Michigan Department of Environment, Great Lakes, and Energy

Wolverine CAG – House Street Feasibility Study

The Wolverine Community Advisory Group (WCAG) represents concerned citizens that have been impacted by PFAS contamination from the Wolverine World Wide Tannery and their waste disposal sites in northern Kent County. The contaminated area covers approximately 25 square miles and PFAS compounds have been detected in 800+ residential wells and the Plainfield Township municipal water supply which serves over 40,000 people. We are responding to the House Street Property Feasibility Study (FS) – Remedial Options by Wolverine World Wide (WWW), Inc. The FS was submitted as a requirement of the Consent Decree (CD), effective February 19, 2020, presented for public comment on February 19, 2021.

The CD specifically requires "The Feasibility Study shall evaluate the following remedy options to (1) manage solid wastes at the House Street Disposal Site and (2) reduce and control potential migration of PFAS Compounds from soils and sludges into the groundwater from the House Street disposal Site."

The CAG's review of the FS concludes that of alternatives presented by WWW in the FS, the "30-acre surface cap without a bottom liner" complies with Part 201 and meets the applicable substantive requirements of Michigan's Part 115 outlined in the CD. This remedy provides a proven solution to "manage solid wastes at the House Street Disposal Site" (HSDS) and acts to substantially "reduce and control potential migration of PFAS Compounds from soils and sludges into the groundwater" as required in the CD. The 30-acre cap is also the default alternative if there is dispute between WWW and The State of Michigan. In the absence of the CAG's two suggested alternatives, not included in the FS (see below), it is the option most likely to be selected under the provisions of the CD, which governs the selection of an alternative.

However, the CAG has suggested two alternatives not included in the present FS. Initially, the House Street community would prefer an alternative that utilizes multiple methods or approaches to achieve the purposes of the CD. The CAG has also proposed an alternative that would meet the CD requirements at the HSDS, while simultaneously intercepting groundwater from the House Street plume prior to it entering the Rogue River. The CAG respectfully requests that WWW and EGLE consider these approaches, which could be implemented simultaneously.

WWW has proposed a PhytoCap remedy that includes limited capping and phytoremediation of PFAS waste using trees and plants. This proposed remedy lacks sufficient detail to show its effectiveness and how phytoremediation can be successfully implemented to manage PFAS wastes at the HSDS. Phytoremediation of PFAS is an experimental procedure and no examples of its successful use to remediate PFAS waste were provided in the FS. The CAG requested and was promised by WWW, certain backup information that would allow an informed comparison between response alternatives. Specifically, the CAG requested modeling of each alternative, which would allow the public to assess each alternative's effectiveness in limiting the continuing spread of PFAS from the House Street site. Specific time estimates as to when each alternative might reach compliance were also requested. This information has not been received from Wolverine, greatly limiting an effective comparison between alternatives. Nevertheless, the CAG has attempted to compare alternatives, based both on the limited information provided in the FS, and based on other publicly available information.

Phytoremediation is the process where contaminants in the groundwater and soil can be removed from the subsurface environment and transferred into plant tissue. Water soluble contaminants can be taken up by plant roots and moved upward into the stems, trunks, and foliage by transpiration. The same process that plants use to transport water soluble nutrients from the soil can be applied to water soluble pollutants. While trees can be used to manage runoff, studies show that trees actually enhance infiltration (Figure 1; Xie et al. 2020).

