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Evaluation of City of Lapeer Wastewater Treatment Plant (WWTP) Site

Lapeer County, MI

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1. Introduction

This report summarizes and reports the findings at one of the Publicly Owned Treatment Works (POTW) facilities, the City of Lapeer Wastewater Treatment Plant (WWTP), located in Lapeer, Michigan. The purpose of the investigation was to the summarize the sources and concentrations of Per- and Polyfluoroalkyl Substances (PFAS) at the WWTP at different treatment stages.

The investigation activities were designed to characterize the current PFAS sources for the WWTP from various Industrial Wastewater sources, evaluate the PFAS fate within various treatment stages of the WWTP, and to collect data to evaluate risk to human health and the environment from the land application of potential PFAS-impacted biosolids and treated effluent discharge to surface water. A review of existing data was used to guide the scope of this investigation. Field investigation activities at the WWTP included aqueous samples from various locations within the WWTP, sludge, and biosolids sampling.

2. PFAS Potential Sources in POTWs

PFAS have been classified by the United States Environmental Protection Agency (USEPA) as an emerging contaminant, that is regulated by the Michigan Department of Environmental Quality (MDEQ) under Part 201 of the Natural Resources and Environmental Protection Act, Act 451 of 1994, as amended and Rule 323.1057 (Rule 57) (Toxic Substances) of the Michigan Administrative Code. PFAS are a complex family of more than 3,000 man-made fluorinated organic chemicals. PFAS are not found naturally in the environment. Due to their unique chemical properties, PFAS have been used in many industries and consumer products since the late 1950's such as carpeting, waterproof clothing, upholstery, food paper wrappings, fire-fighting foams, and metal plating. The Interstate Technology Regulatory Council (ITRC) has identified four primary sources of PFAS: fire training, fire response sites, industrial sites, landfills, and wastewater treatment plants/biosolids.

PFAS sources to POTWs include municipal waste as well as commercial and industrial wastewater effluents. Perfluorooctanoic acid (PFOA) and Perfluorooctane sulfonic acid (PFOS) are two of the most studied PFAS that have been detected frequently in the environment including POTWs and biosolids (ITRC, 2017). PFOA and PFOS are part of two PFAS families known as Perfluoroalkyl carboxylic acids (PFCAs) and Perfluoroalkane sulfonic acids (PFSAs), respectively. Both PFCAs and PFSAs are part of a family known as Perfluoroalkyl acids (PFAAs). PFAAs is a family of non-degradable compounds that are referred to as "terminal PFAS" or "terminal degradation products," meaning that no further degradation products will be formed and are considered to be very persistent in the environment. Precursors are PFAS families that could partially degrade in the environment and biota, to dead-end products like PFAAs.

PFAAs are not expected to be treated during the primary and secondary treatment processes. Some tertiary processes might partially remove PFAAs when filtration processes are present such as granular activated carbon (GAC) or particle activated carbon (PAC). However, the dissolved PFAAs present in the liquid portion of the sludge, when no GAC or PAC is used in any of the treatment processes, are typically expected to bypass the POTW treatment processes. PFAAs precursors used in various industries and consumer products are supposed to be present in the wastewater and have been documented to degrade to PFAAs during the treatment processes. In some cases, PFAAs have been found to be present at higher concentrations in the effluent compared to influent due to the degradation of precursors. The final effluent PFAS concentration is important as the MDEQ has established ambient surface water concentrations for both PFOA and PFOS.

As sludge goes through various treatment processes, the solids are degraded resulting in the increase of PFAAs in the sludge and biosolids. Also, the concentration of PFAAs increases due to the degradation of precursors. The presence of PFAAs in the biosolids is a concern to the MDEQ as some of these biosolids are land applied to agricultural lands.

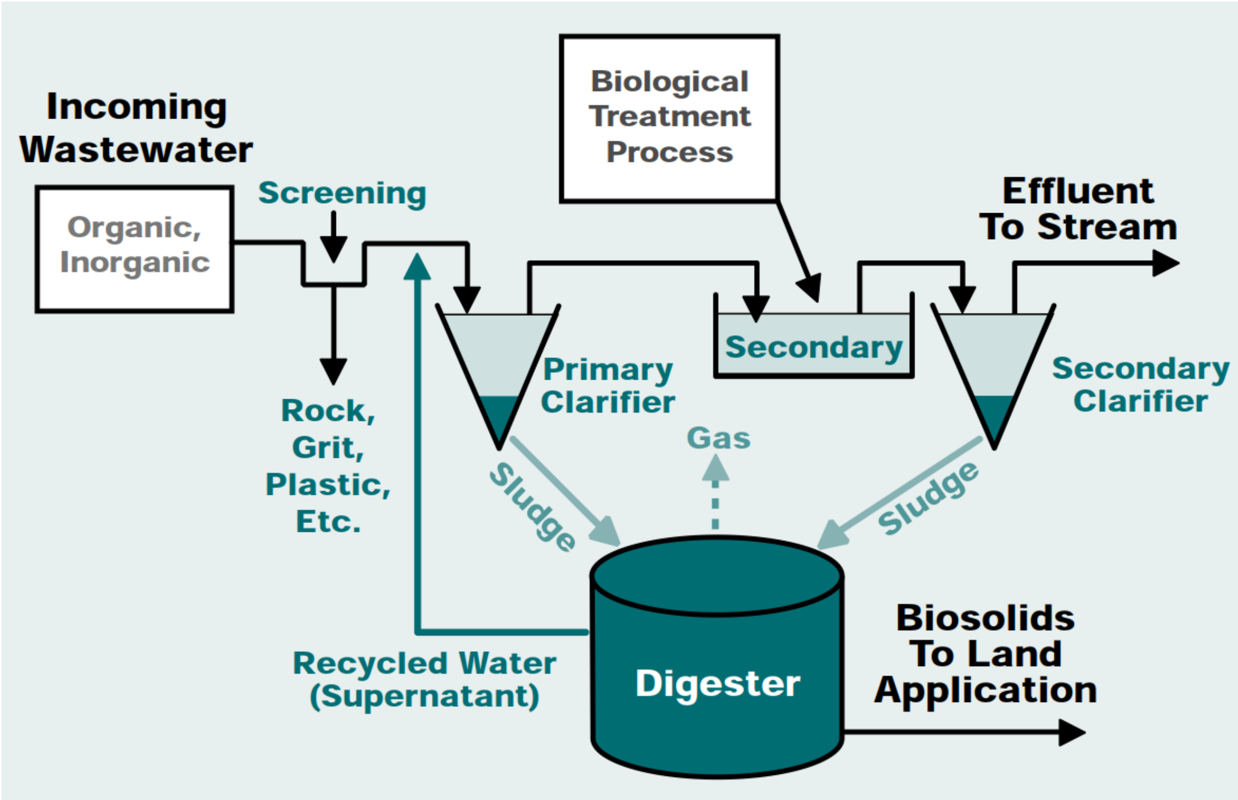
3. Wastewater Treatment Processes

The 1972 Amendments to the Federal Pollution Water Pollution Act, known as the Clean Water Act (CWA) established the foundation for wastewater treatment and discharge. Domestic, commercial, and industrial wastewaters are transported to POTWs. The wastewater from industrial sources often needs to be pretreated to remove contaminants such as metals and other organic pollutants such as chlorinated hydrocarbons. However, historically the PFAS were not monitored and not required to be removed prior to discharge to the POTWs. Typical treatment processes used for wastewater are presented and described in the table below.

Treatment Process	Process Description
Primary	Screening and grit removal eliminates coarse solids that otherwise would interfere with the mechanical equipment at the POTW. The screening and grit are handled as solid waste and landfilled. This part of the primary treatment sometimes is referred to as a preliminary treatment. Typically gravity sedimentation of screened, degritted wastewater removes between 50 to 70 percent of the total suspended solids (TSS) and from 25 to 40 percent of biological oxygen demand (BOD) prior to secondary treatment. The sludge produced during the primary treatment usually contains 2 to 8 percent solids.
Secondary	The secondary treatment relies on biological treatment processes (e.g., suspended growth or fixed growth systems). Microorganisms are used to reduce the BOD. The secondary treatment is the minimum treatment for POTWs under the CWA. The sludge that is separated from the secondary treatment usually has a low solids content of 0.4 to 2 percent as well as 60 to 85 percent of volatile solids.
Tertiary	POTWs that require higher effluent quality than the secondary treatment effluent follow the secondary treatment with a “polish” by further reducing TSS, BOD, phosphorus, and nitrogen with tertiary treatment using filtration and chemical precipitation processes.

Generally, higher degrees of wastewater treatment may increase the total volume of biosolids that is generated. The higher levels of treatment can also increase the concentrations of contaminants in the biosolids because many pollutants removed from the wastewater accumulate in the biosolids. The accumulation of PFAS in biosolids is also expected to increase with higher levels of treatment.

All POTWs have two major flow streams for treatment of wastewater which consists of one flow process for the wastewater (liquid) and a second flow process for the solids removed from the wastewater through the treatment process. An example process flow is presented in the diagram below. The treatment processes for a typical POTW is composed of primary and secondary treatment for the liquid process flow and various processes for the solid process flow which often include a stabilization and dewatering process. The CWA requires the minimum treatment for wastewater to be composed of primary and secondary processes with disinfection of the final effluent. Depending on the POTW a tertiary treatment process could also be added for improved effluent discharge. Multiple devices and designs are available for each treatment process resulting in many configurations for the treatment of the sludge by the POTWs. The addition of various chemicals is also done based on particular POTW design at multiple stages.



Basic wastewater treatment processes typically used by POTWS

Liquid Process Flow – The liquid portion of the wastewater is treated through all of the main treatment processes including primary, secondary, and in some cases, tertiary processes are used for final "polishing" step. Regardless of the treatment steps, the treated wastewater effluent goes through the final disinfection treatment, which is typically performed by adding chlorine and allowing a specific contact time with the effluent or ultraviolet (UV) disinfection of the effluent prior to discharge.

Solid Process Flow – The solids removed during the primary treatment by screening and gritting are disposed to a landfill and are not processed further. Typically the sludge collected from the primary and secondary treatment processes goes to a series of additional treatment processes to facilitate efficient disposal. There are six (6) main treatment processes typically used in the treatment and handling of sludge and are presented in the table below.

Preliminary Operations	Thickening	Stabilization	Conditioning	Dewatering	Disposal
Grinding	Gravity	Alkaline Stabilization	Chemical	Centrifuge	Landfill
Screening	Flotation	Anaerobic Digestion	Thermal	Belt-Filter Press	Direct/Indirect Dryer
Degritting	Centrifugation	Aerobic Digestion		Filter Press	Incineration
Blending	Gravity Belt	Composing		Drying Beds	Land Application
Storage	Rotary-Drum			Lagoons	

4. Biosolids Treatment and Handling

The treatment of wastewater during various processes results in the production of a semisolid byproduct known as biosolids. Historically biosolids were called sewage sludge; however, biosolids is the term used today to emphasize the beneficial nature of this nutrient-rich byproduct. Biosolids are the final result of the solid process treatment performed on the sludge. The six (6) main treatment processes are discussed in more detail below.

4.1 Preliminary Operations

Preliminary operations are not used by all POTWs, but in some cases grinding, screening, degritting, blending and storage of sludge are necessary in order to provide a relatively constant and homogeneous feed to the solid process flow. Some of these operations are sometimes used between other solid treatment processes as well.

Gravity – Sludge grinding is performed when large and stingy materials that are in the sludge are cut or shredded into smaller particles in order to prevent clogging or wrapping around rotating equipment.

Screening – The initial screens that are used in the primary treatment for the raw wastewater can allow significant quantities of solids through; screening is an alternative of grinding. Screening is used to remove nuisance material from the solids stream.

Degritting – In some POTWs where grit-removal is not used in the primary treatment prior to sedimentation tanks, or where grit-removal facilities are not adequate to handle peak flows and peak grit loads, it may be necessary to remove the grit before further processing is performed on the sludge. Degritting can be used when additional thickening of the primary sludge is desired through the application of centrifugal forces in a flowing system to achieve separation of the grit particles from the organic sludge.

Blending – Sludge may be generated during the primary, secondary, and advanced wastewater-treatment processes. Sludge blending may be performed in order to produce a uniform mixture of downstream operations and processes. The uniform mixing is more critical to short detention time systems such as dewatering, heat treatment, and incineration.

Storage – Storage may be performed in order to smooth out fluctuations in the rate of solids and allow solids to accumulate during periods when the solids handling facility is not operating (e.g., night shifts, weekends, and periods when equipment is down). Storage is particularly important in providing a uniform feed rate ahead of mechanical dewatering, lime stabilization, heat drying, and thermal reduction. Short-time solids storage is sometimes used in wastewater settling or thickening tanks. Long-term solids storage may be accomplished in stabilization processes with long detention time such as aerobic and anaerobic digestion, or in specially designed tanks.

4.2 Thickening

The bio-solids generated from the primary, secondary, or the mixture from primary and secondary treatments varies considerably due to the characteristics of the sludge, sludge removal and pumping facilities, and method of operation. The thickening process is a procedure in which a portion of the liquid fraction is removed, and the solids content of the sludge is increased. Thickening is typically accomplished by physical processes such as gravity settling, flotation, centrifugation, gravity belt, and rotary drum.

Gravity – Primary clarifiers are often used to thicken the sludge for further processing. The thickening performed in the primary clarifiers is often referred to as co-settling thickening. A sludge blanket must be first created to consolidate solids without allowing the clarified water to be pulled through. Chemicals are sometimes added to further improve the settling efficiency depending on clarifier overflow rates. Gravity thickening accomplished in a circular tank and similar to a sedimentation tank is one of the most often used methods for thickening. The feed sludge is allowed to settle and compact, and the thickened sludge is withdrawn from the conical tank bottom. The thickened sludge is pumped to the digesters or dewatering equipment, and as a result, storage must be provided for the sludge. Gravity thickeners are most efficient on primary sludge.

Flotation – Dissolved-air is introduced into a wastewater solution and is held at elevated pressure. When the wastewater is depressurized, the dissolved air is released, and finely divided bubbles carry the sludge to the top, where it is removed. Flotation thickening is used most efficiently for waste sludges from suspended-growth biological treatment processes such as the activated-sludge process or the suspended-growth nitrification process. Other sludges such as primary sludge, aerobically digested, and sludges containing metal salts from chemical treatment have been successfully thickened using flotation.

Centrifugation – Centrifuges can be used for both thicken and dewater sludges. Thickening using centrifugation is typically limited only to waste-activated sludges that are produced in the secondary treatment. Thickening by centrifugation is achieved by settling of sludge particles under the influence of centrifugal forces. The most basic type of centrifuge used for thickening is the solid-bowl centrifuge. Under normal conditions, the thickening can be performed without the addition of any polymers, but polymers are sometimes used to improve efficiency. The maintenance and power costs are substantial, and typically centrifugation is used by larger facilities treating in excess of 5 million gallons per day (MGD) or larger, where space is limited or for sludges that are difficult to thicken by more conventional means.

Gravity-Belt – Gravity-belt thickeners have been developed from the application of belt presses for sludge dewatering. The belt-presses used for thickening consist of a gravity belt that moves over rollers driven by a variable–speed drive unit. The sludge is conditioned with polymer and fed into a feed/distribution box at one end, where the sludge is distributed evenly across the width of the moving belt. The sludge concentrates by having the liquid portion of the sludge drain through the belt as it is carried toward the discharge end of the thickener. The sludge is ridged and furrowed by a series of plow blades, which allows the water released from the sludge to pass through the belt. This process has been used to thicken waste-activated sludge, anaerobically and aerobically digested sludge, as well as some industrial sludges. Polymer addition is required for the process to be efficient and operate well.

Rotary-Drum – Rotary-drum thickening system consists of a conditioning polymer feed system and rotating cylindrical screens. The polymer is mixed with the diluted sludge in the conditioning drum. The conditioned sludge is further passed to rotating-screen drums, which enables for the solid sludge to separate from the liquid part. The resulting thickened sludge is discharged at the end of the drum, while the liquid decants drains through the screens. Some rotary-drums designs have been engineered to be combined with belt-filter presses for a combination of sludge thickening and dewatering. Rotary-drum thickeners are typically used in small and medium-sized POTWs for waste-activated sludge thickening.

4.3 Stabilization

Stabilization involves a number of various processes that reduce the pathogen level, odor, and volatile solids content. Stabilization is not used by all of the POTWs but is widely used by many POTWs ranging in size from small to very large. Stabilization is used for volume reduction, production of methane, and improving the dewaterability of sludge. The most frequent methods of stabilization are alkaline stabilization (typically performed with lime), anaerobic digestion, aerobic digestion, and composting. A short description of each stabilization process is provided below.

Alkaline Stabilization – Alkaline stabilization historically has been done using quicklime (CaO) or hydrated lime ($Ca[OH]_2$), which is mixed with the biosolids. Other, frequently used alkaline materials include cement kiln dust, lime kiln dust, Portland cement, and fly ash. The alkaline material is used to make the sludge unsuitable for the survival of microorganisms and sometimes is also applied to the biosolids after the dewatering. Quicklime is preferred because it is exothermic reaction raising the temperature of the mixture above 50°C, which is sufficient to inactive worm eggs. Lime can also be added to the untreated sludge in order to increase the pH to 12 or higher for about 2 hours. The high pH ensures the sludge will not putrefy, create odors, it also inactivates the virus, bacteria, and other microorganisms and reduces vector attraction. The advantage of alkaline stabilization is the production of biosolids with substantially decreasing pathogens. One disadvantage is the increase of biosolids mass due to the addition of lime. The lime is added to the biosolids prior to dewatering to be used either for the direct application of liquid sludge to land, or in order to combine the benefits of sludge conditioning and stabilization prior to dewatering. When lime is used prior to dewatering process, typically the dewatering is performed with a pressure-type filter press, and not centrifuge or belt-filter presses as the lime would cause an abrasive tear and scaling problems in these treatment processes.

Anaerobic Digestion – Anaerobic digestion is one of the oldest processes used for the stabilization of sludge. The stabilization of sludge using anaerobic digestion is typically performed biologically in a closed tank to reduce the organic content, mass, odor, and pathogen content of biosolids. During the digestion, anaerobic bacteria consume a portion of the organic matter, and inorganic matter (mostly sulfate) in the absence of oxygen converts the organic solids to carbon dioxide, methane, and ammonia. Due to the methane generation, which can be recovered and used for energy, the anaerobic digestion is widely used primarily by large POTWs.

