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Town of Edson

Final Preliminary Design Report

Edson West Sanitary Trunk Main

March 2014


ISL Engineering and Land Services Ltd. is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, land, and environmental projects.

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## 1.0 <br> Introduction

### 1.1 Authorization

In August 2013, ISL Engineering and Land Services Ltd. (ISL) was commissioned by the Town of Edson (the Town) to develop a preliminary engineering design for the West End Sanitary Sewer Trunk Main concept presented in the Municipal Servicing Plan update (AECOM, 2011), hereafter referred to as the MSP.

The purpose of this ISL study is to provide a feasible and cost effective preliminary design of the West Sanitary Trunk Main to service the existing and future development areas.

The project was authorized by the Town of Edson by direction of Mr. Dawit Solomon, M.Sc., P. Eng., Director of Engineering of the Town.

### 1.2 Scope of Work

The objective of this project is to develop and review alignment alternatives for the proposed West Sanitary Sewer Trunk Main, to determine the most cost effective alignment/servicing option, and prepare a preliminary design for the most cost effective servicing option. Work tasks include:

- Develop 4 preliminary design alignment options and for each:
- Complete a geotechnical and environmental assessment
- Identify Historical Resource requirements
- Identify any permit and approvals requirements
- Evaluate and recommend the preferred alignment based on feasibility, approvals/permits and cost effectiveness
- Prepare draft preliminary engineering drawings and cost estimate for the preferred option
- Prepare a draft report summarizing the preliminary engineering phase of the project
- Refine the preliminary engineering drawings and cost estimate for the preferred option
- Prepare a final report summarizing the preliminary engineering phase of the project


## 2.0 <br> Background

### 2.1 Previous Studies

### 2.1.1 West Edson Area Structure Plan

The Edson West Area Structure Plan (ASP), prepared by Lovatt Planning Consultants Ltd. (Lovatt), is currently before council for final approval. The ASP provides a framework for servicing of the west most portion of the Town of Edson and Yellowhead County along Highway 16. The ASP indicates future land use is primarily light industrial and commercial development with a small section of residential land east of Rodeo Road north of Highway 16.

### 2.1.2 Municipal Servicing Plan Update

In 2011 AECOM completed an update to the Municipal Servicing Plan (MSP). The study identified that large areas of the existing sewer system within the Town experience sanitary backup during heavy rainfall events, resulting in basement backup. The MSP evaluated upgrade alternatives to address these flood risks.

XP-SWMM modeling software was used to evaluate the dry and wet weather flows for the existing and proposed sanitary system. The existing and future sanitary system analysis was used to evaluate the 5 and 25 year, 4 hour and 24 hour rainfall events. The modeling results were used to evaluate system performance by examining pipe capacity utilization and surcharge levels.

The following highlights the conclusions and recommendations from the study:

- The model was used to assist in identifying flood risk areas and evaluate upgrade alternatives.
- The proposed system improvements were divided into three phases; Phase 1 includes the construction of the West Edson Sanitary Trunk Main to address surcharging within 1.0 m of the ground level for the 5 year 4 hour event.
- Phase 1 upgrades included upgrades on 1 Avenue, 42 Street, 49 Avenue, 51 Street, 52 Street, 53 Street and 70 Street.
- Alternative 1 includes upgrades to the existing West Sanitary Trunk
- Alternatives 2 and 3 involve the construction of a new trunk sewer to the existing sewer at 54 Street
- Alternative 2 includes a 375 mm pipe for existing developments; Alternative 3 includes a 750 mm pipe for 2025 development limit west of the Town to Rodeo Road.

A copy of the XPSWMM model for the MSP was made available and a brief review was completed to confirm the working condition of the model. An in depth audit of the model was not completed as this is outside the scope of the current study.

## Model Calibration

The model was calibrated using rainfall and flow monitoring data and wet weather flows were estimated within 3\% and 19\% of monitored flows for the June 2008 and August 2008 rainfall events.

## Model Service Area and Flows

The hydraulic model incorporated the existing Town sewer drainage and future 2015 and 2025 development areas within both the Town and County. Separate inputs were included for Areas 11 through 13 and Areas 18 through 23 representing future development within the Town and Yellowhead County, respectively. The following information was extracted from the model.

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## Existing Development Scenario (approximate peak flows values)

- Model was based on the 5 year 4 hour event
- The sanitary flow from the proposed 70 Street diversion $0.12 \mathrm{~m}^{3} / \mathrm{s}$
- The proposed pipe design for the new bypass trunk, to provide relief for the existing system at 70 Street and service future development areas 11,12 and 13 , includes a 375 mm diameter pipe at $0.22 \%$ grade

2025 Development Scenario (approximate peak flows values)

- 2025 development flows from County land Areas 21, 22 and 23 is 0.12 m³/s
- 2025 development flows from County land Areas 18, 19 and 20 is $0.09 \mathrm{~m}^{3} / \mathrm{s}$
- 2025 development flows from Town land Area 11 is $0.01 \mathrm{~m}^{3} / \mathrm{s}$
- 2025 development flows from Town land Area 12 is $0.03 \mathrm{~m}^{3} / \mathrm{s}$
- 2025 development flows from Town land Area 13 is 0.04 m³/s


## Model Remarks

- The degree of calibration of the model is considered reasonable for evaluating system flows.
- The modelled flow from the development upstream of the proposed 70 Street connection appears high compared to anticipated flow from rational design calculations. It was noted storm sumps may be connected to the system, however there is no way to confirm the additional inflow without further flow monitoring.
- A detailed audit of the model and confirmation of servicing areas is required to confirm the flows from 70 Street and the interaction of peak flows from each of the contributing areas as currently there is a significant risk that the flows may be over or under predicting.
- The Town has commented that they are uncertain of the accuracy of the flows calculated in the MSP and that the future flows may be greater than identified in the previous study.


### 2.2 Alberta Transportation Plans - Highway 16 By-Pass

Alberta Transportation has future plans to construct a bypass from the east side of the Town that reconnects to the existing highway between 75 Street and Rodeo Road. The schedule for construction of the by-pass is uncertain at this time. The proposed bypass restricts opportunity to install the proposed sewer pipe along the south side of the Highway 16 corridor. It is however anticipated that the proposed sewer will not interfere or impact the construction of the future by-pass as long as the sewer is not installed within the lands allocated for the bypass interchange. No alignments within these lands were considered in this study.

### 2.3 Design Flows

The MSP identified two servicing alternatives with regard to design flows. These are:
Alternative 1: Provide servicing for only the proposed Town growth (Areas 11, 12 and 13) and relief at 70 Street.

Alternative 2: Provide servicing for scenario 1, plus accommodate the potential for flows from the future County growth (Areas 18 - 23)

Preliminary design flows were developed based on the design flows outlined in the MSP and associated XPSWMM model as well as additional calculations and analysis.

The review of the XPSWMM model identified the following concerns:

- The Town indicated that the flows identified in the MSP potentially underestimate the actual future flows
- The flow from the existing development draining to the 70 Street connection appears high relative to the service area
- Even though the 70 Street connection is almost immediately adjacent to part of the new development area, the model shows the peak flows occurring at separate times.

Without addressing the above concerns there is a risk of incorrect sizing of future infrastructure. Oversizing of piping and pumping systems may result in increased capital and maintenance costs. Under-sizing the system may result in reduction of the level of service.

## Future Development Flows

A high level spreadsheet calculation of the sanitary flows from the future development areas, including both County and Town lands was undertaken for comparison with the model flows. The calculation is included in Appendix A. The following tables summarize the difference between spreadsheet calculations and the MSP model flows, for both alternatives.

Table 2.1: Alternative 1 - Design Flow Comparison

| From <br> M.H. | To <br> M.H. | Design Flows Q (L/s) |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Spreadsheet <br> $(\mathbf{Q / 8 6 \%})$ | Model |  |
| Area 11 | 75 Street | 11.6 | 13.5 | 11.3 |
| Area 12 | 75 Street | 43.5 | 50.6 | 28.9 |
| Area 13 | 75 Street | 60.7 | 70.6 | 40.4 |
| 75 Street | 70 Street | 109.8 | 127.7 | 80.4 |

## Notes:

Spreadsheet Calculations are based on the following:

- Residential Sewage Generation Rate $=375 \mathrm{~L} / \mathrm{s} /$ person
- Commercial/Industrial Sewage Generation Rate $=13600 \mathrm{~L} /$ ha/day
- Residential I/I Rate $=0.28 \mathrm{~L} / \mathrm{s} / \mathrm{ha}$
- Commercial/Industrial I/I Rate $=0.05 \mathrm{~L} / \mathrm{s} / \mathrm{ha}$
- Residential Peaking Factor $=2.6 \mathrm{P}^{-0.1}$
- Commercial/Industrial Peaking Factor $=3.0$

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Table 2.2: Alternative 2 - Design Flow Comparison

| From <br> M.H. | To <br> M.H. | Design Flows Q (L/s) |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | Spreadsheet <br> (Q/86\%) | Model |  |
| Area 21 |  | 8.8 | 10.3 | 8.0 |
| Area 22 | Area 23 | 130.6 | 151.9 | 88.9 |
| Area 23 | Area 12 | 181.0 | 210.5 | 122.4 |
| Area 20 | Area 19 | 59.4 | 69.1 | 39.7 |
| Area 19 | Area 18 | 96.0 | 111.7 | 64.0 |
| Area 18 | Area 12 | 141.2 | 164.1 | 94.0 |
| Area 12 | 75 Street | 365.7 | 425.2 | 245.2 |
| Area 11 | 75 Street | 11.6 | 13.5 | 11.3 |
| Area 13 | 75 Street | 60.7 | 70.6 | 40.4 |
| 75 Street | 70 Street | 437.3 | 508.4 | 295.9 |

Tables 2.1 and 2.2 indicate a large discrepancy between the spreadsheet flows and the MSP model flows, with the spreadsheet calculations indicating significantly larger sanitary flows for the future servicing areas than those identified in the MSP. Additional background information of the future development areas is required prior to making recommendation of which design flows are to be used.

## Existing 70 Street Development

The model results show a flow of approximately $141 \mathrm{~L} / \mathrm{s}$ from the development area of about 53.4 ha (45.2 ha residential; 8.2 ha commercial). This flow results in the downstream system to surcharge. As such it is proposed to divert a portion of this flow to the new sewer trunk at 70 Street. This would result in approximately $115 \mathrm{~L} /$ s being diverted to the new trunk.

For comparison a high level calculation of the expected sanitary flow from the existing 70 Street development was also carried out using the following parameters:

| Average Residential Sewage Flow $=$ | $375 \mathrm{~L} /$ person/day |
| :--- | :--- |
| Residential Density $=$ | 40 persons/ha |
| Residential Inflow/Infiltration $=$ | $0.28 \mathrm{~L} / \mathrm{s} / \mathrm{ha}$ |
| Residential Peaking Factor $=$ | $2.6 \mathrm{P}^{-0.1}(\mathrm{P}=$ population/1000 $)$ |
| Average Commercial Sewage Flow $=$ | $13,600 \mathrm{~L} / \mathrm{ha} /$ day |
| Commercial Inflow/Infiltration $=$ | $0.05 \mathrm{~L} / \mathrm{s} / \mathrm{ha}$ |
| Commercial Peaking Factor $=$ | 3.0 |

The calculated peak wet weather flow from the existing development is about $36.1 \mathrm{~L} / \mathrm{s}$, compared to the model flow of $141 \mathrm{~L} / \mathrm{s}$. The difference between the flows may be attributed to downspout connections from residences to the sanitary sewer. Without additional background information a design flow from this development cannot be confirmed at this time. It is recommended that additional analysis be completed during detail design. For the purpose of the current study it was agreed with the Town that the model flows will be used.

## Corresponding Peak Flows

As previously identified the timing of the peak flow from the future development area and existing development, from the proposed 70 Street connection, are slightly offset from each other. The separation is close and without supporting information it is risky to completely rule out the potential for overlap.

Table 2.3: Peak Flow Comparison

|  | Alternative 1 |  | Alternative 2 |  |
| :--- | :---: | :---: | :---: | :---: |
|  | MSP <br> Flow | Modified <br> Flow | MSP <br> Flow | Modified <br> Flow |
| Rodeo Road to 75 Street | $28.9 \mathrm{~L} / \mathrm{s}$ | $28.9 \mathrm{~L} / \mathrm{s}$ | $245 \mathrm{~L} / \mathrm{s}$ | $245 \mathrm{~L} / \mathrm{s}$ |
| 75 Street to 70 Street | $80.4 \mathrm{~L} / \mathrm{s}$ | $80.4 \mathrm{~L} / \mathrm{s}$ | $296 \mathrm{~L} / \mathrm{s}$ | $296 \mathrm{~L} / \mathrm{s}$ |
| 70 Street Connection | $115 \mathrm{~L} / \mathrm{s}$ | $115 \mathrm{~L} / \mathrm{s}$ | $115 \mathrm{~L} / \mathrm{s}$ | $115 \mathrm{~L} / \mathrm{s}$ |
| 70 Street to 54 Street | $84.6 \mathrm{~L} / \mathrm{s}$ | $195 \mathrm{~L} / \mathrm{s}^{*}$ | $299 \mathrm{~L} / \mathrm{s}$ | $411 \mathrm{~L} / \mathrm{s}^{*}$ |

*Flow assumes coinciding peak flows from 75 Street to 70 Street and 70 Street Connection
For the purpose of this study it is recommended to proceed with the modified flows for design flow alternatives. The preliminary design of pipe diameters and grades will be adjusted to meet elevation constraints while maintaining the modified flow requirements. As mentioned previously, the design flows will need to be confirmed during detailed design prior to finalizing the sizing of pipes and other infrastructure.

## 3.0

## Sanitary Trunk Preliminary Design Options

### 3.1 Alignment Alternatives

Four alignment alternatives were considered for the West End Sanitary Sewer Trunk Main. These are described below and shown in Figures 3.1 to 3.4. The upstream point is on Rodeo Road on the West boundary of the Town. The proposed sewer trunk connects to the existing sewer trunk on 54 Street south of Highway 16.

### 3.1.1 Alignment 1 (Figure 3.1)

## Horizontal Alignment

The alignment extends from Rodeo Road to 75 Street within the Highway 16 corridor along the north side of the westbound lanes. East of 74 Street the alignment crosses to the south side of the east bound lanes, immediately west of where the highway divides. From here, the alignment follows Highway 16 east bound lanes to 63 Street where it turns south crossing CN rail tracks. Immediately south of the tracks the alignment turns northeast and follows a cut line along the south boundary of the CN right-of-way. The alignment approaches Bench Creek prior to reaching 54 Street. At this section of Bench Creek the cross section of the creek has been widened, and possibly deepened, previously by CN to manage stormwater runoff. The proposed alignment continues below the widened creek section before connecting into the downstream sewer system on 54 Street.

## Vertical Alignment

The vertical alignment alternatives for this route include gravity and pumped solutions that are impacted by the depth of the downstream connection at 54 Street and the existing surface topography.

The ground elevations at Rodeo Road and 75 Street are around 935 m and 918 m respectively, resulting in and overall grade is about $1.1 \%$. However, the first 600 m stretch is at a grade of $2.3 \%$ and the remaining stretch has a grade of $0.2 \%$. This ground profile is desirable for gravity systems as it allows for gravity sewer flow with minimal installation depths. Conventional open cut construction methods could be used for this section.

East of 75 Street the ground profile continues to fall for a short distance to low point at an elevation of 917 m . From here the ground rises steeply to a high point at an elevation of 925 m , located immediately west of 70 Street. Gravity sewer depths along this section would be greater than 10 m deep, likely requiring installation by trenchless methods.

East of 71 Street the ground profile drops quickly, from an elevation of 925 m to 911 m over a distance of approximately 300 m before flattening out with some undulations, as the alignment approaches 63 Street. From here the ground profile continues to undulate, ranging in elevation from about 909 m to 912 m , up to Bench Creek immediately west of 54 Street. With the exception of the section immediately east of the high point the proposed gravity trunk would be installed at relatively shallow depths.

The proposed sewer crossing of the wet area immediately west of 54 Street shows very shallow depths, about 2.4 m to obvert. The ground profile shown shows the water surface and not the bottom of the ponding area. Taking into account the depth of water at this location (assumed at approximately 1.5 m ) there is likely very little cover, potentially less than 1.0 to 1.5 m . This would be very difficult and costly to construct as well as having a significantly impact on habitat. Even if construction could be completed, the pipe would most likely be significantly impacted by high rates of groundwater infiltration.

To mitigate some of the construction and environmental risk associated with crossing the creek, an option to construct an inverted siphon across the creek was considered. This would allow the crossing to be constructed by directional drilling which would significantly lessen the environmental impact. However, due to the elevation of the tie-in sewer, it would not be possible to gain sufficient head across the siphon for it to work efficiently. This would result in significant operation and maintenance issues and is not recommended. As an alternative to an inverted siphon, an option to install a pump station at this location was also considered and rejected due to costs. This is discussed later in this report.

A pumped solution was considered as an alternative to a gravity sewer from 75 Street to the tie-in. This could offer a cost effective solution as the forcemain can be installed at nominal depth, thereby reducing excavation costs. Pumping through a forcemain also reduces the pipe size and potential for infiltration. The pump alternative includes construction of a gravity sewer from Rodeo Road to a pump station near the low point east of 75 Street. A new sewer pipe would also be required to convey flows from the 70 Street diversion towards the pump station site. The pump station would convey flows through a relatively shallow forcemain pipe from the pump station site to the downstream trunk at 54 Street; the forcemain would be installed at minimum depth, about 3.0 m to obvert. Crossing the wet area the forcemain pipe could be installed at greater depths to reduce the potential of ground disturbance of pond bottom. Finally, the forcemain would tie in directly to the downstream trunk at 54 Street.

The forcemain would be sized to ensure flows do not exceed a maximum flow velocity of $3.0 \mathrm{~m} / \mathrm{s}$ and minimum flow of $0.9 \mathrm{~m} / \mathrm{s}$ to avoid potential sedimentation in the forcemain. At this preliminary phase it has been determined that the forcemain could be designed such to avoid potential vacuum pressures that can be experienced when pumping across a negative static head.

## 70 Street Connection

The proposed 70 Street connection for the gravity sewer option would consist of extending a pipe approximately 200 m from manhole N594 south to the proposed sanitary trunk near Highway 16. The proposed pipe would be installed at minimum depths primarily by open cut construction. The 70 Street sewer extension would require a trenchless crossing of Highway 16 prior to the connection to the new trunk main.

The pump station option would require the diversion of the 70 Street flows west towards a proposed pump station near 75 Street. The length of new pipe is significantly greater than for the gravity sewer, approximately 890 m . The pipe would be installed within the existing service road immediately south of the westbound lanes up to where the undivided highway begins. From here, the pipe would be installed on the north side of the highway corridor to the proposed pump station location near 75 Street.

## Utilities

A review of existing utilities was completed to identify any potential conflicts. The general orientation of existing utility lines has been identified on the plans. At this time as-built information, including depth of installation, is not available. The proposed sewer is below typical installation depths of shallow utilities therefore the risk for conflict with shallow utilities is low. In the event of a conflict occurring with existing pipelines, the sewer design will be modified to accommodate existing utilities where possible. If such a design is impeded by existing utilities, relocations of existing pipelines may need to be considered.

In summary, the following pipeline crossings and shared easements have been identified for sewer Alignment 1:

- A TELUS line found in the north ditch along Hwy 16 between Range Road 180 and 75 Street shares the same general alignment as Alignment 1
- A 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16
- A Yellowhead Gas crossing found near the SE corner of $1 / 4$ Sec $18-53-17-$ W5 along Hwy 16.

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- A 30psi ATCO Gas distribution line running along the eastbound lanes of Hwy 16 in the north ditch right where Hwy 16 splits off east of 74 Street. This looks to feed McPhee Construction Ltd and others on the south side of Hwy 16.
- A Yellowhead Gas line shares the same alignment as sewer Alignment 1 from 63 Street south of the CN tracks as it heads east to 54 Street following the cut line along the south boundary of the CN Rail right-ofway.


### 3.1.2 Alignment 2 (Figure 3.2)

## Horizontal Alignment

Alignment 2 starts at Rodeo Road and follows a proposed road right-of-way, within future development Areas 11 and 12 , to 75 Street. There is no existing development along this stretch with no know encumbrances to construction. At 75 Street the alignment crosses Highway 16 then continues east along the service road for about 400 m then head south to the end of the service road then east through the south section of private property before continuing and north east along the CN rail right-of-way and the tree farm to 63 Street. At 63 Street the alignment turns south crossing CN rail towards the government road allowance, along the south end of SE and SW $1 / 4$ sections 16-53-17-5, and continues towards 54 Street where the alignment heads north towards the tie in location.

## Vertical Alignment

The vertical alignment alternatives for this route include gravity and pumped solutions that are impacted by the depth of the downstream connection at 54 Street and the existing surface topography.

There is a significant amount of grade available from Rodeo Road to 75 Street with an overall grade is about $1.0 \%$. However, the first 600 m stretch is at a grade of $2.3 \%$. The ground profile of the remaining stretch has a grade of $0.2 \%$. This ground profile is desirable for gravity systems as it allows for gravity sewer flow with minimal installation depths. The pipe would be installed at grades of up to $1.5 \%$ before flattening out to $0.5 \%$ coming down from Rodeo Road. Approaching the low point the pipe slope decreases to $0.1 \%$ to keep limit cover.

East of 75 Street the ground profile continues to fall for a short distance to low point a couple hundred meters east of 75 Street at an elevation of 917 m . As the alignment heads south and east around the private property the ground profile has a steep rise to a high point, with an elevation of 925 m . The combination of sewer depth and limited construction R/W makes large excavations for open cut construction difficult. It is anticipated that this section will include some sections to be constructed by trenchless methods, particularly where depth to invert of up to 14 m . At these depths excavations become very wide and require large working areas for conventional open cut methods. Cost of open cut construction at these depths become comparable to trenchless construction.

After the high point the ground gradually falls as the alignment heads south along the service road. As the alignment traverses the private property and along the CN right-of-way the topography has a gentle falling slope to 63 Street. At 63 Street the terrain levels off across the CN tracks and east along the government road allowance to 54 Street. From here, the alignment heads north on 54 Street and the ground elevation drops across Bench Creek, then rises towards the 54 Street connection. At the Bench Creek crossing, the ground cover is less than 1.5 m . This is raises significant construction and operational risks and issues which are discussed in later sections of this report.

The pump and forcemain option would be similar to Alignment 1 with the pump station located at the low point east of 75 Street and a forcemain to 54 Street. The flow diversion from 70 Street requires a new pipe constructed from 70 Street east towards the proposed lift station near 75 Street. The advantage of the pump and forcemain option is that it mitigates the deep sewer construction over the high point and also allow the sewer to be installed by means that mitigate construction risk associated with the Bench Creek crossing.

## 70 Street Connection

The proposed 70 Street connection for the gravity sewer option would consist of extending a pipe approximately 400 m from manhole N594 south to the proposed sanitary trunk near Highway 16. The proposed pipe would be installed at minimum depths primarily by open cut construction. The 70 Street sewer extension would require a trenchless crossing of Highway 16. The sewer pipe would extend another 200 m to the connection to the new trunk main.

The pump station option would require the diversion of the 70 Street flows west towards a proposed pump station near 75 Street. The length of new pipe is significantly greater than for the gravity sewer, approximately 890 m . The pipe would be installed within the existing service road immediately south of the westbound lanes up to where the undivided highway begins. From here, the pipe would be installed on the south side of the highway corridor to the proposed pump station location near 75 Street.

## Utilities

In summary, the following pipeline crossings and shared easements have been identified for sewer Alignment 2:

- A 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16
- A Yellowhead Gas crossing found near the east boundary of S.W. ¼ Sec 18-53-17-W5 north of Hwy 16.
- A 30psi ATCO Gas distribution line crossing right where Hwy 16 splits off into eastbound and westbound lanes east of 74 Street. The sewer alignment shares the same alignment as the ATCO gas lines as it feeds properties located in NW $1 / 4$ 8-53-17-5.
- There is a 38PE Yellowhead Gas line that shares the same alignment along the northbound side of the CN right-of-way south of Hwy 16 eastbound lanes west of 63 Street.
- There are existing Yellowhead Gas, Conserve Oil, and TELUS lines running along the easement between SW $1 / 4$ Sec 16-53-17-5 and NW $1 / 4$ Sec 9-53-17-5 east of 63 Street and west of 54 Street common to proposed sewer Alignment 2.


### 3.1.3 Alignment 3 (Figure 3.3)

## Horizontal Alignment

The alignment extends from Rodeo Road to 75 Street within the Highway 16 corridor along the north side of the west bound lanes. At 75 Street the alignment crosses Highway 16 and heads east along the service road and through the private property immediately south of the highway corridor. About 300m east of 70 Street the alignment meets up with the CN rail right-of way and turns north east to parallel the rail to 63 Street. At this point the alignment separates from the rail right-of way and continues along the south side of the east bound lanes of the highway to 57 Street where it shifts to 1 Avenue before reaching 54 Street. Here, the alignment heads south towards the tie in point, located about 300 m south of 1 Avenue.

## Vertical Alignment

The vertical alignment from Rodeo Road to 63 Street is similar to Alignment 1. East of 63 Street the ground begins to rises to a peak near 58 Street before falling again to 54 Street. In this section the gravity pipe is up to $11-12 \mathrm{~m}$ deep. At the creek crossing the depth of pipe is about 2.5 m to invert. The depth noted is to water surface not bottom of pond. Further investigation is required to determine the depth of the creek to confirm actual ground cover. However, as there is an existing crossing here that ties into the connection manhole, it is anticipated that a gravity crossing can be made at this point.
A pumping option includes the installation of a forcemain at minimum depths of about 3.0m. At the creek crossing the forcemain could be installed at a greater depth to ensure adequate cover beneath the creek.

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## 70 Street Connection

The proposed 70 Street connection for the gravity sewer option would consist of extending a pipe approximately 200 m from manhole N594 south to the proposed sanitary trunk near Highway 16. The proposed pipe would be installed at minimum depths primarily by open cut construction. The 70 Street sewer extension would require a trenchless crossing of Highway 16 prior to the connection to the new trunk main.

The pump station option would require the diversion of the 70 Street flows west towards a proposed pump station near 75 Street. The length of new pipe is significantly greater than for the gravity sewer, approximately 890 m . The pipe would be installed within the existing service road immediately south of the westbound lanes up to where the undivided highway begins. From here, the pipe would be installed on the south side of the highway corridor to the proposed pump station location near 75 Street.

## Utilities

In summary, the following pipeline crossings and shared easements have been identified for sewer Alignment 3:

- A 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16
- A Yellowhead Gas crossing found near the SE corner of $1 / 4$ Sec 18-53-17-W5 north of Hwy 16.
- A 30psi ATCO Gas distribution line crossing right where Hwy 16 splits off into eastbound and westbound lanes east of 74 Street. The sewer alignment shares the same alignment as the ATCO gas lines as it feeds properties located in NW 1/4 8-53-17-5.
- A Yellowhead Gas line crossing at 63 Street as sewer Alignment 3 follows the Hwy 16 eastbound lanes.
- ATCO Gas crossings at 59, 58, and 57 St along Hwy 16 eastbound lanes as Alignment 3 turns south onto 57 Street.
- There are FORTIS and Yellowhead Gas lines running along 1Ave from 57 Street to 55 Street shared by Alignment 3.


### 3.1.4 Alignment 4 (Figure 3.4)

## Horizontal Alignment

The alignment extends from Rodeo Road to 74 Street within the Highway 16 corridor along the north side of the west bound lanes. East of 74 Street the alignment crosses to the south side of the east bound lanes, immediately west of where the highway divides. From here, the alignment follows the roadway up to 63 Street where is turns south, crossing CN Rail towards the government road allowance. The remaining section from 63 Street to the tie in point on 54 Street is the same as described in Alignment 2.

## Vertical Alignment

Alignment 4 is a hybrid of Alignments 1 and 2. East of 63 Street the alignment and profile is similar to that of Alignment 1. East of 63 Street the alignment and profile are similar to that of Alignment 2. As with the other alignments both pumping and gravity options were investigated for this alignment.

There is a significant amount of grade available from Rodeo Road to 75 Street with an overall grade is about $1.0 \%$. However, the first 600 m stretch is at a grade of $2.3 \%$. The ground profile of the remaining stretch has a grade of $0.2 \%$. This ground profile is desirable for gravity systems as it allows for gravity sewer flow with minimal installation depths. The pipe would be installed at grades of up to $1.5 \%$ before flattening out to $0.5 \%$ coming down from Rodeo Road. Approaching the low point the pipe slope decreases to $0.1 \%$ to keep limit cover.

East of 75 Street the ground continues to fall for a short distance to low point east of 75 Street. Here the elevation is approximately 917 m . As the alignment heads south and east around the private property the
ground profile has a steep rise to a high point, with an elevation of 925 m . The combination of sewer depth and limited construction ROW makes large excavations for open cut construction difficult. It is anticipated that this section will include some sections to be constructed by trenchless methods, particularly where depth to invert of up to 14 m . At these depths excavations become very wide excavation and require very wide working areas for conventional open cut methods. Cost of open cut construction at these depths become comparable to trenchless construction.

East of 71 Street the ground profile drops quickly, from an elevation of 925 m to 911 m over a distance of 300 m then is relatively level, with some undulations, as the alignment approaches 63 Street. At 63 Street the terrain levels off across the CN tracks and east along the government road allowance to 54 Street. As the alignment heads north on 54 Street the ground elevation drops across Bench Creek then rises towards the 54 Street connection. At the Bench Creek crossing the ground cover is less than 1.5 m . This is raises significant construction and operational risks and issues which are discussed in later sections of this report.

Similar to the previous alternative, pumping mitigates the deep sewer construction over the high point and also allow the sewer to be installed by means that mitigate construction risk associated with the Bench Creek crossing.

## 70 Street Connection

The proposed 70 Street connection for the gravity sewer option would consist of extending a pipe approximately 200 m from manhole N594 south to the proposed sanitary trunk near Highway 16. The proposed pipe would be installed at minimum depths primarily by open cut construction. The 70 Street sewer extension would require a trenchless crossing of Highway 16 prior to the connection to the new trunk main.

The pump station option would require the diversion of the 70 Street flows west towards a proposed pump station near 75 Street. The length of new pipe is significantly greater than for the gravity sewer, approximately 890 m . The pipe would be installed within the existing service road immediately south of the westbound lanes up to where the undivided highway begins. From here, the pipe would be installed on the north side of the highway corridor to the proposed pump station location near 75 Street.

## Utilities

In summary, the following pipeline crossings and shared easements have been identified for sewer Alignment 4:

- A TELUS line found in the north ditch along Hwy 16 between Range Road 180 and 75 Street shares the same general alignment as Alignment 1.
- A 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16
- A Yellowhead Gas crossing found near the SE corner of $1 / 4$ Sec 18-53-17-W5 north of Hwy 16.
- A 30psi ATCO Gas distribution line crossing right where Hwy 16 splits off into eastbound and westbound lanes east of 74 Street. The sewer alignment shares the same alignment as the ATCO gas lines as it feeds properties located in NW ¼ 8-53-17-5.
- There are existing Yellowhead Gas, Conserve Oil, and TELUS lines running along the easement between SW $1 / 4$ Sec 16-53-17-5 and NW $1 / 4$ Sec 9-53-17-5 east of 63 Street and west of 54 Street common to proposed sewer Alignment 4.


### 3.2 Pump Station Design Requirements

A pump station and forcemain option was identified for each of the four alignment options. This allows for mitigation of risk and expected high costs associated with deep sewer construction as well as providing means to mitigate construction risk associated with the Bench Creek crossing.

The proposed pump station would be located in the vicinity of the low point near 75 Street. The forcemain would extend from 75 Street to the downstream tie in point at 54 Street. Preliminary pump sizing was completed for the two design flow scenarios, as described below.

## Alternative 1:

1. Design flow $=200 \mathrm{~L} / \mathrm{s}$; static head $=-12.00 \mathrm{~m}$; pump head $=20.27 \mathrm{~m}$ (based on Alt 4 alignment)
2. FM size $=400$ PVC SDR 26
3. Min flow in $\mathrm{FM}=200 \mathrm{~L} / \mathrm{s}$ to prevent vacuum condition
4. Initial pump selection $=2 \times 52.2 \mathrm{~kW}(70 \mathrm{hp})($ Duty + Standby $)$

## Alternative 2:

1. Design flow $=500 \mathrm{~L} / \mathrm{s}$; static head $=-12.00 \mathrm{~m} ;$ pump head $=12.89 \mathrm{~m}$ (based on Alt 4 alignment)
2. FM size $=600$ PVC SDR 26
3. Min flow in $\mathrm{FM}=500 \mathrm{~L} /$ s to prevent vacuum condition
4. Initial pump selection $=2 \times 89.5 \mathrm{~kW}(120 \mathrm{hp})($ Duty + Standby $)$

### 3.3 Other Servicing Options

## Multiple Pump Stations

Options to utilize multiple pump stations were considered. However, due to the following issues, the use of multiple pump stations would be neither feasible nor cost effective and therefore, no further consideration was given to their use:

- Increased capital cost for constructing multiple pump stations
- Increased operation and maintenance processes resulting in increased annual operation and maintenance costs
- Operational logistics, programming and reliability of multiple pump stations in series adds unnecessary complexity


## Inverted Siphon

The inverted siphon concept includes constructing a conventional gravity system to the east side of Bench Creek. The creek crossing includes construction of an inverted siphon by directionally drilling either a single or multiple pipes below the creek towards the tie in manhole near 54 Street. This type of system is designed to run full and under pressure. The pressure pipe allows for installation beneath the creek at greater depths, compared to a gravity system, which provides adequate cover from the creek bottom while still tying into the downstream sewer system. The operation of the siphon is highly dependent on the available head to drive flows through the siphon, which in this situation about 3 m minimum is required.

