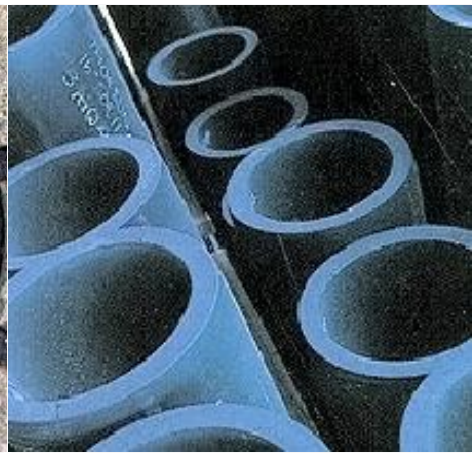
# TOWN OF VERMILION
# SANITARY TRUNK FLOW MONITORING AND UPGRADING

Project number 102414 -20

**Prepared by:**
Focus Corporation
Suite 300, 9925-109 Street
Edmonton, Alberta, Canada, T5K 2J8

**Submitted to:**
Town of Vermilion
5021 – 49 Avenue
Vermilion, Alberta, Canada, T9X 1X1

FOCUS
Engineering - Geomatics - Planning
www.focus.ca

FOCUS

Engineering - Geomatics - Planning

# TOWN OF VERMILION
# SANITARY TRUNK FLOW MONITORING AND UPGRADING

Prepared for:

The Town of Vermilion

Prepared by:

Focus Corporation

Project No.: 102414-20

March 2010

## CORPORATE AUTHORIZATION

This report entitled "**Town of Vermilion Sanitary Trunk Flow Monitoring and Upgrading**", was prepared by Focus Corporation (Focus) for the account of The Town of Vermilion. The material in it reflects the judgment of Focus, in light of the information available at the time of preparation. Any use of the information by a third party, or any reliance on or decisions made on it are the responsibility of such third parties. Focus accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made, or actions taken, based upon information contained in the report.


PROFESSIONAL SEAL

BLAIR E. RAYMOND, M.SC., P.ENG.

PERMIT TO PRACTICE
FOCUS CORPORATION
Signature
Date Apr. 12/10
PERMIT NUMBER: P 6386
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PERMIT TO PRACTICE

# Executive Summary

The Town of Vermilion sanitary trunk sewer is currently undersized for the majority of the sanitary peak wet weather flow. As the Town grows in size and population, the existing system is expected to be upgraded in order to accommodate the increasing sanitary flows. In 2007 the Town retained the Focus Corporation for services including a flow monitoring program and conceptual upgrading recommendations for the existing sanitary trunk sewer.

The flow monitoring program extended from the end of June until mid September 2007. GEOtivity Inc., was retained to install and maintain flow monitors at four locations along the sanitary trunk, as well as a rain gauge to collect rain data. Upon reviewing the flow monitoring data it was decided by Focus that none of the monitoring sites produced data that could be used for estimating average dry weather flows. Possible causes for the poor quality of the data include probe malfunction, drift or poor conditions for flow monitoring. An average dry weather residential flow generation rate of 300 L/person/day was selected instead. The other design criteria used in this analysis were based on the City Of Edmonton Design and Construction Standards.

Sanitary trunk survey data and sanitary trunk elevations from Town engineering drawings were compiled to create a spreadsheet model of the sanitary trunk main. The model was used to calculate the current flow rates and pipe capacities and identify the portions of sanitary sewer trunk currently operating over capacity.

The existing condition analysis confirmed that most of the sanitary sewer trunk west of Highway 41 had additional capacity, although there were several segments of 300 mm sewer currently over 86% of pipe capacity. East of Highway 41 the existing trunk was severely undersized, with utilization as high as 311% upstream of the WWTP. The sewer utilization was reviewed with the addition of approximately 85 ha of future residential development in the west end of the Town and 14 ha commercial development along Highway 41. This scenario showed that sewer utilization is expected to increase and affect parts of the trunk that were previously operating under capacity as well as worsen the conditions west of Highway 41.

Based on these findings, conceptual upgrades were recommended to provide adequate pipe capacity for future development. The proposed sewer improvements were prioritized based on the severity of the capacity constraints. The highest priority was assigned to the sewer section east of the Highway 41 crossing. Two options were examined for the conceptual sizing of the new trunk: a twinning option that would carry a portion of the flows while maintaining the existing trunk in service and a replacement option that would carry all the flows and see the old trunk abandoned. The condition of the existing sewer trunk would need to be assessed prior to selecting the first option. For the second option it was assumed that the existing trunk would remain in service during construction of the new sewer.

Due to the shorter length of the upgrades, the undersized sewer sections west of Highway 41 can be removed and replaced, while optimizing pipe slopes between tie-in points. Since some of the pipes to be upgraded are located in the Provincial Park, it is preferable to replace this sewer section at once.

Conceptual cost estimates have been included for both the twinning and replacement options.

# Table of Contents

## List of Tables



## List of Figures

# 1.0 Introduction

## 1.1 SCOPE OF WORK

The Town of Vermilion Sanitary Trunk Flow Monitoring and Upgrading study presents the results of a sanitary flow monitoring program and the recommended upgrades for the sanitary trunk sewer in the Town of Vermilion. This work was undertaken by the Focus Corporation on behalf of the Town of Vermilion.

The scope of work in the study included the following:

- A flow monitoring program during the summer of 2007 to monitor peak flows in the sanitary trunk for the purpose of determining the utilization of the sewer.
- An assessment of the capacity of the existing sanitary trunk sewer. The assessment looked at pipe capacities under Peak Wet Weather Flows conditions and highlighted the existing system deficiencies.
- Proposed sanitary sewer trunk upgrades as needed for future development within the current Town boundaries

# 2.0 Data Collection

The sources of information used in this report include:

- Sanitary sewer CAD drawings including pipe diameter, lengths and slopes for portions of the existing sanitary sewer system, provided by the Town;
- Sanitary trunk survey information, provided by the Town;
- Town of Vermillion land use and planning information;
- As-built engineering drawings of the sanitary trunk sewer, provided by the Town;
- Sanitary flow and rainfall monitoring data from GEOtivity Incorporated.

## 2.1 EXISTING SANITARY TRUNK SEWER

Based on discussions with the Town of Vermilion, only the sanitary trunk main was used in the analysis. The monitored portion of the sanitary trunk begins as a 300 mm sewer. The trunk crosses Highway 41 in a 600 mm casing with 500 mm liner and then flows east into another 300 mm sanitary sewer. This sewer becomes a 375 mm just north of Young Drive and continues east to the Wastewater Treatment Plant. The existing sanitary trunk system is shown in Figure 2.1.

## 2.2 FLOW MONITORING PROGRAM

GEOtivity Incorporated, a company specialized in flow monitoring was retained to install and maintain several flow monitors along the sanitary trunk. Four monitoring locations were selected by the Focus Corporation following discussions with GEOtivity Incorporated and also based on lateral sewer connections, accessibility and flow conditions. A rain gauge was also installed at the Town office, to collect rain data during the flow monitoring period.

The flow monitoring program extended from the end of June until mid September 2007. The monitoring equipment consisted of flow monitors that measured velocity and depth, which are then used along with the pipe geometry to calculate flow rates. The locations of the flow monitors and rain gauge are listed in Table 2.1. These locations are also illustrated in Figure 2.2 along with the sanitary drainage areas that contribute flows to the monitoring sites.

**Table 2.1 Flow and Rainfall Monitoring Locations**

| Item | Location |
|---|---|
| Flow Monitor 1 | West of the Wastewater Treatment Plant |
| Flow Monitor 2 | 50$^{th}$ Street (Pare Drive), north of Young Drive |
| Flow Monitor 3 | Park Drive and 56$^{th}$ Street |
| Flow Monitor 4 | Corner of Park Drive, north of 56$^{th}$ Street |
| Rain Gauge | Town Office, 5021 – 49$^{th}$ Avenue |

It should be noted that there are a number of factors that contribute to the success of a flow monitoring program. One of the contributing factors is the configuration of the system at the location being monitored. The configuration of the pipes at the manhole chosen for monitoring, as well as the typical flow depth and velocity in the pipe being measured contribute to the quality of the resulting data. For instance, low flow depths and velocities may lead to ragging or fouling on the probes as the flow may not be vigorous enough to prevent debris from catching on the probe. Additionally, very small flow depths can sometimes be problematic to measure.

When the intention of the flow monitoring is to determine peak flows and evaluate the inflow/infiltration (I/I) into a sanitary sewer the pattern of rainfall during the monitoring period is also a factor. Although one season may provide sufficient data to provide a good sense of flow rates, patterns, and rain influences, it should be noted that there is no guarantee that one season of flow monitoring will provide the type of flow data or rainfall events of interest. Typically obtaining data over a series of seasons increases the likelihood of collecting data for the desired weather and flow conditions.

The monitoring sites are discussed below. The flow monitoring data from all of the sites is attached in Appendix A.

### 2.2.1 Flow Monitor 1

Flow Monitor 1 was installed in Sanitary Manhole #3 on the 375 mm sanitary trunk sewer going to the Waste Water Treatment Plant (WWTP). The site receives sanitary flows from a total basin area of 344 ha, of which 304 ha are currently serviced. Sample depth, velocity and flow data from this site is shown in Figure 2.3.

This site shows the expected pattern of daily flows with a large rainfall spike noticeable on 25 June, however, after 10 August velocity data becomes unreliable. The sudden drop in velocity may be due to ragging or debris attached to the probe. This portion of data was not used in the following analysis as it is considered suspect.

### 2.2.2 Flow Monitor 2

Flow Monitor 2 was installed in Sanitary Manhole #14 on the 375 mm sanitary trunk sewer line crossing 50$^{th}$ Street (Paré Drive) just north of Young Drive. The total basin area contributing flows to this monitoring location is 299 ha, of which 264 ha currently serviced.

This site follows a consistent daily flow pattern with large rainfall spikes corresponding to rainfall events on 25 June, 8 July and 11 and 20 August. After 28 August there is a significant jump in the velocity baseline that may be the result of sensor fouling or drift. This portion of data was not used in the following analysis as it is considered suspect.

### 2.2.3 Flow Monitor 3

Flow Monitor 3 was installed in Sanitary Manhole #206 on the 300 mm sanitary trunk sewer at Park drive and 56th Street. The total basin area contributing flows to this monitoring location is 65 ha, of which 63 ha currently serviced.

The flow data at this site shows a daily pattern, although the overall profile is influenced by high variability in the velocity data. There is a gap in recorded data from 10 to 28 August.

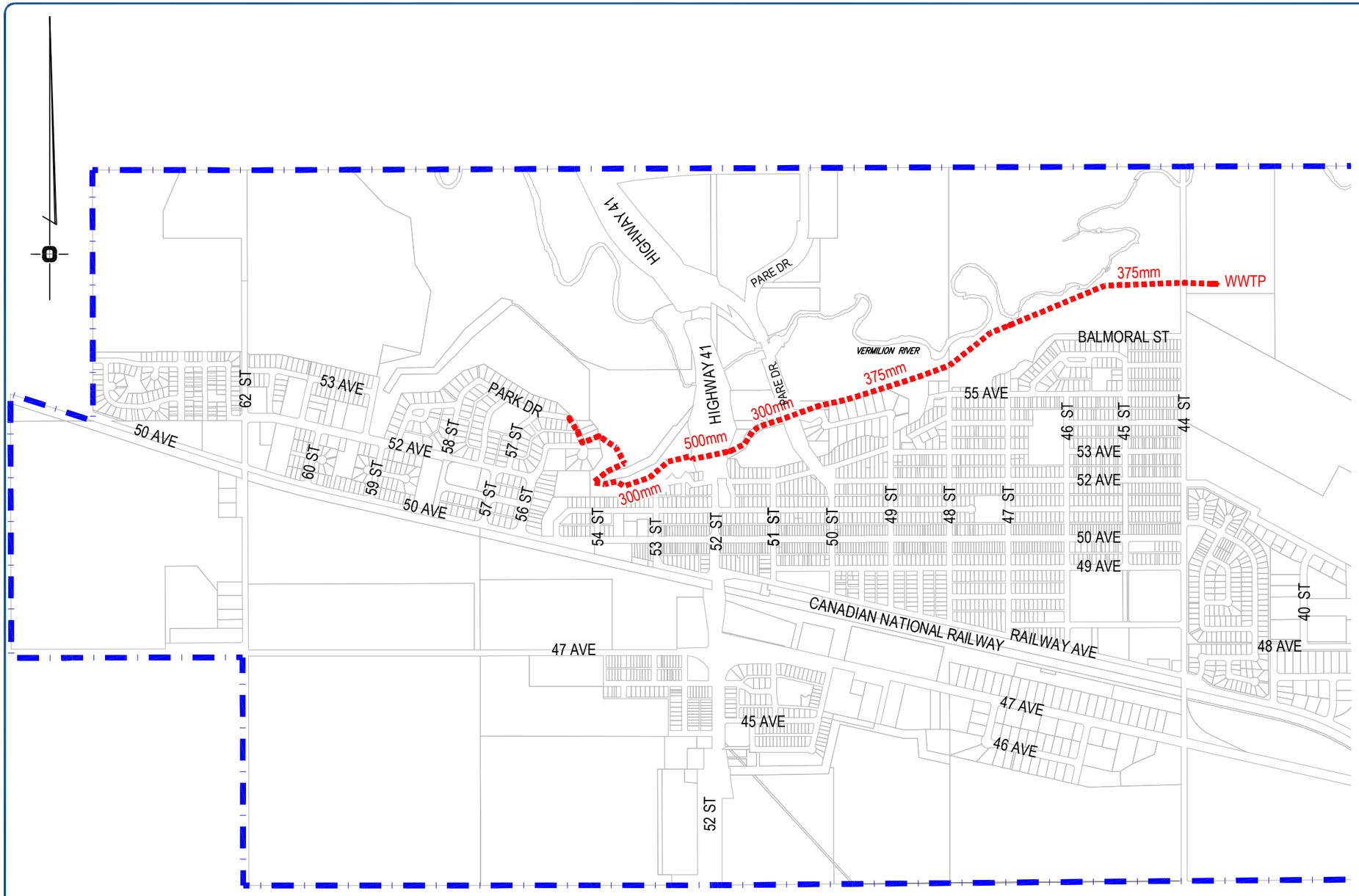
### 2.2.4 Flow Monitor 4

Flow Monitor 4 was installed in Sanitary Manhole #143 on the 300 mm sanitary trunk sewer at the Corner of Park drive, north of 56th Street. This monitoring location receives flows from approximately 51 ha in the northwest corner of the Town, of which 49 ha currently serviced.

Due to large fluctuations in velocity patterns over extended periods, data from Monitor 4 was not further analyzed.

### 2.2.5 Rain Gauge

The rain gauge was installed at the Town office (5021 – 49th Avenue) to collect rain data during the flow monitoring period. Daily rainfall data recorded by this rain gauge is shown in Figure 2.4. The main rainfall events that were likely to cause wet weather flow responses in the sewer took place on 25 June and 20 August.




# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

- TOWN BOUNDARY
- 375mm — SANITARY TRUNK SEWER AND SIZE

## EXISTING SANITARY SEWER TRUNK

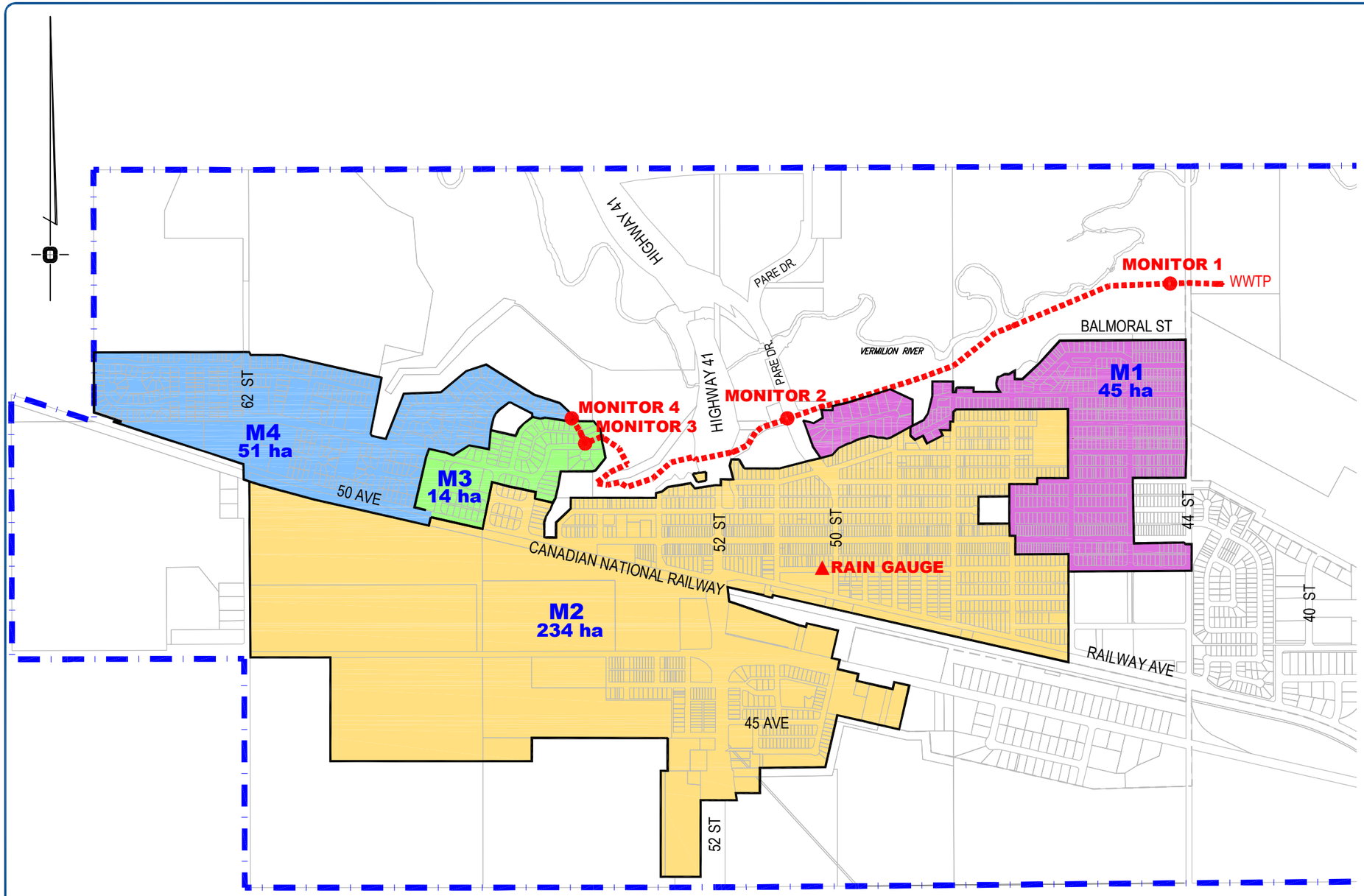
# FIGURE 2.1



FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 2.1-EX SAN TRUNK.dwg
DATE PLOTTED: March 5, 2010




# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

- TOWN BOUNDARY
- SANITARY TRUNK SEWER
- MONITOR LOCATION
- RAIN GAUGE LOCATION
- SANITARY BASIN BOUNDARY
- M2 234 ha — SANITARY BASIN LABEL BASIN AREA

## FLOW AND RAINFALL MONITORING LOCATIONS

## FIGURE 2.2



FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 2.2-FLOW.dwg

DATE PLOTTED: March 5, 2010

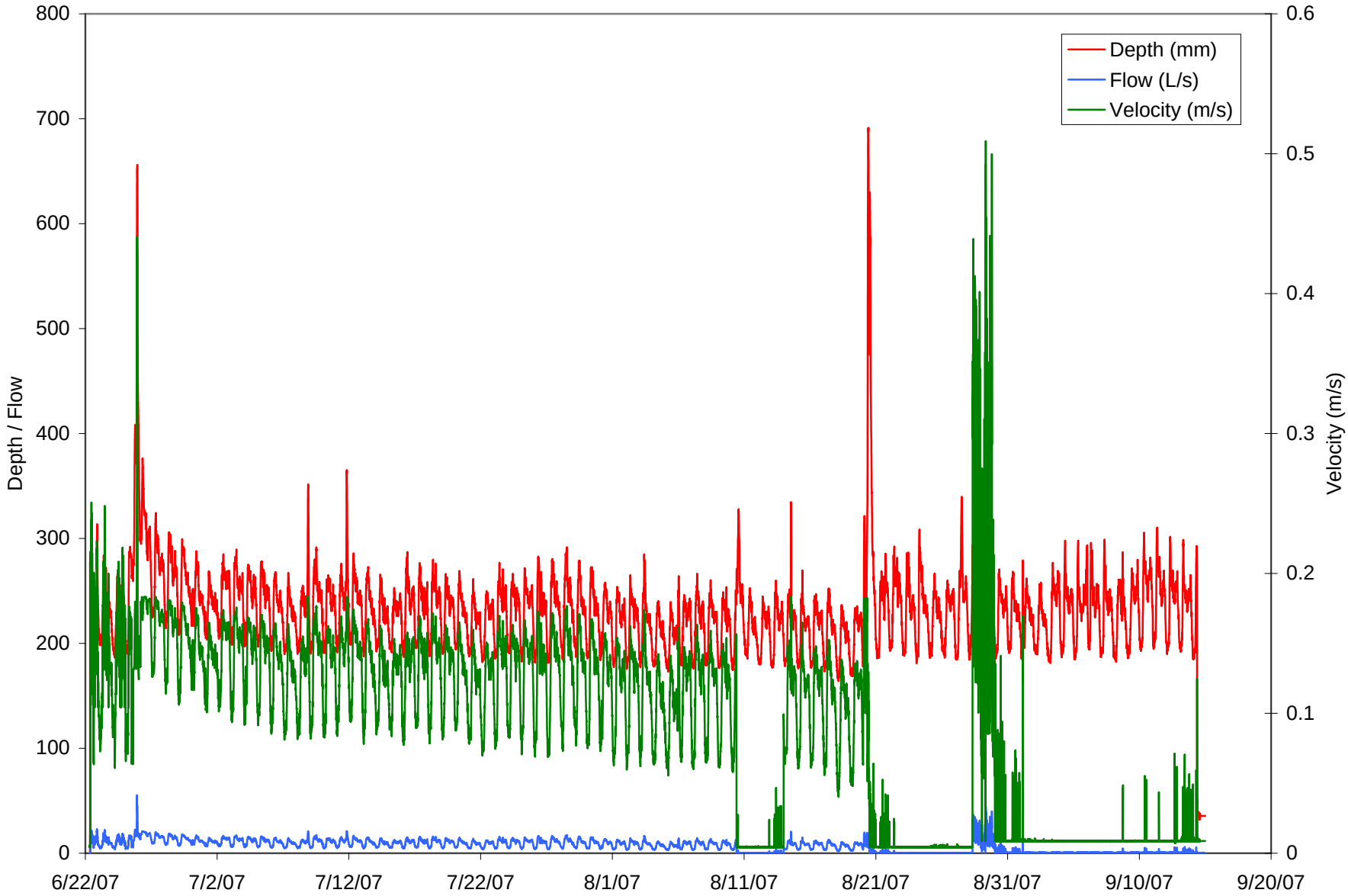



**Figure 2.3**
**Sample Depth, Velocity and Flow Data**

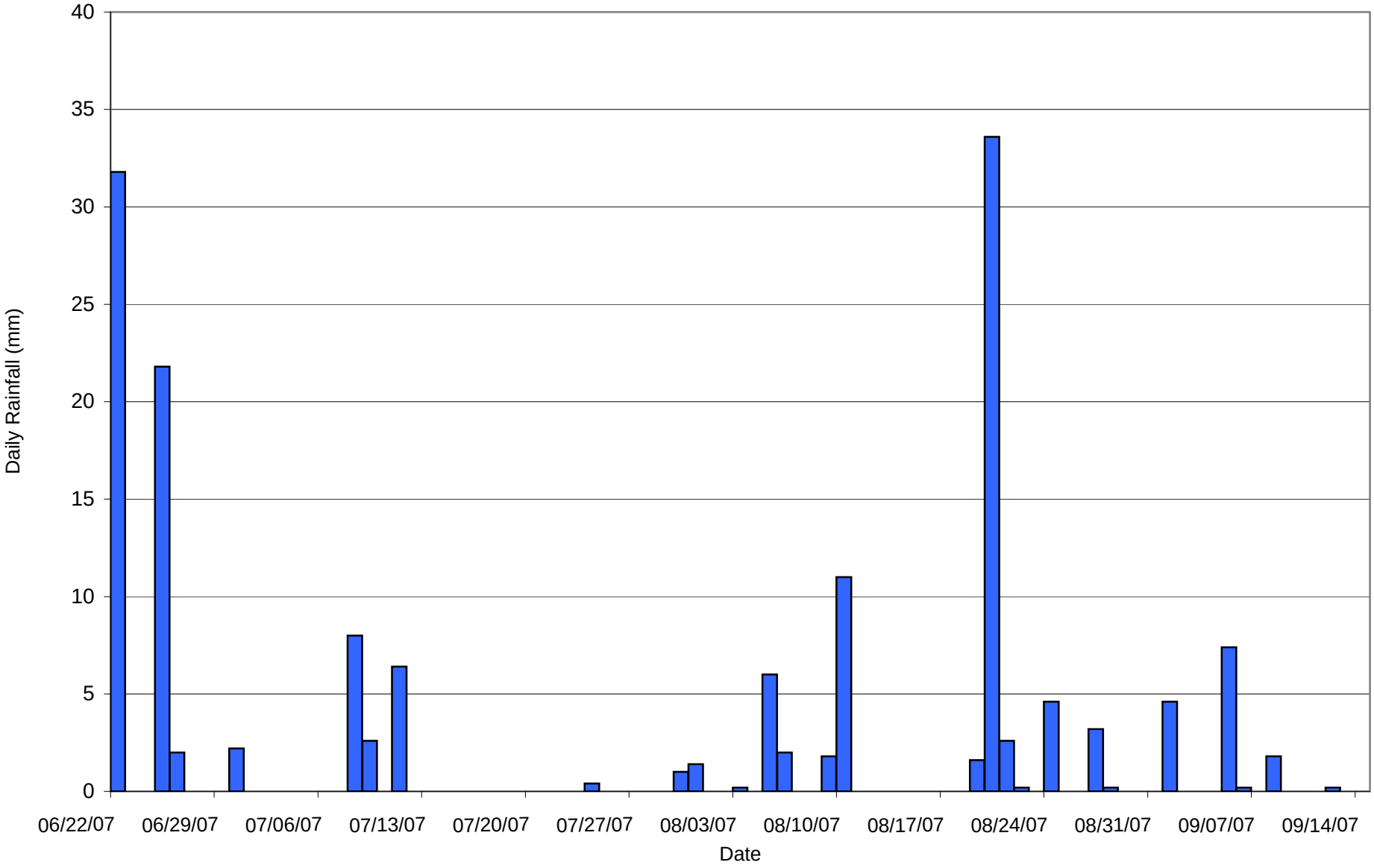



**Figure 2.4**
**Daily Rainfall Data**

# 3.0 Sanitary Trunk Sewer Analysis

As of 2006, the Town of Vermilion had a population of 4,036 and a total area of approximately 14 $Km^2$. Currently the Town has a mix of residential, commercial, industrial and institutional land uses. There is also some cultivated agricultural land that falls within the municipal limits.

