

SITE INVESTIGATION REPORT

Investigation of Per- and Polyfluoroalkyl Substances at Select Source Separated
Organic Material and Yard Waste Sites, Minnesota
Minnesota Pollution Control Agency

Prepared by:

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September 2019

**Investigation of Per- and Polyfluoroalkyl Substances (PFAS)
at Select Source Separated Organic Material and
Yard Waste Sites, Minnesota**

Submitted To:

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September 2019

Project No. 18190012



September 11, 2019

Ms. Kayla Walsh,
Project Manager
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**Re: Site Investigation Report
Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Select Source
Separated Organic Material and Yard Waste Sites, Minnesota**

Wood Project No. 18190002

Dear Ms. Walsh;

Wood Environment & Infrastructure, Solutions, Inc. (Wood) is pleased to submit this Site Investigation Report to the Minnesota Pollution Control Agency (MPCA) to document per- and polyfluoroalkyl substances (PFAS) sampling activities conducted at selected Source Separated Organic Material and Yard Waste Sites across Minnesota.

We appreciate the opportunity to assist you on this project. If you have any questions or concerns, please do not hesitate to contact us as identified below.

Sincerely,

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TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	1
1.1 SCOPE OF WORK.....	1
2.0 BACKGROUND.....	3
3.0 INVESTIGATION ACTIVITIES	6
3.1 FIELD METHODS	6
3.2 EQUIPMENT DECONTAMINATION.....	9
3.3 ANALYTICAL METHODS.....	10
4.0 EVALUATION AND PRESENTATION OF RESULTS.....	12
4.1 SCREENING CRITERIA	12
4.2 ANALYTICAL RESULTS	13
4.2.1 SSOM Facility A.....	13
4.2.2 SSOM Facility B	14
4.2.3 SSOM Facility C	15
4.2.4 SSOM Facility D.....	16
4.2.5 SSOM Facility E.....	18
4.2.6 Yard Waste Site A.....	18
4.2.7 Yard Waste Site B	19
4.3 COMPARISON TO PFAS AMBIENT LEVELS	20
5.0 QUALITY ASSURANCE AND QUALITY CONTROL.....	22
5.1 FIELD QA/QC ACTIVITIES.....	22
5.2 LABORATORY QA/QC	23
5.2.1 November 2018 Water Samples.....	23
5.2.2 April 2019 Water Samples.....	24
5.2.3 May 2019 Water Samples	24
6.0 CONCLUSIONS	25
7.0 NEXT STEPS IN PFAS MANAGEMENT AT SSOM AND YARD WASTE SITES	26
8.0 REFERENCES	28

LIST OF TABLES

TABLE 1	Sampling Plan
TABLE 2	PFAS Analytical Method Summary
TABLE 3A	Surface Water Analytical Results Summary – SSOM Facility A
TABLE 3B	Surface Water Analytical Results Summary – SSOM Facility B
TABLE 3C	Surface Water Analytical Results Summary – SSOM Facility C
TABLE 3D	Surface Water Analytical Results Summary – SSOM Facility D
TABLE 3E	Surface Water Analytical Results Summary – SSOM Facility E
TABLE 3F	Surface Water Analytical Results Summary – Yard Waste Facility A
TABLE 3G	Surface Water Analytical Results Summary – Yard Waste Facility B
TABLE 4	Comparison of Site Analytical Results with PFAS Background Levels

LIST OF FIGURES

FIGURE 1A	Sample Locations and Results – SSOM Facility A
FIGURE 1B	Sample Locations and Results – SSOM Facility B
FIGURE 1C	Sample Locations and Results – SSOM Facility C
FIGURE 1D	Sample Locations and Results – SSOM Facility D
FIGURE 1E	Sample Locations and Results – SSOM Facility E
FIGURE 1F	Sample Locations and Results – Yard Waste Facility A
FIGURE 1G	Sample Locations and Results – Yard Waste Facility B

LIST OF APPENDICES

APPENDIX A	Laboratory Analytical Reports
APPENDIX B	Data Quality Review
APPENDIX C	Conceptual Site Model (Decision Matrix)

ACRONYMS AND ABBREVIATIONS

BPI	Biodegradable Products Institute
CEC	Contaminants of Emerging Concern
CGCP	Cedar Grove Certified Products
COC	Chain-of-Custody
CSM	Conceptual Site Model
DQO	Data Quality Objective
DQR	Data Quality Review
Gen-X	Hexafluoropropylene Oxide Dimer Acid
GPS	Global Positioning System
HBV	Health Based Value
HDPE	High Density Polyethylene
HRL	Health Risk Limit
HSP	Health and Safety Plan
IDW	Investigation Derived Waste
IL	Intervention Limit
MDH	Minnesota Department of Health
MDL	Method Detection Limit
mg/kg	milligram per kilogram
ml	milliliters
MPCA	Minnesota Pollution Control Agency
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAD-83	North American Datum of 1983
ng/L	nanograms per liter
OPR	Ongoing Precision and Recovery
OPRD	Ongoing Precision and Recovery Duplicate
PFBA	Perfluorobutanoate
PFPeA	Perfluoropentanoate
PFHxA	Perfluorohexanoate
PFHpA	Perfluoroheptanoate
PFOA	Perfluorooctanoate



PFNA	Perfluorononanoate
PFDA	Perfluorodecanoate
PFBS	Perfluorobutanesulfonate
PFHxS	Perfluorohexanesulfonate
PFAS	Per- and Polyfluoroalkyl Substances
PFOS	Perfluorooctanesulfonate
POTW	Publicly-owned Treatment Works
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
SA	Site Assessment
SAP	Sampling and Analysis Plan
SSOM	Source Separated Organic Material
US	United States
UTM	Universal Transverse Mercator
Wood	Wood Environment & Infrastructure Solutions, Inc.

1.0 INTRODUCTION

Wood Environment & Infrastructure Solutions, Inc. (Wood), has prepared this report to present findings of an evaluation of per- and polyfluoroalkyl substances (PFAS) at select large-scale composting facilities; specifically, yard waste sites and sites that are permitted to accept source separated organic materials (SSOM). The project is being conducted by the Minnesota Pollution Control Agency (MPCA) funded through the MPCA Environmental Analysis and Outcomes Division to further evaluate contaminants of emerging concern (CEC) at compost and yard waste sites.

The specific purpose of this project is to determine the presence or absence of PFAS in contact water (i.e., any surface water that has come into contact with waste materials) at select SSOM and yard waste sites across the State of Minnesota to further enhance understanding of contact water chemistry with regards to emerging contaminants. Data gathered during this investigation will be used programmatically to support decision making activities for contact water management including working toward identifying potential development and implementation strategies that may work to reduce or eliminate PFAS at compost facilities. The data will also be used to further develop strategies that reduce or eliminate PFAS containing products at these facilities. The data will also be used to further develop the MPCA's understanding of how widespread PFAS impacts may be across the State.

1.1 SCOPE OF WORK

The investigation was authorized by the MPCA on May 25, 2018 and was conducted in general accordance with Work Order 3000022375 dated October 8, 2018 and as amended April 30, 2019. Field investigation activities were conducted in accordance with the Sampling and Analysis Plan (SAP) dated November 2018 and updated April 2019 (Wood, 2019).

The scope of services includes the following:

- Collection of surface water samples from ponds located at five SSOM sites during three separate sampling events;
- Collection of surface water samples from ponds located at two yard waste sites during three separate sampling events;



- Laboratory analysis of surface water for PFAS in accordance with Chemicals of Potential Concern (COPCs);
- Data Quality Review (DQR) of the surface water sample analytical results; and
- Preparation of this site investigation report.

Additionally, the report includes a comparison of PFAS detected in contact water at each of the sites relative to calculated median ambient concentrations of PFAS detected across the State as conducted by the MPCA (MPCA, 2017). The report also identifies a framework for evaluating the next steps in PFAS management at SSOM and yard waste sites across the State.

2.0 BACKGROUND

The seven sites evaluated for this project were selected by the MPCA to be representative of SSOM and yard waste facilities across the Minnesota. Most SSOM facilities in Minnesota accept compostable products in addition to food scraps and yard waste. Compostable products are generally food service items like plates, cups, and utensils. Compostable products can be made from compostable plastics or from paper fiber based items. The Biodegradable Products Institute (BPI) is a third party organization that certifies compostable products as a verification that they meet ASTM standards for composting at commercial compost facilities.

Compost facility rules within the state of Minnesota distinguish between contact water and stormwater at compost sites. Contact water is defined in Minnesota Rule 7035.0300 Sub 20a as water that generally comes into contact with tipping and mixing areas, and active or early stage composting activities. Water from curing or finished compost, is typically defined as stormwater. The distinction between contact water and stormwater was established in a revision to the state's composting rules that was adopted in 2015; however, facilities that were designed and operated prior to the rule revision may not have design features or operational practices in place to separate the two types of water. Contact water must be collected in lined ponds and treated; however, stormwater ponds are generally unlined, and the water is allowed to infiltrate but managed in accordance with site-specific requirements established under the terms of an industrial stormwater permit. Although sampling SSOM contact water was the primary objective of this investigation, stormwater sampling was also conducted at several facilities where more than one pond were present.

According to the compost rule, yard waste sites must control surface water drainage to prevent leachate leaving the facility. Surface water drainage run-on must be diverted from the compost and storage areas. The facility shall be constructed and operated to prevent discharge of yard waste, leachate, residuals, and the final product into waters of the state.

For the purposes of this project, the sites are being reported using a generic facility identifier (i.e., SSOM Facility A, SSOM Facility B, Yard Waste Facility A etc.). The sites evaluated include the following:

SSOM Facility A: The facility is an organics recycling facility that accepts food wastes, non-recyclable paper projects, vegetable oils, compostable products and yard wastes (grass clippings,

leaves, brush, branches and stumps). The facility encompasses approximately 12.4-acres of land that includes a single site building (hoop building), two ponds including a large contact water retention pond located in the southern portion of the facility (Pond 1) and a smaller stormwater pond located along the northern property boundary, not adjacent to active composting or tipping and mixing areas (Pond 2). The facility was designed with the intent that tipping and mixing take place inside the hoop building. All composting related activities take place in the southern portion of the facility which is sloped to the south towards Pond 1. The remainder of the site acreage is used for the sorting, storage, and management of the organic wastes. A site plan showing the sampling locations is provided as Figure 1A.

SSOM Facility B: The facility is an organics recycling facility that accepts food waste and yard wastes (grass clippings, leaves, brush, branches and stumps). The facility encompasses approximately 471 acres of land, with approximately a third of the acreage being used for waste storage and handling activities associated with the compost operation. The SSOM is staged in the east-central portion of the site and a series of ponds are present immediately north of the material staging area. A site plan including the sampling locations is provided as Figure 1B.

SSOM Facility C: The facility is an organics recycling facility that accepts food waste (all food scraps), non-recyclable paper products including napkins, paper towels and tissues, uncoated paper plates, cups and food containers, compostable products certified by BPI or Cedar Grove Certified Products (CGCP) and yard wastes. The facility encompasses approximately 120 acres of land including a paved maintenance yard area with an office. Two ponds are present at the facility including a contact water pond (Pond 1) located in the in the central portion and a stormwater infiltration pond located in the eastern portion of the facility. Pond 1 is adjacent to the composting activities for source separated organics (which includes food scraps, compostable products and yard waste). Pond 2 is located in the eastern portion of the facility, adjacent an area dedicated for use as a yard waste composting area. A site plan including the surface water sample locations is provided as Figure 1C.

SSOM Facility D: The facility is an approximately 17.9 acre organics recycling facility that accepts food waste, non-recyclable paper products, compostable products and yard wastes. Two ponds are present at the facility including a contact water pond located in the southeast portion of the facility (Pond 1) and a stormwater pond located in the north-central portion of the facility (Pond 2). The SSOM activities take place in the southern portion of the facility and contact water from all these activities drains towards Pond 1. The northern portion of the facility is used exclusively

for yard waste operations and water from this area discharges to Pond 2. A site plan including the surface water sample locations is provided as Figure 1D.

SSOM Facility E: The facility is an approximately 17 acre organics recycling facility that accepts food waste and non-recyclable food soiled paper products (such as pizza boxes), compostable products and yard wastes. The SSOM storage and sorting operation covers the majority of the 17 acres, with the primary storage area located in the southeast corner of the site with drainage to an engineered pond structure located immediately southeast of the storage area. A site plan including the surface water sample locations is provided as Figure 1E.

Yard Waste Facility A: The facility is a yard waste site that accepts leaves, grass, garden waste, branches, trees and shrubs. The facility encompasses approximately 7.8 acres consisting of the main yard waste collection and handling area that includes a small pond in the southwest corner of the site. A site plan including the surface water sample locations is provided as Figure 1F.

Yard Waste Facility B: The facility is a yard waste site that accepts leaves, grass, garden waste, branches, trees, shrubs, dirt and sod. The facility encompasses approximately 45 acres consisting of the main yard waste collection and handling area that includes two small ponds, one on the north side of the waste storage area and one located in the southern portion of the facility. Pond 1 is an infiltration pond that collects stormwater from the current yard waste operations located in the northern third of the facility. Pond 2 is a stormwater pond that was designed and constructed in partnership with the operator after yard waste operations were moved to the north of the facility to provide a larger buffer between residences and potential new development. Pond 2 does not receive runoff from current yard waste operations. A site plan including the surface water sample locations is provided as Figure 1G.

3.0 INVESTIGATION ACTIVITIES

The following sections describe the field activities conducted for this investigation and provide an overview of the field methodologies and analytical protocols utilized. Sampling of surface (contact) water was conducted at a total of five SSOM sites and two Yard Waste sites across Minnesota during three mobilizations in November 2018, April and May of 2019. The sites and individual sample locations are shown on Figures 1A through 1G. The sampling methods, analytical parameters and analytical methods followed the SAP as approved by the MPCA, with some exceptions noted in Section 3.1.

Surface water sampling was performed according to the Standard Operating Procedures (SOPs) provided in Appendix A of the SAP, including:

- SOP WOOD-01: *Field Sampling Protocols to Avoid Cross-Contamination of PFAS;*
- SOP WOOD-02: *Field Instrument Calibration*
- SOP WOOD-03: *Surface Water Sampling;*
- SOP WOOD-04: *Equipment Decontamination;*
- SOP WOOD-05: *Sampling Handling and Custody; and*
- SOP WOOD-06: *Protocol to Provide Water Free of Per- and Polyfluorinated Alkyl Substances for Collection of Field Blanks and Equipment Blanks.*

All work performed at the sites was conducted in accordance with the site-specific health and safety plan (HSP) that included activity hazard analyses and health and safety protocols for conducting the field work. All work was performed using modified “Level D” personal protective equipment (PPE), with hard hat when necessary. Access to the sites was coordinated with the site contacts provided by the MPCA prior to each mobilization.

3.1 FIELD METHODS

During the three sampling events, a tailgate health and safety meeting was performed and a PFAS Protocols Checklist from SOP WOOD-01: *Field Sampling Protocols to Avoid Cross-Contamination of PFAS* was completed at the start of each day. Water collected for laboratory analysis was also analyzed in a separate container using a water quality meter for pH, dissolved oxygen, oxidation reduction potential [ORP], specific conductivity, and temperature, and separate meter for turbidity.

Samples were collected using one of three methods: direct immersion, stainless steel dip cup with extension rod, or peristaltic pump, equipped with PFAS free high-density polyethylene (HDPE) tubing. The methods used for each sample location are indicated in Table 1 and discussed below for each site. Sample collection using the stainless steel dip cup were preceded by the decontamination procedures described in Section 3.2. Investigation derived waste (IDW) included used gloves, tubing, paper towels, and other miscellaneous disposable items. Minimal amounts (<100 mL) of excess surface water were discarded back into the ponds once all samples were collected.

The surface water sampling was conducted at each site as described below and summarized in Table 1.

SSOM Facility A: Sampling was conducted at SSOM Facility A during all three sampling events with no exceptions. Two samples were collected from accessible areas of Pond 1 at the south end of the facility, one near the center at a natural inlet/low spot and one near the northeast corner of the pond. One sample was collected from Pond 2 at the north end of the facility from the pond's southern edge. During the November 2018 sampling event, Pond 1 was not completely frozen, and samples were collected via the direct immersion method; Pond 2 was frozen and an on-site backhoe was used to break up the ice prior to Wood arrival on site to allow for direct immersion sampling. For the April and May 2019 sampling events, samples were collected via stainless steel dip cup from both ponds.

SSOM Facility B: Sampling was conducted at SSOM Facility B during all three sampling events with exceptions noted herein. One sample was collected during all three sampling events near the outfall to the pond north of the sorting/storage area at its southwest corner (closest proximity to the organic material storage area). Two samples were collected from a second pond; one near the outfall on the western extent of the pond and one on the eastern extent. The two ponds at Site B are connected via an overflow pipe, the former pond receiving the initial run off water from the site and the latter/second pond receiving the overflow from the former. The western extent of the second pond was dry during the April mobilization and no sample was collected. Samples were collected via direct immersion through the ice during the November 2018 event and via stainless steel dip cup during the April and May 2019 events.

SSOM Facility C: Sampling was conducted at SSOM Facility C during all three sampling events with no exceptions. Two samples were collected from the pond on the north side of the organics

material staging area, one from the southwest corner and one from the northeast corner. A third sample was collected from pooled water in a low area east of the organics sorting/staging area. The third sample was collected via direct immersion for each event, whereas the two samples from the first pond were collected via direct immersion through the ice during the November 2018 event and via stainless steel dip cup during the April and May 2019 events.