The analysis for this alternative evaluated a single- and multiple-pipe siphon systems. The single pipe siphon includes only one pipe to convey dry weather and wet weather flows. Due to the large difference between the dry weather flow and wet weather flow rates it is not possible to select a pipe size that would meet minimum flow velocities, to avoid sedimentation, during dry weather flow and meet the limitation in head available for wet weather flows. Sedimentation in the pipe would result in decreased hydraulic capacity and potential odour issues. Therefore a single pipe siphon system is not feasible.

A multiple siphon pipe scenario was considered. This option would include a sealed gravity sewer system with an inverted siphon crossing at Bench Creek. The gravity sewer would be sized as per typical sewer systems. An inlet structure, located on the west bank of the creek, would divide flows between the various siphon barrels. A multiple barrel system would convey dry weather flow through a primary barrel with additional barrels used to convey additional wet weather flow. The analysis indicated that a 3 or 4 barrel siphon, pipe sizes ranging from 300 mm to 800 mm outside diameter, is technically feasible however wet weather flow barrels would need to be pumped out post event.

Risks identified during the analysis include:

- Requirement for pumping out the wet weather siphon barrels following wet weather events
- Requirement for interim pumping of the dry weather flow barrels until the service area is fully developed.
- Potential for sedimentation and blockages in the siphon barrels that would reduce the capacity of the siphon system.
- Potential for septic conditions to develop resulting in odour and corrosion issues in sewerage system.
- Potential for air entrapment that would reduce the capacity of the siphon system
- Risks associated with the installation of multiple pipes in close proximity by horizontal directional drilling.

Considering the design, operational and construction risks identified above the inverted siphon design was considered unfeasible and henceforth is not carried forward.

### 3.4 Methods of Construction

New trunk construction has been typically done by open cut trenching; however trenchless methods are becoming more prevalent. Traditional open-cut pipe installation consists of excavating a trench, installation of the pipe and bedding and backfilling the excavated material. The level of effort required is dependent on the required depth of the pipe and the subsequent use of the surface above the pipe. Where alignments predominantly cross farm land, the topsoil will be stripped within the pipeline and working rights-of-ways and protected from degradation as per the requirement of the Provincial Soils Conservation Act.

Within existing developed areas it is necessary to restore the pavement surface to at least its original condition. To minimize the surface restoration requirements, or if there are other utilities in close proximity, it is common to use vertical trenching with workers protected by "trench boxes".

The most common trenchless construction techniques for new trunks are Horizontal Directional Drilling (HDD), Case Bore Augering and Pipe Jacking. HDD is conducted in three steps: the initial augering, a series of back reamings with progressively larger sizes, and the pipe insertion. HDD is normally used with HDPE pipe, with the HDPE pipe fused together prior to installation. HDD is only applicable to forcemain construction. HDD Installation of gravity sewer pipe does not meet specified grade tolerances.

Case Bore Augering is a technique in which a casing pipe (usually steel) is simultaneously inserted while forming a bore from a drive pit to a reception pit, by means of a rotating cutting head. Spoil is removed back to the drive shaft by helical wound auger flights rotating in the steel casing. When the casing pipe is completely installed a carrier pipe is inserted into the casing pipe that acts as external protection to the carrier pipe. The auger machine is installed in pits excavated in to a specified length and width for placing the boring machine on line and grade. Case Bore Augering is proposed for locations where casing is required such as roadway or railway crossings.

Pipe Jacking consists of extracting the existing pipe into a receiving pit while inserting a new carrier pipe from a sending pit. The spacing of the two pits is dependent on the size of the line to be replaced, the materials of the existing and new pipe and existing bedding and backfill. This method is limited to concrete pipe or HDPE lined concrete pipe, and thus would only be suitable for the gravity trunk sections.

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Trenchless construction would be required at major roadway crossings, railway crossing(s), and water bodies (e.g. pond immediately west of 54 Street). Trenchless construction would, in all likelihood, be required at local roadway crossings, pipeline crossings and creek crossings. Portions of the gravity trunk may have to be installed using trenchless construction based on the depth of excavation.

Construction methods for water crossings will depend, in part, on the applicable environmental legislation that is expected to govern these watercourse crossings. For the purposes of this report, construction across these watercourses is assumed to be completed by trenchless methods. Open cut construction would require extensive environmental approvals and it is uncertain if the approvals would be granted. The proposed method of construction, for each alignment, is shown on the drawings. Cost estimates are based on these proposed methods of construction.

### 3.5 Servicing of Future Development Areas

### 3.5.1 West Development Areas

A review of the proposed trunk design with regards to on servicing of the future development areas within the Town and County lands was completed. The purpose of this review was to confirm servicing opportunities for these lands and the most cost effective servicing strategy with regards to this servicing and the trunk design.

Areas 11 and 12, north of Highway 16, between 75 Street and Rodeo Road, would be serviced directly by the new sewer trunk by means of local sanitary sewers connecting to the trunk main at manhole locations.

A contour plan of the future developments Area 22 and Area 23, north of Highway 16, shows a significant rise in the ground profile towards the western limit of the proposed development areas. As such, it is anticipated that installation of the sanitary trunk at minimum depths up to Rodeo Road will allow for gravity servicing of these future development areas towards the proposed trunk main connection at the Rodeo Road on the west boundary of Area 12

Area 13 is a low lying area south of Highway 16 between 70 Street and Rodeo Road. The MSP indicates that Area 13 is to be serviced by a lift station to the new sanitary trunk main. If the pump station servicing option, outlined above, is chosen for the new trunk main design the pump station could be designed such that Area 13 could be gravity fed to the new station eliminating the need for a small lift station for Area 13. Contours show that the low lands of Area 13 are at an elevation of about 914m. Assuming minimum depth and slopes on future sanitary services it is estimated that to service this area by gravity the wet well of the proposed pump station would have to be lowered $2-3 m$. The order of magnitude cost to lower the proposed wet well would be $\$ 150,000$. Based on the size of Area 13, it is estimated that a pump station to service this area would cost in the order of magnitude of $\$ 1.2 \mathrm{M}$.

Per the MSP, the proposed servicing for the future development areas west of Rodeo Road and south of Highway 16 (Areas 18, 19 and 20) includes a gravity sewer running west to east through each of the development areas and connecting to the sanitary trunk main at Rodeo Road. However, while the existing topography indicates that the overall ground profile rises up to an elevation of about 970m at the west most point in Area 20, Area 18 includes lands at elevations as low as 928 m . This elevation is lower than the proposed invert at the upstream end of the proposed sanitary trunk, approximately 930 m .

Assuming the low lands of Area 18 require servicing there are two options to achieve this. The first is to maintain the trunk elevations identified in the options presented in this report and pump Area 18 and the second is to deepen the trunk sufficiently so as to enable a gravity discharge from Area 18.

Based on the size of Area 18, it is estimated that a pump station to service this area would cost in the order of magnitude of $\$ 1.5 \mathrm{M}$. Deepening the trunk is feasible because the ground rises considerably from 75 Street to rodeo Road. Preliminary estimates show that in order to service Area 18 by gravity, some 150 m of pipe would need to be lowered by around 5 m . The order of magnitude cost of this is around $\$ 750,000$, which is considerably less than the pumping alternative.

### 3.5.2 South Development Areas

The lands south of CN right-of-way, from 63 Street to 54 Street, are planned for future commercial/industrial development. It would be preferred to service these future developments to the new sanitary trunk. An accessible connection for these future lands should encourage development by lessening offsite servicing costs. The earlier these lands are developed the sooner the Town can realize a growth in their tax base.







## 4.0 <br> Geotechnical Assessment

A geotechnical assessment was carried out by P. Machibroda Engineering Ltd. (PMEL). The general soil profile for the Edson area consists of silt, sand and clay followed by glacial till then sandstone. Groundwater levels for the Edson area is 2 to 3 meters below existing surface. The full geotechnical desktop study, by PMEL, includes additional detail, included in Appendix B.

Open cut and trenchless construction methods are both feasible in this type of soil. That being said, the presence of large rocks and boulders do pose a risk, particularly for trenchless construction. The presence of groundwater may result in the need for dewatering during construction, particularly on deep open cut sections. Provisions to address groundwater would also reduce productivity for trenchless construction. This may result in delays in schedule and increase in construction cost.

## 5.0 <br> Historical Resources Assessment

### 5.1 Historical Resources Review

Turtle Island Cultural Resource Management Inc. completed and submitted a Statement of Justification (SoJ) for Historical Resources Act requirements. The SoJ did recommend a Historical Resource Impact Assessment for the area surrounding the creek crossing. This may be required as the proposed sewer trunk crosses the same watercourse (downstream) of previously recorded cultural resource sites. In addition, the SoJ also identified the potential for First Nations consultation due to the proximity to known culturally relevant sites. This application (\#004539939) was submitted on November 27, 2013. Additional information in included in Appendix C.

### 5.2 Paleontological Review

Steppe Consulting Inc. completed and submitted a Paleontology Statement of Justification for Historical Resources Act requirements. The Statement of Justification suggests that no further paleontological investigation is required. However, awareness of the possible presence, while considered rare, should be passed on to equipment operators, construction supervisors and environmental monitors. Additional information in included in Appendix C.

### 5.3 Alberta Culture Review

Alberta Culture reviewed the Historic Resource application submission sent on November 27, 2013. To satisfy the clearance requirements a Historical Resource Impact Assessment (HRIA) needs to be completed at the Bench Creek crossing location. This requirement is applicable to all alignment alternatives. This requires that a certified archeologist apply for an archeological assessment permit and dig test pits in the vicinity of the pipeline to confirm the presence of historical artifacts. Should any artifacts be found, a report documenting mitigation measures is to be prepared. If nothing is found, a report stating such is to be prepared. This process may be completed at any time prior to construction. The findings of the report do not expire. Documentation of the response from Alberta Culture are included in Appendix C.

## 6.0 <br> Permitting Approvals

### 6.1 Environment

This section provides an overview of environmental issues and approvals applicable to the future trunk. Applicable environmental legislation/regulatory documentation is included in Appendix D. Appendix D also presents a frame work, including anticipated approval timelines, for each approving agency.

### 6.1.1 Federal Legislation

## Fisheries Act

Any project that has the potential for harmful alteration, disruption or destruction (HADD) of fish habitat would require authorization from the Department of Fisheries and Oceans (DFO) pursuant to the fisheries Act. Should any development encroach on the bed and shore of the water body, or cross the watercourse, a fish habitat assessment and authorization pursuant to the Fisheries Act would be required.

A review of Fisheries and Wildlife Management Information System (FWMIS) database was preformed (November 2013) and the database records show that the following fish species are present in the Bench Creek, Brook stickleback, White sucker, and Lake chub.

The Project involves crossing of Bench Creek and because there is record of fish species in the water body, the work will require notification and submission of an application for approval to DFO. Also, the project involves works listed under DFO's Operational Statements. Mitigation guidelines listed in the Operational Statements should be followed.

## Navigable Waters

The navigable Waters Protection Act (NWPA) is administered in Alberta by Transport Canada. Bench Creek is not considered a navigable water therefore approval under Navigable Waters Protection Act is not required.

## Migratory Birds Convention Act and Species at Risk Act

Environment Canada administers the Migratory Birds Convention Act (MBCA) and the Species at Risk Act (SARA). Those Act provide guidelines for enforcement only; neither the MBCA nor the SARA requires permitting or approvals specific to the project. Although no approvals are required, violation of those Acts may result in penalties.

A timing restriction for vegetation clearing is recommended in accordance with the Act. Nesting and fledging seasons for birds included under both federal and provincial legislations are from March 1 to August 15. This timing restriction incorporates early nesters including owl species and late nesters including some passerines.

### 6.1.2 Provincial Legislation

## Water Act

The Province of Alberta owns all water resources in the province. Alberta's Water Act, administered by Alberta Environment and Sustainable Resources Development (AESRD), is the primary piece of legislation governing the use and management of Alberta's water resources, including water held in permanent and temporary wetlands. Approval under the Water Act would be required to drain and fill any of the wetlands. Compensation for wetland loss would be required under the Wetland Policy. Any crossings of the water body - Bench Creek, must follow the "Code of Practice for Watercourse Crossings."

Pipeline or telecommunication lines crossing the water body are subject to the "Code of Practice for Pipelines and Telecommunications Lines Crossing a Water Body".

For the current project, Alberta Environment needs to be consulted regarding this work and required application submitted.

## Alberta Environmental Protection and Enhancement Act

Management facilities including lagoons and sanitary sewer projects are regulated by Alberta's Environmental Protection and Enhancement Act (EPEA). Construction of these facilities requires approval under EPEA.

## Public Lands Act

The bed and shore of water bodies that are permanent and naturally occurring are owned by the province under the Public Lands Act, administered by AESRD. Where applicable, the province may claim wetlands and/or the water body in the study area. Consultation with AESRD will be required to determine ownership of the wetlands and the water body.

## Wildlife Act

The Alberta Wildlife Act prohibits disturbance to a nest or den of a prescribed wildlife species. Although permitting is not required under the Act, violations of the Act may result in fines. To avoid contravention of the Act, any clearing of trees or wetlands should occur outside the breeding season (April 15 to July 31).

Additional environmental investigations will need to be completed in the detailed design phase to address the following:

- Wetland assessment and compensation
- Impacts to existing tree stands
- Assess impact to wildlife corridors
- Erosion control measures


### 6.1.3 Implementation

## Construction Operations

Environmental protection measures will be required throughout construction. These are the responsibility of the Contractor and will require to be addressed in an Environmental Construction Operations (ECO) plan, as outlined by Alberta Transportation's Environmental Construction Operations (ECO) Plan Framework.

## Erosion Control

Erosion protection is recommended. Temporary erosion prevention practices, will need to be identified in the contractor's ECO Plan and should be applied throughout all work areas on exposed or erodible surfaces.

## Environmental Specifications and Recommendations

Review of aerial photos indicates a possible wetland and undisturbed vegetation impacting Alignment 1. Proceeding with this options will require a wetland assessment, potentially leading to compensation is impacted. Further investigation of vegetation in the area will also be required.

Planning should take into consideration: wetlands (both wooded and herbaceous), large tree stands, some of which form a major wildlife corridor through the area, productive agricultural soils, existing development.

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### 6.2 CN Rail

This section provides an overview of CN Rail requirements for sanitary works that are constructed parallel or crossing their right-of-way. A copy of the Water and Sewer Pipeline Guidelines from CN Rail is included in Appendix E. The following design guidelines were identified during the review of the CN guidelines:

## Specifications required on Plan

- Contents of pipe must be noted.
- Crossing angle to be greater than 45 degrees
- Warning markers required on each side of railway right-of-way
- Direction of flow
- Not required for gravity sewer pipe
- Emergency shut-off valve locations on each side of track.
- Not required for gravity sewer pipe
- Method of installation
- 13.7 m minimum clearance to any bridges, buildings, switches, etc.


## Pipe specifications

- Design Loading - Cooper E80 (TC E-10)
- Type of pipe, wall thickness, and pressures (operating \& max. test) of carrier and casing pipe
- Must be steel cased unless it is a non-pressure (under 700 kPa ) gravity feed pipe (sewer) and then the following applies:
- Concrete pipe as per AREMA and CSA, minimum Class 5.
- Coated corrugated metal pipe as per AREMA and CSA.
- Aluminum pipe is not acceptable
- Casing
- Carrier pipe less than 168.3 mm O.D. - Casing pipe must be at least 50 mm O.D. larger.
- Carrier pipe more than 168.3 mm O.D. - Casing pipe must be at least 75 mm O.D. larger.
- Carrier pipe shall be held clear of the casing pipe by properly designed supports, insulators, or centering devices. - CSA Standard 4.12.3.3 (c)
- Casing must extend the full width of the Railway's core right-of-way and a minimum of 15 m on each side from outside track to accommodate for any future construction.
- Wall Thickness
- Minimum 4.8 mm - unless not protective cost or it is not cathodically protected - add 1.6 mm
- Protective coat or cathodically protected not required for concrete pipe.
- Minimum Depth of Burial
- Below Track
- Mainline, Cased - 1.68m
- Below Right-of-Way
- Cased/Uncased - 0.91m
- Nearest point at which digging can take place
- Started 3.05 m ( 10 feet) from the gauge side of the nearest rail, calculate a slope to the bottom of the proposed pipe at 1.5:1. If a 1.5:1 slope cannot be maintained or more restrictive conditions occur, approved shoring will be required.

The following fees associated with gaining approval from CN were identified:

## Engineering Application Fee

- Basic Engineering Application Fee
- Rush Application
- Additional Review Fee


## Agreement / Easement Fee

- 3m wide x 30m long \$1,850.00

Costs may increase due to location and length requested

## Flagging Protection and Signals Protection during Installation

- Flagging Protection $\$ 825.00$ (dependant on location
- Signals Protection $\$ 375.00$

Additional costs for flagging and signals will be invoiced after completion of project if:

- Time on sire was more than one day for either flagging or signals protection.
- A large number of hours were at overtime rates, i.e. weekend installations.
- 24 hour notice of project cancellation is not received. One additional day of flagging will be invoiced


## Survey and Registration

It is the proponent's responsibility and expense to survey and register an easement document

## Approval Timeline

Review of utility applications typically takes 6-8 weeks. This timeline is not guaranteed as it can be extended due to the nature of the application, volume, time of year, etc.

### 6.3 Alberta Transportation

An alignment along Highway 16 would be subject to approval from Alberta Transportation (AT). AT prefer not to permit service/utility infrastructure within its road right-of-ways when feasible alternatives exist.

A copy Alberta Transportation procedures for placement of underground water and sewer pipelines in the vicinity of transportation facilities is included in Appendix F. The following design guidelines pertinent to this project are identified below:

## Parallel Pipeline

No pipeline right-of way or easement shall be placed less than 30 metres parallel to a highway unless prior approval is obtained from the appropriate Operations Manager.

## Crossing Under Pavement - Method of Construction

The open cut method for pipeline installation at any highway is not permitted.
The crossing of highway and pavement surfaces shall be constructed by boring or jacking methods in such a manner that the road grade is not disturbed.
The proposed method of installation shall be shown on the plan of the crossing attached to the application.

## Minimum Depth of Cover on the Highway or Road Right-of-Way

The minimum depth of cover over the pipeline where it crosses the right-of-way of a highway or a road shall be 2.5 metres for water and 1.4 metres for sewer lines under the lowest point in the cross-section.

## Intersection Angle of Pipeline Crossing of Thoroughfare

The desirable angle of crossing is between 70 and 90 degrees; however other angles may also be accepted in special circumstances.

## Slope of Pipeline Crossing

The pipeline shall be placed from one end to the other with a maximum gradient of 1 in 120.

## Horizontal and Vertical Pipeline Bends

No horizontal and/or vertical pipe bends are permitted throughout the right-of-way and within 30 metres of the right-of-way boundaries of a provincial highway, unless approval is obtained from the appropriate Operations Manager.

## Cased Crossing

Where casing is required, it shall be continuous and inserted by boring or driving or other approved method.

## Diameter of Casing

The diameter of the casing shall be at least 5 centimeters greater (2") than the diameter of the carrier pipe.
An exception to this is steel casing of polyethylene pipe, where the next size diameter of pipe may be used.

## Minimum Length of Casing

The casing shall extend across full width of the highway right-of-way.

## Sealed Casing

The casing shall be satisfactorily sealed to the carrier pipe at both ends.

## Casing Not to Carry Other Utilities

No cables of any kind shall be placed within the casing of any pipeline.

## Bored or Augered Crossing

Casing shall be fitted into a bored or augured hole of such diameter as to provide a snug fit for the casing.

## Boring in Non-Cohesive Soils

Closed boring method shall be used in non-cohesive soil conditions.

## Open Excavation, Material and Equipment Storage

No open excavation shall be constructed, nor shall any material or equipment be deposited or stored any closer than 6 metres of a bridge or earth retaining structure (without special consent of the appropriate Regional Bridge Engineer), and 4 metres from the shoulder break of a highway, or a toe of side slope, whichever distance is greater.

## Backfilling of Open Trenches

The backfilling of all trenches in the highway right-of-way or within 6 metres of bridge pier or earth retaining structure shall be undertaken immediately after the installation has been placed and passed any necessary inspection. Backfill materials shall be thoroughly compacted with mechanical compactors and the owner of the pipeline will be held responsible for any settling in backfill for a period of three years after the completion of the work.

## Waste Material

All waste material shall be removed and all disturbed areas shall be leveled and trimmed in approved manner and re-seeded where necessary to restore the right-of-way to at least as good as original or better conditions.

## Work in the Median

No work shall be undertaken in the median of a divided highway unless approved by the appropriate Operations Manager.

## Water Lines - Construction Materials

A heavy wall continuous steel or heavy wall continuous P.E. pipe shall be used for uncased water lines located beneath the road.

Should a cased plastic pipe be used it must be installed in an outer continuous casing and adequately supported at the point where it leaves the casing in order to prevent sheering.

## Manholes

Manholes located within the highway right-of-way shall be placed flush with the adjacent ground.

## Manholes in the Roadway Side Slopes

No manholes shall be placed in the side slopes unless special approval is obtained from the appropriate Operations Manager.

## Manholes in the Median

No manholes shall be located within the centre median of multi-lane highways unless a special permit is obtained from the appropriate Operations Manager.

## Construction Safety

All reasonable precautions shall be undertaken during construction to protect and safeguard public safety and property owners. This includes barricading, signing and flag persons as required, to protect and safeguard the lives and property of the travelling public and adjacent property owners. At no time shall the highway or public roadway be closed to traffic. Where normal traffic patterns are to be interrupted due to ditching or other operations, prior approval must be first obtained. Suitable signs shall be erected and if required, a flag person(s) shall be used to direct traffic through the disruption area as approved by the appropriate Operations Manager.

No work is to be conducted during darkness or when there is reduced visibility.

## Construction Signing

Contractors are to meet the requirements of the latest edition of the Traffic Accommodation in Work Zones 2008 (1st Edition) manual published by Alberta Transportation. The manual is available on the internet at www.transportation.alberta.ca/3815.htm .

If the signing requirements are not met, the appropriate Operations Manager or his representatives have the right to halt all construction until proper signing is erected. The signs are to be removed immediately following construction completion.

## Approval Timeline

Applications for crossing of highways under the jurisdiction of Alberta Transportation by sewer and/or water pipelines shall be submitted to the appropriate Regional Office.

The applicant shall allow minimum 30 working days for the application processing.

## 7.0 <br> Land Assessment / Acquisition

An assessment of the land value for private lands required for both permanent easements and temporary workspaces was completed along all alignment alternatives. The complete Land Assessment report is included in Appendix G. Land values were included in the cost estimation for each alignment.

Easement and work space requirements were based on the following:

- 8 m right-of-way for section line where the sewer is not within public roads or existing right-of-ways.
- workspace width of 30 m for areas of open cut installation
- workspace width of 15 m for areas of trenchless installation

Easement and workspace requirements are illustrated on each alignment figure. The following table summarizes the total right-of-way and total workspace requirements and associated cost for land acquisition for each alignment.

Table 7.1: Land Requirements

| Alignment | Estimate No. of <br> Parcels <br> Impacted | Estimated <br> Total R/W | Estimated <br> Total Work <br> Space | Estimated <br> Total Cost |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 22 | 2.957 ac | 26.650 ac | $\$ 210,059$ |
| 2 | 20 | 5.828 ac | 25.623 ac | $\$ 242,152$ |
| 3 | 18 | 0 | 17.560 ac | $\$ 116,322$ |
| 4 | 26 | 0.398 ac | 18.934 ac | $\$ 154,435$ |

## 8.0

## Option Evaluation and Recommendation

### 8.1 Capital Cost Estimates

Capital cost estimates were developed for the proposed system as described in the previous sections of the report. The capital costs are based on the following components and design parameters:

- Gravity sewer trunk for Alternative 1 flows, Alignments 1 through 4
- Gravity sewer trunk for Alternative 2 flows, Alignments 1 through 4
- Gravity sewer trunk, pump station and forcemain for Alternative 1 flows, Alignments 1 through 4
- Gravity sewer trunk, pump station and forcemain for Alternative 1 flows, Alignments 1 through 4

Cost estimates are provided for each design option in Appendix H. Details for the cost estimates for the pump stations are also included in Appendix H. Table 8.1 is a summary the capital costs for the above design options.

Table 8.1: Capital Cost Summary

| Alignment | Alternative 1 |  | Alternative 2 |  |
| :---: | :---: | ---: | ---: | ---: |
|  | Gravity | PS \& FM | Gravity | PS \& FM |
| 1 | $\$ 13,052,483$ | $\$ 8,259,446$ | $\$ 16,277,090$ | $\$ 11,474,592$ |
| 2 | $\$ 13,522,312$ | $\$ 10,874,253$ | $\$ 15,630,231$ | $\$ 14,299,330$ |
| 3 | $\$ 16,190,799$ | $\$ 8,911,215$ | $\$ 19,946,446$ | $\$ 12,185,968$ |
| 4 | $\$ 13,407,490$ | $\$ 9,559,544$ | $\$ 16,836,322$ | $\$ 13,042,816$ |

The above costs do include:

- Capital construction costs
- Land acquisition
- Contingency
- Engineering and construction administration

The above costs do not include:

- Annual operation and maintenance costs
- Risk contingency

Total Overall Project costs are included later in this section.

### 8.2 Evaluation

### 8.2.1 Life Cycle Costs

Life cycle costs were developed for each alignment, flow alternative and servicing option (gravity sewer or pump station and forcemain to assess the cost effectiveness of each option by taking account of operational expenditure in addition to the capital costs over a 30 year service period (2015 to 2045). This analysis included generating an illustration of the following indicators: Total Annual Costs, Total Annual Cash Flow, and Net Present Value (2014\$). For the purpose of this illustration an interest rate of $6 \%$ was used in conjunction with a stable inflation rate of $3 \%$ to estimate the overall net present worth of each options. Annual operating costs and maintenance and upgrading costs summarized below.

## Annual Operating Costs

The annual energy consumption for the pump station were estimated based on the projected average dry weather flow, the total dynamic head and the overall pump / motor efficiency of $75 \%$ and $95 \%$, respectively.

Other operating costs for the pump station include:

- Town labour costs and miscellaneous supplies of $\$ 25,000$
- Pump operating efficiency of $75 \%$
- Pump motor efficiency of $95 \%$
- Annual energy cost of $\$ 0.15 / \mathrm{kWH}$
- Pipe (gravity or forcemain) operation and maintenance of $\$ 1.00 / \mathrm{m}$.


## Maintenance and Upgrading Costs

The following maintenance and upgrading costs are projected for the pump station:

- Pump Replacement every 15 years as well as miscellaneous station upgrades. Based on 2 pumps (Duty \& Stand-by) at \$80,000 each plus \$500,000 for installation and miscellaneous upgrades, the total costs would be in the order of $\$ 660,000$ (2014\$).

Estimated present worth of operation and maintenance activities for each option is shown in Table 8.2. Further details for each option is included in Appendix H.

Table 8.2: Estimated Operation and Maintenance

| Alignment | Alternative 1 |  | Alternative 2 |  |
| :---: | ---: | ---: | ---: | ---: |
|  | Gravity |  | PS \& FM | Gravity |
| 1 | $\$ 98,561$ | $\$ 1,342,939$ | $\$$ P \& FM |  |
| 2 | $\$ 125,444$ | $\$ 1,369,803$ | $\$ 98,561$ | $\$ 1,386,853$ |
| 3 | $\$ 104,697$ | $\$ 1,349,075$ | $\$ 125,444$ | $\$ 1,413,716$ |
| 4 | $\$ 116,450$ | $\$ 1,360,828$ | $\$ 104,697$ | $\$ 1,392,989$ |

### 8.2.2 Risk Assessment

This section considers the potential risks associated with each of the four alignments, for both gravity and pumped options, as described in Section 3.0. The purpose of this is to provide an evaluation tool to facilitate in the selection of the preferred/recommended alignment.

In order to assess the severity of the risks, each risk item has been assigned a score related to the magnitude/impact (Table 8.3) of the risk and a score related to the likelihood of occurrence (Table 8.4). A risk severity score is then determined by multiplying the magnitude by the probability. The options with the high overall scores are considered less favorable than those with lower scores. The following steps were taken to measure the overall impact of each risk item:

1. Identify the risk / concern
2. Identify the consequence of the risk
3. Determine the magnitude of the consequence if the risk factor is encountered (i.e. Dollar value) using Table 8.3.
4. Determine the likelihood of the risk occurring (i.e. Probability) using Table 8.4
5. Determine the risk severity score, Table 8.5 , by multiplying the magnitude by the likelihood.
6. Calculate the risk contingency to be accounted for in the overall cost by multiplying the cost impact by the probability.

The amount of risk contingency was calculated for each option by multiplying the cost of impact by probability.

Table 8.3: Magnitude of Risk Factor

| Ratings | Magnitude |  | Cost Impact |
| :---: | :---: | :---: | :---: |
| Devastating (1000) | People <br> Environment <br> Financial \& Schedule | Fatality <br> Permanent Environmental Damage, Effects Widespread <br> Costs > Total Project Cost | \$15,000,000 |
| Serious (300) | People <br> Environment <br> Financial \& Schedule | Disabling injury, Long Term Health Impact Severe Environmental Damage, Extensive Costs and/or Delay in Schedule | \$6,000,000 |
| $\begin{aligned} & \text { High } \\ & (100) \end{aligned}$ | People <br> Environment <br> Financial \& Schedule | Lost Time Injury <br> Moderate Environmental Damage, Effects Widespread Considerable Effect on Cost and/or Schedule | \$1,500,000 |
| Moderate (50) | People <br> Environment <br> Financial \& Schedule | Medical Aid Injury <br> Moderate Environmental Damage, Localized <br> Moderate Effect on Cost and/or Schedule | \$600,000 |
| $\begin{aligned} & \text { Low } \\ & \text { (10) } \end{aligned}$ | People Environment Financial \& Schedule | First Aid Injury <br> Minor Environmental Effect, localized <br> Small Effect on Cost and/or Brief Interruption | \$150,000 |
| Very Low <br> (1) | People <br> Environment <br> Financial \& Schedule | Minor Injury <br> Negligible Environmental Effect <br> Trivial Effect on Cost and Schedule | \$15,000 |

Table 8.4: Probability of Risk Factor Occurring During Project Lifespan

| Probability | Description | Ratings |
| :--- | :---: | :---: |
| $>80 \%$ | Highly Probable | 200 |
| $50 \%$ to $80 \%$ | Probable | 100 |
| $20 \%$ to $50 \%$ | Somewhat Likely | 50 |
| $2.0 \%$ to $20 \%$ | Improbable | 25 |
| $0.01 \%$ to $2.0 \%$ | Remote | 10 |
| $<0.01 \%$ | Extremely Remote | 1 |

Engineering and Land Services

Table 8.5: Risk Severity

| Risk Severity | Description | Explanation |
| :---: | :---: | :---: |
| <=100 | Minor | Risk is Negligible |
| 101 -> 1250 | Acceptable | Some risk control may be justified |
| 1251 ->5000 | Significant | Some risk control is required |
| 5001 ->10000 | Substantial | Must implement extensive risk controls before continuing |
| 10001 ->25000 | Critical | Risk must be eliminated before continuing |
| > 25001 | Intolerable | Cannot accept risk. All activities must stop until risk is avoided |

The risk assessment evaluated each risk item based on magnitude/impact and probability for each alignment and servicing option. The detailed risk assessments are included in Appendix I. A summary of the total risk severity and risk contingency is shown in Table 8.6, below.

Table 8.6: Risk Severity and Risk Contingency

| Alignment | Gravity Option |  | PS \& FM Option |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Risk Severity | Risk Contingency | Risk Severity | Risk Contingency |
| 1 | 49251 | $\$ 6,960,150$ | 10251 | $\$ 933,150$ |
| 2 | 26001 | $\$ 4,440,750$ | 501 | $\$ 126,750$ |
| 3 | 34000 | $\$ 5,265,000$ | 8200 | $\$ 993,000$ |
| 4 | 32251 | $\$ 5,010,150$ | 5301 | $\$ 621,150$ |

Review of the risk assessment included the following findings:

- Pump station and forcemain options carry significantly less risk than gravity sewer options.
- The amount of ground cover at the Bench Creek crossing is inadequate for gravity sewer options. There is significant risk of environmental damage resulting potential high costs due to related construction issues and fines should environmental damage occur.
- Installation of a forcemain pipe allows for a much deeper crossing of the creek as the system operates as a pressure system and does not need to be installed at a specified positive grade.
- There is a significant risk associated to deep trenchless installations for the gravity sewer options. The potential for encountering obstacles could result in significant costs to rescue construction equipment and project delays.
- The forcemain is a pressure system that can be installed at minimum depths and open cut methods. Any obstacles encountered could be dealt with much more easily.
- Work adjacent to Highway 16 needs to consider protection of existing infrastructure, including an existing watermain and roadway. Extra consideration would need to be accounted for protection of existing infrastructure and persons.
- Accommodations for traffic and businesses needs to be considered for alignment routed through developed areas.

One risk that was not addressed in the above evaluation is the risk of not receiving approval from Alberta Transportation for the installation of the pipe within the Highway 16 corridor. This risk is applicable to Alignment 1, 3 and 4. If approval is not received from Alberta Transportation Alignment 2 would be the default option as it is located outside of the highway right of way.

### 8.2.3 Present Worth Evaluation

In order to evaluate the most cost effective option, a present worth evaluation was completed accounting for capital costs, operating and maintenance cost as well as construction contingency and risk contingency. A detailed spreadsheet is presented in Appendix H and the results are summarized in Table 8.7.

At this stage of the project the alignment and risk are reasonably well established. Because of this, the construction contingency (not including risk contingency), for planning and estimating errors and omissions, minor price fluctuations due to the rural location, and design developments and changes within the scope, has been reduce from $35 \%$ as per the MSP to $20 \%$.

