January 16, 2007

Piper Peterson Lee
US EPA, Region 10
1200 Sixth Avenue
Seattle, WA 98101

Subject: Thea Foss and Wheeler-Osgood Waterways Remediation Project
Operations, Maintenance, and Monitoring Plan

Dear Ms. Peterson Lee:

Enclosed are the response to EPA comments on the Post-Construction Hydrogeologic Conditions Report for the St. Paul Waterway Confined Disposal Facility and the Technical Memorandum for Identification of Wells to be Monitored to Establish Baseline at the CDF. The comments were provided to the City in an email dated December 20, 2006. Each comment is presented followed by the response to the comment.

Please give me a call if you have any questions concerning the response to comments.

Sincerely,

Mary Henley, P.E.
Project Manager

MLH:sh (Response to EPA – Corps Comments on Baseline Well Selection – Hydrogeo Report.doc

Enclosures

cc: Kym Takasaki, ACOE
Leslie Ann Rose, CHB

File: Foss OMMP

RESPONSE TO COMMENTS ON THE POST-CONSTRUCTION HYDROGEOLOGIC CONDITIONS REPORT

Comment No. 1. General Comments on Methods. Overall report is well-written, and methods for collecting and analyzing slug test data and tidal data are widely-recognized and appropriate. Based on information presented it is uncertain whether some of the wells were developed adequately or if the wells were designed appropriately. The large amount of fine sand and silt removed from the base of the wells indicates that smaller screen-slot size and filter pack sand may have been more appropriate. We anticipate that future development prior to sampling (maybe with a larger pump) will help reduce the turbidity observed in some of the site wells.

Response: *Post-development turbidity levels were relatively low in most of the monitoring wells installed to monitor the CDF indicating that the wells were designed appropriately. Development was performed in accordance with standard protocols as outlined in the OMMP until the measured turbidity had stabilized and significant reductions in turbidity were no longer observed between successive measurements. Although moderate turbidity levels were measured in several wells at the completion of development, additional development including purging the wells utilizing a larger pump and higher pumping rates is not expected to significantly reduce turbidity further in the wells. Low-flow sampling methods will be used to collect groundwater samples from the wells selected for baseline monitoring at the site. It is anticipated that the use of low-flow sampling will result in further reduction in measured turbidity levels in the groundwater that is collected for analysis. If there is difficulty achieving low turbidity levels during quarterly sampling, the City will consider further development to resolve the issue.*

Comment No. 2. Section 3.3, Groundwater Response to Tidal Fluctuations – For completeness, it would be appropriate to state whether there was any precipitation observed at/near the site during the tidal monitoring study that would have affected groundwater levels. Based on a search of Sea-Tac Airport precipitation data, only 0.02 inches of rain fell during the monitoring period there, which would likely have negligible affect on groundwater levels. Additionally, state whether any known nearby industrial wells or other operations occurred during the testing which might affect local groundwater.

Response: *Weather data from weather stations in the vicinity of the CDF (i.e., Fort Lewis and Tacoma Narrows Airport) during the time period of the tidal study (i.e., October 3, 2006 through October 6, 2006) indicates that approximately 0.15 inches of precipitation fell on the final day of the tidal study. The City does not believe that this amount of rain at the end of the tidal study had a discernable affect on groundwater levels.*

Representatives of Simpson who operate the facilities surrounding the CDF were contacted concerning the presence of operations or industrial wells in the vicinity of the CDF. No industrial wells (i.e., extraction or injection wells) or other operations were identified at Simpson's facilities that would have affected local groundwater flow during the testing.

Comment No. 3. Section 3.4, Mean Groundwater Elevation, Gradients, and Flow Direction – Obviously seasonal changes in average groundwater gradient were not considered in this investigation due to its short duration. However, for completeness it would be appropriate to state this and possibly relate any information on seasonality gleaned from other studies within nearby Tacoma waterways if changes in flow direction or gradient magnitudes (horizontally and/or vertically) occur. Seasonal affects have the highest potential to affect gradient magnitudes (both horizontal and vertical) as opposed to averaged flow directions. Also, include representative maps showing high and low tide flow directions.

