# Sanitary Sewer System 2020 Annual Report

Town of Oliver

February 2021

Project No. 306-088-007

ENGINEERING ■ PLANNING ■ URBAN DESIGN ■ LAND SURVEYING

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# Report Submission

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March 1 2021

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# List of Acronyms

| | |
|---|---|
| AC | Asbestos Cement |
| $BOD_5$ | 5-Day Biological Oxygen Demand |
| CPE | Chlorinated Polyethylene |
| EOCP | Environmental Operators Certification Program |
| FLNRO | Ministry of Forests, Lands, and Natural Resource Operations |
| GIS | Geographic Information Systems |
| HDPE | High Density Polyethylene |
| I&I (I/I) | Inflow and Infiltration |
| LS | Lift Station |
| LWMP | Liquid Waste Management Plan |
| MOE | Ministry of Environment and Climate Change Strategy |
| MPN | Most Probable Number |
| MSR | Municipal Sewage Regulation |
| MWR | Municipal Wastewater Regulation |
| OC | Operational Certificate |
| OCP | Official Community Plan |
| OIB | Osoyoos Indian Band |
| PVC | Polyvinyl Chloride |
| RIB | Rapid Infiltration Basin |
| TRUE | TRUE Consulting |
| TSS | Total Suspended Solids |
| WMP | Waste Management Plan |

# Units of Measure

| | |
|---|---|
| km | kilometre |
| L/d | Litres per day |
| L/m | Litres per minute |
| L/s | Litres per second |
| lpcd | Litres per capita per day |
| m | metre |
| mbtoc | meters below top of casing |
| $m^3$/day | cubic metre per day |
| mg/L | milligrams per Litre |
| mm | millimetre |

# Referenced Reports

TRUE Consulting Group (2002). *Town of Oliver 2002 Liquid Waste Management Plan Update.*

TRUE Consulting Group (2018). *Town of Oliver Wastewater Treatement System Capacity Improvements.*

TRUE Consulting Group (2021). Operations and Maintenance Manual Oliver WWTP.

# 1.0 Operational Data

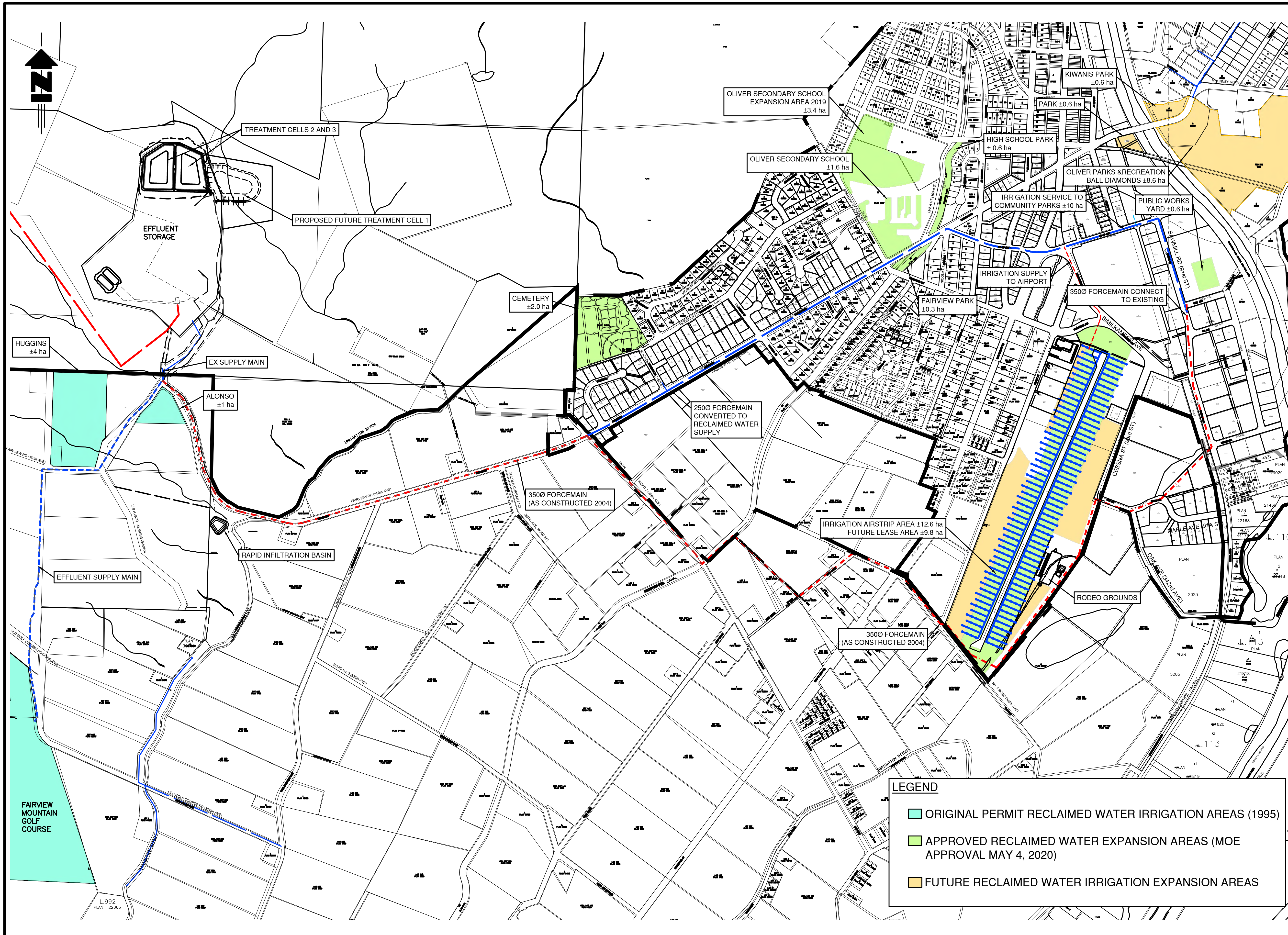
The paragraphs following summarize the operational data for the Town of Oliver's Sanitary Sewer System for 2020. This operational report is formatted in a "source" to "final disposal" format. Each section also includes a reference to the appropriate sections of the Operational Certificate (OC) for the system. Appendix A contains a complete copy of the Operational Certificate for PE 13717 issued by the Ministry of Environment (MOE) on December 14,1995.

As per Section 1 of the OC, specific authorized discharges and requirements are summarized as follows:

- The Town is authorized a maximum average discharge rate of 2,200 $m^3$ per day from the aerated lagoons to the reclaimed wastewater storage reservoir.
- There is no maximum authorized rate of discharge from the storage reservoir for beneficial use as irrigation water.
- It is required that effluent discharged from the aerated lagoons to the storage reservoir not exceed a 5-Day Biological Oxygen Demand ($BOD_5$) of 45 mg/L and Total Suspended Solids (TSS) of 60 mg/L.
- A minimum reservoir retention time of 60 days prior to irrigation use must be maintained.
- Reclaimed wastewater utilized for irrigation shall conform to the effluent irrigation guidelines developed by the BC Ministry of Health. Fecal coliforms shall not exceed 200 MPN per 100 mL for agricultural, silvicultural and low public use lands, or exceed 2.2 MPN per 100 mL for high public use land.

To assist the reader in assessing the system operational data, the following drawings are included:

- Figure 1-1: Overall Plan – Reclaimed Water Supply System and Irrigation Areas
- Figure 1-2 Aerated Lagoon Treatment System




| No. | DATE | DESCRIPTION | BY | APP |
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Town of Oliver
CANADA'S WINE CAPITAL

**SANITARY SEWER ANNUAL REPORT**

**OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS**

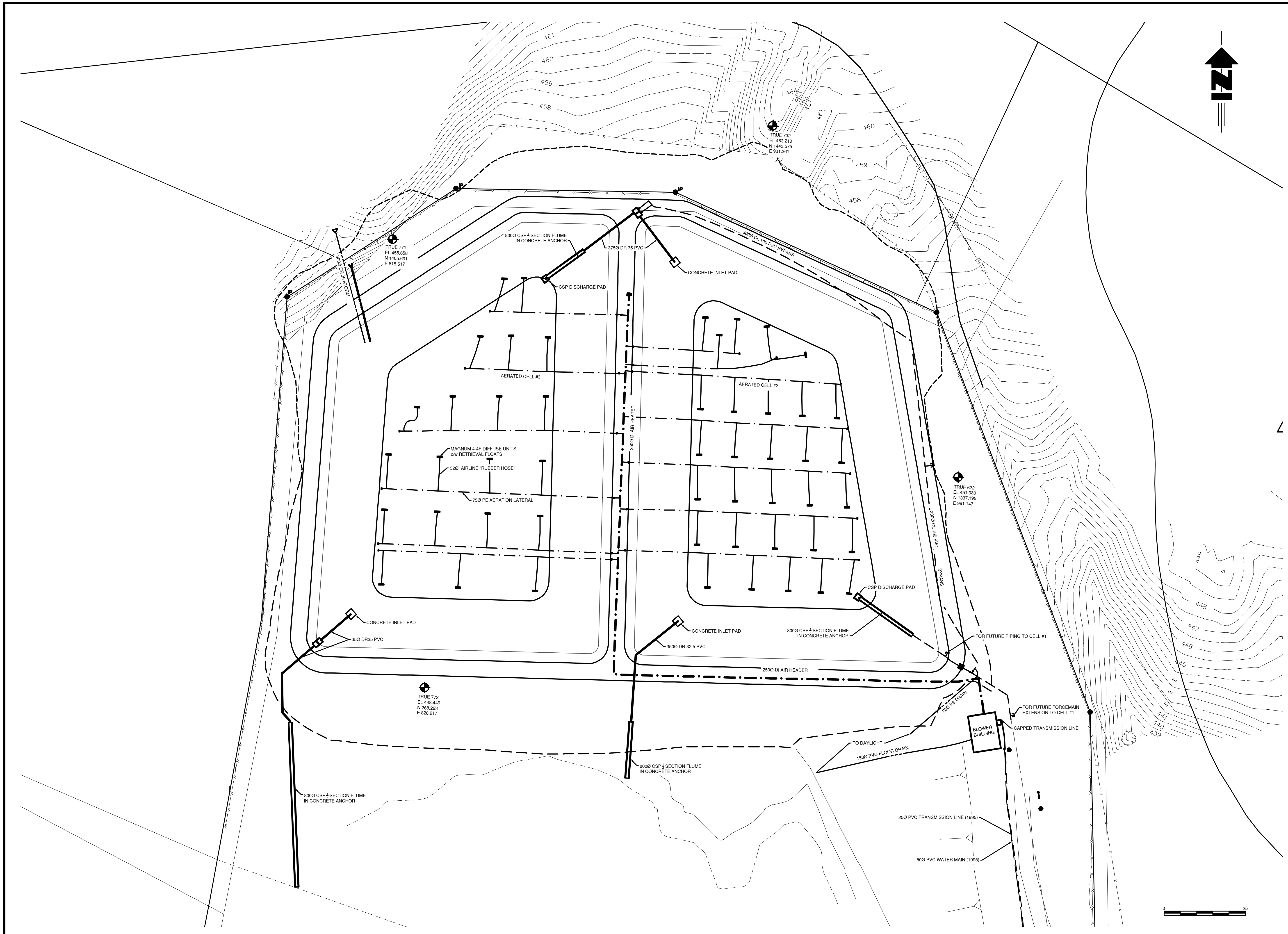
| | |
|---|---|
| SCALE | N.T.S. (11x17) |
| DESIGN BY | TRU |
| DRAWN BY | NA |
| DATE | FEBRUARY 2021 |
| PROJECT REFERENCE No. | 306-088-005 |

DRAWING No.

**FIG 1-1**

SHEET 1 OF 1

ISSUE/REV.




| No. | DATE | DESCRIPTION | BY | APPD |
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Town of Oliver
CANADA'S WINE CAPITAL

**SANITARY SEWER ANNUAL REPORT**

**AREATED LAGOON TREATMENT SYSTEM LAYOUT AND INTERCELL PIPING**

| | |
|---|---|
| SCALE | 1:500 (24x36) |
| DESIGN BY | TRU |
| DRAWN BY | NA |
| DATE | JANUARY 2018 |
| PROJECT REFERENCE No. | 306-088-005 |

DRAWING No.

**FIG 1-2**

SHEET 1 OF 1

ISSUE/REV.

## 1.1 Influent

### 1.1.1 Influent Works (OC 6.4.2)

Influent from the sanitary sewer collection system is pumped through influent screens and piped into a two-cell flow equalization system (“equalization basins”). The original equalization basin was constructed in 1984 and lined with a Chlorinated Polyethylene (CPE) membrane. The second equalization basin was constructed in 2009 and lined with a 60mm HDPE membrane. These liners provide a transfer barrier for liquids from the basins to the native subsurface material. There is no piped interconnection between the Okanagan River and the equalization basins.

A detailed description of the collection system and treatment process can be found in the Town of Oliver’s 2018 Sanitary Capital Plan prepared by TRUE Consulting. This Capital Plan includes an update to the Liquid Waste Management Plan last updated by TRUE in 2002 (see Appendix B). Further details can be found in the Operation and Maintenance Manual Oliver WWTP prepared by TRUE Consulting in February 2021.

### 1.1.2 Influent Flow Data (OC 7.1.2 and 7.2.4.7)

Wastewater is pumped from the equalization basin to the aerated lagoons via the High Lift Station. Daily flow data for the lift station is presented in Appendix C. The total volume pumped to the aerated lagoons in 2020 was 655,853 $m^3$, which equates to an average daily flow of 1,792 $m^3$/day when divided by the leap year’s 366 days. This is an increase of 29,942 $m^3$ (4.6%) compared to 2019. For comparison, total influent flows for the period 1997 to 2020 are summarized in Table 1-1 and graphically in Figure 1-3 as follows.

**TABLE 1-1: ANNUAL TOTAL AND AVERAGE DAILY INFLUENT FLOW DATA**

| Year | Total Influent Volume ($m^3$) | Average Daily Flow ($m^3/d$) |
|---|---|---|
| 1996 | 654,361 | 1,788 |
| 1997 | 682,480 | 1,870 |
| 1998 | 666,322 | 1,826 |
| 1999 | 688,193 | 1,885 |
| 2000 | 702,688 | 1,920 |
| 2001 | 678,052 | 1,858 |
| 2002 | 726,354 | 1,990 |
| 2003 | 751,139 | 2,058 |
| 2004 | 766,048 | 2,093 |
| 2005 | 783,947 | 2,148 |
| 2006 | 829,413 | 2,272 |
| 2007 | 823,011 | 2,255 |
| 2008 | 777,154 | 2,123 |
| 2009 | 758,308 | 2,078 |
| 2010 | 701,475 | 1,922 |
| 2011 | 693,045 | 1,899 |
| 2012 | 658,002 | 1,798 |
| 2013 | 697,377 | 1,911 |
| 2014 | 634,649 | 1,739 |
| 2015 | 679,542 | 1,862 |
| 2016 | 639,794 | 1,753 |
| 2017 | 689,098 | 1,888 |
| 2018 | 666,376 | 1,826 |
| 2019 | 625,911 | 1,715 |
| 2020 | 655,853 | 1,792 |

**FIGURE 1-3: TOTAL ANNUAL INFLUENT SEWAGE FLOWS FOR 1996 TO 2020**


### 1.1.3 Influent Wastewater Sampling (OC 6.1 and 7.1.2)

Influent sampling data for total phosphorus and orthophosphate concentrations is presented in Table 1-2. The average total phosphorous and orthophosphate concentrations from March and September 2020 sampling was 5.21 mg/L and 1.99 mg/L, respectively. The 2020 average concentration for orthophosphate is slightly lower than that measured in 2019, but generally within the historical range observed for influent wastewater.

## TABLE 1-2: INFLUENT SAMPLING ANALYSIS

| Year | Date | Total Phosphorus (mg/L) | Ortho Phosphate (mg/L) |
|---|---|---|---|
| 1996 | Mar. 22 | 5.44 | |
| | Sep. 12 | 5.18 | |
| 1997 | Mar. 19 | 5.87 | |
| 1998 | Mar. 18 | 5.6 | |
| | Sep. 9 | 5.89 | |
| 1999 | Mar. 11 | 6.66 | |
| | Sep. 23 | 4.89 | |
| 2000 | Mar. 23 | 6.48 | 4.69 |
| | Sep. 28 | 8.67 | 3.04 |
| 2001 | Mar. 22 | 4.57 | 2.3 |
| | Sep. 19 | 4.13 | 1.88 |
| 2002 | Mar. 19 | 4.53 | 3.84 |
| | Sep. 10 | 4.52 | 2.55 |
| 2003 | Mar. 10 | 3.78 | 3.78 |
| | Sep. 30 | 4.48 | 4.38 |
| 2004 | Mar. 16 | 5.23 | 4.76 |
| | Sep. 14 | 5.15 | 3.75 |
| 2005 | Mar. 22 | 5.24 | 4.63 |
| | Oct. 5 | 6.74 | 5.58 |
| 2006 | Sep. 14 | 7.05 | 5.96 |
| 2007 | Mar. 13 | 5.03 | 6.43* |
| | Sep. 11 | 6.03 | 5.03 |
| 2008 | Sep. 3 | 7.44 | 3.3 |
| 2009 | Mar. 5 | 8.18 | 3.84 |
| | Sep. 1 | 5.31 | 1.38 |
| 2010 | Mar. 9 | 4.26 | 0.558 |
| | Sep. 2 | 3.36 | 2.16 |
| 2011 | Mar. 8 | 4.9 | 0.316 |
| | Sep. 8 | 11 | 0.859 |
| 2012 | Mar. 1 | 6.16 | 2.23 |
| | Sep. 11 | 7.76 | 3.72 |
| 2013 | Mar. 7 | 5.75 | 2.57 |
| | Sep. 11 | 4.62 | 1.89 |
| 2014 | Mar. 5 | 4.28 | 0.82 |
| | Sep. 17 | 3.82 | not tested |
| 2015 | Mar. 11 | 5.36 | 2.66 |
| | Sep. 16 | 4.55 | 2.96 |
| 2016 | Mar. 7 | 4.17 | 1.21 |
| | Sep. 6 | 2.35 | 0.36* |
| 2017 | Mar. 7 | 3.77 | 2.42 |
| | Sep. 6 | 4.69 | 2.13 |
| 2018 | Mar. 7 | 5.37 | 1.95 |
| | Sep. 4 | 5.89 | 1.83 |
| 2019 | Mar. 11 | 5.34 | 1.97 |
| | Sep. 3 | 5.42 | 2.32 |
| 2020 | Mar. 2 | 4.97 | 1.89 |
| | Sep. 1 | 5.45 | 2.09 |
| **Average for Period of Record** | | **5.43** | **2.79** |

* Suspected error

## 1.2 Wastewater Treatment (OC 6.2 and 7.1.2)

Effluent sampling results from the aerated lagoon system (Cell No. 3) prior to reservoir storage are tabulated in Table 1-3. An exceedance above the OC limit of ≤ 45mg/L for $BOD_5$ was observed in March. No exceedances above the OC limit of ≤ 60mg/L for TSS were observed in 2020.

Cell No. 3 Carbonaceous Biochemical Oxygen Demand (CBOD) samples are collected by the Town. $BOD_5$ is defined by the Municipal Waterwater Regulation (MWR) as CBOD. As such, the Town has now included CBOD in their sampling programme. These results are included in Table 1-3. CBOD is a measurement (in mg/L) of the BOD from organic compounds as well as the oxidation of inorganic compounds such as ferrous iron and sulfide. BOD and CBOD tests are similar except a nitrification inhibitor is added during a CBOD test to prevent nitrifying organisms from consuming oxygen in the nitrification process of converting ammonia to nitrate. CBOD are often lower than BODs for the same wastewater sample, particularly when nitrifiers are presents in the sample and ammonia or nitrate levels are elevated.

The exceedance in March could be the result lowering Cell No. 2 and No. 3 by 3" on February 28, 2020. All other sampling results were well within the permit limits.

**TABLE 1-3 CELL NO. 3- EFFLUENT $BOD_5$ AND TSS**

| Date | $BOD_5$ (mg/L) | CBOD (mg/L) | TSS (mg/L) |
|---|---|---|---|
| **OC Limits** | **45** | | **60** |
| Jan-06 (2020) | 25 | - | 16 |
| Feb-03 (2020) | 20 | - | 19 |
| Mar-02 (2020) | 69.5 | - | 34 |
| Apr-14 (2020) | 29 | 10.1 | 20 |
| May-04 (2020) | 21 | 16.8 | 22 |
| Jun-01 (2020) | 28 | 90.6* | 31 |
| Jul-06 (2020) | 10 | <7.2 | 25 |
| Aug-04 (2020) | 9 | 7.5 | 17 |
| Sep-01 (2020) | 23 | <7.3 | 16 |
| Oct-05 (2020) | <5.9 | <6.0 | <3.3 |
| Nov-09 (2020) | 11 | 8.2 | 10 |
| Dec-02 (2020) | 20 | 8.7 | 14 |

*Poor sample or lab error suspected as CBOD cannot exceed $BOD_5$

As per PE-13717, semi-annual analysis of effluent must include:

- Total phosphorus, ortho-phosphorus, and total dissolved phosphorus (all expressed in mg/L P).
- Total nitrogen, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen and organic nitrogen (all expressed as mg/L N).

A summary of semi-annual sampling for total nitrogen, ammonia, and nitrate from 1997-2020 is presented in Table 1-4. The complete suite of semi-annual sampling and compliance testing requirements is included in Appendix C.

In 2020 sampling was completed on March 2$^{nd}$ and September 1$^{st}$.The generally accepted range for total nitrogen in domestic wastewater is 20 to 50 mg/L. Total nitrogen was within this range for both the September and March 2020 sampling analysis.

Historically, from 1997 to 2002, a significant proportion of ammonia and nitrogen was nitrified through the Town's aerated lagoon system. From 2003 to 2015, the Town accepted wastewater influent from Vincor, resulting in modest levels of nitrification. In January 2012, Vincor implemented a pre-treatment system, resulting in ±90% reduction in BOD. This resulted in reduced loadings which in turn resulted in increased nitrification. As of July 1, 2015, Vincor has been disconnected from the Town's wastewater treatment system.

## TABLE 1-4: CELL NO. 3 EFFLUENT – NITROGEN

| Year | September/October | | | March | | |
|---|---|---|---|---|---|---|
| | Total Nitrogen (mg/L) | Ammonia (mg/L) | Nitrate (mg/L) | Total Nitrogen (mg/L) | Ammonia (mg/L) | Nitrate (mg/L) |
| 1997 | 9.34 | 0.006 | 7.7 | 20.7 | No Data | No Data |
| 1998 | 10.8 | 0.005 | 8.89 | 25.1 | No Data | No Data |
| 1999 | 11.3 | 0.46 | 8.31 | 23.9 | No Data | No Data |
| 2000 | No Data | 0.48 | 9.77 | 29.1 | No Data | No Data |
| 2001 | 34.3 | 4.37 | 7.92 | 31.3 | No Data | No Data |
| 2002 | 17.7 | 0.013 | 16.3 | 23.6 | No Data | No Data |
| 2003 | No Data | 0.71 | 3.9 | 26.9 | No Data | No Data |
| 2004 | 9.8 | 8.46 | 0.29 | 17.2 | No Data | No Data |
| 2005 | 26.4 | 14.2 | No Data | 36.4 | No Data | No Data |
| 2006 | 12.1 | 0.78 | 5.97 | No Data | No Data | No Data |
| 2007 | 20 | 13.2 | 0.92 | 25.7 | No Data | No Data |
| 2008 | 10 | 9.55 | 0.297 | 24.1 | No Data | No Data |
| 2009 | 17 | 14 | 1 | No Data | No Data | No Data |
| 2010 | 16.3 | 8.44 | 3.6 | 27.8 | No Data | No Data |
| 2011 | 26 | 13.7 | 3.27 | 33.5 | No Data | No Data |
| 2012 | 5.28 | 1.95 | 2.17 | 32.2 | No Data | No Data |
| 2013 | 10.10 | 0.289 | 9.43 | 43.7 | 32.5 | 0.489 |
| 2014 | No Data | No Data | No Data | 32.8 | 31.2 | 0.046 |
| 2015 | 19.10 | 17.6 | 0.966 | No Data | No Data | No Data |
| 2016 | 12.80 | 1.82 | 5.33 | 33.2 | 31.2 | 1.05 |
| 2017 | 18.50 | 0.384 | 14.7 | 32 | 23.4 | 0.019 |
| 2018 | 11.9 | 0.916 | 8.2 | 32 | 31.1 | 0.282 |
| 2019 | 18.5 | 0.322 | 10.1 | 27.4 | 27.6 | 0.339 |
| 2020 | 21.9 | 15.6 | 2.36 | 35.3 | 25.2 | 1.2 |

## 1.3 Winter Effluent Storage Reservoir (OC 6.5)

Weekly storage reservoir level data for 2020 is presented in Appendix D. All elevations given are relative to geodetic datum. The elevation data has been converted to total volume in storage above the minimum 60-day storage level. The calibration curve is also included within Appendix D.

As per Section 1.1.1 of the OC, the Town is authorized a maximum effluent discharge rate of 2,200 $m^3$ per day from the aerated lagoon sewage treatment system to the reclaimed wastewater storage reservoir, averaged on a monthly basis. A flow meter is located at the High Lift Station, which pumps wastewater from the equalization basins to the aerated lagoons.

It is assumed that all effluent flows from aerated lagoon Cell No. 3 to the storage reservoir. The metered influent flow provides a conservative value for the discharge volume from Cell No. 3 to storage, as losses due to evaporation and seepage are not included. Monthly volumes are presented in Table 1-5 as follows:

**TABLE 1-5: 2020 MONTHLY EFFLUENT DISCHARGE QUANTITIES**

| | Monthly $m^3$ | Average $m^3$/day |
|---|---|---|
| **January** | 48,666 | 1,570 |
| **February** | 47,858 | 1,650 |
| **March** | 52,224 | 1,685 |
| **April** | 49,259 | 1,642 |
| **May** | 59,189 | 1,909 |
| **June** | 66,356 | 2,212 |
| **July** | 66,286 | 2,138 |
| **August** | 61,583 | 1,987 |
| **September** | 52,971 | 1,766 |
| **October** | 53,356 | 1,721 |
| **November** | 48,623 | 1,621 |
| **December** | 49,481 | 1,596 |
| **Total** | 655,853 | |
| **Average** | | 1,791 |

Annual operating data for the storage reservoir is summarized in Table 1-6. This includes a comparative summary from 2003 to 2020.

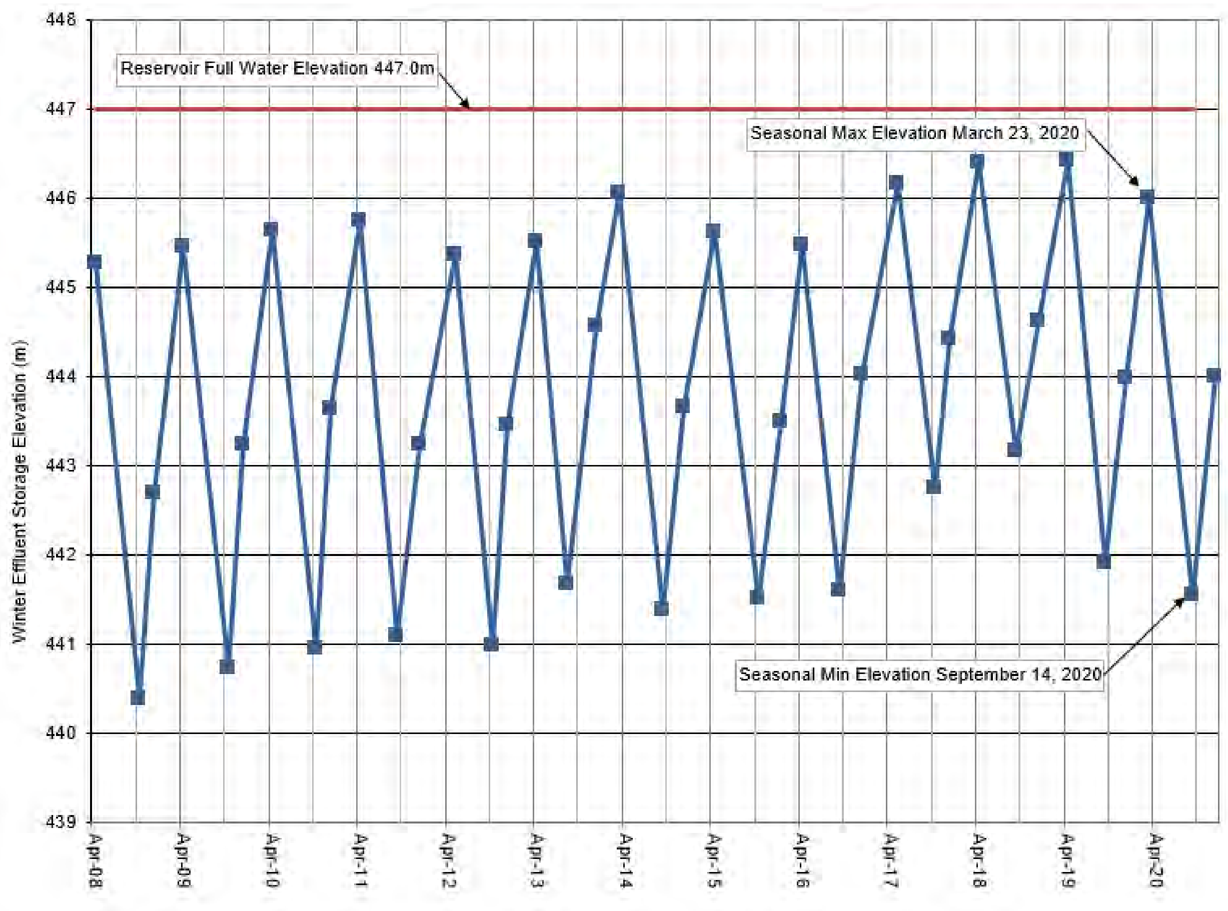
### TABLE 1-6: EFFLUENT STORAGE RESERVOIR LEVEL DATA

| Year | Date | | Elevation (m) | Volume (m$^3$) | Year | Date | | Elevation (m) | Volume (m$^3$) |
|---|---|---|---|---|---|---|---|---|---|
| 2003 | Max. | 22-Apr-03 | 443.96 | 240,000 | 2012 | Max. | 02-May-12 | 445.36 | 338,000 |
| | Min. | 22-Sep-03 | 440.66 | 59,000 | | Min. | 10-Oct-12 | 440.99 | 72,000 |
| | End | 29-Dec-03 | 443.46 | 213,000 | | End | 31-Dec-12 | 443.46 | 211,000 |
| 2004 | Max. | 19-Apr-04 | 445.77 | 377,000 | 2013 | Max. | 25-Apr-13 | 445.52 | 355,000 |
| | Min. | 06-Dec-04 | 444.22 | 260,500 | | Min. | 21-Aug-13 | 441.67 | 106,000 |
| | End | 31-Dec-04 | 444.35 | 272,000 | | End | 31-Dec-13 | 444.56 | 284,000 |
| 2005 | Max. | 18-Apr-05 | 446.4 | 390,000 | 2014 | Max. | 31-Mar-14 | 446.06 | 374,000 |
| | Min. | 24-Oct-05 | 441.18 | 81,000 | | Min. | 15-Sep-14 | 441.39 | 92,000 |
| | End | 27-Dec-05 | 443.38 | 205,000 | | End | 29-Dec-14 | 443.65 | 223,000 |
| 2006 | Max. | 24-Apr-06 | 446.2 | 380,000 | 2015 | Max. | 07-Apr-15 | 445.62 | 351,000 |
| | Min. | 30-Oct-06 | 440.81 | 67,000 | | Min. | 07-Oct-15 | 441.52 | 101,000 |
| | End | 31-Dec-06 | 443.24 | 199,000 | | End | 04-Jan-16 | 443.5 | 214,000 |
| 2007 | Max. | 30-Mar-07 | 446 | 370,000 | 2016 | Max. | 04-Apr-16 | 445.47 | 343,000 |
| | Min. | 23-Sep-07 | 440.34 | 40,000 | | Min. | 19-Sep-16 | 441.60 | 105,000 |
| | End | 31-Dec-07 | 442.76 | 170,000 | | End | 19-Dec-16 | 444.02 | 247,000 |
| 2008 | Max. | 13-Apr-08 | 445.28 | 339,000 | 2017 | Max. | 22-May-17 | 446.17 | 379,000 |
| | Min. | 29-Oct-08 | 440.39 | 49,000 | | Min. | 16-Oct-17 | 442.75 | 167,000 |
| | End | 31-Dec-08 | 442.7 | 167,000 | | End | 18-Dec-17 | 444.43 | 275,000 |
| 2009 | Max. | 14-Apr-09 | 445.45 | 344,000 | 2018 | Max. | 02-Apr-18 | 446.41 | 391,000 |
| | Min. | 11-Oct-09 | 440.72 | 61,000 | | Min. | 10-Sep-18 | 443.17 | 193,000 |
| | End | 31-Dec-09 | 443.24 | 198,000 | | End | 24-Dec-18 | 444.63 | 289,000 |
| 2010 | Max. | 06-Apr-10 | 445.64 | 352,000 | 2019 | Max. | 8-Apr-19 | 446.43 | 397,000 |
| | Min. | 21-Oct-10 | 440.95 | 71,000 | | Min. | 9-Sep-19 | 441.91 | 119,000 |
| | End | 31-Dec-10 | 443.64 | 222,000 | | End | 23-Dec-19 | 443.98 | 245,000 |
| 2011 | Max. | 11-Apr-11 | 445.75 | 357,000 | 2020 | Max. | 23-Mar-20 | 446 | 370,000 |
| | Min. | 26-Sep-11 | 441.09 | 76,000 | | Min. | 14-Sep-20 | 441.55 | 102,000 |
| | End | 31-Dec-11 | 443.24 | 197,000 | | End | 28-Dec-20 | 444.01 | 246,000 |

Winter effluent storage reservoir year-end, maximum and minimum operating elevations for the period 2008 to 2020 are illustrated graphically in Figure 1-4. Referring to this figure:

- The maximum elevation for 2020 (446.00 m on March 23, 2020) is 0.43m lower than the maximum elevation for 2019.
- The 2020-year end volume in storage of 246,000 m$^3$ is 1,000 m$^3$ more than end of year storage in 2019.

**FIGURE 1-4: EFFLUENT STORAGE RESERVOIR LEVELS FOR 2008 TO 2020**



## 1.4 Reclaimed Water Quantities and Quality

### 1.4.1 Irrigation Plan (OC 1.8)

The Town of Oliver currently provides reclaimed water to the Fairview Mountain Golf Course, Alonso Property, Higgins Property, High School Park, Fairview Park, Oliver Secondary School, Public Works, the Airstrip and Cemetery for irrigation purposes. This area has expanded since that outlined in Site Plan A of the Operational Certificate.

On December 13, 2018, the Town submitted an irrigation area expansion notification to the Ministry. An updated plan was submitted to the Ministry on February 25, 2020 to include expansion of the South Okanagan Secondary School irrigation system. These expansion areas were authorized by the Director on May 24, 2020, in accordance with Clause 1.8 of OC 13717 (see Appendix E).

### 1.4.2 Irrigation Volumes (OC 7.2.4.2 and 6.4)

Total reclaimed water usage is measured by a flow meter located at the booster station, located adjacent to the reclaimed water storage reservoir. Meters are also installed at the Cemetery, Linear park, Airport, Public Works Yard, Alonso property, Southern Okanagan Secondary School and Huggins property for the purposes of measuring total reclaimed water use at each location.

A metering system was installed at Fairview Park in 2018. The Town is currently working on calibration and integration into the system works. As a result, usage at the Fairview Mountain Golf Course and Fairview Park are calculated as the total annual irrigation volume less all other metered usage. The Fairview Park meter will be operational in 2021 and more accurate flows will be included in subsequent annual reporting. Table 1-7 summarizes reclaimed irrigation water usage by the seven users.

TABLE 1-7: ANNUAL RECLAIMED WATER USE BY CUSTOMER

| Location | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Fairview Mt. Golf Course & Fairview Park | 290,036 | 297,875 | 248,521 | 316,368 | 346,520 | 322,048 | 311,899 | 281,186 | 329,226 | 399,027 |
| Cemetery | 16,339 | 14,607 | 19,160 | 15,996 | 14,354 | 14,843 | 13,400 | 12,651 | 16,986 | 17,499 |
| Gala Street Linear Park | 6,232 | 6,622 | 8,051 | 8,749 | 7,647 | 8,360 | 1,030* | 5,928 | 8,858 | 1,245 |
| Airport | 147,688 | 153,841 | 185,687 | 124,892 | 115,743 | 98,511 | 101,780 | 99,601 | 69,143 | 19,567 |
| Public Works Yard | 5,164 | 6,409 | 7,086 | 7,393 | 7,380 | 8,095 | 8,341 | 6,261 | 5,940 | 8,320 |
| Alonso | 1,671 | 7,015 | 6,715 | 3,893 | 3,851 | 2,364 | 2,498 | 1,794 | 9,240 | 6,012 |
| Huggins | 3,787 | 2,872 | 1,290 | 0 | 8,554 | 0 | 0 | 0 | 4,614 | 0 |
| Southern Okanagan Secondary School | 0 | 0 | 0 | 4,874 | 0 | 0 | 2 | 0 | 25,744 | 27,420 |
| Infiltration Basin | 0 | 0 | 0 | 0 | 0 | 0 | 23,322 | 38,391 | 16,858 | 11,117 |
| Total Use | 470,917 | 489,241 | 476,510 | 482,164 | 504,049 | 454,221 | 461,241 | 445,812 | 486,610 | 490,207 |

From flow data contained in Appendix D, reclaimed water quantities for each "user" are described as follows:

- **Lot 723, Plan 2361 - Fairview Mountain Golf Course and Fairview Park PID 012-869-92**

| | |
|---|---|
| Total Usage | 399,027 $m^3$ |
| Crop Type | Turf and rough areas |
| Irrigated Area | 45 ha |
| Irrigation Application Rate | 0.89 m |
| Irrigation Period | April to October |

- **Lot A, Plan 24065 - Oliver Cemetery**

| | |
|---|---|
| Total Usage | 17,499 $m^3$ |
| Crop Type | Lawn, trees & shrubs |
| Irrigated Area | 2.3 ha |
| Irrigation Application Rate | 0.76 m |
| Irrigation Period | April to October |

- **Gala Street Linear Park**

| | |
|---|---|
| Total Usage | 1,245 $m^3$ |
| Crop Type | Lawn & trees |
| Irrigated Area | 0.8 ha |
| Irrigation Application Rate | 0.16 m |
| Irrigation Period | April and October |

- **Lot A, Plan 38173 – Oliver Airport**

| | |
|---|---|
| Total Usage | 19,567 $m^3$ |
| Crop Type | Forage Crops |
| Irrigated Area | 12.6 ha |
| Irrigation Application Rate | 0.16 m |
| Irrigation Period | April to October |

The forage crops grown at the Oliver airport were harvested June 15, August 1, and September 15, 2021. The Town stops irrigation one week prior to harvest.