Aerobic Digestion – Aerobic digestion is often used to treat waste activated sludge, a mixture of waste-activated sludge or trickling-filter sludge and primary sludge, or waste sludge from extended aeration plants. Aerobic digestion is performed in open or closed vessels or lagoons using aerobic bacteria in the presence of oxygen, where a portion of the organic solids are converted into carbon dioxide, water, and nitrogen. Pathogens and odors are reduced during the aerobic digestion. Aerobic digestion is typically used by smaller POTWs and is often performed in wastewater lagoons that are equipped with aeration equipment. The aerobic digestion is sometimes performed at high-temperature (i.e., higher than 55^0C [131^0F]) since it produces biosolids with lower pathogen levels and higher solids content than conventional aerobic digestion. Advantages for aerobic digestion, when compared to anaerobic digestion, are: the volatile solids reduction is almost equal to that of anaerobic digestion; lower BOD concentrations in the supernatant liquor, production of odorless, humus-like, and biologically stable end product; lower capital cost; and the operation is relatively quick. Some of the significant disadvantages of the aerobic process are: high power cost associated with the supplying the required oxygen; the digested biosolids produced have poorer mechanical dewatering characteristics; and the high sensitivity of the process to temperature, location, tank geometry, the concentration of feed solids, and type of mixing/aeration device.

Composting – Composting is a cost-effective alternative for the stabilization of sludge. Composting is performed by microorganisms resulting in the decomposition of organic matter in a controlled environment. The size and porosity of the pile, as well as the moisture and oxygen levels, have to be controlled. The biosolids are reduced to humus-like material with excellent soil conditioning properties at a pH range of 6.5 to 8. Composting is performed by the addition of bulking agents such as wood chips, municipal yard trimmings, bark, rice hulls, straw, or previously composted material. About 20 to 30 percent of the volatile solids are converted to carbon dioxide and water. Biosolids decomposed aerobically for 3 to 4 weeks from active composting followed by one month of less-active composting is referred to as curing. During the sludge decomposition, the compost heats to temperatures in the pasteurization range of 60 to 70°C. There are three typical composting processes used such as windrow composting, aerated static piles, and in-vessel composting.

4.4 Conditioning

Conditioning of sludge and biosolids is used to improve the efficiency of the dewatering process. The two main conditioning types are thermal treatment and the chemical addition of inorganic chemicals, organic polyelectrolytes, or both. The mechanical dewatering of biosolids using mechanical dewatering systems such as centrifugation, belt-filter presses, pressure-filter presses, and vacuum filters is more efficient when biosolids are conditioned first. The conditioning of biosolids is a significant component of the operation and maintenance of biosolids.

Chemical – The use of chemicals for conditioning can help reduce the moisture content of the sludge from 90 to 99 percent to 65 to 85 percent depending on the sludge characteristics. Chemical conditioning results in the coagulation of the solids and release of the liquid portion. Inorganic chemicals used for conditioning are ferric chloride, lime, alum, ferrous chloride, aluminum salts, and iron salts. Organic chemical conditioning includes polyelectrolytes which can be classified by the polymer compound's charge (i.e., anionic, nonionic, or cationic), molecular weight, and polymer form (i.e., dry, liquid/solution, emulsions, or gel). Organic chemical conditioning can be used for all mechanical dewatering types.

Thermal – Thermal conditioning has been used in the conditioning and stabilization of sludge, but it is not typically used in new POTWs. Thermal conditioning refers to the simultaneous application of heat and pressure to the biosolids to enhance the dewatering efficiency without the need for conditioning using chemicals. The application of heat lyses the cell walls of the microorganisms contained in the biosolids, releasing bound water from the particles. The process further hydrolyzes and solubilizes hydrated particles in the biosolids, and organic compounds in the primary sludge. The heat conditioning coagulates the solids, breaks down the gel structure, and reduces the water affinity of the sludge soils. The supernatant is high in BOD and may require special sidestream treatment before it is introduced back into the wastewater treatment process.

4.5 Dewatering

Dewatering removes moisture content and is generally performed before the biosolids are dried, incinerated, composted, or landfilled. The dewatering process reduces the biosolids volume and increases the solids concentration. Dewatering might be undesirable for land application of biosolids by injection into the ground or in locations where water itself is a valuable agricultural resource. The biosolids are typically conditioned and thickened prior to the dewatering process. The conditioning of biosolids is performed using chemicals such as lime, ferric chloride, or polymers, which are added to the biosolids in order for the small particles to aggregate into larger masses referred to as “flocs.” The dewatering processes can be divided into two major categories: air drying beds and mechanical systems.

A list and description of various air drying beds are presented in the table below.

Drying Bed Type	Description
Conventional	Conventional rectangular sand drying beds have sidewalls with sand and gravel layers, underdrainage piping in order to carry the drained liquid away with or without provisions for mechanical removal. They can be with or without a roof or a greenhouse-type covering.
Paved	Paved rectangular drying beds have sidewalls, a center sand-drainage strip with or without heating pipes buried in the paved section. They can also be with or without any type of roof. Front-end loaders are easily used for cake removal, and auger mixing vehicles can be used to speed up the drying.
Wedge-Wire	Wedge-wire drying beds have been used since the 1970s where the slurry is spread onto a horizontal and relative open drainage media which results in the formation of a thin layer of water. Additional liquid biosolids are spread on top of the water layer, which results in the controlled formation of cake. Polyelectrolyte flocculants are used in order to promote rapid cake formation. Mechanical cleaning is required and is typically used by small plants.
Vacuum-Assisted	Vacuum-Assisted drying beds have sidewalls and bottom slab with reinforced concrete. A very thin layer of several millimeters thick of stabilized aggregate is used, which is connected to a vacuum pump. A rigid multimedia filter top is applied on top of the aggregate support. The polymer is used to enhance the dewatering process and is injected into the biosolids in the inlet line. The filtrate drains through the multimedia filter into the space containing the aggregate and then to a sump, from where the filtrate is sent back to the POTW. The biosolids are left on the plates for a more extended period of time in order to produce higher solid concentration by evaporation.

The conventional sand drying beds for dewatering biosolids is typically the most common air drying dewatering process used and has been successfully used for over 100 years. This process if properly designed and operated can produce a drier product than most mechanical devices. This process can produce solid content in the biosolids as high as 45 to 90 percent. The typical design for sand drying beds includes sand and gravel layers and a collection system for the drainage. The biosolids on the sand beds are dewatered by drainage and evaporation. The first step is the drainage of water into the sand and gravel layers which is removed through the underdrains, which typically takes several days. Once a sludge supernatant layer has former, decanting removes any surface water which can also be formed due to precipitation. Any water that remains in the sludge after drainage and decanting is removed by evaporation. This dewatering process is suitable in POTWs of all sizes. The advantages of sand drying beds are a low capital cost for small plants, low electric power consumption, low sensitivity to biosolids variability, low chemical consumption, and high dry cake solids contents. The disadvantages are large land requirements, the biosolids need to be stabilized prior to the dewatering process, labor-intensive, permitting and groundwater contamination concerns, and fuel and equipment costs for bed cleaning systems.

Dewatering of biosolids using mechanical systems are presented below and include centrifugal, belt filter press, pressure filter press, and vacuum filters. Large POTWs typically rely on mechanical dewatering systems.

Centrifugal Dewatering - Centrifugal force is applied to a biosolids slurry to facilitate and accelerate the separation of the solids and liquid fraction. The process is composed of a clarification step when solid particles are allowed to settle out of the rounding liquid, and a compaction step where some free water is squeezed out from the settled mass. This process can produce a solid content of 25 to 35 percent. Centrifuges separated sludge into the dewatered cake and clarified “centrate.” The cake and centrate are separated based on density differences between the solids and the liquid present. The centrifugal dewatering is similar to a gravity clarifier, where the centrifugal force is 500 to 3,000 time the force of gravity. Chemical conditioning is often used for centrifugal dewatering. Advantages include minimal odors, little operation attention, high average cake solids, continuous feed, low average maintenance, and high safety record. One disadvantage is that the grit can wear the solid-bowl machine.

Belt-Filter Press Dewatering – Belt-filter presses have double moving belts that are capable of continuously dewatering the biosolids through a combination of gravity drainage and compression. This process started to be used in the mid-1970s, mainly because it was able to dewater secondary sludge and had lower energy requirements compared to centrifuges and vacuum-filter dewatering equipment. The process can produce biosolids with 20 to 32 percent solids content. Chemical conditioning is necessary and organic polymer is the most commonly used. The polymer-flocculated solids are first introduced in a gravity drainage section, where gravity drainage occurs. The filtrate from the gravity zone is then sent to the belt filter press and moves into the compression stage. Further dewatering occurs as the sludge is squeezed between the two porous belts. The biosolids progress through rollers with decreasing diameters, which increase the pressure. The final dewatered cake is removed from the belts by scraper blades.

Plate and Frame Press Dewatering – Pressure filter presses have been used to dewater solids since the mid-1800s, however, only since 1970 has the plate and frame press become more popular by becoming less labor-intensive and more automated. The pressure filter press can produce biosolids with solid content between 35 to 45 percent. The main disadvantage is the capital cost, the high quantities of conditioning chemicals, and periodic adherence of cake to filter medium that requires manual removal. When cake solids with solid content higher than 35 percent are needed, the pressure filter press may be a cost-effective dewatering process. Today fewer filter presses are used compared to other dewatering devices such as centrifuges vacuum filters, and belt presses.

Vacuum Filters Dewatering – Vacuum filters can achieve biosolids with 12 to 22 percent solids content. Vacuum filters typically are composed of a rotating drum submerged in a vat of biosolids that apply a vacuum from within the drum. The vacuum draws water into the drum, leaving the biosolids cake on the outer drum filter medium. The dewatered biosolids are scraped off the filter. Many of the vacuum filters are being replaced by centrifuges, belt filter presses, and in some cases even by pressure filter presses.

Lagoons – Drying lagoons can be used as a substitute for drying beds for the dewatering of digested sludge. The drying lagoons are not suitable for the dewatering of untreated sludge, limed sludge, or sludges with a high strength supernatant because of their odor. Unconditioned digested biosolids are discharged into the lagoon in an even distribution at a depth that ranges between 2.5 to 4 feet (ft). Evaporation is the prime mechanisms for dewatering. The biosolids are removed mechanically and have a typical solid content of 25 to 30 percent. The cycle time for lagoons varies from several months to several years. Typically the biosolids are pumped into the lagoon for 18 months and rest for 6 months. A minimum of two lagoons is always used in order to ensure storage during cleaning, maintenance, or emergency conditions.

4.6 Disposal

In order to meet regulatory requirements that protect human and environmental health, facilitate handling, and reduce disposal costs, the majority of biosolids undergo additional treatment at the POTW as described above prior to disposal. Biosolids that are intended to be land applied or used as compost have to meet regulatory requirements for pathogens, vector attraction reduction, and metal content.

Heat Drying and Pelletizing – Heat drying involves the application of heat to evaporate water and to reduce the moisture content of biosolids below what is achieved by conventional dewatering methods. Active or passive dryers are used to remove moisture from the biosolids during the heat drying process. Sometimes solar drying is used. The heat drying process removes pathogens and eliminates a large percentage of the moisture, which significantly reduces the volume of the biosolids. Heat-dried biosolids from the secondary treatment do not generally have odors when stored dried, where those from the primary treatment typically do. The advantages of heat drying include the reduced biosolids transportation cost, pathogen reduction, and improved storage capacity. Active heat dryers are convection, conduction, radiation, or a combination of both. Indirect dryers are designed in either a horizontal or vertical configuration. The heat dried biosolids are sometimes formed into pellets. The biosolids that have been processed using heat drying processes are very dry and could save significantly on transportation costs. As a result, the heat drying and pelletizing of biosolids is typically the process of choice for urban communities where there are significant distances to agricultural lands.

Incineration – Incineration of the sludge is the total conversion of organic solids to primarily carbon dioxide, water, and ash. The advantages of incineration are maximum volume reduction, reduction of pathogens and toxic compounds, and energy recovery potential. The disadvantages of incineration include high capital and operating cost, skilled operators are required, emission to the air, and potential of the resulting ash sometimes to be classified as hazardous depending on the characteristics. Incineration is typically used by medium and large size POTWs that have limited disposal options. Typical dewatered and untreated sludges are used for incineration and usually are not stabilized prior to incineration.

Landfill – Landfill disposal of biosolids is typically done at landfills that accept stabilized and unstabilized municipal solids that are defined as a monofill or at landfills that accept only municipal solid waste. The design and operation of a monofil are regulated by U.S. EPA under Subpart C of 40 of the Code of Federal Regulations (CFR) Part 503, and the design and operations of a codisposal landfill are regulated by US EPA under 40 CFR Part 258. The most common disposal of sludge is done at landfills regulated under 40 CFR Part 503.

Land Application – Land application of biosolids is defined as the spreading of biosolids on or just below the soil surface. Biosolids may be applied to agricultural lands, forests, large disturbed areas such as mine reclamation sites, parks, golf courses, and dedicated land disposal sites. The land application of biosolids is in many cases is less expensive than other disposal methods. The increased cost of disposal, for example to a landfill, makes the land application of biosolids a good alternative for disposal. A 1997 nationwide survey performed by USEPA recorded that 54 percent of POTWs were practicing beneficial use of biosolids by land application.

Municipal biosolids are regulated at the federal level under 405(d) of the Clean Water Act. In 1993, Title 40 CFR, Part 503 “The Standards for the Use or Disposal of Sewage Sludge” was published. This document lists the requirements that have to be met before the biosolids can be beneficially used. The regulations establish two levels of quality for heavy metal concentrations known as Pollutant Ceiling Concentrations and Pollutant Concentrations which are given in tables as cumulative pollutant loading rate, monthly average concentration, and annual pollutant loading rates. In order for the biosolids to be land applied they must meet pollutant Ceiling Concentrations, Pollutant Concentrations limits, and loading rates for nitrogen. The pathogen reduction requirements for surface disposal and application for biosolids are divided into two classes of pathogen reduction as Class A and Class B.

- **Class A** – Disposal of biosolids for the application to land, lawns, or home gardens must meet Class A pathogen reduction. Class A biosolids have to meet fecal coliform and Salmonella sp. densities. In addition to the density requirement, the Class A biosolids have also need to achieve a time/temperature guidance, alkaline treatment, prior testing for enteric virus/viable helminth ova, or biosolids have been treated by processes to reduce pathogens or equivalent processes further.
- **Class B** – Class B pathogen requirements are the minimum level of pathogen reduction for land application and surface disposal. When biosolids are disposed and covered daily, they do not need to meet Class B requirements. However, biosolids that do not meet the quality of Class B cannot be land applied. Class B biosolids pathogen requirements are met if 1) treatment by processes that significantly reduces the pathogens, or equivalent processes are used, or 2) if at least seven samples collected at the time of use or disposal are analyzed for fecal coliforms during each monitoring period and meet the regulatory criteria.

Pathogen treatment processes that could significantly reduce pathogens are aerobic digestion, air drying, anaerobic digestion, composting, lime stabilization, heat drying, thermophilic aerobic digestion, beta, and gamma-ray irradiation.

Vector-attraction reduction requirements are needed to reduce the potential for spreading of infectious disease agents by vectors such as flies, rodents, and birds. Treatment methods that can be used to minimize vector-attraction are Aerobic digestion, anaerobic digestion, aerobic processes, alkaline stabilization, and drying. The methods used for land application of biosolids can also affect vector-attraction. These methods include injection, incorporation, daily cover, and alkaline treatment which are described in more detail below.

Injection – Liquid biosolids are injected beneath the surface with no significant amount of solids present on the surface after 1 hour. Class A for pathogen reduction must be injected within 8 hours after it was discharged from the pathogen reduction process.

Incorporation – Biosolids that are land applied on the surface of the land should be incorporated into the soil within six (6) hours of application. Class A biosolids that are land applied to the surface must be applied within eight (8) hours after the discharge from the pathogen reduction process.

Daily Cover – Biosolids that are applied on the land surface should be covered with soil or other material at the end of each operating day.

5. City of Lapeer WWTP

The WWTP shown in **Figure 1** is the current Wastewater Treatment Plant for the City of Lapeer. The WWTP was initially constructed in 1957 and consisted of two primary clarifiers, high rate trickling filter, two final clarifiers, and two anaerobic digesters. Modifications to the WWTP were performed in 1985 to provide an average design capacity of 1.85 MGD. The modified plant converted the primary clarifiers to retention/equalization basins. A new 450,000-gallon retention basin and two oxidation ditches were also constructed. The original final clarifiers are still in use. Sand filters were added to provide tertiary treatment. Finally, the anaerobic digesters were converted to aerobic digesters. In 1993, the average design capacity was increased to 2.3 MGD, based on an evaluation of the WWTP.

The WWTP has been operated at an average design flow capacity of 2.3 MGD since 1993. The wastewater enters the WWTP through a lift station consisting of four sewage screw pumps. The wastewater is further advanced through a screen and grit facility to remove any large debris, after which the wastewater flows to the equalization tanks and retention basin, and then passes through to one of the two oxidation ditches. The oxidation ditch is a modified activated sludge process, which provides thoroughly mixed long-term aeration to maintain biomass that oxidizes carbonaceous materials and nitrifies ammonia. Solids are settled out in the final clarifiers. The suspended solids removed in the settling tanks are either recycled to the oxidation ditches or sent to the solids handling process as waste activated sludge. The wastewater from the secondary settling tanks is filtered through rapid sand filters and chlorinated in the chlorine contact tank for disinfection purposes before discharge to the South Branch of the Flint River. The Waste Activated Sludge is thickened via centrifuge before storage and land application. Sludge drying beds are also available for on-site emergency stand-by dewatering. In 2014, further improvements were done to the WWTP of some bypass pumping stations and the addition of Phosphorous Selector Tanks. During normal operation the influent and return activated sludge gravity flow into the chambers for anoxic treatment before going to the oxidation ditches. Two submersible mixers are used to keep all of the contents in anaerobic suspension. Historical and more recent WWTP Process Diagrams can be found in **Appendix A**.

