

PACIFIC groundwater **GROUP**

**Port of Seattle T-108
Groundwater Investigation
Final Report**

October 8, 2007

**PORT OF SEATTLE T-108
GROUNDWATER INVESTIGATION
FINAL REPORT**

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SIGNATURE

This report, and Pacific Groundwater Group's work contributing to this report, were reviewed by the undersigned and approved for release.



Janet N. Knox

A handwritten signature in blue ink that reads "Janet N. Knox".

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EXECUTIVE SUMMARY

A monitoring well network was installed at the Port of Seattle (Port) T-108 site in 2006. Field observations at T-108 suggest groundwater is tidally influenced near the Duwamish Waterway. Contoured elevations of water levels measured during this investigation indicate there is a component of groundwater flow from T-108 toward the Duwamish Waterway.

Four rounds of groundwater sampling at T-108 were completed between June 2006 and May 2007. Analytical results for Rounds 1 and 2 were presented and discussed in the Port T-108 Interim Groundwater and Soil Investigation report (Interim Report; PGG, 2006). Analytical results for Rounds 3 and 4 are presented and discussed in this report. Based on findings presented in the Interim Report, the monitoring well network for Rounds 3 and 4 was reduced to include only wells PGG-5, PGG-6, and PGG-7.

In Rounds 3 and 4, polychlorinated biphenyl (PCB) compounds and petroleum hydrocarbons were not detected in groundwater samples collected from PGG-5 through PGG-7. This is consistent with PCB and petroleum hydrocarbon results for these wells in the earlier sampling rounds.

Some of the project suites of total and dissolved metals were detected in groundwater samples collected in Rounds 3 and 4. The concentrations of the detected metals did not exceed the draft Duwamish groundwater screening levels (SAIC, 2006) based on the sediment cleanup screening levels (CSL) and sediment quality standards (SQS). Again, this is consistent with results of the previous sampling rounds – during Rounds 1 and 2 total and dissolved metals concentrations in samples PGG-5 through PGG-7 did not exceed the groundwater screening levels based on CSL and SQS.

Polynuclear Aromatic Hydrocarbons (PAHs) were not detected in groundwater samples PGG-5 through PGG-7 collected in Rounds 3 and 4. PAHs were not detected in Round 1 samples

collected from wells PGG-5 and PGG-7 or in Round 2 samples from PGG-6 and PGG-7. However, PAH compounds dibenz(a,h)-anthracene and indeno(1,2,3-cd)pyrene were detected in sample PGG-5 during Round 2. The concentrations of the PAHs exceeded the draft Duwamish screening levels based on both CSL and SQS. PAHs were not detected in later samples collected at PGG-5 nor were they detected in PGG-6 and PGG-7. The detections of PAHs in one sampling round appear to be a sampling artifact and not representative of actual groundwater concentrations.

Based on the analytical results of this investigation, groundwater at T-108 does not appear to be transporting petroleum compounds, PCBs, or PAHs to the Duwamish Waterway. Groundwater appears to have detectable concentrations of metals; however, the concentrations do not exceed draft Duwamish screening levels for metals partitioning from groundwater to sediment. These screening levels are designed to be protective of sediment recontamination. Therefore, groundwater at T-108 is not contributing contamination to surface water and sediment in the Duwamish Waterway.

1.0 INTRODUCTION

The Port of Seattle Terminal 108, or T-108, is located in Seattle, Washington near the banks of the Duwamish Waterway (Figure 1). Currently the site is leased by ConGlobal Industries (ConGlobal) although ReNu Recycling Services also leased a portion of the site during this field investigation. ConGlobal operates an active off-dock facility for the storage and repair of intermodal containers and chassis. They occupy the upland area of T-108 and a portion of the shoreline area (not including the immediate shoreline and bank of the terminal). ReNu Recycling, a construction debris recycling division of Nuprecon, Inc., formerly used a portion of T-108 for temporary storage of trucks and roll-off bins. Historic land uses at T-108 have included activities that have likely impacted the quality of soil and groundwater at the facility. These uses include a former City of Seattle sewage treatment plant and repository for contaminated dredged sediment.