- **Lot A, Plan 33094 – Oliver Public Works Yard**

| | |
|---|---|
| Total Usage | 8,320 $m^3$ |
| Crop Type | Lawn, landscaping, compost piles |
| Irrigated Area | 0.6 ha |
| Irrigation Application Rate | N/A |
| Irrigation Period | April to October |

The principal use of reclaimed water at the Public Works Yard is for composting operations, lawn care and landscaping. Because composting use is not separately metered, application rates for the lawn and landscaping areas cannot be calculated independently.

- **Lot A, Plan 37929 – Alonso (former Moir)**

| | |
|---|---|
| Total Usage | 6,012 $m^3$ |
| Crop Type | Vineyard |
| Irrigated Area | approximately 1.0 ha |
| Irrigation Application Rate | 0.60 m |
| Irrigation Period | April to October |

- **Lot 3, Plan 5881 – Huggins**

| | |
|---|---|
| Total Usage | 0 $m^3$ |
| Crop Type | Vineyard |
| Irrigated Area | approximately 3.7 ha |
| Irrigation Application Rate | 0 m |
| Irrigation Period | April to October |

- **South Okanagan Secondary School**

| | |
|---|---|
| Total Usage | 27,420 $m^3$ |
| Crop Type | Lawn and Trees |
| Irrigated Area | approximately 5.4 ha |
| Irrigation Application Rate | 0.51 m |
| Irrigation Period | April to October |

Over the years of record, reclaimed water use on the Fairview Mountain Golf Course has varied significantly on a year to year basis. Table 1-8 has been prepared adding seasonal precipitation to reclaimed water usage to derive an annual total. A summary of seasonal precipitation from 1992-2020 can be found in Appendix F. The tabulation shows that the sum of seasonal precipitation and reclaimed water use for 2020 is 1.07 m applied. This is consistent with historical usage.

The decrease in application rates since 2009 is partially due to the metering of the Alonso and Huggins properties, recognizing the water use for the golf course is approximated as the total annual irrigation volume less all other metered usage. Prior to 2010, Huggins and Alonso usage were assumed to be modest and included in the estimated volume supplied to the Fairview Mountain Golf Course.

Since 2016, reclaimed water has been used to irrigate Fairview Park (approximate area 0.3 ha). The metering system installed in 2018 will be replaced in 2021 and will be included in future annual reporting. The total application rate for 2020, as presented in Table 1-8, includes both the Fairview Mountain Golf Course and Fairview Park.

### Table 1-8: Annual Total Application Rate at the Fairview Mountain Golf Course

| Year | Total Usage ($m^3$) | Application Rate (m) | Seasonal Precipitation (mm) | Total (m) |
|---|---|---|---|---|
| 1995 | 413,000 | 0.92 | 124 | 1.04 |
| 1996 | 426,000 | 0.95 | 216 | 1.16 |
| 1997 | 345,000 | 0.77 | 324 | 1.09 |
| 1998 | 430,580 | 0.96 | 214 | 1.17 |
| 1999 | 342,424 | 0.76 | 162 | 0.92 |
| 2000 | 362,353 | 0.81 | 126 | 0.93 |
| 2001 | 376,353 | 0.84 | 178 | 1.01 |
| 2002 | 433,620 | 0.96 | 83 | 1.05 |
| 2003 | 401,022 | 0.89 | 94 | 0.98 |
| 2004 | 329,575 | 0.73 | 231 | 0.96 |
| 2005 | 373,292 | 0.83 | 131 | 0.96 |
| 2006 | 362,055 | 0.80 | 144 | 0.95 |
| 2007 | 414,225 | 0.92 | 88 | 1.01 |
| 2008 | 417,228 | 0.93 | 74 | 1.00 |
| 2009 | 358,375 | 0.80 | 161 | 0.96 |
| 2010 | 274,877 | 0.61 | 221 | 0.83 |
| 2011 | 290,036 | 0.64 | 151 | 0.80 |
| 2012 | 297,875 | 0.66 | 223 | 0.88 |
| 2013 | 248,521 | 0.55 | 180 | 0.73 |
| 2014 | 316,367 | 0.70 | 175 | 0.88 |
| 2015 | 346,520 | 0.77 | 136 | 0.91 |
| 2016 | 332,048 | 0.74 | 166 | 0.90 |
| 2017 | 311,899 | 0.69 | 133 | 0.82 |
| 2018 | 281,186 | 0.62 | 210 | 0.83 |
| 2019 | 329,226 | 0.73 | 127 | 0.86 |
| 2020 | 399,027 | 0.89 | 186 | 1.07 |

### 1.4.3 Rapid Infiltration

The town infiltrates reclaimed water to the rapid infiltration basins located south of the wastewater treatment facility (see Figure 1-2). In 2020, the Town discharged 11,117 $m^3$ to the rapid infiltration basins.

### 1.4.4 Hydraulic Balance (OC 7.2.4.1)

The annual overall system hydraulic balance (January 1st to December 31st) for the period 2009 to 2020 is summarized as follows:

**TABLE 1-9: HYDRAULIC BALANCE DATA FOR 2009-2020**

| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Volume in Storage on Jan. 1 | 167,000 | 200,000 | 223,000 | 197,000 | 211,000 | 284,000 | 223,000 | 214,000 | 247,000 | 275,000 | 289,000 | 245,000 |
| (+) Total Influent | 758,308 | 701,475 | 693,045 | 658,002 | 697,377 | 634,649 | 679,500 | 639,793 | 689,098 | 666,376 | 625,911 | 655,853 |
| (-) Effluent Irrigation | 520,530 | 519,803 | 470,917 | 489,241 | 476,510 | 482,164 | 504,049 | 454,221 | 437,919 | 407,422 | 469,752 | 479,090 |
| (-) Rapid Infiltration | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23,322 | 38,391 | 16,858 | 11,117 |
| (-) Unaccounted Losses | 206,778 | 159,672 | 248,128 | 154,761 | 147,867 | 213,485 | 184,451 | 152,572 | 199,857 | 206,564 | 183,301 | 164,646 |
| **Net Storage at Year-End ($m^3$)** | 198,000 | 222,000 | 197,000 | 211,000 | 284,000 | 223,000 | 214,000 | 247,000 | 275,000 | 289,000 | 245,000 | 246,000 |

There is no freshwater contribution to the system. Unaccounted losses within the hydraulic balance include evaporation losses from the treatment lagoons and storage reservoir, seepage losses from both the treatment and storage cells, and flow meter inaccuracies. Unaccounted losses of 164,646 $m^3$ were calculated for 2020.

### 1.4.5 Irrigation Water Quality Data (OC 5.1 and 6.3)

Effluent quality for reclaimed water prior to irrigation is presented in Table 1-10. Section 5.1 of the OC requires that fecal coliforms do not exceed 200 MPN per 100 mL for agricultural, silvicultural and low public use lands, or exceed 2.2 MPN per 100mL for high use public land. As seen, results for the 2020 irrigation season are consistent with the OC requirements. Appendix C includes a summary table comparing 2020 WWTP compliance testing against OC criteria.

The BC Reclaimed Water Guidelines require that regularly collected E. Coli samples are <1CFU per 100mL E. Coli or <2 MPN per100 mL E. Coli. E. Coli samples should be collected if the faecal coliforms or total coliforms results are greater than <2 MPN per 100mL.

To provide background data to assist with future assessment studies, the Town of Oliver expanded their monitoring programme in 2020 to include phosphorus, nitrogen, chloride and sodium. Sufficient seasonal samples were collected and sent to the lab but the incorrect analysis was requested. The error was noticed during the annual data review, but the samples could not be re-analyzed at this point. The available 2020 data is presented in Table 1-10.

### Table 1-10: Summary of Reclaimed Water Quality Data

| | Fecal Coliforms | Total Coliforms | Diss P* | Total N** | Free CL Res |
|---|---|---|---|---|---|
| OC Limit | <2.2 MPN/100 ml | n/a | n/a | n/a | n/a |
| Unit | MPN/100ml | MPN/100ml | mg/L | mg/L | mg/L |
| April 14, 2020 | <1.0 | <1.0 | 5.06 | - | 0.19 |
| May 4, 2020 | <1.0 | <1.0 | 4.79 | - | 0.35 |
| June 1, 2020 | <1.0 | 6.3 | - | - | 0.35 |
| July 6, 2020 | <1.0 | <1.0 | - | - | 0.4 |
| August 4, 2020 | <1.0 | <1.0 | - | - | 0.32 |
| September 1, 2020 | <1.0 | <1.0 | - | - | 0.23 |
| October 5, 2020 | <1.0 | <1.0 | - | - | 0.1 |

*Dissolved Phosphorus was analyzed instead of Total Phosphorus, or no analysis was completed, due to a communication error between the Town and Lab.
**Total Nitrogen analysis was not completed on collected samples due to a communication error between the Town and Lab.

### Table 1-11: Historical Reclaimed Water Quality Data

| Year | Seasonal Average Total Phosphorus (mg/L) | Seasonal Average Total Nitrogen (mg/L) | Seasonal Average Sodium (mg/L) |
|---|---|---|---|
| 2000 | 2.92 | 12.5 | |
| 2001 | 2.46 | 14.1 | |
| 2002 | 2.75 | 13.4 | |
| 2003 | 1.2 | 6.8 | 114.3 |
| 2004 | 1.36 | 9.3 | 103.5 |
| 2005 | 2.87 | 11.9 | 94.4 |
| 2006 | 2.4 | 11.6 | 84.4 |
| 2007 | 3.91 | 11.9 | 84.2 |
| 2008 | 3.93 | 14.2 | 89.5 |
| 2009 | 3.27 | 12.1 | 93.7 |
| 2010 | 3.61 | 13.8 | 97.1 |
| 2011 | 3.88 | 16.9 | 111.2 |
| 2012 | 4.01 | 14.3 | 114.6 |
| 2013 | 4.77 | 19.4 | 112.6 |
| 2014 | 5.90 | 26.6 | 120.6 |
| 2015 | 4.04 | 20.3 | 112.3 |
| 2016 | 4.0 | 14.9 | 107.0 |
| 2017 | 4.5 | 16.9 | 108.0 |
| 2018 | 4.6 | 19.0 | 104.7 |
| 2019 | 4.6 | 18.6 | 112.5 |
| 2020* | - | - | - |

*Lab analysis error in 2020.

As previously noted, a communication error between the Town and the contract lab resulted in the incorrect analysis being conducted on the collected samples. Table 1-11 suggests that the average total phosphorus has historically been very consistent and total nitrogen levels have historically decreased compared to 2014.

In 2019, sodium concentrations were consistent with the sampling between 2011 to 2018. Concerns regarding elevated sodium concentrations in the reclaimed water have been expressed by the Fairview Mountain Golf Course. Average seasonal sodium concentrations for the period 2003 to 2019 are illustrated graphically in Figure 1-5. As seen, concentrations were lowest between 2005 and 2010.

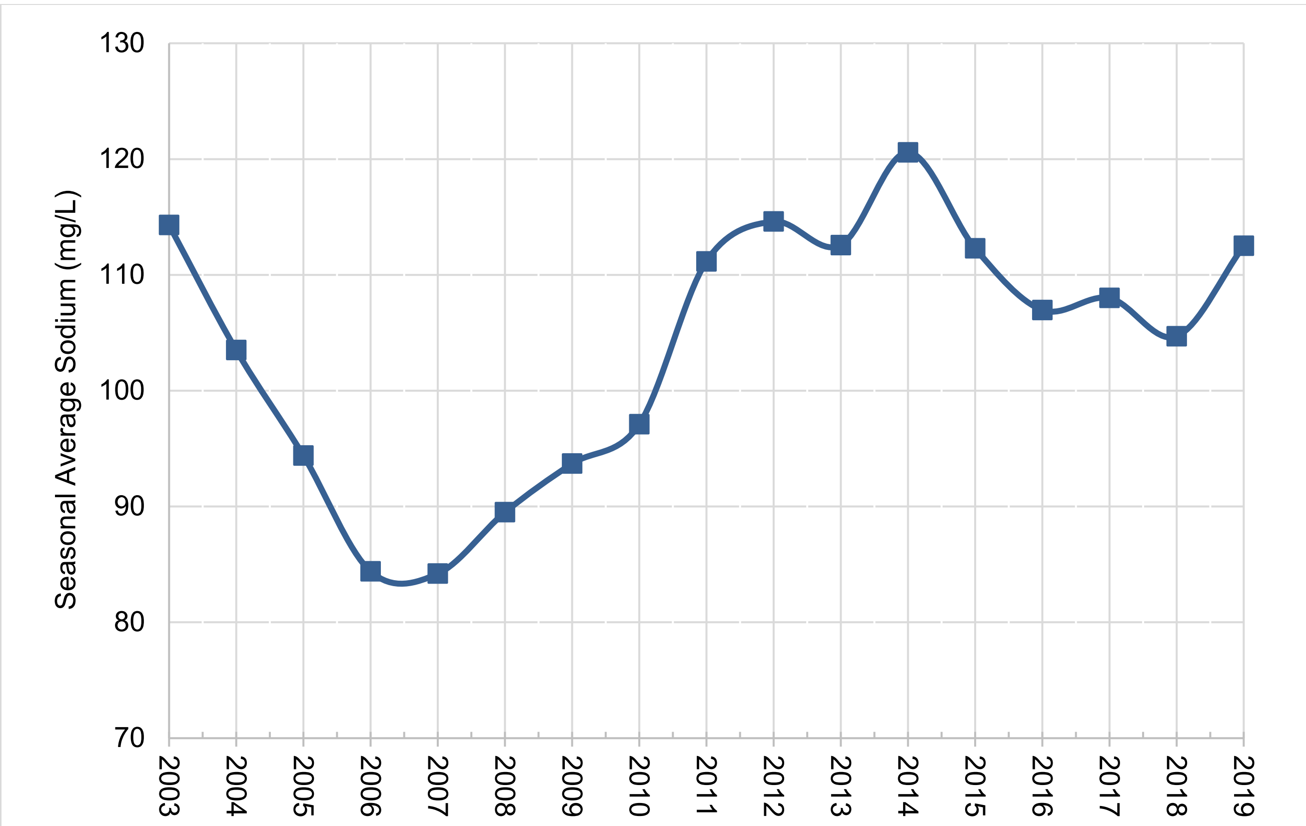



**FIGURE 1-5: AVERAGE SEASONAL SODIUM CONCENTRATIONS FOR 2003 TO 2019**

## 1.5 Summary of 2020 Operational Data

Operation of the Town of Oliver's wastewater collection, treatment and reclaimed water system for 2020 is summarized as follows:

- Total influent quantities were 655,853 $m^3$, an increase of 29,942 $m^3$ or 4.6% as compared to 2019. The 2020 annual influent quantity is comparable to previous years.
- Wastewater effluent quality for $BOD_5$ in the Town's aerated lagoons had a modest exceedance above the OC limit of 45 mg/L as indicated by the March 2nd $BOD_5$ sample result of 69.5 mg/L. This sample is likely unrepresentative of the month of March as it was collected shortly after an operational change to the Cell No. 2 and Cell No. 3 water level on February 28.
- The maximum water level in the storage reservoir was 446.00m.
- The collected 2020 reclaimed water samples were analyzed for the incorrect parameters due to a communication error between the Town and contract lab. The available data has been included in this report.

# 2.0 Supplemental Information

## 2.1 Facility Classification and Operator Certification (OC 3.2 and 3.3)

The Town of Oliver wastewater treatment facility (Facility No. 317) is classified as a Municipal Wastewater Treatment II (MWWT-II) under the Environmental Operators Certification Program.

In compliance with OC Section 3.3 operator certifications are summarized as follows:

| Operator | EOCP Certification |
|---|---|
| Hector Murillo | Wastewater Treatment Level I – In Training<br>Wastewater Collection Level I |
| Keith Postnikoff | Wastewater Collection Level II |
| Ryan Seiling | Wastewater Treatment Level I<br>Wastewater Collection Level I |
| Martin Schori | Wastewater Treatment Level II<br>Wastewater Collection Level II |
| Adrian Zandvliet | Wastewater Treatment Level I<br>Wastewater Collection Level I |

## 2.3 Capital Improvements

Capital improvements and projects completed in 2020 included:

- Aerated cell No. 2 and No. 3 diffuser membranes replacements.
- Airport Street sanitary dump construction.

Capital Projects for 2021 include:

- Installation and commissioning of 40 Hp Blower with VFD for aerated cell No. 2 and No. 3.
- Phase 2 mainline sewer pipe upgrades for Station Street.
- Electrical upgrade and improvements for MacPherson lift station.
- Electrical upgrade and Improvements for Rockcliffe lift station.
- Rotary Beach lift station pump replacement.
- Operation and Maintenance Manual WWTP (completed February 2021).
- Replacement of two groundwater monitoring wells and installation of four new monitoring wells.

## 2.4 Influent Waste Bylaw (OC 3.6 and 7.2.4.4)

*Sanitary Sewer System Use Bylaw No. 547* establishes regulations respecting the type, volume and characteristics of wastewater discharged to the sanitary sewer system.

In January 2002, the Town of Oliver received an application from Vincor requesting approval to connect its winery located on the Osoyoos Indian Reserve, north of the Town boundaries, to the Town's sewerage system. This application relates to both process water and normal domestic sewage and was approved by the Town.

Vincor was connected to the Town's sewerage system from October 2002 to July 01, 2015. During this period, Vincor's wastewater was sampled by the Town at least twice per month to confirm compliance with the terms and conditions of the connection agreement and for invoicing purposes. Since 2015, there has been no influent received from Vincor.

### 2.4.1 Infiltration, Inflow and Cross Connection Reduction (OC7.2.4.3 and 7.2.4.4)

The Town of Oliver has an ongoing video camera inspection program for the sewer collection system. In addition, they have prepared 2019 Sanitary Capital Plan. Within the report, SCADA data is analyzed for possible Inflow & Infiltration (I&I) from 2015 to present. This I&I analysis will allow for correlations between peak rain events, surface water diversions and failures within the pipe infrastructure.

The Town regulates provisions to identify, eliminate and prevent cross connections with non-potable water sources through Bylaw No. 1043

## 2.5 Sludge Management Plan (OC 3.8 and 7.2.4.6)

A Sludge Management Plan was prepared by TRUE in 1997. This plan was updated in February 2019 and is included in Appendix G. The plan provides an overview of the system design, sludge characterization, sludge sampling and monitoring, sludge removal and system recommendations.

Consistent with historical practices, the Town undertook depth and analytical sampling of the sludge in Aerated Lagoon Cell No. 2 in 2020. The analytical data is provided in Appendix G.

## 2.6 Groundwater Monitoring Plan (OC 6.8)

In compliance with Section 6.8 of the OC, the Town of Oliver retained the services of Golder Associates to prepare a groundwater monitoring plan in 1997.

The Town retained Western Water Associates Ltd. (WWA) to review and update the groundwater monitoring plan in 2020 (see Appendix H). Key recommendations from this report are as follows:

i. Increased monitoring at MW4 located near the rapid infiltration basin (RIB). This is to include installation of a transducer to characterize the effect on water levels when the RIB is in use and monthly analytical sampling for a period of one year. After one year the results are to be reviewed for further recommendations.

ii. Include the three existing monitoring wells near the Alonso and Huggins property to the biannual sampling schedule if they are still present. Groundwater levels measured monthly and biannual analytical sampling. One may serve as a future background monitoring well.

iii. Installation of five new monitoring wells at the following locations:

    - Gala Street Linear Park.
    - Public Work yard south end.
    - Cemetery south property boundary.
    - Two monitoring wells east of the Fairview mountain Golf Course to replace MW6 and MW7.

    These replacement wells and new wells are to be sampled following the same biannual sampling presently followed for the existing monitoring wells. The Town has made plans to install these monitoring wells and implement the additional sampling in 2021.

Groundwater table measurements and sampling data for the 2020 sampling program are discussed in the paragraphs following. Figure 2-1 provides a site plan of the groundwater monitoring wells. Groundwater level and water quality analysis are included in Appendix H.

### 2.6.1 Airport Monitoring Wells No. 1 to 3

There is a total of three monitoring wells at the airport site. These wells are all located down gradient from the reclaimed water use area. In 2011, streets were renamed in the Town. Historic street names are referenced in parenthesis in Figure 2-1. Groundwater level data is summarized in Table 2-1.

As seen, the average groundwater table elevation in the Air Cadet and 91A Street wells were similar to those observed in previous years. In 2020, the lowest groundwater table level was observed for the Rodeo Grounds.

Semi-Annual analytical sampling of the three monitoring wells, was initiated by the Town in September 2007. Table 2-2 summarizes the groundwater quality analysis for the three wells from 2007-2020.

The 2020 WWA Hydrogeological Review (Appendix H) included the following conclusions pertinent to water quality data for the airport area groundwater monitoring wells:

- Rodeo Grounds and 91A Street Wells are located downgradient of the airport and generally display the lowest impacts on groundwater quality, with concentrations of chloride, sodium, nitrate and ammonia at what are likely background levels for Aquifer 254. Air Cadet is an exception, as it is characterized by very high nitrate concentrations often above 10 mg/L and reaching as high as 25 mg/L in 2015. The data suggest a point source of nitrate in the area other than the reclaimed water may be impacting groundwater at Well #1. The Air Cadet building is located very close to Well #1. It was noted a vineyard and BC Tree Fruits facility are located across the street to the east.

- The current reclaimed water irrigation monitoring program appears to adequately assess impacts of the reclaimed water irrigation and disposal system downgradient of the airport, however the data for Air Cadet indicates a significant impact to groundwater and warrants additional investigation.

The April and September 2020 groundwater quality data are comparable to historical values and appears consistent with the 2020 WWA Hydrogeological Review conclusions above.

**TABLE 2-1: HISTORICAL SUMMARY OF GROUNDWATER DEPTHS FOR AIRPORT MONITORING WELLS**

| Monitoring Well | Year | Minimum Level (mbtoc)* | Maximum Level (mbtoc)* | Average Level (mbtoc)* | Level Range (m) |
|---|---|---|---|---|---|
| Air Cadet (Well #1) | 2007 | 9.59 | 10.68 | 10.18 | 1.09 |
| | 2008 | 10.52 | 10.79 | 10.69 | 0.27 |
| | 2009 | 10.77 | 11.40 | 10.93 | 0.63 |
| | 2010 | 10.31 | 11.03 | 10.76 | 0.72 |
| | 2011 | 10.33 | 10.80 | 10.55 | 0.47 |
| | 2012 | 9.84 | 10.78 | 10.50 | 0.94 |
| | 2013 | 9.78 | 10.44 | 10.11 | 0.66 |
| | 2014 | 9.98 | 10.58 | 10.33 | 0.60 |
| | 2015 | 10.01 | 10.51 | 10.28 | 0.50 |
| | 2016 | 10.21 | 10.5 | 10.36 | 0.29 |
| | 2017 | 9.9 | 10.59 | 10.32 | 0.69 |
| | 2018 | 9.65 | 10.29 | 10.03 | 0.64 |
| | 2019 | 9.72 | 10.62 | 10.26 | 0.9 |
| | 2020 | 9.62 | 10.51 | 10.22 | 0.89 |
| Rodeo Grounds (Well #2) | 2007 | 5.89 | 6.40 | 6.10 | 0.51 |
| | 2008 | 6.11 | 6.38 | 6.25 | 0.27 |
| | 2009 | 5.83 | 6.54 | 6.20 | 0.71 |
| | 2010 | 5.69 | 6.35 | 6.04 | 0.66 |
| | 2011 | 5.84 | 6.34 | 6.09 | 0.50 |
| | 2012 | 5.84 | 6.54 | 6.20 | 0.70 |
| | 2013 | 5.62 | 6.24 | 5.91 | 0.62 |
| | 2014 | 5.84 | 6.27 | 6.08 | 0.43 |
| | 2015 | 5.69 | 6.66 | 6.08 | 0.97 |
| | 2016 | 5.66 | 5.97 | 5.82 | 0.31 |
| | 2017 | 5.98 | 6.3 | 6.16 | 0.32 |
| | 2018 | 5.81 | 6.24 | 5.99 | 0.43 |
| | 2019 | 6.18 | 6.96 | 6.61 | 0.78 |
| | 2020 | 7.07 | 7.46 | 7.27 | 0.39 |
| 91A St. (Well #3) | 2007 | 1.52 | 2.19 | 1.81 | 0.67 |
| | 2008 | 1.50 | 2.34 | 1.78 | 0.84 |
| | 2009 | 1.47 | 2.05 | 1.77 | 0.58 |
| | 2010 | 1.45 | 1.64 | 1.54 | 0.19 |
| | 2011 | 1.31 | 1.55 | 1.46 | 0.24 |
| | 2012 | 1.38 | 1.54 | 1.46 | 0.16 |
| | 2013 | 1.20 | 1.39 | 1.27 | 0.19 |
| | 2014 | 1.11 | 1.65 | 1.37 | 0.54 |
| | 2015 | 1.21 | 1.66 | 1.41 | 0.45 |
| | 2016 | 1.13 | 1.43 | 1.28 | 0.30 |
| | 2017 | 1.06 | 1.38 | 1.23 | 0.32 |
| | 2018 | 0.87 | 1.51 | 1.2 | 0.64 |
| | 2019 | 1.24 | 1.78 | 1.45 | 0.54 |
| | 2020 | 1.18 | 1.72 | 1.44 | 0.54 |

**Depth indicates the measurement from the top of casing to the water level.*

TABLE 2-2: HISTORICAL SUMMARY OF WATER QUALITY ANALYSIS FOR THE AIRPORT MONITORING WELLS

| Monitoring Well | Sample Date | Chloride | Ammonia | Nitrate + Nitrite | Total Hardness | Sodium |
|---|---|---|---|---|---|---|
| Air Cadet (Well #1) | 19-Sep-2007 | 24.6 | < 0.02 | 7.71 | 535 | 13.9 |
| | 9-Apr-2008 | 9.97 | 0.09 | 2.84 | 773 | 24.1 |
| | 11-Sep-2008 | 12.6 | 0.04 | 1.3 | 817 | 21.7 |
| | 7-Apr-2009 | 11.1 | 0.02 | 0.7 | 1220 | 27.3 |
| | 18-Sep-2009 | 9.23 | 0.02 | 2.3 | 437 | 17.7 |
| | 19-May-2010 | 13.5 | 0.06 | 12.7 | | |
| | 7-Sep-2010 | 13.8 | < 0.02 | 12 | 383 | 22.1 |
| | 28-Apr-2011 | 17.5 | 0.15 | 12.1 | 217 | 9.33 |
| | 28-Sep-2011 | 12.7 | 0.12 | 7.87 | 400 | 18.4 |
| | 24-Apr-2012 | 16.4 | 0.04 | 7.59 | 464 | 20.0 |
| | 16-Oct-2012 | | 0.034 | 9.7 | 481 | 19.8 |
| | 9-Apr-2013 | | 0.034 | 10.1 | 384 | 18.5 |
| | 9-Sep-2013 | | < 0.020 | 20.2 | 383 | 17 |
| | 16-Apr-2014 | | 0.027 | 21.6 | 542 | 18.1 |
| | 4-Sep-2014 | 19.8 | < 0.020 | 23.9 | 402 | 19.5 |
| | 14-Apr-2015 | 20.7 | 0.102 | 24.4 | 485 | 20.5 |
| | 16-Sep-2015 | 15.9 | 0.079 | 20.5 | 590 | 23.5 |
| | - | - | - | - | - | - |
| | 13-Sep-2016 | 13.7 | 0.032 | 15 | 386 | 19.1 |
| | 10-Apr-2017 | 14.2 | 0.033 | 12 | 388 | 19.5 |
| | 11-Sep-2017 | 10.4 | <0.020 | 6.97 | 392 | 18 |
| | 14-May-2018 | 11.9 | 0.025 | 6.75 | 363 | 19.1 |
| | 10-Sep-2018 | 9.92 | <0.020 | 7.97 | 344 | 16.8 |
| | 28-Oct-2019 | 9.77 | 0.023 | 12.6 | 388 | 19.6 |
| | 6-Apr-2020 | 10.3 | <0.050 | 13 | 331 | 18.8 |
| | 1-Sep-2020 | 9.31 | <0.050 | 11.1 | 378 | 19.4 |
| Rodeo Grounds (Well #2) | 19-Sep-2007 | 9.24 | < 0.02 | 0.25 | 2330 | |
| | 9-Apr-2008 | 7.76 | 0.03 | 0.5 | 1690 | 23.7 |
| | 11-Sep-2008 | 12.7 | 0.08 | 1.14 | 890 | 21.7 |
| | 7-Apr-2009 | 10.2 | < 0.02 | 1.28 | 346 | 15.2 |
| | 18-Sep-2009 | 9.01 | < 0.02 | 0.36 | 677 | 19.1 |
| | 19-May-2010 | 9.69 | 0.04 | 0.08 | | |
| | 7-Sep-2010 | 8.93 | < 0.02 | 0.26 | 686 | 22.3 |
| | 28-Apr-2011 | 11.9 | 0.05 | 0.05 | 531 | 9.13 |
| | 28-Sep-2011 | 9.33 | 0.02 | 2.18 | 491 | 16.1 |
| | 24-Apr-2012 | 10.6 | 0.01 | 0.749 | 572 | 17.4 |
| | 16-Oct-2012 | | 0.021 | 0.263 | 661 | 17.8 |
| | 9-Apr-2013 | | 0.047 | 0.121 | 384 | 18.4 |
| | 9-Sep-2013 | | 0.023 | 0.115 | 889 | 18 |
| | 16-Apr-2014 | | 0.024 | 0.123 | 392 | 15.9 |
| | 4-Sep-2014 | 8.47 | 0.02 | 0.584 | 370 | 15.9 |
| | 14-Apr-2015 | 9.05 | 0.094 | 0.865 | 494 | 18.5 |
| | 16-Sep-2015 | 6.56 | 0.037 | 0.3 | 1120 | 31.6 |
| | - | - | - | - | - | - |
| | 13-Sep-2016 | 6.54 | 0.032 | 0.628 | 1110 | 19.2 |
| | 10-Apr-2017 | 7.6 | 0.072 | 0.343 | 914 | 20.4 |
| | 11-Sep-2017 | 6.1 | 0.02 | 0.124 | 959 | 17.1 |
| | 14-May-2018 | 7.2 | 0.1 | 0.122 | 2550 | 20.3 |
| | 10-Sep-2018 | 7.07 | 0.037 | 0.138 | 2090 | 18.9 |
| | 28-Oct-2019 | 6.55 | 0.103 | 0.385 | 2440 | 20.8 |
| | 6-Apr-2020 | 6.44 | 0.101 | 0.212 | 394 | 17.2 |
| | 1-Sep-2020 | 6.86 | 0.081 | 0.173 | 1540 | 18.9 |
| 91A St. (Well #3) | 19-Sep-2007 | 7.46 | 0.06 | 0.05 | 7340* | 15.1 |
| | 9-Apr-2008 | 10 | 0.03 | 0.05 | 972 | 27.5 |
| | 11-Sep-2008 | 14.9 | 0.12 | 0.04 | 5010 | 38.4 |
| | 7-Apr-2009 | 11.8 | 0.02 | 0.026 | 1270 | 31.6 |
| | 18-Sep-2009 | 9.39 | 0.11 | < 0.02 | 1070 | 24.6 |
| | 19-May-2010 | 12.2 | 0.06 | < 0.02 | | |
| | 7-Sep-2010 | 15.1 | 0.35 | 0.35 | 2300 | 37.7 |
| | 28-Apr-2011 | 23.1 | 0.04 | 0.44 | 633 | 15.3 |
| | 28-Sep-2011 | 18.5 | 0.1 | 0.32 | 1160 | 36.8 |
| | 24-Apr-2012 | 18.4 | 0.09 | 0.270 | 1470 | 36.9 |
| | 16-Oct-2012 | | 0.04 | 0.033 | 924 | 31.6 |
| | 9-Apr-2013 | | 0.049 | 0.074 | 834 | 23.9 |
| | 9-Sep-2013 | | 0.07 | 0.101 | 1430 | 24.6 |
| | 16-Apr-2014 | | 0.028 | 0.058 | 399 | 16.9 |
| | 4-Sep-2014 | 125 | 0.023 | 0.032 | 438 | 21.8 |
| | 14-Apr-2015 | 8.99 | 0.086 | 0.106 | 631 | 18.9 |
| | 16-Sep-2015 | 7.59 | 0.047 | 0.035 | 496 | 18.5 |
| | - | - | - | - | - | - |
| | 13-Sep-2016 | 8.01 | 0.032 | 0.214 | 389 | 17.2 |
| | 10-Apr-2017 | 8.07 | 0.059 | 0.334 | 366 | 16.7 |
| | 11-Sep-2017 | 7.64 | <0.020 | 0.042 | 346 | 15.2 |
| | 14-May-2018 | 8.31 | 0.024 | 0.0507 | 381 | 15.4 |
| | 10-Sep-2018 | 8.05 | 0.031 | 0.739 | 355 | 14.4 |
| | 28-Oct-2019 | 7.87 | 0.121 | 0.349 | 360 | 16 |
| | 6-Apr-2020 | 8.03 | 0.095 | 0.315 | 371 | 16.3 |
| | 1-Sep-2020 | 8.47 | <0.050 | 0.0929 | 443 | 16.5 |

* Suspected error.


ISSUES / REVISIONS

| No. | DATE | DESCRIPTION | BY | APP |
|---|---|---|---|---|

CONSULTANT SEAL

TRUE CONSULTING

201 - 2079 Falcon Road ▪ Kamloops BC ▪ V2C 4J2
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Town of Oliver
CANADA'S WINE CAPITAL

**SANITARY SEWER ANNUAL REPORT**

**AIRPORT AREA GROUNDWATER MONITORING WELLS SITE PLAN**

| | |
|---|---|
| SCALE | N.T.S (11x17) |
| DESIGN BY | TRU |
| DRAWN BY | NA |
| DATE | JANUARY 2018 |
| PROJECT REFERENCE No. | 306-088-005 |
| DRAWING No. | FIG 2-1 |
| SHEET | 1 OF 1 |
| ISSUE/REV. | |

FILE: r:\clients\300-399\306\306-088-007\03 drawings\cad\02 design drawings\306-088-007 report figures r1

### 2.6.2 Fairview Monitoring Wells No. 1 to 7

In compliance with the approved groundwater monitoring plan, the Town of Oliver has seven groundwater wells down gradient of the Fairview area. Referring to Figure 2-2, Monitoring wells MW 1 to 3 are located south of the Town's effluent storage site in an area used for infiltration in the mid-1990s. With infiltration of effluent near these wells discontinued in the mid-1990s, the Town has not sampled or measure groundwater elevations in MW 1 to 3. These monitoring wells will be included in the 2021 monitoring program as recommended in the 2020 WWA Hydrogeological Review (Appendix H). Furthermore, four new wells will be drilled in proximity to the reclaimed water usage area and the two Golf Course monitoring wells (MW6 and MW7) will be replaced. These new and replacement wells will be sampled following the existing monitoring schedule. The groundwater monitoring frequency of MW4 will also increase to monthly samples and weekly level measurements.

Monthly groundwater depth measurements for MW 4 to 7 are presented in Appendix H. Annual maximums, minimums and averages and summarized in Table 2-3. Groundwater measurements in MW 4 and 5 are generally consistent with historical data.

MW 4 and 5 were sampled for water quality in 2020, with results tabulated in Table 2-4 and attached in Appendix H.

The 2020 WWA Hydrogeological Review (Appendix H) included the following conclusions pertinent to water quality data for the Fairview Monitoring Wells:

- Water quality in MW4 shows elevated sodium, chloride and nitrate/nitrite concentrations, with the 2019 nitrate sample collected being 17 mg/L, above the drinking water quality guideline of 10 mg/L.
- MW4 is located immediately downgradient of the RIB and in a draw leading from the Alonso and Huggins properties located upslope.
- MW4 appears to be impacted by the RIB and likely upslope land uses.
- A plume of nitrate impacted groundwater is expected to migrate away from the area following loading of the RIB. The geometry and extent of that plume is not known.
- It is likely that the current monitoring program does not capture the full range of impacts from use of the RIB, as it is typically loaded continuously for a period of weeks while water levels are measured monthly and water quality samples are only collected biannually.
- MW5, which is utilized as the program background well, shows water quality impacts. Of note are recurring spikes in ammonia concentrations at levels not seen in other monitoring wells. As lands near MW5 are not currently irrigated with reclaimed water, the observed water quality impacts may be due to other point sources.

