INVENTUM ENGINEERING, PC

April 22, 2021

To: Benjamin McPherson (NYSDEC)

From: Todd Waldrop (Inventum)

CC: Jon Williams (Riverview); John Yensan (OSC); Craig Slater (CS Law); John Black, P.E. and James Edwards (Inventum)

RE: Surface Water System - Next Steps
Riverview Innovation & Technology Campus, Inc.
Brownfield Cleanup Program Site No. C915353
Town of Tonawanda, New York

Inventum Engineering, P.C. (Engineering), on behalf of Riverview Innovation & Technology Campus, Inc. (Riverview), is submitting this summary of the data collected following the cleaning of the surface water collection system along Broadway, the "Box Culvert" and the Mansion Sump. A number of ongoing activities are being implemented to improve the water quality discharging from the site. All parameters are important, but the primary focus of the current action items are three parameters; Ammonia, Cyanide and Mercury. These three parameters have, at times, exceeded the action limits since Riverview took control of the discharge under the SWPPP, and based on the limited records available to Riverview the exceedances of these concentrations occurred before Riverview's control, and therefore have been a historical issue.

Based on the data and observations of the surface water management system, the following recommendations were made and have been implemented since the excursions were first documented:

1. Aeration Testing – Testing of an aeration system in the settling basins. The testing was conducted to determine if the aeration increased the effectiveness of the treatment in the settling ponds. Aeration was effective in warmer weather, likely due to enhanced biological activity.
2. Surface Water Control – The transport of sediment in surface water flow to the sewer system has been reduced due to the surface cleanup and elimination of areas and debris concentrating overland flow. The reduction of concentrated flow and the removal of materials with concentrations of fine particulates reduces the transport of compounds from the surrounding surfaces. The transport of sediment also reduced the possibility of re-accumulation of sediment in the surface water conveyance system.
3. Removal of Sediment and Debris from the Box Culvert – The box culvert contained substantial amounts of sediment. The constriction of flow by the sediment, increased the flow velocity and potential for transport of this material to the downstream components of the surface water

treatment system. Cleaning the Box Culvert reduced solids loading to the Mansion Sump and settling ponds. None of the sediment samples collected indicated the potential for any materials containing hazardous or toxic (e.g. PCBs) materials at concentrations requiring management as hazardous or toxic wastes in the box culvert. The concentration of Ammonia in the box culvert sediment samples ranged from 152 milligrams per kilogram (mg/Kg) to 12.9 mg/Kg, suggesting potential Ammonia Liquor impact or anerobic bacterial activity.

4. Remove Sediment from Mansion Sump – The Mansion Sump Is a sediment trap and oil skimming vault located before the flow enters the North-South Storm Sewer and subsequently the concrete-lined sediment ponds. The sump was initially cleaned by Riverview in December 2019 but had accumulated additional sediment in the subsequent months. After the Surface Water Controls and clearing the Box Culvert, removing the residuals from the Mansion Sump was completed in January 2021 to reduce the potential for loading to the settling ponds. None of the sediment samples (Table 6) indicate the potential for any materials management as hazardous or toxic wastes in the Mansion Sump. The Mansion Sump sediment was a combination of loose material and a hard mass at each end (North and South) of the sump. The material was removed by a combination of excavation and hand removal. The concentration of Ammonia in the Mansion Sump sediment sample was 79 mg/Kg.
5. Laterals – The ends of seventy-three (73) pipes, drop inlets and sumps were identified in the storm sewer investigation. The pipes varied in size from 2- to 18-inches in diameter. While the majority are identified as stormwater conveyances, twenty appeared to have been plugged and may be historic production drains that were taken out of service decades ago. The ends of the undefined pipe were cleaned and plugged to prevent future unrestricted discharges to the Box Culvert during and following demolition. Although the plugs were placed, the data suggests there are either unknown pipes or other sources of seepage along the Box Culvert.
6. Trace the North Storm Sewer – The exact alignment of the North Sewer was unknown in the vicinity of the Oil House and Mansion Sump. A utility locator and a camera survey were used to trace these lines. Notes from the camera survey are included in Appendix A.
7. Monitoring – In addition to the monitoring required under the SWPPP, the erosion and sediment controls preventing buildup of sediment in the storm sewer system should be inspected after all rain events in excess of 0.5 inch. This is an ongoing task for Keith Adderley.

Performance

The surface water system performance is measured at Outfall #001, #002, and #004. The work to date has reduced the magnitude[1] of the excursions above the Action Levels, but the concentrations of Ammonia, Mercury and Cyanide were still above the SWPPP targets in the February sample, and preliminary data suggest the concentrations of those parameters will be similar in the March data.

For source evaluation purposes, eight grab samples of water from the surface water collection system (Figures 1 and 2, and Table 1) were collected on February 24, 2021 coincident with the February SWPPP sample collection. Only the SWPPP sample represents the flow at the discharge, the grab samples are not compliance samples, the samples are not representative of flows from the discharge point.

[1] The frequency may have been reduced, but there is no historic data available to define a trend.

The grab water data indicate that the concentrations of six compounds (Mercury, Ammonia, Cyanide, Benzene, Naphthalene, and Toluene) within the system would exceed the Action Levels if they were discharged through #001 directly. The concentrations of four of the compounds (Mercury, Benzene, Naphthalene, and Toluene) were effectively treated in the system and the February SWPPP sample indicates compliance with the Action Levels for those compounds. Mercury was in compliance in February, but was not in the January sample. The following were noted in the grab water data (Figures 1 and 2, Table 1):

- Mercury is the most variable compound in the samples;
    - The most significant variation of the Mercury concentrations occurred between the sample collected from the box culvert immediately downgradient of the battery (1,100 nanograms per liter [ng/L]) and the sample collected just downgradient of the light oil area (34,000 ng/L).
    - A second variation occurred between the sample collected from the Mansion Sump (SW-MS, 330 ng/L) and the inflow to the North Settling Pond (SW-SPIN, 3,900 ng/L). Based on the video survey of the North-South Sewer (Appendix A), this variation is attributed to sample variation and the possible introduction of sediment in the sample, rather than a source downgradient of the Mansion.
- Ammonia was the most consistent compound in the samples:
    - The highest concentration was in the sample from the Mansion Sump (56 mg/L).
    - The concentrations in all of the other samples ranged between 0.44 mg/L and 7.8 mg/L.
- Cyanide followed a similar pattern to Mercury:
    - The most significant variation of the Cyanide concentrations occurred between the sample collected from the box culvert immediately downgradient of the battery (0.291 mg/L[mg/L]) and the sample collected just downgradient of the light oil area (0.572 mg/L).
    - A second variation occurred between the sample collected from the Mansion Sump (SW-MS, 0.172 mg/L) and the inflow to the North Settling Pond (SW-SPIN, 0.224 mg/L). This is consistent with the variation in Mercury concentrations.
- The sample collected from the North Storm Sewer (SW-MHC) contained four compounds (Mercury, Ammonia, Cyanide, Benzene) that would be above Action Levels, all within the middle range of those detected in the Box Culvert.

