STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
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February 9, 2017

Mr. Ron Walton
Clariant Corporation
4000 Monroe Rd
Charlotte, NC 28205

Re: Further Action at the following Site:

- **Site Name:** Chemtrade Performance Chemicals US LLC
- **Site Address:** 404 Hendrickson Dr., Kalama, WA. 98625
- **Cleanup Site No.:** 1784
- **Facility/Site No.:** 24634187
- **VCP Project No.:** SW0492

Dear Mr. Walton:

The Washington State Department of Ecology (Ecology) received your request for an opinion on your independent cleanup of the Chemtrade Performance Chemicals US LLC facility (Site). This letter provides our opinion. We are providing this opinion under the authority of the Model Toxics Control Act (MTCA), Chapter 70.105D RCW.

Issue Presented and Opinion

Is further remedial action necessary to clean up contamination at the Site?

YES. Ecology has determined that further remedial action is necessary to clean up contamination at the Site.

This opinion is based on an analysis of whether the remedial action meets the substantive requirements of MTCA, Chapter 70.105D RCW, and its implementing regulations, Chapter 173-340 WAC (collectively "substantive requirements of MTCA"). The analysis is provided below.

Description of the Site

This opinion applies only to the Site described below. The Site is defined by the nature and extent of contamination associated with the following release:

- Zinc and Cadmium into the Soil, Ground Water, Surface Water, and Sediment.

Please note a parcel of real property can be affected by multiple sites. At this time, we have no information that the parcel(s) associated with this Site are affected by other sites.

Basis for the Opinion

This opinion is based on the information contained in the following documents:

1. *CDM, Phase I and 2 Environmental Site Assessment* Clariant Corporation Chemical Plant, November 19, 2002.
2. *CDM, Angle Boring Groundwater Analytical Results*, Former Clariant Plant, July 21, 2003.
3. *CDM, Contaminant Delineation*, Former Clariant Corporation Chemical Plant, March 3, 2004.
4. *CDM, Soil Excavation Summary Report* Former Clariant Corporation Chemical Plant, March 3, 2004.
5. *CDM, Winter 2004 Quarter Groundwater Monitoring*, Former Clariant Corporation Chemical Plant, March 24, 2004.
6. *CDM, Spring 2004 – 2nd Quarter Groundwater Monitoring*, Former Clariant Corporation Chemical Plant, July 9, 2004.
7. *CDM, VCP #SW0492 Evaluation of the Cadmium Plume*, Former Clariant Plant, August 17, 2004.
8. *CDM, Summer 2004 – 3rd Quarter Groundwater Monitoring*, Former Clariant Corporation Chemical Plant, October 18, 2004.
9. *CDM, Fall 2004 – 4th Quarter Groundwater Monitoring*, Former Clariant Corporation Chemical Plant, December 3, 2004.
10. *CDM, Winter 2005 – 5th Quarter Groundwater Monitoring*, Former Clariant Corporation Chemical Plant, April 14, 2005.
11. *CDM, Spring/Summer 2005-6th and 7th Quarters Groundwater Monitoring*, Former Clariant Corporation Chemical Plant, September 14, 2005.

12. *CDM, Screening Level Ecological Risk Assessment,* Former Clariant Corporation Chemical Plant, November 30, 2005.
13. *CDM, Site Conceptual Model for Zinc and Cadmium in Groundwater* at the Former Clariant Corporation Chemical Plant, November 30, 2005.
14. *Fall 2005 – 8th Quarter Groundwater Monitoring,* Former Clariant Corporation Chemical Plant, January 3, 2006.
15. *CDM, Summer 2006 Groundwater Monitoring*, Former Clariant Corporation Chemical Plant, September 29, 2006.
16. *CDM, Piezometer Installation and Groundwater Sampling Report* – February 2007, Former Clariant Corporation Chemical Plant, April 12, 2007.
17. *CDM, Feasibility Study*, Former Clariant Corporation Chemical Plant, October 10, 2008.
18. *Hart & Hickman, Remedial Action Report*, Former Clariant Corporation Facility, January 19, 2011.
19. *Hart & Hickman, Post-Injection Monitoring Report & RAWP Addendum*, July 5, 2011.
20. *Hart & Hickman, Pilot Test Plan, Former Clariant Corporation Facility*, September 9, 2011.
21. *Hart & Hickman, Pilot Test Report*, Former Clariant Corporation Facility, October 31, 2011.
22. *Hart & Hickman, Additional Remedial Action & Performance Monitoring Report*, Former Clariant Corporation Facility, October 16, 2012.
23. *Hart & Hickman, Geochemical Evaluation Summary & 2013 Remedial Action Work* Plan, Former Clariant Corporation Facility, March 25, 2013.
24. *Hart & Hickman, Pilot Scale Injection Report*, Former Clariant Corporation Facility, May 22, 2014.
25. *Hart & Hickman, Sediment and Sediment Pore Water Sampling Report*, Former Clariant Corporation Facility, September 30, 2015.

These documents are kept in the Central Files of the Southwest Regional Office of Ecology (SWRO) for review by appointment only. You can make an appointment by calling the SWRO resource contact at 360.407.6365.

This opinion is void if any of the information contained in these documents is materially false or misleading.

Ecology is responding to a September 30, 2015 Sediment and Sediment Porewater Sampling Report for the Site, that contained a request to relocate two groundwater conditional points of compliance, and a statement that it is not practicable to meet the groundwater cleanup levels at the current points of compliance within a reasonable restoration time frame.

