of dollars to place the roads in proper condition again." (AU, Sat.Feb.9, 1907).

March, 1907 Rain-on-Snow Event

This storm probably brought a good deal of snow to the mountains. A rain-on-snow event in March resulted in "a stage higher than at any other period since February, 1890" and was called a "raging torrent." (SBF vol. 82, pg. 279). March 16-17, Mad River left its banks but did little damage."

For the second time in three months, Humboldt had a freshet, and the early part of the week, conditions in the vicinity of Mad river, from the county bridge to the mouth looked "rather squally." The heavy rains of March 16 and 17, started logs booming, and the water reached its highest point about 10 o'clock Sunday morning, the 17th. At the Sheppard & Hammerdiener store on the river, the marks showed that the water did not reach as high a point as in January, but on the other side it seemed higher, on count of the water cutting a channel through above the Mager place and allowing a large volume of water to flow across the bottom. The water was flowing rapidly over the breakwater at the Sheppard ranch, and John Olsen of Warren Creek who was on his way to Dows Prairie in a cart, narrowly escape from drowning at that point. He attempted to drive along the road, when his horse was swept off of its feet, and then carried down against some willows. Olesen was thrown out, but managed to get hold of a fence post, where he was to remain until nearly an hour later. (AU, Mar.23, 1907).

No great damage had been done by the water except to wash some soil "as if a ploughed field" on the Mager place. A quantity of silt and driftwood was deposited here, and destroy a number of fences. At the Glasson ranch, the river ran through a low place and across the road as it did in January, but did not do as much damage to the place as the former freshet did. (AU, Mar.23, 1907).

An account dated April 12, 1907 reported that the river was changing its course on Arcata Bottom and described with detail the erosion that took place.

> "Unless the appropriately named Mad River becalms itself and its treacherous waters became less cutting next year, what is now the river bar from above Hannah's crossing down to the William Turner's place on Arcata Bottom will be but a rocky waste of unproductive ground and the river will cut its way though a new channel, a half mile south of the present course, rendering valuable lands, wagon roads and a big county bridge worthless, says the Herald. In fact, it is almost assured that the river will change its course within the next year or two, and already property owners along that section of the valley are making preparations for the change. The change in the river bed will involve a loss of hundreds of thousands of dollars to the owners of the land in the most productive section of the Arcata Bottom. Even now, the river has cut through to such an extent that during every high water this winter, a

great quantity of the river's water has run through the new course, making roads unusable and even shutting the children away from the Canal Schoolhouse."

"At the point where the new river bed crosses the county road running from Arcata to Hannah's crossing, the water at this writing is up to the hubs of a wagon. Whenever the water becomes low, the river runs back through the old channel, but it is thought that next winter the entire course of the river will be changed unless some work is done this year by the county to protect the banks."

"The river has made its cut about 200 yards above the county bridge at Hannah's crossing, which is situated opposite the Joseph Mager residence. From this point the new course runs south a half mile, then west a mile and a half, and then north, running back into the old channel at a point just above the William Turner home. The new river bed will cross the county road at a point a half mile south of the Mager home. The new course, as outlined above, carried quite a body of water during the March storm and considerable water during Friday, Saturday, and Sunday last week (April 5-7). The water has left its mark by huge piles of sediment and debris along the route."

"At the point where the water cut away from the regular channel above Hannah's crossing, a cut is left large enough for several teams to drive through abreast. The new course will traverse land owned by Joseph Mager, the Shepard ranch, Robert Foster, and William Turner. Also the land owned by David Boyd, Thomas Brogan, Stewart Foster, George Glasson, Andy Kirkpatrick, and M. Bognuda will be directly affected to a great degree by the changing river course. While these farmers mentioned will suffer the greatest loss from the changing stream, and they have already suffered considerable loss, the county will also be a big loser. The county bridge which spans Mad River at Hannah's crossing will be over a barren waste of land, and another bridge will have to be constructed across the new river bed at big expense. New roads will also have to be built and new rip-rapping done. The Arcata Bottom farmers are preparing to take the matter of changing river course up with the county supervisors in an effort to have the rip-rapping work done this summer which may possibly forestall the cutting of the river any further." (FE, April 12, pg. 1 col.4).

Property Owners along Mad River Seek State Aid for Protection From Flooding, 1910-11

In late December, 1910, at the request of a number of lower Mad River ranch owners, Assemblyman William H. Kehoe of Eureka, under the chaperonage of William Turner and A.N. Hunt, visited and inspected about 5 miles of the river bank, viewing the protective work done in the past, and making a careful examination of the weak places threatened by flood waters. (AU, Jan.7, 1911, pg.4).

As a result of the visit, which drew Mr. Kehoe's attention strongly to the needs of the river, Kehoe agreed to introduce a bill asking for an appropriation, and in order to bring the matter before the California Legislature in regular form, a petition was prepared and circulated

by Turner, and was forwarded to Mr. Kehoe at Sacramento. The document bore the names of more than 300 free holders and voters of the 2nd Assembly District, and Mr. Turner "would have no trouble in securing many more, except that he was anxious to lose no time in sending the petition to Sacramento." The document stated that thousands of dollars had been spent, both by the county and by private owners in building protective work along Mad River, and that while the work was proving a protection for the time, the property owners had "spent about all they can spare," and unless state aid was obtained, much of the work already done would be "rendered useless and valueless, as the work needed to be taken up upon a much more extensive scale." It called attention to the fact that no state money has ever been spent on Mad River, and that unless something was done, there is a possibility that many acres of valuable land upon which state and county taxes are now being paid will be swept into the ocean." The article went on to say:

> "The principal point of danger to which Mr. Kehoe's attention was drawn was the low place on the Robert Foster ranch of which Peter Damgaard is the renter, which is known as 'the old bed of Mad river.' At this point there is always danger of the river breaking over ,and if its should do so, it would follow the old water course and run into the bay, doing untold damage to the rich lands of Arcata bottom. Considerable work has been done at this point in years past, but almost every winter the same danger threatens, making it necessary to be constantly spending money upon it."
>
> "The protective work done along the south bank of Mad river in the past hasbeen most effective, and at the same time simple- rock, willow brush, and boxes filled with rock being used principally. Very little piling, concrete or wire cable work have been put in, yet a number of the rock and willow dykes with willow trees growing up in them, have attained a degree of permanancy which could well be imitated on Eel River, where a large part of state money was spent on work which failed to stand the first raise of river. (AU, Jan.7, 1911, pg.4).

Mr. Turner was one of the property owners who has spent considerable money in protective work, and in December ecompleted a piece of work a quarter a mile in length on his lower ranch, which cost him about $2500. Mr. Turner had expended about $8000 in protective work in years past, and had also assisted in other work at points above his property. The other property owners with the help of the county also expended "a like sum," and it was clear that landowners felt strongly that the state should step in and "render some aid upon the proposition that the Lord helps those who help themselves." (AU, Jan.7, 1911).

The property owners along Mad River felt they were entitled to state protection, especially the property owners had done so much for themselves. Mr. Kehoe agreed to interview Governor Johnson on the matter, and if he were to sign a bill for an appropriation without having the property owners put up a like amount, Mr. Kehoe would ask for an

appropriation of from $20,000 to $25,000. If the Governor does make this restriction, the bill would be introduced for $15,000 or less. Senator Cutten had also agreed to take up the bill in the Senate if it passed the Assembly. (AU, Jan.7, 1911, pg.4).

Dec.31, 1913-Jan.2, 1914 Rain-on-snow "High Water Causes Some Damage."

Once again, rain-on-snow resulted in heavy flooding. The bulkhead at the Sheppard place (Brk 6) was damaged as flood waters undermined it. Reports of high tides could be found all up and down the coast as high storm surges coupled with El Nino resulted in considerable damage to coastal areas (Scalici, 1993).

> "Mad River was true to name Wednesday afternoon and Thurday of last week, (December 31-January 1) and the long downpour of warm rain, augmented with a heavy supply of snow on the mountain rages sent the river out of its banks, in the lower section, causing considerable damage to ranches and river banks."
>
> "The bulkhead at the Sheppard Place, which was put in more than 20 years ago, gave away under the strain and the water rushing across the ranches between there and the low lands adjacent to the Mad River slough, carried away yards of fencing, and washed some fields bare, while in teh immediate vicinity of the break, much drift was strwen over the ground." The extensive piece of rip-rap work put in on lower Mad river by William Turner 2 years ago, was damaged considerably by settling, though it is still there, for a foundation for future work. Between the fish camp and the famous Bull Moose Camp the water went over the bank and piled up an enormous lot of drift and logs, completely blocking the road for traffic." (AU, Jan.8, 1914).

Piles of drift afforded crews of men much material to work with, rolling out the logs and drift on the county road on lower Mad River and repairing the break at the Sheppard place. (AU, Jan.8, 1914).

The levee put in near the Canal school house the previous autumn to protect the county road, stood the test, and no water came over the bank at that point. The rip-rap put in recently at the Glasson place stood the test, and was not damaged. The entire reclaimed section about the head of the Mad river slough was under water until Friday (January 2), and while a few haad of stock was drowned, no other damage was reported. All the bridges across Mad river survived the storm (AU, Jan.8, 1914).

In Blue Lake, it was said that "Mad River reached its highest mark in 20 years at least and many believe its highest level since the founding of Blue Lake around 2 p.m. on December 31, but during the night it started to drop."..There was still considerable snow in the

mountains. Along the river, no fences or temporary structures were left standing, but the danger was not considerably heavy." (HS, Jan.1, 1914).

On February 26, 1914, an article appeared in the *Union* suggesting that county and state money be appropriated to repair the damage to the banks of Mad River. The following are excerpts of that article.

> "MAD RIVER LAND OWNERS SHOULD GET BUSY. For several years past it has been evident that unless something is done in the way of protective work along the banks of Mad river to continue the flood waters and to prevent cutting, in a number of places, considerable damage could ensue, and the action of old Mad river during recent high water, the largest in many years, has proved the correctness of this conclusion. At the Sheppard place above the lower Mad River road bridge, the river went through in heavy volume and the bottom ranches for a mile or more were covered with water for several days. Fences were washed away, drift wood deposited and considerable damage was done to both the ranches and the county wagon road. The river bank was also cut badly in several places and on the William Turner ranch, near the mouth of the river, considerable damage was done making it necessary for Mr. Turner to get out with a crew of men, and with bags of sand, brush, and trees tied with wire cables, combat the destructive effect of the swift current which he was successful in doing." (AU, Feb.26, 1914).

The *Union* writer talked with Supervisor Rasmus Anderson, who had also been interviewed by several of the interested property owners, and Mr. Anderson stated that he would take the issue up at the next meeting of the Board to see if the county could not help the property owners in raising the money to do the work. If it would be possible for the county to join in with the property owners on the 'dollar for dollar' basis, it would take $2.00 from the state treasury, for every $1.00 put in by the property owners. The county was interested in two ways, one in helping to protect valuable ranches upon which taxes are being paid, and the other to protect the county wagon roads, which were more or less injured every time the river overflowed. (AU, Feb.26, 1914).

Work to Fix Flood Damage: Summer, 1914

This last flood resulted in the onset of more bank stabilization work on the river along reach 4. The money for this work was put up by the State of California, the County of Humboldt and the individual ranchers and owners, both those living along the banks, whose property is in danger from cutting, and those living further away, whose places are liable to damage from the river leaving the banks and flowing over the bottom lands into the bay, as it did the previous winter (AU, Sept.3, 1914). By the summer, rip-rap work on Mad River was progressing rapidly. The following article was published in the *Arcata Union* on September 3, 1914.

"For some weeks past crews of men with a number of teams have been at work at several points on Mad river putting in substantial rip rap work where the high water of last winter did considerable damage and threatened to do more the coming winter. The first work done on the lower river was along the upper part of the William Turner ranch opposite Tyee City where the angry waters of last winter undermined the protective work done some years ago, and took out quite a section of the bank. The destructive work at this point was prevented during the high water by some quck emergency work on the part of Mr. Turner and crew, and bags of sand, trees, etc., were thrown in the breach to prevent further washing."

"Considerable work had been previously done at this point by the county and Mr. Turner, and the present job, when completed, should certainly afford ample protection. Henry Biddings with a crew of men has been busy laying brush along the curve commencing at a point several hundred yards above where the bad break occurred and ending some distance below it. A heavy mat of large spruce limbs and other brush has been laid along the bank reaching well out into the stream, and upon this brush heavy rock will be laid. The brush work at this point was completed the latter part of last week, and the crew was transferred to the Andrew Olson place above the Carson railroad bridge where a similar piece of work, also under Mr. Biddings, has been in progress. The old landing a short distance below the Carson bridge where several half rotted spiles stood, was also was a danger point, and the wood work was blown out with dynamite and a small piece of rip rap work done here."

"Chris Kjer has taken the contract for getting out the rock, which will be obtained from the old Hannah quarry across Mad river. It is from this quarry that the rock for the Seal Rock Lighthouse was obtained some years ago, and an immense quantity of waste rock was quarried and left on the ground. Most of it is too large to load on wagons, and Mr. Kjer will blast into suitable sizes for handling, and will load the large ones on the wagons with hand winches."

"The rock will commence to move in a few days, the brush work having practically been completed and by winter time the worst places on the bank will be in pretty good shape. Ben Chaffey, with a crew, has also been doing some necessary work along the Sheppard place where the river over flowed last winter, and a more detailed mention of this piece of work will be made in a later issue."

"The money for this work is being put up by the State of California, the County of Humboldt and the individual ranchers and owners, both those liveing along the banks, whose property is in danger from cutting, and those living further away, whose places are liable to damage from the river leaving the banks and flowing over the bottom lands into the bay, as it did last winter. Some years ago, $10,000 was appropriated for the protection work on Mad river with the understanding that the state money could be drawn out 'dollar for dollar' when the property owners started a fund. Supervisor Anderson also agreed to have the county put up a dollar for every one the property owners raised, which makes $4.00 to be expended from three sources for every $1.00 the property owners themselves put up. Sufficient money was raised in this manner to successfully prosecute the work as outlined and there still remains a substantial sum in the State treasury for further work." (AU, Sept.3, 1914).

The town of Blue Lake was continuing to expand and on May 2, 1914, a foot bridge across Mad river from Blue Lake was built by the citizens of Blue Lake. "It will be quite an accommodation to the people of West End wishing to come here at any time."

In March, 1915, minor flooding was reported but little damage occurred. On October 9, 1915, Blue Lake was dry and water levels were low in tank (SBF vol.68, pg.23).

1917 - 1925, Drought and the Onset of Bed Lowering

With drought conditions, recruitment of sediments into the project reaches was reduced, since the large flood events transport sediments. Although a few minor floods were reported during this period, it appears that the river bed reached its highest level and would soon start degrading. In late February, 1917 , the Mad River was 2 feet lower than in 1915. Mad River was high but no damage was reported. (SBF vol. 82, pg. 285).

In November, 1920, the recent raise in the river cut out a bar at the mouth, making a deep channel, which, it was said, "permitted the fish to come in at almost any stage of the tide and allowed an extreme runout" (AU, Nov.4, 1920). This event, and probably others to follow, flushed lower Mad River of the small sediments that had been transported in years past.

The third week of February, 1921, brought a minor flood which caused heavy damage to the Northern Redwood Lumber Company at Korbel. The bridges at Riverside and Canyon Creek were carried away, as were bridges near the mill. (AU, Feb.20, 1921).

High water was reported on February 20, 1922 and "drift was coming down fast," many big logs were seen. (AU, Mar.2, 1922).

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Appendix D

Mad River Biologists
Consultants Report

DRAFT

Program Environmental Impact Report
for
Gravel Mining
Mad River, Humboldt County

Wildlife

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I. Introduction

The purpose of this PEIR is to identify existing and potential significant environmental impacts resulting from instream gravel extraction operations on the lower Mad river, Humboldt County, California, and to consider feasible alternatives to instream mining. The geographic scope of this PEIR is described elsewhere in this document. This section focuses on the effects of instream mining on the non-fish vertebrate wildlife species, i.e.. amphibians, reptiles, birds and mammals.

Concern has been expressed over the effect of gravel mining on the wildlife and habitats of the study area. This report will describe the wildlife habitats of the study area, the wildlife species that are to be expected in each habitat, and the effect (both historical and projected) of changes in these habitats on the wildlife species. Special attention will be given to those species considered endangered, threatened, or of special concern by the U.S. Fish and Wildlife Service and the California Department of Fish and Game.

II. Habitats

Riparian

[Definition of Riparian Habitat included in Botanical Section by Karen Theiss including a discussion of riparian scrub, developing riparian forests and mature riparian forests.]

Riparian habitat as a whole, in all of its successional stages, is a significant resource. Any activity that damages it would be considered to be significantly adverse -- whether or not any sensitive animals were found during the course of this or other studies. Presently, not enough information exists to assess the value of the various successional stages to wildlife. Some attempt will be made to determine each stages wildlife habitat values during this spring field season.

Significant stands of developing and well-developed riparian vegetation exists along the Mad River in the study area (KT). The actual acreage of riparian has ???? over the past ???? years (see discussion by MS,SC,KT?).

The riparian forest provides habitat for nearly all of the reptile, amphibians, birds and mammals listed in Attachment A. Even those that do not use this habitat for feeding, nesting or cover, depend to some extent on the productivity of this habitat. Furthermore, the aquatic habitats (both riverine and pond) adjacent to the riparian forests not only receive organic matter (in the form of plant and animal material) from the riparian forest, but owe much of their physical structure to the influence of the riparian forests.

Gravel mining operations have three potential affects on riparian habitat. The first is the actual removal of riparian habitat due to construction of roads or processing sites. This effect can be mostly avoided in the design of future operations. The extent of past removal of riparian along the study area for the construction of existing gravel operations is ?????.

The second is the direct effect of noise and dust from the mechanical operation. The noise and movement of equipment has an immediate effect on wildlife. While many species can become acclimatized to predictable and/or constant noise, others will simply be displaced. Our present knowledge of wildlife reaction to noise and disturbance does not allow accurate general assessments of affect. Site-specific and species-specific recommendations will be made after the spring field season. The consequences of dust coating riparian vegetation is also of concern, as a layer of dust can inhibit or prevent both plant growth and insect use of plants, both of which consequently affect wildlife use of the habitat, by either directly or indirectly affecting food availability. Watering roads and other operational sites can reduce this dust and minimize its effect.

The third potential effect of gravel mining would result from changes in the location of the river channel as a result of the mining activity. These changes could alter the health and distribution of the riparian habitats. In particular, there is concern that the early successional stages could be altered on a regular basis, preventing the later successional stages from ever developing. An analysis of the distributional history of the riparian forests being done by others (MS,SC?) might shed light on this problem.

Riverine

An important habitat to the fish and aquatic invertebrates of the Mad River system is the river itself. The health of the river obviously effects those species that depend on the fish and aquatic invertebrates for food, such as Double-crested Cormorant, Bald Eagle, Osprey, Common Merganser, and Dipper. A more complete discussion of gravel mining's effect on fish habitat can be found elsewhere in this report (Scientific Committee). In addition, water quality concerns such as spilled petroleum products, waste water, and other by-products of the mining operation could have consequences for wildlife. Strict control over this aspect of the mining operation is necessary.

Gravel Bars

The gravel bar is the habitat most directly affected by the present mining operations. Gravel bars provide feeding habitat for birds such as Spotted Sandpiper and Killdeer, other shorebirds, and various raptors such as Bald Eagle and Turkey Vulture, and roosting sites for gulls and mergansers. In addition, the earliest successional stages of the riparian forests begin on the gravel bars

The actual effect on wildlife using the gravel bars from mining operations will depend on the method used and the amount of gravel mined. In general, operations should be designed to minimize the disruption of natural river events. Where disruption is necessary, the operation should be designed to mimic naturally occurring events when possible. As a last resort, operations should be designed to create mitigating habitat elsewhere, e.g. the creation of ponds through pit mining.

Further management recommendations regarding actual mining plans will be suggested after the spring field season.

Temporary Pools and Backwaters

This habitat category is defined to include the seasonal and temporary quiet waters that develop along the river's course. These can be shallow ponds that are flooded at high water

and then disappear as the season progresses, or backwaters and low sites within the river bed that stay wet all year long because of ground water. These ponds are considered temporary because their structure and distribution can change dramatically during high flow events. During the past few drought years, many of these ponds have developed healthy stands of emergent aquatic vegetation and have become the breeding site for amphibians.

This is one of the most important habitats for the Red-legged Frog and the Western Pond Turtle. In addition, Foothill Yellow-legged Frog, Bullfrog and other amphibians can use this habitat extensively.

We have little data on the importance of these waters for local populations of these species. This spring's field work will attempt to assess the value of these ponds, but future work at other seasons and other years will likely be necessary.

Freshwater Marshes and Ponds (including pits).

Various freshwater marsh and pond habitats occur adjacent to the river channel. These are distinguished from the above classification by their more-or-less permanent nature. As a consequence of their permanent nature, the aquatic vegetation is often well-developed and a more complex habitat structure results providing homes for a variety of wildlife.

Some of these ponds are natural, but many have come about as a consequence of past mining activity. There is potential for creating wildlife habitat using these ponds. This spring field season will attempt to assess their relative value to the species of special concern.

II. Species Accounts

Table 1.
Species of Special Concern

Northern Red-legged Frog	*Rana aurora aurora*	CA2,SC
Foothill Yellow-legged Frog	*Rana boylii*	CA2,SC
Bullfrog	*Rana catesbeiana*	I,HA
Northwestern Pond Turtle	*Clemmys marmorata marmorata*	CA2,SC
Double-crested Cormorant	*Phalacrocorax auritus*	SC
Bald Eagle	*Haliaeetus leucocephalus*	CE,FE,CP
Northern Spotted Owl	*Strix occidentalis caurina*	ST
Sharp-shinned Hawk	*Accipiter striatus*	SC
Cooper's Hawk	*Accipiter cooperi*	SC
Merlin	*Falco columbarius*	SC
American Peregrine Falcon	*Falco peregrinus anatum*	CE,FE,CP
Willow Flycatcher	*Empidonax trailii*	CE
Purple Martin	*Progne subis*	SC
Black-capped Chickadee	*Parus atricapillus*	SC
California Yellow Warbler	*Dendroica petechia brewsteri*	SC
White-footed Vole	*Arborimus albipes*	CA2,SC

CE - Listed as Endangered by the State of California
FE - Listed as Endangered by the Federal Government
CP - California Protected Species
CT - Listed as Threatened by the State of California
CA2 - Category 2 Candidate for listing by the Federal Government (existing information indicates listing may be warranted, but necessary biological data are lacking).
I - Introduced
HA - Harvested Species

Northern Red-legged Frog (*Rana aurora aurora*)

The Northern Red-legged Frog is typically found in ponded areas along the coast and cascade ranges from northern California to southern British Columbia. Here on the north coast of California it is widespread in ponds and along rivers where there is quiet water and emergent aquatic vegetation providing cover. When not breeding this species wanders widely in damp woods, including riparian and coniferous forests. Breeding takes place in late winter and early spring. Red-legged frogs have a weak voice and are consequently inconspicuous. Egg masses consisting of up to 2-3,000 eggs are deposited in water up to 6" deep. Most young are completely transformed into adults by mid-summer or earlier. The diet of Red-legged Frogs consists primarily of insects captured near water.

The Northern Red-legged Frog is considered a Species of Special Concern in California and is a Category 2 Candidate for Federal Listing. The main reasons for concern in California are declining habitat and predation by the introduced Bullfrog.

Locally, we find the Red-legged Frog is not as common along the rivers as the Foothill Yellow-legged Frog. Along the Eel River, Red-legged Frogs were found in **Temporary Pools and Backwaters** where emergent aquatic vegetation had developed to provide sufficient cover. This emergent vegetation probably developed more extensively during the last few drought years. Red-legged Frogs are also found in many **Freshwater Marshes and Ponds** in the study area vicinity.

Gravel mining operations should avoid any disturbance of Red-legged Frog breeding ponds and maintain the integrity of adjacent riparian forests.

One goal of the field surveys to be undertaken in April and May of this year will be to assess the relative value of the permanent ponds and the temporary pools and backwaters to the Red-legged Frogs of the study area. Mitigation measures might include enhancement of Red-legged Frog habitat by the maintenance or construction of quiet water areas where aquatic vegetation can develop. Some forms of gravel mining could, with careful management, provide Red-legged Frog habitat.

Foothill Yellow-legged Frog (*Rana boylii*)

The Foothill Yellow-legged Frog is found in coastal and foothill habitats throughout northern California. Its preferred habitat is along streams and rivers, especially where riffles are present. The Yellow-legged Frog escapes into the water and hides among vegetation or in the bottom when disturbed. It is less likely to use the riparian forests and other adjacent habitats than other frogs. Breeding takes place later in the spring, when high water flows have subsided. Eggs are laid in a mass of up to 1,000 eggs and are attached to rocks in shallow, flowing water. Larvae transform into frogs during the summer.

The Foothill Yellow-legged Frog is considered a Species of Special Concern in California and is a Category 2 Candidate for Federal Listing. The main reasons for concern in California are declining habitat and predation by the introduced Bullfrog.

Along the north coast, Yellow-legged Frogs are found in most rivers and large streams. Its specific status along the Mad River in the study area needs to be determined. This species seems to prefer more sunny areas than the Red-legged Frog. It is found downstream at least to the Water District parks, but may avoid the coastal fog zone. In inland portions of the Eel River, the Yellow-legged Frog has been replaced by the introduced Bullfrog.

Depending on the results of the spring field surveys, management recommendations would include avoidance of disturbance of riffle habitat during the breeding season. Furthermore, any activities that would increase silting in the river during the late spring and early summer could be damaging to larval and transforming young frogs.

Mitigation for deleterious effects on this species would be more difficult than for the Red-legged Frog. The maintenance and/or creation of healthy flowing streams and rivers covers the primary need for this species.

Bullfrog (*Rana catesbeiana*)

The Bullfrog has been introduced in California and now is found in almost all aquatic habitats excepting the high mountains and deserts. It prefers permanent waters, especially with well-developed vegetation and muddy bottoms. It is highly aquatic and rarely ventures from water. The breeding season depends on the particular site but can be anytime from February to July. Anywhere from 10-20,000 eggs are laid in a mass. Larvae may not transform into adults until the second year of life. The Bullfrog has a varied diet that includes insects and other invertebrates, fish, small reptiles, birds, small mammals and other amphibians. Its habit of eating other frogs has caused a decline in both red-legged and Yellow-legged Frogs in the west and its presence is a significant part of the reason that the latter two species are of special concern.

The Bullfrog is a Harvest Species in California that is managed by California Fish and Game.

Bullfrogs are widespread and seemingly becoming more common along the north coast. In the study area, the Bullfrogs specific status needs to be determined.

Management recommendations concerning the Bullfrog are geared towards reducing its population. Elsewhere, Bullfrog management has been suggested as a mitigating measure for disturbance to red and Yellow-legged Frog populations. Depending on the occurrence of Bullfrogs in the study area, similar activities may be suggested here.

Northwestern Pond Turtle (*Clemmys marmorata marmorata*)

The Western Pond Turtle is the only native aquatic turtle in California. It is widely distributed west of the Sierra-Cascade Mountains. Pond Turtles are found near and in water, especially slow moving or quiet waters, primarily ponds, small lakes, reservoirs and quiet streams and rivers. They can be found basking on rocks, logs or on the bank along aquatic vegetation. Places to bask seem an important component of their habitat needs. Females lay a clutch of 5-11 eggs between April and August in a small hole in a dirt bank, sometimes at a distance from her home water. The diet of Pond Turtles consists of aquatic plants, fish, invertebrates and carrion.

The Northwestern Pond Turtle is considered a Species of Special Concern in California and is a Category 2 Candidate for Federal Listing.

Along the north coast of California, the Pond Turtle is sparsely distributed, mainly at ponds in the interior. Its status along the Mad River needs documenting. It is found downstream at least to the Blue Lake bridge area. This species, like the Yellow-legged Frog, seems to prefer sunny areas and so may avoid the coastal fog belt.

Any management recommendations or mitigation measures for the Northwestern Pond Turtle will depend on the results of this springs surveys.

Double-crested Cormorant (*Phalacrocorax auritus*)

The Double-crested Cormorant is a widely distributed species throughout North America. It is the only cormorant to occur regularly in fresh water habitats. Breeding takes place in colonies on islands (especially in ocean environments) or in stands of large trees, often in riparian areas. Food consists of mainly of fish and invertebrates, especially crustaceans.

The Double-crested Cormorant is a Species of Special Concern in California.

In the study area, Double-crested Cormorants are common along the Mad River throughout the year. There are no known nesting areas in the study area, the nearest nesting sites are on the abandoned Arcata Wharf in Humboldt Bay and along sea stacks in and around Trinidad Harbor north of the Mad River mouth.

Management recommendations and mitigation activities for Double-crested Cormorant populations in the study area consist of maintaining a healthy river habitat for fish and other components of the cormorants diet.

Bald Eagle (*Haliaeetus leucocephalus*)

The Bald Eagle is found throughout North America and California. Concentrations of Bald Eagles are found where their preferred food is concentrated, i.e. in major waterfowl wintering areas and along major salmon streams and rivers with adjacent snags for perching. Nesting takes place in large stick nests, often high in a tree, living or dead. Eggs can be laid as early as January, incubation is 30-45 days and the young take their first flight approximately 2 and 1/2 months after hatching. Their food consists largely of fish, either caught themselves or stolen from Ospreys. Bald Eagles also feed upon a wide variety of small mammals, aquatic birds and even carrion.

The Bald Eagle is listed as endangered both in California and the United States. It is a California Protected Species.

Bald Eagles are rare in Humboldt County. Three nests are known in the county, one of which is above Korbel in the present study area. Scattered sightings of Bald Eagles along the

coastal portion of the Humboldt Bay area may refer to this pair and its offspring, or the occasional visitor from elsewhere.

Disturbance to the nest should obviously be avoided. At the present, gravel operations do not take place near the known nest. Site-specific recommendations should be developed in the event of new operations near the nest area. In addition, care must be taken to preserve the integrity of salmon and steelhead habitat in the study area as these are the main food sources for Bald Eagles locally. Maintaining resting and feeding perches in large trees along the river should also be done.

Sharp-shinned Hawk (*Accipiter striatus*)

The Sharp-shinned Hawk is found throughout North America. It is found in a wide variety of forested and scrub habitats where it preys primarily on small birds. Populations in North America have declined due to pesticide residues, habitat destruction and the general decline of songbird populations, its major prey.

The Sharp-shinned Hawk is a Species of Special Concern in California.

Locally, the Sharp-shinned Hawk is an uncommon winter resident and rare summer breeder.

Management recommendations would depend on the location of nests and would consist of reducing or eliminating disturbance during the nesting season. In general, riparian habitats, which support song bird populations, should be protected for the health of this species.

Cooper's Hawk (*Accipiter cooperi*)

The Cooper's Hawk is found throughout North America. It is found in a wide variety of forested and scrub habitats where it preys primarily on song birds. Populations in North America have declined due to pesticide residues, habitat destruction and the general decline of songbird populations, its major prey.

The Cooper's Hawk is a Species of Special Concern in California.

Locally, the Cooper's Hawk is an uncommon winter resident and rare summer breeder.

Management recommendations would depend on the location of nests and would consist of reducing or eliminating disturbance during the nesting season. In general, riparian habitats, which support song bird populations, should be protected for the health of this species.

Merlin (*Falco columbarius*)

The Merlin is found throughout North America. It is found in a wide variety of open habitats where it preys primarily on shorebirds and song birds. Populations in North America have declined due to pesticide residues and habitat destruction.

The Merlin is a Species of Special Concern in California.

Locally, the Merlin is an uncommon winter resident that occasionally hunts along the lower stretches of the Mad River where it preys on Pine Siskins and other small birds.

Management recommendations consist of protecting riparian habitats, which support song bird populations.

American Peregrine Falcon (*Falco peregrinus anatum*)

The Peregrine Falcon is found throughout North America. It is often found in aquatic habitats where it preys primarily on water birds, both shorebirds and ducks. Populations in North America have declined due to pesticide residues, nest disturbances (including the illegal removing of chicks for falconry) and habitat destruction. There seems to be some recovery of the species recently.

The Peregrine Falcon is an Endangered Species in California and the United States and is a California Protected Species.

Locally, the Peregrine Falcon is an uncommon winter resident and rare summer breeder. It is fairly common in the lower reaches of the Mad River (e.g. below the 299 bridge) where it hunts for shorebirds along the river and in the adjacent fields.

Management recommendations would depend on the location of nests in the study area, none of which are known to date.

Northern Spotted Owl (*Strix occidentalis caurina*)

The Northern Spotted Owl is an uncommon and reportedly declining species of old growth forests in the Pacific Northwest. Its habitat is in old-growth or older second growth forests.

The Northern Spotted Owl is a California Threatened Species.

Near the study area, Spotted Owls are locally common in suitable habitat.

None of the present gravel mining operations would impact Spotted Owls in adjacent suitable habitat.

Willow Flycatcher (*Empidonax trailii*)

The Willow Flycatcher is found throughout the northern half of the continental United States. Its preferred habitat is wet meadow and montane riparian habitats dominated by willow thickets. The Willow Flycatcher breeds almost exclusively in dense willow thickets, using the lower branches for feeding and singing perches. This species nests are parasitized by the Brown-headed Cowbird, a significant part of the reason for its California listing.

The Willow Flycatcher is a California Endangered Species.

In Humboldt County the Willow Flycatcher is not yet known to nest, although singing males exhibiting territorial behavior have been noted along the Eel River near Dyerville.

Spring surveys for the Willow Flycatcher will be done in late May to attempt to find territorial birds or evidence of nesting. Management recommendations and/or mitigation activities will result from those surveys. In general, the protection and maintenance of healthy riparian habitats, especially the early seral stages with willow thickets, is important.

Black-capped Chickadee (*Parus atricapillus*)

The Black-capped Chickadee is possibly the most abundant and best-known chickadee in North America. In California it is found almost exclusively in willow/cottonwood habitats along the north coast south to the vicinity of Ferndale.

The Black-capped Chickadee is a Species of Special Concern in California

It has become fairly common along the Mad River from the Mad River County Park upstream in suitable habitat to at least the Blue Lake bridge.

Management recommendations for this species would center around the maintenance of healthy riparian woodland.

California Yellow Warbler (*Dendroica petechia brewsteri*)

Found throughout North America, the Yellow Warbler has been declining as a breeding bird in California due to habitat destruction and parasitization by the Brown-headed Cowbird. Its breeding habitat is in riparian deciduous forests of almost any size.

The Yellow Warbler is a Species of Special Concern in California.

In Humboldt County the Yellow Warbler is a fairly common breeder in riparian habitats including the riparian forests downstream from the Blue Lake bridge.

Management recommendations consist of maintaining healthy riparian woodlands.

White-footed Vole (*Arborimus albipes*)

The White-footed Vole is found along the coastal regions of Oregon and extreme northern California. Its preferred habitat is humid coastal forests of Redwood, Douglas-fir and riparian species. White-footed Voles feed principally on the leaves of green plants, red alder seems to be preferred in some areas.

The White-footed Vole is a Species of Special Concern in California and is a Category 2 Candidate for Federal Listing.

Locally this species is not well known, but seems to prefer riparian vegetation along small streams within the coastal coniferous forests. Field surveys during this March and April will search for this species, but it is not expected in the Cottonwood/willow type of riparian forests of the study area.

Management recommendations will depend on its status as elucidated by field studies.

Future Monitoring Recommendations

Surveys are planned during the months of March, April and May to elucidate the status of the above discussed species on a site by site basis. The methods and results of these surveys, and any specific management recommendations resulting from them, will be described in the Final PEIR.

Since the activity, and even the presence, of these sensitive species is greatly dependent on river flows and season, it is recommended that additional surveys take place during the summer months of July and August. Furthermore, given the great variation in annual rainfall and its consequent effect on river flows and gravel replenishment, it is recommended that annual monitoring of the study area and its sensitive species be established. This could be done on a simple level by repeating, with minor modification as necessary, the methods to be used this spring. This monitoring should be planned for at least 5 years and then the monitoring scheme itself should be reevaluated.

It is further recommended that a wildlife biologist be consulted during the actual planning of the gravel mining method on a site specific basis. The environmental (habitat and hydrologic) impacts of gravel extraction will be very different depending on which extraction scenario is adopted (skimming, trenching or pit mining). Simple on-site modifications have the potential to reap important benefits for wildlife.

Note: I will be happy to expand on the effect of different gravel extraction methods on the sensitive wildlife species after reviewing the other's reports.

Appendix E

Rising Sun Enterprises
Consultants Report

SUPPLEMENTAL INFORMATION

HUMBOLDT COUNTY
PROGRAM EIR FOR GRAVEL REMOVAL
ON THE LOWER MAD RIVER

VIEWSHED

RECREATION

NOISE

TRAFFIC

APRIL 1993

RISING SUN
ENTERPRISES

PLANNING • PERMITTING • ENVIRONMENTAL CONSULTING
1864 Myrtle Avenue • Eureka, CA 95501 • (707) 445-2433

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ATTACHMENT - Draft Surface Mining and Reclamation Plan for Gravel Removal on the Lower Mad River

SUMMARY

The following document analyzes the affects that the existing gravel extraction and processing operations have in relationship to Viewshed, Recreation, Traffic and Noise. Reading this report should make it apparent that the four topics are interrelated to each other. For instance, the viewshed is primarily affected by the duration of extraction equipment on the gravel bars, particularly by recreationists on the river. The duration of and volume of gravel extracted determines the type and level of noise on nearby receptors. Transportation of extracted materials as well as processed materials determines the amount of truck traffic.

Initially, it may be felt by some that, if the extraction season and duration was limited, the affects on the surrounding environment would also be reduced. This is not true. Reducing the extraction period without reducing the extraction volumes would actually increase the intensity of operations. If hours were reduced, the operator would need to bring in more loaders and trucks and have more material leaving the site. If volumes were also decreased, then activities in surrounding rivers or quarries would be increased. Since extraction activity and subsequent processing is market-driven, with operators attempting to stockpile materials to carry through to the next extraction season, curtailment of extraction activity could have adverse affects on the local economic framework dependant on aggregate products. One could also argue a range of proposed actions from "There is no reason to make any changes since this is the way that it's been for the past 25-30 years" to "the river should be returned to its natural state prior to human interference." Neither of these are realistic alternatives to manage the river resources.

Operations have varied greatly in the past as to volumes, extraction season, hours of operation, and number of trucks and equipment, with no coordination between the different operations. All these operations were in existence prior to permits being required or have obtained permits at a time when extraction activity was not an expressed concern. As these sites have become established over the years and difficulty of finding new sites has increased, there is an increased awareness for the need to coordinate the activities that occur on this portion of the Mad River. In light of recent opposition to these operations and the overbearing amount of new regulations, reports and fees, the operators on the Mad River have expressed a willingness to undergo an annual review process similar to what has been approved for several individual operations. This process allows the County, in conjunction with the CA Department of Fish & Game, to place limits on extraction activity based on specific annual conditions. It is this annual review mechanism that the proposed mitigation measures in this report are based on.

Attached to this report is a draft standardized Surface Mining and Reclamation Plan that includes attachments describing the annual review, monitoring and performance standards. It is anticipated that other issues addressed in separate reports will result in limitations to extraction volumes and season. Only after all the relevant sections of the EIR are compiled comprehensively will the effectiveness of the proposed mitigation measures be able to be further analyzed.

Even with the proposed mitigations, there are still unavoidable significant impacts that occur from the ongoing operations. These include noise impacts to (1) recreational users on the river as a result of gravel extraction activity, (2) the RV park residences adjacent to the Arcata Readimix operation as a result of processing, and (3) residences adjacent to the Arcata Readimix, the Glendale Trailer Park and adjacent residences along the City of Blue Lake truck route from truck transportation. The actual impact would depend on the duration and hours of activity and be limited to those present at the time of the activity. Another unavoidable impact would result from the cumulative impact of truck traffic and associated deterioration of the designated truck route through the City of Blue Lake.

VIEWSHED

Setting

The area between Swaesey Dam and the Mad River Fish Hatchery area is characteristically steep forested slopes on either side of a generally narrow confined river channel. This area is within private ownership and is not accessible to the general public. Below the Mad River Fish Hatchery the river flows through a valley with wide river meanders, steep cut river banks and corridors of established riparian vegetation. Between the Mad River Fish Hatchery and the Highway 101 bridge are several communities exhibiting a mixture of agricultural, residential, commercial and industrial activities. Below the Highway 101 bridge, land use is generally agricultural grazing land and forested sand dunes (adjacent to the Pacific Ocean).

Viewshed information was obtained by reviewing gravel extraction and processing operations from adjacent public roads and recreational areas. Analysis occurred both in late fall when leaves were still on deciduous vegetation as well as winter after leafdrop.

Views along North Bank Road, as described driving east from Highway 101, consist primarily of grazing land, inter-dispersed with thick streambank vegetation consisting primarily of alders, willows, cottonwoods and spruce and very short segment of the Mad River. There are several small pull-offs from the road which are generally utilized by fisherman early in the morning during the season when fish are running. North Bank Road leaves the river when across from the Redwood Empire Aggregates Graham Bar. The asphalt plant and conveyor belt can be seen in the distance. More pull-offs are available along North Bank Road adjacent to Arcata Readimix Bar and Johnson-Spina Bars. A short view opens up again to look at the Spini Bar and the Highway 299 bridge.

The river along North Bank Road, for the most part, is screened by vegetation or by distance by grazing lands during the months of extraction. The most visible part of the river along North Bank Road is of the Johnson/Spina Bars downstream from the Highway 299 bridge. A casual passer-byer would not readily notice the intermittent gravel extraction operations occurring on this section of the river due to the curvature and narrowness of North Bank Road. However, equipment would be seen when present on the gravel bar.

Joining Highway 299 going east, the highway passes several of the pump stations and the Water District buildings. Mercer, Fraser Essex Bar processing plant area can be seen. Only short glimpses of the river are visible along this stretch. Again, the streambank is lined with cottonwoods, willows and alders with conifer trees planted both within the CalTrans right-of-way and growing naturally on adjacent land. Adjacent to the Essex Lane underpass, a short glimpse of the railroad bridge and the river

can be seen. The river is then hidden by the adjacent streambank and dense vegetation.

The next available view of the river from Highway 299 travelling east occurs at the Glendale Road underpass looking at the upstream end of Johnson Bar and the Eureka Sand & Gravel - Christie Bar. The river view is of two meanders, where much of the 1990-91 trenching occurred. Further east the Eureka Sand & Gravel plant is highly visible along Highway 299. Some evergreen plantings occur within the CalTrans right-of-way, but most of the processing plant area is exposed to views from Highway 299 traffic, showing the equipment, stockpiles and trucks. The highway at this point veers to the north away from the river and no other views of the river are available when driving east. When driving west from Lord Ellis Summit down towards the Glendale exit, distant views of the river and gravel bars are visible, primarily of the Blue Lake/Christie/Johnson bars.

Within the City of Blue Lake, access to and views of the river are very limited, generally because of streamside vegetation along Dave Powers Creek. Views of gravel bars can be obtained crossing the Hatchery Road bridge and are available by many who utilize the top of the flood control levee north of the river. The primary access to the river at Blue Lake is via the Hatchery Road bridge and levee. Both the Emmerson and Blue Lake bar extraction areas are visible from the bridge and levee. No other views of the river are available along Hatchery Road. Mad River Sand & Gravel processing site is visible but is located approximately 650 feet from Hatchery road.

The Old Meander where the Mad River use to flow until 1964 has become vegetated and portions of the adjacent land is utilized for vegetable growing as part of Potters Produce. Signs of the old bridge location and old river channel are still visible for the wary eye along the road; however, for the most part they are not readily visible.

Views were also analyzed along West End Road, driving between Blue Lake and Arcata. Similar to North Bank Road, West End Road was separated from the river bank by grazing lands. Views were mostly screened by dense stands of riparian vegetation. Views of the Blue Lake and Eureka Sand & Gravel stockpiles and extraction activity could be seen along a limited stretch of the road directly opposite the operations. Warren Creek Road, off of West End Road, had views available of the river from the park adjacent to Pump Station #4 (Park #4) to Pump Station #5, upstream where the railroad crosses Warren Creek Road. Warren Creek Road ends in a private road with no public access or views of the river.

Further west along West End Road, the road parallels closer to the river and offers views of the Essex Bar when summer foliage begins to fall from the trees and further west at the recreational park located adjacent to the Humboldt Bay Water District facilities. Views of the river can only be obtained by a walk through the park. Highway 299 can clearly be heard at

this location. The area between the Water District buildings and Highway 299 bridge can also be viewed through the trees driving further along West End Road.

The only view of the river along Highway 299 west of North Bank Road is as one crosses the river on the Highway 299 bridge. Views of either the Water District buildings or the Johnson-Spina Bar can be seen depending on the direction the person is driving on the Highway. Gravel extraction is visible when it occurs on the Johnson-Spina Bars.

On Guintoli Lane, no views of the river are available. However, Redwood Empire Aggregates and Arcata Readimix processing plants and stockpiles are visible along Guintoli Lane. Guintoli Lane is affected by truck traffic from the importation of gravel to the plants and exportation of aggregate products (including sorted or crushed aggregate, cement and asphalt.)

Views of the river upstream from the U.S. Highway 101 bridge are limited to vehicles as they cross the northbound Highway 101 bridge. No extraction activity can be seen from this vantage point.

Analysis

Views of gravel extraction/processing activity in the study area are generally limited to where public roads run close to processing plants and segments of the river and from the river itself. The area affected by gravel extraction and processing activities is restricted to the area between the Mad River Fish Hatchery downstream to Highway 101. The natural condition of the riverine environment is most noticeably altered within this section. Viewshed impacts would be experienced most by those that use the river for recreation and sports fishing purposes. Noticeable impacts would include gravel extraction areas including skimming, trenching and off-channel pits, summer bridge crossings and haul roads as well as processing and stockpile areas.

Besides views of extraction areas, access roads and stockpiles can generally be seen where adjacent riparian vegetation does not occur. Most of the time the raw material stockpile occurs adjacent to the riparian vegetation, screening processing equipment from river users. Viewers on the river also see the five pump stations and the Water District facility along 1½ miles of river above the Highway 299 bridge.

Views afforded along public roads are, for the most part, screened during the extraction season by dense streamside vegetation and steep streambanks. Views of the river and processing plants during winter months when streambank vegetation loses its foliage are increased. However, extraction activity has generally ceased by that time.

All six processing and/or stockpile sites are visible from public roads. The two sites that are most visible outside of urban areas are the Essex and Eureka Sand & Gravel sites. The Redwood Empire Aggregate site and Arcata Readimix site adjacent to Guintoli Lane are within an industrial and commercial area. The Mad River Sand & Gravel processing plant is visible but not close to local traffic on Hatchery Road.

Though the extraction areas and processing sites may be visible, there is no evidence that would indicate that impacts can be considered significant. Contrarily, it is this section of the river that has historically had high levels of industrial operations, including adjacent aggregate processing as well as wood product industries. It has been these uses (primarily the wood products industry) that has generated the growth of the communities surrounding them.

However, if mitigation measures were found necessary to minimize the impacts, such measures might include dense landscaping at select places adjacent to roadways and the river, and minimization of the extraction season. These mitigation measures are not proposed for this concern since the impacts are not considered to be significant.

Mitigation Measures

None proposed.

RECREATION

Setting

Recreational use of the river includes sportsfishing, swimming, hiking, boating, horseback riding, hunting and off-road vehicle use by dirt bikes and three-wheelers. Recreational off-road vehicle access is limited to only a couple locations. However, once on the river, access is available to long stretches of gravel bar. Controlled vehicular access occurs at gravel extraction/processing sites.

Designated recreational use areas include the Water District's two pump station parks and the Mad River Fish Hatchery. Handicapped fishing access is available at the Mad River Hatchery. Other public accesses include the Hammond Bridge and the County Mad River Beach Park and Boat Ramp. See Figure 1 for these locations. Figure 2 also indicates locations that show signs of river access by fisherman, bathers or others. Many of these locations are utilized without permission by landowners.

Users of the river and river's edge would be able to see gravel extraction activities and skimmed or trenched gravel bars during and subsequent to extraction periods. Extraction has recently been limited to 4-5 months per year. Most operators do not operate on weekends which is also the time that most family recreational use occurs. The majority of fishing activity occurs early in the morning, beginning just prior to dawn, or in the evening hours when processing activities are not occurring. However, fishermen can be seen utilizing the river at all times of the day.

Occasional boating, primarily kayaks and inner tubes, are seen in the summertime. These users have been affected by as many as four summer bridge crossings if one traveled from the Fish Hatchery to Highway 101. The culvert and concrete ramp at REA's Guintoli site would represent a blockage and require portaging. In addition, low flow conditions would require portages at several other places on the river due either to channel configuration or sometimes by artificial blockages such as the weirs at the Humboldt Municipal Water District and the Fish Hatchery. See Figure 2 for some of these locations.

Analysis

The impacts on recreation caused by gravel extraction/processing include adverse affects from increased sound levels; negative aesthetics of equipment on the river bed and as seen through the riparian zone; dust from scraping operations and limits on accessibility to all parts of the river bar. The noise levels generated from the operations are discussed under "Noise". The project area can be expected to have an environment that has been altered by developments along the river banks. Many of these

have been long-term alterations. Gravel processing plants tend to generate higher levels of noise, dust and traffic, though often intermittent. These aspects could be viewed to have an adverse affect on the recreational quality of the project area.

During gravel extraction certain portions of the river bar are physically changed so that, when viewed by a recreationist, they are not natural. The unnatural man-made forms which result from gravel extraction exist generally from May through October or until the first substantial storm. Extraction operations could be viewed as having an adverse affect on the river viewshed and related recreational use.

If all projects operated at maximum permit allowances at the same time in a year, the quality of the recreational experience would be significantly decreased during the extraction season. However, the activity on the gravel bar has been recently restricted by the amount of recruitment and available gravel for the subsequent year. Many years this level is far below the maximum permitted amounts. As a result, the amount of extraction activity on the gravel bar is also limited.

Skimming operations have recently been required to stake and flag extraction areas, turning the gravel bar into what looks like a construction site. Placement of metal fence posts or rebar on the gravel bar detracts from the recreational experience of the river user. However, this has been determined necessary by the CA Department of Fish & Game in order to review compliance to 1603 agreements. Though the final appearance of the gravel bar correlates to the experience and care of the operator, use of a scraper instead of a loader for skimming generally leaves a smoother final grade. Not all operators have a scraper.

Past practices of trenching and allowing stockpiles to be temporarily stored along the trench for several days represents the most-noticeable change on the gravel bar. Adherence to permitting requirements by the U.S. Army Corps of Engineers would severely limit the amount of this type of activity. A nationwide permit for stockpiles below Ordinary High Water and for summer bridge crossings is required to be obtained from the Army Corps of Engineers.

Decreasing the number, length and height of the small stockpiles temporarily placed next to the trenches would minimize the visual impacts to the natural river scene in the area. Requiring general smoothing off or feathering of the limits of skimming would also tend to minimize residual visual evidence of the gravel extraction process between October 1st and May 1st.

Another impact related to trenching is that it limits wading across to the other side of the river and has been found dangerous to those trying to climb back out because of the steep side slopes. During early spring when the river is fairly muddy it is difficult to discern the change in depth caused by the trench and could cause a hazard to persons, horses and vehicles.

The length of the trench would affect the ability to cross the river. When trenching is utilized, a public safety plan, including signs, should be submitted for review and approval as part of the annual review process.

The trenches that were dug in 1990 and 1991 can also be said to have had a positive impact on recreation. These areas are heavily utilized and preferred by bathers in the summertime and subject to heavy fishing pressure during the fall and early winter months.

Some of the gravel operations and other landholdings have been utilized for access to the river bed for sports fishermen and recreationists. This is done without permission and the owners and operators may someday restrict these accesses, particularly if increased use or abuse occurs. Additional public accesses to the river may be desirable.

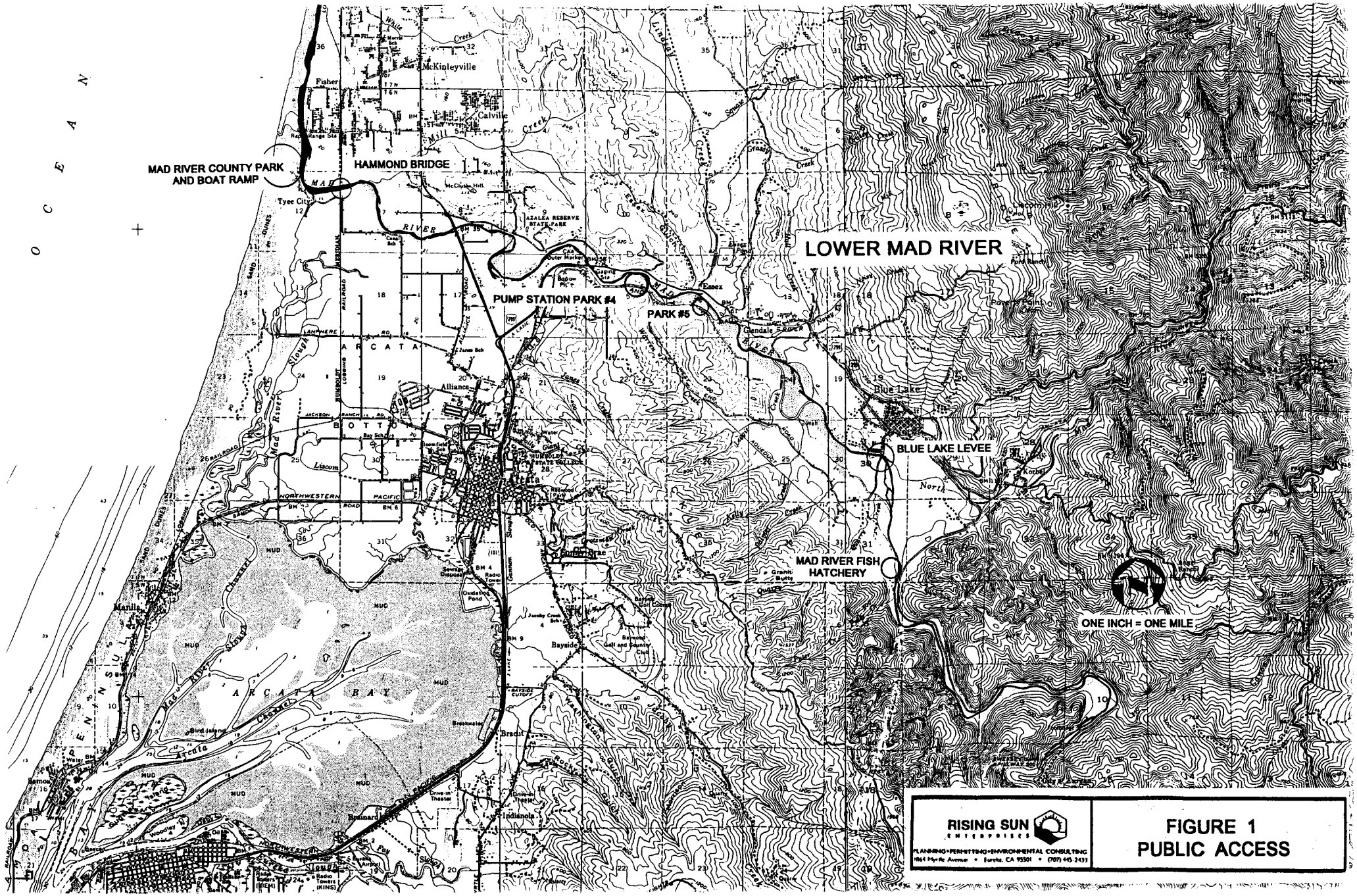
Sports fishermen and other recreationists that have utilized the project area for many years have learned to cope with many of the impacts associated with gravel extraction operations. Sports fisherman or recreationists new to the area attempting to utilize this stretch of river may be less tolerable to the impacts.

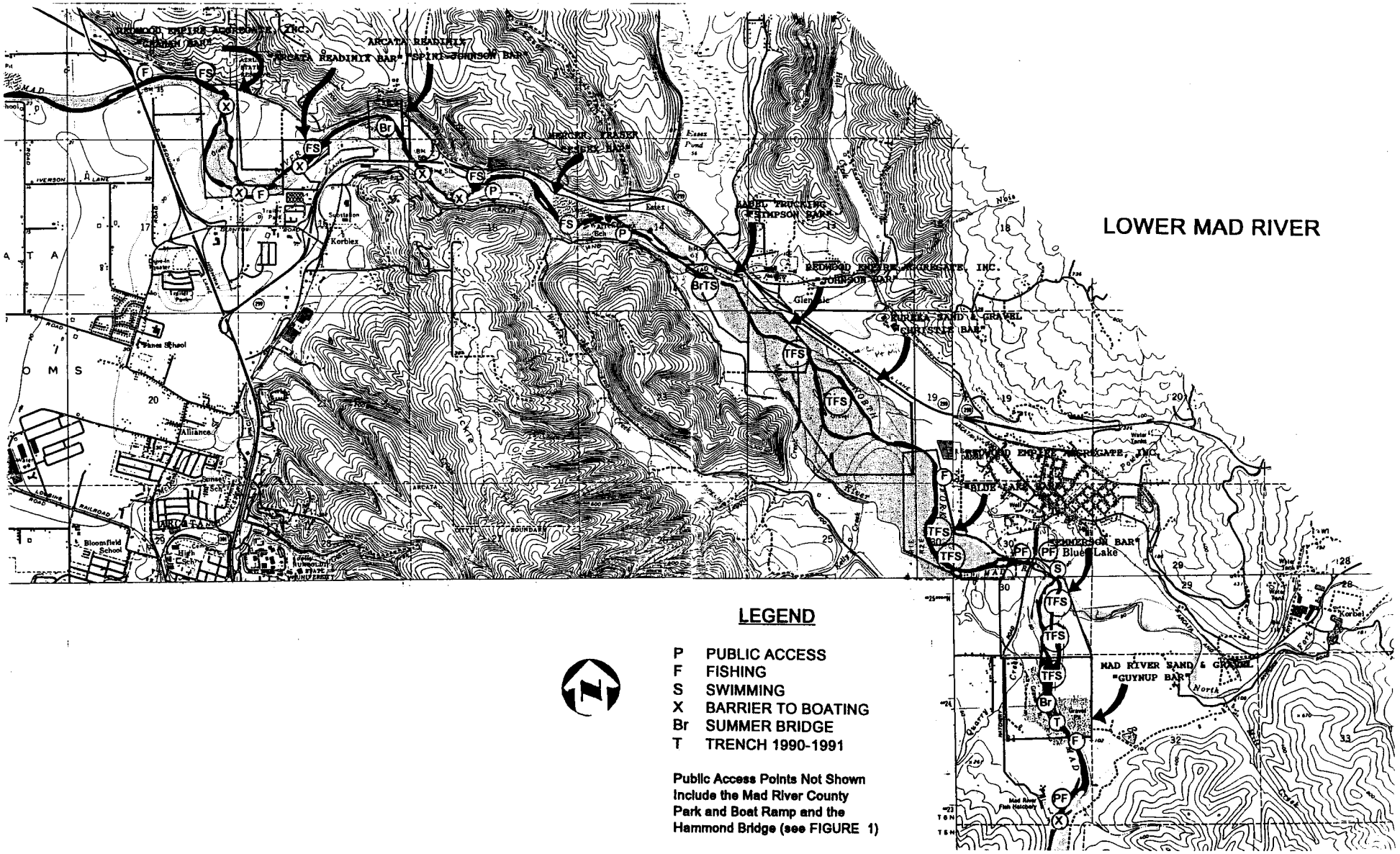
As discussed under "Noise," passive recreational experiences would be impacted by noise levels caused by extraction activities during the period of time when extraction is occurring. However, observations made in the summer of 1992 indicated that people continue to use the river for fishing, swimming, picnicking, horseback riding and other uses, even with extraction activities occurring close by. Some may be intrigued by the activity or not mind the disturbances.

Mitigation Measures

1. When trenching is utilized, a public safety plan, including signs, should be submitted for review and approval as part of the annual review process. Extraction design should consider the length of the trench in relationship to recreational uses and access.

2. See Mitigation Measures listed under the Noise section.


MAD RIVER COUNTY PARK AND BOAT RAMP
HAMMOND BRIDGE
LOWER MAD RIVER
PUMP STATION PARK #4
PARK #5
BLUE LAKE LEVEE
MAD RIVER FISH HATCHERY
ONE INCH = ONE MILE
McKinleyville
Fisher
Calville
Tyee City
Arcata
Alliance
Blue Lake
Essex
Glendale
Manila
Bayside
Bracut
Indianola
Samoa
OCEAN
ARCATA BAY
ARCATA BOTTOM
MUD
Mad River Slough
Arcata Channel
Bird Island
Brookwater
Gannon Slough
Jacoby Creek
Janes Creek
Kelly Creek
North Fork
Mad River
Eureka
Humboldt Bay
Redwood Creek
Elk River
Freshwater Creek
Eureka Slough
Ryan Slough
Hall Slough
Fay Slough
Hookton Slough
Widow White Creek
Lindsay Creek
Swain Creek
Strawberry Creek
Fickle Hill Creek
Myrtle Creek
Mill Creek
Lupton Creek
Fern Canyon
Grizzly Bluff
Fickle Hill
Table Bluff
Table Bluff Reservation
Humboldt Bay National Wildlife Refuge
Arcata Bottom
Arcata Airport
Eureka Municipal Airport
Samoa Airport
Redwood Acres Fairgrounds
Redwood Acres Raceway
Humboldt Bay Golf and Country Club
Arcata Golf Course
Eureka Golf Course
Samoa Golf Course
Arcata Bay Oyster Co.
Humboldt Bay Oyster Co.
Humboldt Bay Mariculture Co.
Humboldt Bay Municipal Water District
Humboldt Bay Harbor, Recreation and Conservation District
Humboldt Bay Wastewater Authority
Humboldt Bay Power Plant
Humboldt Bay Fire Training Facility
Humboldt Bay Aquatic Center
Humboldt Bay Yacht Club
Humboldt Bay Boat Harbor
Humboldt Bay Boat Harbor Park
Humboldt Bay Boat Harbor Park Boat Ramp
Humboldt Bay Boat Harbor Park Boat Ramp Parking
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Humboldt Bay Boat Harbor Park Boat Ramp Parking Lot Restroom Building Entrance Sign Post Base Concrete Footing Rebar Tie Wire Nut Bolt Washer Screw Nail Staple Glue Paint Brush Roller Tray Cover
Humboldt Bay Boat Harbor Park Boat Ramp Parking Lot Restroom Building Entrance Sign Post Base Concrete Footing Rebar Tie Wire Nut Bolt Washer Screw Nail Staple Glue Paint Brush Roller Tray Cover Extension
Humboldt Bay Boat Harbor Park Boat Ramp Parking Lot Restroom Building Entrance Sign Post Base Concrete Footing Rebar Tie Wire Nut Bolt Washer Screw Nail Staple Glue Paint Brush Roller Tray Cover Extension Pole
Humboldt Bay Boat Harbor Park Boat Ramp Parking Lot Restroom Building Entrance Sign Post Base Concrete Footing Rebar Tie Wire Nut Bolt Washer Screw Nail Staple Glue Paint Brush Roller Tray Cover Extension Pole Handle
Humboldt Bay Boat Harbor Park Boat Ramp Parking Lot Restroom Building Entrance Sign Post Base Concrete Footing Rebar Tie Wire Nut Bolt Washer Screw Nail Staple Glue Paint Brush Roller Tray Cover Extension Pole Handle Grip
Humboldt Bay Boat Harbor Park Boat Ramp Parking Lot Restroom Building Entrance Sign Post Base Concrete Footing Rebar Tie Wire Nut Bolt Washer Screw Nail Staple Glue Paint Brush Roller Tray Cover Extension Pole Handle Grip Tape
Humboldt Bay Boat Harbor Park Boat Ramp Parking Lot Restroom Building Entrance Sign Post Base Concrete Footing Rebar Tie Wire Nut Bolt Washer Screw Nail Staple Glue Paint Brush Roller Tray Cover Extension Pole Handle Grip Tape Measure
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Humboldt Bay Boat Harbor Park Boat Ramp Parking Lot Restroom Building Entrance Sign Post Base Concrete Footing Rebar Tie Wire Nut Bolt Washer Screw Nail Staple Glue Paint Brush Roller Tray Cover Extension Pole Handle Grip Tape Measure Level Square Protractor Compass
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Humboldt Bay Boat Harbor Park Boat Ramp Parking Lot Restroom Building Entrance Sign Post Base Concrete Footing Rebar Tie Wire Nut Bolt Washer Screw Nail Staple Glue Paint Brush Roller Tray Cover Extension Pole Handle Grip Tape Measure Level Square Protractor Compass Ruler Pencil
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LOWER MAD RIVER
LEGEND
P PUBLIC ACCESS
F FISHING
S SWIMMING
X BARRIER TO BOATING
Br SUMMER BRIDGE
T TRENCH 1990-1991
Public Access Points Not Shown Include the Mad River County Park and Boat Ramp and the Hammond Bridge (see FIGURE 1)
0
4000'
RISING SUN ENTERPRISES
PLANNING • PERMITTING • ENVIRONMENTAL CONSULTING
1964 Myrtle Avenue • Eureka, CA 95501 • (707) 445-7431
FIGURE 2
RECREATION USE AREAS

NOISE

Setting

Of the 17 miles of river length within the project area (from the Swaesey Dam downstream to the Hammond Bridge), approximately 10 miles is generally quiet, consistent with resource areas, parks and agricultural/rural residential uses. Noise measurements taken in these relatively "quiet" areas away from gravel extraction and processing activities, are approximately 43-45 dBA, rising occasionally to 48-55 dBA when the wind was blowing through nearby vegetation. For the most part, sounds in these areas are created by the wind and rushing water of the river and adjacent creeks. This would generally be considered the ambient level of noise within that portion of the project area. Noise sources affecting this area are limited primarily to periodic agricultural and timber management related noises.

However, this is not true within the noisier segment of the study area, primarily the 7 miles between the Highway 101 bridge and the Mad River Fish Hatchery, and including the developed land uses that occur adjacent to the river and within the valley slopes. Primary noise generating sources as one travels upstream in this section includes: 1) U.S. Highway 101 traffic; 2) Guintoli Lane traffic; 3) North Bank Road traffic; 4) Guintoli Lane industrial and commercial activity including REA and Arcata Readimix processing plants; 5) Highway 299; 6) West End Road traffic; 7) Humboldt Municipal Water District pump stations; 8) Glendale Drive traffic; 9) Glendale industrial and commercial operations; 10) Eureka Sand & Gravel processing plant; 11) City of Blue Lake commercial and industrial processing including UltraPower, Inc., J & S Stakes and Calgon Carbon; 12) Hatchery Road traffic; 13) Mad River Sand & Gravel processing plant; 14) Mad River Fish Hatchery. Noise on the river include gravel extraction equipment and occasional recreational off-road vehicle use on the gravel bars. Other noise sources include airplanes flying over the Mad River heading towards the Arcata Airport and noise associated with railroad use.

Noise is generally defined as unwanted sound by the receiver. Gravel extraction and processing involves the use of noise-generating heavy equipment operating out on the river bar, crushing/processing equipment and batch plants in the yards up out of the river and trucks transporting material from the sites. In considering analysis of impacts related to noise generated by gravel extraction and processing operations, one must consider the ambient noise levels, contributions from other noise sources, distance to the nearest receptor, the types, times and duration of noise.

Land uses generally considered noise sensitive include residential, educational and health facilities, research institutions, certain recreational and entertainment facilities (typically indoor theaters and parks for passive activities) and

churches. Uses considered less sensitive to noise include commercial and industrial facilities and certain noise generating recreational facilities such as playground and gymnasiums.

Though much of the extraction and processing noise along with other industrial, commercial and traffic noises has been occurring since prior to 1965, the cumulative total impact from noise has increased. The past 35 years has seen a substantial increase in residential development consisting of trailer parks and urban residential subdivisions. In addition, surrounding rural residential and farm properties are now more highly sought after as upscale estate type properties. As more people continue to move into the northcoast area for the "rural amenities," conflicts between existing industrial sources and new residents are expected to increase. This is the same phenomena of land use conflicts that occurs with new subdivisions near airports or at the edge of agricultural lands. These impacts are not a result of an increase of industrial processing activities, but to the increase in residential development and the recreational use of the river.

Several terms have been used throughout this report to describe and analyze noise impacts which should be understood by the reader. Decibels (dB) is the unit of measurement to describe sound amplitude and is measurable by noise meters designed for that purpose. Generally, an A-weighted scale is utilized resulting in "dBA" measurements. Since sound levels are intermittent, averaging mechanisms have been developed. The most commonly used measurement for this purpose is Ldn, which is the Day-Night Average Level. When noise sources occur only between 7:00 a.m. and 10:00 p.m., the average decibel (dBA) reading during that period is utilized. If noise sources occur outside of that time period, an added factor is applied to the average, resulting in a slightly higher Ldn level.

Several standards generated by the State Office of Noise Control are applied in analyzing noise impacts. In general, noise sources should be low enough to allow normal conversation and activity to occur inside a residence. Generally this would be at the 45 dBA Ldn level during daytime hours. Considering that older residential construction reduces noise levels by 12-18 dBA (with windows partially open), the 60 dBA, Ldn outdoor value is utilized. Newer construction, with double glazed windows and insulated ceilings, walls and floors would further reduce interior noise levels. A reduction of noise levels also occurs with distance from the source. Generally, noise levels (as measured at 50') would decrease 6 dBA's with a doubling of distance. Utilizing this method allows calculations of noise levels at the nearest receptors.

Noise measurements utilized in this study were taken for short periods of time (5, 10 or 30 minutes intervals) when equipment was operating. Longer periods of time were utilized to obtain an average reading when noise levels fluctuated. Maximum levels were sometimes utilized to measure moving objects such as trucks

and equipment. Measurements have been recorded in decibels (dBA's). To obtain an Ldn level one would calculate the length of time that an activity occurred in a day and average it with the ambient levels occurring during the remainder of the day. For instance, if noise levels were measured at a receptor at 70 dBA for 4 hours and 60 dBA for the other 4 hours of the work day, and ambient levels were 50 dBA after work hours, then the resulting average noise level would be 58 dBA Ldn. Since duration varies to a greater degree the readings were recorded in decibels (dBA's).

For the purpose of this study, noise measurements were taken at and adjacent to the processing and extraction areas and nearby receptors. The following represents site specific noise analysis for each of the extraction and/or processing sites. Table 1 contains a summary analysis of all the sites:

1. Redwood Empire Aggregates Graham/Zanzi Bar

   This site has historically had a processing plant as well as an asphalt batch plant running with large amounts of gravel being processed. The nearest occupied structure is approximately 200'-300' south of the processing equipment. Noise measurements taken from the north sidewalk along Guintoli Lane approximately 350 feet south of the processing equipment with plant operating, were at 68.5 dBA with no traffic. However, levels increased to 73.3 to 79.9 dBA when traffic passed on Guintoli Lane. Levels at this residence would be subject to levels of 65 dBA for the processing plant and 67-74 dBA for Guintoli Lane traffic. The nearest residence to the east is approximately 500' away, resulting in noise levels of 67 dBA. Residences west and north were 1,400' and 1,800' respectively. Noise levels would be reduced to below 55 dBA.

   Fisherman and recreationists utilizing the river bar north of the site would be subjected to sound levels of 48 dBA when processing equipment operated. The primary noise source heard along the river bar at this location is from Highway 101 which generated noise levels of up to 52 dBA when traffic passed over the Highway 101 bridge. When extraction is occurring, noise levels along the river would range from 67-74 dBA at 100'.

2. Arcata Readimix Processing Plant and Associated Gravel Bars

   The Arcata Readimix site consists of processing equipment and a cement batch plant. Other equipment includes front end loaders, dump trucks and mixers. The site, developed in 1951, is located within an industrial area. However, it is located adjacent to and directly north of the Town and Country Trailer Park built in 1955. Some noise complaints have occurred in years past primarily at times when operations needed to start prior to normal operating periods.

Noise levels, measured adjacent to the trailer park range from 55 dBA with no equipment running to 80 dBA when a gravel truck passed within 75 feet. The average noise level for a one hour period, Leq (60), was 63 dBA. When the cement batch plant operated (10 minutes for one load) noise levels increased to 73.5 dBA.

The noise levels during normal working hours would not affect those residents who have gone to work. Others who are retired or of pre-school age or those who work in the home would be affected. Furthermore, since many requests for readymix products are made for early morning deliveries, some processing occurs very early in the morning, during the more sensitive time period (before 7:00 a.m.). These residents are impacted from this operation. Other noise levels in the area include those generated by Highway 299 and from planes flying overhead towards Arcata Airport.

Fisherman and recreationists utilizing the river bar to the north are subjected to noise levels of 51 to 52 dBA when mixer trucks are in high idle when receiving readymix materials. Commercial air flights overhead at this location registered 55 dBA. This noise level could be considered too high to permit high quality, passive recreation and could, therefore, be perceived as an annoyance and impact by people recreating in that area. Further upstream at the Spina-Johnson Bar no processing occurs. Operations are limited to gravel extraction. Equipment on the gravel bar would range from 67-74 dBA at 100'. This too could present a noise impact. Extraction activities at this bar as well as the Arcata Readimix Bar and the Graham-Zanzi Bar are limited and have not occurred to any extent in the past couple of years. When operating, extraction amounts are less than further upstream locations; therefore, extraction periods are less as well.

3. Essex Plant and Gravel Bar

This site historically had a processing plant running with large amounts of gravels being processed. The nearest occupied structures, approximately 450' to the south, would receive a level of 62-65 dBA at the exterior of the structure.

Highway 299 divides the processing site from several residences to the north. Noise levels generated by passenger cars and trucks on the freeway would be higher than that contributed by the processing and extraction operations.

Fisherman and recreationists utilizing the river bar south of the site would be subjected to sound levels of about 67-74 dBA during periods of extraction. The site is adjacent to a popular swimming hole, though no public access other than walking along the river from one of the water district's pump station parks is available. Most access to this hole occurs from individuals trespassing across the Essex site.

Operations are currently limited by the size and replenishment of the gravel bar. The primary method of historic extraction at this site was utilization of a drag line during winter months, allowing for high levels of materials to be extracted annually. Less than 3,600 cubic yards was removed from the gravel bar in 1990 and 2,240 cubic yards was removed in 1991. No material was removed in 1992.

4. Simpson Bar

This site has historically had large amounts of materials extracted and high levels of activity on the gravel bar. No processing has occurred in recent years. Presently there is no processing or stockpile site; material would need to be removed from the site at the time of extraction.

The nearest residences are approximately 400 feet to the north within the Glendale trailer park area, consisting of approximately 35 trailers. These trailers would also be subjected to noise from Highway 299. No noise measurements were taken during extraction since no extraction activity occurred in 1992. Extraction could generate noise levels of 60-62 dBA in the trailer park. The primary activity that affects nearby residences would be hauling of gravel by trucks along Glendale Drive resulting in noise levels of 68-70 dBA at 100'.

Other residences are located on the south side of the river off of Walnut Creek Road and could be located within 600' of extraction equipment. This would result in noise levels of approximately 55-60 dBA when extraction was occurring at this distance away.

5. Johnson Bar

This site is similar to the Simpson Bar in that no processing occurs on-site but material is hauled off from this site primarily from a summer bridge crossing located at the Simpson Bar. This site is further away from the previously mentioned trailer park, but primarily affected residences are located on Warren Creek Road approximately 1,200'-1,800' to the southwest. Extraction equipment producing noise levels of 67-74 dBA at 100' would be reduced below 55 dBA at the residences along Warren Creek Road. Fisherman and recreationists utilizing the river and adjacent river bar would be subjected to sound levels similar to other extraction sites of 67-74 dBA at 100'.

6. Christie Bar/Eureka Sand and Gravel Plant

Noise levels from the processing plant were measured at 85 dBA 50' away from the screen. This was reduced to 65-68 dBA adjacent to Highway 299 approximately 200' north of the plant at times when no traffic was occurring. However, noise levels increased to 63 dBA when cars passed the site

and 73 dBA when trucks passed the site. The closest residence to the north is approximately 1,600' from the processing site and would be affected by traffic on Highway 299 rather than the processing plant. Levels would be less than 60 dBA.

Measurements were also taken adjacent to the river. Ambient levels were primarily between 45 to 50 dBA, but increased to 59 dBA from traffic on Highway 299 at the Glendale interchange. The processing plant can be heard from the river, but did not contribute to ambient noise levels.

Extraction equipment on the gravel bar could produce noise levels audible to residents, primarily to the south of the site. Noise levels of 80 dBA adjacent to the river would be reduced to 52 dBA at the closest residence approximately 1,300' to the southwest and 48 dBA 2,100' to the southeast. The County, during the Notice of Preparation for this EIR, received a complaint about the noise from a resident to the south. In discussing the concern further with the resident, it was not the processing plant but the extraction activity that occurred early in the morning and during weekends in 1992. The 1992 extraction season was compressed to less than 2 months, requiring operators to work extended hours in the 36 days of extraction. In addition, since the season did not begin until July 24th instead of June 1st, the previous year's stockpile of riverrun material had been depleted and there was an immediate need to extract and process a larger percentage at the very beginning of the extraction season.

These are generally short-term intermittent impacts that have occurred in the past and, unless regulated in some manner, would be expected to occur in the future depending on extraction limitations and contract needs. However, resulting noise levels at residences were within acceptable standards.