Table 8.7: Present Worth of the Total Overall Project Cost

| Alignment | Alternative 1 |  | Alternative 2 |  |
| :--- | :---: | :---: | :---: | :---: |
|  | Gravity | PS \& FM | Gravity | PS \& FM |
| 1 | $\$ 20,111,193$ | $\$ 10,535,535$ | $\$ 23,335,801$ | $\$ 13,794,595$ |
| 2 | $\$ 18,088,506$ | $\$ 12,370,806$ | $\$ 20,196,426$ | $\$ 15,839,797$ |
| 3 | $\$ 21,560,496$ | $\$ 11,253,290$ | $\$ 45,027,153$ | $\$ 14,571,956$ |
| 4 | $\$ 18,534,090$ | $\$ 11,541,522$ | $\$ 21,962,922$ | $\$ 15,068,708$ |

The above costs include the following:

- Costs are based on 2014 dollars
- A contingency of $20 \%$ was applied for trunk sewer, forcemain pipe and manhole installations
- Pump station costs include a $35 \%$ contingency. The larger contingency for the pump station is required due to uncertainties regarding the pump station location and corresponding restrictions that may be placed on underground construction methods.
- Land acquisition costs, as per Section 7.0
- Engineering and construction administration, 10\%.
- Allowance for permits and approvals, $2 \%$

Table 8.7 shows using a pump station and forcemain to be the most cost effective option for all alignment options. Alignment 1 has the lowest cost at $\$ 13,794,595$ (Alternative 2 flows). Alignment 2 is the most expensive at $\$ 15,839,797$ (Alternative 2 flows) however the difference is less than the contingency used in the estimates.

Although Alignment 1 has the lowest cost, it also has the highest amount of risk, particularly associated with regulatory approvals (AT and Environmental) and the requirement for R/W through private lands. In particular the crossing of Bench Creek is considered highly sensitive. It also does not address the servicing of the future industrial/commercial land to the south of town between 63 Street and 54 Street.

Alignment 2, is the most expensive option (marginally). However, it has the lowest risk because the majority of the alignment is within future development lands and existing road allowance. It also provides accessible servicing for the future industrial/commercial lands between 63 Street and 54 Street.

Edson West Sanitary Trunk Main

Alignments 3 and 4 rely heavily on utilizing Alberta Transportation R/W for large sections of the alignments. Initial discussions with AT have indicated this is not preferred, particularly if feasible alternatives exist. Alignment 3 also runs through a significant part of the town. Construction of this could cause considerable disruption and would also carry significant risk. Alignment 3, also limits servicing opportunities for the future development area south of the town.

### 8.3 Recommended Option

Although Alignment 2 has marginally higher costs than the alternatives, it has significantly less risk and as well, provides service for the future development area to the south of the town. Alignment 2 is therefore the recommended alignment alternative.

Due to the considerably high costs and risk associated with gravity servicing, it is recommended that the outfall is constructed using a pump station and forcemain to discharge the flow from the vicinity of 75 Street and Highway 16.

The preliminary design of this option is shown in Figure 3.2. As the recommended option includes a forcemain an alternate alignment for the part parallel to Highway 16 and across a private lot and the tree farm east of 74 Street was identified. This may require trenchless installation and is preferred because it significantly reduces the total area of R/W required across this particular lot. For detailed preliminary design drawings refer to Figures 8.1 to 8.18.


Horz 0.150
PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2
$\qquad$


FIGURE 8.1
 EX. GROUND


935

930

925

$\begin{array}{lllll}H O R Z & 0 & 10 & 20 & 30\end{array} \quad 40 m$ EDSON WEST SANITARY TRUNK MAIN
PREFERRED PRELIMINARY ALIGNMENT
1:200
$\qquad$


GRAVITY TRUNK
FIGURE 8.2
EMrom


错Edson


EDSON WEST SANITARY TRUNK MAIN $\qquad$


GRAVITY TRUNK
PREFERRED PRELIMINARY ALIGNMENT
ALIGNMENT 2
EGEND- forcemain


FIGURE 8.3 $\mathrm{A}=-2$

PERMANENT R.O.W


EDSON WEST SANITARY TRUNK MAIN LEGEND
 - GRavity trunk

FIGURE 8.4
PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2 $\qquad$




EDSON WEST SANITARY TRUNK MAIN $\qquad$ FIGURE 8.5
PREFERRED PRELIMINARY ALIGNMENT
ALIGNMENT 2


$\qquad$ FIGURE 8.7

PERMANENT R.O.W.



EDSON WEST SANITARY TRUNK MAIN $\qquad$ - GRAVITY TRUI

FIGURE 8.8
PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2


EDSON WEST SANITARY TRUNK MAIN
PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2

FIGURE 8.9

$\qquad$ FIGURE 8.10
PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2



| LEGEND | GRAVITY TRUNK |
| :---: | :---: |
|  |  |
|  | EX. GROUND |
|  | WORKSPACE |

FIGURE 8.11 PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2



EDSON WEST SANITARY TRUNK MAIN
PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2
$\qquad$ - gRavity tru

FIGURE 8.13



舞Edson

$\qquad$ sемит тrum FIGURE 8.14
PREFERRED PRELIMINARY ALIGNMENT
ALIGNMENT 2


PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2
 - GRAVITY TRU
 WORKSPACE


Permanent r.o.w


$\qquad$ FIGURE 8.16
EDSON WEST SANITARY TRUNK MAIN
PREFERRED PRELIMINARY ALIGNMENT
ALIGNMENT 2




VERT
1:200


EDSON WEST SANITARY TRUNK MAIN
PREFERRED PRELIMINARY ALIGNMENT ALIGNMENT 2

LEGEND


- gravity trunk

FIGURE 8.18

and Land Services

## 9.0 <br> Implementation Plan

### 9.1 Introduction

This section presents an overview of the next steps required to implement the sanitary sewer system. It is understood that the Town would like to commence with the detailed design and construction of the recommended system as soon as possible.

### 9.2 Regulatory Approvals / Considerations

A review of applicable federal and provincial regulations and discussions with regulators identified the following regulatory issues. These will have to be considered during the detailed design and construction phases of this project.

## Federal Government

## Department of Fisheries and Oceans

- The Project involves crossing of Bench Creek and because there is record of fish species in the water body, the work will require notification and submission of an application for approval to DFO. Also, the project involves works listed under DFO's Operational Statements. Mitigation guidelines listed in the Operational Statements should be followed.


## Migratory Birds Convention Act

- Although no approvals are required, a timing restriction for vegetation clearing is recommended in accordance with the Act. Nesting and fledging seasons for birds included under both federal and provincial legislations are from March 1 to August 15.


## Provincial Government

## Water Act

- Crossing of Bench Creek must follow the "Code of Practice for Watercourse Crossings.
- Alberta Environment needs to be consulted regarding this work


## Environmental Protection and Enhancement Act (EPEA)

- Construction of the sewer trunk will require approval under EPEA.


## Public Lands Act

- Crossing of Bench Creek may require a License of Occupation from AESRD under the Public Lands Act; need to contact AESRD during detailed design


## Wildlife Act

- Any clearing of trees or wetlands should occur outside the breeding season (April 15 to July 31)
- No permitting or approvals is required under this act.


### 9.3 Right-of-Way Acquisition

The recommended alignment requires both permanent right-of-way and temporary working easements on up to 20 parcels of land. Upon approval to proceed with detailed design of the recommended design, land acquisition activities should commence. Land acquisition would include the following tasks:

- Upon approval, engage landowners affected by the alignment to perform an initial consultation and acquire written consent to conduct required surveys on the property
- Upon confirmation of the R/W requirements and receipt of individual ownership plans prepared per parcel of land impacted, prepare valuations and offers for each affected parcel
- Prepare Utility Right-of-Way agreements
- Engage affected landowners and negotiate the agreements with the intent to acquire voluntary approval, execute and register against Title accordingly
- Prepare and update project tracking reports outlining any conditions of construction and compensation requirements per parcel


### 9.4 Crossing Agreements

The proposed sewer pipe crosses a CN rail line, Highway 16 and several oil / gas pipeline R/W's. Crossing agreements will need to be obtained for each. The pipeline companies will need to be contacted early in the detailed design phase of the project to identify any site specific conditions that would apply to this project. The following crossings have been identified for the recommended Alignment 2:

- AT approval for the Highway 16 crossing and any sections within 30 m of the highway right-of-way.
- CN Rail track crossing at 63 Street.
- 1050psi ATCO High Pressure Gas pipeline and Yellowhead Gas crossing located north of Hwy 16 on the east side of Rodeo Road north of Hwy 16.
- Yellowhead Gas crossing found near the SE corner of $1 / 4$ Sec 18-53-17-W5 along Hwy 16.
- 30psi ATCO Gas distribution line running along the eastbound lanes of Hwy 16 in the north ditch right where Hwy 16 splits off east of 74 Street. This looks to feed McPhee Construction Ltd and others on the south side of Hwy 16.
- Yellowhead Gas, Conserve Oil and Telus lines run along the government road allowance from 63 street to 54 street parallel to Alignment 2.


### 9.5 Geotechnical Investigation

On acceptance of the recommended Alignment 2, a thorough geotechnical investigation will be carried out. The geotechnical investigation will include a comprehensive borehole investigation to evaluate soil and groundwater conditions. This will aid development of the detailed design, including refining the identification of appropriate methods of construction.

## 10.0 <br> Conclusions and Recommendations

### 10.1 Conclusions

## 1. Previous Studies

The ASP states that the extension of the sanitary trunk is not economically feasible to service future development areas within the County. This statement is not support by the Town.

Alberta Transportation has future plans to construct a bypass from the east side of the Town that reconnects to the existing highway between 75 Street and Rodeo Road. The schedule for construction of the by-pass is uncertain at this time. However, the fact that it is planned, restricts any opportunity to install the proposed sewer pipe along the south side of the Highway 16 corridor. It is however anticipated that the proposed sewer will not interfere or impact the construction of the future by-pass as long as the sewer is not installed within the lands allocated for the bypass interchange.

## 2. Design Flows

The calculated peak wet weather flow from the existing development upstream of 70 Street appears high relative to the service area. Without additional background information a design flow from this development cannot be confirmed at this time. It is recommended that additional analysis be completed during detailed design.

During the review of the model flows it was identified that the timing of the peak flow from the future development area and existing development, from the proposed 70 Street connection, are slightly offset from each other. The separation is too close and without supporting information it is risky to completely rule out the potential for overlap. Design flows will need to be confirmed during detailed design prior to finalizing the sizing of pipes and other infrastructure.

Design flows have been prepare for two Alternatives. Alternative 1 only includes flows from existing and future developments within the Town limits. Alternative 2 includes flows from existing and future development form both the Town and County.

## 3. Utilities

A number of existing utilities are crossed for each alignment, including Telus, ATCO Gas, ATCO Pipelines, and Yellowhead Gas. Crossing agreements will be required at each crossing, however it is anticipated that obtaining these agreements will be straight forward.

## 4. Historical Resources

A Statement for Justification for Historical Resources and Paleontology was submitted to Alberta Culture for review. The Historical Resources review identified previous sites of significance along Bench Creek upstream of the proposed construction work. The document suggests that Alberta Culture may set a requirement for First Nations consultation for work in this area.

The Statement for Justification for Paleontology did not identify any concerns with the construction of the sanitary trunk line and suggested that no additional paleontology investigation is required.

## 5. R/W Assessment

A right-of-way assessment was completed for each alignment. The assessment included a valuation for acquiring a permanent easement and temporary workspace, as required.

## 6. Desktop Geotechnical

The general soil profile for the Edson area consists of silt, sand and clay followed by glacial till then sandstone. Groundwater levels for the Edson area is 2 to 3 meters below existing surface. The high water level will impact the productivity and cost of construction, particularly any deep trenchless installation

## 7. Gravity Sewer

The topography significantly impacts the ability to service by gravity. Although there is significant elevation difference from Rodeo Road, 935 m , and 54 Street, 907 m , the grade drop is not constant along the project length. From west to east, there is a significant drop in elevation from Rodeo Road to east of 75 Street, 935 m to 919 m . Continuing east of 75 street the ground profile reaches an elevations near 925 m , near 72 Street, before falling to 911 m with shallow grades towards 54 Street. A gravity sewer would be installed at steep grades up to 75 Street. From here it would be installed at shallow grades and large depths, up to 12 m towards 70 Street. This would require trenchless installation methods that are expensive and risky. Although much of the section downstream of 70 Street would be relatively shallow, the downstream tie in constraint at 54 Street presents a significant amount of risk with imposing limited cover at the Bench Creek Crossing. This presents significant risk during both construction and operation.

## 8. Pump Station and Forcemain

A pump station design option would include a pump station located at 75 Street that would convey sewage through a forcemain to 54 Street. The forcemain can be installed at minimum depths along the majority of the alignment. At the creek crossing the forcemain can be installed at greater depths to ensure adequate cover. The installation across Bench Creek can be completed using horizontal directional drilling to further reduce impact to the creek and surrounding area. This option has less cost and risk than a gravity sewer option.

## 9. CN Rail Crossings

The design of CN Rail crossings and sections where pipe is placed parallel to the rail immediately adjacent to CN right-of-way, the sewer pipeline will have to meet the requirements outlined by CN for water and sewer pipeline crossings. This will need to be completed during the detail design phase.

## 10. Alberta Transportation Approval

The risk of not receiving approval from Alberta Transportation for the installation of the pipe within the Highway 16 corridor is applicable to Alignment 1, 3 and 4. If approval is not received from Alberta Transportation Alignment 2 would be the default option as it is located outside of the highway right of way.

## 11. Preferred Alignment/Design

The preferred overall design concept includes a gravity sewer to a pump station near 75 Street and a forcemain to 54 Street. The preferred alignment is Alignment 2. The preferred design concept has the following advantages:

- By utilizing a pump station and forcemain the risk associated with the Bench Creek Crossing is significantly reduced as compared to a gravity system as the pipe may be installed at greater depth since it does not require installation at a specified grade.
- Installation of the forcemain also allows for installation at shallower depths than a gravity system. This allows for open cut installation which is less expensive and carries less construction risk.
- Alignment 2 carries the least amount of risk.
- Alignment 2 is the most expensive option however the difference compared to the least expensive option is marginal.
- Alignment 2 provides accessible servicing for future industrial/commercial developments between 63 Street and 54 Street.


### 10.2 Recommendations

1. Ultimate design flow rates, including from future Town and County developments and flow diversion from 70 Street, should be confirmed to ensure proper sizing of piping and other infrastructure.
2. Alignment 2 with a pump station and forcemain is the recommended design option to convey flows to the existing trunk at 54 Street.
3. Implement the implementation plan including:

- A geotechnical investigation to identify soil conditions should commence at the outset of detailed design.
- Prepare and submit applications to environmental agencies
- Land acquisition activities should commence at the outset of detailed design.
- Submit and AT permit application for work within R/W
- Submit AT and CN crossing applications early


## Appendix A <br> Flow Calculations

Table A-1
TOWN OF EDSON
WEST SANITARY TRUNK MAIN
FUTURE FLOWS - TOWN LIMITS ONLY
JAMES KERCHER


| FROM M.H. | $\begin{aligned} & \text { то } \\ & \text { м.Н. } \end{aligned}$ | RES. AREA |  | POPULATION | SUMPOPULATION | COMM. AREA |  | AVERAGE FLOW (RES.) (L/s) | $\begin{array}{\|c\|} \hline \text { PEAK } \\ \text { FACTOR } \\ \text { (RES) } \end{array}$ | AVERAGEFLOW(COM.) (L/s) | PEAK <br> FACTOR (COM) | $\begin{gathered} \text { l/I. } \\ (\mathrm{L} / \mathrm{s}) \end{gathered}$ | $\begin{gathered} \hline \text { DESIGN } \\ Q \\ \mathrm{~L} / \mathrm{s} \\ \hline \end{gathered}$ | $\begin{gathered} \text { DESIGN } \\ 86 \% \text { Q } \\ \text { L/s } \\ \hline \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | ADDED | TOTAL |  |  | ADDED | TOTAL |  |  |  |  |  |  |  |
|  |  | Ha | Ha |  |  | Ha | Ha |  |  |  |  |  |  |  |
| AREA11 | 75 STREET | 20.00 | 20.00 | 500 | 500 | 0.00 | 0.00 | 2.17 | 2.79 | 0.00 | 3.00 | 5.60 | 11.6 | 13.5 |
| AREA12 | 75 STREET | 0.00 | 0.00 | 0 | 0 | 83.30 | 83.30 | 0.00 | 0.00 | 13.11 | 3.00 | 4.17 | 43.5 | 50.6 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| AREA13 | 75 STREET | 0.00 | 0.00 | 0 | 0 | 116.30 | 116.30 | 0.00 | 0.00 | 18.31 | 3.00 | 5.82 | 60.7 | 70.6 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 75 STREET | 70 STREET | 0.00 | 20.00 | 0 | 500 | 0.00 | 199.60 | 0.00 | 2.79 | 31.42 | 3.00 | 15.58 | 109.8 | 127.7 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

PROPOSED DESIGN PARAMETERS (based on the 2009 Sanitary Sewer Master Plan \& Town standards):
AVERAGE RESIDENTIAL SEWAGE FLOW =
COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL SEWAGE FLOW =
RESIDENTIAL INFLOW / INFILTRATION =
COMM., IND., INST. INFLOW / INFILTRATION =
$3600 \mathrm{~L} / \mathrm{Ha}$ /day
$0.28 \mathrm{~L} / \mathrm{s} / \mathrm{ha}$
$0.05 \mathrm{~L} / \mathrm{s} / \mathrm{ha}$
PEAKING FACTOR (COM./IND.) $=3.0$
REQUIRED FLOW $=86 \%$ OF DESIGN FLOW
Manning's $n=0.013$
$\mathrm{MIN} \mathrm{v}=0.6 \mathrm{~m} / \mathrm{s}$

## Table A-2

TOWN OF EDSON
WEST SANITARY TRUNK MAIN
FUTURE FLOWS - TOWN LIMITS AND COUNTY
JAMES KERCHER

| Development | Population | Res. Area | Comm./Ind. Area |
| :--- | :---: | :---: | :---: |
| Area 11 | 500 | 20 | 0.00 |
| Area 12 | 0 | 0 | 83.30 |
| Area 13 | 0 | 0 | 116.30 |
| Area 18 | 0 | 0 | 86.40 |
| Area 19 | 0 | 0 | 70.10 |
| Area 20 | 0 | 0 | 113.80 |
| Area 21 | 460 | 11.5 | 0.00 |
| Area 22 | 0 | 0 | 233.20 |
| Area 23 | 0 | 0 | 96.50 |


| FROM M.H. | $\begin{aligned} & \text { TO } \\ & \text { M.Н. } \end{aligned}$ | RES. AREA |  | ADDED <br> POPULATION | $\begin{array}{\|c} \text { SUM } \\ \text { POPULATION } \end{array}$ | COMM. AREA |  | $\begin{aligned} & \hline \text { AVERAGE } \\ & \text { FLOW } \\ & \text { (RES.) (L/s) } \end{aligned}$ | PEAKFACTOR(RES) | $\begin{aligned} & \text { AVERAGE } \\ & \text { FLOW } \\ & \text { (COM.) (L/s) } \end{aligned}$ | PEAK FACTOR (COM) | $\begin{gathered} 1 / I . \\ (\mathrm{L} / \mathrm{s}) \end{gathered}$ | $\begin{gathered} \hline \text { DESIGN } \\ Q \\ \mathrm{~L} / \mathrm{s} \\ \hline \end{gathered}$ | $\begin{gathered} \hline \text { DESIGN } \\ \text { Q / 86\% } \\ \text { L/s } \\ \hline \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\frac{\text { ADDED }}{\mathrm{Ha}}$ | $\frac{\text { TOTAL }}{\mathrm{Ha}}$ |  |  | $\begin{gathered} \hline \text { ADDED } \\ \hline \mathrm{Ha} \end{gathered}$ | $\begin{gathered} \hline \text { TOTAL } \\ \hline \mathrm{Ha} \\ \hline \end{gathered}$ |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| AREA 21 | AREA 22 | 11.50 | 11.50 | 460 | 460 | 0.00 | 0.00 | 2.00 | 2.81 | 0.00 | 3.00 | 3.22 | 8.8 | 10.3 |
| AREA 22 | AREA 23 | 0.00 | 11.50 | 0 | 460 | 233.20 | 233.20 | 2.00 | 2.81 | 36.71 | 3.00 | 14.88 | 130.6 | 151.9 |
| AREA 23 | AREA 12 | 0.00 | 11.50 | 0 | 460 | 96.50 | 329.70 | 2.00 | 2.81 | 51.90 | 3.00 | 19.71 | 181.0 | 210.5 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| AREA 20 | AREA 19 | 0.00 | 0.00 | 0 | 0 | 113.80 | 113.80 | 0.00 | 0.00 | 17.91 | 3.00 | 5.69 | 59.4 | 69.1 |
| AREA 19 | AREA 18 | 0.00 | 0.00 | 0 | 0 | 70.10 | 183.90 | 0.00 | 0.00 | 28.95 | 3.00 | 9.20 | 96.0 | 111.7 |
| AREA 18 | AREA 12 | 0.00 | 0.00 | 0 | 0 | 86.40 | 270.30 | 0.00 | 0.00 | 42.55 | 3.00 | 13.52 | 141.2 | 164.1 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| AREA 12 | 75 STREET | 0.00 | 11.50 | 0 | 460 | 83.30 | 683.30 | 2.00 | 2.81 | 107.56 | 3.00 | 37.39 | 365.7 | 425.2 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| AREA 11 | 75 STREET | 20.00 | 20.00 | 500 | 500 | 0.00 | 0.00 | 2.17 | 2.79 | 0.00 | 3.00 | 5.60 | 11.6 | 13.5 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| AREA 13 | 75 STREET | 0.00 | 0.00 | 0 | 0 | 116.30 | 116.30 | 0.00 | 0.00 | 18.31 | 3.00 | 5.82 | 60.7 | 70.6 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 75 STREET | 70 STREET | 0.00 | 31.50 | 0 | 960 | 0.00 | 799.60 | 4.17 | 2.61 | 125.86 | 3.00 | 48.80 | 437.3 | 508.4 |

PROPOSED DESIGN PARAMETERS (based on the 2009 Sanitary Sewer Master Plan \& Town standards):
AVERAGE RESIDENTIAL SEWAGE FLOW
COMMERCIAL INDUSTRIAL AND INSTITUTIONAL SEWAGE FLOW
RESIDENTIAL INFLOW / INFILTRATION =
COMM. IND., INST. INFLOW / INFILTRATION =
PEAKING FACTOR (RES.) $=2.6 \mathrm{P}^{-0.1}$ OR 1.5 (THE LARGER OF THE TWO)
PEAKING FACTOR (COM /IND ) $=3.0$
REQUIRED FLOW $=86 \%$ OF DESIGN FLOW
Manning's $n=0.013$
MIN $\mathrm{v}=0.6 \mathrm{~m} / \mathrm{s}$
375 L/person/day
$13600 \mathrm{~L} / \mathrm{Ha} / \mathrm{day}$
$0.28 \mathrm{~L} / \mathrm{s} / \mathrm{ha}$
$0.05 \mathrm{~L} / \mathrm{s} / \mathrm{ha}$

## Appendix B Geotechnical Desktop Study



## P. MACHIBRODA ENGINEERING LTD.

CONSULTING GEOTECHNICAL GEOENVIRONMENTAL ENGINEERS AND GEOSCIENTISTS

## EDMONTON

12114A-163 STREET N.W.
EDMONTON, AB
T5V 1H4
PHONE:
(780) 733-6575

FAX:
(780) 415-5234

E-MAIL:
pmle.ab@machibroda.com WEB:
www.machibroda.com

- Geotechnical Engineering
- Foundation Design

Recommendations

- Inspection Services
- Earthwork Structures
- Slope Stability
- Pavement Design
- Hydrogeological Studies
- Environmental Site Assessments
- Site Decommissioning and Clean-up
- Test Drilling Services
- Piezocone (CPTu) Testing
- Soils Testing
- Concrete Testing
- Asphalt Testing


Member of the Association of Consulting Engineering Companies/Canada

October 11, 2013
ISL Engineering and Land Services Ltd.
7909-51 Avenue
Edmonton, Alberta T6E 5L9
T: 780.438.9000
F: 780.438.3700
Email: JKercher@islengineering.com

## ATTENTION:MR. JAMES KERCHER, P.ENG, PROJECT ENGINEER

Dear Sir:

## RE: GEOTECHNICAL INVESTIGATION - DESKTOP STUDY WEST END SANITARY SEWER TRUNK MAIN PROJECT TOWN OF EDSON, ALBERTA PMEL REPORT NO. A13-2258

P. Machibroda Engineering Ltd. (PMEL) conducted a desktop geotechnical investigation for the above-mentioned project. Authorization to conduct this investigation was provided on September 10, 2013. The Terms of Reference for this investigation were presented in P. Machibroda Engineering Ltd. (PMEL) Proposal No. 0712-2478, dated July 15, 2013.

## Soil Stratigraphy

The general soil profile for the Edson area consisted of variable deposits of silt, sand and clay followed by glacial till then sandstone. Groundwater level for the Edson area is 2 to 3 meters below existing surface.

PMEL has conducted geotechnical investigations for different residential and commercial projects in Edson area and soil profiles are as follows.

## Site-1 (near 31 Street and 1 Avenue)

The general soil profile consisted of a thin layer of topsoil ( 0 to 300 mm ) overlying variable deposits of silt, sand and clay ( 0.3 to 3.3 metres) followed by glacial till, which extended to at least 9 metres below existing ground surface, the maximum depth penetrated by our test holes at this site. Variable inter/intra deposits of sand and clay shale (2.5 to 9 metres) were encountered throughout the subject site. Groundwater seepage and sloughing conditions were encountered during test drilling.

## Site-2 (near 55 Street and 2 Avenue)

The general subgrade soil conditions consisted of a surficial layer of clay fill followed by medium to highly plastic clay ( 1.6 to 7.0 metres) , overlying an extensive deposit of silt and sand ( 7.0 to 9.0 metres), which extended to at least 12.0 metres below existing ground surface, the maximum depth penetrated by our test holes at this site. An extensive peat layer was encountered from 0.5 to 2.6 metres in one Test Hole. Groundwater seepage and sloughing conditions were encountered during test drilling.

## Site-3 (near 59 Street and 4 Avenue)

The general subgrade soil conditions consisted of medium and highly plastic silt and clay ( 0.5 to 3.5 metres) deposits followed by glacial till ( 3.5 to 16.0 metres). The glacial till was underlain by sandstone which extended to a depth of at least 18.0 metres below existing grade, the maximum depth explored with our test holes at this site. The test holes remained open during and immediately after drilling.

The subgrade soils are frost susceptible and the average depth of frost penetration for the Edson area is 2 metres.

## Physiography and Regional Geology

Review of published information (ERCB, 2011) revealed the following:

- The subject property overlies bedrock of the Upper Paskapoo Formation; grey to greenish grey, thick-bedded, calcareous, cherty sandstone; grey and green siltstone and mudstone; minor conglomerate; thin limestone, coal and tuff beds; nonmarine.


## Aerial Photo Record System (APRS)

Historical aerial photographs of 1951, 1969, 1977, 1986, 1995 and 2007 were obtained for the site and examined to identify site specific land-use which may have resulted in environmental concems on and/or adjacent to the site. A summary of observations made has been presented below.

1951 The subject site is mostly undeveloped forested area with some areas of clear-cutting located towards the west. A railroad and Highway No. 16 is visible in the project area. The topography is mainly flat with slight slope.

Substantial clear cutting and cultivation has occurred towards the south. Development within the Town of Edson has occurred.

1977 Construction of the Edson Airport is visible to the north side of the project location.

## P. MACHIBRODA ENGINEERING LTD.

1986 Further development has occurred to the north of the subject site. Construction of the Edson Airport is completed. Highway No. 16 is realigned to the east.

1995
Relatively consistent with 1986 observations.
2007 Relatively consistent with 1995 observations.

## Closure

We trust that this is the information you require at this time. Please contact our office if you should require additional information.

## P. MACHIBRODA ENGINEERING LTD.

John Sowinski, E.I.T.


AHM Zafrul Clam, PEng

$$
\mid 1 s / 2^{013}
$$

Zobayur Rahman, PEng.

Paul Machib , P.Eng., FCSCE
ZA:ZR:PM:zz:clb

Appendix C

# Town of Edson West End Sanitary Sewer Trunk Main 

Statement of Justification (SoJ) for Historical Resource Act Requirements

Prepared For:
Town of Edson
P.O. Box 6300
$605-50^{\text {th }}$ Street
Edson, Alberta.
T7E 1T7

## Prepared By:

Turtle Island Cultural Resource Management Inc. 5 Creston Crescent N.W. Calgary, Alberta. T2M 4J9

Town of Edson Contact:<br>Dawit Solomon<br>780-723-4402<br>dawits@edson.ca

Turtle Island Contact<br>Gareth Spicer<br>403-620-9032<br>gareth@turtleislandcrm.com

## Project Description:

The project involves the installation of a sewer main trunk on the south side of the Town of Edson, Alberta. The primary impact will be to lands owned by the Town of Edson; although some private and crown land will also be impacted depending on the chosen alignment. The project encompasses an area of approximately 2.4 ha in the foothills of the Rocky Mountains immediately south of the Town of Edson. There are four possible alignments each of which follow existing roads, highways, and utility right of ways for the majority of their length. The project proceeds through the town and includes areas of previous disturbance such as: a rail line, the Yellowhead Highway, roads, utility right of ways, and an existent landfill. The work will include a combination of open trench and trenchless excavation methods. Areas of open cut trench will represent significant surface disturbance.

The highest potential for impact to cultural resources is at the crossing of Bench Creek. At this crossing the proposed sewer line will be approximately 2.5 metres under the level of the creek channel, up to 14 metres below the general land surface. There are previously recorded sites associated with Bench Creek including four sites approximately 4.5 km upstream. Although these known sites are located outside the development footprint their presence on the same water course as the development has resulted in a recommendation for a Historic Resources Impact Assessment (HRIA) to focus on the creek crossing and affected land in the immediate vicinity.

Other matters relating to Historic Resource Act (HRA) clearance are palaeontology and sites of cultural interest. The depth of the proposed work may trigger palaeontological requirements that could include deep testing and/or palaeontological monitoring. A Statement of Justification (SoJ) for Historical Resource Act requirements for palaeontology has been prepared and submitted in relation to this project and are currently under review by the Royal Tyrrell Museum. In Addition, all four of the proposed alignments pass into an area that contain sites of recorded aboriginal cultural importance, this is noted as 4c designates from the Listing of Historical Resources (Sept. 2013), these locations are depicted on the included graphic. This indicates that there are culturally relevant sites that have been
recorded by a First Nations community. The actual location of these sites, their nature and communities potentially affected are not made available by Alberta Culture. If one or more of these sites may be impacted by the proposed development Alberta Culture may require consultation with the appropriate First Nations communities.

Historic Resource Act requirements are currently pending review by the Historic Resource Management Branch at Alberta Culture. This application (\#004539939) was submitted on November 27, 2013 and is currently in screening. Historic Resource Act clearance and any pending requirements associated with that clearance are expected to be issued by Alberta Culture in the first half of January 2014.


Figure 1: Project area showing culture resource Sites and HRV notations.

November 28 ${ }^{\text {th }}, 2013$


Steppe Consulting Inc.
264 Edgebrook Park NW, Calgary, AB T3A 5T7
Phone: (403) 286-8608, Cell (403) 615-6325
Email: pemcneil@gmail.com

##  

This document contains sensitive information about Historic Resources that are protected under the provisions of the Alberta Historical Resources Act. This information is to be used to assist in planning the proposed project only. It is not to be disseminated, and no copies of this document are to be made without written permission of the Historic Resources Management Branch, Alberta Culture and Community Spirit.


## $\square \mathbf{r} \square \mathrm{m} \square \square \square \square$

The project area is approximately 2.4 hectares.

## 

The proposed sewer trunk is located on land that has previously been developed for agricultural, transportation, and industrial purposes. Alternatives follow the route of Highway 16 and CN railway tracks just south of the town of Edson.

## 

The proposed sewer trunk route is located on agricultural, industrial land just south of Edson. Ephemeral drainages and sloughs are located throughout the project area, with Bench Creek, at its eastern end, being the only permanent watercourse. Bench Creek is low and swampy with little incision at all potential crossings, so exposure of surficial or bedrock geology is unlikely.

## G

The regional surficial geology is primarily of glacio lacustrine clay silt and sand overlying the Edson Tills (Figure 2). The Edson tills are continental in origin with clasts being dominantly igneous and high grade metamorphics in a silt and clay matrix (Gabert and Roed, 1968; Roed, 1970). In the Project area, the Edson Till overlies a buried river channel filled with an earlier Cordilleran till. Because of the buried channel, the Quaternary deposits in the project area are a minimum of 30 m thick (Gabert and Roed, 1968). The bedrock geology is comprised of the Paleocene Paskapoo Formation. The Paskapoo is fluvial in origin and consists of thickly bedded buff sandstone with greenish siltstone and mudstone (Hamilton et al., 1999; Hamblin, 2004). Given the thickness of the unconformably overlying Quaternary sediments, the Paskapoo Formation should not be impacted during construction.

## 

No palaeontological HRV values have been assigned for any of the LSDs that Project will affect. 5P values are assigned to LSDs which contain the McLeod River Valley south of Edson, because of potential exposure of the Paskapoo Formation. A search of the online HeRMIS database indicates that there are currently not only no fossils in collections from the Project township (53-17W5), but there are also no fossils from any of the surrounding townships as well.