6. Industrial Pretreatment Program

POTWs receive industrial wastewaters from various industrial facilities in Michigan. Pollutants in industrial wastewater may be pretreated with similar processes to those of POTWs. In order to protect the POTWs and the environment, the Pretreatment Program requires the industrial users to use treatment processes and management practices to reduce or eliminate the discharge of harmful pollutants to sanitary sewers. The Pretreatment Program is one of the significant parts of the CWA National Pollutant Discharge Elimination System (NPDES). The discharge of pollutants from industrial wastewaters to POTWs is regulated in Michigan through the Industrial Pretreatment Program (IPP). The purpose of IPP is to:

1. Regulate the disposal of industrial wastewater into the sanitary wastewater collection system.
2. Protect the physical structures and safety of operation and maintenance personnel of the wastewater collection and treatment system.
3. Protect the health and safety of the public and the environment.
4. Comply with pretreatment regulations as required under Federal General Pretreatment Regulations and Categorical Standards and local source control ordinances.

Generally, industrial users are prohibited from discharging wastewater to POTWs if the wastewater would:

1. Pass through the POTWs untreated, and/or
2. Interfere with the operation or performance of the POTWs.

Eight specific restrictions to the discharge of pollutants from industrial wastewaters to the POTWs are:

1. Pollutants that create a fire or explosion hazard in the POTWs sewer system or at the treatment plant.
2. Pollutants that are corrosive including any discharge with a pH lower than 5.0.
3. Solid or viscous pollutants in amounts that would obstruct flow in the collection system and treatment plant, resulting in interference with operations.
4. Any pollutant, including oxygen demanding pollutants released in a discharge at a flow rate and/or concentration which would cause interference.
5. Heat in amounts which would inhibit biological activity in the POTW resulting in interference.
6. Pollutants which result in the presence of toxic gases, vapors, or fumes in a quantity that may cause acute worker health and safety problems.
7. Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause pass through or interference.
8. Trucked or hauled pollutants, except at discharge points designated by the Superintendent.

6.1 MDEQ IPP PFAS Initiative

PFAS are regulated by the MDEQ under Part 201, Environmental Remediation, and Part 31, Water Resources Protection of the Natural Resource and Environmental Protection Act, Act 451 of 1994, as amended and their respective administrative rules, specifically Rule 299.44-299.50 (Generic Cleanup Criteria) and Rule 57) (Toxic Substances) of the Michigan Administrative Code. The Michigan Rule 57 values or Water Quality Standards are developed to protect humans, wildlife, and aquatic life. The applicable (most stringent) Water Quality Standards for PFOS and PFOA are human noncancer values, as follows:

- PFOS: 12 nanograms per liter (ng/l) or parts per trillion (ppt) for surface waters that are not used for drinking water and 11 ng/l for those used as a drinking water source

- PFOA: 12,000 ng/l for surface waters that are not used for drinking water and 420 ng/l for those used as a drinking water source.

For NPDES permittees, Part I.C.1.f. requires permittees to prohibit discharges that cause their POTWs to pass through pollutants greater than water quality standards to surface water. Part I.C.1.g. further prohibits NPDES permittees from accepting discharges that restrict, in whole or part, with their management of biosolids.

The MDEQ, Water Resources Division on February 2018, required all WWTPs with IPPs to evaluate potential sources of PFAS, investigate probable sources, reduce/eliminate the sources found, and take other actions to protect surface water quality as needed.

7. PFAS Evaluations

In 2001 during a statewide PFAS investigation conducted in Michigan PFOS and PFOA were detected at concentrations of 12.31 and 11.94 ng/L, respectively in the Flint River. In 2003 based on the science understood at that time, it was concluded that PFAS were not a significant concern. As science and understanding of PFAS evolved over the years, another statewide PFAS sampling was performed. Additional evaluation of the Flint River was conducted in 2013 and 2014, and the results and discussion are provided below.

7.1 Flint River

Preliminary surface water and fish tissue sampling performed by the MDEQ in 2013 and 2014 on the Flint River found concentrations of PFOS above Michigan's Part 31 Water Quality Standard and Michigan Department of Health and Human Services (MDHHS) screening values for fish tissue. As a result, in 2015, MDHHS released an updated "Eat Safe Fish" guidance where PFOS was the driver for the fish consumption advisory for several species on the Flint River downstream of Mott Dam. Subsequent surface water and the fish collection were conducted in 2016 to investigate the potential sources of PFAS to the river. The results of this 2016 investigation indicated that there was a PFAS source located upstream of Holloway Dam. In 2017, additional monitoring was conducted upstream of Holloway Dam of significant tributaries of the Flint River, and of the three major wastewater treatment plants which discharge to the Flint River within the area of concern. Analysis of the City of Lapeer's WWTP effluent identified in May and July of 2017, the WWTP as a significant source of PFOS to the Flint River, with effluent PFOS concentration of 415 ng/L and 2,000 ng/L, respectively.

7.2 Significant Industrial Users

The Significant Industrial Users (SIUs) that have discharge to the WWTP has changed over time. In 2000, a total of seven (7) SIUs were listed for the WWTP Biosolids Land Application Program as MetoKote and Deco Plate metal finishers, Cambridge Industries, Lapeer Industries, Lapeer Regional Hospital, Thumb Regional Correctional Facility, and Webco Press. The City of Lapeer WWTP has land applied biosolids since 1997. Deco Plate was the only SIU from 2000 that is still discharging to the WWTP today, however the name of the industrial user changed to Lapeer Plate and Plastics (LP&P).

In 2017, eight (8) SIUs were discharging to the City of Lapeer WWTP. These SIUs are listed in the table below, along with the PFOA and PFOS results. Subsequently, LP&P was identified as contributing significant amounts of PFOS to the City's sewer system with a PFOS concentration of 19,000 ng/L. PFOA and PFOS have been detected in the effluents of all of the eight (8) SIUs, but the LP&P PFOS concentration was significantly higher than the others' SIUs effluents.

Significant Industrial User	Sampling Location	PFOS (ng/L)	PFOA (ng/L)
Lapeer Plating & Plastics (LP&P)	Effluent	19,000	2.3
Elite Cleanroom Services	Outfall 001	23	6.1
McLaren Lapeer Region	McLaren North Composite McLaren South Composite	15 5.8	< 2.0 3.2
Thumb Regional Correctional Facility	Effluent	9.1	4.2
Delta Faucet	Effluent	4.9	2.5
Mold Masters	Effluent	4.7	< 2.0
Albar Industries	Albar North Albar South	5.1 6.6	2.0 < 1.7

Significant Industrial User	Sampling Location	PFOS (ng/L)	PFOA (ng/L)
Area 1 & Suncrest	Effluent	12	2.7

7.3 Lapeer Plating and Plastics

Lapeer Plating & Plastics is a chrome plater that produces the following products:

Emblems – Decorative automotive components that are used by Original Equipment Manufacturers to brand vehicles.

Nameplates – Decorative automotive components that display a vehicle's brand name. Nameplates are usually chrome plated and placed on the rear of the vehicle.

Ornamentation – Decorative automotive components that are typically found on the hood, side panel, or rear of the vehicle.

Body Side Moldings - Body Side Moldings are installed across the length of the vehicles. They provide protection to the door against damage and increase the aesthetic appeal of the vehicle.

Grille & Grille Assemblies – A grille is an ornamental grating that forms a barrier or screen at the front end of a vehicle that increases the aesthetic appeal of a vehicle. It functions to cover an opening in the body of a vehicle to allow air to enter while protecting the radiator and engine.

Interior Decorative Trims – Chrome plated interior decorative trims used to accent many luxurious features with decorative trim components such as door spears, center stack, cup holder, and instrument cluster bezels.

Exterior Decorative Trims – Exterior surface decorations are used to achieve market distinction and high consumer appeal. Available finishes that are available are bright chrome, satin 'low-reflection' chrome, emblem painting, and mold-In color polymers.

Headlamp & Tail Light Trims – The headlamp trim, also referred to as the headlight door, is the metal or plastic ring or frame that holds the lens in place in the headlight housing. This customizable component is known to increase the cosmetic look of an entire headlamp housing significantly.

PFAS are used as wetting agents in many wet-chemical processes of surface finishing, such as electroplating. PFOS is used in the chrome plating industry because it has the very high chemical stability to the powerful oxidizer, chromium (VI), and to sulfuric acid/chromo-sulfuric acid. In electroplating systems, PFOS decreases the surface tension of the treatment baths, where components to be treated are immersed and reduces the amount of process solution carried over into subsequent tanks by means of more rapid draining. The complete removal of the process solution from the surface is a prerequisite for the quality and uniformity of coatings. The use of PFOS in chromium electroplaters also reduces the formation of toxic chromium (VI) aerosols by evaporation of hydrogen and oxygen on the electrodes.

PFOS is not expected to form sludge from the degradation products in the tank, which could affect the quality of the component surfaces. While PFOS is not likely to degrade during the plating process, some PFOS is lost due to partial grad-out into subsequent electroplating tanks and needs to be replenished. Under extreme, aggressive chemical conditions, such as those in electroplating, conventional, bio-degradable surfactants would rapidly degrade. PFOS has been used in hard and bright chrome electrolytes, in chromic acid plastic etchants, in alkaline zinc and zinc alloy electrolytes, in precious metal plating (e.g., strongly acidic gold-palladium), rhodium baths, nickel plating, and aluminum anodizing. A list of various wetting agents that contain PFOS used in various plating processes is listed in the table below along with the PFOS concentrations.

Wetting Agent	PFOS Concentration (ng/L)
Fumetrol 140 by Atotech	43,000,000,000
Bayowet FT 248 by Lanxess	580,000,000,000
Proquel Z Fa.Kiesow	50,000,000,000
Silken Wet 302	45,000,000,000
Ankor SRK	69,000,000,000
NCR by Blasberg-Werra-Chemie	50,000,000,000

LP&P has been using wetting agents that contain PFAS such as Ankor® Wetting Agent F and more recently since 2013 Ankor® LF19. As presented in the table above the PFOS concentration in the wetting agents could vary between 43,000,000,000 to 580,000,000,000 ng/L. A formula of Ankor wetting agent was found to have a concentration of 69,000,000,000 ng/L. During the plating process, only a small amount of wetting agent is used, and the industrial wastewater effluent from the facility goes through a series of pretreatment processes. As a result, the PFOS concentrations are expected to be significantly lower than those in the actual concentrate. Concentrations in the LP&P effluent in 2017 varied between 110 to 34,000 ng/L.

The MDEQ has worked with LP&P to improve their treatment system in order to significantly reduce the PFOS concentration in their effluent that discharges to the City of Lapeer WWTP. In order to better understand the PFOS concentrations at various stages in the LP&P's pretreatment system and determine where improvements can be made in the removal of PFOS, samples were collected within the LP&P facility and results are presented in the table below. The PFOS concentrations within the LP&P facility including between various treatment processes varied between 13 to 25,000,000 ng/L. After improvements to the treatment system were made at the LP&P facility, the concentrations varied between non-detect to 4,300 ng/L.

Wetting Agent	PFOS Concentration (ng/L)
Etch Pit 1	1,500,000
Pre-Plate Pit 1	140,000
HI PH Compartment	18,000
E-Copper	440
Clarifier	4,400
Main Holding Tank	5,300
Polymer Storage	13
Etch Pit 2	25,000,000
Pre-Plate Pit 2	610,000
Plating Line Chrome Pit	200,000
Chromium Recovery Unit	480
Steam Line Etch	41
Effluent	13,000
Filter Press	6,100

7.4 City of Lapeer WWTP

Analysis of the City of Lapeer's WWTP effluent identified the WWTP as a significant source of PFOS to the Flint River in May of 2017, with an effluent PFOS concentration of 415 ng/l. The MDEQ identified LP&P as the main PFAS source to the City of Lapeer WWTP. Improvements to the treatment system were made at the LP&P facility in order to reduce the PFOS concentration in the effluent that was directed to the WWTP. Improvements were made by LP&P to treat effluent for PFOS resulted in the WWTP PFOS effluent concentration decreasing from 2,000 ng/l in July 2017 to 14 ng/l in April 2018.

The City of Lapeer was authorized to land-apply biosolids from the Lapeer WWTP in accordance with a Residuals Management Program RMP approved by the MDEQ on October 17, 2000. The biosolids were injected below the surface to a maximum depth of 12 inches. Due to recent concerns regarding the potential for PFAS impacted biosolids being land applied, the MDEQ requested the City of Lapeer to analyze their biosolids for PFAS on August 24, 2017. A biosolids sample was collected from the aerobic digester which had a 4.4 % solids content. Results indicated that PFAS was present in biosolids at elevated concentrations. The concentration of PFOS in the sludge collected was found to be 2,100 ng/g or ppb.

The MDEQ conducted an initial, limited investigation in December 2017 at the Site owned by the City of Lapeer where biosolids from the City of Lapeer WWTP were land applied. The investigation included three surface soil samples and one surface water sample. Approximately 1,423 dry tons of biosolids were applied to this field since 1999 with the last application occurring in 2014. During that time, the Site had repeated biosolids land applications which were generally applied to the 50 acres approved for the application. The results of the initial MDEQ investigation indicated the highest PFAS concentration was PFOS, with an average soil concentration of 500 ppb. In addition, PFOS levels in the pond located on the northeast side of the field were reported at 2,000 ng/l which is above the Part 31 water quality value of 12 ppt. The presence of elevated levels of PFOS in the soils and pond water indicated the potential for PFOS to be present in adjacent groundwater and/or surface waters.

The MDEQ also conducted a limited investigation at the City of Lapeer WWTP by collecting 2 biosolids and 4 liquid samples for PFAS analysis. The investigation was conducted by AECOM on behalf of the MDEQ and was performed in accordance with applicable AECOM, MDEQ, and U.S. EPA guidance documents, including the site-specific Sampling and Analysis Plan and the Quality Assurance Project Plan.

7.4.1 Scope of Work

Biosolids and liquid samples were collected from the WWTP to evaluate the PFAS concentrations within the facility further. A total of two biosolids and four liquid samples were sent for laboratory analysis.

The biosolids and liquid samples were submitted to Vista Analytical Laboratories and analyzed using the isotope dilution method for a list of 24 PFAS which included:

- PFBA = Perfluorobutanoic acid
- PFPeA = Perfluoropentanoic acid
- PFHxA = Perfluorohexaonic acid
- PFHpA = Perfluoroheptanoic acid
- PFOA = Perfluorooctanoic acid
- PFNA = Perfluorononanoic acid
- PFDA = Perfluorodecanoic acid
- PFUnDA = Perfluoroundecanoic acid
- PFDoDA = perfluorododecanoic acid
- PFTeDA = Perfluorotetradecanoic acid

- PFTrDA = Perfluorotridecanoic acid
- PFBS = Perfluorobutane sulfonic acid
- PFPeS = Perfluoropentane sulfonic acid
- PFHxS = Perfluorohexane sulfonic acid
- PFHpS = Perfluoroheptane sulfonic acid
- PFOS = Perfluorooctane sulfonic acid
- PFNS = Perfluorononane sulfonic acid
- PFDS = Perfluorodecane sulfonic acid
- 4:2 FTS = 4:2 fluorotelomer sulfonate
- 6:2 FTS = 6:2 fluorotelomer sulfonate
- 8:2 FTS = 8:2 fluorotelomer suflonate
- PFOSA = Perfluorooctane sulfonamide
- EtFOSAA = N-Ethyl perfluorooctane sulfonamide
- MeFOSAA = N-methylperfluoro-1-octane sulfonamide

The biosolids samples were also submitted to Test America Laboratories for total organic carbon analysis.

7.4.2 Biosolids Samples

Biosolids samples were collected on May 9, 2018 from the thickening and dewatering treatment processes. A biosolids sample was collected from a centrifuge used in the thickening process and another sample from the sand drying beds used in the dewatering process.

The PFAS data (reported as dry weight), percent solids, and total organic carbon results are summarized in the table below and attached **Table 1, Figure 2, Figure 3,** and **Figure 4**. The

Biosolids Sample IDs	Total PFAS (ng/g)	PFOA (ng/g)	PFOS (ng/g)	Percent Solids (%)	Total Organic Carbon (%)
Thickening Centrifuge	217	4	161	7.8	36.0
Sand Drying Beds	2,358	Non-Detect	1,680	4.9	30.0

7.4.3 Liquid Samples

Liquid samples were collected on May 9, 2018 from four locations including the WWTP effluent, drying beds drain, thickening centrifuge centrate and pore water. The centrate was collected from a sampling port located on the thickening centrifuge. The pore water sample was collected in the laboratory by centrifuging the biosolids collected from the thickening centrifuge. The PFAS data results are summarized in the table below and attached **Table 1, Figure 5, Figure 6,** and **Figure 7**.

Liquid Sample IDs	Total PFAS (ng/L)	PFOA (ng/L)	PFOS (ng/L)
WWTP Effluent	374	5	29
Centrate	880	14	48
Biosolids Pore water	1,656	56	182
Drying Beds Drain	8,720	92	3,180

7.4.4 Agricultural Fields

Due to the elevated levels of PFAS identified in the effluent from the WWTP and concerns regarding the potential for PFAS-impacted biosolids being land applied; the MDEQ requested the City of Lapeer WWTP to analyze their biosolids for PFAS in addition to the effluent. The concentration of PFOS in the biosolids was found to be 2,100 nanograms per gram (ng/g) or parts per billion (ppb). In order to evaluate the potential impact of PFAS-contaminated biosolids in fields where they were land applied by the City of Lapeer WWTP, the MDEQ conducted a file review and identified 38 fields used by the City of Lapeer for land application of biosolids since 1997. The City of Lapeer WWTP land applied a total of 8,550 dry tons of biosolids from the WWTP at 38 agricultural fields between 1999 and 2014. In order to meet the Class B pathogen reduction and reduce vector attraction; the sludge was stabilized using aerobic digesters after which the liquid biosolids were pumped to tanker trucks and land applied by injection below the surface to a maximum depth of 12 inches. The stabilization process used in the past utilized anaerobic digesters and was recently retrofitted to aerobic digesters in 1993.

The MDEQ selected four (4) of the agricultural fields, to evaluate the impacts from the biosolids land application, in order to assess the potential PFAS impact on various environmental matrices. Soil, surface water, and groundwater samples were collected from Sites CL01, SK01, TG01, and TG02 (AECOM 2018a, 2018b, 2018c). Sites TG01 and TG02 were group under one investigation due to their very close proximity.

