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September 5, 2019

Katie Moxley
Manager, Environmental Remediation
The Boeing Company
P.O. Box 3707
MC 9U4-26
Seattle, WA 98124-2207

Re: Washington State Department of Ecology Response to the Supplemental Feasibility Study, dated November 29, 2018

Dear Katie:

Thank you for submitting the Supplemental Feasibility Study report (SFS report dated November 29, 2018) to the Washington State Department of Ecology (Ecology) Northwest Regional Office (NWRO). The Boeing Company (Boeing) submitted this report to Ecology per the requirements of the RCRA Corrective Action Agreed Order (AO), No. DE 96HS-N274, Section VII.6 and Ecology's letter dated August 6, 2018.

Ecology shares Boeing's goal of finalizing the remedy selection for the Uplands and Powder Mill Gulch (PMG) area and moving to implementation as soon as possible. We have worked with Boeing under informal and formal dispute resolution over the last 35 months[1] in an attempt to reach agreement on a MTCA-compliant PMG trichloroethylene (TCE) groundwater cleanup action, and have conceptually agreed that the preferred remedy should include:

- Enhanced in-situ bioremediation (EISB) of the TCE groundwater source area; and
- Conversion of the existing interim groundwater pump and treat system to a dynamic groundwater recirculation (DGR) system[2] to treat all downgradient TCE groundwater.

[1] Ecology letters dated August 6, 2019, July 20, 2017 and August 18, 2016.

[2] This requires the addition of several groundwater injection wells and new groundwater extraction wells.

If this remedy is selected, the final DGR design will be based on the original concept proposed by Boeing. However, Ecology requests that the design optimize the DGR[3] system by adding groundwater extraction and injection wells within the downgradient groundwater plume on Boeing Everett and other downgradient properties. Optimizing the DGR system will further reduce the amount of TCE-contaminated groundwater discharging to the creek[4], and reduce the groundwater and surface water restoration timeframes as much as possible. This will maximize the overall effectiveness of the implemented system.

The purpose of the SFS report was to evaluate restoration timeframe, performance criteria, and cost estimate information for a particular remedy implemented to achieve cleanup level compliance at different groundwater point of compliance (POC) locations.[5] For each POC-location scenario, remedial alternative 5 (source area EISB groundwater treatment and the Ecology-modified DGR downgradient groundwater treatment system) and TCE groundwater preliminary cleanup level (0.3 µg/L),[6] were to be the same. It was anticipated that restoration timeframes and/or costs would be affected by POC location, and, as a consequence, the evaluation would conclude with the identification of POC-location scenario more *practicable* than others.

Ecology carefully reviewed and considered the analyses provided in the SFS report. Based on our review of the SFS Report, and consistent with the MTCA regulations, we have determined that remedial alternative 5 should be implemented to attain the groundwater cleanup level at **POC Option #3 – the Boeing Everett property line (Seaway Blvd) and in groundwater prior to discharge to the creek on Boeing property**. Option #3's POC is a *conditional* groundwater POC which will provide surface water protection, with a preliminary groundwater cleanup level of 0.3 µg/L TCE. A second groundwater POC will be applied to the entire groundwater plume (a *standard* POC). Ecology has determined a Method B preliminary cleanup levels to be attained at this second POC at 4.0 µg/L TCE. At these locations the cleanup action must, within a

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[3] The benefits of DGR systems are that there is constant optimization of the groundwater injection and extraction flow rates and locations to create optimal groundwater flow patterns for eliminating stagnant groundwater flow zones and flushing TCE groundwater to extraction wells.

[4] It is important to further minimize the discharge of TCE groundwater to the creek because currently surface water samples from Powder Mill Creek exceed preliminary cleanup levels for surface water and the recent groundwater and surface water data indicate mostly stabilized (some increasing) TCE concentrations in the groundwater and creek.

[5] Refer to the Ecology letter dated August 6, 2018. In this letter, Ecology required the analysis of four different groundwater points of compliance (throughout the plume; downgradient edge of the TCE source area; Boeing Everett property line and in groundwater – upgradient of the transition zone - prior to discharge to the creek on Boeing property; and in groundwater – upgradient of the transition zone - prior to discharge to the creek on Boeing and off properties). Boeing added two less protective additional groundwater conditional points of compliance (CPOCs) that Ecology did not require.

[6] Per WAC 173-340-720(4)(b)(ii), ***Standard Method B potable groundwater cleanup levels.*** *Where the ground water cleanup level is based on a drinking water beneficial use, standard Method B cleanup levels shall be at least as stringent as all of the following:* ***(i) Applicable state and federal laws.*** *Concentrations established under applicable state and federal laws, including the requirements in subsection (3)(b)(ii) of this section;* ***(ii) Protection of surface water beneficial uses.*** *Concentrations established in accordance with the methods specified in WAC 173-340-730 for protecting surface water beneficial uses, unless it can be demonstrated that the hazardous sub-stances are not likely to reach surface water. This demonstration must be based on factors other than implementation of a cleanup action at the site.* ***(iii) Human health protection.*** *For hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, those concentrations which protect human health as determined by the following methods:*

reasonable timeframe, attain groundwater cleanup levels. The technical and regulatory justifications for our determination are provided in Attachments A-D.

The SFS Report contains sufficient information for Ecology to select a preferred PMG TCE groundwater remedial alternative (which, as noted above, is source area EISB and downgradient DGR), groundwater cleanup levels, and groundwater POCs).[7] Further revisions are not necessary to support our decision. However, in Attachments A through D we identify statements in Boeing's SFS Report with which we disagree and where the disagreement was most consequential in terms of Ecology's selection of the PMG TCE groundwater remedy, its POC and cleanup levels.[8]

To reiterate, Boeing should not submit a revised version of the November 2018 SFS Report. The approved Public Review uplands FS Report shall consist of the November 13, 2015 FS Report, Ecology's letters dated August 6, 2016 and July 20, 2017, as modified by this letter and Ecology's letter dated May 2, 2019.[9]

Within ten calendar days of receipt of this letter please notify Ecology, in writing, whether Boeing has any substantive disagreements with, or significant objections to, the contents of this letter.[10] At this time please also notify us if the company requests a meeting with Ecology's Project Coordinator (pursuant to Section VII.4 of the AO). Any meeting request should include clear and brief descriptions of all points of disagreement or questions. If Boeing does not request a meeting, agrees to accept the decisions in Ecology's letter, or does not respond in writing within ten calendar days, the dispute resolution process under the AO will be unnecessary (and not invoked). In this event, Boeing should proceed to prepare the uplands draft cleanup action plan (dCAP).

If you have any questions or require clarifications regarding my decision, you may contact me at (425) 649-7053 or Dean Yasuda at (425) 649-7264 or dyas461@ecy.wa.gov.

Sincerely,

Raman Iyer
Section Manager
Hazardous Waste and Toxics Reduction Program

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[7] Ecology's letter dated May 2, 2019 resolves all points of disagreement that Boeing raised on the other non-PMG TCE groundwater remedy issues.

[8] The attachments only identify those statements in the Report that: (1) Ecology disagrees with, and (2) we must refer to in order to explain the basis for our FS-related conclusions and decisions.

[9] This Ecology letter ended dispute resolution on several points of disagreement within the uplands FS report. The dispute resolution process on these matters is closed and Ecology expects Boeing to follow the instructions we provided in our May 2nd letter.

[10] But not the Ecology final decision letter dated May 2, 2019.

Enclosures: Attachments A through D

Sent by Certified Mail: 9171 9690 0935 0214 2536 02

cc: Ivy Anderson, Assistant Attorney General, Attorney for Department of Ecology
Christa Colouzis, Ecology
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Krissy Bierlein, JSH Properties
Chuck Wiegman, JSH Properties
Wendy McClure, City of Everett
Mike Palacios, City of Everett
Mark Sadler, City of Everett
Dr. Tong Li, Ground Water Solutions
Bill Beckley, Ridolfi

Attachment A

Groundwater Point of Compliance Where Cleanup Levels Must Be Met

Ecology selected the groundwater point of compliance (POC) based on the information provided in the SFS report and the requirements in the Model Toxics Control Act (Chapter 173-340 WAC).

Ecology's decision is based on the following regulations and their requirements:

1. WAC 173-340-720(8)(c)
2. WAC 173-340-720(8)(d)(i) and (ii); and
3. Appropriate evaluation under WAC 173-340-360(2)(a) and (b)[11]

Groundwater Point of Compliance Option 3 – Ecology's preferred groundwater POC is located at the Boeing Everett property line (Seaway Blvd) and in groundwater prior to discharge to the creek on Boeing property.[12] Remedial alternative 5 (source area EISB and downgradient DGR) will be implemented to attain groundwater cleanup levels at POC Option 3. Our regulatory and technical justification follows:

Groundwater Cleanup Levels

The process to determine MTCA Method B groundwater cleanup levels is set out in WAC 173-340-720(4). Where, as is the case at this site, groundwater cleanup levels are based on drinking water beneficial use, the level must be at least as stringent as: concentrations established under state and federal laws; concentrations established in accordance with WAC 173-340-730; and for hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, concentrations which protect human health as determined by certain listed methods. The most stringent concentration for TCE will be the concentration established in accordance with WAC 173-340-730 for protecting beneficial uses. The exception for using this concentration would be if it can be demonstrated that the hazardous substances are not likely to reach surface water. Such a demonstration cannot be made at the Boeing Everett Site.

In determining the concentration for TCE established in accordance with WAC 173-340-730, Ecology uses the process set out for Method B surface water cleanup levels, which requires a concentration at least as stringent as applicable state and federal laws[13] (at a minimum the

[11]Ecology agrees that the use of the DCA criteria to evaluate possible groundwater points of compliance is an unconventional application of the MTCA DCA process for evaluating POCs because it is intended to be used to evaluate the application of different remedial technologies rather than POC options. However, Ecology's intent was to use the DCA evaluative criteria to provide additional meaningful information for comparisons between the POC options.

[12]This is defined by Ecology as a "buffer zone" in the groundwater adjacent to the creek. This is not same as the "transition zone" where groundwater mixes with surface water, or where groundwater enters the creek.

[13] In this process, Ecology would also review concentrations established under WAC 173-340-720(4)(b)(ii) and (iii). In this case, those concentrations are either less stringent or not applicable.

following): all water quality criteria published in the water quality standards for surface waters of the state of Washington; water quality criteria based on the protection of aquatic organisms (acute and chronic criteria) and human health published under section 304 of the Clean Water Act; or National toxics rule. WAC 173-340-730(2)(b)(i). For trichloroethylene the National toxics rule has promulgated a concentration of 0.3 µg/L. 40 CFR Part 131.45(b). This is an Environmental Protection Agency federally promulgated criteria considered part of the water quality standards for surface waters of the state of Washington.

Ecology has determined that the preliminary groundwater cleanup level for TCE is 0.3 µg/L to be met at the POC described in these Attachments[14]. The preliminary surface water cleanup level for TCE for the site is 0.3 µg/L.

In future site documents the *groundwater* cleanup levels, established consistent with MTCA requirements, should consistently be distinguished from "surface water cleanup levels," even when the concentrations associated with the two media's cleanup levels are the same. The groundwater cleanup levels must be met at the selected *groundwater* point of compliance.

Points of Compliance[15]

Remedial alternative 5 (source area EISB and downgradient DGR) is the remedial technology that will be used to attain the site's groundwater cleanup standards. The MTCA regulations and Ecology implementation guidance discuss the requirements for developing conditional points of compliance at sites where contaminated groundwater discharges to surface water.[16]

Pursuant to requirements in WAC 173-340-720, if Ecology decides to approve a conditional groundwater POC (CPOC), that CPOC must not exceed the property boundary, except under the following three off-property situations:

- The source property is abutting surface water;
- The source property is near, but not abutting, surface water; or
- The source property is located in an area with "area-wide" contamination.

With respect to the TCE contaminant plume extending north of the Boeing Everett property, the source property is considered to be near, but not abutting, surface water (Powder Mill Creek). According to Ecology implementation guidance,[17] in these situations the CPOC: 1) must be set as close as practicable to the source, and 2) cannot exceed the point or points where the

[14] For the groundwater plume throughout the site (the standard POC) Ecology expects the groundwater to meet preliminary cleanup levels protective of drinking water beneficial use (TCE = 4 µg/L).

[15] Concentrations as numerically stringent as ARAR values, such as the WQCs are attained at this POC. A second groundwater POC will be applied to the entire groundwater plume (a *standard* POC). The Method B cleanup levels are attained at this second POC (4.0 µg/L TCE). This second POC is not under dispute by Boeing.

[16] Washington Department of Ecology. 2017. *Developing Conditional Points of Compliance at MTCA Sites Where Groundwater Discharges to Surface Water*. Implementation Memorandum No. 16. Revised December 29, 2017.