The removal of the sediment from the box culvert allowed sealing of the laterals draining into the system and inspection of the system. The sediment data collected prior to removal is shown in Table 2 (locations are shown on Figures 1 and 2). Following the Box Culvert cleaning, sediment grab samples were collected from the two settling Ponds (SD-SPN-03172021 and SD-SPS-03172021) for the three compounds affecting the SWPPP (Mercury, Ammonia and Cyanide). The sediment sample from the North settling pond was collected along the north side immediately downgradient of the discharge. The sediment sample from the South settling pond was collected in the southwest corner of the pond. The sample locations were based on visual characteristics on the sediment, the north pond sediment was light brown and somewhat organic in nature, the sample from the south pond was black and released a significant amount of gas when disturbed. The data:

- The Mercury concentrations in the two samples were similar (0.603 and 0.555-mg/Kg) and lower than the concentrations of samples collected below the process area.
- The Ammonia Concentrations in the samples varied greatly (230 mg/Kg in the North pond sediment sample and 78 mg/Kg in the South pond sediment sample), The 230 mg/Kg concentration in the North Pond sediment sample was higher than any other sample collected in the storm water system.
- The Cyanide concentrations had the greatest variation (461 mg/Kg in the North pond sediment sample and 22.7 mg/Kg in the South Pond sediment sample). The 461 mg/Kg concentration was the highest value detected in the system, and one of the highest concentrations detected on the site.

Inspection of the Box Culvert between the Battery and the area downgradient of Light Oil was conducted on April 15, 2021;

- OSC blocked the flow above the suspect section of box culvert and pumped flow from the area above the west end of the battery around the inspection area;
- Determined there are no laterals or pipes that are leaking, but seepage around several pipes was evident; and
- Identified signs of seepage into the Box Culvert along the light oil area, all seepage was at or more than 16-inches below the top of the box culvert.

Groundwater data collected from the monitoring wells near the Box Culvert do not indicate there is a source in the water contained in the fill being monitored by those wells (Table 3). The seepage evident into the box culvert is believed to come from areas near the by-products and light oil areas.

The North Storm Sewer was jetted by Kandy between April 12 and 14, 2021.

a. The manholes along the length of the North Storm Sewer were located and unearthed;
b. The jetting removed[2] all mobile sediment, sludges, and detritus;
c. During jetting the water and sediment was recovered with a vacuum truck. No cleaning flow (liquid or solid) reached the Mansion Sump;
d. The North Storm Sewer system was jetted from MHE (River Water Standpipe) to the Mansion Sump;
e. All sediment jetted from the North Storm Sewer was collected and placed in the sediment containment area;
f. All recovered jetting and decontamination water was collected, conveyed to a weir tank, filtered (particulate and GAC) and discharged to the POTW under Permit No. 331, following approval by the Pre-treatment Coordinator; and
g. A Video, post jetting was taken by remote means (Will provide as soon as it is available).

[2] Jetting is much more aggressive than stormwater flow. Jetting is expected to remove all materials that could be conveyed in stormwater to the Mansion Sump or beyond.

Recommendations

Although they are not compliance samples, the data collected by the grab samples are indicative of potential sources of the Action Level excursions in the stormwater system as summarized below;

- Seepage into the Box Culvert between the Battery and the junction with the North South Section of the Box Culvert (Figure 2, Between Grids Q8 and D7);
- Flow from the North Storm Sewer containing sediment and seepage from the north side of the process area;
- Mobilization of sediment or portioning of compounds from the sediment in the North Pond (The silt traps at the primary outfall is full, see trap locations outlined in the photo below).

Sediment Traps in Settling Ponds

April 15, 2021

Inventum is making the following recommendations to attempt the reduce the concentrations of compounds in the discharge at Outfall #001:

1. Eliminate Seepage into Box Culvert Near the Light Oil Area
    a. Install a 12-inch diameter fusion bonded or corrugated HDPE Culvert along the identified 540-foot long section of the box culvert;
    b. Seal the annular space between the pipe and the box culvert walls at each end with hydraulic cement;
    c. Fill the remaining length with flowable fill or cement to within 16-inches of the top of the box culvert; and
    d. route baseline and normal stormwater flow through the pipe.
2. Confirm Jetting out of the North Storm Sewer;
    a. Collect a 2-hour composite sample from the North Storm Sewer (Manhole MHC), from the box culvert immediately south of the Mansion Sump, and from manhole (MH 1) along the North-South Storm Sewer below the Mansion Sump as a check on potential source control.
    b. The samples will be collected the same day, and to ensure a representative sample will be scheduled no sooner than 2 days after the first significant precipitation event (>0.5 inches of precipitation) following completion of the Box Culvert Sealing.
3. Clean out the Concrete-lined Settling Ponds;
    a. Draft, revise and obtain approval for a Settling Pond IRM Work Plan, including;
        i. Sequentially Open and Close each set of Valves:
            1. Close North Valve;
            2. Open Valve to South Pond, allow to flow for 2 hours, close;
            3. Open Valve to Chase, allow to flow for 2 Hours, close; and
            4. Open North Vale.
        ii. Set up a pump in the North Settling Pond to redirect water to the POTW under an amendment to Permit No. 331, eliminate overflow to the South Pond except in a storm event;
        iii. Dewater the South Settling pond discharging water to the POTW under an amendment to Permit No. 331;
        iv. Stabilize the sediment in the South settling pond (5,300 cubic feet [cf]);
        v. Stabilize the sediment from the effluent chase on the south side of the ponds (leading to Outfall #001) in the south pond;
        vi. Sample stabilized material for waste profile and approval, profile, submit for DEC approval, and dispose of stabilized sediment offsite;
        vii. Open valve to direct all flow to the South settling pond;
        viii. Dewater the North settling pond discharging water to the POTW under an amendment to Permit No. 331;
        ix. Allow sediment in the North settling pond (16,000 cf) to drain discharging water to the POTW under an amendment to Permit No. 331;
        x. Stabilize the sediment in the North settling pond (<16,000 cf after drainage and drying);
        xi. Sample stabilized material for waste profile and approval, profile, submit for DEC approval, and dispose of stabilized sediment offsite;
        xii. Restore flow to the North Pond; and
        xiii. Schedule.