Multiple environmental investigations at T-108 were performed between 1981 and 1992. The objective of the current investigation is to evaluate the shallow groundwater pathway between T-108 and the Duwamish Waterway. The scope for the investigation is documented in the Work Plan (PGG, 2006) and the drilling and initial analytical results are documented in an Interim Report (PGG, 2006). This report summarizes the results of groundwater sampling events that have been performed since the Interim Report was issued.

2.0 SITE INFORMATION

General information describing T-108 and the environmental history are summarized in the following sections for background. Additional details regarding site history and hydrogeology are included in the Work Plan (PGG, 2006) and Interim Report (PGG, 2006).

2.1 SITE DESCRIPTION

The T-108 site occupies approximately 15 acres¹ of Port of Seattle property that extends about 0.25 miles east from the Duwamish Waterway between Diagonal Avenue South and the Oregon Street right-of-way (Figure 2). The site is composed of two legal parcels. ConGlobal leases 11 acres of the eastern parcel of T-108. Since November 2006, ConGlobal has also leased an additional 2 acres of the western parcel of T-108. This area, above the banks of the Duwamish Waterway, is used for truck chassis and cargo container storage. ReNu Recycling leased approximately 1-acre of T-108, south of ConGlobal. In approximately August 2007 the ReNu lease was transferred to ConGlobal. A 1.2 acre Port of Seattle Park with 700 feet of shoreline is located between the former ReNu facility and the Duwamish Waterway.

Ground surface on the upland portion of T-108 is generally level. An earlier site investigation report (AGI, 1992) describes gentle downward slopes toward the east and northwest in the eastern parcel of T-108. The intertidal portion of the Duwamish Waterway bank is steeply sloped in the upper 5 to 10 feet and below that the slope breaks and continues at a gentle incline toward the center of the channel. The former ReNu facility is currently not paved.

Within the active container yard, much of the ground is paved. A portion of the Oregon Street right-of-way (Figure 2) and portions of the central area of the yard are not paved and ground surface cover is crushed rock. Ground cover in the shoreline area occupied by ConGlobal consists of a former asphalt turn-around and an unpaved area covered with grass, low lying brush, blackberries, and trees.

¹ Land area only, from shoreline to eastern property boundary (Figure 2). Total area of T-108 parcels according to King County online property report is 20.21 acres. Unknown how far into the Duwamish Waterway the legal parcel is considered to extend.

2.2 SITE HISTORY

The T-108 site is located in a former tidal marsh area which was reclaimed when the Duwamish Waterway was formed. A City of Seattle sewage treatment plant operated at the T-108 site until the mid-1970s. Around that time, Chiyoda Corporation acquired the site. On September 13, 1974 an accident occurred on the docks at Slip 1, approximately 1,800 feet upstream of T-108. As a result of the accident, a transformer cracked releasing an estimated 250-265 gallons of 98 to 99 percent Aroclor 1242 into the Duwamish Waterway (personal communication, D. Hotchkiss, September 5, 2006).

A major cleanup of the PCB spill occurred in 1976. PCB-contaminated sediment was dredged from the waterway and transported to the Chiyoda property by the US Army Corps of Engineers. Two sludge bed lagoons to contain the PCB-contaminated sediment were excavated along the northern edge of the property. Approximately 10 million gallons of sediment slurry were pumped into the pits. Water was decanted, treated, and discharged to the Duwamish Waterway. Eventually, the pits were back-filled with material from their original excavation and additional sediment that Chiyoda dredged from the shoreline in front of the Duwamish Diagonal treatment plant outfall to improve berthing (AGI, 1992).

The Port acquired the Chiyoda property in 1980 and sold the eastern parcel to Chevron, retaining the portion adjacent to the river. Chevron stock-piled soil contaminated with petroleum hydrocarbons in the vicinity of the former disposal lagoons. This soil was treated and met the state TPH cleanup level at that time. Chevron sampled groundwater at the Chiyoda property in 1991 and 1992. PAHs, petroleum hydrocarbons, and metals were detected in groundwater during the sampling events although sampling methods are unknown.

The Port leased the shoreline parcel of the site to the Lafarge Cement Company, which occupied the property between 1989 and 1998 to load ce-

ment barges at the mooring pile dock. About 1990, the Port acquired the eastern parcel of T-108 back from Chevron.

