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Revision History

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October 6, 2016

Keith Bobey
Engineering Coordinator, Engineering Services
Parkland County
53109A HWY 779
Parkland County, AB T7Z 1R1

Dear Keith:

Project No:  60481223
Regarding:  Acheson and Big Lake Area Sanitary Servicing Study Update 2016

AECOM is pleased to submit our final report for the Acheson and Big Lake Area Sanitary Servicing Study Update 2016. Comments received have been incorporated. Please feel free to call the undersigned with any questions or concerns.

Sincerely,

AECOM Canada Ltd.

[Signature]

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Water Resources Engineer
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PERMIT TO PRACTICE
AECOM CANADA LTD.
Signature

Date: Oct 6/2016
PERMIT NUMBER: P 10450
The Association of Professional Engineers and Geoscientists of Alberta
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Appendix A. Photo Log
Appendix B. Manhole Rehabilitation Products
Appendix C. Detailed Cost Estimates
1. Introduction

1.1 Background

The Acheson and Big Lake areas are located within Parkland County. The Acheson area mainly consists of industrial developments, whereas the Big Lake area consists entirely of residential development. Highway 16 separates the Acheson Industrial Area and the Big Lake residential development.

The Acheson Industrial Area sanitary sewer system was initially designed and constructed in 1995. The original sewer line services the Ellis and Sherwin Industrial Parks – located north of Highway 16A and south of the Canadian National Railway. The sewer line was designed to accommodate the predicted future development areas adjacent to the sewer. This included the majority of the area extending north from the Ellis and Sherwin Industrial Parks to Highway 16. The system connects to the existing sanitary trunk sewer called the Parkland Sewage Transmission System (PSTS) operated by the Alberta Capital Region Wastewater Commission (ACRWC).

Several connections have been added to the Acheson Trunk and have been extended to service a greater number of lots. Connections have been added running parallel to Highway 16 to service areas located east of the Acheson Trunk. The Acheson Trunk runs by gravity along the west side of Range Road 264 and services the area west of Highway 60.

In 2011, AECOM completed the Acheson and Big Lake Area Sanitary Servicing Study. Since then, sanitary servicing has been extended to newly developed areas. The increasing demand for sanitary servicing has created a need to determine the available capacity and to update the sanitary servicing concept to allow development to proceed in the most efficient and cost effective manner.

1.2 Scope of Work

The scope of work includes the following:

- Collect and review all data relevant to the project including existing reports, mapping, as-built data, land use data, population data, and 2015 sewage flow and rainfall monitoring data.
- Update and verify the existing sanitary sewer system model for the Acheson and Big Lake Area.
- Evaluate the existing sanitary sewer system, identify deficiencies, and assess and recommend system improvements.
- Identify and summarize present and future service level challenges that may arise from discussions with ACRWC.
- Develop a servicing concept to address the existing, near future, long term, and ultimate development conditions utilizing XP-SWMM software.
- Develop alternative sanitary servicing concept and recommend preferred alternatives.
- Develop a staging and implementation plan for the preferred alternatives.
- Develop cost estimates for existing system upgrades and near future, long term, and ultimate development conditions.
- Prepare a report detailing the findings of the study update and the proposed sanitary servicing concept for existing, near future, long term, and ultimate development conditions.
2. Study Area

2.1 General

The study area includes the Acheson and Big Lake areas of the Parkland County and is comprised of residential and non-residential land use. The Acheson industrial and Big Lake residential areas are located immediately west of Edmonton. The study area is bordered by the City of Edmonton to the east, City of Spruce Groove to the west, Big Lake and Atim Creek to the north, and Highway 628 to the south. Highway 16 separates Big Lake and Acheson Industrial areas; with the Big Lake area to the north, and the Acheson Industrial area to the south. Highway 60 runs in the north-south direction through the study area dividing it in half. The entire study area covers approximately 6,900 hectares with the majority of the area consisting of industrial development. The study area is shown in Figure 2.1; the figure also includes the eight economic zones within the Acheson area and various areas of environmental importance.

2.2 Land Use

For the portion of the study area north of Highway 16, the Big Lake Area Structure Plan July 2013 Consolidation generally identifies these lands as being estate residential with pockets of neighbourhood commercial areas. For the remaining portion of the study area, being the area south of Highway 16, the 2014 Acheson Industrial Area Structure Plan (ASP) identifies the lands as being primarily industrial. Within the area south of Highway 16, the Acheson Industrial ASP also identifies two specific agriculture areas, the existing Osborne Acres residential subdivision and its surrounding 200 m development restriction area as well as the Wagner Natural Area. The area structure plans, available on www.parklandcounty.com, contain detailed maps of the land uses described above. For the purposes of this study, it is assumed the entire area south of Highway 16, with the exception of the Wagner Natural Area, will eventually be developed with full sanitary sewer and water servicing.

The Atim Creek / Big Lake Overlay, identified in Section 10.3 of Parkland County’s Land Use Bylaw No. 20-2009, was used to create the boundary between the proposed unserviced lands (Open Space, Golf Courses and Lois Hole Provincial Park) to the north and the serviced estate residential area to the south. This overlay is defined as the 1:100 year Flood Plain for Big Lake plus 1 meter, which is consistent with the Big Lake Basin Study 2007 completed by Sameng Inc. The overlay restricts land use in the area north of the 1:100 year boundary, regardless of the underlying land use district. Therefore, for the purposes of developing this sanitary sewer servicing study update, the lands north of this boundary were not considered to be developable lands. The existing small residential subdivision (Grandview Estates) within the NW ¼ of 16-53-26 W4M that extends into the 1:100 year boundary was constructed prior to the recognition of the boundary by Parkland County and Alberta Environment.

Since the area to the south of the Wagner Natural Area is located in the Natural Area’s Groundwater recharge zone, as indicated on Figure 2.1, care must be taken when developing in this area to ensure that groundwater recharge is not interrupted nor affected. Developers will need to undertake necessary subsurface investigation, under the supervision of a professional member experienced in hydrogeology, to ensure proposed underground infrastructure has no significant long-term impact on the groundwater flow system of the Wagner Natural Area. Also, developers need to be aware of the potential for both active and unforeseen groundwater flow conditions in and around the Wagner Natural Area. Active groundwater conditions include, but are not limited to: high water tables, flowing artesian conditions, and strong upward water flow. Furthermore, the area in and around the Wagner
Natural Area is known to have buried sand channels with no surface expression. These buried channels are focal points for groundwater flow, and could pose potential problems associated with pipeline construction. For the purpose of this study, it was assumed that the development within this area would be developed with full sanitary sewer and water servicing similar to the other industrial areas.

2.3 Development Staging

For this Sanitary Servicing Study Update, Parkland County’s Planning and Engineering Departments recommended the following four development staging scenarios, shown on Figure 2.2, be considered and modelled as having full sanitary servicing:

- Existing development (having sanitary service in 2015)
- Near future development (next 10 years, 2016 to 2025)  
  (As estimated by Parkland County’s Planning and Engineering Departments)
- Long term development (11 to 28 years, 2026 to 2043)  
  (As per Map 16 from Parkland County’s Community Scan Analysis, April 2015)
- Ultimate development (29 years +, 2044 to full build-out)

The areas considered as being existing development are shaded in yellow. The near future and long term development areas are expected to be the next areas to be developed. These areas are either easily serviceable areas or infill development areas and are shaded in green and purple, respectively. The ultimate development stage considers full build-out of the entire study area and is shaded blue in Figure 2.2.

It was assumed that 2% of the gross industrial area will be dedicated to roadways, 3% will be dedicated to public utility lots such as stormwater management facilities and 10% will be allocated to reserves (environmental and municipal). The not to be serviced areas also include municipal and environmental reserves, golf courses, other lands within the Atim Creek / Big Lake Overlay Area, and future planned highway expansion areas. The future single services, such as golf course club houses, are included in the analysis.

2.4 Population Projections

Similar to the Acheson and Big Lake Area Water Servicing Study, the County’s Community Scan and Analysis Report, completed by ISL Engineering in April 2015, was obtained in order to provide the study current population information and forecasting. From the Community Scan and Analysis, a population density of 2.8 persons per dwelling will be used in this sanitary sewer study.

Based on the water billing records provided by Parkland County, there are 483 serviced lots within the Big Lake area. Using a population density of 2.8 persons per dwelling, the total serviced population within the Big Lake area is 1352 people.

For future estate residential development in the Big Lake area, the Parkland County Planning Department recommended using a population density of 2 dwellings/gross hectare and 3 persons per dwelling.

The near future development scenario (2025) includes partial development of the Big Lake area and servicing to additional homes within Helenslea. The additional population is 2260 people, for a total serviced population of 3612 people. The long term development scenario (2043) considers full development of the Big Lake residential area. The additional population for the long term scenario is 1191 people, for a total serviced population of 4803.
The Osborne Acres area provides an additional population 120 persons. Due to the high cost of servicing these lots, it is anticipated that Osborne Acres area will not be serviced until the ultimate development scenario. Therefore, the serviced population for the ultimate development scenario is 4923. Table 2-1 summarizes the population projection for Acheson and Big Lake Area.

Table 2-1: Population Projection for Acheson Industrial and Big Lake Area

<table>
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<tr>
<th>Development Stage</th>
<th>Serviced Population Increase</th>
<th>Total Serviced Population</th>
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<tr>
<td>Existing Development</td>
<td>-</td>
<td>1352</td>
</tr>
<tr>
<td>Near Future Development</td>
<td>2260</td>
<td>3612</td>
</tr>
<tr>
<td>Long Term Development</td>
<td>1191</td>
<td>4803</td>
</tr>
<tr>
<td>Ultimate Development</td>
<td>120</td>
<td>4923</td>
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</table>
Figure: 2.1

Legend:
- **STUDY AREA**
- **BIG LAKE FLOOD DELINEATION (1:100 YEAR FLOOD)**
- **WAGNER NATURAL AREA**
- **LOIS HOLE CENTENNIAL PROVINCIAL PARK / ENVIRONMENTAL RESERVE**
- **GROUNDWATER RECHARGE ZONE**

Legend:
- **ZONE 1**
- **ZONE 2**
- **ZONE 3**
- **ZONE 4**
- **ZONE 5**
- **ZONE 6**
- **ZONE 7**
- **ZONE 8**

ACHESON WEST AREA
BIG LAKE AREA STRUCTURE PLAN MODIFIED TO FOLLOW THE BIG LAKE 1:100 YEAR FLOOD DELINEATION
3. Design Criteria

3.1 General

This section provides the design criteria employed in the analysis of the sanitary sewer system. Design criteria recommendations are provided for both the existing and future developments (near future, long term, and ultimate development scenarios).

3.2 Flow Monitoring Data

Flow monitoring data is useful to accurately model the flows in the sanitary system. Average flow patterns can be obtained for dry weather flow, and inflow and infiltration can be accounted for from data obtained during rainfall events. The winter months generally provide the most accurate dry weather flow estimates while the summer data in combination with the rain gauge readings allow for wet weather flow calibration.

Flow monitoring data from September 2015 to March 2016 was obtained by AECOM from Alberta Capital Region Wastewater Commission (ACRWC). The wastewater flow monitoring station was installed in the fall of 2015 and is located on the Acheson Trunk line, north of Highway 16. The data was used to confirm the dry weather flow generation and pattern throughout the day. Flow monitoring data for residential areas is not currently available.

Based on the ACRWC flow data, the average wastewater flow for Acheson was calculated to at approximately 1020 L/ha/d. The peak flow was approximately 1.8 times the average with the peak occurring at midday then tapering off after 6:00 PM. The diurnal pattern was consistent throughout the monitoring period with a noticeable decrease in flow on weekends and holidays as expected for an industrial and commercial area.

3.3 Water Consumption Data

Water consumption rates are detailed in the Acheson and Big Lake Area Water Servicing Study Report (AECOM, 2016). The average industrial water consumption, excluding high demand users, was approximately 1047 L/ha/d in 2015. Average water consumption for residential areas is 259 L/p/d. The residential water consumption rate is consistent with the 2011 rate of 261 L/p/d.

3.4 Design Standards

Parkland County’s Engineering Design Standards specify the following:

- Industrial generation rate: 6170 L/ha/d
- Industrial peaking factor: 3
- Residential generation rate: 350 L/p/d
- Residential peaking factor: Harmon
- Infiltration / Inflow allowance: 0.28 L/s/ha
3.5 Recommended Design Criteria

In the 2011 Sanitary Servicing Study the average dry weather flow for normal demand users was determined to be 500 L/ha/day for existing non-residential areas and 261 L/capita/day for existing residential areas. Recommended rates for this study are summarized below:

Residential Areas:

259 L/p/d, consistent with the water consumption data, has been adopted for this study along with the diurnal flow pattern from the 2011 study for residential areas.

Non-residential Areas:

The 2011 Study utilized a non-residential sewage generation rate of 500 L/ha/d consistent with the estimated water consumption at the time. The 2015 water consumption has increased to 1047 L/ha/d. This is as a result of new development and increased water usage in the area. The monitored sewage generation rate of 1020 L/ha/d compares very well with the water consumption. To be consistent with the Acheson and Big Lake Area Water Servicing Study (2015), as well as conservative, the estimated water consumption value of 1047 L/ha/d will be utilized for this study with the exception of high demand users where actual water consumption was used. The diurnal flow pattern from the 2015 flow data will be used with a peaking factor of 1.8.

Wet weather calibration was not in the current scope, as concurrent rain gauge and flow data was not available, therefore the calibration parameters used in the 2011 Study were utilized to generate wet weather flow for existing areas. The main calibration parameter is effective area which accounts for the inflow and infiltration experienced for different rainfall events.

An effective area, expressed as a percent of the actual lot area, is used to adjust the actual area of each basin to account for inflow and infiltration during rainfall events. The effective area was adjusted in the calibration model until the volume of runoff and peak flow generated represented the inflow and infiltration shown in the flow monitoring data. The 2011 report has calibrated the effective area to be 2.5% for non-residential areas and 1.5% for residential areas.

For future development, Parkland County Standards as shown in Section 3.4 will be used. The recommended design criteria are summarized in Table 3.1.

**Table 3-1: Recommended Design Criteria**

<table>
<thead>
<tr>
<th>Development Stage</th>
<th>Residential Sewage Generation (L/p/d)</th>
<th>Residential Peaking Factor</th>
<th>Non-residential Sewage Generation (L/ha/d)</th>
<th>Non Residential Peaking Factor</th>
<th>I/I Allowance (L/s/ha)</th>
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<tr>
<td>Existing</td>
<td>259</td>
<td>1.4</td>
<td>1047</td>
<td>1.8</td>
<td>Calibrated</td>
</tr>
<tr>
<td>Near Future</td>
<td>350</td>
<td>Harmon</td>
<td>6170</td>
<td>3</td>
<td>0.28</td>
</tr>
<tr>
<td>Long Term</td>
<td>350</td>
<td>Harmon</td>
<td>6170</td>
<td>3</td>
<td>0.28</td>
</tr>
<tr>
<td>Ultimate</td>
<td>350</td>
<td>Harmon</td>
<td>6170</td>
<td>3</td>
<td>0.28</td>
</tr>
</tbody>
</table>
For existing, near future, and long term development, actual water demands have been applied to individual properties for high water demand users. To allow for redevelopment of the industrial areas in ultimate development scenario, the design rate of 6170 L/ha/day was used for all areas, including high water demand users. Future Single Service (i.e. Golf Courses and Recreation Facilities) generation rates were assumed to be 4500 L/d for each location. These recommended wastewater generation rates are illustrated in Figures 3.1 and 3.2.
ULTIMATE WASTEWATER FLOW GENERATION RATES

Figure: 3.2

Date: September 2016

ULTIMATE RESIDENTIAL RATE
(REFER TO SECTION 5.1.2)
ULTIMATE INDUSTRIAL RATE
(6000 L/ha/d)

FUTURE SINGLE SERVICE
(GOLF COURSE / REC FACILITY)
4. System Assessment

4.1 Existing System Description

The existing sanitary sewer system within Acheson flows from south of Acheson to the north through the existing Acheson Trunk. The Acheson Trunk runs along the west side of Range Road 264 by gravity and services the area west of Highway 60. This trunk ranges from 200mm to 675mm in diameter.

The Bevington Trunk sanitary sewer line was installed in 2007. The Bevington Trunk runs along the Bevington Road allowance (also called Range Road 262). This trunk ranges from 450mm to 750mm in diameter with the majority of the line being 600mm in diameter. It ties into a 525mm diameter line in Lake Ridge Estates. The Bevington Trunk will service the area to the east of Highway 60.

Both the Acheson Trunk and Bevington Trunk convey sewage to the Parkland Sewage Transmission System (PSTS) which is part of the ACRWC system. The PSTS consists of a gravity line which starts at Stony Plain, runs through Spruce Grove, and finally to the Parkland Pump Station. The PSTS is 1350mm in diameter at the Acheson connection point. Parkland County has four other connections to this line from several residential subdivisions. The pipes within the residential subdivisions range from 200mm to 525mm in diameter.