7. <u>REA Blue Lake Bar</u>

Ambient levels at the Nicholls industrial/stockpile area off of Taylor Way are approximately 56-60 dBA. Major noise sources include industrial operations in the City of Blue Lake Industrial Park. Activities within the Nicholls Trucking facility would be at 55-80 dBA within the industrial land area, caused primarily by loading equipment and trucks. If a portable processing plant was set up at this location it would be anticipated that it would generate noise levels of 73 dBA at 100'. The closest residences are two houses owned by REA 100' and 400' from the truck yard and 800' to 1,000' from the gravel bar. These residences would receive noise levels of 54 dBA and 55 dBA from extraction activities and 74 dBA and 62 dBA from processing. The next closest residences are within and adjacent to the Blue Lake Rancheria, approximately 1,000' from the levee and 900' from the truck yard. There are also approximately 17 trailers located at

the end of Rancheria Road. These would be subject to noise levels of less than 55 dBA. Residences to the south on West End Road are approximately 1,200'-1,400' from the edge of the extraction area based on current river conditions. These residences would probably hear the extraction activity occurring but noise levels would be at approximately 52 dBA.

This site as well as the two other sites upstream from this location all contribute to truck traffic onto Hatchery Road which proceeds along the truck route along Greenwood Avenue to Blue Lake Boulevard. This truck traffic is required to go through a residential area with adjacent school offices, public library and a church. Noise levels measured in October, 1992, 50' from the centerline of Greenwood Avenue averaged 62 dBA over a 10 minute period. Noise levels from cars and pickup trucks range from 60 to 65 dBA. Flat bed trucks, chip trucks, dump trucks and belly dump trucks produce noise levels from 72 to 77 dBA. No truck percentage ratios were available. It was estimated by City personnel that the percent of trucks passing City Hall were less than 10% in the winter time. In the summer time this percentage was estimated to increase to 50-66%, primarily due to gravel and logging trucks. Utilizing the above percentages, adjacent residences and school would be subject to exterior levels of approximately 55-60 Ldn during the winter and 61-66 Ldn during the summer daytime at 100' distance. Though transportation of gravel occurs year-round, transportation coincides with construction jobs which generally occur during the summer or during the dry periods in the fall or early winter. Therefore, the school has and would continue to be subject to the higher noise levels during the drier periods of the year. This level is within acceptable noise standards for schools.

8. REA Emmerson Bar

This site primarily consists of an extraction site with material being hauled off from the site. Noise related traffic is discussed under the previous site.

The closest residences to this site are located approximately 1,100' to the northwest and 1,200' to the south. There are also approximately 20 houses off of West End Road within 2,000' of the processing area. Extraction activities and transport of gravel would be audible at these locations; however, noise levels would drop to less than 55 dBA due to distance. This would be slightly higher than ambient noise levels.

This bar is popular for use by fisherman during fishing season, which generally occurs in October after extraction activities are completed. Boaters and swimmers utilizing this section of the river in the summer months would be subjected to noise levels, as discussed previously for other sites.

9. Mad River Sand and Gravel, Guynup Bar

Noise measurements taken at 50' from the screen plant/crusher were are approximately 88 dBA. This was slightly higher than other screen plants measured since this material was being washed and sorted at the same time. The closest residence is a house owned by the operator approximately 650' southwest of the processing plant would be subject to exterior noise levels of 66 dBA. Residences on Hatchery Road at West End Road are approximately 1,700' from the processing plant and would be more affected by truck traffic leaving the site. Residences directly west of the processing site are approximately 900' from the processing plant. When the plant is operating these residences would receive noise levels of approximately 63 to 65 dBA at the exterior of the structure. This noise level would be audible but should allow a normal level of conversation to occur. Noise levels adjacent to the river were taken while processing equipment was running and increased from 45 to 49 dBA. However, noise from the processing equipment was drowned out when the wind blew.

Fisherman and recreationists would hear the plant operating but would not be subjected to high noise levels. However, at times of extraction, as mentioned previously, they would be subjected to noise levels ranging from 67-74 dBA at 100 feet. This would be decreased by 5-10 dBA depending where equipment was in relation to the river and the recreationist.

Table 1 - Noise Analysis

Operations	Distance to Receptor (ft.)	Receptor	Approx. Noise Level (dBA)	Source of Prominent Noise
REA Guintoli	200	1 residence (so.)	65	Processing Plant
Arcata Readimix	100	Town & Country	74	Processing Plant
	75	RV Park	80	Truck Traffic
Essex	450	1 residence (so)	62-65	Extraction
Simpson	100	Glendale	68-70	Truck Traffic
	400	Trailer Park	60-62	Extraction
Johnson	100	Glendale Trlr. Pk.	68-70	Truck Traffic
	1,200	2 residences (so.)	53	Extraction
ES & G	1,300	1 residence (so.)	52	Extraction
Blue Lake	100	1 residence (so.)	74	Processing Plant
	400	1 residence (no.)	62	Processing Plant
	900	Blue Lake Mobile Home Park	55	Processing Plant
Emmerson	1,100	1 residence	54	Truck Traffic
MRS & G	650	1 residence	66	Processing Plant
All	100	River users	67-74	Extraction

Analysis

Based on information in Table 1, the most impacted receptors as a result of gravel extraction are river users. This would be too high to permit high quality passive recreation and could, therefore, be perceived as an annoyance and impact by people recreating in that area during the times of extraction. Fisherman and recreationists utilizing the river and adjacent river bar would be subjected to sound levels of 67-74 dBA at 100' from extraction activity.

At times of processing, the Town and Country RV Park next to the Arcata Readimix operations, one residence south of the Essex processing site and the REA owned residence at the Nicholls Trucking facility are adversely affected by existing noise levels. From truck traffic, the Town and Country RV Park adjacent to Arcata Readimix, the Glendale Trailer Park to the north of the Simpson and Johnson Bars and adjacent residences along the City of Blue Lake truck route are adversely affected by high noise levels. The actual impact would depend on the duration and hours of activity and would be limited to those at home at the time of the activity.

Impacts from existing gravel operations, including extraction, processing and transporting of aggregates, do occur to surrounding areas and primarily to surrounding residential areas. It is anticipated that these impacts will increase, not because of increases in noise levels, but because of increased residential developments and recreational uses.

The primary impact from noise, as discussed previously would occur from extraction activities located adjacent to the river when fisherman and recreationists are also utilizing the river's edge. Currently, most operations occur during daylight hours with the vast majority of the activity occurring weekdays during periods of dry weather. The majority of family recreational use that occurs during extraction occurs in the summertime on weekends. However, when school is out, students are seen utilizing the river bar and river at all times even when extraction occurs. To reduce the impact a mitigation measure could be included that would limit the hours of operation for extraction to Monday - Friday during daylight hours, generally 7:00 a.m. to 7:00 p.m., or as otherwise authorized by the Planning Director. This would allow flexibility for specific short-term needs.

Restrictions in the extraction season have resulted in operators extending their normal extraction hours to longer weekday hours and occasional weekend hours. Regulating the hours of the processing operation and truck traffic may affect the ability of operators to meet contract needs, particularly highway projects or emergency repairs. If regulations on the hours and days that operations can occur are proposed, these concerns should be taken into consideration. In the long period of operation at most of these sites noise complaints have been minimal and there is a general acceptance of the operations.

Other methods to reduce impacts would require new residential developments within 200-300 feet of extraction/processing sites and along certain truck routes to be insulated for noise attenuation and/or require notices in deeds of new developments that "Noise levels, due to surrounding aggregate production operations, may be higher than normally acceptable noise levels. These operations are protected by 'Right-to-mine' policies." As the State Geologist classifies the minerals in Humboldt County and designates important sites, further protection may be afforded to those extraction sites.

Even if mitigation measures are proposed to regulate operating periods or noise levels from equipment, the impacts of gravel extraction processing and transporting will remain significant both to nearby residents and recreationists. The practicality of enforcing such regulations may also adversely effect the local economic framework dependant on aggregate products. Therefore, a finding that an unavoidable significant impact occurs should be made. Rather than limiting hours of operation, it is proposed that an annual pre-extraction review of proposed extraction amounts occur. Based on cumulative volumes, proposed extraction season and specific contract needs, limits could be placed on specific operations.

Mitigation Measures

1. As part of pre-extraction annual review, operators are to submit proposed volumes, duration of extraction season, hours and days of extraction and approximate loads per day. Notification of changes is to be provided to the Planning Director for approval.

TRAFFIC

Setting

Traffic information was compiled from existing County, State and local information. The following section assesses the adequacy of existing transportation routes as they relate to increased activity and a description of the existing circulation setting along transportation routes utilized for transporting gravel and aggregate products. The current operations generate a wide range of traffic, primarily dictated by contract demands, weather conditions and extraction seasons.

Specific construction contracts generally dictates the time and duration of traffic generation. Weather is a factor in traffic generation because extraction occurs generally during the drier months of the year. The majority of construction activity also occurs concurrently. During the wetter months of the years, demands of materials are generally decreased and, therefore, processing activity and transportation is also decreased. However, the past several years of drier than normal winters caused an increase in winter season construction projects resulting in an increase demand for aggregate materials during the off-season. When the length of extraction season is shortened, more activity occurs, resulting in a compressed period of higher volume traffic.

Road traffic generated from extraction activities would generally be limited to those sites that have no on-site processing occurring. This would include transporting of equipment and river-run material. Those sites that have processing activities occurring on-site would not generate extraction-related traffic but would generate traffic related to transportation of various aggregate materials including sorted rock, sand, readymix concrete and asphalt paving materials.

All operations reviewed accessed onto city and County roads from private drives. All sites had adequate sight stopping distance based on information in the Highway Design Manual. For roads with 35 m.p.h. traffic, approximately 250' of visual clearance in each direction is required. All sites met this requirement at the locations where driveways accessed onto public roads.

Table 2 shows approximate volumes extracted at the various sites during the years 1990-1991. The table also indicates the average daily traffic (ADT) based on this information, assuming a 5 day work week, 4 month extraction period, 8 month processing/transporting period and 15 yard dump trucks. The actual number of trips per day would be limited by the number of trucks that are available to transport the material and the types of product, whether riverrun material or manufactured aggregate products. The service area for most of the operations range from Eureka to Orick and east to Willow Creek for approximately 50 mile radius.

Table 2 - Approximate Traffic Generation

Site	Cubic yds/yr	Extraction ADT[1] (4 months)	Processing ADT (8 months)
REA (Graham)	36,000 (1990)	118[2]	15
REA (Johnson)	29,700 (1990)	25	13[3]
REA (Blue Lake)	82,750 (1991)	69	35[3]
REA (Emmerson)	28,950 (1991)	24	12[3]
Arcata Readimix	84,950 (1990)	70	35
Essex	3,500 (1990)	3	0
Simpson	62,300 (1990)	52	0
ES & G	50,000 (1990)	0	21
MRS & G	85,000 (1991)	0	35
TOTAL	463,150	361	166

Traffic count information was obtained for the intersections on city, County and State roads and, where available, percentage of traffic that consisted of trucks. Those figures are noted in Table 3. Because these operations are existing, the listed average daily traffic (ADT) totals have incorporated the traffic generated by these projects.

Table 3 - Existing Traffic Levels

Site/Road Segment	ADT[4]	Peak Hour	% Trucks
REA Guintoli			
Highway 299 at Highway 101	9,700	1,050	15
Guintoli, west of Valley West Blvd.	12,200		
Janes Road west of Highway 101	8,500		
Guintoli, east of Valley East Blvd.	6,200		
Arcata Readimix			
Boyd Road	2,200		
Highway 299 at Guintoli	9,800	1,100	14.5
Highway 299 at North Bank Road	10,600	1,150	11.7

[1]These figures represent one-way trips. Figures should be doubled to account for return trips.

[2]This amount includes importation of materials from the other three REA sites.

[3]This amount represents exports from the Guintoli site as a result of importation from this site.

[4]Figures represent totals in both directions.

Table 3 Continued

Site/Road Segment	ADT*	Peak Hour	% Trucks
Essex			
Highway 299 at Essex Lane	9,400	1,050	
Simpson/Johnson/Eureka Sand & Gravel			
Glendale Drive near E & O Market	1,700		
Highway 299 at Glendale Drive	8,500	940	
Blue Lake/Emmerson/Mad River Sand & Gravel			
Highway 299 at Blue Lake Blvd.	3,550	500	18
Blue Lake Blvd. west of Greenwood	5,600		
Greenwood Ave. south of Blue Lake Blvd.	4,000		
Taylor Way north of Hatchery Road	775		
Hatchery Road north of West End Road	750		
West End Road west of Hatchery Road	175		

*CalTrans Information, 1991
City of Arcata Information, 1990-91
County of Humboldt Information, 1992

Individual Sites

Note: Unless otherwise indicated, all truck trips represent one-way trips. Figures should be doubled to account for round trips.

1. The Redwood Empire Aggregates' (REA) site off of Guintoli Lane during the extraction season receives gravel not only from on-site but also from the Johnson, Blue Lake and Emmerson gravel bars. Importation also occurs during the winter months from stockpiles in the Nicholls Trucking yard in Blue Lake. REA has 3 dump trucks and rents others as necessary. Exportation of materials from the Guintoli site averages about 50 loads per day during the summer months with maximums approximating 120 loads per day. In addition, approximately 30-50 customers a day bring their private vehicles to be loaded with various aggregate materials. During winter months the number of loads is reduced to approximately 12 per day, on an average. Accesses onto Guintoli Lane are either at Valley East or Valley West Boulevard where it is a short distance to Highway 299 or Highway 101. All intersections are qualitatively operating at an acceptable Level Of Service (LOS). No access conflicts were noted from this project site.

2. Arcata Readimix has 16 dump trucks and 9 concrete mixers, and accesses onto Boyd Road adjacent to an industrial area. Boyd

Road is also utilized by the adjacent Town and Country Trailer Park. Highway access from Boyd Road is immediately available to the south for both Highway 101 and Highway 299. Qualitatively this intersection also is operating at an acceptable Level Of Service. During summer months there are approximately 50-60 loads per day leaving the processing site, with an average maximum of 110 loads. As many as an additional 100 loads per day are transported along Boyd Road to the processing site when extraction at the Johnson/Spina Bar is occurring. During winter months, trips leaving the processing site are reduced to an average of 20 loads per day. Approximately fifty percent of those loads are presently attributable to material being imported to the plant from materials extracted from the Eel River and stored at Fields Landing. No access conflicts were noted from this project site.

3. Essex yard extraction levels have been reduced in recent years because of the drought and market conditions. Access from this site is directly onto a little used portion of Glendale Drive which then has direct access onto Highway 299 at the Essex Road interchange. In addition to material that is extracted from the gravel bar, this site has historically been used for storage of other aggregate/riprap materials which also results in both importation and exportation traffic. No access conflicts were noted at this project site.

4. The Simpson Bar is an extraction only bar. As material is extracted from the gravel bar it is directly loaded onto trucks and removed from the site, generally to specific construction sites. Therefore, traffic is generally limited to extraction months. The number of trucks leaving this site is limited to both the number of trucks available and the ability of the front-end loader to fill the trucks. A substantial amount of material was removed between April to October in 1990 which resulted in approximately 10-15 trucks per hour or 110-130 loads per day from the Simpson Bar.

   Traffic leaving the site and accessing onto Glendale Drive generally turns right towards the industrial/commercial area on Glendale and accesses onto Highway 299 or left past the trailer park and onto the Essex Lane interchange. Access problems at this location include a narrow and steep access drive which could result in conflicts for two-way traffic. However, radio control in trucks is generally used to prevent conflicts. Cross-traffic includes vehicles on Glendale Drive as well as train traffic. Views of on-coming traffic from the west is partially screened by the existing fence and vegetation, but the higher profile of the trucks provides sufficient sight clearance. Trains currently run in the evening or late at night. No access conflicts remained at this project site.

5. In addition to the traffic generated by the Simpson Bar, extraction on the Johnson Bar also leaves by the same access drive. Estimates provided for 1991 indicated that approximately 100 loads leaving the site per day occurred during the extraction season. Very little activity, if any, occurs during the non-extraction season at both the Simpson and Johnson Bar locations.

6. The Eureka Sand & Gravel operation which is located south of Highway 299 has vehicular access under 299 to Glendale Drive to the north. This operation has 3 dump trucks and 8 mixers. During the summer construction season an average of 35-50 trucks per day leave the site. This is reduced to an average of 5 trucks per day during winter or wet periods. Of the total loads, approximately half are aggregate materials with the other half readimix concrete.

   Access from this site is to Glendale Drive where trucks proceed westerly through the lumber processing and commercial areas and onto Highway 299. No access conflicts were noted from this project site.

7. Traffic associated with the Blue Lake Bar primarily occurs during the extraction season when material is exported to the REA Guintoli processing site. However, some of the material is stockpiled at the Nicholls Trucking facility for transportation during less active periods of the year. Nicholls has 8 dump trucks. In the 1992 winter season, only one truck was utilized to haul gravel daily to the Guintoli site. Traffic from the Blue Lake Bar accesses onto Taylor Way through the City of Blue Lake Industrial Park which currently has a high percentage of chip truck and lumber truck traffic.

8. Traffic from the Emmerson Bar is generally limited to the extraction season except that the post-extraction removal of small stockpiles could end up at the Nicholls Trucking site or the REA Guintoli Lane processing site. Trucks leaving Emmerson Bar access onto Hatchery Road and either proceed through the City of Blue Lake or travel to the Nicholls Trucking facility to stockpile the gravel.

   During the 1992 season, a combined 71,600 cubic yards were extracted on the Blue Lake and Emmerson Bars. Extraction on the Blue Lake Bar occurred on 23 days between August 11th and September 5th, 1992. A total of 1,352 loads for an average of 59 loads per day were removed during this period. Extraction on the Emmerson Bar occurred on 14 days between September 8th and September 24th, 1992. A total of 697 loads for an average of 50 loads per day occurred. However, the number of loads per day actually ranged from 7 to 101 on the Blue Lake Bar and 8 to 96 on the Emmerson Bar. Approximately fifty percentage of the above amounts were stockpiled at Nicholls Trucking with the remaining fifty percentage being transported to the Guintoli Lane site.

9. Traffic from Mad River Sand & Gravel is, for the most part, limited to transportation of sorted and/or washed materials. Trucks on-site range from 2-4 trucks. The majority of material is transported by Wes Green who has 2 additional trucks, or by other contractors. On an average, approximately 3-5 trucks transport material from the site resulting in 25-30 loads per day in the summer months. For a large job, as many as 100 loads per day may leave the site. During the winter months activity is reduced to an average of 4 or 5 truck loads. Many days the gate remains shut and no loads are exported.

Analysis

All sites reviewed had adequate access onto public roads and sufficient sight stopping distance clearance. All intersections function adequately during observations occurring in the study period, which was during the winter months. Highways 101 and 299 adjacent to the project area had a percentage of truck traffic similar to areas away from the Mad River (approximately 13-18%). Truck traffic attributed solely by gravel manufacturers represents a small percentage of the total truck traffic.

Though the majority of sites are dispersed so that there is no concentration of traffic and are located close to suitable transportation routes, one area of conflict does exist, and that is on the truck route through the City of Blue Lake. Transportation of aggregate materials or products from the Blue Lake Bar, Emmerson Bar and Mad River Sand & Gravel processing site are all transported along Hatchery Road to Railroad Avenue and onto Greenwood Avenue where it accesses onto Blue Lake Boulevard (see Figure 3). This transportation route requires that truck traffic travel adjacent to developed residential areas, offices, a church, public library and elementary school. At times when material was removed from the sites for large construction projects such as in the 1960's and 1970's with the construction of Highway 299, large volumes of associated truck traffic proceeded through the town of Blue Lake. This also occurred in 1990 and 1991 when trenching occurred and large volumes of material were extracted. For instance, if the 197,000 total cubic yards extracted in 1991 for these operations was transported in an 8 month period, 5 days per week with 15 yard dump trucks, approximately 82 truck trips (one way) per day would occur. Considering round trips this would amount to 16-20 trucks per hour. Again, summer months would be at higher volumes than winter.

Truck traffic associated with gravel producers also occurs in conjunction with other truck traffic. UltraPower, Inc., in the City of Blue Lake Industrial Park generates a substantial amount of chip truck traffic. A 1988 Conditional Use Permit Amendment estimated that approximately 34 one-way truck trips per day year-round occurs for this operation. Other industrial uses in the industrial park also generate truck traffic. Furthermore, in recent years, Simpson Timber Company has conducted timber

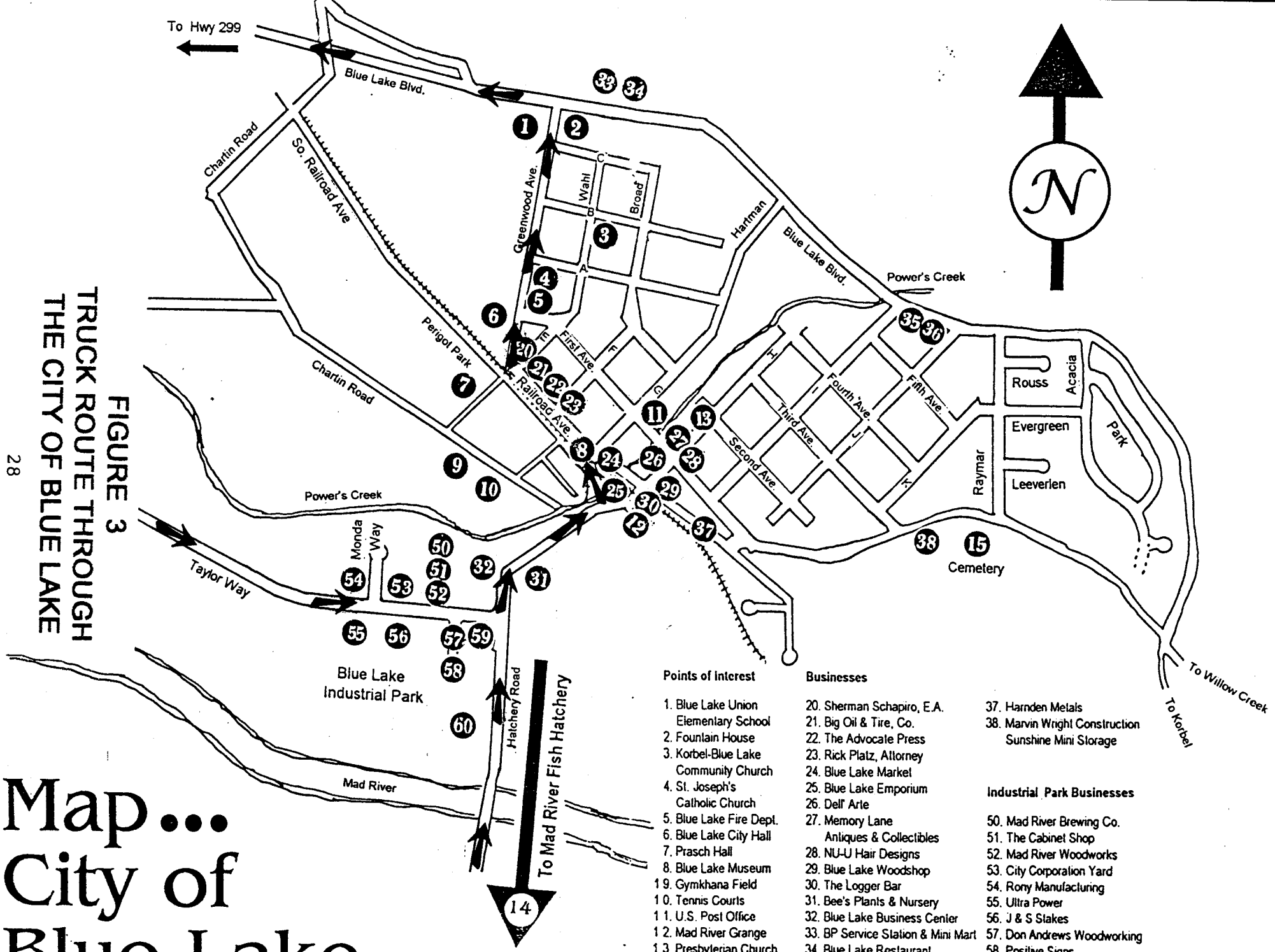


FIGURE 3
TRUCK ROUTE THROUGH
THE CITY OF BLUE LAKE

Map... City of Blue Lake

Source: Blue Lake Chamber of Commerce

Points of Interest

1. Blue Lake Union Elementary School
2. Fountain House
3. Korbel-Blue Lake Community Church
4. St. Joseph's Catholic Church
5. Blue Lake Fire Dept.
6. Blue Lake City Hall
7. Prasch Hall
8. Blue Lake Museum
9. Gymkhana Field
10. Tennis Courts
11. U.S. Post Office
12. Mad River Grange
13. Presbyterian Church
14. Mad River Fish Hatchery
15. Cemetery

Businesses

20. Sherman Schapiro, E.A.
21. Big Oil & Tire, Co.
22. The Advocate Press
23. Rick Platz, Attorney
24. Blue Lake Market
25. Blue Lake Emporium
26. Dell' Arte
27. Memory Lane Antiques & Collectibles
28. NU-U Hair Designs
29. Blue Lake Woodshop
30. The Logger Bar
31. Bee's Plants & Nursery
32. Blue Lake Business Center
33. BP Service Station & Mini Mart
34. Blue Lake Restaurant
35. Blue Lake Video
36. Blue Lake Laundromat
37. Harnden Metals
38. Marvin Wright Construction
    Sunshine Mini Storage

Industrial Park Businesses

50. Mad River Brewing Co.
51. The Cabinet Shop
52. Mad River Woodworks
53. City Corporation Yard
54. Rony Manufacturing
55. Ultra Power
56. J & S Stakes
57. Don Andrews Woodworking
58. Positive Signs
59. Almquist Lumber
60. Trans Pacific Carbon

activities on the west side of the Mad River where logs were transported along Hatchery Road through the City of Blue Lake. When truck associated traffic occurs at the same time from all these uses, the combined amount of truck traffic that travels through the town of Blue Lake can be significant. In the City of Blue Lake 1986 General Plan Circulation Element it was noted that truck traffic was at 6.5% and lower than Highway 101 through Eureka (7-8%). At that time it was felt that 33% of the total truck traffic was from outside the City. As far as a separate truck route, it was felt from a capacity standpoint alone, that one would not be necessitated until trucks made up 30%-40% of the total traffic or if volumes exceeded 8,000 ADT on Greenwood Avenue.

Greenwood Avenue, in 1986, carried 370 vehicles per hour during peak hour traffic (8:00 - 9:00 a.m.). Approximately 1,200-1,300 vehicles per hour would be a high level of traffic for Greenwood Avenue. Traffic levels have increased on Greenwood Avenue from 3,764 in 1985 to 4,000 in 1992. Comparing the % truck traffic with traffic volume would indicate 245 per day in 1985. Extrapolating this to 1992 volumes would indicate 260 truck trips per day on Greenwood Avenue. Therefore, the estimated 164 (82 x 2) trucks per day associated with gravel extraction for 1991, indicated earlier, is realistic.

The percentage of truck traffic through town is an important factor in road maintenance. Based on the CalTrans Highway Design Manual, loading on one three axle truck is equivalent to 1,840 passenger car trips in regards to street degradation. This has less of an impact when streets are constructed to handle truck traffic, such as much of the City of Blue Lake truck route. The Industrial Park EIR recognized that the increased traffic volumes and accompanying degradation of city streets from the Industrial Park was a significant environmental affect which could not be avoided. It has also been noted that the additional truck traffic proposed was not more than that which occurred when the Macnamara and Peepe Mill was in operation at the same location. Mitigation measures proposed in the Industrial Park EIR to reduce the significant impacts related to traffic generation included development and extension of Chartin Road and directing truck traffic through the less-developed western portion of town. This project has not occurred and funding is not likely to be made available.

The City of Blue Lake has effectively enforced the 25 m.p.h. speed limit through town for the chip trucks headed to the City Industrial Park through a condition of the use permit requiring compliance. There is no similar mechanism that the City of Blue Lake has on existing projects outside of the City Industrial Park, including the gravel operations. Neither does it receive funds from property or sales tax from operations outside of the City, which could be utilized in the continued maintenance of the truck route through town. The City has formed and recently expanded its police department, which is now equipped with radar to enforce the speed limit through town.

Another associated impact is the noise generated by the truck traffic. This issue and proposed mitigation measures are discussed in the "Noise" section.

The City of Blue Lake does not have the ability to regulate the number of truck trips or hours of transport for projects outside of City Limits or which have been grandfathered in. The Nicholls Trucking facility could be regulated for truck traffic by the City of Blue Lake if a processing operation was further developed, as part of the use permit process. The Mad River Sand & Gravel operation is outside of any regulatory control of the City. Therefore, such regulations would need to be developed by the County if found necessary.

Measures that limit extraction amounts at the upper sites for other reasons, such as limited bedload replenishment, would reduce the truck traffic through the City of Blue Lake. However, measures that limit extraction periods on the Emmerson and Blue Lake bars would result in shorter but more intense periods of truck traffic. Restrictions in the extraction season have resulted in operators extending their normal extraction hours to longer weekday and occasional weekend hours. Regulating the hours of truck traffic may affect the ability of operators to meet contract needs, particularly for highway projects. If regulations on the hours and days that truck traffic can occur are proposed, these concerns should be taken into consideration. For this reason, a mitigation measure limiting volumes of truck traffic was not proposed. However, annual pre-extraction analysis of proposed volumes and operating hours could occur with limits placed based on cumulative volumes proposed, and contract needs.

Other mitigation measure alternatives include pursuing the Chartin Road extension discussed in the Blue Lake Industrial Park EIR (approximate cost is $2,000,000) or pursue some other truck route alternative such as directing traffic along the County flood protection levee towards the Christie Bar and onto Highway 299 at the Glendale interchange (approximate cost is $6,000,000). This is an alternative that has been proposed in the past; however, no funding has been identified. Unless some feasible mitigation measure or alternative is pursued, the cumulative impact of truck traffic and associated deterioration of the designated truck route through the City of Blue Lake would not be able to be avoided. This finding would be similar to the finding made by the City of Blue Lake in its Industrial Park EIR.

Mitigation Measures

1. As part of pre-extraction annual review for those sites that transport extracted materials directly off-site, operators are to submit information on proposed volumes, duration of extraction season, hours and days of extraction and approximate loads per day. Notification of changes is to provided to the Planning Director for approval.

Appendix F

River Institute
Consultants Report

Mad River EIR Technical Supplement

Section 3: Estimation of Mad River Gravel Recruitment and Analysis of Channel Degradation

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Humboldt State University
5 April 1993

INTRODUCTION

Significance of Gravel Recruitment

Gravel recruitment is the natural resupply of gravel to a channel reach from upstream by bedload transport. It is typically given in tons or cubic yards per year. If average annual gravel extraction is less than or equal to average annual gravel recruitment, then a condition of *sustained yield* exists. If average annual gravel extraction exceeds average annual recruitment, then the gravel resource is being *mined*, or depleted. Such mining commonly leads to undesired effects such as bank erosion or bed degradation downstream. Under sustained yield the channel is more likely to remain reasonably stable. Hence estimation of gravel recruitment is central to any study of the impacts of gravel mining on a channel.

Overview of Mad River Bed Degradation

Over the past thirty years, the bed and bars of the Mad River have in general degraded (lowered) significantly. While this general bed lowering affects the entire channel downstream from the hatchery to the mouth, it is especially obvious in the reach between Blue Lake and the Highway 299 bridge, and has reached the point where it is seriously affecting the Railway bridge, the 299 bridge, and the HBMWD intakes. I list several observations below that indicate the extent of this problem.

- **Blue Lake bridge (Hatchery Road):** Comparison of channel cross-sections surveyed in July 1991 by Andre Lehre and Tom Lisle with original 1982 construction cross-sections shows maximum local bed lowering of 4.5 ft. Mean bed lowering (lowering averaged across the entire channel width) at this site is 1.6 ft.
- **Railway bridge:** The footings of the northern pier of the Railway bridge are virtually completely exposed and appear to be undermined. I was able to thrust a stick 4 -5 feet under the NE corner of the pier without encountering anything solid. A willow growing on the south side of this pier marks a fairly recent position of the old ground surface; the willow's base is now about eight feet above the current bed surface.
- **HBMWD structures:** The HBMWD Ranney collector towers have been increasingly exposed; one tower has had to have two additional lengths of ladder welded on, indicating up to 8 feet of bed lowering. Such bed lowering reduces filtration effectiveness of the collectors. Bed lowering at pump station 6 (which supplies the Samoa mills) has brought the pumps to within 0.5 - 1 foot of sucking air at low water. Cross-sections surveyed for HBMWD indicate mean bed lowering throughout the reach of about 4 - 5 feet since 1960.
- **Highway 299 bridge:** Comparison of channel cross-sections surveyed in July 1991 by Andre Lehre and Tom Lisle with original 1960 construction cross-sections shows maximum local bed lowering of 14 ft under the downstream span of the Hwy 299 bridge. Average bed lowering (across the entire channel width) since 1960 at this site is about 8 ft. CalTrans surveys of the 299 bridge indicate a maximum bed lowering since 1941 of 22 feet on the upstream span. The footings of pier 4 have been exposed and the concreted right bank at pier 5 has been undercut.
- **Highway 101 bridge:** CalTrans surveys of the Highway 101 bridge show maximum downcutting of 17 feet since 1929 on the upstream span and 8 ft since 1957 on the downstream span.
- **Tributary creek downcutting:** Near their entrances to the Mad River, Lindsay and Mill Creeks have cut down 8 to 10 feet since bridges were constructed across them. The eastern footings of the Lindsay Cr. bridge are completely exposed. Large rocks have had to be emplaced below the Hwy 299 Mill Cr. crossing to prevent undercutting and to allow fish passage.

General Causes of Bed Degradation

The gravel resource stored in any reach of a river can be visualized as a bank account. The capital in the account is contained in the bed, the bars, and the banks along the channel. Deposits are made naturally into the account as new gravel is brought in (recruited) from upstream. Natural withdrawals from the account occur as gravel is transported downstream out of the reach by the river. Checks are written on the account as gravel is extracted by man. As with any bank account, if deposits exceed withdrawals, the capital in the account will increase, that is, the river will raise its bed (aggrade) and build up the bars. On the other hand, if withdrawals and checks exceed the deposits, the balance in the account will diminish; in the case of a river, this means lowering of the bed (degradation) and widening of the channel.

The river as a whole can be looked at as a string of serially linked adjacent bank accounts (reaches), whereby the natural withdrawals (outflows) of bed material from each account provide the natural deposits (inflows) to the account immediately downstream. Thus deposits to any downstream account reflect the cumulative effects of all upstream actions. In particular, if upstream reaches intercept most of the natural gravel recruitment (i.e., the cash flow to downstream accounts is reduced), deposits to reaches farther downstream can only come by reducing the capital in the intervening accounts, i.e., by eroding the bed and banks.

The persistent general bed lowering observed in the lower Mad River has been caused by 1) low rates of recruitment of new bed material from upstream because of a succession of dry years with low peak flows, combined with 2) substantial extractions of bed material from the channel by gravel consumers. In order to determine the exact contributions of each cause to the observed bed lowering we would need for several years: 1) measurements of the rate of transport of bed material into, through, and out of the reach; 2) accurate and complete records of the amounts of gravel extracted yearly; and 3) repeated detailed topographic maps and cross-sections of the channel to assess changes in storage. None of these exist. We can, however, use available hydrologic and engineering data to make crude estimates of new gravel recruitment and compare these with past and proposed extractions, and with observed degradation. This crude *sediment budget* should allow at a minimum an order-of-magnitude assessment of the effects of gravel extraction on the river.

Data Sources

Time and money limitations on this study made it impossible to collect new data for this report. Instead, we have had to rely on whatever hydrologic, geologic, and engineering data was already available. Much of this data is scanty or incomplete; it is, however, all that we have, and we must make the best of it despite its shortcomings. Table 3.1 summarizes the sources and type of data we used.

ESTIMATION OF GRAVEL RECRUITMENT

General Approach

Because the estimate of average yearly gravel recruitment is so crucial to analysis of the effects of gravel mining on a river, it is desirable to estimate it using several different, more-or-less independent techniques. At the best, all will yield similar values, suggesting that the estimate is reasonably good. At the worst, the different estimates can be used to put likely upper and lower bounds on the true value. The approaches used depend largely on what data are available. For the Mad River I estimated annual recruitment using:

1) Brown's (1975) bedload rating curves, based on actual bedload measurements;
2) the Ackers-White, Bagnold, Einstein-Brown, Meyer-Peter, and Meyer-Peter-Müller bedload equations;
3) the mean ratio of bedload to suspended load in typical gravel-bed streams.

Each of these methods is described below.

Table 3-1 -- Data Used in Gravel Recruitment and Channel Degradation Study

Type of Information	Site	Dates	Source
Daily flow data	Mad R at Arcata (Hwy 299)	1960-92	USGS
	Mad R near Blue Lake (just above Hatchery)	1972-73	USGS
	Mad River near Kneeland (near Butler Valley)	1965-73	USGS
Bedload discharge measurements Bedload particle-size measurements	Mad R at Arcata	1971-73	USGS; Brown, 1975
	Mad R near Blue Lake	1972-73	USGS; Brown, 1975
	Mad River near Kneeland	1972-73	USGS; Brown, 1975
Bed material surface size distribution	Mad R at Arcata	1972	USGS
	Mad River at Hatchery	1989	Lehre class
Hydraulic geometry (width, depth, velocity) measurements	Mad R at Arcata	1951-91	USGS
	Mad R near Blue Lake	1972-73	Brown, 1975
	Mad River near Kneeland	1966-73	Brown, 1973, 1975
Peak discharge (flood) data	Mad R at Arcata	1910-13, 1950-92	USGS
Suspended sediment discharge measurements	Mad R at Arcata	1957-73	USGS; Brown, 1973, 1975
	Mad R near Blue Lake	1972-73	USGS; Brown, 1975
	Mad River near Kneeland	1970-73	USGS; Brown, 1973, 1975
Channel cross-sections	Blue Lake Bridge	1982	Humboldt Co. Bridge Plans
		1991	Lehre/Lisle survey
	Collector 3	1960, 92	HBMWD
	Collector 5	1960, 92	HBMWD
	Pipeline	1960, 92	HBMWD
	Highway 299 Bridge	1941-91	CalTrans
		1991	Lehre/Lisle survey
		1960, 92	HBMWD
	Highway 101 Bridge	1929-89	CalTrans
		1991	Lehre/Lisle survey
Channel long profile	Mad R near Kneeland	1973?	Brown, 1975
	Mad R near Blue Lake	1973?	Brown, 1975
	Mad R at Hatchery	1989	Lehre class
	Mad R in Guynup Bar reach	1990	Trinity Fisheries Consulting
	Mad R in vicinity of Blue Lake	1956	USCOE, 1956
	Mad R in HBMWD reach	1992	HBMWD
	Mad R between Hwy 299 and Hwy 101	1980	FEMA, 1986
Channel maps	Mad R from Hwy 101 bridge to Hatchery	1954-92	Trinity Restoration Associates

Bedload Transport Measurements

Brown (1975) reported nine measurements of bedload transport in the Mad River at Arcata (just upstream of the Highway 299 bridge), five in the Mad R near Blue Lake (just upstream from the hatchery), and five in the Mad River at Kneeland taken in water years 1972-73. These samples were collected during high flows using a Helley-Smith bedload sampler with a 0.25 ft (3 in) orifice and hence represent the bedload moving within 0.25 ft of the bed. Each reported measurement is the average of 4 to 7 samples taken across the channel. These measurements and the corresponding water discharges are given in Table 3.2.

Table 3.2 -- USGS Mad River bedload transport measurements

Gaging Site	Date	instantaneous water discharge Q cfs	instantaneous bedload discharge Q_b tons/day
Mad R at Arcata	28-Dec-71	1,390	291
	21-Jan-72	23,800	1,870
	24-Jan-72	10,000	451
	4-Mar-72	11,900	990
	25-Apr-72	1,210	34
	20-Feb-73	1,430	330
	1-Mar-73	3,850	753
	20-Mar-73	4,030	246
	12-Apr-73	980	6
Mad R near Blue Lake	20-Dec-72	2,410	2,680
	21-Feb-73	1,190	460
	28-Feb-73	3,250	988
	20-Mar-73	2,850	1,520
	10-Apr-73	986	994
Mad R near Kneeland	18-Jan-73	8,540	3,860
	26-Feb-73	4,240	1,140
	20-Mar-73	1,990	512
	3-Apr-73	1,620	85
	11-Apr-73	946	21

Bedload Transport Rating Curves

Brown plotted bedload transport rate against water discharge to create *bedload transport rating curves* for the three sites (Brown, 1975, figs. 9, 10, and 19). These are reproduced these on a single graph in Fig. 3.1. From these curves and the 1971-72 water discharge records, he estimated the 1971-72 bedload discharge at Arcata as 60,000 tons (43,000 cu. yd. using a unit weight of 1.4 ton/cu. yd. for gravel) and 170,000 tons (121,000 cu. yd.) at Kneeland (Brown, 1975, p. 18 and p. 25). It must be emphasized that these estimates are quite crude, since his bedload transport curves are defined by very few points. These estimates of recruitment should be compared with the 200,000 -500,000 tons/yr (143,000 - 357,000 cu. yd./yr) that he estimates were extracted in the years 1961-70 (Brown, 1975, p. 55), which is 3 to 8 times the estimated transport at Arcata, and 1.2 to 3 times that at Kneeland. It should be noted that water year 1971-72 was a fairly wet year with substantial peak flows, so Brown's transport estimates were optimistic ones.

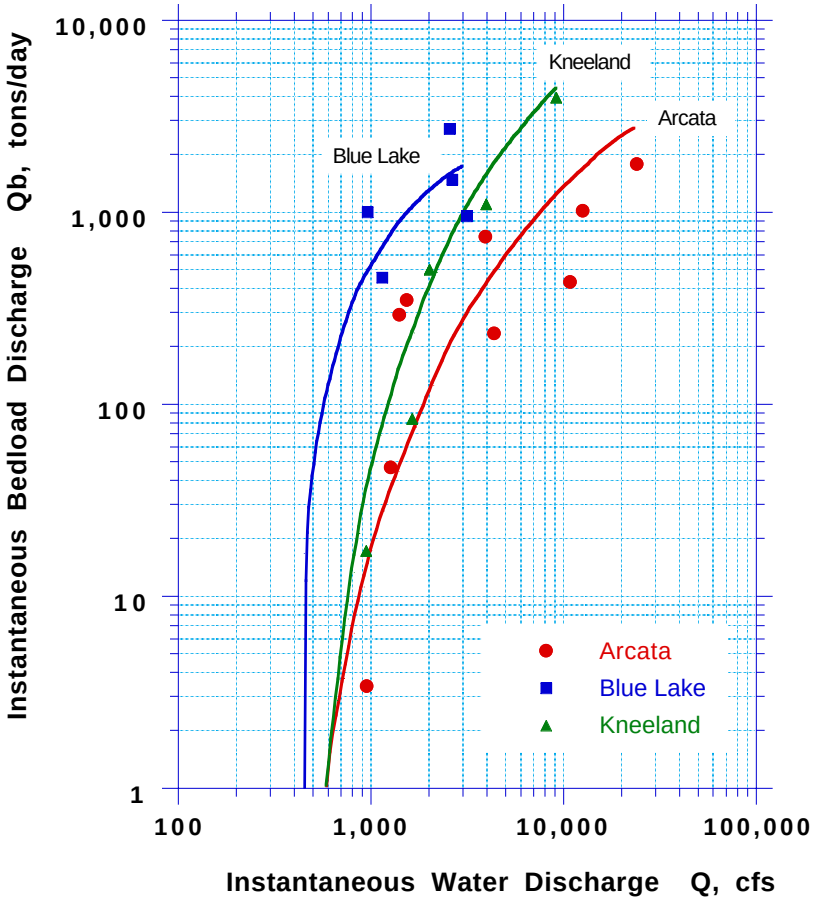


Fig. 3.1 --Bedload transport curves and data for the Mad River at Arcata, Blue Lake, and Kneeland, digitized from Brown (1975)

Bedload Transport Estimated Using Brown's (1975) Rating Curves

Lacking any better data, I estimated bedload discharge at Arcata by applying Brown's bedload transport curve for Arcata to USGS daily flow data for water years (WY) 1962 through 1992 at the gage. (WY 1962 was chosen as the starting date because Ruth Dam was closed across the upper Mad in July 1961.) The resulting daily bedload estimates were summed to yield the yearly totals of Table 3.3.

To estimate bedload transport at Kneeland, the eight years of daily flows (WY 1966-74) at the Kneeland gage were log-transformed and regressed on the corresponding log-transformed daily flows at Arcata . The resulting relations (Fig. 3.2) were used to synthesize daily flows at Kneeland for the periods 1962-65 and 1975-1992. Brown's bedload transport curve for Kneeland was applied to the combined data set and the daily estimates summed to produce the yearly totals in Table 3.3.

To estimate bedload transport at Blue Lake, the four years of daily flows (WY 1972-76) at the Blue Lake gage were log-transformed and regressed on the corresponding log-transformed daily flows at Arcata using a second-order polynomial. The resulting relation (Fig. 3.3) was used to synthesize daily flows at Blue Lake for the periods 1962-72 and 1977-1992. Brown's bedload transport curve for Blue Lake was applied to the combined data set and the daily estimates summed to get the yearly totals in Table 3.3.

Table 3.3 -- Bedload transport at Mad River sites estimated using Brown's (1975) rating curves

Note: To reduce round-off error when summing and averaging, quantities in Table 3.3 are given to more significant figures than justified; individual values should be rounded to the nearest thousand before citation or use. Tonnages were converted to cubic yards using a specific weight of 1.4 tons/cu. yd. (104 lb/cu. ft.)

	Estimated Bedload Discharge, tons			Estimated Bedload Discharge, cu. yd.		
WY	Kneeland	Blue Lake	Arcata	Kneeland	Blue Lake	Arcata
1962	62,491	147,975	27,916	44,636	105,696	19,940
1963	148,939	227,454	58,122	106,385	162,467	41,516
1964	86,093	176,981	35,717	61,495	126,415	25,512
1965	195,022	205,166	64,835	139,301	146,547	46,310
1966	96,212	171,757	36,919	68,723	122,683	26,371
1967	92,998	190,470	40,178	66,427	136,050	28,698
1968	60,999	127,988	24,648	43,571	91,420	17,605
1969	181,521	249,461	60,225	129,658	178,187	43,018
1970	167,677	159,958	48,164	119,769	114,256	34,403
1971	195,938	248,199	67,030	139,955	177,285	47,879
1972	143,905	205,599	53,386	102,789	146,856	38,133
1973	86,471	169,046	34,922	61,765	120,747	24,945
1974	270,120	320,303	94,196	192,943	228,788	67,283
1975	153,301	219,976	59,039	109,501	157,125	42,171
1976	54,782	134,193	25,210	39,130	95,852	18,007
1977	954	11,056	718	681	7,897	513
1978	148,169	251,363	60,278	105,835	179,545	43,056
1979	42,684	111,172	19,669	30,489	79,408	14,049
1980	114,905	216,626	47,922	82,075	154,733	34,230
1981	44,202	110,304	20,350	31,573	78,788	14,536
1982	220,267	309,011	85,141	157,334	220,722	60,815
1983	250,455	308,264	93,079	178,896	220,189	66,485
1984	165,629	266,781	66,121	118,306	190,558	47,230
1985	66,892	133,273	28,033	47,780	95,195	20,023
1986	150,023	176,749	53,544	107,160	126,249	38,245
1987	48,184	116,718	21,603	34,417	83,370	15,431
1988	44,020	85,295	18,290	31,443	60,925	13,064
1989	108,346	204,328	45,454	77,390	145,949	32,467
1990	47,363	124,418	22,428	33,830	88,870	16,020
1991	18,756	80,235	10,662	13,397	57,311	7,616
1992	12,097	53,889	6,806	8,641	38,492	4,861
Total	3,479,416	5,514,005	1,330,606	2,485,297	3,938,575	950,433
Mean yearly bedload discharge	112,239	177,871	42,923	80,171	127,051	30,659

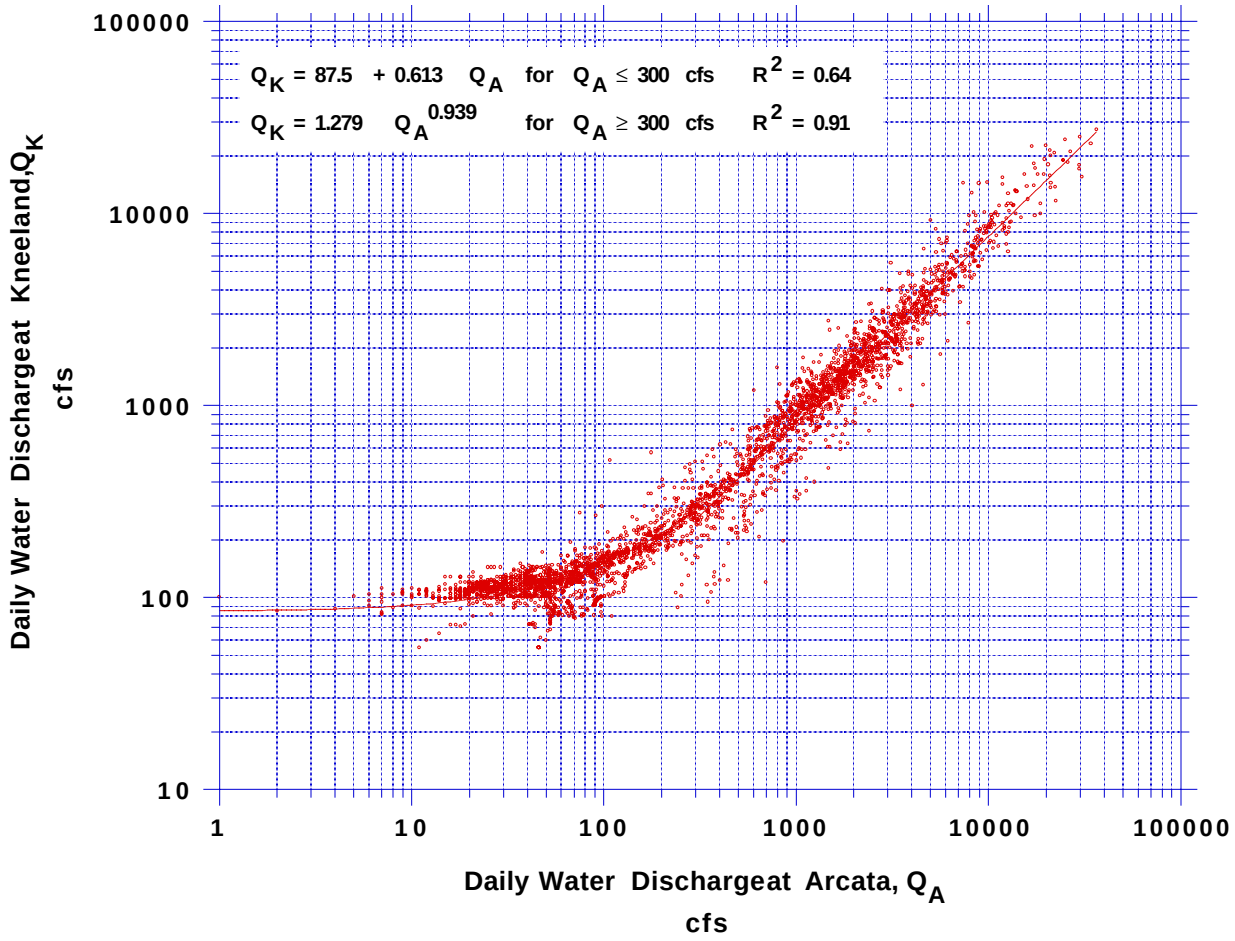


Fig. 3.2 -- Correlation of daily water discharge at Kneeland with daily water discharge at Arcata for WY 1966-1974.

Uncertainty of Rating Curve Estimates

The rating-curve estimates of bedload transport in Table 3.3 contain substantial but unquantifiable uncertainty. I believe, however, that they provide reasonable order-of-magnitude estimates of the bedload transport rate, especially on a long term average basis. The sources of error and their probable effects on the resulting estimates are discussed below.

Sampling error in bedload transport measurements: Bedload transport is highly variable in space, time, and particle size, even when water discharge is constant (e.g., Carson and Griffiths, 1987; Davies, 1987; Dietrich and Gallinatti, 1991; Hubbell, 1987). This makes sampling error a major source of uncertainty in determining bedload transport rates.

a. *Spatial variation:* High rates of bedload transport tend to occur in relatively narrow longitudinal bands separated by wider areas of little or no gravel transport (Davies, 1987). For example, Thompson (1985) found on the Ohau R in New Zealand that even at high flows bed material was in motion over less than 10% of the channel width. The bands of significant transport are not necessarily fixed in position, but may migrate across the bed. Thus adequate spatial sampling across the channel is essential to define the mean transport rate. If the threads of high transport rate are missed, the true bedload discharge will be significantly underestimated; if, however, only such a thread happens to be sampled (as might happen with a single point measurement), the true bedload discharge will be greatly overestimated.

   The USGS bedload measurements in Table 3.2 are averages of 4 to 7 samples taken at different points across the channel. While this number is not ideal (15 to 20 points would be better), it does suggest that spatial error is not likely to be excessive.

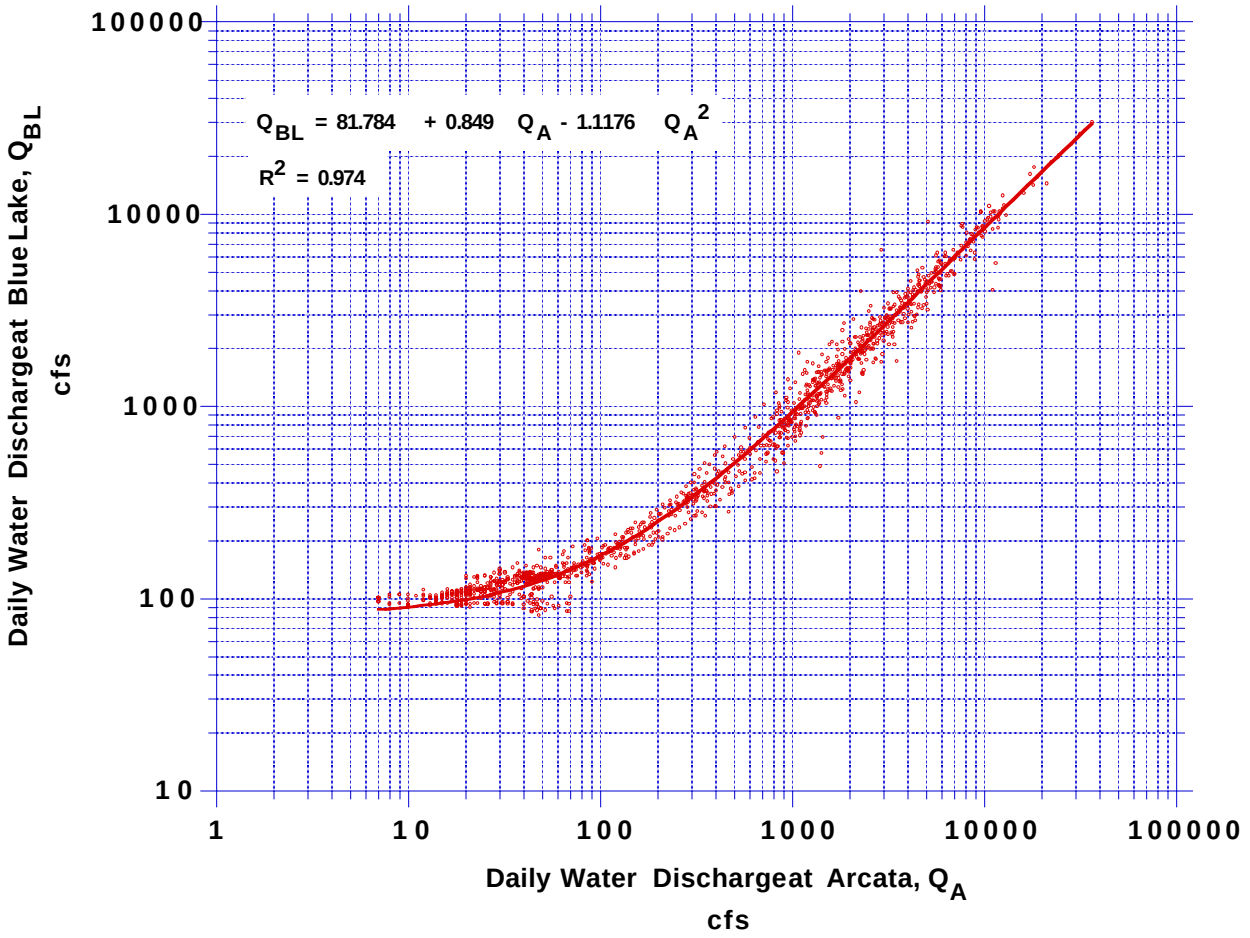


Fig. 3.3 -- Correlation of daily water discharge at Blue Lake with daily water discharge at Arcata for WY 1972-1976.

b. *Temporal variation:* Bedload movement is also typically highly unsteady in time, and transport rates may easily vary by a factor of 2 or more over periods of several minutes to several hours, even when flow is constant. Time variation is especially pronounced when bedload is primarily sand. A single bedload measurement may easily grossly over- or underestimate the true mean transit rate at a point. The USGS data is clearly insufficient in this regard, but there is no way to tell whether the measurements err on the high or low side. From sample to sample these errors may partially cancel, but a particularly low or high value could strongly affect the position of the bedload transport curve.

c. *Particle size:* The particle-size of bed material in transport is governed by both the availability of transportable sizes and the hydraulic characteristics of the flow. As the bed and banks of gravel-bed rivers are commonly quite heterogeneous (e.g., Lisle and Madej, 1992), the particle sizes available for transport may vary widely across the channel. In addition, the particle sizes in transport will vary with time as new bed material is exposed through local disruption of the coarser surface layer (pavement). Since transport rate is strongly related to particle size, these size fluctuations will cause concomitant fluctuations in bedload discharge.

A second type of size sampling error is caused by the dimensions of the Helley-Smith sampler itself. The orifice is 3 in (76 mm) wide. Any particles larger than about 20% of this value (i.e., larger than 15 mm) will tend to be undersampled, and particles larger than 76 mm won't be sampled at all. Thus if large particles are a dominant component of the bed-material load, the load will be underestimated. Judging from the 90th percentile size of the bedload samples, size-related undersampling may be a significant problem at the Kneeland site, a moderate problem at Arcata, and a mild problem at Blue Lake.

Error in fitting the bedload rating curves: The high degree of variability in the bedload discharge measurements, together with the very small number of samples makes fitting the bedload curves problematic. (A large scatter -- often over one to two orders of magnitude -- is typical of points defining bedload transport curves.) The general convex-upward shape of bedload rating curves is well known from measurements on other rivers, and provides some guide to fitting a curve to the observations. Brown (1975) evidently fit his curves (Fig. 3.1) by eye, so there is no way to assess their prediction error. The Arcata and Kneeland curves really look quite good, but the Blue Lake curve is very uncertain -- the points are too clustered to be able to define the curve well. Because the upper end is so ill-defined, it may easily overestimate bedload transport. I have not attempted to re-fit Brown's data; as the field investigator he would have known best how to interpret the measurements.

Error in estimating daily water discharges at Blue Lake and Kneeland: Regressions on mean daily flow at Arcata (Figs. 3.2 and 3.3) were used to synthesize water discharges at Blue Lake and Kneeland for the years they were not gaged. The points cluster tightly around the regression lines, and for the larger flows, where bedload transport becomes significant (above 800 cfs or so), the maximum scatter is less than ±50%. This is really quite good, and the errors will tend to cancel out.

Uncertainty in the temporal applicability of the rating curves: The bedload transport data were collected in WY 1972-73. I have had to assume that rating curves constructed from these data are valid for the entire period 1962-1992, i.e. that over that time span the relationship between water discharge and bedload discharge has remained the same at all three sites. This is a dubious proposition, for several reasons.

First, the bedload data were collected only three years after the removal of Sweasey Dam had released a large amount of coarse sediment into the Mad. This abundant supply of bedload would tend to shift the rating curve upward (higher bedload discharge for a given water discharge), leading to overestimates for years 1) prior to the removal of the dam and 2) following the passage of the slug of sediment downstream. This would not affect the Kneeland gage (upstream from Sweasey Dam) but would certainly affect the Blue Lake and possibly the Arcata gage.

Second, the 1964 flood reorganized the channel and certainly changed the availability of sediment in the Mad. The particular effects of this flood on subsequent bedload transport is unknown, but, based on observations on other streams, it is likely that it also shifted the rating curves upward. How long its effects on bedload transport might have persisted is not known.

Third, the bedload transport measurements were made in or after reasonably wet years, when substantial amounts of bedload would likely be available for transport. This again would tend to move the rating curves upward. It is likely that they overpredict for drier periods.

Fourth, the effects of gravel mining on the applicability of the curves is not known. Large extraction volumes would tend to deplete the amount of gravel available for transport at downstream sites. Mining is not likely to have appreciably affected the Kneeland or Blue Lake curves, but might well cause post-1973 transport rates at Arcata to be less than the curve would indicate.

Use of daily mean discharges with an instantaneous discharge rating curve: The use of daily mean discharges (all we have) generally underestimates the sediment load. Bedload transport goes up as a power function of discharge, not linearly, so averaging the higher and lower flows of each day will yield estimates smaller than those we would get if we could use hourly data. This error is likely to be on the order of 5 - 15%.

Estimated bed-material recruitment from bedload rating curves

Long term mean annual bed-material recruitment on the Mad River estimated using Brown's bedload rating curves ranged from a low of 43,000 tons/yr (31,000 yd^3/yr) at Arcata to a high of 178, 000 tons/yr (127,000 yd^3/yr) at Blue Lake (Table 3.3). Despite the many possible sources of error in these figures (see preceding section), I believe that these estimates are generally in the right range. The values estimated for specific years may well be off the mark, but *over the long term* it seems likely that errors of overestimation will be at least partly canceled by errors of underestimation. These figures suggest that long-term *average* recruitment to the upper end of the extraction reach (i.e., vicinity of Guynup Bar) is on the order of 150,000 to 200,000 tons (110,000 - 140,000 yd^3) annually. The lower rates of bedload transport observed at the Arcata gage may reflect: 1) the effects of upstream gravel extraction reducing the flow of gravel downstream, 2) the continuing breakdown of gravel particles to sand during

downstream transport, or 3) sampling difficulties at the Arcata gage which resulted in catches which underestimated the true transport rate.

Bedload Transport Equations

Over the past century, engineers have proposed at least fifty different equations for estimating rates of bedload transport . The equations attempt to relate the bedload transport rate to the particle size of the bedload and the hydraulic conditions (e.g., slope, depth, width, bed shear stress, velocity, discharge) in the stream. Most of the equations consist of some theoretical construct with constants calibrated from experiments in flumes or, more rarely, natural rivers; a few are strictly empirical. All work best when they are applied to conditions (e.g., particle size, slope, depth, width) similar to those under which they were derived (*see* Carson and Griffiths, 1987; Gomez and Church, 1989; Reid and Dunne, 1992; Vanoni, 1975); none works well under all conditions.

The equations I chose to use on the Mad River were either ones that have been commonly applied to gravel-bed streams in the past (Einstein-Brown, Meyer-Peter, and Meyer-Peter-Müller equations), or which were recommended in recent papers (Gomez and Church, 1989; Reid and Dunne, 1992) as especially promising (Ackers-White and Bagnold 1980 equations). All have been calibrated either by using gravel in flumes, or on natural gravel rivers. Discussions of the strengths and weaknesses of the equations are given by Carson and Griffiths (1987), Gomez and Church (1989), Reid and Dunne (1992), Vanoni (1975), and White et. al. (1973b). Formulas and calculational details of the equations are given in Bagnold (1980), Vanoni (1975), and White et. al. (1973a). All calculations were carried out using Microsoft Excel spreadsheets programmed by me.

Computation of long-term bedload discharge: The complexity and uncertainty of bedload equations made it impractical to compute bedload discharge on a day-by-day or year-by-year basis. Instead, I used each equation to estimate the 30-year mean bedload discharge by: 1) computing the 30-year cumulative frequency distribution of flows at each gage (flow-duration curve); 2) dividing the logarithms of the discharges into 50 equal size classes; 3) computing the bedload discharge corresponding to the median discharge of each size class; 4) multiplying this bedload estimate by the fraction of time in the class; and finally 5) summing the products to get the mean transport rate. The same strategy is commonly used to estimate suspended-sediment discharge.

Data Required for the Equations

The various equations require as input estimates of water discharge (Q), mean depth (d), mean velocity (v), channel width (w), longitudinal water-surface slope (S), and one or more parameters characterizing the diameter (D) of the sediment particles.

Hydraulic parameters: The *hydraulic geometry* of a stream at a gaging station consists of straight-line plots, on log-log paper, of the variation with discharge of width, mean depth, and mean velocity. These lines yield equations of the form $w = aQ^b$, $d = cQ^f$, and $v = kQ^m$, where a, c, k, b, f, and m are constants. (The necessary measurements are made routinely during stream gaging, and are summarized by the USGS on form 9-207.) Given the hydraulic geometry at a site, it is easy to estimate the width, depth, and velocity corresponding to any discharge.

Equations defining the Blue Lake and Kneeland hydraulic geometry were scaled from plots in Brown (1975, p. 44-45.) The hydraulic geometry at Arcata (Fig. 3.4) was constructed from 9-207's supplied by the USGS. Channel slope at Kneeland and Blue Lake are given by Brown (1975, p. 44-45); slope at the Arcata gage was estimated from 1992 HBMWD surveys and Mad River flood profiles (FEMA, 1986.)

Particle-size parameters: Particle-size parameters used in the equations were D_{mean} (average diameter) D_{50} (median diameter), and D_{90} (diameter for which 90% of the particles are smaller). These were calculated from published size analyses of the USGS bedload and bed material samples. The median value of each parameter was used in the computations. Particle-size parameters computed for this study are summarized in Table 3.4.

Table 3.5 summarizes the hydraulic geometry relations, slope, and particle size parameters used in the bedload computations at each site.

The 1962-1992 mean annual bedload recruitment estimates computed with each equation are compared with each other and with the rating curve and suspended-load percentage estimates in Table 3.6. The Einstein-Brown relation was not used because it performed so badly in calibration tests (see below).

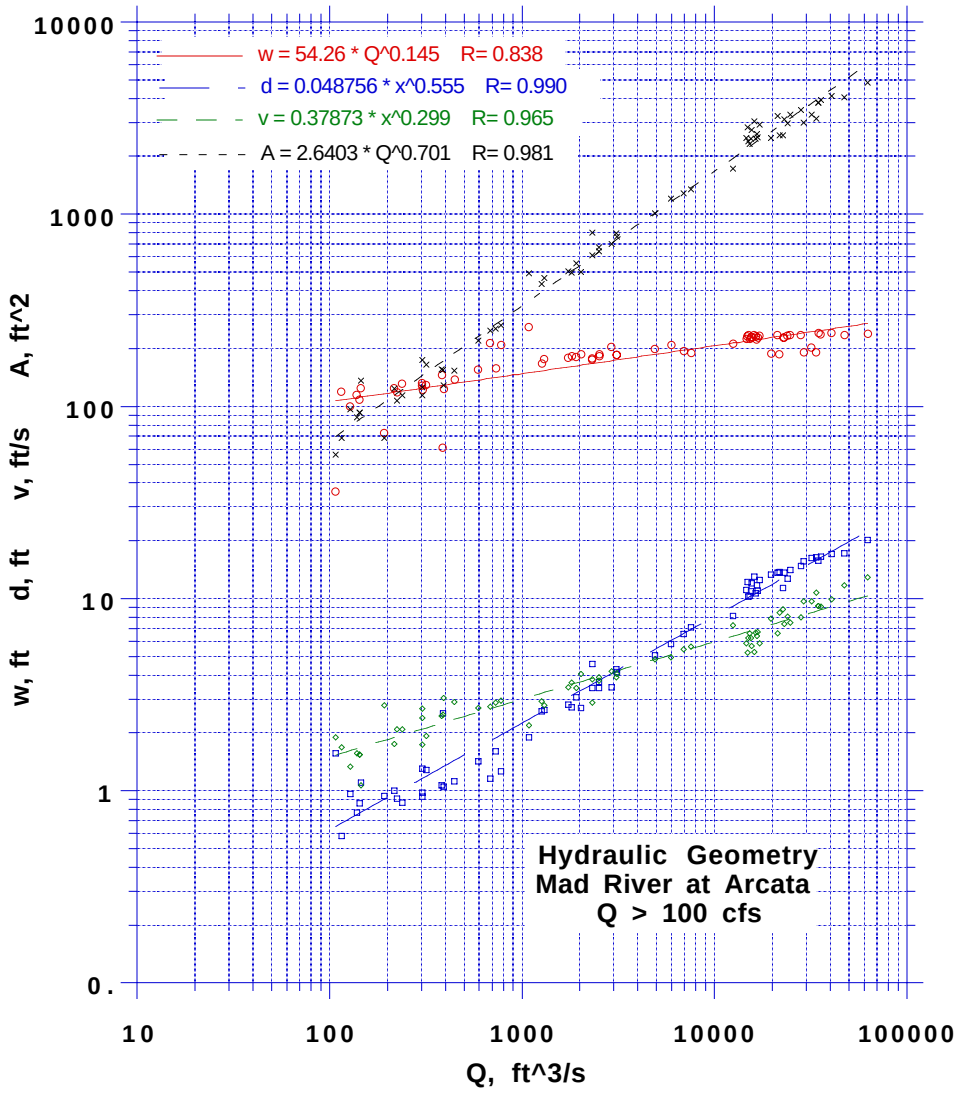


Fig 3.4 -- Hydraulic geometry at Arcata for discharges greater than 100 cfs

Table 3.4a -- Size parameters for USGS bedload samples at Kneeland gage

Date	Type	Q cfs	D90 mm	D84 mm	D65 mm	D50 mm	D35 mm	D16 mm	D10 mm	Dmean mm
18-Jan-73	bedload	8540	32.0	23.43	12.12	8.00	4.36	1.19	0.70	12.31
26-Feb-73	bedload	4240	44.00	35.00	13.83	6.50	2.17	0.67	0.48	14.09
20-Mar-73	bedload	1990	22.77	14.85	14.85	5.83	3.65	1.19	0.70	9.53
3-Apr-73	bedload	1620	35.0	18.16	3.55	1.76	1.19	0.72	0.58	8.81
11-Apr-73	bedload	946	7.32	4.76	1.89	1.27	0.89	0.57	0.47	2.71
		median	32.00	18.16	12.12	5.83	2.17	0.72	0.58	9.53
		mean	28.22	19.24	9.25	4.67	2.45	0.87	0.59	9.49
		std dev	13.93	11.14	6.07	2.99	1.52	0.30	0.11	4.35
		max	44.00	35.00	14.85	8.00	4.36	1.19	0.70	14.09
		min	7.32	4.76	1.89	1.27	0.89	0.57	0.47	2.71

Table 3.4b -- Size parameters for USGS bedload and bed material samples at Blue Lake gage

Date	Type	Q	D90	D84	D65	D50	D35	D16	D10	Dmean
		cfs	mm	mm	mm	mm	mm	mm	mm	mm
20-Dec-72	bedload	2410	9.4	6.70	2.79	1.59	0.98	0.58	0.47	3.22
21-Feb-73	bedload	1190	10.41	8.00	3.86	2.35	1.41	0.66	0.48	4.29
28-Feb-73	bedload	3250	12.10	9.01	3.78	1.68	0.85	0.48	0.40	4.66
20-Mar-73	bedload	2850	9.7	7.44	4.47	3.19	2.26	1.16	0.78	4.21
10-Apr-73	bedload	986	11.33	8.62	4.87	3.33	2.24	1.29	1.00	5.34
22-Oct-89	bed surface*	140	25.38	22.85	16.27	12.87	8.59			12.93
22-Oct-89	bed surface*	140	40.51	31.15	18.84	9.51	5.78			16.18
		median	11.33	8.62	4.47	3.19	2.24	0.66	0.48	4.66
		mean	16.98	13.40	7.84	4.93	3.16	0.83	0.63	7.26
		std dev	11.79	9.63	6.71	4.43	2.92	0.37	0.26	5.11
		max	40.51	31.15	18.84	12.87	8.59	1.29	1.00	16.18
		min	9.40	6.70	2.79	1.59	0.85	0.48	0.40	3.22

* not USGS. Pebble count opposite hatchery by HSU Geology 550 class.

Table 3.4c -- Size parameters for USGS bedload and bed material samples at Arcata gage

Date	Type	Q	D90	D84	D65	D50	D35	D16	D10	Dmean
		cfs	mm	mm	mm	mm	mm	mm	mm	mm
28-Dec-71	bedload	1390	5.56	4.17	2.23	1.53	1.05	0.55	0.43	2.56
21-Jan-72	bedload	23800	24.72	16.88	6.29	3.01	1.61	0.54	0.39	8.50
24-Jan-72	bedload	10000	29.29	19.05	8.56	5.09	2.72	0.47	0.32	10.08
4-Mar-72	bedload	11900	37.00	26.14	9.29	4.00	1.60	0.54	0.38	11.36
25-Apr-72	bedload	1210	1.78	1.50	1.05	0.71	0.48	0.36	0.31	1.10
20-Feb-73	bedload	1430	2.38	1.83	0.95	0.95	0.77	0.55	0.47	1.51
1-Mar-73	bedload	3850	9.23	6.91	1.33	1.33	0.85	0.47	0.38	3.30
20-Mar-73	bedload	4030	4.68	2.75	0.49	0.49	0.41	0.30	0.26	1.87
12-Apr-73	bedload	980	0.76	0.56	0.36	0.36	0.31	0.25	0.19	0.63
20-Nov-72	bed surface	664	18.00	13.31	6.50	3.07	1.39	0.59	0.45	6.36
20-Nov-72	bed surface	664	15.16	11.66	6.11	3.49	1.70	0.63	0.46	5.99
20-Nov-72	bed surface	664	8.50	6.23	2.86	1.38	0.75	0.41	0.34	3.03
20-Nov-72	bed surface	664	23.00	19.00	10.73	7.39	4.00	0.76	0.46	9.11
20-Nov-72	bed surface	664	21.00	16.00	11.16	8.88	5.60	1.72	1.00	9.55
20-Nov-72	bed surface	664	27.00	25.00	18.00	13.94	11.03	6.89	4.00	14.53
20-Nov-72	bed surface	664	15.00	13.00	10.50	8.50	5.18	1.61	1.26	7.61
		median	15.08	12.33	6.20	3.04	1.50	0.55	0.41	6.18
		mean	15.19	11.50	6.03	4.01	2.47	1.04	0.69	6.07
		std dev	11.08	8.39	5.09	3.86	2.82	1.61	0.92	4.22
		max	37.00	26.14	18.00	13.94	11.03	6.89	4.00	14.53
		min	0.76	0.56	0.36	0.36	0.31	0.25	0.19	0.63

Table 3.5 -- Input data for bedload equations

		Arcata	Blue Lake	Kneeland
width	ft	$w = 54.26\ Q^{0.145}$	$w = 34.2\ Q^{0.25}$ $Q \le 1200$ cfs $w = 2.88\ Q^{0.60}$ $Q > 1200$ cfs	$w = 8.00\ Q^{0.40}$ $Q \le 1000$ cfs $w = 56.8\ Q^{0.10}$ $Q > 1000$ cfs
depth	ft	$d = 0.049\ Q^{0.555}$	$d = 0.074\ Q^{0.44}$ $Q \le 1200$ cfs $d = 0.406\ Q^{0.20}$ $Q > 1200$ cfs	$d = 0.460\ Q^{0.20}$ $Q \le 1000$ cfs $d = 0.021\ Q^{0.65}$ $Q > 1000$ cfs
velocity	ft/s	$v = 0.379\ Q^{0.299}$	$v = 0.395\ Q^{0.31}$ $Q \le 1200$ cfs $v = 0.855\ Q^{0.20}$ $Q > 1200$ cfs	$v = 0.270\ Q^{0.40}$ $Q \le 1000$ cfs $v = 0.830\ Q^{0.25}$ $Q > 1000$ cfs
slope		0.0016	0.0028	0.0053
D_{90}	mm	15	11	32
D_{50}	mm	3	3	6
D_{mean}	mm	6	5	9.5

Table 3.6 -- Comparison of long-term mean bedload transport estimates for the Mad River

	mean bedload transport 1962-1992, tons/yr			mean bedload transport 1962-1992, yd^3/yr		
estimation procedure	Arcata	Blue Lake	Kneeland	Arcata	Blue Lake	Kneeland
Brown 1975 rating curve	42,900	178,000	112,000	30,600	127,000	80,200
Ackers-White eqn	106,000	299,000	251,000	75,600	213,000	179,000
Bagnold 1980 eqn	151,000	349,000	649,000	108,000	249,000	463,000
Meyer-Peter eqn	220,000	452,000	1,269,000	157,000	323,000	907,000
Meyer-Peter & Müller eqn	180,000	587,000	876,000	128,000	419,000	626,000
As 5% of suspended load	83,600	--	45,500	59,700	--	32,500
As 10 % of suspended load	167,000	--	91,000	119,000	--	65,000

Bedload Equation Performance

The performance of each bedload equation was tested by comparing its predictions -- computed using the particle size distribution of each bedload sample and the corresponding water discharge -- to the observed transport rates. In Fig. 3.5 I have plotted the observed and computed bedload transport rates against water discharge. The bedload equations almost without exception predict transport rates 2 to 10 times -- and sometimes as much as 1000 times-- greater than the observed rates. Fig. 3.5 shows that the Ackers-White and Bagnold 1980 equations generally performed the best, while the Einstein-Brown equation consistently gave results 100 to 1000 times larger than the observed values. On this basis I discarded further use of the Einstein-Brown relation.

