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30 April 2014

Mr. Steve Teel
Washington State Department of Ecology
Toxics Cleanup Program
Southwest Regional Office
P.O Box 47775
Olympia, Washington 98504-7775

Subject: Response to Comments Provided in Ecology's 3 January 2014 Letter
Augmented Remedial Investigation and Feasibility Study Report
Former Tacoma Metals Site – Tacoma, Washington
Agreed Order DE 97-5435, Facility No. 1257, Cleanup Site ID 3910
K/J 996098.00

Dear Mr. Teel:

On behalf of Portland Avenue Associates (PAA), this letter presents responses to the comments provided by the Washington State Department of Ecology (Ecology) on the *Augmented Remedial Investigation and Feasibility Study Report* dated 30 October 2013 (Augmented RI/FS).

During the 24 January 2014 meeting at Ecology's Southwest Region office, Kennedy/Jenks Consultants (on behalf of Portland Avenue Associates) indicated that additional information would be provided to Ecology regarding boring B-36 and the proposed asphalt cap. The supplemental information is provided in the attachments listed below and will be referenced as appropriate in our responses to Ecology's comments provided in this letter.

- Supplemental information regarding boring B-36 is provided in Attachment A.
- Supplemental information regarding the proposed asphalt cap is provided in Attachment B.

Final revisions to the Augmented RI/FS will be made following receipt of Ecology's comments regarding the content of this letter. Kennedy/Jenks Consultants' responses are presented below in the same sequence as provided in Ecology's comment letter.

Ecology Comment #1: Please add the coking plant structures that were in the creosote plant area to the following RI/FS figures: ***Text Figures 2 and 4****; and* ***Appendix C Figure 1-2****. The 102,000- and 450,000-gallon above-ground storage tanks (ASTs) that are shown on the 1912 Sanborn Fire Insurance Map and the 1,500-gallon AST (discussed in Section 2.1.1) shall also be added to* ***Text Figures 2 and 4 and Appendix C Figure 1-2****.*

Response: Comment noted. Features will be added to the figures referenced above in the comment.

*Ecology Comment #2: The elevation of the creosoting plant is incorrectly shown on **Appendix F Figures 3A, 3C, and 3D**. Please revise these figures to show the working surface elevation of the plant at an approximate depth of 5 feet. Also, remove the projection of the creosote plant from Figure 3B (cross-section BB-BB') because the plant location is greater than 60 feet away from the cross-section.*

Response: Kennedy/Jenks Consultants does not agree that the working surface elevation of the former creosoting plant was 5 feet below current grade and do not know the basis for this statement. Our reconstruction of the former working surface indicates an elevation of approximately 6 feet above mean sea level in the creosoting plant retort area (see Attachment A). This corresponds to a depth of approximately 4 feet below the current ground surface (approximately 10 feet) at the former creosoting plant retort location. The former retort structure will, therefore, be shown at an elevation of 6 feet on the referenced figures.

Figures referenced in the comment will be updated; structures will not be projected more than 60 feet from cross-section lines in accordance with Ecology's request.

*Ecology Comment #3: Please add any former coking plant structures that existed within the cross-section lines of sections **AA-AA', CC-CC', or DD-DD' (Appendix F Figures 3A, 3C, and 3D)** to the cross-section figures at the appropriate elevation. At a minimum, the octagonal tank foundation location (and correct elevation based on field observations of test pit TP-5) shall be added to **cross-section DD-DD' (Figure 3D)**. The ASTs that are shown on the 1912 Sanborn Fire Insurance Map shall also be added to **Appendix F Figures 1, 2A, 2B, 2C, 2D, and 3A (cross-section AA-AA')**.*

Response: Figures referenced in the comment will be updated. The log for test pit TP-5 indicates the test pit was approximately 1.5 feet below surrounding grade (a copy of the TP-5 log is provided in Attachment C). This was the approximate grade after removal of the octagonal foundation, not the elevation of the foundation. The octagonal foundation was exposed at ground surface (the top was actually above surrounding grade), which is approximately 10 feet above mean sea level in the vicinity of the foundation. In addition, the structure associated with the octagonal foundation (presumably a coal-gas storage vessel) is visible at site grade on 1944 ground-level photographs (see Kennedy/Jenks Consultants 17 February 2009 *Response to Ecology Comments* letter). Therefore, the most correct elevation for octagonal foundation is the current site grade.

*Ecology Comment #4: **Text Figure 3**, Sample Locations and Affected Soil Area Map: Please make the following changes to this figure:*

a. *Eliminate the categories of "affected soil related to metals recycling activities" and "affected soil related to creosoting plant activities" and instead simply show the aerial extent of affected soil.*

   Response: While Kennedy/Jenks Consultants does not understand why Ecology does not want to distinguish between the obvious sources of contaminants identified at the site (metals recycling versus creosoting operations), the Figure referenced in the comment will be updated in accordance with Ecology's request.

b. *Separate colors should be used for the zero to 6 feet below ground surface (bgs) and greater than 6 feet to 15 feet bgs affected soil intervals. The greater than 15 feet bgs affected soil interval shall also be shown on the map in a separate color. That way the map will illustrate the entire extent of affected soil from the Site. Even though the greater than 15 feet bgs interval is below the point of compliance for soil cleanup levels based on direct contact, these affected soils are affecting groundwater concentrations and potentially the vapor intrusion pathway.*

Response: The Figure referenced in the comment will be updated to show the greater than 15 feet bgs interval.

*Ecology Comment #5: **Text Figure 4**, General Conceptual Site Model: Please revise the figure to clarify that "metals recycling affected soil area (upper fill area)" contamination includes metals, polychlorinated biphenyls (PCBs), carcinogenic polycyclic aromatic hydrocarbons (cPAHs), total petroleum hydrocarbons (TPH), and benzene, toluene, ethylbenzene and total xylenes (BTEX); and that the "creosote-affected soil area" contamination includes BTEX, cPAHs, and naphthalenes. Also, add the former coking plant structures in the vicinity of the creosoting plant.*

Response: The Figure referenced in the comment will be annotated to show the requested information. The coking plant structures in the vicinity of the creosoting plant will also be added. The generalized lithology (units and depths) will be updated to be consistent with Kennedy/Jenks Consultants most recent cross-sections (those provided in Appendix F, which are also being updated based on comments herein).

Ecology Comment #6: Revised Proposed Remedial Action Excavation and Backfill Areas: Add the excavation of the contamination at B-36 on the Simpson Property (see below Comments 9c and 11b). Also, the legend notes that the thickness of backfill on the East 18th Street Right-of-Way will be typically 2-4 feet. This thickness appears to be too low. The sample at B-23, 9-10 feet depth, exceeded the cPAH cleanup level. This would require a fill depth of approximately 6 feet at this location. Please explain how the "2-4 feet typical" estimate was made.

Response: Kennedy/Jenks Consultants does not agree that excavation in the vicinity of B-36 is appropriate to include in the current proposed cleanup action, because the source of the shallow soil impacts was not located on the former Tacoma Metals Property, and the impacts do not appear to be related to any releases that may have occurred on the former Tacoma Metals Property. Our rationale for this assessment is provided in Attachment A.

Regarding sample B-23-9-10, the surface elevation at the time the boring was advanced (8.4 feet) was several feet lower than the current elevation, because gravel fill was placed in the 18th Street right-of-way (ROW) in approximately 2005 during construction of the Puyallup River Side Channel (see Figure 2 in Attachment A). The 2- to 4-foot backfill thickness is an average for the ROW area and may exceed 4 feet at some locations.

Ecology Comment #7: ***New Text Figure 6****: Please make the following changes to this figure:*

a. *Add the locations of the 1,500-, 102,000-, and 450,000-gallon ASTs.*

   Response: The ASTs will be added to the Figure referenced in the comment. The 1,500-gallon AST is located above the retort at the creosoting plant; the others are located primarily on the Simpson Property (see Attachment A).

b. *Add any former coking plant structures that existed within or near the cross-section line.*

   Response: Former coking plant structures will be added to the Figure referenced above. No coking plant features will be projected from a distance greater than 60 feet from the cross-section line, which is consistent with Comment #2 above.

c. *The elevation of the creosoting plant is incorrectly shown. Please revise to show the working surface elevation of the plant at an approximate depth of 5 feet.*

   Response: The Figure referenced in the comment will be revised as Ecology requires above; but Kennedy/Jenks Consultants disagrees regarding the former working surface elevation (see Attachment A and the response to Comment #2 above).

d. *It is difficult to distinguish between the dark purple and black colors that indicate if cPAH soil contamination was present at soil sample locations. Please use a lighter color for the locations that had cPAH concentrations above the proposed cleanup level.*

   Response: The colors on the Figure referenced in the comment will be revised.

Ecology Comment #8: ***Section 2.1.1, 2nd paragraph, 2nd sentence****: Please revise the text to more specifically reference how the two large ASTs are identified on the Sanborn map (they are labeled "oil tank"). Please also describe what "available information" was used to suggest that the tanks were used to store or mix creosote or wood treatment chemicals.*

Response: Comment noted. Information regarding the two large ASTs will be summarized in more detail in the RI/FS report, including information regarding location and material stored. The requested information is also addressed in the 17 February 2009 *Response to Ecology Comments* letter previously submitted to Ecology.

Ecology Comment #9: ***Section 4.2.1****: Thank you for adding the new text in this section in response to our comments. However, some changes to this text need to be made:*

a. ***Page 4-6, 2nd paragraph, 2nd sentence****: Please replace "creosote-affected" with "COC-affected."*

   Response: Comment noted. Text will be updated.

b. ***Page 4-6, 3rd paragraph, 1st sentence****: Please replace "creosote material associated with" with "contamination beneath the footprint of."*

   Response: Comment noted. Text will be updated.

c. ***Page 4-6, 3rd paragraph, 2nd and 3rd sentence***: *Delete these sentences. The contamination at B-36 above 15 feet bgs is part of the Tacoma Metals Site and shall be treated accordingly. As correctly shown in Figure 2, all three parcels (East 18th Street Right-of-Way, Simpson Property, and the JJ Port Property) are included in the former creosoting plant area. The source for this contamination may be the former ASTs. Reword the text accordingly.*

Response: The area identified as the former creosoting plant area on Figure 2 is based on the extent of creosote-related impacts, which, based on field and analytical data, originated at former creosoting plant structure (i.e., the retort) and were traced laterally beneath the 18th Street ROW, Simpson Property, and JJ Port Property.

Impacts from the former retort area have been identified at B-36, but only at depths below 23 feet bgs. The impacts from ~7 to 10 feet bgs at B-36 did not originate from the creosoting plant retort or from the former Tacoma Metals Property. The large storage tanks do present one potential source, but no substantive releases from these tanks have been identified. In addition, several other possible sources have been identified in the B-36 vicinity. Our findings regarding B-36 are discussed in Attachment A.

Ecology Comment #10: ***Section 4.2.4, LNAPL and DNAPL, 2nd paragraph, 1st sentence***: *Please add an explanation of how and why the conclusion was made that the light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) at the site appeared to be creosote product.*

Response: Discussion of LNAPL and DNAPL both being derived from creosote will be added.

Ecology Comment #11: ***Section 5.2.3, page 5-7, 1st paragraph, 1st sentence and Section 5.5.4***: *Ecology does not agree that the proposed pavement cap of $5x10^{-5}$ centimeters per second (cm/s) or less is sufficiently impermeable. The proposed remedy shall include an impermeable cap that has a hydraulic conductivity of 1×10^{-7} cm/s or less. The cap needs to meet this lower standard because:*

a. *An impermeable cap is needed for the long-term protection of groundwater from residual lead concentrations in shallow soil that exceed Washington State Dangerous Waste criteria.*

Response: Kennedy/Jenks Consultants does not agree that a cap with a permeability of $5x10^{-5}$ is inadequate or inappropriate for the site. Attachment B provides justification as to why we believe this pavement surface will be adequately protective of human health and the environment and meets the intent of the Model Toxics Control Act (MTCA).

b. *According to Asphalt in Hydraulics (The Asphalt Institute Manual Series No. 12, November 1976), to ensure impermeability, a value of less than 1×10^{-7} cm/s is required.*

Response: Comment noted. See response to Comment #11(a) and Attachment B.

c. *Lead concentration data for groundwater data are limited and no data are available since December 2003. Also, the wells in the groundwater monitoring network are not located in the optimum locations for monitoring the area with some of the highest concentrations. For example, there are no monitoring wells downgradient of TP-43 and TP-60. These locations showed maximum lead concentrations in soil of 12,300 milligrams per kilogram (mg/kg) and 10,800 mg/kg, respectively. TP-43 also had a Toxicity Characteristic Leaching Procedure (TCLP) sample result of 63.6 milligrams per liter (mg/L); this value exceeds the 5.0 mg/L criteria for designation as Washington State Dangerous Waste. A total of eight of the 11 samples analyzed for TCLP from the Site exceeded the 5.0 mg/L criteria.*

Response: Comment noted. See response to Comment #11(a) and Attachment B.

d. *A Site-specific study of the solubility and adsorption characteristics of lead in soils was not performed. Such a study would be recommended if a permeable cap were to be considered for the Site.*

Response: Comment noted. See response to Comment #11(a) and Attachment B.

As stated in Asphalt in Hydraulics, impermeable asphalt mixes may be used for the entire cap or may constitute a portion of a more complex lining, such as placed at the surface of a composite section made up of different asphalt layers.

Response: Comment noted.

*Ecology Comment #12: **Section 5.2.3, page 5-7, 3rd paragraph, 1st sentence**: Delete the first use of "where applicable." The Cleanup Action Plan will require will require that a vapor intrusion evaluation will be required to prior to future development on any of the Site parcels.*

Response: Comment noted. Text will be updated.

*Ecology Comment #13: **Section 5.4**: Thank you for adding the new text in this section in response to our comments. However, some changes to the text need to be made:*

a. ***Page 5-8, last paragraph**: Please explain in more detail how it was determined that the proposed cap will be of sufficient thickness. (See also above Comment 6).*

Response: Comment noted. Please refer to Attachment B.

b. ***Page 5-9, 1st paragraph**: Delete this paragraph and reword to include the excavation the contamination at B-36 (see above Comments 6 and 9c).*

Response: Comment noted. As previously stated, Kennedy/Jenks Consultants does not agree that excavation at B-36 is appropriate for inclusion in the current cleanup action, and our findings regarding B-36 are summarized in Attachment A. Excavation of this area is not expected to be included in the Augmented RI/FS report.

c. ***Page 5-9, 3rd paragraph***: *Add that the excavation volume is also increased due to the excavation at B-36. The cost estimate also needs to be adjusted in Appendix H accordingly.*

Response: Comment noted. As previously stated, Kennedy/Jenks Consultants does not agree that excavation at B-36 is appropriate for inclusion in the current cleanup action, and our findings regarding B-36 are summarized in Attachment A. Excavation of this area is not expected to be included in the Augmented RI/FS report.

*Ecology Comment #14: **Section 5.5**: Add a sub-section discussing the excavation of the contamination at B-36 above 15 feet bgs.*

Response: Comment noted. As previously stated, Kennedy/Jenks Consultants does not agree that excavation at B-36 is appropriate for inclusion in the current cleanup action, and our findings regarding B-36 are summarized in Attachment A. Excavation of this area is not expected to be included in the Augmented RI/FS report.

*Ecology Comment #15: **Section 5.5.3, Conditional Point of Compliance**: Please note that as per WAC 173-340-720(8)(d)(i) and (ii), before approving the conditional point of compliance, a notice of the proposal (and invitation for comment) shall be mailed to the natural resources trustees, the Washington State Department of Natural Resources, the U.S. Army Corps of Engineers. This notice shall be in addition to any notice provided under WAC 173-340-600. Also, any affected property owners between the source of contamination and the Puyallup River (for example the city of Tacoma) must agree in writing to the use of the conditional point of compliance.*

Response: Comment noted. Text will be added to reflect comment.

Ecology Comment #16: Remedial Alternative Costs: Please see above Comment 13c. Also, the cost of abandoning and reinstalling groundwater monitoring wells needs to be included. Wells that are in cap and/or remedial areas will need to be abandoned prior to construction. Following the implementation of the cleanup, groundwater monitoring wells will need to be reinstalled. Some well locations will be different from those shown on Figure 3. For example, MW-2 will need to be moved so that it can monitor groundwater downgradient of TP-43. Also, MW-5, -6, and -9 shall be moved to monitor TP-21, TP-33, and TP-38, respectively.

Response: Comment noted. Costs for abandoning and re-installing wells will be added.

Other estimated remedial alternative costs will be updated as appropriate following Ecology's review of the supplemental information provided herein for the Boring B-36 area (Attachment A) and for the proposed pavement cap (Attachment B). Kennedy/Jenks Consultants does not anticipate any substantive changes to the remedial alternative costs for excavation or the cap.

Ecology's Comments #17 through #27 in the 3 January 2014 letter are acknowledged, but are not separately listed herein (these were responses to a previous *Response to Comments* letter submitted to Ecology by Kennedy/Jenks Consultants on 18 June 2013).

If you have any questions regarding the information presented in this response letter, please call us at (253) 835-6400.

Very truly yours,

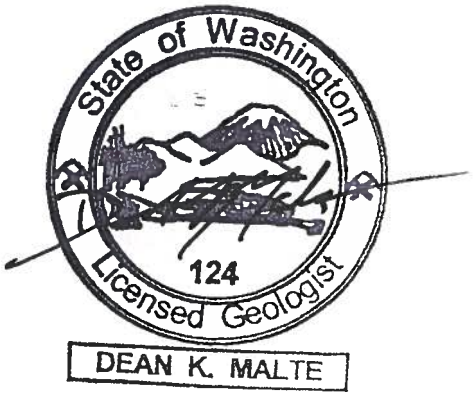
KENNEDY/JENKS CONSULTANTS

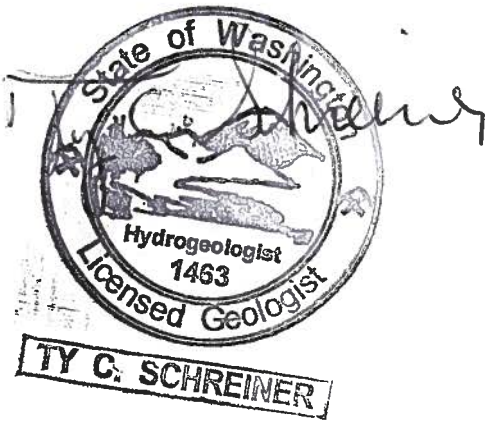
Dean K. Malte, L.G.
Geologist

Ty C. Schreiner, L.Hg.
Vice President

Attachments: A: Technical Memorandum, Former Tacoma Metals Site, Boring B-36
B: Technical Memorandum, Asphalt Cap
C: Log for Test Pit TP-5 (as presented in the 2001 RI/FS)

cc: Mr. Guy Sternal, Eisenhower & Carlson, PLLC





Attachment A

Technical Memorandum, Former Tacoma Metals Site, Boring B-36

30 April 2014

Technical Memorandum

To: Mr. Steve Teel, Washington State Department of Ecology

From: Dean Malte and Ty Schreiner

Subject: Former Tacoma Metals Site
Boring B-36; Simpson Property
K/J 996098*00

This Technical Memorandum presents Kennedy/Jenks Consultants' response to Washington State Department of Ecology's (Ecology's) comments regarding the shallow [<15 feet below ground surface (bgs)] soil contaminants associated with boring B-36, located on the Simpson Property. Ecology's comments were provided by Mr. Steve Teel of Ecology's Southwest Regional Office in the *Transmittal of Ecology Comments on the Augmented Remedial Investigation and Feasibility Report* letter dated 3 January 2014. The information presented herein is also based on our meeting at Ecology's offices on 24 January 2014.

Based on the information reviewed for this Technical Memorandum, impacts to shallow soil at boring B-36 do not appear to be related to contaminants released on the former Tacoma Metals Property. Therefore, further investigation and/or remediation of the shallow soil impacts at boring B-36, which is located on the Simpson Property, should not be part of the cleanup action described in the *Augmented Remedial Investigation and Feasibility Report, Former Tacoma Metals Site* dated October 2013 (Kennedy/Jenks Consultants 2013).

BACKGROUND

Boring B-36 was advanced on the Simpson Property, approximately 175 feet north-northwest of the former Tacoma Metals Property, in February 2006. The Simpson Property is part of the "Creosoting Plant Area" as described in the October 2013 Augmented RI/FS (Kennedy/Jenks Consultants 2013). The location of B-36 is shown on Figure 1 (attached) along with the locations of historical site features.

The "Creosoting Plant Area" was originally delineated based on the lateral extent of creosote-related impacts, which originated at the former Creosoting Plant main retort structure (retort area). Beneath the off-property areas [18th Street Right-of-Way (ROW), Simpson Property, JJ Port Property, see Figure 1] impacts from the retort area are not present at depths less than 15 feet bgs, except at the location of boring B-23 (location shown on Figure 1).

Boring B-23 is located on the 18th Street ROW within approximately 50 feet of the retort building and 20 feet west of the property line. Soil impacts identified in a sample collected at 9 to 10 feet bgs are consistent with the creosote-related impacts identified at the former retort area based on analytical results [total carcinogenic polycyclic aromatic hydrocarbon (cPAH) concentrations above the site cleanup level of 18 milligrams per kilogram (mg/kg)] and field observations [sheen, creosote odor, non-aqueous phase liquid (NAPL)] and correlate laterally with the creosote-related contaminants identified at the former retort (i.e., the creosote product released at the former retort area correlates laterally to B-23). This differs from the soil impacts identified at boring B-36.

BORING B-36 SOIL CONTAMINANT IMPACTS

At boring location B-36, creosote-related contaminants associated with the former retort building were only identified in soil at depths between 23 and 32 feet bgs. These contaminants were present in the lower sand unit, which is the primary lithologic unit in which creosote-related contaminants were transported laterally from the retort area (see Figure 2 attached).

Shallow (i.e., <15 feet bgs) soil impacts related to the retort area are primarily located on the former Tacoma Metals Property, but also extend onto a portion the 18th Street ROW (i.e., B-23 described above). Shallow soil impacts related to the former retort area have not been identified on the Simpson or JJ Port Properties, although cPAHs have been detected in some shallow soil samples at concentrations below the MTCA Method C industrial soil cleanup level of 18 mg/kg. cPAHs have also been detected in shallow soil at concentrations below the Method C soil cleanup level on the former Tacoma Metals Property, including some locations outside the main retort area (but within the larger Creosoting Plant Area).

The shallow soil impacts identified at boring B-36 at approximately 7 to 10 feet bgs (and characterized in a soil sample collected from 8 to 10 feet bgs) do not appear to be related to the creosote-related contaminants that originated from the retort area on the former Tacoma Metals Property. The lateral and vertical extent of soil impacts related to the creosote release at the retort area is well defined and characterized by analytical and field data (see Figure 2). The creosote material from the retort area has a very distinctive odor and appearance (color, sheen, NAPL), which was not evident in the 7- to 10-foot interval at boring B-36.