SSOM Facility D: Sampling was conducted at SSOM Facility D during all three sampling events with no exceptions. Two samples were collected from the pond on the south side of the organics material staging area, one from the western extent and one from the eastern extent. A third sample was collected from the center of the southern extent of the vegetated swale located north of the organics material staging area. The third sample was collected via direct immersion for each event, whereas the two samples from the pond were collected via peristaltic pump with new tubing through the ice during the November 2018 event and via stainless steel dip cup during the April and May 2019 events.

SSOM Facility E: Sampling was conducted at SSOM Facility E during the April and May 2019 sampling events only, due to frozen conditions and confined space entry required during the November 2018 event. During the two 2019 mobilizations, three samples were collected from the pond located in the southeast corner of the site, south of the organics materials staging area; two from either end of the northern extent, and one from the center of the southern extent. During the April 2019 event, the two samples from the northern extent of the pond were collected via a stainless steel dip cup, and the sample on the southern extent was collected via peristaltic pump with new tubing. During the May 2019 event, all three samples were collected via stainless steel dip cup.

Yard Waste Facility A: Sampling was conducted at Yard Waste Site A during all three sampling events with no exceptions. Three samples were collected from the one pond on site located in the southern portion of the site south of the yard waste staging area, one from the northwest extent, one from the southwest extent near an overflow inlet, and one from the southeast extent at the outfall from a drainage channel. Samples were collected via peristaltic pump with new tubing through the ice during the November 2018 event and via stainless steel dip cup during the April and May 2019 events.

Yard Waste Facility B: Sampling was conducted at Yard Waste Site B during all three sampling events with no exceptions. Two samples were collected from the pond on the north side of the

site, north of the yard waste staging area, one from the northwest extent and one from the southeast extent. A third sample was collected from the eastern side of the pond located in the south-central portion of the site, which collects runoff from an area of the facility formerly used for yard waste staging. Samples were collected via peristaltic pump with new tubing through the ice during the November 2018 event and via stainless steel dip cup during the April and May 2019 events.

Sampling locations were surveyed during the November 2018 mobilization using a hand held sub-meter global positioning system (GPS). The system provided sub-meter (0.5m) accuracy in the Universal Transverse Mercator (UTM) zone 15 north coordinate system (North American Datum of 1983 [NAD-83]). The coordinates are included in Table 2.

A total of 90 samples, including quality control samples, were proposed in the SAP. A total of 88 were collected due to the following reasons:

- One of the ponds at Site B had very little water in the secondary pond and only one sample was collected instead of two during the April mobilization.
- Site E was not accessible during the November 2018 mobilization due to frozen conditions and confined space entry required.
- The two yard waste sites (Sites F and G) were sampled during all three mobilizations.
- One duplicate sample was required per 10 primary samples for each mobilization. Nine duplicates were assumed, but only 76 primary samples were collected; therefore, a total of 8 duplicate samples were collected.
- One equipment blank was required per piece of equipment for each day of sampling (9 days proposed = 9 equipment blanks; however, the non-dedicated equipment (dip cup) was only used on 6 of the 9 sampling days and therefore only 6 equipment blanks were collected.

Surface water samples were submitted for analysis to SGS AXYS laboratory in Sidney, British Columbia, Canada via FedEx Priority Overnight international shipping procedures.

3.2 EQUIPMENT DECONTAMINATION

During water sampling, the stainless steel dip cup with extension rod was the only non-dedicated piece of sampling equipment used for sample collection. Before and between uses at each sample

location, the dip cup was decontaminated according to SOP WOOD-04 (PFAS) using the following procedure:

1. Nitrile gloves were worn by all personnel involved in order to prevent personal exposure and cross-contamination.
2. When necessary, the dip cup was scrubbed to remove solid debris.
3. The dip cup was rinsed using a mixture of store-bought distilled water and Alconox® soap.
4. The dip cup was then rinsed twice using store-bought distilled water.
5. A final rinse of the dip cup was conducted using laboratory certified "PFAS-free" water in accordance with SOP WOOD-06.
6. An equipment blank was collected using the laboratory certified "PFAS-free" water at a frequency of once per piece of equipment per day.

Other sampling methods, including peristaltic pump with new tubing and direct immersion sampling, do not require decontamination as outlined above. When sampling was completed using the peristaltic pump, brand new high-density polyethylene (HDPE) and silicone tubing were used. When direct immersion was used, the sample container was triple rinsed using the surface water being sampled and the rinse water was discarded in a separate location so as not to include it in the final sample.

3.3 ANALYTICAL METHODS

A total of 88 samples were analyzed as part of the surface water SA, including 59 primary environmental samples and 29 quality assurance/quality control (QA/QC) samples (i.e., eight duplicates, six matrix spike/matrix spike duplicate (MS/MSD), six equipment blanks and nine field blanks). All samples were collected into clean, laboratory-supplied HDPE containers and placed into an ice-chilled cooler. The samples were submitted to the SGS AXYS laboratory via FedEx Priority Overnight international shipping procedures using standard chain-of-custody protocol and in accordance with SOP WOOD-05.

The primary and QA/QC samples were analyzed for the same PFAS analyte list during each event. However, after the November 2018 sampling event, the laboratory changed methods and the April and May 2019 samples were analyzed using an updated analyte list. The two different laboratory methods include:

- November 2018 event: MLA 060

- April and May 2019 events: MLA 110

The intent of the sampling protocol was to utilize SGS AXYS analytical method MLA 110 for analysis of 29 PFAS compounds plus hexafluoropropylene oxide dimer acid (Gen-X) for all sampling events; however, due to laboratory contracting issues between the MPCA and the selected laboratory, the November 2018 sampling event was modified to complete sample analysis using MLA 060 which includes a subset of the MLA 110 analyte list. A comparison of the analyte list including the specific PFAS constituents included in each method is presented in Table 2.

Following the November 2018 sampling event, SGS AXYS encountered difficulties in analyzing the samples due to the presence of very fine, suspended particulate matter within the aqueous portion of most samples received. The suspended particulate matter could not be sufficiently removed prior to analysis using centrifugation and/or allowing the samples to settle out prior to filtration. As a result, the laboratory was required to complete analysis using a reduced sample size (60 milliliters [ml] vs. the method standard of 500 ml). The reduced sample volume resulted in elevated reporting limits, which were often not sensitive enough to allow screening against regulatory criteria. In order to analyze a reduced sample volume, the laboratory extracted 60 ml from the original 500 ml sample. The extraction (subsample) possibly resulted in an unknown analytical bias that was dependent of the composition of the subsample rather than the composition of the original 500 ml sample as a whole.

Samples collected during the April and May 2019 sampling events were extracted and analyzed using SGS AXYS method MLA 110, which requires a lower initial sample volume. The analysis was not affected by the suspended particulate matter and therefore reporting limits were not elevated as was the case in November 2018. The reporting limits in April and May 2019 were sufficiently low to allow screening against regulatory criteria. Since subsampling was not required, the reported results are representative of the sample as a whole, thereby reducing the possibility of introducing analytical bias.

4.0 EVALUATION AND PRESENTATION OF RESULTS

4.1 SCREENING CRITERIA

The contact water samples were analyzed for the presence of PFAS by SGS-AXYS using the methods identified in Section 3.0.

PFAS analytical results were compared to applicable Minnesota Department of Health (MDH) Health Risk Limits (HRLs) and Health Based Values (HBVs). Both HRLs and HBVs reflect the level of a contaminant that can be present in water and pose little or no health risk to a person drinking the water (MDH, 2019a). The HRLs and HBVs are guidance values used by the public, risk managers, and other stakeholders to make informed decisions about managing the health risks of contaminants in water. The HRLs are values promulgated through the Minnesota rulemaking process, whereas HBVs have not been promulgated but are used as technical guidance made available by the MDH. In situations where specific chemicals are detected in water, MDH anticipates that HBVs will be promulgated as HRLs during a subsequent rulemaking process (MDH, 2019b).

Four of the PFAS constituents analyzed have HRLs including perfluorobutanoate (PFBA) and perfluorooctanoate (PFOA) (2018 update), perfluorobutanesulfonate (PFBS) (2017 update), and perfluorooctanesulfonate (PFOS) (2009 update). HBVs are applicable for PFBS (2017 update), perfluorohexanesulfonate (PFHxS), and PFOS (2019 update).

In accordance with MPCA Solid Waste Program guidance, contact water must meet a quarter of the HRL or HBV value for a specific analyte, defined as the Intervention Limit (ILs). The IL is a level which indicates when additional action must be taken. Due to PFAS chemistry and risk limits, low laboratory method detection limits are required to accurately report PFAS concentrations and associated risk to environmental media. Due to the low method detection limits especially for constituents such as PFOS and PFOA, using a quarter of the HRL or HBV is problematic as laboratories may not be able to achieve the low levels necessary to accurately report concentrations down to these limits (i.e., 3.75 nanograms per liter [ng/L] for PFOS). In such circumstances, the use of the IL could lead to a misrepresentation of the number of actionable sites; however, for the purpose of this investigation, the ILs are used as screening criteria in accordance with current program requirements.

Collectively the HRL, HBVs and ILs are referred to as screening criteria.

4.2 ANALYTICAL RESULTS

Water analytical results are presented by Site in Tables 3A through 3G and analytical detections for those PFAS constituents with regulatory screening criteria are presented in Figures 1A through 1G. Laboratory analytical reports are provided in Appendix A and Wood's DQR summaries are included in Appendix B. Subsequent to the provision of final laboratory reports, the laboratory provided all analytical results to the MPCA in an EQUIS electronic data deliverable format on July 9, 2019.

The data shown in the tables and figures are reported to the lowest concentration that the laboratory could meet to determine the presence of a particular analyte (i.e., the method detection limit [MDL] or lowest achievable calibration level).

The following subsections present a discussion of the analytical results by Site, focusing on PFAS detections above the screening criteria presented in Section 4.1.

4.2.1 SSOM Facility A

A total of 12 water samples were collected at SSOM Facility A including, one primary water sample at each of three sample locations during the three separate sampling events and two field duplicates.

A total of eight PFAS constituents (PFBA, perfluoropentanoate [PFPeA], perfluorohexanoate [PFHxA], perfluoroheptanoate [PFHpA], PFOA, PFBS, PFHxS and PFOS) were detected in one or more of the sampling events, including detections of three PFAS (PFHxS, PFOA, and PFOS) at concentrations above applicable screening criteria.

PFHxS was only detected above screening criteria in the sample collected from SW01 in the November 2018 sampling event (MR-SW01-1118-100). The detection was an estimated concentration (153 J nanograms per liter [ng/L]) that exceeded the HBV of 47 ng/L and IL of 11.75 ng/L. As discussed in Section 3.0, the analysis of samples collected in November 2018 was completed using method ML-060 which was limited by matrix interference associated with the presence of suspended particulates in the samples. Due to the matrix interference, the lab extracted a reduced sample volume which resulted in elevated reporting limits. As PFHxS was not

detected in either of the subsequent sampling events where samples were analyzed using analytical method ML-110, the November exceedance of PFHxS is considered an anomaly and not representative of PFHxS concentrations at this location.

PFOA was detected in both samples collected from Pond 1 (SW01 and SW02) in the April and May sampling events at concentrations above the IL (8.75 ng/L). The concentrations of PFOA ranged from 9.83 ng/L (MR-SW01-0419-100) to 20.9 ng/L (MR-SW01-0419-100). PFOA was not detected in any of the samples collected during the November 2018 sampling event; however, due to sample matrix interference, the elevated reporting limit was above the IL screening criteria and therefore direct comparison cannot be made.

PFOS was detected above screening criteria in three samples collected during this investigation including a detection in SW01 (1,700 ng/L) in November 2018 that exceeded the HRL, HBV and IL; and detections in SW02 in April 2019 (15.5 ng/L) that exceeded the HBV and IL, and in May 2019 (9.69 ng/L) that exceeded the IL (3.75 ng/L). During Wood's data quality review, the detection of PFOS in SW01 in November 2018 was flagged as an estimated concentration due to analytical imprecision between the primary and field duplicate. The imprecision was likely a result of the analytical bias introduced through analysis of the subsamples required with the smaller sample volume.

PFOS was not detected in SW02 or SW03 in November 2018; however, due to sample matrix interference, the elevated reporting limit was above both the HBV and the IL screening criteria and therefore direct comparison cannot be made.

The detection limits for PFOS in both April and May 2019 were not sufficiently low enough to meet the IL screening level and therefore it is uncertain as to whether PFOS is present at concentrations above the IL.

4.2.2 SSOM Facility B

A total of nine water samples were collected at SSOM Facility B, including one primary water sample at each of three sample locations during the three separate sampling events (with the exception of SM-SW02 that was only sampled in November 2018 and May 2019) and one field duplicate.

A total of eight PFAS constituents (PFBA, PFPeA, PFHxA, PFHpA, PFOA, perfluorodecanoate [PFDA], PFBS, and PFOS) were detected in one or more of the sampling events, including detections of two PFAS (PFOA and PFOS) at concentrations above applicable screening criteria.

PFOA was detected in all three sampling locations at concentrations below the HRL (35 ng/L), but above the IL (8.75 ng/L). The concentrations of PFOA were relatively homogenous between sampling locations, ranging from 16.3 ng/L to 23.3 ng/L, with the highest concentrations being reported in the May 2019 sampling event. The maximum concentration of PFOS at SSOM Site B was 23.3 ng/L detected in SM-SW01-0419-100.

PFOA and PFHxS were identified as non-detect in the samples collected in November 2018, however, due to sample matrix interference, the elevated reporting limit was above the IL screening criteria and therefore direct comparison cannot be made.

PFOS was detected in the SM-SW01 and SM-SW03 locations at concentrations exceeding the HBV (15 ng/L) and/or IL (3.75 ng/L). PFOS was detected in SM-SW01 during the May 2019 sampling event; with an estimated concentration of 15.5 J ng/L in the primary sample, exceeding the HBV, and of 10.2 J ng/L in the associated field duplicate sample, exceeding the IL. In SM-SW03, PFOS was detected in both the November 2018 and April 2019 sampling events with the concentration in November 2018 (83.3 J ng/L) exceeding the HBV, and the concentration in April 2019 (6.7 J ng/L) exceeding the IL (3.75 ng/L).

PFOS was not detected in SW01 or SW02 in November 2018; however, the due to sample matrix interference, the elevated reporting limit was above both the HBV and the IL screening criteria and therefore direct comparison cannot be made.

The detection limits for PFOS in both April and May 2019 were not sufficiently low enough to meet the IL screening level and therefore it is uncertain as to whether PFOS is present at concentrations above the IL.

4.2.3 SSOM Facility C

A total of 11 water samples were collected at SSOM Facility C, including one primary water sample at each of three sample locations during the three separate sampling events and two field duplicates.

A total of seven PFAS constituents (PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, and PFOS) were detected in one or more of the sampling events, including detections of two PFAS (PFOA, and PFOS) at concentrations above applicable screening criteria. It is important to note that due to sample matrix interference in the November 2018 sampling event the elevated detection limit for PFHxS was not low enough to meet the IL screening criteria and therefore it is uncertain as to whether PFHxS is present at concentrations exceeding the IL during this sampling event.

PFOA was detected in all three sampling locations at concentrations above the HRL (35 ng/L) and/or IL (8.75 ng/L). The concentrations of PFOA ranged from 32.1 J ng/L to 69.6 ng/L, with the highest concentrations of PFOA being detected in each sample during the April 2019 sampling event. The highest concentration of PFOS at SSOM Site C was 69.6 J ng/L that was detected SE-SW03.

PFOS was detected in all three sampling locations at concentrations above the HRL (300 ng/L), HBV (15 ng/L) or IL (3.75 ng/L). The concentrations of PFOS ranged from 7.28 ng/L to 3,070 J ng/L, with the highest concentration of PFOS being detected in SE-SW02 during the November 2018 sampling event. In SE-SW01, PFOS was detected in both the April and May 2019 sampling events with the concentration in April (7.28 ng/L) exceeding the IL, the concentration in the May primary sample (15.1 J ng/L) exceeding the HBV, and the concentration in the May field duplicate sample (9.36 J ng/L) exceeding the IL. In SE-SW02, PFOS was detected in November 2018 and May 2019; the concentration in November 2018 (3,070 J ng/L) exceeded the HRL and the concentration in May 2019 (11.5 J ng/L) exceeded the IL. In SE-SW03, PFOS was detected in both April (17.8 J ng/L) and May 2019 (18.7 J ng/L) at concentrations exceeding the HBV.

PFOS was not detected in SW01 or SW03 in November 2018; however, due to sample matrix interference, the elevated reporting limit was above both the HBV and the IL screening criteria and therefore direct comparison cannot be made.

The detection limits for PFOS in both April and May 2019 were not sufficiently low enough to meet the IL screening level and therefore it is uncertain as to whether PFOS is present at concentrations above the IL.

4.2.4 SSOM Facility D

A total of 10 water samples were collected at SSOM Facility D, including one primary water sample at each of three sample locations during the three separate sampling events and one field duplicate.

A total of seven PFAS constituents (PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, and PFOS) were detected in one or more of the sampling events, including detections of three PFAS (PFBA, PFOA, and PFOS) at concentrations above applicable screening criteria. It is important to note that due to sample matrix interference in the November 2018 sampling event the elevated detection limit for PFHxS was not low enough to meet the IL screening criteria and therefore it is uncertain as to whether PFHxS is present at concentrations exceeding the IL during this sampling event.

