Rose & Westra
A Division of GZA

GEOTECHNICAL
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WATER
CONSTRUCTION MANAGEMENT

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Ms. Abigail Hendershott
Michigan Department of Environment, Great Lakes, and Energy (EGLE)
5th Floor – Unit 10
350 Ottawa Avenue NE
Grand Rapids, MI 49503

Re: Wolverine World Wide, Inc. (Wolverine)
Response to June 4, 2019 Letter

Dear Ms. Hendershott:

On behalf of Wolverine, this letter responds to the EGLE's June 4, 2019 letter entitled *Wolverine World Wide, Inc. Per- and Polyfluoroalkyl Substances (PFAS) Response Drinking Water Well Resampling Summary and Request Kent County, Michigan*. EGLE's comments and questions are set forth in italics.

1. *While EGLE recognizes that PFAS results appear consistent with those from last year as summarized in the March 21, 2019, summary report, EGLE requests that detection limits be listed in the summary tables and reports, because different laboratories were used for analysis.*

Response: As you indicated, the results of the resampling are consistent with the prior results. This is true despite the EGLE-requested change of analytical methods between the sampling events. Additionally, a switch in laboratories occurred between the two sampling events and the results were consistent. While Wolverine has already provided the detection limits information you requested in the GIS information sent to EGLE via AECOM and the PDF format laboratory reports sent directly to EGLE, we are providing that information again in the enclosed revised table.

2. *The technical approach presented in the October 16, 2018, work plan was utilized to determine which homes Rose & Westra, a Division of GZA (GZA) would resample. It is EGLE's position that this approach is not adequately supported or explained within the work plan or the March 21, 2019, summary report. In order to be protective of human health, and in lieu of resampling all remaining wells that do not have a whole house point of entry treatment system (WHF), Wolverine World Wide, Inc. (WWW) must provide a thorough evaluation of the initial hypotheses and methods used to determine which homes should be resampled within the House Street Study Area, including all supporting data. At a minimum, the following items need to be discussed and verified to provide the evidence to EGLE that the initial assumptions were verified, and that the same approach is appropriate to be applied to other sampling areas (i.e., Wolven/Jewell):*

a. *Provide analytical data validating that the mole ratio of perfluorobutane sulfonic acid (PFBS) to perfluorooctane sulfonic acid (PFOS) + perfluorooctanoic acid (PFOA) is consistent for a specific product/waste stream.*

b. *Provide data tables, graphs, and scientific rationale for determining a mole ratio of PFBS to PFOS+PFOA of 0.65 in the House Street Study Area and a ratio of 0.10 in the Wolven/ Jewell Study Area.*

c. *Explain the basis for why detections of PFOA and PFOS greater than 1,000 ng/L were excluded from GZA's evaluation, despite being closer in proximity to source areas. It is EGLE's opinion that the evaluation of groundwater contamination should also include detections of PFOA and PFOS greater than 1,000 ng/L.*

Response:

Item a: EGLE already has the data used in our calculations of the mole ratio. Certainly, different waste streams were disposed on the House Street site during its use. However, the wastes have comingled over the past 50 years, resulting in one comingled source and the PFAS plume emanating from the House Street site. The former separate waste streams are not leaching individually through over fifty feet of sand to the groundwater.

Item b: The PFBS/PFOA+PFOS mass ratios were initially calculated at individual wells by dividing the PFBS concentration by the sum of the PFOA+PFOS concentrations. The average PFBS/PFOA+PFOS ratio for individual study areas was calculated using the following formula:

$$Average\ Ratio = \frac{\sum_i^n a_i}{n}$$

Where:

$$a = \frac{PFBS}{PFOS + PFOA}$$

i = individual well results (record number 1 through n)

n = total number of individual well results in each study area

A list of residential wells that were used are enclosed. Sample dates ranged from July 18, 2017 through August 17, 2018. If an address had a point-of-entry treatment (so-called WHF) system installed at the time of sampling, influent results were used. Duplicate results were also included.