Since the Big Lake residential area is located in close proximity to the ARCWC PSTS trunk, many of the residential subdivisions connections directly to the PSTS trunk. Most of the residential system is gravity with the exception of Grandin Estates, Green Briar Estates, and part of Walker Lake which are located along the north end of Range Road 264. These three subdivisions are serviced by low pressure wastewater mains.

The existing system is shown in Figure 4.1.

4.2 Relevant Studies and Reports

The following documents pertaining to the Acheson and Big Lake sanitary sewer system have been reviewed and the applicable data has been incorporated into this study update:

- Parkland County Acheson and Big Lake Area Sanitary Sewer Servicing Study, AECOM, 2011
- Parkland County Acheson and Big Lake Area Water Servicing Study Update, AECOM, 2015
- Parkland County Acheson Industrial Area Structure Plan, Parkland County, 2014
- Wastewater Collection System Record Drawings
- Engineering Design Standards, Parkland County, 2015
4.3 Field Program

A field investigation of the existing sanitary sewer collection system was carried out on April 20, 2016. The two lift stations within Acheson, Zone 5 and Zone 3 lift stations were viewed as well as some of the manholes noted to have high infiltration.

The Zone 5 lift station is located on the east side of Range Road 264 just north of Highway 16A, on Lot 3 PUL, Block 1 Plan 0725979 in the NW quarter section of 33-52-26-W4M. It is a wet well lift station equipped with two lead/lag pumps with a capacity of 160 L/s @16 m. The lift station services the majority of the development south of Highway 16A.

The Zone 3 lift station is located at the west end of Zone 3 on Lot 821 PUL Block 3 Lot 1223960 in the SW quarter section of 5-53-26-W4M on Acheson Road. It is a wet well lift station with two lead/lag pumps with a capacity of 54 L/s at 10 m head. The lift station services the area South of the CN rail in Consor Area in Zone 3 and area west of Consor Area in the Acheson West Area.

The Zone 5 and Zone 3 lift stations are both fairly new, constructed in 2007 and 2011, respectively. There were no issues noted with the operation of the stations.

The County has many manholes located in the ditches throughout Acheson. During periods of rainfall or snowmelt when the ditches fill with water, high infiltration and inflow through the manholes is experienced. County staff showed AECOM several representative manholes. A photo log is provided in Appendix A.

The following main issues were noted:

1. The manholes are commonly extended above ground using grade rings. The grade rings are connected with grout which has cracked or the rings have shifted creating gaps.
2. During high water, the manholes will become submerged allowing inflow through the cover and the sides.
3. In areas with high groundwater, infiltration occurs through the grade rings and joints below ground.

The County has placed inserts in some of the manholes which significantly slow the rate of flow from the cover to the sanitary sewer system. These inserts are helpful and can help reduce the peak flow to the sanitary sewer. They do require cleaning and replacement from time to time. Improvement opportunities are identified in the following section.

4.3.1 Improvement Opportunities

AECOM performed a review of alternative waterproofing products to determine suitable products for the County’s use on future sanitary sewer construction projects, as well as product options for the rehabilitation of existing manholes. A review of Parkland County’s Engineering Design Standards was also performed to identify any clauses that may be contributing to Developer’s current installation practices and whether Developers may be misinterpreting the Standard’s intent.

Product information sheets for the available products are provided in Appendix B.
**Manhole Waterproofing Recommendations**

The inflow and infiltration of storm water into the sanitary sewer system occurs from a variety of sources. Inflow is typically attributed to direct flow from inlets (i.e. manhole covers) or connections (i.e. residential cross-connections, roof drains and sump pumps), whereas infiltration refers to groundwater seepage through joints, cracks and areas of deterioration. Inflow and infiltration present a problem for sanitary sewer systems because it takes up pipe capacity reserved for wastewater flows and places additional stress on downstream transmission and treatment systems, in this case the ACRWC (Alberta Capital Region Wastewater Commission) system.

Due to the high groundwater table in the area, infiltration has been previously identified as a concern. The County may therefore consider specifying the following waterproofing products for future sanitary sewer construction projects:

- Xypex products may be specified as an additive or coating for manhole barrel sections. This product is a chemical treatment for concrete that prevents the penetration of water through concrete’s pores and capillaries.
- Joint wraps, such as Cretex Wrap, Infi-Shield Gator Wrap (Photo 1) or Rub’R Nek, consist of a synthetic material and adhesive applied externally around manhole construction joints. The product provides a watertight seal that prevents groundwater from infiltrating through construction joints. The product may also be specified for the joints between concrete pipe sections.
- Chimney seal products, such as External/Internal Chimney Seals, Infi-Shield Uni-Band (Photo 2), or WrapidSeal, may be applied around the neck section of a manhole structure to provide a watertight seal and prevent water from infiltrating through the joints between grade rings (if infiltration has been identified as a concern by project designers at elevations near the manhole’s rim).
- Manhole inserts (Photo 3) may be installed beneath the manhole frame and cover to reduce the rate of inflow through the cover (from the cover’s pick holes, as well as the joint between the manhole frame and cover). This product has been previously installed by the County at several locations. The inserts have shown to work effectively at reducing the inflow rate, but do not entirely prevent inflow.

*Note: Photos 1 to 3 obtained from Sealing System Inc. and Parson Environmental Products Inc.*

**Manhole Rehabilitation Recommendations**

Field reconnaissance of sanitary sewers in the Acheson area noted that inflow and infiltration has been occurring due to the location of several sanitary sewer alignments within ditch networks. The placement of manholes within a ditch allows ditch conveyance and surface flows to enter the sanitary system through manhole covers and construction joints in the above-ground manhole structure.
Considering the recent installation of numerous existing manhole structures, the removal, replacement and relocation of these structures is considered expensive and excessive. Therefore, alternative rehabilitation products were reviewed to provide the County with options based on product effectiveness and cost. These products range from joint wraps and external sealing systems to manhole liners and epoxies.

Developer installation practices for above-ground manhole structures were found to be conducive to creating inflow and infiltration problems. As shown in Photo 4, the use of grade rings to raise the manhole frame above finished grade creates multiple construction joints for inflow. Typically, grade rings are used to make slight adjustments to the manhole structure’s rim elevation in order to match the ground or pavement finished grade. The use of grade rings above finished grade could also be considered a safety concern by the County, as the grade rings could potentially shift over time and fall, causing injury or an exposed manhole opening.

Grouting the construction joints between grade rings, as shown in Photo 5, is not a recommended practice for waterproofing due to weather exposure, vulnerability to freeze-thaw cycles and potential damage by mowing or snow removal equipment, which will cause the eventual deterioration of the grout. Synthetic products have been developed by manufacturers to address manhole inflow and infiltration and may provide better solutions. Some manufacturers claim to have developed products that are abrasion resistant.

Manhole lid sealing products are available to address inflow through manhole frames and covers. Lid gaskets can be used to prevent inflow through the joint between the frame and cover, whereas pick hole plugs can be used to prevent inflow through the pick holes in the manhole cover. Operations and Maintenance crews can remove the gaskets and plugs using pliers to access the manholes for inspection (although this may result in the regular replacement of these products as they may be damaged by crew disturbance).

Inflow concerns can be further mitigated by installing manhole inserts beneath the frame and cover. As previously noted, this product has been used by the County at several existing locations. The inserts have shown to work effectively at reducing the inflow rate, but do not prevent inflow.

Joint wraps, such as Cretex Wrap, Infi-Shield Gator Wrap or Rub’R Nek, may be applied to each above-ground construction joints of existing structures. Alternatively, Chimney seal products, such as External/Internal Chimney Seals, Infi-Shield Uni-Band, or WrapidSeal, may be more effective where several joints occur within a small vertical distance. These synthetic products may be applied around the above-ground neck section of a manhole structure to provide a watertight seal and prevent surface runoff from inflowing through the existing construction joints.
Joint wrap and chimney seal products are relatively inexpensive (compared to manhole liners) and may mitigate surface runoff inflow to acceptable levels. However, inflow and infiltration should still be expected due to the high groundwater table, which will cause infiltration through pipe joints, excess flows and below-ground construction joint flows. In order to reduce below-ground infiltration quantities for existing manholes, the County can consider sealants, liners and epoxys.

Manhole epoxies, such as Liquiforce, can be sprayed onto the inside of the manhole to coat the structure and mitigate groundwater intrusion. Application of these products on a 1200 mm diameter manhole is estimated at approximately $1200 per vertical meter. Alternatively, cast-in-place liners can be installed to coat the manhole’s interior with a resin, thereby mitigating groundwater intrusion. Recent estimates for a cast-in-place liner on a 1200 mm diameter manhole were at approximately $6000 per vertical meter. Since this price exceeds the cost of removing and replacing the manhole, cast-in-place liners may not be feasible for the County’s rehabilitation plans.

The last product provided for the County's consideration is a sealant, such as Flex-Seal Utility Sealant, which may be applied to grade ring and joint sections from the inside of the manhole structure. The paint-like application of this product is anticipated to cost less than a spray-on epoxy due to its spot-repair nature, but it is not expected to provide the same degree of protection as an epoxy or cast-in-place liner. Note that this section provides examples of potential products but is not necessarily an exhaustive list. There may be other similar or equivalent products available.

Review of Parkland County Engineering Design Standards

Field reconnaissance of sanitary sewers in the Acheson area noted that inflow and infiltration has been occurring due to the location of several sanitary sewer alignments within ditch networks, as opposed to beneath the adjacent roadways. Future sanitary sewer inflow and infiltration concerns can be reduced by locating manholes within the driving lane of roadways (at a suitable distance from curbs and gutters for urbanized road cross-sections).

Parkland County Engineering Design Standards already address this through Clause 4.5.4, which states that, “Unless approved otherwise, all (sanitary) mains shall be installed within the center of the road driving lane.” Figures 7.1 to 7.7 in the Design Standards also clearly show the location of the sanitary sewer main below the roadway for a typical road cross-section.

Therefore, since designing the sanitary sewer alignment within ditch areas constitutes an exception to the Design Standards, AECOM suggests that future reviews of proposed sanitary sewer alignments located within ditch areas consider the following additional requirements:

- Manhole rim elevation should be designed and constructed at a minimum 300 mm above the estimated 100 year high water level to mitigate frame and cover inflow.
- If the manhole structure must be raised above finished grade to meet the minimum rim elevation requirement, additional barrel sections should be placed below the eccentric cone to raise the manhole rim to the required elevation. Grade rings should not be used above finished grade.
- All construction joints should be waterproofed using sealants, joint wraps, chimney seals, Xypex or approved equivalent products to mitigate inflow and infiltration.

Aside from waterproofing concerns, field reconnaissance also noted instances where floating frames and covers (NF-80 or NF-90 style) where used in landscaped or natural areas, as shown in Photo 6. Clause 4.4.5 of the Design Standards indicates that, “Manhole frames and covers shall be type NF-80 in paved areas, NF-90 gasketed in sags and NF-39 in landscaped or natural areas (or approved equal).” Type NF-80 and NF-90 style frames and covers are designed to “float” on road surface materials in order to accommodate roadway material expansion/contraction and mitigate the subsequent discrepancies created between the manhole rim and road finished elevations. This style of frame/cover requires the use of road materials under the frame to provide support to the frame. As noted on the Norwood Foundry website, floating style frames must not rest on the concrete ring to prevent damage to the
concrete, or flipping of the frame/cover. It is recommended that floating frame/cover types are not approved for use in landscaped or natural areas.

The Developer’s use of grade rings to raise the manhole frame above finished grade could possibly be attributed to Figure 4.1 and 4.3 in the Design Standards, which note the minimum use of 2 grade rings. The County may consider revising these Figures to note a minimum/maximum distance between finished grade and the eccentric conical top complete with grade rings as required, as opposed to specifying a minimum use of 2 grade rings.

### 4.3.2 ACRWC

Acheson and Big Lake wastewater flows drain to the ACRWC PSTS (Parkland Sewage Transmission System) which collects flow by gravity from Stony Plain, Spruce Grove upstream of Acheson and Big Lake before flowing to the Parkland Pump Station located in Lakeshore Estates. There it is pumped to the START (St. Albert Regional Trunk) line where it flows to the treatment plant near Fort Saskatchewan.

A meeting was held with ACRWC on May 3, 2016 to gain an understanding of the status of the system and future initiatives for system upgrades and wet weather flow reduction.

The ACRWC system experiences large increases in flow during periods of heavy rain which strain the current capacity. ACRWC has implemented storage at the Morinville Lagoons and is considering using the Spruce Grove Lagoons (located in Parkland County) for storage as well. They are currently conducting preliminary design on the connection to the lagoons which involves the twinning of a portion of the PSTS trunk upstream of Spruce Grove, a real time control gate at Century Road (Range Road 272) and some environmental investigation as well as condition assessments surrounding the lagoons. Although the improvements are not directly adjacent to the Parkland County connection points, the overall capacity for flows at Acheson and Big Lake is affected by the ability to divert to the lagoons during high flows.

ACRWC has conducted modelling on their system. AECOM reviewed the modeling assumption for Parkland County to confirm they are compatible with the current Study.

Currently there is no formal wet weather strategy in place but ACRWC is conducting consultations on the implementation of a plan. There is potential that member municipalities may have to pay a premium for high wet weather flows or that rates will increase for all members to pay for future upgrades.
4.4 Model Development

XP-SWMM, an industry accepted modelling software program, was used to develop the detailed model of the existing sanitary sewer system. The model features the XP-SWMM runoff layer, which generates wet weather flows. It also features the XP-SWMM hydraulics layer, which simultaneously simulates the dry and wet weather. These two layers allow for the collection of simulated data for both dry and wet weather flows.

The model was built on previous work completed as part of the 2011 study. Physical data including manhole rim elevation, invert elevation, pipe diameter, and slope was obtained from as built drawings and supplementary survey data provided by the County. The study area was delineated into sanitary sewer catchment areas that were used in both dry and wet weather flow simulations. These were estimated based on the locations where sewage would enter the system and allows for input of flow into all pipes as well as the examination of localized problem areas. Table 4-1 summarizes the breakdown of serviced areas in the Acheson Industrial Area, and the projected population increases in the Big Lake Area throughout the development stages.

Table 4-1: Land Use for Acheson Industrial and Big Lake Area

<table>
<thead>
<tr>
<th>Development Stage</th>
<th>Non-Residential Area (ha)</th>
<th>Serviced Population Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>711</td>
<td>-</td>
</tr>
<tr>
<td>Near Future</td>
<td>596</td>
<td>2260</td>
</tr>
<tr>
<td>Long Term</td>
<td>563</td>
<td>1191</td>
</tr>
<tr>
<td>Ultimate</td>
<td>1541</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>3411</td>
<td>4923</td>
</tr>
</tbody>
</table>

4.4.1 Dry Weather Flow Model

Dry weather flow was generated by the model based on the parameters calculated through analysis of the data provided, including flow monitoring and water consumption data. Calibration of the dry weather flow model is discussed in Section 4.5.

4.4.2 Wet Weather Flow Model

The XP-SWMM runoff layer was used to generate the wet weather flow in the model. The wet weather calibration established in the 2011 study was utilized. As discussed in Section 3.5, the primary calibration parameter is effective area which is used to generate the runoff that will enter the sanitary sewer. The wet weather flow into the sanitary system varies significantly with the depth and distribution of rainfall and the type of servicing. In order to simulate the inflow and infiltration process, an effective drainage area was identified for each basin. Only a portion of runoff will enter the sanitary sewer which means only a portion of the basin area is contributing runoff to the sanitary sewer. The model is then representative of the actual inflow and infiltration that occurs for any given rainfall event. Inflow and infiltration sources include roof leaders, storm drains connected to the sanitary sewer, cracked manholes, and leaky pipes and manhole covers. The infiltration parameters used in the model are summarized in Table 4-2. These are based on the soil conditions typical for the area.
Table 4-2: Soil Infiltration Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impervious Area – Manning’s n</td>
<td>0.015</td>
</tr>
<tr>
<td>Previous Area – Manning’s n</td>
<td>0.25</td>
</tr>
<tr>
<td>Impervious Depression Storage</td>
<td>3.20 mm</td>
</tr>
<tr>
<td>Pervious Depression Storage</td>
<td>6.40 mm</td>
</tr>
<tr>
<td>Initial Infiltration Rate</td>
<td>75 mm/hr</td>
</tr>
<tr>
<td>Final Infiltration Rate</td>
<td>3.5 mm/hr</td>
</tr>
<tr>
<td>Decay Rate</td>
<td>0.00115 /s</td>
</tr>
</tbody>
</table>

An impervious percentage of 50% was used for both residential and non-residential area. These values are conservative as the residential lots are quite large and the non-residential areas currently have relatively small impervious area.

