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AGENCY OF NATURAL RESOURCES

February 26, 2018

**COMMENTS
ON
DRAFT CONCEPTUAL SITE MODEL AND SITE INVESTIGATION REPORT
BENNINGTON, VERMONT
PREPARED BY BARR ENGINEERING
FOR SAINT-GOBAIN PERFORMANCE PLASTICS
FEBRUARY 2018**

On February 21, 2018, the Vermont Agency of Natural Resources (VT ANR) provided comments on the "Draft Interim Conceptual Site Model Site Investigation Report; Bennington, Vermont-December 2017," prepared by Barr Engineering (Barr) for Saint-Gobain Performance Plastics (Saint-Gobain). On February 15, 2018, VT ANR received an updated SI report entitled "Draft Conceptual Site Model Site Investigation Report; Bennington Vermont-February 2018," prepared by Barr for Saint-Gobain. In the comments below, the above-referenced December 2017 report will be referred to as the original SI report and the above-referenced February 2018 report will be referred to as the updated SI report. The primary difference between the original and updated SI reports is that the updated report includes data obtained from site investigation activities associated with the installation of four bedrock wells within or near the Bennington Landfill site. These comments below are considered additional to those provided to Saint-Gobain and Barr on February 21, 2018, and focus primarily on the new data, figures, tables, and narrative generated from the bedrock-related site investigation activities. After receiving a final SI report in March 2018, the VT ANR reserves the right to provide additional comments.

Response to Barr's Findings-General Comments

In the updated SI report, Barr makes the following findings in their Executive Summary:

- *Hydrogeologic conditions are similar to those used in the conceptual site model (CSM*);
- *Relationships and trends in PFAS concentrations indicate that current concentrations in CAAII soils are not indicative of historical impacts from the former Chemfab facilities;*
- *Statistical analysis of available groundwater data from this investigation suggest different (multiple) PFAS sources, including the Bennington Landfill, as reflected by groundwater of different PFAS composition;*
- *Concentrations of PFAS compounds in the bedrock aquifer at Bennington Landfill are highest directly downgradient (southwest) of the landfill cap area; are at much lower concentrations upgradient of this area; are consistent with bedrock flow through fractures and zones of*

bedrock alteration forming discrete flow paths In the Summary Section, Barr stated that the bedrock analytical data indicate that the Bennington Landfill is the primary source of PFAS in groundwater south and southwest of the landfill. and

- *Measured soil concentrations across the investigation area are generally consistent with background concentrations and may also be indicative of localized sources of PFAS.*

VT ANR's general response to these findings are provided:

1. *Hydrogeologic conditions are similar to those used in the conceptual site model (CSM)*

   VT ANR does not agree with this conclusion because the new SI data show that there are sufficient differences in the hydrogeologic conditions that warrant an update to the CSM and the applicable numerical models prepared by Barr Engineering. VT ANR provided remarks on this finding in previous comments (VT ANR comments dated February 21, 2018) on the original SI. In addition, this updated SI report lacks discussion of the influence of major structural features on the CSM, particularly groundwater flow and contaminant migration. The final report must address the influence of these major geologic features on the CMS. As stated in our comments on the original SI, the input parameters of the unsaturated zone and groundwater model also must be revised to reflect the fact that there is more organic carbon present in the subsurface than assumed in Barr's numerical models.

2. *Relationships and trends in PFAS concentrations indicate that current concentrations in CAAII soils are not indicative of historical impacts from the former Chemfab facilities*

   VT ANR does not agree with this finding and provided remarks on this finding in previous comments (VT ANR comments dated February 21, 2018) on the original SI, which included the following:

   - Air modeling, completed by both Barr and VT ANR, indicates PFOA deposition occurred throughout CAA II from the former Chemfab facilities; and
   - The concern that soil sample collected predominately in disturbed areas compromise the ability to evaluate relationships and trends in PFAS distribution and to assess the measured distribution of PFAS in soils and groundwater against the predicted distribution based on modeling of air emissions from the former Chemfab facilities.