For each study area, the average PFBS/(PFOA+PFOS) ratio was calculated for the relatively low PFOA+PFOS concentration area where PFOA+PFOS concentrations were greater than 70 ng/L but less than 1,000 ng/L. The average PFBS/PFOA+PFOS ratio for the House Street Study Area is 0.65, and for the combined Wolven and Jewell Study Areas is 0.1. The average ratio for all project areas is 0.3. Given this calculated ratio, the PFBS concentration is 21 ng/L when PFOS+PFOA is equal to 70 ng/L:

$$\frac{PFBS\ (21\frac{ng}{L})}{(PFOS + PFOA)\ (70\frac{ng}{L})} = 0.3$$

Where PFOS+PFOA was greater than 70 ng/L but less than 1,000 ng/L, 95% of the samples had PFBS concentrations greater than or equal to 5 ng/L; therefore, 5 ng/L of PFBS was conservatively used as an indicator for potential PFOS+PFOA detection at a concentration of 70 ng/L. Additionally, you will note the

method detection limit for PFBS using analytical Method 537, 1.1 is nearly 5 ng/L. Setting a lower PFBS threshold is neither practical nor necessary.

Enclosed Figure 1 maps the interpolated PFBS isoconcentration in residential water wells, overlaid with water well results where PFOS+PFOA exceeded 70 ng/L. Figure 2 includes the PFBS/(PFOA+PFOS) ratio mapped in isoconcentrations, overlaid with water well results where residential well data exceeds 70 ng/L.

Item c: Wells containing PFOS+PFOA greater than 1,000 ng/L were excluded from this analysis because they are not representative of the leading edge of the plume and, if anything, would skew the mole ratio, resulting in fewer private residential wells being resampled. Not using these higher concentration values found in closer proximity to the source provides a more conservative sampling approach, resulting in a higher number of residential wells being resampled. For these reasons, we do not understand the following statement in comment 2c: "*It is EGLE's opinion that the evaluation of groundwater contamination should also include detections of PFOA and PFOS greater than 1,000 ng/L.*" Please provide the scientific basis and supporting documentation for that statement.

3. *Address and discuss the chemistry of PFAS that were used and disposed of by WWW. To our knowledge, perfluorooctane sulfonyl fluoride (POSF) was the key intermediate from which all PFOS-related products were subsequently produced prior to 2002. The 3M Company focused on POSF-based chemistry with PFOS and PFOS-precursors of eight carbon chain lengths as being the dominant PFAS used in their products. As a result, PFBS is believed to have been produced as an impurity and not a main PFAS compound. This is expected to have potentially resulted in variations to the PFBS present in each batch and over time. Therefore, using a PFBS to PFOS+PFOA mole ratio as a tracer for source identification may not be appropriate.*

Response: As noted in response to item 2, the possible variation of the PFBS concentration in "each batch over time" is irrelevant as the waste has been present at the site for approximately 50 to 60 years and has comingled during that time. However, it appears that EGLE may have specific information regarding historical 3M manufacturing and formulation processes, which information EGLE believes must be considered as part of this analysis. EGLE has not shared this information with Wolverine. So we can better understand and respond to your request, please provide the information used to develop comment 3.

4. *Discuss and support the statement that "as PFBS and PFOS+PFOA leach in groundwater and migrate, PFBS is expected to move faster than PFOS+PFOA."*

a. Address the differences between the Perfluroalkyl carboxylic acids (PFOA family) and Perfluoroalkane sulfonic acids (PFOS family), particularly concerning adsorption to soils. Assuming that both PFOA and PFOS will behave the same in the environment is not accurate. For example, there are many studies that show that PFOA adsorption to granular activated carbon is less than PFOS.

b. Provide graphics and figures with environmental and residential data that supports your hypotheses and include all supporting documentation.

Response:

Item a: Compounds with higher organic carbon partitioning coefficients (Koc) tend to adsorb onto soil matrix, a mass transfer process between the constituents dissolved in groundwater (aqueous phase) and the constituents sorbed on soil (solid phase). As constituents advance downgradient in groundwater, the transfer of aqueous-phase concentrations to solid-phase concentrations causes the advance of the constituents to be retarded. Compounds with higher Koc values are expected to have greater retardation

factors, therefore slower transport velocity in groundwater. There are numerous publicly available research papers and scientific journals that support that the Koc value for PFBS is significantly less than those of PFOS and PFOA, which therefore support our statement "…as PFBS and PFOS+PFOA leach in groundwater and migrate, PFBS is expected to move faster than PFOS+PFOA." addresses the behavior of PFOS and PFOA adsorption to soils. Two such documents are:

> Concawe, 2016, "*Environmental fate and effects of poly- and perfluoroalkyl substances (PFAS). Report No. 8/16.*" Auderghem, Belgium: Concawe.
>
> Michigan PFAS Science Advisory Panel, 2018, "*Scientific Evidence and Recommendations for Managing PFAS Contamination in Michigan.*"

The data collected during the resampling effort based on the PFBS-approach clearly supports our approach and stands on its own.