2.3 SITE HYDROGEOLOGY

The shallow hydrostratigraphic units encountered while drilling the T-108 monitoring wells for this investigation consist of fill underlain by tidal marsh deposits (Appendix A). The fill is a heterogeneous deposit that extends from ground surface to the top of the tidal marsh deposits. Outcrops of fill, which are predominantly gray silty sand but show significant variability, are visible along the Duwamish Waterway. The fill can include zones of significant organic content, localized cementation, and variations in silt and gravel content. During geologic logging, the fill was identified by the presence of significant sand and anthropogenic materials, and lack of peaty material.

The tidal marsh deposits underlie the fill at T-108. Outcrops of tidal marsh are visible along the Duwamish Waterway near mean sea level. In outcrop, the deposits consist of sandy silt with a high organic content (peat). During drilling, the tidal marsh deposits were distinctive and identified by the presence of a compact silty lithology with peaty grass and root material.

3.0 WORK PLAN FIELD TASKS

Activities and findings of the work plan field tasks completed in 2007 are documented in the following sections. Activities related to drilling, monitoring well installation, soil sampling, and groundwater sampling Rounds 1 and 2 are documented in the Interim Report (PGG, 2006).

3.1 WORK PLAN MODIFICATIONS

Some of the investigation findings documented in the Interim Status Report were field observations that monitoring wells PGG-1, PGG-2, and

PGG-3 are low yielding and therefore present difficulties in collecting representative groundwater samples. During a February 1, 2007 meeting, Ecology acknowledged this difficulty and agreed that investigating groundwater contaminant transport from T-108 to the Duwamish Waterway could be achieved if the wells sampled in the remaining sampling rounds were reduced to the shoreline wells: PGG-5, PGG-6, and PGG-7 (Figure 2). Construction information for the T-108 monitoring wells are presented in Table 1. Another modification to the Work Plan was Ecology's request to add mercury to the analytical suite for the remaining sampling rounds.

3.2 GROUNDWATER SAMPLING ROUND 3

Groundwater samples for Round 3 were collected by PGG representatives on February 19 and 20, 2007. Samples were collected from the modified well network (PGG-5 through PGG-7, Figure 2) and sampling methodology and wastewater management were in compliance with the T-108 Work Plan (PGG, 2006).

Reasonable effort was made to schedule sample times to approximately coincide with low daily tides in the waterway. Round 3 groundwater samples were collected between 10 minutes and 2 hours after predicted low tides in the Duwamish Waterway. The daytime low tides in the waterway at Eighth Avenue South were predicted to be 3.2 and 1.9 feet above MLLW² on February 19 and 20, 2007 respectively. Sample times and corresponding tides are presented in Table 2.

At the beginning of the sampling round, a water level snapshot was attempted in monitoring

² The Duwamish Waterway, Eighth Avenue South location is the tide prediction station identified in this investigation closest to T-108. While predicted tides are available for this station, verified or observed tides are not. The closest observed tide station to T-108 is the Seattle station at the Coleman Dock ferry terminal. Observed low tides for the Seattle station as reported by NOAA were 3.6 and 2.5 feet above MLLW on February 19 and 20, 2007 respectively.

wells PGG-1 through PGG-7. During the snapshot, damage to the wellhead at PGG-3 was observed. The flush monument protecting the wellhead appeared to have been hit by contractor's equipment and pushed a few inches. The monument still surrounded the PVC well casing and damage to the casing was not observed; however, it appeared that the 2-inch compression well cap could not be securely reinstalled if removed. The damage was discussed with the contractor who agreed to make an effort to avoid the wellhead in future.

3.3 GROUNDWATER SAMPLING ROUND 4

Groundwater samples for Round 4 were collected by PGG representatives on May 29 and 30, 2007. Samples were collected from PGG-5 through PGG-7 and sampling methodology and wastewater management were in compliance with the T-108 Work Plan (PGG, 2006).

Sample times were scheduled to approximately coincide with the daily low tides in the Duwamish Waterway. Round 4 groundwater samples were collected between 5 minutes and 1.5 hours after predicted low tides in the Duwamish Waterway. The daytime low tides in the waterway at Eighth Avenue South were predicted to be -0.6 and -1.2 feet below MLLW on May 29 and 30, 2007 respectively. Sample times and the corresponding tides are presented in Table 3³.