Two angled monitoring wells, AB1 and AB2, have been used for evaluating groundwater compliance with approved cleanup levels. These two monitoring wells are located at the western edge of the Site, within approximately 20 feet of the Columbia River. However, no record of the process for required Ecology approval of these angled monitoring wells as conditional points of compliance has been located in the Site record. Contamination above cleanup levels continues to be measured in groundwater samples obtained from these monitoring wells. The request is to move the conditional points of compliance to new angled wells closer to the Columbia River, to an area of the Site that appears to contain hyporheic flow of Columbia River surface water.

Analysis of the Cleanup

Ecology has concluded that **further remedial action** is necessary to clean up contamination at the Site. That conclusion is based on the following analysis:

1. Characterization of the Site.

A remedial investigation, feasibility study with modifications, and several independent remedial actions have been conducted at the Site. To reduce contamination at the Site, a total of approximately twenty-six thousand tons of contaminated soil was removed and disposed of offsite. Chemicals were injected to immobilize contaminant concentrations in soil and groundwater. Hyporheic flow of Columbia River surface water beneath the Site limited the effectiveness of subsurface injections of the calcium polysulfide, ferrous sulfate and magnesium hydroxide used to immobilize groundwater contamination. A monitored natural attenuation component of the selected remedial alternative included up to 30 years of performance monitoring for monitored natural attenuation parameters after the conclusion of other active remedial action components.

Soil and groundwater at the Site contain zinc and cadmium above cleanup levels. The consultant for the Site asserts[1] that it has been demonstrated that it is not practicable to meet groundwater cleanup levels at the current angled boring points of compliance, within a reasonable restoration time frame.

[1] Scott Drury email to Adam Harris, RE: Clariant Kalama - Proposed Angle Wells, October 12, 2016.

Therefore, two new horizontal/angle wells are proposed for installation closer to the ground water/surface water interface. Additional remedial technologies are discussed, and are discounted as being expensive and as having drawbacks that make them unreasonable.

Selected Remedial Action Site History.

- A March 3, 2004 report[2] refers to a Site assessment in 2002-2003 that *"identified high concentrations of metals in soil and groundwater"*. The report states that in 2003, almost 16,000 tons of soil were subsequently removed from the Site for appropriate offsite disposal. This appears to have been conducted as an interim action to reduce contamination. Areas of contamination are reported to have been left in place.
- A 2008 feasibility study for the Site concluded that "*Current technologies simply do not provide a long term solution that can achieve cleanup levels in a timely manner and at a reasonable cost for this Site.*"[3] The preferred cleanup alternative is stated to "*provide the most cost effective reduction in contaminant concentrations*", and that "*It is not expected that any of these alternatives would result in complete restoration, to the effect that all cleanup levels (soil, groundwater, surface water) would be met throughout the site and such that compliance monitoring and facility maintenance, if applicable, would no longer be required within a reasonable time frame (i.e. less than 30 years)*"[4].
- A 2010 Remedial Action Work Plan is provided in the Site record. As an alternative to the limestone cap identified as part of the selected remedial alternative from the 2008 feasibility study, the work plan proposed soil excavation and injection of calcium polysulfide into the subsurface of the Site. The objectives of the 2010 Remedial Action Work Plan were to remediate soil and groundwater and meet cleanup standards.
- A January 2011 Remedial Action Report states that 11,500 tons of additional excavated materials were removed and disposed of offsite as part of the 2010 remedial work plan implementation. This brings the total amount of contaminated soil removed from the Site to more than 26,000 tons.

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[2] Soil Excavation Summary Report, Former Clariant Corporation Chemical Plant, CDM Corporation, March 3, 2004.
[3] Feasibility Study Former Clariant Corporation Chemical Plant. CDM Corporation, October 10, 2008. Page 8-1.
[4] Feasibility Study Former Clariant Corporation Chemical Plant. CDM Corporation, October 10, 2008. Page 7-12

- An October 2012 Additional Remedial Action and Performance Monitoring Report for the Site states that in September 2010, September 2011, and December 2011 injections of calcium polysulfide were conducted at the Site.
- Performance groundwater monitoring detailed in a March 2013 Geochemical Evaluation Summary and 2013 Remedial Action Work Plan led to the statement that *"application of CaSx" (Calcium Polysulfide) "to the subsurface has generally not produced the anticipated reduction of dissolved Zn concentrations in site ground water as a result of the oxidation of sulfide and metal sulfides, primarily because of the inability to maintain reducing conditions as a result of aquifer fluctuations and interactions with the Columbia River."*[5]
- In 2013, a pilot scale injection of ferrous sulfate and magnesium hydroxide was conducted at the Site. Results detailed in a May 2014 Report[6] detail that "*it appears that increasing aquifer pH is the approach best suited for reduction of dissolved zinc concentrations in the site's aquifer*", but that *"due to the interactions of the Columbia River and the site aquifer, the long-term effectiveness of aquifer pH is unknown."*
- A 2015 sediment and porewater study is also included in the Site record.[7] Sediment and Porewater contamination was studied along the banks of the Columbia River.
- Ecology provided written opinions on the Site investigation and cleanup in 2004, 2006, and 2008.

Establishing conditional points of compliance.

It is not clear how groundwater monitoring wells AB1 and AB2, the reported current conditional points of compliance for the protection of surface water, were established as conditional points of compliance. Ecology's last opinion for the Site (November 10, 2008), provided cleanup standards including standard points of compliance for the Site. Emails from a previous Ecology Site manager in 2010 mention use of conditional points of compliance at the Site.

