



STATE OF WASHINGTON  
DEPARTMENT OF ECOLOGY

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November 22, 2017

Ms. Dana Cannon  
West of 4<sup>th</sup> Project Coordinator  
Aspect Consulting  
401 2nd Ave S, Suite 201  
Seattle, WA 98104

Re: **West of 4<sup>th</sup> Site - Agreed Order #DE 10402**  
**Site Unit 1, CVOC Pilot Study Work Plan**

Dear Ms. Cannon:

On March 31, 2017, the Washington State Department of Ecology (Ecology) received an Emailed copy of the draft *Site Unit 1, CVOC Pilot Study Work Plan* from the West of 4<sup>th</sup> PLPs. Following consideration of Ecology comments Emailed to the PLPs in early May, a revised draft of the Work Plan was prepared and submitted on June 22. These draft versions of the Work Plan were submitted in accordance with the PLPs' December 16, 2016, proposed "path forward" letter and schedule.<sup>1</sup>

On November 21, 2017, the West of 4<sup>th</sup> Agreed Order was amended to include requirements and deliverable due dates for the Site Unit 1 CVOC Pilot Study. In accordance with that amendment the PLPs should revise the revised-draft Work Plan submitted last June to satisfactorily address Ecology's enclosed comments. At that time the document's schedule should also be updated. These revisions of the document are due to Ecology within thirty (30) days of receipt of today's letter.

If you have any questions, or would like to schedule a meeting or conference call to discuss Ecology's comments, please contact me at (425) 649-4449 or [ejon461@ecy.wa.gov](mailto:ejon461@ecy.wa.gov).

Sincerely,

Ed Jones  
Environmental Engineer  
Hazardous Waste and Toxics Reduction Program

Enclosure  
By certified mail: 9171 9690 0935 0169 7331 29

<sup>1</sup> On December 19, 2016, Ecology approved the PLPs' proposed due dates for the: (1) draft Site Unit 1 CVOC pilot-study work plan; and, (2) draft Site Unit 1 "metals" pilot-study work plan.



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cc: William Joyce, SJZ  
William Carroll, PCE  
Janet Knox, PGG  
Jeff Kaspar/Peter Jewett, Farallon  
Ronald Taylor, CI  
Donald Verfurth, G&R  
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ecc: Tong Li, GWS  
Peter Hapke, ALG  
Nels Johnson, AAG  
Patty Foley/Sherell Ehlers, GTCC

## ENCLOSURE

### Site Unit 1, CVOC Pilot Study Work Plan COMMENTS

#### Specific Comments

*NOTE: Page numbers and Sections referred to in the comments below correspond to the revised draft Work Plan, dated June 14, 2017.*

1. Pages 3 and 4, Section 2.3. Point of clarification: the Work Plan notes that remediation levels (RELs) “may be applied if it is not practicable to achieve cleanup levels” within a reasonable timeframe at the point of compliance. Ecology agrees that RELs can certainly be “applied” in this situation. However, in general a groundwater remedial action that does not attain cleanup standards cannot be considered a MTCA-compliant cleanup action. Instead, it would typically be considered an interim action.

Table 2 provides RELs from the SU1 FS Report. As we discussed on June 22, 2017, the revised Work Plan should briefly explain that the RELs are provided for reference, will not be used during pilot testing, and may later be updated and used in the FS Report Addendum.

2. Page 9, Section 3.3. At the bottom of the page the Work Plan correctly identifies six historic direct push locations (Q32, Q32B, Q32D, GP6, Q32A, and GP7) where elevated levels of trichloroethene (TCE) were detected in the 2002-2005 time period. The Work Plan goes on to state that these detections indicate that the associated area is “the predominant CVOC transport pathway in groundwater to the Waterway.”

