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Glossary

ACCRETION—The addition to land by deposition of water-borne sediment. An increase in land along the shores of a body of water, as by Alluvial deposit.

AGGRADATION: The geologic process in which streambeds, floodplains, and the bottoms of other water bodies are raised in elevation by the deposition of material eroded and transported from other areas. It is the opposite of degradation.

ALLUVIUM: A general term for all deposits resulting directly or indirectly from the sediment transport of streams, thus including the sediments lay down in riverbeds, floodplains, lakes, fans, and estuaries. ALLUVIAL *adj.*

ANADROMOUS: Fish that leave freshwater and migrate to the ocean to mature then return to freshwater to spawn. Salmon, steelhead, and shad are examples.

AERIAL: Having to do with or done by aircraft. For example, aircraft equipped with cameras capture images of the earth in air photos.

BANKFULL DISCHARGE: The discharge corresponding to the stage at which the floodplain of a particular stream reach begins to be flooded; the point at which bank overflow begins.

BANKFULL WIDTH: The width of the channel at the point at which overbank flooding begins.

BASIN: see watershed.

BOULDER: Stream substrate particle larger than 10 inches (256 millimeters) in diameter.

CALWATER: A set of standardized watershed boundaries for California nested into larger previously standardized watersheds and meeting standardized delineation criteria.

CANOPY: The overhead branches and leaves of streamside vegetation.

CANOPY COVER: The vegetation that projects over the stream.

CANOPY DENSITY: The percentage of the sky above the stream screened by the canopy of plants, sometimes expressed by species.

CHANNEL: A natural or artificial waterway of perceptible extent that periodically or continuously contains moving water. It has a definite bed and banks, which serve to confine the water.

COAST RANGE: A string of mountain ranges along the Pacific Coast of North America from Southeastern Alaska to lower California.

COBBLE: Stream substrate particles between 2.5 and 10 inches (64 and 256 millimeters) in diameter.

CONIFEROUS: Any of various mostly needle-leaved or scale-leaved, chiefly evergreen, cone-bearing gymnospermous trees, or shrubs such as pines, spruces, and firs.

COVER: Anything that provides protection from predators or ameliorates adverse conditions of streamflow and/or seasonal changes in metabolic costs. May be instream cover, turbulence, and/or overhead cover, and may be for the purpose of escape, feeding, hiding, or resting.

CULTURAL EUTROPHICATION: Accelerated eutrophication (generally enrichment by nutrients) that occurs as a result of human activities in the watershed that increase nutrient loads in runoff water that drains into surface water

DEBRIS: Material scattered about or accumulated by either natural processes or human influences.

DEBRIS JAM: Logjam. Accumulation of logs and other organic debris.

DECIDUOUS: A plant (usually a tree or shrub) that sheds its leaves at the end of the growing season.

DELTA: A fan-shaped alluvial deposit at the mouth of a river.

DEPOSITION: The settlement or accumulation of material out of the water column and onto the streambed. Occurs when the energy of flowing water is unable to support the load of suspended sediment.

DEPTH: The vertical distance from the water surface to the streambed.

DISCHARGE: Volume of water flowing in a given stream at a given place and within a given period of time, usually expressed as cubic meters per second (m^3/sec), or cubic feet per second (cfs).

DISSOLVED OXYGEN (DO): The concentration of oxygen dissolved in water, expressed in mg/l or as percent saturation, where saturation is the maximum amount of oxygen that can theoretically be dissolved in water at a given altitude and temperature.

DIVERSION: A temporal removal of surface flow from the channel.

EMBEDDEDNESS: The degree that larger particles (boulders, rubble, or gravel) are surrounded or covered by fine sediment. Usually measured in classes according to percentage of coverage of larger particles by fine sediments.

ENDANGERED SPECIES: Any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man.

EROSION: The group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from the earth's surface. EROSIONAL *adj.*

ESTUARY: A water passage where the tide meets a river current.

EUTROPHIC: Pertaining to a lake or other body of water characterized by large nutrient concentrations such as nitrogen and phosphorous and resulting high productivity. Such waters are often shallow, with algal blooms and periods of oxygen deficiency.

EXTINCTION: The death of an entire species.

FINE SEDIMENT: The fine-grained particles in stream banks and substrate. Those are defined by diameter, varying downward from 0.24 inch (6 millimeters).

FISH HABITAT: The aquatic environment and the immediately surrounding terrestrial environment that, combined, afford the necessary biological and physical support systems required by fish species during various life history stages.

FLATWATERS: In relation to a stream, low velocity pool or run habitat.

FLOOD: Any flow that exceeds the bankfull capacity of a stream or channel and flows out of the floodplain; greater than bankfull discharge.

FLOODPLAIN: The area bordering a stream over which water spreads when the stream overflows its banks at flood stages.

FLOW: a) the movement of a stream of water and/or other mobile substances from place to place; b) the movement of water, and the moving water itself; c) the volume of water passing a given point per unit of time. Discharge.

FLUVIAL: Relating to or produced by a river or the action of a river. Situated in or near a river or stream.

FRESHETS: A sudden rise or overflowing of a small stream as a result of heavy rains or rapidly melting snow.

GEOGRAPHIC INFORMATION SYSTEM (GIS): A computer system for capturing, storing, checking, integrating, manipulating, analyzing, and displaying data related to positions on the Earth's surface. Typically, a GIS is used for handling maps of one kind or another. These might be represented as several different layers where each layer holds data about a particular kind of feature (e.g. roads). Each feature is linked to a position on the graphical image of a map.

GEOMORPHOLOGY: The study of surface forms on the earth and the processes by which these develop.

GRADIENT: The slope of a streambed or hillside. For streams, gradient is quantified as the vertical distance of descent over the horizontal distance the stream travels.

GRAVEL: Substrate particle size between 0.08 and 2.5 inches (2 and 64 millimeters) in diameter.

HABITAT: The place where a population lives and its surroundings, both living and nonliving; includes the provision of life requirements such as food and shelter.

HABITAT TYPE: A land or aquatic unit, consisting of an aggregation of habitats having equivalent structure, function, and responses to disturbance.

HYDROLOGY: The science of water, its properties, phenomena, and distribution over the earth's surface.

INSTREAM COVER: Areas of shelter in a stream channel that provide aquatic organisms protection from predators or competitors and/or a place in which to rest and conserve energy due to a reduction in the force of the current.

INTERMITTENT STREAM: A stream in contact with the ground water table that flows only at certain times of the year when the ground water table is high and/or when it receives water from springs or from

some surface source such as melting snow in mountainous areas. It ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. Seasonal.

LARGE WOODY DEBRIS (LWD): A large piece of relatively stable woody material having a diameter greater than 12 inches (30 centimeters) and a length greater than 6 feet (2 meters) that intrudes into the stream channel. Large organic debris.

LEVEE (MANMADE)—An embankment, generally constructed on or parallel to the banks of a stream, lake or other body of water, for the purpose of protecting the land side from inundation by flood water or to confine the stream flow to its regular channel.

LEVEE (NATURAL)—Bank of sand and silt built by a river during floods, where the Suspended Load is deposited in greatest quantity close to the river. The process of developing natural levees tends to raise river banks above the level of the surrounding flood plains.

LEVEE SYSTEM—A flood protection system which consists of a levee, or levees, and associated structures, such as closure and drainage devices.

MACROINVERTEBRATE: An invertebrate animal (animal without a backbone) large enough to be seen without magnification.

MAINSTEM: The principal, largest, or dominating stream or channel of any given area or drainage system.

NUTRIENT: A nourishing substance; food. The term *nutrient* is loosely used to describe a compound that is necessary for metabolism.

ONCORHYNCHUS: A genus of the family salmonidae (salmons and trouts). They are named for their hooked (onco) nose (rhynchus).

ORGANIC DEBRIS: Debris consisting of plant or animal material.

PERMANENT STREAM: A stream that flows continuously throughout the year. Perennial.

pH: A measure of the hydrogen ion activity in a solution, expressed as the negative $\log_{10}$ of hydrogen ion concentration on a scale of 0 (highly acidic) to 14 (highly basic) with a pH of 7 being neutral.

PRODUCTIVITY: a) Rate of new tissue formation or energy utilization by one or more organisms; b) Capacity or ability of an environmental unit to produce organic material; c) The ability of a population to recruit new members by reproduction.

REDD: A spawning nest made by a fish, especially a salmon or trout.

RIFFLE: A shallow area extending across a streambed, over which water rushes quickly and is broken into waves by obstructions under the water.

RIPARIAN: Pertaining to anything connected with or immediately adjacent to the banks of a stream or other body of water.

RIPARIAN AREA: The area between a stream or other body of water and the adjacent upland identified by soil characteristics and distinctive vegetation. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

RIPARIAN VEGETATION: Vegetation growing on or near the banks of a stream or other body of water on soils that exhibit some wetness characteristics during some portion of the growing season.

SALMONID: Fish of the family *Salmonidae*, including salmon, trout, chars, whitefish, ciscoes, and graylings.

SCOUR: The localized removal of material from the stream bed by flowing water. This is the opposite of fill.

SEDIMENT: Fragmented material that originates from weathering of rocks and decomposition of organic material that is transported by, suspended in, and eventually deposited by water or air, or is accumulated in beds by other natural phenomena.

SLOUGH: A tidally influence side channel or bottom-land creek.

SMOLT: Juvenile salmonid one or more years old that has undergone physiological changes to cope with a marine environment, the seaward migration stage of an anadromous salmonid.

SMOLTIFICATION: The physiological change adapting young anadromous salmonids for survival in saltwater.