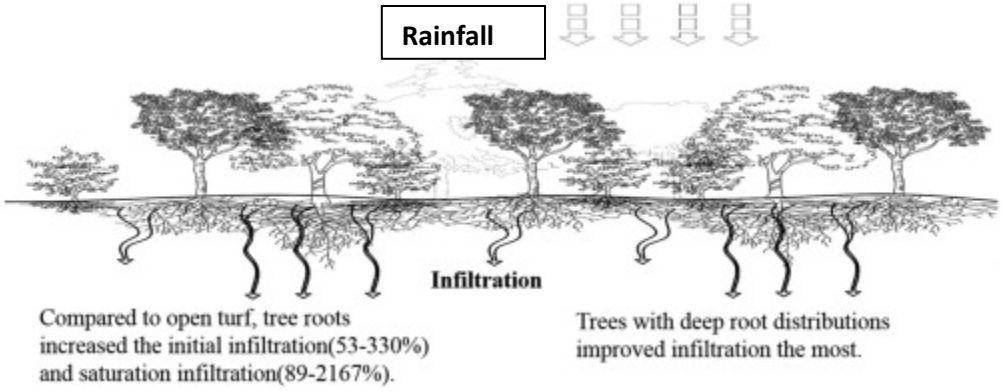

Figure 1. The enhancement of infiltration by tree roots (Xie et al., 2020).

Increasing inflow to groundwater is contrary to the requirements of the Consent Decree to "reduce and control potential migration of PFAS Compounds from soils and sludges into the groundwater from the House Street Disposal Site". The fact that infiltration will be significantly

enhanced by the PhytoCap remedy renders it less desirable than the 30-acre cap, which provides an immediate impermeable barrier upon implementation. Importantly, EPA (1999) has stated that: "general site conditions best suited for use of phytoremediation include large areas of low to moderate surface soil (0 to 3 feet) contamination or large volumes of water with low-level contamination subject to low (stringent) treatment standards. …. disadvantages include the long lengths of time required, depth limitations (3 feet for soil and 10 feet for ground water), and the possibility of contaminant entrance into the food chain through animal consumption of plant material." Cross sections of the waste included in the FS and Summary Report for the Implementation of the Extent of Contamination Study Removal Work Plan (RWP) dated May 29, 2018 show PFAS wastes are buried 3-20 feet deep. WWW also proposes to increase cover over near-surface waste to a minimum of 2 feet throughout the site. This will further bury the wastes, making them even less accessible by phytoremediation. In summary, the HSDS does not meet any of the EPA criteria for phytoremediation as the site has high levels of deep contamination in the soil and groundwater and also provides considerable opportunity for wildlife exposure.

There are 8 significant comments with respect to the Feasibility Study and the selection of the final response action for the HSDS:

1. **Remedy Option 1. Maintaining the status quo (the "No Further Action Option").** The no action alternative mentions that "Existing vegetation will continue to uptake at least some amount of PFAS from beneath the surface, thereby preventing at least some PFAS from migrating to groundwater and ultimately to surface water. Residual concentrations of PFAS at the HSDS will slowly attenuate over hundreds of years." The House Street Disposal Site is located in a forested area with mature trees improving the hydrology and providing some degree of phytoremediation. The PhytoCap alternative assumes it will ultimately provide better results than current site conditions; however, baseline conditions have not been assessed in the FS. In fact, mature trees with developed root

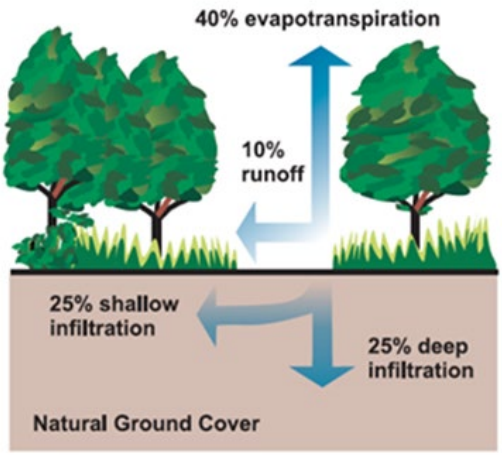

Figure 2. The hydrologic balance under natural ground cover conditions.