R&W/GZA combined PFOS+PFOA together when comparing to PFBS transport velocity for two reasons; 1) the migration analysis was based on the 70 ppt Part 201 criteria that also combines PFOS+PFOA, and 2) because the Koc values for both PFOA and PFOS are much greater than that of PFBS, thus the transport velocity for PFOA or PFOS are expected to be less than that of PFBS. We understand the Koc values and other physiochemical properties for PFOA and PFOS are different. R&W/GZA did not make the statement that PFOA and PFOS will behave the same in the environment. But we would like EGLE to provide the information and documentation, including the referenced "many studies" utilized to support EGLE's statement in comment 4a: "*Assuming that both PFOA and PFOS will behave the same in the environment is not accurate. For example, there are many studies that show that PFOA adsorption to granular activated carbon is less than PFOS."* If EGLE is aware of studies that would improve Wolverine's work and analysis, it would benefit EGLE, Wolverine, and affected residents to specifically reference and share those studies with us rather than vaguely referencing their potential existence. Also please explain EGLE's rationale for comparing carbon adsorption in a treatment setting to migration of PFAS-containing groundwater through native soil. This does not appear to be an appropriate comparison.

Item b: The requested map is included in the response to item 2b. Additionally, we reiterate the method detection limit for PFBS is approximately 5 ng/L. As indicated in the PFBS-based resampling work plan, using 5 ng/L of PFBS captures 95% of wells over 70 ng/L PFOS+PFOA.

5. *Provide supporting tables, documentation, and information used to produce figures in the House Street and Wolven/Jewell work plans. EGLE would like to understand what monitoring wells and residential wells were considered when evaluating the interpolated PFBS isoconcentration map offered in Figure 2 of the work plans. The scientific rational of using 5 ng/L for PFBS as plume delineation should be presented along with supporting tables and documentation.*

Response: This was addressed in the response to comments 2b and 4b.

6. *For Figure 3 in the October 2018 House Street work plan and the January 2019 Wolven/Jewell work plan, please clarify how data above 1,000 ng/L for PFOA+PFOS were used when these figures were produced. EGLE would like to see figures that show the ratio of PFBS to PFOA+PFOS included within the aquifer both horizontally and vertically. Ratio figures should be used in addition to isoconcentration figures to evaluate the data and determine if ratios of these compounds can indeed be used to evaluate the entire plume migration.*

Response: The response to this comment is already addressed in the answers to comments 2a/b and 4b. All residential wells were included in the analysis, regardless of depth. Additionally, those that fell within the 5 ng/L PFBS boundary were sampled regardless of depth, again, being more conservative for this resampling effort.

7. *Discuss and demonstrate the vertical extent of the plume in each of the study areas and how the geology and residential well screen depths may play a role in the resulting isoconcentration figures. The use of geological data is necessary for evaluation and interpretation of plume migration that may affect public health and the environment.*

Response: As noted above, the residential screen depths were not a factor for this evaluation and analysis, since all residential wells were included in the analysis. As EGLE is aware, the delineation of the House Street plume is underway. The remedial investigation at the Wolven/Jewell area is also in progress. So that we may better understand EGLE's expectations and understanding regarding interpretation of plume migration, we are also requesting EGLE provide the background information and documentation used for the following statement in comment 7 "*The use of geological data is necessary for evaluation and interpretation of plume migration that may affect public health and the environment."* We understand that additional geological data is often useful, but we need additional information to understand your unsupported claim that it is "necessary" for purposes of the resampling analysis here.

Wolverine would like to reiterate again that all of the residents in the House Street and Wolven/Jewell areas are offered and provided, if desired, alternate drinking water in the form of water delivery service, point-of-use filtration units, and/or whole house filtration systems. Any public health risk has been mitigated while the investigation is on-going.

