# TECHNICAL STUDY
# FOR THE
# MILL POND IMPROVEMENT PROJECT

## GEORGIA-PACIFIC'S FORMER SAWMILL FACILITY, FORT BRAGG, MENDOCINO COUNTY, CALIFORNIA



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**PREPARED
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# TECHNICAL STUDY FOR THE MILL POND IMPROVEMENT PROJECT

## 1.0 BACKGROUND

### 1.1 General

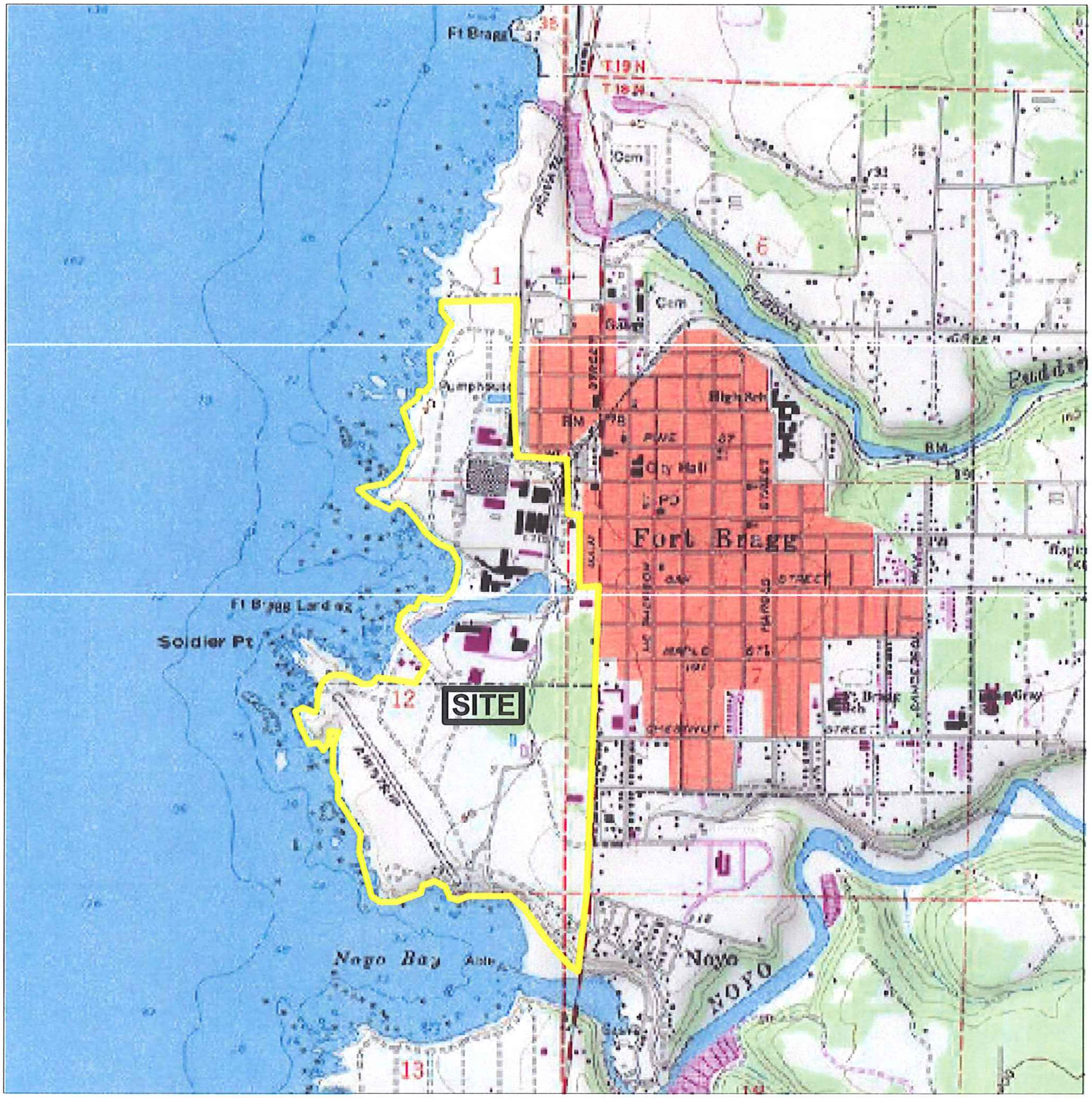
Georgia-Pacific (G-P) is in the process of decommissioning its Fort Bragg Sawmill Facility (Sawmill Site) located along the coast in Mendocino County, California (Figure 1). The Sawmill Site covers about 415 acres which includes nine ponds that were historically used for a variety of industrial purposes (Figure 2); some are still used for on-site fire protection purposes. Mill Pond is the largest of these ponds covering approximately 7.3 acres.

The City of Fort Bragg (City) has initiated the Georgia-Pacific Sawmill Site Open Space Acquisition Project to acquire portions of the Sawmill Site, including Mill Pond, for coastal access, recreation, and other public purposes. If acquired for open space, there are issues associated with Mill Pond that would likely necessitate that it ultimately be improved. This technical study identifies feasible concepts for the necessary improvements (Mill Pond Improvement Project).

Improvements to Mill Pond would likely involve alterations to the dam or modifications to the pond. These activities would trigger the need for permits and approvals from several federal and state agencies. The State Department of Water Resources, Division of Safety of Dams (DSOD), under the California Water Code, regulates non-federal dams in California that meet certain size criteria[1]. DSOD has exerted jurisdiction over Mill Pond dam[2] and over the years has performed inspections of dam and prepared inspection reports. DSOD has expressed concern about the dam's condition and has directed Georgia-Pacific to make repairs. Georgia-Pacific has requested delaying repair until the future use of the dam has been determined (DSOD, May 2004). The U.S. Army Corps of Engineers regulates discharge of fill material into federal

[1] Dams under DSOD jurisdiction are non-federal artificial barriers, together with appurtenant works, which are 25 feet or more in height or have an impounding capacity of 50 acre-feet or more. Any artificial barrier not in excess of 6 feet in height, regardless of storage capacity, or that has a storage capacity not in excess of 15 acre-feet, regardless of height, is not considered jurisdictional. DSOD reviews plans and specifications for the construction of new dams or for the enlargement, alteration, repair, or removal of existing dams, under application, and must grant written approval before the owner can proceed with construction. DSOD must have issued a certificate of approval based upon the findings of its personnel, before water can be impounded behind a new dam or behind an existing dam which has been enlarged, altered, or repaired. These certificates may contain restrictive conditions and may be amended or revoked by DSOD.

[2] DSOD has determined that the dam height is 33 feet and the impounding volume capacity is 88 acre-feet, which falls within DSOD jurisdiction (DWR 1993).




APPROXIMATE SCALE (FEET)
0 2,000 4,000

LEGEND

Approximate site boundary

N

SOURCE:
National Geographic
USGS Topographic Maps on CD-ROM:
Fort Bragg Quadrangle


**VICINITY MAP**

**FIGURE 1**

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FIGURE 2

**Legend**

**Potentially Environmentally Sensitive Habitat Areas**

- Seasonal Wetland
- Seasonal Wetland Ditch
- Wetland Seep
- Industrial Ponds
- Riparian Wetland
- Streams and Drainages

| ESHA I.D. | Acreage or Length |
|---|---|
| Pond 1 | 0.46 |
| Pond 2 | 0.77 |
| Pond 3 | 1.50 |
| Pond 4 | 0.10 |
| Pond 5 | 0.58 |
| Pond 6 | 0.17 |
| Pond 7 | 0.10 |


GRAPHICAL SCALE (FEET)

0 600 1,200 1,800 2,400

SAWMILL SITE BOUNDARY (APPROXIMATE)

# SAWMILL SITE MAP

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jurisdictional waters under the federal Clean Water Act (Section 404), subject to the state's approval authority (under Section 401). The State Water Resources Control Board, through its Regional Water Quality Control Boards, regulates discharges of any waste into state jurisdictional waters under the California Porter-Cologne Water Quality Control Act. The California Coastal Commission, under the federal Coastal Zone Management Act, has federal consistency review authority over Corps regulatory actions that affect coastal waters. The Commission also regulates discharges of fill into state jurisdictional waters under the California Coastal Act, and the City of Fort Bragg regulates under the Act's Local Coastal Program. The California Department of Fish and Game regulates alterations to state jurisdictional waters under the California State Fish and Game Code (Sections 1600 – 1616). Permits and approvals from these agencies would likely incorporate stringent design requirements, mitigation measures, and performance standards that could significantly influence the nature and extent of allowable improvements to Mill Pond.

## 1.2 Project Purpose

Georgia-Pacific and the City have identified multiple Project purposes:

- To eliminate potential geotechnical hazards related to Mill Pond Dam

  While detailed geotechnical and engineering analyses have not been performed, it appears that the Mill Pond dam may not meet structural and seismic safety standards and is in need of repair. DSOD has asked Georgia-Pacific to make repairs, and the City has concerns about potential safety and risk management issues which may be compounded by public access and intensified use of the beach and surrounding environs.

- To enhance stormwater quality

  Mill Pond is an important feature of the City's storm drainage system and it also will be an important drainage facility for the future development of the Sawmill Site. Mill Pond will need to continue to function as a stormwater quality enhancement facility.

- To provide public access, scenic and recreational amenities

  The Mill Pond area is slated for acquisition by the City for open space and has the potential to be a key scenic and public recreational amenity. Its current configuration, including a steep embankments and wood/timber walls along nearly the entire perimeter of the pond, are not optimal for public use.

- To restore and enhance wildlife habitat

  Mill Pond is heavily choked with parrot's feather, a non-native invasive aquatic plant, which limits the pond's habitat value. In addition, the edges of the pond are either hardscape or steep and do not fully support typical native pond fringe vegetation. There is an opportunity to reduce invasive plant growth, restore native pond fringe vegetation, and provide substantially improved wildlife habitat.

## 2.0 ENVIRONMENTAL SETTING

### 2.1 Physiography and Drainage

Fort Bragg, California lies on an elevated terrace (at about elevation 100 feet) bounded on the north by Pudding Creek, on the south by the Noyo River, and on the west by the sea cliffs and rocky shoreline of the Pacific Ocean. Rainfall averages about 40 inches per year. The Fort Bragg terrace is drained by small watercourses that discharge to Pudding Creek or the Noyo River, or municipal storm drains that ultimately discharge to alluvial bottomlands or beaches. The terrace is overlain by marine terrace deposits, which consist of poorly consolidated sand, silt, gravel, and clay. The bedrock geology consists of sandstone, shale, and minor inclusions of volcanic rocks of the Franciscan Complex, which is exposed along the coastal bluffs.

The Sawmill Site covers about 415 acres of terrace and alluvial bottomland between Highway 1 and the ocean. About 80 percent of the Sawmill Site is covered with asphalt, crushed rock, or a mixture of both. Fort Bragg Landing Bay, also referred to as Soldier Bay, cuts into the rocky shoreline and terminates at a beach adjacent to an alluvial bottomland (Figure 3). Beyond the northern boundary of the Sawmill Site lie undeveloped lands and the outlet of Pudding Creek. A landing strip and the City of Fort Bragg wastewater treatment plant lie to the south of Mill Pond.

The surface geology of the Sawmill Site is primarily artificial fill material consisting of sands with gravel, gravels with sand, and gravels to a depth of approximately 0-20 feet. Underlying the fill material are marine terrace deposits which consist of silty sands, sand, gravel with sand, and gravel. The marine terrace deposits vary in thickness across the site from 12 to greater than 70 feet. Underlying the marine terrace deposits are Franciscan sandstone and conglomerate bedrock. In the alluvial bottomland, alluvial material overlies lower elevation marine terrace deposits or, possibly, Franciscan bedrock.

The surface drainage of the Sawmill Site generally follows the topography towards the west. There are few well-defined surface drainage features or constructed stormwater facilities that concentrate the runoff; rather, runoff appears to generally flow in a distributed fashion. Some of the industrial ponds collect runoff from small, localized surrounding areas. Overflow from Ponds 1 - 4 spills into the southwestern corner of Mill Pond. A drainage area along the southeastern edge of the site near Maple Street collects localized surface runoff in a catch basin where a City storm drain also discharges. From the catch basin water is conveyed through a pipeline to Mill Pond. Another pipeline containing water collected from the City's Alder Street storm drain discharges into Mill Pond.

Depth to groundwater varies over the Sawmill Site, from as shallow as 1 foot below grade (fbg) in the alluvial bottomland to over 25 fbg on the terrace. Groundwater flow converges toward the


MILL POND AND COASTAL LOWLAND AREAS OF G-P FORT BRAGG SAWMILL SITE

FIGURE 3

alluvial bottomland, generally following the topography. A large seep occurs along the northern edge above the alluvial bottomland where groundwater daylights along the terrace.

## 2.2 Mill Pond and Dam

Sometime around 1885, after the Sawmill Site was originally developed, Mill Pond was formed by constructing an earthen dam along the terrace above the alluvial bottomland and on top of the rock comprising the edge of the coastal bluff. Apparently, a depression was excavated into the terrace behind the dam to provide additional storage capacity and Alder Creek was diverted into the pond that was formed. The dam has two concrete spillways set side-by-side along the coastal bluff -- an upper spillway and a lower spillway. The spillways discharge directly on to Soldier Bay beach and then into the ocean.

Mill Pond Dam consists of embankments along most of the pond perimeter. The dam appears to have been modified over the years and consists of a non-uniform assemblage of rock and debris, wood walls, timber crib walls, concrete retaining walls, and earthen berms. Along the coastal bluff on the west side of the pond, the embankment was constructed by placing fill material on top of exposed bedrock. Stacked concrete or timber crib walls were constructed in crevasses in the bluff to create a more resistant base for the overlying earthen fill. Fill material was deposited directly on top of the bedrock, or on top of the stacked concrete and crib walls. Along the north side, a wood wall was constructed with a fill embankment extending down to the alluvial bottomland. On the south and east sides, it appears that the pond was excavated into native soils, and a wood wall was constructed to retain the overlying slopes.

Based on a topographic/bathymetric map of the Mill Pond area, the lowest points in the pond are at approximately elevation 36.7 feet, the two spillway crests are at approximately elevation 40.7 feet (upper spillway) and 39.3 feet (lower spillway), and the top of dam is at about elevation 44.0 feet. With the water level at the upper spillway crest the maximum pond water depth is about 4.0 feet, and the pond covers about 5.2 acres and contains about 14 acre-feet of water.

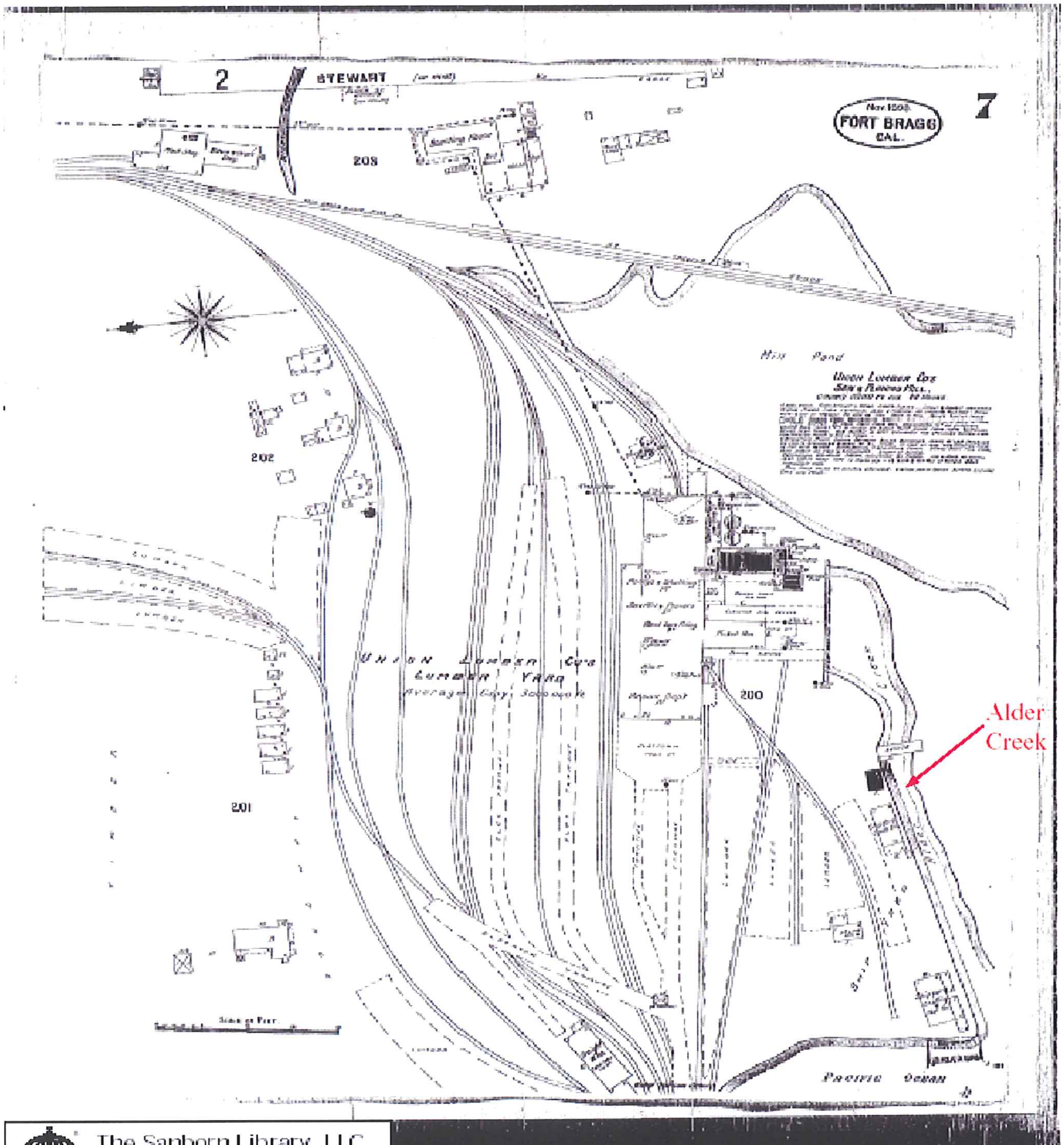
A geotechnical study was performed to evaluate the condition of the dam and make preliminary recommendations for repairs (Appendix A, Geotechnical Evaluation). The study, based on visual inspection and assumed soil conditions (no soil testing was performed), found that the dam is potentially unstable, particularly along the coastal bluff. Soil investigations and laboratory strength tests would be required to provide a more accurate evaluation. The study presented options for stabilizing the dam, which include constructing a retention structure along the centerline of the dam, removing and rebuilding the dam, building a new interior dam, or excavating a deeper pond and lowering the dam.

## 2.3 Mill Pond Hydrology

Historically, Alder Creek drained central Fort Bragg and entered what is now the Sawmill Site from the east, dropping down onto the alluvial bottomland before discharging to Soldier Bay (Figure 4). After the Sawmill Site was developed, apparently Alder Creek was diverted into the constructed Mill Pond. Today Mill Pond is fed by two city storm drains, on-site surface runoff, and natural groundwater seepage. Historically, imported water pumped from G-P's Pudding Creek Reservoir and other on-site processing ponds has also been delivered to Mill Pond for industrial and fire prevention purposes. Beginning about three years ago, these imported water deliveries were reduced. Water exits the pond naturally through seepage and evapotranspiration. Except during wet periods, inflow exceeds natural outflow and water flows over the spillway onto Soldier Bay beach and the Pacific Ocean.

Two City storm drains, referred to as the Alder Street and the Maple Street pipelines, discharge along the eastern edge of Mill Pond via 36-inch reinforced concrete pipes. The source of the discharged water is stormwater runoff and groundwater seepage that infiltrates into the City stormwater network. The drainage basin for the Alder Street pipeline follows the approximate alignment of the historical Alder Creek encompassing approximately 104 acres consisting mainly of residential neighborhoods and business districts in the north-central portion of the City. The drainage basin for the Maple Street pipeline includes most central Fort Bragg encompassing approximately 130 acres consisting mainly of residential neighborhoods and commercial (Winzler & Kelly, 2004). Mill Pond also receives surface runoff from about 141 acres of the Sawmill Site consisting of distributed runoff, some of which collects in Ponds 1 - 4 and spills into the southwestern corner of the pond. In addition to surface inflow, Mill Pond is also probably fed by natural groundwater seepage directly entering the pond from surrounding areas.

Historical hydrologic records and approximations of imported deliveries were analyzed to evaluate the long term self-sustainability of Mill Pond relying solely on natural sources of inflow (Appendix B, Hydrologic Analysis). Analysis of these records and approximations found that during periods of normal rainfall natural sources are probably sufficient to sustain the pond year round. To test this hypothesis, during the summer of 2005 all artificial water deliveries to Mill Pond were terminated and the pond was left to rely solely on natural inflow from the Alder Street and Maple Street storm drains and groundwater seepage. The spillway was observed on nearly a daily basis from July through September. The pond remained full by base flow and water flowed continuously over the spillway at an estimated rate of about 30-60 gallons per minute throughout this period. Spillway flow was higher during storm events. Inflow was not measured so the contributions from the storm drains and groundwater seepage cannot be determined. Nonetheless, the summer 2005 observations support the likelihood that Mill Pond is self-






**SANBORN MAP FROM 1898 SHOWING HISTORICAL ALDER CREEK**

**FIGURE 4**

sustainable during years of normal precipitation.[3] During dry periods, particularly during summers of prolonged droughts when groundwater levels decline and groundwater seepage directly into the pond and indirectly through infiltration into the Alder Street and Maple Street storm drains diminishes, the water level in Mill Pond could decline and imported water deliveries may be needed to sustain the pond.

### 2.5 Mill Pond Habitat

Mill Pond has an extensive coverage of emergent vegetation, with very little open water. The interior of the pond is almost completely covered by the invasive, non-native aquatic plant, parrot's feather *(Myriophyllum brasiliense).* Water parsley *(Oenanthe sarmentosa)* and cattail *(Typha latifolia)* grow along the pond fringe – less where wood walls create a steep drop off and reduce the extent of the fringe.

Historically, Mill Pond has retained water year round for industrial and fire prevention purposes. Mill Pond provides habitat for fish, amphibians, invertebrates, and nesting, foraging and roosting habitat for a variety of avian species, particularly waterfowl. Species observed during a field assessment on March 13, 2003 included (TRC, 2003):

- Red-winged blackbird (*Agelaius phoeniceus*)-several breeding pair
- Mallard (*Anus platyrhynchos*) – several breeding pair
- American coots (*Fulica americana*) – several breeding pair
- Great egret (*Ardea alba*) – single bird foraging
- Belted kingfisher (*Ceryle alcyon*) – pair foraging
- Canada goose (*Branta canadensis*)

No threatened or endangered species were observed within or near Mill Pond.

[3] Precipitation records from the Desert Research Institute for station 043161 in Fort Bragg indicate that precipitation for water year 2005 totaled 46.20 inches. Average precipitation at this station is 40.22 inches for the period 1949 – 2005 and annual precipitation ranges from 16.56 to 77.31 inches, so 2005 can be considered a "near normal" water year.

## 3.0 PROJECT CONSTRAINTS

The following are identified constraints that need to be factored into the design of improvements to Mill Pond:

- Conform to the conservation acquisition and open space framework

  A draft report of Preliminary Acquisition, Development, and Management Plan has been prepared by the City of Fort Bragg (City of Fort Bragg, 2004) for the Sawmill Site. Mill Pond improvements should generally conform to this conservation acquisition and open space framework (Figure 5).

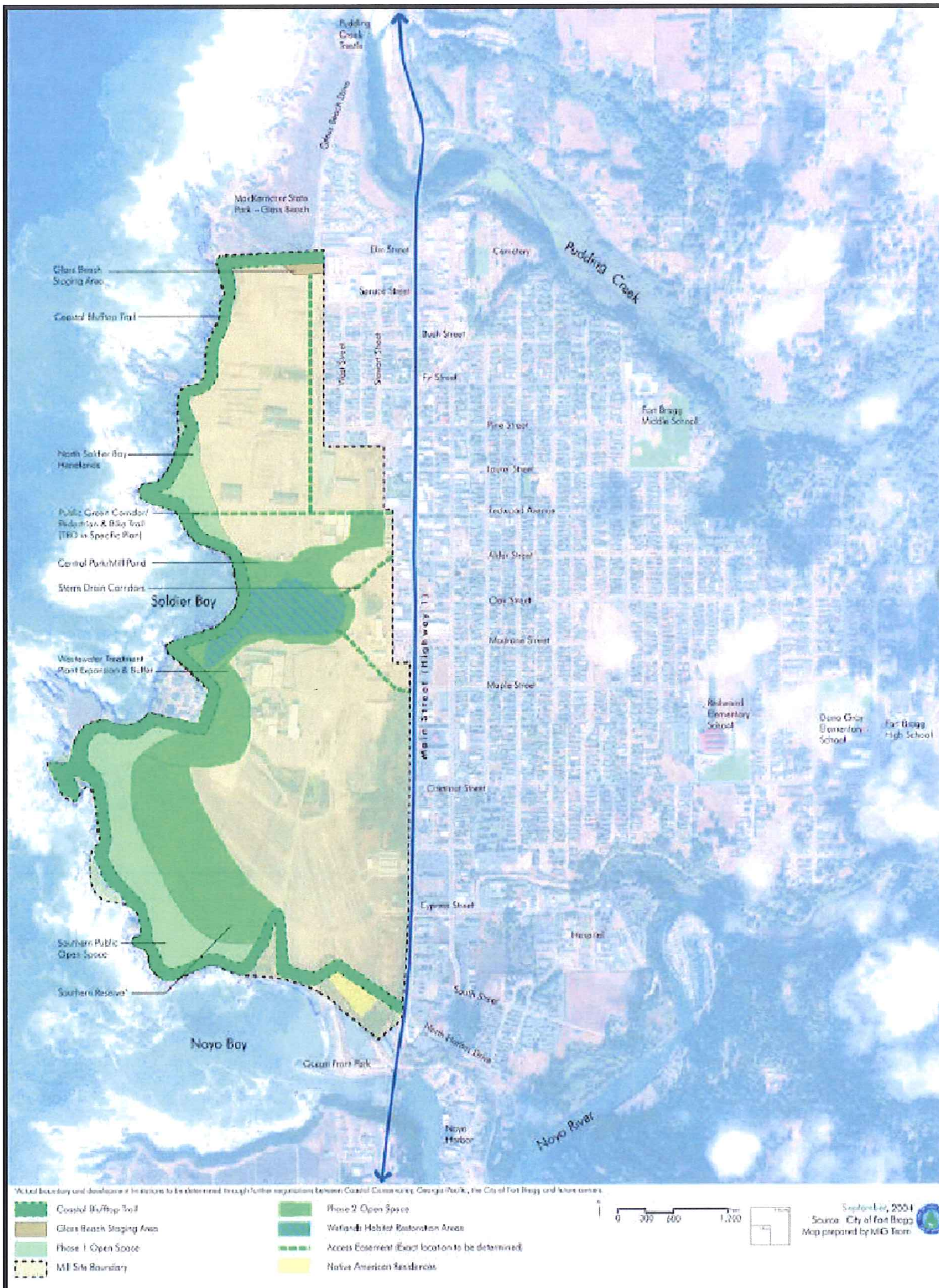
- Provide adequate storage capacity for treatment of off-site and on-site stormwater runoff

  In the future, discharge from Mill Pond to the ocean will likely be subject to the requirements of the City's Municipal Storm Water Permit issued by the Regional Water Quality Control Board. Mill Pond improvements should retain and enhance its functionality to polish the stormwater in compliance with the future permit.