At the beginning of the Round 4, a water level snapshot was measured in monitoring wells PGG-1, PGG-2, and PGG-4 through PGG-7.

3.4 PHASED WELL DECOMMISSIONING

A number of monitoring wells were installed during previous investigations at T-108. PGG attempted to locate the wells in order to have

³ Observed low tides at the Seattle station as reported by NOAA were -0.7 and -1.3 feet below MLLW on May 29 and 30, 2007 respectively.

them decommissioned. Our source of information regarding locations of the older wells is the Site Investigation report (AGI, 1992). The report does not include co-ordinates for the well locations but does include figures showing the approximate well locations. These figures were found to be of little use in the field because they depict no reference objects that still exist on the site. PGG digitized the well locations from the AGI figures onto current aerial photos and attempted to field locate the old wells visually and with a metal detector. ConGlobal operates a very busy container and chassis storage facility with heavy equipment constantly moving throughout the site. Because of the amount of metal at the site, the metal detector was not effective for locating wells. The vicinity of each old wellhead was visually inspected during each sampling round as access through the containers and equipment permitted. No wellheads were identified. In some places, cracks in the asphalt that may suggest a buried monument were observed; however, those observations were not considered reliable enough to cut up the pavement to inspect for the wells given the only representation we have of the locations are approximate on a figure at a scale of 1 inch to 100 feet.

The methods used to try and locate the old monitoring wells at T-108 are consistent with typical inspection methods. Given the traffic and heavy equipment associated with the ConGlobal operation, these methods were not successful. We recommend that the Port stay aware of any periods that the ConGlobal site, or portions of the site, may not be active and seize that opportunity to try and locate the old wells.

4.0 SHALLOW GROUNDWATER FLOW

The uppermost water bearing zone at T-108 occurs in the fill unit which is referred to as the shallow aquifer throughout this investigation. T-108 monitoring wells installed for this investigation are completed in the shallow aquifer (Table 1 and Appendix A). Groundwater near the Duwamish Waterway is tidally influenced. Because

the system is so dynamic, interpretations of groundwater flow based on water levels measured over a short window of time, or “snapshot,” are more representative than flow interpretations based on water levels measured at the time of sampling which occurs over the course of two days. Water level snapshots were measured in the T-108 monitoring wells at the beginning of the sampling rounds. Snapshot water levels are summarized in Table 1. Sampling water levels are summarized in Table 2.

During Round 3, groundwater levels were measured at PGG-1, PGG-2, and PGG-4 through PGG-7 in succession on February 19, 2007 between 9:19 and 10:22 am. Water levels measured during the Round 3 snapshot are summarized in Table 1. The groundwater level contour map (Figure 3) indicates that groundwater in the shallow aquifer flowed radially from a high in the vicinity of PGG-2 during the Round 3 water level snapshot. Observed tides for the Seattle station at Coleman Dock as reported by NOAA range from 8.29 feet above MLLW at 9:18 to 5.73 feet above MLLW at 10:24 (Table 1). Tide elevations in the Duwamish Waterway were above groundwater elevations in the shoreline wells (PGG-5 through PGG-7) during the snapshot measurements at those wells.

Groundwater levels were measured at the beginning of Round 4 in PGG-1, PGG-2, and PGG-4 through PGG-7 in succession on May 29, 2007 between 8:54 and 10:01 am (Table 1). The groundwater level contour map of the data (Figure 4) indicates a similar flow pattern to Round 3; radial groundwater flow in the shallow aquifer from a groundwater mound near PGG-2. Observed tides during the Round 4 snapshot ranged from 0.33 feet above MLLW at 8:54 am to -0.68 feet below MLLW at 10:00 as reported by NOAA at the Seattle station (Table 1). Therefore, tide elevations in the Duwamish Waterway were below groundwater elevations during the Round 4 snapshot.

The groundwater flow patterns observed in Rounds 3 and 4 are consistent with those presented in the Interim Report (PGG, 2006). AGI reported radial groundwater flow from a

groundwater high point centered approximately 100 feet south of PGG-1. The reason for the “mound” is unknown at this time. Aerial photos of the site from 1940 and Sanborn maps of the area suggest an old channel occurred from the Duwamish Waterway along the Oregon Street right-of-way. Near PGG-1 the channel turned southeast and entered the T-108 site. The channel was backfilled, possibly when the stormwater and sewer lines were installed. Assuming coarse material was used for backfill, the relic channel may be locally influencing groundwater flow by providing a preferential flow path. The ultimate discharge point for this flow path is likely the Duwamish Waterway.