Response: *The groundwater gradients and flow directions identified as part of the post-construction hydrogeologic conditions evaluation are consistent with regional groundwater flow patterns and information gathered from investigations of the St. Paul and Thea Foss Waterways as part of remedial design (City of Tacoma, 1999). As part of design activities, a tidal study was conducted for the Thea Foss Waterway in August 1997. The design tidal study was conducted during the summer, when water levels are generally low, while the tidal study conducted as part of this evaluation was performed in the fall when in general, intermediate water levels are observed. Although these studies were conducted in different seasons, similar horizontal and vertical groundwater flow gradients were observed adjacent to the waterways.*

Additional information on seasonal affects on groundwater gradients was identified from review of groundwater monitoring at the Reichhold Tacoma facility located adjacent to the Blair Waterway in the Tacoma tideflats. As part of the quarterly groundwater monitoring at the Reichhold facility, groundwater flow gradients are evaluated through performance of quarterly tidal studies. The results of the monitoring performed in 2004 and 2005 at the Reichhold facility were reviewed to assess seasonal variability.

Groundwater at the Reichhold facility flows from recharge areas at higher elevations toward the Blair Waterway and Commencement Bay similar to groundwater flow at the CDF (i.e., from higher elevations to adjacent waterways). The annual average net gradient was upward for both 2004 and 2005 at the Reichhold facility from deep wells to intermediate depth wells. A vertical upward gradient from the deeper wells to the intermediate wells was observed in all four quarterly events in 2004 for all six well pairs. In 2005, a vertical upward gradient was observed in all six well pairs for three quarters and in five of six well pairs in the remaining quarter. The vertical gradient in the remaining well pair was essentially zero (i.e., -0.001). The magnitude of the vertical gradient varied moderately but the direction of the gradient did not change. The standard deviation between the quarterly (seasonal) monitoring events for both 2004 and 2005 was less than 50 percent. Therefore, the vertical gradients between the intermediate and the deep wells varied less than an order of magnitude as a response to seasonal affects.

Similarly, the standard deviation of the horizontal hydraulic gradient between the quarterly (seasonal) monitoring events for both 2004 and 2005 was less than 30 percent. Therefore, the horizontal gradients across the facility also varied less than an order of magnitude in response to seasonal affects.

The calculated vertical and horizontal groundwater gradients were fairly consistent between each quarterly monitoring event and over the course of a total of eight sampling events at the Reichhold facility. These data indicate that the seasonal affects are not substantial and that regional groundwater patterns and tidal cycles have more impact on both the direction and magnitude of groundwater flow and gradients.

Additional figures have been prepared that present the groundwater flow directions at the lowest low tide and the highest high tide for each of the well intervals – shallow, intermediate, and deep. The additional figures are provided with this response to comments.

Comment No. 4. Figure 9, Groundwater Elevations Map for Intermediate Wells – Groundwater flow direction arrows should always be perpendicular to potentiometric contours; therefore flow direction arrow on figure should be revised to be more southwesterly as opposed to westerly. This has implications for which parts of the CDF would actually be monitored by well MW-11.

Response: *Comment noted. Figure 9 has been revised so that the groundwater flow direction indicated by the arrow on the figure is in the southwesterly direction. A revised Figure 9 is provided with this response to comments. Upon approval, this figure will be provided to planholders to replace the existing Figure 9 in the report.*

Comment No. 5. Boring/well logs are missing for MW-01 through MW-04.

Response: *Comment noted. Copies of the boring/well logs for MW-01 through MW-04 are provided with this response to comments. The boring logs for MW-01 through MW-04 must have been inadvertently left out of the copy of the report provided to the Corps in the process of reproduction.*