  In accordance with best management practices, the required pond volume for stormwater quality enhancement is estimated to be approximately 18 acre-feet assuming half of the developed Sawmill Site is built to drain to the pond based on the site topography (Appendix C, Capacity Analysis for Stormwater Quality Enhancement). The capacity of the existing pond at the crest of the upper spillway is about 14 acre-feet.

- Comply with applicable environmental regulations

  Improvements to Mill Pond will be subject to permits and approvals from several regulatory agencies, which would likely incorporate stringent design requirements, mitigation measures, and performance standards.




**CONSERVATION ACQUISITION AND OPEN SPACE FRAMEWORK, CITY OF FORT BRAGG**

**FIGURE 5**

## 4.0 PROJECT OPPORTUNITIES

The following are identified opportunities to achieving the multiple purposes of the Mill Pond Improvement Project:

- Expand or enhance existing features of Mill Pond and nearby ponds

  The existing features of Mill Pond and/or other nearby ponds could be expanded or enhanced. Some of the ponds near Mill Pond could be restored to enhance habitat values and to contribute to the needs of stormwater treatment. If Mill Pond were to be retained, either entirely or in a smaller footprint, the edges of the pond could be enhanced by grading and re-contouring the slopes and planting native pond fringe and upland vegetation.

- Control non-native invasive plant species

  Parrot's feather is a non-native invasive aquatic plant found throughout the north coast area. It can choke shallow freshwater lagoons. While herbicide treatments are available, it frequently returns after treatment and long-term maintenance is difficult. However, if water depths are greater than 5 feet or the pond is brackish or saline, it will not become a serious problem. Therefore, any design for pond improvement should include measures to prevent recurrence of parrot's feather.

- Re-create historical riparian corridors and wetland in the alluvial bottomland

  Riparian corridors along Alder Creek and other watercourses probably occurred years ago before the Sawmill Site was originally developed. The alluvial bottomland probably supported a wetland during pre-development times as well. Shallow groundwater and the historical Alder Creek alluvial channel, now probably buried, would have been conducive to creating a sustainable pond and wetland environment. Re-creation of historical riparian corridors and the alluvial bottomland wetland with native emergent vegetation and upland buffer zones is possible. Removing the Soldier Bay beach berm would restore the historical tidal connection with the alluvial bottomland wetland.

- Use treated wastewater as a backup source of freshwater

  The City of Fort Bragg municipal wastewater treatment plant is located just south of Mill Pond. It is possible that with sufficient treatment to meet stringent water quality and public health standards some of this water could be recycled to provide make-up freshwater as needed to sustain the pond and wetland during extended dry periods.

## 5.0 PROJECT CONCEPTS

### 5.1 Criteria for Formulating Project Concepts

Conceptual designs for the Mill Pond Improvement Project have been formulated that achieve all of the multiple purposes of the Project while complying with the constraints and drawing on the opportunities described above. Each design is feasible from the standpoint of constructability, sustainability, and regulatory compliance. The table below summarizes design measures employed in each concept to achieve the multiple project purposes.

| Purpose: | Design Measure: |
|---|---|
| Eliminate geotechnical hazards | Incorporate stabilization measures (as per Appendix A, Geotechnical Evaluation), or fill the pond. |
| Low maintenance and sustainability | Install simple mechanical devices to intercept trash and debris where City storm drains discharge to the pond; make full use of natural sources of surface and groundwater inflow to sustain pond and wetland hydrology. |
| Stormwater quality enhancement | Intercept trash and debris at inflow points; provide a stormwater detention volume of at least 18 acre-feet (Appendix C, Capacity Analysis for Stormwater Quality Enhancement). |
| Public access, scenic opportunities | Allow for public access and pathways by providing buffers surrounding improved areas; eliminate steep embankments and wood/timber walls along the pond perimeter. |
| Wildlife habitat enhancement | Improve habitat by deepening the pond to inhibit growth of parrot's feather; regrade the shoreline to enlarge the pond fringe. |
| Regulatory compliance | Mitigate for impacts to jurisdictional waters at a ratio of 1:1 (Appendix D, Summary of Meetings with Environmental Regulatory Agencies). For purposes of determining mitigation requirements for ponds that are impacted, the following jurisdictional acreages have been used (per WRA, 2005)[4]: |

[4] Based on California Coastal Commission ESHA areas.

**TABLE 1**
**ACREAGES OF JURISDICTIONAL WATERS**

| Jurisdictional Water | Acreage/Length |
|---|---|
| Pond 1 | 0.46 ac |
| Pond 2 | 0.77 ac |
| Pond 3 | 1.50 ac |
| Pond 4 | 0.10 ac |
| Pond 5 | 0.58 ac |
| Pond 6 | 0.17 ac |
| Pond 7 | 0.10 ac |
| Pond 8 | 7.29 ac |
| Pond 9 | 0.71 ac |
| Pond E | 0.06 ac |
| Seep | 0.30 ac |
| Wetland | 5.78 ac |
| Drainage | 0.16 ac and 1,227 ft |

Source: WRA, 2005

For mitigating impacts to jurisdictional waters by re-creating the historical wetland in the alluvial bottomland, it has been assumed that construction of a wet meadow wetland would be favored over a coastal lagoon for several reasons. These include less maintenance, less potential impact on endangered steelhead, and a higher probability of self-sustainability and overall success.

The two project purposes that have the most influence on the nature and extent of the improvements to Mill Pond are stormwater quality enhancement and elimination of geotechnical hazards. Stormwater quality enhancement sets the requirement for minimum size of the stormwater pond: Using a required detention volume of 18 acre-feet and a minimum average depth of 5 to 8 feet to prevent parrot's feather, then about 2 to 4 acres are needed for the stormwater pond. Elimination of geotechnical hazards bears on the impacts to Mill Pond, which in turn influences the amount of stormwater detention volume that needs to be made-up and the amount of mitigation that needs to be provided. Acceptable stabilization measures include filling the pond, or stabilizing the dam using the "new interior embankment dam" and the "embankment modification" methods (per Appendix A, Geotechnical Evaluation) – the "structural retention" and "rebuild existing embankment" options have been eliminated from further consideration due to uncertainties about desirability, feasibility, and cost.

## 5.2 Descriptions of Alternative Project Concepts

Three general categories of conceptual designs have been developed that cover the range of feasible options. Each concept has variants.

**<u>Concept 1 – Retain Existing Pond Configuration</u>**

Concept 1 has two variants, 1a and b. The conceptual design for Concept 1a is shown in Figure 6. Key elements include:

- Stabilize the dam using "embankment modification" method lowering it from el. 44 feet down to el. 38 feet (Appendix A, Geotechnical Evaluation, p. 9 and Figure 10)
- Construct a new spillway at el. 35 feet and low-level outlet
- Excavate the pond down to el. 29 feet to create stormwater capacity and prevent parrot's feather
- Modify the inlet structures to conform to the modified pond configuration, prevent erosion, and contain trash and debris
- Re-grade and re-contour the banks and shoreline of the pond to add 50 feet of emergent wetland fringe for habitat enhancement and stormwater quality improvement
- Repair or remove the cribwall

The conceptual design for Concept 1b is shown in Figure 7. Concept 1b is similar to 1a, except that the stabilization method is the "new interior embankment" method (Appendix A, Geotechnical Evaluation, p. 8 and Figure 9). Removal or repair of the cribwall would not be necessary.

**<u>Concept 2 – Remove Dam and Partially Fill Pond</u>**

Concept 2 has three variants. The conceptual design for Concept 2a is shown in Figure 8. Key elements include:

- Fill the western part of the pond
- Excavate the remaining part of the pond down to el. 35 feet to create stormwater capacity and prevent parrot's feather
- Install a new spillway to el. 41 feet and low-level outlet with stilling basin and construct a culvert through the beach berm or remove the beach berm
- Modify the inlet structures to conform to the modified pond configuration, prevent erosion, and contain trash and debris
- Mitigate for the pond filling by excavating, planting and re-creating 2.7 acres of wet meadow with riparian corridor in the alluvial bottomland

**Alternative 2a Mitigation Summary**

| Loss | Gain |
|---|---|
| -2.7 ac for lost Pond 8 area (filling) | +2.7 ac for created wetland |

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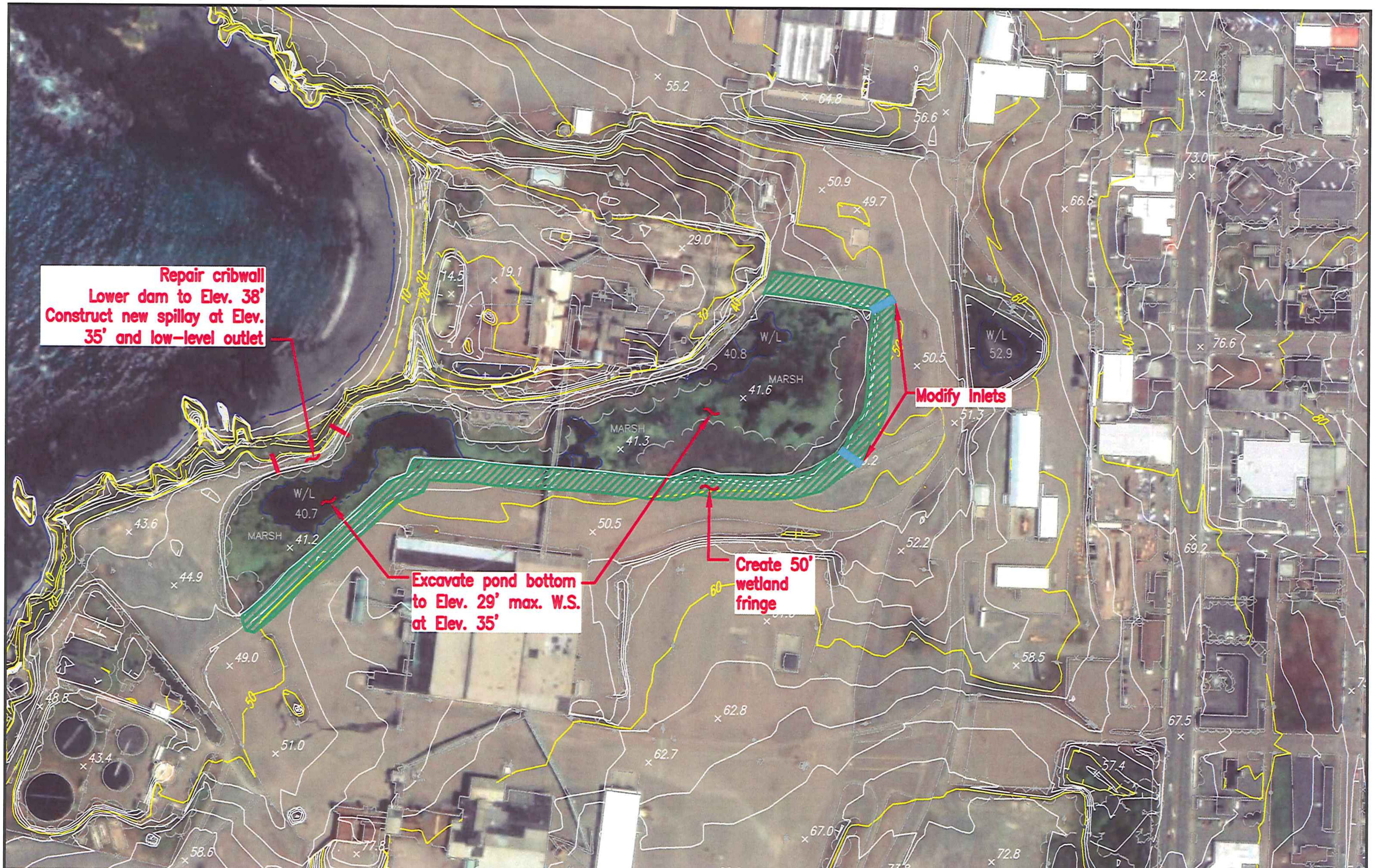


SCALE

0 150 300 600 FEET

N W E S

CONCEPT 1a – RETAIN EXISTING POND CONFIGURATION

PLAN VIEW

STETSON ENGINEERS INC.

FIGURE 6

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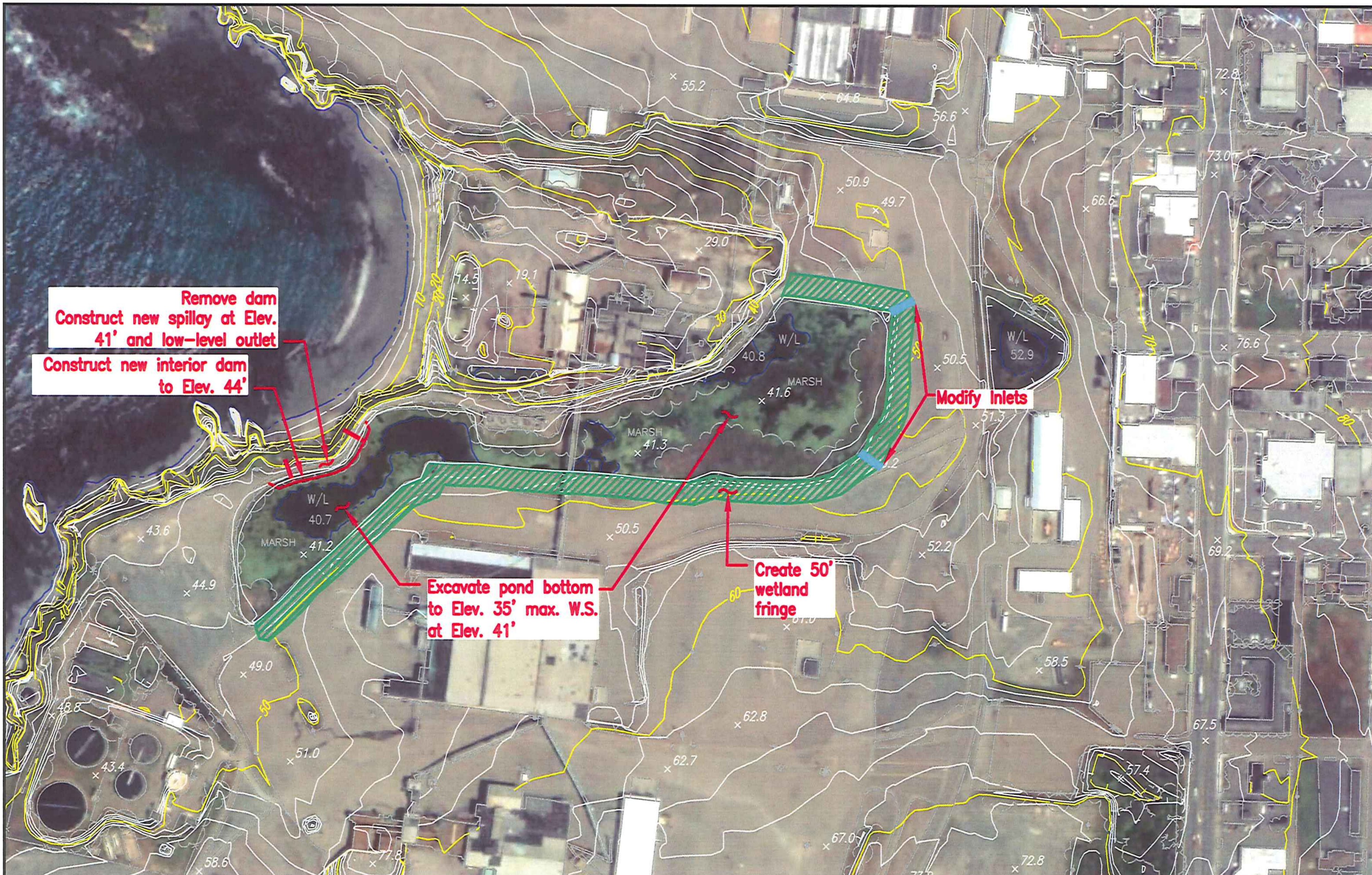


SCALE

0 150 300 600 FEET

N E S W

CONCEPT 1b – RETAIN EXISTING POND CONFIGURATION

PLAN VIEW

STETSON ENGINEERS INC.

FIGURE 7

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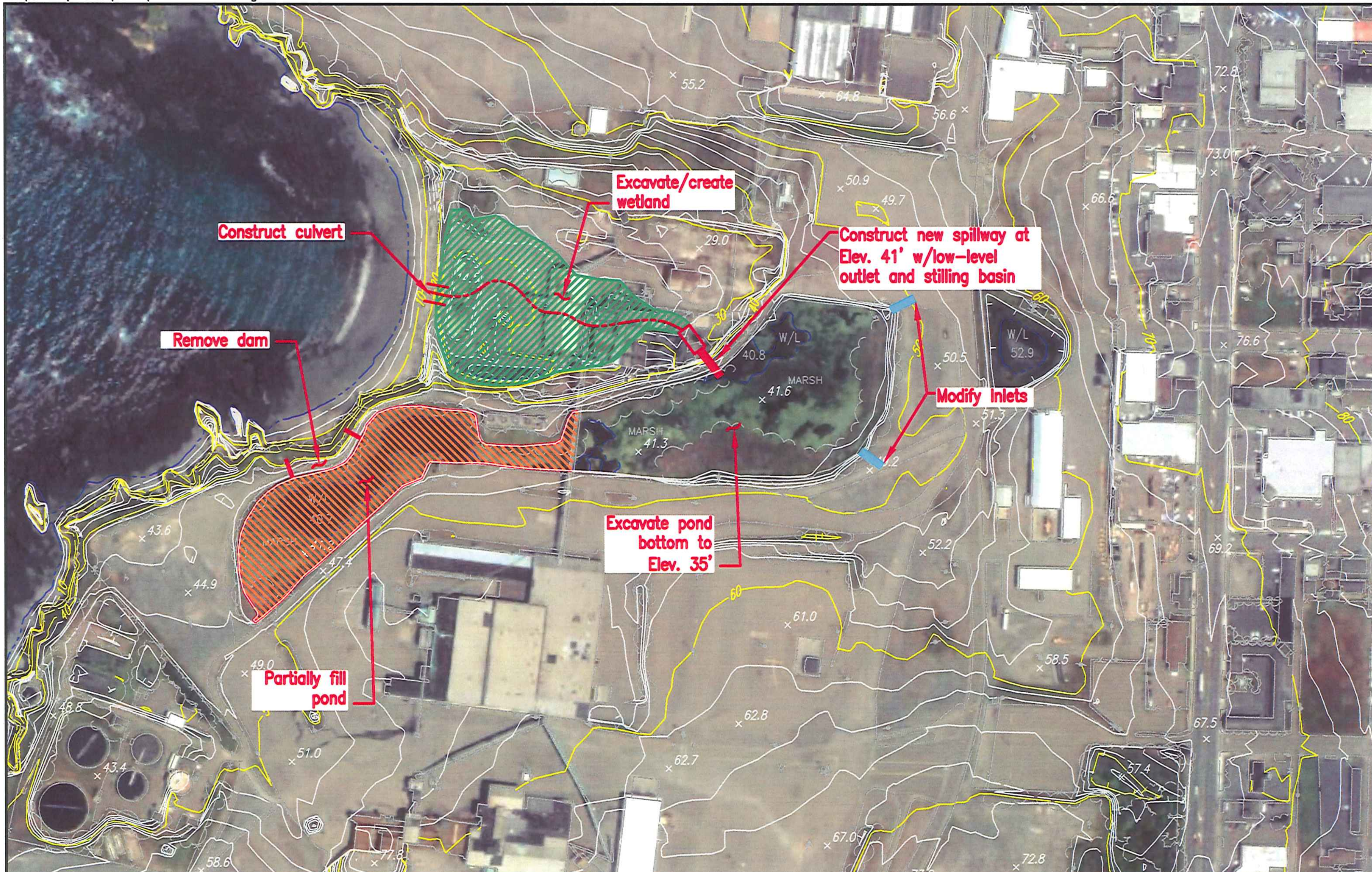


SCALE

0 150 300 600 FEET

N W E S

ALTERNATIVE 2a – REMOVE DAM AND PARTIALLY FILL POND

PLAN VIEW

STETSON ENGINEERS INC.

FIGURE 8

Concept 2b, shown in Figure 9, is similar to Concept 2a but it provides expanded habitat enhancements, which include:

- Re-grade/re-contour the banks and shoreline of the pond to add 50 feet of emergent wetland fringe for habitat enhancement and stormwater quality improvement
- Demolish and remove the spillway, remove the dam and re-grade down to the rocks
- Remove the wood wall and re-grade/re-contour the embankment along the northern side of the pond down to the alluvial bottomland
- Construct a pipeline to redirect the Alder Street storm drain to discharge into the Maple Street catch basin
- Construct a spillway with low level outlet at the Maple Street catch basin
- Create a stream channel with riparian corridor to convey outflow from the Maple Street catch basin to Mill Pond
- Remove the beach berm and re-grade to join Soldier Bay beach

**Alternative 2b Mitigation Summary**

| Loss | Gain |
|---|---|
| -2.7 ac for lost Pond 8 area (filling) | +2.8 ac for created wetland |
| -0.1 ac for lost Pond 7 area | |
| -2.8 ac | + 2.8 ac |

Concept 2c, shown in Figure 10, is similar to Concept 2b except that it moves the stormwater quality enhancement function from Mill Pond to the Maple Street catch basin where a new stormwater pond is created. This necessitates additional mitigation to compensate for about 5.9 acres of lost wetland drainage in the catch basin, which is achieved by expanding the created wet meadow in the alluvial bottomland and crediting the stream/riparian corridor and wetland fringe around Mill Pond.[5]

**Alternative 2c Mitigation Summary**

| Loss | Gain |
|---|---|
| -2.7 ac for lost Pond 8 area (filling) | +5.54 ac for created wetland |
| -0.1 ac for lost Pond 7 area | +1.7 ac for riparian corridor |
| -5.78 ac for lost wetland | +1.5 ac for Pond 8 fringe |
| -0.16 ac for lost drainage | |
| -8.74 ac | + 8.74 ac |

[5] The Regional Water Quality Control Board would not credit the created stream channel/riparian corridor and the 50 foot wetland fringe around Mill Pond toward mitigation for the loss from filling Mill Pond because, in Concept 2b, these features receive stormwater *before* treatment. On the otherhand, in Concept 2c, these features receive stormwater *after* treatment at the converted Maple Street pond and, consequently, would be credited toward mitigation.