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[5] Geochemical Evaluation Summary and 2013 Remedial Action Work Plan, Former Clariant Corporation, March 25, 2013. Hart Hickman. Page 19.
[6] Pilot-Scale Injection Report, Former Clariant Corporation Facility, May 22, 2014, Hart Hickman. .
[7] Sediment and Sediment Pore Water Sampling Report, Former Clariant Corporation Facility, Hart Hickman, September 30, 2015.

However, there is no indication in the Site record how the requirements of Washington Administrative Code (WAC) 173-340-720(8) were met to establish conditional points of compliance at this Site abutting surface water. To establish conditional points of compliance at the Site, the requirements will need to be met and documented.

A conditional point of compliance for groundwater may only be established where it can be demonstrated that it is not practicable (due to technological limitations, environmental conditions, or other factors) to meet the cleanup level throughout the site within a reasonable restoration time frame (WAC 173-340-350 through 173-340-390). This demonstration should be conducted through evaluation of remedial alternatives in a fully supported feasibility study (FS) with disproportionate cost analysis (DCA) that meets the minimum requirements of MTCA.

Following agency review of the FS and DCA, if Ecology agrees that it is not practicable to meet the cleanup level throughout the site within a reasonable restoration time frame, the department may approve a conditional point of compliance that shall be as close as practicable to the source of hazardous substances, and except as provided under ((WAC) 173-340-720(8)(d)), not to exceed the property boundary. Where a conditional point of compliance is proposed, the person responsible for undertaking the cleanup action shall demonstrate that all practicable methods of treatment are to be used in the site cleanup ((WAC) 173-340-720(8)(c)).

Comments:
Ecology realizes that substantial cleanup has been conducted at the Site over the last 15 years, including remedial excavations and injections. However, the following additional information is needed for Ecology to evaluate the claim that it has been demonstrated that it is not practicable to meet groundwater cleanup levels at the current points of compliance within a reasonable restoration time frame, and to evaluate the establishment of conditional points of compliance at the Site:

a) **Please provide a work plan for Ecology review and approval for conducting a seep study at the Site.** Ecology recommends performing a seep study in sediment along the banks of the Columbia River at the Site, to evaluate current compliance with surface water and sediment cleanup standards at locations of preferential pathways, and to help determine whether additional remedial actions are needed at the Site.

The seep study should evaluate if preferential pathways are present for contamination to enter sediments and surface water, and what the maximum contamination loading is in surface water and sediment at the Site at the locations of preferential pathways.

Because of the presence of riprap armoring along the shoreline of the Site, the seep study may also need to include or be preceded by a conductivity or other geophysical survey. Results from a seep study will be needed to help evaluate remedial alternatives by updating the conceptual site model with current conditions at the Site.

Please update the conceptual site model with current delineated plan view maps and geologic cross sections. After conducting a seep study, Ecology recommends updating the conceptual site model with current lateral and vertical extents of remaining soil and groundwater contamination at the Site. The locations of remaining soil contamination at the Site that are contributing to ongoing groundwater contamination are not currently clear. The locations of remaining contamination will need to be clearly delineated for evaluating the practicability of additional remediation, and potentially for establishing an environmental covenant at the Site. Current lateral and vertical extents of contamination in soil and groundwater are needed in both delineated geologic cross sections and plan view maps. These maps should:

i) Delineate by concentration contours the locations of remaining contamination throughout the Site.

ii) Include the accurate locations of all soil and groundwater sampling locations, borings and monitoring wells, the most recent groundwater elevations and contaminant concentrations, excavations, injections, removed USTs, roads, sidewalks, utilities and other infrastructure for reference.

iii) Include locations of preferential pathways (seeps) to the Columbia River sediments.

iv) Clearly indicate all areas exceeding cleanup levels. Include all sample results above and below cleanup levels to evaluate clean extents reported.

v) Clearly indicate data points used to determine isoconcentrations of contaminants in groundwater, especially those used to determine plume extents.

vi) Document the nature and extents of hyporheic river flow and groundwater flow affecting the Site.

vii) Include the Columbia River in cross-section and plan view sufficient to understand the interaction of groundwater and hyporheic river flow at the Site.

viii) Illustrate sampling locations exceeding cleanup levels in red and include a table with applicable contaminant concentrations and cleanup levels.

ix) Evaluate the manufacturing facility as a possible source of contamination. Use of zinc in the facility's manufacturing process continued until 2016. In October 2016, the facility was reported to have been cleaned and residues of zinc were removed from the facility. Until October, 2016, industrial processes may have been an ongoing source of contamination at the Site and account for ongoing contamination detected in groundwater. In Site figures, please include contamination in the subsurface measured below the manufacturing facility, including below rusted drains in the concrete flooring, below the "Pit" area of the manufacturing facility, and below the locations of tanks and other process equipment that may have released contaminants of concern into the environment until October, 2016. This area of the Site will need to be fully delineated and included in the feasibility study.