Boring B-36 Findings

A copy of the boring log for B-36 is provided in Attachment 1, and the lithologic and field-screening information is summarized below (all depths are approximate):

- ***0 to 3.5 feet bgs:*** Gravel with silt and sand; no field indication of contaminant impacts. This material may have been placed in approximately 1985 (see following section).
- ***3.5 to 5.5 feet bgs:*** Wood fill, including fine chips and sawdust with little soil matrix; no field indication of contaminant impacts. This material appears to have been placed sometime between 1956 and 1985 (i.e., prior to placement of the overlying gravel).
- ***5.5 to 11.5 feet bgs:*** Silty sand with some gravel with some wood material. From 7 to 10 feet bgs, a moderate odor (not described as creosote) and sheen were observed; below 10 feet bgs, a slight odor was observed but no sheen. The top of this unit appears to represent the approximate former "working surface" at the time of creosoting plant operations (1910s to 1930s). This material overlies the older wood fill unit present throughout the site.
- ***11.5 to 23 feet bgs:*** Wood fill, including coarse wood debris with silt and sand matrix. This material was originally placed at the site (and surrounding area) as fill to raise the surface elevation when the Puyallup River was rerouted from its original channel in the 1890s and primarily included wood waste from the St. Paul and Tacoma lumber mill.

No contaminant odor was identified in the wood fill material. A light to moderate sheen (increasing with depth) was identified, along with localized NAPL blebs below approximately 18 feet bgs. Because no odor was observed, the sheen and NAPL do not appear to be related to soil contaminants in the wood fill (typically, a distinctive creosote odor is present in impacted soil). The observed sheen and NAPL are likely related to groundwater impacts from upgradient locations and/or partitioning of the lighter creosote components from the upper part of the sand unit underlying the wood fill.

- ***23 to 32 feet bgs:*** Poorly graded sand, locally with some silt. A strong creosote odor and heavy sheen with NAPL blebs were observed from 23 to 24 feet bgs (directly below the wood fill layer), and a moderate creosote odor and sheen from 23 to 27 feet bgs. A slight creosote odor and light sheen were observed from 27 to 29.5 feet bgs, increasing to a moderate creosote odor and sheen from 29.5 to 31 feet bgs. From 31 to 32 feet bgs, a strong creosote odor and heavy sheen with NAPL blebs was observed (directly above the underlying silty sand layer).

- ***32 to 34.5 feet bgs***: Silty sand with no field indication of contaminant impacts (i.e., no odor, no sheen/NAPL).

- ***34.5 to 36 feet bgs:*** Poorly graded medium to coarse sand with no field indication of impacts.

Based on the field observations for boring B-36, the contaminants associated with shallow soil (7 to 10 feet bgs) differ from those observed between 23 and 32 feet bgs. The deeper soil contaminants are related to the creosote release from the retort area, and correlate laterally between boring B-36 and the retort area, as depicted on the cross-sections provided in the October 2013 Augmented RI/FS (Kennedy/Jenks Consultants 2013) (Cross-section A-A' is presented on Figure 2 for reference). The shallower soil contaminants do not appear to be related to the release from the retort area and do not correlate vertically or laterally with the creosote-related impacts identified at the retort area.

Former Working Surface Reconstruction

To facilitate the evaluation of possible sources of shallow soil contamination at B-36, the working surface at the site during creosoting plant operations was reconstructed using information from soil boring and test pit logs.

Surveyed elevation data (based on the NGVD 1929 vertical datum) was available for the current ground surface elevation at most of the boring and well locations [surveys were performed by KPG, Inc. of Tacoma, Washington, (formerly EarthTech) on multiple occasions during the RI]. For former test pit locations (and borings/wells without ground surface elevation data), elevations were estimated from nearby spot elevation survey points and/or from survey-based elevation contours. The survey map and boring/well elevation measurements are included in Attachment 1.

Ground-level photographs from 1920 to 1922 provided a visual reference for ground surface conditions at the time (copies included in Attachment 2).

- A 1922 photograph of the retort structure (1922A) and immediate area shows an apparently hard-packed dirt surface with grass growing in places and some scattered wood debris.

- Another photograph from 1922 (1922B) shows a wood chip storage area associated with the overhead tramway constructed in 1920 (discussed in a following section) to the east of the retort building (which is visible at the left edge of the photograph). The area to the south of the wood chip storage area (right foreground of the photograph) includes some dirt pathways, but the surface is also strewn with assorted wood debris. In this photograph, the overall ground surface appears to slope toward the Puyallup River.

- A 1920 photograph (1920A) shows Canal Street (aka Portland Avenue) and creosoting plant storage tanks (right side of the photograph). The elevated wood chip tramway is visible across the frame of the photograph, and a crane (with support towers) and elevated platforms are visible behind the tramway and storage tanks. The ground surface appears to be generally flat with a gravely dirt surface with scattered wood debris.

The former working surface is presumed to consist of fill (typically silty to sandy materials with some gravel and/or woody debris) that was installed over the coarse wood fill material that was placed at the site in the late 1890s (when the Puyallup River was rerouted) to provide a stable surface for the heavy structures (retort, storage tanks) associated with the creosoting plant.

The material above the former working surface is presumed to be the gravelly fill installed in the early 1940s prior to construction of the former coke plant on the Tacoma Metals Property. The materials installed above the former working surface on the Simpson Property and 18th Street ROW included wood waste fill (different from the older wood fill) overlain by gravelly fill. The fill materials installed in the 1940s differ lithologically from the presumed former working surface materials.

Based on the surface conditions shown on the ground-level photographs and the anticipated stratigraphic interval of the former working surface, the existing boring and test pit logs were reviewed to identify soil layers that represented the former working surface. The suspected former working surface was typically identified based on a distinct change in lithology from the overlying gravelly fill material, with silty to sandy materials with some gravel and/or woody debris being most common. At some boring and test pit locations, mostly on the former Tacoma Metals Property, the working surface does not appear to have been preserved. Demolition of the existing structures in the former retort area (and Creosoting Plant Area in general) likely disrupted or removed the existing ground surface at these locations. These locations were not included in the working surface reconstruction.

Using the surveyed elevations for the current ground surface and the depths to tops of the stratigraphic units identified as the likely former working surface, an elevation contour map of the approximate former working surface was constructed.

A map showing the former working surface elevation contours superimposed on a 1931 aerial photograph is provided on Figure 3 (attached).

Based on the former working surface reconstruction, the ground surface elevation in the retort area during creosoting plant operation (i.e., historical ground surface) was approximately 6 feet above mean sea level (msl). The current surface is at an approximate elevation of 10 feet msl, 4 feet above the historical ground surface. This is consistent with our previous interpretation of 3 to 5 feet of gravel fill being placed after demolition of the creosoting plant structures.

The historical ground surface in the vicinity of boring B-36 (elevation approximately 4.5 feet msl) appears to have been approximately 1.5 feet lower than the retort area. The shallow soil impacts observed from 7 to 10 feet below the current ground surface at boring B-36 (approximately 9.8 feet msl) correspond to a depth below the historical ground surface of approximately 1.5 to 4.5 feet (or 3 to 6 feet below the historical retort area elevation). The lateral distance between B-36 and the retort area is approximately 200 feet.

Based on the migration characteristics of the creosote-related impacts identified at the former retort area, it is unlikely that any release from the retort area could have migrated laterally at shallow depths to the B-36 area. In the immediate vicinity of the former retort area, the primary contaminant transport direction is downwards (into the underlying wood fill and sand units) with limited lateral transport. Lateral contaminant transport occurs primarily in the sand unit underlying the wood fill (but also in the wood fill to lesser extent), which is encountered at 23 feet bgs at boring B-36. Refer to Figure 2 for a depiction of the typical transport model for creosote-related contaminants from the former retort area.

Based on analytical data, field observations, and historical site elevation, conditions, and uses, the shallow soil impacts observed at boring B-36 must be derived from a different source than the impacts related to the creosote-related contaminants from the retort area.

POTENTIAL SOURCES OF B-36 SHALLOW SOIL IMPACTS

To evaluate potential sources for the shallow soil contaminants at boring B-36, historical aerial photographs and maps were reviewed. These included:

- Aerial photographs for the years 1931, 1940, 1941, 1946, 1949, 1950, 1956 (oblique), 1965, 1969, 1970, 1973, 1976, 1979, 1981, 1985, 1989, 1990, 1995, 1998, 2002, 2005, and 2006.
- Ground-level photographs from 1920, 1922, 1927, and 1944 (obtained from the Tacoma Public Library, the 21 May 1921 issue of American Lumberman, and the book Mill on the Boot).
- Sanborn Fire Insurance Map from 1912 (with updates through approximately 1930) (copy provided in Attachment 3).
- Metsker's Map from 1926 (copy provided in Attachment 3).
- Site map of the St. Paul and Tacoma Lumber Company facilities provided in the 21 May 1921 issue of *American Lumberman* (date of map not specified) (copy provided in Attachment 3).

- *St. Paul and Tacoma Lumber Company documents housed at the University of Washington Special Collections library.*

Aerial and ground-level photographs were the primary information sources for locations of historical site features. The maps provided supplemental information regarding designations and uses for many of the historical site features, but not all features depicted on maps were labeled, and some features visible on the photographs were not shown on the maps.

The materials listed above were reviewed with particular attention to the following:

- Locations and uses of historical structures and possible work areas, including those associated with the creosoting plant and those contemporaneous with the creosoting plant, in the vicinity of boring B-36.
- Other historical property uses (subsequent to creosoting plant operations) in the vicinity of boring B-36.
- Historical placement of fill materials in the vicinity of boring B-36.

Figures 4 through 9 show aerial photographs for the years 1931, 1940, 1949, 1965, 1985, and 2005, respectively, with the locations of historical features. These years were chosen to provide a representative depiction of the significant changes to the boring B-36 area over time, including property use and placement of fill materials. Unmarked copies of the aerial photographs used for Figures 4 through 9 are provided in Attachment 4.

Potential sources for the shallow soil impacts at boring B-36 are discussed below.

Former Crane Area

A crane and two potentially associated elevated structures are visible on the Simpson Property on the 1931 aerial (Figure 4) and 1920s ground-level photographs (Attachment 2). The crane area and elevated structure footprints are shown on the 1926 Metsker's Map and the St. Paul and Tacoma site map, but are not labeled (copies provided in Attachment 3). The purpose of the elevated structures is uncertain, but they appear to be the only features located within the working radius of the crane. They could be some sort of elevated fabrication platforms, but this could not be verified.

St. Paul and Tacoma Lumber Company documents reviewed by Kennedy/Jenks Consultants in 2008 include references to "creosote dip tanks and crane for handling poles" and indicate that these are part of a "plant we built for butt-treating poles" (copies of these documents are provided in Kennedy/Jenks Consultants' *Response to Ecology Comments* letter dated 17 February 2009). These documents also indicate the dip tanks and crane were installed in 1916 as a separate facility from the retort structure, which began operation in 1912.

Based on the information in the St. Paul and Tacoma Lumber Company documents, the crane may have been used for butt-treating poles; however, the large storage tanks located on the Simpson Property both appear to be closed-top tanks, and no other features that appear to be

dip tanks (including the elevated platforms described above) have been identified on historical maps or photographs in the vicinity of the former crane.

Regardless of its specific use, the crane appears to have been installed as a separate facility from the main creosoting plant retort structure, and no indication that the crane and elevated platforms were directly associated with operations at the former retort area was identified. There is no direct access from the former retort area to the crane (blocked by tanks, crane support towers, and the elevated wood chip conveyor), and the working area of the crane does not appear to extend over the large oil tanks. In addition, a hoist associated with the former creosoting plant (presumably for loading/unloading rail cars used for the retort) is shown on the 1926 Metsker's map, and a building identified as a hoist shed is shown on the St. Paul and Tacoma site map at the same location (building CR4). Although it is possible that creosote-treated materials from the main creosoting plant were moved using the large crane, the apparent presence of a separate hoist for loading/unloading retort cars suggests that the large crane was not directly associated with the main creosoting plant.

Boring B-36 is located beneath the working area of the crane. Spills related to crane operations in the area could have contributed to the shallow soil impacts at boring B-36. The crane was dismantled sometime between 1931 and 1940 based on aerial photographs (Figures 4 and 5).

[Note: An elevated wood-chip conveyor was constructed across the site in 1920 (see Figure 4 and Attachment 2). The conveyor was used to transport sawdust and wood chip waste to a barge loading area on the Puyallup River and crossed the site approximately through the center of the 18th Street ROW. The wood waste was transported from St. Paul and Tacoma mills to Consumers' Central Heating Company for use as hog fuel for steam generation and was not related to the creosoting plant. The wood chip enclosure area (see Figures 1 and 4 and Attachment 2) also appears to have been constructed in 1920.]

Former Oil Storage Tanks

Boring B-36 is located in the general proximity of the large oil tanks associated with the creosoting plant. The tanks are visible on the 1931 aerial photograph (Figure 4), and an impression is visible on the ground surface at the former location of the large tank on the 1940 (Figure 5) and 1949 (Figure 6) aerial photographs. Both tanks are shown on the Sanborn, Metsker's and St. Paul and Tacoma maps (Attachment 3).

Although some minor spillage to the ground surface may have occurred in the general boring B-36 area, creosote-related impacts [i.e., cPAHs, naphthalene, and/or benzene, toluene, ethylbenzene, and total xylenes (BTEX) above site cleanup levels] to shallow soil in the vicinity of the former tanks have not been identified. At the off-property areas in general (Simpson Property, JJ Port Property, and 18th Street ROW Propery), cPAHs have been detected in some shallow soil samples, but at concentrations below the site cleanup levels (except B-23, as previously discussed). This is consistent with some localized spillage in the oil tank area, but does not indicate a substantive release from a specific location. In addition, the B-36 boring log for does not indicate the presence of a creosote odor in shallow soil. Therefore, it seems unlikely that minor spillage related to the former oil tanks could have contributed significantly to the shallow soil contaminants at boring B-36.

Materials Storage

On the 1949 photograph (Figure 6), a pile of linear objects is visible on the western portion of the Simpson Property, including the boring B-36 area. These objects could not be specifically identified, but could be wooden poles or pilings, or possibly disassembled components of the former crane towers or elevated wood chip tramway. Regardless, the pile is uncovered, and if any of these materials included treated wood, shallow soil contaminants could have been introduced to the boring B-36 area by infiltration of rainwater through the piled materials into the underlying soil. These objects also appear to be present on the 1940 photograph, but farther west than on the 1949 photograph.

Former Wood Fill Area Access Road

In the late 1940s, the United States Army Corps of Engineers (USACE) constructed an earthen levee between the site and the Puyallup River. The construction of the levee isolated a portion of the former river channel from the newly-established channel. The former channel area was filled, primarily with wood waste material, beginning in the early 1950s.

The primary access road to the wood fill area was initially located on the JJ Port Property, but sometime between 1956 and 1965, the access road was shifted to the northern portion of Simpson Property. Boring B-36 appears to be located within the footprint of this wood fill access roadway, as shown on the 1965 aerial photograph (Figure 7).

Based on a comparison of aerial photographs from 1931 to 1965, the ground surface elevation near boring B-36 does not appear to have changed prior to construction of the access road (i.e., there is no indication of fill placement, grading, excavations, etc.). It is uncertain whether the access road was graded into the existing surface or if a layer of gravel was installed, but it does not appear that the elevation was significantly altered.

Leaks and spills from vehicles using the access road are a potential source for the shallow soil impacts at boring B-36.

Backfill on Simpson Property

The access roadway through the boring B-36 area is visible on aerial photographs through 1973. On the 1976 photograph, fill material appears to be present on the Simpson Property, including the boring B-36 area. The fill material is most likely wood waste, which is present in boring B-36 from 3.5 to 5.5 feet bgs (see Attachment 1). On the 1985 photograph (Figure 8), additional fill is visible on the Simpson Property, presumably the gravel fill present from 0 to 3.5 feet bgs at boring B-36 (Attachment 1). The 2005 aerial photograph (Figure 9) shows the site during construction of the Puyallup River Side Channel.

Because no field indication of contaminant impacts was observed in the upper wood fill and shallow gravelly fill at boring B-36, it is most likely that the shallow soil contaminants at boring B-36 were released some time before 1976.

SUMMARY

The available information indicates the shallow soil impacts at boring B-36 are not associated with the creosote-related impacts at the former retort area based on the following:

- The soil impacts identified in shallow (7 to 10 feet bgs) soil at boring B-36 differ from those in deeper (23 to 32 feet bgs) soil, and the impacted intervals are vertically separated by approximately 13 feet.
- The depth range of the shallow soil impacts at boring B-36 corresponds to approximately 1.5 to 4.5 feet below the historical ground surface (i.e., the former working surface). The lateral distance between boring B-36 and the former retort area is approximately 200 feet. It is very unlikely that creosote-related contaminants from the former retort area could have been transported laterally at such shallow depths over that distance.
- The shallow soil impacts at boring B-36 do not correlate laterally with the former retort area impacts.

Possible sources for the shallow soil impacts at boring B-36 include the following:

- Spills to the ground surface associated with operation of a crane, possibly used for butt-treating poles in dip tanks, on the Simpson Property (1910s to 1930s) .
- Minor spillage in the general area of the former oil tanks (1910s to 1930s).
- Leaching of contaminants from materials stored on the Simpson Property (1940s).
- Spillage/leakage from vehicles using a road on the Simpson Property to access the former Puyallup River channel wood fill area (1960s to 1970s).

Based on Kennedy/Jenks Consultants evaluation of the existing information, impacts to shallow soil at boring B-36 do not appear to be related to the former Tacoma Metals Property or the specific activities performed on-property. Therefore, further investigation and/or remediation of the shallow soil impacts at boring B-36 should not be associated with the planned cleanup action at the former Tacoma Metals site. If you have any questions regarding the information presented in this letter, please call us at (253) 835-6400.

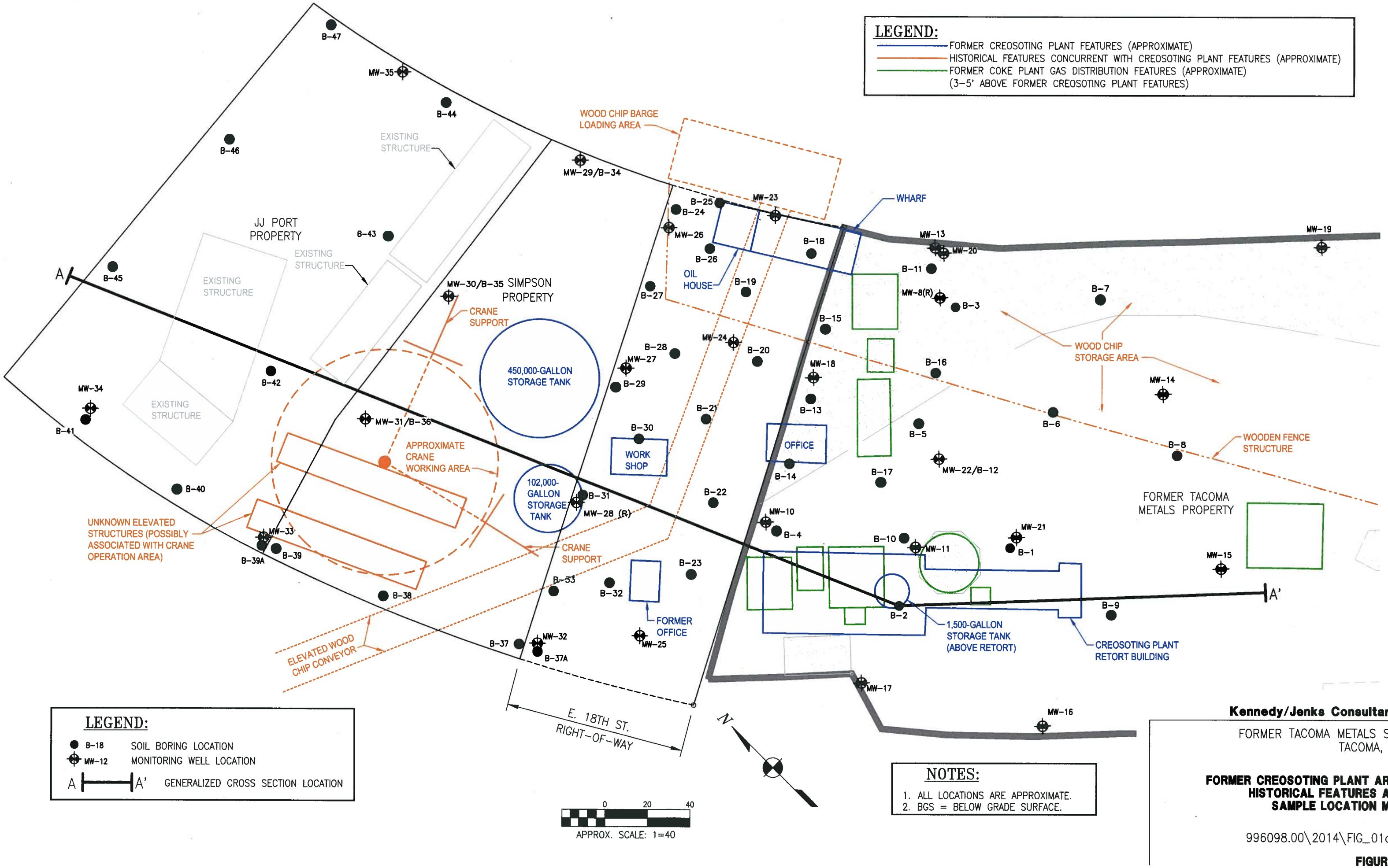
References

Kennedy/Jenks Consultants. 2013. Augmented Remedial Investigation and Feasibility Report, Former Tacoma Metals Site. Prepared for the Washington State Department of Ecology. Dated October 2013.

Washington State Department of Ecology. 2014. Transmittal of Ecology Comments on the Augmented Remedial Investigation and Feasibility Report, dated October 2013, prepared by Kennedy/Jenks Consultants, Former Tacoma Metals Site, Agreed Order DE 97-5435,Facility /Site No. 1257, Cleanup Site ID no. 3910. Dated 3 January 2014.