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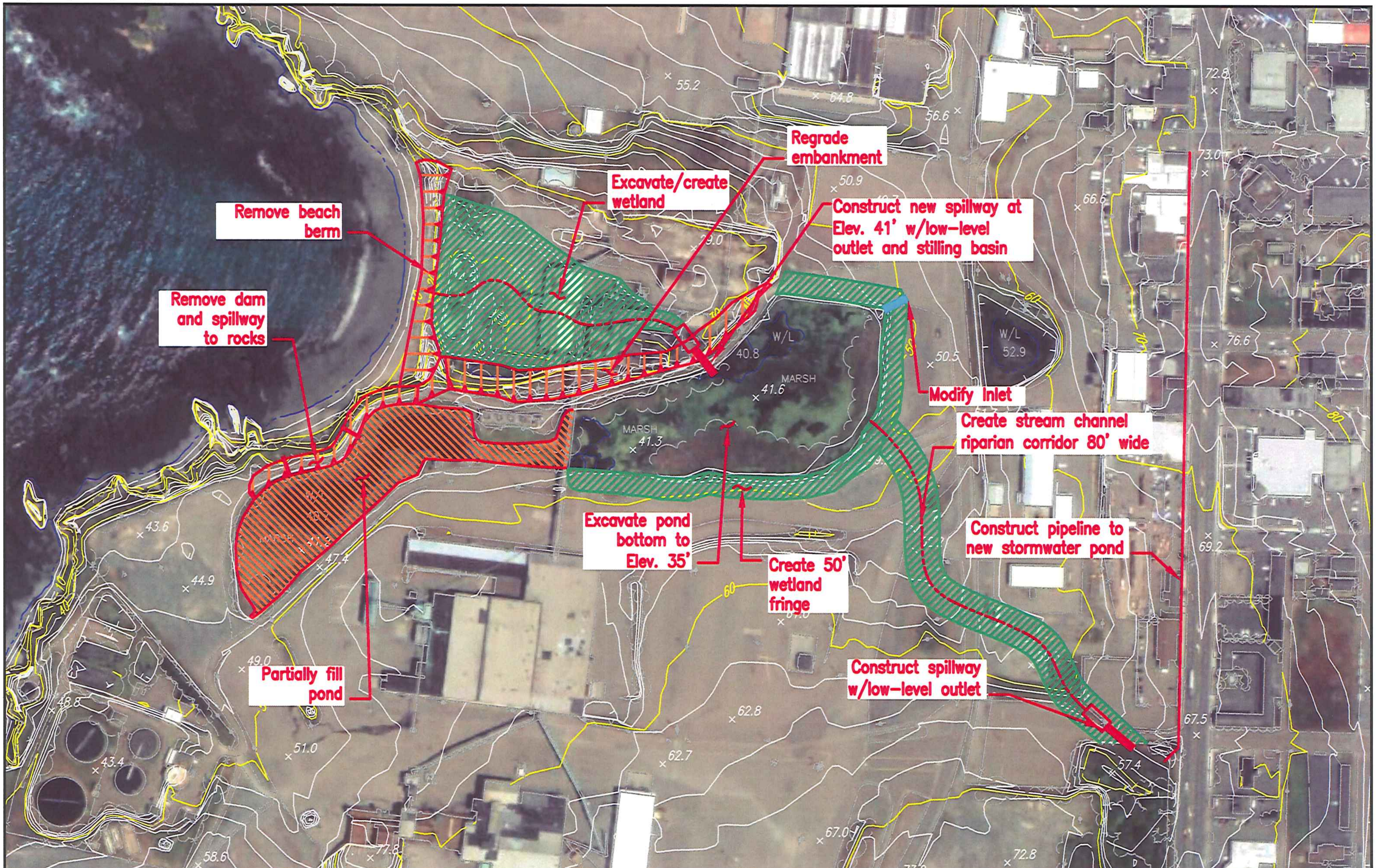


ALTERNATIVE 2b – REMOVE DAM AND PARTIALLY FILL POND

PLAN VIEW

STETSON ENGINEERS INC.

FIGURE 9

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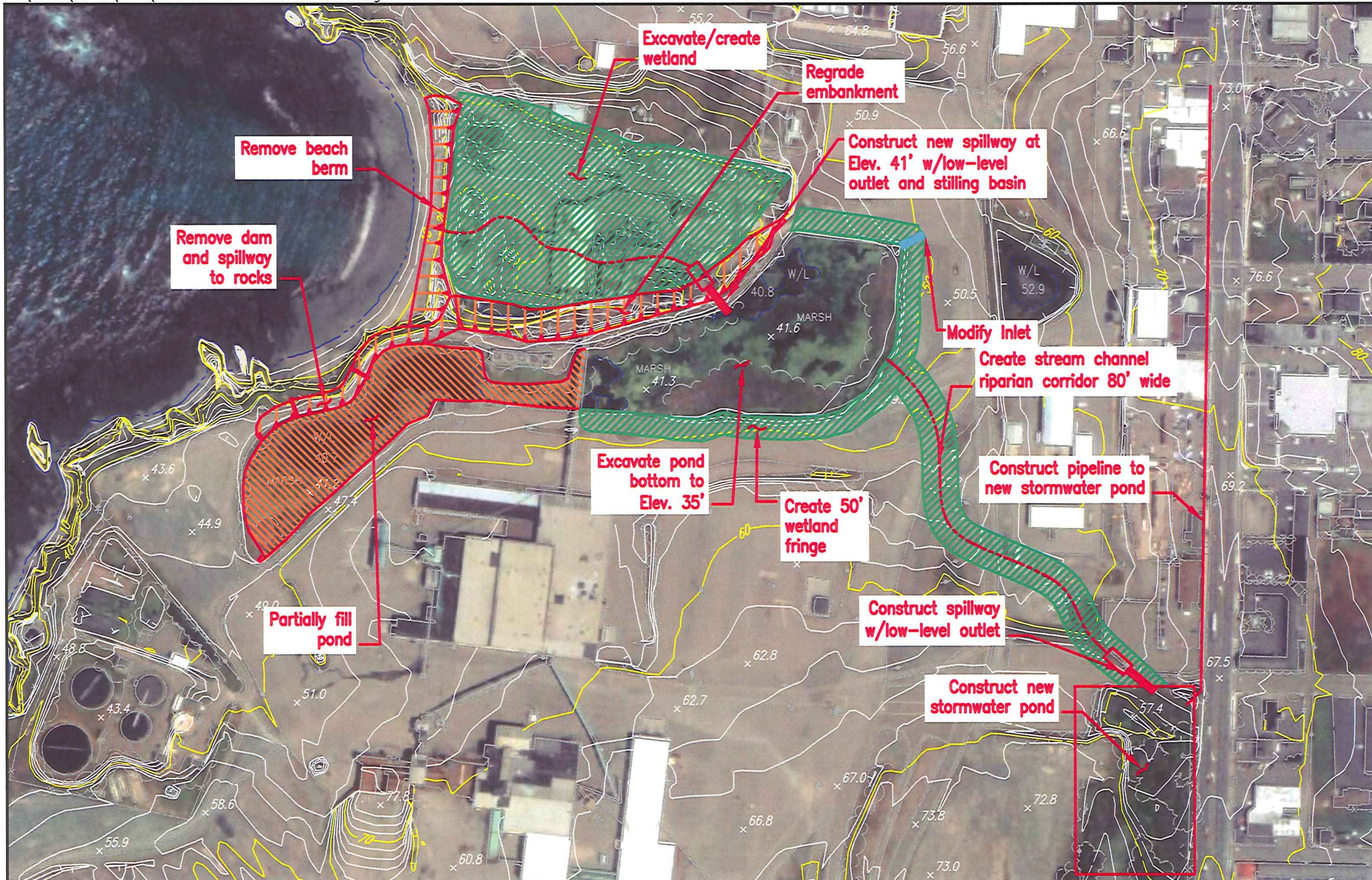


SCALE

0 150 300 600 FEET

N W E S

ALTERNATIVE 2c – REMOVE DAM AND PARTIALLY FILL POND

PLAN VIEW

STETSON ENGINEERS INC.

FIGURE 10

**Concept 3 – Remove Dam and Completely Fill Pond**

Concept 3 has two variants, 3a and b. The conceptual design for Concept 3a is shown in Figure 11. Key elements include:

- Fill the entire pond
- Construct a new stormwater pond at the Maple Street catch basin
- Extend the Alder Street storm drain to discharge to the new Maple Street stormwater pond
- Mitigate for the filling Mill Pond and loss of the Maple Street catch basin by (a) excavating, planting and creating a 5.8 acre stream channel/riparian corridor extending from the new Maple Street stormwater pond to the coastal lowland; and (b) excavating, planting and creating 7.4 acres of wet meadow in the coastal lowland
- Construct a culvert through the beach berm
- Remove the dam and re-grade down to the rocks
- Repair or remove the cribwall
- Remove beach berm and re-grade

**Alternative 3a Mitigation Summary**

| Loss | Gain |
|---|---|
| -7.3 ac for lost Pond 8 area (filling) | +7.4 ac for created wetland |
| -5.78 ac for lost wetland | +5.8 ac for riparian corridor |
| -0.16 ac for lost drainage | |
| -13.2 ac | +13.2 ac |

Concept 3b is similar to 3a, except that the new stormwater pond is constructed at Pond 5, which necessitates 0.6 acres of mitigation to compensate for the lost Pond 5 area. This mitigation is accomplished by increasing the area of the created wet meadow wetland in the coastal lowland. The conceptual design for Concept 3b is shown in Figure 12.

**Alternative 3b Mitigation Summary**

| Loss | Gain |
|---|---|
| -7.3 ac for lost Pond 8 area (filling) | +7.2 ac for created wetland |
| -0.6 ac for lost Pond 5 | +0.7 ac for riparian corridor |
| -0.16 ac for lost drainage | |
| -7.9 ac | +7.9 ac |

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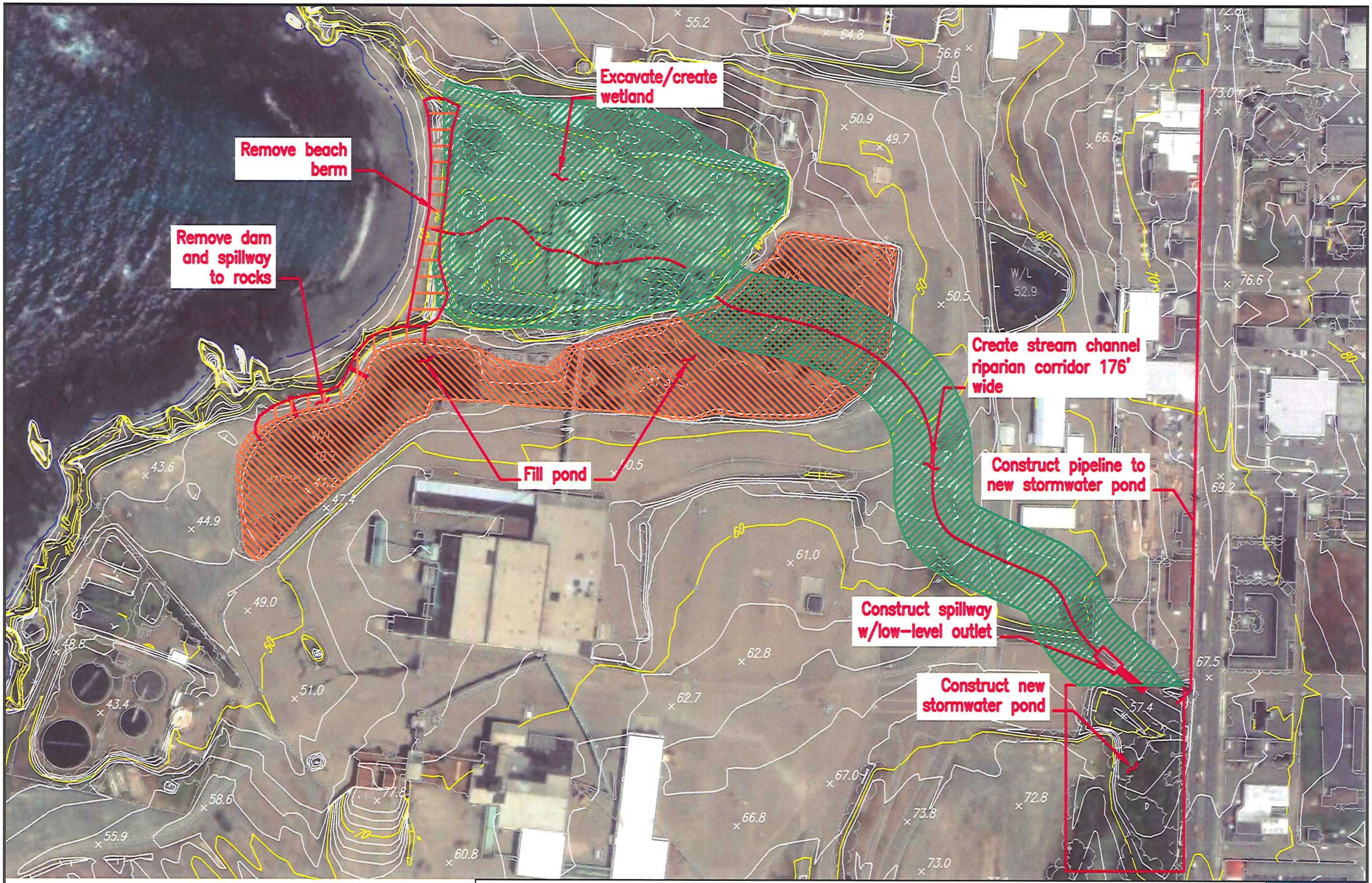


CONCEPT 3a – REMOVE DAM AND COMPLETELY FILL POND
PLAN VIEW

STETSON ENGINEERS INC.

FIGURE 11

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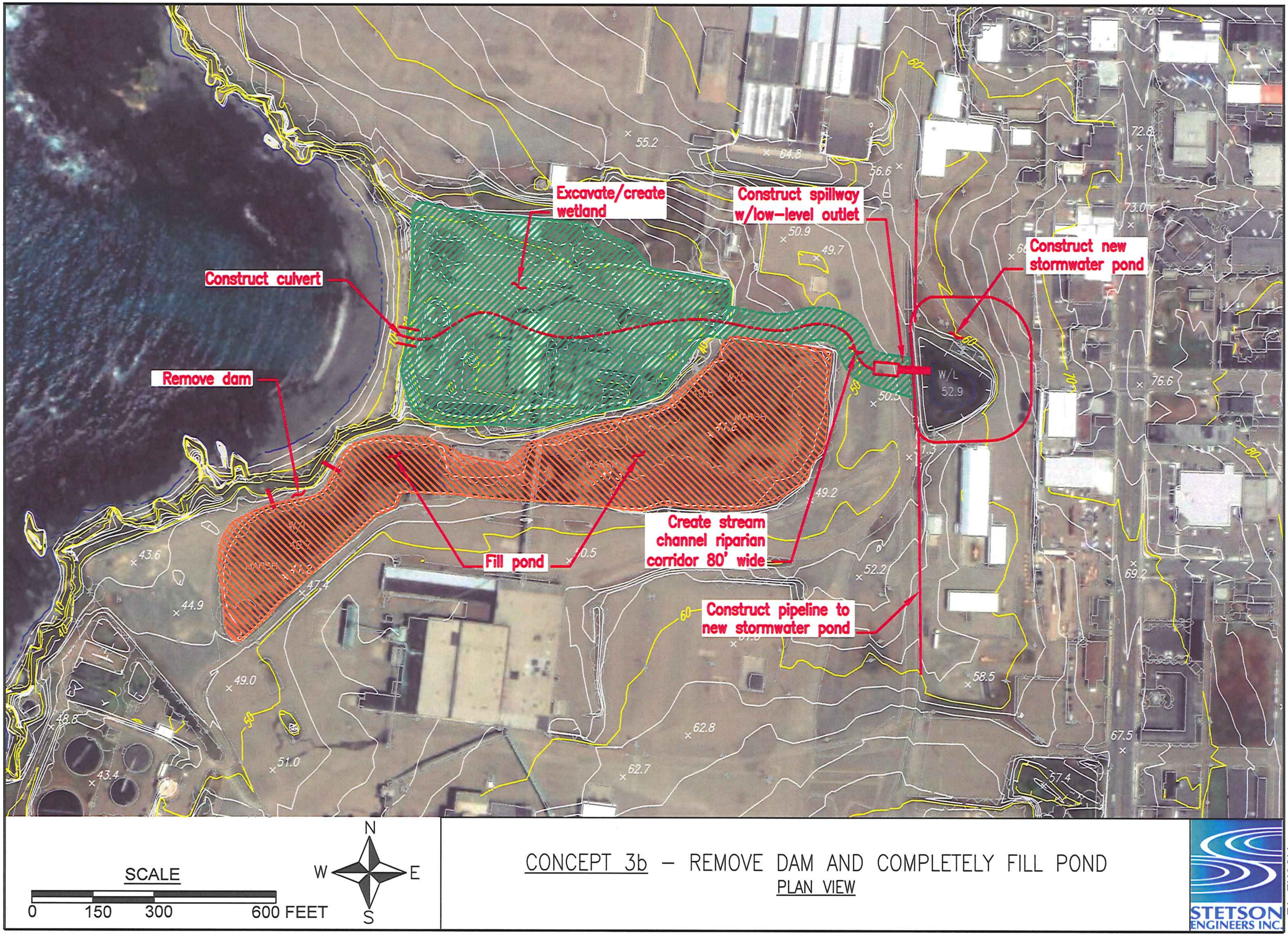


CONCEPT 3b – REMOVE DAM AND COMPLETELY FILL POND
PLAN VIEW

STETSON ENGINEERS INC.

FIGURE 12

## 6.0 PROJECT IMPLEMENTATION

Implementation of the Mill Pond Improvement Project can occur in three phases: Phase 1, preliminary design and environmental regulatory compliance; Phase 2, final design; and Phase 3, construction. Following is a bulleted list of key activities and milestones for Phase 1.

- For purposes of NEPA and CEQA compliance, prepare a Project Description, Statement of Purpose and Need, and define the Project area.
- Prepare a protocol level delineation of jurisdictional waters within the Project area and submit to the Corps and CCC for written verification.
- Review existing biological and cultural resources surveys, conduct supplemental protocol level surveys within the Project area and surrounding affected areas as needed. These surveys should determine the presence or absence of any plant or animal species afforded special protection under the State and Federal law, as well as cultural resources. Prepare biological and cultural resources assessment reports to support environmental regulatory compliance.
- Prepare a detailed engineering feasibility study that formulates and analyzes Project alternatives. Each alternative should meet the stated purpose and need, comply with permitting and mitigation requirements of all agencies, be compatible with pollution cleanup activities, and meets (pending) RWQCB NPDES stormwater permit requirements. At least one alternative should be developed that avoids or at least minimizes impacts to jurisdictional waters and all alternatives. The feasibility study should analyze the Project alternatives in accordance with EPA 404(b)(1) Guidelines and CCC guidelines, select a preferred alternative, and provide feasibility-level design and costs for the preferred alternative.
- Prepare a single Project Description document for the selected preferred alternative Project that is suitable for all agencies. Complete specialized application forms for each agency, attach the Project Description document to each specialized application form, and submit to the agencies along with appropriate fees.
- Prepare CEQA documentation (City is Lead Agency).
- City adopts CEQA finding.
- CDFG issues SAA.
- RQWCB issues 401 certification or waiver.
- City issues CDP.
- After all State permits are issued, Corps completes NEPA and prepares FONSI (assuming EA/FONSI are appropriate), and issues permit.
- Prepare final design.
- Construct.

**REFERENCES**


City of Fort Bragg, 2004. Preliminary Acquisition, Development & Management Plan.

Department of Safety of Dams, 2004. DSOD Inspection Report.

Department of Water Resources, 1993. Dams within Jurisdiction of the State of California, Bulletin 17 – 93.

TRC, 2003. Jurisdictional Determination and Habitat Assessment.

Winzler &Kelly, 2004. Storm Drainage Master Plan, City of Fort Bragg.

WRA, 2005. Assessment of Environmentally Sensitive Habitat Areas.

# APPENDIX A:

# GEOTECHNICAL EVALUATION

# GEORGIA-PACIFIC MILL POND AND DAM
# FORT BRAGG, CALIFORNIA

MILLER PACIFIC ENGINEERING GROUP

MARCH 21, 2005

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ENGINEERING GROUP

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March 21, 2005
File: 960.03altr.doc

Stetson Engineers
2171 East Francisco Boulevard, Suite K
San Rafael, CA 94901

Attn: James Reilly

Re: Geotechnical Evaluation
Georgia-Pacific Mill Pond and Dam
Fort Bragg, California

Gentlemen:

## Introduction

This letter summarizes our geotechnical evaluation of the Georgia-Pacific Mill Pond and Dam as part of the Georgia-Pacific decommissioning project located in Fort Bragg, California. A site location map is shown on Figure 1. We are providing services in accordance with our proposal and Agreement dated January 4, 2005. Our scope of services included review of available geologic data, a site reconnaissance to observe existing conditions, evaluation of geologic and geotechnical hazards, preliminary evaluation of the dam, and preliminary geotechnical recommendations.

The purpose of our geotechnical services is to evaluate the stability of the earth embankment along the coastal bluff and north side of Mill Pond 8. The embankment was most likely constructed around 1885 by building timber retaining walls and placing fill on the exposed rock along the coastal bluff.

Currently the pond retains city storm water, water from Georgia-Pacific's other on-site processing ponds, water pumped in from the Pudding Creek Reservoir and surface runoff. The State Department of Water Resources, Division of Safety of Dams (DSOD) has questioned the global stability of the embankment under static and seismic conditions. This letter summarizes our preliminary geotechnical evaluation of the Mill Pond embankment and provides various mitigation options.

## Regional Geology and Expected Subsurface Conditions

The Georgia Pacific Mill Pond is located within the Coast Range Geomorphic Province of California. The regional bedrock geology consists of complexly folded, faulted, sheared, and altered sedimentary, igneous, and metamorphic rock of the Jurassic-Cretaceous age (65-190 million years ago) Franciscan Complex.

Northwest-southeast trending mountain ridges formed from previous tectonic activity characterizes the regional topography. Extensive faulting during the Pliocene Age (1.8-7 million years ago) formed the uneven depression that is now the San Francisco Bay. More recent tectonic activity is concentrated along the San Andreas Fault zone, a complex group of generally parallel faults.

Regional geologic maps[1] indicate the majority of the site lies within marine terrace deposits (map symbol Qmts), which consist of poorly consolidated sand, silt, gravel, and clay. Bedrock of the Coastal Belt Franciscan Complex is mapped on the western bluffs (map symbol TKfs). This rock formation consists of sandstone, shale and minor inclusions of volcanic rocks.

Site Reconnaissance

We performed a site reconnaissance on December 14, 2004 to observe surface conditions and identify potential geologic hazards. The embankments are constructed of variable fill with some debris. Along the bluff, the base of the embankment varies due to variation in the native topography. In a few areas, stacked concrete or timber crib walls were constructed in crevasses in the bluff to create a more resistant base for the fill. On the north side of the pond, a wood wall was constructed along the pond edge with a fill embankment that extends down to the lower elevation around the power house site. On the south and east side, it appears the pond was excavated into the native soils.

It appears that the embankment has performed relatively well over the years. We did not observe any areas of significant instability. There are some localized areas of instability in the vicinity of the timber cribwall due to deterioration of the timber and soil erosion. A few localized seepage areas were observed in the bluff below the pond. It appears minor repairs have been performed over time in the form of various intermittent timber and concrete retaining walls.

Seismicity

The Mill Pond is located within the seismically active San Francisco Bay Region. It is expected that the Mill Pond and dam will experience the effects of future earthquakes. Such earthquakes could occur on or near any of several active faults within the region. The California Geological Survey has mapped active faults in the region (CDMG, 1994). The locations of these faults relative to the Mill Pond are shown on the Active Fault Map, Figure 3. An "active" fault is one that has been active within the last 11,000 years and therefore, is considered more likely to generate a future earthquake than a fault that shows no sign of recent activity. The closest known active fault to the site is the North Coast segment of the San Andreas Fault, located approximately 6.5 miles (10.5 km) west of the site.

Historical Fault Activity – Numerous earthquakes have been felt in the region within historical times. The results of our computer database search indicate that 16 earthquakes (Richter Magnitude 5.0 or larger) have occurred within 100 kilometers of the site area between 1735 and 2004. Using empirical attenuation relationships, the maximum historical bedrock acceleration (median peak) within the study area is approximately 0.12g. The five most significant historical earthquakes to affect the Mill Pond site are summarized in Table A.

---

[1] Kilbourne, R.T., "DMG Open File Report 83-05, Geologic and Geomorphic Features Related to Landsliding, Fort Bragg 7.5' Quadrangle, Mendocino County, California," Department of Conservation Division of Mines and Geology, 1983

TABLE A
Significant Historical Seismic Activity
Georgia Pacific Mill Pond Dam
Fort Bragg, California

| Epicenter Latitude, Longitude | Richter Magnitude | Historic Year | Distance | Maximum Peak Acceleration |
|---|---|---|---|---|
| 39.20, -123.80 | 6.4 | 1898 | 26 km | 0.12 g |
| 39.45, -123.26 | 5.2 | 1977 | 47 km | 0.02 g |
| 40.10, -124.00 | 5.8 | 1878 | 75 km | 0.02 g |
| 40.24, -124.35 | 6.2 | 1991 | 99 km | 0.02 g |
| 39.07, -123.32 | 5.2 | 1962 | 58 km | 0.01 g |

References: Sources: USGS (2003), Abrahamson & Silva (1997)

The calculated bedrock accelerations should only be considered as reasonable estimates. Many factors (soil conditions, orientation to the fault, etc.) can influence the actual ground surface accelerations. Significant deviation from the values presented is possible due to geotechnical and geologic variations from the typical conditions used in the empirical correlations.

Probability of Future Earthquakes – The historical records do not directly indicate either the maximum credible earthquake or the probability of such a future event. To evaluate earthquake probability in this region, the USGS has assembled a group of researchers into the "Working Group on California Earthquake Probabilities" to estimate the probabilities of earthquakes on active faults. Potential sources were analyzed considering fault geometry, geologic slip rates, geodetic strain rates, historic activity, and micro-seismicity, to arrive at estimates of probabilities of earthquakes with a Moment Magnitude greater than 6.7 by 2032.

The probability studies focus on seven "fault systems" within the Bay Area. Fault systems are composed of different, interacting fault segments capable of producing earthquakes within the individual segment or in combination with other segments of the same fault system. The probabilities for the individual fault segments in the San Francisco Bay Area are presented on Figure 3, Fault Map.

In addition to the seven fault systems, the studies included probabilities of "background earthquakes." These earthquakes are not associated with the identified fault systems and may occur on lesser faults (i.e., West Napa) or previously unknown faults (i.e., the 1989 Loma Prieta and 2000 Mt. Veeder Earthquake, Napa). When the probabilities on all seven fault systems and the background earthquakes are combined mathematically, there is a 62 percent chance for a magnitude 6.7 or larger earthquake to occur in the Bay Area by the year 2032. Smaller earthquakes (between magnitudes 6.0 and 6.7), capable of considerable damage depending on proximity to urban areas, have about an 80 percent chance of occurring in the Bay Area by 2032 (USGS, 2002).

Geologic Hazards Evaluation

General – This section identifies potential geologic and geotechnical hazards at the Mill Pond site, their significant adverse impacts, and our recommended mitigation measures.

A. Fault Surface Rupture

Under the Alquist-Priolo Special Studies Zone Act, the CDMG produced 1:24,000 scale maps showing all known active faults and defining zones within which special fault studies are required. The Mill Pond site is not located within an Alquist-Priolo Special Studies Zone. The potential for fault surface rupture at the site is therefore low.