Approximately 1,423 dry tons of biosolids from the WWTP were land applied to Site CL01, owned by the City of Lapeer, between 1999 and 2014. The highest groundwater PFAS concentration of 41,823 ppt was detected in a perched zone approximately 6 ft below ground surface. The highest surface water PFAS concentration of about 2,500 ppt was detected in samples from an onsite pond and swale. The highest soil PFAS concentration of 598 ppb was detected at Site CL01. The results from Site CL01 showed that high levels of PFAS could potentially be found in soils and leach to the surface water and groundwater at agricultural sites where PFAS-impacted biosolids have been land applied. Elevated PFAS surface water concentrations, especially the onsite pond, are likely related to a combination of surface runoff and discharge of shallow, perched groundwater into the surface water body. A potential for ingestion of PFAS-impacted fish near the Site was identified. A fish advisory for several fish species is currently in place for the South Branch of the Flint River. The surface water concentrations did not exceed the Part 31 Final Acute Value (FAV) and Final Chronic Value (FCV).

A total of 700 dry tons of biosolids was applied at Site SK01 between 1997 through 2007. The highest PFAS concentrations at Site SK01 in the soils, surface water, and groundwater were 14 ppb, 2,106 ppt, and 169 ppt, respectively. Elevated PFAS surface water concentrations, are likely related to a combination of surface runoff and discharge of shallow groundwater into the Lake Pleasant Drain which flows into Lake Pleasant, approximately 3,400 feet south of the Site. A potential for ingestion of PFAS-impacted fish was identified and PFAS was subsequently detected in the tissue of largemouth bass collected from the lake; however, Lake Pleasant is currently not under a PFAS fish advisory. In addition, the PFAS surface water concentrations did not exceed the Part 31 FAV and FCV, and as a result ecological impacts are not likely.

A total of 548 dry tons of biosolids were applied at Sites TG01 and TG02 between 2014 through 2017. The highest PFAS concentrations at Sites TG01 and TG02 in the soils, surface water, and groundwater were 22.22 ppb, 14.93 ppt, and 5.31 ppt, respectively. Low PFAS surface water concentrations are likely related to a combination of surface runoff and discharge of shallow groundwater into the surface water bodies. A potential for ingestion of PFAS-impacted fish near the Site was identified, but does not pose an unacceptable risk. In addition, the PFAS surface water concentrations did not exceed the Part 31 FAV and FCV, and as a result ecological impacts are not likely.

8. Pathway and Receptors Evaluation

An exposure pathway includes five components: a source of contamination; environmental media and transport mechanism; the point of exposure; the route of exposure; and a receptor population. A pathway is considered potentially complete if all five components are present and one or more hazardous substances are detected. The human health risk associated with a possibly complete exposure pathway is acceptable if concentrations do not exceed the applicable criteria and background concentrations (Rule 299.1013(3). Ecological risks are acceptable if concentrations do not exceed water quality values or soil screening values.

Potentially complete surface water exposure pathways associated with the Site and corresponding Part 31 Water Quality Values or other criteria/screening values are:

- Ingestion of surface water incidental to recreational activities (human cancer values and non-cancer values for non-drinking water sources) (PFOA 12,000 ppt and PFOS 12 ppt).
- Ingestion of fish (human cancer values and non-cancer values for non-drinking water sources) PFOA 12,000 ppt and PFOS 12 ppt).
- Aquatic life exposures FCV (PFOA 880,000 ppt and PFOS 140,000 ppt) and final FAV (PFOA 15,000,000 ppt and PFOS 1,600,000 ppt)).

Potentially complete biosolids exposure pathways associated with the WWTP and corresponding Part 201 cleanup criteria (if available) are:

- Direct Contact Criteria (DCC; criteria not available).
- Soil protection of groundwater for drinking water (DWPC; proposed criteria PFOS 1.4 ppb and PFOA 59 ppb).
- Soil protection for the groundwater-surface water interface (GSIPC; PFOS 0.24 ppb and PFOA 10,000 ppb).
- Human exposure by consuming impacted vegetation (gardening, farming; screening levels not available).

Potential receptors associated with surface water are:

- People using the river and other impacted surface waters for recreational fishing, and
- Fish and other aquatic life.

Potential receptors associated with biosolids are:

- WWTP workers at the plant, and
- Non-residential use of impacted biosolids areas, such as farming and commercial use.

<u>Surface Water Evaluation</u>

PFAS concentrations were detected in the WWTP effluent, centrate, biosolids pore water, and drying beds drain with all four locations exceeding the Part 31 Water Quality Value for PFOS. However, no exceedances of the Part 31 FCV and FAV values were detected. Based on the Part 31 Water Quality Value exceedance there is the potential for exposure to PFAS from ingestion of PFAS-impacted fish due to bioaccumulation of PFOS in fish tissue. A fish advisory for several fish species is currently in place for the South Branch of the Flint River due to elevated PFOS concentrations in the fish.

Biosolids Evaluation

On-site workers may encounter biosolids impacted with PFAS; however, no Part 201 DCC have been established for PFOS and PFOA. All of the biosolids samples exceeded the GSIPC and the proposed DWPC for PFOS, indicating a potential of PFOS concentrations to leach into groundwater at levels that exceed the Part 31 Water Quality Value and Part 201 Drinking Water Criteria (PFOA and PFOS 70 ppt).

PFAS has been documented to transfer to various plants. Depending on the plant type and individual PFAS, the accumulation of PFAS is not evenly distributed throughout the major components of the plant. Some of the PFAS will accumulate more in the roots while others will accumulate in the leaves and fruit. However, there is the possibility of exposure to PFAS via plant uptake through direct or indirect ingestion of PFAS-impacted plants. Currently there are no PFAS criteria for plants; however, consumption advisory could be developed in the future similar to those for fish.

9. Summary and Discussion

PFAS were detected in both biosolids samples (**Figure 2**), and all four liquid samples (**Figure 5**). The following criteria were exceeded:

- GSIPC for PFOS in both biosolids samples,
- Proposed DWPC, and
- Part 31 Water Quality Value for PFOS in all liquid samples.

The PFOS liquid sample results were above the Part 31 Water Quality Value. The PFOS concentrations varied between 28.7 to 3,180 ng/l. However, the only liquid sample that discharges to the environment is the WWTP effluent. The other liquid samples are from various treatment processes that are not released to the environment and recycled within the treatment processes. The PFOS concentration in the WWTP effluent was 28.7 ng/l more than twice the Part 31 Water Quality Value of 12 ng/l. However, the results are significantly lower than 2,000 ng/l detected in July 2017. LP&P has made modifications to its industrial pretreatment wastewater system and has decreased the PFAS concentrations they are discharging to the WWTP. The other SIUs that discharge to the WWTP had significantly lower concentrations in their industrial discharges and are not expected to be a significant contributor to the WWTP. The PFAS from the wastewater is likely to accumulate in the biosolids as it goes through various treatment processes resulting in a decreased concentration in the liquid phase.

Only one round of sampling was conducted at the wastewater treatment plant on May 9, 2018, and no trend analysis was able to be performed. PFAS are expected to concentrate in the wastewater solids (sludge and biosolids) and the precurors are expected to partially degrade to dead-end PFAS such as PFOA and PFOS. The wastewater collected further down the treatment process are expected to have higher PFAS concentrations due to the degradation of precusors through the treatment processes. In addition, liquids in the solids stream are expected to have higher PFAS concentrations due to contact with the solids (sludge and biosolids) containing higher concentration of PFAS. At this time the influent of the WWTP was not sampled, but the concentrations in the wastewater increased as the samples were collected further downgradient in the treatment process. The highest PFAS concentration, from liquid samples, was detected in the drain of the drying beds associated with solids handling process. The underdrain for the drying beds collects liquid that is released from the solids placed in the drying beds or collected from precipitation events. The effluent from the drying beds is recycled back into the secondary treatment.

The PFAS concentration in the biosolids exceeded both the proposed DWPC and GSIPC, indicating that there is potential for PFAS to leach from the biosolids to the groundwater or surface water that will exceed the Part 201 Residential Drinking Water Criterion and Part 31 Water Quality Value. The concentrations may also be high enough for transfer to various plants. As mentioned in different sections above, the concentration of pollutants is expected to increase in the biosolids as the wastewater goes through multiple treatment processes due to the degradation of precusors and accumulation in the sludge andbio solids. The total PFAS concentration in the drying beds biosolids was 2,358 ppb and in the thickening centrifuge was 217 ppb. The biosolids sample from the drying beds had lower percent solids than that of the thickened centrifuge biosolids, probably due to precipitation. In August 2017 a sample from the aerobic digester was collected, and the total PFAS concentration was 2,337 ppb. The concentration in the aerobic digester would be expected to be similar to that of the thickened centrifuge biosolids. All three of the biosolids samples collected from the WWTP were collected after the sludge has gone through the final stabilization treatment process. The variation in the PFAS concentrations between the three biosolids samples collected in 2017 and 2018 are most likely attributed to the variation in PFAS concentrations in the WWTP influent over time.

A direct contact exposure risk was not identified at any of the Sites. The South Branch of the Flint River was found to be impacted by PFAS due to the WWTP effluent but did not exceed the Part 31 Water Quality Value for PFOS downstream of the WWTP discharge location. However, surface water samples significantly above the Part 31 Water Quality Value for PFOS were detected at agricultural sites where biosolids were land applied. The groundwater and soils could also be impacted at agricultural fields where biosolids were land applied. The actual PFAS concentrations detected at sites where the land application of PFAS-impacted biosolids occurred could vary significantly depending on the frequency of the biosolids application, PFAS concentrations in the biosolids, the percentage of the land used for biosolids application, geochemistry, and geology of the site. Uptake of PFAS to various crops is also possible, but an ingestion criterion for plants has not been established. Ecological screening levels are also not available for soil or sediments at this time.

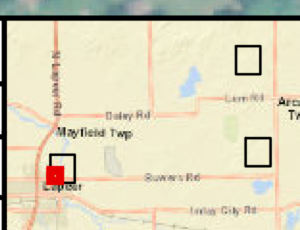
Figures

AECOM

Drawn: Date: 9/28/2018

Approved: Date: 9/28/2018

Project #:



Legend

- Waste Water Treatment Plant
- Road
- Surface Water

0 90 180 Feet

N

FIGURE 1
LAPEER WWTP
SITE OVERVIEW

LAPEER COUNTY, MI

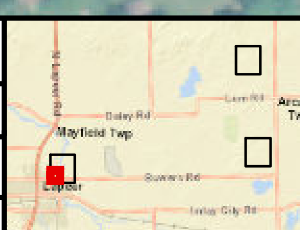
Document Path: G:\GrandRapids\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Lapeer_LPP\MXDs\8.5x11\CL01_WWTP.mxd

AECOM

Drawn: Date: 10/5/2018

Approved: Date: 10/5/2018

Project #:



Sampling Results

Total PFAS (ng/g or ppb)

- ND
- >0 - 50
- >50 - 100
- >100 - 1000
- >1000

Waste Water Treatment Plant

Road

Surface Water

0 90 180 Feet

N

FIGURE 2
LAPEER WWTP
BIOSOLIDS TOTAL PFAS
CONCENTRATION

LAPEER COUNTY, MI

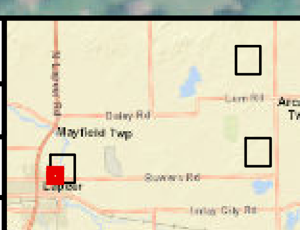
Document Path: G:\GrandRapids\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Lapeer_LPP\MXDs\8.5x11\Heatmaps\WWTP\CL01_WWTP_Biosolids_totalPFAS.mxd

AECOM

Drawn: Date: 10/5/2018

Approved: Date: 10/5/2018

Project #:



Sampling Results

PFOS (ng/g or ppb)

- ND
- >0 - 50
- >50 - 100
- >100 - 1000
- >1000

Waste Water Treatment Plant

Road

Surface Water

0 100 200 Feet

N

FIGURE 3
LAPEER WWTP
BIOSOLIDS PFOS
CONCENTRATION

LAPEER COUNTY, MI

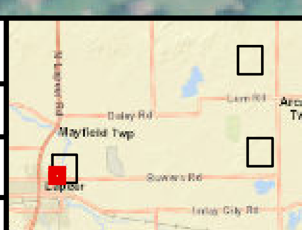
Document Path: G:\GrandRapids\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Lapeer_LPP\MXDs\8.5x11\Heatmaps\WWTP\CL01_WWTP_Biosolids_PFOS.mxd

AECOM

Drawn: Date: 10/5/2018

Approved: Date: 10/5/2018

Project #:



Sampling Results

PFOA (ng/g or ppb)

- ND
- >0 - 50
- >50 - 100
- >100 - 1000
- >1000

Waste Water Treatment Plant

Road

Surface Water

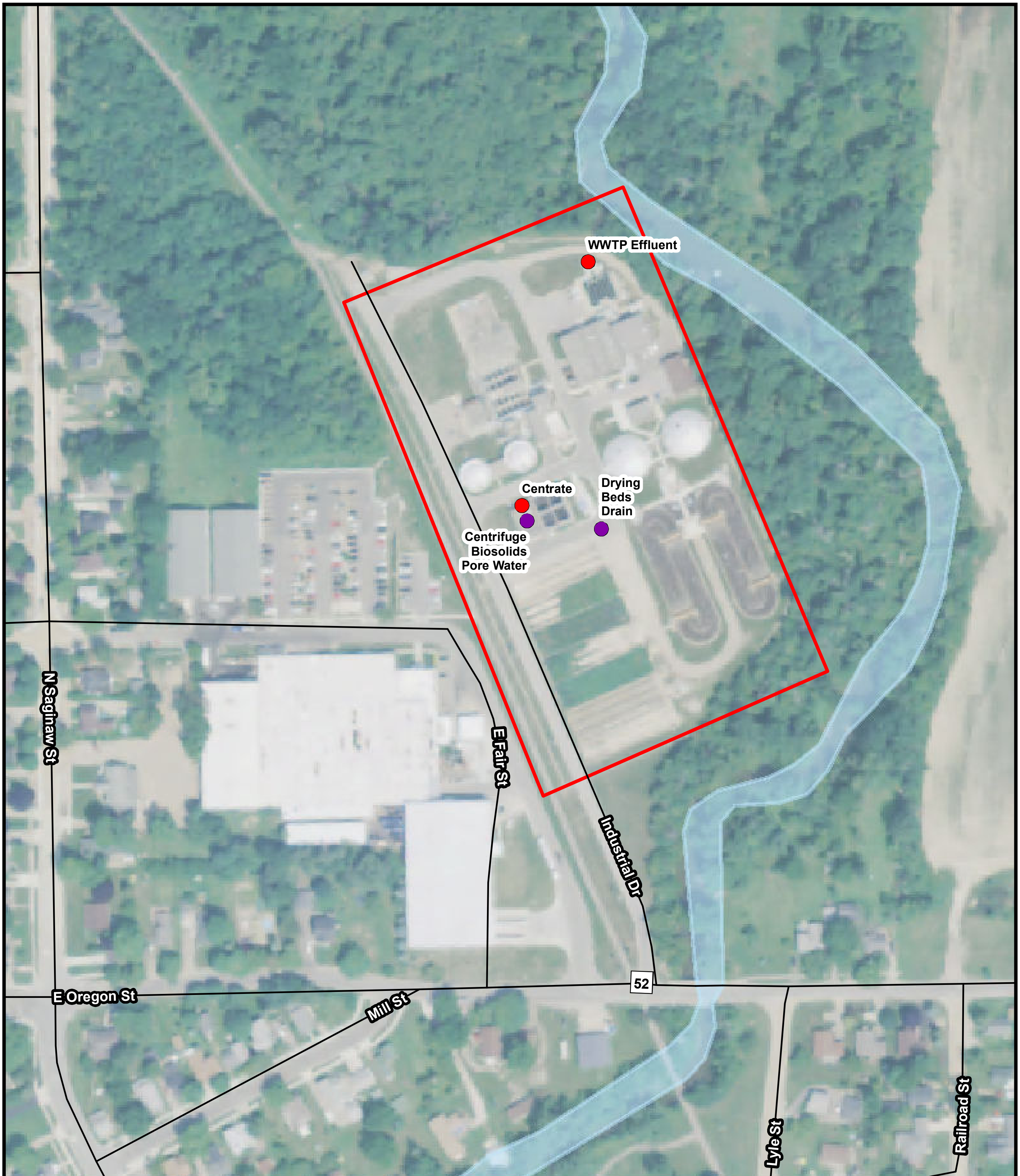
0 100 200 Feet

N

FIGURE 4
LAPEER WWTP
BIOSOLIDS PFOA
CONCENTRATION

LAPEER COUNTY, MI

Document Path: G:\GrandRapids\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Lapeer_LPP\MXDs\8.5x11\Heatmaps\WWTP\CL01_WWTP_Biosolids_PFOA.mxd



AECOM

Drawn: Date: 10/5/2018

Approved: Date: 10/5/2018

Project #:

Sampling Results

Total PFAS (ng/L or ppt)