Future growth is expected to include an additional 14 ha of commercial development in the south end of the Town, along Highway 41 and approximately 85 ha of residential development in the west end of the Town. Further development on the Lakeland College campus is also expected to take place at the same time.

The land uses for the existing and future development areas within the Town are shown in Figure 3.1. The figure is based on the Town of Vermilion Land Use By-Law 1-2006. The future growth areas, based on discussion with the Town, are illustrated in Figure 3.2.

## 3.1 FLOW MONITORING DATA ANALYSIS

A cursory review of the flow data was performed by comparing flows for sites that are upstream and tributary to other sites. The sample flow data presented in Figure 3.3 shows flow magnitude anomalies for Sites 1, 2 and 3 and the high variability in the flow pattern that was previously noted for Site 4. As Site 3 is upstream of Site 2, the flows measured by Monitor 3 are expected to be lower than those measured by Monitor 2. The plot consistently shows Site 3 flows almost double in magnitude to those measured at Site 2.

The flows at Site 3 also appear unrealistically high when compared with the flows recorded at Site 1, as both flows are in the same order of magnitude but Site 1, which is downstream of Site 3, services a significantly larger area. Both anomalies indicate that there may have been some fouling of the flow monitoring probes at Site 3.

The flow data collected from Sites 1, 2 and 3 was then reviewed in order to estimate actual flow generation rates. The first step was the identification and screening of dry weather days for each of these sites.

Dry weather days are days in which sanitary flows are not influenced by rainfall; as such they can be used to determine average dry weather flows at the monitoring sites. In order to isolate the dry weather days, the rainfall data was screened based on the following criteria:

- no rainfall for the day
- less 2.5 mm cumulative rainfall within preceding 24 hours
- less than 10 mm cumulative rainfall within three days
- less than 25 mm cumulative rainfall within five days

For each monitoring site the dry weather days were screened in order to eliminate days which showed unusual flow patterns (outliers). Dry weather days with consistent flow patterns were divided into weekdays, Saturdays and Sundays and their data was averaged to produce typical dry weather days for these three groups.

The resulting daily flows calculated for the monitoring sites are shown in Table 3.1. As previously pointed out Site 3 dry weather flows seem suspiciously high when compared to the downstream sites. They are included in the following tables only for reference purposes.

**Table 3.1 Measured Flows**

| Monitoring Site | Average Dry Weather Flow (L/s) | Peak Dry Weather Flow (L/s) | Peak Wet Weather Flow (L/s) |
|---|---|---|---|
| 1 | 9.7 | 14.1 | 55.4 |
| 2 | 5 | 7.5 | 61.8 |
| 3 | 9.5 | 14.6 | 27.6 |

The typical dry weather days were then compared to the flows on the days with larger wet weather flows to estimate the I/I component of the flow. With the measured basin areas and estimated populations in those areas, the per capita flow generation and Inflow/Infiltration (I/I) were calculated, as shown in Table 3.2.

**Table 3.2 Flow Generation and I/I Calculations**

| Monitoring Site | Serviced Area (ha) | Population | Average Dry Weather Flow (L/person/day) | I/I (L/s/ha) |
|---|---|---|---|---|
| 1 | 304 | 3,767 | 223 | 0.23 |
| 2 | 264 | 2,894 | 150 | 0.37 |
| 3 | 63 | 944 | 867 | 0.32 |

As seen from the tabulated data none of the sites produced flow monitoring data that results in an estimation of average dry weather flows. If data for Site 3 is discarded, the average dry weather flow for Sites 1 and 2 becomes 187 L/person/day and 0.30 L/s/ha for I/I. As the flows shown in Tables 3.1 and 3.2 are based on total flows, they include the flows generated in commercial, industrial and institutional areas. That makes the actual per capita flow generation even lower than the average calculated here. It can be concluded that it is more realistic to use the dry weather wastewater generation rate of 300 L/person/day than the average of Sites 1 and 2, based on one season of flow monitoring. The calculated average I/I value matches the 0.28 L/s/ha recommended by Alberta Environment.

## 3.2 DESIGN CRITERIA

The design criteria used in this analysis are based on the City of Edmonton Design Standards and the Alberta Environment "Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems":

- Average dry weather wastewater generation rates:
  - Residential average flow = 300 L/person/day
  - Commercial / Industrial / Institutional average flows = 20 $m^3$/day/ha (0.2 L/s/ha)
- Peaking factors used to determine the peak dry weather wastewater flows:
  - Residential Peaking Factor, larger than 1.5 or PF = $2.6*P^{-0.1}$, where P is the population in thousands
  - Non-residential Peaking Factor, PF = 10 $Q_{avg}^{-0.45}$, with a minimum value of 2.5 and a maximum value of 25, where $Q_{avg}$ is the average flow rate
- Inflow/Infiltration = 0.28 L/s/ha
- Pipe roughness coefficient for all pipes = 0.013

The following design criteria, also based on the City of Edmonton Design Standards, were used for the sanitary trunk upgrades:

- New sanitary sewers not to exceed 86% of pipe capacity.
- Minimum design slopes:

| Sewer Diameter (mm) | <Minimum Design Slope% |
|---|---|
| 200 | 0.40 |
| 250 | 0.28 |
| 300 | 0.22 |
| 375 | 0.15 |
| 450 | 0.12 |
| 525 and Greater | 0.10 |

- Minimum drop at manholes:

| Change of direction | Minimum Drop (mm) |
|---|---|
| 0º - 45º | 30 mm |
| 45º - 90º | 60 mm |

- Minimum cover for sanitary sewer: 2.6 m to top of the pipe

Existing population densities were set to match the 2006 census population based on the existing developed residential areas in Town:

- Low and Medium Density Residential = 2.2 cap/lot
- High Density Residential = 240 cap/ha

For future residential growth a density of 15 lots/gross ha was assumed, while keeping the existing population density of 2.2 cap/lot.

## 3.3 SANITARY TRUNK MODEL

A model of the sanitary trunk main was created using Microsoft Excel in order to calculate the current flow rates and pipe capacities. The direction of flow in the sanitary sewers was used to delineate the sanitary basins of the flow monitors. Out of each sanitary basin, the serviced area was further segregated by type of land occupancy and used to estimate sanitary flow contributions. Portions of sanitary sewer trunk currently operating over capacity were identified. The model was then adjusted to reflect future growth and identify additional trunk portions that are expected to be over capacity as additional development takes place.

### 3.3.1 Existing Sanitary Sewer Trunk Utilization

The existing sanitary sewer trunk utilization illustrated in Figure 3.4 was determined based on the design flow generation rates and peaking factors. The calculations are based on the 2006 census population.

With the current development and land uses most of the sanitary trunk sewer west of Highway 41 seems to have additional capacity. Upstream of the Highway 41 crossing there are several segments of 300 mm sewer that show utilization values over 86%, with a total estimated length of 315 m. Survey data also indicates a negative slope of -0.2% for the sewer between SanMH327 and SanMH327A.

Downstream of the Highway 41 crossing the eastern half of the trunk is running severely over capacity, as the existing 375 mm line is not large enough to convey all the sanitary flows. Calculated utilization values for this portion of the trunk sewer range between 87% and 311%, with the segments most heavily over utilized being downstream of the Paré Drive crossing.

The utilization of the sanitary trunk sewer is as follows:

- 148 m utilized between 86% and 100%
- 297 m utilized between 100% and 120%
- 1,381 m utilized over 120%

It should also be noted that the existing sewer is shallow in places and does not meet the minimum 2.6 m recommended cover. The sewer utilization calculations are summarized in Table 3.3.

### 3.3.2 Existing Sanitary Sewer Trunk Utilization with Future Development

The sewer utilization was reviewed with the addition of approximately 85 ha of future residential development in the west end of the Town and 14 ha commercial development along Highway 41. The growth scenario also assumes that additional development on the Lakeland College campus will occupy approximately half of the campus area.

The future residential land use is expected to be of the low or medium density type, with lot densities of approximately 15 units/gross ha and an average population density of 2.2 cap/unit.

The sewer utilization resulting from adding the flows generated by future development to the existing trunk is shown in Figure 3.5. Trunk utilization is expected to increase and affect some segments in the western half of the trunk that previously were operating either below 86% capacity or between 86% and 100%. Downstream of the Paré Drive crossing utilization values for the trunk would run as high as 411%.

The utilization of the sanitary trunk sewer is as follows:

- 154 m utilized between 86% and 100%
- 229 m utilized between 100% and 120%
- 1,678 m utilized over 120%

The sewer utilization calculations are summarized in Table 3.4.

### 3.3.3 Future Sanitary Sewer Trunk Utilization

The current design requirement for new sanitary sewers is not to exceed 86% of pipe capacity. The overall capacity of the existing sanitary sewer trunk can be increased either by replacing the sewer in place with larger size pipes or by twinning. Although it is possible to build short temporary by-passes and re-route sewage during construction, a parallel sewer is preferable for larger scale upgrades, as the existing sewer can remain in service during construction.

This section identifies on a conceptual basis the sanitary trunk improvements needed for sections that are currently or expected to be exceeding capacity. The intent is not to propose the exact alignment of the sewer improvements, but rather a general framework that can be used in the future to select the most efficient upgrade option. The proposed sewer improvements are prioritized based on the severity of the capacity constraints under both present and future conditions.

**Proposed sanitary trunk upgrades west of Highway 41 crossing**

The sewer upstream of the Highway 41 crossing can be upgraded by replacing the undersized portions in place. This includes the following improvements, illustrated in Figure 3.8:

**Upgrade 1** - 23 m of 525 mm sanitary sewer between sanitary manholes 142 and 143

This is a high priority upgrade. The current 195% sewer overutilization is due to the flat 0.02% slope on the existing 300 mm pipe. The 525 mm upgrade assumes that the vertical alignment is maintained at both manholes. A better hydraulic solution would be replacing both this pipe and the pipe downstream while equalizing the pipe grades.

**Upgrade 2** - 62 m of 375 mm sanitary sewer between sanitary manholes 206 and 341

There is only marginal need for this upgrade, as the predicted utilization value for the existing sewer with future development is 89%. This sewer section is located in Vermilion Provincial Park, and has no services directly attached to it. As there are no risks of basement flooding, flows for this portion of the sanitary trunk can be monitored, without replacing the sewer unless it becomes necessary.

**Upgrade 3** - 230 m of 375 mm sanitary sewer between sanitary manholes 327 and T101

This is a medium priority upgrade. Current utilization values for this section are below 120%, whereas predicted utilization with future growth would reach 169%. The upgrade is also intended to correct the negative slope for the sewer between SanMH327 and SanMH327A.

This portion of the existing sewer trunk is located in the Vermilion Provincial Park and has no services directly connected to it. Although there is no risk of basement flooding associated with surcharge for this sewer section, there are potential environmental concerns. Due to existing terrain and restricted work spaces it is recommended to replace this entire length of sewer at once. It should be noted that the existing sewer is shallow in this area and appropriate insulation should be provided for the new pipes.

### Proposed sanitary trunk upgrades east of Highway 41 crossing

These upgrades are urgent in nature, due to the severe overutilization of the sewer downstream of sanitary manhole 231. Since the entire length of the sewer to the WWTP has to be replaced while keeping the existing trunk in operation, the recommended upgrade philosophy would be to construct a new trunk, parallel to the old one. It is unknown at the moment if two sanitary trunks can fit side by side in the existing sewer alignment, or if terrain and vegetation conditions are too restrictive to allow for the additional sewer. Further investigation is needed to determine the feasibility of the proposed upgrades.

Two options, 4.A and 4.B, were investigated for this upgrade. Both options are based on tying the new sewer with the existing invert at the WWTP, while allowing for the minimum drops at manholes and the minimum pipe slopes. Under these circumstances there are several locations that do not meet the recommended 2.6 m of cover to the top of the pipe. Insulation can be provided to protect these sewer sections against freezing, or pipe grades can be adjusted to provide the minimum cover. In this case a lift station would be required at the WWTP.

#### Upgrade 4.A - Twinning the sanitary trunk from sanitary manhole 231 to the WWTP

Downstream of the crossing, the sewer can be twinned with an additional sanitary sewer intended to convey to the WWTP the flows tributary to sanitary manhole 231, basin M2. The rest of the sanitary flows will be conveyed to the WWTP by the existing sanitary sewer trunk. Connections between the old and new sewer could be made to make up for the lack of capacity in individual segments of the existing sewer. The estimated sizes and lengths of upgrades are as follows:

- 355 m of 375 mm sanitary sewer
- 475 m of 525 mm sanitary sewer
- 995 m of 600 mm sanitary sewer

The conceptual improvements needed for this option are summarized in Table 3.5 and illustrated in Figures 3.6 and 3.9

#### Upgrade 4.B - Sanitary trunk replacement from Sanitary Manhole 231 to the WWTP

Prior to twin line design, the general condition of the existing sanitary pipes should be investigated to decide if the sewer should be kept in service. In case the existing trunk is found to be in poor condition, and rehabilitation is not feasible, the proposed twin line can be sized to convey all sanitary flows to the WWTP. Under this scenario, once the new trunk is built, the existing trunk will be abandoned in place. The estimated sizes and lengths of upgrades are as follows:

- 355 m of 375 mm sanitary sewer
- 380 m of 600 mm sanitary sewer
- 995 m of 675 mm sanitary sewer
- 95 m of 750 mm sanitary sewer

The conceptual improvements needed for this option are summarized in Table 3.6 and illustrated in Figures 3.7 and 3.10.

**Table 3.3**
**Existing Sewer Utilization Calculations**

FOCUS

**PROJECT:** TOWN OF VERMILION
**JOB No. :** 102414
**DATE:** 2-Feb-10
**Computed by:** SHS
**Checked by:** BER

| | | | | | |
|---|---|---|---|---|---|
| Per Capita Flow = | 300 | L/cap/day | Infiltration Allowance = | 0.28 | L/s/ha |
| Commercial Flow = | 0.20 | L/s/ha | Sag MH Inflow = | 0.4 | L/s/MH |
| Industrial Flow = | 0.20 | L/s/ha | Pipe Roughness Coeff. = | 0.013 | (unitless) |
| Institutional Flow = | 0.20 | L/s/ha | Residential Peaking Factor = | 2.6P-0.1 | |

| Population Density | |
|---|---|
| Low and Medium Density Residential | 2.2 cap/lot |
| High Density Residential | 240 cap/ha |