This overprediction of transport rates is typical of bedload equations (Gomez and Church, 1989), and is caused by several factors:

1) the equations assume a one-dimensional steady-state equilibrium between transport processes and flow that applies uniformly across the channel. This is unrealistic as transport rates in natural channels are always observed to fluctuate widely in space and time (cf. discussion on p. 7-8).
2) the equations assume that there are no limitations on supply of particles of the size that can be moved by the flow. In reality, natural bed armoring by coarser particles may reduce the supply to well below the stream's transport capacity.

3) the use of hydraulic parameters averaged across the whole channel (e.g., mean depth, mean slope, mean velocity, mean shear stress) significantly overestimates transport. The shear stress (tractive stress) actually experienced by the bed particles is usually significantly less than the channelwide mean value, which includes flow resistance caused by bedforms, channel configuration, and bank roughness, as well as grain stress (Carson and Griffiths, 1987; Gomez and Church, 1989). Partitioning the channel into subsections and use of local depth and slope measurements reduces the overestimation (Carson and Griffiths, 1987; Thompson, 1985), but such data is not generally available without prior planning for its collection.

The long term mean estimates of annual recruitment (Table 3.5) suffer in addition from the following errors:

4) the hydraulic geometry of the Mad River is not known for flows exceeding 20,000 cfs at Kneeland and 4,000 cfs at Blue Lake. To cover higher discharges I had no choice other than to extend Brown's relations as straight lines. This is almost certainly in error, especially at the Blue Lake site, where the hydraulic geometry predicts an unreasonably wide channel at high flows. Without channel surveys at these sites it is impossible to assess the extent and seriousness of the errors.

5) the hydraulic geometry and longitudinal slope at the gaging sites must be assumed to have remained constant with time. The extent to which this is likely at Blue Lake and Kneeland is unknown. The hydraulic geometry at the Arcata gage appears to have changed little with time for flows > 100 cfs (Fig. 3.4). Since the Mad River has lowered its bed up to 8 feet in the past 30 years, it is likely that the longitudinal slope has changed with time. We have no information which allows us to assess the extent to which this has occurred.

6) the equations are generally quite sensitive to the grain size used in the computations. Doubling the grain size can easily halve the predicted sediment load or worse. The dominant particle size in bedload transport assuredly varies with time, spatial position in the channel, and discharge. This variation is unknown and thus we have no basis for using anything but a constant grain size for all calculations at a site. This is a significant source of error.

   In addition, there is the problem of *what* measured grain size should be used in the calculations. Research over the last decade suggests that the particles in bedload transport are generally closer in size to those particles *in* the bed (i.e., beneath the surface layer) then they are to those on the bed surface. Lacking any better procedure, it seemed reasonable to use the median value of the bedload-sample size parameters (D_{50}, D_{90}, D_{mean}) at each site. Again, this may be a significant source of error.

Estimated mean annual bed-material recruitment from bedload equations

Long term mean annual bed-material recruitment on the Mad River estimated using four bedload equations ranged from a low of 106,000 tons/yr (76,000 yd^3/yr) with the Ackers-White equation at Arcata to a high of 1,269,000 tons/yr (906,000 yd^3/yr) with the Meyer-Peter equation at Kneeland (Table 3.6). Consideration of the assumptions underlying the bedload equations and their general lack of agreement, as well as comparison of predicted with observed transport rates (Fig. 3.4) suggests that the equations in general significantly overestimate the true mean recruitment rate. The most consistent estimates are those at the Arcata gage, which suggest average annual recruitment of 100,000 to 200,000 tons (70, 000 - 140,000 yd^3). This seems the right order of magnitude. The estimates at the Blue Lake and Kneeland gages scatter very widely, with the highest and lowest values differing by a factor of 6. I do not trust these values and believe that at Kneeland and Blue Lake the equations greatly overestimate recruitment. The Ackers-White estimates of 250,000-300,000 tons/yr (180,000 - 215,000 yd^3/yr) at these sites probably provide an upper bound on average annual resupply.

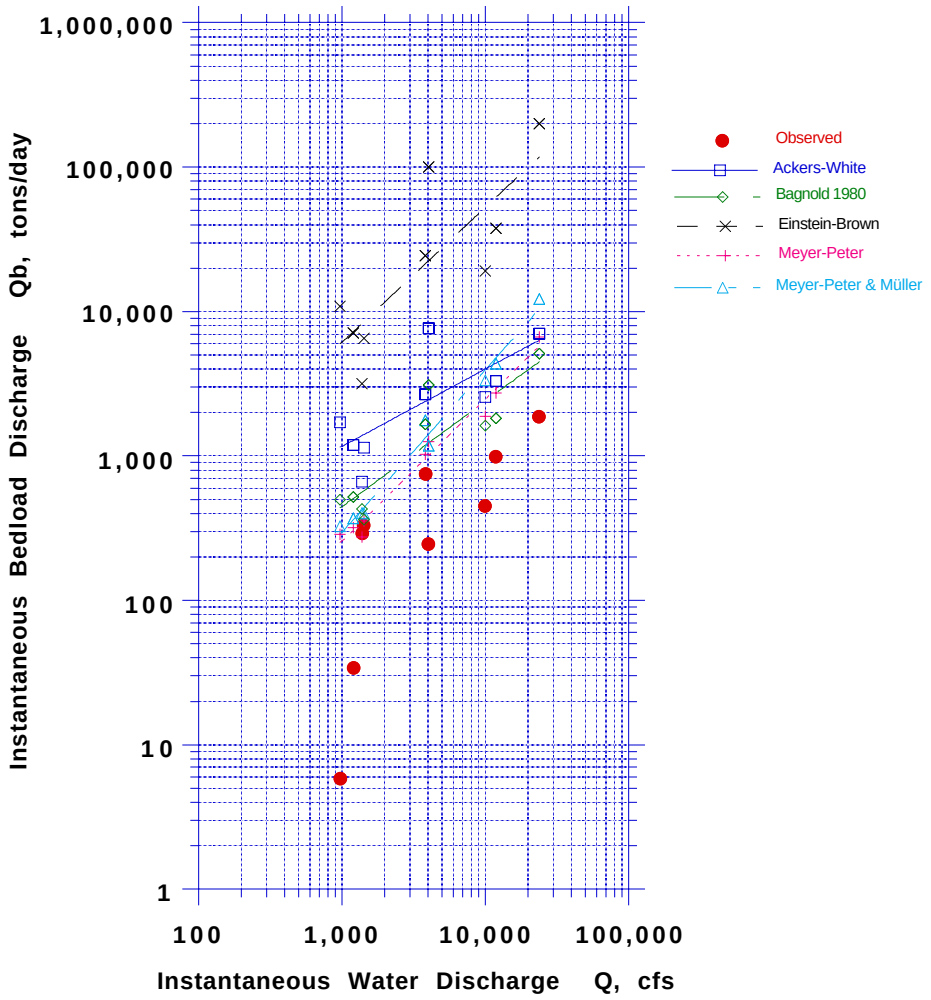


Fig. 3.5a -- Comparison of observed and predicted bedload transport rates at Arcata gage

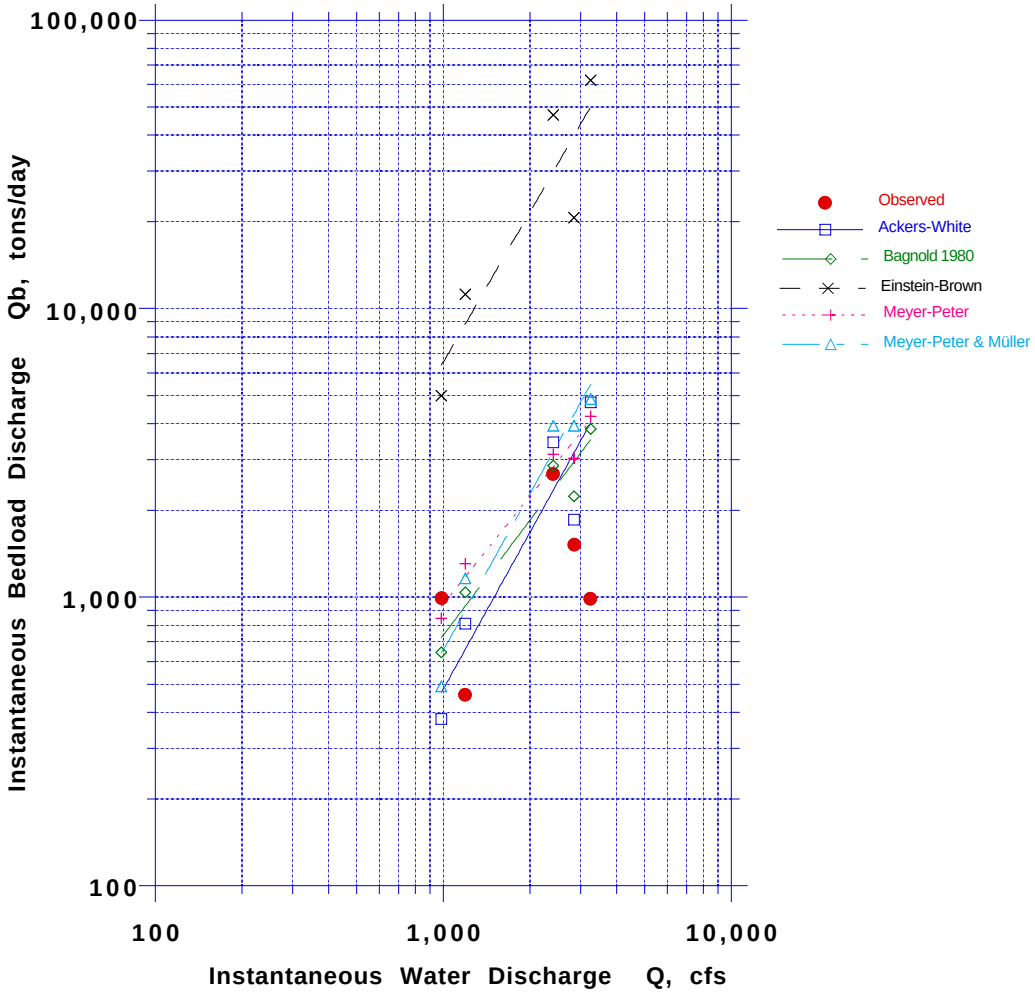


Fig. 3.5b -- Comparison of observed and predicted bedload transport rates at Blue Lake gage

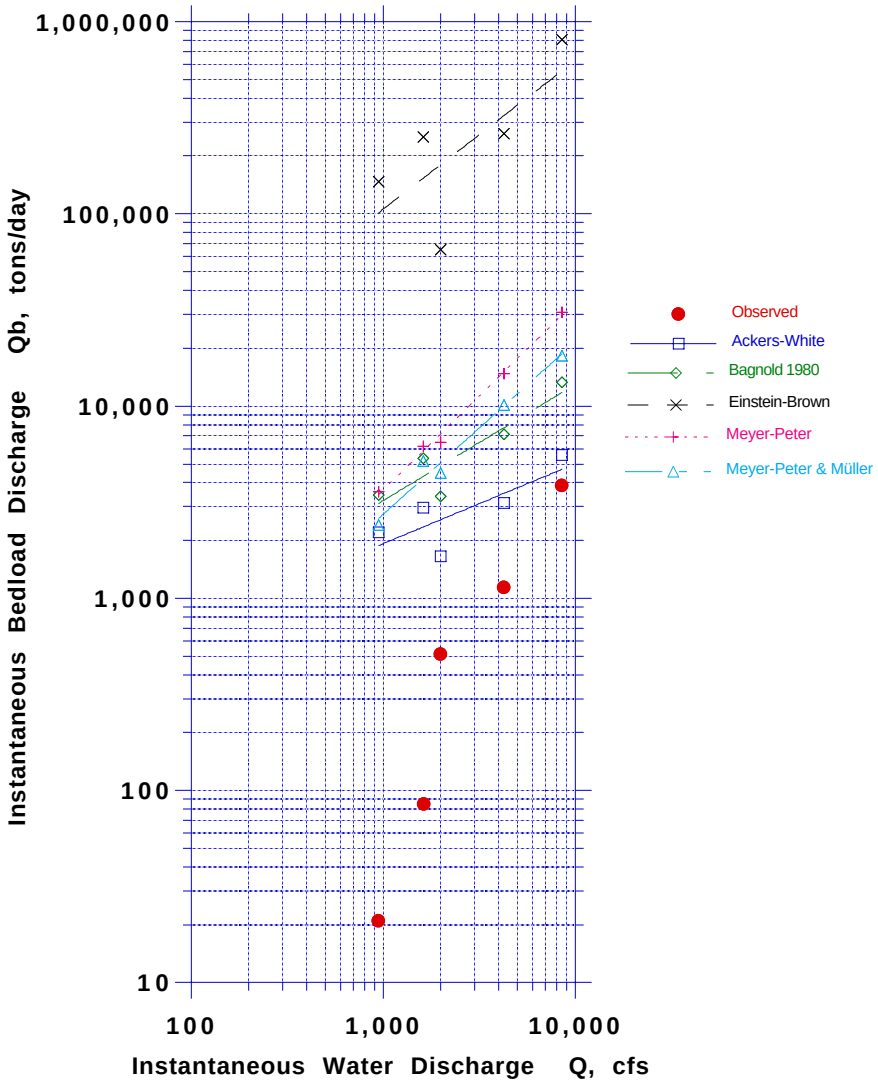


Fig. 3.5c -- Comparison of observed and predicted bedload transport rates at Kneeland gage

Estimating Bedload Transport as a Percentage of the Suspended Load

Finally, a crude but usable method for estimating mean annual bedload recruitment is to compute it as a fixed percentage of the average annual suspended-sediment load based on observations on rivers where both suspended load and bedload have been measured (e.g., Collins and Dunne, 1990; Reid and Dunne, 1992). According to data presented in Reid and Dunne (1992, Table 12), the bedload discharge of gravel-bed rivers is characteristically equal to about 4-5% of their suspended load discharge; 10% seems a typical upper limit.

To estimate the suspended-load discharge at Arcata and Kneeland, I applied Brown's suspended-sediment discharge curve (Brown, 1975, Fig. 14) to daily water discharges for the period 1962-1992 at Arcata (observed) and Kneeland (observed plus synthesized). The resulting daily suspended-load estimates were summed to give the yearly estimates in Table 3.7. Suspended-load data was not available for the Blue Lake site. It should be noted that Brown's curve is quite well-defined, being based on a large number of samples taken over several years.

Computing mean annual bedload discharge as 5% of the mean annual suspended load yields estimates of 46,000 -84,000 tons/yr (33,000 -60,000 yd^3/yr), while estimating it at 10% of the suspended load (a likely upper limit) gives mean annual recruitment of 91,000 -167,000 tons/yr (65,000 -119, 000 yd^3/yr). Both estimates have been entered in Table 3.6 for comparison with the other methods.

Table 3.7 -- Suspended-load transport at Mad River sites estimated using Brown's (1975) rating curve

Note: To reduce round-off error when summing and averaging, quantities in Table 3.7 are given to more significant figures than justified; individual values should be rounded to the nearest thousand before citation or use.

	Estimated Suspended-Load Discharge, tons	
WY	Kneeland	Arcata
1962	289,412	521,008
1963	998,951	1,957,140
1964	707,672	1,455,183
1965	2,824,846	6,462,996
1966	790,124	1,674,069
1967	587,928	1,039,300
1968	416,732	551,596
1969	2,080,017	2,214,490
1970	2,159,346	2,965,339
1971	1,964,178	2,776,911
1972	1,343,810	3,223,401
1973	478,360	717,933
1974	2,410,880	4,222,285
1975	1,237,707	2,547,387
1976	284,535	518,908
1977	8,547	11,602
1978	844,606	1,619,995
1979	185,557	327,200
1980	672,083	1,291,124
1981	198,152	352,220
1982	1,545,735	3,100,750
1983	1,815,575	3,651,493
1984	1,007,427	1,947,504
1985	373,910	706,151
1986	1,627,517	3,508,748
1987	215,954	384,398
1988	242,316	453,663
1989	568,594	1,068,726
1990	208,484	370,459
1991	79,526	130,521
1992	53,453	86,859
mean yearly suspended-load discharge	910,385	1,672,883

Summary of Bedload Transport Estimates

Average annual bedload recruitment to the Mad River below the hatchery was estimated with three different techniques: bedload rating curves, bedload transport equations, and ratio to suspended load. The two methods based on actual field measurements agree reasonably well and suggest that true mean annual recruitment lies somewhere in the range of 50,000 - 200,000 tons/yr (35,000 - 140,000 yd^3/yr). The bedload equations give inconsistent results which almost certainly overpredict the load at the upstream sites. The equations give more consistent results at Arcata, again suggesting that average annual recruitment lies in the range of 100, 000 - 200,000 tons/yr (70,000 - 140,000 yd^3/yr). In my opinion, a reasonable estimate of mean annual recruitment for planning purposes is 150,000 yd^3/yr, with 200,000 yd^3/yr certainly a ceiling.

ANALYSIS OF BED DEGRADATION

Amount of bed lowering since 1960

As stated in the introduction, the bed of the Mad River between the hatchery and the Highway 101 has undergone significant and consistent degradation (lowering) over the past 32 years. Evidence from CalTrans bridge surveys suggests that bed lowering has been going on since at least 1929. The data presently available to us are insufficient to allow us to address the possible causes of this earlier lowering; our analysis is restricted to bed degradation since 1960 between the hatchery and the Highway 101 bridge, which is reasonably well documented.

The quantitative data used in this study are summarized in Table 3.8; for further information the reader is referred to Table 3.1 and the Introduction (p. 1-2). The bulk of our measurements come from repeated cross-sections at bridge sites, with additional data available from cross-sections and observations in the HBMWD reach, which extends from the Railroad Bridge down to Highway 299. These cross-sections are included as an appendix (Figs. 3.A1 – 3.A4).

The mean yearly lowering rates for the period 1960 - 1992 are remarkably consistent along the river from the Blue Lake (Hatchery Road) Bridge down to Highway 101, ranging from 0.11 to 0.27 ft/yr and averaging about 0.15 ft/yr. This means that the entire width of the bed has been lowered about 5 feet since 1960.

Bridge sites are notorious for scour because bridges typically narrow the channel and hence speed up the river. This has undoubtedly occurred to some extent in the maximum scour at Hwy. 299. The fact, however, that the mean lowering rates at the bridge sites are consistent with each other, with the rates in the HBMWD reach, and with the observed downcutting at tributary mouths strongly suggests that the bridge cross-sections are reasonably representative of overall bed lowering.

Table 3.8 -- Summary of bed degradation measurements used in study

Site	Period	Δ Time	Maximum Lowering	Mean Lowering	Scour Width	Δ Area	Mean Lowering Rate	Source
		yr	ft	ft	ft	ft^2	ft/yr	
Blue Lake Bridge	1982-91	9	4.5	1.6	181	290	0.18	Lehre/County
Collector 3	1960-92	32	7.2	3.5	638	2231	0.11	HBMWD
Collector 5 (incomplete xs)	1960-92	32	9.6	4.2	492	2089	0.13	HBMWD
Pipeline (oblique)	1960-92	32	25.0	5.8	500	2885	0.18	HBMWD
299 Bridge	1960-92	32	13.1	6.1	251	1523	0.19	HBMWD
Hwy 299 Bridge East Span	1941-60	29	11.1	8.8	300	2640	0.30	CalTrans
	1960-72	12	5.5	4.3	300	1290	0.36	
	1972-91	19	7.0	3.5	300	1050	0.18	
	1960-91	31	12.0	7.8	300	2340	0.25	
	1941-91	50	22.1	16.6	300	4980	0.33	
Hwy 299 Bridge West Span	1960-91	31	12.3	8.4	299	2512	0.27	CalTrans
partial survey	1991-92	1	1.9	0.0	254	0	0.00	
Hwy 299 Bridge West Span	1960-91	31	13.7	7.8	294	2293	0.25	Lehre/CalTrans
Hwy 101 Bridge East Span	1929-57	28	13.9	9.7	233	2252	0.35	CalTrans
	1957-72	15	8.5	5.2	233	1214	0.35	
	1972-89	17	1.5	0.2	233	45	0.01	
	1957-89	32	7.7	5.4	233	1260	0.17	
	1929-89	50	17.0	15.1	233	3511	0.30	
Hwy 101 Bridge East Span	1957-91	34	6.7	4.1	228	935	0.12	Lehre/CalTrans
Hwy 101 Bridge West Span	1957-72	15	9.3	4.2	229	968	0.28	CalTrans
	1972-89	17	2.6	0.5	229	125	0.03	
	1957-89	32	8.2	4.8	229	1093	0.15	

Volume of bed erosion since 1960

To estimate the volume of material removed from the Mad River by bed erosion, I divided the channel into four relatively homogeneous reaches (Hatchery to Blue Lake Bridge, Blue Lake Bridge to Railroad Bridge, Railroad Bridge to Hwy. 299, and Hwy. 299 to Hwy 101). Trinity Restoration Associates delineated and digitized the boundaries of the active channel on blowups of airphotos taken in 1954, 1988, and 1992, and provided me with estimates of channel area for each reach (Table 3.9). I estimated the volume of material lost from each by multiplying the area of each reach by the average of the mean lowering rates at each end. These computations are shown in Table 3.10. Approximately 5.5 million cubic yards of material were removed by bed lowering in the period 1962-1992, or about 185,000 cubic yards per year.

Table 3.9 -- Areas of active channel, 1954-1992

	Area of Active Channel, ft^2				
	Hatchery to Blue Lake Br	Blue Lake Br to Railroad Br	Railroad Br to Hwy 299 Br	Hwy 299 Br to Hwy 101 Br	Total
1954	4,773,000	15,980,000	4,299,000	6,195,000	31,247,000
1988	6,451,000	16,575,000	3,867,000	4,562,000	31,455,000
1992	4,410,000	11,161,000	3,897,000	4,331,000	23,799,000
mean	5,211,333	14,572,000	4,021,000	5,029,333	28,833,667

Table 3.10 -- Mad River bed erosion volumes, 1962-1992

Note: To reduce round-off error when summing and averaging, quantities in Table 3.10 are given to more significant figures than justified; individual values should be rounded to the nearest ten-thousand before citation or use.

Reach	Mean Active Channel Area ft^2	Lowering Rate Upper End ft/yr	Lowering Rate Lower End ft/yr	Mean Lowering Rate ft/yr	Volume removed ft^3	Volume removed yd^3
Hatchery to Blue Lake Br	5,211,333		0.18	0.18	28,141,200	1,042,267
Blue Lk Br to Railroad Br	14,572,000	0.18	0.12	0.15	65,574,000	2,428,667
Railroad Br to Hwy 299 Br	4,021,000	0.12	0.26	0.19	22,919,700	848,878
Hwy 299 Br to Hwy 101 Br	5,029,333	0.26	0.16	0.21	31,684,800	1,173,511
Total (1962-1992)	28,833,667	—	—	—	148,319,700	5,493,322
Yearly average (1962-1992)	—	—	—	—	4,943,990	183,111

Bed sediment budget for the Mad River channel between hatchery and Highway 101

Comparison of recruitment and extraction volumes: A simple but instructive bed sediment budget for the lower Mad River channel can be developed by comparing the mean annual volume of bedload recruitment to that removed by gravel mining. Based on data supplied by individual gravel extractors and the U.S. Bureau of Mines, the *minimum* volume of gravel removed from the reach since 1960 is about 13.6 million cubic yards (Table 3.11, Figs. 3.6 and 3.7), or an average of 425,000 yd^3/year. My best estimate of long-term *average* annual recruitment is about 150,000 yd^3/yr, with 200,000 yd^3/yr an upper limit. This indicates that, on the average, somewhere between 225,000 to 275,000 yd^3/yr are removed *in excess of annual resupply*. (That is, sustained yield is being exceeded by 225,000 to 275,000 yd^3/yr over the long term.) Note that this deficit is about the same size as the average annual bed degradation volume of 185,000 yd^3/yr. This strongly suggests that gravel extraction substantially in excess of long term sustained yield is responsible for virtually all of the of the bed lowering observed in the past 30 years. These computations are summarized in Table 3.12.

Comparison of bedload transport rates at Arcata and Blue Lake: Comparison of measured bedload transport at the Arcata (Hwy. 299) and Blue Lake (hatchery) gages provides a second means for assessing the relation of gravel extraction to bed lowering. Using Brown's (1975) bedload rating curves, estimated 1962-1992 mean annual bedload discharge is 127,000 yd^3/yr at Blue Lake and 31,000 yd^3/yr at Arcata (Table 3.3). Thus, if these estimates can be trusted, some 96,000 yd^3/yr is "lost" between the hatchery and Highway 299 -- removed from bedload transport by bed aggradation (deposition), particle breakdown, or gravel extraction.

Between the hatchery and Highway 299, 1962-1992 mean annual gravel extraction was a minimum of 233,000 yd^3/yr (data from Table 1.1). For the same period, bed lowering upstream of Highway 299 yielded 144,000 yd^3/yr (Table 3.10). The difference between volume extracted and that accounted for by bed lowering in the reach -- 89,000 yd^3/yr -- *must* be supplied by new recruitment from upstream.

Thus gravel extraction would not only account for *all* the observed bed lowering, but would also cause annual gravel transport at Highway 299 to be about 89,000 yd^3/yr less than that at the hatchery. This is virtually identical to the 96,000 yd^3/yr difference obtained from Brown's (1975) data.

Comparison of cumulative extraction and bed lowering: Finally, additional proof that bed lowering is strongly connected to gravel extraction is provided by Fig. 3.8. Here I have plotted cumulative bed lowering measured at the 299 and 101 bridges against cumulative gravel extraction upstream. The nearly straight-line relationship between extraction and bed lowering at the 299 bridge is quite striking, and strongly suggests that the two are causally linked.

Further downstream at the 101 bridge, Fig. 3.8 and the data in Tables 3.8 and 3.12 suggest that 1) little coarse bed material currently reaches the site -- it is all removed upstream; and 2) after 1972 the gradient had been flattened enough that little further bed erosion was able to occur, even though the stream was starved for sediment. This hypothesis is consistent with field observations that the bed at the 101 bridge is weedy and covered with finer sediment.

Table 3.11 -- Mad River bed lowering and cumulative gravel extraction, 1957-1992

Note: To reduce round-off error when summing and averaging, quantities in Table 3.11 are given to more significant figures than justified; individual values should be rounded to the nearest ten-thousand before citation or use.

year	cum volume extracted abv 299 since 1952 yd^3	cum volume extracted abv 299 since 1960 yd^3	cum mean lowering at 299 ft	cum volume extracted below 299 since 1952 yd^3	cum volume extracted below 299 since 1957 yd^3	total cum volume extracted since 1952 yd^3	cum total volume extracted since 1957 yd^3	cum mean lowering at 101 ft
1957	570,000			617,030	0	1,187,030	0	0.0
1960	905,000	0	0.0	1,088,272	471,242	1,993,272	806,242	
1972	3,953,499	3,048,499	4.3	4,627,731	4,010,701	8,581,230	7,394,200	5.2
1989	7,487,094	6,582,094		7,331,104	6,714,074	14,818,198	13,631,168	5.7
1991	7,926,105	7,021,105	7.8	7,508,884	6,891,854	15,434,989	14,247,959	
1992	8,078,722	7,173,722	7.8	7,508,884	6,891,854	15,587,606	14,400,576	

Table 3.12 -- Simple sediment budget for Mad River channel between hatchery and Hwy. 101

mean annual recruitment yd^3/yr	mean annual extraction yd^3/yr	recruitment - extraction yd^3/yr	mean bed lowering yd^3/yr
150,000 (best est)	425,000	–275,000	185,000
200,000 (max est)	425,000	–225,000	185,000

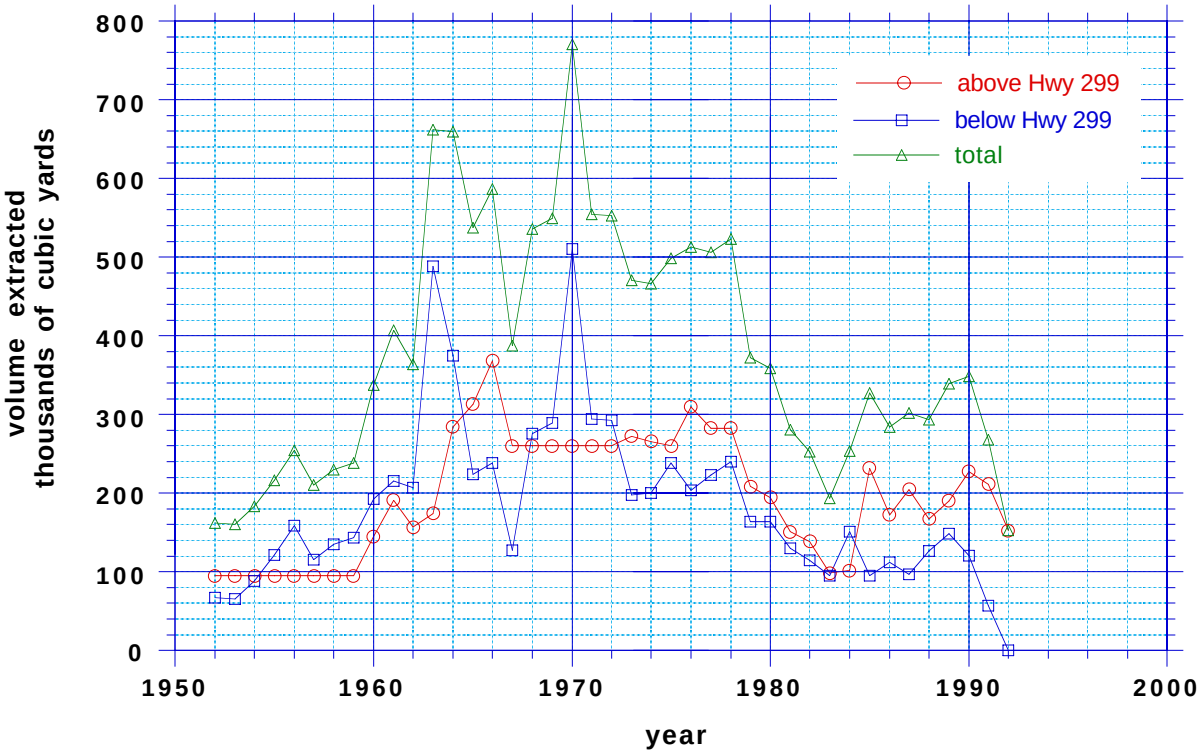


Fig. 3.6 -- Minimum yearly gravel extraction on the Mad River, 1952-1992

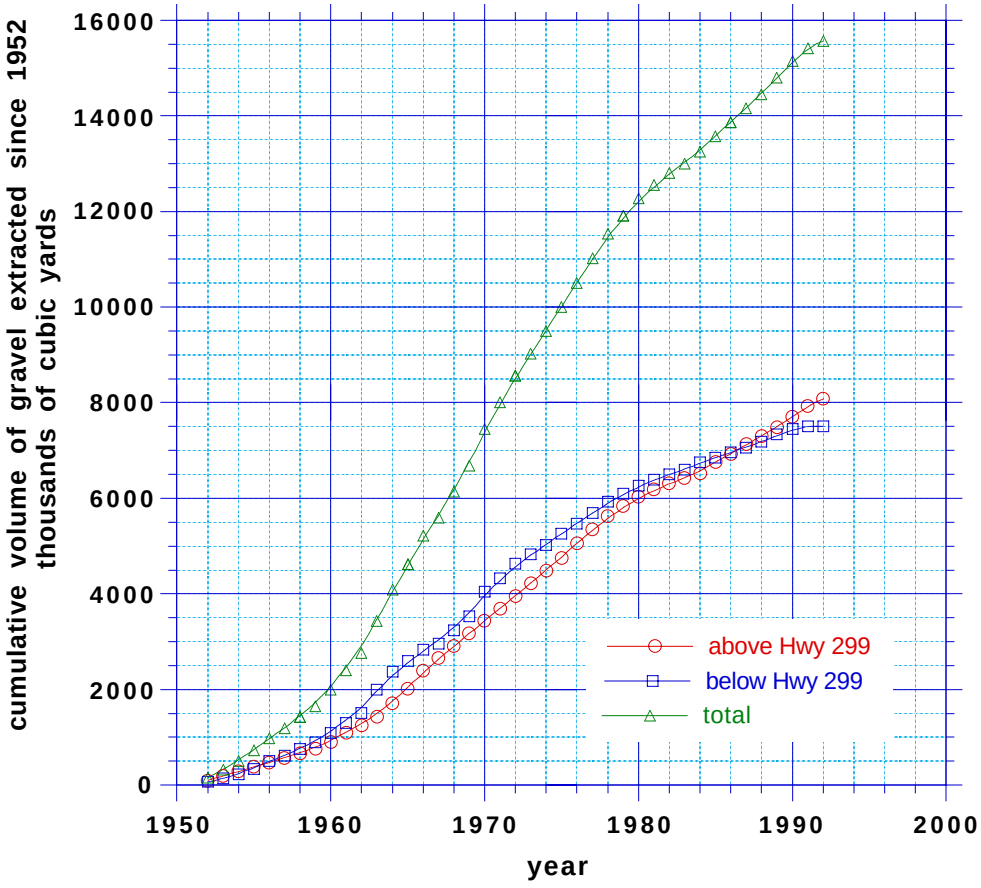


Fig. 3.7 -- Cumulative minimum gravel extraction from the Mad River 1952-1992

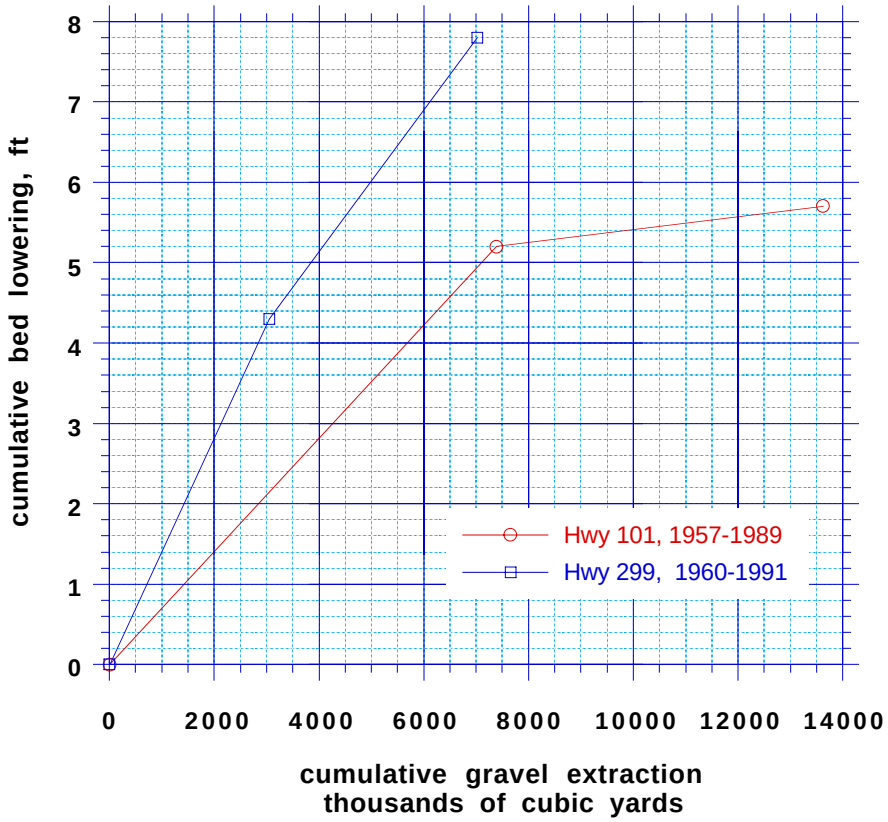


Fig. 3.8-- Cumulative bed lowering vs. cumulative gravel extraction on the Mad River since 1957. Relation is based on data in Table 3.11.

MANAGEMENT IMPLICATIONS

The recruitment study and analysis of bed degradation strongly suggest that the lowering of the Mad River channel observed over the last thirty years is not some short-term phenomenon related to the recent drought, but rather the response of the channel to the long-term and persistent removal of gravel in excess of what the river can resupply from upstream. The study suggests that long-term mean annual recruitment is probably less than 150,000 yd^3/yr, with 200,000 yd^3/yr certainly a maximum. Average annual removal by gravel extractors over the past thirty years is a *minimum* of 425,000 yd^3/yr; the deficit has resulted in continued bed lowering. The bed will continue to degrade as long as extractions generally outpace resupply, or until the channel 1) encounters resistant underlying bedrock or 2) reduces its gradient to the point where it is incapable of effectively transporting coarse bedload. None of these are particularly desirable alternatives, either from the standpoint of extractors, those interested in river ecology, or other river users such as CalTrans and HBMWD.

We can see the first instance, degradation to bedrock or underlying more resistant materials, beginning to occur around the Hwy. 299 bridge. Large rocks have started to poke up out of the channel above the bridge, the bridge footings are being undermined, and older, silt-and-clay rich sediments are beginning to be exposed in the vicinity of the Johnson-Spini bar, making extraction there less desirable.

The second instance, reduction of gradient to one where little transport of coarse sediment occurs, appears to have happened at the 101 bridge. Between 1929 to 1972 the riverbed there dropped an average of ten feet. Since 1972 it has lowered only 0.2 - 0.5 foot. The river there is pool-like at low flow and fine sediment and aquatic plants cover the bottom. It is possible that the rapid northward migration of the Mad River mouth and the concomitant growth of the estuary may be in due, at least in part, to lack of recruitment of sufficient sediment from upstream. The sediment budget and observations at Hwy. 101 suggest that little coarse sediment is making it way to the mouth. The implications of this need to be investigated.

Bed lowering has already compromised the seismic stability of bridges crossing the Mad River and bridge footings are being undermined or exposed and will require replacement or remedial work (Dennis McBride, pers. communication). Bed lowering in the HBMWD reach has threatened the usability of Pump Station 6, and the reduced gravel thickness over the Ranney collectors reduces natural filtration. Continued bed lowering will only make matters worse. Thus it would seem prudent to manage gravel extraction in such a way that it does not exceed annual recruitment.

I wish to emphasize that bed lowering is a persistent, long-term phenomenon related to long-term average replenishment and extraction rates, and for sustained yield the river must be managed on that basis. Great fluctuations in supply may occur from year to year, depending on whether we have droughts or floods, but in the long term, lean years will be balanced by fat years and vice versa. A long-term mean annual extraction volume could be set, and extractors would have to manage their operations to live within that. It would be reasonable to mine more than the annual recruitment in a dry year, realizing though that this would mean that in a wet year merchantable gravel would have to be left behind in compensation. Such a strategy would provide an even flow to extractors, while preventing continued bed lowering. Bed elevations might fluctuate from year to year, but if the long-term balance is kept there will be no net degradation.

If the river is to be kept in its current state, on the basis of current knowledge I recommend that mean total extraction on the Mad River not exceed 150,000 yd^3/yr. If the management objective is not simply to maintain the status quo, but to induce aggradation (recovery of bed elevation) it would be reasonable to limit mean total extraction to no more than 100,000 yd^3/yr. River bed elevations and cross-sections should monitored. Long-term extraction targets could then be adjusted upwards or downwards depending upon the observed river response.

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Addendum to Mad River EIR Technical Supplement Section 3:
Estimation Of Mad River Gravel Recruitment And Analysis Of Channel Degradation

Prepared by Andre Lehre -- 22 December 1994

Estimation of bedload transport from filling of Sweasey Dam

An independent estimate of mean bedload transport rate in the Mad River is provided by the filling of Sweasey Dam. Sweasey Dam was constructed in 1938 to provide water supply for the city of Eureka. It was located about 5 mi upstream from the Blue Lake gage and impounded a 3,000 acre-foot reservoir (Brown, 1975, p. 47). The reservoir filled with sediment during floods in the 1950's, and was not functional for water-supply purposes by the early 1960's (Brown, 1975). The dam was removed by dynamiting in August, 1970. According to Brown (1975, p. 49) more than 2,000 acre-feet of sediment, mostly gravel and sand, was deposited behind the dam.

The mean annual bedload transport rate at Sweasey Dam can be computed by dividing the volume of sediment behind the dam by the number of years it took to fill. A maximum transport rate can be estimated by assuming that the entire reservoir capacity was filled and that filling was complete by 1960. A minimum transport rate can be calculated by assuming that only 2,000 acre-feet of the reservoir were filled and that filling was not complete until 1970. These bedload transport estimates are given in the table below.

Addendum Table 1 -- Bedload transport estimates from filling of Sweasey Dam

estimate	fill volume acre-feet	fill volume yd^3	time span	fill time yr	transport rate yd^3/yr	transport rate tons/yr
maximum	3000	4,840,000	1938 - 1960	22	220,000	308,000
intermediate	3000	4,840,000	1938 - 1970	32	151,000	212,000
minimum	2000	3,230,000	1938 - 1970	32	101,000	141,000

Between Sweasey Dam and the Blue Lake gage, only one significant tributary, Canon Creek, enters. The amount of bedload it contributes to the system is unknown, but an estimate of its *maximum* possible contribution can be obtained by assuming that *all* the difference in bedload between the Kneeland and Blue Lake gages comes from Canon Cr. From the estimates in Table 3.6, this amounts to about 47,000 yd^3/yr. Since the drainage area of Canon Cr occupies about half of the area between the Kneeland and Blue Lake gages, a more reasonable estimate of its contribution might be 25,000 yd^3/yr.

The estimates of bedload recruitment derived earlier in this report (e.g., Table 3.6; p. 15) were on the order of 100, 000 - 200,000 yd^3/yr. The estimates derived from the filling of Sweasey Dam are in the same range: 101,000 - 220,000 yd^3/yr for the reservoir alone, and 125,000 - 245,000 yd^3/yr if Canon Cr is included.

Section 3 Appendix: Cross-sections used in calculation of bed degradation

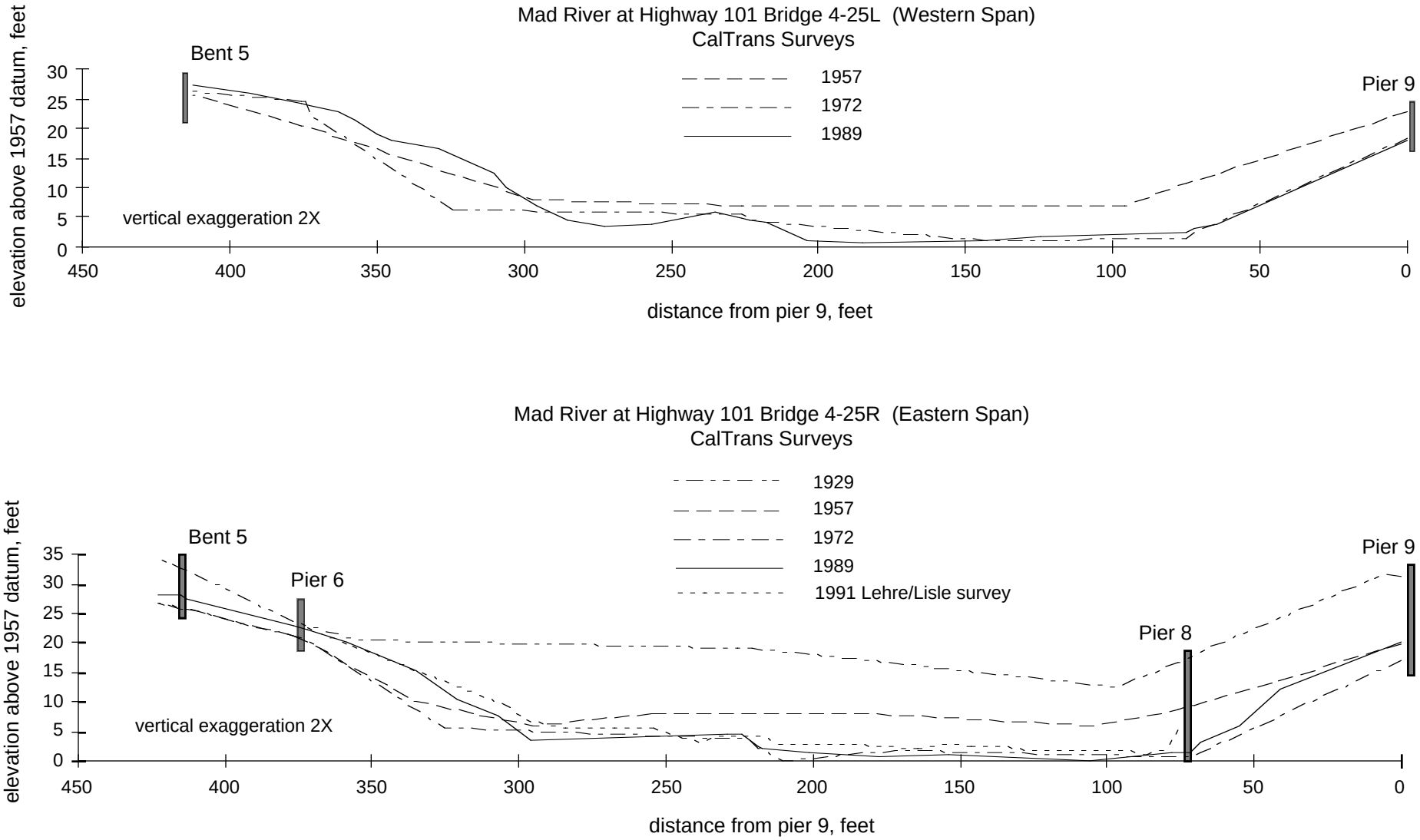


Fig. 3.A1 -- Cross-sections of the Mad River at Highway 101 bridge

View is downstream.

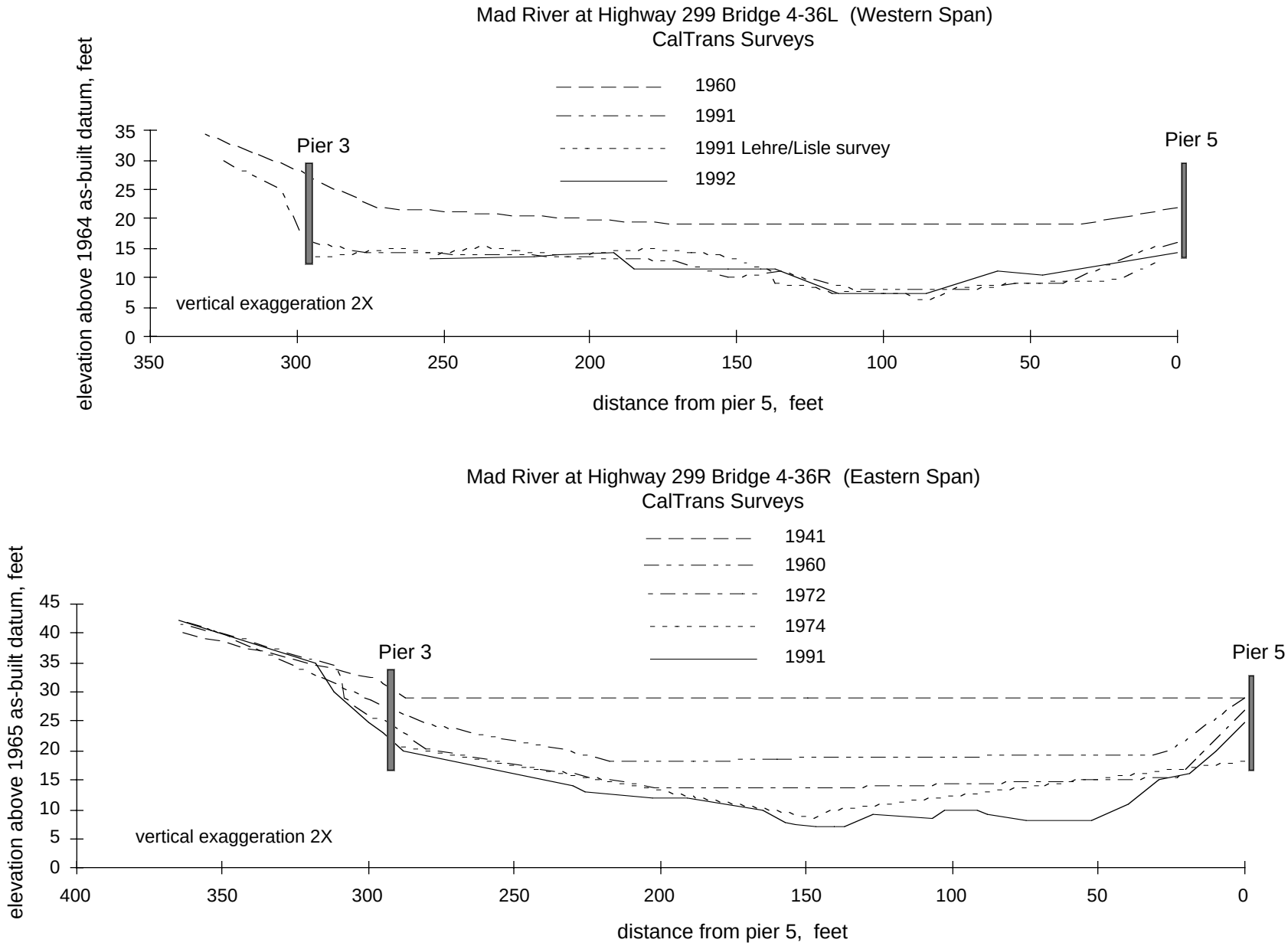
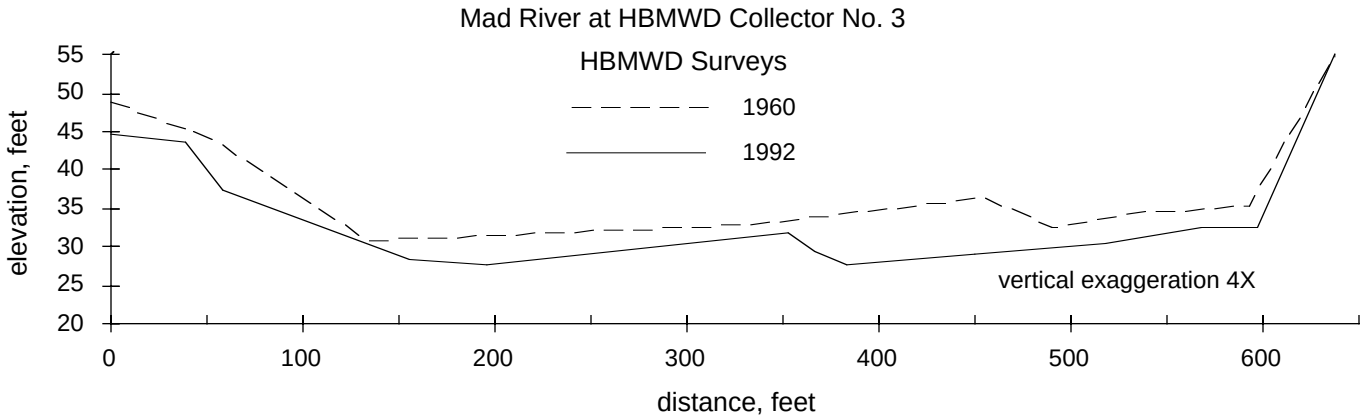
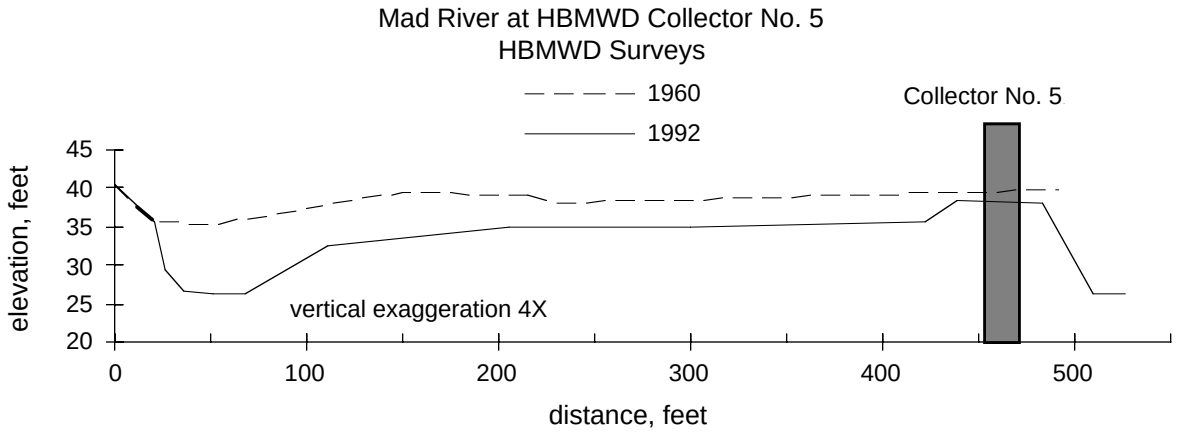


Fig. 3.A2 -- Cross-sections of the Mad River at Highway 299 bridge

View is downstream.





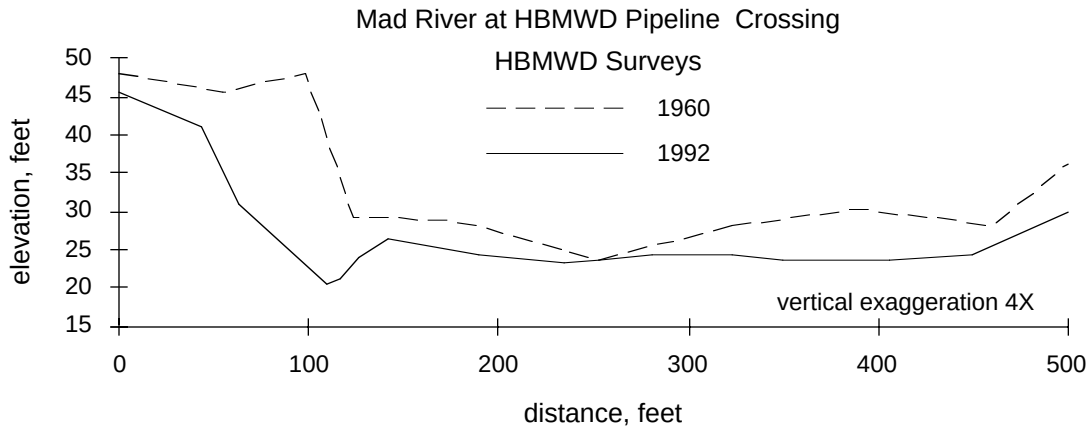


Fig. 3.A3 -- Cross-sections of the Mad River in the HBMWD reach

View is downstream.

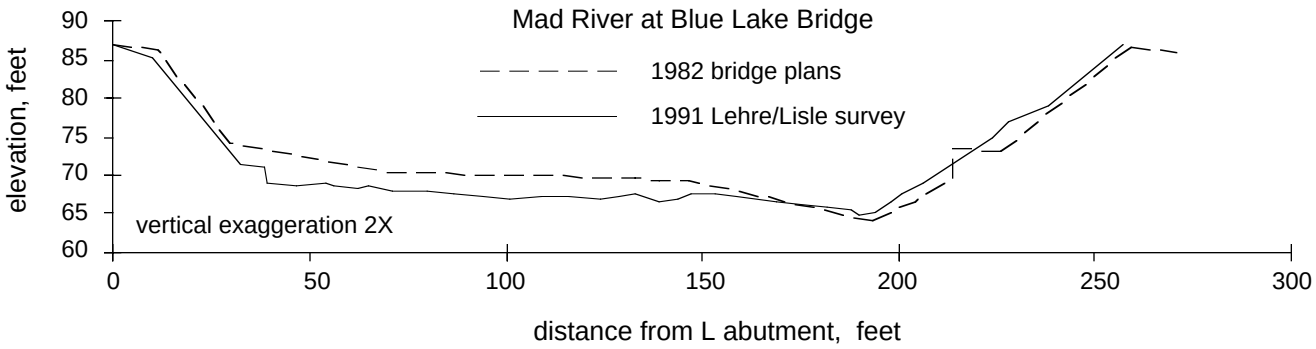


Fig. 3.A4 -- Cross-sections of the Mad River at Blue Lake (Hatchery Road) Bridge

View is downstream.

Mad River EIR Technical Supplement

Section V. Fisheries Inventory and Analysis

INTRODUCTION

Our investigation of the Mad River fishery centered on the lower mainstem channel from Mad River Hatchery to the Mad River estuary. We will not evaluate potential effects of the Blue Lake Hatchery, sport and commercial fishing, or timber harvest practices on the fishery. Rather, we present: (1) a list of species sampled in the basin, (2) a review of rearing and spawning timing for anadromous species, (3) description of rearing and spawning habitat requirements, use, and availabilty in the lower mainstem Mad River, then (4) focus on fishery concerns for the project reach concerning gravel extraction.

The following fish species have been found in the Mad River Basin, including the estuary (CDFG 1968):

Common Species

Chinook salmon	*Oncorhynchus tshawytscha*
Coho salmon	*O. kisutch*
Steelhead	*O. mykiss*
Rainbow trout (resident)	*O. mykiss*
Coastal cutthroat trout	*O. clarki*
Three-spine stickleback	*Gasterosteus aculeatus*
Riffle sculpin	*Cottus gulosus*
Coastrange sculpin	*Cottus aleuticus*
Staghorn sculpin	*Leptocottus armatus*
Shiner surfperch	*Cymatogaster aggregata*
Sacramento sucker	*Catostomus occidentalis*
Eulachon	*Thaleichthys pacificus*
Pacific lamprey	*Entosphenus tridentatus*

Infrequent Species

Sturgeon	*Alosa sapidissima*
Pink salmon	*Oncorhynchus gorbuscha*
Chum salmon	*O. keta*

Species of Unknown Status

Catfish	(sp?) Introduced in 1881.
Japanese ayu	*Plecoglossus altivelis* Introduced to Ruth Reservoir in 1964.

Presently, five anadromous salmonid spawning runs occur in the Mad River drainage: fall chinook salmon, coho salmon, winter steelhead trout, summer steelhead trout, and coastal cutthroat trout. Other anadromous salmonid species are infrequently observed. For example, in 1952, Elton Bailey, in a letter to Dick Hallock (October 23, 1952), noted "Incidentally, we

took a male pink salmon in one of our seine hauls. It was in good shape and with free flowing milt."

The numerically dominant fish species in the lower mainstem (observed during everal dives in 1992) are juvenile steelhead and three-spine sticklebacks. The broad, sandy runs common in the study reach provide excellent foraging habitat for the sticklebacks.

GENERAL REARING AND SPAWNING TIMING IN THE MAD RIVER BASIN

Chinook Salmon

The chinook salmon of the Mad River exhibit the "ocean-type" behavior defined by Healey (1991) as those populations that "migrate to sea during their first year of life, normally within three months after emergence from the spawning gravel, spend most of their ocean life in coastal waters, and return to their natal river in the fall, a few days or weeks before spawning."

Adult chinook enter the Mad River with the first "substantial" fall rains in October or November (Pelgen and Fisk 1958). Historically, the first high flow event would breach the sand bar that often closed the mouth during summer low flow periods. In years when the mouth remained open, chinook entered the river as early as August, but upstream migration was often blocked by dry or extremely shallow sections a few miles from the mouth (Pelgen and Fisk 1958). Based on adult trapping data from the Mad River Hatchery, the run may extend from late August through mid February, but more typically from late-October through mid-January. Counts at the Sweasey Dam fish ladder from 1949 through 1963 indicate the peak migration usually occurs in November (approximately 75 percent), with around 15 percent in October, 10 percent in December, and less than 1 percent in January and February (CDFG 1968). Bailey (1952) reports most upstream migration occurs during the day.

Information on the timing of Mad River chinook spawning is lacking. CDFG redd counts indicate most spawning occurs in December, though poor visibility in the Mad River during the fall and winter greatly hampers direct observation. A December peak concurs with Healey's observation (1991) that chinook populations in the southern portion of their range spawn from November to January. Data on redd construction in the Mad River were not found, though chinook salmon are known to construct larger redds than other Pacific salmon species. Healey (1991) reports a range in redd surface area from 0.5 to 44.8 m^2.

The largest documented Mad River chinook salmon captured weighed 73 pounds in 1895 (Ridenhour, Johnson, and Skeesick 1961). Fish greater than 50 pounds were common until approximately 1925, when fishermen noticed declines in salmon numbers and size (Ridenhour, Johnson, and Skeesick 1961). The commercial catch in the early 1900's averaged 3 to 4 chinook salmon for every coho salmon.

The fecundity, incubation and emergence of naturally reproducing chinook salmon in the Mad River are poorly understood. Bailey (1952) calculated average fecundities of 4,421 and 4,750 eggs for chinook taken at the Sweasey Dam fish ladder in the 1950-51 and 1951-52 spawning seasons respectively. Average fecundities also are available from Mad River Hatchery reports. Barngrover (1990) estimated an average chinook salmon fecundity 3,813 eggs/female in 1988-1989 at the Mad River Hatchery. Chinook fecundity generally increases with fish size, though not to the degree reported for other species (Healey 1991). Chinook eggs spawned in the fall usually hatch by March or April, with alevins remaining in the gravel two to three

weeks thereafter (Moyle 1976). Naturally spawned chinook in the Mad River probably emerge from the gravel in late-February through early-May.

CDFG downstream migrant trapping records indicate downstream smolt and pre-smolt migration begins in April, peaks in early to mid-June, and tapers to completion in late-July (Bailey 1952; CDFG 1968). Bailey (1952) also noted most downstream migration in the Mad River occurs at night, typical for the species (also Healey 1991). In his study of estuarine residence and out-migration of juvenile chinook in the Mad River, Taniguchi (1970) reported smolts first entered the estuary in early April leading to a peak in early June with peak outmigration from the estuary occuring in early July. Taniguchi (1970) also noted although the size of smolts entering the estuary in 1952 and 1969 differed significantly, the sizes on out-migration from the estuary were comparable, indicating a possible "optimum size for sea water adaptation." No studies have addressed salmonid habitat preferences in the Mad River estuary.

Coho Salmon

Adult coho may enter the Mad River as early as October but do not run in large numbers until stream flows have increased substantially (CDFG 1968). Based on adult trapping data from Mad River Hatchery, the run may extend from late-September through mid-February, but more typically from late-October through mid-January. Counts at the Sweasey Dam fish ladder from the late 1940's to the early 1960's indicate that coho stocks native to the Mad River may exhibit substantially different monthly migration patterns than the introduced Klaskanine and Quilcene strains (CDFG 1968). Most native coho migrate upstream in December, while introduced stocks peak in October (CDFG 1968). Shapovalov and Taft (1954) noted 81 percent of the total coho run passing over Sweasey Dam from 1941 through 1953 occurred in six weeks between November 12 and December 23. Most upstream coho migration takes place during the day (Sandercock 1991).

Downstream smolt migration, after rearing in the tributaries for one year and several months, peaks from mid-May through June and extends into July (Boydstun 1974).

Steelhead Trout

Steelhead trout exhibit more variable life history strategies, relative to chinook and coho salmon. Most Northern California steelhead juveniles spend one or two years in freshwater before migrating to the ocean, but three and four year freshwater residencies are found (Meehan, 1991; Trush, unpubl. data). Boydstun (1974) presents an adult scale analysis documenting a similar life history pattern for Mad River steelhead. Often, yearling and older juveniles will gradually migrate downstream. Unfortunately, most research on steelhead life history has been confined to the tributaries. Boydstun (1974) inventoried 89 miles of suitable steelhead spawning habitat in the basin's tributaries (i.e., available rearing miles). Though processes can be identified (e.g., juveniles grow as they slowly migrate downstream), the quantitative significance of each process for a basin's fish population is difficult to determine. In this example, how many two-year old juvenile steelhead depend on the mainstem channel for additional growth, compared to the number of two-year old juveniles rearing in the tributaries, then quickly migrate to the Pacific Ocean? This cannot be answered for the most studied large river in California.

Boydstun (1974) reported earlier downstream trapping at Sweasey Dam by CDFG documented most age classes were migrating from May 1 through August 1 (the sampling period), peaking in July.

Adult winter steelhead can enter the Mad River at the same time as chinook salmon (late-August), though most of the run enters later in the winter. For example, Bailey (1953) seined 252 chinook salmon and four steelhead in the Bugenig and Carson holes from October 10 to November 1952. Peak migration usually occurs from December to late February, overlapping the coho runs more than chinook runs. Boydstun (1974) suggests (on page 49) an early winter stock was present, but in low numbers. The Mad River also supports a half-pounder run of unknown size (Boydstun 1974). Spawning can occur from late-December to mid-April, depending on annual flows. Weekly salmon and steelhead counts for the Mad River Hatchery 1988 to 1989 demonstrate a typical spawning year and the timing relationships among species (Table V.1).

A run of summer steelhead, a stock of special concern (Moyle et al. 1989), enter the river in late-spring (Knutson 1975). These steelhead hold in the lower mainstem channel through the summer. Adults captured at Sweasey Dam in May were believed to be summer steelhead (Boydstun 1974) because they "lacked the physical characteristics of sexually mature fish."

Table V.1. Weekly adult salmon and steelhead trapping data for Mad River Salmon and Steelhead Hatchery, 1988 to 1989 (Barngrover 1990).

Week of:	Chinook Salmon		Coho Salmon		Steelhead
	Adult	Grilse	Adult	Grilse	Adult
Nov. 6	108	32	69	71	12
Nov. 13	26	24	106	153	69
Nov. 20	5	9	25	96	53
Nov. 27	2	9	15	121	41
Dec. 4	11	9	9	25	19
Dec. 11				2	1
Dec. 18			1		3
Dec. 25	2		12	56	197
Jan. 1	4		28		239
Jan. 8		8	18		151
Jan. 15				11	400
Jan. 22	1		2	7	258
Jan. 29			1	1	96
Feb. 5			1	2	161
Feb. 12					125
Feb. 19			5		64
Feb. 26					278
Mar. 5					167
Mar. 12					165
Mar. 19					30

JUVENILE ANADROMOUS SALMONID REARING HABITAT

All newly-emerged salmonid fry aggregate in shallow water at the stream margins, often associated with overhanging cover, backwaters, and eddies created by instream structure (Hartmann 1965; Healey 1991).

Egg survival in the basin may be low. Boydstun (1974) notes, "Turbidity has probably limited the Mad River salmon and steelhead sport fishery more than any other factor. Heavy silt loads of over 1000 ppm prevail during winter floods. Experimental incubation of king salmon eggs at Sweasey Dam in 1960-61 resulted in heavy losses due to siltation. It is assumed that survival of naturally spawned eggs in the river and tributaries is probably affected similarly by this problem."

As fry grow, they progressively move to deeper, swifter water where interspecies competition may become important. However, steelhead juveniles tend to occupy swifter, shallower riffles and runs , compared to coho juveniles that prefer slower flowing habitats (especially pools with abundant woody debris) (Meehan 1991). For coastal streams in British Columbia, Hartman (1965) observed both species occupy different microhabitats; coho salmon utilized pools and steelhead occupied riffles.

Annual peak downstream migration, in the river and entering the estuary, occurs at the same time, indicating Mad River juvenile chinook spend little time rearing in the lower mainstem (CDF&G[1] 1968; Taniguchi 1970). The estuary could serve as the primary rearing habitat until outmigration to the ocean. No studies to date have quantified or assessed juvenile salmonid habitat in the Mad River estuary or lower mainstem. On July 15, Don La Faunce (CDFG 1976, letter to Region 1) noted the Mad River at the Highway 299 bridge was almost dry. Over a 0.25 mile reach, from the lowermost water collector to the bridge, CDFG found 300 juvenile steelhead (2.5 to 6.0 inches long) and 300 juvenile chinook salmon (2.5 to 3.0 inches long). While these counts cannot be used for fish density estimation, the data do show juvenile salmon occupy the channel in mid-July. No juvenile coho salmon were found.

Snorkel surveys of the lower Mad River indicate large woody debris may provide critical cover in an otherwise "cover-limited" stream. On October 17, 1992, Terry Roelofs (HSU), Bill Trush (HSU), Brian Winters (CDFG), and eight Humboldt State University Fisheries students snorkeled several sections of the lower mainstem, including the reach above the railroad bridge to the Eureka Sand and Gravel Bar (below Blue Lake Bridge). The purpose of the survey was to estimate abundances of rearing juveniles and adult spawners. Few juveniles were observed. Four yearling steelhead were seen under the bridge abutment of the railroad bridge. Four young-of-the-year steelhead were counted in the eddy of a six foot boulder, approximately 300 feet upstream of the railroad bridge. No other salmonids were observed (sticklebacks and suckers were abundant). Divers noted juvenile steelhead were usually associated with large woody debris. Woody debris and undercut banks (uncommon in lower mainstem) are critical over-wintering habitat for both species (Hartman 1965).

UPSTREAM MIGRATION AND SPAWNING HABITAT

Chinook salmon, coho salmon, steelhead trout, and cutthroat trout spawn in tributaries and the mainstem of the Mad River Basin. All anadromous species are prevented from utilizing the entire basin by natural barriers. On the mainstem, a twenty five foot waterfall approximately

24 miles above the Sweasey Dam site, roughly 0.5 miles below the Bug Creek confluence, stops upstream migration (CDWR 1958). A steep cascade five miles upstream from the mouth of the North Fork Mad River also prevents salmon migration and greatly restricts steelhead access. Removal of both barriers would approximately double basinwide anadromous fish spawning habitat at the time of this assessment (CDWR 1958).

Principal spawning tributaries downstream of the Mad River Hatchery are the North Fork Mad River, Lindsay Creek, Mill Creek, and Warren Creek (Plate 2). Lindsay Creek, the largest tributary downstream of the North Fork, has approximately 7 miles of spawning habitat (McCormick 1956). Lindsay Creek has the dual distinction of being been cited as "Lindsey has the reputation of being the best local stream for cutthroat trout fishing" (McCormick 1956) and "Lindsay Creek is the most important silver salmon tributary in the Mad River drainage" (CDFG Water Projects Branch 1968). McCormick (1956) estimated 200 to 250 coho salmon, 50 chinook salmon, a few steelhead trout, and an unknown number of cutthroat trout spawn annually in the creek. A USFWS investigation (1967), responding to a proposed dam on Linsay Creek by the Army Corps of Engineers, estimated 1000 coho salmon, 800 chinook salmon, and 800 steelhead trout annually spawned.

The best record of upstream adult migrants is the Sweasey Dam fish ladder counts from 1938 to 1964 (Table V.2). Boydstun (1974) notes the Sweasey Dam counts represent approximately ten percent of the annual spawning run. While chinook salmon, coho salmon, and steelhead trout exhibit decreasing numbers over the counting period, the variation between successive years is considerable (e.g., the coho salmon count in 1962). Migration blockage by the ladders probably underestimate run size at the dam (Ridenhour, Johnson and Skeesick 1961). Annual anadromous fish runs to the Mad River Hatchery have been extremely variable (Barngrover 1990) during operation of the hatchery from 1971 to the present (Table V.3). Operation of the fish weir and various stocking efforts (e.g., a 1957 coho salmon stocking program) also affected continuity of the record, .

Few annual salmon run estimates are available below the Sweasey Dam site. Ridenhour, Johnson, and Skeesick (1961) estimated an annual chinook salmon run of 10,000 fish in 1905 using cannery records. In the early 1950s, CDFG attempted to quantify the total annual chinook spawning run. Bailey (1953) estimated, from their mark-recapture results, 6,320 adult chinook entered the river in the 1952 spawning run. Tagging was accomplished by seining and tagging 252 fish from three pools in the tidal zone. Recovery of tagged salmon were from three sources: carcass recoveries, Sweasey Dam fish ladder counts, and angler catch. Gibbs (1955) estimated 3900 chinook salmon entered the river in 1954 using similar methodologies (however, only 82 chinook were tagged in the mark-recapture experiment). Given the large error in mark-recapture methodologies, both annual chinook population estimates must be considered extremely conservative.

Salmon and steelhead do spawn in the study reach. During the 1977 drought year, forty redds were observed by CDFG from Mad River Hatchery downstream to the 101 Highway Bridge (Temple and Hansen 1977). "Most" redds were sighted above the railroad bridge. A CDFG (1992) redd survey documented eight steelhead redds from Mad River Hatchery to Blue Lake Bridge.

Only limited data are available on direct consequences of changing channel morphology on adult anadromous fish holding habitat and upstream access within the study site. We were unable to inventory potential spawning sites in January through March of 1993 because of high flows and extreme water turbidity. A CDFG report (1956), on riffle dimensions from the

Essex Diversion to the Pifferini Riffle, documented one riffle in a gravel operation (below the 299 Bridge 605 feet long and 80 feet wide at 22.8 cfs on August 23, 1956. The greatest water depth across a transect through the riffle was 0.2 feet. Another riffle at an unspecified gravel operation was 43 feet long but 140 feet wide with a maximum water depth of 0.2 feet. Water depths at this low flow (22.8 cfs) may not be a barrier because migration would not have commenced (an average velocity of 1.4 fps). A 100 cfs flow, a potential spawning flow early in the fall, would average 0.63 feet deep at the first site (assuming velocity of 2.0 fps and no change in width), below the minimum migration depth of 0.80 feet (McLeod 1987).

Table V.2. Sweasey Dam anadromous fish counts (CDFG 1968).

Year	Chinook	Coho	Steelhead
1938	1273	498	3110
1939	1257	725	3118
1940	1293	73	5706
1941	3139	308	4583
1942	1676	378	6650
1943	1236	259	4921
1946	1181	415	5106
1947	717	510	3582
1948	672	515	3139
1949	484	512	4074
1950	1505	147	4430
1951	1519	414	5543
1952	401	72	5613
1953	847	91	2943
1954	409	59	2390
1955	390	2	148
1956	129	21	2717
1957	494	11	1957
1958	478	3	1780
1959	19	541	1376
1960	55	244	1343
1961	40	710	1985
1962	238	3580	1708
1963	232	1419	2178
1964	492	332	373

Table V.3. Summary of salmon and steelhead runs to Mad River Salmon and Steelhead Hatchery (Barngrover 1990).

Year	Chinook		Coho		Steelhead
	Adults	Grilse	Adults	Grilse	
1971-1972	238	85	268	69	42
1972-1973	656	380	235	231	52
1973-1974	390	105	281	46	1086
1974-1975	181	50	141	19	311
1975-1976	94	184	506	1597	190
1976-1977	478	661	217	976	658
1977-1978	163	87	452	194	1191
1978-1979	56	190	73	524	2190
1979-1980	128	17	129	223	1411
1980-1981	66	20	162	341	730
1981-1982	38	213	78	135	442
1982-1983	648	900	149	473	1087
1983-1984	313	124	22	65	774
1984-1985	34	48	20	4	585
1985-1986	177	98	38	7	753
1986-1987	227	72	59	265	13807
1987-1988	568	278	220	733	4303
1988-1989	159	83	254	591	2529

SPECIFIC FISHERIES MANAGEMENT CONSIDERATIONS

Specific potential concerns for adult holding habitat and mainstem access within the study reach include:

(1) possible warming temperatures below the Humboldt Water District intakes may inhibit farther upstream migration during low autumn flows.

(2) loss of channel structure (fewer shallower pools and overall decreased amounts of inchannel woody debris) provides poor holding cover.

-The Mill Creek Hole in Elton Bailey's 1953 spawner report was a well known hoding area of upstream spawners. Lowering of the main channel may have affected this hole.

-Dives by Terry Roelofs, Bill Trush, and fisheries students in summer 1992 found holding summer steelhead were associated with woody debris accumulations in fast moving runs and riffles, all unmined channel reaches.

(3) artificially produced pools may concentrate fish in upstream ends (fish utilizing bubble curtain as only cover), increasing vulnerability to poaching and excessive fishing pressure.

-Interviews with local anglers indicate upstream ends of long trenches are "hot spots" for catching salmon and steelhead.

(4) scraped riffles may become too broad to support minimum water access depths during early autumn upstream migration under relatively (compared to typical November flows) low flows.

-Spawner access to the basin has always been a partial function of flow. Low flows in October and/or November often confined adults to the lower channel until sufficient rainfall improved access. For example, in 1952 the mouth remained open through the summer and fall, allowing chinook salmon to enter the river by August 28 (Bailey 1953). However, river

flow did not permit upstream migrants to ascend higher than the North Fork confluence; several river reaches were completely dry until November 14.

Specific potential concerns for spawning habitat within the study reach are:

(1) downcutting of the mainstem could propagate into the tributaries, decreasing or eliminating access by upstream migrating adult salmonids.

-Field inspection of Warren, Lindsay, and Mill Creek confluences found clear evidence of channel downcutting (see Channel Bed and Bank Erosion section). However access does not appear impaired at Warren and Lindsay Creeks. The steep, constructed boulder cascade at the mouth of Mill Creek could be a partial barrier.

(2) alteration of the planform and hydraulic geometry could reduce spawning habitat quality by creating unfavorable water depths and velocities over former spawning beds, and by altering the bed composition of the spawning beds.

-Because of the high flows and extreme turbidity in January through March of 1993, we could not inventory and/or qualify contemporary spawning habitat. Qualitative surveys by Trush in 1991 found many pool tails, on mined and unmined reaches, had sufficient depths and a proper range of velocities for supporting favorable spawning environment. No data are available characterizing gravel bed composition, or assessing changes to gravel composiiton directly attributable to gravel extraction.