No Quaternary fossils are known from the project area and the glacial deposits present are low in palaeontological potential. However while Quaternary fossils are rare, and their occurrence difficult to predict, they can, and are, unearthed in construction projects across the province. The Paleocene Paskapoo Formation is a source of a variety of mammal fossils (e.g. Fox, 1994; Scott, 2006), plants (e.g. Hoffman and Stockey, 1999), freshwater and terrestrial molluscs, reptiles (e.g. turtle, crocodile), freshwater fish, and insects (e.g. Hoffman and Stockey, 1999).

| Ar $\square$ R $\square$ r $\square$ Since this SOJ is focused on palaeontology, no archaeological information is included here. |  |  |  |
| :---: | :---: | :---: | :---: |
| $\square \square \mathbf{r d} \square \square \square$ | HR | R (distance and direction from project) |  |
| $\mathbf{I} \square \square \square \mathbf{r} \square\\|\square \mathbf{M} \square \mathbb{r}\\| ा$ Project Plans. |  |  |  |
| E <br> The Quaternary geology consists of glacio-lacustrine deposits overlying continental and Cordilleran tills, all of which have low palaeontological potential. The Quaternary deposits are greater than 30m thick in the project area indicating that the potentially fossiliferous Paleocene Paskapoo Formation will not be impacted. |  |  |  |
| R <br> No further proposed <br> Quaternary impacts, ca passed on monitors. If contacted. <br> (Recommend palaeontologist, |  | tological I investigation or mon est Sanitary Trunk Main. <br> while extremely rare in the su . Therefore awareness of their ment operators, construction tered, they should be set asid <br> garding paleontological resources mus | ring is recommended for the <br> ial deposits that the project ssible presence should be ervisors and environmental nd a palaeontologist <br> be made by a professional |
| Recommen Paul McNeil | dation | made by: | Date: <br> November 28, 2013 |

## $\mathbf{R} \square \| \mathbf{r} \square \square \square \square$

Fox, R.C., 1990. The Succession of Paleocene Mammals in Western Canada, in Brown, T.M. and Rose, K.D., eds., Dawn of the Age of Mammals in the Northern Part of the Rocky Mountain Interior, North America: Boulder Colorado, Geological Society of America, Special Paper 243.

Gabert, G.M., and Roed, M.A., 1968. Bedrock topography and surficial aquifers, Edson Area, Alberta. Research Council of Alberta, Report 68-1.

Hamblin, A.P., 2004. Paskapoo-Porcupine Hills Formations in western Alberta: Synthesis of regional geology and resource potential. Geological Survey of Canada, Open File 4679.

Hamilton, W.N., Price, M.C., and Langdenberg, C.W., (compilers), 1999.
Geological Map of Alberta. Alberta Geological Survey, Alberta Energy and Utilities Board, Map No. 236. Scale 1:1,000,000.

Hoffman, G.L., and Stockey, R.A., 1999. Geological setting and paleobotany of the Joffre Bridge Roadcut fossil locality (Late Pleistocene), Red Deer Valley, Alberta. Canadian Journal of Earth Sciences 36: 2073-2084.

Roed, M.A., 1970. Surficial Geology Edson NTS 83F. Research Council of Alberta Map 33: Scale 1:250,000.

Scott, C.S., 2006. A New Erinaceid (Mammalia, Insectivore) from the Late Paleocene of Western Canada, Canadian Journal of Earth Sciences 43: 16951709.


Figure 1: Satellite image showing all four alternative routes.


Figure 2: Surficial geology. All four project alternatives will fall within the red rectangle. Acronyms: 2 - Edson Till; 14 - glacio-lacustrine sand, silt and clay. Modified from Roed (1970).

Heritage Division
Old St. Stephen's College

Via e-mail: dawits@edson.ca

February 18, 2014
Project File: 4710-14-0001
OPaC Application: 004539939
Mr. Dawit Solomon
Town of Edson
P.O. Box 6300, $605-50^{\text {th }}$ Street

Edson, Alberta
T7E 1T7

Dear Mr. Solomon:

## SUBJECT: HISTORICAL RESOURCES ACT (HRA) APPROVAL TOWN OF EDSON WEST END SANITARY SEWER TRUNK MAIN SEWAGE LINE

The attached Schedule "B" outlines Alberta Culture's requirements for the proposed footprint of Town of Edson: West End Sanitary Sewer Trunk Main, as illustrated on the attached plan. These requirements involve the conduct of a Historic Resources Impact Assessment (HRIA) for any portion of the Project that passes through the SE-16-53-17W5M. The Town of Edson is granted conditional Historical Resources Act clearance to proceed with development of the remainder of the project on the understanding that the required HRIA will be undertaken.

Should you require additional information or have any questions concerning these requirements, please contact Barry Newton (Land Use Planner) at 780-431-2330 (toll-free 310-0000) or barry.newton@gov.ab.ca.

I would like to thank representatives of the Town of Edson for their cooperation in our endeavour to conserve the Province's historic resources.


David Link, PhD<br>Assistant Deputy Minister

Attachments

OPaC: 004539939

## HISTORICAL RESOURCES ACT APPROVAL

TOWN OF EDSON TOWN OF EDSON: WEST END SANITARY SEWER TRUNK MAIN SEWAGE LINE

HRA REQUIREMENTS PROJECT FILE: 4710-14-0001
(Schedule "B")

For the purposes of this Schedule the Town of Edson shall be referred to as the "Proponent" and Town of Edson: West End Sanitary Sewer Trunk Main shall be referred to as the "Project."

A Historic Resources Impact Assessment is required for portions of the Project as outlined below. Part I of this Approval provides the Proponent with Historical Resources Act clearance for components of the Project while Part II outlines the conditions attached to this Approval.

## I. HISTORICAL RESOURCES ACT APPROVAL

Historical Resources Act conditional clearance is granted to the Proponent for the Project as illustrated on the attached plan with the exception of any of the alignments which pass through the SE-16-53-17-W5M.

## II. CONDITIONS ATTACHED TO APPROVAL

The Proponent is granted conditional Historical Resources Act clearance to proceed with the Project on the understanding that a Historical Resources Impact Assessment (HRIA) for archaeological resources will be conducted within SE-16-53-17-W5M, as outlined below.

### 1.0 ARCHAEOLOGICAL RESOURCES

The potential for selected components of the Project to affect archaeological resources is high.

### 1.1 Historic Resources Impact Assessment

Pursuant to Section 37(2) of the Historical Resources Act (HRA, or Act) a Historic Resources Impact Assessment (HRIA) for archaeological resources and any work resulting from this assessment is to be conducted on behalf of the Proponent by an archaeologist qualified to hold an Archaeological Research Permit within the Province of Alberta. In order to conduct the HRIA, the archaeological consultant must submit "An Application for an Archaeological Research Permit Mitigative Research Project" to the Historic Resources Management Branch, Heritage Division,

Alberta Culture. Please allow ten working days for the permit to be processed. An approved permit must be issued prior to the initiation of any archaeological field investigations.

### 1.1.1 Alberta Regulation 254/2002

Archaeological investigations conducted under permit in Alberta are subject to the conditions stated within Alberta Regulation 254/2002, Archaeological and Palaeontological Research Permit Regulation, conditions set forth in the approved permit, and any other conditions that the Minister imposes under Section 30 of the Act.

### 1.1.2 Contacting the Archaeological Survey

For further information regarding the acquisition of a Permit to Excavate Archaeological Resources and/or archaeological consultants obligations under Alberta Regulation 254/2002, please contact Martina Purdon, Head, Archaeological Information \& Regulatory Approvals at 780-431-2331 (toll-free 310-0000), or e-mail martina.purdon@ gov.ab.ca

### 1.1.3 Coverage

A pre-construction HRIA is required for any chosen route of the Project that crosses SE-16-53-17W5M. The HRIA is to include all areas of high archaeological potential.

### 1.1.4 Timing

The HRIA is to be carried out prior to the initiation of any land surface disturbance activities under snow-free, unfrozen ground conditions. Should the Project require field studies under winter conditions, directions in the Archaeological Survey, Survey Notes and Instructions: Information Bulletin Regarding Winter HRIA Work must be followed.

### 1.1.5 Deep Testing

A deep testing program is required in areas of significant sedimentation.

### 1.1.6 Relationship to known sites in Project area

Historic structures may be located within or adjacent to lands affected by the Project. During the conduct of the HRIA the Proponent's archaeological consultant is to confirm the relationship between the Project and historic structures. If historic structures are encountered within or adjacent to the Project the directions included in the Requirements for recording and reporting historic structures within the context of archaeological HRIAs (Revised February 2013) apply.

### 1.1.7 Location of HRIA studies

Within the final report and any interim report(s) the location of pedestrian surveys, deep testing program(s) and the location and number of shovel tests must be discussed and clearly illustrated.

### 1.2 Reporting the results of archaeological resources HRIA

### 1.2.1 Submission of "Archaeological Site Inventory Data" forms

The Proponent's archaeological consultant is required to submit "Archaeological Site Inventory Data" forms for each prehistoric and historic archaeological site recorded or re-examined during the conduct of the HRIA. While the discovery of a site must be reported within 30 days following the date of discovery, site data forms are to be submitted within 30 days of the date on which the permit period ends, or at the same time or prior to the submission of any interim report or the final report, whichever comes first.

### 1.2.2 Submission of HRIA final report

The final report must be submitted within 180 days after the expiration of the permit, or at least six weeks prior to the anticipated conduct of land surface disturbance activities, whichever comes first. Copies of the final report and any interim reports are to be submitted to the Historic Resources Management Branch, Heritage Division, Alberta Culture, Old St. Stephen's College, 8820-112 Street, Edmonton, Alberta, T6G 2P8.

### 1.2.3 Submission of interim report(s)

Should the Proponent find it necessary to obtain Historical Resources Act clearance for portions or all of the lands affected by the Project prior to the submission of the final report, Alberta Culture will consider accepting the submission of an interim report, or reports.

### 2.0 STANDARD CONDITIONS UNDER THE HISTORICAL RESOURCES ACT

The Proponent must comply with standard conditions under the Historical Resources Act, which are applicable to all land surface disturbance activities in the Province. Standard conditions require applicants to report the discovery of historic resources and comply with the historic resources section of Alberta's First Nations Consultation Guidelines on Land Management and Resource Development (Alberta Culture's Consultation Guidelines). These requirements are stated in Attachment 1-Standard Requirements under the Historical Resources Act, Reporting the Discovery of Historic Resources.

### 3.0 FURTHER SALVAGE, PRESERVATIVE OR PROTECTIVE MEASURES

Based upon the results of the HRIA(s) reporting the discovery of archaeological resources, palaeontological resources, historic period sites and/or Aboriginal Traditional Use Site(s), the Proponent may be ordered to undertake further salvage, preservative or protective measures or take any other actions that the Minister responsible for the Historical Resources Act considers necessary.

### 4.0 REQUESTS FOR HISTORICAL RESOURCES ACT CLEARANCE

Based upon the results of the HRIA studies, Alberta Culture may consider granting Historical Resources Act clearance to all or portions of the Project area. In the final report, and any interim report(s) the Proponent's consultant(s) must clearly identify and illustrate those portions of the Project area for which Historical Resources Act clearance is requested.

### 5.0 PRE-EMINENCE OF CONDITIONS OF HRA REQUIREMENTS

Should the contents of conditions included within this Schedule be at variance with any instructions associated with the Listing of Historic Resources and/or the permit application, the conditions of the Schedule take precedence. Following instructions as outlined in this Schedule should result in the granting of Historical Resources Act clearance and/or the issuance of requirements regarding further historic resources studies in a timely manner.

### 6.0 COMPLIANCE IS MANDATORY

These conditions shall be considered directions of the Minister of Alberta Culture under the Act. The Proponent and agents acting on behalf of the Proponent are required to become knowledgeable of the conditions. Failure to abide by the conditions will result in Historical Resources Act approval not being granted, or delayed.

# Application for Historical Resources Act Clearance 

Activity Administration

## Culture

Date Received: January 16, 2014

HRM File: 4710-14-0001

| Purpose of Application: | $;$ | All New Lands | - | Additional Lands | - |
| :--- | :--- | :--- | :--- | :--- | :--- |

Project Category: Waste M anagement and Water Treatment (4710)
Project Type: ; Sewage Line Approximate Project Area (ha) 2.4 ha

| Project Identifier: | Town of Edson: West End Sanitary Sewer Trunk M ain |
| :--- | :--- |
| Additional Identifier(s): |  |


| Key Contact: | Ryan Eldridge | Affiliation: | Turtle Island CRM |
| :--- | :--- | :--- | :--- |
| Address: | 6131 Lacombe Way Sw | City / Province: | Calgary, AB |
| Postal Code: | T3E 5T4 | Phone: | (403) 589-9347 |
| E-mail: | ryan@turtleislandcrm.com | Fax: | () |
|  |  | Your File Number: |  |


| Is the Proponent the same as the Key Contact? | - | Yes | ; No If no, complete the following: |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Proponent: | Town of Edson |  | Contact Name: | Dawit Solomon |  |
| Address: | P.O. Box $6300605-50$ st |  |  | City / Province: | Edson, AB |
| Postal Code: | T7E 1T7 |  | Phone: | (780) 723-4402 |  |
| E-mail: | dawits@edson.ca |  |  | Fax: | (780) 723-3508 |


| Proposed Development Area |  | Land Ownership |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MER | RGE | TWP | SEC | LSD List | FRH | SA | CU | CT |
| 5 | 17 | 53 | 9 | $13-16$ | - | - | $;$ | - |
| 5 | 17 | 53 | 16 | $1-9$ | - | - | $;$ | - |
| 5 | 17 | 53 | 8 | $13-16$ | - | - | $;$ | - |
| 5 | 18 | 53 | 13 | 1 | - | - | $;$ | - |
| 5 | 17 | 53 | 18 | $1-4$ | - | - | $;$ | - |
| 5 | 17 | 53 | 17 | $1-4$ | - | - | $;$ | - |
| 5 | 17 | 53 | 7 | $13-16$ | - | - | $;$ | - |


| Historical Resources Impact Assessment: <br> For archaeological resources: |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Has a HRIA been conducted? | - | Yes | $;$ | No | Permit Number (if applicable): |
| For palaeontological resource: |  |  |  |  |  |$\quad-\quad$ Yes $\quad ; \quad$ No $\quad 0$

Historical Resources Act clearance is granted for the activities described on this application and its attached plan(s)/sketch(es) subject to the conditions specified in the attached document(s).


February 18, 2014
David Link Date

ATTACHMENT 1

STANDARD REQUIREMENTS UNDER THE HISTORICAL RESOURCES ACT REPORTING THE DISCOVERY OF HISTORIC RESOURCES

Pursuant to Section 31 of the Historical Resources Act, Proponents are required to report the discovery of historic resources. These requirements are applicable to all activities in the Province. This bulletin provides Proponents and their agents with instructions for contacting the Heritage Division of Alberta Culture.

### 1.0 ARCHAEOLOGICAL RESOURCES

### 1.1 Reporting the discovery of archaeological resources

During the conduct of developments, Proponents and/or their agents may become aware of and/or encounter archaeological resources. The discovery of archaeological resources is to be reported to Martina Purdon, Head, Archaeological Information and Regulatory Approvals at 780-431-2331 (toll-free 310-0000), or e-mail martina.purdon@gov.ab.ca.

### 2.0 PALAEONTOLOGICAL RESOURCES

### 2.1 Reporting the discovery of palaeontological resources

During the conduct of developments, Proponents and/or their agents may encounter palaeontological resources. The discovery of palaeontological resources is to be reported to Dan Spivak, Head, Resource Management, Royal Tyrrell Museum of Palaeontology at 403-820-6210 (toll-free 310-0000), or e-mail dan.spivak@gov.ab.ca.

### 3.0 HISTORIC PERIOD SITES

### 3.1 Reporting the discovery of historic period sites

During the conduct of developments, Proponents and/or their agents may become aware of and/or encounter historic period sites. The discovery of historic period sites is to be reported to Martina Purdon, Head, Archaeological Information and Regulatory Approvals at 780-431-2331 (toll-free 310-0000), or e-mail martina.purdon@gov.ab.ca. Please note that some historic period sites may also be considered Aboriginal Traditional Use Sites.

ATTACHMENT 1
REPORTING THE DISCOVERY OF HISTORIC RESOURCES

### 4.0 ABORIGINAL TRADITIONAL USE SITES

### 4.1 Reporting the discovery of Aboriginal traditional use sites

During the conduct of consultation processes and/or activities associated with developments, Proponents and/or their agents may become aware of and/or encounter Aboriginal Traditional Use Sites which Alberta Culture may consider as historic resources under the Historical Resources Act. A listing of Aboriginal Traditional Use Sites considered as historic resources under the Historical Resources Act is provided in Attachment 2. The discovery of any Aboriginal Traditional Use Site that is of a type described in Attachment 2 is to be reported to Valerie Knaga, Director, Aboriginal Heritage Section at 780-431-2371 (toll-free 310-0000), or e-mail valerie.k.knaga@gov.ab.ca.

### 4.2 Aboriginal traditional use sites and Alberta Culture's Consultation Guidelines

Under the circumstance described in Condition 4.1 Reporting the discovery of Aboriginal traditional use sites, Proponents must comply with Part V Tourism, Parks, Recreation and Culture Guidelines for First Nations Consultation on Resource Development and Land Management (Alberta Culture's Consultation Guidelines) of Alberta's First Nations Consultation Guidelines on Land Management and Resource Development.

### 5.0 FURTHER SALVAGE, PRESERVATIVE OR PROTECTIVE MEASURES

Based upon the results of reporting of the discovery of archaeological resources, palaeontological resources, historic period sites and/or Aboriginal Traditional Use Site(s), Proponents may be ordered to undertake further salvage, preservative or protective measures or take any other actions that the Minister responsible for the Historical Resources Act considers necessary.

This bulletin may be cited as:
Standard Requirements under the Historical Resources Act, Reporting the discovery of historic resources. Land Use Planning, Archaeological Survey, Historic Resources Management Branch, Heritage Division, Alberta Culture, Edmonton, Alberta.

## ATTACHMENT 2

## ABORIGINAL TRADITIONAL USE SITES

Aboriginal Traditional Use Sites considered by Alberta Culture as historic resources under the Historical Resources Act include but may not be limited to the following:

Historic cabin remains;
Historic cabin (unoccupied);
Cultural or historical community camp site;
Ceremonial site/Spiritual site;
Gravesite(s);
Historic settlement/Homestead;
Historic site;
Oral history site;
Ceremonial plant or mineral gathering site;
Trail; and,
Wickiup/Sweat lodge site.

This listing updates the list on pages 5 and 6 of Tourism, Parks, Recreation and Culture Guidelines for First Nations Consultation on Resource Development and Land Management (referred to as the Alberta Culture's Consultation Guidelines), Part V of Alberta's First Nations Consultation Guidelines on Land Management and Resource Development, dated November, 2007.

## Appendix D Environmental Review

## Reference:- Environmental overview - Edson West Sanitary Trunk Alignment

## 1. Introduction

The purpose of the Edson West Sanitary Trunk Alignment Environmental Overview is to provide the planning team with natural site and ecological connections information to guide the preparation of the alignment design plans.
Environmental Overview includes environmental opportunities and constraints in the area and future permitting pathways.

## 2. Project Description

Town of Edson is proposing alignments options for new trunk sewer from Rodeo Road to the existing sewer trunk on 54 Street.

## 3. Environmental Legislation/Permits/Authorizations

These environmental legislations should be considered during planning of the project.

## Federal Legislation

## $>$ Fisheries Act

Any project that has the potential for harmful alteration, disruption or destruction (HADD) of fish habitat would require authorization from the Department of Fisheries and Oceans (DFO) pursuant to the Fisheries Act. Should any development encroach on the bed and shore of the water body, or cross the watercourse, a fish habitat assessment and authorization pursuant to the Fisheries Act would be required.
Review of Fisheries and Wildlife Management Information System (FWMIS) database was preform (November 2013), the database records are showing that fish species are present in the Bench Creek including: Brook stickleback, White sucker, Lake chub.

The Project involves crossing of Bench Creek and there is record of fish species in the water body, DFO should be contacted regarding this proposed work and application for approval should be submitted to DFO. Also, the project involves works listed under DFO's Operational Statements. Mitigation guidelines listed in the Operational Statements should be followed. Notification is to be submitted to DFO.

## > Navigable Waters

The navigable Waters Protection Act (NWPA) is administered in Alberta by Transport Canada. The Bench Creek is not considered a navigable water therefore approval under Navigable Waters Protection Act is likely not required (Please see attached: navigable waters map of Alberta).

## > Migratory Birds Convention Act And Species at Risk Act

Environment Canada administers the Migratory Birds Convention Act (MBCA) and the Species at Risk Act (SARA). Those Act provide guidelines for enforcement only; neither the MBCA nor the SARA requires permitting or approvals specific to the project. Although no approvals are required, violation of those Acts may result in penalties.
A timing restriction for vegetation clearing is recommended in accordance with the Act. Nesting and fledging seasons for birds included under both federal and provincial legislations are from March 1 to August 15. This timing restriction incorporates early nesters including owl species and late nesters including some passerines.

## Provincial Legislation

## $>$ Water Act

The Province of Alberta owns all water resources in the province. Alberta's Water Act, administered by Alberta Environment and Sustainable Resources Development (AESRD), is the primary piece of legislation governing the use and management of Alberta's water resources, including water held in permanent and temporary wetlands. Approval under the Water Act would be required to drain and fill any of the wetlands. Compensation for wetland loss would be required under the Wetland Policy. Any crossings of the water body - Bench Creek, must follow the "Code of Practice for Watercourse Crossings", any outfalls into the water body must follow the "Code of Practice for Outfall Structures on Water Bodies". Pipeline or telecommunication lines crossing the water body are subject to the "Code of Practice for Pipelines and Telecommunications Lines Crossing a Water Body".
For the current project, Alberta Environment needs to be consulted regarding this work and required application submitted.

## > Alberta Environmental Protection and Enhancement Act

Management facilities including lagoons and sanitary sewer projects are regulated by Alberta's Environmental Protection and Enhancement Act (EPEA). Construction of these facilities requires approval under EPEA.

## > Public Lands Act

The bed and shore of water bodies that are permanent and naturally occurring are owned by the province under the Public Lands Act, administered by AESRD. The province may claim wetlands and/or the water body in the study area. Consultation with AESRD will be required to determine ownership of the wetlands and the water body.

## > Widlife Act

The Alberta Wildlife Act prohibits disturbance to a nest or den of a prescribed wildlife species. Although permitting is not required under the Act, violations of the Act may result in fines. To avoid contravention of the Act, any clearing or trees or wetlands should occur outside the breeding season (April 15 to July 31).

## 4. Construction operations

Environmental protection measures will be utilized throughout construction and are the responsibility of the Contractor. As outlined by Alberta Transportation's Environmental Construction Operations (ECO) Plan Framework, environmental issues that will be addressed in the Contractor's ECO Plan include, but not limited to the following:
> Handling and disposal of reject material;
> Procedures to prevent/mitigate oil/fuel spills;
> Fuelling and servicing equipment;
$>$ Rinsing of truck boxes;
$>$ Dust control;
> Machinery emissions;
> Managing the application of oil products

## 5. Erosion Control

Erosion protection is recommended. Temporary erosion prevention practices, as identified in the contractor's ECO Plan should be applied throughout all work areas on exposed or erodible surfaces, and are the responsibility of the Contractor during construction.

## 6. Environmental Specifications and Recommendations

It is difficult to assess which alignment is most favorable from environmental point of view.
From aerial photos looks like Alignment 2 is crossing wetlands and undisturbed vegetation, in this option further investigation is required and wetland assessment and compensation would apply.

Further investigation of vegetation in the area is required.
Planning should take into consideration: wetlands (both wooded and herbaceous), large tree stands, some of which form a major wildlife corridor through the area, productive agricultural soils, existing development.

## ISL Engineering and Land Services Ltd.

Marta Sudyk, B.Sc., CPESC
Environmental Specialist


Table D-1 - Environmental Regulatory Planning Framework

Engineering
and Land Services

## Federal



Canadian Environmental Assessment Act (CEAA) - admin by Federal Responsible Authority (agency that granted approval or funding

| 3 | Does the Project require federal <br> approval OR receive federal funding OR <br> is located on federal lands? | YES $\longrightarrow$ | Screening Environmental Assessment is <br> required (info from DFO/NWPA application <br> may be sufficient). Full EIA may be required | $0-6$ months <br> (more if full EIA required) |
| :--- | :--- | :--- | :--- | ---: |


| Migratory Birds Convention Act (MCBA) - administered by Canadian Wildlife Service (CWS) |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :---: |
| 4 | Will there be any tree removals or <br> disturbance to shore areas/wetlands <br> required? | YES $\longrightarrow$ | Restrict tree removals and shore/wetland <br> modifications to outside bird nesting season |  |  |

## Provincial

| Water Act (WA)- administered by Alberta Environment |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| 5 | $\begin{array}{l}\text { Does the Project involve construction in } \\ \text { or affecting a naturally occurring } \\ \text { creek/river or other waterbody? }\end{array}$ | YES | $\begin{array}{l}\text { Fish assessment report (usually needed) } \\ \text { Submit Application (template available) DFO } \\ \text { provides Authorization OR Letter of Advice }\end{array}$ | $\begin{array}{r}\text { Application 1-2 months } \\ \text { Public Notice 2 weeks } \\ \text { Approval 2-4 months } \\ \text { (total 4-6 months) }\end{array}$ |
|  | NO $\longrightarrow$ | Water Act does not apply | $\begin{array}{r}\text { Provide notice 14 days } \\ \text { prior to construction }\end{array}$ |  |
| (COP notification form) |  |  |  |  |$\}$

Public Lands Act - administered by Alberta Sustainable Resource Development (ASRD)

| 6 | Does the Project involve construction on <br> public lands, including bed/banks of <br> creek/river or bed/shore of naturally <br> occurring wetlands/lakes? | UNSUR <br> E? $\longrightarrow$ | Determination from SRD Lands required. <br> For wetlands, Class IV and V may be claimed. <br> For lakes, need the legal bank of water body. | $1-3+$ months |  |
| :--- | :--- | :--- | :--- | :--- | :--- |


| YES $\longrightarrow$ | Submit application for Approval <br> Review and approvals by ASRD <br> (may be approval, Temporary Field <br> Authorization, Disposition) | $2-6+$ months |
| :--- | :--- | :--- | :--- | :--- |


| Historical Resources Act (HRA)- administered by Alberta Culture \& Community Spirit |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
| 7 | Will the Project affect an undisturbed <br> areas (e.g. native grasslands, forests, <br> river valleys) or Heritage Sites? | YES $\longrightarrow$ | Submit project overview <br> If notified, complete Historical Resources <br> Overview (by archeological sub) <br> If notified, complete Historical Resources <br> Impact Assessment (sub) | If req $+2-4$ months |

## Measures to Avoid Causing Harm to Fish and Fish Habitat

If you are conducting a project near water, it is your responsibility to ensure you avoid causing serious harm to fish in compliance with the Fisheries Act. The following advice will help you avoid causing harm and comply with the Act.

PLEASE NOTE: This advice applies to all project types and replaces all "Operational Statements" previously produced by DFO for different project types in all regions.

## Measures

## Project Planning

Timing

- Time work in water to respect timing windows to protect fish, including their eggs, juveniles, spawning adults and/or the organisms upon which they feed.
- Minimize duration of in-water work.
- Conduct instream work during periods of low flow, or at low tide, to further reduce the risk to fish and their habitat or to allow work in water to be isolated from flows.
- Schedule work to avoid wet, windy and rainy periods that may increase erosion and sedimentation.


## Site Selection

- Design and plan activities and works in waterbody such that loss or disturbance to aquatic habitat is minimized and sensitive spawning habitats are avoided.
- Design and construct approaches to the waterbody such that they are perpendicular to the watercourse to minimize loss or disturbance to riparian vegetation.
- Avoid building structures on meander bends, braided streams, alluvial fans, active floodplains or any other area that is inherently unstable and may result in erosion and scouring of the stream bed or the built structures.
- Undertake all instream activities in isolation of open or flowing water to maintain the natural flow of water downstream and avoid introducing sediment into the watercourse.


## Contaminant and Spill Management

- Plan activities near water such that materials such as paint, primers, blasting abrasives, rust solvents, degreasers, grout, or other chemicals do not enter the watercourse.
- Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance and keep an emergency spill kit on site.
- Ensure that building material used in a watercourse has been handled and treated in a manner to prevent the release or leaching of substances into the water that may be deleterious to fish.


## Erosion and Sediment Control

- Develop and implement an Erosion and Sediment Control Plan for the site that minimizes risk of sedimentation of the waterbody during all phases of the project. Erosion and sediment control measures should be maintained until all disturbed ground has been permanently stabilized, suspended sediment has resettled to the bed of the waterbody or settling basin and runoff water is clear. The plan should, where applicable, include:
- Installation of effective erosion and sediment control measures before starting work to prevent sediment from entering the water body.
- Measures for managing water flowing onto the site, as well as water being pumped/diverted from the site such that sediment is filtered out prior to the water entering a waterbody. For example, pumping/diversion of water to a vegetated area, construction of a settling basin or other filtration system.
- Site isolation measures (e.g., silt boom or silt curtain) for containing suspended sediment where inwater work is required (e.g., dredging, underwater cable installation).
- Measures for containing and stabilizing waste material (e.g., dredging spoils, construction waste and materials, commercial logging waste, uprooted or cut aquatic plants, accumulated debris) above the high water mark of nearby waterbodies to prevent re-entry.
- Regular inspection and maintenance of erosion and sediment control measures and structures during the course of construction.
- Repairs to erosion and sediment control measures and structures if damage occurs.
- Removal of non-biodegradable erosion and sediment control materials once site is stabilized.


## Shoreline Re-vegetation and Stabilization

- Clearing of riparian vegetation should be kept to a minimum: use existing trails, roads or cut lines wherever possible to avoid disturbance to the riparian vegetation and prevent soil compaction. When practicable, prune or top the vegetation instead of grubbing/uprooting.
- Minimize the removal of natural woody debris, rocks, sand or other materials from the banks, the shoreline or the bed of the waterbody below the ordinary high water mark. If material is removed from the waterbody, set it aside and return it to the original location once construction activities are completed.
- Immediately stabilize shoreline or banks disturbed by any activity associated with the project to prevent erosion and/or sedimentation, preferably through re-vegetation with native species suitable for the site.
- Restore bed and banks of the waterbody to their original contour and gradient; if the original gradient cannot be restored due to instability, a stable gradient that does not obstruct fish passage should be restored.
- If replacement rock reinforcement/armouring is required to stabilize eroding or exposed areas, then ensure that appropriately-sized, clean rock is used; and that rock is installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment.
- Remove all construction materials from site upon project completion.


## Fish Protection

- Ensure that all in-water activities, or associated in-water structures, do not interfere with fish passage, constrict the channel width, or reduce flows.
- Retain a qualified environmental professional to ensure applicable permits for relocating fish are obtained and to capture any fish trapped within an isolated/enclosed area at the work site and safely relocate them to an appropriate location in the same waters. Fish may need to be relocated again, should flooding occur on the site.
- Screen any water intakes or outlet pipes to prevent entrainment or impingement of fish. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself.
- In freshwater, follow these measures for design and installation of intake end of pipe fish screens to protect fish where water is extracted from fish-bearing waters:
- Screens should be located in areas and depths of water with low concentrations of fish throughout the year.
- Screens should be located away from natural or artificial structures that may attract fish that are migrating, spawning, or in rearing habitat.
- The screen face should be oriented in the same direction as the flow.
- Ensure openings in the guides and seals are less than the opening criteria to make "fish tight".
- Screens should be located a minimum of 300 mm (12 in.) above the bottom of the watercourse to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
- Structural support should be provided to the screen panels to prevent sagging and collapse of the screen.
- Large cylindrical and box-type screens should have a manifold installed in them to ensure even water velocity distribution across the screen surface. The ends of the structure should be made out of solid materials and the end of the manifold capped.
- Heavier cages or trash racks can be fabricated out of bar or grating to protect the finer fish screen, especially where there is debris loading (woody material, leaves, algae mats, etc.). A 150 mm (6 in.) spacing between bars is typical.
- Provision should be made for the removal, inspection, and cleaning of screens.
- Ensure regular maintenance and repair of cleaning apparatus, seals, and screens is carried out to prevent debris-fouling and impingement of fish.
- Pumps should be shut down when fish screens are removed for inspection and cleaning.
- Avoid using explosives in or near water. Use of explosives in or near water produces shock waves that can damage a fish swim bladder and rupture internal organs. Blasting vibrations may also kill or damage fish eggs or larvae.
- If explosives are required as part of a project (e.g., removal of structures such as piers, pilings, footings; removal of obstructions such as beaver dams; or preparation of a river or lake bottom for installation of a structure such as a dam or water intake), the potential for impacts to fish and fish habitat should be minimized by implementing the following measures:
- Time in-water work requiring the use of explosives to prevent disruption of vulnerable fish life stages, including eggs and larvae, by adhering to appropriate fisheries timing windows.
- Isolate the work site to exclude fish from within the blast area by using bubble/air curtains (i.e., a column of bubbled water extending from the substrate to the water surface as generated by forcing large volumes of air through a perforated pipe/hose), cofferdams or aquadams.
- Remove any fish trapped within the isolated area and release unharmed beyond the blast area prior to initiating blasting
- Minimize blast charge weights used and subdivide each charge into a series of smaller charges in blast holes (i.e., decking) with a minimum 25 millisecond ( $1 / 1000$ seconds) delay between charge detonations (see Figure 1).
- Back-fill blast holes (stemmed) with sand or gravel to grade or to streambed/water interface to confine the blast.
- Place blasting mats over top of holes to minimize scattering of blast debris around the area.
- Do not use ammonium nitrate based explosives in or near water due to the production of toxic by-products.
- Remove all blasting debris and other associated equipment/products from the blast area.


## Figure 1: Sample Blasting Arrangement



Per Fig. 1: 20 kg total weight of charge; 25 msecs delay between charges and blast holes; and decking of charges within holes.