| | | | Residential | | | | | | | | | Non-Residential | | | | | | I/I | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From MH | To MH | Landuse | Added Lots | Total Lots | Pop. Dens. (cap/lot) | Added Area (ha) | Total Area (ha) | Pop. Dens. (cap/ha) | Added Pop. | Total Pop. | Peak Factor | Avg. Flow (L/s) | Added Area (ha) | Total Area (ha) | Added Avg Flow (L/s) | Peak Factor | Tot Avg. Flow (L/s) | PDWF (L/s) | General (L/s) | Added Sag MH | Total Sag MH | Sag MH Inflow (L/s) | PWWF (L/s) | Size (mm) | Slope (%) | Length (m) | Cap. (L/s) | Full Flow Vel. (m/s) | PWWF Flow Vel. (m/s) | PDWF Flow Vel. (m/s) | PWWF to Cap. (%) | U/S Rim (m) | U/S Inv. (m) | D/S Inv. (m) | U/S Cover (m) | D/S Cover (m) |
| | | Industrial | | 0 | | | 0.00 | | 0 | 0 | 1.50 | 0.00 | 1.94 | 1.94 | 0.39 | 15.31 | 0.39 | 5.94 | 0.54 | | 0.00 | 0.00 | 6.48 | | | | | | | | | | | | |
| | | LDR | 310 | 310 | 2.2 | 46.81 | 46.81 | | 682 | 682 | 2.70 | 2.37 | | 1.94 | 0.00 | 15.31 | 0.39 | 12.34 | 13.65 | | 0.00 | 0.00 | 25.99 | | | | | | | | | | | | |
| | | MDR | 2 | 312 | 2.2 | 0.1 | 46.91 | | 4 | 686 | 2.70 | 2.38 | | 1.94 | 0.00 | 15.31 | 0.39 | 12.38 | 13.68 | | 0.00 | 0.00 | 26.05 | | | | | | | | | | | | |
| | | HDR | 3 | 315 | | 0.25 | 47.16 | 240 | 60 | 746 | 2.68 | 2.59 | | 1.94 | 0.00 | 15.31 | 0.39 | 12.88 | 13.75 | | 0.00 | 0.00 | 26.63 | | | | | | | | | | | | |
| SanMH143 | SanMH142 | | | 315 | | | 47.16 | | 0 | 746 | 2.68 | 2.59 | | 1.94 | 0.00 | 15.31 | 0.39 | 12.88 | 13.75 | | 0.00 | 0.00 | 26.63 | 300 | 0.02 | 22.70 | 13.68 | 0.19 | 0.42 | 0.22 | 195% | 611.606 | 606.276 | 606.272 | 5.030 | 4.920 |
| SanMH142 | SanMH141 | | | 315 | | | 47.16 | | 0 | 746 | 2.68 | 2.59 | | 1.94 | 0.00 | 15.31 | 0.39 | 12.88 | 13.75 | | 0.00 | 0.00 | 26.63 | 300 | 0.84 | 35.40 | 88.63 | 1.25 | 1.10 | 0.89 | 30% | 611.492 | 606.192 | 605.896 | 5.000 | 5.350 |
| | | Commercial | | 315 | | | 47.16 | | 0 | 746 | 2.68 | 2.59 | 0.15 | 2.09 | 0.03 | 14.81 | 0.42 | 13.13 | 13.79 | | 0.00 | 0.00 | 26.92 | | | | | | | | | | | | |
| | | Institutional | | 315 | | | 47.16 | | 0 | 746 | 2.68 | 2.59 | 4.20 | 6.29 | 0.84 | 9.02 | 1.26 | 18.28 | 14.97 | | 0.00 | 0.00 | 33.25 | | | | | | | | | | | | |
| | | LDR | 28 | 343 | 2.2 | 7.39 | 54.55 | | 62 | 808 | 2.66 | 2.81 | | 6.29 | 0.00 | 9.02 | 1.26 | 18.80 | 17.04 | | 0.00 | 0.00 | 35.83 | | | | | | | | | | | | |
| | | HDR | 5 | 348 | | 0.51 | 55.06 | 240 | 122 | 930 | 2.62 | 3.23 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.81 | 17.18 | | 0.00 | 0.00 | 36.98 | | | | | | | | | | | | |
| SanMH141 | SanMH206 | | | 348 | | | 55.06 | | 0 | 930 | 2.62 | 3.23 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.81 | 17.18 | | 0.00 | 0.00 | 36.98 | 300 | 0.78 | 41.20 | 85.40 | 1.21 | 1.16 | 0.98 | 43% | 611.546 | 605.896 | 605.574 | 5.350 | 6.200 |
| | | LDR | 6 | 354 | 2.2 | 1.08 | 56.14 | | 13 | 944 | 2.62 | 3.28 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.91 | 17.48 | | 0.00 | 0.00 | 37.39 | | | | | | | | | | | | |
| SanMH206 | SanMH341 | | | 354 | | | 56.14 | | 0 | 944 | 2.62 | 3.28 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.91 | 17.48 | | 0.00 | 0.00 | 37.39 | 300 | 3.41 | 61.80 | 178.57 | 2.53 | 2.00 | 1.68 | 21% | 612.074 | 605.574 | 603.465 | 6.200 | 3.540 |
| | | LDR | 2 | 356 | 2.2 | 0.36 | 56.50 | | 4 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | | | | | | | | | | | | |
| SanMH341 | SanMH341A | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 10.60 | 69.20 | 314.83 | 4.45 | 3.02 | 2.49 | 12% | 607.305 | 603.315 | 595.972 | 3.690 | 1.850 |
| SanMH341A | SanMH329 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 1.18 | 61.50 | 105.04 | 1.49 | 1.36 | 1.14 | 36% | 598.122 | 595.972 | 595.247 | 1.850 | 1.750 |
| SanMH329 | SanMH328 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 0.49 | 62.00 | 67.69 | 0.96 | 0.98 | 0.83 | 55% | 597.297 | 595.117 | 594.813 | 1.880 | 1.610 |
| SanMH328 | SanMH340 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 0.71 | 42.50 | 81.48 | 1.15 | 1.13 | 0.95 | 46% | 596.723 | 594.753 | 594.452 | 1.670 | 1.990 |
| SanMH340 | SanMH327 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 0.59 | 45.90 | 74.28 | 1.05 | 1.05 | 0.89 | 51% | 596.742 | 594.312 | 594.043 | 2.130 | 1.720 |
| SanMH327 | SanMH327A | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | -0.02 | 40.60 | #NUM! | #NUM! | #NUM! | #NUM! | #NUM! | 596.063 | 594.043 | 594.053 | 1.720 | 2.660 |
| SanMH327A | SanMH326 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 0.55 | 31.10 | 71.72 | 1.01 | 1.03 | 0.87 | 52% | 597.013 | 594.053 | 593.883 | 2.660 | 1.850 |
| SanMH326 | SanMH325 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 0.51 | 91.60 | 69.06 | 0.98 | 1.00 | 0.85 | 54% | 596.033 | 593.873 | 593.402 | 1.860 | 2.000 |
| SanMH325 | SanMH342 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 0.12 | 84.60 | 33.50 | 0.47 | 0.54 | 0.49 | 112% | 595.702 | 593.382 | 593.262 | 2.020 | 1.860 |
| SanMH342 | T100 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 0.27 | 80.95 | 50.25 | 0.71 | 0.78 | 0.67 | 75% | 595.422 | 593.252 | 593.036 | 1.870 | 2.185 |
| T100 | T101 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 300 | 0.14 | 24.75 | 35.53 | 0.50 | 0.57 | 0.52 | 106% | 595.521 | 593.036 | 593.003 | 2.185 | 1.897 |
| T101 | SanMH231 | | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | | 6.29 | 0.00 | 9.02 | 1.26 | 19.95 | 17.58 | | 0.00 | 0.00 | 37.53 | 500 | 0.89 | 123.78 | 356.22 | 1.81 | 1.18 | 0.98 | 11% | 595.200 | 592.600 | 591.500 | 2.100 | 3.000 |
| | | Commercial | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | 33.11 | 39.40 | 6.62 | 3.95 | 7.88 | 39.73 | 26.85 | | 0.00 | 0.00 | 66.58 | | | | | | | | | | | | |
| | | Industrial | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | 2.10 | 41.50 | 0.42 | 3.86 | 8.30 | 40.63 | 27.44 | | 0.00 | 0.00 | 68.07 | | | | | | | | | | | | |
| | | Institutional | | 356 | | | 56.50 | | 0 | 948 | 2.61 | 3.29 | 69.32 | 110.82 | 13.86 | 2.50 | 22.16 | 64.01 | 46.85 | | 0.00 | 0.00 | 110.86 | | | | | | | | | | | | |
| | | LDR | 762 | 1118 | 2.2 | 94.92 | 151.42 | | 1676 | 2624 | 2.36 | 9.11 | | 110.82 | 0.00 | 2.50 | 22.16 | 76.92 | 73.43 | | 0.00 | 0.00 | 150.35 | | | | | | | | | | | | |
| | | MDR | 8 | 1126 | 2.2 | 0.32 | 151.74 | | 18 | 2642 | 2.36 | 9.17 | | 110.82 | 0.00 | 2.50 | 22.16 | 77.05 | 73.52 | | 0.00 | 0.00 | 150.57 | | | | | | | | | | | | |
| | | HDR | 17 | 1143 | | 1.05 | 152.79 | 240 | 252 | 2894 | 2.34 | 10.05 | | 110.82 | 0.00 | 2.50 | 22.16 | 78.90 | 73.81 | | 0.00 | 0.00 | 152.71 | | | | | | | | | | | | |
| SanMH231 | SanMH230 | | | 1143 | | | 152.79 | | 0 | 2894 | 2.34 | 10.05 | | 110.82 | 0.00 | 2.50 | 22.16 | 78.90 | 73.81 | | 0.00 | 0.00 | 152.71 | 300 | 1.82 | 63.05 | 130.46 | 1.85 | 2.09 | 1.93 | 117% | 595.000 | 591.078 | 589.953 | 3.622 | 5.340 |
| SanMH230 | SanMH228 | | | 1143 | | | 152.79 | | 0 | 2894 | 2.34 | 10.05 | | 110.82 | 0.00 | 2.50 | 22.16 | 78.90 | 73.81 | | 0.00 | 0.00 | 152.71 | 300 | 3.37 | 69.50 | 177.52 | 2.51 | 2.82 | 2.44 | 86% | 595.593 | 589.953 | 587.608 | 5.340 | 1.760 |
| SanMH228 | SanMH177 | | | 1143 | | | 152.79 | | 0 | 2894 | 2.34 | 10.05 | | 110.82 | 0.00 | 2.50 | 22.16 | 78.90 | 73.81 | | 0.00 | 0.00 | 152.71 | 300 | 8.85 | 100.30 | 287.67 | 4.07 | 4.13 | 3.47 | 53% | 589.668 | 587.568 | 578.688 | 1.800 | 4.850 |
| SanMH177 | SanMH178 | | | 1143 | | | 152.79 | | 0 | 2894 | 2.34 | 10.05 | | 110.82 | 0.00 | 2.50 | 22.16 | 78.90 | 73.81 | | 0.00 | 0.00 | 152.71 | 375 | 1.00 | 78.50 | 175.33 | 1.59 | 1.79 | 1.55 | 87% | 583.838 | 578.578 | 577.792 | 4.885 | 3.125 |
| SanMH178 | SanMH179 | | | 1143 | | | 152.79 | | 0 | 2894 | 2.34 | 10.05 | | 110.82 | 0.00 | 2.50 | 22.16 | 78.90 | 73.81 | | 0.00 | 0.00 | 152.71 | 375 | 0.21 | 45.70 | 80.35 | 0.73 | 1.40 | 0.83 | 190% | 581.292 | 577.772 | 577.675 | 3.145 | 2.435 |
| | | LDR | 22 | 1165 | 2.2 | 4.99 | 157.78 | | 48 | 2942 | 2.33 | 10.22 | | 110.82 | 0.00 | 2.50 | 22.16 | 79.26 | 75.21 | | 0.00 | 0.00 | 154.46 | | | | | | | | | | | | |
| SanMH179 | SanMH333 | | | 1165 | | | 157.78 | | 0 | 2942 | 2.33 | 10.22 | | 110.82 | 0.00 | 2.50 | 22.16 | 79.26 | 75.21 | | 0.00 | 0.00 | 154.46 | 375 | 0.32 | 89.90 | 99.18 | 0.90 | 1.03 | 1.00 | 156% | 580.485 | 577.675 | 577.390 | 2.435 | 2.425 |
| SanMH333 | SanMH345 | | | 1165 | | | 157.78 | | 0 | 2942 | 2.33 | 10.22 | | 110.82 | 0.00 | 2.50 | 22.16 | 79.26 | 75.21 | | 0.00 | 0.00 | 154.46 | 375 | 0.21 | 133.60 | 80.35 | 0.73 | 1.48 | 0.83 | 192% | 580.190 | 577.380 | 577.093 | 2.435 | 2.285 |
| SanMH345 | SanMH336 | | | 1165 | | | 157.78 | | 0 | 2942 | 2.33 | 10.22 | | 110.82 | 0.00 | 2.50 | 22.16 | 79.26 | 75.21 | | 0.00 | 0.00 | 154.46 | 375 | 0.09 | 120.20 | 52.60 | 0.48 | 17.19 | 0.54 | 294% | 579.753 | 577.093 | 576.981 | 2.285 | 3.195 |
| SanMH336 | SanMH346 | | | 1165 | | | 157.78 | | 0 | 2942 | 2.33 | 10.22 | | 110.82 | 0.00 | 2.50 | 22.16 | 79.26 | 75.21 | | 0.00 | 0.00 | 154.46 | 375 | 0.63 | 124.80 | 139.16 | 1.26 | 1.43 | 1.30 | 111% | 580.551 | 576.981 | 576.200 | 3.195 | 2.305 |
| SanMH346 | SanMH346A | | | 1165 | | | 157.78 | | 0 | 2942 | 2.33 | 10.22 | | 110.82 | 0.00 | 2.50 | 22.16 | 79.26 | 75.21 | | 0.00 | 0.00 | 154.46 | 375 | 0.15 | 122.00 | 67.91 | 0.61 | 3.57 | 0.70 | 227% | 578.880 | 576.200 | 576.020 | 2.305 | 2.235 |
| SanMH346A | SanMH351 | | | 1165 | | | 157.78 | | 0 | 2942 | 2.33 | 10.22 | | 110.82 | 0.00 | 2.50 | 22.16 | 79.26 | 75.21 | | 0.00 | 0.00 | 154.46 | 375 | 0.31 | 60.45 | 97.62 | 0.88 | 1.03 | 0.98 | 158% | 578.630 | 576.020 | 575.830 | 2.235 | 2.585 |
| SanMH351 | SanMH7A | | | 1165 | | | 157.78 | | 0 | 2942 | 2.33 | 10.22 | | 110.82 | 0.00 | 2.50 | 22.16 | 79.26 | 75.21 | | 0.00 | 0.00 | 154.46 | 375 | 0.13 | 60.39 | 63.22 | 0.57 | 5.55 | 0.64 | 244% | 578.790 | 575.830 | 575.770 | 2.585 | 2.995 |
| | | Institutional | | 1165 | | | 157.78 | | 0 | 2942 | 2.33 | 10.22 | 3.62 | 114.44 | 0.72 | 2.50 | 22.89 | 81.07 | 76.22 | | 0.00 | 0.00 | 157.29 | | | | | | | | | | | | |
| | | LDR | 364 | 1529 | 2.2 | 31.75 | 189.53 | | 801 | 3743 | 2.28 | 13.00 | | 114.44 | 0.00 | 2.50 | 22.89 | 86.83 | 85.11 | | 0.00 | 0.00 | 171.95 | | | | | | | | | | | | |
| | | MDR | 1 | 1530 | 2.2 | 0.33 | 189.86 | | 2 | 3745 | 2.28 | 13.00 | | 114.44 | 0.00 | 2.50 | 22.89 | 86.85 | 85.20 | | 0.00 | 0.00 | 172.05 | | | | | | | | | | | | |
| | | HDR | 2 | 1532 | | 0.09 | 189.95 | 240 | 22 | 3767 | 2.28 | 13.08 | | 114.44 | 0.00 | 2.50 | 22.89 | 87.00 | 85.23 | | 0.00 | 0.00 | 172.23 | | | | | | | | | | | | |
| SanMH7A | SanMH6 | | | 1532 | | | 189.95 | | 0 | 3767 | 2.28 | 13.08 | | 114.44 | 0.00 | 2.50 | 22.89 | 87.00 | 85.23 | | 0.00 | 0.00 | 172.23 | 375 | 0.15 | 116.00 | 67.91 | 0.61 | 7.81 | 0.69 | 254% | 579.140 | 575.770 | 575.545 | 2.995 | 2.730 |
| SanMH6 | SanMH6A | | | 1532 | | | 189.95 | | 0 | 3767 | 2.28 | 13.08 | | 114.44 | 0.00 | 2.50 | 22.89 | 87.00 | 85.23 | | 0.00 | 0.00 | 172.23 | 375 | 0.15 | 115.10 | 67.91 | 0.61 | 7.81 | 0.69 | 254% | 578.650 | 575.545 | 575.380 | 2.730 | 2.880 |
| San MH6A | San MH5 | | | 1532 | | | 189.95 | | 0 | 3767 | 2.28 | 13.08 | | 114.44 | 0.00 | 2.50 | 22.89 | 87.00 | 85.23 | | 0.00 | 0.00 | 172.23 | 375 | 0.15 | 123.30 | 67.91 | 0.61 | 7.81 | 0.69 | 254% | 578.635 | 575.380 | 575.160 | 2.880 | 3.085 |
| SanMH5 | SanMH4 | | | 1532 | | | 189.95 | | 0 | 3767 | 2.28 | 13.08 | | 114.44 | 0.00 | 2.50 | 22.89 | 87.00 | 85.23 | | 0.00 | 0.00 | 172.23 | 375 | 0.16 | 105.90 | 70.13 | 0.63 | 6.38 | 0.71 | 246% | 578.620 | 575.160 | 574.990 | 3.085 | 3.065 |
| SanMH4 | SanMH3 | | | 1532 | | | 189.95 | | 0 | 3767 | 2.28 | 13.08 | | 114.44 | 0.00 | 2.50 | 22.89 | 87.00 | 85.23 | | 0.00 | 0.00 | 172.23 | 375 | 0.18 | 105.94 | 74.39 | 0.67 | 4.43 | 0.76 | 232% | 578.430 | 574.990 | 574.800 | 3.065 | 1.925 |
| SanMH3 | SanMH2 | | | 1532 | | | 189.95 | | 0 | 3767 | 2.28 | 13.08 | | 114.44 | 0.00 | 2.50 | 22.89 | 87.00 | 85.23 | | 0.00 | 0.00 | 172.23 | 375 | 0.10 | 64.63 | 55.44 | 0.50 | 26.75 | 0.58 | 311% | 577.100 | 574.800 | 574.730 | 1.925 | 3.645 |
| | | Commercial | | 1532 | | | 189.95 | | 0 | 3767 | 2.28 | 13.08 | 4.25 | 118.69 | 0.85 | 2.50 | 23.74 | 89.13 | 86.42 | | 0.00 | 0.00 | 175.55 | | | | | | | | | | | | |
| | | Industrial | | 1532 | | | 189.95 | | 0 | 3767 | 2.28 | 13.08 | 53.12 | 171.81 | 10.62 | 2.50 | 34.36 | 115.69 | 101.29 | | 0.00 | 0.00 | 216.98 | | | | | | | | | | | | |
| | | Institutional | | 1532 | | | 189.95 | | 0 | 3767 | 2.28 | 13.08 | 6.86 | 178.67 | 1.37 | 2.50 | 24.26 | 90.43 | 103.21 | | 0.00 | 0.00 | 193.65 | | | | | | | | | | | | |
| | | LDR | 113 | 1645 | 2.2 | 40.42 | 230.37 | | 249 | 4016 | 2.26 | 13.94 | | 178.67 | 0.00 | 2.50 | 24.26 | 92.20 | 114.53 | | 0.00 | 0.00 | 206.73 | | | | | | | | | | | | |
| | | MDR | 11 | 1656 | 2.2 | 0.88 | 231.25 | | 24 | 4040 | 2.26 | 14.03 | | 178.67 | 0.00 | 2.50 | 24.26 | 92.37 | 114.78 | | 0.00 | 0.00 | 207.15 | | | | | | | | | | | | |
| SanMH2 | SanMH1 | | | 1656 | | | 231.25 | | 0 | 4040 | 2.26 | 14.03 | | 178.67 | 0.00 | 2.50 | 22.89 | 88.94 | 114.78 | | 0.00 | 0.00 | 203.72 | 375 | 0.18 | 95.10 | 74.39 | 0.67 | 14.84 | 0.76 | 274% | 578.750 | 574.730 | 574.560 | 3.645 | 2.465 |
| SanMH1 | | | | 1656 | | | 231.25 | | 0 | 4040 | 2.26 | 14.03 | | 178.67 | 0.00 | 2.50 | 22.89 | 88.94 | 114.78 | | 0.00 | 0.00 | 203.72 | | | | | | | | | 577.400 | 574.640 invert to WWTP | | 2.760 | |
| | | | | | | | 231.25 | | | | | | | 178.67 | | | | | | | | | | | | | | | | | | | | | |

**Notes:**

1. PDWF - Peak Dry Weather Flow
2. PWWF - Peak Wet Weather Flow
3. Based on design standard, PWWF ≤ 0.86% of pipe capacity
4. Industrial / Commercial flow generation as per City of Edmonton Design Standards (0.2 L/s/ha)
5. Institutional Flow generation rate assumed to be same as Commercial / Industrial
6. Survey indicates a negative slope for sewer between SanMH327 and SanMH327A
7. Casing inverts used for T101 - SanMH231 (600 mm casing with 500 mm lining)
8. Sewer between SanMH230 and SanMH177 is of unknown size, assumed to be 300 mm
9. Pipe slopes taken from drawings and calculated from survey data
10. Some invert and slope information might contain errors due to combining data from different sources
11. Flow Monitoring manholes

| Manhole # | Monitor # |
|---|---|
| 143 | 4 |
| 206 | 3 |
| 177 | 2 |
| 3 | 1 |

12. pipes that are over 86% capacity

**Table 3.4**
**Existing Sewer Utilization Calculations with Future Development**

FOCUS

**PROJECT:** TOWN OF VERMILION
**JOB No. :** 102414
**DATE:** 2-Feb-10
**Computed by:** SHS
**Checked by:** BER

| | | | | | |
|---|---|---|---|---|---|
| **Per Capita Flow =** | **300** | **L/cap/day** | | | |
| **Commercial Flow =** | **0.20** | **L/s/ha** | | | |
| **Industrial Flow =** | **0.20** | **L/s/ha** | | | |
| **Institutional Flow =** | **0.20** | **L/s/ha** | | | |
| **Infiltration Allowance =** | **0.28** | **L/s/ha** | Population Density | | |
| **Sag MH Inflow =** | **0.4** | **L/s/MH** | Low and Medium Density Residential | 2.2 | **cap/lot** |
| **Pipe Roughness Coeff. =** | **0.013** | **(unitless)** | High Density Residential | 240 | **cap/ha** |
| **Residential Peaking Factor =** | **2.6P-0.1** | | | | |

| | | | Residential | | | | | | | | | | Non-Residential | | | | | | I/I | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **From MH** | **To MH** | **Landuse** | **Added Lots** | **Total Lots** | **Pop. Dens. (cap/lot)** | **Added Area (ha)** | **Total Area (ha)** | **Pop. Dens. (cap/ha)** | **Added Pop.** | **Total Pop.** | **Peak Factor** | **Avg. Flow (L/s)** | **Added Area (ha)** | **Total Area (ha)** | **Added Avg Flow (L/s)** | **Peak Factor** | **Tot Avg Flow (L/s)** | **PDWF (L/s)** | **General (L/s)** | **Added Sag MH** | **Total Sag MH** | **Sag MH Inflow (L/s)** | **PWWF (L/s)** | Size (mm) | Slope (%) | Length (m) | Cap. (L/s) | Full Flow Vel. (m/s) | PWWF Flow Vel. (m/s) | PDWF Flow Vel. (m/s) | PWWF to Cap. (%) | **U/S Rim (m)** | **U/S Inv. (m)** | **D/S Inv. (m)** | **U/S Cover (m)** | **D/S Cover (m)** |
| | | Industrial | | 0 | | | 0.00 | | 0 | 0 | 1.50 | 0.00 | 1.94 | 1.94 | 0.39 | 15.31 | 0.39 | 5.94 | 0.54 | | 0.00 | 0.00 | 6.48 | | | | | | | | | | | | |
| | | LDR | 1670 | 1670 | 2.2 | 46.81 | 46.81 | | 3674 | 3674 | 2.28 | 12.76 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.06 | 13.65 | | 0.00 | 0.00 | 48.71 | | | | | | | | | | | | |
| | | MDR | 2 | 1672 | 2.2 | 0.1 | 46.91 | | 4 | 3678 | 2.28 | 12.77 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.09 | 13.68 | | 0.00 | 0.00 | 48.77 | | | | | | | | | | | | |
| | | HDR | 3 | 1675 | | 0.25 | 47.16 | 240 | 60 | 3738 | 2.28 | 12.98 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.52 | 13.75 | | 0.00 | 0.00 | 49.27 | | | | | | | | | | | | |
| SanMH143 | SanMH142 | | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.52 | 13.75 | | 0.00 | 0.00 | 49.27 | 300 | 0.02 | 22.70 | 13.68 | 0.19 | 27.83 | 2.92 | 360% | 611.606 | 606.276 | 606.272 | 5.030 | 4.920 |
| SanMH142 | SanMH141 | | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.52 | 13.75 | | 0.00 | 0.00 | 49.27 | 300 | 0.84 | 35.40 | 88.63 | 1.25 | 1.29 | 1.18 | 56% | 611.492 | 606.192 | 605.896 | 5.000 | 5.350 |
| | | Commercial | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | 0.15 | 2.09 | 0.03 | 14.81 | 0.42 | 35.77 | 13.79 | | 0.00 | 0.00 | 49.56 | | | | | | | | | | | | |
| | | Institutional | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | 4.20 | 6.29 | 0.84 | 9.02 | 1.26 | 40.93 | 14.97 | | 0.00 | 0.00 | 55.89 | | | | | | | | | | | | |
| | | LDR | 28 | 1703 | 2.2 | 7.39 | 54.55 | | 62 | 3800 | 2.28 | 13.19 | | 6.29 | 0.00 | 9.02 | 1.26 | 41.36 | 17.04 | | 0.00 | 0.00 | 58.40 | | | | | | | | | | | | |
| | | HDR | 5 | 1708 | | 0.51 | 55.06 | 240 | 122 | 3922 | 2.27 | 13.62 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.23 | 17.18 | | 0.00 | 0.00 | 59.41 | | | | | | | | | | | | |
| SanMH141 | SanMH206 | | | 1708 | | | 55.06 | | 0 | 3922 | 2.27 | 13.62 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.23 | 17.18 | | 0.00 | 0.00 | 59.41 | 300 | 0.78 | 41.20 | 85.40 | 1.21 | 1.31 | 1.20 | 70% | 611.546 | 605.896 | 605.574 | 5.350 | 6.200 |
| | | LDR | 6 | 1714 | 2.2 | 1.08 | 56.14 | | 13 | 3936 | 2.27 | 13.67 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.33 | 17.48 | | 0.00 | 0.00 | 59.81 | | | | | | | | | | | | |
| SanMH206 | SanMH341 | | | 1714 | | | 56.14 | | 0 | 3936 | 2.27 | 13.67 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.33 | 17.48 | | 0.00 | 0.00 | 59.81 | 300 | 3.41 | 61.80 | 178.57 | 2.53 | 2.28 | 2.07 | 33% | 612.074 | 605.574 | 603.465 | 6.200 | 3.540 |
| | | LDR | 2 | 1716 | 2.2 | 0.36 | 56.50 | | 4 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | | | | | | | | | | | | |
| SanMH341 | SanMH341A | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 10.60 | 69.20 | 314.83 | 4.45 | 3.43 | 3.13 | 19% | 607.305 | 603.315 | 595.972 | 3.690 | 1.850 |
| SanMH341A | SanMH329 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 1.18 | 61.50 | 105.04 | 1.49 | 1.53 | 1.41 | 57% | 598.122 | 595.972 | 595.247 | 1.850 | 1.750 |
| SanMH329 | SanMH328 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.49 | 62.00 | 67.69 | 0.96 | 1.08 | 1.01 | 89% | 597.297 | 595.117 | 594.813 | 1.880 | 1.610 |
| SanMH328 | SanMH340 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.71 | 42.50 | 81.48 | 1.15 | 1.26 | 1.16 | 74% | 596.723 | 594.753 | 594.452 | 1.670 | 1.990 |
| SanMH340 | SanMH327 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.59 | 45.90 | 74.28 | 1.05 | 1.17 | 1.08 | 81% | 596.742 | 594.312 | 594.043 | 2.130 | 1.720 |
| SanMH327 | SanMH327A | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | -0.02 | 40.60 | #NUM! | #NUM! | #NUM! | #NUM! | #NUM! | 596.063 | 594.043 | 594.053 | 1.720 | 2.660 |
| SanMH327A | SanMH326 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.55 | 31.10 | 71.72 | 1.01 | 1.14 | 1.06 | 84% | 597.013 | 594.053 | 593.883 | 2.660 | 1.850 |
| SanMH326 | SanMH325 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.51 | 91.60 | 69.06 | 0.98 | 1.10 | 1.03 | 87% | 596.033 | 593.873 | 593.402 | 1.860 | 2.000 |
| SanMH325 | SanMH342 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.12 | 84.60 | 33.50 | 0.47 | 0.71 | 0.53 | 179% | 595.702 | 593.382 | 593.262 | 2.020 | 1.860 |
| SanMH342 | T100 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.27 | 80.95 | 50.25 | 0.71 | 0.80 | 0.80 | 119% | 595.422 | 593.252 | 593.036 | 1.870 | 2.185 |
| T100 | T101 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.14 | 24.75 | 35.53 | 0.50 | 0.64 | 0.57 | 169% | 595.521 | 593.036 | 593.003 | 2.185 | 1.897 |
| T101 | SanMH231 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 500 | 0.89 | 123.78 | 356.22 | 1.81 | 1.35 | 1.23 | 17% | 595.200 | 592.600 | 591.500 | 2.100 | 3.000 |
| | | Commercial | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | 47.11 | 53.40 | 9.42 | 3.44 | 10.68 | 67.80 | 30.77 | | 0.00 | 0.00 | 98.57 | | | | | | | | | | | | |
| | | Industrial | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | 2.10 | 55.50 | 0.42 | 3.39 | 11.10 | 68.59 | 31.36 | | 0.00 | 0.00 | 99.95 | | | | | | | | | | | | |
| | | Institutional | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | 99.58 | 155.08 | 19.92 | 2.50 | 31.02 | 108.55 | 59.24 | | 0.00 | 0.00 | 167.79 | | | | | | | | | | | | |
| | | LDR | 762 | 2478 | 2.2 | 94.92 | 151.42 | | 1676 | 5616 | 2.19 | 19.50 | | 155.08 | 0.00 | 2.50 | 31.02 | 120.21 | 85.82 | | 0.00 | 0.00 | 206.03 | | | | | | | | | | | | |
| | | MDR | 37 | 2515 | 2.2 | 0.32 | 151.74 | | 81 | 5698 | 2.18 | 19.78 | | 155.08 | 0.00 | 2.50 | 31.02 | 120.76 | 85.91 | | 0.00 | 0.00 | 206.67 | | | | | | | | | | | | |
| | | HDR | 17 | 2532 | | 1.05 | 152.79 | 240 | 252 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | | | | | | | | | | | | |
| SanMH231 | SanMH230 | | | 2532 | | | 152.79 | | 0 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | 300 | 1.82 | 63.05 | 130.46 | 1.85 | 2.17 | 2.10 | 160% | 595.000 | 591.078 | 589.953 | 3.622 | 5.340 |
| SanMH230 | SanMH228 | | | 2532 | | | 152.79 | | 0 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | 300 | 3.37 | 69.50 | 177.52 | 2.51 | 2.84 | 2.71 | 118% | 595.593 | 589.953 | 587.608 | 5.340 | 1.760 |
| SanMH228 | SanMH177 | | | 2532 | | | 152.79 | | 0 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | 300 | 8.85 | 100.30 | 287.67 | 4.07 | 4.44 | 3.91 | 73% | 589.668 | 587.568 | 578.688 | 1.800 | 4.850 |
| SanMH177 | SanMH178 | | | 2532 | | | 152.79 | | 0 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | 375 | 1.00 | 78.50 | 175.33 | 1.59 | 1.79 | 1.72 | 119% | 583.838 | 578.578 | 577.792 | 4.885 | 3.125 |
| SanMH178 | SanMH179 | | | 2532 | | | 152.79 | | 0 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | 375 | 0.21 | 45.70 | 80.35 | 0.73 | 10.96 | 0.82 | 260% | 581.292 | 577.772 | 577.675 | 3.145 | 2.435 |
| | | LDR | 22 | 2554 | 2.2 | 4.99 | 157.78 | | 48 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | | | | | | | | | | | | |
| SanMH179 | SanMH333 | | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 375 | 0.32 | 89.90 | 99.18 | 0.90 | 3.24 | 1.01 | 212% | 580.485 | 577.675 | 577.390 | 2.435 | 2.425 |
| SanMH333 | SanMH345 | | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 375 | 0.21 | 133.60 | 80.35 | 0.73 | 11.63 | 0.82 | 262% | 580.190 | 577.380 | 577.093 | 2.435 | 2.285 |
| SanMH345 | SanMH336 | | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 375 | 0.09 | 120.20 | 52.60 | 0.48 | 134.41 | 3.33 | 400% | 579.753 | 577.093 | 576.981 | 2.285 | 3.195 |
| SanMH336 | SanMH346 | | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 375 | 0.63 | 124.80 | 139.16 | 1.26 | 1.42 | 1.42 | 151% | 580.551 | 576.981 | 576.200 | 3.195 | 2.305 |
| SanMH346 | SanMH346A | | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 375 | 0.15 | 122.00 | 67.91 | 0.61 | 32.20 | 0.96 | 310% | 578.880 | 576.200 | 576.020 | 2.305 | 2.235 |
| SanMH346A | SanMH351 | | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 375 | 0.31 | 60.45 | 97.62 | 0.88 | 3.54 | 0.99 | 216% | 578.630 | 576.020 | 575.830 | 2.235 | 2.585 |
| SanMH351 | SanMH7A | | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 375 | 0.13 | 60.39 | 63.22 | 0.57 | 48.73 | 1.22 | 333% | 578.790 | 575.830 | 575.770 | 2.585 | 2.645 |
| | | Institutional | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | 3.62 | 158.70 | 0.72 | 2.50 | 31.74 | 124.62 | 88.61 | | 0.00 | 0.00 | 213.23 | | | | | | | | | | | | |
| | | LDR | 364 | 2918 | 2.2 | 31.75 | 189.53 | | 801 | 6799 | 2.15 | 23.61 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.02 | 97.50 | | 0.00 | 0.00 | 227.53 | | | | | | | | | | | | |
| | | MDR | 1 | 2919 | 2.2 | 0.33 | 189.86 | | 2 | 6801 | 2.15 | 23.62 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.04 | 97.60 | | 0.00 | 0.00 | 227.64 | | | | | | | | | | | | |
| | | HDR | 2 | 2921 | | 0.09 | 189.95 | 240 | 22 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | | | | | | | | | | | | |
| SanMH7A | SanMH6 | | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 375 | 0.15 | 116.00 | 67.91 | 0.61 | 55.19 | 1.23 | 335% | 578.790 | 575.820 | 575.545 | 2.595 | 2.730 |
| SanMH6 | SanMH6A | | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 375 | 0.15 | 115.10 | 67.91 | 0.61 | 55.19 | 1.23 | 335% | 578.650 | 575.545 | 575.380 | 2.730 | 2.880 |
| San MH6A | San MH5 | | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 375 | 0.15 | 123.30 | 67.91 | 0.61 | 55.19 | 1.23 | 335% | 578.635 | 575.380 | 575.160 | 2.880 | 3.085 |
| SanMH5 | SanMH4 | | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 375 | 0.16 | 105.90 | 70.13 | 0.63 | 45.87 | 1.10 | 325% | 578.620 | 575.160 | 574.990 | 3.085 | 3.065 |
| SanMH4 | SanMH3 | | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 375 | 0.18 | 105.94 | 74.39 | 0.67 | 32.54 | 0.94 | 306% | 578.430 | 574.990 | 574.800 | 3.065 | 1.925 |
| SanMH3 | SanMH2 | | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 375 | 0.10 | 64.63 | 55.44 | 0.50 | 167.77 | 3.65 | 411% | 577.100 | 574.800 | 574.730 | 1.925 | 3.645 |
| | | Commercial | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | 4.25 | 162.95 | 0.85 | 2.50 | 32.59 | 132.31 | 98.81 | | 0.00 | 0.00 | 231.12 | | | | | | | | | | | | |
| | | Industrial | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | 53.12 | 216.07 | 10.62 | 2.50 | 43.21 | 158.87 | 113.69 | | 0.00 | 0.00 | 272.55 | | | | | | | | | | | | |
| | | Institutional | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | 6.86 | 222.93 | 1.37 | 2.50 | 44.59 | 162.30 | 115.61 | | 0.00 | 0.00 | 277.90 | | | | | | | | | | | | |
| | | LDR | 113 | 3034 | 2.2 | 40.42 | 230.37 | | 249 | 7071 | 2.14 | 24.55 | | 222.93 | 0.00 | 2.50 | 44.59 | 163.96 | 126.92 | | 0.00 | 0.00 | 290.89 | | | | | | | | | | | | |
| | | MDR | 11 | 3045 | 2.2 | 0.88 | 231.25 | | 24 | 7096 | 2.14 | 24.64 | | 222.93 | 0.00 | 2.50 | 44.59 | 164.12 | 127.17 | | 0.00 | 0.00 | 291.29 | | | | | | | | | | | | |
| SanMH2 | SanMH1 | | | 3045 | | | 231.25 | | 0 | 7096 | 2.14 | 24.64 | | 222.93 | 0.00 | 2.50 | 44.59 | 164.12 | 127.17 | | 0.00 | 0.00 | 291.29 | 375 | 0.18 | 95.10 | 74.39 | 0.67 | 166.01 | 3.16 | 392% | 578.750 | 574.730 | 574.560 | 3.645 | 2.465 |
| SanMH1 | | | | 3045 | | | 231.25 | | 0 | 7096 | 2.14 | 24.64 | | 222.93 | 0.00 | 2.50 | 44.59 | 164.12 | 127.17 | | 0.00 | 0.00 | 291.29 | | | | 0.00 | | | | | 577.400 | 574.640 | | 2.760 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | invert to | | | | |
| Totals | | | | | | | 231.25 | | | 7096 | | | | 222.93 | | | 44.59 | | | | | | | | | | | | | | | WWTP | | | | |