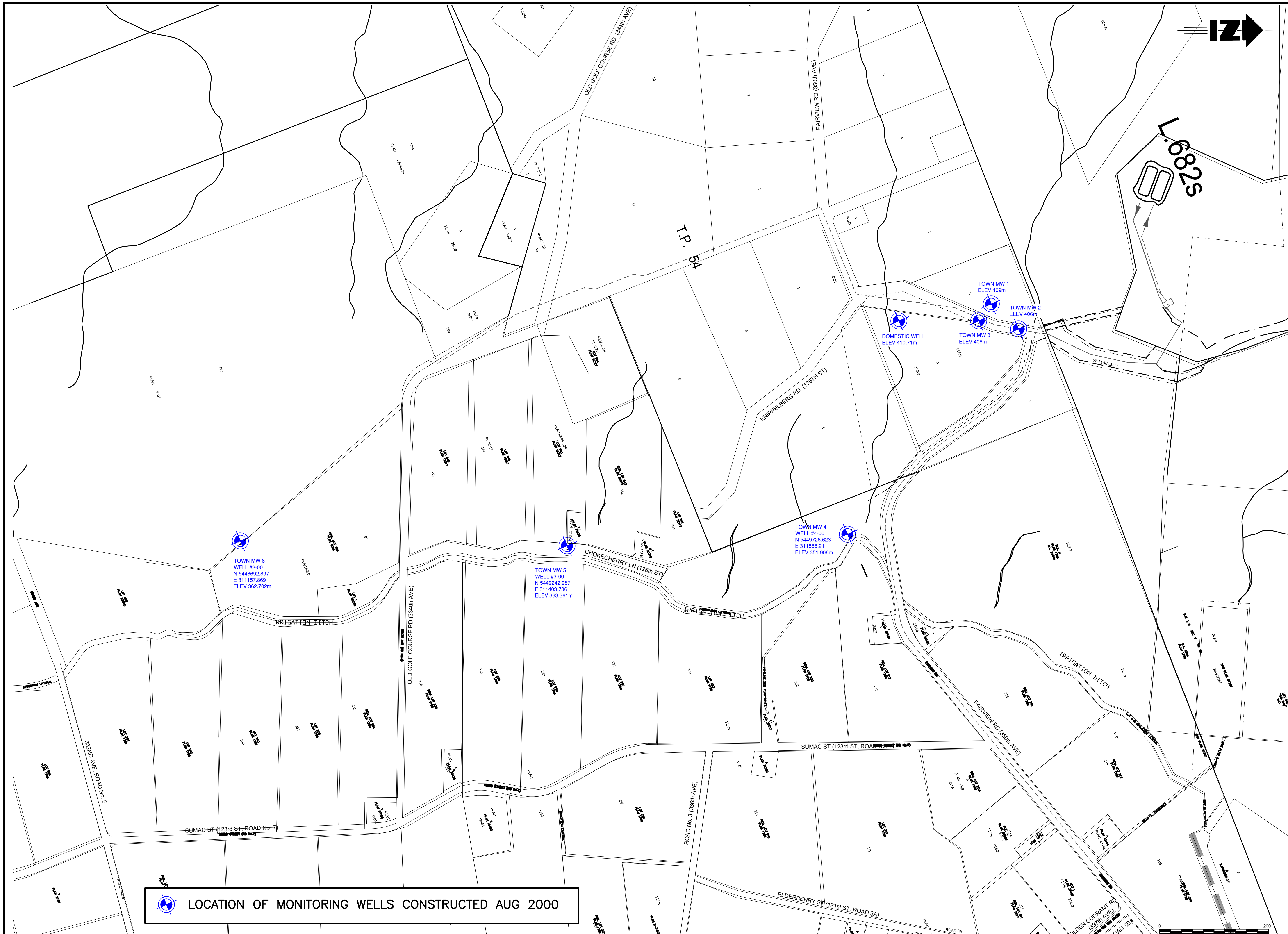
The April and September 2020 groundwater quality data are comparable to historical values and appear consistent with the 2020 WWA Hydrogeological Review. One notable difference is the 2020 MW4 sampling data results show that Nitrate/Nitrite Concentration was below the drinking water quality guideline of 10mg/L in April and September 2020.

## TABLE 2-3: SUMMARY OF GROUNDWATER DEPTHS FOR FAIRVIEW MONITORING WELLS

| Monitoring Well | Year | Minimum Level (mbtoc) | Maximum Level (mbtoc) | Average Level* (mbtoc) | Level Range (m) |
|---|---|---|---|---|---|
| **Test Well #4 (Sand Pit)** | 2003 | 9.24 | 11.13 | 9.76 | 1.89 |
| | 2004 | 8.16 | 9.56 | 8.77 | 1.40 |
| | 2005 | 8.12 | 10.33 | 8.91 | 2.21 |
| | 2006 | 8.35 | 11.16 | 9.45 | 2.82 |
| | 2007 | 8.55 | 11.36 | 10.06 | 2.81 |
| | 2008 | 8.70 | 11.34 | 10.06 | 2.64 |
| | 2009 | 8.80 | 11.30 | 10.15 | 2.50 |
| | 2010 | 8.28 | 10.61 | 9.32 | 2.33 |
| | 2011 | 8.36 | 11.24 | 9.74 | 2.88 |
| | 2012 | 8.48 | 10.85 | 9.79 | 2.37 |
| | 2013 | 8.21 | 10.64 | 8.89 | 2.43 |
| | 2014 | 7.43 | 9.62 | 8.57 | 2.19 |
| | 2015 | 8.08 | 10.20 | 8.92 | 2.12 |
| | 2016 | 7.79 | 8.98 | 8.38 | 1.19 |
| | 2017 | 6.24 | 8.33 | 7.71 | 2.09 |
| | 2018 | 1.99 | 8.13 | 6.75 | 6.14 |
| | 2019 | 7.81 | 9.4 | 8.47 | 1.59 |
| | 2020 | 7.8 | 10.43 | 9.03 | 2.63 |
| **Test Well #5 (125th Street)** | 2003 | 7.30 | 9.48 | 8.68 | 2.18 |
| | 2004 | 7.95 | 10.59 | 9.57 | 2.64 |
| | 2005 | 7.77 | 10.22 | 9.25 | 2.45 |
| | 2006 | 7.44 | 9.74 | 8.83 | 2.30 |
| | 2007 | 7.64 | 9.92 | 8.99 | 2.28 |
| | 2008 | 9.57 | 11.32 | 10.41 | 1.75 |
| | 2009 | 10.17 | 10.81 | 10.47 | 0.64 |
| | 2010 | 8.26 | 11.97 | 10.20 | 3.71 |
| | 2011 | 5.38 | 9.69 | 8.12 | 4.31 |
| | 2012 | 6.41 | 9.54 | 8.48 | 3.13 |
| | 2013 | 5.59 | 9.23 | 7.95 | 3.64 |
| | 2014 | 8.13 | 9.77 | 9.04 | 1.64 |
| | 2015 | - | - | - | - |
| | 2016 | 4.57 | 9.90 | 7.70 | 5.33 |
| | 2017 | 4.56 | 10.57 | 7.93 | 6.01 |
| | 2018 | 5.28 | 9.09 | 7.78 | 3.81 |
| | 2019 | 7.89 | 9.66 | 9.01 | 1.77 |
| | 2020 | 7.36 | 10.1 | 9 | 2.74 |
| **Test Well #6** | 2003-2019 | *13.92 (Dry)* | | | |
| **Test Well # 7 (Road No. 5)** | 2003 | 25.87 | 25.89 | 25.88 | 0.02 |
| | 2004 | 25.89 | 25.89 | 25.89 | 0.00 |
| | 2005 | 25.44 | 25.89 | 25.86 | 0.45 |
| | 2006 | 25.00 | *25.91 (Dry)* | 25.56 | 0.91 |
| | 2007-2019 | *25.91 (Dry)* | | | |

**TABLE 2-4: HISTORICAL SUMMARY OF WATER QUALITY ANALYSIS FOR FAIRVIEW MONITORING WELLS**

| Monitoring Well | Sample Date | Chloride | Ammonia | Nitrate + Nitrite | Total Hardness | Sodium |
|---|---|---|---|---|---|---|
| Test Well #4 (Sand Pit) | 22-Apr-2003 | 72 | 0.05 | 0.52 | 1060 | 55.8 |
| | 30-Sep-2003 | 94 | 0.08 | 0.39 | 1370 | 80.3 |
| | 20-Apr-2004 | 111 | 0.04 | 0.97 | 1130 | 73.1 |
| | 4-Sep-2004 | 123 | 0.02 | 0.35 | 3280 | 108 |
| | 12-Apr-2005 | 102 | <0.01 | 1.44 | 1060 | 85.1 |
| | 9-Apr-2008 | 103 | <0.02 | 2.46 | 1170 | 104 |
| | 7-Apr-2009 | 128 | <0.02 | 2.21 | 1030 | 103 |
| | 16-Sep-2009 | 108 | 0.09 | 0.74 | 4980 | 125 |
| | 19-May-2010 | 137 | 0.02 | 2.43 | | |
| | 7-Sep-2010 | 135 | 0.03 | 1.02 | 1310 | 128 |
| | 28-Apr-2011 | 135 | 0.08 | 2.95 | 1020 | 108 |
| | 24-Apr-2012 | 130 | 0.04 | 2.39 | 1110 | 101 |
| | 16-Oct-2012 | | 0.034 | 0.691 | 1420 | 119 |
| | 9-Apr-2013 | | 0.091 | 1.78 | 1070 | 118 |
| | 9-Sep-2013 | | 0.156 | 2.06 | 1350 | 146 |
| | 16-Apr-2014 | | 0.073 | 3.02 | 1050 | 115 |
| | 4-Sep-2014 | 125 | | 1.68 | | 127 |
| | Apr. 14, 2015 | 141 | | 3.56 | | 120 |
| | 16-Sep-2015 | 135 | 0.023 | 1.53 | 1440 | 127 |
| | - | - | - | - | - | - |
| | 13-Sep-2016 | 129 | 0.021 | 1.63 | 1700 | 19.2 |
| | 10-Apr-2017 | 121 | 0.084 | 10.2 | 820 | 108 |
| | 11-Sep-2017 | 110 | <0.020 | 3.05 | 387 | 11.5 |
| | 14-May-2018 | 111 | 0.035 | 4.12 | 725 | 100 |
| | 10-Sep-2018 | 96 | 0.043 | 2.99 | 838 | 87.1 |
| | 28-Oct-2019 | 103 | 0.222 | 16.9 | 704 | 93 |
| | 6-Apr-2020 | 119 | 0.091 | 8.03 | 659 | 92.2 |
| | 1-Sep-2020 | 101 | 0.072 | 1.11 | 1120 | 86.9 |
| Test Well #5 (125th Street) | 22-Apr-2003 | 36.1 | <0.01 | 3.9 | 367 | 29.5 |
| | 30-Sep-2003 | 29.2 | 0.02 | 3.9 | 391 | 29 |
| | 20-Apr-2004 | 30.4 | 0.03 | 3.6 | 395 | 23.8 |
| | 4-Sep-2004 | 22.3 | 0.02 | 6.52 | 447 | 32.4 |
| | 12-Apr-2005 | 34.2 | <0.01 | 5.81 | 409 | 25.5 |
| | 7-Sep-2005 | 46.5 | <0.01 | 12.4 | 537 | 25.7 |
| | 15-Jun-2006 | 34.8 | <0.01 | 8.62 | 543 | 27 |
| | 21-Sep-2006 | 34.6 | 1.65 | 6.05 | 399 | 28 |
| | 1-May-2007 | 34.4 | 0.41 | 2.15 | 355 | 26 |
| | 13-Sep-2007 | 27.5 | 0.03 | 2.95 | 388 | 30.2 |
| | 9-Apr-2008 | 29.1 | 0.08 | 3.62 | 399 | 35.9 |
| | 11-Sep-2008 | 36 | 0.13 | 2.8 | 512 | 33.7 |
| | 7-Apr-2009 | 76 | <0.02 | 6.1 | 407 | 35.1 |
| | 16-Sep-2009 | 77.7 | <0.02 | 5.72 | 480 | 21.6 |
| | 19-May-2010 | 53.9 | 0.03 | 3.03 | | |
| | 7-Sep-2010 | 37.3 | 0.03 | 1.03 | 467 | 29.2 |
| | 28-Apr-2011 | 26.3 | 0.04 | 2.1 | 639 | 41 |
| | 28-Sep-2011 | 38.5 | 0.35 | 2.75 | 423 | 48.7 |
| | 24-Apr-2012 | 48.8 | 1.9 | 3.19 | 460 | 22.4 |
| | 16-Oct-2012 | | 0.025 | 2.94 | 446 | 19.3 |
| | 9-Apr-2013 | | 0.036 | 1.11 | 381 | 15.9 |
| | 9-Sep-2013 | | 0.071 | 0.652 | 398 | 12.4 |
| | 16-Apr-2014 | | 0.022 | 0.577 | 465 | 13.1 |
| | 4-Sep-2014 | 14.7 | | 0.683 | | 14 |
| | 14-Apr-2015 | 16.7 | | 1.31 | | 14.7 |
| | 16-Sep-2015 | 27.7 | < 0.020 | 0.794 | 456 | 31.6 |
| | - | - | - | - | - | - |
| | 13-Sep-2016 | 23.9 | 0.022 | 1.11 | 960 | 20.4 |
| | 10-Apr-2017 | 17 | 0.052 | 1.21 | 481 | 14.1 |
| | 11-Sep-2017 | 16.5 | 0.089 | 1.11 | 917 | 88.4 |
| | 14-May-2018 | 16 | 0.058 | 0.569 | 400 | 12.8 |
| | 10-Sep-2018 | 15.6 | 0.066 | 1.59 | 348 | 10.3 |
| | 28-Oct-2019 | 16.1 | 0.774 | 2.18 | 415 | 13.6 |
| | 6-Apr-2020 | 16.7 | <0.050 | 1.6 | 409 | 14 |
| | 1-Sep-2020 | 17.7 | <0.050 | 2.28 | 419 | 17.7 |




| No. | DATE | DESCRIPTION | BY | APPD |
|---|---|---|---|---|

ISSUES / REVISIONS

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Town of Oliver
CANADA'S WINE CAPITAL

**SANITARY SEWER ANNUAL REPORT**

**AIRPORT AREA GROUNDWATER MONITORING WELLS SITE PLAN**

| | |
|---|---|
| SCALE | N.T.S. (11x17) |
| DESIGN BY | TRU |
| DRAWN BY | NA |
| DATE | JANUARY 2018 |
| PROJECT REFERENCE No. | 306-088-005 |

DRAWING No.

**FIG 2-2**

SHEET 1 OF 1

ISSUE/REV.

## 2.7 Soils Assessment (OC 5.4, 5.5, 6.9)

In accordance with Section 6.9 of the OC, a soils assessment of the irrigated areas was completed and is summarized herein. This assessment was completed by Hamilton & Associates in 2020 (Appendix I) to determine whether the soils present within the irrigation areas are capable of accepting reclaimed wastewater for irrigation purposes.

The report concluded that the Cemetery, Oliver Secondary School, and Oliver Community Park were suitable for irrigation with reclaimed water subject to regulatory requirements and assuming best practices are followed. The report also noted that if the airport irrigation areas were to be further expanded, the lack of topsoil and sparse vegetation would require a shorter watering season (June 15 to September 10) and reduced intensity of about one-half of the BC Agricultural Water Calculator. As the topsoil develops, future soil assessments could re-evaluate the shorter season and reduced watering intensity.

A summary of the soil classifications, characteristics, physical properties, and drainage for the reclaimed water irrigation areas is presented in Table 2-5. Detailed individual profile descriptions and an overview map of the soil parent materials is provided in Appendix I. As seen, all irrigated areas are well to rapidly drained except for the Public Works Yard. At this location, reclaimed water is used for compost operations and landscape irrigation, therefore it does not present an issue with respect to surface runoff or surfacing of reclaimed water.

#### TABLE 2-5 SOILS OVERVIEW RECLAIMED WATER IRRIGATION AREAS

| Irrigation Location | Soil Name | Soil Texture | Drainage | Coarse Fragment | Parent Material |
|---|---|---|---|---|---|
| Cemetery[1,2] | Ponderosa | Sandy Loam | Well-drained | 65 | FLUV |
| Oliver Secondary School[1,2] | Rutland | Sandy Loam | Rapidly-drained | 63 | GLFL |
| High School Park[1] | Rutland | Sandy Loam | Rapidly-drained | 63 | GLFL |
| Public Works Yard[1,2] | Cawston | Silt Loam | Poorly drained | 15 | FLUV |
| Airport[1] | Rutland | Sandy Loam | Rapidly-drained | 63 | GLFL |
| Oliver Community Park[3] | Kinney | Sandy Loam | Imperfect | - | FLUV |
| Alonso | Approved in Operational Certificate PE-13717 | | | | |
| Huggins | Approved in Operational Certificate PE-13717 | | | | |
| Fairview Mountain Golf Course | Approved in Operational Certificate PE-13717 | | | | |

[1]Approved in Principle by the Ministry in August 2002.
[2]Previously irrigated with freshwater, simple replacement.
[3]Area considered for future reclaimed water irrigation.

### 2.7.1 Soil Descriptions (OC 6.9)

**Ponderosa Soils**

Ponderosa soils only occur in the vicinity of Oliver. They have developed in a gravelly, moderately coarse textured fluvial veneer between 10 to 50 cm thick, overlying gravelly coarse textured fluvial fan deposits. Surface and subsurface textures are gravelly or very gravelly sandy loam or gravelly loam. Subsoils are very gravelly loamy sand. The soil drainage class is well to rapid.

**Rutland Soils**

Rutland soils occupy significant areas throughout the Okanagan Valley. The parent material is a moderately coarse textured veneer between 10 and 25 cm thick, which overlies gravelly and stony, very coarse textured glaciofluvial deposits. Surface soil textures are dominantly sandy loam or loamy sand. Subsurface are gravelly sand or gravelly loamy sand. The soil drainage class is rapid.

**Cawston Soils**

Cawston soils occur on the Okanagan River floodplain. They have developed in medium textured recent fluvial deposits generally between 50 to 100 cm thick, overlying moderately coarse textured materials. Surface and subsurface textures are silt loam or loam. Subsoil textures are gravelly sandy loam or gravelly loamy sand. They are moderately pervious, have a high water holding capacity and slow surface runoff. Their soil drainage class is dominantly poor, ranging to imperfect.

**Kinney Soils**

Kinney soils occur on the Okanagan River floodplain. They have developed in loamy fluvial veneer, usually between 30 and 80cm thick, overlying sandy floodplain deposits. Surface and subsurface textures are sandy loam or loam. The subsoil is loamy sand or sand and sometimes contains thin silty lenses. These soils are imperfectly drained, moderately pervious, and have moderate to low water holding capacity.

### 2.7.2 Surface Runoff (OC 5.4)

To date, the Town has not observed surface water runoff generated from reclaimed water irrigation use. As outlined in the soil profiles, the parent material at each irrigation area is well-drained. In this arid climate, runoff has not been an operational issue.

### 2.7.3 Surfacing Reclaimed Wastewater (OC 5.5)

Their irrigation system is designed and managed to ensure that there is no surfacing of irrigation tail water down slope of the point of irrigation. A hydrogeological study of the rapid infiltration basin was completed by Golder Associates in 1998. The system capacity of 355 $m^3$/day was derived on the basis of the natural discharge capacity of the subsurface soils such that surfacing of effluent will not occur within 150m of the site.

# APPENDIX A

## Operational Certificate for PE 12717

Province of British Columbia

MINISTRY OF ENVIRONMENT, LANDS AND PARKS

BC Environment

Environmental Protection
#201-3547 Skaha Lake Rd.
Penticton, British Columbia
V2A 7K2
Telephone: (604) 490-8200
Fax: (604) 492-1314

Date: December 14, 1995

File: 76750-40/PE-13717 (01)

**REGISTERED MAIL**

The Corporation of the Town of Oliver
PO Box 638
Oliver BC VOH 1TO

Attention: Tom Szalay, Administrator

Enclosed is a copy of the Operational Certificate No. PE-13717 issued under the provisions of the Waste Management Act. This Operational Certificate supersedes Permit PE-00102 which is cancelled in accordance with Section 16(13) of the Waste Management Act. Your attention is respectfully directed to the terms and conditions outlined in the Operational Certificate. An annual Permit fee will be determined according to the Waste Management Permit Fee Regulation.

This Operational Certificate does not authorize entry upon, crossing over, or use for any purpose of private or Crown lands or works, unless and except as authorized by the owner of such lands or works. The responsibility for obtaining such authority shall rest with the Operational Certificate holder.

This Operational Certificate is issued pursuant to the provisions of the Waste Management Act to ensure compliance with Section 34(3) of that statute, which makes it an offence to discharge waste without proper authorization. It remains the responsibility of the Operational Certificate holder to ensure that all activities conducted under this authorization comply with any other applicable legislation which may be in force from time to time.

The administration of this Operational Certificate will be carried out by staff from our Regional Office located in Penticton, (telephone 490-8200). Plans, data and reports pertinent to the Operational Certificate are to be submitted to the Environmental Protection office, Suite 201, 3547 Skaha Lake Road, Penticton, British Columbia, V2A 7K2. - 30th Street, Vernon, British Columbia, V1T 9G3.

This decision may be appealed by any person(s) who considers themselves aggrieved by this decision, in accordance with Part 5 of the Waste Management Act. Written notice of intent to appeal must be received by the Regional Waste Manager within twenty-one (21) days of the date of notification of this decision.

Yours truly,

T.R. Forty, P.Eng.
Assistant Regional Waste Manager
Okanagan Sub-Region

Enclosure

PROVINCE OF
BRITISH COLUMBIA

Environmental Protection
#201 - 3547 Skaha Lake Road
Penticton
British Columbia, V2A 7K2
Telephone: (604) 490-8200

MINISTRY OF ENVIRONMENT,
LANDS AND PARKS

# OPERATIONAL CERTIFICATE

# PE 13717

*Under the Provisions of the Waste Management Act*

**TOWN OF OLIVER**

**P.O. Box 638**

**Oliver, British Columbia**

**V0E 1T0**

is authorized to discharge reclaimed wastewater to the ground by irrigation, from a municipal sewage collection and aerated lagoon sewage treatment facility located at Oliver, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the Waste Management Act and may result in prosecution.

## 1. SPECIFIC AUTHORIZED DISCHARGES AND RELATED REQUIREMENTS

The discharge of effluent to which this sub-section is applicable is from a municipal sewage treatment facility located approximately as shown on the attached Site Plan A and Site Plan B. The reference number (S.E.A.M. site number) for this discharge is E222150.

### 1.1 Discharge Quantity

1.1.1 The maximum authorized rate of effluent to be discharged from the aerated lagoon sewage treatment system to the reclaimed wastewater storage reservoir, averaged on a monthly basis:

1995 - 1950 $m^3$ per day
1996 - 2000 $m^3$ per day
1997 - 2050 $m^3$ per day
1998 - 2100 $m^3$ per day
1999 - 2150 $m^3$ per day
2000 - 2200 $m^3$ per day

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

1.1.2 There is no maximum authorized rate of reclaimed wastewater to be discharged from the storage reservoir for beneficial use as irrigation water.

## 1.2 Discharge Quality

1.2.1 It is recommended that to ensure reclaimed wastewater is adequately renovated prior to irrigation, the characteristics of the effluent discharged from the aerated lagoon treatment system to the reclaimed wastewater storage reservoir not exceed:

5 Day Biochemical Oxygen Demand, 45 mg/L; and

Total Suspended Solids - 60 mg/L.

## 1.3 Permit Fee Calculations for Reclaimed Wastewater Discharge to Land

1.3.1 The characteristics of the reclaimed wastewater discharged from the storage reservoir and beneficially used for irrigation, for the purposes of permit fee calculations, the following discharge factors have been assumed:

5 Day Biochemical Oxygen Demand, 10 mg/L; and

Total Suspended Solids - 10 mg/L.

## 1.4 Authorized Works

The works authorized are: sewage collection system, sewage treatment plant concrete tankage for emergency containment, influent screen, flow equalization basin, pumping station, pressure forcemain to aerated lagoons, aerated lagoon treatment system, reclaimed wastewater storage reservoir sized to provide a minimum retention time of 60 days prior to spray irrigation, post storage chlorination, pressure forcemain to the golf course and related irrigation supply mains and sprinkler irrigation equipment, infiltration basin, and other related appurtenances, approximately as shown on the attached Site Plan A.

## 1.5 Source of Discharge

The source of discharge and sewage collection system services the Town of Oliver and surrounding area.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

### 1.6 Location of Works

The location of the sewage collection, flow equalization basin and effluent pumping station is: Block 47 of District Lot 2450s, Similkameen Division of Yale District.

The location of the effluent aerated lagoon treatment facilities, reclaimed wastewater storage reservoir, chlorination and withdrawal facilities is: District Lot 763s, and Block B, District Lot 682s, Similkameen Division of Yale District. The location of the potential infiltration basin sites: Block K, Plan 1789 (Town Sand Pit) and Lot 2, Plan 5881 (Town Gravel Pit).

### 1.7 Location of Discharge

The location where reclaimed wastewater may be irrigated is described generally as Oliver and the surrounding area.

### 1.8 Irrigation Plan

Submit for review, and obtain written authorization from the Regional Waste Manager, an "Irrigation Plan" of all new areas of land to be irrigated prior to commencement of irrigation with reclaimed wastewater. Areas for effluent irrigation are as indicated in the Oliver Waste Management Plan and as indicated on Site Plan A.

## 2. GENERAL REQUIREMENTS

### 2.1 Maintenance of Works, Emergency Procedures and Noncompliance Reporting

Inspect the pollution control works regularly and maintain them in good working order. In the event of an emergency or any condition which prevents continuing operation of the approved method of pollution control or results in noncompliance with the terms and conditions of this Operational Certificate, immediately notify the Regional Waste Manager and take appropriate remedial action.

### 2.2 Bypasses

The discharge of effluent which has bypassed the designated treatment works is prohibited, unless the consent of the Regional Waste Manager is obtained and confirmed in writing.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

## 2.3 Process Modifications

Notify the Regional Waste Manager, and his written consent obtained, prior to implementing changes to any process that may affect the quality and/or quantity of the discharge.

## 2.4 Alternate Water Supply

Provide alternate water supplies if any privately owned well is adversely affected by the land disposal scheme as determined by the Regional Waste Manager.

## 2.5 Plans - New Works

2.5.1 Plans of modifications and/or extensions to the existing works shall be signed and sealed by a Professional Engineer licensed to practise in the Province of British Columbia.

2.5.2 Copies of all "as-built" plans and drawings for the effluent treatment system, signed and sealed by a Professional Engineer licensed to practise in the Province of British Columbia, shall be submitted to the Regional Waste Manager on completion of construction.

2.5.3 Plans and specifications of any proposed new works, modifications or additions to the works authorized in this Operational Certificate, including the infiltration basin plans, and with the exception of the sewage collection system, shall be submitted to the Regional Waste Manager, and his written consent obtained before construction commences. The works shall be constructed in accordance with such plans.

2.5.4 Retain a copy of all "as-built", plans of modifications and/or extensions to the sewage collection system for perusal by the Regional Waste Manager, or his designate, upon request.

2.5.5 Plans for modifications of, and/or extensions to, the existing reclaimed wastewater irrigation system shall be approved by a person qualified in the design of irrigation systems.

2.5.6 Design and construct the irrigation works in accordance with best current agricultural practice and:

> The "Pollution Control Guidelines for Municipal Effluent Application to Land", dated January 1983, and any amendments thereto, issued by the Ministry of Environment of British Columbia.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

The "B.C. Sprinkler Irrigation Manual" 1989 issue, prepared by the B.C. Ministry of Agriculture and Fisheries.

The "Health and Safety Criteria for the Use of Reclaimed Wastewater", 1991, developed by the Ministry of Health and the Ministry of Environment.

## 3. GENERAL REQUIREMENTS - ALL DISCHARGES

### 3.1 Operation and Maintenance

Develop and maintain both an Operational and Maintenance Manual for the sewage collection, sewage treatment and reclaimed wastewater utilization. A copy of the Operational and Maintenance Manuals shall be retained at the treatment facility for inspection by the Regional Waste Manager or their designate.

### 3.2 Facility Classification

Maintain the wastewater treatment facility classification as authorized in Section 1.4 with the "British Columbia Water and Wastewater Operators Certification Program Society" (BCWWOCPS). The new aerated lagoon treatment facility is presently classified as a Level II facility.

### 3.3 Operator Certification

3.3.1 All operators in training (OIT) working at this Level II facility classified by the BCWWOCPS shall be required to successfully pass an OIT examination within three (3) months of commencement of employment at the facility. The OIT certificate shall be valid for fifteen (15) months from the date of issue. Prior to the expiry date of the OIT certificate, but not sooner than twelve (12) months from the date when the OIT commenced facility operation, the OIT shall successfully complete a Class I certification examination in order to continue to operate at the facility.

3.3.2 The facility is currently classified by the BCWWOCPS at Level II. Designate at least one operator to be the "Chief Operator" of the facility by **December 1, 1996**. The "Chief Operator" shall be certified at a Class II level, at a minimum.

After **December 1, 1996**, no person shall have "Direct Responsible Charge", as defined by the BCWWOCPS, of a municipal wastewater treatment facility classified at Level II or higher unless they possess a valid operator's certificate not more than one level below the classification level of the facility. **"Direct Responsible Charge" is the "Chief Operator" of the facility, the identifiable senior person who is in charge of the plant.**

3.3.3 Should the facility be reclassified by the BCWWOCPS at Level III, designate a "Chief Operator", certified at a Class III level by **December 1, 1998.**

3.3.4 Should the facility be reclassified by the BCWWOCPS at Level IV, designate a "Chief Operator", certified at a Class IV level by **December 1, 1998.**

### 3.4 Water Conservation

Establish a water conservation program to encourage a reduction in the volume of domestic and industrial wastewaters discharged to the sewage collection system.

### 3.5 Sewage Collection System - Groundwater Infiltration, Inflow and Cross Connections

Inspect and maintain the sewage collection system works so as to minimize the possibility of cross connections between the storm sewer and the sanitary sewer systems, to minimize infiltration of groundwater, to minimize inflow of water from basement sump pumps and roof drains, and minimize exfiltration of the collected sewage from the sewage collection system to the ground.

### 3.6 Influent Wastes Bylaw

Subject to being declared a Sewage Control Area under Section 17 of the Waste Management Act, and in order to minimize the potential effect of heavy metals or other toxic materials in the effluent and/or sludge, prepare, implement and/or amend an Influent Wastes Bylaw, Building Bylaw, or other similar bylaws, to regulate the input of such wastes to the sewage collection system. Devices to process household putrescible waste for disposal to the sewage collection system shall be prohibited.

### 3.7 Contingency Plan

Prepare a Contingency Plan that will address the appropriate course of action to be taken in any particular preconceived emergency situation. The Contingency Plan shall include chlorine leaks and any potential point of concern in the collection, treatment and disposal systems. Attention is to be given to public safety and the protection of the environment. The Contingency Plan is to be continually updated as necessary to reflect the current operation. A copy of the Contingency Plan shall be forwarded to the Regional Waste Manager on or before December 31, 1997.

### 3.8 Sludge Management Plan

The rationale of sludge management, including frequency of withdrawal of sludge from the sewage treatment plant and the location(s) used for disposal and/or utilization shall be developed into a Sludge Management Plan. The Sludge Management Plan shall be prepared and submitted to the Regional Waste Manager for approval on or before December 31, 1996.

### 3.9 Odours

Should odours become objectionable, additional works shall be provided when so directed in writing by the Regional Waste Manager.

### 3.10 Fencing

Erect a fence around the sewage treatment facility, storage reservoir and such other areas as required by the Regional Waste Manager. The height and type of fencing shall meet the approval of the Regional Waste Manager.

### 3.11 Surface Water Diversionary Works

Surface water shall be intercepted and diverted away from the effluent treatment facilities to the greatest extent possible.

### 3.12 Signage

3.12.1 A suitable sign erected at the main entrance to the site shall have the appropriate emergency phone numbers for use by the general public and others.

3.12.2 Prominent "NO TRESPASSING", signs shall be erected around agricultural and silvicultural sites irrigated with reclaimed wastewater, warning persons of the possible health hazard during the irrigation season and advising that the water used for irrigation is NOT POTABLE. The wording shall be in language or symbols readily comprehensible by the general public. eg. "NO TRESPASSING - RECLAIMED WASTEWATER - DO NOT DRINK"

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

## 4. GENERAL REQUIREMENTS - EFFLUENT STORAGE RESERVOIR

### 4.1 Leakage

Operate and maintain the reclaimed wastewater storage reservoir to minimize fluid leakage. Leakage shall not aggravate or produce soil or bedrock instability or erosion elsewhere or contaminate ground or surface water.

## 5. GENERAL REQUIREMENTS - EFFLUENT IRRIGATION

### 5.1 Disinfection - Chlorination

5.1.1 Adequate chlorination shall be maintained and provide not less than one hour's contact time at average flow rates in the reclaimed wastewater discharging from the chlorination facility to the irrigation system.

5.1.2 Reclaimed wastewater utilized for irrigation shall conform to the effluent irrigation guidelines developed by the B.C. Ministry of Health. Fecal coliforms shall not exceed 200 MPN per 100 mL for agricultural, silvicultural and low public use lands, or exceed 2.2 MPN per 100 mL for high public use lands.

### 5.2 Annual Irrigation

5.2.1 The authorized discharge period for irrigation is during the period March 15 to October 31, inclusive.

5.2.2 With the written authorization of the Regional Waste Manager, the irrigation schedule may be extended on a weekly basis beyond these limits. Any extension will be considered only upon receipt of a substantiated written request.

### 5.3 Buffer Zones

5.3.1 The requirement for formal buffer zones surrounding lands irrigated with reclaimed wastewater is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager.

5.3.2 Reclaimed wastewater applied by irrigation shall not be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water.

5.3.3 There shall be no reclaimed wastewater irrigated within 30 metres of any well or inground reservoir for domestic supply.

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## 5.4 Surface Runoff

There shall be no surface runoff of irrigated reclaimed wastewater from the irrigated lands.

## 5.5 Surfacing Reclaimed Wastewater

Irrigation shall be managed in such a fashion as to preclude surfacing of irrigation tail water down slope of the point of irrigation.

## 5.6 Spray Irrigation Drift

The reclaimed wastewater irrigation system shall be managed in such a fashion as to preclude aerosol drift from leaving the irrigated lands.

## 5.7 Irrigation Rates

5.7.1 Irrigation rates shall not exceed the rates given in "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries.

5.7.2 Soils of the irrigated lands shall be monitored to prevent saturation, erosion, and instability.

## 5.8 Agricultural Products Lag Time

5.8.1 A three day lag time is required before uninspected livestock intended for human consumption are permitted on areas irrigated with reclaimed wastewater. No lag time is required if livestock are subjected to the federal meat inspection program.

5.8.2 A six day lag time is required before dairy cattle are permitted in areas irrigated with reclaimed wastewater.

5.8.3 A three day lag time, after irrigation has ceased, is required before a crop intended for animal feed is harvested.

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

## 6. MONITORING REQUIREMENTS

### 6.1 Influent Sampling Program - (Equalization Basin)

6.1.1 Install and maintain a suitable sampling facility at the equalization basin outlet, (S.E.A.M. site number E222152), and obtain a grab sample of the plant influent **semi-annually** (a proportional continuous sampler may be used).

6.1.2 Obtain analyses of the influent sample for the following:

total phosphorus and ortho phosphorus, expressed as P in mg/L;

### 6.2 Effluent Sampling Program - (Cell #3, prior to storage reservoir)

6.2.1 Install and maintain a suitable sampling facility on the outlet of the aerated treatment lagoon, Cell #3, (S.E.A.M. site number E222151), and obtain a grab sample of the effluent before it is discharged to the storage reservoir, for analysis by a suitably accredited laboratory, a proportional continuous sampler may be used, provided that prior written approval has been obtained from the Regional Waste Manager.

6.2.2 Obtain analyses of the effluent sample for the following:

total suspended solids (non-filterable residue), (**monthly** analysis), mg/L;

5-day biochemical oxygen demand, (**monthly** analysis), mg/L;

total phosphorus, ortho phosphorus and total dissolved phosphorus, (**quarterly analysis during 1996, and semi-annually** analysis, thereafter), all expressed as mg/L P; and

total nitrogen, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen, and organic nitrogen, (**quarterly analysis during 1996, and semi-annually analysis thereafter**), all expressed as mg/L N.

6.2.3 Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

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Assistant Regional Waste Manager

## 6.3 Effluent Irrigation Sampling Program - (Chlorine Contact Chamber, prior to Irrigation)

6.3.1 Install a suitable sampling facility after the chlorine contact chamber, prior to irrigating, (S.E.A.M. site number E222150) and obtain a grab sample of the reclaimed wastewater **during the irrigation season.**

6.3.2 Obtain analyses of the sample, parameters and frequency as follows:

faecal coliforms, M.P.N./100ml, on a **monthly** basis;

total coliforms, M.P.N./100ml, on a **monthly** basis;

total phosphorus, mg/L, on a **monthly** basis;

total nitrogen, mg/L, on a **monthly** basis; and

chlorine residual, mg/L, on a **weekly** basis.

6.3.3 Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

## 6.4 Effluent Irrigation Monitoring Program

6.4.1 Provide and maintain a suitable flow measuring device to measure total volume of reclaimed wastewater irrigated annually and record the areas where it is utilized.

6.4.2 Provide and maintain a suitable flow measuring device to measure the amount of fresh water make-up from Okanagan River to the equalization basin in $m^3$/day, and totalize this make up water volume on an annual basis in $m^3$/year.

6.4.3 Provide and maintain a suitable flow measuring device and record once per day the reclaimed wastewater volume irrigated over a 24-hour period. Record the flows for each calendar month and for each calendar year.

## 6.5 Storage Reservoir Level Monitoring Program

6.5.1 Provide a suitable staff gauge or other similar device as approved by the Regional Waste Manager in the storage reservoir and take weekly measurements of the water level in the storage reservoir on a year round basis.

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Assistant Regional Waste Manager

## 6.6 Sampling and Analytical Requirements

6.6.1 Proper care should be taken in sampling, storing and transporting the samples to adequately control temperature and avoid contamination, breakage, etc.

6.6.2 Occasional full chemical analysis of the main cations and anions and other characteristics may be required at the discretion of the Regional Waste Manager.

6.6.3 Analyses are to be carried out in accordance with procedures described in the second edition of "A Laboratory Manual for the Chemical Analysis of Waters, Wastewaters, Sediments and Biological Materials, (March 1994 Permittee Edition)", or by suitable alternative procedures as authorized by the Regional Waste Manager.