SPAWNING: To produce or deposit eggs.

STREAM: (includes creeks and rivers): A body of water that flows at least periodically or intermittently through a bed or channel having banks and supports fish or other aquatic life. This includes watercourses having a surface or subsurface flow that supports or has supported riparian vegetation.

STREAM BANK: The portion of the channel cross section that restricts lateral movement of water at normal water levels. The bank often has a gradient steeper than 45 degrees and exhibits a distinct break in slope from the stream bottom. An obvious change in substrate may be a reliable delineation of the bank.

STREAM CORRIDOR: A stream corridor is usually defined by geomorphic formation, with the corridor occupying the continuous low profile of the valley. The corridor contains a perennial, intermittent, or ephemeral stream and adjacent vegetative fringe.

STREAM REACH: A section of a stream between two points.

SUBSTRATE: The material (silt, sand, gravel, cobble, etc.) that forms a stream or lakebed.

SUBWATERSHED: One of the smaller watersheds that combine to form a larger watershed.

THALWEG: The line connecting the lowest or deepest points along a streambed.

THREATENED SPECIES: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

TIDAL FLAT: An extensive flat tract of land alternatively covered and uncovered by the tide, and comprising mostly unconsolidated mud and sand. Also referred to as Tide Flat.

TIDAL MARSH: Low, flat marshlands traversed by interlaced channels and tidal sloughs and subject to tidal inundation. Typically, the only vegetation present is salt-tolerant bushes and grasses (Halophytes).

TIDAL PRISM: The volume of water exchanged in an estuary between high and low tide

TIDE GATE: A swinging gate on the outside of a drainage conduit from a diked field that excludes water at high tide and permits drainage at low tide.

TOPOGRAPHY: The general configuration of a land surface, including its relief and the position of its natural and man-made features.

TRIBUTARY: A stream feeding, joining, or flowing into a larger stream. Feeder stream, side stream.

UNDERCUT BANK: A bank that has had its base cut away by the water action along man-made and natural overhangs in the stream.

VELOCITY: The time rate of motion; the distance traveled divided by the time required to travel that distance.

WATERSHED ASSESSMENT: An interdisciplinary process of information collection and analysis that characterizes current watershed conditions at a course scale.

WATERSHED: Total land area draining to any point in a stream, as measured on a map, aerial photograph or other horizontal plane. Also called catchment area, watershed, and basin.

WETLAND: An area subjected to periodic inundation, usually with soil and vegetative characteristics that separate it from adjoining non-inundated areas.

Salt River Restoration Appendix

When envisioning the future of the Salt River it is imperative that we look to the past in order to determine the ecological conditions of the delta prior to Euro-American settlement. Of course, we will never fully understand the conditions that fashioned the Salt River; however, through the researching of historical maps and documents particular problems have been identified as issues that inhibit the Salt River from functioning properly.

By looking to the past to infer restoration directives for the future we inherently arrive at the questions of 'what is natural' and 'are natural conditions a desired goal'? It should be understood that the Salt River was likely an abandoned channel of the Eel River. There are in fact many abandoned channels upon the delta. In alluvial systems, such as the Eel River Delta, the natural course of succession of abandoned channels is to fill with sediment and vegetation; eventually becoming land once again. Therefore, the Salt River has followed a somewhat natural path of aquatic ecosystem succession, but at an accelerated rate.

The rapid pace of eutrophication of the Salt River can be largely attributed to the unregulated land use decisions of humans over the past 150 years. Some might say that to restore the Salt River is to fight against natural processes. Most will agree however, that the proper hydraulic function of the Salt River is necessary to meet the community's socio-economic needs and also in the interest of restoring habitat for several listed species. The Salt River will likely never return to its 1850 size or function, nor is it necessary for that to happen. It is only necessary to make channel and watershed conditions such that the Salt River can become hydrologically functional again and provide ecological and economic benefits.

Current Restoration Alternatives

The Salt River Advisory Group (SRAG), a sub-committee of the Humboldt County Resource Conservation District, is comprised of many land owners and representatives from the California Department of Fish and Game, Natural Resource Conservation Service, Humboldt County Resource Conservation Service, the City of Ferndale, Humboldt County and the Coastal Conservancy. The NRCS Small Watershed Planning program and SRAG have discussed preliminary Salt River restoration concepts; however, current restoration alternatives are still being evaluated and necessary hydrological analysis has yet to be conducted.

The Salt River Watershed is almost entirely privately owned and therefore the restoration of the Salt River is dependent upon the involvement of many private landowners. A viable restoration strategy of the Salt River cannot go forth without involvement and input from all land owners within the Basin. The landowner community is ultimately responsible for the success of restoration efforts in the Salt River Basin. A lack of community interest and ownership of the problems in the Salt River Basin may have been one of the reasons why past improvement efforts have not succeeded.

The following section details various treatment options that can be implemented to fix problems in the Salt River. These treatment options differ from those proposed in 1993 in that they focus on complementing and accommodating watershed processes rather than focusing on treating conditions. These options are organized by landscape areas of the Basin from the headwaters to the confluence with the Eel River. This order follows hydrologic transport processes based on source, transport and depositional reaches for watershed products.

Figure 33. Examples of erosion in the upland Salt River Tributaries.

Upland reaches of the Wildcat Tributaries

(Centerville Road and Grizzly Bluff Road South):

PROBLEM: The Wildcat Hills are naturally prone to erosion which has been made worse by historic and current land use decisions. The major management concerns in the upland reaches of the Salt River tributaries are stream bank/road related erosion, and aquatic/riparian habitat enhancement.

POTENTIAL SOLUTIONS: There are a variety of treatment options that can be employed in the upland reaches of Williams, Francis, Reas, and Russ creeks:

- Erosion hazard assessment and planning;
- Erosion proofing and upgrades of road systems;
- Decommission abandoned or unnecessary roads;
- Near-stream and riparian tree planting;
- Temporary riparian cattle exclusion fencing, where appropriate;
- Removal or modification of fish barriers;
- Installation of stream enhancement structures, where appropriate.

A road and streambank erosion hazard inventory is currently being conducted in the uplands of the Salt River tributaries and a list of priority treatment options will be generated. Watershed groups, like the Salt River Advisory Group, can seek funding for watershed restoration from grant sources such as the CDFG Fisheries Restoration Grant Program or other watershed improvement programs.

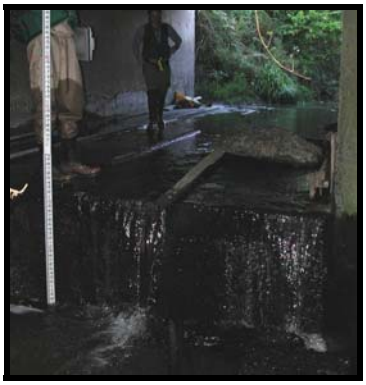


Figure 34. Examples of fish passage barriers in the upland Salt River tributaries.

Figure 35. Trans-delta reach of Williams Creek.

Figure 36. Trans-delta reach of Francis Creek.

Figure 37. Trans-delta reach of Reas Creek.

Trans-Delta Reaches of the Wildcat Tributaries
(Centerville Road and Grizzly Bluff Road to Salt River)

PROBLEM: The principal concern in managing the trans-delta reaches of the Wildcat tributaries is to decrease sediment contributions to the mainstem Salt River and to promote riparian and aquatic habitat integrity. The four main tributaries to the Salt River (Williams, Francis Reas and Russ creeks) have been modified to the extent that sediment processes and hydrologic function have been compromised. The modifications (riparian deforestation, urban development, and channelization) have resulted in the following problems:

- Increased occurrence of long-term flooding;
- Significant cost to individual landowners for loss of agricultural production;
- Significant cost to Ferndale for sediment removal;
- Channel widening in Williams Creek;
- Loss of ecologic integrity, specifically in regards to riparian and salmonid habitat.

POTENTIAL SOLUTIONS: One way to promote natural sediment processes in the trans-delta reaches is to utilize set-back levees. Appropriately sized setback levees:

- Allow controlled sediment deposition within a levee system which will decrease sediment contributions to the mainstem Salt River;
- Help protect flood prone properties;
- Facilitate the establishment of a riparian zone;
- Allow the stream to meander and support numerous riparian and aquatic habitat types;
- Allow the stream to connect with its floodplain.

The major disadvantage of setback levees is that land contained within the levees will have reduced agricultural production. Also, wider levee systems cannot be applied in all instances. For example, Francis Creek does not allow an adequate length to utilize the full potential of levee setbacks. Although setback levees can still be installed along lower Francis Creek, the maintenance time would be shortened due to smaller sediment storage capacity within the levee system. Other potential solutions include:

- **Sediment basins:** can capture sediment on the trans-delta reaches for manual removal as a maintenance program.
- **Promotion of riparian areas or flood-plain forests:** would curtail channel widening and promote channel integrity and offer other ecosystem benefits; however, overbank deposition would not be alleviated.

Mainstem Salt River- Reas Creek to Williams Creek

River mile: 3.4 to 7.5

PROBLEM: The mainstem Salt River from Reas Creek to Williams Creek has experienced severe aggradation since Euro-American settlement; the results of which have become most severe in the past 10 years.

- The river corridor from Reas to Francis Creek (R.M 3.4 to 5.1) has prolific nuisance instream vegetation growth that has clogged the channel. The channel is a braided configuration within this corridor and there are portions where a defined channel is difficult to distinguish. Subsurface flow during the dry summer months was apparent at River Mile 3.9 in 2004.
- The river corridor from Francis Creek to Williams Creek (R.M 5.1 to 7.5) is dry in the summer and is flooded during the winter. Due to a large sediment plug that formed in the mainstem Salt River in 1998, Williams Creek found a new path to the Eel River via Old River and Perry Slough. This dramatic change in watershed condition has reduced the Salt River Watershed size by 42% and eliminated fish passage to a once anadromous stream.

