GEOMATRIX

Final Feasibility Study for Remediation of Wood Surface Protection Chemicals

Sierra Pacific Industries
Arcata Division Sawmill
2593 New Navy Base Road
Arcata, California

Prepared for:

Sierra Pacific Industries

December 1, 2003

Project No. 9329, Task 16

Geomatrix Consultants

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GEOMATRIX

December 1, 2003
Project 9329, Task 11

Executive Officer
California Regional Water Quality Control Board
North Coast Region
5550 Skylane Boulevard, Suite A

Attention: Dean Prat

Subject: Final Feasibility Study for Remediation of Wood Surface Protection Chemicals
Sierra Pacific Industries
Arcata Division Sawmill
2593 New Navy Base Road
Arcata, California

Dear Mr. Prat:

As requested by Sierra Pacific Industries, we have enclosed a copy of the subject report prepared on behalf of Sierra Pacific Industry Industries

Sincerely yours,
GEOMATRIX CONSULTANTS, INC.

Ross Steenson

Ross Steenson, C.HG.
Senor Hydrogeologist

Edward P. Conti, C.E.G., C.HG.
Principal Geologist

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Enclosure

cc: Bob Ellery, Sierra Pacific Industries (with enclosure)
Gordie Amos, Sierra Pacific Industries (with enclosure)
David Dun, Dun and Martinek, LLP (with enclosure)
Fred Evenson, Law Offices of Frederic Evenson (with enclosure)
Jim Lamport, Ecological Rights Foundation (with enclosure)

Geomatrix Consultants, Inc.
Engineers, Geologists, and Environmental Scientists

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Geomatrix Consultants

PROFESSIONAL CERTIFICATION

FINAL FEASIBILITY STUDY FOR
REMEDIATION OF WOOD SURFACE
PROTECTION CHEMICALS
Sierra Pacific Industries
Arcata Division Sawmill
2593 New Navy Base Road
Arcata, California

December 1, 2003
Project No. 9329.000, Task 16

EDWARD P. CONTI
No. HG 214

This report was prepared by Geomatrix Consultants, Inc., under the professional supervision of Edward P. Conti. The findings, recommendations, specifications and/or professional opinions presented in this report were prepared in accordance with generally accepted professional hydrogeologic practice, and within the scope of the project. There is no other warranty, either express or implied.

Edward P. Conti, C.E.G., C.HG.
Principal Geologist

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FINAL FEASIBILITY STUDY FOR REMEDIATION OF WOOD SURFACE PROTECTION CHEMICALS

Sierra Pacific Industries
Arcata Division Sawmill
2593 New Navy Base Road
Arcata, California

1.0 INTRODUCTION

This report presents an evaluation of the feasibility of remedial alternatives for remediation of wood surface protection chemicals at the Sierra Pacific Industries (SPI) Arcata Division Sawmill located in Arcata, California (the site, Figure 1). Geomatrix Consultants, Inc. (Geomatrix), has prepared this report on behalf of SPI in accordance with Provision 5 of Cleanup and Abatement Order No. R1-2003-0127, issued by the California Regional Water Quality Control Board, North Coast Region (RWQCB), on November 13, 2003. The purpose of this report is to evaluate potential remedial technologies and develop alternatives to address wood surface protection chemicals that have been detected in site soil, groundwater, and storm water runoff. Based on the evaluation, a preferred remedial alternative is presented. In accordance with Provision 6 of Cleanup and Abatement Order No. RI-2003-0127, a Remedial Action Plan will be submitted within 90 days of concurrence with this report by the RWQCB.

This report is organized as follows:

- Site background, including a discussion of site history and previous environmental investigations, is presented in Section 2.0.
- Subsurface conditions, including lithology and the occurrence and movement of groundwater, are presented in Section 3.0.
- The nature and extent of wood surface protection chemicals present in the vicinity of the former green chain and the chemicals of concern at the site are discussed in Section 4.0.
- Interim Remedial Measures previously implemented at the site are discussed in Section 5.0.
- The remedial action objectives are presented in Section 6.0.
- The screening of remedial technologies for soil, groundwater, and storm water runoff is presented in Section 7.0.

- Remedial action alternatives are assembled and evaluated in Section 8.0.
- The preferred remedial action alternative is summarized in Section 9.0.
- References used in preparation of this report are listed in Section 10.0.

2.0 SITE BACKGROUND

This section provides background information regarding the site setting and history, including current and historical site uses and previous and recent environmental investigations performed at the site. Information presented in this section is summarized primarily from reports of previous investigative work at the site prepared by EnviroNet Consulting (Environet) and MFG, Inc. (MFG); reports from which this information is derived are listed in Section 10.0.

2.1 SITE HISTORY

The approximately 68-acre site is located on the Samoa Peninsula, inland of the northern shoreline of Humboldt Bay and approximately 4 miles east of the town of Arcata, California. The site is bounded to the north and east by the Mad River Slough, to the northwest by an old railroad grade, and to the south by New Navy Base Road and mud flats of Humboldt Bay (Figure 1).

The site is currently an active sawmill; current features are shown on Figure 2. The sawmill has operated at the site since approximately 1950. Prior to construction of the mill facilities, the site consisted of undeveloped sand dunes and mud flats. During construction of mill facilities in the 1950s and 1960s, portions of the Mad River Slough on the eastern, northern, and southern sides of the site were filled. The current mill facility consists of an administrative building, a main sawmill building, numerous wood-processing buildings, log storage areas, milled lumber storage areas, and loading/unloading areas. A 140-foot deep water supply well (Feature 48 on Figure 2) also is present on the site and provides water for log sprinkling. An older, shallow water supply well that is no longer used because it began to produce sand also is present adjacent to the deeper, in-service well.

Wood surface protection activities historically conducted at the site included the use of solution containing chlorinated phenols, including pentachlorophenol (PCP) and tetrachlorophenol (TCP), for sap stain and mold control on a small amount of milled lumber. The anti-stain solution was applied in an aboveground dip tank located in the middle of the former green chain located immediately south of the eastern end of the current sorter building (Feature 49 on Figure 2). Use of solution containing chlorinated phenols in the former green chain area of the site reportedly commenced in the early to mid-1960s and was discontinued in 1985 (Environet, 2002b). At the direction of the RWQCB, SPI stopped purchasing anti-stain solution containing chlorinated phenols in 1985 and commenced a process of relocating the remaining solution containing chlorinated phenols to a new dip tank facility for recycling (MFG, 2003a). Due to the difficulty of disposing of the old solution containing chlorinated phenols, the remaining solution from the old dip tank was mixed with a new anti-stain solution that did not contain chlorinated phenols at the new dip tank facility (Feature 21 on Figure 2). Recycling of the solution containing chlorinated phenols in the new dip tank continued until 1987, at which time the drip basin adjacent to of the old dip tank was cleaned out, filled with sand, and capped with 3 to 4 inches of concrete (MFG, 2003c). The new dip tank has been cleaned three times since 1987.

2.2 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Previous and recent environmental investigations conducted in the former green chain area at the site are summarized below. Figure 3 presents the locations of numerous soil borings completed at the site and the locations of current monitoring wells. Additional sampling locations associated with recent storm water and storm water solids, soil and concrete sampling, and source area excavation activities at the site are presented on Figures 4 and 5.

Soil, materials, groundwater, and storm water data collected at the site are included in Appendix A.

2.2.1 Investigation Sampling

Previous soil and groundwater investigation sampling locations at the site are shown on Figures 3 through 5. Historical soil analytical results are presented in Appendix A-1 and historical grab groundwater analytical results are presented in Appendix A-2.

Between July and August 2001, thirty eight (38) soil borings (B-1 through B-38 on Figure 3) were drilled in the vicinity of the sawmill building and former green chain to evaluate horizontal and vertical impact to soil and groundwater from historical use of solution containing chlorinated phenols (Environet, 2001). Soil and grab groundwater samples were collected from each boring and analyzed for PCP; grab groundwater samples also were analyzed for 2,3,4,6-TCP; 2,3,5,6-TCP; and 2,3,4,5-TCP. Select soil samples also were analyzed for pH and total organic carbon content; select grab groundwater samples also were analyzed for pH and total dissolved solids.

To refine the extent of impact identified in the 2001 investigation, additional soil and grab groundwater samples were collected and nine monitoring wells were installed and sampled in two 2002 field efforts (Environet, 2002a, 2003). In March 2002, soil and grab groundwater samples were collected from five soil borings (B-39 through B-43 on Figure 3) located north and west of the timber toter building (Feature 12 on Figure 2) and from four soil borings (B-44 through B-47) located in the vicinity of the dry sheds (Feature 15 on Figure 2) and analyzed for chlorinated phenols. In addition, the soil sample collected from boring B-57 was analyzed for CAM-17 metals and the soil samples collected from borings B-57 and B-58 were analyzed for polychlorinated dibenzodioxins (dioxins) and polychlorinated dibenzofurans (furans). Dioxins and furans are impurities associated with the chlorinated phenol formulations used historically for wood surface protection at the site.

Nine shallow groundwater monitoring wells (i.e., wells screened from 2 to 8 feet below ground surface [bgs]) were installed within and downgradient of the former green chain area in March 2002 (Environet, 2002a). Monitoring well locations MW-1 through MW-9 are shown on Figure 3; construction details for monitoring wells are presented in Appendix A-3. Soil samples were collected during installation of each well and analyzed for chlorinated phenols; concrete and asphalt samples also were collected at locations MW-6 and MW-7 and analyzed for chlorinated phenols; these data are presented in Appendix A-4. Groundwater samples were collected from each well following development and analyzed for chlorinated phenols, total organic carbon, chemical oxygen demand, and chloride.

In November 2002, soil and grab groundwater samples were collected from 13 soil borings (B-48 through B-60 on Figure 3) located within or adjacent to the sawmill building; soil and grab groundwater samples were analyzed for chlorinated phenols (Environet, 2003a). Six additional shallow groundwater monitoring wells and four deeper groundwater monitoring wells (i.e., screened from 15 to 20 feet bgs) were installed in the vicinity of the sawmill building in November 2002 (Environet, 2003a). Locations for shallow monitoring wells MW-10 through MW-12, MW-14, MW-17, and MW-18 and deeper monitoring wells MW-13D, MW-14D, MW-16D, and MW-19D are shown on Figure 3; construction details for these wells are presented in Appendix A-3. Soil samples were collected during installation of each well and analyzed for chlorinated phenols. Groundwater samples were collected from each well following development and analyzed for chlorinated phenols.

In April 2003, soil samples were collected from six soil borings (TP-1, TP-1A, TP-2 through TP-5 on Figure 3) completed to between 2.5 and 4.0 feet bgs in the vicinity of the former teepee burner (MFG, 2003d). The former teepee burner (Feature 47 on Figure 2) was used to burn wood waste materials generated at the site. Samples were analyzed for chlorinated phenols, dioxins, and furans; sampling locations are shown on Figure 3.

2.2.2 Source Area Removal Sampling

Between May and November 2003, various sampling activities were undertaken prior to and following source area excavation activities in the location of the former green chain; these activities are detailed in the *Report on Interim Remedial Measures: Source Area Removal* (Geomatrix, 2003b) and summarized in Section 5.0. Sampling conducted as part of the source area removal is discussed below; sampling locations are shown on Figures 4 and 5.

In May 2003, one solids sample (UCW-South Sand), one woody debris sample (UCW-South Wood), and one water sample (UCW-South-Water) were collected from a shallow pit identified under the south end of the former aboveground dip tank at the former green chain (Figure 4). Data for the soil and wood samples are included in Appendix A-1; data for the water sample are included in Appendix A-2. In June and July 2003, fill samples were collected at five locations within and adjacent to the pit (4″ Under 2nd Slab, Pit Bottom, Pit under 2nd Slab, S-1, and S-2); concrete samples C-1 and C-2 also were collected at locations S-1 and S-2, respectively (Figure 4). Data for the fill samples are included in Appendix A-1; data for the concrete samples are included in Appendix A-4. In August 2003, six soil samples and four concrete samples were collected from boring locations B-61 through B-63 located north of the pit near the southern end of the sorter building (Figure 4). Data for the soil samples are included in Appendix A-1; data for the concrete samples are included in Appendix A-4.

In September 2003, following activities to remove soil and concrete underlying the former dip tank at the former green chain, soil samples were collected from 12 sidewall locations (S-1 through S-12) and four bottom locations (B-1 through B-4) from within the excavation (Figure 5). In November 2003, following activities to excavate additional soil from the previous excavation, additional confirmation soil samples were collected from one sidewall location (S-30) and one bottom location (S-31) from within the enlarged excavation; one water sample also was collected from the bottom of the excavation (Figure 5). Data for the confirmation soil samples are included in Appendix A-1; data for the confirmation water sample are included in Appendix A-2.

2.2.3 Groundwater Monitoring

Depth to water has been measured quarterly in all site monitoring wells (MW-1 through MW-19D) and at a monitoring point in the Mad River Slough. Groundwater samples have been collected quarterly from site wells and analyzed for chlorinated phenols and total dissolved solids. In addition, samples collected from monitoring well MW-7 have been analyzed for dioxins, furans, and total metals. Groundwater monitoring data are presented in Appendix A-3.

Several natural attenuation parameters have been measured in site groundwater samples collected in January and October 2003; analytical data are presented in Appendix B.

2.2.4 Storm Water Sampling

Storm water runoff from the site is collected through drop inlets and drainage ditches and directed through drainage ditches and culverts to the Mad River Slough through five outfalls (Outfalls 1 through 5) located along the eastern boundary of the site; outfalls and outfall sampling locations are shown on Figure 2. Historical analytical results for PCP and TCP in storm water samples collected at the site are presented in Appendix A-5.

Storm water observations and storm water quality monitoring have been conducted at the site since 1983 (MFG, 2003c). Mill staff record daily observations regarding rainfall and storm water flow from storm water outfalls at the site; storm water samples are collected periodically from the outfalls. Storm water samples also were collected by the RWQCB between 1986 and 1993.

Ten storm water solids samples were collected in the vicinity of storm water outfalls and drainage ditches for analysis of PCP and TCP in June 2001 (Environet, 2001). At this time, RWQCB personnel also collected three storm water solids samples (0106461-1A, 0106461-2A, 0106461-3A) from storm water Outfalls 1 and 4 and Ditch #4 for analysis of dioxins and furans (Environet, 2001). Sampling locations are shown on Figure 2.

In May 2003, storm water and storm water solids samples were collected from locations near six previous sampling locations (B-14, B-33, B-36, B-37, MW-6, and MW-7) in the vicinity of the former green chain area at which water seeps, ponded storm water, and/or accumulations of entrained solids (mixtures of saw dust, woody debris and sediment) were observed; sampling locations are shown on Figure 4. In August 2003, a solids sample was collected from drainage Ditch #2 and analyzed for PCP and TCP; this drainage ditch is shown on Figure 2.

3.0 SUBSURFACE CONDITIONS

Subsurface conditions at the site, including lithology and the occurrence and movement of groundwater, are presented in this section. Subsurface lithology and hydrogeology at the site were previously investigated and described by Environet (Environet, 2003a).

3.1 LITHOLOGY

The site is located adjacent to the Mad River Slough along the northern shoreline of Humboldt Bay. The eastern, northern, and southern portions of the site were filled in the 1950s and 1960s. Environmental borings have been completed at the site to approximately 20 feet bgs. Observations made during these investigations indicate that shallow subsurface lithology at the site is predominantly fine- to medium-grained sand of apparent sand dune origin. At numerous boring locations (i.e., B-26, B-28, B-29, MW-3, MW-10, MW-15D, MW-16D, and MW-17), finer-grained material (classified on the boring logs as "bay mud") was noted at a depth of approximately 6 to 8 feet bgs. Logs from deeper borings at wells MW-15D and MW-16D show that sand was again encountered below approximately 15 feet bgs. Sand reportedly was encountered from ground surface to total depth during installation of a 140-foot-deep water supply well in the northeast area of the property (Feature 48 on Figure 2) (Environet, 2001). Woody materials and fill were noted in the logs for borings B-41 and B-47 and monitoring wells MW-13D and MW-15D.

3.2 OCCURRENCE AND MOVEMENT OF GROUNDWATER

Measured depth to groundwater in nineteen groundwater monitoring wells installed at the site generally ranges between approximately 0.5 and 5 feet bgs in the shallow wells (i.e., screened from 2 to 8 feet bgs) and between approximately 4 and 6 feet bgs in the deeper wells (i.e., screened from 15 to 20 feet bgs). In the eastern portion of the site, groundwater flow generally is to the east, toward the Mad River Slough (MFG and Geomatrix, 2003). In the southwestern portion of the site, groundwater flow is likely generally to the south-southeast, toward Humboldt Bay (MFG and Geomatrix, 2003). Tidal fluctuations in the Mad River Slough and nearby Humboldt Bay influence groundwater levels at the site in the vicinity of the bay shore. A 2002 tidal influence study conducted at the site by Environet suggested that tidal effects become negligible at distances greater than 100 feet from the bay shore (Environet, 2003a).

Depth to groundwater measurements in shallow monitoring wells at the site (i.e., screened from 2 to 8 feet bgs) suggest that the lateral hydraulic gradient for shallow groundwater is generally easterly near the sorter building with a magnitude of approximately 0.005 to 0.007 foot/foot and northeasterly in the sawmill area with a magnitude of approximately 0.02 to 0.03 foot/foot.

A groundwater depression exists northeast of the sawmill building in the vicinity of monitoring well MW-2. Depth to groundwater measurements in deeper monitoring wells (i.e., screened from 15 to 20 feet bgs) suggest that the lateral hydraulic gradient for deeper groundwater at the site is generally easterly with a magnitude of approximately 0.003 to 0.008 foot/foot.

4.0 NATURE AND EXTENT OF WOOD SURFACE PROTECTION CHEMICALS

The occurrence of wood surface protection chemicals in soil, groundwater, and storm water at the site has been assessed through numerous investigations (see Section 2.2). The results of these investigations are presented in tabular form in Appendix A and summarized below.

4.1 CHEMICALS OF CONCERN

Based on the results of previous investigations, the chemicals of concern at the site for this feasibility study are the chlorinated phenols PCP and TCP and the dioxins and furans that were impurities associated with the chlorinated phenol chemical formulations historically used for wood surface protection at the site.

4.1.1 Physical and Chemical Properties

The physical and chemical properties of PCP, TCP, dioxins, and furans are similar and provide useful information for determining the fate and transport of these compounds at the site (Table 1). Chlorinated phenols, dioxins, and furans have very low vapor pressures and water solubilities. Conversely, these compounds are highly soluble in fatty substances (lipophilic) and have high octanol-water partition and soil adsorption coefficients. As a result, these compounds are likely to be present only at trace concentrations in the atmosphere or dissolved in water.

4.1.2 Fate and Transport

Based on their physical and chemical properties, PCP, TCP, dioxins, and furans tend to bind to organic materials and particulate matter. Consequently, these compounds exhibit limited partitioning to water that contacts impacted soil, sediments, or woody material, and thus exhibit limited mobility as aqueous constituents in the subsurface. These compounds can, however, be mobilized by surface water and groundwater flow while bound to entrained sediments and particulate matter.

4.1.3 Baseline Human Health Risk Assessment

A Baseline Human Health Risk Assessment was conducted to evaluate potential health risks for on-site and off-site human receptors to concentrations of chemicals of concern detected in soil and groundwater at the site (Geomatrix, 2003a). Currently, there are no exposures for on-site workers or off-site residents in areas where chemicals of concern have been detected. The areas of affected soil are paved, preventing direct contact. Groundwater has not migrated beyond the former green chain for use as a potential drinking water source, and on-grade buildings are not located over areas with volatile organic compounds in soil or groundwater.

Future potential exposures to chemicals in soil and groundwater were quantitatively evaluated for the following receptors: an indoor industrial worker, an outdoor industrial worker, a construction worker, a trench/utility worker, and an off-site resident. Data available in published reports were included in the evaluation (Environet, 2003a and MFG, 2003a, 2003b, 2003d, and 2003e). The estimated cancer risks and hazard indexes based on potential exposure to chemicals in soil and groundwater were as follows:

- For the outdoor industrial worker, the carcinogenic risk was at $1x10^{-5}$, and the noncarcinogenic hazard index was less than 1.
- For the indoor industrial worker, the carcinogenic risk was not quantified because no volatile carcinogenic chemicals were detected in soil or groundwater. The noncarcinogenic hazard index was less than 1.
- For the construction worker, the potential carcinogenic risk was less than $1x10^{-4}$, and the noncarcinogenic hazard index was 1.
- For the trench/utility worker, the potential carcinogenic risk was greater than $1x10^{-4}$ ($3x10^{-4}$), and the noncarcinogenic hazard index was 1.
- For the off-site resident, the potential carcinogenic risk was less than $1x10^{-6}$, and the noncarcinogenic hazard index was significantly less than 1.

Potential dermal exposure to PCP in groundwater accounted for over 95 percent of the carcinogenic risk and noncarcinogenic hazard index for the construction and trench/utility workers. It should be noted that exposure to PCP in groundwater via dermal contact may be overestimated based on the assumed permeability of PCP through the skin as acknowledged in U.S. Environmental Protection Agency's (U.S. EPA) dermal exposure guidance (U.S. EPA, 2001).

In conjunction with the Baseline Human Health Risk Assessment, risk-based remediation goals were developed for the chemicals of concern at the site using the generally accepted risk range of $1x10^{-4}$ to $1x10^{-6}$ and a hazard index of one. These values may be used to evaluate concentrations of chemical of concern detected in site soil and groundwater during future phases of investigation and remediation.

4.2 SOIL

The distribution of PCP in soil samples collected from soil borings B-1 through B-63, TP-1, TP-1A, TP-2 through TP-5, and monitoring well locations MW-1 through MW-19D is presented on Figure 6. The results of soil sampling programs completed at the site suggest that PCP impact to soil is limited to shallow soil (i.e., the upper 3 feet) beneath and adjacent to the east end of the sorter building, in the vicinity of the former green chain (Environet, 2001, 2002a, 2003; Geomatrix, 2003b). PCP was detected in soil samples collected at 19 of 88 borings advanced at the site at concentrations ranging from 1 milligram per kilogram (mg/kg) to 71 mg/kg; detected concentrations were greater than 5 mg/kg in samples collected at only eight of these locations. Chlorinated phenols were not detected in soil samples collected from 69 borings advanced at the site, including the six boring locations near the former teepee burner. Soil samples from these borings containing the highest reported PCP concentrations generally were collected between 2 and 3 feet bgs from borings located immediately northeast of the former green chain, beneath the current sorter building (i.e., 71 mg/kg at B-3; 20 mg/kg at B-4; 59 mg/kg at B-38; and 21 mg/kg at B-62). Trichlorophenol and TCP were not detected above laboratory reporting limits in samples collected at any of the 88 borings advanced at the site. Chlorinated phenols were not detected above laboratory reporting limits in the asphalt and concrete samples collected at location MW-6 or in the concrete sample collected at MW-7.

Soil samples collected at boring locations B-57, B-58, and B-61 through B-63 (located beneath and adjacent to the eastern end of the sorter building) and TP-1 and TP-1A (located near the former teepee burner) were analyzed for dioxins and furans (Environet, 2003a; MFG, 2003d). Sampling locations are shown on Figure 3. Samples were collected between 1 and 5 feet bgs; dioxins and furans were detected in samples collected at all seven locations. Concentrations of dioxins/furans, which refers to a complex mixture of various dioxin/furan congeners, are generally summarized in terms of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) based on toxic equivalency factors adopted by the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (Cal-EPA, 2003). The toxic equivalency (TEQ) calculated from the results of soil samples collected at these boring locations ranged from 0.5 to 3,809 picograms per gram (pg/g); the percentage of toxic equivalency contributed by 2,3,7,8-TCDD ranged from 0 to 6.4 percent.

During recent sampling activities associated with identification of a shallow pit under the south end of the former aboveground dip tank at the former green chain (Figure 4), PCP was detected in samples of soil and wood collected from the pit and in samples of concrete collected in the vicinity of the pit (Geomatrix, 2003b). PCP concentrations were less than 15 mg/kg in all samples except the soil sample collected from the pit bottom (380 mg/kg) and the wood sample collected from the pit (4,600 mg/kg); TCP also was detected in these two samples. Dioxins and furans also were detected in samples of soil and wood collected from the pit and in samples of concrete collected in the vicinity of the pit. The dioxin/furan toxic equivalency calculated from the results of the pit samples ranged from 112 to 1,940,000 pg/g; the percentage of toxic equivalency contributed by 2,3,7,8-TCDD ranged from 0 to 1.3 percent.

As discussed in the *Report on Interim Remedial Measures: Source Area Removal* (Geomatrix, 2003b) and summarized in Section 5.0, material within the shallow pit recently was removed and excavation was completed in the vicinity of and north of the shallow pit; the extent of the excavation is shown on Figures 4 and 5. Confirmation samples were collected from the sidewalls and bottom of the excavation following completion of excavation activities. PCP concentrations in final confirmation soil samples ranged from non-detect to 33 mg/kg; TCP concentrations in confirmation soil samples ranged from non-detect to 18 mg/kg. The dioxin/furan toxic equivalency calculated for the confirmation soil samples ranged from 173 to 4,564 pg/g; the percentage of toxic equivalency contributed by 2,3,7,8-TCDD ranged from 0 to 3.5 percent.

4.3 GROUNDWATER

Grab groundwater and groundwater monitoring data collected at the site are discussed below.

4.3.1 Grab Groundwater Sample Results

Prior to installation of monitoring wells at the site, grab groundwater samples were collected at boring locations B-1 through B-60 (Figure 3) and analyzed for chlorinated phenols; pH and total dissolved solids concentrations also were measured for selected samples (Environet, 2001, 2002a, and 2003). Samples were not analyzed for dioxins or furans. Chlorinated phenol concentrations reported for grab groundwater samples collected from borings B-1 through B-60 are presented in Appendix A-2; PCP concentrations reported in these grab groundwater samples ranged from non-detect to 100,000 micrograms per liter (μg/L).

Grab groundwater sampling generally provides a screening assessment of groundwater impact, and is typically followed by monitoring well installation and sampling for assessing the actual magnitude of impact. Chlorinated phenol concentrations reported for grab groundwater samples collected at the site are not likely representative of dissolved concentrations in site groundwater due to the presence of high levels of suspended solids in the grab samples. As discussed in Section 4.1.1, these compounds preferentially bind to sediments under the pH conditions existing at the site. As a result, entrainment of particulate matter in unfiltered grab samples likely resulted in artificially high concentrations being reported for the grab samples. The pH of grab groundwater samples collected between July and August 2001 ranged from 6.1 to 7.5; the average pH in grab groundwater samples collected within and immediately downgradient of the former green chain area was 6.3.