RESPONSE TO COMMENT ON THE TECHNICAL MEMORANDUM

Comment No. 1. Based on the information presented in the Hydrogeologic Conditions Report, we agree with the proposed baseline monitoring well sampling recommendations and rationale, with two additions, adding sampling of the deep wells MW-12 and MW-08. Although the hydraulic gradient between intermediate and deep wells downgradient (west) of the CDF is upward, there is about a 30-foot span of aquifer not being monitored between the downgradient intermediate and deep well pairs. Section B-B' (Figure 5 of report) shows dredged fill present in the center of the CDF as deep as -55 ft MLLW, indicating groundwater would flow from the base of the CDF west toward but underneath intermediate well MW-11. If only shallow and intermediate wells MW-10 and MW-11 were to be monitored at this location, potential contaminated groundwater from the CDF that could be monitored by MW-12 might be missed. Monitoring of deep downgradient well MW-08 would not be appropriate based solely on the data collected during the investigation because the top of the screen is below the bottom of the CDF in this area, and with an upward gradient all groundwater from the CDF would be passing above the MW-08 well screen. However, seasonally the vertical gradient might reverse and become downward between wells MW-07 and MW-08 (unlikely from a conceptual standpoint but no data exists to disprove this) in which case monitoring of deep well MW-08 would be appropriate.

Also to obtain a more complete data set and confirm gradients present at the site, we recommend adding water level measurements to all site wells during baseline sampling.

Response*: The deep monitoring wells MW-08 and MW-12 will be included as part of the baseline monitoring program (i.e., two years of quarterly monitoring) to provide baseline conditions for all wells located between the CDF and surface waters in the St. Paul and Middle Waterways and Commencement Bay. Monitoring of wells MW-08 and MW-12 will provide additional information on the range of baseline water quality conditions at the site. A revised Figure 1 has been provided that includes MW-08 and MW-12 as wells to be monitored as part of baseline groundwater monitoring.*

It should be noted that, as identified in the Post-Construction Hydrogeologic Conditions Report (Figure 10), the overall horizontal groundwater gradient at the depth of the base of the CDF is flat, so that horizontal transport of water present at depth from the CDF to surface water is not likely to occur. Additionally, the groundwater gradients at depth (i.e., -40 to -70 feet MLLW or approximately 60 to 90 feet below the ground surface) are not likely to be significantly altered by seasonal variation as gradients at depth will be dominated by regional groundwater flow patterns and tidal fluctuations. The results of quarterly tidal studies performed at the nearby

Reichhold facility, located on the Blair Waterway, has shown only minor affects on groundwater gradients from seasonal variation. The vertical gradient in deep wells at the Reichhold facility is consistently upward, similar to the gradient measured in downgradient deep wells adjacent to the CDF and Middle Waterway during the 72-hour tidal study performed at the CDF (see response to Comment 3 above). However, as indicated above, MW-08 and MW-12 will be added to the quarterly monitoring program to establish the baseline conditions.

Water level measurements will be taken as part of standard protocols prior to sampling each well selected for baseline monitoring (i.e., MW-01, MW-02, MW-04, MW-05, MW-06, MW-07, MW-08, MW-10, MW-11, and MW-12) (see Section D.6.1 of the OMMP). However, site-wide "snapshot" groundwater level measurement have not been included as part of monitoring activities because they will not provide additional information concerning overall groundwater gradients and resulting net groundwater flow direction. Site-wide groundwater levels change rapidly due to tidal fluctuations as shown in the Post-Construction Hydrogeologic Conditions Report (see Attachment C-3 of Appendix C). Therefore, collection of an accurate "snapshot" of site-wide groundwater levels during baseline groundwater sampling events is not possible as the water levels in most wells will change significantly in the time it takes to collect water level measurements for all 15 wells. Additionally, "snapshot" water level measurements will not confirm the overall groundwater gradients (i.e., horizontal and vertical gradients) because a "snapshot" only defines an instantaneous point in time and not net groundwater flow direction at the site. The 72-hour tidal study was performed to provide overall groundwater gradients and net groundwater flow direction. Using the data from the 72-hour tidal study, the mean groundwater elevation for each well was calculated from 288 individual water level measurements and used to identify overall horizontal and vertical groundwater gradients and flow direction at the site. As stated in the Post-Construction Hydrogeologic Conditions Report, the horizontal and vertical groundwater gradients identified at the CDF are consistent with those identified during design investigations.