Schedule

The following is the proposed schedule for the next phase of the surface water system Interim Remedial Measures (IRMs):

1. Lining/pipe in leaking section of Box Culvert – By May 15, 2021;
2. Sample flow from North Storm Sewer and Box Culvert – by Mid-May 2021;
3. May SWPPP Compliance Sampling - By May 20, 2021 but no sooner than 3 days after the pipe is installed;
4. Cleaning of South Settling Basins – Work Plan submission Mid-May 2021.

Tables

Table 1
February 2021
Stormwater System Testing - Source Evaluation
Riverview Innovation Technology Campus, Inc.
Tonawanda, New York

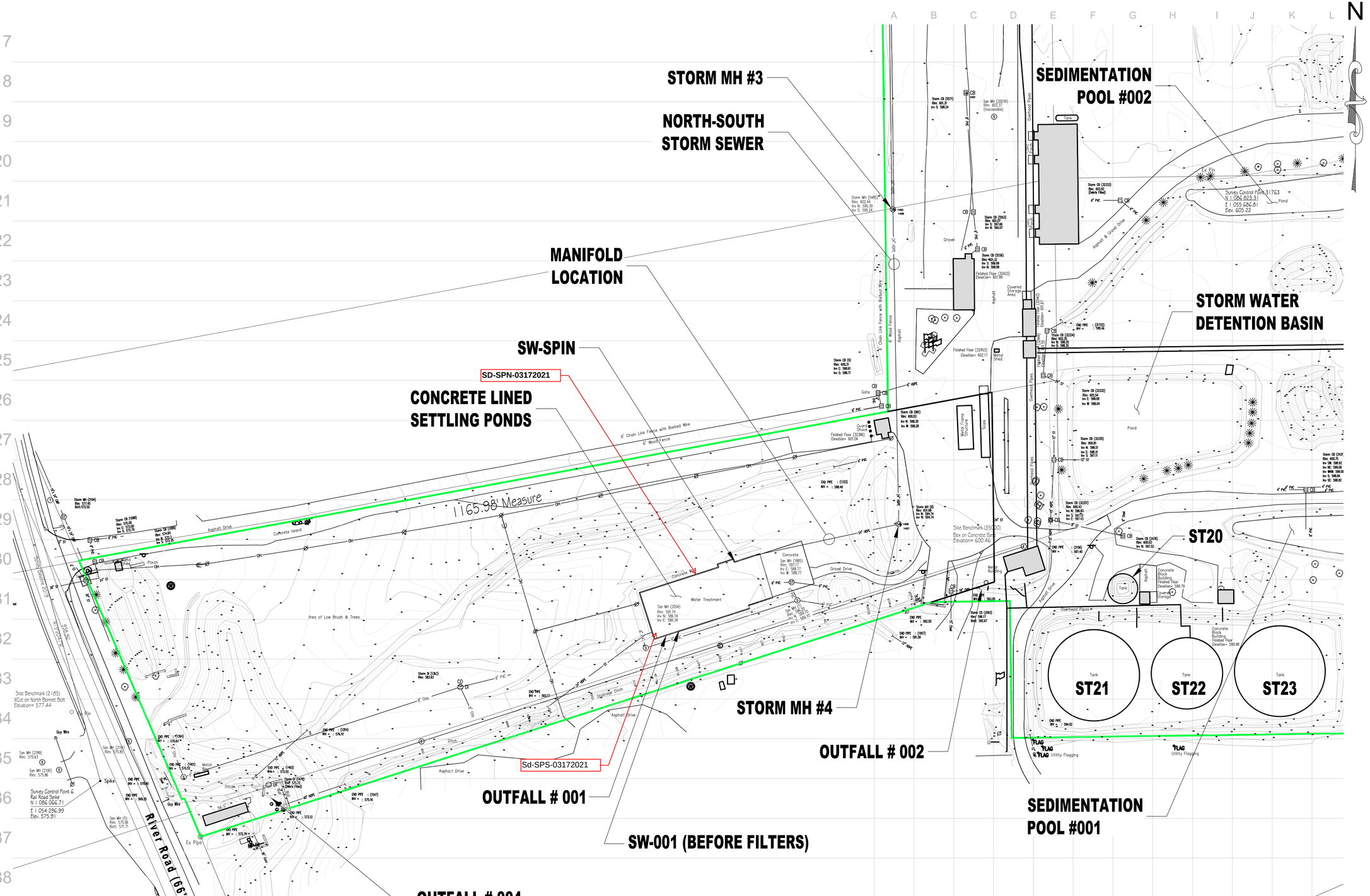
Outfall 001		Lab Project IDs: 210160 and L2101189			Lab Project IDs: 210741		Lab Project IDs: 210740		Lab Project IDs: 210740		Lab Project IDs: 210740		Lab Project IDs: 210740		Lab Project IDs: 210740		Lab Project IDs: 210740		Lab Project IDs: 210740		Lab Project IDs: 210740	
Parameter	Action Level	Sample # SWPPP-001-ES-01082021 SWPPP-001-01122021 SWPPP-001-PS-01082021			Sample # SWPP-001-02242021		Sample # SW-001 Sample for Box Culvert Evaluation Before Filters		Sample # SW-SPIN Sample for Box Culvert Evaluation At Discharge to Sedimentation Ponds		Sample # SW-MS Sample for Box Culvert Evaluation At Inflow to Mansion Sump		Sample # SW-MHC Sample for Box Culvert Evaluation At North Sewer Manhole Near Oil House		Sample # SW-BC-1349 Sample for Box Culvert Evaluation Grate Downgradient of Light Oil Area		Sample # SW-BC-1332 Sample for Box Culvert Evaluation Downgradient of Battery and Tar Management		Sample # SW-BC-1255 Sample for Box Culvert Evaluation East End of Battery, Below Drainage from Battery Basement		Sample # SW-BC-1220 Sample for Box Culvert Evaluation Downstream of Purifier Boxes	
		Sample Date(s): 01/08/2021 and 01/12/2021			2/24/2021		Sample Date(s): 02/24/2021		Sample Date(s): 02/24/2021		Sample Date(s): 02/24/2021		Sample Date(s): 02/24/2021		Sample Date(s): 02/24/2021		Sample Date(s): 02/24/2021		Sample Date(s): 02/24/2021		Sample Date(s): 02/24/2021	
		Measurement	Laboratory Qualifier/Comment	Units	Measurement	Units	Measurement	Units	Measurement	Units	Measurement	Units	Measurement	Units	Measurement	Units	Measurement	Units	Measurement	Units	Measurement	Units
Flow	-	0.06		MGD	0.088	MGD		MGD		MGD		MGD		MGD		MGD		MGD		MGD		MGD
Temperature	-	35.6 - 48.9		°F	41-64.5	°F		°F		°F		°F		°F		°F		°F		°F		°F
Solids, Total Suspended	-	4		mg/L	3.8	mg/L	6	mg/L	820	mg/L	56	mg/L	2800	mg/L	**5900**	mg/L	**5800**	mg/L	**4000**	mg/L	**400**	mg/L
Mercury, Total	-	**70.9** **85.4**	Two samples (primary and duplicate) were collected 1/8/21 for comparison of variability.	ng/L	**4.3**	ng/L	**31**	ng/L	**3900**	ng/L	**330**	ng/L	**1500**	ng/L	**34000**	ng/L	**1100**	ng/L	<50	ng/L	**2600**	ng/L
Ammonia, Total (as N)	1.5	**4.71** **4.63**	Two samples (primary and duplicate) were collected 1/8/21 for comparison of variability.	mg/L	**6.3**	mg/L	**3.5**	mg/L	**2.5**	mg/L	**56**	mg/L	**0.44**	mg/L	**6.8**	mg/L	**4.9**	mg/L	**7.8**	mg/L	**1.2**	mg/L
Cyanide, Total	0.03	**0.065** **0.072**	Two samples (primary and duplicate) were collected 1/8/21 for comparison of variability.	mg/L	**0.0403**	mg/L	**0.06**	mg/L	**0.224**	mg/L	**0.172**	mg/L	**0.213**	mg/L	**0.572**	mg/L	**0.291**	mg/L	**0.192**	mg/L	**0.165**	mg/L
Benzene	0.0015	-	-	mg/L	**0.00112**	mg/L	**0.00602**	mg/L	**0.0225**	mg/L	**0.081**	mg/L	**0.00161**	mg/L	**0.0451**	mg/L	<0.001	mg/L	N.A	mg/L	N.A	mg/L
Napthalene	0.003	-	-	mg/L	<0.00967	mg/L	<0.005	mg/L	<0.005	mg/L	**0.0154**	mg/L	<0.005	mg/L	**0.0653**	mg/L	**0.0301**	mg/L	N.A	mg/L	N.A	mg/L
Toluene	0.003	-	-	mg/L	<0.002	mg/L	<0.002	mg/L	**0.0037**	mg/L	**0.0193**	mg/L	<0.002	mg/L	**0.00823**	mg/L	<0.002	mg/L	N.A	mg/L	N.A	mg/L