The above manual may be purchased from Queens Printer Publications Centre, 2nd Floor, 563 Superior Street, Victoria, B.C., V8V 4R6, 1-800-663-6105. The manual may also be reviewed at any Environmental Protection Program Office.

6.6.4 Sampling and flow measurement shall be carried out in accordance with the procedures described in "Field Criteria for Sampling Effluents and Receiving Waters", April 1989, 17 pp., or by other suitable alternative procedures as authorized by the Regional Waste Manager.

6.6.5 The Permittee is required to follow the terms and conditions of the Quality Assurance Regulation (EQDA). Ten percent of the samples collected shall be duplicated to provide data quality assurance. Quality control information generated by the Permittee lab while analyzing parameters required by this Permit shall also be provided with the data required to be reported.

## 6.7 Sludge Sampling and Monitoring Program

Develop and maintain a record keeping system for measuring and recording the depth of sludge collecting in the lagoons and volume of sludge removed from the treatment lagoons during desludging operations, the location where the sludge was discharged, and the amount of sludge discharged at each location. The Regional Waste Manager is to be notified in writing at least two weeks prior to the commencement of desludging operations. Analysis of the sludge may be required by the Regional Waste Manager.

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Assistant Regional Waste Manager

### 6.8 Groundwater Monitoring Program

A Groundwater Monitoring Program, shall be submitted to the Regional Waste Manager. The Groundwater Monitoring Program shall be designed by a Professional Engineer or a Hydrogeological Technologist licensed to practice in the Province of British Columbia, to establish with acceptable scientific accuracy, the groundwater flow pattern and nutrient removal capability of the soil to ensure reasonable notice of impending high phosphorus or nitrate levels that may adversely affect surface water, groundwater or domestic waterwells. The sampling, measurement frequency and analyses shall be conducted in accordance with the Groundwater Monitoring Program upon its written authorization by the Regional Waste Manager. The Groundwater Monitoring Program to be submitted to the Regional Waste Manager by December 31, 1997.

### 6.9 Soils Assessment Program

A ground assessment of any new areas to be irrigated, as shown in the "Irrigation Plan", shall be performed by a suitably qualified professional, using best current climate and soils data to substantiate that the land is capable of accepting reclaimed wastewater for irrigation purposes. This assessment is to include any suggested restrictions or recommendations that the suitably qualified professional deems necessary. This Soils Assessment shall be submitted to the Regional Waste Manager for review prior to the initial commencement of irrigation annually. Further review and ongoing soils assessments may be required by the Regional Waste Manager.

## 7. REPORTING

### 7.1 General Reporting

7.1.1 Maintain the monitoring data required in Section 6 for inspection.

7.1.2 The influent/effluent water quality analyses and flow data is to be submitted to the Regional Waste Manager such that they are received by the Regional Waste Manager within 30 days of the results being sent out by the testing agency.

7.1.3 Monitoring data shall be submitted in an electronic and/or printed format satisfactory to the Regional Waste Manager.

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## 7.2 Annual Reporting

7.2.1 Submit an Annual Report which includes a summary of the results of all sampling and monitoring programs as specified in this permit, data interpretation and trend analyses by a suitably qualified professional.

7.2.2 This report is to be in a format which is suitable for review by the public and/or other government agencies.

7.2.3 The first report is due on or before 60 days of the end of a calendar year for that year's monitoring. Raw data are to be attached as appendices to the report.

7.2.4 Maintain and submit records of the following as a part of the annual report:

7.2.4.1 Records of reclaimed wastewater balance, that is, the flows to and from the storage reservoir. This balance, must also include the freshwater make-up.

7.2.4.2 Records of the duration, intensity, property owner, acreage, location, and type of reclaimed wastewater irrigation.

7.2.4.3 Records of efforts to reduce infiltration, inflow and cross connections for inspection by the Regional Waste Manager or his designate.

7.2.4.4 Records of efforts to administer the Influent Wastes By-law(s) for inspection by the Regional Waste Manager or his designate. Include as an attachment, any amendments to the Influent Wastes By-law(s) that have been made during the past year.

7.2.4.5 Copy of the Contingency Plan.

7.2.4.6 Copy of the Sludge Management Plan.

7.2.4.7 Copy of the Annual Flow Summaries.

7.2.4.8 Copy of the Annual Irrigation Summaries.

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Assistant Regional Waste Manager

# APPENDIX A

*Requirements of Reclaimed Wastewater Users*

**The holder of this Operational Certificate (The reclaimed wastewater supplier) shall be responsible for ensuring that the contractual agreement with the Reclaimed Wastewater User is in accordance with the Operational Certificate. A copy of this Appendix is to be provided to each user prior to the commencement of irrigation EACH YEAR.**

## 1 GENERAL REQUIREMENTS

### 1.1 Plans - New Works

1.1.1 Plans for modifications and/or extensions to the existing reclaimed wastewater irrigation system shall be approved by a person qualified in the design of irrigation systems.

1.1.2 Design and construct the irrigation works in accordance with best current agricultural practice and the "Pollution Control Guidelines for Municipal Effluent Application to Land", dated January 1983, and any amendments thereto, issued by the Ministry of Environment of British Columbia, and also in accordance with the "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries.

### 1.2 Construction Criteria

1.2.1 All reclaimed water user valves, shall be of a type or secured in a manner that permits operation by only personnel authorized by each wastewater user. All piping, valves and outlets should be marked to differentiate reclaimed wastewater from domestic water. All reclaimed wastewater controllers, valves, etc., shall be affixed with reclaimed wastewater warning signs.

1.2.2 Use or installation of hose-bibbs on any irrigation system presently operating, or designated to operate with reclaimed wastewater, regardless of the hose-bibb construction or identification, is not permitted.

1.2.3 There shall be at least a 3 metre horizontal and a 0.3 metre vertical separation (with domestic water pipeline above the reclaimed water pipeline) between all pipelines transporting reclaimed water and those transporting domestic water.

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1.2.4 There shall be no connection between a potable water supply, irrigation water or industrial well, and piping containing reclaimed wastewater, except through an air gap separation or reduced pressure principle device.

### 1.3 Fencing

The Reclaimed Wastewater User MAY be required by the Regional Waste Manager to erect a fence around the disposal area to restrict public access. The height and type of fencing shall meet the approval of the Regional Waste Manager.

### 1.4 Signage

1.4.1 Prominent "NO TRESPASSING", signs shall be erected around agricultural and silvicultural sites irrigated with reclaimed wastewater, warning persons of the possible health hazard during the irrigation season and advising that the water used for irrigation is NOT POTABLE. The wording shall be in language or symbols readily comprehensible by the general public. eg. "NO TRESPASSING - RECLAIMED WASTEWATER - DO NOT DRINK"

1.4.2 Warning signs shall be posted in sufficient numbers and size and at strategic locations to advise the public that reclaimed water is being used. Additional signage may be required as directed by the Regional Waste Manager.

## 2 GENERAL REQUIREMENTS - RECLAIMED WASTEWATER IRRIGATION

### 2.1 Buffer Zones

2.1.1 The requirement for formal buffer zones surrounding lands irrigated with reclaimed wastewater is no longer in effect, however, a buffer zone may be specified by the Regional Waste Manager.

2.1.2 Reclaimed wastewater applied by irrigation shall not be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water.

2.1.3 There shall be no reclaimed wastewater irrigated within 30 metres of any well or inground reservoir for domestic supply.

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## 2.2 Surface Runoff

2.2.1 There shall be no surface runoff of irrigated reclaimed wastewater from the irrigated lands.

2.2.2 The maximum ground slope shall not exceed 20% without the written consent of the Regional Waste Manager.

## 2.3 Surfacing Reclaimed Wastewater

2.3.1 Irrigation shall be managed in such a fashion as to preclude surfacing of irrigation tail water down slope of the point of irrigation.

2.3.2 Irrigation shall be managed as to prevent ponding.

## 2.4 Spray Irrigation Drift

2.4.1 Reclaimed wastewater shall be confined to the area designated and approved for reclamation. The reclaimed wastewater irrigation system shall be managed in such a fashion as to prevent aerosol drift from leaving the irrigated lands.

2.4.2 Precautions shall be taken to ensure that reclaimed water will not have contact with any facility or area not designated for reclamation, such as passing vehicles, buildings, domestic water facilities, fruit and vegetable gardens, or food handling facilities.

2.4.3 Drinking water facilities shall be protected from direct or wind blown reclaimed wastewater spray.

## 2.5 Irrigation Rates

2.5.1 Irrigation rates shall not exceed the rates given in "B.C. Sprinkler Irrigation Manual", dated 1989, prepared by the B.C. Ministry of Agriculture and Fisheries.

2.5.2 Soils of the irrigated lands shall be monitored periodically or as otherwise directed by the Regional Waste Manager or the Town of Oliver, to prevent saturation, erosion, and instability .

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Assistant Regional Waste Manager

## 2.6 Agricultural Products Lag Time

2.6.1 A three day lag time is required before uninspected livestock intended for human consumption are permitted on areas irrigated with reclaimed wastewater. No lag time is required if livestock are subjected to the federal meat inspection program.

2.6.2 A six day lag time is required before dairy cattle are permitted in areas irrigated with reclaimed wastewater.

2.6.3 A three day lag time, after irrigation has ceased, is required before a crop intended for animal feed is harvested.

## 2.7 Insect and Vector Control

Adequate measures shall be taken to prevent the breeding of insects and other vectors of health significance, and the creation of odors, slimes or unsightly deposits.

## 2.8 Irrigation of Public Areas

2.8.1 Irrigation on golf courses or cemeteries shall only be practised when the public are not present.

2.8.2 Golf score cards shall indicate that reclaimed wastewater is used for irrigation on the golf course lands.

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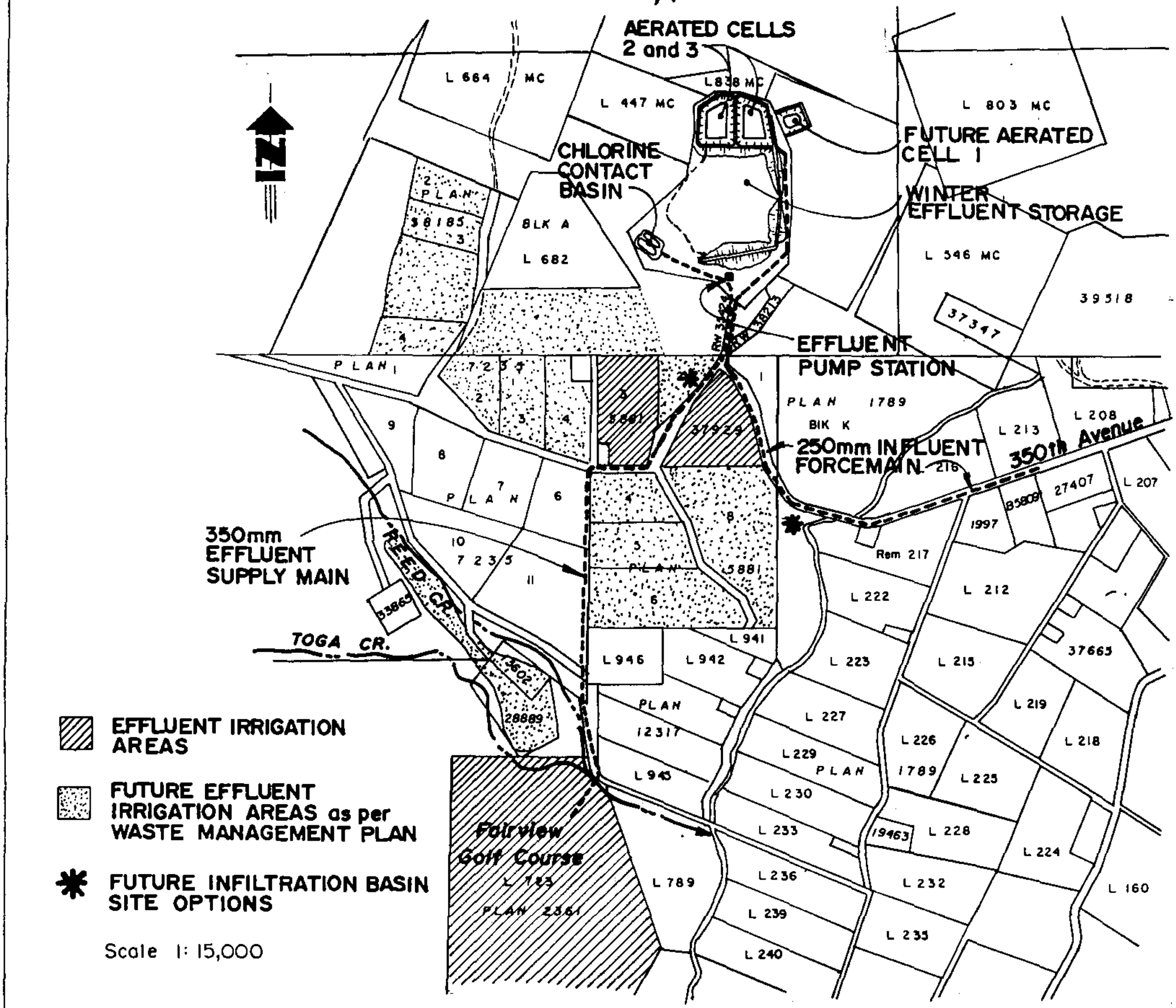
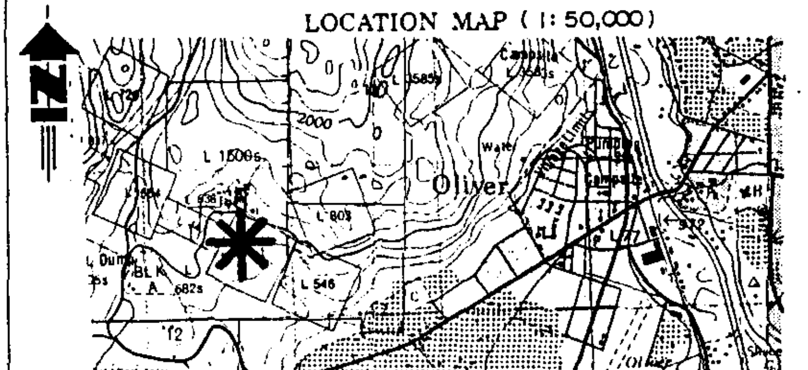
Assistant Regional Waste Manager

## SITE PLAN A




LOCATION MAP (1: 50,000)




(FOR OFFICE USE ONLY)

December 14, 1995
Date Issued

Date Amended

T.R. Forty, P.Eng.
Assistant Regional Waste Manager

Page

Permit No./Approval No. PE 13717

# APPENDIX B

## Sanitary Capital Plan

# 2018 Sanitary System Capital Plan

BRITISH COLUMBIA
Town of Oliver

March 2019

Project No. 306-1751

TRUE

ENGINEERING ■ PLANNING ■ URBAN DESIGN ■ LAND SURVEYING

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# Revision Log

| Revision # | Revised by | Date | Issue / Revision Description |
|---|---|---|---|
| **0** | A Schultz | 2019-02-05 | |
| **1** | A Schultz | 2019-03-08 | |
| **2** | D Grant | 2019-12-04 | Inclusion of FCM MAMP assistance statement |
| | | | |

# Report Submission

*Report Prepared By:*

*Alyssa Schultz, EIT*
*Project Engineer*

*Report Reviewed By:*

*Steve Underwood, P. Eng.*
*Project Engineer*

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# Table of Contents

**APPENDICES**

# List of Tables



# List of Figures

# List of Acronyms

| | |
|---|---|
| AC | Asbestos Cement |
| CPE | Chlorinated Polyethylene |
| FLNRO | Ministry of Forests, Lands, and Natural Resource Operations |
| GIS | Geographic Information Systems |
| HDPE | High Density Polyethylene |
| I&I (I/I) | Inflow and Infiltration |
| LS | Lift Station |
| LWMP | Liquid Waste Management Plan |
| MOE | Ministry of Environment and Climate Change Strategy |
| MSR | Municipal Sewage Regulation |
| MWR | Municipal Wastewater Regulation |
| OC | Operational Certificate |
| OCP | Official Community Plan |
| OIB | Osoyoos Indian Band |
| PCSWMM | Storm Water Management Model |
| PVC | Polyvinyl Chloride |
| SCADA | Supervisory Control and Data Acquisition |
| TRUE | TRUE Consulting |
| WMP | Waste Management Plan |

# Units of Measure

| | |
|---|---|
| km | kilometre |
| L/d | Litres per day |
| L/m | Litres per minute |
| L/s | Litres per second |
| lpcd | Litres per capita per day |
| m | metre |
| $m^3$/day | cubic metre per day |
| mg/L | milligrams per Litre |
| mm | millimetre |

# Referenced Reports


TRUE Consulting Group (2002). *Town of Oliver 2002 Liquid Waste Management Plan Update.*

TRUE Consulting Group (2018). *Town of Oliver Wastewater Treatement System Capacity Improvements.*


# Support from FCM




The preparation of this document was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

# 1.0 Introduction

The purpose of this report is to evaluate the sanitary collection network and treatment system performance under existing and future conditions in order to develop a guide for staged system improvements and expansions. In addition, guideline recommendations from the Ministry of Environment and Climate Change (MOE) to review Liquid Waste Management Plans (LWMP) every 5 to 10 years has prompted an update to the Town's LWMP, which was most recently updated in 2002. This report serves as the 2018 LWMP Update. It includes revisions to the forecasted reclaimed water irrigation flow rates; review of all system works, summarizes upgrades to the Town's collection, treatment and reclaimed water system; and updates projected capital asset management costs.

The following general scope of work was completed:

- Reviewed the Town of Oliver's Liquid Waste Management Plan Update (2002)
- Reviewed historical population and generation rates in the Town in order to generate projected flows on a 20-year design horizon
- Developed a sanitary collection network model using PCSWMM including:
  - Reviewed record drawings and survey data to populate the model
  - Reviewed Official Community Plan (OCP) land use for existing and future conditions
- Reviewed available SCADA data for lift stations and the treatment system.
- Prepared a report to summarize the analysis and recommendations for replacement, rehabilitation, or improvements to infrastructure

# 2.0 Background

The Town's sanitary system is referred to in two distinct systems: the sanitary collection network and the treatment system. The sanitary collection network consists of gravity pipe, six lift stations, and their respective forcemains. The collection network converges at the Influent Lift Station where it then begins the treatment process at the screening station. All components beyond and including the screening station comprise the treatment system.

## 2.1 Sanitary Collection Network

The Town's sanitary collection network consists of approximately 41.5 kilometers of gravity mains, six lift stations, and 3 kilometers of force mains. As shown on Figure 2-1, the gravity network and lift stations convey all generated flows to the Influent Lift Station which pumps into the screening station (the first step in the treatment process). The network is generally separated into six areas, each of which supplies by gravity to one of the lift stations.

1. Influent Lift Station
2. McPherson Lift Station
3. Rockcliffe Lift Station
4. Rotary Beach Lift Station
5. Sawmill Road Lift Station
6. Scott Road Lift Station

The existing sanitary collection network is generally limited to within the Municipal boundary. However, there are some parcels outside the Municipality which are serviced or planned to be serviced in the future. These parcels are primarily on Osoyoos Indian Band (OIB) land. The installation year of infrastructure within the sanitary network ranges from the 1960s to present as there is ongoing development in the Town.

## 2.2 Treatment System

The original wastewater treatment system consisted of an equalization basin, wastewater pump station and activated sludge treatment system. These works were constructed pre-1985 and are located on the former treatment plant site adjacent to the Town's Public Works Yard at 5971 Sawmill Road. From 1962 to 1984 treated effluent was then discharged into the Okanagan River. In the mid 1980's the Town of Oliver adopted a plan for reuse of treated effluent in the Fairview area, thereby discontinuing direct discharge of treated effluent to the Okanagan River. A summary of system improvements and expansions from 1966 to present are listed in Section 2.2.8.

The existing treatment process now consists of an influent screening station, two equalization basins, a wastewater pump station and forcemain, an aerated lagoon treatment system, reservoir storage, and reclaimed water irrigation system. These system components are described in more detail below, and an overview of the wastewater treatment system can be seen in Figure 2-2, including site plans for the overall reclaimed water supply system and aerated lagoon areas.

### 2.2.1 Influent Screens

The first step in the treatment process is solids removal. This is achieved by pumping influent through rotating screens. These screens were part of the initial treatment system and are located on the former treatment plant site, adjacent to the Town's Public Works Yard.

A real-time flow meter has operated at the screening station in recent years, however it only began storing historical sub-daily flow data on the SCADA system in December 2018. Sub-daily refers to data taken at shorter intervals (ie. Minutes or seconds) to record flow levels throughout the day. All other flow meters or flow totalizers in the system are located after the equalization basins, and therefore do not represent the actual sub-daily generated flows.

### 2.2.2 Equalization Basin

Following solids removal, effluent is piped into a two-cell flow equalization system. Construction of Cell 1 was prompted by unreliable electrical services in the South Okanagan in the early 1980's. During this time, the Town experienced numerous, short duration interruptions in their electrical service on a daily basis throughout the summer months. In 1985, a design decision was made to construct a CPE-lined equalization basin (Cell 1) to store flows during short duration power failures rather than provide standby power. Since the early 1980's, the electrical utility has undertaken major improvements to the electrical distribution system and short duration power failures are now infrequent.

Inflow to the equalization basins flows through concrete open channels that formerly comprised the aeration basins and sludge digestor. The decommissioned tankage has a total storage volume of 900 $m^3$ and can be used as emergency storage if required. Piping systems and valves remain in place, allowing for wastewater to be diverted to this tankage and then returned to the normal wastewater system if required.

In 1995, a floating surface aeration mixer was installed in Cell 1 for odor reduction. Cell 2 was constructed in 2009 as a result of energy incentives from Fortis BC to discharge during off-peak hours. Cell 2 is comprised of a 60 mil HDPE membrane lining and aerators, comparable to Cell 1. A site plan of the equalization basin is found in Figure 2-3.

### 2.2.3 Wastewater Pump Station and Forcemain

Following the equalization basins, the effluent is pumped from the High Lift Station through 3,400 m of 350 mm diameter PVC forcemain to a two-cell aerated treatment lagoon system. Pumping at the High Lift Station generally occurs in the evenings and on weekdays to optimize energy incentives offered by Fortis BC. The current forcemain was constructed in 2004., during which time the former 250 mm diameter forcemain was converted to a reclaimed water supply main.

### 2.2.4 Aerated Lagoon Treatment System

This two-cell aerated lagoon system is located off Fairview Road in the southeast area of the Town (see Figure 2-4) and was constructed in 1995 to replace the previous activated sludge plant. The aerated lagoon cells are designated as No. 2 and 3, with a third cell (No. 1) planned in the build out design (see Appendix A).

Air to the system is provided by two 40 Hp positive displacement blowers housed in a building located at the south east corner of aerated cell #2. Piping, electrical and space provisions have been made in the building for installation of two additional blower units. Figure 2-5 shows details of the Aeration Treatment System Layout and Intercell Piping.

### 2.2.5 Reservoir Storage

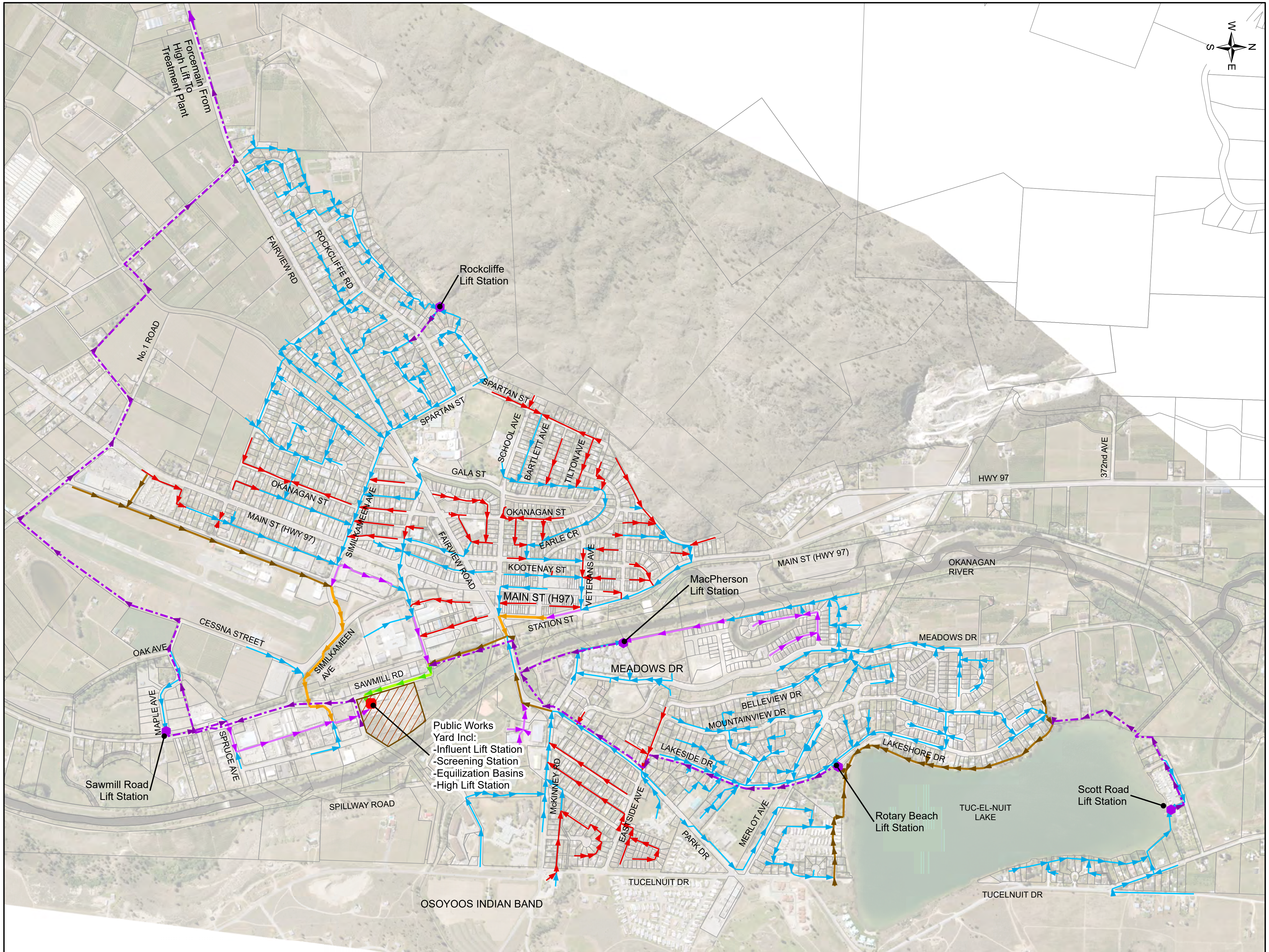
The winter effluent storage reservoir was constructed in 1984 and is comprised of two earth fill berms, which traverse the south and east side of a natural topographic depression. The maximum operating elevation of the reservoir is 447.0 m, at which point the surface area of the reservoir is 6.5 ha. Prior to distribution for irrigation use, effluent is pumped from reservoir storage to the chlorine contact basins.

### 2.2.6 Chlorine Contact Chambers

Following reservoir storage, the irrigation booster station pumps effluent from the winter storage reservoir to the chlorine contact basins. The booster station is equipped with two 50 Hp horizontal split case pumps, which have a combined operating capacity of 76 to 100 L/s (depending on the effluent elevation in the storage reservoir). Space and piping provisions have been made for a third pump. The Town utilizes chlorine gas in the booster station for effluent disinfection, followed by two CPE membrane-lined chlorine contact basins, each measuring 15m x 52m with a design operating depth of 2.6 m operate in series and provide a contact volume of 2180 m$^3$.

### 2.2.7 Reclaimed Water Irrigation

Reclaimed water supply and distribution was first constructed to the Fairview Mountain Golf Course in the 1980s. From 2004 to 2005, the reclaimed water distribution system was expanded to serve the seven additional sites including: the cemetery, Linear Park, Airport, Public Works Yard, Alonso, Huggins, and the Secondary School as shown on Figure 2-2. This distribution system uses the previous 250 mm diameter sanitary forcemain, now converted to reclaimed water supply. Flow meters measure reclaimed water usage at all sites except the Fairview Mountain Golf Course. Reclaimed water usage at the Fairview Mountain Golf Course has since been calculated as the total annual irrigation volume less all other metered usage.




# Sanitary Collection Network Layout

## Legend

- Forcemains
- Public Works
- Lift Stations
- Influent Lift Station

**Diameter (mm)**

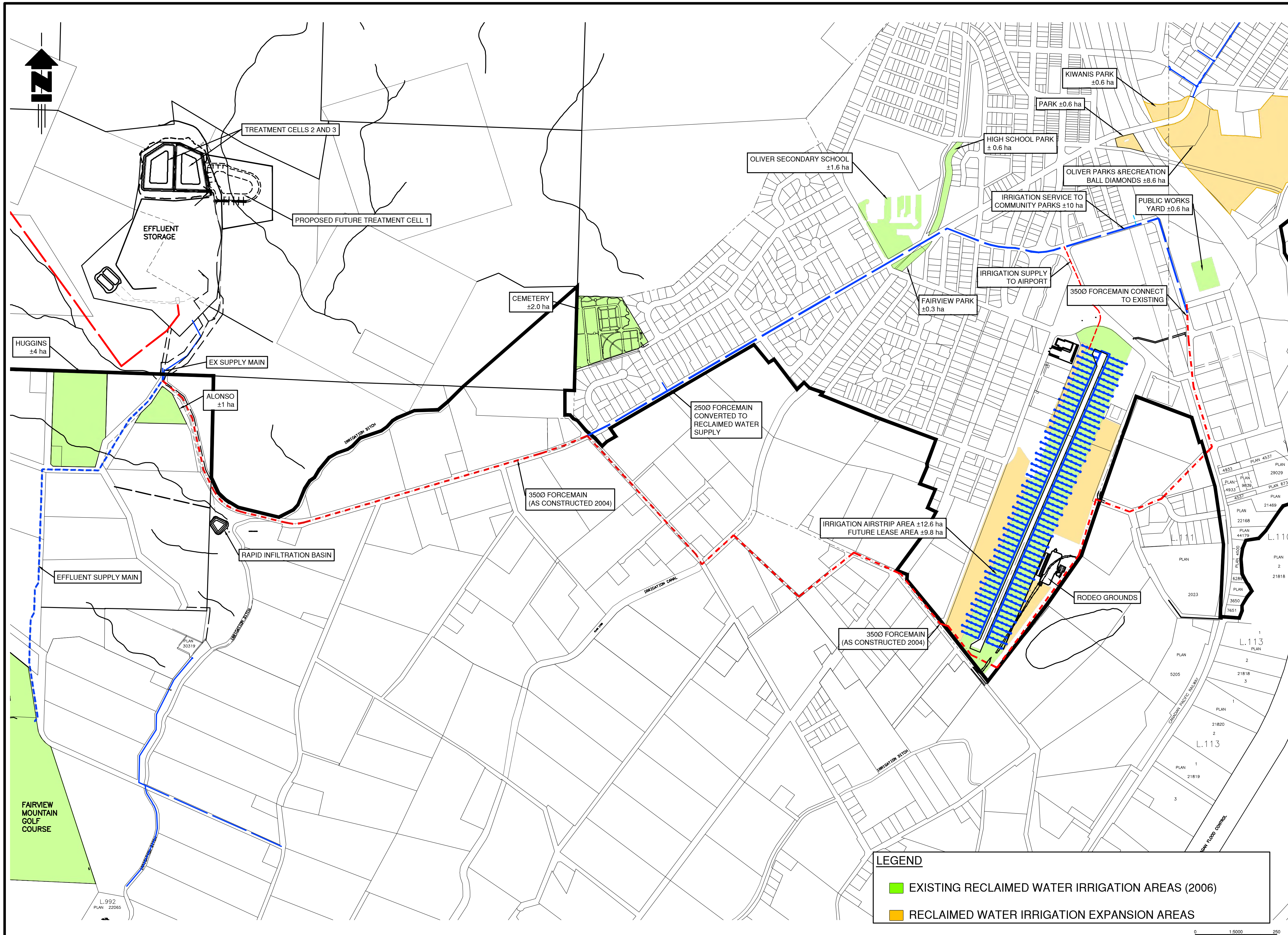
- 150
- 200
- 250
- 300
- 375
- 600
- Property Cadastre

1:12,500

0 125 250 500 Meters

**Figure 2-1**

R:\Clients\300-399\306\306-1751\03 Drawings\GIS\Maps\306-1751-001 Fig Sanitary Collection Layout.mxd




ISSUES / REVISIONS

| No. | DATE | DESCRIPTION | BY | APP |
|---|---|---|---|---|

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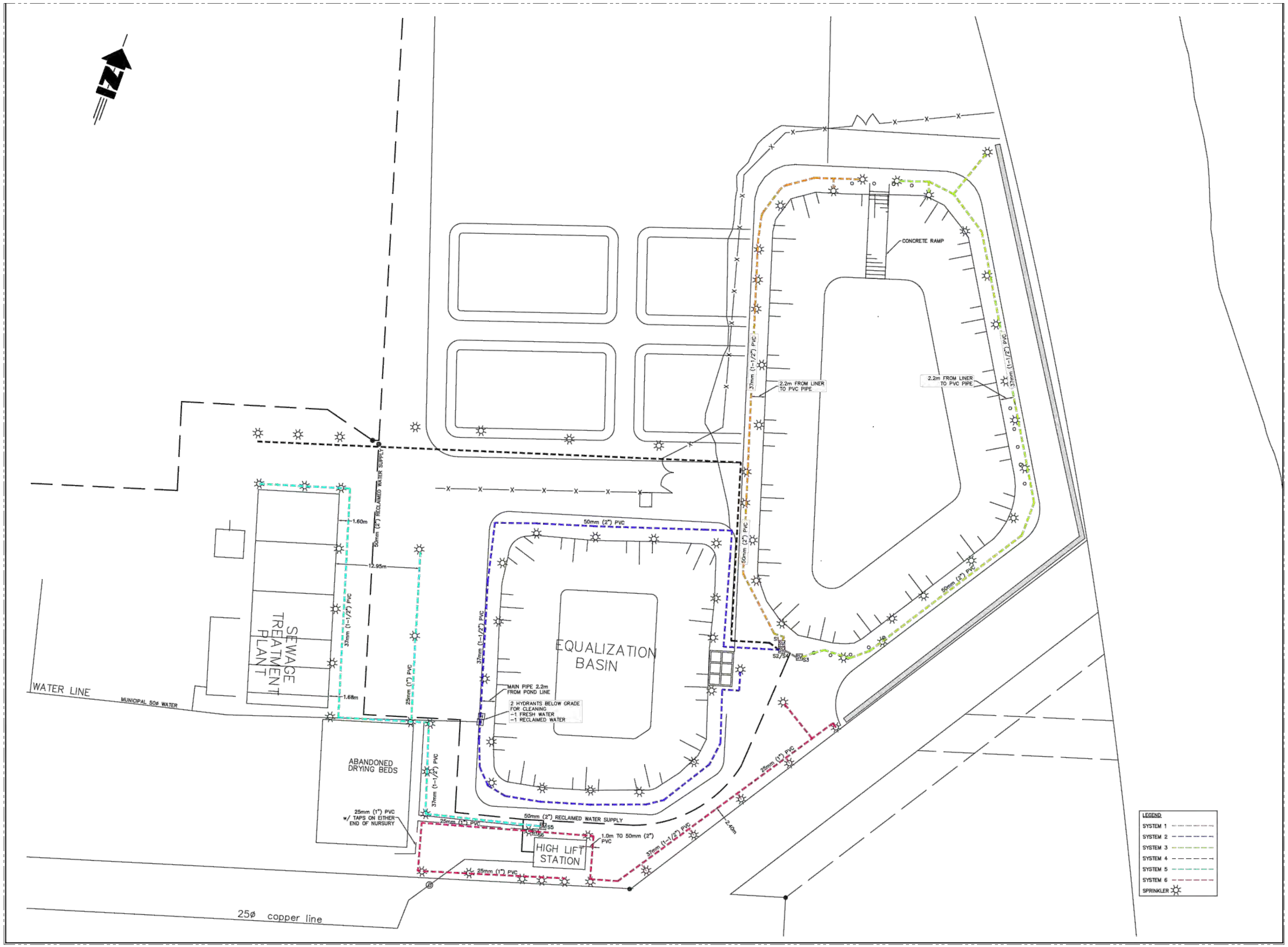
info@TRUE.bc.ca

British Columbia Town of Oliver

**2019 SANITARY CAPITAL PLAN**

**OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS**

| | |
|---|---|
| SCALE | N.T.S. (11X17) |
| DESIGN BY | TRU |
| DRAWN BY | NA |
| DATE | JANUARY 2018 |
| PROJECT REFERENCE No. | 306-1751 |
| DRAWING No. | FIG 2-2 |
| SHEET | 1 OF 1 |
| ISSUE/REV. | |




No. | DATE | DESCRIPTION | BY | APP'D

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British Columbia Town of Oliver