systems may be more effective at removing PFAS than replacing them with small specimens as part of the PhytoCap alternative. There would likely be no change in the hydrology beyond what can be expected from the mature forest under the "no action" alternative. In fact, mature trees improve deep infiltration and are frequently used in storm water management (Figure 2; FISRWG 1998). Based on the current plume, phytoremediation by the existing mature tree farm has not been effective in reducing infiltration and removing PFAS. In the FS, WWW failed to explain why their "heavily wooded property" has been ineffective with respect to infiltration management and why the proposed PhytoCap solution will be any better. The failure of the existing forest to remediate PFAS could be a function of bioavailability, root depth, waste depth and concentrations, limited growing season, and/or the natural promotion of water infiltration by trees. But such an analysis as to why there has been no phytoremediation benefit from the existing forest is lacking in the FS. WWW makes four references that phytoremediation will either reduce or control infiltration, yet they ignore the fact that forests promote infiltration. What studies have been done to evaluate the infiltration occurring in the current forested condition and how would the additional tree plantings result in a significantly different increase in infiltration reduction? Again, a mature tree canopy will reduce infiltration more than fresh transplants. In fact, there would be an obvious increase in infiltration due to removal of any of the existing canopy and digging holes to plant thousands of new trees. Was this increase in filtration factored into WWW's estimates? We know that phytoremediation will not alter the hydrology beyond what can be expected for a mature forest, which is 25% deep infiltration.

2. **Remedy Option 2 – Cap Option.** For the 30-acre Cap Alternative, WWW claims "It will take over 100 years for the Cap Option to make measurable progress toward achieving the remedial objective of this FS." To the contrary, the use of a cap is a proven and widely used technology, which will immediately cut off the infiltration pathway consistent with the CD, requiring the remedy option to "reduce and control potential migration of PFAS Compounds from soils and sludges into the groundwater from the House Street Disposal Site." Plume management is an important part of the GSI evaluation, and it starts by managing the waste on the HSDS and preventing the

migration of PFAS into the groundwater by leaching. Caps have been used successfully under Michigan Parts 111, 115, and 201 for closure of landfills and other waste disposal and contaminated sites. Contrary to the concerns noted in the FS, cap construction activities typically include:

- Use of standard construction techniques and equipment;
- Result in no more impact to roadways, truck traffic, vehicle/pedestrian safety, or clear/cutting/grubbing of wooded areas than construction of a typical residential/commercial development or operation of a gravel pit;
- The noted requirement to define the limits of near-surface waste is not unique to the capping option, but should be performed for any chosen remedial action;
- Finally, no information is provided to support 30 months to complete implementation of this project.

3. **Phytoremediation Accumulation Limits.** WWW makes the following statement "For example, spruce trees growing in soil containing 220,000 µg/kg PFOS and 50 µg/kg PFOA can extract approximately 2,000,000 µg/kg PFOS and 800 µg/kg PFOA. Growing in the same soil, willows can extract approximately 1,100,000 µg/kg PFOS and 1,200 µg/kg PFOA, birch can extract approximately 3,100,000 µg/kg PFOS and 1,800 µg/kg PFOA, and grasses can extract approximately 2,400,000 µg/kg PFOS and 1,300 µg/kg PFOA. Grown in soil containing 10,000 µg/kg PFOS and 10 µg/kg PFOA, spruce can extract approximately 96,000 µg/kg PFOS and 200 µg/kg PFOA, while willow can extract approximately 52,000 µg/kg PFOS and 300 µg/kg PFOA." No source of peer-reviewed literature for these high levels of accumulation was provided. If true, the effect of wildlife and insects consuming vegetation with 3,100,000 µg/kg PFOS needs to be seriously evaluated. The projected PFAS accumulation rates would result in Spruce tree concentrations exceeding 0.3% PFOS and require special waste management procedures to deal with fallen foliage and dead trees.
4. **PhytoCap Fails to Consider Actual Conditions.** WWW uses scientific literature to support the following claim "Multiple studies have shown a variety of plants accumulate PFAS in both roots and above-ground tissues, with accumulation depending on plant species, type of PFAS, and PFAS soil and water concentrations.