[17] Washington Department of Ecology. 2017. *Developing Conditional Points of Compliance at MTCA Sites Where Groundwater Discharges to Surface Water*. Implementation Memorandum No. 16. Revised December 29, 2017.

groundwater flows into the surface water [see WAC 173-340-720(8)(d)(ii)]. In addition, the CPOC location must meet all the requirements under WAC 173-340-720(8)(c) and (d)(i). This means that the CPOC may not be set within the surface water body. **Based on these requirements, Boeing's remedial alternative #5 using the groundwater POC Option 1 is not consistent with MTCA policy and regulations, not a possible groundwater POC, and Ecology eliminates this option from further consideration.**

Utilizing remedial alternative 5, the farthest downgradient that the groundwater CPOC may potentially be set is within the sediment porewater/groundwater transitional zone, **POC Option 2a**[18].

There are significant challenges to identifying the correct locations to establish a groundwater CPOC for POC Option 2a. First, the 3000 foot length of Powder Mill Creek is affected by discharges of contaminated groundwater from the Site. Second, there is seasonal uncertainty of groundwater/surface water interactions (gaining/losing) in the transitional zone. Third, the depth of the transition zone varies along the length of the creek affecting where monitoring wells should be located and screened. In addition, many groundwater seeps occur along the impacted 3000-foot length of Powder Mill Creek. Some of the seeps are located in wetland areas or old creek channels at variable distances from the creek. Ecology noticed groundwater seeps near and distant from the creek bed. Under POC Option 2a, besides the challenge of selecting POC monitoring points whose samples will be more representative of discharging groundwater quality than surface water quality, there is the difficulty of locating monitoring points whose samples would ensure that all groundwater seeps met groundwater cleanup levels before entering the creek. In addition, due to the seasonal rising and falling of the creek elevation (including post-storm events), the creek can at times become a losing stream, thus allowing cleaner surface water to migrate into the groundwater/surface water transition zone. This can result in the dilution of TCE concentrations in any groundwater samples collected from the transition zone, giving a false indication that groundwater cleanup levels are being met. For these reasons, Ecology believes it is infeasible to design a suitably robust and conservative monitoring program for POC Option #2a. Therefore, Remedial Alternative 5 using groundwater POC **Option 2a** does not meet threshold criteria, WAC 173-340-360(2)(a)(i) through (iv), and cannot be selected as the final groundwater cleanup remedy. In addition, *the CPOC must be set as close as practicable to the source of hazardous substances.* **POC Option 2a** ("Groundwater CPOC in the Transitional Zone at the Creek"), is not located *as close as practicable to the source of hazardous substances* (WAC 173-340-720(8)(c) and (d)), therefore cannot be selected. In fact, POC Option 2a is located as far as possible from the source of hazardous substances. POC Option 2a also does not meet the requirement that *all practicable methods of treatment are to be used in the site cleanup* (WAC 173-340-720(8)(c) and (d)), because the difficulty in accurately monitoring the transition zone (as stated earlier in this paragraph), does not allow adequate and accurate groundwater sampling to verify the groundwater treatment was effective.

[18]Washington Department of Ecology. 2017. *Developing Conditional Points of Compliance at MTCA Sites Where Groundwater Discharges to Surface Water*. Implementation Memorandum No. 16. Revised December 29, 2017.

Remedial alternative 5 using a groundwater POC **Option 2b** proposes a CPOC in the aquifer immediately upgradient of the creek on Boeing property and City of Everett property.[19] It would be easier to install groundwater compliance monitoring wells spatially at the appropriate horizontal locations and vertical intervals under Option 2b than Option 2a. However, selecting a CPOC at these locations requires that they be as close as *practicable* to the source (under WAC 173-340-720(8)(c) and (d)). Such a CPOC could be as close as practicable to Boeing sources if the benefits to its selection (including cost benefits) outweighed the benefits of POCs located more upgradient and closer to the source. Ecology has, therefore, carried POC Option 2b through our groundwater POC analyses below.

Remedial alternative 5 with groundwater POC Options 3[20] and 4[21] are CPOCs on Boeing property and closer to the sources of hazardous substances than POC Option 2b. Remedial alternative 5 using groundwater POC Option 5[22] is the groundwater standard point of compliance. This is considered the default groundwater POC, and is selected at cleanup sites unless it can be demonstrated to Ecology that it is *not practicable to meet the cleanup level throughout the site within a reasonable restoration time frame*.

Disproportionate Cost Analysis

Under this analysis, remedial alternative 5 (source area EISB and downgradient DGR) is used to meet groundwater cleanup levels at various groundwater points of compliance.

Section 4.3.2 of the SFS Report includes a disproportionate cost analysis (DCA) evaluation for remedial alternative 5 using four different POC options identified by Ecology as Options 2b, 3, 4, and 5, as well as two additional POC options not requested and eliminated by Ecology (Options 1 and 2a) as discussed above. The comparison of benefits and costs in a DCA may be quantitative, but Ecology has the discretion to favor or disfavor qualitative benefits in selecting a cleanup action [see WAC 173-340-360(3)(e)(ii)(C)]. In practice, DCAs are often qualitative and require the use of best professional judgment.

Protectiveness

This criterion evaluates alternatives based on overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.

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[19] This COPC would be located in a *buffer zone* within groundwater adjacent to the creek, but not in the transition zone where groundwater mixes with surface water, or where groundwater enters the creek.

[20] Groundwater conditional point of compliance at the Boeing property boundary and within groundwater –upgradient of the transition zone and creek - on Boeing property

[21] Groundwater conditional point of compliance immediately downgradient of the TCE groundwater source area – on Boeing property

[22] Groundwater point of compliance located throughout the source area and all downgradient plumes.

The DCA evaluation included in the SFS Report assumes that for most factors considered as part of the protectiveness evaluation for remedial alternative 5 using all POC options are equivalent, with the primary difference being the time required to attain cleanup standards. Based on this assumption, a longer timeframe is expected to cleanup groundwater at CPOCs located closer to the source of hazardous substances. These CPOCs are, therefore, assigned lower scores in the SFS Report. Ecology does not fully agree with these assumptions.

Groundwater restoration timeframe is essentially the length of time it will take to attain groundwater cleanup standards. For cleanup sites using CPOCs, then, it is the period of time needed to attain groundwater cleanup levels in contaminated groundwater at and downgradient of the CPOC. At some sites contaminant concentrations at groundwater locations near the CPOC take the longest to reach cleanup levels; at other sites it is groundwater locations well downgradient of the CPOC that are the last to reach attainment.

In the Boeing Everett SFS, the implementation of remedial alternative 5 using each successive POC Option (2b, 3, 4, and 5) attains cleanup levels at its respective POC in the same timeframe. Each then includes additional treatment (and more time) to attain cleanup standards farther upgradient. For example, remedial alternative 5 using POC Option 3 would attain groundwater cleanup standards at CPOC 2b in 20 to 24 years, the same timeframe as Option 2b, but would then continue groundwater treatment until cleanup standards were attained farther upgradient at the Boeing Property Line and in groundwater upgradient of the transition zone and creek on Boeing property. Since each successive POC option evaluated treats more groundwater than the preceding option, each successive option is more protective (not less protective) and provides a) a greater improvement of the overall environmental quality, and b) a greater level of certainty (reduced risk) that groundwater discharging to the creek meets cleanup levels.

Remedial alternative 5 using **POC Options 3 through 5** will further reduce potential exposures to walkers (i.e., visitors) on City of Everett property who could contact TCE-contaminated groundwater seeps and surface water above cleanup levels. Even though there is some signage on City of Everett property asking walkers to stay out and away from the creek, the signs are not a physical barrier between the trail and the creek/seeps. Walkers in the area, including children, could miss or disregard the signs. Furthermore, Boeing does not own and have direct control over the creek on properties north of Seaway Boulevard.

The longer that groundwater treatment continues, the smaller the area exceeding groundwater cleanup levels would be, and the lower the contaminant concentrations should be at any specific spatial point. The resulting higher overall environmental quality, and at least potential benefit to protectiveness, should be factored into the evaluation of remedial alternatives and optional POCs. Boeing, however, assigns a higher rank to remedial alternative 5 using POC options located closer to the creek where groundwater cleanup levels can be attained sooner, but less groundwater treatment is implemented. While Ecology agrees in theory that shorter timeframes to reach cleanup levels are beneficial, if this shorter period is simply the result of moving the POC downgradient to receptor points, that remedial alternative is not more protective. Remedial alternative 5 using groundwater POC Option 5 treats more groundwater to groundwater cleanup

levels compared to using POC Option 4. Remedial alternative 5 using POC Option 4 likewise treats more groundwater to groundwater cleanup levels compared to using POC Option 3. Therefore, Ecology ranks the Remedial Alternative 5 POC Options for this protectiveness category as: **POC Option 5>4>3>>2b**.

Permanence

This criterion evaluates the degree to which an alternative permanently reduces the toxicity, mobility, or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated.

The DCA evaluation in the SFS Report assumes that for most factors considered in the permanence evaluation, remedial alternative 5 and all POC options are equivalent AND the main difference between the options is the degree to which the options reduce the volume of hazardous substances and the type and amount of treatment residuals generated.

Boeing's analysis assumes that TCE groundwater not treated by bioremediation in the source area or by the downgradient DGR system will ALL be removed by the near-creek extraction wells and not discharged to the creek, regardless of the groundwater POC location selected. However, data from the Powder Mill Gulch Downgradient Plume Interim Action show that the extraction wells along the creek do not intercept and remove all of the TCE contaminated groundwater before discharging to the creek. Enough TCE contaminated groundwater enters the creek to result in exceedances of the Washington surface water quality standards in surface water grab samples. The farther the groundwater POC is located from the TCE source, the less groundwater treatment occurs and the more likely it is that TCE-contaminated groundwater will discharge to the creek.

Under remedial alternative 5, each successive groundwater POC (from option 2b to 5) is associated with treating more contaminated groundwater to meet groundwater cleanup levels. This results in more reduction in hazardous substance volume, and more hazardous substance destruction due to increased bioremediation in the source area and more contaminant removal (by DGR treatment with activated carbon). In addition, there would be less TCE mass available for discharge into the creek (also an important criteria in evaluating the "effectiveness" criteria). Ecology ranks the Remedial Alternative 5 POC Options for the *permanence* category as: **POC Option 5>4>3>>2b**.

Effectiveness Over the Long Term

This criterion evaluates the degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. The following types of cleanup action components may be used as a guide,

in descending order, when assessing the relative degree of long-term effectiveness: Reuse or recycling; destruction or detoxification; immobilization or solidification; on-site or off-site disposal in an engineered, lined and monitored facility; on-site isolation or containment with attendant engineering controls; and institutional controls and monitoring.

Using remedial alternative 5, Ecology believes that the closer the groundwater POC is to the creek the more uncertain it is that Boeing can both measure and verify that contaminant concentrations near (and eventually) entering the creek are below groundwater cleanup levels. We also believe that if more groundwater is remediated to the 0.3 µg/L TCE cleanup level and, and this is confirmed by monitoring farther upgradient of the Creek, it is more likely that contamination entering the creek will have concentrations as low as cleanup levels and less TCE mass will discharge into the creek. This is important because any monitoring system employed only at locations close to the creek has the potential to miss elevated TCE-contaminated groundwater discharging to the creek at unmonitored locations. Thus, when larger amounts of upgradient groundwater are remediated (by EISB and DGR) there is more certainty that the remedial alternative successfully minimizes the potential for unacceptable TCE levels to enter the creek.

In addition, when assessing the relative degree of long-term effectiveness, more TCE groundwater destruction or detoxification occurs with remedial alternative 5 using POC options 3, 4 and 5, than with option 2b. The latter relies relatively more on dilution, engineering controls; and institutional controls and monitoring.

Boeing asserts that operating remedial alternative 5 to treat more groundwater to meet the 0.3 µg/L TCE cleanup level (as would be needed for POC options closer to contaminant source areas), will result in longer treatment system operation periods, which will lead to more system failures, lower treatment system efficiency, and lower reliability. Ecology does not believe there is any significant difference in groundwater GAC system and air stripper residual management for the treated groundwater under all POC options. But we agree that a longer period of treatment operation will result in higher operation-related costs. And Boeing is correct that this will include higher costs for maintenance and repair. However, routine treatment system maintenance should minimize system failures and maintain system efficiency. System component replacements and adequate O&M procedures should adequately keep the treatment systems operating at an effective level for the longer timeframes associated with the POC options located closer to Boeing's source areas.

Ecology ranks the Remedial Alternative 5 POC Options for this effectiveness category as: **POC Option 5>4>3>>2b**.