PFBA was detected in all three sampling locations in all three sampling events, with the exception of the April 2019 sampling event at TC-SW03. The concentrations of PFBA were below the HRL (7,000 ng/L); however, the concentrations in the May 2019 sampling event exceeded the IL in both TC-SW01 and TC-SW02. The concentrations of PFBA ranged from 51.3 ng/L to 2,060 J ng/L with the highest concentration being detected in TC-SW02 in May 2019.

PFOA was detected in both samples collected from Pond 1, including detections in both April and May 2019 a concentrations below criteria in TC-SW01 and a detection above the IL in TC-SW02 (9.03 ng/L) during the May 2019 sampling event. PFOA was not detected in the sample collected from Pond 2 (TC-SW03).

PFOS was detected in two samples collected at SSOM Facility D including TC-SW02 and TC-SW03 at concentrations exceeding the HRL (300 ng/L) or HBV (15 ng/L), both samples collected during the November 2018 sampling event. The highest concentration of PFOS was detected in TC-SW03 (547 ng/L) collected in Pond 2. PFOS was not detected in TC-SW01.

PFOS was not detected in SW01 in November 2018; however, the due to sample matrix interference, the elevated reporting limit was above both the HBV and the IL screening criteria and therefore direct comparison cannot be made.

The detection limits for PFOS in both April and May 2019 were not sufficiently low enough to meet the IL screening level and therefore it is uncertain as to whether PFOS is present at concentrations above the IL.

4.2.5 SSOM Facility E

A total of 7 water samples were collected at SSOM Facility E, including one primary water sample at each of three sample locations during two separate sampling events (April and May 2019) and one field duplicate. No sampling was conducted at this facility in November 2018 at the request of the facility due to safety concerns and low water levels within the pond.

A total of 10 PFAS constituents (PFBA, PFPeA, PFHxA, PFHpA, PFOA, perfluorononate [PFNA], PFDA, PFBS, PFHxS and PFOS) were detected in one or more of the sampling events, including detections of two PFAS (PFOA and PFOS) at concentrations above applicable screening criteria.

PFOA was detected in all samples collected at this facility at concentrations above both the HRL (35 ng/L) and the IL (8.75 ng/L). The concentrations ranged from 106 ng/L in the May 2019 sampling events at both WL-SW02 and WL-SW03 to 133 ng/L in the April 2019 sampling event in WL-SW02.

PFOS was detected in all of the samples collected at SSOM Facility D at concentrations exceeding the HBV (15 ng/L) and/or IL (3.75 ng/L). In April 2019, PFOS was detected above the IL in WL-SW01 (10.9 ng/L), the primary sample (13.8 ng/L) and the field duplicate sample (14.7 ng/L) collected from WL-SW02, and in WL-SW03 (15.5 ng/L), which also exceeded the HBV. In May 2019, PFOS was detected at concentrations ranging from 10.5 J ng/L in WL-SW02 to 18.1 J ng/L in WL-SW03. All detections exceeded the IL of 3.75 ng/L and the detections in WL-SW01 and WL-SW03 exceeded the HBV.

4.2.6 Yard Waste Site A

A total of 10 water samples were collected at Yard Waste Facility A, including one primary water sample at each of three sample locations during three separate sampling events, and one field duplicate.

A total of four PFAS constituents (PFBA, PFHxA, PFHxS, and PFOS) were detected in one or more of the sampling events, including detections of two PFAS (PFHxS, and PFOS) at concentrations

above applicable screening criteria. It is important to note that due to sample matrix interference in the November 2018 sampling event the elevated detection limit for PFOA was not low enough to meet the IL screening criteria and therefore it is uncertain as to whether PFOA is present at concentrations exceeding the IL during this sampling event.

PFHxS was detected in all samples collected during the May 2019 sampling event at concentrations ranging from 9.78 J ng/L at FS-SW01 to 14 J ng/L at FS-SW02. The highest concentration of PFHxS was 14 J ng/L which exceeds the IL (11.75 ng/L). No PFHxS was detected in November 2018; however, due to sample matrix interference, the elevated reporting limit was above the IL screening criteria and therefore direct comparison cannot be made.

PFOS was detected in all samples collected at Yard Waste Facility A at concentrations above the HBV (15 ng/L) and IL (3.75 ng/L). The concentrations of PFOS ranged from 24.7 ng/L at FS-SW02 in April 2019 to 104 J ng/L in FS-SW01 in the November 2018 sampling event.

4.2.7 Yard Waste Site B

A total of 10 water samples were collected at Yard Waste Facility A, including one primary water sample at each of three sample locations during three separate sampling events, and one field duplicate.

Seven PFAS constituents (PFBA, PFPeA, PFHxA, PFOA, PFBS, PFHxS, and PFOS) were detected in one or more of the sampling events, including detections of three PFAS (PFHxS, PFOA and PFOS) at concentrations above applicable screening criteria.

PFHxS was detected in two samples (WB-SW01 and WB-SW03) collected in November 2018. The concentration of PFHxS exceeded the HBV (47 ng/L) and the IL (11.75 ng/L) in both WB-SW01 (249 ng/L) and WB-SW03 (all samples collected during the May 2019 sampling event at concentrations ranging from 9.78 J ng/L at FS-SW01 to 14 J ng/L at FS-SW02). The highest concentration of PFHxS was 14 J ng/L which exceeds the IL (11.75 ng/L). PFHxS was not detected in SW02 in November 2018; however, due to sample matrix interference, the elevated reporting limit was above the IL screening criteria and therefore direct comparison cannot be made.

PFOA was only detected in one sample collected at Yard Waste Facility B (WB-SW03) during the November 2018 sampling event. The concentration of PFOA was 20.3 ng/L that exceeded the IL (8.75 ng/L).

PFOS was detected in four samples collected at Yard Waste Facility B, all at concentrations above one or more screening criteria. PFOS was detected in November 2018 at WB-SW01 (7,709 ng/L) and WB-SW03 (2,640 ng/L) at concentrations that exceeded the HRL (300 ng/L) and at WB-SW02 (50.4 ng/L) at a concentration exceeding the HBV (15 ng/L). The only other PFOS detection was an exceedance of the IL (3.75 ng/L) in WB-SW02 from the May 2019 sampling event. It is important to note that the PFOS samples in November 2018 were affected by increased detection limits associated with the analysis of a smaller sample volume and possible introduction of analytical bias. As such the results from November 2018, may not be representative of actual concentrations of PFOS at this location.

The detection limits for PFOS in both April and May 2019 were not sufficiently low enough to meet the IL screening level and therefore it is uncertain as to whether PFOS is present at concentrations above the IL.

4.3 COMPARISON TO PFAS AMBIENT LEVELS

In order to provide additional understanding of the PFAS detected at each of the sites, the results were compared to both PFAS detected in areas with known or suspected contamination, and ambient groundwater PFAS concentrations in Minnesota, as provided in Tables 3 and 4 of the report titled "Perfluorinated Chemicals in Minnesota's Ambient Groundwater, 2013" by the MPCA (MPCA, 2017). The study provided ambient concentrations for the 13 PFAS compounds that were available for laboratory analysis at the time of the assessment, which was representative of the November 2018 analyte list as shown in Table 2 of this report. These ambient PFAS concentrations as presented by the MPCA are compared to concentrations of PFAS detected during this investigation in Table 4.

As shown in Table 4, the range (minimum and maximum concentrations) of PFAS detected at the SSOM and Yard Waste facilities generally exceed both the respective ambient concentration of PFAS detected in all other parts of Minnesota and the median PFAS concentration for areas with known or suspected contamination for all PFAS constituents detected during this investigation and where ambient concentrations were available. The only exception to this circumstance was



PFBA at SSOM Facilities A, B, and D, and the two Yard Waste sites, where the lowest concentration of PFBA detected was lower than the reported background concentration in areas with known or suspected contamination.

Although the ambient concentrations represent groundwater concentrations, the data provide useful comparison with regards to anticipated levels of PFAS in the environment. The concentrations of PFAS in the sites sampled as part of this investigation demonstrate that activities at the facilities are likely contributing to increased PFAS in the contact water and potentially impacting other environmental media in the vicinity of the sites.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

The data quality objectives (DQOs) for the project are as follows:

- Determine if PFAS are present in contact water at each of the selected sites;
- Measure the concentration of chemical analytes with sufficient accuracy to allow a comparison to regulatory standards and to support conclusions regarding the presence or absence of chemicals in contact water at levels exceeding applicable screening criteria; and,

The QA/QC measures taken to address the DQOs were as follows:

- Follow standard field protocols;
- Follow standard laboratory methods and laboratory QA/QC procedures;
- Analyze blank samples;
- Analyze laboratory control samples;
- Utilize standard data quality assurance procedures including data validation; and
- Calibrate field sampling equipment.

5.1 FIELD QA/QC ACTIVITIES

A field QA/QC audit was conducted during the April 2019 sampling event. The following items were reviewed by the auditor:

- Field-sampling records (field activity daily logs and sample collection forms)
- Sample identifications following the specified protocol
- Field instrument calibration records and procedures
- Sample handling and packaging procedures
- Chain-of-custody (COC) procedures

Field forms were found to be accurate and complete. Sample numbers were assigned according to the protocol specified in the SAP. Field instruments were calibrated daily by field personnel. Reusable sampling equipment was cleaned between sampling locations with water in accordance with SOP WOOD-04 Equipment Decontamination.

Sample containers, applicable to the analytical methods, were provided by SGS-AXYS. The sample containers were filled with the collected sample, preserved if necessary, given the analytical method, labeled and managed in accordance with Wood sampling protocols and sampling guidelines, which are sufficient to meet the data quality objectives of this project. Water samples were placed in an ice-filled cooler immediately following collection, and were handled and subsequently shipped to the laboratory under chain-of-custody protocol.

5.2 LABORATORY QA/QC

A DQR was completed for all samples collected as part of the PFAS site evaluation to evaluate the usability of the data. Laboratory analytical reports and supporting documentation were reviewed to assess completeness, chain-of-custody compliance, holding time compliance, presence or absence of laboratory contamination, sampling and analytical precision (field duplicates), and assessment of field contamination (field blanks). Copies of the DQR reports are presented in Appendix G. The following is a summary of findings from the DQR.

5.2.1 November 2018 Water Samples

Water analytical results from the November 2018 sampling event were reported and validated across two data packages, including DPWG67084 dated February 6, 2019 and DPWG66995 dated February 20, 2019. Copies of the laboratory reports are provided in Appendix A. Wood evaluated a total of 299 data records from target analytes in field samples during this DQR. Wood J qualified (estimated) or UJ qualified (non-detected/estimated) 123 records (41.1%) as estimated concentrations due to improper preservation, low ongoing precision and recovery (OPR), low MS/MSD recovery, low internal standard recovery, and field duplicate imprecision. No records were U qualified (non-detected) or R qualified (rejected) as a part of the DQR. A complete DQR summary is provided in Appendix B. Wood concluded that all of the data should be considered valid with the addition of the qualifiers noted in the DQR report.

5.2.2 April 2019 Water Samples

Water analytical results from the April 2019 sampling event were reported in data package, DPWG68411 dated June 12, 2019. A copy of the laboratory analytical report is provided in Appendix A. Wood evaluated a total of 870 data records from target analytes in field samples during this DQR. Wood J qualified (estimated) or UJ qualified (non-detected/estimated) 11 records (1.3%) as estimated concentrations due to low MS/MSD recovery, and low internal standard recovery. No records were U qualified (non-detected) or R qualified (rejected) as a part of the DQR. The DQR summary is provided in Appendix B. Wood concluded that all of the data should be considered valid with the addition of the qualifiers noted in the DQR report.

5.2.3 May 2019 Water Samples

Water analytical results from the May 2019 sampling event were reported in data package, DPWG68375 dated June 7, 2019. A copy of the laboratory analytical report is provided in Appendix A. Wood evaluated a total of 900 data records from target analytes in field samples during this DQR. Wood J qualified (estimated) or UJ qualified (non-detected/estimated) 76 records (8.4%) as estimated concentrations due to high and low OPR recovery, relative percent differences between the OPR/ORPD, low MS/MSD recovery, low internal standard recovery, and field duplicate imprecision. No records were U qualified (non-detected) or R qualified (rejected) as a part of the DQR. A complete DQR summary is provided in Appendix B. Wood concluded that all of the data should be considered valid with the addition of the qualifiers noted in the DQR report.

6.0 CONCLUSIONS

Wood prepared this report to present findings of an evaluation of PFAS at selected large-scale composting facilities; specifically, five SSOM and two yard waste sites at locations across the State to further enhance understanding of contact water with regards to emerging contaminants. In order to meet the identified objective, surface water sampling was completed from up to three locations at five SSOM and two yard waste sites that were selected by the MPCA. Sampling was also conducted on three separate occasions to assess changes in concentrations over time.

The results of this investigation have confirmed the presence of one or more PFAS at concentrations above screening criteria at all SSOM and yard waste sites sampled. PFOS was detected at concentrations exceeding the HRL and/or HBV in one or more samples collected at all five SSOM facilities and both yard waste sites. PFOA was detected at concentrations above the HRL and/or HBV at SSOM facilities C and E and yard waste facility B. PFOS and/or PFOA were detected at all facilities at concentrations above the IL. For the SSOM facility sites, the detected PFAS included PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFBS, PFHxS and PFOS. For the yard waste sites, the detected PFAS constituents include, PFBA, PFPeA, PFHxA, PFOA, PFBS, PFHxS, and PFOS. In general, the two yard waste sites had much lower PFAS detection frequency than the SSOM Facilities, which is consistent with the nature of the different wastes at the different types of sites, with SSOM sites having more food and paper wastes (which have a higher probability of PFAS-containing material) and yard waste sites containing primarily organic and plant material wastes.

Any PFAS detected were compared to ambient background concentrations of PFAS across Minnesota based on a document entitled "Perfluorinated Chemicals in Minnesota's Ambient Groundwater, 2013" by the MPCA (MPCA, 2017)." Based on the comparison, the PFAS concentrations at the SSOM and yard waste sites were found to be up to orders of magnitude higher than reported background concentrations (MPCA, 2017).

Based on findings from this investigation, PFAS are present in contact water at the SSOM and yard waste sites at concentrations above screening criteria that could potentially be impacting other environmental media. Additional sampling would be warranted to evaluate the extent to which other media (i.e., groundwater, sediment, soil) have been impacted by activities at the facilities.



7.0 PFAS MANAGEMENT AT SSOM AND YARD WASTE SITES LITERATURE REVIEW

Several PFAS were detected in contact water at the selected SSOM and yard waste sites as part of the site investigation activities conducted as part of this evaluation. The principal concern for PFAS related to these sites is twofold:

- 1) the potential for PFAS contaminated contact water to contaminate run-off and surface water on-site and nearby off-site and,
- 2) the potential for PFAS to leach into soil and/or groundwater via stormwater infiltration ponds, further contaminating both groundwater, via soil to groundwater pathway.

In order to assess these concerns in a broader context, Wood performed a preliminary literature review at the request of the MPCA, to compare measured concentrations against published municipal landfill leachate data to determine if the PFAS concentrations at SSOM and yard waste sites were comparable to municipal landfill concentrations. Exhibit 1 below illustrates the range of PFAS concentrations from:

- 1) A study in Michigan (MWRA, 2019) of statewide municipal waste landfill leachate, influent concentrations at publicly-owned treatment works (POTW) where leachate was not accepted, and influent concentrations at POTW where leachate was accepted.
- 2) A US-wide municipal landfill leachate study that evaluated landfills by climate (wet, temperate, and dry) (Lang et al, 2017).

Exhibit 1 – Literature Review

Study	Description	Range (ng/L)		Reference
		PFOS	PFOA	
MI	MWRA-leachate	100-710	240-3,200	Michigan Waste & Recycling Association Statewide Study on Landfill Leachate PFOA and PFOS Levels and Relative Influence on Water Resource Recovery Facility (WRRF) Influent Completed in Collaboration with Michigan Department of Environmental Quality Summary Report March 1, 2019
MI	influent POTW/WRRF- no leachate accepted	ND- 499	ND- 17.9	
MI	influent- POTW/WRRF- leachate accepted	ND-62.4	ND-64.6	
US	municipal landfill leachate- landfill - wet climate (above 75 cm/yr precipitation)	100	1000	Lang, J. R., B. M. Allred, J. A. Field, J. W. Levis, and M.A. Barlaz. 2017. "National Estimate of Per- and Polyfluoroalkyl Substance (PFAS) Release to US Municipal Landfill Leachate." Environmental Science and Technology 51 (4): 2197–2205.

The Michigan study (MWRA, 2019) also included a literature review of PFOS and PFOA concentrations in landfill leachate globally. Data was compiled from the United States (US), Canada, Denmark, Sweden, Germany, Spain, Australia and China. Samples sizes ranged from 5-97 sites. In nearly every case, and in all cases in the US, PFOA was detected 100% of the time and PFOS was detected at 100% for nearly all sites. Median concentrations in the US range from 490 to 1050 ng/L for PFOA and 97-155 ng/L for PFOS.

At every SSOM or Yard Waste facility, measured PFOS and PFOA concentrations were generally lower but within the range of concentrations found in this published literature. Concentrations at the SSOM sites generally tended to be higher than those at the yard waste sites. This is consistent with the nature of the different wastes at the 2 types of sites, with SSOM sites having more food and paper wastes and Yard Waste Sites containing primarily organic and plant material wastes.

In order to support future management and decision making efforts regarding PFAS at SSOM and Yard Waste sites, Wood has included a draft conceptual site model (CSM) table and figure that was developed as part of the PFAS protocol project completed for the MPCA. The CSM table and figure are included in Appendix C.