**2019 SANITARY CAPITAL PLAN**

**EQUALIZATION BASIN OVERALL SITE PLAN**

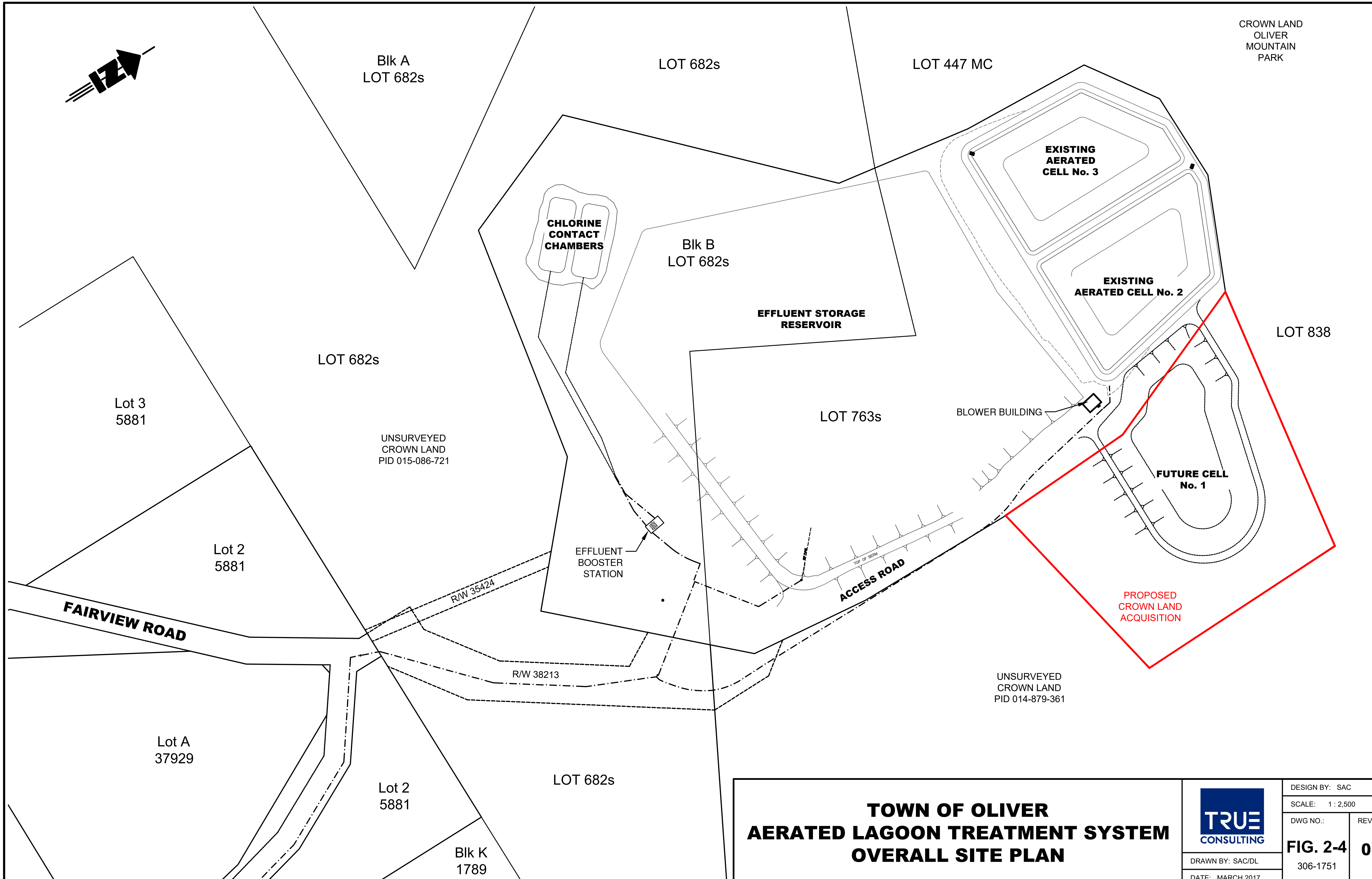
| | |
|---|---|
| SCALE | N.T.S. (11X17) |
| DESIGN BY | TRU |
| DRAWN BY | NA |
| DATE | JANUARY 2018 |
| PROJECT REFERENCE No. | 306-1751 |

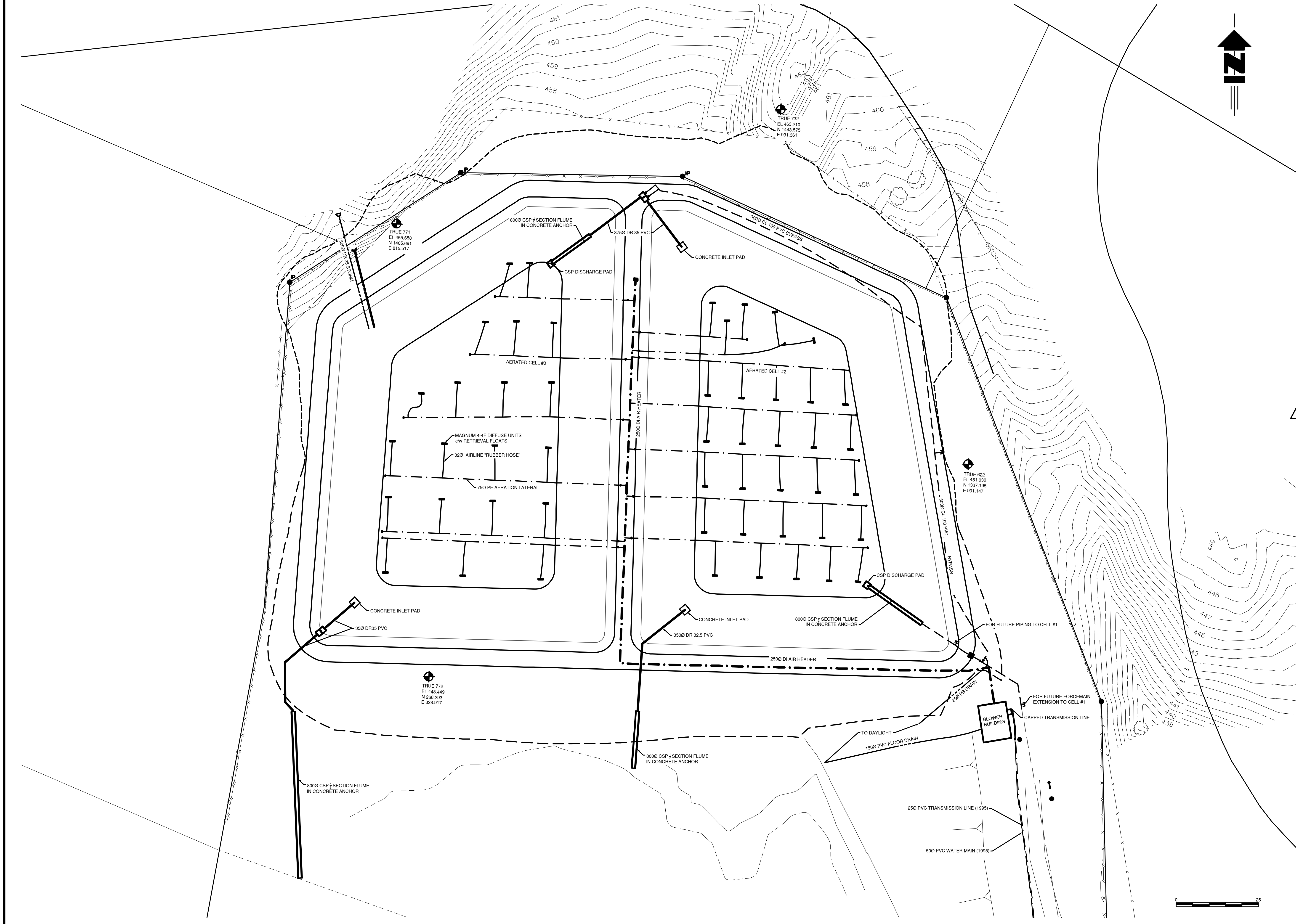
DRAWING No. **FIG 2-3**

SHEET OF

ISSUE/REV.

FILE: r:\clients\300-399\306\306-1751\03 drawings\cad\02 design drawings\306-1751 -march 7 2018


Blk A
LOT 682s
LOT 682s
LOT 447 MC
CROWN LAND
OLIVER
MOUNTAIN
PARK
CHLORINE
CONTACT
CHAMBERS
Blk B
LOT 682s
EXISTING
AERATED
CELL No. 3
EXISTING
AERATED CELL No. 2
EFFLUENT STORAGE
RESERVOIR
LOT 838
LOT 682s
Lot 3
5881
LOT 763s
BLOWER BUILDING
UNSURVEYED
CROWN LAND
PID 015-086-721
FUTURE CELL
No. 1
Lot 2
5881
EFFLUENT
BOOSTER
STATION
R/W 35424
ACCESS ROAD
TOP OF BERM
FAIRVIEW ROAD
PROPOSED
CROWN LAND
ACQUISITION
R/W 38213
UNSURVEYED
CROWN LAND
PID 014-879-361
Lot A
37929
Lot 2
5881
LOT 682s
Blk K
1789
TOWN OF OLIVER
AERATED LAGOON TREATMENT SYSTEM
OVERALL SITE PLAN
TRUE CONSULTING
DESIGN BY: SAC
SCALE: 1 : 2,500
DWG NO.:
REV:
FIG. 2-4
0
306-1751
DRAWN BY: SAC/DL
DATE: MARCH 2017




| No. | DATE | DESCRIPTION | BY | APP'D |
|---|---|---|---|---|

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British Columbia Town of Oliver

**2019 SANITARY CAPITAL PLAN**

**AREATEION SYSTEM LAYOUT AND INTERCELL PIPING**

| | |
|---|---|
| SCALE | N.T.S. (11 X 17) |
| DESIGN BY | TRU |
| DRAWN BY | NA |
| DATE | JANUARY 2019 |
| PROJECT REFERENCE No. | 306-1751 |
| DRAWING No. | FIG 2-5 |
| SHEET | 1 OF 1 |
| ISSUE/REV. | |

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### 2.2.8 Chronological Summary of Improvements and Expansion of Sewerage Works

The Town completed their first Liquid Waste Management Plan (LWMP) in 1992, which provides a framework for collection, treatment, and disposal of wastewater. An update to the LWMP was completed in 2002, summarizing expansions and upgrades since publication of the 1992 LWMP. System improvements and expansions completed by the Town since 1966 are listed below in Table 2-1.

**TABLE 2-1: CHRONOLOGICAL SUMMARY OF IMPROVEMENTS AND EXPANSIONS TO SEWERAGE WORKS**

| YEAR | IMPROVEMENTS AND EXPANSIONS |
|---|---|
| **1966** | - Sanitary sewage treatment system implementation.<br>- Treated effluent discharged to Okanagan River. |
| **1983** | - Fairview Mountain Golf Course irrigation system constructed.<br>- Authorization Permit No.:PE-00102 |
| **1985** | - Construction of winter effluent storage and land disposal systems in the Fairview area.<br>- Receipt of Authorization Permit No.: PE13717<br>- Discharge to Okanagan River discontinued.<br>- Reclaimed water supply to Fairview Mountain Golf Course. |
| **1992** | - Adoption of Liquid Waste Management Plan<br>- Additional lands suitable for irrigation identified. |
| **1994** | - Aerated lagoon earthworks. |
| **1995** | - Aeration system, Topping Lake manhole intake.<br>- Blower building and appurtenances.<br>- Operational Certificate No. PE-13717 Amended |
| **1998** | - Town initiated update of 1992 LWMP.<br>- Rapid Infiltration Basins on Lot 2 Plan 5881. |
| **1999** | - High rate irrigation on Lots 5 and 6, Plan 5881.<br>- Town advised that reclaimed water irrigation expansion in the Fairview area, consistent with the 1992 LWMP would not be approved. |
| **2000** | - Town initiated a second update of the LWMP, with the principle objective of identifying lands for expansion of the reclaimed water irrigation system. |
| **2001** | - Rapid Infiltration Basins on Lots 5 and 6 Plan 5881 |
| **2002** | - LWMP Update reviewed and accepted. |
| **2004** | - Installation of 5020 metres of 350 mm ductile iron and PVC forcemain from the public works yard to the wastewater treatment site.<br>- Reclaimed water supply main from 350$^{th}$ Ave to the cemetery.<br>- Pressure reducing station at Oliver Secondary School.<br>- Reclaimed water supply main from 348$^{th}$ Ave to the airport.<br>- Public works yard reclaimed water service construction.<br>- Airport reclaimed water irrigation system construction, including: pipes, fittings, sprinklers, control valves, etc.<br>- Installation of flow meters at the airport, park adjacent to high school, cemetery and public works yard. |

| YEAR | | IMPROVEMENTS AND EXPANSIONS |
|---|---|---|
| **2005** | - | Reclaimed water system extensions placed into service at the public works yard, Linear Park, cemetery and airport. |
| **2009** | - | Construction of raw wastewater equalization basin #2. |
| **2010** | - | Upgrading of the chlorine contact basins at the wastewater treatment facility and reclaimed watermain from the reclaimed water booster station to the chlorine contact basin. |
| **2012** | - | Installation of rotary drum screen #2. |
| **2014** | - | Construction of infiltration basin (Town sand pit). |

# 3.0 Current and Projected Population

Population data has been updated since the 2002 LWMP Update. Using 2016 census information from Statistics Canada, projected growth rates for the short term and long term design horizons were revised.

# 3.1 Updated Population Data (1991-2016)

Updated population data is summarized in Table 3-1. This is compared to population estimates projected in the 2002 LWMP Update. To date, only agricultural properties in the North Tuc-El-Nuit Lake and 342[nd] area remain un-serviced by the Town's sanitary sewer system. Un-serviced properties within municipal boundaries represents approximately 2% of the Town's total population. For the purposes of this analysis, the Actual Population is derived from Statistics Canada and BC Stats.

**TABLE 3-1 TOWN OF OLIVER POPULATION PROJECTIONS**

| YEAR | 2002 LWMP ASSUMED POPULATION | ACTUAL POPULATION | ANNUAL AVERAGE POPULATION GROWTH RATE |
|---|---|---|---|
| 1991 | | 3,743 | 2.8% |
| **1996 | | 4,285 | -0.3% |
| **2001 | 4,867 | 4,224 | 0.7% |
| **2006 | 5,320 | 4,370 | 2.0% |
| *2011 | 5,687 | 4,824 | 0.4% |
| *2016 | 6,053 | 4,928 | |

*Source: Statistics Canada for Actual Population
**Source: BC Stats for Actual Population

# 3.2 Short and Long Term Population Projections

The average population growth rate from the 2001 to 2016 census is 1% annually. While BC Stats predicts population growth within the Regional District to be at a rate of 1% to 1.5%, this is mostly occurring in the City of Penticton and may not be an appropriate representation of the Region. The Town of Oliver Official Community Plan (OCP) anticipates a growth rate between -1% to 1% annually over the next 20 years. To provide a conservative estimate for analysis of the Town's sanitary system, a growth rate of 1% annually has been used for population projections within the Town of Oliver.

As shown in Table 3-2 below, the 10-year population projection (short term design horizon) is anticipated to reach a population of 5,550 and the 20-year population projection (long term design horizon) is expected to reach a population of 6,130. When compared to the 2002 LWMP Update, the actual 2018 population is approximately 1,200 fewer than previously projected.

**TABLE 3-2: TOWN OF OLIVER SHORT TERM AND LONG TERM POPULATION PROJECTIONS**

| YEAR | 2018 POPULATION PROJECTION | 2002 LWMP POPULATION PROJECTIONS |
|---|---|---|
| 2016 | 4,928 | 6,053 |
| 2017 | 4,977 | 6,127 |
| 2018 | 5,027 | 6,200 |
| 2028 (Short Term Horizon) | 5,550 | |
| 2038 (Long Term Horizon) | 6,130 | |

## 3.3 Land Use and Equivalent Population

In order to populate a hydraulic model of the collection network, parcel land-use was used to determine the generation rate of flow throughout the sanitary collection network. Detailed dwelling counts at existing conditions were not available from the town, therefore the OCP land-use and typical population densities were used to determine an equivalent population (see Table 3-3).

**TABLE 3-3: OCP LAND USE AND POPULATION DENSITY**

| LAND USE | POPULATION DENSITY | |
|---|---|---|
| | PER HA | PER PARCEL |
| AGRICULTURAL | | 1 |
| COMMERCIAL HWY | 50 | |
| COMMERCIAL TOURIST | 50 | |
| HIGH DENSITY RESIDENTIAL | 80 | |
| INDUSTRIAL | 50 | |
| INSTITUTIONAL | 50 | |
| LOW DENSITY RESIDENTIAL | | 1 |
| MEDIUM DENSITY RESIDENTIAL | 40 | |
| OTHER LOTS | | 1 |
| TOWN CENTRE | 50 | |

Table 3-4 below shows the calculated equivalent populations for each land use category and the respective serviced area. Based on anticipated future development of undeveloped parcels, the same values were calculated for future conditions. The future equivalent population calculated referencing the OCP land use is consistent with the projected 20-year design horizon population at 1% annual population growth.

### Table 3-4: OCP Equivalent Populations

| Population Density | Existing Conditions | | Future Conditions | |
|---|---|---|---|---|
| | Equivalent Population | Area (ha) | Equivalent Population | Area (ha) |
| AGRICULTURAL | 2 | 0.8 | 2 | 0.8 |
| COMMERCIAL HWY | 477 | 9.5 | 1065 | 21.3 |
| COMMERCIAL TOURIST | 260 | 5.2 | 260 | 5.2 |
| HIGH DENSITY RESIDENTIAL | 760 | 9.5 | 1339 | 16.7 |
| INDUSTRIAL | 1560 | 31.2 | 1562 | 31.2 |
| INSTITUTIONAL | 1557 | 31.1 | 1557 | 31.1 |
| LOW DENSITY RESIDENTIAL | 1431 | 141.2 | 1463 | 155.3 |
| MEDIUM DENSITY RESIDENTIAL | 949 | 23.7 | 1319 | 33.0 |
| OTHER LOTS | 4 | 52.1 | 4 | 52.1 |
| TOWN CENTRE | 406 | 8.1 | 452 | 9.0 |
| **Total** | **7406** | **312.5** | **9022** | **355.8** |

# 4.0 Capacity Assessment of Treatment System

A capacity assessment for each component of the Town's treatment system is described below, including review of wastewater transmission, treatment and disposal. Population growth projections were integrated into the assessment, providing information on the service population capacity of each system component. This assessment was undertaken based on the 2002 LWMP Update and the OC No. PE-13717 for the system.

## 4.1 Wastewater Flows

### 4.1.1 Average Influent Flows

A comparison table of average daily and total annual influent flows are shown in Table 4-1. This table compares projections derived in the 2002 LWMP Update to actual data recorded by the Town. As seen, the average daily flow generated from recorded data in 2017 is significantly lower than the daily flow forecasted in the 2002 LWMP Update (1,888 m³/day and 2,423 m³/day respectively).

**TABLE 4-1: TOWN OF OLIVER SANITARY SEWER INFLUENT FLOWS FROM 2002-2017**

| | 2002 LWMP | | | Actual | | | |
|---|---|---|---|---|---|---|---|
| Year | Population* | Annual Influent Volume (m³) | Avg. Daily Flow (m³/d) | Population | Annual Influent Volume (m³) | Avg. Daily Flow (m³/d) | Per Capita Flow (m³/capita/day) |
| 2002 | 4,984 | 744,295 | 2,039 | 4,253 | 726,354 | 1,990 | 0.47 |
| 2003 | 5,100 | 762,994 | 2,090 | 4,282 | 751,139 | 2,058 | 0.48 |
| 2004 | 5,173 | 774,771 | 2,123 | 4,312 | 766,048 | 2,099 | 0.49 |
| 2005 | 5,247 | 786,548 | 2,155 | 4,341 | 783,947 | 2,148 | 0.49 |
| 2006 | 5,320 | 798,326 | 2,187 | 4,370 | 829,413 | 2,272 | 0.52 |
| 2007 | 5,393 | 810,103 | 2,219 | 4,461 | 823,011 | 2,255 | 0.51 |
| 2008 | 5,467 | 821,880 | 2,252 | 4,552 | 777,154 | 2,129 | 0.47 |
| 2009 | 5,540 | 833,658 | 2,284 | 4,642 | 758,308 | 2,078 | 0.45 |
| 2010 | 5,613 | 845,435 | 2,316 | 4,733 | 701,475 | 1,922 | 0.41 |
| 2011 | 5,687 | 857,212 | 2,349 | 4,824 | 693,045 | 1,899 | 0.39 |
| 2012 | 5,760 | 868,990 | 2,381 | 4,845 | 658,002 | 1,803 | 0.37 |
| 2013 | 5,833 | 880,767 | 2,413 | 4,866 | 697,377 | 1,911 | 0.39 |
| 2014 | 5,907 | 892,544 | 2,445 | 4,886 | 634,649 | 1,739 | 0.36 |
| 2015 | 5,980 | 904,322 | 2,478 | 4,907 | 679,542 | 1,862 | 0.38 |
| 2016 | 6,053 | 916,099 | 2,510 | 4,928 | 639,794 | 1,753 | 0.36 |
| **2017** | **6,127** | **927,876** | **2,542** | **4,977** | **689,098** | **1,888** | **0.38** |

*Assumes 1.5% population growth rate from 2002 onwards.

The decrease in per capita sewage flows observed over the past twelve years can be attributed to legislation within the province related to low flow fixture installation, greater public awareness and conservation efforts, as well as disconnection of the Vincor winery. Future wastewater flows derived herein are based on a per capita contribution of 0.38 $m^3$/day and a population growth rate of 1% annually, as shown in Table 4-2.

**TABLE 4-2: PROJECTED FUTURE INFLUENT FLOWS**

| YEAR | PROJECTED POPULATION | ANNUAL AVERAGE FLOW ($M^3$/D) | AVERAGE FLOW (L/S) |
|---|---|---|---|
| 2017 | 4,977 | 1,888 | 21.9 |
| 2018 | 5,027 | 1,907 | 22.1 |
| 2023 | 5,283 | 2,004 | 23.2 |
| 2028 | 5,553 | 2,107 | 24.4 |
| 2033 | 5,836 | 2,214 | 25.6 |
| 2038 | 6,134 | 2,328 | 26.9 |
| 2043 | 6,446 | 2,446 | 28.3 |
| 2048 | 6,775 | 2,571 | 29.8 |
| 2053 | 7,121 | 2,703 | 31.3 |
| 2058 | 7,484 | 2,841 | 32.9 |
| 2063 | 7,866 | 2,986 | 34.6 |
| 2068 | 8,267 | 3,138 | 36.3 |
| 2073 | 8,689 | 3,299 | 38.2 |
| 2078 | 9,132 | 3,467 | 40.1 |
| 2083 | 9,598 | 3,644 | 42.2 |

### 4.1.2 Reservoir Operational Data

Effluent is stored in the Town's storage reservoir during the winter months (October to April). This equates to ± 240 days residence time in the reservoir, including a 60-day retention time, as per the requirements of the Town's OC. Reservoir operational data from 2002-2017 is presented in Table 4-3 on Page 17. The total storage utilized per capita ranges from 37-63 $m^3$ annually. Per capita storage from 2002 was excluded from this range, as the value appears to be a data anomaly. Variability in the rate of utilization can be attributed to climatic factors and user demand.

### 4.1.3 Annual Effluent Flows

The overall hydraulic balance of treated effluent from 2002 to 2017 is presented in Table 4-4 on Page 18. As seen, total influent volumes have decreased significantly since 2002 and the net effluent storage per capita has varied from year to year. Fluctuations in the reservoir storage requirements are related to seasonal weather variations and changes in user demand effecting irrigation demand. Unaccounted losses are comprised of seepage from the aerated lagoons and effluent storage reservoir, evaporative losses, and flow meter inaccuracies.

### TABLE 4-3: RESERVOIR STORAGE AND IRRIGATION SUMMARY 2002-2017

| YEAR | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volume in Storage on Jan. 1 ($m^3$)** | 82,000 | 90,000 | 213,000 | 272,000 | 205,000 | 197,000 | 170,000 | 167,000 | 200,000 | 223,000 | 197,000 | 211,000 | 284,000 | 223,000 | 214,000 | 247,000 |
| **Total Influent Volume ($m^3$)** | 726,354 | 751,139 | 766,048 | 783,947 | 829,413 | 823,011 | 777,154 | 758,308 | 701,475 | 693,045 | 658,002 | 697,377 | 634,649 | 679,542 | 639,794 | 689,098 |
| **Total Irrigation Volume ($m^3$)** | 433,620 | 401,022 | 329,575 | 620,982 | 636,315 | 649,220 | 606,744 | 520,530 | 519,803 | 470,917 | 489,241 | 476,510 | 482,164 | 504,049 | 454,221 | 437,919 |
| **Rapid Infiltration ($m^3$)** | 0 | 54,300 | 139,470 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23,322 |
| **Unaccounted Losses ($m^3$)** | 284,734 | 172,817 | 238,003 | 229,965 | 199,098 | 200,791 | 173,410 | 206,778 | 159,672 | 248,128 | 154,761 | 147,867 | 213,485 | 184,493 | 152,573 | 199,857 |
| **Net Storage at Year-End ($m^3$)** | 90,000 | 213,000 | 272,000 | 205,000 | 199,000 | 170,000 | 167,000 | 198,000 | 222,000 | 197,000 | 211,000 | 284,000 | 223,000 | 214,000 | 247,000 | 275,000 |
| **Total Area Irrigated ($m^2$)** | 450,000 | 450,000 | 450,000 | 186,000 | 613,000 | 613,000 | 613,000 | 613,000 | 660,000 | 660,000 | 660,000 | 660,000 | 186,000 | 186,000 | 186,000 | 623,000 |
| **Storage Period (days)** | 147 | 153 | 231 | 189 | 189 | 177 | 199 | 180 | 198 | 168 | 161 | 118 | 168 | 183 | 168 | 147 |

### TABLE 4-4: WINTER EFFLUENT STORAGE OPERATING DATA

| YEAR | DATE | | ELEVATION (M) | STORAGE VOLUME ($M^3$) | STORAGE PERIOD (DAYS) | TOTAL STORAGE USED ($M^3$) | TOTAL STORAGE PER CAPITA ($M^3$/CAPITA) |
|---|---|---|---|---|---|---|---|
| 2002 | Max. | 22-Apr-02 | 443.73 | 228,000 | 147 | 90,000 | 21 |
| | Min. | 16-Sep-02 | 440.05 | 34,000 | | | |
| 2003 | Max | 22-Apr-03 | 443.96 | 240,000 | 153 | 213,000 | 50 |
| | Min. | 22-Sep-03 | 440.66 | 59,000 | | | |
| 2004 | Max. | 19-Apr-04 | 445.77 | 377,000 | 231 | 272,000 | 63 |
| | Min. | 06-Dec-04 | 444.22 | 260,500 | | | |
| 2005 | Max. | 18-Apr-05 | 446.4 | 390,000 | 189 | 205,000 | 47 |
| | Min. | 24-Oct-05 | 441.18 | 81,000 | | | |
| 2006 | Max. | 24-Apr-06 | 446.2 | 380,000 | 189 | 199,000 | 46 |
| | Min. | 30-Oct-06 | 440.81 | 67,000 | | | |
| 2007 | Max. | 30-Mar-07 | 446 | 370,000 | 177 | 170,000 | 38 |
| | Min. | 23-Sep-07 | 440.34 | 40,000 | | | |
| 2008 | Max. | 13-Apr-08 | 445.28 | 339,000 | 199 | 167,000 | 37 |
| | Min. | 29-Oct-08 | 440.39 | 49,000 | | | |
| 2009 | Max. | 14-Apr-09 | 445.45 | 344,000 | 180 | 198,000 | 43 |
| | Min. | 11-Oct-09 | 440.72 | 61,000 | | | |
| 2010 | Max. | 06-Apr-10 | 445.64 | 352,000 | 198 | 222,000 | 47 |
| | Min. | 21-Oct-10 | 440.95 | 71,000 | | | |
| 2011 | Max. | 11-Apr-11 | 445.75 | 357,000 | 168 | 197,000 | 41 |
| | Min. | 26-Sep-11 | 441.09 | 76,000 | | | |
| 2012 | Max. | 02-May-12 | 445.36 | 338,000 | 161 | 211,000 | 44 |
| | Min. | 10-Oct-12 | 440.99 | 72,000 | | | |
| 2013 | Max. | 25-Apr-13 | 445.52 | 355,000 | 118 | 284,000 | 58 |
| | Min. | 21-Aug-13 | 441.67 | 106,000 | | | |
| 2014 | Max. | 31-Mar-14 | 446.06 | 374,000 | 168 | 223,000 | 46 |
| | Min. | 15-Sep-14 | 441.39 | 92,000 | | | |
| 2015 | Max. | 07-Apr-15 | 445.62 | 351,000 | 183 | 214,000 | 44 |
| | Min. | 07-Oct-15 | 441.52 | 101,000 | | | |
| 2016 | Max. | 04-Apr-16 | 445.47 | 343,000 | 168 | 247,000 | 50 |
| | Min. | 19-Sep-16 | 441.60 | 105,000 | | | |
| 2017 | Max. | 22-May-17 | 446.17 | 379,000 | 147 | 275,000 | 55 |
| | Min. | 16-Oct-17 | 442.75 | 167,000 | | | |

Historically, reclaimed water usage has been measured by a flow meter located at the booster station (adjacent to the reclaimed water storage reservoir), the Alonso property and the Higgins property. In 2005, flow meters were installed at the cemetery, Linear Park, the airport, the school, and the public works yard. Reclaimed water usage at the Fairview Mountain Golf Course is calculated as the total annual irrigation volume less all other metered usage. Table 4-5 lists the sites currently serviced with reclaimed water irrigation and their total irrigated area.

**TABLE 4-5: TOWN OF OLIVER IRRIGATION AREAS**

| LOCATION | AREA ($M^3$) |
|---|---|
| Fairview Mountain Golf Course | 450,000 |
| Cemetery | 23,000 |
| 103rd Street Linear Park | 8,000 |
| Airport | 126,000 |
| Public Works Yard | 6,000 |
| Alonso2 | 10,000 |
| Huggins2 | 37,000 |
| Secondary School | 7,000 |
| **Total** | **667,000** |

## 4.2 Equalization Basin

Cell 1 has a total storage volume of 1,100 $m^3$ and was designed to include equalization storage (15% of average daily flow) and emergency storage (12 hours or 50% of average daily flow). A residence time of 0.67 days is used for storage capacity projections. This measurement is derived using a maximum storage period of 16 hours, as per peak electricity rate hours during the shoulder season (i.e. Mar.-Jun., Sept. and Oct.).

Cell 2 was constructed northeast of the existing equalization basin and provides operational storage of 2,300 $m^3$. A residence time of 0.67 days was again assumed for capacity projections. An overview of the equalization basin Cell 2 system expansion design and pre-design brief can be found in Appendix B. The total available storage of the two equalization basins, as well as the 900 $m^3$ of emergency storage described in Section 2.2.2, is summarized in Table 4-6.

**TABLE 4-6: EQUALIZATION BASIN STORAGE CAPACITY**

| STORAGE AREA | TOTAL STORAGE VOLUME ($M^3$) |
|---|---|
| Equalization Cell 1 | 1,100 |
| Equalization Cell 2 | 2,300 |
| Emergency Storage (in original treatment plant location) | 900 |
| **Total Capacity** | **4,300 $m^3$** |
| **Total Capacity excl. Emergency Storage** | **3,400 $m^3$** |

The total design capacity of the two equalization basins is 3,400 $m^3$, excluding emergency storage. Table 4-7 forecasts storage requirements for operation using a 0.67 day residence time. Under this operational design, capacity is estimated to be reached in 2090. This projection assumes a 1.3 factor of safety, 1% population growth, 0.38 $m^3$/capita*day generation rate and 16-hour storage period. This capacity projection defines the point at which the system will no longer be able to store effluent to pump during off-peak hours.

**Table 4-7: Equalization Basin Storage Capacity Projection**

| Year | Population (1% Growth Rate) | Flow ($m^3/d$) | Storage Required ($m^3$) |
|---|---|---|---|
| 2017 | 4,977 | 1,888 | 1,636 |
| 2018 | 5,027 | 1,907 | 1,653 |
| 2019 | 5,077 | 1,926 | 1,669 |
| 2020 | 5,128 | 1,945 | 1,686 |
| 2025 | 5,389 | 2,045 | 1,772 |
| 2030 | 5,664 | 2,149 | 1,863 |
| 2035 | 5,953 | 2,259 | 1,958 |
| 2040 | 6,257 | 2,374 | 2,058 |
| 2045 | 6,576 | 2,496 | 2,163 |
| 2050 | 6,912 | 2,623 | 2,273 |
| 2055 | 7,264 | 2,757 | 2,389 |
| 2060 | 7,635 | 2,898 | 2,512 |
| 2065 | 8,024 | 3,046 | 2,640 |
| 2070 | 8,433 | 3,201 | 2,775 |
| 2075 | 8,864 | 3,365 | 2,916 |
| 2080 | 9,316 | 3,537 | 3,065 |
| 2085 | 9,791 | 3,717 | 3,222 |
| 2090 | 10,290 | 3,907 | 3,386 |
| 2091 | 10,393 | 3,946 | 3,420 |

## 4.3 High Lift Station

The SCADA system records the pump hours and number of starts at the High Lift Station, as well as the total daily flow using a flow totalizer. Based on this data, the operating capacity of the High Lift Station is approximately 30 L/s per pump. The Lift Station contains three pumps, one of which is reserved as a stand-by unit, meaning that the design capacity of the Lift Station is approximately 40 L/s (3,450 $m^3$/day).

As influent is stored in the equalization basins such that pumping can be done in off-peak hours, the capacity assessment of the High Lift Station is subject to average influent flows, rather than peak daily flows. Based on Table 4-7 above, the High Lift Station configuration is anticipated to meet the average daily flow pumping requirements until 2077, well past the long term design horizon (≥ 20 years).

## 4.4 Treatment

The two aerated lagoons in service have a combined capacity of approximately 75,800 $m^3$ and an operating depth of 5.3 m. Aeration is achieved through a submerged bottom fixed fine bubble diffuser system. A design summary was completed by TRUE in 2018 (see Appendix A) to establish the approximate timeline for construction of aerated lagoon No.1. Under existing conditions with lagoons fully de-sludged, it was determined that effluent BOD will exceed permitted concentrations in 2077, with a population of 9,080 people at 1% annual growth rate.

Under existing conditions where lagoons are not de-sludged, effluent BOD will exceed permitted concentrations in 2040, with a population of approximately 6,300 people. Under these assumptions, it is not anticipated that construction of the future aerated lagoon No. 1 will be required until 2040. This timeline will be dependent upon sludge accumulation, future desludging efforts and actual population growth rates.

A preliminary design for aerated lagoon No. 1 was completed by TRUE to determine the future Right of Way (ROW) area requirements for construction. In February 2017, a crown land tenure application was submitted to the Ministry of Forests, Lands, and Natural Resource Operations and Rural Development (FLNRORD) to obtain crown land necessary for the construction of aerated lagoon No.1. FLNRORD indicated the crown land tenure ROW necessary for the future construction of the lagoon could be incorporated into the Oliver Mountain assessment.

## 4.5 Winter Effluent Storage

The storage reservoir water elevation fluctuates between 439.00 m and 447.00 m, between which the total storage provided is estimated to be approximately 470,000 m$^3$. The lower elevation limit was generated based on a 60-day effluent residence time prior to discharge for irrigation.

The service capacity of the storage reservoir is dependent on climatic conditions both in the preceding irrigation season and the spring following the storage period. Construction of the infiltration basin in 2014 now assists the Town in addressing climatic variability. Winter storage requirements are derived from volume and flow data. A summary of winter effluent storage volumes from 2007-2017 is provided in Figure 4-1.

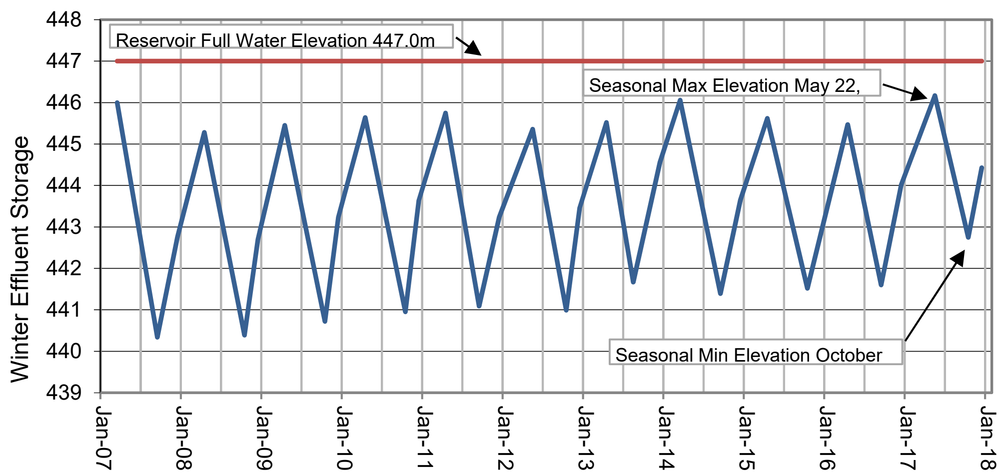



**FIGURE 4-1: RESERVOIR WINTER EFFLUENT STORAGE ELEVATIONS (2005-2017)**

A per capita storage requirement of 47 $m^3$/capita was averaged from 2003 to 2017. A multiplication factor of 1.2 was added to allow for a conservative estimate of future requirements. A 21 $m^3$/capita contribution provision was applied to meet the 60-day minimum retention time (as stated in the OC for PE 13717). This equates to a total requirement of 77 $m^3$/capita.

Measured storage requirements to date and projected requirements are presented in Table 4-8. Based on the above assumptions, the reservoir is anticipated to reach its design capacity in 2037 without any upgrades to the system or expansion of the reclaimed water irrigation area.

**TABLE 4-8: RESERVOIR WINTER STORAGE REQUIREMENTS**

| YEAR | POPULATION (1% GROWTH) | VOLUME ($M^3$) |
|---|---|---|
| 2018 | 5027 | 387,083 |
| 2019 | 5077 | 390,954 |
| 2020 | 5128 | 394,863 |
| 2021 | 5179 | 398,812 |
| 2022 | 5231 | 402,800 |
| 2023 | 5283 | 406,828 |
| 2024 | 5336 | 410,896 |
| 2025 | 5390 | 415,005 |
| 2026 | 5444 | 419,155 |
| 2027 | 5498 | 423,347 |
| 2028 | 5553 | 427,581 |
| 2029 | 5609 | 431,856 |
| 2030 | 5665 | 436,175 |
| 2031 | 5721 | 440,537 |
| 2032 | 5778 | 444,942 |
| 2033 | 5836 | 449,391 |
| 2034 | 5895 | 453,885 |
| 2035 | 5954 | 458,424 |
| 2036 | 6013 | 463,008 |
| 2037 | 6073 | 467,639 |

## 4.6 Reclaimed Water Irrigation

There are five reclaimed water supply mains: the original two to Fairview Golf Course and the old forcemain to the Public Works Yard were built in 1983. The other three mains were built in 2004. It is recommended that Town Operations maintain a record of leaks, repairs, or operational concerns on the original supply mains to ensure their condition is being monitored.