POTENTIAL SOLUTIONS: Treatment options within this project reach are focused on the manual reconfiguration of a proper channel. Preliminary concepts of the Salt River configuration indicate a relatively small low-flow channel with a wide terraced flood plain area. The vegetation composition would likely be managed to maintain an herbaceous plant community on the floodplain with coniferous trees on the higher terraces.

This massive dredging project will likely entail the removal of up to 250,000 yd^3 of material. Dredging within this project area will require clearing a maximum of 29.5 acres of riparian vegetation. It is a possibility that the path of the Salt River could be changed from its historic route to better conform to current land elevations. One possible reconfiguration of the Salt River is through the Williams Creek Overflow which is a swale that runs beneath highway 211 near the junction of Port Kenyon Road. Final restoration directives and the exact configuration of the Salt River in this project area are dependent upon land owner input and the results of further hydrological analysis, especially within the tidal estuarine zone, that will be conducted in 2005.

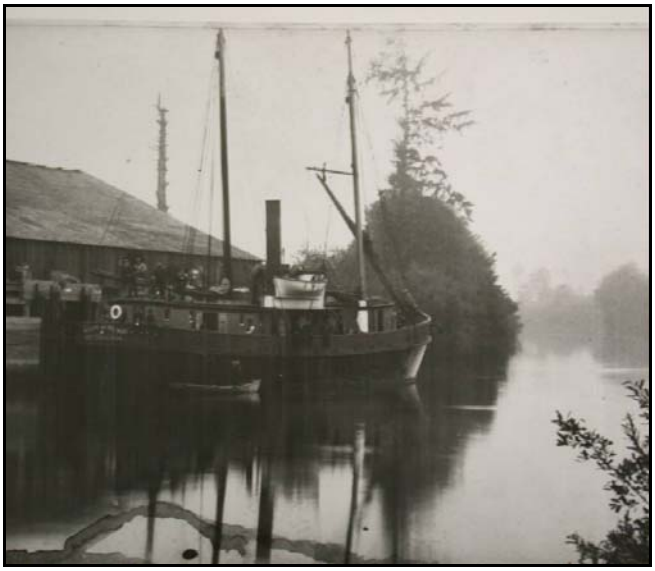


Figure 38. The Salt River- then and now; steamer Mary Hume 1885 at Port Kenyon (left) and mainstem channel at nearby Dillon Road Bridge 2004 (right).

Figure 39. Salt River Estuary upstream of Smith Creek, note the wide floodplain and vegetation composition.

Figure 40. Tide gate on Cuttoff Slough.

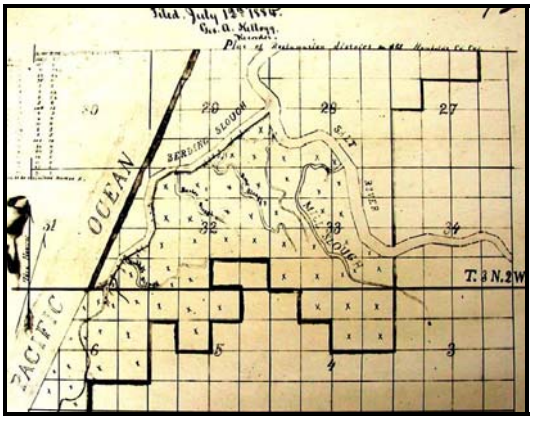


Figure 41. 2,900 acres of Salt River tideland were reclaimed prior to 1900.

Salt River Estuary – Reas Creek to Eel River

Length: Mouth to river mile 3.4

PROBLEM: A fundamental problem with the Salt River Estuary is that its tidal area and tidal prism are too small to adequately exhaust sediment from the system. Historically, the ebb and flow of the tide flushed sediment, eroded from the Wildcat Hills, from the Salt River channel. Slowly over the years tidal flushing has decreased and sediment has deposited permanently upon the bottom of the Salt River channel. Modifications in this region have created a simplified estuarine aquatic habitat.

POTENTIAL SOLUTIONS: In order to increase the tidal prism and to improve habitat complexity of the Salt River dramatic solutions must be implemented. Among the most dramatic includes the conversion of agricultural land back into tide land. This solution may entail consideration of:

- removal or modification of tidegates;
- dredging of accreted floodplain;
- dredging of channel bottom;
- levee removal;
- breeching of levees.

The specifics of potential restoration treatment options are dependant upon the results of a hydrological analysis, especially within the tidal estuarine zone, that will be conducted in 2005.

Summary of Recommendations

The dysfunction of the Salt River has been the topic of numerous reports and studies over the past few years. The following recommended restoration activities have been compiled from the following documents:

- *Salt River Local Implementation Plan.* USDA Soil Conservation Service, 1993;
- *Draft Preliminary Management Plan.* United States Army Corps of Engineers, 2004;
- *An Overview of an Enhancement Program for the Eel River Estuary.* Phillip Williams and Associates, 1988;
- *Biological Conditions of the Eel River Delta.* Chad Roberts, Ph.D. Oscar Larson and Associates, 1992;
- *Hydraulic/ Sedimentation Study for the Salt River, CA.* Questa Engineering Corporation.

Table 22. Proposed Salt River restoration activities.

Tidal Basin: a body of water that is subject to tides whose water level is maintained at a desired level by artificial means.	
Purpose	To increase tidal prism and to increase channel scouring velocities. Estimated to be 90 acre feet capacity.
Location	Two tidal basin sites were evaluated: The first tidal basin was proposed along the banks of the Salt River, near the confluence of Reas Creek; however, this site location was ruled out because the site proved to be ineffective in enhancing the scour in the river upstream of Reas Creek. The preferred alternative that was proposed was located between Port Kenyon Road and the Salt River upstream of Dillon Road. It is estimated that 90,000 yds^3 of spoils would need to excavated and relocated to disposal sites. This option would require that the Salt River channel downstream of the basin be 20 feet wide with side slopes of two horizontal to one vertical (2:1).
Benefits	This option was deemed by Questa Engineering to be "the most effective alternative… and stable with respect to the scour and deposition of sediment, without the need for maintenance dredging of the channel"; Would increase tidal prism; Increase downstream channel scouring capacity; Partially self-cleansing; Increase estuarine habitat.
Disadvantages	Would only increase scour below the tidal basins; therefore, those areas upstream of the basin would not receive significant benefits from this alternative; Tidal basins would be a depositional area and would be subject to regular maintenance and cleaning; Large flood events in the Eel River would deliver significant quantities of sediment to the basin; Land acquisition would be necessary.
Sediment Basins on Tributaries: Sediment basins are structures designed to detain the flow of a watercourse. The slowed water velocities allow sediments to drop out of the water column, which can then be removed manually.	
Purpose	To control sediment deposition at a certain location where it can be managed easily in order to reduce the quantity of sediment depositing in the mainstem Salt River
Location	Three basins were proposed in the Local Implementation Plan: Reas Creek; approximately 100 feet upstream from Meridian Road; Francis Creek, approximately 100 feet upstream from the Port Kenyon Road culvert; Williams Creek, approximately 100 feet upstream from the confluence with the Salt River.
Benefits	Sediment contribution to the mainstem Salt River will be significantly reduced; Fish passage accommodations can be made to sediment basins;

	Will better ensure successful restoration of any dredging activities;
Disadvantages	Regular manual removal of sediment basins would be required;
Dredging: It is inevitable that the restoration of the Salt River will include dredging/ excavation to some degree. Two dredging alternatives have been proposed; from the outlet to Williams Creek (A) and from Reas Creek to Francis Creek (B)	
Purpose	Enlarge Salt River channel and increase channel capacity
Location	(A) From the Outlet to Williams Creek=170,000 yds^3 of spoils Would require clearing 29.5 acres of riparian vegetation Instream structures would need to be installed at the confluence of all Salt River tributaries to avoid down cutting.
	(B) From Reas Creek to Francis Creek = 50,000 yds^3 of spoils Would require clearing 16.4 acres of riparian vegetation Instream structures would need to be installed at the confluence of all Salt River tributaries to avoid downcutting.
Benefits	Could be preformed in combination with other alternatives or alone; Would improve flood capacity and alleviate winter flooding; Would increase tidal influence, could help control instream plant growth; Would open passage to salmonids.
Disadvantages	Wider channel or cross-sectional area may decrease scour due to reduced velocities; May not be self maintaining and could require regular dredging depending on watershed conditions; Dredging is an alternative that alleviates conditions but does not guarantee long term success; Large quantities of spoils to be disposed of; Environmental review process for a dredging project would be highly contentious and would result in a longer and more expensive review process; The effects of dredging cannot be mitigated.
Tide Gate Removal: Tide gate removal was not considered a viable alternative by the Local Implementation Plan because the removal would not result in a net increase in sediment removal. Tide gate modification should be considered for the purpose of salmonid passage.	
Purpose	Removal of one or more of the tide gates tributary to the Salt River to restore tidal action to those areas upstream of existing tide gates; Modification of tide gates to allow for salmonid passage.
Location	Centerville Slough, approximately 900 feet upstream of its confluence with the Salt River; Salt River near Riverside Ranch, approximately 300 feet downstream of Smith Creek confluence; Salt River on north side of Riverside Ranch opposite Morgan Slough; Smith Creek, approximately 200 feet upstream of its confluence with the Salt River.
Benefits	Increase tidal influence above tide gate; Increase in channel scour in reaches downstream of the tide gate; Would allow for the passage of anadromous fishes.
Disadvantages	Potential loss of agricultural land to salt water intrusion; Decrease in scour in reaches upstream of tide gates.
Levee Removal: Removal or breaching of levees in the western delta is another means to increase the estuary's tidal prism.	
Purpose	Breaching levees would allow land to be returned to its natural estuarine conditions.
Location	Unknown
Advantages	This alternative would avoid the significant adverse effects associated with dredging; Would increase tidal area while preserving existing substrate;