*No mitigation measures are required.*

B. Seismic Ground Shaking

The intensity of ground shaking depends on the characteristics of the causative fault, distance from the fault, the earthquake magnitude and duration, and site-specific geologic conditions. Estimates of peak accelerations are based on either deterministic or probabilistic methods. For small commercial developments, deterministic methods are more commonly used.

Deterministic methods use empirical relations developed from data collected during previous earthquakes to provide estimates of median peak ground accelerations. A summary of the active faults that could most significantly affect the planning area, their maximum credible magnitude, closest distance to the project area, and median peak accelerations are summarized in Table B.

TABLE B
Estimated Peak Ground Accelerations
Georgia Pacific Mill Pond Dam
Fort Bragg, California

| Fault | Max. Credible Moment Magnitude | Distance to Fault | Median Peak Ground[1] Acceleration |
|---|---|---|---|
| San Andreas | 7.9 | 10 km | 0.46 g |
| Maacama | 7.1 | 37 km | 0.11 g |
| Bartlett Springs | 7.1 | 72 km | 0.06 g |
| Rodgers Creek | 7.1 | 7.1 km | 0.04 g |
| San Gregorio | 7.3 | 161 km | 0.03 g |

(1) Determined from attenuation relationship by Abrahamson & Silva (1997).
Reference: CDMG (1998), USGS (1999)

The calculated accelerations should only be considered as reasonable estimates. Many factors (soil conditions, distance, orientation to the fault, etc.) can influence the actual ground surface accelerations. The locations of the principal active faults and other significant faults are shown on the Active Fault Map, Figure 3.

The potential for strong seismic shaking at the Mill Pond site is high. The significant adverse impact associated with strong seismic shaking is potential damage to structures and improvements. Ground shaking can result in a decrease in slope stability increasing the probability of ground cracking and landslides.

*Seismic Shaking Mitigation Measures – Mitigation measures would include modifying the existing embankment to withstand the pseudo-static forces generated by seismic shaking. A detailed geotechnical investigation will be required to analyze the existing subsurface conditions and to develop detailed engineered mitigation options. Various schematic mitigation options are discussed further in this letter.*

C. Liquefaction Potential and Related Impacts

Liquefaction refers to the sudden, temporary loss of soil strength during strong ground shaking. This phenomenon can occur in saturated, loose, granular deposits when they are subjected to seismic shaking. Liquefaction related phenomena include seismically induced settlement, flow failure, and lateral spreading. The anticipated embankment subsurface conditions include variable gravelly clayey sand and silt fill over bedrock. The clayey fill is typically not liquefiable.

*No special mitigation measures are required.*

D. Erosion

Sandy soils on moderate slopes or clayey soils on steep slopes are susceptible to erosion when exposed to concentrated surface water flows. Within the Mill Pond site, the soils are relatively clayey and the slopes are lightly vegetated. Weathered bedrock is exposed at the current spillway location and along the bluff. Therefore, the potential for significant erosion is low.

*Erosion Mitigation Measures – The project Civil Engineer should design the site drainage to collect surface water into a storm drain system and discharge water at an appropriate location. Re-establishing vegetation on disturbed slopes will also be required to minimize erosion. Erosion control measures during and after construction should conform to the most recent version of the Erosion and Sediment Control Field Manual (California, 2002). Any modifications to the spillway should be design to accommodate future storm events without overtopping the dam.*

E. Settlement

Settlement occurs from structures and other surface loads that cause deformation of the subsurface soils. We do not anticipate any soft compressible materials exist within the embankment. Additionally, since the embankment was constructed around 1885, any compressible material within the embankment will most likely have fully consolidated by this time.

*No special mitigation measures are required.*

F. Flooding

The Mill Pond site is not located within the FEMA 100-year or 500-year flood zone. Considering the elevation and topography at the Mill Pond, the potential for widespread flooding at the site is low.

*Flooding Mitigation Measures – The project Civil Engineer should analyze the effect of intense rainfall on the capacity of the reservoir.*

G. Seiche and Tsunami

Seiche and tsunamis are short duration earthquake-generated water waves in enclosed bodies of water and the open ocean, respectively. Considering the Mill Pond site elevation and distance from the shoreline, the risk of tsunami damage to improvements located on the existing terrace is low to moderate. Since tsunami run-up predictions (feet above mean sea level) along the California Coast vary from 5 to 20 feet for 100 year and 500 year tsunami events, there is an increased risk of damage to improvements located below elevation +20 (around the powerhouse building).

*Seiche and Tsunami Mitigation Measures – There is no way to prevent a tsunami from occurring. Recommended mitigation measures include consideration of the possibility of a tsunami wave impact and temporary inundation for design of the planned improvements. The existing ocean berm may provide some protection from tsunami waves.*

H. Expansive Soil

Expansive soil occurs when clay particles interact with water causing volume changes in the clay soil. The clay soil swells when saturated and contracts when dried. This phenomenon generally decreases in magnitude with increasing confinement pressure at depth. These volume changes may damage lightly loaded foundations, retaining walls and shallow improvements. Based on our site observations, the Mill Pond site appears to be blanketed with soils of low expansion potential.

*No mitigation measures are required.*

I. Lurching and Ground Cracking

We did not observe any signs of landsliding on the property. Lurching and associated ground cracking can occur during strong ground shaking. The ground cracking generally occurs along the tops of slopes where stiff soils are underlain by soft deposits or along steep channel banks. We did not perform a subsurface exploration within the embankment and therefore are uncertain of the soil stratigraphy. However, based on the overall performance of the embankment, we do not anticipate this soil condition exists within the embankment.

*No special mitigation measures are required. Subsurface exploration should be performed to confirm absence of soils under the embankment.*

J. Landsliding

Landslides can occur on steep slopes or moderate slopes with weak subsurface soils. The slopes of the existing embankments range from 3:1 (Horizontal:Vertical) to 1:1. Additionally, because the fill was placed in 1885, the quality of the fill most likely does not meet current construction standards. Therefore, the risk of landslides occurring within the embankment is low to moderate under static conditions and moderate to high under seismic conditions. More discussion of landsliding is presented later in this letter.

*Landsliding Mitigation Measures – Landslide mitigation can consist of numerous options including replacing the portions of the existing embankment or constructing structural elements. Schematic options to improve stability are discussed further the following section of this letter.*

Conclusions

Based on our site inspection, research and evaluation, it is our professional opinion that stabilization of the Mill Pond Dam and creation of new wetland areas are feasible from a geotechnical standpoint. The significant geologic and geotechnical issues that need to be considered are the potential for strong ground shaking and landsliding. Other issues are DSOD jurisdiction of the dam and possible DSOD requirements for improvements.

General discussions regarding slope stability and mitigation options are outlined below. However, a detailed geotechnical investigation with subsurface exploration and laboratory testing will be required to provide recommendations and criteria for use in the design and construction of the project.

**Dam Stability** – We have performed preliminary slope stability analyses utilizing assumed soil properties on 3-cross sections along the existing embankment as shown in Figure 2, Site Plan. The results of these analyses indicate the static factor of safety varies from slightly above 1.0 to near 3.0 based on the assumed strengths and location. The recommended minimum static factor of safety is 1.5. The western portion of the dam in the vicinity of the timber crib wall has a calculated factor of safety less than 1.5 and will likely require remediation work to achieve adequate factors of safety. The estimated extent of the probable remediation work is shown on Figure 2. The results of the preliminary stability analyses are presented on Figures 4 through 6.

Under seismic conditions (pseudo-static analyses with a design acceleration of 0.46g), the calculated factors of safety range from 0.47 to 1.31. A calculated factor of safety less than 1.0 indicates instability and displacement during a seismic event. All three sections have the potential for seismic instability and displacement.

Since the stability analyses are based on assumed soil strengths, a soil investigation will be required to explore subsurface conditions and perform laboratory strength tests on the fill material and underlying natural soil and bedrock. Using actual strength data, the stability analyses can be refined to provide more accurate factors of safety and determine the portions or extent of the embankments that need to be improved.

**Department of Safety of Dams (DSOD) Evaluation** – Currently the Mill Pond Dam has been determined by DSOD to be within their jurisdiction because they have a maximum measured height of 31.8 feet from toe to spillway and a reservoir capacity of about 66 acre-feet. Dams that are higher than 6 feet and store more than 50 acre-feet of water or dams that are higher than 25 feet and store more than 15 acre-feet of water are jurisdictional size and improvements may be subject to DSOD criteria. Stetson has estimated the storage capacity of the pond to be about 14 acre-feet, therefore DSOD's jurisdiction may be questionable.

If required, some DSOD criteria relevant to the dam improvements include a spillway designed to pass a storm event with a 1000-year return period, a minimum freeboard of 4 feet from spillway crest to dam crest, and a minimum residual freeboard (distance from maximum design reservoir elevation to dam crest) of 1.5 feet. Considering the dam is an existing embankment, it is unclear whether additional requirements such as outlet structures and controls may be required.

We recommend that part of the design of the planned improvements include a meeting with DSOD to determine whether the dam is subject to DSOD jurisdiction and, if so, what modification could be performed to remove the dam from DSOD jurisdiction or what criteria may need to be included in the planned improvements.

**Dam Stabilization Options** – We have prepared four schematic slope stabilization mitigation options and very rough cost estimates for use in the planning and design of the improvements.

*Option A, Structural Retention* – This option entails excavating a trench along the crest of the embankment through the fill materials and into the underlying firm soil or bedrock. The trench will be filled with reinforced concrete to increase the shear strength of the embankment. Drilled pier foundations or grouted tie-backs may be necessary to provide additional support, but will require further engineering analysis.

This stabilization option will have the least amount of impact on the current retention pond and coastal bluffs during construction. Additionally, it will not affect the overall capacity of the pond. However, there is a possibility of encountering large debris during excavation, which would result in over-excavation and extra cost. Also, because the embankment height will not change it may still fall under the jurisdiction of DSOD.

The estimate costs will depend on the results of subsequent design level analyses to determine the extent the embankment that requires stability improvement. For rough cost estimating, we recommend using $1,000 per linear foot for the reinforced concrete retaining structure in portions of the embankment that are less than 10-feet in height and $2,000 per linear foot for portions of the embankment greater than 10-feet in height.

*Option B, Rebuild Existing Embankment* – This option would require the removal of the existing embankment, excavating terraced benches into the underlying bedrock, and constructing a new compacted fill embankment. This mitigation option provides a stable embankment in both static and seismic conditions and allows the pond to maintain its current capacity. However, this option will require either fully draining the pond or providing temporary retention system to construct the new embankment. Additionally, because the embankment will not change in height it may remain under DSOD jurisdiction and may therefore require special permits to construct.

The estimated costs will depend on the results of subsequent design level analyses to determine the extent of over-excavation required and the suitability of the existing fill. For rough cost estimating, we recommend using $50 per cubic yard to excavate and re-build the new embankment, $10 per cubic yard for any disposal and $15 per cubic yard for imported material.

*Option C, New Interior Embankment* – This mitigation option involves constructing a new embankment immediately upstream of the existing embankment. Aside from providing a stable embankment, this option requires less disturbance of the coastal bluff than Option B and may fall out of DSOD jurisdiction. However, similar to Option B, this option will require either fully draining the pond or providing temporary retention system to construct the new embankment. Additionally, this option will reduce the overall capacity of the pond.

For rough cost estimating, we recommend using $35 per cubic yard for the new embankment and $15 per cubic yard for imported material.

*Option D, Embankment Modification* – This mitigation option involves lowering the existing embankment height and lowering the pond floor to maintain the existing capacity. The existing spillway will also require modification to reflect the new embankment elevation. The existing intermittent retaining walls will need to be lowered. Depending on the amount of material removed the finished pond may fall out of DSOD jurisdiction. This option will require completely draining the pond and will produce excess material that will require disposal.

The cost estimate for Option D is dependant on the cost of disposal of the embankment materials and pond tailings. Assuming special permitting is not required for disposal, we recommend using $15 per cubic foot for excavation of the embankment and pond bottom.

Supplemental Services

Following preliminary approval of the Mill Pond modifications, a geotechnical investigation including subsurface exploration and laboratory testing will be needed to provide geotechnical recommendations and criteria for the design and construction of the dam rehabilitation and grading for new wetlands.

During construction, we must observe and test the geotechnical portions (foundations, subsurface drainage and site grading) of the project to confirm that subsurface conditions are as expected and the contractors work is performed in accordance with the contract documents.

Please call if there are any questions or if we can be of further service.

Yours very truly,
MILLER PACIFIC ENGINEERING GROUP

Benjamin S. Pappas
Civil Engineer No. 63940
(Expires 9/30/06)

Scott A. Stephens
Geotechnical Engineer No. 2398
(Expires 6/30/05)

Attachments: Figure 1, Site Location Map
Figure 2, Site Plan
Figure 3, Active Fault Map
Figures 4 through 6 Slope Stability Analyses
Figures 7 through 10 Embankment Mitigation Options

3 copies submitted

LIST OF REFERENCES

American Society for Testing and Materials; 2000 Annual Book of ASTM Standards, Section 4, Construction, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics, ASTM, Philadelphia, 1999.

California Department of Conservation, Division of Mines and Geology, Fault Activity of California and Adjacent Areas, Map No. 6, 1994.

California Department of Conservation, Division of Mines and Geology, Hart, E. W. and Bryant, A.B. Fault Rupture Hazards Zones in California, Special Publication 42, California Division of Mines and Geology, Revised 1997.

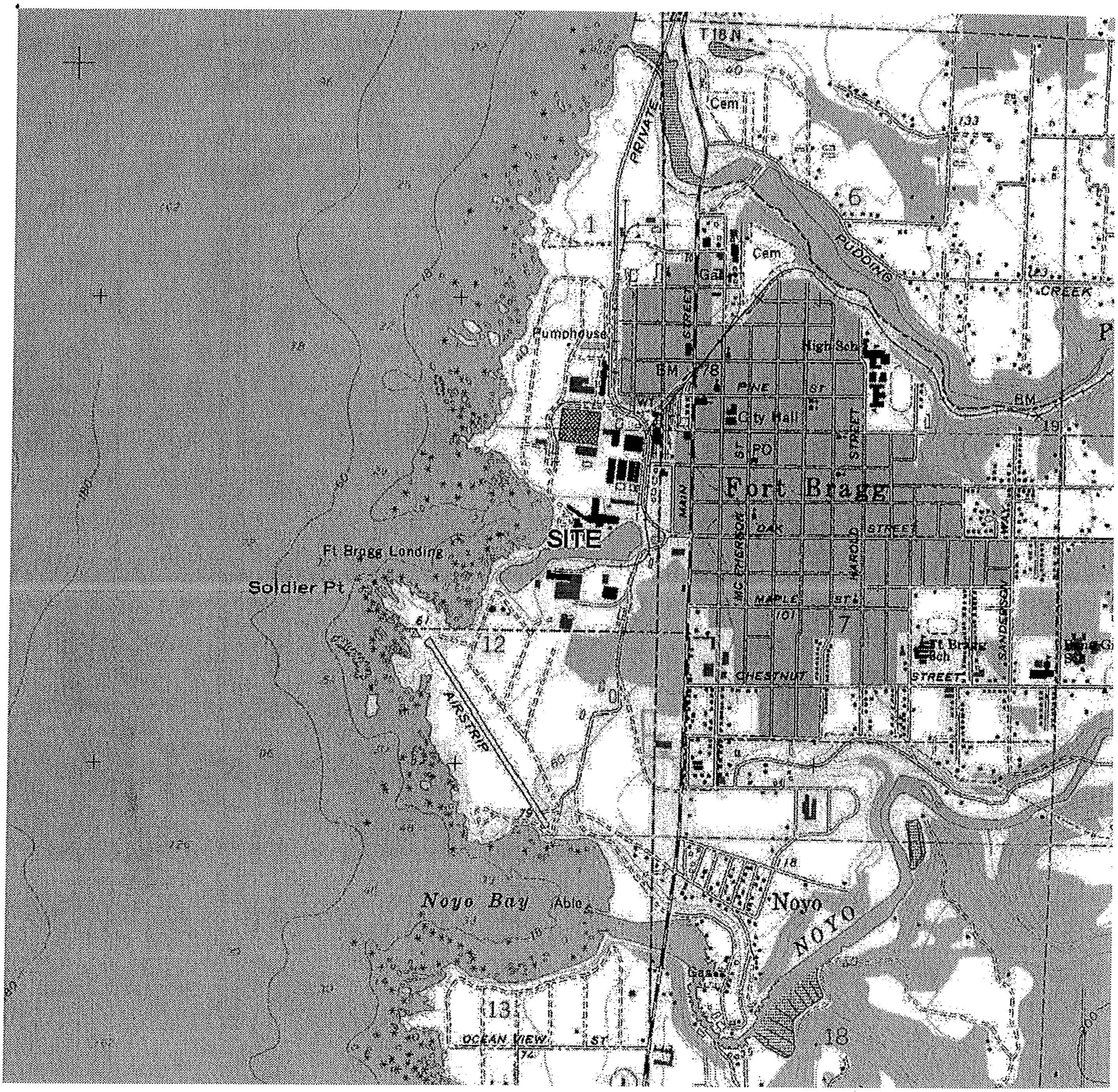
Abrahamson N. & Silva, W., Empirical Response Spectral Attenuation Relations for Shallow Crustal Earthquakes, Lecture Notes from CE 275, Fall Semester 1997, University of California at Berkeley.

Kilbourne, R.T., DMG Open File Report 83-05, Geologic and Geomorphic Features Related to Landsliding, Fort Bragg 7.5' Quadrangle, Mendocino County, California, Department of Conservation Division of Mines and Geology, 1983

California Building Code, 2001 Ed., California Building Standards Commission, Sacramento, California, California Code of Regulations, Title 24, Part 2, Volume 2, Chapter 16.

U.S. Geological Survey, Database of Potential Sources for Earthquakes Larger than Magnitude 6 in Northern California, The Working Group on Northern California Earthquake Potential, Open File Report 96-705, 1996.

U.S. Geological Survey, Earthquake Probabilities in the San Francisco Bay Region, 2000 to 2032 – A Summary of Finding, The Working Group on California Earthquake Probabilities, Open File Report 99-517, 2002.




## SITE LOCATION

SCALE

0 1000 2000 4000 FEET

0 500 1000 METERS

NORTH

REFERENCE: DeLorme 3D TopoQuads, 1999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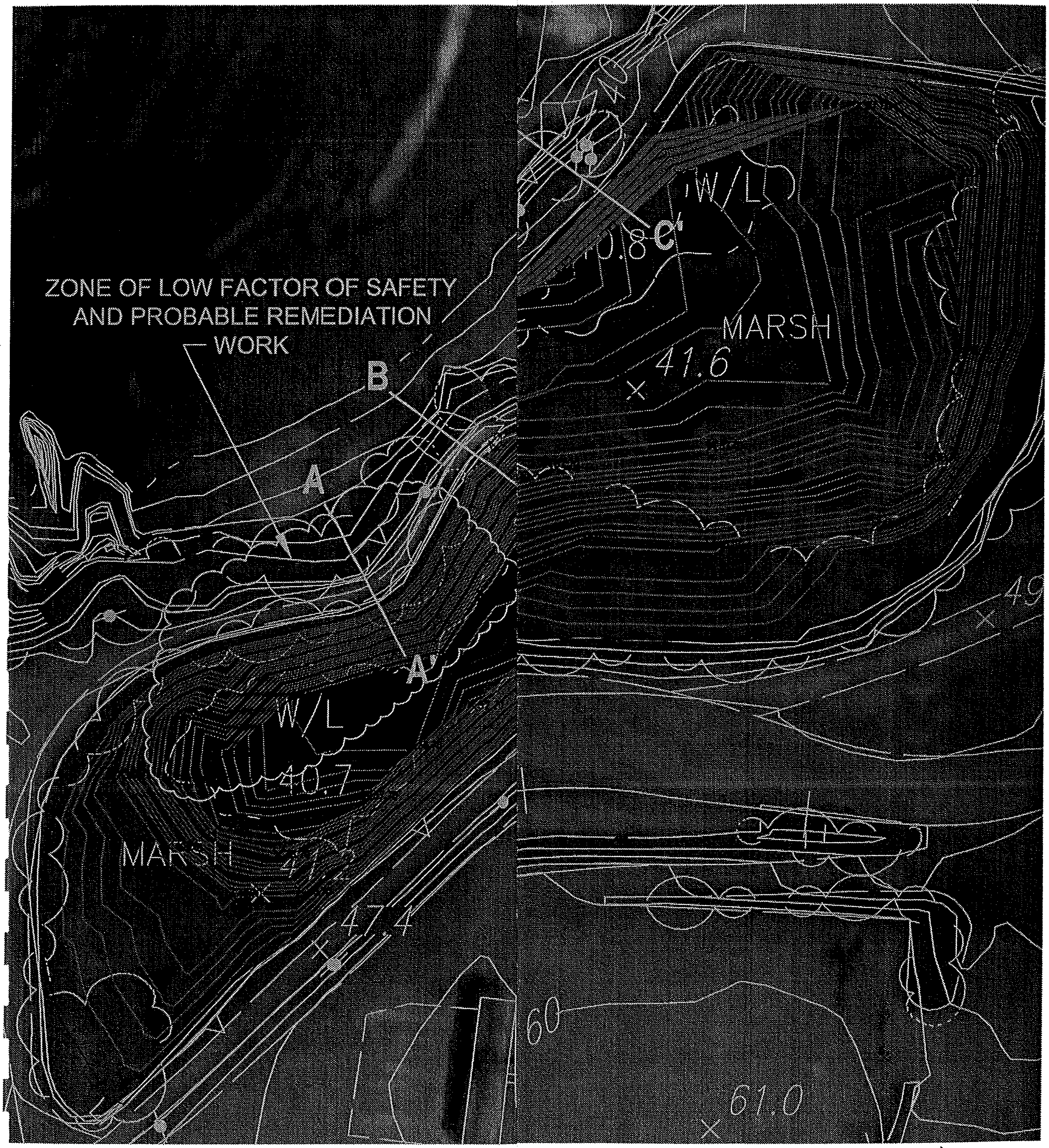
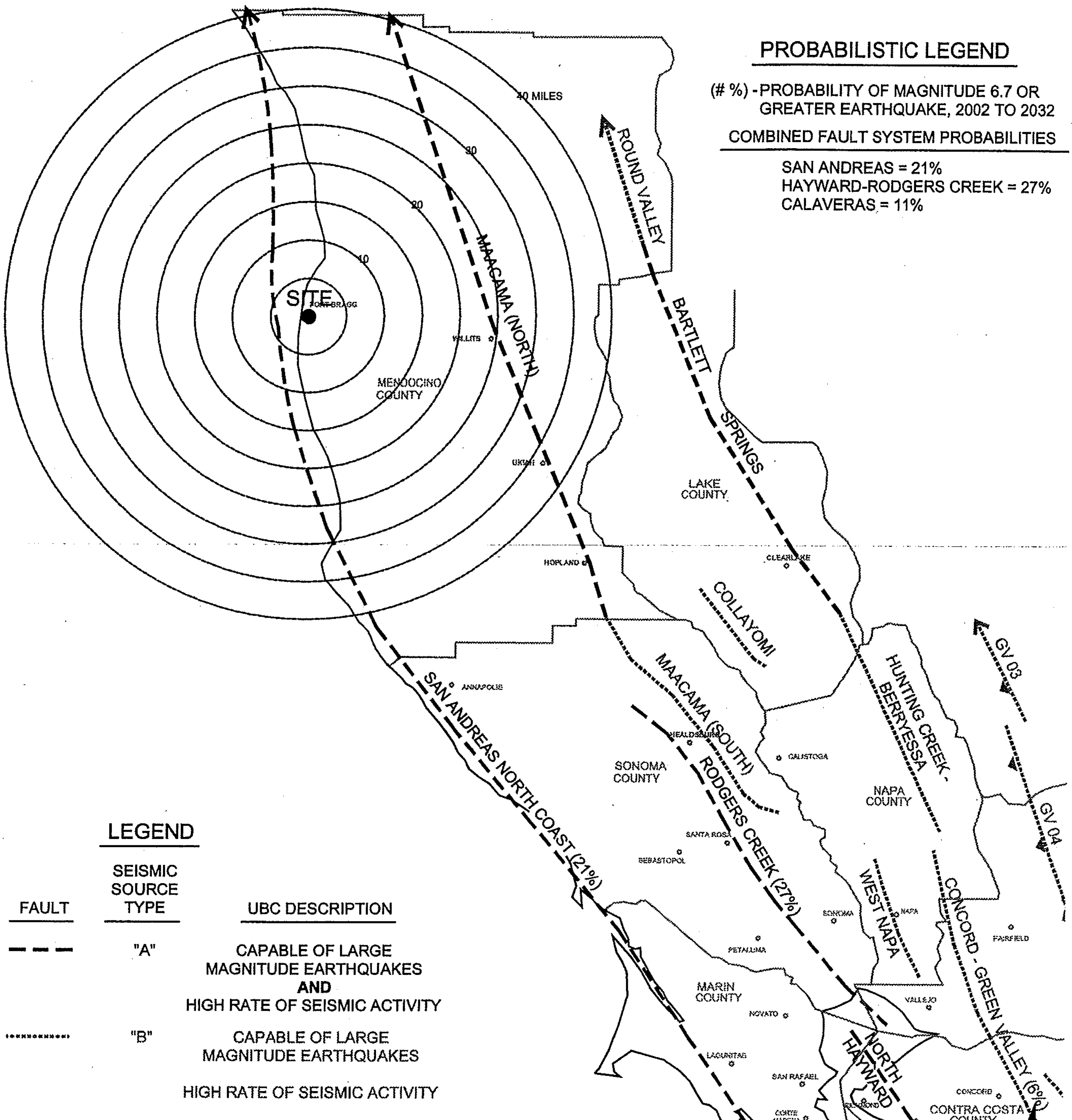
| Miller Pacific ENGINEERING GROUP | SITE LOCATION MAP<br>Stetson - Georgia Pacific Mill Pond Dam<br>Fort Bragg, California | 1 |
|---|---|---|
| Project No. 960.03 | Date 3/09/05 Approved By: YKS | Figure |