It is the opinion of R&W/GZA and Wolverine that the information both previously supplied in work plans and summary reports as well as this response is sufficient to support deviation from EGLE's November 21, 2018 sampling request.

Please let us know if you have any further questions or would like additional information.

Sincerely,

Rose & Westra, a Division of GZA GeoEnvironmental, Inc.

Loretta J. Powers
Senior Project Manager

Mark Westra
Principal

ljp/jc/maw

c/enc: Mr. Dave Latchana – Wolverine World Wide, Inc.
Mr. John V. Byl – Warner Norcross & Judd LLP

Resampling Results Summarized with MDLs

(Response to Comment 1)

Address	Original Result PFOS+PFOA/Total PFAS	Original Result Reporting Limits	Resample Result PFOS+PFOA/Total PFAS	Resample Result Reporting Limit
2416 FROND ST NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.7
2559 VAN DAM DR NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.5
2787 ROGUE RIVER RD NE	0/0	Back: 1.7 PFOA, 8.5 PFBA, 4.2 Remaining PFAS Front: 1.8 PFOA, 8.8 PFBA, 4.4 Remaining PFAS	0/5.3 (PFBS) Back and 0/0 Front	3.7 Back and 3.6 Front
2801 ROGUE RIVER RD NE	0/0	1.7 PFOA 8.5 PFBA 4.2 Remaining PFAS	0/0	3.7
6300 BELSHIRE AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.6
6751 PIXLEY AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	4.2
6780 PIXLEY AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/7.1 (PFBS)	4.1
6795 BELMONT AVE NE	0/0	1.8 PFOA 8.8 PFBA 4.4 Remaining PFAS	0/0	3.6
6818 BELMONT AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.7
6845 PACKER DR NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.5
6813 BELMONT AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.6
6959 BELMONT AVE NE	0/0	1.8 PFOA 8.8 PFBA 4.4 Remaining PFAS	0/0	3.6
7050 BELMONT AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.7
7064 BELMONT AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.7
7100 CHANDLER DR NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.6
6843 PACKER DR NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/3.6 (PFBS)	3.6
6132 ROGUE LN NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/6.7 (PFBS)	3.6
6201 MAKSIMOWSKI AVE NE	0/0	2 PFOA 10 PFBA 5 Remaining PFAS	0/0	3.5
2730 VAN DAM DR NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/4.3 (PFBS)	3.6
1499 HOUSE ST NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.6
6210 MAKSIMOWSKI AVE NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.7
6240 MAKSIMOWSKI AVE NE	0/0	1.8 PFOA 8.8 PFBA 4.4 Remaining PFAS	0/0	3.6
6510 BELMONT AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.6
6594 BELMONT AVE NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.8
6887 BLUE RIDGE DR NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.8

Resampling Results Summarized with MDLs

(Response to Comment 1)

Address	Original Result PFOS+PFOA/Total PFAS	Original Result Reporting Limits	Resample Result PFOS+PFOA/Total PFAS	Resample Result Reporting Limit
7049 HERRINGTON AVE NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.8
7177 PACKER DR NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.9
1359 HOUSE ST NE	0/0	1.7 PFOA 8.5 PFBA 4.2 Remaining PFAS	0/0	3.6
6260 MAKSIMOWSKI AVE NE	0/0	1.8 PFOA 8.8 PFBA 4.4 Remaining PFAS	0/0	3.6
7144 BELMONT AVE NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.6
6818 PIXLEY AVE NE	0/0	1.7 PFOA 8.5 PFBA 4.2 Remaining PFAS	0/0	3.8
6215 MAKSIMOWSKI AVE NE	0/0	1.8 PFOA 8.8 PFBA 4.4 Remaining PFAS	0/0	3.4
6859 BELMONT AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.4
6990 HERRINGTON AVE NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.6
6550 BELMONT AVE NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.5
2440 FROND ST NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/3.5 (PFBS)	3.4
2671 VAN DAM DR NE	0/0	2.1 PFOA 11 PFBA 5.3 Remaining PFAS	0/0	3.6
1572 HOUSE ST NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.5
6835 BELMONT AVE NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.4
7170 BELMONT AVE NE	0/0	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.6
2727 VAN DAM DR NE	0/0	1.6 PFOA 8.1 PFBA 4.1 Remaining PFAS	0/0	3.4
2750 VAN DAM DR NE	0/0	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/0	3.5
6175 MAKSIMOWSKI AVE NE	0/0	1.8 PFOA 8.8 PFBA 4.4 Remaining PFAS	0/0	3.5
7161 PACKER (WOODS) DR NE	0/11 (PFHxS)	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/13 (PFHxS)	3.6
6911 BELMONT AVE NE	0/12.5 (PFBS/PFHxA)	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/0	3.6
1820 10 MILE RD NE	0/15.4 (PFBS/PFHxA)	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/6.8 (PFBS)	3.8
6858 BELMONT AVE NE	0/31.6 (several)	1.8 PFOA 8.8 PFBA 4.4 Remaining PFAS	0/29.5 (several)	3.5
6885 BELMONT AVE NE	0/4.5 (PFBS)	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/6.2 (PFBS)	3.7
6848 PIXLEY AVE NE	0/4.7 (PFBS)	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	0/5 (PFBS)	3.8
2789 ROGUE RIVER RD NE	0/4.8 (PFBS)	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/4.6 (PFBS)	3.8
6841 PACKER DR NE	0/5 (PFBS)	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/5.7 (PFBS)	3.6

