Clear Form

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

SPDES DISCHARGE PERMIT
Detailed Mixing Zone Form

Purpose & Instructions

The following information will inform the Department's review of your SPDES permit and the resulting effect on the receiving waterbody. Complete the information (one form for each outfall) based on either field observations or schematics/design drawings to the best of your ability. Please see the Mixing Zone Guidance for additional instructions. If an item is unavailable or non-applicable, please describe. Submit with the NY-2A or NY-2C Application Form to SPDESapp@dec.ny.gov.

Facility Name: Oak Orchard Wastewater Treatment Plant SPDES No.: NY0030317 Outfall #: 001

NYSDEC Permit Writer: Monica Moss, PE Receiving Waterbody Class: B

Email: monica.moss@dec.ny.gov Phone No.: (518) 402-8104

Observation Information

Name & Title of Observer: Kevin Russel Date of Observation: 04/21/2025

Phone Number: (315) 414-2024 Email: krussell@anchorqea.com

Name of Receiving Waterbody: Oneida River

Weather conditions at time of observation (describe any recent rain/melt events):

Cloudy, temperature in the 40s to 50s, intermittent rain, winds 10 mph with gusts up to 25 mph.

Avg. Width (ft): 475.0 Avg. Depth (ft): 10.4 Local Depth at Outfall (ft): 6.0-6.5 Source: Based on bathymetric survey

Has the receiving waterbody run dry in the last 5 years? ☐Yes ▣No

Are tidal conditions present? ☐Yes ▣No

Measured Velocity (fps): 0.54 Source or Method: USGS Gage 04247000 (avg. velocity on 4/21/25)

Receiving Water Information

All Receiving Waters

Surface Temperature (°F): See below Bottom Temperature (if depth >10 ft) (°F): See below

Lakes: If receiving waterbody is a lake, attach any available summer and/or winter temperature data.

Describe seasonal variability of receiving waterbody (low-flow conditions, nearby dams, canal operations, stratification):

Gage data is available for USGS gage 04247000 from 1996 to present, located approximately 900 feet downstream from the existing Oak Orchard WWTP outfall. Mean daily discharge ranges from -52 to 10,600 cfs with lower flows generally occurring in the summer months (May through October) and higher flows in the Winter and Spring months (October through April). The Caughdenoy Dam is located approximately 2.5 miles upstream along the Oneida River, and is operated and maintained by the NYS Canals Corp. The dam operates to provide adequate flows/depths along the River during the navigable season (May through October).

Saline Waterbody

If receiving waterbody is saline (Class SA, SB, SC, SD, I) density information is required.

Surface Density (kg/m³): Bottom Density (kg/m³):

Source of Density Information:

▣Additional information regarding the receiving waterbody is attached (i.e. temperature/ tidal/ density studies).

Effluent Discharge Information

Temperature (°F): Under existing diffuser conditions & existing effluent flows, recorded effluent temperature from 2021-2024 was averaged for summer (May-Oct) and winter (Nov-April). Summer average effluent temperature = 20.31 degrees C & winter average effluent temperature = 10.64 degress C. Under future flow conditions, effluent temperatures were assumed to equal WWTP influent temperatures. Summer and winter influent WWTP temperatures were averaged from 2021-2024. Average summer effluent temp = 18.09 degrees C & average winter effluent temp = 14.02 degrees C.

Outfall Location & Configuration

Outfall #: 001 Location at end of pipe: Latitude: N43° 12' 19.19" Longitude: W76° 12' 51.55"

Describe the outfall (location, size, configuration, condition of the structure):

The existing Oak Orchard WWTP outfall pipe is located near the intersection of Oak Orchard Rd. and the entrance road to the WWTP, 175 feet upstream of the mouth of Mud Creek. The outfall pipe is a 72-inch diameter, RCP pipe and is approximately 132 feet in length. The outfall pipe is encased in concrete and is approximately 13-feet wide. Originally, 16, 18" diameter vertical riser pipes were located along the top of the outfall pipe over a span of 96 feet; however, survey confirmed all riser pipes have broken off or were purposely

Please select the option below (1 – 3) that best describes your facility's outfall configuration.

☒ I have attached supporting as-built drawings, sketches, or engineering plans to help describe the outfall.

☐ **Option #1: Bank Discharge** (outfall pipe/channel does not extend into waterbody).

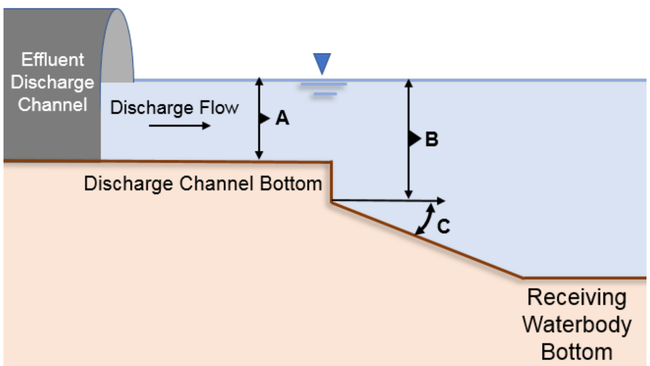
☐ Outfall pipe (____inch diameter) discharges to waterbody at ____ feet from bank

☐ Outfall pipe is above (or partially above) water surface OR

☐ Outfall pipe is submerged and located ____ feet above channel bottom

OR

☐ Channel/ditch (____ft wide x ____ft deep x ____ft long) discharges to waterbody at bank



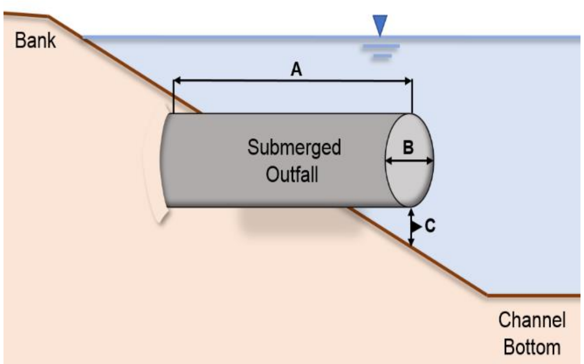
A. Average depth of water in channel (ft): ________

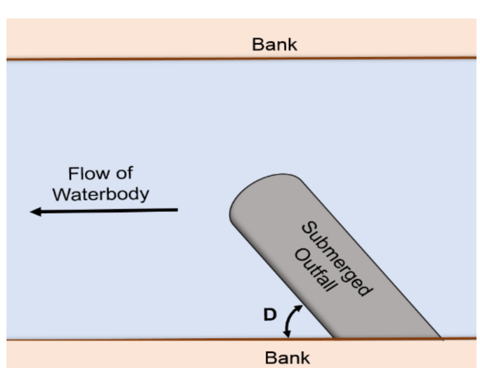
B. Local depth at outfall (ft): ________

C. Bottom slope (degrees): ________

Source: ________

☐ **Option #2: Extended Pipe Discharge** (outfall pipe extends into waterbody) with **no** multiport diffuser.

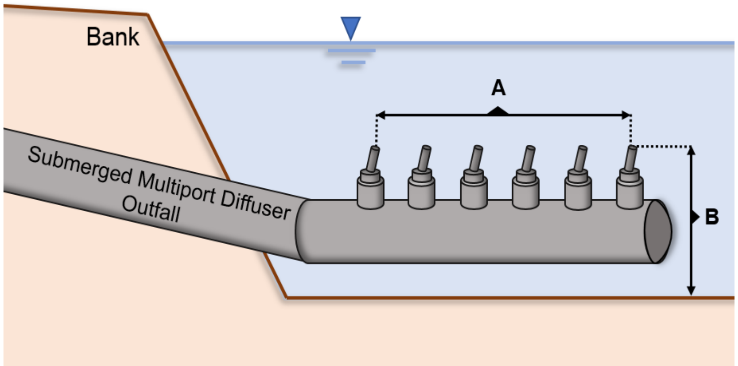


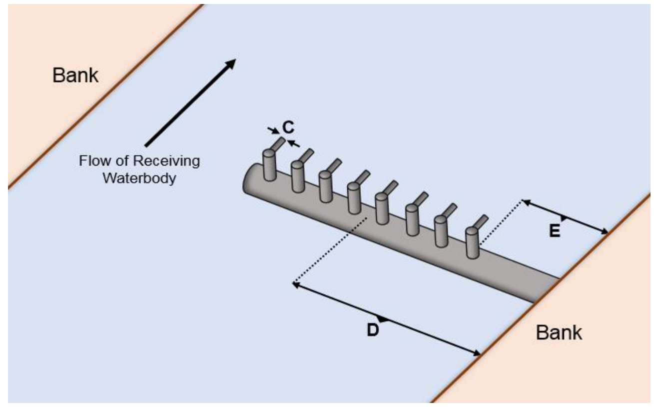


		Source
A. Distance from bank to end of pipe (ft):	______	______
B. Outfall pipe diameter (in):	______	______
C. Distance from bottom of outfall pipe to immediate bottom of channel (ft):	______	______
D. Angle between bank and outfall:	______	______

☒ **Option #3: Extended Pipe Discharge** (outfall pipe extends into waterbody) **with** multiport diffuser.

☒ Attach a detailed drawing of the diffuser (required). If not available, please contact the DEC permit writer.



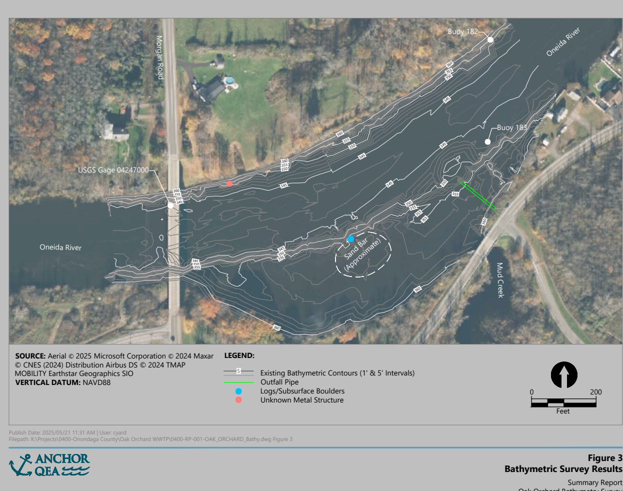


No. of openings: 16 Orientation: ☒ Unidirectional ☐ Alternating Direction: ☒ Line ☐ Fanned out

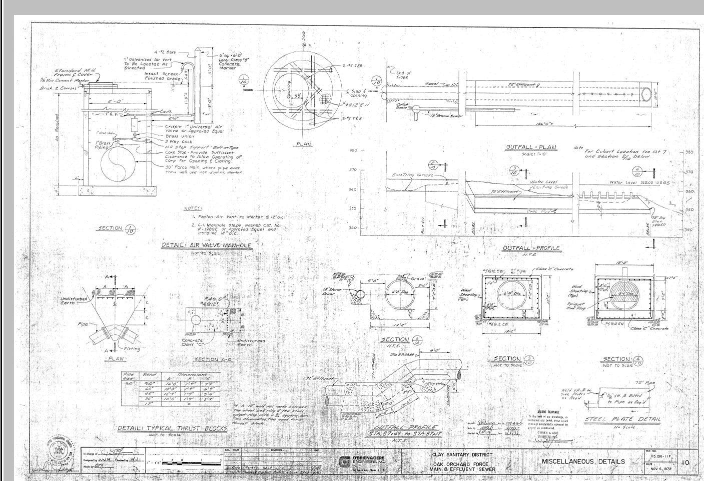
			Source
A.	Length of diffuser line (ft):	96.00	As-builts/confirmed via survey
B.	Height of discharge (top of diffuser nozzle to channel bottom) (ft):	0.00	Survey verified risers were absent & likely
C.	Diameter of nozzles (in):	18.00	As-builts
D.	Distance from bank to middle of diffuser line (ft):	84.00	As-builts & verified by bathymetric survey
E.	Distance from bank to first diffuser nozzle (ft):	40.00	Bathymetric survey

Outfall Photos & Schematics

Upload or attach photos/schematics that depict the outfall (i.e. satellite images, hand sketches, design drawings, view upstream/downstream). **You will be prompted twice to select your photo / schematic.** You may upload more than two photos by repeating this process. They will be included as attachments.