An irrigation area expansion plan was submitted to the MOE in December 2018. Following submission of the 2019 Liquid Waste Management Plan Update and Sanitary Sewer Annual Report, the MOE will proceed with an amendment of the Town's OC to be consistent with current reclaimed water irrigation areas.

# 5.0 Collection Network Hydraulic Model Results

The following sections summarizes the development, methodology, and results of the hydraulic model of the gravity collection network.

## 5.1 Wastewater Flows

### 5.1.1 Diurnal Curve

Historical SCADA data is available from the Town of Oliver for pump hours and number of starts at each Lift Station. Unfortunately, there are no flow meters throughout the collection network until the screening station which only recently began storing data in December 2018. In order to convert the pump hours to flow rate, a system curve analysis was conducted with pump specifications provided by Town staff.

Data from 2015-2018 was analyzed to determine the actual sub-daily flows for use in the hydraulic model. The selected diurnal curve is shown in Figure 5-1 for the Influent LS, which represents the Town's entire catchment. In 2016 and 2017, there was a distinct increase in flows between dry weather and freshet conditions at the Influent LS and MacPherson LS likely due to their catchments' proximity to the Okanagan River. The increased level of the Okanagan River follows a similar trend year-to-year compared to the increase in sewage flows in the spring. Therefore, Figure 5-1 shows diurnal curves for dry weather and freshet conditions.

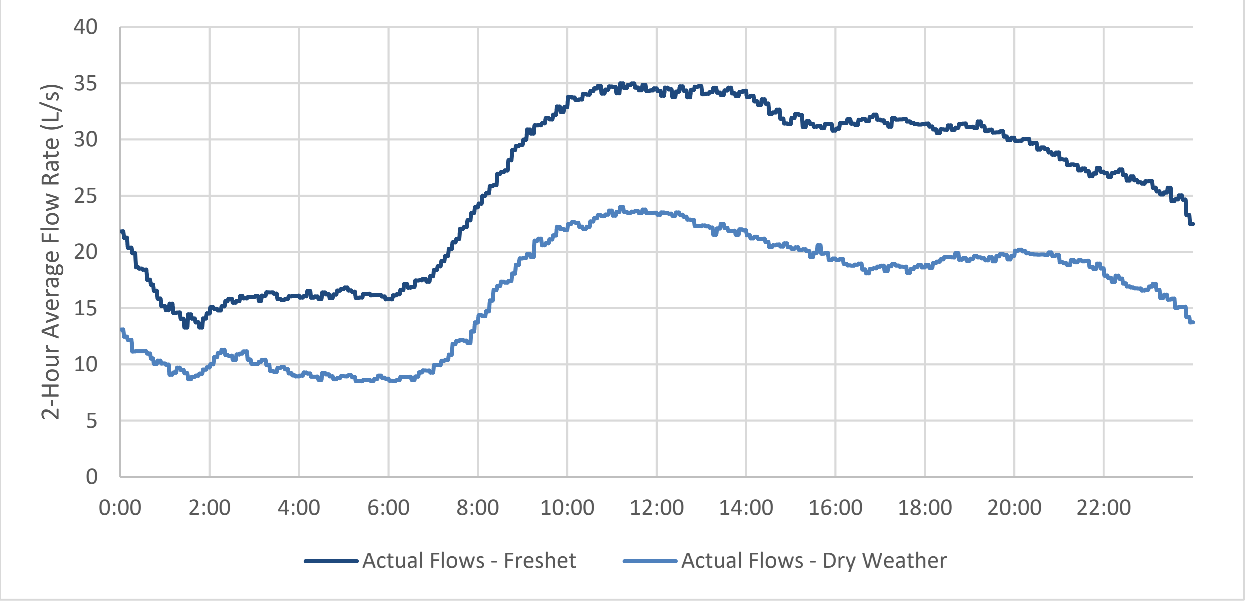



**FIGURE 5-1: INFLUENT LIFT STATION DIURNAL CURVES – DRY WEATHER AND FRESHET**

The average daily flow at the Influent LS has been determined as 17.5 L/s in the dry season, and 26.2 L/s during freshet. These values are consistent with the treatment facility's average annual flow of 21.9 L/s in 2017. During freshet, the Influent LS experienced 9.7 L/s of additional peak flow; while the McPherson LS experienced 1.1 L/s of additional peak flow.

### 5.1.2 Rain Event I&I

SCADA data was analyzed for possible Inflow and Infiltration (I&I) on all peak rain event days from 2015 to present. Peak rain events were determined using Osoyoos' daily precipitation data, which was checked against the Town of Oliver's daily recorded rainfall. This I&I analysis found no pattern of increased flows during peak rain events until two events in March 2018, in which the Influent LS experienced 16.7 L/s in additional peak flow.

This sudden change is I&I response may be the result of construction sites draining excess surface water into the sanitary system, which has been a concern for the Town in recent years. For the purpose of this analysis, a constant I&I design criteria of 8000 L/Ha/Day has been assigned.

### 5.1.3 Land-Use Generation Rates

Using the equivalent population from the OCP land use described in Section 3.3 and an equivalent per capita flow rate in the dry season and during freshet, a generation rate was assigned to each OCP parcel under existing and future conditions. Table 5-1 below shows the estimated amount of flow that is contributed from each land use category. Under both existing and future conditions, the primary contributors are Industrial, Institutional, and Low Density Residential.

**TABLE 5-1: GENERATION BASELINE FLOWS BY OCP LAND USE**

| OCP LAND USE | EXISTING – AVERAGE FLOW RATE (L/S) | FUTURE – AVERAGE FLOW RATE (L/S) |
|---|---|---|
| AGRICULTURAL | 0.0 | 0.0 |
| COMMERCIAL HWY | 1.1 | 2.5 |
| COMMERCIAL TOURIST | 0.6 | 0.6 |
| HIGH DENSITY RESIDENTIAL | 1.8 | 3.2 |
| INDUSTRIAL | 3.7 | 3.7 |
| INSTITUTIONAL | 3.7 | 3.7 |
| LOW DENSITY RESIDENTIAL | 3.4 | 3.5 |
| MEDIUM DENSITY RESIDENTIAL | 2.2 | 3.1 |
| OTHER LOTS | 0.0 | 0.0 |
| TOWN CENTRE | 1.0 | 1.1 |
| **Total** | **17.5** | **21.3** |

### 5.1.4 Lift Stations & Force Mains

Through the pump curve analysis, the operating point of each pump was calculated and presented in Table 5-2. As mentioned, each lift station is designed with a stand-by pump such that the design capacity of each station assumes that one pump is offline.

**TABLE 5-2: LIFT STATION ESTIMATED OPERATING POINTS AND AVERAGE DAILY FLOWS**

| LIFT STATION | # OF PUMPS | PUMP OPERATING POINT (L/S) | LIFT STATION DESIGN CAPACITY (L/S) |
|---|---|---|---|
| Influent Lift Station | 3 | 35 | 70 |
| McPherson | 2 | 18.5 | 18.5 |
| Rockcliffe | 2 | 5.8 | 5.8 |
| Rotary Beach | 2 | 14.9 | 14.9 |
| Sawmill Road | 2 | 25.5 | 25.5 |
| Scott Road | 2 | 15 | 15 |

## 5.2 Model Development

A hydraulic model was developed using the latest version of PCSWMM in order to model all sanitary sewers and lift stations up to the Influent LS. The base data for the sanitary network was sourced from TRUE's GIS data of the Town's sanitary system. This GIS data included some general attributes (diameter, length, direction) of each conduit, but did not include any elevation data.

Manhole surface elevations were provided by Town staff from a survey conducted in 2018. The locations of surveyed manholes were compared to the GIS data and analyzed for data gaps. Invert elevations and other data gaps were first filled with information from record drawings as available; attributes such as diameter and direction of flow were also confirmed through record drawings. In the absence of record information, values were assumed based on surrounding information (e.g. inverts were interpolated based on available inverts nearby). All changes to the data set were tracked and coded so that staff could review and potentially update the base GIS data set.

Average daily flows were developed for all scenarios based on parcel area, generation rate, population densities and equivalent populations as detailed previously. The flows were spatially distributed through the model utilizing the spatial proximity of a parcel to the sanitary network. The model calculates the peak flow for each pipe segment by applying the diurnal curve to the average daily flow, routing the flows through the system, and applying a constant inflow for I&I and freshet flows.

## 5.3 Model Results

The model results have been summarized in Table 5-3 under the following four flow conditions:

**TABLE 5-3: COLLECTION NETWORK HYDRAULIC MODEL SCENARIOS**

| CONDITIONS | SEASON | RAIN EVENT I&I (L/HA/DAY) | AVERAGE DAILY FLOW (L/S) | PEAK FLOW (L/S) | TOTAL DAILY VOLUME ($M^3$) |
|---|---|---|---|---|---|
| Existing | Dry Weather | N/A | 17.4 | 23.8 | 1,510 |
| Existing | Freshet | 8,000 | 37.5 | 66.5 | 3,240 |
| Future | Dry Weather | N/A | 21.3 | 29.6 | 1,840 |
| Future | Freshet | 8,000 | 41.2 | 71.0 | 3,560 |

### 5.3.1 Existing Conditions

The total daily flow under existing dry weather conditions reported in the model is 1,510 $m^3$/day, with an average daily flow of 17.4 L/s and a peak daily flow of 23.8 L/s. Existing flows were also modelled in a wet weather scenario with a baseline I&I from freshet and I&I from a rain event during peak hours; the resulting total daily flow was 3,240 $m^3$/day, with an average daily flow of 37.5 L/s and a peak daily flow of 66.5 L/s. Figure 5-2 below shows the modelled sub-daily data for inflow to the Influent LS under these existing conditions, overlaid with the actual diurnal curves for the Influent LS.

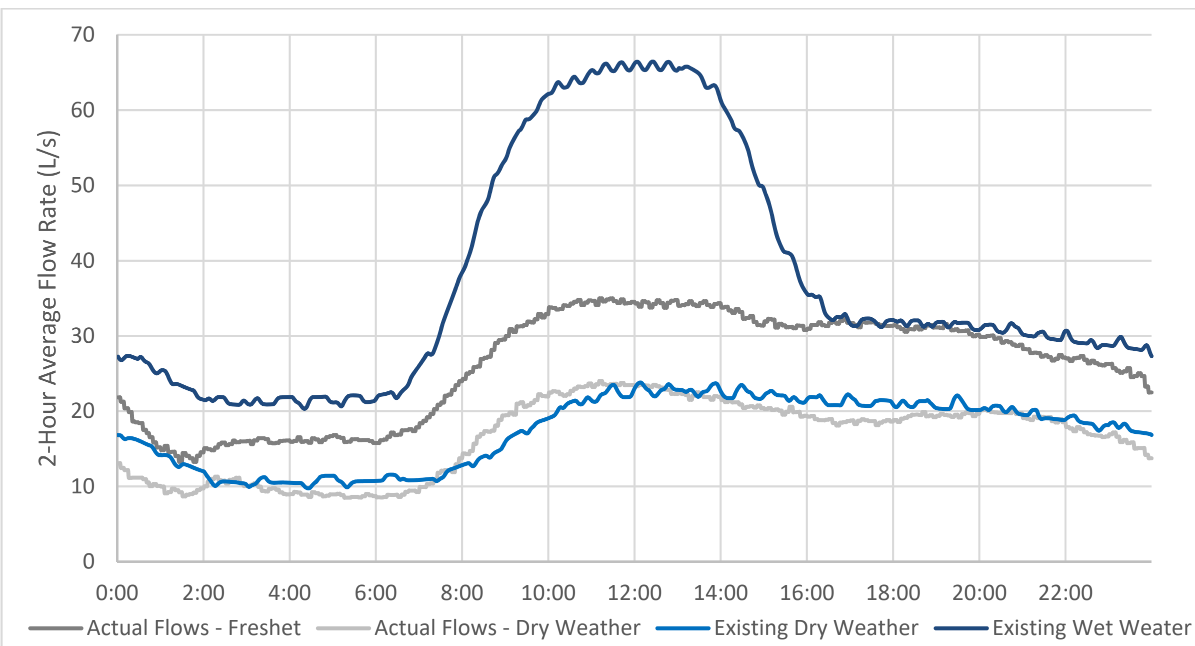
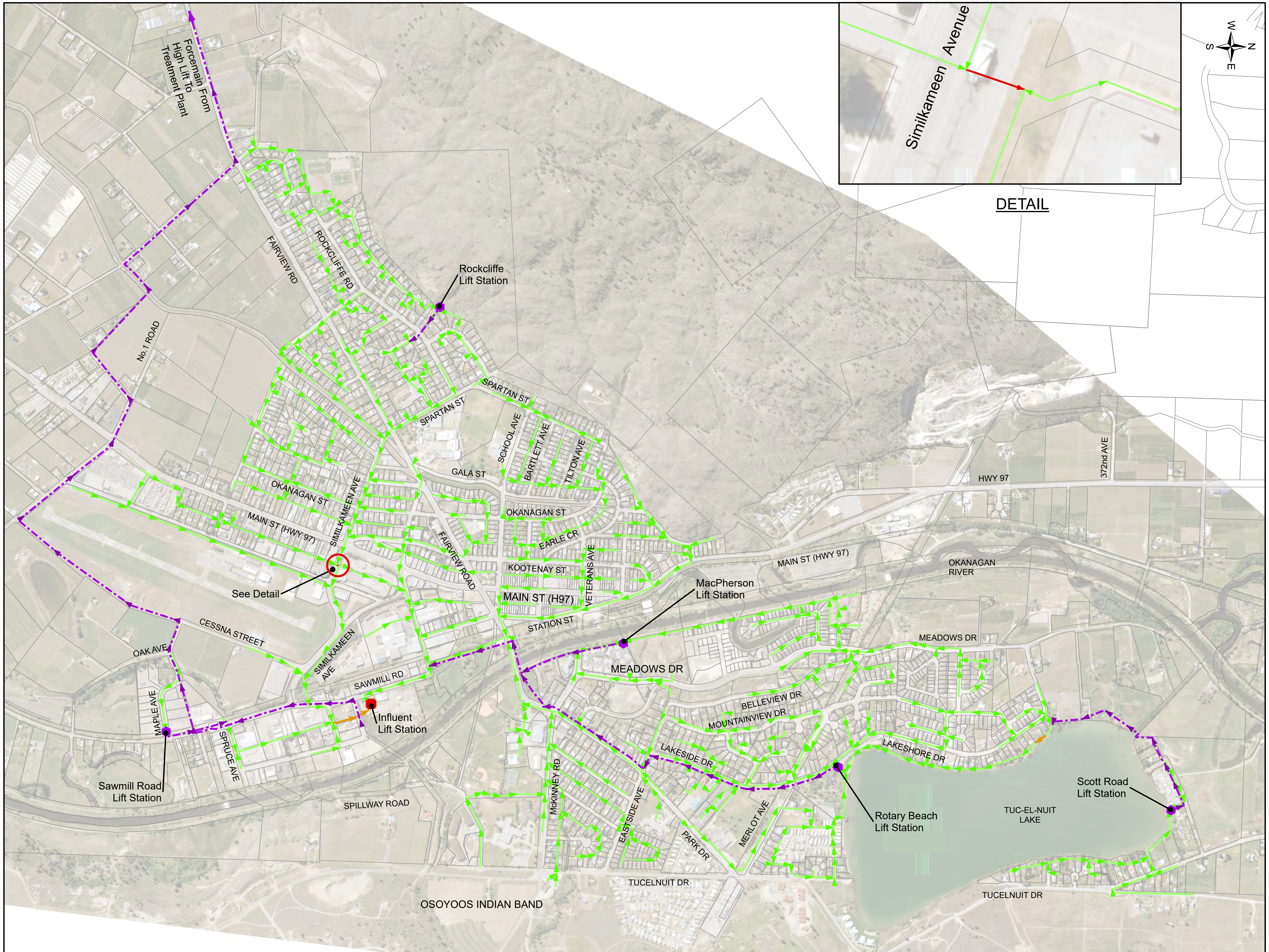



**FIGURE 5-2: PCSWMM RESULTS AT INFLUENT LIFT STATION – EXISTING CONDITIONS**




# Model Results- Existing and Future Wet Weather Conditions

## Legend

- Forcemains
- Lift Stations
- Influent Lift Station

**Sanitary Mains**

**Max Flow / Full Flow**

- < 0.50
- 0.50 - 0.66
- > 0.66
- Property Cadastre

1:12,500

0 125 250 500 Meters

TRUE

Figure 5-3

R:\Clients\300-399\306\306-1751\03 Drawings\GIS\Maps\306-1751-003 Fig Existing and Future Wet Conditions.mxd

During dry weather flows, there is no apparent surcharging of manholes or pipe, flooding, or pipe flowing above 2/3 of full flow. During wet weather conditions, there is one section of pipe operating above 2/3 of full flow, five sections above 1/2 of full flow, and no flooding or surcharging of manholes. Table 5-4 and Figure 5-3 (previous) summarize the pipe sections above 1/2 and 2/3 of full flow.

**TABLE 5-4: PCSWMM RESULTS – EXISTING CONDITIONS - GRAVITY PIPE ABOVE 1/2 FULL FLOW**

| ID | INLET NODE | OUTLET NODE | DIAM (MM) | SLOPE (%) | LENGTH (M) | MAX/FULL FLOW RATIO | MAX DEPTH/ DIAMETER RATIO |
|---|---|---|---|---|---|---|---|
| C2 | D-178 | D-177 | 0.2 | 0. 2 | 8.5 | 1.09 | 0.58 |
| C712 | T-696 | T-697 | 0.3 | 0.1 | 45.1 | 0.61 | 0.39 |
| C12 | D-152 | D-101 | 0.25 | 0.6 | 17.6 | 0.57 | 0.57 |
| C376 | D-153 | D-152 | 0.25 | 0.6 | 48.2 | 0.55 | 0.54 |
| C377 | D-155 | D-154 | 0.25 | 0.6 | 11.5 | 0.55 | 0.53 |
| C81 | D-154 | D-153 | 0.25 | 0.6 | 76.2 | 0.55 | 0.53 |

### 5.3.2 Future Conditions

The same dry weather and wet weather conditions were modelled for future generated flows for a 20-year design horizon. The total daily flow under future dry weather conditions reported in the model is 1,840 m³/day, with an average daily flow of 21.3 L/s and a peak daily flow of 29.6 L/s. Existing flows were also modelled in a wet weather scenario with a baseline I&I from freshet and I&I from a rain event during peak hours; the resulting total daily flow was 3,560 m³/day, with an average daily flow of 341.2 L/s and a peak daily flow of 71.0 L/s. Figure 5-4 below shows the modelled sub-daily data for inflow to the Influent LS under these future conditions, overlaid with the actual diurnal curves for the Influent LS.

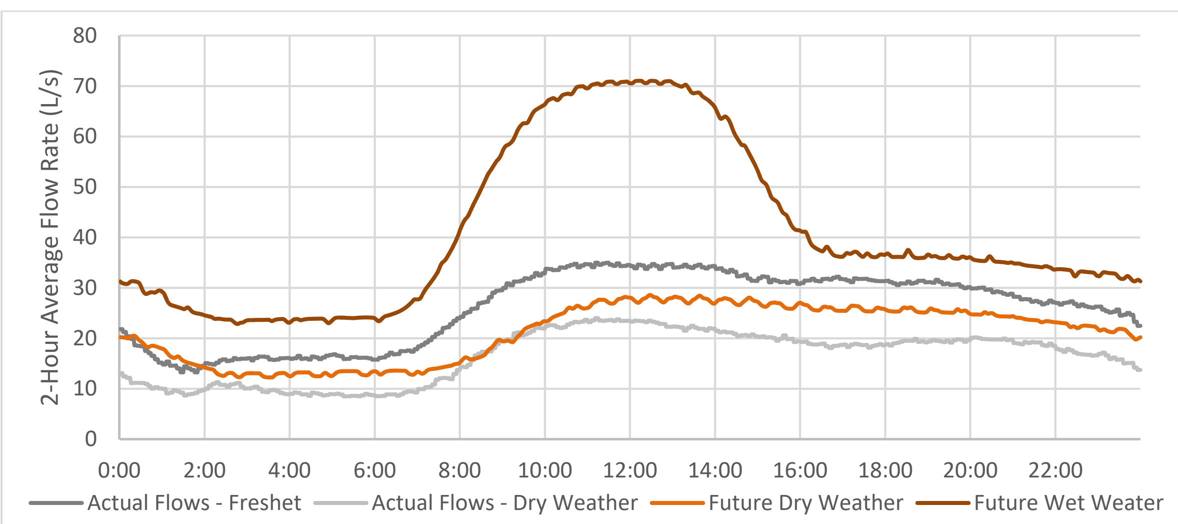



**FIGURE 5-4: PCSWMM RESULTS AT INFLUENT LIFT STATION - FUTURE CONDITIONS**

The results under future conditions are comparable to existing conditions: there is no surcharging or flooding of nodes, and the same sections of pipe operating above 1/2 and 2/3 of full flow under wet weather conditions.

### 5.3.3 Lift Station Performance

Table 5-5 below shows the peak inflows to each lift station under the maximum flow conditions (future wet weather), the operating capacity of each station based on the system curve analysis, and the surplus or deficit of capacity at peak flow.

**TABLE 5-5: PCSWMM RESULTS – FUTURE WET WEATHER CONDITIONS - LIFT STATION CAPACITIES**

| LIFT STATION | LIFT STATION DESIGN CAPACITY (L/S) | PEAK INFLOW (L/S) | SURPLUS (+) / DEFICIT (-) IN CAPACITY (L/S) |
|---|---|---|---|
| Influent Lift Station | 70 | 71.0 | -1.0 |
| McPherson | 18.5 | 8.1 | 10.4 |
| Rockcliffe | 5.8 | 5.3 | 0.5 |
| Rotary Beach | 14.9 | 15.5 | -0.6 |
| Sawmill Road | 25.5 | 1.1 | 24.4 |
| Scott Road | 15 | 1.8 | 13.1 |

Although Rotary Beach LS's capacity is exceeded in the model, Figure 5-5 below shows that the pump is able to continue pumping down the water level in the Lift Station at a slower rate. The Influent LS also has a deficit in capacity from peak flow and may not be capable of keeping up with the additional peaks in flow caused by the other lift stations.

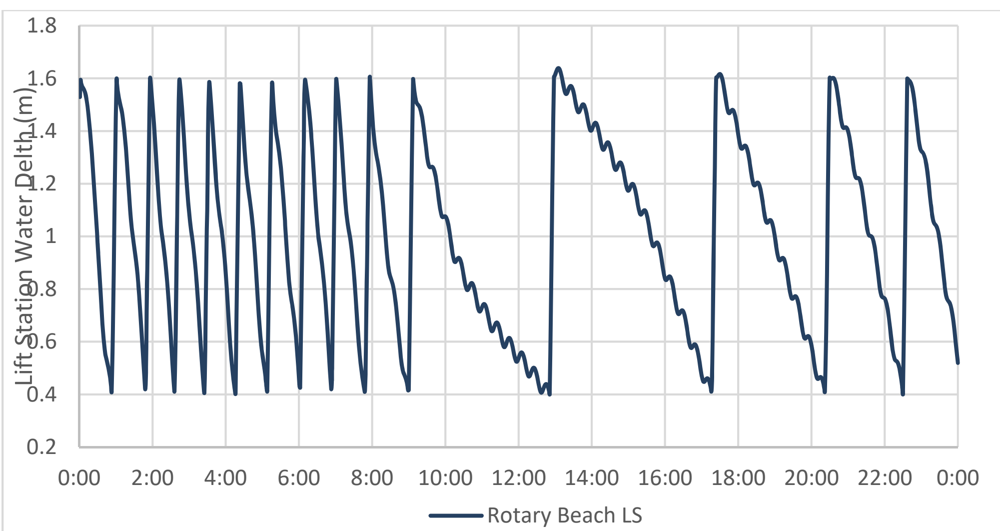



**FIGURE 5-5: PCSWMM RESULTS – ROTARY BEACH LIFT STATION DEPTH**

## 5.4 Asset Management

### 5.4.1 Collection Network

Developing a hydraulic model for the Town's sanitary collection network involved a systematic and in-depth review of the Town's sanitary manholes and linear assets. The data set has been improved based on the best available information and should be adopted as the Town's base data set to be maintained and improved upon over time.

The Town currently manages approximately 41.5 km of sanitary collection infrastructure including Polyvinyl Chloride (PVC), Vitrified Clay Tile (VCT), and Asbestos Cement (AC) pipe. Figure 5-6 provides a summary of the material types while Figure 5-7 provides and overview of materials for pipe segments in the system.

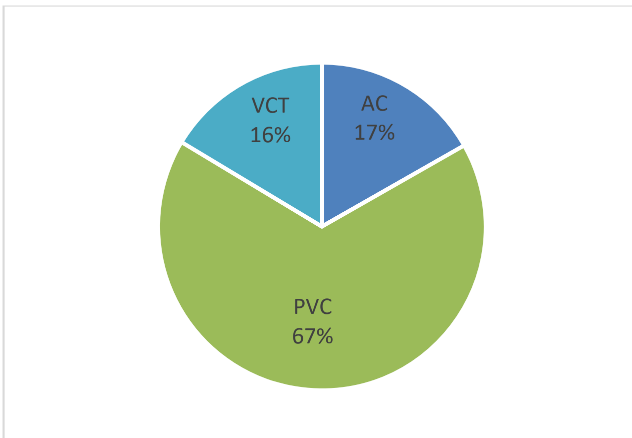


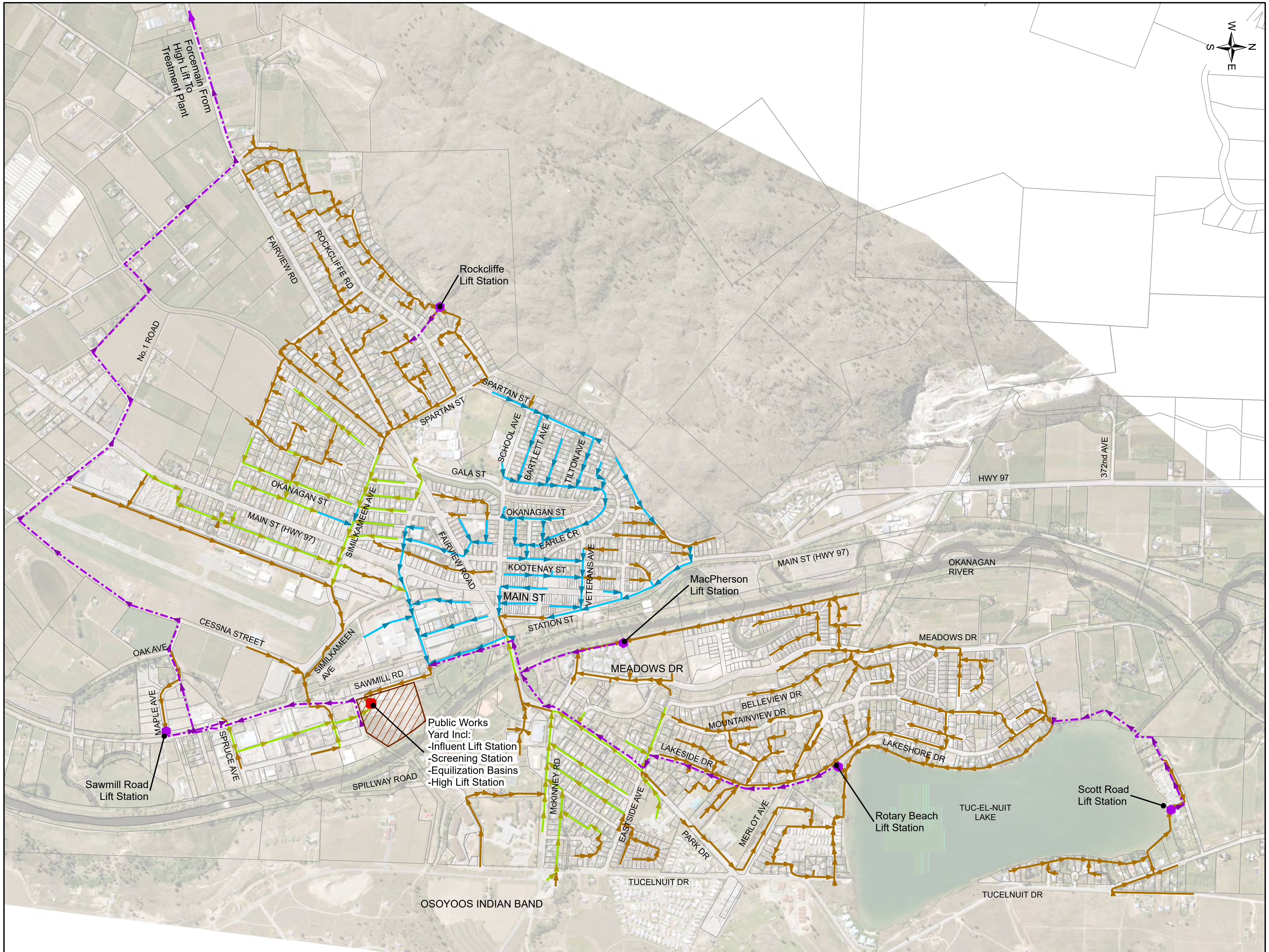

**FIGURE 5-6: COLLECTION NETWORK PIPE MATERIAL PIE CHART**

The outputs of a hydraulic model allow performance of the system to be incorporated into decision making for capital projects and assists with the prioritization of replacement projects. A simple risk model was developed to identify and prioritize replacement projects. The risk equation is:

Risk = Probability x Criticality

Probability was determined based on condition (if available) and remaining useful life which is a function of material and installation year. Condition inspections were conducted on many of the older VCT and AC pipes in 2016 and 2017. Criticality is based on size of pipe, contributing serviced area, and the max/full flow ratio from the model. In addition to compliance with the Sewerage System Regulation of BC, the Town of Oliver Subdivision and Development Servicing Standards outlines design standards for the sanitary sewer system including the maximum to full flow ratio is not to exceed 2/3 for pipe over 200 mm in diameter.

Once the risk score was determined, the assets were classified into high, medium, and low categories. Table 5-6 provides a breakdown of the risk categories.




# Asset Management Materials

## Legend

- Public Works
- Lift Stations
- Influent Lift Station
- Forcemains

**MATERIAL**

- AC
- PVC
- VCT
- Property Cadastre

1:12,500

0 125 250 500 Meters

**Figure 5-7**

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**TABLE 5-6: COLLECTION NETWORK - SUMMARY OF RISK SCORES**

| CATEGORY | LENGTH (M) | PERCENTAGE OF COLLECTION NETWORK |
|---|---|---|
| High | 3,800 | 9% |
| Medium | 4,700 | 11% |
| Low | 33,000 | 80% |

The dividing line between categories is rather arbitrary and was set based on experience with other municipalities. Figure 5-8 breaks out the risk categories by pipe material.

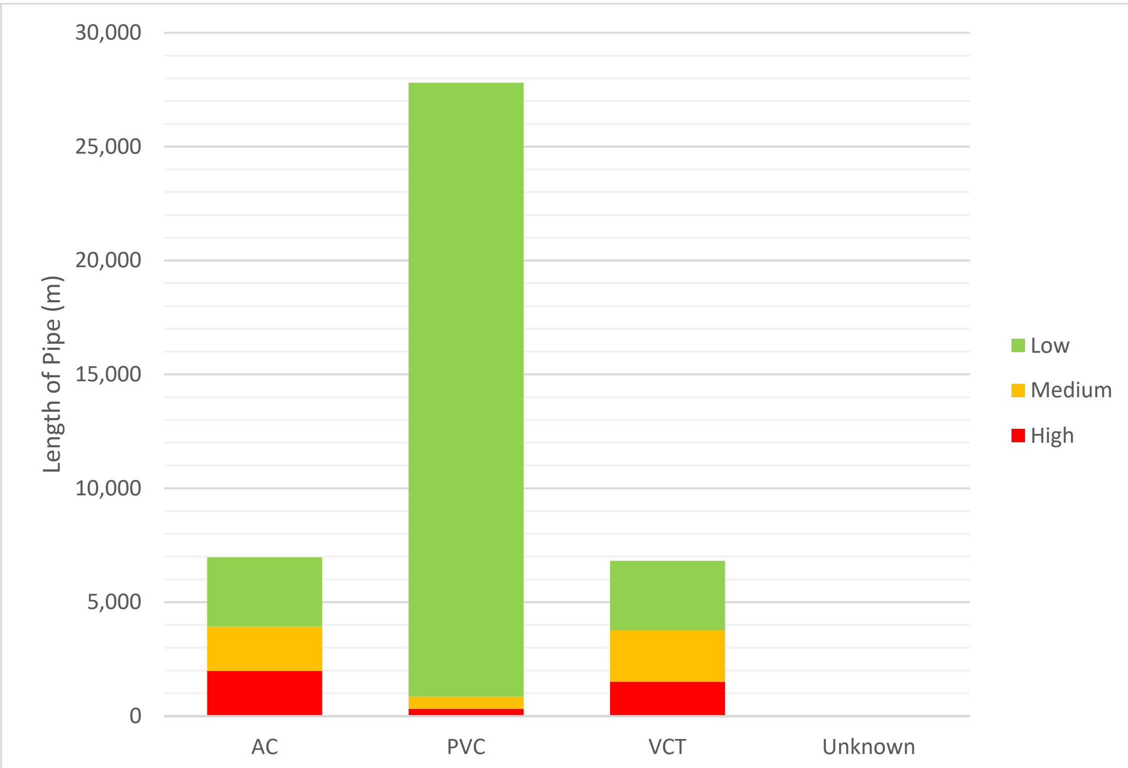
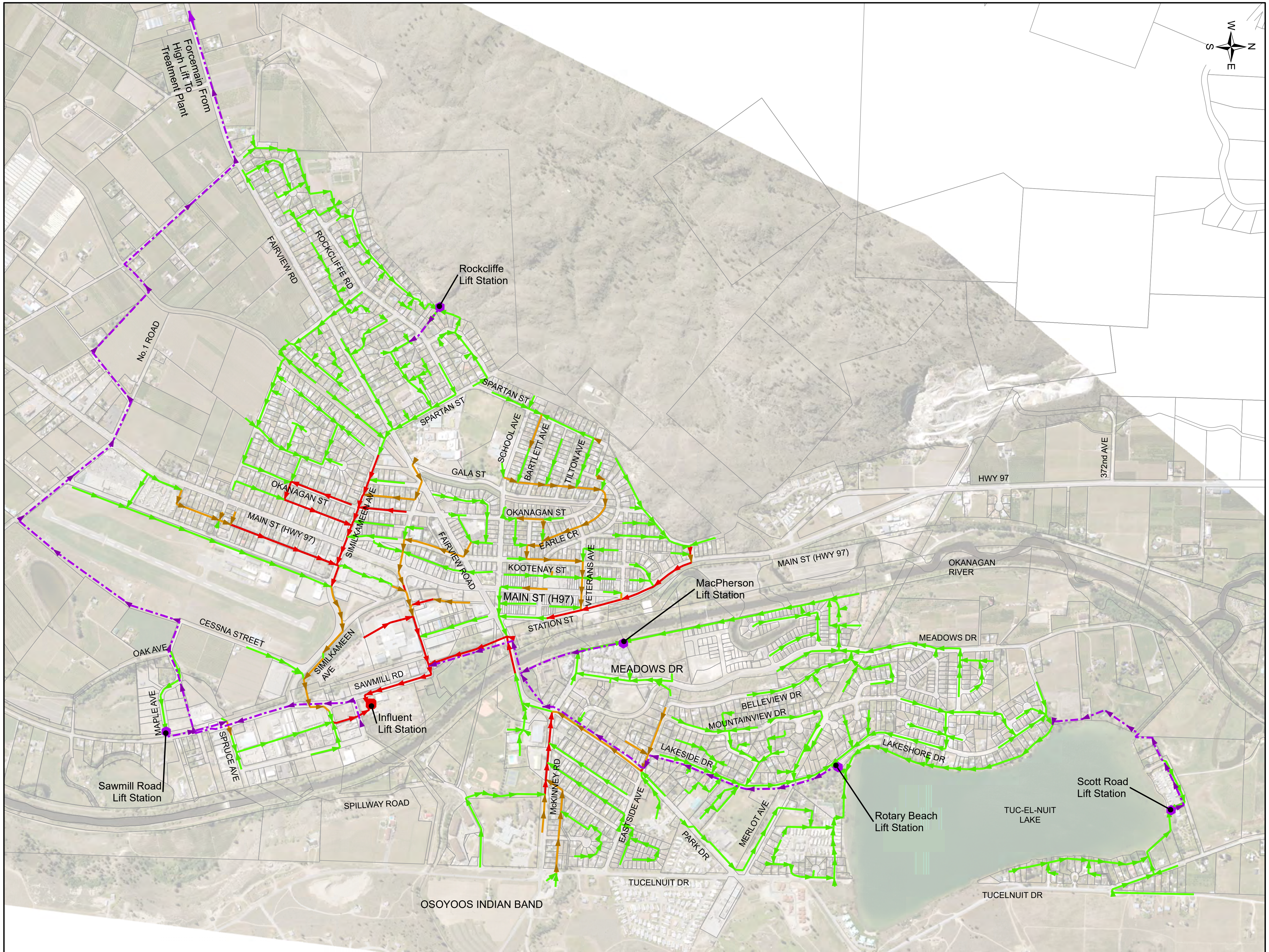



**FIGURE 5-8: RISK SCORES BY PIPE MATERIAL**

The AC and VCT pipe are largely classified as high and medium-risk due their age and estimated remaining useful life. However, the condition inspections from 2016 and 2017 show that some of the AC and VCT pipe is in good condition. PVC pipes are generally newer assets in the system and are classified as low risk. However, there are some segments of PVC near the Influent LS which have been flagged as high and medium risk due to their size and large contributing area. Figure 5-9 highlights the risk categories throughout the collection network.