Resampling Results Summarized with MDLs

(Response to Comment 1)

Address	Original Result PFOS+PFOA/Total PFAS	Original Result Reporting Limits	Resample Result PFOS+PFOA/Total PFAS	Resample Result Reporting Limit
6206 MAKSIMOWSKI AVE NE	0/67 (PFBS)	1.8 PFOA 9.2 PFBA 4.6 Remaining PFAS	0/40 (PFBS)	3.7
2512 LYNHURST ST NE	0/9.4 (PFBS)	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/7.9 (PFBS)	3.8
1840 10 MILE RD NE	1.21/4.099 (PFBS/PFHxS)	7.38 Perfluorooctadecanoic acid 2.46 Remaining PFAS	0/0	3.4
8183 HERRINGTON AVE NE	12.3/16.9 (PFBS)	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	9.2/13.2 (PFHxS)	3.6
6230 BELSHIRE AVE NE	12.7/32.8 (several)	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	8.4/27.8 (several)	3.6
1271 HOUSE ST NE	2.1/2.1	1.7 PFOA 8.5 PFBA 4.2 Remaining PFAS	0/0	3.5
7555 CHANDLER DR NE	28/50.2 (PFHpA/PFHxS)	1.6 PFOA 8.1 PFBA 4.1 Remaining PFAS	14/23.1 (PFHxS)	3.5
2260 SPRUCEWOOD CT NE	5.6/17.6 (PFBS)	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	5.1/22.2 (PFBS/PFHxS)	3.5
7641 HERRINGTON AVE NE	5.9/17.9 (PFBS)	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	0/7.6 (PFBS)	3.5
7444 HERRINGTON AVE NE	5/24.8 (several)	1.7 PFOA 8.6 PFBA 4.3 Remaining PFAS	4.9/8.0 (PFBS)	3.7
7601 HERRINGTON AVE NE	8.1/8.1	1.7 PFOA 8.3 PFBA 4.2 Remaining PFAS	7.7/7.7	3.7

Compounds in parantheses are PFAS compounds detected other than PFOS or PFOA.

Residential Wells Used for Calculations

(Response to Comment 2b)