4.3.2 Monitoring Well Sample Results

Following installation of a monitoring well network at the site in 2002, groundwater samples have been collected quarterly from site monitoring wells MW-1 through MW-19D (Figure 3) and analyzed for chlorinated phenols and, recently, total dissolved solids (MFG and Geomatrix, 2003). In addition, samples collected from monitoring well MW-7 have been analyzed for dioxins, furans, and total metals.

The distribution of PCP in groundwater samples collected from site monitoring wells is presented on Figure 7. These results of groundwater sampling activities indicate that shallow groundwater (i.e., water table to approximately 8 feet bgs) at the site is impacted by chlorinated phenols in the vicinity of the former dip tank at the former green chain and downgradient to the vicinity of well MW-7, located northeast of the former green chain.

Tetrachlorophenols (including 2,4,6-TCP; 2,3,5,6-TCP; 2,3,4,6-TCP; and 2,3,4,5-TCP) and trichlorophenols (including 2,3,4-trichlorophenol; 2,3,5-trichlorophenol; and 2,4,6-trichlorophenol) historically have been detected in groundwater samples collected from wells MW-7 and MW-9. TCP and trichlorophenols have not been detected in samples collected from well MW-9 since March 2002. Trichlorophenols have not been detected in samples collected from well MW-7 since January 2003. TCP concentrations in samples collected from well MW-7 either decreased or remained consistent with historical results between January and November 2003 (Appendix A-3); the total TCP concentration in the sample collected from well MW-7 in November 2003 was 651 μg/L. These results indicate that TCP impact to groundwater at the site is limited to shallow groundwater in the vicinity of the former dip tank at the former green chain and downgradient to the vicinity of well MW-7; this is consistent with the distribution of PCP in site groundwater.

Dioxins and furans have been detected in groundwater samples collected from well MW-7; the dioxin/furan toxic equivalency calculated from the sample results have ranged from 0.004 to 2.7 picograms per liter (pg/L). These dioxin/furan toxic equivalencies have consistently been below the water quality objective for 2,3,7,8-TCDD toxic equivalency of 30 pg/L established in Cleanup and Abatement Order R1-2003-0127.

4.3.3 Pit and Excavation Water Sample Results

During recent sampling activities associated with identification of a shallow pit under the south end of the former aboveground dip tank at the former green chain (Figure 4), a grab sample of water that had collected in the pit was collected (Geomatrix, 2003b). PCP was detected in the sample at a concentration of 11,000 µg/L and total tetrachlorophenols were detected at a concentration of 1,169 µg/L. Material was excavated from the pit in June 2003 and from a wider area in the vicinity of the pit in September and November 2003; the extent of these excavations are shown on Figures 4 and 5. Following completion of these excavation activities, a grab sample of water that had collected in the excavation was collected; PCP was detected at a concentration of 35,000 µg/L; total tetrachlorophenols were detected at a concentration of 18,052 µg/L; and 2,4,6-trichlorophenol was detected at concentration of 19 µg/L. As discussed in Section 4.3.1, chlorinated phenol concentrations reported for these grab water samples likely are not representative of dissolved concentrations in site groundwater due to the presence of high levels of suspended solids in the samples.

4.4 STORM WATER

Historically, PCP and TCP have been detected periodically in storm water runoff samples collected at Outfalls 1 through 4 (MFG, 2003c). In 1987, the area of the site where anti-stain solution containing chlorinated phenols was used was capped with concrete at the direction of the RWQCB. Some storm water samples collected from 1988 through 2000 continued to have detections of TCP and PCP, generally at low concentrations (i.e., less than 20 µg/L). Additional interim remedial measures were implemented at the site at the end of 1999 (as discussed in Section 5.0). Since completion of the additional interim remedial measures, PCP has been detected at concentrations between 1.2 µg/L and 2.4 µg/L only in storm water samples collected from monitoring point SL-2 (Outfall 2), and TCP has not been detected in any storm water samples above the laboratory reporting limit of 1.0 µg/L. Analytical data for storm water runoff samples are presented in Appendix A-5.

In June 2001, ten storm water solids samples were collected in the vicinity of storm water outfalls and drainage ditches for analysis for PCP and TCP (Environet, 2001); the outfalls and drainage ditches are shown on Figure 2. TCP and PCP were not detected in any of the solids samples. Dioxins and furans were detected in sediment samples collected from storm water Outfalls 1 and 4, and Ditch #4 in 2001 (Environet, 2003a). Sampling locations are shown on

Figure 2. The dioxin/furan toxic equivalency calculated from the sample results ranged from 1.01 to 23.7 pg/g; the percentage of toxic equivalency contributed by 2,3,7,8-TCDD ranged from 0 to 4 percent.

In May 2003, samples of pooled storm water and storm water solids were collected near six previous sampling locations (B-14, B-33, B-36, B-37, MW-6, and MW-7) in the former green chain area (Geomatrix, 2003b). Sampling locations are shown on Figure 4. Chlorinated phenols were detected in the solids sample (SS-Near B-37 Sediment) collected from the puddle of water seeping out of the elevated concrete pad for the former green chain (PCP concentration of 94 mg/kg; total TCP concentration of 12.3 mg/kg); chlorinated phenols were not detected above laboratory detection limits in the other storm water solids samples. Elevated concentrations of chlorinated phenols also were reported for the sample (SS-Near B-37 Water) of water seeping out of the elevated concrete pad for the former green chain (PCP concentration of 33,000 μg/L; total TCP concentration 8,010 μg/L; 2,4,6-trichlorophenol concentration of 2.0 μg/L). PCP concentrations in the other five pooled storm water samples collected were less than 30 μg/L, and TCP concentrations were less than 10 μg/L; 2,4,6-trichlorophenol was not detected in any of the other five water samples.

In August 2003, a storm water sample was collected from drainage Ditch #2 (Figure 2). PCP and TCP were not detected in the sample; the sample was not analyzed for dioxins and furans.

5.0 INTERIM REMEDIAL MEASURES

Historically, some storm water runoff from the site appears to have been impacted by chlorinated phenols and dioxins/furans (see Appendix A-5). As discussed in Section 4.1, these compounds bind tightly to soil and other particulate matter. Between 1983 and 1999, various Best Management Practices were initiated to prevent the impairment of storm water at the site (MFG, 2003a). These Best Management Practices included removal of the dip tank from the former green chain area, clean out and concrete capping of the former green chain drip basin, and reducing materials to which chlorinated phenols tend to adsorb, such as woody debris and particulate matter, from storm water discharges. Measures to reduce woody debris and particulate matter from discharges have included reducing woody debris across the site and regular cleaning of exposed storm water drainage ditches.

Between 2000 and 2003, additional remedial measures were implemented at the site to further reduce woody debris and particulate matter from storm water discharges, minimize commingling of groundwater and storm water, and improve the drainage system (MFG, 2003a). Wood debris was cleaned and removed from the entire mill site, and screens, rock-filled bags, hay bales, and waddles were placed at storm water inlets to intercept woody debris and particulate matter prior to discharge. Improvements to the drainage system included repair, lining, and replacement of degraded culverts, conversion of an open ditch to a culvert, and installation of settling basins to allow suspended sediments to settle out of the storm water prior to discharge. Leaks in water and condensate lines at the site also were repaired to reduce non-storm water inputs to the drainage system.

In April and May 2003, during surface cleaning activities to reduce woody debris and particulate sources to storm water at the site, SPI staff performed extensive surface cleaning in the area of the former green chain (Geomatrix, 2003b). During this surface cleaning, mill staff swept away a thin concrete veneer that covered wood planking located in the area of the southern catwalk along the former green chain. The wood planking was removed by SPI staff and was found to cover a shallow pit containing woody debris, sand, and water (Figure 4). The pit appears to have been located under the south end of the former aboveground dip tank. The concrete base of the former green chain is elevated above the surrounding ground surface, allowing storm water that percolates through the concrete surface in the vicinity of the former dip tank to subsequently seep out onto the ground surface.

In June 2003, an initial excavation (First Phase) of woody debris was conducted to remove material with elevated chlorinated phenol, dioxin, and furan concentrations from the pit. Based on results of additional sampling conducted between June and August 2003, an additional phase of excavation (Second Phase) was conducted in September 2003 (Geomatrix, 2003b). The objective of this source area excavation was to remove soil, concrete, and woody material impacted by elevated concentrations of chlorinated phenols, dioxins, and furans that were serving as a contaminant source to groundwater and storm water at the site.

As shown on Figure 5, the Second Phase excavation area measured approximately 20 feet by 29 feet, extended across the entire width of the elevated concrete pad for the former green chain, and was approximately centered on the former dip tank location. The excavation extended to a depth of approximately 4 feet below the adjacent grade to the north and south (approximately 5 feet below the top of the elevated concrete slab for the former green chain), except at the southeast corner, which was deepened to approximately 7 feet below the adjacent grade to create a dewatering sump. Material removed from the excavation included sand, two layers of concrete, and materials associated with a rail spur formerly located below the green chain (rails and railroad ties). Approximately 80 percent of the material excavated was observed to be moderately stained greenish gray at the time of excavation, and moderate staining was observed in the final north, south, and west excavation sidewalls and in the base of the excavation. The total volume of soil and other material removed was approximately 130 cubic yards. Groundwater was encountered at a depth of approximately 2 feet below the adjacent grade to the north and south. Approximately 1750 gallons of groundwater were pumped from the excavation to facilitate the work.

Confirmation soil sampling was performed following completion of the Second Phase excavation work. Confirmation soil sample locations are presented on Figure 5; soil analytical results are included in Appendix A-1. Elevated concentrations of PCP were reported in Second Phase confirmation samples collected from two areas of the excavation, sample S-6N-1.5' collected from the north face of the excavation and sample B-4-West collected from the bottom of the excavation. Based on these results, a Third Phase of excavation was conducted in November 2003. Additional material was excavated approximately 1 foot to the north of sampling location S-6N-1.5 and an additional 1.5 feet of material was removed from the bottom of the northern half of the excavation in the vicinity of sampling location B-4-West. The final excavation area measured approximately 20 feet by 30 feet; total depth of the excavation ranged from 4 to 5.5 feet below the adjacent grade. Post-excavation confirmation samples were collected for PCP and TCP analyses from each area where additional material was excavated (samples S-30-1.5' and S-31-5.5'); PCP was not detected above the laboratory reporting limit in either of the post-excavation confirmation samples. A grab sample of groundwater from the excavation also was collected and analyzed for chlorinated phenols; PCP was detected in the sample at a concentration of 35,000 μg/L; total tetrachlorophenols were detected at a concentration of 18,052 μg/L; and 2,4,6-trichlorophenol was detected at concentration of 19 μg/L.

Confirmation samples collected during the Third Phase were not analyzed for dioxins and furans. However, as noted in Section 4.3, the chemical analysis results for groundwater samples collected from monitoring well MW-7 have consistently been below the groundwater quality objectives for dioxins and furans. Consequently, residual dioxin and furan concentrations in soil in the vicinity of the former green chain do not appear to represent a continuing threat to groundwater quality.

6.0 REMEDIAL ACTION OBJECTIVES

The remedial goals for the site are to comply with appropriate RWQCB requirements to protect human health and the environment and implement a final remedy that does not have a detrimental impact on the surrounding community and Mad River Slough. To accomplish this goal, a preferred remedial alternative will be recommended for implementation at the site based on a screening of appropriate remedial technologies and a detailed evaluation of remedial action alternatives.

The remedial action objectives for the site are to: (1) reduce the potential for off-site migration of chemicals of concern in groundwater to adjacent surface water; (2) reduce the potential for off-site migration of chemicals of concern in storm water to adjacent surface water; (3) reduce mass of chemicals of concern in soil; and (4) reduce mass of chemicals of concern in groundwater.

7.0 SCREENING OF REMEDIAL TECHNOLOGIES

This section identifies and screens remedial technologies considered for implementation at the site. The objective of this section is to develop an appropriate range of remedial technologies that will be combined into a group of potential remedial action alternatives. A detailed evaluation will be performed on these remedial action alternatives (Section 8.0), and a preferred alternative will be recommended for implementation at the site (Section 9.0).

7.1 SCREENING CRITERIA

The remedial technologies initially were identified based on their (1) technical applicability[1] at the site, and (2) demonstrated effectiveness at other sites with similar site conditions. After assessing those technologies with the greatest potential to reduce chemicals of concern in soil, groundwater, and storm water at the site, a list of potentially applicable remedial technologies was developed and is presented in Table 2. Each of these remedial technologies was then evaluated based on the following two screening criteria:

- Remedial Action Objectives: Capability of the remedial technology to meet the remedial action objectives established in Section 6.0; and
- Site Conditions: Applicability of the remedial technology to conditions at the site. Site-specific factors that affect implementation and success of remedial action alternatives include lithologic conditions, depth to groundwater, proximity to surface water, types and chemical properties of the chemicals of concern present, impacted media, operational status of the site (active sawmill), and potential impacts to adjacent communities as a result of remedial activities.

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[1] Technical applicability is defined as the ability of the technology to mitigate the types and concentrations of chemicals of concern at a subject site.

The results of the remedial technologies screening are summarized in Table 2. Technologies that did not meet the first criterion of technical applicability are not included in the tables, and were excluded from further evaluation in the screening process. Only those technologies that met both screening criteria[2] were included in the detailed evaluation of remedial action alternatives.

7.2 SITE MANAGEMENT PLAN

All of the remedial action alternatives evaluated for the site, except the No Action alternative, include a Site Management Plan. The Site Management Plan would include a variety of controls designed to prevent current and future property owners and operators from taking actions that would expose workers or other potential receptors to unacceptable risk, interfere with the effectiveness of the final remedy, convert the site to an end-use that is not consistent with the level of remediation, and/or allow chemicals of concern from impacted site media to migrate off-site and impact surrounding surface water.

The Site Management Plan may include, but is not limited to, the following:

- Controls[3] on construction activities that may be detrimental to the final remedy implemented at the site,
- Controls[3] on certain end uses of the site that may be incompatible with the level of cleanup associated with the final remedy, and
- Informational tools[4] to inform current and future owners of the presence of the environmental conditions at the site.

7.3 SOIL

The following sections provide a description of the remedial technologies considered for the treatment of soil. Each technology is evaluated based on the screening criteria established in Section 7.1.

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[2] Remedial technologies that satisfy at least one of the four components of the remedial action objectives and are applicable to site conditions meet both screening criteria.

[3] Proprietary controls may include deed restrictions, covenants, and easements. Deed restrictions prohibit a person from disturbing residual contamination at an impacted site, but are typically non-enforceable. Covenants are written contracts that can prohibit specific types of development or construction activities at a site. Easements grant access or restrict site owners to uses that are compatible with the final remedy at the site.

[4] Informational tools provide information about residual contamination or a remedy that has been conducted at the site. Examples include state registries of contaminated properties, deed notices, and advisories. Informational tools are used most frequently as a secondary measure to help ensure the overall reliability of other controls.

7.3.1 Source Removal through Excavation

This technology involves the identification and physical removal of soil and woody material impacted with elevated concentrations of chemicals of concern. This option includes excavation with standard construction equipment. Depending on site-specific considerations, excavated soil can be stockpiled for further handling or off-hauled to an appropriate off-site recycling or disposal facility. Excavation sidewall and bottom confirmation sampling is conducted to document site conditions following excavation.

As discussed in Section 5.0, excavation was conducted in the former green chain area as part of the interim remedial measures approved by the RWQCB and as described in the *Report on Interim Remedial Measures: Source Area Removal*, dated December 1, 2003 (Geomatrix, 2003). During the excavation, a concrete slab covering the green chain area was removed and soil and woody material was excavated in an approximately 20 feet by 30 feet area to a depth of approximately 4 feet below surrounding grade (5 feet below the top of the elevated green chain slab) in the south of the excavation, and 5.5 feet below surrounding grade in the north of the excavation. The area of excavation is shown on Figure 5.

The excavation removed mass of chemicals of concern from the area containing elevated concentrations of wood surface protection chemicals. The soil and woody material in this area served as a source of chemicals of concern in groundwater, overland flow (storm water), and ultimately, surface water. Therefore, source area excavation meets the technology screening criteria and is included in the evaluation of remedial action alternatives.

7.3.2 In-Situ Chemical Oxidation

In situ chemical oxidation refers to the injection or placement of a chemically reactive compound into the subsurface to directly degrade or destroy target constituents. This remedial technology converts organic compounds into innocuous materials, such as carbon dioxide, chloride, and water. Typical oxidants include hydrogen peroxide (with or without iron sulfate to promote Fenton's reagent chemistry), sodium or potassium permanganate, and ozone. The reactive treatment compounds may be liquid, gas, or solid particles. Both conventional well injection techniques and innovative emplacement technologies have been used to inject chemical treatment agents into the subsurface. However, in situ chemical oxidation is not routinely used to treat soil because delivery of the oxidants would require surface flooding or very closely spaced injection points.

Chemical oxidation can be an effective method for the treatment of chemicals of concern in soil at the site. However, this technology poses safety concerns, may produce air emissions due to exothermic reactions with chlorinated phenols in the subsurface and is highly dependent on pH control. Additionally, an effective oxidant delivery system for soil in the vadose zone would be difficult to install due to shallow groundwater at the site. The use of in-situ chemical oxidation in soil does not meet the technology screening criteria and is therefore excluded from the evaluation of remedial action alternatives.

7.3.3 In-Situ Bioremediation

In-situ bioremediation occurs when microorganisms degrade organic contaminants found in the soil to carbon dioxide, water, and microbial cell mass. Under appropriate conditions, biodegradation of chlorinated phenols can occur relatively rapidly, while the biodegradation rate for dioxins and furans is expected to be slower. Microorganisms will preferentially degrade chlorinated phenols and potentially other carbon sources, and then seek dioxins and furans a as secondary food source once the primary compounds are degraded to a certain concentration. The activity of the microorganisms is stimulated by delivering nutrient or other solutions through impacted soil to enhance biological degradation of the chemicals of concern in the subsurface. Both conventional and innovative injection methods can be used to deliver necessary bioremediation solutions into the subsurface. However, in-situ bioremediation is not routinely used to treat soil because delivery of nutrients or other solutions would require surface flooding or very closely spaced injection points, and multiple injections.

Although in-situ bioremediation is a potentially effective method for the treatment of chemicals of concern in soil, it cannot practically be implemented at the site because an effective delivery system for the vadose zone would be difficult to install due to shallow groundwater. The use of in-situ bioremediation does not meet both screening criteria and is therefore excluded from the evaluation of remedial action alternatives.

7.4 GROUNDWATER

The following sections provide a description of the remedial technologies considered for the treatment of groundwater. Each technology is evaluated based on the screening criteria established in Section 7.1.

7.4.1 Monitored Natural Attenuation

Natural attenuation processes promote the in situ reduction in concentration and mass of target chemicals in groundwater, without the intervention of human-based enhancements or mechanical methods (e.g., injection of treatment materials, groundwater extraction and treatment, etc.). The natural processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical transformation of chemicals. The ability of these processes to successfully reduce the concentration and mass of the target chemicals within an accepted time period and over an acceptable area forms the basis of a monitored natural attenuation strategy. The biological natural attenuation processes are similar to those described for in-situ bioremediation in Section 7.3.3.

A natural attenuation strategy, if appropriately implemented, is a potentially effective method for the treatment of groundwater to meet the remedial action objectives. See Appendix B for more details regarding biological natural attenuation processes, chemical parameters used to evaluate whether natural attenuation is occurring, and an assessment of the dominant natural attenuation processes at the site. Natural attenuation meets the technology screening criteria and is included in the evaluation of remedial action alternatives.

7.4.2 In-situ Chemical Oxidation

As discussed in Section 7.3.2, the use of in-situ chemical oxidation may be a potentially effective method for the treatment of chemicals of concern of the site. Unlike the treatment of soil in the vadose zone, an effective groundwater delivery system, such as injection points, can be installed at the site. In addition, effective measures can be implemented to address safety concerns, pH control, and air emissions from exothermic reactions with chemicals of concern when in situ chemical oxidation is implemented in groundwater. In-situ chemical oxidation for the treatment of groundwater meets the screening criteria and is included in the evaluation of remedial action alternatives.

7.4.3 In-situ Bioremediation

As discussed in Section 7.3.3, in-situ bioremediation is a potentially effective method for the treatment of chemicals of concern at the site. Unlike the treatment of soil in the vadose zone, an effective groundwater treatment delivery system, such as widely spaced injection points, can be installed at the site. The use of in-situ bioremediation for the treatment of groundwater meets the screening criteria and is included in the evaluation of remedial action alternatives.

7.4.4 Groundwater Extraction and Treatment

Groundwater extraction involves the removal of groundwater from the subsurface using either extraction wells or trenches. Extracted groundwater is then conveyed to an above-ground facility for ex-situ treatment. Treatment methods involve the removal, chemical alteration, or destruction of constituents in groundwater via chemical, physical, or biological processes. Treated water is subsequently discharged to a storm drain under the National Pollutant Discharge Elimination System Permitting Program, or to a Publicly-Owned Treatment Works in accordance with applicable state or local permitting requirements, or is re-injected into the subsurface. This technology is an effective method to provide hydraulic control of impacted groundwater and, in some circumstances, can be effective at removing mass of target chemicals from groundwater.

Groundwater extraction and treatment will not be effective at the site because of the physical and chemical properties of the chemicals of concern. Because chlorinated phenols and dioxins and furans preferentially sorb to solids, we would expect only trace concentrations of the chemicals of concern to be present in extracted groundwater. In addition, the desorbtion of chemicals of concern to the dissolved phase would be very slow. As a result, this technology would not effectively remove mass of chemicals of concern in groundwater. Additionally, the plume of impacted groundwater underlying the former green chain area appears to be stable and not impacting the downgradient surface water. Consequently, hydraulic control is not needed at the site. For these reasons, groundwater extraction and treatment is not applicable to site conditions. Since groundwater extraction and treatment does not meet the screening criteria, it is excluded from the evaluation of remedial action alternatives.

7.5 STORM WATER

The following sections provide a description of the remedial technology considered for the management of storm water. Site Best Management Practices is evaluated based on the screening criteria established in Section 7.1.

7.5.1 Site Best Management Practices

Historically, some storm water runoff from the site appears to have been impacted by chemicals of concern. As discussed in Section 4.1, these compounds bind tightly to soil and other particulate matter. As part of the Interim Remedial Measures implemented at the site (Section 5.0), various best-management practices were initiated to prevent the impairment of storm water. These Best Management Practices include improvements to the drainage system and excavation of soil and woody material containing elevated concentrations of chemicals of concern from the source area below the former dip tank at the former green chain.

7.5.1.1 Drainage System Improvements

Improvements to the drainage system included replacement of degraded culverts and installation of settling basins to allow suspended sediments to settle out of the storm water.

In addition, numerous other Best Management Practices, including regular surface cleaning and use of various sediment control devices, have been implemented at the site. These improvements reduce the potential for chemicals of concern at the site to enter storm water and, consequently, surface water. The use of these Best Management Practices meets the screening criteria and is included in the evaluation of remedial action alternatives.

7.5.1.2 Source Removal Through Excavation

Removal of impacted soil and woody material from the source area below the former dip tank at the former green chain is also an effective Best Management Practice to control discharges of chemicals of concern into surface water, as storm water exposure to soil with the highest concentrations of chemicals of concern is reduced significantly. As described in Section 5.0, the concrete base of the former green chain is elevated above the surrounding ground surface. Some of the storm water that percolated through the concrete surface in the vicinity of the former dip tank came into contact with soil and woody material with elevated concentrations of chemicals of concern and subsequently seeped out onto the ground surface. That water contained elevated concentrations of chemicals of concern and was subsequently commingled with storm water runoff from the site.

Source removal has been implemented as part of the Interim Remedial Measures discussed in Section 5.0. Source removal meets the screening criteria and is included in the evaluation of remedial action alternatives.

8.0 EVALUATION OF REMEDIAL ACTION ALTERNATIVES

The remedial technologies considered appropriate for the site following the technology screening were combined to form remedial action alternatives and evaluated in greater detail. The criteria used for the remedial action alternatives evaluation were developed to facilitate the selection of a preferred remedial action alternative.

8.1 EVALUATION CRITERIA

The remedial action alternatives evaluation was based on the following criteria:

- <u>Effectiveness</u>: Ability of the remedial action alternative to meet the remedial action objectives, protect human health and the environment, comply with regulatory requirements, be effective in the long and short term, and reduce toxicity and mobility of chemicals of concern at the site.
- <u>Implementability</u>: Technical and administrative feasibility, including the availability of the selected technologies; the availability of materials, equipment, and labor necessary to implement the technologies; level of disruption to sawmill operations;

regulatory requirements and permitting considerations; community acceptance; the potential effects on human health during construction and implementation; and the relative capital and operations and maintenance costs.

Descriptions and detailed evaluations of the remedial action alternatives developed are presented below (Sections 8.2 through 8.5). The evaluation of remedial action alternatives is summarized in Table 3.

The preferred remedial alternative is recommended for implementation at the site based on the evaluation of remedial action alternatives.

8.2 ALTERNATIVE A: NO ACTION

This alternative requires no remedial action. The current groundwater monitoring program would continue.

8.2.1 Detailed Evaluation

There are no capital costs to implement this alternative. The total cost of this alternative is approximately $45,000 per year for the ongoing groundwater monitoring. .

SPI has previously determined that the "No Action" alternative does not meet the evaluation criteria. Consequently, numerous Interim Remedial Measures, including source area excavation, have been implemented as described in Section 5.0. Although Alternative A does not meet all criteria for effectiveness and implementability, it is retained for comparison with other alternatives.

8.3 ALTERNATIVE B: SOURCE REMOVAL AND MONITORED NATURAL ATTENUATION

This alternative includes excavation of soil containing elevated concentrations chemicals of concern from below the former dip tank at the former green chain, and monitoring of groundwater in and around the PCP groundwater plume to demonstrate that attenuation of contaminants is naturally occurring. This alternative is shown on Figure 8.

The Interim Remedial Measures described in Section 5.0, including source area excavation and implementation of storm water Best Management Practices, will contribute to reducing the mass and mobility of chemicals of concern. A Site Management Plan would be developed that implements controls to minimize risks associated with residual chemicals of concern in site media and regulates activities that could interfere with the effectiveness of the remedy or cause migration of chemicals of concern. Groundwater monitoring would continue, but the scope of the monitoring program would be modified to include monitoring of natural attenuation parameters, as described below.