SITE PLAN
Stetson - Georgia Pacific
Fort Bragg, California

2

960.03 Date 3/09/05 Approved By: Figure




## PROBABILISTIC LEGEND

(# %) - PROBABILITY OF MAGNITUDE 6.7 OR GREATER EARTHQUAKE, 2002 TO 2032

COMBINED FAULT SYSTEM PROBABILITIES

SAN ANDREAS = 21%
HAYWARD-RODGERS CREEK = 27%
CALAVERAS = 11%

## LEGEND

| FAULT | SEISMIC SOURCE TYPE | UBC DESCRIPTION |
|---|---|---|
| — — — | "A" | CAPABLE OF LARGE MAGNITUDE EARTHQUAKES **AND** HIGH RATE OF SEISMIC ACTIVITY |
| ············ | "B" | CAPABLE OF LARGE MAGNITUDE EARTHQUAKES HIGH RATE OF SEISMIC ACTIVITY |

NOTES:

GV = GREAT VALLEY

▼ = THRUST FAULT

ALL COUNTIES SHOWN ON MAP ARE IN SEISMIC ZONE 4

APPROXIMATE SCALE

0 10 20 40 MILES

0 15 30 60 KILOMETERS

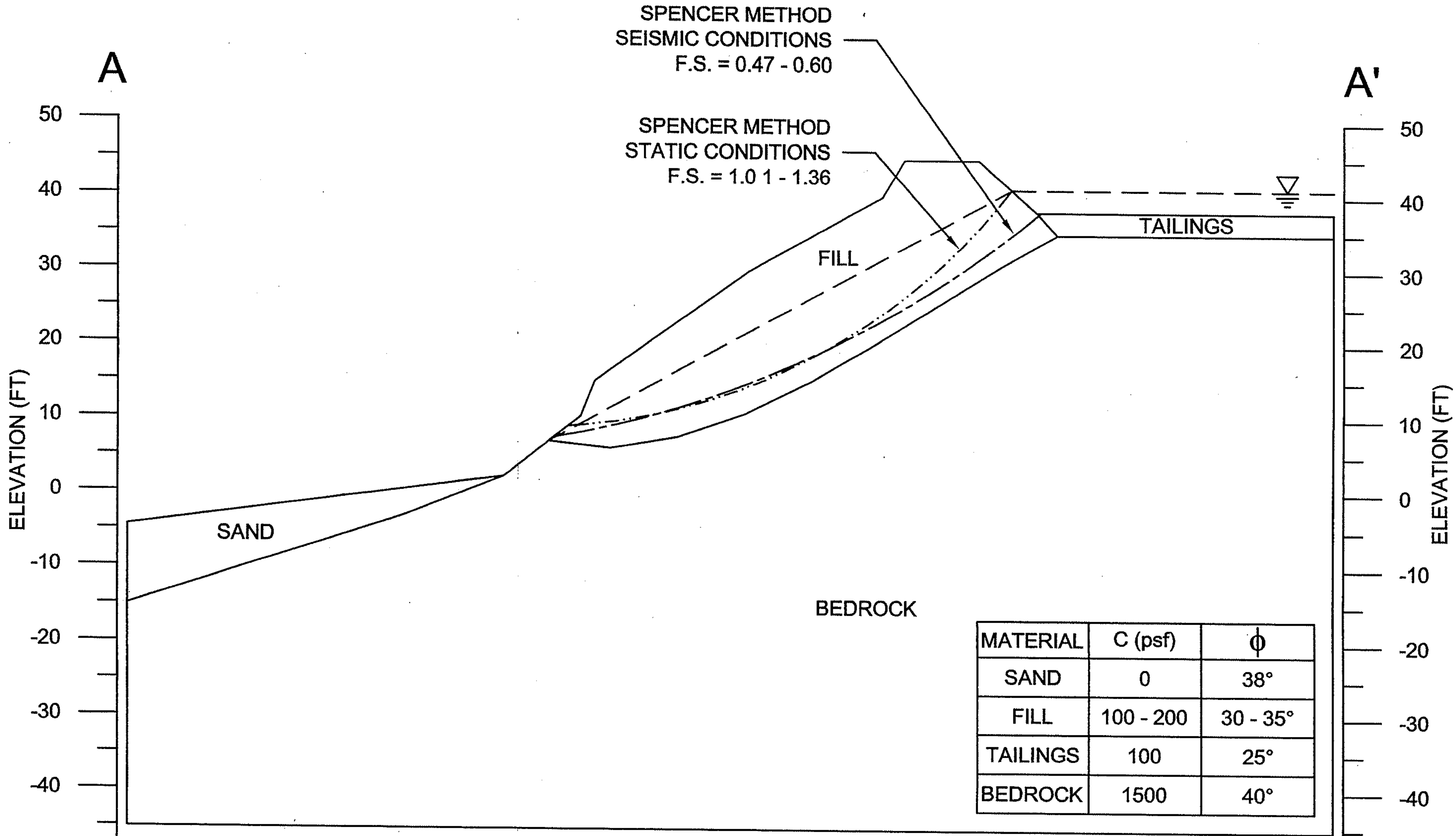

REFERENCES:

1) MAPS OF KNOWN ACTIVE FAULT NEAR-SOURCE ZONES IN CALIFORNIA, CDMG/SEAOC/ICBO, FEBRUARY 1998
2) DATABASE OF POTENTIAL SOURCES FOR EARTHQUAKES LARGER THAN MAG. 6 IN N. CALIFORNIA, USGS OFR 96-705, 1996
3) EARTHQUAKE PROBABILITIES IN THE S.F. BAY REGION, 2000 - 2030, USGS OFR 99-517, 1999



FILE: 960.03FM.dwg

| Miller Pacific ENGINEERING GROUP | ACTIVE FAULT MAP<br>Stetson - Georgia Pacific Mill Pond Dam<br>For Bragg, California | 3 |
|---|---|---|
| Project No. 960.03 | Date 3/07/05 | Approved By: [signature] Figure |




| MATERIAL | C (psf) | ϕ |
|---|---|---|
| SAND | 0 | 38° |
| FILL | 100 - 200 | 30 - 35° |
| TAILINGS | 100 | 25° |
| BEDROCK | 1500 | 40° |

# SLOPE STABILITY ANALYSES - SECTION A - A'

SCALE 1" = 20'

SCALE

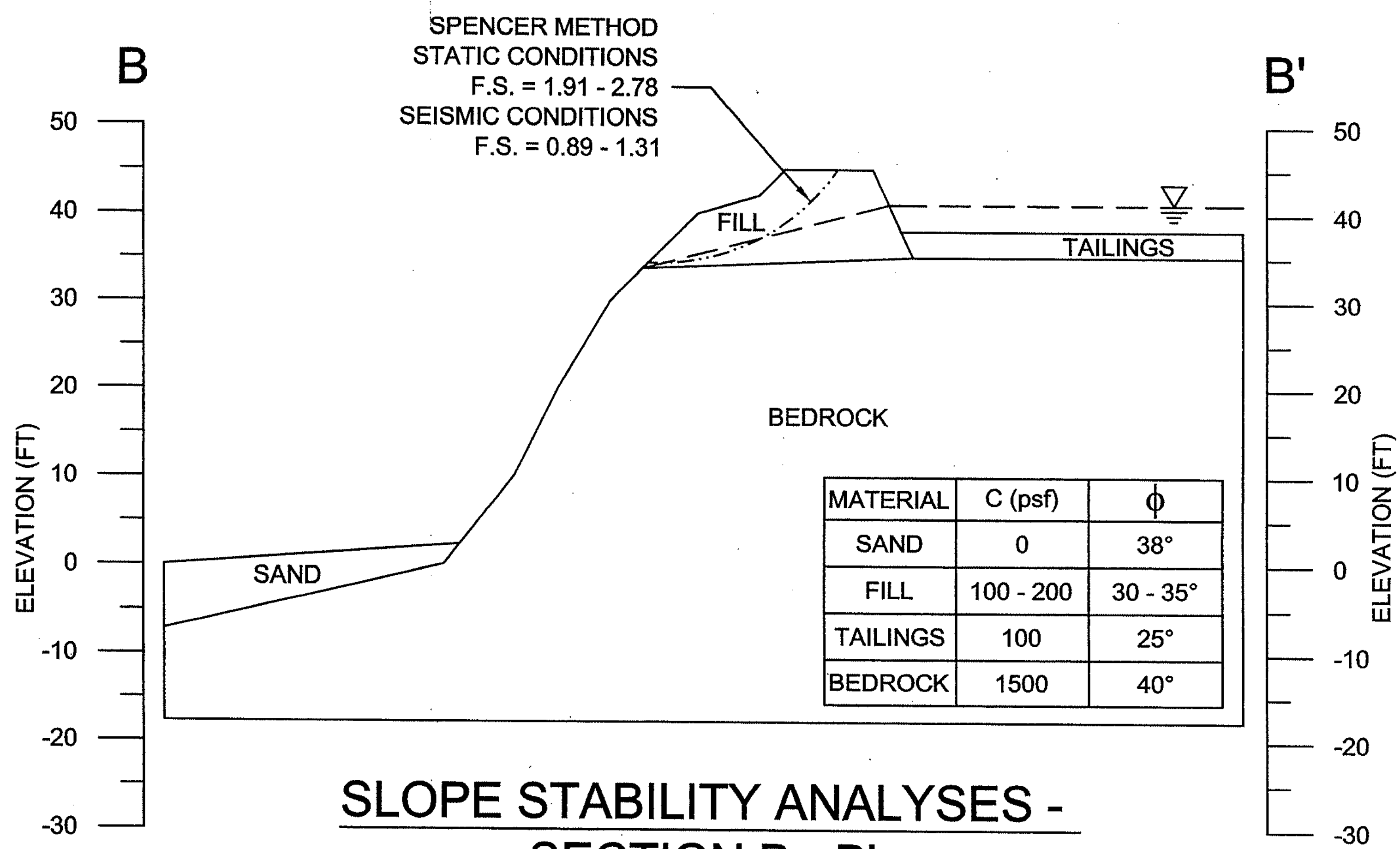
0 10 20 40 FEET



**Miller Pacific**
ENGINEERING GROUP

SLOPE STABILITY ANALYSIS RESULTS
Stetson - Georgia Pacific
Fort Bragg, California

| Project No. | 960.03 | Date | 3/09/05 | Approved By: | [signature] | Figure | 4 |
|---|---|---|---|---|---|---|---|




| MATERIAL | C (psf) | ϕ |
|---|---|---|
| SAND | 0 | 38° |
| FILL | 100 - 200 | 30 - 35° |
| TAILINGS | 100 | 25° |
| BEDROCK | 1500 | 40° |

# SLOPE STABILITY ANALYSES - SECTION B - B'

SCALE 1" = 20'

SCALE 0 10 20 40 FEET

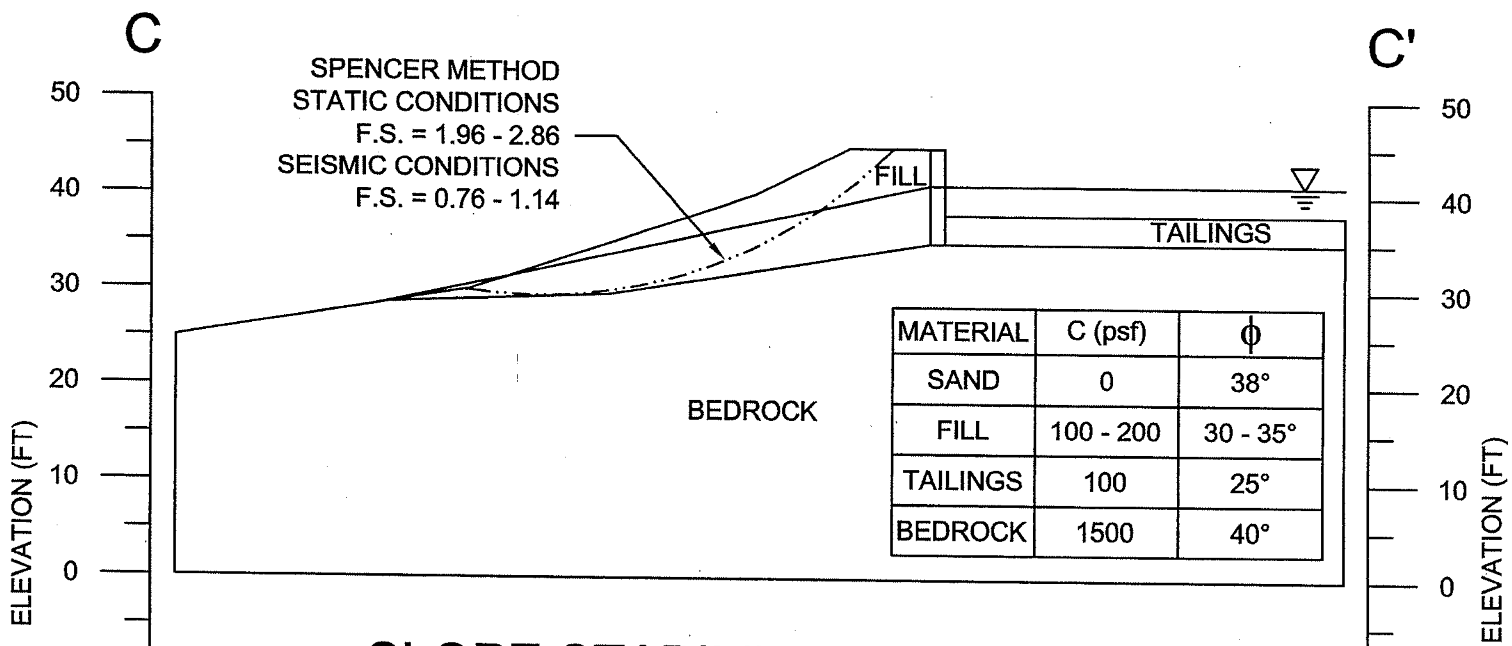

FILE: 960.03SlideSecs.dwg

**Miller Pacific** ENGINEERING GROUP

SLOPE STABILITY ANALYSIS RESULTS
Stetson - Georgia Pacific
Fort Bragg, California

Figure 5

Project No. 960.03 | Date 3/09/05 | Approved By: [signature]




| MATERIAL | C (psf) | ϕ |
|---|---|---|
| SAND | 0 | 38° |
| FILL | 100 - 200 | 30 - 35° |
| TAILINGS | 100 | 25° |
| BEDROCK | 1500 | 40° |

# SLOPE STABILITY ANALYSES - SECTION C - C'

SCALE 1" = 20'


FILE: 960.03SlideSecs.dwg

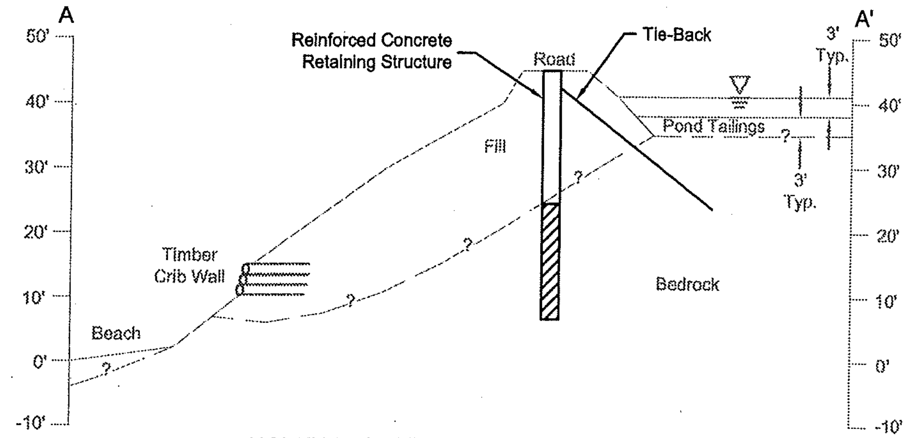
SCALE: 0 10 20 40 FEET

**Miller Pacific**
ENGINEERING GROUP

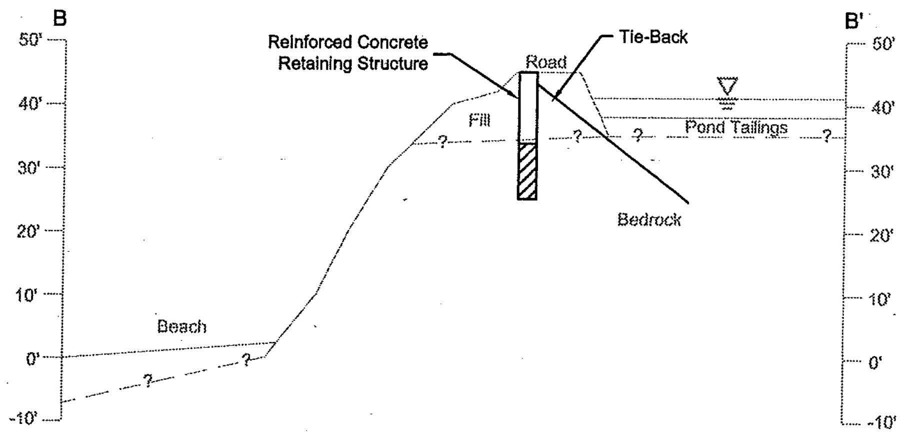
SLOPE STABILITY ANALYSIS RESULTS
Stetson - Georgia Pacific
Fort Bragg, California

Figure 6

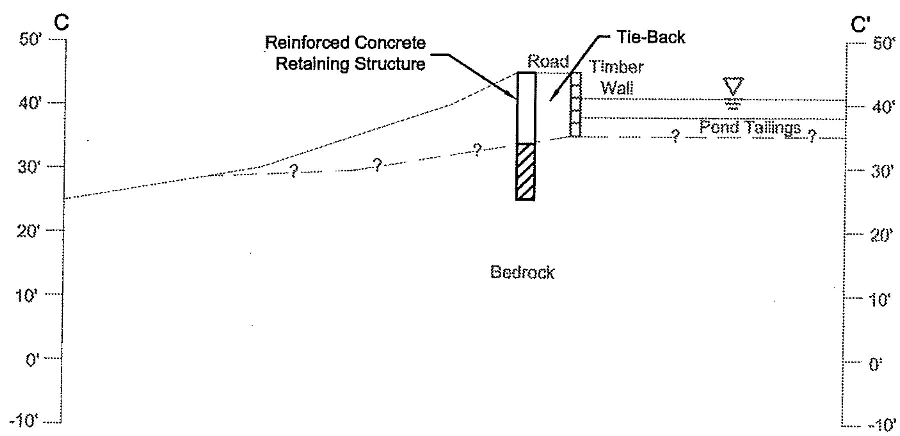
Project No. 960.03 | Date 3/09/05 | Approved By: [signature]



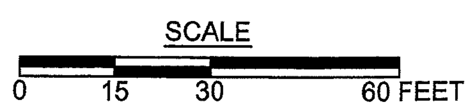

NORTHWEST NEAR TIMBER CRIB WALL




NORTHWEST AT SPILLWAY




NORTHEAST MILL POND





FILE: 960.03_Xsect.dwg

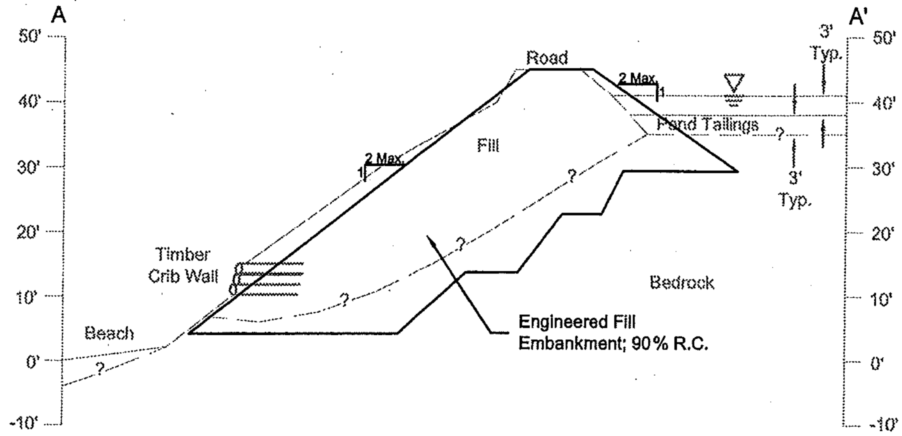
**Miller Pacific**
ENGINEERING GROUP

CROSS SECTIONS -OPTION A
Stetson - Georgia Pacific Mill Pond Dam
Fort Bragg, California

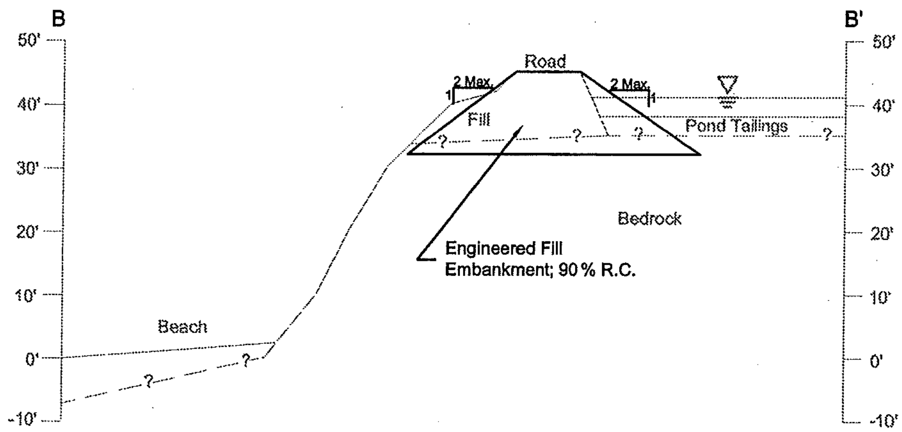
7

Project No. 960.03 | Date 1/19/05 | Approved By: [signature]

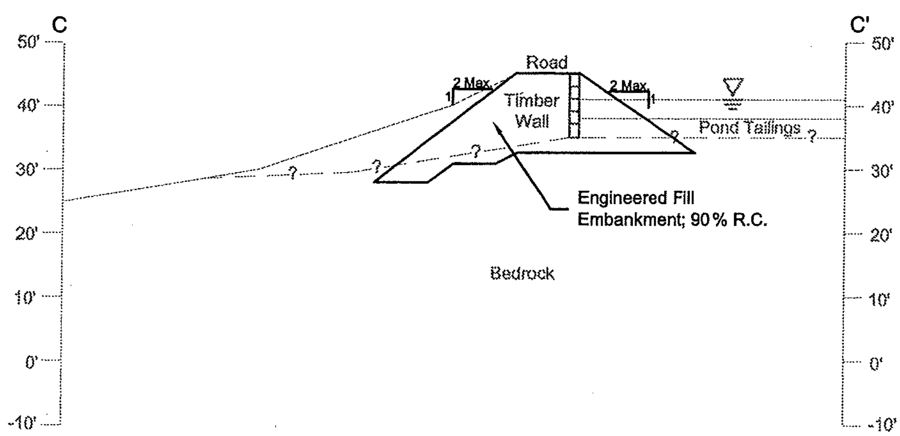
Figure



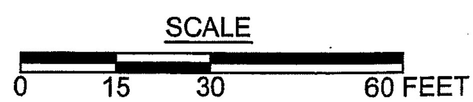

NORTHWEST NEAR TIMBER CRIB WALL




NORTHWEST AT SPILLWAY




NORTHEAST MILL POND





FILE: 960.03_Xsect.dwg

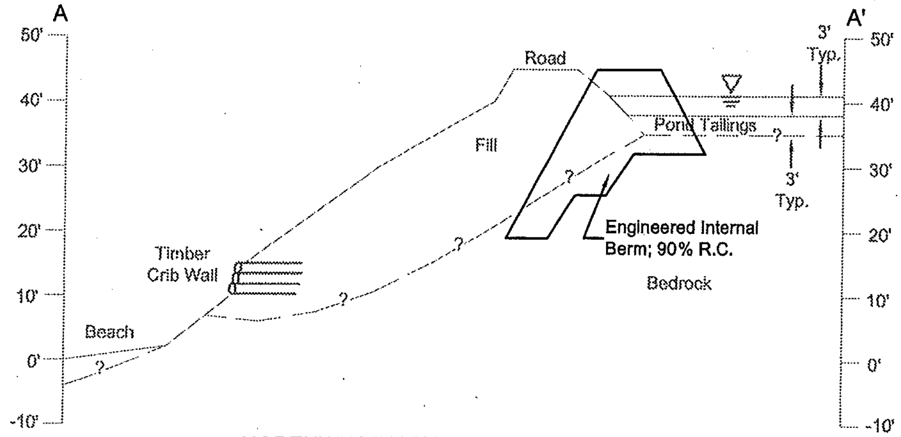
**Miller Pacific**
ENGINEERING GROUP

CROSS SECTIONS -OPTION B
Stetson - Georgia Pacific Mill Pond Dam
Fort Bragg, California

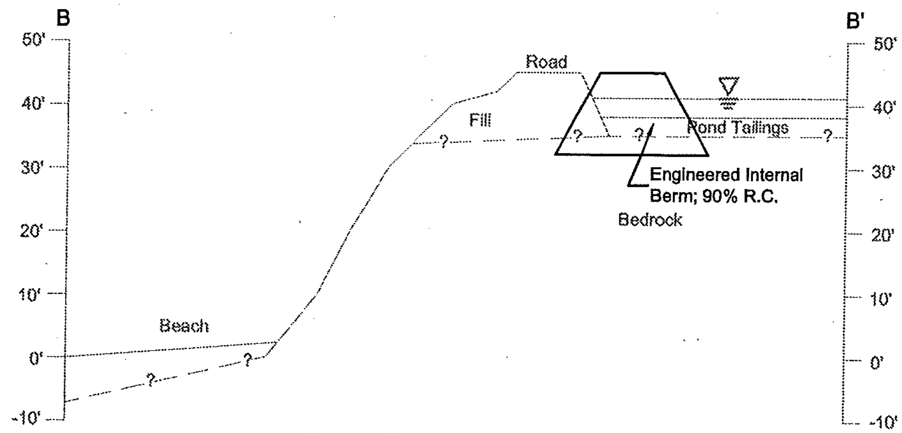
8

Project No. 960.03 | Date 3/09/05 | Approved By: [signature]