8.0 REFERENCES

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Evaluation of PFAS at Select SSOM and Yard Waste Sites
Minnesota Pollution Control Agency
September 2019



TABLES

Table 1
Sampling Plan
Site Investigation Report
Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Site	Sample Location ID	Sample Matrix Code ¹	Rationale	Sampling Method			Sample Counts	Matrix	Sample Location			Analytes	
				Direct	Stainless Steel Dip Cup	Peristaltic Pump			Northing	Easting	Depth	Field Parameter ²	PFAS ²
A	MR-SW01	SW	Surface water sample collected near the center at a natural inlet/low spot of the northern extent of Pond 1 located in the southern portion of the site.	x	x		3	Surface water	4874198.18	417823.8686	Near surface of pond	x	x
	MR-SW02	SW	Surface water sample collected near the northeast corner of Pond 1 located in the southern portion of the site.	x	x		3	Surface water	4874197.998	417893.1898	Near surface of pond	x	x
	MR-SW03	SW	Surface water sample collected on the southern extent of Pond 2 located near the northern site boundary.	x	x		3	Surface water	4874388.617	417847.1554	Near surface of pond	x	x
B	SM-SW01	SW	Surface water sample collected near the outfall to the pond north of the sorting/storage area at its southwest corner (closest proximity to the organic material storage area).	x	x		3	Surface water	4957332.768	463906.2609	Near surface of pond	x	x
	SM-SW02	SW	Surface water sample collected near the outfall on the western extent of a second pond northeast of the sorting/storage area. This area of the pond was dry during the April mobilization.	x	x		2	Surface water	4957366.159	463988.6804	Near surface of pond	x	x
	SM-SW03	SW	Surface water sample collected on the eastern extent of the second pond northeast of the sorting/storage area.	x	x		3	Surface water	4957356.65	464042.7186	Near surface of pond	x	x
C	SE-SW01	SW	Surface water sample collected from the southwest corner of the pond on the north side of the organics material staging area.	x	x		3	Surface water	4950923.712	495920.4676	Near surface of pond	x	x
	SE-SW02	SW	Surface water sample collected from the northeast corner of the pond on the north side of the organics material staging area.	x	x		3	Surface water	4950945.102	495961.1033	Near surface of pond	x	x
	SE-SW03	SW	Surface water sample collected from pooled water in a low area east of the organics sorting/staging area.	x			3	Surface water	4950772.667	496204.5414	Near surface of pond	x	x
D	TC-SW01	SW	Surface water sample collected from the western extent of the pond located south of the organics material staging area.		x	x	3	Surface water	5046744.148	415225.0829	Near surface of pond	x	x
	TC-SW02	SW	Surface water sample collected from the eastern extent of the pond located south of the organics material staging area.		x	x	3	Surface water	5046759.372	415245.4981	Near surface of pond	x	x
	TC-SW03	SW	Surface water sample collected from the center of the southern extent of the vegetated swale located in the north-central portion of the site, north of the organics material staging area.	x	x		3	Surface water	5046863.018	415120.8934	Near surface of pond	x	x
E	WL-SW01	SW	Surface water sample collected from the northwest extent of the pond located in the southeast corner of the site and south of the organics materials staging area.		x		2	Surface water	5179050.924	567051.6898	Near surface of pond	x	x
	WL-SW02	SW	Surface water sample collected from the northeast extent of the pond located in the southeast corner of the site and south of the organics materials staging area.		x		2	Surface water	5179043.889	567042.9275	Near surface of pond	x	x
	WL-SW03	SW	Surface water sample collected from the center of the southern extent of the pond located in the southeast corner of the site and south of the organics materials staging area.		x	x	2	Surface water	5179049.322	567063.4932	Near surface of pond	x	x
F	FS-SW01	SW	Surface water sample collected from the northwest extent of the pond located in the southern portion of the site south of the yard waste staging area.		x	x	3	Surface water	4979490.813	495957.2556	Near surface of pond	x	x
	FS-SW02	SW	Surface water sample collected from the southwest extent of the pond (near an overflow inlet) located in the southern portion of the site south of the yard waste staging area.		x	x	3	Surface water	4979475.437	495959.4911	Near surface of pond	x	x
	FS-SW03	SW	Surface water sample collected from the southeast extent of the pond (at the outfall from a drainage channel) located in the southern portion of the site south of the yard waste staging area.		x	x	3	Surface water	4979482.121	495977.2756	Near surface of pond	x	x

Table 1
Sampling Plan
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Site	Sample Location ID	Sample Matrix Code ¹	Rationale	Sampling Method			Sample Counts	Matrix	Sample Location			Analytes	
				Direct	Stainless Steel Dip Cup	Peristaltic Pump			Northing	Easting	Depth	Field Parameter ²	PFAS ²
G	WB-SW01	SW	Surface water sample collected from the northwest extent of the pond located in the northern portion of the site north of the yard waste staging area.		x	x	3	Surface water	4996561.777	492447.1793	Near surface of pond	x	x
	WB-SW02	SW	Surface water sample collected from the southeast extent of the pond located in the northern portion of the site north of the yard waste staging area.		x	x	3	Surface water	4996542.15	492454.2094	Near surface of pond	x	x
	WB-SW03	SW	Surface water sample collected from the eastern side of the pond located in the south-central portion of the site, which collects runoff from an area of the facility formerly used for yard waste staging.		x	x	3	Surface water	4996248.49	492515.5918	Near surface of pond	x	x
Project Quality Assurance/Quality Control Samples	Duplicate Sample	FD	One duplicate sample per 10 primary samples during each sampling event and a total of 8 duplicate samples collected (59 primary samples collected, so extra duplicates were collected).				8	Surface water	Various	Various	Near surface of pond	x	x
	Matrix Spike/Matrix Spike Duplicates	MS/MSD	One matrix spike/matrix spike duplicate per 20 primary samples during each sampling event for a total of 6 matrix spike/matrix spike duplicates.				6	Surface water	Various	Various	Near surface of pond	x	x
	Equipment Blank	EB	One equipment blank per piece of non-dedicated, reusable sampling equipment per day to validate decontamination procedures. If the immersion sampling method was used each day of sampling, no equipment blanks were collected.				6	Water	n/a	n/a	n/a		x
	Field Blank	FB	One field blank was collected per day.				9	Water	n/a	n/a	n/a		x

TOTAL PRIMARY SAMPLES: 59
TOTAL QUALITY ASSURANCE/QUALITY CONTROL: 29
TOTAL 88

Notes:

- SSOM - source separated organic materials
 SW - Surface Water Sample
 FB - field blank sample
 EB - equipment blank sample
 FD - field duplicate sample
 MS/MSD - matrix spike/matrix spike duplicate sample
- PFAS includes parameters identified in Table 2 and will be analyzed by liquid chromatography tandem mass spectrometry (LC-MS/MS)
 n/a = Not Applicable

Table 2
PFAS Analytical Method Summary
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Cas Number	Abbreviation	Analyte Name	SGS Axys Method MLA 060	SGS Axys Method MLA 110
375-22-4	PFBA	Perfluorobutanoate	x	x
2706-90-3	PFPeA	Perfluoropentanoate	x	x
307-24-4	PFHxA	Perfluorohexanoate	x	x
375-85-9	PFHpA	Perfluoroheptanoate	x	x
335-67-1	PFOA	Perfluorooctanoate	x	x
375-95-1	PFNA	Perfluorononanoate	x	x
335-76-2	PFDA	Perfluorodecanoate	x	x
2058-94-8	PFUnA	Perfluoroundecanoate	x	x
307-55-1	PFDoA	Perfluorododecanoate	x	x
72629-94-8	PFTriDA	Perfluorotridecanoate		x
376-06-7	PFTeDA	Perfluorotetradecanoate		x
375-73-5	PFBS	Perfluorobutanesulfonate	x	x
2706-91-4	PFPeS	Perfluoropentanesulfonate		x
355-46-4	PFHxS	Perfluorohexanesulfonate	x	x
375-92-8	PFHpS	Perfluoroheptanesulfonate		x
1763-23-1	PFOS	Perfluorooctanesulfonate	x	x
68259-12-1	PFNS	Perfluorononanesulfonate		x
335-77-3	PFDS	Perfluorodecanesulfonate		x
79780-39-5	PFDoS	Perfluorododecanesulfonate		x
757124-72-4	4:2 FTS	4:2 fluorotelomersulfonate		x
27619-97-2	6:2 FTS	6:2 fluorotelomersulfonate		x
39108-34-4	8:2 FTS	8:2 fluorotelomersulfonate		x
2355-31-9	N-MeFOSAA	N-Methylperfluorooctanesulfonamidoacetic acid		x
2991-50-6	N-EtFOSAA	N-Methylperfluorooctanesulfonamidoacetic acid		x
754-91-6	PFOSA	Perfluorooctane sulfonamide	x	x
31506-32-8	N-MeFOSA	N-Methylperfluorooctanesulfonamide		x
4151-50-2	N-EtFOSA	N-Ethylperfluorooctanesulfonamide		x
24448-09-7	N-MeFOSE	N-Methylperfluorooctanesulfonamidoethanol		x
1691-99-2	N-EtFOSE	N-Ethylperfluorooctanesulfonamidoethanol		x
62037-80-3	Gen-X	Hexafluoropropylene oxide dimer acid		x

Notes:

Analytical method: LC-MS/MS

Table 3A
Surface Water Analytical Results: SSOM Facility A
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Parameter	Sample Location			MR-SW01				MR-SW02			MR-SW03			
	Sample Name			MR-SW01-1118-100	MR-SW01-1118-300	MR-SW01-0419-100	MR-SW01-0519-100	MR-SW02-1118-100	MR-SW02-0419-100	MR-SW02-0519-100	MR-SW03-1118-100	MR-SW03-0419-100	MR-SW03-0419-300	MR-SW03-0519-100
	Sample Date			11/28/2018	11/28/2018	4/5/2019	5/15/2019	11/28/2018	4/5/2019	5/15/2019	11/28/2018	4/5/2019	4/5/2019	5/15/2019
	Analytical Method			MLA 060	MLA 060	MLA 110	MLA 110	MLA 060	MLA 110	MLA 110	MLA 060	MLA 110	MLA 110	MLA 110
	Regulatory Criteria			HRL	HBV	Intervention Limit								
PERFLUORINATED ALKYL SUBSTANCES (ng/L)														
PFBA	7,000	---	1,750	927 J	1,040 J	511 J	77.3 U	205 J	535 J	49.7 U	59.1 J	38	33.9	56.1
PFPeA	---	---	---	29.1 UJ	23.4 UJ	63	76.6 J	21.6 UJ	66.7	89.9 J	19.7 UJ	15.4	13.5 U	25.7
PFHxA	---	---	---	256 J	279 J	134	218	55.3 J	150	212	44.9 J	57.7	53	100
PFHpA	---	---	---	29.1 UJ	20.9 UJ	6.42 U	8	21.6 UJ	6.65 U	6.15	19.7 UJ	7.38 U	6.76 U	11.4 U
PFOA	35	---	8.75	29.1 UJ	20.9 UJ	9.83	10.2	21.6 UJ	20.9	11.2	19.7 UJ	7.38 U	6.76 U	11.4 U
PFNA	---	---	---	29.1 UJ	20.9 UJ	6.26 U	6.89 U	21.6 UJ	7.97	6.04 U	19.7 UJ	7.2 U	6.6 U	11.4 U
PFDA	---	---	---	29.1 UJ	20.9 UJ	6.26 U	6.89 U	21.6 UJ	6.49 U	6.04 U	19.7 UJ	7.2 U	6.6 U	11.4 U
PFUnA	---	---	---	29.1 UJ	20.9 UJ	6.26 U	6.89 U	21.6 UJ	6.49 U	6.04 U	19.7 UJ	7.2 U	6.6 U	11.4 U
PFDoA	---	---	---	29.1 UJ	20.9 UJ	6.26 U	6.89 U	21.6 UJ	6.49 U	6.04 U	19.7 UJ	7.2 U	6.6 U	11.4 U
PFTrDA	---	---	---	NS	NS	11.1 U	6.89 U	NS	7.99 U	6.04 U	NS	7.2 U	6.6 U	11.4 U
PFTeDA	---	---	---	NS	NS	6.26 U	6.89 U	NS	6.49 U	10.2 U	NS	7.2 U	6.6 U	11.4 U
PFBS	7,000	2,000	500 ^A	58.3 UJ	41.9 UJ	6.42 U	7.81	43.3 UJ	6.65 U	7.09	39.3 UJ	7.38 U	6.76 U	11.4 U
PFPeS	---	---	---	NS	NS	5.95 U	6.89 U	NS	6.16 U	6.04 U	NS	6.84 U	6.27 U	11.4 U
PFHxS	---	47	11.75 ^A	153 J	41.9 UJ	6.42 U	6.89 U	43.3 UJ	6.65 U	6.04 U	39.3 UJ	7.38 U	6.76 U	11.4 U
PFHpS	---	---	---	NS	NS	5.95 U	6.89 U	NS	6.16 U	6.04 U	NS	6.84 U	6.27 U	11.4 U
PFOS	300	15	3.75 ^A	1,700 J	41.9 UJ	6.42 U	6.89 U	43.3 UJ	15.5	9.69 J	19.7 UJ	7.38 U	6.76 U	11.4 U
PFNS	---	---	---	NS	NS	5.95 U	6.89 U	NS	6.16 U	6.04 U	NS	6.84 U	6.27 U	11.4 U
PFDS	---	---	---	NS	NS	6.42 U	6.89 U	NS	6.65 U	6.04 U	NS	7.38 U	6.76 U	11.4 U
PFDoS	---	---	---	NS	NS	5.95 U	6.89 UJ	NS	6.16 U	6.04 UJ	NS	6.84 UJ	6.27 U	11.4 UJ
4:2 FTS	---	---	---	NS	NS	25.1 U	27.5 U	NS	26 U	24.2 U	NS	28.8 U	26.4 U	45.5 U
6:2 FTS	---	---	---	NS	NS	22.5 U	24.8 U	NS	23.4 U	21.7 U	NS	25.9 U	23.7 U	41 U
8:2 FTS	---	---	---	NS	NS	25.1 U	27.5 U	NS	26 U	24.2 U	NS	28.8 U	26.4 U	45.5 U
PFOSA	---	---	---	29.1 UJ	20.9 UJ	6.42 U	6.89 U	21.6 UJ	6.65 U	6.04 U	39.3 UJ	7.38 U	6.76 U	11.4 U
N-MeFOSA	---	---	---	NS	NS	7.2 U	7.92 U	NS	7.46 U	6.95 U	NS	8.27 U	7.59 U	13.1 U
N-EtFOSA	---	---	---	NS	NS	15.7 U	17.2 U	NS	16.2 U	15.1 U	NS	18 U	16.5 U	28.5 UJ
MeFOSAA	---	---	---	NS	NS	6.26 U	6.89 U	NS	6.49 U	6.04 U	NS	7.2 U	6.6 U	11.4 U
EtFOSAA	---	---	---	NS	NS	6.26 U	6.89 U	NS	6.49 U	6.04 U	NS	7.2 U	6.6 U	11.4 U
N-MeFOSE	---	---	---	NS	NS	63.9 U	68.9 U	NS	66.2 U	60.4 U	NS	73.4 U	67.3 U	114 U
N-EtFOSE	---	---	---	NS	NS	47.9 U	51.6 U	NS	49.6 U	45.3 U	NS	55 U	50.5 U	85.4 U
HFPO-DA	---	---	---	NS	NS	5.95 U	6.89 U	NS	6.16 U	6.04 U		6.84 U	6.27 U	111.4 U

NOTES:

ng/L = Nanograms per Liter.

J = Result is estimated

U = Analyte was not detected above the applicable method detection limit

NS = Not sampled - Analyte not included in Analytical Metho MLA-060

MDH = Minnesota Department of Health

HRL = MDH Health Risk Limit

HBV = MDH Health-Based Value

Intervention Limit = MPCA Solid Waste Program screening level; calculated value based on one quarter of the HRL or HBV. Values shown represent one quarter of the HRL unless noted

^A = Intervention Limit shown reflects the HBV and representative of most conservative screening criteria

--- = Regulatory criteria not established.