Enclosures:
Figure 1 – Former Creosoting Plant Area Historical Features and Sample Location Map
Figure 2 – Former Creosoting Plant Area Generalized Cross Section A-A'
Figure 3 – Former Creosoting Plant Area Historical Working Surface Elevation Contour Map
Figure 4 – Former Creosoting Plant Area Historical Site Features 1931 Aerial Photograph
Figure 5 – Former Creosoting Plant Area Historical Site Features 1940 Aerial Photograph
Figure 6 – Former Creosoting Plant Area Historical Site Features 1949 Aerial Photograph
Figure 7 – Former Creosoting Plant Area Historical Site Features 1965 Aerial Photograph
Figure 8 – Former Creosoting Plant Area Historical Site Features 1985 Aerial Photograph
Figure 9 – Former Creosoting Plant Area Historical Site Features 2005 Aerial Photograph
Attachment 1 – Boring Log for B-36 / MW-31 (Simpson Property) and survey maps/data
Attachment 2 – Ground-Level Photographs 1920 and 1922
Attachment 3 – Historical Maps, including: 1912 Sanborn Map, 1926 Metsker's Map, and 1921 (or earlier) St. Paul and Tacoma Lumber Company map provided in the 5/21/1921 issue of American Lumberman
Attachment 4 – Aerial Photographs (unmarked) for 1931, 1940, 1949, 1965, 1985, and 2005

Figures



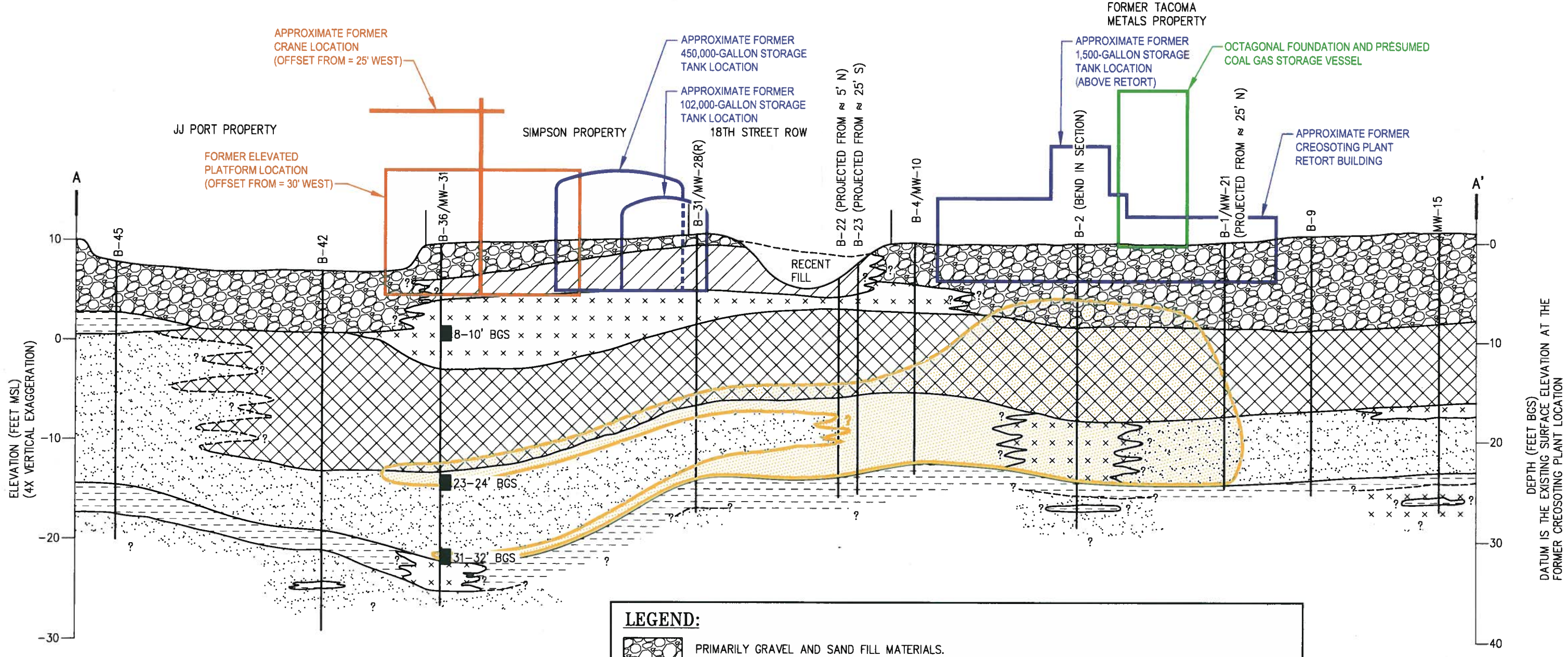
Kennedy/Jenks Consultants

FORMER TACOMA METALS SITE
TACOMA, WA

FORMER CREOSOTING PLANT AREA HISTORICAL FEATURES AND SAMPLE LOCATION MAP

996098.00\2014\FIG_01dwg

FIGURE 1



NOTES:

1. REFER TO FIGURE 1 FOR CROSS SECTION LOCATION.
2. ALL LOCATIONS AND DEPTHS ARE APPROXIMATE.
3. MSL = FEET ABOVE MEAN SEA LEVEL (NGVD 1929).
4. BGS = BELOW GROUND SURFACE.

APPROX. SCALE: 1=40 HORIZONTAL (0, 20, 40)

APPROX. SCALE: 1=10 VERTICAL (0, 5, 10)

LEGEND:

- PRIMARILY GRAVEL AND SAND FILL MATERIALS.
- PRIMARILY WOODY MATERIAL WITH NO EVIDENT MATRIX.
- PRIMARILY SILTY SAND WITH SOME GRAVEL AND/OR CLAY LOCALLY.
- PRIMARILY WOODY MATERIAL WITH SAND, SILT, AND/OR CLAY MATRIX.
- PRIMARILY SAND WITH SOME SILT LOCALLY.
- PRIMARILY CLAY AND SILT WITH SOME SAND LOCALLY.
- APPROXIMATE AREA OF FIELD INDICATION OF HEAVY SOIL IMPACTS FROM RETORT AREA RELEASE.
- SOIL SAMPLE INTERVALS FOR BORING B-36.
- APPROXIMATE FORMER PRIMARY CREOSOTING PLANT FEATURE LOCATION.
- APPROXIMATE FORMER OTHER FEATURE LOCATIONS CONCURRENT WITH CREOSOTING PLANT.
- FORMER COKE PLANT GAS DISTRIBUTION FEATURES (APPROXIMATE) (3-5' ABOVE FORMER CREOSOTING PLANT FEATURES)

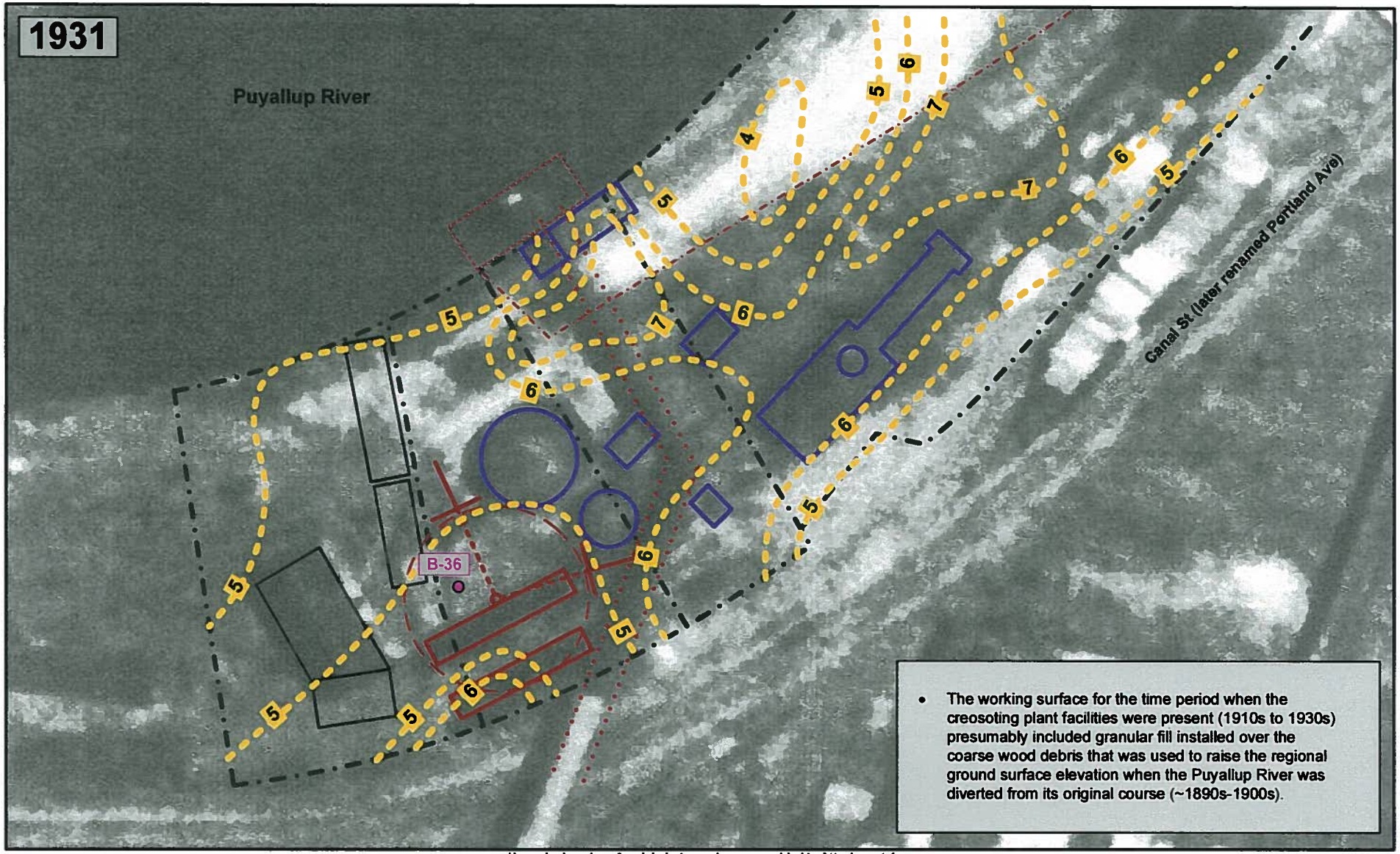
Kennedy/Jenks Consultants

FORMER TACOMA METALS SITE
TACOMA, WA

FORMER CREOSOTING PLANT AREA GENERALIZED CROSS SECTION A-A'

996098.00\2014\FIG_02

FIGURE 2



Unmarked copies of aerial photographs are provided in Attachment 4

Legend:

- Approximate former working surface elevation during creosoting plant operations (contour interval = 1 foot).
- Former creosoting plant primary structures depicted on the 1912 Sanborn and 1926 Metsker's maps.
- Other historical site features shown on the 1912 Sanborn and 1926 Metsker's maps.
- Approximate current property boundaries.

Notes:

1. All locations are approximate. Elevations are in feet above mean sea level (NGVD 1929).
2. See Figures 4 through 9 for a description of historical site features.
3. Historical surface reconstructed based on boring and test pit observatiions and depictions of the previous surface conditions observed on ground-level photographs from 1920 to 1922.

N

0 50 100 150

Approximate scale in feet

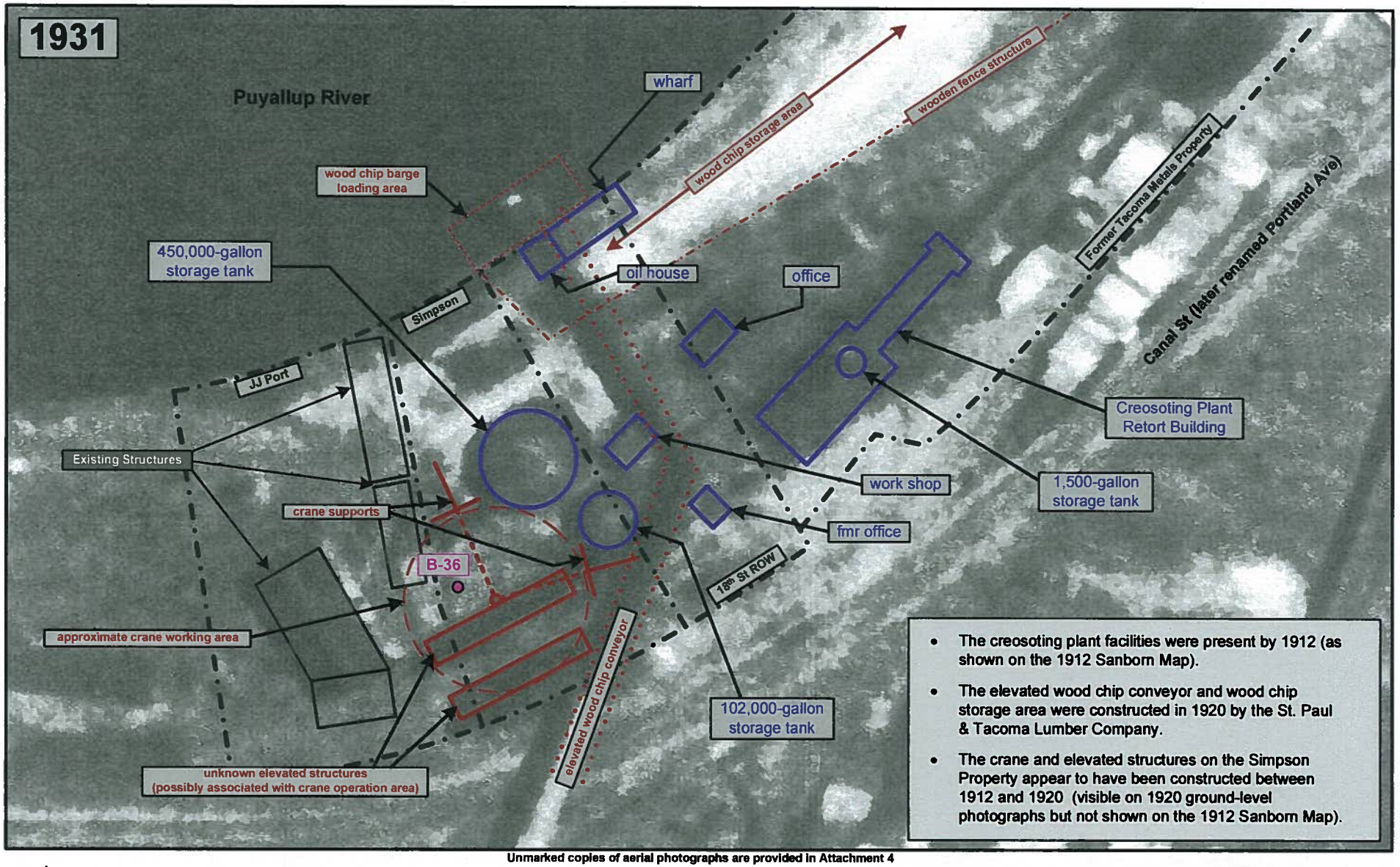
Kennedy/Jenks Consultants

Former Tacoma Metals Site
Tacoma, WA

Former Creosoting Plant Area Historical Working Surface Elevation Contour Map

996098.00/2014/histmaps.VSD

FIGURE 3



Unmarked copies of aerial photographs are provided in Attachment 4

Legend:

- Former creosoting plant primary structures depicted on the 1912 Sanborn and 1926 Metsker's maps.
- Other historical site features shown on the 1912 Sanborn and 1926 Metsker's maps.
- Approximate current property boundaries.

N

0 50 100 150

Approximate scale in feet

Notes:

1. All locations are approximate.
2. Historical site features were also identified on ground-level photographs from 1920 to 1922.

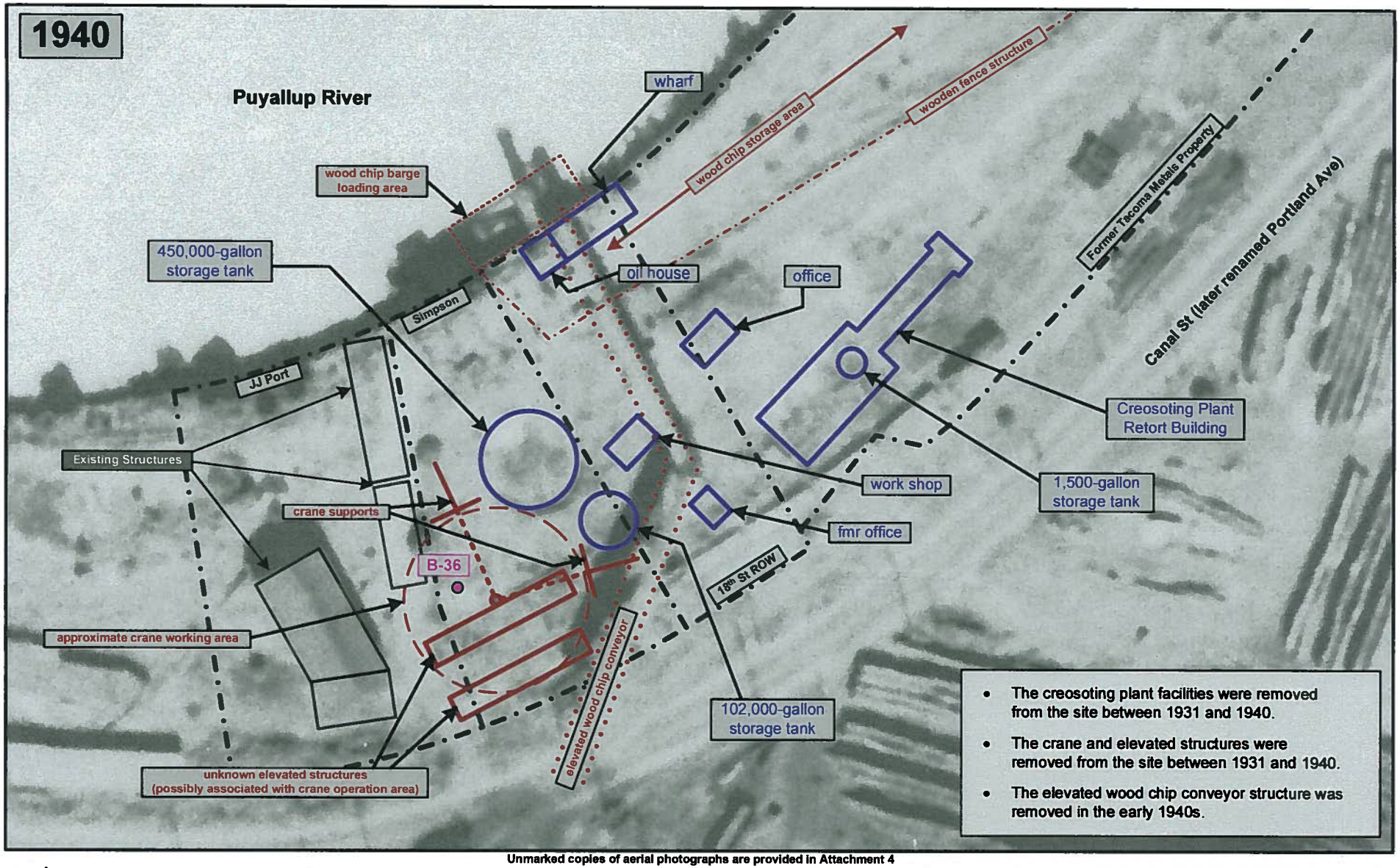
Kennedy/Jenks Consultants

Former Tacoma Metals Site
Tacoma, WA

Creosoting Plant Area
Historical Site Features
1931 Aerial Photograph

996098.00/2014/histmaps.VSD

FIGURE 4



Unmarked copies of aerial photographs are provided in Attachment 4

Legend:

- Former creosoting plant primary structures depicted on the 1912 Sanborn and 1926 Metsker's maps.
- Other historical site features shown on the 1912 Sanborn and 1926 Metsker's maps.
- Approximate current property boundaries.

N

0 50 100 150

Approximate scale in feet

Notes:

1. All locations are approximate.
2. Historical site features were also identified on ground-level photographs from 1920 to 1922.

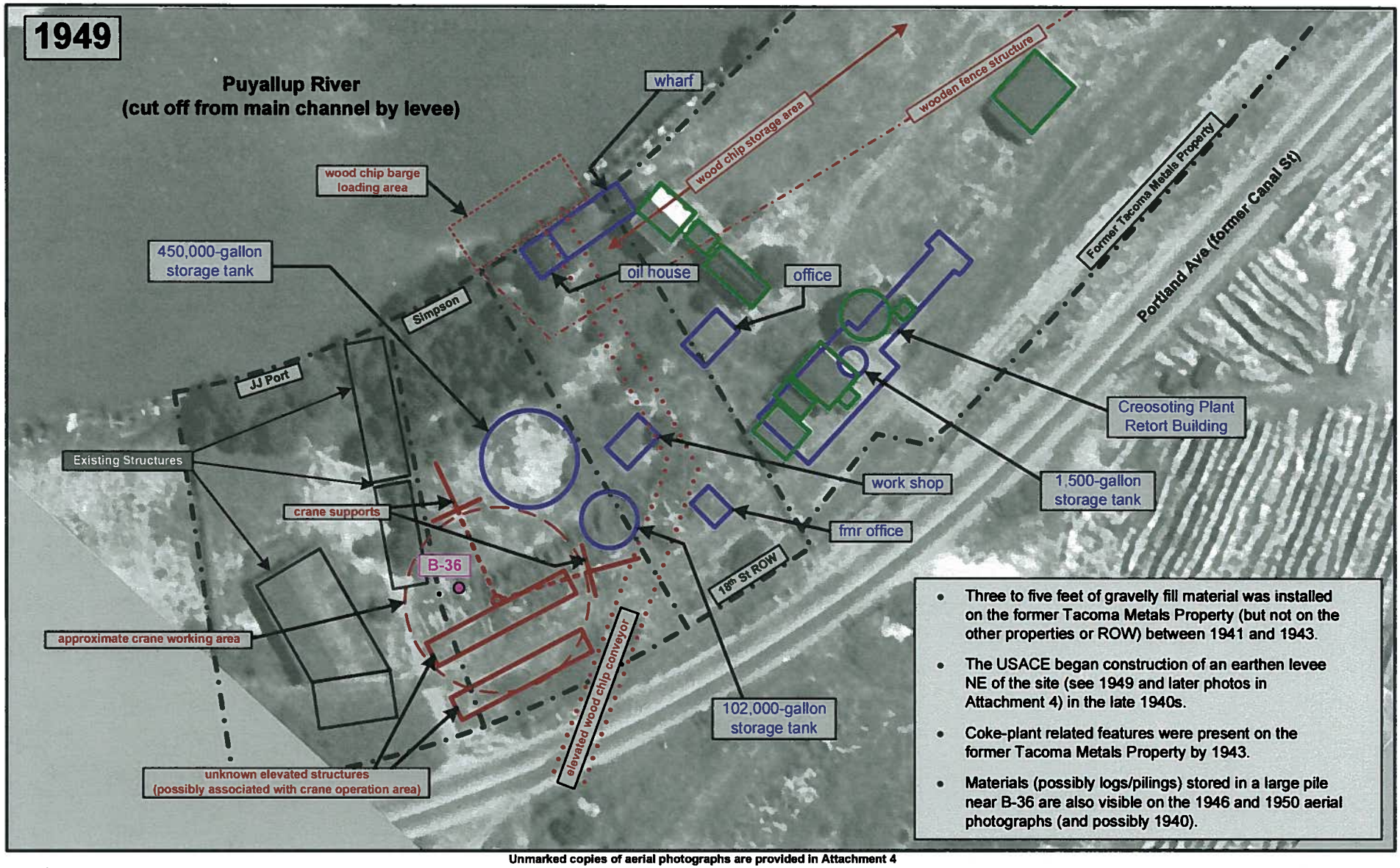
Kennedy/Jenks Consultants

Former Tacoma Metals Site
Tacoma, WA

Creosoting Plant Area
Historical Site Features
1940 Aerial Photograph

996098.00/2014/histmaps.VSD

FIGURE 5



Unmarked copies of aerial photographs are provided in Attachment 4

Legend:

- Former creosoting plant primary structures depicted on the 1912 Sanborn and 1926 Metsker's maps.
- Other historical site features shown on the 1912 Sanborn and 1926 Metsker's maps.
- Approximate current property boundaries.
- Approximate former coke plant and coal gas distribution structure locations.