(3) channel alterations reduce habitat quantity below the Mad River Hatchery.

-Review of aerial photos indicate (see other sections of this report) a reduction in riffles and an increase in runs. However, aerial photo scale does not permit a more intensive assessment.

(4) greater fishing pressure increases disturbance of spawning fish and increase poaching (when the fish are extremely vulnerable), especially with lack of cover.

Specific potential concerns for rearing habitat and downstream smolt migration in the study are:

(1) loss of riffles (converted to deep runs and trenches) reduces rearing habitat for juvenile steelhead trout and benthic invertebrate production.

(2) lack of woody debris in mined riffles and pools also reduces habitat quality for all rearing salmonid species.

-Lack of habitat structure probably is the major impact of gravel extraction. Without sampling fish densities in channel reaches with and without woody debris, the biological effect of an absence of woody debris was not estimated.

-The right bank channel below Eureka Sand and Gravel but above recent mining (just upstream of the A&MRR bridge) retains the most woody debris in the study reach. This unconfined reach has not been mined for many years, and would function as an excellent future monitoring site.

(3) downstream migration of chinook fry can extend into July. Care should be taken to avoid trapping fish in irrigation inlets and trenching; production of suspended sediment during trenching probably is not physiologically harmful to juveniles, but may force individuals from cover and/or displace others downstream.

(4) invertebrate adundance was not quantitatively assessed due to lack of data. Short (less than 100 feet), steep riffles produced sufficient bed surface coarsening (large gravel and cobbles) to support diverse and dense invertebrate populations (Trush, personal observation). These riffles were unmined.

(5) downstream migrant trapping documents peak salmon migrations during the extraction season, June through July. Juvenile steelhead migrate downstream throughout the summer.

(6) warm summer water temperatures in the lower mainstem (Boydstun 1974; Barngrover 1990) may require juveniles to seek cool water. Stream confluences and intergravel flow at the downstream base of gravel bars should be identified, mapped, and maintained as juvenile rearing habitat

SUMMARY

Lack of rearing and spawning data for the lower mainstem precludes a satisfactory evaluation of potential gravel extraction effects on fisheries. In lieu of badly needed habitat inventories and fish monitoring, the following concerns can be highlighted:

(1) Juvenile salmonids are actively migrating through the lower mainstem during the spring and most of the summer. Screening of water intakes and potential juvenile fish isolating depressions/trenches, especially during declining spring flows, should be closely monitored.

(2) Lack of woody debris probably limits juvenile rearing habitat and adult salmonid holding habitat, particularly for summer steelhead. Woody debris, particularly large trees, should be left intact on the bars (to be re-worked into the wetted channel by the next flood) and inchannel. Sections of the river should be maintained as "free zones" were mining is restricted, to allow woody debris accumulation and development of steep, coarse riffles for invertebrate production and juvenile steelhead rearing habitat.

(3) Trenching may concentrate adult fish at the entrance, increasing vulnerability to poaching and excessive angling pressure. Besides the serious problem of routing sediment through mainstem trenching, trenches probably should be avoided for fisheries concerns: marginal adult holding habitat and unsatisfactory rearing habitat.

(4) Cold water pockets in the lower mainstem should be identified, mapped, and maintained as fish rearing habitat.

(5) Post-extraction channel geometries, at summer's end, should have a minimum depth of one foot at typical August and September low flows. High winter flows may reshape the channel geometry, but this provision would allow free migration upstream during a low flow autumn. A "design" low flow should be established by CDFG for consideration in the annual 1603 gravel extraction agreements.

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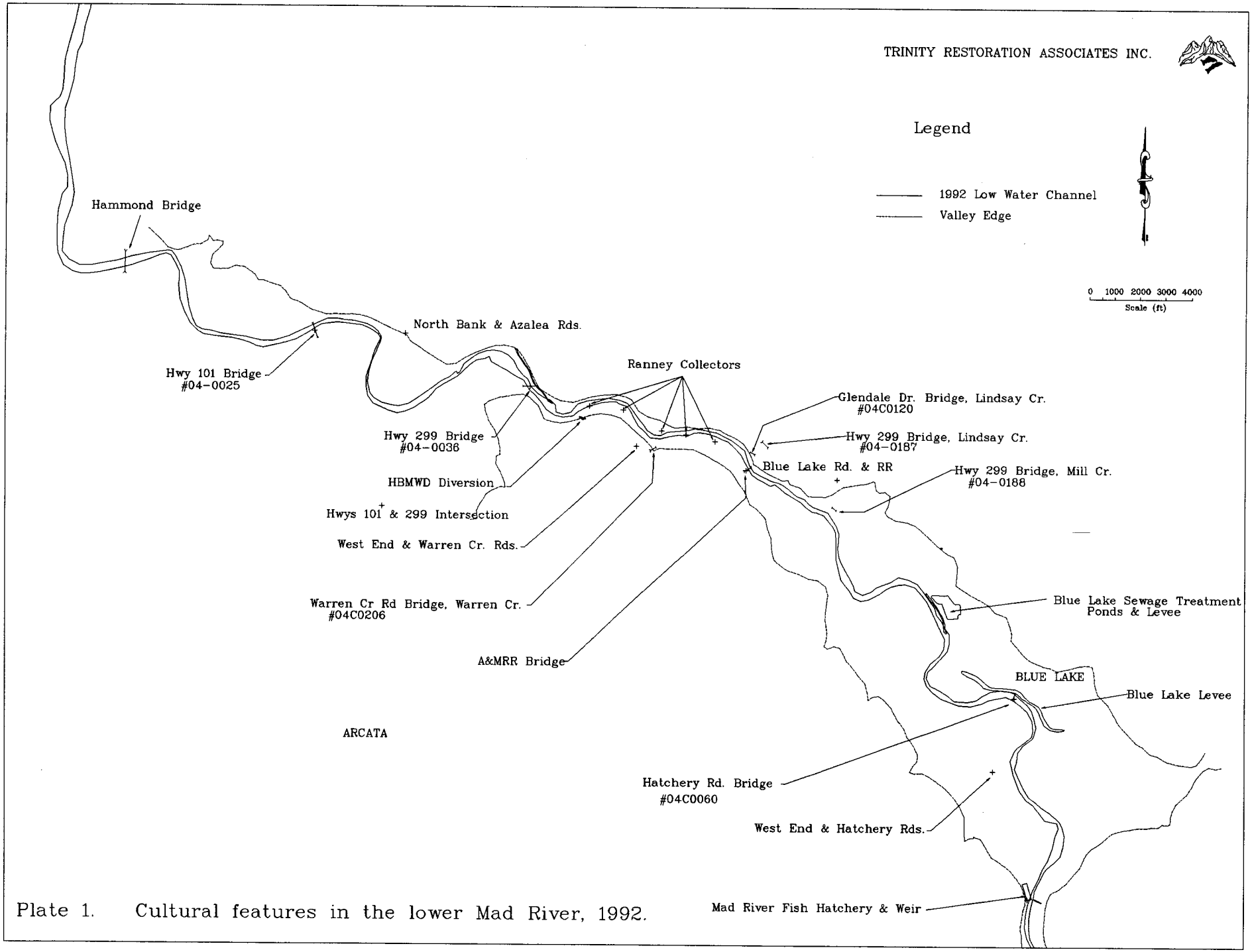


Plate 1. Cultural features in the lower Mad River, 1992.

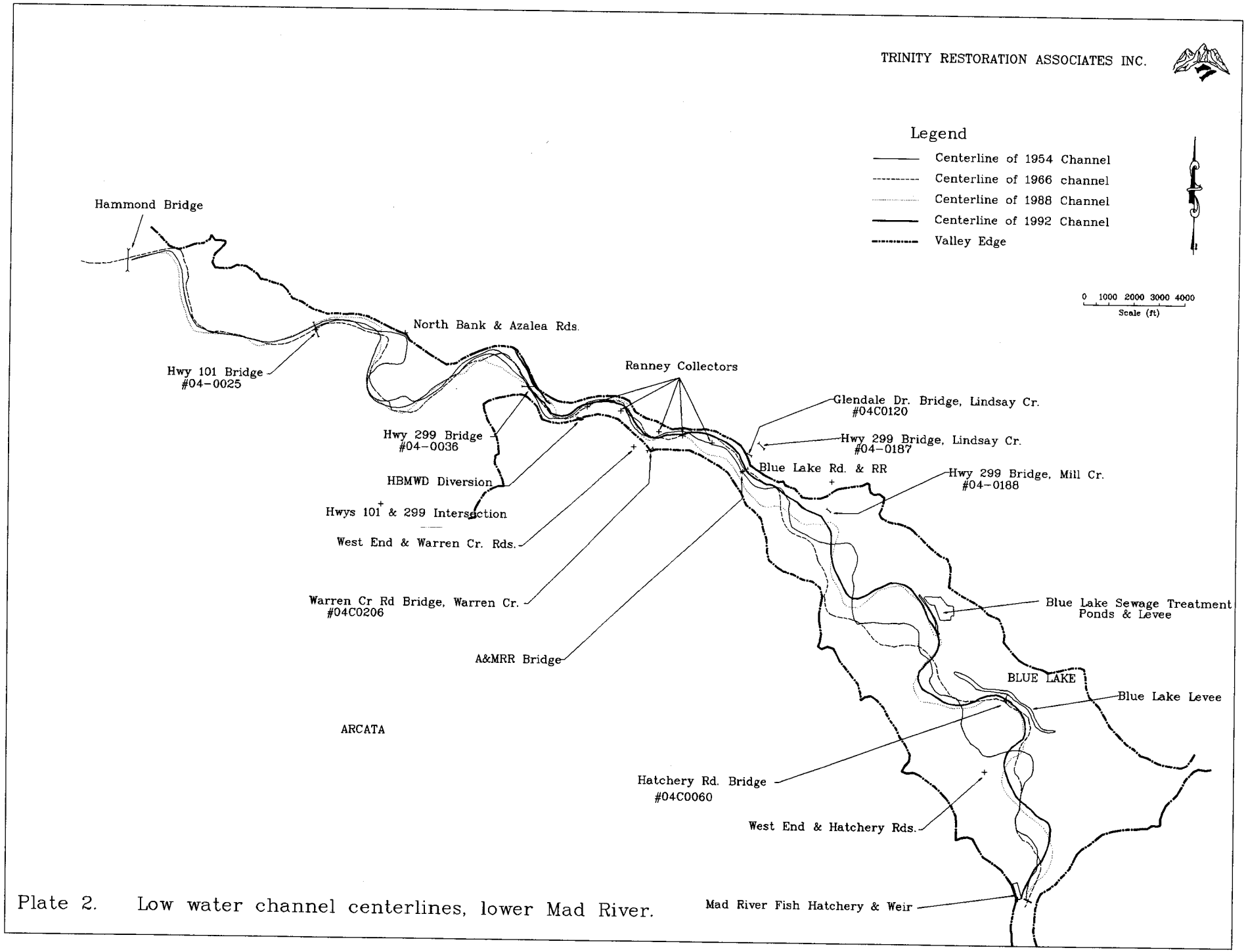


Plate 2. Low water channel centerlines, lower Mad River.

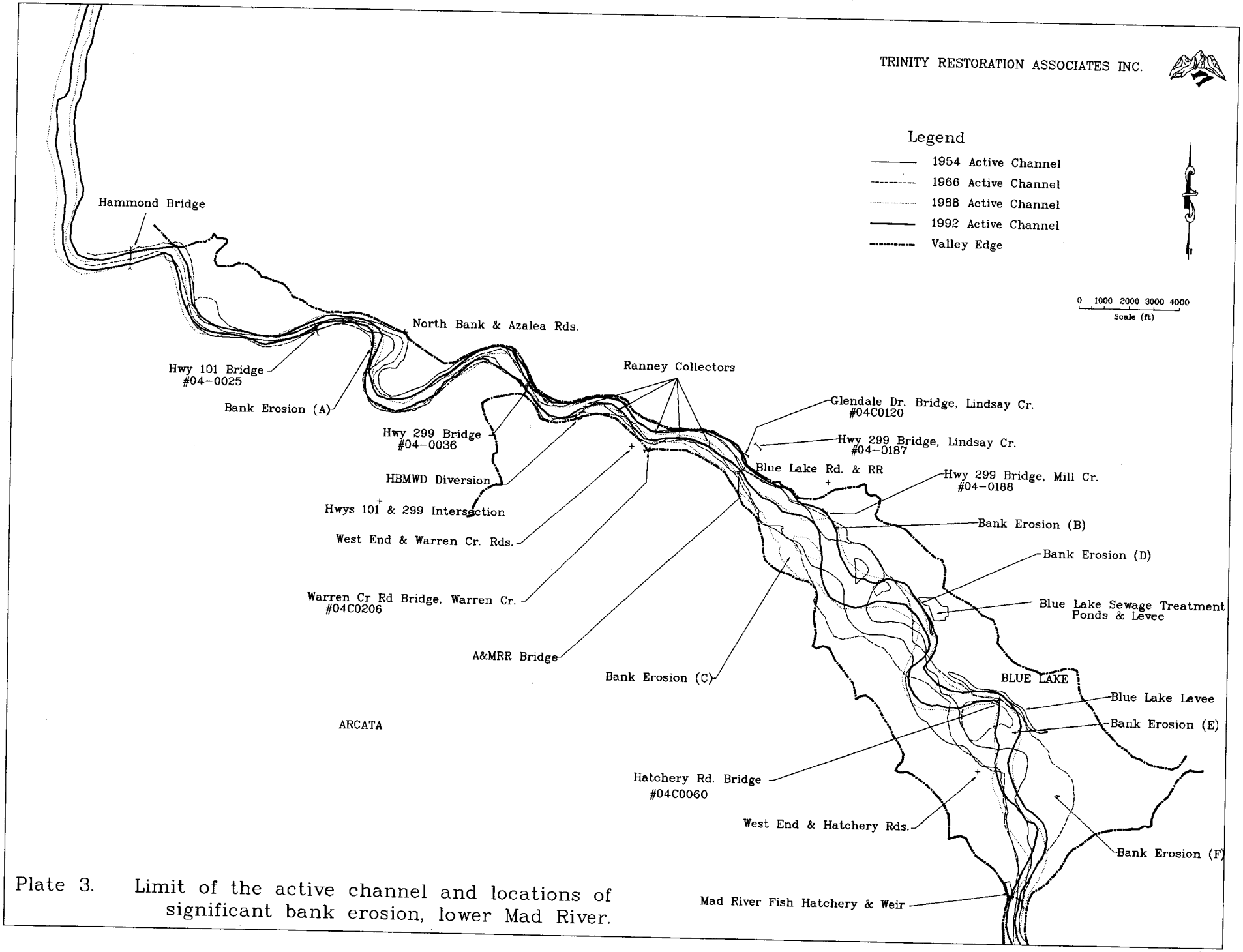


Plate 3. Limit of the active channel and locations of significant bank erosion, lower Mad River.

Appendix G

James Roscoe
Consultants Report

A Cultural Resources Study of Proposed Gravel Extraction Areas on the Mad River, Humboldt County, California

Prepared by

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&
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Prepared for
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March 1993

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Introduction

During the months of January, February, and March, this Cultural Resources Investigation was conducted at the request of the Humboldt County Planning Department of ten sites proposed for gravel extraction along the lower Mad River. The Humboldt County Planning Department is preparing a Programmatic Environmental Impact Report (PEIR) which takes into account the potential adverse impacts of future gravel operations along the Mad River to significant cultural resources, among other variables. The County is the lead agency for the permitting of surface mining and reclamation and intends to prepare and publish this PEIR in conformance with the California Environmental Quality Act. The County is evaluating these ten sites along the lower reach of the Mad River from Hammond Bridge to the former Sweasey Dam site (see Map 1).

The purposes of this investigation were to (1) locate and record project area cultural resources; (2) to evaluate the significance of study area cultural resources; (3) to assess potential impacts to cultural resources resulting from instream gravel operations; (4) to recommend appropriate mitigation measures,if necessary.

The following people were instrumental in providing information which helped in the completion of this report:

Allan Bramlette, Professor, Humboldt State University

Rick Fitzgerald, Research Associate

Albert James, Chairman, Table Bluff Rancheria

Project Area Description

The ten sites composing the project area are all located within the existing banks of the lower reaches of the Mad River, Humboldt County, California. These sites are shown on accompanying sections of the Arcata North, Korbel, and Blue Lake, 7.5', USGS topographic quadrangles (see Maps 2 and 3). The sites consisted of ten different gravel bars proposed for

future gravel extraction operations. The environment of the project area consisted of a riparian corridor associated with the Mad River. Adjoining land consisted of river terraces currently being used for agricultural purposes, gravel production, or for low density residential and light industrial purposes. The topography of the proposed sites was predominantly level to gently rolling.

Investigation Methods

The background research for this project included an examination of the archaeological site records, maps, and project files of the Northwest Regional Information Center of the California Archaeological Inventory, located at Sonoma State University, Rohnert Park, California. This record search, which updated the author's base maps and site records for the project area, was completed on December 4, 1992. The Regional Information Centers have been established by the California Office of Historic Preservation as the local repository for all archaeological reports which are prepared under cultural resource management regulations. The background literature search at the appropriate Regional Information Center is required by state guidelines and current professional standards. Following completion of this archaeological study, a copy of this report also must be deposited with that organization. The literature search is undertaken to determine if there are any previously recorded archaeological resources or historic structures within the project area and whether the area has been included within any previous archaeological research or reconnaissance projects.

In addition to the above record search at Sonoma State University, additional research was completed using historic maps, historic photographs, local newspapers, historic books and monographs, and oral history testimony.

After completion of the above research, Albert James, Chairman of the Table Bluff Rancheria, was consulted regarding any specific Native American concerns for the project area. Mr. James visited the project area and the two prehistoric archaeological sites recorded during this investigation and shared his knowledge and concerns about Wiyot sites in the area.

Following the pre-field research, a mixed strategy archaeological field reconnaissance of the project areas was conducted. The field reconnaissance was completed during the months of January, February and March by James Roscoe, Kimberley Roscoe, and Rick Fitzgerald. During this field survey the proposed direct impact areas were walked in a series of transects. More intensive coverage was given to areas characterized by two or more of the following variables associated with predicted high archaeological sensitivity: undisturbed or natural soil surfaces, level terrain above the Mad River floodplain, presence of creeks and margins of valleys. Most of the proposed project areas were within the floodplain and consisted of gravels and silts deposited during winter freshets. Areas where the original ground surface was visible were closely inspected for signs of archaeological materials. The exposed banks of the Mad river were also examined for evidence of buried strata of archaeological materials.

Extant cultural resources were recorded on standard archaeological site record forms devised for California by the Department of Parks and Recreation. No artifacts were collected, and no subsurface testing was performed during this study.

Ethnographic Background and Land Use

The project area is located within the ethnographic territory of the Wiyot Indians. The Wiyot at the time of White contact were divided into three principal groups, speaking a mutually intelligible language which differed markedly from the Athabascan languages to the east and south and the Yurok language to the north. Although Yurok and Wiyot are both considered by linguists to be Algic languages, they are not closely related. A speaker of Wiyot can not understand the speech of a Yurok. The three subdivisions of the Wiyot were (1)the Patawat, who lived in the villages on the lower Mad River, (2) the Wiki on Humboldt Bay, and (3) the Wiyot along the lower Eel River (Elsasser 1978). It is the name of the Eel River division which is now used exclusively in accounts pertaining to the entire group.

With a population numbering somewhere between a low estimate of 1,000 by Kroeber (1925) and a high estimate of 3,300 by Cook (1956), the Wiyot lived almost exclusively in villages along the protected shores of

Humboldt Bay and near the mouths of the Eel and Mad Rivers. Villages consisted of dwellings which were rectangular in plan, made from split redwood planks. Associated with most Wiyot villages was a sweathouse used by Wiyot men for sleeping, gambling, and ceremony. With these villages as their base, the Wiyot were able to hunt and gather a wide variety of plant and animal resources within their territory. Mollusks, sea lions, and stranded whales were among the ocean resources utilized by the Wiyot, while deer, elk, and acorns constituted more important land resources. Perhaps the most important protein source for the Wiyot were the yearly anadromous fish runs on the Eel and Mad rivers, during which the Wiyot were able to smoke and store enough salmon to last through the winters when other food resources were not as abundant.

Although the Wiyot had contacts with White explorers and fur trappers prior to the California Gold Rush, it was this monumental event that was to change the character of northwestern California forever and lead to the decimation and displacement of the Wiyot in the short course of 15 years. From 1850 to 1865, the territory of the Wiyot became the center for the largest concentration of Whites in California north of San Francisco, due to the use of Humboldt Bay as a shipping point to the mines, the establishment of a redwood timber industry, and the homesteading of the Eel River and Arcata bottoms for ranching and farming purposes. The whites who came into Humboldt County in the 1850's, and 1860's were not known for their tolerance toward cultures other than their own, and many came from areas to the east where Indians were feared and hated. Soon after the first White settlements were established on Humboldt Bay, the Wiyot population was decimated by Euro-American violence and introduced diseases. Those who did not die from these causes were displaced from their villages (often located on the best plots of land) and driven to distant reservations or marginal lands within the Humboldt Bay region.

Ethnographic and archaeological data collected by L.L. Loud (1918) for Wiyot territory provides the best published record of prehistoric land-use of the project area. As shown on Map 4, Loud (1918; Plate 1) identified a number of Wiyot habitation and resource procurement sites within or near the present study area. Loud had only a limited amount of time for his fieldwork in this area. He describes his methodology as follows:

Most of the modern village sites on Mad River, from its mouth to Blue Lake,were located by the help of Aleck Sam...We drove up one side of the river in a wagon, the sites being pointed out as we passed them. This was done in one day's time, so only in a few cases did we get out of the wagon to take a look at the exact spot. (Loud 1918:276).

Loud made the following comments regarding the Wiyot population density and settlement pattern in the project vicinity starting at the bend of Mad River between site 7B and site 8:

This was a very thickly settled district, with many villages so close together that, at the present time, it is difficult to identify them with the names of sites secured from native informants. Site 9, containing a considerable bed of shell, was the only one of these sites actually visited and located by the writer. It is located on the ranch of W.E. Clark, about the center of the southeast quarter of section 17, township 6 north, range 1 east. It becomes necessary to thus definitely locate this place, because there has been such a great change in the course of the river here, which formerly made a bend of over a mile to the south of its present channal. However, this change seems to be due to a definite local cause rather than to any general migratory character of the river bed, such as we find in the delta of Eel river. Mad River has a fairly definite channel.

The cause of the formation of this great bend seems to be revealed in the description of site H. Here a tremendous jam of logs had been piled up by winter floods. It is possible that some generations ago, before the log jam was formed, the river had a straight channel as a present, but that owing to the obstruction the river had to find a new channel. The bend to the south ran shallow, so that fish could be easily taken during the semiannual run, hence the unusually large population in the vicinity. The Indians burnt the jam at site H one summer. After that the place was a noted feeding ground for elk. There was also a good place for taking eels and salmon near this village, yet it contained only three houses within the memory of Aleck Sam. After the whites came, they cut a ditch across the peninsula-like bend, and the force of the current ripped out a new channel, tearing out great trees and straightening the river once more.

...From pioneers living in Arcata, the following information was

obtained regarding the group of villages about the bend of the river. One stated that there were probably twenty houses, including one sweat-house, covered with earth, within two hundred to three hundred yards of each other, situated on both sides of the river. Another said that about all the Indians of this vicinity lived on an area of thirty acres. A third informant, who was often present at their dances, estimated that two to three hundred indians gathered at their summer festivities, erecting very large conical bark and brush houses. At such times the square plank houses were but few in comparison to the temporary conical houses .

...scattered along the river, between the bend and Blue Lake, there were half a dozen small villages or camps. That is, about every mile there was an Indian house or two. High hills flanked both sides of the river, and the forest was dense, so population here was not large. But near Blue Lake the conditions were more favorable. There was here a valley, formed by the junction of the North Fork with the main river, which contained several patches of prairie...besides the more extensive ones on the ridges. There were good fishing holes on the North Fork where the Indians regularly camped...Another fishing place was.... at the base of a waterfall blocking the advance of salmon (Loud 1918:261-264).

In summary, it is probable that fish resources made the study area attractive for resource procurement and settlement. Prehistoric-era archaeological remains which might be preserved in the study area include concentrations of chipped and ground stone artifacts found in poorly developed midden and non-midden contexts. These sites would most likely be found on elevated terraces situated near the river, creeks, or springs. The gravel bars which constitute the majority of the direct impact areas would not have been archaeologically sensitive because any prehistoric sites or artifacts located there would have been completely destroyed or carried away by previous major floods (especially those in the decades of the nineteen-fifties, and sixties).

Historic Overview

Early exploration along the northern coast of California included ships under the British, Spanish, and Russian flags, with the first recorded

landing at Trinidad by the Spanish in 1775. Captain Jonathan Winship, master of the ship "O'Cain" and under contract with the Russian-American Company, entered the Bay in 1806 with Aleut hunters in search of sea otters. Finding the hunting poor, their stay was short and it was another 43 years before the Bay was "rediscovered" by a land party in December 1849. Under the leadership of Dr. Josiah Gregg, the party of eight, which included L.K. Wood who left record of the expedition, came westward from the mining district on the North Fork Trinity River in search of Trinidad Bay. After an arduous journey, the party reached the coast near Little River after a short excursion northward, turned back and proceeded down the coast, eventually reaching the shores of Humboldt Bay (Lewis, 1943). Wood's narrative describes the party's encounter with Mad River:

Little River was soon recrossed after which nothing occurred to interrupt our progress until we reached another stream which was then a large river being swollen by the heavy rains. Its banks ran full and its waters near the mouth appeared deep and moved so slowly and gently that we concluded that it must be a navigable stream. Our next difficulty was to cross this river. Here the harmony that had existed for so short a time was again disturbed. The Doctor wished to ascertain the latitude of the mouth of the river, in order hereafter to know where it was. This was of course opposed by the rest of the company. Regardless of this opposition he proceeded to take his observation. We were equally obstinate in adhering to the determination of proceeding without delay. Thus decided, our animals were speedily crossed over and our blankets and ourselves placed in canoes--which we had procured from the Indians for this purpose--ready to cross. As the canoes were about pushing off the Doctor, as if convinced that we would carry our determination into effect and he be left behind, hastily caught up his instruments and ran for the canoe, to reach which, however, he was compelled to wade several steps in the water. His cup of wrath was now filled to the brim; but he remained silent until the opposite shore was gained, when he opened upon us a perfect battery of the most withering and violent abuse. Several times during the ebullition of the old man's passion he indulged in such insulting language and comparisions that some of the party, at best not too amiable in their disposition, came very near inflicting upon him summary punishment by consigning him, instruments and all, to his beautiful river. Fortunately for the old gentleman pacific councils prevailed and we were soon ready and off again. This stream in

commemoration of the difficulty I have just related we called Mad River (Lewis, 1966 pp.134,135)

With the party's arrival in Sonoma County, without Dr. Gregg, who perished on the trip, news spread quickly about the Bay and the first settlement companies reached its shores in April 1850. The towns of Union (Arcata) and Eureka were established on the Bay along with a number of outlying communities. On lower Mad River, the bottomland provided rich soils for growing grains and potatoes, the first agricultural products of the area; in time, however, cultivated crops gave way to the dairy industry, which continues as a major land-use in the Bottom.

Mad River was an important part of this area's daily life: it flooded periodically, it had to be crossed to go up the coast or inland to Trinity, it had a significant fishery, and its banks were lined with a dense forest of immense trees. A description of the lower river in 1878 is found in a local newspaper:

Mad River runs in a northwesterly direction and empties into the Pacific Ocean about a mile north of the sloughs of Humboldt Bay. The first three miles of the south side of the river from its mouth is what might truly be termed river bottom land, very rich and mostly covered with goose thimble and salmonberry brush, willow, dogwood, and a few spruces interspersed (enough of either to make a full crop in any other country) though there are some fine farms under cultivation in this section. This portion is a part of what is commonly called Arcata valley.

The next sixteen miles up the river on the south side is redwood timber, with the exception of a few small farms. The belt extends to the tops of the ridges, which on an average are about four miles, making about sixty-four square miles of redwood timber yet to be rolled into Mad river from the south. The next sixteen miles up the river on the same side are fir and mountain oak, but only extends about two miles back....

The first three miles on the north side of the river from its mouth is a strip of land averaging about one-half mile in width of excellent quality covered with the same growth as the south side opposite with the exception of three or four cultivated farms....

Sixteen miles further up the stream will embrace first the Lindsey creek tributary, the mouth of which one of Humboldt county's enterprising citizens dammed thereby forming a large basin of water for logging purpoes. At this place he has his shingle and sawmills and machinery for hauling up logs for loading his cars which are taken by a genuine locomotive over his own iron road some four miles down the river on the north side, then it crosses the stream on a substantial bridge runs one mile further to the tidewater of Humboldt Bay.

This Lindsey creek is about eight miles long and runs in a southeasterly direction. Its watershed is almost entirely covered with redwood timber and embraces thirty-two miles. The next order is the North Fork of Mad river which also runs in a south-easterly direction and empties into the main river about six miles above Lindsey creek...(Daily Standard, 19 Jan. 1878).

The river and its watershed have been subjected to a variety of management activities dating to the earliest days of settlement. One of he first was the construction of 1854 of the Mad River Canal, which it was believed would take "almost the entire stream" and become the permanent bed of Mad River (HT, 2 Dec. 1854).

This half-mile long canal connected the river with Mad River Slough and was first used in 1858 to bring logs into the bay for transport to Eureka mills (HT, 1 May 1858). There were problems from the outset with the canal and the idea of "driving" logs down the river. During high water, logs, deris, and sediment spilled over the banks of the canal and were deposited on bottomland ranches and without a structure to catch fast-moving logs and divert them into the canal, millions of feet of timber were swept to the ocean (WHT, 4 July 1874; 18 Aug. 1877). Several attempts were made to construct a boom to withstand huge redwood logs coming downstream on a fast current, but they were "carred away" as were the logs (WHT, 7 Nov. 1874; 28 Nov. 1874). In the spring of 1876, the State Legislature authorized construction of a boom which was completed in October 1877 at a cost of $11,000 (WHT 11 March 1876; 6 Oct. 1877). There was considerable local controversy over the boom, but to the credit of the builders, it lasted four years. In December 1881, it broke after 600 logs had been turned into the canal, sending an additional 800 to the ocean (WHT 31 Dec 1881). The newspaper noted that "thousands of logs are on the beach near the mouth of the river, where the waves left them," (WHT,

14 Jan, 1882). With the extension of the Arcata and Mad River Railroad to Warren Creek in 1882 and to Blue Lake the following year, the need for river driving passed and people began to call for closure of the canal (WHT, 22 April 1882; DTT, 8 May 1883; WHT, 26 Feb. 1881.). The Harbor Commissioners finally ordered the canal's closure which was completed in 1888 after considerable public complaint about the filling in of the north bay and damage to farmland on Arcata bottom (AU, 31 July 1886; 14 Aug. 1886; 10 Sept. 1887; 21 July 1888). Physical evidence of the canal is still visible near Tyee City on the Mad River Beach Road, almost 140 years after it's original construction.

The "fine timber" on Mad River was the object of limited logging as early as 1858, when a Mr. Lakin began bringing logs down the river and through the canal (HT,1 May 1858). A freshet in the fall of 1859 resulted in the loss of about 200,000 feet of saw logs belonging to Lakin and about the same quantity belonging to Mr. A. Handy (NC, 16 Nov. 1859). Certainly there were other small operations on the river, but it wasn't until 1874 that the "initiatory step to logging business on a grand scale" on Mad River began on the Preston claim, four and a half miles from Arcata (WHT, 4 July 1874). Messrs. Jackson and McCann had logged the previous year on a claim nearer the mouth of the river, putting the first logs into the Bay that came from above tide water (WHT, 4 July 1874). These gentlemen's first efforts opened the logging floodgates and the following year, 1875, John Vance completed the Big Bonanza mill at Essex and built a railroad from the mill to the Arcata wharf. As part of this development, Lindsey Creek was dammed near its mouth to create a logging pond that filled the lower reaches of the Essex Valley (WHT, 18 Sept. 1875). The Vance railroad, known as the Mad River and Humboldt Bay Railroad, cost $15,000 per mile including the Baldwin locomotive and 24 truck cars, upon which was transported each day "immense logs and large quanties of lumber" which added up to about 20 million feet per year (WHT, 14 Dec. 1878). In writing about Vance's railroad, A.T. Hawley noted that Vance was contemplating extension of the road eastwardly to the "dense redwoods on Mad River (and they were a sight to behold) and northeasterly to the splendid timber on Little River." The Vance road crossed Mad River on a Howe Truss bridge with two spans of 120 feet each, built by the Pacific Bridge Company at a cost of $10,000 (WHT, 14 Dec. 1878). The location of that bridge is uncertain, but the railroad apparently came downstream from Essex on the north bank, crossing below the present Highway 101 bridges (WHT, 26 Feb. 1881).

In July 1881, the Arcata and Mad River Railroad was incorporated for the purpose of extending the railroad from its terminus at the Dolly Varden Mill on Janes Creek to the new Minor mill on Mad River at Warren Creek. This extension of the Arcata Transportation Company's road, which ran between the Dolly Varden Mill and the Arcata Wharf, was to eventually reach the North Fork Mad River (WHT, 23 JULY 1881; 20 Aug. 1881). Chinese laborers were employed at a wage of $1.25 per day to construct the initial three-and-a-half miles to the Warren Creek Mill, which produced its first lumber in December 1881 (WHT, 20 Aug. 1881; 17 Dec. 1881). In March of 1883, the Arcata and Mad River Railroad became the property of the Korbel Bros. and the railline was again extended to serve the new Chandler Mill in Blue Lake and then up the North Fork to the Korbel's mill (DS, 31 March 1883; DTT, 5 May 1883; DS, 1 Sept. 1883). The railroad crossed Mad River at Skedaddle, just above the mouth of Lindsey Creek, and then followed the river on the north side to Blue Lake. The bridge consisted of three spans with a total length of 500 feet and stood 33 feet above low water (DTT, 7 April 1883). The Korbels' mill began cutting lumber in earnest in the fall of 1883 (DS, 3 Nov. 1883). Chandler built another mill, known as the Riverside Mill, at the mouth of the North Fork in the spring of 1886 (DHS, 27 Feb, 1886; 3 May 1886). Sometime between the springs of 1885 and 1886. Isaac Minor built another mill at Glendale on Hall Creek (DHS, 30 April 1885; 3 May 1886). A note in the Arcata Union in August 1886 stated that between Arcata and the North Fork, 700 men were at work in the mills and woods (AU, 14 Aug. 1886); a year later 1,000 were working in this same stretch (HS, 24 Aug. 1887). The railroad served four mills in 1883 and during that year transported almost 12 million feet in lumber, eight million shingles and 175,000 shakes (HS, 17 Jan. 1884).

In 1888 the Arcata and Mad River Railroad Company let a contract to the San Francisco Bridge Company to build a bridge across Mad River on the site of the existing bridge (AU, 21 Jan. 1888). A tragic accident on that bridge in 1896 resulted in the death of seven people and many injuries (AU, 19 Sept. 1896). The bridge was repaired and used until 1914, when a new steel bridge was constructed at the "immediate site of the present wooden railroad bridge" (AU, 25 June 1914). The new bridge consisted of three spans of 165 feet each with solid re-inforced concrete piers resting on a platform of 70 spiles drive down to bedrock; the gravel was excavated to a depth of about 15 feet below low water and the concrete work extended down that far. Although the wooden bridge was in perfect condition, it

was demolished after the new bridge was constructed a few feet downstream (AU, 25 June 1914).

In 1903 the mills at Korbel and Riverside was consolidated along with the railroad under the new firm known as the Northern Redwood Company (AU, 7 Feb. 1903). In 1956, Simpon purchased the Northern Redwood Lumber Company (AU, 3 Feb. 1956) and continues to operate the Korbel mill, retooled as a second-growth mill in the early 1980's. Simpson has logged an extensive area in the Mad River watershed over the past decade.

In the spring of 1896, the Vance railroad, known as the Eureka and Klamath River Railroad, was constructed between the Lindsey Creek possession of Dolbeer and Carson to the new mill on the Peninsula at Samoa (AU, 16 May 1896; 13 June 1896). The Humboldt Northern Railroad was completed in 1905, crossing Mad River where the present Hammond bridge is located (AU, 24 June 1905). The Little River Redwood Company, later Hammond, Georgia Pacific, and now Louisiana Pacific, extended the line from just north of this river crossing up the beach to Crannell in 1929 in order to transport logs directly from its Little River possession to the mill at Samoa (AU, 24 Jan. 1929).

Travel from Humboldt Bay northward up the coast and eastward to the Trinity and Hoopa Valley involved river crossing. Ferries, conducted at various points on the lower river, were subject to the vagaries of storms and high water. As the result of one "freshet" in the fall of 1859, Mr. Hale's ferry boat was carried down stream and lodged "high on a drift pile" and the Nixon ferry boat went "out to sea" (NC, 16 Nov. 1959). The call for a bridge across Mad River began to be heard again and again.

> *Impressing the claims of the people of this and the northern portion of the county, for a bridge across Mad River, we have several times referred to the amount of travel that goes that way. Since last Sunday morning more than one hundred and twenty-five loaded pack mules have left here for the mountian travel, all of which has to be unloaded and reloaded on the other bank and the animals swim the river, incurring the risk of loss of life to both man and beast and still these men had to pay as much taxes as if they had the convenience and safety of bridge they are so justly entitled to. There is no place in the county where a bridge is so much needed as at Mad River, near the Prigmore place and no route in the county where so much valuable freight passes over and is exposed to so much risk....(DS, 15 May 1880).*

That first bridge was completed in the fall of 1883, clearing low water by 33 feet and allowing a sweep of 275 feet between the piers. It was a "gratifying event" to people living in the northern and eastern portion of the county and to the constantly increasing travel to the Trinity and Salmon river mines (DS, 27 Oct. 1883). Wooden, covered bridges were built as crossings with the first steel truss spans on concrete piers appearing in 1929 as part of the final construction phase for the Redwood Highway (AU, 21 March 1929).

The first settlement in the Blue Lake area was actually at Scott's Ranch, somewhat north of the present community. By 1871 Scottsville, located seven miles from Arcata, had a hotel, school, blacksmith shop, a good wagon road, 45 voters, and the landscape was dotted with "neat, comfortable houses" (HT, 5 Aug. 1871). Located on the trail leading eastward to Trinity River county and Redwood Creek valley, Scottsville provided services and accommodations for this segment of the traveling public and its importance didn't begin to fade until the mill development and railroad of the early 1880's shifted the focus to Blue Lake. By 1886, Mr. Chartin, owner of the Blue Lake property, was proceeding in a "satisfactory manner" to develop a "thriving village" by laying out streets and lots to provide for the families of men engaged in lumber operations on Mad River (AU, 25 Dec. 1886).

Another significant development on Mad River were the granite rock quarries, one located up Warren Creek belonging to Isaac Minor, and the other on the north side of the river near Hannah's Crossing, which was about where the present 101 crossing is in the south half of the northwest quarter of the southeast quarter, section 8, 6N1E. In 1884, 2,000 tons of granite from the Hannah quarry were used in the construction of the Seal Rock Lighthouse off Point St. George at Crescent City (HS, 5 June 1884). Master stonecutter James Greig, who operated a granite works at Hannah's opined that this granite was the "best in the world" (FE, 27 Sept. 1898). Granite from the Minor quarry was used in the construction of his own masoleum in 1909; in various construction projects, including houses in Arcata; and in the reconstruction of the North Jetty in 1920 (AU, 9 Oct. 1909; 6 Aug. 1910; 1 Oct. 1914; and HT, 28 Sept. 1920).

Mad River flooding and channel changes since Euro-American settlement were recorded to some degree prior to aerial photography. References in local newspapers noted the more extreme flood events and

the impacts of those events on property, particularly along the lower reaches of the Mad River. A reference in 1857 noted that Mad River "came over the bottom" for the first time since the winter of 1852-53 (HT, 21 Feb. 1857). A "freshet" in the fall of 1859 resulted in bottomland flooding, the third such event recorded in the first nine years of settlement.

> *The Freshet--the storm of the preceeding week reached its greatest intensity on Thursday evening last. Up to this time, the rain had fallen heavily and steadily. Owing to the absence of snow on the mountains, this early in the season, the falling water was precipitated from the hillside into ravines and gulches, swelling the mountain streams and raising Mad River two feet higher than ever before known to white man. Overflowing its banks, the water spread over lowlands, flats, and marshes, filling sloughs, submerging and carrying off bridges and fences with a strong and steady current of four miles per hour till it met and mingled with the incoming tide. On Friday morning the view from the hill, beyond town, was novel. The praire lying close to Mad River, nearly all submerged, presented the appearance of a vast lake--its placid surface broken only by the ripple of fences. At the house of D. Martin the water stood a foot in depth, flooding the lower rooms and wetting 300 to 400 bushels of wheat in bins at his barn. The damage done to loggers was the most serious. Mr. Lakin lost about 200 M feet of saw logs and Mr. A. Handy about the same quantity--estimated at $5 per M. The ferries on Mad River suffered considerably--Hale's ferrry boat carried down stream and lodged high on a drift pile; John Nixon's ferry boat carried out to sea. With the falling of the River on Friday morning the roads in the vicinity were choked with drift wood and blocked by immense logs and trees...(NC, 16 Nov. 1859).*

But the big storm hit the entire northern California area in late 1861, causing considerable damage.

> *Storm and Freshet--We have been favored with a number of rainy days previous to Monday last, but on that day rain set in earnest and for 60 hours poured in torrents. By Wednesday noon the waters of Mad River were eighteen inches higher than ever before know to white man. The bottom lands west and north of Arcata were submerged; fences, bridges, and out-houses were swept away, which will require an expenditure of thousands of dollars to replace. It is estimated that*

over a half million feet saw-logs--belonging to various parties--were swept from the sloughs and booms, out to sea.....(HT, 30 Nov. 1861).

Letter from Arcata, Dec. 6th, 1861, Editor Times--In your last week's issue you made brief mention of the freshet that reached its highest point on Wednesday morning, at that time the water was considerably higher than ever before known. The rain ceased on Tuesday night and by Wednesday Mad River was again 'confined to its bed' and our citizens concluded that the flood of the season was past, but on Thursday and Friday the windows of heaven were again opened and continuing to pour, on Saturday the river now truly Mad, again rushed over its banks and submerged our prairie. The water continued to rise till dark Sunday night, at which time it was much higher then the oldest inhabitants had ever before known....

Mad River swept over out bottom land to the bay with great force, carrying with it fences, bridges, and all moveable objects with which it came in contact, the soil in many fields was washed off for several inches in depth and deposited on the neighboring farms or carried into the sloughs, while on some places were left banks and bars of gravel and sand several feet in depth....

The four bridges on the stream passing near town were washed away, cutting off for a time all communication with the county except by boats. Thousands of acres were flooded and there are but few of our farmers that did not suffer some loss....

Although it has been a remarkable freshet and destruction of much property. It is difficult yet to estimate the loss, but thousands of dollars would be required to replace the damage sustained. The people will necessarily be greatly inconvenienced during the winter by the loss of bridges, etc. Such an inundation was never before known, and we hope its equal may never visit us again (HT, 7 Dec. 1861).

The following summer, farmers on Arcata bottom began to consider the danger that threatened them each winter and decided on a "little simple engineering" at a "trifling expense" to change the channel of the Mad River. A ditch was cut, commencing near Shaw's crossing (near the middle of the north line of section 16), to divert the river from its old channel to one farther north, reconnecting with the old bed "some miles

below" (AU, 4 Feb. 1888). The scheme worked and the big bend that curved toward the bay was cut off. Later floods, particularly the event of 1890, demonstrated that additional steps were needed to ensure that the river didn't break through into the old bed (AU, 5 April 1890). By the fall of 1890, a breakwater near Shepard's place was completed to keep the river from its old bed and protect what was now pasture land (AU, 27 Sept. 1890; 4 Oct. 1890), In 1906, a canal was dug to drain the lagoon left from this original channel; after the dynamite charge, the water rushed out through Janes Creek at six or seven miles per hour and out into the bay via Daniels' slough (AU, 22 Sept. 1906).

This editorial comment following the 1890 flood is worth quoting:

> *It is a well known fact to the people at this end of the bay that the Arcata bottom is what is known as made land, which is a thick deposit of suspended soil from Mad River that at some period yearly inundated the entire bottom until the depth of the deposit and the growth of trees and other vegetation checked the previously uninterrupted course of the water and gradually caused it to conform its course to the present north bank, which is a natural waterway, being bluff and rocky in nature.*
>
> *In early years the clearing of a portion of the bottom land adjacent to Arcata and extending back to the river resulted in an overflow of the cleared portion, the water leaving th eriver at the Schuyler Clark place and passing into the bay through the Daniels slough. Many of our older inhabitants vividly remember the occurrence, while at present time deep gullies are to be seen through the farms traversed by the flood.....(AU, 5 April 1890).*

Like other coastal streams, such as Redwood Creek and the Mattole River, Mad River historically closed during low flow periods in late summer and into the fall. It was not uncommon to have a solid sand spit across the mouth as late as November. Newspaper references in October and November noted that the salmon were waiting for the rains and the breaking of the spit to make their run up the river.

> *Will Stay Closed-- The mouth of the Mad River had been closed with sand during the summer-- the feeble current as low water being insufficient to wash it out as fast as the surf of the ocean throws it in,*

a small ditch connecting the river with a slough from the Bay carrying off what little water comes down. In consequence of this obstruction at the mouth, the salmon cannot run up, thereby cutting off a great supply of food of the friendly Indians on the river. Some of the settlers on the other side of the river, near the mouth, concluded to open the same and one day last week set about it with treams and road-scrapers, shovels, etc., and after considerable hard work the pent up water once more flowed through into the ocean. The Indians were very grateful and rejoiced in the prospect of a harvest of salmon, but old Ocean in this instance as in many others, made sport of man's efforts and the next morning there was not a trace of all the labor that had been done--the river mouth was again closed as before (HT, 24 Oct. 1857).

Construction of Eureka's water supply on Mad River began in the summer of 1935 and was completed in the fall of 1938 (HS, 27 July 1935; 3 Nov. 1938). Named for the late Mayor of Eureka, Sweasey Dam was a $2,000,000 project, located about 30 miles upstream from the river's mouth (HT, 28 Oct. 1938; TS, 22 Nov. 1991). The project was replaced by the larger dam at Ruth, built in the early 1960's but its capacity was significantly reduced by sediment storage. With the dam's removal on August 1, 1970, it was estimated that 3,000 acre-feet of sand was delivered to the river's mouth between 1971 and 1973 (TS,22 Nov. 1991).

Although newspaper references providing informatin on Mad River's fisheries might be considered anecdotal, it is, in some cases, the only information available, particulary the early accounts. Numbers of fish are not available, but salmon were described as "plentiful" or the river was furnishing "large quantities of fish" or there were "lots" of fish in the river or the salmon were "swarming in the surf" waiting to enter the river or they were running in "large numbers" (HT, 14 Nov. 1857' 28 Aug. 1875; 31 March 1883; AU, 22 Nov. 1890; Fe, 24 Oct. 1899). In the fall of 1882, Mr. A. Hall, who lived at the mouth of Mad River, brought down to the cannery seven tons of salmon and the following year, he caught two tons "in a very short space of time" on one day (HT, 4 Nov. 1882; DTT, 14 Nov 1883).

Mad River was not closed to seasons until 1913, although gillnets continued to be used below the Carson railroad bridge during the lawful season (AU, 22 May 19134). Some idea of the numbers of salmon caught

is found in reports of gillnet catches. In the fall of 1905, Mad River fisherman shipped on one day 30,600 pounds of fish and the following month another 23,000 pounds on a single day (AU, 9 Nov. 1905; 23 Dec. 1905). A reference in 1907 indicates that two fisherman shippd 60 boxes of fish, each weighing about 300 pounds (AU, 9 Nov. 1907). Beginning in 1912, yearly releases of hatchery--raided fry were made in Mad River in an effort to boost a depleted fishery (AU, 22 March 1917). In 1913, 100,000 salmon fry from the Price Creek Hatchery on Eel River were released in Mad River (AU, 6 March 1913); in 1917 a quarter of a million Quinnat salmon fry, raised at Fort Seward, went into the river (AU, 22 March 1917); in 1922, another 250,000 Quinnat salmon were released (AU, 27 April 1922).

Not only did the numbers of salmon drop, but so did their size. References in 1925 described local anglers catching salmon weighing over 50 pounds and 40 punders were not uncommon (AU, 26 Nov. 1926). In 1940, the big fish were 25 and 34 pounds and the following year, the Arcata Union talked about fish in the 15 pound category (AU, 22 Nov. 1940; 7 Nov. 1941).

Description of Recorded Sites

Two prehistoric archaeological sites were recorded on river terraces above proposed gravel extraction areas as a result of this investigation.

Note: This section removed to maintain confidentiality of known archaeological resources
(end of page 18 and all of page 19)

Recommendations

The archaeological site of CA-HUM-930 will apparently not be directly impacted by gravel extraction from Johnson Bar (site 5) as the archaeological deposit is situated on a river terrace over 50 feet above the Mad River and no access roads or processing areas are apparently planned within the archaeological site area. While visiting the site, Albert James noticed that portions of the edge of the archaeological deposit were eroding into the river below. Mr. James expressed concern that accelerated gravel mining from the bar immediately below and upstream of the archaeological site could lead to increased erosion and damage. It is recommended that future gravel extraction activities in the area completely avoid the archaeological site area as shown on the attached site map. Gravel mining within the Johnson Bar should be coordinated with geological and hydrological studies so that increased erosion does not impact this potentially significant cultural resource.

The archaeological site of CA-HUM-931 is also situated well over 50 feet above the Mad river channel and will not be directly impacted by any activities currently planned for gravel extraction at Johnson Bar. Although erosion damage to the archaeological deposit seems to be less likely at this site, it is recommended that future gravel mining operations in the area be planned so as to avoid any negative impacts to the site due to increased erosion.

The Arcata and Mad River Railroad and associated features (CA-HUM-827/H) will not be impacted directly by gravel mining operations. Although erosion damage to the railroad bed, trestles, and bridge was not apparent during our field investigaton, it is recommended that future gravel operations avoid any impacts to this significant historical feature.

Although no cultural resources are likely to be discovered during gravel mining within the stream bed of the Mad River, there is the remote possibility that buried archaeological materials may be uncovered by future gravel operations. Should concentrations of archaeological materials be encountered during such operations, all ground-disturbing work should be temporarily halted and shifted to another area. Work near the archaeological finds should not be resumed until a qualified archaeologist has evaluated the materials and offered recommendations for futher action.

Prehistoric materials which could be encountered include: obsidian or chert flakes or tools, locally darkened midden, groundstone artifacts, deposits of shell, dietary bone, and human burials. Should human remains be encountered during future ground disturbing activities within the project area, State law requires that the County Coroner be contacted immediately. Should the Coroner determine that the remains are likely those of a Native American, he or she must contact the California Native American Heritage Commission. The Heritage Commission consults with the most likely Indian descendants from the area to determine appropriate treatment of the remains.

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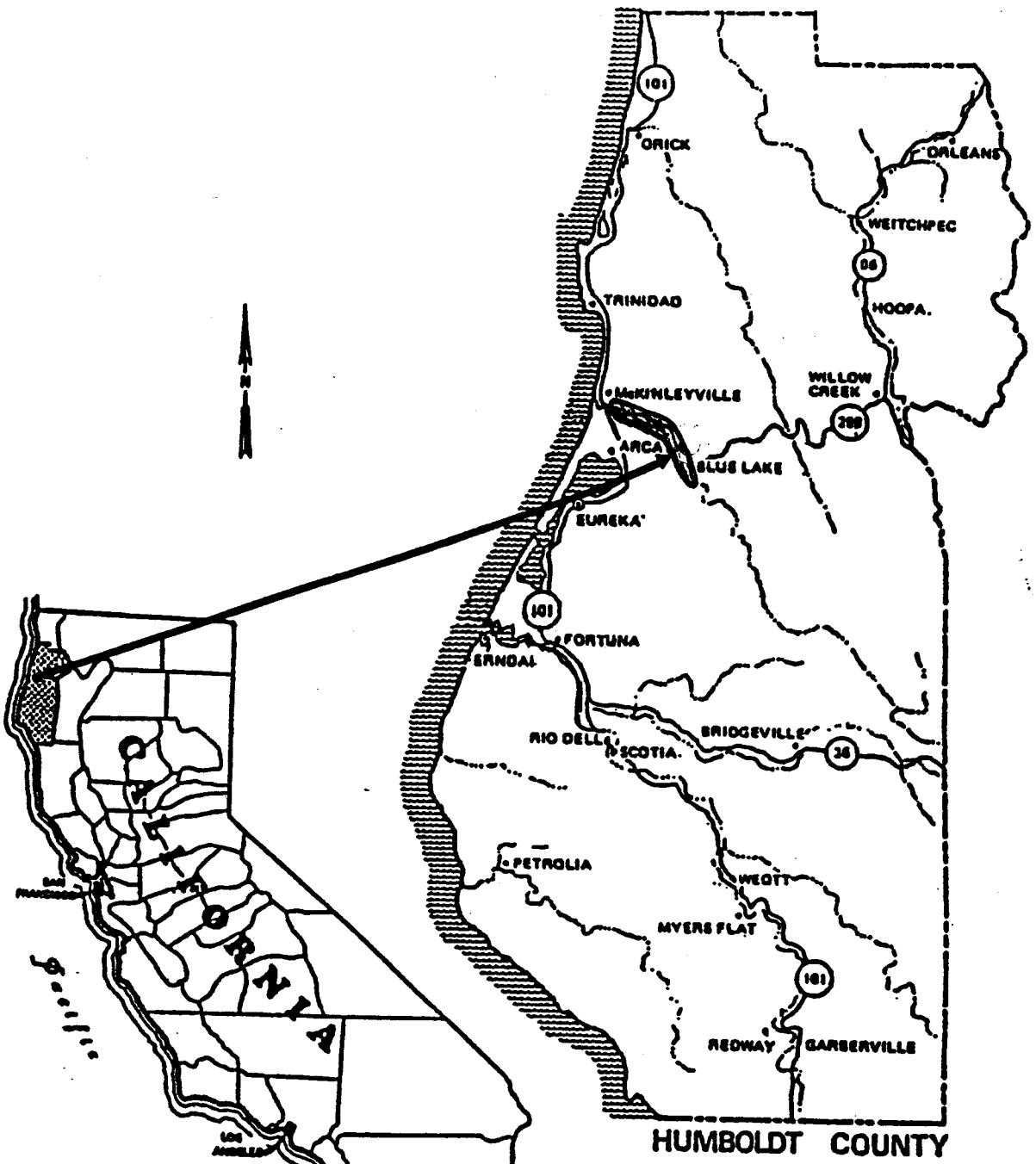
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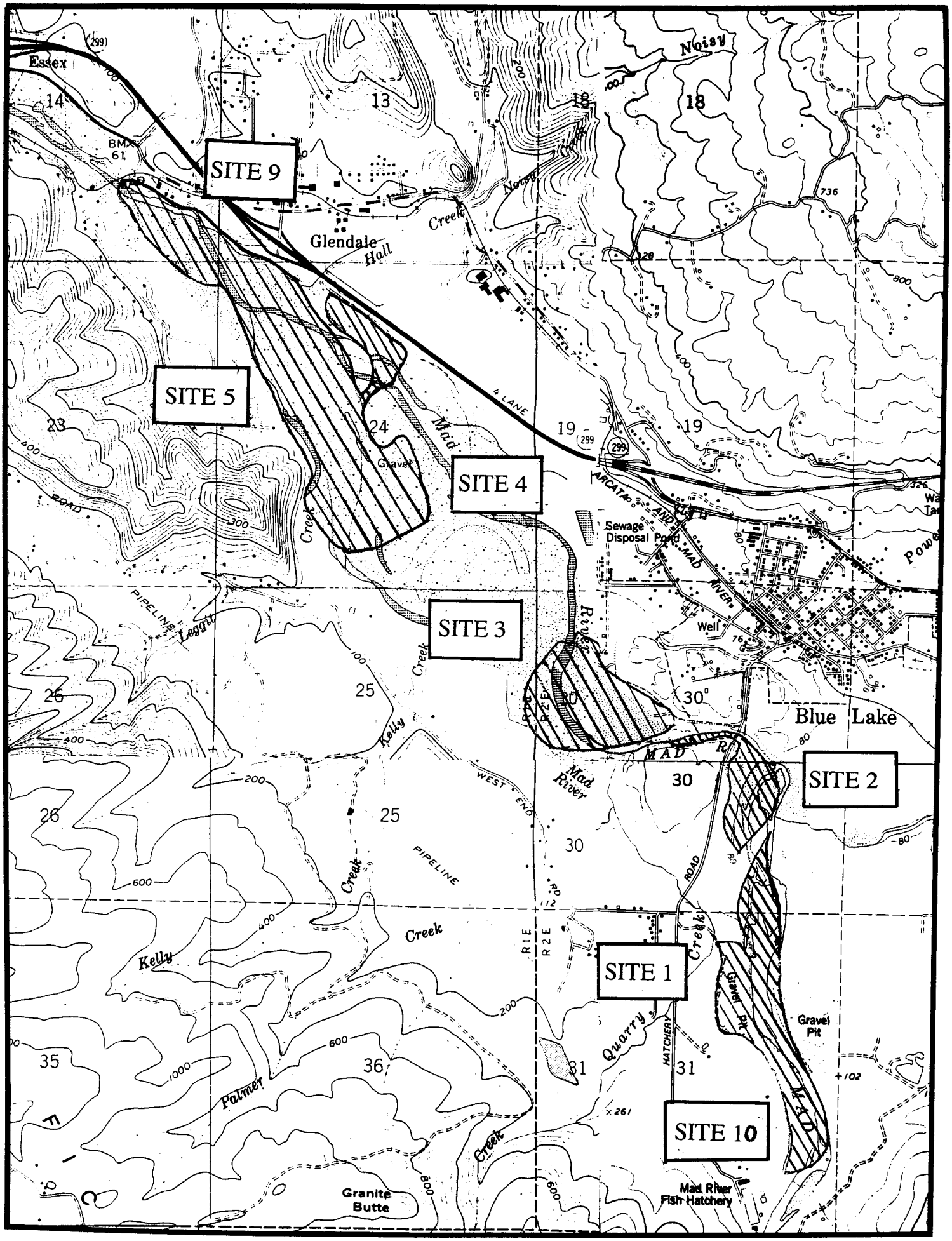
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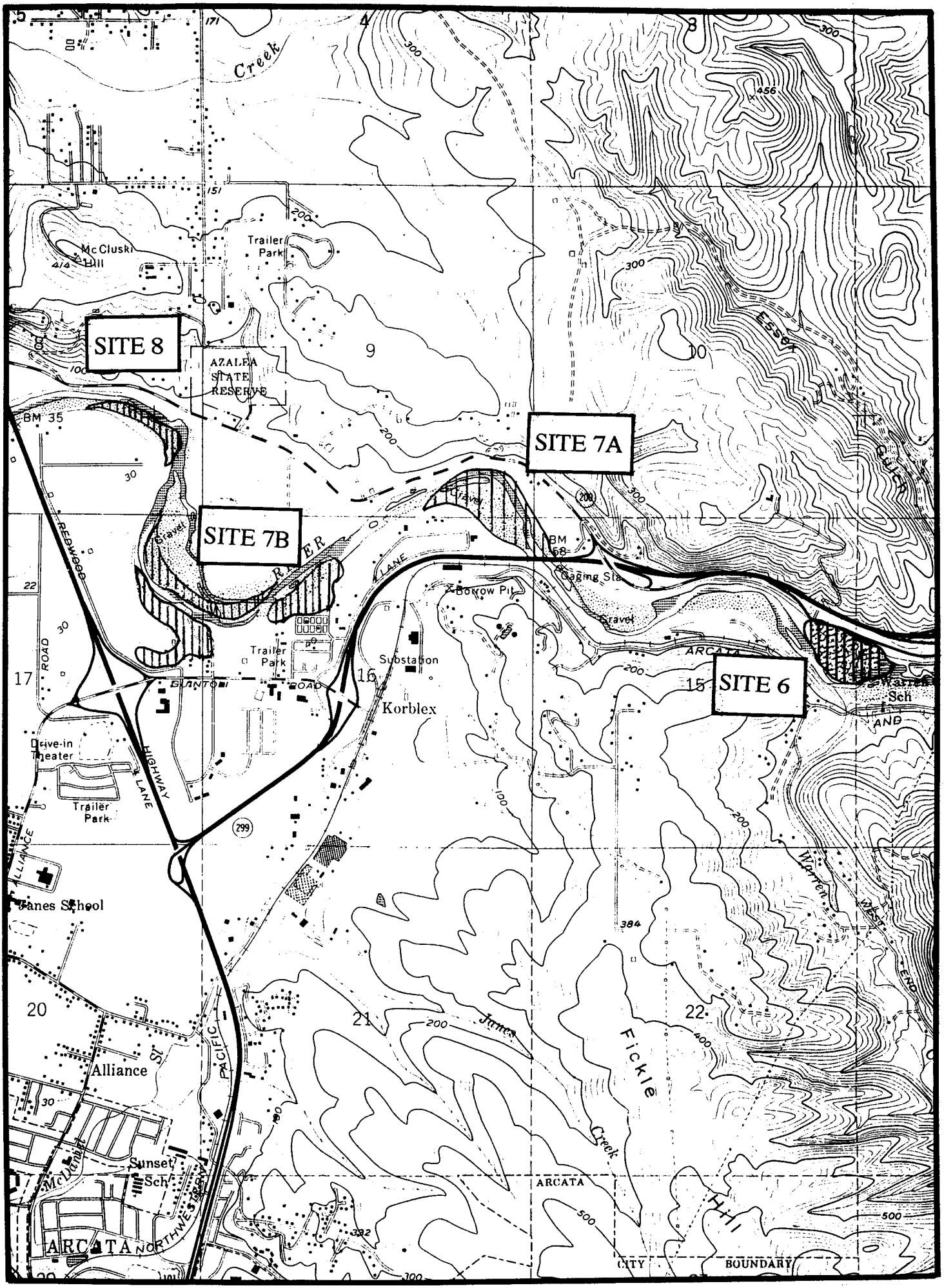
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Map 1

REGION MAP


SITE 9
SITE 5
SITE 4
SITE 3
SITE 2
SITE 1
SITE 10
Essex
Glendale
Hall
Noisy
Creek
Mad
River
Gravel
4 LANE
ARCATA
AND
EUREKA
Sewage
Disposal Pond
MAD
RIVER
Well
Blue Lake
MAD R.
Mad River
WEST END
ROAD
PIPELINE
Leggit
Kelly
Palmer
Quarry
HATCHERY
Gravel Pit
Granite
Butte
Mad River
Fish Hatchery
R1E
R2E
T
1
N
13
14
18
19
24
25
26
30
31
35
36
BMK
61
736
328
326
299
101
800
600
400
300
200
100
80
76
102
261


SITE 8
SITE 7A
SITE 7B
SITE 6
AZALEA STATE RESERVE
McCluski Hill
Trailer Park
BM 35
Gravel
Borrow Pit
Substation
Korblex
Drive-in Theater
Trailer Park
Janes School
Alliance
Sunset Sch
ARCATA
Fickle Creek
CITY BOUNDARY
HIGHWAY
REDWOOD
BANTOM ROAD
ARCATA NORTHWESTERN
PACIFIC
Warren Creek
Essex
Quick
Sch
ANB

Map of the Territory of the
Wiyot Language Showing Village Sites
(from Loud 1918; Plate 1)

Note: This map removed to maintain confidentiality of known archaeological resources

Appendix H

Karen Theiss & Associates
Consultants Report

Karen Theiss and Associates

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DRAFT BOTANICAL RESOURCES STUDY
FOR PROGRAM EIR
MAD RIVER, MAD RIVER GRAVEL EXTRACTION

MARCH 8, 1993

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DRAFT BOTANICAL RESOURCES STUDY
FOR PROGRAM EIR
MAD RIVER, MAD RIVER GRAVEL EXTRACTION

MARCH 8, 1993

I INTRODUCTION

The following report has been prepared for use in the Program EIR for instream gravel extraction on the lower Mad River in Humboldt County, California. The study area extends along an approximate 17-mile stretch of Mad River, from the historic location of Swasey Dam downstream to the Hammond Bridge. The geographic scope, as defined by the Humboldt County Planning Department, is bank to bank where instream gravel mining presently occurs, plus adjacent processing sites. The report includes existing facilities, extraction areas, and roads only, and does not address the impacts of future facilities expansion, increased extraction volumes, or new operations.

II STUDY GOALS

The goals of this study are to evaluate the potential impacts of instream gravel mining on riparian vegetation and associated habitat values, and to present mitigation strategies which can minimize and/or eliminate potential impacts. It is proposed to meet these goals by attaining the following objectives:

- description of the existing botanical habitats, including a discussion as to their development and brief comment as to their potential wildlife habitat value;

- discussion of the potential impacts of instream gravel mining operations, both direct and indirect, on existing habitats;

- discussion of possible mitigation measures to be employed to reduce or avoid potential impacts; and

- a discussion of the characteristics of each gravel bar under examination in the Program EIR.

III METHODOLOGY

The following tasks were undertaken and completed for the study:

- review of pertinent literature and aerial photography with regard to the vegetative characteristics of the study area;

- review of pertinent literature and aerial photography with regard to the evolution of the riparian vegetation;

- review of methodologies employed for in-stream mining operations;

- literature and agency review with regard for the potential for sensitive plant species;

- field reconnaissance to delineate existing botanical habitats within the study area;

- field survey to document presence or absence of sensitive botanical species in the survey area.

IV BOTANICAL HABITATS

A. Overview

Field investigation was undertaken during February 1993 to determine the nature and extent of botanical habitat types within the survey area. Results of the field survey along with information gathered from aerial photography from the 1992 season indicate the presence of four distinct habitat types. Arbitrary cover class designations are used within the report as follow:

- sparse <10% cover,
- low 10%-30% cover,
- moderate 30%-70% cover,
- dense 70%-90% cover,
- very dense >90% cover.

Starting from the summertime low-water wetted channel and moving upland, these include gravel bar, riparian scrub, and mature riparian forest. Ponds and backwaters, the fourth type, are found infrequently within both the scrub and forest vegetation types.

A "typical" cross section of riparian vegetation shows a progression, starting at the gravels alongside the channel, of sparse herbaceous vegetation to low density woody vegetation (early successional scrub) to dense woody vegetation (late successional scrub) to riparian forest. The progression of vegetation is correlated to terrace elevation and depth of sediment deposits, with the sparse herbaceous vegetation at the lowest elevations, the early successional scrub on the lower (most recently formed) terraces, the late successional scrub on the moderate-elevation terraces, and the riparian forest on the higher terraces. Of importance to the development of vegetation in terrace evolution is the deposition of silt and fines, which provide a medium for vegetation development. As early vegetation establishes, additional sediment is trapped and nutrients are added to the

developing soil. This process continues as the terrace evolves, allowing for the establishment of woody scrub species and, eventually, tree species.

Remnant channels and backwaters occur throughout the study area, and interrupt the "typical" vegetative progression. This creates linear stands of differing ages of scrub vegetation and, occasionally, young forest vegetation. Some backwaters and ponds persist long enough to allow for the growth of emergent wetland vegetation, which provides a small but notable component of the riparian vegetation complex.

Riparian vegetation provides a high degree of potential wildlife habitat value, in term of species diversity, species density, and Species of Special Concern as listed by the California Department of Fish and Game. Wildlife habitat value is afforded by a variety in food sources, cover, vertical structural, and proximity to water. The dynamic nature of natural riverine systems results in the establishment of different zones of vegetation, each with its own special characteristics. Even within a single habitat type, early successional stages offer different habitat values than do the later, more mature stages.

Portions of the study area appear to meet the wetlands criteria for the California Department of Fish and Game and/or the US Army Corps of Engineers. The wetlands characteristics of the study area are not addressed as a separate issue within this report, but will need to be addressed on an individual permit basis in the future.

B. Gravel Bar

The gravel bar habitat encompasses that area which is seasonally inundated and scoured by normal winter flows. The substrate is comprised of varying amounts of cobbles, pebbles, and gravel with minor amounts of silt and sand. Large woody debris (tree trunks and root wads) has accumulated at a number of spots within this habitat type.

Gravel bars are generally devoid of perennial woody vegetation, and support annual forbs and grasses during spring and summer months. In some areas, large woody debris provides localized protection for vegetative growth. The diversity and density of this vegetation is quite variable and depends on site-specific characteristics, including period of inundation, availability of moisture during summer months, insolation, substrate qualities (e.g., amount of accumulated fines), and mechanical disturbance. Most of this area was either under water or had been recently inundated during field investigation in February 1993. A few seedlings were noted during field review; identification was not attempted this early in the season.

A period of prolonged drought, such as that which has occurred over recent years, not only results in less frequent inundation during winter months, but may also result in lower summertime flows. Lowering of the channel bed (degradation) has also occurred within the study area during recent years (Jager, et. al, 1992). A combination of these two factors has apparently led to a lowering of the water table and allowed sparse woody vegetation, primarily arroyo willow (*Salix lasiolepis*) or coyote brush (*Baccharis pilularis* var. *consanguinea*), to establish in some areas which might not otherwise support these species. These areas of young woody vegetation are often linear patches running parallel to the direction of high winter flow. As these patches mature, they trap sediment and debris, resulting in the formation of hummocks of differing vegetation within the gravel bar habitat.

C. Riparian Scrub

Riparian scrub extends transversely from the lowest terraces bordering the gravel bar to the uppermost terraces supporting riparian forest. The substrate is comprised of coarse fragments (cobbles, pebbles, and gravel) overlain with fine deposits (sand and silt) which increase in depth from the lower to upper terraces. Woody debris has accumulated in some of the lower areas, and appears to be generally smaller than that found on the gravel bars. This debris is often trapped against existing vegetative stands.

The vegetation is quite variable within the habitat, in terms of diversity, density, and spatial distribution. The greatest vegetative diversity is generally located within the early successional stages on the lower terraces, which are characterized by extensive herbaceous cover and sparse young woody vegetation (coyote brush and/or arroyo willow). Late successional vegetation is located at slightly higher elevations and is generally underlain with a deeper layer of fine deposits. The later stages are characterized by a decrease in herbaceous cover, an increase in shrub density and cover, a deepening of fine deposits, and an increase in elevation. Young red alder (*Alnus rubra*) and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) may be found sparingly at the upper edges of mature scrub vegetation.

It appears that the combined influences of the recent drought period along with channel degradation may have allowed the early stages of the riparian scrub to encroach further onto the gravel bar than would occur during "normal" hydrologic years. Low winter flows have deposited fine sediments at lower elevations in areas which are usually subject to annual scouring. The accumulation of these sediments has, in turn, allowed for encroachment of herbaceous and woody species, and expanded the spatial extent of the scrub habitat and associated potential wildlife value.

D. Riparian Forest

This habitat is located on higher terraces than the others and is usually spatially the farthest away from the river channel. On alluvial terraces, the substrate is characterized by deep silt and sand deposits overlying coarse material. On native slopes (e.g., between Glendale and Essex, and upriver of the fish hatchery), the substrate is comprised of native material, with occasional rocky outcrops. River-borne woody debris is sparse to absent within this habitat.

Within the riparian forest may be single-aged or mixed-aged stands of vegetation, depending on historic river channel locations, flood activity, and land use practices. Within the study area, the riparian forest is typified by moderately dense to dense canopy cover with black cottonwood, red alder, and yellow willow (*Salix lasiandra*) being dominant. In more mesic areas associated canopy species include California bay (*Umbellaria californica*) and cascara sagrada (*Rhamnus purshiana*) with occasional Sitka spruce (*Picea sitchensis*) and coast redwood (*Sequoia sempervirens*). By virtue of its spatial location, the riparian forest is protected from frequent periodic inundation, which, in turn, has allowed the canopy species to develop and mature.

The shrub layer is present in low to moderate cover classes. Characteristic species include coyote brush, salmonberry (*Rubus spectabilis*), and red elderberry (*Sambucus racemosa* ssp. *pubens* var. *arborescens*), with California blackberry (*Rubus vitifolius*) and Himalaya berry (*Rubus discolor*) being more evident along the edges and in disturbed areas. The herb layer generally exhibits low cover values, with sword fern (*Polystichum munitum*) and bracken fern (*Pteridium aquilinum* var. *pubescens*) being typical.

The relative species composition of the riparian forest is variable within the study area. In some stands cottonwood is the dominant species, with red alder being a moderate to very minor component. Other stands are dominated by red alder with cottonwood being a minor to absent component. Yellow willow was noted primarily in the vicinity of Graham Bar, associated with both cottonwood and red alder.

The age class of forest vegetation is also variable within the study area. Review of historic aerial photography and conversations with the property owner indicate that the young forest complex adjacent to Graham Bar has developed within the last 25 years. Examples of older stands include those just downstream of Hatchery Bridge as well as those adjacent to agricultural fields in the Blue Lake area. Isolated mature cottonwood on agricultural fields are most likely remnants from a more extensive forest which existed prior to clearing for agriculture.

E. Ponds and Backwaters

There are isolated backwaters and ponds, generally within the scrub habitat, which are subject to inundation more frequently than the rest of the habitat and which accumulate silt deposits. A number of these persist for a period sufficient to support a different flora than the remainder of the scrub with the vegetation being characterized by hydrophytic species. Slough sedge (*Carex obnupta*), broadleaf cattail (*Typha latifolia*), and horsetail (*Equisetum laevigatum*) are the most common. Adjacent vegetation is variable, from sparse to very dense shrubs and young trees. The location of these backwaters and ponds change periodically, depending on the annual flow characteristics of the river. Their present locations will be addressed later in this report in the section dealing with site-specific characteristics.

F. Sensitive Plant Species

An inquiry was made to the Natural Diversity Data Base with regard to presence of rare, threatened and/or endangered plant species within the project area. There are no records of any species within the study area. Additionally, review of the Inventory of Rare and Endangered Vascular Plant Species (CNPS, 1988) and the California Department of Fish and Game's Special Plant List (CDF, 1991) does not reveal any species which would be expected within the habitats found in the study area.

G. Wildlife Habitat Value

This discussion is intended only as a brief overview of the potential wildlife values of each vegetation habitat for terrestrial species. Species-specific values of each vegetation habitat will be discussed separately in the wildlife report to be prepared by Ron LeValley.

The wildlife habitat value of the gravel bar habitat is low in comparison with the remaining riparian habitats due to the relative absence of cover and scarcity of food. Scattered patches of woody vegetation which have developed within the gravel bar habitat act to locally enhance wildlife values by providing cover and a food source for species which may not usually be found here.

The riparian scrub provides habitat for a wide variety of small and moderate-size mammals and birds. In general, the potential wildlife habitat value increases with an increase in the vegetative density, with the denser stands supporting a greater diversity of species and number of individuals.

The riparian forest provides a high degree of wildlife habitat value, due to well-developed vertical structure, extent of cover, and food availability. This habitat is utilized by a wide variety and large numbers of insects, birds, and mammals.

Persistent ponds and backwaters with emergent vegetation provide habitat for several wildlife species of concern, including the California red-legged frog, the northern yellow-legged frog, and the western pond turtle. The potential value of this habitat lies not so much in the diversity of species but in the particular special species which it supports. These areas most likely meet the wetlands criteria of both the California Department of Fish and Game and the US Army Corps of Engineers.

IV POTENTIAL IMPACTS RESULTING FROM GRAVEL EXTRACTION

A. Direct Impacts

The immediate impact of gravel extraction on botanical habitats is the removal of vegetation and an overall decline in the botanical diversity. A reduction in vegetative cover will result in a decrease in wildlife habitat value with an expected decline in the numbers of individuals and species present. With respect to current conditions and values, the removal of gravel bar habitat would result in the least overall degree of direct impact while the removal of riparian forest would result in the greatest overall degree of impact on both botanical and wildlife values. There has been no attempt to quantify vegetation removal and/or disruption, as the results of concurrent studies (e.g., wildlife, fisheries, fluvial processes) and operational details of individual permit applications are not known at this time.

Removal of isolated patches of moderate to late stage scrub vegetation and young forest stands from the gravel bar and early scrub habitats would preclude the development and expansion of these vegetation types over time. These "islands" of more developed vegetation serve to enhance habitat values for wildlife; their removal would result in an overall decline in habitat value.

Continued excavation in any one area precludes the natural evolution of terraces and subsequent development of riparian vegetation. The low-lying herbaceous and early scrub habitats would be the most affected. The localized long-term effects would include the loss of early stage scrub, the maturation of the later stage scrub and forest, a decline in vegetative diversity, a decline in wildlife habitat values, and a likely decline in wildlife diversity.

B. Indirect Impacts

A natural riverine system is highly dynamic and routinely experiences changes in the location of the channel and the area of wetted surface over time. Depending on the nature and extent of relocation, bank erosion may occur on either side of the stream bed. Bank erosion, whether on low terraces vegetated with riparian scrub or on high terraces with mature riparian forest, results in

loss of vegetation, habitat diversity, and a decline in overall habitat value. In a natural system, erosion on one side of the channel is generally accompanied by deposition on the opposite side, with development of vegetation over time. The natural replenishment of the riparian vegetation is thus closely correlated with the hydrologic processes. The alteration of natural hydrologic processes by instream gravel extraction can affect riparian vegetation by accelerating the rate of erosion and/or precluding the deposition of materials (and subsequent establishment of vegetation) over time. These changes can occur both upstream and downstream of active mining areas as well as directly at the extraction sites.