Soil organic carbon content and pH also affect PFAS uptake by plants, by influencing PFAS sorption/desorption from soil surfaces and availability in soil pore water (Huff et al., 2020; Wang et al., 2020)." The study by Huff et al. (2020) was conducted in a greenhouse using sand and PFAS laden irrigation water. It was specifically designed to not include any effects of soil/PFAS interactions or pore water concentrations. This study has limited relevance to the conditions at House Street. The paper by Wang et al (2020) correctly identified that organic carbon and soil conditions can influence the ability of plants to absorbed PFAS. GZA made no effort to quantify the soil/PFAS conditions at the House Street Site with respect to sorption and plant availability. Given the application history of highly organic, PFAS-laden tannery sludges and the significant retention of PFAS in the waste material, the feasibility of phytoremediation cannot be evaluated without this information. Poor site bioavailability may be the reason for uncontrolled migration of PFAS from the House Street Disposal Site and the inability to see reductions from phytoremediation by the existing mature forest.

5. **The Absence of Successful PFAS Phytoremediation Examples for Waste Disposal Sites.** Contrary to the discussion provided by WWW, the phytoremediation of PFAS is a presumptive approach and only one study using the technique at an actual PFAS site has been reported. Gobelius et al., 2017 evaluated the use of Phytoremediation at the Stockholm Arlanda airport where levels of 26 PFAS compounds in soil were detected in soil at concentrations ranging from 16 to 160 ng/g (16-160 ug/kg) dry weight. House Street Disposal Area soils contain PFOS levels ranging 4-81,000 ug/kg so the study site was significantly less contaminated that the location the results were applied to. Based on the study results, the extraction of PFOS by birches and spruces would need 160,000 years and 48,000 years, respectively, to achieve the target value for sensitive land use (Residential; 3 ug/kg) or 58,000 years and 18,000 years, respectively, for the non-sensitive land use (Industrial; 20 ug/kg). Based on the current status of the plume and the high level of PFAS in the source area, remedial solutions with this timeline are unacceptable and not consistent with the requirements of the CD. While additional modeling may indicate contrary results or shorter time period, the assumptions utilized by WWW in such modeling would need to be carefully

reviewed. In summary, WWW has not provided any examples of studies that show the successful use of phytoremediation at a waste disposal site with characteristics in anyway similar to the HSDS.

6. **Implementation issues.** The FS does not discuss several key issues related to the implementation of the phytoremediation remedy, including:
    a. Certain PFAS compounds like PFOS may accumulate more in the roots due to the higher partition coefficient. While WWW states they will remove fallen trees, the roots of a fallen tree will decay and recycling PFOS back to the water table.
    b. Details are lacking about how the annual dropping of needles and leaves will be managed so wildlife and the groundwater will be protected.
    c. WWW fails to provide details on how the performance of phytoremediation will be measured. How does WWW propose to monitor root depth to see if the waste deposits have coverage? How will WWW monitor and calculate the amount of PFAS being removed on an annual basis?
    d. Site remediation should be implemented in a timely manner by the responsible party to "reduce and control potential migration of PFAS Compounds from soil and sludges into the groundwater from the House Street Disposal Site." Planting trees and implementing a "wait-and-see" approach spanning 100's of years with no means to measure the success of phytoremediation does not meet site remediation objectives.

    Details are lacking about how the success of the PhytoCap will be measured. Since we are dealing with an experimental remedy that requires hundreds to thousands of years, there is a significant possibility that bioavailability, depth, and uncontrolled leaching will cause considerable migration of PFAS from the site compared to the 30-acre cap. WWW should have performance milestones for the PhytoCap and be responsible for the cost of damages and restoration if wastes are not managed properly and infiltration and leaching continue to spread the plume without control.