N

0 50 100 150
Approximate scale in feet

Notes:

1. All locations are approximate.
2. Historical site features were also identified on ground-level photographs from 1920 to 1922.

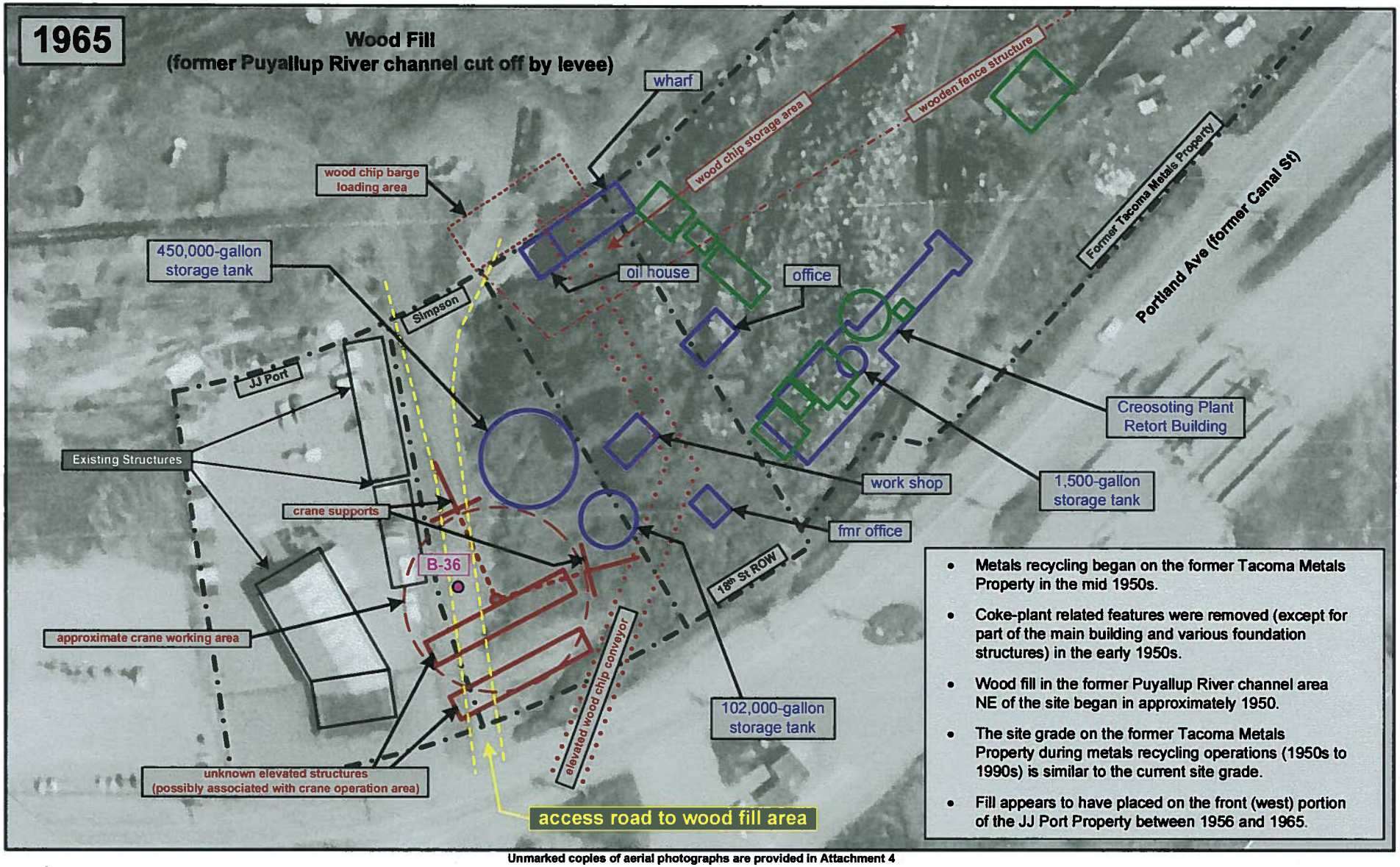
Kennedy/Jenks Consultants

Former Tacoma Metals Site
Tacoma, WA

Creosoting Plant Area
Historical Site Features
1949 Aerial Photograph

996098.00/2014/histmaps.VSD

FIGURE 6



Unmarked copies of aerial photographs are provided in Attachment 4

Legend:

- Former creosoting plant primary structures depicted on the 1912 Sanborn and 1926 Metsker's maps.
- Other historical site features shown on the 1912 Sanborn and 1926 Metsker's maps.
- Approximate current property boundaries.
- Approximate former coke plant and coal gas distribution structure locations.

Notes:

1. All locations are approximate.
2. Historical site features were also identified on ground-level photographs from 1920 to 1922.

N

0 50 100 150

Approximate scale in feet

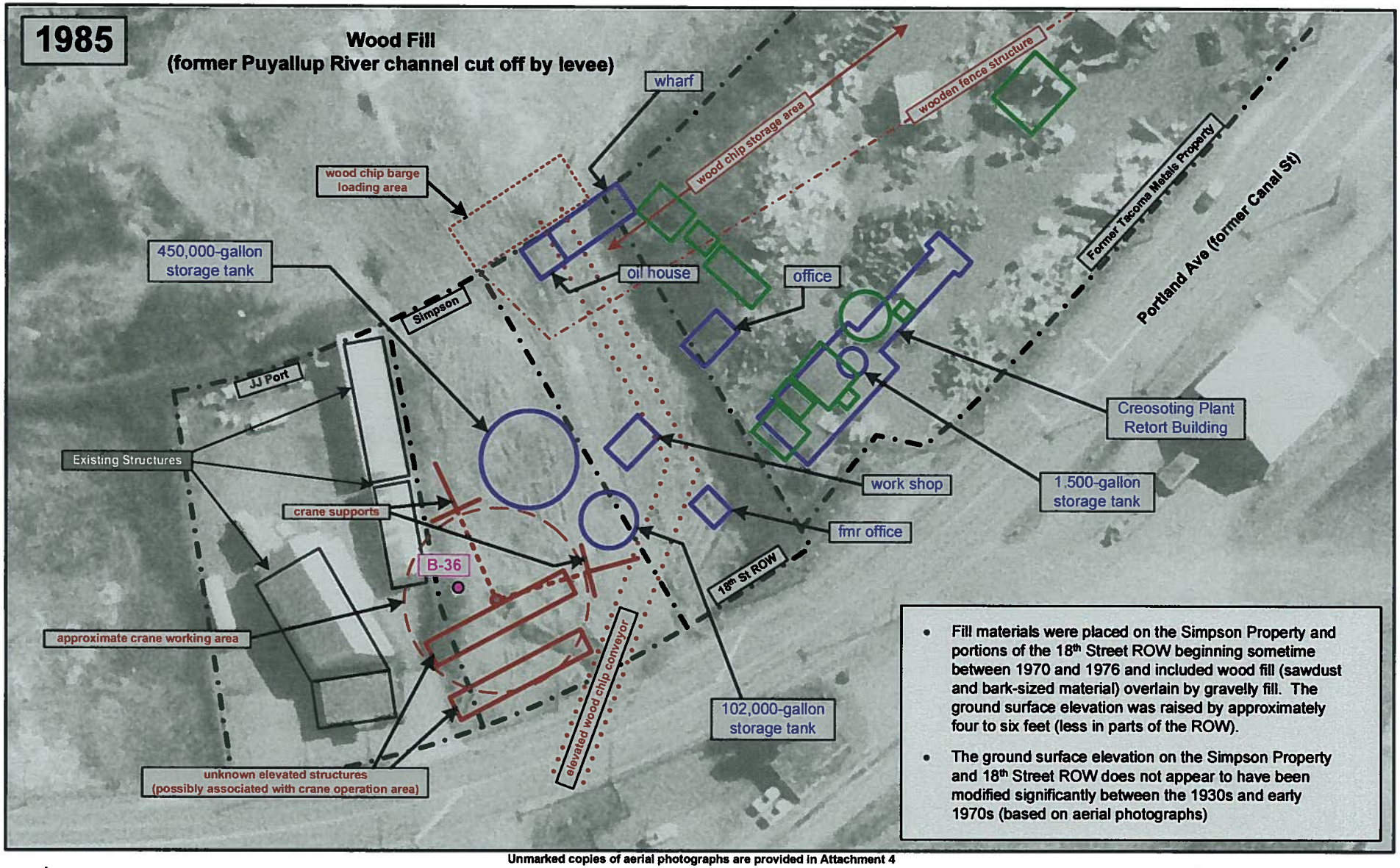
Kennedy/Jenks Consultants

Former Tacoma Metals Site
Tacoma, WA

Creosoting Plant Area
Historical Site Features
1965 Aerial Photograph

996098.00/2014/histmaps.VSD

FIGURE 7



Unmarked copies of aerial photographs are provided in Attachment 4

Legend:

- Former creosoting plant primary structures depicted on the 1912 Sanborn and 1926 Metsker's maps.
- Other historical site features shown on the 1912 Sanborn and 1926 Metsker's maps.
- Approximate current property boundaries.
- Approximate former coke plant and coal gas distribution structure locations.

N

0 50 100 150

Approximate scale in feet

Notes:

1. All locations are approximate.
2. Historical site features were also identified on ground-level photographs from 1920 to 1922.

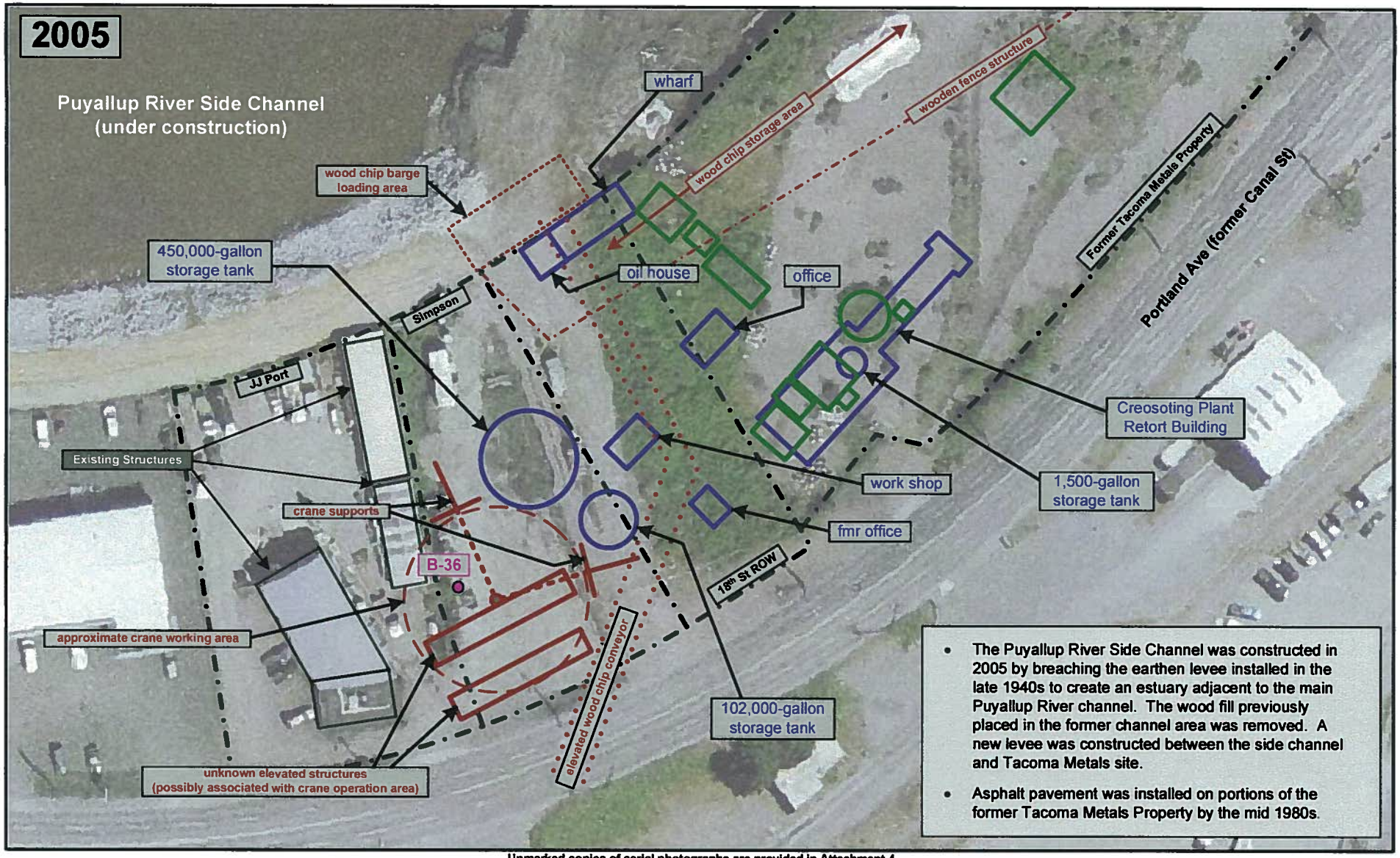
Kennedy/Jenks Consultants

Former Tacoma Metals Site
Tacoma, WA

Creosoting Plant Area
Historical Site Features
1985 Aerial Photograph

996098.00/2014/histmaps.VSD

FIGURE 8



Unmarked copies of aerial photographs are provided in Attachment 4

Legend:

- Former creosoting plant primary structures depicted on the 1912 Sanborn and 1926 Metsker's maps.
- Other historical site features shown on the 1912 Sanborn and 1926 Metsker's maps.
- Approximate current property boundaries.
- Approximate former coke plant and coal gas distribution structure locations.

Notes:

1. All locations are approximate.
2. Historical site features were also identified on ground-level photographs from 1920 to 1922.

N

0 50 100 150

Approximate scale in feet

Kennedy/Jenks Consultants

Former Tacoma Metals Site
Tacoma, WA

Creosoting Plant Area
Historical Site Features
2005 Aerial Photograph

996098.00/2014/histmaps.VSD

FIGURE 9

Attachment 1

- Boring Log for B-36 / MW-31, Simpson Property
- Survey Data and Maps

Boring & Well Construction Log

Kennedy/Jenks Consultants

BORING LOCATION: Simpson Property nearest Portland Avenue		**Well Name** MW-31 / B-36	
DRILLING COMPANY: Cascade	DRILLER: Casey / Jaymen	**Project Name** Former Tacoma Metals	
DRILLING METHOD(S): HSA / GeoProbe	DRILL BIT(S) SIZE: 9-inch / 2-inch	**Project Number** 998098.00	
ISOLATION CASING: N/A	FROM N/A TO N/A FT.	ELEVATION AND DATUM	TOTAL DEPTH: 36.0 ft. bgs
BLANK CASING: 2" Schedule 40 PVC Pipe	FROM 0 TO 32.7 / 22.7 FT. 33	DATE STARTED: 2/14/06	DATE COMPLETED: 2/15/06
SLOTTED CASING: 2" Schedule 40 PVC Pipe, 0.010-Slot	FROM 22.7 TO 32.7 FT.	INITIAL WATER DEPTH (FT): 10.0	
SIZE AND TYPE OF FILTER PACK: Lapis Lustre #2/12 Monterey Sand	FROM 20 TO 33 FT.	LOGGED BY: DKM	
SEAL: Pure Gold Bentonite Chips	FROM 1.5 / 33 TO 20 / 36 FT.	SAMPLING METHODS: MacroCore w/PVC Liner	WELL COMPLETION: ■ SURFACE HOUSING ☐ STAND PIPE _____ FT.
GROUT: Concrete	FROM 0 TO 1.5 FT.		

SAMPLES TYPE	RECOV. (FEET)	PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
SH	2							GW/ GM	**Well-graded GRAVEL with silt and sand** Tan, gravel fill with sand and silt, dense, moist, no odor, no sheen.
SH	3.5		5					Wood	**WOOD DEBRIS** Orange/brown, wood material, fine chips to coarse sawdust size, some silt present locally (<5% total), moderately loose, moist, no odor, no sheen.
SH	3.5		10	B36-8-10		72.6		SM	**Silty SAND with gravel** Dark brown, Mixture of silt (20-30%), gravel (10-15%), fine sand, and wood material, moderately loose, moist to wet, moderate odor with moderate sheen ~7-10 feet bgs, slight odor but no sheen below ~10 feet.
SH	3		15					Wood	**WOOD DEBRIS** Gray, coarse wood material coated with silt and fine sand matrix (5-10% overall but locally variable), wet, no odor, light to moderate sheen increasing with depth.
SH	1					6.7			NAPL blebs are locally visible on the water surface in the sampler, increasing with depth.
SH	3		20	B36-23-24		20.8			
SH	3		25			3.4		SP	**Poorly graded SAND** Dark gray, poorly graded sand, mostly fine sand at 23 feet bgs, medium to coarse sand ~24-25 feet bgs, becoming silty (up to ~10%) below ~26 feet bgs, wet, strong creosote odor with heavy sheen and brownish NAPL blebs visible ~23-24 feet bgs, moderate odor and sheen (no visible NAPL blebs) below ~24 feet bgs.
SH	2.5		30	B36-31-32		2.5		SP/ SM	**Poorly graded SAND with silt** Gray, poorly graded fine sand with 10-15% silt, moderately dense, wet, slight creosote odor, light sheen.
SH	3.5		35	B36-34-35		31.5		SP	**Poorly graded SAND** Gray to dark gray, fine to medium sand at top grading to mostly medium sand by ~32 feet bgs, moderately dense, wet, moderate creosote odor and sheen above ~31 feet bgs, strong odor with heavy sheen with NAPL blebs visible below ~31 feet bgs.
						1.1		SM	
						0.8		SP	**Silty SAND** Gray, fine sand with 15-20% silt, moderately dense, wet, no odor, no sheen.

(See next page for lithology description)

NOTES

1. Sampling and lithologic logging were performed during GeoProbe boring on 2/14/06. The well was installed at the same location on 2/15/06.

KJ PNW LOGS MW-28R TO MW-31 2006.GPJ KJ PNW.GDT 2/19/13

F-40.1
(6-87) (3-88) (8-90)

Boring & Well Construction Log

Kennedy/Jenks Consultants

Project Name Former Tacoma Metals **Project Number** 998098.00 **Well Name** MW-31 / B-36

SAMPLES TYPE	SAMPLES RECOV. (FEET)	SAMPLES PENETR. RESIST. BLOWS/6"	DEPTH (FEET)	SAMPLE NUMBER	WELL CONSTRUCTION	OVA	LITHOLOGY	USCS LOG	SAMPLE DESCRIPTION AND DRILLING REMARKS
									Poorly graded SAND Gray, poorly graded medium to coarse sand, moderately dense, wet, no odor, no sheen.

KJ PNW_LOGS MW-28R TO MW-31 2006.GPJ KJ PNW.GDT 2/19/13

F-40.1
(6-87) (3-88) (8-90)

TACOMA METALS, INC.
1919 PORTLAND AVE.
TACOMA, WA.

MONORITING WELL	GROUND ELEV	N. RIM ELEV	N. TOP PVC ELEV
20	7.58'	10.60'	10.21'
13	7.33'	10.29'	9.84'
8R	8.64'	11.44'	11.12'
18	9.40'	12.09'	11.79'
10	9.65'	10.02'	9.39'
17	9.90'	9.90'	9.57'
7	9.84'	9.85'	9.45'
11	9.49'	9.84'	9.47'
21	9.77'	9.81'	9.47'
15	10.77'	10.83'	10.49'
14	10.05'	10.08'	9.77'
19	7.58'	11.14'	10.78'
16	10.23'	10.26'	9.72'

BORING	
B-1	9.86'
B-2	9.68'
B-3	9.30'
B-4	9.44'
B-5	9.89'
B-6	9.78'
B-7	9.41'
B-8	10.15'
B-9	10.51'
B-10	9.29'
B-11	7.42'

DATE OF SURVEY = MARCH 13, 2003 BY EARTH TECH, INC.

ELEVATIONS BASED ON THE CITY OF TACOMA DATUM.

FORMER TACOMA METALS SITE
1919 PORTLAND AVE.
TACOMA, WA.

MONORITING WELL	GROUND ELEV.	TOP CONC. ELEV.	N. TOP CASE ELEV.	N. RIM PVC ELEV.
MW-23	12.4'	12.72'	14.89'	14.39'
MW-24	8.3'	8.63'	10.96'	10.67'
MW-25	9.0'	9.36'	11.60'	11.26'
BORING				
B-18	9.4'			
B-19	9.6'			
B-20	7.9'			
B-21	7.2'			
B-22A	7.1'			
B-22B	7.0'			
B-23	8.4'			

DATE OF SURVEY = APRIL 14,2004 BY EARTH TECH, INC.

ELEVATIONS BASED ON THE CITY OF TACOMA DATUM.

FORMER TACOMA METALS SITE
1919 PORTLAND AVE.
TACOMA, WA.

MONORITING WELL	GROUND ELEV.	N. TOP CASE ELEV.	N. RIM PVC ELEV.
MW-26	13.0'	13.02'	12.49'
MW-27	11.6'	11.63'	11.15'
MW-28	11.0'	11.04'	10.43'

BORING	
B-24	12.7'
B-25	12.5'
B-26	12.4'
B-27	14.3'
B-28	11.6'
B-29	11.5'
B-30	11.2'
B-31	10.9'
B-32	7.9'
B-33	9.9'

DATE OF SURVEY = APRIL 21,2005 BY EARTH TECH, INC.