Ecology agrees with the statements here as they relate to TCE. However, as discussed on June 22, the revised Work Plan should additionally describe the cis-1,2 DCE and vinyl chloride concentrations detected at the temporary groundwater locations referred to below:

- Q32F: 2002 levels of cis-1,2-dichloroethene (DCE) at 22’ bgs at this location were higher than levels found at any of the other ten Q32 and STG-GP historic locations along Fidalgo St. Levels of vinyl chloride at 18’-22’ were higher than those detected at Q32 and Q32D.
- Q32G: 2002 levels of cis-1,2-DCE at 18’-22’ were higher than levels detected at Q32, Q32A, Q32B, Q32D, and GP7. Vinyl chloride at 18’ was also higher than levels of the compound measured at those five points. While TCE concentrations were lower than at the six locations constituting “the predominant CVOC transport pathway,” at 21’ the compound was detected at a level just below 500 µg/l.
- GP5: 2005 levels of cis-1,2-DCE at 17’ were higher than levels detected at Q32A, Q32B, and GP7. Vinyl chloride at 17’ was higher than concentrations measured at Q32, Q32A, Q32B, Q32D, and GP7.

3. Page 11, Section 3.4. The presence of ethane/ethene at the study site indicates reducing aquifer conditions, and can be an indication of the dechlorination of TCE/DCEs/vinyl chloride. However, a stronger indication of reductive dechlorination, in our opinion, is the presence of ethane at levels higher than concentrations detected at the same depth in monitoring wells close to, but outside, the plume. As discussed on June 22, during the project the PLPs will measure a dissolved-gas suite (which includes ethane and ethane) at well PSC-142-40, which is outside the CVOC plume.
4. Page 11, Section 3.5. The last sentence of the second bullet states that the planned pilot-study location is far enough upgradient of the Waterway to avoid significant tidal influences. The revised Work Plan should better clarify how hydraulic tidal influence will be accounted for during the pilot study. As discussed on June 22, it should also note that hydraulic tidal effects will be monitored using pressure transducers during pilot testing, and later applied to the hydraulic interpretation of pilot test results. Please see Comment #13 below.
5. Pages 12 and 14, Sections 4.1.1 and 4.1.3. On page 12 the Work Plan proposes to locate the pilot study “in the vicinity of...locations PSC-Q32 and PSC-Q32-D in the Shallow Interval.” Ecology agrees that the study should target the Shallow zone. It may also be the case that highly elevated levels of TCE continue to be present at the Q32 and Q32D locations, intercepting contamination migrating downgradient from the area of well clusters 21 and 26. However, in 2016 TCE ranged from 16 to 21 µg/l at MW 24-30. MW 24-30 appears to be no more than 40’ away from Q32 and Q32D. It may be, then, that TCE daughter products are currently more likely to be elevated in the study area than the parent compound. For example, in 2016 vinyl chloride:
  - ranged from 24-42 µg/l at well 24-30. Cis-1,2-DCE levels were ≈ 120 µg/l;
  - varied from 20 to 27 µg/l at 151-25, while TCE was ~non-detect;
  - was about 60 µg/l at 22-30, with cis-1,2-DCE ≈ 580 µg/l. TCE was ≈ 12 µg/l; and,
  - was about 6 µg/l at well 23-30, while TCE and cis-1,2-DCE were ~non-detect.

The future choice of the primary technology implemented during the study should therefore be guided not only by its likely effectiveness in reducing TCE, but by an expectation that:

- a) its de-chlorination of TCE will not lead to elevated cis-1,2-DCE and/or vinyl chloride concentrations capable of being discharged to the Waterway, and
- b) it should reduce vinyl chloride levels in (and migrating to) the area to either surface water cleanup levels or protective RELs.

As discussed in the Work Plan, the understanding of CVOC distribution in this area is limited by the collection date of the temporary groundwater samples. This is a basis for installation of the new monitoring wells and baseline sampling before final pilot test design.

