

Design Standard

Wastewater Lift Station

January 2021

City of Regina



REGINA
Infinite Horizons

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1. General

1.1. Introduction

- 1.1.1. Lift Stations accommodate wastewater flows from areas of the City where flow by gravity is physically or economically insurmountable. The need for a lift station is to be justified, and the City must approve the design and construction of any new lift station in Regina.
- 1.1.2. This standard generally applies to stations with pumping capacity in the range of 19 – 300kW. Some requirements within this design standard may not apply to smaller stations, such as maintenance hole lift stations.
- 1.1.3. This standard should be used in conjunction with the General Design Standard, the Wastewater Design Standard and the guiding documents listed below.
- 1.1.4. Where acts, bylaws, regulations and standards are referred to, they shall be current, amended and updated issues.
- 1.1.5. It shall be the designers' responsibility to be aware of the statutory requirements governing such works and for compliance with those requirements. The listing provided below is for guidance. Other statutory instruments not included here may be applicable.

1.2. Guiding Documents

1.2.1. City Guiding Documents

- 1.2.1.1. Design Regina: Official Community Plan
- 1.2.1.2. City of Regina Wastewater Master Plan
- 1.2.1.3. Water and Sewer Utility Bylaw
- 1.2.1.4. Wastewater and Storm Water Bylaw
- 1.2.1.5. Building Bylaw
- 1.2.1.6. Regina Zoning Bylaw
- 1.2.1.7. City of Regina Construction Specifications and Drawings
- 1.2.1.8. City of Regina Electrical Design Standard – Lift and Pump Stations
- 1.2.1.9. City of Regina Contemporary Office Space Allocation Guidelines
- 1.2.1.10. Facilities Management Services Operational Space Guidelines

1.2.2. Governmental Authorities

- 1.2.2.1. In addition to meeting the requirements as laid out in this design standard, the design and construction of wastewater lift stations must meet all the requirements of other governmental authorities having jurisdiction, including but not limited to:
 - 1.2.2.1.1. Saskatchewan Ministry of the Environment
 - 1.2.2.1.2. Saskatchewan Ministry of Labour Relations and Workplace Safety;
 - 1.2.2.1.3. Saskatchewan Ministry of Government Relations-Building Standard Licensing Branch
 - 1.2.2.1.4. The Water Security Agency (WSA)
 - 1.2.2.1.5. SaskPower

1.2.3. Regulations, Guidelines, and Standards

1.2.3.1. The design shall adhere to all applicable federal and provincial regulations, guidelines, and standards, including but not limited

to:

1.2.3.2. Federal

- 1.2.3.2.1. All CSA Standards
- 1.2.3.2.2. Canadian Electrical Code (CEC) and Handbook
- 1.2.3.2.3. National Building Code of Canada (NBC)
- 1.2.3.2.4. National Energy Code for Buildings (NECB)
- 1.2.3.2.5. National Fire Code of Canada (NFC)
- 1.2.3.2.6. National Plumbing Code (NPC)

1.2.3.3. Provincial

- 1.2.3.3.1. Canadian Electrical Code Saskatchewan Interpretations
- 1.2.3.3.2. The Environmental Management and Protection Act
- 1.2.3.3.3. Occupational Health and Safety Act
- 1.2.3.3.4. Occupational Health and Safety Regulations, 1996
- 1.2.3.3.5. The Plumbing Regulations
- 1.2.3.3.6. Sewage Works Design Standard-EPB 503
- 1.2.3.3.7. The Uniform Building and Accessibility Standards Act
- 1.2.3.3.8. The Uniform Building and Accessibility Standards Regulations
- 1.2.3.3.9. The Waterworks and Sewage Works Regulations

1.2.3.4. Other

- 1.2.3.4.1. All equipment shall bear a CSA, or equivalent as accredited by the Standards Council of Canada, approved label.
- 1.2.3.4.2. Hydraulic Institute (HI) Standards
- 1.2.3.4.3. Illuminating Engineering Society (IES) Standards
- 1.2.3.4.4. ASHRAE Standards
- 1.2.3.4.5. Additional requirements for individual wastewater lift stations imposed by the City of Regina as conditions warrant.
- 1.2.3.4.6. The design may require specialized equipment that bears no CSA or equivalent label. The City will review and potentially approve a design exception based on the relevant safety and operational aspects in this event.

1.3. Definitions

- 1.3.1. Bypass – A bypass allows wastewater flows to bypass the station using auxiliary equipment to pump wastewater from a bypass maintenance hole to the station's main discharge pipe.
- 1.3.2. Designer – The engineer, architect or other professional responsible for any aspect of the lift station design.
- 1.3.3. Double Block and Bleed System – For this design standard, a double block and bleed system consists of two isolation valves with a drain between the two valves that, as an assembly, can provide positive double isolation when only one side is under pressure.
- 1.3.4. Emergency Overflow – An emergency overflow delivers wastewater flows from the lift station to a downstream sanitary sewer, storm sewer or natural watercourse if capacity in the downstream sanitary system is not available. An emergency overflow may deliver flows by gravity or using pumps.

- 1.3.5. Gravity Overflow – A gravity overflow delivers wastewater flows from the lift station to a downstream sanitary sewer, storm sewer or natural watercourse without pumps.
- 1.3.6. Wastewater Lift Station – For this design standard, a wastewater lift station delivers wastewater flows under pressure to a downstream outlet where flow by gravity is not feasible.
- 1.3.7. Wet Well/Dry Well – Wet well/dry well is a lift station configuration where an internal divider separates wastewater in the wet well from pumps in the dry well.
- 1.3.8. Wet Well Only – Wet well only is a type of lift station configuration where pumps, or intake assembly of the pumps, are submerged in wastewater within the wet well.

2. Lift Station Design

2.1. Location

- 2.1.1. Special consideration shall be given to the location of wastewater lift stations relative to existing or proposed adjacent development to minimize the station's impact in terms of aesthetics, odour and noise.
- 2.1.2. New wastewater lift stations shall not be located in the immediate proximity of school sites and playgrounds.
- 2.1.3. Lift stations shall be located outside of the limits of any area subject to surface ponding or inundation by surface flow during major runoff events to be accessible in all weather conditions.
- 2.1.4. Lift Stations shall not be located in the flood plain or flood fringe areas.