Instream gravel extraction in excess of recruitment may lead to stream bed degradation which, in turn, results in a lowering of the water table. Many riparian species thrive where they do because of their specific water requirements. A significant lowering of the water table will alter the density and diversity of plant species growing in any specific location. Young shoots of arroyo willow, for instance, tend to colonize close to the water's edge in order to take advantage of the proximity of the water table. A lowering of the water table due to degradation of the low-water wetted channel is expected to preclude new colonization of these areas and to stress existing young stands.

V POTENTIAL IMPACTS RESULTING FROM GRAVEL PROCESSING

The areas currently used for gravel processing have been in operation for a number of years and are highly disturbed. Many of them, however, have remnant stands of mature forest and scrub vegetation at their outer edges. A substantial increase in the volume of material processed and stored at any one site might require additional space, which could result in the removal of these remnant stands.

VI MITIGATION MEASURES

It is recommended that a gravel management plan be prepared by the County in order to provide scenarios which allow for continuing gravel extraction with a minimal impact to other resources of the riverine system. A comprehensive management plan should include a monitoring program which documents the changes over time to the various components of the study area. The use of aerial photography with ground-truthing is an effective means of tracking changes over time. The acreages of each existing vegetation type should be calculated from the 1992 aerial photographs to serve as baseline data. There is also aerial photography available from several earlier dates which could be utilized for an historical perspective. If, for instance, one of the goals of the management plan is to maintain a certain percentage cover by riparian forest

within the study area, then routine calculation of the riparian forest coverage can be made from aerial photography to determine if this goal is being met.

Specific mitigation plans and monitoring programs should be developed for each individual permit. Monitoring programs should include measurable success standards and include a time frame in which the standards are to be met. Remedial action should be proposed should the standards not be met within the specified time frame. It is recommended that all mitigation occur as close to the area of impact as possible so as to minimize overall loss of habitat value. Mitigation plans need to be prepared to meet site-specific goals as well as comprehensive goals presented in the study area management plan.

Two specific mitigation measures are offered to reduce the impacts of gravel extraction on riparian vegetation - avoidance and revegetation. Avoidance should be employed in those areas of continuous, well established vegetation, from moderate scrub to mature forest. At any one particular site, at least some of the early successional scrub should be avoided in order to allow for diversity of age class and attendant habitat value. Isolated stands of moderate age scrub and young forest within the gravel bar habitat should be considered on a case by case basis to evaluate their contribution to the overall habitat value. It is recommended that those patches with a high probability for surviving the forces of high water flows be avoided.

Revegetation allows for continued gravel extraction followed by habitat creation and enhancement. Salvage of existing plant material, particularly woody species, is recommended wherever possible. Salvaged material needs to be properly stored and maintained (e.g., adequate water supply, protection from desiccation). Reclamation also offers an opportunity for habitat diversification if desired. An example would be the creation of small ponds which allow for the establishment and support of particular species such as the California red-legged frog and the northern yellow-legged frog.

VII SITE-SPECIFIC CONSIDERATIONS

A. Site No. 1, Guynup Bar, Mad River Sand and Gravel

This includes a processing yard located on the uppermost terrace, as well as the bar itself. There is a remnant stand of riparian forest on the southeasterly side of the processing yard which extends down slope to meet with a mature scrub stand at the bottom. The forest supports a mix of cottonwood and red alder, with some mature arroyo willow. There was standing water several feet deep along the base of this slope at the time of field review, with vegetation on both sides. This is either a remnant channel or

a backwater area with potential habitat value for amphibians. A mix of forest and mature scrub continues northerly along the bank. The remainder of the area is comprised of gravel bar habitat and early to mid-successional scrub habitat. It is recommended that the mature scrub/forest complex on the slope and the associated low-lying backwater be avoided.

B. Site No. 2, Emmerson Bar, Redwood Empire Aggregates

This site is characterized primarily by gravel bar and early successional riparian scrub. There are a few isolated patches of woody vegetation, including several stands of 20-foot arroyo willow in the gravel bar and a patch of young cottonwood (to 25-30 feet), arroyo willow, and coyote brush in the lower reach of the riparian scrub. These patches have apparently been able to mature sufficiently in recent years to attain some height and begin accumulating silt and other debris at the base. They likely enhance the habitat value of the bar and lower terrace in providing cover and some food for wildlife. It is recommended that these patches be avoided during extraction, and that extraction be accomplished so as to minimize erosion around these areas during winter months.

A pond with emergent vegetation (primarily cattail) is located at the northerly end of the bar, at the base of the slope. It is surrounded by a moderately dense stand of arroyo willow and red alder. This pond potentially has high habitat value for amphibians due to its persistence and the presence of good vegetative cover, and should be avoided in order to protect its comparatively unique habitat value. This area would likely meet the wetland criteria of both the California Department of Fish and Game and the US Army Corps of Engineers.

A small bar is located just downstream of hatchery bridge, on the south side of the channel. At the time of field investigation, the lower part was under water and the remainder had been covered with up to a foot of sediment. Access to this site is via a road through a mature cottonwood forest. Portions of the access road are also used for storage of materials.

C. Site No. 3, Blue Lake Bar, Redwood Empire Aggregates,

Much of this bar is typified by gravel bar bordered by early successional riparian scrub, with patches of later successional scrub (dense arroyo willow thickets) concentrated in the northerly portion. There is a small stand of cottonwood (riparian forest) on the slope from the processing/storage yard down to the duck pond installed at the end of 1992. In addition, there is a large patch of transitional scrub/forest to the south of the duck pond; this area has an approximate 20% cover by coyote brush and clumps of arroyo willow and small diameter cottonwood to 15 and 25 feet in height respectively.

Due to the lack of riparian forest on this site, it is recommended that this latter area, particularly the woody clumps, be avoided during extraction so as to allow for the maturation of the cottonwood and development of riparian forest. Development of riparian forest at this site would not only diversify the on-site habitat and increase the value to wildlife, but would assist in providing a corridor for wildlife migration between forest patches upstream and downstream of this bar. Revegetation in and around the duck pond could be incorporated for mitigation should this area not revegetate naturally, as had been expected.

D. Site No. 4, Christie Bar, Eureka Sand and Gravel

Nearly all of this site supports the gravel bar and very early successional riparian scrub habitat types. A few patches of arroyo willow are present toward the established scrub habitat. In addition there is a small population of mixed riparian forest and scrub on a terrace remnant toward the easterly (upstream) end of the bar. This terrace remnant appears to be rapidly eroding. Two ponds have been excavated on the bar, one toward the upstream side (1989) and one toward the downstream side (1992). There is a broad stand of mature scrub and patches of forest vegetation between the processing yard and the gravel bar, much of which has evolved over the last few decades. It is recommended to continue using the existing roads between the processing and extraction areas in order to preclude disruption of this stand. Revegetation in and around the ponds could be incorporated for mitigation should these areas not revegetate naturally, as had been expected.

E. Site No. 5, Johnson Bar, Redwood Empire Aggregates

Most of the Johnson Bar, as delineated by the County, is comprised of gravel bar habitat. There was a small linear stand of scrub willow (to 10 feet in height) noted as well as patches of early successional scrub. There is a broad terrace above this bar to the south which is dominated by early and mid successional scrub vegetation with strips of mature scrub. There were a few older backwater channels which may persist long enough for amphibian breeding. If this is, in fact, the case, then these areas should be avoided during excavation. Planting around these backwater channels for mitigation of impacts on other areas of the bar would enhance the potential wildlife value. No other recommendations are offered for this site.

F. Site No. 6, Essex Bar, Mercer Fraser

The upper terrace of this site is utilized for storage of materials from on and off site. Vegetation in this area is quite sparse, with ruderal (weedy) herbaceous species and a few coyote brush being noted in areas not recently disturbed. There is a narrow band of mixed scrub and forest vegetation between the storage terrace and the riverside gravel bar, characterized by

arroyo willow and red alder with sparse cottonwood. The gravel bar exhibited virtually no vegetation at the time of field review. The bar itself was partially covered with several inches of sediment, apparently from this year's high flows. It was noted during field review that a number of alder had been cut very recently on the adjacent upstream parcel. It is recommended that the existing roads between the storage and extraction areas be utilized, and that the narrow band of scrub/forest be left undisturbed.

G. Site No. 7A, Johnson-Spini Bar, Arcata Ready Mix

This site is characterized by two large gravel bars just downstream of the US 299 bridge, and a very small strip of gravel bar along the southerly bank. Moderate amounts of sediment have been deposited unevenly on the bars during the past winter. There was no vegetation noted on either bar during field review; the northerly bank of the this stretch of river has been lined with rip rap, and supports a moderately dense cover of arroyo willow (scrub). The southerly edge of the study area is lined with a mature forest supporting a mix of cottonwood and red alder. Access is via a road on the south side of the river, through the cottonwood/alder stand. It is recommended that this road continue to be utilized, and that no new roads be cut through the forest.

H. Site No. 7B, Arcata Ready Mix Bar

This site is comprised primarily of the processing plant and storage yard. There is a mature stand of mixed scrub-forest vegetation along the easterly half of the slope descending from the upper terrace to the river. At the time of field investigation, the entire area below this band of vegetation had been covered with up to several feet of sediment; no exposed gravels were noted. It is recommended that the band of scrub-forest between the processing and extraction areas not be disturbed.

I. Site No. 8, Graham Bar, Redwood Empire Aggregates

This site includes the Redwood Empire Aggregates processing yard and narrow bar on the south side of the river, a long narrow bar on the northerly bend on the river, and another bar on the westerly side of the downstream bend. The southerly side of the river supports a band of fairly mature forest, dominated by red alder with yellow willow and cottonwood present in lesser amounts. The southerly bar was covered with several feet of sediment at the time of field investigation. There is a pocket of mature scrub vegetation on the downstream bend, and sparse early scrub vegetation on the bar itself.

The northerly bar, across from the processing plant, is at the edge of a moderately aged stand of mixed forest vegetation which has developed within the last twenty-five years. Several low-lying areas within the forest are wet enough to support

emergent vegetation. Thick sediment deposits with no exposed gravel were noted during field review on this bar. There are no stands of forest vegetation of equal or greater size downstream. It is recommended that extraction operations be conducted to minimize impacts on the forest stand so as to allow it to mature.

J. Site No. 9, Simpson Bar

The Simpson Bar is bounded by native slopes rather than alluvial terraces on both sides of the river. The current channel is on the northerly side of the canyon. This site supports an open gravel bar habitat with early scrub vegetation being extremely sparse to absent. The banks on both sides of the river support mature arroyo willow on the lower slope and a mature red alder forest on the upper slope. At the top of both banks, the deciduous riparian forest grades into a mixed forest with cottonwood, alder, and sparse California bay (*Umbellaria californica*) and Sitka spruce (*Picea sitchensis*).

Bank erosion in this area would result in the loss of mature riparian scrub and forest habitat, and could undermine the upland forest on top of the bank. It is recommended that gravel extraction in this area be undertaken in such as manner as to minimize bank erosion. Due to the current position of the low-water wetted channel, the northerly bank is probably more exposed to erosion than is the southerly bank.

K. Site No. 10, Simpson (across from hatchery)

This site is located at the upstream end of the Blue Lake Valley. It is characterized by a mid-stream gravel bar (with gravel bar habitat), gravel bar and early to mid-aged scrub on the easterly side, and mixed young and moderate age scrub on the westerly side. Portions of the westerly bank are being actively eroded. While mature scrub and riparian forest were not observed within the active area defined by the county, they are located adjacent to and westerly from the site. It is recommended that extraction activities be undertaken in such a manner as to not accelerate the erosional process (and loss of mature vegetation) on the westerly bank.

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APPENDIX
COMPILED SPECIES LIST

CANOPY SPECIES

Alnus rubra	red alder
Ilex aquifolium	English holly
Picea sitchensis	Sitka spruce
Populus balsamifera ssp. *trichocarpa*	black cottonwood
Rhamnus purshiana	cascara sagrada
Salix lasiolepis	arroyo willow
Salix lasiandra	yellow willow
Sequoia sempervirens	coast redwood
Umbellaria californica	California laurel

SHRUB AND VINE SPECIES

Baccharis pilularis ssp. *consanguinea*	coyote brush
Rubus discolor	Himalaya berry
Rubus spectabilis var. *spectabilis*	salmon berry
Rubus vitifolius	California blackberry
Sambucus racemosa ssp. *pubens* var. *arborescens*	red elderberry

HERB AND FERN SPECIES

Anaphalis margaritacea	pearly everlasting
Bellis perenne	English daisy
Bromus sp.	brome
Carex obnupta	slough sedge
Cirsium vulgare	bull thistle
Cortaderia selloana	pampas grass
Daucus carota	Queen Anne's lace
Dipsacus fullonum	teasle
Equisetum laevigatum	horsetail
Festuca sp.	fescue
Foeniculum vulgare	fennel
Hedera helix	English ivy
Holcus lanatus	velvet grass
Hypochoeris radicata	perennial cat's ear
Melilotus alba	sweet white clover
Plantago lanceolata	English plantain
Poa sp.	bluegrass
Polystichum munitum	sword fern

APPENDIX
COMPILED SPECIES LIST
(continued)

Pteridium aquilinum var. *pubescens*	bracken fern
Raphanus sativa	wild radish
Scrophularia californica	California beeplant
Stachys sp.	hedge nettle
Trifolium sp.	clover
Typha latifolia	broadleaf cattail
Verbascum thapsus	wooly mullein
Vinca major	periwinkle

Appendix I

Agencies that may use the PEIR

Permits

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Permits

General

The Lead agency is "the public agency with the principal responsibility for carrying out or approving a project. The lead agency will decide whether an EIR or negative declaration will be required for the project and will cause the document to be prepared" [California Environmental Quality Act (CEQA) Guidelines Section 15367]. The County of Humboldt is the lead agency for the preparation of this PEIR, and for the permitting of surface mining operations within the scope of the PEIR.

The Responsible agency is "a public agency which proposes to carry out or approve a project, for which a lead agency is preparing or has prepared an EIR or negative declaration. In addition, for the purposes of CEQA, the term 'responsible agency' includes all public agencies other than the lead agency which have discretionary approval power over the project" (CEQA Guidelines, Section 15381). Responsible agencies for the preparation of this PEIR may include: California Coastal Commission; California Department of Conservation's, Division of Mines & Geology; California Department of Parks and Recreation; California Department of Transportation (CalTrans); California Division of Boating and Waterways; California Regional Water Quality Control Board; North Coast Unified Air Quality Management District; State Water Resources Control Board; Army Corps of Engineers; National Marine Fisheries; and the U.S. Fish & Wildlife Service.

The Trustee agency is "a state agency having jurisdiction by law over natural resources affected by a project which are held in trust for the people of the State of California" (CEQA Guidelines, Section 15386). Trustee agencies for the preparation of this PEIR may include: the State Lands Commission, Native American Heritage Commission, and the Department of Fish and Game.

Surface Mining Permit

"Surface mining operations," as defined by Public Resources Code [Surface Mining and Reclamation Act (SMARA)] Section 2735, is "all, or any part of, the process involved in the mining of minerals on mined lands by removing overburden and mining directly from the mineral deposits, open-pit mining of minerals naturally exposed, mining by the auger method, dredging and quarrying, or surface work incident to an underground mine."

Except as specifically exempted in SMARA (Section 2714) and Humboldt County Code (HCC, Section 391-3 or A314-36) "no person shall conduct surface mining operations unless a permit is obtained from, a reclamation plan has been submitted to, and approved by, and financial assurances for reclamation have been approved by the lead agency" (SMARA, Section 2770).

The permit issued by the County of Humboldt, under SMARA, takes the form of a Conditional Use Permit and/or the recognition of a vested right. A Conditional Use Permit may be granted after a public hearing before the Humboldt County Planning Commission. The decision of the Planning Commission is appealable to the Humboldt County Board of Supervisors, whose

decision is final. The recognition of vested right is made by Humboldt County's Director of the Planning and Building Department. The Director's decision is appealable to the Humboldt County Board of Supervisors (HCC Section 317-51).

A reclamation plan, may be approved after a public hearing before the Humboldt County Planning Commission, the reclamation plan assures that "mined lands are reclaimed to a usable condition which is readily adaptable for alternate land uses and create no danger to public health or safety" (SMARA, Section 2733). The decision of the Planning Commission is appealable to the Humboldt County Board of Supervisors, whose decision is final.

Financial assurances are approved by the Humboldt County Planning Department and are to ensure reclamation is performed in accordance with the approved reclamation plan (SMARA 2773.1).

According to CEQA, the review and approval of a Conditional Use Permit and/or a reclamation plan are considered "projects", and are therefore subject to environmental review pursuant to CEQA Guidelines Section 15378. The County of Humboldt has determined that the review and recognition of vested rights, and the review and approval of financial assurances are either not subject to, or are exempt from CEQA.

As part of the review process for a Conditional Use Permit and/or a reclamation plan, an initial study is prepared to determine if the project may have a significant effect on the environment. As part of the initial study process, the Humboldt County Planning Department consults with the responsible and trustee agencies, which are responsible for resources affected by the project, to obtain recommendations on whether an EIR or a Negative Declaration should be prepared (CEQA Guidelines, Section 15063).

In addition to granting Conditional Use Permits, recognizing vested rights, and approving reclamation plans and financial assurances for surface mining operations, Humboldt County is responsible for issuing Coastal Development Permits for operations located in the Coastal Zone and within the permit jurisdiction of the County. The County's permit jurisdiction does not include tidelands, submerged lands, and public trust lands, whether filled or unfilled. These areas are within the permitting authority of the California Coastal Commission. Map No. XX illustrates the limit of the Coastal Zone in relation to the scope of this PEIR. All lands within the Coastal Zone and subject to this PEIR are in the jurisdiction of the County.

Other Agencies

There are other agencies expected to use this PEIR:

- Resources Agency

The Resources Agency provides state agency coordination for activities which may affect the free-flowing and natural character of the state's public trust resources, adopts the California Environmental Quality Act (CEQA, Public Resource Code Section 21000 et seq.) Guidelines, and coordinates various inter-department issues. The following are all departments of the Secretary of Resources Agency: Department of Conservation; California Coastal Commission; Department of Fish and Game; Department of Boating and Waterways; Department of Parks and Recreation; and, the Department of Water Resources.

◆ Department of Conservation

The *State Mining and Geology Board* is composed of nine members appointed by the Governor. The Board has broad policy responsibilities for mineral resource conservation, mining, and reclamation pursuant to the Surface Mining and Reclamation Act of 1975 (SMARA).

The State Mining and Geology Board established the *Division of Mines and Geology* (DMG). The DMG implements a *Reclamation Program* which carries out many of SMARA's reclamation provisions. The Board sets policy for the Reclamation Program, and other DMG programs, and is the agency responsible for certifying local surface mining reclamation ordinances. The Reclamation Program is responsible for reviewing and commenting on reclamation plans submitted by lead agencies pursuant to SMARA.

The *Office of Mine Reporting and Reclamation Compliance* (MRRC) is a division of the Department of Conservation. The MRRC is responsible, among other things, for review of financial assurances and annual reports pursuant to SMARA.

◆ California Coastal Commission

In general, the coastal zone extends from the State's three-mile seaward limit to 1,000 yards inland from the mean high tide of the sea. In coastal estuaries, watersheds, wildlife habitats, and recreational areas, the coastal zone may extend inland to the ridge of the nearest mountain range or farther. In urban areas, the coastal zone may extend inland less than 1,000 yards from the mean high tide of the sea.

Specifically, for this project the coastal zone extends up the Mad River to approximately the upstream end of the extraction area for Site 8, see Map #. The river bed, bank to bank, is under the permit jurisdiction of the California Coastal Commission (CCC). The upland area west of the river is within the County's permit jurisdiction.

Because Humboldt County has a LCP, the CCC's role in coastal development regulation is reduced to a few well-defined responsibilities: 1) retains permit jurisdiction in certain areas such as state tidelands, submerged lands, public trust lands, and uncertified geographic areas (areas of deferred certification); 2) hears appeals from local actions on appealable developments; 3)determines jurisdiction in cases where a local determination is questioned or challenged (Regulation Section 13569); 4) enforces permits it issued before LCP certification; and 5) reviews projects for federal consistency.

The CCC also has an ongoing responsibility to monitor LCP implementation: 1) reviewing notices of pending local hearings and pending non-hearing actions; 2) reviewing notices of final local action; and 3) providing notice of appealable development to the CCC.

Anyone proposing development within the coastal zone must obtain a coastal development permit. For development in areas under the permit jurisdiction of the CCC, the project proponent must apply to the CCC. For development in areas under the permit jurisdiction of the County, the project proponent must apply for the Coastal Development Permit with the County. For a more detailed discussion of project conformance with applicable LCPs, see Section VIII, Environmental Setting.

◆ California Department of Fish & Game

Any person proposing an activity that will change the natural state of any river, stream, or lake must enter into a Stream or Lake Alteration Agreement with the California Department of Fish & Game (CDFG). These agreements are often call "1601" or "1603" permits, since many people use the statutory reference. As a general rule, this requirement applies to any work undertaken within the mean high-water mark of a body of water containing fish or wildlife resources or where the project sponsor will use material from the streambed.

The CDFG uses the following factors to determine the high-water mark: 1) the height of residue deposited by the stream, river or lake on its bank or beach in the course of a normal year; 2) the yearly fluctuation in flow; 3) personal knowledge of the area involved; and, 4)United State Geological Survey charts. The CDFG enters into Stream or Lake Alteration Agreements to protect the fish and wildlife resources of the state. In addition to its regulatory responsibilities, the CDFG reviews and recommends modification, approval or denial of projects requiring federal, state, and county permits that may affect fish and wildlife.

The CDFG bases the evaluation of an application for a Stream or Lake Alteration Agreement on the anticipated impact of the proposed project on fish and wildlife resources. Consequently, the CDFG will write the Stream or Lake Alteration Agreement with terms and conditions designed to protect these resources. The CDFG may impose additional conditions on the Agreement in the event that the project impairs the physical condition of the project area or an operation changes.

If a project sponsor does not agree to the conditions or modifications of the Stream or Lake Alteration Agreement, the CDFG and sponsor must establish an arbitration panel. The panel consists of a representative of the CDFG, the applicant or representative, and a neutral chairman selected with the approval of both. The panel may settle disagreements and make binding decisions concerning the proposed conditions or modifications.

Anyone proposing to use suction or vacuum dredging equipment with an intake diameter of 12 inches or less in any river, stream or lake designated as open for dredging must obtain a standard suction dredging permit from CDFG. Anyone proposing to use suction or vacuum dredge equipment with an intake diameter over 12 inches; or anyone proposing to use suction or vacuum dredging equipment of any size in any area designated as closed for dredging, must obtain a special suction dredging permit.

◆ California Department of Boating and Waterways

For all summer bridge crossings, the California Department of Boating and Waterways requires clear markings to warn recreational users of the river that hazards may exist.

◆ North Coast Unified Air Quality Management District

The State Air Resources Board (ARB) and the Federal Environmental Protection Agency (EPA) have established standards which govern the quality of the surrounding atmosphere, known as ambient air quality standards. The North Coast Unified Air Quality Management District (NCUAQMD), and, in some cases, the EPA, may also have established emission limits for specific types of equipment. The NCUAQMD is a multi-county special district funded partially by the State of California and partially by those operations that fall under its jurisdiction.

In addition to emission limits and ambient air quality standards, the NCUAQMD may have adopted what are commonly known as New Source Review Rules. New Source Review Rules regulate all new or modified sources with emissions exceeding a specified limit for any pollutant for which there is a state or national ambient air quality standard (excluding carbon monoxide) or any precursor to such a pollutant. The NCUAQMD also determines whether the new emissions violate any carbon monoxide standard at the ground level point where they are most concentrated. All new or modified stationary sources with a net increase in emissions greater than the limit must be constructed using the best available control technology (BACT).

Even in areas where the ambient air quality standards are not being violated, the NCUAQMD may determine that additional emissions would cause a violation of a standard at the point of greatest concentration at ground level. The project sponsor must reduce these emissions to a level where no violation exists.

Any person or organization proposing to construct, modify, or operate a facility or equipment that may emit pollutants from a stationary source into the atmosphere must first obtain an Authority to Construct from the NCUAQMD.

If the NCUAQMD denies and Authority to Construct, the applicant may appeal the decision within 10 days of the denial notice to the district's Hearing Board. The Hearing Board must reach a decision within 30 days of receipt of the appeal, unless the applicant and the NCUAQMD agree to additional time.

The Authority to Construct permit cannot be transferred to another party. Also, the project sponsor must comply with all conditions included in the permit. The NCUAQMD may, after holding a public hearing, revoke an Authority to Construct permit if it finds the project sponsor has violated any district rules, regulation, or permit conditions.

Any person proposing to operate equipment that emits pollutants into the atmosphere must obtain a Permit to Operate from the NCUAQMD. The project sponsor may apply for the permit only after obtaining an Authority to Construct permit.

The NCUAQMD may cancel a Permit to Operate if the project sponsor has not begun operating the facility within one year of completing construction. The Hearing Board may revoke a Permit to Operate if it finds, after a public hearing, that the permittee has violated any district rules and regulations.

- State Water Resources Control Board

The owner or operator of any facility or activity that will discharge waste into any surface waters of the state must obtain waste discharge requirements. The requirements serve as a federal National Pollutant Discharge Elimination System (NPDES) permit from the Regional Water Quality Control Board (RWQCB).

The RWQCB evaluates the NPDES permit application to determine whether the proposed discharge is consistent with the RWQCB's adopted water quality objectives, the Areawide Waste Treatment Management ("208") Plan, the Basin Plan for the area in which the project is located, and federal effluent limitations.

When approving an NPDES permit, the RWQCB sets limits on each discharge. These limits assure that the discharge will not harm public water supplies, agricultural and industrial water

use, wildlife habitat, or any water-related recreational activity, and that the discharge will comply with the requirements of federal and state law.

The RWQCB denies an NPDES permit if the discharge contains a harmful biological, radiological, or chemical agent or if the discharge would substantially impair the anchorage and navigability of the waterway.

The RWQCB decision to issue, or not issue, a NPDES can be appealed to the State Water Resources Control Board.

The State or RWQCB may require the project sponsor to discontinue the discharge if the sponsor violates the conditions of the waste discharge requirements or has misrepresented the activity to obtain the requirements. The State or RWQCB may also go to court to seek fines for violation of the permit.

In late 1991, the RWQCB was delegated responsibility to implement a Statewide General Permit that may be used by surface mining operations which have NPDES permits. The Statewide General permit requires the operator to eliminate any possibility of non-stormwater discharge, prepare and implement a Stromwater Pollution Prevention Plan and prepare and implement a Stromwater Discharge Monitoring Program.

The RWQCB is responsible for verifying compliance with the General Permit and may use any of its enforcement authorities to obtain compliance.

The RWQCB also is responsible for regulating handling and storage of petroleum products. Any above ground tanks must comply with State registration and monitoring regulations. Tanks with a capacity over 700 gallons must be have a Spill Prevention Control, Countermeasure and Contingency Plan. However, the regulation of underground tanks is the responsibility of the Humboldt County Department of Environmental Health.

The objective of the petroleum storage regulations is to avoid spillage of fuels and asphalt products where they may immediately affect the sensitive uses of the Mad River or its tributaries. The RWQCB has enforcement powers to regulate compliance with the petroleum storage and handling requirements.

- State Lands Commission

The State of California acquired sovereign ownership of the beds of navigable waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all the people of the State. The Statewide Public Trust is for purposes of waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation and open space.

The State Lands Commission comments, pursuant to CEQA, on projects which may affect state lands or public trust easements, and collects royalties for the removal of mineral resources from state fee-owned lands.

- Department of Transportation

Any proposed activity within, under, or over the State highway right of way must have an encroachment permit from the Department of Transportation (Caltrans). Encroachment permits are issued to: 1) ensure that the proposed encroachment is compatible with the primary uses

of the State highway system; 2) ensure the safety of both the permittee and the highway users; and 3) protect the State's investment in the highway facility.

If the proposed encroachment is minor and will have no significant effect on the environment or is exempt from the California Environmental Quality Act, the permit engineer will review the application to determine whether the encroachment is compatible with other highway uses and conforms to Caltrans standards. If the application is acceptable, the permit engineer will issue the permit.

If the proposed encroachment is major, the permit engineer inspects the project area. Other Caltrans units, such as Traffic, Design, Hydraulics, and Environmental, may review the application to determine the proposed encroachment's effect of the use of the State highway and on the environment. If these units find the encroachment acceptable, the permit engineer will issue the permit.

Caltrans has no formal appeal process, however, in cases where the permit engineer and the project sponsor cannot reach an agreement, the District maintenance engineer will negotiate with the applicant. If an agreement is not reached at this level, the District Director will negotiate with the applicant. If unsuccessful, the District Director may seek the advice of Department Headquarters in Sacramento to resolve the conflict. The decision of the Department Director of Caltrans is final.

Caltrans may revoke a permit and order the removal of an encroachment, if the permittee has not complied with all terms and conditions of an approved permit, or if the continuance of the encroachment is incompatible with highway use.

- United States Army Corps of Engineers

Any person or public agency proposing to locate a structure, excavate, or discharge dredged or fill material into waters of the United States or to transport dredged material for the purpose of dumping it into ocean waters must obtain a United States Army Corps of Engineers (corps) permit, often referred to as a "404" permit.

Sections 9 and 10 of the federal River and Harbor Act of 1899 gave the Corps permit power over activities in navigable waters. Navigable waters were defined as those suitable for commercial transport. Recent court decisions and new legislation, however, such as Section 404 of the federal Clean Water Act and Section 103 of the Marine Protection, Research and Sanctuaries Act, have widened the definition of navigable waters and have expanded the Corps' regulatory jurisdiction. Now "navigable waters" include rivers, coastal waters, adjacent wetlands, lakes intermittent streams, and low-lying areas behind dikes along the coast.

The Corps evaluates each application for any effects on the environment, navigation, or flood control. The Corps' primary area of expertise is in navigation and flood control, so they ask other public agencies to assist in evaluating the environmental effects of a project. The Corps will also consider safety, water quality, land use effects, historic values, aesthetics, economics, conservation, and the welfare of the general public when reviewing the merits of a proposal.

The Corps will not issue a permit when other government agencies object. The Corps has no formal procedures for appeals.

Although the Corps issues the Section 404 permits, the Environmental Protection Agency (EPA) has developed the 404(b)(1) Guidelines and retains veto power over Section 404 permits and may designate specific areas as non-discharge sites. The EPA will comment on individual permit applications and often acts as an agency "watchdog" to ensure compliance with the 404(b)(1) Guidelines and NEPA.

- National Marine Fisheries Service

The National Marine Fisheries Service is responsible for preserving and enhancing marine, estuarine, and anadromous fish resources and the habitats that support these resources.

- Fish and Wildlife Service

The United States Fish and Wildlife Service (USFWS) is responsible for regulating the Endangered Species Act and updating the list of threatened or endangered species. All Federal agencies are required to consult the USFWS before taking any action which could adversely affect threatened or endangered species or result in the destruction or adverse modification of lands determined by the USFWS to be 'critical habitat'. The consultation does not apply to private actions; it applies only to actions involving permits or other approvals by the federal government.

- Humboldt Bay Municipal Water District

The Humboldt Bay Municipal Water District operates wells and provides water supplies that draw from the Mad River and its underlying aquifers, and submits comments as an interested agency on proposed projects subject to CEQA which may affect the volume or quality of its water supplies.

Appendix J

Draft
Surface Mining Reclamation Plan

by
Rising Sun Enterprises

DRAFT

SURFACE MINING AND RECLAMATION PLAN

FOR GRAVEL REMOVAL ON THE LOWER MAD RIVER

APPLICANTS:

REDWOOD EMPIRE AGGREGATES
ARCATA READIMIX
MERCER, FRASER COMPANY
EUREKA SAND AND GRAVEL
MAD RIVER SAND AND GRAVEL
ZABLE TRUCKING

THE PURPOSE OF THIS DOCUMENT IS TO PROVIDE COMPREHENSIVE RECLAMATION STANDARDS FOR CONTINUED COMMERCIAL EXTRACTION OF RIVER RUN MATERIALS FOR EACH OF THE INDIVIDUAL OPERATIONS ON THE LOWER MAD RIVER

APRIL 1993

RISING SUN
ENTERPRISES

PLANNING • PERMITTING • ENVIRONMENTAL CONSULTING
1864 Myrtle Avenue • Eureka, CA 95501 • (707) 445-2433

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INTRODUCTION

The purpose of this project is to provide comprehensive reclamation standards for continued commercial extraction of riverrun materials. This reclamation plan defines the reclamation of operations that are expected to continue indefinitely. These operations will be subject to the conditions and mitigation measures, including annual review and monitoring, required by the Mad River EIR.

As stated in Attachment A, annual monitoring of the gravel bars will be conducted before and after seasonal extraction to determine the impact (positive or negative) of the mining. The results (cross-sections) will be submitted annually to the Humboldt County Planning Department and California Department of Fish & Game to verify compliance and determine the appropriate mining strategy to be used the next year.

Although all sites are being proposed to be governed by similar standards and regulations, the proposed revisions would constitute changes in each of the operations individual reclamation plan. All operations are meant to remain as separate operations.

GENERAL INFORMATION

1. Name of Mineral Property/Project Name/Permit #'s

Graham/Zanzi/REA Gravel Bar. SMR 09-91, CDF 46-91, SP 39-91

2. Applicant/Lessee/Operator

Redwood Empire Aggregates
P.O. Box 299
Arcata, CA 95521
(707) 822-4853

3. Property Owners/Owner of Mineral Rights

Carol & Donald Graham
1706 Guintoli Lane
Arcata, CA 95521
(707) 822-1060

Ellen Zanzi
P.O. Box 2542
Yountville, CA 94599

REA
P.O. Box 299
Arcata, CA 95521
(707) 822-4853

4. Agent of Process

Pacific Affiliates
835 Third Street
Eureka, CA 95501
(707) 445-3001

5. Project Description Summary

The project entails an ongoing gravel extraction operation. The mining operation would continue to extract up to 100,000 cubic yards of riverrun materials on an annual basis. The project would potentially continue to excavate as long as material is available on the gravel bar (as defined herein).

6. Site Description

SW¼ Sec. 8, NE¼ Sec. 17, NW¼ Sec. 16, T6N, R1E, H.B.M. The site location is depicted on maps included in Section IV. Assessor Parcel Numbers 504-141-11, 32 & 42. Project is in the Coastal Zone (Humboldt Bay Area Plan).

The parcels total approximately 80 acres. The portion of gravel bar on this property which would be disturbed in any given year and described in this reclamation plan could range from 1 to 17 acres based on current river conditions.

7. Access Route

Primary access to the site is off of existing driveways accessing Guintoli Lane opposite Valley East and Valley West Boulevards.

GENERAL INFORMATION

1. Name of Mineral Property/Project Name/Permit #'s

   Arcata Readimix Gravel Bar, Spina/Johnson Gravel Bar.
   SMR-03-88, SP 91-88

2. Applicant/Lessee/Operator

   Arcata Readimix
   P.O. Box 4657
   Arcata, CA 95521
   (707) 822-1795

3. Property Owners/Owner of Mineral Rights

   William O'Neill
   Richard Hunt
   Stan Johnson
   Ben Spina

4. Agent of Process

   Rising Sun Enterprises
   1864 Myrtle Avenue
   Eureka, CA 95501
   (707) 445-2433

5. Project Description Summary

   The project entails an ongoing gravel extraction operation. The mining operation would continue to extract up to 80,000 cubic yards of riverrun materials on an annual basis. The project would potentially continue to excavate as long as material is available on the gravel bar (as defined herein).

6. Site Description

   NW¼ & NE¼ Sec. 16, SE¼ Sec. 9, T6N, R1E, H.B.M.
   The site location is depicted on maps included in Section IV.
   Assessor Parcel Numbers are as follows:

OWNER/APN	TOTAL PARCEL AREA (acres)	AREA UTILIZED FOR PROJECT (acres)	GRAVEL BAR (acres)	PROCESSING (acres)
O'Neill				
507-381-03, 04, 05	20	20	6	14
Hunt				
507-131-18	20	1	1	0
Johnson				
507-131-83	25	11	11	0
504-181-28	5	.5	.5	0
Spina				
504-181-18, 26	20	3.5	3.5	0
507-261-16, 9, 10				
TOTAL (acres)	90	36	22	14

The parcels total approximately 90 acres. The portion of gravel bar on this property which would be disturbed in any given year and described in this reclamation plan could range from 1 to 22 acres based on current river conditions.

7. Access Route

Primary access to the site is off of an existing driveway accessing Boyd Road approximately 1,500' and 3,500' north of Giuntoli Lane.

GENERAL INFORMATION

1. Name of Mineral Property/Project Name/Permit #'s

   Essex Gravel Bar. SP 26-88

2. Applicant/Lessee/Operator

   Mercer, Fraser Company
   P.O. Box 1006
   Eureka, CA 95502
   (707) 443-6371

3. Property Owners/Owner of Mineral Rights

   Mercer, Fraser Company
   P.O. Box 1006
   Eureka, CA 95502
   (707) 443-6371

4. Agent of Process

   Rising Sun Enterprises
   1864 Myrtle Avenue
   Eureka, CA 95501
   (707) 445-2433

5. Project Description Summary

   The project entails an ongoing gravel extraction operation. The mining operation would continue to extract up to 40,000 cubic yards of riverrun materials on an annual basis. The project would potentially continue to excavate as long as material is available on the gravel bar (as defined herein).

6. Site Description

   NE¼ Sec. 15, T6N, R1E, H.B.M.
   The site location is depicted on maps included in Section IV.
   Assessor Parcel Numbers 504-161-10.

   The parcel is approximately 8 acres total. The portion of gravel bar on this property which would be disturbed in any given year and described in this reclamation plan could range from 1 to 3.5 acres based on current river conditions.

7. Access Route

   Primary access to the site is off of an existing driveway accessing Glendale Drive approximate 2,000' west of Essex Lane in the Glendale vicinity.

GENERAL INFORMATION

1. Name of Mineral Property/Project Name/Permit #

   Simpson Gravel Bar. No County permit approvals.

2. Applicant/Lessee/Operator

   Zabel Trucking
   P.O. Box 3772
   Eureka, CA 95501
   (707) 445-2958

3. Property Owners/Owner of Mineral Rights

   Simpson Train Company
   P.O. Box 1169
   Arcata, CA 95521
   (707) 822-0371

4. Agent of Process

   Rising Sun Enterprises
   1864 Myrtle Avenue
   Eureka, CA 95501
   (707) 445-2433

5. Project Description Summary

   The project entails an ongoing gravel extraction operation. The mining operation would continue to extract up to 40,000 cubic yards of riverrun materials on an annual basis. The project would potentially continue to excavate as long as material is available on the gravel bar (as defined herein).

6. Site Description

   SE¼ Sec. 14, NW¼ Sec. 23, SW¼ Sec. 13, T6N, R1E, H.B.M. The site location is depicted on maps included in Section IV. Assessor Parcel Numbers 504-131-02 & 04; 516-161-04.

   The parcels total approximately 50 acres. The portion of gravel bar on this property which would be disturbed in any given year and described in this reclamation plan could range from 1 to 27 acres based on current river conditions.

7. Access Route

   Primary access to the site is off of an existing driveway accessing Glendale Drive approximately 1,300' east of Fieldbrook Road in the Glendale vicinity.

GENERAL INFORMATION

1. Name of Mineral Property/Project Name/Permit #

   Johnson Gravel Bar. CUP-34-91/SMR-11-91.

2. Applicant/Lessee/Operator

   Redwood Empire Aggregates
   P.O. Box 299
   Arcata, CA 95521
   (707) 822-4853

3. Property Owners/Owner of Mineral Rights

   Redwood Empire Aggregates
   P.O. Box 299
   Arcata, CA 95521
   (707) 822-4853

4. Agent of Process

   Pacific Affiliates
   835 Third Street
   Eureka, CA 95501
   (707) 445-3001

5. Project Description Summary

   The project entails an ongoing gravel extraction operation. The mining operation would continue to extract up to 30,000 cubic yards of riverrun materials on an annual basis. The project would potentially continue to excavate as long as material is available on the gravel bar (as defined herein).

6. Site Description

   NW¼ Sec. 24, T6N, R1E, H.B.M.
   The site location is depicted on maps included in Section IV.
   Assessor Parcel Number 516-161-02.

   The parcel is approximately 36 acres total. The portion of gravel bar on this property which would be disturbed in any given year and described in this reclamation plan could range from 1 to 20 acres based on current river conditions.

7. Access Route

   Primary access to the site is off of an existing driveway accessing Glendale Road approximate 1,300' east of Fieldbrook Road in the Glendale vicinity via property owned by Simpson Train Company.

GENERAL INFORMATION

1. Name of Mineral Property/Project Name/Permit #'s

   Christie Gravel Bar. CUP-08-88, CUP-24-91/SMR-05-91, CUP-129-85

2. Applicant/Lessee/Operator

   Eureka Readimix
   P.O. Box 3568
   Eureka, CA 95502
   (707) 822-2937

3. Property Owners/Owner of Mineral Rights

   Phyllis M. Christie
   P.O. Box 187
   Blue Lake, CA 95525

4. Agent of Process

   Pacific Affiliates
   835 Third Street
   Eureka, CA 95501
   (707) 445-3001

5. Project Description Summary

   The project entails an ongoing gravel extraction operation. The mining operation would continue to extract up to 50,000 (150,000) cubic yards of riverrun materials on an annual basis. The project would potentially continue to excavate as long as material is available on the gravel bar (as defined herein).

6. Site Description

   Sec. 24, T6N, R1E, H.B.M.
   The site location is depicted on maps included in Section IV.
   Assessor Parcel Numbers 516-171-05, 06, 07; 516-181-09, 10.

   The parcels total approximately 200 acres. The portion of gravel bar on this property which would be disturbed in any given year and described in this reclamation plan could range from 1 to 71.5 acres based on current river conditions.

7. Access Route

   Primary access to the site is off of an existing driveway accessing Glendale Road approximate 1,800' northeast from the Highway 101 interchange.

GENERAL INFORMATION

1. Name of Mineral Property/Project Name/Permit #

   Blue Lake Gravel Bar. SMR-08-91/SP-38-91

2. Applicant/Lessee/Operator

   Redwood Empire Aggregates
   P.O. Box 299
   Arcata, CA 95521
   (707) 822-4853

3. Property Owners/Owner of Mineral Rights

   1. Redwood Empire Aggregates
   2. CWDT, Inc.
   3. Leavey

4. Agent of Process

   Pacific Affiliates
   835 Third Street
   Eureka, CA 95501
   (707) 445-3001

5. Project Description Summary

   The project entails an ongoing gravel extraction operation. The mining operation would continue to extract up to 100,000 cubic yards of riverrun materials on an annual basis. The project would potentially continue to excavate as long as material is available on the gravel bar (as defined herein).

6. Site Description

   NW¼ Sec. 30, T6N, R2E, H.B.M.
   The site location is depicted on maps included in Section IV.
   Assessor Parcel Numbers 312-161-07; 313-231-01, 02, 03; 516-181-07, 516-191-09.

   The parcels total approximately 400 acres. The portion of gravel bar on this property which would be disturbed in any given year and described in this reclamation plan could range from 1 to 63 acres based on current river conditions.

7. Access Route

   Primary access to the site is off of an existing driveway accessing Taylor Way in the Blue Lake Industrial Park.

GENERAL INFORMATION

1. Name of Mineral Property/Project Name/Permit #

   Emmerson Gravel Bar. SMR-06-91/CUP-25-91

2. Applicant/Lessee/Operator

   Redwood Empire Aggregates
   P.O. Box 299
   Arcata, CA 95521
   (707) 822-4853

3. Property Owners/Owner of Mineral Rights

   Emmerson & Son
   P.O. Box 1189K
   Arcata, CA 95521
   (707) 443-3111

4. Agent of Process

   Pacific Affiliates
   835 Third Street
   Eureka, CA 95501
   (707) 445-3001

5. Project Description Summary

   The project entails an ongoing gravel extraction operation. The mining operation would continue to extract up to 50,000 cubic yards of riverrun materials on an annual basis. The project would potentially continue to excavate as long as material is available on the gravel bar (as defined herein).

6. Site Description

   SW¼ Sec. 30 & SE¼ Sec. 14, NW¼ Sec. 23, SW¼ Sec. 13, T5N, R2E, H.B.M.
   The site location is depicted on maps included in Section IV.
   Assessor Parcel Numbers 312-151-15, 19, 25-161-05.

   The parcels total are approximately 250 acres. The portion of gravel bar on this property which would be disturbed in any given year and described in this reclamation plan could range from 1 to 33 acres based on current river conditions.

7. Access Route

   Primary access to the site is off of existing driveways accessing Hatchery Road approximate 350' north of West End Road in the Glendale vicinity.

GENERAL INFORMATION

1. Name of Mineral Property/Project Name/Permit #

   Guynup Gravel Bar. SP-36-88, CUP-35-91

2. Applicant/Lessee/Operator

   Mad River Sand & Gravel
   1206 W. 14th Street
   Eureka, CA 95501
   (707) 443-7039

3. Property Owners/Owner of Mineral Rights

   Mad River Sand & Gravel
   1206 W. 14th Street
   Eureka, CA 95501
   (707) 443-7039

4. Agent of Process

   Rising Sun Enterprises
   1864 Myrtle Avenue
   Eureka, CA 95501
   (707) 445-2433

5. Project Description Summary

   The project entails an ongoing gravel extraction operation. The mining operation would continue to extract up to 200,000 cubic yards of riverrun materials on an annual basis. The project would potentially continue to excavate as long as material is available on the gravel bar (as defined herein).

6. Site Description

   NE¼ Sec. 31, T6N, R2E, H.B.M.
   The site location is depicted on maps included in Section IV.
   Assessor Parcel Numbers 313-061-05, 313-081-23, 303-061-01.

   The parcels total approximately 160 acres. The portion of gravel bar on this property which would be disturbed in any given year and described in this reclamation plan could range from 1 to 30 acres based on current river conditions.

7. Access Route

   Primary access to the site is off of an existing driveway accessing Hatchery Road just south of West End Road.

Summary of Gravel Projects on Mad River

Gravel Bar	Operator	Amounts Covered by Reclamation Plan (cubic yards)	Size (ac.) of Gravel Bar (1992)[1]
Graham/Zanzi/REA Bars	Redwood Empire (REA) Aggregates	100,000	17
Arcata Readimix/ Spina/Johnson Bar	Arcata Readimix	80,000	22
Essex Gravel Bar	Mercer, Fraser Co.	40,000	3.5
Simpson Gravel Bar	Zabel Trucking	40,000	27
Johnson Gravel Bar	REA	30,000	20
Christie Gravel Bar	Eureka Sand & Gravel	150,000	71.5
Blue Lake Gravel Bar	REA	100,000	63
Emmerson Gravel Bar	REA	50,000	33
Guynup Gravel Bar	Mad River Sand & Gravel	200,000	30
TOTAL		730,000	260

[1]Acres operated varies year to year.

8. Location and Vicinity Maps

See attached Location Map, Site Maps, Photographs, and Mining Plans - Section IV.

9. Project Description

The project detailed herein is for existing surface mining operations (i.e., gravel extraction). The extracted gravel will generally be used for local construction projects. The gravel is commonly gathered using one of the following two techniques: Skimming and/or trenching. Skimming is the preferred method and is accomplished by scraping a section of the bar parallel to the river channel. The bar is often graded toward the river. Patterns are dependent on site specific characteristics. Skimming occurs so that holes or depressions are not created to trap migratory fish during migration.

Trenching involves using an excavator and digging a trench . Trenches often parallel the existing river channel or are used in developing an off-channel pond. Based on specific river conditions and recommendations by the California Department of Fish & Game, channelization (trenching in the live stream channel) may also be used to retain the river's present channel position or relieve erosional pressure on stream banks. However, this is not presently being used based on current river conditions but may be considered sometime as part of the annual review listed in Attachment A.

The extraction areas will be on the gravel bar and are located away from housing so that disruption to occupants has been kept to a minimum. The operating hours will be limited to daylight hours generally from 7:00 a.m. to 6:00 p.m., Monday through Friday. Occasionally Saturday and Sunday extraction will occur contingent upon demand. The number of employees at each extraction site consist of those necessary to operate machinery; generally one person to operate the scraper or excavator, one person to operate the loader and a variable number (3-5) of people to operate dump trucks. This may be increased at times of a reduced extraction season.

This project is an annual/seasonal operation and will operate pursuant to governmental regulations. The operation will also be subject to seasonal flow conditions.

Access to the site is by way of private access roads. These roads are accessed through locked gates on existing road approaches. Trucks would travel on local collectors and connect directly with Highways 299 and Highway 101 to destinations located in the near vicinity.

I. ENVIRONMENTAL SETTING

Please refer to information in the Program EIR for Gravel Removal on the Lower Mad River prepared by Humboldt County and incorporated herein by reference.

II. MINING PLAN

A. MAP OF OPERATIONS

See Section IV.

B. PRODUCTION LEVELS

Production levels in the past have varied and have been in response to providing both local timber and construction needs as well as major highway construction projects which required road base, asphalt paving, concrete bridges, interchanges, overpasses, etc. Large projects occurring between the 1950's and 1970's include construction of the Highway 101 Arcata-Eureka freeway (8 miles built in the 1950's) and Arcata to Big Lagoon freeway (27 miles built in the 1960's); Highway 299 freeway from Highway 101 to Berry Summit (35 miles built in the late 1960's, early 1970's) and Highway 255 (Samoa Boulevard) from Arcata to the Coast Guard Station (11 miles built in the 1960's).

Other projects that required substantial amounts of material removed from the Mad River include the Arcata Airport (1940's - +300,000 cubic yards), and base and paving material for majority of mill yards in the Arcata-Eureka area (as an example the Simpson Samoa Pulp Mill required 90,000 cubic yards of material for base and concrete in the 60's). Most of the concrete buildings in Eureka built in the 60's obtained materials from the Mad River. The County Courthouse required 40,000 cubic yards of concrete itself. The development of Humboldt State University's concrete buildings, base and paving utilized material from the Mad River. In 1972, 5,000 dolos were constructed for the jetties. Of the 212,000 tons of material, half consisted of Mad River sand.[2]

Gravel extraction practices during those times allowed a dragline to operate even during winter months. As soon as material was removed, it was replenished by winter flows, allowing for large stockpiles to be developed in winter for summer construction projects. This practice ceased in the early 1970's when the CA Department of Fish & Game restricted gravel extraction to other methods, such as gravel bar skimming. Production levels were decreased and, at the same time, most of the large highway construction projects were completed. Local construction needs of Mad River aggregate remained high through the 1970's and into the 1980's and supply appears to have kept up with demand. Several large floods and normal wet winters provided sufficient recruitment of gravels to meet demand during that time. The Eel River was not used as a source for these kinds of projects until

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[2]Based on discussions with operators.

the late 1970's, when ready mix concrete operations were developed. The six years of drought since 1986 has caused a drastic reduction in recruitment levels, though actual figures are unavailable.

Presently permitted and approved operations allow an annual maximum of 690,000 cubic yards. However, recent extraction has been much less than this. In 1991, when increased extraction was allowed because of a trenching alternative, approximately 305,000 cubic yards of material was removed. Without the trenching alternative, production levels are much less. In 1992, only 104,500 cubic yards were removed which included both gravel bar skimming and off-river pits.[3]

C. MINING PLAN

1. Operating Plan

The projects are currently operating and will continue as long as material is permitted to be removed. Extraction is proposed to generally occur June through September but annual operating periods are to be determined on an annual basis based on river conditions (see Attachment A).

2. Topsoil

No topsoil is present where mining will occur.

3. Overburden/Waste/Ore

a. The proposed mining type will be riverrun gravel extraction.

b. Equipment utilized at the site will include scrapers, excavators, loaders and dump trucks for hauling gravel away from the site to be processed. Other alternatives, as technology provides, may be utilized. Summer bridge crossing(s) will also be required based on specific river conditions.

c. Explosives - N/A.

d. The exact method of extraction will be determined based on annual river conditions. The California Department of Fish & Game will be notified of specific operating procedures. Options include using a skimming technique and/or a trenching technique. Skimming consists of the use of a scraper or loader generally moving parallel to the river channel and skimming a layer of gravel from the bar. The process continues by scraping consecutive strips, moving away

[3]Based on estimates by operators.

from the river channel. In most cases the process creates a smooth finished bar gently sloping towards the river.

Trenching involves using an excavator and digging a trench parallel to the existing river channel. Based on river conditions and recommendations by the California Department of Fish & Game, channelization (trenching the live stream channel) may be used to retain the rivers present channel position to prevent erosion, improve future characteristics, restoration, etc.

e. At the request of the County as lead agency and DMG, in previous comments the following baselines have been developed:

For gravel bar skimming, the overall maximum depth of removal will be based on the 1992 low water surface elevation based on cross-sections taken in the fall, 1992 or other historic evidence.

The baseline depth will be above 1% slope line measured from the baseline described above. Operations will occur above this line.

If trenching or channelization occurs, a maximum 20 foot depth below the baseline described above could occur.

This baseline is established based on existing information and may be revised based on an analysis of historic review and cumulative impacts, or when deemed appropriate for flood management or fish and wildlife concerns. This is determined as part of the Annual Review (Attachment A).

e. Cross-Sections - See Attachment B.

f. No phasing is proposed; however, the following year's extraction activity is defined, in part, by the preceding winter's replenishment of the gravel bar.

3. Mine Waste

No waste is produced from this type of project. Due to the nature of the activity and the proposed methods of extraction, no waste will either be retained on-site or disposed off-site. No discharge from industrial activities into State waters occurs.

a. All materials will be removed from the bar.

b. Spoil piles - N/A

c. Spoil to be backfilled - N/A

d. No toxic materials will be used at the site.

e. Compaction of backfilled materials - N/A

D. SIZE

1. Acreage Permitted

Parcels that are utilized for gravel extraction/ processing operations total approximately 1,274 acres. Based on present conditions approximately 300 acres are presently available for gravel extraction, 62 acres are utilized for industrial processing and 912 acres as streambank vegetation, agricultural or other land use.

The area where surface mining occurs can change after a substantial flood event and change in the river course. The area subject to this Reclamation Plan will be determined annually based on the review in Attachment A.

2. Acreage Disturbed

Acreage disturbed in any year will be dependent on the area permitted for gravel extraction per review in Attachment A.

3. Acreage Reclaimed

Acreage to be left in a reclaimed manner will be dependent on the amount of acreage disturbed as described above. Reclamation limited to disturbed areas except as described in Section III(H).

E. WATER REQUIREMENTS

No water is generally required for extraction purposes. Water is sometimes utilized adjacent to several gravel bars as part of processing activities on the upland sites.

F. CONTAMINANTS

1. No servicing of equipment (fueling or lubricating) will occur within the extraction area. In the event of an accidental lubricant or fuel leak (i.e., hydraulic lines breaking, etc.), operators will be instructed to move equipment to safer high ground (roadway or upper bench). If gravel is contaminated with a spillage, the material will be removed and properly disposed.

2. Any materials brought on the site shall be removed at the end of the extraction season.

G. WASTE WATER

No water will be used on-site.

H. WATER IMPOUNDMENTS AND DIVERSIONS

Water is required to be used for processing activities at several locations (Arcata Readimix, Redwood Empire Aggregates, Eureka Sand & Gravel, Mad River Sand & Gravel). Process water is returned to the river system by percolation through sediment settling ponds.

I. ORE PROCESSING

No ore processing occurs. All material mined is removed from the extraction site and is utilized as mined or subject to manufacturing processes. Gravel is processed at adjacent or off-site locations. In addition, gravel may be processed on-site with portable equipment or removed from the site for processing at another location. Gravel is generally processed by using a screening/gradation technique.

J. IN-STREAM MINING

1. Most surface mining will occur adjacent to, but outside of, the live stream. Operations could require placement of a summer railcar crossing to reach the extraction site, based on current river conditions. Operating machinery will be kept out of the live stream channel when excavating.

   In-stream mining may occur by the method of river channelization under the direction of the California Department of Fish & Game and approved by Humboldt County (see Attachment A).

2. The mining operation will occur on the floodwashed portion of the gravel bar. Minimal vegetation is present here, as it is usually removed from the bar every year or two by average annual high water. Riparian vegetation will re-introduce itself to the bar through natural processes.

3. Fauna/Flora - See "Environmental Setting" Section I.

4. Annual Stream Alteration Agreements have been obtained from the Department of Fish & Game in the past. See Attachment A for proposed review process.

III. RECLAMATION PLAN

A. SUBSEQUENT USES

1. Extraction Area

The extraction areas are generally in the floodway of the Mad River. It is anticipated that this area would continue to be utilized for floodway management in conjunction with related gravel extraction. The subsequent use of the gravel bar after extraction will continue to be as floodway, open space and unspecified recreational access to the river. The river itself will most likely continue to be managed for anadromous fisheries by resource agencies. Extraction generally occurs in a manner that annually leaves the gravel bar in a final reclaimed condition.

2. Processing Sites

The following sites have no designated on-site processing sites. Portable processing equipment may be moved on the site but, as defined in the Reclamation Plan, is required to be removed within 15 days of the end of extraction or as may be otherwise defined in the annual review described in Attachment A.

1. Arcata Readimix Spina-Johnson Bar
2. Zabel Trucking Simpson Bar
3. Redwood Empire Aggregates Johnson Bar
4. Redwood Empire Aggregates Emmerson Bar

The remaining sites are adjacent to existing industrial aggregate processing sites (Redwood Empire Aggregates - Graham Bar and Blue Lake Bar; Arcata Readimix - Arcata Readimix Bar; Mercer, Fraser Co. - Essex Bar; Eureka Sand & Gravel - Christie Bar; Mad River Sand & Gravel - Guynup Bar).

Reclamation activities of the existing processing sites is limited to any necessary grading activities for erosion control purposes and to assure that surface water from industrial process areas does not enter a conveyance that would cause discharge into State waters. At present, site drainage enters sediment settling ponds which are proposed to be retained for this purpose if necessary after processing activities cease. Stockpiles of unprocessed riverrun materials are also proposed to remain on-site and if not sold could be utilized for raising the elevation of the processing areas to a higher flood elevation for subsequent industrial activities. The sites are within the 100-year Flood Plain and are of sufficient size to allow spreading existing stockpiles of gravel and sorted materials across the site to provide an

industrial area out of the 100-year Flood Plain. Other improvements on the site including storage buildings above ground fuel tanks, equipment sheds, power generators, etc., would remain on-site and are consistent with the end use of future industrial development.

The processing sites have been in existence prior to the 1960's and could be utilized for processing aggregate brought in from other sources or for remanufacturing asphalt or concrete if gravel was no longer available on the Mad River. It is for both local and regional economic importance that these processing facilities remain since it would be very difficult to locate a new processing site. The existing processing sites are in a location that meets the needs of State, County and local construction projects from Orick (40 miles north) to Eureka (10 miles south) and east as far as Willow Creek (35 miles).

The proposed subsequent use of the processing area will be for future industrial activity consistent with County Codes Section 23016 of the economic policies of the County's General Plan, which supports resource dependent industrial uses outside of urban areas when uses are: a) dependant upon close proximity to resources production lands; and b) not dependant on urban services. Section 1441 of the Plan supports a "common sense" interpretation of the Plan to encourage reasonable development which can meet the community's needs with minimal impacts on the environment and minimal demands on public services.

3. Notification of Reclamation - See enclosed Statement to be signed after final revisions/approval received.

4. Public Purpose - N/A.

B. RECLAMATION SCHEDULE

1., 2., 3. The extraction area will be mined in a manner for reclamation (Section II[C]). Natural bedload transport processes will be a major factor that will allow future excavation yearly with the advent of annual high water flowing over the bar and reshaping and replenishing gravel. The extent that this occurs will partially determine the extent of surface mining in subsequent years. Revegetation by natural means will also occur from this process. See Part F (Revegetation).

4. Slopes Design Calculations - N/A.

C. POST-MINING TOPOGRAPHY

1. Baseline cross-sections were completed in the Fall of 1992 to establish the baseline for most bars. Cross-sections will be performed by licensed professionals in a

manner that can be reestablished should flooding substantially change the site. A permanent benchmark on each site has or will be established prior to the 1993 extraction season.

2. Pre- and post-mining cross-section information will be submitted to Humboldt County Planning Department and California Department of Fish & Game on an annual basis as long as they are required (see Attachment B).

3. Stabilization of banks-extraction generally will not occur near river banks; slopes will not be destabilized. See Section III(G) for further information on monitoring and corrective measures.

4. Slope Design Calculations - N/A.

D. IMPOUNDMENTS

N/A.

E. DRAINAGE

If a skimming technique is used, the gravel bar will be graded towards the river with a slope resembling natural conditions (1-3% grade). Drainage of the gravel bar occurs by infiltration instead of surface run-off; this drainage pattern will not be disturbed by mining.

F. DISPOSITION OF OLD EQUIPMENT

No equipment will be left in the extraction area. Any equipment or supplies left from surface mining activities have and will continue to be removed from the gravel bar at the end of the extraction period.

G. REVEGETATION

1. a. Topsoil Redistribution - N/A.

   b. Mine Waste Testing - N/A.

   c. Soil Stockpile Protection - N/A.

2. Fertilizers, Etc. - N/A.

3. Landscape Plan

   The areas of extraction are located away from established riparian area. The floodwashed portion of the gravel bar contains primarily annual vegetation. Due to less than average annual flows, some young willows are growing near the river channel. Natural processes of removal by flood and replacement by deposition annually renews vegetation to these areas. Past experience on these gravel bars indicates that this vegetation is being replaced.

No established vegetation is proposed to be removed and, as a result other than natural reoccurrence, no revegetation is proposed. Riparian vegetation that begins to become established in the floodway may be moved to a suitable location or mitigated and will be based on a specific year's extraction proposal. Specifics for transplanting or mitigating will generally occur as described in III(G)(4, 5).

Revegetation of the access roads are not proposed except as may become necessary for erosion control purposes. Inspection/maintenance occurs several times per year even for idle mines.

Section III(H) - Monitoring Program describes the process for revegetation for any areas adversely affected by extraction activities caused by individual projects.

4., 5. Planting Method, Timing

Willows growing in the approved extraction area that are required to be moved will be removed by equipment and deposited in a hole of adequate size and with access to groundwater at a pre-approved location established as part of annual review. Willow cuttings will be planted according to established practices for any mitigation required, as described in Section H.

6. Plant Protection

It is not reasonable nor necessary to provide fencing or other barriers for transplants or new plantings as they are accessible to the general public at all times of the day. By not posting signs or fencing, it is likely that they have a better chance of survival by being inconspicuous than drawing attention to them. Predation is not believed to be a significant threat to the species being planted.

If high water in a subsequent year should remove these plantings then they shall not be replaced, as a naturally occurring process has removed them. This is consistent with the State Mining and Geology Board Resolution 92-24 regarding "Act of God."

7. Irrigation

Plants would be watered through rainfall and moisture obtained from the high water table that exists on the gravel bar. If replanting is determined, through annual inspection, to be required, then vegetation will be planted during the winter months (December-February).

H. MONITORING AND MAINTENANCE

1. Monitoring Program

Each year's County review (Attachment A) and CA Department of Fish & Game's Annual 1603 Agreement will rely on the following approach which will become an ongoing process of:

1) cross-section surveying in the spring;
2) establishment of extraction volumes;
3) operator-agencies negotiations;
4) design of extraction geometry;
5) re-surveying in the fall to determine compliance and provide documentation for the following years recruitment survey.

Aerial photographs will be provided showing river morphology/riparian vegetation changes which might be attributed to extraction activities. The aerial photo should extend 500 feet above and below the extraction activity area from the previous year. If necessary, seasonal revegetation and/or correction to stream morphology may be required as a condition for continuation of project and may be considered a violation of the previous years permit approval until remedied.

Accompanied with each annual monitoring report, information will be provided assessing the amount of area affected by the project and subject to reclamation as defined in this report. A performance agreement with an appropriate amount to cover the required items will be submitted prior to initiation of the following year's extraction activity.

The area for proposed extraction activities will be surveyed to depict actual volumes of gravel available for extraction by gravel skimming processes. These will be repeated each year prior to extraction occurring.

A permanent reference bench mark will be placed at each site and all cross-sections will be referenced from that mark. Cross-sections will be surveyed perpendicular to the river direction at equivalent spacing.

Subsequent surveying is proposed for the following spring after extraction, which will show amounts of gravel replenished on the bars. After the next and each extraction season thereafter, cross-sections will be surveyed at the end of the extraction season (November) at the same locations as those generated in spring for those areas where extraction activity occurred.

An analysis of the aerial and elevational extent of gravel removal will be depicted in report/graphic form

and submitted to Humboldt County Planning Department and CA Department of Fish & Game.

If requested, a meeting will be held to discuss any areas needing grading modification, revegetation from past year's activity and will discuss tentative areas and conditions for the next extraction season.

Prior to the next season's extraction activity, cross-sections will be submitted for the upcoming activity area, as well as last year's activity area.

Information submitted will include discussion of river changes from the winter, gravel bar recruitment, proposed mining areas and any suggested conditions of operation.

2. Standards

Monitoring specifications may be adjusted to meet current requirements as may be adopted by the County and/or as part of Annual Review.

a. Annual Review - See standards listed in Attachment A.

b. Monitoring - See standards listed in Attachment B.

c. Performance - See standards listed in Attachments C and D.

d. Planting Plan for Mitigation if Willows are not Transplanted - See standards listed in Attachment E.

3. Responsibility

The operator/owners have the responsibility to create a successful mitigation program and will manage the mitigation site in such a manner. For any area tending towards unsuccessful revegetation, the operator will take action to correct those trends. These actions would include replanting and/or regrading. Any problem and subsequent solutions should be evident within the first few years of monitoring.

Major corrective actions will be taken only after consultation and approval by Humboldt County. This will generally occur only after an annual progress report has been submitted.

The operator will be responsible for implementing this revegetation program. He will be responsible for assuring that operators are aware of the conditions stated herein.

4. Assurance of Success

The area affected by extraction activities will be assessed during annual reports submitted to the County and verified during site inspections. Financial assurances will be adjusted annually to include any necessary mitigation requirements. Worksheet for determining financial assurances is included in Attachment D. Progress reports will include all monitoring data and discuss the status of the mitigation efforts during the previous year.

I. IN-STREAM MINING

1. Rehabilitation

At the end of each season and within 15 days of completion of gravel removal, the Applicant/Operator will be responsible for smoothing out the river bar so that no benches, trenches, wells or topographic features remain that degrade the environment (such as ponding, erosion, sedimentation or stream channel alteration except as otherwise provided by the necessary operating approvals). Site specific requirements are also required by the CA Department of Fish and Game for seasonal completion through the Stream Alteration (1603) Agreement. These would also be implemented as may be revised annually.

Following or in conjunction with the smoothing of the gravel bar the Operator shall be responsible for removing any and all machinery, equipment, waste or other evidence of the operation from the river channel or gravel bar.

At the end of the annual gravel operation post mining topography will be consistent and homogenous with the upstream and downstream topography. This will constitute completion of final reclamation for the year.

Rehabilitation will occur through natural processes (i.e., high annual flow will reshape and replenish gravel to the stream channel and gravel bar.)

2. Annual Monitoring

As stated in Attachment A, annual monitoring of the gravel bars will be conducted before and after seasonal extraction to determine the impact (positive or negative) of the mining. The results (cross-sections) will be submitted annually to the Humboldt County Planning Department and California Department of Fish & Game to verify compliance and determine the appropriate mining strategy to be used the next year.

J. FUTURE MINING

It is expected that average annual high water should provide adequate bed load deposits to the gravel bar so that mining may continue on an annual basis. The amount of gravel that may be extracted will vary depending on the amount of bedload transport that occurs. Replenishment amounts will, in part, determine the amount of gravel that may be taken. Less amounts may be available when total replenishment does not occur.

K. PUBLIC SAFETY

The project areas are each controlled by a gate located on the existing road approach. In addition, personnel routinely inspect the areas throughout the year.

Access to the site is by way of private roads behind a locked gate to keep the general public away. Occasionally the public crosses private lands to obtain access to the river bar. This can cause a problem when trenching is proposed. Signage will be provided surrounding the trenched area when this method is utilized. Specifics will be provided as part of annual review when this alternative is proposed.

STATEMENT OF RESPONSIBILITY

Substantial deviations from the approved reclamation plan shall not be undertaken until an amendment has been filed with, and approved by, Humboldt County Planning Department. Any successor or assignees in interest of this surface mining operation are required to assume responsibility for meeting the terms of the approved reclamation plan.

I, the undersigned, hereby agree to accept full responsibility for reclaiming all mined lands that I operate, as described and submitted herein with modifications required by the Humboldt County Planning Commission as conditions of approval.

Signed this _____ day
of _____, 19____

_____	_____
Mine Site	Owner or Operator
_____	_____
Mine Site	Owner or Operator
_____	_____
Mine Site	Owner or Operator
_____	_____
Mine Site	Owner or Operator

Approved:

_____ Date:_____
Lead Agency Representative

ATTACHMENT A

ANNUAL REVIEW

A. Reclamation Plan

1. The applicant shall obtain a determination of vested rights and/or a Surface Mining Permit/Conditional Use Permit for surface mining operations prior to beginning operations. If a vested right has been acknowledged, no amount of extraction in excess of the vested right amount shall be extracted in any year until the operator has obtained an amendment to the vested right or a surface mining permit for that additional extraction amount.

2. The Reclamation Plan shall be subject to annual review, pursuant to the Surface Mining and Reclamation Act. The annual review shall include on-site inspection by the Planning Department and CA Department of Fish and Game, and may include inspection by other agencies with jurisdiction over river resources. The annual review shall include, but not be limited to, evaluation of annual recruitment, post extraction channel configuration, riverine environment (riparian and wetland habitat, wildlife, and fisheries characteristics), and conformance with reclamation conditions and standards per the approved Reclamation Plan and underlying extraction operation.

3. Following the annual review/inspection, the Department of Fish and Game, other agencies, and interested persons who have previously commented or participated in the annual review/inspection process shall make written comments and recommendations to the Planning Department regarding any requested revisions or additions to the Reclamation Plan and underlying extraction operations. These written comments and recommendations shall include an explanation of the methodology, factual and scientific basis, and reasoning process upon which they are based. The operator shall provide written responses to any such comments including the methodology, factual and technical basis, and reasoning processes utilized in responding to such proposed revisions or additions to the Reclamation Plan and underlying extraction operation. The Planning Director shall make the final written determination of which appropriate revisions or additions, if any, shall be incorporated in the Reclamation Plan or underlying extraction. The Planning Director's final written determination shall include the methodology, factual and technical basis, reasoning processes, and findings upon which the final determination was based. These changes will be allowed as part of administration approval by the Planning Director.

4. The Reclamation Plan shall be approved for a 15 year period, subject to the annual review described above. As part of the annual review, the Planning Director shall determine whether the Reclamation Plan shall be (1) voided due to inadequacy or insufficiency, based in part upon an analysis of potential adverse environmental impacts, (ii) amended by (a) significant or (b) insignificant amendments pursuant to SMARA and local ordinances.

5. For periods when extraction is proposed to be reduced or prohibited as a part of the annual review process, interim management procedures to maintain the site will be set by the Planning Director. Compliance with specifications in the approved reclamation plan and any conditions of approval will remain in effect, including subsequent annual review. Other provisions of Public Resource Code Section 2770(h) shall apply.

6. The Planning Department shall deliver a copy of the final Reclamation Plan, permit or vested rights approval, and responses to comments by the Division of Mines and Geology to the Mined-Land Reclamation Project Office.

B. Mining Standards

1. Operating standards shall be subject to annual review as described above for the Reclamation Plan.

2. Minimum operating slopes near the stream channel at this operating site shall be established on the basis of the need to maintain channel stability and flow capacity and shall generally be 2 to 3 % from the point 1 foot above low flow water surface elevation, except as otherwise expressly authorized by the Planning Director after consultation with the Department of Fish and Game.

3. Trenching for the purpose of enhancing or modifying existing channel configurations to correct for braided channel conditions may be permitted by express approval of the Planning Director after consultation with Department of Fish and Game. The Planning Director's final written determination approving or disapproving any such proposed gravel extraction shall include the methodology, factual basis, reasoning processes, and findings upon which the final determination was based. The operator shall notify the Army Corps of Engineers of any proposed trenching operation.

4. Removal of gravel, as part of the mining operation, for the purpose of encouraging wetland development, improved spawning, rearing and migration habitat, restoration of river environment, or other reasonable purpose may be permitted by express approval of the Planning Director after consultation with Department of Fish and Game. The

Planning Director's final written determination approving or disapproving any such proposed gravel extraction shall include the methodology, factual basis, reasoning processes, and findings upon which the final determination was based.

5. Operating period shall be June 1st through October 1st in any operating year. By approval of the Planning Director, after consultation with Department of Fish and Game, annual extraction operations may begin before or continue after the stated dates based upon a site specific review, including evaluation of annual precipitation rates, river flows, fish migrations and spawning activities, and other environmental concerns. The Planning Director's final written determination approving or disapproving any such proposed gravel extraction shall include the methodology, factual basis, reasoning process, and findings upon which the final determination was based.

C. Traffic/Noise

In conjunction with submittal of extraction volumes, techniques and final slopes, the operator is to provide dates for the duration of the extraction season, hours and days of operations and approximately loads per day. Notification of changes is to be provided to the Planning Director for approval.

D. Public Safety

When trenching is proposed, the operator will propose a plan for protecting the public from associated hazards. The Plan will include but not be limited to the type, size and placement of signs and ongoing monitoring.

E. Recreational Uses

An informal inventory and analysis of types, frequency and intensity of recreational uses during the extraction season will be submitted by each operator to Humboldt County Planning Department as part of annual review.

F. Stream and Bedload Characteristics

Both pre- and post-extraction observations of stream characteristics and bedload will be visually noted within and immediately outside of each operating bar. Such inventories shall include identification of significant pools, riffles and flat sections of the river, and recordation of changes in average bedload/gravel diameters.

G. Wildlife/Fisheries

Observations by the operators of wildlife use on or adjacent to the extraction area are to be noted and turned in as part of the annual review. Observations from snorkeling in the River just prior to the beginning and at the end of the extraction season will be turned in as part of annual review.

ATTACHMENT B

MONITORING STANDARDS

The following standards are made part of the Monitoring Section of the Reclamation Plan. These standards may be revised as part of the Annual Review process.

Monitoring, which shall be incorporated into the Annual Review, shall be completed as follows:

1. Cross-sections to extend completely across the river channel and to terminate on banks with mature riparian vegetation (e.g., 10-15 year old vegetation). Cross-sections to include the river bottom (especially location of the thalweg) as well as the water surface. Water surface elevation alone is insufficient - the bed must be included.

2. All site maps to be prepared on the most recent (preferably post-extraction) air photo base. A current photo base is essential. Cross-section endpoints and tie points to be clearly monumented and labeled in the field and accurately located on current air photos and maps. A common color of flagging to be used to mark cross-sections at all sites.

3. Cross-sections to be tied to a common vertical and horizontal control datum across the extraction site.

4. Cross-sections for planning extractions to be surveyed in late May of the year in which extraction is proposed. Earlier cross-sections may be submitted with the operation's acknowledgement that, should subsequent rains occur, revised cross-sections may be required.

5. Cross-sections to be resurveyed from the same endpoints each year and the previous year's cross-sections to be superimposed on the current one. New cross-sections to be added as necessary as the river's course shifts and to be oriented approximately normal to the channel.

6. Cross-sections at all site to be plotted at the same simple, usable vertical and horizontal scales. (Suggested is a horizontal scale of 1 inch = 50 feet and vertical scale of 1 inch = 5 feet.)

7. Cross-sections to be surveyed and drafted consistently so that the right bank (RB) of the river as you face downstream is at the right side of the drafted cross-section.

8. Zero (0) distance in cross-sections to be at the left (LT) endpoint as you face downstream.

9. Cross-sections to be tied to a common vertical and horizontal control datum across the extraction site.

ATTACHMENT C

The following further defines performance standards for this project described in Article 9. Reclamation Standards of the State Mining & Reclamation Act.

3700. Applicability

Reclamation of mined lands shall be implemented in conformance with the standards in this Attachment.

(a) The standards shall apply to this surface mining operation to the extent that:

(1) they are consistent with required mitigation identified in conformance with the California Environmental Quality Act, provided that such mitigation is at least as stringent as the standards; and

(2) they are consistent with the planned or actual subsequent use or uses of the mining site.

(b) Where an applicant demonstrates to the satisfaction of the lead agency that an exception to the standards specified in this article is necessary based upon the approved end use, the lead agency may approve a different standard for inclusion in the approved reclamation plan . . .

(c) Since substantial amendments are proposed to reclamation plans which received approval prior to performance standards requirements, the standards set forth in this Attachment are to be applied by the lead agency in approving the amended reclamation plan.

(d) The standards in this Attachment shall not apply to the existing processing sites or haul roads where consistent with the proposed end use and as described in the approved Reclamation Plan.

3701. Definitions - As described in SMARA Article 9 shall apply.

3702. Financial Assurances.

Lead agencies shall require financial assurances for reclamation in accordance with Public Resources Code section 2773.1 to ensure that reclamation is performed in accordance with the approved reclamation plan and with this Attachment. See Worksheet in Attachment D to be used in annual assessment.