Please provide for Ecology review and approval an outline of proposed remedial alternatives to be included in a feasibility study. After updating the Conceptual Site Model, to evaluate the practicability of meeting cleanup levels throughout the Site within a reasonable restoration timeframe, Ecology suggests providing for our review and approval an outline of remedial alternatives for the Site that will then be considered in a feasibility study with fully supported disproportionate cost analysis. Remedial alternatives to be evaluated need to be inclusive of the results of the seep study and updated Conceptual Site Model. The feasibility study will need to evaluate and fully support by disproportionate cost analysis remedial alternatives that meet the minimum threshold requirements of MTCA (WAC 173-340-360(a)). The disproportionate cost analysis should include detailed cost estimates for each remedial alternative, and closely follow guidelines for numerical evaluation of alternatives provided by Ecology.

Establishment of cleanup standards:

a) **Cleanup levels applicable to this Site:**

Soil- Direct Contact:

- Cadmium 2 mg/kg[8]
- Zinc 24,000 mg/kg[9]

[8] MTCA Method A, WAC 173-340-900, Table 740-1
[9] MTCA Standard Method B, WAC 173-340-740(3)(b)(iii)(B)

Saturated Soil- Protection of Groundwater[10]:

- Cadmium 0.035 mg/kg[11]
- Zinc 299 mg/kg[12]

Unsaturated Soil- Protection of Groundwater[13]:

- Cadmium 0.69 mg/kg
- Zinc 5970 mg/kg

Soil - Protection of Plants, Soil Biota and Wildlife[14]:

	Plants	Soil Biota	Wildlife
• Cadmium	4 mg/kg	20 mg/kg	14 mg/kg
• Zinc	86 mg/kg	200 mg/kg	360 mg/kg

Groundwater- Potable:

- Cadmium 5 µg/L[15]
- Zinc 4,800 µg/L[16]

Groundwater- Protective of Surface Water, Surface Water[17]:

- Cadmium 0.7 µg/L
- Zinc 66 µg/L

Sediment Cleanup Objectives[18]:

- Cadmium 2.1 mg/kg
- Zinc 3,200 mg/kg

Sediment Bioaccumulation Target Concentrations[19]:

- Cadmium 11.3 mg/kg
- Zinc 2,783 µg/kg

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[10] At this Site, it has not been demonstrated that standard method B soil cleanup levels for the protection of saturated and unsaturated groundwater are sufficiently protective. The final cleanup action must meet groundwater and surface water cleanup standards.
[11] MTCA Standard Method B, WAC 173-340-740(3)(b)(iii)(B)
[12] MTCA Standard Method B, WAC 173-340-740(3)(b)(iii)(A)
[13] MTCA Standard Method B, WAC 173-340-740(3)(b)(iii)(A)
[14] WAC 173-340-900, Table 749-3
[15] MTCA Method A, WAC 173-340-900, Table 720-1
[16] MTCA Standard Method B, WAC 173-740-730 (3)(b)
[17] Values calculated from current surface water regulations (WAC 173-201A-240, amended May 9, 2011) using the Columbia River average hardness value of 58 milligrams per liter (mg/L).
[18] WAC 173-204-563 Dry Weight Sediment Cleanup Objectives for chemical toxicity to the freshwater benthic community. Additional minimum requirements for sediment cleanup actions are provided in WAC 173-204-570(3).
[19] Dredged Material Management Office, U.S. Army Corps of Engineers, Seattle District, Dredged Material Evaluation and Disposal Procedures User Manual, November 2015. Table 10-1. List 1 Bioaccumulative Chemicals of Concern. The BT is set at a sediment concentration that constitutes a "reason to believe" that the chemical would accumulate in the tissues of target organisms.

Points of Compliance

The following points of compliance are applicable to this Site:

- **Soil-Direct Contact (WAC 173-340-740(6)(d)):** Based on human exposure via direct contact, the point of compliance is throughout the Site from ground surface to fifteen feet below the ground surface.
- **Soil- Protection of Groundwater (WAC 173-340-747):** Based on the protection of groundwater, the point of compliance is throughout the Site.
- **Soil-Protection of Plants, Soil Biota and Wildlife (WAC 173-340-7490(4)(b)):** Based on ecological protection, the point of compliance is throughout the Site from ground surface to fifteen feet below the ground surface.
- **Groundwater (WAC 173-340-720(8)(b)):** Based on the protection of groundwater quality, points of compliance are established as throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site.
- **Groundwater-Surface Water Protection (WAC 173-340-730(6)):** Based on the protection of surface water, the point of compliance is all locations where hazardous substances are released to surface water.
- **Air Quality (WAC 173-340-750(6)):** Based on the protection of air quality, the point of compliance is ambient and indoor air throughout the Site.
- **Sediment (WAC 173-340-760):** Based on the protection of sediment quality, compliance with the requirements of 173-204 WAC.

b) **Request for Conditional Points of Compliance:**

The current request to establish conditional points of compliance will be evaluated based on the requirements of WAC 173-340-8(c), which requires a demonstration of impracticability to meet current cleanup standards under WAC 173-340-350 through WAC 173-340-390. Additional requirements for establishing conditional points of compliance at this Property abutting surface water are detailed in WAC 173-340-720 (d)(ii).

3. **Selection of cleanup action.**

Ecology has determined the cleanup action you selected for the Site, excavation of contaminated soils and pilot scale remedial injections, does not meet the substantive requirements of MTCA. In 2008, Ecology approved a feasibility study containing a selected remedial alternative for the Site, with modifications in 2010 and 2011. The 2008 feasibility study[20] and the Ecology opinion of the sufficiency of the selected remedial alternative[21] both indicate that the selected remedial alternative was not designed to meet the minimum threshold requirements of MTCA (WAC 173-340-360(a)), and was therefore conducted as an interim action to reduce contamination at the Site[22]. A feasibility study for the Site is needed that provides remedial alternatives meeting minimum threshold requirements. That feasibility study may demonstrate that additional remedial action is disproportionately costly at the Site compared to the benefit to be obtained by additional remedial action.