4.5 Model Verification

The sanitary sewer model employed in the 2011 Acheson and Big Lake Area Sanitary Servicing Study was verified with data obtained in Section 3. A combination of flow monitoring data from Acheson Trunk line flow monitoring record and water consumption data from the 2015 Parkland County Acheson and Big lake Area Water Servicing Study Update were used in the verification of the existing sanitary sewer flows. The calibrated dry weather flow determines the average sewage generation rate and the flow pattern throughout a typical day for the existing system. Wet weather flow calibration is not currently included in the scope of work as concurrent rainfall and flow data was not available. The wet weather calibration from the 2011 study was carried forward.

ACRWC now has a permanent flow meter on the Acheson Trunk and a rain gauge in Acheson. It is recommended that as more data becomes available, an update to the model calibration be conducted. While, the ACRWC flow meter provides an overall measurement for Acheson, additional flow monitoring throughout Acheson and Big Lake is recommended to better understand flows from both residential and non-residential flows. A more comprehensive flow monitoring program with locations throughout the service area would also be helpful in better identifying I/I problem areas and together with the rainfall data can help predict the flow response depending on the amount of rain.

4.6 Existing System Evaluation

The existing system was assessed to examine the system performance for various rainfall events and to identify any deficiencies in the system. The existing system was evaluated for the 5 year and 25 year 4 hour events.

The following criteria were used to evaluate the existing system:

- A sewage generation rate of 1047 L/ha/d for all existing non-residential areas, unless identified as a high water demand user.
- A sewage generation rate of 259 L/c/d for all existing residential areas.
- Actual sewage generation rate for high water demand users, value based on water usage records to be conservative.
- The calibrated and verified diurnal curves as shown in Figure 4.2 for both residential and non-residential areas.
- Inflow and Infiltration on effective area for existing residential area of 1.5%, per 2011 Sanitary Servicing Study.
- Inflow and Infiltration on effective area for existing non-residential area of 2%, per 2011 Sanitary Servicing Study.

The existing sewage generation rates for the study area are shown in Figure 3.1. The existing system was evaluated for the 5 and 25 years 4 hour rainfall events.

A 4 hour “Chicago” distribution was adopted for both rainfall events. This distribution results in a high intensity rainfall, which is representative of short duration rainfall events. This distribution is typically used in computer modelling of urban drainage systems. The rainfall depths for the design events are summarized in Table 4-3.

### Table 4-3: Design Rainfall Events

<table>
<thead>
<tr>
<th>Return Period (years)</th>
<th>Duration (hours)</th>
<th>Total Rainfall (mm)</th>
<th>Peak Intensity (mm/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>33.34</td>
<td>72.95</td>
</tr>
<tr>
<td>25</td>
<td>4</td>
<td>46.37</td>
<td>110.75</td>
</tr>
</tbody>
</table>

The existing system was evaluated to assess the system performance with the proposed sewage generation rates by examining the following parameters:

- The capacity utilization within the system to identify potential locations where pipe flow exceeds pipe capacity, and
- The hydraulic grade line within the system to identify potential surcharge locations.

The magnitude of surcharging at manholes was calculated by subtracting the maximum hydraulic grade line (HGL) from the ground elevation and was divided into three levels, outlined in Table 4-4.

### Table 4-4: Sanitary Sewer Manhole Surcharging Levels

<table>
<thead>
<tr>
<th>Rating</th>
<th>Depth of HGL Below Ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>More than 2 m</td>
</tr>
<tr>
<td>Blue</td>
<td>1 m to 2 m</td>
</tr>
<tr>
<td>Red</td>
<td>Flooding to 1 m</td>
</tr>
</tbody>
</table>

The capacity utilization in the pipe was calculated by taking the ratio of the peak flow in the pipe to the pipe capacity and was divided into 3 levels as outlined in Table 4-5. Red indicates that the pipes are over utilized, blue denotes the cautionary range, and green indicates that capacity is available.

### Table 4-5: Sanitary Sewer Capacity utilization Levels

<table>
<thead>
<tr>
<th>Rating</th>
<th>Ratio of Peak Flow to Pipe Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>0.0 to 1.2</td>
</tr>
<tr>
<td>Blue</td>
<td>1.2 to 2.0</td>
</tr>
<tr>
<td>Red</td>
<td>Above 2.0</td>
</tr>
</tbody>
</table>

Figures 4.3 to 4.5 illustrate the surcharge and capacity utilization levels in the existing system for dry weather flow as well as at various rainfall events. The colour of the nodes or manholes indicates the level of surcharging and the colours of the pipes indicate the capacity utilization.
4.6.1 Dry Weather Flow Results

As seen in Figure 4.3, the existing system is sufficient to handle the dry weather flows. The majority of the manholes and pipes are green, indicating sufficient capacity. Several manholes are blue, indicating that the hydraulic grade line is between 1 and 2 meter below ground level. However these sewers are shallow so this does not indicate surcharging in the system, as the maximum hydraulic grade line is still within the diameter of the pipe. Issues with the wastewater collection system are generally caused by various rainfall events, as discussed in the following sections.

4.6.2 5 Year 4 Hour Event Results

The 5 year 4 hour rainfall event was simulated and the results are illustrated in Figure 4.4. It can be seen that some blue manholes and blue pipes are present in the intersection of Range Road 264 and Township Road 531A. This indicates manholes surcharging and higher than capacity flow occurs in the wastewater sewers. Another location showing blue manholes and pipes is near the Petro-Canada site at the intersection of Highway 16 and Highway 60. Other blue manholes in Zones 1 and 3 are shallow so this does not indicate surcharging in the system, as the maximum hydraulic grade line is still within the diameter of the pipe. The area downstream of the Zone 3 Lift Station is sufficient for the 5 year 4 hour rainfall event. Blue manholes downstream of the Zone 3 lift station represents shallow manholes in that area. The entire Big Lake area appears to have sufficient capacity for the 5 year 4 hour rainfall event.

4.6.3 25 Year 4 Hour Event Results

The 25 year 4 hour rainfall event was simulated and the results are illustrated in Figure 4.5. This more significant rainfall event amplifies the manhole surcharging issues and over utilization of wastewater lines in three areas. An area that is surcharging is on Hayes and Walker Crescent area within Parkland Business Park. There are simulated manholes overflowing on Hayes Crescent, west of the Petro Canada property. The second area of interest is located at the intersection of Acheson Road and Highway 60, within Ellis Industrial Park. Several blue manholes and pipes were simulated in this area indicating manhole surcharging and pipe over utilization. Both Zone 3 and Zone 5 Lift Stations are operating within capacity. Other blue manholes in Zones 1 and 3 are shallow so this does not indicate surcharging in the system, as the maximum hydraulic grade line is still within the diameter of the pipe. No issues are simulated in the Big Lakes residential area under the 25 year 4 hour rainfall event.

4.6.4 Existing System Improvements

As indicated in the previous 2011 Sanitary Servicing Study, the existing system will require upgrades to adequately convey the high peak wet weather flows resulting from infiltration and inflow. Upon adding additional flows from future development areas, further upgrades to the existing system are necessary. Therefore, existing system upgrades will be sized for the ultimate development scenario for the governing 25 year 4 hour rainfall event. All upgrades are discussed in Section 5. I/I reduction measures discussed in Section 4.3.1 have the potential to reduce the wet weather flow experienced, however, for the purposes of this study, the current level of I/I as per the model calibration has been used to size improvements.
CALIBRATED RESIDENTIAL DIURNAL CURVE

CALIBRATED NON-RESIDENTIAL DIURNAL CURVE
5. Sanitary Sewer Servicing Concept

5.1.1 General

A sanitary servicing plan was developed for Acheson and Big Lake area for near future, long term, and ultimate development scenarios. These scenarios assume the full build-out of the areas identified in Figure 2.2. Areas were connected to the existing system where they could best be serviced by gravity as well as where capacity is available if possible. The approximate locations of future gravity sewer mains and forcemains have been identified. The system was then analyzed to identify deficiencies as well as any required improvements.

The future servicing concept plan for each development stage assumes that all of the recommended upgrades outlined in previous stages have been completed. The near future stage upgrades are based on the assumption that the recommended existing system upgrades have been implemented and the long term stage upgrades are based on the assumption that the recommended near future stage upgrades have been implemented and so on.

5.1.2 Design Criteria

For future developments, the design criteria used for this study are as follows:

- A residential sewage generation rate of 350 L/c/d, for all future developments.
- A Harmon’s peaking factor of $1+(14/(4+p^{1/2}))$ for residential areas, where $p$ denotes population in thousands, and the peaking factor has a maximum value of 2.5.
- A residential inflow/infiltration allowance of 0.28 L/s/ha.
- A non-residential sewage generation rate of 6170 L/ha/d with a peaking factor of 3.0, at Near Future and Long Term development stages.
- A non-residential inflow/infiltration allowance of 0.28 L/s/ha.
- Actual high water user sewage generation rates will be used, at Near Future and Long Term development stages. Value is based on water usage records.
- A non-residential sewage generation rate of 6170 L/ha/d with a peaking factor of 3.0, at ultimate development stage including existing areas.

There are two golf course clubhouses in the northwest corner of the study area, north of Highway 16. These clubhouses currently exist, however they are not currently serviced by the sanitary sewer system. The clubhouses were added to the network in the near future development with a sewage generation rate of 4,500 L/day each. Two additional single services located within Zone 1 are added to the network in the near future development, with a sewage generation rate of 4,500 L/day each. The Ranch clubhouse located in the southeast portion of the study area is not currently serviced by the sanitary sewer system. It was assumed to be serviced in the ultimate scenario when adjacent development occurs. An allowance for three additional golf course clubhouses / recreational facilities was included as part of the ultimate development at a sewage generation rate of 4,500 L/day each. The locations of all clubhouses / recreational facilities are indicated on Figure 2.2.
5.2 Servicing Concept

The design sewage generation rates and their respective areas are shown in Figures 3.1 and 3.2. In this study update, future servicing concepts is broken down to three development stages: Near Future, Long Term, and Ultimate development. Each development stages are simulated with the 25 year 4 hour rainfall event, as it is the governing rainfall event for the wastewater collection system. Each development stage is discussed in detail below.

5.2.1 Near Future Development

For near future development, the new areas to be developed are connected to the existing sanitary system. Preliminary pipe sizing and alignment is provided in Figure 5.3. However, these pipe designs must be confirmed at the area structure plan or neighbourhood design level as development proceeds and road alignments and more detailed elevations become available.

Near Future developments in Acheson industrial Zones 1, 3, 5, 7, and western portions of Zones 2 and 4 will be connected to the Acheson Trunk Line and discharged into ACRWC PSTS line. Near Future developments in the remainder of Zones 2, 4, and Zone 6 will be serviced by the Bevington Road Trunk line, discharging to PSTS line.

In the Big Lake residential area, all near future developments are connected to existing sanitary lines discharging into the PSTS line. No new connections to PSTS are planned and it is assumed that the existing wastewater system will be utilized for future development.

It is anticipated, based on preliminary information, one additional wastewater lift station will be required in the near future stage. One lift station, named Future Lift Station #1 in Figure 5.3, is required to service near future properties adjacent to Highway 16A and Highway 60, in Zone 6. This lift station should have a capacity of approximately 38 L/s during the near future development stage.

As mentioned in Section 5.1.2, four future single service connections (golf courses/recreation facilities) are assumed to be added to the wastewater collection system in the near future stage. It is anticipated the future single service located north of Osborne Acres will drain towards the existing low pressure wastewater main on Township Road 531A. The facility east of Osborne Acres will drain by gravity and the two facilities in Lois Hole Park will have a new low pressure service. The Edmonton Trailer Site currently has a low pressure service and therefore the adjacent lots can either have a low pressure connection to the existing service or depending on the required flow a new gravity main can be installed.

Figure 5.3 show the surcharge and capacity utilization levels in the near future system for the 25 year 4 hour event. The results for the near future system are based on the assumption that upgrades recommended for the existing stage in Section 5.2.4.1 are complete.

There are two red manholes in the near future scenario: In Zone 1 near the intersection of Highway 16 and Highway 60, and in the Big Lake residential area near Countryside Ravines, in Section 14. Both manholes are not flooding in the near future condition, but the HGL within these manholes are less than 1 meter from the ground surface. There are also several red and blue pipes in these areas.

Several manholes are blue, indicating that the hydraulic grade line is between 1 and 2 meter below ground level. However these sewer mains are shallow so this does not indicate surcharging in the system, as the maximum hydraulic grade line is still within the diameter of the pipe.
5.2.2 Long Term Development

Long term developments mainly occur in outskirts of the Acheson Industrial Park. Approximately 300 ha of land in Zones 1, 3, 5, and Acheson West Area is slated to be developed in the long term time frame. This area is anticipated to connect to the existing wastewater collection system to the east and discharges into the PSTS line through lift stations and gravity mains. Long term development area in Zones 2, 4, 6, and 8 are anticipated to connect to existing Bevington Trunk, via gravity mains and lift stations as required.

Four additional lift stations are anticipated to be installed in the long term development stage. Based on preliminary ground contour data, the elevation of the Acheson Trunk Line is higher than the elevation at many long term development areas. Long term development areas in sections 6, 31, 32, and 27, of Zones 3, 5 and 8 respectively may require lift stations and forcemains. The requirement for wastewater lift stations depends on the ground elevation during the development stage and should be reviewed as more detail becomes available. The locations shown in Figure 5.5 are approximate.

Most of the long term Big Lake residential development area is located between Highway 60 and Range Road 265, and north of Highway 16. It is anticipated wastewater services will be connected to existing wastewater mains by gravity. Ultimately, the wastewater is discharged into the PSTS line north of the residential areas.

In the simulation results shown in Figure 5.5, there are several red and blue manholes and pipes in the Zone 5 and Zone 3. The existing wastewater mains in the Zone 5 area are significantly over utilized under the long term scenario and significant flooding is simulated in this area. The red manhole in Zone 3 is a result of a combination of shallow manholes and high hydraulic grade line.

5.2.3 Ultimate Development

In Acheson Industrial Park, ultimate development area consists of the remainder of the unserviced areas, excluding area not to be serviced, illustrated in Figure 5.7. Some of the areas not to be serviced include Lois Hole Centennial Provincial Park, Wagner Natural Area, and southern portions of Acheson Industrial Zones 7 and 8.

Ultimate development areas in the Acheson West Area are anticipated to be serviced by a new line, referred to as the Atim Road trunk, which will connect directly to the ACRWC PSTS Line. Based on preliminary contour data, there is sufficient drop in elevation to install a gravity wastewater line in this area.

Ultimate areas to the south of Highway 16A and west of Highway 60 are connected to the system at the Zone 5 Lift Station, at Range Road 264. This will be referred to as the Acheson Trunk extension. The areas to the south of Highway 16A and east of Highway 60 will be served by the Bevington Road Trunk extension. Based on preliminary contour data, forcemains may be necessary as there are insufficient elevation changes for the installation of gravity mains. The residential area of Osborne Acres can be serviced by the Acheson trunk line through a low pressure wastewater main. Depending on actual grading of development, lift stations may be required for area north of Highway 16A in section 2 of Zone 4, and south of Highway 16A, in sections 26, 27, 29, and 35 in Zones 8, 7 and 6 respectively.

Simulation results are shown in Figure 5.7. Significant flooding is simulated in both Zone 5 and Zone 3. A majority of the manholes in these two areas are red or blue and some pipes along the Acheson Trunk are over utilized. Zone 5 Lift Station will also need to be upgraded at this stage.
5.2.4 Staged Upgrades

Currently, as discussed in Section 4.6, the existing wastewater system within the study area does not have sufficient capacity to convey the existing wastewater flows during the design rainfall events. As development expands within the Acheson and Big Lake area, and flows increase, deficiencies within the system will become more apparent. Consequently, it is recommended that the existing system pipe upgrades be sized to accommodate the ultimate development flows where necessary to avoid re-upgrading in the future. The upgrades are recommended to take place in stages. Some upgrades should take place right away in areas that are already showing issues. Some should be implemented during near future development, and some during ultimate development. The upgrades are broken down into the different development plans with staged existing system upgrades.