**Notes:**

1. PDWF - Peak Dry Weather Flow
2. PWWF - Peak Wet Weather Flow
3. Based on design standard, PWWF ≤ 0.86% of pipe capacity
4. Industrial / Commercial flow generation as per City of Edmonton Design Standards (0.2 L/s/ha)
5. Institutional Flow generation rate assumed to be same as Commercial / Industrial
6. Survey indicates a negative slope for sewer between SanMH327 and SanMH327A
7. Casing inverts used for T101 - SanMH231 (600 mm casing with 500 mm lining)
8. Sewer between SanMH230 and SanMH177 is of unknown size, assumed to be 300 mm
9. Pipe slopes taken from drawings and calculated from survey data
10. Some invert and slope information might contain errors due to combining data from different sources
11. Flow Monitoring manholes

| Manhole # | Monitor # |
|---|---|
| 143 | 4 |
| 206 | 3 |
| 177 | 2 |
| 3 | 1 |

12. [ ] pipes that are over 86% capacity

**Table 3.5**
**Upgraded Sewer Utilization Calculations - Twinning**

FOCUS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROJECT: | TOWN OF VERMILION | Per Capita Flow = | 300 | L/cap/day | Infiltration Allowance = | 0.28 | L/s/ha |
| JOB No. : | 102414 | Commercial Flow = | 0.20 | L/s/ha | Sag MH Inflow = | 0.4 | L/s/MH |
| DATE: | 2-Feb-10 | Industrial Flow = | 0.20 | L/s/ha | Pipe Roughness Coeff. = | 0.013 | (unitless) |
| Computed by: | SHS | Institutional Flow = | 0.20 | L/s/ha | Residential Peaking Factor = | 2.6P-0.1 | |
| Checked by: | BER | | | | | | |

| Population Density | |
|---|---|
| Low and Medium Density Residential | 2.2 cap/lot |
| High Density Residential | 240 cap/ha |

| From MH | To MH | Landuse | Residential | | | | | | | | | Non-Residential | | | | | PDWF | I/I | | | PWWF | Size | Slope | Length | Cap. | Full Flow Vel. | PWWF Flow Vel. | PDWF Flow Vel. | PWWF to Cap. | U/S Rim | U/S Inv. | D/S Inv. | U/S Cover | D/S Cover |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Added Lots | Total Lots | Pop. Dens. (cap/lot) | Added Area (ha) | Total Area (ha) | Pop. Dens. (cap/ha) | Added Pop. | Total Pop. | Peak Factor | Avg. Flow (L/s) | Added Area (ha) | Total Area (ha) | Added Avg Flow (L/s) | Peak Factor | Tot Avg. Flow (L/s) | (L/s) | General (L/s) | Added Sag MH | Total Sag MH | Sag MH Inflow (L/s) | (L/s) | (mm) | (%) | (m) | (L/s) | (m/s) | (m/s) | (m/s) | (%) | (m) | (m) | (m) | (m) | (m) |
| | | Industrial | | 0 | | | 0.00 | | 0 | 0 | 1.50 | 0.00 | 1.94 | 1.94 | 0.39 | 15.31 | 0.39 | 5.94 | 0.54 | | 0.00 | 0.00 | 6.48 | | | | | | | | | | | | |
| | | LDR | 1670 | 1670 | 2.2 | 46.81 | 46.81 | | 3674 | 3674 | 2.28 | 12.76 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.06 | 13.65 | | 0.00 | 0.00 | 48.71 | | | | | | | | | | | | |
| | | MDR | 2 | 1672 | 2.2 | 0.1 | 46.91 | | 4 | 3678 | 2.28 | 12.77 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.09 | 13.68 | | 0.00 | 0.00 | 48.77 | | | | | | | | | | | | |
| | | HDR | 3 | 1675 | | 0.25 | 47.16 | 240 | 60 | 3738 | 2.28 | 12.98 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.52 | 13.75 | | 0.00 | 0.00 | 49.27 | | | | | | | | | | | | |
| SanMH143 | SanMH142 | *Upgrade 1* | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.52 | 13.75 | | 0.00 | 0.00 | 49.27 | *525* | *0.02* | *22.70* | *60.82* | *0.28* | *0.31* | *0.29* | *81%* | *611.606* | *606.276* | *606.272* | *4.805* | *4.695* |
| SanMH142 | SanMH141 | | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.52 | 13.75 | | 0.00 | 0.00 | 49.27 | 300 | 0.84 | 35.40 | 88.63 | 1.25 | 1.29 | 1.18 | 56% | 611.492 | 606.192 | 605.896 | 5.000 | 5.350 |
| | | Commercial | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | 0.15 | 2.09 | 0.03 | 14.81 | 0.42 | 35.77 | 13.79 | | 0.00 | 0.00 | 49.56 | | | | | | | | | | | | |
| | | Institutional | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | 4.20 | 6.29 | 0.84 | 9.02 | 1.26 | 40.93 | 14.97 | | 0.00 | 0.00 | 55.89 | | | | | | | | | | | | |
| | | LDR | 28 | 1703 | 2.2 | 7.39 | 54.55 | | 62 | 3800 | 2.28 | 13.19 | | 6.29 | 0.00 | 9.02 | 1.26 | 41.36 | 17.04 | | 0.00 | 0.00 | 58.40 | | | | | | | | | | | | |
| | | HDR | 5 | 1708 | | 0.51 | 55.06 | 240 | 122 | 3922 | 2.27 | 13.62 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.23 | 17.18 | | 0.00 | 0.00 | 59.41 | | | | | | | | | | | | |
| SanMH141 | SanMH206 | | | 1708 | | | 55.06 | | 0 | 3922 | 2.27 | 13.62 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.23 | 17.18 | | 0.00 | 0.00 | 59.41 | 300 | 0.78 | 41.20 | 85.40 | 1.21 | 1.31 | 1.20 | 70% | 611.546 | 605.896 | 605.574 | 5.350 | 6.200 |
| | | LDR | 6 | 1714 | 2.2 | 1.08 | 56.14 | | 13 | 3936 | 2.27 | 13.67 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.33 | 17.48 | | 0.00 | 0.00 | 59.81 | | | | | | | | | | | | |
| SanMH206 | SanMH341 | | | 1714 | | | 56.14 | | 0 | 3936 | 2.27 | 13.67 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.33 | 17.48 | | 0.00 | 0.00 | 59.81 | 300 | 3.41 | 61.80 | 178.57 | 2.53 | 2.28 | 2.07 | 33% | 612.074 | 605.574 | 603.465 | 6.200 | 3.540 |
| | | LDR | 2 | 1716 | 2.2 | 0.36 | 56.50 | | 4 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | | | | | | | | | | | | |
| SanMH341 | SanMH341A | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 10.60 | 69.20 | 314.83 | 4.45 | 3.43 | 3.13 | 19% | 607.305 | 603.315 | 595.972 | 3.690 | 1.850 |
| SanMH341A | SanMH329 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 1.18 | 61.50 | 105.04 | 1.49 | 1.53 | 1.41 | 57% | 598.122 | 595.972 | 595.247 | 1.850 | 1.750 |
| SanMH329 | SanMH328 | *Upgrade 2* | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | *375* | *0.49* | *62.00* | *122.73* | *1.11* | *1.10* | *1.01* | *49%* | *597.297* | *595.117* | *594.813* | *1.805* | *1.535* |
| SanMH328 | SanMH340 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.71 | 42.50 | 81.48 | 1.15 | 1.26 | 1.16 | 74% | 596.723 | 594.753 | 594.452 | 1.670 | 1.990 |
| SanMH340 | SanMH327 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.59 | 45.90 | 74.28 | 1.05 | 1.17 | 1.08 | 81% | 596.742 | 594.312 | 594.043 | 2.130 | 1.720 |
| *SanMH327* | *SanMH327A* | *Upgrade 3* | | *1716* | | | *56.50* | | *0* | *3940* | *2.27* | *13.68* | | *6.29* | *0.00* | *9.02* | *1.26* | *42.36* | *17.58* | | *0.00* | *0.00* | *59.94* | *375* | *0.31* | *40.60* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *596.063* | *594.043* | *593.92* | *1.645* | *2.720* |
| *SanMH327A* | *SanMH326* | *Upgrade 3* | | *1716* | | | *56.50* | | *0* | *3940* | *2.27* | *13.68* | | *6.29* | *0.00* | *9.02* | *1.26* | *42.36* | *17.58* | | *0.00* | *0.00* | *59.94* | *375* | *0.31* | *31.10* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *597.013* | *593.86* | *593.76* | *2.780* | *1.895* |
| *SanMH326* | *SanMH325* | *Upgrade 3* | | *1716* | | | *56.50* | | *0* | *3940* | *2.27* | *13.68* | | *6.29* | *0.00* | *9.02* | *1.26* | *42.36* | *17.58* | | *0.00* | *0.00* | *59.94* | *375* | *0.31* | *91.60* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *596.033* | *593.73* | *593.45* | *1.925* | *1.876* |
| *SanMH325* | *SanMH342* | *Upgrade 3* | | *1716* | | | *56.50* | | *0* | *3940* | *2.27* | *13.68* | | *6.29* | *0.00* | *9.02* | *1.26* | *42.36* | *17.58* | | *0.00* | *0.00* | *59.94* | *375* | *0.31* | *84.60* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *595.702* | *593.42* | *593.16* | *1.906* | *1.886* |
| *SanMH342* | *T100-R* | *Upgrade 3* | | *1716* | | | *56.50* | | *0* | *3940* | *2.27* | *13.68* | | *6.29* | *0.00* | *9.02* | *1.26* | *42.36* | *17.58* | | *0.00* | *0.00* | *59.94* | *375* | *0.31* | *80.95* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *595.422* | *593.13* | *592.88* | *1.916* | *2.264* |
| T100-R | T101 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 375 | *0.31* | 24.75 | 97.66 | 0.88 | 0.93 | 0.85 | 61% | 595.521 | 592.85 | 592.775 | 2.294 | 2.050 |
| T101 | SanMH231 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 500 | 0.89 | 123.78 | 356.22 | 1.81 | 1.35 | 1.23 | 17% | 595.200 | 592.600 | 591.500 | 2.100 | 3.000 |
| | | Commercial | | 0 | | | 0.00 | | 0 | 0 | 1.50 | 0.00 | 47.11 | 47.11 | 9.42 | 3.64 | 9.42 | 34.34 | 13.19 | | 0.00 | 0.00 | 47.53 | | | | | | | | | | | | |
| | | Industrial | | 0 | | | 0.00 | | 0 | 0 | 1.50 | 0.00 | 2.10 | 49.21 | 0.42 | 3.57 | 9.84 | 35.17 | 13.78 | | 0.00 | 0.00 | 48.95 | | | | | | | | | | | | |
| | | Institutional | | 0 | | | 0.00 | | 0 | 0 | 1.50 | 0.00 | 99.58 | 148.79 | 19.92 | 2.50 | 29.76 | 74.40 | 41.66 | | 0.00 | 0.00 | 116.06 | | | | | | | | | | | | |
| | | LDR | 762 | 762 | 2.2 | 94.92 | 94.92 | | 1676 | 1676 | 2.47 | 5.82 | | 148.79 | 0.00 | 2.50 | 29.76 | 88.77 | 68.24 | | 0.00 | 0.00 | 157.01 | | | | | | | | | | | | |
| | | MDR | 37 | 799 | 2.2 | 0.32 | 95.24 | | 81 | 1758 | 2.46 | 6.10 | | 148.79 | 0.00 | 2.50 | 29.76 | 89.39 | 68.33 | | 0.00 | 0.00 | 157.72 | | | | | | | | | | | | |
| | | HDR | 17 | 816 | | 1.05 | 96.29 | 240 | 252 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | | | | | | | | | | | | |
| SanMH231 | SanMH TW1 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 375 | 2.00 | 50 | 247.95 | 2.25 | 2.38 | 2.07 | 65% | 595.0 | 591.078 | 590.08 | 3.547 | 5.147 |
| SanMH TW1 | SanMH TW2 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 375 | 5.05 | 75 | 394.01 | 3.57 | 3.38 | 2.90 | 41% | 595.6 | 590.05 | 586.26 | 5.177 | 3.015 |
| SanMH TW2 | SanMH TW3 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 375 | 4.00 | 115 | 350.66 | 3.17 | 3.10 | 2.67 | 46% | 589.7 | 586.23 | 581.63 | 3.044 | 1.794 |
| SanMH TW3 | SanMH TW4 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 375 | 3.80 | 115 | 341.78 | 3.09 | 3.04 | 2.62 | 47% | 583.8 | 581.60 | 577.23 | 1.824 | 2.015 |
| SanMH TW4 | SanMH TW5 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 525 | 0.20 | 95 | 192.33 | 0.89 | 0.99 | 0.88 | 83% | 579.6 | 577.08 | 576.89 | 2.015 | 2.725 |
| SanMH TW5 | SanMH TW6 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 525 | 0.20 | 95 | 192.33 | 0.89 | 0.99 | 0.88 | 83% | 580.1 | 576.86 | 576.67 | 2.755 | 2.805 |
| SanMH TW6 | SanMH TW7 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 525 | 0.20 | 95 | 192.33 | 0.89 | 0.99 | 0.88 | 83% | 580.0 | 576.64 | 576.45 | 2.835 | 3.025 |
| SanMH TW7 | SanMH TW8 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 525 | 0.20 | 95 | 192.33 | 0.89 | 0.99 | 0.88 | 83% | 580.0 | 576.42 | 576.23 | 3.055 | 3.045 |
| SanMH TW8 | SanMH TW9 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 525 | 0.20 | 95 | 192.33 | 0.89 | 0.99 | 0.88 | 83% | 579.8 | 576.20 | 576.01 | 3.075 | 3.395 |
| SanMH TW9 | SanMH TW10 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 95 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 579.9 | 575.94 | 575.84 | 3.395 | 2.920 |
| SanMH TW10 | SanMH TW11 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 95 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 579.4 | 575.81 | 575.72 | 2.950 | 2.475 |
| SanMH TW11 | SanMH TW12 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 75 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 578.8 | 575.69 | 575.61 | 2.505 | 2.930 |
| SanMH TW12 | SanMH TW13 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 115 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 579.1 | 575.58 | 575.47 | 2.960 | 2.585 |
| SanMH TW13 | SanMH TW14 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 115 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 578.7 | 575.44 | 575.32 | 2.615 | 2.715 |
| SanMH TW14 | SanMH TW15 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 120 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 578.6 | 575.29 | 575.17 | 2.745 | 2.850 |
| SanMH TW15 | SanMH TW16 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 110 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 578.6 | 575.14 | 575.03 | 2.880 | 2.800 |
| SanMH TW16 | SanMH TW17 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 110 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 578.4 | 575.00 | 574.89 | 2.830 | 3.260 |
| SanMH TW17 | SanMH TW18 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 65 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 578.8 | 574.86 | 574.80 | 3.290 | 2.005 |
| SanMH TW18 | SanMH TW19 | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | 600 | 0.10 | 95 | 194.17 | 0.69 | 0.77 | 0.68 | 82% | 577.4 | 574.77 | 574.67 | 2.035 | |
| SanMH TW19 | | *Upgrade 4.A* | | 816 | | | 96.29 | | 0 | 2010 | 2.42 | 6.98 | | 148.79 | 0.00 | 2.50 | 29.76 | 91.32 | 68.62 | | 0.00 | 0.00 | 159.94 | | | | | | | | | | | 574.64 invert to WWTP | |
| SanMH231 | SanMH230 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 1.82 | 63.05 | 130.46 | 1.85 | 1.81 | 1.65 | 46% | 595.000 | 591.078 | 589.953 | 3.622 | 5.340 |
| SanMH230 | SanMH228 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 3.37 | 69.50 | 177.52 | 2.51 | 2.27 | 2.06 | 34% | 595.593 | 589.953 | 587.608 | 5.340 | 1.760 |
| SanMH228 | SanMH177 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 8.85 | 100.30 | 287.67 | 4.07 | 3.21 | 2.91 | 21% | 589.668 | 587.568 | 578.688 | 1.800 | 4.850 |
| SanMH177 | SanMH178 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 375 | 1.00 | 78.50 | 175.33 | 1.59 | 1.44 | 1.31 | 34% | 583.838 | 578.578 | 577.792 | 4.885 | 3.125 |
| SanMH178 | SanMH179 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 375 | 0.21 | 45.70 | 80.35 | 0.73 | 0.80 | 0.74 | 75% | 581.292 | 577.772 | 577.675 | 3.145 | 2.435 |
| | | LDR | 22 | 1738 | 2.2 | 4.99 | 61.49 | | 48 | 3988 | 2.26 | 13.85 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.70 | 18.98 | | 0.00 | 0.00 | 61.68 | | | | | | | | | | | | |
| SanMH179 | SanMH333 | | | 1738 | | | 61.49 | | 0 | 3988 | 2.26 | 13.85 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.70 | 18.98 | | 0.00 | 0.00 | 61.68 | 375 | 0.32 | 89.90 | 99.18 | 0.90 | 0.95 | 0.86 | 62% | 580.485 | 577.675 | 577.390 | 2.435 | 2.425 |
| SanMH333 | SanMH345 | | | 1738 | | | 61.49 | | 0 | 3988 | 2.26 | 13.85 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.70 | 18.98 | | 0.00 | 0.00 | 61.68 | 375 | 0.21 | 133.60 | 80.35 | 0.73 | 0.80 | 0.74 | 77% | 580.190 | 577.380 | 577.093 | 2.435 | 2.285 |
| SanMH345 | SanMH336 | | | 1738 | | | 61.49 | | 0 | 3988 | 2.26 | 13.85 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.70 | 18.98 | | 0.00 | 0.00 | 61.68 | 375 | 0.09 | 120.20 | 52.60 | 0.48 | 0.54 | 0.53 | 117% | 579.753 | 577.093 | 576.981 | 2.285 | 3.195 |
| SanMH336 | SanMH346 | | | 1738 | | | 61.49 | | 0 | 3988 | 2.26 | 13.85 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.70 | 18.98 | | 0.00 | 0.00 | 61.68 | 375 | 0.63 | 124.80 | 139.16 | 1.26 | 1.22 | 1.11 | 44% | 580.551 | 576.981 | 576.200 | 3.195 | 2.305 |
| SanMH346 | SanMH346A | | | 1738 | | | 61.49 | | 0 | 3988 | 2.26 | 13.85 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.70 | 18.98 | | 0.00 | 0.00 | 61.68 | 375 | 0.15 | 122.00 | 67.91 | 0.61 | 0.70 | 0.65 | 91% | 578.880 | 576.200 | 576.020 | 2.305 | 2.235 |
| SanMH346A | SanMH351 | | | 1738 | | | 61.49 | | 0 | 3988 | 2.26 | 13.85 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.70 | 18.98 | | 0.00 | 0.00 | 61.68 | 375 | 0.31 | 60.45 | 97.62 | 0.88 | 0.93 | 0.85 | 63% | 578.630 | 576.020 | 575.830 | 2.235 | 2.585 |
| SanMH351 | SanMH7A | | | 1738 | | | 61.49 | | 0 | 3988 | 2.26 | 13.85 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.70 | 18.98 | | 0.00 | 0.00 | 61.68 | 375 | 0.13 | 60.39 | 63.22 | 0.57 | 0.65 | 0.61 | 98% | 578.790 | 575.830 | 575.770 | 2.585 | 2.645 |
| | | Institutional | | 1738 | | | 61.49 | | 0 | 3988 | 2.26 | 13.85 | 3.62 | 9.91 | 0.72 | 7.35 | 1.98 | 45.92 | 19.99 | | 0.00 | 0.00 | 65.91 | | | | | | | | | | | | |
| | | LDR | 364 | 2102 | 2.2 | 31.75 | 93.24 | | 801 | 4789 | 2.22 | 16.63 | | 9.91 | 0.00 | 7.35 | 1.98 | 51.54 | 28.88 | | 0.00 | 0.00 | 80.42 | | | | | | | | | | | | |
| | | MDR | 1 | 2103 | 2.2 | 0.33 | 93.57 | | 2 | 4791 | 2.22 | 16.64 | | 9.91 | 0.00 | 7.35 | 1.98 | 51.55 | 28.97 | | 0.00 | 0.00 | 80.53 | | | | | | | | | | | | |
| | | HDR | 2 | 2105 | | 0.09 | 93.66 | 240 | 22 | 4813 | 2.22 | 16.71 | | 9.91 | 0.00 | 7.35 | 1.98 | 51.70 | 29.00 | | 0.00 | 0.00 | 80.70 | | | | | | | | | | | | |
| SanMH7A | SanMH6 | | | 2105 | | | 93.66 | | 0 | 4813 | 2.22 | 16.71 | | 9.91 | 0.00 | 7.35 | 1.98 | 51.70 | 29.00 | | 0.00 | 0.00 | 80.70 | 375 | 0.15 | 116.00 | 67.91 | 0.61 | 0.69 | 0.68 | 119% | 578.790 | 575.820 | 575.545 | 2.595 | 2.730 |
| SanMH6 | SanMH6A | | | 2105 | | | 93.66 | | 0 | 4813 | 2.22 | 16.71 | | 9.91 | 0.00 | 7.35 | 1.98 | 51.70 | 29.00 | | 0.00 | 0.00 | 80.70 | 375 | 0.15 | 115.10 | 67.91 | 0.61 | 0.69 | 0.68 | 119% | 578.650 | 575.545 | 575.380 | 2.730 | 2.880 |