2.2. Lift Station Configuration

- 2.2.1. A wet well/dry well configuration shall be used where the total pumping capacity is 75kW or greater.
- 2.2.2. A wet well only configuration is acceptable at a station where pumping capacity is less than 75kW. The pumps are to be located 8.0m or less below ground elevation in the wet well.

2.3. Building Requirements

- 2.3.1. A building will be required at all lift stations to house all process, electrical and control equipment.
- 2.3.2. The building envelope shall be designed by a registered architect licensed to practise in Saskatchewan.
- 2.3.3. The building design shall adhere to the City of Regina Facilities Management Services Operational Space Guidelines, where applicable.
- 2.3.4. The building shall be designed to accommodate the removal of all equipment for repair or replacement.
- 2.3.5. Tool storage space, office space and a washroom shall be provided for all stations with a pumping capacity of 75 kW or greater.
- 2.3.6. The building dry well shall be completely isolated from the lift station wet well.
- 2.3.7. Access to the wet well shall only be from the outside through doors or access hatches.
- 2.3.8. Direct access between dry and wet wells is strictly prohibited.
- 2.3.9. All-access hatches shall be aluminum. Steel hatches are prohibited.
- 2.3.10. Alternative corrosive resistant, light weight hatches may be considered if the load bearing requirements are met and they are not exposed to Ultraviolet light.
- 2.3.11. Steel doors and frames shall be used.
- 2.3.12. The wet well entrance door shall be epoxy-coated steel.

- 2.3.13. All-access hatches and doors shall have a safe means to be secured in a fully open position. The manufacturer shall provide Hold-open systems. Add-on devices are prohibited.
- 2.3.14. Locking and alarm systems for lift stations shall be per City of Regina standards.
- 2.3.15. Building access control (i.e. Card Reader) may be required, depending on facility. Locking and alarm systems for lift stations shall be per City of Regina standards.
- 2.3.16. An intrusion alarm shall be provided, and provision shall be made for transmission of an alarm to the City of Regina monitoring facilities in the event of an unauthorized entry.
- 2.3.17. Roof systems shall be long-life and low maintenance, such as styrene-butadiene-styrene (SBS) or standing seam metal. A 2-year SRCA Saskatchewan Roofing Contractors Association (SRCA) warranty shall be provided.
- 2.3.18. Where equipment is located on the roof or the building is higher than 6.1m:
 - 2.3.18.1. Maintenance access shall be provided. Stairs are preferred over ladders.
 - 2.3.18.2. Equipment shall be located at least 2m from the edge of the roof.
 - 2.3.18.3. A maintenance walkway shall be provided on the roof to allow access to equipment and shall be at least 2m from the edge of the roof.
 - 2.3.18.4. Where stairs are not feasible for roof maintenance access:
 - 2.3.18.4.1. A permanent ladder shall be located inside the building with an appropriate fall protection system.
 - 2.3.18.4.2. The ladder shall provide access to the roof at least 2m from the edge of the roof.
- 2.3.19. Insulation rating shall adhere to requirements of the National Energy Code for Buildings.
- 2.3.20. Masonry walls shall be provided for durability, longevity and low maintenance.
- 2.3.21. Exterior finishes shall be graffiti and vandal resistant.
- 2.3.22. A geotechnical study of soil conditions on site shall inform and provide recommendations for foundation design. A preference shall be given to concrete pile foundations where they are provided with other options.
- 2.3.23. All concrete shall be sulphate resistant.
- 2.3.24. All concrete within the wet well shall be protected against deterioration due to H₂S. Acceptable protection includes:
 - 2.3.24.1. Epoxy coating
 - 2.3.24.2. The application of crystalline technology
- 2.3.25. A gas monitoring system shall be provided.
- 2.3.26. All exits shall be equipped with panic bars.

2.4. Pumping Capacity Requirements

- 2.4.1. Pumping equipment shall be selected with capacity in excess of the inflow into the lift station as determined by methods outlined in the Wastewater Design Standard. Inflow shall include peak dry weather wastewater flow plus the extraneous flow allowance.
- 2.4.2. For stations in new developments, the station's ultimate pumping capacity may be staged incrementally to reflect changes in inflow and downstream capacity over time. Provisions to incrementally increase pumping capacity shall be considered in the initial lift station design.

2.4.3. A minimum of two pumps is required for each lift station.

2.4.3.1. Where only two pumping units are provided, they shall be identical and interchangeable with the same pumping capacity. Each unit operating independently shall be capable of pumping at the station's design capacity flow rate under the service conditions.

2.4.3.2. When there are three or more pumping units, they shall have redundant pumping capacity designed to accommodate the largest unit being out of service. The remaining units operating in parallel shall be capable of pumping at the station's design capacity flow rate under the service conditions.

2.5. Operational Reliability

2.5.1. Lift stations shall be designed to remain fully operational during the 1:100 storm event.

2.5.2. The station must deliver flows to the sanitary system, storm system or natural watercourse up to and including the 1:100 storm event while meeting the emergency overflow requirements of the Water Security Agency. This does not mean the station must provide storage or deliver flows to a downstream sanitary outlet during the 1:100 storm event.

2.5.3. The lift station shall not overflow to the storm system or a natural watercourse during storm events less than the minimum stated in EPB 503.

2.5.4. The designer is required to contact the WSA for more information about the minimum transfer requirements for wet weather wastewater flows. WSA has indicated that the current requirements in EPB 503 may be revised.

2.6. Electrical Back-up Provisions

2.6.1. The electrical back-up system shall adhere to CSA 282.

2.6.2. Onsite installed emergency standby power equipment shall be provided.

2.6.3. Critical HVAC, process, controls, life safety and security systems shall be connected to emergency power.

2.6.4. The emergency back-up generation set shall be powered by natural gas.

2.6.5. Diesel generators may be considered as a design exception based on station capacity, size and other factors.

2.6.6. The emergency back-up generation set shall be housed within the building and in a separate room from all other equipment. An external enclosure is prohibited.