- ND
- >0 - 50
- >50 - 100
- >100 - 1000
- >1000

Waste Water Treatment Plant

Road

Surface Water

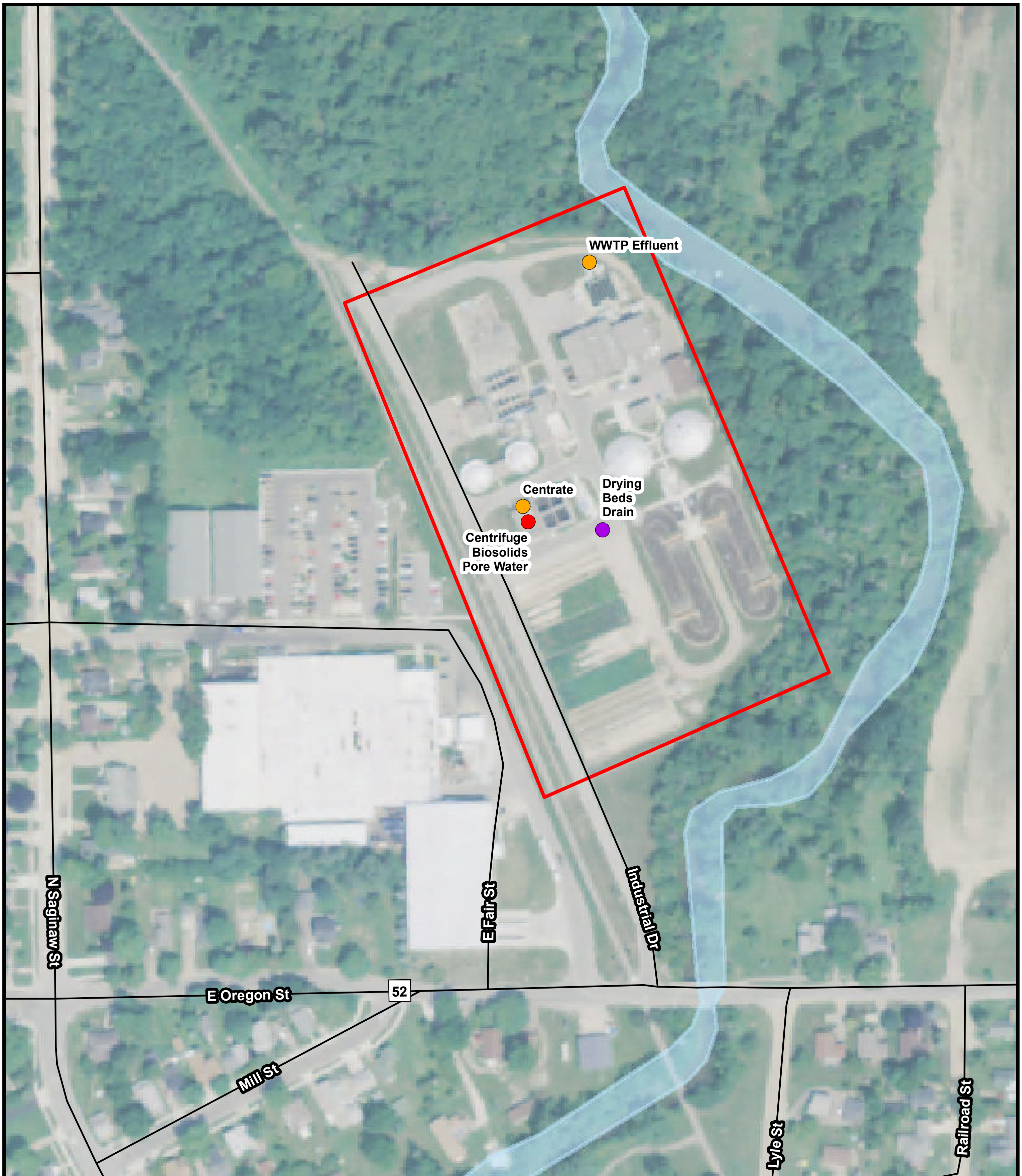
0 90 180 Feet

N

FIGURE 5
LAPEER WWTP
LIQUID TOTAL PFAS
CONCENTRATION

LAPEER COUNTY, MI

Document Path: G:\GrandRapids\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Lapeer_LPP\MXDs\8.5x11\Heatmaps\WWTP\CL01_WWTP_Aqueous_totalPFAS.mxd



AECOM

Drawn: Date: 10/5/2018

Approved: Date: 10/5/2018

Project #:

Sampling Results
PFOS (ng/L or ppt)

- ND
- >0 - 12
- >12 - 70
- >70 - 1000
- >1000

Waste Water Treatment Plant
Road
Surface Water

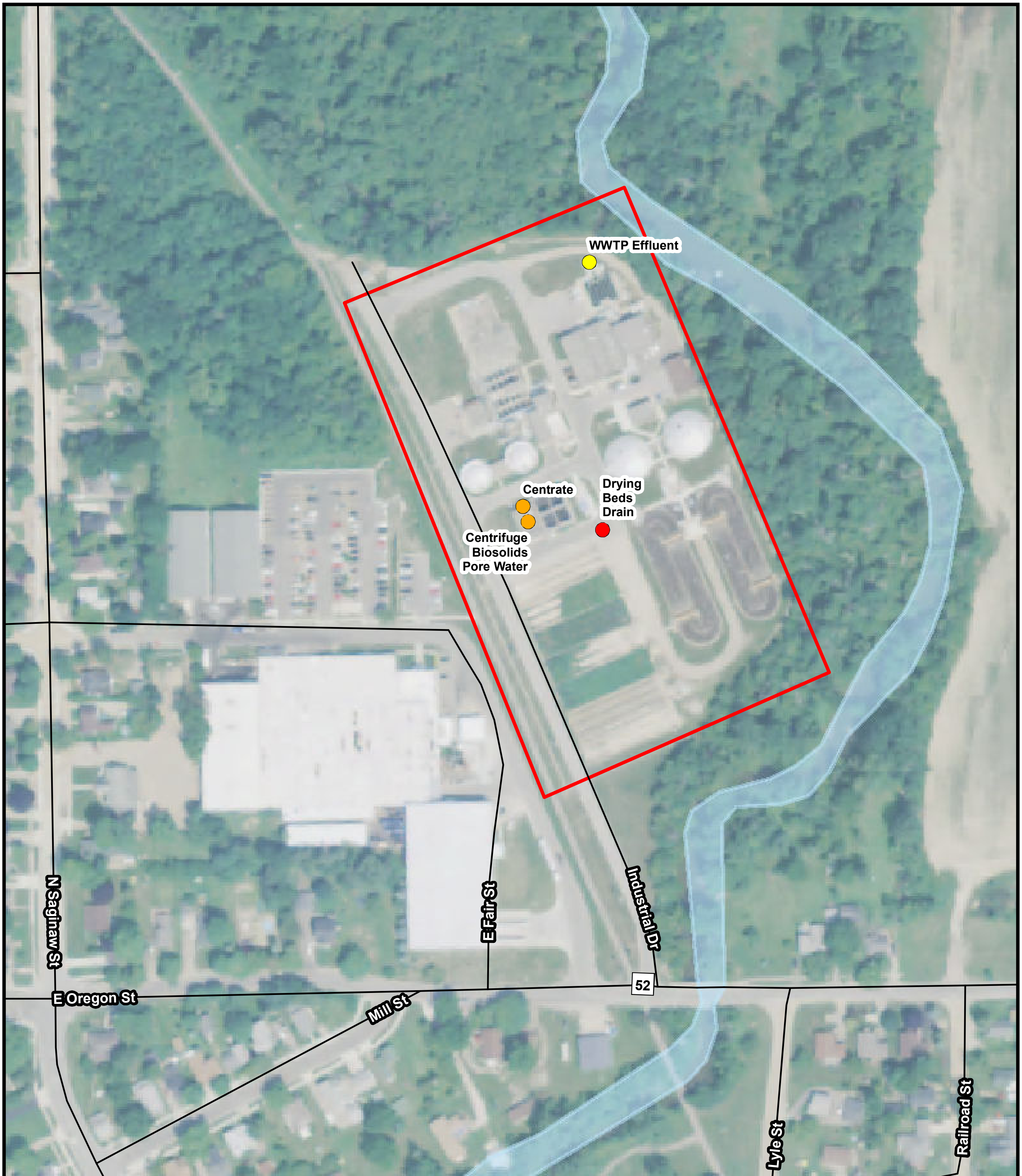
0 90 180 Feet

N

FIGURE 6
LAPEER WWTP
LIQUID PFOS
CONCENTRATION

LAPEER COUNTY, MI

Document Path: G:\GrandRapids\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Lapeer_LPP\MXDs\8.5x11\Heatmaps\WWTP\CL01_WWTP_Aqueous_PFOS.mxd

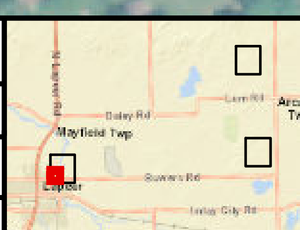


AECOM

Drawn: Date: 10/5/2018

Approved: Date: 10/5/2018

Project #:



Sampling Results
PFOA (ng/L or ppt)

- ND
- >0 - 12
- >12 - 70
- >70 - 1000
- >1000

- Waste Water Treatment Plant
- Road
- Surface Water

0 90 180 Feet

N

FIGURE 7
LAPEER WWTP
LIQUID PFOA
CONCENTRATION

LAPEER COUNTY, MI

Document Path: G:\GrandRapids\DCS\GIS\ArcMap_GeoDB_Projects\ENV\GIS_Data\GIS\Lapeer_LPP\MXDs\8.5x11\Heatmaps\WWTP\CL01_WWTP_Aqueous_PFOA.mxd

Table

Table 1
City of Lapeer WWTP
Aqueous and Biosolids Analytical Results Summary

Aqueous Sample (ng/L)	Sample Description	Sample Date	Time	Total PFAS	PFOA + PFOS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUnDA	PFDoDA	PFTrDA	PFTeDA	PFBS	PFPeS	PFHxS	PFHpS	PFOS	PFNS	PFDS	4:2 FTS	6:2 FTS	8:2 FTS	PFOSA	EtFOSAA	MeFOSAA
WWTPWW0100180509N	Drying Beds Drain	5/9/2018	1630	8,720.02	3,271.60	294.00	959.00	1,400.00	757.00	91.60	16.00	17.10	8.42	10.00	ND	ND	18.20	ND	17.70	ND	3,180.00	ND	41.00	ND	1,910.00	ND	ND	ND	ND
WWTPWW0100180509N	Centrate	5/9/2018	1615	880.00	62.50	39.50	134.00	204.00	171.00	14.10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	48.40	ND	ND	ND	269.00	ND	ND	ND	ND
WWTPEF0100180509N	WWTP Effluent	5/9/2018	1505	373.97	33.73	29.30	81.40	90.80	122.00	5.03	1.15	ND	ND	ND	ND	ND	7.46	ND	ND	ND	28.70	ND	ND	ND	8.13	ND	ND	ND	ND
WWTPSL0100180509N	Centrifuge Biosolids Pore Water	5/9/2018	1545	1,656.42	237.70	141.00	275.00	462.00	415.00	55.70	6.44	5.18	ND	ND	ND	ND	12.10	ND	ND	ND	182.00	ND	ND	ND	102.00	ND	ND	ND	ND
Biosolids Sample (ng/g)																													
WWTPSL0100180509N	Drying Beds Biosolids	5/9/2018	1705	2,357.90	1.78	8.73	26.00	48.00	14.80	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,680.00	ND	ND	ND	562.00	8.51	ND	ND	9.86
WWTPSL0100180509N	Centrifuge Biosolids	5/9/2018	1545	217.00	165.34	ND	5.82	13.20	15.40	4.34	ND	3.94	ND	ND	ND	ND	ND	ND	ND	ND	161.00	ND	ND	ND	7.41	ND	ND	ND	5.89

ND = Non Detect
Aqueous concentrations are reported as ng/L or ppt
Biosolids concentrations are reported as ng/g or ppb

Bolded values indicate detection

PFBA = Perfluorobutanoic acid
PFPeA = Perfluoropentanoic acid
PFHxA = Perfluorohexanoic acid
PFHpA = Perfluoroheptanoic acid
PFOA = Perfluorooctanoic acid
PFNA = Perfluorononanoic acid
PFDA = Perfluorodecanoic acid

PFUnDA = Perfluoroundecanoic acid
PFDoDA = Perfluorododecanoic acid
PFTrDA = Perfluorotridecanoic acid
PFTeDA = Perfluorotetradecanoic acid
PFHxDA = Perfluorohexadecanoic acid
PFODA = Perfluoro-n-octadecanoic acid

PFBS = Perfluorobutane sulfonic acid
PFPeS = Perfluoropentane sulfonic acid
PFHxS = Perfluorohexane sulfonic acid
PFHpS = Perfluoroheptane sulfonic acid
PFOS = Perfluorooctane sulfonic acid
PFDS = Perfluorodecane sulfonic acid

4:2 FTS = 4:2 Fluorotelomer sulfonic acid
6:2 FTS = 6:2 Fluorotelomer sulfonic acid
8:2 FTS = 8:2 Fluorotelomer sulfonic acid
PFOSA = Perfluorooctane sulfonamide
EtFOSAA - N-Ethyl Perfluorooctane sulfonamindoacetic acid
MeFOSAA = N-Methyl Perfluorooctane sulfonamide

Aqueous Criteria (ng/L or ppt):	PFOS	PFOA
Part 31 Generic Residential Groundwater Surface Water Interface Criteria (non-drinking source) (GSIC)	12	12,000
Part 31 Final Chronic Value (FCV)	140,000	880,000
Part 31 Final Acute Value (FAV)	1,600,000	15,000,000

Aqueous Criteria Exceedances:
Green indicates PFAS exceeded GSIC
Orange indicates PFAS exceeded FCV
Red indicates PFAS exceeded both FCV and FAV

Soil Criteria (ug/kg or ppb):	PFOS	PFOA
Part 201 Generic Residential Groundwater Surface Water Interface Protection Criteria (for soils) (GSIPC)	0.24	10,000
Proposed Drinking Water Criteria (DWPC)	1.4	59

Soil Criteria Exceedances:
Green indicates PFAS exceeded DWPC
Yellow indicates PFAS exceeded GSIPC
Orange indicates PFAS exceeded both DWPC and GSIPC

Appendix A

Laboratory Analytical Reports

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Edison
777 New Durham Road
Edison, NJ 08817
Tel: (732)549-3900

TestAmerica Job ID: 460-159618-1
Client Project/Site: Lloyd Kahn Samples

For:
AECOM
250 Apollo Drive
Chelmsford, Massachusetts 01824

Attn: Mr. Robert Kennedy

Authorized for release by:
7/18/2018 7:03:42 PM

Kris Brooks, Project Manager II
(330)966-9790
kris.brooks@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Definitions/Glossary

Qualifiers

General Chemistry

Qualifier	Qualifier Description
H	Sample was prepped or analyzed beyond the specified holding time

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Job ID: 460-159618-1

Laboratory: TestAmerica Edison

Narrative

CASE NARRATIVE

Client: AECOM

Project: Lloyd Kahn Samples

Report Number: 460-159618-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica Canton attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The Lloyd Kahn Total Organic Carbon analysis was performed at the TestAmerica Edison laboratory.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header.

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT
The samples were received on 6/28/2018 9:40 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 5.4° C.

Receipt Exceptions

The Chain-of-Custody (COC) was incomplete as received and/or improperly completed, No analysis on COC, no sample date/time on sample containes, analysis put on HOLD

TOTAL ORGANIC CARBON
Samples WWTPSL0100180509N (460-159618-1) and WWTPSL0100180509N (460-159618-2) were analyzed for total organic carbon in accordance with Lloyd Kahn Method. The samples were analyzed on 07/17/2018.

The following samples were received outside of holding time for LLoyd Kahn. Client advised the lab to proceed outside of holding time: WWTPSL0100180509N (460-159618-1) and WWTPSL0100180509N (460-159618-2).

Job ID: 460-159618-1 (Continued)

Laboratory: TestAmerica Edison (Continued)

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

PERCENT SOLIDS

Samples WWTPSL0100180509N (460-159618-1) and WWTPSL0100180509N (460-159618-2) were analyzed for percent solids in accordance with ASTM Method D2216-80. The samples were analyzed on 07/14/2018.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Detection Summary

Client: AECOM
Project/Site: Lloyd Kahn Samples

TestAmerica Job ID: 460-159618-1

Client Sample ID: WWTPSL0100180509N — Lab Sample ID: 460-159618-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
TOC Result 1	300000	H	1600	1100	mg/Kg	1	☼	Lloyd Kahn	Total/NA

Client Sample ID: WWTPSL0100180509N — Lab Sample ID: 460-159618-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
TOC Result 1	360000	H	1500	1000	mg/Kg	1	☼	Lloyd Kahn	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample ID: WWTPSL0100180509N
Lab Sample ID: 460-159618-1
Date Collected: 05/18/18 11:35
Matrix: Solid
Date Received: 06/28/18 09:40

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	93.8		1.0	1.0	%			07/14/18 08:19	1
Percent Solids	6.2		1.0	1.0	%			07/14/18 08:19	1

Client Sample ID: WWTPSL0100180509N
Lab Sample ID: 460-159618-1
Date Collected: 05/18/18 11:35
Matrix: Solid
Date Received: 06/28/18 09:40
Percent Solids: 6.2

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
TOC Result 1	300000	H	1600	1100	mg/Kg	☼		07/17/18 15:26	1

Client Sample ID: WWTPSL0100180509N
Lab Sample ID: 460-159618-2
Date Collected: 05/18/18 12:10
Matrix: Solid
Date Received: 06/28/18 09:40

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	93.3		1.0	1.0	%			07/14/18 08:19	1
Percent Solids	6.7		1.0	1.0	%			07/14/18 08:19	1

Client Sample ID: WWTPSL0100180509N
Lab Sample ID: 460-159618-2
Date Collected: 05/18/18 12:10
Matrix: Solid
Date Received: 06/28/18 09:40
Percent Solids: 6.7

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
TOC Result 1	360000	H	1500	1000	mg/Kg	☼		07/17/18 15:34	1

Method: Lloyd Kahn - Organic Carbon, Total (TOC)

Lab Sample ID: MB 460-537280/3
Client Sample ID: Method Blank
Matrix: Solid
Prep Type: Total/NA
Analysis Batch: 537280

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
TOC Result 1	ND		100	69	mg/Kg			07/17/18 13:23	1

Lab Sample ID: LCSSRM 460-537280/4
Client Sample ID: Lab Control Sample
Matrix: Solid
Prep Type: Total/NA
Analysis Batch: 537280

Analyte			Spike Added	LCSSRM Result	LCSSRM Qualifier	Unit	D	%Rec	%Rec. Limits		
TOC Result 1			5770	5910		mg/Kg		102.4	35.4 - 194.1		

General Chemistry

Analysis Batch: 536389

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
460-159618-1	WWTPSL0100180509N	Total/NA	Solid	Moisture	
460-159618-2	WWTPSL0100180509N	Total/NA	Solid	Moisture	

Analysis Batch: 537280

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
460-159618-1	WWTPSL0100180509N	Total/NA	Solid	Lloyd Kahn	
460-159618-2	WWTPSL0100180509N	Total/NA	Solid	Lloyd Kahn	
MB 460-537280/3	Method Blank	Total/NA	Solid	Lloyd Kahn	
LCSSRM 460-537280/4	Lab Control Sample	Total/NA	Solid	Lloyd Kahn	

Client Sample ID: WWTPSL0100180509N
Date Collected: 05/18/18 11:35
Date Received: 06/28/18 09:40

Lab Sample ID: 460-159618-1
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	536389	07/14/18 08:19	BJP	TAL EDI

Client Sample ID: WWTPSL0100180509N
Date Collected: 05/18/18 11:35
Date Received: 06/28/18 09:40