5.0 ANALYTICAL RESULTS

During groundwater sample collection, field parameters pH, conductivity, dissolved oxygen, oxidation reduction potential, and temperature were measured using a multi-parameter meter and flow through cell. Groundwater samples collected from PGG-5 through PGG-7 in Rounds 3 and 4 were submitted to TestAmerica Analytical Testing Corporation (TestAmerica), a Washington-state certified laboratory in Bothell, Washington. The samples were analyzed for the following:

- Polychlorinated biphenyls (PCBs) by EPA Method 8082 Modified
- Polynuclear Aromatic Hydrocarbons (PAHs) by EPA 8270C-HVI (GC/MS)
- Gasoline and Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) by NWTPH-Gx/8021B
- Total Petroleum Hydrocarbons Diesel-extended by NWTPH-Dx
- Total metals (arsenic, cadmium, chromium, lead, copper, nickel, zinc) by EPA 6020
- Dissolved metals (arsenic, cadmium, chromium, lead, copper, nickel, zinc), field filtered, analyzed by EPA 6020

- Round 3 samples analyzed for additional total and dissolved metals (barium, iron, and manganese) by EPA 6010B and EPA 6020; dissolved samples were field filtered
- Round 3 samples analyzed for total mercury by EPA 7470A
- Round 3 samples analyzed for dissolved mercury by EPA 7470A-Diss (field filtered)
- Round 4 samples analyzed for total mercury by EPA 1631E
- Round 4 samples analyzed for dissolved mercury by EPA 1631E (field filtered)

Analytical results are discussed in the following sections and summarized in Tables 2 and 3. The draft Duwamish groundwater screening levels (SAIC, 2006) based on the sediment cleanup screening levels (CSL) and sediment quality standards (SQS) are presented in Tables 2 and 3 for comparison to the T-108 groundwater results. These screening levels are designed to be protective of sediment recontamination. Laboratory reports and a quality assurance/quality control assessment of the data are presented in Appendices B and C.

Analytical results of groundwater sampling Round 1 and Round 2 and soil sampling during drilling are not specifically discussed in this report. However, in an effort to present a useful reference document, summary tables of these results are reproduced from the Interim Report in Appendices D, E, and F.

5.1 PCBS

Groundwater samples collected from wells PGG-5 through PGG-7 in Rounds 3 and 4 did not have detectable concentrations of PCBs (detection limit 0.100 ug/L for each Aroclor, Tables 2 and 3). The detection limit achieved by the lab is lower than the draft Duwamish groundwater screening levels, where developed, with the following exception:

- In Rounds 3 and 4, the detection limit for Aroclor 1260 (0.100 ug/L) is not lower than

the draft Duwamish groundwater screening level based on SQS (0.058 ug/L). The detection limit is lower than the screening level based on CSL (0.31 ug/L).

5.2 PAHS

Groundwater samples collected from the modified T-108 monitoring well network in Rounds 3 and 4 did not have detectable concentrations of PAHs (Tables 2 and 3). The detection limits for PAHs in Round 3 ranged from 0.00980 to 0.0990 ug/L. The detection limits for PAHs in Round 4 ranged from 0.00943 to 0.472 ug/L. These detection limits are below the draft Duwamish groundwater screening levels, where developed, with the following exception:

- In sample PGG-5, the Round 4 detection limit of dibenz(a,h)anthracene (0.0472 ug/L) is not lower than the draft Duwamish groundwater screening level based on SQS (0.0046 ug/L) or the screening level based on CSL (0.013 ug/L)

5.3 PETROLEUM HYDROCARBONS

Samples PGG-5 through PGG-7 collected in Rounds 3 and 4 did not have detectable concentrations of gasoline (detection limit 50 ug/L), diesel (detection limits 0.236 to 0.248 mg/L), and lube oil (detection limits 0.472 to 0.495 mg/L) range hydrocarbons. In addition, the groundwater samples did not have detectable concentrations of benzene (detection limit 0.500 ug/L), toluene (detection limit 0.500 ug/L), ethylbenzene (detection limit 0.500 ug/L) and total xylenes (detection limit 1.00 ug/L). Draft Duwamish groundwater screening levels have not been developed for petroleum hydrocarbons.