-100 samples are primary results, -300 samples represent field duplicate results

MLA 060 - SGS-Axys Analytical Method (13 PFAS Compounds)

MLA-110 - SGS-Axys Analytical Method: 29 PFAS compounds plus Gen-X (HFPO-DA)

Table 3B
Surface Water Analytical Results: SSOM Facility B
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Parameter	Sample Location			SM-SW01				SM-SW02		SM-SW03		
	Sample Name			SM-SW01-1118-100	SM-SW01-0419-100	SM-SW01-0519-100	SM-SW01-0519-300	SM-SW02-1118-100	SM-SW02-0519-100	SM-SW03-1118-100	SM-SW03-0419-100	SM-SW03-0519-100
	Sample Date			11/28/2018	4/2/2019	5/15/2019	5/15/2019	11/28/2018	5/15/2019	11/28/2018	4/2/2019	5/15/2019
	Analytical Method			MLA 060	MLA 110	MLA 110	MLA 110	MLA 060	MLA 110	MLA 060	MLA 110	MLA 110
	Regulatory Criteria											
	HRL	HBV	Intervention Limit									
PERFLUORINATED ALKYL SUBSTANCES (ng/L)												
PFBA	7,000	---	1,750	318	543	412	352	536 J	335	114	30.6	377
PFPeA	---	---	---	148	425	373 J	337 J	264	306 J	75	20.5	312 J
PFHxA	---	---	---	1,560	2,970	2,580	2,270	2,530	2,090	583	211	2,270
PFHpA	---	---	---	19.8 U	23.5	23.8	20.5	23	17.5	21.1 U	6.15 U	19.7
PFOA	35	---	8.75	19.8 U	20.1	23.3	20.1	21.1 U	16.3	21.1 U	6.15 U	17.2
PFNA	---	---	---	19.8 U	6.26 U	6.62 U	6.54 U	21.1 U	6.54 U	21.1 U	6 U	6.73 U
PFDA	---	---	---	19.8 U	6.26 U	8.2	6.54 U	21.1 U	6.54 U	21.1 U	6 U	6.73 U
PFUnA	---	---	---	19.8 U	6.26 U	6.62 U	6.54 U	21.1 U	6.54 U	21.1 U	6 U	6.73 U
PFDoA	---	---	---	19.8 U	6.26 U	6.62 U	6.54 U	21.1 U	6.54 U	21.1 U	6 U	6.73 U
PFTrDA	---	---	---	NS	6.26 U	6.62 U	6.54 U	NS	6.54 U	NS	6 U	6.73 U
PFTeDA	---	---	---	NS	6.26 U	6.62 U	6.54 U	NS	6.54 U	NS	6 U	6.73 U
PFBS	7,000	2,000	500 ^A	39.6 U	12.3	14.9 J	12.6 J	42.3 U	10.3 J	42.1 U	6.15 U	12.2 J
PFPeS	---	---	---	NS	5.94 U	6.62 U	6.54 U	NS	6.54 U	NS	5.7 U	6.73 U
PFHxS	---	47	11.75 ^A	39.6 U	6.41 U	6.62 U	6.54 U	42.3 U	6.54 U	42.1 U	6.15 U	6.73 U
PFHpS	---	---	---	NS	5.94 U	6.62 U	6.54 U	NS	6.54 U	NS	5.7 U	6.73 U
PFOS	300	15	3.75 ^A	39.6 U	6.41 U	15.5 J	10.2 J	42.3 U	6.54 U	83.3	6.7	6.73 U
PFNS	---	---	---	NS	5.94 U	6.62 U	6.54 U	NS	6.54 U	NS	5.7 U	6.73 U
PFDS	---	---	---	NS	6.41 U	6.62 U	6.54 U	NS	6.54 U	NS	6.15 U	6.73 U
PFDoS	---	---	---	NS	5.94 U	6.62 U	6.54 U	NS	6.54 U	NS	5.7 U	6.73 U
4:2 FTS	---	---	---	NS	25.0 U	26.5 U	26.1 U	NS	26.2 U	NS	24 U	26.9 U
6:2 FTS	---	---	---	NS	22.5 U	23.8 U	23.5 U	NS	23.6 U	NS	21.6 U	24.2 U
8:2 FTS	---	---	---	NS	25 U	26.5 U	26.1 U	NS	26.2 U	NS	24 U	26.9 U
PFOSA	---	---	---	19.8 U	6.41 U	6.62 U	6.54 U	21.1 U	6.54 U	21.1 U	6.15 U	6.73 U
N-MeFOSA	---	---	---	NS	7.19 U	7.62 U	7.52 U	NS	7.52 U	NS	6.9 U	7.74 U
N-EtFOSA	---	---	---	NS	15.6 U	16.6 U	16.3 U	NS	16.4 U	NS	15 U	16.8 U
MeFOSAA	---	---	---	NS	6.26 U	6.62 U	6.54 U	NS	6.54 U	NS	6 U	6.73 U
EtFOSAA	---	---	---	NS	6.26 U	6.62 U	6.54 U	NS	6.54 U	NS	6 U	6.73 U
N-MeFOSE	---	---	---	NS	63.8 U	66.2 U	65.4 U	NS	65.4 U	NS	61.2 U	67.3 U
N-EtFOSE	---	---	---	NS	47.9 U	49.7 U	49 U	NS	49.1 U	NS	45.9 U	50.4 U
HFPO-DA	---	---	---	NS	25 U	6.62 U	6.54 U	NS	6.54 U	NS	24 U	6.73 U

NOTES:

ng/L = Nanograms per Liter.

J = Result is estimated

U = Analyte was not detected above the applicable method detection limit

NS = Not sampled - Analyte not included in Analytical Metho MLA-060

MDH = Minnesota Department of Health

HRL = MDH Health Risk Limit

HBV = MDH Health-Based Value

Intervention Limit = MPCA Solid Waste Program screening level; calculated value based on one quarter of the HRL or HBV. Values shown represent one quarter of the HRL unless noted

^A = Intervention Limit shown reflects the HBV and representative of most conservative screening criteria

--- = Regulatory criteria not established.

-100 samples are primary results, -300 samples represent field duplicate results

MLA 060 - SGS-Axys Analytical Method (13 PFAS Compounds)

MLA-110 - SGS-Axys Analytical Method: 29 PFAS compounds plus Gen-X (HFPO-DA)

Table 3C
Surface Water Analytical Results: SSOM Facility C
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Parameter	Sample Location			SE-SW01				SE-SW02				SE-SW03		
	Sample Name			SE-SW01-1118-100	SE-SW01-0419-100	SE-SW01-0519-100	SE-SW01-0519-300	SE-SW02-1118-100	SE-SW02-1118-300	SE-SW02-0419-100	SE-SW02-0519-100	SE-SW03-1118-100	SE-SW03-0419-100	SE-SW03-0519-100
	Sample Date			11/27/2018	4/4/2019	5/14/2019	5/14/2019	11/27/2018	11/27/2018	4/4/2019	5/14/2019	11/27/2018	4/4/2019	5/14/2019
	Analytical Method			MLA 060	MLA 110	MLA 110	MLA 110	MLA 060	MLA 060	MLA 110	MLA 110	MLA 060	MLA 110	MLA 110
	Regulatory Criteria													
			HRL	HBV	Intervention Limit									
PERFLUORINATED ALKYL SUBSTANCES (ng/L)														
PFBA	7,000	---	1,750	1,070 J	1,080 J	861 J	920	716 J	847 J	1,060 J	905	509	308	1,340
PFPeA	---	---	---	325	456	376	403	266 J	285 J	461	393	280	215	780
PFHxA	---	---	---	1,740	2,000	1,540	1,620	1,230 J	1,440 J	1,990	1,610	1,100	712	3,350
PFHpA	---	---	---	30	36.2	28.6	26.8	22.4 J	27.2 J	37.5	32.8	29.6	36.7	61.4
PFOA	35	---	8.75	32.1	63.7	32.1	34.2	37.1 J	27.9 J	66.8	39.2	57.4	69.6	67.4
PFNA	---	---	---	20.4 U	6.7 U	5.74 U	7.07 U	21.5 UJ	21.6 UJ	6.96 U	7.19 U	19.6 U	6.77	7.05
PFDA	---	---	---	20.4 U	6.7 U	5.74 U	7.07 U	21.5 UJ	21.6 UJ	6.96 U	7.19 U	19.6 U	11.1	9.27
PFUnA	---	---	---	20.4 U	6.7 U	5.74 U	7.07 U	21.5 UJ	21.6 UJ	6.96 U	7.19 U	19.6 U	6.54 U	5.94 U
PFDoA	---	---	---	20.4 U	6.7 U	5.74 U	7.07 U	21.5 UJ	21.6 UJ	6.96 U	7.19 U	19.6 U	6.54 U	5.94 U
PFTTrDA	---	---	---	NS	8.4 U	5.74 U	7.07 U	NS	NS	6.96 U	7.19 U	NS	6.54 U	5.94 U
PFTeDA	---	---	---	NS	6.7 U	5.74 U	7.07 U	NS	NS	6.96 U	7.19 U	NS	6.54 U	5.94 U
PFBS	7,000	2,000	500 ^A	40.8 U	24.7	25.1	24.5	42.9 UJ	43.3 UJ	21.1	24.7	39.2 U	15.7	57.3
PFPeS	---	---	---	NS	6.37 U	5.74 U	7.07 U	NS	NS	6.61 U	7.19 U	NS	6.21 U	5.94 U
PFHxS	---	47	11.75 ^A	40.8 U	6.87 U	5.74 U	7.07 U	42.9 UJ	43.3 UJ	7.14 U	7.19 U	39.2 U	6.7 U	5.94 U
PFHpS	---	---	---	NS	6.37 U	5.74 U	7.07 U	NS	NS	6.61 U	7.19 U	NS	6.21 U	5.94 U
PFOS	300	15	3.75 ^A	20.4 U	7.28	15.1 J	9.36 J	3,070 J	43.3 UJ	7.14 U	11.5 J	39.2 U	17.8	18.7 J
PFNS	---	---	---	NS	6.37 U	5.74 U	7.07 U	NS	NS	6.61 U	7.19 U	NS	6.21 U	5.94 U
PFDS	---	---	---	NS	6.87 U	5.74 U	7.07 U	NS	NS	7.14 U	7.19 U	NS	6.7 U	5.94 U
PFDoS	---	---	---	NS	6.37 U	5.74 UJ	7.07 UJ	NS	NS	6.61 U	7.19 UJ	NS	6.21 U	5.94 UJ
4:2 FTS	---	---	---	NS	26.8 U	23 U	28.3 U	NS	NS	27.8 U	28.8 U	NS	26.2 U	23.8 U
6:2 FTS	---	---	---	NS	24.1 U	20.7 U	25.4 U	NS	NS	25.1 U	25.9 U	NS	23.5 U	21.4 U
8:2 FTS	---	---	---	NS	26.8 U	23 U	28.3 U	NS	NS	27.8 U	28.8 U	NS	26.2 U	23.8 U
PFOSA	---	---	---	40.8 U	6.87 U	5.74 U	7.07 U	21.5 UJ	21.6 UJ	7.14 U	7.19 U	19.6 U	6.7 U	5.94 U
N-MeFOSA	---	---	---	NS	7.71 U	6.61 U	8.13 U	NS	NS	8.01 U	8.27 U	NS	7.52 U	6.84 U
N-EtFOSA	---	---	---	NS	16.8 U	14.4 U	17.7 U	NS	NS	17.4 U	18 U	NS	16.4 U	14.9 U
MeFOSAA	---	---	---	NS	6.7 U	5.74 U	7.07 U	NS	NS	6.96 U	7.19 U	NS	6.54 U	5.94 U
EtFOSAA	---	---	---	NS	6.7 U	5.74 U	7.07 U	NS	NS	6.96 U	7.19 U	NS	6.54 U	5.94 U
N-MeFOSE	---	---	---	NS	68.3 U	57.4 U	70.7 U	NS	NS	71 U	71.9 U	NS	66.7 U	59.4 U
N-EtFOSE	---	---	---	NS	51.3 U	43.1 U	53 U	NS	NS	53.3 U	54 U	NS	50 U	44.6 U
HFPO-DA	---	---	---	NS	6.37 U	5.74 U	7.07 U	NS	NS	6.61 U	7.19 U	NS	26.2 U	5.94 U

NOTES:

- ng/L = Nanograms per Liter.
- J = Result is estimated
- U = Analyte was not detected above the applicable method detection limit
- NS = Not sampled - Analyte not included in Analytical Metho MLA-060
- MDH = Minnesota Department of Health
- HRL = MDH Health Risk Limit
- HBV = MDH Health-Based Value
- Intervention Limit = MPCA Solid Waste Program screening level; calculated value based on one quarter of the HRL or HBV. Values shown represent one quarter of the HRL unless noted
- ^A = Intervention Limit shown reflects the HBV and representative of most conservative screening criteria
- = Regulatory criteria not established.
- 100 samples are primary results, -300 samples represent field duplicate results
- MLA 060 - SGS-Axys Analytical Method (13 PFAS Compounds)
- MLA-110 - SGS-Axys Analytical Method: 29 PFAS compounds plus Gen-X (HFPO-DA)

Table 3D
Surface Water Analytical Results: SSOM Facility D
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Parameter	Sample Location			TC-SW01				TC-SW02			TC-SW03		
	Sample Name			TC-SW01-1118-100	TC-SW01-0419-100	TC-SW01-0519-100	TC-SW01-0519-300	TC-SW02-1118-100	TC-SW02-0419-100	TC-SW02-0519-100	TC-SW03-1118-100	TC-SW03-0419-100	TC-SW03-0519-100
	Sample Date			11/27/2018	4/5/2019	5/13/2019	5/13/2019	11/27/2018	4/5/2019	5/13/2019	11/27/2018	4/5/2019	5/13/2019
	Analytical Method			MLA 060	MLA 110	MLA 110	MLA 110	MLA 060	MLA 110	MLA 110	MLA 060	MLA 110	MLA 110
	Regulatory Criteria												
			HRL	HBV	Intervention Limit								
PERFLUORINATED ALKYL SUBSTANCES (ng/L)													
PFBA	7,000	---	1,750	875 J	1,260 J	1,770 J	1,810 J	1,570 J	1,160 J	2,060 J	87.4	27.3 U	51.3
PFPeA	---	---	---	131 J	255	438 J	386 J	199	253	534 J	39.8	13.6 U	21.5 J
PFHxA	---	---	---	1,130	1,830	2,820	2,780	2,110	1,750	3,440	143	75.2	83.2
PFHpA	---	---	---	19.7 UJ	16.9	23.6	23.5	21 U	15.6	31.2	20.5 U	6.82 U	6.07 U
PFOA	35	---	8.75	19.7 U	8.11	6.39	7.32	21 U	6.35 U	9.03	20.5 U	6.82 U	6.07 U
PFNA	---	---	---	19.7 U	6.55 U	6.29 U	6.51 U	21 U	6.2 U	6.38 U	20.5 U	6.65 U	6.07 U
PFDA	---	---	---	19.7 U	6.55 U	6.29 U	6.51 U	21 U	6.2 U	6.38 U	20.5 U	6.65 U	6.07 U
PFUnA	---	---	---	19.7 U	6.55 U	6.29 U	6.51 U	21 U	6.2 U	6.38 U	20.5 U	6.65 U	6.07 U
PFDoA	---	---	---	19.7 U	6.55 U	6.29 U	6.51 U	21 U	6.2 U	6.38 U	20.5 U	6.65 U	6.07 U
PFTrDA	---	---	---	NS	6.55 U	6.29 U	6.51 U	NS	6.2 U	6.38 U	NS	6.65 U	6.07 U
PFTeDA	---	---	---	NS	6.55 U	6.29 U	6.51 U	NS	6.2 U	6.38 U	NS	6.65 U	6.07 U
PFBS	7,000	2,000	500 ^A	39.4 U	6.71 U	11.8 J	12.4 J	42 U	7.72	13.5	41.1 U	6.82 U	6.07 U
PFPeS	---	---	---	NS	6.22 U	6.29 U	6.51 U	NS	5.89 U	6.38 U	NS	6.32 U	6.07 U
PFHxS	---	47	11.75 ^A	39.4 U	6.71 U	6.29 U	6.51 U	42 U	6.35 U	6.38 U	41.1 U	6.82 U	6.07 U
PFHpS	---	---	---	NS	6.22 U	6.29 U	6.51 U	NS	5.89 U	6.38 U	NS	6.32 U	6.07 U
PFOS	300	15	3.75 ^A	39.4 U	6.71 U	6.29 U	6.51 U	113	6.35 U	6.38 U	547	6.82 U	6.07 U
PFNS	---	---	---	NS	6.22 U	6.29 U	6.51 U	NS	5.89 U	6.38 U	NS	6.32 U	6.07 U
PFDS	---	---	---	NS	6.71 U	6.29 U	6.51 U	NS	6.35 U	6.38 U	NS	6.82 U	6.07 U
PFDoS	---	---	---	NS	6.22 U	6.29 U	6.51 U	NS	5.89 U	6.38 U	NS	6.32 U	6.07 U
4:2 FTS	---	---	---	NS	26.2 U	25.2 U	26 U	NS	24.8 U	25.5 U	NS	26.6 U	24.3 U
6:2 FTS	---	---	---	NS	23.6 U	22.7 U	23.4 U	NS	22.3 U	23 U	NS	24 U	21.9 U
8:2 FTS	---	---	---	NS	26.2 U	25.2 U	26 U	NS	24.8 U	25.5 U	NS	26.6 U	24.3 U
PFOSA	---	---	---	19.7 U	6.71 U	6.29 U	6.51 U	21 U	6.35 U	6.38 U	20.5 U	6.82 U	6.07 U
N-MeFOSA	---	---	---	NS	7.53 U	7.24 U	7.48 U	NS	7.13 U	7.34 U	NS	7.65 U	6.98 U
N-EtFOSA	---	---	---	NS	16.4 U	15.7 U	16.3 U	NS	15.5 U	16 U	NS	16.6 U	15.2 U
MeFOSAA	---	---	---	NS	6.55 U	6.29 U	6.51 U	NS	6.2 U	6.38 U	NS	6.65 U	6.07 U
EtFOSAA	---	---	---	NS	6.55 U	6.29 U	6.51 U	NS	6.2 U	6.38 U	NS	6.65 U	6.07 U
N-MeFOSE	---	---	---	NS	66.8 U	62.9 U	65.1 U	NS	63.2 U	63.8 U	NS	67.9 U	60.7 U
N-EtFOSE	---	---	---	NS	50.1 U	47.2 U	48.8 U	NS	47.4 U	47.9 U	NS	50.9 U	45.5 U
HFPO-DA	---	---	---	NS	6.22 U	6.29 U	6.51 U	NS	5.89 U	6.38 U	NS	6.32 U	6.07 U

NOTES:

ng/L = Nanograms per Liter.