2.6.7. Uninterruptible power supply (UPS) battery back-up shall be provided to bridge power loss and emergency generator start-up.

2.6.8. UPS shall be provided for critical systems such as HVAC, station controls, life safety and security systems.

2.7. Alarm Telemetry - General Requirements

2.7.1. Automated remote sensing equipment shall be provided at each wastewater lift station. This equipment shall detect the status of selected operating conditions and transmission of appropriate alarms to monitoring facilities operated by the City of Regina.

2.7.2. Alarms shall be provided for key HVAC systems.

- 2.7.3. Minimum HVAC alarms required are room temperature, supply air temperature, fan status, pressure drop over filters, exhaust system status, ventilation failure, and high H₂S levels.
- 2.7.4. Consult this standard and the *Electrical Design Standard Lift and Pump Stations* for more information on alarms.

2.8. Emergency Overflow

- 2.8.1. All lift stations shall be designed to overflow to the City's storm system (or a natural watercourse) and/or sanitary system.
 - 2.8.1.1. Provision of a gravity overflow to an adjacent or downstream sanitary sewer system is required whenever feasible. This connection should permit the overflow to bypass the lift station. If this is not possible, then overflow from the lift station wet well will be permitted.
 - 2.8.1.2. The station shall include an emergency overflow to the storm system or a natural watercourse if a gravity overflow to a downstream system is not feasible or does not allow the station to remain fully operational during a 1:100 storm event.
- 2.8.2. All emergency overflows shall have a means for wastewater samples to be taken safely and reasonably during storm events under which the station is to remain fully operational. Sampling shall be done with a vacuum pump-style auto-sampler.
- 2.8.3. Emergency overflows shall be provided with suitable means to prevent backflow from the overflow into the lift station. Duckbill valves are preferred.
- 2.8.4. The elevation and hydraulic capacity of overflows shall be optimized to minimize basement flooding risk due to sanitary system back-up.
- 2.8.5. The elevation of emergency overflow outfalls shall be above the discharge body water level under normal conditions.

2.9. Emergency Bypass

- 2.9.1. An emergency bypass tee-connection with an isolation valve on the branch shall be provided on the main discharge pipe within each lift station, upstream of the force main isolation. The unconnected end of the tee connection must be oriented to facilitate an auxiliary pump discharge or outlet line from the bypass maintenance hole.
- 2.9.2. The emergency bypass connection shall be sized appropriately to meet the station's needs based on inflow into the station.
- 2.9.3. Bypass maintenance holes shall be located within the fenced compound.
- 2.9.4. Access covers shall be a 900mm diameter vault cover or a 900mm square hatch.

2.10. Wastewater Inlet Sewer

- 2.10.1. Inlet sewer slope and elevation shall conform to Hydraulic Institute standards.
- 2.10.2. Only one sewer connection shall be provided into a wet well to convey wastewater from the contributing sanitary collection system.
- 2.10.3. If more than one sewer enters the site or is required to be connected to the lift station, a collection maintenance hole shall be provided as a junction point for all incoming sewers. Appropriate stubs are to be provided for all future connections. Only a single connection shall be made to the wet well of the lift station.
- 2.10.4. The collection maintenance hole is typically the bypass maintenance hole, which is the first maintenance hole upstream of the lift station and located within the fenced compound. In some cases, a collection maintenance hole may be

located upstream of the bypass maintenance hole. In all cases, the bypass maintenance hole must be located within the fenced compound.

- 2.10.5. Access covers on collection maintenance holes shall be a 900mm diameter vault cover or a 900mm square hatch.
- 2.10.6. A double block and bleed system is to be provided on the inlet to the wet well. The system (valves and drain) shall be located within the building's dry well.

2.11. Storage

- 2.11.1. Onsite storage of wastewater shall be provided when necessary to satisfy the acceptable level of sanitary service downstream of the lift station as defined in the Wastewater Design Standard.
- 2.11.2. The need for and size of storage shall be determined by modelling.
- 2.11.3. Storage shall be sized to satisfy Operational Reliability requirements defined in this standard.
- 2.11.4. Wastewater storage must be sized to meet the acceptable level of downstream service defined in the Wastewater Design Standard and adhere to WSA requirements concerning overflows. The current requirement does not allow overflow (spill) during events less than 24 hours in a 1:25 return event.
- 2.11.5. In-line storage will typically not be considered as large diameter pipe presents problems when used to convey dry weather flows.
- 2.11.6. For stations in new developments, the station's storage capacity may be staged incrementally to reflect changes in inflow and downstream capacity over time. Provisions to incrementally increase storage capacity shall be considered in the initial lift station design.
- 2.11.7. Any downstream level sensor used to control flow in or out of onsite storage shall not be placed in the receiving maintenance hole.
- 2.11.8. The optimal location of the downstream sensor is to be determined by the designer through hydraulic modelling.
- 2.11.9. Onsite storage structures, and any gravity overflow from the storage tank to the storm system or natural watercourse, shall be self-cleaning and accessible for cleaning.
- 2.11.10. Signage shall be placed to clearly indicate the location (at all four corners) and maximum permitted loading over any underground storage tank.

2.12. Screening

- 2.12.1. Screens (6 mm) shall be provided at all stations downstream of the McCarthy Boulevard Pumping Station.
- 2.12.2. The screening process shall provide redundancy to facilitate maintenance or repair of the equipment. A minimum of two screening units shall be provided, each with the capability of screening the design wastewater inflow received at the station.

2.13. Odour Control

- 2.13.1. Lift Stations shall be equipped with activated carbon odour control technology.
- 2.13.2. Lift Station odour control technology is continuously evolving. Alternative odour control measures may be considered in consultation with the City.
- 2.13.3. Odour control equipment shall be easily accessible for maintenance and removal.
- 2.13.4. Access hatches to odour control equipment shall be equipped with hydraulic arms to support the hatch doors in an open position.