3. *Statistical analysis of available groundwater data from this investigation suggest different (multiple) PFAS sources, including the Bennington Landfill, as reflected by groundwater of different PFAS composition.*

   VT ANR does not agree with this finding and provided remarks on this finding in previous comments (VT ANR comments dated February 21, 2018) on the original SI. In addition, VT ANR has several other issues concerning this analysis. First, PFOS detection limits in many samples around the former Chemfab Water Street facility were elevated (many wells, including the Water Street monitoring wells, had detection limits for PFOS of 40 or 13 ng/l, higher than many of the PFOS detects near the landfill of <10 ng/l). Second, the ratio of PFHpA/PFOA in most drinking water well samples, in addition to the groundwater samples taken as part of this site investigation, have a ratio of PFHpA/PFOA of 0.02-0.05, compared to the ratio of PFHpA/PFOA (ranging from 0.22 to 0.28) in SG3-MW17-BR2, which Barr identified to be influenced by the landfill. On the other hand, the ratio in SG3-MW17-BR3, the reported downgradient bedrock monitoring well from the landfill, is 0.03, which is consistent with the area-wide ratio. Third, even using the groupings presented in the report (Figure 4.12), there is no clear spatial representation of the three independent groups. For the most part, the data points are randomly spread around the site, specifically for Group C. VT ANR does not agree with Barr's interpretation that the patterns of groupings can explain any specific source(s) for the PFAS identified in this analysis. Even if there are other possible localized sources of PFAS in select wells, the low levels of all other PFAS compounds, other than PFOA, does not clearly indicate a source for the PFOA identified in these wells.

4. *Concentrations of PFAS compounds in the bedrock aquifer at Bennington Landfill are highest directly downgradient (southwest) of the landfill cap area; are at much lower concentrations upgradient of this area; are consistent with bedrock flow through fractures and zones of bedrock alteration forming discrete flow paths. In the Summary Section, Barr states that the bedrock analytical data indicate that the Bennington Landfill is the primary source of PFAS in groundwater south and southwest of the landfill.*

   The sections of the updated report that pertain to the hydrogeology and PFAS fate & transport for the Bennington area is confusing, contradictory, and does not adequately explain how PFAS transport can occur from the landfill waste and/or soils to the groundwater under the landfill to groundwater outside the landfill. Barr must revise the updated SI report to adequately explain this and to make it less confusing. The revision must address the following:

   The February 2018 CSM by Barr Engineering acknowledges that groundwater flow directions in the bedrock aquifer in the Bennington landfill area are complex, heterogeneous, and spatially variable, but they do not integrate all existing data sets at the scale of the landfill to comprehensively characterize the aquifer(s). The regional potentiometric contour map for the bedrock aquifer (Kim and Dowey, VG2017-4D) is not of suitable scale for a detailed look in this area (as noted on the map), since it does not include the static water level information from the McLaren/Hart (1997) report (or the recent work by Barr/Golder/RealTime Aquifer Services). Barr must revise the "landfill CSM" to include the following:

   - Potentiometric surface contour map of the surficial aquifer.
   - Potentiometric surface contour map of the bedrock aquifer.
   - Bedrock surface contour map.
   - Overburden thickness (isopach) map.
   - Ocher/Kaolin thickness map.
   - Geophysical logs placed in the structural (anticline) and lithologic (formation contact) context of the bedrock geologic map.
   - PFAS fate and transport

5. *Measured soil concentrations across the investigation area are generally consistent with background concentrations and may also be indicative of localized sources of PFAS.*

   VT ANR does not agree with this finding/conclusion and provided remarks on this finding/conclusion in our February 21, 2018 letter on the original SI. As stated, and supported, in previous comments on the original SI, VT ANR has concluded that the variability in data does not support Barr's basis for applying a background adjustment to explain why their model simulations under-predicts the measured PFOA concentrations found in area-wide groundwater. Another explanation for the under-prediction of PFOA in their model simulations is that the emission rates were greater than used in their model.

Specific Comments

6. Section 2.3 Characteristics of PFOA, PFOS, and Associated Compounds (Page 8), last sentence – The updated SI report states, "Very small sources of PFOA and PFOS can result in detections in groundwater in the ppt and parts per billion (ppb) range." VT ANR agrees, SPLP testing of soils at site shows non-detect levels in soils (less than 1 ppb PFOA) can result in detectable levels of PFOA in water extract. This could be one explanation into why at some parts of CAA II PFOA is not detected in soils samples but is found in groundwater samples.

7. Section 3.2.3.2 Flow Logging, paragraph 2 (Page 19) – The updated SI report states, "This suggests that flow through the borehole is predominately lateral." This statement, along with others to follow pertaining to groundwater flow around the landfill, is confusing. As stated in Comment 3, VT ANR requests that Barr explains their statements about groundwater flow around the landfill.

8. Section 3.2.3.3 Discrete Interval Sampling (Page 20), paragraph 3 - This paragraph appears to contradict itself. The updated SI report does not provide sufficient information that supports the claim that apparent leakage during the packer tests is from hydraulic connections around the borehole through fractures rather than inadequate packer inflation. In either case (vertical fractures or an inadequate seal), mixing of water during discreate sampling intervals is inevitably occurring.