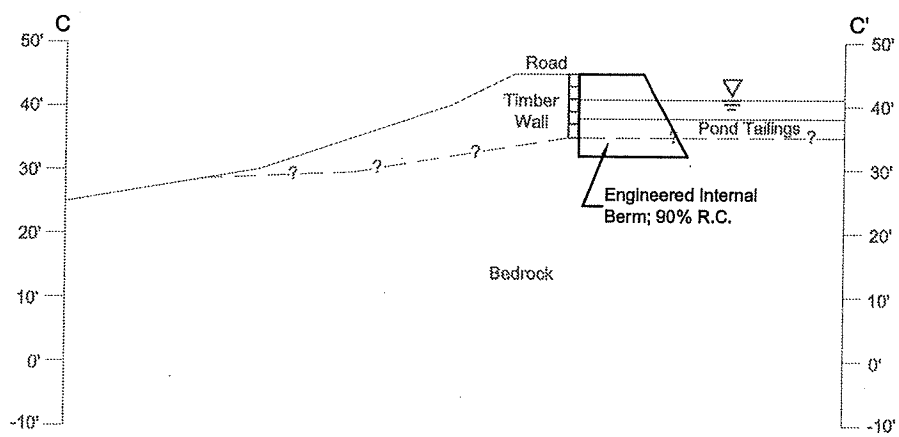
Figure




NORTHWEST NEAR TIMBER CRIB WALL




NORTHWEST AT SPILLWAY




NORTHEAST MILL POND

SCALE

0 15 30 60 FEET

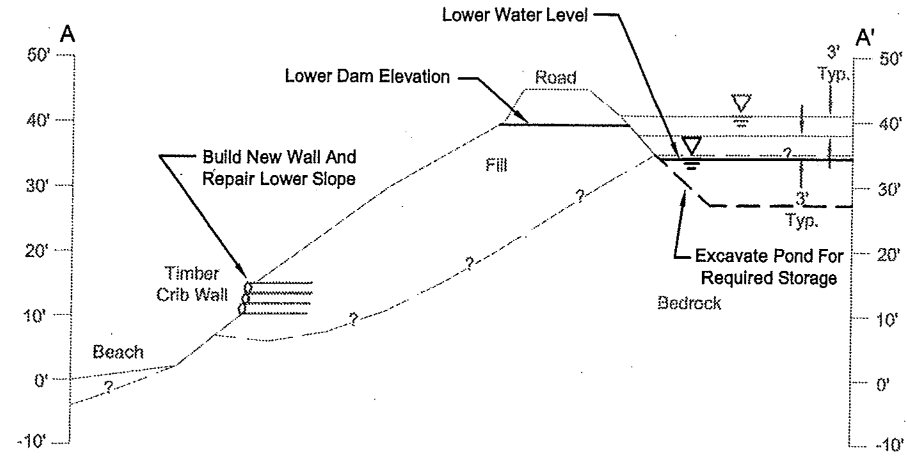

FILE: 960.03_Xsect.dwg

**Miller Pacific**
ENGINEERING GROUP

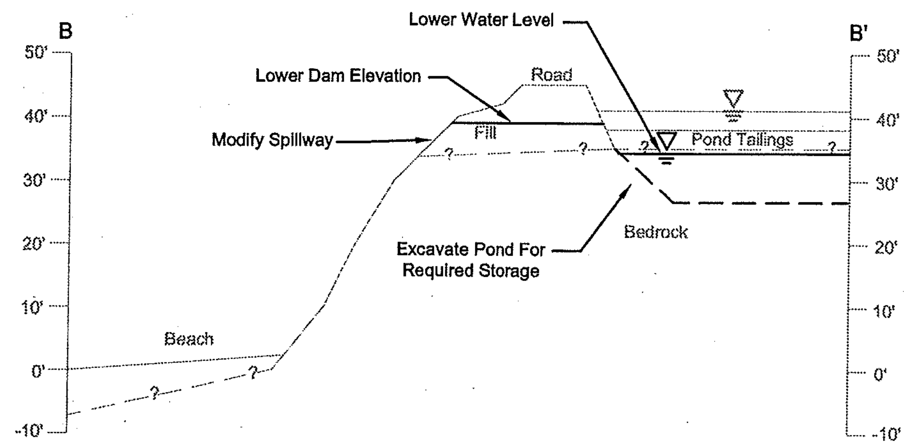
CROSS SECTIONS -OPTION C
Stetson - Georgia Pacific Mill Pond Dam
Fort Bragg, California

Figure 9

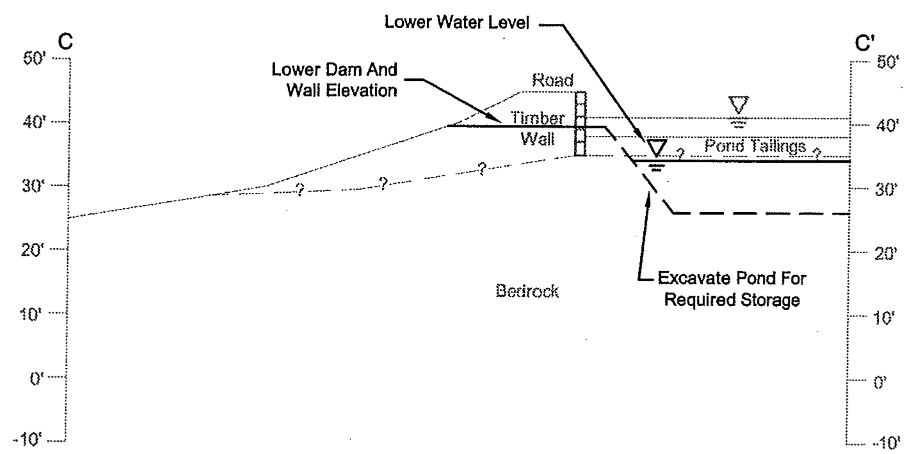
Project No. 960.03 | Date 3/09/05 | Approved By: [signature]



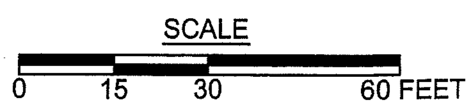

NORTHWEST NEAR TIMBER CRIB WALL




NORTHWEST AT SPILLWAY




NORTHEAST MILL POND





FILE: 960.03_Xsect.dwg

**Miller Pacific**
ENGINEERING GROUP

CROSS SECTIONS -OPTION D
Stetson - Georgia Pacific Mill Pond Dam
Fort Bragg, California

| Project No. 960.03 | Date 3/09/05 | Approved By: [signature] | Figure 10 |
|---|---|---|---|

# APPENDIX B:

# HYDROLOGIC ANALYSIS

# GEORGIA-PACIFIC MILL POND
# FORT BRAGG, CALIFORNIA

STETSON ENGINEERS

JANUARY 31, 2005

# TECHNICAL MEMORANDUM

STETSON ENGINEERS INC.

**2171 E. Francisco Blvd., Suite K • San Rafael, California • 94901**
TEL: (415) 457-0701 FAX: (415) 457-1638 e-mail: jamesr@stetsonengineers.com

| | | | |
|---|---|---|---|
| **TO:** | Julie Raming, R.G., Georgia-Pacific | **DATE:** | January 31, 2005 |
| **FROM:** | Stetson Engineers | **JOB NO.:** | 2090 |
| **SUBJECT:** | **Mill Pond Hydrologic Analysis** | | |

The purpose of this memorandum is to provide a preliminary assessment of the long term self-sustainability of Mill Pond relying solely on natural sources of inflow using two independent methods; (1) water budget analysis and (2) groundwater flow analysis.

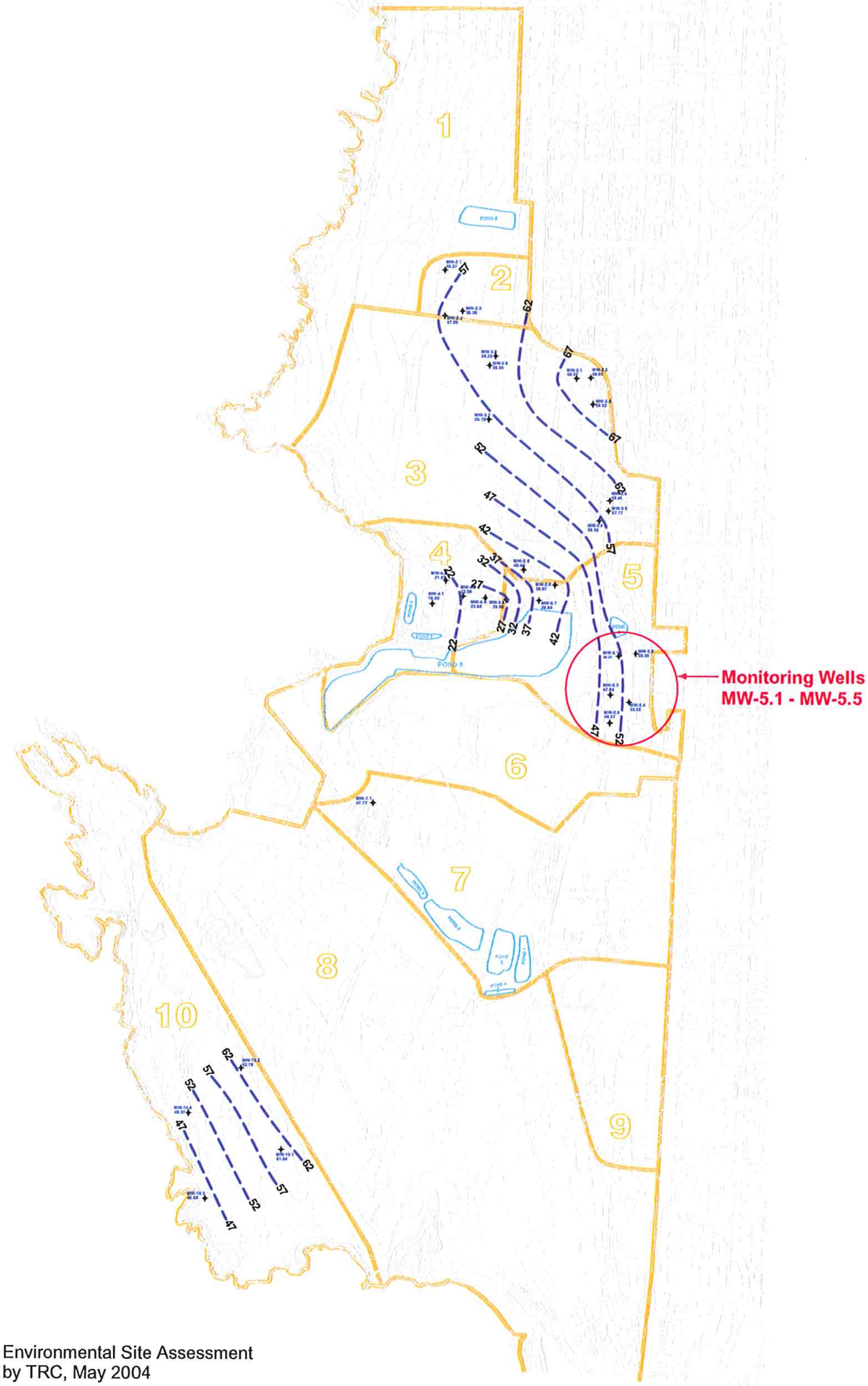
Mill Pond is fed by two storm drains of the City of Fort Bragg, water pumped from G-P's other on-site processing ponds, water pumped by G-P from their Pudding Creek Reservoir, on-site surface runoff, and groundwater seepage. In the long term, Mill Pond will not receive pumpage from other on-site processing ponds or from Pudding Creek. The self-sustainability of Mill Pond hydrology relying solely on nature sources needs to be assessed.

**Mill Site Groundwater Conditions**

G-P conducted groundwater level measurements in January, June, and September 2004. A groundwater contour map based on January 2004 measurements was prepared (Figure B-1). Based on the groundwater monitoring data and topographic gradients, the groundwater flow direction at the site was primarily to the west-southwest, converging onto the alluvial bottomland. Groundwater seepage entered Mill Pond primarily from the east. Analysis of groundwater monitoring data in June and September 2004 indicated that groundwater levels surrounding Mill Pond during these two months were lower than January 2004 by approximately 1.5 ft and 2.5 ft, respectively.

**Mill Pond Bathymetry**

Mill Pond bathymetry was estimated using water depth measurements at 59 locations in the pond taken by TRC in July 2003. The data was then processed using AutoCAD to generate bathymetric contours which were merged into the topographic map (Figure B-2). Stage-area-capacity curves of Mill Pond were prepared based on the merged topographic/bathymetric map (Figure B-3). According to the pond bathymetry, the bottom elevation of Mill Pond is approximately 36.7 ft, the elevations of the upper and lower spillway crests are approximately 40.7 ft and 39.3 ft, respectively, and the top of dam elevation is approximately 44.0 ft. The water surface of Mill Pond at the upper and lower spillway crest elevations covers approximately 5.2 ac and 4.1 ac, respectively, and 7.6 acres at the top of dam elevation.




Source: Phase II Environmental Site Assessment
Report Prepared by TRC, May 2004

**LEGEND**

| | |
|---|---|
| ⌖ | Monitoring Well |
| 45.63 | Groundwater Elevation (Feet Above Mean Sea Level), January 2004 |
| 47– – – – | Estimated Groundwater Contour (With Elevation) |

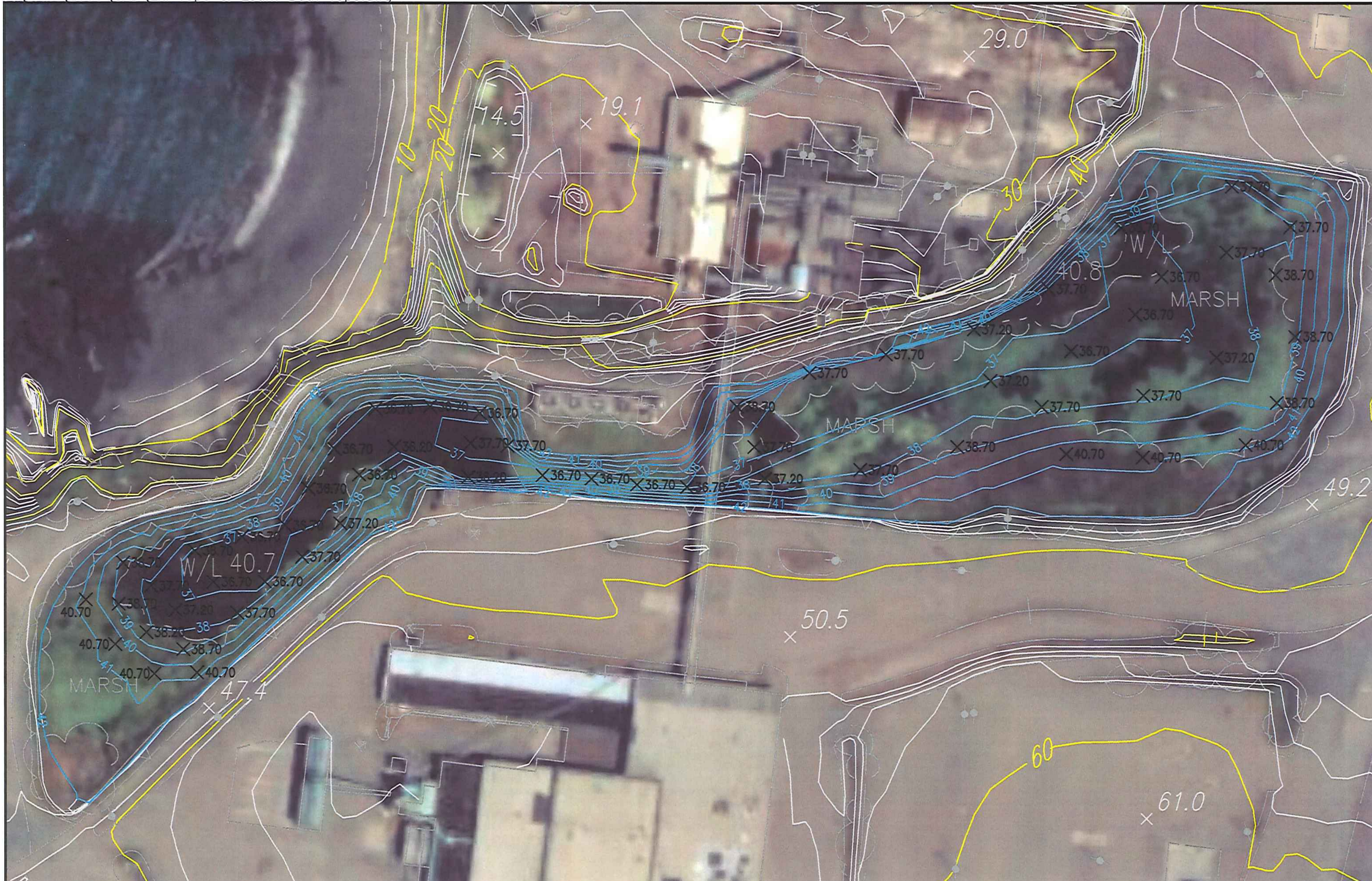
N

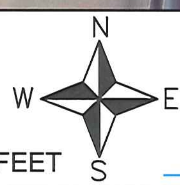
GRAPHICAL SCALE (FEET)
0 300 600 900 1,200

**GROUNDWATER CONTOUR MAP**
**January 2004**

**FIGURE B-1**

F:\DATA\2090\CAD\Exi Topo & Estim Bath Topo.dwg




SCALE

0 75 150 300 FEET

Legend

×37.70 Estimated bathymetric elevation based on pond depth measurements performed by TRC in July 2003

—37— Estimated bathymetric contour

EXISTING TOPOGRAPHIC AND ESTIMATED BATHYMETRIC CONTOURS MAP

PLAN VIEW

STETSON ENGINEERS INC.

FIGURE B-2

## FIGURE B-3 STORAGE, SURFACE AREA VS. WATER LEVEL OF MILL POND

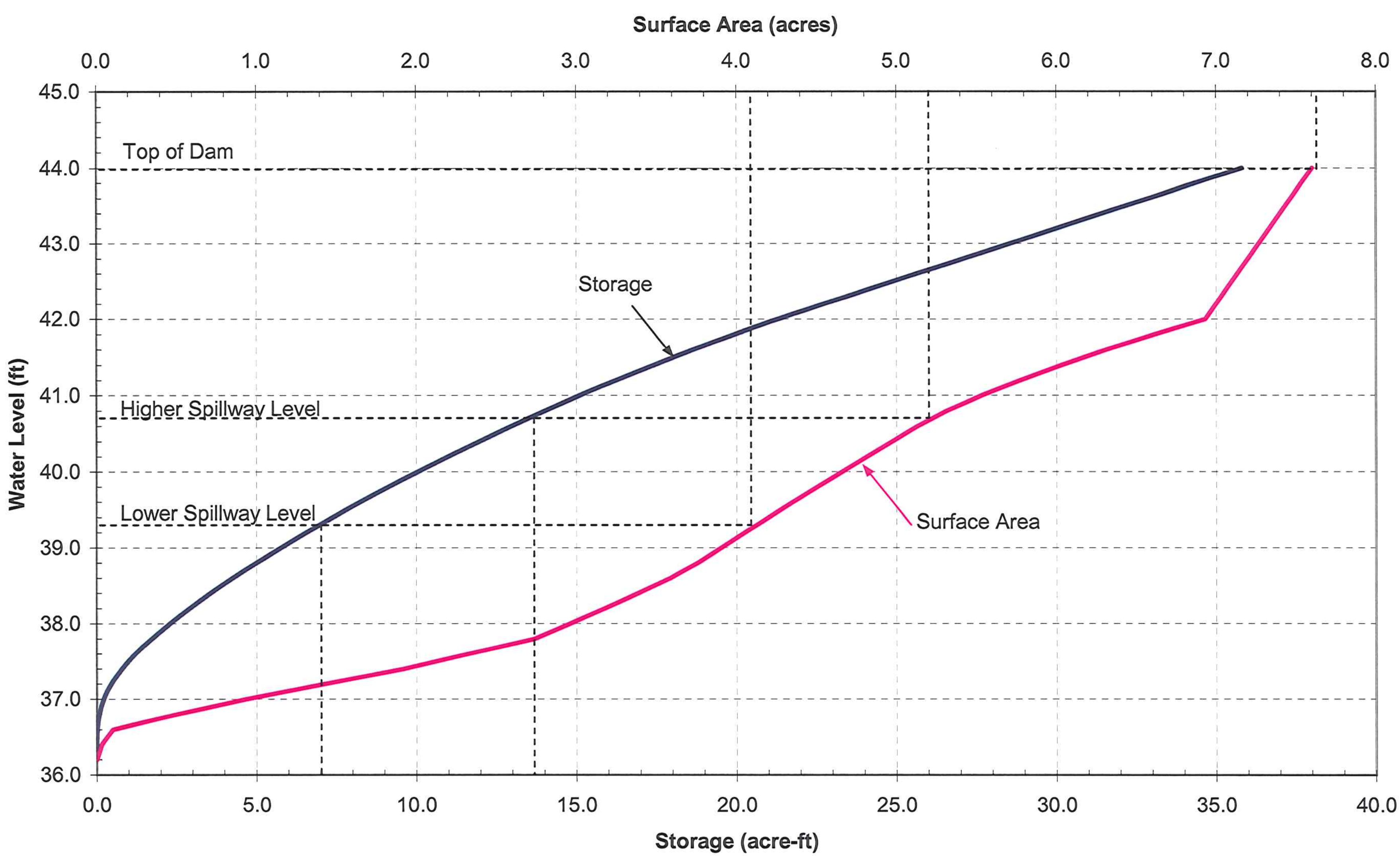
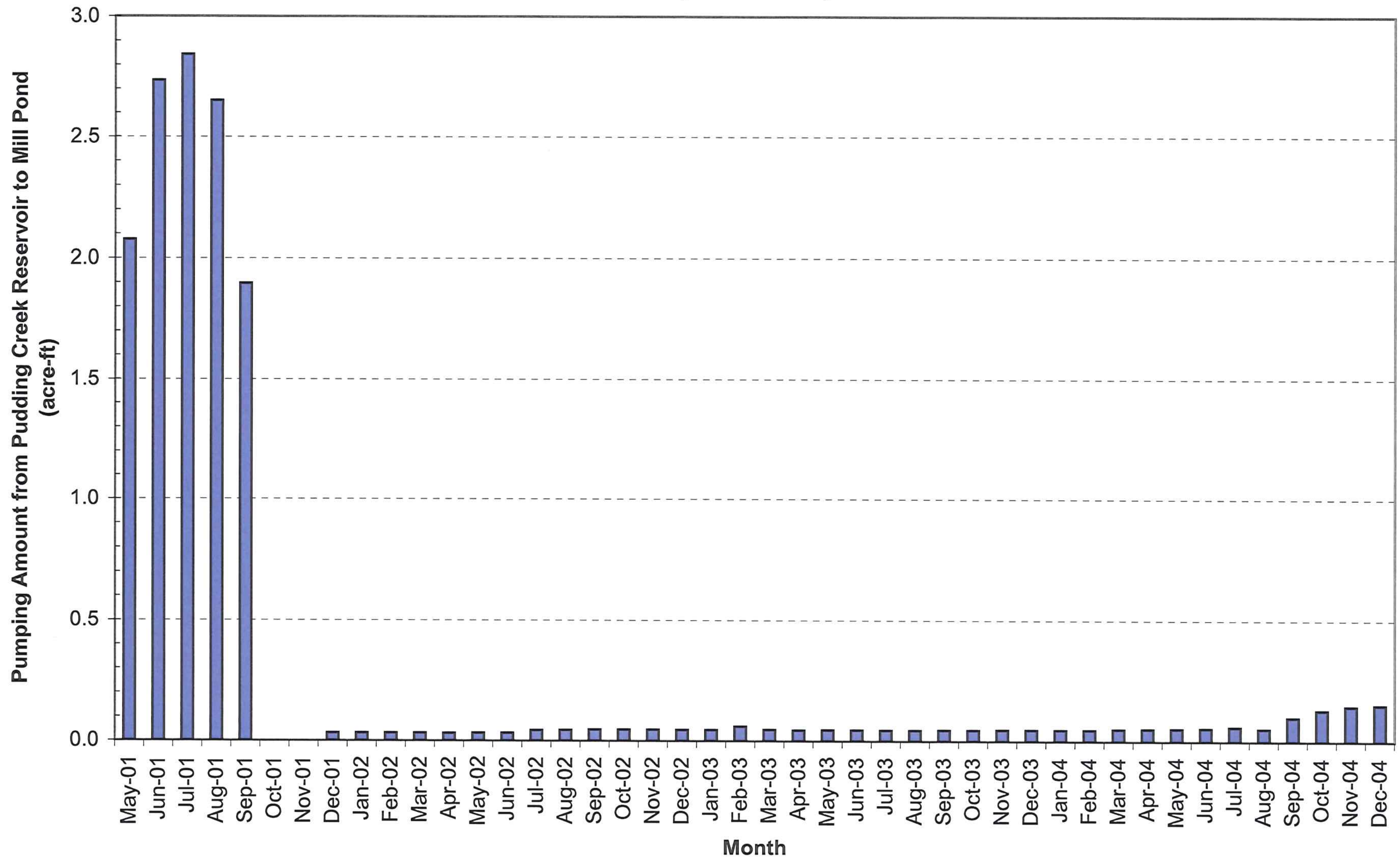


FIGURE B-4 MONTHLY PUMPING AMOUNT FROM PUDDING CREEK RESERVOIR TO MILL POND (2001 - 2004)



**Historical Water Pumping from Pudding Creek Reservoir to Mill Pond**

The monthly volumes pumped from Pudding Creek Reservoir to the Mill Site for the periods 2001 - 2004 were obtained from G-P. Paul Johnson, acting mill manager who was in charge of the pumping, estimated that about (5) five percent of the volume pumped was delivered into Mill Pond. The monthly volume delivered to Mill Pond was 2.0 to 3.0 acre-ft per month during the period of May to September 2001 and ranged from 0.0 to 0.15 acre-ft per month thereafter (Figure B-4).