Tacoma

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Thea Foss and Wheeler-Osgood Waterways
Baseline Groundwater Monitoring

Figure 1
Baseline Groundwater Monitoring Locations

DATE: 1/12/2007 9:12:24 AM
MXD NAME: F:\projects\KPFF Foss\GIS\Revised OMMP\St Paul CDF GW\Baseline GW Memorandum Figures\Figure 1 (Baseline Groundwater Monitoring Locations).mxd

SIMPSON TACOMA KRAFT MILL

SURFACE WATER SWALE

STORMWATER SWALE

OFFSET BERM

CONTAINMENT BERM

ST PAUL CONFINED DISPOSAL FACILITY (CDF)

ST PAUL WATERWAY

SIMPSON LOG STORAGE PROPERTY

9.04 MW-14

9.0

8.6

8.2

7.8

MW-07 7.68

7.67 MW-11

CDF CAP DRAINAGE SYSTEM

MIDDLE WATERWAY

0 150 300

Feet

Legend

- MW-07 — Intermediate Monitoring Well
- 7.67 — Mean Groundwater Elevation (in feet MLLW)
- 8.6 — Groundwater Elevation Contour (Contour Interval: 0.4 feet)
- General Groundwater Flow Direction
- Area of Confined Disposal Facility

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Post-Construction Hydrogeologic Conditions Report

Figure 9
Groundwater Elevations Map
Intermediate Wells, October 2006

DATE: 11/15/2006 3:31:57 PM
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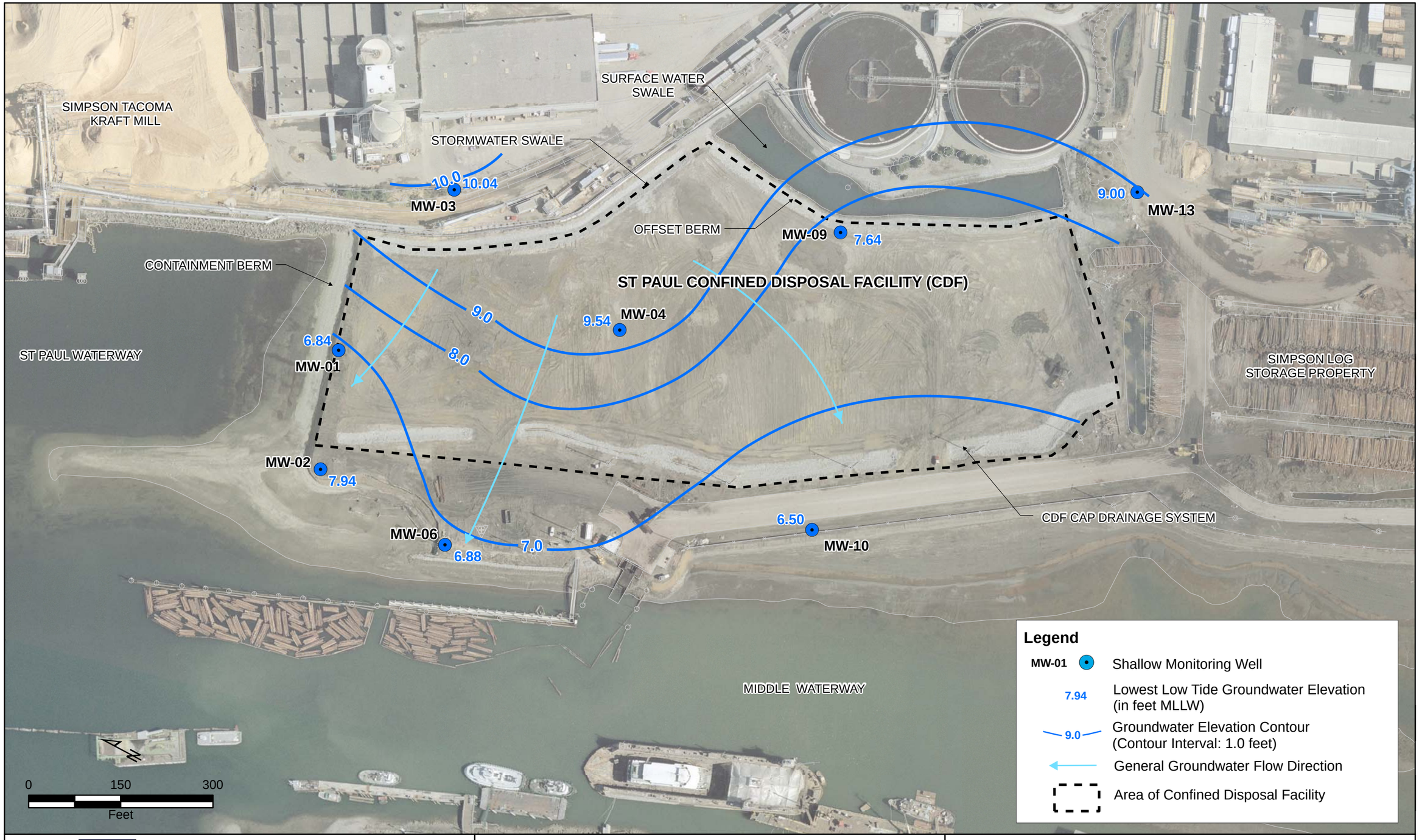