ELEVATIONS BASED ON THE CITY OF TACOMA DATUM.

FORMER TACOMA METALS SITE
1919 PORTLAND AVE.
TACOMA, WA.

PREVIOUS SURVEY INFORMATION IN 2004 AND 2005

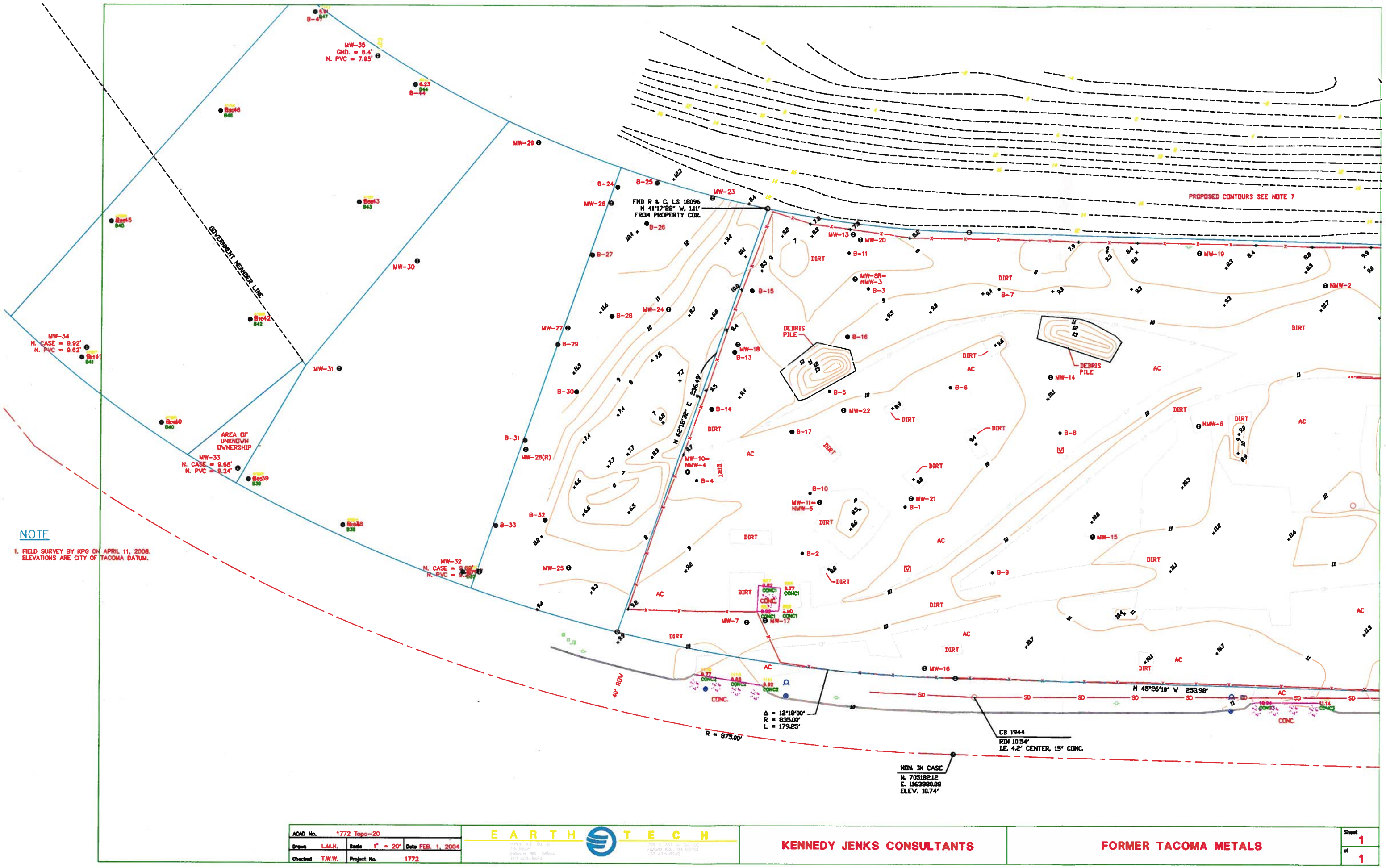
MONORITING WELL	GROUND ELEV.	N. TOP CASE ELEV.	N. RIM PVC ELEV.
MW-23	12.4'	14.89'	14.39'
MW-24	8.3'	10.96'	10.67'
MW-25	9.0'	11.60'	11.26'
MW-26	13.0'	13.02'	12.49'
MW-27	11.6'	11.63'	11.15'
MW-28	11.0'	11.04'	10.43'

NEW SURVEY INFORMATION

MW-23	12.6'	14.74'	14.35'
MW-24	10.3'	10.71'	10.58'
MW-25	9.3'	11.58'	11.24'
MW-26	12.9'	12.91'	12.52'
MW-27	11.4'	11.37'	11.06'
MW-28	10.8'	10.78'	10.42'
MW-29	11.7'	11.70'	11.12'
MW-30	10.5'	10.45'	10.05'
MW-31	9.8'	9.83'	9.38'

DATE OF SURVEY = MARCH 29, 2006 BY KPG, INC.

ELEVATIONS BASED ON THE CITY OF TACOMA DATUM.



NOTE

1. FIELD SURVEY BY KPG ON APRIL 11, 2008. ELEVATIONS ARE CITY OF TACOMA DATUM.

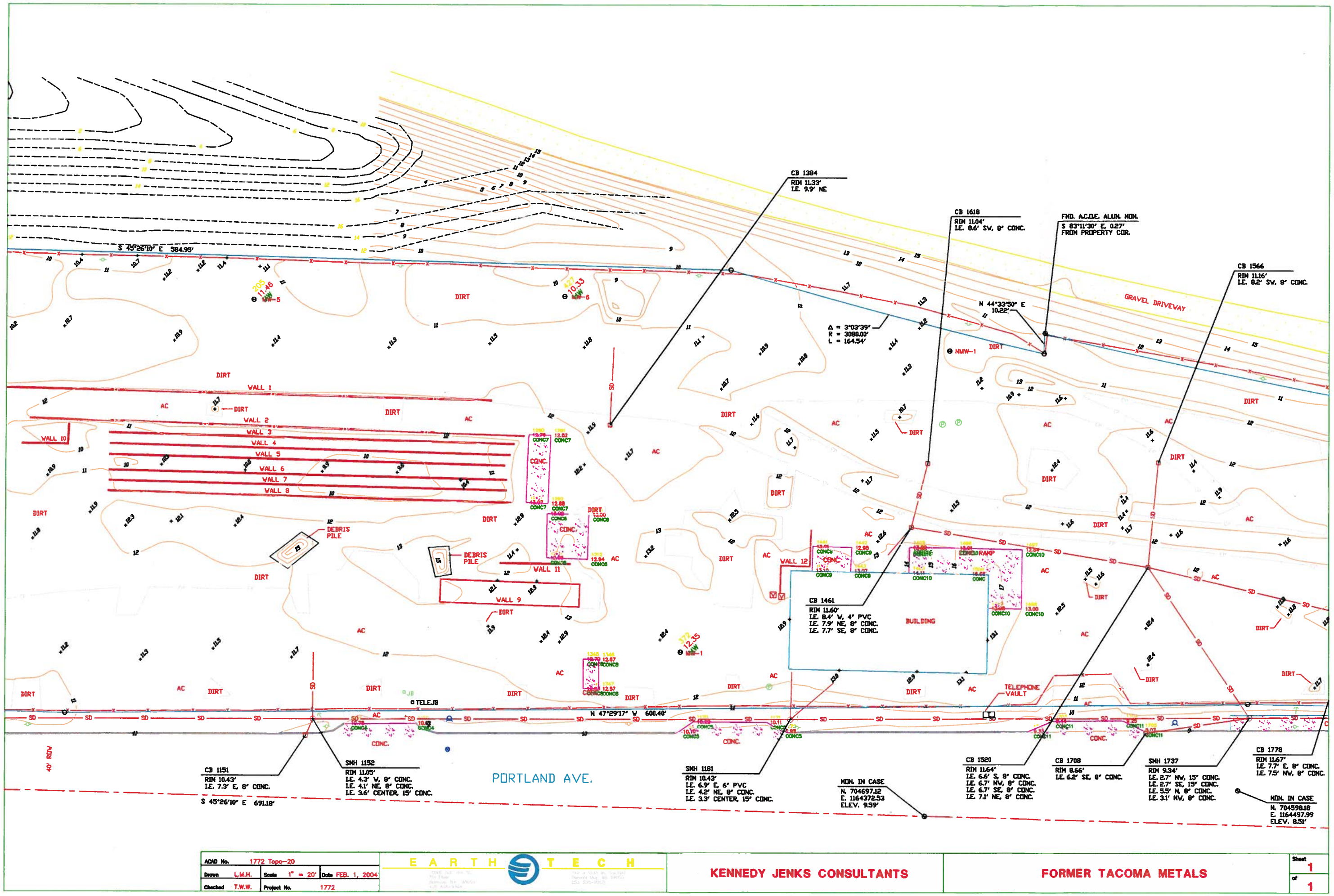
ACAD No. 1772 Topo-20			
Drawn L.M.H.	Scale 1" = 20'	Date FEB. 1, 2004	
Checked T.W.W.	Project No. 1772		

EARTH TECH

KENNEDY JENKS CONSULTANTS

FORMER TACOMA METALS

Sheet 1 of 1



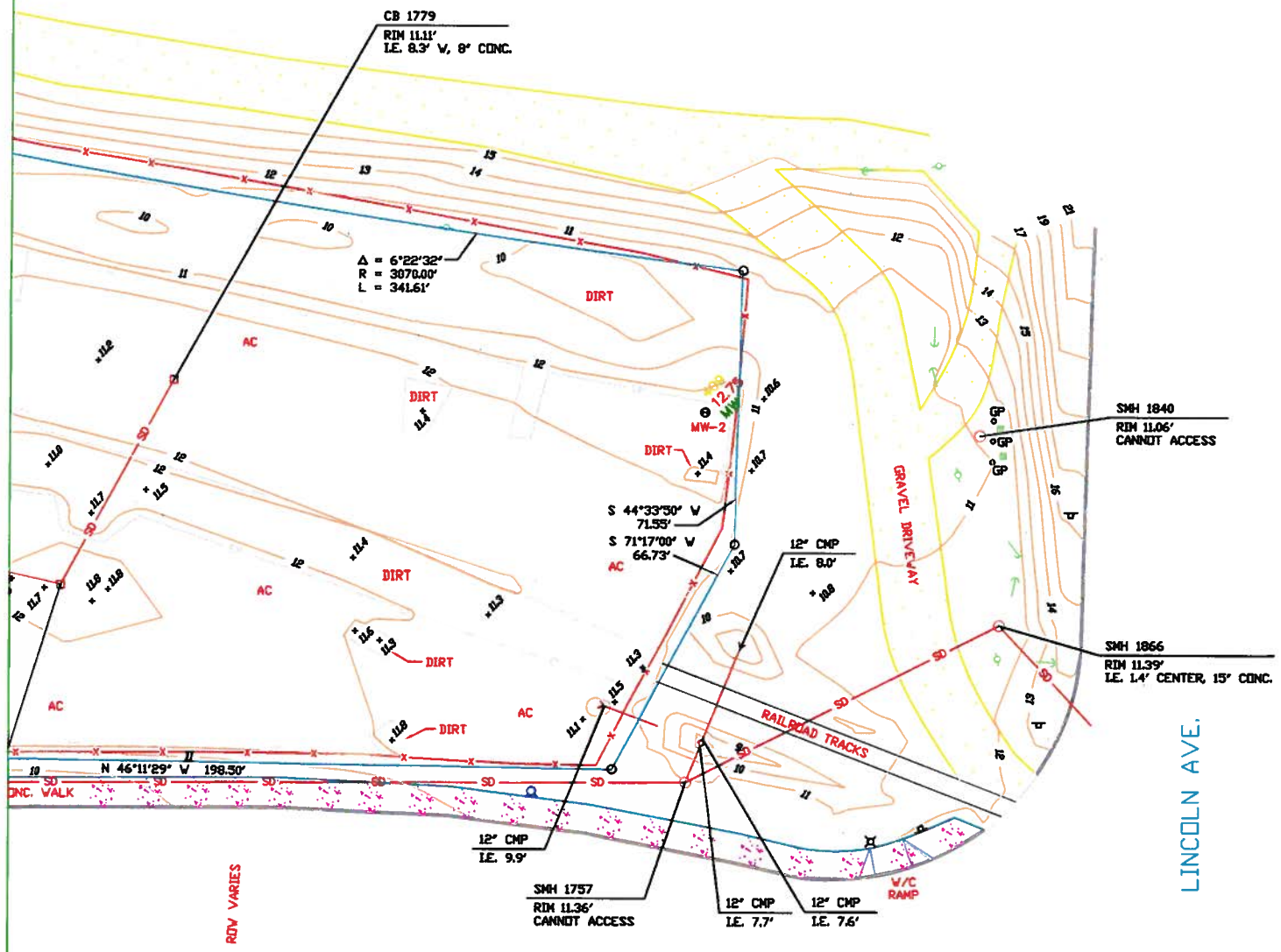
ACAD No.	1772 Topo-20		
Drawn	L.M.H.	Scale 1" = 20'	Date FEB. 1, 2004
Checked	T.W.W.	Project No.	1772

EARTH TECH

KENNEDY JENKS CONSULTANTS

FORMER TACOMA METALS

Sheet 1 of 1



1" = 40'

LEGEND

- SPOT ELEVATION
- POWER POLE
- GUY WIRE ANCHOR
- POWER METER BOX
- POWER MANHOLE
- JB POWER JUNCTION BOX
- SIGN
- LIGHT POLE
- GP GUARD POST
- UTILITY VAULT
- TELE.JB TELEPHONE JUNCTION BOX
- FIRE HYDRANT
- WATER METER
- WATER VALVE
- SANITARY SEWER MANHOLE
- CATCH BASIN
- AC ASPHALT
- SD STORM DRAIN LINE
- FENCE LINE
- EDGE OF PAVEMENT
- CURB & GUTTER
- MONORITING WELL
- BORE
- SET REBAR & CAP LS 21601

NOTES

1. IT IS UNDERSTOOD AND AGREED THAT THE CALCULATIONS, DRAWINGS, AND SPECIFICATIONS PREPARED PURSUANT TO THIS AGREEMENT, WHETHER IN HARD COPY OR MACHINE READABLE FORM, ARE INSTRUMENTS OF PROFESSIONAL SERVICE INTENDED FOR ONE-TIME USE. IN THE EVENT PROJECT DOCUMENTATION PROVIDED IN MACHINE READABLE FORM IS CONVERTED, THE CLIENT AGREES TO ASSUME ALL RISKS ASSOCIATED THEREWITH, AND TO HOLD HARMLESS AND INDEMNIFY EARTH TECH INC., AGAINST ALL CLAIMS, LIABILITIES, LOSSES, DAMAGES, AND COSTS IN ANY WAY CONNECTED WITH THE MODIFICATION, MISINTERPRETATION, MISUSE, OR REUSE BY OTHERS OF THE MACHINE READABLE INFORMATION AND DATA PROVIDED BY EARTH TECH INC. UNDER THIS AGREEMENT, EXCEPTING ONLY SUCH USE AS MAY BE AUTHORIZED, IN WRITING, BY EARTH TECH INC.
2. THE LOCATION OF EXISTING UNDERGROUND UTILITY SYSTEMS, AS SHOWN HEREON, ARE TAKEN FROM UTILITY LOCATE PAINT MARKS OR AS-BUILT PLANS AND ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES. ALL LOCATOR SERVICES SHOULD BE CONTACTED PRIOR TO ANY CONSTRUCTION OR SUBSURFACE EXPLORATION. CALL 1-800-424-5555.
3. CONTOUR INTERVAL = 1 FOOT.
4. HORIZONTAL DATUM IS THE CITY OF TACOMA (NAD 83/91). SET SURVEY CONTROL POINTS AS SHOWN HEREON.
5. VERTICAL DATUM IS THE CITY OF TACOMA (NGVD 29). SET TEMPORARY BENCH MARKS AS SHOWN HEREON.
6. FIELD SURVEY BY EARTH TECH INC., JAN. 21-27, 2004.
7. PROPOSED CONTOURS SUPPLIED BY BERGER/ABAM ENGINEERS AND SHOWN ON THE PLANS FOR THEA FOSS AND WHEELER-OSGOOD WATERWAYS REMEDIATION PROJECT, DRAWING NO. C-43.1, AREA UNDER CONSTRUCTION JAN. 2004.
8. WALLS 1-12 ARE CONCRETE FOUNDATIONS. WALL 9 AND 12 ARE FLUSH WITH THE GROUND. ALL OTHER WALLS VARY IN HEIGHT 0' TO 2' HIGH.
9. FLOW THROUGH SANITARY SEWER MANHOLES APPEARS TO BE STORM DRAINAGE.
10. MONORITING WELLS AND BORES SHOWN WERE LOCATED ON PREVIOUS SURVEYS.
11. PROJECT SITE AREA = 5.81 ACRES, MORE OR LESS.

ACAD No.	1772 Topo-20		
Drawn	L.M.H.	Scale	1" = 20'
Checked	T.W.W.	Project No.	1772