Study Area	ParcelID	Address
House St Site	411009100026	7419 CHANDLER DR NE
House St Site	411010376024	6814 WILDWOOD CREEK DR NE
House St Site	411010376019	6800 WILDWOOD CREEK DR NE
House St Site	411010377004	6840 WILDWOOD CREEK DR NE
House St Site	411010377002	6884 WILDWOOD CREEK DR NE
House St Site	411015201023	6724 WILDWOOD CREEK DR NE
House St Site	411010352010	6817 PIXLEY AVE NE
House St Site	411010352009	6821 PIXLEY AVE NE
House St Site	411004300063	7885 IMPERIAL PINE DR NE
House St Site	411009251011	7355 TERRIE LYNN DR NE
House St Site	411009251007	7336 TERRIE LYNN DR NE
House St Site	411004300054	1786 HOUSE ST NE
House St Site	411009251004	2147 MEEK DR NE
House St Site	411009251012	7347 TERRIE LYNN DR NE
House St Site	411010352014	6881 PIXLEY AVE NE
House St Site	411009200025	7501 CHANDLER DR NE
House St Site	411009100036	7480 CHANDLER DR NE
House St Site	411009251010	7371 TERRIE LYNN DR NE
House St Site	411004300052	1698 HOUSE ST NE
House St Site	411009100013	7485 CHANDLER DR NE
House St Site	411009251003	2141 MEEK DR NE
House St Site	411010352007	6830 BELMONT AVE NE
House St Site	411009251027	2154 MEEK DR NE
House St Site	411010376022	6826 WILDWOOD CREEK DR NE
House St Site	411009251006	7318 TERRIE LYNN DR NE
House St Site	411010352005	6868 BELMONT AVE NE
House St Site	411004300057	1778 HOUSE ST NE
House St Site	411015201024	6688 WILDWOOD CREEK DR NE
House St Site	411004300010	1781 HOUSE ST NE
House St Site	411004300022	1711 HOUSE ST NE
House St Site	411004300023	1767 HOUSE ST NE
House St Site	411010353017	6858 PIXLEY AVE NE
House St Site	411015376032	2805 ROGUE RIVER RD NE
House St Site	411004300041	7879 IMPERIAL PINE DR NE
House St Site	411010377001	6900 WILDWOOD CREEK DR NE
Jewell Study Area	410633201008	9000 JEWELL AVE NE
Jewell Study Area	410633251006	8980 JEWELL AVE NE
Jewell Study Area	410633100032	9171 JEWELL AVE NE
Jewell Study Area	410633201005	9090 JEWELL AVE NE
Jewell Study Area	410633201006	9070 JEWELL AVE NE
Jewell Study Area	410633201001	9150 JEWELL AVE NE
Jewell Study Area	410633201002	2050 11 MILE RD NE
North Childsdale	411002200055	8349 CHILDSDALE AVE NE
North Childsdale	411002200053	8341 CHILDSDALE AVE NE
Rogue River Area	411021226030	2330 ROGUE RIVER RD NE
Rogue River Area	411023100040	6573 WEST RIVER DR NE

Residential Wells Used for Calculations

(Response to Comment 2b)

Study Area	ParcelID	Address
Rogue River Area	411002200063	8135 CHILDSDALE AVE NE
Jewell Study Area	410633100033	9165 JEWELL AVE NE
Jewell Study Area	410633100011	9101 JEWELL AVE NE
Wolven Study Area	410634227008	9128 LADY LAUREN DR NE
Wolven Study Area	410634227064	2960 ROYAL HANNAH DR NE
Wolven Study Area	410634227065	2972 ROYAL HANNAH DR NE
Wolven Study Area	410634227062	2975 ROYAL HANNAH DR NE
Wolven Study Area	410634227019	9175 LADY LAUREN DR NE
Wolven Study Area	410634227001	9070 LADY LAUREN DR NE
WHF	410635100027	8922 ELSTNER AVE NE
Wolven Study Area	410634227038	8942 LADY LAUREN DR NE
Wolven Study Area	410633226013	9053 ALGOMA AVE NE
Wolven Study Area	410625301039	3826 WHIRLWIND DR NE
Wolven Study Area	410635201012	3616 11 MILE RD NE
Wolven Study Area	410633226009	9045 ALGOMA AVE NE
Wolven Study Area	410635301006	3235 BENT TREE RIDGE DR NE
Wolven Study Area	410635301011	3290 BENT TREE RIDGE DR NE
Wolven Study Area	410634227018	9187 LADY LAUREN DR NE
Wolven Study Area	410628451002	2011 11 MILE RD NE
Wolven Study Area	410633226008	9049 ALGOMA AVE NE
Wolven Study Area	410633226006	9057 ALGOMA AVE NE
Wolven Study Area	410635353004	8497 WINDSTONE DR NE
Wolven Study Area	410633226007	9059 ALGOMA AVE NE
Wolven Study Area	410633226012	9051 ALGOMA AVE NE
Wolven Study Area	410635353003	8475 WINDSTONE DR NE
Wolven Study Area	410634227058	3035 ROYAL HANNAH DR NE
Wolven Study Area	410633276001	9001 ALGOMA AVE NE
Wolven Study Area	410635100026	8948 ELSTNER AVE NE
Wolven Study Area	410628452002	9215 BOOTH BAY CT NE
Wolven Study Area	410628452003	9227 BOOTH BAY CT NE
Wolven Study Area	410633226014	9063 ALGOMA AVE NE
Wolven Study Area	410634227066	2988 ROYAL HANNAH DR NE
Wolven Study Area	410625301040	3823 WHIRLWIND DR NE
Wolven Study Area	410628452008	9277 NANTUCKET CT NE
Wolven Study Area	410628452006	9261 NANTUCKET CT NE
Wolven Study Area	410634227071	3056 ROYAL HANNAH DR NE
Wolven Study Area	410634227025	3062 SIR CHARLES DR NE
Wolven Study Area	410628452005	9253 NANTUCKET CT NE
Wolven Study Area	410628300011	1981 11 MILE RD NE
Wolven Study Area	410635120025	8910 HOPEWELL DR NE
Wolven Study Area	410634227069	3030 ROYAL HANNAH DR NE
Wolven Study Area	410634227063	2963 ROYAL HANNAH DR NE
Wolven Study Area	410634227068	3016 ROYAL HANNAH DR NE
Wolven Study Area	410634227067	3000 ROYAL HANNAH DR NE
Wolven Study Area	410635351009	3256 STONERIDGE DR NE
Wolven Study Area	410634227054	3099 ROYAL HANNAH DR NE