5.2.4.1 Existing Development Stage Upgrades

As discussed in Section 4, there are several areas of surcharging in the existing development condition. The most critical results for the existing development were experienced during the 25 year 4 hour rainfall event. The recommendations based on the existing system assessment are as follows and shown in Figure 5.1 and 5.2:

- Upgrades in the Parkland Business Park in Zone 2, near the Petro Canada Property, should be implemented at the existing stage. By upsizing the mains from 250mm and 300mm diameter to 300mm and 375mm diameter, respectively, most of the surcharged manholes are improved.
- Wastewater mains on Acheson Road, from Fulton Drive to Meyer Road in Zone 3 may require upgrading contingent on the amount of contributing wet weather flows coming from area east of Highway 60, namely flow from Standard General and Alberta Infrastructure properties in Zone 4. The proposed upgrades will eliminate potential manhole surcharging issues in the area. Flow monitoring is recommended to confirm the wet weather flow at this location.
- Upgrades in Zone 1 near the intersection of Range Road 264 and Township Road 531A should also be implemented at the existing stage. This upgrade will improve manhole surcharging and over utilized mains in the area east of the intersection.
- Blue manholes in Zone 2 on Walker Crescent in Parkland Business Park, in Zone 3 in Sherwin Industrial Park, in Zone 5 at the Highway 16A crossing near Glowing Embers, and in Zone 1 along the Acheson Trunk are caused by shallow manholes. The hydraulic grade line is within the diameter of the wastewater main. No upgrades are required in the existing stage.

The recommended upgrades for the existing system are summarized in Table 5-1. Both replacement and twinning diameters are shown. Twinning is favourable when the existing pipe is in good condition, as it is generally a more cost effective option. Replacement is a better option when the existing pipe is old or deteriorating.

It is important to note that the majority of wastewater sewer problems experienced are due to wet weather flows. Ongoing maintenance and improvements to decrease wet weather flow entering the wastewater sewer system can be implemented as the opportunity arises when other repairs or upgrades are being carried out. Improvement opportunities are discussed in Section 4.3.1.

A flow monitoring program is also recommended to help identify areas with high I/I. ACRWC has installed a permanent flow meter and rain gauge in Acheson. Flow monitoring throughout the system is also recommended to determine the extent of the wet weather issues.
The surcharging in the residential area is minimal under existing conditions, and does not pose a significant risk for basement flooding. No residential upgrades are required for existing development.

The maximum flow to the Zone 5 Lift Station is 100 L/s and occurs during the 25 year 4 hour rainfall event. This is lower than the approximate Zone 5 Lift Station and forcemain capacity of 160 L/s, and therefore the forcemain and lift station do not need to be upgraded at the existing development stage.

The maximum flow to the Zone 3 Lift Station is 45 L/s and occurs during the 25 year 4 hour rainfall event. This is lower than the Consor Lift Station and forcemain capacity of 54 L/s, and therefore the forcemain and lift station do not need to be upgraded at the existing development stage. The upgraded existing wastewater system is shown in Figure 5.2.

<table>
<thead>
<tr>
<th>Upgrades</th>
<th>Link Name</th>
<th>Length (m)</th>
<th>Upstream Manholes</th>
<th>Downstream Manholes</th>
<th>Existing Diameter (m)</th>
<th>Replacement Diameter (m)</th>
<th>Twin Diameter (m)</th>
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5.2.4.2 Near Future Development Stage Upgrades

Several upgrades are necessary at the near future development stage, as shown in Figure 5.3. System upgrades under the near future development stage incorporates upgrades recommended in previous stages. The recommendations for the near future development stage are as follows:

- The residential creek crossing along Meridian Avenue at the east side of the residential area in Section 14 shows significant risk of flooding, and should be upgraded at the near future development stage.
- Wastewater mains on Acheson Road, in Zones 3 and 4, from Alberta Infrastructure’s west property line to Fulton Drive may require upgrading contingent on the amount of contributing wet weather flows coming from area east of Highway 60, namely flow from Standard General and Alberta Infrastructure properties in Zone 4.
- Wastewater mains parallel to Highway 16, from Highway 60 to Range Road 264 in Zone 1, can be upgraded to alleviate a red manhole near the intersection of Highway 16 and Highway 60. Performing roughly 850m of upgrades will change the red manhole to a blue manhole, where the HGL will be between 1 and 2m from the ground surface. Performing roughly 1500m of upgrades will change the red manhole to a green manhole, where the HGL is more than 2m from the ground surface.
- Blue manholes on Walker Crescent in Parkland Business Park in Zone 2, in Sherwin Industrial Park in Zone 3, at Highway 16A crossing near Glowing Embers in Zone 5 and along Acheson Trunk in Zone 1 are caused by shallow manholes. The hydraulic grade line is within the diameter of the wastewater main. No upgrades are required in the near future stage.
- Future Lift Station #1 in Zone 6 required capacity is 38 L/s and the accompanying forcemain is required to be 200mm in diameter in the near future stage. Potential lift station capacity upgrades to 96 L/s are required in later stages as detailed in the next section.

The recommended upgrades for the near future collection system are summarized in Table 5-2. Both replacement and twinning diameters are shown. The near future collection system with improvements are shown in Figure 5.4.

### Table 5-2: Near Future Development Upgrades

<table>
<thead>
<tr>
<th>Upgrades</th>
<th>Pipe Name</th>
<th>Length (m)</th>
<th>Upstream Manholes</th>
<th>Downstream Manholes</th>
<th>Existing Diameter (m)</th>
<th>Replacement Diameter (m)</th>
<th>Twin Diameter (m)</th>
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<td></td>
<td>LM135</td>
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<td></td>
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</table>
The proposed upgrading costs for upgrades parallel to Highway 16 can be reduced by approximately half if upgrades are performed to reduce the surcharging to below one meter rather than 2 m below the ground. Since there are likely no basements in the nearby industrial area, it is recommended that only the first phase be implemented unless issues are arise.

5.2.4.3 Long Term Development Stage Upgrades

Most of the required upgrades at the long term development stage are located in industrial Zones 3 and 5, as shown in Figure 5.5. System upgrades under the long term development stage incorporates upgrades recommended in previous stages. The recommendations for the long term development stage are as follows:

- Wastewater mains in Zone 5 need to be upgraded to alleviate the over utilized mains and to eliminate manhole flooding.
- Segments of the Acheson Trunk in Zone 1 should be upgraded to lower the HGL in the Sherwin Industrial Park in Zone 3. This segment of trunk has a smaller diameter than the upstream and downstream mains, limiting the capacity of the trunk.
- Future Lift Station #2 in Acheson west Area is required to be capable of delivering 22.5 L/s; accompanying forcemain is required to be 150mm in diameter.
- Future Lift Station #3 in Acheson West Area is required to be capable of delivering 727 L/s; accompanying forcemain is required to be 300mm in diameter.
- Zone 5 Future Lift Station #4 is required to be capable of delivering 83 L/s; accompanying forcemain is required to be 300mm in diameter.
- Zone 8 Future Lift Station #5 is required to be capable of delivering 58 L/s; accompanying forcemain is required to be 250mm in diameter. Based on the conceptual servicing alignment, this lift station’s forcemain is connected to Future Lift Station #1. Hence Future Lift Station #1 is required to be upgraded to be capable of delivering 96 L/s of flow in the long term stage, Future Lift Station #1’s forcemain is required to be upgraded from 200mm to 300mm in diameter.
Blue manholes on Walker Crescent in Parkland Business Park in Zone 2, in Sherwin Industrial Park in Zone 3, at Highway 16A crossing near Glowing Embers in Zone 5 and along Acheson Trunk in Zone 7 are caused by shallow manholes. The hydraulic grade line is within the diameter of the wastewater main. No upgrades are required in the long term stage.

The recommended upgrades for the long term collection system are summarized in Table 5-3. Both replacement and twinning diameters are shown. Note that pipes Link737 and L276.1 are upsized to 525mm and 450mm, respectively, in the long term development stage. These two links are also recommended to be upsized to 675mm and 600mm, respectively, in the ultimate development stage. This segment of wastewater mains can be sized for ultimate development demands during long term development stage upgrades. Upgrades long term wastewater collection system is illustrated in Figure 5.6.

Table 5-3: Long Term Development Upgrades

<table>
<thead>
<tr>
<th>Upgrades</th>
<th>Pipe Name</th>
<th>Length (m)</th>
<th>Upstream Manholes</th>
<th>Downstream Manholes</th>
<th>Existing Diameter (m)</th>
<th>Replacement Diameter (m)</th>
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</table>

*Note: Links Link737 and L276.1 are upsized to 0.525m and 0.450m, respectively, in the long term development stage. These two links are also recommended to be upsized to 0.675m and 0.600m, respectively, in the ultimate development stage. This segment of wastewater mains can be sized for ultimate development demands during long term development stage upgrades.

5.2.4.4 Ultimate Development Stage Upgrades

Any deficiencies in system capacity at the ultimate development stage that have not been addressed in previous development stages should be addressed at the ultimate development stage. The recommended upgrades to the existing system for the ultimate development stage are summarized in Table 5-4. System upgrades under the ultimate development stage incorporates upgrades recommended in previous stages. The recommendations for the ultimate development stage are as follows and shown in Figure 5.7:
Segment of Acheson Trunk upstream of Zone 5 Lift Station, between Township Road 525A and Highway 16A, is over utilized and affects the HGL in the western portion of Zone 5. Upsizing are recommended for these mains.

- The peak sewage generation rate for the area in Zone 5 is increased to 375 L/s. It is recommended to construct a new lift station with a capacity of 215 L/s in addition to the existing Zone 5 Lift Station with a capacity of 160 L/s. The new pump station’s forcemain should be 450mm in diameter.

- Wastewater mains on Acheson Road, west of Range Road 264, and parts of the Acheson Trunk from Acheson Road to Range Road 263A should be upgraded in the ultimate development stage. The recommended upgrades will reduce the risk of manhole surcharging in the Sherwin Industrial Park.

- Zone 7 Future Lift Station #6 requires a capacity of 47 L/s; accompanying forcemain is required to be 250mm in diameter.

- Zone 8 Future Lift Station #7 requires a capacity of 27 L/s; accompanying forcemain is required to be 150mm in diameter.

- Zone 8 Future Lift Station #8 requires a capacity of 22 L/s; accompanying forcemain is required to be 150mm in diameter.

- Zone 8 Future Lift Station #9 requires a capacity of 24 L/s; accompanying forcemain is required to be 150mm in diameter.

- Zone 8 Future Lift Station #10 requires a capacity of 50 L/s; accompanying forcemain is required to be 250mm in diameter.

- Zone 6 Future Lift Station #11 requires a capacity of 53 L/s; accompanying forcemain is required to be 250mm in diameter.

- Zone 4 Future Lift Station #12 requires a capacity of 50 L/s; accompanying forcemain is required to be 250mm in diameter.

- Zone 4 Future Lift Station #13 requires a capacity of 50 L/s; accompanying forcemain is required to be 250mm in diameter.

- Blue manholes on Walker Crescent in Parkland Business Park, in Sherwin Industrial Park, at Highway 16A crossing near Glowing Embers and along Acheson Trunk are caused by shallow manholes. The hydraulic grade line is within the diameter of the wastewater main. No upgrades are required in the ultimate development stage.

The results for the ultimate development with upgrades implemented are shown in Figure 5.8 for the 25 year 4 hour rainfall event. Note that pipes Link737 and L276.1 are upsized to 525mm and 450mm, respectively, in the long term development stage. These two links are also recommended to be upsized to 675mm and 600mm, respectively, in the ultimate development stage. This segment of wastewater mains can be sized for ultimate development demands during long term development stage upgrades. Table 5-4 summarizes the recommended upgrades in the ultimate development stage.
### Table 5-4: Ultimate Development Upgrades

<table>
<thead>
<tr>
<th>Upgrades</th>
<th>Pipe Name</th>
<th>Length (m)</th>
<th>Upstream Manholes</th>
<th>Downstream Manholes</th>
<th>Existing Diameter (m)</th>
<th>Replacement Diameter (m)</th>
<th>Twin Diameter (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acheson Trunk Upstream of Zone 5 Lift Station</td>
<td>Link737*</td>
<td>10</td>
<td>N246</td>
<td>Z5LS</td>
<td>0.525</td>
<td>0.675</td>
<td>0.450</td>
</tr>
<tr>
<td></td>
<td>L276.1*</td>
<td>168</td>
<td>N267.1</td>
<td>N246</td>
<td>0.450</td>
<td>0.600</td>
<td>0.450</td>
</tr>
<tr>
<td></td>
<td>L276.2.1</td>
<td>120</td>
<td>N267.2.1</td>
<td>N267.1</td>
<td>0.250</td>
<td>0.525</td>
<td>0.525</td>
</tr>
<tr>
<td></td>
<td>L276.2</td>
<td>120</td>
<td>N267.2</td>
<td>N267.2.1</td>
<td>0.250</td>
<td>0.525</td>
<td>0.525</td>
</tr>
<tr>
<td></td>
<td>L276</td>
<td>83</td>
<td>N267</td>
<td>N267.2</td>
<td>0.250</td>
<td>0.525</td>
<td>0.525</td>
</tr>
<tr>
<td>Range Road 264 and Acheson Road</td>
<td>L23</td>
<td>152</td>
<td>MH23</td>
<td>MH24</td>
<td>0.600</td>
<td>0.750</td>
<td>0.450</td>
</tr>
<tr>
<td></td>
<td>L22</td>
<td>145</td>
<td>MH22</td>
<td>MH23</td>
<td>0.600</td>
<td>0.750</td>
<td>0.450</td>
</tr>
<tr>
<td></td>
<td>L21</td>
<td>137</td>
<td>MH21</td>
<td>MH22</td>
<td>0.600</td>
<td>0.750</td>
<td>0.525</td>
</tr>
<tr>
<td></td>
<td>L20</td>
<td>108</td>
<td>MH20</td>
<td>MH21</td>
<td>0.600</td>
<td>0.750</td>
<td>0.600</td>
</tr>
<tr>
<td></td>
<td>L18A</td>
<td>80</td>
<td>MH18A</td>
<td>MH20</td>
<td>0.600</td>
<td>0.750</td>
<td>0.750</td>
</tr>
<tr>
<td></td>
<td>L19B1</td>
<td>41</td>
<td>MH19B1</td>
<td>MH18A</td>
<td>0.375</td>
<td>0.525</td>
<td>0.450</td>
</tr>
<tr>
<td></td>
<td>L19B</td>
<td>96</td>
<td>MH19B</td>
<td>MH19B1</td>
<td>0.375</td>
<td>0.525</td>
<td>0.450</td>
</tr>
<tr>
<td></td>
<td>L19C</td>
<td>120.5</td>
<td>MH19C</td>
<td>MH19B</td>
<td>0.375</td>
<td>0.525</td>
<td>0.375</td>
</tr>
</tbody>
</table>

*Note: Pipes Link737 and L276.1 are upsized to 525 and 450 mm, respectively, in the long term development stage. These two links are also recommended to be upsized to 675 and 600 mm, respectively, in the ultimate development stage. This segment of wastewater mains can be sized to ultimate development demand during long term development stage upgrades.*
ACHESON AND BIG LAKE AREA WASTEWATER SERVICING STUDY UPDATE
PARKLAND COUNTY
Project No.: 60481223
Date: September 2016

EXISTING WASTEWATER SEWER SYSTEM UPGRADE LOCATIONS

LEGEND:
- STUDY AREA
- EXISTING DEVELOPMENT
- NEAR FUTURE DEVELOPMENT
- LONG TERM DEVELOPMENT
- ULTIMATE DEVELOPMENT
- HIGH DEMAND USERS
- NOT TO BE SERVICED

ACRWC PSTS LINE
- FORCEMAIN
- LOW PRESSURE WASTEWATER MAIN
- MAX FLOW/PIPE CAPACITY 0-1.2
- MAX FLOW/PIPE CAPACITY 1.2-2
- MAX FLOW/PIPE CAPACITY >2
- DEPTH BELOW GROUND TO HGL > 2 m
- DEPTH BELOW GROUND TO HGL 1-2 m
- DEPTH BELOW GROUND TO HGL 0-1 m
- LIFT STATION
- GRINDER PUMP / LOW PRESSURE CONNECTION
- Existing System Upgrade Location

EXISTING DEVELOPMENT
- Near Future Development
- Long Term Development
- Ultimate Development
- High Demand Users
- Not to Be Serviced
Figure: 5.8

ACRES AND BIG LAKE AREA
WASTEWATER SERVICING STUDY UPDATE
PARKLAND COUNTY
Project No.: 60481223
Date: September 2016

LEGEND:

STUDY AREA
EXISTING DEVELOPMENT
NEAR FUTURE DEVELOPMENT
LONG TERM DEVELOPMENT
ULTIMATE DEVELOPMENT
HIGH DEMAND USERS
NOT TO BE SERVICED

FUTURE SINGLE SERVICE
(GOLF COURSE / REC FACILITY)

ACRWC PSTS LINE
FORCEMAIN
LOW PRESSURE WASTEWATER MAIN
MAX FLOW/PIPE CAPACITY 0-1.2
MAX FLOW/PIPE CAPACITY 1.2-2
MAX FLOW/PIPE CAPACITY >2

DEPTH BELOW GROUND TO HGL > 2 m
DEPTH BELOW GROUND TO HGL 1-2 m
DEPTH BELOW GROUND TO HGL 0-1 m

LIFT STATION
GRINDER PUMP / LOW PRESSURE CONNECTION

UPGRADED ULTIMATE WASTEWATER SEWER SYSTEM
25 YEAR 4 HOUR EVENT RESULTS

Figure: 5.8

Date: September 2016
6. Implementation Plan and Cost Estimates

The recommended upgrades account for ultimate development flows, and should be implemented in stages to best account for existing and future flows. The staged upgrades are summarized in Table 6-1. Some upgrades are necessary to be completed at the existing development stage, as the existing system cannot handle the existing flows as well as inflow and infiltration from the design rainfall events. Other upgrades can be deferred until future development stages contribute additional flows to the system. Upgrades in residential areas should take priority over those in non-residential areas due to the risk of potential basement flooding in residential areas. Areas with simulated flooding risks should be upgrades before areas without flooding risks. An implementation order has been created based on the consequence of the risk. Installation of lift station and forcemains should be implemented based on the development rate.