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Post-Construction Hydrogeologic Conditions Report

Groundwater Elevations Map
Shallow Wells, Lowest Low Tide
9:00 AM October 4, 2006

DATE: 12/28/2006 10:23:03 AM
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SIMPSON TACOMA KRAFT MILL

SURFACE WATER SWALE

STORMWATER SWALE

MW-03 10.20

? ?

OFFSET BERM

MW-09 10.85

8.97 MW-13

9.0

CONTAINMENT BERM

ST PAUL CONFINED DISPOSAL FACILITY (CDF)

MW-04 9.65

12.76 MW-01

12.0 11.0 10.0

ST PAUL WATERWAY

SIMPSON LOG STORAGE PROPERTY

MW-02 11.77

? ? ?

MW-06 12.24

9.72 MW-10

CDF CAP DRAINAGE SYSTEM

MIDDLE WATERWAY

0 150 300

Feet

Legend

- MW-01 — Shallow Monitoring Well
- 11.77 — Highest High Tide Groundwater Elevation (in feet MLLW)
- 9.0 — Groundwater Elevation Contour (Contour Interval: 1.0 feet)
- General Groundwater Flow Direction
- Area of Confined Disposal Facility

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Post-Construction Hydrogeologic Conditions Report

Groundwater Elevations Map
Shallow Wells, Highest High Tide
3:30 PM October 5, 2006

DATE: 11/15/2006 3:23:02 PM
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Post-Construction Hydrogeologic Conditions Report

Groundwater Elevations Map
Intermediate Wells, Lowest Low Tide
9:00 AM October 4, 2006

DATE: 12/28/2006 10:29:06 AM
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SIMPSON TACOMA KRAFT MILL

SURFACE WATER SWALE

STORMWATER SWALE

OFFSET BERM

CONTAINMENT BERM

ST PAUL CONFINED DISPOSAL FACILITY (CDF)

ST PAUL WATERWAY

SIMPSON LOG STORAGE PROPERTY

9.0

9.05

MW-14

9.4

9.8

10.2

10.6

MW-07

10.69

MW-11

10.66

CDF CAP DRAINAGE SYSTEM

MIDDLE WATERWAY

0 150 300

Feet

Legend

- MW-07 — Intermediate Monitoring Well
- 10.69 — Highest High Tide Groundwater Elevation (in feet MLLW)
- 9.4 — Groundwater Elevation Contour (Contour Interval: 0.4 feet)
- General Groundwater Flow Direction
- Area of Confined Disposal Facility

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Post-Construction Hydrogeologic Conditions Report

Groundwater Elevations Map
Intermediate Wells, Highest High Tide
3:30 PM October 5, 2006

DATE: 12/28/2006 10:28:06 AM
MXD NAME: F:\projects\KPFF Foss\GIS\Revised OMMP\St Paul CDF GW\Hydrogeologic Conds Report Figures\Revised or New Figures based on EPA Comments\Intermediate Groundwater Elevations Highest High Tide 122806.mxd