Date FEB. 1, 2004

EARTH TECH

KENNEDY JENKS CONSULTANTS

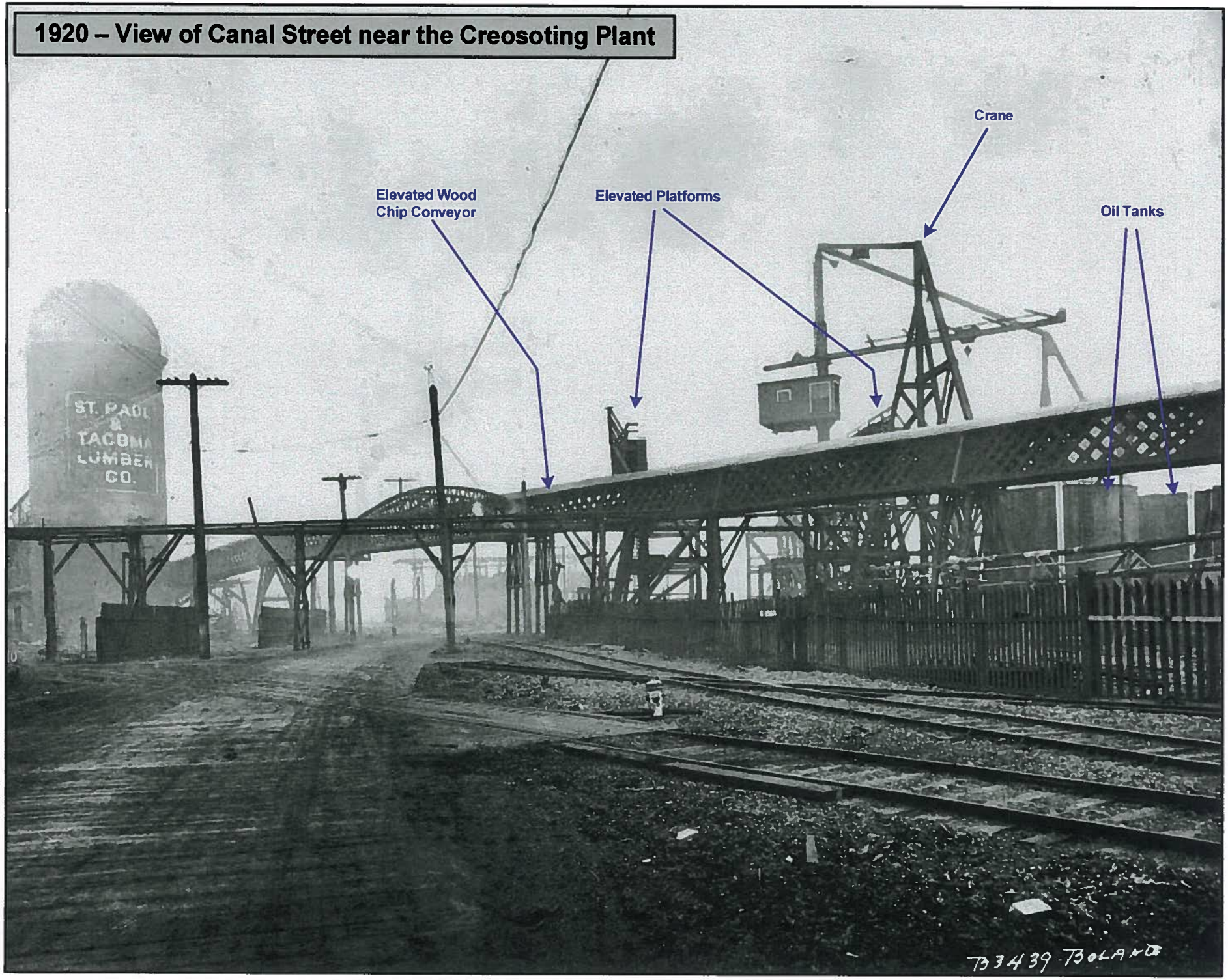
FORMER TACOMA METALS

Sheet 1 of 1

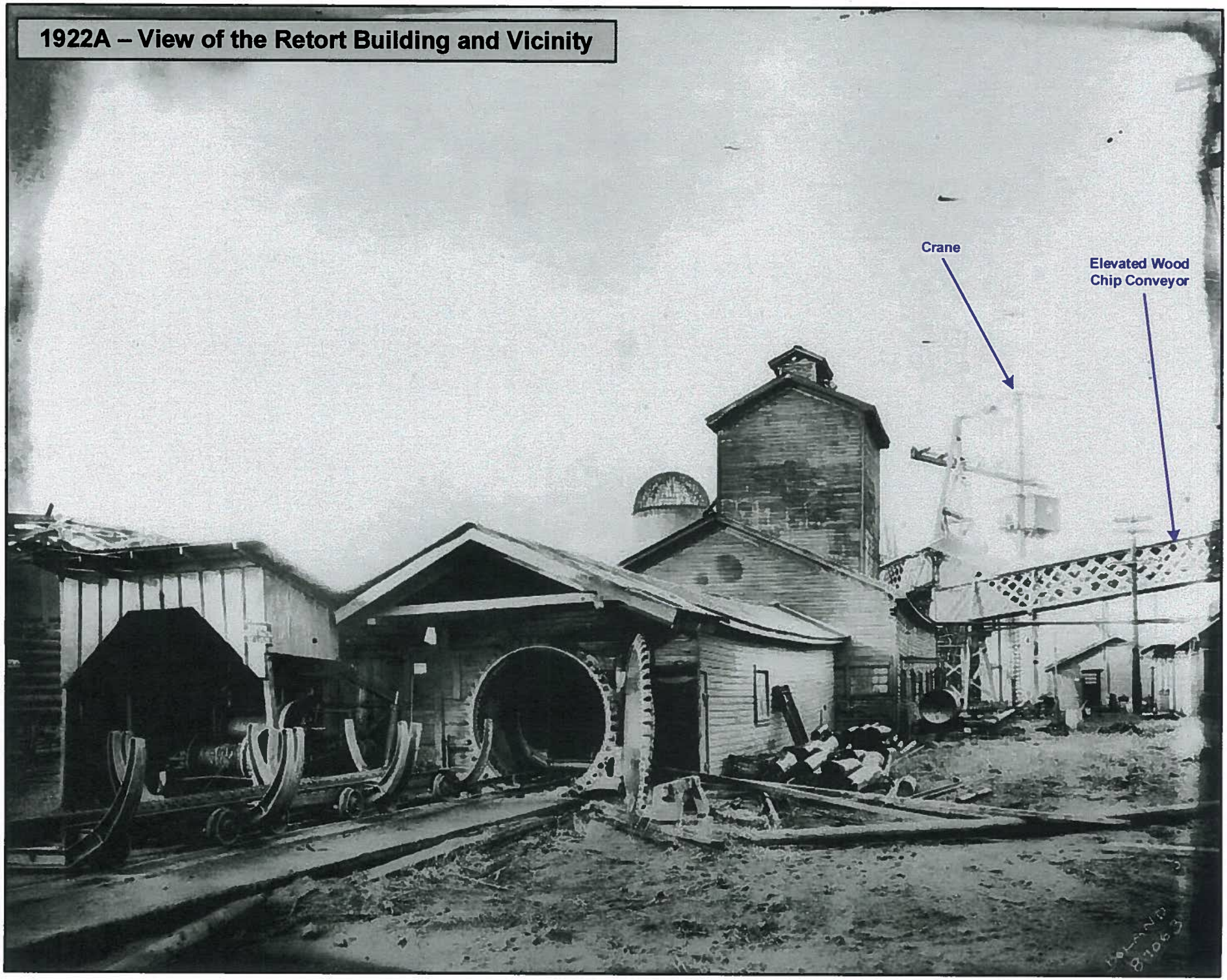
Attachment 2

Ground-Level Photographs 1920 and 1922

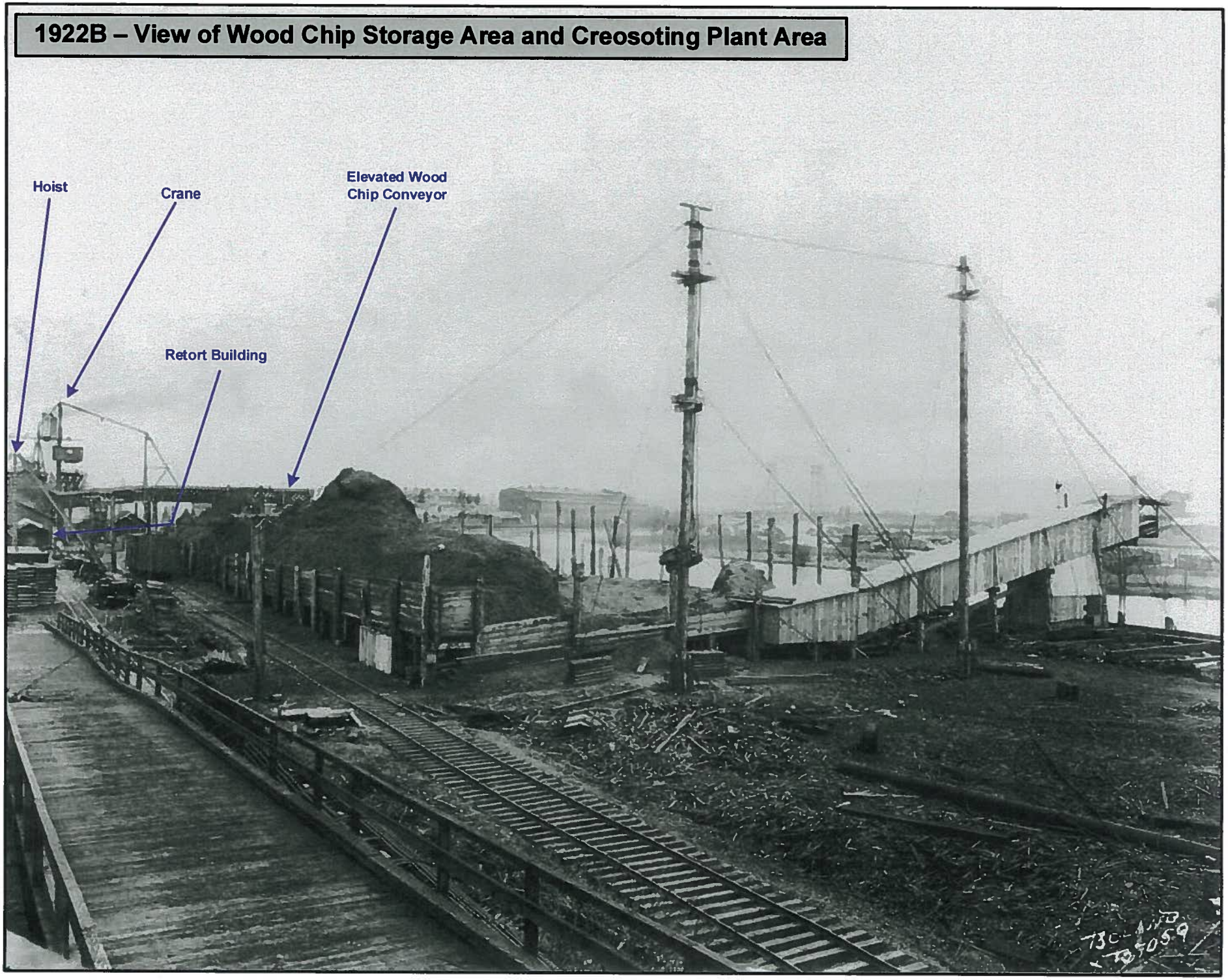
1920 – View of Canal Street near the Creosoting Plant



1922A – View of the Retort Building and Vicinity

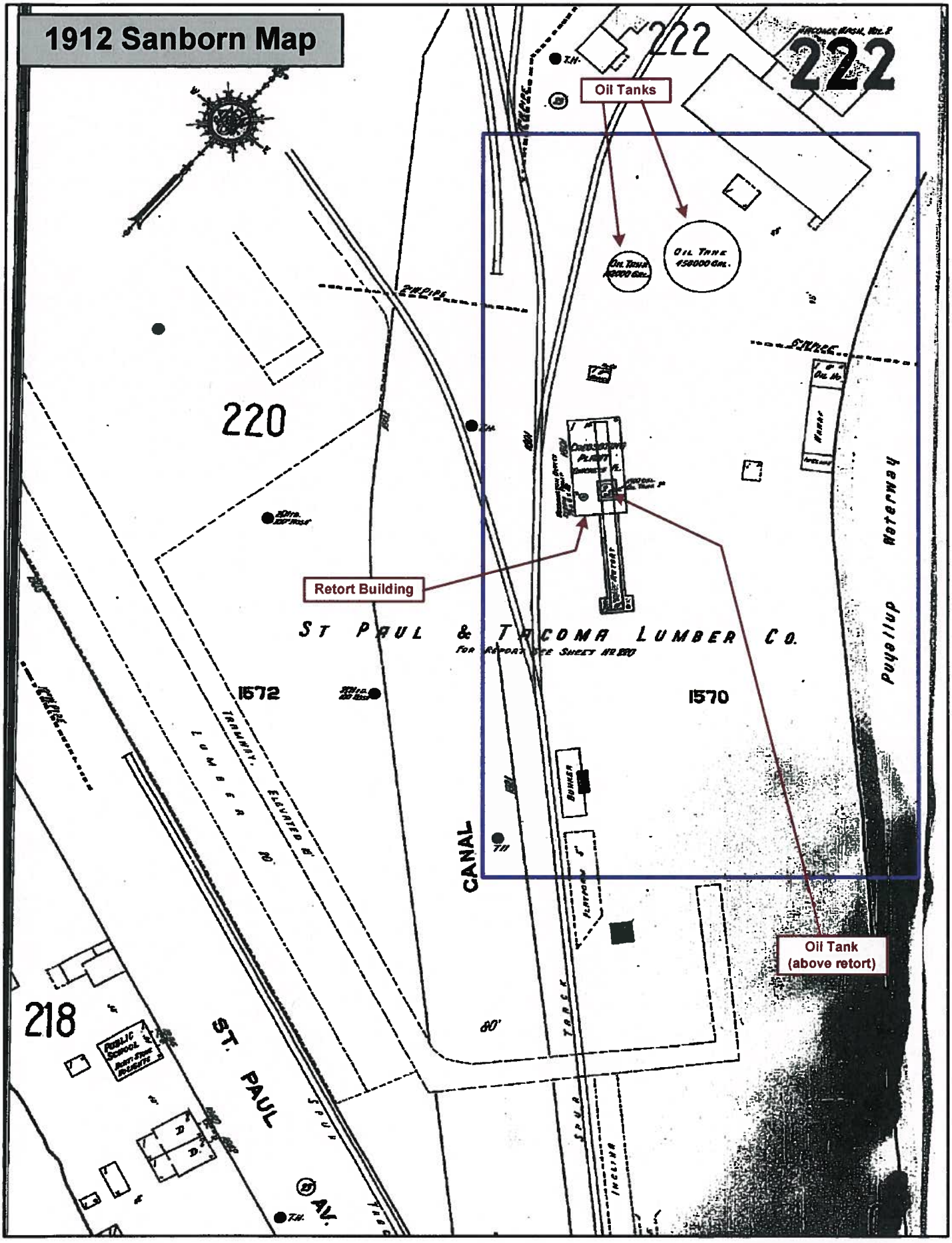


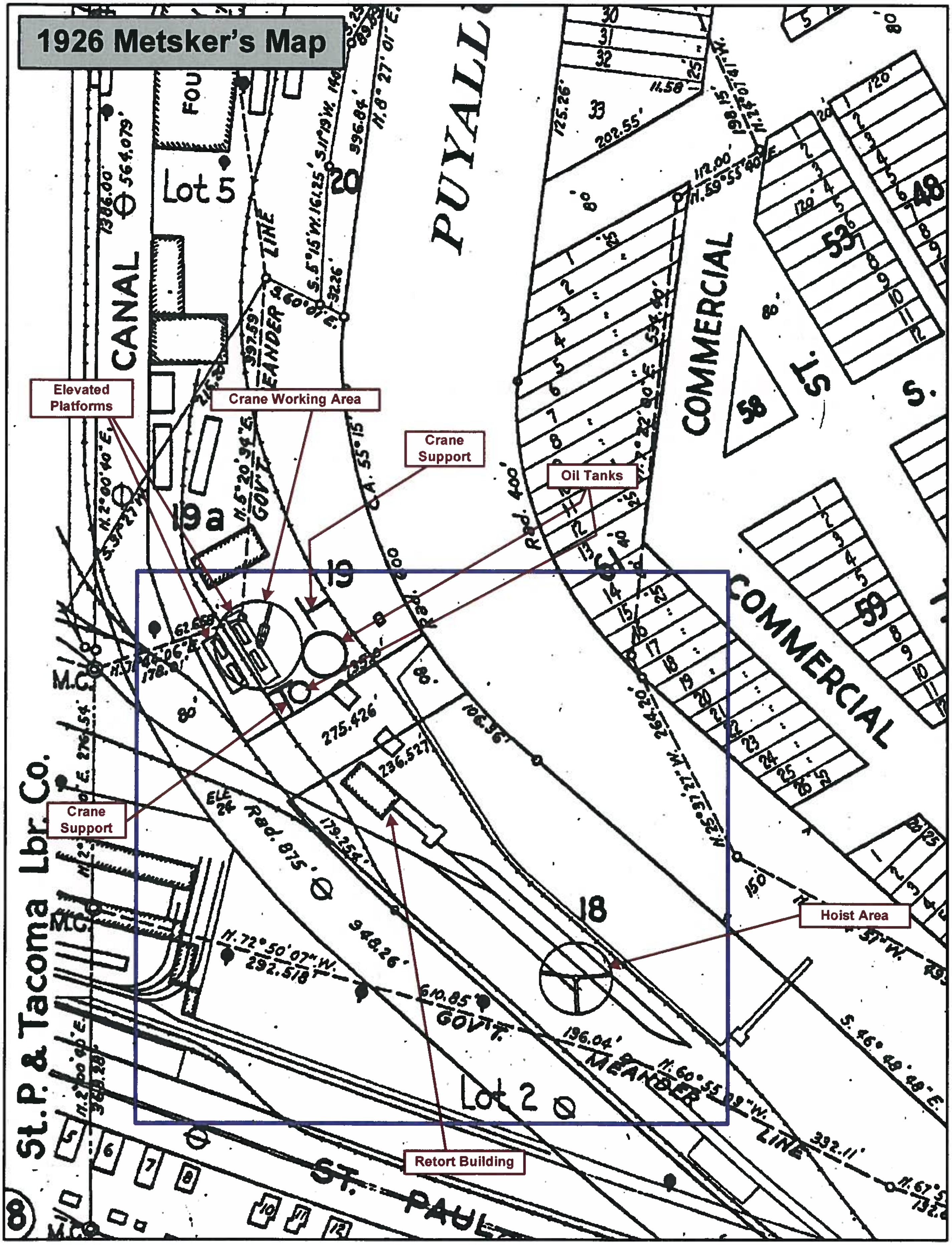
1922B – View of Wood Chip Storage Area and Creosoting Plant Area



Attachment 3

Historical Maps, including: 1912 Sanborn Map, 1926 Metsker's Map, and 1921 (or earlier) St. Paul and Tacoma Lumber Company Map Provided in the 5/21/1921 Issue of American Lumberman


1912 Sanborn Map
Oil Tanks
Retort Building
Oil Tank
(above retort)
222
220
218
1572
1570
ST PAUL & TACOMA LUMBER CO.
CANAL
ST. PAUL
Puyallup Waterway

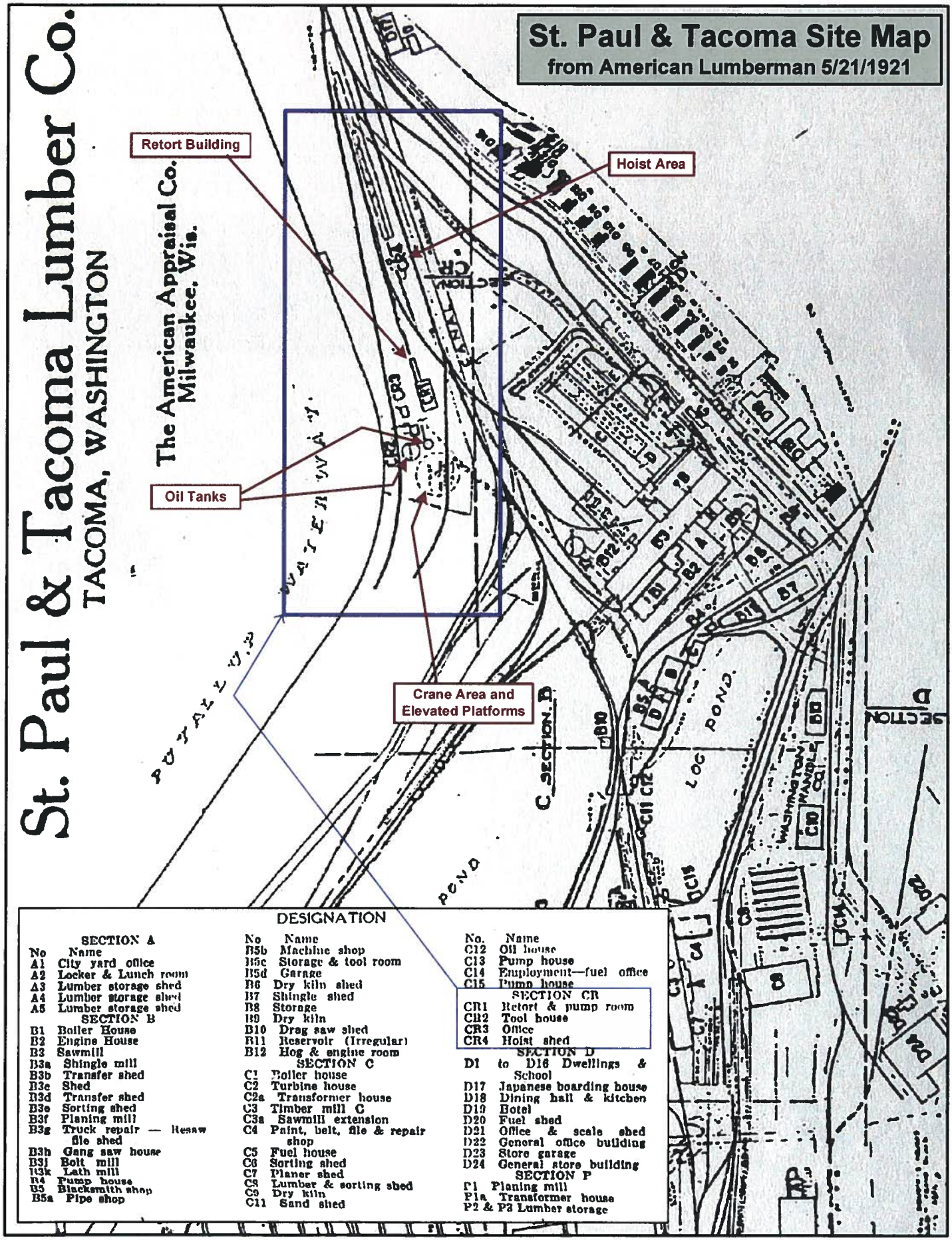

1926 Metsker's Map
Elevated Platforms
Crane Working Area
Crane Support
Oil Tanks
Crane Support
Hoist Area
Retort Building
Lot 5
CANAL
PUYALL
COMMERCIAL
ST.
COMMERCIAL
St. P. & Tacoma Lbr. Co.
Lot 2
GOV'T. MEANDER LINE
ST. PAUL

St. Paul & Tacoma Lumber Co.

TACOMA, WASHINGTON

The American Appraisal Co.
Milwaukee, Wis.

St. Paul & Tacoma Site Map
from American Lumberman 5/21/1921



DESIGNATION

SECTION A

No	Name
A1	City yard office
A2	Locker & Lunch room
A3	Lumber storage shed
A4	Lumber storage shed
A5	Lumber storage shed

SECTION B

No	Name
B1	Boiler House
B2	Engine House
B3	Sawmill
B3a	Shingle mill
B3b	Transfer shed
B3c	Shed
B3d	Transfer shed
B3e	Sorting shed
B3f	Planing mill
B3g	Truck repair — Resaw file shed
B3h	Gang saw house
B3j	Bolt mill
B3k	Lath mill
B4	Pump house
B5	Blacksmith shop
B5a	Pipe shop
B5b	Machine shop
B5c	Storage & tool room
B5d	Garage
B6	Dry kiln shed
B7	Shingle shed
B8	Storage
B9	Dry kiln
B10	Drag saw shed
B11	Reservoir (Irregular)
B12	Hog & engine room

SECTION C

No	Name
C1	Boiler house
C2	Turbine house
C2a	Transformer house
C3	Timber mill C
C3a	Sawmill extension
C4	Paint, belt, file & repair shop
C5	Fuel house
C6	Sorting shed
C7	Planer shed
C8	Lumber & sorting shed
C9	Dry kiln
C11	Sand shed
C12	Oil house
C13	Pump house
C14	Employment—fuel office
C15	Pump house

SECTION CR

No	Name
CR1	Retort & pump room
CR2	Tool house
CR3	Office
CR4	Hoist shed

SECTION D

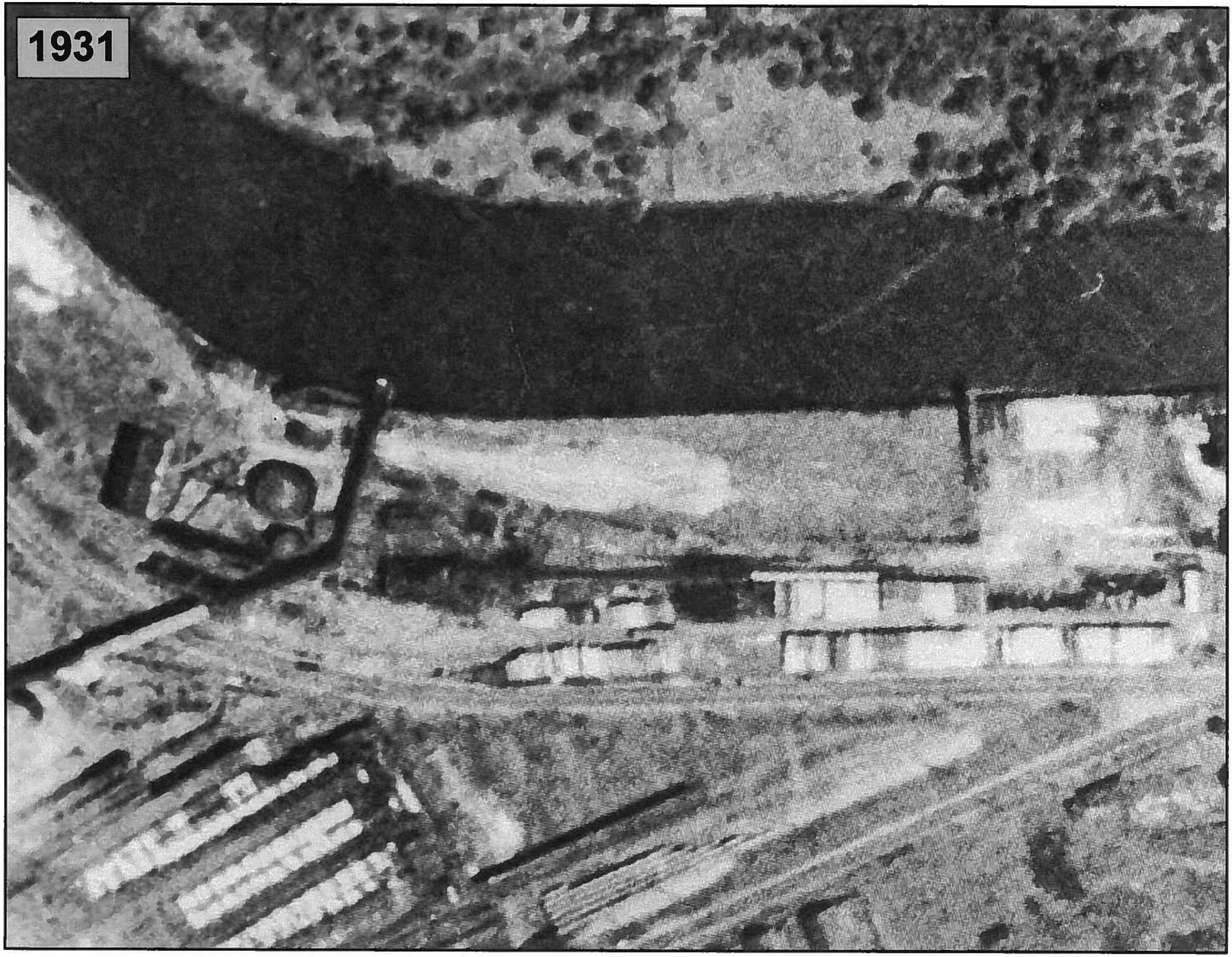
No.	Name
D1 to D16	Dwellings & School
D17	Japanese boarding house
D18	Dining hall & kitchen
D19	Hotel
D20	Fuel shed
D21	Office & scale shed
D22	General office building
D23	Store garage
D24	General store building