As described in Appendix B, measurement of geochemical parameters in groundwater shows that reducing, anoxic, and methanogenic conditions exist in shallow groundwater at the site, and that all conditions typically necessary for the destruction of PCP through reductive dechlorination are present. The groundwater monitoring program would be modified to include sampling of selected wells (likely wells MW-2, MW-3, MW-5 and MW-7) and analyzing the samples for natural attenuation parameters (including Eh, dissolved oxygen, nitrate, manganese(II), iron(II), sulfate, carbon dioxide, methane, total organic carbon, chloride, alkalinity, calcium, magnesium, pH, specific conductance and temperature). In addition, groundwater samples from well MW-7 and possibly other selected wells would be analyzed for breakdown products of PCP, including tetrachlorophenol, trichlorophenol, dichlorophenol, and chlorophenol. Analytical results would be evaluated to demonstrate that reducing, anoxic, and methanogenic conditions continue to be present at the site, and that concentrations of PCP and its breakdown products are generally stable or reducing.

8.3.1 Detailed Evaluation

Capital costs associated with this alternative include approximately $396,000 for the Interim Remedial Measures described in Section 5.0 that have already been implemented, and approximately $10,000 to develop a Site Management Plan. The capital cost of this alternative is $406,000. The annual costs for this alternative would be approximately $40,000 per year to implement the natural attenuation groundwater monitoring program.

As shown in Table 3, the monitored natural attenuation alternative meets all effectiveness and implementabiltiy criteria.

8.4 ALTERNATIVE C: SOURCE REMOVAL AND IN-SITU BIOREMEDIATION

This alternative involves excavation of soil containing elevated concentrations of chemicals of concern from below the former dip tank at the former green chain and injection of materials into the subsurface to enhance the ongoing natural attenuation process. This alternative is shown in Figure 9.

The Interim Remedial Measures described in Section 5.0, including source area excavation and implementation of storm water Best Management Practices, will contribute to reducing the mass and mobility of chemicals of concern. A Site Management Plan would be developed that implements controls to minimize risk associated with residual chemicals of concern in site media and regulates activities that could interfere with the effectiveness of the remedy or cause migration of chemicals of concern. Groundwater monitoring would continue, but the scope of the monitoring program would be modified to include monitoring of two additional performance wells and monitoring of bioremediation parameters in selected wells, as described below.

Selection of the injected material and design of the injection system would be made after completion of a bioremediation bench or pilot study that determined the rate-limiting factor(s) of the ongoing natural attenuation process. For purposes of this feasibility study, a 10-foot spacing of injection points and a single injection of a nutrient were assumed over an area of approximately 160 feet by 50 feet in the vicinity of the former green chain. The injection probes would be installed using direct-push methods to a depth of approximately 5 feet, and a measured amount of nutrient would be injected at low pressure into the formation. After injection was complete at each injection point, the injection probe would be removed and the hole sealed. One or two additional performance monitoring wells would be installed in the downgradient portion of the treatment area if suitable well locations could be selected given the constraints of the site buildings and equipment.

Performance of the enhanced bioremediation would be monitored through sampling and chemical analysis of groundwater in and around the area. The additional performance monitoring wells and wells MW-2, MW-3, MW-5, and MW-7 would be sampled and analyzed for bioremediation parameters, including Eh, dissolved oxygen, nitrate, manganese(II), iron(II), sulfate, carbon dioxide, methane, total organic carbon, chloride, alkalinity, calcium, magnesium, pH, specific conductance and temperature. In addition, groundwater samples from the additional performance wells, well MW-7, and possibly other selected wells, would be analyzed for breakdown products of PCP, including tetrachlorophenol, trichlorophenol, dichlorophenol, and chlorophenol.

8.4.1 Detailed Evaluation

The capital cost to implement the enhanced in-situ bioremediation program described above is approximately $167,000. Other capital costs associated with this alternative include approximately $396,000 for the Interim Remedial Measures described in Section 5.0 that have already been implemented, and approximately $10,000 to develop a Site Management Plan. The total capital cost of this alternative is approximately $563,000. The annual costs for this alternative would be approximately $50,000 per year to implement the modified groundwater monitoring program.

As shown in Table 3, the in-situ bioremediation alternative meets the effectiveness criteria but does not meet the implementability criterion of minimizing disruption to mill operations.

8.5 ALTERNATIVE D: SOURCE REMOVAL AND IN-SITU CHEMICAL OXIDATION

This alternative involves excavation of soil containing elevated concentrations of chemicals of concern from below the former dip tank at the former green chain and injection of oxidizing materials into the subsurface to oxidize and destroy chemicals on contact. This alternative is shown on Figure 10.

The Interim Remedial Measures described in Section 5.0, including source area excavation and implementation of storm water Best Management Practices, will contribute to reducing the mass and mobility of chemicals of concern. A Site Management Plan would be developed that implements institutional controls to minimize risks associated with residual chemicals of concern in site media and regulates activities that could interfere with the effectiveness of the remedy or cause migration of chemicals of concern. Groundwater monitoring would continue, but the scope of the monitoring program would be modified to include monitoring of two additional performance wells, as described below.

The oxidizing agent (e.g. sodium or potassium permanganate, Fenton's reagent, hydrogen peroxide or ozone) would be selected after completion of a chemical oxidation bench or pilot study, based on its ability to minimize the potential for exothermic reactions that could damage nearby mill equipment while maximizing the potential to destroy the target chemicals. Because the oxidizing agent only acts on contact with the chemical, injection points must be closely spaced. For application at the site, where the injection would occur at depths of about 5 feet, injection pressures must be low to prevent hydro-fracturing the subsurface, which would create preferential pathways for the movement of the oxidizing agent instead of flow into the soil pore space. For purposes of this feasibility study, a 3-foot spacing of injection points and a single injection of an oxidizing agent were assumed over an area of approximately 160 feet by 50 feet in the vicinity of the former green chain. The injection probes would be installed using direct-push methods to a depth of approximately 5 feet and a measured amount of oxidizing agent would be injected. After injection was complete at each injection point, the injection probe would be removed and the hole sealed. One or two additional performance monitoring wells would be installed in the downgradient portion of the treatment area if suitable well locations could be selected given the constraints of the site buildings and equipment..

Performance of the chemical oxidation area would be monitored through sampling and chemical analysis of groundwater in and around the area. The additional performance monitoring wells and wells MW-2, MW-3, MW-5, and MW-7 would be sampled and analyzed for PCP and breakdown products of PCP, including tetrachlorophenol, trichlorophenol, dichlorophenol, and chlorophenol.

8.5.1 Detailed Evaluation

The capital cost to implement the in-situ chemical oxidation program described above is approximately $748,000. Other capital costs associated with this alternative include approximately $396,000 for the Interim Remedial Measures described in Section 5.0 that have already been implemented, and approximately $10,000 to develop a Site Management Plan. The total capital cost of this alternative is approximately $1,144,000. The annual cost for this alternative would be approximately $35,000 per year to implement the modified groundwater monitoring program.

As shown in Table 3, the in-situ chemical oxidation alternative meets the effectiveness criteria but does not meet the implementability criterion of minimizing disruption to mill operations.

8.6 COMPARATIVE ANALYSIS

The screening and evaluation of the four remedial action alternatives is presented in Table 3.

- Alternative A (No Action) does not meet the criteria for effectiveness and implementability.
- Alternative B (Source Removal and Monitored Natural Attenuation) meets all effectiveness and implementability criteria. The capital cost of Alternative B is approximately $406,000 and groundwater monitoring costs are approximately $40,000 per year.
- Alternative C (Source Removal and In-Situ Bioremediation) meets the effectiveness criteria but does not meet the implementability criterion of minimizing disruption to mill operations. The installation of over 70 injection points on 10-foot centers will significantly impact mill operations. The capital cost of Alternative C is approximately $563,000 and groundwater monitoring costs are approximately $50,000 per year.
- Alternative D (Source Removal and In-Situ Chemical Oxidation) meets the effectiveness criteria and but does not meet the implementability criterion of minimizing disruption to the mill operations. The installation of over 900 injection points on 3-foot centers will significantly impact mill operations. The capital cost of Alternative D is approximately $1,144,000 and groundwater monitoring costs are approximately $35,000 per year.

Based on the analysis presented in this report, Alternative B (Source Removal and Monitored Natural Attenuation) is selected as the preferred remedial action alternative. This alternative meets all of the established effectiveness and implementability criteria, is the most cost effective, and is the least disruptive of mill operations

9.0 SUMMARY OF PREFERRED REMEDIAL ACTION ALTERNATIVE

The preferred alternative, Source Removal and Monitored Natural Attenuation, includes excavation of soil containing elevated concentrations of chemicals of concern from below the former dip tank at the former green chain, implementation of storm water Best Management Practices, and monitoring of groundwater to demonstrate that attenuation of contaminants is naturally occurring. This alternative is shown on Figure 8.

The Interim Remedial Measures described in Section 5.0, including source area excavation and implementation of storm water Best Management Practices, will contribute to reducing the mass and mobility of chemicals of concern. A Site Management Plan will be developed that implements controls to minimize risks associated with residual chemicals of concern in site media and regulates activities that could interfere with the effectiveness of the remedy or cause migration of chemicals of concern. Groundwater monitoring will continue, and will include monitoring of natural attenuation parameters as described below.

The modified groundwater monitoring program will consist of the existing program plus sampling selected wells (likely wells MW-2, MW-3, MW-5 and MW-7) for analysis of natural attenuation parameters (including Eh, dissolved oxygen, nitrate, manganese(II), iron(II), sulfate, carbon dioxide, methane, total organic carbon, chloride, alkalinity, calcium, magnesium, pH, specific conductance and temperature). In addition, groundwater samples from well MW-7, and possibly other selected wells, will be analyzed for breakdown products of PCP, including tetrachlorophenol, trichlorophenol, dichlorophenol, and chlorophenol. Analytical results will be evaluated to demonstrate that reducing, anoxic, and methanogenic conditions continue to be present at the site, and that concentrations of PCP and its breakdown products are generally stable or reducing.

10.0 REFERENCES

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Environet, 2003a, Results of the Remedial Investigation for Sierra Pacific Industries, Arcata Division Sawmills, Arcata, California, May 1.

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Geomatrix, 2003b, Report on Interim Remedial Measures: Source Area Removal, Arcata Division Sawmill, prepared for Sierra Pacific Industries, Arcata, California, December 1.

MFG, Inc. (MFG), 2003a, Plywood Covered Ditch Investigation Report, Sierra Pacific Industries Arcata Division Sawmill, June 9.

MFG, 2003b, Waste Oil Underground Storage Tank Investigation and Closure Report, Sierra Pacific Industries Arcata Division Sawmill, June 10.

MFG, 2003c, Interim Remedial Measures Report, Arcata Division Sawmill, prepared for Sierra Pacific Industries, Arcata, California, June 10.

MFG, 2003d, Former Teepee Burner Investigation Report, Arcata Division Sawmill, prepared for Sierra Pacific Industries, Arcata, California, July 21.

MFG, 2003e, Second Quarter 2003 Groundwater Monitoring Report, Sierra Pacific Industries Arcata Division Sawmill, August, 7.

MFG, 2003f, Third Quarter 2003 Groundwater Monitoring Report, Sierra Pacific Industries, prepared for Sierra Pacific Industries, Arcata, California, November 3.

MFG and Geomatrix, 2003, Third Quarter Groundwater Monitoring Report, Arcata Division Sawmill, prepared for Sierra Pacific Industries, Arcata, California, November 3.

U.S. EPA, 2001, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Office of Emergency and Remedial Response, EPA/540/R/99/005, OSWER 9285.7-02EP, PB99-963312, September.

TABLES

TABLE 1

PHYSICAL AND CHEMICAL PROPERTIES OF CHEMICALS OF CONCERN [1]

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Compound	Water Solubility (mg/L)	Vapor Pressure (mm Hg)	Octanol-Water Partition Constant (mean log K_{ow})	Soil Adsorption Coefficient (mean log K_{oc})
Pentachlorophenol	14	1.1×10^{-4}	5.01	4.5
Tetrachlorophenols[2] 2,3,4,5-Tetrachlorophenol 2,3,4,6-Tetrachlorophenol 2,3,5,6-Tetrachlorophenol	100 - 183	5.9×10^{-3}	4.45 to 4.90	2.9 - 4.21
Dioxin 2,3,7,8-TCDD[3]	7.9×10^{-6} - 3.2×10^{-4}	7.4×10^{-10}	6.80 - 7.58	481,340
Furan 2,3,7,8-TetraCDF[3]	4.2×10^{-4}	9.2×10^{-7}	5.82	5.61 (estimated)

Notes:
1. Data obtained from Agency of Toxic Substances and Disease Registry website (http://www.atsdr.cdc.gov/toxprofiles/tp51-c4.pdf)
2. The physical and chemical properties are listed for three congeners of tetrachlorophenol.
3. For dioxins and furans, physical and chemical properties are listed for congeners with the greatest potential for risk due to toxicity.

Abbreviations:
mg/L = milligrams per liter
2,3,7,8-TCDD = 2,3,7,8-Tetrachlorodibenzo-p-dioxin
2,3,7,8-TetraCDF = 2,3,7,8-Tetrachlorodibenzofuran

TABLE 2

SCREENING OF REMEDIAL TECHNOLOGIES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Remedial Technology	Remedial Action Objectives: Reduce Potential for Off-site Movement of COC[1] in Groundwater to Adjacent Surface Water (Mad River Slough)	Remedial Action Objectives: Reduce Potential for Off-site Movement of COC[1] in Storm Water to Adjacent Surface Water (Mad River Slough)	Remedial Action Objectives: Remove COC Mass from Soil	Remedial Action Objectives: Remove COC Mass from Groundwater	Applicable to Site Conditions? [2]	Considered for Remedial Action Alternative Evaluation?
SOIL						
Source Removal through Excavation	Yes	Yes	Yes	No	Yes	Yes
In-Situ Chemical Oxidation in Soil	No	Yes	Yes	No	No	No
In-Situ Bioremediation in Soil	No	Yes	Yes	No	No	No
GROUNDWATER						
Monitored Natural Attenuation	Yes	Yes	No	Yes	Yes	Yes
In-Situ Chemical Oxidation in Groundwater	Yes	Yes	No	Yes	Yes	Yes
In-Situ Bioremediation in Groundwater	Yes	Yes	No	Yes	Yes	Yes
Groundwater Extraction and Treatment	Yes	Yes	No	No	No	No
STORM WATER						
Storm Water Best Management Practices	No	Yes	No	No	Yes	Yes

Notes:

1. COC = chemicals of concern (pentachlorophenol, tetrachlorophenols, dioxins, and furans)
2. The criteria for Site Conditions include lithologic conditions, depth to groundwater, proximity to surface water, types and properties of chemicals present, current use of the site, and potential impacts to adjacent communities.

TABLE 3

EVALUATION OF REMEDIAL ACTION ALTERNATIVES

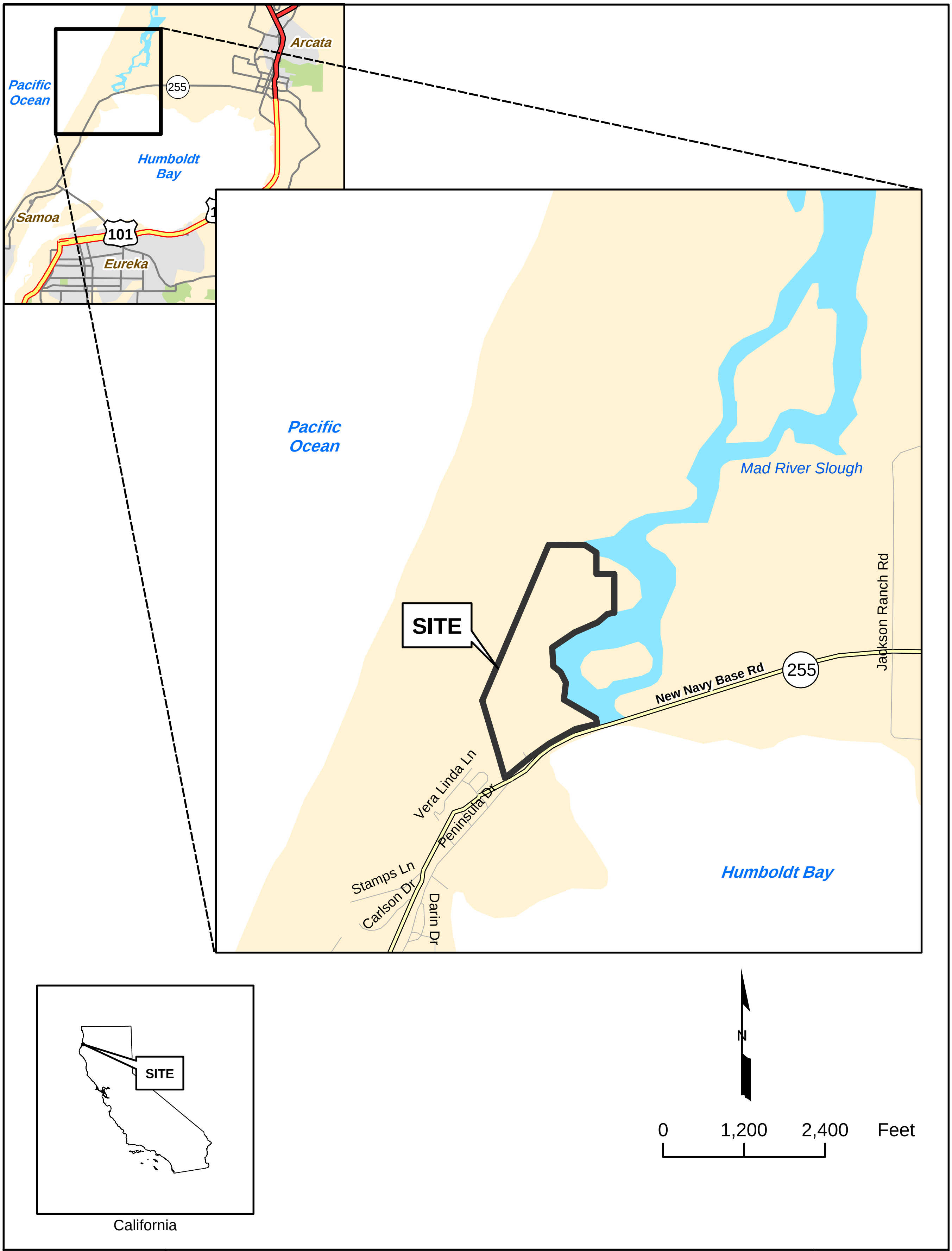
Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

	Effectiveness Criteria						Implementability Criteria								
Remediation Treatment Alternative	Meets Remedial Objectives	Protects Human Health and the Environment	Complies with Regulatory Requirements	Long Term Effectiveness	Short Term Effectiveness	Reduces Toxicity and Mobility of Chemicals of Concern	Technical and Administrative Feasibility	Availabilty of Technology	Availability of materials, labor & equpt. to implement technology	Minimizes Disruption to Mill Operations	Regulatory Acceptance	Permitting Feasibility	Community Acceptance	Mitigate health & safety concerns of workers and public during construction and implementation	Cost [1]
Alternative A: No Action															
Groundwater Monitoring	No	No	No	No	No	No	Yes	Yes	Yes	Yes	No	No	No	Yes	$45,000 [2] annually
Alternative B: Source Removal and Monitored Natural Attenuation															
Source Area Removal Site Best Management Practices Monitored Natural Attenuation in Groundwater Site Management Plan	Yes	Yes	Yes	Yes	Yes, through source removal	Yes, through source removal and natural attenuation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	$406,000 capital plus $40,000 annually
Alternative C: Source Removal and In-Situ Bioremediation															
Source Area Removal Site Best Management Practices In-Situ Bioremediation in Groundwater Site Management Plan	Yes	Yes	Yes	Yes	Yes, through source removal and in-situ bioremediation	Yes, through source removal and in-situ bioremediation	Yes	Yes	Yes	No, due to installation of a large number of injection points in an activity-intensive portion of the facility	Yes	Yes	Yes	Yes	$563,000 capital plus $50,000 annually
Alternative D: Source Removal and In-Situ Chemical Oxidation															
Source Area Removal Site Best Management Practices In-Situ Chemical Oxidation in Groundwater Site Management Plan	Yes	Yes	Yes	Yes	Yes, through source removal and in-situ chemical oxidation	Yes, through source removal and in-situ chemical oxidation	Yes	Yes	Yes	No, due to installation of a large number of injection points in an activity-intensive portion of the facility	Yes	Yes	Yes	Yes	$1,144,000 capital plus $35,000 annually

Notes:

1. For Alternatives B, C and D, $396,000 has already been spent in implementation of Interim Remedial Measures.
2. Current annual groundwater monitoring budget.

FIGURES



GEOMATRIX

SITE LOCATION MAP
Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Project No.	9329
Figure No.	1

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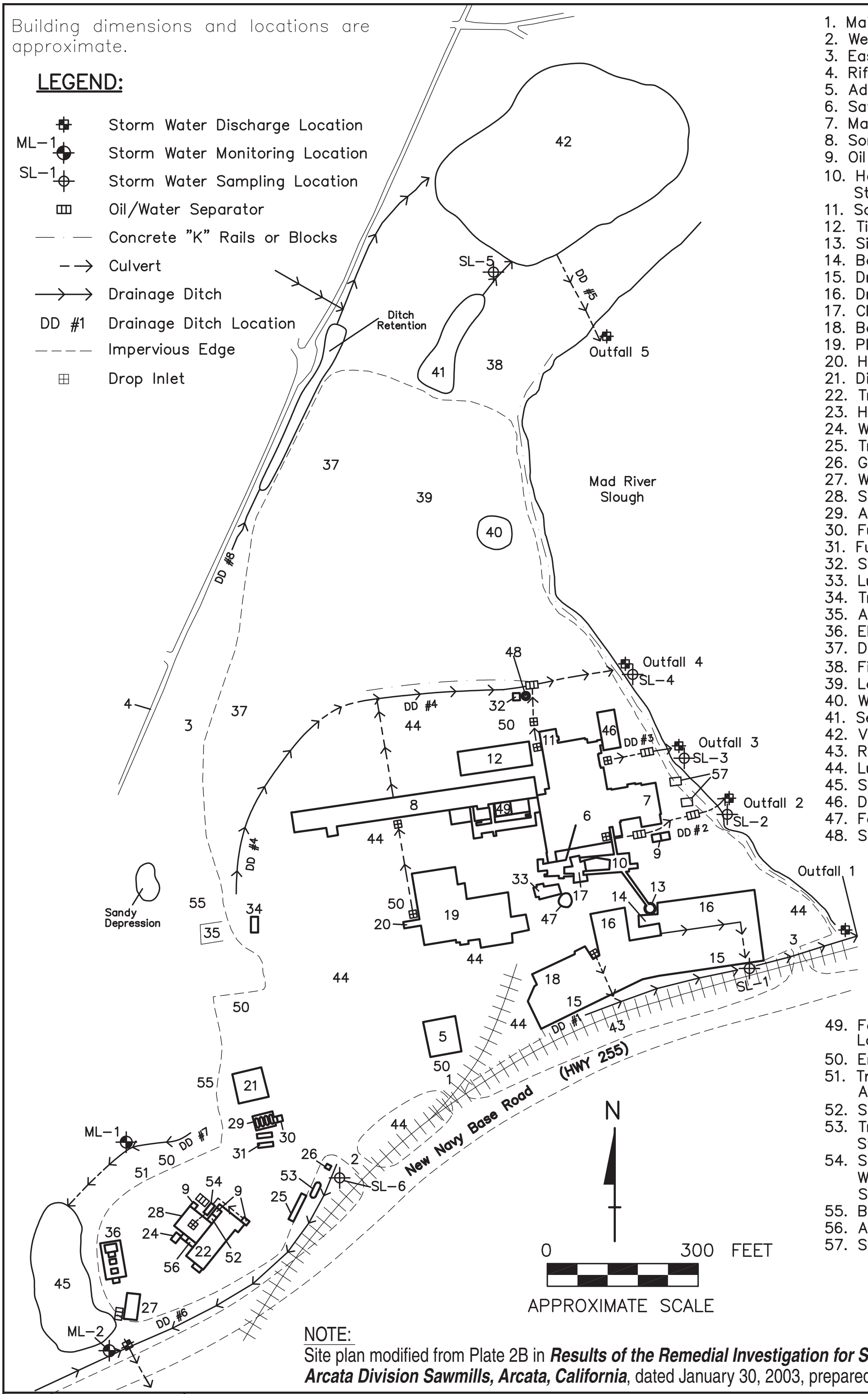
Building dimensions and locations are approximate.



LEGEND:

✚	Storm Water Discharge Location
ML-1 ⊕	Storm Water Monitoring Location
SL-1 ⊕	Storm Water Sampling Location
▥	Oil/Water Separator
— · —	Concrete "K" Rails or Blocks
– – →	Culvert
——→	Drainage Ditch
DD #1	Drainage Ditch Location
– – – –	Impervious Edge
⊞	Drop Inlet

1. Main Entrance
2. West Entrance
3. East Entrance
4. Rifle Range Road
5. Administrative Office
6. Sawmill Building
7. Maintenance Building
8. Sorter Building
9. Oil Sheds
10. Hog Fuel / Wood Chip Storage Bins
11. Saw Shop
12. Timber Toter
13. Silo
14. Boilers
15. Dry Sheds
16. Dry Kiln
17. Chipper
18. Bander
19. Planer Building
20. Hula Trim
21. Dip Tank Building
22. Truck Shop
23. Hyster Shop
24. Waste Oil Shed
25. Truck Scale
26. Guard Shack
27. Wash Rack Area
28. Steam Cleaning Area
29. Aboveground Fuel Tanks
30. Fuel Shed
31. Fuel Dispenser Islands
32. Scale Shack
33. Lunchroom Building
34. Trailer Lift
35. Ash Stockpile
36. Electrical Substation
37. Douglas Fir Log Desk
38. Fir/Pine Log Desk
39. Log Unloading Area
40. Wood Waste Stockpile
41. Settling Basin
42. Vegetated Pond
43. Railroad Tracks
44. Lumber Storage Area
45. Shop Retention Pond
46. Debarker
47. Former Teepee Burner
48. Sprinkler Water Well
49. Former Dip Tank Location
50. Employee Parking Areas
51. Transport Truck Parking Area
52. Steam Cleaning Shed
53. Truck Scale Storm Water Storage Tank
54. Steam Cleaner Waste Water Underground Storage Tank
55. Bone Yard Area
56. Air Compressor Shed
57. Scrap Metal bins

NOTE:
Site plan modified from Plate 2B in ***Results of the Remedial Investigation for Sierra Pacific Industries - Arcata Division Sawmills, Arcata, California***, dated January 30, 2003, prepared by EnviroNet.