**Table 3.5**
**Upgraded Sewer Utilization Calculations - Twinning**

FOCUS

**PROJECT:** TOWN OF VERMILION
**JOB No. :** 102414
**DATE:** 2-Feb-10
**Computed by:** SHS
**Checked by:** BER

| | | | | | |
|---|---|---|---|---|---|
| Per Capita Flow = | 300 | L/cap/day | Infiltration Allowance = | 0.28 | L/s/ha |
| Commercial Flow = | 0.20 | L/s/ha | Sag MH Inflow = | 0.4 | L/s/MH |
| Industrial Flow = | 0.20 | L/s/ha | Pipe Roughness Coeff. = | 0.013 | (unitless) |
| Institutional Flow = | 0.20 | L/s/ha | Residential Peaking Factor = | 2.6P-0.1 | |

| Population Density | |
|---|---|
| Low and Medium Density Residential | 2.2 cap/lot |
| High Density Residential | 240 cap/ha |

| | | | Residential | | | | | | | | Non-Residential | | | | | | I/I | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From MH | To MH | Landuse | Added Lots | Total Lots | Pop. Dens. (cap/lot) | Added Area (ha) | Total Area (ha) | Pop. Dens. (cap/ha) | Added Pop. | Total Pop. | Peak Factor | Avg. Flow (L/s) | Added Area (ha) | Total Area (ha) | Added Avg Flow (L/s) | Peak Factor | Tot Avg. Flow (L/s) | PDWF (L/s) | General (L/s) | Added Sag MH | Total Sag MH | Sag MH Inflow (L/s) | PWWF (L/s) | Size (mm) | Slope (%) | Length (m) | Cap. (L/s) | Full Flow Vel. (m/s) | PWWF Flow Vel. (m/s) | PDWF Flow Vel. (m/s) | PWWF to Cap. (%) | U/S Rim (m) | U/S Inv. (m) | D/S Inv. (m) | U/S Cover (m) | D/S Cover (m) |
| San MH6A | San MH5 | | | 2105 | | | 93.66 | | 0 | 4813 | 2.22 | 16.71 | | 9.91 | 0.00 | 7.35 | 1.98 | 51.70 | 29.00 | | 0.00 | 0.00 | 80.70 | 375 | 0.15 | 123.30 | 67.91 | 0.61 | 0.69 | 0.68 | 119% | 578.635 | 575.380 | 575.160 | 2.880 | 3.085 |
| SanMH5 | SanMH4 | | | 2105 | | | 93.66 | | 0 | 4813 | 2.22 | 16.71 | | 9.91 | 0.00 | 7.35 | 1.98 | 51.70 | 29.00 | | 0.00 | 0.00 | 80.70 | 375 | 0.16 | 105.90 | 70.13 | 0.63 | 0.72 | 0.69 | 115% | 578.620 | 575.160 | 574.990 | 3.085 | 3.065 |
| SanMH4 | SanMH3 | | | 2105 | | | 93.66 | | 0 | 4813 | 2.22 | 16.71 | | 9.91 | 0.00 | 7.35 | 1.98 | 51.70 | 29.00 | | 0.00 | 0.00 | 80.70 | 375 | 0.18 | 105.94 | 74.39 | 0.67 | 0.77 | 0.73 | 108% | 578.430 | 574.990 | 574.800 | 3.065 | 1.925 |
| SanMH3 | SanMH2 | | | 2105 | | | 93.66 | | 0 | 4813 | 2.22 | 16.71 | | 9.91 | 0.00 | 7.35 | 1.98 | 51.70 | 29.00 | | 0.00 | 0.00 | 80.70 | 375 | 0.10 | 64.63 | 55.44 | 0.50 | 0.56 | 0.57 | 146% | 577.100 | 574.800 | 574.730 | 1.925 | 3.645 |
| | | Commercial | | 2105 | | | 93.66 | | 0 | 4813 | 2.22 | 16.71 | 4.25 | 14.16 | 0.85 | 6.26 | 2.83 | 54.86 | 30.19 | | 0.00 | 0.00 | 85.05 | | | | | | | | | | | | | |
| | | Industrial | | 2105 | | | 93.66 | | 0 | 4813 | 2.22 | 16.71 | 53.12 | 67.28 | 10.62 | 3.10 | 13.46 | 78.91 | 45.06 | | 0.00 | 0.00 | 123.97 | | | | | | | | | | | | | |
| | | Institutional | | 2105 | | | 93.66 | | 0 | 4813 | 2.22 | 16.71 | 6.86 | 74.14 | 1.37 | 2.97 | 14.83 | 81.20 | 46.98 | | 0.00 | 0.00 | 128.18 | | | | | | | | | | | | | |
| | | LDR | 113 | 2218 | 2.2 | 40.42 | 134.08 | | 249 | 5062 | 2.21 | 17.58 | | 74.14 | 0.00 | 2.97 | 14.83 | 82.92 | 58.30 | | 0.00 | 0.00 | 141.22 | | | | | | | | | | | | | |
| | | MDR | 11 | 2229 | 2.2 | 0.88 | 134.96 | | 24 | 5086 | 2.21 | 17.66 | | 74.14 | 0.00 | 2.97 | 14.83 | 83.09 | 58.55 | | 0.00 | 0.00 | 141.63 | | | | | | | | | | | | | |
| SanMH2 | SanMH1 | | | 2229 | | | 134.96 | | 0 | 5086 | 2.21 | 17.66 | | 74.14 | 0.00 | 2.97 | 14.83 | 83.09 | 58.55 | | 0.00 | 0.00 | 141.63 | 375 | 0.18 | 95.10 | 74.39 | 0.67 | 1.30 | 0.77 | 190% | 578.750 | 574.730 | 574.560 | 3.645 | 2.465 |
| SanMH1 | | | | 2229 | | | 134.96 | | 0 | 5086 | 2.21 | 17.66 | | 74.14 | 0.00 | 2.97 | 14.83 | 83.09 | 58.55 | | 0.00 | 0.00 | 141.63 | | | | | | | | | 577.400 | 574.640 | | 2.760 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | invert to | | | |
| Totals | | | | | | | 231.25 | | | 7096 | | | | 222.93 | | | 44.59 | | | | | | | | | | | | | | | | WWTP | | | |

**Notes:**

1. PDWF - Peak Dry Weather Flow
2. PWWF - Peak Wet Weather Flow
3. Based on design standard, PWWF ≤ 0.86% of pipe capacity
4. Industrial / Commercial flow generation as per City of Edmonton Design Standards (0.2 L/s/ha)
5. Institutional Flow generation rate assumed to be same as Commercial / Industrial
6. Casing inverts used for T101 - SanMH231 (600 mm casing with 500 mm lining)
7. Sewer between SanMH230 and SanMH177 is of unknown size, assumed to be 300 mm
8. Pipe slopes taken from drawings and calculated from survey data
9. Some invert and slope information might contain errors due to combining data from different sources
10. Flow Monitoring manholes

| Manhole # | Monitor # |
|---|---|
| 143 | 4 |
| 206 | 3 |
| 177 | 2 |
| 3 | 1 |

11. ▭ pipes that are over 86% capacity

**Table 3.6**
**Upgraded Sewer Utilization Calculations - Replacement**

FOCUS

**PROJECT:** TOWN OF VERMILION
**JOB No. :** 102414
**DATE:** 2-Feb-10
**Computed by:** SHS
**Checked by:** BER

| | | | | | |
|---|---|---|---|---|---|
| Per Capita Flow = | 300 | L/cap/day | Infiltration Allowance = | 0.28 | L/s/ha |
| Commercial Flow = | 0.20 | L/s/ha | Sag MH Inflow = | 0.4 | L/s/MH |
| Industrial Flow = | 0.20 | L/s/ha | Pipe Roughness Coeff. = | 0.013 | (unitless) |
| Institutional Flow = | 0.20 | L/s/ha | Residential Peaking Factor = | 2.6P-0.1 | |

| Population Density | |
|---|---|
| Low and Medium Density Residential | 2.2 cap/lot |
| High Density Residential | 240 cap/ha |

| | | | Residential | | | | | | | | | Non-Residential | | | | | PDWF | I/I | | | | PWWF | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From MH | To MH | Landuse | Added Lots | Total Lots | Pop. Dens. (cap/lot) | Added Area (ha) | Total Area (ha) | Pop. Dens. (cap/ha) | Added Pop. | Total Pop. | Peak Factor | Avg. Flow (L/s) | Added Area (ha) | Total Area (ha) | Added Avg Flow (L/s) | Peak Factor | Tot Avg Flow (L/s) | | General (L/s) | Added Sag MH | Total Sag MH | Sag MH Inflow (L/s) | | Size (mm) | Slope (%) | Length (m) | Cap. (L/s) | Full Flow Vel. (m/s) | PWWF Flow Vel. (m/s) | PDWF Flow Vel. (m/s) | PWWF to Cap. (%) | U/S Rim (m) | U/S Inv. (m) | D/S Inv. (m) | U/S Cover (m) | D/S Cover (m) |
| | | Industrial | | 0 | | | 0.00 | | 0 | 0 | 1.50 | 0.00 | 1.94 | 1.94 | 0.39 | 15.31 | 0.39 | 5.94 | 0.54 | | 0.00 | 0.00 | 6.48 | | | | | | | | | | | |
| | | LDR | 1670 | 1670 | 2.2 | 46.81 | 46.81 | | 3674 | 3674 | 2.28 | 12.76 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.06 | 13.65 | | 0.00 | 0.00 | 48.71 | | | | | | | | | | | |
| | | MDR | 2 | 1672 | 2.2 | 0.1 | 46.91 | | 4 | 3678 | 2.28 | 12.77 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.09 | 13.68 | | 0.00 | 0.00 | 48.77 | | | | | | | | | | | |
| | | HDR | 3 | 1675 | | 0.25 | 47.16 | 240 | 60 | 3738 | 2.28 | 12.98 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.52 | 13.75 | | 0.00 | 0.00 | 49.27 | | | | | | | | | | | |
| **SanMH143** | SanMH142 | *Upgrade 1* | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.52 | 13.75 | | 0.00 | 0.00 | 49.27 | *525* | *0.02* | *22.70* | *60.82* | *0.28* | *0.31* | *0.29* | *81%* | *611.606* | *606.276* | *606.272* | *4.805* | *4.695* |
| SanMH142 | SanMH141 | | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | | 1.94 | 0.00 | 15.31 | 0.39 | 35.52 | 13.75 | | 0.00 | 0.00 | 49.27 | 300 | 0.84 | 35.40 | 88.63 | 1.25 | 1.29 | 1.18 | 56% | 611.492 | 606.192 | 605.896 | 5.000 | 5.350 |
| | | Commercial | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | 0.15 | 2.09 | 0.03 | 14.81 | 0.42 | 35.77 | 13.79 | | 0.00 | 0.00 | 49.56 | | | | | | | | | | | |
| | | Institutional | | 1675 | | | 47.16 | | 0 | 3738 | 2.28 | 12.98 | 4.20 | 6.29 | 0.84 | 9.02 | 1.26 | 40.93 | 14.97 | | 0.00 | 0.00 | 55.89 | | | | | | | | | | | |
| | | LDR | 28 | 1703 | 2.2 | 7.39 | 54.55 | | 62 | 3800 | 2.28 | 13.19 | | 6.29 | 0.00 | 9.02 | 1.26 | 41.36 | 17.04 | | 0.00 | 0.00 | 58.40 | | | | | | | | | | | |
| | | HDR | 5 | 1708 | | 0.51 | 55.06 | 240 | 122 | 3922 | 2.27 | 13.62 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.23 | 17.18 | | 0.00 | 0.00 | 59.41 | | | | | | | | | | | |
| **SanMH141** | SanMH206 | | | 1708 | | | 55.06 | | 0 | 3922 | 2.27 | 13.62 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.23 | 17.18 | | 0.00 | 0.00 | 59.41 | 300 | 0.78 | 41.20 | 85.40 | 1.21 | 1.31 | 1.20 | 70% | 611.546 | 605.896 | 605.574 | 5.350 | 6.200 |
| | | LDR | 6 | 1714 | 2.2 | 1.08 | 56.14 | | 13 | 3936 | 2.27 | 13.67 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.33 | 17.48 | | 0.00 | 0.00 | 59.81 | | | | | | | | | | | |
| **SanMH206** | SanMH341 | | | 1714 | | | 56.14 | | 0 | 3936 | 2.27 | 13.67 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.33 | 17.48 | | 0.00 | 0.00 | 59.81 | 300 | 3.41 | 61.80 | 178.57 | 2.53 | 2.28 | 2.07 | 33% | 612.074 | 605.574 | 603.465 | 6.200 | 3.540 |
| | | LDR | 2 | 1716 | 2.2 | 0.36 | 56.50 | | 4 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | | | | | | | | | | | |
| **SanMH341** | SanMH341A | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 10.60 | 69.20 | 314.83 | 4.45 | 3.43 | 3.13 | 19% | 607.305 | 603.315 | 595.972 | 3.690 | 1.850 |
| SanMH341A | SanMH329 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 1.18 | 61.50 | 105.04 | 1.49 | 1.53 | 1.41 | 57% | 598.122 | 595.972 | 595.247 | 1.850 | 1.750 |
| SanMH329 | SanMH328 | *Upgrade 2* | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | *375* | *0.49* | *62.00* | *122.73* | *1.11* | *1.10* | *1.01* | *49%* | *597.297* | *595.117* | *594.813* | *1.805* | *1.535* |
| SanMH328 | SanMH340 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.71 | 42.50 | 81.48 | 1.15 | 1.26 | 1.16 | 74% | 596.723 | 594.753 | 594.452 | 1.670 | 1.990 |
| SanMH340 | SanMH327 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 300 | 0.59 | 45.90 | 74.28 | 1.05 | 1.17 | 1.08 | 81% | 596.742 | 594.312 | 594.043 | 2.130 | 1.720 |
| SanMH327 | SanMH327A-R | *Upgrade 3* | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | *375* | *0.31* | *40.60* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *596.063* | *594.043* | *593.92* | *1.645* | *2.720* |
| SanMH327A-R | SanMH326-R | *Upgrade 3* | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | *375* | *0.31* | *31.10* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *597.013* | *593.86* | *593.76* | *2.780* | *1.895* |
| SanMH326-R | SanMH325-R | *Upgrade 3* | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | *375* | *0.31* | *91.60* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *596.033* | *593.73* | *593.45* | *1.925* | *1.876* |
| SanMH325-R | SanMH342-R | *Upgrade 3* | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | *375* | *0.31* | *84.60* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *595.702* | *593.42* | *593.16* | *1.906* | *1.886* |
| SanMH342-R | T100-R | *Upgrade 3* | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | *375* | *0.31* | *80.95* | *97.23* | *0.88* | *0.93* | *0.85* | *62%* | *595.422* | *593.13* | *592.88* | *1.916* | *2.264* |
| T100-R | T101 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 375 | 0.31 | 24.75 | 97.66 | 0.88 | 0.93 | 0.85 | 61% | 595.521 | 592.85 | 592.775 | 2.294 | 2.050 |
| T101 | SanMH231 | | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | | 6.29 | 0.00 | 9.02 | 1.26 | 42.36 | 17.58 | | 0.00 | 0.00 | 59.94 | 500 | 0.89 | 123.78 | 356.22 | 1.81 | 1.35 | 1.23 | 17% | 595.200 | 592.600 | 591.500 | 2.100 | 3.000 |
| | | Commercial | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | 47.11 | 53.40 | 9.42 | 3.44 | 10.68 | 67.80 | 30.77 | | 0.00 | 0.00 | 98.57 | | | | | | | | | | | |
| | | Industrial | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | 2.10 | 55.50 | 0.42 | 3.39 | 11.10 | 68.59 | 31.36 | | 0.00 | 0.00 | 99.95 | | | | | | | | | | | |
| | | Institutional | | 1716 | | | 56.50 | | 0 | 3940 | 2.27 | 13.68 | 99.58 | 155.08 | 19.92 | 2.50 | 31.02 | 108.55 | 59.24 | | 0.00 | 0.00 | 167.79 | | | | | | | | | | | |
| | | LDR | 762 | 2478 | 2.2 | 94.92 | 151.42 | | 1676 | 5616 | 2.19 | 19.50 | | 155.08 | 0.00 | 2.50 | 31.02 | 120.21 | 85.82 | | 0.00 | 0.00 | 206.03 | | | | | | | | | | | |
| | | MDR | 37 | 2515 | 2.2 | 0.32 | 151.74 | | 81 | 5698 | 2.18 | 19.78 | | 155.08 | 0.00 | 2.50 | 31.02 | 120.76 | 85.91 | | 0.00 | 0.00 | 206.67 | | | | | | | | | | | |
| | | HDR | 17 | 2532 | | 1.05 | 152.79 | 240 | 252 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | | | | | | | | | | | |
| **SanMH231** | SanMH TW1 | *Upgrade 4.B* | | 2532 | | | 152.79 | | 0 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | 375 | 2.00 | 50 | 247.95 | 2.25 | 2.51 | 2.24 | 84% | 595.0 | 591.078 | 590.08 | 3.547 | 5.147 |
| SanMH TW1 | SanMH TW2 | *Upgrade 4.B* | | 2532 | | | 152.79 | | 0 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | 375 | 5.05 | 75 | 394.01 | 3.57 | 3.62 | 3.15 | 53% | 595.6 | 590.05 | 586.26 | 5.177 | 3.015 |
| SanMH TW2 | SanMH TW3 | *Upgrade 4.B* | | 2532 | | | 152.79 | | 0 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | 375 | 4.00 | 115 | 350.66 | 3.17 | 3.31 | 2.89 | 60% | 589.7 | 586.23 | 581.63 | 3.044 | 1.794 |
| SanMH TW3 | SanMH TW4 | *Upgrade 4.B* | | 2532 | | | 152.79 | | 0 | 5950 | 2.18 | 20.66 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.48 | 86.20 | | 0.00 | 0.00 | 208.68 | 375 | 3.79 | 115 | 341.33 | 3.09 | 3.24 | 2.84 | 61% | 583.8 | 581.60 | 577.24 | 1.824 | 2.003 |
| | | LDR | 22 | 2554 | 2.2 | 4.99 | 157.78 | | 48 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | | | | | | | | | | | |
| SanMH TW4 | SanMH TW5 | *Upgrade 4.B* | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 600 | 0.17 | 95 | 253.16 | 0.90 | 1.00 | 0.89 | 83% | 579.6 | 577.02 | 576.86 | 2.003 | 2.685 |
| SanMH TW5 | SanMH TW6 | *Upgrade 4.B* | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 600 | 0.17 | 95 | 253.16 | 0.90 | 1.00 | 0.89 | 83% | 580.1 | 576.83 | 576.66 | 2.715 | 2.736 |
| SanMH TW6 | SanMH TW7 | *Upgrade 4.B* | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 600 | 0.17 | 95 | 253.16 | 0.90 | 1.00 | 0.89 | 83% | 580.0 | 576.63 | 576.47 | 2.766 | 2.928 |
| SanMH TW7 | SanMH TW8 | *Upgrade 4.B* | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 600 | 0.17 | 95 | 253.16 | 0.90 | 1.00 | 0.89 | 83% | 580.0 | 576.44 | 576.28 | 2.958 | 2.919 |
| SanMH TW8 | SanMH TW9 | *Upgrade 4.B* | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 600 | 0.17 | 95 | 253.16 | 0.90 | 1.00 | 0.89 | 83% | 579.8 | 576.25 | 576.09 | 2.949 | 3.241 |
| SanMH TW9 | SanMH TW10 | *Upgrade 4.B* | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 600 | 0.17 | 95 | 253.16 | 0.90 | 1.00 | 0.89 | 83% | 579.9 | 576.06 | 575.90 | 3.271 | 2.862 |
| SanMH TW10 | SanMH TW11 | *Upgrade 4.B* | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 675 | 0.10 | 95 | 265.82 | 0.74 | 0.82 | 0.73 | 79% | 579.4 | 575.82 | 575.73 | 2.862 | 2.387 |
| SanMH TW11 | SanMH TW12 | *Upgrade 4.B* | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | | 155.08 | 0.00 | 2.50 | 31.02 | 122.81 | 87.60 | | 0.00 | 0.00 | 210.41 | 675 | 0.10 | 75 | 265.82 | 0.74 | 0.82 | 0.73 | 79% | 578.8 | 575.70 | 575.62 | 2.417 | 2.842 |
| | | Institutional | | 2554 | | | 157.78 | | 0 | 5998 | 2.17 | 20.83 | 3.62 | 158.70 | 0.72 | 2.50 | 31.74 | 124.62 | 88.61 | | 0.00 | 0.00 | 213.23 | | | | | | | | | | | |
| | | LDR | 364 | 2918 | 2.2 | 31.75 | 189.53 | | 801 | 6799 | 2.15 | 23.61 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.02 | 97.50 | | 0.00 | 0.00 | 227.53 | | | | | | | | | | | |
| | | MDR | 1 | 2919 | 2.2 | 0.33 | 189.86 | | 2 | 6801 | 2.15 | 23.62 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.04 | 97.60 | | 0.00 | 0.00 | 227.64 | | | | | | | | | | | |
| | | HDR | 2 | 2921 | | 0.09 | 189.95 | 240 | 22 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | | | | | | | | | | | |
| SanMH TW12 | SanMH TW13 | *Upgrade 4.B* | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 675 | 0.10 | 115 | 265.82 | 0.74 | 0.83 | 0.74 | 86% | 579.1 | 575.59 | 575.48 | 2.872 | 2.497 |
| SanMH TW13 | SanMH TW14 | *Upgrade 4.B* | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 675 | 0.10 | 115 | 265.82 | 0.74 | 0.83 | 0.74 | 86% | 578.7 | 575.45 | 575.33 | 2.527 | 2.627 |
| SanMH TW14 | SanMH TW15 | *Upgrade 4.B* | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 675 | 0.10 | 120 | 265.82 | 0.74 | 0.83 | 0.74 | 86% | 578.6 | 575.30 | 575.18 | 2.657 | 2.762 |
| SanMH TW15 | SanMH TW16 | *Upgrade 4.B* | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 675 | 0.10 | 110 | 265.82 | 0.74 | 0.83 | 0.74 | 86% | 578.6 | 575.15 | 575.04 | 2.792 | 2.712 |
| SanMH TW16 | SanMH TW17 | *Upgrade 4.B* | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 675 | 0.10 | 110 | 265.82 | 0.74 | 0.83 | 0.74 | 86% | 578.4 | 575.01 | 574.90 | 2.742 | 3.172 |
| SanMH TW17 | SanMH TW18 | *Upgrade 4.B* | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | | 158.70 | 0.00 | 2.50 | 31.74 | 130.18 | 97.62 | | 0.00 | 0.00 | 227.81 | 675 | 0.10 | 65 | 265.82 | 0.74 | 0.83 | 0.74 | 86% | 578.8 | 574.87 | 574.81 | 3.202 | 1.917 |
| | | Commercial | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | 4.25 | 162.95 | 0.85 | 2.50 | 32.59 | 132.31 | 98.81 | | 0.00 | 0.00 | 231.12 | | | | | | | | | | | |
| | | Industrial | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | 53.12 | 216.07 | 10.62 | 2.50 | 43.21 | 158.87 | 113.69 | | 0.00 | 0.00 | 272.55 | | | | | | | | | | | |
| | | Institutional | | 2921 | | | 189.95 | | 0 | 6823 | 2.15 | 23.69 | 6.86 | 222.93 | 1.37 | 2.50 | 44.59 | 162.30 | 115.61 | | 0.00 | 0.00 | 277.90 | | | | | | | | | | | |
| | | LDR | 113 | 3034 | 2.2 | 40.42 | 230.37 | | 249 | 7071 | 2.14 | 24.55 | | 222.93 | 0.00 | 2.50 | 44.59 | 163.96 | 126.92 | | 0.00 | 0.00 | 290.89 | | | | | | | | | | | |
| | | MDR | 11 | 3045 | 2.2 | 0.88 | 231.25 | | 24 | 7096 | 2.14 | 24.64 | | 222.93 | 0.00 | 2.50 | 44.59 | 164.12 | 127.17 | | 0.00 | 0.00 | 291.29 | | | | | | | | | | | |
| SanMH TW18 | SanMH TW19 | *Upgrade 4.B* | | 3045 | | | 231.25 | | 0 | 7096 | 2.14 | 24.64 | | 222.93 | 0.00 | 2.50 | 44.59 | 164.12 | 127.17 | | 0.00 | 0.00 | 291.29 | 750 | 0.10 | 95 | 352.05 | 0.80 | 0.89 | 0.78 | 83% | 577.4 | 574.73 | 574.64 | 1.917 | |
| SanMH TW19 | | *Upgrade 4.B* | | 3045 | | | 231.25 | | 0 | 7096 | 2.14 | 24.64 | | 222.93 | 0.00 | 2.50 | 44.59 | 164.12 | 127.17 | | 0.00 | 0.00 | 291.29 | 750 | | | | | | | | | | 574.64 invert to WWTP | |
| Totals | | | | | | | 231.25 | | | 7096 | | | | 222.93 | | | 44.59 | | | | | | | | | | | | | | | | | |