Table 2
Sediment Sample Data
Stormwater System Testing - Source Evaluation
Riverview Innovation Technology Campus, Inc.
Tonawanda, New York

		Lab Project IDs: 211053		Lab Project IDs: 211053		Lab Project IDs: R2008433		Lab Project IDs: R2008433		Lab Project IDs: R2008433		Lab Project IDs: 200559		Lab Project IDs: R2008433		Lab Project IDs: R2008433		Lab Project IDs: R2008433	
		Sample # SD-SPS-03172021 Concrete Lined Settling Pond - Southwest Corner		Sample # SD-SPN-03172021 Concrete Lined Settling Pond - North Central		Sample # SD-MS-09082020 Mansion Sump Sediment		Sample # SD-BC1415-09082020 North South Box Culvert North of Junction		Sample # SD-BC1350-09082020 East West Box Culvert Below Lateral 1350		Sample # BC0002-02052020 East West Box Culvert Below Battery		Sample # SD-BC1329-09082020 East West Box Culvert Below Laterals 1329 and 1336		Sample # SD-BC1266-09082020 East West Box Culvert Below Laterals 1266 and 1267		Sample # SD-BC1219-09082020 East West Box Culvert Below Purifier Boxes	
		Sample Date(s): 03/17/2021		Sample Date(s): 03/17/2021		Sample Date(s): 09/08/2020		Sample Date(s): 09/08/2020		Sample Date(s): 09/08/2020		Sample Date(s): 02/05/2020		Sample Date(s): 09/08/2020		Sample Date(s): 09/08/2020		Sample Date(s): 09/08/2020	
		Measurement	Laboratory Qualifier/ Comment	Measurement	Laboratory Qualifier/ Comment	Measurement	Laboratory Qualifier/ Comment	Measurement	Laboratory Qualifier/ Comment	Measurement	Laboratory Qualifier/ Comment	Measurement	Laboratory Qualifier/ Comment	Measurement	Laboratory Qualifier/ Comment	Measurement	Laboratory Qualifier/ Comment	Measurement	Laboratory Qualifier/ Comment
FIELD PARAMETERS																			
	GPD																		
	S.U.					*6.51*		*6.85*		*6.99*				*6.91*		*7.29*		*6.3*	
	° F																		
METALS																			
Arsenic	*mg/Kg*					*12.7*		*30*		*6.3*		*5.09*		*4.4*		*3.7*		*37*	
Barium	*mg/Kg*					*78.7*		*366*		*82.4*		*ND*		*34.7*		*35.9*		*64*	
Beryllium	mg/Kg					1.8		5.7		0.88		0.395		0.54		0.6		ND	
Cadmium	mg/Kg					3		6.4		1.65		1.26		0.91		ND		ND	
Chromium	mg/Kg					103		197		49.3		21.5		19.9		9.9		70.6	
Copper	*mg/Kg*					*176*		*356*		*103*		*31.6*		*22.1*		*36.2*		*114*	
Lead	*mg/Kg*					*95*		*142*		*ND*		*12.7*		*20.3*		*16.7*		*44*	
Nickel	*mg/Kg*					*21*		*166*		*21.7*		*24.4*		*12.1*		*10.5*		*ND*	
Selenium	mg/Kg					ND		ND		ND		4.02		ND		ND		ND	
Silver	mg/Kg					ND		ND		ND		0.643		ND		ND		ND	
Zinc	*mg/Kg*					*315*		*741*		*311*		*118*		*82.2*		*82*		*70*	
Mercury	*mg/Kg*	*0.555*		*0.603*		*2.4*		*3.41*		*3.08*		*0.139*		*0.361*		*0.142*		*0.73*	
	mg/Kg																		
SEMI-VOLITILE ORGANIC COMPOUNDS																			
2-Methylnapthalene	ug/Kg					ND		ND		1800		763		910		ND		ND	
Acenaphthylene	*ug/Kg*					*ND*		*ND*		*1900*		*684*		*2600*		*ND*		*ND*	
Anthracene	ug/Kg					ND		ND		3500		1180		2800		1100		ND	
Benzo(a)anthracene	*ug/Kg*					*2800*		*ND*		*10000*		*3380*		*6100*	E	*2800*		*8200*	
Benzo(a)pyrene	*ug/Kg*					*3500*		*ND*		*9100*		*2280*		*5800*	*E*	*2800*		*8900*	
Benzo(b)fluoranthene	*ug/Kg*					*5100*		*9800*		*15000*		*3110*		*9800*	E	*4400*		*16000*	
Benzo(g,h,i)perylene	ug/Kg					2500		ND		5000		1280		4600		1700		7300	
Benzo(k)fluoranthene	*ug/Kg*					*ND*		*ND*		*4600*		*1410*		*3100*		*1500*		*5400*	
Carbazole	ug/Kg					ND		ND		1800		1080		890		890		ND	
Chrysene	*ug/Kg*					*3300*		*7500*		*11000*		*3550*		*6300*	E	*3600*		*11000*	
Dibenz(a,h)anthracene	ug/Kg					ND		ND		1800		514		1300		550		ND	
Dibenzofuran	ug/Kg					ND		ND		1700		693		1100		ND		ND	
Fluoranthene	*ug/Kg*					*5500*		*12000*		*11000*		*5710*		*7100*	E	*4600*		*14000*	
Fluorene	*ug/Kg*					*ND*		*ND*		*1800*		*738*		*1800*		*ND*		*ND*	
Indeno(1,2,3-cd)pyrene	*ug/Kg*					*2700*		*ND*		*5400*				*45000*		*1800*		*7200*	
Napthalene	*ug/Kg*					*2200*		*ND*		*4700*		*5810*		*3600*		*720*		*6600*	
Phenanthrene	*ug/Kg*					*3300*		*6700*		*8100*		*4160*		*6200*	E	*2800*		*9400*	
Phenol	*ug/Kg*					*ND*		*ND*		*1400*		*977*		*ND*		*ND*		*ND*	
Pyrene	ug/Kg					4400		9500		9800		3680		6200	E	3700		11000	
VOLITILE ORGANIC COMPOUNDS																			
Acetone	ug/Kg					190		280		36				32		27		150	
Benzene	ug/Kg					ND		ND		16				ND		ND			
OTHER COMPOUNDS																			
Ammonia	*mg/Kg*	78		230		79		152		18.8				39.7		12.9		77	
Cyanide	*mg/Kg*	22.7		461		96.8		254		8				10.3		7.12		90.9	
SOILDS																			
Percent Solids	%	26.2		3.8		19.2		9.2		54.7		40.3		69.2		63.3		29	
SURFACTANTS																			
Notes:																			