4. **Cleanup.**

Cleanup actions performed at the Site are described in Section 1. Ecology has determined the cleanup you performed does not meet current cleanup standards for the Site. Pilot scale remedial injections were not effective due to unanticipated hyporheic flow of Columbia River surface water beneath the Site. Full scale remedial injections were not conducted. The cleanup was not effective in meeting approved cleanup standards.

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[20] Feasibility Study Former Clariant Corporation Chemical Plant. CDM Corporation, October 10, 2008. Page 8-1. *"Current Technologies simply do not provide a long term solution that can achieve cleanup levels in a timely manner and at a reasonable cost for the Site."*

[21] Ecology Opinion on Proposed Cleanup of the Former Clariant Corporation Chemical Plant (aka Chemtrade Performance Chemicals US LLC), November 10, 2008. *"CDM determined that Alternative 3 appears to provide the most cost effective reduction in contaminant concentrations. However, the net overall effects of this approach cannot be determined without implementing a pilot program. Based on this, CDM has recommended implementing Alternative 3 in a phased approach. Soil removal, construction of the neutralization cap in the area of SB#2 only, and institutional controls would be applied immediately. The site would be monitored on a regular basis (i.e., semi-annually). At the end of a five-year period, the effectiveness of these actions would be re-evaluated"*

[22] WAC 173-340-200, WAC 173-340-430

Limitations of the Opinion

1. Opinion does not settle liability with the state.

Liable persons are strictly liable, jointly and severally, for all remedial action costs and for all natural resource damages resulting from the release or releases of hazardous substances at the Site. This opinion **does not**:

- Resolve or alter a person's liability to the state.
- Protect liable persons from contribution claims by third parties.

To settle liability with the state and obtain protection from contribution claims, a person must enter into a consent decree with Ecology under RCW 70.105D.040(4).

2. Opinion does not constitute a determination of substantial equivalence.

To recover remedial action costs from other liable persons under MTCA, one must demonstrate that the action is the substantial equivalent of an Ecology-conducted or Ecology-supervised action. This opinion does not determine whether the action you performed is substantially equivalent. Courts make that determination. *See* RCW 70.105D.080 and WAC 173-340-545.

3. State is immune from liability.

The state, Ecology, and its officers and employees are immune from all liability, and no cause of action of any nature may arise from any act or omission in providing this opinion. *See* RCW 70.105D.030(1)(i).

Contact Information

Thank you for choosing to clean up the Site under the Voluntary Cleanup Program (VCP). After you have addressed our concerns, you may request another review of your cleanup. Please do not hesitate to request additional services as your cleanup progresses. We look forward to working with you.

For more information about the VCP and the cleanup process, please visit our web site: www.ecy.wa.gov/programs/tcp/vcp/vcpmain.htm. If you have any questions about this opinion, please contact me by phone at (360) 407-6528 or e-mail at adam.harris@ecy.wa.gov.

Sincerely,

Adam Harris, LHG
SWRO Toxics Cleanup Program

By Certified Mail: [91 7199 9991 7037 0278 3768]

AH: kb

Enclosures (1): A – Description and Diagrams of the Site

cc: Scott Drury, Hart & Hickman
Nicholas Acklam, Ecology
Matthew Alexander, Ecology

Enclosure A

Description and Diagrams of the Site

The site lies within the Columbia River Basin and is underlain by alluvial river deposits and river dredge spoils. The facility was a chemical processing plant that produced sodium hydrosulfite and zinc oxide. Prior to 1969, the site was filled with approximately 20 feet of dredge spoils. The property was first developed with the present facility in 1969 by Virginia Chemicals. From approximately 1969-1973, zinc hydrosulfite (ZnS_2O_4) was manufactured. From 1974 until 2016 when the plant closed, sodium hydrosulfite was manufactured, although the process changed over the years. Under the most recent manufacturing process, zinc oxide was generated as a byproduct. From approximately 1974 until the late 1970s or early 1980s, the process generated zinc carbonate sludge as a byproduct. The sludge was discharged to settling basin #2 (SB#2) until 1984 and accumulated there until the process changed. SB#3 and SB#4 were never used. SB#1 received some spillage of zinc carbonate sludge from a conveyance trough. The settling basins were filled in 1989 by removing the zinc carbonate sludge, and pushing in the sides of the basins.

Prior to January 2004, cadmium sulfate was used as a catalyst, especially when lead impurities were present in the zinc. The use of this chemical was reduced over the years until its eventual elimination from the process.

Clariant Corporation (Clariant) operated the facility until December 30, 2002, when it was sold to Chemtrade Performance Chemicals (Chemtrade). As part of the sales agreement, Clariant agreed to clean up the site. Clariant entered the Voluntary Cleanup Program (VCP) on May 14, 2003.