Click to Upload Photos

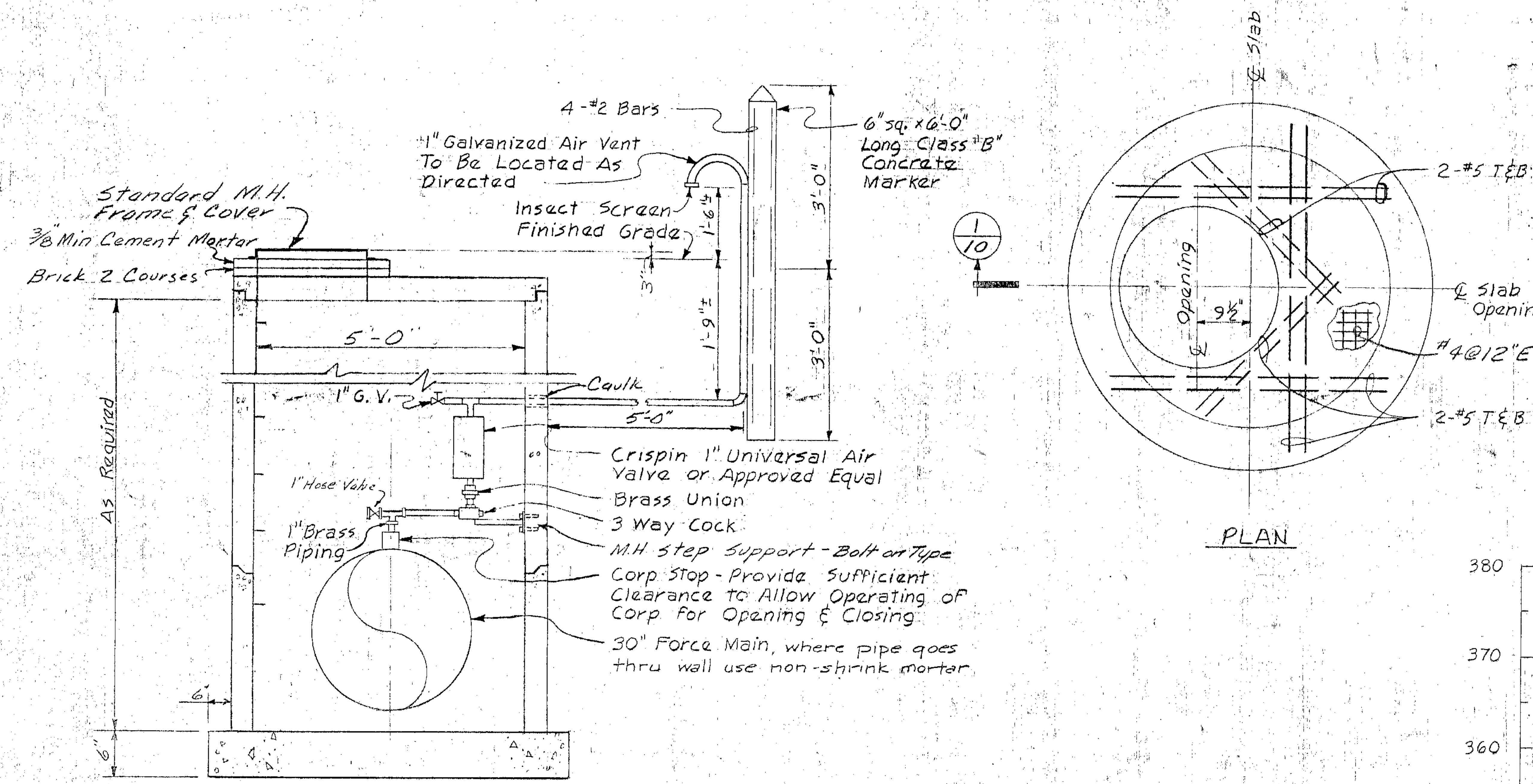


Click to Upload Photos

Plan view of bathymetric survey performed on 4/21/25 by Anchor QEA.

Existing outfall and diffuser detail drawing as-built.

Description: Description:



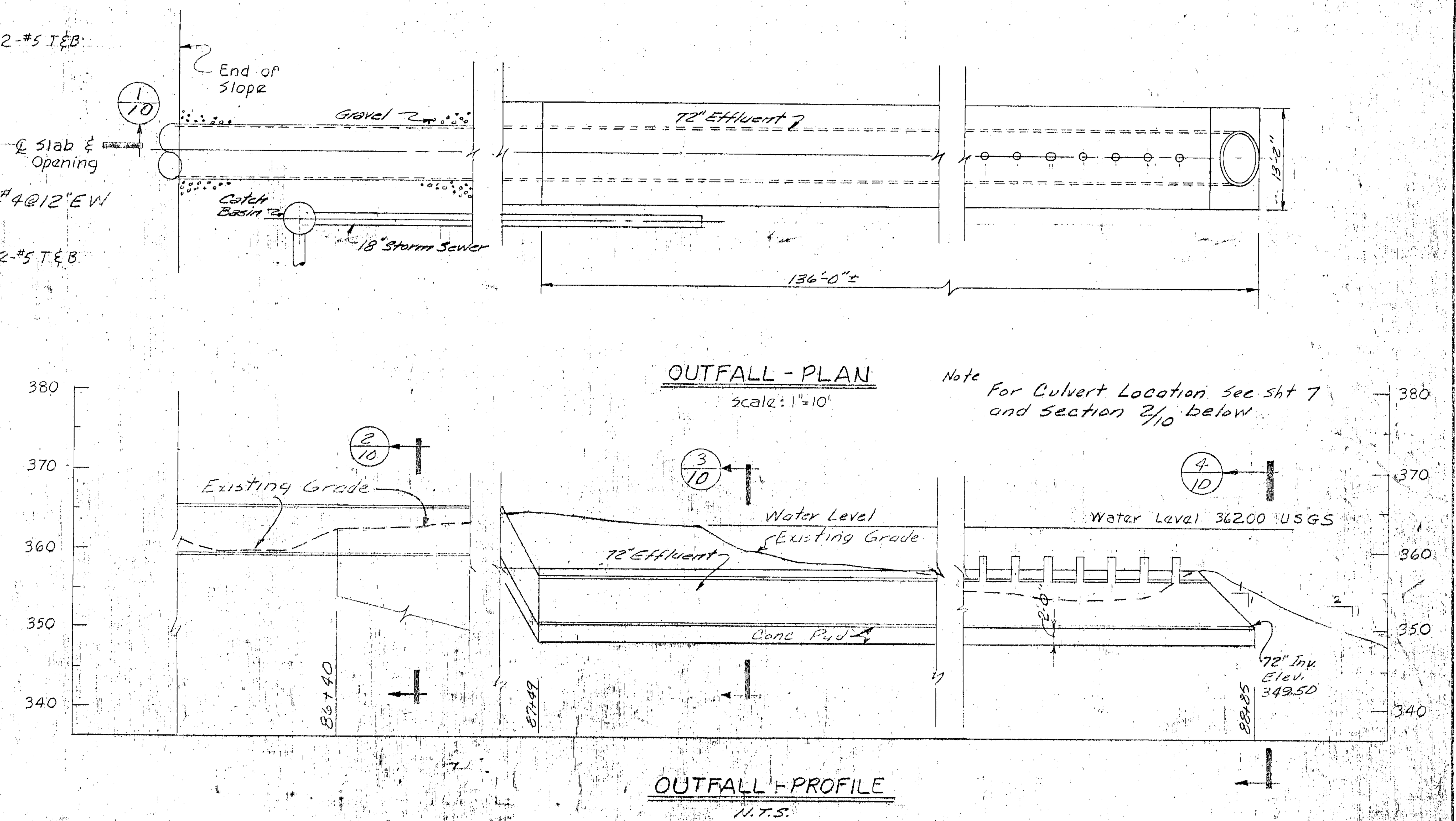
SECTION 1/10

NOTES:

1. Fasten Air Vent to Marker @ 12" o.c.
2. C.I. Manhole Steps, Neenah Cat. No. R-1980E or Approved Equal and Installed 12" o.c.

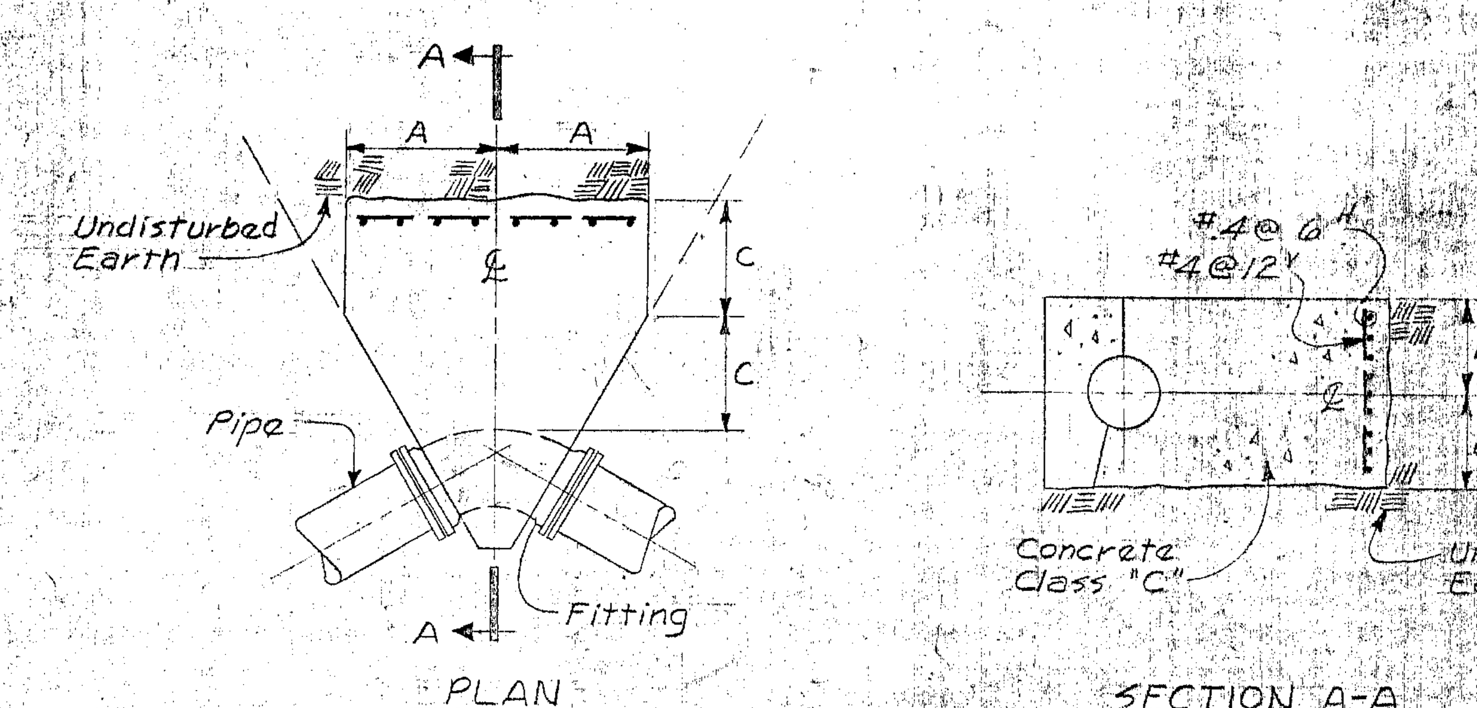
DETAIL: AIR VALVE MANHOLE

Not to Scale



OUTFALL - PROFILE

N.T.S.