## Operation of Machinery

- Ensure that machinery arrives on site in a clean condition and is maintained free of fluid leaks, invasive species and noxious weeds.
- Whenever possible, operate machinery on land above the high water mark, on ice, or from a floating barge in a manner that minimizes disturbance to the banks and bed of the waterbody.
- Limit machinery fording of the watercourse to a one-time event (i.e., over and back), and only if no alternative crossing method is available. If repeated crossings of the watercourse are required, construct a temporary crossing structure.
- Use temporary crossing structures or other practices to cross streams or waterbodies with steep and highly erodible (e.g., dominated by organic materials and silts) banks and beds. For fording equipment without a temporary crossing structure, use stream bank and bed protection methods (e.g., swamp mats, pads) if minor rutting is likely to occur during fording.
- Wash, refuel and service machinery and store fuel and other materials for the machinery in such a way as to prevent any deleterious substances from entering the water.

Date modified:
2013-11-25

## Appendix E CN Rail Guidelines

## $\square N$

## A GUIDE TO THE PIPE AND WIRE PROCESS

## - WATER/SEWER PIPELINE -

$$
\underline{\mathbf{G} \square \square \mathbf{r} \square \mathbf{G} \square \mathbf{d} \square \square \square}
$$

## 1. Applications

Applications must have five (5) copies of an acceptable plan attached. Plans must provide sufficient information to determine that installation will meet Railway Standards, General Order requirements and CSA Standards. They must be to scale or have all dimensions shown. They must clearly and accurately show Railway property lines. Refer to Appendix "C-1" for detail list of areas where Railway requirements exceed General Order or CSA Standards as well as a list of common omissions.

## 2. Agreement/Easement

2.1 When plans are approved by the Railway for installation, the Company will be sent appropriate documents with:
i. Agreement/Easement for signing.
ii. Costs.
iii. Special conditions will be identified.
iv. Company responsibilities will be listed.
2.2. Acceptance by the Company will be by signing appropriate documents, and returning it with a cheque in the amount requested. If the Company is not incorporated, the signature should be witnessed.
2.3 When the Company's acceptance is received, the Railway will reply with a Letter of Acknowledgment with contact names and phone numbers of local CN personnel to make arrangements.

## 3. Installation

3.1 Installation can be done with Ten (10) working days' notice to the contacts listed on Letter of Acknowledgment. This notice will allow the Railway to arrange for flagging protection and signals location as required. See Appendix "B-1".
3.2 After installation, if there are no additional flagging charges, and payment was prepaid, the account will be closed. If additional charges are applicable, an invoice will be produced.

Mail/Email should be directed to:

## NORTHERN ONTARIO, MANITOBA,AND SASKATCHEWAN

CN Design and Construction
Prairie Division
Operations Building B, $2^{\text {nd }}$ Floor
$10229-127^{\text {th }}$ Avenue
Edmonton, AB T5E 0B9

ATTENTION: Utilities Coordinator
Telephone: (780) 643-7668
Fax: (780) 472-3047
Email: praengsvc@cn.ca

## ALBERTA AND BRITISH COLUMBIA

CN Design and Construction
Pacific Division
Operations Building B, $2^{\text {nd }}$ Floor
10229 - $127^{\text {th }}$ Avenue
Edmonton, AB T5E OB9
ATTENTION: Utilities Coordinator
Telephone: (780) 472-3041
Fax: (780) 472-3047
Email: wcengsvc@cn.ca

## BC RAIL TERRITORY

CN Design and Construction
Pacific Division
Operations Building B, $2^{\text {nd }}$ Floor
$10229-127^{\text {th }}$ Avenue
Edmonton, AB T5E 0B9
ATTENTION: Utilities Coordinator
Telephone: (780) 643-7668
Fax: (780)472-3047
Email: wcengsvc@cn.ca

## FLAGGING $\square$ ROTECTION $\square$ SIGNALS $\square$ COMMUNICATIONS $\square$ ROTECTION

## What is flagging protection and signals protection?

Flagging protection consists of protecting men and equipment from passing trains and protecting passing trains from possible damage that could occur to the track infrastructure as a result of construction. Signals protection is locating underground and/or above ground signal wires, underground Railway power lines, Railway fibre optics cable and the protection of these facilities while the work is in progress.

## When is it required?

Flagging is required for men and equipment on the Railway right-of-way unless so specified. Signals protection is required if the Signals \& Communication Department ("S\&C") has identified the work area as being one of possible conflict.

## What are the costs?

The Railway recovers from the Company it's costs for actual time spent getting to, from, and on the site by Railway field forces. Flagging protection is provided by a flagging foreman, and the signals protection is provided by a S\&C Maintainer.

Time required to contact the Railway's Traffic Controller and set up "flagging protection" could vary daily, depending on conditions. Flags or other positive protection must be in place before the contractor starts work and removed only after the contractor's day is over, or protection has expired.

Work blocks for the next twenty-four (24) hours have to be communicated to the Railway's Traffic Controller by 1400 hours. The Company, or its agent, is responsible to advise the Railway flag person on site prior to that time, of their schedule for the following day.

Depending on the flagging protection provided, it may not be possible to provide extensions or reductions to the length of time set up to provide protection for the Company or its agent on that day.

## CONSTRUCTION 0 ERATION AND MAINTENANCE OF CROSSINGS

1. The Company shall give the Railway at least ten (10) days' prior notice of its intention to do any construction or maintenance work. The determination of this notice period shall not include Saturdays, Sundays and statutory holidays. Should an emergency situation arise, the Company shall contact the Railway to make special arrangements. The Railway agrees to act reasonably in these situations.
2. Construction and maintenance by the Company of any crossing shall be subject to the supervision of the Railway or the Railway's appointed representatives.
3. Should any work be required to support or repair the tracks or facilities of the Railway or to protect train movements due to the construction, operation, maintenance or removal of crossings, such work shall be performed by the Railway and the Company shall reimburse the Railway for all reasonable costs associated with such work upon receipt of the Railway's account.
4. The Company shall maintain all Crossings under this Agreement in good order and condition in accordance with the applicable rules, requirements and specifications issued from time to time by the Canadian Standards Association and approved by Transport Canada. If at any time during the term of this Agreement, the Company neglects to do any restoration and Maintenance work required to keep any Crossing free from hazard, the Railway, after giving reasonable prior written notice to the Company specifying the nature of the work required, may itself carry out such work. The Company shall reimburse the Railway for all reasonable costs associated with this work upon receipt of the Railway's account.
5. The construction, operation and Maintenance of Crossings shall be carried out in a manner so as to minimize interference with Railway Property, facilities and operations. When any such work has been completed, Railway Property shall be restored by the Company to its former condition so far as practicable. The Company shall, at its expense, expeditiously and effectively, remedy any interference that does occur, or, should no appropriate remedy be found, remove such crossing and restore the Railway Property to good order and condition. Should the Company fail to correct such interference, the Railway reserves the right to do so at the Company's expense and the Company will reimburse the Railway upon receipt of the Railway's account therefore.
6. The Railway may impose other construction conditions at time of application.

## FEE SCHEDULE

## 

1. Basic Engineering Application Fee

Rush application

- response back within two weeks (workload permitting)
\$ 750.00
add $\$ 2,500.00$
\$ 1,850.00

2. Agreement/Easement Fee starting at:
$\$ 1,850.00$ applies to a 3 m wide $\times 30 \mathrm{~m}$ long
or
$\$ 10,000.00$ applies to a 3 m wide $\times 30 \mathrm{~m}$ long for major yards
NOTE: Cost may increase due to location and length requested
3. Flagging Protection and Signals Protection During Installation

Minimum costs: Flagging protection $\$ 825.00$ (dependent on location)
Signals protection \$ 375.00
Additional costs for flagging and signals will be invoiced after completion of project if:

- time on site was more than one day for either flagging or signals protection
- a large number of hours were at overtime rates,i.e. weekend installations.
- 24 hour notice of project cancellation is not received. One additional day of flagging will be invoiced.

4. Additional Review Fee
\$ 200.00 per review

## 5. Additional Costs

The Railway reserves the right to charge for additional costs incurred by the Railway as a result of specific applications. Without limiting the generality, this includes items such as open-cut installations, inductive coordination, charges for train delays and slow orders, consulting and inspection costs.
6. Fee Review

All fees and charges that may be imposed under this Agreement are subject to annual review and adjustment by the Railway.

## 7. Survey and Registration

It is the Company's responsibility and expense to survey and register an easement document.

## WATER/SEWER PIPELINE CROSSINGS

Applicants must submit five (5) copies of an acceptable plan. Plans must meet TC E-10 and CN Standards.
Cost for reviewing the first plan received shall be included in the basic engineering application fee. The applicant may be charged an additional fee for each review after the initial application due to inadequate or missing information.

## Plans Must Have:

> Plan Number \& Date
o Revised plans must have a revision number \& date of revision.
F Full company name \& contact information of the owner of the pipeline.
o can be on the application letter
> Land Description (legal description \& or CN Subdivision \& Mileage)
> Site Plan \& Profile
o width of CN right-of-way / number of tracks / angle of crossing
o If encased . . . a cross section or a note advising on spacers, etc.
$>$ Drawing must be to scale or have all dimensions/measurement noted.
> NOTE stating: "Installation and maintenance to be in accordance with TC E10."
> "Signed" stamp of a Professional Engineer.

## SPECS Required on Plan:

> Contents of pipe must be noted.
>Crossing angle to be greater than 45 degrees.
> Warning Markers required on each side of the railway right-of-way
> Direction of flow.
o Not required for a gravity sewer pipe.
> Emergency Shut-off Valve locations noted on each side of track.
o Not required for a gravity sewer pipe.
> Method of Installation.
> 13.7 m minimum clearance to any bridges, buildings, switches, etc.
PIPE SPECS
> Design Loading - Cooper E80 (TCE-10)
> Type of Pipe, Wall Thickness, and Pressures (operating \& max. test) of carrier \& casing pipe.
> Must be STEEL CASED unless it is a non-pressure (under 700 kpa ) gravity feed pipe (sewer) and then the following applies:

- concrete pipe as per AREMA \& CSA, minimum Class 5.
- Coated corrugated metal pipe as per AREMA \& CSA.
o ALUMINUM PIPE is not acceptable!
cont'd $\mathrm{A} \square \mathrm{d}$ " $\mathrm{C}^{1 "}$
(pipe specs)
> Casing
o Carrier pipe less than 168.3 mm O.D. . . . casing pipe must be at least 50 mm O.D. larger.
o Carrier pipe more than 168.3 mm O.D. . . casing pipe must be at least 75 mm O.D. larger.
o Carrier pipe shall be held clear of the casing pipe by properly designed supports, insulators, or centering devices. - CSA Standard 4.12.3.3 (c)
o Casing must extend the full width of the Railway's core right-of-way and a minimum of 15 m on each side from outside track to accommodate for any future construction. Based on our standard 100' right-of-way.

NOTE: TC E-10 \& Z662 states a 7 m minimum from center outside track.
o Casing pipe to be left open on the ends (not sealed) when the ends of the casing are at or above ground surface and above high-water level (AREMA 5.1.6.4).

## $>$ Wall Thickness

o minimum 4.8 mm . . . unless no protective coat or it is not cathodically protected . . . ADD 1.6 mm. (TCE-10 \& AREMA) . . ie . . . YJ-1 = yellow jacket coding
o see Table 4.10 CSA Z662 for all sizes (Table 4.9 CSA Z662-99)
o protective coat or cathodically protected not required for concrete pipe
> Minimum Depth of Burial

- BELOW TRACK

Mainline Cased $\quad 1.68 \mathrm{~m}(168 \mathrm{~cm})$
(5.5 ft)

Other Tracks Cased/Uncased 1.37 m (137 cm)

- BELOW RIGHT-OF-WAY

Cased/Uncased $\quad .91 \mathrm{~m}$ (91 cm)

## Geo-technical Report:

If installation is known or suspected to be a problem due to soil conditions at location or if this is a large bore pipeline (cased or uncased), a written recommendation from a Geo-technical Engineer, who has reviewed soil testing and water table results, will be required. The written recommendation is to note the following:
> That the method of installation is appropriate to the soil conditions.
$>$ There will be no adverse affect to CN operations and property.
$>$ The contingency plan if problems arise during construction at the site.

## Nearest Point at which digging can take place.

Starting 10 (ten) feet from the gauge side of the nearest rail, calculate a slope to the bottom of the proposed pipe at 1.5:1. If a 1.5:1 slope cannot be maintained or more restrictive conditions occur, approved shoring will be required.

## Canadă

# Standards Respecting Pipeline Crossings Under Railways 

TC E-10, June 21, 2000

## Table of Contents

a. Scope
b. General Applications and Exclusions
c. General Conditions
d. Requirements for Pipelines Crossing under Railways - General
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## Appendix A:

Plans and Design Requirements for Pipelines Crossing under Railways

## 1. Scope

1. These standards may be known as the "Pipeline Crossing Standards".
1.2 These standards are intended to ensure that pipeline crossings under Railways are installed, renewed and maintained in a safe manner. These standards apply to Railway Companies subject to the jurisdiction of the Minister of Transport pursuant to the Railway Safety Act.

## 2. General Applications and Exclusions

2.1 Pipeline Installation Procedures shall be in strict conformance with all Federal, Provincial and local safety regulations.
2.2 These standards do not include overhead cable crossings, overhead pipeline crossings, and underground cable crossings.
2.3 These standards do not apply to any pipe installed under a railway right-of-way prior to the date of approval of these standards, unless the pipeline crossing is to be reconstructed.

## 3. General Conditions

3.1 No person shall commence the installation of any pipe under a railway without:
a. submitting to the railway company detailed plans of the proposed installation in accordance with the requirements outlined in Appendix 'A'; and
b. obtaining a written approval from the railway company that owns, operates or has control of the railway.
3.2 No person shall commence the repair, maintenance or removal of any pipe under a railway without obtaining a written approval from the railway company that owns, operates or has control of the railway.
3.3 Every owner of a pipe installed under a railway, shall at all times maintain the pipe in good working order and condition, so that:
a. the safety of railway operations is not threatened in any manner;
b. the safety of the public, including the lives, well-being and health of people is safeguarded; and
c. the environment is protected.

## 4. Requirements for Pipelines Crossing under Railways General

For oil and gas pipelines crossing under railways, the requirements of C.S.A. Standard Z662-99, and subsequent revisions, will apply as modified and amended in Section 5 herein.

For steam, water, sewer or other non-flammable substance pipelines crossing under railways, the requirements of Section 6 shall apply.

The term "Engineer" used herein means the Chief Engineer of the railway company or his authorized representative.
General: Railway design loading applicable to all pipelines crossing under railways shall be Cooper's E80 track loading, with diesel impact as specified in C.S.A. Standard Z662-99. The use of optional limits states design processes under C.S.A. Standard Z662-99 will not apply to the design of oil and gas pipelines crossing under railways.

## 5. Requirements for Oil and Gas Pipelines under Railways

### 5.1 Amend C.S.A. Standard Z662-99 Clause 4.7 Cover and Clearance Requirements as follows:

Table 4.8 "Minimum Cover and Clearance Requirements": In the case of oil and gas, and hazardous* gas pipelines crossing under railways, Table 4.8 shall be amended as follows:

Table 4.8: Minimum Cover and Clearance Requirements
(1) Minimum cover for buried pipelines, cm (measured to top of carrier or casing pipe, as applicable)

Minimum Cover and Clearance Requirements

| Location | Type of Pipeline | Class Location | Normal Excavatio n | Rock excavation requiring blasting or removal by comparable means |
| :---: | :---: | :---: | :---: | :---: |
| Crossings of railway rights-of-way: below base of rail** All tracks: |  |  |  |  |
| Cased | Flammable or hazardous* gas or liquid | All | 168 (5.5ft) | 168 (5.5ft) |
| Uncased | Flammable or hazardous* gas or liquid | All | $\begin{aligned} & 305 \\ & (10.0 \mathrm{ft}) \end{aligned}$ | 305 (10.0ft) |
| Crossings of railway rights-of-way: below bottom of ditches or ground surface*** |  |  |  |  |
| Cased | Flammable or hazardous* gas or liquid | All | 91 (3.0ft) | 91 (3.0ft) |
| Uncased | Flammable or hazardous* gas or liquid | All | 183 (6.0ft) | 183 (6.0ft) |
| Railway rights-of-way for cased or uncased buried longitudinal pipelines*** |  |  |  |  |
| Between 762cm and 1524 cm from centreline of nearest track | Flammable or hazardous* gas or liquid | All | 183 (6.0ft) | 183 (6.0ft) |
| Greater than 1524 cm from the centre-line of nearest track | Flammable or hazardous* gas or liquid | All | 152 (5.0ft) | 152 (5.0ft) |

* Non-flammable gas or liquid products which, from their nature or pressure, might cause damage or endanger the lives, well-being and health of people, or the environment, if escaping on or in the vicinity of railway property.
** Within 7 metres of centre of outside rail, measured at right angles to the centre-line of the track.
*** On portions of the right-of-way where carrier or casing pipe is not directly eneath any track.
5.2 Amend C.S.A. Standard Z662-99 Clause 4.7.1 as follows;

Add to end of Clause 4.7.1:

- For oil and gas pipelines crossing under railways, minimum cover requirements shall be in accordance with Table 4.8 of the referenced standard C.S.A. Z662-99, as amended herein. For any proposed pipeline crossing physically unable to meet the minimum cover requirements specified in Table 4.8 as amended herein, the applicant will propose alternative methods and shall obtain approval of the Engineer to use such methods.
5.3 Amend C.S.A. Standard Z662-99 as follows;

Add as a new Clause 4.8 .5 called "Pipe installation near railway bridges and buildings" the following:

- Pipelines carrying flammable or hazardous gas or liquids under railways shall not be placed within a culvert, under railway bridges nor closer than 13.7 m to any portion of any railway bridge, building or other important structure on a railway right-of-way, except in special cases and then by special design as approved by the Engineer.


## Add to Clause 10.2.2:

- Emergency response procedures shall be developed by the applicant to handle a situation in which a pipeline leak or railroad derailment or incident may jeopardize the integrity of the pipeline. Local conditions shall be considered when developing these procedures.


## Add to Clause 10.2.8.4:

- Oil and gas pipeline crossings shall be prominently identified where pipelines enter and exit railway right-of-way, approximately on the limits thereof, by signs in a language or languages appropriate to the region in which the sign is located. Such signs shall meet the requirements of C.S.A. Standard Z662-99, as amended herein. Additional signage will be required by the Engineer where the above signs are not readily visible from the track.

Add as a new Clause 4.4 .11 called "Emergency Shutoff Valves" the following:

- For oil and gas pipelines, accessible emergency shutoff valves shall be located each side of the railway within effective distances as mutually agreed to by the Engineer and the pipeline company. These valves shall be marked with signs for identification. Where pipelines are provided with automatic control stations and/or valves that are remotely operated, no emergency shutoff valves are required at the crossing.

Add as a new Clause 4.7 .4 called "Longitudinal installations" the following:

- Longitudinal oil and gas pipelines on the railway right-of-way shall be located as far as possible from any track. They shall not be within 7.62 m of the centre-line of any track, and shall be marked by a sign approved by the Engineer every 152.4 m and at every road crossing, streambed, other utility crossing, and at locations of major change in direction of the line. In exceptional situations, where it is not physically possible to locate the pipeline beyond 7.62 m of the centre-line of a track, the carrier pipe shall be encased or of special design and must be approved by the Engineer.
5.4 Amend C.S.A. Standard Z662-99 Table 4.9 "Least Nominal Wall Thickness for Steel Casing Pipe in Cased Crossings and Carrier Pipe in Uncased Crossings" as follows;

All least nominal wall thicknesses for steel casing pipe in cased crossings and steel carrier pipe in uncased crossings shall be as shown in Table 4.9, except that the least nominal wall thickness shall not be less than 4.8 mm in any case.

Add new Notes under Table 4.9, as follows:
Notes:
a. When steel casing pipe or carrier pipe is installed under a railway without benefit of a protective coating or is not cathodically protected, the least nominal wall thickness shown in Table 4.9 shall be increased by a minimum of 1.6 mm .
b. Steel casing or carrier pipe installed under a railway shall have a specified minimum yield strength of 241 Mpa or greater.
5.5 Amend C.S.A. Standard Z662-99 Clause 4.8 .3 "Crossings of Roads and Railways" as follows;

Add new item to Clause 4.8.3.3 Cased Crossings:
(h) Casing pipe and joints under railways shall be of leakproof construction capable of withstanding railway loadings specified herein, and shall be of steel unless otherwise indicated herein, or as approved by the Engineer.
5.6 Replace C.S.A Standard Z662-99 Clause 12.4.6 with the following:

Polyethylene carrier pipe may be used in pipeline systems for the transportation of gaseous hydrocarbons under railways if:
a. The design pressure does not exceed 700 kPa .
b. The carrier pipe is made from polyethylene materials permitted by C.S.A. Standard CAN/CSA-B137.4-92 (R1998), and subsequent revisions.
c. The outside diameter of the carrier pipe is not greater than 168.3 mm .
d. The polyethylene carrier pipe within the entire limits of the railway right-of-way, is encased in a steel casing pipe meeting the requirements of C.S.A Standard Z662-99, as amended herein.
5.7 Replace C.S.A. Standard Z662-99 Clause 15.4.5 with the following:

Aluminum pipe is not acceptable for use in pipeline crossings under railways.

## 6. Requirements for Steam, Water, Sewer and Other NonFlammable Substance Pipelines under Railways

### 6.1 Carrier and Casing Pipe Requirements

Pipelines carrying steam, water (other than oilfield steam and water), sewer, and other non-flammable or non-hazardous substances under railways shall be encased in a larger pipe or conduit called the casing pipe. Casing pipe may be omitted under the following conditions:
a. under secondary or industrial tracks as approved by the Engineer, provided maximum operating pressure in the carrier pipe does not exceed 700 kPa .;
b. for non-pressure sewer crossings where the strength of the pipe and its joints are capable of withstanding railway loading, as approved by the Engineer.

Carrier pipe, casing pipe, and joints shall conform to the applicable requirements of AREMA Ch. 1 Section 5.3 with respective materials in conformance with C.S.A. Standards, and be:
a. of acceptable material and construction as approved by the Engineer, and
b. of sufficient strength to withstand the internal pressure and external loading, and
c. properly connected at the joints and leakproof.

Joints for carrier line pipe shall be leakproof mechanical or welded type.

For steel carrier or casing pipe the least nominal wall thickness shall be in accordance with C.S.A. Standard Z662-99 as amended in Section 5 of this Pipeline Crossing Standard.

For pressures under 700 kPa in the carrier pipe, the casing pipe, if required, may be reinforced concrete pipe conforming to specifications in AREMA Manual for Railway Engineering Chapter 8 "Concrete Structures and Foundations", Part 10 "Reinforced Concrete Culvert Pipe", or coated corrugated metal pipe conforming to AREMA Manual Chapter 1, Part 4, all as approved by the Engineer. Respective materials shall conform to applicable C.S.A. standards.

### 6.2 Minimum Cover and Clearance Requirements

a) Minimum cover for buried pipelines, cm (measured to top of carrier or casing pipe, as applicable)

Minimum cover and clearance requirements for burried pipelines

| Location | Type of Pipeline | Class Locatio | Normal Excavation | Rock Excavation requiring blasting or removal by comparable means |
| :---: | :---: | :---: | :---: | :---: |
| Crossings of railway rights-of-way: below base of rail** Main tracks: |  |  |  |  |
| Cased | Water, sewer, steam or nonflammable or non-hazardous* substance | All | 168 (5.5 ft) or below frost line | 168 (5.5 ft) or below frost line |
| Crossings of railway rights-of-way: below base of rail** Second or Industrial Tracks: |  |  |  |  |
| Cased | Water, sewer, steam or nonflammable or non-hazardous* substance | All | 137 ( 4.5 ft ) or below frost line | 137 (4.5 ft) or below frost line |
| Uncased | Water, sewer, steam or nonflammable or non-hazardous* substance | All | 137 ( 4.5 ft ) or below frost line | 137 (4.5 ft) or below frost line |
| Crossings of railway rights-of-way below bottom of ditches or ground surface*** |  |  |  |  |
| Cased | Water, sewer, steam or nonflammable or non-hazardous* substance | All | $91(3.0 \mathrm{ft})$ or below frost line | 91 (3.0 ft) or below frost line |
| Uncased | Water, sewer, steam or nonflammable or non-hazardous* substance | All | 91 (3.0 ft) or below frost line | 91 (3.0 ft) or below frost line |
| Railway rights-of-way for cased or uncased buried longitudinal pipelines*** |  |  |  |  |
| Up to 1524 cm from centre-line of nearest track | Water, sewer, steam or nonflammable or non-hazardous* substance | All | 122 ( 4.0 ft ) or below frost line | 122 (4.0 ft) or below frost line |
| Greater than 1524 cm from centre-line of nearest track | Water, sewer, steam or nonflammable or non-hazardous* substance | All | 91 (3.0 ft) or below frost line | 91 (3.0 ft) or below frost line |

* Non-flammable gas or liquid products which, from their nature or pressure, might cause damage or endanger the lives, well-being and health of people, or the environment, if escaping on or in the vicinity of railway property.
** Within 7 metres of centre of outside rail, measured at right angles to the centre-line of the track.
*** On portions of the right-of-way where carrier or casing pipe is not directly beneath any track.


### 6.3 General Installation Requirements

For water and sewer crossings under railways, the highest point of carrier pipe shall be below the frost line. In regions of permafrost or where other obstacles make it impossible to place the pipe below the frost line, the applicant will propose alternate methods to protect the pipe in sub-freezing temperatures and shall obtain approval of the Engineer to use such methods.

Pipelines carrying steam, water (including oilfield steam and water), sewer and other non-flammable or non-hazardous substances under railways, shall not be placed within culverts nor under railway bridges where there is likelihood of restricting the area required for the purposes for which the culverts or bridges were built, or of endangering the foundations. Any such pipelines laid longitudinally on railway rights-of-way shall be located as far as practicable from any tracks or other important structures. If located within 7.62 metres of the centre-line of any track, or where there is significant risk of damage from leakage to any bridge, building or other important structure, the carrier pipe shall be encased or of special design as approved by the Engineer.

Every open drain crossing tracks in a railway yard shall be safely covered for at least 3.0 m from the centre-line of track, except in times of flood when uncovered open drains may be provided as may be necessary. In this case warning signs shall be erected.
C.S.A. Standards current at time of constructing the pipeline, shall govern the inspection and testing of the facility within the railway rights-of-way. The proof testing of the strength of carrier pipe shall be in accordance with C.S.A requirements.

## Appendix A: Plans and Design Requirements for Pipelines Crossing under Railways

For all pipeline crossings under railways (including oil and gas, steam, water, sewer, storm drain, etc.), plans for proposed installation shall be submitted to and meet the approval of the Engineer before construction is begun.

Plans shall be drawn to scale showing the relation of the proposed pipeline to railway tracks, angle of crossing, location of nearest shut-off valves, railway mileage, right-of-way lines and general layout of tracks and railway structures and facilities. Plans should also show a cross-section (or sections) from field survey, showing pipe in relation to actual profile of ground and tracks, with location of any joints in the carrier or casing pipe within the railway right-of-way, and necessary geotechnical boreholes (soil type) and ground water levels. Pipelines shall be installed under tracks by boring and/or jacking, if practicable. If open-cutting or tunneling is approved, the proposed limits of excavation, details of sheeting and method of supporting tracks or driving tunnel shall be shown, with supporting engineering calculations.

In addition to the above, plans should contain the following data:

- Railway Mileage \& Subdivision
- Municipal Descriptions of Adjoining Properties
- Name of Pipeline Owner

| Data | Carrier Pipe | Casing Pipe |
| :--- | :--- | :--- |
| Contents to be handled |  |  |
| Outside Diameter |  |  |
| Pipe Material |  |  |
| Specification and grade |  |  |
| Wall thickness |  |  |
| Maximum Operating Pressure |  |  |
| Maximum Surge \& Test Pressure |  |  |
| Maximum Operating Temperature |  |  |
| Minimum Operating Temperature |  |  |
| Type of joint |  |  |
| Coating |  |  |
| Method of installation |  |  |

## Vents:

- Number
- Size
- Height above ground


## Seals:

- Both ends
- Type


## Other Information:

- Bury: Base of rail to top of casing (m)
- Bury: (Not beneath tracks) (m)
- Bury: (Roadway ditches) (m)
- Extent of casing measured perpendicular to centre-line of track (m)
- Type, size and spacing of insulators or supports (m)
- Distance C.L. track to face of jacking/receiving pits (m)
- Bury: Base of rail to bottom jacking/receiving pits (m)
- Cathodic Protection: yes/no
- Geotechnical Boreholes: yes/no
- Soil Type:
- Base of Rail to ground water (m)

Plans shall be sealed and signed by a professional engineer, competent in this field, registered in the province or territory in which the pipeline crossing is located.

The execution of work on railway rights-of-way, including the supporting of tracks, shall be subject to the inspection and direction of the Engineer.

Where laws or orders of public authority prescribe a higher degree of protection than specified herein, then the higher degree of protection so prescribed shall be deemed a part of this Standard.

Date Modified: 2009-08-27

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Storm Sewer Specifications
-OD-1500mm

- Material -Reinforced Concrete C-76, Jacking Pipe, CLASSV
- Joints - Steel Belt Bands
- Trenchless installation From MH5 to MH6
-85 m @ $0.20 \%$ grade
- Gravity Storm Sewer Line (non-pressure)
- OWNER - TOWN OF MUNDARE

NB - INSTALLATION AND MAINTENANCE TO BE IN ACCORDANCE WITH TC E10.

$S_{\text {AMPLE }}$
UNCASED
EWER CROSSING
SEWER CROSSI


## Appendix F

 Alberta Transportation Guidelines
# A $\square$ LICATION $\square$ ROCEDURES FOR LACEMENT OF UNDERGROUND WATER AND SEWER $\square \square E L I N E S$ IN THE $\square$ ICINITY OF TRANS $\square$ ORTATION FACILITIES UNDER THE URISDICTION OF AL $\square$ ERTA TRANS $\square$ ORTATION 

1.0 Application Procedures
2.0 General Construction Guidelines
$\mathrm{F} \square \mathbf{r} \square \mathbf{r} \square \square \square \mathbf{1}$

## 1. A LICATION ROCEDURES

Applications for crossing of highways under the jurisdiction of Alberta Transportation by sewer and/or water pipelines shall be submitted to the appropriate Regional Office.

The applicant shall allow minimum 30 working days for the application processing.

Application for water and/or sewer crossing public roads other than highways within the boundaries of any Municipal District or County shall be submitted to the appropriate Municipality.

### 1.01 APPLICATION REQUIREMENTS

The application should clearly state the purpose of the application, the type of the facility, method of construction, and provide the legal land description, number of the highway involved, and particulars of the contact person responsible for the application. In case of sewer lines it should also state whether the line is for sanitary sewage or storm drainage.

Incomplete applications without proper documentation will be returned without review.

A copy of the permit issued shall be provided to the contractor and made available for verification at the construction site at all times.

No construction may be undertaken without a valid permit.
Only work covered by original permit can be performed at the site. Any additional work, variation or change from the proposal covered by the original permit requires additional approval(s).

Each of the drawings submitted with the application shall have a number for reference purposes.

The application should contain a key plan showing proposed crossing location(s) and two (2) copies of the crossing plan for each proposed crossing. Attached to these procedures are sample crossing plans.

Each crossing plan shall include:

1) Key plan at a suggested scale of 1:10,000 indicating legal land description for the proposed crossing including appropriate section number, township, range;
2) Detail plan of the crossing at a minimum scale of 1:1000 showing: a dimensional tie along the centre-line of the highway or road to the known point, the proposed angle of the crossing and the pipeline alignment to a minimum distance of 50 metres on each side of the highway right-of-way;
3) Proposed surveyed cross-section of the crossing at a minimum horizontal scale of 1:200 and vertical 1:100.

The cross-section has to show:
a) Width of the existing highway right-of-way,
b) Width of proposed highway right-of-way (if known),
c) Type of road surface, e.g. paved, graveled or dirt,
d) Slope pipe below highway (maximum 1:120), and
e) Minimum depth of cover - (i) 1.4 metres for sewer, and (ii) 2.5 metres for water line throughout the highway right-of-way and within 30 metres each side of its right-of-way boundaries;
4) Profile along the centre-line of the highway or road for minimum distance of 400 metres in each direction from the crossing at a minimum horizontal scale of 1:5000 and vertical 1:200; and
5) Pipe specifications of pipeline at the crossing site, including:
I. Carrier pipe specifications:
a) Outside diameter,
b) Wall thickness,
c) Maximum operating pressure,
d) Minimum yield strength of pipe, and
e) Fittings, if any.
II. Casing pipe specifications (cased crossings only):
a) Outside diameter,
b) Wall thickness, and
c) Minimum yield strength and information if a casing pipe is new or used.

## . GENERAL CONSTRUCTION GUIDELINES

### 2.01 CONSTRUCTION COMMENCEMENT AND COMPLETION

The applicant shall contact the appropriate Operations Manager or Development and Planning Technologist at least two working days prior to commencement of construction to review the project.

The applicant shall contact the appropriate Operations Manager or Development and Planning Technologist at least two working days prior to construction completion to allow for site inspection if required.

### 2.02 PARALLEL PIPELINE

No pipeline right-of way or easement shall be placed less than 30 metres parallel to a highway unless prior approval is obtained from the appropriate Operations Manager.

### 2.03 CROSSING UNDER PAVEMENT - METHOD OF CROSSING

## The open cut method for pipeline installation at any highway is not permitted.

The crossing of highway and pavement surfaces shall be constructed by boring or jacking methods in such a manner that the road grade is not disturbed.