SIMPSON TACOMA KRAFT MILL

SURFACE WATER SWALE

STORMWATER SWALE

OFFSET BERM

CONTAINMENT BERM

ST PAUL CONFINED DISPOSAL FACILITY (CDF)

ST PAUL WATERWAY

SIMPSON LOG STORAGE PROPERTY

MIDDLE WATERWAY

CDF CAP DRAINAGE SYSTEM

MW-15 7.50

MW-05 8.03

7.8

7.4

7.0

6.6

6.2

MW-12 6.63

MW-08 5.73

5.8

0 150 300

Feet

Legend

- MW-08 — Deep Monitoring Well
- 7.50 — Lowest Low Tide Groundwater Elevation (in feet MLLW)
- 7.4 — Groundwater Elevation Contour (Contour Interval: 0.4 feet)
- General Groundwater Flow Direction
- Area of Confined Disposal Facility

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Post-Construction Hydrogeologic Conditions Report

Groundwater Elevations Map
Deep Wells, Lowest Low Tide
9:00 AM October 4, 2006

DATE: 12/28/2006 11:55:13 AM
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Thea Foss and Wheeler-Osgood Waterways
Post-Construction Hydrogeologic Conditions Report

Groundwater Elevations Map
Deep Wells, Highest High Tide
3:30 PM October 5, 2006

DATE: 12/28/2006 11:31:03 AM
MXD NAME: F:\projects\KPFF Foss\GIS\Revised OMMP\St Paul CDF GW\Hydrogeologic Conds Report Figures\Revised or New Figures based on EPA Comments\Deep Groundwater Elevations Highest High Tide 122806.mxd

Log of Soil Boring and Well Construction B01/MW-01

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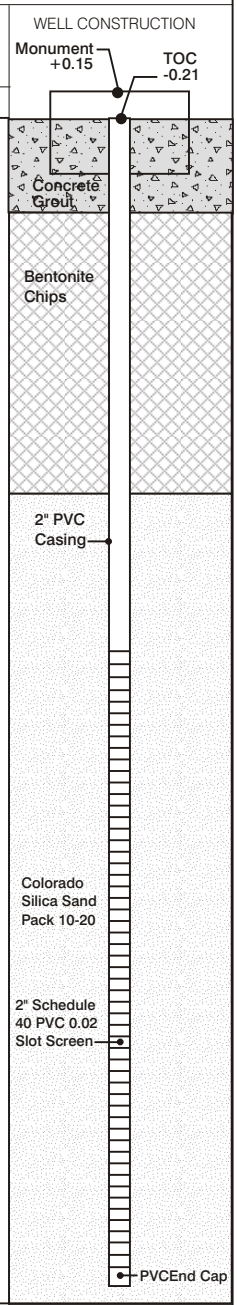
Floyd Snider
Boring B-01/MW-01 Date 8-28-06 Sheet 1 of 1
Job St Paul CDF
Logged By Chris Gardner Weather Sunny
Drilled By Holt Drilling
Drill Type/Method 4" ID HSA
Sampling Method 140 lb Auto Hammer
Bottom of Boring 19.0 ATD Water Level Depth 9.0 Ft
Ground Surface Elevation 18.2

Obs. Well Install. ~~Yes~~ No

SAMPLE ID	Blow Count N/12"	RECOVERY From	RECOVERY To	GRAPHIC RECOVERY	USCS Symbol	DESCRIPTION: color, texture, moisture MAJOR CONSTITUENT. NON-SOIL SUBSTANCES: Odor, staining, sheen, scrap, slag, etc.
						Brown, Dry, GRAVEL with Silt and Sand. (Fill)
S-1	12	2.5	4.0		GW	Brown to gray, damp GRAVEL with fine to coarse Sand.
S-2	12	7.5	9.0		SW	Brown to gray, fine to coarse, moist SAND and Gravel.
S-3	5	12.5	14.0		SW	Gray to brown, fine to coarse, wet SAND with Gravel. (Mostly slough. Limited recovery.)
S-4	8	17.5	19.0		GW	Gray, wet GRAVEL with fine to coarse Sand. (Limited recovery.)
						Bottom of boring at 19.0 feet.