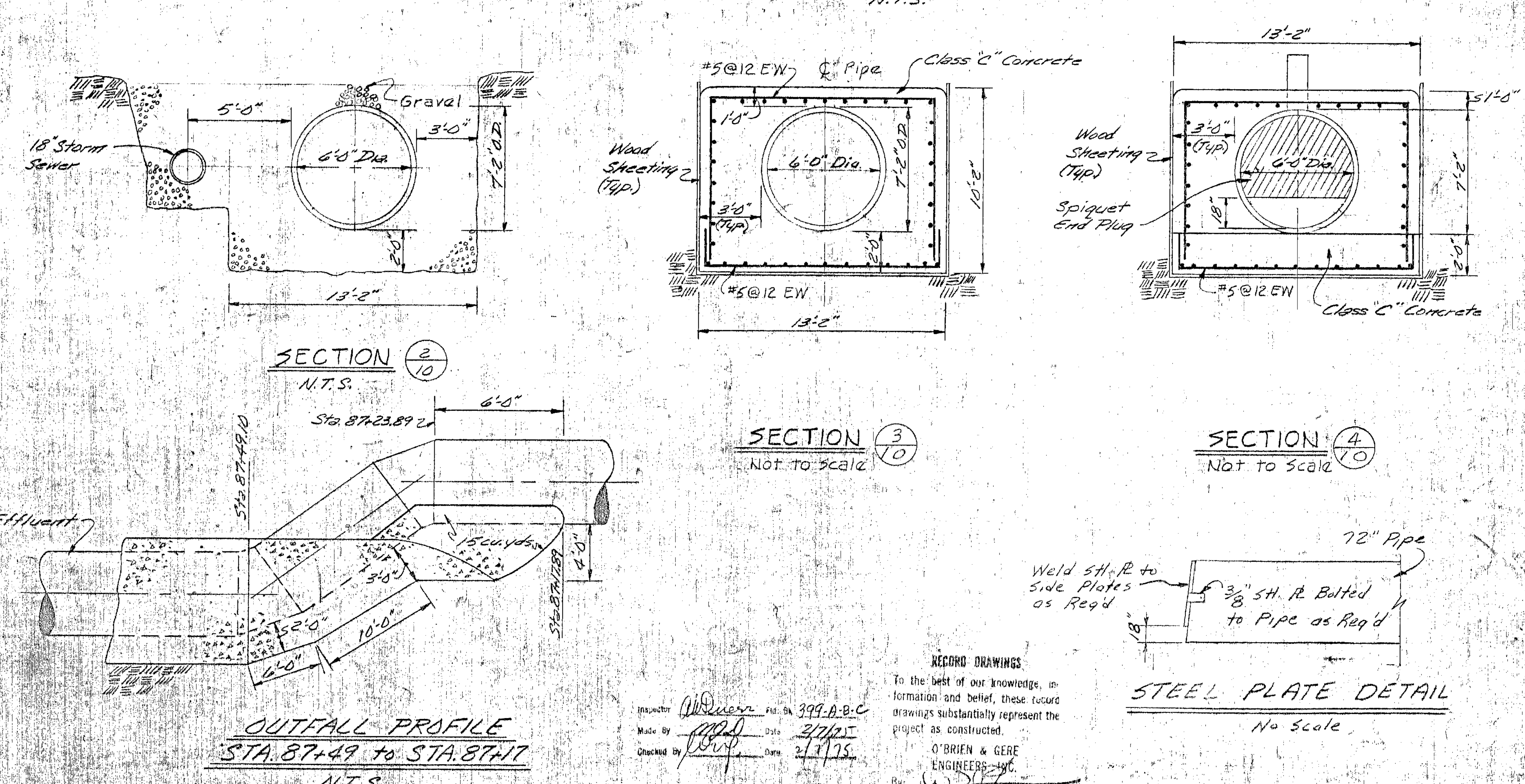


Pipe Size	Bend	Dimensions A	B	C
30"	90°	16'-0"	1'-9"	7'-3"
	60°	13'-3"	1'-9"	6'-9"
	45°	10'-9"	1'-9"	5'-6"
	30°	10'-0"	1'-9"	3'-9"
	17°		*	

* A 12" weld was made between the steel bell ring & the steel spigot ring with a 1½ square bar. This eliminates the need for a thrust block.

DETAIL: TYPICAL THRUST BLOCKS

Not to Scale



Inspector: Fld. Bk. 399-A-B-C
Made by: Date 3/7/75
Checked by: Date 2/3/75

RECORD DRAWINGS
To the best of our knowledge, information and belief, these record drawings substantially represent the project as constructed.
O'BRIEN & GERE ENGINEERS, INC.
By:

In charge of: C.S.
Designed by: W.J.M. Checked by: W.J.
Made by: G.P.K.

1" = 1'0"

NO.	DATE	REVISION	INIT.
2	5/31/73	Revised Sect. 1/10	
1	5/4/73	Changed Outfall Profile & Sect. 3/10	

O'BRIEN & GERE ENGINEERS, INC.
Syracuse, New York

CLAY SANITARY DISTRICT

OAK ORCHARD FORCE MAIN & EFFLUENT SEWER

MISCELLANEOUS DETAILS

FILE NO. 115.216-11F

DATE NOV. 6, 1972

10

PLAN
SCALE 1" = 50'

Note:
1. For Outfall Details See Sht. No 10
2. M.H. #4 & M.H. 4A to be raised to elevations shown.

PROFILE
SCALE: HORIZONTAL 1" = 50'
VERTICAL 1" = 5'

NOTE: All manhole rim elevations to be set in field.

NO.	DATE	REVISION	INIT.
11	4/3/74	Relocated Access Road	GBC
10	3/6/74	Updated Sheet 7R GRHL	
9	2/27/74	Removed 18" RCP Culvert Class V	MJD
8	2/21/74	Added Mat & Cradle to Profile	MJD
7	1/31/74	Changed 18 pipe dia. & MH 6 dam, depth	
6	1/17/74	[illegible]	
5		[illegible] for Lagoon	
4	5/4/73	Revised Plan @ 18" Culvert	
3	5/2/73	Change Profile from Sta 83 to End	DMB
2	3/27	Change Outfall - MH 6 to MH 1	
1	3/26	Rim El. MH-4 & MH-5	

In charge of ______
Designed by WUM Checked by ______
Made by BFB

1" = 50' 50 0 50 100
1" = 5'0" 5 0 5 10

O'BRIEN & GERE ENGINEERS, INC.
Syracuse, New York

CLAY SANITARY DISTRICT
OAK ORCHARD FORCE MAIN & EFFLUENT SEWER

EFFLUENT SEWER
PLAN & PROFILE

FILE NO. 115.216-20F
DATE NOV. 6, 1972
19

SOURCE: Aerial © 2025 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS © 2024 TMAP MOBILITY Earthstar Geographics SIO
VERTICAL DATUM: NAVD88

LEGEND:

- Existing Bathymetric Contours (1' & 5' Intervals)
- Outfall Pipe
- Logs/Subsurface Boulders
- Unknown Metal Structure

0 200
Feet

Publish Date: 2025/05/21 11:31 AM | User: cyard
Filepath: K:\Projects\0400-Onondaga County\Oak Orchard WWTP\0400-RP-001-OAK_ORCHARD_Bathy.dwg Figure 3

ANCHOR QEA

Figure 3
Bathymetric Survey Results

Summary Report
Oak Orchard Bathymetry Survey

CORMIX Modeling

Oak Orchard Wastewater Treatment Plant

Onondaga County Department of Environmental Protection

February 25, 2022

→ **The Power of Commitment**

Contents

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Figure index

1. Introduction

The Oak Orchard Wastewater Treatment Plant (WWTP) has been in service since 1981 and is permitted to treat an average maximum monthly flow of 10 million gallons per day (mgd) and provides treatment for a peak hourly flow of 24 mgd. Influent flows to the plant average 5.9 mgd, while maximum monthly flows have reached 9.3 mgd.

The current State Pollutant Discharge Elimination System (SPDES) permit limitations are based on the maximum monthly average flow of 10 mgd discharging through an outfall to the Oneida River. The historical 10-year seven-day average flow (7Q10) in the Oneida River of 123 cubic feet per second (cfs) in the summer and 199 cfs in the winter were used for assimilative capacity calculations.

The Oak Orchard WWTP maximum monthly and peak hourly flow capacities are proposed to be increased to 21.1 mgd and 37.7 mgd, respectively. This proposed plant capacity increase has been developed to provide the County with the ability to accommodate new flows and loads, including high-technology industry wastewater and associated supply chain industry, along with future residential and commercial development within the Oak Orchard WWTP service area.

The purpose of this report is to present the methodology and results for an assimilative capacity analysis of Oak Orchard WWTP effluent discharges into the Oneida River based on updated 7Q10 flow rates and the proposed maximum monthly discharge of 21.1 mgd. The analysis includes a comparison of ideal mixing ratios and mixing ratios calculated by CORMIX. CORMIX is a computer model for the analysis, prediction, and design of aqueous toxic or conventional pollutant discharges into diverse water bodies. The major emphasis of the model is on the geometry and dilution characteristics of the initial mixing zone under steady ambient conditions. CORMIX uses the following input data: ambient characteristics (river flow rate, river water temperature, river cross section), effluent characteristics (effluent flow rate, effluent water temperature, design of diffuser).

The remainder of this report is organized as follows:

- Section 2 presents the calculation methodology for the ambient conditions in the Oneida River, including updated 7Q10 flow rates, widths, depths, water temperatures, and wind speed.
- Section 3 presents the calculation methodology for the effluent conditions from the WWTP, including effluent water temperatures and diffuser characteristics.
- Section 4 presents the ideal mixing analysis.
- Section 5 presents the CORMIX analysis.
- Section 6 presents the conclusions and recommendations.

2. Ambient Characterization

2.1 Oneida River Flow Rate, Depth, and Width

The flow rate, depth, and width for the Oneida River were calculated from the United States Geological Survey (USGS) station number 04247000, Oneida River Near Euclid, NY. The characteristics of this station are provided in Table 2.1.

Table 2.1 USGS Station Information

Station Number	Station Name	Latitude	Longitude	Drainage Area	Years of Data
04247000	Oneida River Near Euclid, NY	43°12'19.3"	76°13'04.0"	1,439 mi²	1997-2020

The USGS software program, SW Toolbox was used to calculate the average seven-day flow that occurs once every 10 years (7Q10). The calculated 7Q10 flow rates for summer and winter are presented in Table 2.2.

Table 2.2 7Q10 for Oneida River Near Euclid Station

Season	Dates	7Q10 (cfs)
Summer	Jun 1 to Oct 31	224
Winter	Nov 1 to May 31	300

The depth, width, and velocity at the summer and winter 7Q10 flow rates were calculated from the field measurement data collected by USGS for this station. The field measurements include area and depth (derived from measurements taken at the site) and velocity (derived from in-stream velocity sensors). The width was calculated as the area divided by the depth. Flow measurements within 20 percent of the 7Q10 estimates were averaged and shown in Table 2.3. There was little variation between summer and winter in depth and width. Therefore, all simulations assumed a depth of 15 feet and a width of 280 feet.

Table 2.3 Depth, Width, and Velocity at 7Q10 Flow

Season	Flow Range (cfs) [1]	Average Depth During 7Q10 Flow (ft)	Average Width During 7Q10 Flow (ft)	Average Velocity During 7Q10 Flow (ft/s)
Summer	179.2 to 268.8	14.6	284.7	0.058
Winter	240.0 to 360.0	15.0	276.7	0.077
Note	[1] Flow range is within 20% on either side of the 7Q10 flow rate.			

2.2 Oneida River Water Temperature

The water temperature in the Oneida River was obtained from the 1996-2013 Three Rivers data provided by the County. There are two river buoys near the wastewater treatment plant outfall: buoy 178 and buoy 182. The water temperature data was collected at both the surface and the bottom of the river. It should be noted that there was little variation between the surface and the bottom of the River (less than 0.5 ºC). The data were all measured in the summer months (June to September). Since there were no available data for water temperature in the winter, the water temperature data were assumed. The assumed minimum water temperature (4ºC) is the minimum water temperature allowed in CORMIX. The assumed maximum water temperature (10ºC) corresponds to a water temperature in late Fall or early Spring in the state of New York according to USGS stations in other rivers. The data are summarized in Table 2.4.

Table 2.4 Water Temperature

Season	Average Water Temperature (ºC)	Maximum Water Temperature (ºC)	Minimum Water Temperature (ºC)
Summer	22.9	27.2	17.4
Winter	N/A	10 [1]	4 [1]
Note:	[1] Assumed value		

2.3 Wind Speed

The wind data were taken from the National Oceanic and Atmospheric Administration (NOAA) station number USW00014771, Syracuse Hancock International Airport, NY. Daily weather data for the period of 1938 to 2021 were downloaded and analyzed. The data were split according to season: Summer was June to August, and Winter was December to February. The average daily wind speed for each season is presented on Table 2.5.

Table 2.5 Wind Speed

Season	Average Daily Wind Speed (mph)
Summer	7.1
Winter	9.5

3. Effluent Characterization

3.1 Effluent Water Temperature

The Oak Orchard WWTP effluent water temperature was calculated from daily effluent water temperature data measured at the plant from 2009 to 2019. The average for summer was based on the data for June, July, and August, and the average for winter was based on the data for December, January, and February. The effluent temperature data are summarized in Table 3.1.