J = Result is estimated

U = Analyte was not detected above the applicable method detection limit

NS = Not sampled - Analyte not included in Analytical Metho MLA-060

MDH = Minnesota Department of Health

HRL = MDH Health Risk Limit

HBV = MDH Health-Based Value

Intervention Limit = MPCA Solid Waste Program screening level; calculated value based on one quarter of the HRL or HBV. Values shown represent one quarter of the HRL unless noted

^A = Intervention Limit shown reflects the HBV and representative of most conservative screening criteria

--- = Regulatory criteria not established.

-100 samples are primary results, -300 samples represent field duplicate results

MLA 060 - SGS-Axys Analytical Method (13 PFAS Compounds)

MLA-110 - SGS-Axys Analytical Method: 29 PFAS compounds plus Gen-X (HFPO-DA)

Table 3E
Surface Water Analytical Results: SSOM Facility E
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Parameter	Sample Location			WL-SW01		WL-SW02			WL-SW03	
	Sample Name			WL-SW01-0419-100	WL-SW01-0519-100	WL-SW02-0419-100	WL-SW02-0419-300	WL-SW02-0519-100	WL-SW03-0419-100	WL-SW03-0519-100
	Sample Date			4/2/2019	5/13/2019	4/2/2019		5/13/2019	4/2/2019	5/13/2019
	Analytical Method			MLA 110	MLA 110	MLA 110	MLA 110	MLA 110	MLA 110	MLA 110
	Regulatory Criteria									
	HRL	HBV	Intervention Limit							
PERFLUORINATED ALKYL SUBSTANCES (ng/L)										
PFBA	7,000	---	1,750	348 J	474 J	376 J	389 J	368 J	371 J	360 J
PFPeA	---	---	---	257	223 J	258	238	230 J	237	232 J
PFHxA	---	---	---	979	965	964	891	989	959	982
PFHpA	---	---	---	54	52.7	50	51.2	50.8	49.2	50.1
PFOA	35	---	8.75	127	108	133	126	106	127	106
PFNA	---	---	---	13.7	11.3 J	12.7	12.4	8.45 J	11.5	8.26 J
PFDA	---	---	---	21.4	25.5	24.2	25.8	11.5	23.7	15.8
PFUnA	---	---	---	6.2 U	6.79 U	6.38 U	6.15 U	6.31 U	6.2 U	6.42 U
PFDoA	---	---	---	6.2 U	6.79 U	6.38 U	6.15 U	6.31 U	6.2 U	6.42 U
PFTrDA	---	---	---	6.2 U	6.79 U	6.38 U	6.15 U	6.31 U	6.2 U	6.42 U
PFTeDA	---	---	---	6.2 U	6.79 U	6.38 U	6.15 U	6.31 U	6.2 U	6.42 U
PFBS	7,000	2,000	500 ^A	6.36 U	7.41 J	7.25	6.75	8.12 J	6.94	10.7 J
PFPeS	---	---	---	5.89 U	6.79 U	6.06 U	5.84 U	6.31 U	5.89 U	6.42 U
PFHxS	---	47	11.75 ^A	6.36 U	6.97 J	6.54 U	6.3 U	6.84 J	6.36 U	6.48 J
PFHpS	---	---	---	5.89 U	6.79 U	6.06 U	5.84 U	6.31 U	5.89 U	6.42 U
PFOS	300	15	3.75 ^A	10.9	15.6 J	13.8	14.7	10.5 J	15.5	18.1 J
PFNS	---	---	---	5.89 U	6.79 U	6.06 U	5.84 U	6.31 U	5.89 U	6.42 U
PFDS	---	---	---	6.36 U	6.79 U	6.54 U	6.3 U	6.31 U	6.36 U	6.42 U
PFDoS	---	---	---	5.89 U	6.79 U	6.06 U	5.84 U	6.31 U	5.89 U	6.42 U
4:2 FTS	---	---	---	24.8 U	27.2 U	25.5 U	24.6 U	25.2 U	24.8 U	25.7 U
6:2 FTS	---	---	---	22.3 U	24.4 U	23 U	22.1 U	22.7 U	22.3 U	23.1 U
8:2 FTS	---	---	---	24.8 U	27.2 U	25.5 U	24.6 U	25.2 U	24.8 U	25.7 U
PFOSA	---	---	---	6.36 U	6.79 U	6.54 U	6.3 U	6.31 U	6.36 U	6.42 U
N-MeFOSA	---	---	---	7.13 U	7.81 U	7.34 U	7.07 U	7.26 U	7.14 U	7.38 U
N-EtFOSA	---	---	---	15.5 U	17 U	16 U	15.4 U	15.8 U	15.5 U	16 U
MeFOSAA	---	---	---	6.2 U	6.79 U	6.38 U	6.15 U	6.31 U	6.2 U	6.42 U
EtFOSAA	---	---	---	6.2 U	6.79 U	6.38 U	6.15 U	6.31 U	6.2 U	6.42 U
N-MeFOSE	---	---	---	63.3 U	67.9 U	65.1 U	62.7 U	63.1 U	63.3 U	64.2 U
N-EtFOSE	---	---	---	47.4 U	50.9 U	48.8 U	47 U	47.3 U	47.5 U	48.1 U
HFPO-DA	---	---	---	24.8 U	6.79 U	25.5 U	24.6 U	6.31 U	24.8 U	6.42 U

NOTES:

ng/L = Nanograms per Liter.

J = Result is estimated

U = Analyte was not detected above the applicable method detection limit

NS = Not sampled - Analyte not included in Analytical Metho MLA-060

MDH = Minnesota Department of Health

HRL = MDH Health Risk Limit

HBV = MDH Health-Based Value

Intervention Limit = MPCA Solid Waste Program screening level; calculated value based on one quarter of the HRL or HBV. Values shown represent one quarter of the HRL unless noted

^A = Intervention Limit shown reflects the HBV and representative of most conservative screening criteria

--- = Regulatory criteria not established.

-100 samples are primary results, -300 samples represent field duplicate results

MLA 060 - SGS-Axys Analytical Method (13 PFAS Compounds)

MLA-110 - SGS-Axys Analytical Method: 29 PFAS compounds plus Gen-X (HFPO-DA)

Table 3F
Surface Water Analytical Results: Yard Waste Facility A
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Parameter	Sample Location			FS-SW01				FS-SW02			FS-SW03		
	Sample Name			FS-SW01-1118-100	FS-SW01-0419-100	FS-SW01-0419-300	FS-SW01-0519-100	FS-SW02-1118-100	FS-SW02-0419-100	FS-SW02-0519-100	FS-SW03-1118-100	FS-SW03-0419-100	FS-SW03-0519-100
	Sample Date			11/26/2018	4/4/2019	4/4/2019	5/14/2019	11/26/2018	4/4/2019	5/14/2019	11/26/2018	4/4/2019	5/14/2019
	Analytical Method			MLA 060	MLA 110	MLA 110	MLA 110	MLA 060	MLA 110	MLA 110	MLA 060	MLA 110	MLA 110
	Regulatory Criteria												
	HRL	HBV	Intervention Limit										
PERFLUORINATED ALKYL SUBSTANCES (ng/L)													
PFBA	7,000	---	1,750	121 J	67.6	65.3	91.2	94.4 J	43.1	96.1	183 J	72.7	86.6
PFPeA	---	---	---	19.6 UJ	14.4 U	13.4 U	13.4 U	20.9 UJ	12.5 U	13.2 U	19.9 UJ	12.8 U	13.2 U
PFHxA	---	---	---	19.6 UJ	7.18 U	6.71 U	6.71 U	20.9 UJ	6.26 U	6.61 U	19.9 UJ	6.38 U	7.14
PFHpA	---	---	---	19.6 UJ	7.18 U	6.71 U	6.71 U	20.9 UJ	6.26 U	6.61 U	19.9 UJ	6.38 U	6.59 U
PFOA	35	---	8.75	19.6 UJ	7.18 U	6.71 U	6.71 U	20.9 UJ	6.26 U	6.61 U	19.9 UJ	6.38 U	6.59 U
PFNA	---	---	---	19.6 UJ	7 U	6.55 U	6.71 U	20.9 UJ	6.1 U	6.61 U	19.9 UJ	6.22 U	6.59 U
PFDA	---	---	---	19.6 UJ	7 U	6.55 U	6.71 U	20.9 UJ	6.1 U	6.61 U	19.9 UJ	6.22 U	6.59 U
PFUnA	---	---	---	19.6 UJ	7 U	6.55 U	6.71 U	20.9 UJ	6.1 U	6.61 U	19.9 UJ	6.22 U	6.59 U
PFDoA	---	---	---	19.6 UJ	7 U	6.55 U	6.71 U	20.9 UJ	6.1 U	6.61 U	19.9 UJ	6.22 U	6.59 U
PFTTrDA	---	---	---	NS	7 U	6.55 U	6.71 U	NS	6.1 U	6.61 U	NS	6.22 U	6.59 U
PFTeDA	---	---	---	NS	7 U	6.55 U	6.71 U	NS	6.1 U	6.61 U	NS	6.22 U	6.59 U
PFBS	7,000	2,000	500 ^A	39.1 UJ	7.18 U	6.71 U	6.71 U	41.8 UJ	6.26 U	6.61 U	39.7 UJ	6.38 U	6.59 U
PFPeS	---	---	---	NS	6.65 U	6.22 U	6.71 U	NS	5.8 U	6.61 U	NS	5.91 U	6.59 U
PFHxS	---	47	11.75 ^A	39.1 UJ	7.18 U	6.71 U	9.78 J	41.8 UJ	6.26 U	14.0 J	39.7 UJ	6.38 U	11.4 J
PFHpS	---	---	---	NS	6.65 U	6.22 U	6.71 U	NS	5.8 U	6.61 U	NS	5.91 U	6.59 U
PFOS	300	15	3.75 ^A	104 J	30.7	25.8	38.9 J	83.4 J	24.7	38.9 J	61.7 J	29.6	33.9 J
PFNS	---	---	---	NS	6.65 U	6.22 U	6.71 U	NS	5.8 U	6.61 U	NS	5.91 U	6.59 U
PFDS	---	---	---	NS	7.18 U	6.71 U	6.71 U	NS	6.26 U	6.61 U	NS	6.38 U	6.59 U
PFDoS	---	---	---	NS	6.65 U	6.22 U	6.71 U	NS	5.8 U	6.61 U	NS	5.91 U	6.59 U
4:2 FTS	---	---	---	NS	28.0 U	26.2 U	26.8 U	NS	24.4 U	26.5 U	NS	24.9 U	26.4 U
6:2 FTS	---	---	---	NS	25.2 U	23.6 U	24.2 U	NS	22 U	23.8 U	NS	22.4 U	23.7 U
8:2 FTS	---	---	---	NS	28 U	26.2 U	26.8 U	NS	24.4 U	26.5 U	NS	24.9 U	26.4 U
PFOSA	---	---	---	19.6 UJ	7.18 U	6.71 U	6.71 U	20.9 UJ	6.26 U	6.61 U	19.9 UJ	6.38 U	6.59 U
N-MeFOSA	---	---	---	NS	8.05 U	7.53 U	7.72 U	NS	7.02 U	7.6 U	NS	7.16 U	7.58 U
N-EtFOSA	---	---	---	NS	17.5 U	16.4 U	16.8 U	NS	15.3 U	16.5 U	NS	15.6 U	16.5 U
MeFOSAA	---	---	---	NS	7 U	6.55 U	6.71 U	NS	6.1 U	6.61 U	NS	6.22 U	6.59 U
EtFOSAA	---	---	---	NS	7 U	6.55 U	6.71 U	NS	6.1 U	6.61 U	NS	6.22 U	6.59 U
N-MeFOSE	---	---	---	NS	71.4 U	66.8 U	67.1 U	NS	62.3 U	66.1 U	NS	63.5 U	65.9 U
N-EtFOSE	---	---	---	NS	53.6 U	50.1 U	50.3 U	NS	46.7 U	49.6 U	NS	47.6 U	49.5 U
HFPO-DA	---	---	---	NS	28 U	6.22 U	6.71 U	NS	5.8 U	6.61 U	NS	5.91 U	6.59 U

NOTES:
 ng/L = Nanograms per Liter.
 J = Result is estimated
 U = Analyte was not detected above the applicable method detection limit
 NS = Not sampled - Analyte not included in Analytical Metho MLA-060
 MDH = Minnesota Department of Health
 HRL = MDH Health Risk Limit
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 Intervention Limit = MPCA Solid Waste Program screening level; calculated value based on one quarter of the HRL or HBV. Values shown represent one quarter of the HRL unless noted
^A = Intervention Limit shown reflects the HBV and representative of most conservative screening criteria
 --- = Regulatory criteria not established.
 -100 samples are primary results, -300 samples represent field duplicate results
 MLA 060 - SGS-Axys Analytical Method (13 PFAS Compounds)
 MLA-110 - SGS-Axys Analytical Method: 29 PFAS compounds plus Gen-X (HFPO-DA)

Table 3G
Surface Water Analytical Results: Yard Waste Facility B
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

Parameter	Sample Location			WB-SW01			WB-SW02			WB-SW03		
	Sample Name			WB-SW01-1118-100	WB-SW01-0419-100	WB-SW01-0519-100	WB-SW02-1118-100	WB-SW02-0419-100	WB-SW02-0519-100	WB-SW03-1118-100	WB-SW03-0419-100	WB-SW03-0519-100
	Sample Date			11/27/2018	4/4/2019	5/14/2019	11/27/2018	4/4/2019	5/14/2019	11/27/2018	4/4/2019	5/14/2019
	Analytical Method			MLA 060	MLA 110	MLA 110	MLA 060	MLA 110	MLA 110	MLA 060	MLA 110	MLA 110
	Regulatory Criteria											
	HRL	HBV	Intervention Limit									
PERFLUORINATED ALKYL SUBSTANCES (ng/L)												
PFBA	7,000	---	1,750	574	77.7	418	294	79.2	445	39.9	26.9 U	29
PFPeA	---	---	---	38.5	12.7 U	29.6	20.9 U	13.4 U	28.7	20.3 U	13.5 U	11.8 U
PFHxA	---	---	---	31.3	6.36 U	12.7	20.9 U	6.72 U	8.68	20.3 U	6.73 U	5.88 U
PFHpA	---	---	---	18.9 U	6.36 U	7.12 U	20.9 U	6.72 U	5.86 U	20.3 U	6.73 U	5.88 U
PFOA	35	---	8.75	64.6	6.36 U	7.12 U	20.9 U	6.72 U	5.86 U	20.3	6.73 U	5.88 U
PFNA	---	---	---	18.9 U	6.21 U	7.12 U	20.9 U	6.55 U	5.86 U	20.3 U	6.56 U	5.88 U
PFDA	---	---	---	18.9 U	6.21 U	7.12 U	20.9 U	6.55 U	5.86 U	20.3 U	6.56 U	5.88 U
PFUnA	---	---	---	18.9 U	6.21 U	7.12 U	20.9 U	6.55 U	5.86 U	20.3 U	6.56 U	5.88 U
PFDoA	---	---	---	18.9 U	6.21 U	7.12 U	20.9 U	6.55 U	5.86 U	20.3 U	6.56 U	5.88 U
PFTTrDA	---	---	---	NS	6.21 U	7.12 U	NS	6.55 U	5.86 U	NS	6.56 U	5.88 U
PFTeDA	---	---	---	NS	6.21 U	7.12 U	NS	6.55 U	5.86 U	NS	6.56 U	5.88 U
PFBS	7,000	2,000	500 ^A	50.2	6.36 U	16.9	41.9 U	6.72 U	22.6	40.6 U	6.73 U	5.88 U
PFPeS	---	---	---	NS	5.9 U	7.12 U	NS	6.23 U	5.86 U	NS	6.24 U	5.88 U
PFHxS	---	47	11.75 ^A	249	6.36 U	7.12 U	41.9 U	6.72 U	5.86 U	85	6.73 U	5.88 U
PFHpS	---	---	---	NS	5.9 U	7.12 U	NS	6.23 U	5.86 U	NS	6.24 U	5.88 U
PFOS	300	15	3.75 ^A	7,790	6.36 U	7.12 U	50.4	6.72 U	6.58 J	2,640	6.73 U	5.88 U
PFNS	---	---	---	NS	5.9 U	7.12 U	NS	6.23 U	5.86 U	NS	6.24 U	5.88 U
PFDS	---	---	---	NS	6.36 U	7.12 U	NS	6.72 U	5.86 U	NS	6.73 U	5.88 U
PFDoS	---	---	---	NS	5.9 U	7.12 U	NS	6.23 U	5.86 U	NS	6.24 U	5.88 U
4:2 FTS	---	---	---	NS	24.8 U	28.5 U	NS	26.2 U	23.4 U	NS	26.3 U	23.5 U
6:2 FTS	---	---	---	NS	22.4 U	25.6 U	NS	23.6 U	21.1 U	NS	23.6 U	21.2 U
8:2 FTS	---	---	---	NS	24.8 U	28.5 U	NS	26.2 U	23.4 U	NS	26.3 U	23.5 U
PFOSA	---	---	---	18.9 U	6.36 U	7.12 U	20.9 U	6.72 U	5.86 U	20.3 U	6.73 U	5.88 U
N-MeFOSA	---	---	---	NS	7.14 U	8.19 U	NS	7.54 U	6.74 U	NS	7.55 U	6.76 U
N-EtFOSA	---	---	---	NS	15.5 U	17.8 U	NS	16.4 U	14.7 U	NS	16.4 U	14.7 U
MeFOSAA	---	---	---	NS	6.21 U	7.12 U	NS	6.55 U	5.86 U	NS	6.56 U	5.88 U
EtFOSAA	---	---	---	NS	6.21 U	7.12 U	NS	6.55 U	5.86 U	NS	6.56 U	5.88 U
N-MeFOSE	---	---	---	NS	63.3 U	71.2 U	NS	66.9 U	58.6 U	NS	67 U	58.8 U
N-EtFOSE	---	---	---	NS	47.5 U	53.4 U	NS	50.1 U	44 U	NS	50.2 U	44.1 U
HFPO-DA	---	---	---	NS	5.9 U	7.12 U	NS	6.23 U	5.86 U	NS	6.24 U	5.88 U

NOTES:

ng/L = Nanograms per Liter.