The revised Work Plan should acknowledge that the use of ISCR + EAnB is the most likely approach based on existing data. But depending on baseline sampling results, EAnB could possibly be a preferable option. To better determine EAnB’s effectiveness,

baseline sampling will additionally include microbiological analysis at select monitoring wells. The results of these analyses will be used for reagent selection and final field pilot test design in the FIWP.

6. Page 13, Section 4.1.1. Ecology agrees that increases in groundwater metals concentrations may be temporary, but the extent of temporary metals mobilization associated with reductive dissolution of aquifer minerals is site-specific and difficult to predict. As the Work Plan states, estimating the degree and longevity of metals mobilization is a pilot test objective. The revised document should also note that: a) the project's monitoring well network has been designed such that the most downgradient locations are expected to show redox recovery, and b) the distance between the injection locations and the Waterway is more than adequate (based on the Design team's experience at other sites) to prevent any discharge of groundwater with elevated dissolved metal concentrations.
7. Page 16, Section 4.3. In general, Ecology agrees with the objective stated in "(2)." We think that the ISCR, or EAnB treatment tested during the pilot study will reduce CVOC concentrations faster than MNA processes alone. However, the Work Plan states that study area CVOC reduction rates (in the shallow zone) will be compared to "site-specific MNA degradation rates." As discussed on June 22, the Work Plan's statement regarding a "comparison to site-specific MNA degradation rates" should be removed from the text. Instead, the revised document should state that post-injection CVOC trends at wells influenced by injections will be compared to trends not influenced by injections to evaluate effectiveness.
8. Page 18, Section 5.2. The Work Plans propose two DR monitoring wells in the first bullet, located approximately 5-8 feet downgradient along the injection transect line. We agree, but as we discussed on June 22, an additional monitoring well should be installed 15-20 feet upgradient of the injection transect to evaluate CVOC concentrations and the geochemistry of groundwater entering the pilot test area. Another additional monitoring well should be installed approximately 15-20 feet downgradient of the injection transect and south of PSW-2.
9. Pages 18 and 19, Section 5.2. The Work Plan propose three performance monitoring wells in the second bullet. Ecology agrees with the proposed new well locations and also the rationale for using MW-24-30 and MW-24-50 as PSW wells. However, as we discussed on June 22, PSW-3 should be re-located installed south of MW-24-30, and MW-24, the existing WT zone monitoring well, should be added to the monitoring program in the revised Work Plan.
10. Page 19, Section 5.3. The Work Plan states that PSC-140-40 will be sampled during the baseline event to represent biogeochemical conditions outside of the CVOC plume. As discussed on June 22, PSC-142-40 is outside the CVOC plume and should be proposed for baseline sampling.

In addition, the text here refers to "seven" new monitoring wells. Elsewhere only five are proposed. The inconsistency should be corrected in the revised Work Plan.

11. Pages 21 through 26, Section 6. Proposals included in this section, unless otherwise the subject of an Ecology comment, seem reasonable for this stage of the study's design. As the PLPs state, the future FIWP will provide more detailed proposals once baseline sampling results have been analyzed and a remedial technology and specific tracer selected. Because of the noted unknowns that limit the Work Plan's ability to include proposals with a high degree of specificity, though, Ecology expects the follow-up FIWP for the study to be a comprehensive Sampling and Analysis Plan (SAP). It should also revisit Section 6's Study Design, proposing those changes – if any – needed to meet study objectives for the actual (and specific) remedial technology the PLPs' propose.

Please also see Comment #16 below.