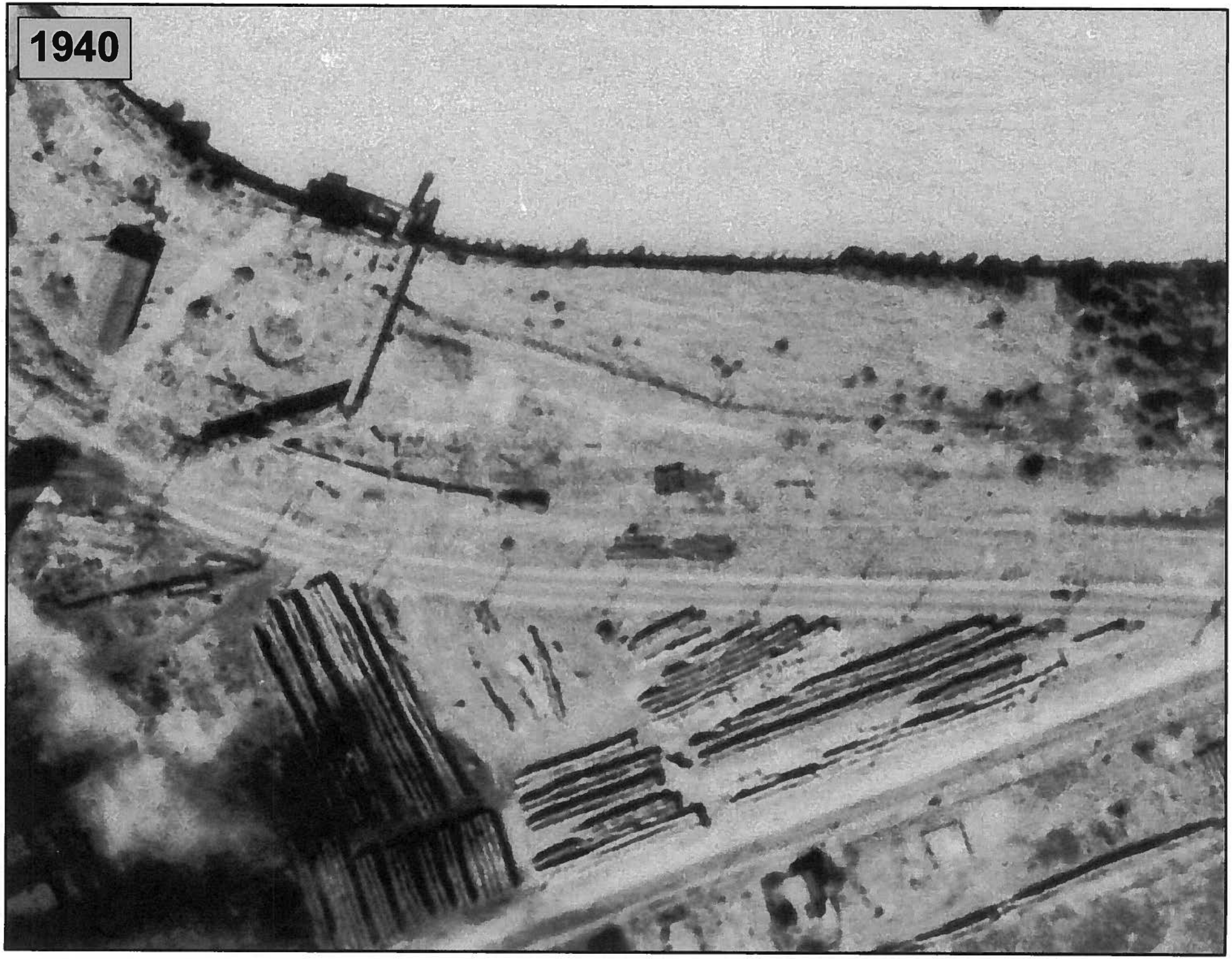
SECTION P

P1	Planing mill
P1a	Transformer house
P2 & P3	Lumber storage

Attachment 4

Aerial Photographs (unmarked) for 1931, 1940, 1949, 1965, 1985, and 2005


1931


1940


1949


1965


1985


2005

Attachment B

Technical Memorandum, Asphalt Cap

30 April 2014

Technical Memorandum

To: Mr. Steve Teel, Washington State Department of Ecology

From: Dean Malte and Ty Schreiner

Subject: Former Tacoma Metals Site
Asphalt Cap
K/J 996098*00

The proposed remedial action for the Former Tacoma Metals Site (site) includes construction of an asphalt cap that is equipped with a stormwater conveyance system (including multiple catch basins and subsurface conveyance piping leading to a detention and treatment facility). The pavement system proposed for the site has not been designed at this time; however, the proposed cap surface will be designed by an engineer licensed in the State of Washington and will be suitable for the expected loads at the site (anticipated to be heavy industrial).

The cap will substantially reduce or eliminate infiltration of surface water and will also provide a solid physical barrier to prevent direct contact with contaminants present below the cap. Long-term monitoring of the cap will be performed to confirm the effectiveness of the pavement system into the future.

At a minimum, the cap design will consist of the following:

- A pavement surface configuration that would prevent surface water from accumulating (ponding) on the surface of the cap. Given the relatively limited topographic relief across the site, the site surface would likely be divided into multiple cells or sections in a waffle pattern (estimated at 10 to 20 sections across the site). Each section would be crowned in the center and sloped toward the edges where a catch basin would be located to convey stormwater to a belowground detention and treatment system. This design configuration would prevent stormwater from accumulating on the site surface, virtually eliminating infiltration that could potentially leach contaminants from the shallow soils to groundwater. Because of these design features, the amount of precipitation infiltration through the cap surface is expected to be negligible.

- A structural base course material [crushed surfacing base course (CSBC)] of sufficient thickness to support the expected loads for the site would be installed above the ground surface. At a minimum, the structural subgrade will consist of 3 inches of CSBC. Additional CSBC may be applied, depending on the estimated post-construction loads for the site, possibly as much as 8 inches total thickness.

- The pavement surface will consist of low-permeability asphaltic concrete with a vertical hydraulic conductivity of 5 $X10^{-5}$ centimeters per second (cm/s).

This cap design is considered to be adequate to reduce or eliminate the threat of future contaminant leaching to groundwater while mitigating the direct contact exposure pathway for constituents of concern (COCs) in shallow soils. This conclusion is based on the information presented below.

SPLP Results for Site Soils

During the remedial investigation (Kennedy/Jenks Consultants 2001), five soil samples with varying total lead concentrations were submitted for Synthetic Precipitate Leaching Procedure (SPLP) extraction and metals analysis. These samples were collected from an unpaved area along the northern fence line where the highest total lead concentrations were detected onsite. Based on the results of these analyses (provided in the table below), concentrations of lead in the precipitate were either below detectable levels or detected at low concentrations.

Sample	TP-16-2-3	TP-39-0-1	TP-40-2-3	TP-43-2-3	TP-61-0-1
Total Lead (mg/kg)	8,240	1,040	2,050	12,300	4,180
SPLP Lead (mg/l)	<0.02	0.03	<0.02	0.03	0.07

Notes:
mg/kg = milligrams per kilogram
mg/l = milligrams per liter

The SPLP extraction process subjects a soil sample to acidic conditions composed of a mixture of water, sulfuric, and nitric acids (5.0 pH) as the sample is tumbled end over end for 18 hours. Even under very aggressive conditions of the SPLP test, metals in site soils demonstrated limited to no solubility. Site soils below the cap surface would never encounter these types of aggressive leaching conditions and, consequently, are not expected to leach lead, even at these relatively high total lead concentrations.

Mathematical Modeling of Leaching

During the remedial investigation (Kennedy/Jenks Consultants 2001), the VLEACH model was used to estimate the concentration of metals potentially leached from site soils [refer to Section 8 – Chemical Fate and Transport in the 2001 *Remedial Investigation and Feasibility Report* (RI/FS Report)]. The model was run using a lead concentration of 10,000 mg/kg with leaching occurring over 500 years.

Based on the model results, the lead concentration after 500 years could reach up to 5 micrograms per liter (µg/l) in the pore water before reaching groundwater. Once in groundwater, natural attenuation of this estimated concentration would occur through mechanical dispersion. Furthermore, this estimated concentration does not include adsorption of lead by the vadose zone soil column or cation exchange in saturated soils (which is expected to be the dominant adsorptive mechanism). These two mechanisms would further attenuate the pore water lead concentration as predicted by VLEACH modeling.

Empirical Evidence of Leaching

Based on existing analytical results for the site collected during the remedial investigation (Kennedy/Jenks Consultants 2001) and subsequent investigations, leaching of metals does not appear to pose a threat to groundwater quality. This conclusion is based on the following observations:

- Groundwater samples from six of the site wells (MW-2, MW-4R, MW-5, MW-6, MW-8R, and MW-9) that are screened in shallow groundwater directly below where the highest concentrations of total lead are detected in shallow soil (along the northern fence line, adjacent to the Puyallup River) were collected on four separate occasions (March/May 2000; November 2000; March 2001; December 2003) and submitted for total metals analysis. (Note: Dissolved metals analyses were also performed, but results for total metals, which are typically higher than for dissolved metals, are discussed herein.)

  For each monitoring event, total lead concentrations in groundwater were below detectable levels or below 2.5 µg/l in the wells specified above with few exceptions. For the May 2000 sampling event, total lead was detected at 20 µg/l in well MW-4R and at 6 µg/l in wells MW-8R and MW-9. Total lead was below detectable levels or below 2.5 µg/l in wells MW-4R, MW-8R, and MW-9 for all subsequent monitoring events. For the most recent monitoring event (March 2003), the total lead concentration was below 2.5 µg/l for all wells referenced above (see attached monitoring results tables). (Note: The reporting limits for the samples collected in 2000 and 2001 are above 2.5 µg/l.)

  Although the lead-affected soil material has been in place for up to 60 years and is directly exposed to precipitation (at the locations of the six wells specified above), there has been no indication of metals leaching to groundwater (i.e., lead concentrations in groundwater at these six wells are below detectable levels or below 2.5 µg/l except as noted above). Because precipitation is conservatively estimated to take approximately 60 days to reach the water table, if transport of elevated metals concentrations were occurring, it would be apparent in the current groundwater monitoring data set.

  The few detections of total lead in groundwater at concentrations above 2.5 µg/l occur as isolated incidents and were not reproducible in subsequent sampling events. Analysis of these same samples for dissolved lead did not reproduce the detectable lead concentration. Because these lead detections identified above occurred in a single isolated incident during one sampling event (May 2000), were not reproducible, and were not present in dissolve metals analyses, the detections are considered anomalies in the data set.

- During the RI, test pit sampling was performed at discrete vertical intervals in areas where elevated lead was detected at the ground surface. These results indicate elevated lead concentrations have not migrated below 2 to 3 feet below grade in most cases (refer Table 4-1 of the 2001 RI/FS Report, Kennedy/Jenks Consultants 2001). The lack of elevated metal concentrations in deeper soils provides additional evidence that

leaching of lead through the soil column and to groundwater is not occurring at a level that will impact these media.

- Monitoring wells MW-4R, MW-5, MW-6, and MW-9 are located adjacent to the Puyallup River Side Channel (PRSC) where lead acid battery waste was encountered during a 2005 construction project. During soil removal for the PRSC construction, elevated lead concentrations were detected in soils along with lead battery casing wastes. Soluble lead concentrations from soil samples from this area were detected at concentrations up to 230 mg/l using Toxicity Characteristic Leaching Procedure (TCLP) extraction methods. However, monitoring wells MW-4R, MW-5, MW-6, and MW-9 (located less than 25 feet from the waste material) did not contain elevated lead concentrations in groundwater samples collected during sampling events in 2000, 2001, and 2003 except as previously noted above. These data demonstrate that lead concentrations detected in soil are not soluble and have not impacted groundwater.

These empirical data demonstrate that lead in shallow site soils is not soluble, not mobile in either the vadose zone or saturated zone, and not expected to impact shallow groundwater (even without a cap).

Cost versus Benefit

Although a formal disproportionate cost analysis has not been performed in accordance with WAC 173-340-360(3)(e), it appears that an asphalt pavement mix with a vertical hydraulic conductivity of 1 $X10^{-7}$ cm/s would be disproportionately more expensive than a higher permeability asphalt mix.

Based on information provided by Mr. Dan Glover of Tucci & Sons (a Tacoma, Washington, based asphalt paving company, phone number 253-952-6676), attempting to achieve an asphalt mix of 1 $X10^{-7}$ cm/s would increase capping costs by approximately 30 percent or more over a standard low permeability asphalt mix. Furthermore, an asphalt surface with a 1 $X10^{-7}$ cm/s hydraulic conductivity would have a shorter lifespan under a typical heavy industrial use scenario, due to the increased oil and fines content and decreased aggregate size of the mix. The reduced strength of a less permeable pavement would further increase costs through long-term maintenance of the cap surface.

Summary and Conclusion

The information provided above demonstrates that:

- Aggressive leaching tests performed during the remedial investigation indicated the solubility of lead in the site soils is very low (even under aggressive leaching solutions and aggressive tumbling of the material). Because site soils will be placed below a low permeability cap designed to prevent runoff and infiltration, leaching is not expected to occur.

- Mathematical modeling estimated worst-case leaching of lead at up to 5 µg/l after 500 years. This model did not include attenuation of lead concentrations by natural ongoing processes, such as the cation exchange capacity of soil or mechanical dispersion. Consequently, the model confirms available groundwater monitoring results for possible metals leaching.

- Empirical results, which include both vertical soil sampling from test pits and groundwater monitoring from wells, has demonstrated that lead has not migrated from its point of deposition on the ground surface or in the saturated zone on the PRSC and has not impacted groundwater (other than a few anomalies described above), even without a cap in place.

Based on the information presented herein, the lower permeability asphalt mix would provide no apparent technical benefits for protection of human health and the environment, and the cost would be disproportionately more expensive than a higher permeability mix. Therefore, an asphalt cap with a permeability of 5 $X10^{-5}$ cm/s is appropriate for the site.

References

Kennedy/Jenks Consultants. 2001. Remedial Investigation and Feasibility Report, Former Tacoma Metals Facility. Prepared for the Washington State Department of Ecology. Dated 19 June 2001.

Attachment: Monitoring Results Tables

Attachment 1

Monitoring Results Tables

TABLE 5-5

REMEDIAL INVESTIGATION
GROUNDWATER ANALYTICAL RESULTS - TOTAL METALS
Former Tacoma Metals Facility

Sample Designation	Sample Date	Total Metals (µg/l)[a]								
		Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Silver
MW-1	3/14/2000	<5[b]	12	<5	30	---[c]	<4	<0.2	<50	<7
	11/21/2000	<50	9	<2	<5	11	<20	<0.1	<50	<3
	3/5/2001	<50	13	<2	<5	<2	<20	<0.1	<50	<3
MW-2	3/14/2000	<5	5	<5	190	—	<4	<0.2	<50	<7
	11/21/2000	<50	28	<2	<5	***20***	<20	<0.1	<50	<3
	3/5/2001	<50	13	<2	<5	<2	<20	<0.1	<50	<3
MW-4(R)[d]	5/11/2000	<5	8	<5	<10	—	***20***	<0.2	<50	<7
	11/20/2000	<50	12	<2	<5	<2	<20	<0.1	<50	<3
	3/5/2001	<50	14	<2	<5	8	<20	<0.1	<50	<3
MW-5	3/14/2000	<5	18	<5	30	—	<4	<0.2	<50	<7
	11/21/2000	<50	2	<2	<5	4	<20	<0.1	<50	<3
	3/5/2001	<50	21	<2	<5	3	<20	<0.1	<50	<3
MW-6	3/14/2000	<5	24	<5	70	—	<4	<0.2	<50	<7
	11/21/2000	<50	3	<2	<5	5	<20	<0.1	<50	<3
	3/5/2001	<50	22	***3***	<5	<2	<20	<0.1	<50	<3
MW-7	3/14/2000	<5	23	<5	20	—	<4	<0.2	<50	<7
	11/21/2000	<50	31	<2	<5	8	<20	<0.1	<50	<3
	3/6/2001	<50	34	<2	<5	<2	<20	<0.1	<50	<3
MW-8(R)/MW-800[e]	5/12/2000	<5	15	<5	<10	—	***6***	<0.2	<50	<7
	11/20/2000	<50/<50	13/11	<2/<2	<5/<5	2/<2	<20/<20	<0.1/<0.1	<50/<50	<3/<3
	3/6/2001	<50/<50	14/15	<2/<2	<5/<5	<2/<2	<20/<20	<0.1/<0.1	<50/<50	<3/<3
MW-9	5/11/2000	<5	17	<5	<10	—	***6***	<0.2	<50	<7
	11/21/2000	<50	16	<2	<5	<2	<20	<0.1	<50	<3
	3/5/2001	<50	90	<2	<5	<2	<20	<0.1	<50	<3
MW-10	11/20/2000	<50	10	<2	<5	3	<20	<0.1	<50	<3
	3/6/2001	<50	9	<2	<5	4	<20	<0.1	<50	<3
MW-11	11/20/2000	<50	9	<2	<5	3	<20	<0.1	<50	<3
	3/6/2001	<50	8	<2	<5	<2	<20	<0.1	<50	<3
MW-12	11/20/2000	<50	3	<2	<5	<2	<20	<0.1	<50	<3
	3/6/2001	<50	31	<2	<5	<2	<20	<0.1	<50	<3
MTCA Method B Surface Water Cleanup Level[f]		0.00982 (1)	NA[g]	20.3	NA	2,660	NA	NA	NA	25,900
MTCA Method C Surface Water Cleanup Level[f]		2.46 (1)	NA	50.6	NA	6,660	NA	NA	NA	64,800
Ecology Chronic Freshwater Surface Water Cleanup Level[h]		190	NA	1.59[f]	288.07[f,j]	18.76[f]	4.74[f] (1)	0.012 (1)	5 (1)	NA
National Toxics Rule for Consumption of Organisms[k]		1.4 (1)	NA	NA	NA	NA	NA	1.5 (1)	NA	NA

TABLE 5-5

REMEDIAL INVESTIGATION
GROUNDWATER ANALYTICAL RESULTS - TOTAL METALS
Former Tacoma Metals Facility

Notes:

(a) Groundwater samples were analyzed for metals by EPA Methods 6010/7000 series.
(b) "<" denotes analyte was not detected at the indicated reporting limit.
(c) "---" Sample not analyzed for indicated analyte.
(d) "R" = Replacement well.
(e) Sample MW-800 is a duplicate sample collected from well MW-8(R).
(f) MTCA Method B and C surface water cleanup levels based on CLARC II, dated February 1996.
(g) "NA" = No cleanup level available.
(h) Ecology Chronic Freshwater Surface Water Standard (WAC 173-201A).
(i) Surface Water Quality Standard is based on an average groundwater hardness of 180 mg/l.
(j) Chromium as chromium III, (CAS# 7440-47-3).
(k) National Toxics Rule for consumption of organisms only based on 40 CFR 131.36 for a risk level of $1x10^{-5}$.

(1) Denotes practical quantification limit (PQL) is greater than MTCA cleanup levels and/or applicable, relevant, and appropriate requirements (ARARs) (Ecology 1993).

µg/l - micrograms per liter
mg/l - milligrams per liter

TABLE 5-6

REMEDIAL INVESTIGATION
GROUNDWATER ANALYTICAL RESULTS - DISSOLVED METALS
Former Tacoma Metals Facility

Sample Designation	Sample Date	Dissolved Metals (µg/l)[a][b]								
		Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Silver
MW-1	11/21/2000	<50[c]	19	<2	<5	<2	<20	<0.1	<50	<3
	3/5/2001	<50	14	<2	<5	<2	<20	<0.1	<50	<3
MW-2	11/21/2000	<50	11	<2	<5	<2	<20	<0.1	<50	<3
	3/5/2001	<50	10	<2	<5	<2	<20	<0.1	<50	<3
MW-4(R)[d]	11/20/2000	<50	13	<2	<5	<2	<20	<0.1	<50	<3
	3/5/2001	<50	10	<2	<5	<2	<20	<0.1	<50	<3
MW-5	11/21/2000	<50	35	<2	<5	<2	<20	<0.1	<50	<3
	3/5/2001	<50	21	<2	<5	<2	<20	<0.1	<50	<3
MW-6	11/21/2000	<50	34	<2	<5	<2	<20	<0.1	<50	<3
	3/5/2001	<50	22	<2	<5	<2	<20	<0.1	<50	<3
MW-7	11/21/2000	<50	39	<2	<5	3	<20	<0.1	<50	<3
	3/6/2001	<50	34	<2	<5	<2	<20	<0.1	<50	<3
MW-8(R)/MW-800[e]	11/20/2000	<50/<50	15/15	<2/<2	<5/<5	<2/<2	<20/<20	<0.1/<0.1	<50/<50	<3/<3
	3/6/2001	<50/<50	19/19	<2/<2	<5/<5	<2/<2	<2/<2	<0.1/<0.1	<50/<50	<3/<3
MW-9	11/21/2000	<50	102	<2	<5	<2	<20	<0.1	***70***	<3
	3/5/2001	<50	97	<2	<5	<2	<20	<0.1	<50	<3
MW-10	11/20/2000	<50	12	<2	<5	<2	<20	<0.1	<50	<3
	3/6/2001	<50	11	<2	<5	<2	<20	<0.1	<50	<3
MW-11	11/20/2000	<50	10	<2	<5	<2	<20	<0.1	<50	<3
	3/6/2001	<50	9	<2	<5	<2	<20	<0.1	<50	<3
MW-12	11/20/2000	<50	35	<2	<5	<2	<20	<0.1	<50	<3
	3/6/2001	<50	33	<2	<5	<2	<20	<0.1	<50	<3
MTCA Method B Surface Water Cleanup Level[f]		0.00982 (1)	NA[g]	20.3	NA	2,660	NA	NA	NA	25,900
MTCA Method C Surface Water Cleanup Level[f]		2.46 (1)	NA	50.6	NA	6,660	NA	NA	NA	64,800
Ecology Chronic Freshwater Surface Water Cleanup Level[h]		190	NA	1.59[i]	288.07[i,j]	18.76[i]	4.74[i] (1)	0.012 (1)	5 (1)	NA
National Toxics Rule for Consumption of Organisms[k]		1.4 (1)	NA	NA	NA	NA	NA	1.5 (1)	NA	NA

Analytes detected in samples at concentrations exceeding one or more of the cleanup levels or comparison values are shown in bold and italics.