J = Result is estimated

U = Analyte was not detected above the applicable method detection limit

NS = Not sampled - Analyte not included in Analytical Metho MLA-060

MDH = Minnesota Department of Health

HRL = MDH Health Risk Limit

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Intervention Limit = MPCA Solid Waste Program screening level; calculated value based on one quarter of the HRL or HBV. Values shown represent one quarter of the HRL unless noted

^A = Intervention Limit shown reflects the HBV and representative of most conservative screening criteria

--- = Regulatory criteria not established.

-100 samples are primary results, -300 samples represent field duplicate results

MLA 060 - SGS-Axys Analytical Method (13 PFAS Compounds)

MLA-110 - SGS-Axys Analytical Method: 29 PFAS compounds plus Gen-X (HFPO-DA)

Table 4
Comparison of Site Analytical Results with PFAS Background Levels
 Site Investigation Report
 Evaluation of PFAS at Select SSOM and Yard Waste Sites, Minnesota

PFAS	Areas with known or suspected contamination (ng/L)	Ambient groundwater in all other parts of Minnesota (ng/L)	Range of PFAS Detections													
			SSOM Facility A		SSOM Facility B		SSOM Facility C		SSOM Facility D		SSOM Facility E		Yard Waste Facility A		Yard Waste Facility B	
PFBA	227	6.9	33.9	1040	30.6	536	308	1340	87.4	2060	348	474	43.1	121	29	574
PFBS	1.8*	.002*	7.09	7.81	10.3	14.9	15.7	57.3	7.72	13.5	6.75	10.7	--	--	16.9	50.2
PFDA	--	--	--	--	--	8.2	--	--	--	--	11.5	25.8	--	--	--	--
PFDoA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PFDoS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PFDS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PFHpA	0.7	0.1*	6.15	8	17.5	23.8	22.4	61.4	15.6	31.2	49.2	--	--	--	--	--
PFHpS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PFHxA	5.5	0.2*	53	279	211	2970	712	3350	75.2	3440	891	54	--	7.14	12.7	31.3
PFHxS	0.8	.002*	--	--	--	--	--	--	--	--	6.75	6.97	9.78	14	85	249
PFNA	--	--	--	7.97	--	--	6.77	7.05	--	--	8.26	13.7	--	--	--	--
PFNS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PFOA	7.9	0.4	9.83	20.9	16.3	23.3	27.9	69.6	6.39	9.03	106	133	--	--	--	--
PFOS	1.7	0.1*	9.69	1700	6.7	83.3	7.28	3070	113	547	10.5	18.1	24.7	104	6.58	7790
PFOSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PFPeA	6.8	0.8*	15.4-89.9	15.4-89.9	20.5	425	215	780	21.5	438	230	258	--	--	28.7	38.5
PFPeS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PFTeDA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PFTrDA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PFUnA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4:2 FTS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6:2 FTS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
8:2 FTS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EtFOSAA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HFPO-DA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MeFOSAA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
N-EtFOSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
N-EtFOSE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
N-MeFOSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
N-MeFOSE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

NOTES:

ng/L = Nanograms per Liter.

J = Result is estimated

U = Analyte was not detected above the applicable method detection limit

R = Result rejected

NS = Not sampled - Analyte not included in Analytical Metho MLA-060

MDH = Minnesota Department of Health

HRL = MDH Health Risk Limit

HBV = MDH Health-Based Value

Intervention Limit = MPCA Solid Waste Program screening level; calculated value based on one quarter of the HRL or HBV. Values shown represent one quarter of the HRL unless noted

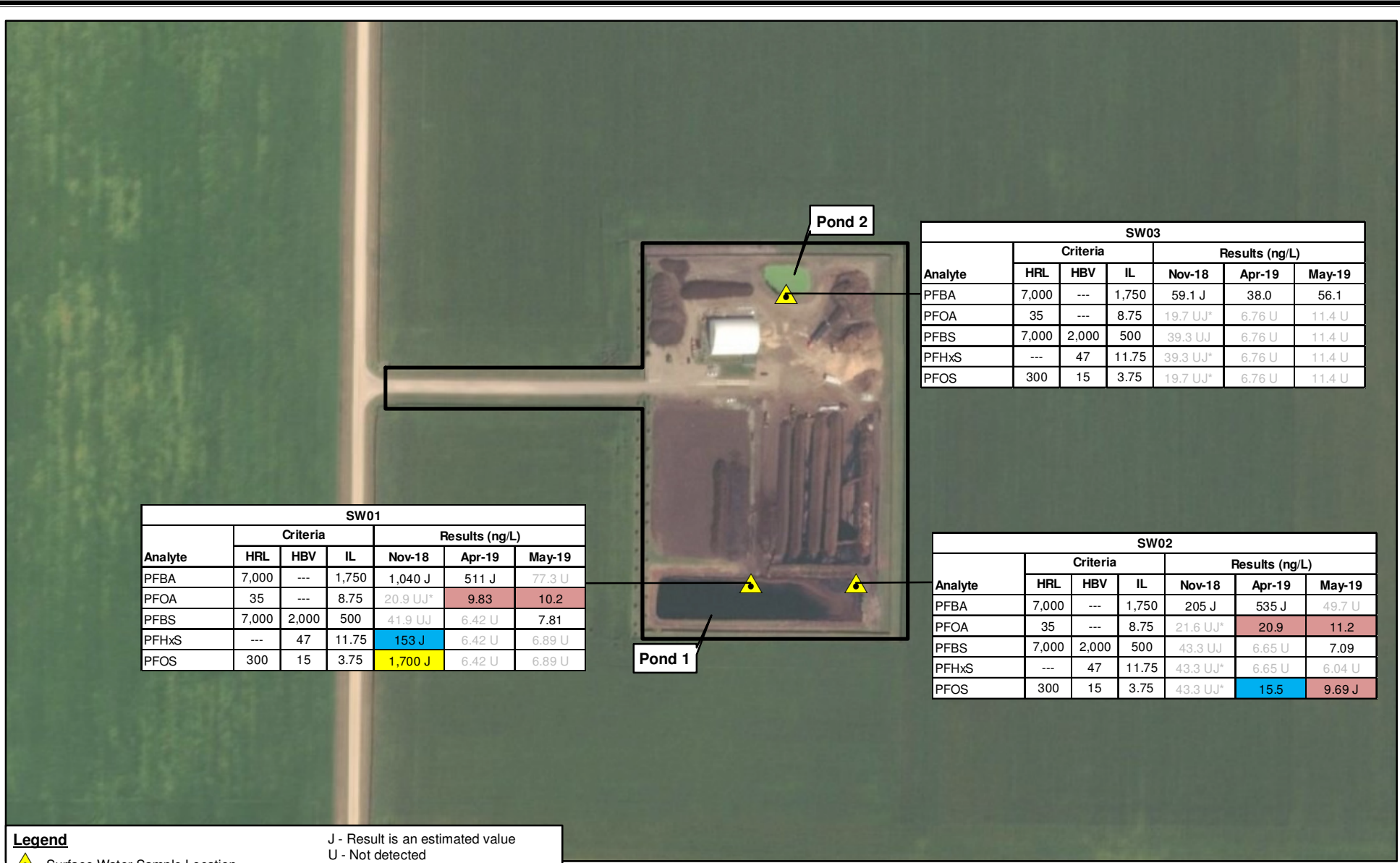
A = Intervention Limit shown reflects the HBV and representative of most conservative screening criteria

--- = Regulatory criteria not established.

*Median concentration estimate is tenuous due to greater than 80% censored data.



FIGURES



Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	1,040 J	511 J	77.3 U
PFOA	35	---	8.75	20.9 UJ*	9.83	10.2
PFBS	7,000	2,000	500	41.9 UJ	6.42 U	7.81
PFHxS	---	47	11.75	153 J	6.42 U	6.89 U
PFOS	300	15	3.75	1,700 J	6.42 U	6.89 U

Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	59.1 J	38.0	56.1
PFOA	35	---	8.75	19.7 UJ*	6.76 U	11.4 U
PFBS	7,000	2,000	500	39.3 UJ	6.76 U	11.4 U
PFHxS	---	47	11.75	39.3 UJ*	6.76 U	11.4 U
PFOS	300	15	3.75	19.7 UJ*	6.76 U	11.4 U

Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	205 J	535 J	49.7 U
PFOA	35	---	8.75	21.6 UJ*	20.9	11.2
PFBS	7,000	2,000	500	43.3 UJ	6.65 U	7.09
PFHxS	---	47	11.75	43.3 UJ*	6.65 U	6.04 U
PFOS	300	15	3.75	43.3 UJ*	15.5	9.69 J

Legend

- Surface Water Sample Location
- Approximate Site Boundary

Analytical Criteria Exceedances

- Exceedance of Health Risk Limit (HRL)
- Exceedance of Health Based Value (HBV)
- Exceedance of Intervention Limit (IL)

J - Result is an estimated value
 U - Not detected
 UJ - Estimated non-detection
 PFBA - Perfluorobutanoate
 PFOA - Perfluorooctanoate
 PFBS - Perfluorobutane sulfonate
 PFHxS - Perfluorohexane sulfonate
 PFOS - Perfluorooctane sulfonate
 ng/L - nanograms per liter
 For field duplicates, the highest result is displayed
 * - Elevated reporting limits exceeded applicable criteria

SAMPLE RESULTS
 Evaluation of PFAS at Select
 SSOM and Yard Waste Sites
 SSOM Facility A

Note: Imagery courtesy of ESRI (DigitalGlobe 2017)
 Additional information regarding data qualifiers can be found in Appendix B

Figure: **1A**

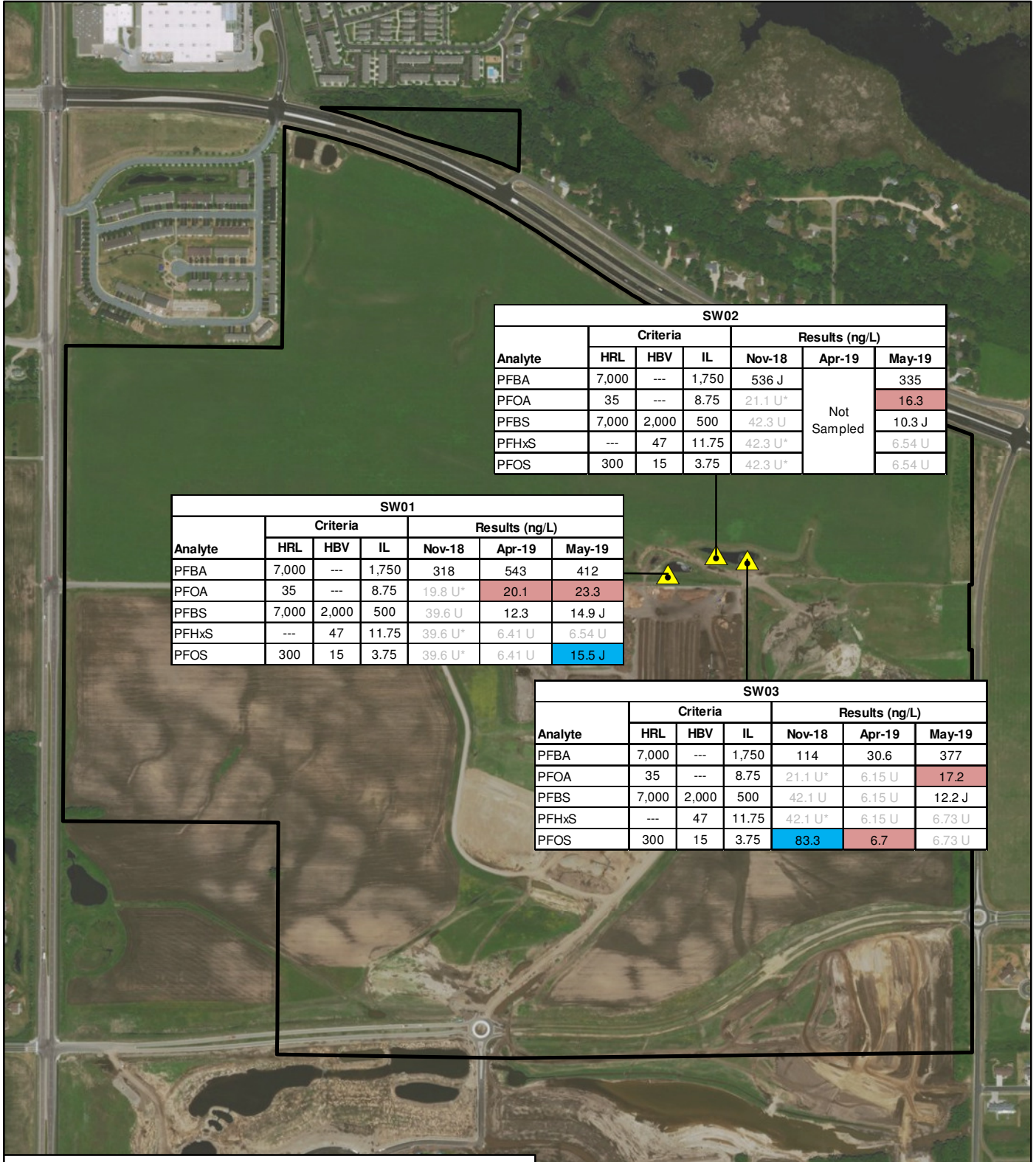
	Drawn: MJV	Project No. 18190012
	Checked: ED	Date: 09/08/2019

1:3,600 1 inch equals 300 feet

Approximate Scale in Feet

0 300 600





SW02						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	536 J	Not Sampled	335
PFOA	35	---	8.75	21.1 U*		16.3
PFBS	7,000	2,000	500	42.3 U		10.3 J
PFHxS	---	47	11.75	42.3 U*		6.54 U
PFOS	300	15	3.75	42.3 U*		6.54 U

SW01						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	318	543	412
PFOA	35	---	8.75	19.8 U*	20.1	23.3
PFBS	7,000	2,000	500	39.6 U	12.3	14.9 J
PFHxS	---	47	11.75	39.6 U*	6.41 U	6.54 U
PFOS	300	15	3.75	39.6 U*	6.41 U	15.5 J

SW03						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	114	30.6	377
PFOA	35	---	8.75	21.1 U*	6.15 U	17.2
PFBS	7,000	2,000	500	42.1 U	6.15 U	12.2 J
PFHxS	---	47	11.75	42.1 U*	6.15 U	6.73 U
PFOS	300	15	3.75	83.3	6.7	6.73 U

Legend

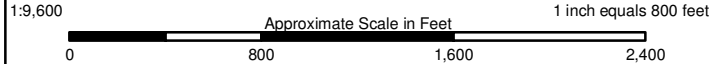
- ▲ Surface Water Sample Location
- Approximate Site Boundary
- Analytical Criteria Exceedances
- Exceedance of Health Risk Limit (HRL)
- Exceedance of Health Based Value (HBV)
- Exceedance of Intervention Limit (IL)

J - Result is an estimated value
 U - Not detected
 UJ - Estimated non-detection
 PFBA - Perfluorobutanoate
 PFOA - Perfluorooctanoate
 PFBS - Perfluorobutane sulfonate
 PFHxS - Perfluorohexane sulfonate
 PFOS - Perfluorooctane sulfonate
 ng/L - nanograms per liter
 For field duplicates, the highest result is displayed
 * - Elevated reporting limits exceeded applicable criteria

SAMPLE RESULTS
 Evaluation of PFAS at Select SSOM and Yard Waste Sites SSOM Facility B

Note: 2017 Imagery courtesy of ESRI (DigitalGlobe)
 Additional information regarding data qualifiers can be found in Appendix B

Date: 09/11/2019	Project No. 18190012	Figure:
Drawn: MJV	wood.	1B
Checked: ED		








SW02						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	847 J	1,060 J	905
PFOA	35	---	8.75	37.1 J	66.8	39.2
PFBS	7,000	2,000	500	42.9 UJ	21.1	24.7
PFHxS	---	47	11.75	42.9 UJ*	7.14 U	7.19 U
PFOS	300	15	3.75	3,070 J	7.14 U	11.5 J

SW01						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	1,070 J	1,080 J	920
PFOA	35	---	8.75	32.1	63.7	34.2
PFBS	7,000	2,000	500	40.8 U	24.7	25.1
PFHxS	---	47	11.75	40.8 U*	6.87 U	5.74 U
PFOS	300	15	3.75	20.4 U*	7.28	15.1 J

SW03						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	509	308	1,340
PFOA	35	---	8.75	57.4	69.6	67.4
PFBS	7,000	2,000	500	39.2 U	15.7	57.3
PFHxS	---	47	11.75	39.2 U*	6.7 U	5.94 U
PFOS	300	15	3.75	39.2 U*	17.8	18.7 J

Legend

-  Surface Water Sample Location
-  Approximate Site Boundary
- Analytical Criteria Exceedances
-  Exceedance of Health Risk Limit (HRL)
-  Exceedance of Health Based Value (HBV)
-  Exceedance of Intervention Limit (IL)