2.14. Wet Well Size and Detail

- 2.14.1. Wet well size and detail shall conform to Hydraulic Institute Standards.
- 2.14.2. The maximum retention time in the wet well shall not exceed 30 minutes for the design minimum flow rate anticipated when the contributing area is fully developed.
- 2.14.3. Wet wells should be sized small enough to minimize total retention time; The time wastewater is held in the wet well, and any rising force main and be sized large enough to control the pump frequency starts.
- 2.14.4. Total retention time in the wet well and force main should be kept to a minimum to avoid anaerobic fermentation and the resultant production of odorous, hazardous and corrosive gases. Otherwise, provisions must be made to control anaerobic conditions. It is desirable to have a wet well with sufficient active volume. All wastewater within the discharge force main will be replaced during one pumping cycle, especially if sags exist in the force main profile.
- 2.14.5. The depth from the "pump off" level to the floor of the wet well should be kept to an acceptable minimum to minimize dead storage volume. Hydraulic Institute intake standards for suction pipe inlet will dictate the required depth, pump manufacturer's requirements for submergence or cooling, net positive suction head, priming requirements, and vortex control.
- 2.14.6. Wet wells should be sized large enough to maximize pump life by decreasing the frequency of pump starts.
- 2.14.7. Pump starts shall not exceed 6 per hour with pump alternation and 10 per hour with the standby pump inoperative. The manufacturers' recommendations concerning the allowable frequency of pump starts for the specific size and type of motor shall be satisfied.
- 2.14.8. Exceeding a frequency of 10 to 12 starts per hour for above 30 kW motors increases the cost of switchgear and motor maintenance, decreasing the reliability and life of the machinery and electric components. A high frequency of pump starts also increases power consumption and operating cost. Accordingly, sufficient storage between switching levels is needed to limit the number of pump starts.
- 2.14.9. A 100mm standpipe shall be provided for hydro-vac access.
- 2.14.10. For wet well/dry well stations, a noncorrosive platform with a handrail or other fall protection shall extend around the entire perimeter of the wet well to facilitate cleaning.
- 2.14.11. For wet well only stations, a ladder and a noncorrosive platform with a handrail or other fall protection are required to facilitate access to valves and wand washing of the walls.
- 2.14.12. Access hatches to provide direct access to the wet well and allow worker rescue operations shall be provided. Wet Well access hatches shall be a minimum of 720mm x 720mm.
- 2.14.13. All bolts, nuts and other fasteners used in wet well areas shall be 316 stainless steel.
- 2.14.14. All supports, brackets, gratings, ladders and other structures shall be of corrosion-resistant materials. Acceptable corrosion-resistant materials include:
 - 2.14.14.1. Carboline Reactimine 760
 - 2.14.14.2. Spectrashield
 - 2.14.14.3. Sewergard Glaze No.210G Clayburn Refractories
 - 2.14.14.4. 680 Ceilcote Primer, 664 Ceilcote
 - 2.14.14.5. 610 Ceilcote ceilpatch
 - 2.14.14.6. Valespar78 hi-build epoxy
- 2.14.15. Lifting chains in the wet well shall be nickel-plated or galvanized and have a molybdenum-based corrosion protection coating.

- 2.14.16. Wet wells shall have a non-stick coating
- 2.14.17. The non-stick coating is intended to prevent grease build-up. Elastomeric polyurethane is an example of an acceptable coating. A similarly functioning coating may be acceptable upon review by the City.
- 2.14.18. The coating is to be applied in the wet well to a point above the high operating level.
- 2.14.19. To deal with ragging (pump plugging) issues, provisions shall be included in the design for the full installation of a comminutor/grinder device to reduce pump clogging.

- 2.14.19.1. This provision does not apply to stations requiring screening as outlined in Section 2.12 of this standard.

- 2.14.19.2. Depending upon the quality of wastewater inflow, a grinder may be required to be installed during initial construction.

- 2.14.20. Floats and level sensing equipment shall be accessible without entering the wet well.

2.15. Pumps

- 2.15.1. Submersible pumps shall be provided for all configurations (wet well/dry well or wet well only). The cables, seals, connectors and electronic controls etc., shall allow dry mounted pumps to operate underwater.
- 2.15.2. Pumps shall be removable and replaceable without dewatering the wet well without requiring personnel to enter the wet well.
- 2.15.3. Pump impellers shall be of a non-clog design and be capable of passing spherical solids of 75 mm diameter.
- 2.15.4. The pump shall not exceed the motor's power rating at any operating condition on the characteristic curve of the pump.
- 2.15.5. Flush valves or recirculation pipes from the pump discharge to the wet well shall be provided for occasional aeration and suspension of grit and solids in the wet well. Provision shall be made for automating the cleaning and agitation system based on timing or other factors.
- 2.15.6. Hydraulic Institute standards shall be used to facilitate the design and selection of pumps to avoid cavitation.
- 2.15.7. Main pump motors shall operate on 600 volts, 3 phase power.

2.16. Pump Arrangement

- 2.16.1. Two or more pumps shall be connected in a parallel arrangement to a common header located within a control building or dry well.
- 2.16.2. All isolation and check valves shall be accessible for operation and maintenance.
- 2.16.3. Pumps shall be connected such that when any pump is removed for servicing, the remaining pump(s) will remain operational.
- 2.16.4. Each pump shall have its own individual intake and/or suction connection to the wet well.
- 2.16.5. Intake design shall conform to Hydraulic Institute requirements for selected pumps operating over their full range.