Management of Short Term Risks

This criterion evaluates the degree of risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks. Ecology believes that remedial alternative 5 using any of the groundwater POC options can implement measures to manage these short-term risks equivalently. Ecology believes that Boeing can implement measures to manage any small

amount of risk related to the drilling and installation of additional monitoring wells for the POC options that have shorter and longer restoration timeframes. Ecology ranks the Remedial Alternative 5 POC Options for the *management of short-term risks* category as: **POC Option 5=4=3=2b**.

Technical and Administrative Implementability

This criterion evaluates the ability of alternatives to be implemented including consideration of whether the alternative is technically possible; availability of necessary off-site facilities, services, and materials; administrative and regulatory requirements; scheduling; size; complexity; monitoring requirements; access for construction operations and monitoring; and integration with existing facility operations and other current or potential remedial actions.

In the SFS DCA evaluation, this criterion reflected the greatest difference in scoring between the groundwater POC Options evaluated under remedial alternative 5. The primary considerations in comparing the options included:

- Consideration of whether the alternative is technically possible and effective.
- Access for construction operations and monitoring.
- Integration with existing facility operations.
- Integration with current or potential remedial actions.

Section 4.1 of the SFS, indicates that attaining groundwater cleanup levels becomes "progressively less technically practicable to achieve in a reasonable restoration timeframe the closer to the source area the POC location is." However, the term "technically possible" referred to in this FS criterion is different from the term "technically practicable" used in the SFS evaluation. Technically possible is defined in MTCA as "*capable of being designed, constructed and implemented in a reliable and effective manner, regardless of cost" (WAC 173-340-200)*. <u>If it is not "technically possible" for a remedial alternative to attain groundwater cleanup levels at any POC, then it should not be included in the SFS</u>.

The SFS's selected remedial alternative 5 (enhanced bioremediation and DGR) are both technically and administratively implementable. The technologies have been successfully used at other sites and access is available for construction (no buildings in the main portion of downgradient the plume). Whether they can be implemented in an *effective manner*, depends on what they are expected to accomplish. Similarly, MNA's effectiveness depends on the expectations site decision-makers have for natural attenuation's ability to achieve specified remediation objectives. Boeing has not demonstrated that a combination of the SFS's remedial technologies, together with natural attenuation, are incapable – technically – of achieving groundwater cleanup levels, nor has the company demonstrated that the technologies and natural attenuation are only capable of attaining groundwater cleanup levels in portions of the plume. Instead, it has been Ecology's understanding that the technologies and natural attenuation should be able to effectively achieve groundwater cleanup levels. However, Ecology realizes that

attaining groundwater cleanup levels in parts of the plume, while possible, will take a relatively long time. Factors such as favorable site-specific aquifer hydraulic characteristics (a relatively homogeneous and conductive aquifer with high groundwater velocities/permeability), low total organic content (TOC), and a lack of known DNAPL sources support such an understanding. Plus, in Boeing's SFS Table 4.3 POC Options 3 and 4 are ranked indicating that the company believes the remedy and these two POCs are technically implementable and effective.

Under the MTCA DCA evaluative criteria – technical/administrative implementation, Boeing provided the following rankings for remedial alternative 5 using different groundwater POC Options: 7 (excellent) for POC option 2b, 5 (good) for option 3, 3 (fair) for option 4, and 1 (poor) for option 5. Ecology believes the rankings assigned to options 2b through 5 should be higher based on factors described in the paragraph above.

When comparing factors related to access for construction and monitoring, remedial alternative 5 should score lower for CPOC options located off Boeing property. Boeing will also have less control over off-property activities such as ensuring the effectiveness of institutional and engineering controls. These considerations are not reflected in the SFS report DCA scoring and evaluation. In addition, in order to implement remedial alternative 5 with an off-property groundwater CPOC, Boeing needs the consent of the respective property owners. This is an implementation hurdle avoided by a standard POC or a property-boundary CPOC. Boeing should not assume involved property owners will easily give written consent for an off-property CPOC.

For the reasons stated above, Ecology ranks the Remedial Alternative 5 POC Options for the *Technical and Administrative Implementability* category as: **POC Option 5=4=3>>2b**.

Consideration of Public Concerns

This criterion evaluates whether the community has concerns regarding the alternative and, if so, the extent to which the alternative addresses those concerns. This includes concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the site.

In the DCA evaluation included in the SFS, each POC Option associated with remedial alternative 5 is scored the same for this criterion, with each receiving the highest possible score (10 out of 10). While we are not aware of public concerns that have been expressed to date regarding the various POC options, we believe that the degree that each POC Option affects public lands or resources could significantly impact the degree of public concern.

As alluded to in the discussion of Implementability, several additional actions are required under MTCA when an off-property CPOC is approved. Before approving an **off-property** CPOC a notice of the proposal shall be mailed to the natural resource trustees, Washington State Department of Natural Resources, and the U.S. Army Corps of Engineers. The notice shall be in addition to any notice provided under WAC 173-340-600 and invite comments on the proposal.

Further, the affected off-property owners between the Boeing source of contamination and the surface water body must agree in writing to the use of the conditional point of compliance. This would include the City of Everett, the Powder Mill Business Center, and the Seaway Center (Seaway West, LLC). As stated earlier, Boeing should not assume full cooperation from other property owners.

Additionally, for an **off-property** CPOC, institutional controls must remain on public and private (non-Boeing) lands until groundwater concentrations achieve cleanup standards (for example 0.3 µg/L TCE).

Based on these considerations, Ecology believes that the options that place the groundwater POC on Boeing's property reduce associated public concerns. We expect that the City of Everett, Prudential, and Seaway, LLC would rather have the groundwater under their properties meet the cleanup level of 0.3 µg/L TCE, rather than providing written consent to a CPOC and accepting institutional controls on their properties. Although these considerations are not reflected in the SFS report's DCA scoring, we believe they should be. Therefore, Ecology ranks the Remedial Alternative 5 POC options for the *Consideration of Public Concerns* category as: **POC Option 5=4=3>>2b**.

Cost

The cost estimates provided in Appendix C of the Draft SFS Report were reviewed and checked. Because the main difference between remedial alternative 5 using different groundwater POC options relates to the length of time required to achieve cleanup levels at the various points of compliance, the time value of money is a significant factor in determining whether the costs of the alternative groundwater POC options are proportional to the benefits. The remedial alternative 5 point-of-compliance cost estimates included in Appendix C of the SFS account for the time value of money by using a "discount rate" of 0.6 percent. However, EPA guidance on Feasibility Study cost estimates states: "A real discount rate of 7 percent should generally be used for all non-Federal facility sites" (EPA, 2000)[23].

The use of a discount rate of 7 percent, as opposed to 0.6 percent, results in significantly less difference in costs between the POC options. A sensitivity analysis of the POC cost estimates using a range of discount rates is provided in Attachment B.

Ecology believes it is reasonable to expect higher costs for implementing the same groundwater remedy for a longer period of time to reach cleanup levels for more of the plume. However, given the uncertainties associated with the cost estimates for each POC option (-30%, +50%), those higher net present value (NPV) cost estimates for POC alternatives are not significantly different and Ecology does not consider those cost increases to be disproportionate to the increased environmental benefit as one moves from groundwater POC option 2b to 5.

[23]Boeing used the 0.6% real discount rate from 2017 in the OMB Circular No A-94. The real and nominal discount rates are 1.5% and 3.6% from the 2018 Circular No. A-94.

Ecology disagrees with many of the line item cost estimates provided in SFS Report, Appendix C. However, only the most critical points of disagreement, that significantly affect the net present value, are provided here. Ecology acknowledges that certain cost estimate elements were clarified by the Boeing Company in correspondence to Ecology dated March 8, 2019. This additional information was considered.

Table C-1a through Table C1f – Annual Operation, Maintenance, Monitoring, and Reporting, Line Item 3

The spreadsheet provided with the letter dated March 8, 2019 from Boeing to Ecology calculates the carbon costs on an annual basis; however, the corresponding notes in the spreadsheet state that carbon costs should be calculated every other year (biennial basis). A biennial carbon replacement results in slightly lower annual operating and maintenance costs for all groundwater POC options.

Table C-1a through Table C1f – Annual and Non-Routine Operation, Maintenance, Monitoring, and Reporting, Present-Worth Presumed Discount Rate

The presumed discount rate of 0.6 percent that Boeing used was taken from the Office of Management and Budget (OMB), Circular A-94, Appendix C; however, this rate is not consistent with the guidance provided in the U.S. Environmental Protection Agency document *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA. 2000). Section 4.3 of the EPA Guide states: "A real discount rate of 7 percent should generally be used for all non-Federal facility sites."

Regarding Federal facility sites, the EPA Guide states: "Real discount rates from Appendix C of OMB Circular A-94 should generally be used for all Federal facility sites."
Since the Boeing Everett Site is not a federal facility site, a discount rate of 7 percent should be applied to all future costs to calculate the present worth cost.

Table C-1a through Table C1f – Annual and Non-Routine Operation, Maintenance, Monitoring, and Reporting, Annual and Quarterly Sampling

It seems that some of the sampling may be redundant. For example, Line Item 1 of the Non-Routine Operation, Maintenance, Monitoring, and Reporting shows a baseline groundwater/surface water sampling cost. Ecology believes that Boeing should consider an annual monitoring event used as one of the quarterly events for annual monitoring. This would reduce the annual number of monitoring events from five to four.

Summary of Ecology Selection of the Remedial Alternative 5 using Groundwater Point of Compliance Option 3 – Boeing Everett property line (Seaway Blvd) and in groundwater[19] prior to discharge to the creek on Boeing property. Ecology ranking of the decision criteria is as follows:

Protectiveness: Option 5>4>3>>2b.
Permanence: Option 5>4>3>>2b
Effectiveness Over the Long Term: 5>4>3>>2b.
Management of Short Term Risks: 5=4=3=2b.

Technical and Administrative Implementability: 5=4=3>>2b.
Consideration of Public Concerns: 5=4=3>>2b.
Cost: 5>4>3>2b (but not disproportionate cost differential)

Groundwater Restoration Timeframe

Although it is not one of the criteria explicitly identified in WAC 173-340-360(3)(f) for evaluating cleanup action alternatives to determine which is permanent to the maximum extent practicable, the choice of a groundwater POC, by itself, can affect restoration timeframe. Ecology recognizes that the groundwater restoration timeframe generally increases from POC option 2b, to 3, 4, and 5, and this is because it takes more time to remediate more contaminated groundwater to attain groundwater cleanup levels. The extra time is effectively used to remove additional contaminant mass and remediate/restore more areas downgradient of the TCE source and Boeing property. Given the ranges and uncertainties in the restoration timeframe calculations (groundwater modeling), the difference between 24 to 48 years is not significant. Ecology believes that given the size and magnitude of the groundwater plume, the longer restoration timeframes (24 to 48 years) do not preclude POC Options 3, 4, and 5 (as well as 2b) from being selected. ALL of the timeframes associated with these options appear reasonable and achievable.

Conclusion

In conclusion, Ecology prefers Remedial Alternative 5 with groundwater POC Option 3. In our opinion: (1) the groundwater CPOC is as close as practicable to site contaminant sources; (2) all practicable methods of treatment will be used in the cleanup associated with this CPOC; (3) there is a high degree of confidence that institutional controls on Boeing-only property will be effective as required under MTCA for this CPOC; (4) among remedial alternative 5 POC options 3, 4, and 5, which are sufficiently protective, it is associated with the shortest restoration timeframe; and, (5) its associated remedy has the lowest NPV cost estimate (of POC options 3, 4, and 5), while also meeting protectiveness, permanence, effectiveness, implementability, public concern, and short-term risk considerations in a manner acceptable to Ecology under MTCA.

Ecology eliminated remedial alternative 5 using groundwater **POC options 1 and 2a** (refer to the point of compliance discussion). Groundwater **POC option 2b** is not acceptable to Ecology because the POC location is too far from the sources of hazardous substances and too close to the receptors the cleanup action is being implemented to protect. In addition, in our opinion POC options 3-5 are better justified than option 2b when considering public concerns, effectiveness, and permanence. Option 2b also over-relies, from our perspective, on institutional controls; the additional groundwater treatment employed by remedial alternative 5 and POC options 3-5 results in cleanups less reliant on such controls. Compared to remedial alternative 5 with CPOC

option 3, the same remedy alternative coupled with option 2b does not appear to utilize "all practicable methods of treatment… in the site cleanup."

Remedial alternative 5 with groundwater **POC option 3** ranks slightly lower than POC options 4 and 5 (standard POC) when considering protectiveness, permanence, and effectiveness. However, in our opinion, the overall benefits to its selection outweigh the benefits of POCs located more upgradient. The groundwater cleanup levels for remedial alternative 5 using POC option 3 are attained within an estimated 24-32 years for those off-site properties not under Boeing control, versus longer restoration timeframes of 34-39 years and 44-48 years using POC options 4 and 5, respectively. The selection of remedial alternative 5 utilizing POC option 3 should also be less costly than choosing either POC option 4 or 5. Ecology is confident that Boeing can implement and enforce required institutional controls on Boeing property, upgradient of Option 3's groundwater POC where the groundwater contaminant concentrations exceed cleanup levels.