1. Detections and estimated values only. All otheres were ND - Not Detected.
2. Samples and field data collected February 5, 2020 through September 8, 2020.
3. Compounds in italic text are monitored in the SWPPP.

Figures



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CHECKED	
APPROVED	

STORMWATER OUTFALL LOCATIONS
RIVERVIEW INNOVATION & TECHNOLOGY CAMPUS
TONAWANDA, NEW YORK

INVENTUM ENGINEERING
481 CARLISLE DRIVE
SUITE 202
HERNDON, VIRGINIA 20170
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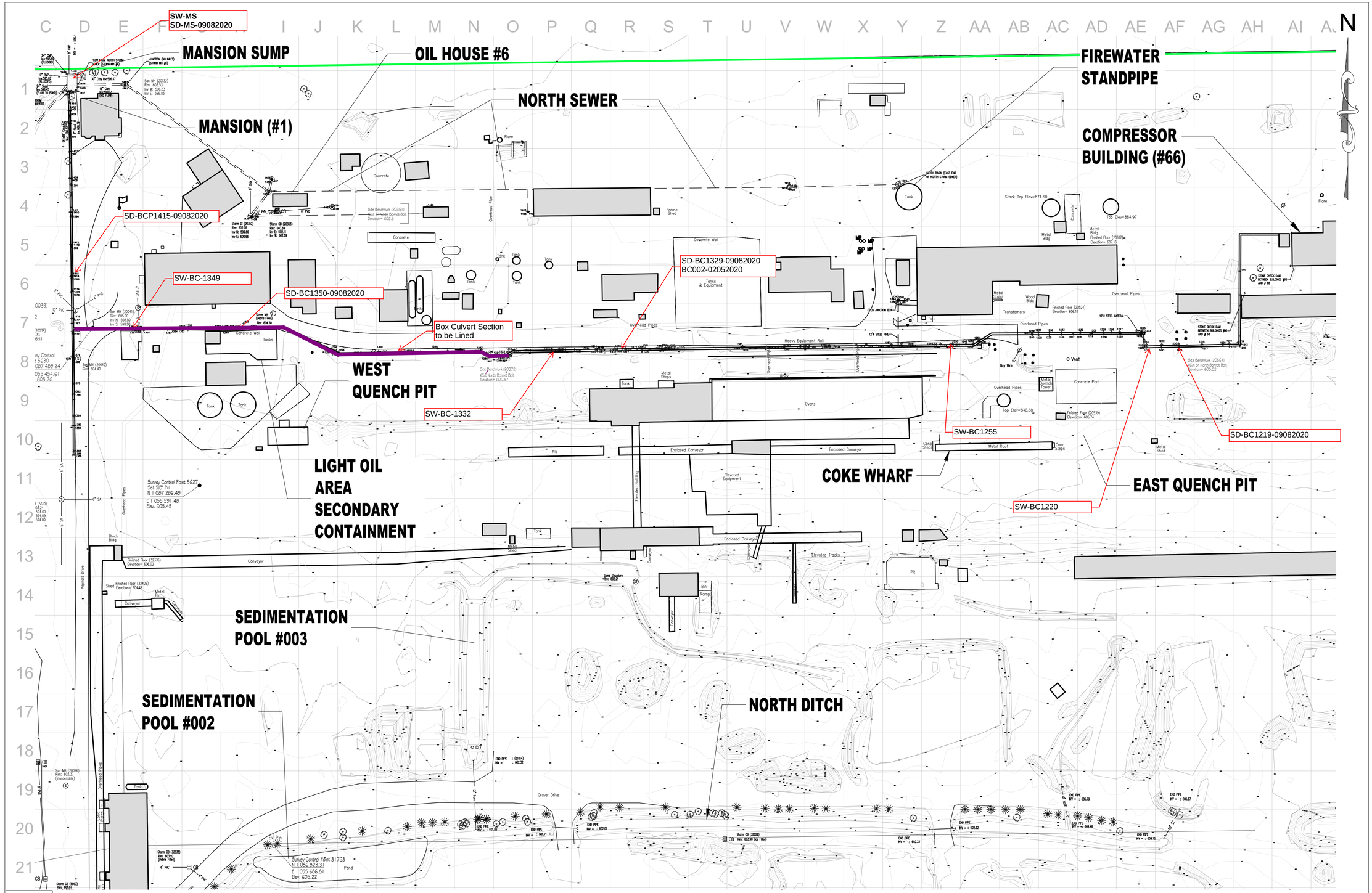
FIGURE 1

DRAWING NUMBER
SW-002



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CHECKED	
APPROVED	

NORTH SURFACE WATER COLLECTION SYSTEMS
RIVERVIEW INNOVATION & TECHNOLOGY CAMPUS
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FIGURE 2

DRAWING NUMBER
SW-003

Appendix – Video Inspection

APPENDIX

Notes on the Video Inspections by Kandy

Inspection Sections

Notes:

1 - The red line was added by videographer to indicate the length of sections associated with each video segment.