Lab Sample ID: 460-159618-1
Matrix: Solid
Percent Solids: 6.2

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Lloyd Kahn		1	537280	07/17/18 15:26	JXT	TAL EDI

Client Sample ID: WWTPSL0100180509N
Date Collected: 05/18/18 12:10
Date Received: 06/28/18 09:40

Lab Sample ID: 460-159618-2
Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	536389	07/14/18 08:19	BJP	TAL EDI

Client Sample ID: WWTPSL0100180509N
Date Collected: 05/18/18 12:10
Date Received: 06/28/18 09:40

Lab Sample ID: 460-159618-2
Matrix: Solid
Percent Solids: 6.7

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Lloyd Kahn		1	537280	07/17/18 15:34	JXT	TAL EDI

Laboratory References:

TAL EDI = TestAmerica Edison, 777 New Durham Road, Edison, NJ 08817, TEL (732)549-3900

Accreditation/Certification Summary

Client: AECOM
Project/Site: Lloyd Kahn Samples

TestAmerica Job ID: 460-159618-1

Laboratory: TestAmerica Edison

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
Connecticut	State Program	1	PH-0200	09-30-18
DE Haz. Subst. Cleanup Act (HSCA)	State Program	3	N/A	12-31-18
New Jersey	NELAP	2	12028	06-30-19
New York	NELAP	2	11452	04-01-19
Pennsylvania	NELAP	3	68-00522	02-28-19
Rhode Island	State Program	1	LAO00132	12-30-18
USDA	Federal		NJCA-003-08	06-13-20

Laboratory: TestAmerica Canton

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
California	State Program	9	2927	02-23-19
Connecticut	State Program	1	PH-0590	12-31-19
Florida	NELAP	4	E87225	06-30-19
Illinois	NELAP	5	200004	07-31-18 *
Kansas	NELAP	7	E-10336	01-31-19
Kentucky (UST)	State Program	4	58	02-23-19
Kentucky (WW)	State Program	4	98016	12-31-18
Minnesota	NELAP	5	039-999-348	12-31-18
Minnesota (Petrofund)	State Program	1	3506	07-31-18 *
Nevada	State Program	9	OH-000482008A	07-31-18 *
New Jersey	NELAP	2	OH001	06-30-19
New York	NELAP	2	10975	03-31-19
Ohio VAP	State Program	5	CL0024	09-06-19
Oregon	NELAP	10	4062	02-23-19
Pennsylvania	NELAP	3	68-00340	08-31-18 *
Texas	NELAP	6	T104704517-17-9	08-31-18 *
USDA	Federal		P330-16-00404	12-28-19
Virginia	NELAP	3	460175	09-14-18 *
Washington	State Program	10	C971	01-12-19
West Virginia DEP	State Program	3	210	12-31-18

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

Method	Method Description	Protocol	Laboratory
Lloyd Kahn	Organic Carbon, Total (TOC)	EPA	TAL EDI
Moisture	Percent Moisture	EPA	TAL EDI

Protocol References:

EPA = US Environmental Protection Agency

Laboratory References:

TAL EDI = TestAmerica Edison, 777 New Durham Road, Edison, NJ 08817, TEL (732)549-3900

Sample Summary

Client: AECOM
Project/Site: Lloyd Kahn Samples

TestAmerica Job ID: 460-159618-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
460-159618-1	WWTPSL0100180509N	Solid	05/18/18 11:35	06/28/18 09:40
460-159618-2	WWTPSL0100180509N	Solid	05/18/18 12:10	06/28/18 09:40

159618

Chain-of-Custody Record

Vista Analytical Laboratory

Samples from:
Vista Analytical Laboratory
1104 Windfield Way
El Dorado Hills, CA 95762
916-673-1520

5.4°C IR11

Samples sent to:
TestAmerica Edison
777 New Durham Road
Edison, NJ 08817-2859

Attn: Sample receiving/Kris Brooks

Client CS

Sample Information

Vista ID	Sample Name	Sampled	Matrix	#Containers	Method 1	Method 2	Method 3
1800935-01	WWTPEF0100180509N	09-May-18 11:10	Effluent	0			
1800935-02	WWTPSL0100180509N	09-May-18 11:35	Sludge	1	1		
1800935-03	WWTPWW0100180509N	09-May-18 11:40	Wastewater	0			
1800935-04	WWTPWW0100180509N	09-May-18 12:00	Wastewater	0			
1800935-05	WWTPSL0100180509N	09-May-18 12:10	Sludge	1	2		

460-159618 Chain of Custody

Special Requests:

Relinquished (Printed Name/Signature/Date/Time)	Received (Printed Name/Signature/Date/Time)
Bettina Benedict [signature] 06/26/18 1411	[signature] TAED via FedEx 6/28/18 0940

Relinquished (Printed Name/Signature/Date/Time) | Received (Printed Name/Signature/Date/Time)

TestAmerica Edison
Receipt Temperature and pH Log

Page ____ of ____

Job Number: 159618

Number of Coolers: 1 **IR Gun #** 11

Cooler Temperatures

	RAW	CORRECTED		RAW	CORRECTED		RAW	CORRECTED
Cooler #1:	5.4 °C	5.4 °C	Cooler #4:	°C	°C	Cooler #7:	°C	°C
Cooler #2:	°C	°C	Cooler #5:	°C	°C	Cooler #8:	°C	°C
Cooler #3:	°C	°C	Cooler #6:	°C	°C	Cooler #9:	°C	°C

TALS Sample Number	Ammonia (pH<2)	COD (pH<2)	Nitrate Nitrite (pH<2)	Metals* (pH<2)	Hardness (pH<2)	Pest (pH 5-9)	EPH or QAM (pH<2)	Phenols (pH<2)	Sulfide (pH>9)	TKN (pH<2)	TOC (pH<2)	Total Cyanide (pH>12)	Total Phos (pH<2)	Other	Other

If pH adjustments are required record the information below:

Sample No(s). adjusted: ____________________

Preservative Name/Conc.: ____________________ Volume of Preservative used (ml): ____________________

Lot # of Preservative(s): ____________________ Expiration Date: ____________________

The appropriate Project Manager and Department Manager should be notified about the samples which were pH adjusted.

* *Samples for Metal analysis which are out of compliance must be acidified at least 24 hours prior to analysis.*

EDS-WI-038, Rev 4, 06/09/2014 **Initials:** CA **Date:** 6/28/18

Login Sample Receipt Checklist

Client: AECOM | Job Number: 460-159618-1

Login Number: 159618 | **List Source: TestAmerica Edison**
List Number: 1
Creator: Meyers, Gary

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	client custody seal received
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	No analysis requiring residual chlorine check assigned.

1 2 3 4 5 6 7 8 9 10 11 12 13 14

June 27, 2018

Vista Work Order No. 1800935

Ms. Maya Murshak
Merit Laboratories, Inc.
2680 East Lansing Drive
East Lansing, MI 48823

Dear Ms. Murshak,

Enclosed are the results for the sample set received at Vista Analytical Laboratory on May 12, 2018. This sample set was analyzed on a standard turn-around time, under your Project Name 'Lapeer'.

Vista Analytical Laboratory is committed to serving you effectively. If you require additional information, please contact me at 916-673-1520 or by email at mmaier@vista-analytical.com.

Thank you for choosing Vista as part of your analytical support team.

Sincerely,

Martha Maier
Laboratory Director

Vista Work Order No. 1800935
Case Narrative

Sample Condition on Receipt:

One effluent sample, two sludge samples and two wastewater samples were received in good condition and within the method temperature requirements. The samples were received and stored securely in accordance with Vista standard operating procedures and EPA methodology.

Analytical Notes:

As requested, sample "CL1CS0100180509N" was centrifuged and the aqueous and solid phases extracted and analyzed separately. The solid phase has been reported as Lab Sample 1800935-06.

PFAS Isotope Dilution Method

The aqueous samples were extracted and analyzed for a selected list of PFAS using Vista's PFAS Isotope Dilution Method. This method is listed on Vista's NELAP certificate as Modifed EPA Method 537. The results for PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Results for all other analytes include the linear isomers only.

The samples contained particulate and were centrifuged prior to extraction.

Subsamples of "CL1CW0100180509N" and "CL1MH0100180509N" were extracted due to the appearance of the samples. The Solid Phase Extraction cartridge clogged during the extraction of sample "CL1CS0100180509N" and an additional cartridge was used to complete the extraction. Sample "CL1MH0100180509N" was eluted under vacuum.

Holding Times

The samples were extracted and analyzed within the method hold times.

Quality Control

The Initial Calibration and Continuing Calibration Verifications met the method acceptance criteria.

A Method Blank and Ongoing Precision and Recovery (OPR) sample were extracted and analyzed with the preparation batch. No analytes were detected in the Method Blank above 1/2 the LOQ. The OPR recoveries were within the method acceptance criteria.

The labeled standard recoveries outside the acceptance criteria are listed in the table below.

VAL-PFAS

Sample "CL1MC0100180509N" and the solid phase of sample "CL1CS0100180509N" were extracted and analyzed for a selected list of PFAS using VAL Method PFAS. The results for PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Results for all other analytes include the linear isomers only.

Sample "CL1MC0100180509N" built up pressure during storage and immediately expanded upon removing the lid. The sample was transferred to a large pan and homogenized prior to removing an aliquot for extraction.

Holding Times

The samples were extracted and analyzed within the hold times.

Quality Control

The Initial Calibration and Continuing Calibration Verifications met the method acceptance criteria.

A Method Blank and Ongoing Precision and Recovery (OPR) sample were extracted and analyzed with each preparation batch. In prep batch B8F0074, a concentration of 1.99 ng/g of 6:2 FTS was detected in the Method Blank. No other analytes were detected in the Method Blank above 1/2 of the LOQ concentrations. The recoveries of 6:2 FTS and MeFOSAA were 134% and 69.5% in the OPR. A concentration of 562 ng/g of 6:2 FTS was detected in the sample, which is greater than 10X the level detected in the Method Blank; the background concentration did not signifcantly affect the sample results. The recoveries of all other analytes within the method acceptance criteria. The sample was extracted twice, with similar results.

A Method Blank and Ongoing Precision and Recovery (OPR) sample were extracted and analyzed with preparation batch B8F0153. No analytes were detected in the Method Blank above 1/2 the LOQ. The recoveries of PFHpS and 8:2 FTS were greater than 130% in the OPR. These analytes were not detected in the samples. The recoveries of all other analytes were within the method acceptance criteria.

The labeled standard recoveries outside the acceptance criteria are listed in the table below.

QC Anomalies

LabNumber	SampleName	Analysis	Analyte	Flag	%Rec
1800935-01	WWTPEF0100180509N	PFAS Isotope Dilution Method	13C2-PFTeDA	H	49.1
1800935-02	WWTPSL0100180509N	PFAS Isotope Dilution Method	13C2-PFTeDA	H	35.4
1800935-04	WWTPWW0100180509N	PFAS Isotope Dilution Method	13C2-PFTeDA	H	27.5
1800935-05	WWTPSL0100180509N	VAL - PFAS	13C2-PFTeDA	H	40.8
1800935-06	WWTPSL0100180509N	VAL - PFAS	d3-MeFOSAA	H	39.2
1800935-06	WWTPSL0100180509N	VAL - PFAS	d5-EtFOSAA	H	43.4
B8E0190-BLK1	B8E0190-BLK1	PFAS Isotope Dilution Method	13C8-PFOSA	H	40.1
B8E0190-BS1	B8E0190-BS1	PFAS Isotope Dilution Method	13C8-PFOSA	H	42.0
B8F0074-BLK1	B8F0074-BLK1	VAL - PFAS	13C8-PFOSA	H	37.3
B8F0074-BS1	B8F0074-BS1	VAL - PFAS	13C8-PFOSA	H	35.8
B8F0153-BLK1	B8F0153-BLK1	VAL - PFAS	13C8-PFOSA	H	45.7
B8F0153-BS1	B8F0153-BS1	VAL - PFAS	13C8-PFOSA	H	46.2

H = Recovery was outside laboratory acceptance criteria.

TABLE OF CONTENTS

Sample Inventory Report

Vista Sample ID	Client Sample ID	Sampled	Received	Components/Containers
1800935-01	WWTPEF0100180509N WWTPEF0100180509N WWTPEF0100180509N	Effluent Sample 09-May-18 11:10	12-May-18 09:57	HDPE Bottle, 250 mL HDPE Bottle, 250 mL
1800935-02	WWTPSL0100180509N	Centrifuge - SLUDGE 09-May-18 11:35	12-May-18 09:57	HDPE Bottle, 250 mL HDPE Bottle, 250 mL
1800935-03	WWTPWW0100180509N	Centrifuge - Wastewater 09-May-18 11:40	12-May-18 09:57	HDPE Bottle, 250 mL HDPE Bottle, 250 mL
1800935-04	WWTPWW0100180509N	Man Hole near mixing cell - Wastewater 09-May-18 12:00	12-May-18 09:57	HDPE Bottle, 250 mL HDPE Bottle, 250 mL
1800935-05	WWTPSL0100180509N	Mixing Cell - SLUDGE 09-May-18 12:10	12-May-18 09:57	HDPE Bottle, 250 mL HDPE Bottle, 250 mL

Vista Project: 1800935 Client Project: Lapeer

ANALYTICAL RESULTS

Sample ID: Method Blank | **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Matrix: Aqueous
Project: Lapeer

Laboratory Data

Lab Sample: B8E0190-BLK1
Column: BEH C18

Analyte	CAS Number	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFPeA	2706-90-3	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFBS	375-73-5	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
4:2 FTS	757124-72-4	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFHxA	307-24-4	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFPeS	2706-91-4	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFHpA	375-85-9	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFHxS	355-46-4	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
6:2 FTS	27619-97-2	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFOA	335-67-1	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFHpS	375-92-8	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFNA	375-95-1	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFOSA	754-91-6	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFOS	1763-23-1	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFDA	335-76-2	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
8:2 FTS	39108-34-4	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFNS	68259-12-1	ND	0.715	0.750	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
MeFOSAA	2355-31-9	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
EtFOSAA	2991-50-6	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFUnA	2058-94-8	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFDS	335-77-3	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFDoA	307-55-1	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFTrDA	72629-94-8	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
PFTeDA	376-06-7	ND	0.423	0.500	1.00		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	96.6	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C3-PFPeA	IS	95.4	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C3-PFBS	IS	105	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C2-4:2 FTS	IS	96.3	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C2-PFHxA	IS	93.0	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C4-PFHpA	IS	98.1	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
18O2-PFHxS	IS	97.3	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C2-6:2 FTS	IS	87.3	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C2-PFOA	IS	87.2	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C5-PFNA	IS	96.2	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C8-PFOSA	IS	40.1	50 - 150	H	B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C8-PFOS	IS	93.3	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C2-PFDA	IS	73.0	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1

Sample ID: Method Blank | **PFAS Isotope Dilution Method**

Client Data				**Laboratory Data**			
Name:	Merit Laboratories, Inc.	Matrix:	Aqueous	Lab Sample:	B8E0190-BLK1	Column:	BEH C18
Project:	Lapeer						

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-8:2 FTS	IS	84.2	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
d3-MeFOSAA	IS	68.7	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
d5-EtFOSAA	IS	65.8	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C2-PFUnA	IS	67.6	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C2-PFDoA	IS	53.5	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1
13C2-PFTeDA	IS	60.1	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:28	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: OPR | **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Lapeer
Matrix: Aqueous

Laboratory Data

Lab Sample: B8E0190-BS1
Column: BEH C18

Analyte	CAS Number	Amt Found (ng/L)	Spike Amt	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	40.7	40.0	102	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFPeA	2706-90-3	39.8	40.0	99.5	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFBS	375-73-5	39.5	40.0	98.7	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
4:2 FTS	757124-72-4	38.1	40.0	95.2	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFHxA	307-24-4	39.5	40.0	98.8	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFPeS	2706-91-4	39.9	40.0	99.6	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFHpA	375-85-9	40.2	40.0	101	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFHxS	355-46-4	46.1	40.0	115	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
6:2 FTS	27619-97-2	43.2	40.0	108	60 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFOA	335-67-1	43.0	40.0	108	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFHpS	375-92-8	43.7	40.0	109	60 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFNA	375-95-1	44.6	40.0	112	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFOSA	754-91-6	37.8	40.0	94.5	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFOS	1763-23-1	36.6	40.0	91.5	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFDA	335-76-2	45.7	40.0	114	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
8:2 FTS	39108-34-4	41.4	40.0	104	60 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFNS	68259-12-1	35.2	40.0	87.9	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
MeFOSAA	2355-31-9	32.5	40.0	81.2	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
EtFOSAA	2991-50-6	35.3	40.0	88.3	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFUnA	2058-94-8	41.4	40.0	103	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFDS	335-77-3	40.5	40.0	101	60 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFDoA	307-55-1	42.2	40.0	105	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFTrDA	72629-94-8	42.3	40.0	106	60 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
PFTeDA	376-06-7	47.3	40.0	118	70 - 130		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	96.1	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C3-PFPeA	IS	97.6	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C3-PFBS	IS	108	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C2-4:2 FTS	IS	93.5	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C2-PFHxA	IS	93.8	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C4-PFHpA	IS	104	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
18O2-PFHxS	IS	98.1	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C2-6:2 FTS	IS	81.3	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C2-PFOA	IS	82.7	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C5-PFNA	IS	67.9	50- 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1

Sample ID: OPR | **PFAS Isotope Dilution Method**

Client Data				**Laboratory Data**			
Name:	Merit Laboratories, Inc.	Matrix:	Aqueous	Lab Sample:	B8E0190-BS1	Column:	BEH C18
Project:	Lapeer						

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C8-PFOSA	IS	42.0	50 - 150	H	B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C8-PFOS	IS	99.0	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C2-PFDA	IS	78.3	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C2-8:2 FTS	IS	84.9	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
d3-MeFOSAA	IS	80.1	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
d5-EtFOSAA	IS	79.0	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C2-PFUnA	IS	79.7	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C2-PFDoA	IS	73.4	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1
13C2-PFTeDA	IS	67.7	50 - 150		B8E0190	23-May-18	0.250 L	30-May-18 06:18	1