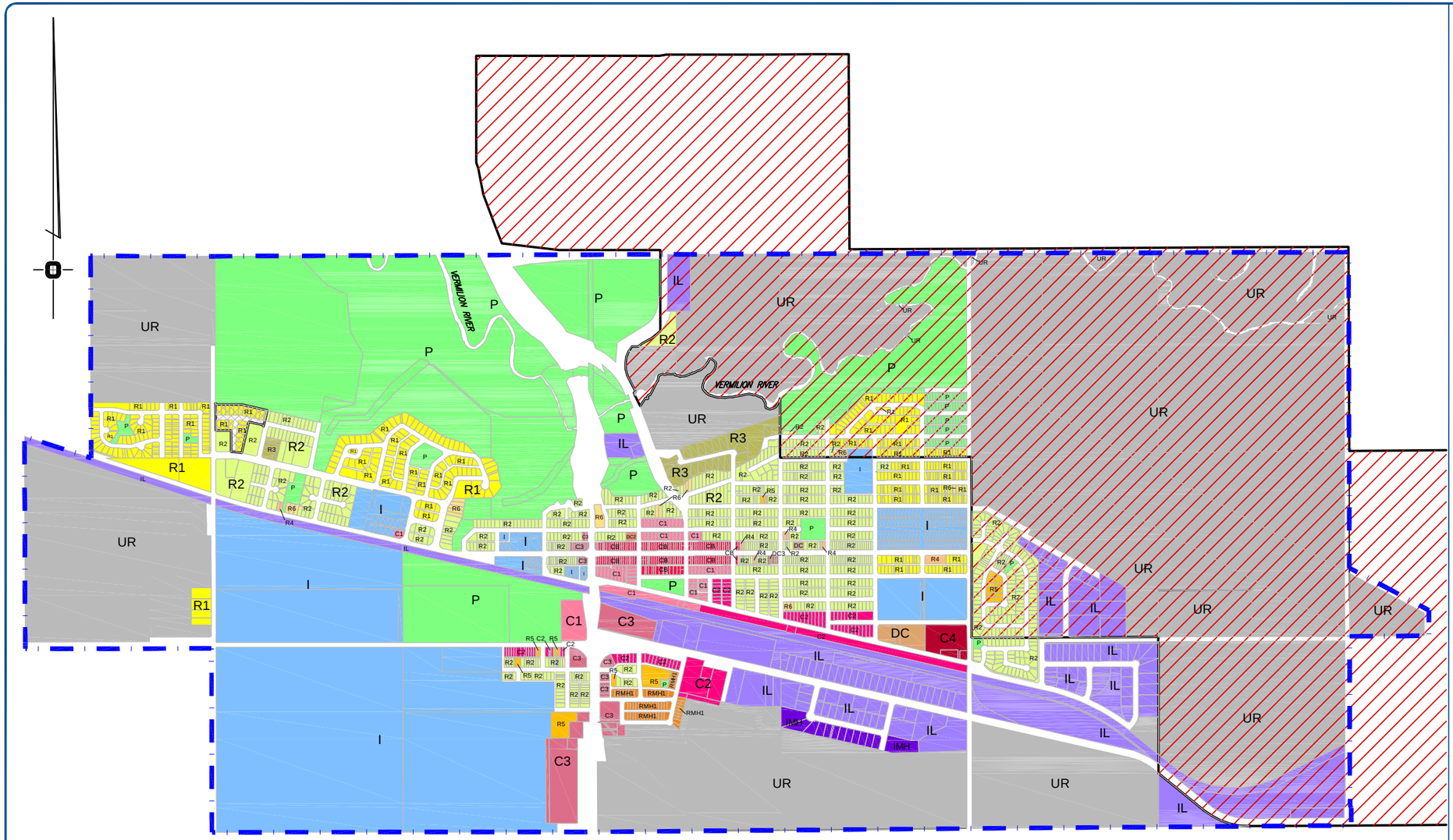
**Notes:**

1. PDWF - Peak Dry Weather Flow
2. PWWF - Peak Wet Weather Flow
3. Based on design standard, PWWF ≤ 0.86% of pipe capacity
4. Industrial / Commercial flow generation as per City of Edmonton Design Standards (0.2 L/s/ha)
5. Institutional Flow generation rate assumed to be same as Commercial / Industrial
6. Casing inverts used for T101 - SanMH231 (600 mm casing with 500 mm lining)
7. Pipe slopes taken from drawings and calculated from survey data
8. Some invert and slope information might contain errors due to combining data from different sources
9. Flow Monitoring manholes

| Manhole # | Monitor # |
|---|---|
| 143 | 4 |
| 206 | 3 |
| 177 | 2 |
| 3 | 1 |

# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE




LEGEND:

TOWN BOUNDARY

| | |
|---|---|
| C1 - Commercial District | DC - Direct Control District |
| C2 - Commercial District | DC1 - Direct Control District |
| C3 - Highway Commercial District | DC2 - Direct Control District |
| C4 - Shopping Centre District | DC3 - Direct Control District |
| CB - Central Business District | |

| | |
|---|---|
| IL - Light Industrial District | R1 - Residential District |
| IMH - Medium / Heavy Industrial District | R2 - Residential District |
| P - Community District | R3 - Residential District |
| I - Institutional District | R4 - Residential District |
| | R5 - Residential District |

| | |
|---|---|
| R6 - Residential District | |
| RMH1 - Residential Manufacture Home Subdivision District | |
| UR - Urban Reserve District | |
| AVO - Airport Vicinity Overlay District | |
| ACO - Architectural Control Overlay District | |

## LAND USE PLAN

# FIGURE 3.1

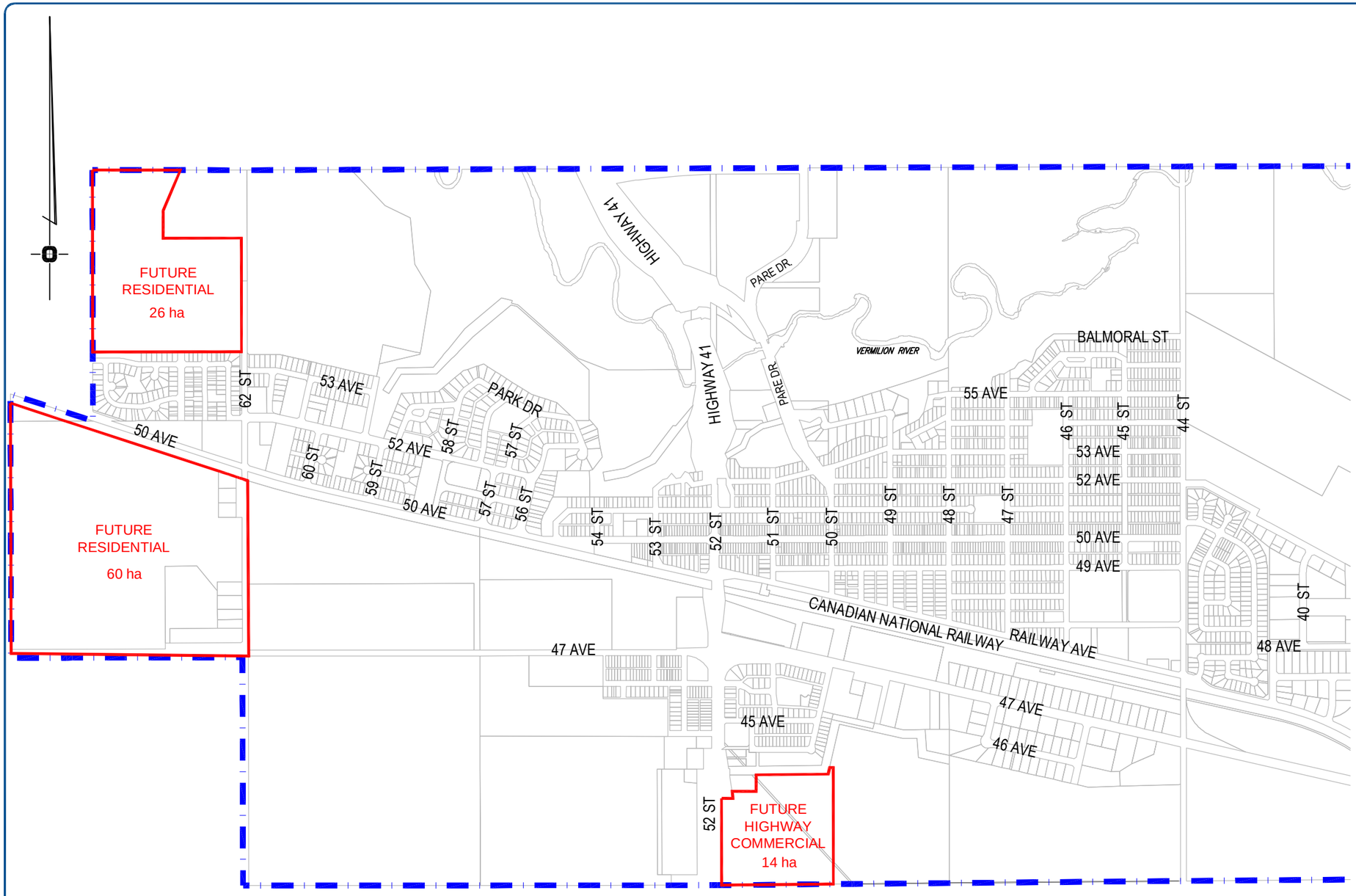


FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 3.1-LANDUSE.dwg

DATE PLOTTED: March 5, 2010




Vermilion, Alberta
Solid Roots - Strong Future

# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

- TOWN BOUNDARY
- FUTURE GROWTH AREA

## FUTURE GROWTH AREAS

## FIGURE 3.2



FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 3.2-FUTURE GROWTH.dwg
DATE PLOTTED: March 5, 2010

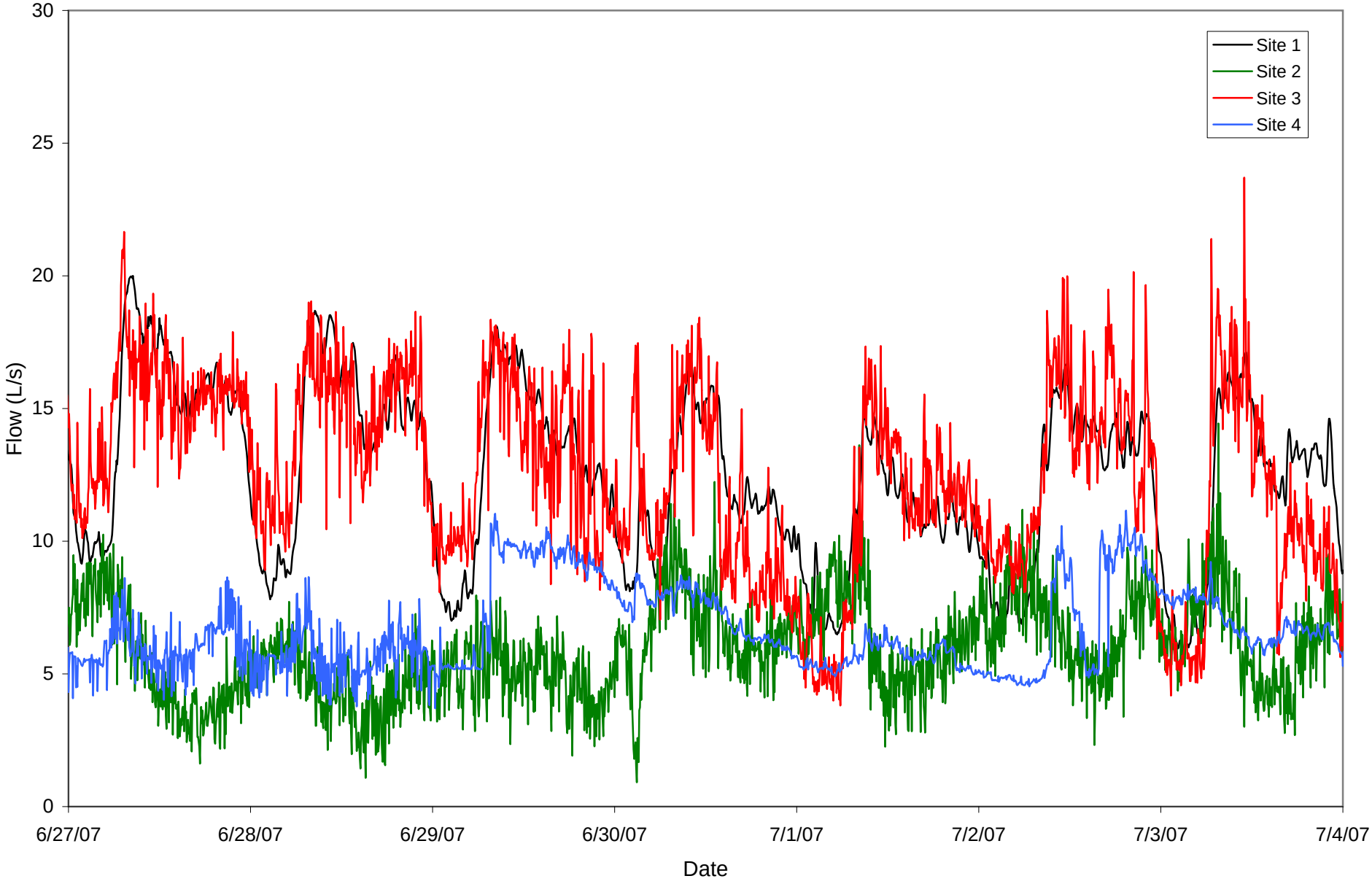
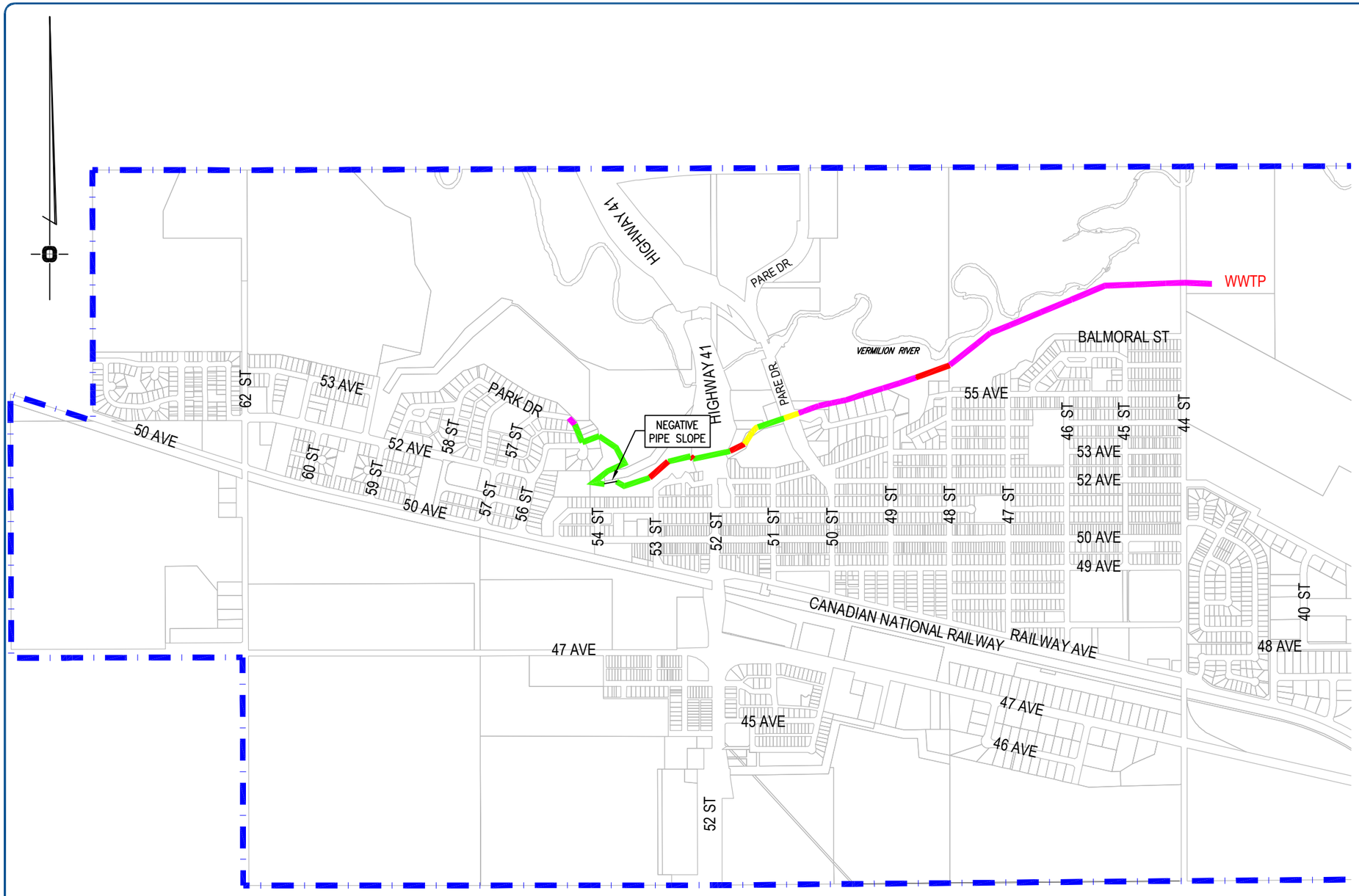



**Figure 3.3**
**Flow Data Comparison Between Monitoring Sites**




Vermilion, Alberta
Solid Roots - Strong Future

# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

- TOWN BOUNDARY
- < 86% CAPACITY
- 86% - 100% CAPACITY
- 100% - 120% CAPACITY
- > 120% CAPACITY

## EXISTING SANITARY SEWER TRUNK UTILIZATION

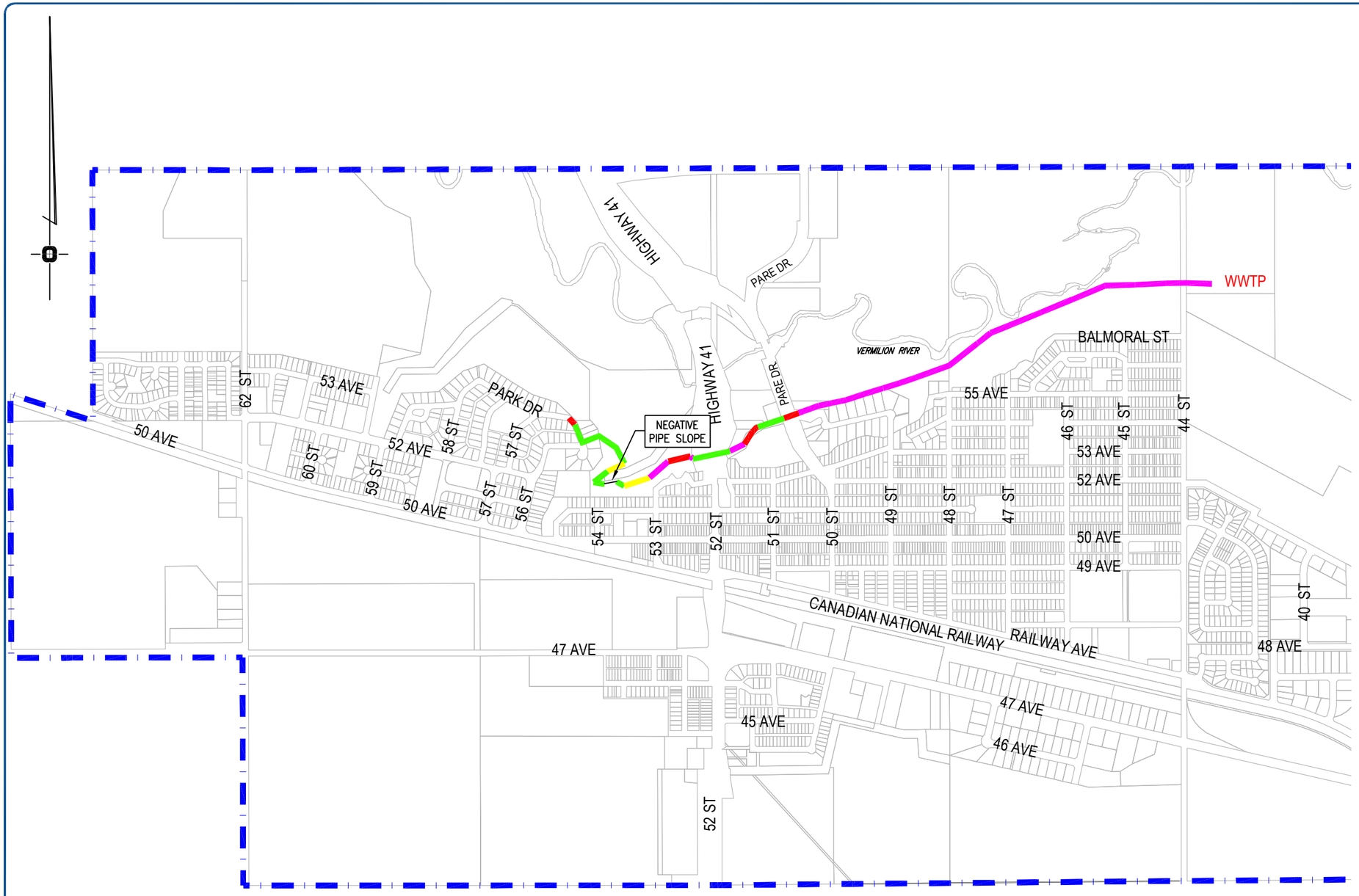
# FIGURE 3.4



FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 3.4-EX SEWER.dwg
DATE PLOTTED: March 5, 2010




Vermilion, Alberta
Solid Roots - Strong Future

# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

- TOWN BOUNDARY
- < 86% CAPACITY
- 86% - 100% CAPACITY
- 100% - 120% CAPACITY
- > 120% CAPACITY

## EXISTING SANITARY SEWER TRUNK UTILIZATION WITH FUTURE DEVELOPMENT

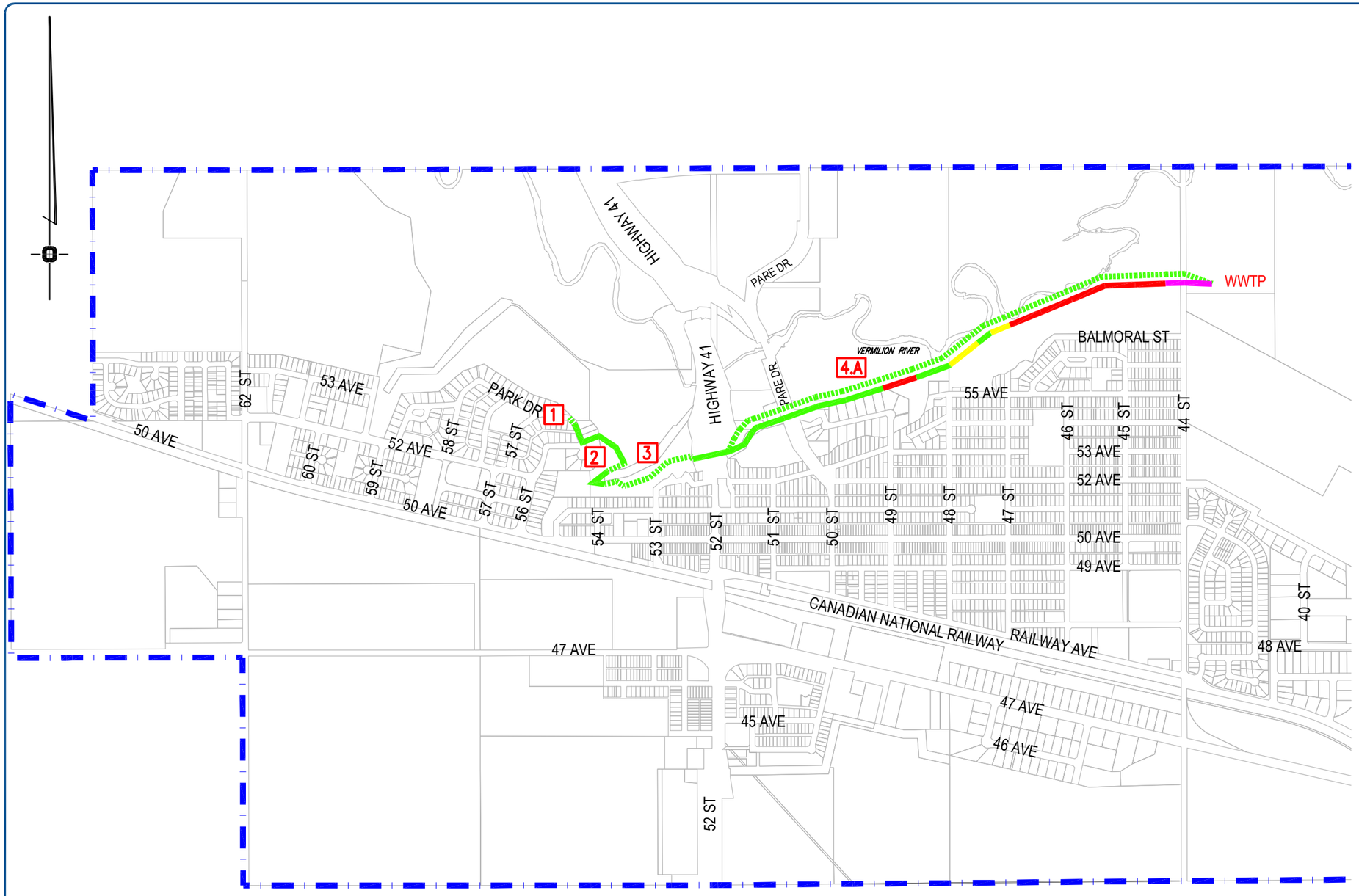
# FIGURE 3.5



FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 3.5-FUTURE SEWER.dwg
DATE PLOTTED: March 5, 2010




# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

- TOWN BOUNDARY
- 1 — UPGRADE NO.