It should be noted that all the proposed upgrades assume that the I/I from the existing areas is not controlled or improved. I/I reduction measures can be implemented to attempt to reduce wet weather flows such as those listed in Section 4.3.1.

The effectiveness of these measures can then be confirmed with flow monitoring. There is potential then to reduce or delay the required upgrades. Similarly, if the I/I rate is controlled to below the standard of 0.28 L/s/ha assumed for new development areas, there is potential to reduce the pipe size and lift station capacity required.

In cases where surcharging occurs but manholes are not flooded to ground, I/I reduction may be effective in reducing the required improvements. In the upgraded existing development stage, manholes south of the intersection of Highway 16 and Highway 60, and southeast of the intersection of Range Road 264 and Township Road 531A are surcharging but not flooding. During the near future development stage with upgrades implemented, manholes in the northwestern portion of Kalwin Business Park are surcharging but not flooding. Within the upgraded long term development stage, in addition to the northwestern portion of Kalwin Business Park, manholes south of the intersection of Highway 16 and Highway 60, and on Acheson Road within Sherwin Industrial Park are also experiencing surcharging but not flooding. At the upgraded ultimate development stage, manholes near the intersection of Range Road 264 and Highway 16, and in the area south of intersection of Highway 16 and Highway 60 are surcharging but not flooding. Table 6-1 summarizes the costs and implementation plan for each upgrade. The replacement and twinning cost for each individual upgrade includes 10% engineering and 30% contingency costs.

Table 6-1: Upgrade Implementation Stages and Cost Summary

<table>
<thead>
<tr>
<th>Stage</th>
<th>Implementation Order</th>
<th>Upgrades to be Implemented</th>
<th>Reason for Upgrades</th>
<th>Replacement Cost (2016 $)</th>
<th>Twinning Cost (2016 $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>1</td>
<td>Parkland Business Park</td>
<td>Flooding near two manholes</td>
<td>$910,000</td>
<td>$778,000</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Range Road 264 and Township Road 531A</td>
<td>Multiple surcharging manholes</td>
<td>$242,200</td>
<td>$187,600</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Acheson Road</td>
<td>Several surcharging manholes</td>
<td>$347,000</td>
<td>$302,800</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td></td>
<td></td>
<td>$1,499,200</td>
<td>$1,268,400</td>
</tr>
</tbody>
</table>
A detailed table of recommended upgrades, and their associated costs, can be found in Appendix C.

In order to expand the collection system to service the ultimate development areas, several new wastewater mains must be added as described in Section 5.2.3 and Figure 5.8. The costs for new Atim Road Trunk, the Acheson Trunk Extension, and the Bevington Road Trunk Extension have been summarized in Table 6-2. Detailed table of the new pipe installations for the ultimate development scenario can be found in Appendix C.

Table 6-2: New Extensions for Ultimate Development Scenarios

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Atim Road trunk</td>
<td>5340</td>
<td>N/A</td>
<td>$2,902,000</td>
<td>$0</td>
<td>$2,902,000</td>
</tr>
<tr>
<td>Acheson Trunk Extension</td>
<td>4550</td>
<td>One Lift Station c/w 800m of forcemain</td>
<td>$2,799,000</td>
<td>$1,360,000</td>
<td>$4,159,000</td>
</tr>
<tr>
<td>Bevington Trunk Extension*</td>
<td>4234</td>
<td>Seven Lift Station c/w 1034m of forcemain</td>
<td>$2,387,000</td>
<td>$9,197,000</td>
<td>$11,584,000</td>
</tr>
<tr>
<td>Subtotal</td>
<td>10924</td>
<td>Eight Lift Stations c/w 1834m of forcemain</td>
<td>$8,088,000</td>
<td>$10,557,000</td>
<td>$18,645,000</td>
</tr>
<tr>
<td>Engineering and Contingency (40%)</td>
<td></td>
<td></td>
<td>$3,235,200</td>
<td>$4,222,800</td>
<td>$7,458,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>$11,322,000</td>
<td>$14,779,800</td>
<td>$26,103,000</td>
</tr>
</tbody>
</table>

* Cost does not include Zone 5 Lift Station Upgrade Costs (approximately $3 million without contingency and engineering costs).

The estimated costs for future lift station construction and upgrade are summarized below in Table 6-3. The 10% engineering and 30% contingency costs are included in each individual upgrades. Detailed cost estimate are compiled in Appendix C. Note that costs are estimated in 2016 dollars.
Table 6-3: Future Lift Stations and Forcemain Costs

<table>
<thead>
<tr>
<th>Stage</th>
<th>Future Lift Stations</th>
<th>Reason for Upgrades</th>
<th>Cost (2016 $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Future</td>
<td>Future Lift Station # 1 and Forcemain</td>
<td>Service area south-east of the intersection of Highway 16A and Highway 60</td>
<td>$1,724,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Subtotal</td>
</tr>
<tr>
<td>Long Term</td>
<td>Future Lift Station # 1 and Forcemain upgrade</td>
<td>Improve service area south-east of the intersection of Highway 16A and Highway 60</td>
<td>$1,750,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 2 and Forcemain</td>
<td>Service area west of Consor Development Area in Acheson West Area</td>
<td>$1,365,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 3 and Forcemain</td>
<td>Service area west of Leder Development Area in Zone 5</td>
<td>$2,004,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 4 and Forcemain</td>
<td>Service area west of Leder Development Area in Zone 5</td>
<td>$1,438,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 5 and Forcemain</td>
<td>Service area south of The Ranch Golf and Country Club</td>
<td>$1,929,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Subtotal</td>
</tr>
<tr>
<td>Ultimate</td>
<td>Future Lift Station # 6 and Forcemain</td>
<td>Service future development area</td>
<td>$1,512,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 7 and Forcemain</td>
<td>Service future development area</td>
<td>$1,057,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 8 and Forcemain</td>
<td>Service future development area</td>
<td>$1,384,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 9 and Forcemain</td>
<td>Service future development area</td>
<td>$1,288,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 10 and Forcemain</td>
<td>Service future development area</td>
<td>$1,512,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 11 and Forcemain</td>
<td>Service future development area</td>
<td>$1,512,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 12 and Forcemain</td>
<td>Service future development area</td>
<td>$1,708,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 13 and Forcemain</td>
<td>Service future development area</td>
<td>$1,561,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Subtotal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TOTAL</td>
</tr>
</tbody>
</table>
7. Conclusion and Recommendations

The existing system model was calibrated for the dry weather flow based on water consumption data and ACRWC flow monitoring data. Wet weather calibration from previous 2011 Sanitary Servicing Study was used for this study. Design criteria used for existing and future stages are summarized in Table 7-1 below.

Table 7-1: Summary of Design Criteria

<table>
<thead>
<tr>
<th>Development Stage</th>
<th>Residential Sewage Generation (L/p/d)</th>
<th>Residential Peaking Factor</th>
<th>Non-residential Sewage Generation (L/ha/d)</th>
<th>Non Residential Peaking Factor</th>
<th>I/I Allowance (L/s/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>259</td>
<td>1.4</td>
<td>1047</td>
<td>1.8</td>
<td>Calibrated*</td>
</tr>
<tr>
<td>Near Future</td>
<td>350 Harmon*</td>
<td></td>
<td>6170</td>
<td>3</td>
<td>0.28</td>
</tr>
<tr>
<td>Long Term</td>
<td>350 Harmon*</td>
<td></td>
<td>6170</td>
<td>3</td>
<td>0.28</td>
</tr>
<tr>
<td>Ultimate</td>
<td>350 Harmon*</td>
<td></td>
<td>6170</td>
<td>3</td>
<td>0.28</td>
</tr>
</tbody>
</table>

*For the existing development condition, I/I Allowance were carried over from 2011 Sanitary Servicing Study.
* A Harmon’s Peaking Factor of 1+14/(4+p ½) is used for residential areas. P denotes population in thousands. The standards indicate a maximum value of 2.5

For existing, near future, and long term development, actual water demands have been applied to individual properties for high water demand users. To allow for redevelopment of the industrial areas in ultimate development scenario, the design rate of 6170 L/ha/day was used for all areas, including high water demand users. Golf course generation was assumed to be 4500 L/d for each course. These recommended wastewater generation rates are illustrated in Figures 3.1 and 3.2.

Staged upgrades to the existing system are recommended at the existing, near future, long term, and ultimate development stages, and are shown in Figures 5.1, 5.3, 5.5, and 5.7. Details are presented in Appendix C.

Twinning is favourable when the existing pipe is in good condition, as it is generally a more cost effective option if there is adequate space. Replacement is a better option when the existing pipe is old or deteriorating.

The County has placed inserts in some of the manholes which significantly slow the rate of flow from the cover to the sanitary sewer system. The inflow and infiltration may be further reduced by implementing reduction measures such as lining manholes and replacing manhole covers for manholes located in ditches. These measures have the potential to reduce the peak flow to the sanitary system, and also decrease the amount of required upgrades, but this must be confirmed with flow monitoring data. Reduction measures such as manhole liners require cleaning and replacement from time to time. Improvement opportunities are identified in section 4.3.1.

ACRWC now has a permanent flow meter on the Acheson Trunk and a rain gauge in Acheson. It is recommended that as more data becomes available, an update to the model calibration be conducted.

While, the ACRWC flow meter provides an overall measurement for Acheson, additional flow monitoring throughout Acheson and Big Lake is recommended to better understand flows from both residential and non-residential flows. A more comprehensive flow monitoring program with locations throughout the service area would also be helpful in better identifying I/I problem areas. Once flow and rainfall data is collected, the model can be calibrated and refined to better predict existing flows.
Existing Development Stage

- Several issues occur in the existing system as a result of the wet weather flow applied during design rainfall events. Three upgrades should take place at this stage.
  - Parkland Business Park: Flows cannot be accommodated in this area without improvements. It is recommended that several pipes be upsized in order to relieve surcharging of manholes in this area, as well as increase pipe capacity to accommodate high peak flows.
  - Range Road 264 and Township Road 531A: Currently there is risk of flooding as the HGL in one manhole is less than one meter from the ground surface, and the HGL in several manholes are less than 2 m from the ground surface. Several segments of pipe are also being over utilized under existing conditions. Upsizing the mains are recommended to minimize manhole surcharging and improve pipe capacity.
  - Acheson Road, from Fulton Drive to Meyer Road: Wastewater mains on Acheson Road, from Fulton Drive to Meyer Road may require upgrading contingent on the amount of contributing wet weather flows coming from area east of Highway 60, namely flow from Standard General and Alberta Infrastructure properties. The proposed upgrades will eliminate potential manhole surcharging issues in the area.

Near Future Development Stage

- Near future development results in problems in three additional locations:
  - Acheson Road, east of Fulton Drive: Wastewater mains on Acheson Road, from Alberta Infrastructure’s west property line to Fulton Drive may require upgrading contingent on the amount of contributing wet weather flow coming from area east of Highway 60, namely flow from Standard General and Alberta Infrastructure properties. Flows cannot be accommodated in this area without upgrades.
  - Meridian Avenue Creek Crossing: There is significant surcharging at the residential creek crossing at the east side of the residential area. This poses the risk of basement flooding for any adjacent homes, and should be addressed in the near future stage.
  - Highway 16, from Highway 60 to Range Road 264: It is recommended this segment of pipes to be upgraded to alleviate a red node near the intersection of Highway 16 and Highway 60. Performing roughly 850 m of upgrades will change the red node to blue node, where the HGL will be between 1 and 2 m from the ground surface. Alternatively, performing roughly 1500 m of upgrades will change the red node to green node, where the HGL is more than 2 m from the ground surface.
  - One future lift station is required to convey flow from near future developments in Zone 6.

Long Term Development Stage

- Long term development results in problems in two additional locations:
  - Zone 5: The existing pipes in the Leder Area cannot effectively convey projected flows and are simulated to experience flooding and over utilized mains in the long term stage. Pipe upsizing are required in this area to accommodate peak flow and minimize manhole surcharging.
  - Acheson Trunk, south of Osborne Acres: this segment of pipe is recommended to be upsized to lower the HGL in the Sherwin Industrial Park in Zone 1. Currently this segment of pipe has a smaller diameter than the upstream and downstream mains, acting as a bottleneck limiting the conveyance capability of the Acheson Trunk.
  - Four future lift stations are required to convey flow from long term developments in Zones 5, 8, and Acheson West Area.
Ultimate Development Stage

- For the ultimate development scenario, the Atim Road Trunk, Acheson Trunk Extension, and the Bevington Road Trunk Extension service the ultimate development areas. The costs are summarized in Table 7-2. The detailed information can be found in Appendix C.

Table 7-2: New Extensions for Ultimate Development Scenarios

<table>
<thead>
<tr>
<th>Installations</th>
<th>Total Gravity Pipe Length (m)</th>
<th>Total Pumping Facilities</th>
<th>Gravity Pipe Cost</th>
<th>Pumping Cost</th>
<th>Total Cost (2016 $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atim Road trunk</td>
<td>5340</td>
<td>N/A</td>
<td>$2,902,000</td>
<td>N/A</td>
<td>$2,902,000</td>
</tr>
<tr>
<td>Acheson Trunk Extension</td>
<td>4550</td>
<td>One Lift Station c/w 800m of forcemain</td>
<td>$2,799,000</td>
<td>$1,360,000</td>
<td>$4,159,000</td>
</tr>
<tr>
<td>Bevington Trunk Extension*</td>
<td>4234</td>
<td>Seven Lift Station c/w 1034m of forcemain</td>
<td>$2,387,000</td>
<td>$9,197,000</td>
<td>$11,584,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>10924</td>
<td>Eight Lift Stations c/w 1834m of forcemain</td>
<td>$8,088,000</td>
<td>$10,557,000</td>
<td>$18,645,000</td>
</tr>
<tr>
<td>Engineering and Contingency (40%)</td>
<td></td>
<td></td>
<td>$3,235,200</td>
<td>$4,222,800</td>
<td>$7,458,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>$11,322,000</strong></td>
<td><strong>$14,779,800</strong></td>
<td><strong>$26,103,000</strong></td>
</tr>
</tbody>
</table>

- Connecting the ultimate development areas to the system causes problems at two additional locations:
  - Acheson Trunk, upstream of Zone 5 Lift Station, between Township Road 525A and Highway 16A: Under the 25 year 4 hour rainfall event, there is simulated flooding occurring near Acheson Trunk upstream of Zone 5 lift station. The existing mains are also over utilized during this rainfall event. This segment of pipes is recommended to be upsized to eliminate manhole surcharging and pipe over utilization.
  - Range Road 264 and Acheson Road: Wastewater mains on Acheson Road, west of Range Road 264, and parts of the Acheson Trunk from Acheson Road to Range Road 263A should be upgraded in the ultimate development stage. The recommended upgrades will reduce the risk of manhole surcharging in the Sherwin Industrial Park.
  - Eight future lift stations are required to convey flow from ultimate developments in zones 4, 6, 7, and 8.

- The cost and staged implementation of the upgrades are summarized in Table 7-3. Detailed improvement recommendations can be found in Appendix C.