3703. Performance Standards for Wildlife Habitat.

Wildlife and wildlife habitat shall be protected in accordance with the following standards:

(a) Rare, threatened or endangered species as listed by the California Department of Fish and Game or the U.S. Fish and Wildlife Service, or species of special concern as listed by the California Department of Fish and Game in the Special Animals List, Natural Diversity Data Base and their respective habitat shall be conserved as prescribed by the Federal Endangered

Species Act of 1973 and the California Endangered Species Act. If avoidance cannot be achieved through the available alternatives, mitigation shall be proposed in accordance with the provisions of the California Endangered Species Act and the Federal Endangered Species Act of 1973.

(b) At the conclusion of surface mining activities, wildlife habitat shall be allowed to reestablished on gravel extraction areas in a condition at least as good as that which existed before the lands were disturbed by surface mining operations. The proposed end use of the processing site and access road precludes its use as wildlife habitat, as described in the approved reclamation plan.

(c) Wetland habitat shall be avoided. Any wetland habitat impacted as a consequence of surface mining operations shall be mitigated at a minimum of one to one ratio for wetland habitat acreage and wetland habitat value. Except where specific vegetation differentiates from normally expected bar vegetation, exposed gravel bars within the full bank discharge area should not be considered wetlands.

*Financial assurances to obtain the performance standards above are not required at this time but may change as determined through the annual review process.

3704. Performance Standards for Backfilling, Regrading, Slope Stability and Recontouring.

Backfilling, regrading, slope stabilization and recontouring shall conform with the following standards:

(a) Backfilling for urban uses - N/A.

(b) Where backfilling is required for resource conservation purposes (e.g., agriculture, fish and wildlife habitat and wildlife conservation), fill material shall be backfilled to the standards required for the resource conservation use involved.

(c) Mining waste - N/A.

(d) Final reclaimed fill slopes - N/A.

(e) Fill slopes - N/A.

(f) Cut slopes, left as part of annual surface mining operations, shall have a minimum slope stability factor of safety that is suitable for the proposed end use and conform with the surrounding topography and/or approved end use.

(g) Mining waste - N/A.

*Financial assurances to obtain the performance standards above are not required at this time but may change as determined through the annual review process.

3705. Performance Standards for Revegetation

Revegetation of the existing processing site and access roads are not consistent with the approved end use. For other areas, if and when established vegetation is removed by surface mining operations:

(a) Vegetative cover or density, and species-richness shall be, where appropriate, sufficient to stabilize the surface

against effects of long-term erosion and shall be similar to naturally occurring habitats in the surrounding area.

(b) Test plots are not proposed since standards for revegetation, as proposed in the approved Reclamation Plan, have been successfully implemented under similar circumstances.

(c) Where surface mining activities result in compaction of the soil, ripping, disking or other means shall be used in areas to be revegetated to eliminate compaction and to establish a suitable root zone in preparation for planting.

(d) At the close of surface mining activities, access roads, haul roads and other traffic routes will remain consistent with the approved Reclamation Plan.

(e) Soil analysis - N/A.

(f) Temporary access for exploration - N/A.

(g) Native plant species shall be used for revegetation, except when introduced species are necessary to meet the end use (erosion control) specified in the approved reclamation plan. Portions of the processing site and haul roads shall be revegetated as may be necessary, to control erosion. In this circumstance, non-native plant species may be used if they are not noxious weeds and if they are species known not to displace native species in the area.

(h) Planting shall be conducted during the most favorable period of the year for plant establishment.

(i) Soil stabilization practices shall be used where necessary to control erosion and for successful plant establishment.

(j) Irrigation - N/A.

(k) Noxious weeds shall be managed: (1) when they threaten the success of the proposed revegetation; (2) to prevent spreading to nearby areas; and (3) to eliminate fire hazard.

(l) Protection measures, such as fencing of revegetated areas and/or the placement of cages over individual plants, shall be used in areas where grazing, trampling, herbivory or other causes threaten the success of the proposed revegetation. Fencing shall be maintained until revegetation efforts are successfully completed and the lead agency authorizes removal.

(m) Success of revegetation shall be judged based upon the effectiveness of the vegetation for the approved end use, and by comparing the quantified measures of vegetative cover, density and species-richness of the reclaimed mined-lands to similar parameters of naturally occurring vegetation in the area.

*Financial assurances to obtain the performance standards above are not required at this time but may change as determined through the annual review process.

3706. Performance Standards for Drainage, Diversion Structures, Waterways and Erosion Control

(a) Surface mining and reclamation activities shall be conducted to protect on-site and downstream beneficial uses of water in accordance with the Porter-Cologne Water Quality Control Act and the Federal Clean Water Act.

(b) Groundwater aquifers - N/A.

(c) Erosion and sedimentation shall be controlled during all phases of construction, operation, reclamation and closure of a surface mining operation to minimize siltation of water courses, as required by the Regional Water Quality Control Board or the State Water Resources Control Board.

(d) Surface runoff and drainage from surface mining activities shall be controlled by berms, silt fences, sediment ponds, revegetation, hay bales or other erosion control measures, to ensure that surrounding land and water resources are protected from erosion, gullying, sedimentation and contamination. Erosion control methods shall be designed to handle runoff from not less than the 20 year/1 hour intensity storm event.

(e) Where natural drainages are covered, restricted, rerouted or otherwise impacted by surface mining activities, mitigating alternatives shall be proposed and specifically approved in the reclamation plan or as part of annual review to assure that runoff shall not cause increased erosion or sedimentation.

(f) When stream diversions are required, they shall be constructed in accordance with:

(1) the stream and lake alteration agreement between the operator and the Department of Fish and Game; and

(2) the requirements of the Federal Clean Water Act, Sections 301 and Section 404 and/or Section 10 of the Rivers and Harbors Act of 1899.

(g) When no longer needed to achieve the purpose for which they were authorized, all temporary stream channel diversions shall be removed and the affected land reclaimed.

*Financial assurances to obtain the performance standards above are not required at this time but may change as determined through the annual process.

3707. Performance Standards for Prime Agricultural Land Reclamation - N/A.

3708. Performance Standards for Other Agricultural Land - N/A.

3709. Performance Standards for Building, Structure and Equipment Removal.

(a) All equipment, supplies and other materials shall be stored in designated areas (as shown in the approved reclamation plan). All waste shall be disposed of in accordance with State and local health and safety ordinances.

(b) All buildings, structures and equipment outside of the designated Processing Area shall be dismantled and removed prior to final mine closure.

*See Attachment D. Except at otherwise specified in Attachment D, financial assurances to obtain the performance standards above are not required at this time but may change as determined through the annual process.

3710. Performance Standards for Stream Protection, Including Surface and Groundwater.

(a) Surface and groundwater shall be protected from siltation and pollutants which may diminish water quality as required by the Federal Clean Water Act, the Porter-Cologne Act, County grading ordinances, the Regional Water Quality Control Board or the State Water Resources Control Board.

(b) In-stream surface mining operations shall be conducted in compliance with section 1600 et seq. of the California Fish and Game Code, section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899.

(c) Extraction of sand and gravel from river channels shall be regulated to control channel degradation in order to prevent undermining of bridge supports, exposure of pipelines or other structures buried within the channel, loss of spawning habitat, lowering of groundwater levels, destruction of riparian vegetation and increased stream bank erosion (exceptions may be specified as part of annual review as required in the approved reclamation plan). Changes in channel elevations and bank erosion shall be evaluated annually using records of annual extraction quantities and benchmarked annual cross-sections and/or sequential aerial photographs to determine appropriate extraction locations and rates.

(d) In accordance with requirements of the Department of California Fish and Game Code section 1600 et seq., in-stream mining activities shall not cause fish to become entrapped in pools or in off-channel pits, nor shall they restrict spawning or migratory activities.

*See Attachment D. Except at otherwise specified in Attachment D, financial assurances to obtain the performance standards above are not required at this time but may change as determined through the annual review process.

3711. Performance Standards for Topsoil Salvage, Maintenance and Redistribution - N/A.

3712. Performance Standards for Tailing and Mine Waste Management - N/A.

3713. Performance Standards for Closure of Surface Openings - N/A.

ATTACHMENT D

1993 FINANCIAL ASSURANCE WORKSHEET
for Lower Mad River Operations

Item		Activity	Hours	Rate	Subtotal
3703	Wildlife Habitat	None required			
3704	Backfilling	None required			
3705	Revegetation	None required			
3706	Drainage	None required			
3707	N/A				
3708	N/A				
3709	Equipment	Removal of summer bridge, etc.	1	$120/hr.	120
3710	Stream Protection	Corrective grading	7	$120/hr.	840
3711	N/A				
3712	N/A				
3713	N/A				
Other					
Mobilization		Transport of Equipment to Site	1	$120/hr.	120
Mitigation for Removal of Plant Material		None required			
Administrative (10%)					108
TOTAL for each active bar					$1,188

ATTACHMENT E

PLANTING PLAN FOR MITIGATION
IF WILLOWS ARE NOT TRANSPLANTED

General tasks will include: 1) Cutting willow branches from sources on-site; 2) Planting cuttings in designated areas;

b. Cutting/Willow Branches

Salix ssp - Cuttings will be salvaged from trees on the site or nearby sources. Willow cuttings shall be taken from large vigorous growing shrubs and trees soon after leaf drop in late autumn and prior to bud swelling in early spring. Cuttings should be approximately 18-32 inches long and from 3/4 inch to 3 inches in diameter. Each cut should be made approximately at a 45° angle to the stem. Cuttings are to be bundled in lots of 25 to 50 each with the basal ends all oriented in the same direction. Side branches and leaves are to be stripped off of the cuttings. Stem cuttings shall not include the tips of branches. The top of each cutting shall be just above a leaf bud, the bottom cut just below one.

Cuttings shall be kept out of direct sunlight until ready to plant. If it is necessary to store cuttings prior to planting, they shall be wrapped in moist newspaper with dry newspaper covering or in plastic bags with moist sawdust. Willow cuttings shall not be allowed to dry out before or during planting operations.

c. Plant Salvaged Cuttings

Cuttings will be planted in rows, in clumps of ten to twenty cuttings. If the top of the cutting is damaged during planting, then the damaged portion will be cut off. Planting will be done at 10'-16' spacing staggered from adjacent rows.

Cuttings must be planted right side up. At least 75% of the cutting length shall be planted in the ground, leaving at least two budding nodes above ground. Soil shall be firmly pressed around cutting to reduce moisture loss and improve soil contact.

d. Performance Criteria

Plant survival and vigor will be assessed for every cutting annually during the spring. Plant survival will be a simple test and assigned only an "alive" or "dead" notation to each plant. Plant vigor will require assigning each tree or shrub to one of three vigor classes. Class One plants exhibit vigorous growth, no die-back of the crown, and relative absence of insect or other infestations. Class Two plants will exhibit moderate to strong vigor, no die-back of the crown without replacement shoots and minimal infestations. Class Three plants exhibit poor to no vigor, die-back of the crown with no replacement shoots, and large to extensive infestations.

Planting is proposed at a density allowing a minimum 75% survival standard at the end of the monitoring period. The vigor test requires that all plants be at least of Class Two vigor or better.

Appendix K

Comments received on the NOP

Comments on Notice of Preparation of Mad River EIR

Date:	Sender:	Summary:	Contact:
8/12/92	Ted Schuette, Simpson 822-0371	Map of extent of project area--Simpson Bar drawn in by request.	
8/13/92	Donald C. Tuttle, Environmental Services Manager Public Works	Response to NOP of Draft EIR. He requests that the DEIR address the potential significant adverse effect of a lowered bed of the Mad River.	
8/18/92	Arthur Bolli General Manager, Humboldt Bay Municipal Water District 828 Seventh Street P.O. Box 95 Eureka, CA 95501 (707) 443-5018 Fax: (707) 443-5731	Lists specific concern; that the EIR identify the impact of gravel removal on streambed degradation. Related question: Can gravel removal be done in such a way as to optimize recruitment of bars that are currently degrading?	
8/18/92	James R. Bybee, Environmental Coordinator, Northern Area, United States Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Region, HCB 777 Sonoma Avenue, Rm 325 Santa Rosa, CA 95404	Supports decision to undertake a DEIR. Suggests consideration of following issues: Any of project elements that require filling may requiere a Corps of Engineers Section 404 permit. Other projects may require a Section 10 permit. If there are enough elements requiring Corps permits, there may be enough to justify preparation of a DEIS/DEIR, to allow Federal review under NEPA and the Fish and Wildlife Coordination Act. Other less-damaging alternatives should be carefully considered to the dredging. Should do an analysis of annual need for gravel and the amount upland quarry gravels can meet that need. Possible minimum-impact alternative. Analysis of streambed degradation should not be limited to effects at bridges, water intakes, etc. Should look at the river as a whole. This DEIR should consider pro-active ways in which mining projects and reclamation could be used to restore salmon habitat. DEIR should develop a management/monitoring plan that will provide the data and expertise to allow annual scientific assessment.	James R. Bybee or Chris Mobley (707) 578-7513.

8/21/92	Christine Kinne Acting Deputy Director, Permit Assistance, State of California, Governor's Office of Planning and Research, 1400 Tenth Street, Sacramento, CA 95814	Copy of letter to reviewing agencies from State of California. SCH #92083049.	Michael Chiriatti, (916) 445-0613.
8/24/92	W.B. Lindsey, Hydrology/ Hydraulics Engineer California Dept. of Transportation, Division of Structures, P.O. Box 924874 Sacramento, CA 94274-0001 Fax (916) 455-0574 TDD (916) 445-5945	Concerned with the potential adverse effects of long term, large scale extraction operations on any river environment. Program scope should assess gravel extraction's **past** and potential future impacts on instream bridge structures. Caltrans recommends developing a Gravel Management Plan similar to that proposed in the Eel River EIR. Caltrans requests inclusion on the State Agency Technical Advisory Committee for preparation of the EIR.	Cathy Crossett, (916) 327-3218, Fax: (916) 327-2179
8/27/92	Patricia L. Secoy, Chief, Transportation Planning Branch, California Dept. of Transportation, District 1, P.O. Box 3700 Eureka, CA 95502-3700 (707) 445-6412 TDD (707) 445-6463	SCH No: 92083048 The DEIR should include a traffic analysis of the following: -The existing traffic conditions -The cumulative traffic impacts and all known planned development in the area -The necessary traffic mitigation and implementation responsibilities -Access route to the State Highway system for each project -Anticipated number of hauling trips -Time period the trucks would be hauling -Access of hauling trucks to scales -Complete travel route of loaded trucks -Comparison of past hauling volumes per project to anticipated volumes -The use of rail to transport gravel.	Dave Carstensen, (707) 441-5813
8/28/92	James S. Pompy, Mined-Land Reclamation Project Manager, Dept. of Conservation, Division of Mines and Geology, Mined-Land Reclamation Program, 801 K Street, MS 09-37 Sacramento, CA 95814-3531	Response to invitation to 8/28/92 scoping meeting. Did not receive notice until 8/27/92, so will be unable to attend. Response faxed and mailed.	

8/30/92	Susie Van Kirk, Conservation Chair, Sierra Club, Redwood Chapter North Group P.O. Box 238 Arcata, CA 95521	Important issues which need to be resolved before any action is taken to implement the preparation of an EIR for the Mad River: Identification of the project, and the County's process for selecting the consultant. Point made that the Eel River Gravel EIR is not a river management plan, but an assessment of a number of specific gravel extraction operations. The EIR states that the plan will be written at a later date. This limited focus is a critical flaw, and should not be repeated in this EIR. She makes the point that the river has value as an integral part of the landscape, and the ecological functions of this landscape transcends the needs of the gravel industry. She also makes the point that gravel is only one of many uses for the Mad River. Each use must be identified and fully recognized for its value, and for compatibility or incompatibility with other values. Selection of a consultant must be without bias. The job must be widely advertised and select a firm with professional expertise.	
8/31/92	David S. Krueger, Attorney, P.O. Box 649 Arcata, CA 95521 (707) 839-5971	He feels it is important that there be a complete project description, especially that it clearly delineate the intended uses of the EIR. He is concerned that planning regarding the Mad River should focus on restoration, not maintaining the status quo. It should focus on opportunities, not just problems. He wants mining at alternative locations to be considered along with the no action alternative. See letter for many other points.	
9/6/92	J.R. McCollister, Unit Chief, Dept. of Forestry and Fire Protection 118 S. Fortuna Blvd. Fortuna, CA 95540 (707) 725-4413, 725-4572	From review of NOP, it appears proposed extraction will not disturb timbered areas.	Steve H. Hubbard, Environmental Coordinator

9/10/92	Wayne S. White, Field Supervisor U.S. Dept. of the Interior, Fish and Wildlife Service, Fish and Wildlife Enhancement, Sacramento Field Office 2800 Cotage Way, Room E-1803 Sacramento, CA 95825-1846	Strongly supports the preparation of a comprehensive EIR. Specific comments that should be incorporated: 1. Alternatives analysis in the DEIR should include a discussion of upland sites and alternative sources. 2. Development of a thorough monitoring program that assess gravel recruitment and changes in bed morphology. 3. Should consider the environmental impacts associated with processing water, especially groundwater pumping. Appropriate mitigation measures such as a water budget for individual projects that prevent groundwater overdrafting. 4. Extraction methods should focus on restoring and enhancing in-stream and riparian habitat conditions for salmonids and steelhead. See enclosures for more.	Jim Browning, (916) 978-4613
9/14/92	Thomas B. Dunbar, Associate Water Resource Control Engineer California Regional Water Quality Control Board North Coast Region 5550 Skyline Blvd., Suite A Santa Rosa, CA 95403 (707) 576-2220	See the EIR for gravel extraction on the Eel River prepared by Public Works earlier in 1992 for a good description of CRWQCB's concerns. If the equipment does not operate in the flowing stream and muddy washwater is not discharged into the stream, surface mining of sand and gravel from river bars is not a water quality issue. Enforcement of the Fish and Game Code adequately protects water quality due to streambed alteration agreements with gravel mining operators. Describes Corps of Engineers Permits and Stormwater Permits.	

9/15/92	Banky E. Curtis, Regional Manager California Dept. of Fish and Game 601 Locust Street Redding, CA 96001 (916) 225-2300	Permitted gravel could all be extracted from upper channel and shared with all permitted users. Certain amounts of gravel could be "allowed" to pass downstream in order to support channel morphology needs in downstream reaches. Gravel extraction upstream could be further limited in order to allow transfer of gravel downstream to sites where it could be extracted at permitted sites and/or used to support channel morphology needs in downstream reaches. Channel morphology needs to include maintaining channel confinement and channel stability, minimizing adverse impacts on natural erosion processes, as well as protecting the needs of riparian vegetation, protection of fish and wildlife resources, protection of groundwater levels, and protection of human infrastructure.	For questions, and in order to set up the first meeting, contact: David Hoopaugh, Environmental Specialist III, Department of Fish and Game, 601 Locust Street Redding, CA 96001. (916) 225-2373
9/18/92	Stephen F. Crook Acting Executive Director North Coast Railroad Authority P.O. Box 1211 Eureka, CA 95502 (707) 441-1625 Fax: (707) 441-1324	Refer to correspondence regarding preparation of a DEIR on surface mining of sand and gravel on the Mad River. Gravel extraction operations have had devastating effects on NCR's A&MR Division Bridge. The bridge footings have been exposed due to degradation of the gravel and river bed. If not corrected, the bridge could be lost. Consulting engineers estimate repairs may cost in excess of $75,000. A full description of needed repairs should be available in Nov., 1992. If funds are made available to compensate for these and future repairs, NCRA would like to work with any and all parties so secure reimbursement.	

9/21/92	Dwight E. Sanders Chief, Division of Environmental Planning and Management California State Lands Commission Executive Office 1807 13th Street Sacramento, CA 95814	File Ref: SD 92-08-17.3 W 24873 Proposed project includes sovereign and trust lands of the Mad River. Calif. holds a fee ownership in the bed of the reiver between two ordinary low water marks. Entire river between ordinary high water marks is subject to Public Trust Easement. Both under jurisdiction of SLC. Exact location of State's sovereign interest relative to project sites not yet determined. Contact Linda Martinez regarding extent of SLC's jurisdiction. SLC staff agrees with concerns expressed by Dept. of Fish and Wildlife (9/15/92 letter). See letter for comments and concerns. Mad River is a Limited Use Area. Commission staff is also concerned with potential stream crossings associated with mining and/or gravel extraction. Will activity affect existing public use? If crossing is involved, is the crossing of sufficient height for safe passage under the structure?	Linda Martinez (916) 322-6375 (SLC jurisdiction) Questions: Dr. Diana Jacobs, (916) 445-5034.

9/21/92	Deborah Herrmann, Environmental Program Coordinator California Dept. of Conservation 801 K Street Sacramento, CA 95814- 3514 (916) 445-8733	SCH #92083049 The EIR should include characterization of slope, sinuosity, width and depth of the low flow channel, and overbank areas of the river from the Swasey dam site to the mouth at Mad River estuary. Rates of change over time in these parameters should be measured. EIR should include a sediment budget for the Mad River. Study area should be examined in terms of possible correlation between mining rates, changes in cross sectional area, and the severity of the water year. EIR should present a design and implementation plan for a program to document future physical changes in channel configuration which may occur over time. EIR should examine hydraulic implications to alternative mining. EIR should examine potential impacts to groundwater storage and recharge from streambed degradation (lowering). EIR should examine past and future aggregate supply and demand, uses, specifications, production and possible alternative sources. Request that Dept. of Conservation be included on State Agency Technical Advisory Committee in preparation of the EIR. Reclamation plans must conform to the mitigation measures that are indicated for the adopted mining alternative. Send all required amendments to James Pompy, Mined-Land Reclamation Program Manager for review and comment.	Deborah Herrmann Environmental Program Coordinator (916) 324-4026 Contact for State Agency Technical Advisory Committee formation: Michael Sandecki, Division of Mines and Geology (916) 324-4026 Send required amendments to the reclamation plans impacted by the EIR to: James Pompy, Mined-Land Reclamation Program Manager

9/22/92	John Rogerson, Chairman City of Blue Lake Planning Commission City Hall, 111 Greenwood Ave., P.O. Box 458 Blue Lake, CA 95525 (707) 668-5655	NOP of EIR discussed at regular 9/21/92 Blue Lake Planning Commission meeting. The Commission concurred with the items identified as potentially significant environmental effects, and wants them to be adequately addressed. Other specific concerns: 1. Impacts of number of trucks traffic passing through center of town, through commercial and residential areas, and near the elementary school 2. Possible degradation to and undermining of the flood control levee. 3. Possible undermining of the railroad bridge containing the pipe to the city's water supply. 4. Impact to recreation/ sport fishing. 5. Continued availability of gravel for local construction nees as opposed to exports.	
9/24/92	Karen Nessler City Clerk City of Blue Lake Planning Commission City Hall, 111 Greenwood Ave., P.O. Box 458 Blue Lake, CA 95525 (707) 668-5655	Blue Lake City Council voted unanimously to support the BL Planning Commission's comments and concerns in their letter (9/22/92).	
10/16/92	Bruce Hunner P.O. Box 1011 Arcata, CA 95521	Gravel operation close to E/O Market on Highway 299 (Eureka Ready Mix?) is across the river from his home. Although recently quieted, in past years of operation the company has shown blatant disregard for civic peace on weekends, starting operation as early as 6:00 am on Saturday and Sunday mornings. If they are allowed to take more gravel, they should not be allowed to do it at early times on weekends. He states that he doesn't live in the country to have his peace and quiet shattered by some firm operating only with profits in mind.	

10/20/92	Karen Nessler City Clerk City of Blue Lake Planning Commission City Hall, 111 Greenwood Ave., P.O. Box 458 Blue Lake, CA 95525 (707) 668-5655	NOP discussed by Blue Lake City Council at 10/13/92 meeting. Requests consideration on the following concerns: 1. City of Blue Lake has a wastewater treatment plant and ponds protected by a rock slope on the Mad River. 2. Blue Lake is responsible for maintaining a levee down river from Hatchery Road, West of the bridge. 3. In the early 80's a bridge was destroyed by debris build-up, which weakened the piers. Blue Lake Volunteer Fire Dist. depends on this bridge. 4. A water line is connected to the railroad bridge at Essex. This carries water to the City of Blue Lake, consumers on Glendale Rd., and some commercial users. 5. City of Blue Lake is not opposed to gravel extraction from the Mad River Gravel Bar. It may have different affects on the river.	

Appendix L

NOP

PLANNING DIVISION
OF THE PLANNING AND BUILDING DEPARTMENT

COUNTY OF HUMBOLDT

3015 H STREET
EUREKA, CALIF. 95501-4484 PHONE (707) 445-7541

NOTICE OF PREPARATION

TO:

FROM: Sidnie L. Olson
Senior Planner
Planning Department
3015 H Street
Eureka, CA 95501

SUBJECT: NOTICE OF PREPARATION OF A DRAFT ENVIRONMENTAL IMPACT REPORT

The Humboldt County Planning Department will be the Lead Agency and will prepare an Environmental Impact Report for the project identified below. We need to know the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the Environmental Impact Report prepared by our agency when considering your permit or other approval for the project.

The project description, location, and the probable environmental effects are contained in the attached materials. A copy of the Initial Study is not attached.

Due to time limits mandated by State Law, your responses must be sent at the earliest possible date, but not later than 30 days after receipt of this notice.

Please send your response to Sidnie L. Olson at the address shown above. We will need the name of a contact person in your agency.

PROJECT TITLE: THE SURFACE MINING OF SAND AND GRAVEL ON THE MAD RIVER.

PROJECT DESCRIPTION: The annual extraction of up to 510,000 cubic yards of sand and gravel from the Mad River from the old Swasey Dam site downstream to the Railroad Bridge, which is downstream of the Highway 101 Bridge. Attachment 1 illustrates the existing and proposed surface mining sites (See Table 1) in the study area.

The sand and gravel is generally removed by skimming off the gravel bars at a grade between 2% and 3% upward from the live channel. In addition, gravel may be removed by trenching or pitting techniques. Gravel may be stockpiled up on the river bank, out of the 25-year flood plain. Gravel processing facilities including jaw crushers and conveyor belts may be located near the gravel stockpiles.

Summer bridges may be placed or constructed over the live channel to provide access for gravel removal equipment. Gravel is removed from various river bars and stockpiled generally between June 1st and October 1st of each year. Gravel is retrieved from stockpiles, crushed, sorted, and processed year round.

A Memorandum of Agreement, Attachment 2, is in place for the extraction season of 1992. Techniques to be employed in the 1992 extraction season have been determined by a scientific team of 4 individuals with the concurrence of the California Department of Fish & Game. The Scientific Studies are included herein as Attachment 3.

PROBABLE ENVIRONMENTAL EFFECTS: The EIR will analyze potential impacts and cumulative effects of sand and gravel mining on:

Water quality and biological productivity of the river channel;

Fish spawning, rearing habitat and maintenance of an adequate fish passage;

Sport fishing in the area;

Riparian vegetation from lowered water surface elevations;

Wildlife;

River morphology;

Noise from the extraction and processing operations, and along access and haul routes;

Public access and passive recreation;

River view aesthetics;

Flood hazards;

Traffic circulation;

Sediment size distribution;

Degradation of the Mad River at the Mad River Hatchery weir;

Recruitment potential;

Degradation of the streambed near or so as to affect adversely the Highway 101, Highway 299, Railroad and Blue Lake Boulevard bridges;

Streambed degradation and water surface elevation at the Humboldt Bay Municipal Water District's Ranney well collector and direct river diversion.

TABLE 1 - OPERATIONS INCLUDED IN EIR

Operations with Required County approvals:

Operator	Location (Attachment 1)		Maximum Annual Extraction Amount	
Mad River Sand & Gravel	Site No. 1		200,000 c.y.	Use Permit
Redwood Empire Aggregates	Site No. 2	Emmerson Bar	50,000 c.y.	Vested
Redwood Empire Aggregates	Site No. 3	Blue Lake Bar	50,000 c.y.	Vested
Eureka Sand and Gravel	Site No. 4	Christie Bar	50,000 c.y.	Use Permit
Mercer Fraser, Co.	Site No. 6	Essex Bar	40,000 c.y.	Vested
Arcata Readi-Mix	Site No. 7		80,000 c.y.	Vested

Operations with approved reclamation plans and with vested right claim pending:

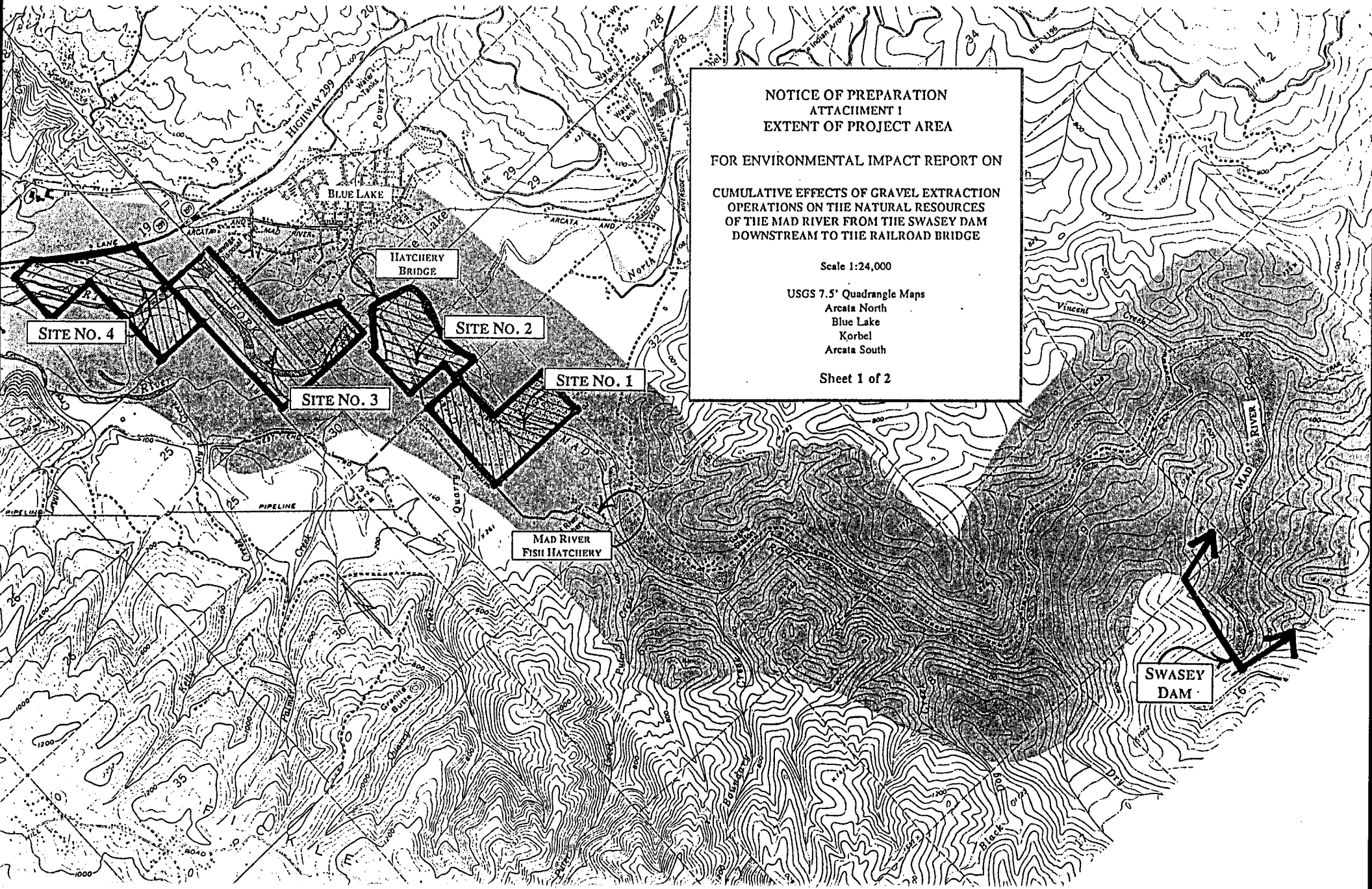
Operator	Location (Attachment 1)		Proposed Maximum Annual Extraction Amount	
Redwood Empire Aggregates	Site No. 5	Johnson Bar	30,000 c.y.	Vested Right Claim
Redwood Empire Aggregates	Site No. 8	Graham Bar	10,000 c.y.	Vested Right Claim

Date: August 11, 1992

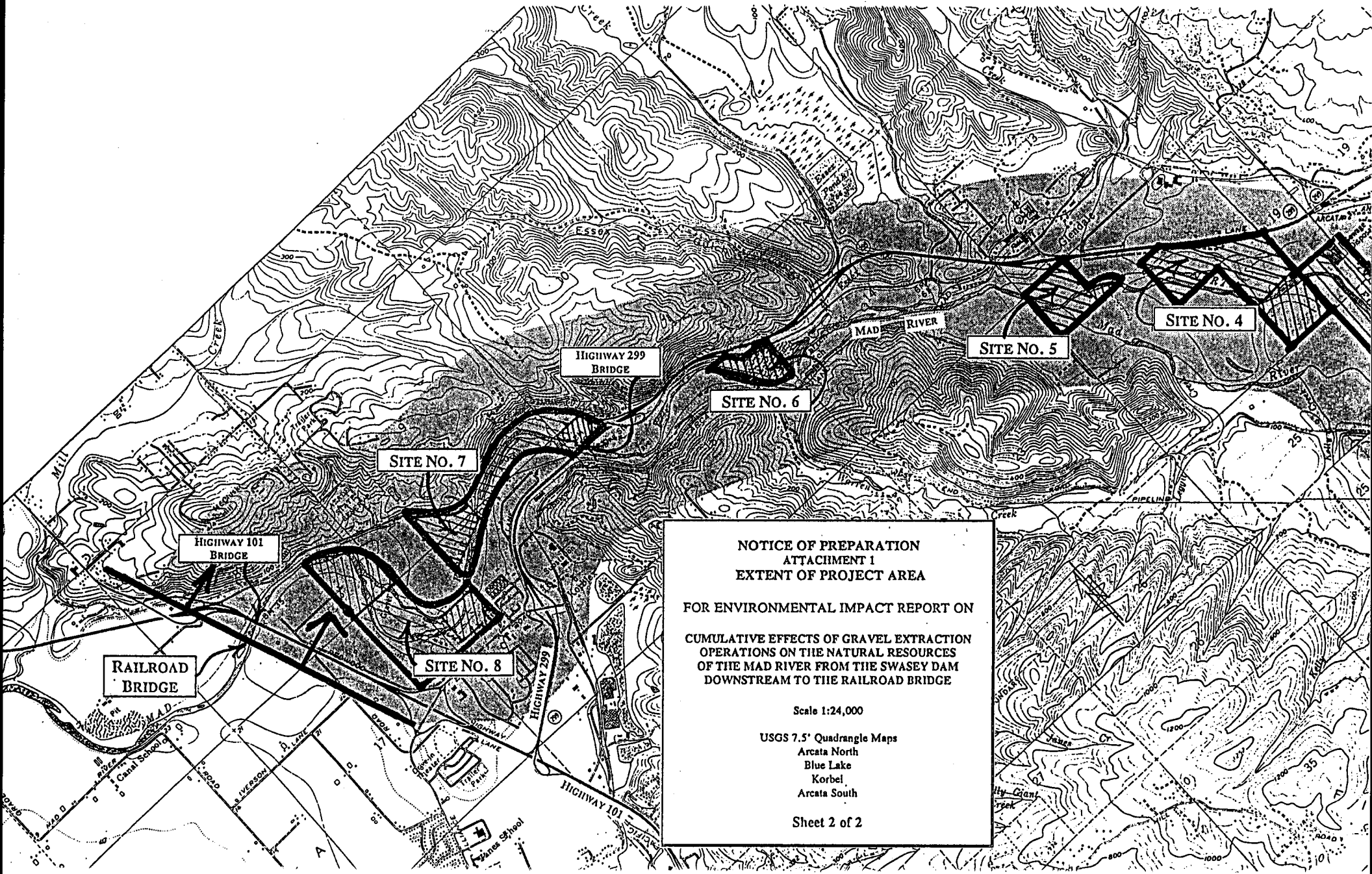
Sidnie L. Olson
Senior Planner

(smara2\a:\mstrplan\nop-mad.doc)

REDUCED (65%)


NOTICE OF PREPARATION
ATTACHMENT 1
EXTENT OF PROJECT AREA
FOR ENVIRONMENTAL IMPACT REPORT ON
CUMULATIVE EFFECTS OF GRAVEL EXTRACTION OPERATIONS ON THE NATURAL RESOURCES OF THE MAD RIVER FROM THE SWASEY DAM DOWNSTREAM TO THE RAILROAD BRIDGE
Scale 1:24,000
USGS 7.5' Quadrangle Maps
Arcata North
Blue Lake
Korbel
Arcata South
Sheet 1 of 2
SITE NO. 1
SITE NO. 2
SITE NO. 3
SITE NO. 4
HATCHERY BRIDGE
MAD RIVER FISH HATCHERY
SWASEY DAM
BLUE LAKE
HIGHWAY 299
PIPELINE
MAD RIVER

REDUCED (65%)


SITE NO. 4
SITE NO. 5
SITE NO. 6
SITE NO. 7
SITE NO. 8
HIGHWAY 299 BRIDGE
HIGHWAY 101 BRIDGE
RAILROAD BRIDGE
MAD RIVER
HIGHWAY 299
HIGHWAY 101
NOTICE OF PREPARATION
ATTACHMENT 1
EXTENT OF PROJECT AREA
FOR ENVIRONMENTAL IMPACT REPORT ON
CUMULATIVE EFFECTS OF GRAVEL EXTRACTION OPERATIONS ON THE NATURAL RESOURCES OF THE MAD RIVER FROM THE SWASEY DAM DOWNSTREAM TO THE RAILROAD BRIDGE
Scale 1:24,000
USGS 7.5' Quadrangle Maps
Arcata North
Blue Lake
Korbel
Arcata South
Sheet 2 of 2

MEMORANDUM OF AGREEMENT

concerning

GRAVEL EXTRACTION OPERATIONS ON THE MAD RIVER

IN HUMBOLDT COUNTY
DURING 1992

I. PURPOSES AND INTENTION OF MOA

Whereas, the Mad River ecosystem located within Humboldt County contains valuable high quality natural resources, including but not limited to spawning and rearing habitat for anadromous fish that supports a commercial and recreational fishery, gravel resources used for local construction activities, and riparian and wetland habitat supporting wildlife, all of which contribute to the local economy and quality of life.

Whereas, the undersigned parties recognize the need for a full evaluation of the short-term and the long-term environmental effects of various activities, including the cumulative impacts of gravel extraction operations, on the natural resources of the Mad River, and also recognize the need to obtain gravel for use within the County during 1992;

Whereas, gravel extraction operations must comply with all applicable permit and approval requirements of state and local agencies, and state and local agencies must comply with the applicable provisions of the California Environmental Quality Act;

Whereas, although in areas which are not subject to tidal influences the State holds fee title in trust for the public to rivers and streams below their ordinary low watermarks and holds an easement termed the public trust easement over the areas between the ordinary high and ordinary low watermarks of rivers and streams, the precise location of the low water and high water boundaries on the Mad River has not been determined as of the date of this agreement;

Whereas, in order for gravel extraction from the Mad River which will not result in significant adverse environmental effects to proceed in 1992, pending a full evaluation of the cumulative, longterm impacts of existing and proposed activities on the natural resources of the Mad River, it is necessary and appropriate to develop special operating conditions and to coordinate state and local agency proceedings concerning gravel extraction operations in 1992;

Whereas, the undersigned parties desire to expedite and to work cooperatively in assessing environmental impacts, both from individual projects and cumulatively, and in processing applications for approval related to gravel extraction operations on the Mad River;

Whereas, the undersigned parties desire also to avoid and to reduce duplication and potential conflict in the processing by state and local agencies of applications for gravel extraction operations and reclamation plans on the Mad River;

Whereas, the undersigned parties do not by this agreement waive or intend to waive, nor shall this agreement be construed to waive, any rights, claims, or statutory responsibilities of any of the parties hereto.

BASED UPON AND FOR THE REASONS SET FORTH ABOVE, THE UNDERSIGNED PARTIES AGREE AS FOLLOWS:

II. SCOPE AND APPLICABILITY OF THIS MOA

A. AGENCY ROLES AND RESPONSIBILITIES

Humboldt County (hereinafter "County") is the lead agency for purposes of compliance with the California Environmental Quality Act (CEQA, Public Resources Code Section 21000 et seq.) in adopting a general plan and ordinances and in issuing conditional use permits (CUPs) and other county permits, entitlements, or approvals for gravel extraction operations; and is the lead agency for purposes of the Surface Mining and Reclamation Act (SMARA), as certified by the Mining and Geology Board.

The Resources Agency (hereinafter "Agency") provides state agency coordination for activities which may affect the free-flowing and natural character of the state's designated wild and scenic rivers, adopts the state CEQA Guidelines and coordinates various inter-Department issues.

The Mining and Geology Board (hereinafter "Board") and the Department of Conservation are the state agencies with responsibility for implementing SMARA (Public Resources Code Section 2710 et seq.). Pursuant to SMARA the Board establishes standards for reclamation plans, has certified the County's ordinance governing reclamation of mining sites, and exercises continuing review authority with regard to lead agency compliance with SMARA. Pursuant to SMARA and CEQA the Department of Conservation (hereinafter "DOC") reviews and submits comments on proposed reclamation plans for gravel extraction operations, monitors compliance with approved reclamation plans, and monitors lead agency implementation of SMARA.

The Department of Fish and Game (hereinafter "DFG"), as the state trustee agency for fish and wildlife (Fish and Game Code Sections 711.7 and 1802) and pursuant to CEQA, reviews and submits comments on projects which may affect fish and wildlife resources, reviews projects which may adversely affect the free-flowing and natural character of designated wild and scenic rivers, enters into agreements pursuant to Fish and Game Code Section 1600 et seq., and is responsible for administering Section 1505 of the Fish and Game Code.

The State Lands Commission (hereinafter "Commission") administers lands and resources owned by the state and public trust easements overlying such lands and resources, submits comments pursuant to CEQA on projects which may affect state lands or public trust easements, and collects royalties for the removal of mineral resources from state fee-owned lands.

B. GRAVEL EXTRACTION OPERATIONS

This agreement shall apply to all surface mining operations (hereinafter "Operators") which are in the bed or within one-half (1/2) mile from the center line of the Mad River; which receive or have received county authorization applicable to 1992 extraction operations; and which have signed this agreement. These operators may include, but are not limited to, the following companies: Eureka Sand and Gravel, Mad River Sand and Gravel, and Redwood Empire Aggregates.

C. OTHER AGENCY PARTICIPATION

The public agencies below are agencies interested in, and possess subject matter expertise related to, and may submit comments pursuant to CEQA on the gravel extraction operations which are the subject of this agreement.

(1) The California Department of Transportation (Caltrans) submits comments pursuant to CEQA and SMARA (Public Resources Code Section 2770.5) on projects which may affect Caltrans facilities, including bridges crossing the Mad River.

(2) The North Coast Regional Water Quality Control Board submits comments as an interested or responsible agency on projects subject to CEQA which may affect water quality, and assists in developing monitoring plans to meet water quality objectives adopted pursuant to the Porter-Cologne Water Quality Control Act (Water Code Section 13000 et seq.).

(3) The Humboldt Bay Municipal Water District operates wells and provides water supplies which draw on the Mad River and its underlying aquifers, and submits comments as an interested agency on proposed projects subject to CEQA which may affect the volume or the quality of its water supplies.

(4) The federal agencies which may comment and provide information concerning the impacts of proposed gravel extraction operations include the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service.

IV. SHORT TERM OPERATIONS

The parties agree that the following provisions shall apply to all gravel extraction activity which occurs on the Mad River in 1992. These provisions are intended and understood to apply as conditions to gravel extraction in 1992, pending the completion of the environmental impact report described below in Section V which is to address the cumulative effects of gravel extraction operations on the Mad River.

A. On behalf of the undersigned parties, a Technical Committee, comprised of the persons listed on Attachment 1, is established and has provided direction, as set forth in a letter dated June 12, 1992, which is incorporated herein as Attachment 2, to the Scientific Committee which is established pursuant to paragraph IV. B. below.

B. A Scientific Committee is established for the purposes of conducting a review of the current condition of natural resources of the Mad River and providing recommendations to public agencies concerning the volumes, methodologies and sites of potential, environmentally safe gravel extraction operations, if any, for 1992 on the Mad River. The Scientific Committee consists of the following four members:

Douglas Jager, CSU at Humboldt

William Trush, River Institute

Andre Lehre, Pacific Southwest Range and Experiment Station

Randall Klein, National Park Service, Redwood National Park

(1) Each member of the Scientific Committee shall disclose for the period from January 1, 1990 through the present, all economic interests in and income from (including income of more than $250 from any single source) any business or activity which is related in any way to gravel extraction operations in Northern California. Disclosure shall be accomplished by filing a statement of economic interest at the Office of the County Clerk, Humboldt County, and at the Office of the Secretary for Resources in Sacramento, as soon as possible after the effective date of this agreement.

(2) Pursuant to the guidance and direction received from the Technical Committee and based on its review of the present condition of the natural resources of the Mad River, the Scientific Committee shall provide recommendations to the undersigned public agencies concerning gravel extraction operations which may occur in 1992, if any, without significant environmental harm or risk of such harm.

(3) The Scientific Committee shall provide its recommendations, along with a succinct statement of supporting facts and reasoning, in writing to the undersigned public agencies. The written report shall be submitted within 15 calendar days after receiving a written request and direction from the Technical Committee; provided, however, that the Scientific Committee may request an extension of time, if necessary, to complete its evaluation and recommendations.

(4) If significant new or additional information which may affect the recommendations of the Committee is submitted to one or more of the undersigned public agencies, the new information shall be referred immediately to the Scientific Committee for evaluation. Upon completing its evaluation, the Scientific Committee shall promptly submit to the undersigned agencies such further written recommendations as may be appropriate.

C. The parties agree that the following standard conditions shall be included in all permits, amendments, approvals, and Section 1603 agreements issued by state and local agencies which apply to surface mining activities on the Mad River in 1992.

(1) Authorizations shall be issued for and apply to gravel extraction operations in 1992 only. Before commencing mining in 1992, each operator shall have both a reclamation plan and financial assurances approved by the County in compliance with requirements of SMARA.

(2) The locations, depths, methods and volumes of allowed gravel extraction shall not exceed the levels or alter the methods recommended by the Scientific Committee. In accordance with the recommendations of the Scientific Committee, gravel retention requirements may be specified as percentage (%) of annual recruitment at specified sites, as necessary for downstream recruitment, stream restoration or other resource protection purposes, pending the completion of the EIR described in Section V below.

(3) Each operator shall create and maintain a written record of gravel extraction during 1992 which contains at least the following information for each surface mining site: a site description, boundary lines, baseline cross-section or transect data, the estimated mineral volume (cubic yards) removed during each day of operations, ending cross-section or transect data,

riverbed depth at close of 1992 operations, and the estimated total mineral volume (cubic yards) removed in 1992.

(4) Appropriate monitoring requirements shall be included for each gravel extraction operation, and shall require each operator to submit to the County no later than November 15, 1992, a written report containing the results of required monitoring and the information required by paragraph (3) above. The County shall provide copies of monitoring reports to the undersigned public agencies.

(5) Recognizing the claim to jurisdiction of the State Lands Commission regarding state owned lands and resources, pending and subject to the final determination of the ordinary low water boundary of the Mad River, (a) the existing low flow riverbed channel shall be treated administratively by the parties to this agreement as belonging to the State, and the remainder of the riverbed up to the ordinary high watermark shall be treated as subject to a public trust easement held by the State; and (b) gravel extraction operations shall be approved only in those areas which are above the presently existing low watermark.

D. The operators agree as follows to provide funding for the preparation of the EIR as described below in Section V. Each operator agrees to deposit in an interest bearing trust account established by the County the sum of $5,000.00 within 10 days of signing this agreement, and to deposit funds monthly, after removing the first 5,000 cubic yards of gravel in 1992, in amounts equal to $1.00 per cubic yard of gravel removed in 1992. Any balance of funds which is not needed for and remains after the completion of the EIR shall be returned to the operators in amounts proportional to their contributions.

E. Each operator agrees to provide the following information to the County within two weeks after the end of 1992 operations:

(1) wildlife observed during operations;

(2) recreational uses observed nearby;

(3) number of trucks per day that used access and haul routes;

(4) noise levels measured at 50 feet for 10-yard dump trucks, front-end loader and gravel crusher; and, noise levels measured at the exterior wall of the nearest occupied residence;

(5) acres of bar vegetation removed;

(6) sieve analysis of at least three bed samples taken

at the start and three more bed samples after completion of operation;

(7) a record of fish use of the River by snorkeling and visual analysis of the low flow channel and related pools for each gravel mining site at least three times during the gravel removal season; and

(8) black and white aerial photographs at 1" = 500' taken after the end of the 1992 operating season, but before the first rain in 1992.

F. The County shall review each reclamation plan and financial assurances for operators on the Mad River after the close of 1992 operations, and, before any 1993 operations may begin, shall determine such revisions as may be necessary to address the operations and the current riverine conditions in compliance with SMARA.

G. To the maximum extent feasible and practicable all affected state and local public agencies shall review and evaluate proposed gravel extraction operations based upon the same information and documentation.

V. LONG TERM EVALUATION OF THE RESOURCES

The County shall prepare, or cause to be prepared under contract to it, a programmatic EIR to evaluate the cumulative effects of gravel extraction operations on the natural resources of the Mad River from the Swasey Dam downstream to the railroad bridge which is downstream of the Highway 101 Bridge.

(1) The County agrees to commence the preparation of this EIR upon the effective date of this agreement, and to pursue the completion of the EIR in accordance with the schedule set forth in Attachment 3, which is incorporated herein by this reference.

(2) Except for the normal costs of administrative processing, which shall be borne by the County and shall include providing public notice, circulating draft documents, collecting comments, and holding public meetings, the costs of the preparation of the draft and the final EIR shall be borne by and shared among the Operators with authorizations for extraction in 1992, and shall be allocated in proportion to the gravel volumes extracted. The signature of an Operator to this agreement shall signify agreement to bear a proportionate share of the preparation costs for the EIR described herein.

(3) Each signatory state agency shall designate a person to provide technical advice and assistance through consultation with the County concerning the EIR. These representatives, along with

the representatives of interested state agencies, shall serve as a State Agency Technical Advisory Committee to the County with regard to the preparation of the EIR.

(4) The County shall request comments from the County Advisory Committee, which is presently being formed and appointed by the County Board of Supervisors, regarding the preparation of the EIR.

VI. EFFECTIVE DATE, IMPLEMENTATION AND TERMINATION

A. For purposes of implementing this agreement, each state and local agency described in Section II. A. above shall designate a contact person for consultation and coordination with other agencies, and shall inform the Resources Agency and the County of the designated person's name, phone number, facsimile number, and business address. Each interested agency described above in Section II. C. is encouraged likewise to designate a contact person.

B. This agreement shall be effective upon its execution by the state agencies listed below, the County, and the Operators listed below. This agreement may be executed in any number of counterparts, and each executed counterpart shall have the same force and effect as an original instrument and as if all of the parties to the counterparts had signed the same instrument.

C. Each party agrees to implement, to monitor compliance with, and to cooperate in the enforcement of the terms of this agreement.

D. This agreement shall terminate upon whichever of the two following dates occurs first, the date the notice of determination is filed for the final EIR described above in Section V or June 15, 1993.

ATTACHMENTS INCORPORATED IN THIS MOA BY REFERENCE

Attachment 1 -- Technical Committee Membership List

Attachment 2 -- Technical Committee letter of June 12, 1992, to the Scientific Committee

Attachment 3 -- Schedule for EIR Preparation

SIGNATURES

DATE: _____

Chairman, Board of Supervisors
Humboldt County

DATE: _____

Approved as to form:
County Counsel, Humboldt County

DATE: _____

Secretary for Resources
California Resources Agency

DATE: _____

Executive Officer
Board of Mining and Geology

DATE: _____

Director, Department of Conservation

DATE: _____

Director, Department of Fish and Game

DATE: 7-23-92

Executive Director, State Lands Commission

DATE: _____

Eureka Sand and Gravel

DATE: _____

Mad River Sand and Gravel

DATE: _____

Redwood Empire Aggregates

MOU GRAVEL EXTRACTION OPERATIONS - MAD RIVER

TECHNICAL COMMITTEE

Name	Address	Telephone
* Ms. Bonnie Neely, Supervisor Humboldt County	825 Fifth Street, Room 111 Eureka, California 95501	(707) 445-7694
* Mr. Banky Curtis Regional Manager Department of Fish and Game	601 Locust Redding, California 96001	(916) 225-2363
Mr. Larry Preston Associate Fishery Biologist Department of Fish and Game	619 Second Street Eureka, California 95501	(707) 445-6493
Ms. Karen Kovacs Associate Wildlife Biologist Department of Fish and Game	619 Second Street Eureka, California 95501	(707) 445-6493
Ms. Anna Sparks, Supervisor Humboldt County	825 Fifth Street, Room 111 Eureka, California 95501	(707) 445-7694
Mr. Don Tuttle Environmental Services Manager Department of Public Works Humboldt County	1106 Second Street Eureka, California 95501-0579	(707) 445-7741
Mr. Bill Davis Dun & Martinek Attorneys at Law	730 Seventh Street, Suite B Eurrkea, California 95501	(916) 442-3791
Mr. David Krueger Environmental Concerns	Box 649 Arcata, California 95521	(707) 839-5971
Mr. Tom Conlon Planning Director Humboldt County	3015 H Street Eureka, California 95501	(707) 445-7541
Ms. Cathy Crossett Hydraulic Engineer Department of Transportation	P.O. Box 942874 Sacramento, California 94274-0001	(916) 327-3218
Ms. Diana Jacobs Staff Ecologist State Lands Commission	1807 13th Street Sacramento, California 95814	(916) 445-5034

* Co-Chair Persons

STATE OF CALIFORNIA—THE RESOURCES AGENCY

PETE WILSON, Gover

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
P.O. BOX 944209
SACRAMENTO, CA 94244-2090
(916) 225-2363

June 12, 1992

Mr. Randy Klein
Consultant
1360 Stromberg Avenue
Arcata, California 95521

Dr. Andre Lehre
Humboldt State University
2335 Grace Avenue
McKinleyville, California 95521

Dr. Doug Jager
Humboldt State University
349 Stagecoach Road
Trinidad, California 95570

Dr. Bill Trush
Humboldt State University
Arcata, California 95521

Dear Mr. Klein and Drs. Lehre, Jaeger, and Trush:

Potential for Gravel Extraction on the Mad River in 1992

It is my understanding that you have all been contacted by Mr. Tom Conlon, Humboldt County Planning Director, and have agreed to participate as members of the scientific team for assessing the potential for environmentally safe gravel extraction on the Mad River in 1992. As co-chairman of the task force charged with the establishment of a Memorandum of Understanding (MOU) between the Resources Agency, State Lands Commission, Humboldt County, California Department of Fish and Game, and the gravel operators on the Mad River, I want to thank you for your willingness to participate in this process.

I understand that you will meet soon and discuss the protocol and scheduling for your task. On behalf of Ms. Bonnie Neely and myself as co-chairs of the technical committee, I want to be sure you are apprised of the objectives that were agreed upon by the various agencies and other representatives at the May 22, 1992 meeting in Eureka.

The primary question that needs to be addressed is -- how much, if any, gravel could be extracted from sites with all the necessary county permits on the Mad River in 1992 without resulting in significant adverse enrionmental impact in the near term and without long-term damage to the natural resources of this river system? This assessment should also include recommendations for methods of extraction and methods, sites, and amounts of gravel that need to be maintained in the river to begin the restoration process.

Priority should be given to the sites of Arcata Readimix, Eureka Sand and Gravel, Mercer Fraser, and Mad River Sand and Gravel companies, which are currently the operations with the necessary legal entitlements except for required agreements under Section 1603 of the Fish and Game Code.

Potential gravel extraction sites should also be assessed in the same manner on four Redwood Empire Aggregates' parcels which do not currently have the necessary county permits. The Department of Fish and Game and the Resources Agency may agree to consider, as part of the proposed MOU, a conditional one-season permit and reclamation plan for Redwood Empire Aggregates' sites provided the county completes an adequate CEQA document and agrees to complete an EIR for all gravel extraction on the Mad River prior to the 1993 gravel extraction season.

Your assessment should embrace the concerns of all agencies and special service districts. These concerns are:

1) Fish spawning and rearing habitat and maintenance of an adequate fish passage.

2) Degradation of the Mad River at the Mad River Hatchery weir.

3) Degradation of the streambed near or so as to affect adversely the Highway 101, Highway 299, Railroad and Blue Lake Boulevard bridges.

4) Streambed degradation and water surface elevation at the Humboldt Bay Municipal Water District's Ranney well collector and direct river diversion.

5) Impact to riparian vegetation from lowered water surface elevations.

6) Recruitment potential to downstream areas.

7) Bank failure, riparian loss, and increases of instream sedimentation.

We appreciate your acceptance of this challenging task, and we believe that you are collectively the most qualified team to make this assessment and submit recommendations to the decision making agencies. Please conduct your field assessment and provide us your recommendations as soon as possible.

Please contact me if you have any questions. My address is Department of Fish and Game, 601 Locust, Redding, California 96001, telephone (916) 225-2363.

Sincerely,

COPY Original signed by Banky Curtis

Banky E. Curtis
Regional Manager
Region 1

cc: Mr. William Davis
Dun & Martinek
Attorney at Law
730 Seventh Street, Suite B
Eureka, California 95501

Ms. Christine Sproul
Assistant Secretary, Legal Affairs
Resources Agency
1416 Ninth Street, 13th Floor
Sacramento, California 95814

Ms. Bonnie Neely, Supervisor
Humboldt County
825 Fifth Street, Room 111
Eureka, California 95501

Ms. Sandra Corcoran
District Office Field Representative
Assemblyman Dan Hauser's Office
510 O Street, Suite G
Eureka, California 95501

Mr. Dennis O'Bryant, Chief
Office of Mine Reporting and Reclamation Compliance
Department of Conservation
801 K Street, MS 09-06
Sacramento, California 95814

Mr. Lance Kiley, Senior Staff Counsel
State Lands Commission
1807 13th Street
Sacramento, California 95814

Mr. Art Bolli, General Manager
Humboldt Bay Municipal Water District
P.O. Box 95
Eureka, California 95502

cc: (Cont.)

Mr. David Krueger
Environmental Concerns
Box 649
Arcata, California 95521

Mr. Jerry Haynes, Deputy District Director
Project Development
Department of Transportation
P.O. Box 3700
Eureka, California 95501

Mr. Don Tuttle, Environmental Services Manager
Department of Public Works
Humboldt County
1106 Second Street
Eureka, California 95501-0579

Ms. Cathy Crossett, Hydraulic Engineer
Department of Transportation
P.O. Box 942874
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Ms. Diana Jacobs, Staff Ecologist
State Lands Commission
1807 13th Street
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Ms. Anna Sparks, Supervisor
Humboldt County
825 Fifth Street, Room 111
Eureka, California 95501

Mr. John Hannum
Senior Water Resources Control Engineer
Regional Water Quality Control Board
5550 Skylane Boulevard, Suite A
Santa Rosa, California 95403

Attachment 3

SCHEDULE FOR EIR PREPARATION AND COMPLETION

(A) On or before August 12, 1992, issue Notice of Preparation.

(B) On or before September 1, 1992, select technical consultant(s) and execute contracts between County and consultant(s).*

(C) Hold scoping meeting(s) between August 15, 1992 and September 1, 1992.

(D) On or before September 1, 1992, gather from all affected state and local agencies technical comments regarding the scope of the EIR, existing research data and other relevant information to be taken into consideration in drafting the EIR. This information shall include any needed subsurface geology data, which is to be obtained as soon as possible by Caltrans, near and underlying the footings of the Highway 101 and Highway 299 Bridges; fisheries and hydrology data from DFG; water quality and flow data from the Humboldt Bay Municipal Water District and the North Coast Regional Water Quality Control Board.

(E) On or before September 15, 1992, request comments from the State Agency Technical Advisory Committee regarding the scope of the EIR.

(F) On or before September 15, 1992, request comments from the County Public Advisory Committee, which is presently being formed and appointed by the County Board of Supervisors, regarding the scope of the EIR.

(G) On or before December 15, 1992, provide notification of the availability of the draft EIR for public review and of the public comment period, which shall close no earlier than sixty (60) days after issuance of the notice of availability.

(H) Prepare final EIR.

(I) Certify and adopt the final EIR by May 1, 1993.

* The schedule may be extended accordingly should County be required to solicit proposals for contracted work regarding the EIR.

Dr. Douglas Jager
349 Stagecoach Road
Trinidad CA 95570
707-677-0604

Ms. Bonnie Neely, Supervisor
Humboldt County
825 Fifth Street, Room 111
Eureka CA 95501

June 24, 1992

Dear Ms. Neely:

Enclosed you will find a report prepared by the Mad River MOU scientific team with recommendations for 1992 gravel extraction at the first priority bars. Our team will add a short supplement to this report with recommendations for the priority two bars soon after we receive additional cross section and map information. We anticipate receiving this additional information in the next few days.

I have sent a copy of this report to Mr. Banky Curtis. He should receive his copy on June 25th. We have not released this information to any other parties.

If you have questions please call me.

Sincerely,

D Jager

Dr. Douglas Jager

RECEIVED
BOARD OF SUPERVISORS

JUN 24 1992

AM 7 8 9 10 11 12 1 2 3 4 5 6 PM

cc: Banky Curtis

GRAVEL EXTRACTION TECHNICAL COMMITTEE

REPORT OF THE SCIENTIFIC TEAM

RECOMMENDATIONS FOR CURRENTLY PERMITTED BARS

Doug Jager
Randy Klein
Andre Lehre
Bill Trush

23 June 1992

Notice of Preparation
Attachment 3
Technical Studies

INTRODUCTION

Charge to the Scientific Team

The specific charge to the Scientific Team is given in Banky Curtis' letter of 12 June 1992 (Attachment 1). This letter indicates that priority should be given to the four sites which had county permits as of 12 June 1992 (Attachment 1, paragraphs 3 and 4). We were also asked to investigate extraction potential at four other currently unpermitted sites (Attachment 1, paragraph 5). However, as of 19 June 1992 the scientific team had not been provided with current maps, cross-sections, or plans for these additional sites. Thus, in the interest of timeliness, we address in this report only the four permitted sites (Guynup, Christie , Essex, and Johnson-Spini bars). The scientific team will address four priority two (REA) sites soon after the required maps and cross-sections are made available.

Personnel and Individual Responsibilities

The scientific team consists of Dr. Doug Jager, Mr. Randy Klein, Dr. Andre Lehre, and Dr. Bill Trush. Doug Jager, forester and hydrologist, is professor of forestry and watershed management at HSU. Randy Klein, hydrologist, is an independent consultant as well as a watershed hydrologist at Redwood National Park. Andre Lehre, geomorphologist and hydrologist, is professor of geology at HSU. Bill Trush, fisheries biologist and fluvial geomorphologist, is both an independent consultant and lecturer in fisheries at HSU.

The team spent 2.5 days together in the field investigating the four permitted gravel extraction sites, the Highway 299, Railroad, and Blue Lake bridges, and the HBMWD intake reach; 0.75 day meeting in Eureka with concerned individuals: Art Bolli, Harold Hunt, and Lloyd Hecathorn, HBMWD; Dennis McBride, CalTrans; and Supervisors Stan Dixon and (briefly) Anna Sparks; and 1 day in the office establishing design criteria, studying cross-sections and airphotos, reviewing available data, finalizing prescriptions, and revising this report. In addition, individual team members were assigned the following responsibilities: Doug Jager was liaison with the various governmental and private entities and individuals. Randy Klein calculated our proposed extraction volumes from the cross-sections, maps, and airphotos. Andre Lehre computed estimated bedload recruitment from hydraulic data and wrote this report. Bill Trush evaluated the effects of extraction plans on the fisheries and riparian/wetland resources and suggested designs for mitigation.

GENERAL OVERVIEW OF THE PROBLEM

Significance of the bed degradation problem

Over the past ten to fifteen years, the bed and bars of the Mad River have in general degraded (lowered) significantly. While this general bed lowering affects the entire channel downstream from the hatchery to the mouth, it is especially obvious in the reach between Blue Lake and the Highway 299 bridge, and has reached the point where it is seriously affecting the Railway bridge, the 299 bridge, and the HBMWD intakes. We list several observations below that indicate the extent of this problem.

- Comparison of channel cross-sections surveyed in July 1991 by Andre Lehre and Tom Lisle with original construction cross-sections show maximum local bed lowering of 4.5 ft at the Blue Lake bridge since 1982 and 14 ft at the 299 bridge since 1960. Average bed lowering (across the entire channel width) at these sites is 1.6 ft and 8 ft respectively. At the 299 bridge the footings of pier 4 have been exposed and the concreted right bank at pier 5 has been undercut.
- The footings of the northern pier of the Railway bridge are virtually completely exposed and appear to be undermined. We were able to thrust a stick 4-5 feet under the NE corner of the pier without encountering anything solid! A willow growing on the south side of this pier marks a fairly recent position of the old ground surface; the willow's base is now about eight feet above the current bed surface.
- The HBMWD Ranney collector towers have been increasingly exposed; one tower has had to have two additional lengths of ladder welded on, indicating 8 - 10 feet of bed lowering. Such bed lowering reduces filtration effectiveness of the collectors. Bed lowering at pump station 6 (which supplies the Samoa mills) has brought the pumps to within 0.5 - 1 foot of sucking air at low water.

In addition, CalTrans has expressed concern about substantial bed lowering and potential pier undermining at the Highway 101 bridge.

Causes of bed degradation

The gravel resource stored in any reach of a river can be visualized as a bank account. The capital in the account is contained in the bed, and in the bars and banks along the channel. Deposits are made naturally into the account as new gravel is brought in (recruited) from upstream. Natural withdrawals from the account occur as gravel is transported downstream out of the reach by the river. Checks are written on the account as gravel is extracted by man. As with any bank account, if deposits exceed withdrawals, the capital in the account will increase, that is, the river will raise its bed (aggrade) and build up the bars. On the other hand, if withdrawals and checks exceed the deposits, the balance in the account will diminish; in the case of a river, this means lowering of the bed (degradation) and widening of the channel.

The river as a whole can be looked at as a string of serially linked adjacent bank accounts (reaches), whereby the natural withdrawals (outflows) of bed material from each account provide the natural deposits (inflows) to the account immediately downstream. Thus deposits to any downstream account reflect the cumulative effects of all upstream actions. In particular, if upstream reaches intercept most of the natural gravel recruitment (i.e., the cash flow to downstream accounts is reduced), deposits to reaches farther downstream can only come by reducing the capital in the intervening accounts, i.e., by eroding the bed and banks.

The persistent general bed lowering in the lower Mad River described above has been caused by 1) low rates of recruitment of new bed material from upstream (because of a succession of dry years with low peak flows) combined with 2) substantial extractions from the channel by gravel consumers. In order to determine the contributions of each cause to the observed bed lowering we would need for several years: 1) measurements the rate of transport of bed material through the reach ; 2) accurate and complete records of the amounts of gravel extracted yearly; and 3) repeated detailed topographic maps and cross-sections of the channel. None of these exist. We can, however, use historical data to make some extremely crude estimates of new gravel recruitment, and compare this with proposed extractions.

Brown (1973) made nine measurements of bedload transport on the Mad River at Arcata (just upstream of the Highway 299 bridge) and five on the Mad River at Kneeland in water year 1972-73. He plotted bedload transport rate against water discharge to create bedload transport curves for the two sites (Brown, 1973, figs. 9 and 10). From these curves and the 1971-72 water discharge records, he estimated the 1971-72 bedload discharge at Arcata as 60,000 tons (74,000 cu. yd. using Brown's unit weight of 60 lb/cu. ft) and 170,000 tons (210,000 cu. yd.) at Kneeland (Brown, 1973, p. 18 and p. 25). It must be emphasized that these estimates are quite crude, since his bedload transport curves are defined by very few points. These estimates of recruitment should be compared with the 200,000 -500,000 tons/yr (247,000 - 618,000 cu. yd./yr) that he estimates were extracted in the years 1961-70 (Brown, 1973, p. 55), which is 4 to 10 times the estimated transport at Arcata, and 1.2 to 3 times that at Kneeland. It should be noted that later year 1971-72 was a fairly wet year with substantial peak flows, so Brown's transport estimates are optimistic ones.

Lacking any better data, we applied Brown's sediment transport curve for Arcata (his fig. 9) to hourly flow data at the Arcata gage (obtained from the Department of Water Resources) for water year 1990-91 (1 Oct. 1990 - 30 Sept 1991), and for the current water year through May (1 Oct. 1991 - 31 May 1992). Our calculations yielded 10,300 tons (12,700 cu. yd.) for water year 1990-91, and 7,500 tons (9,300 cu. yd.) for the current water year. These quantities are far less than the proposed extractions. Even if our estimates are low by a factor of 3 to 5, which is certainly possible, the estimated yearly recruitment is much less than the yearly extraction.

From the above calculations, it seems likely that gravel extraction significantly in excess of replenishment has played an important role in recent bed degradation on the lower Mad River. Thus one of our highest priorities is to ensure that future extraction is managed in such a way that newly recruited material has a reasonable opportunity to reach degraded sites downstream.

Basis for the Recommendations

Our recommendations are guided by the following unanimously agreed-upon objectives:

a. maintenance of a reasonably well-defined and stable mainstem channel at low and moderate discharges;

b. maintenance of downstream and cross-stream bar and bed slopes sufficient to allow transport of gravel to downstream sites; and

c. avoidance of extractions, such as trenching, which could trap excessive gravel, or through headward erosion, undermine upstream structures.

If bars are skimmed too flat and too close to the low-water surface, at slightly higher stages the river will tend to spread across the bars, reducing the depth of flow, and the channel may both migrate rapidly and break into a number of shallow channels or threads. Such sites will tend to trap gravel which would otherwise move downstream.

Trenching should be avoided in reaches immediately downstream of threatened structures. The increased bed gradient at the head of a trench, together with the increased depth of water downstream tends to cause headward (upstream) scour.

Site-Specific Recommendations for Permitted Bars

These site-specific recommendations are only for the four currently permitted bars. Please note that these recommendations are specifically for 1992 and were made under the assumption that the coming water year will be no wetter than the past few have been. This is a reasonable and conservative assumption, as dry years tend to occur in groups. If water year 1993 is much wetter and leads to substantial recruitment of new gravel, our prescriptions in the following year would change.

Guynup Bar (Mad River Sand & Gravel)

Prescription

We recommend that gravel be extracted in 1992 by bar skimming according to the following specifications:

a. Gravel removal is to begin one (1) foot in elevation above the water surface as defined in cross-sections 1-8 surveyed by Ormsberg & Co. in April 1992 (xs sheets 1 and 2).

b. The extraction is to grade upslope away from the river at 3% for fifty (50) horizontal feet, and then to grade away at 2% to daylight or to our limit of extraction (see c below), whichever comes first.

c. The limits of extraction vary from cross-section to cross-section as specified in the table below. These limits refer to the horizontal distance scales shown on the Ormsberg cross-sections.

XS	riverward limit ft	landward limit ft	extraction width ft
1	177	323	146
2	330	690	360
3	340	648	308
4	85	395	310
5	346	696	350
6	493	538	45
7	460	560	100
8	537	712	175

The limit of extraction *between* cross-sections is defined by a smooth curve connecting the extraction limits at the adjoining cross-sections (See Fig. 1).

Amount of Extractable Gravel (1992)

We estimate that this prescription will yield approximately 33,000 cubic yards on the upper bar and 9000 cu. yd. on the lower bar (including 1000 cu. yd. on the downstream end of the lower bar on the Emerson property), for a total of 42,000 cu. yd. at this site.

Rationale

This bar, the first below the hatchery, is particularly crucial in permitting transport of bed sediment (gravel and coarse sand) downstream. In view of the small recruitment of new gravel from upstream during these dry years, we consider it especially important that 1) no trenching be allowed at this site, and 2) that the river be kept more confined here in order to allow some fraction of the newly recruited bed material to pass downstream.

Our observations in this reach showed that last year's trench had nearly filled with new gravel. The next trench downstream (Emerson Bar) had only slightly filled, however, suggesting that most of the newly recruited gravel had been retained in the upstream trench. While this may be good for the Guynup bar, it is certainly deleterious for resupply of the bars and bed farther downstream. Hence we recommend against any further trenching here.

We also recommend against excessive flattening and lowering of the Guynup bars, which could lead to channel widening or braiding and retention again of most newly recruited gravel at this site. The objectives of the one-foot vertical offset and the 3%->2% slope change are to maintain flow confinement at low to moderate discharges and to facilitate transport of bed sediment through the reach to supply downstream areas.

Our placement of the outer limit of extraction is designed 1) to preserve the zone of early (3-5 yr) successional riparian vegetation and 2) to leave gravel available for transport at higher flows.

CHRISTIE BAR (EUREKA SAND & GRAVEL; EUREKA READYMIX)

Prescription

We recommend that gravel be extracted in 1992 by a combination of skimming on the lower portion of the bar and a limited pit excavation on the five-year terrace.

Skimming should be conducted according to the following specifications:

a. Gravel removal is to begin one (1) foot in elevation above the water surface as defined in the Pacific Affiliates cross-sections surveyed May 13 1992.

b. The extraction is to grade upslope away from the river at 2% to daylight.

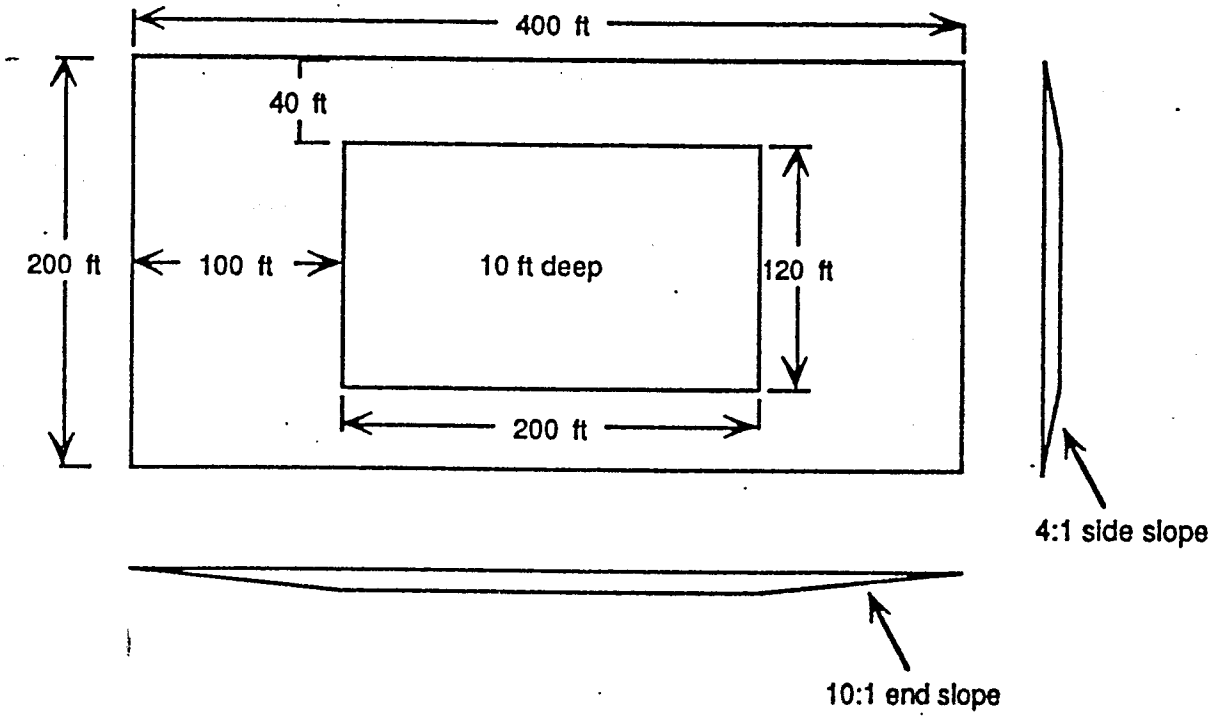
c. The limits of extraction vary from cross-section to cross-section as specified in the table below. These limits refer to the horizontal distance scales shown on the Pacific Affiliates cross-sections of the site. Pacific Affiliates set the zero distance in each cross section at their baseline and scaled

distances away from it in either direction . In order to distinguish the two directions, we indicate distances on the *riverward* side of the baseline as *positive* (+) and those on the *landward* side as *negative* (-)

XS	riverward limit ft	landward limit ft	extraction width ft
0+00	+235	+80	155
6+67	+300	+100	200
13+33	+225	-20	245
20+00	+40	-65	105
22+84	+80	-75	155

The limit of extraction between cross-sections is defined by a smooth curve connecting the extraction limits at the adjoining cross-sections (See Fig. 2).

The pit should be located on the five-year terrace approximately 200 ft NE of station 2+00 on the baseline (see Fig. 2). We recommend a pit 200 ft wide by 400 ft long with a maximum depth of 10 ft oriented as shown in Fig. 2. Our proposed design is shown below:



It is important that the corridor of riparian vegetation on the streamward side of the pit be preserved as shown in Fig. 2.

We carefully selected the pit site so as to avoid 1) significant adverse impacts on wildlife, 2) permanent changes in the landscape, and 3) changes in land use of agricultural areas located on high terraces near the river. This pit will be subject to occasional flooding and is likely to be obliterated by a large (e.g. 20 year) flood.

Our pit design is based on the assumption that the summer water table lies within about six feet of the present bar surface. If the water table is significantly lower than six feet, our design may have to be modified to encourage the growth of wetland vegetation such as cattails and horsetails. If necessary, any member of the scientific team can easily modify the design during excavation.