5.4 METALS

Total and dissolved metals were detected in each of the wells sampled in Rounds 3 and 4. The total metals in the T-108 analytical suite that

were detected in Rounds 3 and 4 are arsenic, chromium, copper, nickel, and zinc. Through a laboratory error, Round 3 samples were analyzed for metals in addition to the project suite. Total barium, total iron, and total manganese were also detected in the Round 3 samples. The concentrations of total metals detected in the Round 3 and Round 4 groundwater samples were below the draft Duwamish groundwater screening levels, where developed.

The dissolved metals in the T-108 analytical suite that were detected in Rounds 3 and 4 are arsenic, chromium, copper, and nickel. Round 3 samples also had detectable concentrations of dissolved barium, dissolved iron, and dissolved manganese. These metals are not part of the project suite and were not analyzed in the other sampling rounds. The concentrations of dissolved metals in the Round 3 and Round 4 groundwater samples were below the draft Duwamish groundwater screening levels, where developed.

5.4.1 Mercury

Total and dissolved mercury were added to the metals suite for sampling Round 3 and Round 4. Total and dissolved mercury were not detected in the groundwater samples collected in Round 3. The detection limits in Round 3 (0.200 ug/L) were not lower than the draft Duwamish screening levels (0.0074 ug/L based on CSL and 0.0052 ug/L based on SQS). In order to achieve detection limits below the draft screening levels, low-level mercury analysis was performed on the Round 4 groundwater samples. Total and dissolved mercury were not detected in Round 4 groundwater samples and the detection limits (0.00500 ug/L) were lower than the draft Duwamish groundwater screening levels.

6.0 INTERIM REPORT ERRATA

Following the T-108 Groundwater and Soil Investigation Interim Report submittal to the Washington State Department of Ecology, errors were noted in a table and figure. Specifically, in

Table 1 of the Interim Report (table title: T-108 Groundwater and Shoreline Soil Investigation Monitoring Well Construction Summary), well elevations were incorrectly calculated to the Mean Low Low Water (MLLW) vertical datum. An incorrect measuring point elevation was also presented in Figure A-4 (figure title: Geologic Log and As-Built for Well PGG-4). Measuring point elevations on the remaining geologic logs (Interim Report Figures A-1 to A-3 and A-5 through A-7) were reported correctly and groundwater elevation contours (Interim Report Figures 3 to 5) were calculated using the correct measuring point elevations.

The corrected well elevations are presented in Table 1 of this report and should replace the elevations reported in the Interim Report. The corrected elevation of PGG-4 is presented in Figure A-4 of this Final Investigation Report and should replace Figure A-4 in the Interim Report.

7.0 RECOMMENDATIONS

The objective of the T-108 Groundwater and Soil Investigation was to evaluate the groundwater pathway between T-108 and the Duwamish Waterway. To meet this objective, the Port installed a network of monitoring wells and performed four groundwater sampling rounds. Analytical results have been compared to the draft Duwamish groundwater screening levels, designed to be protective of sediment recontamination. Because the groundwater quality results from this investigation have met the screening levels based on CSL and SQS, we recommend that groundwater monitoring at T-108 cease. We further recommend that the T-108 groundwater pathway be considered closed as a pathway of contamination to the Duwamish Waterway under the Duwamish Source Control Program.

The remaining recommendations are related to site monitoring wells. As discussed in Section 4.4, the current operations at ConGlobal significantly impaired our ability to locate old wells at the site. We recommend that the Port take advantage of any windows of inactivity at the site, especially any vacancies, to make further at-

tempts to locate old wells and have them decommissioned by a licensed well driller. In addition, we recommend that the damaged monitoring well PGG-3, and PGG-1 and PGG-4, be decommissioned in the near future before major site changes, such as ground paving at the former ReNu operation, occur. If there are future monitoring plans for the shoreline wells, we recommend that the monuments around PGG-2 and PGG-6 be replaced with high-traffic rated monuments. This portion of T-108 was inactive when the wells were installed and therefore the heavy monuments were not considered necessary at the time.

8.0 REFERENCES

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