The proposed method of installation shall be shown on the plan of the crossing attached to the application.
2.04 MINIMUM DEPTH OF COVER ON THE HIGHWAY OR ROAD RIGHT-OF-WAY

The minimum depth of cover over the pipeline where it crosses the right-of-way of a highway or a road shall be 2.5 metres for water and 1.4 metres for sewer lines under the lowest point in the cross-section.
2.05 INTERSECTION ANGLE OF PIPELINE CROSSING OF THOROUGHFARE

The desirable angle of crossing is between 70 and 90 degrees; however other angles may also be accepted in special circumstances.

### 2.06 SLOPE OF PIPELINE CROSSING

The pipeline shall be placed from one end to the other with a maximum gradient of 1 in 120.

### 2.07 HORIZONTAL AND VERTICAL PIPELINE BENDS

No horizontal and/or vertical pipe bends are permitted throughout the right-ofway and within 30 metres of the right-of-way boundaries of a provincial highway, unless approval is obtained from the appropriate Operations Manager.

### 2.08 CASED CROSSING

Where casing is required, it shall be continuous and inserted by boring or driving or other approved method.

### 2.09 DIAMETER OF CASING

The diameter of the casing shall be at least 5 centimetres greater (2") than the diameter of the carrier pipe. An exception to this is steel casing of polyethylene pipe, where the next size diameter of pipe may be used.
2.10 MINIMUM LENGTH OF CASING

The casing shall extend across full width of the highway right-of-way.

### 2.11 SEALED CASING

The casing shall be satisfactorily sealed to the carrier pipe at both ends.

### 2.12 CASING NOT TO CARRY OTHER UTILITIES

No cables of any kind shall be placed within the casing of any pipeline.

### 2.13 VENTING OF CASING PIPE

Vents shall not be placed within the limits of the highway right-of-way.
2.14 BORED OR AUGURED CROSSING

Casing shall be fitted into a bored or augured hole of such diameter as to provide a snug fit for the casing.
2.15 BORE SIZE

The bore size for heavy wall pipe shall be no more than one pipe size larger than the installed pipe. If the bore is larger than one pipe size, a pipe of the bore size shall be installed to form a cased crossing.

### 2.16 BORING IN NON-COHESIVE SOILS

Closed boring method shall be used in non-cohesive soil conditions.
2.17 DRAINAGE STRUCTURE

A pipeline shall not run through a culvert or drainage structure.

### 2.18 PIPELINE ATTACHMENTS TO BRIDGE STRUCTURES

No pipeline shall be attached to bridge structure without the written consent of the appropriate Regional Bridge Engineer.

### 2.19 OPEN EXCAVATION, MATERIAL AND EQUIPMENT STORAGE

No open excavation shall be constructed, nor shall any material or equipment be deposited or stored any closer than 6 metres of a bridge or earth retaining structure (without special consent of the appropriate Regional Bridge Engineer), and 4 metres from the shoulder break of a highway, or a toe of sideslope, whichever distance is greater.

### 2.20 BACKFILLING OF OPEN TRENCHES

The backfilling of all trenches in the highway right-of-way or within 6 metres of bridge pier or earth retaining structure shall be undertaken immediately after the installation has been placed and passed any necessary inspection. Backfill materials shall be thoroughly compacted with mechanical compactors and the owner of the pipeline will be held responsible for any settling in backfill for a period of three years after the completion of the work.

### 2.21 WASTE MATERIAL

All waste material shall be removed and all disturbed areas shall be leveled and trimmed in approved manner and re-seeded where necessary to restore the right-of-way to at least as good as original or better conditions.

### 2.22 WORK IN THE MEDIAN

No work shall be undertaken in the median of a divided highway unless approved by the appropriate Operations Manager.

### 2.23 WATER LINES -- CONSTRUCTION MATERIALS

A heavy wall continuous steel or heavy wall continuous P.E. pipe shall be used for uncased water lines located beneath the road.

Should a cased plastic pipe be used it must be installed in an outer continuous casing and adequately supported at the point where it leaves the casing in order to prevent sheering.

### 2.24 <br> MANHOLES

Manholes located within the highway right-of-way shall be placed flush with the adjacent ground.

### 2.25 MANHOLES IN THE ROADWAY SIDESLOPES

No manholes shall be placed in the sideslopes unless special approval is obtained from the appropriate Operations Manager.

### 2.26 MANHOLES IN THE MEDIAN

No manholes shall be located within the centre median of multi-lane highways unless a special permit is obtained from the appropriate Operations Manager.

### 2.27 CONSTRUCTION SAFETY

All reasonable precautions shall be undertaken during construction to protect and safeguard public safety and property owners. This includes barricading, signing and flagpersons as required, to protect and safeguard the lives and property of the travelling public and adjacent property owners. At no time shall the highway or public roadway be closed to traffic. Where normal traffic patterns are to be interrupted due to ditching or other operations, prior approval must be first obtained. Suitable signs shall be erected and if required, a flagperson(s) shall be used to direct traffic through the disruption area as approved by the appropriate Operations Manager.

No work is to be conducted during darkness or when there is reduced visibility.

### 2.28 CONSTRUCTION SIGNING

Contractors are to meet the requirements of the latest edition of the Traffic Accommodation in Work Zones 2008 ( $1^{\text {st }}$ Edition) manual published by Alberta Transportation. The manual is available on the internet at www.transportation.alberta.ca/3815.htm .

If the signing requirements are not met, the appropriate Operations Manager or his representatives have the right to halt all construction until proper signing is erected. The signs are to be removed immediately following construction completion.
2.29 MODEL AGREEMENTS

There is no model agreement available at this time.



## Appendix G <br> Land Assessment Report



605-50th Street, P.O. Box 6300 Edson, Alberta T7E 1T7

\#100, 7909-51 Avenue NW, Edmonton, AB T6E 5L9

Prepared for: $\square \square \square \mathbf{K} \square \square \square \mathbf{r}$
T: 780.438.9000 / F: 780.438.3700 / E-mail: JKercher@islengineering.com


100, 11634 - 142 St, Edmonton, AB T5M 1V4
Prepared by: $\mathbf{S} \square \square \mathbf{L} \square \mathbf{d} \square \mathbf{L} \square \square \square \mathbf{L d}$.
100, 11634 - 142 St, Edmonton, AB T5M 1V4 / T 780-428-2212 / Fax 780-425-5263 / E-mail edmonton@scottland.ca

| $\mathbf{H} \square \mathbf{d} \square \square$ | $\square \square \square \square$ |
| :--- | :--- |
| $\mathbf{C} \square \square \mathbf{r} \square \square \square$ | 1 |



3

- Compensation Analysis (inserted)
- Limiting Conditions

- Review \& Valuation (inserted drawing)
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- Review \& Valuation (inserted drawing)

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- Review \& Valuation (inserted drawing)

- Review \& Valuation (inserted drawing)
$0 \square \mathbf{r m a}$ $\square 1$
- Preliminary Alignment Option 1
- Preliminary Alignment Option 2
- Preliminary Alignment Option 3
- Preliminary Alignment Option 4

Preliminary Alignment Options: 1 to 4; Review \& Valuation March 20, 2014

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See the following inserted page.

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The values provided are intended to aid in the functional evaluation of this specific study. These values are not provided for use in the acquisition of right-of-way or temporary workspace associated with this or any other project. This report and the values provided within are not to be considered an appraisal.

| Parcel Sizes |  |  |  |  |  |  | under 1 |  | $\begin{aligned} & \text { Zoning Details } \\ & \text { DC: Direct Control } \\ & \text { UR: Urban } \\ & \text { GSI - C: Glenwood Service Industr. } \\ & \text { M - 1A: Light Industrial (Serviced) } \\ & \text { CS: Community Services } \end{aligned}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 80 to 160+ | 40 to 80 | 20 to 40 | 10 to 20 | 5 to 10 | 2.5 to 5 | 1 to 2.5 |  |  |  |  |
| 104.1 | 61.73 | 24.01 | 14.55 | 9.63 | 4.82 | 2.19 | 0.68 |  |  |  |
| 119.305 | 46.06 | 26.56 | 15.56 | 9.63 | 3 | 2.07 | 0.68 |  |  |  |
| 214.944 | 47.83 | 26.46 | 16.53 | 8.77 | 3.19 | 1.99 | 0.68 |  |  |  |
| 104.1 | 46.06 | 26.46 | 14.11 | 5.56 | 4.74 | 2.03 | 0.9 |  |  |  |
| 119.305 | 61.04 | 40.04 | 10.16 | 9.63 | 2.89 | 1.31 | 0.82 |  |  |  |
| 160 | 40.04 |  | 14.55 | 8.77 | 4.82 | 2.07 | 0.99 |  |  |  |
| 114.39 | 61.73 |  | 15.56 | 9.63 | 3 | 2.08 | 0.68 |  |  |  |
| 214.944 | 46.06 |  |  |  | 3.19 | 1.31 | 0.68 |  |  |  |
| 104.1 | 61.04 |  |  |  | 2.89 | 1.1 | 0.68 |  |  |  |
| 119.305 |  |  |  |  |  | 1.1 | 0.9 |  |  |  |
| 214.944 |  |  |  |  |  | 1.1 |  |  |  |  |
| 104.1 |  |  |  |  |  | 1.22 |  |  |  |  |
| 119.305 |  |  |  |  |  | 1.11 |  |  |  |  |
| 214.944 |  |  |  |  |  | 1.98 |  |  |  |  |
| 160 |  |  |  |  |  | 2.19 |  |  |  |  |
| 214.944 |  |  |  |  |  | 2.07 |  |  |  |  |
|  |  |  |  |  |  | 1.99 |  |  |  |  |
|  |  |  |  |  |  | 2.03 |  |  |  |  |
|  |  |  |  |  |  | 1.31 |  |  |  |  |


|  | Valuation per Acre |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Market Value | 6 แ\|rav |  | 1 1-10\|c|l| | - | - | - | प\| |  |
| Temp Workspace | H M | H $\square$ | $\mathbf{H} \square$ | Fm\|r | F | F | $\mathbf{F} \quad \mathrm{m}$ <br> Tาा | F |
|  |  |  |  |  |  |  |  |  |
|  |  | N/A; Cemetery |  |  | N/A; ER |  |  |  |
|  | N/A; Railway |  |  |  |  |  |  |  |
|  |  |  |  |  |  | N/A; Railway |  |  |
|  |  |  |  | Extrapolated, limited current sales or listings in this cateaorv | Extrapolated, limited current sales or listings in this cateaorv |  |  |  |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation March 20, 2014

(Reference Drawing; 13890-AL 1 161213.pdf)

See the following inserted drawing.



| ISL Engineering | 镇Edson. |  | EDSON WEST SANITARY TRUNK MAIN | LEGENO <br> gravtr sewer | FIGURE A1 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | ALIGNMENT 1 | - forceman |  |
|  |  |  |  | ExStTMG Ground | DECCmER, 2013 |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation
March 20, 2014

## 



| Legal Description: | $0122165 ; 1 ; 9$ |
| :--- | :--- | :--- |
| LINC\#: | 0030789663 |
| Parcel Size: | 104.1 ac |
| Picture reference \#(s): | 1 |
| Picture(s): |  |
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| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 18 ;$ SE |
| LINC\#: | 0022037618 |
| Parcel Size: | 9.63 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.298 ac |
| Zoning: | UR |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


| Legal Description: | $5 ; 17 ; 53 ; 18 ;$ SE |
| :--- | :--- |
| LINC\#: | 0022037592 |
| Parcel Size: | 119.305 ac |
| Picture reference \#(s): | 2 |
| Picture(s): |  |
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| Legal Description: | $0125979 ; 8 ; 3$ |
| :--- | :--- |
| LINC\#: | 0029127685 |
| Parcel Size: | 2.19 ac |
| Picture reference \#(s): | 3 |
| Picture(s): |  |
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| Legal Description: | $9920048 ; 8 ; 2$ |
| :--- | :--- |
| LINC\#: | 0029127677 |
| Parcel Size: | 4.82 ac |
| Picture reference \#(s): | 4 |
| Picture(s): |  |
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| :--- | :--- |
| Legal Description: | $5756 \mathrm{HW} ; 8 ; \mathrm{P}$ |
| LINC\#: | 0016621690 |
| Parcel Size: | 2.07 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.113 ac |
| Zoning: | GSI-C |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


| Legal Description: | $5756 \mathrm{HW} ; 7 ; 1$ |
| :--- | :--- | :--- |
| LINC\#: | 0014909691 |
| Parcel Size: | 0.68 ac |
| Picture reference \#(s): | 5 |
| Picture(s): |  |
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| Legal Description: | $9620096 ; 7 ; 6$ |
| :--- | :--- | :--- |
| LINC\#: | 0026622472 |
| Parcel Size: | 068 ac |
| Picture reference \#(s): | 5 |
| Picture(s): |  |
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| Legal Description: | $9620096 ; 7 ; 5$ |
| :--- | :--- | :--- |
| LINC\#: | 0026622464 |
| Parcel Size: | 0.68 ac |
| Picture reference \#(s): | 5 |
| Picture(s): |  |
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| Legal Description: | $9620096 ; 7 ; 4$ |
| :--- | :--- | :--- |
| LINC\#: | 0026622457 |
| Parcel Size: | 0.9 ac |
| Picture reference \#(s): | 5 |
| Picture(s): |  |
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| Legal Description: | 3344 TR;11;3 |
| :--- | :--- |
| LINC\#: | 0016287682 |
| Parcel Size: | 1.99 ac |
| Picture reference \#(s): | 6 |
| Picture(s): |  |
|  |  |
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|  |  |
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| Legal Description: | 3344TR;11;2 |
| :---: | :---: |
| LINC\#: | 0016287690 |
| Parcel Size: | 3 ac |
| Picture reference \#(s): | 6 |
| Picture(s): |  |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.46 ac |
| Zoning: | M-1A |
| Valuation: | \$10,000.00 |
| Additional Notes: | Chain link fence replacement (not valuated), damages for office trailer relocation during utilization of TWS $(\$ 5,000.00)$ |


| Legal Description: | 3344 TR;11;1 |
| :--- | :--- |
| LINC\#: | 0013183934 |
| Parcel Size: | 3.19 ac |
| Picture reference \#(s): | 6 |
| Picture(s): |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  | Inside Municipal or Provincial Roadway |
| Estimated ROW area |  |
| required (ac): | 0.46 ac |
| Estimated TWS area |  |
| required (ac): |  |


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| :--- | :--- |
| Legal Description: | 6389 LZ;OT |
| LINC\#: | 0016257230 |
| Parcel Size: | 14.55 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.852 ac |
| Zoning: | M-1A |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


| Legal Description: | $5314 Z ; \mathrm{B}$ |
| :--- | :--- |
| LINC\#: | 0015924111 |
| Parcel Size: | 15.56 ac |
| Picture reference \#(s): | 7 |
| Picture(s): |  |
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|  | Legal Description: |
| :--- | :--- |
| LINC\#: | 0016 Z 732596 |
| Parcel Size: | 61.73 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 1.114 ac |
| Zoning: | CS |
| Valuation: | N/A |
| Additional Notes: | Cemetery, if Town or County owned may not require valuation for <br> TWS, approval required from Director of Cemeteries in Service <br> Alberta, heavily treed, otherwise vacant |
|  |  |


| Legal Description: | 8022726;201;2 |
| :---: | :---: |
| LINC\#: | 0012062220 |
| Parcel Size: | 2.03 ac |
| Picture reference \#(s): | 8 |
| Picture(s): |  |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.175 ac |
| Zoning: | C2 |
| Valuation: | \$5,000.00 |
| Additional Notes: | Some minor landscaping damages, otherwise vacant |





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| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 16 ;$ SW |
| LINC\#: | 0011091650 |
| Parcel Size: | 46.06 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | 1.721 ac |
| Estimated TWS area required (ac): | 6.181 ac |
| Zoning: | UR |
| Valuation: | \$48,115.00 |
| Additional Notes: | Vacant |
|  |  |


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| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 16 ;$ SE |
| LINC\#: | 0021983755 |
| Parcel Size: | 47.83 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | 1.236 ac |
| Estimated TWS area required (ac): | 4.655 ac |
| Zoning: | UR |
| Valuation: | $\$ 47,995.00$ |
| Additional Notes: | Largely vacant and heavily treed, potential impact with <br> improvement on east end (uninspected) |
|  |  |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation March 20, 2014

(Reference Drawing; 13890-AL 2 161213.pdf)

See the following inserted drawing.


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|  |  |
| :--- | :--- |
| Legal Description: | $0122165 ; 1 ; 9$ |
| LINC\#: | 0030789663 |
| Parcel Size: | 104.1 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | 2.214 ac |
| Estimated TWS area required (ac): | 5.939 ac |
| Zoning: | DC |
| Valuation: | $\$ 31,101.00$ |
| Additional Notes: | Assume TWS will be adjusted to avoid impacting the <br> improvement, no damages valuated. |
|  |  |


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| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 18 ;$ SE |
| LINC\#: | 0022037618 |
| Parcel Size: | 9.63 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | 0.27 ac |
| Estimated TWS area required (ac): | 0.372 ac |
| Zoning: | UR |
| Valuation: | $\$ 15,800.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | 4513RS;;A |
| LINC\#: | 0015120835 |
| Parcel Size: | 24.01 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | 0.55 ac |
| Estimated TWS area required (ac): | 0.970 ac |
| Zoning: | UR |
| Valuation: | \$15,525.00 |
| Additional Notes: | Vacant |
|  |  |


| Legal Description: | $5 ; 17 ; 53 ; 18 ;$ SE |  |
| :--- | :--- | :--- |
| LINC\#: | 0022037592 |  |
| Parcel Size: | 119.305 ac |  |
| Picture reference \#(s): | 2 |  |
| Picture(s): |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  | 0.825 ac |  |


| Legal Description: | 5;17;53;8;NW |
| :---: | :---: |
| LINC\#: | 0019088830 |
| Parcel Size: | 26.56 ac |
| Picture reference \#(s): | 10 |
| Picture(s): |  |
| Estimated ROW area required (ac): | 0.614 ac |
| Estimated TWS area required (ac): | 2.27 ac |
| Zoning: | UR |
| Valuation: | \$33,235.00 |
| Additional Notes: | Proximity damages to dwelling, power lines also in close proximity and damages for shelter belt tree loss $(\$ 7,000.00)$ |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
| Legal Description: | $8520288 ; 1 ; 1$ |
| LINC\#: | 0011065993 |
| Parcel Size: | 16.53 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | 0.034 ac |
| Estimated TWS area required (ac): | 0.150 ac |
| Zoning: | UR |
| Valuation: | $\$ 5,850.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 8 ; \mathrm{NW}$ |
| LINC\#: | 0027842889 |
| Parcel Size: | 26.46 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | 0.614 ac |
| Estimated TWS area required (ac): | 2.27 ac |
| Zoning: | UR |
| Valuation: | $\$ 28,735.00$ |
| Additional Notes: | Damages for relocation of stored equipment $(\$ 2,500.00)$ |
|  |  |


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| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 8 ; \mathrm{NE}$ |
| LINC\#: | 0021986583 |
| Parcel Size: | 8.77 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | 0.767 ac |
| Estimated TWS area required (ac): | 2.273 ac |
| Zoning: | UR |
| Valuation: | $\$ 35,680.00$ |
| Additional Notes: | Vacant |
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Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
| Legal Description: | $9524985 ; 1 ; 1$ |
| LINC\#: | 0026588807 |
| Parcel Size: | 4.74 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | N/A |
| Estimated TWS area required (ac): | 0.751 ac |
| Zoning: | UR |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 16 ;$ SW |
| LINC\#: | 0011091650 |
| Parcel Size: | 46.06 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.98 ac |
| Zoning: | UR |
| Valuation: | $\$ 4,900.00$ |
| Additional Notes: | Vacant |


|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 9 ; \mathrm{NW}$ |
| LINC\#: | 0021720420 |
| Parcel Size: | 61.04 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.984 ac |
| Zoning: | UR |
| Valuation: | $\$ 4,920.00$ |
| Additional Notes: | Vacant |
|  |  |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 16 ;$ SE |
| LINC\#: | 0021983762 |
| Parcel Size: | 40.04 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.978 ac |
| Zoning: | UR |
| Valuation: | $\$ 4,890.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 9 ; \mathrm{NE}$ |
| LINC\#: | 0017174582 |
| Parcel Size: | 160 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.984 ac |
| Zoning: | UR |
| Valuation: | $\$ 2,952.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $8720609 ; 1 ; 2$ |
| LINC\#: | 0010642262 |
| Parcel Size: | 2.07 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.098 ac |
| Zoning: | M1B |
| Valuation: | $\$ 7,500.00$ |
| Additional Notes: | Uninspected fencing likely impacted (not valuated), damages for <br> relocation of vehicles during TWS utilization (\$2,500.00) |
|  |  |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
| Legal Description: | $8720609 ; 1 ; 1$ |
| LINC\#: | 0010607083 |
| Parcel Size: | 2.08 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.098 ac |
| Zoning: | $\mathrm{M}-1 \mathrm{~B}$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $0124430 ; 3 ; 2 \mathrm{ER}$ |
| LINC\#: | 0029013877 |
| Parcel Size: | 5.56 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.196 ac |
| Zoning: | ER |
| Valuation: | N/A |
| Additional Notes: | Environmental Reserve |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $0124430 ; 3 ; 1$ |
| LINC\#: | 0029013869 |
| Parcel Size: | 14.11 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.207 ac |
| Zoning: | $\mathrm{M}-2$ |
| Valuation: | $\$ 7,500.00$ |
| Additional Notes: | Uninspected fencing likely impacted (not valuated), damages for <br> relocation of vehicles during TWS utilization (\$2,500.00) |
|  |  |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 15 ;$ SW |
| LINC\#: | 0029013852 |
| Parcel Size: | 114.39 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.033 ac |
| Zoning: | UR |
| Valuation: | \$500.00 (minimum payment) |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $9826359 ; ; 1$ |
| LINC\#: | 0027779495 |
| Parcel Size: | 2.89 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.13 ac |
| Zoning: | $\mathrm{M}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $1118 \mathrm{CL} ; \mathrm{OT}$ |
| LINC\#: | 0027 779 487 |
| Parcel Size: | 214.944 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.245 |
| Zoning: | M-2 |
| Valuation: | N/A |
| Additional Notes: | Acquisition likely not required, should be nominally approved <br> through railway encroach permit |
|  |  |


(Reference Drawing; 13890-AL 3 161213.pdf)

See the following inserted drawing.



| Engineering | 䇾EAson.un |  | EDSON WEST SANITARY TRUNK MAIN | $\frac{\text { LEGEND }}{\text { GRAVITY SEWER }}$ | FIGURE A3 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | ALIGNMENT 3 |  |  |
|  |  | - - = |  | - Exsting grouno | DCCEMEE, 2013 |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation
March 20, 2014

## 



| Legal Description: | $0122165 ; 1 ; 9$ |  |
| :--- | :--- | :--- |
| LINC\#: | 0030789663 |  |
| Parcel Size: | 104.1 ac |  |
| Picture reference \#(s): | 1 |  |
| Picture(s): |  |  |
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|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 18 ;$ SE |
| LINC\#: | 0022037618 |
| Parcel Size: | 9.63 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.296 ac |
| Zoning: | UR |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


| Legal Description: | $5 ; 17 ; 53 ; 18 ;$ SE |
| :--- | :--- |
| LINC\#: | 0022037592 |
| Parcel Size: | 119.305 ac |
| Picture reference \#(s): | 2 |
| Picture(s): |  |
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| Legal Description: | $5 ; 17 ; 53 ; 8 ; \mathrm{NW}$ |
| :--- | :--- |
| LINC\#: | 0027842889 |
| Parcel Size: | 26.46 ac |
| Picture reference \#(s): | 11 |
| Picture(s): |  |
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| Legal Description: | $5 ; 17 ; 53 ; 8 ; \mathrm{NE}$ |
| :--- | :--- |
| LINC\#: | 0021986583 |
| Parcel Size: | 8.77 ac |
| Picture reference \#(s): | 12 |
| Picture(s): |  |
|  |  |
|  |  |
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Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
| Legal Description: | $9521371 ; ; 34$ |
| LINC\#: | 0026361162 |
| Parcel Size: | 1.31 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.725 ac |
| Zoning: | $\mathrm{C}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |
|  | $9521371 ; ; 33$ |
|  | 0026361155 |
| Legal Description: | 1.1 ac |
| LINC\#: | $\mathrm{N} / \mathrm{A}$ |
| Parcel Size: | $\mathrm{N} / \mathrm{A}$ |
| Picture reference \#(s): | Picture(s): |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.122 ac |
| Zoning: | $\mathrm{C}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $1322934 ; 200 ; 1 \mathrm{C}$ |
| LINC\#: | 0035727361 |
| Parcel Size: | 10.16 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.911 ac |
| Zoning: | $\mathrm{C}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


| Legal Description: | $8022726 ; 200 ; 11$ |
| :--- | :--- | :--- |
| LINC\#: | 0012059366 |
| Parcel Size: | 0.82 ac |
| Picture reference \#(s): | 13 |
| Picture(s): |  |
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Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
|  | $9521371 ; ; 26$ |
| Legal Description: | 0026361089 |
| LINC\#: | 1.1 ac |
| Parcel Size: | $\mathrm{N} / \mathrm{A}$ |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | Inside Municipal or Provincial Roadway |
| Estimated ROW area required (ac): | Inse\| |
| Estimated TWS area required (ac): | 0.222 |
| Zoning: | $\mathrm{C}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |
|  | $9521371 ; ; 25$ |
|  | 0026361071 |
| Legal Description: | 1.1 ac |
| LINC\#: | $\mathrm{N} / \mathrm{A}$ |
| Parcel Size: | $\mathrm{N} / \mathrm{A}$ |
| Picture reference \#(s): | Picture(s): |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.226 ac |
| Zoning: | $\mathrm{C}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $9521371 ; ; 24$ |
| LINC\#: | 0026361063 |
| Parcel Size: | 1.1 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.226 ac |
| Zoning: | $\mathrm{C}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Proximity to improvement |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
|  | $9521371 ; ; 23$ |
| Legal Description: | 0026361056 |
| LINC\#: | 0.99 ac |
| Parcel Size: | $\mathrm{N} / \mathrm{A}$ |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | Inside Municipal or Provincial Roadway |
| Estimated ROW area required (ac): | Ins |
| Estimated TWS area required (ac): | 0.203 ac |
| Zoning: | $\mathrm{C}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |
|  | $9521371 ; ; 22$ |
|  | 0026361048 |
| Legal Description: | 1.22 ac |
| LINC\#: | $\mathrm{N} / \mathrm{A}$ |
| Parcel Size: | $\mathrm{N} / \mathrm{A}$ |
| Picture reference \#(s): | Picture(s): |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.249 ac |
| Zoning: | $\mathrm{C}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $9521371 ; ; 21$ |
| LINC\#: | 0026361030 |
| Parcel Size: | 1.11 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.226 ac |
| Zoning: | $\mathrm{C}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $9521371 ; ; 20$ |
| LINC\#: | 0027380435 |
| Parcel Size: | 1.98 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.158 ac |
| Zoning: | M1A |
| Valuation: | \$5,000.00 |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $1118 \mathrm{CL} ; \mathrm{OT}$ |
| LINC\#: | 0027779487 |
| Parcel Size: | 214.944 |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.899 ac |
| Zoning: | M-2 |
| Valuation: | N/A |
| Additional Notes: | Acquisition likely not required, should be nominally approved <br> through railway encroach permit |
|  |  |

(Reference Drawing; 13890-AL 4 161213.pdf)

See the following inserted drawing.


| 15L Engineering | 榫Edson |  | EDSON WEST SANITARY TRUNK MAIN | LEGEND <br> GRAVITY SEWER | FIGURE A |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | ALIGNMENT 4 | - forcenain |  |
|  |  |  |  | ExSting grouno | EECEMEER, 2013 |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation
March 20, 2014

## 



| Legal Description: | $0122165 ; 1 ; 9$ |  |
| :--- | :--- | :--- |
| LINC\#: | 0030789663 |  |
| Parcel Size: | 104.1 ac |  |
| Picture reference \#(s): | 1 |  |
| Picture(s): |  |  |
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|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 18 ;$ SE |
| LINC\#: | 0022037618 |
| Parcel Size: | 9.63 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.298 ac |
| Zoning: | UR |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


| Legal Description: | $5 ; 17 ; 53 ; 18 ;$ SE |
| :--- | :--- |
| LINC\#: | 0022037592 |
| Parcel Size: | 119.305 ac |
| Picture reference \#(s): | 2 |
| Picture(s): |  |
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| Legal Description: | $0125979 ; 8 ; 3$ |
| :--- | :--- | :--- |
| LINC\#: | 0029127685 |
| Parcel Size: | 2.19 ac |
| Picture reference \#(s): | 3 |
| Picture(s): |  |
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|  | Legal Description: |
| :--- | :--- |
| LINC\#: | $0920048 ; 8 ; 2$ |
| Parcel Size: | 4.82 ac |
| Picture reference \#(s): | 4 |
| Picture(s): |  |
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|  |  |
| :--- | :--- |
| Legal Description: | $5756 \mathrm{HW} ; 8 ; \mathrm{P}$ |
| LINC\#: | 0016621690 |
| Parcel Size: | 2.07 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.181 ac |
| Zoning: | GSI-C |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |


| Legal Description: | 5756HW;7;1 |
| :---: | :---: |
| LINC\#: | 0014909691 |
| Parcel Size: | 0.68 ac |
| Picture reference \#(s): | 5 |
| Picture(s): |  |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.08 ac |
| Zoning: | GSI-C |
| Valuation: | \$5,000.00 |
| Additional Notes: | Chain link fence replacement (not valuated), otherwise vacant |


| Legal Description: | 9620096;7;6 |
| :---: | :---: |
| LINC\#: | 0026622472 |
| Parcel Size: | 0.68 ac |
| Picture reference \#(s): | 5 |
| Picture(s): |  |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.08 ac |
| Zoning: | GSI-C |
| Valuation: | \$5,000.00 |
| Additional Notes: | Chain link fence replacement (not valuated), otherwise vacant |


| Legal Description: | 9620096;7;5 |
| :---: | :---: |
| LINC\#: | 0026622464 |
| Parcel Size: | 0.68 ac |
| Picture reference \#(s): | 5 |
| Picture(s): |  |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.08 ac |
| Zoning: | GSI-C |
| Valuation: | \$5,000.00 |
| Additional Notes: | Chain link fence replacement (not valuated), otherwise vacant |


| Legal Description: | $9620096 ; 7 ; 4$ |
| :--- | :--- | :--- |
| LINC\#: | 0026622457 |
| Parcel Size: | 0.9 ac |
| Picture reference \#(s): | 5 |
| Picture(s): |  |
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| Legal Description: | 3344 TR;11;3 |
| :--- | :--- |
| LINC\#: | 0016287682 |
| Parcel Size: | 1.99 ac |
| Picture reference \#(s): | 6 |
| Picture(s): |  |
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| Legal Description: | 3344TR;11;2 |
| :---: | :---: |
| LINC\#: | 0016287690 |
| Parcel Size: | 3 ac |
| Picture reference \#(s): | 6 |
| Picture(s): |  |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.46 ac |
| Zoning: | M-1A |
| Valuation: | \$10,000.00 |
| Additional Notes: | Chain link fence replacement (not valuated), damages for office trailer relocation during utilization of TWS $(\$ 5,000.00)$ |


| Legal Description: | 3344 TR;11;1 |
| :--- | :--- |
| LINC\#: | 0013183934 |
| Parcel Size: | 3.19 ac |
| Picture reference \#(s): | 6 |
| Picture(s): |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  | Inside Municipal or Provincial Roadway |
| Estimated ROW area |  |
| required (ac): | 0.46 ac |
| Estimated TWS area |  |
| required (ac): |  |


|  |  |
| :--- | :--- |
| Legal Description: | 6389 LZ;OT |
| LINC\#: | 0016257230 |
| Parcel Size: | 14.55 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.852 ac |
| Zoning: | $\mathrm{M}-1 \mathrm{~A}$ |
| Valuation: | \$5,000.00 |
| Additional Notes: | Vacant |


| Legal Description: | $5314 Z ; \mathrm{B}$ |
| :--- | :--- |
| LINC\#: | 0015924111 |
| Parcel Size: | 15.56 ac |
| Picture reference \#(s): | 7 |
| Picture(s): |  |
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|  | Legal Description: |
| :--- | :--- |
| LINC\#: | 001673732596 |
| Parcel Size: | 61.73 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 1.114 ac |
| Zoning: | CS |
| Valuation: | N/A |
| Additional Notes: | Cemetery, if Town or County owned may not require valuation for <br> TWS, approval required from Director of Cemeteries in Service <br> Alberta, heavily treed, otherwise vacant |
|  |  |


| Legal Description: | $8022726 ; 201 ; 2$ |
| :--- | :--- | :--- |
| LINC\#: | 0012062220 |
| Parcel Size: | 2.03 ac |
| Picture reference \#(s): | 8 |
| Picture(s): |  |
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| Legal Description: | 4040TR;OT |
| :---: | :---: |
| LINC\#: | 0018627182 |
| Parcel Size: | No Title |
| Picture reference \#(s): | 9 |
| Picture(s): |  |
| Estimated ROW area required (ac): | 0.034ac |
| Estimated TWS area required (ac): | 0.012 ac |
| Zoning: | C-2 |
| Valuation: | N/A |
| Additional Notes: | Acquisition likely not required, should be nominally approved through railway crossing permit, proximity to water well |


| Legal Description: | 9521371;;34 |
| :---: | :---: |
| LINC\#: | 0026361162 |
| Parcel Size: | 1.31 ac |
| Picture reference \#(s): | 9 |
| Picture(s): |  |
| Estimated ROW area required (ac): | 0.034 ac |
| Estimated TWS area required (ac): | 0.078 |
| Zoning: | C-2 |
| Valuation: | N/A |
| Additional Notes: | Acquisition likely not required, should be nominally approved through railway crossing permit |


| Legal Description: | 1118CL;OT |
| :---: | :---: |
| LINC\#: | 0027779487 |
| Parcel Size: | 214.944 ac |
| Picture reference \#(s): | 9 |
| Picture(s): |  |
| Estimated ROW area required (ac): | 0.108 ac (crossing tracks) |
| Estimated TWS area required (ac): | 0.151 ac |
| Zoning: | M-2 |
| Valuation: | N/A |
| Additional Notes: | Acquisition likely not required, should be nominally approved through railway crossing permit |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 16 ;$ SW |
| LINC\#: | 0011091650 |
| Parcel Size: | 46.06 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | 0.222 ac (Partially in road) |
| Estimated TWS area required (ac): | 1.260 ac |
| Zoning: | UR |
| Valuation: | $\$ 8,520.00$ |
| Additional Notes: | Vacant |


|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 9 ;$ NW |
| LINC\#: | 0021720420 |
| Parcel Size: | 61.04 ac |
| Picture reference \#(s): | N/A |
| Picture(s): | N/A |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.975 ac |
| Zoning: | UR |
| Valuation: | $\$ 9,750.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 16 ;$ SE |
| LINC\#: | 0021983762 |
| Parcel Size: | 40.04 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.963 ac |
| Zoning: | UR |
| Valuation: | $\$ 9,360.00$ |
| Additional Notes: | Vacant |
|  |  |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation

|  |  |
| :--- | :--- |
| Legal Description: | $5 ; 17 ; 53 ; 9 ; \mathrm{NE}$ |
| LINC\#: | 0017174582 |
| Parcel Size: | 160 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.984 |
| Zoning: | UR |
| Valuation: | $\$ 2,952.00$ |
| Additional Notes: | Vacant |
|  |  |


|  |  |
| :--- | :--- |
| Legal Description: | $9826359 ; ; 1$ |
| LINC\#: | 0027779495 |
| Parcel Size: | 2.89 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.096 ac |
| Zoning: | $\mathrm{M}-2$ |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |


|  |  |
| :--- | :--- |
| Legal Description: | $1118 \mathrm{CL} ; \mathrm{OT}$ |
| LINC\#: | 0027779487 |
| Parcel Size: | 214.944 ac |
| Picture reference \#(s): | $\mathrm{N} / \mathrm{A}$ |
| Picture(s): | $\mathrm{N} / \mathrm{A}$ |
| Estimated ROW area required (ac): | Inside Municipal or Provincial Roadway |
| Estimated TWS area required (ac): | 0.288 ac |
| Zoning: | M-2 |
| Valuation: | $\$ 5,000.00$ |
| Additional Notes: | Vacant |
|  |  |