Table 3.1 Daily Effluent Temperature

Season	Average Effluent Temperature (ºC)	Maximum Effluent Temperature (ºC)	Minimum Effluent Temperature (ºC)
Summer	20.6	24.7	13.2
Winter	8.9	14.6	3.7

3.2 Outfall Diffuser Configuration

The outfall diffuser configuration was obtained from record drawings of the plant. The outfall diffuser configuration is summarized in Table 3.2. The drawings indicate that the diffuser is located in a shallow part of the river (approximately three feet in depth), but the river itself is approximately 15 feet deep.

Table 3.2 Outfall Diffuser Configuration

Description	Value
Number of risers	16
Number of ports per riser	1
Distance between risers	6 ft
Depth of ports	2-3 ft (diffuser is in a shallow portion of the river)
Diameter of risers	1.5 ft
Distance from bank to first port	10 ft (approximate)
Distance from bank to last port	116 ft
Direction of diffuser	Perpendicular to flow
Angle of discharge	Unknown – reviewed both horizontal and vertical discharge

Two uncertainties were identified for the diffuser configuration. The first uncertainty is due to the depth of the diffuser. CORMIX requires that the depth of the discharge be within 30 percent of the total depth. This diffuser is located in a shallow part of the river and is not located within the bottom 30 percent of the river depth. After discussion with the New York State Department of Environmental Conservation (NYSDEC), it was decided to model the diffuser in both shallow conditions with a lower flow in the river (i.e., assume that mixing occurs only in the top “slice” of the river) and in deep conditions with a deeper diffuser. This provides an understanding of the sensitivity of the mixing ratio to the depth of the diffuser.

The second uncertainty relates to the direction of discharge. Available record drawings were unclear on the direction of discharge. Both horizontal and vertical discharge were considered in the mixing analysis.

4. Ideal Mixing Analysis

Ideal mixing assumes that there is instantaneous mixing between the effluent and the ambient. The effluent would become fully mixed across the width and depth of the river. It represents the theoretical best-case mixing scenario. The ideal mixing ratio can be calculated using the effluent and ambient flow rates, according to Equation 1:

$$Ratio = \frac{Effluent+Ambient}{Effluent} \qquad \text{Equation 1}$$

The ideal mixing ratios were calculated for the existing conditions (using the 7Q10 values in the SPDES permit) and the proposed conditions (using the updated 7Q10 values), as shown in Table 4.1. The ideal mixing ratios have decreased from the existing conditions to the proposed conditions. Although the effluent flow rate has doubled, the expected decrease in mixing ratio was partially offset by increased 7Q10 flow rates.

Table 4.1 Ideal Mixing Ratios, Existing and Proposed

Time Period	Season	Effluent Flow (cfs)	7Q10 River (cfs)	Ideal Mixing Ratio
Existing	Summer	15.5	123	8.9
	Winter	15.5	199	13.8
Proposed	Summer	32.6	224	7.9
	Winter	32.6	300	10.2

5. CORMIX Analysis

5.1 Approach

Based on discussions with the NYSDEC, a sensitivity analysis approach was selected for this project. The purpose of the sensitivity analysis was to explore the sensitivity of the mixing ratio to different conditions. There were four attributes with two values each (see Table 5.1), and therefore a total of 16 CORMIX scenarios were modelled to analyze summer and winter seasons.

Table 5.1 Attributes for CORMIX Sensitivity Analysis

Attribute	First Value	Second Value
Season	Summer	Winter
Ambient/Effluent Water Temperature	Average mixing • Average ambient water temperature • Average effluent water temperature	Worst-case mixing • Minimum ambient water temperature • Maximum effluent water temperature
River Depth	Shallow • Mixing occurs in top layer only (3.5 feet)	Deep • Mixing occurs in full depth (15 feet)
Port Discharge Direction	Horizontal	Vertical
Number of Simulations	16	

5.2 CORMIX Results for Existing Diffuser

The 16 scenarios in the sensitivity analysis were setup in CORMIX, and the mixing zone characteristics are included in 5.2. The results indicated that the mixing ratio is sensitive to river depth and port discharge direction. The season and the ambient/effluent water temperature did not have a large impact on the mixing ratios. The results will be reviewed in four sets of four:

1. Deep depth, horizontal discharge (Scenarios 1 -4)
2. Shallow depth, horizontal discharge (Scenarios 5 -8)
3. Deep depth, vertical discharge (Scenarios 9 – 12)
4. Shallow depth, vertical discharge (Scenarios 13 – 16)

Deep Depth, Horizontal Discharge Scenarios

The deep depth and horizontal discharge scenario results are presented in Scenarios 1 to 4 in Table 5.2. All four scenarios have the same mixing ratio (3.1:1) and the same mixing zone length (388 m).

The effluent plume for these scenarios is shown on Figure 5.1. The effluent plume has a strong interaction with the near edge of the river. In addition, the plume does not mix across the depth of the river (it remains near the bottom of the river).

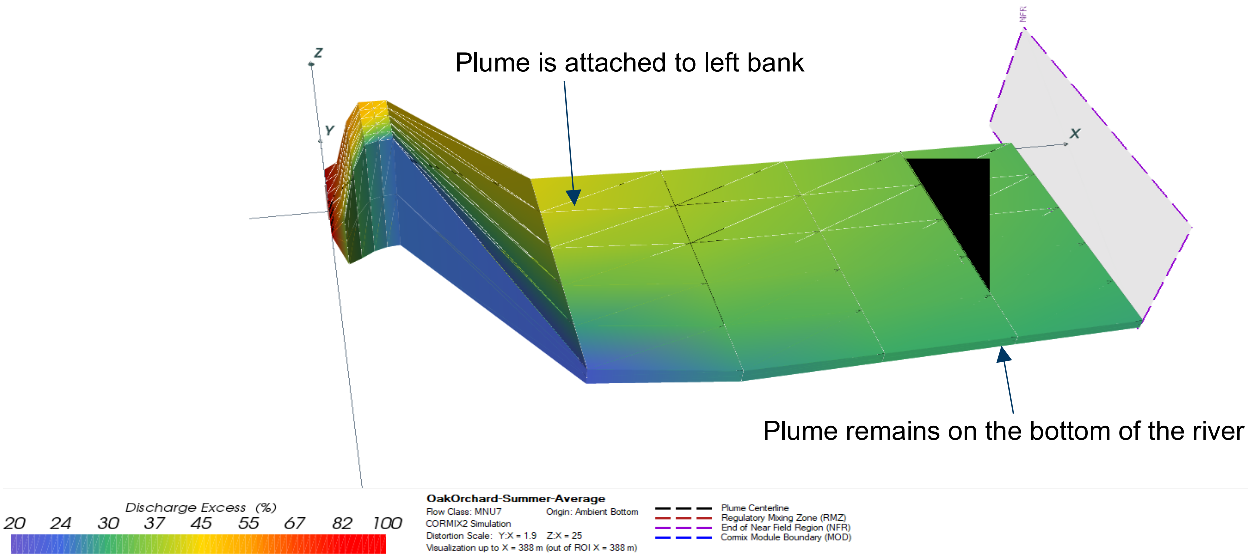


Figure 5.1 Effluent Plume Calculated for CORMIX for the Deep Depth and Horizontal Discharge Scenarios

Shallow Depth, Horizontal Discharge Scenarios

The shallow depth and horizontal discharge scenario results are presented in Scenarios 5 to 8 in Table 5.2. All four scenarios have the same mixing ratio (2.2:1) and the same mixing zone length (388 m).

The effluent plume for these scenarios is shown on Figure 5.2. When only the top "slice" of the river is considered (3.5 feet), the effluent plume has a very strong interaction with the near edge of the river, and there is poor mixing across the river width.

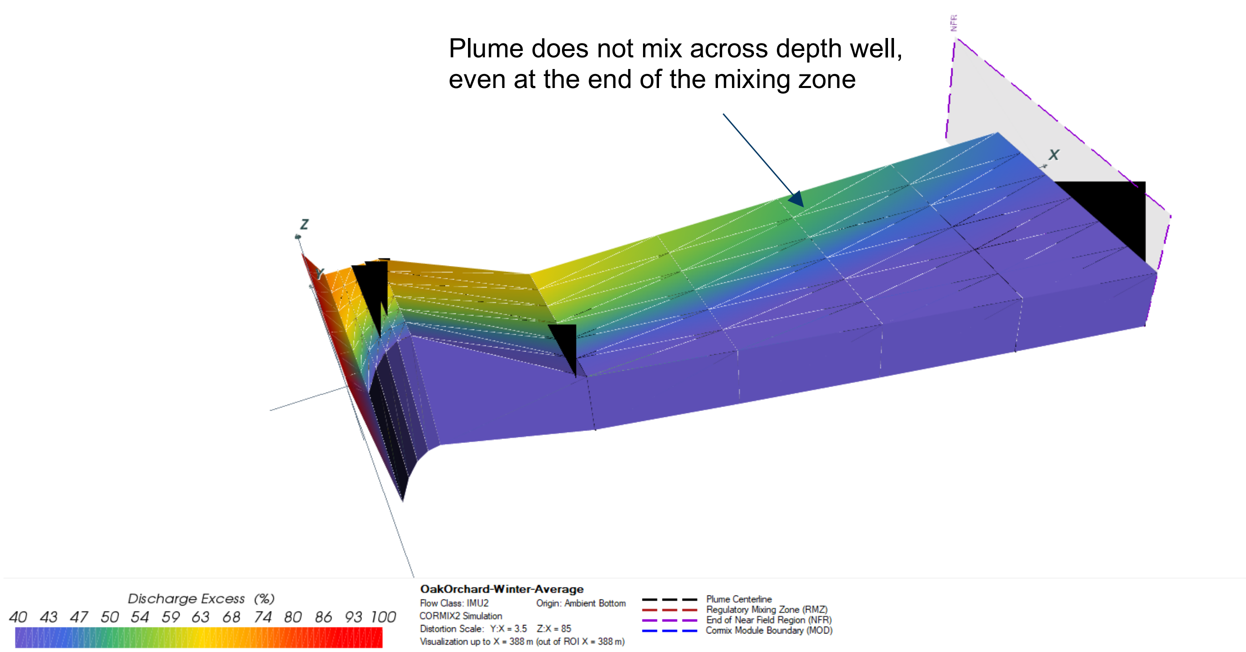


Figure 5.2 Effluent Plume Calculated for CORMIX for the Shallow Depth and Horizontal Discharge Scenarios

Deep Depth, Vertical Discharge Scenarios

The deep depth and vertical discharge scenario results are presented in Scenarios 9 to 12 in Table 5.2. CORMIX could not calculate accurate plumes for three of the scenarios. CORMIX stated that the upstream intrusion was large and that the mixing ratio was likely to be unrealistic. The results for these three scenarios were not considered valid. The remaining scenario had a mixing ratio of 3.1:1 and a mixing zone length of 388 m. This is consistent with the deep depth and horizontal discharge results.

The effluent plume for a scenario with large upstream intrusion is shown on Figure 5.3. The effluent plume has multiple regions, with rapid changes in concentrations between the regions. For the winter average scenario (scenario 11), the effluent plume is similar to the effluent plume in Figure 5.1.

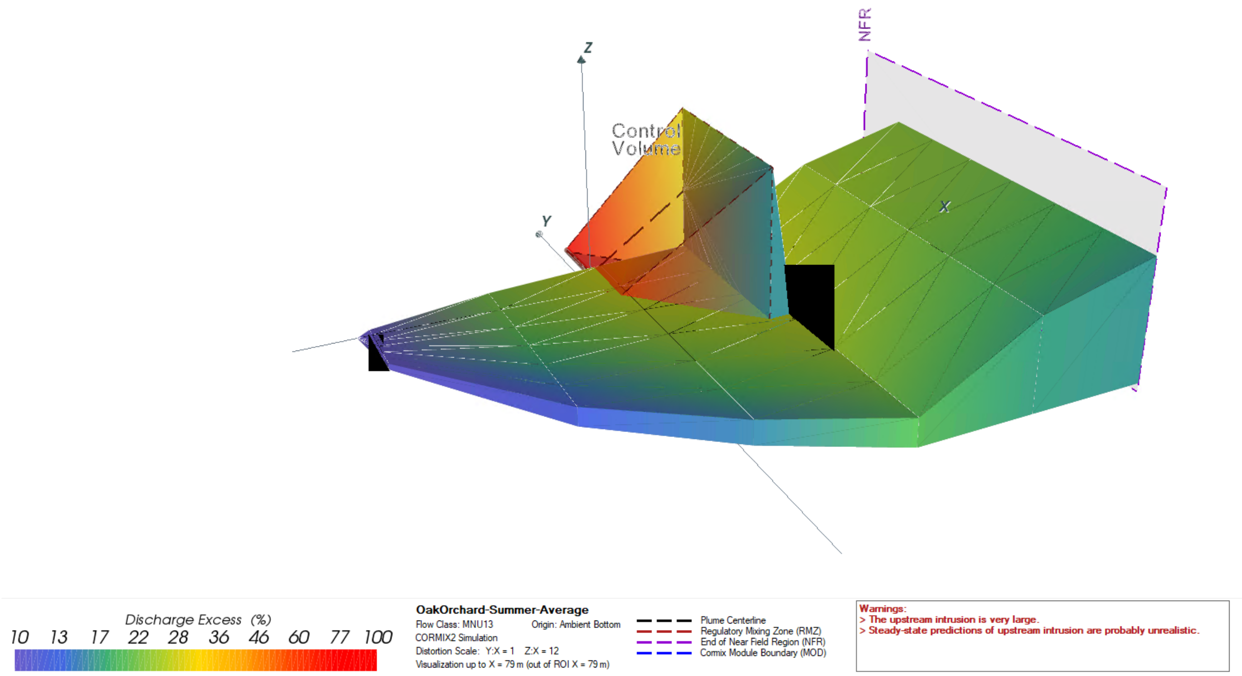


Figure 5.3 Effluent Plume Calculated for CORMIX for the Deep Depth and Vertical Discharge Scenarios, Showing Large Upstream Intrusion

Shallow Depth, Vertical Discharge Scenarios

The shallow depth and vertical discharge scenario results are presented in Scenarios 13 to 16 in Table 5.2. Two of the scenarios could not be calculated accurately by CORMIX, since they had large upstream intrusions. The remaining two scenarios had mixing ratios of 2.2:1 and mixing zone lengths of 388 m. This is consistent with the shallow depth and horizontal discharge results.

The effluent plume for the scenarios that do not have large upstream intrusions is shown on Figure 5.4. The effluent plume is similar to the effluent plume for the shallow depth and horizontal discharge scenarios.

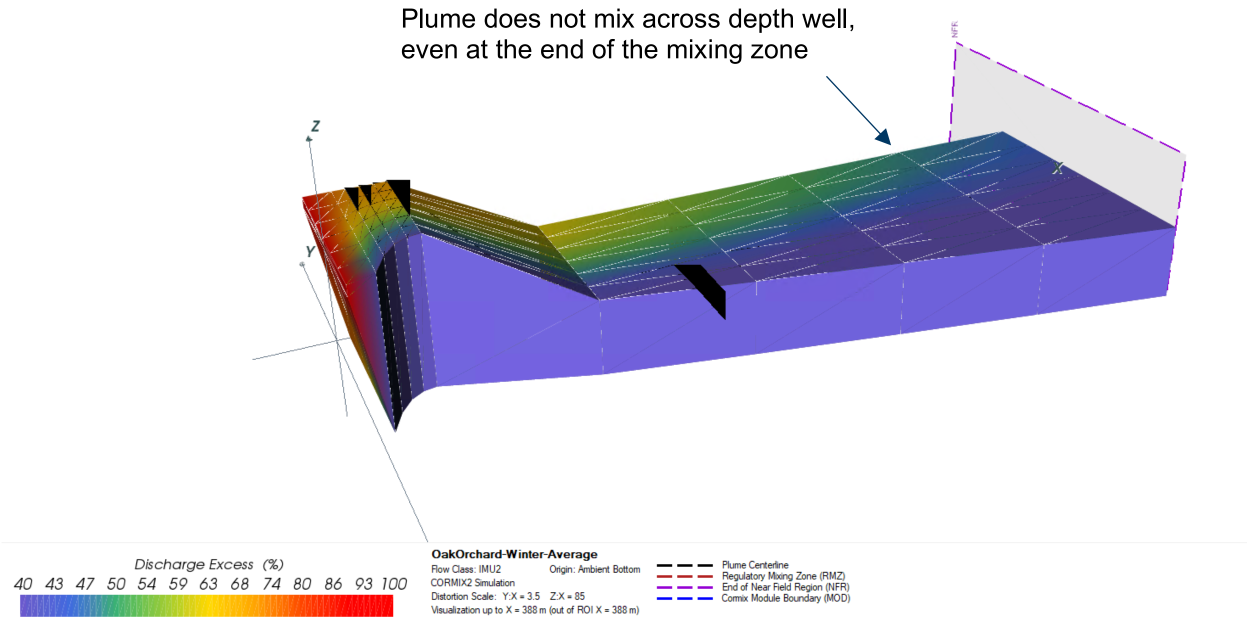


Figure 5.4 Effluent Plume Calculated for CORMIX for the Shallow Depth and Vertical Discharge Scenarios

Summary

The mixing ratios calculated by CORMIX were approximately 3:1 for the deep scenarios, and approximately 2:1 for the shallow scenarios. The mixing zone length was approximately 388 m long.

Table 5.2 Scenario Analysis Results with Existing Diffuser

Scenario Number	Season	Ambient/ Effluent Temp.	River Depth	Port direction	Water Depth (ft)	Ambient Temp (ºC)	Effluent Temp (ºC)	Effluent Flow (cfs)	River Flow (cfs)	Wind Speed (mph)	Length of Near Field (m)	Mixing Ratio
1	Summer	Average	Deep	Horizontal	15	22.9	20.6	32.6	224	7.1	388	3.1
2	Summer	Worst-case	Deep	Horizontal	15	17.4	24.7	32.6	224	7.1	388	3.1
3	Winter	Average	Deep	Horizontal	15	10	8.9	32.6	300	9.5	388	3.1
4	Winter	Worst-case	Deep	Horizontal	15	4	14.6	32.6	300	9.5	388	3.1
5	Summer	Average	Shallow	Horizontal	3.5	22.9	20.6	32.6	75	7.1	388	2.2
6	Summer	Worst-case	Shallow	Horizontal	3.5	17.4	24.7	32.6	75	7.1	388	2.2
7	Winter	Average	Shallow	Horizontal	3.5	10	8.9	32.6	75	9.5	388	2.2
8	Winter	Worst-case	Shallow	Horizontal	3.5	4	14.6	32.6	75	9.5	388	2.2
9	Summer	Average	Deep	Vertical	15	22.9	20.6	32.6	224	7.1	79	4.4 [1]
10	Summer	Worst-case	Deep	Vertical	15	17.4	24.7	32.6	224	7.1	462	36.7 [1]
11	Winter	Average	Deep	Vertical	15	10	8.9	32.6	300	9.5	46	3.3
12	Winter	Worst-case	Deep	Vertical	15	4	14.6	32.6	300	9.5	161	12.8 [1]
13	Summer	Average	Shallow	Vertical	3.5	22.9	20.6	32.6	75	7.1	41	1.6 [1]
14	Summer	Worst-case	Shallow	Vertical	3.5	17.4	24.7	32.6	75	7.1	136	6.0 [1]
15	Winter	Average	Shallow	Vertical	3.5	10	8.9	32.6	75	9.5	388	2.2
16	Winter	Worst-case	Shallow	Vertical	3.5	4	14.6	32.6	75	9.5	388	2.2
Notes:	[1] CORMIX results state that the upstream intrusion is very large in this scenario and the mixing ratio is probably unrealistic.											

5.3 Proposed Conditions

Based on the results of the initial modeling and the resultant mixing ratios obtained, GHD evaluated potential modifications to the existing diffuser configuration to achieve better mixing results. A key controlling factor in the amount of mixing that occurs within the near-field mixing zone is the port discharge velocity. With the existing number of ports (16) and the size of each port, the discharge velocity is approximately 1.2 ft/s. Therefore, blocking some of the ports to increase port discharge velocity was evaluated (see Table 5.3).

Table 5.3 Port Discharge Velocity Calculations

Number of Ports	Port Discharge Velocity (ft/s)
16	1.2
8	2.3

The operation of a diffuser requires sufficient hydraulic head to drive the flow out of the diffuser ports into the river. As the number of ports decreases the required amount of hydraulic head increases, and there may be an impact on the hydraulic capacity at the WWTP. A preliminary review of the diffuser and outfall indicates that there is sufficient hydraulic head available between the dichlorination tank effluent weir and the outfall to accommodate a decrease in the number of diffuser ports.

Additional scenarios were simulated using CORMIX with the following changes in the diffuser configuration:

- Close the first eight ports
- Add a “head” to the riser so that the discharge is horizontal (if it is currently vertical discharge)

Eight additional scenarios were calculated in CORMIX. As for the existing conditions, the results will be reviewed in sets of four.

Deep Depth Scenarios

The deep depth scenario results are presented in Scenarios 17 to 20 in Table 5.4. All four scenarios have the same mixing ratio (14.2:1) and the same mixing zone length (388 m). The mixing ratio is greater than the ideal mixing ratio, which can occur downstream from the discharge location as more water is mixed with the plume.

The effluent plume for these scenarios is shown on Figure 5.5. The effluent plume shows better, more even mixing with only 8 ports than the scenarios with 16 ports. The plume stays near the bottom, but the plume is “thicker” than in the 16 port scenarios. Overall, the mixing is significantly improved by reducing the number of operational ports.

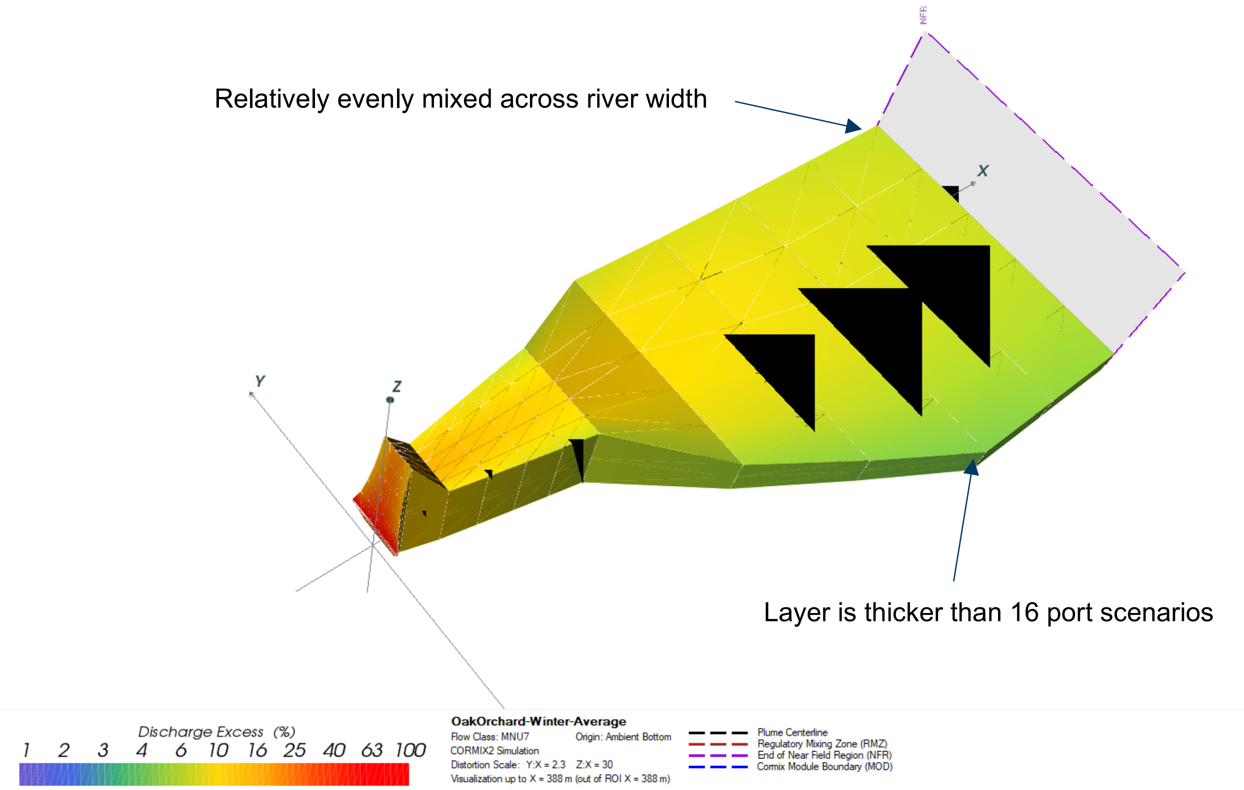


Figure 5.5 Effluent Plume Calculated for CORMIX for the Deep Depth and Horizontal Discharge Scenarios

Shallow Depth Scenarios

The shallow depth and horizontal discharge scenario results are presented in Scenarios 21 to 24 in Table 5.4. All four scenarios have the same mixing ratio (7.6:1) and the same mixing zone length (388 m).

The effluent plume for these scenarios is shown on Figure 5.6. These scenarios also indicate that the mixing is more even, and generally improved, with the smaller number of operational ports. The plume is no longer attached to the left bank and is mixed across the full width of the river.

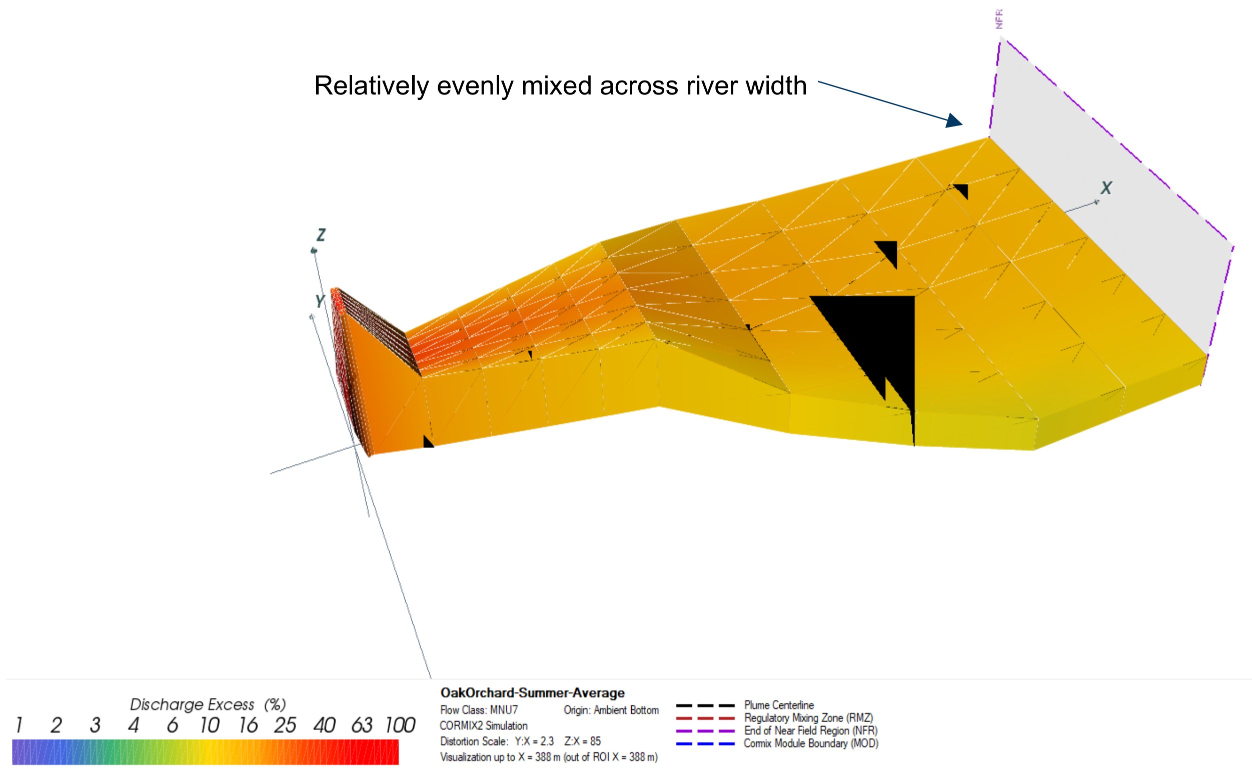


Figure 5.6 Effluent Plume Calculated for CORMIX for the Shallow Depth and Horizontal Discharge Scenarios

Summary

The mixing ratios calculated by CORMIX were approximately 14:1 for the deep scenarios, and approximately 8:1 for the shallow scenarios. The mixing zone length was approximately 388 m long. These mixing ratios indicate that there would be a significant improvement in mixing if the number of ports were reduced.

Additional changes could also be considered, as indicated as follows. However, these were not evaluated.

- Further decrease the number of operational ports
- Install “duckbill” ports to increase port discharge velocity
- Remove the existing diffuser and install a diffuser in the deeper part of the river

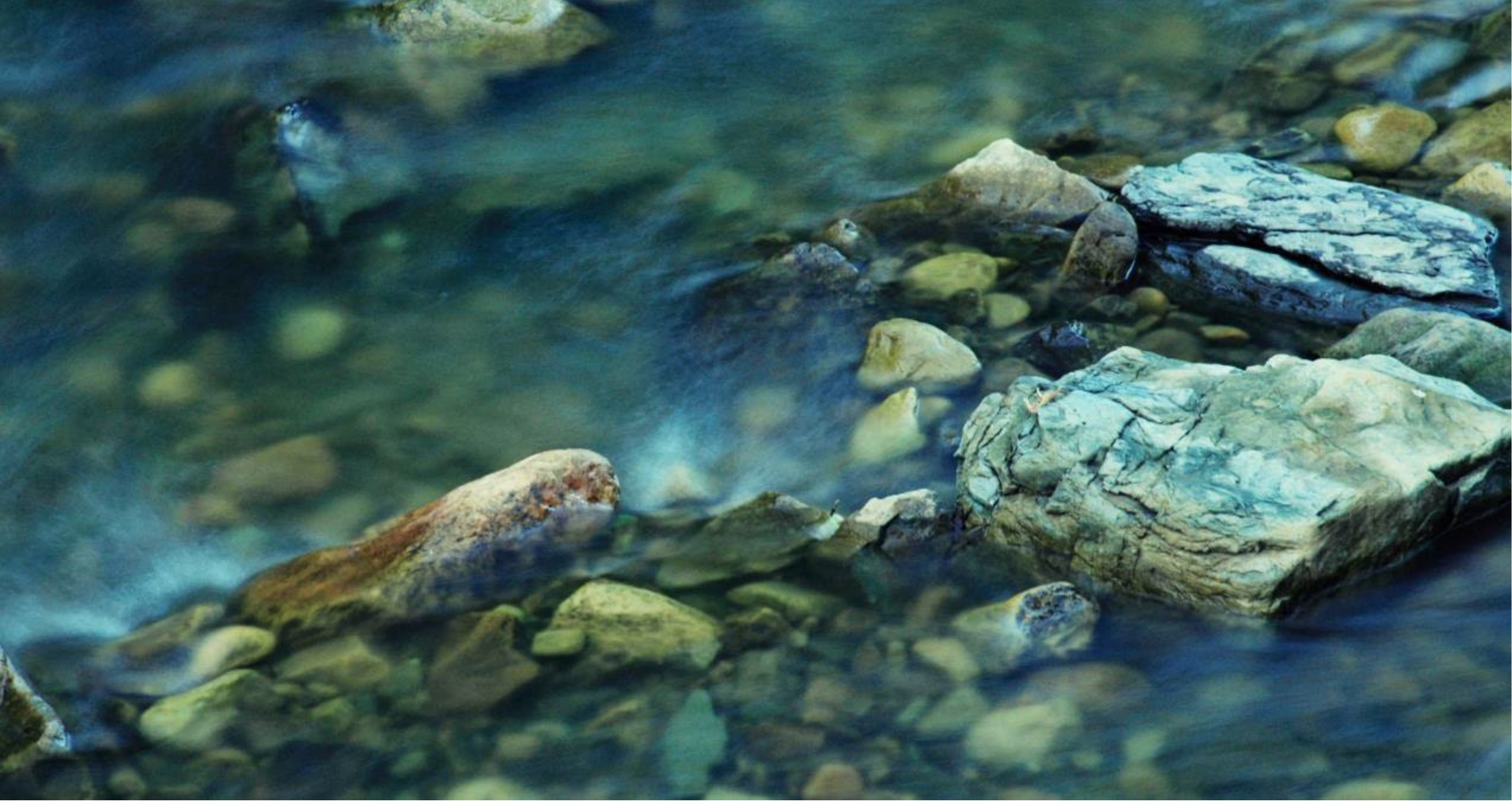
Table 5.4 Scenario Analysis Results with Proposed Diffuser

Scenario Number	Season	Ambient/ Effluent Temp.	River Depth	Port direction	Water Depth (ft)	Ambient Temp (ºC)	Effluent Temp (ºC)	Effluent Flow (cfs)	River Flow (cfs)	Wind Speed (mph)	Length of Near Field (m)	Mixing Ratio
17	Summer	Average	Deep	Horizontal	15	22.9	20.6	32.6	224	7.1	388	14.2
18	Summer	Worst-case	Deep	Horizontal	15	17.4	24.7	32.6	224	7.1	388	14.2
19	Winter	Average	Deep	Horizontal	15	10	8.9	32.6	300	9.5	388	14.2
20	Winter	Worst-case	Deep	Horizontal	15	4	14.6	32.6	300	9.5	388	14.2
21	Summer	Average	Shallow	Horizontal	3.5	22.9	20.6	32.6	75	7.1	388	7.6
22	Summer	Worst-case	Shallow	Horizontal	3.5	17.4	24.7	32.6	75	7.1	388	7.6
23	Winter	Average	Shallow	Horizontal	3.5	10	8.9	32.6	75	9.5	388	7.6
24	Winter	Worst-case	Shallow	Horizontal	3.5	4	14.6	32.6	75	9.5	388	7.6

6. Conclusions and Recommendations

The proposed maximum monthly flow capacity for the Oak Orchard WWTP is approximately double the existing flow capacity (proposed capacity is 21.1 mgd, existing capacity is 10 mgd). The ideal mixing ratio for the proposed discharge is approximately 8:1 to 10:1 depending upon the season. The CORMIX analysis indicated that the actual mixing ratio for the proposed discharge would be approximately 2:1 to 3:1. In addition, the mixing is relatively poor, and the plume interacts with the near edge of the river.

GHD recommends considering modifications to the diffuser to improve mixing ratio. The outfall should be inspected to verify the orientation of the discharge (vertical or horizontal). The upgrades include closing the first eight ports and ensuring that the discharge is horizontal. These changes increase the mixing ratios to approximately 8:1 to 14:1, which are similar to the ideal mixing ratios. The effluent also mixes across the width of the river with minimal edge interaction.



May 2025
Oak Orchard Wastewater Treatment Plant

Bathymetric Survey and 3D Scan Summary Report

Prepared for Carollo Engineers

May 2025
Oak Orchard Wastewater Treatment Plant

Bathymetric Survey and 3D Scan Summary Report

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Project Number: E40400-01.01 Task 10.1
\\WCL-FS1\Syracuse\Projects\Onondaga_County\Oak Orchard WWTP\Documents\Summary_Report\Draft\Oak Orchard WWTP_Survey Summary Report_May2025.docx

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FIGURES

APPENDICES

1 Introduction

As part of the proposed expansion of the Oak Orchard Wastewater Treatment Plant (WWTP), Anchor QEA performed a bathymetric survey of the Oneida River in the vicinity of the WWTP outfall pipe to record elevations of the river bottom. Additionally, a physical survey of the WWTP outfall pipe was performed during the same field event. The WWTP and survey area are located in the Town of Clay, Onondaga County, New York. The survey area spanned from approximately 200 feet downstream of U.S. Geological Survey (USGS) Gauging Station 04247000 (downstream of the Morgan Road bridge) upstream to the New York State Canal Corporation Buoy 182 (Figure 1). Field activities for both the bathymetric survey and physical survey were performed on April 21 and 22, 2025. Survey methods and results are described in the following sections.

2 Methods

2.1 Bathymetric Survey

A single-beam bathymetric survey was performed with a BioSonics MX Aquatic Habitat Echosounder. Specifications for the echosounder include 1.7-centimeter accuracy (±0.2% of depth), a depth range of 1 to 100 meters, and a 9° conical beam. The echosounder was mounted to a 16-foot jon boat. The smaller size and flat bottom design of the vessel allowed for surveying in shallow water conditions (Appendix A, Photograph 1). The vessel was navigated through the survey area along 27 target transect lines spaced 50 feet apart perpendicular to the centerline of the river (blue lines in Figure 2). Navigation along the transects was accomplished using a Trimble Catalyst GPS receiver and tablet combination with real-time display and submeter accuracy; actual vessel track lines with dots indicating depth recordings are shown in red in Figure 2. In addition to the original target transects, supplemental transects were completed around the Morgan Road bridge, diffuser pipe, and other areas of interest (Figure 2). Transects in the vicinity of the USGS gauging station (Appendix A, Photographs 2 and 3) were shifted slightly to align more directly with the station north to south (parallel to the Morgan Road bridge). In shallow water areas near the riverbanks not accessible by boat, data were collected by wading with a Trimble R6 rover unit to collect individual points along the target transects (light blue dots in Figure 2). The Trimble R6 receiver used a mobile hot spot to gain connection to the New York State Spatial Reference Network and achieve real-time centimeter level positioning. Trimble R6 accuracies ranged from 0.03 to 0.20 survey foot horizontally and 0.04 to 0.39 survey foot vertically. Most locations were in the range of 0.03 to 0.15 survey foot of accuracy with a few of the nearshore locations ranging higher due to tree cover blocking connection to satellites.

In the areas directly over and adjacent to the diffuser pipe, the bathymetric survey was performed at an increased density. Additional transects were run parallel to the shoreline at approximately 10-foot spacing that extended from the mouth of Mud Creek to approximately 150 feet upstream of the diffuser (Figure 2). Some target transects were adjusted in the field to accommodate site conditions. Two transects were added to extend the survey area to Buoy 182, and multiple parallel and perpendicular transects were completed around a sandbar observed in the approximate center of the survey area (Figure 2).

Water depths were collected with the Biosonics MX Aquatic Habitat Echosounder along the actual transects shown in Figure 2 (dotted red lines), and the raw data were post-processed using the Biosonics software. Post-processing involved interpolating water depths where data points were unable to be logged because of signal interference due to shallow water (<3 feet).

Stream water surface elevation was determined to be 362.70 feet (North American Vertical Datum of 1988 [NAVD88]) for the duration of the survey, as reported by USGS Gauging Station 04247000. To calculate the river bottom elevations, the water depths collected with the echosounder were subtracted from the stream water surface elevation. Actual river bottom elevations were collected in shallow water for the individual points logged with the Trimble R6 GPS. Biosonics and Trimble R6 data were merged in CAD, and elevations were interpolated between transect lines to produce a complete surface of the survey area.

A survey benchmark was accessed before and after the survey to perform a check of the Trimble R6 unit. The benchmark is maintained by the New York State Canal Corporation and is located at Lock 24 in the Village of Baldwinsville, Onondaga County, New York. Elevations logged by the Trimble R6 differed from the benchmark by an average of 0.086 foot. The horizontal measurements differed by 0.1 foot.

2.2 Outfall Pipe Physical Survey

A physical profile and camera survey of the existing WWTP diffuser pipe was completed. A 0.5-inch diameter steel probing rod was used to confirm the location of the pipe and determine sediment thickness and type adjacent to the pipe. Water depth was recorded at multiple points over the pipe using the marked probing rod. Measurements of the pipe and diffuser location and geometry were collected using the probing rod and GPS equipment.

Prior to commencing the camera survey, as-built drawings of the pipe were reviewed in detail for reference. Based on these drawings, the outfall diffuser pipe appears to be encased in a rectangular concrete structure (O'Brien & Gere 1975[1]). A Delta Vision HD underwater video camera mounted to an extendable pole was used in attempt to confirm the exterior condition of the pipe and any visible damage or deterioration, as well as ports and positions on the diffusers. Video was recorded using software on a laptop computer.

2.3 Identification of Other Structures or Hazards

General field conditions, structures, and any hazards observed during the field event were noted and described in the field log (Appendix B). GPS coordinates were logged and mapped out for objects of interest.

[1] O'Brien & Gere (O'Brien & Gere Engineers, Inc.), 1975. Contract Drawings. Oak Orchard Force Main and Effluent Sewer Contract IA. Clay Sanitary District. Available at: https://static.ongov.net/WEP/OakOrchard_WWTP/Drawings/OO_Force_Main_&_Effluent_Sewer_1975.pdf.

3 Results

3.1 Bathymetric Survey

River bottom elevations are shown in Figure 3 as contour lines at 1-foot and 5-foot intervals, which were derived from a combination of the Biosonics and Trimble R6 data. Bathymetry data were imported into Civil 3D AutoCAD and a Triangulated Irregular Network was generated to create the contour lines. Elevations ranged from 363 feet NAVD88 at the shoreline down to 341 feet NAVD88 in the center of the navigation channel. The navigation channel is well defined between the 345-foot NAVD88 elevation contours and bounded with steep slopes on either side ranging up to 360 feet NAVD88 to the north and 355 feet NAVD88 to the south. The streambank on the north side of the river is generally much steeper than the south side in the surveyed area, with elevations ranging from 350 to 360 feet NAVD88 over an approximate 60-foot distance. A more gradual slope exists on the south streambank, with the same elevation increase occurring over approximately 200 to 300 feet of distance. Where the riverbank cuts to the south just upstream of the Morgan Road bridge to form a small embayment, there is a subsurface sandbar containing a large log and multiple boulders located in the approximate center of the embayment, with depths ranging from 2 to 8 feet (Figure 3).

3.2 Outfall Pipe Survey

The outfall pipe location was confirmed to be 175 feet upstream of the mouth of Mud Creek (Figure 3). It was easily located with the probing rod by contacting the rectangular concrete casing that houses the pipe. The structure was found 40 feet from shore and able to be followed out into the river with the probing rod. Its location is also marked on land on the south streambank by two concrete posts between the shoreline and Oak Orchard Road (Appendix A, Photograph 4). Using the probing rod and Trimble Catalyst GPS, the outfall pipe was measured to be 132 feet in length, extending into the river from the south shoreline. The overall width of the concrete casing was measured at 13 feet. Water depths over the structure ranged from 6.0 to 6.5 feet from the top of the structure to the surface, as determined by the probing rod. Sediment has built up evenly with the top of pipe elevation along each side and consists of 3 to 4 feet of medium to coarse sand and gravel (refusal of the probing rod was encountered beyond the 3 to 4 feet depth). Based on the water depths collected, the elevation of the top of the concrete structure ranges from 356.2 to 356.7 feet NAVD88.

The risers shown in the as-built drawings appear to have been broken off, because none were visible during video surveys or identified while probing. Furthermore, multiple ports were located using the probing rod, confirming the absence of the risers. Probing inside the openings revealed the presence of silt and sand (approximately 6 inches) at the bottom of the pipe, with a hard surface detected below that. Overall, probing determined the concrete structure surrounding the pipe is intact. Immediately beyond the end of the pipe opening, the water depth increases to 11 feet. Buildup of sediment in and around the structure prohibited recording clear, discernable footage with the underwater camera (Appendix A, Photographs 5 and 6).

3.3 Identification of Other Structures and Hazards

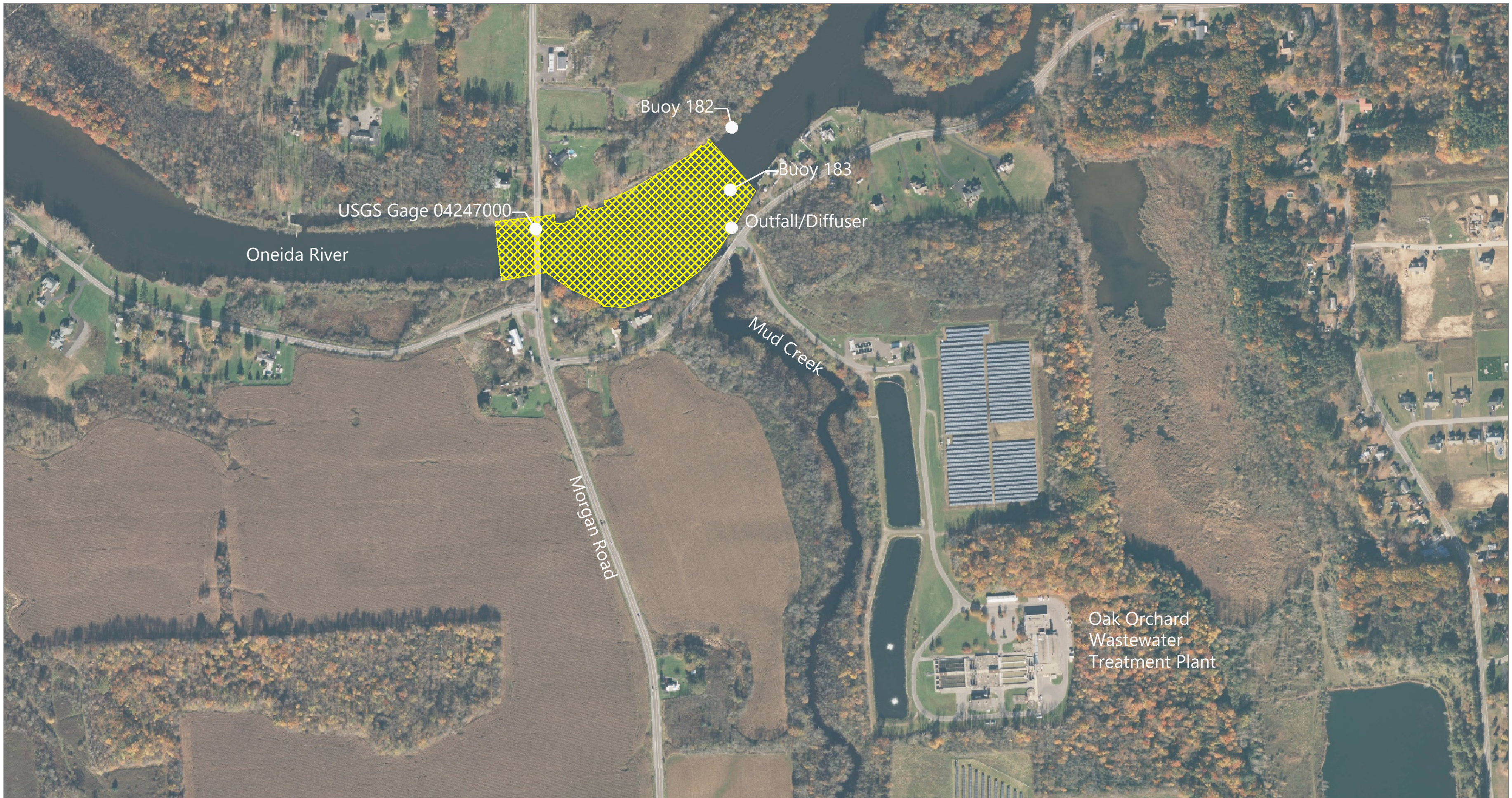
Structures and hazards located above the water and beneath the water surface were documented. GPS coordinates were logged, and underwater video was recorded of the equipment associated with the USGS gauge (Appendix A, Photograph 7), which was assessed to be in good condition. The USGS staff gauge was found attached to the northern-most bridge abutment (Appendix A, Photograph 8). A large metal structure was observed above water and located upstream of Morgan Road (Figure 3 and Appendix A, Photograph 9). The purpose of the structure was undetermined. Additionally, GPS coordinates were logged for Buoys 182 and 183 (Appendix A, Photograph 10). A private dock (Appendix A, Photograph 11) is located on the north streambank, downstream of the USGS gauge. After three attempts concentrated in the area of the Morgan Road bridge, the velocimeter associated with the USGS gauge was unable to be located. In the area of the sandbar in the embayment south of the navigation channel, there are multiple large logs caught on the river bottom and protruding above the water surface, as well as boulders just below the surface (Figure 3 and Appendix A, Photograph 12).

3.4 Project Deliverables

In conjunction with this summary report, all raw data files will be transmitted electronically (Appendix C) and include the following:

- Biosonics raw data
- Trimble R6 data files
- Underwater Video
- Trimble Catalyst and tablet data file
- CAD files
- Site photographs

Figures



SOURCE: Aerial © 2025 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS © 2024 TMAP MOBILITY Earthstar Geographics SIO

LEGEND:

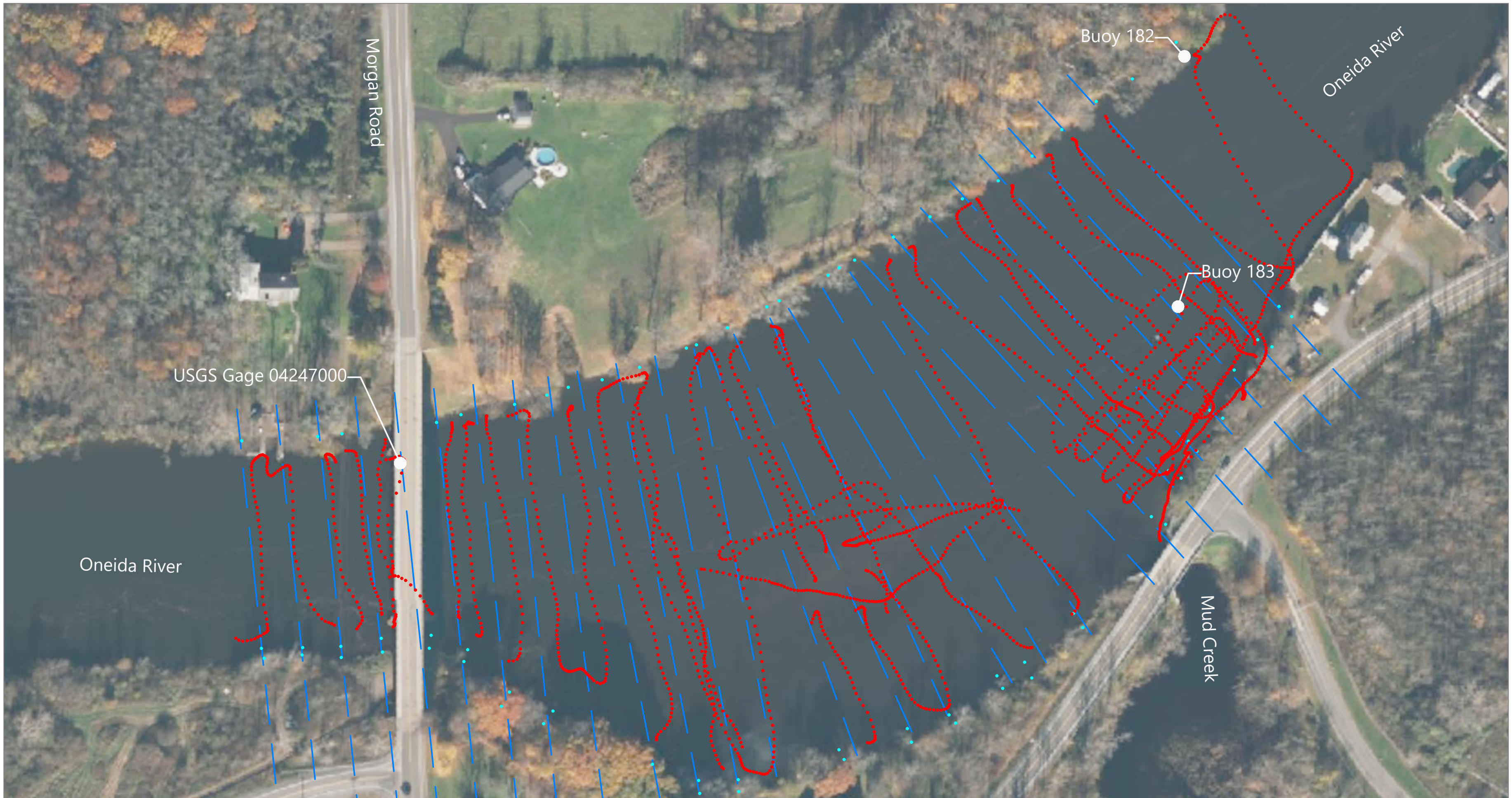
Survey Area

0 800
Feet

Publish Date: 2025/05/21 11:41 AM | User: cyard
Filepath: K:\Projects\0400-Onondaga County\Oak Orchard WWTP\0400-RP-002-OAK_ORCHARD_Survey.dwg Figure 1

ANCHOR QEA

Figure 1
Survey Area



SOURCE: Aerial © 2025 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS © 2024 TMAP MOBILITY Earthstar Geographics SIO
VERTICAL DATUM: NAVD88

LEGEND:

Target Survey Transect (Perpendicular to Centerline of River)

Survey Transect (Actual)

Trimble R6 Points

0 200
Feet

Publish Date: 2025/05/21 11:31 AM | User: cyard
Filepath: K:\Projects\0400-Onondaga County\Oak Orchard WWTP\0400-RP-001-OAK_ORCHARD_Bathy.dwg Figure 2

ANCHOR QEA

Figure 2
Survey Transects

Summary Report
Oak Orchard Bathymetry Survey

SOURCE: Aerial © 2025 Microsoft Corporation © 2024 Maxar © CNES (2024) Distribution Airbus DS © 2024 TMAP MOBILITY Earthstar Geographics SIO
VERTICAL DATUM: NAVD88

LEGEND:

- Existing Bathymetric Contours (1' & 5' Intervals)
- Outfall Pipe
- Logs/Subsurface Boulders
- Unknown Metal Structure

0 200
Feet

Publish Date: 2025/05/21 11:31 AM | User: cyard
Filepath: K:\Projects\0400-Onondaga County\Oak Orchard WWTP\0400-RP-001-OAK_ORCHARD_Bathy.dwg Figure 3

ANCHOR QEA

Figure 3
Bathymetric Survey Results

Summary Report
Oak Orchard Bathymetry Survey

Appendix A
Photograph Log

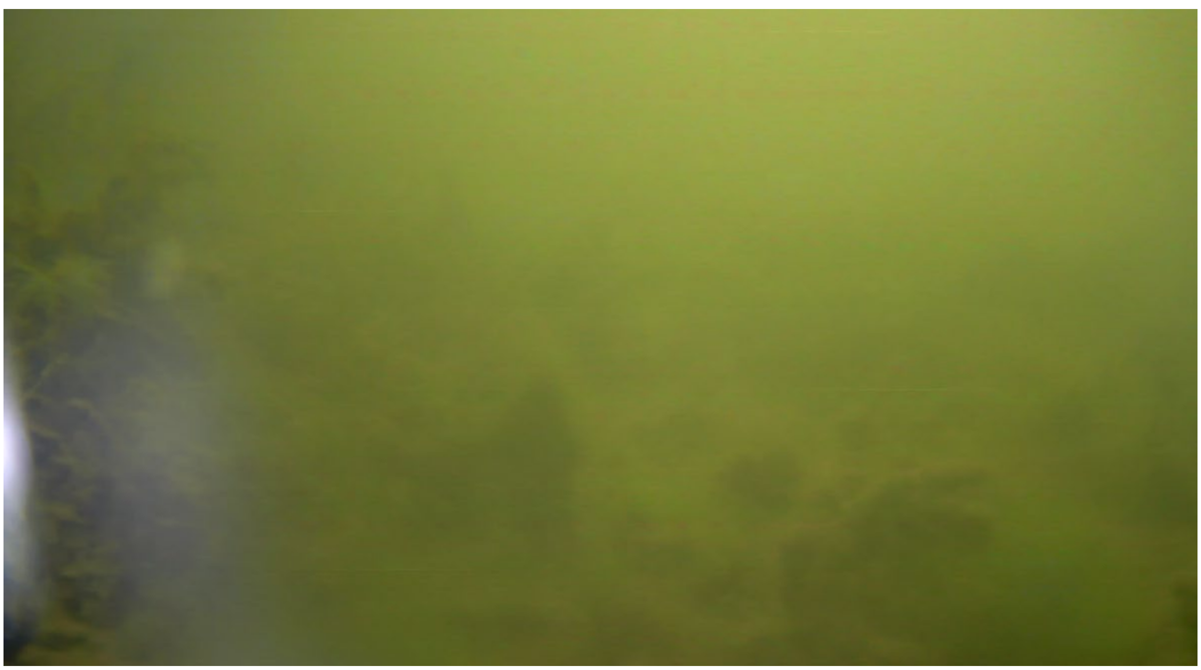
Photograph 1: Flat-bottom jon boat used for shallow water survey.

Photograph 2: Transect locations in vicinity of USGS gage.

Photograph 3: USGS Gage Station.

Photograph 4: Diffuser pipe location marked with concrete posts, former concrete outfall pipe.

Photograph 5: Underwater still of diffuser pipe covered in sediment and vegetation.



Photograph 6: Underwater still of diffuser pipe covered in sediment and vegetation.

Photograph 7: USGS Gage underwater.

Photograph 8: USGS staff gauge in good condition.

Photograph 9: Large metal structure upstream of Morgan Road.

Photograph 10: Buoy 182 looking towards location of diffuser pipe.

Photograph 11: Dock at the downstream edge of the survey area on north side of the river.

Photograph 12: Large partially submerged tree located on sandbar south of the navigation channel (Figure 3).

Appendix B
Field Log

OOWWTP Survey

4/21/25 Cloudy, ~40's -50's, rain on and off. winds 10-25 mph, gusts

1125 - CC + EM arrive @ Bonstance Rd boat launch. J. R. already there.

- Begin prepping to launch. Having issues getting the RG to connect to anyone's WiFi.
- Decision is made to move on without it. J. R. will continue troubleshooting.

1200 - on water & heading to survey area.

1230 - Begin bathy transects. wind gusts making it difficult to stay on course.

- Redo first three due to depth range not being set correctly in VA software.
- Did 2 extra transects near bridge that run parallel w/ it.

1300

1315

1300 - Transects in middle of survey area get a little wonky due to wind gusts and stronger current in the middle of river.

1315 - Large sandbar and log along w/ some boulders located in middle of river + transect area.

- Ⓢ side is ~ 1.5-2.5' deep
  Ⓝ side is ~ 4-5' deep

- Ran transects from each river bank up to the log/sandbar. ~~but~~ Then would stop, ~~and~~ go around, and continue from the other side.

1430 - Transects in Field Maps don't reach buoy 182.
  - Add two extra transects so that missing area is covered as well.

1445 - complete transect

1500 - Begin using video camera to search for diffuser.

- WP Figure shows it located on left side of mouth of Mud Creek near bridge but previous figures showed it closer to where the concrete pipe comes out of the bank, near the SPDES permit sign.

- search around bridge on foot + w/ camera, nothing

1530 Begin to run transects parallel w/ river bank from mouth of mud creek to the black manmade wall.

1630 completed six parallel transects and multiple perpendicular/circular runs in various areas with no luck.

1640 -

1700

1640 - Head over to USGS gauge area to photo/film.

- We are unable to locate a velocimeter after an initial attempt when we first arrived on site and a second now.

1705 - Return to diffuser area to re-attempt
- Change angle of camera on rod

- Bottom is a mix of ~~[illegible]~~ gravel, riprap, and boulders, - all covered w/ algae.
  - makes it difficult for EM to discern ~~[illegible]~~ features.

1840 - Head off site to return tomorrow.

1820 - Off water

4/22/25

0800 - CC + EM arrive @ Bonstance Rd launch

0830 - Meet J.R. @ survey area

0845 - Begin taking pole shots along shore at each ~~mapped trs~~ targeted transect.

1045 - ~~Po~~ Pole shots complete. Transects 1, 8, and 5 (near USGS gage) had poor signal + accuracy.

- There was ~0.5' - 2' of loose silt/organics/woody debris on the river bottom in the vicinity of transects 9, 10, and 11

- There is a dock on (W) end of transect 2 that prevented us from ~~gettin~~ completing the transect.

1100 - Begin searching for diffuser in area mentioned by D. Sachs of Carollo.

1130 - ~~[illegible]~~ Can't find anything w/ camera
- begin probing.

1135 - Locate possible structure but it's difficult to drive boat in winds and probe at the same time.

1140 - J.R. comes on boat to probe as well.
Confirms location of diffuser

- Joe from WWTP comes down points out where it should be as well.

1150 - J.R. locates a riser hole.
- Risers appear to no longer be present, as was mentioned by Joe.

1155 - begin taking measurements both manually and adding points in Field Maps.

- very difficult due to windspeeds and direction

- Top of pipe/diffuser is ~72"-78" below surface of water.
- begins about 10 yds from shore and continues ~~for~~ for slightly over 100' from shore.

- appears to be ~~~6.0' wide~~ ~6.5-7.5' wide
  - again, difficult to get exact measurements from surface b/c of conditions

~1300 - complete survey of pipe/diffuser

1305 - CC & EM return to bridge to add points in Field Maps for USGS gauge

- decide to run perpendicular transects around the sand bar/log area on the way back.

1315 - one final search for velocimeter
- no luck

1320 - ~~Pre~~ leave site to demob.

1400 - off water & travelling home

Appendix C
Raw Survey Data

To be submitted electronically.