Attachment B: Net Present Value Calculations

Total Project Cost Estimate

	Option 1 Total	Option 2A Total	Option 2B Total	Option 3 Total	Option 4 Total	Option 5 Total
Boeing - 0.6%	$ 14,147,000	$ 14,697,000	$ 15,663,000	$ 16,833,000	$ 19,471,000	$ 22,332,000
Ecology- 0.6%	$ 14,136,596	$ 14,729,915	$ 15,623,893	$ 16,572,907	$ 19,440,025	$ 22,286,491
Difference (Boeing-Ecology)	**$ 10,404**	**($ 32,915)**	**$ 39,107**	**$ 260,093**	**$ 30,975**	**$ 45,509**
Percent Difference	**0.07%**	**-0.22%**	**0.25%**	**1.55%**	**0.16%**	**0.20%**
Ecology - 1.5%	$ 13,500,035	$ 14,034,955	$ 14,794,646	$ 15,540,023	$ 17,830,985	$ 19,986,185
Ecology - 2.0%	$ 13,179,099	$ 13,684,935	$ 14,380,169	$ 15,030,445	$ 17,060,432	$ 18,918,621
Ecology - 3.0%	$ 12,598,445	$ 13,052,394	$ 13,637,147	$ 14,128,876	$ 15,736,888	$ 17,139,710
Ecology - 3.6%	$ 12,284,940	$ 12,711,330	$ 13,240,008	$ 13,653,644	$ 15,060,578	$ 16,258,797
Ecology - 4.0%	$ 12,088,963	$ 12,498,310	$ 12,993,311	$ 13,360,892	$ 14,651,590	$ 15,735,701
Ecology - 5.0%	$ 11,640,028	$ 12,010,935	$ 12,433,071	$ 12,703,393	$ 13,754,971	$ 14,615,209
Ecology - 6.0%	$ 11,242,823	$ 11,580,518	$ 11,943,560	$ 12,137,675	$ 13,008,714	$ 13,711,128
Ecology - 7.0%	$ 10,890,004	$ 11,198,929	$ 11,514,115	$ 11,648,536	$ 12,383,038	$ 12,973,784

Attachment C: Comments on Correlation of TCE Concentrations in Groundwater and Surface Water Figures – SFS Figures 4-7A through 4-7C

Boeing presented Figures[24] 4-7A through 4-7C in an attempt to correlate TCE concentrations in groundwater and the nearby creek[25] using a "data correlation" approach. Ecology does not agree and does not approve the results in Figures 4-7A through 4-7C due to the following significant flaws in that methodology:

- The data correlation uses a surface water TCE concentration (SW-PMG-4, SW-PMG-8, and SW-PMG11 in Figures 4-7a, 4-7b, and 4-7c, respectively) as a groundwater point of compliance where groundwater cleanup levels are met. The surface water sampling results cannot be used in the data correlation analysis with groundwater data because surface water sampling locations cannot be used as a groundwater conditional point of compliance. This approach assumes the maximum mixing/dilution within the creek and the transition zone, which is not allowed under WAC 173-340-720(8)(d)(i)).

- The three selected short groundwater to creek transects (Figure 4-7 and Figures 4-7A through 4-7C) are not representative of the groundwater flow paths "from the core of the plume to the creek". First, as shown in Figure 4-7, the three selected transects are very short and the transects are not parallel to the general groundwater flow directions demonstrated by a majority of the groundwater elevation contour lines of the TCE plume. Second, groundwater flow paths have been altered by extraction wells along the Creek[26]. The flow direction of "groundwater to the creek" along each of the three transects are no longer valid after the PMG Downgradient Plume Interim Action was implemented. The groundwater flow paths will have yet more significant changes after the DGR system is designed and implemented. The "extrapolated trend lines", indicated by Figures 4-7A through 4-7C, are incorrect and invalid for predicting future flow paths.

- The spatial relationships between the TCE groundwater plume and the creek and at different points within the groundwater plume are complex and controlled by multiple flow and contaminant transport mechanisms. It is misleading to derive a simple special "reduction factor" and conclude that when drinking water cleanup levels were achieved in groundwater (TCE = 4 µg/L), the 0.3 µg/L TCE cleanup level would be met in the Creek. Likewise, there is no simple spatial reduction factor between the two or three selected monitoring points within the groundwater plume. Groundwater flow paths are not straight and parallel lines and contaminant transport parameters are not constant and uniform in the aquifer. For example, based on groundwater contour

[24] Also provided as part of the November 16, 2017 Deliverable - Boeing Everett Uplands/Powder Mill Gulch Feasibility Study, Boeing's Alternative Proposal for Formally Disputed Items submitted September 8, 2017.

[25] The derivation of those "extrapolated trend lines" is explained in a letter from Stanley Alpert, Boeing Counsel to Ivy Anderson, AAG, dated December 15, 2017.

[26] Refer to the groundwater contours near Transect A: Figure 5A Phase 1 Area Groundwater Elevation Contour Map, October 17, 2018. Quarterly Summary Report for August 1 through October 31, 2018.

maps and variations in transport parameters under the current and future pumping and DGR conditions, Ecology expects that past and future concentrations changes at EGW132 to be unrelated to concentrations changes at P13A near Transect A-A'. Therefore, the "reduction factor" derived linearly from the two monitoring points (EGW132 and P13A, Figure 4-7a) is flawed and invalid. Predicting the relationship between TCE groundwater concentrations in nearby groundwater wells is far more complicated than the assumptions behind Boeing's correlation analysis.

- Averaging concentration ratios or "reduction factors" between locations on the transects over a several year period introduces significant errors and further makes the correlations invalid. For example, "the average concentration reduction factor between EGW 132 and P13A was calculated to be 2.4" (page 2 of December 15, 2017 deliverable). However, the concentration ratios calculated based on the most recent 2017-2019 quarterly TCE groundwater concentration data between EGW132 and P13A are 1.21, 0.85, 0.79, 0.79, 0.71, 0.50, 0.39, 0.46, 0.31, and 0.32. The TCE concentrations at P13A have been steadily increasing (91 µg/L to 270 µg/L TCE) while the TCE concentrations at EGW132(2) initially decreased until reaching a stable state (110 µg/L to 87 µg/L TCE). Furthermore, the <1.0 reduction factors from the most recent data indicate increasing concentrations between the mid-plume groundwater monitoring well EGW132(2) and the near creek piezometer, P13A.

- The groundwater and surface water sample locations do not all lie on their respective transects, therefore the results of the TCE concentration correlation among these points are arbitrary and invalid. For example, figure 4-7b shows a transect profile (B-B') from EGW-164 through PMG-P5 to SW-PMG8. SW-PMG-8 (observed TCE concentrations: 0.1 µg/L – 1.5 µg/L from 2017 - 2019) is located approximately 200-250 feet downstream of the expected end point of transect B-B'. Similarly, figure 4-7c shows the transect C-C' from EGW-214 through EGW-199 to SW-PMG11. SW-PMG11 (observed TCE concentrations: 0.6 µg/– 1.2 µg/L from 2017-2019) is located approximately 300 feet downstream of the expected end point of transect C-C' where groundwater would discharge to the creek. The expected creek endpoint for transect B-B' should be closer to SW-PMG85 and the expected creek end point for transect C-C' should be close to SW-PMG95. Ecology would expect higher TCE surface water concentrations in the creek near PMG85 and PMG95 compared to PMG8 and PMG11, respectively. This would result in lower reduction factors between the groundwater and surface water TCE concentrations.

Attachment D: Supplemental Feasibility Study (SFS) Report-Detailed Comments

1. Executive Summary (ES), General Comment: Remedial alterative 1 (current and ongoing Powder Mill Gulch (PMG) trichloroethylene (TCE) groundwater source area and downgradient interim action) is not acceptable as a final groundwater remedy under MTCA. Powder Mill Creek surface water TCE concentrations AND groundwater seep TCE concentrations are currently as much as an order of magnitude or more greater than the Washington surface water quality standards for the creek (surface water) located on Boeing and City of Everett, properties.

2. ES, Remedial Alternatives Evaluation, Page iii, Bullet #1: Boeing heavily favored Remedial Action Alternative #1 (IA pump and treat system only) in the draft Uplands FS report. However, Ecology determined that Alternative #1 did not meet MTCA threshold criteria. It should therefore be excluded from the disproportional cost analysis (DCA) and eliminated from further consideration as a final groundwater cleanup remedy (see Ecology's previous letters dated August 18, 2016 and July 20, 2017).

3. ES, Remedial Alternatives Evaluation, Page iii, Bullet#2: Ecology determined that Alternative #2 (TCE source area enhanced bioremediation and operation of the IA pump and treat system) does not meet the reasonable restoration timeframe criteria [WAC 173-340-360)(2)(b)(ii)]; is not permanent to the maximum extent practicable ([WAC 173-340-360)(2)(b)(i)]; and, does not adequately account for the discharge of TCE-contaminated groundwater seeps to the creek.[27]

4. ES, Point of Compliance Options Evaluation, Page vi, Paragraph 4: Ecology disagrees with Boeing's determination that groundwater POC option #1 is permanent to the maximum extent practicable and the preferred POC option for use in combination with Remedial Alternative 5. As we explain in Attachment A, POC option #1 is not compliant with the MTCA regulations.

5. ES, Remedial Alternatives Evaluation, Page vi, Paragraph 5 through page vii: Boeing states that groundwater POC options #2 through #5 are technically impracticable. Neither MTCA nor WAC 173-340 has a "technical impracticability" option in evaluating remedial actions. The WAC 173-340-360(3)(f)(vi) DCA evaluation criterion – technical/administrative implementation – asks us to consider whether the option\alternative is "technically possible" to implement.

   Boeing asserts that "it is technically impracticable to achieve cleanup of dissolved chlorinated solvents in groundwater to concentrations lower than the state drinking water

[27]Ecology's previous letters dated August 18, 2016 and July 20, 2017

standard (i.e., 4 µg/L TCE)". However, Ecology believes it is technically possible to attain these levels. It is unclear what Boeing is specifically referring to by "a large body of technical data, relevant case studies, and professional literature". It may be difficult to achieve full cleanup of chlorinated solvents in source release areas, especially if DNAPL or residual solvents are trapped in a fine-grained aquifer matrix or in fractured bedrock. However, it is certainly possible to fully cleanup a dissolved solvent plume in a relatively homogeneous sand aquifer (Esperance Sand Aquifer). Site-specific conditions play an important role in determining how well, and how quickly, a site can be cleaned up. The site-specific conditions at Boeing's downgradient TCE plume area (conductive aquifer with low TOC) are favorable to achieve the site cleanup goals. While case and treatability study information reported in the remediation literature can offer important information for choosing and evaluating cleanup options, cleanup decisions cannot be based solely on such sources.

Boeing provided the following technical and administrative implementability rankings for remedial alternative 5 for achieving the groundwater cleanup level at POC option 2b (7 = excellent), option 3 (5= good), option 4 (3 = fair), and option 5 (1 poor). Ecology believes the rankings assigned to options 3 through 5 should be much higher as explained in Attachment A. Nevertheless, Boeing's own rankings of Options 2b through 4 are reflective of remedies and POCs that are both technically implementable and effective.

6. Section 1.0 Introduction, Page 1-1, Paragraph 3: Boeing's statement in this paragraph regarding application of the Washington surface water quality standards is misleading. The requirements of WAC 173-340-720(4)(b) are, in our opinion, unequivocal. They require the groundwater cleanup levels for Boeing's TCE-contaminated aquifer to be (at least) as numerically stringent as: a) concentrations established under applicable state and federal laws; b) "concentrations established in accordance with the methods specified in WAC 173-340-730" for the protection of surface water beneficial uses; and, (c) concentrations which protect human health. The "methods specified in WAC 173-340-730" for the "protection of surface water beneficial uses" are the Method A, B, and C requirements for establishing surface water cleanup levels. Please refer to Ecology's previous letter dated August 6, 2018.

7. Section 2.1, Summary of 2015 FS Remedial Alternatives, Page 2-1, Paragraph 1: As noted in Comment #2, Alternative #1 does not meet MTCA threshold criteria, cannot be considered a MTCA-compliant cleanup action, and should therefore be excluded from the FS disproportionate cost analysis (DCA). As noted in Comment #3, Ecology also previously identified inherent deficiencies in Alternative #2.[28]

[28]Ecology's previous letters dated August 18, 2016 and July 20, 2017.