**Groundwater Seepage Estimate Using Water Budget Analysis**

Water budget analysis was performed to estimate seepage from groundwater to Mill Pond under hydrologic conditions that occurred in June 2004. Water budget analysis uses the principle of mass balance to back-calculate seepage during a defined time period based on measurements of change in pond storage and measurements and estimates of inflow and outflow components. Figure B-5 shows a schematic of water budget components.

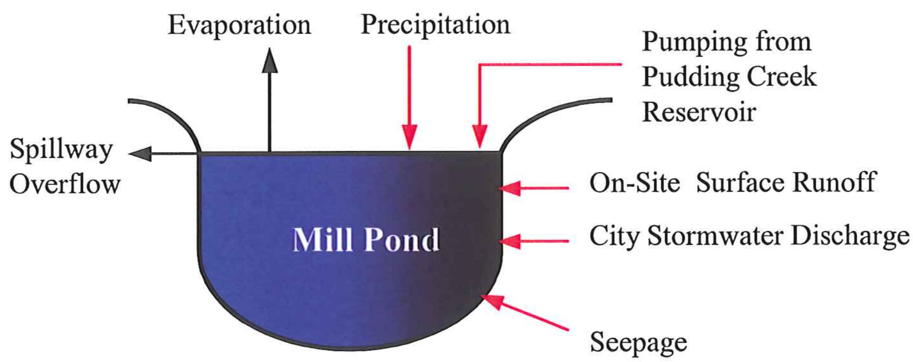



**Figure B-5 Schematic of Mill Pond Water Budget Analysis**

The water budget components include:

- Inflow components:
  - Pumping from Pudding Creek Reservoir
  - On-site surface runoff
  - Discharges from the two city storm drains
  - Groundwater seepage.
- Outflow components:
  - Evaporation
  - Spillway overflow

Because June 2004 was a dry month (0.05 in of precipitation), it was assumed that the inflow components of precipitation, on-site surface runoff and city stormwater discharge and the outflow component of spillway discharge were negligible. Thus the remaining water budget components include:

- Inflow components:
  - Pumping from Pudding Creek Reservoir
  - Groundwater seepage

- Outflow components:
  - Evaporation

The change in storage ($\Delta V$) during June 2004 was equal to the inflows minus the outflows according to the following equation:

$$\Delta V = \text{Pumping from Pudding Creek Reservoir} + \text{Groundwater Seepage} - \text{Evaporation}$$

Given the change in storage during the month, the groundwater seepage was back-calculated using the above equation.

Table B-1 shows Desert Research Institute precipitation data at Fort Bragg and pan evaporation data at Coyote Dam in 2003 and 2004. Figure B-6 shows average monthly precipitation during the period of record 1948 – 2004 and average monthly pan evaporation during the period of record 1995 – 2004. Year 2003 was near average while 2004 was slightly dry. Precipitation during June 2004 was very little (0.05 in) and pan evaporation was about normal (9.33 in). Using a pan-to-lake coefficient of 0.75 for June, the Mill Pond evaporation in June 2004 was estimated to be approximately 7.0 inches. The water level in the pond in June 2004 was estimated at about 40.7 ft, about at the upper spillway crest elevation, and the corresponding estimated evaporation was about 3.0 acre-ft.

According to G-P staff, the Mill Pond water level dropped about 6 inches during the summer 2004. Based on the evaporation and precipitation data in Table B-1, it was estimated that 1.5 inches of the 6 inch drop occurred in June. The corresponding change in pond storage during June was about minus 0.62 acre-ft.

As shown in Figure B-4, the water volume pumped from Pudding Creek Reservoir to Mill Pond in June 2004 was 0.05 acre-ft. Thus the groundwater seepage to Mill Pond in June 2004 was calculated to be 2.33 acre-ft (i.e., 3.0 – 0.05 – 0.62).

**FIGURE B-6 AVERAGE MONTHLY PRECIPITATION AND PAN EVAPORATION**
**(Data source: Desert Research Institute precipitation data for Fort Bragg (1948-2004); Pan evaporation data at Coyote Dam (1995 - 2004)**

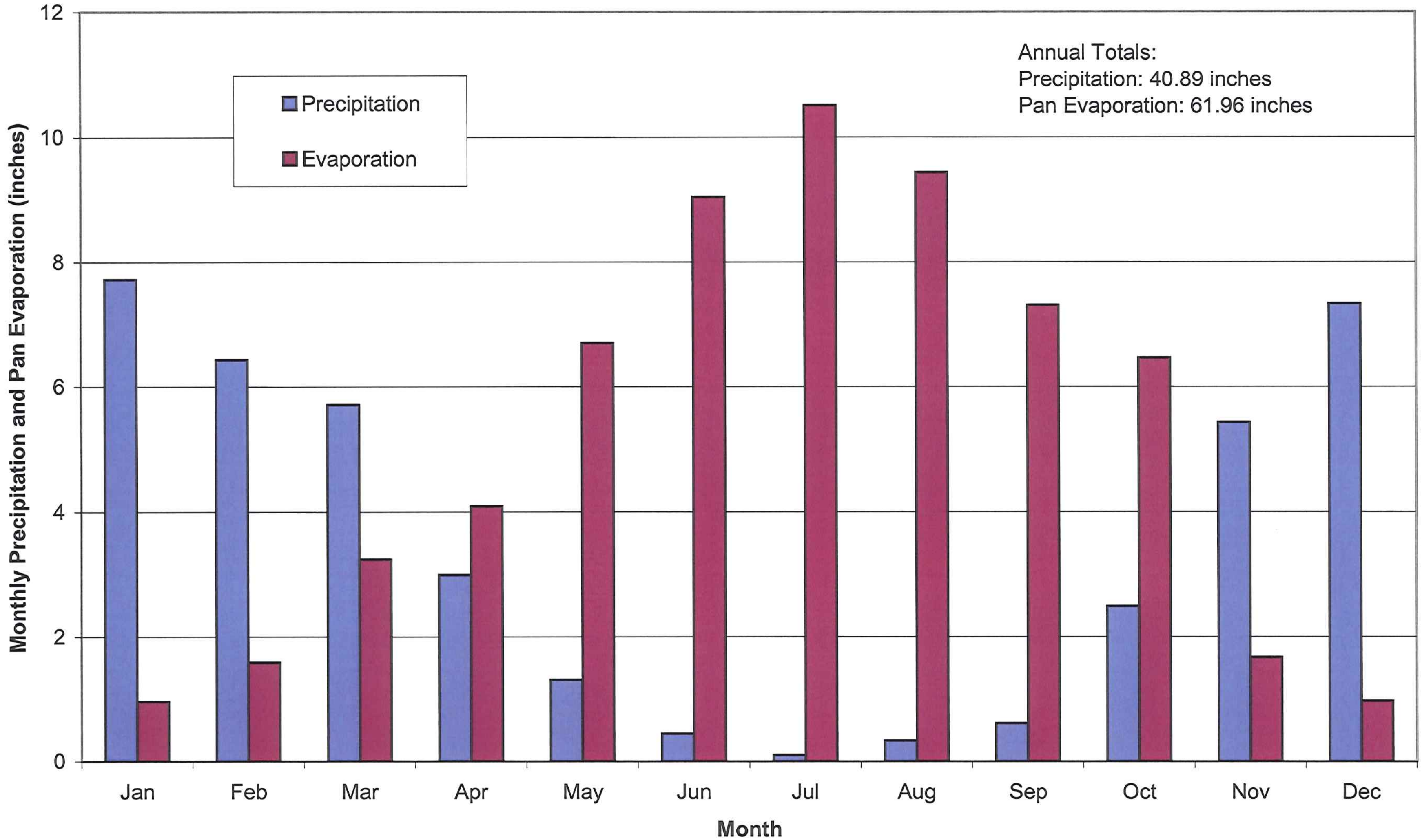


**Table B-1 Fort Bragg Precipitation and Pan Evaporation in 2003 and 2004**

| Month | 2003 | | 2004 | |
|---|---|---|---|---|
| | Precipitation (inches) | Pan Evaporation (inches) | Precipitation (inches) | Pan Evaporation (inches) |
| Jan | 6.42 | 1.08 | 7.08 | 1.05 |
| Feb | 4.41 | 1.94 | 9.76 | 1.53 |
| Mar | 5.86 | 3.24 | 1.86 | 4.33 |
| Apr | 11.64 | 2.12 | 1.58 | 5.20 |
| May | 0.88 | 6.27 | 0.23 | 7.24 |
| Jun | 0.04 | 9.07 | 0.05 | 9.33 |
| Jul | 0.02 | 10.44 | 0.08 | 10.47 |
| Aug | 0.03 | 8.97 | 0.19 | 9.61 |
| Sep | 0.54 | 7.14 | 0.18 | 7.74 |
| Oct | 0.00 | 5.19 | 5.30 | 3.69 |
| Nov | 4.64 | 1.31 | 1.37 | 1.73 |
| Dec | 12.06 | 0.75 | 7.62 | 1.40 |
| **Annual** | **46.54** | **57.52** | **35.30** | **63.32** |

Source: Desert Research Institute precipitation data at Fort Bragg; Pan evaporation data at Coyote Dam.

**Groundwater Seepage Estimate Using Groundwater Flow Analysis**

To provide a check on the results of the water budget analysis, the groundwater seepage was also estimated using Darcy's groundwater flow equation:

$$Q = k \cdot i \cdot A$$

Where $Q$ is groundwater seepage, $k$ is aquifer hydraulic conductivity, $i$ is groundwater gradient, and $A$ is cross-section area.

Based on the groundwater monitoring data and the groundwater contour map for January 2004, groundwater seepage primarily occurred along the east face of Mill Pond. The groundwater gradient was estimated to be 0.028. The estimated aquifer hydraulic conductivity is 55 ft per day, which is within a reasonable range for an aquifer consisting of sand and gravel.

Based on the estimated aquifer hydraulic conductivity and gradient, groundwater seepage into Mill Pond under different groundwater levels was estimated. Figure B-7 shows the estimated groundwater seepage for a range of groundwater levels averaged by the five monitoring wells MW-5.1 - MW-5.5. These five monitoring wells are located south-east of Mill Pond (see Figure B-1). The groundwater seepage for the groundwater conditions in January and September 2004 is estimated to be approximately 3.0 and 1.9 acre-ft, respectively, which matches well with the 2.3 ac-ft from the water budget analysis.

Figure B-8 shows the estimated monthly variation in groundwater seepage into Mill Pond and groundwater levels averaged by the five monitoring wells MW-5.1 – MW-5.5. The monthly variation of the averaged groundwater levels for the five monitoring wells were estimated by interpolation based on the precipitation and evaporation data shown in Table B-1 and the measured groundwater levels in January (52.0 ft), June (50.5 ft), and September (49.5 ft) 2004.

**Mill Pond Water Level Estimate under Natural Inflow Conditions**

Using the above estimated monthly groundwater seepage and water budget method, monthly water levels of Mill Pond can be estimated. Figure B-9 shows the estimated monthly variation of Mill Pond water levels. The Mill Pond water level starts decreasing in June until September. The estimated decrease in water level during the summer in a normal year is approximately 0.6 feet or 7 inches.

FIGURE B-7 ESTIMATED GROUNDWATER SEEPAGE INTO MILL POND FOR A RANGE OF GROUNDWATER LEVELS AVERAGED BY MONITORING WELLS MW-5.1- MW-5.5

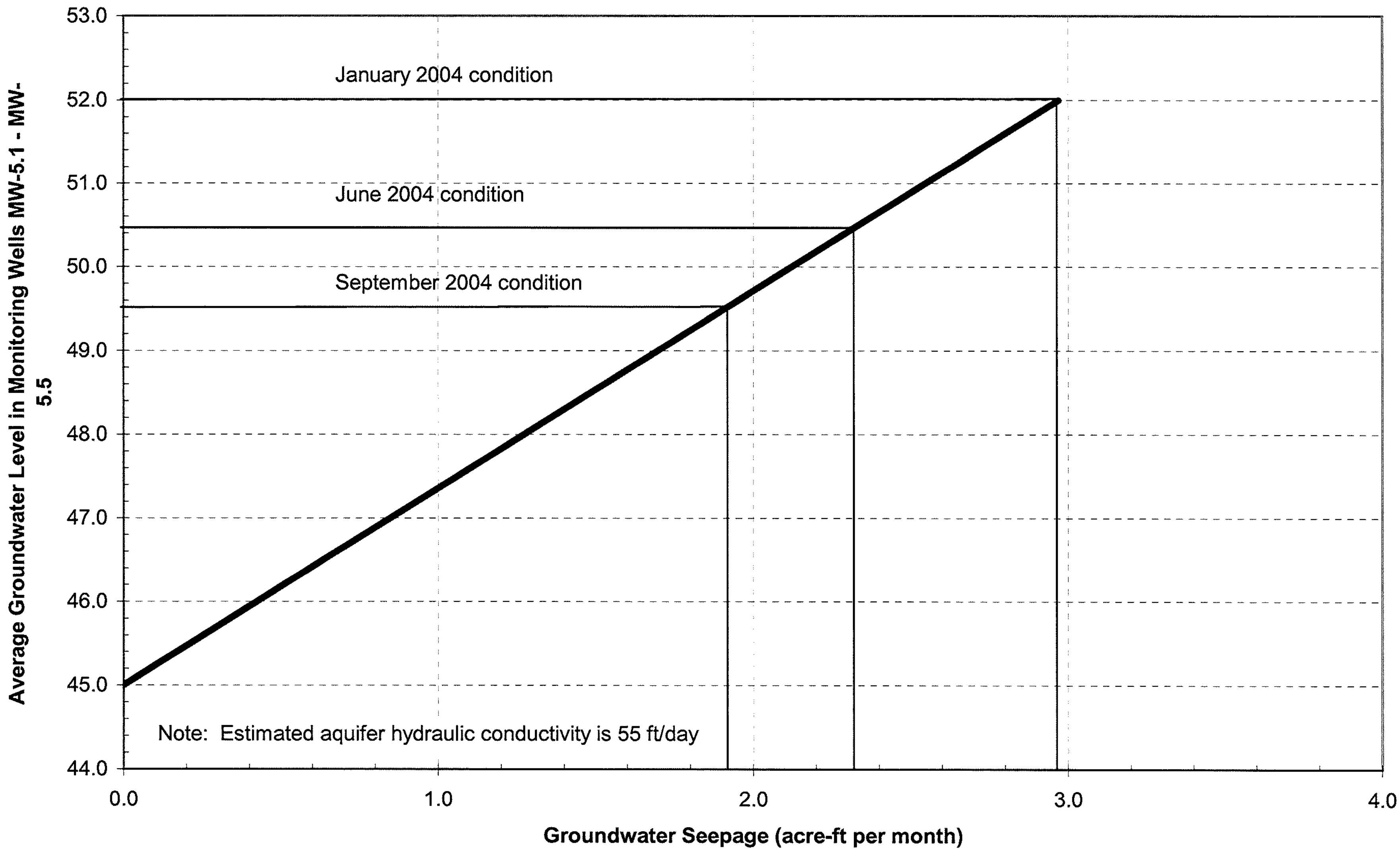


FIGURE B-8  ESTIMATED AVERAGE MONTHLY GROUNDWATER SEEPAGE INTO MILL POND AND GROUNDWATER LEVELS AVERAGED BY THE FIVE MONITORING WELLS MW-5.1- MW-5.5

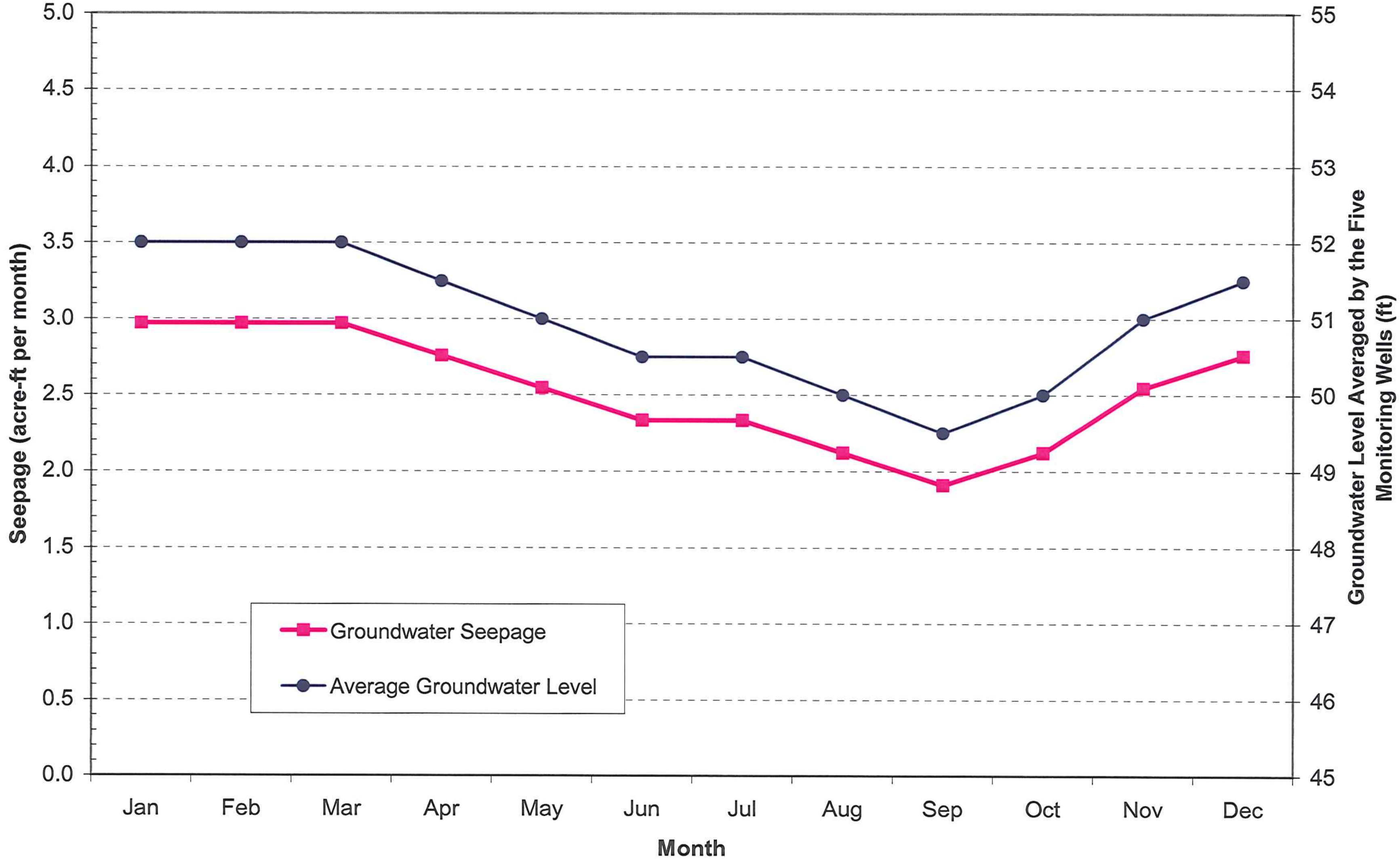
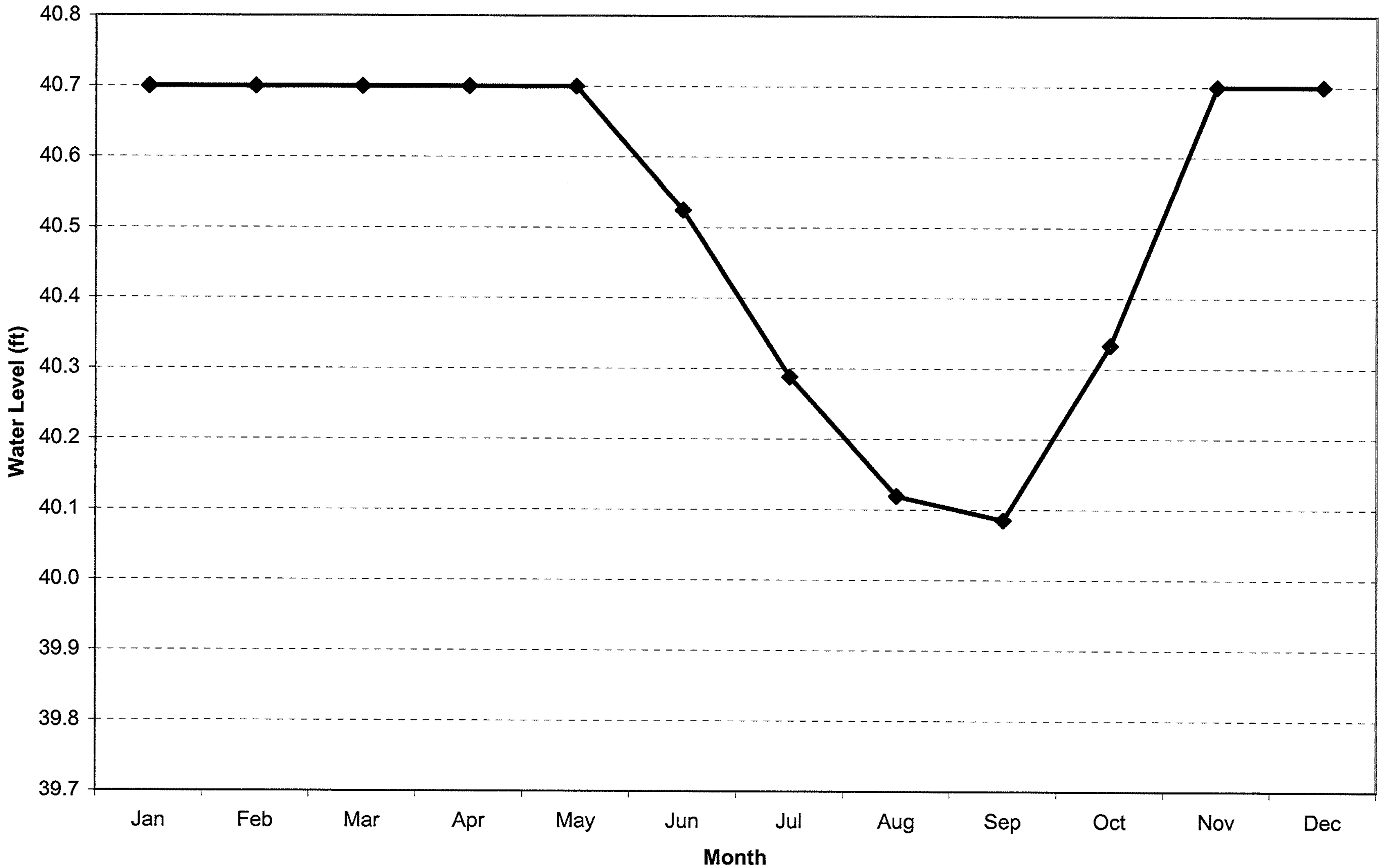


FIGURE B-9  ESTIMATED MONTHLY WATER LEVELS OF MILL POND



# APPENDIX C:

# CAPACITY ANALYSIS FOR STORMWATER QUALITY ENHANCEMENT

## GEORGIA-PACIFIC MILL POND
## FORT BRAGG, CALIFORNIA

STETSON ENGINEERS

JANUARY 14, 2005

# TECHNICAL MEMORANDUM

STETSON ENGINEERS INC.
**2171 E. Francisco Blvd., Suite K • San Rafael, California • 94901**
TEL: (415) 457-0701 FAX: (415) 457-1638 e-mail: jamesr@stetsonengineers.com

| | | | |
|---|---|---|---|
| **TO:** | Julie Raming, R.G., Georgia-Pacific | **DATE:** | January 14, 2005 |
| **FROM:** | Stetson Engineers | **JOB NO.:** | 2090 |
| **SUBJECT:** | **Capacity Analysis for Stormwater Quality Enhancement** | | |

Wet ponds (a.k.a. stormwater ponds, retention ponds, wet extended detention ponds) are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season) and differ from constructed wetlands primarily in having a greater average depth. Ponds treat incoming stormwater runoff by settling and biological uptake. The primary removal mechanism is settling as stormwater runoff resides in this pool, but pollutant uptake, particularly of nutrients, also occurs to some degree through biological activity in the pond. Wet ponds are among the most widely used stormwater practices. While there are several different versions of the wet pond design, the most common is the extended detention wet pond, where storage is provided above the permanent pool in order to detain stormwater runoff and promote settling. This version is appropriate where groundwater or surface runoff are sufficient year round to maintain suitable hydrologic conditions.

A key point to consider in the sizing of treatment control for stormwater quality enhancement is that the design is most efficient and economical when it targets small, frequent storm events that, over time, produce more cumulative runoff than the larger, infrequent storms targeted for design of flood control facilities.

Typically, a volume-based wet pond design criteria calls for the capture and treatment of a certain percentage of the runoff from the project site, usually in the range of 75% to 85% of the average annual runoff volume. This range corresponds to the point of inflection where the magnitude of the event increases more rapidly than number of events captured for many sites in California whose composite runoff coefficient is in the 0.50 to 0.95 range.

The California Stormwater Best Management Practices Handbook ("BMP Handbook"; California Stormwater Quality Association, 2003) gives the following design and sizing guidelines for wet ponds that are relevant to Mill Pond:

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- Outlet designed to discharge the capture volume over a period of 48 hours.