NEW SEWER

- < 86% CAPACITY

EXISTING SEWER

- < 86% CAPACITY
- 86% - 100% CAPACITY
- 100% - 120% CAPACITY
- > 120% CAPACITY

## UPGRADED SANITARY SEWER TRUNK UTILIZATION

TWINNING

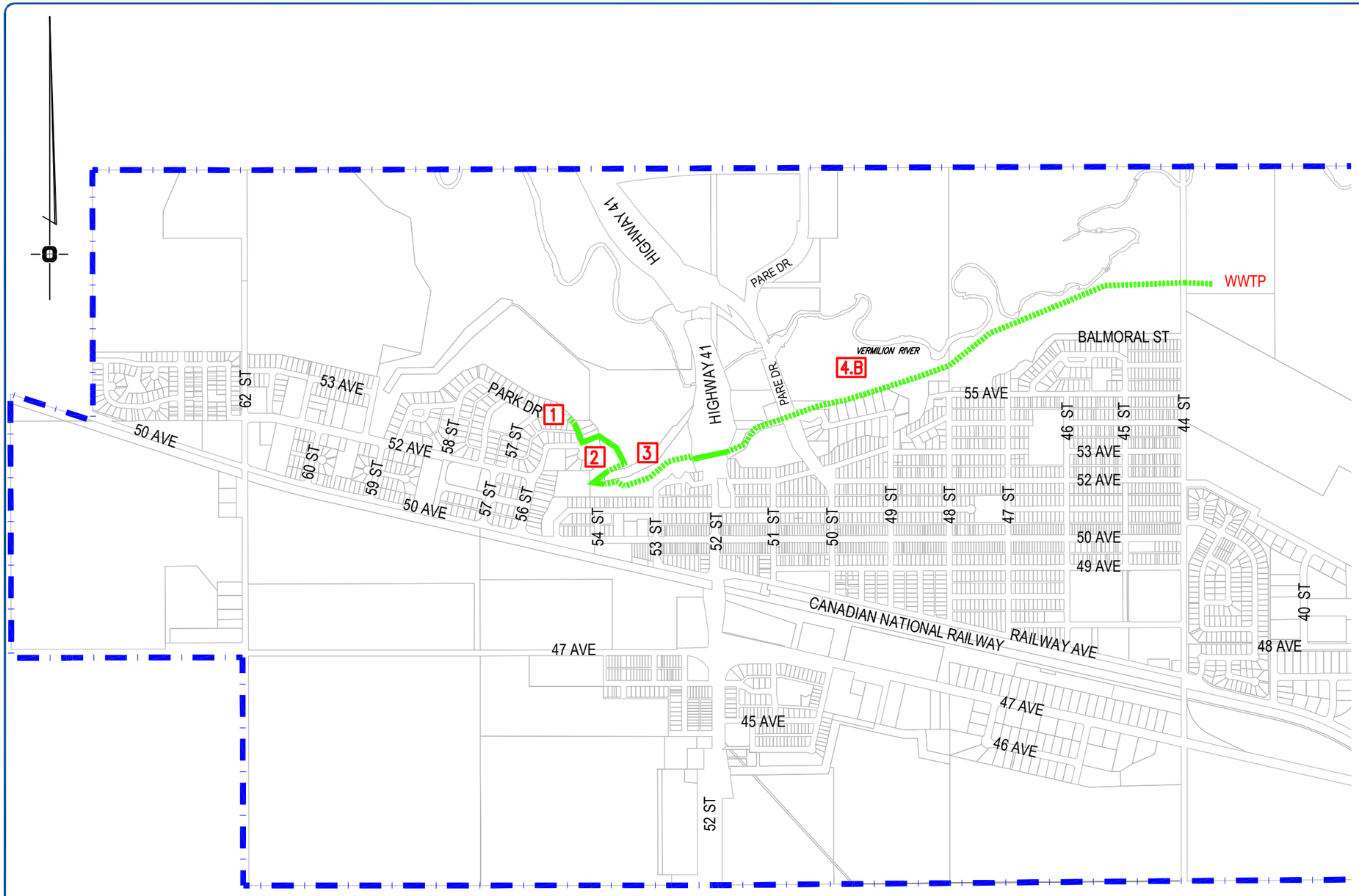
# FIGURE 3.6



FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 3.6-UPGRADED SEWER-TWINNING.dwg
DATE PLOTTED: March 5, 2010




Vermilion, Alberta
Solid Roots - Strong Future

# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

- TOWN BOUNDARY
- 1 — UPGRADE NO.
- NEW SEWER
  - < 86% CAPACITY
- EXISTING SEWER
  - < 86% CAPACITY

## UPGRADED SANITARY SEWER TRUNK UTILIZATION

REPLACEMENT

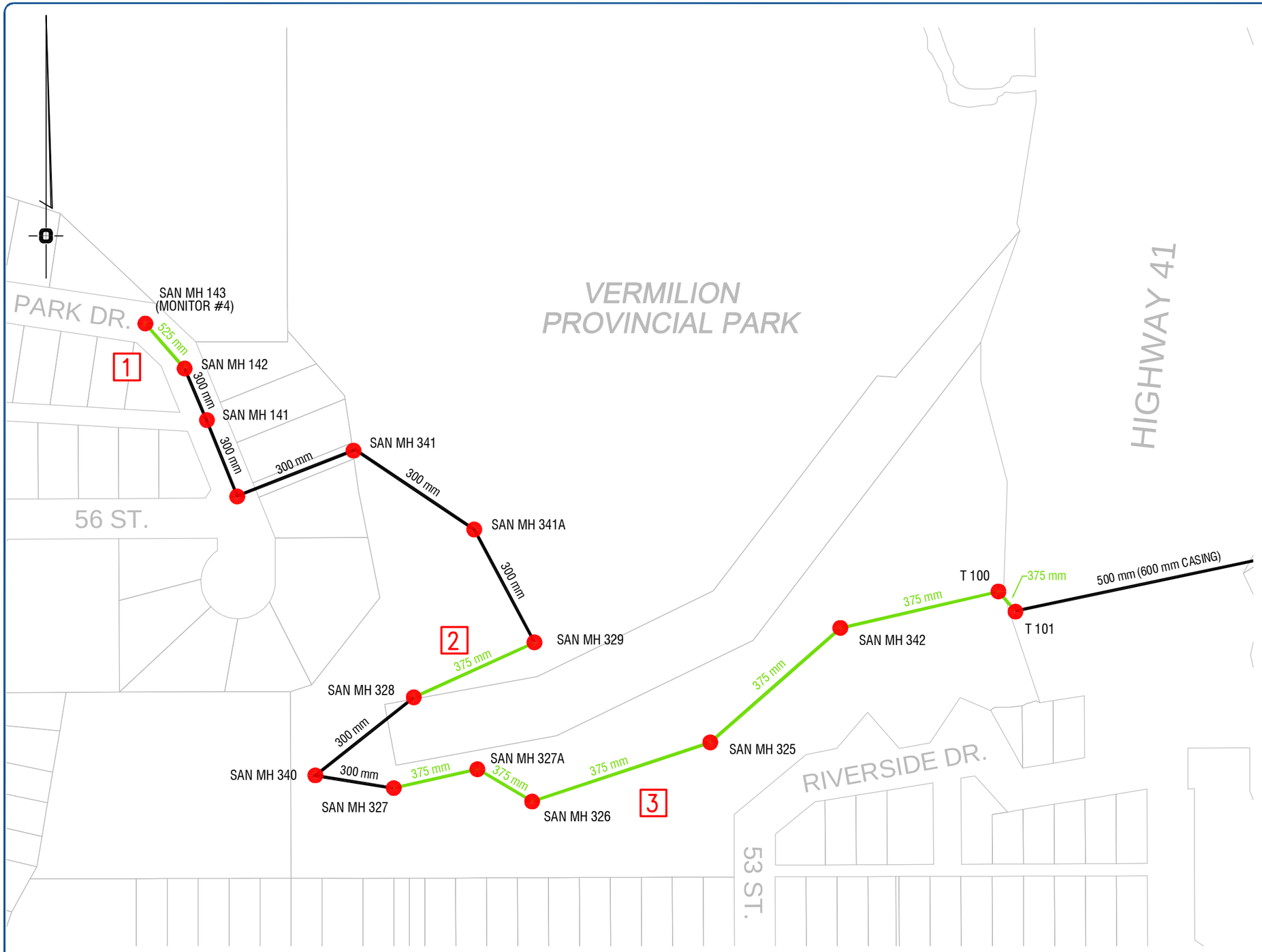
# FIGURE 3.7



FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 3.7-UPGRADED SEWER-REPLACEMENT.dwg
DATE PLOTTED: March 5, 2010




Vermilion, Alberta
Solid Roots - Strong Future

# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

- 1 — UPGRADE NO.
- 300 mm — EXISTING SEWER
- 375 mm — PROPOSED UPGRADE

## PROPOSED SANITARY SEWER TRUNK UPGRADES 1, 2 AND 3

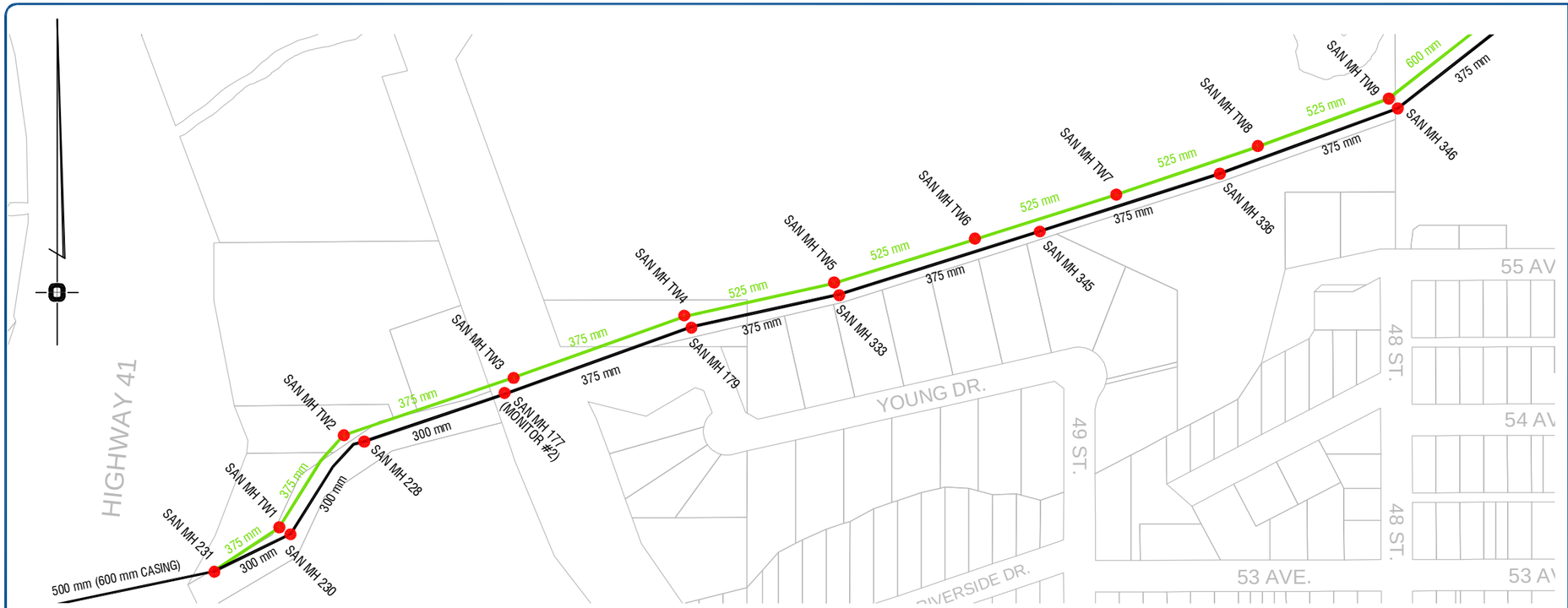
# FIGURE 3.8

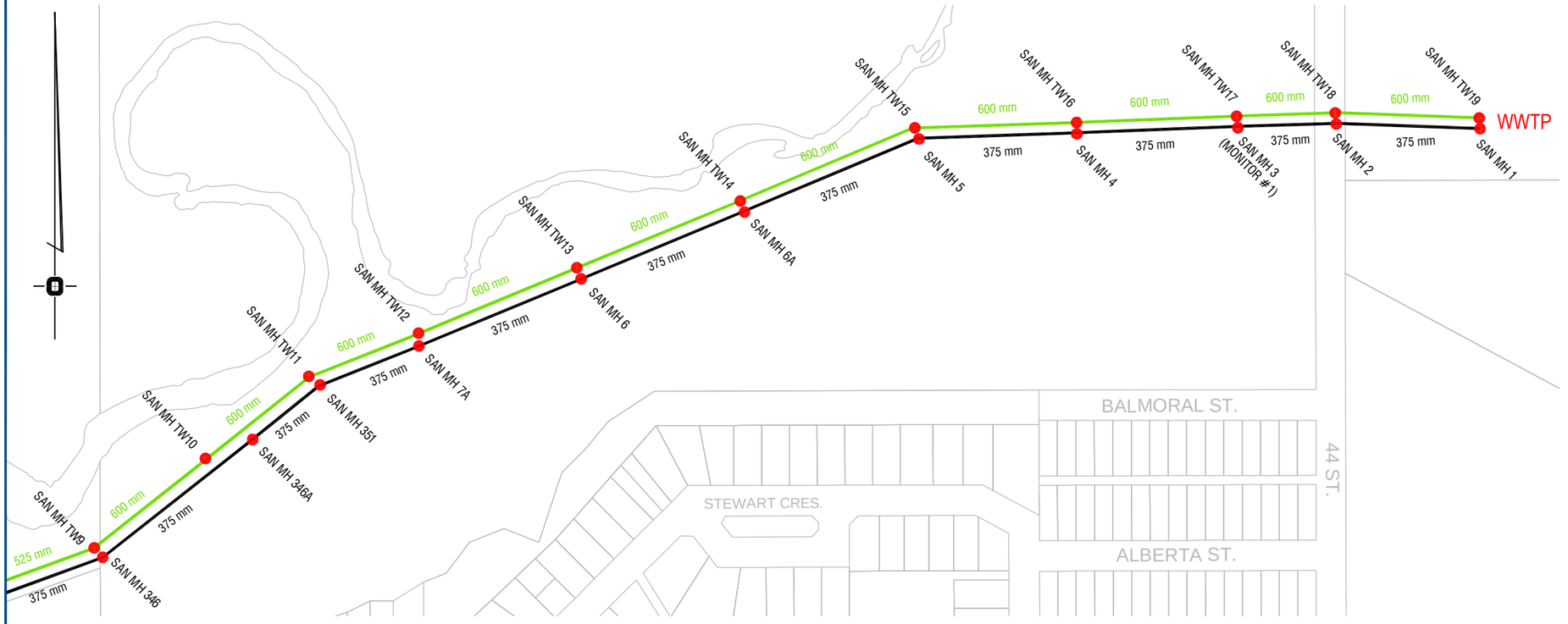


FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | 1:2000 |

CAD FILE NAME: 102414-FIG 3.8-PROPOSED SEWER UPGRADES 1,2&3.dwg
DATE PLOTTED: March 5, 2010




# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

300 mm — EXISTING SEWER

375 mm — PROPOSED UPGRADE

## PROPOSED SANITARY SEWER TRUNK UPGRADE 4.A

## FIGURE 3.9

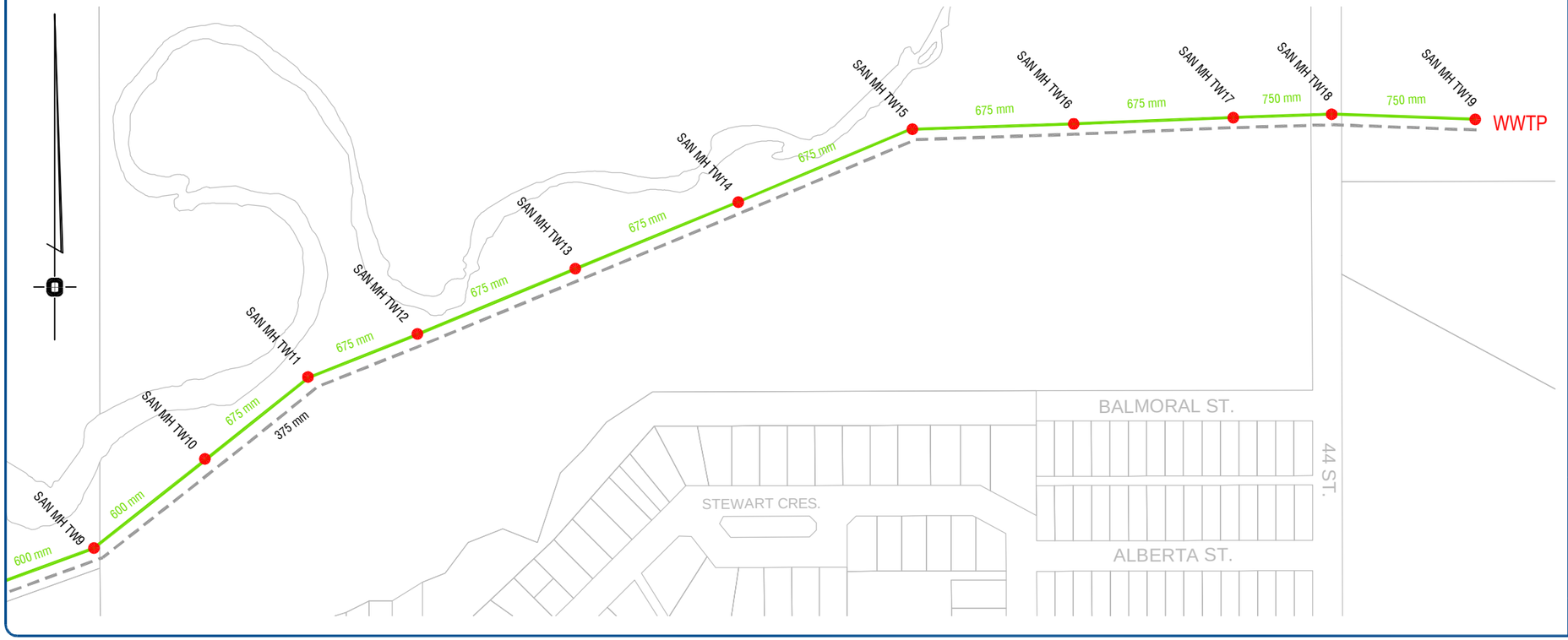


FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 3.9-PROPOSED SEWER UPGRADES 4A.dwg

DATE PLOTTED: March 5, 2010


Vermilion, Alberta
Solid Roots - Strong Future

# TOWN OF VERMILION

## SANITARY TRUNK FLOW MONITORING AND UPGRADE

LEGEND:

- 300 mm — EXISTING SEWER
- 375 mm — PROPOSED UPGRADE
- ABANDONED SEWER

## PROPOSED SANITARY SEWER TRUNK UPGRADE 4.B

# FIGURE 3.10



FOCUS
Engineering - Geomatics - Planning

| Project No. | Date. | Scale |
|---|---|---|
| 102414 | DEC., 2009 | N.T.S. |

CAD FILE NAME: 102414-FIG 3.10-PROPOSED SEWER UPGRADES 4B.dwg
DATE PLOTTED: March 5, 2010

# 4.0 COST ESTIMATES

These cost estimates are based upon current (2010) unit rates for similar construction work in Edmonton. A contingency allowance of 20% and engineering and testing costs of 15% were also added to the construction cost.

## 4.1 SANITARY TRUNK UPGRADES WEST OF HIGHWAY 41

The proposed upgrades west of Highway 41 are common to both sewer trunk upgrade scenarios. The preliminary cost estimates for these upgrades are summarized in Table 4.1. Insulation costs were added where the proposed sewer is shallow and does not meet 2.6 metres of cover.

The current cost for sanitary trunk upgrades upstream of Highway 41 is approximately $1,187,000, with the cost breakdown as follows:

### 4.1.1 Upgrade 1: $64,000

Costs are based on open cut between sanitary manholes 143 and 142, with the existing 300 mm sewer removed and replaced with a 525 mm.

From a hydraulic standpoint it would be better to replace both the undersized segment and the leg downstream, between sanitary manholes 142 and 141, as this would allow a steeper grade on the sewer between sanitary manholes 143 and 142.

### 4.1.2 Upgrade 2: $175,000

As discussed previously in Section 3.3.3, there is only marginal need for this upgrade. Flows for this portion of the sanitary trunk can be monitored, without replacing the sewer unless it becomes necessary. Since the proposed sewer upgrade is located in the Vermilion Provincial Park, cost estimates include additional expenses for directional drilling or augering.

### 4.1.3 Upgrade 3: $948,000

This portion of the existing sewer trunk is located in Vermilion Provincial Park. As mentioned, due to existing terrain and restricted working space it is recommended to replace this entire length of sewer at once. Cost estimates for this upgrade are based on completing the work via directional drilling or augering to minimize the surface impact.

## 4.2 SANITARY TRUNK UPGRADES EAST OF HIGHWAY 41

The preliminary cost estimates presented in Tables 4.2 and 4.3 detail the cost estimates for the sanitary trunk upgrades east of Highway 41. Cost estimates have been prepared for open cut construction as well as confined open cut construction where clearing would be limited to a 5 metre width and spoil material would be cycled.

Based on terrain and vegetation conditions, a combination of the two installation methods might be the most advantageous solution, which would result in the expected cost being between the open cut and confined open cut cost estimates.

Insulation costs were added where the proposed sewer is shallow and does not meet 2.6 metres of cover.

### 4.2.1 Upgrade 4.A - Twinning

The preliminary cost estimates for this upgrade are summarized in Table 4.2

The estimated cost for sewer trunk twinning from sanitary manhole 231 to the WWTP is approximately $ 1,243,000 for green-field open-cut installation and $ 2,031,000 for confined open-cut.

### 4.2.2 Upgrade 4.B - Replacement

The preliminary cost estimates for this upgrade are summarized in Table 4.3

The estimated cost for sewer trunk replacement from sanitary manhole 231 to the WWTP is approximately $ 1,318,000 for open cut installation and $ 2,106,000 for confined open cut. These costs do not include allowance for bypass or pumping costs.

**Table 4.1 Cost Estimates**
**Town of Vermilion Sanitary Trunk Upgrades**

**Sanitary Sewer Trunk Upgrades West of Highway 41 Crossing**

| Item # | Item | Unit | Unit Price | Quantity | Cost |
|---|---|---|---|---|---|
| **Upgrade 1** | **San MH 143 to San MH 142 - open cut** | | | | |
| 1.1 | 525 mm PVC @ 4 - 6 m Depth | m | $ 1,400 | 23 | $ 32,200 |
| 1.2 | Remove and replace | m | $ 660 | 23 | $ 15,180 |
| 1.3 | Manholes (1200 mm) | vm | $ 1,300 | - | $ - |
| 1.4 | Contingency Allowance @20% | | | | $ 9,476 |
| 1.5 | Engineering and Testing @15% | | | | $ 7,107 |
| | **Sub-total** | | | | **$ 63,963** |
| **Upgrade 2** | **San MH 206 to San MH 341 - directional drill / auger** | | | | |
| 2.1 | 375 mm PVC @ 4 - 6 m Depth | m | $ 1,780 | 62 | $ 110,360 |
| 2.2 | Manholes (1200 mm) | vm | $ 1,300 | - | $ - |
| 2.3 | Pipe insulation (2.8 m wide) | $m^2$ | $ 110 | 174 | $ 19,096 |
| 2.4 | Contingency Allowance @20% | | | | $ 25,891 |
| 2.5 | Engineering and Testing @15% | | | | $ 19,418 |
| | **Sub-total** | | | | **$ 174,766** |
| **Upgrade 3** | **San MH 327 to T 101 - directional drill / auger** | | | | |
| 3.1 | 375 mm PVC @ 0 - 4 m Depth | m | $ 1,780 | 330 | $ 587,400 |
| 3.2 | Manholes | vm | $ 1,300 | 10 | $ 13,000 |
| 3.3 | Pipe insulation (2.8 m wide) | m | $ 110 | 924 | $ 101,640 |
| 3.4 | Contingency Allowance @20% | | | | $ 140,408 |
| 3.5 | Engineering and Testing @15% | | | | $ 105,306 |
| | **Sub-total** | | | | **$ 947,754** |

**Notes:**
1. Assumed 2.8 m wide pipe insulation, 75 mm thickness
2. Pipe costs for Upgrade 1 include street restoration

**Table 4.2 Cost Estimates**
**Town of Vermilion Sanitary Trunk Upgrades**

**Sanitary Sewer Trunk Upgrades East of Highway 41 Crossing**

| Item # | Item | Unit | Unit Price | Quantity | Cost |
|---|---|---|---|---|---|
| **Upgrade 4.A** | **Twin Line from San MH 231 to STWTP - open cut** | | | | |
| 4.A.1 | 375 mm PVC @ 0 - 4 m Depth | m | $ 280 | 230 | $ 64,400 |
| 4.A.2 | 375 mm PVC @ 4 - 6 m Depth | m | $ 380 | 125 | $ 47,500 |
| 4.A.3 | 525 mm PVC @ 0 - 4 m Depth | m | $ 380 | 475 | $ 180,500 |
| 4.A.4 | 600 mm PVC @ 0 - 4 m Depth | m | $ 430 | 995 | $ 427,850 |
| 4.A.5 | Manholes (1200 mm) | vm | $ 1,300 | 17 | $ 22,100 |
| 4.A.6 | Manholes (1500 mm) | vm | $ 1,700 | 45 | $ 76,500 |
| 4.A.7 | Pipe insulation (2.2 m wide) | m | $ 110 | 924 | $ 101,640 |
| 4.A.8 | Contingency Allowance @20% | | | | $ 184,098 |
| 4.A.9 | Engineering and Testing @15% | | | | $ 138,074 |
| | **Sub-total** | | | | **$ 1,242,662** |
| **Alternative installation method** | | | | | |
| **Upgrade 4.A** | **Twin Line from San MH 231 to STWTP - open cut - confined** | | | | |
| 4.A.1 | 375 mm PVC @ 0 - 4 m Depth | m | $ 600 | 230 | $ 138,000 |
| 4.A.2 | 375 mm PVC @ 4 - 6 m Depth | m | $ 700 | 125 | $ 87,500 |
| 4.A.3 | 525 mm PVC @ 0 - 4 m Depth | m | $ 700 | 475 | $ 332,500 |
| 4.A.4 | 600 mm PVC @ 0 - 4 m Depth | m | $ 750 | 995 | $ 746,250 |
| 4.A.5 | Manholes (1200 mm) | vm | $ 1,300 | 17 | $ 22,100 |
| 4.A.6 | Manholes (1500 mm) | vm | $ 1,700 | 45 | $ 76,500 |
| 4.A.7 | Pipe insulation (2.2 m wide) | m | $ 110 | 924 | $ 101,640 |
| 4.A.8 | Contingency Allowance @20% | | | | $ 300,898 |
| 4.A.9 | Engineering and Testing @15% | | | | $ 225,674 |
| | **Sub-total** | | | | **$ 2,031,062** |