The gentle side and endslopes of the pit are designed to enable creatures to enter or leave the water body and to enhance the development of a wide band of nearshore wet site riparian vegetation such as cattails and horsetails.

Fine silty overburden should be stockpiled during excavation. To enhance revegetation after ecavation the stockpiled overburden should be spread over disturbed areas adjacent to the pit.

Amount of Extractable Gravel (1992)

We estimate that this prescription will yield approximately 20,000 cubic yards from bar skimming and 9,000 cu. yd. from the pit, for a total of 39,000 cu. yd. at this site.

Rationale

The objective of the 1 foot offset and 2% slope for bar skimming is to provide both channel confinement and transport capacity through the reach while allowing limited deposition in this extremely wide cross-section. Such deposition will ultimately enhance confinement and transport capacity downstream. We recommend against any channel or bar trenching for the same reasons as at the Guynup site: it would intercept too much gravel recruitment from upstream.

We observed partial refilling of last year's trenches at the Christie site. The emptiness of the trenches between the Blue Lake bridge and the Guynup site indicates that this refilling resulted from local redistribution of gravel from the bed and bar upstream, rather than new recruitment.

The Christie bar is very wide and has a substantial area that is flooded only at infrequent (e.g., 5 - 50 yr) intervals. Extracting gravel using a pit on the 5-year terrace (i.e., the surface which is just inundated by the 5-year flood) should not inhibit bedload transport to downstream areas at frequent flood flows. Although the 5-year flood may leave silt and organic debris in the pit, large magnitude flood flows (e.g., the 20-year flood) will rework the entire bar and will refill the pit with merchantable gravel.

Although the proposed pit will destroy some young riparian forest, our pit design will replace it with quality wetland. In any case, the riparian forest at the pit site is low enough on the bar that it is likely that it will be removed by floods before it can grow very old. Because the 5-year terrace will only infrequently be covered with water (once in *any* five-year period on the average), problems of fish entrapment should be minimal.

ESSEX BAR (MERCER-FRASER)

rescription

We recommend that no gravel be extracted from this bar in 1992 due to its proximity to 1) the Humboldt Bay Municipal Water District intakes and 2) the Highway 299 bridge downstream. Both these sites are suffering from marked bed degradation (lowering) and it is important to facilitate gravel recruitment to them.

Amount of Extractable Gravel (1992)

None

Rationale

The amount of gravel available here above the 2% slope needed for transport is minimal. Since the bar is immediately upstream from important sites suffering from significant bed degradation, it is very important that transport be maintained through the reach.

JOHNSON-SPINI BAR (ARCATA READYMIX)

Prescription

We recommend that no gravel be extracted from this site in 1992 due to its proximity to the Highway 299 bridge a short distance upstream.

Amount of Extractable Gravel (1992)

None

Rationale

This bar has already been skimmed flat enough and low enough that there are currently minimal opportunities for further skimming. Trenching is not an option here because of the likelihood that headward migration and scour would further undermine the bridge.

Examination of older (pre-1988) airphotos shows the central bar downstream of the 299 bridge formerly extending under the middle bridge pier, presumably protecting and supporting for the pier. It is important to foster accumulation of gravel under the bridge, and to re-establish the bar.

GENERAL RECOMMENDATIONS

Preparation of Cross-Sections and Site Plans

The work of the scientific team was significantly hampered by the generally inadequate and poor-quality data provided on the geometry of the bars and of proposed extractions. For example, cross-sections commonly: 1) did not cross the entire channel or did not show the channel bed; 2) did not have end points located on the maps; 3) were insufficiently detailed; and 4) were inconsistently oriented or mislabeled, while the cross-section locations and proposed extractions were shown on out-of-date air photos. We spent much time and effort in the field trying to relocate the cross-sections and relate what we could see on the ground to the maps given us. Adequately located and surveyed cross-sections and current photos would have cut our field time by at least 30% and would permit far better estimates of the volume of gravel which can be extracted.

In light of the inadequacies and inconsistencies of the current data, we recommend that, in the future, *all* cross-sections and maps submitted by gravel extractors on the Mad River meet the following specifications:

a. Cross-sections to extend completely across the river channel and to terminate on banks with mature riparian vegetation (e.g., 10-15 year old alders.)

b. Cross-sections to include the river bottom (especially location of the thalweg) as well as the water surface. Water surface elevation alone is insufficient; the bed *must* be included!

c. All site maps to be prepared on the most recent (preferably post-extraction) air photo base. A current photo base is essential!

d. Cross-section endpoints and tie points to be clearly monumented and labeled in the field and accurately located on current airphotos and maps. A common color of flagging to be used to mark cross-sections at all sites.

e. Cross-sections for planning extractions to be surveyed in late May of the year in which extraction is proposed.

f. Cross-sections to be resurveyed from the same endpoints each year and the previous year's cross-section to be superimposed on the current one. New cross-sections to be added as necessary as the river's course shifts, and to be oriented approximately normal to the channel.

g. Cross-sections at all sites to be plotted at the same simple, usable vertical and horizontal scales. We suggest a horizontal scale of 1 inch = 50 feet and a vertical scale of 1 inch = 5 feet.

h. Cross-sections to be surveyed and drafted consistently so that the right bank (RB) of the river as you face downstream is at the right side of the drafted cross-section.

i. Zero (0) distance in cross-sections to be at the left (LB) endpoint as you face downstream.

j. Cross-sections to be tied to a common vertical and horizontal control datum among all extraction sites.

In addition, we urge that cross-sections be required across the upstream and downstream limits of each extraction reach.

Future Monitoring

Cross-sections have traditionally been prescribed for monitoring changes in channel morphology. However, recent advances in surveying technology have made three-dimensional channel surveys with a tal station a superior monitoring tool. Use of a total station would:

1) provide a much better representation of bed and bar morphology;
2) allow quick and accurate assessment of extraction and replenishment volumes
3) reduce costs over traditional cross-section surveying.

Because of the downstream interconnection between bars, we strongly recommend that the entire channel be surveyed, not just whatever bars happen to be undergoing extraction at the time. Only by monitoring both active and inactive bars can the routing of bed material downstream be addressed and the successes or shortcomings of prescrptions be assessed.

References Cited

Brown, William M. III, 1973, Sediment transport, turbidity, channel configuration, and possible effects of impoundment of the Mad River, Humboldt County, California: *U.S. Geological Survey Water Resources Investigations 26-75*, 63 p.

ATTACHMENT !

STATE OF CALIFORNIA—THE RESOURCES AGENCY

PETE WILSON, Governor

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
P.O. BOX 944209
[illegible]AMENTO, CA 94244-2090
[illegible]6) 225-2363

June 12, 1992

Mr. Randy Klein
Consultant
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Dr. Andre Lehre
Humboldt State University
2335 Grace Avenue
McKinleyville, California 95521

Dr. Doug Jager
Humboldt State University
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Trinidad, California 95570

Dr. Bill Trush
Humboldt State University
Arcata, California 95521

Dear Mr. Klein and Drs. Lehre, Jaeger, and Trush:

Potential for Gravel Extraction on the Mad River in 1992

It is my understanding that you have all been contacted by Mr. Tom Conlon, Humboldt County Planning Director, and have agreed to participate as members of the scientific team for assessing the potential for environmentally safe gravel extraction on the Mad River in 1992. As co-chairman of the task force charged with the establishment of a Memorandum of Understanding (MOU) between the Resources Agency, State Lands Commission, Humboldt County, California Department of Fish and Game, and the gravel operators on the Mad River, I want to thank you for your willingness to participate in this process.

I understand that you will meet soon and discuss the protocol and scheduling for your task. On behalf of Ms. Bonnie Neely and myself as co-chairs of the technical committee, I want to be sure you are apprised of the objectives that were agreed upon by the various agencies and other representatives at the May 22, 1992 meeting in Eureka.

The primary question that needs to be addressed is -- how much, if any, gravel could be extracted from sites with all the necessary county permits on the Mad River in 1992 without resulting in significant adverse enrionmental impact in the near term and without long-term damage to the natural resources of this river system? This assessment should also include recommendations for methods of extraction and methods, sites, and amounts of gravel that need to be maintained in the river to begin the restoration process.

Priority should be given to the sites of Arcata Readimix, Eureka Sand and Gravel, Mercer Fraser, and Mad River Sand and Gravel companies, which are currently the operations with the necessary legal entitlements except for required agreements under Section 1603 of the Fish and Game Code.

Potential gravel extraction sites should also be assessed in the same manner on four Redwood Empire Aggregates' parcels which do not currently have the necessary county permits. The Department of Fish and Game and the Resources Agency may agree to consider, as part of the proposed MOU, a conditional one-season permit and reclamation plan for Redwood Empire Aggregates' sites provided the county completes an adequate CEQA document and agrees to complete an EIR for all gravel extraction on the Mad River prior to the 1993 gravel extraction season.

Your assessment should embrace the concerns of all agencies and special service districts. These concerns are:

1) Fish spawning and rearing habitat and maintenance of an adequate fish passage.

2) Degradation of the Mad River at the Mad River Hatchery weir.

3) Degradation of the streambed near or so as to affect adversely the Highway 101, Highway 299, Railroad and Blue Lake Boulevard bridges.

4) Streambed degradation and water surface elevation at the Humboldt Bay Municipal Water District's Ranney well collector and direct river diversion.

5) Impact to riparian vegetation from lowered water surface elevations.

6) Recruitment potential to downstream areas.

7) Bank failure, riparian loss, and increases of instream sedimentation.

We appreciate your acceptance of this challenging task, and we believe that you are collectively the most qualified team to make this assessment and submit recommendations to the decision making agencies. Please conduct your field assessment and provide us your recommendations as soon as possible.

Please contact me if you have any questions. My address is Department of Fish and Game, 601 Locust, Redding, California 96001, telephone (916) 225-2363.

Sincerely,

Banky E. Curtis
Regional Manager
Region 1

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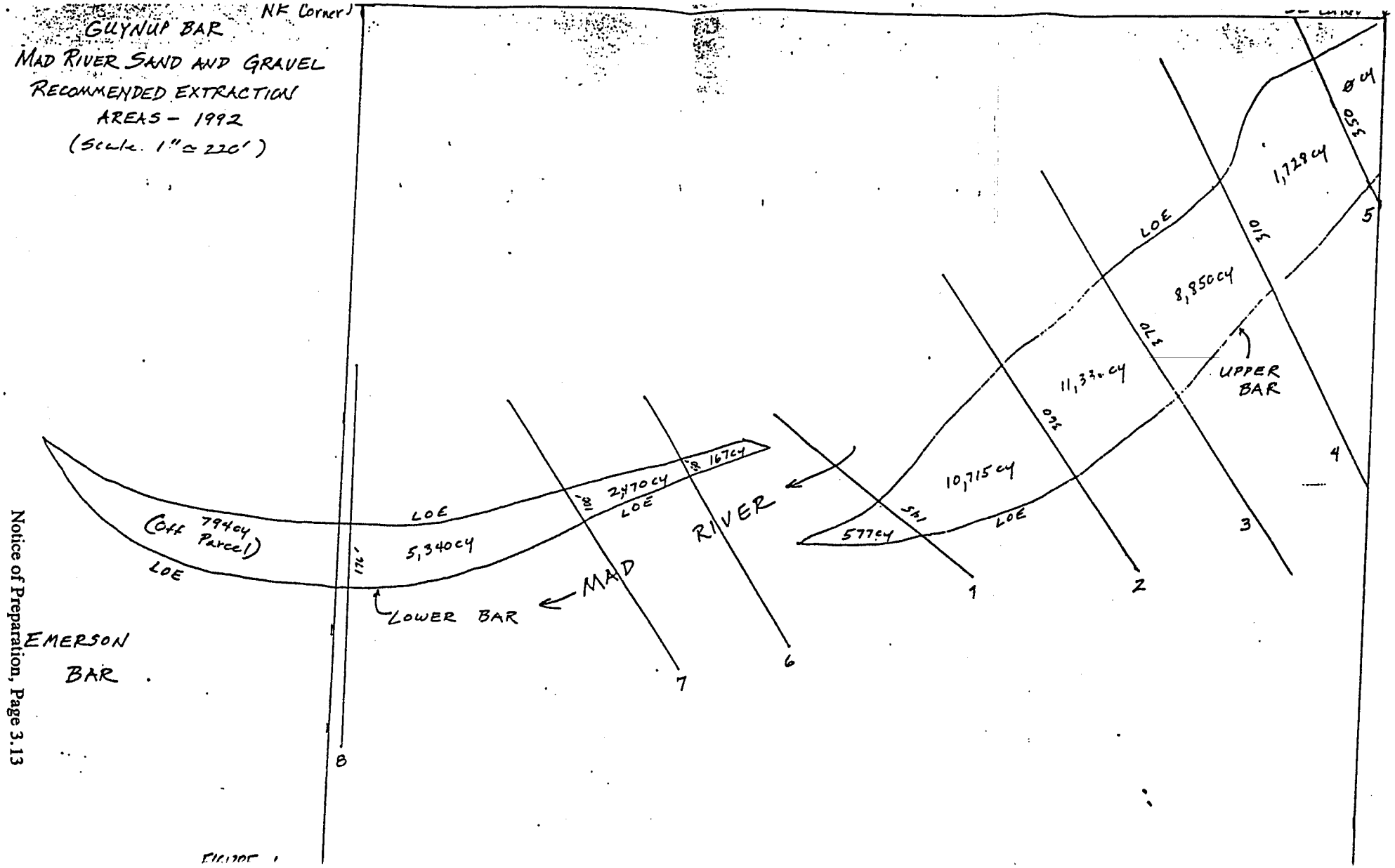
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GUYNUP BAR
MAD RIVER SAND AND GRAVEL
RECOMMENDED EXTRACTION
AREAS – 1992
(Scale 1" = 220')
NE Corner
LOE
(Off Parcel)
7940 CY
5,340 CY
2,470 CY
1,167 CY
10,715 CY
11,330 CY
8,850 CY
1,728 CY
577 CY
LOWER BAR
UPPER BAR
MAD RIVER
EMERSON BAR
1
2
3
4
5
6
7
8

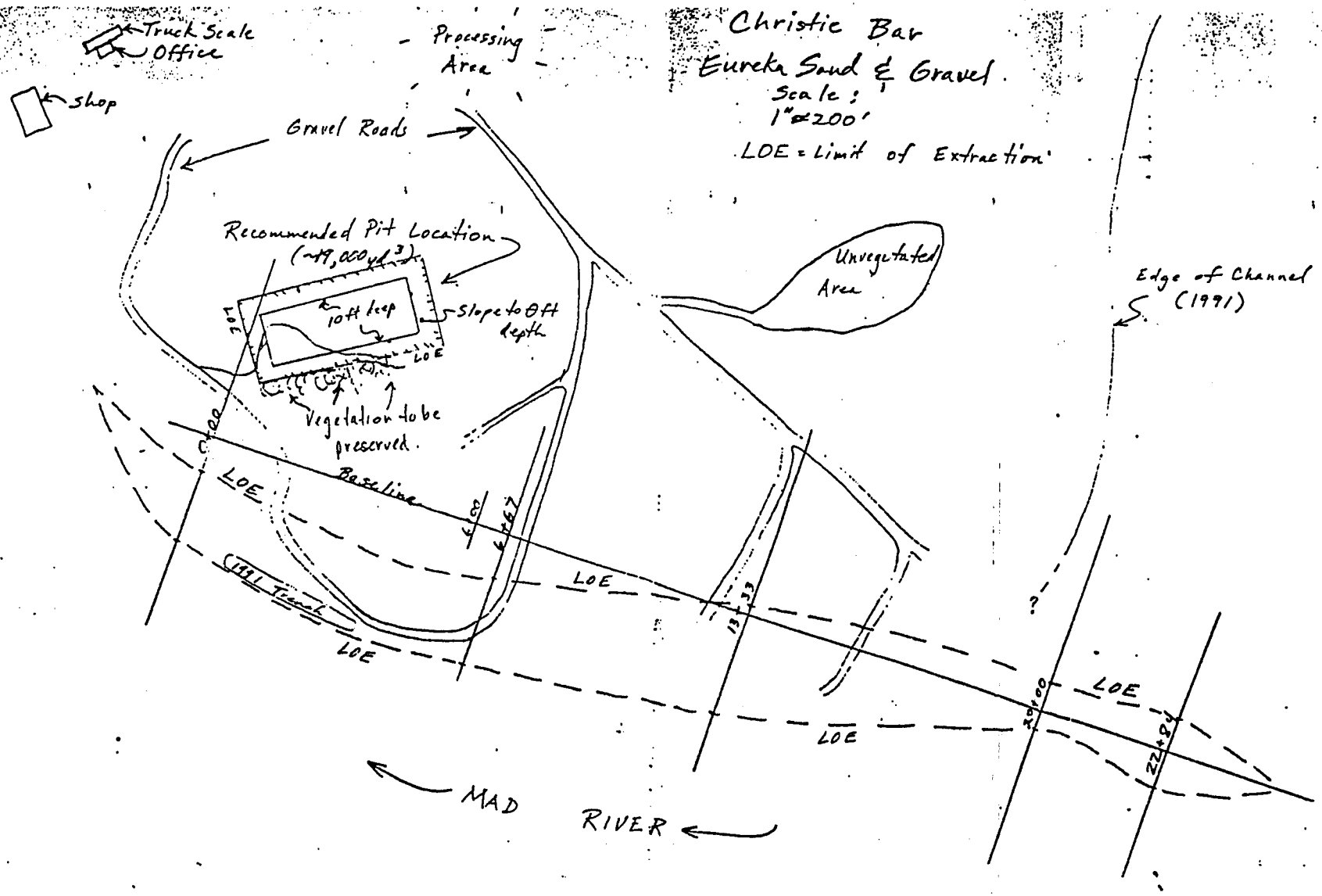


FIGURE 2

NOTE: 1991 photo enlargements borrowed from

GRAVEL EXTRACTION TECHNICAL COMMITTEE

REPORT OF THE SCIENTIFIC TEAM

ADDENDUM: RECOMMENDATIONS FOR ADDITIONAL BARS

Doug Jager
Randy Klein
Andre Lehre

14 July 1992

INTRODUCTION

This report is an addendum to our original report of 23 June 1992 and covers the four REA bars (Emmerson, Blue Lake, Johnson, and Graham bars) which we were asked to address in Banky Curtis' letter of 12 June 1992 . We were given the necessary current maps and cross-sections of the sites on 13 July and conducted our field investigation that afternoon.

The team spent 0.5 days together in the field investigating the REA gravel extraction sites and developing prescriptions. Due to other committments, Bill Trush was unable to go out in the field with the group or participate in the development of the report. In addition, Randy Klein calculated our proposed extraction volumes from the cross-sections, maps, and airphotos, while Andre Lehre wrote this report.

This report covers only our prescriptions for the four REA bars. For details on the bed degradation problem, our methodology, and the general basis for our recommendations, the reader should refer to our original report.

SITE-SPECIFIC RECOMMENDATIONS FOR PERMITTED REA BARS

These site-specific recommendations are only for the four currently permitted REA bars. Please note that these recommendations are specifically for 1992 and were made under the assumption that the coming water year will be no wetter than the past few have been. This is a reasonable and conservative assumption, as dry years tend to occur in groups. If water year 1993 is much wetter and leads to substantial recruitment of new gravel, our prescriptions in the following year would change.

EMMERSON BAR (REDWOOD EMPIRE AGGREGATES)

Prescription

We recommend that gravel be extracted in 1992 by bar skimming according to the following specifications:

a. Gravel removal is to begin at the riverward limit shown on the Pacific Affiliates cross-sections (undated; photo date 4-1-92).

b. The extraction is to grade upslope away from the river at 3% to daylight or to our limit of extraction (see c below), whichever comes first.

c. The limits of extraction vary from cross-section to cross-section as specified in the table below. These limits refer to the horizontal distance scales shown on the Pacific Affiliates cross-sections.

XS	riverward limit ft	landward limit ft	extraction width ft
1+00	none	none	0
6+00	none	none	0
11+00	340	235	105
15+00	370	305	65
18+38	385	175	210
23+00 LB bar	190	15	175
23+00 RB bar	none	none	0
27+00	315	500	185
30+00	480	660	180

The limit of extraction *between* cross-sections on each bar is defined by a smooth curve connecting the extraction limits at the adjoining cross-sections (See Fig. 3).

Amount of Extractable Gravel (1992)

We estimate that this prescription will yield approximately 7000 cubic yards on the downstream left bank bar and 3000 cu. yd. on the upstream right bank bar, for a total of 10,000 cu. yd. at this site. Note that 1000 cu. yd. on the right bank (upstream) bar was included in our estimate for the Guynup bar in our previous report (see p.5 of that report) and should not be double-counted. We revised our estimate upward based on the newly supplied cross-sections.

Rationale

This bar, the second below the hatchery, is quite important in allowing transport of bed sediment (gravel and coarse sand) downstream. In view of the small recruitment of new gravel from upstream during these dry years, we consider it especially important that 1) no trenching be allowed at this site, and 2) that the river be kept more confined here in order to allow some fraction of the newly recruited bed material to pass downstream.

Our observations in this reach showed that last year's trench had only slightly filled with gravel, suggesting that most of the newly recruited gravel had been retained in the Guynup trench upstream. Hence we recommend against any further trenching here.

We also recommend against excessive flattening and lowering of the Emmerson bars, which could lead to channel widening or braiding and retention of most newly recruited gravel at this site. The objectives of the riverward extraction limit and the 3% slope are to maintain flow confinement at low to moderate discharges and to facilitate transport of bed sediment through the reach to supply downstream areas.

Our placement of the landward limit of extraction is designed 1) to preserve the zone of early (3-5 yr) successional riparian vegetation and 2) to leave gravel available for transport at higher flows.

Because the left bank (LB) bar lies immediately upstream from the Blue Lake bridge which has experienced an average bed lowering of about 1.6 ft since 1982 (and a maximum point lowering of 4.5 ft), it is particularly important to 1) encourage transport through the reach and 2) to leave gravel available for transport at higher flows.

BLUE LAKE BAR (REDWOOD EMPIRE AGGREGATES)

Prescription

We recommend that gravel be extracted in 1992 by a combination of skimming on the lower portion of the bar and a limited pit excavation on the three to five-year terrace.

Skimming should be conducted according to the following specifications:

a. Gravel removal is to begin one (1) foot in elevation above the water surface as defined in the Pacific Affiliates cross-sections (undated; photo date 4-1-92).

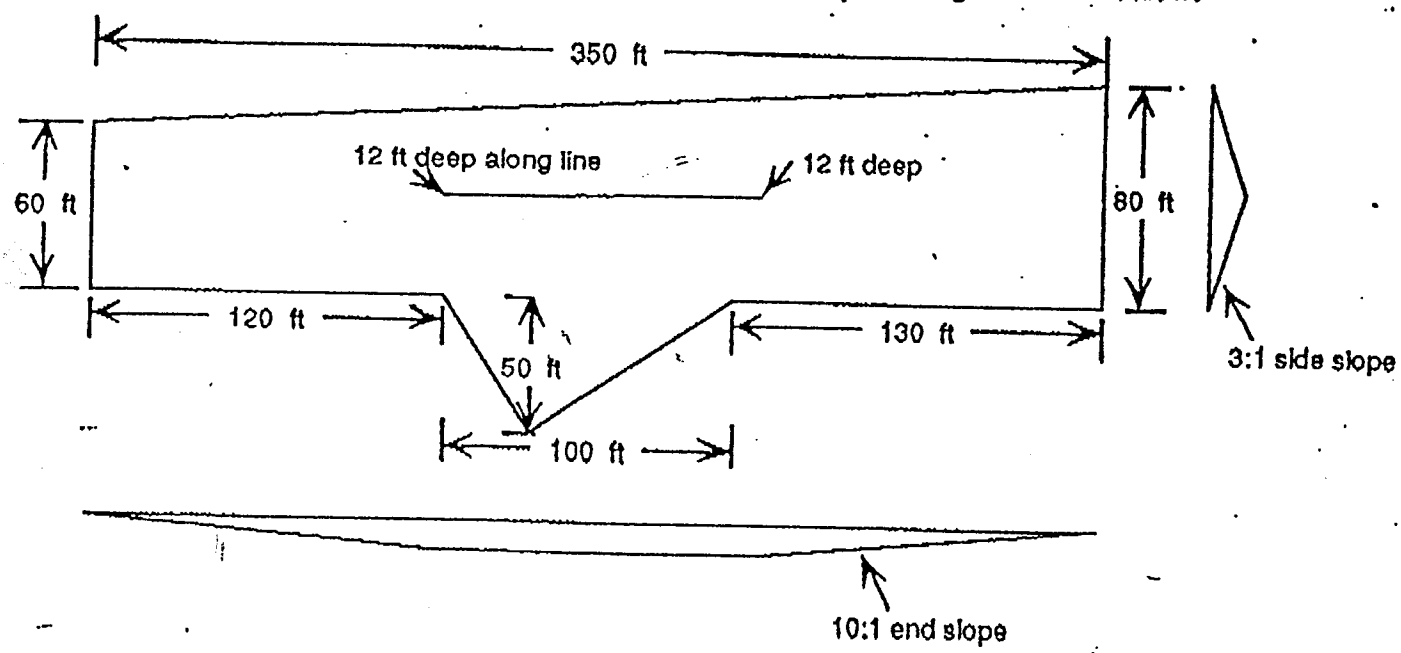
b. The extraction is to grade upslope away from the river at 2% to daylight.

c. The limits of extraction vary from cross-section to cross-section as specified in the table below. These limits refer to the horizontal distance scales shown on the Pacific Affiliates cross-sections of the site.

XS	riverward limit ft	landward limit ft	extraction width ft
0+00	0	0	0
10+00	195	375	180
20+00	445	640	195
30+00	385	480	95
38+00	none	none	0
42+00	none	none	0

The limit of extraction between cross-sections is defined by a smooth curve connecting the extraction limits at the adjoining cross-sections (See Fig. 4).

The pit should be located on the three to five-year terrace approximately 100 ft NW of the north end of cross-section 20+00 (see Fig. 4). We recommend a pit averaging 70 ft wide by 350 ft long with a maximum depth of 12 ft oriented as shown in Fig. 4 Our proposed design is shown below:



It is important that the corridor of riparian vegetation on the streamward side of the pit be preserved as shown in Fig. 4.

We carefully selected the pit site so as to avoid 1) significant adverse impacts on wildlife, 2) permanent changes in the landscape, and 3) changes in land use of agricultural areas located on high terraces near the river. This pit will be subject to occasional flooding and is likely to be obliterated by a large (e.g. 20 year) flood.

Our pit design is based on the assumption that the summer water table lies within about seven feet of the present bar surface. If the water table is significantly lower than seven feet, our design may have to be modified to encourage the growth of wetland vegetation such as cattails and horsetails. If necessary, any member of the scientific team can easily modify the design during excavation.

The gentle side and endslopes of the pit are designed to enable creatures to enter or leave the water body to enhance the development of a wide band of nearshore wet site riparian vegetation such as cattails and horsetails.

Fine silty overburden should be stockpiled during excavation. To enhance revegetation after excavation the stockpiled overburden should be spread over disturbed areas adjacent to the pit.

Amount of Extractable Gravel (1992)

We estimate that this prescription will yield approximately 20,000 cubic yards from bar skimming and 4000 cu. yd. from the pit, for a total of 24,000 cu. yd. at this site.

Rationale

The objective of the 1 foot offset and 2% slope for bar skimming is to provide both channel confinement and transport capacity through the reach while allowing limited deposition in this extremely wide cross-section. Such deposition will ultimately enhance confinement and transport capacity downstream. We recommend against any channel or bar trenching for the same reasons as at the Guynup site: it would intercept too much gravel recruitment from upstream.

We observed slight refilling of last year's trenches at the Blue Lake site. The emptiness of the trenches at the Emmerson site indicates that this refilling resulted from local redistribution of gravel from the bed and bar upstream, rather than new recruitment.

The Blue Lake bar is very wide and has a substantial area that is flooded only at infrequent (e.g., 5 - 50 yr) intervals. Extracting gravel using a pit on the 3 to 5-year terrace (i.e., the surface which is just inundated by the 3 to 5-year flood) should not inhibit bedload transport to downstream areas at frequent flood flows. Although the 5-year flood may leave silt and organic debris in the pit, large magnitude flood flows (e.g., the 20-year flood) will rework the entire bar and will refill the pit with merchantable gravel.

The proposed pit lies in a currently barren area at the back of the bar. Our pit design will replace it with quality wetland. Because the 3 to 5-year terrace will only infrequently be covered with water (once in *any* three to five-year period on the average), problems of fish entrapment should be minimal.

JOHNSON BAR (REDWOOD EMPIRE AGGREGATES)

Prescription

We recommend that no gravel be extracted from this bar in 1992 due to its proximity to 1) the railway bridge and 2) the Humboldt Bay Municipal Water District intakes downstream. Both these sites are suffering from marked bed degradation (lowering) and it is important to facilitate gravel recruitment to them.

Amount of Extractable Gravel (1992)

None

Rationale

The amount of gravel available here above the 2% slope needed for transport is minimal. Since the bar is immediately upstream from important sites which are suffering from significant bed degradation, it is very important that transport be maintained through the reach.

GRAHAM BAR (REDWOOD EMPIRE AGGREGATES)

Prescription

We recommend that no gravel be extracted from this site in 1992 due to its proximity to the Highway 101 bridge a short distance downstream.

Amount of Extractable Gravel (1992)

None

Rationale

This site is immediately upstream of the Highway 101 bridge which, according to CalTrans, is hreatened by significant bed degradation. Any removal of gravel in a site so near the bridge may exacerbate the situation. Gravel accumulation in the reach should be encouraged.

GENERAL COMMENT ON EXTRACTION VOLUMES

Our estimates of the extractable gravel volumes at the Emmerson and Blue Lake bars are based on the cross-sections and maps we were provided by Pacific Affiliates. We are uncertain as to the correctness of these documents, however. Specifically:

1) On both maps, the positions of the cross-sections along the baseline as drafted were not consistent with the map scale of 1 in = 400 ft. That is, the distances between the cross-sections as shown on the map are not consistent with the surveyed distances based on the station numbers. To the extent that these positions are incorrect, our volume estimates will be incorrect.

2) The lengths of the cross-sections as drafted on the map are not consistent with the lengths as shown in the cross-sections. We extended the cross-sections based on the map scale using the water's edge as a common reference point.

3) Some water surfaces shown on the plots seemed to be lower than we observed in the field, and on several cross-sections the water surface sloped significantly from one bank to the other when it should have been more nearly flat. Thus we are uncertain as to what the true water surface elevation was. When there were ambiguities, we chose the more conservative estimate (higher water surface elevation) which, of course, yields less gravel.

4) The base line (the line connecting the cross-sections on the map) was not shown in any of the cross-sections, making it difficult to locate the limits of extraction on the map. It also made locating in the field more difficult.

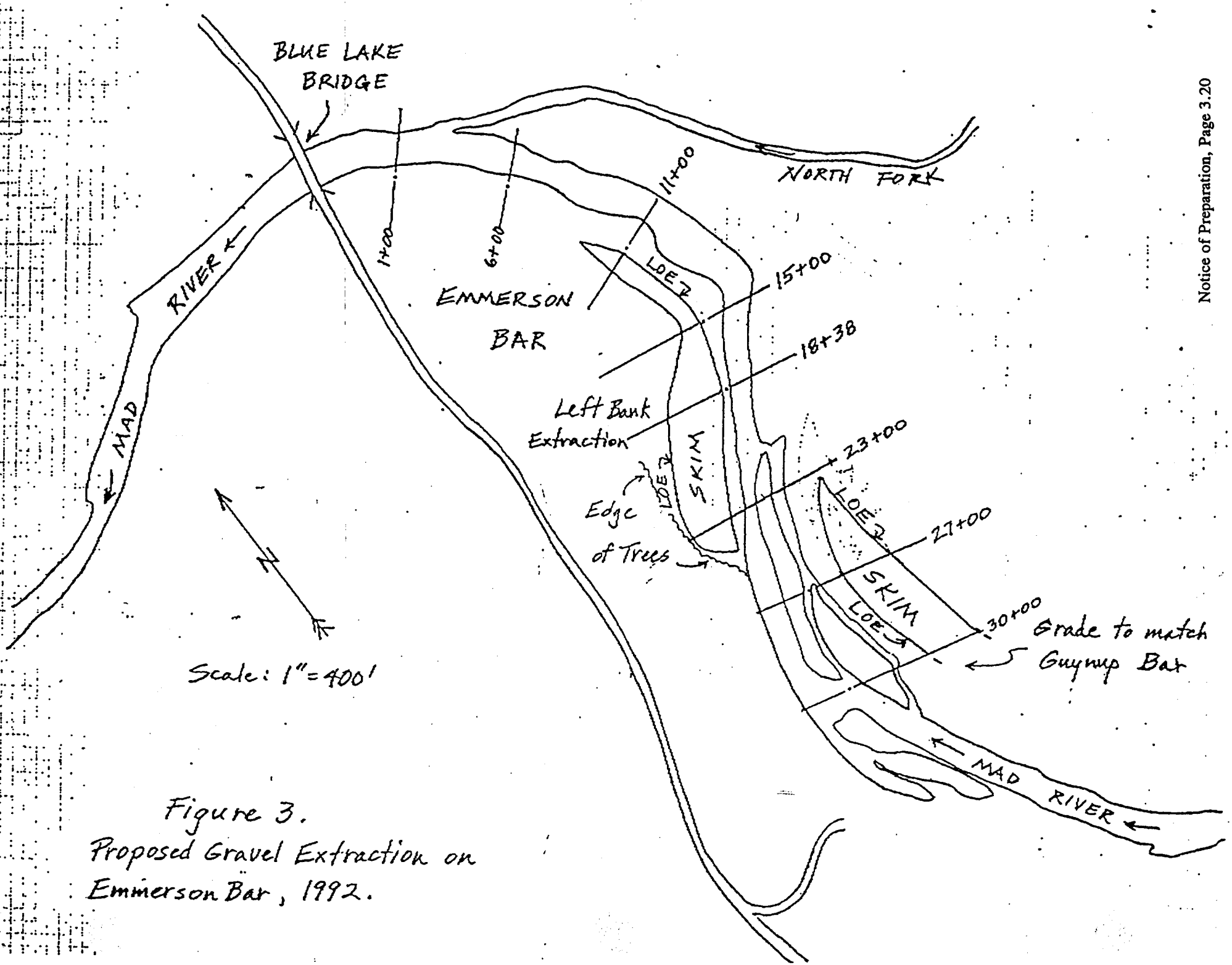


Figure 3.
Proposed Gravel Extraction on Emmerson Bar, 1992.

Notice of Preparation Page 32

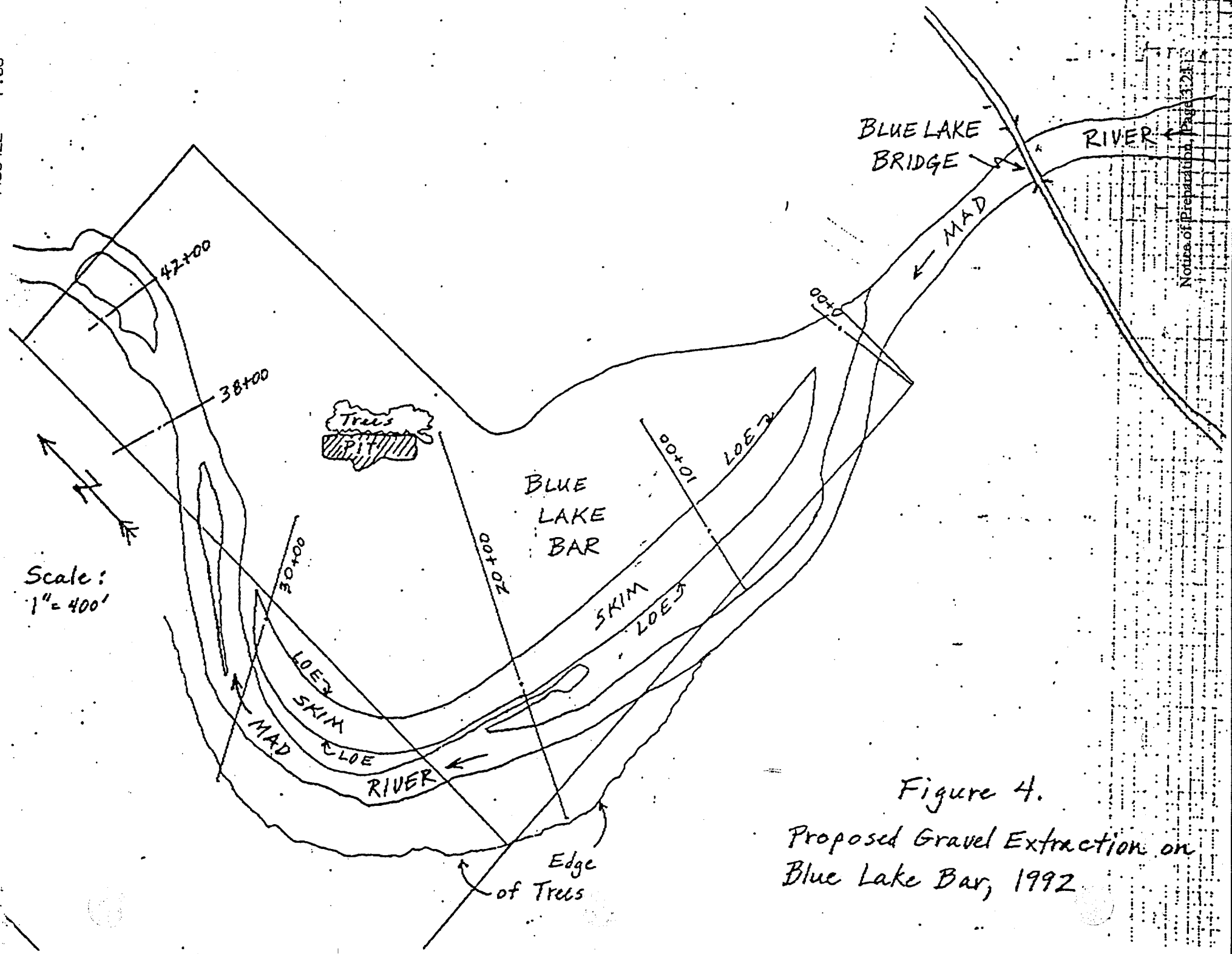


Figure 4.
Proposed Gravel Extraction on Blue Lake Bar, 1992

Appendix M

John Henry Grobey
Consultants Report

THE ECONOMIC IMPACT OF RIVERBED GRAVEL MINING IN HUMBOLDT COUNTY

By John H. Grobey, Ph. D.
April 10, 1993

INTRODUCTION.

Gravel mining operations have had, and will continue to have, substantial effects on the Humboldt County economy. It provides an input of vital and perhaps indispensable importance to a number of key activities in the construction industry. Construction sand and gravel provide the necessary ingredient in foundation construction and other stabilization requirements in road construction, maintenance and repair. Concrete blocks and bricks, asphaltic concrete aggregates and other bituminous mixtures cannot be prepared without these inputs. Other important uses include fill materials, snow and ice control, and railroad-grade ballast. The importance of these uses is out of all proportion to the modest market values and regional cash flows generated by this sector of the economy.[1] Questions about the economic significance of this industry may be addressed by asking what would happen to the economy if gravel mining were brought to a complete halt. It is hard to imagine what substitute material might be used, or where it could be obtained as cheaply. Many economic activities would simply cease. The significance of this industry might be likened to the proverbial horseshoe nail.

The presentation of the following economic analysis does not rest on such a drastic scenario as the shut down of the industry, but rather on marginal changes in the volume and value of industry ouput. The unit cost of sand and gravel has increased sharply in the past several years due to regulatory constraints on riverbed mining operations. Unfortunately, there is no easy way to estimate the value to the economic base of the county's economy of assets that were NOT constructed due to reduction in the quantity demanded of gravel and sand inputs in response to the increases in their prices. While total county production of sand and gravel is not yet known for 1991 and 1992, Mad River production levels fell by 43 percent from 1991 to 1992. If this figure is indicative of what happened to total county production, it can be stated that such a reduction must have been attended by the curtailment of some projects requiring sand and gravel inputs.

But one cannot engage in economic analysis of events that did not happen unless those events that would have happened barring a particular circumstance can be identified. These effects are termed "forward-linked" effects, and are not typically treated in regional economic impact analyses. These effects are arguably more important than the analysis of "backward-linked" effects of an industry's activity, but the difficulty of measuring them precludes their inclusion in the analysis except anecdotally, as in the present case. Perhaps an example will help to illustrate the significance of this class of issues and the difficulty of including them in the analysis. One could ask Simpson Investment Company officials if they would have retro-fitted and upgraded their pulp mill instead of shutting it down had it not been for the sharp increase in the price of concrete. It is obviously difficult to answer the question of whether the price of concrete was a decisive factor in the decision to shut down the mill. While it was probably not, another example easier to determine would be to estimate the reduction in maintenance and repairs on county roads out of a fixed budget due to the increased price. These sorts of

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[1] See California Minerals Yearbook--1988, page 97.

hypothetical questions would have to be repeated for many other possible events, and the answers one could define from them would cast the precision of the analysis in serious doubt. For that reason, most economic impact analyses therefore do not attempt to account for them, focussing instead on backward-linked effects which are relatively easily accessable to the analysis. While this study is no exception to the general rule, I believe it important at least to make mention of the class of events excluded from the analysis.

THE APPROACH OF THIS STUDY

I have employed an existing 1985 Input-Output model originally developed by the University of Minnesota at St. Paul and the U. S. Forest Service Research Laboratory at Fort Collins, Colorado, in cooperation with the U. S. Bureau of Economic Analysis, of the Department of Commerce. This model is known as the IMPLAN model. I adapted the model to the county's economy and the task at hand; namely, to estimate the backward-linked effects of changes in the output of the gravel mining industry.

Analysis of backward-linked impacts is performed by asking how change in final demand for the output of the industry in question (the direct impact) will indirectly affect those industries which supply it with necessary inputs (the first-round indirect impact). These first-round effects feed back through the interindustry structure many times, generating additional indirect impacts. In doing so, household income levels are also affected, and thus, consumption spending is also impacted. These latter effects are called induced impacts. The model employed aggregates the economy of the county into 45 sectors, which is sufficiently detailed for the purpose of the study. A complete list of IMPLAN sector numbers, names, and their corresponding Bureau of Economic Analysis commodity numbers, and Standard Industrial Classification Codes are listed in the Appendix. Standard Input-Output techniques are employed to perform the analysis.[2] Several comments are in order.

First, Input-Output models were developed to analyze demand-side disturbances, and their use in analyzing changes in supply rather than demand requires that the analysis be transformed into an "equivalent change in demand". This, however, must not be allowed to obscure the fact that no demand change has taken place. Further, Input-Output models assume that no change in the vector of industry prices takes place, basically implying infinitely elastic supply functions, when that is clearly not the case. Appropriate adjustments must be made to the analysis to account for these difficulties. For example, to the extent that supply constraints involve increases in the unit price of the output, a smaller change in physical output would generate a particular change in gross receipts. Such a price change would also generate changes in interindustry demand, involving forward-linked effects already noted above as not examined here except anecdotally. Appropriate adjustments have been made in the analysis that follows.

I used the model to address the question of what would happen if the 1985 output of the industry had changed by one million 1985 dollars, based on prices prevailing at the time (estimated at about $5 per cubic yard, river run, delivered to an average haul distance). This would involve, in other words a change (in either direction) of output of about 200,000 cubic yards in 1985. It is to be noted that at current prices, it would take a change of only about 69,000

[2]A thorough description of I/O techniques is beyond the scope of this study. The reader may wish to consult a standard reference work on the subject such as, Miernyk, William H. 1965. The Elements of Input-Output Analysis. Random House. New York.

cubic yards to generate the same million dollar change in gross sales. Direct employment effects of output-level changes are based on physical output per man-year. Since the change in physical output required to change gross receipts by a similar amount is smaller now than in 1985, the direct employment effects would be proportionally smaller. But another way to look at it is that the gross value of output per worker has gone up substantially in step with the price increases, so that an equivalent physical output change would generate nearly three times the change in gross sales. Of course, the price increase reduces quantity demanded, so that physical output will be substantially smaller. The demand for some uses of sand and gravel is elastic, while other uses have relatively inelastic demand. Inelastic demand means that the percent reduction in the quantity demanded is smaller than the percent increase in the price.

The price increase is a reflection of much-elevated regulatory costs, and the higher unit costs of extracting an equivalent volume of gravel during the reduced window of time for mining operations under current regulatory practices. Compression of the time to mine a year's supply has necessitated the use of more capital equipment, larger storage capacity, and more labor during that limited period. One operator, Bill O'Neill of Arcata Readimix reported in response to my telephone survey that his annual costs as of April 1, 1993 had risen byalmost $405,000 as a direct result of newly imposed regulations. These costs are partly reflected in the higher prices, but are also partly absorbed, resulting in lower yields on invested capital and land rent.

HUMBOLDT COUNTY GRAVEL PRODUCTION, GROSS VALUE, AND PRICES

Table I lists industry production levels, values, and prices per cubic yard for the period 1975 to 1992. Production levels are given for The Mad River and for the County as a whole. Some of the production figures are based on estimates that I would characterize as pretty rough. Mad River figures are probably more reliable, but even these figures may contain significant errors. The figures for the county as a whole are less reliable. This was clear from inspection of the data, which indicated that for some years, production for the county was less than the Mad River component. In such cases, I substituted estimates for the county based on the application of the average ratio of county to Mad River production. But I have little confidence either in these production estimates or in the estimates of unit prices found by dividing gross value by total production. The gross value figures are, for the most part, not very reliable either. I did a quick telephone survey of three firms, asking them for their best estimates of average delivered prices over time. I believe these price estimates are more reliable than those listed, found by dividing gross sales by total production. While I could have "backed-out" estimates of gross production by dividing these prices into gross values, I did not have sufficient confidence in the gross value estimates to make the exercise worthwhile. I believe the 1985 data, on which basis the Input-Output model was constructed are reasonably reliable since they were compiled by the Bureau of Economic Analysis from their County Business Patterns database.

Table II shows a summary of selected Input-Output information, for the industry including:

- Base year information
- Base year coefficients
- Multipliers for the sand and gravel mining industry

Type I and Type III multipliers are given for ouput, personal income, total income, value added, and employment. Type I multipliers account for direct and indirect impacts, while induced

effects are added as well in the Type III multipliers. Type I multipliers, for example, are computed by summing the direct and indirect impacts and dividing them by the direct impacts. Table III presents the impacts of a one-million dollar change in 1985 output of the industry on employee compensation, property income, total income, value added, and employment. Direct, indirect, induced, and total impacts are given. These figures could be determined by applying the type I and Type III multipliers to the direct impacts. They were compiled here from the detailed tables derived from the I-O model (Tables IV, V, and VI). These latter tables enable one to identify the other sectors of the economy impacted by the change in output of the gravel industry.

Industry and Commodity Balance Sheets are included in an appendix which give even more detailed information about the industry. The reader may find it necessary to consult the glossary in order to interpret the data in the balance sheets. Also included in the appendix is the aforementioned list of industries, BEA commodities, and associated SIC codes.

TABLE 1

HUMBOLDT COUNTY GRAVEL PRODUCTION, 1975-1992					
YEAR	MAD RIVER CUYDS (000)	COUNTY TOTAL (000)	GROSS VALUE ($x1000)	AVERAGE PRICE PER CU. YD. (CURRENT $)	PRICE ESTIMATE BASIS
1975	498.8	749	2173	2.90	G. V./COUNTY TOTAL
1976	513.5	1037.3EST	NA	NA	NA
1977	505.9	1021.9EST	NA	NA	NA
1978	523.5	845.2	2136	2.53	G. V./COUNTY TOTAL
1979	372.7	825.4	2094	2.54	G. V./COUNTY TOTAL
1980	358.6	1075.2	3119	2.90	G. V./COUNTY TOTAL
1981	281.1	567.8EST	NA	NA	$6 SURVEY
1982	252.9	395.8	1081	2.73	G. V./COUNTY TOTAL
1983	193.7	391.2EST	NA	NA	$6.50 SURVEY
1984	253.3	514.8	1152	2.24NR	G. V./COUNTY TOTAL
1985	327.1	660.7EST	3327.5 BEA	5.04	G. V./COUNTY TOTAL
1986	284.2	680.4	2172	3.19NR	G. V./COUNTY TOTAL
1987	302.3	610.6EST	NA	NA	$8.00 SURVEY
1988	293.3	635.6	2878	4.53	G. V./COUNTY TOTAL
1989	339.3	685.4EST	4194	6.12	G. V./COUNTY TOTAL
1990	348.4	746.4	NA	NA	$10.00 SURVEY
1991	268.4	NA	NA	NA	$10.00 SURVEY
1992	152.6	NA	NA	$13.50SUR	TEL SURVEY
1993	NA	NA	NA	$14.5SUR	TEL SURVEY
NOTES:	(1)EST Based on applying average ratio of county total to Mad River				
	(2)NA= Not Available				
	(3) NR=Author deems Not Reliable				
	(4) BEA=U. S. Bureau of Economic Analysis			Regional Econ. Info. System	
Sources:	(1)Compiled by Randy Klein from California Board of Mining & Geology				
	together with some estimates made by Lane Davis of Pacific Affiliates				

TABLE II

HUMBOLDT COUNTY SAND & GRAVEL MINING INDUSTRY: INPUT-OUTPUT INFORMATION SUMMARY							
ITEM	ECONOMIC IMPACT ANALYSIS 1985 DOLLARS IN MILLIONS			IMPLAN REPORT MID.901A			
	Base Year Final Demand	Base Year TIO	Employee Comp Inc.	Property Income	Total PoW Income	Total Value Added	Employment No. of Jobs
BASE YEAR INFORMATION-198	3.3275	1.773	0.65	0.3902	1.0402	1.078	19
	ECONOMIC IMPACT ANALYSIS 1985 DOLLARS IN MILLIONS			IMPLAN REPORT MID.901B			
	Base Year Final Demand	Base Year TIO	Employee Comp Coefficient (Income/MM$)	Property Inc Coefficient (Income/MM$)	Total Income Coefficient (Income/MM$)	Value Addec Coefficient (V.A./MM$)	Employment Coefficient (No.Jobs/MM$)
BASE YEAR COEFFICIENTS	3.327	1.7732	0.3666	0.22	0.5866	0.6077	10.715

HUMBOLDT COUNTY SAND & GRAVEL MINING INDUSTRY MULTIPLIERS						
MULTIPLIER TYPE	DIRECT	INDIRECT	INDUCED	TOTAL	TYPE I	TYPE III
OUTPUT	1	0.12509	0.23901	1.3641	1.12509	1.3641
PERSONAL INCOME	0.3666	0.0419	0.0852	0.4937	1.1142	1.3467
TOTAL INCOME	0.5866	0.0699	0.1352	0.7918	1.1192	1.3497
VALUE ADDED	0.6077	0.0786	0.15	0.8362	1.1293	1.3761
EMPLOYMENT	10.715	1.9717	4.3296	17.0163	1.184	1.5881

TABLE III

IMPACT ON THE HUMBOLDT COUNTY ECONOMY OF A ONE-MILLION $ CHA IN THE OUTPUT OF THE GRAVEL MINING INDUSTRY--1985 DOLLARS							
TOTALS BY TYPE	Final Demand (MM$)	Industry Output (MM$)	Employee Income (MM$)	Property Income (MM$)	Total PoW Income (MM$)	Total Value Added (MM$)	Employment Number of Jobs)
direct	1	1	0.3666	0.22	0.5866	0.6077	10.71
indirect	0	0.1251	0.0419	0.0281	0.0699	0.0786	1.97
induced	0.2624	0.3205	0.1143	0.0671	0.1814	0.2011	5.81
TOTAL	1.3	1.4	0.52	0.32	0.84	0.89	18.5
Change in Population =		46.					

TABLE IV

HUMBOLDT COUNTY–GRAVEL MINING INDUSTRY	$MM 1985	Impact Report #904					
INDIRECT EFFECTS OF ONE MILLION DOLLARS OF GROSS SALES							
SECTOR #	INDUSTRY IMPACTED BY CHANGE AGGREGATED INDUSTRY DESCRIPTION	Final Demand (MM$)	Total Output (MM$)	Employee Income (MM$)	Property Income (MM$)	Total PoW Income (MM$)	Total Value Added (MM$)	Employment (Number of Jobs)
1	AGG AGRICULTURE & FISHERIES	0	0.0004	0.0001	0.0001	0.0002	0.0002	0.01
22	AGG FORESTRY	0	0	0	0	0	0	0
47	AGG MINING, EXCEPT SAND & GRAVEL	0	0	0	0	0	0	0
48	CONSTR SAND & GRAVEL MINING	0	0.0002	0.0001	0	0.0001	0.0001	0
66	AGG RESIDENTIAL & OTHER CONSTRUCTION	0	0.001	0.0002	0.0002	0.0004	0.0004	0.01
67	AGG INDUSTRIAL CONSTRUCTION	0	0.0037	0.0011	0.0007	0.0018	0.0018	0.04
82	AGG FOOD & KINDRED PROD & TOBACCO PR	0	0.0002	0	0	0.0001	0.0001	0
151	AGG TEXTILES AND APPAREL	0	0	0	0	0	0	0
160	LOGGING CONTRACTORS	0	0	0	0	0	0	0
161	AGG PRIMARY SAWMILLS	0	0.0001	0	0	0	0	0
165	AGG REMANUFACTURED WOOD PRODUCTS	0	0	0	0	0	0	0
174	AGG WOOD FURNITURE	0	0	0	0	0	0	0
186	AGG FURNITURE & FIXTURES, N.E.C.	0	0	0	0	0	0	0
187	PULP MILLS	0	0.0002	0	0	0.0001	0.0001	0
200	AGG PRINTING & PUBLISHING	0	0.0012	0.0004	0.0002	0.0006	0.0006	0.02
215	AGG CHEM & ALLIED PROD, & DRUGS & SUNI	0	0.0002	0	0	0	0	0
234	AGG PAINTS & ALLIED, & PETROLEUM PROD	0	0	0	0	0	0	0
243	AGG TIRES, RUBBER & PLASTICS	0	0	0	0	0	0	0
252	AGG LEATHER PRODUCTS	0	0	0	0	0	0	0
255	AGG GLASS & CERAMIC S PRODUCTS	0	0	0	0	0	0	0
292	AGG STEEL & NON-FERROUS METALS	0	0	0	0	0	0	0
308	AGG MISC. FABRICATED METAL PRODUCTS	0	0.0009	0.0003	0.0001	0.0004	0.0004	0.01
334	AGG MISCELLANEOUS MACHINERY	0	0.0002	0.0003	-0.0002	0.0001	0.0001	0
349	AGG FOREST PRODUCTS MACH	0	0	0	0	0	0	0
362	AGG ELECTRONIC COMPUTERS & OFFC EQU	0	0	0	0	0	0	0
368	AGG ELECTRICAL EQUIPMENT	0	0	0	0	0	0	0
409	SHIP & BOAT BUILDING & REPAIR	0	0	0	0	0	0	0
417	AGG INSTRUMENTS & SUPPLIES	0	0.0003	0.0001	0	0.0001	0.0001	0
446	RAILROADS AND RELATED SERVICES	0	0.0016	0.0008	0.0001	0.0009	0.001	0.02
447	AGG TRANSIT & MOTOR FREIGHT	0	0.0053	0.0021	0.0014	0.0035	0.0035	0.1
449	WATER TRANSPORTATION	0	0.0005	0.0001	0	0.0002	0.0002	0
450	AGG MISC. TRANSPORT & COMMUNICATIONS	0	0.0042	0.0014	0.0012	0.0027	0.0028	0.04
457	AGG UTILITIES	0	0.0082	0.0008	0.0014	0.0022	0.0026	0.02
461	AGG WHOLESALE TRADE	0	0.0213	0.009	0.0034	0.0124	0.0158	0.31
462	AGG RETAIL TRADE	0	0.0023	0.0009	0.0004	0.0013	0.0015	0.05
464	AGG FINANCE INSURANCE & REAL ESTATE	0	0.0283	0.0088	0.0096	0.0182	0.0185	0.33
471	AGG PERSONAL SERVICES	0	0.0215	0.0061	0.0041	0.0102	0.0122	0.49
480	AGG BUSINESS SERVICES	0	0.0207	0.0091	0.0051	0.0141	0.0143	0.42
503	AGG MEDICAL SERVICES	0	0	0	0	0	0	0
507	AGG EDUCATION & EDUCATION SERVICES	0	0	0	0	0	0	0
511	LABOR & CIVIC ORGANIZATIONS	0	0	0	0	0	0	0
516	AGG FEDERAL GOVERNMENT ENTERPRISES	0	0.0019	0.0013	-0.0001	0.0011	0.0011	0.04
519	AGG STATE & LOCAL GOVT ENTERPRISES	0	0.0026	0.0009	0.0002	0.001	0.001	0.04
525	GOVERNMENT INDUSTRY	0	0	0	0	0	0	0
527	HOUSEHOLD INDUSTRY	0	0	0	0	0	0	0
	TOTAL	0	0.1251	0.0419	0.0281	0.0699	0.0786	1.97

TABLE V

HUMBOLDT COUNTY		$MM 1985		Impact Report #905				
IMPACT OF RIVERBED GRAVEL MINING		INDUCED EFFECTS BASED ON 2 ITERATIONS						
	INDUSTRY IMPACTED BY CHANGE	Final	Industry	Employee	Property	Total PoW	Total Value	Employment
SECTOR #	AGGREGATED INDUSTRY DESCRIPTION	Demand (MM$)	Output (MM$)	Income (MM$)	Income (MM$)	Income (MM$)	Added (MM$)	Number of Jobs)
1	AGG AGRICULTURE & FISHERIES	0.0032	0.0042	0.0009	0.0012	0.0021	0.0022	0.09
22	AGG FORESTRY	0	0	0	0	0	0	0
47	AGG MINING, EXCEPT SAND & GRAVEL	0	0	0	0	0	0	0
48	CONSTR SAND & GRAVEL MINING	0	0	0	0	0	0	0
66	AGG RESIDENTIAL & OTHER CONSTRUCTION	0	0.002	0.0005	0.0003	0.0008	0.0008	0.02
67	AGG INDUSTRIAL CONSTRUCTION	0	0.0015	0.0004	0.0003	0.0007	0.0007	0.02
82	AGG FOOD & KINDRED PROD & TOBACCO PR	0.0029	0.0036	0.0006	0.0002	0.0008	0.0008	0.02
151	AGG TEXTILES AND APPAREL	0.0009	0.0009	0.0002	0.0001	0.0003	0.0003	0.02
160	LOGGING CONTRACTORS	0	0.0001	0	0	0	0	0
161	AGG PRIMARY SAWMILLS	0.0001	0.0004	0.0001	0	0.0001	0.0002	0
165	AGG REMANUFACTURED WOOD PRODUCTS	0.0001	0.0002	0	0	0.0001	0.0001	0
174	AGG WOOD FURNITURE	0.0009	0.0009	0.0003	0.0001	0.0004	0.0004	0.02
186	AGG FURNITURE & FIXTURES, N.E.C.	0	0	0	0	0	0	0
187	PULP MILLS	0	0.0002	0	0	0.0001	0.0001	0
200	AGG PRINTING & PUBLISHING	0.0003	0.0028	0.001	0.0005	0.0015	0.0015	0.04
215	AGG CHEM & ALLIED PROD, & DRUGS & SUNI	0.0003	0.0005	0.0001	0.0001	0.0001	0.0001	0
234	AGG PAINTS & ALLIED, & PETROLEUM PROD	0	0	0	0	0	0	0
243	AGG TIRES, RUBBER & PLASTICS	0	0	0	0	0	0	0
252	AGG LEATHER PRODUCTS	0.0001	0.0001	0	0	0	0	0
255	AGG GLASS & CERAMIC S PRODUCTS	0	0.0001	0	0	0	0	0
292	AGG STEEL & NON-FERROUS METALS	0	0	0	0	0	0	0
308	AGG MISC. FABRICATED METAL PRODUCTS	0	0	0	0	0	0	0
334	AGG MISCELLANEOUS MACHINERY	0	0	0	0	0	0	0
349	AGG FOREST PRODUCTS MACH	0	0	0	0	0	0	0
362	AGG ELECTRONIC COMPUTERS & OFFC EQU	0	0	0	0	0	0	0
368	AGG ELECTRICAL EQUIPMENT	0	0	0	0	0	0	0
409	SHIP & BOAT BUILDING & REPAIR	0	0	0	0	0	0	0
417	AGG INSTRUMENTS & SUPPLIES	0.0004	0.0007	0.0002	0.0001	0.0003	0.0003	0.01
446	RAILROADS AND RELATED SERVICES	0.0001	0.0002	0.0001	0	0.0001	0.0001	0
447	AGG TRANSIT & MOTOR FREIGHT	0.0012	0.0039	0.0015	0.001	0.0025	0.0026	0.07
449	WATER TRANSPORTATION	0.0001	0.0003	0.0001	0	0.0001	0.0001	0
450	AGG MISC. TRANSPORT & COMMUNICATIONS	0.0093	0.0158	0.0055	0.0047	0.0102	0.0107	0.15
457	AGG UTILITIES	0.0057	0.0096	0.001	0.0016	0.0026	0.0031	0.02
461	AGG WHOLESALE TRADE	0.0162	0.0206	0.0087	0.0033	0.012	0.0152	0.3
462	AGG RETAIL TRADE	0.0628	0.0844	0.0258	0.0111	0.0369	0.0425	1.36
464	AGG FINANCE INSURANCE & REAL ESTATE	0.0409	0.0519	0.013	0.019	0.032	0.0365	0.65
471	AGG PERSONAL SERVICES	0.0458	0.0525	0.0148	0.01	0.0248	0.0298	1.21
480	AGG BUSINESS SERVICES	0.0044	0.0131	0.0058	0.0032	0.009	0.0091	0.27
503	AGG MEDICAL SERVICES	0.056	0.0571	0.0277	0.0094	0.0371	0.0374	1.25
507	AGG EDUCATION & EDUCATION SERVICES	0.0024	0.0024	0.0012	0.0002	0.0014	0.0014	0.08
511	LABOR & CIVIC ORGANIZATIONS	0.002	0.002	0.0009	0.0003	0.0011	0.0011	0.05
516	AGG FEDERAL GOVERNMENT ENTERPRISES	0.0011	0.0031	0.0021	-0.0002	0.0019	0.0019	0.06
519	AGG STATE & LOCAL GOVT ENTERPRISES	0.0049	0.0055	0.0018	0.0004	0.0022	0.0022	0.08
525	GOVERNMENT INDUSTRY	0	0	0	0	0	0	0
527	HOUSEHOLD INDUSTRY	0	0	0	0	0	0	0
	Total	0.2624	0.3205	0.1143	0.0671	0.1814	0.2011	5.81

TABLE VI

HUMBOLDT COUNTY		$MM 1985		Impact Report #906				
TOTAL EFFECTS OF ONE MILLION DOLLARS OF GRAVEL GROSS SALES								
SECTOR #	INDUSTRY IMPACTED BY CHANGE AGGREGATED INDUSTRY DESCRIPTION	Final Demand (MM$)	Industry Output (MM$)	Employee Income (MM$)	Property Income (MM$)	Total PoW Income (MM$)	Total Value Added (MM$)	Employment Number of Jobs)
1	AGG AGRICULTURE & FISHERIES	0.0032	0.0046	0.001	0.0014	0.0024	0.0024	0.1
22	AGG FORESTRY	0	0	0	0	0	0	0
47	AGG MINING, EXCEPT SAND & GRAVEL	0	0	0	0	0	0	0
48	CONSTR SAND & GRAVEL MINING	1	1.0002	0.3666	0.2201	0.5867	0.6078	10.72
66	AGG RESIDENTIAL & OTHER CONSTRUCTION	0	0.0029	0.0007	0.0005	0.0012	0.0012	0.03
67	AGG INDUSTRIAL CONSTRUCTION	0	0.0051	0.0015	0.001	0.0025	0.0025	0.06
82	AGG FOOD & KINDRED PROD & TOBACCO PR	0.0029	0.0038	0.0006	0.0003	0.0008	0.0009	0.02
151	AGG TEXTILES AND APPAREL	0.0009	0.001	0.0003	0.0001	0.0003	0.0003	0.02
160	LOGGING CONTRACTORS	0	0.0001	0	0	0	0	0
161	AGG PRIMARY SAWMILLS	0.0001	0.0005	0.0001	0	0.0002	0.0002	0.01
165	AGG REMANUFACTURED WOOD PRODUCTS	0.0001	0.0002	0.0001	0	0.0001	0.0001	0
174	AGG WOOD FURNITURE	0.0009	0.0009	0.0003	0.0001	0.0004	0.0004	0.02
186	AGG FURNITURE & FIXTURES, N.E.C.	0	0	0	0	0	0	0
187	PULP MILLS	0	0.0004	0.0001	0.0001	0.0001	0.0001	0
200	AGG PRINTING & PUBLISHING	0.0003	0.004	0.0014	0.0007	0.0021	0.0021	0.05
215	AGG CHEM & ALLIED PROD. & DRUGS & SUNI	0.0003	0.0006	0.0001	0.0001	0.0002	0.0002	0
234	AGG PAINTS & ALLIED, & PETROLEUM PROD	0	0	0	0	0	0	0
243	AGG TIRES, RUBBER & PLASTICS	0	0	0	0	0	0	0
252	AGG LEATHER PRODUCTS	0.0001	0.0001	0	0	0	0	0
255	AGG GLASS & CERAMIC S PRODUCTS	0	0.0001	0	0	0	0	0
292	AGG STEEL & NON-FERROUS METALS	0	0	0	0	0	0	0
308	AGG MISC. FABRICATED METAL PRODUCTS	0	0.0009	0.0003	0.0001	0.0004	0.0004	0.01
334	AGG MISCELLANEOUS MACHINERY	0	0.0002	0.0003	-0.0002	0.0001	0.0001	0
349	AGG FOREST PRODUCTS MACH	0	0	0	0	0	0	0
362	AGG ELECTRONIC COMPUTERS & OFFC EQU	0	0	0	0	0	0	0
368	AGG ELECTRICAL EQUIPMENT	0	0	0	0	0	0	0
409	SHIP & BOAT BUILDING & REPAIR	0	0	0	0	0	0	0
417	AGG INSTRUMENTS & SUPPLIES	0.0004	0.001	0.0003	0.0001	0.0004	0.0004	0.01
446	RAILROADS AND RELATED SERVICES	0.0001	0.0019	0.001	0.0001	0.0011	0.0011	0.02
447	AGG TRANSIT & MOTOR FREIGHT	0.0012	0.0091	0.0036	0.0024	0.006	0.0061	0.18
449	WATER TRANSPORTATION	0.0001	0.0008	0.0002	0.0001	0.0002	0.0002	0
450	AGG MISC. TRANSPORT & COMMUNICATIONS	0.0093	0.0199	0.0069	0.006	0.0129	0.0136	0.2
457	AGG UTILITIES	0.0057	0.0178	0.0018	0.003	0.0048	0.0056	0.05
461	AGG WHOLESALE TRADE	0.0162	0.0419	0.0177	0.0067	0.0244	0.031	0.61
462	AGG RETAIL TRADE	0.0628	0.0666	0.0267	0.0115	0.0382	0.044	1.41
464	AGG FINANCE INSURANCE & REAL ESTATE	0.0409	0.0782	0.0196	0.0287	0.0483	0.055	0.97
471	AGG PERSONAL SERVICES	0.0458	0.074	0.0209	0.0141	0.035	0.0419	1.7
480	AGG BUSINESS SERVICES	0.0044	0.0339	0.0148	0.0083	0.0231	0.0234	0.69
503	AGG MEDICAL SERVICES	0.056	0.0571	0.0277	0.0094	0.0371	0.0374	1.25
507	AGG EDUCATION & EDUCATION SERVICES	0.0024	0.0025	0.0012	0.0002	0.0014	0.0014	0.08
511	LABOR & CIVIC ORGANIZATIONS	0.002	0.002	0.0009	0.0003	0.0011	0.0011	0.05
516	AGG FEDERAL GOVERNMENT ENTERPRISES	0.0011	0.005	0.0034	-0.0003	0.003	0.003	0.1
519	AGG STATE & LOCAL GOVT ENTERPRISES	0.0049	0.0082	0.0027	0.0005	0.0032	0.0032	0.12
525	GOVERNMENT INDUSTRY	0	0	0	0	0	0	0
527	HOUSEHOLD INDUSTRY	0	0	0	0	0	0	0
	TOTAL	1.2624	1.4456	0.5227	0.3152	0.8379	0.8874	18.49
Change in Population = 46.								