### 5.4.2 Lift Stations & Forcemains

The Town keeps a record of lift station pump models and installation years as shown below in Table 5-7. Based on a 20-year useful life, three pumps should be assessed for replacement.




BRITISH COLUMBIA Town of Oliver

# Asset Management Risk Categories

## Legend

- Forcemains
- Lift Stations
- Influent Lift Station

**Sanitary Mains**

**RISK**

- High
- Medium
- Low
- Property Cadastre

1:12,500

0 125 250 500 Meters

TRUE

**Figure 5-9**

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### Table 5-7: Asset Management - Lift Station Pumps

| Lift Station | Asset | Manufacturer | Model # | Install Year | Useful Life | Useful Life Remaining | Anticipated Replacement Year |
|---|---|---|---|---|---|---|---|
| Rotary Beach | Pump 1 | Flygt | 3153.185 | 2018 | 20 | 19 | 2038 |
| | Pump 2 | Flygt | 3152.181 | 1993 | 20 | -6 | 2013 |
| Rockcliffe | Pump 1 | Flygt | 3127.180 | 1994 | 20 | -5 | 2014 |
| | Pump 2 | Flygt | 3127.180 | 1994 | 20 | -5 | 2014 |
| Scott Road | Pump 1 | Flygt | 3127.181 | 2010 | 20 | 11 | 2030 |
| | Pump 2 | Flygt | 3127.181 | 2010 | 20 | 11 | 2030 |
| Sawmill Road | Pump 1 | Flygt | 3085.183 | 2014 | 20 | 15 | 2034 |
| | Pump 2 | Flygt | 3085.183 | 2014 | 20 | 15 | 2034 |
| MacPherson | Pump 1 | Flygt | 3127.181HT | 2013 | 20 | 14 | 2033 |
| | Pump 2 | Flygt | 3127.160 | 2017 | 20 | 18 | 2037 |
| Influent Lift | Pump 1 | Flygt | 3127.181 | 2013 | 20 | 14 | 2033 |
| | Pump 2 | Flygt | 3127.181 | 2012 | 20 | 13 | 2032 |
| | Pump 3 | Flygt | 3127.160 | 2015 | 20 | 16 | 2035 |

The forcemain asset information is summarized in Table 5-8 below. The forcemains were installed in the 1980s and 1990s using PVC.

### Table 5-8: Asset Management - Forcemains

| Forcemains | Length (m) | Material | Diameter (mm) | Install Year | Useful Life | Useful Life Remaining | Anticipated Replacement Year |
|---|---|---|---|---|---|---|---|
| MacPherson Lift Station to 350th Ave Bridge | 373 | PVC | 150 | 1983 | 80 | 44 | 2063 |
| Junction by 350th Ave. Bridge to MH D-104 | 418 | PVC | 200 | 1983 | 80 | 44 | 2063 |
| Rotary Beach Lift Station to 350th Ave Bridge | 1298 | PVC | 150/250 | 1982 | 80 | 43 | 2062 |
| Rockcliffe Lift Station to MH D-232 | 158 | PVC | 100 | 1994 | 80 | 55 | 2074 |
| Scott Road Lift Station to MH T-751 | 720 | PVC | 150 | 1993 | 80 | 54 | 2073 |

# 6.0 System Upgrades

Based on these capacity assessments, a list of system upgrades has been developed for the collection network, lift stations, and treatment system. For the collection network, these projects are primarily based on available asset information; The first step in all recommended system upgrades is to verify the GIS information and determine the actual condition of these assets in order to avoid premature replacement. Alternatively, the Town may choose to undertake any of these projects outright based on its criticality to the system as risk of continued degradation may not be acceptable to the Town.

## 6.1 Collection Network

As discussed in Section 5.4, the risk model identified approximately 4 km of sanitary piping as high risk and therefore due for replacement or rehabilitation. The risk model is a prioritization tool to indicate which assets should be considered or investigated first.

The following list of projects has been developed assuming that all assets in the high-risk category need replacement or rehabilitation. These preliminary cost estimates will assist the Town in incorporating projects into their capital planning. Following further investigation into the high-risk assets, the Town may wish to reprioritize these projects if specific assets are found to be in satisfactory condition or the GIS information was incorrect.

**TABLE 6-1: SANITARY COLLECTION NETWORK - SYSTEM UPGRADES**

| ID | PROJECT | EST. CAPITAL COST | EST. DCC ELIGIBILITY |
|---|---|---|---|
| S1 | Fairview to Sawmill Road | $425,000 | 75% |
| S2 | Main & Station Street (Hillside to Bank Ave) | $583,000 | 69% |
| S3 | Similkameen Avenue (Tulameen to Airport) | $601,000 | 32% |
| S4 | Okanagan Street at Similkameen | $564,000 | 0% |
| S5 | Airport Street Alley (Skagit to Similkameen) | $313,000 | 0% |
| S6 | McKinney Road (Coyote to Park) | $117,000 | 0% |
| S7 | River Crossing at Fairview Road | $239,000 | 56% |
| S8 | Co-op Road (Main to Sawmill) | $339,000 | 0% |
| S9 | Fir Avenue to Influent Lift Station | $181,000 | 56% |
| | **Total** | **$3,362,000** | |

A reasonable goal would be to replace or rehabilitate the high-risk assets within 10 years which equates to approximately 400 m of replacement each year. This replacement program covers approximately 10% of the sanitary collection network in the next 10 years. At this rate, the Town would replace the entire sanitary collection network in 100 years which exceeds the typical useful life of system components (approximately 80 years for PVC). Therefore, this program is just a start, and development of a long term replacement program will be vital to sustainably manage the sanitary collection network.

Project sheets containing additional information and detailed cost estimates for each project can be found in Appendix C.

## 6.2 Lift Stations

***Pump Replacement – Rockcliffe Lift Station***

Both pumps at the Rockcliffe LS are beyond their estimated useful life and should be assessed for replacement. Based on the results of the capacity assessment, replacing the pumps with new models of similar capacity will be adequate for future demand.

***Capacity Assessment & Pump Replacement – Rotary Beach Lift Station***

One pump at Rotary Beach LS is beyond its estimated useful life and should be assessed for replacement. While the collection network capacity assessment showed that Rotary Beach LS is nearing its capacity during peak I&I conditions, it is recommended to conduct a capacity assessment of the lift station to confirm the operating capacity. There are two forcemains available for the Rotary Beach LS to pump and Town staff believe that the station is currently pumping to the smaller of the two forcemains. Part of a capacity assessment of the LS would be to confirm which of the two historical forcemains is currently being used and determine options to increase capacity at the station. This will ensure that the replacement pump is adequate for future and peak I&I demand.

## 6.3 Treatment System

The service capacity of each component of the wastewater treatment system is a function of the useful life of the asset and the population which it can serve. The Town prepared a Wastewater Treatment Systems Capacity Improvement Design Brief in January 2019 to outline proposed upgrading works (see Appendix D). The recommendations are based on addressing deficiencies to the existing aerated lagoon treatment system, which is the only component of the treatment system forecasted to require upgrading within the next 15-years. The upgrades listed below have a combined capital cost estimate for $4,645,000. The detailed cost estimate can be found in Appendix D.

***Middle Berm Stabilization***

This project will involve stabilizing the saturated middle berm of aerated lagoons Cell No. 2 and 3. To rectify this issue, it is proposed to install two lock block walls along the length of this berm. These walls would be tied to each other with geogrid to provide stability and infilled. A secondary benefit of this berm stabilization would be that the existing lagoon capacity would increase due to the installation of a wall structure in place of the existing 3:1 lagoon slopes.

***Aeration System Upgrades***

Upgrades to the aeration system would include desludging of Cell No. 2, installation of a new aeration header and lateral pipes to each lagoon, provision for a new aeration system diffuser and installation of a new blower to the existing blower building. The new blower would act as the duty blower for the aeration system.

***Installation of a 50 kW Photovoltaic System***

It is proposed to utilize the aerated lagoon site as a location for renewable energy production as a means to offset emissions produced by the Town of Oliver. The Photovoltaic (PV) power will be connected to the system by means of a “grid-tie” inverter and metered by FortisBC under their net metering program.

# 7.0 Other Recommendations

In addition to the system upgrades summarized in Section 6, there are a number of additional areas of interest or concern which the Town may wish to investigate:

***Electrical Systems Review***

Aside from regular maintenance, the electrical systems in the lift stations and treatment system have not been upgraded since installation in the 1980s and 1990s. It is recommended that the Town review their electrical systems and determine if upgrades are required to maintain safe and reliable operations and meet future demand. Upgrades have already been identified by Town Operations staff to increase electrical service to 600V at the Scott Road and Rockcliffe Lift Stations.

***Inflow & Infiltration***

In order to further investigate the suspected I&I events in 2017 and 2018, the Town may wish to install portable flow monitors throughout the collection network to narrow down the problem areas. As part of the investigation into I&I, it is important to have accurate sub-daily precipitation data in order to identify a direct correlation between rainfall and increased flow. Therefore, it is recommended that the Town install a rain gauge and data collection system which would allow them to track sub-daily precipitation.

***Winter Storage Options Assessment***

Based on the capacity assessment of the treatment system, winter effluent storage will be the first limiting component in future development. Capacity of the current storage reservoir is estimated to be reached by 2037. It is recommended that the Town undertake an options assessment to begin long term planning to upgrade this facility.

***SCADA System Review***

A detailed review of the SCADA system is recommended to ensure that the Town is recording all necessary data in the correct format and timestep and identify any gaps in the data collection system. This review may result in recommendations to change, update, or add to the existing data collection systems.

# APPENDIX A

## Aerated Lagoon No. 1 – Design Summary

# Internal Memorandum

| | | | |
|---|---|---|---|
| **To:** | TRUE Staff | **From:** | Sean Curry, P. Eng. |
| **Attn:** | Staff on Oliver LWMP Update | | |
| **Date:** | December 5, 2018 | **File No:** | **306-985** |

**RE: Aerated Lagoon No. 1 – Design Summary**

This memo is written to provide a summary of preliminary design considerations relating to the future construction of Aerated Lagoon No. 1 at the Town's wastewater treatment facility in the Fairview area.

Design considerations for this lagoon are based off of the Town's LWMP Update dated January 2002 (TRUE project number 306-083). In this report, the future Aerated Lagoon No. 1 design considerations were specified as follows:

- Capacity – minimum 20,000 m³
- Interior slopes – 3:1
- Exterior slopes – 2:1
- Liquid depth – 5.25m
- Top of water level – 448.30m (match existing lagoons - see drawing 306-291) – topographic survey indicates that Aerated Lagoon No. 2 has a liquid elevation of 448.35m
- Bottom of water level – 443.00m (match existing lagoons - see drawing 306-291)
- Top of berm – 449.30m (i.e. 1.0m of freeboard)

In February 2017, a crown land tenure application was submitted to the Ministry of Forests, Lands, and Natural Resource Operations (MFLNRO) to obtain crown land necessary for the construction of Aerated Lagoon No. 1. This work was done in conjunction with another crown land tenure application submitted on behalf of the Town. Upon receipt, MFLNRO staff informed the author that an assessment relating to recreation and environmental protection of the Oliver Mountain area was currently being undertaken. Therefore, MFLNRO staff indicated that the required crown land tenure right-of-way necessary for the future construction of this lagoon should be incorporated into the Oliver Mountain assessment. Preliminary design for this lagoon was therefore authorized by Town staff to determine a required right-of-way area for construction of the future lagoon. This preliminary design is illustrated on the enclosed drawing 306-985-Fig 1.

It is important to note that the Town has no current plans for construction of the future Aerated Lagoon No. 1. The crown land tenure application process was started to ensure that land would be available when expansion of the wastewater treatment facility was deemed necessary. The 2002 LWMP Update indicated that construction of Aerated Lagoon No. 1 would provide service

201-2079 Falcon Road ■ Kamloops BC ■ V2C 4J2 ■ www.true.bc.ca ■ tel 250.828.0881 ■ fax 250.828.0717

capacity for a population equivalent of about 11,000 persons while the existing system (i.e. 2 aerated lagoons in service with a combined capacity of about 75,800 m³) had a capacity for a service population of about 7,000 persons. The 2016 census population for the Town of Oliver was found to be 4,928 persons. Clearly, the existing system is adequate for the Town's current service population.

Based on the above, it is also important to provide an opinion on when the treatment objectives relating to the existing treatment system will exceed permitted maximum levels of 45 mg/L BOD and 60 mg/L of TSS. The following calculations are provided to indicate when these treatment objectives will be exceeded based on existing conditions (i.e. lagoons are not desludged) and ideal conditions (i.e. lagoons are fully desludged). Note that winter conditions govern and the Town's 2016 Annual Report indicated that average flow for this system is about 1,753 m³/d.

Existing Design Conditions (i.e. lagoons are fully desludged)

- Volume: Lagoon 2 has capacity of 37,600 m³ while lagoon 3 has capacity of 38,200 m³ resulting in a total design capacity of 75,800 m³
- Detention time = 75,800 m³ divided by 1,753 m³/day = 43.2 days
- 2016 Oliver census population = 4,928 persons
- Theoretical BOD = 0.17 lb/capita or 0.077 kg/capita x 4,928 persons = 379 kg/day BOD in
- Influent BOD concentration = BOD in divided by flow = 379 kg/day divided by 1,753 m³/day = 0.216 kg/m³ x $1x10^6$ mg/kg divided by 1,000 L/m³ = 216 mg/L BOD in
- Theoretical reaction rate if wastewater temperature is assumed to be 5ºC during winter conditions = 0.162 $day^{-1}$
- Removal efficiency = 1 / (1 + reaction rate x detention time) = 12.5% remaining
- Wastewater treatment system Effluent BOD = removal efficiency x BOD in = 12.5% x 216 mg/L = 27.0 mg/L BOD
- Use solver to determine when effluent BOD will exceed 45 mg/L during winter conditions: found to be in 2077 with a population equivalent of about 9,080 persons (assumes 1% growth rate consistent with LWMP Update dated October 2017 306-1751). Refer to R:\Clients\300-399\306\306-985\04 Design\Aerated Lagoon No 1\Calculations.xlsx

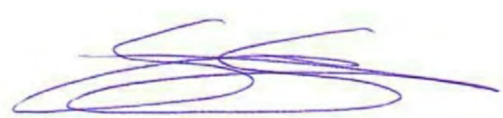
Existing Conditions (i.e. lagoons are not desludged)

- Volume: As of 2011, Lagoon 2 had a sludge accumulation of 5,000 m³ while lagoon 3 had a sludge accumulation of 5,000 m³. Sludge accumulation is based off a survey conducted by Lambourne Environmental Ltd. in December 2011. This report can be found in R:\Clients\300-399\306\306-985\02 Correspondence\Grant Applications\2016 Clean Water and Wastewater Fund\CWWF 2016-Application No. 68\E Relevant Studies and Reports\Oliver survey report 2011.pdf
- Projected sludge accumulation is based off annual sludge accumulation between 1996 and 2011.
- Detention time = about 65,000 m³ divided by 1,753 m³/day = 37.1 days for 2016 conditions
- 2016 Oliver census population = 4,928 persons

- Theoretical BOD = 0.17 lb/capita or 0.077 kg/capita x 4,928 persons = 379 kg/day BOD in
- Influent BOD concentration = BOD in divided by flow = 379 kg/day divided by 1,753 $m^3$/day = 0.216 kg/$m^3$ x $1x10^6$ mg/kg divided by 1,000 L/$m^3$ = 216 mg/L BOD in
- Theoretical reaction rate if wastewater temperature is assumed to be 5ºC during winter conditions = 0.162 $day^{-1}$
- Removal efficiency = 1 / (1 + reaction rate x detention time) = 14.3% remaining
- Wastewater treatment system Effluent BOD = removal efficiency x BOD in = 14.3% x 216 mg/L = 30.8 mg/L BOD
- Use solver to determine when effluent BOD will exceed 45 mg/L during winter conditions: found to be in 2040 with a population equivalent of about 6,300 persons (assumes 1% growth rate consistent with LWMP Update dated October 2017 306-1751). Refer to R:\Clients\300-399\306\306-985\04 Design\Aerated Lagoon No 1\Calculations.xlsx

Based on the above, it can be assumed that the existing system has adequate capacity for the existing service population. Also, construction of the future Aerated Lagoon No. 1 will not be necessary until between 2040 and 2077 (depending upon sludge accumulation and future desludging efforts). A recommendation moving forward should be to fully desludge these lagoons on a regular basis to ensure that adequate treatment capacity is maintained. Desludging will allow the Town to defer capacity upgrades in the future.

Regards,



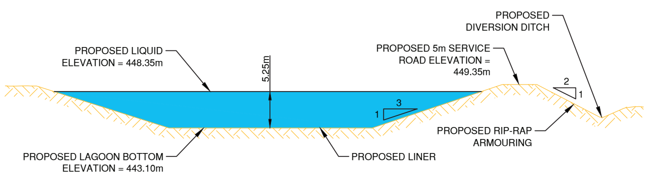
Sean Curry, P. Eng.

SAC/slf

enclosures: hand calculations and drawing 306-985-Figure 1 showing the preliminary design and right-of-way requirements for the future Aerated Lagoon No. 1

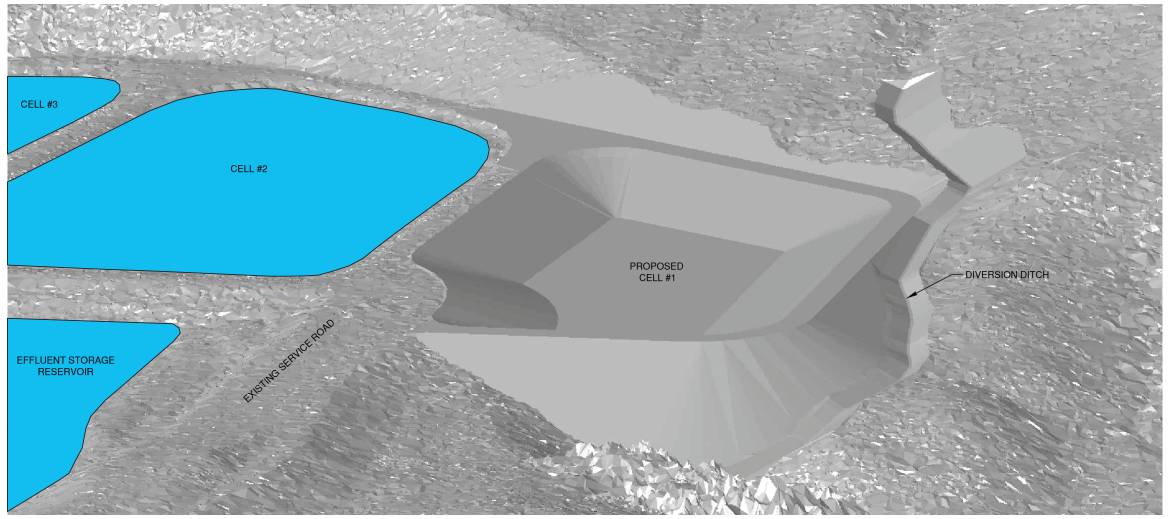
R:\Clients\300-399\306\306-985\02 Correspondence\Outgoing\306-985-Internal Memo-Oliver Aerated Lagoon No 1 Calculations-2018-12-05.docx






**SECTION A - PROPOSED CELL #1 & DIVERSION DITCH**

*HORIZONTAL & VERTICAL*
*SCALE 1:500*




**CUT/FILL QUANTITIES**

*PROPOSED CELL #1 EARTHWORKS*

24,000 m³ (CUT)
19,500 m³ (FILL)
*NET 4,500 m³ (CUT)*

*NOT INCLUDING STRIPPING*
*APPROXIMATE VOLUME 3,900 m³ (CUT)*

*PROPOSED CELL #1 CAPACITY*
*26,000 m³*

DRAFT

| No. | DATE | DESCRIPTION | BY | APP'D |
|---|---|---|---|---|
| 0 | SEPT 07/2017 | ISSUED FOR DISCUSSION | DF | SC |

ISSUES / REVISIONS

CONSULTANT SEAL


TRUE CONSULTING
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info@TRUE.bc.ca


BRITISH COLUMBIA Town of Oliver

**AERATED LAGOON TREATMENT SYSTEM**

**PROPOSED CELL #1**

| | |
|---|---|
| SCALE | 0 — 1:500 — 25 |
| DESIGN BY | SU/SC |
| DRAWN BY | DF |
| DATE | SEPTEMBER, 2017 |
| PROJECT REFERENCE No. | 306-083 & 306-291 |
| DRAWING No. | 306-1751 |
| SHEET | 1 OF 1 |
| ISSUE/REV. | 0 |

**FIG. 3-1**

FILE: r:\clients\300-399\306\306-985\03 drawings\cad\02 design drawings\dn-306-985-oliver treatment

# APPENDIX B

## Equalization Basin Expansion – Predesign Brief

# Equalization Basin Expansion

## *Predesign Brief*

*Prepared by:*

TRUE CONSULTING GROUP

February 2007
Ref: 306-081

## TABLE OF CONTENTS

## 1.1 General Description – Town of Oliver Wastewater Treatment and Disposal Systems

Up to 1985, the Town of Oliver discharged treated wastewater from a secondary modified activated sludge treatment plant to the Okanagan River. To achieve compliance with initiatives of the Provincial government to reduce phosphorus loadings to Okanagan Valley watercourses, the Town of Oliver constructed effluent storage and effluent irrigation systems in the Fairview area in 1985. *Figure 2* is an overall plan of the Town of Oliver wastewater treatment, storage and related facilities and includes areas where the Town uses reclaimed water for irrigation purposes. In 1995, the Town constructed an aerated lagoon treatment system adjacent to the winter effluent storage reservoir and at that point, abandoned the secondary treatment plant at the public works yard.

The terminus of the Town's sewage collection remains at the Public Works yard. Wastewater is pumped through a rotating screen, piped to an equalization basin from where it is pumped to the Fairview area.

## 1.2 Waste Management Plan Update 2002

In 2002 the Town of Oliver completed a major revision and update of its Waste Management Plan focusing on the identification of additional lands for irrigation with reclaimed water. This update of the Waste Management Plan assessed several directions for expansion of the Town's reclaimed water irrigation supply system and concluded that the preferred option was the construction of supply mains to make reclaimed water available for irrigation purposes at Town/Public lands including the Airport, Cemetery, Public Works Yard, South Okanagan Secondary School, etc.

Once the preferred direction for irrigation area expansion was identified, the Waste Management Plan then assessed supply alternatives. The options were:

- construct new supply mains from the Fairview Area to the identified reclaimed water irrigation expansion areas.

or

- construct a new forcemain from the Public Works Yard to the Fairview area and use the existing forcemain constructed in 1985 as the reclaimed water supply main.

A major advantage of a new forcemain option was the opportunity for the Town to take advantage of, at that time, proposed time of use energy cost incentives to be offered by the electrical utility. The new forcemain option was recommended as the preferred option and the forcemain was constructed in 2004. Reclaimed water for irrigation purposes has been used at the cemetery, airport and public works yard in 2005 and 2006 supplied through the original forcemain.

## 1.3 Functional Description of the Existing Equalization Basin

The Town's existing equalization basin at the Public Works yard is a lagoon type structure, lined with a hypalon membrane and has an operating capacity of about 1100 cubic meters. In the early 1980's, the electrical service in the South Okanagan was very unreliable with numerous short duration interruptions in electrical service occurring on a daily basis through the summer months. In 1985, a design decision was made to construct an equalization basin to store flows during a short duration power failure rather than provide standby power which at that time may have started and stopped numerous times on a daily basis through the summer months. Since the early 1980's the electrical utility has undertaken major improvements to the Oliver and electrical distribution system and short duration power failures are now infrequent.

Consistent with its Waste Management Plan, the Town of Oliver has modified the controls of high lift station pumps to assess the practicality of fully complying with time of use operational restrictions and thereby achieve significantly reduced costs for electrical energy. The equalization basin's primary functional use has therefore changed from a facility to be used during power interruptions to a storage facility to take advantage of energy cost incentives. On a trail basis, the Town has successfully operating its 3 – 100 HP high lift pumps on a time of use basis through 2005 and 2006. Energy cost savings realized by the Town are of the order of $20,000 annually. The existing equalization basin is not of sufficient volume for the Town to continue to operate its high lift pumps on a time of use basis therefore the project proposal to construct a second equalization basin.

## 2.1 Time of Use Energy Cost Incentives

Time of use energy cost incentives are offered by Fortis Canada if the operation of the Town's high lift wastewater pump station can be limited to off peak periods. The off peak periods vary from summer to winter and are summarized as follows.

Winter – November, December, January, February
- off peak – Midnight to 7:00 AM – 7 hours
- peak – 7:00 AM to Noon – 5 hours
- off peak – Noon to 4:00 PM – 4 hours
- peak – 4:00 PM to 10:00 PM – 6 hours
- off peak – 10:00 PM to Midnight – 2 hours

Winter Maximum Storage Period – 6 hours

Summer – July, August
- off peak – Midnight to 10:00 AM – 10 hours
- peak – 10:00 AM to 9:00 PM – 11 hours
- off peak – 9:00 PM to Midnight – 3 hours

Summer Maximum Storage Period – 11 hours

Shoulder Seasons – March, April, May, June , September, October
- off peak – Midnight to 6:00 AM – 6 hours
- peak – 6:00 AM to 10:00 PM – 16 hours
- off peak – 10:00 PM to Midnight – 2 hours

Shoulder Season Maximum Storage Period – 16 hours

For the Town to take full advantage of the time of use energy incentives offered by Fortis, the design storage volume requirements to be provided in the equalization basins is determined by the shoulder season during which wastewater inflow has to be stored for a 16 hour period from 6:00 AM to 10:00 PM and pumped to the Town's treatment lagoon system over an 8 hour period from 10:00 PM to 6:00 AM.

## 2.2 Equalization Basin Sizing Criteria

Average daily sewage flows on a monthly basis measured at the Town's High Lift Station for the period 2003 to 2006 inclusive are presented in Table 2.1. The flow data illustrates some variation in average daily sewage flows between winter and summer with winter flows being about 93% of the annual average and summer flows being about 113% of the annual average. Higher flows during the summer months may be indicative of infiltration during freshet flows in the Okanagan River and tourism related summer period commercial uses.

*Table 2.1*
*Town of Oliver*
*Summary of Monthly Sewer Flows*

| | 2003 High Lift Station | | 2004 High Lift Station | | 2005 High Lift Station | | 2006 High Lift Station | |
|---|---|---|---|---|---|---|---|---|
| | Total Monthly m3/day | Monthly Average m3/day | Total Monthly m3/day | Monthly Average m3/day | Total Monthly m3/day | Monthly Average m3/day | Total Monthly m3/day | Monthly Average m3/day |
| Jan | 60226 | 1943 | 61225 | 1975 | 63969 | 2064 | 65959 | 2128 |
| Feb | 53430 | 1908 | 56546 | 1950 | 57824 | 2065 | 60239 | 2151 |
| Mar | 58878 | 1899 | 60063 | 1938 | 62488 | 2016 | 66581 | 2148 |
| Apr | 59758 | 1992 | 59838 | 1995 | 63396 | 2113 | 63534 | 2118 |
| May | 61955 | 1999 | 62370 | 2012 | 65867 | 2125 | 72354 | 2334 |
| Jun | 61281 | 2043 | 61728 | 2058 | 68081 | 2269 | 77483 | 2583 |
| Jul | 68917 | 2223 | 70059 | 2260 | 73239 | 2363 | 78623 | 2536 |
| Aug | 69251 | 2234 | 73069 | 2357 | 73976 | 2386 | 76326 | 2462 |
| Sep | 65661 | 2189 | 67545 | 2251 | 64542 | 2151 | 68481 | 2283 |
| Oct | 67753 | 2186 | 68490 | 2209 | 65567 | 2115 | 69071 | 2228 |
| Nov | 61983 | 2066 | 62127 | 2071 | 61595 | 2053 | 64857 | 2162 |
| Dec | 62047 | 2002 | 62988 | 2032 | 63403 | 2045 | 65905 | 2126 |
| Total | 751139 | | 766048 | | 783947 | | 829413 | |
| Average | 2052 | | 2093 | | 2147 | | 2272 | |

For determination of the equalization volume requirements to enable the Town to take full advantage of the Fortis time of use energy incentives, the June 2006 shoulder season average daily sewage flow of 2583 $m^3$/day has been utilized. Equalization volume requirements are derived as follows:

- design shoulder season flow – 2583 $m^3$day
- shoulder season storage period – 16 hours
- storage volume – 16/24 x 2583 $m^3$ = 1722 $m^3$
- adjustment factor for flow variations – 30%
- storage volume – 1722 x 130% - 2238 $m^3$

- 2006 serviced population – 4200
- mid term horizon population as per the Waste Management Plan – 6200
- storage volume required to 6200 population horizon – 3300 $m^3$

The existing equalization provides approximately 1100 $m^3$of storage between normal low and high operating levels therefore the proposed expansion of the equalization basin has to provide a minimum of 2200 $m^3$ of operating storage.

## 2.3 Project Description

Proposed equalization basin number 2 is illustrated conceptually on drawing 306-1121-SK1. Equalization basin 2 is proposed to be located northeast of the existing basin generally occupying a vacant portion of the Public Works yard site between the Okanagan River flood control dyke and the existing basin and an area formerly used for sludge drying beds. When the Town completed the aerated lagoons in the Fairview area in 1995, the activated sludge treatment plant on the Public Works site was removed from service and the drying beds ancillary to the treatment plant were no longer required.

Referring to drawing 306-1121-SK1, the proposed equalization basin and related works are briefly described as follows.

- the equalization basin is proposed as a lagoon type structure with a 60 mil HDPE membrane lining comparable to the existing basin. At the average operating level, the basin measures approximately 30 m x 50 m.
- the proposed basin will have a floor, top of berm and operating elevations the same as the existing basin. It is therefore assumed that the two basins will be operated together, i.e. inflow directed to each basin through the existing diversion structure and withdrawn simultaneously from each basin through the same diversion structure.
- inlet and outlet piping connecting to chambers in the existing diversion structure intended for future extensions to a second equalization basin.
- two surface aerator/mixers to provide circulation in the basin and thereby minimize stagnant conditions that may result in odor problems.

As illustrated in drawing 306-1121-SK1 all proposed works associated with equalization basin 2 are within the Town's Public Works Yard.

## 2.4 Capital Cost Estimate

A preliminary capital cost estimate for Equalization Basin 2 is presented in the tabulation follows.

*Preliminary Capital Cost Estimate*
*Equalization Cell No. 2*

| | | |
|---|---|---|
| 1. Strip Site | 4500m² @ $2.00 | $9,000 |
| 2. Excavation and Embankment | 1000m³ @ $8.00 | $8,000 |
| 3. Import Fill | 4000m³ @ $15 | $60,000 |
| 4. Sand Base for Liner | 2800m² @ $6.00 | $16,800 |
| 5. 60 Mil HDPE Liner | 2800m² @ $30 | $72,000 |
| 6. Site Piping | | |
| 6.1 Inlet Pipe | 70 m @ $200 | $14,000 |
| 6.2 Outlet Pipe | 40 m @ $200 | $8,000 |
| 6.3 Outlet Structure | allow | $5,000 |
| 6.4 375 Tee complete with Valves | | $16,000 |
| 6.5 Modify Existing Diversion Structure complete with Slide Gates | | $18,000 |
| 6.6 Piping in Abandoned STP | allow | $10,000 |
| 6.7 Abandoned STP to Diversion Structure | 100m @ $250 | $25,000 |
| 7. Mixers complete with Electrical | 2 ea. @ $35,000 | $70,000 |
| 8. Remove and Replace Liner in Existing Basin | 1600m² @ $35 | $56,000 |
| | Subtotal Construction | $387,800 |
| | Contingencies and Engineering (allow 25%) | $96,200 |
| | Total Project | $484,000 |

# APPENDIX C

## Collection Network Upgrades – Project Sheets

# Project: S1 – Fairview to Sawmill Road

**Priority:** 1
**Type:** Replacement/Upgrade
**Trigger:** Future Development
**DCC:** 75%

**Location Map**


**Issue**

This main is a very critical connection in the sanitary collection network, and services a corridor of future development. The 300 mm VCT pipe has surpassed its anticipated useful life.

**Scope**

Removal of approximately 315m of 300 mm VCT. Installation 315m of 600 mm PVC including reconnection of all existing services. New connections for future development are required.

**DCC Justification**

This project increases the capacity of the system for long term growth. DCC portion will be determined based on the change in cross sectional area of the upgrade:

$$DCC\,\% = 1 - \frac{\left(\frac{\pi (D_1)^2}{4}\right)}{\left(\frac{\pi (D_2)^2}{4}\right)} = 1 - \left(\frac{D_1}{D_2}\right)^2 = 1 - \left(\frac{0.3}{0.6}\right)^2 = 75\%$$

**Time Frame**

1-3 years

## Cost Estimate

| ITEM NO. | DESCRIPTION | UNIT | EST. QUANT. | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| **S1** | **Fairview to Sawmill Road** | | | | |
| 1.1 | Materials | | | | |
| | *600Ø PVC Sanitary Main - Supply and Install* | m | 315 | $700 | $220,500 |
| | *Lined Concrete Manhole - Supply and Install* | ea | 4 | $8,000 | $32,000 |
| 1.2 | Service Connections | | | | |
| | *Tie into existing* | ea | 2 | $5,000 | $10,000 |
| | *Reconnect existing services* | ea | 1 | $1,000 | $1,000 |
| | *Connect New Services* | ea | 2 | $2,000 | $4,000 |
| 1.3 | Other Construction | | | | |
| | *Asphalt Restoration* | m² | 800 | $45 | $36,000 |
| | *Bare Land Restoration* | m² | 460 | $10 | $4,600 |
| | *Curb and Gutter* | m | 8 | $110 | $880 |
| | *Sidewalk* | m | 8 | $105 | $840 |
| | *Traffic Control* | L.S. | | $5,000 | $5,000 |
| | | | | **Subtotal** | **$315,000** |
| | | | | Engineering & Contingency (35%) | $110,000 |
| | | | | **TOTAL** | **$425,000** |

# Project: S2 – Main & Station Street (Hillside to Bank)

**Priority:** 1

**Trigger:** Future Development

**Type:** Replacement/Upgrade

**DCC:** 69%

**Location Map**


**Issue**

This main is a key connection in the sanitary collection network, and services a corridor of future development. The existing VCT pipe has surpassed its anticipated useful life.

**Scope**

Replacement of approximately 475 m of 200 mm VCT and 25 m of 250 mm VCT with 500 m of 300 mm PVC, including reconnection of all existing services. New connections for future development are required.

**DCC Justification**

This project is driven by need for additional capacity due to planned development along this corridor. DCC portion will be determined based on the change in cross sectional area of the upgrade and length of each section of pipe where the area is changing of the upgrade:

$$DCC\ \% = 1 - \frac{\left(\left(\frac{\pi(D_{1.1})^2}{4}\right) * L_{1.1}\right) + \left(\left(\frac{\pi(D_{1.2})^2}{4}\right) * L_{1.2}\right)}{\left(\left(\frac{\pi(D_2)^2}{4}\right) * L_2\right)} = 1 - \frac{({D_{1.1}}^2 * L_{1.1}) + ({D_{1.2}}^2 * L_{1.2})}{({D_2}^2 * L_2)}$$

$$DCC\ \% = 1 - \frac{(0.2^2 * 25m) + (0.25^2 * 475m)}{(0.375^2 * 500m)} = 52\%$$

**Time Frame**

1-3 years

**Cost Estimate**

| ITEM NO. | DESCRIPTION | UNIT | EST. QUANT. | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| **S2** | **Main & Station Street (Hillside to Bank)** | | | | |
| 1.1 | Materials | | | | |
| | *375Ø PVC Sanitary Main - Supply and Install* | m | 500 | $480 | $240,000 |
| | *Lined Concrete Manhole - Supply and Install* | ea | 8 | $8,000 | $64,000 |
| 1.2 | Service Connections | | | | |
| | *Tie into existing* | ea | 6 | $3,000 | $18,000 |
| | *Reconnect existing services* | ea | 5 | $1,000 | $5,000 |
| 1.3 | Other Construction | | | | |
| | *Asphalt Restoration* | m² | 2000 | $45 | $90,000 |
| | *Traffic Control* | L.S. | | $15,000 | $15,000 |
| | | | | **Subtotal** | **$432,000** |
| | | | | Engineering & Contingency (35%) | $151,000 |
| | | | | **TOTAL** | **$583,000** |

# Project: S3 – Similkameen Avenue (Tulameen to Airport)

**Priority:** 2 | **Type:** Replacement/Upgrade

**Trigger:** Capacity/Aging Infrastructure | **DCC:** 32%

**Location Map**


**Issue**

This main is a key connection in the sanitary collection network. The existing AC and VCT pipe is beyond its anticipated useful life of 50 years, and inspections in 2016 and 2017 reported that the pipe has significant condition issues. This segment of pipe is also flagged in the hydraulic model as having capacity issues under current and future wet weather conditions.

**Scope**

Replace approximately 415m of 200 mm and 75m of 250 mm of VCT/AC with 415m of 300 mm PVC and 85 m of 375 mm PVC to tie into existing 375 mm.