8. **Plume Migration Claims Must be Supported.** To provide further assurance that plume migration will be addressed with the Phyto-Cap, WWW makes multiple statements that "Wolverine will continue to address the GSI pathway through ongoing

investigation at the surface water receptor." We are unaware of any actions Wolverine is willing to undertake to address plume migration in the Phyto-Cap alternative. This statement should be deleted, or the specific actions Wolverine will take to limit plume migration needs to be included. Conducting GSI studies without the commitment to a remedial solution does not address the groundwater plume.

9. **Passive Recreation Options for the 30 Acre Cap**. There are a number of passive uses for the property with a 30 acre cap that WWW has not included in the FS. While it is necessary to fence the capped areas, the remaining 46 acres can be used for a network of hiking trails. Capped areas also can be used for observation, sledding, and kite flying with openings in the fence containing restricted access bollards to prevent motorized vehicles from damaging the cover material. The cap is vegetated, thus it can be a larger greenspace.

The plume from the HSDS has traveled past the Rogue River and now appears to have migrated to the opposite side of the Grand River from the Plainfield Township Well Field (Figure 3).

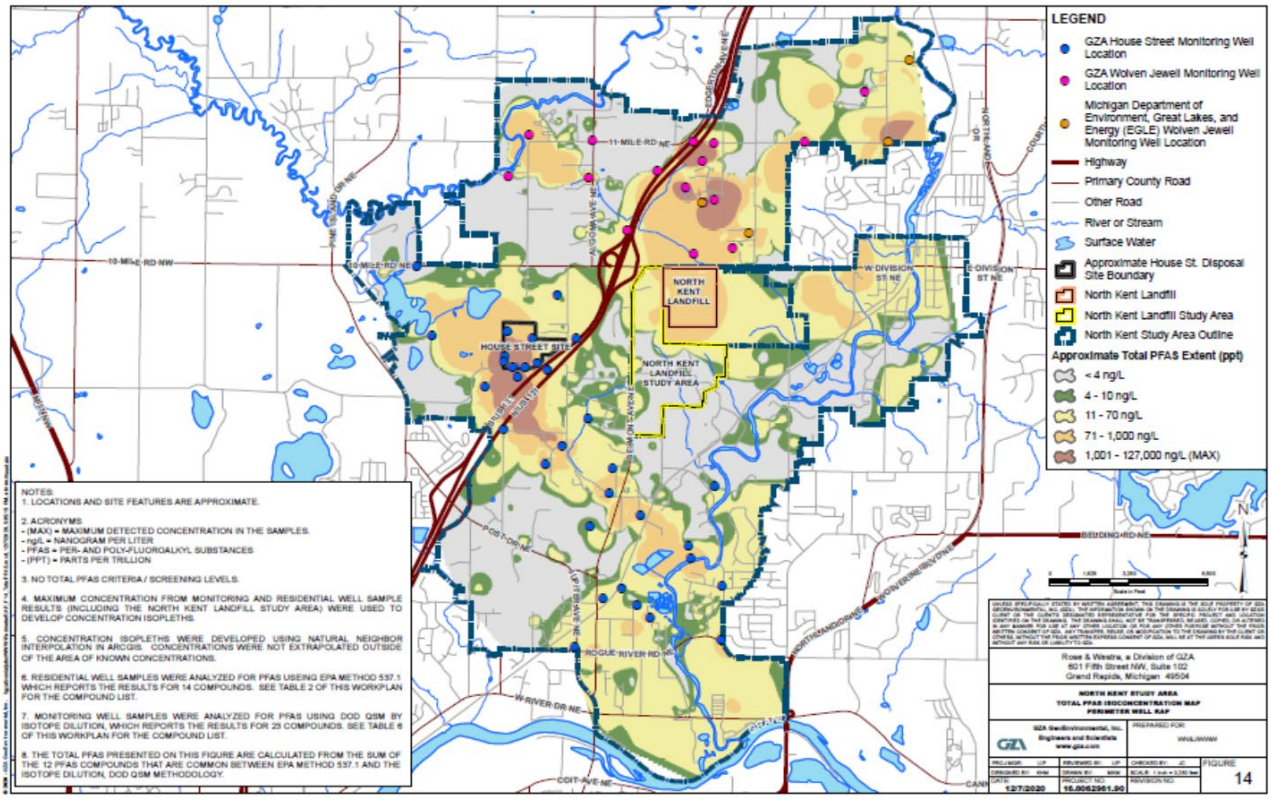

Figure 3. The House Street PFAS Plume.