8. Section 2.1.1, Alternative 1: Continued Operation of Existing GET System and Institutional Controls, Page 2-1, Paragraph 1: Please see Comment #2 regarding Alternative #1.

   Alternative #1 will not achieve groundwater cleanup levels without chemical or biological TCE source treatment. The current pump and treat system still results in violations of preliminary surface water cleanup levels in the creek and Ecology would not expect this to change under continued use. Groundwater TCE concentrations in many areas have reached asymptotic levels under the current pump and treat system.

   Furthermore, the PMG TCE groundwater downgradient pump and treat system was required as an interim action. It was not envisioned or designed, nor is it sufficient, to serve as the final groundwater cleanup remedy for the entire site.

9. Section 2.1.2, Alternative 2: EISB Source Area Remediation, Continued Operation of Existing GET System and Institutional Controls, Page 2-2: Please see Comment #3 regarding Alternative #2 for reasons why it is not a MTCA compliant cleanup action.[29]

10. Section 2.1.3, Alternative 3: Focused ISCO Remediation, Continued Operation of Existing GET System and Institutional Controls, Page 2-3: Ecology previously determined that alternatives 3 and 4 met threshold and other criteria under MTCA [WAC 173-340-360(2)(a)(b)] and scored equivalently in the DCA[30]. This was an acceptable remedial alternative, but one that Boeing elected not to pursue. However, Ecology will consider this remedial alternative as one of several possible contingent remedies if the selected remedy alternative 5 fails.

11. Section 2.1.4, Alternative 4: EISB Source Area and Downgradient Plume Remediation, Continue Operation of Existing GET System and Institutional Controls, Page 2-4: Alternative 4: This was Ecology's previous preferred remedial alternative. Knowledge of the aquifer's hydraulic characteristics and geochemical conditions, and our assessment of the existing GET System operational performance, did not lead us to conclude that implementation of Alternative 4 would result in extreme well fouling. We also believed there were various engineering and system maintenance measures available to minimize or mitigate any well fouling that was to occur.[31]

[29]Ecology's previous letters dated August 18, 2016 and July 20, 2017.

[30]Ecology's previous letters dated August 18, 2016 and July 20, 2017.

[31]Ecology's previous letter dated July 20, 2017.

12. Section 2.2, Alternative 5: Dynamic Groundwater Recirculation and Source Area EISB, Page 2-4 to page 2-5: As we stated in our August 6, 2018 letter: *Ecology agrees in concept that the Boeing proposed additional alternative #5 (with the additions suggested by Ecology) has the potential to be effective as source area and downgradient in-situ bioremediation both technically and from a cost perspective. We believe the Boeing proposed additional alternative (with the additions suggested by Ecology) should help further minimize the discharge of TCE (in groundwater) to the creek as well as reduce the groundwater restoration timeframe. Protectiveness, permanence of the remedy and restoration timeframe are significant factors Ecology will consider when evaluating this alternative in the Supplemental FS report. Ecology is willing to consider the DGR groundwater technology in lieu of in-situ bioremediation of all downgradient TCE groundwater. Ecology anticipates that EISB in the TCE groundwater source area concurrent with use of the DGR system, as modified by Ecology, in all downgradient TCE groundwater, will be its preferred treatment technology for groundwater at the Site – with the understanding that a final cleanup action plan for the Site is subject to review and comment by the Environmental Protection Agency (EPA) and the public, and Ecology may revise its approach (in consultation with Boeing) in response to those comments.*[32]

13. Section 2.2, Alternative 5: Dynamic Groundwater Recirculation and Source Area EISB, Page 2-4 to page 2-5: *Adaptive management and dynamic operation* of the downgradient DGR system includes (but not exclusively): the addition of injection and/or extraction wells in new locations (plume interior and exterior); increasing/varying injection and/or extraction flow rates at one or more locations in order to help capture the TCE plume; faster remediation of the TCE-contaminated aquifer; and, eliminating stagnant groundwater treatment zones by optimizing the 'pushing' and 'pulling' effect of injection and extraction wells. The first objective of the *adaptive management and dynamic operation* of the DGR system should be to quickly meet the Powder Mill Creek surface water cleanup levels.

14. Section 2.2.1, Basis of Selection of Dynamic Groundwater Recirculation pages 2-5 to 2-6: Ecology's August 6, 2018 letter stated that remedial alternative 5 (source area EISB and downgradient DGR) *has the potential to be effective as source area and downgradient in-situ bioremediation both technically and from a cost perspective.* We

[32]Based on the previous Draft FS report that evaluated four groundwater treatment options: (1) Continued operation of the interim action groundwater pump and treatment system; (2) Source area EISB only; (3) Source area and downgradient in-situ chemical oxidation; and (4) Source area and downgradient groundwater EISB treatment. Ecology previously determined that options (1) and (2) did not meet WAC 173-340-360(2)(a) or (b) requirements and options (3) and (4) are roughly equivalent permanent cleanup options and expected to achieve shorter restoration timeframes compared to other FS technologies evaluated and both rely more on destruction of the contaminant in-situ rather than dispersion and dilution. Ecology is now willing to accept DGR as downgradient groundwater treatment instead of EISB downgradient groundwater treatment. Ecology considers the EISB/DGR hybrid approach as a modified option (4) and equivalent to option (4) – Ecology's previously selected groundwater cleanup technology.

have already accepted the preliminary design of the DGR system with EISB source area treatment as the preferred groundwater treatment technologies.

15. Section 2.2.2, Alternative 5 - DGR Pilot Study, Page 2-6, Paragraph 2: The objective of the pilot study is not to reach groundwater cleanup levels in the pilot study area. Rather, the study's goal is to identify and refine DGR design and operation parameters to better inform injection/extraction well design, the needed numbers and locations of these wells, and optimum operational flow rates for the full-scale DGR system that will meet the Method B groundwater cleanup levels (4.0 µg/L TCE) throughout the entire plume and attain groundwater cleanup levels (0.3 µg/L TCE) at CPOC Option 3. Improving estimates of aquifer hydraulic parameter values (such as hydraulic conductivity and flow capacity) and observing well fouling/rehabilitation are, from our perspective, more secondary objectives. This is because before the study began we either already had ample data (i.e., hydraulic conductivity), or the observations and data we needed to collect/make (e.g., information related to injection well fouling/rehab) will require a longer timeframe than the study is scheduled to last. Ecology is hopeful we will have adequate hydraulic data (water level elevations/ flow rates) and TCE concentration data to support the full-scale design in one year or less.

16. Section 2.2.2, Alternative 5-DGR Pilot Study, Page 2-7, Paragraph 2, Last Bullet: Ecology would only concur with this bullet were it to be modified as follows: *Recommended criteria indicating success of the pilot study and results necessary to conclude that full scale implementation will be appropriate and cost-effective should include: …… ~~firm~~ reasonable projections based on the results of the pilot study that the final remedy, under full scale implementation, would result in meeting the estimated restoration timeframes with reasonable uncertainty or significant improvement versus running the current the current interim action groundwater pump and treat system.*

    In our opinion, the predicted restoration timeframe due to operation of the proposed DGR system cannot be quantified or "firmly projected" based on the pilot study results. The projection of a 50 percent timeframe reduction may be too ambitious and cannot be achieved through the pilot study. Ecology disagrees with this stringent 50% reduction criterion in order to justify moving to the full-scale DGR system design and construction. In our opinion, the text as written in the SFS report is biased toward concluding that the full-scale DGR system will not function effectively.

17. Section 2.2.2 Alternative 5-DGR Pilot Study, Page 2-7, Last Paragraph through Page 2-8: Ecology and Boeing will determine, based on the results of the downgradient DGR pilot study, if pilot scale data indicate the full scale DGR should be designed and constructed. Ecology does not agree with the 50 percent reduction criteria (see paragraph 16 above). Accurately quantifying timeframe reduction in advance is difficult. When restoration timeframes are estimated either through modeling or observed data extrapolation, those

estimates are typically reported with timeframe ranges that attempt to account for the significant uncertainty associated with the estimating process.

If Ecology concludes from the pilot study results that it will not be possible to modify the design of the full-scale system to improve treatment effectiveness and meet remediation objectives, and that the DGR is an ineffective treatment for the downgradient plume, Boeing shall then implement the Ecology-approved contingent remedy. If no contingent remedy is approved by Ecology prior to completion of the pilot study, then Boeing will need to evaluate alternative groundwater treatment technologies. These would likely include downgradient in-situ chemical reduction (ISCO), in-situ chemical reduction (ISCR) injections, enhanced bioremediation, barrier wall treatment technologies, recirculating enhanced bioremediation, and perhaps other technologies approved for review by Ecology. In any case, Ecology expects source area EISB to be implemented immediately, even if an analysis of contingent downgradient remedies is later required.

Ecology would only concur with this bullet if it were modified as follows: *Based on our initial evaluation and restoration time frame modeling (see Section 2.3.6), the reduction in downgradient plume restoration time frame as a result of operation of the DGR system could be as much as 50 percent (north of Seaway Boulevard) to 70 percent (south of Seaway Boulevard). If the pilot study failed to provide dependable design parameters for the full scale DGR system and indicates minimal reductions in restoration timeframes ~~significantly less than these projections~~ not acceptable to Ecology, the ~~cost of~~ full-scale implementation may be determined to be impracticable to implement or will not reach the cleanup levels in a reasonable timeframe, ~~disproportionately costly in comparison to other remedial alternatives that do not include such significant construction and implementation requirements, such as FS Alternative 2 (source area EISB and downgradient operation of the GET system)~~. If Ecology concurs, an Ecology approved contingent remedy will be designed and implemented.*

18. Section 2.2.3, Alternative 5- DGR Conceptual Plan: The goal of the full-scale groundwater remedy should be to attain the Powder Mill Gulch surface water cleanup levels first (at the surface water point of compliance), then the Method B cleanup levels (4.0 µg/L TCE) throughout the plume, and then the 0.3 µg/L TCE groundwater cleanup levels protective of surface water at and downgradient of the POC Option 3. Boeing should initiate discussions prior to development of the draft cleanup action plan (dCAP) to secure written access agreements with all property owners whose consent will be needed to install, operate, and maintain the downgradient injection and extraction well system.

19. Section 2.2.4, Alternative 5-Source Area EISB, Page 2-9, Paragraph 1, Bullet#1: Ecology notes that the number of alternative #2 source-area EISB injections appears to be less than the number for alternative #4. This may have been an unintentional artifact of

the Draft Uplands FS report. However, Ecology's expectation is that an adequate number of source area EISB injections are conducted to quickly reach groundwater drinking water cleanup levels throughout the source and downgradient plume.

20. Section 2.2.5 Alternative 5-Institutional Controls, Page 2-10: The Ecology-selected groundwater remedial alternative shall include multiple institutional controls. These controls are needed to:
    - Prevent withdrawal of contaminated groundwater (with contaminant concentrations higher than drinking water-based cleanup levels) for any purpose;
    - Prevent actions that could potentially redirect or accelerate TCE-contaminated groundwater (with contaminant concentrations higher than groundwater cleanup levels) migration to the creek;
    - Add and maintain warning signage along Powder Mill Creek on City of Everett property;
    - Provide vapor intrusion-related notifications and require engineered measures, as necessary, should vapor intrusion unacceptably impact indoor air quality in future buildings above the TCE groundwater plume;
    - Prevent consumption of contaminated surface water and aquatic organisms;
    - Prevent worker contact with contaminated surface water; and,
    - Meet other requirements of WAC 173-340-440, and as more fully evaluated in the uplands dCAP and EDR.[33]

21. Section 2.3.1, Evaluation of Alternative 5 for Compliance with MTCA Requirements-Protection of Human Health and the Environment, Page 2-10: Ecology's August 6, 2018 letter stated that alternative 5 (source area enhanced bioremediation and downgradient DGR) *has the potential to be effective as source area and downgradient in-situ bioremediation both technically and from a cost perspective* and we have already accepted the preliminary design of the DGR system with EISB source area treatment as the groundwater treatment technology. Ecology also previously determined that alternatives 3 and 4 meet threshold and other criteria under MTCA [WAC 173-340-360(2)(a)(b)] and scored equivalently under the DCA.[34] Alternative 3 was an acceptable remedial alternative that Boeing elected not to pursue.

    Implementation of Institutional Controls are required – not optional – until cleanup levels as numerically stringent as WQC are met. Refer to Comment #20, above.

22. Section 2.3.1, Evaluation of Alternative 5 for Compliance with MTCA Requirements-Protection of Human Health and the Environment, Page 2-10, Paragraph 1, First Bullet:

[33] Ecology's previous letters dated August 18, 2016 and July 20, 2017.
[34] Ecology's previous letters dated August 18, 2016 and July 20, 2017.

Groundwater cleanup levels must be met at the Ecology-selected groundwater POC (Option 3).