2.17. Piping Arrangement

- 2.17.1. All pump piping shall conform to Hydraulic Institute standards.
- 2.17.2. In wet well/dry well stations, a full-sized valved crossover pipe shall be installed connecting the individual suction pipes, and isolation valves shall be placed on the pump suction pipes between the crossover connections and the pumps. The piping and valve arrangement shall be suitable to permit any individual pump isolation for maintenance or removal.
- 2.17.3. Piping and valves shall be provided to back flush each pumping unit and its suction, using the discharge flow from another pump directed through the unit's discharge being flushed.
- 2.17.4. A piping arrangement to flush the pumps with utility water is strictly prohibited. A piping arrangement to allow flushing of the pumps with utility water creates an undesirable risk of cross-contamination.
- 2.17.5. The minimum diameter for all pump suction and discharge piping shall be 100 mm nominal.
- 2.17.6. Piping shall be sized so that flow velocity will not exceed 1.8 m/s in suction piping or 3.0 m/s in the lift station's discharge header.
- 2.17.7. Minimum flow velocities for station piping shall be identical to the minimum velocities for the discharge force main. Discharge piping should be as large as possible while maintaining this minimum velocity for scouring.
- 2.17.8. All piping within wastewater lift stations shall be corrosion-resistant material. All pipes in the wet well area must be stainless steel 316 and welded. Flanges may be considered as a design exception where welding is not feasible.
- 2.17.9. The buried pipe under the facility and within the excavation limits shall be steel pipe designed for a minimum pressure of 900 kPa to ASTM A53 or CSA Z245.1 with a minimum yield strength of 241 MPa and the following coatings:
 - 2.17.9.1. Exterior coatings:
 - 2.17.9.1.1. fusion epoxy coating (min 406 μm); or
 - 2.17.9.1.2. for a pipe of 600mm or smaller only - high-density polyethylene covering.
 - 2.17.9.2. Interior Coating: fusion bonded epoxy (min 406 μm).
- 2.17.10. Transition to forcemain pipe shall be provided using two transition couplings to allow for deflection settlement.
- 2.17.11. The pressure rating for all piping within the station shall suit the service requirement and shall be a minimum of 900 kPa.

2.18. Valve Arrangement

- 2.18.1. A check valve shall be installed on the discharge line between each pump and an isolation valve.
- 2.18.2. A check valve shall be installed after the bypass tee connection isolation valve to prevent backflow from any connected auxiliary pump.
- 2.18.3. Vertically mounted check valves shall not be the flapper type.
- 2.18.4. Check valves shall be supplied with external levers and spring and limit switches to indicate and prove valve opening.
- 2.18.5. Isolation valves shall be included on each pump's discharge lines between the pump check valve and the discharge header within the dry well. Isolation valves shall also be included on the suction side of each pump.
 - 2.18.5.1. Full port ball valves shall be used for all isolation valves up to and including 200mm.

2.18.5.2. Plug or gate valves shall be used for all isolation valves greater than 200mm.

- 2.18.6. Drains shall be provided on the inlet and outlet side of the pumps, and other required equipment, to permit draining of the pipe.
- 2.18.7. Drain shall be installed between the pump discharge valve and the discharge header in the dry well to relieve pressure when servicing pumps and allow pump priming.
- 2.18.8. A double block and bleed (DBB) system are typically two isolation valves with a drain between the two valves. The two isolation valves do not need to be located close (e.g. a system where the two isolation valves are located on different floors within the station may be acceptable).
- 2.18.9. A system that utilizes an isolation valve, a drain and an engineered back-up, such as a blind flange, may also be acceptable. Consultation with the City operations group during detailed design is required to ensure acceptable DBB systems are provided for in the design.
- 2.18.10. All drains shall be 50 mm, complete with a ball valve.
- 2.18.11. All isolation valves shall contribute to a double block and bleed the system.
- 2.18.12. All process equipment shall be protected by a double block and bleed the system.
- 2.18.13. Provisions shall be made in the piping for the removal of all valves and equipment.
- 2.18.14. Appropriately located vent and drain valves shall be provided to permit all piping drainage to facilitate valve and equipment removal.
- 2.18.15. Piping and valves shall be positioned to provide space for the removal of all valves and equipment.

2.19. Pump Control and Instrumentation Requirements

- 2.19.1. Control panels shall be located to avoid flooding under any foreseeable circumstances.
- 2.19.2. Control panels shall be mounted on a concrete base or steel support posts founded in concrete bases that ensure the control panel's stability.
- 2.19.3. Control panels shall be located 1.0 – 1.2 m above floor level.
- 2.19.4. All control, communications and electrical distribution panels are located in a separate room separated from the wet well, pumps, valves, and screens.
- 2.19.5. A 12" Human Machine Interface (HMI) of the entire process shall be provided.
- 2.19.6. A control system remote node (Ethernet cable access) shall be provided near the pumps.
- 2.19.7. Station controls shall be set up for periodic automated flushing of the wet well and force main.
- 2.19.8. This will typically be accomplished by backing-up a sufficient amount of wastewater into the collection system to allow for a longer pumping cycle. The design of the collection system upstream of the lift station must allow for this activity without the potential for sewer back-up in the services upstream of the station. Discussion between the designer and City operations will be necessary to determine specific requirements.

2.20. Pressure Gauges

- 2.20.1. Gauge taps with shutoff valves suitable for portable quick-connect pressure gauges shall be provided.
- 2.20.2. Gauge taps shall be installed on the suction, and discharge side of all dry well mounted pumps, on the discharge pipe from all wet well mounted pumps and on the main discharge to the force main.

- 2.20.3. The gauge taps are required to determine the operating pressures of the pumps for comparison with the pump curves to identify any change in operating pressures indicative of an operational problem.
- 2.20.4. Pump discharge gauge taps shall be located between the pump discharge and the discharge check valve.
- 2.20.5. Gauges shall be a compound pressure/vacuum type, equipped with a diaphragm seal and isolation valves.
- 2.20.6. Gauges provided for the discharge shall be liquid-filled with a maximum range of twice the working pressure.
- 2.20.7. Gauge displays shall be located 1.2m above the floor level to facilitate reading.
- 2.20.8. The gauge display range shall be 0 to 1.2x the maximum allowable working pressure (MAWP).

2.21. Flow Measurement

- 2.21.1. Flow measurement devices are required for all lift stations and shall be properly located for accurate readings with valving and fittings for minimum downtime maintenance.
- 2.21.2. Flow monitoring equipment shall determine and record the flow rate, duration, volumetric sum, and frequency for each pump, bypass, and overflow.
- 2.21.3. Flow monitoring equipment shall interface with the station control system.
- 2.21.4. All flow meters shall be magnetic flow meters and shall be installed to ensure the meter always runs full.