Sample ID: WWTPEF0100180509N | **PFAS Isotope Dilution Method**

Client Data

Name: Merit Laboratories, Inc.
Project: Lapeer
Location: WWTP-EFF

Matrix: Effluent
Date Collected: 09-May-18 15:05

Laboratory Data

Lab Sample: 1800935-01
Date Received: 12-May-18 09:57
Column: BEH C18

Analyte	CAS Number	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	29.3	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFPeA	2706-90-3	81.4	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFBS	375-73-5	7.46	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
4:2 FTS	757124-72-4	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFHxA	307-24-4	90.8	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFPeS	2706-91-4	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFHpA	375-85-9	122	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFHxS	355-46-4	1.32	1.32	1.93	3.86	J	B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
6:2 FTS	27619-97-2	8.13	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFOA	335-67-1	5.03	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFHpS	375-92-8	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFNA	375-95-1	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFOSA	754-91-6	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFOS	1763-23-1	28.7	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFDA	335-76-2	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
8:2 FTS	39108-34-4	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFNS	68259-12-1	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
MeFOSAA	2355-31-9	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
EtFOSAA	2991-50-6	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFUnA	2058-94-8	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFDS	335-77-3	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFDoA	307-55-1	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFTrDA	72629-94-8	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
PFTeDA	376-06-7	ND	1.32	1.93	3.86		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	102	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C3-PFPeA	IS	101	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C3-PFBS	IS	119	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C2-4:2 FTS	IS	95.4	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C2-PFHxA	IS	98.1	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C4-PFHpA	IS	114	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
18O2-PFHxS	IS	96.6	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C2-6:2 FTS	IS	81.6	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C2-PFOA	IS	92.9	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C5-PFNA	IS	87.7	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C8-PFOSA	IS	54.0	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C8-PFOS	IS	112	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C2-PFDA	IS	89.0	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1

Sample ID: WWTPEF0100180509N

PFAS Isotope Dilution Method

Client Data				**Laboratory Data**			
Name:	Merit Laboratories, Inc.	Matrix:	Effluent	Lab Sample:	1800935-01	Column:	BEH C18
Project:	Lapeer	Date Collected:	09-May-18 15:05	Date Received:	12-May-18 09:57		
Location:	WWTP-EFF						

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-8:2 FTS	IS	95.0	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
d3-MeFOSAA	IS	82.9	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
d5-EtFOSAA	IS	92.8	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C2-PFUnA	IS	69.1	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C2-PFDoA	IS	72.5	50 - 150		B8E0190	23-May-18	0.259 L	30-May-18 06:39	1
13C2-PFTeDA	IS	49.1	50 - 150	H	B8E0190	23-May-18	0.259 L	30-May-18 06:39	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: WWTPSL0100180509N **PFAS Isotope Dilution Method**

Client Data				Laboratory Data			
Name:	Merit Laboratories, Inc.	Matrix:	Sludge	Lab Sample:	1800935-02	Column:	BEH C18
Project:	Lapeer	Date Collected:	09-May-18 15:45	Date Received:	12-May-18 09:57		
Location:	WWTP-Centrifuge						

Analyte	CAS Number	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	141	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFPeA	2706-90-3	275	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFBS	375-73-5	12.1	9.39	13.7	27.4	J	B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
4:2 FTS	757124-72-4	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFHxA	307-24-4	462	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFPeS	2706-91-4	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFHpA	375-85-9	415	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFHxS	355-46-4	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
6:2 FTS	27619-97-2	102	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFOA	335-67-1	55.7	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFHpS	375-92-8	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFNA	375-95-1	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFOSA	754-91-6	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFOS	1763-23-1	182	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFDA	335-76-2	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
8:2 FTS	39108-34-4	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFNS	68259-12-1	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
MeFOSAA	2355-31-9	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
EtFOSAA	2991-50-6	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFUnA	2058-94-8	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFDS	335-77-3	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFDoA	307-55-1	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFTrDA	72629-94-8	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
PFTeDA	376-06-7	ND	9.39	13.7	27.4		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	99.3	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C3-PFPeA	IS	96.3	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C3-PFBS	IS	104	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C2-4:2 FTS	IS	95.1	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C2-PFHxA	IS	91.5	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C4-PFHpA	IS	101	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
18O2-PFHxS	IS	89.9	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C2-6:2 FTS	IS	90.4	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C2-PFOA	IS	82.4	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C5-PFNA	IS	81.5	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C8-PFOSA	IS	58.9	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C8-PFOS	IS	75.6	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C2-PFDA	IS	70.0	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1

Sample ID: WWTPSL0100180509N | **PFAS Isotope Dilution Method**

Client Data				**Laboratory Data**			
Name:	Merit Laboratories, Inc.	Matrix:	Sludge	Lab Sample:	1800935-02	Column:	BEH C18
Project:	Lapeer	Date Collected:	09-May-18 15:45	Date Received:	12-May-18 09:57		
Location:	WWTP-Centrifuge						

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-8:2 FTS	IS	78.6	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
d3-MeFOSAA	IS	60.0	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
d5-EtFOSAA	IS	67.7	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C2-PFUnA	IS	70.2	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C2-PFDoA	IS	54.5	50 - 150		B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1
13C2-PFTeDA	IS	35.4	50 - 150	H	B8E0190	23-May-18	0.0365 L	30-May-18 06:49	1

DL - Detection Limit

LOD - Limit of Detection

LOQ - Limit of quantitation

Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: WWTPWW0100180509N **PFAS Isotope Dilution Method**

Client Data				**Laboratory Data**			
Name:	Merit Laboratories, Inc.	Matrix:	Wastewater	Lab Sample:	1800935-03	Column:	BEH C18
Project:	Lapeer	Date Collected:	09-May-18 16:15	Date Received:	12-May-18 09:57		
Location:	WWTP-Centrifuge						

Analyte	CAS Number	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	39.5	17.0	24.9	49.8	J	B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFPeA	2706-90-3	134	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFBS	375-73-5	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
4:2 FTS	757124-72-4	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFHxA	307-24-4	204	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFPeS	2706-91-4	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFHpA	375-85-9	171	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFHxS	355-46-4	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
6:2 FTS	27619-97-2	269	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFOA	335-67-1	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFHpS	375-92-8	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFNA	375-95-1	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFOSA	754-91-6	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFOS	1763-23-1	48.4	17.0	24.9	49.8	J	B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFDA	335-76-2	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
8:2 FTS	39108-34-4	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFNS	68259-12-1	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
MeFOSAA	2355-31-9	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
EtFOSAA	2991-50-6	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFUnA	2058-94-8	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFDS	335-77-3	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFDoA	307-55-1	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFTrDA	72629-94-8	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
PFTeDA	376-06-7	ND	17.0	24.9	49.8		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	93.2	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C3-PFPeA	IS	92.1	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C3-PFBS	IS	106	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C2-4:2 FTS	IS	84.9	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C2-PFHxA	IS	92.5	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C4-PFHpA	IS	87.0	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
18O2-PFHxS	IS	98.0	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C2-6:2 FTS	IS	86.1	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C2-PFOA	IS	66.5	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C5-PFNA	IS	66.8	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C8-PFOSA	IS	57.2	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C8-PFOS	IS	80.3	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C2-PFDA	IS	87.9	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1

Sample ID: WWTPWW0100180509N | **PFAS Isotope Dilution Method**

Client Data				**Laboratory Data**			
Name:	Merit Laboratories, Inc.	Matrix:	Wastewater	Lab Sample:	1800935-03	Column:	BEH C18
Project:	Lapeer	Date Collected:	09-May-18 16:15	Date Received:	12-May-18 09:57		
Location:	WWTP-Centrifuge						

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-8:2 FTS	IS	89.2	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
d3-MeFOSAA	IS	93.4	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
d5-EtFOSAA	IS	91.3	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C2-PFUnA	IS	73.3	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C2-PFDoA	IS	78.8	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1
13C2-PFTeDA	IS	72.2	50 - 150		B8E0190	23-May-18	0.0201 L	30-May-18 07:00	1

DL - Detection Limit

LOD - Limit of Detection

LOQ - Limit of quantitation

Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: WWTPWW0100180509N | **PFAS Isotope Dilution Method**

Client Data			
Name:	Merit Laboratories, Inc.	Matrix:	Wastewater
Project:	Lapeer	Date Collected:	09-May-18 16:30
Location:	WWTP-ManHole-MC		

Laboratory Data			
Lab Sample:	1800935-04	Column:	BEH C18
Date Received:	12-May-18 09:57		

Analyte	CAS Number	Conc. (ng/L)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	294	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFPeA	2706-90-3	959	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFBS	375-73-5	18.2	17.0	24.8	49.6	J	B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
4:2 FTS	757124-72-4	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFHxA	307-24-4	1400	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFPeS	2706-91-4	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFHpA	375-85-9	757	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFHxS	355-46-4	17.7	17.0	24.8	49.6	J	B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
6:2 FTS	27619-97-2	1910	84.9	124	248	D	B8E0190	23-May-18	0.0202 L	02-Jun-18 18:29	5
PFOA	335-67-1	91.6	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFHpS	375-92-8	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFNA	375-95-1	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFOSA	754-91-6	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFOS	1763-23-1	3180	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFDA	335-76-2	17.1	17.0	24.8	49.6	J	B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
8:2 FTS	39108-34-4	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFNS	68259-12-1	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
MeFOSAA	2355-31-9	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
EtFOSAA	2991-50-6	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFUnA	2058-94-8	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFDS	335-77-3	41.0	17.0	24.8	49.6	J	B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFDoA	307-55-1	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFTrDA	72629-94-8	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
PFTeDA	376-06-7	ND	17.0	24.8	49.6		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	96.1	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C3-PFPeA	IS	90.9	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C3-PFBS	IS	99.1	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C2-4:2 FTS	IS	87.9	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C2-PFHxA	IS	93.4	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C4-PFHpA	IS	93.8	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
18O2-PFHxS	IS	90.9	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C2-6:2 FTS	IS	97.7	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C2-PFOA	IS	79.4	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C5-PFNA	IS	78.7	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C8-PFOSA	IS	51.1	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C8-PFOS	IS	84.8	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C2-PFDA	IS	83.6	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1

Sample ID: WWTPWW0100180509N | **PFAS Isotope Dilution Method**

Client Data

Name:	Merit Laboratories, Inc.	Matrix:	Wastewater
Project:	Lapeer	Date Collected:	09-May-18 16:30
Location:	WWTP-ManHole-MC		

Laboratory Data

Lab Sample:	1800935-04	Column:	BEH C18
Date Received:	12-May-18 09:57		

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-8:2 FTS	IS	80.4	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
d3-MeFOSAA	IS	70.5	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
d5-EtFOSAA	IS	62.8	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C2-PFUnA	IS	59.4	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C2-PFDoA	IS	56.0	50 - 150		B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1
13C2-PFTeDA	IS	27.5	50 - 150	H	B8E0190	23-May-18	0.0202 L	30-May-18 07:10	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Vista Analytical Laboratory

Sample ID: Method Blank | **VAL - PFAS**

Client Data
Name: Merit Laboratories, Inc. — Matrix: Solid
Project: Lapeer

Laboratory Data
Lab Sample: B8F0074-BLK1 — Column: BEH C18

Analyte	CAS Number	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFPeA	2706-90-3	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFBS	375-73-5	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
4:2 FTS	757124-72-4	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFHxA	307-24-4	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFPeS	2706-91-4	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFHpA	375-85-9	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFHxS	355-46-4	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
6:2 FTS	27619-97-2	1.99	0.845	1.00	2.00	J	B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFOA	335-67-1	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFHpS	375-92-8	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFNA	375-95-1	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFOSA	754-91-6	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFOS	1763-23-1	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFDA	335-76-2	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
8:2 FTS	39108-34-4	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFNS	68259-12-1	ND	1.43	1.50	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
MeFOSAA	2355-31-9	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
EtFOSAA	2991-50-6	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFUnA	2058-94-8	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFDS	335-77-3	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFDoA	307-55-1	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFTrDA	72629-94-8	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
PFTeDA	376-06-7	ND	0.845	1.00	2.00		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	93.7	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C3-PFPeA	IS	85.9	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C3-PFBS	IS	98.7	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C2-4:2 FTS	IS	85.1	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C2-PFHxA	IS	88.2	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C4-PFHpA	IS	84.9	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
18O2-PFHxS	IS	96.1	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C2-6:2 FTS	IS	86.0	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C2-PFOA	IS	79.0	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C5-PFNA	IS	86.8	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C8-PFOSA	IS	37.3	50 - 150	H	B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C8-PFOS	IS	98.4	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C2-PFDA	IS	73.0	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1

Sample ID: Method Blank **VAL - PFAS**

Client Data				Laboratory Data			
Name:	Merit Laboratories, Inc.	Matrix:	Solid	Lab Sample:	B8F0074-BLK1	Column:	BEH C18
Project:	Lapeer						

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-8:2 FTS	IS	90.6	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
d3-MeFOSAA	IS	83.8	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
d5-EtFOSAA	IS	79.9	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C2-PFUnA	IS	81.7	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C2-PFDoA	IS	72.1	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1
13C2-PFTeDA	IS	75.4	50 - 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:23	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: OPR VAL - PFAS

Client Data				Laboratory Data			
Name:	Merit Laboratories, Inc.	Matrix:	Solid	Lab Sample:	B8F0074-BS1	Column:	BEH C18
Project:	Lapeer						

Analyte	CAS Number	Amt Found (ng/g)	Spike Amt	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	8.61	10.0	86.1	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFPeA	2706-90-3	8.90	10.0	89.0	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFBS	375-73-5	8.84	10.0	88.4	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
4:2 FTS	757124-72-4	8.77	10.0	87.7	60 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFHxA	307-24-4	9.29	10.0	92.9	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFPeS	2706-91-4	9.64	10.0	96.4	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFHpA	375-85-9	8.86	10.0	88.6	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFHxS	355-46-4	8.72	10.0	87.2	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
6:2 FTS	27619-97-2	13.4	10.0	134	60 - 130	B, H	B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFOA	335-67-1	10.2	10.0	102	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFHpS	375-92-8	9.49	10.0	94.9	60 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFNA	375-95-1	8.13	10.0	81.3	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFOSA	754-91-6	8.61	10.0	86.1	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFOS	1763-23-1	7.48	10.0	74.8	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFDA	335-76-2	9.13	10.0	91.3	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
8:2 FTS	39108-34-4	9.29	10.0	92.9	60 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFNS	68259-12-1	7.73	10.0	77.3	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
MeFOSAA	2355-31-9	6.95	10.0	69.5	70 - 130	H	B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
EtFOSAA	2991-50-6	9.82	10.0	98.2	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFUnA	2058-94-8	8.81	10.0	88.1	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFDS	335-77-3	9.12	10.0	91.2	60 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFDoA	307-55-1	8.63	10.0	86.3	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFTrDA	72629-94-8	9.51	10.0	95.1	60 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
PFTeDA	376-06-7	8.28	10.0	82.8	70 - 130		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	100	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C3-PFPeA	IS	96.2	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C3-PFBS	IS	106	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C2-4:2 FTS	IS	106	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C2-PFHxA	IS	97.8	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C4-PFHpA	IS	95.5	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
18O2-PFHxS	IS	100	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C2-6:2 FTS	IS	92.6	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C2-PFOA	IS	87.7	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C5-PFNA	IS	80.1	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1

Sample ID: OPR **VAL - PFAS**

Client Data			
Name:	Merit Laboratories, Inc.	Matrix:	Solid
Project:	Lapeer		

Laboratory Data			
Lab Sample:	B8F0074-BS1	Column:	BEH C18

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C8-PFOSA	IS	35.8	50- 150	H	B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C8-PFOS	IS	102	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C2-PFDA	IS	83.0	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C2-8:2 FTS	IS	108	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
d3-MeFOSAA	IS	72.3	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
d5-EtFOSAA	IS	61.8	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C2-PFUnA	IS	76.8	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C2-PFDoA	IS	76.7	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1
13C2-PFTeDA	IS	79.1	50- 150		B8F0074	11-Jun-18	1.00 g	15-Jun-18 13:13	1

Sample ID: WWTPSL0100180509N **VAL - PFAS**

Client Data				Laboratory Data			
Name:	Merit Laboratories, Inc.	Matrix:	Sludge	Lab Sample:	1800935-05	Column:	BEH C18
Project:	Lapeer	Date Collected:	09-May-18 17:05	Date Received:	12-May-18 09:57		
Location:	WWTP-Mixing Cell			% Solids:	4.98		

Analyte	CAS Number	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	8.73	5.58	6.61	13.2	J	B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFPeA	2706-90-3	26.0	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFBS	375-73-5	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
4:2 FTS	757124-72-4	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFHxA	307-24-4	48.0	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFPeS	2706-91-4	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFHpA	375-85-9	14.8	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFHxS	355-46-4	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
6:2 FTS	27619-97-2	562	5.58	6.61	13.2	B	B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFOA	335-67-1	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFHpS	375-92-8	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFNA	375-95-1	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFOSA	754-91-6	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFOS	1763-23-1	1680	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFDA	335-76-2	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
8:2 FTS	39108-34-4	8.51	5.58	6.61	13.2	J	B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFNS	68259-12-1	ND	9.45	9.91	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
MeFOSAA	2355-31-9	9.86	5.58	6.61	13.2	J	B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
EtFOSAA	2991-50-6	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFUnA	2058-94-8	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFDS	335-77-3	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFDoA	307-55-1	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFTrDA	72629-94-8	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
PFTeDA	376-06-7	ND	5.58	6.61	13.2		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	94.4	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C3-PFPeA	IS	93.9	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C3-PFBS	IS	99.5	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C2-4:2 FTS	IS	90.7	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C2-PFHxA	IS	95.5	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C4-PFHpA	IS	96.2	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
18O2-PFHxS	IS	94.0	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C2-6:2 FTS	IS	95.2	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C2-PFOA	IS	90.0	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C5-PFNA	IS	87.9	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C8-PFOSA	IS	59.1	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C8-PFOS	IS	90.9	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C2-PFDA	IS	94.6	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1

Sample ID: WWTPSL0100180509N | **VAL - PFAS**

Client Data				**Laboratory Data**			
Name:	Merit Laboratories, Inc.	Matrix:	Sludge	Lab Sample:	1800935-05	Column:	BEH C18
Project:	Lapeer	Date Collected:	09-May-18 17:05	Date Received:	12-May-18 09:57		
Location:	WWTP-Mixing Cell			% Solids:	4.98		