	The levee breaching alternative would be "much more likely than the dredging alternative to gain ultimate acceptance and regulatory approval" (Roberts, 1992);
Disadvantages	Net decrease in agricultural land in the Salt River Delta. Existing functional values of habitats in the western delta (ie. Seasonal wetlands) could be compromised by the conversion of habitats into estuarine conditions, which could result in regulatory approvals being withheld.
Re-introduction of Eel River Flow: The Eel River once flowed across the southern portion of the Eel River Delta; this function was curtailed by construction of the Leonardo levee, and sedimentation.	
Purpose	Provide for the introduction of Eel River discharge into the upper reaches of the Salt River to create flushing flow and increased scour in order to improve channel capacity.
Location	Would likely occur near the Leonardo levee.
Benefits	May increase the scouring potential of the Salt River in its upper reaches.
Disadvantages	A canal and gates would be necessary to connect the Salt River and Eel River; these structures would need maintenance; Major infrastructural changes would be necessary (bridges) and risks to public and private property exist The unpredictable nature of Eel River discharge; Salt River channels and swales no longer exist as they did before the construction of the Leonardo levee.
Upland Erosion Control Measures: Local sponsors would provide services and funding to alter land-use activities in the Wildcat Tributaries to promote riparian areas and reduce erosion (ie. riparian exclusion fencing, streambank stabilization, riparian re-vegetation, road upgrading, road decommissioning).	
Purpose	To promote riparian corridors in the upland Wildcat Tributaries to decrease preventable erosion.
Location	Priority tributaries include Williams, Francis and Reas creeks.
Benefits	Ecosystem benefits for fish and wildlife; Decrease in road and stream bank erosion.
Disadvantages	Would require years of advanced planning; Would require cooperation from a majority of landowners.
Resource Enhancement: Sustainable watershed management	
Purpose	Proposes actions to protect, restore, and enhance natural resources in the Eel River Delta (Roberts 1992).
Actions	**Resource Enhancement:** Resist further urbanization; Limit water quality degradation; Increase riverine pool volume; Curtail excessive erosion; Increase estuarine tidal prism; Prohibit riparian destruction; Limit access to sensitive areas; Allow or increase localized flooding; Manage livestock to benefit wetland values; Stabilize eroding uplands and stream banks; Enhance native plant species and their habitats.
Setback Levees Levees can be set back away from the stream to allow for bankfull discharge and provides connectivity between the stream and the floodplain, while continuing to protect flood prone properties.	
Purpose	The purpose of setback levees is to control flood waters and to allow for a functional riparian corridor, channel meanders, and habitat diversity.

Location	The proposed site currently is the trans-delta reach of Reas Creek, however, this technique can be utilized on Francis and Williams Creek as well. "Proper siting and alignment of proposed structures can be established based on hydraulic calculations, historical flood data, and geotechnical analysis of riverbank stability" (EPA, 1993).
Benefits	Setback levees are an effective method of protecting flood prone properties; Setback levees are less prone to erosion and other damage during flood events; Setback levees facilitate the establishment of a riparian zone along the trans-delta reach; Setback levees allow the stream channel to meander and support numerous aquatic habitat types; Setback levees enhance sediment processes and allow deposition on the alluvial fan;
Disadvantages	Setback levees would require the retirement of agricultural land to accommodate for a wider levee configuration;

Salt River Advisory Group (SRAG) Goals and Objectives

The following list of preliminary goals and objectives were a collaborative effort between landowners and public agencies in the Salt River Advisory Group (SRAG).

Re-establish and maintain the functionality of the Salt River watershed by:

- Establish effective drainage patterns and meander zones in the lower reaches of the system to reduce flooding;
- Establish effective and acceptable riparian vegetation species and distribution;
- Establish channel management corridors;
- Identify and treat upslope sediment sources and reduce sedimentation;
- Conduct demonstration and interim projects;
- Secure regulatory support for channel project permits;
- Support efforts to improve conditions for the Ferndale sewage treatment plant;
- Promote improvement of dairy waste management practices;
- Improve fish and wildlife habitat;
- Promote public education and community support;
- Identify landowner incentives for landowner participation.

Salt River Improvement Program Mission Statement

The Salt River Improvement Program will provide local effort and guidance to restore natural hydrologic function and beneficial conditions to the Salt River watershed for the improvement of adequate drainage, water quality, wastewater treatment, flood control, anadromous fisheries and other benefits to local economic and environmental resources.

Salt River Advisory Group Opportunity

There is an opportunity to improve aquatic/riparian function and conditions in several miles of the Salt River drainage system as well as many acres of tidal lands. According to the 2004 Army Corps of Engineers Salt River Project Management Plan Draft, "restoring the natural function of the corridor would provide access to rearing, resident and migratory habitats for anadromous fish species, and have positive impacts on upper reaches of the Salt River as well as the Eel River Estuary in general. Without the project, water quality and habitat quality will continue to degrade in this system." By aiming to improve ecosystem conditions within the Salt River Basin, pressing socio-economic issues such as wastewater treatment, dairy waste management, flood control and fishery health will be addressed and improved.

Goal One: Improve watershed education outreach and monitoring

Objective 1: Build upon the effective partnership that has initially organized background information and human resources to address the need for action. Promote Salt River Advisory Group as a lead entity to facilitate local coordination with agencies and to promote funding activities as well as to act as a clearing house to disseminate information to appropriate parties.

Objective 2: Improve educational and community outreach.

Task 1: Engage local school group participation with watershed education groups such as:

- AmeriCorps Watershed Stewards Project;
- Salmon in the Classroom.

Task 2: Employ various forms of media and community activities to improve landowner participation and understanding of the Salt River watershed situation and improvement alternatives to include:

- An informational Salt River community workshop scheduled for March 12, 2005, 0900 – 1500;
- Salt River Journal;

- Salt River website;
- Radio public service announcements;
- Newspapers;
- Information / status reports for elected officials.

Objective 3: Establish sampling frameworks and protocols for monitoring water quality, fishery status, and instream habitat conditions.

Task 1: Continue and expand water quality monitoring efforts to include a robust assemblage of water quality parameters.

Task 2: Conduct systematic assessment of biological resources in the Salt River Basin.

Task 3: Establish systematic monitoring of fish populations in the Eel River Delta and Salt River system.

Task 4: Establish systematic monitoring of Salt River Basin salmonid habitat.

Goal Two: Improve water quality conditions in the Salt River Basin

Objective 1: Decrease sediment contributions to the mainstem Salt River by conducting the following activities in the Wildcat tributaries:

Activity 1: Conduct upslope erosion inventory, prioritize treatable stream bank and road erosion sites, and organize and implement projects (in progress).

Task 1: Consultants will conduct an initial upslope erosion inventory and identify priority treatable erosion sites by March 2005 (in progress).

Task 2: The Salt River Advisory Group will develop grant proposals and cost estimates by May 2005 to treat priority stream bank and road related erosion sources in the Salt River for implementation in 2006. Erosion reduction projects may include but are not limited to the following:

- Control stream bank erosion sites;
- Conduct road erosion proofing upgrades and decommissions where necessary and beneficial;
- Plant native riparian plants in areas where canopy density is lacking;
- Install temporary riparian exclusion fencing where necessary and beneficial to aquatic/riparian conditions.

Task 3: Consultants will prepare a comprehensive survey of treatable erosion sites by December 2005 identifying priority erosion reduction projects and cost estimates (in progress).

Task 4: Salt River Advisory Group will identify funding sources and prepare proposals by May 2006 for a second phase of work to treat the remainder of identified priority stream bank and road related erosion sources in the Salt River system for implementation in 2007.

Task 5: Implement erosion reduction projects in the summer of 2006, if 2005 grant monies are awarded.

Task 6: Implement additional, identified erosion reduction projects in the summer of 2007, if 2006 grant monies are awarded.

Activity 2: Design, install and maintain sediment basins on tributaries where sediment loads, stream alterations and infrastructure limit opportunities for restoring natural processes, such as lower Francis Creek.

Task 1: Perform preliminary site analyses, prepare conceptual plans and outline roles and responsibilities for construction and maintenance.

Option 1: Include the construction of a sediment basin on Francis Creek into future Ferndale sewer treatment alternatives.

Option 2: Design and build sediment basins where necessary and beneficial using the USDA PL-83-566 Program.

Option 3: Emphasize sediment basin construction as a feature of the USACE/Coastal Conservancy Section 206 Aquatic Ecosystem Restoration Feasibility Study.

Objective 2: Improve Ferndale wastewater treatment facility (See Goals 4 and 5).

Objective 3: Decrease non-point source pollution by improving dairy waste management (See Goal 5).

Goal Three: Restore Salt River channel function and condition.

Objective 1: Determine property boundaries for parcels adjacent to the Salt River corridor (in progress).

Activity 1: Develop real estate scope of work for delineating ownership boundaries within the areas identified in alternatives development.