J - Result is an estimated value
 U - Not detected
 UJ - Estimated non-detection
 PFBA - Perfluorobutanoate
 PFOA - Perfluorooctanoate
 PFBS - Perfluorobutane sulfonate
 PFHxS - Perfluorohexane sulfonate
 PFOS - Perfluorooctane sulfonate
 ng/L - nanograms per liter
 For field duplicates, the highest result is displayed
 * - Elevated reporting limits exceeded applicable criteria

SAMPLE RESULTS
 Evaluation of PFAS at Select
 SSOM and Yard Waste Sites
 SSOM Facility C

Note: 2017 Imagery courtesy of ESRI
 Additional information regarding data qualifiers can be found in Appendix B

Figure: **1C**



Drawn: MJV
 Checked: ED
 Project No. 18190012
 Date: 09/11/2019

1:4,800
 Approximate Scale in Feet
 1 inch equals 400 feet
 0 400 800








SW03						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	87.4	27.3 U	51.3
PFOA	35	---	8.75	20.5 U*	6.82 U	6.07 U
PFBS	7,000	2,000	500	41.1 U	6.82 U	6.07 U
PFHxS	---	47	11.75	41.1 U*	6.82 U	6.07 U
PFOS	300	15	3.75	547	6.82 U	6.07 U

SW02						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	1,570 J	1,160 J	2,060 J
PFOA	35	---	8.75	21 U*	6.35 U	9.03
PFBS	7,000	2,000	500	42 U*	7.72	13.5
PFHxS	---	47	11.75	42 U*	6.35 U	6.38 U
PFOS	300	15	3.75	113	6.35 U	6.38 U

SW01						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	875 J	1,260 J	1,810 J
PFOA	35	---	8.75	19.7 U*	8.11	7.32
PFBS	7,000	2,000	500	39.4 U*	6.71 U	12.4 J
PFHxS	---	47	11.75	39.4 U*	6.71 U	6.29 U
PFOS	300	15	3.75	39.4 U*	6.71 U	6.29 U


Legend


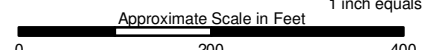
-  Surface Water Sample Location
-  Approximate Site Boundary
- Analytical Criteria Exceedances
-  Exceedance of Health Risk Limit (HRL)
-  Exceedance of Health Based Value (HBV)
-  Exceedance of Intervention Limit (IL)

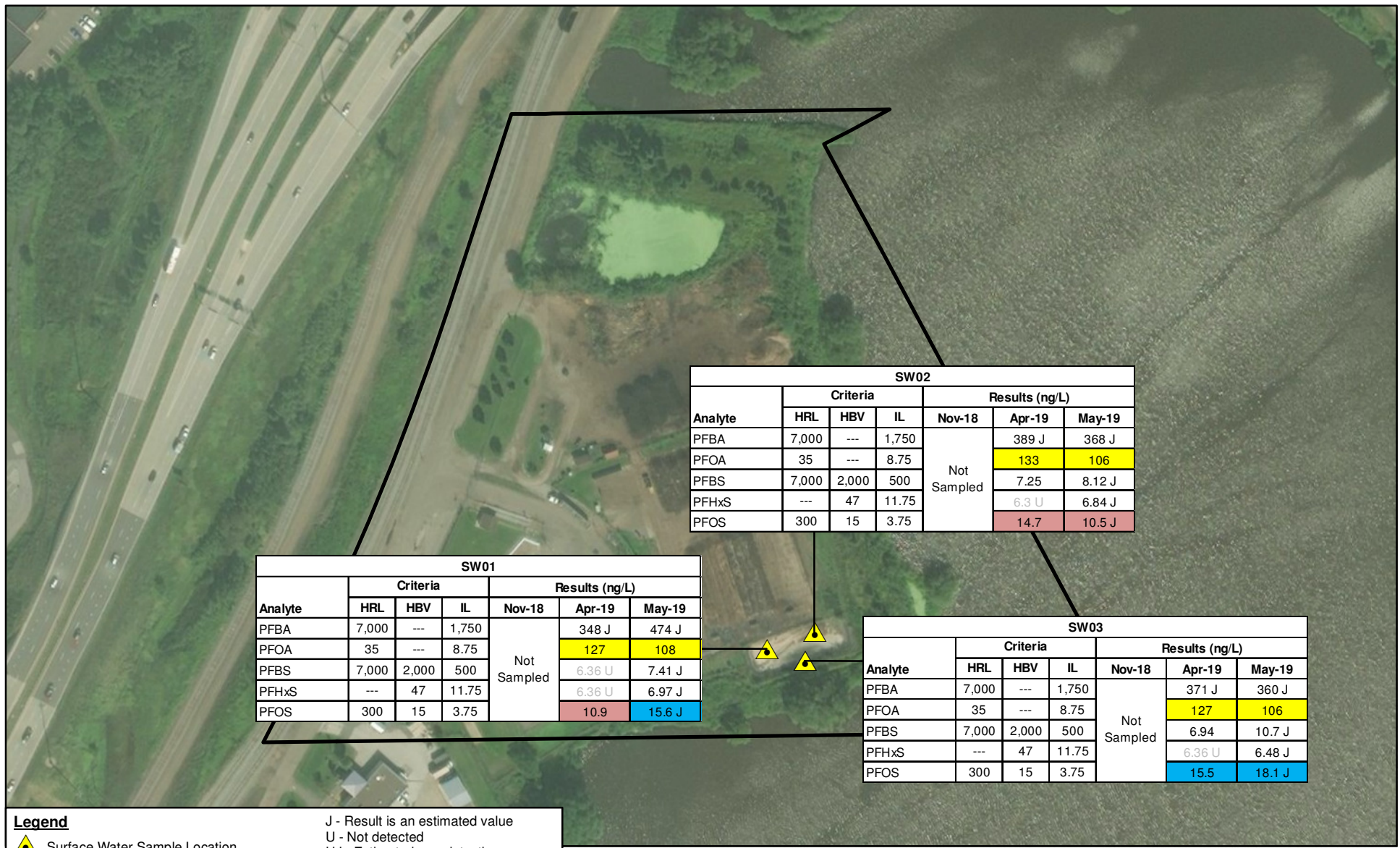
J - Result is an estimated value
 U - Not detected
 UJ - Estimated non-detection
 PFBA - Perfluorobutanoate
 PFOA - Perfluorooctanoate
 PFBS - Perfluorobutane sulfonate
 PFHxS - Perfluorohexane sulfonate
 PFOS - Perfluorooctane sulfonate
 ng/L - nanograms per liter
 For field duplicates, the highest result is displayed
 * - Elevated reporting limits exceeded applicable criteria

SAMPLE RESULTS
 Evaluation of PFAS at Select
 SSOM and Yard Waste Sites
 SSOM Facility D

Note: Imagery courtesy of ESRI (DigitalGlobe 2014)
 Additional information regarding data qualifiers can be found in Appendix B

Figure: **1D**


	Drawn: MJV	Project No. 18190012
	Checked: ED	Date: 09/11/2019
1:2,400		1 inch equals 200 feet
 Approximate Scale in Feet 0 200 400		



SW02						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	Not Sampled	389 J	368 J
PFOA	35	---	8.75		133	106
PFBS	7,000	2,000	500		7.25	8.12 J
PFHxS	---	47	11.75		6.3 U	6.84 J
PFOS	300	15	3.75		14.7	10.5 J

SW01						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	Not Sampled	348 J	474 J
PFOA	35	---	8.75		127	108
PFBS	7,000	2,000	500		6.36 U	7.41 J
PFHxS	---	47	11.75		6.36 U	6.97 J
PFOS	300	15	3.75		10.9	15.6 J

SW03						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	Not Sampled	371 J	360 J
PFOA	35	---	8.75		127	106
PFBS	7,000	2,000	500		6.94	10.7 J
PFHxS	---	47	11.75		6.36 U	6.48 J
PFOS	300	15	3.75		15.5	18.1 J

Legend

- Surface Water Sample Location
- Approximate Site Boundary
- Analytical Criteria Exceedances**
- Exceedance of Health Risk Limit (HRL)
- Exceedance of Health Based Value (HBV)
- Exceedance of Intervention Limit (IL)

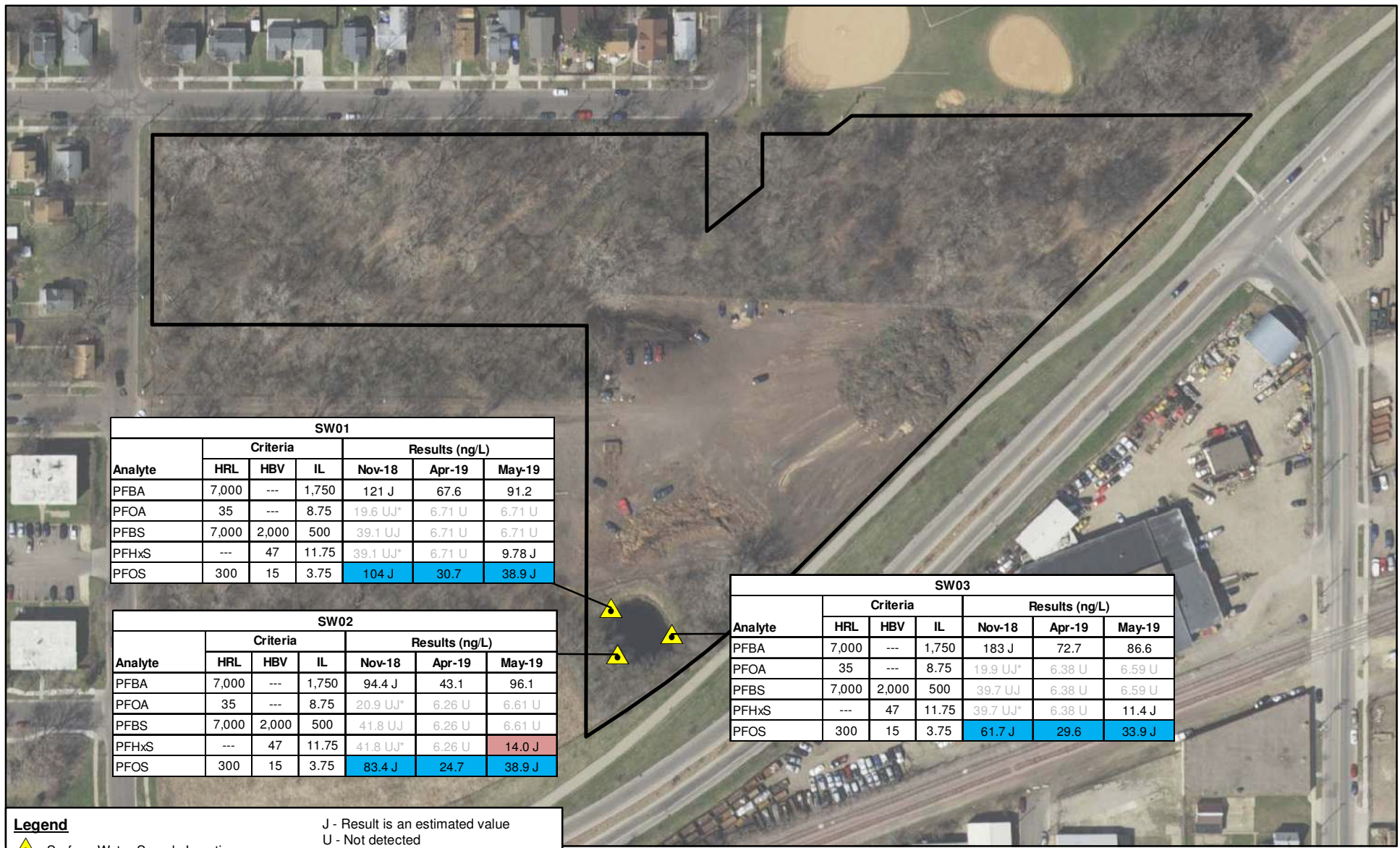
J - Result is an estimated value
 U - Not detected
 UJ - Estimated non-detection
 PFBA - Perfluorobutanoate
 PFOA - Perfluorooctanoate
 PFBS - Perfluorobutane sulfonate
 PFHxS - Perfluorohexane sulfonate
 PFOS - Perfluorooctane sulfonate
 ng/L - nanograms per liter
 For field duplicates, the highest result is displayed
 * - Elevated reporting limits exceeded applicable criteria

SAMPLE RESULTS
 Evaluation of PFAS at Select
 SSOM and Yard Waste Sites
 SSOM Facility E

Note: Imagery courtesy of ESRI (DigitalGlobe 2018)
 Additional information regarding data qualifiers can be found in Appendix B

Figure: **1E**

	Drawn: MJV	Project No. 18190012	
	Checked: ED	Date: 09/11/2019	
1:2,400		Approximate Scale in Feet	
0		1 inch equals 200 feet	
		200	
		400	



SW01						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	121 J	67.6	91.2
PFOA	35	---	8.75	19.6 UJ*	6.71 U	6.71 U
PFBS	7,000	2,000	500	39.1 UJ	6.71 U	6.71 U
PFHxS	---	47	11.75	39.1 UJ*	6.71 U	9.78 J
PFOS	300	15	3.75	104 J	30.7	38.9 J

SW02						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	94.4 J	43.1	96.1
PFOA	35	---	8.75	20.9 UJ*	6.26 U	6.61 U
PFBS	7,000	2,000	500	41.8 UJ	6.26 U	6.61 U
PFHxS	---	47	11.75	41.8 UJ*	6.26 U	14.0 J
PFOS	300	15	3.75	83.4 J	24.7	38.9 J

SW03						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	183 J	72.7	86.6
PFOA	35	---	8.75	19.9 UJ*	6.38 U	6.59 U
PFBS	7,000	2,000	500	39.7 UJ	6.38 U	6.59 U
PFHxS	---	47	11.75	39.7 UJ*	6.38 U	11.4 J
PFOS	300	15	3.75	61.7 J	29.6	33.9 J

Legend

- Surface Water Sample Location
- Approximate Site Boundary
- Analytical Criteria Exceedances**
- Exceedance of Health Risk Limit (HRL)
- Exceedance of Health Based Value (HBV)
- Exceedance of Intervention Limit (IL)

J - Result is an estimated value
 U - Not detected
 UJ - Estimated non-detection
 PFBA - Perfluorobutanoate
 PFOA - Perfluorooctanoate
 PFBS - Perfluorobutane sulfonate
 PFHxS - Perfluorohexane sulfonate
 PFOS - Perfluorooctane sulfonate
 ng/L - nanograms per liter
 For field duplicates, the highest result is displayed
 * - Elevated reporting limits exceeded applicable criteria

SAMPLE RESULTS
 Evaluation of PFAS at Select
 SSOM and Yard Waste Sites
 Yard Waste Facility A

Note: 2016 Imagery courtesy of MnGeo WMS
 Additional information regarding data qualifiers can be found in Appendix B

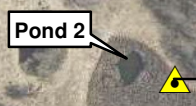
Figure: **1F**

	Drawn: MJV	Project No. 18190012	
	Checked: ED	Date: 09/11/2019	
1:1,800		Approximate Scale in Feet	
		1 inch equals 150 feet	
		0 150 300	

SW01						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	574	77.7	418
PFOA	35	---	8.75	64.6	6.36 U	7.12 U
PFBS	7,000	2,000	500	50.2	6.36 U	16.9
PFHxS	---	47	11.75	249	6.36 U	7.12 U
PFOS	300	15	3.75	7,790	6.36 U	7.12 U



SW02						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	294	79.2	445
PFOA	35	---	8.75	20.9 U*	6.72 U	5.86 U
PFBS	7,000	2,000	500	41.9 U	6.72 U	22.6
PFHxS	---	47	11.75	41.9 U*	6.72 U	5.86 U
PFOS	300	15	3.75	50.4	6.72 U	6.58 J



SW03						
Analyte	Criteria			Results (ng/L)		
	HRL	HBV	IL	Nov-18	Apr-19	May-19
PFBA	7,000	---	1,750	39.9	26.9 U	29.0
PFOA	35	---	8.75	20.3	6.73 U	5.88 U
PFBS	7,000	2,000	500	40.6 U	6.73 U	5.88 U
PFHxS	---	47	11.75	85	6.73 U	5.88 U
PFOS	300	15	3.75	2,640	6.73 U	5.88 U

Legend

Surface Water Sample Location

Approximate Site Boundary

Analytical Criteria Exceedances

Exceedance of Health Risk Limit (HRL)

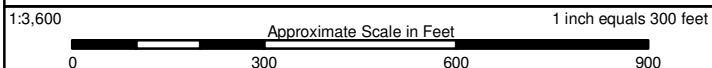
Exceedance of Health Based Value (HBV)

Exceedance of Intervention Limit (IL)

J - Result is an estimated value
 U - Not detected
 UJ - Estimated non-detection
 PFBA - Perfluorobutanoate
 PFOA - Perfluorooctanoate
 PFBS - Perfluorobutane sulfonate
 PFHxS - Perfluorohexane sulfonate
 PFOS - Perfluorooctane sulfonate
 ng/L - nanograms per liter
 For field duplicates, the highest result is displayed
 * - Elevated reporting limits exceeded applicable criteria

SAMPLE RESULTS
 Evaluation of PFAS at Select
 SSOM and Yard Waste Sites
 Yard Waste Facility B

Note: 2016 Imagery courtesy of MnGeo WMS
 Additional information regarding data qualifiers can be found in Appendix B



	Date: 09/11/2019	Project No. 18190012	Figure:
	Drawn: MJV		1G
	Checked: ED		