9. Section 3.3.5-Hydraulic Conductivity- The hydraulic conductivity values derived from specific capacity testing of the four new bedrock wells was significantly higher in 3 of the four bedrock wells (Table 3.15 and Table G.4.1) than the K used in the groundwater model (1 ft/d). Barr must revise their groundwater model and CSM to reflect this site-specific data or substantiate why incorporating site-specific data is not warranted.

10. Section 4.2.2.2 Bedrock Aquifer (Page 37), paragraph 3 – The updated SI report states, "The barometric response observed in the transducer data indicates that the bedrock aquifer is confined." This section must clarify where Barr believes that the bedrock aquifer is confined (everywhere on site, in CAA II, or just around the landfill) and explain the transport mechanism that is taking the PFAS from the landfill into this aquifer.

11. Section 4.2.3 Hydrogeologic Setting of the Bennington Landfill – This section requires revisions to address the following:

    a. As stated in Comment 4, a potentiometric surface contour map of the bedrock aquifer for the Bennington landfill area is needed using bedrock water level data from bedrock monitoring wells within and near the landfill and from drinking water wells installed with pressure transducers. The hydrogeology section on the Bennington landfill discusses the presence of discrete flow pathways and the hydrologic significance of the hydrothermally altered bedrock (previously referred to as saprolite by McLaren and Hart) and groundwater flow direction. In subsection 4.2.3.1, the report indicates it intention to evaluate the existence of "discrete flow paths" in bedrock. This section does little more than to acknowledge that the bedrock system comprises a discrete fracture network, which over an equivalent elemental volume, can be approximated or modeled as an equivalent porous media. Due to the degree of fracturing encountered, the elemental volume at which the system behaves as an equivalent porous media should not be large and it should be possible to interpret potentiometric surfaces and groundwater flow directions with the scale of the Bennington Landfill setting.

b. Section 4.2.3.2 Hydraulic Significance of Bedrock Alteration - This section concludes that the altered bedrock (whether of Cheshire or Dunham Formation) is more transmissive than unaltered bedrock without an explanation. An explanation must be provided to support this conclusion and to address whether the altered bedrock and unaltered bedrock represent the same or different hydro-stratigraphic units.

c. Section 4.2.3.3 Groundwater Levels and Flow Directions – This section provides no technical evaluation of the water level data collected. The introduction to the section concludes that the groundwater conditions in the discretely fractured bedrock are too heterogeneous and complicated to allow interpretation of heads and flow directions in the bedrock aquifer. The subsection goes on to concur with the interpretation of McLaren/Hart of the existence of a perched overburden groundwater system underlying the landfill that flows toward the southeast. The second paragraph of this section states that directions of groundwater inferred from this recent study and regional mapping are to the west and southwest. The section goes on to state that the water levels measured in older bedrock wells at the landfill were consistent with historical data from McLaren/Hart but fails to acknowledge that McLaren/Hart interpreted deep bedrock groundwater to have a west to east flow direction component under the landfill. The updated SI report makes no effort to compare the water levels from its own study to the very generalized regional groundwater flow map present by Kim and Downey (2017). This paragraph also places unreasonable weight on the water levels from SG3-MW-17-BR2 as being indicative of potentiometric conditions that defy interpretation due to heterogeneity. Discussion is needed that addresses the comments within this paragraph and explain why there is a large hydraulic head drop from the unaltered to the altered bedrock or articulate whether this large hydraulic head drop indicates that the unaltered Cheshire and altered Cheshire/Dunham represents two separate and distinct hydro-stratigraphic units. Also, more explanation, including supporting discussion of hydraulic head distribution and consideration of the previously discussed geology, is needed to support the conclusion in this section that the orientation of fractures has a greater control on groundwater flow direction at the local (landfill scale).

12. Section 4.3.1.2 Spatial Trends in Soil PFAS - Explain how the statistical analysis of trends in PFOA would be affected by fact that the majority of soils samples being collected from

previously disturbed soil horizons when the objective was collection of samples from undisturbed (since the late 1960s) locations.

13. Section 4.3.2.2 Multivariate Analysis of Available Groundwater Data – See Comment 3.

14. Section 4.4.2 Bennington Landfill Impacts (Page 46), last paragraph – The updated SI report states, "Capping of the unlined landfill was completed in 1999, which effectively cut off the source of infiltration within the footprint of the cap." If this is true, which it may well be, then why is PFOA still present at SG3-MW17-BR2? Barr's CSM states that PFOA is not attenuated in the bedrock aquifer, and if this is the case, without an ongoing source, wouldn't all of the PFOA in the bedrock aquifer have flowed out of the groundwater system?