Recovery
Subsample for Analysis
Driven Interval

▽ Groundwater Observed At Time of Drilling

Log of Soil Boring and Well Construction B02/MW-02

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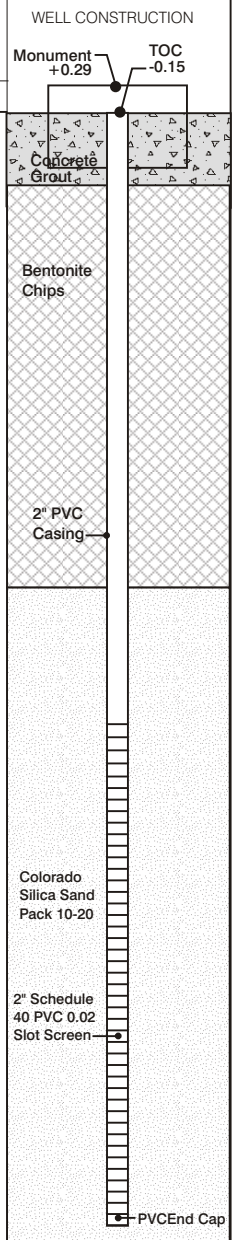
Floyd Snider
Boring B-02/MW-02 Date 8-28-06 Sheet 1 of 1
Job St Paul CDF
Logged By Chris Gardner Weather Clear/Sun
Drilled By Holt Drilling
Drill Type/Method 4" ID HSA
Sampling Method 140 lb Split Spoon
Bottom of Boring 23.5 ATD Water Level Depth 13.75 Ft
Ground Surface Elevation 19.8

Obs. Well Install. ☒ Yes ☐ No

SAMPLE ID	Blow Count N/12"	RECOVERY From	RECOVERY To	GRAPHIC RECOVERY	USCS Symbol	DESCRIPTION: color, texture, moisture MAJOR CONSTITUENT. NON-SOIL SUBSTANCES: Odor, staining, sheen, scrap, slag, etc.
S-1	24	3.5	5.0		GM	Dark gray, moist, GRAVEL with Silt and Sand.
S-2	5	8.5	10.0		SM	Dark gray to brown, moist, fine SAND with Silt.
S-3	1	13.5	15.0		ML	Gray to black, moist, SILT with Sand. (Abundant wood fragments present throughout drive.)
S-4	3	18.5	20.0		SM ML	Dark brown, wet, SILT with fine Sand to fine Sand with Silt. (Wood fragments present throughout drive.)
S-5	6	22.0	23.5		SM	Dark gray, wet, SAND with Silt. (Abundant wood fragments throughout drive. H_2S like odor.)
						Bottom of boring at 23.5 feet.



Recovery
Subsample for Analysis
Driven Interval

▽ Groundwater Observed At Time of Drilling

Log of Soil Boring and Well Construction B03/MW-03

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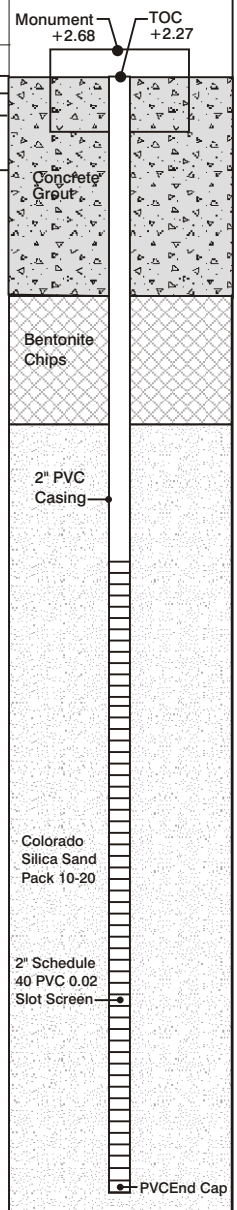
Floyd Snider
Boring B-03/MW-03 Date 9-5-06 Sheet 1 of 1
Job St Paul CDF
Logged By Chris Gardner Weather Sun
Drilled By Holt Drilling
Drill Type/Method 4" ID HSA
Sampling Method 140 lb Auto Hammer
Bottom of Boring 19.5 ATD Water Level Depth 9.9 Ft
Ground Surface Elevation 17.8