2.22. Permanent Hoist Equipment

- 2.22.1. Permanent hoist equipment and access hatches shall be provided to permit all pumps and valves removal and replacement.
- 2.22.2. A Professional Engineer licensed to practice structural design in Saskatchewan shall design the permanent hoist equipment.
- 2.22.3. For wet well pump installations, the provision and arrangement of lifting equipment are to be such that the need for personnel to enter the wet well to remove equipment is minimized.
- 2.22.4. Hoists and beams shall allow for equipment placement onto service vehicles without double handling or use of mobile cranes.
- 2.22.5. Hoists and beams shall be robust, allowing for dynamic loads in case of hoist failure. Load rating for beam and hoist in wet well conditions must include provision for the additional load caused by ragging.
- 2.22.6. Lifting equipment shall have sufficient capacity to handle the heaviest load anticipated, including an allowance for dynamic forces due to load shifting and debris loads. Safe working load on the beams shall be at least 1.5x the expected pump size.
- 2.22.7. All lifting equipment's capacity shall be clearly posted, and the safe working load shall be marked on hoist beams.
- 2.22.8. A swivel shall be installed between the load chain and the equipment attachment point.
- 2.22.9. Lifting systems shall not allow chains to remain submerged in wastewater.
- 2.22.10. The hoist system shall not require chains residing in wastewater to pass through the lifting mechanism at any point during pump removal to prevent grit build-up within the hoist mechanism.

2.23. Access into Station Structures

- 2.23.1. Suitable and safe means of access shall be provided to all equipment requiring inspection or maintenance and the wet well for inspection and cleaning.

- 2.23.2. Stairways and ladders, including fall arrest hoops and rest platforms must comply with the requirements of the Occupational Health and Safety Regulations, 1996.
- 2.23.3. Roof entry shall not be the primary access for any equipment. All equipment shall be easily accessible from within the building for inspection and maintenance.
- 2.23.4. All roof-mounted equipment must have a work platform, appropriate access such as permanently mounted ladders or stairs, and appropriate fall protection such as a railing around the equipment or permanently mounted engineered fall protection anchor points.
- 2.23.5. All stairs shall be of a non-skid type.
- 2.23.6. Confined spaces shall be eliminated through design. Any confined spaces are to be identified and must be reviewed by the appropriate City operations and OH&S staff.
- 2.23.7. If a design exception is approved for a confined space, areas designated as confined spaces shall have a system of the rescue made available. This shall include standard davit bases to be installed at access openings and the provision for a straight-line lifting rescue path out of the confined space.
- 2.23.8. Provision of fall protection for ladders exceeding 2.5 metres shall be provided.
- 2.23.9. Anchor points for safety ropes are to be provided above ladders, where the drop in height is greater than 2.5 meters.
- 2.23.10. Access into the wet well shall be from outside and not through the dry well. Stairways shall be provided for wet well access in wet well/dry well stations.
- 2.23.11. All external access hatches shall be pad-lockable.
- 2.23.12. All doors and access hatches must have a suitable and safe means to be secured in a fully open position.
- 2.23.13. For all entry hatches, non-protruding extension ladders are to be provided, which must be located far enough away from the walls to be pulled up through the access opening and extended to a height of at least 1.0 m.
- 2.23.14. Guard rails shall be provided around access openings. Chains are prohibited.
- 2.23.15. Access hatch covers for all roof openings in the wet well and dry well shall be sealed.
- 2.23.16. Floors and platforms shall be provided to allow access to all components to facilitate maintenance, repair, removal and replacement tasks. Such floors and platforms shall not obstruct access to any other component.

2.24. Lighting

- 2.24.1. Lighting shall be provided for the entire facility and shall adhere to IES Illumination Level Standards.
- 2.24.2. Light fixtures shall be LED.
- 2.24.3. Emergency back-up lighting (battery packs) shall be provided to bridge power loss and emergency back-up start-up.
- 2.24.4. Wet well lighting shall be arranged to be indirect (from outside of the well) and maintainable without entering the wet well whenever feasible.
- 2.24.5. LED lighting may be used in the wet well if installed in a location above a catwalk and safely accessible by a ladder for replacement.
- 2.24.6. Exterior lights shall be provided to illuminate all building entrance areas, entrance hatches and outside equipment access locations and shall be placed at an appropriate height to prevent vandalism.
- 2.24.7. Lights shall be located on the wall at an appropriate height for maintenance and replacement.

2.25. HVAC

- 2.25.1. HVAC system design shall adhere to the National Building Code (NBC) and ASHRAE.
- 2.25.2. Natural gas forced air heating shall be provided.
- 2.25.3. High-efficiency furnaces or boilers and heat recovery units to recover waste heat from exhausted air shall be used to minimize heating costs.
- 2.25.4. In rooms where the load is too small for gas-fired equipment, such as the washroom, electrical heating may be considered a design exception.
- 2.25.5. Forced mechanical ventilation shall be provided.
- 2.25.6. Suitable equipment shall be installed to provide ventilation meeting with the requirements outlined in EPB 503.
 - 2.25.6.1. Ventilation may be intermittent or continuous. The designer must demonstrate that the operating cost premium is acceptable if continuous ventilation is proposed.
 - 2.25.6.2. For intermittent ventilation, automatic controls shall be provided to increase ventilation rates interlocked to turn on with light switches or door switches.
- 2.25.7. Completely separate systems are required for each well, and there must be no interconnection between the wet well and dry well ventilation systems.
- 2.25.8. Fresh air, heated and thermostatically controlled, shall be forced into each area 150 mm above the floor in dry wells and 150 mm above the high-water level in wet wells and exhausted at higher levels. In pits over 4.5 m deep, multiple inlets and outlets are desirable.
- 2.25.9. Provision shall be made to detect and actuate an alarm if the ventilation system fails. A local alarm indicator, noticeable before station entry but not noticeable to the public, is required. A volume controllable buzzer and red beacon on the inside of a building, visible as soon as the doors open, is acceptable. Provision shall be made for transmission of the alarm to the City of Regina monitoring facilities.
- 2.25.10. For wet well only stations, provisions for connection of portable ventilation equipment may be included as an alternative to continuous ventilation for the wet well where the largest pump is 5 kW.
- 2.25.11. Provision shall be made for ventilation of wet wells using portable ventilation equipment in case of failure of the built-in system. This provision consists of a minimum 200mm diameter standpipe extending from inside the wet well to a flanged connection on the exterior of the facility. The end of the standpipe is to be located to permit air discharge through the standpipe to a point 150 mm above the normal high operating level of the wet well.
- 2.25.12. All HVAC equipment and valves shall be housed within the building.
- 2.25.13. Access from within the building shall be provided for all HVAC equipment.
- 2.25.14. All HVAC equipment shall be controlled by the same system as the station's process equipment.