Task 1: Establish land ownership for the purpose of evaluating restoration alternatives including at least:

- Preliminary parcel mapping within the project area derived from Humboldt County Assessors Office maps, property owner interaction and, where necessary, property surveys;
- Map feasible private property access routes in the Wildcat Range and Salt River Delta to facilitate project implementation;
- Prepare comparative report on private property access requirements for each alternative;
- Develop land cost estimates for alternatives.

Objective 2: Conduct necessary activities and analyses for channel restoration project design, and to understand the physical and economic affects of the re-establishment of the Salt River channel from Coffee Creek to the confluence with the Eel River.

Activity 1: Conduct topographic mapping of the Eel River Delta (in progress).

Task 1: Consultants will conduct an elevation survey of the Salt River corridor from the Old River (river mile 7.7) downstream to the mouth of the Salt River. The elevation survey will include portions of Williams Creek, Francis Creek and Reas Creek as they flow across the delta as well as numerous swales and other drainage features (in progress).

Task 2: Conduct necessary mapping and elevations on tide gates, levees, channel dimensions, mudflats, and salt marshes (in progress).

Task 3: Analyze topographic elevations to:

- Determine the location and relative size of sediment accumulations in the mainstem Salt River;
- Determine potential interim projects to alleviate current conditions (in progress).

Task 4: Conduct land surveys outlined under the Army Corps of Engineers Section 206 Aquatic Ecosystem Restoration Program Project Management Plan (PMP): "Obtain sufficient data to generate 1-foot contours at plus or minus 0.1-foot accuracy between Fulmor Bridge and the Salt River Beach, the vicinity of swales upstream between the Eel River and Fulmor Bridge, and between the Leonardo Levee and the Eel/Van Duzen River confluence, approximately 1000 feet upstream along the Van Duzen River and 5000 feet upstream along the Eel River. Completion of basin hydraulics tasks is dependent on this task. Schedule to be determined based upon USCOE funding availability.

Activity 2: Analyze Salt River hydrology and hydrodynamics to include the estuary portion and the Salt River tributaries.

Task 1: Conduct basin hydrological analysis as outlined under the Army Corps of Engineers (PMP): "Obtain sufficient data on pertinent basin hydrology to develop and/or update flow-frequency, flow-duration and stage-discharge relationships. Determine upstream boundary conditions at the Eel River and the Salt River tributaries for a range of flows covering flood frequencies of 50, 25, 10, 4, 2 and 1% recurrence intervals. Completion of basin hydraulics task is dependent on this subtask. May be concurrent with hydrology work." Scope and schedule to be determined based on available funds.

Task 2: Develop a basin hydraulics model as outlined under the Army Corps of Engineers PMP: "Assemble and test a numerical model to demonstrate that it will duplicate measured or observed conditions within the project area over a range of flood frequencies, as mentioned above, with various probable bed-form and hydraulic upstream and downstream boundary conditions, including all of the above Salt River tributaries, swales upstream from the project area, and Eel River upstream conditions, with and without the Leonardo Levee (upstream). Completion of project sediment task is dependent on this subtask. Scope and schedule based on available funds.

Activity 3: Analyze fluvial geomorphology in the Salt River Basin as outlined under the Army Corps of Engineers PMP.

Task 1: Conduct sediment analysis as outlined in Army Corps of Engineers PMP: "Determine tidal and fluvial sources of sediment and the existing status (stable, accumulating or degrading). Obtain characteristics of samples that have been taken from suitable project locations. Estimate sediment transport quantities and character of suspended and bed loads. Estimate tidal volume in the existing project and in comparable project locations in previous times. Estimate previous sediment conditions. Completion of project geomorphology task is dependent on this subtask. Scope and schedule dependent on available funds.

Activity 4: Analyze geomorphic changes in the Eel River Delta to include changes in channel dimensions, sedimentation, channel location and shore lines over the past 130 years.

Task 1: Conduct geomorphology assessment as outlined in the Army Corps of Engineers PMP: "Compare Salt River channel conditions with a similar existing slough or sloughs in the Eel River delta. Estimate probable outcome for project geomorphology based on the comparison(s). Completion of project baseline task is dependent on this subtask. Scope and schedule dependent on available funds.

Task 2: Compile an historical atlas of the Salt River using legacy maps to "rubber-sheet and geo-correct various maps into a mosaic of the study area" 1 to determine relative changes in channel dimensions and locations over the past 150 years. This process will standardize various maps of different sizes to a common dimension. Scope and schedule are dependent on available funds.

Activity 5: Compile information from Activities 1-4, and perform an assessment of opportunities and constraints and develop alternatives.

Activity 6: Determine locations for the disposal of dredging spoils.

Goal Four: Improve drainage and flood control functions

Objective 1: Reduce the potential for flooding of community infrastructure, particularly the Ferndale Wastewater Treatment Plant and key transportation routes.

Activity 1: Organize coordinated planning with City of Ferndale focusing on:

- Development of integrated goals and objectives;
- Sharing data;
- Development of a project to meet community goals for wastewater treatment that minimizes risk for stream discharge in floods;
- Flood damage reduction generally, including reduction in chronic flooding to transportation routes and agricultural lands;
- Fisheries and habitat enhancement.

Activity 2: Implement Ferndale Drainage Master Plan.

1. **Rose Avenue Culvert** - Replace existing Rose Avenue 12-inch storm drain with 470 feet of new 24-inch to 30-inch pipe. Will require obtaining easements, and working in narrow areas. Estimated cost does not include the cost to acquire easements.

2. **Fifth Street Storm Drain** - Regrade and widen the channel west of 5th Street to improve flow conditions and replace the existing 6-inch by 24-inch storm drain crossing 5th Street with a new 2-foot by 4-foot storm drain.

[1] Scope of Work. Aldaron Laird, Environmental Planner, May, 2004.

3. **Herbert Street Storm Drain System and Dewey Avenue -** Install a drop inlet and 510 feet of 48-inch pipe from Herbert Street down Dewey Avenue to the East Side Drainage Channel.

4. **Intersection of Shaw Avenue and Berding Street -** Overlay 100 feet of roadway on Shaw Avenue west of the intersection and repair 200 feet of roadway on Berding Street south of the intersection to improve cross slopes.

5. **Washington Street Culvert -** Replace existing 24-inch Washington Street culvert with a 4-foot wide by 2-foot high concrete box culvert or equivalent.

6. **Market Street Culvert -** Abandon the culvert crossing Market Street just north of Highway 255 and redirect the flow to keep the water on the west side of Market Street. Will require upsizing several driveway culverts and increasing the capacity of the existing ditch.

7. **Ambrosini Lane Culvert -** Replace the existing 36-inch section of the Ambrosini Lane culvert with a new 48-inch section.

8. **Fairgrounds Storm Sewer Pipe -** Install a new storm sewer line through the Fairgrounds between Arlington Avenue and Van Ness Avenue.

Activity 3: Establish a Market Street Drainage Plan and reintroduce East Side drainage into Francis Creek downstream of Port Kenyon Road.

- Identify sources of drainage and quantify.
- Determine possible routes to convey drainage and lessen flooding.
- Work with affected property owners.
- Establish a scope of work.
- Complete the environmental review process.
- Identify sources of funding for construction.

Activity 4: Map permanent drainage ditches in the Salt River Basin.

Goal Five: Improve and prevent point and non-point source water pollution

Objective 1: Continue implementation of dairy waste production program (in progress)

Objective 2: Obtain compliance at Ferndale Waste Water Treatment Plant.

- Adopt increased sewer rates to provide construction and financing funds.
- Receive Funding Notices from Agencies
- Complete Permit and Environmental Processes

Objective 3: Investigate the coordination of an anaerobic digestion system between the City of Ferndale wastewater treatment plant and the Dairy Waste Production Program to facilitate both programs' operations, provide regional energy generation, and improve water quality.

Goal Six: Enhance and protect fishery and wetland habitats

Objective 1: Increase tidal influence to enhance discharge of sediment as well as for the improvement of estuarine rearing habitat (contingent upon estuarine analysis and topographic analysis). Possible actions to achieve the objective likely would include a combination of the following:

- Acquire identified parcels for tideland and channel restoration;
- Increase tidal prism by the breaching or removal of levees in the western delta;
- Increase tidal prism by dredging lower Salt River;
- Increase tidal prism by constructing a tidal basin upstream of Dillon Road Bridge;
- Increase tidal prism by removing or modifying identified tide gates.

Objective 2: In order to improve fish passage and instream habitat condition in the Salt River system, the following activities must be addressed.

Activity 1: Re-establish mainstem Salt River at river mile 5.1 to 8.3 (Francis Creek to Coffee Creek), and improve channel conditions from river mile 3.4 to 5.1 (Reas Creek to Francis Creek) to allow access for salmonids and to alleviate flooding. Options to achieve this activity include but are not limited to the following (contingent upon the findings of the channel corridor elevation survey as well as the basin hydrological survey):

- Dredge mainstem Salt River;
- Increase tidal influence of the Salt River to improve channel cleansing;
- Analyze the practicality of allowing the Eel River to flow across the Salt River Delta during high water events.

Activity 2: Replace or modify culverts or barriers that create fish passage problems:

- Francis Creek- Port Kenyon Road culvert;

- Reas Creek- Port Kenyon Road culvert, Meridian Road culvert, Centerville Road culvert and Oeschger Road culvert;
- Russ Creek- Centerville Road culvert;
- Russ Creek- Modify barrier 500 feet upstream of Centerville Road.

Objective 2: Increase pool quantity and quality in the Wildcat tributary reaches.

Activity 1: Where feasible, design and engineer pool enhancement structures to increase the number of pools. This must be done where the banks are stable or in conjunction with stream bank armor to prevent erosion.

Objective 3: Increase canopy cover in specific reaches in the Wildcat tributary reaches.

Activity 1: Increase the canopy on Salt River tributaries by planting appropriate native species such as willow, alder, spruce, and Douglas fir along the stream where shade canopy is not at functional levels. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.

Objective 4: Improve fish habitat conditions in the trans-delta reach of Reas Creek and Williams Creek.

Activity 1: Widen and re-align Reas Creek trans-delta levee system for flood control, channel meander, and riparian function within levees.

Activity 2: Utilize increased channel gradient and stream energy in trans-delta reach to establish habitat diversity.

Objective 5: Enhance wetland protections for the purpose of flood storage capacity improvements, nutrient assimilation, and wildlife benefits.

Option 1: Utilize USDA/NRCS Wetland Reserve Program or Farm and Ranch Land Protection Program.

Option 2: Utilize California Department of Conservation or Coastal Conservancy conservation easement programs.

Salt River Tributary Appendix

Williams Creek

Williams Creek is historically a tributary to the Salt River, a tributary to the Eel River, a tributary to the Pacific Ocean, located in Humboldt County, California (Map 1). Williams Creek's legal description at the confluence with Salt River is T02N R02W S01. Its location is 40°35’21.0” north latitude and 124°14’16.0” west longitude. Williams Creek is a second order stream and has approximately 8.3 miles of blue line stream according to the USGS Ferndale 7.5 minute quadrangle. Williams Creek drains a watershed of approximately 6.8 square miles. Elevations range from about 30 feet at the mouth of the creek to 750 feet in the headwater areas. Grass, mixed hardwood and Redwood/Douglas Fir forest dominate the watershed. The watershed is entirely privately owned and is managed for rangeland and timber production. Vehicle access exists via Grizzly Bluff Road.

The habitat inventory of 6/2/2003 to 6/16/2003, was conducted by Elizabeth Pope and Kevin Lucey (WSP). The total length of the stream surveyed was 21,881 feet.

Williams Creek is a G4 channel type for the first 2,011 feet of the stream surveyed, an F4 channel type for the next 17,607 feet of the stream surveyed and an A1 channel type for the remaining 2,263 feet of the stream surveyed. G4 channels are entrenched “gully” step-pool channels on moderate gradients with low width /depth ratios and gravel dominant substrates. F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. A1 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and a very stable bedrock channel.

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: Williams Creek | LLID: 1242377405892 | Drainage: Eel River - Lower

Survey Dates: 6/3/2002 to 6/16/2003 | Survey Length (ft.): 21881 | Main Channel (ft.): 21881 | Side Channel (ft.): 0

Confluence Location: Quad: FERNDALE | Legal Description: T02NR02WS01 | Latitude: 40:35:21.0N | Longitude: 124:14:16.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: G4
Reach Length (ft.): 2011
Riffle/Flatwater Mean Width (ft.): 8.3
BFW:
Range (ft.): 17 to 22
Mean (ft.): 17
Std. Dev.: 2
Base Flow (cfs.): 2.5
Water (F): 57 - 61 Air (F): 58 - 66
Dry Channel (ft): 0

Canopy Density (%): 78
Coniferous Component (%): 0
Deciduous Component (%): 100
Dominant Bank Vegetation: Deciduous Trees
Vegetative Cover (%): 79
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 8
LWD per 100 ft.:
Riffles: 0
Pools: 0
Flat: 1

Pools by Stream Length (%): 56
Pool Frequency (%): 52
Residual Pool Depth (%):
< 2 Feet Deep: 6
2 to 2.9 Feet Deep: 29
3 to 3.9 Feet Deep: 29
>= 4 Feet Deep: 35
Mean Max Residual Pool Depth (ft.): 3.3
Mean Pool Shelter Rating: 59

Pool Tail Substrate (%): Silt/Clay: 18 Sand: 0 Gravel: 76 Sm Cobble: 6 Lg Cobble: 0 Boulder: 0 Bedrock: 0

Embeddedness Values (%): 1. 0 2. 0 3. 6 4. 94 5. 0

STREAM REACH: 2

Channel Type: F4	Canopy Density (%): 61	Pools by Stream Length (%): 34
Reach Length (ft.): 17607	Coniferous Component (%): 4	Pool Frequency (%): 31
Riffle/Flatwater Mean Width (ft.): 12.8	Deciduous Component (%): 96	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Deciduous Trees	< 2 Feet Deep: 33
Range (ft.): 15 to 35	Vegetative Cover (%): 85	2 to 2.9 Feet Deep: 41
Mean (ft.): 23	Dominant Shelter: Small Woody Debris	3 to 3.9 Feet Deep: 21
Std. Dev.: 4	Dominant Bank Substrate Type: Sand/Silt/Clay	>= 4 Feet Deep: 5
Base Flow (cfs.): 2.5	Occurrence of LWD (%): 17	Mean Max Residual Pool Depth (ft.): 2.5
Water (F): 55 - 66 Air (F): 54 - 70	LWD per 100 ft.:	Mean Pool Shelter Rating: 28
Dry Channel (ft): 0	Riffles: 0	
	Pools: 2	
	Flat: 0	

Pool Tail Substrate (%): Silt/Clay: 3 Sand: 6 Gravel: 66 Sm Cobble: 13 Lg Cobble: 9 Boulder: 2 Bedrock: 1

Embeddedness Values (%): 1. 16 2. 12 3. 21 4. 50 5. 1

STREAM REACH: 3

Channel Type: A1	Canopy Density (%): 65	Pools by Stream Length (%): 7
Reach Length (ft.): 2263	Coniferous Component (%): 2	Pool Frequency (%): 10
Riffle/Flatwater Mean Width (ft.): 6.4	Deciduous Component (%): 98	Residual Pool Depth (%):
BFW:	Dominant Bank Vegetation: Brush	< 2 Feet Deep: 60
Range (ft.): 15 to 35	Vegetative Cover (%): 85	2 to 2.9 Feet Deep: 20
Mean (ft.): 19	Dominant Shelter: Boulders	3 to 3.9 Feet Deep: 20
Std. Dev.: 2	Dominant Bank Substrate Type: Bedrock	>= 4 Feet Deep: 0
Base Flow (cfs.): 2.5	Occurrence of LWD (%): 0	Mean Max Residual Pool Depth (ft.): 1.9
Water (F): 54 - 62 Air (F): 57 - 71	LWD per 100 ft.:	Mean Pool Shelter Rating: 8
Dry Channel (ft): 0	Riffles: 2	
	Pools: 1	
	Flat: 1	

Pool Tail Substrate (%): Silt/Clay: 0 Sand: 0 Gravel: 40 Sm Cobble: 20 Lg Cobble: 0 Boulder: 0 Bedrock: 40

Embeddedness Values (%): 1. 0 2. 20 3. 40 4. 40 5. 0

Francis Creek

Francis Creek is tributary to the Salt River, which is tributary to the Eel River Estuary. Francis Creek is a second order stream and has approximately 5.2 miles of blue line stream according to the USGS Ferndale 7.5 minute quadrangle. Francis Creek's legal description at the confluence with Salt River is T03N R02W S35. Its location is 40° 35' 40.0" north latitude and 124° 15' 46.0" west longitude. Francis Creek drains a watershed of approximately 4.6 square miles. Elevations range from about 25 feet at the mouth of the creek to 1000 feet in the headwater areas. Grass and mixed hardwood and conifer forests dominate the watershed. The watershed is primarily privately owned and is managed for timber production and rangeland. The watershed is also influenced by urban and suburban development. The habitat assessment survey began just off Eugene Street in Ferndale and extended upstream 2.7 miles.

The habitat inventory of June 2nd to June 20th, 2003, was conducted by Sarah Ganas, Lesley Merrick , Dian Bacigalupi (AmeriCorps WSP). The total length of the stream surveyed was 14,062 feet with an additional 103 feet of side channel.

This section of Francis Creek has two channel types: an F4 channel type for the first 9,114 feet of the stream surveyed (Reach 1) and an A4 channel type for the next 4,948 feet of the stream surveyed (Reach 2). F4 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and gravel-dominant substrates. The suitability of F4 channels for fish habitat improvement structures are good

for bank place boulders, fair for plunge weirs, single and opposing wing deflectors, channel constrictors, and log cover; and are poor for boulder clusters. A4 channels are steep, narrow, cascading, step-pool, high energy debris transporting channels associated with depositional soils, and gravel channels. A4 channels are generally not suitable for fish habitat improvement structures.