Edson West End Sanitary Trunk Main
Preliminary Alignment Options: 1 to 4; Review \& Valuation


| $\begin{aligned} & \mathbf{E} \square \square \square \mathbb{d} \square \square \square \square \mathbf{r} \square \square ा \\ & \mathbf{I} \square \square \square \square \mathbf{d} \end{aligned}$ | E | E | $\mathbf{E}$ |
| :---: | :---: | :---: | :---: |
| 22 | 2.957 ac | 25.650 ac | \$210,059.00 |



|  | E | E | $\mathbf{E}$ |
| :---: | :---: | :---: | :---: |
| 20 | 5.828 ac | 25.623 ac | \$242,152.00 |





|  | E | E | $\mathbf{E}$ |
| :---: | :---: | :---: | :---: |
| 26 | 0.398 ac | 18.934 ac | \$154,435.00 |

## Appendix H

Cost Estimate and Analysis

## Table H -1a

Alignment 1
Altrnative 1 Flows


## Table

Alignment 1
Alte


## Table $\mathrm{H}-1 \mathrm{c}$

Alignment 1
Alternative 2 Flows



Aliternentive 1 Flows
Gravits Sewerer


## Table $\mathrm{H}-2$

Alignment 2
Alternative 1 Flow


Alignment2
Alterative e Flows
Gravity Sewer


## Table

Alignment 2
2 Flows



## Table

Table H -3b
Alignment 3
Alte


## Table $\mathrm{H}-3 \mathrm{C}$

Alignment 3
Alternative 2 Flows


## Table 3

Alignment 3
Alte


## Table $\mathrm{H}-4 \mathrm{a}$

Aliternative 1 Flows
Al


## Table H -4b

Alignment 4
Alte


## Table $\mathrm{H}-\mathrm{Cc}$

Alignment 4
Alternative 2 Flows


## Table H -4d

Alignment 4
Altativ 2 Flows


13890 Edson WEST
Initial Cost Estimate for Scenario 1 Pump Station

| Item | Description |  | Cost |  |
| :---: | :---: | :---: | :---: | :---: |
| 1 | General |  |  |  |
|  | 1.1 | Mobilization/Demobilization | \$ | 50,000 |
|  | 1.2 | Cash allowance for utilities (water, gas, electrical, and phone line) | \$ | 25,000 |
|  | 1.3 | Commissioning | \$ | 50,000 |
| 2 | Site work |  |  |  |
|  | 2.1 | Clearing and relocating | \$ | 50,000 |
|  | 2.2 | Access road and fence | \$ | 30,000 |
|  | 2.3 | Gravity pipes and inlet manhole | \$ | 50,000 |
|  | 2.4 | Pressure pipes | \$ | 50,000 |
|  | 2.5 | Miscellaneous site work | \$ | 25,000 |
| 3 | Structures |  |  |  |
|  | 3.1 | Wet Well | \$ | 100,000 |
|  | 3.2 | Valve Chamber | \$ | 100,000 |
|  | 3.3 | Building | \$ | 100,000 |
| 4 | Mechanical |  |  |  |
|  | 4.1 | Sluice gates | \$ | 30,000 |
|  | 4.2 | Grinder and overflow screen | \$ | 65,000 |
|  | 4.3 | Pumps and accessories (duty + standby) | \$ | 150,000 |
|  | 4.4 | Lifting equipment | \$ | 20,000 |
|  | 4.5 | Piping and valves | \$ | 150,000 |
|  | 4.6 | HVAC | \$ | 100,000 |
|  | 4.7 | Plumbing | \$ | 25,000 |
| 5 | Electrical |  |  |  |
|  | 5.1 | Electrical | \$ | 250,000 |
|  | Cost summery |  |  |  |
| 6 |  |  |  |  |
|  | 6.1 | Construction subtotal | \$ | 1,495,000 |
|  | 6.3 | Estimated engineering and construction contingency (35\%) | \$ | 523,250 |
|  | 6.4 | Total Project Costs | \$ | 2,018,250 |

Table H-5b
13890 Edson WEST
Initial Cost Estimate for Scenario 2 Pump Station

| Item | Description |  | Cost |  |
| :---: | :---: | :---: | :---: | :---: |
| 1 | General |  |  |  |
|  | 1.1 | Mobilization/Demobilization | \$ | 50,000 |
|  | 1.2 | Cash allowance for utilities (water, gas, electrical, and phone line) | \$ | 25,000 |
|  | 1.3 | Commissioning | \$ | 50,000 |
| 2 | Site work |  |  |  |
|  | 2.1 | Clearing and relocating | \$ | 50,000 |
|  | 2.2 | Access road and fence | \$ | 30,000 |
|  | 2.3 | Gravity pipes and inlet manhole | \$ | 75,000 |
|  | 2.4 | Pressure pipes | \$ | 75,000 |
|  | 2.5 | Miscellaneous site work | \$ | 25,000 |
| 3 | Structures |  |  |  |
|  | 3.1 | Wet Well | \$ | 350,000 |
|  | 3.2 | Valve Chamber | \$ | 150,000 |
|  | 3.3 | Building | \$ | 100,000 |
| 4 | Mechanical |  |  |  |
|  | 4.1 | Sluice gates | \$ | 50,000 |
|  | 4.2 | Grinder and overflow screen | \$ | 85,000 |
|  | 4.3 | Pumps and accessories (duty + standby) | \$ | 200,000 |
|  | 4.4 | Lifting equipment | \$ | 20,000 |
|  | 4.5 | Piping and valves | \$ | 300,000 |
|  | 4.6 | HVAC | \$ | 100,000 |
|  | 4.7 | Plumbing | \$ | 25,000 |
| 5 | Electrical |  |  |  |
|  | 5.1 | Electrical | \$ | 350,000 |
|  | $5.2$ | Standby generator set | \$ | 100,000 |
| 6 | Cost summery |  |  |  |
|  | 6.1 | Construction subtotal | \$ | 2,210,000 |
|  | 6.3 | Estimated engineering and construction contingency (35\%) | \$ | 773,500 |
|  | 6.4 | Total Project Costs | \$ | 2,983,500 |

Engineering
and Land Services

## 13890 Edson West Sanitary Sewer Trunk Life Cycle Costs <br> Alignment 1, Alternative 1 or 2, Gravity Sewer

| Year No. | Year | Operating Costs |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |
|  |  |  | Daily Run Tim¢ | Energy | Energy |
|  |  | (L/s) | hrs. | (KWH) | Cost |
| 1 | 2015 |  |  |  |  |
| 2 | 2016 |  |  |  |  |
| 3 | 2017 |  |  |  |  |
| 4 | 2018 |  |  |  |  |
| 5 | 2019 |  |  |  |  |
| 6 | 2020 |  |  |  |  |
| 7 | 2021 |  |  |  |  |
| 8 | 2022 |  |  |  |  |
| 9 | 2023 |  |  |  |  |
| 10 | 2024 |  |  |  |  |
| 11 | 2025 |  |  |  |  |
| 12 | 2026 |  |  |  |  |
| 13 | 2027 |  |  |  |  |
| 14 | 2028 |  |  |  |  |
| 15 | 2029 |  |  |  |  |
| 16 | 2030 |  |  |  |  |
| 17 | 2031 |  |  |  |  |
| 18 | 2032 |  |  |  |  |
| 19 | 2033 |  |  |  |  |
| 20 | 2034 |  |  |  |  |
| 21 | 2035 |  |  |  |  |
| 22 | 2036 |  |  |  |  |
| 23 | 2037 |  |  |  |  |
| 24 | 2038 |  |  |  |  |
| 25 | 2039 |  |  |  |  |
| 26 | 2040 |  |  |  |  |
| 27 | 2041 |  |  |  |  |
| 28 | 2042 |  |  |  |  |
| 29 | 2043 |  |  |  |  |
| 30 | 2044 |  |  |  |  |
| 31 | 2045 |  |  |  |  |

Table H-6b
13890 Edson West Sanitary Sewer Trunk
Life Cycle Costs
Alignment 1, Alternative 1 with Pump Station


| Year <br> No. | Year | Operating Costs |  |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance | Refurb. |  |  |  |
|  |  |  | Daily Run Timf | Energy | Energy | O\&M |  |  |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost | Cost |  |  |  |
| 1 | 2015 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$42,133 | \$39,748 |
| 2 | 2016 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$43,397 | \$38,623 |
| 3 | 2017 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$44,699 | \$37,530 |
| 4 | 2018 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$46,040 | \$36,468 |
| 5 | 2019 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$47,421 | \$35,436 |
| 6 | 2020 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$48,843 | \$34,433 |
| 7 | 2021 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$50,309 | \$33,458 |
| 8 | 2022 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$51,818 | \$32,511 |
| 9 | 2023 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$53,372 | \$31,591 |
| 10 | 2024 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$54,974 | \$30,697 |
| 11 | 2025 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$56,623 | \$29,828 |
| 12 | 2026 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$58,322 | \$28,984 |
| 13 | 2027 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$60,071 | \$28,164 |
| 14 | 2028 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$61,873 | \$27,367 |
| 15 | 2029 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$63,729 | \$26,592 |
| 16 | 2030 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 | \$660,000 | \$700,906 | \$1,124,748 | \$442,753 |
| 17 | 2031 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$67,611 | \$25,108 |
| 18 | 2032 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$69,639 | \$24,398 |
| 19 | 2033 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$71,728 | \$23,707 |
| 20 | 2034 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$73,880 | \$23,036 |
| 21 | 2035 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$76,096 | \$22,384 |
| 22 | 2036 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$78,379 | \$21,751 |
| 23 | 2037 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$80,731 | \$21,135 |
| 24 | 2038 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$83,153 | \$20,537 |
| 25 | 2039 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$85,647 | \$19,956 |
| 26 | 2040 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$88,217 | \$19,391 |
| 27 | 2041 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$90,863 | \$18,842 |
| 28 | 2042 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$93,589 | \$18,309 |
| 29 | 2043 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$96,397 | \$17,791 |
| 30 | 2044 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 |  | \$40,906 | \$99,288 | \$17,287 |
| 31 | 2045 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$4,931 | \$660,000 | \$700,906 | \$700,906 | \$115,127 |


| $\$ 340,210$ | $\$ 775,000$ | $\$ 152,861$ | $\$ 1,320,000$ | $\$ 2,588,071$ | $\$ 3,764,492$ | $\$ 1,342,939$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |

Table H-6c
13890 Edson West Sanitary Sewer Trunk
Life Cycle Costs
Alignment 1, Alternative 2 with Pump Station

Engineering
and Land Services
Table H-7a
13890 Edson West Sanitary Sewer Trunk
Life Cycle Costs
Alignment 2, Alternative 1 or 2, Gravity Sewer

| Year No. | Year | Operating Costs |  |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance | Refurb. |  |  |  |
|  |  |  | Daily Run Timd | Energy | Energy | O\&M |  |  |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost | Cost |  |  |  |
| 1 | 2015 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$6,464 | \$6,098 |
| 2 | 2016 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$6,658 | \$5,926 |
| 3 | 2017 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$6,858 | \$5,758 |
| 4 | 2018 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$7,064 | \$5,595 |
| 5 | 2019 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$7,276 | \$5,437 |
| 6 | 2020 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$7,494 | \$5,283 |
| 7 | 2021 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$7,719 | \$5,133 |
| 8 | 2022 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$7,950 | \$4,988 |
| 9 | 2023 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$8,189 | \$4,847 |
| 10 | 2024 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$8,434 | \$4,710 |
| 11 | 2025 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$8,687 | \$4,576 |
| 12 | 2026 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$8,948 | \$4,447 |
| 13 | 2027 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$9,217 | \$4,321 |
| 14 | 2028 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$9,493 | \$4,199 |
| 15 | 2029 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$9,778 | \$4,080 |
| 16 | 2030 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$10,071 | \$3,964 |
| 17 | 2031 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$10,373 | \$3,852 |
| 18 | 2032 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$10,684 | \$3,743 |
| 19 | 2033 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$11,005 | \$3,637 |
| 20 | 2034 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$11,335 | \$3,534 |
| 21 | 2035 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$11,675 | \$3,434 |
| 22 | 2036 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$12,025 | \$3,337 |
| 23 | 2037 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$12,386 | \$3,243 |
| 24 | 2038 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$12,758 | \$3,151 |
| 25 | 2039 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$13,141 | \$3,062 |
| 26 | 2040 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$13,535 | \$2,975 |
| 27 | 2041 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$13,941 | \$2,891 |
| 28 | 2042 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$14,359 | \$2,809 |
| 29 | 2043 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$14,790 | \$2,730 |
| 30 | 2044 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$15,233 | \$2,652 |
| 31 | 2045 |  |  |  |  |  | \$6,276 |  | \$6,276 | \$6,276 | \$1,031 |

Table H-7b
13890 Edson West Sanitary Sewer Trunk
Life Cycle Costs
Alignment 2, Alternative 1 with Pump Station

| Year <br> No. | Year | Operating Costs |  |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance | Refurb. |  |  |  |
|  |  |  | Daily Run Time | Energy | Energy | O\&M |  |  |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost | Cost |  |  |  |
| 1 | 2015 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$43,517 | \$41,054 |
| 2 | 2016 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$44,823 | \$39,892 |
| 3 | 2017 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$46,167 | \$38,763 |
| 4 | 2018 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$47,552 | \$37,666 |
| 5 | 2019 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$48,979 | \$36,600 |
| 6 | 2020 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$50,448 | \$35,564 |
| 7 | 2021 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$51,962 | \$34,557 |
| 8 | 2022 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$53,520 | \$33,579 |
| 9 | 2023 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$55,126 | \$32,629 |
| 10 | 2024 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$56,780 | \$31,706 |
| 11 | 2025 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$58,483 | \$30,808 |
| 12 | 2026 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$60,238 | \$29,936 |
| 13 | 2027 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$62,045 | \$29,089 |
| 14 | 2028 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$63,906 | \$28,266 |
| 15 | 2029 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$65,823 | \$27,466 |
| 16 | 2030 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 | \$660,000 | \$702,250 | \$1,126,904 | \$443,602 |
| 17 | 2031 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$69,832 | \$25,933 |
| 18 | 2032 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$71,927 | \$25,199 |
| 19 | 2033 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$74,085 | \$24,486 |
| 20 | 2034 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$76,307 | \$23,793 |
| 21 | 2035 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$78,597 | \$23,120 |
| 22 | 2036 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$80,954 | \$22,465 |
| 23 | 2037 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$83,383 | \$21,829 |
| 24 | 2038 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$85,885 | \$21,212 |
| 25 | 2039 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$88,461 | \$20,611 |
| 26 | 2040 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$91,115 | \$20,028 |
| 27 | 2041 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$93,848 | \$19,461 |
| 28 | 2042 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$96,664 | \$18,910 |
| 29 | 2043 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$99,564 | \$18,375 |
| 30 | 2044 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 |  | \$42,250 | \$102,551 | \$17,855 |
| 31 | 2045 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$6,275 | \$660,000 | \$702,250 | \$702,250 | \$115,348 |


| $\$ 340,210$ | $\$ 775,000$ | $\$ 194,525$ | $\$ 1,320,000$ | $\mathbf{\$ 2 , 6 2 9 , 7 3 5}$ | $\mathbf{\$ 3 , 8 3 1 , 6 9 6}$ | $\mathbf{\$ 1 , 3 6 9 , 8 0 3}$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |

Table H-7c
13890 Edson West Sanitary Sewer Trunk
Life Cycle Costs
Alignment 2, Alternative 2 with Pump Station

| Year <br> No. | Year | Operating Costs |  |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance | Refurb. |  |  |  |
|  |  |  | Daily Run Time | Energy | Energy | O\&M |  |  |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost | Cost |  |  |  |
| 1 | 2015 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$45,780 | \$43,189 |
| 2 | 2016 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$47,153 | \$41,966 |
| 3 | 2017 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$48,568 | \$40,779 |
| 4 | 2018 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$50,025 | \$39,624 |
| 5 | 2019 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$51,526 | \$38,503 |
| 6 | 2020 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$53,071 | \$37,413 |
| 7 | 2021 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$54,664 | \$36,354 |
| 8 | 2022 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$56,304 | \$35,326 |
| 9 | 2023 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$57,993 | \$34,326 |
| 10 | 2024 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$59,732 | \$33,354 |
| 11 | 2025 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$61,524 | \$32,410 |
| 12 | 2026 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$63,370 | \$31,493 |
| 13 | 2027 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$65,271 | \$30,602 |
| 14 | 2028 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$67,229 | \$29,736 |
| 15 | 2029 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$69,246 | \$28,894 |
| 16 | 2030 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 | \$660,000 | \$704,447 | \$1,130,430 | \$444,990 |
| 17 | 2031 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$73,463 | \$27,282 |
| 18 | 2032 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$75,667 | \$26,510 |
| 19 | 2033 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$77,937 | \$25,759 |
| 20 | 2034 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$80,275 | \$25,030 |
| 21 | 2035 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$82,684 | \$24,322 |
| 22 | 2036 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$85,164 | \$23,633 |
| 23 | 2037 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$87,719 | \$22,965 |
| 24 | 2038 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$90,351 | \$22,315 |
| 25 | 2039 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$93,061 | \$21,683 |
| 26 | 2040 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$95,853 | \$21,069 |
| 27 | 2041 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$98,729 | \$20,473 |
| 28 | 2042 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$101,690 | \$19,894 |
| 29 | 2043 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$104,741 | \$19,331 |
| 30 | 2044 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 |  | \$44,447 | \$107,883 | \$18,784 |
| 31 | 2045 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$6,275 | \$660,000 | \$704,447 | \$704,447 | \$115,709 |


| $\$ 408,318$ | $\$ 775,000$ | $\$ 194,525$ | $\$ 1,320,000$ | $\$ 2,697,843$ | $\$ 3,941,552$ | $\$ 1,413,716$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |

Engineering
and Land Services
Alignment 3, Alternative 1 or 2, Gravity Sewer

| Year No. | Year | Operating Costs |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance |  |  |  |
|  |  |  | Daily Run Tim¢ | Energy | Energy | O\&M |  |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost |  |  |  |
| 1 | 2015 |  |  |  |  |  | \$5,238 | \$5,238 | \$5,395 | \$5,090 |
| 2 | 2016 |  |  |  |  |  | \$5,238 | \$5,238 | \$5,557 | \$4,946 |
| 3 | 2017 |  |  |  |  |  | \$5,238 | \$5,238 | \$5,724 | \$4,806 |
| 4 | 2018 |  |  |  |  |  | \$5,238 | \$5,238 | \$5,895 | \$4,670 |
| 5 | 2019 |  |  |  |  |  | \$5,238 | \$5,238 | \$6,072 | \$4,538 |
| 6 | 2020 |  |  |  |  |  | \$5,238 | \$5,238 | \$6,254 | \$4,409 |
| 7 | 2021 |  |  |  |  |  | \$5,238 | \$5,238 | \$6,442 | \$4,284 |
| 8 | 2022 |  |  |  |  |  | \$5,238 | \$5,238 | \$6,635 | \$4,163 |
| 9 | 2023 |  |  |  |  |  | \$5,238 | \$5,238 | \$6,834 | \$4,045 |
| 10 | 2024 |  |  |  |  |  | \$5,238 | \$5,238 | \$7,039 | \$3,931 |
| 11 | 2025 |  |  |  |  |  | \$5,238 | \$5,238 | \$7,251 | \$3,820 |
| 12 | 2026 |  |  |  |  |  | \$5,238 | \$5,238 | \$7,468 | \$3,711 |
| 13 | 2027 |  |  |  |  |  | \$5,238 | \$5,238 | \$7,692 | \$3,606 |
| 14 | 2028 |  |  |  |  |  | \$5,238 | \$5,238 | \$7,923 | \$3,504 |
| 15 | 2029 |  |  |  |  |  | \$5,238 | \$5,238 | \$8,161 | \$3,405 |
| 16 | 2030 |  |  |  |  |  | \$5,238 | \$5,238 | \$8,405 | \$3,309 |
| 17 | 2031 |  |  |  |  |  | \$5,238 | \$5,238 | \$8,658 | \$3,215 |
| 18 | 2032 |  |  |  |  |  | \$5,238 | \$5,238 | \$8,917 | \$3,124 |
| 19 | 2033 |  |  |  |  |  | \$5,238 | \$5,238 | \$9,185 | \$3,036 |
| 20 | 2034 |  |  |  |  |  | \$5,238 | \$5,238 | \$9,460 | \$2,950 |
| 21 | 2035 |  |  |  |  |  | \$5,238 | \$5,238 | \$9,744 | \$2,866 |
| 22 | 2036 |  |  |  |  |  | \$5,238 | \$5,238 | \$10,037 | \$2,785 |
| 23 | 2037 |  |  |  |  |  | \$5,238 | \$5,238 | \$10,338 | \$2,706 |
| 24 | 2038 |  |  |  |  |  | \$5,238 | \$5,238 | \$10,648 | \$2,630 |
| 25 | 2039 |  |  |  |  |  | \$5,238 | \$5,238 | \$10,967 | \$2,555 |
| 26 | 2040 |  |  |  |  |  | \$5,238 | \$5,238 | \$11,296 | \$2,483 |
| 27 | 2041 |  |  |  |  |  | \$5,238 | \$5,238 | \$11,635 | \$2,413 |
| 28 | 2042 |  |  |  |  |  | \$5,238 | \$5,238 | \$11,984 | \$2,344 |
| 29 | 2043 |  |  |  |  |  | \$5,238 | \$5,238 | \$12,344 | \$2,278 |
| 30 | 2044 |  |  |  |  |  | \$5,238 | \$5,238 | \$12,714 | \$2,214 |
| 31 | 2045 |  |  |  |  |  | \$5,238 | \$5,238 | \$5,238 | \$860 |


| $\$ 0$ | $\$ 0$ | $\$ 162,378$ | $\$ 162,378$ | $\$ 261,914$ | $\$ 104,697$ |
| :--- | :--- | :--- | :--- | :--- | :--- |

Table H-8b
13890 Edson West Sanitary Sewer Trunk
Life Cycle Costs
Alignment 3, Alternative 1 with Pump Station

| Year <br> No. | Year | Operating Costs |  |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance | Refurb. |  |  |  |
|  |  |  | Daily Run Timf | Energy | Energy | O\&M |  |  |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost | Cost |  |  |  |
| 1 | 2015 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$42,449 | \$40,046 |
| 2 | 2016 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$43,722 | \$38,913 |
| 3 | 2017 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$45,034 | \$37,811 |
| 4 | 2018 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$46,385 | \$36,741 |
| 5 | 2019 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$47,777 | \$35,701 |
| 6 | 2020 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$49,210 | \$34,691 |
| 7 | 2021 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$50,686 | \$33,709 |
| 8 | 2022 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$52,207 | \$32,755 |
| 9 | 2023 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$53,773 | \$31,828 |
| 10 | 2024 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$55,386 | \$30,927 |
| 11 | 2025 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$57,048 | \$30,052 |
| 12 | 2026 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$58,759 | \$29,202 |
| 13 | 2027 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$60,522 | \$28,375 |
| 14 | 2028 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$62,338 | \$27,572 |
| 15 | 2029 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$64,208 | \$26,792 |
| 16 | 2030 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 | \$660,000 | \$701,213 | \$1,125,240 | \$442,947 |
| 17 | 2031 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$68,118 | \$25,297 |
| 18 | 2032 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$70,162 | \$24,581 |
| 19 | 2033 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$72,266 | \$23,885 |
| 20 | 2034 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$74,434 | \$23,209 |
| 21 | 2035 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$76,667 | \$22,552 |
| 22 | 2036 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$78,967 | \$21,914 |
| 23 | 2037 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$81,336 | \$21,294 |
| 24 | 2038 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$83,777 | \$20,691 |
| 25 | 2039 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$86,290 | \$20,105 |
| 26 | 2040 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$88,879 | \$19,536 |
| 27 | 2041 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$91,545 | \$18,983 |
| 28 | 2042 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$94,291 | \$18,446 |
| 29 | 2043 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$97,120 | \$17,924 |
| 30 | 2044 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 |  | \$41,213 | \$100,034 | \$17,417 |
| 31 | 2045 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,238 | \$660,000 | \$701,213 | \$701,213 | \$115,178 |


| $\$ 340,210$ | $\$ 775,000$ | $\$ 162,378$ | $\$ 1,320,000$ | $\$ 2,597,588$ | $\$ 3,779,843$ | $\$ 1,349,075$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |

Alignment 3, Alternative 2 with Pump Station

| Year <br> No. | Year | Operating Costs |  |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual <br> Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance |  |  |  |  |
|  |  |  | Daily Run Time | Energy | Energy | O\&M |  | Refurb. |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost | Cost |  |  |  |
| 1 | 2015 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$44,712 | \$42,181 |
| 2 | 2016 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$46,053 | \$40,987 |
| 3 | 2017 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$47,435 | \$39,827 |
| 4 | 2018 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$48,858 | \$38,700 |
| 5 | 2019 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$50,324 | \$37,605 |
| 6 | 2020 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$51,833 | \$36,540 |
| 7 | 2021 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$53,388 | \$35,506 |
| 8 | 2022 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$54,990 | \$34,501 |
| 9 | 2023 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$56,640 | \$33,525 |
| 10 | 2024 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$58,339 | \$32,576 |
| 11 | 2025 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$60,089 | \$31,654 |
| 12 | 2026 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$61,892 | \$30,758 |
| 13 | 2027 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$63,748 | \$29,888 |
| 14 | 2028 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$65,661 | \$29,042 |
| 15 | 2029 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$67,631 | \$28,220 |
| 16 | 2030 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 | \$660,000 | \$703,410 | \$1,128,766 | \$444,334 |
| 17 | 2031 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$71,749 | \$26,645 |
| 18 | 2032 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$73,902 | \$25,891 |
| 19 | 2033 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$76,119 | \$25,158 |
| 20 | 2034 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$78,402 | \$24,446 |
| 21 | 2035 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$80,755 | \$23,754 |
| 22 | 2036 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$83,177 | \$23,082 |
| 23 | 2037 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$85,672 | \$22,429 |
| 24 | 2038 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$88,243 | \$21,794 |
| 25 | 2039 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$90,890 | \$21,177 |
| 26 | 2040 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$93,617 | \$20,578 |
| 27 | 2041 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$96,425 | \$19,995 |
| 28 | 2042 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$99,318 | \$19,430 |
| 29 | 2043 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$102,297 | \$18,880 |
| 30 | 2044 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 |  | \$43,410 | \$105,366 | \$18,345 |
| 31 | 2045 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,238 | \$660,000 | \$703,410 | \$703,410 | \$115,538 |

Engineering
and Land Services

| Year <br> No. | Year | Operating Costs |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance |  |  |  |
|  |  |  | Daily Run Timf | Energy | Energy | O\&M |  |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost |  |  |  |
| 1 | 2015 |  |  |  |  |  | \$5,826 | \$5,826 | \$6,001 | \$5,661 |
| 2 | 2016 |  |  |  |  |  | \$5,826 | \$5,826 | \$6,181 | \$5,501 |
| 3 | 2017 |  |  |  |  |  | \$5,826 | \$5,826 | \$6,366 | \$5,345 |
| 4 | 2018 |  |  |  |  |  | \$5,826 | \$5,826 | \$6,557 | \$5,194 |
| 5 | 2019 |  |  |  |  |  | \$5,826 | \$5,826 | \$6,754 | \$5,047 |
| 6 | 2020 |  |  |  |  |  | \$5,826 | \$5,826 | \$6,957 | \$4,904 |
| 7 | 2021 |  |  |  |  |  | \$5,826 | \$5,826 | \$7,165 | \$4,765 |
| 8 | 2022 |  |  |  |  |  | \$5,826 | \$5,826 | \$7,380 | \$4,630 |
| 9 | 2023 |  |  |  |  |  | \$5,826 | \$5,826 | \$7,602 | \$4,499 |
| 10 | 2024 |  |  |  |  |  | \$5,826 | \$5,826 | \$7,830 | \$4,372 |
| 11 | 2025 |  |  |  |  |  | \$5,826 | \$5,826 | \$8,065 | \$4,248 |
| 12 | 2026 |  |  |  |  |  | \$5,826 | \$5,826 | \$8,306 | \$4,128 |
| 13 | 2027 |  |  |  |  |  | \$5,826 | \$5,826 | \$8,556 | \$4,011 |
| 14 | 2028 |  |  |  |  |  | \$5,826 | \$5,826 | \$8,812 | \$3,898 |
| 15 | 2029 |  |  |  |  |  | \$5,826 | \$5,826 | \$9,077 | \$3,787 |
| 16 | 2030 |  |  |  |  |  | \$5,826 | \$5,826 | \$9,349 | \$3,680 |
| 17 | 2031 |  |  |  |  |  | \$5,826 | \$5,826 | \$9,629 | \$3,576 |
| 18 | 2032 |  |  |  |  |  | \$5,826 | \$5,826 | \$9,918 | \$3,475 |
| 19 | 2033 |  |  |  |  |  | \$5,826 | \$5,826 | \$10,216 | \$3,376 |
| 20 | 2034 |  |  |  |  |  | \$5,826 | \$5,826 | \$10,522 | \$3,281 |
| 21 | 2035 |  |  |  |  |  | \$5,826 | \$5,826 | \$10,838 | \$3,188 |
| 22 | 2036 |  |  |  |  |  | \$5,826 | \$5,826 | \$11,163 | \$3,098 |
| 23 | 2037 |  |  |  |  |  | \$5,826 | \$5,826 | \$11,498 | \$3,010 |
| 24 | 2038 |  |  |  |  |  | \$5,826 | \$5,826 | \$11,843 | \$2,925 |
| 25 | 2039 |  |  |  |  |  | \$5,826 | \$5,826 | \$12,198 | \$2,842 |
| 26 | 2040 |  |  |  |  |  | \$5,826 | \$5,826 | \$12,564 | \$2,762 |
| 27 | 2041 |  |  |  |  |  | \$5,826 | \$5,826 | \$12,941 | \$2,684 |
| 28 | 2042 |  |  |  |  |  | \$5,826 | \$5,826 | \$13,329 | \$2,608 |
| 29 | 2043 |  |  |  |  |  | \$5,826 | \$5,826 | \$13,729 | \$2,534 |
| 30 | 2044 |  |  |  |  |  | \$5,826 | \$5,826 | \$14,141 | \$2,462 |
| 31 | 2045 |  |  |  |  |  | \$5,826 | \$5,826 | \$5,826 | \$957 |