GEOMATRIX

SITE PLAN
Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Project No.
9329

Figure
2

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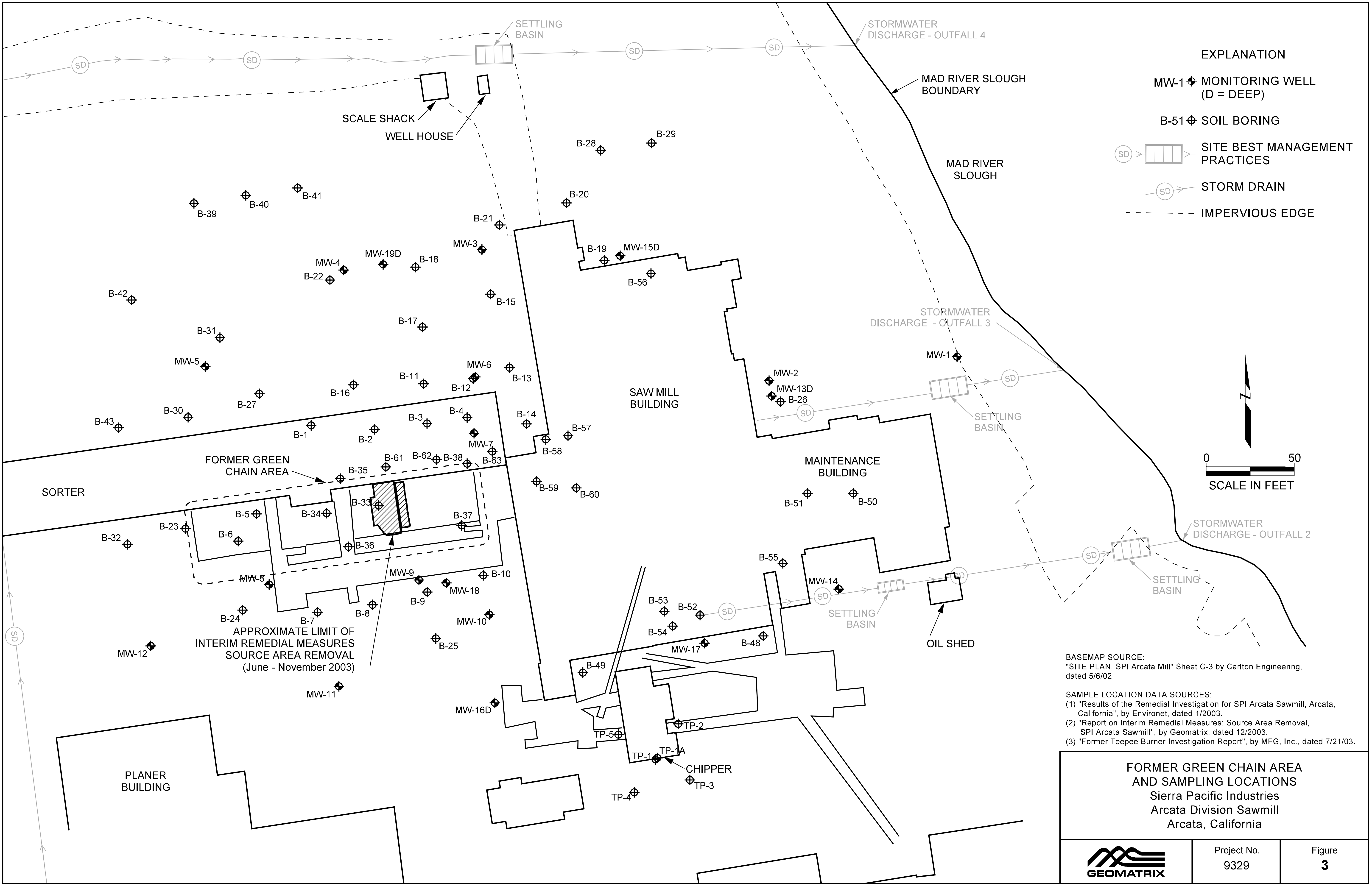

BASEMAP SOURCE:
"SITE PLAN, SPI Arcata Mill" Sheet C-3 by Carlton Engineering, dated 5/6/02.

SAMPLE LOCATION DATA SOURCES:
(1) "Results of the Remedial Investigation for SPI Arcata Sawmill, Arcata, California", by Environet, dated 1/2003.
(2) "Report on Interim Remedial Measures: Source Area Removal, SPI Arcata Sawmill", by Geomatrix, dated 12/2003.
(3) "Former Teepee Burner Investigation Report", by MFG, Inc., dated 7/21/03.

FORMER GREEN CHAIN AREA
AND SAMPLING LOCATIONS
Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

GEOMATRIX

Project No.	Figure
9329	3

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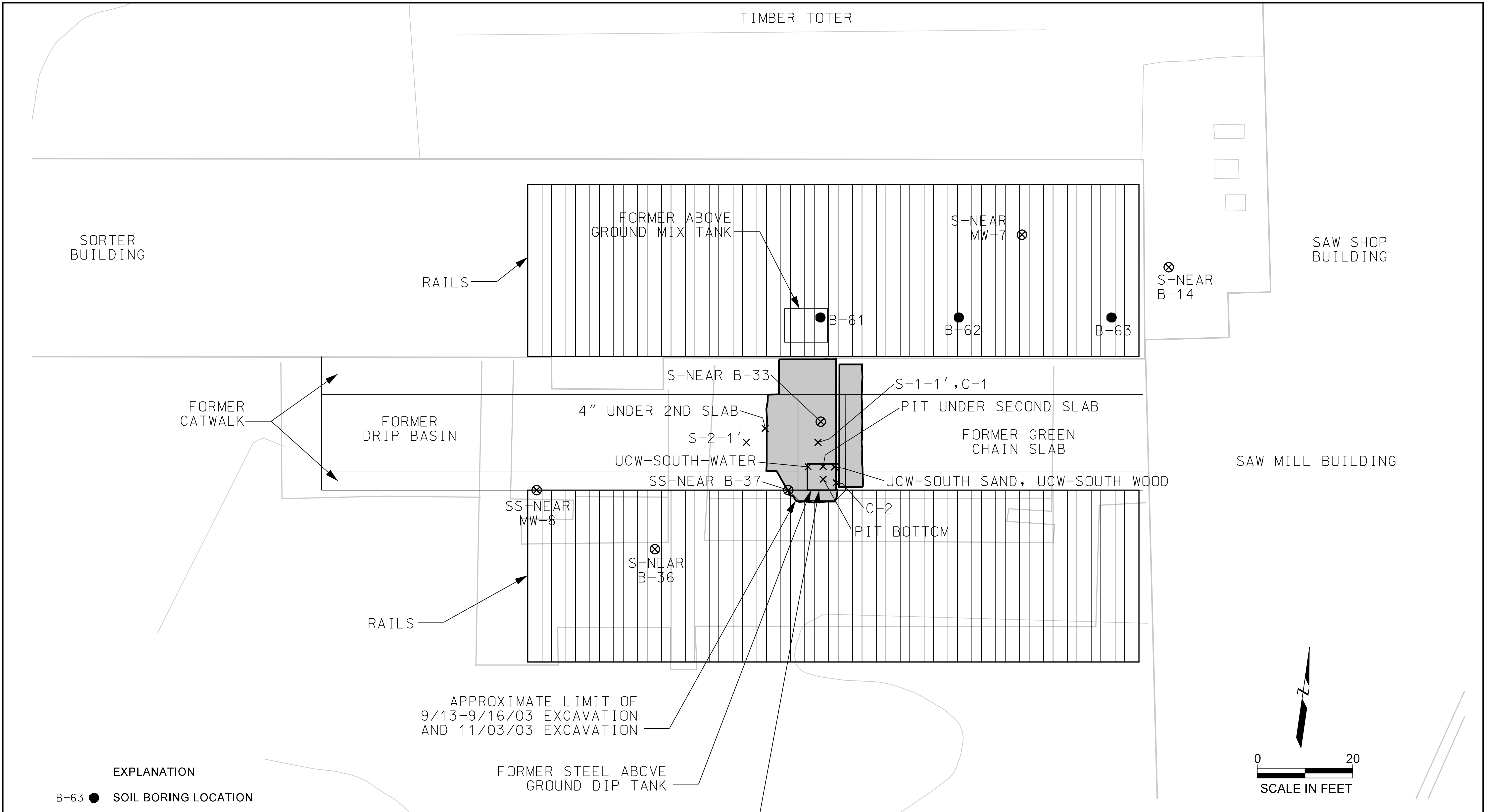

EXPLANATION

B-63 ● SOIL BORING LOCATION

S-NEAR B-33 ⊗ STORM WATER AND STORM WATER SOLIDS SAMPLE

S-2-1' × GRAB SAMPLE

▨ EXTENT OF SOURCE AREA EXCAVATION

SOURCE:
"Plan of Former Green Chain and Well MW-7 Areas with Additional Sampling Locations" from MFG, Inc., dated 11/19/03.

RECENT SAMPLING LOCATIONS IN
THE VICINITY OF THE FORMER GREEN CHAIN
Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

GEOMATRIX

GEOMATRIX	Project No.	Figure
	9329	4

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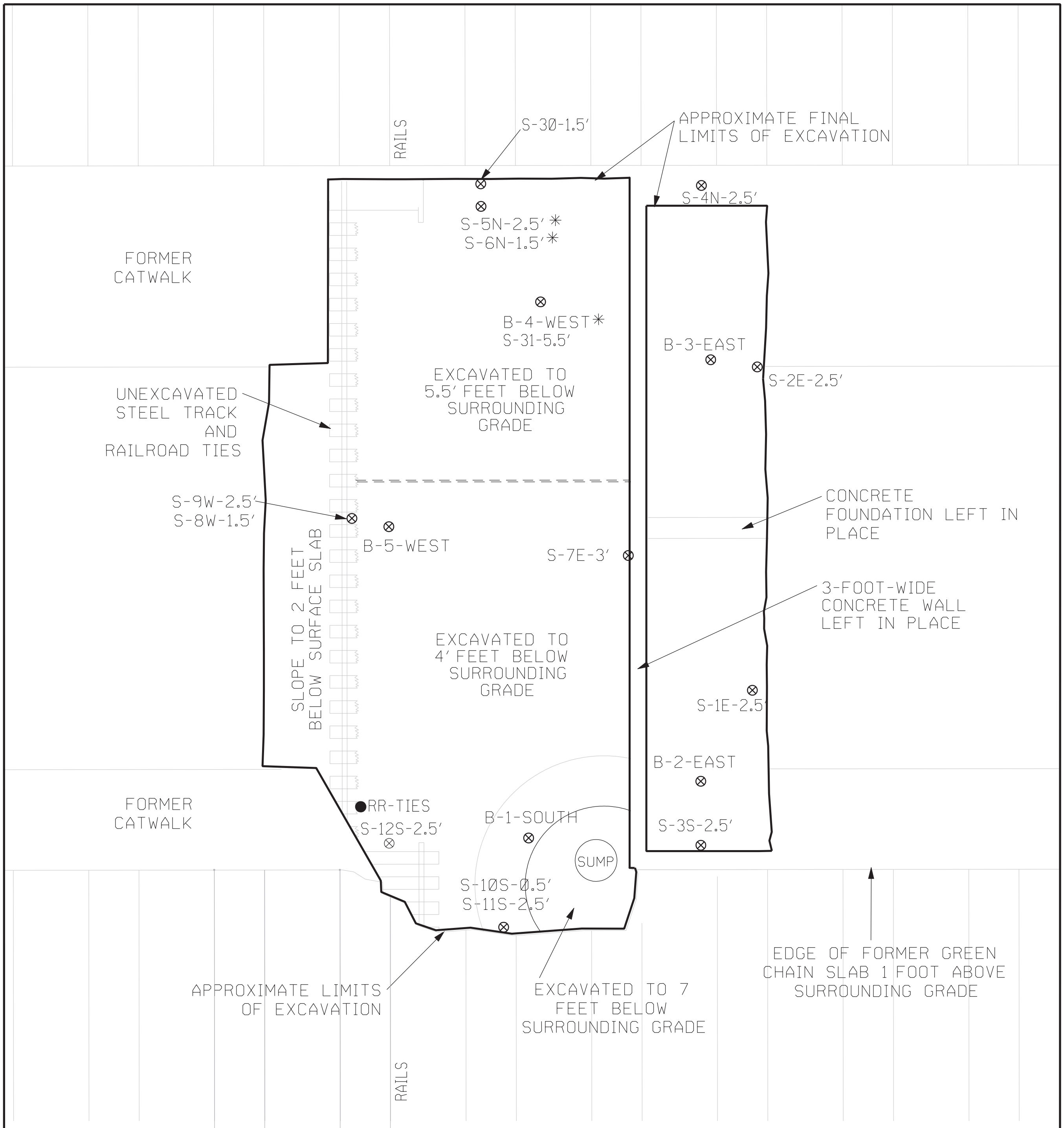


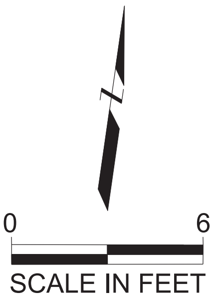
EXPLANATION

B-5-WEST ⊗ SOIL SAMPLE LOCATION AND DESIGNATION

RR-TIES ● WOOD SAMPLE LOCATION AND DESIGNATION

✳ MATERIAL REPRESENTED BY SAMPLE WAS REMOVED THROUGH SUBSEQUENT EXCAVATION IN THIS AREA

NOTE:
Base map provided by MFG, Inc., on 11/19/2003.



GEOMATRIX

FINAL SOURCE AREA EXCAVATION PLAN WITH CONFIRMATION SAMPLE LOCATIONS

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Project No.
9329

Figure
5

BASEMAP SOURCE:
"SITE PLAN, SPI Arcata Mill" Sheet C-3 by Carlton Engineering, dated 5/6/02.

SOIL BORING DATA SOURCES:
(1) "Results of the Remedial Investigation for SPI Arcata Sawmill, Arcata, California", by Environet, dated 1/2003.
(2) "Report on Interim Remedial Measures: Source Area Removal, SPI Arcata Sawmill", by Geomatrix, dated 12/2003.
(3) "Former Teepee Burner Investigation Report", by MFG, Inc., dated 7/21/03.

PENTACHLOROPHENOL IN SOIL
Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

GEOMATRIX

Project No.	Figure
9329	6

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EXPLANATION

MW-1 ⊕ MONITORING WELL (D = DEEP)

● ○ PENTACHLOROPHENOL (PCP) CONCENTRATION IN GROUNDWATER (µg/L)

OPEN SYMBOL DENOTES SAMPLE RESULT BELOW LABORATORY REPORTING LIMIT FOR PCP (1.0 µg/L)

ND NOT DETECTED AT OR ABOVE LABORATORY REPORTING LIMIT

— — INDICATES LABORATORY REPORTING LIMIT OF 1.0 µg/L

SD SITE BEST MANAGEMENT PRACTICES

SD STORM DRAIN

- - - IMPERVIOUS EDGE

BASEMAP SOURCE:
"SITE PLAN, SPI Arcata Mill" Sheet C-3 by Carlton Engineering, dated 5/6/02.

GROUNDWATER DATA SOURCES:
(1) "Results of the Remedial Investigation for SPI Arcata Sawmill, Arcata, California", by Environet, dated 1/2003.
(2) "Fourth Quarter 2003 Groundwater Monitoring Report, SPI Arcata Division Sawmill," by MFG, Inc., dated 11/2003.

PENTACHLOROPHENOL IN GROUNDWATER
Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

GEOMATRIX

Project No.	Figure
9329	7

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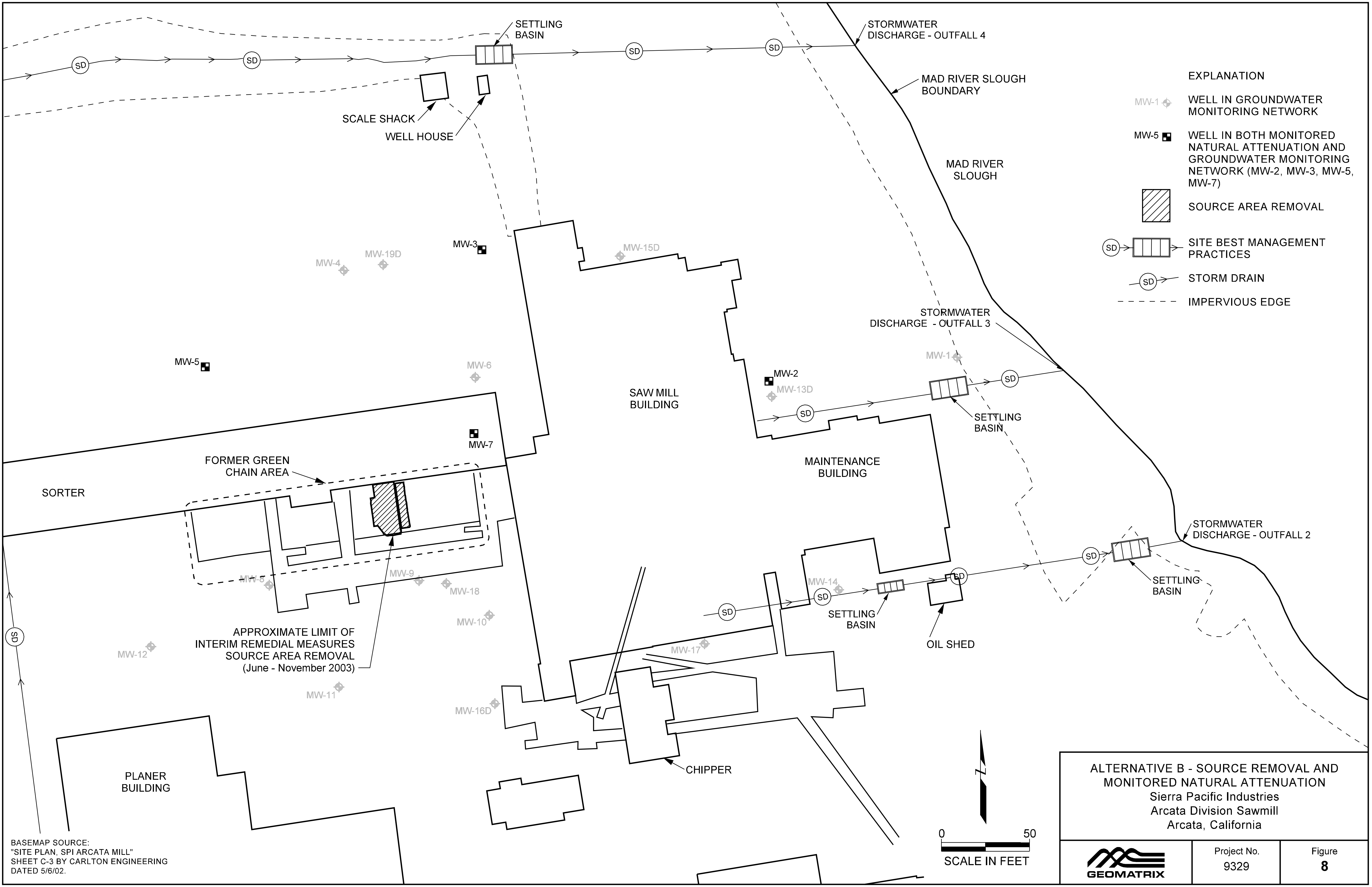

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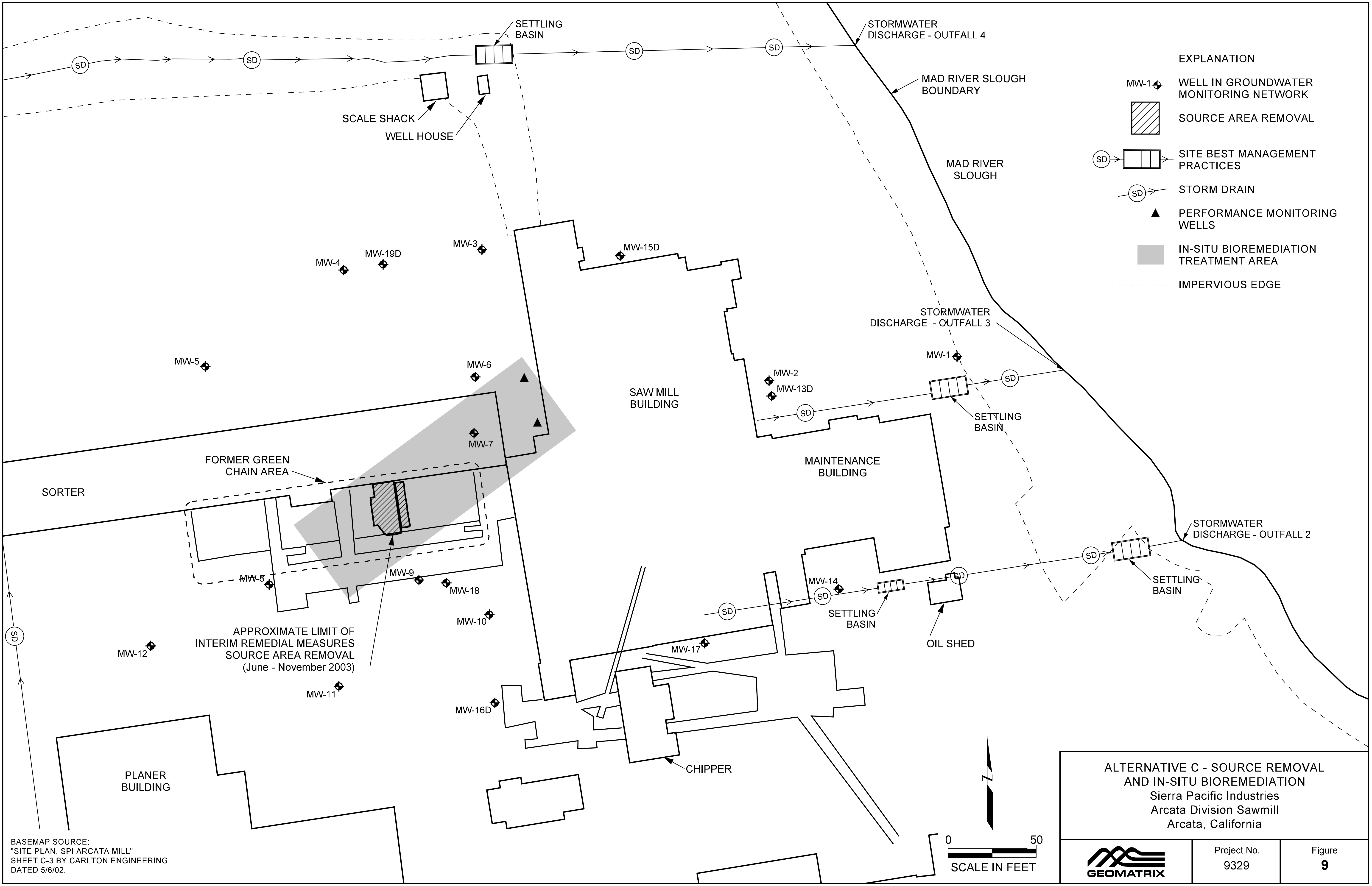
ALTERNATIVE B - SOURCE REMOVAL AND MONITORED NATURAL ATTENUATION
Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

GEOMATRIX	Project No. 9329	Figure **8**



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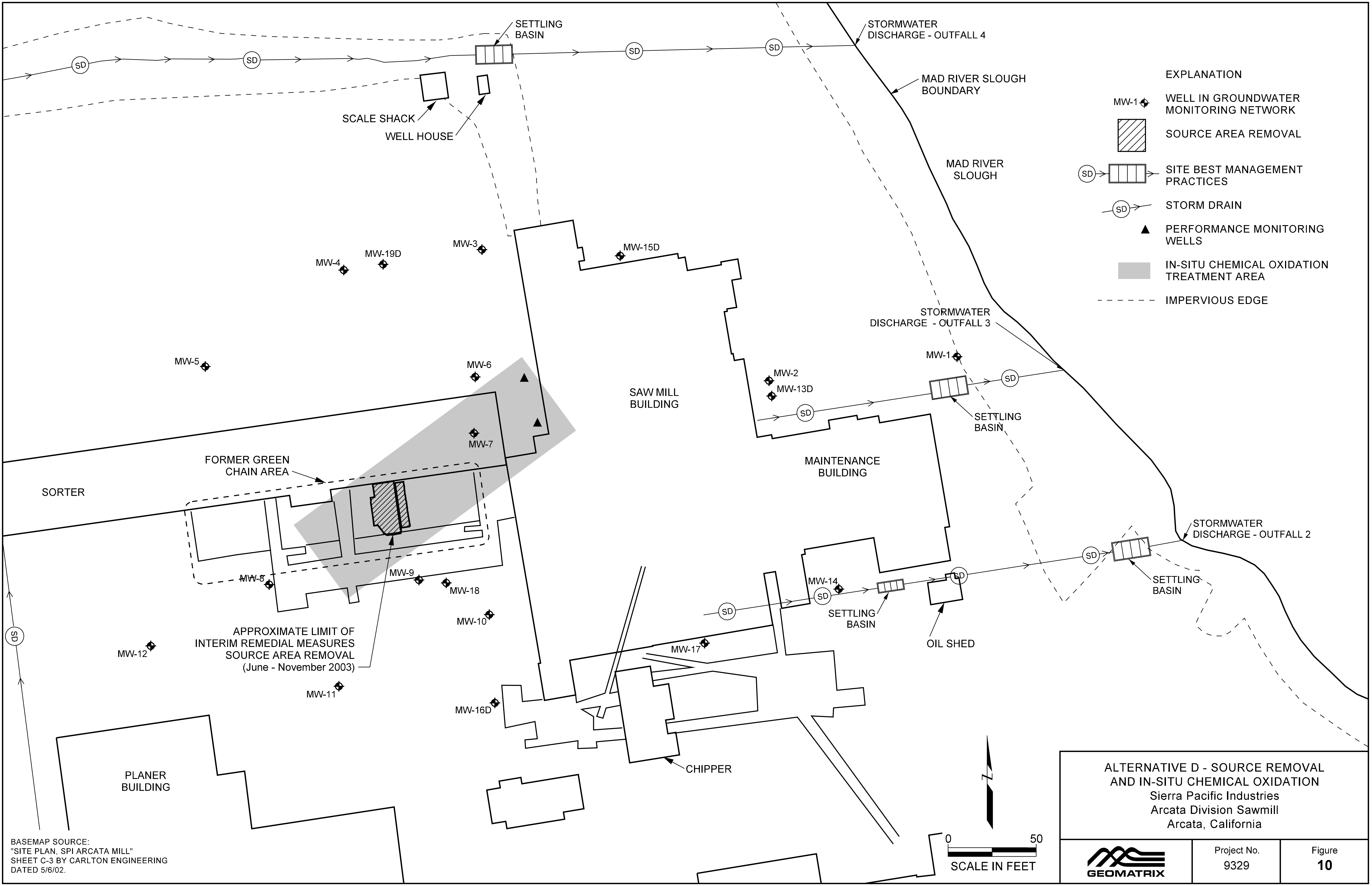
ALTERNATIVE C - SOURCE REMOVAL
AND IN-SITU BIOREMEDIATION
Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

GEOMATRIX

Project No.	Figure
9329	9



BASEMAP SOURCE:
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DATED 5/6/02.