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: Francis Creek | LLID: 1242628405945 | Drainage: Eel River - Lower

Survey Dates: 6/2/2003 to 6/20/2003 | Survey Length (ft.): 14165 | Main Channel (ft.): 14062 | Side Channel (ft.): 103

Confluence Location: Quad: FERNDALE | Legal Description: T03NR02WS35 | Latitude: 40:35:40.0N | Longitude: 124:15:46.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F4
Reach Length (ft.): 9114
Riffle/Flatwater Mean Width (ft.): 8.6
BFW:
Range (ft.): 13 to 21
Mean (ft.): 17
Std. Dev.: 2
Base Flow (cfs.): 1.1
Water (F): 53 - 60 Air (F): 54 - 70
Dry Channel (ft): 0

Canopy Density (%): 89
Coniferous Component (%): 3
Deciduous Component (%): 97
Dominant Bank Vegetation: Deciduous Trees
Vegetative Cover (%): 80
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 16
LWD per 100 ft.:
Riffles: 1
Pools: 3
Flat: 1

Pools by Stream Length (%): 46
Pool Frequency (%): 45
Residual Pool Depth (%):
< 2 Feet Deep: 71
2 to 2.9 Feet Deep: 26
3 to 3.9 Feet Deep: 2
>= 4 Feet Deep: 1
Mean Max Residual Pool Depth (ft.): 1.7
Mean Pool Shelter Rating: 32

Pool Tail Substrate (%): Silt/Clay: 13 Sand: 0 Gravel: 86 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 1
Embeddedness Values (%): 1. 2 2. 19 3. 43 4. 35 5. 1

STREAM REACH: 2

Channel Type: A4
Reach Length (ft.): 4948
Riffle/Flatwater Mean Width (ft.): 4.3
BFW:
Range (ft.): 13 to 22
Mean (ft.): 17
Std. Dev.: 3
Base Flow (cfs.): 1.1
Water (F): 54 - 58 Air (F): 55 - 63
Dry Channel (ft): 0

Canopy Density (%): 80
Coniferous Component (%): 10
Deciduous Component (%): 90
Dominant Bank Vegetation: Deciduous Trees
Vegetative Cover (%): 84
Dominant Shelter: Boulders
Dominant Bank Substrate Type: Cobble/Gravel
Occurrence of LWD (%): 18
LWD per 100 ft.:
Riffles: 3
Pools: 10
Flat: 3

Pools by Stream Length (%): 12
Pool Frequency (%): 29
Residual Pool Depth (%):
< 2 Feet Deep: 94
2 to 2.9 Feet Deep: 6
3 to 3.9 Feet Deep: 0
>= 4 Feet Deep: 0
Mean Max Residual Pool Depth (ft.): 1.3
Mean Pool Shelter Rating: 31

Pool Tail Substrate (%): Silt/Clay: 12 Sand: 0 Gravel: 73 Sm Cobble: 0 Lg Cobble: 0 Boulder: 12 Bedrock: 3
Embeddedness Values (%): 1. 0 2. 21 3. 42 4. 18 5. 18

Russ Creek

Russ Creek is a tributary to Centerville Slough, which is a tributary to Cutoff Slough, which is a tributary to Salt River, which is a tributary to Eel River, which is a tributary to the Pacific Ocean, located in Humboldt County, California. Russ Creek's legal description at the confluence with Centerville Slough is T02N R02W S06. Its location is 40°35'31" north latitude and 124°20'10" west longitude, LLID number 1243360405919. Russ Creek is a second order stream and has approximately 5.2 miles of blue line stream according CDFG river mile and stream length index for the Eel River Basin. The Russ Creek watershed is located within the USGS Ferndale 7.5 minute quadrangle. Russ Creek drains a watershed of approximately 2335 acres (3.65 mi2). Elevations range from about 5 feet at the mouth of the creek to 1515 feet in the

headwater areas. Douglas fir, Sitka spruce and mixed hardwood forests dominate the watershed. The watershed is entirely privately owned and is managed for timber production and rangeland. Vehicle access exists via-Centerville Road to Fern Cottage.

The habitat inventory of 10/13/2004 to 10/18/2004, was conducted by Corby Hines (CCC), Kevin Lucey (PSMFC). The total length of the stream surveyed was 11,609 feet with an additional 56 feet of side channel.

Russ Creek is a F6 channel type for 3196 feet of the stream surveyed (Reach 1), a B6 channel type for 8413 feet of the stream surveyed (Reach 2). F6 channels are entrenched, meandering, riffle/pool channels on low gradients with high width/depth ratios and silt-dominant substrates. B6 channels are moderately entrenched, moderate gradient, riffle dominated channels with infrequently spaced pools, very stable plan and profile, stable banks on moderate gradients with low width /depth ratios and silt dominant substrates.

Table 8 - Fish Habitat Inventory Data Summary

Stream Name: Russ Creek | LLID: 1243360405919 | Drainage: Eel River - Lower

Survey Dates: 10/13/2004 to 10/18/2004 | Survey Length (ft.): 11665 | Main Channel (ft.): 11609 | Side Channel (ft.): 56

Confluence Location: Quad: FERNDALE | Legal Description: T02NR02WS06 | Latitude: 40:35:31.0N | Longitude: 124:20:10.0W

Summary of Fish Habitat Elements By Stream Reach

STREAM REACH: 1

Channel Type: F6
Reach Length (ft.): 3196
Riffle/Flatwater Mean Width (ft.): 6.8
BFW:
Range (ft.): 8 to 18
Mean (ft.): 13
Std. Dev.: 4
Base Flow (cfs.): 0.0
Water (F): 55 - 58 Air (F): 55 - 74
Dry Channel (ft): 0

Canopy Density (%): 78
Coniferous Component (%): 10
Deciduous Component (%): 90
Dominant Bank Vegetation: Deciduous Trees
Vegetative Cover (%): 85
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 10
LWD per 100 ft.:
Riffles: 0
Pools: 2
Flat: 0

Pools by Stream Length (%): 33
Pool Frequency (%): 40
Residual Pool Depth (%):
< 2 Feet Deep: 46
2 to 2.9 Feet Deep: 29
3 to 3.9 Feet Deep: 21
>= 4 Feet Deep: 4
Mean Max Residual Pool Depth (ft.): 2.4
Mean Pool Shelter Rating: 61

Pool Tail Substrate (%): Silt/Clay: 22 Sand: 0 Gravel: 70 Sm Cobble: 0 Lg Cobble: 0 Boulder: 0 Bedrock: 9
Embeddedness Values (%): 1. 0 2. 0 3. 46 4. 25 5. 29