15. Section 4.4.2 Bennington Landfill Impacts (Page 46) – The Section states, "Since the leachate collection system was decommissioned in 2008, no leachate infiltration has occurred in the leachate infiltration gallery and little or no infiltration has occurred through the footprint of the landfill in recent years. VT ANR would again like to reiterate that the landfill leachate from the vault was treated with carbon, thereby eliminating or greatly reducing the mass of PFAS going into the leachate infiltration gallery. At the end of this paragraph it states that the PFAS would most likely be in deeper media like bedrock groundwater. As stated in previous comments, explain this transport mechanism to bedrock given the presence of confining layer(s) between the overburden saturated zone and the bedrock aquifer in the landfill area.

16. Section 4.4.2.2 Groundwater (Page 47), paragraph 2 – VT ANR does not agree with the statement that radial flow outward from the landfill could explain low level detections of PFOA in well SG3-MW17-BR1 and B-4-3 as wells as low-level detections of PFOA in private wells north and west of Bennington Landfill. The groundwater flow directions show on Figures 4.15A and 4.15B must be re-evaluated based on Comment 11. VT ANR disagrees with the conclusion that detections of PFOA (14 ng/L) in the up-gradient bedrock well (BR-1) could be a result of groundwater flow from landfill. A more in-depth analysis of the local groundwater flow conditions around the landfill is required. How does the lack of other (non-PFOA) PFAS compounds (i.e., those detected in the vault and BR-2) in well SG3-MW17-BR3, approximately 1000 feet downgradient of SG3-MW17-BR2, affect the CSM relative the fate and transport of PFAS in this area.

17. Section 4.4.2.2 Groundwater (Page 47), paragraph 3 – the updated SI report states, "PFAS concentrations in well SG3-MW17-BR2 are interpreted to be the result of leakage and downward flow from Bennington Landfill." This statement is inconsistent with the statements made on pages 19 and 46. A more clearly prepared and supported CSM of the landfill is needed. VTANR does not concur with the conclusion in this paragraph (that the landfill is the source of the PFAS identified in wells south and southwest of the landfill). If the landfill, a point source, were the source of the PFOA identified in the wells south and southwest of the landfill, one would expect that dilution and dispersion would decrease the levels of PFOA with distance from the source (the landfill). This is not what is observed in these drinking water wells. Additionally, there are a number of shallow drinking water wells in CAA II that could not be impacted in the manner that is presented in this section. Atmospheric contamination of soils around these wells is a much more plausible explanation

as to how these wells became contaminated. Lastly, the PFHpA/PFOA ratios in these wells is consistent with the levels identified in drinking water wells located near the Water Street Chemfab facility and not similar to the ratio identified in SG3-MW17-BR2.

18. Section 5.0 Summary – For the reasons stated in the previous comment letter and this letter, VTANR does not concur with many of the conclusions in this section and has concluded that atmospheric deposition from the two former Chemfab facilities is the most reasonable explanation for the PFOA identified in the drinking water wells located in CAA II. VTANR does not rule out that other potential sources of PFASs may have contributed to smaller amounts of PFAS compounds in some of the samples collected throughout the site.

19. Section 5.3.2 Bennington Landfill-Based on updated SI report, only SG-3MW17-BR 2 which is located at the boundary of the landfill cap, has other PFAS compounds similar to those found in the landfill vault. Provide a summary table and/or figure that supports the conclusion that private wells south a west of landfill are related to the other compounds (non PFOA) detected in leachate.

20. Section 5.3.2 Bennington Landfill- A CSM needs to account for all sources of contamination release. The CSM SI Report must acknowledge and evaluate the other (non - Air deposition) Chemfab contributions of PFOA to the Bennington landfill; namely the 14,000 gallons of waste from Chemfab and sludge from the WWTP disposed of at the landfill, since the WWTP received industrial process waste water from Chemfab

21. Appendix A.2 – There is no information other than the cover page. Include this information in the next report.

22. Appendix H.1 – other Sources. The assessment begins with the premise that Chemfab only emitted PFOA during manufacturing and that other PFAS compounds were not part of the dispersions used or emissions discharged. As stated in comments on the original SI report, Barr must provide evidence that supports this assertion.

23. Appendix H.2 Potential PFAS Contributions to Bennington Landfill Memorandum (dated February 8, 2018) – To avoid confusion for readers, the heading in the first row-second column must be revised to "Potential PFAS-Containing Products…" This reinforces that the list provided is not a known inventory of products used at a given facility but a suspected/potential inventory list of PFAS-containing products that a given manufacture may have used based on a literature review.