Obs. Well Install. ~~Yes~~ No

SAMPLE ID	Blow Count N/12"	RECOVERY From	RECOVERY To	GRAPHIC RECOVERY	USCS Symbol	DESCRIPTION: color, texture, moisture MAJOR CONSTITUENT. NON-SOIL SUBSTANCES: Odor, staining, sheen, scrap, slag, etc.
						ASPHALT
						Removed via Vac Truck
						Large 3" to 5" diameter cobbles
S-1	NA	0.6	1.5			Gray, damp, fine SAND.
						(Sample S-1 collected by hand from 0.6' to 1.5' depth interval.)
						0.0' to 0.25' Asphalt 0.25' to 0.60' Large 3" to 5" diameter cobbles 0.60' to ? Gray, damp fine SAND
						Brown to gray, damp GRAVEL with fine to coarse Sand. (Excavated 0' to 10' using vacuum truck due to utility concerns.)
S-2	2	13.0	14.5		SP	Dark gray, wet, fine SAND with trace Silt.
S-3	2	18.0	19.5		SM	Dark gray, wet, fine to medium SAND with Silt.
						Bottom of boring at 19.50 feet.

WELL CONSTRUCTION



Recovery
Subsample for Analysis
Driven Interval

▽ Groundwater Observed At Time of Drilling

Log of Soil Boring and Well Construction B04/MW-04

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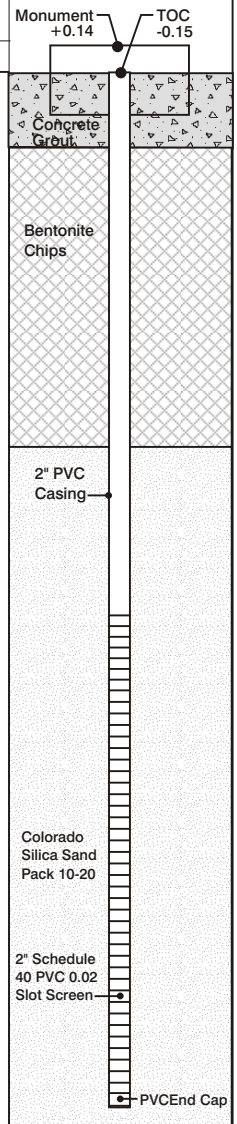
Floyd Snider
Boring B-04/MW-04 Date 9/06/06 Sheet 1 of 1
Job St Paul CDF
Logged By Chris Gardner Weather Sun
Drilled By Holt Drilling
Drill Type/Method 4" ID HSA
Sampling Method 140 lb Auto Hammer
Bottom of Boring 21.5 ATD Water Level Depth 12.20 Ft
Ground Surface Elevation 18.7

Obs. Well Install. ~~Yes~~ No

SAMPLE ID	Blow Count N/12"	RECOVERY From	RECOVERY To	USCS Symbol	DESCRIPTION: color, texture, moisture MAJOR CONSTITUENT. NON-SOIL SUBSTANCES: Odor, staining, sheen, scrap, slag, etc.
				GM	Brown, loose, damp, GRAVEL with Silt and Sand. (Fill)
					Cuttings show abundant damp wood fragments.
S-1	4	13.5	15.0	ML	Dark gray, moist to wet, SILT with fine Sand. (Abundant wood fragments.)
S-2	1	18.5	20.0		Dark brown, wet, SILT with abundant fine Sand. (Scattered wood fragments throughout drive.)
S-3	2	20.0	21.5	SM-ML	
					Bottom of boring at 21.5 feet.

WELL CONSTRUCTION



Recovery
Subsample for Analysis
Driven Interval

▽ Groundwater Observed At Time of Drilling