2.26. Water Supply

- 2.26.1. A potable water supply shall be provided.
- 2.26.2. A hose with a 50 mm Camlock and a floor drain shall be provided on every floor.
- 2.26.3. There shall be no physical connection that might under any condition cause contamination of the potable water supply.
- 2.26.4. Backflow prevention and cross-connection control must comply with current municipal, provincial and federal requirements. Backflow preventers shall be the reduced pressure principle type installed 1.0 m above grade.

2.27. Washroom and Office Space

2.27.1. A partitioned accessible washroom shall be provided and include the following:

- 2.27.1.1. A toilet
- 2.27.1.2. A sink
- 2.27.1.3. A washroom exhaust fan interlocked with the light switch.
- 2.27.1.4. Floor drains with positive trapping.
- 2.27.1.5. A mirror
- 2.27.1.6. A soap dispenser
- 2.27.1.7. A towel dispenser
- 2.27.1.8. Supply storage

2.27.2. Office space and work area shall be provided. The office space shall comply with the requirements for a D-1 workspace (touchdown station) as outlined in the City of Regina's Contemporary Office Space Allocation Guidelines. The office space shall include the following:

- 2.27.2.1. An ergonomic desk and swivel-tilt armchair
- 2.27.2.2. Waste receptacles
- 2.27.2.3. Fire extinguishers
- 2.27.2.4. Spare parts storage
- 2.27.2.5. A bookshelf and/or filing cabinet to store O&M Manual, MSDS manual and drawings

2.27.3. The tool space's size to be provided shall be determined through consultation with the City during detailed design.

2.27.4. The size of waste receptacles, spare parts storage, and bookshelf shall be determined through consultation with the City during detailed design.

2.28. Sump Pump

2.28.1. Dry wells must be equipped with a sump and sump pump to deal with leakage or seepage. The sump pump shall discharge to the wet well at a point above the maximum high water level. A check valve and isolation valve downstream of the check valve shall be provided in the discharge pipe to preclude backflow of wastewater into the sump.

2.28.2. Sump pumps shall be of the appropriate size and capacity to handle sediment and be capable of draining the well. The sump's connection to the wet well must be high enough to allow the pump out of the dry well into the wet well for the condition where the dry well is flooded.

2.28.3. Provision shall be made for transmission of an alarm to the City of Regina monitoring facilities in the event of a sump pump failure.

2.29. Site Requirements

2.29.1. The site shall be designed to accommodate the load and maneuverability of a Tridem Drive Straight Truck 4 Axles vehicle for winter primary as defined by *A Guide to Saskatchewan Weight and Dimension Regulations, 2014*.

2.29.2. A minimum 4.5 m wide paved road shall be provided into the site directly from the road right-of-way, with extensions as appropriate to provide maintenance vehicle access to electrical transformers and for removal or delivery of all other station equipment.

2.29.3. Dropped curbs shall be used where it is necessary to cross a curb line.

2.29.4. All lift stations shall be fenced. Fencing shall include the following:

- 2.29.4.1. A swing gate for entry of vehicles that is pad lockable.
- 2.29.4.2. A man door entrance that is pad-lockable.
- 2.29.4.3. Padlocks keyed to City of Regina standards.
- 2.29.4.4. Fences shall be zinc-coated industrial-grade steel chain link security type, of 1.83 m overall height complete with three-strand barbed wire overhang. Architectural fences providing a similar level of security may be considered where dictated by aesthetic considerations.
- 2.29.4.5. Fencing shall be durable and maintenance-free.
- 2.29.5. The lift station site shall be graded so that stormwater drains freely away from the building. No ponding of water will occur adjacent to buildings, entrances or around electrical transformers. Site elevations shall be established such that the facility is not subject to flooding due to runoff flows or ponding under any conditions of rainfall or runoff from snowmelt.
- 2.29.6. Gutters and downspouts shall drain at least 1.22m away from the building onto a splash pad and allow stormwater to drain freely away from the building with no ponding.
- 2.29.7. Vehicle access, turnarounds, and parking shall be paved. All other areas shall be low maintenance ground cover material that effectively inhibits the growth of weeds. Grass is prohibited as a ground cover. Acceptable ground cover includes crusher dust or crushed rock.
- 2.29.8. Signage shall be provided.
 - 2.29.8.1. Signage shall identify the facility as a City of Regina lift station.
 - 2.29.8.2. Signage shall indicate that all unauthorized personnel must keep out.
 - 2.29.8.3. Signage shall indicate that the premises are monitored.
 - 2.29.8.4. Signage shall indicate any hazards, such as the presence of H₂S.
 - 2.29.8.5. Signage shall be placed around the fencing at each corner and intervals no less than 10m.

3. Force Main Design

3.1. Velocity

- 3.1.1. The minimum force main velocity for fixed speed systems shall be 1.1m/s.
- 3.1.2. For stations with variable frequency drives (VFD), a minimum velocity of 1.1m/s must be achieved to re-suspend solids in the force main. The system may be designed to reduce velocity after re-suspension of solids. Under no circumstances shall the force main velocity in VFD systems drop below 0.6 m/s.
- 3.1.3. Force main velocity shall not exceed 3.0 m/s.

3.2. Design Pressures

- 3.2.1. The pressure design for force mains shall consider normal static and dynamic operating pressures, the potential conditions that may occur due to outlet surcharge or blockages and transient pressure (water hammer) effects. A transient pressure analysis is required to determine if protection is required, and appropriate provisions must be incorporated into the pumping system design.