TABLE 5-6

REMEDIAL INVESTIGATION
GROUNDWATER ANALYTICAL RESULTS - DISSOLVED METALS
Former Tacoma Metals Facility

Notes:

(a) Groundwater samples were analyzed for metals by EPA Methods 6010/7000 series.
(b) All groundwater samples were field filtered. All concentrations are dissolved.
(c) "<" denotes analyte was not detected at the indicated reporting limit.
(d) "R" = Replacement well.
(e) Sample MW-800 is a duplicate sample collected from well MW-8(R).
(f) MTCA Method B and C surface water cleanup levels based on CLARC II, dated February 1996.
(g) "NA" = No cleanup level available.
(h) Ecology Chronic Freshwater Surface Water Standard (WAC 173-201A).
(i) Surface Water Quality Standard is based on an average groundwater hardness of 180 mg/l.
(j) Chromium as chromium III, (CAS # 7440-47-3).
(k) National Toxics Rule for consumption of organisms only based on 40 CFR 131.36 for a risk level of $1x10^{-5}$.

(1) Denotes practical quantification limit (PQL) is greater than MTCA cleanup levels and/or applicable, relevant, and appropriate requirements (ARARs) (Ecology 1993).

mg/l - milligrams per liter
µg/l - micrograms per liter

TABLE 8

OCTOBER 2001
GROUNDWATER ANALYTICAL RESULTS - DISSOLVED LEAD[a]
Former Tacoma Metals Facility

Sample Designation	Sample Date	Metals (µg/l)[b]								
		Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Silver
MW-1	10/30/2001	--[c]	--	--	--	--	0.304	--	--	--
MW-2	10/30/2001	--	--	--	--	--	0.269	--	--	--
MW-4(R)	10/30/2001	--	--	--	--	--	0.199	--	--	--
MW-5	10/30/2001	--	--	--	--	--	0.292	--	--	--
MW-6	10/30/2001	--	--	--	--	--	0.383	--	--	--
MW-7	10/30/2001	--	--	--	--	--	0.249	--	--	--
MW-8(R)	10/30/2001	--	--	--	--	--	0.231	--	--	--
MW-9	10/30/2001	--	--	--	--	--	0.226	--	--	--
MW-10	10/30/2001	--	--	--	--	--	0.246	--	--	--
MW-11	10/30/2001	--	--	--	--	--	0.413	--	--	--
MW-12	10/30/2001	--	--	--	--	--	0.303	--	--	--
MTCA Method B Surface Water Cleanup Level[d]		0.0982 ** / 5[e]	NA[f]	20.3	NA	2,660	NA	NA	NA	25,900
NRWQC - Aquatic Organisms Chronic Freshwater Criterion[g]		150	NA	0.37 ***	119.94 ***	14.8 ***	4.74 ***	0.77	5.0	NA
NRWQC - Human Health Consumption of Organisms[h]		0.14 ** / 5[e]	NA	NA	NA	NA	NA	NA	4,200	NA
NTR - Aquatic Organisms Chronic Freshwater Criterion[i]		190	NA	1.59 ***	288.07 ***	18.76 ***	4.74 ***	0.012 * / 0.1[j]	5	NA
NTR - Human Health Consumption of Organisms[k]		0.14 ** / 5[e]	NA	NA	NA	NA	NA	0.15	NA	NA

Notes:

(a) Samples were field filtered using a 0.45 micron filter.
(b) Samples were analyzed for metals by EPA Method 200.8.
(c) "--" denotes samples not analyzed for listed compound.
(d) Model Toxics Control Act (MTCA) Method B surface water cleanup levels based on CLARC v3.1, dated November 2001 (Ecology 2001b).
(e) Natural background concentration (Ecology 2001b).
(f) "NA" denotes no cleanup level established.
(g) National Recommended Water Quality Criteria (NRWQC) chronic freshwater criterion (EPA 2002) pursuant to Section 304(a)(1) of the Clean Water Act and in accordance with Washington Administrative Code (WAC) 173-201A at a risk level of $1x10^{-6}$.
(h) NRWQC for consumption of organisms only (EPA 2002) pursuant to Section 304(a)(1) of the Clean Water Act and in accordance with WAC 173-201A at a risk level of $1x10^{-6}$.
(i) National Toxics Rule (NTR) chronic freshwater criterion based on 40 CFR 131.36 at a risk level of $1x10^{-6}$.
(j) Practical quantitation limit (PQL) (Ecology 2001b).
(k) NTR for consumption of organisms only based on 40 CFR 131.36 at a risk level of $1x10^{-6}$.

* Denotes PQL is higher than MTCA cleanup levels and/or applicable, relevant, and appropriate requirements (ARARs).
** Denotes natural background concentration is higher than MTCA cleanup levels and/or ARARs.
*** Freshwater criterion is expressed as a function of groundwater hardness. Average groundwater hardness at the site is 180 mg/l.

µg/l - micrograms per liter
mg/l - milligrams per liter

TABLE 7F

JUNE-AUGUST 2002 INVESTIGATION
GROUNDWATER ANALYTICAL RESULTS - TOTAL AND DISSOLVED METALS
Former Tacoma Metals Facility

Sample Designation	Sample Date		Metals (µg/l)[a]								
			Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Silver
MW-13	8/5/2002	Total	<50/1.1[c]	26	<2[d]	9	3	<20/3[c]	<0.1	<50/0.7[c]	<3
		Dissolved[b]	<50/1.1[c]	23	<2	8	<2	<20/<1[c]	<0.1	<50/0.9[c]	<3
MTCA Method B Surface Water Cleanup Level[e]			0.0982 ** / 5[f]	NA[g]	20.3	NA	2,660	NA	NA	2,700	25,900
NRWQC - Aquatic Organisms Chronic Freshwater Criterion[h]			150	NA	0.37 ***	119.94 ***	14.8 ***	4.74 ***	0.77	5.0	NA
NRWQC - Human Health Consumption of Organisms[i]			0.14 ** / 5[f]	NA	NA	NA	NA	NA	NA	4,200	NA
NTR - Aquatic Organisms Chronic Freshwater Criterion[j]			190	NA	1.59 ***	288.07 ***	18.76 ***	4.74 ***	0.012 * / 0.1[k]	5	NA
NTR - Human Health Consumption of Organisms[l]			0.14 ** / 5[f]	NA	NA	NA	NA	NA	0.15	NA	NA

Notes:

(a) Samples were analyzed for metals by EPA Methods 6010/7470 series.
(b) Groundwater samples for dissolved metals were field filtered using a 0.45 micron filter.
(c) Samples were re-analyzed for metals by EPA Method 200.8 to obtain lower laboratory reporting limits.
(d) "<" denotes analyte was not detected at the indicated laboratory reporting limit.
(e) Model Toxics Control Act (MTCA) Method B surface water cleanup levels based on CLARC v3.1, dated November 2001 (Ecology 2001b).
(f) Natural background concentration (Ecology 2001b).
(g) "NA" denotes no cleanup level established.
(h) National Recommended Water Quality Criteria (NRWQC) chronic freshwater criterion (EPA 2002) pursuant to Section 304(a)(1) of the Clean Water Act and in accordance with Washington Administrative Code (WAC) 173-201A at a risk level of $1x10^{-6}$.
(i) NRWQC for consumption of organisms only (EPA 2002) pursuant to Section 304(a)(1) of the Clean Water Act and in accordance with WAC 173-201A at a risk level of $1x10^{-6}$.
(j) National Toxics Rule (NTR) chronic freshwater criterion based on 40 CFR 131.36 at a risk level of $1x10^{-6}$.
(k) Practical quantitation limit (PQL) (Ecology 2001b).
(l) NTR for consumption of organisms only based on 40 CFR 131.36 at a risk level of $1x10^{-6}$.

* Denotes PQL is higher than MTCA cleanup levels and/or applicable, relevant, and appropriate requirements (ARARs).

** Denotes natural background concentration is greater than MTCA cleanup levels and/or ARARs.

*** Freshwater criterion is expressed as a function of groundwater hardness. Average groundwater hardness at the site is 180 mg/l.

µg/l - micrograms per liter
mg/l - milligrams per liter

TABLE 5D

DECEMBER 2003
GROUNDWATER ANALYTICAL RESULTS - TOTAL METALS (RCRA 8 + COPPER)
Former Tacoma Metals Facility

Sample Designation	Sample Date	Metals (µg/l)[a]								
		Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Silver
MW-1	12/29/2003	0.69	20.7	<1[b]	5.05	1.41B1	0.51J	***0.179J***	2.24	<1
MW-2	12/29/2003	<1	11.8	<1	0.96J	0.76JB1	0.64J	***0.149J***	3.91	<1
MW-4(R)	12/29/2003	1.22	20.5	<1	2.5	2.25B1	1.34	***0.102J***	2.31	<1
MW-5	12/29/2003	<1	21.2	<1	1.72	3.16B1	2.44	***0.149J***	2.22	<1
MW-6	12/29/2003	***5.33***	56.8	<1	2.14	2.69B1	1.81	<0.2	3.67	<1
MW-7	12/29/2003	<1	35.6	<1	0.895J	1.88B1	0.91J	<0.2	1.02J	<1
MW-8(R)	12/26/2003	<1	32.1	<1	3.85	1.89	0.515J	***0.215***	<2	<1
MW-9	12/29/2003	***5.5***	140	<1	1.95	0.83JB1	<1	***0.258***	***10.5***	<1
MW-10	12/23/2003	0.78J	7.44	<1	2.07	7.76	3.05	<0.2	<2	<1
MW-11	12/26/2003	<1	31.5	<1	3.2	28.9	***40.8***	<0.2	<2	<1
MW-12	12/22/2003	0.665J	20.5	<1	<1	1.38	0.605J	<0.2	1.52J	<1
MW-13	12/22/2003	3.17	13.5	<1	6.9	4.94	1.26	<0.2	2.54	<1
MW-14	12/23/2003	<1	8.77	<1	3.99	2	0.785J	<0.2	1.52J	<1
MW-15	12/29/2003	1.59	31.1	<1	0.815J	7.23B1	1.95	<0.2	<2	<1
MW-16	12/29/2003	1.05	8.14	<1	2.48	0.925JB1	0.665J	<0.2	<2	<1
MW-17	12/23/2003	<1	23.9	<1	2.24	3.06	0.65J	<0.2	<2	<1
MW-18	12/22/2003	1.39	25.5	<1	2.73	0.88J	<1	<0.2	2	<1
MW-19 (MW-200)[c]	12/29/2003	<1 (<1)	23.5 (22.1)	<1 (<1)	5.42 (6.12)	14.1B2 (14.5B2)	***8.43 (8.7)***	***0.16J*** (<0.2)	<2 (1.27J)	<1 (<1)
MW-20	12/22/2003	3.65	7.96	<1	14.2	0.73J	<1	<0.2	***10.1***	<1
MW-21	12/23/2003	1.03	29.5	<1	1.31	3.11	1.61	<0.2	<2	<1
MW-22	12/23/2003	1.61	19.6	<1	1.21	2.36	0.91J	<0.2	<2	<1
MTCA Method B Surface Water Cleanup Level[d]		0.0982 ** / 5[e]	NA[f]	20.3	NA	2,660	NA	NA	2,700	25,900
NRWQC - Aquatic Organisms Chronic Freshwater Criterion[g]		150	NA	0.37 ***	119.94 ***	14.8 ***	4.74 ***	0.77	5.0	NA
NRWQC - Human Health Consumption of Organisms[h]		0.14 ** / 5[e]	NA	NA	NA	NA	NA	NA	4,200	NA
NTR - Aquatic Organisms Chronic Freshwater Criterion[i]		190	NA	1.59 ***	288.07 ***	18.76 ***	4.74 ***	0.012 * / 0.1[i]	5	NA
NTR - Human Health Consumption of Organisms[k]		0.14 ** / 5[e]	NA	NA	NA	NA	NA	0.15	NA	NA

TABLE 5D

DECEMBER 2003
GROUNDWATER ANALYTICAL RESULTS - TOTAL METALS (RCRA 8 + COPPER)
Former Tacoma Metals Facility

Notes:

(a) Samples were analyzed for metals by EPA Methods 6020/7470 series.
(b) "<" denotes analyte was not detected at the indicated laboratory reporting limit.
(c) "( )" denotes duplicate sample.
(d) Model Toxics Control Act (MTCA) Method B surface water cleanup levels based on CLARC v3.1, dated November 2001 (Ecology 2001b).
(e) Natural background concentration (Ecology 2001b).
(f) "NA" denotes no cleanup level established.
(g) National Recommended Water Quality Criteria (NRWQC) chronic freshwater criterion (EPA 2002) pursuant to Section 304(a)(1) of the Clean Water Act and in accordance with Washington Administrative Code (WAC) 173-201A at a risk level of $1x10^{-6}$.
(h) NRWQC for consumption of organisms only (EPA 2002) pursuant to Section 304(a)(1) of the Clean Water Act and in accordance with WAC 173-201A at a risk level of $1x10^{-6}$.
(i) National Toxics Rule (NTR) chronic freshwater criterion based on 40 CFR 131.36 at a risk level of $1x10^{-6}$.
(j) Practical quantitation limit (PQL) (Ecology 2001b).
(k) NTR for consumption of organisms only based on 40 CFR 131.36 at a risk level of $1x10^{-6}$.

* Denotes PQL is higher than MTCA cleanup levels and/or applicable, relevant, and appropriate requirements (ARARs).
** Denotes natural background concentration is higher than MTCA cleanup levels and/or ARARs.
*** Freshwater criterion is expressed as a function of groundwater hardness. Average groundwater hardness at the site is 180 mg/l.

Qualifiers:

J: Estimated concentration above the method reporting limit (MRL) but below the PQL.
B1: Compound also detected in method blank. Analyte concentration was determined not to be significantly higher than associated method blank (i.e., <10 times the concentration reported in the blank).
B2: Compound also detected in method blank. Analyte concentration was determined to be significantly higher than associated method blank (i.e., >10 times the concentration reported in the blank).

Analytes detected in samples at concentrations exceeding one or more of the cleanup levels or comparison values are shown in bold and italics. Where appropriate, surface water standards have been adjusted upward to the natural background concentration and/or PQL [WAC 173-340-730(5)(c)].

µg/l - micrograms per liter
mg/l - milligrams per liter

TABLE 5E

DECEMBER 2003

GROUNDWATER ANALYTICAL RESULTS - DISSOLVED METALS (RCRA 8 + COPPER)[a]

Former Tacoma Metals Facility

Sample Designation	Sample Date	Metals (µg/l)[b]								
		Arsenic	Barium	Cadmium	Chromium	Copper	Lead	Mercury	Selenium	Silver
MW-1	12/29/2003	0.945J	19.6	<1[c]	24.8	<1	<1	***0.195J***	2.38	<1
MW-2	12/29/2003	1.79	12.2	<1	6.77	<1	0.68J	***0.136J***	5	<1
MW-4(R)	12/29/2003	0.9J	20.6	<1	26.2	1.48	0.955J	<0.2	2.24	<1
MW-5	12/29/2003	0.58	21.2	<1	32.4	<1	<1	<0.2	1.2J	<1
MW-6	12/29/2003	4.7	54.8	<1	30.4	<1	<1	<0.2	3.28	<1
MW-7	12/29/2003	<1	31.9	<1	23.4	<1	<1	***0.182J***	<2	<1
MW-8(R)	12/26/2003	2.18	27.4	<1	15.7	<1	<1	<0.2	<2	<1
MW-9	12/29/2003	3.49	123	<1	30.7	0.755J	0.6J	<0.2	***11.5***	<1
MW-10	12/23/2003	<1	6.58	<1	9.53	0.98J	0.545J	<0.2	<2	<1
MW-11	12/26/2003	1.11	29.1	<1	14	1.52	1.93	<0.2	<2	<1
MW-12	12/22/2003	0.605J	19.6	<1	10.3	<1	0.505J	<0.2	<2	<1
MW-13	12/22/2003	2.13	13	<1	15.3	0.89J	<1	<0.2	<2	<1
MW-14	12/23/2003	0.6J	8.03	<1	15.6	<1	<1	***0.182J***	1.47J	<1
MW-15	12/29/2003	0.845J	28.8	<1	20.8	1.04	0.93J	<0.2	1.67J	<1
MW-16	12/29/2003	0.605J	8.51	<1	22.7	<1	0.7J	***0.297***	1.3J	<1
MW-17	12/23/2003	<1	23.4	<1	13.1	<1	<1	<0.2	<2	<1
MW-18	12/22/2003	1.59	24.3	<1	19.3	<1	<1	<0.2	<2	<1
MW-19 (MW-200)[d]	12/29/2003	1.25 (1.3)	21.4 (20.3)	<1 (<1)	25.3 (23.9)	<1.23 (<1.19)	0.95J (0.805J)	***0.283 (0.451)***	1.76J (1.34J)	<1 (<1)
MW-20	12/22/2003	2.85	8.84	<1	26.4	<1	<1	<0.2	6.11	<1
MW-21	12/23/2003	<1	28.9	<1	12.4	<1	<1	<0.2	<2	<1
MW-22	12/23/2003	<1	18.8	<1	15.5	<1	<1	***0.191J***	<2	<1
MTCA Method B Surface Water Cleanup Level[e]		0.0982 ** / 5[f]	NA[g]	20.3	NA	2,660	NA	NA	2,700	25,900
NRWQC - Aquatic Organisms Chronic Freshwater Criterion[h]		150	NA	0.37 ***	119.94 ***	14.8 ***	4.74 ***	0.77	5.0	NA
NRWQC - Human Health Consumption of Organisms[i]		0.14 ** / 5[f]	NA	NA	NA	NA	NA	NA	4,200	NA
NTR - Aquatic Organisms Chronic Freshwater Criterion[j]		190	NA	1.59 ***	288.07 ***	18.76 ***	4.74 ***	0.012 * / 0.1[k]	5	NA
NTR - Human Health Consumption of Organisms[i]		0.14 ** / 5[f]	NA	NA	NA	NA	NA	0.15	NA	NA

TABLE 5E

DECEMBER 2003

GROUNDWATER ANALYTICAL RESULTS - DISSOLVED METALS (RCRA 8 + COPPER)[a]

Former Tacoma Metals Facility

Notes:

(a) Samples were field filtered using a 0.45 micron filter.
(b) Samples were analyzed for metals by EPA Methods 6020/7470 series.
(c) "<" denotes analyte was not detected at the indicated laboratory reporting limit.
(d) "( )" denotes duplicate sample.
(e) Model Toxics Control Act (MTCA) Method B surface water cleanup levels based on CLARC v3.1, dated November 2001 (Ecology 2001b).
(f) Natural background concentration (Ecology 2001b).
(g) "NA" denotes no cleanup level established.
(h) National Recommended Water Quality Criteria (NRWQC) chronic freshwater criterion (EPA 2002) pursuant to Section 304(a)(1) of the Clean Water Act and in accordance with Washington Administrative Code (WAC) 173-201A at a risk level of $1x10^{-6}$.
(i) NRWQC for consumption of organisms only (EPA 2002) pursuant to Section 304(a)(1) of the Clean Water Act and in accordance with WAC 173-201A at a risk level of $1x10^{-6}$.
(j) National Toxics Rule (NTR) chronic freshwater criterion based on 40 CFR 131.36 at a risk level of $1x10^{-6}$.
(k) Practical quantitation limit (PQL) (Ecology 2001b).
(l) NTR for consumption of organisms only based on 40 CFR 131.36 at a risk level of $1x10^{-6}$.

* Denotes PQL is higher than MTCA cleanup levels and/or applicable, relevant, and appropriate requirements (ARARs).
** Denotes natural background concentration is higher than MTCA cleanup levels and/or ARARs.
*** Freshwater criterion is expressed as a function of groundwater hardness. Average groundwater hardness at the site is 180 mg/l.

Qualifiers:

J: Estimated concentration above the method reporting limit (MRL) but below the PQL.

Analytes detected in samples at concentrations exceeding one or more of the cleanup levels or comparison values are shown in bold and italics. Where appropriate, surface water standards have been adjusted upward to the natural background concentration and/or PQL [WAC 173-340-730(5)(c)].

µg/l - micrograms per liter
mg/l - milligrams per liter

Attachment C

Test Pit TP-5 Summary of Observations

Summary of Test Pit Obeservations for Test Pit TP-5

Reproduced from original document presented in Appendix C of the Ocotober 2001 RI/FS Report

Test Pit Number	Test Pit Location	Depth (feet)	Unit Depths (feet)	Noticeable Odors[a]	Water Sheen[b]	OVM (ppm)[c]	Soil Sample Number	Description	USCS Symbol	Comments
TP-5	Grid Location	8.5	0.0-3.5	NONE	NS	26	TP-5-0-1	Fill: Sandy gravel, well-graded gravel (55-60%), loose, brown, dry.	GW	Note: TP in center of former octagon fndn; approximately 1.5 feet below surrounding grade.
				NONE	NS	5.3	TP-5-2-3	Fill: Sandy gravel, well-graded gravel (55-60%), loose, brown, dry.	GW	
			3.5-7.0	MOD-VS PH	VSS-HS	303	TP-5-4-6	Fill: Gravelly sand, well-graded sand, well-graded gravel (30-40%), ~10% fines, medium dense, brown.	SW	Abundant wood debris below 6.0 feet, wet at 7.0 feet.
			7.0-8.5+	VS PH	HS	1176(?)	TP-5-6-10	Fill: Wood debris, silty sand matrix, fine-medium sand, fine-course gravel (20%), medium dense, brown.	(SW-SM)	Refusal at 8.5 feet (large timbers at bottom of TP).

Notes:

(a) Noticeable odors: none = no odor, VSL = very slight, SL = slight, MOD = moderate, S = strong, VS = very strong, PH = petroleum hydrocarbon.

(b) Water sheen: NS = no sheen, VSS = very slight sheen, SS = slight sheen, MS = moderate sheen, HS = heavy sheen.

(c) OVM = organic vapor meter. Photoionization detector (PID) calibrated to 100 parts per million (ppm) isobutylene. Background = 0.0 ppm; ? = PID/OVM data questionable.