- Permanent pool volume equal to twice the extended detention volume.
- Water depth not to exceed about 8 feet.
- Wetland vegetation occupying no more than 50% of surface area.
- Include energy dissipation in the inlet design and a sediment forebay to reduce resuspension of accumulated sediment and facilitate maintenance.
- A maintenance ramp should be included in the design to facilitate access to the forebay for maintenance activities and for vector surveillance and control.
- To facilitate vector surveillance and control activities, perimeter road access on both sides should be provided or be designed such that no parcel of water is greater than seven meters from the road.
- Each pond should have a low level drain pipe that can completely or partially drain the pond. The drain pipe shall have an elbow within the pond to prevent sediment deposition, and a diameter capable of draining the pond within 24 hours.

The BMP Handbook also gives the volume-based BMP sizing curves in California. Figure C-1 shows the curve using the rainfall data at the rain gage at Eureka WFO Woodley Island (gage elevation 20 ft). This rain gage is close to Fort Bragg and has similar elevation to the Sawmill Site.

The following steps describe the use of the BMP sizing curve:

1. Identify the "BMP Drainage Area" that drains to the proposed BMP. This includes all areas that will contribute runoff to the proposed BMP, including pervious areas, impervious areas, and off-site areas, whether or not they are directly or indirectly connected to the BMP.
2. Calculate the composite runoff coefficient "C" for the area identified in Step 1.
3. Determine the applicable requirement for capture of runoff (Capture, % of Runoff).
4. Enter the capture curve selected in Step 3 on the vertical axis at the "Capture, % Runoff" value identified in Step 3. Move horizontally to the right across capture curve until the curve corresponding to the drainage area's composite runoff coefficient "C" determined in Step 2 is intercepted. Interpolation between curves may be necessary. Move vertically down from this point until the horizontal axis is intercepted. Read the "Unit Basin Storage Volume" along the horizontal axis.
5. Calculate the required capture volume of the BMP by multiplying the "BMP Drainage Area" from Step 1 by the "Unit Basin Storage Volume" from Step 4 to give the BMP volume.

Runoff is directly proportional to the value assigned to the runoff coefficient "C". Proper selection of this value is critical for stormwater runoff calculations. The values for "C" are listed in Table C-1 and existing land uses are shown in Figure C-2.

The required wet pond volume for stormwater quality enhancement at the capture of 85% annual runoff is summarized in Table C-2. In addition to receiving stormwater discharges from the City's Drainage Basins C and D (Figure C-3), it is estimated that approximately 50% of the on-site stormwater from the developed Sawmill Site will discharge into Mill Pond based on the site topography. The required pond volume to capture and treat the on-site and off-site stormwaters is estimated to be approximately 18 acre-ft. This required volume includes the permanent pool volume.

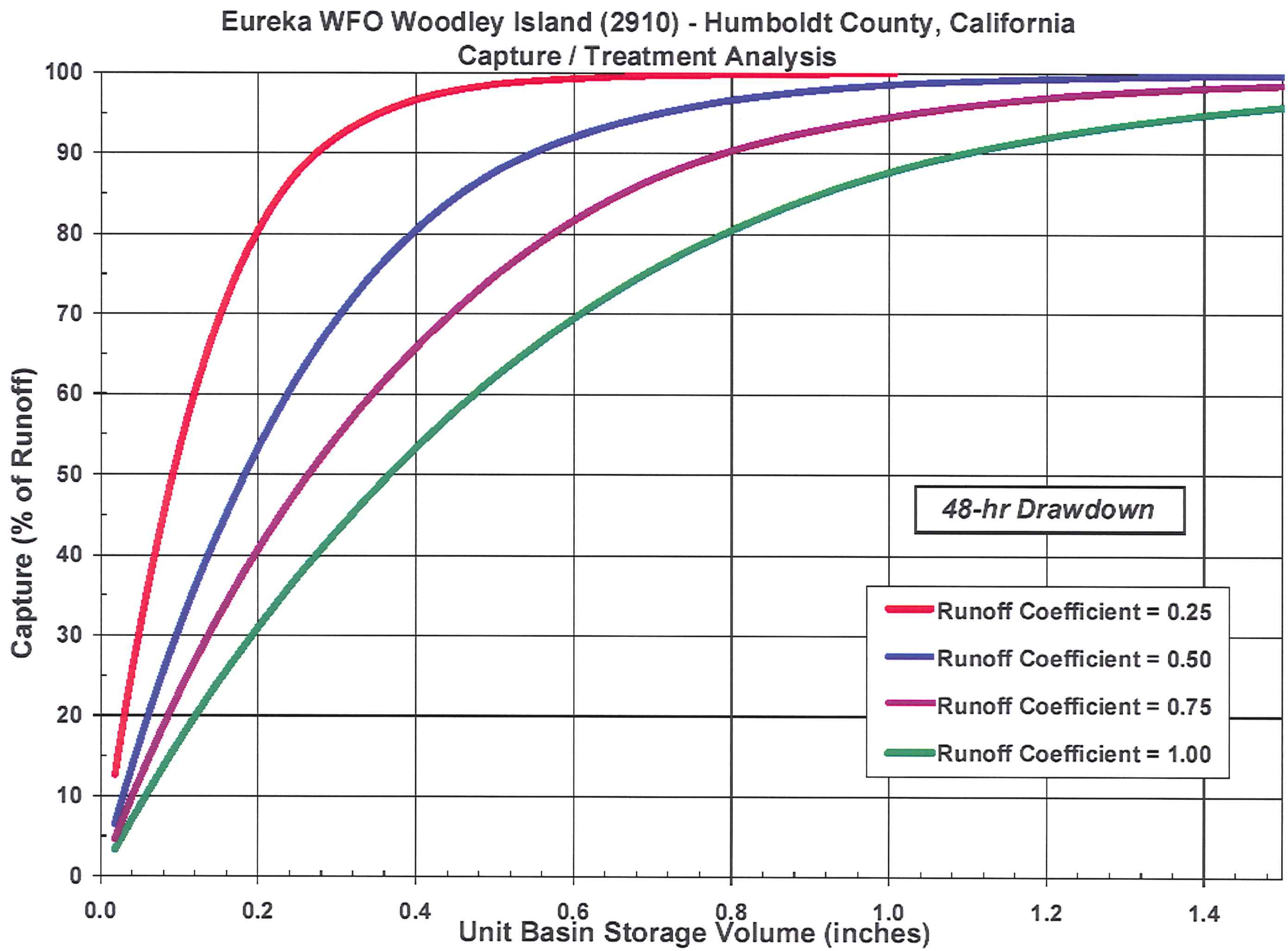
**Table C-1 Runoff Coefficient "C" for Different Land Uses**

| Land Use Designation | Runoff Coefficient "C" |
|---|---|
| **Residential** | |
| RR5—Large Lot Rural Residential (1 unit per 5 acres) | 0.35 |
| RR2—Medium Lot Rural Residential (1 unit per 2 acres) | 0.35 |
| RR1—Rural Residential (1 unit per acre) | 0.40 |
| SR—Suburban Residential (1-3 units per acre) | 0.40 |
| R1—Low Density Residential (3-6 units per acre) | 0.55 |
| R2—Medium Density Residential (6-12 units per acre) | 0.70 |
| R3—High Density Residential (6-15 units per acre) | 0.75 |
| R4—Very High Density Residential (6-24 units per acre) | 0.85 |
| **Commercial** | |
| CBD—Central Business District | 0.85 |
| C1—Neighborhood Commercial | 0.85 |
| C2—General Commercial | 0.85 |
| C3—Highway Visitor Commercial | 0.85 |
| C4—Office Commercial | 0.85 |
| **Industrial** | |
| LI—Light Industrial | 0.85 |
| HI—Heavy Industrial | 0.90 |
| TRI—Timber Resources Industrial | 0.90 |
| **Other** | |
| HD—Harbor District | 0.85 |
| PR—Parks and Recreation | 0.25 |
| PF—Public Facilities | 0.35 |
| OS—Open Space | 0.20 |
| A—Agricultural | 0.30 |

### Table C-2 Calculation of Required Wet Pond Volume for Stormwater Water Quality Enhancement (Drawdown Time = 48 hours)

| Item | Drainage Area (acres) | Land Use Classification | Composite Runoff Coefficient | Captured Runoff (inches) | Captured Runoff (acre-ft) |
|---|---|---|---|---|---|
| City Drainage Basin C | 130 | R1—Low Density Residential; R2—Medium Density Residential; R4—Very High Density Residential; C1—Neighborhood Commercial; C2—General Commercial; PF—Public Facilities; HI—Heavy Industrial | 0.70 | 0.60 | 6.5 |
| City Drainage Basin D | 104 | R1—Low Density Residential; R2—Medium Density Residential; R4—Very High Density Residential; C1—Neighborhood Commercial; PF—Public Facilities; CBD—Central Business District | 0.70 | 0.60 | 5.2 |
| Surface Runoff Basin from Mill Site – Future Maximum | 220 | Residential; Commercial; Golf Course; Resort; Open Space | 0.40 | 0.35 | 6.4 |
| **Total – Future Maximum** | **454** | | | | **18.1** |

# FIGURE C-1


Eureka WFO Woodley Island (2910) - Humboldt County, California
Capture / Treatment Analysis
Capture (% of Runoff)
100
90
80
70
60
50
40
30
20
10
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
Unit Basin Storage Volume (inches)
48-hr Drawdown
Runoff Coefficient = 0.25
Runoff Coefficient = 0.50
Runoff Coefficient = 0.75
Runoff Coefficient = 1.00

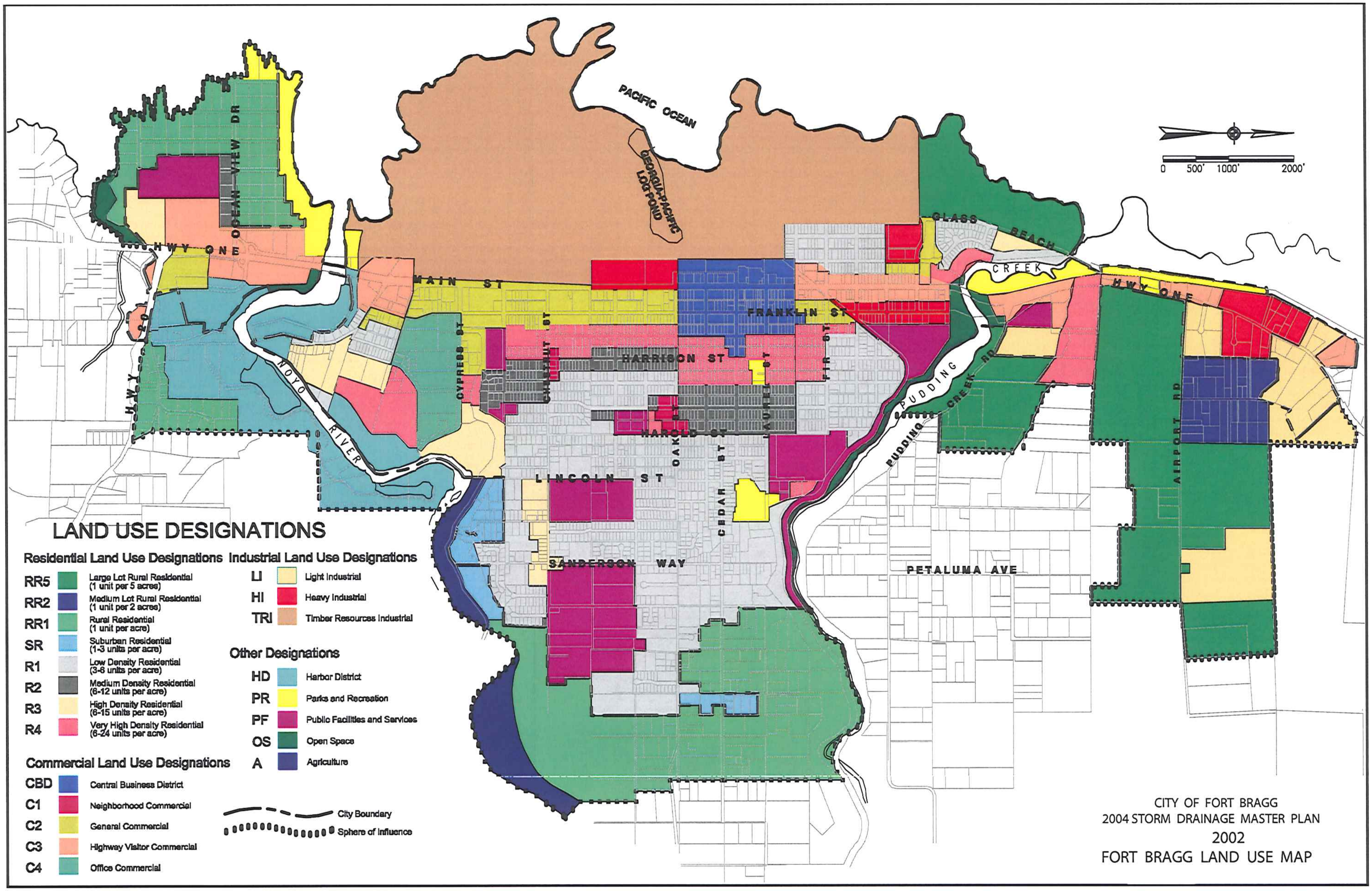



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FIGURE C-2 CITY OF FORT BRAGG LAND USE MAP

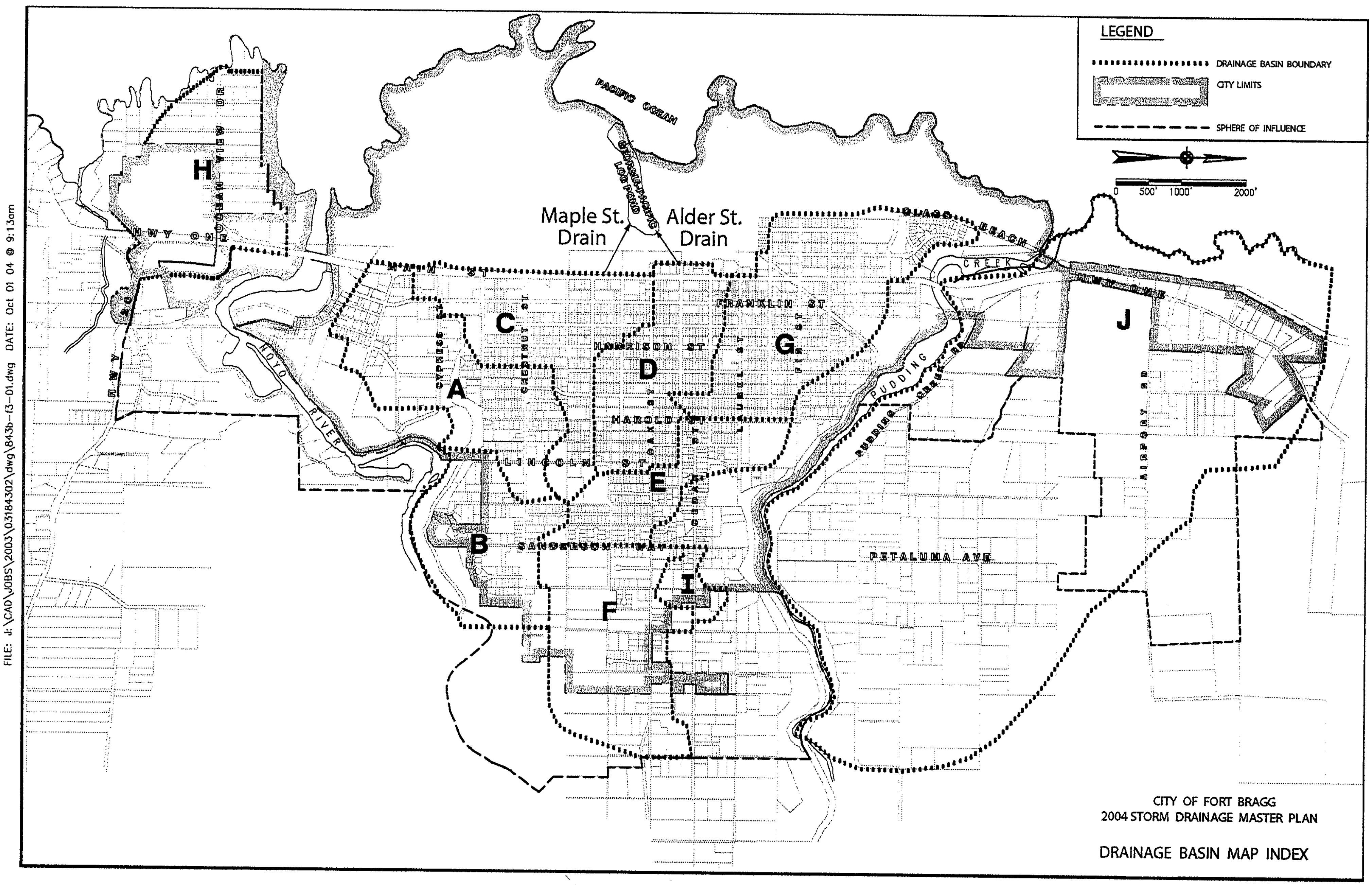


FIGURE C-3 CITY OF FORT BRAGG STORMWATER DRAINAGE BASINS

# APPENDIX D:

# SUMMARY NOTES OF MEETINGS WITH REGULATORY AGENCIES ON FEBRUARY 9 AND 10, 2005

# MILL POND IMPROVEMENT PROJECT

# MEMORANDUM

STETSON ENGINEERS INC.
**2171 E. Francisco Blvd., Suite K • San Rafael, California • 94901**
TEL: (415) 457-0701 FAX: (415) 457-1638 e-mail: jamesr@stetsonengineers.com

| | | | |
|---|---|---|---|
| **TO:** | Julie Raming, R.G., Georgia-Pacific | **DATE:** | March 1, 2005 |
| **FROM:** | Stetson Engineers | **JOB NO.:** | 2090 |

**SUBJECT:** **Summary of Meetings With Regulatory Agencies on February 9 and 10, 2005 Regarding the Mill Pond Improvement Project**

Meetings were held with regulatory agencies on February 9 and 10, 2005 regarding the Mill Pond Improvement Project. Meeting participants are listed below:

**February 9, Army Corps of Engineers Interagency Meeting, San Francisco**

Peter Straub, Project Manager, U.S. Army Corps/San Francisco District (415) 977-8443
Mike Monroe, U.S. Environmental Protection Agency, Region IX (415) 972-3453
Liam Davis, California Department of Fish and Game (707) 944-5529
Charles Reed, California Regional Water Quality Control Board, North Coast Region (707) 576-2752
John Short, California Regional Water Quality Control Board, North Coast Region (707) 576-2065

Julie Raming, G-P
Carol Stephens, G-P
Doug Heitmeyer, G-P
Don Moody, CB Richard Ellis for G-P
Linda Ruffing, Community Development Director, City of Fort Bragg
James Reilly, PE, Stetson Engineers
Mike Josselyn, WRA Consultants

**February 10, Fort Bragg**

Bob Merrill, California Coastal Commission/Eureka Office (707) 445-7874
Ruby Pap, California Coastal Commission/San Francisco Office (415) 904-5200

Julie Raming, G-P
Carol Stephens, G-P
Doug Heitmeyer, G-P
Don Moony, Coldwell Banker for G-P
Andy Whiteman, City Manager, City of Fort Bragg
Linda Ruffing, Community Development Director, City of Fort Bragg
Dave Goble, Public Works Director, City of Fort Bragg
Mark Johnson, Finance Director, City of Fort Bragg
James Reilly, PE, Stetson Engineers

## Key Remarks Made During the Meetings

General remarks:

In general, all agencies voiced support for the Project concepts that call for restoration of natural habitat functions and values and mimic natural conditions. For these Project concepts, a mitigation ratio of 1:1 would be acceptable. Impacts to existing stormwater ponds would need to be mitigated, but creation of new replacement stormwater ponds would not be credited toward this mitigation.

All agencies would require similar information to be included in their application documents. One single Project Description document would be acceptable; however, each agency has a special application form (and fees) that would need to be attached as a cover.

Army Corps of Engineers:

- Corps jurisdiction covers all waters of the U.S., including ocean tidal waters and shorelines, and fresh waters.
- Need to prepare a Project description and statement of "purpose and need."
- Need to establish a Project boundary that defines the limits of the Project area.
- Need to perform, and submit to the Corps for verification, a protocol level delineation of waters of the U.S. within the Project area. Need to assess existing habitat functions.
- Corps jurisdiction would not likely apply to the industrial processing ponds – only to Mill Pond and the catch basin area.
- Need a Corps permit, most likely a Nationwide Permit would not apply; an Individual Permit would probably be required. Individual Permit requires a 404(b)(1) Alternatives Analysis. EPA's 404(b)(1) Guidelines prohibit issuance of a Permit where water quality/toxic standard are violated, or where there is a "practicable," less environmentally damaging alternative available that meets the Project purpose and need.
- Defining the Project purpose to include restoration of natural conditions would increase the likelihood that the Naturalistic or similar concepts would be acceptable under 404(b)(1).
- Corps would prepare required NEPA documentation. Compliance with NEPA and other Federal statutes would need to be considered in the NEPA analysis.
- The amount of time required for processing a Corps permit would be lengthened if endangered species may be affected. This would trigger lengthy consultation with wildlife resources agencies under the Endangered Species Act.
- Pollution cleanup permitting activities may occur in parallel with the Project.
- Corps has no preference on the concepts presented.

EPA:

- EPA favors projects that emulate natural conditions, restore natural habitat functions, and result in a net increase in jurisdictional waters and habitat functions and values.

- EPA would accept a 1:1 area mitigation ratio, or less if overall habitat functions and values are replaced at 1:1. Important to assess existing habitat functions in order to determine appropriate mitigation goal.
- Coastal Lagoon may provide the most habitat value, but there may be problems, such as mosquitoes and bacteria (from bird droppings and inadequate flushing).

California Department of Fish and Game:

- A Stream Alteration Agreement (SAA) would be required for the Project from CDFG.
- A SAA cannot be issued until CEQA is completed.
- City would act as Lead Agency under CEQA.
- SAA application requires similar information as the Corps permit application. Call (707) 944-5520 for application form from Cory Gray.
- CDFG jurisdiction would not likely apply to the processing ponds – only to Mill Pond and the catch basin area.

Regional Water Quality Control Board:

- RWQCB approval for the Project would come in the form of RWQCB issuance of 401 certification or waiver during the Corps permitting process. RWQCB issues 401 certification or waiver if it finds that the Project would not result in violation of State water quality standards.
- RWQCB 401 permit application requires similar information as the Corps permit application.
- RWQCB is currently processing an NPDES stormwater permit to the City.
- RWQCB jurisdiction would not likely apply to the processing ponds if they were used for water treatment – only to Mill Pond and the catch basin area.
- RWQCB would accept nothing less than a 1:1 mitigation ratio.
- Stormwater quality enhancement ponds constructed under the Project cannot be counted toward mitigation credit. For those existing ponds currently functioning as stormwater quality enhancement pond that are impacted by the Project, would need to be replaced with non-stormwater ponds or wetlands at 1:1.

California Coastal Commission:

- State process governs first, particularly the coastal permit process. A Coastal Development Permit (CDP) is required.
- Federal Consistency and Review Certification Process may be required. This may result in a "Negative Determination" (N.D.) -- if the Applicant submits a letter to the CCC then CCC staff can prepare the N.D.
- CCC encourages restoration that mimics natural conditions, over mitigation. No preference between Coastal Lagoon or Naturalistic or Wet Meadow – just restore natural conditions.

- Salmonid entrapment in a Coastal Lagoon is a concern – would trigger consultation with wildlife resources agencies under the State and Federal Endangered Species Acts which would lengthen the permitting process.
- Suggest restoration that is sustainable and easy to maintain.
- CCC typically requires 100 foot buffers along creeks; placement of biologically sensitive habitat areas away from public use areas and avoidance of trails in these sensitive areas.
- Impacts to the processing ponds may complicate the CCC permitting process; CCC recommends not including improvements to these in the Project.
- CCC requires an alternatives analysis similar to that described in EPA's 404(b)(1) Guidelines.

**Key Activities and Milestones Needed to Comply with Regulatory Requirements, by Stetson Engineers With Review by WRA Based on Feedback Received in the Meetings**

- Prepare Project Description, statement of purpose and need, and define the Project area.
- Prepare and submit to the Corps for verification a protocol level delineation of waters of the U.S. within the Project area.
- Conduct initial site assessments and review G-P documents and perform protocol level surveys, if necessary, within the Project area and surrounding affected areas needed to support the permitting and NEPA process. These include surveys to determine the presence or absence of any plant or animal species afforded special protection under the State and Federal law, including the Endangered Species Acts, historical properties, and cultural resources.
- Develop Project alternatives that meet the stated purpose and need and comply with permitting and mitigation requirements of all agencies. At least one alternative should be developed that avoids or at least minimizes impacts to existing waters of the U.S. This development of alternatives should be part of a detailed feasibility study.
- Prepare an alternatives analysis in accordance with EPA 404(b)(1) Guidelines and CCC guidelines (also, part of the detailed feasibility study).
- Select the preferred alternative based on cost or other discretionary criteria. Check to see that selected alternative is compatible with pollution cleanup activities and meets (pending) RWQCB NPDES stormwater permit requirements.
- Prepare a single Project Description document which is suitable for all agencies, for the selected preferred alternative Project. Complete specialized application forms for each agency; attach the Project Description document to each specialized application form; and submit to the agencies along with appropriate fees.
- Prepare CEQA documentation (City is Lead Agency).
- City adopts CEQA finding.
- CDFG issues SAA.
- RQWCB issues 401 certification or waiver.
- City issues CDP.
- After all State permits are issued, Corps completes NEPA and prepares FONSI (assuming EA/FONSI are appropriate), and issues permit.