12. Pages 21 and 22, Section 6.1.1. Based on our experiences with ISCO injections at the Stericycle (east of 4<sup>th</sup>) and GE sites, Ecology believes that the key for successful delivery of reagent solution in the site area is transmissive injection well/DP screens. During preparation of the draft FIWP the PLPs should consider whether any additional pressure need be applied to the injection well head if the mixing tank on the truck is elevated. The tank elevation may provide more than enough hydraulic head to gravitationally feed the injected solution to the shallow interval. If the measured flow rate is found to be too low under gravitational-only injection (i.e., without any additional applied pressure), the PLPs may then consider different DP screens or opt for standard 2-inch injection wells.
13. Page 24, Section 6.2.1. The third bullet in this section of the Work Plan proposes water level monitoring. Ecology agrees, but as we discussed on June 22, water level measurements should be conducted at all PSW wells, MW-24-30, and 24-50 at a frequency of twice a day (in addition to the injection points and DR wells). Pressure transducers should also be installed in DR wells located close to the injection line to record more frequent water levels (P and T° every 5-10 minutes). The pressure transducer data may be additionally used to evaluate tidal influence at the DR monitoring well locations.
14. Page 24, Section 6.2.1. The fourth bullet of the section discusses breakthrough monitoring. Ecology assumes that the chosen tracer will travel at approximately the same rate as the groundwater seepage velocity. Reagent breakthrough will then be slower than tracer breakthrough, depending on the site/reagent-specific retardation factor. We also assume that the reagent lab samples (or other chemical analyses for reagent parameters) will be collected during the same time intervals the tracer samples are measured. The draft FIWP should better clarify how the PLPs will determine when to collect samples, and which samples to collect, for laboratory analyses, based on visual field screening.
15. Pages 24 and 25, Section 6.2.2. Ecology generally agrees with the proposed performance monitoring frequencies and analytes. For short-term monitoring, however, we believe that one round of sampling should be added for a *week one* sampling event (i.e., between the 0 days and week 2 sampling). In addition, flexibility should be built-in to the schedule for the later short-term and longer-term monitoring events. Observations may deviate from the expected and we want to ensure that all important geochemical and CVOC concentration changes are captured. The scheduled events and locations for early

short-term monitoring should also be flexible enough to respond to unanticipated operational-monitoring observations (e.g., breakthrough observations).

As discussed on June 22, the revised Work Plan should include an additional “one-week” monitoring event at the dose-response monitoring wells, and include language to allow flexibility in the timing of performance monitoring events.

16. Page 27, Section 7.2. Ecology agrees that the QAPP prepared for the Art Brass RI has applicability to a number of data-gathering activities proposed for the pilot study. However, in addition to the QA/QC needs associated with tracer testing, there are needs related to the type of remediation agent to be injected and its monitoring that are not anticipated by the RI QAPP. The FIWP should therefore be supplemented with a study-specific QAPP. This document can refer to portions of the RI QAPP and/or West of 4<sup>th</sup> SOPs that Ecology has previously approved, but should be focused on the data quality needs/objectives and QA/QC pertaining specifically to the pilot study project.
17. Page 28, Section 8. The Work Plan’s proposed content for the FIWP is reasonable, but the PLPs should additionally include injection operation procedures, injection sequences, and alternative injection patterns along the transect line.

The PLPs plan to submit the Completion Report 45 days after “receiving all analytical data.” Ecology would prefer that the Report be submitted 45 days after receiving all analytical data *critical to meeting study objectives*. This provides some flexibility for scenarios such as the following:

- (1) the study – and technology – is successful, but we collect enough data to meet our needs in less than a year; or, conversely,
- (2) there are study problems, or poor technology performance, and this is apparent soon after the injections. There may therefore need to be re-thinking of the study and implementation of a “Plan B.”

18. Table 4. Well 142-40 is correctly listed in the first column, but well 140-40 was referred to in the text (see Comment #10 above).

In addition, as we discussed on June 22<sup>nd</sup> the revised Work Plan should:

- re-name the Table. Although it is titled “Performance Monitoring Program” it includes groundwater sampling activities conducted prior to injections, as well as during “operational” monitoring;
- clarify that the second baseline sampling event will be performed immediately before injections because: a) this will provide more than one data point for evaluating performance, and b) there may be several months between the first event and the start of the field test; and,
- modify the text regarding PSW-4 to be consistent with Table 4.