2 – The MH designations are by Kandy.

3 - The colors noted from the video are not necessarily true colors as the light from the robot and pipe enclosure can distort the color.

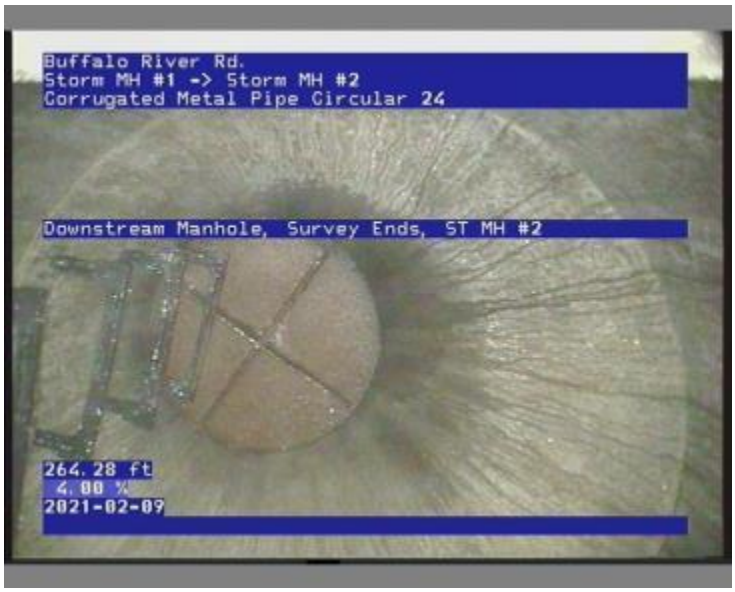
North - South Storm Sewer

The North-south Storm Sewer conveys flow from the mansion Sump to the concrete-lined Settling Ponds. There are several yard inlets in the Parking Lot AOI that discharge into this sewer. No process water is known to discharge to this sewer. The video files are only available digitally and have been submitted under separate cover.

MH #1 to MH #2 (264.2-foot-long section, traveling south, February 9, 2021)

West of the Maintenance Shop at the bend in the North South Storm Sewer between the Mansion Sump and the concrete-lined Settling Ponds.

- Clean Corrugated Metal Pipe
  - First 36 Feet (0 – 36 feet)
    - There is little flow or sediment evident in video, water appears to be clear.
    - Little more sediment at 36 feet (joint?)
  - 36- to 180 feet
    - Water still appears to be clear.
    - Water gets deeper, max at 60- to 85-feet (uneven pipe slope?)
    - Water shallow is by 180 feet
  - 180- to 264.2 feet
    - Water gets deep quickly after 180 feet
    - Deeper water after 190 feet
    - Pipe ¼ full of water by 230 feet
    - Water very clear at MH#2 ≈ 260 feet, some fine sediment stirred up as robot stopped.
    - Some wood (possible root material) debris in manhole sump.



MHA to MH #1 (218.2-foot-long section, traveling northeast to Mansion Sump [MH #A], February 9, 2021)

- Clean Corrugated Metal Pipe
  - First 0- to 25 feet
    - Some brown/tan sediment on bottom of pipe.

  - 25- 80-feet
    - Root across bottom at joint 56 feet
    - Some sediment at roots, water cloudy to 70-feet.
    - Little water at 80 feet
  - 80- to 190-feet
    - The depth of water increases from 80- to 90-feet
    - Gray and tan sediment at 90 feet
    - Roots (minor) at ~118 feet
    - Standing water ¼ to 1/3 after ≈ 125 feet
    - Less apparent water depth after at 170 feet
  - 190- to 218.2 feet
    -
    - Deeper as approach MHA
    - Roots at 190 feet (minor)
    - MHA at grate (mansion sump)
    - No flow from Mansion Sump so only a small amount of water is standing in pipe. (No flow observation is possible as there is a layer of snow at grate)
    - Pipe not level or backed up from ponds

MH #2 to MH #3 (568.1 .2-foot-long section, traveling south from Manhole #2 to Manhole #3, February 9, 2021)

- 0- to 280 feet
  - Water ≈ ¼ full along this segment
  - Hanging root mat at 73 feet; broke through

- Water with much more floating detritus after 73 feet, brownish yellow. Some black floating material similar to the organic material that forms on ponds periodically.– Water is backed up?
- Water clearer after 280 feet.

- 280- to 568.1-feet
  - Water appears clear by 350-feet.
  - Roots, heavy at 462-feet; Robot passed

  - Water noticeably clearer after roots passed.
  - Water depth almost zero at 520 feet.
  - There is a sudden change and water becomes deeper after 520 feet, notable depth of water by 530 feet.
  - Water with dark sediment at approach to MH #2.
  - MH#2 sump appears to be full of black sediment and a piece of wood (root material?).

MH #3 to MH #4 (383.1-foot-long section, traveling south from MH #3 to MH#4, February 9, 2021)

- 0- to 95-feet
  - Water, dark with sediment from start (0 feet)
  - Roots at 52 feet
  - Water at ¼ depth at 52 feet
  - Note the pipe high water mark appears to have been >3/4 full.

  - Water clears at 95 feet

- 95- to 383.1 Feet
    - Water cloudy at 200 feet.
    - Water depth is 1/3 of the pipe by 260 feet.
    - The robot stirred up brown sediment at ~285 feet.
    - Water depth is nearly ½ by 340 feet.
    - Water at ¼ depth at MH #4, some sediment apparent (383 feet).

MH #4 to Ponds (113-foot-long section, traveling west-southwest from MH #4 to Settling Pond, February 9, 2021)

- 0- to 113 feet
    - Water ≈ 1/3 full, but appears to be standing (Backup from pond)
    - Water has clear appearance, some floating detritus.
    - Roots visible ~ 65 feet.
    - Roots at 111'; Large roots and water ½ to ¾ full. Standing water based on video
    - Pipe deformed at 112.98 feet, wood, or metal debris?
    - Robot could not pass deformed section of pipe.