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ALTERNATIVE D - SOURCE REMOVAL AND IN-SITU CHEMICAL OXIDATION

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

GEOMATRIX

Project No.	Figure
9329	**10**

APPENDIX A

Historical Data

Appendix A-1	Soil
Appendix A-2	Grab Groundwater
Appendix A-3	Monitoring Well Construction Details and Groundwater Monitoring Data
Appendix A-4	Asphalt and Concrete
Appendix A-5	Storm Water, Storm Water Solids, and Drainage Ditch Samples

Appendix A-1 Soil

Table 3: Soil Analytical Results - PCP, Total Carbon, & pH - 2001
2293 Samoa Road, Arcata, California

ID	Date	PCP by 8040-Mod	PCP Duplicate	Total Carbon	pH
		mg/kg			
B-1-1'	07/23/01	ND		11,200	7.6
B-1-3'	07/23/01	ND		8,570	5.8
B-2-1.5'	07/23/01	3.2		16,700	7.5
B-2-3'	07/23/01	ND		7,700	6.5
B-3-1.5'	07/23/01	50		8,640	6.0
B-3-3'	07/23/01	71	68	9,040	6.1
B-3-5'	07/23/01	ND		7,790	5.5
B-3-6.5'	07/23/01	ND		6,930	4.8
B-4-1'	07/23/01	3.1		7,170	7.0
B-4-3'	07/23/01	20		6,740	6.2
B-4-5'	07/23/01	ND		5,040	5.8
B-4-6.5'	07/23/01	ND		5,970	6.7
B-5-3.5'	07/24/01	ND		8,870	9.8
B-5-5'	07/24/01	ND		9,530	7.0
B-6-3.5'	07/24/01	1.0	ND	7,660	6.1
B-6-5'	07/24/01	ND		6,240	7.0
B-6-7'	07/24/01	ND		6,770	6.9
B-6-9' (BM)	07/24/01	ND		47,000	5.8
B-7-1.5'	07/24/01	ND		6,010	6.4
B-7-3'	07/24/01	ND		5,850	6.0
B-8-2'	07/24/01	ND		7,480	6.0
B-8-4'	07/24/01	ND		7,040	4.8

Table 3, Continued: Soil Analytical Results - PCP, Total Carbon, & pH - 2001
2293 Samoa Road, Arcata, California

ID	Date	PCP by 8040-Mod	PCP Duplicate	Total Carbon	pH
		mg/kg			
B-9-1.5'	07/24/01	ND		6,600	6.5
B-9-3'	07/24/01	7.6	1.3	19,300	9.7
B-9-5'	07/24/01	ND		5,390	6.7
B-10-1.5'	07/24/01	ND		6,550	7.4
B-10-3'	07/24/01	ND		7,070	6.2
B-11-1'	07/24/01	1.0		8,080	6.1
B-11-3'	07/24/01	ND		6,680	6.4
B-12-1.5'	07/24/01	ND		5,990	7.1
B-12-3'	07/24/01	ND		7,890	6.6
B-13-1.5'	07/25/01	ND		8,710	8.0
B-13-3'	07/25/01	ND		8,790	6.8
B-14-1'	07/25/01	ND		9,490	6.2
B-14-3'	07/25/01	5.5	3.3	9,060	6.3
B-14-5'	07/25/01	2.4		6,330	6.0
B-14-6.5'	07/25/01	ND		6,460	5.8
B-15-1.5'	07/25/01	ND		17,300	7.6
B-15-3'	07/25/01	ND		4,870	6.4
B-16-1.5'	07/25/01	ND		5,170	6.6
B-16-3'	07/25/01	11	ND*	7,500	9.4
B-16-5'	07/25/01	ND		8,210	6.6
B-17-2'	07/25/01	ND		12,600	6.5
B-17-4'	07/25/01	ND		6,010	6.4

Table 3, Continued: Soil Analytical Results - PCP, Total Carbon, & pH - 2001
2293 Samoa Road, Arcata, California

ID	Date	PCP by 8040-Mod	PCP Duplicate	Total Carbon	pH
		mg/kg			
B-18-1'	07/25/01	ND		23,700	6.1
B-18-3'	07/25/01	ND		20,800	5.9
B-19-1.5'	07/26/01	1.0		56,700	6.8
B-19-3'	07/26/01	ND		7,300	6.1
B-20-2.5'	07/26/01	ND		24,600	6.0
B-20-4'	07/26/01	ND		5,540	5.8
B-21-3'	07/26/01	ND		36,200	6.4
B-21-4'	07/26/01	ND		6,580	6.4
B-22-2'	07/26/01	ND	ND	7,020	6.0
B-22-3'	07/26/01	ND		5,680	5.1
B-23-2'	07/26/01	ND		6,180	5.6
B-23-3'	07/26/01	ND		7,220	5.6
B-24-1.5'	07/26/01	ND		4,750	7.1
B-24-3'	07/26/01	ND		4,980	6.5
B-25-2'	07/26/01	ND		29,300	9.8
B-25-3'	07/26/01	ND		7,540	6.9
B-26-2'	07/26/01	ND		43,000	6.8
B-26-3'	07/26/01	ND		21,000	6.5
B-27-2'	07/26/01	1.4	ND	5,330	9.9
B-27-3'	07/26/01	ND		4,600	6.2
B-28-1.5'	07/27/01	ND		12,700	6.6
B-28-4.5'	07/27/01	ND		9,970	6.6

Table 3, Continued: Soil Analytical Results - PCP, Total Carbon, & pH - 2001
2293 Samoa Road, Arcata, California

ID	Date	PCP by 8040-Mod	Total Carbon	pH
		—— mg/kg ——		
B-30-2.5'	07/27/01	ND	7,250	7.2
B-30-4'	07/27/01	ND	7,890	6.9
B-31-3.5'	07/27/01	ND	5,740	6.7
B-31-5'	07/27/01	ND	8,600	6.6
B-32-2.5'	07/27/01	ND	11,900	7.2
B-32-4'	07/24/01	ND	6,110	6.4
B-33-4'	08/01/01	4.7	NA	NM
B-33-5'	08/01/01	ND	NA	NM
B-33-6.5'	08/01/01	ND	NA	NM
B-34-4'	08/01/01	2.2	NA	NM
B-34-5'	08/01/01	1.9	NA	NM
B-34-6.5'	08/01/01	ND	NA	NM
B-35-2'	08/01/01	ND	NA	NM
B-35-3'	08/01/01	ND	NA	NM
B-36-2'	08/01/01	1.3	NA	NM
B-36-3'	08/01/01	ND	NA	NM
B-37-1.5'	08/01/01	ND	NA	NM
B-37-2.5'	08/01/01	ND	NA	NM
B-38-2'	08/01/01	59	NA	NM
B-38-3'	08/01/01	27	NA	NM
B-38-4.5'	08/01/01	ND	NA	NM

* Lab reports sample collected from other end of sample tube.

Table 6: Soil Analytical Results - Borings - March 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
B-39-1.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-39-2'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-39-4'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-39-4.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-39-5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-40-1'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-40-2'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-40-3'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-40-4'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-40-5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-41-1'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-41-2'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-41-3'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-41-4'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-41-5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-42-2'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-42-2.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-42-3'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-42-4'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-42-5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0

Table 6, Continued: Soil Analytical Results - Borings - March 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
B-43-2'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-43-2.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-43-3'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-43-4'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-43-5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-44-1'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-44-2'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-44-3'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-44-4'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-44-5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-45-1'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-45-2'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-45-3.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-45-4'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-45-5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-46-3'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-46-3.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-46-4'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-46-5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-46-5.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0

Table 6, Continued: Soil Analytical Results - Borings - March 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
B-47-2'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-47-3'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-47-3.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-47-4.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-47-5.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-1-2.5'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-1-4.5'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-2-2.5'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-2-4'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-3-4'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-3-5'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-4-2.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-4-3.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-5-2'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-5-3.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6-1.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6-3'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6-SA	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6-SC	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0

Table 6, Continued: Soil Analytical Results - Borings - March 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
MW-7-1.5'	03/07/02	10	<1.0	<1.0	<1.0	<1.0
MW-7-3'	03/07/02	19	<1.0	<1.0	<1.0	<1.0
MW-7-5.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-7-6.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-7-SC	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-8-1.5	03/08/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-8-3'	03/08/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-9-2.5	03/08/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-9-4	03/08/02	<1.0	<1.0	<1.0	<1.0	<1.0

Table 15: Soil Analytical Results - Monitoring Wells - November 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
MW-10-2'	11/11/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-10-4'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-11-2'	11/12/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-11-4'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-12-4'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-12-4'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-13D-5'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-13D-10'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-13D-15'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-13D-20'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-14-1.5'	11/13/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-14-3.5'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-14-5.5'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-15D-2.5'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-15D-4.5'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-16D-2'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-16D-4'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-17-1.5'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-17-3.5'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-17-5.5'		<1.0	<1.0	<1.0	<1.0	<1.0

Table 15, Continued: Soil Analytical Results - Monitoring Wells - November 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
MW-18-1.5'	11/13/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-18-3.5'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-19D-7'	11/14/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-19D-10'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-19D-15.5'		<1.0	<1.0	<1.0	<1.0	<1.0
MW-19D-21'		<1.0	<1.0	<1.0	<1.0	<1.0

Table 16: Soil Analytical Results - Borings - November 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
B-48-2'	11/13/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-48-4'		<1.0	<1.0	<1.0	<1.0	<1.0
B-48-6'		<1.0	<1.0	<1.0	<1.0	<1.0
B-49-2'	11/14/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-49-4'		<1.0	<1.0	<1.0	<1.0	<1.0
B-50-2'		<1.0	<1.0	<1.0	<1.0	<1.0
B-50-4'		<1.0	<1.0	<1.0	<1.0	<1.0
B-51-2'		<1.0	<1.0	<1.0	<1.0	<1.0
B-51-4'		<1.0	<1.0	<1.0	<1.0	<1.0
B-52-1.5'		<1.0	<1.0	<1.0	<1.0	<1.0
B-52-3.5'		<1.0	<1.0	<1.0	<1.0	<1.0
B-53-1'		<1.0	<1.0	<1.0	<1.0	<1.0
B-53-3'		<1.0	<1.0	<1.0	<1.0	<1.0
B-54-1'	11/15/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-54-3'		<1.0	<1.0	<1.0	<1.0	<1.0
B-55-1.5'		<1.0	<1.0	<1.0	<1.0	<1.0
B-55-3.5'		<1.0	<1.0	<1.0	<1.0	<1.0
B-56-2'		<1.0	<1.0	<1.0	<1.0	<1.0
B-56-4'		<1.0	<1.0	<1.0	<1.0	<1.0

Table 16, Continued: Soil Analytical Results - Borings - November 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
B-57-1'	11/15/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-57-3'		1.9	<1.0	<1.0	<1.0	<1.0
B-57-5'		<1.0	<1.0	<1.0	<1.0	<1.0
B-58-1'		<1.0	<1.0	<1.0	<1.0	<1.0
B-58-3'		<1.0	<1.0	<1.0	<1.0	<1.0
B-58-5'		1.2	<1.0	<1.0	<1.0	<1.0
B-59-1'		<1.0	<1.0	<1.0	<1.0	<1.0
B-59-1.5'		<1.0	<1.0	<1.0	<1.0	<1.0
B-60-1'		<1.0	<1.0	<1.0	<1.0	<1.0
B-60-1.5'		<1.0	<1.0	<1.0	<1.0	<1.0

Table 17: Soil Analytical Results - Borings - November 2002 - CAM-17 Metals
2293 Samoa Road, Arcata, California

Sample ID	Date	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
		mg/kg																
B-57-3'	11/15/02	<15	<5.0	12	<0.75	<1.0	22	20	<10	<5.0	<0.2	<10	24	<1.0	<5.0	<7.0	9.2	17

TABLE 1

SUMMARY OF CHEMICAL ANALYSIS OF SOIL SAMPLES FOR CHLORINATED PHENOLS

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

SAMPLE ID	BORING ID	BORING TOTAL DEPTH (feet bgl)	SAMPLE DEPTH (feet bgl)	SAMPLE DEPTH (feet below apparent baked clay layer)[1]	SAMPLE DATE[2]	LITHOLOGY	CHLORINATED PHENOLS (mg/kg)
						Reporting Limit:	1.0
TP-1A	TP-1	2.5	0.75-1.25	--	03-Apr-03	SAND	ND
TP-1B			2.0-2.5	0.5-1.0	03-Apr-03	SAND	ND
TP-1A(0-1.0)A[3]	TP-1A	4.0	1.5-2.5	0.0-1.0	16-Apr-03	SAND	ND
TP-1A(1-2.0)A[3]			2.5-3.5	1.0-2.0	16-Apr-03	SAND	ND
TP-2A	TP-2	4.2	0.5-1.0	--	03-Apr-03	SAND	ND
TP-2(0-0.5)			1.7-2.2	0.0-0.5	16-Apr-03	SAND	ND
TP-2(2.0-2.5)			3.7-4.2	2.0-2.5	16-Apr-03	SAND	ND
TP-3A	TP-3	4.4	0.5-1.0	--	03-Apr-03	SAND	ND
TP-3(0-0.5)			1.9-2.4	0.0-0.5	16-Apr-03	SAND	ND
TP-3(2.0-2.5)			3.9-4.4	2.0-2.5	16-Apr-03	SAND	ND
TP-4A	TP-4	4.0	0.6-0.8	--	03-Apr-03	SAND	ND
TP-4 CHIP[4]			1.25	--	16-Apr-03	CLAY[3]	ND
TP-4(0-0.5)			1.5-2.0	0.0-0.5	16-Apr-03	SAND	ND
TP-4(2.0-2.5)			3.5-4.0	2.0-2.5	16-Apr-03	SAND	ND
TP-5A	TP-5	4.0	0.5-0.7	--	03-Apr-03	SAND	ND
TP-5(0-0.5)			1.5-2.0	0.0-0.5	16-Apr-03	SAND	ND
TP-5(2.0-2.5)			3.5-4.0	2.0-2.5	16-Apr-03	SAND	ND

NOTES:

bgl	Below ground level.
mg/kg	Milligrams per kilogram.
--	Not Applicable.
ND	Not detected at or above the laboratory reporting limit indicated at the top of the column.
1.	Hand auger refusal was encountered in borings TP-2, TP-3, TP-4 and TP-5 on April 3, 2003; however, the apparent baked clay layer was encountered only in borings TP-2, TP-3 and TP-4 on April 16, 2003.
2.	Borings TP-2, TP-3, TP-4 and TP-5 drilled on April 16, 2003 were offset approximately 6 to 18 inches from the April 3, 2003 locations. Boring TP-1A was located approximately 24 inches northeast of boring TP-1.
3.	Composite sample.
4.	Sample of the apparent baked clay layer.

Chlorinated phenols were analyzed using the Canadian Pulp Method and included the following target analytes: 2,4,6-trichlorophenol; 2,3,5,6-tetrachlorophenol; 2,3,4,6-tetrachlorophenol; 2,3,4,5-tetrachlorophenol; and pentachlorophenol.

Dioxins and Furans - Borings - November 2002

SAMPLE NAME	SAMPLE LOCATION	TYPE	DATE COLLECTED	
1467-01-SA	B-57-3'	Sediment	11/15/2002	
Acronym	**Name**	**Toxicity Equiv. Factor 1997**	**Detection**	**TEQ**
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	0.618	0.618000
1,2,3,7,8-PeCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	6.45	6.450000
1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	11.8	1.180000
1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	98.8	9.880000
1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	23.1	2.310000
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	2460	24.600000
OCDD	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	0.0001	25600	2.560000
2,3,7,8-TCDF	2,3,7,8-Tetrachlorodibenzofuran	0.1	0	0.000000
1,2,3,7,8-PeCDF	1,2,3,7,8-Pentachlorodibenzofuran	0.05	0.98	0.049000
2,3,4,7,8-PeCDF	2,3,4,7,8-Pentachlorodibenzofuran	0.5	0.712	0.356000
1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	10.8	1.080000
1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	11.5	1.150000
2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	19	1.900000
1,2,3,7,8,9-HxCDF	1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	3.15	0.315000
1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	520	5.200000
1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	57.2	0.572000
OCDF	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	0.0001	2070	0.207000
			0=ND	**58.427000**

When mixtures of these compounds are present in an environmental sample a Toxicity Equivalent or TEQ is calculated to express the toxicity of the mixture. The TEQ is defined as the sum of the products of each congener concentration multiplied by its Toxicity Equivalent Factor or TEF for all congeners in a mixture expressed as if the toxicity were due entirely to 1,3,7,8-TCDD (Dioxin). The percentage of the TEQ that is actually contributed by 2,3,7.,8-TCDD should be clearly shown with the TEQ. It is determined by multiplying the congener concentrations in the mixture by their TEFs and summing the TEF concentrations.

Dioxins and Furans - Borings - November 2002

SAMPLE NAME	SAMPLE LOCATION	TYPE	DATE COLLECTED	
1467-02-SA	B-57-5'	Sediment	11/15/2002	
Acronym	**Name**	**Toxicity Equiv. Factor 1997**	**Detection**	**TEQ**
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	0	0.000000
1,2,3,7,8-PeCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	0	0.000000
1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	0	0.000000
1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	1.24	0.124000
1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	0	0.000000
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	27.8	0.278000
OCDD	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	0.0001	359	0.035900
2,3,7,8-TCDF	2,3,7,8-Tetrachlorodibenzofuran	0.1	0	0.000000
1,2,3,7,8-PeCDF	1,2,3,7,8-Pentachlorodibenzofuran	0.05	0	0.000000
2,3,4,7,8-PeCDF	2,3,4,7,8-Pentachlorodibenzofuran	0.5	0	0.000000
1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,7,8,9-HxCDF	1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	6.17	0.061700
1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0	0.000000
OCDF	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	0.0001	23.9	0.002390
			0=ND	**0.501990**

When mixtures of these compounds are present in an environmental sample a Toxicity Equivalent or TEQ is calculated to express the toxicity of the mixture. The TEQ is defined as the sum of the products of each congener concentration multiplied by its Toxicity Equivalent Factor or TEF for all congeners in a mixture expressed as if the toxicity were due entirely to 1,3,7,8-TCDD (Dioxin). The percentage of the TEQ that is actually contributed by 2,3,7.,8-TCDD should be clearly shown with the TEQ. It is determined by multiplying the congener concentrations in the mixture by their TEFs and summing the TEF concentrations.

Dioxins and Furans - Borings - November 2002

SAMPLE NAME	SAMPLE LOCATION	TYPE	DATE COLLECTED	
1467-03-SA	B-58-5'	Sediment	11/15/2002	
Acronym	**Name**	**Toxicity Equiv Factor 1997**	**Detection**	**TEQ**
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	0	0.000000
1,2,3,7,8-PeCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	1.09	1.090000
1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	1.95	0.195000
1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	16.9	1.690000
1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	2.46	0.246000
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	365	3.650000
OCDD	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	0.0001	3270	0.327000
2,3,7,8-TCDF	2,3,7,8-Tetrachlorodibenzofuran	0.1	0	0.000000
1,2,3,7,8-PeCDF	1,2,3,7,8-Pentachlorodibenzofuran	0.05	0	0.000000
2,3,4,7,8-PeCDF	2,3,4,7,8-Pentachlorodibenzofuran	0.5	0	0.000000
1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	1.59	0.159000
1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	1.39	0.139000
2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	2.38	0.238000
1,2,3,7,8,9-HxCDF	1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	87.1	0.871000
1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	9.71	0.097100
OCDF	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	0.0001	310	0.031000
			0=ND	**8.733100**

When mixtures of these compounds are present in an environmental sample a Toxicity Equivalent or TEQ is calculated to express the toxicity of the mixture. The TEQ is defined as the sum of the products of each congener concentration multiplied by its Toxicity Equivalent Factor or TEF for all congeners in a mixture expressed as if the toxicity were due entirely to 1,3,7,8-TCDD (Dioxin). The percentage of the TEQ that is actually contributed by 2,3,7.,8-TCDD should be clearly shown with the TEQ. It is determined by multiplying the congener concentrations in the mixture by their TEFs and summing the TEF concentrations.

TABLE 2

SUMMARY OF CHEMICAL ANALYSES OF SOIL SAMPLES FOR DIOXINS AND FURANS

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

SAMPLE ID	BORING ID	SAMPLE DEPTH (feet bgl)	SAMPLE DEPTH (feet below apparent baked clay layer)[1]	SAMPLE DATE	LITHOLOGY	2, 3, 7, 8-TCDD (pg/g)	1, 2, 3, 7, 8-PeCDD (pg/g)	1, 2, 3, 4, 7, 8-HxCDD (pg/g)	1, 2, 3, 6, 7, 8-HxCDD (pg/g)	1, 2, 3, 7, 8, 9-HxCDD (pg/g)	1, 2, 3, 4, 6, 7, 8-HpCDD (pg/g)	OCDD (pg/g)	2, 3, 7, 8-TCDF (pg/g)	1, 2, 3, 7, 8-PeCDF (pg/g)	2, 3, 4, 7, 8-PeCDF (pg/g)	1, 2, 3, 4, 7, 8-HxCDF (pg/g)	1, 2, 3, 6, 7, 8-HxCDF (pg/g)	2, 3, 4, 6, 7, 8-HxCDF (pg/g)	1, 2, 3, 7, 8, 9-HxCDF (pg/g)	1, 2, 3, 4, 6, 7, 8-HpCDF (pg/g)	1, 2, 3, 4, 7, 8, 9-HpCDF (pg/g)	OCDF (pg/g)	TOTAL TEQ[2,3] (pg/g)	PERCENT 2,3,7,8-TCDD
TP-1A2	TP-1	0.75-1.25	--	03-Apr-03	SAND	10.2	47.6	44.2	517	177	4,370	5,170	5.38	2.99	3.11	2.89	4.20	5.49	0.967 J	102	4.06	188	181	5.64
TP-1A(0-1.0)B[4]	TP-1A[5]	1.5-2.5	0.0-1.0	16-Apr-03	SAND	19.6	89.5	77.8	835	297	6,670	6,060	11.1	5.05	5.62	4.68	7.37	8.48	1.83 J	111	5.44	198	306	6.41
TP-1A(1-2.0)B[4]	TP-1A[5]	2.5-3.5	1.0-2.0	16-Apr-03	SAND	1.25	4.96	4.47	57.1	21.2	524	495	2.39	1.09 J	1.33 J	0.88 J	1.36 J	1.4 J	ND[0.337]	8.58	ND[0.623]	13.5	21.2	5.90
					TEF[6]:	1	1	0.1	0.1	0.1	0.01	0.0001	0.1	0.05	0.5	0.1	0.1	0.1	0.1	0.01	0.01	0.0001	--	--

NOTES:

TCDD	Tetrachlorodibenzo-p-dioxin
PeCDD	Pentachlorodibenzo-p-dioxin
HxCDD	Hexachlorodibenzo-p-dioxin
HpCDD	Heptachlorodibenzo-p-dioxin
OCDD	Octachlorodibenzo-p-dioxin
TCDF	Tetrachlorodibenzofuran
PeCDF	Pentachlorodibenzofuran
HxCDF	Hexachlorodibenzofuran
HpCDF	Heptachlorodibenzofuran
OCDF	Octachlorodibenzofuran
TEQ	Toxicity equivalency.
bgl	Below ground level.
pg/g	Picograms per gram.
--	Not applicable
ND	Not detected at or above the laboratory reporting limit shown in [ ].
[ ]	Indicates the reporting limit.
J	Concentration detected was below the calibration range.
1.	Depth below apparent baked clay layer encountered in borings TP-2, TP-3 and TP-4.
2.	Calculated by multiplying the congener concentration by its TEF.
3.	NDs were assigned a concentration of 0 pg/g to calculate TEQ.
4.	Composite sample.
5.	Boring TP-1A was located approximately 24 inches northeast of boring TP-1.
6.	Toxicity equivalency factor (unitless) from the World Health Organization, 1997 (WHO-97), adopted from F.X.R. van Leeuwen, 1997.

Dioxins and furans were analyzed using EPA Method 1613.