Residential Wells Used for Calculations

(Response to Comment 2b)

Study Area	ParcelID	Address
Wolven Study Area	410635351005	3261 STONERIDGE DR NE
Wolven Study Area	410634227055	3081 ROYAL HANNAH DR NE
Wolven Study Area	410634227072	3070 ROYAL HANNAH DR NE
Wolven Study Area	410628452007	9269 NANTUCKET CT NE
Wolven Study Area	410634227048	8941 LADY LAUREN DR NE
Wolven Study Area	410628451003	2029 11 MILE RD NE
Wolven Study Area	410634227037	8954 LADY LAUREN DR NE
Wolven Study Area	410634227011	9164 LADY LAUREN DR NE
Wolven Study Area	410635351008	3232 STONERIDGE DR NE
Wolven Study Area	410634227070	3042 ROYAL HANNAH DR NE
Wolven Study Area	410635100029	8870 ELSTNER AVE NE
Wolven Study Area	410634227029	3012 SIR CHARLES DR NE
Wolven Study Area	410634227049	8947 LADY LAUREN DR NE
Wolven Study Area	410635301007	3275 BENT TREE RIDGE DR NE

N
W E
S

Legend

APPROXIMATE HOUSE ST SITE BOUNDARY

PARCEL_DATA

PARCEL_DATA

PARCEL POINT (PFOS & PFOA, ng/L)

- ND
- Greater Than Detection Limit to 10
- Greater Than 10 to 70
- Greater Than 70 to 1000
- Greater Than 1000

INTERPOLATED PFBS ISOCONCENTRATION (ng/L) - DRINKING WATER WELLS

- 0 - 5
- 5.000000001 - 10
- 10.00000001 - 100
- 100.0000001 - 1,000
- 1,000.000001 - 50,000
- SURFACE WATER

0 1,750 3,500 7,000

Scale in Feet

NO.	ISSUE/DESCRIPTION	BY	DATE

Rose & Westra, a Division of GZA
601 Fifth Street NW, Suite 102
Grand Rapids, Michigan 49504

PFBS ISOCONCENTRATION
PARCELS WHERE PFOS & PFOA EXCEEDING 70 PPT

GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
WN&J/WWW

PROJ MGR: LIP	REVIEWED BY: LIP	CHECKED BY: LIP	FIGURE 1
DESIGNED BY: JC	DRAWN BY: JC/JMG	SCALE: 1"=1500'	
DATE: 07-11-19	PROJECT NO. 16.0062355.52	REVISION NO.	