Table 7-3: Upgrade Implementation Stages and Costs Summary

<table>
<thead>
<tr>
<th>Stage</th>
<th>Implementation Order</th>
<th>Upgrades to be Implemented</th>
<th>Reason for Upgrades</th>
<th>Replacement Cost (2016 $)</th>
<th>Twining Cost (2016 $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>1</td>
<td>Parkland Business Park</td>
<td>Flooding near two manholes</td>
<td>$910,000</td>
<td>$778,000</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Range Road 264 and Township Road 531A</td>
<td>Multiple surcharging manholes</td>
<td>$242,200</td>
<td>$187,600</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Acheson Road</td>
<td>Several surcharging manholes</td>
<td>$347,000</td>
<td>$302,800</td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td><strong>$1,499,200</strong></td>
<td><strong>$1,268,400</strong></td>
</tr>
<tr>
<td>Stage</td>
<td>Implementation Order</td>
<td>Upgrades to be Implemented</td>
<td>Reason for Upgrades</td>
<td>Replacement Cost (2016 $)</td>
<td>Twining Cost (2016 $)</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------</td>
<td>----------------------------------</td>
<td>------------------------------------------</td>
<td>---------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Near Future</td>
<td>1</td>
<td>Acheson Road</td>
<td>Basement flooding</td>
<td>$672,900</td>
<td>$561,100</td>
</tr>
<tr>
<td></td>
<td>2 (tied)</td>
<td>Meridian Avenue</td>
<td>Multiple surcharging manholes</td>
<td>$550,400</td>
<td>$461,700</td>
</tr>
<tr>
<td></td>
<td>2 (tied)</td>
<td>Highway 16</td>
<td>Surcharging manhole</td>
<td>$1,022,800</td>
<td>$718,300</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>$2,246,100</strong></td>
</tr>
<tr>
<td>Long Term</td>
<td>1</td>
<td>Leder Development Area</td>
<td>Multiple flooding manholes</td>
<td>$589,400</td>
<td>$721,600</td>
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<tr>
<td></td>
<td>2</td>
<td>Acheson Trunk</td>
<td>Several surcharging manholes</td>
<td>$518,100</td>
<td>$377,300</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>$1,578,500</strong></td>
</tr>
<tr>
<td>Ultimate</td>
<td>1</td>
<td>Acheson Trunk Upstream of Zone 5 Lift Station and Zone 5 Lift Station Upgrade</td>
<td>Severe flooding and surcharging manholes</td>
<td>$4,659,000</td>
<td>$4,624,000</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Range Road 264 and Acheson Road</td>
<td>Several surcharging manholes</td>
<td>$1,707,000</td>
<td>$1,287,000</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal</strong></td>
<td><strong>$6,366,000</strong></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>$11,478,800</strong></td>
</tr>
</tbody>
</table>

- The total replacement cost for upgrades for existing, near future, long term, and ultimate developments are $1,268,400, $1,741,100, $1,098,900, and $1,727,600, respectively.
- The total cost for lift station and forcemain installations and upgrades are summarized in Table 7-4.

### Table 7-4: Lift Station and Forcemain Costs

<table>
<thead>
<tr>
<th>Stage</th>
<th>Future Lift Stations</th>
<th>Reason for Upgrades</th>
<th>Cost (2016 $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Future</td>
<td>Future Lift Station # 1 and Forcemain</td>
<td>Service area south-east of the intersection of Highway 16A and Highway 60</td>
<td>$1,724,000</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td>Long Term</td>
<td>Future Lift Station # 1 and Forcemain upgrade</td>
<td>Improve service area south-east of the intersection of Highway 16A and Highway 60</td>
<td>$1,750,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 2 and Forcemain</td>
<td>Service area west of Consor Development Area in Acheson West Area</td>
<td>$1,365,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 3 and Forcemain</td>
<td>Service area west of Leder Development Area in Zone 5</td>
<td>$2,004,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 4 and Forcemain</td>
<td>Service area west of Leder Development Area in Zone 5</td>
<td>$1,438,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 5 and Forcemain</td>
<td>Service area south of The Ranch Golf and Country Club</td>
<td>$1,929,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td>Ultimate</td>
<td>Future Lift Station # 6 and Forcemain</td>
<td>Service future development area</td>
<td>$1,512,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 7 and Forcemain</td>
<td>Service future development area</td>
<td>$1,057,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 8 and Forcemain</td>
<td>Service future development area</td>
<td>$1,384,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 9 and Forcemain</td>
<td>Service future development area</td>
<td>$1,288,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 10 and Forcemain</td>
<td>Service future development area</td>
<td>$1,512,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 11 and Forcemain</td>
<td>Service future development area</td>
<td>$1,512,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 12 and Forcemain</td>
<td>Service future development area</td>
<td>$1,708,000</td>
</tr>
<tr>
<td></td>
<td>Future Lift Station # 13 and Forcemain</td>
<td>Service future development area</td>
<td>$1,561,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Subtotal</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>
- Parkland County has previously identified inflow and infiltration as a concern for sanitary sewers within the Acheson area. The high groundwater table, existing sanitary sewer alignments within the extents of ditch flow, and Developer installation practices were determined to be conducive to inflow and infiltration. Parkland County has previously attempted to rehabilitate existing locations to reduce manhole inflow, but inflow and infiltration remains a concern.

- Manhole rehabilitation is recommended in problem areas and enforcement of the engineering standards for future areas is recommended. Rehabilitation products such as lid gaskets, pick hole plugs, manhole inserts, joint wraps, chimney seals, manhole epoxies, and sealant products can reduce infiltration and inflow into the wastewater collection system. Future reviews and enforcement of the engineering standards regarding minimum manhole rim elevations in regard to 100 year high water level, rising manhole structures, and waterproofing construction joints are also recommended.

- Based on the current model calibration wet weather flow can reach up to ten (10) times the dry weather flow for the 25 year event. A reduction in I/I can reduce the extent of upgrades required allowing excess capacity to be available for future development.

- Flow and rainfall monitoring is recommended to better estimate actual sewage generation and infiltration and inflow rates and to differentiate sewage generation rates between different land uses. Model calibration can then be completed in more detail.

- The effectiveness of any I/I reduction measures implemented can then be confirmed with flow monitoring data to determine if any proposed upgrades can be reduced in size or delayed.

- A flow monitoring program should be continue to be implemented to confirm the flow rates anticipated throughout the system during both dry and wet weather. This data can be used to confirm or re-assess the design criteria during future studies.
Appendix A

Manhole Photo Log
Photo 1: Manhole in ditch bottom on Acheson Road (Zone 3). Manhole is submerged during rainfall events.

Photo 2: Manhole in ditch bottom on Acheson Road. Manhole insert limits the rate of stormwater entering the manhole through the lid.
Photo 3: Manhole in ditch sideslope on TWP Rd 525A (Zone 5)

Photo 4: Manhole in ditch sideslope on TWP Road 525A. Manhole rings used to raise top of manhole. Inconsistent grout is visible.
Photo 5: Manhole in ditch sideslope. Manhole rings visible. Country style manhole cover

Photo 6: Manhole in ditch bottom Walker Crescent (Zone 2). Floating style cover for asphalt purposes
Photo 7: Manhole in Lake Ridge Estates subdivision on RR263. Visible infiltration below grade rings.

Photo 8: Manhole on Bevington Trunk south of RR263. Grade rings offset. Floating style manhole cover for asphalt applications
Appendix B

Manhole Rehabilitation Products
Description
Xypex is a unique chemical treatment for the waterproofing, protection and repair of concrete. XYPEX CONCENTRATE is the most chemically active product within the Xypex Crystalline Waterproofing System. When mixed with water, this light grey powder is applied as a cementitious slurry coat to above-grade or below-grade concrete, either as a single coat or as the first of a two-coat application. It is also mixed in Dry-Pac form for sealing strips at construction joints, or for the repairing of cracks, faulty construction joints and honeycombs. Xypex prevents the penetration of water and other liquids from any direction by causing a catalytic reaction that produces a non-soluble crystalline formation within the pores and capillary tracts of concrete and cement-based materials.

Recommended for:
• Reservoirs
• Sewage and Water Treatment Plants
• Underground Vaults
• Secondary Containment Structures
• Foundations
• Tunnels and Subway Systems
• Swimming Pools
• Parking Structures

Advantages
• Resists extreme hydrostatic pressure
• Becomes an integral part of the substrate
• Can seal hairline cracks up to 0.4 mm
• Allows concrete to breathe
• Highly resistant to aggressive chemicals
• Non-toxic
• Does not require a dry surface
• Cannot puncture, tear or come apart at the seams
• No costly surface priming or leveling prior to application
• Does not require sealing, lapping and finishing of seams at corners, edges or between membranes
• Can be applied to the positive or the negative side of the concrete surface
• Does not require protection during backfilling or during placement of steel, wire mesh or other materials
• Less costly to apply than most other methods
• Not subject to deterioration
• Permanent

Packaging
Xypex Concentrate is available in 20 lb. (9.1 kg) pails, 60 lb. (27.2 kg) pails and 50 lb. (22.7 kg) bags.

Storage
Xypex products must be stored dry at a minimum temperature of 45ºF (7ºC). Shelf life is one year when stored under proper conditions.

Coverage
For normal surface conditions, the coverage rate for each Xypex coat is 6 to 7.2 sq. ft./lb. (1.25 - 1.5 lb./sq. yd. or 0.65 - 0.8 kg/m²).

Test Data
PERMEABILITY
U.S. Army Corps of Engineers (USACE) CRD C48-73, “Permeability of Concrete”, Pacific Testing Labs, Seattle, USA
Two in. (51 mm) thick, 2000 psi (13.8 MPa) Xypex-treated concrete samples were pressure tested up to a 405 ft. (124 m) water head (175 psi/1.2 MPa), the limit of the testing apparatus. While untreated samples showed marked leakage, the Xypex-treated samples (as a result of the crystallization process) became totally sealed and exhibited no measurable leakage.

DIN 1048, “Water Impermeability of Concrete”, Bautest – Corporation for Research & Testing of Building Materials, Augsburg, Germany
Twenty cm thick Xypex-treated concrete samples were pressure tested up to 7 bars (230 ft./70 m water head) for 24 hours to determine water impermeability. While the reference specimens measured water penetration up to a depth of 92 mm, Xypex-treated samples measured water penetration of zero to an average of 4 mm.

ÖNORM B 3303, “Water Impermeability of Concrete”, Technologisches Gerwerbemuseum, Federal Higher Technical Education & Research Institute, Vienna, Austria
Xypex-treated concrete samples were pressure tested to a maximum 7 bars (230 ft./70 m water head) for 10 days. Test revealed that while 25 ml of water had penetrated the untreated concrete samples, zero ml had penetrated the Xypex-treated samples. Test specimens were then
broken and showed water penetration to a depth of 15 mm on untreated samples but no measurable water penetration on the Xypex-treated samples.

CSN 1209/1321, “Impermeability and Resistance to Pressurized Water”, Institute of Civil Engineering, Technology and Testing, Bratislava, Slovak Republic

Xypex-treated and untreated concrete samples were exposed to 1.2 MPa of pressure to determine water permeability. Results showed the Xypex-treated samples provided effective protection against hydrostatic water pressure. Treated and untreated samples were also subjected to contact with silage juices and various petroleum products (e.g. diesel oil, transformer oil, gasoline) at 14 kPa for 28 days. The Xypex-treated samples significantly reduced the penetration of these solutions.

CHEMICAL RESISTANCE

Xypex-treated cylinders and untreated cylinders were exposed to hydrochloric acid, caustic soda, toluene, mineral oil, ethylene glycol, pool chlorine and brake fluid and other chemicals. Results indicated that chemical exposure did not have any detrimental effects on the Xypex coating. Tests following chemical exposure measured an average 17% higher compressive strength in the Xypex-treated specimens over the untreated control samples.

IWATE University Technical Report, “Resistance to Acid Attack”, Tokyo, Japan

Xypex-treated mortar and untreated mortar were measured for acid resistance after exposure to a 5% H₂SO₄ solution for 100 days. Xypex suppressed concrete erosion to 1/8 of the reference samples.

FREEZE/THAW DURABILITY

Xypex-treated samples restricted chloride ion concentration to below the level necessary to promote electrolytic corrosion of reinforcing steel. Visual examination of untreated panels after 50 freeze/thaw cycles showed a marked increase in surface deterioration compared to Xypex-treated samples.

JIS A 6204, “Concrete Freeze/Thaw”, Japan Testing Center for Construction Materials, Tokyo, Japan

The resonating frequency of both untreated and Xypex-treated concrete samples were measured throughout 435 freeze/thaw cycles. At 204 cycles, the Xypex-treated samples showed 96% relative durability compared to 90% in the untreated samples. At 435 cycles, the Xypex-treated samples measured 91% relative durability compared to 78% in the untreated reference samples.

POTABLE WATER EXPOSURE

Exposure testing of potable water in contact with Xypex-treated samples indicated no harmful effects.

RADIATION RESISTANCE

After exposure to 5.76 x 10⁴ rads of gamma radiation, the Xypex treatment revealed no ill effects or damages.

Application Procedures

1. SURFACE PREPARATION  Concrete surfaces to be treated must be clean and free of laitance, dirt, film, paint, coating or other foreign matter. Surfaces must also have an open capillary system to provide “tooth and suction” for the Xypex treatment. If surface is too smooth (e.g. where steel forms are used) or covered with excess form oil or other foreign matter, the concrete should be lightly sandblasted, waterblasted, or etched with muriatic (HCl) acid.

2. STRUCTURAL REPAIR  Rout out cracks, faulty construction joints and other structural defects to a depth of 1.5 in. (37 mm) and a width of 1 in. (25 mm). Apply a brush coat of Xypex Concentrate as described in steps 5 & 6 and allow to dry for 10 minutes. Fill cavity by tightly compressing Dry-Pac into the groove with pneumatic packing tool or with hammer and wood block. Dry-Pac is prepared by mixing six parts Xypex Concentrate powder with one part water to a dry, lumpy consistency.

NOTE:

i. Against a direct flow of water (leakage) or where there is excess moisture due to seepage, use Xypex Patch’n Plug then Xypex Dry-Pac followed by a brush coat of Xypex Concentrate. (Refer to Xypex Specifications and Applications Manual for full details.)

ii. For expansion joints or chronic moving cracks, flexible materials such as expansion joint sealants should be used.

3. WETTING CONCRETE  Xypex requires a saturated substrate and a damp surface. Concrete surfaces must be thoroughly saturated with clean water prior to the application so as to aid the proper curing of the treatment and to ensure the growth of the crystalline formation
deep within the pores of the concrete. Remove excess surface water before the application. If concrete surface dries out before application, it must be re-wetted.

4. MIXING FOR SLURRY COAT Mix Xypex powder with clean water to a creamy consistency in the following proportions:

   **For Brush Application**
   
   1.25 - 1.5 lb./sq. yd. (0.65 - 0.8 kg/m²)  
   5 parts powder to 2 parts water

   2.0 lb./sq. yd. (1.0 kg/m²)  
   3 parts powder to 1 part water

   **For Spray Application**

   1.25 - 1.5 lb./sq. yd. (0.65 - 0.8 kg/m²)  
   (ratio may vary with equipment type)

   5 parts powder to 3 parts water

Do not mix more Xypex material than can be applied in 20 minutes. Do not add water once mix starts to harden. Protect hands with rubber gloves.

5. APPLYING XYPEX Apply Xypex with a semi-stiff nylon bristle brush, push broom (for large horizontal surfaces) or specialized spray equipment. The coating must be uniformly applied and should be just under 1/16 in. (1.25 mm). When a second coat (Xypex Concentrate or Xypex Modified) is required, it should be applied after the first coat has reached an initial set but while it is still “green” (less than 48 hours). Light pre-watering between coats may be required due to drying. The Xypex treatment must not be applied under rainy conditions or when ambient temperature is below 40°F (4°C). For recommended equipment, contact Xypex Chemical Corporation or your nearest Xypex representative.

6. CURING A misty fog spray of clean water must be used for curing the Xypex treatment. Curing should begin as soon as the Xypex has set to the point where it will not be damaged by a fine spray of water. Under normal conditions, it is sufficient to spray Xypex-treated surfaces three times per day for two to three days. In hot or arid climates, spraying may be required more frequently. During the curing period, the coating must be protected from rainfall, frost, wind, the puddling of water and temperatures below 36°F (2°C) for a period of not less than 48 hours after application. If plastic sheeting is used as protection, it must be raised off the Xypex to allow the coating to breathe. Xypex Gamma Cure may be used in lieu of water curing for certain applications (consult with Xypex Chemical Corporation or your nearest Xypex distributor).

NOTE: For concrete structures that hold liquids (e.g., reservoirs, swimming pools, tanks, etc.), Xypex should be cured for three days and allowed to set for 12 days before filling the structure with liquid.

Technical Services

For more instructions, alternative application methods, or information concerning the compatibility of the Xypex treatment with other products or technologies, contact the Technical Services Department of Xypex Chemical Corporation or your local Xypex representative.

Safe Handling Information

Xypex is alkaline. As a cementitious powder or mixture, Xypex may cause significant skin and eye irritation. Directions for treating these problems are clearly detailed on all Xypex pails and packaging. The Manufacturer also maintains comprehensive and up-to-date Material Safety Data Sheets on all its products. Each sheet contains health and safety information for the protection of workers and customers. The Manufacturer recommends you contact Xypex Chemical Corporation or your local Xypex representative to obtain copies of Material Safety Data Sheets prior to product storage or use.