23. Section 2.3.1, Evaluation of Alternative 5 for Compliance with MTCA Requirements-Protection of Human Health and the Environment, Page 2-10, Paragraph 1, Second Bullet: Surface water cleanup levels must be met at the surface water point of compliance (groundwater point of entry into the creek). Please see Comment #20 regarding vapor intrusion-related controls.

24. Section 2.3.2 Compliance with Cleanup Standards, Page 2-11: As noted in the comment above, groundwater cleanup levels must be attained at the Ecology-selected groundwater conditional POC (Option 3).

25. Section 2.3.5, Use Permanent Solutions – WAC 173-340-360(2)(b), Page 2-12: As Ecology stated in its letters dated February 6, 2019 and August 6, 2018, remedial alternatives #3 and #4 are as permanent as alternative #5 (EISB source area treatment and downgradient DGR).

26. Section 2.3.6 Provide for a Reasonable Restoration Timeframe – WAC 173-340-360(2)(b)(ii), Page 2-12, Paragraph 3: The predicted restoration timeframes for remedial alternatives #3 and #4 are reasonable (53 years),[35] given the groundwater plume size and current TCE concentrations. For the same reasons, the predicted restoration timeframes for alternative #5, using groundwater POC options 2b through 5, are also reasonable (24-48 years).

    Timeframe predictions calculated using both Batch Flushing and BIOCHLOR models are estimates with a significant degree of associated uncertainty. However, the model results can be properly used to qualitatively compare alternatives to each other under various POC options.

27. Section 2.3.6 Provide for a Reasonable Restoration Timeframe – WAC 173-340-360(2)(b)(ii), Potential Risks to Human Health and the Environment, Page 2-13: Residents walk on City of Everett property (Lot#9) near the creek. There is also access to the creek's TCE-contaminated surface water via the Exotic Tool Property (west side of the creek). A complete exposure pathway therefore exists between a) contaminated surface water and groundwater seeps, and b) walkers/visitors that contact this water at the creek and shoreline. Even though there are some signs posted telling people to stay out of the creek, the signs are not a physical barrier and cannot by themselves prevent contact with contaminated water. More effective minimization of the risks posed by direct

[35] Ecology's previous letters dated August 18, 2016 and July 20, 2017.

contact with contaminated surface water and groundwater seeps results from further EISB and DGR treatment of TCE contaminated groundwater prior to discharge to the creek.

28. Section 2.3.6 Provide for a Reasonable Restoration Timeframe – WAC 173-340-360(2)(b)(ii), Practicability of achieving a shorter restoration timeframe, Page 2-13: Please see Comment #26 regarding restoration timeframes for alternatives #3, 4, and 5.

29. Section 2.3.6 Provide for a Reasonable Restoration Timeframe – Current and Future Use of the Site, surrounding areas and associated resources that are, or may be affected by releases form the Site, WAC 173-340-360(2)(b)(iii) and (iv), Page 2-13: Please see Comment #27 regarding receptors potentially contacting contaminated creek or groundwater seep water.

30. Section 2.3.6 Provide for a Reasonable Restoration Timeframe, Likely Effectiveness and Reliability of Institutional Control, WAC 173-340-360(2)(b)(vi), Page 2-14: The City of Everett and Exotic Tool properties have complete exposure pathways from TCE-contaminated surface water and groundwater seeps to human receptors. Signage should be increased as a first step. Please see Comment #27 above.

31. Section 2.3.6 Provide for a Reasonable Restoration Timeframe – Ability to Control and Monitor Migration of Hazardous Substances from the Site, WAC 173-340-360(2)(b)(vii), Page 2-14: In our opinion, the existing groundwater extraction wells have not reduced the migration of TCE-contaminated groundwater to the City of Everett property (Lot#9) to the maximum extent practicable. The most recent groundwater chemical data from wells located just north of Seaway Blvd indicate that elevated levels of TCE in groundwater are still flowing beyond the Boeing property line. Furthermore, it is incorrect to state that TCE groundwater concentrations are steadily decreasing without qualifying the assertion. In some areas, groundwater TCE concentrations are decreasing or have reached an asymptotic lower concentration and stabilized; but in other areas TCE concentrations are increasing. Surface water (in-stream) TCE concentrations remain above Washington surface water quality standards.

32. Section 2.3.6 Provide for a Reasonable Restoration Timeframe –Toxicity of Hazardous Substances at the Site, WAC 173-340-360(2)(b)(viii), Page 2-14: It is incorrect to state that the toxicity of TCE is **moderate** to human and ecological receptors. TCE is a known carcinogen and as such has been assigned very low media cleanup levels. It is also incorrect to state that there are low and declining TCE concentrations present in certain locations, without also noting that TCE groundwater and surface water concentrations are up to several orders of magnitude higher than their respective cleanup levels in other areas.

33. Section 2.3.6, Provide for a Reasonable Restoration Timeframe - Natural Processes that reduce concentrations of hazardous substances and have been documented to occur at the Site, WAC 173-340-360(2)(b)(ii), Page 2-14: Ecology has seen very little data to support conclusions, or even assumptions, that the natural biodegradation of TCE in groundwater downgradient of the TCE source area (where enhanced biodegradation was performed as an interim action), or within the creek, is significantly reducing concentrations. Downgradient groundwater is under oxidized geochemical conditions with relatively high dissolved oxygen concentrations. Natural biodegradation through reductive dechlorination is therefore slow and minimal. In addition, the aquifer's total organic carbon is low, and as a result, retardation through sorption is low. All aquifer conditions are actually favorable for TCE transport and unfavorable for its natural biodegradation. Indications of reduced groundwater conditions, a necessity for TCE reductive dechlorination in groundwater, do not extend very far downgradient of the source area. Any attenuation within the TCE groundwater plume or in the surface water/groundwater transition zone that has occurred likely resulted from advection, dispersion, or mixing/dilution.

34. Section 3.0 Detailed Evaluation of the Remedial Action Alternatives, Page 3-1, Paragraph 2: Ecology understands that the remedial action alterative evaluation was performed based on the assumption that the groundwater cleanup endpoint was attainment of 4.0 µg/L of TCE (the Boeing preferred cleanup level) throughout the plume. However, as noted above, the groundwater cleanup level protective of surface water is an order of magnitude lower than the 4.0 µg/L drinking water-based cleanup level.

35. Section 3.2 Alternative 5 Benefit Analysis, Page 3-2: Please see Comment #21 regarding remedial alternative 5's effectiveness, the preliminary design of the DGR system with EISB source area treatment, and Ecology's conclusions concerning remedial alternative 3 and 4.

    As discussed in Attachment A (with the POC cost estimates), the SFS accounted for the time value of money by using a "discount rate" of 0.6 percent. However, EPA guidance on Feasibility Study cost estimates states: "A real discount rate of 7 percent should generally be used for all non-Federal facility sites" (EPA, 2000). The use of a discount rate of 7 percent, as opposed to 0.6 percent, results in significantly less difference in costs between remedial alternatives 3-5. In addition, given the uncertainties associated with estimating the costs for remedial alternatives 3-5 (-30%, +50%),[36] their respective NPV cost estimates are not significantly different.

[36]Ecology previously determined that alternative 1 failed the threshold criteria under WAC 173-340-360(2)(a) and that alternative 2 was not permanent to the maximum extent practicable and relies primarily on dilution in lieu of enhanced bioremediation of the downgradient TCE groundwater plume. Alternative #2 also allows more TCE contaminated groundwater

36. Section 3.3, Results of the Disproportionate Cost Analysis, Page 3-3: Ecology analysis of remedial alternatives 3, 4, and 5 differ from the SFS report text.

    - Bullet #1-Protectiveness: Remedial alternatives 3, 4 and 5 all expect to reach groundwater cleanup levels at the Ecology-required groundwater POC (Option 3). Boeing estimates that alternative 5 (38 years) will reach attainment in a shorter timeframe than alternatives 3 (53 years) and 4 (53 years). However, Ecology does not agree with Boeing's latest timeframe refinement (September 20, 2017 technical memorandum and SFS Report dated November 30, 2018), where three years were added to previous alternatives #2 through #5 restoration timeframes to account for source area remediation FIRST before starting the groundwater model to calculate downgradient restoration timeframe (RT). Ecology assumes that source area and downgradient groundwater remediation will occur concurrently. In any case, the predicted restoration timeframes from modeling (both BIOCHLOR and Batch Flushing models) for all active treatment systems employed in the downgradient plume are estimates with significant associated uncertainties. Ecology believes that remedial alternatives 3, 4, and 5 would meet protectiveness criteria in an equivalent manner because Ecology is confident these three remedial alternatives have the ability to achieve cleanup levels at the Ecology POC (Option 3). We would rank alternative 5 somewhat higher (in terms of restoration timeframe) than alternatives 3 and 4, but are not confident that the actual difference in timeframes between them would be 15 years.

    - Bullet-#2-Permanence: Remedial alternatives 3 and 4 require the in-situ chemical or biological treatment of downgradient TCE contaminated groundwater in addition to operating an optimized groundwater extraction system to further reduce untreated TCE contaminated groundwater from entering the creek. Remedial alternative 5 requires the in-situ bioremediation of source area TCE groundwater coupled with operation of the DGR[37] system on the downgradient TCE contaminated groundwater. Ecology considers remedial alternatives #3, #4 and 5 equally permanent.

    - Bullet-#3-Effectiveness over the long term: Remedial alternatives 3 and 4 utilize mature and well-established groundwater treatment technologies that have been

to enter the creek [note that the groundwater extraction wells near the creek do not remove all of the TCE groundwater prior to discharge]. Surface water samples from the creek presently show up to order of magnitude exceedances of Washington surface water quality standards. Therefore, alternative #1 and #2 alternative cost estimates are not part of this discussion.

[37]DGR system consists of the optimization of the same interim action groundwater extraction wells along the creek. The optimization takes the form of added extraction wells (at least 2) and injection wells. Extracted groundwater is treated by an air stripping unit prior to discharge of the treated groundwater to Powder Mill Creek.

proven effective in numerous applications. Remedial alternative 5 employs a newer groundwater treatment technology (compared to the technologies for alternatives 3 and 4) and therefore its certainty of success may be slightly less than the other two alternatives. On the other hand, the aquifer's hydraulic and geochemical conditions are favorable to alternative 5. It therefore seems reasonable to rank remedial alternatives #3, #4 and #5 equally.

- Bullet #4-Management of short –term risks: Ecology believes the remedial alternatives 3, 4, and 5 can all be designed so that the risk of danger to the public and site workers is minimal. We note that the text in the FS report (page 8-25) appears to concur: *These risks can typically be managed effectively through careful design and implementation, however the risks are present.*

- Bullet #5-Technical and Administrative Implementability: Remedial alternatives #3, #4, and #5 are both technically and administratively implementable. Enhanced bioremediation and in-situ chemical oxidation are well-established groundwater treatment technologies. Alternative #5's DGR system utilizes the existing groundwater extraction well within the downgradient plume, but adds injection wells and a few additional extraction wells. There should not be significant technical or administrative hurdles to implementing any of the three alternatives.

- Bullet#6-Consideration of Public Concerns: Ecology would rank remedial alternatives 3, 4 and 5 equivalently since all three require TCE source area in-situ treatment and downgradient TCE groundwater treatment.

- Bullet #7- Cost: As Ecology indicated earlier, the cost estimates for remedial alternatives 3, 4, and 5 are expected to be accurate to within -30% and +50%.

  In addition, for the purposes of the SFS a discount rate of 7.0 percent should be used.[38] Applying this larger discount rate (Boeing used a rate of 0.6%) significantly reduces the cost differentials between remedial alternatives 3, 4 and 5. Use of the 7.0 percent discount rate and the accuracy (-30% and +50%) of the costs, results in a much smaller cost differential between remedial alternatives 3, 4 and 5.

37. Section 3.3 Results of Disproportionate Cost Analysis, Pages 3-4 and 3-5: Based on Ecology's analysis of the DCA criteria and using our best professional judgment (see WAC 173-340-360(3)(e)(ii)(C)), remedial alternatives 3, 4, and 5 are ranked equivalently. Alternative 3 was an acceptable remedial alternative to Ecology that

[38]EPA 540-R-00-002, July 2000, A guide to Developing and Documenting Cost Estimates During the Feasibility Study.

Boeing elected not to pursue. Alternative 4 was Ecology's preferred remedial alternative under the Draft Uplands FS report. However, as we stated in our August 6, 2018 letter, alternative 5 (source area enhanced bioremediation and downgradient DGR) *has the potential to be effective as source area and downgradient in-situ bioremediation (alternative 4) both technically and from a cost perspective* and Ecology has accepted the preliminary design of the DGR system with EISB source area treatment as the groundwater treatment technology. Alternatives 3 and 4 are viable remedial alternatives to consider if, later, alternative 5 is deemed unable to meet the site's cleanup objectives.