The continued leaching of concentrated wastes from the source area will make controlling the impact and damages to the receiving waters and regional aquifers costlier and more difficult to remediate.

Alternative CAG Proposal 1. Remedy Option 4: Multi-Method Response Action. While WWW and the State of Michigan review "single method" options, the House Street community encourages a final solution which uses multiple methods presented in the FS. More specifically, they prefer a plan which utilizes a combination of proven remediation methods to maximize the effectiveness of this clean-up effort. Such a plan might include utilizing strategic caps where high contamination levels are known, limited excavation and removal of soil with the highest contamination levels, and the installation of a pump/treat solution to intercept a portion of the most contaminated groundwater from leaving the HSDS. To address the complexities of this contamination site, a multi-solution approach seems reasonable and may be most effective in producing measurable results toward meeting both objectives of the CD.

Alternative CAG Proposal 2. Although not currently a proposed FS alternative, the CAG recommends that the FS include a new alternative. More specifically, a multi-method approach to waste management and plume migration requirements of the CD, while simultaneously limiting the existing flow of PFAS contamination from the House Street plume (see Proposal 1 above).

With in-home PFAS filters and the provision of Plainfield Township water largely addressing human exposure within the plume area, significant impact to Rogue River surface water is the most immediate and significant human and environmental exposure pathway associated with the House Street plume migration. In fact, state surface water limits for PFAS are exceeded once the Rogue encounters the plume. The Consent Decree grants WWW additional years to assess GSI, presumably quantifying the precise amount of groundwater impacts to surface water. Unless this alternative is implemented, it will be many years before House Street plume impacts on the Rogue and downstream waters are addressed.

The CAG formally requests that both WWW and regulators consider the fact that House Street PFAS is clearly impacting the Rogue, and that WWW should install a groundwater extraction and GAC treatment system (similar to the one currently being installed at the Former

WWW Tannery). Since the Rogue is the single largest human/environmental exposure pathway for the House Street plume, it should be considered concurrently as part of the FS. Limiting the PFAS plume's impact on the Rogue goes directly to the CD requirement to "reduce and control potential migration of PFAS Compounds" from the House Street Site. Failure to address impacts to the Rogue as part of the FS will result in years of additional delay in cutting off this exposure pathway.

Conclusion

The Wolverine Community Advisory Group appreciates the opportunity to comment on the House Street FS. It is critical that the PFAS contamination at the HSDS be managed in a manner that greatly reduces the ability of PFAS to migrate into the groundwater and continue to feed the groundwater plume that is continuing to expand, impacting surface water. Of the FS Alternatives presented by WWW, the CAG supports the 30-acre cap, as it meets the CD's objectives. However, the CAG has also suggested FS alternatives which might be more expeditious and beneficial to human health and the environment. The use of a multi-method approach (combining caps of highly impacted areas, limited excavation of the worse source areas, and pump/treat of the most contaminated groundwater currently leaving the HSDS). The CAG has also recommended intercepting the House Street plume prior it entering the Rogue River, thereby addressing the most significant open exposure pathway currently existing for HSDS PFAS contamination. Both CAG-suggested alternatives could be utilized concurrently. Finally, the CAG urges the rejection of the PhytoCap remedy, because it fails to address PFAS waste leaching and lacks verifiable information that it will be an effective remedy.

Sincerely,

Richard R. Rediske, Ph.D.
Leadership Team
Wolverine Community Advisory Group

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