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-8:2 FTS	IS	130	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
d3-MeFOSAA	IS	67.7	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
d5-EtFOSAA	IS	73.8	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C2-PFUnA	IS	81.7	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C2-PFDoA	IS	84.8	50 - 150		B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1
13C2-PFTeDA	IS	40.8	50 - 150	H	B8F0074	11-Jun-18	3.04 g	15-Jun-18 13:34	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: Blank **VAL - PFAS**

Client Data				**Laboratory Data**			
Name:	Merit Laboratories, Inc.	Matrix:	Solid	Lab Sample:	B8F0153-BLK1	Column:	BEH C18
Project:	Lapeer						

Analyte	CAS Number	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFPeA	2706-90-3	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFBS	375-73-5	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
4:2 FTS	757124-72-4	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFHxA	307-24-4	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFPeS	2706-91-4	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFHpA	375-85-9	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFHxS	355-46-4	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
6:2 FTS	27619-97-2	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFOA	335-67-1	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFHpS	375-92-8	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFNA	375-95-1	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFOSA	754-91-6	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFOS	1763-23-1	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFDA	335-76-2	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
8:2 FTS	39108-34-4	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFNS	68259-12-1	ND	1.43	1.50	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
MeFOSAA	2355-31-9	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
EtFOSAA	2991-50-6	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFUnA	2058-94-8	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFDS	335-77-3	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFDoA	307-55-1	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFTrDA	72629-94-8	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
PFTeDA	376-06-7	ND	0.845	1.00	2.00		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	93.2	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C3-PFPeA	IS	91.3	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C3-PFBS	IS	103	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C2-4:2 FTS	IS	86.0	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C2-PFHxA	IS	85.7	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C4-PFHpA	IS	86.9	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
18O2-PFHxS	IS	92.9	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C2-6:2 FTS	IS	82.5	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C2-PFOA	IS	75.6	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C5-PFNA	IS	78.7	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C8-PFOSA	IS	45.7	50 - 150	H	B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C8-PFOS	IS	104	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C2-PFDA	IS	56.2	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1

Sample ID: Blank

VAL - PFAS

Client Data

Name: Merit Laboratories, Inc.
Project: Lapeer
Matrix: Solid

Laboratory Data

Lab Sample: B8F0153-BLK1
Column: BEH C18

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-8:2 FTS	IS	76.5	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
d3-MeFOSAA	IS	86.6	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
d5-EtFOSAA	IS	90.5	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C2-PFUnA	IS	63.7	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C2-PFDoA	IS	64.3	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1
13C2-PFTeDA	IS	61.9	50 - 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:28	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

Sample ID: LCS **VAL - PFAS**

Client Data

Name: Merit Laboratories, Inc.
Project: Lapeer
Matrix: Solid

Laboratory Data

Lab Sample: B8F0153-BS1
Column: BEH C18

Analyte	CAS Number	Amt Found (ng/g)	Spike Amt	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	11.1	10.0	111	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFPeA	2706-90-3	11.3	10.0	113	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFBS	375-73-5	11.8	10.0	118	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
4:2 FTS	757124-72-4	11.0	10.0	110	60 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFHxA	307-24-4	11.7	10.0	117	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFPeS	2706-91-4	12.3	10.0	123	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFHpA	375-85-9	11.3	10.0	113	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFHxS	355-46-4	12.2	10.0	122	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
6:2 FTS	27619-97-2	11.8	10.0	118	60 - 130		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:18	1
PFOA	335-67-1	12.8	10.0	128	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFHpS	375-92-8	13.7	10.0	137	60 - 130	H	B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFNA	375-95-1	10.4	10.0	104	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFOSA	754-91-6	10.0	10.0	100	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFOS	1763-23-1	10.7	10.0	107	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFDA	335-76-2	7.56	10.0	75.6	70 - 130		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:18	1
8:2 FTS	39108-34-4	15.1	10.0	151	60 - 130	H	B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFNS	68259-12-1	10.7	10.0	107	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
MeFOSAA	2355-31-9	10.4	10.0	104	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
EtFOSAA	2991-50-6	8.60	10.0	86.0	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFUnA	2058-94-8	11.0	10.0	110	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFDS	335-77-3	11.3	10.0	113	60 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFDoA	307-55-1	11.1	10.0	111	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFTrDA	72629-94-8	9.67	10.0	96.7	60 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
PFTeDA	376-06-7	12.1	10.0	121	70 - 130		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	88.0	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C3-PFPeA	IS	84.8	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C3-PFBS	IS	97.0	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C2-4:2 FTS	IS	92.5	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C2-PFHxA	IS	77.7	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C4-PFHpA	IS	80.5	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
18O2-PFHxS	IS	79.1	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C2-6:2 FTS	IS	74.9	50- 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:18	1
13C2-PFOA	IS	67.7	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C5-PFNA	IS	74.8	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1

Sample ID: LCS **VAL - PFAS**

Client Data

Name: Merit Laboratories, Inc.
Project: Lapeer
Matrix: Solid

Laboratory Data

Lab Sample: B8F0153-BS1
Column: BEH C18

Labeled Standards	Type	% Rec	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C8-PFOSA	IS	46.2	50- 150	H	B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C8-PFOS	IS	89.7	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C2-PFDA	IS	57.2	50- 150		B8F0153	20-Jun-18	1.00 g	23-Jun-18 07:18	1
13C2-8:2 FTS	IS	89.9	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
d3-MeFOSAA	IS	68.2	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
d5-EtFOSAA	IS	82.0	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C2-PFUnA	IS	66.3	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C2-PFDoA	IS	76.9	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1
13C2-PFTeDA	IS	67.5	50- 150		B8F0153	20-Jun-18	1.00 g	25-Jun-18 18:31	1

Vista Analytical Laboratory

Sample ID: WWTPSL0100180509N **VAL - PFAS**

Client Data				Laboratory Data			
Name:	Merit Laboratories, Inc.	Matrix:	Solid	Lab Sample:	1800935-06	Column:	BEH C18
Project:	Lapeer	Date Collected:	09-May-18 15:45	Date Received:	12-May-18 09:57		
Location:	WWTP-Centrifuge			% Solids:	7.78		

Analyte	CAS Number	Conc. (ng/g)	DL	LOD	LOQ	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
PFBA	375-22-4	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFPeA	2706-90-3	5.82	3.51	4.16	8.32	J	B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFBS	375-73-5	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
4:2 FTS	757124-72-4	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFHxA	307-24-4	13.2	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFPeS	2706-91-4	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFHpA	375-85-9	15.4	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFHxS	355-46-4	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
6:2 FTS	27619-97-2	7.41	3.51	4.16	8.32	J	B8F0153	20-Jun-18	3.09 g	23-Jun-18 07:49	1
PFOA	335-67-1	4.34	3.51	4.16	8.32	J	B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFHpS	375-92-8	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFNA	375-95-1	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFOSA	754-91-6	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFOS	1763-23-1	161	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFDA	335-76-2	3.94	3.51	4.16	8.32	J	B8F0153	20-Jun-18	3.09 g	23-Jun-18 07:49	1
8:2 FTS	39108-34-4	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFNS	68259-12-1	ND	5.95	6.24	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
MeFOSAA	2355-31-9	5.89	3.51	4.16	8.32	J	B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
EtFOSAA	2991-50-6	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFUnA	2058-94-8	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFDS	335-77-3	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFDoA	307-55-1	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFTrDA	72629-94-8	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
PFTeDA	376-06-7	ND	3.51	4.16	8.32		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C3-PFBA	IS	87.9	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C3-PFPeA	IS	83.5	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C3-PFBS	IS	91.7	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C2-4:2 FTS	IS	80.6	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C2-PFHxA	IS	80.5	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C4-PFHpA	IS	90.1	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
18O2-PFHxS	IS	84.5	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C2-6:2 FTS	IS	85.3	50 - 150		B8F0153	20-Jun-18	3.09 g	23-Jun-18 07:49	1
13C2-PFOA	IS	82.4	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C5-PFNA	IS	87.7	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C8-PFOSA	IS	55.0	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C8-PFOS	IS	85.2	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C2-PFDA	IS	70.7	50 - 150		B8F0153	20-Jun-18	3.09 g	23-Jun-18 07:49	1

Sample ID: WWTPSL0100180509N | **VAL - PFAS**

Client Data				**Laboratory Data**			
Name:	Merit Laboratories, Inc.	Matrix:	Solid	Lab Sample:	1800935-06	Column:	BEH C18
Project:	Lapeer	Date Collected:	09-May-18 15:45	Date Received:	12-May-18 09:57		
Location:	WWTP-Centrifuge			% Solids:	7.78		

Labeled Standards	Type	% Recovery	Limits	Qualifiers	Batch	Extracted	Samp Size	Analyzed	Dilution
13C2-8:2 FTS	IS	104	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
d3-MeFOSAA	IS	39.2	50 - 150	H	B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
d5-EtFOSAA	IS	43.4	50 - 150	H	B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C2-PFUnA	IS	73.1	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C2-PFDoA	IS	79.2	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1
13C2-PFTeDA	IS	55.4	50 - 150		B8F0153	20-Jun-18	3.09 g	25-Jun-18 18:41	1

DL - Detection Limit

LOD - Limit of Detection
LOQ - Limit of quantitation

The results are reported in dry weight.
The sample size is reported in wet weight.
Results reported to the DL.

When reported, PFHxS, PFOA, PFOS, MeFOSAA and EtFOSAA include both linear and branched isomers. Only the linear isomer is reported for all other analytes.

DATA QUALIFIERS & ABBREVIATIONS

B	**This compound was also detected in the method blank**
Conc.	**Concentration**
D	**Dilution**
DL	**Detection limit**
E	**The associated compound concentration exceeded the calibration range of the instrument**
H	**Recovery and/or RPD was outside laboratory acceptance limits**
I	**Chemical Interference**
J	**The amount detected is below the Reporting Limit/LOQ**
LOD	**Limits of Detection**
LOQ	**Limits of Quantitation**
M	**Estimated Maximum Possible Concentration (CA Region 2 projects only)**
NA	**Not applicable**
ND	**Not Detected**
Q	**Ion ratio outside of 70-130% of Standard Ratio. (DOD PFAS projects only)**
TEQ	**Toxic Equivalency**
U	**Not Detected (specific projects only)**
*****	**See Cover Letter**

Unless otherwise noted, solid sample results are reported in dry weight. Tissue samples are reported in wet weight.

CERTIFICATIONS

Accrediting Authority	Certificate Number
Alaska Department of Environmental Conservation	17-013
Arkansas Department of Environmental Quality	17-015-0
California Department of Health – ELAP	2892
DoD ELAP - A2LA Accredited - ISO/IEC 17025:2005	3091.01
Florida Department of Health	E87777-18
Hawaii Department of Health	N/A
Louisiana Department of Environmental Quality	01977
Maine Department of Health	2016026
Minnesota Department of Health	1322288
New Hampshire Environmental Accreditation Program	207717
New Jersey Department of Environmental Protection	CA003
New York Department of Health	11411
Oregon Laboratory Accreditation Program	4042-008
Pennsylvania Department of Environmental Protection	014
Texas Commission on Environmental Quality	T104704189-17-8
Virginia Department of General Services	9077
Washington Department of Ecology	C584
Wisconsin Department of Natural Resources	998036160

Current certificates and lists of licensed parameters are located in the Quality Assurance office and are available upon request.

Revised COC - received from client 6/19/18 (initials)

Vista Analytical Laboratory

CHAIN OF CUSTODY

For Laboratory Use Only
Work Order #: 1800935 Temp: ___ °C
Storage ID: ___ Storage Secured: Yes ☐ No ☐

TAT (check one): Standard: [x] 21 days; Rush (surcharge may apply) ☐ 14 days ☐ 7 days Specify: ___

Project ID: Lapeer PFAS Biosolids Investigation PO#: 60570635 Sampler: Stan Krenz (name)

Invoice to: Name	Company	Address	City	State	Ph#	Fax#
Stephanie Kammer	MDEQ	525 W. Allegan Street	Lansing	MI	517-897-1597	517-241-3571

Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time
Dorin Bogdan (signature)	5/16/2018	17:30			

SHIP TO: Vista Analytical Laboratory
1104 Windfield Way
El Dorado Hills, CA 95762
Ph: (916) 673-1520; Fax: (916) 673-0106

ATTN: Jennifer Miller

Method of Shipment: ~~FED EX~~
Tracking No.:

Add Analysis(es) Requested: PFAS Isotope Dilution; USEPA Method 537

Sample ID	Date	Time	Location/Sample Description	Quantity	Type	Matrix	List of 21	List of 21 w/Isomers	List of 24	List of 24 w/Isomers	List of 28	Other: Please List Below	PFOA/ PFOS	UCMR3 PFAS List:6	PFAS List: 14	Comments
WWTPEF0100180509N	5/9/18	1505	WWTP-EFF	2	P	EF			X							Effluent Sample
WWTPSL0100180509N	5/9/18	1545	WWTP-Centrifuge	2	P	SL			X							Centrifuge - SLUDGE
WWTPWW0100180509N	5/9/18	1615	WWTP-Centrifuge	2	P	WW			X							Centrifuge - Wastewater
WWTPWW0100180509N	5/9/18	1630	WWTP-ManHole-MC	2	P	WW			X							Man Hole near mixing cell - Wastewater
WWTPSL0100180509N	5/9/18	1705	WWTP-Mixing Cell	2	P	SL			X							Mixing Cell - SLUDGE

Special Instructions/Comments: Send Results and Acknowledgements to the list provided by e-mail to Vista.

SEND DOCUMENTATION AND RESULTS TO:
Name: Stephanie Kammer
Company: MDEQ
Address: 525 W. Allegan Street
City: Lansing State: MI Zip: 48909
Phone: 517-897-1597 Fax: 517-241-3571
Email: dorin.bogdan@aecom.com

Container Types: P= HDPE, PJ= HDPE Jar, O = Other: ___

Bottle Preservation Type: T = Thiosulfate, TZ = Trizma: ___

Matrix Types: AQ = Aqueous, DW = Drinking Water, EF = Effluent, PP = Pulp/Paper, SD = Sediment, SL = Sludge, SO = Soil, WW = Wastewater, B = Blood/Serum, O = Other: ___

Vista Analytical Laboratory

CHAIN OF CUSTODY

For Laboratory Use Only
Work Order #: 1800935 Temp: 1.9 °C
Storage ID: WR-2 Storage Secured: Yes [X] No [ ]

TAT (check one): Standard: [x] 21 days
Rush (surcharge may apply) [ ] 14 days [ ] 7 days Specify: ____

Project ID: **Lapeer** PO#: **60570635** Sampler: **Stan Krenz** (name)

Invoice to:	Name	Company	Address	City	State	Ph#	Fax#
	Stephanie Kammer	**MDEQ**	**525 W. Allegan Street**	**Lansing**	**MI**	**517-897-1597**	**517-241-3571**

Relinquished by (printed name and signature)	Date	Time	Received by (printed name and signature)	Date	Time
Stan Krenz [signature]	5-11-18	1245	Bettina Benedict [signature]	05/12/18	1030

SHIP TO: Vista Analytical Laboratory
1104 Windfield Way
El Dorado Hills, CA 95762
Ph: (916) 673-1520; Fax: (916) 673-0106

ATTN: Jennifer Miller

Method of Shipment: FED EX

Tracking No.:

Add Analysis(es) Requested: PFAS Isotope Dilution; USEPA Method 537

Sample ID	Date	Time	Location/Sample Description	Quantity	Type	Matrix	List of 21	List of 21 w/Isomers	List of 24	List of 24 w/Isomers	List of 28	Other: Please List Below	PFOA/PFOS	UCMR3 PFAS List:6	PFAS List: 14	Comments
CL1EF0100180509N	5/9/18	1110	Lapeer	2	P	EF			X							
CL1CS0100180509N	5/9/18	1135	Lapeer	2	P	SL			X							Centrifuge Soil
CL1CW0100180509N	5/9/18	1140	Lapeer	2	P	WW			X							Centrifuge Water
CL1MH0100180509N	5/9/18	1200	Lapeer	2	P	WW			X							Mixing cell waste water
CL1MC0100180509N	5/9/18	1210	Lapeer	2	P	SL			X							Mixing cell soil

Special Instructions/Comments: **Send Results and Acknowledgements to the list provided by e-mail to Vista.**

SEND DOCUMENTATION AND RESULTS TO:
Name: **Stephanie Kammer**
Company: **MDEQ**
Address: **525 W. Allegan Street**
City: **Lansing** State: **MI** Zip: **48909**
Phone: **517-897-1597** Fax: **517-241-3571**
Email: dorin.bogdan@aecom.com

Container Types: P= HDPE, PJ= HDPE Jar, O = Other: ____

Bottle Preservation Type: T = Thiosulfate, TZ = Trizma: ____

Matrix Types: AQ = Aqueous, DW = Drinking Water, EF = Effluent, PP = Pulp/Paper, SD = Sediment, SL = Sludge, SO = Soil, WW = Wastewater, B = Blood/Serum, O = Other: ____

Vista Analytical Laboratory

Sample Log-in Checklist

Vista Work Order #: 1800935 **TAT** std

Samples Arrival:	**Date/Time** 05/12/18 0957	**Initials:** BLB	**Location:** WR-2 **Shelf/Rack:** NA
Logged In:	**Date/Time** 05/12/18 1139	**Initials:** WWS	**Location:** WR-2 **Shelf/Rack:** 2-4

Delivered By:	**FedEx**	UPS	On Trac	GSO	DHL	Hand Delivered	Other
Preservation:	**Ice**		Blue Ice		Dry Ice		None

Temp °C: 2.0 **(uncorrected)**	**Time:** 1034	**Thermometer ID:** IR-4
Temp °C: 1.9 **(corrected)**	**Probe used:** Yes☐ No☑	

	YES	NO	NA
Adequate Sample Volume Received?	WWS		
Holding Time Acceptable?	WWS		
Shipping Container(s) Intact?	BLB		
Shipping Custody Seals Intact?	BLB		
Shipping Documentation Present?	BLB		
Airbill 2 of 2 — Trk # 7722 1188 4554	BLB		
Sample Container Intact?	WWS		
Sample Custody Seals Intact?			WWS
Chain of Custody / Sample Documentation Present?		BLB	
COC Anomaly/Sample Acceptance Form completed?		WWS	WWS

If Chlorinated or Drinking Water Samples, Acceptable Preservation?						WWS
Preservation Documented:	$Na_2S_2O_3$	Trizma	**None**	Yes	**No**	**NA**
Shipping Container	**Vista**	Client	**Retain**	Return	Dispose	

Comments: