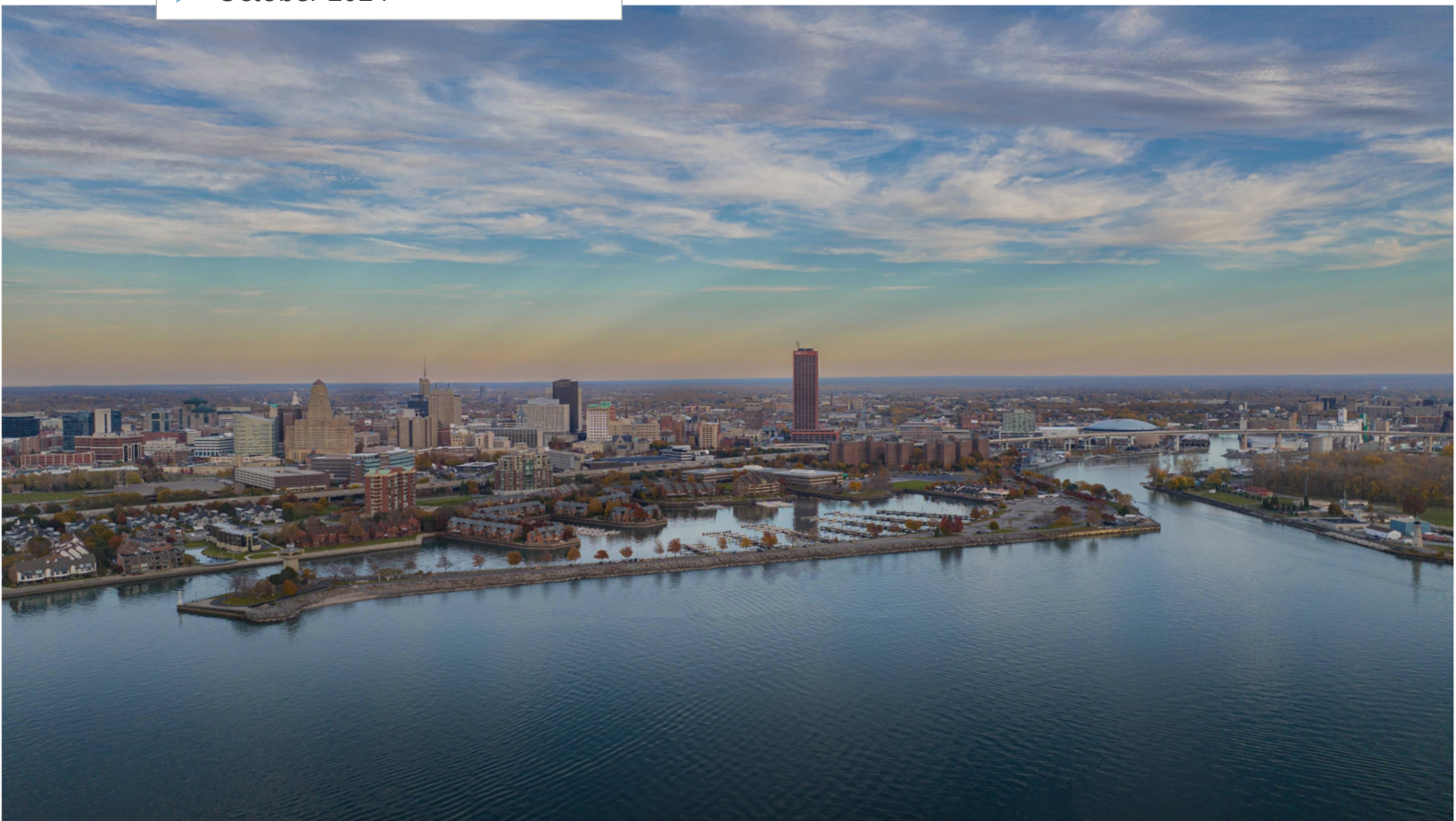


Appendix A: CSO Storage Tank Flushing Design Guide Memorandum

► October 2024



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SECTION 1 INTRODUCTION

1.1 Objective

The goal of this design guide memorandum is to provide recommendations to the Buffalo Sewer Authority (BSA) for the design of flushing systems for Combined Sewer Overflow (CSO) storage tanks and to facilitate standardization across designs, current and future. Design standardization will achieve simplification of maintenance activities and operator training and to allow a robust spare part stockpile that will lead to decreased down time for CSO storage tank flushing equipment.

1.2 Purpose

The purpose of a CSO storage tank is to store combined sewer flow during wet weather events to minimize a CSO event to nearby waterways and improving the water quality by reducing the discharge of E.coli, solids and floatables in the waterways due to CSOs. A CSO storage tank has the ability to store flow during a wet weather event and then release flow back into the collection system. The combined sewage stored in the CSO storage tank will be conveyed to the Bird Island Wastewater Treatment Facility (WWTF) for treatment after a wet weather event. CSO storage tanks can be covered or uncovered and can be of a variety of shapes and sizes, depending on the site layout. Following a wet weather event, debris and sediment may settle along the tank bottom which requires cleaning to prevent odors.

There are multiple methods that can be used to flush CSO storage tanks after being drained.

- Manual Cleaning: Clean the tank with hoses, either from above or within the tank after a wet weather event.
- Mechanical Cleaning: There are multiple types of equipment used to flush tanks, including tipping buckets, flushing gates, pivoting drums, and vacuum flushing. Tipping buckets and flushing gates are the most commonly used equipment for flushing CSO storage tanks.

This memorandum provides an overview of tipping buckets and flushing gates, design guidance, recommended design criteria and when to use each technology for BSA.

SECTION 2 TIPPING BUCKETS

2.1 Equipment Overview

Tipping buckets are a flushing system used to remove solids from the tank floor to a downstream sump. The tipping bucket is filled to a preset level with an external supply of water. When the bucket reaches capacity, it pivots backwards, and releases water in a flushing wave action into the storage tank, pushing the debris on the tank floor into the downstream sump. The tipping bucket then returns to its original position for the process to repeat again, if needed.

When using tipping buckets, the storage tank floor will be divided by guide walls into flushways to allow for efficient flushing of the tank floor. The flushways allow for a path of travel for the water after the bucket is emptied. Guide walls along the bottom of the tank prevent spreading of the flushing wave generated by each bucket as the wave moves downstream (see **Figure 2-1**).



Figure 2-1: Tipping Buckets (source: Grande Water Management Systems)

2.2 Design Criteria

2.2.1 Design Parameters

- Maximum Flushway Width: 30ft
 - Flushway width is usually determined by column spacing in closed tanks.
- Maximum Flushway Length: 350ft
- Tipping buckets use an external supply of water (potable, treated effluent, clean water) for flushing.
- The size of the water fill line is based on the size, number, and required fill time for flushing.
- The tipping buckets can be constructed in 316SS or 304SS to minimize corrosion and maintenance requirements for painting and coating.
- Suitable for rectangular storage tanks, which are most common for collection systems
- Guide walls along each flushing:

- Typically provide 2-foot-high guide walls for the first 20' of flushway and then 1 foot guide walls for the remainder of the tank length to maximize flushing wave action
- Provide access to the tipping bucket bearings for maintenance (see below).
 - For open top storage tanks, it is recommended to provide a walkway adjacent to the tipping buckets for access for maintenance staff.
 - In closed storage tanks, it is recommended to provide access to the bearings via an access point located above each bearing.

2.2.2 Maintenance Requirements

The maintenance required should be coordinated with the manufacture for each installation.

- In general, it is recommended to visually inspect the tipping buckets after the first three events and then every six months
- Inspect and grease bearings every five years

2.3 Advantages and Disadvantages

2.3.1 Advantages

- Unlimited flushes, if required.
- Least amount of water used per flush.
- Can be remotely operated.
- Can be installed in new or existing tanks.
- Fresh source of water ensures no additional debris is added to the tank during the flushing operation.
- Entire tipping bucket assembly can be located above the maximum water surface elevation in the tank, so it is never submerged in raw sewage.

2.3.2 Disadvantages

- No side wall cleaning with flushing wave, which may be required for high debris scenarios.
- External water source required
- Length of flushway which cannot exceed 350ft.
- Not suitable for circular tanks.
 - Flushing gates or vacuum flush can be used for circular tank configurations.
- Requires walkway or access points above the tipping bucket bearings for inspection due to the typical height of the tipping buckets above the tank floor
 - If the tank is enclosed, access points located above the bearings to allow for visual inspection are recommended. Access within the tank to complete maintenance will require confined space entry.
- Access for enclosed tanks can be challenging; depending on the size of the tipping bucket, removable concrete panels may be required to remove the tipping bucket for replacement.

2.4 Tipping Bucket Manufacturers

Multiple manufacturers provide tipping buckets, including: Grande Water Management Systems, Gabriel Novac & Associates, and Veolia.

NOTE: If the project is funded by a State Revolving Fund (SRF), then coordination with the equipment manufacturers is advised for any Made in America requirements that may be enforced (Build America, Buy America).

2.5 Guide Specification

The guide specification for tipping buckets can be found in Appendix A.

SECTION 3 FLUSHING GATES

3.1 Equipment Overview

Flushing gates are a tank flushing system to remove solids settled on the bottom of tank floors. Water is stored behind a gate until the tank is drained. The gate is opened, and the water released in a flushing wave action, pushing the debris on the storage tank floor to a downstream sump. During a wet weather event, the CSO storage tank is filled. The flushing gates are in the closed position, allowing for the storage area to be filled with in-situ water. The flushing gates are typically hydraulically actuated, with the hydraulic system being oil based.

The water level inside the flush storage area, following a wet weather event, activates the electronic signal, which pressurizes the gate cylinder causing the gate latching hooks to open. The hydrostatic pressure causes the flushing gate to open, releasing flush water down the flushway for the length of the CSO storage tank, taking debris on the tank floor with it to the downstream sump. Once the flush water is emptied, the gate closes, and the gate latching hooks move back to the closed position to secure the gate shut.

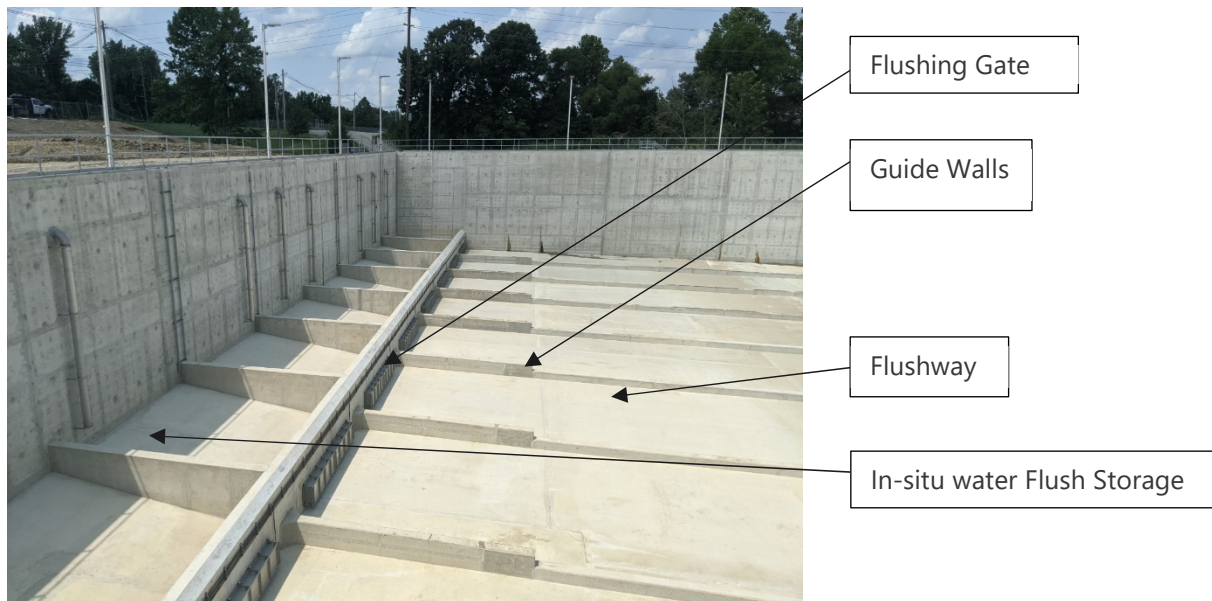


Figure 3-1: Flushing Gates (source: TYLin, Greeley and Hansen Water Solutions)

3.2 Design Criteria

3.2.1 Design Parameters

- Maximum flushing length: 850-feet
 - It is feasible to have longer than 850-foot flushing lengths. If the CSO storage tank is longer than 850-feet, coordinate with the equipment manufacturer on the water requirements needed for flushing.
- Typically uses in situ water for flush and no external water source is required.
- The flushing gates are constructed in 316SS or 304SS to minimize maintenance requirements.
- 2-foot guide walls for the first 20' of the flushway and then 1-foot guide walls for the remainder of the tank length to maximize flushing wave action.

- The flushway width should not exceed 30" from the flushing gate opening to prevent debris buildup in the corners.
- Flushing gates are typically designed to hold 5 to 6-feet of water in the flush water storage area.

3.2.2 Maintenance Requirements

The maintenance required should be coordinated with the manufacturer for each installation.

- In general, it is recommended to visually inspect the flushing gates every quarter
- It is recommended to change the oil filter cartridge every 2 to 5 years depending on usage frequency

3.3 Advantages and Disadvantages

3.3.1 Advantages

- Remotely operated
- No external water supply required
- Easy installation for new and existing storage tanks
- Can be used in rectangular or circular storage tanks
- Works with open or closed storage tanks.
- Gates are sized such that they can typically be removed through 48-inch diameter manholes
- Area behind flushing gate can serve as energy dissipation pool when sewers entering the tank are significantly above tank floor elevation.

3.3.2 Disadvantages

- Requires the most amount of water to flush
- No side wall cleaning with flushing wave (if required for high debris scenarios).
- Generally, single flush only. However, an external water source can be provided to refill the flush storage area behind the flushing gates if there are concerns with a single flush.
- Debris can get stuck between the flap and frame of the flushing gate and require maintenance
- A hydraulic system is typically used to actuate the flushing gate and requires additional maintenance.
- Maintenance of flushing gates in both open and closed tanks would require confined space entry

3.4 Recommended Manufacturers

Multiple manufacturers provide tipping buckets, including: Grande Water Management Systems and Gabriel Novac & Associates.

NOTE: If the project is funded by a State Revolving Fund (SRF), then coordination with the equipment manufacturers is advised for any Made in America requirements that may be enforced (Build America, Buy America).

3.5 Guide Specification

The guide specification for flushing gates can be found in Appendix B.

SECTION 4 SUMMARY

Both tipping buckets and flushing gates can be used at BSA CSO storage tanks as a means to flush the tanks after a wet weather event. The project specific requirements will dictate the selection of the equipment to be used.

The project specific requirements and design considerations should include the following:

4.1 CSO Storage Tank Dimensions

The maximum flushway length for the CSO storage tank when using tipping buckets is 350ft. For storage tanks that are longer than 350ft, the recommended option for the flushing system would be to utilize a flushing gate system.

4.2 Access to a Water Source

Tipping buckets require an external water source (potable, treated effluent, clean water) to flush the debris in the CSO storage tank. Flushing gates use in-situ water for flushing which is more readily available. If it is challenging to provide an external water source for flushing, it may be optimal to use a flushing gate system.

4.3 Maintenance Requirements for Equipment

Due to the minimal moving parts in a tipping bucket system, the resulting maintenance requirements are less than that of a flushing gate system. The tipping bucket system requires visual inspection and periodic greasing of the bearings. Due to the use of potable water in tipping buckets, the equipment is not exposed to debris from the water source. The flushing gate system can be prone to debris getting stuck between the flap and the frame of the gate due to the use of in situ water.

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APPENDIX A: Guide Specification - Tipping Sediment Flushing Tanks

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SECTION 46 46 13 TIPPING SEDIMENT FLUSHING TANKS

PART 1 GENERAL

1.1 SUMMARY

NOTE: Fill in required description or location.

- A. Section includes: Requirements for furnishing and installing a tipping sediment flushing tank (called a tipping bucket hereafter) system in the storage tank including tipping buckets, tipping bucket anchors, and appurtenances necessary for a complete installation.

- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

NOTE: Add required information.

1. Section 05 12 00 – Structural Steel Framing
2. Section 05 50 00 – Metal Fabrications
3. Section 03 30 00 – Cas-In-Place Concrete
4. Section 40 05 00 – Common Work Results for Process Interconnections

1.2 SYSTEM DESCRIPTION

NOTE: Add required information.

- A. Provide all special tools, materials and labor for furnishing the flushing equipment as shown on the plans. Provide tipping buckets suitable for flushing accumulated solids and debris from the retention basin floor with a single flushing sequence only.

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Shop Drawings: Submit shop drawings for all tipping buckets and appurtenances including identification of each item, its exact location, material of construction, standard part number, and all pertinent dimensions for proper installation of the tipping bucket system. Submit installation instructions for each tipping bucket system.
- C. Quality Control Submittals: Submit manufacturer's certified performance and materials record as specified.
- D. Operation and Maintenance: Submit operation and maintenance manuals for the equipment in accordance with Division 1.

- E. Submit documentation that manufacturer's equipment has been installed in at least ten (10) different facilities currently in operation, and that the equipment has been in operation for at least 10 years.

1.4 DELIVERY AND HANDLING

- A. General: Deliver and handle all products and materials as specified in Division 1.
- B. Care: Use every precaution to prevent damage to the tipping buckets during transportation and delivery to the site. Take extreme care in loading and unloading the tipping buckets and accessories. Deliver in undamaged condition in manufacturer's unopened containers or packaging, dry, with identifying labels intact and legible.
- C. Arrange deliveries of products with proper sequencing and scheduling in accordance with the approved Official Project Construction Schedule. Allow time for inspection prior to installation.
- D. Damaged Tipping Buckets: If, in the process of transportation or handling, any tipping bucket is damaged, replace or repair such tipping bucket(s). Have all repairs made by the manufacturer or manufacturer's representative to the satisfaction required.

1.5 SPARE PARTS

- A. Furnish the following:
 - 1. Two sets of 316 Stainless Steel bearings for each size bucket provided.
 - 2. Sufficient lubricants for two years operation at the manufacturer's recommended lubrication interval.

1.6 WARRANTY

- A. Provide manufacturer's warranty for a period of two (2) years against manufacturing and design defects for the tipping bucket system, and all its appurtenances, from the date of substantial completion except as noted below.
 - 1. Each tipping bucket system (the support system complete with bearings and anchoring and the tipping bucket) shall be guaranteed against manufacturing and design defects for a period of two (2) years from the date of installation. The manufacturer warrants that the flushing system will effectively remove the sediments deposited on the basin floor using only one flushing, under "normal" loading conditions, which is defined as 2" deposition across the entire tank floor. If there is 4-6" deposition across the entire tank floor, then a second flush may be required.

PART 2 PRODUCT

NOTE: This Guide Spec is based on equipment supplied by the listed manufacturers.

2.1 MANUFACTURERS

- A. Acceptable manufacturers are as listed. Manufacturers of equivalent products may be submitted.
1. Gabrial Novac & Associates, Inc.
Montreal, Quebec, Canada
 2. Grande Water Management Systems, Inc.
Laval, Quebec, Canada
 3. Veolia
Montreal, Quebec, Canada

2.2 DESIGN AND CAPACITY

NOTES:

1. Edit as required.
2. Specify capacity, CSO storage tank dimensions, and slope of flushway.
3. Specify material for tipping buckets. Plate thickness of bucket shall be no less than 1/8 inch to withstand static and dynamic loading.

- A. General: Design the tipping buckets to become unstable as a result of a shift in the center of gravity and tip thereby causing the water contents to spill along the back wall of the CSO storage tank and run along the floor of the storage tank. The resulting high celerity wave will wash debris and settled materials, which have deposited on the floor and into sump area downstream of the tank. Fabricate the bucket to return to its stable, upright position using only the force of gravity after the tipping bucket has discharged its contents.
- B. Tipping Bucket Design: The design will have ____ (number) flush tipping buckets, ____ (number) stainless steel tipping bucket side wall support systems, and ____ (number) stainless steel tipping bucket back wall support system. Provide a system designed to clean the tank floor in ____ flush(es) with a minimum volume of ____ gallons per linear foot of bucket length. The minimum total volume of each bucket shall not be less than ____ gallons. Verify volume with aid of meter in the field. The tipping bucket shall be fabricated entirely of ____ (material). The CSO Storage Tank will have a slope of ____%. Provide weepholes at the bottom to allow for draining of any excess to ensure no standing water in the bucket after flushing is complete.
- C. Supports: The support system shall be fabricated entirely of ____ (304 Stainless Steel/ 316 Stainless Steel) and anchored into the side walls of the tank using chemical anchors; anchors, nuts, washers and lock washers shall be fabricated entirely of ____ (material).). The support system material should be the same as the tipping bucket material. The support systems shall be designed to withstand both the static and dynamic loads. In addition, the manufacturer will supply the static and dynamic loads as well as their exact locations to the ENGINEER to verify the structural design of the concrete.

- D. Bearings: The bearings will consist of tapered spherical double roller bearings with locking sleeve in a split housing equipped with an end cap and double lip seal or equivalent. The bearings will be factory installed and tested and will be lubricated with waterproof grease. The bearing housing material will be 316 Stainless Steel.
- E. Design, factory fabricate, assemble, test, and place in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer of the arrangement, minimum size, capacities and characteristics shown or described.

PART 3 EXECUTION

3.1 GENERAL

- A. General: Install the tipping buckets in the locations shown and in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. All required concrete anchors shall be made of 316 Stainless Steel threaded rods by Hilti. The rods should be installed with chemical anchors by Hilti, Model HAS-SS, or approved equal.
- C. The tipping bucket shall be shipped to site preassembled and ready to install. The manufacturer's field technician will verify the complete installation, make any necessary mechanical adjustments, and initiate start-up.
- D. The manufacturer's field technician shall prepare a field report and submit the report to the ENGINEER.
- E. The equipment manufacturer shall provide the services of a qualified field technician to instruct the OWNER's personnel in the proper maintenance of the equipment.
- F. The CONTRACTOR shall coordinate the installation of the tipping bucket with the construction of the flushing water structures to assure a satisfactory installation and the successful operation of the sediment flushing tipping bucket's system.
- G. Tests: After installation of the flushing system subject the units to a field running test, as specified in Division 1, under actual operating conditions.

3.2 STORAGE AND PROTECTION

- A. The CONTRACTOR shall comply with the following storage and protection requirements:
 - 1. Use all means necessary to protect products of this Section before, during and after installation and to protect installed work and materials of all other trades.

2. Store all products in strict accordance with the manufacturer's recommendations as approved by the ENGINEER with all labels and seals intact and legible.
3. Provide off-site storage and protection when site does not permit on-site storage or protection.
4. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement or damage.
5. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.
6. Replacement: In the event of damage to a product during transportation, handling or storage, the CONTRACTOR shall immediately make all repairs and replacements necessary to the approval of the ENGINEER and at no additional cost to the OWNER.

3.3 INSPECTION

- A. Verification of Conditions: The CONTRACTOR shall examine the areas and conditions under which the work of this Section will be installed and correct conditions detrimental to proper and timely completion of the Work. The CONTRACTOR shall not proceed until unsatisfactory conditions have been corrected.

3.4 INSTALLATION

- A. General: Install equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Make all necessary adjustments to equipment to provide complete and satisfactory operation upon completion of the installation.
- B. Mount flushing equipment using a top-wall mounting support system in accordance with the manufacturer's recommendations. Provide raised reinforced equipment supports if needed for the proper equipment operation within the space provided on the structure. Place approximately $\frac{3}{4}$ inch non-shrink cement grout beneath the bearing plates to assure uniform support, in accordance with Section 03 60 00 - Grouting.
- C. Run non-metallic grease lines from the bearings to within easy reach of the adjacent walk. Provide Zerk grease fittings at that location mounted on a 316 stainless steel angle mounts mounted to the tank wall with anchor bolts.
- D. Lubrication: Properly lubricate all pieces of equipment, furnished with lubrication fittings, prior to start-up and at recommended intervals before turning equipment over to the OWNER. Attach a linen tag or heavy-duty shipping tag to each piece of equipment showing the date of lubrication and the name and number of lubricants used. Furnish list of each item lubricated and the type of lubricant used.

3.5 TOLERANCE

- A. The CONTRACTOR shall be responsible for any changes, addition or deletions to the dimensions and their tolerances from the drawings which may adversely affect the installation or operation of the sediment flushing tipping bucket system. These dimensions

and their tolerances shall be clearly indicated on the manufacturer's shop drawings to be submitted to the ENGINEER for his review and approval.

3.6 FIELD QUALITY CONTROL

- A. Upon completion of the installation, the CONTRACTOR shall furnish all personnel and equipment necessary to test and retest the complete system, making all adjustments required, as specified herein and as specified by the manufacturer. This shall include the inspection of the equipment by the manufacturer with a written field report and certification stating that the sediment flushing tipping bucket system has been properly installed and is operating satisfactorily.
- B. Tests: After installation of the flushing tipping buckets and all appurtenances, subject each unit to a field running test as specified in Division 1, under actual operating conditions.

END OF SECTION

APPENDIX B: Guide Specification – Flushing Gates

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SECTION 46 46 16
FLUSHING GATES

PART 1 GENERAL

1.1 SUMMARY

NOTE: Fill in required description or location.

- A. Section includes: Requirements for furnishing and installing a flushing gate system in the storage tank including flushing gates, gate anchors, hydraulic piping, valves, hydraulic power pack, control panel and controls, together with all controls and appurtenances necessary for a complete installation.

- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

NOTE: Add required information.

1. Section 03 30 00 – Cast-in-Place Concrete
2. Section 09 91 00 – Painting
3. Section 40 61 00 – Process Control and Enterprise Management Systems General Provisions
4. Section 40 61 00 – Process Control System General Provisions
5. Section 40 63 43 – Programmable Logic Controllers
6. Section 40 05 53 – Process Valves
7. Section 26 05 00 – Common Work Results for Electrical

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
1. NEC - National Electrical Code

1.3 SYSTEM DESCRIPTION

NOTE: Add required information.

- A. General: Provide a flushing gate system designed to clean sedimented debris from the floor of the storage tank. The system uses combined sewage as the flush water with flush water storage areas located behind the gates, which are filled using the system inflow.
- B. Gate Design: Provide a flushing gate system designed to clean the tank floor in one flush with a minimum depth of ____ inches of flush water being stored behind the gate.

1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.

- B. Shop Drawings: Submit working drawings, including arrangement and erection drawings of the equipment and control equipment, manufacturer catalog cutsheets, hydraulic fluid data, schematic control diagrams, electrical connection diagrams and complete description of the control system.
- C. Quality Control Submittals: Submit manufacturer's certified performance and materials record as specified.
- D. Submit documentation that manufacturer's equipment has been installed in at least ten (10) different facilities currently in operation, and that the equipment has been in operation for at least 10 years.

1.5 DELIVERY AND HANDLING

- A. General: Deliver and handle all products and materials as specified in Division 1.
- B. Care: Use every precaution to prevent injury to the flushing gates during transportation and delivery to the site. Take extreme care in loading and unloading the flushing gates and accessories. Do such Work slowly with skids and suitable power equipment so that the flushing gates are under full control at all times. Do not drop, bump, drag, push, roll or move the flushing gate in any way which will cause damage to the tank under any conditions.
- C. Damaged Flushing Gate: If, in the process of transportation or handling, any flushing gate is damaged, replace or repair such flushing gate or gates. Have all repairs made by the manufacturer or manufacturer's representative to the satisfaction required.

1.6 QUALITY CONTROL SUBMITTALS

- A. General: Submit certified copies of the factory test report for each component prior to shipment. Factory assemble and test each component of the flushing gate system. The maximum permissible leakage rate is not to exceed 0.1 gpm per foot of seal length.

1.7 SPARE PARTS

- A. Furnish the following:
 - 1. One set of gaskets for each size gate provided.
 - 2. One gate locking mechanism.
 - 3. One solenoid operated valve of each size and type provided.
 - 4. One spare oil filter.

1.8 WARRANTY

- A. Provide manufacturer's warranty for a period of five (5) years against manufacturing and design defects for the flushing gate system, and all its appurtenances, from the date of delivery except as noted below.
 - 1. Provide manufacturer's warranty for a period of one (1) year against manufacturing and design defects for the electronic control panel, PLC, expansion modules, solenoids, motor, relays, timers, floats and all other electronic components supplied by the flushing gate system manufacturer from the date of delivery.

PART 2 PRODUCTS

NOTE: This Guide Spec is based on equipment supplied by the listed manufacturers.

2.1 MANUFACTURERS

- A. Acceptable manufacturers are as listed. Manufacturers of equivalent products may be submitted.
 - 1. Gabrial Novac & Associates, Inc.
Montreal, Quebec, Canada
 - 2. Grande Water Management Systems, Inc.
Laval, Quebec, Canada

2.2 DESIGN AND CAPACITY

NOTES:

1. Edit as required.
2. Specify capacity and CSO storage tank dimensions.
3. Specify material for flushing gates.
4. Provide a maximum of 30" of flushway on either side of the gate opening to limit debris buildup in the corners.

- A. General: Provide flushing gates which are capable of flushing the width and length of the CSO storage tank. The CSO storage tank will have a length of _____ feet, width of _____ feet, and a height of _____ feet. The flushing gate will be fabricated of _____ (304 Stainless Steel/ 316 Stainless Steel).
- B. Hinge Mechanism: Design hinge mechanism to withstand all operational force and to allow for full travel and permit manual lifting of the gate flap to a minimum of _____ degrees from the vertical plane (when the gate is full closed). Hinges to be constructed of _____ (material).

- C. Locking Mechanism: Construct locking mechanism and hydraulic cylinder of _____(material).
- D. Gate Frame: Construct the gate frame of _____(material). The face of the gate anchoring channels must be flush with the opening and must be impacted and certified by the gate manufacturer prior to gate installation.

2.3 HYDRAULIC OIL PIPING AND VALVES

- A. General: Provide ____diameter hydraulic oil piping made of _____(material) designed for an operating pressure of ____ psi. Provide _____ (material) compression type couplings.
- B. Valves: Provide ____ (material) ____ (type) valves designed for a minimum operating pressure of ____ psi.
- C. Control Valves: Provide hydraulic control valves designed for a minimum operating pressure of ____ psi.

2.4 HYDRAULIC FLUID

- A. Provide hydraulic fluid suitable for an outdoor or indoor installation. Hydraulic fluid must be rated for operation in temperatures ranging from -20 – +120 degrees F (outdoor).

2.5 HYDRAULIC POWER PACK

- A. General: Provide a hydraulic power pack complete with oil pump, oil reservoir, solenoid-operated valves, and system alarms. Provide the hydraulic power pack with a NEMA 4X stainless steel enclosure designed for post mountings that can be padlocked.
- B. Oil Pump: Provide a gear type oil pump with a minimum capacity of 0.72 gpm at a pressure of 225 psi and driven by a minimum 3/4 HP, 120 V, 1-phase, 60 Hz motor.

NOTES:

1. Coordinate specific equipment number and size with manufacturer. Below is an example of typical equipment provided as part of the hydraulic system.

- C. Enclosure: Provide the hydraulic power pack enclosure with the following:

1. One (1) hydraulic oil pump.
2. One (1) two-gallon hydraulic reservoir.
3. One (1) normally closed, triple ported, solenoid operated, 120V AC hydraulic cartridge valve.
4. Five (5) normally closed, triple ported, solenoid operated, 120V AC hydraulic cartridge valves.
5. One (1) hydraulic fluid low-level switch.
6. One (1) hydraulic fluid high temperature switch.
7. One (1) hydraulic fluid low-pressure switch.

8. One (1) hydraulic fluid pressure relief valve (adjustable).
 9. One (1) temperature and level gauge.
 10. One (1) pressure gauge (0-300 psi).
 11. Aluminum manifold to mount all solenoid valves and pressure relief valve.
 12. Subpanel enclosure for electrical components and terminal connections.
 13. Main power disconnect, circuit breakers, motor starter, control power transformers and fuses.
- D. Refer to Specification Section 26 05 00 for enclosure types dependent on the location installed.
- E. System Controls: There will be one control panel/hydraulic power pack for the flushing gate. The control panel will control the manual/remote flushing of the system from a series of cabinet face mounted push buttons, located on the interior door of the enclosure. Each enclosure will be equipped with a PLC and a three- position key operated selector switch which will allow for MANUAL/OFF/REMOTE operation. The control panel enclosure will house both the previously described hydraulic equipment and the electronic components. A second enclosure within the first will separate the electronic components from the hydraulic ones. The enclosure will be sized to accommodate the equipment required. It will be equipped with a main breaker and fuses.
1. The following minimum status indication, control functions, and alarms should be provided in the control panel enclosure:
 - a. System ON or OFF indication.
 - b. LOCAL and REMOTE Mode indication.
 - c. MANUAL or AUTO flushing control for each gate.
 - d. Low oil level alarm.
 - e. High oil temperature alarm
 - f. Low oil pressure alarm.
 - g. Flush sump level for each gate.
 - h. Flush sequence stop and start control.

NOTES:

1. All alarms will be manually reset, and alarms and status lights may have dry contacts for future SCADA system connection.

2. Include in the control panel manual flush controls (push button) for each flush gate so that any of the flush ways may be flushed at random. Once a flush sequence is started, the control system will not accept another signal, other than abort, until the flush sequence is completed and the gate sumps are empty. It will be equipped with a status light indicating which flushing gate is operating. The flushing gates can be opened locally (at the CSO storage tank) or remotely (at the WWTP). The manual operation allows the operators to initiate the flushing sequence and the automatic operation allows the sequence to be initiated after a set period of time when the CSO storage tank is empty. The Control devices are to be industrial, heavy-duty, oil-tight, 30.5MM in size.

3. Provide mercury free, explosion proof, float type switches in each of the gate sumps to provide water level indications when CSO overflow fills the gate sumps. The float switch will send the signal to the PLC to either automatically or manually open the flushing gates. Provide each float switch with a PVC deflector to protect it from physical damage.
4. The flushing gate PLC will be used to control the duration of the flush by using various internal timers and relays. The flushing gate PLC shall accept a flush command via the Owner's main SCADA system. The flushing gate system shall be interlocked and prohibited to flush under the following conditions:
 - a. Sump structure access hatch is detected to be open.
 - b. The level in the flushing chamber does not have sufficient water to flush effectively.
 - c. The level in the storage tank is too high.
5. The flushing gate PLC shall accept the following signals as digital inputs:
 - a. Sump structure access hatch open (via magnetic door contacts)
 - b. Storage Tank Empty (via Station Control Panel)
 - c. Initiate Flush (via station control panel)

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install the flush gate system in accordance with the approved shop drawings and the manufacturer's recommendations.
- B. All required concrete inserts for the flushing gate anchoring system are to be Type 316 stainless steel, supplied by the manufacturer, and delivered to the site well in advance of the CONTRACTOR setting forms.
- C. Ship preassembled flushing gates to the site for installation. Provide hydraulic power packs / control panel preassembled and factory tested. Make all field connections to the level indicators, and interconnections to control panel and power supply.

3.2 FIELD QUALITY CONTROL

- A. Manufacturers Field Services: Provide the services of a qualified representative of the manufacturer to provide instruction on proper installation of the equipment, inspect the installation of the equipment, make any necessary adjustments, place it in initial trouble-free operation and instruct the operating personnel in its operation and maintenance as specified in Division 1.
 1. Prior to installing the gates, manufacturer is to conduct a site inspection of the gate anchoring system to determine its suitability for equipment installation.
- B. Field Test: After installation of the gate, control equipment and all appurtenances, subject the system to a field running test under actual operating conditions. Operate each flush gate

a minimum of four times (two manual and two automatic). Perform the field tests in the presence of the ENGINEER. Provide the field tests as specified in Division 1.

3.3 CLEANING AND PAINTING

- A. Provide painting as specified in Section 09 91 00.

END OF SECTION

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