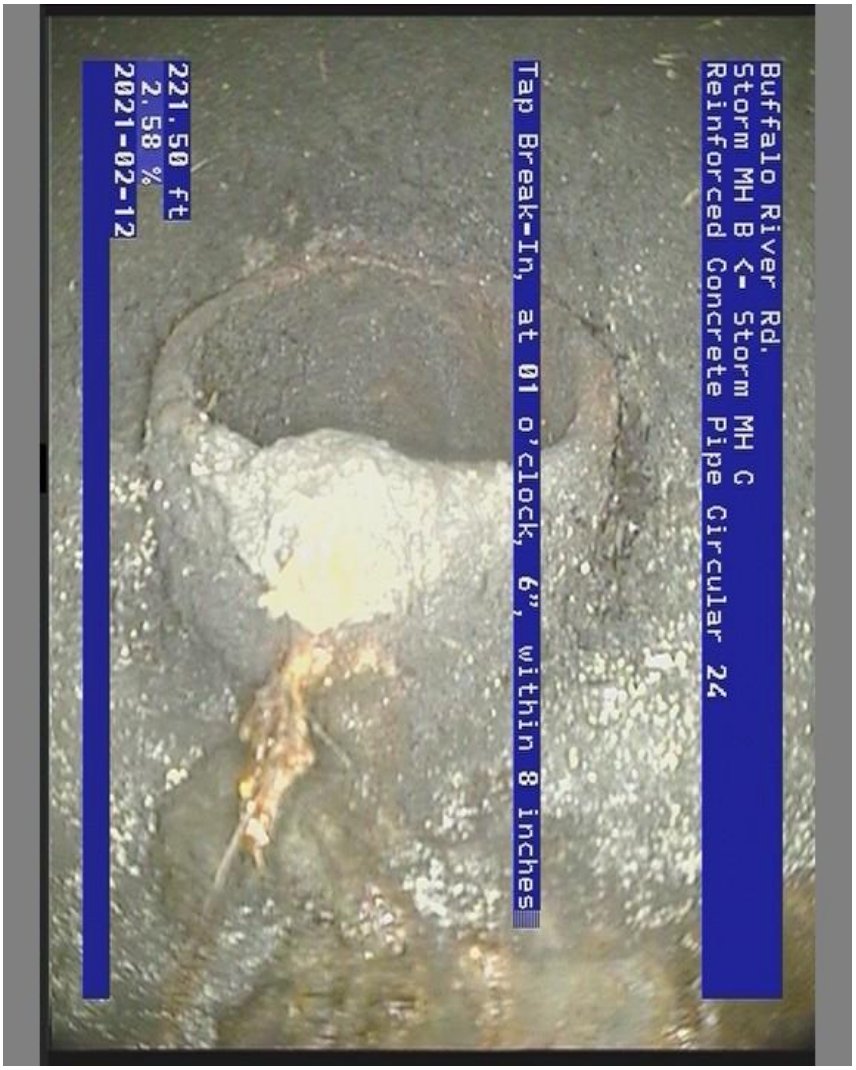

Deformed, 20 %, Pipe looks to be out of round,
potentially offset.
112.98 ft
2.62 %
2021-02-09

North Storm Sewer

The North Storm Sewer conveys flow from catch basins in the North Rail Corridor AOI and the north side of the Process Area AOI. The sewer starts at the firewater standpipe and flows to the Mansion Sump. The video reviewed below is before jetting. After jetting the contractor collected additional video of the North Storm Sewer. The post jetting video is not yet available.

MH#C to MH#B (223-foot section traveling northwest from MH #C to Manhole B (Toward Mansion Sump), February 12, 2021)

- Smooth concrete 24" diameter concrete pipe
  - 0- to 90-feet
    - Much more coating and sludge than the North-South Storm Sewer.
    - Backup of liquid that is largely full of sludge and sediment. No visible movement.
    - Sludge/sediment appears to be dark gray to yellow.
    - Sludge sediment is dense enough that the robot is riding on (v moving through) the materials.
  - Around 90 feet the coating on the walls is less apparent.
  - 90- to 223- feet
    - Joints have seepage of "sludge" ≈ 100- to 130 feet, more from 130- to 180-feet.
    - Heavy sludge seepage at 200- to 210 feet.
    - Lateral at 220' (8-inch diameter)
  - At 223 feet, manhole construction set too high, causes backup of liquid. Water at manhole base appears to be only 1-inch.



Note: image rotated to orient lateral in proper direction, note sediment dropping.

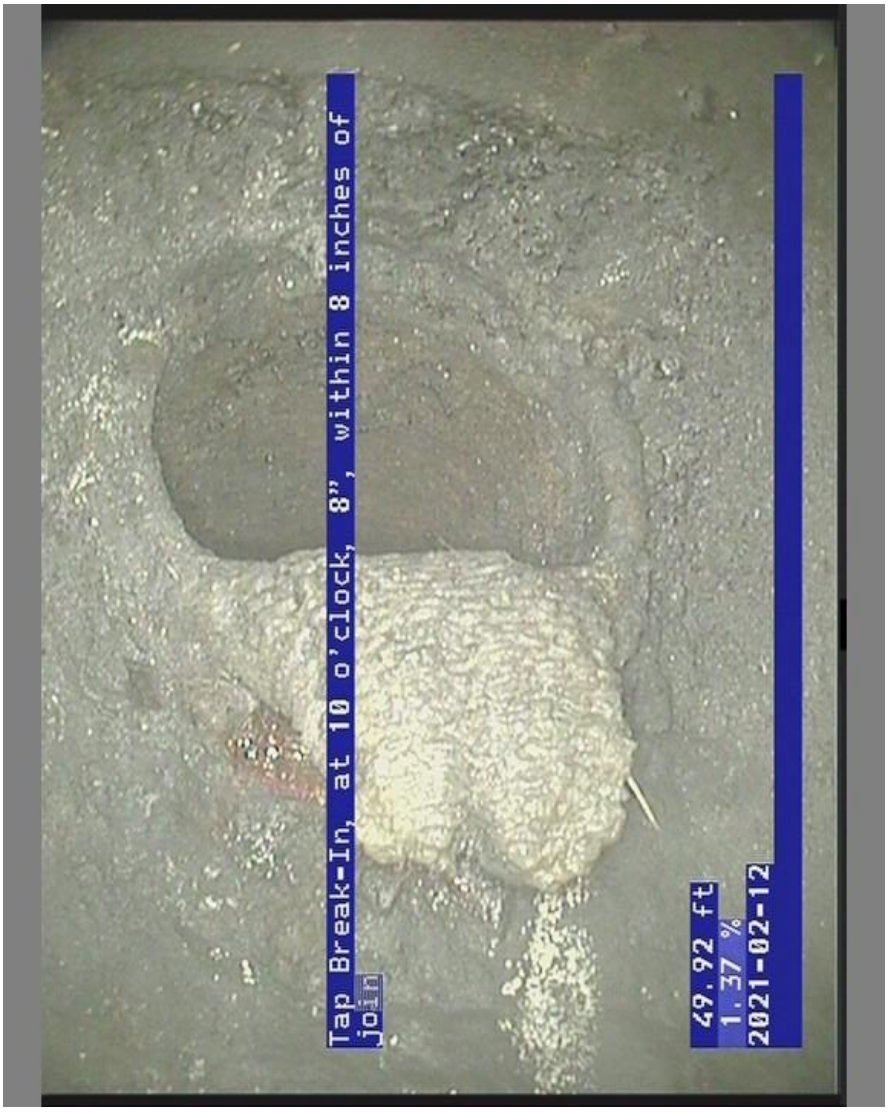

Buffalo River Rd.
Storm MH B <- Storm MH C
Reinforced Concrete Pipe Circular 24
223.00 ft
4.47 %
2021-02-12