TABLE 1 (EXCERPT)
SUMMARY OF CHEMICAL ANALYSIS
RESULTS FROM THE FORMER GREEN CHAIN AREA COLLECTED DURING IRM ACTIVITIES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Sample ID	Date Sampled	Depth (feet) bgs	Matrix	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP	PCP	Total Dioxins and Furans TEQ [1,2,3,4]
		units for soil and wood samples		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pg/g
		units for water samples		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(no water samples)
SAMPLES FROM SHALLOW PIT BENEATH THE SOUTH CATWALK									
UCW-South Sand[5]	06-May-03	(0.5)	Soil	<1.0	<1.0	<1.0	<1.0	1.4	4,910
UCW-South Wood[5]	06-May-03	(0.5)	Wood	<1.0	<25	1400	<25	4600	1,940,000
UPPER FILL MATERIAL SAMPLES									
S-1-1'[5]	19-Jun-03	0.0	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	1,410
S-2-1'[5]	19-Jun-03	0.0	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	720
FIRST PHASE OF EXCAVATION—CONFIRMATION SOIL SAMPLES									
Pit Bottom[5]	09-Jul-03	1.3	Soil	<1.0	<1.0	100	1.7	380	10,700
Pit Under 2nd Slab	09-Jul-03	1.3	Soil	<1.0	<1.0	<1.0	<1.0	2.3	2,570
LOWER FILL MATERIAL SAMPLE									
4" Under 2nd Slab[5]	17-Jul-03	1.3	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	3,020
SOIL BORINGS NEAR MONITORING WELL MW-7									
B-61-1.2'	29-Aug-03	1.2	Soil	<1.0	<1.0	<1.0	<1.0	2.5	3,820
B-61-3'	29-Aug-03	3.0	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	na
B-62-1'	29-Aug-03	1.0	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	589
B-62-3'	29-Aug-03	3.0	Soil	<1.0	<1.0	<1.0	<1.0	21	na
B-63-1'	29-Aug-03	1.0	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	231
B-63-3'	29-Aug-03	3.0	Soil	<1.0	<1.0	<1.0	<1.0	17	na
SECOND PHASE OF EXCAVATION—CONFIRMATION SOIL SAMPLES									
Excavation Sidewall Soil Samples									
S-1E-2.5'	14-Sep-03	2.5	Soil	<1.0	<1.0	<1.0	<1.0	2.1	284
S-2E-2.5'	14-Sep-03	2.5	Soil	<1.0	<1.0	18	<1.0	32	na
S-3S-2.5'	14-Sep-03	2.5	Soil	<1.0	<1.0	4.6	<1.0	33	na
S-4N-2.5'	14-Sep-03	2.5	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	na
S-5N-2.5'[5]	15-Sep-03	2.5	Soil	<1.0	<1.0	1.1	<1.0	3.2	98.8
S-6N-1.5'[5]	16-Sep-03	1.5	Soil	<1.0	<1.0	560	1.7	850	11,500
S-7E-3'	16-Sep-03	3.0	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	4,560
S-8W-1.5'	16-Sep-03	1.5	Soil	<1.0	<1.0	6.5	<1.0	19	na

TABLE 1 (EXCERPT)
SUMMARY OF CHEMICAL ANALYSIS
RESULTS FROM THE FORMER GREEN CHAIN AREA COLLECTED DURING IRM ACTIVITIES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Sample ID	Date Sampled	Depth (feet) bgs	Matrix	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP	PCP	Total Dioxins and Furans TEQ ^{1,2,3,4}
		units for soil and wood samples		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pg/g
		units for water samples		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(no water samples)
S-9W-2.5'	16-Sep-03	2.5	Soil	<1.0	<1.0	1.6	<1.0	3.2	238
S-10S-0.5'	16-Sep-03	0.5	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	na
S-11S-2.5'	16-Sep-03	2.5	Soil	<1.0	<1.0	3.1	<1.0	9.2	650
S-12S-2.5'	16-Sep-03	2.5	Soil	<1.0	<1.0	4.5	<1.0	7.1	1,150
Excavation Base Soil Samples									
B-1-South	14-Sep-03	6.5	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	173
B-2-East	14-Sep-03	4.0	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	na
B-3-East	14-Sep-03	4.0	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	na
B-4-West^{5}	15-Sep-03	4.0	Soil	<1.0	<1.0	170	<1.0	640	17,600
B-5-West	16-Sep-03	4.0	Soil	<1.0	<1.0	2.2	<1.0	4.9	na
THIRD PHASE OF EXCAVATION—CONFIRMATION SOIL SAMPLES									
Excavation Sidewall Soil Samples									
S-30-1.5'	06-Nov-03	1.5	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	na
Excavation Base Soil Samples									
S-31-5.5'	06-Nov-03	5.5	Soil	<1.0	<1.0	<1.0	<1.0	<1.0	na

Abbeviations

-- = not analyzed
< = target analyte was not detected at or above the laboratory reporting limit shown.
bgs = Below ground surface
mg/kg = milligrams per kilogram
µg/l = micrograms per liter
PCP = pentachlorophenol
pg/g = picograms per gram
TCP = tetrachlorophenol
TEQ = toxic equivalency

Shading indicates material represented by this sample was removed during excavation activities conducted subsequent to collection of this sample.

Notes:

1. Calculated by multiplying the congener concentration by its Toxic Equivalency Factor (TEF).
2. When an analyte concentration was not detected, it was assigned a concentration of 0 pg/g to calculate TEQ.
3. World Health Organization, 1998 (WHO-98)
4. The total TEQ is the total TEQ for the analytical method target analytes.
5. Material represented by this sample was removed during excavation activities conducted subsequent to collection of this sample.

Appendix A-2 Grab Groundwater

Table 4	Grab Groundwater Results—Chlorophenols, TDS, &pH—2001 (Environet, 2003a)
Table 7	Groundwater Analytical Results—Borings—March 2002 (Environet, 2003a)
Table 18	Groundwater Analytical Results—Borings—November 2002 (Environet, 2003a)
Table 1 (Excerpt)	Summary of Chemical Analysis Results From the Former Green Chain Area Collected During IRM Activities (Geomatrix, 2003b)

Table 4: Groundwater Analytical Results - Chlorophenols, TDS, & pH - 2001
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,3,4,6-TCP+ 2,3,5,6-TCP	2,3,4,5-TCP	TDS	pH
		ug/L				
B-1-Water	07/23/01	16	6.0	3.0		6.1
B-2-Water	07/23/01	36	13	2.2		6.3
B-3-Water	07/23/01	58,000	ND	ND		6.3
B-4-Water	07/23/01	43,000	ND	ND		6.2
B-5-Water	07/24/01	57	16	ND		6.3
B-6-Water	07/24/01	61	5.3	ND		7.5
B-7-Water	07/24/01	ND	ND	ND		6.3
B-8-Water	07/24/01	ND	ND	ND		6.2
B-9-Water	07/24/01	5.8	3.6	ND		6.2
B-10-Water	07/24/01	12	6.8	ND		6.4
B-11-Water	07/24/01	27,000	410	ND		6.3
B-12-Water	07/24/01	39	5.9	ND		6.3
B-13-Water	07/25/01	6,300	ND	ND	520,000	6.8
B-14-Water	07/25/01	63,000	670	ND	550,000	6.3
B-15-Water	07/25/01	3.6	ND	ND		6.6
B-16-Water	07/25/01	29	2.9	ND		6.2
B-17-Water	07/25/01	4.0	ND	ND		6.2
B-18-Water	07/25/01	ND	ND	ND		6.2
B-19-Water	07/26/01	ND	ND	ND	290,000	6.4

Table 4, Continued: Groundwater Analytical Results - Chlorophenols, TDS, & pH - 2001
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,3,4,6-TCP+ 2,3,5,6-TCP	2,3,4,5-TCP	TDS	pH
		ug/L				
B-20-Water	07/26/01	3.5	ND	ND		6.2
B-21-Water	07/26/01	ND	ND	ND		6.2
B-22-Water	07/26/01	ND	ND	ND		6.2
B-23-Water	07/26/01	4.2	4.2	ND		6.4
B-24-Water	07/26/01	ND	ND	ND		6.5
B-25-Water	07/26/01	ND	ND	ND		6.6
B-26-Water	07/26/01	ND	ND	ND	690,000	6.3
B-27-Water	07/26/01	80	29	ND		6.6
B-28-Water	07/27/01	ND	ND	ND		6.1
B-29-Water	07/27/01	NA	NA	NA		NM
B-30-Water	07/27/01	ND	ND	ND		7.4
B-31-Water	07/27/01	ND	ND	ND		6.2
B-32-Water	07/27/01	ND	ND	ND		6.4
B-33-Water	08/01/01	14,000	6,900	ND		NM
B-34-Water	08/01/01	3,200	1,400	ND		NM
B-35-Water	08/01/01	1,200	380	ND		NM
B-36-Water	08/01/01	1,200	500	ND		NM
B-37-Water	08/01/01	350	93	ND		NM
B-38-Water	08/01/01	100,000	ND	ND		NM

Table 7: Groundwater Analytical Results - Borings - March 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		ug/L				
B-39	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-40	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-41	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-42	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-43	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-44	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-45	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-46	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-47	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0

Table 18: Groundwater Analytical Results - Borings - November 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		ug/L				
B-48	11/13/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-49	11/14/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-50		<1.0	<1.0	<1.0	<1.0	<1.0
B-51		<1.0	<1.0	<1.0	<1.0	<1.0
B-52		<1.0	<1.0	<1.0	<1.0	<1.0
B-53		<1.0	<1.0	<1.0	<1.0	<1.0
B-54	11/15/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-55		<1.0	<1.0	<1.0	<1.0	<1.0
B-56		<1.0	<1.0	<1.0	<1.0	<1.0
B-57		5,200	<1.0	40	240	11
B-58		580	<1.0	<10	33	2.6
B-59		85	<1.0	<1.0	150	<1.0
B-60		1.3	<1.0	<1.0	<1.0	<1.0

TABLE 1 (EXCERPT)
SUMMARY OF CHEMICAL ANALYSIS
RESULTS FROM THE FORMER GREEN CHAIN AREA COLLECTED DURING IRM ACTIVITIES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Sample ID	Date Sampled	Depth (feet) bgs	Matrix	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP	PCP	Total Dioxins and Furans TEQ [1,2,3,4]
	units for soil, sediment, concrete samples			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pg/g
		units for water samples		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(no water samples)
WATER SAMPLE FROM SHALLOW PIT BENEATH THE SOUTH CATWALK									
UCW-South-Water[5]	05-May-03	--	Pit Water	<1.0	< 8.5	1,100	69	11,000	na
SECOND PHASE OF EXCAVATION—CONFIRMATION WATER SAMPLE									
Excavation Water Sample									
Pit Water	17-Sep-03	--	Pit Water	19	<1.0	18,000	52	35,000	na

Abbeviations
-- = not analyzed
< = target analyte was not detected at or above the laboratory reporting limit shown.
bgs = Below ground surface
mg/kg = milligrams per kilogram
µg/l = micrograms per liter
PCP = pentachlorophenol
pg/g = picograms per gram
TCP = tetrachlorophenol
TEQ = toxic equivalency
Shading indicates material represented by this sample was removed during excavation activities conducted subsequent to collection of this sample.

Notes:

1. Calculated by multiplying the congener concentration by its Toxic Equivalency Factor (TEF).
2. When an analyte concentration was not detected, it was assigned a concentration of 0 pg/g to calculate TEQ.
3. World Health Organization, 1998 (WHO-98)
4. The total TEQ is the total TEQ for the analytical method target analytes.
5. Material represented by this sample was removed during excavation activities conducted subsequent to collection of this sample.

Appendix A-3 Monitoring Well Construction Details and Groundwater Monitoring Data

TABLE 1

MONITORING WELL CONSTRUCTION DETAILS [1]

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

WELL NO.	DATE INSTALLED	TOTAL BORING DEPTH (ft bgl)	TOTAL WELL DEPTH (ft bgl)	WELL DIAMETER (inches)	SCREENED INTERVAL (ft bgl)	SCREEN SLOT SIZE (inches)	FILTER PACK INTERVAL (ft bgl)	BENTONITE SEAL INTERVAL (ft bgl)	SURFACE SEAL INTERVAL [2] (ft bgl)
MW-1	5-Mar-02	8.0	8.0	2	2.0 – 8.0	0.010	1.5 – 8.0	1.0 – 1.5	0 – 1.0
MW-2	5-Mar-02	9.0	8.0	2	2.0 – 8.0	0.010	1.5 – 9.0	1.0 – 1.5	0 – 1.0
MW-3	5-Mar-02	8.5	8.0	2	2.0 – 8.0	0.010	1.5 – 8.5	1.0 – 1.5	0 – 1.0
MW-4	5-Mar-02	8.0	8.0	2	2.0 – 8.0	0.010	1.5 – 8.0	1.0 – 1.5	0 – 1.0
MW-5	7-Mar-02	8.0	8.0	2	2.0 – 8.0	0.010	1.5 – 8.0	1.0 – 1.5	0 – 1.0
MW-6	7-Mar-02	8.0	8.0	2	2.0 – 8.0	0.010	1.5 – 8.0	1.0 – 1.5	0 – 1.0
MW-7	7-Mar-02	8.0	8.0	2	2.0 – 8.0	0.010	1.5 – 8.0	1.0 – 1.5	0 – 1.0
MW-8	8-Mar-02	8.0	8.0	2	2.0 – 8.0	0.010	1.5 – 8.0	1.0 – 1.5	0 – 1.0
MW-9	8-Mar-02	8.0	8.0	2	2.0 – 8.0	0.010	1.5 – 8.0	1.0 – 1.5	0 – 1.0
MW-10	11-Nov-02	9.5	8.0	2	2.0 – 8.0	0.010	1.5 – 9.5	1.0 – 1.5	0 – 1.0
MW-11	12-Nov-02	8.5	8.0	2	2.0 – 8.0	0.010	1.5 – 8.5	1.0 – 1.5	0 – 1.0
MW-12	12-Nov-02	9.5	8.0	2	2.0 – 8.0	0.010	1.5 – 9.5	1.0 – 1.5	0 – 1.0
MW-13D	12-Nov-02	21.0	20.0	2	15.0 – 20.0	0.010	13.5 – 21.0	12.0 – 13.5	0 – 12.0
MW-14	13-Nov-02	8.0	8.0	2	2.0 – 8.0	0.010	1.5 – 8.0	1.0 – 1.5	0 – 1.0
MW-15D	13-Nov-02	21.0	20.0	2	15.0 – 20.0	0.010	14.0 – 21.0	12.0 – 14.0	0 – 12.0
MW-16D	14-Nov-02	21.5	20.0	2	15.0 – 20.0	0.010	14.0 – 21.5	12.0 – 14.0	0 – 12.0
MW-17	14-Nov-02	9.0	8.0	2	2.0 – 8.0	0.010	1.5 – 9.0	1.0 – 1.5	0 – 1.0
MW-18	13-Nov-02	9.5	8.0	4	2.0 – 8.0	0.010	1.5 – 9.5	1.0 – 1.5	0 – 1.0
MW-19D	14-Nov-02	21.5	20.0	2	15.0 – 20.0	0.010	14.0 – 21.0	12.0 – 14.0	0 – 12.0

NOTES:

ft bgl Feet below ground level.

1 Construction details for wells MW-1 through MW-9 were obtained from *Report on Recent Hydrogeologic Investigations at Sierra-Pacific Industries, Arcata Division Sawmill*, dated April 19, 2002 prepared by Environet Consulting. Construction details for wells MW-10 through MW-19D were obtained from *Results of the Remedial Investigation for Sierra Pacific Industries – Arcata Division Sawmills, Arcata, California*, dated January 30, 2003, prepared by Environet Consulting.

2 Surface seal interval includes the concrete surface seal and neat cement sanitary seal.

TABLE 4

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER SAMPLES FROM MONITORING WELLS FOR CHLORINATED PHENOLS

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

WELL NO.	DATE SAMPLED [1]	PCP (µg/L)	2,4,6-TRI-CHLORO-PHENOL (µg/L)	2,3,5,6-TCP (µg/L)	2,3,4,6-TCP (µg/L)	2,3,4,5-TCP (µg/L)
MW-1	14-Mar-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	18-Jul-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	16-Sep-02	1.8	< 1.0	< 1.0	< 1.0	< 1.0
	03-Oct-02 [2]	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	02-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-2	14-Mar-02	7.4	< 1.0	< 1.0	< 1.0	< 1.0
	18-Jul-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	16-Sep-02	2.5	< 1.0	< 1.0	< 1.0	< 1.0
	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-3	14-Mar-02	1.2	< 1.0	< 1.0	< 1.0	< 1.0
	18-Jul-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	16-Sep-02	5.0	< 1.0	< 1.0	< 1.0	< 1.0
	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-4	14-Mar-02	8.6	< 1.0	< 1.0	< 1.0	< 1.0
	18-Jul-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	16-Sep-02	5.7	< 1.0	< 1.0	< 1.0	< 1.0
	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-5	14-Mar-02	4.3	< 1.0	< 1.0	< 1.0	< 1.0
	18-Jul-02	9.1	< 1.0	< 1.0	< 1.0	< 1.0
	16-Sep-02	25	< 1.0	< 1.0	< 1.0	< 1.0
	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03 [3]	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

TABLE 4

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER SAMPLES FROM MONITORING WELLS FOR CHLORINATED PHENOLS

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

WELL NO.	DATE SAMPLED [1]	PCP (μg/L)	2,4,6-TRI-CHLORO-PHENOL (μg/L)	2,3,5,6-TCP (μg/L)	2,3,4,6-TCP (μg/L)	2,3,4,5-TCP (μg/L)
MW-6	14-Mar-02	4.5	< 1.0	< 1.0	< 1.0	< 1.0
	18-Jul-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	16-Sep-02	6.3	< 1.0	< 1.0	< 1.0	< 1.0
	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-7	14-Mar-02	31,000	< 1.0	41	650	24
	18-Jul-02	33,000	< 1.0	< 1.0	990	56
	16-Sep-02	44,000	< 1.0	< 1.0	920	64
	03-Dec-02	46,000	< 1.3	76	1,300	52
	14-Jan-03 [4]	51,000	2.4	< 1.0	970	52
	20-Mar-03	19,000	< 1.0	36	460	22
	22-May-03	19,000	< 1.0	< 1.0	470	< 100
	22-May-03 [3]	16,000	< 1.0	< 1.0	400	< 100
	22-May-03 [5]	14,000	< 1.0	< 1.0	400	< 100
	27-Aug-03	31,000	< 1.5	41	710	39
	27-Aug-03 [3]	18,000	< 1.0	28	450	26
MW-8	14-Mar-02	22	< 1.0	< 1.0	< 1.0	< 1.0
	18-Jul-02	31	< 1.0	< 1.0	< 1.0	< 1.0
	16-Sep-02	4.8	< 1.0	< 1.0	< 1.0	< 1.0
	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	18-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	21-May-03	1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-9	14-Mar-02	94	3.1	21	130	5.5
	18-Jul-02	2.1	< 1.0	< 1.0	< 1.0	< 1.0
	16-Sep-02	3.1	< 1.0	< 1.0	< 1.0	< 1.0
	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	18-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	23-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-10	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	18-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	23-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

TABLE 4

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER SAMPLES FROM MONITORING WELLS FOR CHLORINATED PHENOLS

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

WELL NO.	DATE SAMPLED [1]	PCP (µg/L)	2,4,6-TRI-CHLORO-PHENOL (µg/L)	2,3,5,6-TCP (µg/L)	2,3,4,6-TCP (µg/L)	2,3,4,5-TCP (µg/L)
MW-11	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	21-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-12	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	18-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	21-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-13D	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-14	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-15D	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-16D	03-Dec-02	1.3	< 1.0	< 1.0	< 1.0	< 1.0
	18-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	23-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-17	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
MW-18	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	18-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	23-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

TABLE 4

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER SAMPLES FROM MONITORING WELLS FOR CHLORINATED PHENOLS

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

WELL NO.	DATE SAMPLED [1]	PCP (µg/L)	2,4,6-TRI-CHLORO-PHENOL (µg/L)	2,3,5,6-TCP (µg/L)	2,3,4,6-TCP (µg/L)	2,3,4,5-TCP (µg/L)
MW-19D	03-Dec-02	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	20-Mar-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	22-May-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	27-Aug-03	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

NOTES:

PCP	Pentachlorophenol.
TCP	Tetrachlorophenol.
µg/L	Micrograms per liter.
<	Target analyte was not detected at or above the laboratory reporting limit shown.
1.	Data prior to March 18, 2003 were obtained from *Results of the Remedial Investigation for Sierra Pacific Industries - Arcata Division Sawmills, Arcata, California* , dated January 30, 2003, prepared by Environet Consulting.
2.	Confirmation sample collected due to detection of PCP on September 16, 2002.
3.	Duplicate sample.
4.	Sample also contained 280 µg/L of 2,3,4-trichlorophenol and 190 µg/L of 2,4,5-trichlorophenol.
5.	Filtered sample.

Chlorinated phenols were analyzed using the Canadian Pulp Method.

Table 8: Groundwater Analytical Results - Monitoring Wells
Total Organic Carbon, Chemical Oxygen Demand, and Chloride - March 2002
2293 Samoa Road, Arcata, California

ID	Date	Total Organic Carbon	Chemical Oxygen Demand	Chloride
		mg/L		
MW-1	03/25/02	45.7	110	520
MW-2		31.1	100	200
MW-3		20.0	57	41
MW-4		17.1	47	32
MW-5		9.04	28	16
MW-6		14.6	47	40
MW-7		23.2	57	73
MW-8		20.1	47	23
MW-9		12.3	47	37

Table 11: Groundwater Analytical Results - CAM-17 Metals - MW-7
2293 Samoa Road, Arcata, California

ID	Date	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
		mg/L																
MW-7	01/15/03	<0.15	<0.20	<0.05	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.2	<0.01	<0.4	<0.05	<0.05

Table 10: Groundwater Analytical Results - Monitoring Wells
Natural Attenuation Parameters - January 2003
2293 Samoa Road, Arcata, California

[illegible] ID	Conductivity	Total Alkalinity	Free CO_2	NO_3	SO_4	Mn	Fe [illegible]	Ca	Mg	ORP	TSS	TDS	DO	pH
	uS/cm	mg $CaCO_3$/L	mg CO_2/L	mg/L						mVolts	[illegible]			[illegible]
MW-3	1,050	420	NA	NA	NA	5.3	32	59	49	130	220	550	9.3	6.38
MW-7	660	350	280	<0.5	<2.0	2.9	35	30	50	190	950	560	8.6	6.45

TABLE 5

SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER SAMPLES FROM MONITORING WELL MW-7 FOR DIOXINS AND FURANS

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

		DIOXINS								FURANS												
WELL NO.	DATE SAMPLED	2, 3, 7, 8-TCDD (pg/L)	1, 2, 3, 7, 8-PeCDD (pg/L)	1, 2, 3, 4, 7, 8-HxCDD (pg/L)	1, 2, 3, 6, 7, 8-HxCDD (pg/L)	1, 2, 3, 7, 8, 9-HxCDD (pg/L)	1, 2, 3, 4, 6, 7, 8-HpCDD (pg/L)	OCDD (pg/L)	TOTAL DIOXINS [1] (pg/L)	2, 3, 7, 8-TCDF (pg/L)	1, 2, 3, 7, 8-PeCDF (pg/L)	2, 3, 4, 7, 8-PeCDF (pg/L)	1, 2, 3, 4, 7, 8-HxCDF (pg/L)	1, 2, 3, 6, 7, 8-HxCDF (pg/L)	2, 3, 4, 6, 7, 8-HxCDF (pg/L)	1, 2, 3, 7, 8, 9-HxCDF (pg/L)	1, 2, 3, 4, 6, 7, 8-HpCDF (pg/L)	1, 2, 3, 4, 7, 8, 9-HpCDF (pg/L)	OCDF (pg/L)	TOTAL FURANS [1] (pg/L)	TOTAL [2, 3] TEQ (pg/L)	PERCENT 2, 3, 7, 8-TCDD [4] (%)
MW-7	16-Sep-02 [5]	<3.12	<3.45	<5.82	<6.31	<5.32	32.4	144	194	<3.36	<4.21	<4.59	<2.38	<2.81	<2.86	<2.99	6.59	<6.67	22.2	103.63 J	0.407	0
	22-May-03	<1.62	<4.05	22.6 J	<3.83	<3.10	30.2	449	550.5 J	<1.26	<2.04	<2.02	<1.02	<1.17	<1.19	<1.15	4.97 J	<0.807	20.7 J	69.14 J	2.66	0
	22-May-03 [6]	<1.27	<2.00	7.89 J	<2.47	<1.97	16.3 J	231	281 J	<1.01	<1.66	<1.64	<1.09	<1.28	<1.40	<1.67	2.09 J	<1.19	7.05 J	39.68 J	0.996	0
	TEF [7]:	1	1	0.1	0.1	0.1	0.01	0.0001	NA	0.1	0.05	0.5	0.1	0.1	0.1	0.1	0.01	0.01	0.0001	NA	NA	NA

NOTES:

TCDD	Tetrachlorodibenzo-p-dioxin
PeCDD	Pentachlorodibenzo-p-dioxin
HxCDD	Hexachlorodibenzo-p-dioxin
HpCDD	Heptachlorodibenzo-p-dioxin
OCDD	Octachlorodibenzo-p-dioxin
TCDF	Tetrachlorodibenzofuran
PeCDF	Pentachlorodibenzofuran
HxCDF	Hexachlorodibenzofuran
HpCDF	Heptachlorodibenzofuran
OCDF	Octachlorodibenzofuran
TEQ	Toxicity equivalency.
pg/L	Picograms per liter.
NA	Not applicable.
<	Target analyte was not detected at or above the laboratory reporting limit shown.
J	Analyte concentration was below the calibration range.
TEF	Toxicity equivalency factor (unitless).

1. Total concentration includes target and non-target analytes.
2. Calculated by multiplying the congener concentration by its TEF.
3. When an analyte concentration was not detected, it was assigned a concentration of 0 pg/L to calculate TEQ.
4. Calculated by dividing the concentration of 2, 3, 7, 8-TCDD by the Total TEQ. When the concentration of 2, 3, 7, 8-TCDD was not detected, it was assigned a concentration of 0 pg/L for this calculation.
5. Data were obtained from *Results of the 3rd Quarter 2002 Groundwater Monitoring and Sampling Event for Sierra Pacific Industries - Arcata Division Sawmills, Arcata, California*, dated November 25, 2002, prepared by Environet Consulting.
6. Filtered sample.
7. World Health Organization, 1997 (WHO-97) adopted from F.X.R. van Leeuwen, 1997.

Dioxins and furans were analyzed using EPA Method 1613.

TABLE A-3A
ANALYSIS OF GROUNDWATER SAMPLE FROM WELL MW-7 FOR DIOXINS AND FURANS

Sierra Pacific Industries
Arcata Sawmill Division
Arcata, California

Sample Location	**MW-7**	
Sample ID	**A311061-02**	
Media	**Groundwater**	
Dat Sampled	**3-Nov-03**	
Compound	**Concentration (pg/L)**	**TCDD Equivalent (pg/L)**
Dioxin		
2,3,7,8-TCDD	<2.22	0
1,2,3,7,8-PeCDD	<4.82	0
1,2,3,4,7,8-HxCDD	<9.48	0
1,2,3,6,7,8-HxCDD	<10.4	0
1,2,3,7,8,9-HxCDD	<9.25	0
1,2,3,4,6,7,8-HpCDD	<9.54	0
OCDD	41.1	0.00411
Furan		
2,3,7,8-TCDF	<2.29	0
1,2,3,7,8-PeCDF	<7.96	0
2,3,4,7,8-PeCDF	<5.93	0
1,2,3,4,7,8-HxCDF	<2.11	0
1,2,3,6,7,8-HxCDF	<2.51	0
2,3,4,6,7,8-HxCDF	<2.63	0
1,2,3,7,8,9-HxCDF	<3.12	0
1,2,3,4,6,7,8-HpCDF	<3.03	0
1,2,3,4,7,8,9-HpCDF	<4.42	0
OCDF	<10.6	0
Total TCDD/TCDF TEQ (pg/L)		0.0041

Notes:
TCDD = Tetrachlorodibenzo-p-dioxin
PeCDD = Pentachlorodibenzo-p-dioxin
HxCDD = Hexachlorodibenzo-p-dioxin
HpCDD = Heptachlorodibenzo-p-dioxin
OCDD = Octachlorodibenzo-p-dioxin
TCDF = Tetrachlorodibenzofuran
PeCDF = Pantachlorodibenzofuran
HxCDF = Hexachlorodibenzofuran
HpCDF = Heptachlorodibenzofuran
OCDF = Octachlorodibenzofuran
TEQ = Toxic Equivalency
pg/L = picrograms per liter
< = compound not detected above laboratory reporting limit indicated

TABLE A-3B
SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER SAMPLES FROM MONITORING WELLS FOR CHLORINATED PHENOLS

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Concentrations in micrograms per liter (µg/L)

Well Number	Date Sampled	Penta-chlorophenol	2,4,6-trichloro-phenol	2,3,5,6-tetrachloro-phenol	2,3,4,6-tetrachloro-phenol	2,3,4,5-tetrachloro-phenol
MW-1	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-2	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-3	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-4	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-5	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-7-LF-U	3-Nov-03	20,000	<5.0	28	450	24
MW-7-LF-F	3-Nov-03	14,000	<5.0	19	300	17
MW-7-B-U	3-Nov-03	28,000	<5.0	36	580	35
MW-7-B-F	3-Nov-03	31,000	<5.0	47	740	43
MW-8	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-9	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-10	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-11	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-12	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-13D	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-14	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-15D	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-16D	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-17	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-18	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0
MW-19D	4-Nov-03	<1.0	<1.0	<1.0	<1.0	<1.0

Appendix A-4 Asphalt and Concrete

Table 6	Soil Analytical Results—Borings—March 2002 (Environet, 2003a)
Table 1 (Excerpt)	Summary of Chemical Analysis Results From the Former Green Chain Area Collected During IRM Activities (Geomatrix, 2003b)

Table 6, Continued: Soil Analytical Results - Borings - March 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
B-47-2'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-47-3'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-47-3.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-47-4.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
B-47-5.5'	03/06/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-1-2.5'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-1-4.5'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-2-2.5'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-2-4'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-3-4'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-3-5'	03/05/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-4-2.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-4-3.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-5-2'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-5-3.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6-1.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6-3'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6-SA	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-6-SC	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0

Note: Sample MW-6-SA is a surface asphalt sample collected at location MW-6; sample MW-6-SC is a surface concrete sample collected at location MW-6.

Table 6, Continued: Soil Analytical Results - Borings - March 2002
2293 Samoa Road, Arcata, California

ID	Date	PCP	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP
		mg/kg				
MW-7-1.5'	03/07/02	10	<1.0	<1.0	<1.0	<1.0
MW-7-3'	03/07/02	19	<1.0	<1.0	<1.0	<1.0
MW-7-5.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-7-6.5'	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-7-SC	03/07/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-8-1.5	03/08/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-8-3'	03/08/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-9-2.5	03/08/02	<1.0	<1.0	<1.0	<1.0	<1.0
MW-9-4	03/08/02	<1.0	<1.0	<1.0	<1.0	<1.0

Note: Sample MW-7-SC is a surface concrete sample collected at location MW-7.

TABLE 1 (EXCERPT)
SUMMARY OF CHEMICAL ANALYSIS
RESULTS FROM THE FORMER GREEN CHAIN AREA COLLECTED DURING IRM ACTIVITIES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Sample ID	Date Sampled	Depth (feet) bgs	Matrix	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP	PCP	Total Dioxins and Furans TEQ ^{1,2,3,4}
	units for soil, sediment, concrete samples			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pg/g
		units for water samples		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(no water samples)
CONCRETE AND UPPER FILL MATERIAL SAMPLES									
C-1[5]	19-Jun-03	--	Concrete	--	--	--	--	--	3,050
C-2[5]	19-Jun-03	--	Concrete	--	--	--	--	--	52,900
SOIL BORINGS NEAR MONITORING WELL MW-7									
B-61-Concrete Upper	29-Aug-03	--	Concrete	<1.0	<1.0	12	<1.0	15	17,400
B-61-Concrete Lower	29-Aug-03	--	Concrete	<1.0	<1.0	<1.0	<1.0	1.2	11,800
B-62-Concrete Upper	29-Aug-03	--	Concrete	<1.0	<1.0	<1.0	<1.0	<1.0	112
B-62-Concrete Lower	29-Aug-03	--	Concrete	<1.0	<1.0	<1.0	<1.0	<1.0	4,940

Abbeviations
-- = not analyzed
< = target analyte was not detected at or above the laboratory reporting limit shown.
bgs = Below ground surface
mg/kg = milligrams per kilogram
µg/l = micrograms per liter
PCP = pentachlorophenol
pg/g = picograms per gram
TCP = tetrachlorophenol
TEQ = toxic equivalency

Shading indicates material represented by this sample was removed during excavation activities conducted subsequent to collection of this sample.

Notes:

1. Calculated by multiplying the congener concentration by its Toxic Equivalency Factor (TEF).
2. When an analyte concentration was not detected, it was assigned a concentration of 0 pg/g to calculate TEQ.
3. World Health Organization, 1998 (WHO-98)
4. The total TEQ is the total TEQ for the analytical method target analytes.
5. Material represented by this sample was removed during excavation activities conducted subsequent to collection of this sample.

Appendix A-5 Storm Water, Storm Water Solids, and Drainage Ditch Samples

Table 2	Summary of Historical Storm Water Chemical Analyses (MFG, 2003c)
Form 1	Sampling and Analysis Result (Environet, 2003b)
Table 2	Historical Unconfirmed Locations Storm Water Analytical Results—PCP and TCP (Environet, 2003a)
Table 5	Soil Analytical Results—Drainages—2001 (Environet, 2003a)

Dioxins and Furans—NCRWQCB—June 2001 (Environet, 2003a)

Table 1 (Excerpt)	Summary of Chemical Analysis Results From the Former Green Chain Area Collected During IRM Activities (Geomatrix, 2003b)

TABLE 2

SUMMARY OF HISTORICAL STORM WATER CHEMICAL ANALYSES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

DATE	SL-1		SL-2		SL-3		SL-4		SL-5		SL-6		VEGETATED POND		SPRINKLER SUPPLY WELL	
	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
1983																
9/9/1983	0.58	0.66	--	--	--	--	17	114	--	--	--	--	--	--	--	--
10/24/1983	6.9	13.3	--	--	--	--	1.05	0.35	--	--	--	--	--	--	<0.05	<0.05
11/23/1983	94	79	--	--	--	--	47	33	--	--	--	--	--	--	--	--
12/15/1983	51	24	--	--	--	--	86	110	--	--	--	--	--	--	--	--
1984																
1/20/1984	8.7	7.1	--	--	--	--	1.1	0.84	--	--	--	--	--	--	--	--
2/16/1984	14	12	--	--	--	--	5.7	3.9	--	--	--	--	--	--	--	--
3/21/1984	74	68	--	--	--	--	55	125	--	--	--	--	--	--	--	--
4/16/1984	28	18	--	--	--	--	3.1	2.4	--	--	--	--	--	--	--	--
5/15/1984	2	15	--	--	--	--	0.51	17	--	--	--	--	--	--	--	--
6/18/1984	--	--	--	--	--	--	2	17.6	--	--	--	--	--	--	--	--
7/14/1984	--	--	--	--	--	--	2.1	14.4	--	--	--	--	--	--	--	--
8/15/1984	--	--	--	--	--	--	0.55	2.7	--	--	--	--	--	--	--	--
8/27/1984	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<0.2	<0.2
9/24/1984	--	--	--	--	--	--	0.7	3.7	--	--	--	--	--	--	--	--
11/1/1984	88	355	--	--	--	--	2.8	13	--	--	--	--	--	--	--	--
12/4/1984	51	65	--	--	--	--	51	61	--	--	--	--	--	--	--	--
1985																
1/14/1985	54	52	--	--	--	--	4	19	--	--	--	--	--	--	--	--
Duplicate	59	53	--	--	--	--	4	20	--	--	--	--	--	--	--	--
2/15/1985	20	--	--	--	--	--	249	604	--	--	--	--	--	--	--	--
Duplicate	--	--	--	--	--	--	242	486	--	--	--	--	--	--	--	--
3/8/1985	224	355	--	--	--	--	35	65	--	--	--	--	--	--	--	--
Duplicate	187	270	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 2

SUMMARY OF HISTORICAL STORM WATER CHEMICAL ANALYSES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

DATE	SL-1		SL-2		SL-3		SL-4		SL-5		SL-6		VEGETATED POND		SPRINKLER SUPPLY WELL	
	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
4/10/1985	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
5/6/1985	--	--	--	--	--	--	4	16	--	--	--	--	--	--	--	--
7/3/1985	--	--	--	--	--	--	4	14	--	--	--	--	--	--	--	--
8/9/1985	--	--	--	--	--	--	2	4	--	--	--	--	--	--	--	--
9/3/1985	--	--	--	--	--	--	<1	3	--	--	--	--	--	--	--	--
10/31/1985	16	19	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
1986																
1/16/1986	24	29	--	--	--	--	18	33	--	--	--	--	--	--	--	--
2/6/1986	3	3	--	--	--	--	4	7	--	--	--	--	--	--	--	--
3/11/1986	12	12	--	--	--	--	46	50	--	--	--	--	--	--	--	--
3/14/1986	--	--	--	--	--	--	--	--	--	--	--	--	<1	<1	--	--
4/14/1986	6	4	--	--	--	--	8	11	--	--	--	--	--	--	--	--
9/26/1986	10	10	--	--	--	--	185	275	--	--	--	--	--	--	--	--
12/8/1986	5	3	--	--	--	--	1	5	--	--	--	--	--	--	--	--
1987																
2/13/1987	2	1	--	--	--	--	9	30	--	--	--	--	--	--	--	--
2/26/1987	6	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3/13/1987	23	15	--	--	--	--	180	410	--	--	--	--	--	--	--	--
4/21/1987	--	--	--	--	--	--	<1	2	--	--	--	--	--	--	--	--
5/18/1987	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
6/10/1987	--	--	--	--	--	--	1	3	--	--	--	--	--	--	--	--
11/13/1987	9	11	--	--	--	--	7	24	--	--	--	--	--	--	--	--
12/1/1987	6	5	--	--	--	--	39	87	--	--	--	--	--	--	--	--
12/30/1987	23	10	--	--	--	--	5	4	--	--	--	--	--	--	--	--

TABLE 2

SUMMARY OF HISTORICAL STORM WATER CHEMICAL ANALYSES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

DATE	SL-1		SL-2		SL-3		SL-4		SL-5		SL-6		VEGETATED POND		SPRINKLER SUPPLY WELL	
	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
1988																
1/11/1988	37	66	--	--	--	--	11	2	--	--	--	--	--	--	--	--
2/19/1988	--	--	--	--	--	--	--	--	--	--	--	--	<1	<1	<1	<1
5/12/1988	3	3	5	6	<1	1	3	8	--	--	--	--	--	--	--	--
11/15/1988	3	1	--	--	--	--	16	30	--	--	--	--	--	--	--	--
12/22/1988	3	1	--	--	--	--	2	4	--	--	--	--	--	--	--	--
1989																
3/13/1989	1	<1	--	--	--	--	1	5	--	--	--	--	--	--	--	--
4/24/1989	<1	<1	--	--	--	--	1	3	--	--	--	--	--	--	--	--
5/25/1989	1	<1	--	--	--	--	<1	2	--	--	--	--	--	--	--	--
11/27/1989	<1	<1	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
1990																
1/8/1990	1	<1	--	--	--	--	5	11	--	--	--	--	--	--	--	--
5/23/1990	<1	<1	--	--	--	--	<1	<1	--	--	--	--	<1	<1	<1	<1
11/27/1990	<1	<1	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
1991																
2/5/1991	<1	<1	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
3/6/1991	<1	<1	--	--	--	--	<1	1.6	--	--	--	--	--	--	--	--
11/21/1991	<1	<1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
12/2/1991	--	--	--	--	--	--	<1	<1	--	--	--	--	--	--	--	--
1992																
2/12/1992	<1	<1	--	--	--	--	130	140	--	--	--	--	--	--	--	--
4/15/1992	<1	<1	--	--	--	--	<1	1 2	--	--	--	--	<1	<1	<1	<1
11/2/1992	3 8	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--

TABLE 2

SUMMARY OF HISTORICAL STORM WATER CHEMICAL ANALYSES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

DATE	SL-1		SL-2		SL-3		SL-4		SL-5		SL-6		VEGETATED POND		SPRINKLER SUPPLY WELL	
	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
1993																
1/7/1993	1.4	<1	--	--	--	--	19	20	--	--	--	--	--	--	--	--
6/1/1993	0.48	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
12/13/1993	1.9	<1	<0.3	<1	--	--	--	--	--	--	--	--	--	--	--	--
1994																
1/25/1994	1.2	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
2/18/1994	1.3	<1	--	--	--	--	27	15	--	--	--	--	--	--	--	--
3/31/1994	0.65	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
11/11/1994	0.5	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
12/28/1994	1.3	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
1995																
1/31/1995	1.9	<1	--	--	--	--	2.9	1.4	--	--	--	--	--	--	--	--
2/31/1995	1.9	<1	--	--	--	--	2.9	1.4	--	--	--	--	--	--	--	--
4/7/1995	2.5	<1	160	62	<0.3	<1	20	13	--	--	--	--	<0.3	<1	<0.3	<1
12/1/1995	2.9	<1	--	--	--	--	13	7.9	--	--	--	--	--	--	--	--
1996																
1/16/1996	1.9	<1	--	--	--	--	38	24	--	--	--	--	--	--	--	--
3/1/1996	0.5	<1	--	--	--	--	1.6	<1	--	--	--	--	--	--	--	--
4/17/1996	<0.3	<1	15	7.9	--	--	12	6.9	--	--	--	--	<0.3	<1	<0.3	<1
5/15/1996	0.49	<1	--	--	--	--	18	10	--	--	--	--	--	--	--	--
10/22/96	0.61	<1	--	--	--	--	0.5	<1	--	--	--	--	--	--	--	--
11/18/1996	2.3	<1	--	--	--	--	0.56	<1	--	--	--	--	--	--	--	--
12/5/1996	0.73	<1	--	--	--	--	15	7.5	--	--	--	--	--	--	--	--

TABLE 2

SUMMARY OF HISTORICAL STORM WATER CHEMICAL ANALYSES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

DATE	SL-1		SL-2		SL-3		SL-4		SL-5		SL-6		VEGETATED POND		SPRINKLER SUPPLY WELL	
	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
1997																
2/27/1997	1.5	<1	--	--	--	--	1.2	<1	--	--	--	--	--	--	--	--
4/16/1997	0.99	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
5/23/1997	0.43	<1	10	<1	--	--	<0.3	<1	--	--	--	--	<0.3	<1	<0.3	<1
9/17/1997	1.3	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
10/9/1997	0.41	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
1998																
1/5/1998	<0.3	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
2/5/1998	<0.3	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
4/10/1998	1.7	<1	13	2.5	--	--	<0.3	<1	--	--	--	--	<0.3	<1	<0.3	<1
4/13/1998	<0.3	<1	--	--	--	--	<0.3	<1	--	--	--	--	--	--	--	--
11/6/1998	2.2	<1	--	--	--	--	4.3	3.3	--	--	--	--	--	--	--	--
1999																
1/18/1999	0.69	<1	--	--	--	--	2	<1	--	--	--	--	--	--	--	--
2/8/1999	2.2	<1	--	--	--	--	9.2	3.3	--	--	--	--	--	--	--	--
4/5/1999	1.1	<1	--	--	--	--	0.34	<1	--	--	--	--	--	--	--	--
10/28/1999	<0.3	<1	--	--	--	--	0.44	<1	--	--	--	--	--	--	--	--
11/19/1999	2	<1	--	--	--	--	2.7	2.2	--	--	--	--	--	--	--	--
2000																
11/13/2000	0.99	<1.0	--	--	--	--	<0.3	<1.0	--	--	--	--	--	--	--	--
2001																
2/9/2001	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--	--	<1.0	<1.0	<1.0	<1.0	--	--
10/30/2001	<1.0	<1.0	1.2	1.2	<1.0	<1.0	<1.0	<1.0	--	--	<1.0	<1.0	--	--	--	--
11/16/2001	--	--	--	--	--	--	--	--	<1.0	<1.0	--	--	--	--	--	--

TABLE 2

SUMMARY OF HISTORICAL STORM WATER CHEMICAL ANALYSES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

DATE	SL-1		SL-2		SL-3		SL-4		SL-5		SL-6		VEGETATED POND		SPRINKLER SUPPLY WELL	
	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP	PCP	TCP
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
2002																
2/19/2002	<1.0	<1.0	2.2	<1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--	--	--	--
6/5/2002	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<1.0	<1.0

Notes:

SL	Storm water sampling location
PCP	Pentachlorophenol
TCP	Tretachlorophenol
µg/L	micrograms/liter
<	Not detected at or above the listed laboratory reporting limit
--	Indicates data not collected
Duplicate	Field duplicate of the preceding sample in this table
	Storm water sampling location SL-1 was relocated in 2000 from a location near the outfall of dicth # 1 into the Mad River Slough to its present location.

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FORM 1-SAMPLING & ANALYSIS RESULTS

FIRST STORM EVENT

- If analytical results are less than the detection limit (or non detectable), show the value as less than the numerical value of the detection limit (example: <.05)
- If you did not analyze for a required parameter, do not report "0". Instead, leave the appropriate box blank
- When analysis is done using portable analysis (such as portable pH meters, SC meters, etc.), indicate "PA" in the appropriate test method used box.
- Make additional copies of this form as necessary.

NAME OF PERSON COLLECTING SAMPLE(S): Arnold Parks TITLE: Field Technician SIGNATURE: Arnold E Parks

DESCRIBE DISCHARGE LOCATION Example: NW Out Fall	DATE/TIME OF SAMPLE COLLECTION	TIME DISCHARGE STARTED	ANALYTICAL RESULTS For First Storm Event									
			BASIC PARAMETERS					OTHER PARAMETERS				
			pH	TSS	SC	O&G	COD	TCP	PCP	TPH-D	TPH-MO	TPH-G
SL-1	11/07/02 ☒ AM 8:15 ☐ PM	4:00 ☒ AM ☐ PM	6.6	20	28,000	5.4	390	<1.0	<1.0	<50	110	<50
SL-2	11/07/02 ☒ AM 8:35 ☐ PM	4:00 ☒ AM ☐ PM	5.9	130	3,800	<5.0	860	<1.0	1.8	1,300	940	200
SL-3	11/07/02 ☒ AM 8:50 ☐ PM	4:00 ☒ AM ☐ PM	4.8	3,700	650	<5.0	3,200	<1.0	<1.0	870	3,600	130
SL-4	11/07/02 ☒ AM 9:00 ☐ PM	4:00 ☒ AM ☐ PM	5.8	1,100	360	6.8	1,600	<1.0	<1.0	320	1,400	140
TEST REPORTING UNITS:			pH Units	mg/l	umho/cm	mg/l	mg/l	ug/L	ug/L	ug/L	ug/L	ug/L
TEST METHOD DETECTION LIMIT:			3.0	1.0	20	5.0	10	1.0	1.0	50/54/53/56	100/110/110/110	50
TEST METHOD USED:			EPA 150.1	EPA 160.2	EPA 120.1	EPA 1664	EPA 410.2	Canadian Pulp Method	Canadian Pulp Method	EPA 8015 DRO	EPA 8015 DRO	EPA 8015 GRO
ANALYZED BY (SELF/LAB):			Alpha Analytical Laboratories, Inc									

TSS - Total Suspended Solids SC - Specific Conductance O&G - Oil & Grease TOC - Total Organic Carbon

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FORM 1-SAMPLING & ANALYSIS RESULTS

FIRST STORM EVENT

- If analytical results are less than the detection limit (or non detectable), show the value as less than the numerical value of the detection limit (example: <.05)
- If you did not analyze for a required parameter, do not report "0". Instead, leave the appropriate box blank
- When analysis is done using portable analysis (such as portable pH meters, SC meters, etc.), indicate "PA" in the appropriate test method used box.
- Make additional copies of this form as necessary.

NAME OF PERSON COLLECTING SAMPLE(S): Arnold Parks **TITLE:** Field Technician **SIGNATURE:** Arnold E. Parks

DESCRIBE DISCHARGE LOCATION Example: NW Out Fall	DATE/TIME OF SAMPLE COLLECTION	TIME DISCHARGE STARTED	ANALYTICAL RESULTS For First Storm Event									
			BASIC PARAMETERS					OTHER PARAMETERS				
			pH	TSS	SC	O&G	COD	TCP	PCP	TPH-D	TPH-MO	TPH-G
SL-5	11/8/02 ☒ AM 7:50 ☐ PM	11/7/02 ☐ AM 8:00 ☒ PM	7.2	480	400	<5.0	450	<1.0	<1.0	180	560	99
SL-6	12/16/02 ☒ AM 10:20 ☐ PM	Early ☒ AM ☐ PM	6.4	12	59	<5.0	42	<1.0	<1.0	54	120	<50
Veg. Pond Discharge	11/7/02 ☒ AM 9:45 ☐ PM	4:00 ☒ AM ☐ PM	6.4	12	490	<5.0	95	<1.0	<1.0	<50	<100	<50
	☐ AM ☐ PM	☐ AM ☐ PM										
TEST REPORTING UNITS:			pH Units	mg/l	umho/cm	mg/l	mg/l	ug/L	ug/L	ug/L	ug/L	ug/L
TEST METHOD DETECTION LIMIT:			3.0	1.0	20	5.0	10	1.0	1.0	53/50/50	110/100/100	50
TEST METHOD USED:			EPA 150.1	EPA 160.2	EPA 120.1	EPA 1664	EPA 410.2	Canadian Pulp	Canadian Pulp	EPA 8015 DRO	EPA 8015 DRO	EPA 8015 GRO
ANALYZED BY (SELF/LAB):			Alpha Analytical Laboratories, Inc					Method	Method			

TSS - Total Suspended Solids SC - Specific Conductance O&G - Oil & Grease TOC - Total Organic Carbon

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FORM 1-SAMPLING & ANALYSIS RESULTS

SECOND STORM EVENT

- If analytical results are less than the detection limit (or non detectable), show the value as less than the numerical value of the detection limit (example: <.05)
- If you did not analyze for a required parameter, do not report "0". Instead, leave the appropriate box blank
- When analysis is done using portable analysis (such as portable pH meters, SC meters, etc.), indicate "PA" in the appropriate test method used box.
- Make additional copies of this form as necessary.

NAME OF PERSON COLLECTING SAMPLE(S): Arnold Parks **TITLE:** Field Technician **SIGNATURE:** Arnold E. Parks

DESCRIBE DISCHARGE LOCATION Example: NW Out Fall	DATE/TIME OF SAMPLE COLLECTION	TIME DISCHARGE STARTED	ANALYTICAL RESULTS For First Storm Event									
			BASIC PARAMETERS					OTHER PARAMETERS				
			pH	TSS	SC	O&G	COD	TCP	PCP	TPH-D	TPH-MO	TPH-G
SL-1	3/13/03 ☐ AM 12:50 ☒ PM	8:00 ☒ AM ☐ PM	6.7	22	1,300	<5.0	110	<1.0	<1.0	63	320	<50
SL-2	3/13/03 ☒ AM 11:25 ☐ PM	8:00 ☒ AM ☐ PM	6.6	200	200	5.2	560	<1.0	2.4	1,300	2,000	750
SL-3	3/13/03 ☒ AM 11:55 ☐ PM	8:00 ☒ AM ☐ PM	5.9	150	180	<5.0	390	<1.0	<1.0	200	740	<50
SL-4	3/13/03 ☒ AM 12:10 ☐ PM	8:00 ☒ AM ☐ PM	6.2	68	140	<5.0	160	<1.0	<1.0	84	300	<50
TEST REPORTING UNITS:			pH Units	mg/l	umho/cm	mg/l	mg/l	ug/L	ug/L	ug/L	ug/L	ug/L
TEST METHOD DETECTION LIMIT:			3.0	1.0	20	5.0	10/50/50/50	1.0	1.0	52/52/54/51	100/100/110/100	50
TEST METHOD USED:			EPA 150.1	EPA 160.2	EPA 120.1	EPA 1664	EPA 410.2	Canadian Pulp Method	Canadian Pulp Method	EPA 8015 DRO	EPA 8015 DRO	EPA 8015 GRO
ANALYZED BY (SELF/LAB):			Alpha Analytical Laboratories, Inc									

TSS - Total Suspended Solids SC - Specific Conductance O&G - Oil & Grease TOC - Total Organic Carbon

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FORM 1-SAMPLING & ANALYSIS RESULTS

SECOND STORM EVENT

- If analytical results are less than the detection limit (or non detectable), show the value as less than the numerical value of the detection limit (example: <.05)
- If you did not analyze for a required parameter, do not report "0". Instead, leave the appropriate box blank
- When analysis is done using portable analysis (such as portable pH meters, SC meters, etc.), indicate "PA" in the appropriate test method used box.
- Make additional copies of this form as necessary.

NAME OF PERSON COLLECTING SAMPLE(S): Arnold Parks

TITLE: Field Technician

SIGNATURE:

DESCRIBE DISCHARGE LOCATION Example: NW Out Fall	DATE/TIME OF SAMPLE COLLECTION	TIME DISCHARGE STARTED	ANALYTICAL RESULTS For First Storm Event									
			BASIC PARAMETERS					OTHER PARAMETERS				
			pH	TSS	SC	O&G	COD	TCP	PCP	TPH-D	TPH-MO	TPH-G
SL-5	3/13/03 ☐ AM 12:40 ☒ PM	9:00 ☒ AM ☐ PM	6.7	190	420	<5.0	300	<1.0	<1.0	150	470	58
SL-6	3/14/03 ☒ AM 7:20 ☐ PM	Late ☐ AM 3/13/03 ☒ PM	6.0	16	79	<5.0	65	<1.0	<1.0	56	150	<50
Veg. Pond Discharge	3/13/03 ☐ AM 12:15 ☒ PM	9:00 ☒ AM ☐ PM	6.3	9.7	410	7.6	260	<1.0	<1.0	<50	<100	<50
	☐ AM ☐ PM	☐ AM ☐ PM										
TEST REPORTING UNITS:			pH Units	mg/l	umho/cm	mg/l	mg/l	ug/L	ug/L	ug/L	ug/L	ug/L
TEST METHOD DETECTION LIMIT:			3.0	1.0	20	5.0	50/10/50	1.0	1.0	52/51/50	100	50
TEST METHOD USED:			EPA 150.1	EPA 160.2	EPA 120.1	EPA 1664	EPA 410.2	Canadian Pulp Method	Canadian Pulp Method	EPA 8015 DRO	EPA 8015 DRO	EPA 8015 GRO
ANALYZED BY (SELF/LAB):			Alpha Analytical Laboratories, Inc									

TSS - Total Suspended Solids SC - Specific Conductance O&G - Oil & Grease TOC - Total Organic Carbon

Table 2: Sierra Pacific Industries
Historical Unconfirmed Locations Storm Water Analytical Results - PCP and TCP
2293 Samoa Road, Arcata, California

ID	Date	PCP	TCP
		ug/L	
WRT 3.86.5	03/13/86	5.0	7.0
Culvert Storage Shed	12/30/87	11.0	36.0
WRT 2.91.1	02/28/91	ND	ND
WRT 6.91.07	06/19/91	ND	ND
WRT 6.91.09	06/19/91	ND	ND
WRT 93.1.02	01/27/93	0.52	1.1
WRT 93.1.04	01/27/93	8.6	7.3

Table 5: Soil Analytical Results - Drainages - 2001
2293 Samoa Road, Arcata, California

ID	Date	PCP & TCP
		mg/kg
Outfall 4	06/14/01	ND
Outfall #2 D.I.	06/14/01	ND
Ditch 1@ Dry Shed	06/14/01	ND
Outfall 1, Road Entrance	06/14/01	ND
Ditch 4@ Crossing	06/14/01	ND
Outfall 3A	06/14/01	ND
Outfall 2	06/14/01	ND
Ditch 4-80' W-Xing	07/09/01	ND
Ditch 4-150' W-Xing	07/09/01	ND
Ditch 4-250' W-Xing	07/09/01	ND

Dioxins and Furans - NCRWQCB - June 2001

SAMPLE NAME	SAMPLE LOCATION	TYPE	DATE COLLECTED	
0106461-1A	Outfall 1	Sediment	6/14/2001	
Acronym	**Name**	**Toxicity Equiv. Factor 1997**	**Detection**	**TEQ**
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	0	0.000000
1,2,3,7,8-PeCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	0	0.000000
1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	6	0.600000
1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	0	0.000000
1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	0	0.000000
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	40	0.400000
OCDD	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	0.0001	120	0.012000
2,3,7,8-TCDF	2,3,7,8-Tetrachlorodibenzofuran	0.1	0	0.000000
1,2,3,7,8-PeCDF	1,2,3,7,8-Pentachlorodibenzofuran	0.05	0	0.000000
2,3,4,7,8-PeCDF	2,3,4,7,8-Pentachlorodibenzofuran	0.5	0	0.000000
1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,7,8,9-HxCDF	1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0	0.000000
1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0	0.000000
OCDF	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	0.0001	0	0.000000
			0=ND	**1.012000**

When mixtures of these compounds are present in an environmental sample a Toxicity Equivalent or TEQ is calculated to express the toxicity of the mixture. The TEQ is defined as the sum of the products of each congener concentration multiplied by its Toxicity Equivalent Factor or TEF for all congeners in a mixture expressed as if the toxicity were due entirely to 1,3,7,8-TCDD (Dioxin). The percentage of the TEQ that is actually contributed by 2,3,7.,8-TCDD should be clearly shown with the TEQ. It is determined by multiplying the congener concentrations in the mixture by their TEFs and summing the TEF concentrations.

Dioxins and Furans - NCRWQCB - June 2001

SAMPLE NAME	SAMPLE LOCATION	TYPE	DATE COLLECTED	
0106461-2A	Outfall 4	Sediment	6/14/2001	
Acronym	**Name**	**Toxicity Equiv Factor 1997**	**Detection**	**TEQ**
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	0	0.000000
1,2,3,7,8-PeCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	0	0.000000
1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	19	1.900000
1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	0	0.000000
1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	8.3	0.830000
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	260	2.600000
OCDD	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	0.0001	1700	0.170000
2,3,7,8-TCDF	2,3,7,8-Tetrachlorodibenzofuran	0.1	1.4	0.140000
1,2,3,7,8-PeCDF	1,2,3,7,8-Pentachlorodibenzofuran	0.05	0	0.000000
2,3,4,7,8-PeCDF	2,3,4,7,8-Pentachlorodibenzofuran	0.5	0	0.000000
1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,7,8,9-HxCDF	1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	31	0.310000
1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0	0.000000
OCDF	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	0.0001	68	0.006800
			0=ND	5.956800

When mixtures of these compounds are present in an environmental sample a Toxicity Equivalent or TEQ is calculated to express the toxicity of the mixture. The TEQ is defined as the sum of the products of each congener concentration multiplied by its Toxicity Equivalent Factor or TEF for all congeners in a mixture expressed as if the toxicity were due entirely to 1,3,7,8-TCDD (Dioxin). The percentage of the TEQ that is actually contributed by 2,3,7.,8-TCDD should be clearly shown with the TEQ. It is determined by multiplying the congener concentrations in the mixture by their TEFs and summing the TEF concentrations.

Dioxins and Furans - NCRWQCB - June 2001

SAMPLE NAME	SAMPLE LOCATION	TYPE	DATE COLLECTED	
0106461-3A	Ditch 4	Sediment	6/14/2001	
Acronym	**Name**	**Toxicity Equiv. Factor 1997**	**Detection**	**TEQ**
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	1	1.000000
1,2,3,7,8-PeCDD	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	5.8	5.800000
1,2,3,4,7,8-HxCDD	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	62	6.200000
1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	5.7	0.570000
1,2,3,7,8,9-HxCDD	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	18	1.800000
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	680	6.800000
OCDD	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin	0.0001	3900	0.390000
2,3,7,8-TCDF	2,3,7,8-Tetrachlorodibenzofuran	0.1	1.9	0.190000
1,2,3,7,8-PeCDF	1,2,3,7,8-Pentachlorodibenzofuran	0.05	0	0.000000
2,3,4,7,8-PeCDF	2,3,4,7,8-Pentachlorodibenzofuran	0.5	0	0.000000
1,2,3,4,7,8-HxCDF	1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,7,8,9-HxCDF	1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0	0.000000
1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	92	0.920000
1,2,3,4,7,8,9-HpCDF	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0	0.000000
OCDF	1,2,3,4,6,7,8,9-Octachlorodibenzofuran	0.0001	170	0.017000
			0=ND	**23.687000**

When mixtures of these compounds are present in an environmental sample a Toxicity Equivalent or TEQ is calculated to express the toxicity of the mixture. The TEQ is defined as the sum of the products of each congener concentration multiplied by its Toxicity Equivalent Factor or TEF for all congeners in a mixture expressed as if the toxicity were due entirely to 1,3,7,8-TCDD (Dioxin). The percentage of the TEQ that is actually contributed by 2,3,7.,8-TCDD should be clearly shown with the TEQ. It is determined by multiplying the congener concentrations in the mixture by their TEFs and summing the TEF concentrations.

GEOMATRIX

TABLE 1 (EXCERPT)
SUMMARY OF CHEMICAL ANALYSIS
RESULTS FROM THE FORMER GREEN CHAIN AREA COLLECTED DURING IRM ACTIVITIES

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Sample ID	Date Sampled	Depth (feet) bgs	Matrix	2,4,6-TCP	2,3,5,6-TCP	2,3,4,6-TCP	2,3,4,5-TCP	PCP	Total Dioxins and Furans TEQ ^{1,2,3,4}
	units for soil, sediment, concrete samples			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pg/g
		units for water samples		(µg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)	(no water samples)
STORM WATER AND STORM WATER SEDIMENT SAMPLES									
S-Near B-14 Water	01-May-03	--	Storm water	<1.0	<1.0	<1.0	<1.0	<1.0	na
S-Near B-14 Sediment	01-May-03	--	Solids	<1.0	<1.0	<1.0	<1.0	<1.0	na
S-Near B-33 Water	01-May-03	--	Storm water	<1.0	<1.0	<1.0	<1.0	<1.0	na
S-Near B-33 Sediment	01-May-03	--	Solids	<1.0	<1.0	<1.0	<1.0	<1.0	na
S-Near B-36 Water	01-May-03	--	Storm water	<1.0	<1.0	<1.0	<1.0	2.1	na
S-Near B-36 Sediment	01-May-03	--	Solids	<1.0	<1.0	<1.0	<1.0	<1.0	na
S-Near MW-7 Water	01-May-03	--	Storm water	<1.0	<1.0	8.1	2.6	28	na
S-Near MW-7 Sediment	01-May-03	--	Solids	<1.0	<1.0	<1.0	<1.0	<1.0	na
S-Near MW-8 Water	01-May-03	--	Storm water	<1.0	<1.0	<1.0	<1.0	<1.0	na
S-Near MW-8 Sediment	01-May-03	--	Solids	<1.0	<1.0	<1.0	<1.0	<1.0	na
SS-Near B-37 Water	01-May-03	--	Storm water	2.0	<1.0	7,900	110	33,000	na
SS-Near B-37 Sediment	01-May-03	--	Solids	<1.0	<1.0	11	1.3	94	na
DRAINAGE DITCH #2 SAMPLE									
#2	04-Aug-03	--	Surface water	na	<1.0	<1.0	<1.0	<0.3	na

Abbeviations

-- = not analyzed
< = target analyte was not detected at or above the laboratory reporting limit shown.
bgs = Below ground surface
mg/kg = milligrams per kilogram
µg/l = micrograms per liter
PCP = pentachlorophenol
pg/g = picograms per gram
TCP = tetrachlorophenol
TEQ = toxic equivalency

Notes:

1. Calculated by multiplying the congener concentration by its Toxic Equivalency Factor (TEF).
2. When an analyte concentration was not detected, it was assigned a concentration of 0 pg/g to calculate TEQ.
3. World Health Organization, 1998 (WHO-98)
4. The total TEQ is the total TEQ for the analytical method target analytes.
5. Material represented by this sample was removed during excavation activities conducted subsequent to collection of this sample.

APPENDIX B

Natural Attenuation Parameters and Evaluation

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APPENDIX B

NATURAL ATTENUATION PARAMETERS AND EVALUATION

Sierra Pacific Industries
Arcata Division Sawmill
2593 New Navy Base Road
Arcata, California

B1.0 NATURAL ATTENUATION BY BIODEGRADATION

Pentachlorophenol will biodegrade in the natural environment under both aerobic and anaerobic conditions. Both of these processes are discussed below. Following U.S. Environmental Protection Agency (U.S. EPA) guidance, "lines of evidence" are developed to assess the occurrence of natural attenuation processes. As part of this assessment, geochemical testing of site groundwater was performed and is reported herein. Finally, an assessment of biodegradation of chemicals of concern at the site is presented.

Based on the results of previous investigations, the primary chemical of concern at the site is pentachlorophenol, a chlorinated phenol compound that was a constituent of wood surface protection chemicals used historically at the site. The presence of the remaining chemicals of concern (tetrachlorophenol, dioxins, and furans) is largely coincident with the distribution of pentachlorophenol at the site. Therefore, for the purpose of this discussion of natural attenuation, pentachlorophenol is identified as the indicator chemical. The other chemicals of concern at the site also are expected to decrease in mass and concentration due to the same natural attenuation processes, although at different rates.

B1.1 AEROBIC BIODEGRADATION

Pentachlorophenol dissolved in groundwater can biodegrade aerobically. The aerobic degradation pathway can occur at a faster rate than the anaerobic pathway under ideal conditions. However, groundwater containing pentachlorophenol is generally anaerobic (Rittman and McCarty, 2001). Therefore, creating an in situ aerobic zone in which pentachlorophenol could biodegrade would require the introduction of significant amounts of oxygen to overcome the anaerobic conditions. Sustaining this aerobic zone for a time sufficient to allow concentrations of pentachlorophenol in groundwater to meet remedial action objectives most likely would require multiple injections of oxygen-containing compounds over a long period of time.

During aerobic biodegradation, the phenol ring is broken down early in the biodegradation process and complete mineralization to carbon dioxide, water, and chloride occurs (MacEwen et al., 2001). Aerobic degradation occurs more readily for the less chlorinated phenols (e.g., trichlorophenol and dichlorophenol) and less readily for the more chlorinated phenols (e.g., pentachlorophenol and tetrachlorophenol) (Rittman and McCarty, 2001). Initial intermediate products include tetrachloroatechol, tetrachlorohydroquinone, tetrachlorobenzoquinone, trichlorohydroxylbenzoquinone, trichlorohydroxylquinone, dichlorohydroxylquinone, and chlorohydroxylquinone (MacEwen et al., 2001). For aerobic degradation of pentachlorophenol, a dissolved oxygen concentration of at least 2 milligrams per liter (mg/L) typically is required (MacEwen et al., 2001).

B1.2 ANAEROBIC BIODEGRADATION

Pentachlorophenol can be biodegraded anaerobically, and groundwater containing pentachlorophenol is generally anaerobic (Rittman and McCarty, 2001). During anaerobic biodegradation, pentachlorophenol generally degrades by reductive dehalogenation (Rittman and McCarty, 2001), which involves sequential removal and replacement of each of the five chloride ions in the molecule by a hydrogen ion. The reductive sequence is as follows: pentachlorophenol, tetrachlorophenol, trichlorophenol, dichlorophenol, and finally chlorophenol before the phenol ring is mineralized to smaller organic intermediate compounds and finally to carbon dioxide and water. Potential isomers that may be present during the dehalogenation process include three isomers of tetrachlorophenol, five isomers of trichlorophenol, six isomers of dichlorophenol, and three isomers of chlorophenol (Cozza and Woods, 1992). The actual pathway of biodegradation appears to be dependent on the indigenous microorganisms present at the site. In general, for reductive dehalogenation to occur, the site must have low values of dissolved oxygen (less than 0.5 mg/L), oxidation-reduction potential (relative to hydrogen electrode [E_h]), nitrate, and sulfate; and adequate concentrations of total organic carbon.

B1.3 MONITORED NATURAL ATTENUATION

The U.S. Environmental Protection Agency (U.S. EPA) published a directive (U.S. EPA, 1999) that provides guidance on assessing the occurrence of natural attenuation processes, including biodegradation; this directive was based on an earlier technical document on the same subject (U.S, EPA, 1998). The goal of the directive is to provide the practitioner with guidance for assessing natural attenuation processes according to several "lines of evidence", including:

- Historical information on target constituents that demonstrates decreasing contaminant mass or concentration as time progresses,

- Geochemical data (aside from target chemical information) that demonstrate indirectly the type(s) of biotransformation processes active at the site, and
- Microcosm studies, (i.e. laboratory assessment of indigenous microbial populations in site groundwater).

Historical information that demonstrates decreasing contaminant mass or concentration over time includes the presence of breakdown, or “daughter”, products of primary, or “parent”, target chemicals and site-specific information on the temporal and spatial distribution of parent chemicals and daughter products. Available information from the site that could be used to demonstrate historical trends in concentrations of parent chemicals and daughter products includes analytical data from groundwater monitoring wells that have been collected since March 2002. Because of the long history of use of wood surface protection chemicals at the at the site, groundwater for approximately 40 years, groundwater data from only the previous year and a half is not considered sufficient to demonstrate historical trends. These data were therefore not used as a line of evidence to demonstrate natural attenuation.

The geochemical parameters most frequently relied on to provide data appropriate for interpreting the presence of biodegradation processes are listed and described in Table B-1. These parameters were measured in samples of groundwater from selected wells at the site to assist in the evaluation of natural attenuation, as described below.

Microcosm studies can be performed to assess the occurrence and capacity of site-specific microbial processes to degrade certain constituents; however, the results of these studies cannot be readily demonstrated under field conditions. A microcosm study was not performed in the natural attenuation assessment for the site.

B2.0 NATURAL ATTENUATION ASSESSMENT AT THE SITE

This evaluation relied on an assessment of the site geochemical parameters presented in Table B-1, as well as other groundwater chemistry data (i.e., field water quality parameters [e.g., pH, temperature, and specific conductance]). A field study was performed to (1) evaluate whether site conditions are conducive to biological natural attenuation and (2) evaluate whether evidence of biological natural attenuation processes exists.

Geochemical data were collected and evaluated to assess indirectly the type(s) of biological natural attenuation processes occurring at the site. On November 3, 2003, Geomatrix collected groundwater samples from four monitoring wells at the site (wells MW-2, MW-3, MW-5, and

MW-7) for analysis of natural attenuation parameters. The analytical data from these samples are presented in Table B-2. These four wells were selected based on pentachlorophenol concentrations detected in previous groundwater samples collected from these wells, their locations along the centerline of the pentachlorophenol plume, and their locations relative to groundwater flow direction. Well MW-5 was selected to provide background geochemical information, well MW-3 was selected because it is cross-gradient to the pentachlorophenol plume, well MW-7 was selected because samples collected from this well have had elevated concentrations of pentachlorophenol, and well MW-2 was selected because it is downgradient of well MW-7. In addition to analyzing for natural attenuation parameters, water quality field measurements (dissolved oxygen, reduction-oxidation potential, pH, specific conductance, and temperature) were measured in samples collected from each of the wells.

The geochemical results are presented in Table B-2. The results indicate that the following conditions exist in site groundwater:

- Oxidation-reduction conditions are reducing (196 to 255 millivolts [mV] as E_h),
- Dissolved oxygen is very low (0.1 to 0.3 mg/L), indicating anaerobic conditions,
- Dissolved manganese (II) and iron (II) are reduced,
- Nitrate is depleted near the source area (MW-7) and upgradient (MW-5), indicating reducing conditions,
- Sulfate concentrations are low to non-detect, indicating reducing conditions,
- Total organic carbon concentrations are greater than 20 mg/L, and are adequate to drive the reductive process (Wiedemeier, et al., 1999),
- Dissolved methane gas is present, indicating that methanogenic conditions exist,
- Concentrations of chloride are lower upgradient of well MW-7 and progressively increase downgradient of well MW-7 (MFG, 2003), and
- Alkalinity and concentrations of carbon dioxide increase downgradient of well MW-7, which suggests that carbon dioxide is being produced as a by-product of the biodegradation of organic carbon.

Measurements of Eh and concentrations of dissolved oxygen, manganese (II), iron (II), nitrate, sulfate, total organic carbon, and dissolved methane in groundwater at the site indicate that reducing, methanogenic conditions exist in groundwater. These data also indicate that site conditions are conducive to biological natural attenuation, and they demonstrate indirectly that reductive biotransformation processes are active at the site.

Increasing concentrations of chloride ions downgradient of well MW-7 suggest that pentachlorophenol in groundwater near MW-7 is degrading by dechlorination, as this process provides a source of chloride ions in groundwater. Similarly, increased carbon dioxide and alkalinity downgradient of MW-7 suggest that there is significant anaerobic biological activity in groundwater near MW-7.

B3.0 SUMMARY OF GEOCHEMICAL CONDITIONS AND NATURAL ATTENUATION PROCESSES AT THE SITE

As part of this study, geochemical parameters were analyzed in samples of site groundwater from the vicinity of the former green chain area. These parameters included E_h, dissolved oxygen, manganese (II), iron (II), nitrate, sulfate, total organic carbon, dissolved methane, alkalinity and carbon dioxide. Based on the evaluation of these geochemical parameters, groundwater conditions at the site are reducing, anaerobic and highly methanogenic, and favor reductive dehalogenation of chlorinated compounds (Wiedemeier, et al., 1999). The data indicate that conditions exist in shallow groundwater at the site that are appropriate for biological natural attenuation of pentachlorophenol and other chemicals of concern to occur.

B4.0 REFERENCES

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TABLE B-1

GEOCHEMICAL PARAMETERS FOR NATURAL ATTENUATION IN GROUNDWATER

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Geochemical Parameter	Description
Reduction-oxidation (redox) potential	Redox reactions involve the transfer of electrons from a donor molecule to an acceptor molecule. The electron donor loses electrons and is oxidized. Redox potential typically is measured in an aqueous solution by a voltmeter in units of millivolts (mV) and is termed oxidation-reduction potential (ORP). The equivalent Eh of the solution is calculated by adding 199 mV to the measured ORP.[1] Aqueous solutions with Eh values less than +300 mV are considered reducing and higher chlorinated constituents are unstable under this condition. Aqueous solutions with greatly negative Eh values are conducive to complete destruction of chlorinated constituents.
Electron donors (naturally available carbon, and anthropogenic sources, including pentachlorophenol)	Naturally occurring carbon or anthropogenic sources. These substrates are used as energy sources for metabolic functions. Total organic carbon or dissolved organic carbon measurements are useful to evaluate the reducing capacity of the groundwater system to drive the ORP low enough to supply enough hydrogen for reductive dehalogenation.
Electron acceptors (dissolved oxygen, nitrate, manganese (IV), iron (III), chlorinated phenols, sulfate, and carbon dioxide)	A microorganism in the step-wise thermodynamic ladder for energy utilizes dissolved oxygen (DO) first. Concentrations below 0.5 milligrams per liter generally indicate an anaerobic pathway. After DO has been utilized, nitrate is used as an electron acceptor. Manganese (IV) reduction occurs (creating manganese (II)) in the absence of DO and nitrate during microbial degradation of organic compounds. Iron (III) reduction occurs (creating iron [II]) in the absence of DO, nitrate, and manganese (IV). Pentachlorophenol reduction (i.e., pentachlorophenol, tetrachlorophenol, trichlorophenol, dichlorophenol, chlorophenol) occurs after iron (III) reduction. Sulfate reduction occurs after organic compound reduction. Carbon dioxide reduction occurs after sulfate reduction and is produced during biodegradation of many types of organic carbon. Decreased concentrations of DO, nitrate, sulfate, and carbon dioxide and increased concentrations of reduced species of manganese (II), iron (II), and daughter products within a plume are indicative chemical signatures from biological degradation processes.
Dissolved hydrocarbon gases	Production of methane from carbon dioxide reduction is indicative of biodegradation processes.
Chloride	During reductive dechlorination, chloride ions are removed from the pentachlorophenol molecule and replaced with hydrogen ions. Chloride concentrations greater than background concentrations indicate reductive dechlorination is occurring.

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[1] This conversion assumes that ORP was measured using a standard platinum and silver/silver-chloride electrode. The conversion factor is different for different types of electrodes.

TABLE B-1

GEOCHEMICAL PARAMETERS FOR NATURAL ATTENUATION IN GROUNDWATER

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Geochemical Parameter	Description
Dissolved Hydrogen	Dissolved hydrogen is an electron donor for halorespiration. During the reductive dechlorination process, hydrogen replaces the chlorine of the parent compound, creates daughter products, and ultimately end products. Under natural conditions, available organic carbon in the aquifer drives the fermentation process and generates hydrogen. The generated hydrogen is used by other aerobic, anaerobic, and halorespiratory micro-organisms for energy. Halorespirators require at least 1 nanomolar (nM) of hydrogen for growth to occur (Smatlak, et al., 1996). This analysis is optional.

TABLE B-2

ANALYTICAL RESULTS OF GEOCHEMICAL TESTING IN GROUNDWATER

Sierra Pacific Industries
Arcata Division Sawmill
Arcata, California

Concentrations reported in milligrams per liter (mg/l)

Well	**Sample Date**	**Eh (mV)[2, 3]**	**Dissolved Oxygen[3]**	**Nitrate**	**Manganese (II)**	**Iron (II)**	**Sulfate**	**Carbon Dioxide**	**Methane**	**Total Organic Carbon**	**Chloride**	**Total Alkalinity as Calcium Carbonate**	**Calcium**	**Magnesium**	**pH[3]**	**Specific Conductance (µS/cm)[3]**	**Temperature (°C)[3]**
Natural Attenuation Evaluation Wells																	
MW-5 (Upgradient)	11/03/03	255	0.3	<1.0[4]	0.42	0.97	<0.5	125.486	8.211	9.36	25	350	28	45	6.25	655	17.4
MW-3 (Crossgradient)	11/03/03	201	0.3	4.6	3.9	9.1	<0.5	173.945	5.44	18.0	37	460	55	36	6.34	922	16.5
MW-7 (Former Green Chain Area)	11/03/03	197	0.1	<1.0	13	2.3	<0.5	152.071	8.791	28.1	45	420	26	42	6.38	863	12.7
MW-2 (Downgradient)	11/03/03	226	0.4	2.8	6	30	<0.5	314.32	3.766	33.9	240	520	66	40	6.21	1583	15.9
Wells Not Used In Natural Attenuation Study																	
MW-1	11/04/03	222	0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns[5]	ns	ns	6.44	2371	17.3
MW-4	11/03/03	207	0.1	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.34	673	18.4
MW-6	11/04/03	236	0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.34	890	12.7
MW-8	11/04/03	237	0.3	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.16	738	17.0
MW-9	11/04/03	211	0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.37	809	16.6
MW-10	11/04/03	215	0.1	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.39	884	18.1
MW-11	11/04/03	196	0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.39	872	18.5
MW-12	11/04/03	251	0.4	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.17	812	17.5
MW-13D	11/04/03	253	0.1	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	5.88	672	15.6
MW-14	11/04/03	234	0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.33	2693	16.2
MW-15D	11/04/03	255	0.3	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.49	1241	14.2
MW-16D	11/04/03	246	0.1	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	7.52	4609	15.8
MW-17	11/04/03	240	0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.36	973	14.9
MW-18	11/04/03	198	0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.43	953	16.9
MW-19D	11/03/03	197	0.3	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6.49	729	17.5

Notes:

1. Samples collected by Geomatrix and analyzed by EPA Method 415.1 (total organic carbon), EPA Method 200 (calcium and magnesium), EPA Method 300 (chloride, nitrate and sulfate), EPA Method 6010B (Iron (II) and Manganese (II)), Standard Methods 2320B (total alkalinity), RSK 175 (carbon dioxide and methane).
2. Eh = reduction-oxidation potential standardized to hydrogen electrode for silver/silver-chloride electrode (199 millivolts was added to the field measurement).
3. Water quality parameters measured in the field in a flow-through cell.
4. < = Not detected at or above laboratory reporting limit
5. ns = Natural attenuation parameters not sampled.

Abbreviations:
mV = millivolts
µS/cm = microSiemens per centimeter
°C = Degrees Celsius