38. Section 4.0 Evaluation of Groundwater Point of Compliance, Page 4-1, Paragraph 2: Ecology's disagrees with the text in this paragraph. Our August 6, 2018 letter stated that: *Ecology reviewed with Boeing the preliminary groundwater cleanup level for the site. Under the Model Toxics Control Act (MTCA), groundwater cleanup levels are set using the criteria in WAC 173-340-720. For a Standard Method B potable groundwater cleanup level based on a drinking water beneficial use, the cleanup level must be at least as stringent as concentrations established in setting MTCA surface water cleanup levels (WAC 173-340-730) protecting surface water beneficial uses. See WAC 173-340-720(4)(b)(ii). For TCE, a cleanup level protective of drinking water would be set at 4 µg/L, while a cleanup level as stringent as the surface water cleanup level would be set at 0.3 µg/L.*

39. Section 4.1.1 Technical Impracticability of Meeting the Surface Water Cleanup Levels in Groundwater throughout the Site in a Reasonable Time Frame, Page 4-2, Paragraph 1 through Page 4-3: Boeing uses the term *technical impracticability* in its discussion here. As we discuss in Attachment A, MTCA does not have a "technical impracticability" option in evaluating remedial actions (CERCLA does use this term). Under the MTCA DCA evaluation criterion of technical/administrative implementability, remedial alternatives are assessed to determine whether they are *technically **possible*** to implement, and can be implemented in a reliable and effective manner. Boeing provided the following rankings for this criterion: POC option 2b (7 = excellent), option 3 (5= good), option 4 (3 = fair), option 5 (1 poor). Ecology believes the rankings assigned to options 3 through 5 should be higher, as explained in Attachment A. But in any case, Boeing's own rankings indicate that Options 2b through 4 are associated with remedies and POCs that are technically possible to implement and implement in a reliable and effective manner.

    All characteristics of the Esperance Sand Aquifer point to good results with remedial alternative #5 (EISB and DGR) coupled with POC options #2b through 5. (Refer to tables 4.1 and 4.3.) On page 4-3 of the Report, Boeing compares and extrapolates the results from other sites where DGR was used in order to justify the company's conclusion that DGR will be unable to achieve groundwater cleanup levels at POC options 2b

through 5. Case studies and examples can be helpful in selection and engineering design of a remedy.[39] But translating results from a case study to the Everett site is only reasonable if the two cleanup sites have similar hydrogeological and contaminant characteristics. Different site-specific conditions at the case study sites make it difficult to use the outcomes at those sites to predict remedy effectiveness at the Everett site before a remedy has even been designed.

The Esperance Sand Aquifer is relatively homogenous and conductive (relatively high permeability), and contains low total organic carbon (TOC), few silt units (so the potential for significant contaminant sorption/desorption is relatively low), no known source-area DNAPL, and no low permeability, highly heterogeneous geology. While we acknowledge that groundwater geochemistry is not generally conducive to the natural biodegradation of TCE, these other site-specific characteristics suggest that it should be technically possible to achieve low groundwater cleanup levels. Restoration timeframes may be long (decades), but the determination as to whether an alternative's timeframe is "reasonable" is based on a number of factors, foremost of which is the capability of a competing alternative to meet the same remedial objectives within a shorter period.

In our opinion, the key to cleanup success will be sufficient source area groundwater remediation using enhanced bioremediation[40] (below the 100 µg/L TCE threshold proposed by Boeing), which will then allow the downgradient DGR system to flush fewer pore volumes of groundwater through the downgradient aquifer system in order to reach the low groundwater cleanup levels. Given the size and concentration of the TCE groundwater plume, a restoration time frame of several decades for remedial alternative 5 to achieve groundwater cleanup levels at POC options #3 through 5 is, from our perspective, reasonable.

40. Section 4.1.2 Reasonableness of Estimated Restoration Timeframes to Meet Cleanup Standards at Evaluated Points of Compliance, Page 4-4, Paragraphs 2 and 3:

    The intent of WAC 173-340-360(4) is to require a determination as to whether the proposed cleanup action's restoration timeframe is "too long." If it is practicable to achieve a shorter restoration timeframe with a different or modified remedy, the proposed action's timeframe may not be *reasonable*. WAC 173-340-360(4) is not one of the evaluation criteria utilized in WAC 173-340-360(3) for determining whether a proposed cleanup action uses permanent solutions to the maximum extent practicable.

[39] Many of these case studies involved sites where DNAPL source material was present as well as dissolved groundwater contamination. Many of the sites were also characterized as having complex, low permeability, and highly heterogeneous geology.

[40] It is not clear if any of the DGR sites referenced by Boeing used the same enhanced bioremediation in the source area.

Boeing's Report, however, appears to be using this MTCA regulation to assert that a cleanup action designed to achieve less remediation at the site should, if its restoration timeframe is shorter, be favored over an action with higher performance expectations if the timeframe for attaining these higher expectations is longer. The Report therefore concludes that the estimated restoration timeframe for the cleanup action associated with groundwater CPOC option 1 (15-23 years) is – among the options evaluated – the only reasonable timeframe.

However, the cleanup action associated with any groundwater POC must be the action that uses permanent solutions to the maximum extent practicable. If that action utilizes a groundwater CPOC it is only because it is not practicable to meet the groundwater cleanup level – whether that cleanup level is based on drinking water or surface water protection – throughout the site within a reasonable restoration timeframe, and:

- The COPC is located as close as practicable to the contamination source, and
- The action uses "all practicable methods of treatment."

As explained above, and in Attachment A, POC options 1, 2a, and 2b (and their associated remedial alternatives) do not, in our opinion, fully meet these requirements.

Remedial alternative 5 using groundwater POC options 3, 4 or 5 have estimated restoration timeframes between 24-48 years (Table 4-1). As previously stated, when considering the evaluation factors in WAC 173-340-360(4)(b), these timeframes are reasonable given the size and magnitude of the TCE groundwater plume.[41]

41. Section 4.2 Factors for Use for an Off-Property Conditional Point of Compliance, Page 4-5, Paragraph (a): Ecology acknowledges that contaminated groundwater is entering and will continue to enter Powder Mill Creek. However, the downgradient DGR system can be further optimized to minimize the amount of TCE-contaminated groundwater discharging to the creek. Currently, surface water TCE concentrations exceed Washington surface water quality standards by an order of magnitude or more. Groundwater seep TCE concentrations are higher than in-stream surface water samples.

42. Section 4.2 Factors for Use for an Off-Property Conditional Point of Compliance, Page 4-5, Paragraph (b): A longer, yet reasonable restoration timeframe is expected for attainment of the groundwater cleanup level with remedial alternative 5 using groundwater POC options 2b through 5. But a longer, yet reasonable, restoration timeframe does not mean that remediation to cleanup levels is not technically possible (see WAC-360(3)(f)(vi)), as Boeing asserts. In addition, under POC Option 2a, most of the 'attenuation' occurring within the transition zone during the rainy season will be due to dilution from the influx of surface water (losing stream) into the groundwater transition zone.

[41] Practicability of achieving a shorter restoration time frame, lower effectiveness of ICs, high toxicity of TCE, etc.

43. Section 4.2 Factors for Use for an Off-Property Conditional Point of Compliance, Page 4-5, Paragraph (d): Ecology acknowledges that the downgradient groundwater interim action (groundwater extraction wells and treatment of extracted TCE groundwater prior to discharge to the creek under a NPDES permit) has shown positive results. However, in order for a final remedy to meet the MTCA requirement for an off-property conditional point of compliance, all known available and reasonable methods of treatment must be used on groundwater prior to releasing it to surface water. To employ all methods of treatment, would require more enhanced bioremediation in the TCE source area, and optimization of the number and flow rates of injection and extraction wells. These changes would maximize the amount of TCE-contaminated groundwater removed from the aquifer, reduce the restoration timeframe, and further minimize the amount of that TCE bypassing groundwater extraction wells and discharging to the creek. Ecology expects that optimization will continue throughout the duration of DGR system operation.

44. Section 4.3.1 Points of Compliance Being Evaluated, Page 4-7, Paragraph 1: Remedial alternative 4 with groundwater POC option 1 cannot be used as the proposed DCA 'baseline' option since it, and its associated remedy, is not the most practicable permanent solution (see WAC 173-340-360(3)(e)(ii)(B), and the discussion above and in Attachment A). In addition, the conditions for use of any groundwater CPOC at the City of Everett property must meet more stringent requirements in WAC 173-340-720(8)(d)(ii) not those of WAC 173-340-720(8)(d)(i).

45. Footnote #25: Boeing states that they are committed to addressing groundwater seeps per their November 16, 2017 technical memo. However, that technical memo does not state how it will identify all groundwater seeps along the ¾ mile stretch of contaminated groundwater. While it is an admirable goal, Ecology believes this is not possible to do. Nor is it possible, in our opinion, to accurately identify the groundwater/surface water transition zone for monitoring along that same length of creek. In this stretch of the creek the creek channel varies seasonally and from large storm events. Groundwater seeps can be found in old creek channels and wetland areas near the creek.

    We also disagree that seeps present a very minor contribution to total flow and mass discharge. Boeing did not provide any reasonable basis for making this statement.

46. Section 4.3.1 Points of Compliance Being Evaluated, Page 4-8, Paragraph 2, Bullet #1 Please see Comment #44 and Attachment A for further explanation why POC option 1 is not allowed under the MTCA regulations (and therefore not allowed as the baseline option). In addition, the conditions for use of any groundwater CPOC on the City of Everett property must meet more stringent requirements in WAC 173-340-720(8)(d)(ii) not those of WAC 173-340-720(8)(d)(i).

47. Section 4.3.1 Points of Compliance Being Evaluated, Page 4-8, Paragraph 2, Bullet #2: As noted above, groundwater POC option 2a and its associated remedy do not fully meet WAC 173-340-720(8)(c),(d) and -360(2)(a) requirements (please see Attachment A).

48. Section 4.3.1 Points of Compliance Being Evaluated, Page 4-8, Paragraph 2, Bullet #3: The location of groundwater POC option 2b is not as close as practicable to the contamination source and remedial alternative 5 applied at POC Option 2b is not permanent to the maximum extent practicable. (please see Attachment A).

49. Section 4.3.1 Points of Compliance Being Evaluated, Page 4-9, Paragraphs 3 and 4: Boeing states: *The use of both a standard POC and a CPOC is inconsistent with the application of CPOCs in groundwater under MTCA.* WAC 173-340-720(8)(c) does not discuss those scenarios where a cleanup action includes the establishment of multiple groundwater POCs. For most sites and cleanup actions a single groundwater POC is sufficient to meet the "expectations for cleanup action alternatives" required by WAC 173-340-370. However, WAC 173-340-720 does not disallow the use of multiple POCs and for some site-specific situations the use of more than a single groundwater POC may be reasonably justified.

50. Section 4.3.2 Points of Compliance Evaluation Criteria, Protectiveness, (a) Overall protectiveness of human health and the environment, (b) including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, (c) on-site and off-site risks resulting from implementing the alternative, and (d) improvement of the overall environmental quality, Pages 4-10 to 4-11: Please see Attachment A and our comments above regarding groundwater POC options 1, 2a and 2b.

    In addition, Ecology also does not agree with following statement: *It was previously demonstrated that when drinking water cleanup levels were achieved in groundwater at the standard POC, SWQS would be met in the creek (Boeing 2017b, c). The data trends from this previous evaluation show that, if the drinking water cleanup level for TCE (4 µg/L) is met throughout groundwater, surface water TCE concentrations will not only meet but are predicted to be below the SWQS (0.3 µg/L). Specifically, an evaluation of TCE concentrations in groundwater and surface water along groundwater flow path transects between the core of the plume and the creek demonstrated that once TCE concentrations have been reduced to 4 µg/L in groundwater throughout the Site that the TCE concentrations in the creek would be well below the SWQS of 0.3 µg/L, see Figure 4-7(and Figures 4-7a–c).*

    We do not agree with the asserted data correlation between groundwater TCE concentrations and surface water concentrations. The site's groundwater TCE concentrations, surface water TCE concentrations, hydrogeology, and groundwater flow

paths are far too complicated to be represented by this simplified data correlation. Additional justification for our disagreement is provided in Attachment C.

Ecology's evaluation of this criteria for meeting groundwater cleanup levels at groundwater POC options 2b through 5 is included in Attachment A.

51. Section 4.3.2 Points of Compliance Evaluation Criteria, Permanence – (a) The degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, (b) including the adequacy of the alternative in destroying the hazardous substances, (c) the reduction or elimination of hazardous substance releases and sources of releases, (d) the degree of irreversibility of waste treatment process, and (e) the characteristics and quantity of treatment residuals generated, pages 4-12 to 4-13: The SFS report asserts that: (1) only a small amount of TCE mass would be removed from the aquifer between achieving the drinking water MCL and meeting the 0.3 µg/L TCE groundwater cleanup level; and, (2) there is very little difference in TCE mass removal between the six POC options under remedial alternative 5.