MH #B to MH #A (traveling west from MH #B to Manhole A (Mansion Sump), February 12, 2021)

- Smooth concrete 24” diameter concrete pipe
    - Coating around entire circumference.
    - Heavy sludge at bottom ≈ 4” thick. Materials are in piles v loose material with a level surface.
    - Thick sludge buildup to Mansion Sump
    - Notable that there is little water flow/depth at Mansion Sump (shows how irregular the slope of the North Storm Sewer is).

MH #D to MH #C (traveling west from MH #D to Manhole #C (Sample Location)), February 12, 2021)

- Smooth concrete 24" diameter concrete pipe
  - Pipe clear at 0- to 20 feet. Little visible coating or sediment.
  - Some sediment leakage through joints 20 feet. (Video misty)
  - 8-inch diameter pipe lateral at 50 feet (See picture, sediment load from lateral)



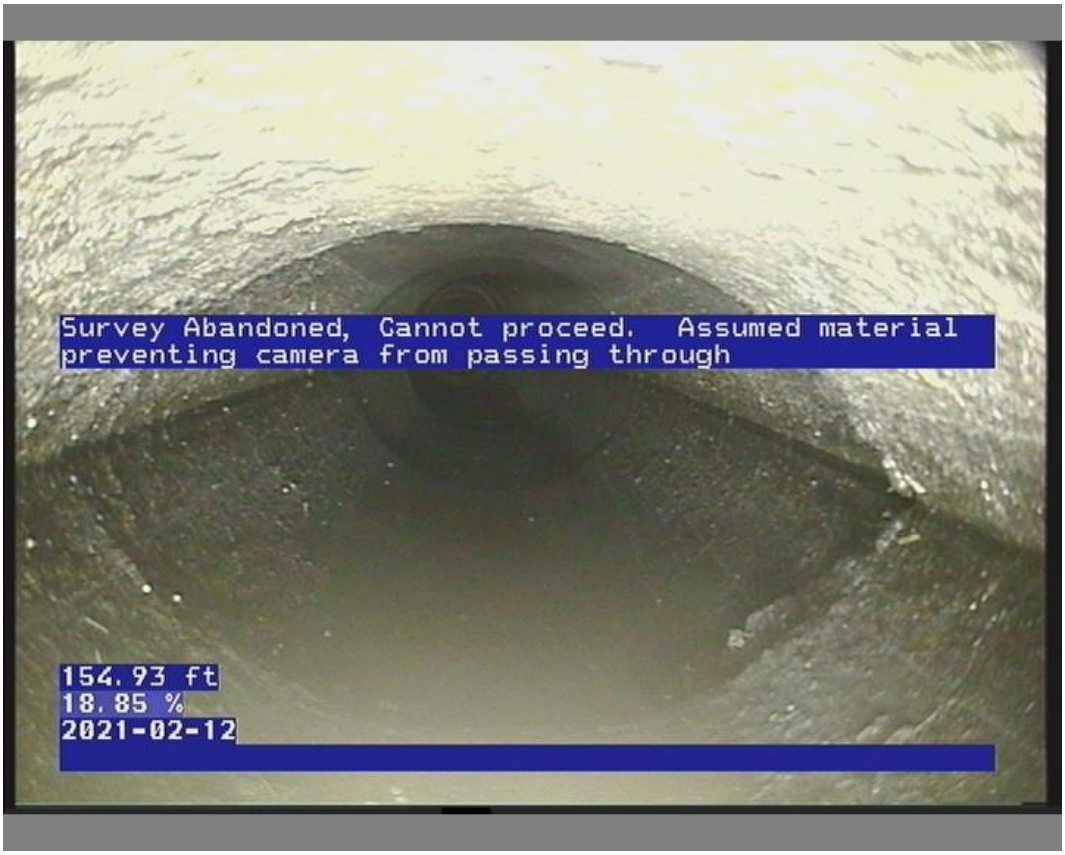
  - Heavy sludge and sediment bottom ¼ from 50 feet
  - Significant joint seepage from 50 feet west at joints that are at 10 feet spacing.
  - No noticeable flow, largely standing water .
  - Piles of sludge/sediment to 150 feet.

- Some form of penetration (root or pipe?) at ~167 feet, top ¼ of pipe.

MH #E to MH#D (traveling west from MH #E to Manhole #D1, February 12, 2021)

- Smooth concrete 24 inch diameter concrete pipe
  - Clean pipe some sediment at 0 feet
  - Clean pipe; 1/3 full water at ~12feet' some sediment
  - 1/3 full of water and sediment at 25 feet; Uneven pipe?
  - Yellow and gray sediment/sludge throughout.
  - After 50 feet the robot seems to be riding on, v through, the sediment, but pipe walls seem clean.
  - Water depth to ½ by 60 feet
  - Water getting deeper after 70 feet, standing?
  - Water clear > ½ of pipe at 80 feet.
  - Water depth ¼ by 100 feet.

- Some joints with yellow buildup.
- At 2" by 120' flow ≈ 2" deep.
- Possible lateral at ~150 feet, top ¼ of circumference but crusted over, no flow.
- Box manhole, pipes not directly opposite/offset. Significant sediment in base.
- After manhole, water ≈ 2" deep, pipe clean
- Water > ½ by 130' clear
- Coating on pipe, after 130 feet. Sufficient coating to obscure joints. Appears to be light colored in video, possible organic sludge.
- Obstruction at 154.93 feet.



- No original video from Manhole MH#D1 to MH#D. MH#D1 was the terminal point in video, and was not visible at the ground surface. OSC subsequently excavated and found the Manhole.
- Sediment and sludge impeded progress, very slow from 150- to 154.93 feet.
- Water was too deep to proceed beyond MH#D1. Additional video was collected after jetting.