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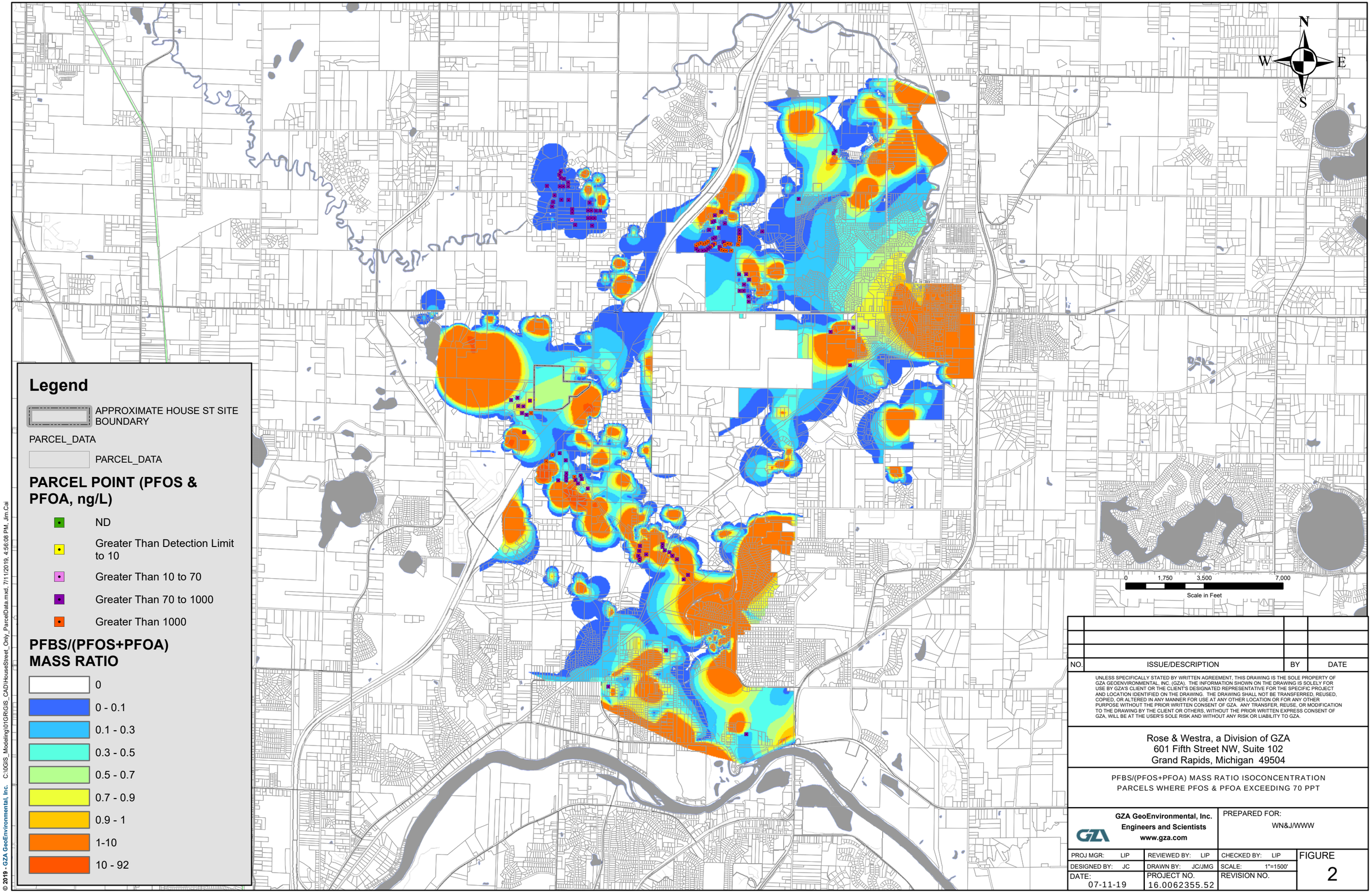

NO.	ISSUE/DESCRIPTION	BY	DATE

Rose & Westra, a Division of GZA
601 Fifth Street NW, Suite 102
Grand Rapids, Michigan 49504

PFBS/(PFOS+PFOA) MASS RATIO ISOCONCENTRATION
PARCELS WHERE PFOS & PFOA EXCEEDING 70 PPT

GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
WN&J/WWW

PROJ MGR: LIP	REVIEWED BY: LIP	CHECKED BY: LIP	FIGURE 2
DESIGNED BY: JC	DRAWN BY: JC/JMG	SCALE: 1"=1500'	
DATE: 07-11-19	PROJECT NO. 16.0062355.52	REVISION NO.	

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