**Notes:**
1. Assumed 2.2 m wide pipe insulation, 75 mm thickness
2. For confined installation assume 5 m wide clearing, cycle dirt 1 mile round trip

**Table 4.3 Cost Estimates**
**Town of Vermilion Sanitary Trunk Upgrades**

**Sanitary Sewer Trunk Upgrades East of Highway 41 Crossing**

| Item # | Item | Unit | Unit Price | Quantity | Cost |
|---|---|---|---|---|---|
| **Upgrade 4.B** | **Replace Line from San MH 231 to STWTP - open cut** | | | | |
| 4.B.1 | 375 mm PVC @ 0 - 4 m Depth | m | $ 280 | 230 | $ 64,400 |
| 4.B.2 | 375 mm PVC @ 4 - 6 m Depth | m | $ 380 | 125 | $ 47,500 |
| 4.B.3 | 600 mm PVC @ 0 - 4 m Depth | m | $ 430 | 570 | $ 245,100 |
| 4.B.4 | 675 mm PVC @ 0 - 4 m Depth | m | $ 460 | 805 | $ 370,300 |
| 4.B.5 | 750 mm PVC @ 0 - 4 m Depth | m | $ 500 | 95 | $ 47,500 |
| 4.B.6 | Manholes (1200 mm) | vm | $ 1,300 | 14 | $ 18,200 |
| 4.B.7 | Manholes (1500 mm) | vm | $ 1,700 | 48 | $ 81,600 |
| 4.B.8 | Pipe insulation (2.2 m wide) | m | $ 110 | 924 | $ 101,640 |
| 4.B.9 | Contingency Allowance @20% | | | | $ 195,248 |
| 4.B.10 | Engineering and Testing @15% | | | | $ 146,436 |
| | **Sub-total** | | | | **$ 1,317,924** |

**Alternative installation method**

| | | | | | |
|---|---|---|---|---|---|
| **Upgrade 4.B** | **Replace Line from San MH 231 to STWTP - open cut - confined** | | | | |
| 4.B.1 | 375 mm PVC @ 0 - 4 m Depth | m | $ 600 | 230 | $ 138,000 |
| 4.B.2 | 375 mm PVC @ 4 - 6 m Depth | m | $ 700 | 125 | $ 87,500 |
| 4.B.3 | 600 mm PVC @ 0 - 4 m Depth | m | $ 750 | 570 | $ 427,500 |
| 4.B.4 | 675 mm PVC @ 0 - 4 m Depth | m | $ 780 | 805 | $ 627,900 |
| 4.B.5 | 750 mm PVC @ 0 - 4 m Depth | m | $ 820 | 95 | $ 77,900 |
| 4.B.6 | Manholes (1200 mm) | vm | $ 1,300 | 14 | $ 18,200 |
| 4.B.7 | Manholes (1500 mm) | vm | $ 1,700 | 48 | $ 81,600 |
| 4.B.8 | Pipe insulation (2.2 m wide) | m | $ 110 | 924 | $ 101,640 |
| 4.B.9 | Contingency Allowance @20% | | | | $ 312,048 |
| 4.B.10 | Engineering and Testing @15% | | | | $ 234,036 |
| | **Sub-total** | | | | **$ 2,106,324** |

**Notes:**
1. Assumed 2.2 m wide pipe insulation, 75 mm thickness
2. For confined installation assume 5 m wide clearing, cycle dirt 1 mile round trip
3. Costs do not include allowance for bypass / pumping

# 5.0 CONCLUSIONS AND RECOMMENDATIONS

## 5.1 CONCLUSIONS

The following conclusions are a result of the analysis conducted in this study:

- The flow monitoring program that took place during the summer of 2007 did not produce flow monitoring data that could be used for estimating average dry weather flows. Instead a dry weather wastewater generation rate of 300 L/person/day was used.
- Survey data indicates a negative slope of -0.2% for the sewer between SanMH327 and SanMH327A.
- The existing sewer east of Highway 41 is shallow in places, with cover falling under the recommended 2.6 metres to the top of pipe.
- Based on the current development and land uses it can be concluded that most of the sanitary sewer trunk west of Highway 41 has additional capacity, although there are several segments of 300 mm sewer with utilization over 86%.
- East of Highway 41 the existing trunk is running significantly over capacity, with utilization as high as 311% upstream of the WWTP.
- The existing sewer trunk utilization was reviewed with the addition of future residential, commercial and institutional development. The amount of trunk sewer with utilization over 86% is expected to increase, as well as worsen the conditions west of Highway 41.

## 5.2 RECOMMENDATIONS

The following actions are recommended based on this review of the sanitary trunk capacity:

- Confirm rim and invert elevations along the sanitary sewer trunk and check sanitary pipes slopes prior to detailed design. This includes confirming the negative slope for the sewer between SanMH327 and SanMH327A.
- The physical condition of the existing sanitary trunk sewer east of Highway 41 should be investigated to determine the remaining service life of the existing trunk.
- The replacement option outlined as 4.B is recommended over the twinning option as it provides the full future required capacity for only a marginal increase in cost. Depending on the existing sewer's condition it can either be abandoned or maintained in service for emergencies.
- Proceed with design of the sanitary trunk upgrade east of Highway 41.

# 6.0 REFERENCES

**City of Edmonton** (2004), Design and Construction Standards, Volume 3 (Drainage)

**Stantec Consulting Ltd.** (1994), Sewage Treatment and Collection Study, (prepared for the Town of Vermilion)

**Town of Vermilion** (2004), Municipal Development Plan, Bylaw 3-2004

**Town of Vermilion** (2006), Land Use Bylaw 1-2006

# APPENDIX A

## Flow Monitoring Data

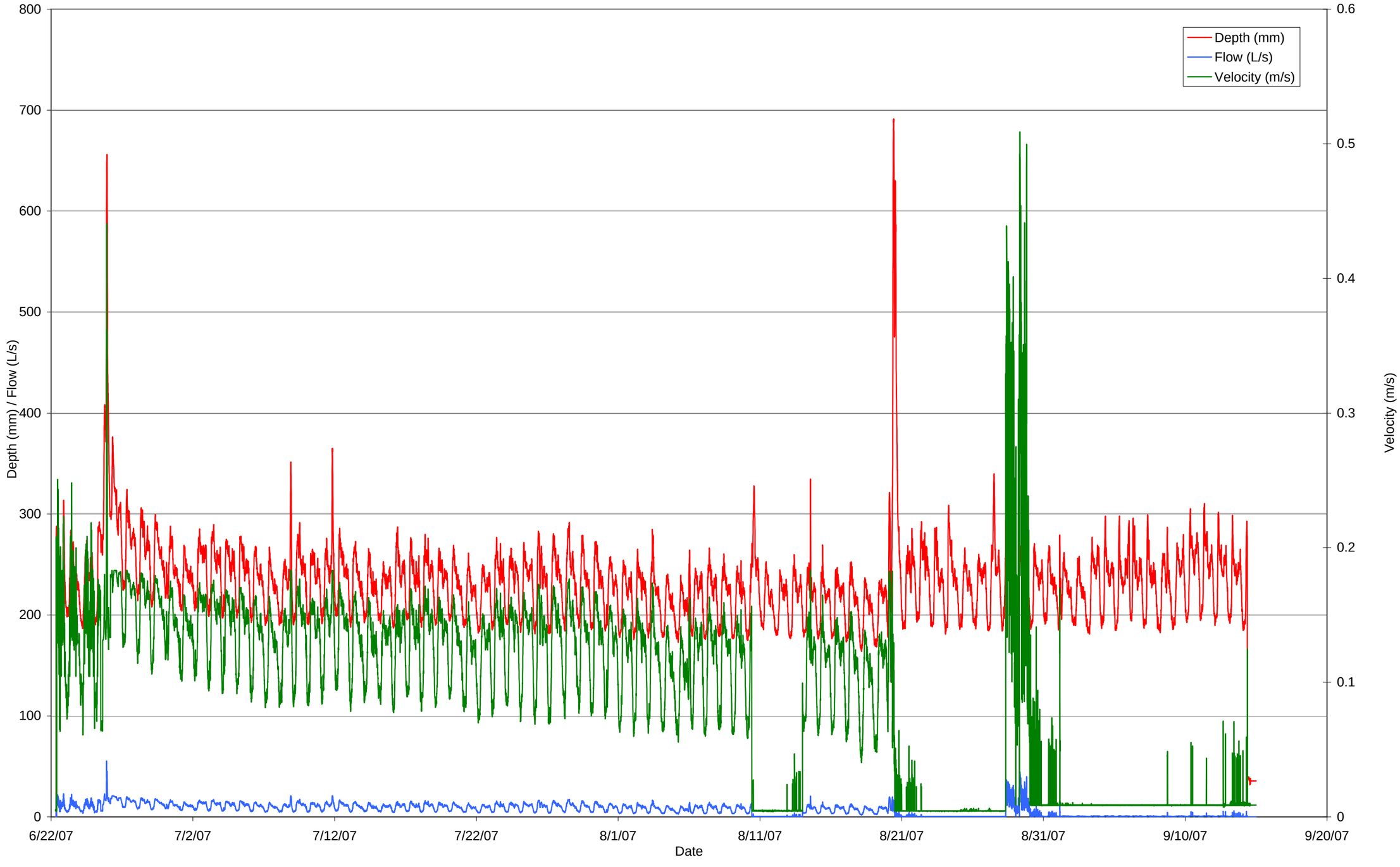



**Figure A.1**
**Site 1 - Depth, Flow and Velocity Data**

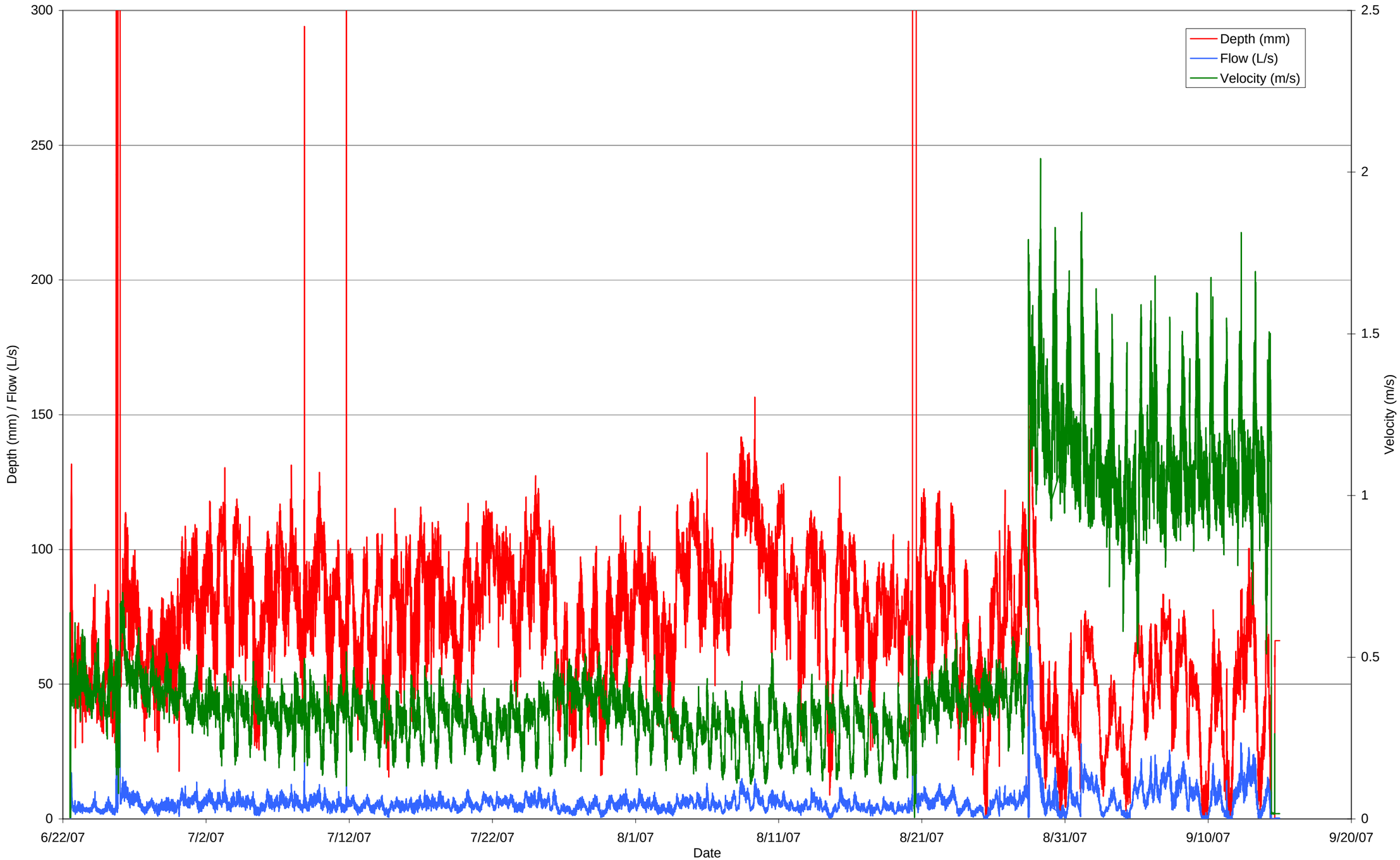



**Figure A.2**
**Site 2 - Depth, Flow and Velocity Data**

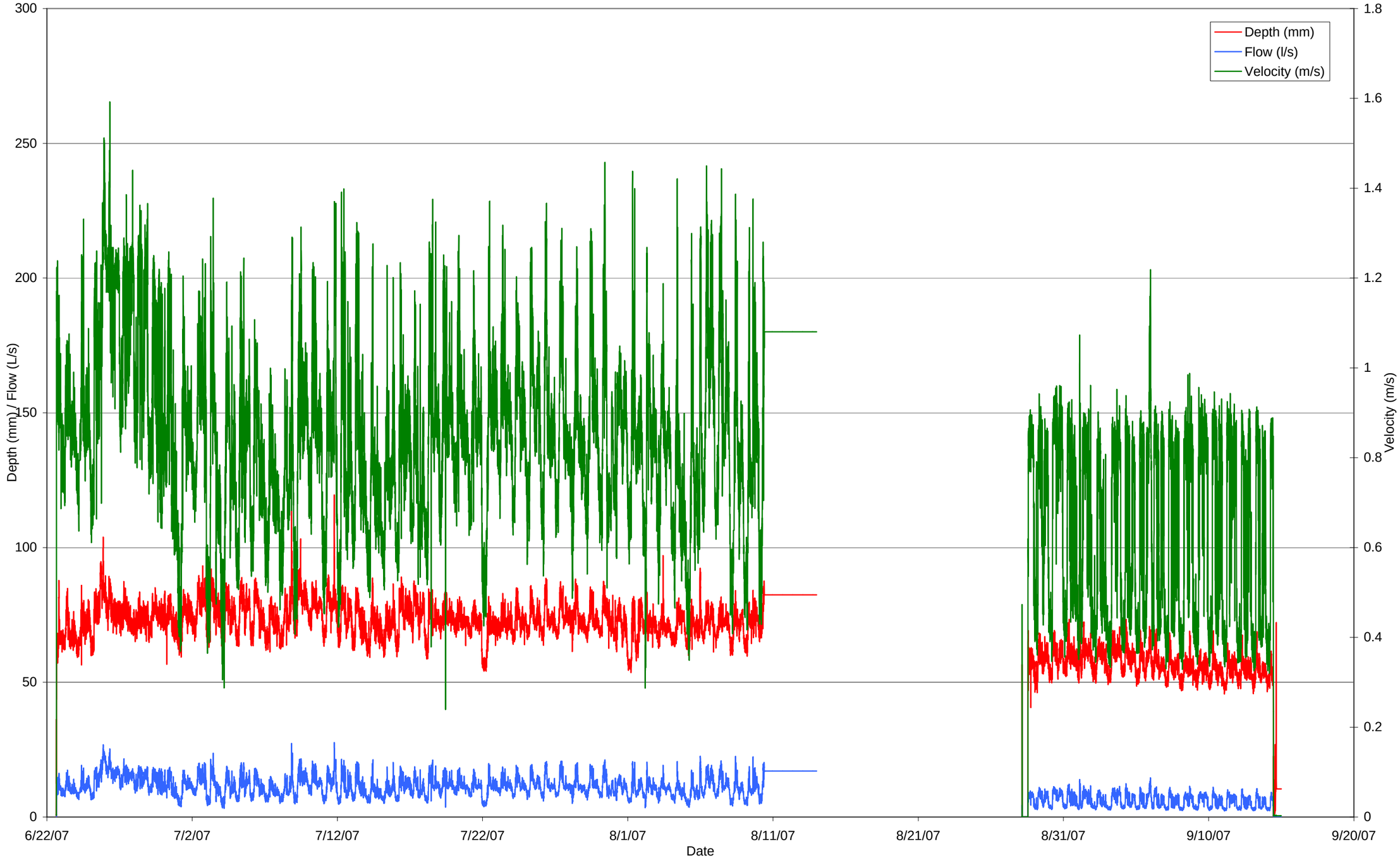



**Figure A.3**
**Site 3 - Depth, Flow and Velocity Data**

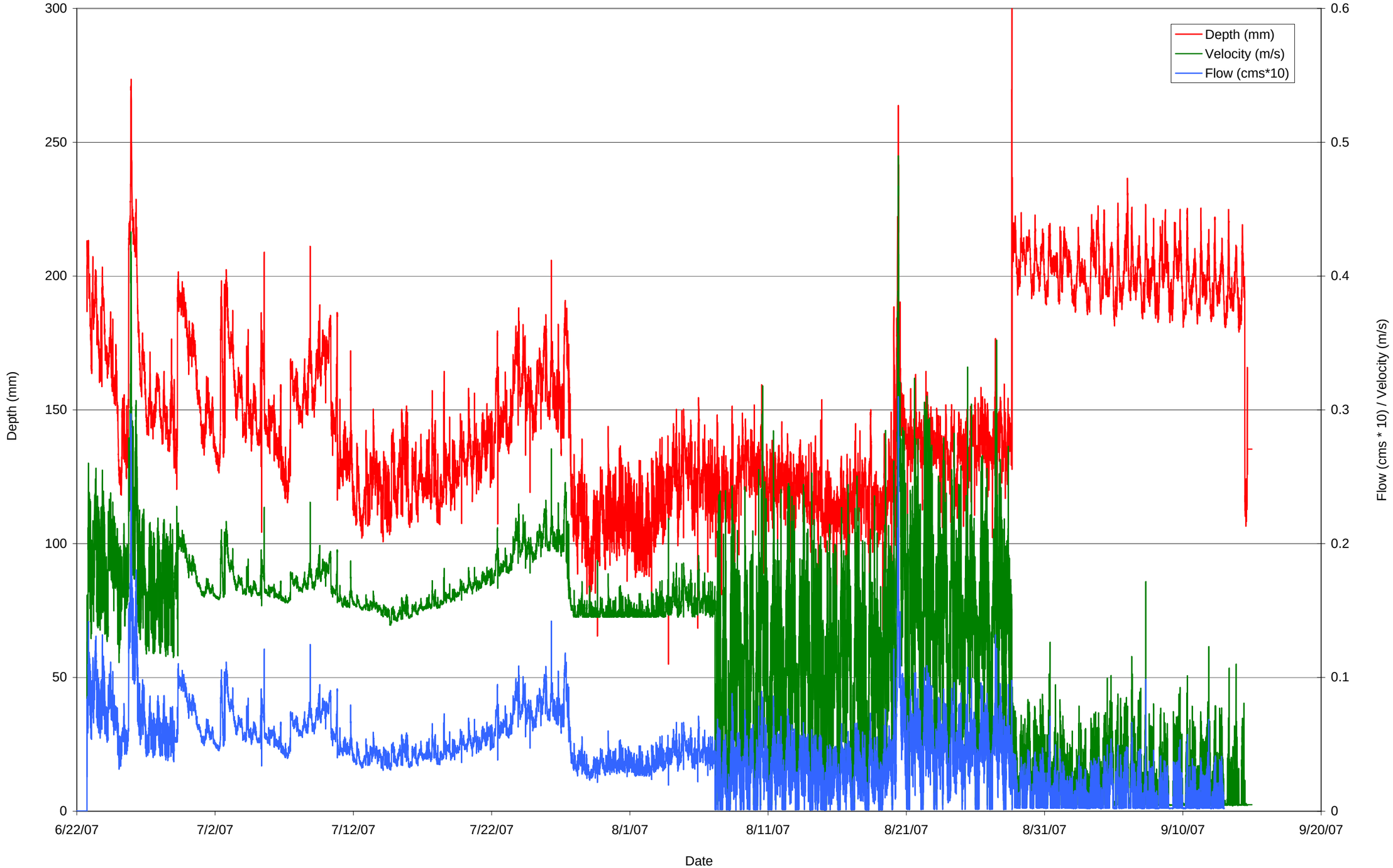



**Figure A.4**
**Site 4 - Depth, Flow and Velocity Data**

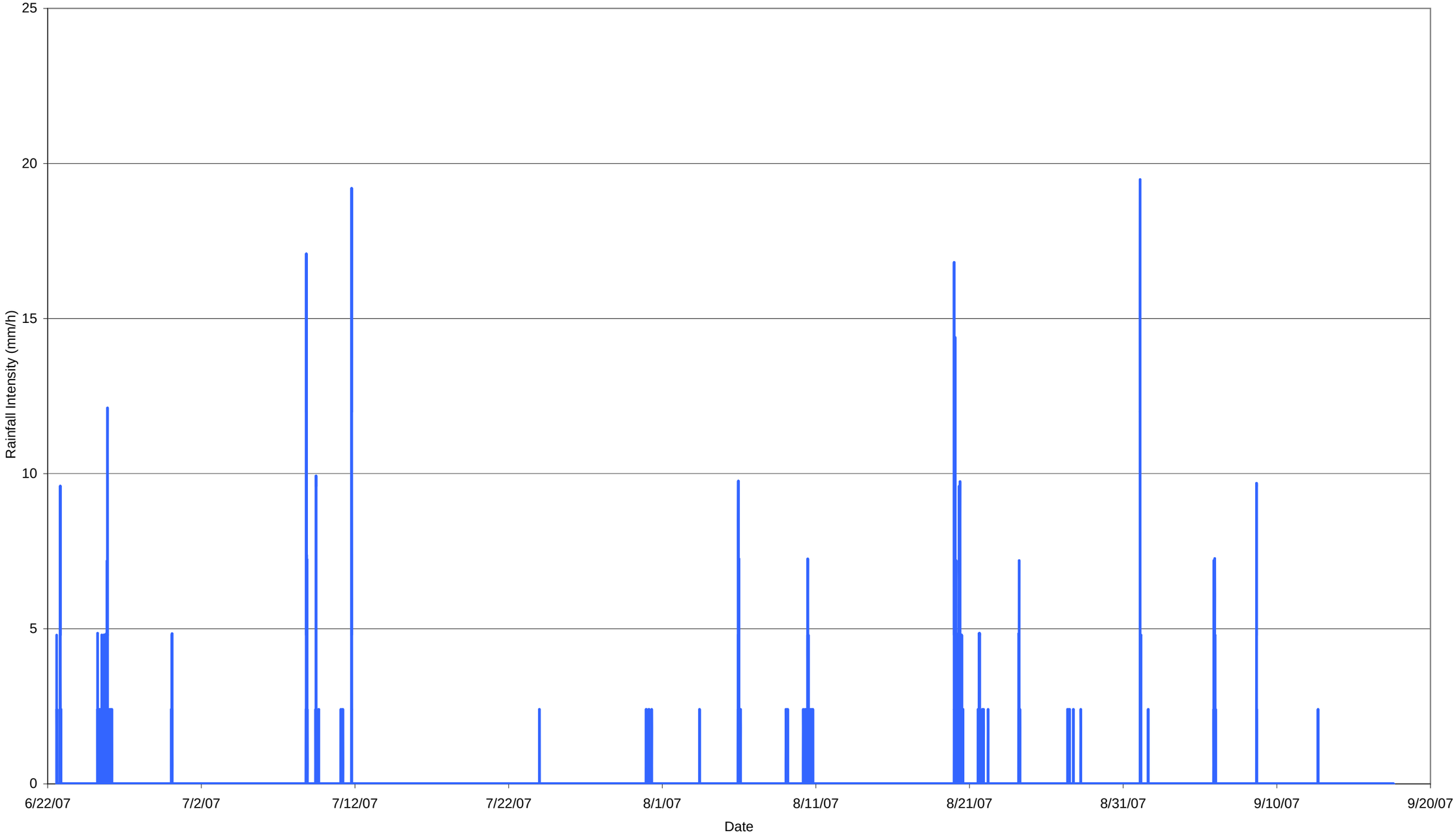



**Figure A.5**
**5-Minute Rainfall Intensity**