Warranty

The Manufacturer warrants that the products manufactured by it shall be free from material defects and will be consistent with its normal high quality. Should any of the products be proven defective, the liability to the Manufacturer shall be limited to replacement of the product ex factory. The Manufacturer makes no warranty as to merchantability or fitness for a particular purpose and this warranty is in lieu of all other warranties expressed or implied. The user shall determine the suitability of the product for his intended use and assume all risks and liability in connection therewith.
**What It Is**

**EZ-WRAP** is an extruded butyl adhesive tape designed to provide high strength, watertight seals on properly primed concrete surfaces and concrete structure joints. The butyl compound is soft, tacky, and bonded to either a plastic backing or an EPDM rubber backing. Both kinds of tape are wound in rolls on a release liner for easy application.

**Why It’s Better**

- High quality butyl rubber base.
- Available with EPDM Rubber or HDPE Plastic backing.
- All-weather performance.
- Good adhesion to dry concrete, commonly specified concrete coatings, steel, glass, or painted surfaces.
- Coated release paper for easy installation.
- Long service life.
- Primers recommended for use on damp, contaminated, or difficult surfaces.

**How It Performs**

**EZ-WRAP BUTYL JOINT WRAP** meets or exceeds all requirements of the following Standards, Specifications and/or Test Methods:

**ASTM C 877 (Type III)** - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections

**Typical Applications**

- Sanitary Manhole Joints
- Grade Ring Joints
- Stormwater Manhole Joints
- Irrigation and Drainage Systems
- Box Culverts
- Elliptical/Arch Pipe
- Architectural Foundations
- Underground Utility Vaults
- Stormwater Treatment Structures
- Stormwater Inlet Structures
- On-Site Treatment Tanks
- Grease Interceptors
- Wet Wells
- Concrete Bridge Spans

Press-Seal believes all information is accurate as of its publication date. Information, specifications, and prices are all subject to change without notice. Press-Seal is not responsible for any inadvertent errors. Copyright 2012.
EZ-WRAP PLASTIC

The joints and/or joining surfaces of the structures shall be sealed with a butyl-rubber-based tape. The material shall be EZ-WRAP Plastic as supplied by PRESS-SEAL GASKET CORPORATION, Fort Wayne, Indiana, or approved equal. The butyl component of the tape shall consist of 50% (min.) butyl rubber, shall contain 2% or less volatile matter, and shall be .050” (1.3 mm) thick. The backing component shall be high-density polyethylene film. A release paper may be utilized.

For manholes, the tape width shall be 6” (150 mm) wide. The tape shall be overlapped at least twice its width. The tape shall not be stretched during application. Primer and/or adhesive as recommended by the tape supplier shall be employed for adverse, critical, or other applications.

Testing of joints and compliance with construction requirements shall be conducted in strict conformance with the requirements of the sealant supplier.

EZ-WRAP RUBBER

The joints and/or joining surfaces of the structures shall be sealed with a butyl-rubber-based tape. The material shall be EZ-WRAP Rubber as supplied by PRESS-SEAL GASKET CORPORATION, Fort Wayne, Indiana, or approved equal. The butyl component of the tape shall consist of 50% (min.) butyl rubber, shall contain 2% or less volatile matter, and shall be .030” (0.75 mm) thick. The backing component shall be EPDM rubber, and shall be .045” (1.1 mm) thick. A release paper may be utilized.

For manholes, the tape width shall be 6” (150 mm) wide. The tape shall be overlapped at least twice its width. The tape shall not be stretched during application. Primer and/or adhesive as recommended by the tape supplier shall be employed for adverse, critical, or other applications.

Testing of joints and compliance with construction requirements shall be conducted in strict conformance with the requirements of the sealant supplier.

<table>
<thead>
<tr>
<th>Width</th>
<th>Width</th>
<th>Length</th>
<th>Length</th>
<th>Backing</th>
<th>Part Number</th>
<th>Width</th>
<th>Length</th>
<th>Length</th>
<th>Backing</th>
<th>Part Number</th>
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</thead>
<tbody>
<tr>
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<td>100’</td>
<td>30.5 m</td>
<td>HDPE</td>
<td>276.773.6</td>
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<td>100’</td>
<td>30.5 m</td>
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<tr>
<td>9”</td>
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<td>100’</td>
<td>30.5 m</td>
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<td>12”</td>
<td>300 mm</td>
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<td>50’</td>
<td>15.25 m</td>
<td>EPDM</td>
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</tbody>
</table>

ALSO AVAILABLE: EZ-WRAP PAKS are pre-cut packages of EZ-WRAP designed specifically to seal manhole joints. Each EZ-WRAP PAK includes an easy-to-use spray adhesive and pre-cut wraps for standard 48” (1200 mm), 60” (1500 mm), or 72” (1800 mm) manhole joints.

NOTE:
- EZ-WRAP is designed to be used with EZ-STIK No. 4 primer, or our spray adhesive.
- EZ-WRAP should not be stretched during installation.

If you have any questions, please contact our Customer Service Department or your Press-Seal representative.

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1. Clean the exterior surfaces of the joint area. Make sure that the cleaned area is at least 2" wider than the width of the EZ-WRAP used and that the cleaned area is centered on the joint. The concrete must be dry before applying wrap or primer. Primer is most important when installing in cold temperatures.

2. Stir primer thoroughly before application to ensure rubber solids are equally dispensed throughout the solution. Using a paint brush or roller apply a thin even coat of EZ-STIK #4 PRIMER all the way around the joint. Prime the area at least 2" wider than the width of the EZ-WRAP used.

3. Allow the solvents dispense from the primed surface (10-30 minutes depending on temperature), so that a clean, smooth surface is ready for installation of the EZ-WRAP.

   Never apply EZ-WRAP to wet #4 EZ STIK Primer.

4. Cut the EZ-Wrap to the correct length prior to applying it to the joint. The below table will give you an idea of the most common lengths.

<table>
<thead>
<tr>
<th>Diameter of Manhole</th>
<th>Length of EZ-WRAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>48&quot; ID X 5&quot; wall</td>
<td>16 feet</td>
</tr>
<tr>
<td>60&quot; ID X 6&quot; wall</td>
<td>20 feet</td>
</tr>
<tr>
<td>72&quot; ID X 7&quot; wall</td>
<td>24 feet</td>
</tr>
</tbody>
</table>

5. The butyl sealant side of EZ-WRAP is protected by release paper. Apply the EZ-WRAP to the structure, taking care to centering it so both sides of the joint are equally covered; remove the release paper as you apply the EZ-WRAP. Press the EZ-WRAP down firmly and evenly as you cover the joint area. A rubber roller may be used to assist in applying even pressure.

6. Complete the seal by overlapping the EZ-WRAP 6 to 9 inches. Apply #4 EZ STIK Primer to the section of EZ-Wrap attached to the manhole that will be covered by the overlap; let the solvents dispense from the #4 EZ STIK Primer; press the overlapped end firmly against the installed EZ-WRAP.

Storage/Application Notes:

EZ-WRAP - Store and apply at temperatures from 32 F (0 C) to 110 F (43 C).

EZ-PRIMER #4 - Store and apply at temperatures from 32 F (0 C) to 110 F (43 C). Shelf life of 12 months when stored in unopened original container. After opening, keep container covered when not in use.

SAFETY PRECAUTIONS - Keep both products away from heat, sparks or open flame. Use only with adequate ventilation. Avoid breathing vapors. Refer to MSDS for additional information.

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GENERAL PURPOSE SPRAY ADHESIVE

What It Is

GENERAL PURPOSE SPRAY ADHESIVE is a fast drying, super strength adhesive for bonding rubber to concrete and other substrates. GENERAL PURPOSE SPRAY ADHESIVE is a great general purpose rubber cement that is packaged in a convenient 16 oz. aerosol can.

Why It’s Better

• Fast drying.
• High strength.
• Adjustable spray nozzle.
• Convenient aerosol.
• Methylene chloride free formula.

Method of Application

• Shake well prior to use.
• Surfaces should be clean, dry and free of debris.
• Spray adhesive using a web pattern to insure coverage.
• Allow solvent to flash for 1 to 3 minutes, until tacky, and then press rubber to adhesive.
Infi-Shield® Gator Wrap prevents infiltration by providing a water-tight seal around any manhole, catch basin or concrete pipe joint. Gator Wrap resists harsh soil conditions and also provides a root barrier for any crack or joint. Infi-Shield® Gator Wrap installs easily with no special tools and can be immediately backfilled.

**Infi-Shield® Gator Wrap Specification**

Each manhole, catch basin or pipe joint shall be sealed with an external rubber sleeve similar to the Infi-Shield Gator Wrap as manufactured by Sealing Systems Inc (763-478-2057). The seal shall be made of a Stretchable, Self-Shrinking, Intra-Curing Halogenated based rubber with a minimum thickness of 30 mils. The back side of each unit shall be coated with a cross-linked re-enforced butyl adhesive. The butyl adhesive shall be non-hardening sealant with a minimum thickness of 30 mils. The seal shall be designed to stretch around the joint and then overlapped creating a cross-link and fused bond between the rubber and butyl adhesive. Gator Wrap forms a continuous rubber seal on a manhole joint which prevents water and soil from infiltrating through the manhole, catch basin or concrete pipe joint.

INFI-SHIELD GatorWrap® is available in 6” and 9” widths and comes in a 50 foot roll or in a user-friendly kit which has six sixteen foot rolls. Upon special order, we can also manufacture a 12” width but please allow four weeks for delivery.

**EPDM Rubber Specifications**

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>ASTM Test Method</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheer Strength</td>
<td>D816</td>
<td>15 lb. PSI min</td>
</tr>
<tr>
<td>Tensile, PSI</td>
<td>D412</td>
<td>50 PSI</td>
</tr>
<tr>
<td>Elongation %</td>
<td>D412</td>
<td>500 %</td>
</tr>
<tr>
<td>Penetration</td>
<td>D217</td>
<td>40/120 MM</td>
</tr>
<tr>
<td>Low Temperature</td>
<td>D746</td>
<td>Minus 49º F flexibility</td>
</tr>
<tr>
<td>Heat Aging</td>
<td>D573 7 days @ 90 degrees C</td>
<td></td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>minimum, PSI (MPa) &gt; 100 PSI</td>
<td>Pass</td>
</tr>
<tr>
<td>Fusion</td>
<td>5/64” (0.2) max</td>
<td>Pass</td>
</tr>
<tr>
<td>Elongation %</td>
<td>minimum 300% at break</td>
<td>Pass</td>
</tr>
<tr>
<td>Ozone Resistance</td>
<td>no visible signs of cracking</td>
<td>Pass</td>
</tr>
<tr>
<td>Aging and Storage</td>
<td>300% elongation applied (10 Years)</td>
<td>Pass</td>
</tr>
<tr>
<td>UV Resistance</td>
<td>No visible signs of cracking</td>
<td>Pass</td>
</tr>
</tbody>
</table>


Disclaimer: This technical data information and recommendations offered are based on test results, and findings we believe to be reliable and complete.
1. Expose the area that is to be sealed. Clean the entire area around the joint with a wire brush and whisk broom. Remove any sharp protruding edges around the joint with an abrasive tool. When finished cleaning, the entire area must be dry and free of any dirt.

2. Remove the first foot of paper backing from the mastic. Center and place the Gator Wrap around the joint. Continue to remove paper backing as you apply the Gator Wrap to the entire structure.

3. Seal the overlapping area with a 6” overlap. Be sure not to stretch material at the overlap area.

4. Cut excess material using a utility knife. Using a rubber mallet or hand held roller, firmly flatten the Gator Wrap 360 degrees around joint.

Material: Rubber meets ASTM C923 and C877 – Mastic Meet ASTM C990

Disclaimer: This technical data information and recommendations offered are based on test results, and findings we believe to be reliable and complete.

Sealing Systems, Inc.
9350 County Road 19  •  Loretto, MN 55357  •  763-478-2057  •  800-478-2054  •  Fax 763-478-8868  •  www.infi-shield.com
PRECAST MANHOLE WITH EXTERNAL SEAL

1. The rubber sleeve is available in a 9” height (Standard).

2. See the chimney height table below for seal and extension combinations needed to span from the frame to the top of the cone on manholes with various chimney heights. Frame offsets or diameter differentials will reduce these span heights.

3. The top of the cone shall have a minimum of 3” high vertical sealing surface that is smooth and free of any form offsets or excessive honeycomb.

CHIMNEY HEIGHT TABLE

<table>
<thead>
<tr>
<th>COMBINATIONS OF SEALS AND EXTENSIONS</th>
<th>TO SPAN HEIGHTS OF:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 9” Only</td>
<td>Over 3” – 6.5”</td>
</tr>
<tr>
<td>Standard Seal + Extension</td>
<td>Over 6.5” – 13.5”</td>
</tr>
<tr>
<td>Standard Seal + Multi Extensions</td>
<td>Over 13.5”</td>
</tr>
</tbody>
</table>

Add 7” of coverage for each additional Extension.
CONCRETE DRAWING: Internal Chimney Seal

PRECAST MANHOLE WITH INTERNAL SEAL

1. The rubber sleeve is available in heights of 8.5” (Standard) a 10” (Wide) & a 13” (Extra Wide). The same expansion bands are used on all three.

2. See the chimney height table below for seal and extension combinations needed to span from the frame to the top of the cone on manholes with various chimney heights. Frame offsets or diameter differentials will reduce these span heights.

3. The top of the cone shall have a minimum of 3” high vertical sealing surface that is smooth and free of any form offsets or excessive honeycomb.

CHIMNEY HEIGHT TABLE

<table>
<thead>
<tr>
<th>COMBINATIONS OF SEALS AND EXTENSIONS</th>
<th>TO SPAN HEIGHTS OF:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W/ STANDARD SEAL</td>
</tr>
<tr>
<td>Seal Only</td>
<td>0” to 4.5”</td>
</tr>
<tr>
<td>Seal + 7” Extension</td>
<td>Over 4.5” – 10.5”</td>
</tr>
<tr>
<td>Seal + 10” Extension</td>
<td>Over 10.5” – 13”</td>
</tr>
<tr>
<td>Seal + Multi Extensions</td>
<td>Over 13”</td>
</tr>
</tbody>
</table>

Add 6” of coverage for each additional 7” Extension.
Add 8.5” of coverage for each additional 10” Extension.
Prevents Inflow and Infiltration in Sanitary Manholes
Provides Erosion Control by Preventing Siltation in Manholes

The Problem

The new and improved Infi-Shield® Uni-band is an inexpensive and permanent method of externally sealing the grade adjustment ring area of a manhole. The one piece molded seal has a reinforced preformed L shaped corner. Accommodating ground movement, Infi-Shield Uni-band’s high quality rubber and non-hardening butyl mastic provide a flexible watertight seal around the structure. Infi-Shield® Uni-band saves taxpayer’s money by not having to treat the extra clear water and by avoiding expensive repair and maintenance costs.

The Solution

New & Improved Seal

Works on top slab installations too!

Sealing Systems, Inc.
9350 County Road 19 • Loretto, MN 55357 • 763-478-2057 • 800-478-2054 • Fax 763-478-8868 • www.infi-shield.com
# INFI-SHIELD®

## APPLICATION STANDARDS & TECHNICAL DATA TEST RESULTS

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>ASTM TEST METHOD</th>
<th>REQUIREMENTS</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>HARDNESS</td>
<td>D2240</td>
<td>60 +/-5 DURO</td>
<td>61 DURO</td>
</tr>
<tr>
<td>TENSILE</td>
<td>D412</td>
<td>1200 PSI/MIN</td>
<td>1510 PSI/MIN</td>
</tr>
<tr>
<td>ELONGATION</td>
<td>D412</td>
<td>350 % MIN</td>
<td>460%</td>
</tr>
<tr>
<td>OZONE RESISTANCE</td>
<td>D1149 72 HRS @ 50 PPHM</td>
<td>NO CRACKS</td>
<td>PASS</td>
</tr>
<tr>
<td>COMPRESSION SET</td>
<td>D395 METHOD B 22 HRS @ 77°C</td>
<td>25% MAX</td>
<td>24%</td>
</tr>
<tr>
<td>HEAT AGED HARDNESS</td>
<td>D573 70 HRS @ 100°C</td>
<td>No Requirements</td>
<td>+65 (+4 PTS)</td>
</tr>
<tr>
<td>HEAT AGED TENSILE</td>
<td>D573 70 HRS</td>
<td>-15% MAX</td>
<td>-1390 PSI (-14%)</td>
</tr>
<tr>
<td>HEAT AGED ELONGATION</td>
<td>D573 70 HRS @ 100°C</td>
<td>-20% MAX</td>
<td>370% (-20%)</td>
</tr>
<tr>
<td>WATER RESISTANCE</td>
<td>D471 70 HRS @ 100°C</td>
<td>VOLUME CHANGE +10% MAX</td>
<td>+1.8%</td>
</tr>
<tr>
<td>LOW TEMPERATURE BRITTLENESS</td>
<td>D2137 –40°C</td>
<td>NO CRACK ON IMPACT</td>
<td>PASS</td>
</tr>
</tbody>
</table>

The Infi-Shield® Uni-band has an inspection tab attached at the top of the seal and an aerosol primer is also included. A clean surface is necessary but no special tools are required for installation. The Infi-Shield® Uni-band can be immediately backfilled.