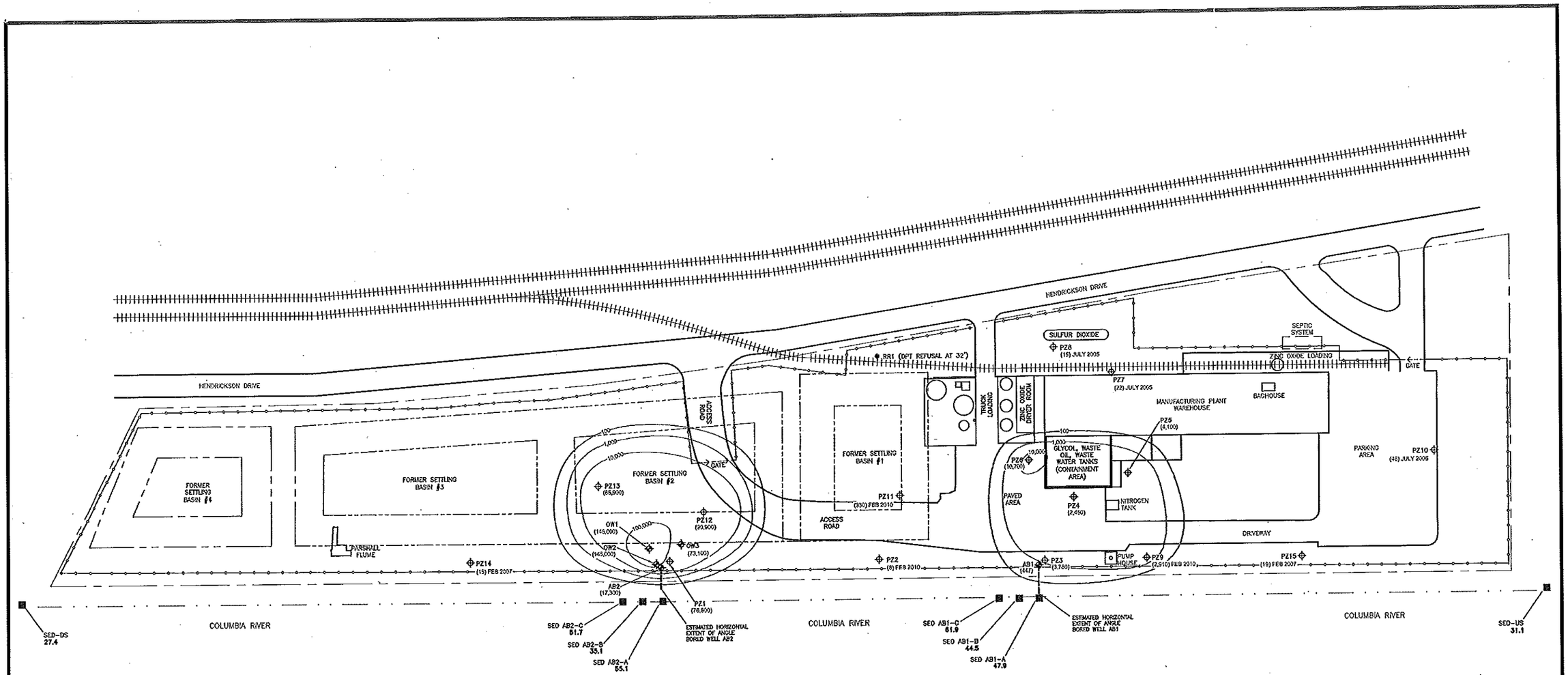
The following is an update to the Site description provided in Ecology's November 10, 2008 opinion letter:

- A 2010 Remedial Action Work Plan is provided in the Site record. As an alternative to the limestone cap identified as part of the selected remedial alternative from the 2008 feasibility study, the work plan proposed soil excavation and injection of calcium polysulfide into the subsurface of the Site. The objectives of the 2010 Remedial Action Work Plan were to remediate soil and groundwater and meet cleanup standards.
- A January 2011 Remedial Action Report states that 11,500 tons of additional excavated materials were removed and disposed of offsite as part of the 2010 remedial work plan implementation.
- An October 2012 Additional Remedial Action and Performance Monitoring Report for the Site states that in September 2010, September 2011, and December 2011 injections of calcium polysulfide were conducted at the Site.

- Performance groundwater monitoring detailed in a March 2013 Geochemical Evaluation Summary and 2013 Remedial Action Work Plan led to the statement that *"application of CaSx to the subsurface has generally not produced the anticipated reduction of dissolved Zn concentrations in site ground water as a result of the oxidation of sulfide and metal sulfides, primarily because of the inability to maintain reducing conditions as a result of aquifer fluctuations and interactions with the Columbia River."*[23]
- In 2013, a pilot scale injection program of ferrous sulfate and magnesium hydroxide was conducted at the Site. Results detailed in a May 2014 Report[24] detail that "*it appears that increasing aquifer pH is the approach best suited for reduction of dissolved zinc concentrations in the site's aquifer*", but that *"due to the interactions of the Columbia River and the site aquifer, the long-term effectiveness of aquifer pH is unknown."*
- A 2015 sediment and porewater study is also included in the Site record.[25] Sediment and Porewater contamination was studied along the banks of the Columbia River.

[23] Geochemical Evaluation Summary and 2013 Remedial Action Work Plan, Former Clariant Corporation, March 25, 2013. Hart Hickman. Page 19.
[24] Pilot-Scale Injection Report, Former Clariant Corporation Facility, May 22, 2014, Hart Hickman. .
[25] Sediment and Sediment Pore Water Sampling Report, Former Clariant Corporation Facility, Hart Hickman, September 30, 2015.