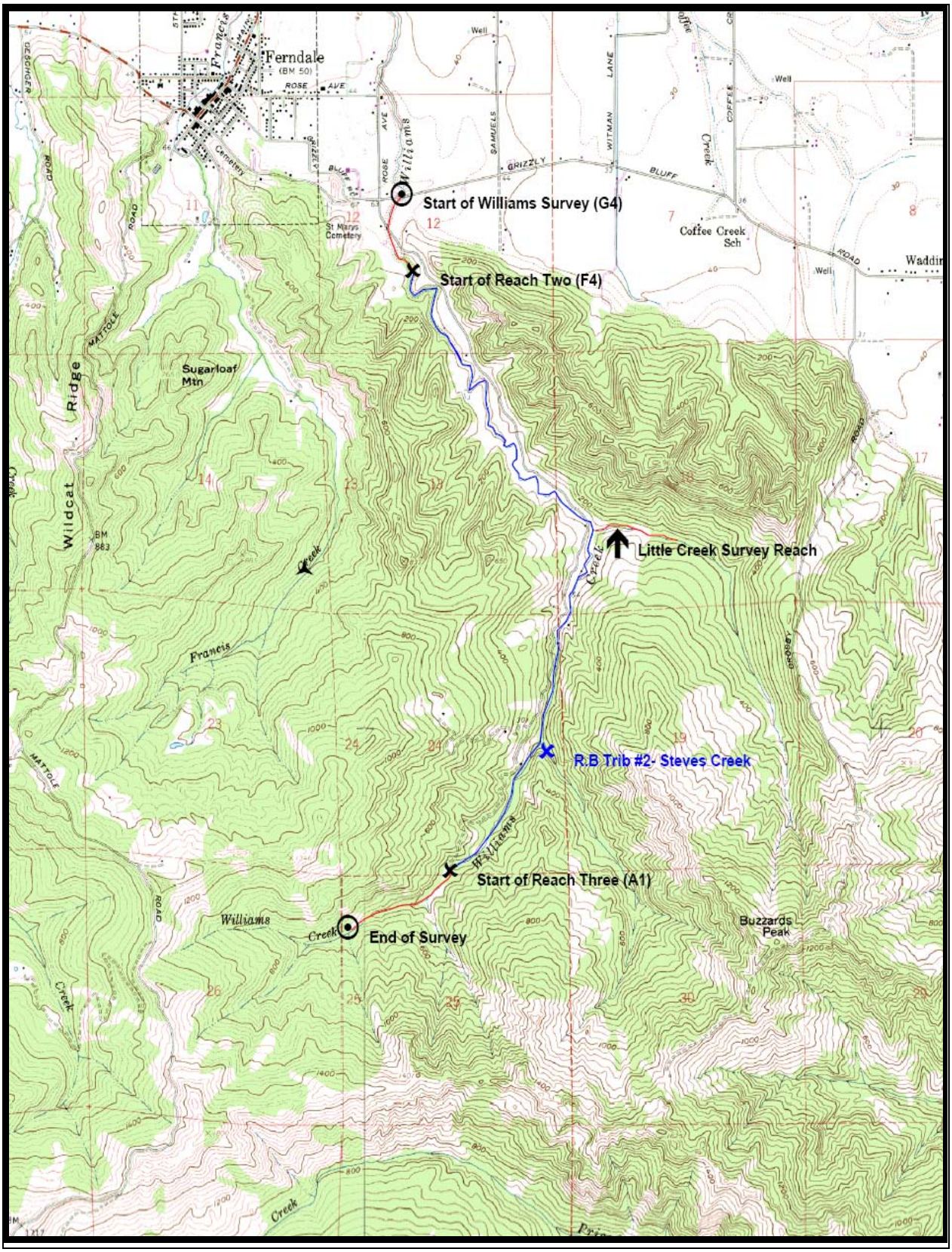
STREAM REACH: 2

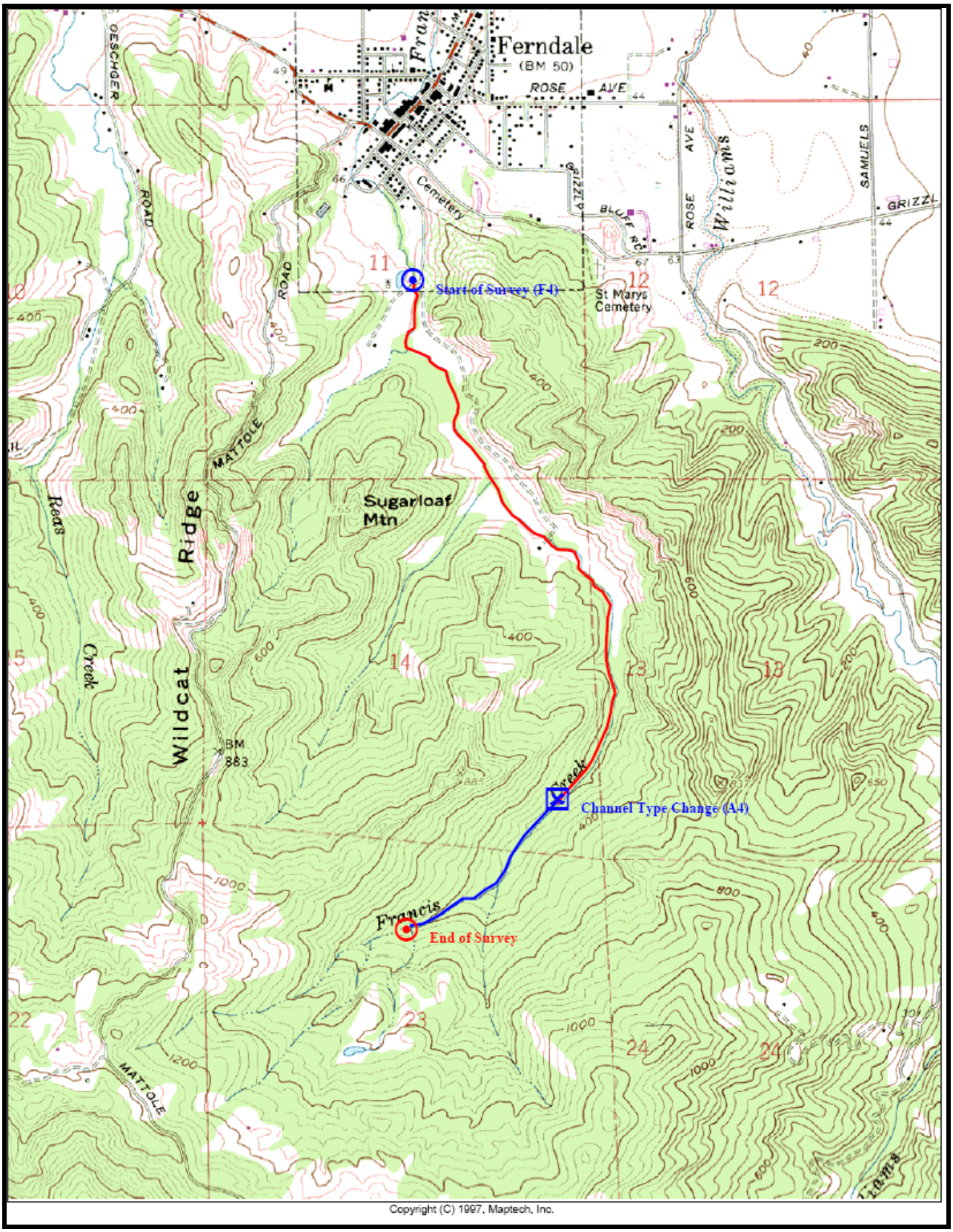
Channel Type: B6
Reach Length (ft.): 8413
Riffle/Flatwater Mean Width (ft.): 6.7
BFW:
Range (ft.): 11 to 22
Mean (ft.): 17
Std. Dev.: 4
Base Flow (cfs.):
Water (F): 0 - 62 Air (F): 0 - 74
Dry Channel (ft): 0

Canopy Density (%): 80
Coniferous Component (%): 22
Deciduous Component (%): 78
Dominant Bank Vegetation: Deciduous Trees
Vegetative Cover (%): 90
Dominant Shelter: Small Woody Debris
Dominant Bank Substrate Type: Sand/Silt/Clay
Occurrence of LWD (%): 34
LWD per 100 ft.:
Riffles: 0
Pools: 4
Flat: 0

Pools by Stream Length (%): 25
Pool Frequency (%): 41
Residual Pool Depth (%):
< 2 Feet Deep: 47
2 to 2.9 Feet Deep: 36
3 to 3.9 Feet Deep: 11
>= 4 Feet Deep: 6
Mean Max Residual Pool Depth (ft.): 2.3
Mean Pool Shelter Rating: 87

Pool Tail Substrate (%): Silt/Clay: 25 Sand: 0 Gravel: 71 Sm Cobble: 2 Lg Cobble: 0 Boulder: 0 Bedrock: 2
Embeddedness Values (%): 1. 0 2. 6 3. 61 4. 7 5. 26


Ferndale
Start of Williams Survey (G4)
Start of Reach Two (F4)
Coffee Creek Sch
Sugarloaf Mtn
Wildcat Ridge
Little Creek Survey Reach
R.B Trib #2- Steves Creek
Start of Reach Three (A1)
End of Survey
Buzzards Peak


Ferndale
(BM 50)
ROSE AVE
Cemetery
Start of Survey (F4)
St Marys Cemetery
Sugarloaf Mtn
Wildcat Ridge
Reas Creek
Francis Creek
Channel Type Change (A4)
End of Survey
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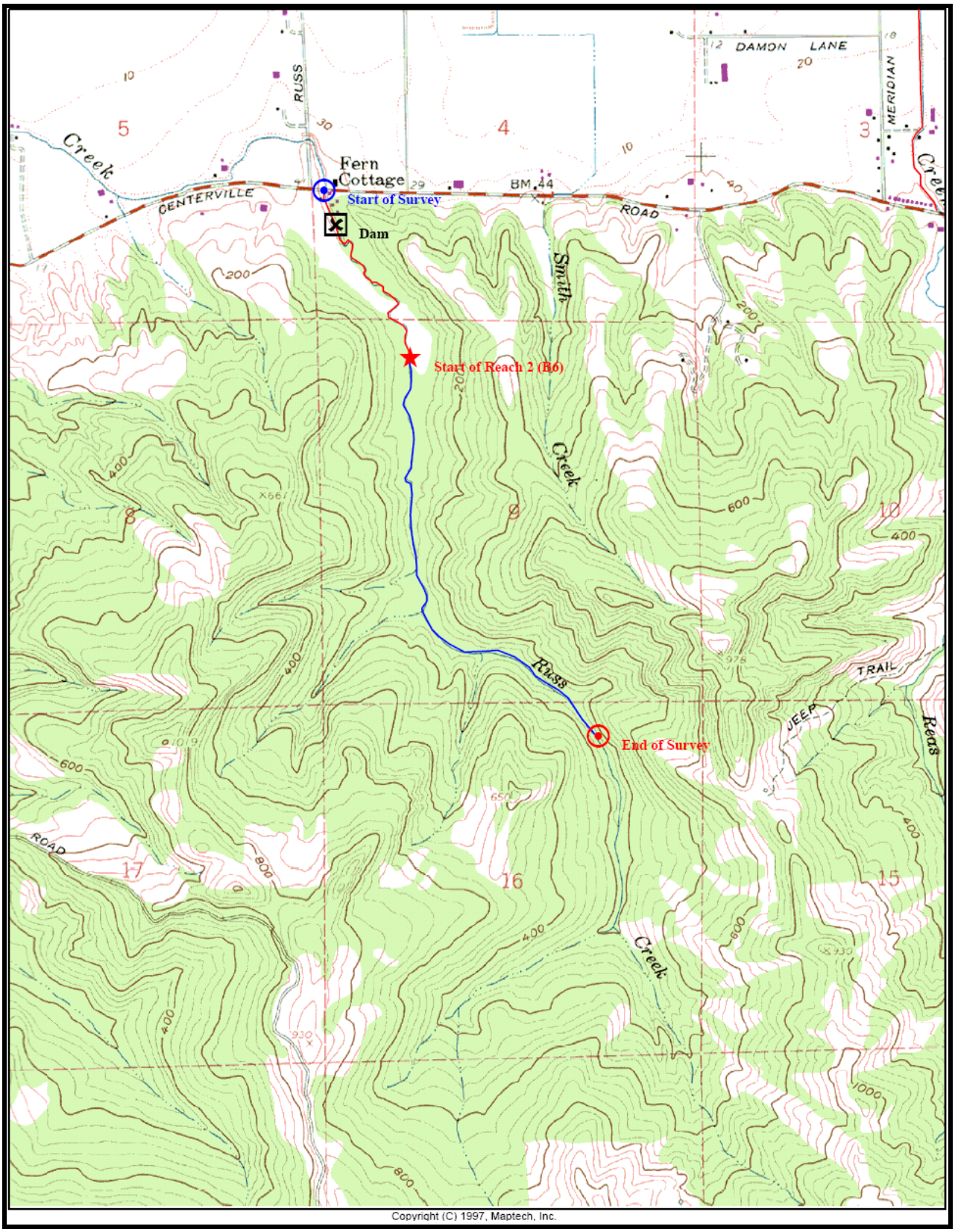
DAMON LANE
MERIDIAN
RUSS
Fern Cottage
Start of Survey
Dam
CENTERVILLE
ROAD
BM 44
Smith
Creek
Start of Reach 2 (B6)
Russ
End of Survey
TRAIL
JEEP
Russ
ROAD
Creek
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