3.3. Surge Relief

- 3.3.1. Surge relief valves shall be designed with a suitable discharge location and be located with a suitable method of access. Discharge to the surface or the environment is prohibited.
- 3.3.2. Direct-acting surge relief valves regulated with external springs or counterweights and dashpots shall be used for wastewater and liquids with substantial solids content. Rupture discs are prohibited.
- 3.3.3. Surge release valves should drain to the wet well.

3.4. Slope

- 3.4.1. All force mains shall be sloped sufficiently to promote air discharge during filling and permit the force main to be drained.
- 3.4.2. Force mains shall not be installed at zero slopes and shall be designed to be self-draining.

3.5. Alignment

- 3.5.1. Force mains shall have a straight alignment. The use of 90° bends is prohibited. A series of 45° or smaller deflection bends will be used where extreme direction changes are required.

3.6. Air Release

- 3.6.1. Automatic air release valves shall be provided at all relative high points along with the force main. The need for air release valves shall be minimized by establishing the grade profile to eliminate summits.
- 3.6.2. Air release valves are installed in waterproof concrete access chambers, insulated to prevent freezing and with provisions for drainage.

3.7. Blowoff Valves

- 3.7.1. A valve for blowoff and drainage of the force main is to be provided at each low point.

3.8. Vacuum Relief

- 3.8.1. Provision for vacuum relief shall be made as necessary where force mains are proposed to drain by gravity between pumping cycles.

3.9. Force Main Outlet

- 3.9.1. The force main shall enter the receiving maintenance hole horizontally at an invert elevation no more than 300 mm above the receiving sewer's flow line. A smooth flow transition to the gravity sewer is to be designed to minimize turbulence at the point of discharge.
- 3.9.2. Inert materials or protective coatings shall be used for areas subject to sulphide attack.

3.10. Force Main Depth

- 3.10.1. Force mains shall be installed with suitable depth for protection against heavy external loads and protection against frost. The minimum depth of cover shall be 2.6m.

3.11. Requirements for Locating Force Mains

- 3.11.1. To facilitate location, a tracing wire shall be placed along with all force mains at the construction time. The wire shall be terminated in a labelled electrical box in the lift station (or appropriate secure location) and looped in any valve chambers and blowoff chambers to allow for an electronic locator's connection at intervals not greater than every 300 m along the length of the force main. If a chamber is

not available to provide this interval, the wire shall be looped into a cast iron valve box set at grade level. The locator wire shall be stranded 12-gauge copper with insulation for direct burial. Underground splice connections shall be minimized and shall be rated for direct burial service.

3.12. Requirements for Force Main Inspection and Cleaning

- 3.12.1. A swab launch port with a drain on the discharge header shall be provided at the lift station.
- 3.12.2. A swab retrieval with a drain shall be provided at the terminal of the force main.
- 3.12.3. Similar provisions for swab launch and retrieval shall be provided wherever the force main changes direction with an elbow of more than 45 degrees.
- 3.12.4. The swab launch and swab retrieval systems shall be designed to drain into a sanitary sewer or back into the force main. Discharge to the surface or environment is prohibited.
- 3.12.5. The swab launch intends to allow cleaning using conventional swabs and inspection using smart pigs, televising or other equipment without significant pipe disassembly.

3.13. Force Main Isolation

- 3.13.1. Force main isolation shall be included on the main discharge pipe where it connects to the discharge force main, leaving the facility to isolate the force main from the lift station. Force main isolation shall be a double block and bleed system.
- 3.13.2. A force main is connected to the McCarthy Force Main, a double block and bleed isolation system is required upstream of the connection to the McCarthy Force Main.

4. Submission Requirements

4.1. Design Report

- 4.1.1. Before detailed design, a design report for pump selection shall be provided to the City of Regina in paper and electronic copies (.pdf and in .xls or .xlsx).
- 4.1.2. The report should detail the step-wise selection of pump(s), including the development of complete "system head" curves for each force main, considering the wet well water level at its lowest and highest points and for each different pump operation combination possible. Calculations specify the design friction coefficients, minor losses, equivalent hydraulic length and design operating conditions.

4.2. Engineering/Architectural Drawings

- 4.2.1. Before acceptance of any lift station and/or force main, the following record drawings shall be provided to the City of Regina as paper copies and as electronic copies (pdf and a version of AutoCAD that is acceptable to the City of Regina):

- 4.2.1.1. Electrical
- 4.2.1.2. Mechanical
- 4.2.1.3. Structural
- 4.2.1.4. Instrumentation
- 4.2.1.5. P&ID
- 4.2.1.6. Architectural

- 4.2.2. Drawings shall include "system head" curves for each force main, considering the wet well water level at its lowest and highest points and for each different pump operation combination possible. The plans shall specify the design friction coefficients, equivalent hydraulic length and design operating conditions.

4.3. Operation and Maintenance Manual

4.3.1. Before accepting any lift station, an operational and maintenance manual shall be provided. The manual shall include:

- 4.3.1.1. Location and size of contributing area.
- 4.3.1.2. Average dry weather flow, peak dry weather flow, and peak wet weather flow for the contributing area as defined in the Wastewater Design Standard.
- 4.3.1.3. Complete equipment manufacturers' operation, maintenance, service and repair instructions.
- 4.3.1.4. Complete manuals and parts lists for all mechanical and electrical equipment, including all control diagrams and schematics with wires individually numbered and identified.
- 4.3.1.5. Statement of the control sequence identifying the controlled equipment and setpoint values including any equations or tables of values from which setpoints are derived, including operation of back-up facilities such as emergency generators and storage tanks.
- 4.3.1.6. List all monitored quantities, statuses and alarms and their setpoint values.
- 4.3.1.7. Instrument calibration and device settings as detailed in the *Electrical Design Standard Lift and Pump Stations*.
- 4.3.1.8. PLC programming documentation.
- 4.3.1.9. Facility operation and maintenance requirements.

Revisions		
Conversion from Development Standards Manual and Update	See List of Specific Changes for 2021	January 2021