    The Report fails to recognize that in a conductive/permeable aquifer a small amount of TCE mass can contaminate a large volume of groundwater to concentrations above cleanup levels. The Esperance Sand Aquifer at the Boeing site is conductive and discharges to Powder Mill Creek. Roughly two gallons of TCE can create a downgradient plume that is nearly 3000 feet long and a few hundred feet wide, and result in exceedances of the Washington surface water quality standards in the creek.

    Ecology's evaluation of this criterion for meeting groundwater cleanup levels –at groundwater POC options 2b through 5 (utilizing remedial alternative 5) is included in Attachment A.

52. Effectiveness over the long term – Long-term effectiveness includes (a) the degree of certainty that the alternative will be successful, (b) the reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, (c) the magnitude of residual risk with the alternative in place, and (d) the effectiveness of controls required to manage treatment residues or remaining wastes, pages 4-13 to 4-14: The Report states that implementing remedial alternative 5 to attain groundwater cleanup levels at groundwater POC options farther from the creek is technically impracticable.

    Ecology's disagrees with Boeing's position on this criterion. Please see our discussions in Attachment A (Technical Implementability) and comments #5, #39 and #42 above for Ecology's evaluation of the long-term effectiveness criterion for implementing remedial alternative 5 using POC options 2b through 5.

53. Management of short term risks-The risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks, Page 4-14: Boeing can implement measures to manage potential short term risks regardless of where the POC is located. The company can also implement measures to minimize the potential for (any) short-term risks associated with **construction and implementation** of remedial alternative 5 (including the safety hazards related to drilling and installing additional monitoring wells).

54. Technical and administrative implementability-Ability to be implemented including consideration of (a) whether the alternative is technically possible, (b) availability of necessary off-site facilities, services and materials, (c) administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, (d) access for construction operations and monitoring, and (e) integration with existing facility operations and other current or potential remedial actions, Pages 4-15 to 4-16: Ecology believes that it is technically possible to implement remedial alternative 5 to attain groundwater cleanup levels at all groundwater POC options. We also believe when implementing remedial alternative 5 with each evaluated POC option:
    - The necessary **off-site facilities, services and materials** are available,
    - The **administrative and regulatory requirements** are similar, and
    - The needs for **integration with existing facility operations and other current or potential remedial actions** are similar.

    For example, Ecology expects off-property groundwater monitoring regardless of the Ecology POC location. Groundwater sampling of wells installed in the source area (detention basin) and removal of contaminated sediment from the stormwater basins will occur regardless of the groundwater POC selected. Also refer to Attachment A (Technical Implementability) and comment #39 above.

55. Consideration of Public Concerns-Whether the community has concerns regarding the alternative and, if so, the extent to which the alternative addresses those concerns. This process includes concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the site. Page 4-16: Please see Ecology's evaluation of this criterion for implementing remedial alternative 5 using POC options 2b through 5 in Attachment A.

56. Cost-The cost to implement the alternative, including the cost of construction, the net present value of any long-term costs, and agency oversight costs that are cost recoverable. Long-term costs include operation and maintenance costs, monitoring costs, equipment replacement costs, and the cost of maintaining institutional controls. Cost estimates for treatment technologies shall describe pretreatment, analytical, labor, and waste management costs. The design life of the cleanup action shall be estimated and the

cost of replacement or repair of major elements shall be included in the cost estimate, Page 4-16: Please see Ecology's evaluation of this criterion for implementing remedial alternative 5 using POC options 2b through 5 in Attachments A and B.

57. Section 4.3.3 Point of Compliance Evaluation Results-Protectiveness, Page 4-17: Under this criterion Ecology ranks Remedial Alternative 5 using POC options 2b through 5 as:

POC Option 5>4>3>>2b

The Report states that reaching a cleanup level at any of the Options faster is more protective. All else being equal, Ecology agrees. But the Report also seems to assert that an action that quickly reaches cleanup levels at a POC location well downgradient of the source area is more protective than an action that reaches cleanup levels slower because it remediates more groundwater in order to reach cleanup levels at a POC located farther upgradient. Ecology believes that faster attainment when the POC locations are different (and closer to receptors) is not necessarily more protective of human health and the environment. Improving environmental quality and reducing the potential for elevated levels of TCE-contaminated groundwater to discharge to Powder Mill Creek are important protectiveness-related cleanup goals. Achieving them is best accomplished by establishing the CPOC as close as practicable to the TCE source. Refer to Paragraphs 40 and 50 above, and Attachment A.

58. Section 4.3.3 Point of Compliance Evaluation Results-Permanence, Page 4-17: Under this criterion Ecology ranks Remedial Alternative 5 using POC options 2b through 5 as:

POC Option 5>4>3>>2b

The closer the CPOC is to the TCE source (under the detention basin) the higher degree of permanence, because additional contaminant mass is removed, and contaminant mobility to downgradient areas is reduced. The additional reduction of contaminant mass is permanent, effectively destroying the hazardous substances. Boeing's Report argues that regardless of the groundwater POC location, only a small amount of TCE mass will be in the aquifer after completing groundwater remediation. This may be true. But if the "completion of groundwater remediation" is defined as attainment of a 4.0 µg/L TCE concentration throughout the plume, the additional reduction of TCE mass (of whatever amount) and mobility reduction needed to achieve a level of 0.3 µg/L at the more upgradient POC locations enhances the permanence of their associated cleanup actions. Also refer to Paragraph 51 above and Attachment A.

59. Section 4.3.3 Point of Compliance Evaluation Results-Effectiveness Over the Long Term, Page 4-17: Under this criterion Ecology ranks Remedial Alternative 5 using POC options 2b through 5 as:

POC Option 5>4>3>>2b

Boeing' Report states that a longer restoration timeframe results in a higher probability of remediation system failure and, therefore, a lower effectiveness of the action over the long term. One could argue, though, that the longer any system operates the more likely it becomes that its components will malfunction and require repair, replacement, etc. But while we agree that any remedial action risks system upsets and shutdowns due to mechanical failures, proper engineering design and frequent O&M implementation can reduce system shutdowns and failures.

Instead of focusing only on the treatment systems themselves, Ecology evaluated the effectiveness criterion in terms of the remedial action (alternative 5 and its groundwater POC) reliability in preventing TCE groundwater discharges above Washington surface water quality standards to the creek. When this is the primary test of long-term effectiveness, we believe a POC located closer to (or as close as practicable to) to the TCE source will, over the long term, more effectively and reliably (i.e., with less uncertainty) prevent hot-spot TCE groundwater zones from ultimately discharging to the creek.

Refer to Attachment A and comment #52 above.

60. Section 4.3.3 Point of Compliance Evaluation Results-Management of Short Term Risks, Page 4-17: Under this criterion Ecology ranks remedial alternative 5 using POC options 2b through 5 as:

    POC Option 5=4=3=2b

    Please see Attachment A and comment 53.

61. Section 4.3.3 Point of Compliance Evaluation Results-Technical and Administrative Implementability, Page 4-17: Under this criterion Ecology ranks remedial alternative 5 using POC options 2b through 5 as:

    POC Option 5=4=3>>2b.

    As part of the evaluation of this criterion it is, of course, important to determine whether it is technically possible for remedial alternative 5 associated with each POC option to meet groundwater cleanup levels at each POC option.[42] Boeing's Report states that it is technically impracticable to implement remedial alternative 5 to attain these standards if the groundwater POC is established at locations corresponding to POC options #2b through #5. However, as we note above, Boeing's own evaluation of remedial alternative 5 using POC Options 2b, 3, and 4 appears to conclude that each would eventually, but effectively, reach these goals.

[42] **"Technically possible"** means capable of being designed, constructed and implemented in a reliable and effective manner, regardless of cost. WAC 173-340-200.

Boeing's Report states that: *The degree of administrative challenges associated with maintaining property access agreements with at three separate offsite property owners increases commensurate with the length of additional time it takes to achieve the SWQS (including associated OM&M) progressively farther from the creek. Additionally, Option 1 would not require use of institutional controls (and associated 5-year reviews) that would have to be maintained with the other options.*

Access agreements are now in place with many off-property owners for the installation, sampling and maintenance of groundwater (and soil gas) monitoring wells. It is reasonable to assume, as the Report states, that the administrative workload associated with maintaining access agreements will, in total, be higher the longer those agreements are needed. However, in our opinion the continued maintenance (and updating) of access agreements does not, by itself, seem a large enough burden to significantly alter the POC options degrees of implementability.

Boeing's Report states that: *The degree of challenges related to integration of the remedial action with existing facility operations (i.e., Boeing Site Services performance of O&M of the detention basin) increases commensurate with the length of additional time it takes to achieve the SWQS in groundwater beneath detention basin. Similarly, the degree of challenges related to integration with sediment and surface water remedial actions (e.g., stormwater solids/sediment removal activities) also increases with time.*

Boeing did not provide any specific details to support these new assertions, but it seems reasonable to expect the number of integration-related "challenges" to increase the longer such integration is needed. O&M and annual sediment cleanout activities in the basins are required and are ongoing interim action activities. They will continue as necessary under a final cleanup action plan. Groundwater sampling of monitoring wells installed within the stormwater detention basin is also a required and ongoing interim action activity. These activities will also continue as necessary under a final cleanup action plan. Ecology generally agrees that longer restoration timeframes are associated with cleanup actions whose POCs are located closer to the source. However, the continued integration burdens Boeing refers to should not, in our opinion, significantly affect the conclusions regarding a POC's (and its associated remedy's) overall implementability.

Please see Attachment A (*Technical and Administrative Implementability)* and comment 54 above.

62. Section 4.3.3 Point of Compliance Evaluation Results - Consideration of Public Concerns, Page 4-18: Under this criterion Ecology ranks POC options 2b through 5 as:

POC Options 5=4=3>>2b

Please see Attachment A and comment #55 above.

63. Section 4.3.3 Point of Compliance Evaluation Results - Cost, Page 4-18: The use of a 7 percent discount rate, as opposed to 0.6 percent (used in the Report), results in significantly less difference in costs between the remedial alternative 5 coupled with the possible groundwater POC options. A sensitivity analysis of the POC cost estimates using a range of discount rates is provided in Attachment B. In addition, given the uncertainties associated with the cost estimates for each POC option (-30%, +50%), Ecology does not consider the NPV cost estimates for meeting groundwater cleanup levels at groundwater POC options located closer to the source area to necessarily be a great deal higher than the estimates for POC options located farther from the source area. We concluded that the incremental degree of environmental benefits obtained from using POC Option 3, over locating the CPOC much farther downgradient (as proposed in option 2b), exceeds the incrementally higher costs of POC Option 3 (over option 2b). Refer to Attachment A.

64. Section 5.1 Preferred Cleanup Action, Page 5-1: In our August 18, 2016 and July 20, 2017 letters, Ecology stated that alternatives #3 and #4 are equally permanent to the maximum extent practicable. In our letter dated February 6, 2019 we stated that alternative #4 is equally permanent to alternative #5, and we expect the two alternatives to be equally effective.

65. Section 5.2 Preferred POC for Alternative 5, Page 5-1 to 5-2: As discussed in Attachment A, POC Options 1 and 2a were eliminated from further consideration by Ecology. We elected to carry Option 2b through the DCA analysis, as well as Options 3, 4, and 5. Ecology's Attachment A-D analysis of the SFS Report concludes that remedial alternative 5 should be implemented to attain groundwater cleanup levels at POC Option 3.

    - We concluded that the incremental degree of environmental benefits obtained from implementing remedial alternative 5 using POC option 3, over implementing remedial alternative 5 using groundwater POC option 2b, exceeds the incrementally higher costs of groundwater POC Option 3 over POC Option 2b. Remedial alternative #5 using groundwater POC option 3 should be significantly more protective, permanent, effective over the long term, and more acceptable to the public.

    - Using Remedial Alternative #5, it is technically possible to achieve surface water-protective groundwater cleanup levels –as numerically stringent as the WQCs - at

POC Option 3. This conclusion is based on Table 4-1 of the SFS report and Ecology's analysis in Attachments A, and Attachment D (comments #5 and #39). Ecology disagrees with Boeing's groundwater to surface water data correlation analysis. Refer to Attachment C.

- Implementation of Remedial Alternative #5 to achieve groundwater cleanup levels at groundwater POC Option 3, concurrent with implementing required institutional controls on Boeing property, constitute a final groundwater cleanup action that meets the threshold and other requirements of WAC 173-340-360(2)(a) and (b) at a lower cost than using groundwater POC Options 4 and 5.