APPENDIX

HUMBOLDT COUNTY	$MM 1985		ACCOUNTS REPORT # 114A		
INDUSTRY BALANCE SHEET, PART I					
INDUSTRY 48: CONSTRUCTION SAND AND GRAVEL					

REGIONAL COMMODITY	COMMODITY PRODUCTION ($MM)	MARKET SHARE COEFFICIENT	BY-PRODUCT COEFFICIENT	REGIONAL PURCHASE COEFFICIENT	TOTAL COMMODITY EXPORTS ($MM)	
44	0.02648	0.77657	0.01493	0.00001	0.0341	
48	1.7266	0.95067	0.97371	0.01038	1.79383	
55	0.00912	0.83314	0.00515	0	0.00976	
238	0.00835	0.26942	0.00471	0.01703	0	
267	0.00074	0.02849	0.00042	0	0.02586	
269	0.00193	0.00259	0.00109	0.00004	0.74554	
TOTAL	1.77322				2.60909	

HUMBOLDT COUNTY	$MM 1985	ACCOUNTS REPORT #114B
INDUSTRY BALANCE SHEET, PART II (INPUTS)		
INDUSTRY 48: CONSTRUCTION SAND AND GRAVEL		

COMMODITY	TOTAL ABSORPTION COEFFICIENT	GROSS INPUTS ($MM)	REGIONAL PURCHASE COEFFICIENT	REGIONAL ABSORPTION COEFFICIENT	REGIONAL INPUTS ($MM)	DOMESTIC IMPORTS ($MM)
27	0.0001066	0.00019	0.96269	0.0001026	0.00018	0.00001
39	0.0000015	0	0	0	0	0
40	0.0012479	0.00221	0	0	0	0.00221
44	0.0000222	0.00004	0.00001	0	0	0.00004
45	0.0001282	0.00023	0	0	0	0.00023
46	0.0000418	0.00007	0	0	0	0.00007
47	0.0000562	0.0001	0.00303	0.0000002	0	0.0001
48	0.0206878	0.03665	0.01038	0.0002145	0.00038	0.03627
55	0.0416258	0.07381	0	0	0	0.07381
74	0.003667	0.0065	0.82718	0.0030332	0.00538	0.00112
115	0.000107	0.00019	0.00015	0	0	0.00019
151	0.000308	0.00055	0.07051	0.0000217	0.00004	0.00051
190	0.0000769	0.00014	0	0	0	0.00014
191	0.0001744	0.00031	0	0	0	0.00031
194	0.0074441	0.0132	0	0	0	0.0132
195	0.0002519	0.00045	0	0	0	0.00045
198	0.0003872	0.00069	0	0	0	0.00069
199	0.0001291	0.00023	0.04837	0.0000062	0.00001	0.00022
201	0.0005473	0.00097	0.00749	0.0000041	0.00001	0.00096
204	0.0001445	0.00026	0.01571	0.0000023	0	0.00025
205	0.0002187	0.00039	0.0817	0.0000179	0.00003	0.00036
207	0.0001393	0.00025	0.00817	0.0000011	0	0.00024
208	0.0000464	0.00008	0.0047	0.0000002	0	0.00008
215	0.0009401	0.00167	0.26086	0.0002452	0.00043	0.00123
216	0.0006393	0.00113	0.14002	0.0000895	0.00016	0.00097
221	0.0026053	0.00462	0.00026	0.0000007	0	0.00462
235	0.018857	0.03344	0.00844	0.0001591	0.00028	0.03316
236	0.0012716	0.00225	0.00193	0.0000025	0	0.00225

COMMODITY	TOTAL ABSORPTION COEFFICIENT	GROSS INPUTS ($MM)	REGIONAL PURCHASE COEFFICIENT	REGIONAL ABSORPTION COEFFICIENT	REGIONAL INPUTS ($MM)	DOMESTIC IMPORTS ($MM)
240	0.0007236	0.00128	0.00001	0	0	0.00128
243	0.0007455	0.00132	0.00221	0.0000016	0	0.00132
244	0.0003595	0.00064	0.0009	0.0000003	0	0.00064
245	0.0025678	0.00455	0.00001	0	0	0.00455
255	0.0001222	0.00022	0.1749	0.0000214	0.00004	0.00018
273	0.0001747	0.00031	0	0	0	0.00031
275	0.0002825	0.0005	0	0	0	0.0005
280	0.0048763	0.00865	0.00012	0.0000006	0	0.00865
292	0.0008698	0.00154	0.01289	0.0000112	0.00002	0.00152
298	0.0006865	0.00122	0.00028	0.0000002	0	0.00122
308	0.0031382	0.00556	0.00022	0.0000007	0	0.00556
315	0.0014829	0.00263	0.00005	0.0000001	0	0.00263
320	0.0001388	0.00025	0.00128	0.0000002	0	0.00025
325	0.0064484	0.01143	0.12942	0.0008345	0.00148	0.00995
329	0.0014333	0.00254	0.00743	0.0000106	0.00002	0.00252
331	0.0117767	0.02088	0.00349	0.0000411	0.00007	0.02081
334	0.0168802	0.02993	0.00842	0.0001422	0.00025	0.02968
335	0.0013654	0.00242	0.00014	0.0000002	0	0.00242
338	0.0072787	0.01291	0.00035	0.0000026	0	0.0129
339	0.0004286	0.00076	0.00057	0.0000002	0	0.00076
340	0.0016721	0.00296	0.00017	0.0000003	0	0.00296
343	0.0002228	0.0004	0.05001	0.0000111	0.00002	0.00038
344	0.0004808	0.00085	0.02624	0.0000126	0.00002	0.00083
353	0.0031734	0.00563	0	0	0	0.00563
354	0.0017715	0.00314	0	0	0	0.00314
355	0.0003243	0.00058	0	0	0	0.00058
357	0.0012312	0.00218	0	0	0	0.00218
359	0.0004443	0.00079	0	0	0	0.00079
361	0.0033126	0.00587	0.00001	0	0	0.00587
373	0.0000068	0.00001	0.00011	0	0	0.00001
374	0.0015755	0.00279	0.00012	0.0000002	0	0.00279
375	0.0025914	0.0046	0.00008	0.0000002	0	0.00459
378	0.00002	0.00004	0.00001	0	0	0.00004
386	0.0002338	0.00041	0	0	0	0.00041
387	0.0001866	0.00033	0.00004	0	0	0.00033
396	0.0000252	0.00004	0	0	0	0.00004
399	0.0000528	0.00009	0.00191	0.0000001	0	0.00009
400	0.0005752	0.00102	0.00713	0.0000041	0.00001	0.00101
404	0.0066782	0.01184	0.00739	0.0000494	0.00009	0.01175
420	0.0002225	0.00039	0.77805	0.0001731	0.00031	0.00009
425	0.0001483	0.00026	0.00006	0	0	0.00026
445	0.000634	0.00112	0.03584	0.0000226	0.00004	0.00108
446	0.0052411	0.00929	0.30075	0.0015763	0.0028	0.0065
447	0.0007065	0.00125	0.32583	0.0002302	0.00041	0.00084
448	0.0028629	0.00508	1	0.0028629	0.00508	0
449	0.0005759	0.00102	0.75761	0.0004363	0.00077	0.00025
450	0.0011754	0.00208	0.10751	0.0001264	0.00022	0.00186
451	0.0001938	0.00034	0	0	0	0.00034

COMMODITY	TOTAL ABSORPTION COEFFICIENT	GROSS INPUTS ($MM)	REGIONAL PURCHASE COEFFICIENT	REGIONAL ABSORPTION COEFFICIENT	REGIONAL INPUTS ($MM)	DOMESTIC IMPORTS ($MM)
454	0.0013219	0.00234	0.87009	0.0011502	0.00204	0.0003
456	0.056914	0.10092	0.00189	0.0001074	0.00019	0.10073
457	0.0032707	0.0058	1	0.0032707	0.0058	0
458	0.0001068	0.00019	0.96853	0.0001034	0.00018	0.00001
459	0.0026488	0.0047	1	0.0026488	0.0047	0
460	0.0001525	0.00027	0	0	0	0.00027
461	0.0221341	0.03925	0.89501	0.0198103	0.03513	0.00412
462	0.000016	0.00003	1	0.000016	0.00003	0
463	0.0014947	0.00265	1	0.0014947	0.00265	0
464	0.0069191	0.01227	1	0.0069191	0.01227	0
465	0.0007613	0.00135	0.79577	0.0006058	0.00107	0.00028
466	0.0001653	0.00029	1	0.0001653	0.00029	0
467	0.0036714	0.00651	0.21388	0.0007852	0.00139	0.00512
470	0.0351569	0.06234	0.4216	0.014822	0.02628	0.03606
471	0.0065014	0.01153	1	0.0065014	0.01153	0
472	0.0000935	0.00017	1	0.0000935	0.00017	0
475	0.0004467	0.00079	1	0.0004467	0.00079	0
478	0.0031346	0.00556	0.77718	0.0024361	0.00432	0.00124
480	0.0004947	0.00088	0.18087	0.0000895	0.00016	0.00072
481	0.0050811	0.00901	0.26156	0.001329	0.00236	0.00665
482	0.0041046	0.00728	0.18112	0.0007434	0.00132	0.00596
483	0.0001918	0.00034	0.40585	0.0000778	0.00014	0.0002
484	0.0116529	0.02066	0.60175	0.0070121	0.01243	0.00823
485	0.0001054	0.00019	0.75821	0.0000799	0.00014	0.00005
486	0.0020701	0.00367	0.55409	0.001147	0.00203	0.00164
487	0.0016039	0.00284	1	0.0016039	0.00284	0
488	0.0026505	0.0047	0.60865	0.0016132	0.00286	0.00184
489	0.0028024	0.00497	1	0.0028024	0.00497	0
490	0.0015815	0.0028	1	0.0015815	0.0028	0
491	0.0031266	0.00554	1	0.0031266	0.00554	0
492	0.0006281	0.00111	0.47413	0.0002978	0.00053	0.00059
493	0.0060585	0.01074	1	0.0060585	0.01074	0
497	0.0003908	0.00069	0.0826	0.0000323	0.00006	0.00064
508	0.0001933	0.00034	0.19603	0.0000379	0.00007	0.00028
510	0.0013429	0.00238	0.35016	0.0004702	0.00083	0.00155
513	0.0000969	0.00017	1	0.0000969	0.00017	0
516	0.0009246	0.00164	1	0.0009246	0.00164	0
521	0.0015501	0.00275	1	0.0015501	0.00275	0
522	0.0002317	0.00041	0	0	0	0.00041
524	0.0005499	0.00098	0.00573	0.0000031	0.00001	0.00097
TOTAL	0.3923137	0.69566		0.1025293	0.18181	0.51385

EMPLOYMENT COMPENSATION ($MM)	.6500
INDIRECT BUSINESS TAXES ($MM)	.0374
PROPRIETARY INCOME ($MM)	.0994
OTHER PROPERTY INCOME ($MM)	.2907
TOTAL VALUE ADDED ($MM)	1.0776
TOTAL INDUSTRY OUTPUT ($MM)	1.7732

END BALANCE SHEET, INDUSTRY 48

HUMBOLDT COUNTY	$MM 1985	ACCOUNTS REPORT #115A			
COMMODITY BALANCE SHEET, PART I					
COMMODITY 48: CONSTRUCTION SAND AND GRAVEL					
	INDUSTRY	MARKET			
REGIONAL	PRODUCTION	SHARE	BY-PRODUCTS		
INDUSTRY	($MM)	COEFFICIENT	COEFFICIENT		
48	1.7266	0.95067	0.97371		
268	0.00068	0.00037	0.00164		
269	0.01353	0.00745	0.01889		

HUMBOLDT COUNTY	$MM 1985	ACCOUNTS REPORT #115B				
COMMODITY BALANCE SHEET, PART II						
COMMODITY 48: CONSTRUCTION SAND AND GRAVEL						
	TOTAL	GROSS	REGIONAL	REGIONAL	REGIONAL	DOMESTIC
REGIONAL	ABSORPTION	INPUTS	PURCHASE	ABSORPTION	INPUTS	IMPORTS
INDUSTRY	COEFFICIENT	($MM)	COEFFICIENT	COEFFICIENT	($MM)	($MM)
47	0.00022	0.00005	0.01038	0	0	0.00005
48	0.02087	0.03685	0.01038	0.00021	0.00038	0.03627
66	0.00018	0.00762	0.01038	0	0.00008	0.00754
67	0.00051	0.04472	0.01038	0.00001	0.00046	0.04426
68	0.00056	0.00522	0.01038	0.00001	0.00005	0.00517
69	0.00618	0.03842	0.01038	0.00006	0.0004	0.03802
70	0.00112	0.00049	0.01038	0.00001	0.00001	0.00049
71	0.00071	0.00112	0.01038	0.00001	0.00001	0.00111
72	0.00191	0.01509	0.01038	0.00002	0.00016	0.01493
73	0.00055	0.00467	0.01038	0.00001	0.00005	0.00462
74	0.00405	0.05975	0.01038	0.00004	0.00062	0.05913
75	0.00857	0.12103	0.01038	0.00009	0.00126	0.11977
215	0.00001	0	0.01038	0	0	0
234	0.00012	0.0001	0.01038	0	0	0.0001
243	0.00044	0.00035	0.01038	0	0	0.00035
244	0.00008	0.00008	0.01038	0	0	0.00008
255	0.00943	0.00283	0.01038	0.0001	0.00003	0.0029
268	0.02167	0.00899	0.01038	0.00022	0.00009	0.0089
269	0.0691	0.04948	0.01038	0.00072	0.00051	0.04897
515	0.00011	0.00286	0.01038	0	0.00003	0.00283
PCE-LOW		0	0.01038		0	0
PCE-MEDIUM		0	0.01038		0	0
PCE-HIGH		0	0.01038		0	0
CAPITAL FORMATION		0	0.01038		0	0
INVENTORY ADDITION		0.08265	0.01038		0.00086	0.08179
S/L GOVT PUR/NON-ED		0	0.01038		0	0
S/L GOVT PURCH/ED		0	0.01038		0	0
FED GOVT PUR/NON-MIL		0	0.01038		0	0
FED GOVT PUR/MIL		0	0.01038		0	0
COMMODITY CREDIT CORP		0	0.01038		0	0
FOREIGN EXPORTS		0.01736	1		0.01736	0
DOMESTIC EXPORTS		0			1.79383	0
TOTAL FINAL DEMAND		0.10001	0.01038		0.01822	0.08179
TOTAL COMMODITY OUTPUT		1.7408				
END BALANCE SHEET, COMMODITY 48						

EXHIBIT A-2
INDUSTRY CLASSIFICATION OF THE
MICRO-IMPLAN 528 SECTOR
INPUT/OUTPUT TABLES

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
1	Dairy Farm Products	1.0100	0241 Also: part of 0191, 0259, 0291
2	Poultry & Eggs	1.0200	0251, 0252, 0253 Also: part of 0191, 0219, 0259, 0291
3	Ranch Fed Cattle	1.0311	Part of 0191, 0212, 0219, 0259, 0291
4	Range Fed Cattle	1.0312	Part of 0191, 0212, 0219, 0259, 0291
5	Cattle Feedlots	1.0313	0211 Also: part of 0191, 0219, 0259, 0291
6	Sheep, Lambs & Goats	1.0314	0214 Also: part of 0191, 0219, 0259, 0291
7	Hogs, Pigs & Swine	1.0315	0213 Also: part of 0191, 0219, 0259, 0291
8	Other Meat Animal Products	1.0316	Part of 0191, 0219, 0259, 0291
9	Misc. Livestock	1.0302	0271, 0272 Also: part of 0191, 0219, 0259, 0279, 0291
10	Cotton	2.0100	0131 Also: part of 0191, 0219, 0259, 0291
11	Food Grains	2.0201	0111, 0112 Also: part of 0191, 0219, 0259, 0291
12	Feed Grains	2.0221	0115 Also: part of 0139, 0191, 0219, 0259, 0291
13	Hay & Pasture	2.0222	Part of 0139, 0191, 0219, 0259, 0291
14	Grass & Seeds	2.0203	Part of 0139, 0191, 0219, 0259, 0291
15	Tobacco	2.0300	0132 Also: part of 0191, 0219, 0259, 0291
16	Fruits	2.0401	0171, 0172, 0174, 0175 Also: part of 0179, 0191, 0219, 0259 0291
17	Tree Nuts	2.0402	Part of 0173, 0179, 0191, 0219, 0259, 0291
18	Vegetables	2.0501	0134, 0161 Also: part of 0119, 0139, 0191, 0219, 0259, 0291
19	Sugar Crops	2.0502	0133 Also: part of 0191, 0219, 0259, 0291
20	Misc. Crops	2.0503	Part of 0119, 0139, 0191, 0219, 0259, 0291
21	Oil Bearing Crops	2.0600	0116 Also: part of 0119, 0139, 0173, 0219, 0259, 0291
22	Forest Products	2.0701	Part of 0181, 0191, 0219, 02591, 0291
23	Greenhouse & Nursery Products	2.0702	0182, 0189 Also: part of 0181, 0191, 0219, 0259, 0291
24	Forestry Products	3.0001	0810, 0820, 0840, 0970
25	Commercial Fishing	3.0002	0910
26	Agriculture, Forestry & Fishery Services	4.0001	0710, 0720, 0750, 0760, 0254, 0850, 0920 Also: part of 0279
27	Landscape & Horticultural Services	4.0002	0780
28	Iron Ores	5.0100	1011
29	Ferroalloy Ores (Except Vanadium)	5.0200	1061
30	Copper Ores	6.0100	1021
31	Lead & Zinc Ores	6.0201	1031
32	Gold Ores	6.0202	1041
33	Silver Ores	6.0203	1044
34	Bauxite & Other Aluminum Ores	6.0204	1051
35	Metal Mining Services	6.0205	1081
36	Mercury Ores	6.0306	1092
37	Uranium-Radium- Vanadium Ores	6.0207	1094
38	Metal Ores (N.E.C.)	6.0208	1099
39	Anthracite & Anthracite Mining	7.0100	1111 Also: part of 1112
40	Bituminous & Lignite Mining, Services	7.0200	1211 Also: part of 1213
41	Natural Gas	8.0101	Caution: 1310 is split between 8.0101 and 8.0102
42	Crude Petroleum	8.0102	1310 See note above.
43	Natural Gas Liquids	8.0200	1321

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
44	Dimension Stone	9.0100	1411
45	Crushed & Broken Limestone	9.0201	1422
46	Crushed & Broken Granite	9.0202	1423
47	Crushed & Broken Stone	9.0203	1429
48	Construction Sand & Gravel	9.0301	1442
49	Industrial Sand	9.0302	1446
50	Bentonite	9.0400	1452
51	Fire Clay	9.0500	1453
52	Fuller's Earth	9.0600	1454
53	Kaolin & Ball Clay	9.0700	1455
54	Clay, Ceramic, Refractory Minerals	9.0800	1459
55	Nonmetallic Minerals (Except Fuels)	9.0900	1451
56	Gypsum	9.1000	1482
57	Talc, Soapstone & Borate Mines	9.1100	1496
58	Misc. Nonmetallic Minerals (N.E.C.)	9.1200	1499
59	Barite	10.0100	1492
60	Flourspar	10.0200	1473
61	Potash, Soda & Borate Minerals	10.0300	1474
62	Phosphate Rock	10.0400	1475
63	Rock Salt	10.0500	1476
64	Sulfur	10.0600	1477
65	Chemical, Fertilizer, Mineral Mines N.E.C.	10.0700	1479
66	New Residential Structures	11.0100	1521, 1522, 1530 In reality: part of the corresponding SICs
67	New Industrial & Commercial Buildings	11.0200	1541, 1542 In reality: part of the corresponding SICs
68	New Utility Structures	11.0300	1623 Also: part of 1629
69	New Highways & Streets	11.0400	1611, 1622
70	New Farm Structures	11.0500	
71	New Mineral Extraction Facilities	11.0600	Part of 108, 1112, 1213, 136, 148
72	New Government Facilities	11.0700	1629 In reality: part of 1629
73	Maintenance & Repair, Residential	12.0100	
74	Maintenance & Repair, Other Facilities	12.0200	
75	Maintenance & Repair, Oil & Gas Wells	12.0215	1380 In reality: part of 138
76	Complete Guided Missiles	13.0100	3761
77	Ammunition (Except for Small Arms)	13.0200	3483
78	Tanks & Tank Components	13.0300	3795
79	Small Arms	13.0500	3484
80	Small Arms Ammunition	13.0600	3482
81	Other Ordnance & Accessories	13.0700	3489
82	Meat Packing Plants	14.0101	2011
83	Sausages & Other Prepared Meats	14.0102	2013
84	Poultry Dressing Plants	14.0103	2016
85	Poultry & Egg Proc.	14.0104	2017
86	Creamery Butter	14.0200	2021
87	Cheese: Natural & Processed	14.0300	2022
88	Condensed & Evaporated Milk	14.0400	2023
89	Ice Cream & Frozen Desserts	14.0500	2024
90	Fluid Milk	14.0600	2026
91	Canned & Cured Sea Foods	14.0700	2091
92	Canned Specialties	14.0800	2032

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
93	Canned Fruits & Vegetables	14.0900	2033
94	Dehydrated Food Products	14.1000	2034
95	Pickles, Sauces, & Salad Dressings	14.1100	2035
96	Fresh or Frozen Packaged Fish	14.1200	2092
97	Frozen Fruits, Juices, & Vegetables	14.1301	2037
98	Frozen Specialties	14.1302	2038
99	Flour & Other Grain Mill Products	14.1401	2041
100	Cereal Preparations	14.1402	2043
101	Blended & Prepared Flour	14.1403	2045
102	Dog, Cat, & Other Pet Food	14.1501	2047
103	Prepared Feeds (N.E.C.)	14.1502	2048
104	Rice Milling	14.1600	2044
105	Wet Corn Milling	14.1700	2046
106	Bread, Cake, & Related Products	14.1801	2051
107	Cookies & Crackers	14.1802	2052
108	Sugar	14.1900	2061, 2062, 2063
109	Confectionery Products	14.2001	2065
110	Chocolate & Cocoa Products	14.2002	2066
111	Chewing Gum	14.2003	2067
112	Malt Liquors	14.2101	2082
113	Malt	14.2102	2083
114	Wines, Brandy, & Brandy Spirit	14.2103	2084
115	Distilled Liquor (Except Brandy)	14.2104	2085
116	Bottled & Canned Soft Drinks	14.2200	2086
117	Flavoring Extracts & Syrups (N.E.C.)	14.2300	2087
118	Cottonseed Oil Mills	14.2400	2074
119	Soybean Oil Mills	14.2500	2075
120	Vegetable Oil Mills (N.E.C.)	14.2600	2076
121	Animal & Marine Fats & Oils	14.2700	2077
122	Roasted Coffee	14.2800	2095
123	Shortening & Cooking Oils	14.2900	2079
124	Manufactured Ice	14.3000	2097
125	Macaroni & Spaghetti	14.3100	2098
126	Food Preparations (N.E.C.)	14.3200	2099
127	Cigarettes	15.0101	2111
128	Cigars	15.0102	2121
129	Chewing & Smoking Tobacco	15.0103	2131
130	Tobacco Stemming & Redrying	15.0200	2141
131	Broadwoven Fabric Mills & Finishing	16.0100	2211, 2221, 2231, 2261, 2262
132	Narrow Fabric Mills	16.0200	2241
133	Yarn Mills & Finishing of Textiles (N.E.C.)	16.0300	2269, 2281, 2282, 2283
134	Thread Mills	16.0400	2284
135	Floor Coverings	17.0100	2273
136	Felt Goods (N.E.C.)	17.0200	2291
137	Lace Goods	17.0300	2292
138	Padding & Upholstery Filling	17.0400	2293
139	Processed Textile Waste	17.0500	2294
140	Coated Fabrics (Not Rubberized)	17.0600	2295
141	Tire Cord & Fabric	17.0700	2296

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commidity	Standard Industry Classification
142	Cordage & Twine	17.0900	2298
143	Nonwoven Fabrics	17.1001	2297
144	Textile Goods (N.E.C.)	17.1002	2299
145	Women's Hosiery (Except Socks)	18.0101	2251
146	Hosiery (N.E.C.)	18.0102	2252
147	Knit Outerwear Mills	18.0201	2253
148	Knit Underwear Mills	18.0202	2254
149	Knitting Mills (N.E.C.)	18.0203	2259
150	Knit Fabric Mills	18.0300	2257, 2258
151	Apparel Made From Purchased Materials	18.0400	2310, 2320, 2330, 2340, 2350, 2360, 2370, 2380 Also: part of 3999
152	Curtains & Draperies	19.0100	2391
153	Housefurnishings (N.E.C.)	19.0200	2392
154	Textile Bags	19.0301	2393
155	Canvas Products	19.0302	2394
156	Pleating & Stitching	19.0303	2395
157	Automotive & Apparel Trimmings	19.0304	2396
158	Schiffi Machine Embroideries	19.0305	2397
159	Fabricated Textile Products (N.E.C.)	19.0306	2399
160	Logging Camps & Logging Contractors	20.0100	2410
161	Sawmills & Planning Mills, General	20.0200	2421
162	Hardwood Dimension & Flooring Mills	20.0300	2426
163	Special Product Sawmills (N.E.C.)	20.0400	2429
164	Millwork	20.0501	2431
165	Wood Kitchen Cabinets	20.0502	2434
166	Veneer & Plywood	20.0600	2435, 2436
167	Structural Wood Members (N.E.C.)	20.0701	2439
168	Prefabricated Wood Buildings	20.0702	2452
169	Wood Preserving	20.0800	2491
170	Wood Pallets & Skids	20.0901	2448
171	Particleboard	20.0902	2492
172	Wood Products (N.E.C.)	20.0903	2499
173	Wood Containers	21.0000	2441, 2449
174	Wood Household Furniture	22.0101	2511
175	Household Furniture (N.E.C.)	22.0102	2519
176	Wood TV & Radio Cabinets	22.0103	2517
177	Upholstered Household Furniture	22.0200	2512
178	Metal Household Furniture	22.0300	2514
179	Mattresses & Bedsprings	22.0400	2515
180	Wood Office Furniture	23.0100	2521
181	Metal Office Furniture	23.0200	2522
182	Public Building Furniture	23.0300	2531
183	Wood Partitions & Fixtures	23.0400	2541
184	Metal Partitions & Fixtures	23.0500	2542
185	Blinds, Shades, & Drapery Hardware	23.0600	2591
186	Furniture & Fixtures (N.E.C.)	23.0700	2599
187	Pulp Mills	24.0100	2610
188	Paper Mills (Except Building Paper)	24.0200	2620
189	Paperboard Mills	24.0300	2630

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
190	Envelopes	24.0400	2642
191	Sanitary Paper Products	24.0500	2647
192	Building Paper & Board Mills	24.0602	2660
193	Paper Coating & Glazing	24.0701	2641
194	Bags (Except Textile)	24.0702	2643
195	Die-Cut Paper & Board	24.0703	2645
196	Pressed & Molded Pulp Goods	24.0704	2646
197	Stationery Products	24.0705	2648
198	Converted Paper Products (N.E.C.)	24.0706	2649
199	Paperboard Containers & Boxes	25.0000	2650
200	Newspapers	26.0100	2710
201	Periodicals	26.0200	2720
202	Book Publishing	26.0301	2731
203	Book Printing	26.0302	2732
204	Misc. Publishing	26.0400	2740
205	Commercial Printing	26.0501	2751, 2752, 2754
206	Lithographic Platemaking & Services	26.0502	2795
207	Manifold Business Forms	26.0601	2760
208	Blankbooks & Looseleaf Binders	26.0602	2782
209	Greeting Card Publishing	26.0700	2770
210	Engraving & Plate Printing	26.0801	2753
211	Bookbinding & Related Work	26.0802	2789
212	Typesetting	26.0803	2791
213	Photoengraving	26.0804	2793
214	Electrotyping & Stereotyping	26.0805	2794
215	Industrial Inorganic & Organic Chemicals	27.0100	2810, 2865, 2869 In reality only part of 2819
216	Nitrogenous & Phosphatic Fertilizers	27.0201	2873, 2874
217	Fertilizers (Mixing Only)	27.0202	2875
218	Agricultural Chemicals (N.E.C.)	27.0300	2879
219	Gum & Wood Chemicals	27.0401	2861
220	Adhesives & Sealants	27.0402	2891
221	Explosives	27.0403	2892
222	Printing Ink	27.0404	2893
223	Carbon Black	27.0405	2895
224	Chemical Preparations (N.E.C.)	27.0406	2899
225	Plastics Materials & Resins	28.0100	2821
226	Synthetic Rubber	28.0200	2822
227	Cellulosic Man-Made Fibers	28.0300	2823
228	Organic Fibers (Noncellulosic)	28.0400	2824
229	Drugs	29.0100	2830
230	Soap & Other Detergents	29.0201	2841
231	Polishes & Sanitation Goods	29.0202	2842
232	Surface Active Agents	29.0203	2843
233	Toilet Preparations	29.0300	2844
234	Paints & Allied Products	30.0000	2850
235	Petroleum Refining	31.0101	2910
236	Lubricating Oils & Greases	31.0102	2992
237	Petroleum & Coal Products (N.E.C.)	31.0103	2999
238	Paving Mixtures & Blocks	31.0200	2951

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
239	Asphalt Felts & Coatings	31.0300	2952
240	Tires & Inner Tubes	32.0100	3011
241	Rubber & Plastics Footwear	32.0200	3021
242	Reclaimed Rubber	32.0301	3031
243	Fabricated Rubber Products (N.E.C.)	32.0302	3061
244	Misc. Plastics Products	32.0400	3079
245	Rubber & Plastics Hose & Belting	32.0500	3041
246	Leather tanning & Finishing	33.0001	3111
247	Footwear Cut Stock	34.0100	3131
248	Shoes (Except Rubber)	34.0201	3143, 3144, 3149
249	House Slippers	34.0202	3142
250	Leather Gloves & Mittens	34.0301	3151
251	Luggage	34.0302	3161
252	Women's Handbags & Purses	34.0303	3171
253	Personal Leather Goods	34.0304	3172
254	Leather Goods (N.E.C.)	34.0305	3199
255	Glass Products (N.E.C.)	35.0100	3211, 3229, 3231
256	Glass Containers	35.0200	3221
257	Cement, Hydraulic	36.0100	3241
258	Brick & Structural Clay Tile	36.0200	3251
259	Ceramic Wall & Floor Tile	36.0300	3253
260	Clay Refractories	36.0400	3255
261	Structural Clay Products (N.E.C.)	36.0500	3259
262	Vitreous Plumbing Fixtures	36.0600	3261
263	Vitreous China Food Utensils	36.0701	3262
264	Fine Earthenware Food Utensils	36.0702	3263
265	Porcelain Electrical Supplies	36.0800	3264
266	Pottery Products (N.E.C.)	36.0900	3269
267	Concrete Block & Brick	36.1000	3271
268	Concrete Products (N.E.C.)	36.1100	3272
269	Ready-Mixed Concrete	36.1200	3273
270	Lime	36.1300	3274
271	Gypsum Products	36.1400	3275
272	Cut Stone & Stone Products	36.1500	3281
273	Abrasive Products	36.1600	3291
274	Asbestos Products	36.1700	3292
275	Gaskets, Packing & Sealing Devices	36.1800	3293
276	Minerals, Ground or Treated	36.1900	3295
277	Mineral Wool	36.2000	3296
278	Nonclay Refractories	36.2100	3297
279	Nonmetallic Mineral Products (N.E.C.)	36.2200	3299
280	Blast Furnaces & Steel Mills	37.0101	3312
281	Electrometallurgical Products	37.0102	3313
282	Steel Wire & Related Products	37.0103	3315
283	Cold Finishing of Steel Shapes	37.0104	3316
284	Steel Pipe & Tubes	37.0105	3317
285	Iron & Steel Foundries	37.0200	3321
286	Iron & Steel Forging	37.0300	3462
287	Metal Heat Treating	37.0401	3398

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
288	Primary Metal Products (N.E.C.)	37.0402	3399
289	Primary Copper	38.0100	3331
290	Primary Lead	38.0200	3332
291	Primary Zinc	38.0300	3333
292	Primary Aluminum	38.0400	3334 Also: part of 2819
293	Primary Non-Ferrous Metals (N.E.C.)	38.0500	3339
294	Secondary Non-Ferrous Metals	38.0600	3340
295	Copper Rolling & Drawing	38.0700	3351
296	Aluminum Rolling & Drawing	38.0800	3353, 3354, 3355
297	Non-Ferrous Rolling & Drawing (N.E.C.)	38.0900	3356
298	Non-Ferrous Wire Drawing & Insulating	38.1000	3357
299	Aluminum Castings	38.1100	3361
300	Brass, Bronze, & Copper Castings	38.1200	3362
301	Non-Ferrous Castings (N.E.C.)	38.1300	3369
302	Non-Ferrous Forging	38.1400	3463
303	Metal Cans	39.0100	3411
304	Metal Barrels, Drums, & Pails	39.0200	3412
305	Metal Sanitary Ware	40.0100	3431
306	Plumbing Fixture Fittings & Trim	40.0200	3432
307	Heating Equipment (Except Electric)	40.0300	3433
308	Fabricated Structural Metal	40.0400	3441
309	Metal Doors, Sash, & Trim	40.0500	3442
310	Fabricated Plate Work (Boiler Shops)	40.0600	3443
311	Sheet Metal Work	40.0700	3444
312	Architectural Metal Work	40.0800	3446
313	Prefabricated Metal Buildings	40.0901	3448
314	Misc. Metal Work	40.0902	3449
315	Screw Machine Products & Bolts	41.0100	3450
316	Automotive Stamping	41.0201	3465
317	Crowns & Closures	41.0202	3466
318	Metal Stamping (N.E.C.)	41.0203	3469
319	Cutlery	42.0100	3421
320	Hand & Edge Tools (N.E.C.)	42.0201	3423
321	Hand Saws & Saw Blades	42.0202	3425
322	Hardware (N.E.C.)	42.0300	3429
323	Plating & Polishing	42.0401	3471
324	Metal Coating & Allied Services	42.0402	3479
325	Misc. Fabricated Wire Products	42.0500	3495, 3496
326	Steel Springs (Except Wire)	42.0700	3493
327	Pipe, Valves, & Pipe Fittings	42.0800	3494, 3498
328	Metal Foil & Leaf	42.1000	3497
329	Fabricated Metal Products (N.E.C.)	42.1100	3499
330	Steam Engines & Turbines	43.0100	3511
331	Internal Combustion Engines (N.E.C.)	43.0200	3519
332	Farm Machinery & Equipment	44.0001	3523
333	Lawn & Garden Equipment	44.0002	3524
334	Construction Machinery & Equipment	45.0100	3531
335	Mining Machinery (Except Oil Fields)	45.0200	3532
336	Oil Field Machinery	45.0300	3533

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
337	Elevators & Moving Stairways	46.0100	3534
338	Conveyors & Conveying Equipment	46.0200	3535
339	Hoists, Cranes, & Monorails	46.0300	3536
340	Industrial Trucks & Tractors	46.0400	3537
341	Machine Tools, Metal Cutting Types	47.0100	3541
342	Machine Tools, Metal Forming Types	47.0200	3542
343	Special Dies & Tools & Accessories	47.0300	3544, 3545
344	Power Driven Hand Tools	47.0401	3546
345	Rolling Mill Machinery	47.0402	3547
346	Metalworking Machinery (N.E.C.)	47.0403	3549
347	Food Products Machinery	48.0100	3551
348	Textile Machinery	48.0200	3552
349	Woodworking Machinery	48.0300	3553
350	Paper Industries Machinery	48.0400	3554
351	Printing Trades Machinery	48.0500	3555
352	Special Industry Machinery (N.E.C.)	48.0600	3559
353	Pumps & Compressors	49.0100	3561, 3563
354	Ball & Roller Bearings	49.0200	3562
355	Blowers & Fans	49.0300	3564
356	Industrial Patterns	49.0400	3565
357	Power Transmission Equipment	49.0500	3566, 3568
358	Industrial Furnaces & Ovens	49.0600	3567
359	General Industrial Machinery (N.E.C.)	49.0700	3569
360	Carburetors, Pistons, Rings, Valves	50.0001	3592
361	Machinery (Except Electrical) (N.E.C.)	50.0002	3599
362	Electronic Computing Equipment	51.0101	3573
363	Calculating & Accounting Machinery	51.0102	3574
364	Scales & Balances	51.0300	3576
365	Typewriters & Office Machines	51.0400	3572, 3579
366	Automatic Merchandising Machines	52.0100	3581
367	Commercial Laundry Equipment	52.0200	3582
368	Refrigeration & Heating Equipment	52.0300	3585
369	Measuring & Dispensing Pumps	52.0400	3586
370	Service Industry Machines (N.E.C.)	52.0500	3589
371	Instruments to Measure Electricity	53.0100	3825
372	Transformers	53.0200	3612
373	Switchgear & Switchboard Apparatus	53.0300	3613
374	Motors & Generators	53.0400	3621
375	Industrial Controls	53.0500	3622
376	Welding Apparatus, Electric	53.0600	3623
377	Carbon & Graphite Products	53.0700	3624
378	Electrical Industrial Apparatus (N.E.C.)	53.0800	3629
379	Household Cooking Equipment	54.0100	3631
380	Household Refrigerators & Freezers	54.0200	3632
381	Household Laundry Equipment	54.0300	3633
382	Electric Housewares & Fans	54.0400	3634
383	Household Vacuum Cleaners	54.0500	3635
384	Sewing Machines	54.0600	3636
385	Household Appliances (N.E.C.)	54.0700	3639

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
386	Electric Lamps	55.0100	3641
387	Lighting Fixtures & Equipment	55.0200	3645, 3646, 3647, 3648
388	Wiring Devices	55.0300	3643, 3644
389	Radio & TV Receiving Sets	56.0100	3651
390	Phonograph Records & Tapes	56.0200	3652
391	Telephone & Telegraph Apparatus	56.0300	3661
392	Radio & TV Communication Equipment	56.0400	3662
393	Electron Tubes	57.0100	3671, 3672, 3673
394	Semiconductors & Related Devices	57.0200	3674
395	Electronic Components (N.E.C.)	57.0300	3675,3676, 3677, 3678, 3679
396	Storage Batteries	58.0100	3691
397	Primary Batteries, Dry & Wet	58.0200	3692
398	X-Ray Apparatus & Tubes	58.0300	3693
399	Engine Electrical Equipment	58.0400	3694
400	Electrical Equipment (N.E.C.)	58.0500	3699
401	Truck & Bus Bodies	59.0100	3713
402	Truck Trailers	59.0200	3715
403	Motor Vehicles	59.0301	3711
404	Motor Vehicle Parts & Accessories	59.0302	3714
405	Aircraft	60.0100	3721
406	Aircraft & Missile Engines & Parts	60.0200	3724, 3764
407	Aircraft & Missile Equipment (N.E.C.)	60.0400	3728, 3769
408	Ship Building & Repairing	61.0100	3731
409	Boat Building & Repairing	61.0200	3732
410	Railroad Equipment	61.0300	3740
411	Motorcycles, Bicycles, & Parts	61.0500	3750
412	Travel Trailers & Campers	61.0601	3792
413	Mobile Homes	61.0602	2451
414	Motor Homes	61.0603	3716
415	Transportation Equipment (N.E.C.)	61.0700	3799
416	Engineering & Scientific Instruments	62.0100	3811
417	Mechanical Measuring Devices	62.0200	3823, 3824, 3829
418	Automatic Temperature Controls	62.0300	3822
419	Surgical & Medical Instruments	62.0400	3841
420	Surgical Appliances & Supplies	62.0500	3842
421	Dental Equipment & Supplies	62.0600	3843
422	Watches, Clocks, & Parts	62.0700	3870
423	Optical Instruments & Lenses	63.0100	3830
424	Ophthalmic Goods	63.0200	3850
425	Photographic Equipment & Supplies	63.0300	3860
426	Jewelry, Precious Metal	64.0101	3911
427	Jewelers' Materials & Lapidary	64.0102	3915
428	Silverware & Plated Ware	64.0104	3914
429	Costume Jewelry	64.0105	3961
430	Musical Instruments	64.0200	3930
431	Games, Toys, & Children's Vehicles	64.0301	3944
432	Dolls	64.0302	3942
433	Sporting & Athletic Goods	64.0400	3949
434	Pens & Mechanical Pencils	64.0501	3951

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
435	Lead Pencils & Art Goods	64.0502	3952
436	Marking Devices	64.0503	3953
437	Carbon Paper & Inked Ribbons	64.0504	3955
438	Artificial Trees & Flowers	64.0600	3962
439	Buttons	64.0701	3963
440	Needles, Pins, & Fasteners	64.0702	3964
441	Brooms & Brushes	64.0800	3991
442	Hard Surface Floor Coverings	64.0900	3996
443	Burial Caskets & Vaults	64.1000	3995
444	Signs & Advertising Displays	64.1100	3993
445	Manufacturing Industries (N.E.C.)	64.1200	3999 In reality: part of 3999
446	Railroads & Related Services	65.0100	4010, 4040, 4740 Also: part of 4789
447	Local, Interurban Passenger Transit	65.0200	4110, 4120, 4130, 4140, 4150, 4170
448	Motor Freight Transport & Warehousing	65.0300	4210, 4220, 4230 Also: part of 4789
449	Water Transportation	65.0400	4410, 4420, 4430, 4440, 4450, 4460
450	Air Transportation	65.0500	4510, 4520, 4580
451	Pipe Lines (Except Natural Gas)	65.0600	4610
452	Transportation Services	65.0701	4710, 4723, 4780 In reality: part of 4780
453	Arrangement of Passenger Transportation	65.0702	4722
454	Communications (Except Radio & TV)	66.0000	4810, 4820, 4890
455	Radio & TV Broadcasting	67.0000	4830
456	Electric Services	68.0100	4910 Also: part of 4930
457	Gas Production & Distribution	68.0200	4920 Also: part of 4930
458	Water Supply & Sewage System	68.0301	4940, 4952
459	Sanitary Services & Steam Supplies	68.0302	4953, 4959, 4960, 4970 Also: part of 4930
460	Recreational Related Wholesale Trade	69.0101	5041, 5043
461	Other Wholesale Trade	69.0102	5010, 5020, 5030, 5042, 5050, 5060, 5070, 5080, 5090, 5100
462	Recreational Related Retail Trade	69.0201	5551, 5561, 5941, 5946, 5947, 5948
463	Other Retail Trade	69.0202	5200, 5300, 5400, 5510, 5520, 5530, 5540, 5570, 5590, 5600, 5700, 5910, 5920, 5930, 5942, 5943, 5944, 5945, 5949, 5960, 5980, 5990, 7396, 8042
464	Banking	70.0100	6000
465	Credit Agencies	70.0200	6100, 6710, 6720, 6733, 6790
466	Security & Commodity Brokers	70.0300	6200
467	Insurance Carriers	70.0400	6300
468	Insurance Agents & Brokers	70.0500	6400
469	Owner-Occupied Dwellings	71.0100	
470	Real Estate	71.0200	6500, 6600 Also: part of 1531; excluding part of 6552
471	Hotels & Lodging Places	72.0100	7000
473	Laundry, Cleaning, & Shoe Repair	72.0201	7210, 7250
473	Funeral Service & Crematories	72.0202	7260
474	Portrait & Photographic Studios	72.0203	7220, 7290
475	Electrical Repair Services	72.0204	7620
476	Watch, Clock, Jewelry & Furniture Repair	72.0205	7630, 7640
477	Beauty & Barber Shops	72.0300	7230, 7240
478	Misc. Repair Shops	73.0101	7690
479	Services to Buildings	73.0102	7340
480	Personnel Supply Services	73.0103	7360
481	Computer & Data Processing Services	73.0104	7370

No.	IMPLAN Sector Name	Bureau of Economic Analysis Commodity	Standard Industry Classification (SIC)
482	Management & Consulting Services	73.0105	7391, 7392, 7397
483	Detective & Protective Services	73.0106	7393
484	Equipment Repair & Leasing	73.0107	7394
485	Photofinishing, Commercial Photography	73.0108	7332, 7333, 7395
486	Other Business Services	73.0109	7320, 7331, 7339, 7350, 7399
487	Advertising	73.0200	7310
488	Legal Services	73.0301	8110
489	Engineering, Architectural Services	73.0302	8910
490	Accounting, Auditing, & Bookkeeping	73.0303	8930, 8990
491	Eating & Drinking Places	74.0000	5800 Also: part of 70
492	Automobile Rental & Leasing	75.0001	7510
493	Automobile Repair & Services	75.0002	7530, 7549
494	Automobile Parking & Car Wash	75.0003	7520, 7542
495	Motion Pictures	76.0100	7800
496	Dance Halls, Studios, & Schools	76.0200	7910
497	Theatrical Producers, Bands, Etc.	76.0201	7920
498	Bowling Alleys & Pool Halls	76.0202	7930
499	Commercial Sports (Except Racing)	76.0203	7941
500	Racing & Track Operation	76.0204	7948
501	Membership Sports & Recreation	76.0205	7997
502	Amusement & Recreation Service	76.0207	7992, 7993, 7996, 7999
503	Doctors & Dentists	77.0100	8010, 8020, 8030, 8041
504	Hospitals	77.0200	8060
505	Nursing & Protective Care	77.0301	8050
506	Other Medical & Health Services	77.0302	0740, 8049, 8070, 8080, 8090
507	Elementary & Secondary Schools	77.0401	8210
508	Colleges, Universities, Schools	77.0402	8220
509	Other Educational Services	77.0403	8230, 8240, 8290
510	Business Associations	77.0501	8610, 8620
511	Labor & Civil Organizations	77.0502	8630, 8640
512	Religious Organizations	77.0503	8660
513	Other Nonprofit Organizations	77.0504	8400, 8650, 8690, 6732, 8922
514	Residential Care	77.0800	8361
515	Social Services (N.E.C.)	77.0900	8321, 8399, 8331, 8351
516	U.S. Postal Service	78.0100	4311
517	Federal Electric Utilities	78.0200	Part of 491
518	Other Federal Government Enterprises	78.0400	--
519	Local Government Passenger Transit	79.0100	Part of 41
520	State & Local Electric Utilities	79.0200	Part of 491
521	Other State & Local Government Enterprises	79.0300	--
522	Noncomparable Imports	80.0000	--
523	Scrap	81.0001	--
524	Used & Secondhand Goods	81.0002	--
525	Government Industry	82.0000	--
526	Rest of the Worl Industry	83.0000	--
527	Household Industry	84.0000	8800
528	Inventory Valuation Adjustment	85.0000	--

GLOSSARY

By-Products Matrix The fraction of each industry's Total Output that each commodity represents.

Absorption Matrix The fractions of each industry's total outlay spent on commodities consumed during production, net of imports.

Make Matrix The values of commodities produced by each industry.

Use Matrix The values of commodities (columns) used in production by each industry (rows), net of imports.

Market Shares The fraction of each commodity's Total Supply produced by each industry.

Total Absorption Coefficient The corresponding industry column from the National absorption matrix (if unmodified).

Gross Inputs The industry's total purchase of the commodity (includes imports). This can be calculated as Total Industry Output * Total Absorption Coefficient

Regional Absorption Coefficient The fraction of the industry's total outlay spent on a commodity (net of imports). This is the product of the Total Absorption Coefficient * RPC.

Regional Inputs The industry's local purchase of each commodity. This is equal the product of Gross Inputs times the RPC.

Domestic Imports This is actually Total Imports and is equal to Gross Inputs minus Regional Inputs.

Value added components and Total Industry Output are shown to complete the input requirements for the industry balance sheet.

Industry Production Total production of the highlighted commodity by each industry producing the commodity.

Market Share Coefficient The non-zero components from the corresponding commodity column of the Market Share matrix.

By-Product Coefficient The non-zero components from the corresponding commodity column of the By-product matrix.

GLOSSARY

By-Products Matrix The fraction of each industry's Total Output that each commodity represents.

Absorption Matrix The fractions of each industry's total outlay spent on commodities consumed during production, net of imports.

Make Matrix The values of commodities produced by each industry.

Use Matrix The values of commodities (columns) used in production by each industry (rows), net of imports.

Market Shares The fraction of each commodity's Total Supply produced by each industry.

Total Absorption Coefficient The corresponding industry column from the National absorption matrix (if unmodified).

Gross Inputs The industry's total purchase of the commodity (includes imports). This can be calculated as Total Industry Output * Total Absorption Coefficient

Regional Absorption Coefficient The fraction of the industry's total outlay spent on a commodity (net of imports). This is the product of the Total Absorption Coefficient * RPC.

Regional Inputs The industry's local purchase of each commodity. This is equal the product of Gross Inputs times the RPC.

Domestic Imports This is actually Total Imports and is equal to Gross Inputs minus Regional Inputs.

Value added components and Total Industry Output are shown to complete the input requirements for the industry balance sheet.

Industry Production Total production of the highlighted commodity by each industry producing the commodity.

Market Share Coefficient The non-zero components from the corresponding commodity column of the Market Share matrix.

By-Product Coefficient The non-zero components from the corresponding commodity column of the By-product matrix.

Appendix N

1993 CDFG
1603 Notification Process

STATE OF CALIFORNIA—THE RESOURCES AGENCY PETE WILSON, *Governor*

DEPARTMENT OF FISH AND GAME
601 LOCUST STREET
REDDING, CA 96001
(916) 225-2300

RECEIVED
APR 13 1993
HUMBOLDT COUNTY
PLANNING COMMISSION

April 7, 1993

Humboldt County Gravel Operators:

1993 Streambed Alteration Agreement Notification Process
Gravel Extraction and Monitoring, Humboldt County

The Department of Fish and Game (DFG) has previously contacted you by letter (November 1990, February 1991) summarizing the information needed by DFG to evaluate your gravel extraction project. These needs were described relative to your 1991 and 1992 streambed alteration agreements which were consummated pursuant to Fish and Game Code, Section 1600 et seq. We requested this information to help us begin the difficult task of assessing direct as well as cumulative impacts of gravel operations. These impacts relate to the number and proximity of operations on adjacent parcels on the same bar, as well as operations on consecutive bars, both upstream and downstream.

We have occasionally asked members of the scientific community qualified in hydrology, geology and engineering to review certain gravel extraction projects for potential impacts to fish and wildlife resources. In addition, through the memorandum of understanding (MOU) process completed last year for the Mad River, a scientific committee reviewed several proposed gravel operations. During their review, the scientists discovered that it was difficult to interpret some of the cross-sectional or project map information provided us by operators. They also observed that the presentation of information was not always consistent between different operators.

Based on these experiences and a desire to avoid future problems, we began developing a consensus building process through which we can standardize and clarify the informational and monitoring requirements for streambed alteration agreements for gravel extraction projects. A key component of this process is the development of consistent guidelines for applicants to use in describing clearly the specific physical aspects of proposed extractions, which in turn will form the basis upon which the DFG can evaluate potential adverse project impacts or benefits and develop mitigation measures.

In addition, the requested information is essential for the DFG, Humboldt County and the applicant to be able to monitor the success of extraction prescriptions in achieving desired mitigation goals and thus prevent impacts to fish and wildlife resources. These same techniques may also be required by Humboldt

County, the local lead agency, when they establish monitoring requirements and develop gravel management plans for gravel extraction projects on the Mad, Trinity, Eel, and Van Duzen River systems.

To accomplish our goals in this regard, a series of meetings was held in an attempt to determine what information is specifically needed to conduct a thorough review of gravel extraction project impacts to stream resources. These meetings clearly established the need for a more coordinated approach for providing project information, monitoring and data collection. The first meeting was attended by the DFG, Mr. Tom Conlon (Humboldt County Planning Department Director), Mr. William Davis (representing most north coast gravel operators), some environmental groups and numerous gravel operators and their consultants/engineers.

During this initial meeting, the attendees agreed by consensus that it would be to everyone's benefit to develop standardized and consistent informational requirements and monitoring standards for incorporation into the DFG's streambed alteration agreement process for gravel extraction projects. The group also agreed that this information would be developed in subsequent meetings with representatives from DFG, Pacific Affiliates, Trinity River Restoration Associates, Incorporated, Rising Sun Enterprises, Baird Engineering, Dr. Douglas Jager, Dr. William Trush, Mr. Randy Klein and others. After this initial meeting, two additional meetings were held.

We are very encouraged by the progress made at these meetings in the development of informational requirements and monitoring standards. We also appreciate the willingness of the operators to work together cooperatively and operate on the river in a manner that benefits gravel procurement while protecting riverine resources. We believe this approach worked well last year on the Mad River. Humboldt County's environmental impact report for gravel extraction on the lower Eel River strongly focuses on this type of approach.

We encourage operators who work adjacent parcels and bars, as well as their respective consultants/engineers, to coordinate their information gathering and monitoring activities. Such coordination should significantly reduce duplication of effort and costs associated with these informational and monitoring requirements and could go a long way toward achieving our mutual goal of sustainable gravel extraction and fish and wildlife resource protection on our coastal rivers and streams.

The criteria presented here will form much of the basis for the DFG to develop streambed alteration agreements for gravel extraction projects. We also believe Humboldt County, as lead agency, could use this information in formulating a program for managing gravel extraction on a river system basis.

Based on the consensus reached by the scientific community and the local operators and their consultants/engineers, the DFG will require that the following information be included in all 1993 streambed alteration agreement notifications. There are some exceptions to these requirements described below that may apply to smaller operations that extract less that 5,000 cubic yards of material. Incomplete notifications will not be accepted and will be returned to the applicant.

Except as provided below, all notifications of streambed alteration for gravel extraction projects shall include, at a minimum, the following documentation and information:

A. Documentation of approved conditional use/vested right entitlements and reclamation plans. It is not necessary to resubmit this information if your entitlement was approved prior to 1992 and DFG has already received a complete copy. The DFG cannot issue a streambed alteration agreement for gravel extraction unless the applicant already has a legal entitlement from the local lead agency to extract gravel. In addition, we cannot issue an agreement for amounts that exceed the maximum identified quantity or using an extraction method that is inconsistent with legal entitlements and reclamation plans.

B. A blue line print (print) of a recent (within one year and since the most recent high water) aerial photograph at a scale of 1" = 400' that shows the river at a low enough flow such that the entire proposed extraction area is above water and clearly visible. In addition, all parcel lines, horizontal and vertical control points, cross sections, permanent monuments, and bench marks shall be clearly delineated on the print. The print shall also contain a legend which has the project name, property owner, Assessor's parcel number and the date and scale of the underlying aerial photograph used to make the print.

C. A preextraction narrative shall specify all methods and areas that may be potentially worked and these areas shall be delineated and detailed on the print. A project map drawn to a scale of 1" = 400' on the print, or on a sheet of clear acetate (mylar) overlaying the print, shall indicate

the exact location and limits of the proposed gravel operation, as well as access roads, equipment storage areas, stockpile areas and established riparian vegetation.

Although not mandatory, we recommend applicants consider using a more detailed print and project map scale (e.g. 1" = 100' or 1" = 50') where appropriate to show a more detailed extraction scenario in cases where a 1" = 400' scale results in a map that is too cluttered to read or understand adequately.

A clearly documented estimate of gravel recruitment from the previous winter, based on preextraction transects of successive seasons, should be provided.

D. The pre- and postextraction transects shall be established according to the following criteria:

1. Two bench marks (e.g., permanent monuments) shall be established for each bar above the stream's active banks. Bench mark elevations shall be reported or indicated relative to the 1929 National Geodetic Datum elevation for sea level and serve as common elevational controls for all transects.

2. Surveyed transects should be accurate to 0.1 feet and must document all breaks in slope, water's edge and, where readily discernible, the high-water mark for the previous winter's flow. The maximum distance between any two elevational points along a transect shall be 50 feet, inclusive of the wetted portion. If the distance between elevational points is found to be level for the first 500 feet, then the distance between elevational points can be increased to 100 feet. Thalweg location and thalweg elevation measured at the time of the transect shall be included independent of the 50-foot requirement.

3. End points for each transect shall extend beyond the actively scoured channel width (bank full width) and (a) onto a terrace flooded by a 10-year flood or greater, or (b) into established riparian vegetation clearly older than 10 years (e.g., 4" dbh or larger).

4. Preextraction (spring) transects shall be surveyed each year at the appropriate time relative to the applicant's desire to begin extracting gravel. Only those portions of each transect inundated by the previous winter's highest water need to be resurveyed.

If the highest flood of the season occurs after the transect survey is completed, another transect survey must be completed. Thus, applicant's wishing to survey transects early in the spring should be aware that they will risk the need to resurvey if storm events occur.

Preextraction transect information submitted with the streambed alteration notification shall overlay the previous season's postextraction transects to document recruitment.

5. Postextraction (fall) transects need only be resurveyed through those portions of the transect altered by extraction, temporary stockpiles or construction of roads and equipment storage areas. Postextraction transects shall overlay the preextraction transects to demonstrate compliance with the streambed alteration agreement.

6. The number of required cross-sectional transects for individual projects shall be based on the following guidelines (a diagram prepared by Mr. Lane Davis, Pacific Affiliates, Inc., illustrating cross-section location and the following guidelines is attached):

   a. A hypothetical center line for the river channel, measured equidistant from both banks and delineating the actively scoured channel (bank full width), must be established to determine length of the project line.

   b. If the radius of curvature is less than ten times greater than the average actively scoured channel width of the project reach, the reach will be considered a bend. If the radius of curvature is ten times greater than the average actively scoured channel width of the project reach, the reach will be considered straight.

   c. Transects shall be oriented perpendicular to the radius of the curvature.

   d. Transects shall be no greater than 400 feet apart except on straight reaches which can be 500 feet. If the length of the project reach is not evenly divided by 400 or 500 feet, the number of transects should be rounded up, e.g., a straight

reach of 2300 feet along on the Eel River will require (2300/500 feet = 4.6) 5 transects as a minimum.

e. We encourage operators to do the following additional monitoring whenever any permanent bridge, instream water diversion facility or other significant permanent structure is located within 2000 feet upstream or downstream of the project boundaries. In those cases, an annual pre-extraction transect near the structure should be surveyed as described above. The applicant's consultant/engineer should contact the agency or entity responsible for the structure to coordinate surveying activity and discuss extraction plans with them.

f. All survey notes, maps, drawings, etc., prepared in meeting the requirements outlined in Item 6a-d above, shall be made available to DFG upon request if we find additional information is necessary for us to adequately evaluate project impacts or monitoring results.

E. Postextraction volumetric estimates.

The preextraction narrative shall also include a quantifiable procedure for determining the upcoming season's postextraction volume estimates. We believe that, in many cases, the required permanent transects for monitoring purposes may be too wide to provide an adequate estimate of extraction volumes. It will be the responsibility of the applicant to ensure additional transects are made using a scientifically acceptable method for making this estimate with reasonable accuracy and precision. In addition, the applicant or his engineer shall certify that such estimate is accurate to the best of their ability.

F. Cross-sections shall be delineated and provided to DFG according to the following criteria and in the following manner:

1. Cross section plots shall be drafted to a vertical scale of 1 inch = 5 feet, and horizontal scale of 1 inch = 50 feet.

2. A clear delineation of the high-water mark of the previous winter's peak flow, water's edge and specific survey dates shall be provided.

3. Right bank (RB) and left bank (LB) facing downstream shall be indicated on the project map. Zero distance in cross-sections shall always originate on the left bank (LB).

G. Although not mandatory, DFG would prefer having the cross-sectional information and aerial photograph presented on a 24-inch x 36-inch print keyed to the original 1" = 400' aerial photograph, with cross-sections plotted on 100-square/inch grid paper. It is also preferred that cross-sectional information and aerial photographs be presented on the same 24 x 36-inch mylar sheet, with the aerial photograph presented on the top 12 x 36-inch area and the cross-section overlays on the lower 12 x 36-inch area.

DFG recognizes there may be occasion for smaller projects under 5,000 yards to be exempted from some or all of these requirements. Exemptions will be valid for one year only and will not automatically allow the applicant to be exempt from the subsequent year's monitoring requirements. The DFG will grant exemptions on a case by case basis each year. The applicant must submit pertinent information and the rationale for an exemption early enough in the season for evaluation by DFG in a timely manner. The applicant's compliance with the previous year's streambed alteration agreement conditions will be a major factor in DFG's decision regarding exemptions for subsequent years.

We realize that Fish and Game Code Section 1600 et seq. guarantees the applicant's right to arbitrate any conditions presented by the DFG in response to a notification. Because the informational and monitoring requirements described above were developed by consensus between DFG and representatives of the gravel operators, we believe future negotiations and possible arbitration will be limited to specific prescriptions for gravel extraction.

DFG will evaluate each project on a site by site basis and will be as flexible as possible in attempting to work with all operators. However, DFG is required to ensure our legislative and Fish and Game Commission mandates to protect fish and wildlife resources are met. This is especially important in terms of protecting anadromous fish spawning and rearing habitat.

DFG also realizes that it may be necessary for the operators and their consultants/engineers to alter or change some existing transects to conform to these standard requirements. In order to provide a reasonable transition period, we will not require complete compliance for transect relocation (items 6 a., b., c.) in 1993 but will make it mandatory for all 1994 notifications.

In addition, we recognize there may be more effective or efficient ways of developing, displaying or presenting the requested project and monitoring information. Therefore, we would appreciate receiving any suggestions you may have for improving this process once you have had an opportunity to try things out this year. We look forward to hearing from you at the end of this year's extraction season.

We again wish to express our appreciation for the cooperation of the gravel extraction industry in Humboldt County as we attempt to achieve the important goals of sustainable gravel extraction and natural resource protection within our river systems. If you have any questions regarding this matter, please contact Mr. Larry Preston at (707) 441-5736 or Ms. Karen Kovacs at (707) 441-5789.

Sincerely,

Richard L. Elliott

Richard L. Elliott
Regional Manager

Enclosure

cc: See attached list.

1993 MONITORING TRANSECTS GUIDELINES

Please refer to the sample drawing (Attachment "A") as you go through the following steps.

1. Delineate "Bankful Limit" (usually Vegetation Limit).

2. Scribe "Best Fit" centerline between the bankful limits ("Meander Centerline").

3. Identify: Beginning of Curve (BC)
   End of Curve (EC)
   Tangents

   EC's and BC's will be the points of inflection.

4. Scribe a line perpendicular to the tangent, at the inflection point (EC, BC); connect the lines to create a "Radial Axis".

5. Measure the angle, divide by five (5), and mark each segment.

6. Divide each segment in half and place a mark on the meander centerline.

7. Draw a line from the radial axis through each point (Step 6). The line should extend from the radial axis to the far bankful limit. The field transect shall be located on this line and shall extend from the left bankful limit to the right bankful limit.

8. The maximum distance between the transects shall be 500* feet as measured from points on the meander centerline.

9. The previously established transects (1991, 1992) shall be reviewed to see if they approximate this monitoring plan; otherwise, new transects will be required.

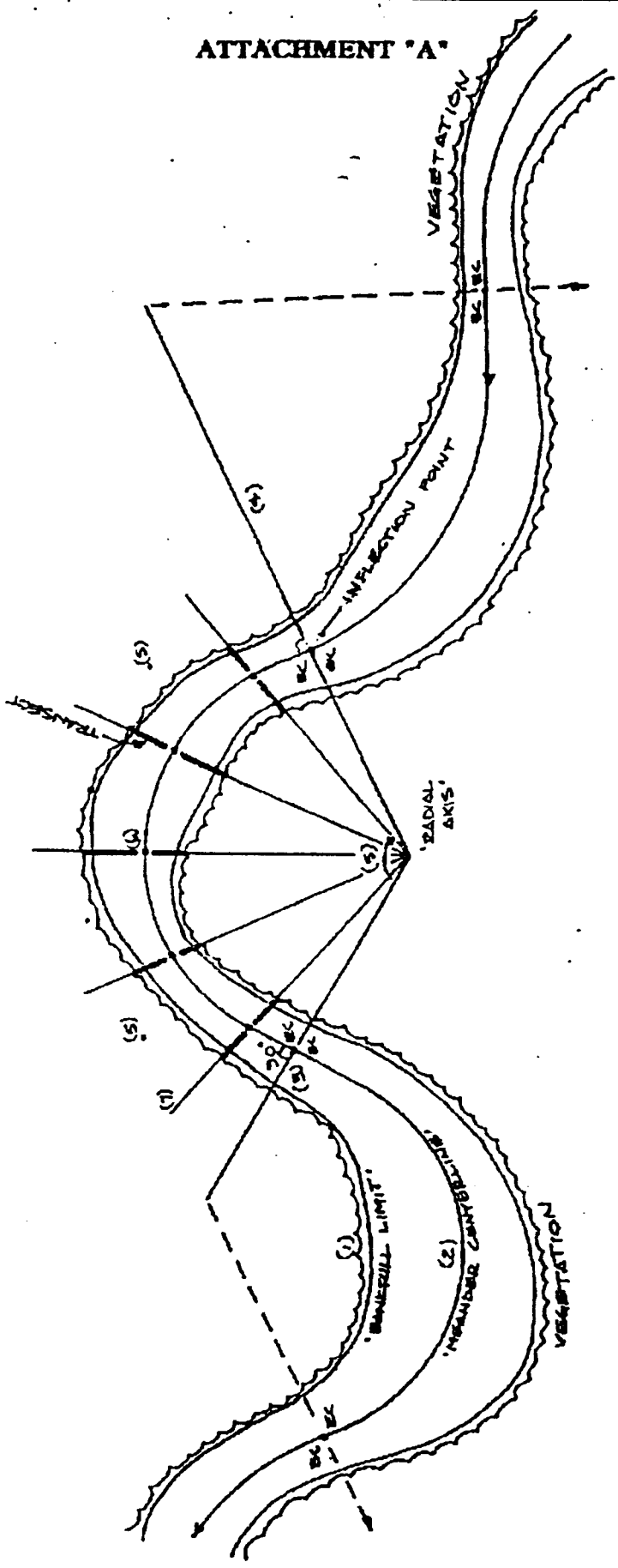
10. The 8-1/2"x17" photocopy (Attachment "B") shows the layout which shall be used for transect submittals. Aerial Photo Scale is 1"=400'. Cross-sections plotted at a scale of 1"=50' horizontally and 1"=5' vertically.

11. If you have any questions contact Mr. Larry Preston at the Department of Fish and Game, (707) 441-5736.

* 400 feet on curves.

(1/15/93)DPG

ATTACHMENT "A"



APPENDIX O

TESTIMONIALS REGARDING GRAVEL INDUSTRY

MERCER, FRASER COMPANY
General Contractors and Engineers
SINCE 1870
P.O. BOX 1006 • (707) 443-6371
EUREKA, CALIFORNIA 95502-1006

APRIL 22, 1992

THE GRAVEL FROM THE RIVERS IN HUMBOLDT, TRINITY, DEL NORTE, AND MENDOCINO COUNTIES IS THE MOST ECONOMICAL AND PRACTICAL MATERIAL FOR USE IN ALL CONSTRUCTION FOR HOMES, ROADS, SUBDIVISIONS, AND ANY OTHER CONSTRUCTION REQUIRING CONCRETE, ASPHALT MIX, OR PLAIN RIVER GRAVEL FILL.

IF CURRENT GRAVEL OPERATIONS ARE PROHIBITED FROM OBTAINING RIVER GRAVEL IN ORDER TO CONTINUE OPERATING, AND ARE FORCED TO USE OTHER SOURCES NAMELY ROCK QUARRIES OR IMPORTED MATERIALS FROM OTHER STATES THE PRICE OF THE PRODUCT WOULD BE PROHIBITIVE, ESPECIALLY TO NEW HOME BUILDERS AND TO BUILDING CONTRACTORS WHO USE CONCRETE AND ROCK PRODUCTS.

THIS ALONE WOULD DAMAGE OUR LOCAL ECONOMY, PROBABLY BRINGING ALL CONSTRUCTION TO A STAND STILL. THIS WOULD INCLUDE HIGHWAY AND BRIDGE CONSTRUCTION. THE MINING OF RIVER GRAVEL MUST CONTINUE FOR THE SAKE OF THE ECONOMY IN OUR AREA, WITHOUT THIS RESOURCE OUR ECONOMY IS CONDEMNED TO COMPLETE FAILURE.

SINCERELY,

Frederick O Bott

FREDERICK O. BOTT,
PRESIDENT

EUREKA READY MIX CONCRETE CO., INC.

EUREKA SAND & GRAVEL

P.O. Box 3568
Eureka, CA 95502-356

Mr.William O.Davis
Dun and Martinek
Attorneys at Law
730 Seventh St.,Suite B
Eureka, CA. 95501

April 23, 1992

Dear Mr. Davis,

I am sending you this letter to answer your question on alternate gravel sources in our area . At the present time there are no other sources for gravel in our local area other than the Mad,Eel,and Van Dusen rivers. I see no reason to believe this will change in the future. There are a few rock quarries locally but they deal in large,1 foot in diameter and larger, granite rock that would not be a usable material to make the products we need.

If these rivers were to be closed to gravel extraction it would have a devastating effect on our local economy. Unable to supply area contractors with concrete,sand and gravel they need to build homes and commercial buildings, we would be forced to close down. These possible river closures would also affect asphalt plants which supply materials to paving contractors.

Sincerely,

Larry McLaughlin

Larry McLaughlin
Eureka Readymix Co.

Eureka Office (707) 443-2791 • FAX (707) 443-1368
Blue Lake Plant (707) 822-2937 • Shop (707) 822-5736 • Shop FAX (707) 822-9218
Fortuna Plant (707) 725-4417 • Crescent City Plant (707) 464-3126

R.A.O. CONSTRUCTION CO., INC.

5503 WALNUT DRIVE ■ EUREKA, CA 95501 ■ 707-443-2118

APRIL 22, 1992

TO WHOM IT MAY CONCERN:

R.A.O. CONSTRUCTION COMPANY IS CONCERNED ABOUT RECENT RUMORS THAT PERMITS WILL NOT BE ISSUED FOR ANY EXTRACTION OF GRAVEL ON THE MAD RIVER AND ONLY A FEW PERMITS ISSUED ON THE EEL RIVER.

IF THIS WERE TO INDEED HAPPEN IT WOULD BE AN ECONOMICAL DISASTER TO R.A.O. CONSTRUCTION AND MANY OTHER BUSINESSES IN THIS AREA. IF A LOCAL BUSINESS COULD NOT SUPPLY US WITH SAND, GRAVEL, CONCRETE AND ASPHALT WE WOULD BE FORCED OUT OF BUSINESS. WE EMPLOY AN AVERAGE OF TEN PEOPLE FULL TIME AND ANOTHER SIX TO EIGHT PART TIME.THESE PEOPLE WOULD ALSO BE OUT OF WORK.

WE URGE YOU TO CONSIDER THE EFFECT NOT ISSUING PERMITS WOULD HAVE ON THIS COMMUNITY.

YOURS TRULY,

Rich Olson

RICH OLSON
PRESIDENT
R.A.O. CONSTRUCTION CO., INC.

DANCO
BUILDERS

April 22, 1992

To Whom It May Concern:

We are writing this letter in response to what affect the possibility of not having any local gravel will do to our business.

We are a general contractor, building residential and commercial projects. We use gravel, and concrete in our daily business.

In the event we have to import gravel, or go to a different method of construction, it could become quite costly and the new home builder may think twice about building his home in our local area. Or the commercial builder will think twice about building a new building or remodeling an old one in our area because the cost is much too high. Why build here, when you could build in Redding, Crescent City, etc. much lower.

Gravel and Concrete are the foundations of all building projects, and without it we can have no projects, and no forward growth for our County.

Sincerely,

Dan J. Johnson

3952 Jacobs Avenue, Eureka, CA 95501 • Tel: (707) 442-5911 • Facsimile: (707) 443-1946
CONTRACTOR'S LICENSE CA #500851

KRAMER PROPERTIES, INC.
1653 MYRTLE AVENUE • EUREKA, CA 95501 • (707) 444-2919

April 23, 1992

To whom it may concern:

This letter is in regard to the availability of readimix products (concrete, sand, gravel and asphalt).

We are a development/construction company and we use concrete, sand, gravel and asphalt regularly. We employee seven (7) individuals on a full-time basis. If the above mentioned readimix products were unavailable our business would be unoperational and our employees would be unemployed.

We hope this situation can be resolved and the permits issued soon.

Sincerely,

Kurt G. Kramer
President

ARCATA READIMIX

P.O. Box 4657 Arcata, California 95521

Phone (707) 822-1795

April 23, 1992

TO WHOM IT MAY CONCERN:

Immediate action is needed on our local rivers concerning the extraction of sand and gravel materials. These natural resources must be processed for use in construction of concrete and asphalt. In an already depressed and unemployed county, we need to find a balance between man and nature. If current gravel operations are not permitted, we will have to import these materials. The cost would be prohibitive. The damage to our local economy would bring construction to a halt. We cannot afford the impact this would have on our local owned businesses and their employees. The domino effect of this would be devastating to the economy and the quality of life of residents of the North coast.

Sincerely,

Bill O'Neill

Bill O'Neill
President

RESCO
construction

April 23, 1992

To Whom it May Concern:

It has recently come to my attention that permits have not yet been issued to extract gravel from the lower Mad River bar.

If this is not corrected soon, the agencies responsible for delaying this process will be making a major policy error.

Without a stable gravel supply, our local area's ability to produce gravel for asphalt and concrete will be seriously impacted. Both of these items are already in short supply, and are both necessary for maintaining our county's infrastructure.

The lower Mad River has long been a source of gravel for these purposes, and it is necessary that this continue. I understand and believe that environmental implications must be considered and we must strive for balance and fairness in our decision making and policy decisions.

This would include the impact of not harvesting the gravel - to the businesses that harvest the gravel, the employees and families that depend upon this to put food on the table and pay rent, and the end users of the gravel.

This gravel is eventually used to supply much needed housing, concrete for medical facilities, roads, employment, and a variety of other uses that benefit our society.

All of these factors should be entered into the equation.

It is my hope that action is taken soon so that these people can get back to business, and their employees can get out of the unemployment line.

Sincerely,

Jeffrey Smith
President

GENERAL CONTRACTORS

DENIS E. COSBY CONSTRUCTION
General Building and Concrete Construction
5000 West End Road, Suite #4 • Arcata, CA 95521 • (707) 822-2112
Lic. No. 437978

May 8,1992

Department of Fish and Game
Attention: Banky Curtis

Re: Gravel Extraction on local river bars

Gentlemen:

I wish to voice my concerns on the detrimental effects that closure of local rivers to gravel extraction will have.

I first want to mention that I do have concern for ecology and the environment. If I saw neglect or destructive actions purposefully taken that would harm the rivers, I would be taking these same steps in support of closure. Instead I have witnessed well planned, enacted and supervised gravel harvesting. Steps were taken to ensure water depth maintenance, flow stability and done at a time of the year for the least amount of impact on the river habitat. How much more can a business do in good faith to stay in business. Gravel is used in all phases of construction from road and foundation fill to concrete, asphalt and landscaping needs. The pressure on builders to supply affordable housing is greater than ever, yet nothing is happening to make that realistic; lumber prices through the roof, developers impact fees and escalating land prices. Gravel prices have doubled in the last two years and the outlook for gravel prices soaring is near with acceptance of a river bar closure. It comes down to jobs again: if you can't afford to build affordable housing, you can't stay in business, no work, no jobs.

The recent turn of events regarding development and the difficulty with project approval leads me to conclude that the agenda for the Audubon Society is singular: shut down development in Humboldt County completely. A narrow view which has no consideration for the welfare of the citizen and economy of Humboldt County.

Thank you for your time,

Denis E. Cosby

Denis E. Cosby
Denis E. Cosby Construction

DEC/tm

WES GREEN LANDSCAPING AND MATERIALS
5611 HEINDON RD
ARCATA, CA 95521

(707) 822-8035

May 8, 1992

Department of Fish & Game
Banky E. Curtis
Regional Manager
601 Locust St
Redding, CA 96001

Dear Mr. Curtis:

My name is Wes Green. I am an Excavating Contractor in Arcata. I am writing this letter in regards to the permits that are pending of the extraction of the gravel on the Mad River.

My company alone uses on the average of 15 to 20 thousand yards of gravel per year. With the economy and recent disaster of the earthquake, that we have had in our area, we will be using at least that much or more this year.

I would like to ask you to please issue permits to extract the gravel form the Mad River.

Thank You,

Wes Green

DUTRA TRUCKING CO., INC.
P.O. BOX 277
ARCATA, CA 95521
(707) 822-8133

May 8, 1992

Department of Fish & Game
Banky E. Curtis
Regional Manager
601 Locust Street
Redding, CA 96001

Dear Mr. Curtis:

We are a local trucking firm in the Arcata area. This letter is being written in regards to the permits that are pending of the extraction of the gravel on the Mad River.

With the current down swing in the economy and the recent damage caused by the earthquake in our area, our area could use the jobs and revenue generated by the release of the permits.

I would like to ask you to please issue permits to extract the gravel from the Mad River.

Sincerely,

DUTRA TRUCKING CO., INC.

Jim Cyphers

JDC:tls

McKenny & Sons, Inc.
General Building Contractors

2341 Fern St. • Eureka, California 95501 • (707) 443-2244

April 22, 1992

To Whom it May Concern:

We, as building constructors, are concerned with the onslaught of new found restrictions and regulations impacting the aggregate industry. The wide spread ramifications to the construction industry go without saying. Aggregate uses range from concrete (a primary structural component), sand (used in brick and tile works), to asphalt (paved roads).

The California Environmental Quality Act (CEQA) is being skewed towards a halting of aggregate removal. This is not the intended use of CEQA. Rather the CEQA process should be used to strike a **BALANCE** with all environmental concerns. The CEQA process does not specifically have to look at the economic impacts to the aggregate industry. It does, however, need to look at the environmental impacts associated with a limited supply of materials to our infrastructure. Further, secondary economic impacts such as affordable housing, the maintenance of existing road systems for traffic flow, and the construction of new infrastructures for the health and welfare of the population (the Freshwater Water Project, etc.) have to be considered.

The process for permits should be well defined. The process provides for a balance through mitigation or a statement of overriding consideration. The proper decision makers should make those tough decisions in a timely manner. We in the construction industry need the governmental agencies to work together in harmony with the aggregate industry to obtain a timely environmentally balanced resolution to the extraction process.

Thank You,

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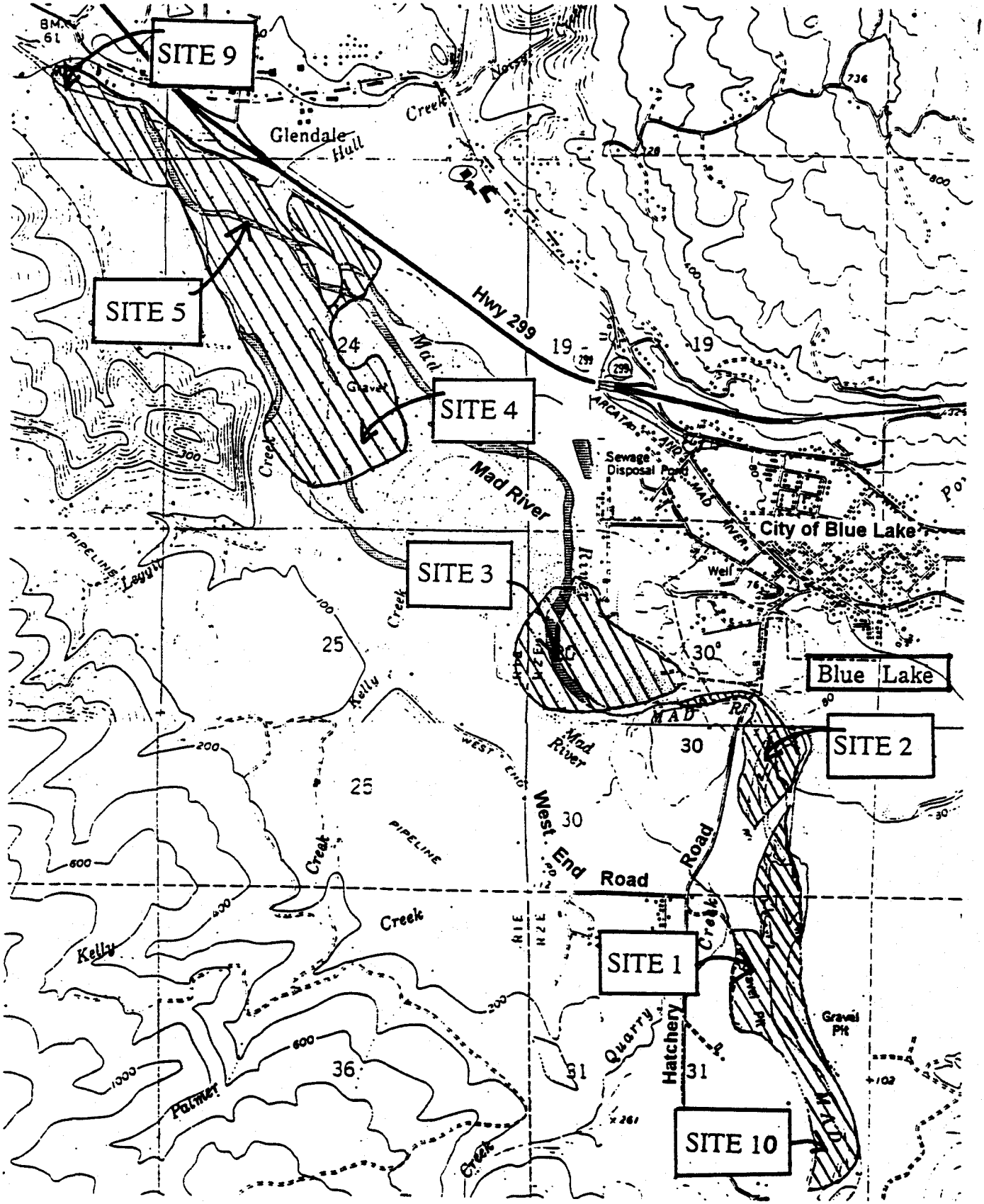
As a Contractor engaged in the construction of subdivisions and in the performance of Public Works improvement projects I am very concerned with any regulations or proposed regulations that may restrict the excavation and removal of river gravels in Humboldt County.

If regulations are enacted that drastically curtail and/or prohibit gravel extraction from local rivers the cost of construction will become prohibitive and will stifle our already sluggish and tenuous economy. Our local gravel companies must be allowed to continue to extract gravels from our local rivers.We don't have any other economic choice.

YOURS TRULY

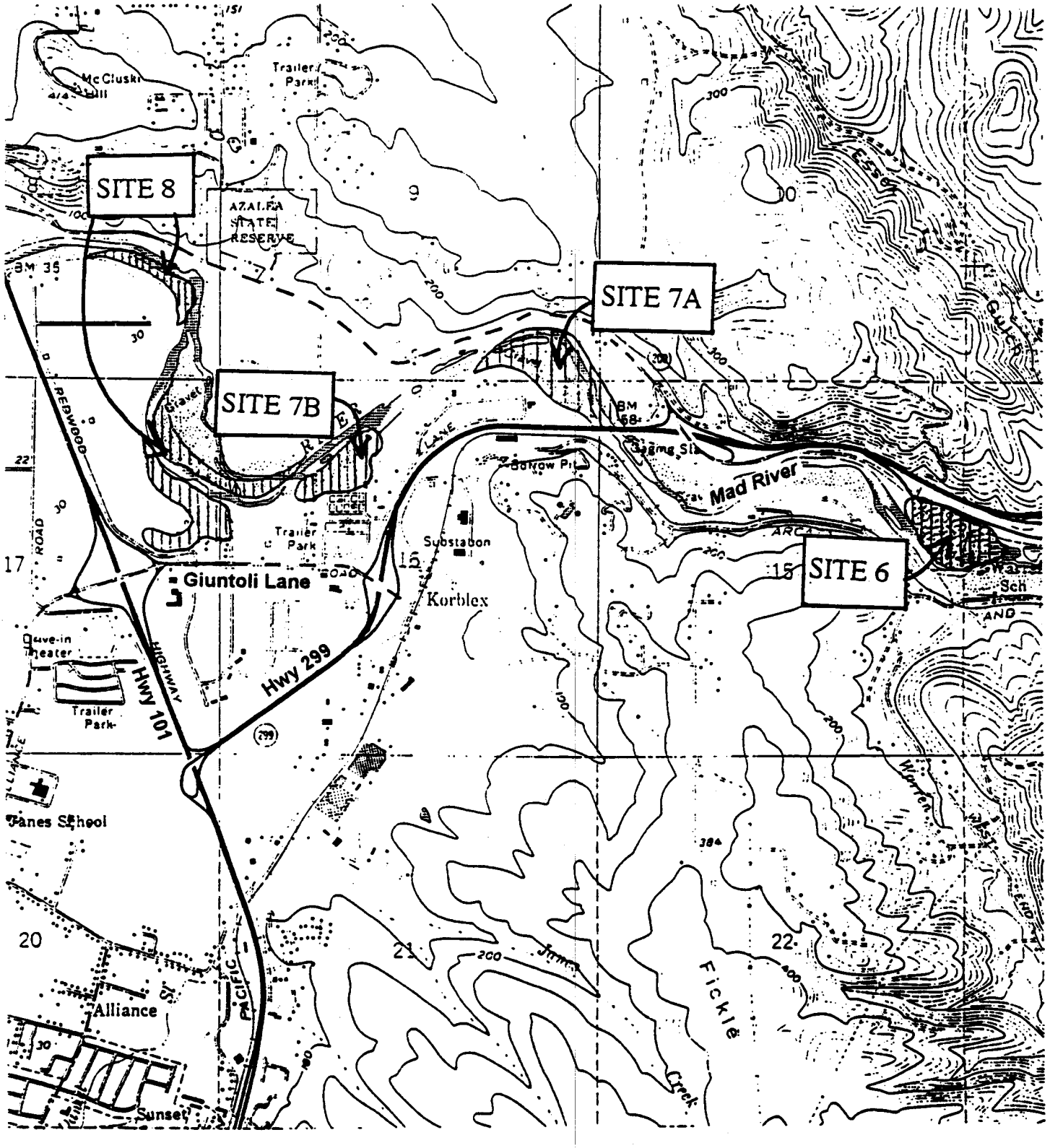
Bill Sheppard

Bill Sheppard
Owner



Map 1.2-3
Vicinity Map
1 of 2

(adapted from: James Roscoe Consultants Report, Appendix G)



Map 1.2-4
Vicinity Map
2 of 2

(adapted from: James Roscoe Consultants Report, Appendix G)