Table H-9b
13890 Edson West Sanitary Sewer Trunk
Life Cycle Costs
Alignment 4, Alternative 1 with Pump Station

| Year <br> No. | Year | Operating Costs |  |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance | Refurb. |  |  |  |
|  |  |  | Daily Run Timg | Energy | Energy | O\&M |  |  |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost | Cost |  |  |  |
| 1 | 2015 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$43,055 | \$40,617 |
| 2 | 2016 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$44,346 | \$39,468 |
| 3 | 2017 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$45,677 | \$38,351 |
| 4 | 2018 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$47,047 | \$37,266 |
| 5 | 2019 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$48,458 | \$36,211 |
| 6 | 2020 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$49,912 | \$35,186 |
| 7 | 2021 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$51,409 | \$34,190 |
| 8 | 2022 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$52,952 | \$33,223 |
| 9 | 2023 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$54,540 | \$32,282 |
| 10 | 2024 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$56,176 | \$31,369 |
| 11 | 2025 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$57,862 | \$30,481 |
| 12 | 2026 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$59,598 | \$29,618 |
| 13 | 2027 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$61,385 | \$28,780 |
| 14 | 2028 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$63,227 | \$27,965 |
| 15 | 2029 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$65,124 | \$27,174 |
| 16 | 2030 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 | \$660,000 | \$701,801 | \$1,126,184 | \$443,318 |
| 17 | 2031 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$69,090 | \$25,658 |
| 18 | 2032 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$71,163 | \$24,931 |
| 19 | 2033 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$73,297 | \$24,226 |
| 20 | 2034 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$75,496 | \$23,540 |
| 21 | 2035 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$77,761 | \$22,874 |
| 22 | 2036 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$80,094 | \$22,227 |
| 23 | 2037 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$82,497 | \$21,597 |
| 24 | 2038 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$84,972 | \$20,986 |
| 25 | 2039 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$87,521 | \$20,392 |
| 26 | 2040 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$90,147 | \$19,815 |
| 27 | 2041 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$92,851 | \$19,254 |
| 28 | 2042 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$95,637 | \$18,709 |
| 29 | 2043 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$98,506 | \$18,180 |
| 30 | 2044 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 |  | \$41,801 | \$101,461 | \$17,665 |
| 31 | 2045 | 16 | 1.92 | 73,164 | \$10,975 | \$25,000 | \$5,826 | \$660,000 | \$701,801 | \$701,801 | \$115,274 |



Table H-9c
13890 Edson West Sanitary Sewer Trunk
Life Cycle Costs
Alignment 4, Alternative 2 with Pump Station

| Year No. | Year | Operating Costs |  |  |  |  |  |  | Total Annual Costs | Future Costs with Inflation | NPV Annual Costs (2014\$) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Av. Flow Rate | Pumping |  |  |  | Conveyance Maintenance |  |  |  |  |
|  |  |  | Daily Run Timg | Energy | Energy | O\&M |  | Refurb. |  |  |  |
|  |  | (L/s) | hrs. | (KWH) | Cost | Cost | Cost | Cost |  |  |  |
| 1 | 2015 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$45,317 | \$42,752 |
| 2 | 2016 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$46,677 | \$41,542 |
| 3 | 2017 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$48,077 | \$40,367 |
| 4 | 2018 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$49,520 | \$39,224 |
| 5 | 2019 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$51,005 | \$38,114 |
| 6 | 2020 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$52,535 | \$37,035 |
| 7 | 2021 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$54,111 | \$35,987 |
| 8 | 2022 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$55,735 | \$34,969 |
| 9 | 2023 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$57,407 | \$33,979 |
| 10 | 2024 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$59,129 | \$33,017 |
| 11 | 2025 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$60,903 | \$32,083 |
| 12 | 2026 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$62,730 | \$31,175 |
| 13 | 2027 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$64,612 | \$30,293 |
| 14 | 2028 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$66,550 | \$29,435 |
| 15 | 2029 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$68,547 | \$28,602 |
| 16 | 2030 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 | \$660,000 | \$703,998 | \$1,129,709 | \$444,706 |
| 17 | 2031 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$72,721 | \$27,006 |
| 18 | 2032 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$74,903 | \$26,242 |
| 19 | 2033 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$77,150 | \$25,499 |
| 20 | 2034 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$79,464 | \$24,777 |
| 21 | 2035 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$81,848 | \$24,076 |
| 22 | 2036 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$84,304 | \$23,395 |
| 23 | 2037 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$86,833 | \$22,733 |
| 24 | 2038 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$89,438 | \$22,089 |
| 25 | 2039 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$92,121 | \$21,464 |
| 26 | 2040 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$94,885 | \$20,857 |
| 27 | 2041 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$97,731 | \$20,266 |
| 28 | 2042 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$100,663 | \$19,693 |
| 29 | 2043 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$103,683 | \$19,135 |
| 30 | 2044 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 |  | \$43,998 | \$106,794 | \$18,594 |
| 31 | 2045 | 28 | 1.34 | 87,810 | \$13,172 | \$25,000 | \$5,826 | \$660,000 | \$703,998 | \$703,998 | \$115,635 |


| $\$ 408,318$ | $\$ 775,000$ | $\$ 180,606$ | $\$ 1,320,000$ | $\$ 2,683,924$ | $\$ 3,919,101$ | $\$ 1,404,742$ |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |

## Appendix I

Risk Assessment

| \# | Risk / Concern | Consequence | Magnitude |  | \$ Impact | Probability Rationale | Probability |  |  | Risk Severity |  | Mitigation Strategy | Risk Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Design |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Depth of gas and oil pipelines is unknown | - Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint | Mod | 50 | \$600,000 | Gas/oil pipelines are generally at more shallow depths | Improbable | 25 | 0.2 | Acceptable | 1250 | Hydrovac utility crossings during detailed design. <br> Use pump station and forcemain system. Forcemain can be installed at greater depths to avoid conflict | \$120,000 |
|  | Delays in acquiring approvals through environmental agencies | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Send in applications as soon as possible during detailed design | \$30,000 |
|  | Easements may not be obtained in time because owners do not cooperate | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Choose alignment and start land acquisition activities as soon as possible | \$30,000 |
|  | Additional backfill / restoration requirements in developed areas | - Increase Cost | Low | 10 | \$150,000 | Backfill requirements will be addressed in design | Improbable | 25 | 0.2 | Acceptable | 250 |  | \$30,000 |
|  | Potential wetland west of Bench Breek may be impacted by design and construction. | - Wetland compensation may be required. <br> -Additional trenchless construction which may increase costs | Low | 10 | \$150,000 | Alignment goes directly through Wetland area. Need additional assessment during detailed design | Probable | 100 | 0.8 | Acceptable | 1000 | Wetland crossing requires further review during detailed design. | \$120,000 |
|  | Adequate cover cannot be maintained on downstream gravity sections | - Potential freezing of pipe flows | Mod | 50 | \$600,000 | Downstream elevation constraints restrict the depth of the gravity sewer | Probable | 100 | 0.8 | Significant | 5000 | Use pump station and forcemain system. Forcemain can be installed at greater depths to ensure adequate cover | \$480,000 |
|  | Adequate cover cannot be maintained at Bench Creek Crossing | - Excessive erosion in creek resulting in significant environmenal damage and fines | Ser | 300 | \$6,000,000 | Limited depth of cover due to downstream elevation constraints | Probable | 100 | 0.8 | Intolerable | 30000 | Use pump station and forcemain system. Forcemain can be installed at greater depths to ensure adequate cover | \$4,800,000 |
|  | Construction |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Construction adjacent to HWY 16 undermines roadway | - Worker and public safety - Highway closures -additional cost to repair | High | 100 | \$1,500,000 | Depth of pipe in open cut section is not great. | Improbable | 25 | 0.2 | Significant | 2500 | Use vertical trenching to reduce width of trenching activities | \$300,000 |
|  | Construction adjacent to HWY 16 undermines existing watermain | - Worker and public safety <br> - Disrupts water servicing to surrounding development -additional cost to repair | Mod | 50 | \$600,000 | Depth of pipe in open cut section is not great. | Improbable | 25 | 0.2 | Acceptable | 1250 | Use vertical trenching to reduce width of trenching activities | \$120,000 |


| Construction along 1A Avenue causes traffic backups | - Public complaints <br> - construction delays <br> -additional traffic accomodation | Mod | 50 | \$600,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Improbable | 25 | 0.2 | Acceptable | 1250 | Use vertical trenching to reduce width of trenching activities | \$120,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Construction in front of businesses disrupts accesses | - Public complaints | Low | 10 | \$150,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Improbable | 25 | 0.2 | Acceptable | 250 | Provide adequate notification to businesses prior to construction | \$30,000 |
| Construction adjacent to CN Rail undermines track | - Worker and public safety <br> - Track closures -additional cost to repair | High | 100 | \$1,500,000 | Alignment to be located at the required distance away from the track and zone of influence | Remote | 10 | 0.02 | Acceptable | 1000 | Keep the alignment at the required distance away from the track and zone of influence | \$30,000 |
| Construction activities adjacent to existing (parallel) utilities or services | - Potential damage to existing utility main line or services | V Low | 1 | \$15,000 | Minimal amount of utilities parallel to alignment | Ex Remote | 1 | 0.01 | Minor | 1 | Provide adequate notification to businesses prior to construction | \$150 |
| Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections | - Need to construct rescue shaft to recover equipment <br> - Additional construction costs and schedule delay | High | 100 | \$1,500,000 | - Geotechnical desktop study indicates high ground water table - Presence of bouders is possible in glacial till | Somewhat Likely | 50 | 0.5 | Significant | 5000 | Complete thorough getechnical borehole program especially in section where trenchless construction is proposed | \$750,000 |

## Edson - West Sanitary Sewer Trunk

Table I-2 Alignment 1 - Forcemain Option
Risk Quantification Worksheet

| \# | Risk / Concern | Consequence | Magnitude |  | \$ Impact | Probability Rationale | Probability |  |  | Risk Severity |  | Mitigation Strategy | Risk Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Design |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Depth of gas and oil pipelines is unknown | - Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint | Mod | 50 | \$600,000 | Gas/oil pipelines are generally at more shallow depths | Ex Remote | 1 | 0.01 | Minor | 50 | Hydrovac utility crossings during detailed design. | \$6,000 |
|  | Delays in acquiring approvals through environmental agencies | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Send in applications as soon as possible during detailed design | \$30,000 |
|  | Easements may not be obtained in time because owners do not cooperate | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Choose alignment and start land acquisition activities as soon as possible | \$30,000 |
|  | Additional backfill / restoration requirements in developed areas | - Increase Cost | Low | 10 | \$150,000 | Backfill requirements will be addressed in design | Improbable | 25 | 0.2 | Acceptable | 250 |  | \$30,000 |
|  | Potential wetland west of Bench Breek may be impacted by design and construction. | - Wetland compensation may be required. <br> -Additional trenchless construction which may increase costs | Low | 10 | \$150,000 | Alignment goes directly through Wetland area. Need additional assessment during detailed design | Probable | 100 | 0.8 | Acceptable | 1000 | Wetland crossing requires further review during detailed design. | \$120,000 |
|  | Adequate cover cannot be maintained on downstream sections | - Potential freezing of pipe flows | Mod | 50 | \$600,000 | Forcemain can be installed at greater depth; does not require specific grade | Ex Remote | 1 | 0.01 | Minor | 50 |  | \$6,000 |
|  | Adequate cover cannot be maintained at Bench Creek Crossing | - Excessive erosion in creek resulting in significant environmenal damage and fines | Ser | 300 | \$6,000,000 | Forcemain can be installed at greater depth; does not require specific grade Fracking out is a concern due to distance of crossing | Remote | 10 | 0.02 | Significant | 3000 |  | \$120,000 |
|  | Construction |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Construction adjacent to HWY 16 undermines roadway | - Worker and public safety <br> - Highway closures -additional cost to repair | High | 100 | \$1,500,000 | Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities | Improbable | 25 | 0.2 | Significant | 2500 | Use vertical trenching to reduce width of trenching activities | \$300,000 |


| Construction adjacent to HWY 16 undermines existing watermain | - Worker and public safety <br> - Disrupts water servicing to surrounding development -additional cost to repair | Mod | 50 | \$600,000 | Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities | Improbable | 25 | 0.2 | Acceptable | 1250 | Use vertical trenching to reduce width of trenching activities | \$120,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Construction along 1A Avenue causes traffic backups | - Public complaints <br> - construction delays <br> -additional traffic accomodation | Mod | 50 | \$600,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Improbable | 25 | 0.2 | Acceptable | 1250 | Use vertical trenching to reduce width of trenching activities | \$120,000 |
| Construction in front of businesses disrupts accesses | - Public complaints | Low | 10 | \$150,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Improbable | 25 | 0.2 | Acceptable | 250 | Provide adequate notification to businesses prior to construction | \$30,000 |
| Construction adjacent to CN Rail undermines track | - Worker and public safety <br> - Track closures <br> -additional cost to repair | High | 100 | \$1,500,000 | Forcemain can be installed at minimal depth outside the track zone of influence | Ex Remote | 1 | 0.01 | Minor | 100 | Keep the alignment at the required distance away from the track and zone of influence | \$15,000 |
| Construction activities adjacent to existing (parallel) utilities or services | - Potential damage to existing utility main line or services | V Low | 1 | \$15,000 | Minimal amount of utilities parallel to alignment | Ex Remote | 1 | 0.01 | Minor | 1 | Provide adequate notification to businesses prior to construction | \$150 |
| Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections | - Need to construct rescue shaft to recover equipment <br> - Additional construction costs and schedule delay | Mod | 50 | \$600,000 | Forcemain can be installed at minimal depth; does not require specific grade | Ex Remote | 1 | 0.01 | Minor | 50 | Complete thorough getechnical borehole program especially in section where trenchless construction is proposed | \$6,000 |

## Edson - West Sanitary Sewer Trunk

Table I-3 Alignment 2-Gravity Option
Risk Quantification Worksheet

| \# | Risk / Concern | Consequence | Magnitude |  | \$ Impact | Probability Rationale | Probability |  |  | Risk Severity |  | Mitigation Strategy | Risk Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Design |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Change in land use plan relocates future road ROW west of 75 Street | Need to adjust alignment of sewer | V Low | 1 | \$15,000 | Land use plan has been approved by Town | Remote | 10 | 0.02 | Minor | 10 |  | \$300 |
|  | Depth of gas and oil pipelines is unknown | - Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint | Mod | 50 | \$600,000 | Gas/oil pipelines are generally at more shallow depths | Improbable | 25 | 0.2 | Acceptable | 1250 | Hydrovac utility crossings during detailed design. <br> Use pump station and forcemain system. Forcemain can be installed at greater depths to avoid conflict | \$120,000 |
|  | Delays in acquiring approvals through environmental agencies | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Send in applications as soon as possible during detailed design | \$30,000 |
|  | Easements may not be obtained in time because owners do not cooperate | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Choose alignment and start land acquisition activities as soon as possible | \$30,000 |
|  | Additional backfill / restoration requirements in developed areas | - Increase Cost | V Low | 1 | \$15,000 | Backfill requirements will be addressed in design | Remote | 10 | 0.02 | Minor | 10 |  | \$300 |
|  | Adequate cover cannot be maintained on downstream gravity sections | - Potential freezing of pipe flows | Mod | 50 | \$600,000 | Downstream elevation constraints restrict the depth of the gravity sewer | Probable | 100 | 0.8 | Significant | 5000 | Use pump station and forcemain system | \$480,000 |
|  | Adequate cover cannot be maintained at Bench Creek Crossing | - Excessive erosion in creek resulting in significant environmenal damage and fines | Ser | 300 | \$6,000,000 | Limited depth of cover due to downstream elevation constraints | Somewhat Likely | 50 | 0.5 | Critical | 15000 | Use pump station and forcemain system | \$3,000,000 |
|  | Construction |  |  |  |  |  |  |  |  |  |  |  | \$0 |
|  | Construction adjacent to CN Rail undermines track | - Worker and public safety <br> - Track closures -additional cost to repair | High | 100 | \$1,500,000 | Alignment to be located at the required distance away from the track and zone of influence | Remote | 10 | 0.02 | Acceptable | 1000 | Keep the alignment at the required distance away from the track and zone of influence | \$30,000 |
|  | Construction activities adjacent to existing (parallel) utilities or services | - Potential damage to existing utility main line or services | V Low | 1 | \$15,000 | Minimal amount of utilities parallel to alignment | Ex Remote | 1 | 0.01 | Minor | 1 | Provide adequate notification to businesses prior to construction | \$150 |


| Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections | - Need to construct rescue shaft to recover equipment <br> - Additional construction costs and schedule delay | High | 100 | \$1,500,000 | - Geotechnical desktop study indicates high ground water table - Presence of bouders is possible in glacial till | Somewhat Likely | 50 | 0.5 | Significant | 5000 | Complete thorough getechnical borehole program especially in section where trenchless construction is proposed | \$750,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  | 26001 |  | \$4,440,750 |

## Edson - West Sanitary Sewer Trunk

Table 1-4 Alignment 2 - Forcemain Option
Risk Quantification Worksheet

| \# | Risk / Concern | Consequence | Magnitude |  | \$ Impact | Probability Rationale | Probability |  |  | Risk Severity |  | Mitigation Strategy | Risk Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Design |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Change in land use plan relocates future road ROW west of 75 Street | -Need to adjust alignment of sewer | V Low | 1 | \$15,000 | Land use plan has been approved by Town | Remote | 10 | 0.02 | Minor | 10 |  | \$300 |
|  | Depth of gas and oil pipelines is unknown | - Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint | Mod | 50 | \$600,000 | Gas/oil pipelines are generally at more shallow depths | Ex Remote | 1 | 0.01 | Minor | 50 | Hydrovac utility crossings during detailed design. | \$6,000 |
|  | Delays in acquiring approvals through environmental agencies | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Send in applications as soon as possible during detailed design | \$30,000 |
|  | Easements may not be obtained in time because owners do not cooperate | - Project delays | V Low | 1 | \$15,000 |  | Improbable | 25 | 0.2 | Minor | 25 | Choose alignment and start land acquisition activities as soon as possible | \$3,000 |
|  | Additional backfill / restoration requirements in developed areas | - Increase Cost | V Low | 1 | \$15,000 | Backfill requirements will be addressed in design | Remote | 10 | 0.02 | Minor | 10 |  | \$300 |
|  | Adequate cover cannot be maintained on downstream sections | - Potential freezing of pipe flows | Mod | 50 | \$600,000 | Forcemain can be installed at greater depth; does not require specific grade | Ex Remote | 1 | 0.01 | Minor | 50 |  | \$6,000 |
|  | Adequate cover cannot be maintained at Bench Creek Crossing | - Excessive erosion in creek resulting in significant environmenal damage and fines | Ser | 300 | \$6,000,000 | Forcemain can be installed at greater depth; does not require specific grade | Ex Remote | 1 | 0.01 | Acceptable | 300 |  | \$60,000 |
|  | Construction |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Construction adjacent to CN Rail undermines track | - Worker and public safety <br> - Track closures -additional cost to repair | High | 100 | \$1,500,000 | Forcemain can be installed at minimal depth outside the track zone of influence | Ex Remote | 1 | 0.01 | Minor | 100 | Keep the alignment at the required distance away from the track and zone of influence | \$15,000 |
|  | Construction activities adjacent to existing (parallel) utilities or services | - Potential damage to existing utility main line or services | V Low | 1 | \$15,000 | Minimal amount of utilities parallel to alignment | Ex Remote | 1 | 0.01 | Minor | 1 | Provide adequate notification to businesses prior to construction | \$150 |


| Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections | - Need to construct rescue shaft to recover equipment <br> - Additional construction costs and schedule delay | Mod | 50 | \$600,000 | Forcemain can be installed at minimal depth; does not require specific grade | Ex Remote | 1 | 0.01 | Minor | 50 | Complete thorough getechnical borehole program especially in section where trenchless construction is proposed | \$6,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 501 |  |  |  |  |  |  |  |  |  |  |  | 126,750 |

## Edson - West Sanitary Sewer Trunk

Table I-5 Alignment 3-Gravity Option
Risk Quantification Worksheet

| \# | Risk / Concern | Consequence | Magnitude |  | \$ Impact | Probability Rationale | Probability |  |  | Risk Severity |  | Mitigation Strategy | Risk Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Design |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Depth of gas and oil pipelines is unknown | - Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint | Mod | 50 | \$600,000 | Gas/oil pipelines are generally at more shallow depths | Improbable | 25 | 0.2 | Acceptable | 1250 | Hydrovac utility crossings during detailed design. <br> Use pump station and forcemain system. Forcemain can be installed at greater depths to avoid conflict | \$120,000 |
|  | Delays in acquiring approvals through environmental agencies | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Send in applications as soon as possible during detailed design | \$30,000 |
|  | Easements may not be obtained in time because owners do not cooperate | - Project delays | Low | 10 | \$150,000 |  | Somewhat Likely | 50 | 0.5 | Acceptable | 500 | Choose alignment and start land acquisition activities as soon as possible | \$75,000 |
|  | Additional backfill / restoration requirements in developed areas | - Increase Cost | Low | 10 | \$150,000 | Backfill requirements will be addressed in design | Probable | 100 | 0.8 | Acceptable | 1000 |  | \$120,000 |
|  | Adequate cover cannot be maintained on downstream gravity sections | - Potential freezing of pipe flows | Mod | 50 | \$600,000 | Downstream elevation constraints restrict the depth of the gravity sewer | Probable | 100 | 0.8 | Significant | 5000 | Use pump station and forcemain system | \$480,000 |
|  | Adequate cover cannot be maintained at Bench Creek Crossing | - Excessive erosion in creek resulting in significant environmenal damage and fines | Ser | 300 | \$6,000,000 | Limited depth of cover due to downstream elevation constraints | Somewhat Likely | 50 | 0.5 | Critical | 15000 | Use pump station and forcemain system | \$3,000,000 |
|  | Construction |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Construction adjacent to HWY 16 undermines roadway | - Worker and public safety <br> - Highway closures -additional cost to repair | High | 100 | \$1,500,000 | Depth of pipe in open cut section is not great. | Improbable | 25 | 0.2 | Significant | 2500 | Use vertical trenching to reduce width of trenching activities | \$300,000 |
|  | Construction adjacent to HWY 16 undermines existing watermain | - Worker and public safety - Disrupts water servicing to surrounding development -additional cost to repair | Mod | 50 | \$600,000 | Depth of pipe in open cut section is not great. | Improbable | 25 | 0.2 | Acceptable | 1250 | Use vertical trenching to reduce width of trenching activities | \$120,000 |
|  | Construction along 1A Avenue causes traffic backups | - Public complaints <br> - construction delays <br> -additional traffic accomodation | Low | 10 | \$150,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Somewhat Likely | 50 | 0.5 | Acceptable | 500 | Use vertical trenching to reduce width of trenching activities | \$75,000 |


| Construction in front of businesses disrupts accesses | - Public complaints | Low | 10 | \$150,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Somewhat Likely | 50 | 0.5 | Acceptable | 500 | Provide adequate notification to businesses prior to construction | \$75,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Construction activities adjacent to existing (parallel) utilities or services | - Potential damage to existing utility main line or services | Mod | 50 | \$600,000 |  | Improbable | 25 | 0.2 | Acceptable | 1250 |  | \$120,000 |
| Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections | - Need to construct rescue shaft to recover equipment <br> - Additional construction costs and schedule delay | High | 100 | \$1,500,000 | - Geotechnical desktop study indicates high ground water table - Presence of bouders is possible in glacial till | Somewhat Likely | 50 | 0.5 | Significant | 5000 | Complete thorough getechnical borehole program especially in section where trenchless construction is proposed | \$750,000 |

Edson - West Sanitary Sewer Trunk
Table I-6 Alignment 3 - Forcemain Option
Risk Quantification Worksheet

| \# | Risk / Concern | Consequence | Magnitude |  | \$ Impact | Probability Rationale | Probability |  |  | Risk Severity |  | Mitigation Strategy | Risk Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Design |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Depth of gas and oil pipelines is unknown | - Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint | Mod | 50 | \$600,000 | Gas/oil pipelines are generally at more shallow depths | Ex Remote | 1 | 0.01 | Minor | 50 | Hydrovac utility crossings during detailed design. | \$6,000 |
|  | Delays in acquiring approvals through environmental agencies | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Send in applications as soon as possible during detailed design | \$30,000 |
|  | Easements may not be obtained in time because owners do not cooperate | - Project delays | Low | 10 | \$150,000 |  | Somewhat Likely | 50 | 0.5 | Acceptable | 500 | Choose alignment and start land acquisition activities as soon as possible | \$75,000 |
|  | Additional backfill / restoration requirements in developed areas | - Increase Cost | Low | 10 | \$150,000 | Backfill requirements will be addressed in design | Probable | 100 | 0.8 | Acceptable | 1000 |  | \$120,000 |
|  | Adequate cover cannot be maintained on downstream sections | - Potential freezing of pipe flows | Mod | 50 | \$600,000 | Forcemain can be installed at greater depth; does not require specific grade | Ex Remote | 1 | 0.01 | Minor | 50 |  | \$6,000 |
|  | Adequate cover cannot be maintained at Bench Creek Crossing | - Excessive erosion in creek resulting in significant environmenal damage and fines | Ser | 300 | \$6,000,000 | Forcemain can be installed at greater depth; does not require specific grade | Ex Remote | 1 | 0.01 | Acceptable | 300 |  | \$60,000 |
|  | Construction |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Construction adjacent to HWY 16 undermines roadway | - Worker and public safety <br> - Highway closures -additional cost to repair | High | 100 | \$1,500,000 | Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities | Improbable | 25 | 0.2 | Significant | 2500 | Use vertical trenching to reduce width of trenching activities | \$300,000 |
|  | Construction adjacent to HWY 16 undermines existing watermain | - Worker and public safety <br> - Disrupts water servicing to surrounding development -additional cost to repair | Mod | 50 | \$600,000 | Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities | Improbable | 25 | 0.2 | Acceptable | 1250 | Use vertical trenching to reduce width of trenching activities | \$120,000 |


| Construction along 1A Avenue causes traffic backups | - Public complaints <br> - construction delays <br> -additional traffic accomodation | Low | 10 | \$150,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Somewhat Likely | 50 | 0.5 | Acceptable | 500 | Use vertical trenching to reduce width of trenching activities | \$75,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Construction in front of businesses disrupts accesses | - Public complaints | Low | 10 | \$150,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Somewhat Likely | 50 | 0.5 | Acceptable | 500 | Provide adequate notification to businesses prior to construction | \$75,000 |
| Construction activities adjacent to existing (parallel) utilities or services | - Potential damage to existing utility main line or services | Mod | 50 | \$600,000 |  | Improbable | 25 | 0.2 | Acceptable | 1250 |  | \$120,000 |
| Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections | - Need to construct rescue shaft to recover equipment <br> - Additional construction costs and schedule delay | mod | 50 | \$600,000 | Forcemain can be installed at minimal depth; does not require specific grade | Ex Remote | 1 | 0.01 | Minor | 50 | Complete thorough getechnical borehole program especially in section where trenchless construction is proposed | \$6,000 |
|  |  |  |  |  |  |  |  |  |  | 8200 |  | \$993,000 |

## Edson - West Sanitary Sewer Trunk

Table I-7 Alignment 4-Gravity Option
Risk Quantification Worksheet

| \# | Risk / Concern | Consequence | Magnitude |  | \$ Impact | Probability Rationale | Probability |  |  | Risk Severity |  | Mitigation Strategy | Risk Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Design |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Depth of gas and oil pipelines is unknown | - Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint | Mod | 50 | \$600,000 | Gas/oil pipelines are generally at more shallow depths | Improbable | 25 | 0.2 | Acceptable | 1250 | Hydrovac utility crossings during detailed design. <br> Use pump station and forcemain system. Forcemain can be installed at greater depths to avoid conflict | \$120,000 |
|  | Delays in acquiring approvals through environmental agencies | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Send in applications as soon as possible during detailed design | \$30,000 |
|  | Additional backfill / restoration requirements in developed areas | - Increase Cost | Low | 10 | \$150,000 | Backfill requirements will be addressed in design | Improbable | 25 | 0.2 | Acceptable | 250 |  | \$30,000 |
|  | Easements may not be obtained in time because owners do not cooperate | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Choose alignment and start land acquisition activities as soon as possible | \$30,000 |
|  | Adequate cover cannot be maintained on downstream gravity sections | - Potential freezing of pipe flows | Mod | 50 | \$600,000 | Downstream elevation constraints restrict the depth of the gravity sewer | Probable | 100 | 0.8 | Significant | 5000 | Use pump station and forcemain system | \$480,000 |
|  | Adequate cover cannot be maintained at Bench Creek Crossing | - Excessive erosion in creek resulting in significant environmenal damage and fines | Ser | 300 | \$6,000,000 | Limited depth of cover due to downstream elevation constraints | Somewhat Likely | 50 | 0.5 | Critical | 15000 | Use pump station and forcemain system | \$3,000,000 |
|  | Construction |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Construction adjacent to HWY 16 undermines roadway | - Worker and public safety <br> - Highway closures <br> -additional cost to repair | High | 100 | \$1,500,000 | Depth of pipe in open cut section is not great. | Improbable | 25 | 0.2 | Significant | 2500 | Use vertical trenching to reduce width of trenching activities | \$300,000 |
|  | Construction adjacent to HWY 16 undermines existing watermain | - Worker and public safety - Disrupts water servicing to surrounding development -additional cost to repair | Mod | 50 | \$600,000 | Depth of pipe in open cut section is not great. | Improbable | 25 | 0.2 | Acceptable | 1250 | Use vertical trenching to reduce width of trenching activities | \$120,000 |
|  | Construction along 1A Avenue causes traffic backups | - Public complaints <br> - construction delays <br> -additional traffic accomodation | Mod | 50 | \$600,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Improbable | 25 | 0.2 | Acceptable | 1250 | Use vertical trenching to reduce width of trenching activities | \$120,000 |


| Construction in front of businesses disrupts accesses | - Public complaints | Low | 10 | \$150,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Improbable | 25 | 0.2 | Acceptable | 250 | Provide adequate notification to businesses prior to construction | \$30,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Construction activities adjacent to existing (parallel) utilities or services | - Potential damage to existing utility main line or services | V Low | 1 | \$15,000 | Minimal amount of utilities parallel to alignment | Ex Remote | 1 | 0.01 | Minor | 1 | Provide adequate notification to businesses prior to construction | \$150 |
| Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections | - Need to construct rescue shaft to recover equipment <br> - Additional construction costs and schedule delay | High | 100 | \$1,500,000 | - Geotechnical desktop study indicates high ground water table - Presence of bouders is possible in glacial till | Somewhat Likely | 50 | 0.5 | Significant | 5000 | Complete thorough getechnical borehole program especially in section where trenchless construction is proposed | \$750,000 |

Edson - West Sanitary Sewer Trunk
Table I-8 Alignment 4-Forcemain Option
Risk Quantification Worksheet

| \# | Risk / Concern | Consequence | Magnitude |  | \$ Impact | Probability Rationale | Probability |  |  | Risk Severity |  | Mitigation Strategy | Risk Cost |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Design |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Depth of gas and oil pipelines is unknown | - Sewer profile may conflict with gas/oil pipelines requiring realignment of pipeline or deepening of sewer that would be lower than downstream elevation constraint | Mod | 50 | \$600,000 | Gas/oil pipelines are generally at more shallow depths | Ex Remote | 1 | 0.01 | Minor | 50 | Hydrovac utility crossings during detailed design. | \$6,000 |
|  | Delays in acquiring approvals through environmental agencies | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Send in applications as soon as possible during detailed design | \$30,000 |
|  | Easements may not be obtained in time because owners do not cooperate | - Project delays | Low | 10 | \$150,000 |  | Improbable | 25 | 0.2 | Acceptable | 250 | Choose alignment and start land acquisition activities as soon as possible | \$30,000 |
|  | Additional backfill / restoration requirements in developed areas | - Increase Cost | Low | 10 | \$150,000 | Backfill requirements will be addressed in design | Improbable | 25 | 0.2 | Acceptable | 250 |  | \$30,000 |
|  | Adequate cover cannot be maintained on downstream sections | - Potential freezing of pipe flows | Mod | 50 | \$600,000 | Forcemain can be installed at greater depth; does not require specific grade | Ex Remote | 1 | 0.01 | Minor | 50 |  | \$6,000 |
|  | Adequate cover cannot be maintained at Bench Creek Crossing | - Excessive erosion in creek resulting in significant environmenal damage and fines | Ser | 300 | \$6,000,000 | Forcemain can be installed at greater depth; does not require specific grade | Ex Remote | 1 | 0.01 | Acceptable | 300 |  | \$60,000 |
|  | Construction |  |  |  |  |  |  |  |  |  |  |  |  |
|  | Construction adjacent to HWY 16 undermines roadway | - Worker and public safety <br> - Highway closures -additional cost to repair | High | 100 | \$1,500,000 | Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities | Improbable | 25 | 0.2 | Significant | 2500 | Use vertical trenching to reduce width of trenching activities | \$300,000 |
|  | Construction adjacent to HWY 16 undermines existing watermain | - Worker and public safety <br> - Disrupts water servicing to surrounding development -additional cost to repair | Mod | 50 | \$600,000 | Depth of pipe in open cut section is not great. Use vertical trenching to reduce width of trenching activities | Improbable | 25 | 0.2 | Acceptable | 1250 | Use vertical trenching to reduce width of trenching activities | \$120,000 |


| Construction along 1A Avenue causes traffic backups | - Public complaints <br> - construction delays <br> -additional traffic accomodation | Low | 10 | \$150,000 | Use of proper public notification and traffic accomodation plans should limit complaints | Improbable | 25 | 0.2 | Acceptable | 250 | Use vertical trenching to reduce width of trenching activities | \$30,000 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Construction in front of businesses disrupts accesses | - Public complaints | Low | 10 | \$150,000 | Use of proper public notification and traffic accomodation plans should limit complaints | remote | 10 | 0.02 | Minor | 100 | Provide adequate notification to businesses prior to construction | \$3,000 |
| Construction activities adjacent to existing (parallel) utilities or services | - Potential damage to existing utility main line or services | V Low | 1 | \$15,000 | Minimal amount of utilities parallel to alignment | Ex Remote | 1 | 0.01 | Minor | 1 | Provide adequate notification to businesses prior to construction | \$150 |
| Encounter poor ground conditions during trenchless installation of gravity pipe in deep sections | - Need to construct rescue shaft to recover equipment <br> - Additional construction costs and schedule delay | Mod | 50 | \$600,000 | Forcemain can be installed at minimal depth; does not require specific grade | Ex Remote | 1 | 0.01 | Minor | 50 | Complete thorough getechnical borehole program especially in section where trenchless construction is proposed | \$6,000 |
| 5301 |  |  |  |  |  |  |  |  |  |  |  | 621,150 |