Sealing Systems, Inc.
9350 County Road 19 • Loretto, MN 55357 • 763-478-2057 • 800-478-2054 • Fax 763-478-8868 • [www.infi-shield.com](http://www.infi-shield.com)
WrapidSeal™
Heat Shrinkable Manhole Encapsulation System

System Components

WrapidSeal is typically shipped in bulk rolls. Closures are shipped pre-cut. The adhesive is protected from contamination by an inner liner. Primer is sold separately.

Storage & Safety Guidelines

To ensure maximum performance, store Canusa products in a dry, ventilated area. Keep products sealed in original cartons and avoid exposure to direct sunlight, rain, snow, dust or other adverse environmental elements. Avoid prolonged storage at temperatures above 95°F (35°C) or below -4°F (-20°C). Product installation should be done in accordance with local health and safety regulations.

Equipment List

These installation instructions are intended as a guide for standard products. Consult your Canusa representative for specific projects or unique applications.


Product Preparation Guidelines

As a guideline, cut the required lengths of Sleeve material (L) and Closure material (W) from the bulk roll as follows:

- L = Manhole structure circumference + overlap dimension (6" minimum)
- W = Sleeve Width

Ensure that the sleeve and closure are not damaged or contaminated.

Surface Preparation

Ensure all surfaces which the sleeve will be applied to are clean, dry and free of foreign objects and sharp edges.

Sleeve Sizing

WrapidSeal™ should be sized to extend 3" - 4" above and below the upper and lower joints of the cone section, grade rings and frame. As a guide, make a series of marks around the manhole where the bottom of the sleeve will be. Determine the layflat length of the sleeve by measuring the circumference of the manhole structure at the marks and add the overlap dimension, (6" minimum).

Pre-Heat

Using the torch, warm the surface to drive off any moisture.
Sleeve Finishing

5a

Apply WrapidSeal™ Primer to the application surfaces, i.e., steel, concrete, fiberglass etc. Wait until the primer is slightly tacky to touch before proceeding. This will take 5-15 minutes depending on temperature and humidity conditions.

5b

Roll up the cut sleeve ensuring that the release liner is still on the adhesive backing

Caution: Do not allow exposed adhesive to fold over on itself.

5c

At the overlap, ensure that the top and bottom edges of the sleeve are uniformly aligned.

Sleeve Overlap

6

Place the closure seal on a flat surface (adhesive side up) and apply gentle heat to activate the adhesive. Center the closure vertically over the overlap and apply a small amount of heat to the face of the closure. Using a gloved hand pat the closure down and, alternating with heat and pressure. Continue until the closure is fully bonded.

Closure Installation

7

Using a moderate to high flame, begin heating the sleeve from the bottom edge. Apply heat circumferentially around the structure. Continue heating upward as the sleeve shrinks. Use a gloved hand or roller to smooth wrinkles and push out trapped air.

Sleeve Shrinking

8

After shrinking, WrapidSeal™ will be draped over the manhole frame gussets. Using a knife, cut the sleeve around the gussets. Apply gentle heat and press the sleeve onto the steel frame. Trim excess material protruding above the steel manhole frame and cover.

Sleeve Preparation

9

Visually inspect the installed sleeve for the following:
- Sleeve is in full contact with the cone section and manhole frame
- Adhesive flows beyond the sleeve edges
- No cracks or holes in the sleeve backing

Inspection

10

After shrinking is complete, allow the sleeve to cool prior to backfilling. Water quenching of the sleeve is acceptable to facilitate immediate backfilling. To prevent damage to the sleeve, use selected backfill material, (no sharp stones or large particles), otherwise an extruded polyethylene mesh or other suitable shield should be used.

Backfilling Guidelines

Inspect

Please contact manufacturer's representative when considering use of WrapidSeal™ on above grade structural applications.
PARSON MANHOLE INSERT

DESCRIPTION: PARSON MANHOLE INSERTS are manufactured from ultra high density, high molecular weight polyethylene and have been proven effective in reducing or preventing surface water inflow to the collection system, through the manhole lid. Operating, utility and maintenance costs for plant equipment and pumps are minimized, due to reduced flow during heavy rainfall. PARSON MANHOLE INSERTS are a practical solution to expensive plant expansions, new construction moratoriums or high sewage treatment costs.

ADVANTAGES:
- NO VALVE method of ventilation available
- Single or double valve ventilation system available
- NO Corrosive parts
- Easy installation and removal
- Requires no maintenance
- Dramatically reduce sewage treatment costs
- Keeps grit, sand, salt, chemical spills, foreign objects, road oils, etc. from entering collection systems
- Cost-effective alternative to replacing existing manhole covers with “water-tight” covers

PHYSICAL PROPERTIES:
PARSON MANHOLE INSERTS are manufactured from Ultra High Density, high molecular weight Polyethylene, meeting the requirements of ASTM D-1248, Class A, Category 5, with a finish thickness of 1/8”. Ventilation is achieved by either the thru-bore, single or double valve methods. A corrosion resistant 1” heavy weight polypropylene strap is factory installed to make removal of the unit a simple, one person operation. A factory installed closed-cell neoprene or cross-linked polyethylene gasket is available upon request.

INSTALLATION: No special tools are required to install PARSON MANHOLE INSERTS. Just remove the manhole cover and clean the rim of the frame. Place the PARSON MANHOLE INSERT on the manhole frame rim and replace the manhole cover.

MEASUREMENTS NEEDED FOR PROPER INSTALLATION OF PARSON MANHOLE INSERTS
(Please enclose a copy of this drawing with your order)
LiquiForce
Liner Systems

The #1 Manhole, Wetwell and Wastewater Treatment Plant
No-Dig Rehabilitation Solution

GRAVITY
The proven trenchless sewer program cities trust

www.liquiforce.com • 1.800.265.0863
Eliminate the Risk and Cost to your Community and the Environment

Deteriorated manhole, wetwell and wastewater treatment plant structures put people and communities at risk and allow wastewater to leak out of the system into the surrounding watershed -- a community’s source for drinking water.

Deteriorated piping also allows clean groundwater to enter the wastewater pipeline system, adding unnecessary treatment costs.

Why Dig and Replace?

4 Step Process

Step 1
**Preparation**
Water blasting removes debris and loose material to provide a reliable surface for the unique LiquiForce SpectraSheild multi-coating liner system.

Step 2
**Moisture Barrier Installation**
A silicone polyurea moisture barrier and adhesion coating is applied to form the base layer of the new SpectraSheild stress-skin panel liner.

Step 3
**Surfacerc Coating**
A complete closed-cell, polyurethane foam coating is applied to fill in all eroded areas.

Step 4
**Corrosion Barrier**
A silicone polyurea barrier is applied, providing the final corrosion barrier for the new multi-layer SpectraSheild stress-skin panel liner.
Applications

- Manholes
- Wetwells
- Headworks
- Grit Chambers
- Clarifiers
- Aeration Basins
- Digester Roofs
- Water Valve Chambers
- Tunnels

Advantages

- No-Dig Cost Savings
- Environmentally Friendly
- Best-In-The-Industry Warranty
- 100 Year Design Life
- Eliminates Infiltration
- Prevents Corrosion
- Eliminates Root Intrusion
- Restores Structural Integrity

Region Of York, Ontario  Edmonton, Alberta  Toronto, Ontario
7 Million Square Feet Installed

55,000 manholes and 1900 other wastewater structures rehabilitated

Waste Water Clarifier
Algae removal made easy!

Waste Water Treatment
Facility Concrete Rehabilitation
High Viscosity Modified Structural Epoxy System
NPR-5304

Typical Physical Properties

NPR-5304 is a rapid curing, high strength, high corrosion resistant modified epoxy resin designed to repair manholes, sumps, wetwells, pipelines, tanks, etc. Excellent cure at low temperatures and in the presence of water. Typically develops a hard surface in one-two hours.

Rapid development of physical properties. Excellent chemical resistance to both acids, caustics, gasoline and other hydrocarbons. Film thickness of 80 – 250 mils in a single pass by spray or brush. Outstanding resistance to 30% sulfuric acid, hydrogen sulfide, 5% nitric acid, 5% sodium hydroxide, gasoline, and other chemicals demonstrated by independent third party testing and extensive field experience.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity (resin)</td>
<td>1.06 – 1.09 G/ml.</td>
</tr>
<tr>
<td>Weight Per Gallon (resin)</td>
<td>8.9 – 9.1 Lb</td>
</tr>
<tr>
<td>Specific Gravity (hardener)</td>
<td>1.64 – 1.71 G/ml.</td>
</tr>
<tr>
<td>Weight Per Gallon (hardener)</td>
<td>13.9 – 14.3 Lb</td>
</tr>
<tr>
<td>Weight Per Gallon (mixture)</td>
<td>11.3 – 11.7 Lb</td>
</tr>
<tr>
<td>Mix Ratio (Resin/Hardener)</td>
<td>1.5 to 1 By Volume</td>
</tr>
<tr>
<td>Mix Ratio (Resin/Hardener)</td>
<td>1 to 1 By Weight</td>
</tr>
<tr>
<td>Flexural Modulus (ASTM D-790)</td>
<td>600,000 psi</td>
</tr>
<tr>
<td>Flexural Strength (ASTM D-790)</td>
<td>14,000 psi</td>
</tr>
<tr>
<td>Tensile Elongation (ASTM D-638)</td>
<td>5%</td>
</tr>
<tr>
<td>Tensile Strength (ASTM D-638)</td>
<td>7,500 psi</td>
</tr>
<tr>
<td>Tensile Modulus (ASTM D-638)</td>
<td>290,000 psi</td>
</tr>
<tr>
<td>Compressive Strength (ASTM C-579)</td>
<td>13,500 psi</td>
</tr>
<tr>
<td>Coefficient of Linear Thermal Expansion</td>
<td>$3.7 \times 10^4 \text{cm/cm/F}$</td>
</tr>
<tr>
<td>Maximum Service Temp. (ambient cure)</td>
<td>150°F (66°C)</td>
</tr>
<tr>
<td>Maximum Service Temp. (postcured)</td>
<td>168°F (76°C)</td>
</tr>
<tr>
<td>Shore D Hardness (ASTM D-4541-95el)</td>
<td>&gt;86</td>
</tr>
<tr>
<td>Shrinkage</td>
<td>&lt;0.5%</td>
</tr>
<tr>
<td>Adhesion: Concrete (ASTM D-4541-95el)</td>
<td>Concrete Fails</td>
</tr>
<tr>
<td>Adhesion: Steel (ASTM D-4541-95el)</td>
<td>&gt;2500 psi</td>
</tr>
<tr>
<td>Abrasion Resistance (D4060-95, CS17)</td>
<td>50mg/1000 @1000 gram load</td>
</tr>
</tbody>
</table>

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An inexpensive and permanent method of sealing the grade adjustment ring area and joint sections in a manhole or catch basin from the inside of the structure. This state-of-the-art urethane material is packaged in a kit that is easily applied by SSI certified installers.

Sealing Systems, Inc.
9350 County Road 19 • Loretto, MN 55357 • 800-478-2054 • Fax 763-478-8868 • www.ssisealingsystems.com
## FLEX-SEAL UTILITY SEALANT®

**SEALING SYSTEMS, INC.**  
APPLICATION STANDARDS & TECHNICAL, DATA TEST RESULTS

<table>
<thead>
<tr>
<th>Property</th>
<th>Measuring Condition</th>
<th>Flex-Seal Utility Sealant®</th>
<th>Primer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>ASTM-E 201</td>
<td>9.5# per gal.</td>
<td>9.4# per gal.</td>
</tr>
<tr>
<td>Solid Content</td>
<td>By Volume</td>
<td>91%</td>
<td>92.2%</td>
</tr>
<tr>
<td>Hardness (Durometer)</td>
<td>ASTM-D 2240</td>
<td>75</td>
<td>85-90</td>
</tr>
<tr>
<td>Elongation (at break)</td>
<td>ASTM-D 412</td>
<td>800%</td>
<td>400%</td>
</tr>
<tr>
<td>Vacuum</td>
<td>ASTM-C 1244</td>
<td>2 min. @ 10 inches</td>
<td></td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>ASTM-D 412</td>
<td>1,150 p.s.i.</td>
<td>3200 p.s.i.</td>
</tr>
<tr>
<td>Adhesive Strength</td>
<td>ASTM –D 903</td>
<td>175 lb. 1/in.</td>
<td>400 lb. 1/in.</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>ASTM –D 570</td>
<td>.05% by weight</td>
<td>.03% by weight</td>
</tr>
<tr>
<td>Tear Resistance</td>
<td>ASTM-D 1004</td>
<td>155 lb. 1/in.</td>
<td>210 lb. 1/in.</td>
</tr>
<tr>
<td>Weatherability</td>
<td>ASTM-D 822 500 hrs</td>
<td>Slight color change</td>
<td>Loss of gloss</td>
</tr>
<tr>
<td>Temp. Cure Range</td>
<td>Fed Std 141 meth 6223</td>
<td>-65 to 250 F</td>
<td>-65 to 250 F</td>
</tr>
</tbody>
</table>

Calcium Chloride (Road Salt) No Effect  
1% Detergent Solution No Effect  
Chlorinated Pool Water No Effect  
Anti-Freeze No Effect  
Motor Oil Stained  
Hydraulic Brake Fluid Slight Bleaching  
Gasoline Slight Swelling  
Hydrogen Sulfide No Effect  
Sulfuric Acid (20%) No Effect  
Sodium Hydroxide (5%) No Effect

Disclaimer: This technical data information and recommendations offered are based on test results, and findings we believe to be reliable and complete.

---

Flex-Seal Utility Sealant® is packaged in a kit weighing just 9-1/2 pounds. The recommended mil thickness is directly related to the expansion associated within the territories climate.

Sealing Systems, Inc.  
9350 County Road 19.  
Loretto, MN 55357  
763-478-2057  
800-478-2054  
Fax 763-478-8868  
www.flexseal.com
Appendix C

Detailed Cost Estimates
### Table C.1: Existing Upgrades

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<th>Pipe Replacement Unit Cost</th>
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Subtotal $649,916
Engineering and Contingency (40%) $259,974
Total $909,890

### Table C.2: Near Future Upgrades

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Subtotal $649,916
Engineering and Contingency (40%) $259,974
Total $909,890
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Table C.3: Long Term Upgrades

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Subtotal: $518,394

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Subtotal: $370,024

Subtotal: $888,418

Table C.4: Engineering and Contingency (40%)

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Subtotal: $370,024

Subtotal: $888,418

Subtotal: $1,022,761

Subtotal: $718,288

Subtotal: $1,731,049

Subtotal: $1,295,223

Subtotal: $3,026,272

Subtotal: $2,061,365

Subtotal: $4,127,630

Subtotal: $2,562,999

Subtotal: $5,125,989

Subtotal: $3,390,799

Subtotal: $6,781,798

Appendix C.xlsx Page 2 of 4
### Table C.5: Lift Station and Forcemain Costs

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<th>DS Node</th>
<th>Slope</th>
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<th>Twin Dia</th>
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<th>Pipe Replacement Unit Cost</th>
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**Subtotal:** $3,972,945

**Engineering and Contingency (40%):** $4,803,492

**Total:** $9,776,437

### Table C.4: Ultimate Upgrades:

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<th>Slope</th>
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<th>Replacement Dia</th>
<th>Twin Dia</th>
<th>Average Depth</th>
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<th>Pipe Replacement Unit Cost</th>
<th>Replacement Cost</th>
<th>Pipe Twin Manhole Unit Cost</th>
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**Subtotal:** $3,972,945

**Engineering and Contingency (40%):** $4,803,492

**Total:** $9,776,437

### Table C.6: Ultimate Extension Costs

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**Subtotal:** $3,972,945

**Engineering and Contingency (40%):** $4,803,492

**Total:** $9,776,437

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Appendix C.xlsx
### Acheson Trunk Extension

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<th>DS Inv</th>
<th>US MH</th>
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<th>DS Ground</th>
<th>Depth</th>
<th>Unit Cost</th>
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Subtotal | $1,080,000 | Lift Station |

### Bevington Trunk Extension

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Subtotal | $988,750 | Lift Station |

### Engineering and Contingency (40%) | $1,663,500 | TOTAL | $5,822,245 |
About AECOM
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As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges.
From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM companies had revenue of approximately US$19 billion during the 12 months ended June 30, 2015.
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