Diagrams



LEGEND:

- PROPERTY LINE
- FENCE LINE
- RAILROAD TRACK
- APPROXIMATE EAST EDGE OF COLUMBIA RIVER
- EXTENT OF FORMER SETTLING BASIN
- MONITORING/OBSERVATION WELL
- PIEZOMETER
- (447) ZINC CONCENTRATION (µg/L)
- 1,000 ZINC ISOCONCENTRATION CONTOUR IN µg/L
- SEDIMENT SAMPLE LOCATION
- 27.4 SEDIMENT SAMPLE ZINC CONCENTRATION (mg/kg)

NOTES
1. HISTORICAL GROUND WATER SAMPLE DATA USED TO AID IN CONTOURING.
2. GROUND WATER ZINC DATA FROM JANUARY 2015 UNLESS OTHERWISE INDICATED (BY DATE).
3. SEDIMENT SAMPLES COLLECTED JULY 2015.

APPROXIMATE
0 100 200
SCALE IN FEET

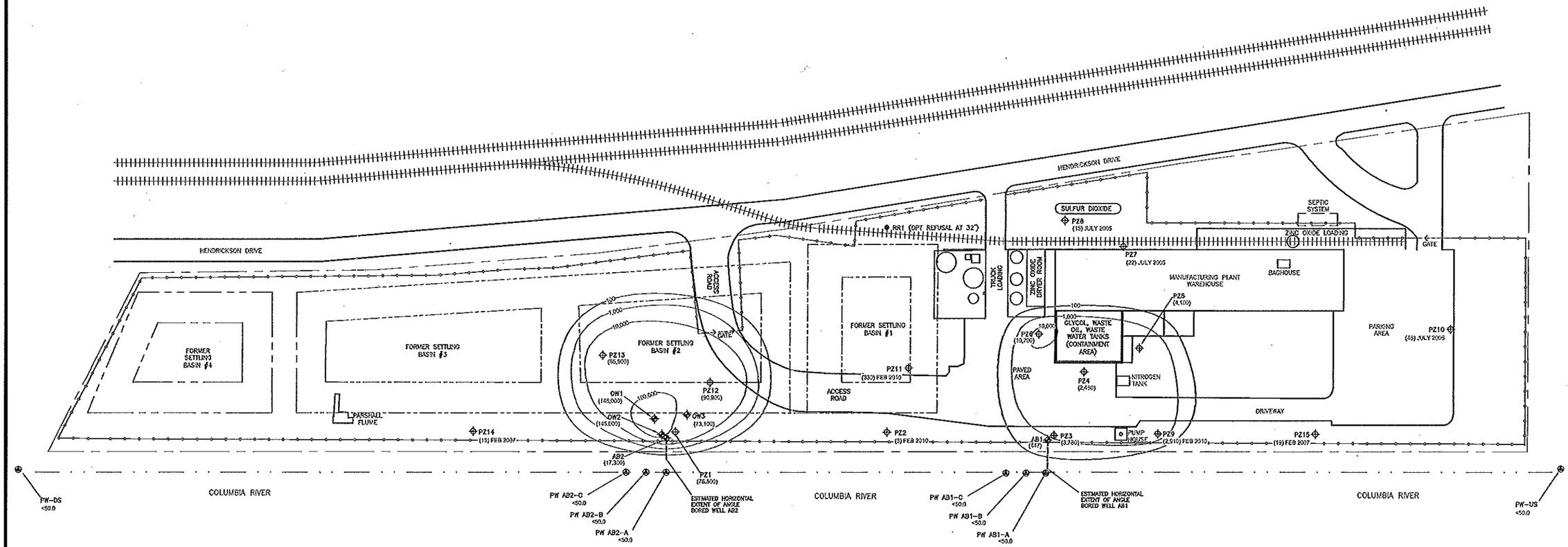
TITLE
SEDIMENT SAMPLE ZINC CONCENTRATION AND GROUND WATER ZINC ISOCONCENTRATION OVERLAY MAP

PROJECT
CLARIANT - KALAMA SITE
404 HENDRICKSON DRIVE
KALAMA, WASHINGTON

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS
2923 South Tryon Street-Suite 100
Charlotte, North Carolina 28203
704-586-0007(p) 704-586-0373(f)
License # C-1269 / #C-245 Geology

DATE: 08/29/15	REVISION NO. 0
JOB NO. CLR-045	FIGURE NO. 2

S:\AAA-Master Projects\Clariant - CLR\CLR-045 Kalama, WA RA\POC Relocation Effort\Figures\dwg, FIG2 SED, 8/31/2015 4:43:53 PM



LEGEND:

- PROPERTY LINE
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- (447) JANUARY 2015 ZINC CONCENTRATION (µg/L)
- 1,000 ZINC ISOCONCENTRATION CONTOUR IN µg/L
- SEDIMENT PORE WATER SAMPLE LOCATION
- <50.0 JULY 2015 SEDIMENT PORE WATER SAMPLE ZINC CONCENTRATION (µg/L)

NOTES
1. HISTORICAL GROUND WATER SAMPLE DATA USED TO AID IN CONTOURING.
2. GROUND WATER ZINC DATA FROM JANUARY 2015 UNLESS OTHERWISE INDICATED (BY DATE).
3. SEDIMENT PORE WATER SAMPLES COLLECTED JULY 2015.

APPROXIMATE
0 100 200
SCALE IN FEET

TITLE
SEDIMENT PORE WATER ZINC CONCENTRATION AND GROUND WATER ZINC ISOCONCENTRATION OVERLAY MAP

PROJECT
CLARIANT - KALAMA SITE
404 HENDRICKSON DRIVE
KALAMA, WASHINGTON

hart hickman
SMARTER ENVIRONMENTAL SOLUTIONS
2923 South Tryon Street-Suite 100
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704-586-0007(p) 704-586-0373(f)
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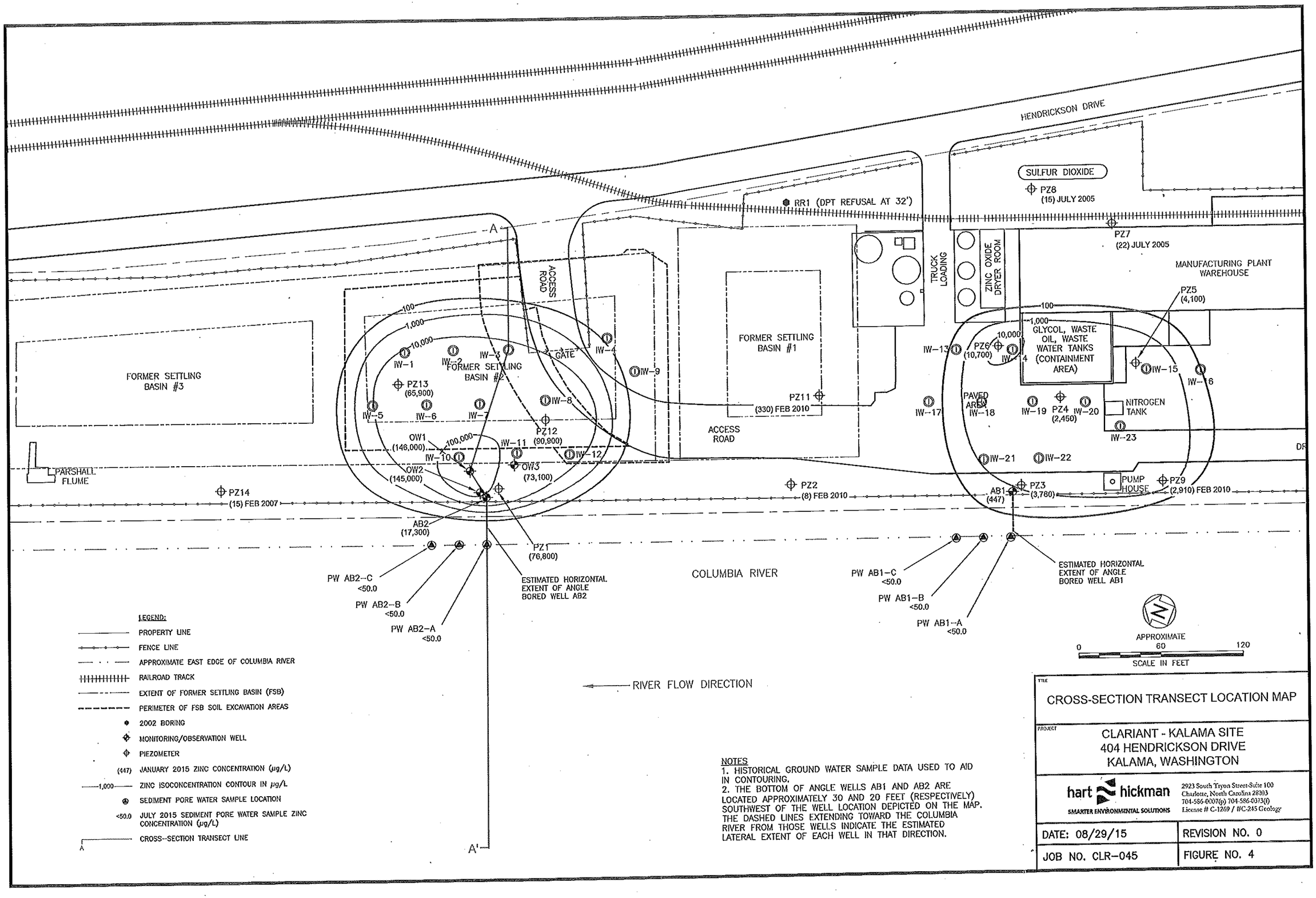
DATE: 08/29/15	REVISION NO. 0
JOB NO. CLR-045	FIGURE NO. 3

S:\AAA-Master Projects\Clariant - CLR\CLR-045 Kalama, WA RAI\POC Relocation Effort\Figures\dwg_FIG3 PW, 8/31/2015 8:04:23 PM



NOTES
1. HISTORICAL GROUND WATER SAMPLE DATA USED TO AID IN CONTOURING.
2. THE BOTTOM OF ANGLE WELLS AB1 AND AB2 ARE LOCATED APPROXIMATELY 30 AND 20 FEET (RESPECTIVELY) SOUTHWEST OF THE WELL LOCATION DEPICTED ON THE MAP. THE DASHED LINES EXTENDING TOWARD THE COLUMBIA RIVER FROM THOSE WELLS INDICATE THE ESTIMATED LATERAL EXTENT OF EACH WELL IN THAT DIRECTION.

TITLE
CROSS-SECTION TRANSECT LOCATION MAP

PROJECT
CLARIANT - KALAMA SITE
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DATE: 08/29/15	REVISION NO. 0
JOB NO. CLR-045	FIGURE NO. 4

S:\AAA-Master Projects\Clariant - CLR\CLR-045 Kalama, WA RAP\OC Relocation Effort\Figures.dwg, FIG4 TRANS, 8/31/2015 4:44:50 PM