**DCC Justification**

This project is driven by need for additional capacity. DCC portion will be determined based on the change in cross sectional area of the upgrade and length of each section of pipe where the area is changing:

$$DCC\ \% = 1 - \frac{\left(\left(\frac{\pi(D_{1.1})^2}{4}\right) * L_{1.1}\right) + \left(\left(\frac{\pi(D_{1.2})^2}{4}\right) * L_{1.2}\right)}{\left(\left(\frac{\pi(D_2)^2}{4}\right) * L_2\right)} = 1 - \frac{(D_{1.1}{}^2 * L_{1.1}) + (D_{1.2}{}^2 * L_{1.2})}{(D_2{}^2 * L_2)}$$

$$DCC\ \% = 1 - \frac{(0.2^2 * 415m) + (0.25^2 * 75m)}{(0.3^2 * 500m)} = 32\%$$

## Time Frame

3-5 Years

## Cost Estimate

| ITEM NO. | DESCRIPTION | UNIT | EST. QUANT. | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| **S3** | **Similkameen Avenue (Tulameen to Airport)** | | | | |
| 1.1 | Materials | | | | |
| | *300Ø PVC Sanitary Main - Supply and Install* | m | 415 | $400 | $166,000 |
| | *375Ø PVC Sanitary Main - Supply and Install* | m | 85 | $480 | $40,800 |
| | *Lined Concrete Manhole - Supply and Install* | ea | 11 | $8,000 | $88,000 |
| 1.2 | Service Connections | | | | |
| | *Tie into existing* | ea | 10 | $3,000 | $30,000 |
| | *Reconnect existing services* | ea | 13 | $1,000 | $13,000 |
| 1.3 | Other Construction | | | | |
| | *Asphalt Restoration* | m² | 2000 | $45 | $90,000 |
| | *Curb and Gutter* | m | 8 | $110 | $880 |
| | *Sidewalk* | m | 8 | $105 | $840 |
| | *Traffic Control* | L.S. | | $15,000 | $15,000 |
| | | | | **Subtotal** | **$445,000** |
| | | | | Engineering & Contingency (35%) | $156,000 |
| | | | | **TOTAL** | **$601,000** |

# Project: P4 – Okanagan Street at Similkameen

| | | | |
|---|---|---|---|
| **Priority:** | 2 | **Type:** | Replacement/Upgrade |
| **Trigger:** | Aging Infrastructure | **DCC:** | 0% |

**Location Map**


**Issue**

The existing AC and VCT pipe is beyond its anticipated useful life of 50 years, and inspections in 2016 and 2017 reported that the pipe has significant condition issues.

**Scope**

Replace approximately 385m of 150 mm AC and 315m of 200 mm AC and VCT with 700m of 200 mm PVC.

**DCC Justification**

This project would not qualify for DCC.

**Time Frame**

3-5 Years

## Cost Estimate

| ITEM NO. | DESCRIPTION | UNIT | EST. QUANT. | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| **S4** | **Okanagan Street at Similkameen** | | | | |
| 1.1 | Materials | | | | |
| | *200Ø PVC Sanitary Main - Supply and Install* | m | 700 | $240 | $168,000 |
| | *Lined Concrete Manhole - Supply and Install* | ea | 8 | $8,000 | $64,000 |
| 1.2 | Service Connections | | | | |
| | *Tie into existing* | ea | 4 | $3,000 | $12,000 |
| | *Reconnect existing services* | ea | 40 | $1,000 | $40,000 |
| 1.3 | Other Construction | | | | |
| | *Asphalt Restoration* | m² | 2800 | $45 | $126,000 |
| | *Curb and Gutter* | m | 12 | $110 | $1,320 |
| | *Sidewalk* | m | 12 | $105 | $1,260 |
| | *Traffic Control* | L.S. | | $5,000 | $5,000 |
| | | | | **Subtotal** | **$418,000** |
| | | | | Engineering & Contingency (35%) | $146,000 |
| | | | | **TOTAL** | **$564,000** |

# Project: P5 – Airport Street Alley (Skagit to Similkameen)

**Priority:** 2

**Trigger:** Aging Infrastructure

**Type:** Replacement/Upgrade

**DCC:** 0%

**Location**


**Issue**

The existing AC pipe is beyond its anticipated useful life of 50 years, and inspections in 2016 and 2017 reported that the pipe has significant condition issues.

**Scope**

Replacement of approximately 400m of 200 mm AC with 200 mm PVC.

**DCC Justification**

This project would not qualify for DCC.

**Time Frame**

3-5 Years

**Cost Estimate**

| ITEM NO. | DESCRIPTION | UNIT | EST. QUANT. | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| **S5** | **Airport Street Alley (Skagit to Similkameen)** | | | | |
| 1.1 | Materials | | | | |
| | *200Ø PVC Sanitary Main - Supply and Install* | m | 400 | $240 | $96,000 |
| | *Lined Concrete Manhole - Supply and Install* | ea | 4 | $8,000 | $32,000 |
| 1.2 | Service Connections | | | | |
| | *Tie into existing* | ea | 2 | $3,000 | $6,000 |
| | *Reconnect existing services* | ea | 23 | $1,000 | $23,000 |
| | *Connect New Services* | ea | 0 | $2,000 | $0 |
| 1.3 | Other Construction | | | | |
| | *Asphalt Restoration* | $m^2$ | 1600 | $45 | $72,000 |
| | *Curb and Gutter* | m | 4 | $110 | $440 |
| | *Sidewalk* | m | 4 | $105 | $420 |
| | *Traffic Control* | L.S. | | $2,500 | $2,500 |
| | | | | **Subtotal** | **$232,000** |
| | | | | Engineering & Contingency (35%) | $81,000 |
| | | | | **TOTAL** | **$313,000** |

# Project: P6 – McKinney Road (Coyote to Park)

| | | | |
|---|---|---|---|
| **Priority:** | 3 | **Type:** | Rehabilitation |
| **Trigger:** | Aging Infrastructure | **DCC:** | 0% |

**Location Map**

**Issue**

The existing 200 mm AC pipe is beyond its anticipated useful life of 50 years. Inspections in 2016 and 2017 reported that the pipe is in acceptable condition given its age. Rehabilitation is intended to extend the useful life of these assets with decreased cost.

**Scope**

Trenchless rehabilitation of 285m of 200 mm AC pipe using cured-in-place lining.

**DCC Justification**

This project would not qualify for DCC.

**Time Frame**

5-10 Years

## Cost Estimate

| ITEM NO. | DESCRIPTION | UNIT | EST. QUANT. | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| **S6** | **McKinney Road (Coyote to Park)** | | | | |
| 1.1 | Materials | | | | |
| | *Trenchless Rehabilitation (cured-in-place lining)* | m | 285 | $250 | $71,250 |
| 1.2 | Service Connections | | | | |
| | *Lining at Manholes* | ea | 5 | $1,000 | $5,000 |
| | *Lining at existing services* | ea | 1 | $500 | $500 |
| 1.3 | Other Construction | | | | |
| | *Bypass Pumping* | L.S. | | $10,000 | $10,000 |
| | | | | **Subtotal** | **$87,000** |
| | | | | Engineering & Contingency (35%) | $30,000 |
| | | | | **TOTAL** | **$117,000** |

# Project: P7 – River Crossing at Fairview Road

| | | | |
|---|---|---|---|
| **Priority:** | 3 | **Type:** | Replacement/Upgrade |
| **Trigger:** | Aging Infrastructure | **DCC:** | 56% |

**Location Map**


**Issue**

This main is a very critical connection in the sanitary collection network. The existing 200 mm AC pipe is beyond its anticipated useful life of 50 years and is a high risk asset to the collection network.

**Scope**

Replace approximately 130m of 200 mm AC with 300 mm PVC.

**DCC Justification**

This project increases the capacity of the system for long term growth. DCC portion will be determined based on the change in cross sectional area of the upgrade:

$$DCC\ \% = 1 - \frac{\left(\frac{\pi (D_1)^2}{4}\right)}{\left(\frac{\pi (D_2)^2}{4}\right)} = 1 - \left(\frac{D_1}{D_2}\right)^2 = 1 - \left(\frac{0.2}{0.3}\right)^2 = 56\%$$

**Time Frame**

5-10 Years

## Cost Estimate

| ITEM NO. | DESCRIPTION | UNIT | EST. QUANT. | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| **S7** | **River Crossing at Fairview Road** | | | | |
| 1.1 | Materials | | | | |
| | *300Ø PVC Sanitary Main - Supply and Install* | m | 130 | $400 | $52,000 |
| | *Lined Concrete Manhole - Supply and Install* | ea | 2 | $8,000 | $16,000 |
| | *Hardware (incl. hangers, casing, spacers, fittings)* | m | 75 | $1,000 | $75,000 |
| 1.2 | Service Connections | | | | |
| | *Tie into existing* | ea | 2 | $3,000 | $6,000 |
| 1.3 | Other Construction | | | | |
| | *Asphalt Restoration* | m² | 260 | $45 | $11,700 |
| | *Curb and Gutter* | m | 8 | $110 | $880 |
| | *Sidewalk* | m | 8 | $105 | $840 |
| | *Traffic Control* | L.S. | | $15,000 | $15,000 |
| | | | | **Subtotal** | **$177,000** |
| | | | | Engineering & Contingency (35%) | $62,000 |
| | | | | **TOTAL** | **$239,000** |

# Project: P8 – Co-op Road (Main to Sawmill)

| | | | |
|---|---|---|---|
| **Priority:** | 3 | **Type:** | Replacement/Upgrade |
| **Trigger:** | Aging Infrastructure | **DCC:** | 0% |

**Location**


**Issue**

This main is a key connection in the sanitary collection network. The existing VCT pipe is beyond its anticipated useful life of 50 years, and inspections in 2016 and 2017 reported that sections of the pipe have condition issues.

**Scope**

Replace approximately 85 m of 150 mm, 115 m of 200 mm, and 170 m of 250 mm of VCT with 270 m of 250 mm PVC.

**DCC Justification**

This project would not qualify for DCC.

**Time Frame**

5-10 Years

**Cost Estimate**

| ITEM NO. | DESCRIPTION | UNIT | EST. QUANT. | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| **S8** | **Co-op Road (Main to Sawmill)** | | | | |
| 1.1 | Materials | | | | |
| | *250Ø PVC Sanitary Main - Supply and Install* | m | 270 | $350 | $94,500 |
| | *Lined Concrete Manhole - Supply and Install* | ea | 9 | $8,000 | $72,000 |
| 1.2 | Service Connections | | | | |
| | *Tie into existing* | ea | 5 | $5,000 | $25,000 |
| | *Reconnect existing services* | ea | 5 | $1,000 | $5,000 |
| 1.3 | Other Construction | | | | |
| | *Asphalt Restoration* | m² | 1080 | $45 | $48,600 |
| | *Curb and Gutter* | m | 4 | $110 | $440 |
| | *Sidewalk* | m | 4 | $105 | $420 |
| | *Traffic Control* | L.S. | | $5,000 | $5,000 |
| | | | | **Subtotal** | **$251,000** |
| | | | | Engineering & Contingency (35%) | $88,000 |
| | | | | **TOTAL** | **$339,000** |

# Project: P9 – Fir Avenue to Influent Lift Station

**Priority:** 3 **Type:** Replacement/Upgrade

**Trigger:** Aging Infrastructure **DCC:** 56%

**Location Map**

**Issue**

This main is a very critical connection in the sanitary collection network. The existing 250 mm AC pipe has 10 years remaining in its anticipated useful life of 50 years.

**Scope**

Replace approximately 150m of 250 mm AC with 375 mm PVC and regrade to ensure adequate velocities to the Influent Lift Station.

**DCC Justification**

This project increases the capacity of the system for long term growth. DCC portion will be determined based on the change in cross sectional area of the upgrade:

$$DCC\ \% = 1 - \frac{\left(\frac{\pi(D_1)^2}{4}\right)}{\left(\frac{\pi(D_2)^2}{4}\right)} = 1 - \left(\frac{D_1}{D_2}\right)^2 = 1 - \left(\frac{0.25}{0.375}\right)^2 = 56\%$$

**Time Frame**

5-10 Years

## Cost Estimate

| ITEM NO. | DESCRIPTION | UNIT | EST. QUANT. | UNIT PRICE | TOTAL PRICE |
|---|---|---|---|---|---|
| **S9** | **Fir Avenue to Influent Lift Station** | | | | |
| 1.1 | Materials | | | | |
| | *375Ø PVC Sanitary Main - Supply and Install* | m | 150 | $480 | $72,000 |
| | *Lined Concrete Manhole - Supply and Install* | ea | 4 | $8,000 | $32,000 |
| 1.2 | Service Connections | | | | |
| | *Tie into existing* | ea | 2 | $5,000 | $10,000 |
| | *Reconnect existing services* | ea | 2 | $1,000 | $2,000 |
| 1.3 | Other Construction | | | | |
| | *Asphalt Restoration* | m² | 120 | $45 | $5,400 |
| | *Bare Land Restoration* | m² | 480 | $10 | $4,800 |
| | *Curb and Gutter* | m | 12 | $110 | $1,320 |
| | *Sidewalk* | m | 12 | $105 | $1,260 |
| | *Traffic Control* | L.S. | | $5,000 | $5,000 |
| | | | | **Subtotal** | **$134,000** |
| | | | | Engineering & Contingency (35%) | $47,000 |
| | | | | **TOTAL** | **$181,000** |

# APPENDIX D

## Wastewater Treatment System Capacity Improvements Design Brief

(*Report Appendix A Excluded)

# Wastewater Treatment System Capacity Improvements

Design Brief

Town of Oliver

British Columbia

TRUE

January 2019

Project No. 306-1752

ENGINEERING ■ PLANNING ■ URBAN DESIGN ■ LAND SURVEYING

201-2079 Falcon Rd | Kamloops BC | V2C 4J2 | www.true.bc.ca | tel 250.828.0881 | fax 250.828.0717

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# Revision Log

| Revision # | Revised by | Date | Issue / Revision Description |
|---|---|---|---|
| **0** | SAC | Jan. 21, 2019 | Final |
| | | | |
| | | | |
| | | | |

# Report Submission

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# List of Acronyms

| | |
|---|---|
| BOD | Biochemical Oxygen Demand |
| LWMP | Liquid Waste Management Plan |
| MCC | Motor Control Centre |
| MFLNRO | Ministry of Forests, Lands, and Natural Resource Operations |
| MOE | Ministry of Environment |
| OCP | Official Community Plan |
| PLC | Programmable Logic Controller |
| PV | Photovoltaic |
| SCADA | Supervisory Control and Data Acquisition |
| TRUE | TRUE Consulting |
| TSS | Total Suspended Solids |

# Units of Measure

| | |
|---|---|
| hp | horsepower |
| kg | kilogram |
| kW | kilowatt |
| lb | pound |
| $m^3$ | cubic metre |
| $m^3$/day | cubic metres per day |
| m | metre |
| mg | milligram |
| mg/L | milligrams per Litre |
| SCFM | standard cubic feet per minute |

# Referenced Reports

Golder Associates Ltd. “Pseudo-Static and Liquefaction Assessment – Oliver Effluent Reservoir Dams,” <17 April 2018>

TRUE Consulting Ltd. Liquid Waste Management Plan (LWMP) Update. <January 2002>

TRUE Consulting Ltd. Sanitary Sewer System 2017 Annual Report. <18 July 2018>

# 1.0 Description of Existing Wastewater Treatment Works

The wastewater treatment facility for the Town of Oliver has been in operation since 1965. From 1965 to 1984, the Town operated a treatment plant for municipal wastewater and discharged treated effluent to the Okanagan River. In response to regulatory agency requirements for reduced phosphorus loadings to surface water courses in the Okanagan River Basin, the Town constructed effluent storage and land disposal systems in the Fairview area in 1983 and 1984. Discharge to the Okanagan River was discontinued. Finally, in 1995, a two-cell aerated lagoon system was constructed in the Fairview area.

Currently, the overall existing wastewater treatment system is comprised of influent screening, equalization storage, a high lift pump station, a two-cell aerated lagoon treatment system, winter effluent storage, chlorine contact system and reclaimed water irrigation.

This two-cell aerated lagoon system is located north and adjacent to the winter effluent storage reservoir. The aerated cells designated as Cell No. 2 and Cell No. 3 have been constructed as the second and third cells of an ultimate 3 cell system. Piping and other design provisions have been made for the third cell to be located immediately east of the existing lagoons. The capacity of the existing aerated lagoon system is as follows. Note that each cell has an operating depth of 5.3m.

- Cell No. 2 – 37,600 $m^3$
- Cell No. 3 – 38,200 $m^3$

Aeration is provided by a submerged bottom fixed fine bubble diffuser system. Air to the system is supplied by two 40 hp positive displacement Aerzen Model GM35S blowers housed in a building located at the south-east corner of Cell No. 2. Piping, electrical and space provisions have been made in the building for the installation of two additional blower units.

The treatment system effluent is regulated by Operational Certificate for PE 13717 issued by the Ministry of Environment (MOE). This operation certificate specifies the following limits:

- Discharge rate – 2,200 $m^3$/day
- 5 Day Biochemical Oxygen Demand – 45 mg/L
- Total Suspended Solids – 60 mg/L

A location and site plan of the aerated lagoon treatment system is provided in Appendix B.

## 1.1 Existing Flows Entering Aerated Lagoon System

The total volume pumped to the aerated lagoons in 2017 was 689,098 m³, as specified in the Town's Sanitary Sewer System 2017 Annual Report, which equates to an average daily flow of 1,888 m$^3$/day. This is an increase of 49,300 m$^3$ (7%) compared to 2016. For comparison, average day influent flows for the period 1996 to 2017 are illustrated in Figure 1-1 as follows. This figure also illustrates census population for the Town over that time period.

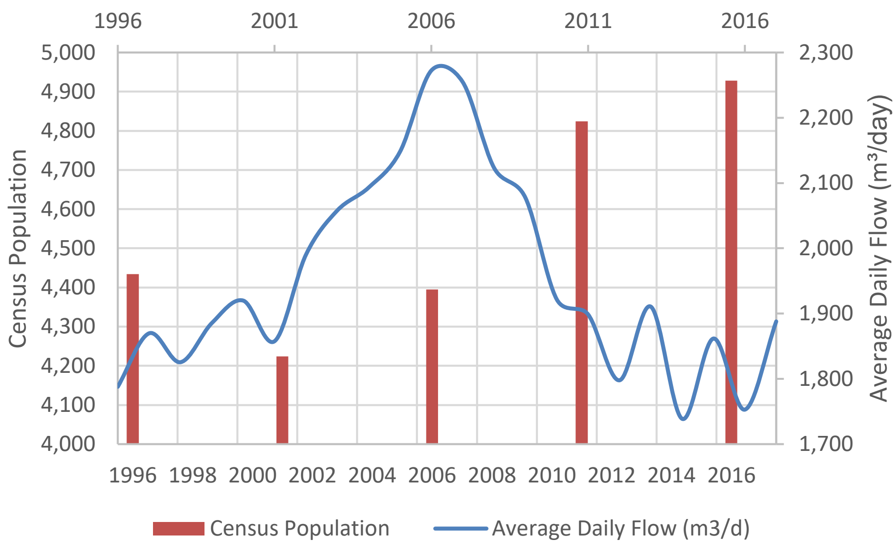



**FIGURE 1-1: AVERAGE DAILY INFLUENT SEWAGE FLOWS AND CENSUS POPULATION FOR 1996 TO 2017**

# 2.0 Wastewater Treatment System Deficiencies

The design average daily flow for the aerated lagoon system is 3,000 $m^3$/day with a detention time of 12 days for each cell. The Town's Liquid Waste Management Plan (LWMP) Update dated January 2002 noted that the upgrading works for the system would be necessary around 2020, at which time it was recommended that the Town proceed with the construction of a third aerated lagoon. This future lagoon (referred to as Cell No. 1) would be sized at 20,000 $m^3$.

It should be noted that growth projections from the Town's LWMP Update dated January 2002 have not yet been realized. Therefore, it is anticipated that the existing treatment works will be adequate past the 2020 upgrading date specified in that report, but this timeframe is limited by current and future sludge accumulation.

The Town's Sanitary Sewer System 2017 Annual Report reported multiple instances of BOD and TSS levels exceeding permitted levels. These exceedances have been attributed to sludge accumulation in the aerated lagoons. Based on these exceedances, the Town has begun the process of working towards providing additional capacity to this aerated lagoon system.

Other issues related to the aerated lagoon treatment system are summarized in the following sections.

## 2.1 Concerns Related to Proposed Cell No. 1 Location

In February 2017, a crown land tenure application was submitted to the Ministry of Forests, Lands, and Natural Resource Operations (MFLNRO) to obtain crown land necessary for the construction of Cell No. 1. Upon receipt of the crown land tenure application, MFLNRO staff informed the Town that an assessment relating to recreation and environmental protection of the Oliver Mountain area was currently being undertaken. MFLNRO also conducted a site visit and deemed the area to be "very" environmentally sensitive with significant concerns related to the following species:

- Lewis woodpecker
- Great Basin Spadefoot
- Behr's Hairstreak

On the basis of concerns raised by MFLNRO staff, it was recommended that the Town review other options for increasing the treatment capacity of the treatment works.

## 2.2 Sludge Accumulation

Sludge accumulation, specified in 2011 as approximately 5,000 $m^3$ in Cell No. 2 and 3,000 $m^3$ in Cell No. 3, has had the effect of reducing lagoon capacity and detention time. Therefore, sludge requires removal prior to treatment objectives being compromised due to reduced lagoon capacity. In this case, the Town of Oliver retained a sludge survey specialist in 2011 to conduct a review of sludge accumulation in the period since the lagoons were first constructed (summer 1995). The results of this survey indicated that sludge accumulation was far greater in Cell No. 2 than in Cell No. 3. This result is consistent with other municipalities experiences where sludge is found to accumulate near the inlet of the treatment system. After reviewing these findings, it was recommended that sludge removal from Cell No. 2 would represent a higher priority than Cell No. 3 recognizing that the sludge volume is greater as a percentage of the total volume. Also, detention time at the inlet to the treatment system is more important than detention time near the "end" of the treatment system. In the period since 2011, sludge accumulation has likely remained consistent.

## 2.3 Middle Berm Stability

The third significant issue with the existing treatment system relates to the instability of the earthen berm separating Cell No. 2 and Cell No. 3. The Town's Pseudo-Static and Liquefaction Assessment of the Town's effluent reservoir dams completed by Golder Associates Ltd. in April 2018 also noted that this berm would be likely to fail during a seismic event. This berm is known to be saturated and will likely fail if Cell No. 2 is drained and bypassed during sludge removal operations. Another complicating factor is that Cell No. 3 must also remain in service to ensure that operating permit effluent quality is achieved. Therefore, operating levels must be adequate to allow for treatment to occur. Since minimum operating levels must be provided, it will be necessary to stabilize the earthen berm.

## 2.4 Summary of Aerated Lagoon Deficiencies

Considering the above Sections 2.1 to 2.3, the following summary of deficiencies is presented. These deficiencies represent required high priority upgrades necessary for the Town to correct issues related with the aerated lagoon and achieve treatment objectives specified in Operational Certificate PE 13717.

- Exceedance of permitted effluent BOD and TSS levels.
  - Capacity improvements are required for treatment objectives to be achieved.
- Stability of middle berm.
  - Middle berm is saturated and requires upgrading. The existing two-cell aerated lagoon system does not provide redundancy since the middle berm cannot be relied upon.

As discussed in Section 2.1, the proposed location of Cell No. 1 does not appear to be viable. Therefore, the Town will be forced to consider alternative options for achieving treatment objectives in the future. Expansion of the existing lagoon footprint also does not appear to be a viable option. Therefore, upgrading of the aerated lagoon treatment works will be required.

# 3.0 Upgrading Objectives

The primary objective of the Wastewater Treatment System upgrading will be the resolution of deficiencies related to the existing aerated lagoon system. As previously discussed, these deficiencies are related to capacity and safety. Upgrading should also consider the potential of an expansion of the overall capacity to meet future requirements.

The following sections are presented to ensure that recommended upgrades are consistent with the Town's future capacity requirements. Therefore, expected flows arising from future population growth will be reviewed in detail.

## 3.1 Population Projections

The 2016 Town of Oliver census population was 4,928. The Town of Oliver Official Community Plan projects that the Town can anticipate a growth rate between -1% to 1% over the next 20 years. A growth rate of 1% per year is used for population projections within the Town of Oliver to provide a representative estimate for asset upgrades and replacement. A growth rate of 2% is also presented to provide a more conservative estimate.

**TABLE 3-1: POPULATION PROJECTIONS BASED ON 2016 CENSUS**

| | *Population Projection* | |
|---|---|---|
| ***Year*** | ***1% growth rate*** | ***2% growth rate*** |
| *2018* | *5,027* | *5,127* |
| *2028* | *5,553* | *6,250* |
| *2038* | *6,134* | *7,619* |
| *2048* | *6,776* | *9,287* |
| *2058* | *7,485* | *11,321* |
| *2068* | *8,268* | *13,800* |
| *2078* | *9,133* | *16,822* |

The following Figure 3-1 illustrates expected sewer influent flow associated with both specified growth rates. Note that future influent flow levels are based on 2016 average day flow conditions. The following figure shows that the two-cell aerated treatment system is expected to be adequate until between 2040 and 2070 depending upon future growth rates. This projection assumes that sludge accumulation does not affect treatment capacity.

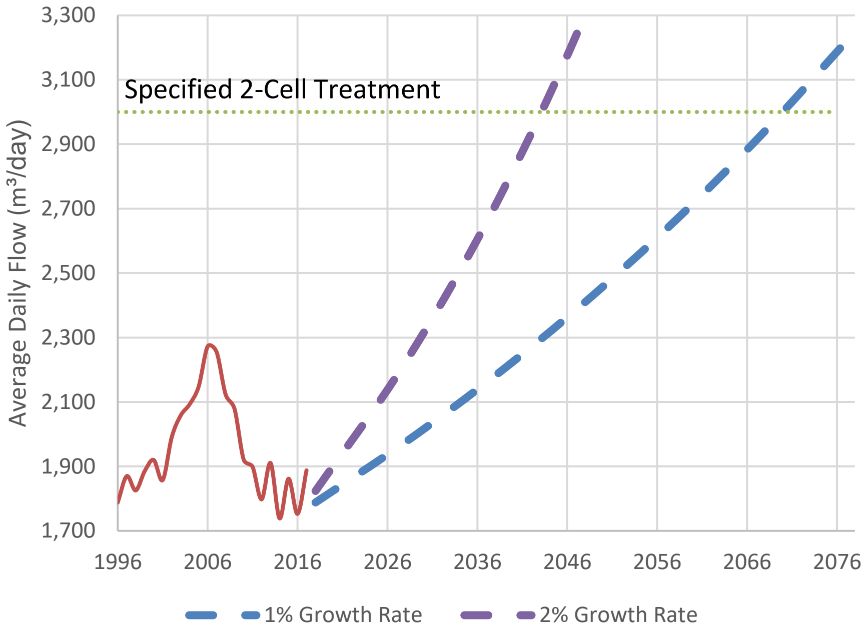



**FIGURE 3-1: PROJECTED AVERAGE DAILY SEWAGE INFLUENT FLOWS**

## 3.2 Design Capacity

This section is provided to determine when the treatment objectives relating to the existing treatment system will exceed permitted maximum levels of 45 mg/L BOD and 60 mg/L TSS. The following calculations are provided to indicate when these treatment objectives will be exceeded based on existing conditions (i.e. lagoons are not desludged) and ideal conditions (i.e. lagoons are fully desludged). Note that winter conditions govern and the Town's 2016 Annual Report indicated that average flow for this system is about 1,753 $m^3$/d.

<u>Existing Design Conditions (i.e. lagoons are fully desludged)</u>

- Volume: Cell No. 2 has capacity of 37,600 $m^3$ while Cell No. 3 has capacity of 38,200 $m^3$ resulting in a total design capacity of 75,800 $m^3$
- Detention time = 75,800 $m^3$ divided by 1,753 $m^3$/day = 43.2 days
- 2016 Oliver census population = 4,928 persons
- Theoretical BOD = 0.17 lb/capita or 0.077 kg/capita x 4,928 persons = 379 kg/day BOD in
- Influent BOD concentration = BOD in divided by flow = 379 kg/day divided by 1,753 $m^3$/day = 0.216 kg/$m^3$ x 1x$10^6$ mg/kg divided by 1,000 L/$m^3$ = 216 mg/L BOD in
- Theoretical reaction rate if wastewater temperature is assumed to be 5ºC during winter conditions = 0.162 $day^{-1}$

- Removal efficiency = 1 / (1 + reaction rate x detention time) = 12.5% remaining
- Wastewater treatment system Effluent BOD = removal efficiency x BOD in = 12.5% x 216 mg/L = 27.0 mg/L BOD
- Exceedance of 45 mg/L during winter conditions:
  - found to be in 2077 with a population equivalent of about 9,080 persons (assumes 1% growth rate)
  - found to be in 2046 with a population equivalent of about 9,080 persons (assumes 2% growth rate)

Existing Conditions (i.e. lagoons are not desludged)

- Volume: As of 2011, Cell No. 2 had a sludge accumulation of 5,000 $m^3$ while Cell No. 3 had a sludge accumulation of 3,000 $m^3$.
- Projected sludge accumulation is based off annual sludge accumulation between 1996 and 2011.
- Detention time = about 65,000 $m^3$ divided by 1,753 $m^3$/day = 37.1 days for 2016 conditions
- 2016 Oliver census population = 4,928 persons
- Theoretical BOD = 0.17 lb/capita or 0.077 kg/capita x 4,928 persons = 379 kg/day BOD in
- Influent BOD concentration = BOD in divided by flow = 379 kg/day divided by 1,753 $m^3$/day = 0.216 kg/$m^3$ x $1x10^6$ mg/kg divided by 1,000 L/$m^3$ = 216 mg/L BOD in
- Theoretical reaction rate if wastewater temperature is assumed to be 5ºC during winter conditions = 0.162 $day^{-1}$
- Removal efficiency = 1 / (1 + reaction rate x detention time) = 14.3% remaining
- Wastewater treatment system Effluent BOD = removal efficiency x BOD in = 14.3% x 216 mg/L = 30.8 mg/L BOD
- Exceedance of 45 mg/L during winter conditions:
  - found to be in 2040 with a population equivalent of about 6,270 persons (assumes 1% growth rate)
  - found to be in 2032 with a population equivalent of about 6,780 persons (assumes 2% growth rate)

Based on the above, it can be assumed that the existing system has adequate capacity for the existing service population. Also, additional lagoon capacity will not be necessary until between 2032 and 2077 (depending upon sludge accumulation and future desludging efforts). Desludging will therefore allow the Town to defer capacity upgrades in the future. This projection is approximately consistent with the findings presented in Section 3.1.

# 4.0 Proposed Upgrading Works

The upgrading works discussed in this section have been recommended on the basis of addressing deficiencies to the existing aerated lagoon treatment system. As discussed in Section 0, the Town's aerated lagoons have adequate capacity to achieve treatment objectives until at least 2032 providing that adequate desludging occurs on an ongoing basis. Therefore, upgrading works will mostly address deficiencies related to safety and operational issues, but will also consider capacity upgrades that will be necessary at some point in the future. A site plan of the proposed upgrades is provided in Appendix B.

The following sections summarize proposed upgrades to address aerated lagoon system deficiencies. Also note that a photovoltaic system has been recommended to offset a portion of greenhouse gas emissions associated with operating the aeriated lagoon system.

## 4.1 Middle Berm Stabilization

The initial component of the project would be to stabilize the existing middle berm. As previously discussed, this berm is known to be saturated and would likely fail if the water level of one of the lagoons was lowered independently of the other. Therefore, to rectify this issue, it is proposed that two lock block walls be installed along the length of this berm. These walls would be tied to each other with geogrid to provide stability and infilled. Since the existing aeration system header is installed within the existing berm, this project would necessitate the replacement of the lagoon aeration system. It should also be noted that the existing aeration system is reaching the end of its expected lifespan and therefore this project would allow for its replacement. A secondary benefit of this berm stabilization would be that the existing lagoon capacity would increase due to the installation of a wall structure in place of the existing 3:1 lagoon slopes.

## 4.2 Aeration System Upgrades

Following the proposed middle berm stabilization project, the following upgrades are proposed as a means to increase treatment capacity of the existing lagoon system.

- Desludging of Cell No. 2:
  - draining of liquid components from Cell No. 2 to Cell No. 3,
  - removal of the aeration system in both cells,
  - pumping of sludge from Cell No. 2 to a dewatering system which is to be located in a Town owned property approximately 850m away from the lagoon system,
- Aeration system upgrades:
  - Installation of a new aeration header and laterals pipes to each lagoon. Note that a floating aeration system is proposed to ease future operations and maintenance.

- Provision of new aeration system diffusers.
- Installation of a new blower in the existing blower building. The new blower will act as the duty blower for the aeration system and is proposed to be controlled by a dissolved oxygen sensor in the lagoon. Therefore, the level of dissolved oxygen in the treatment system will control the level of airflow from the proposed blower. This system is expected to result in a more efficient aeration system and help the Town of Oliver to reduce power consumption relating to wastewater treatment.

The aeration system would be designed to allow for future conversion of the treatment works to an intermittently decanted extended aeration system. This type of system would allow higher levels of BOD, TSS and ammonia removal while continuing to utilize the existing lagoon footprint. These future improvements would be installed on an as required timeline based on population growth of the Town of Oliver.

## 4.3 50 kW Photovoltaic System

The final portion of this project will be to utilize the aerated lagoon site as a location for renewable energy production as a means to offset emissions produced by the Town of Oliver. The Photovoltaic (PV) power will be connected to the system by means of a “grid-tie” inverter and metered by FortisBC under their net metering program. This means that the grid is used as the battery, and electricity can flow in both directions as required. This project would place Oliver as a leader in the province in terms of photovoltaic energy production at a time when renewable energy is as important as ever. It will also further local knowledge and expertise in the photovoltaic industry. The proposed solar array would be sized at 50 kW which will ensure that the project remains within FortisBC’s net metering limit per electrical service. Further, the anticipated consumption remains under the amount consumed at each location (another criteria of the FortisBC net metering program). The electricity usage at this site is by the municipality and is anticipated to remain stable long term.

# 5.0 Future Upgrades

As discussed in Section 4.2, the proposed upgrades would be designed to allow for future conversion of the treatment works to an intermittently decanted extended aeration system. This future upgrade will require the installation of the following additional components:

- Blowers – airflow requirement of 1,150 SCFM
- Floating aeration system (this would be included in the aeration system upgrades portion of the project – see Section 4.2)
- Lagoon baffle curtains
- Influent manifold
- PLC Control system and control valves
- Control probes and transducers

The above upgrades are expected to increase the lagoon reaction rate of the aerated lagoons. A projection of treatment levels associated with these future upgrades are summarized following:

- Discharge rate – 3,230 $m^3$/day
- 5 Day Biochemical Oxygen Demand – 20 mg/L
- Total Suspended Solids – 20 mg/L

The 2016 average daily flow equates to approximately 355 L/capita/day. Therefore, the peak flow able to be treated utilizing the future intermittently decanted extended aeration system is approximately equivalent to 9,100 people which is projected to occur in about 60 years assuming the OCP specified growth rate remains appropriate. It should also be noted that the assumed future treatment objectives of 20 mg/L for both BOD and TSS are higher than the existing Class ‘C’ effluent requirements currently specified in the Town’s operational certificate. If the specified effluent requirements remain consistent with current conditions, the future design flow rate would increase accordingly.

# 6.0 Assessment Summary

The Town's aerated lagoon treatment works were constructed in 1995/1996 to treat wastewater effluent to at least 45 mg/L BOD and 60 mg/L TSS. In the period since the treatment system was constructed, various deficiencies have been identified relating to capacity and operation issues. Deficiencies associated with the aerated lagoon treatment system are:

- Exceedance of permitted effluent BOD and TSS levels.
  - Capacity improvements are required for treatment objectives to be achieved.
- Stability of middle berm.
  - Middle berm is saturated and requires upgrading. The existing two-cell aerated lagoon system does not provide redundancy since the middle berm cannot be relied upon.

Conceptually, upgrading works to address the above identified deficiencies would comprise:

- Middle berm stabilization
- Aeration system upgrades including desludging
- Allowances for future capacity upgrades

The project would also include a 50 kW photovoltaic system to reduce the carbon footprint of the Town's treatment system.

A capital cost estimate for the above upgrades of $4,645,000 is derived in the following Section 6.1.

Further to these proposed upgrades, a recommendation moving forward would be to desludge these lagoons on a regular basis to ensure that adequate treatment capacity is maintained. It should also be noted that a geotechnical investigation relating to the preferred method for stabilizing the middle berm would be required for this project. It is suggested that the Town proceed with this geotechnical investigation prior to commencement of the detailed design phase.

## 6.1 Capital Cost Estimate

A preliminary (Class D) capital cost estimate of expected costs associated with this project is provided following.

## Table 6-1: Capital Cost Estimate

| | | | |
|---|---|---|---|
| ***Part A - Middle Berm Stabilization*** | | | |
| **A1.0** | **Bulk excavation of existing middle berm to allow installation of proposed lock block walls** | 22000 m³ @ $15 / m³ | $330,000 |
| **A2.0** | **Two lock block walls** | 2000 m² @ $1000 / m² | $2,000,000 |
| **A3.0** | **Infill between lock block walls** | 4900 m³ @ $20 / m³ | $98,000 |
| **A4.0** | **LDPE membrane** | 2000 m² @ $20 / m² | $40,000 |
| | **Subtotal: Part A - Middle Berm Stabilization** | | $2,468,000 |
| ***Part B - Aeration System Upgrades*** | | | |
| **B1.0** | **Remove aeration system** | Allow | $10,000 |
| **B2.0** | **phases to allow for dewatering of geotextile tubes)** | | |
| 2.1 | Mobilization and demobilization | Allow | $20,000 |
| 2.2 | Construct laydown area | Allow | $15,000 |
| 2.3 | Supply only geotextile tubes | 12 ea. @ $15000 ea. | $180,000 |
| 2.4 | Temporary overland piping to laydown area | 850 l.m. @ $50 / l.m. | $42,500 |
| 2.4 | Pump sludge to geotextile tubes | 12000 m³ @ $20 / m³ | $240,000 |
| 2.5 | Bottom area cleanup and leveling | Allow | $15,000 |
| **B3.0** | **Aeration system** | | |
| 3.1 | Aeration header | 300 l.m. @ $150 / l.m. | $45,000 |
| 3.2 | Aeration laterals (allow for floating system) | 1000 l.m. @ $115 / l.m. | $115,000 |
| 3.3 | Diffusers complete with rubber hose and connection to laterals | 50 ea. @ $1500 ea. | $75,000 |
| **B4.0** | **Supply and install 30hp blower complete with variable frequency drive** | L.S. | $55,000 |
| **B5.0** | **Electrical and programming** | Allow | $30,000 |
| | **Subtotal: Part B - Aeration System Upgrades** | | $842,500 |
| ***Part C - 50 kW Photovoltaic System*** | | | |
| **C1.0** | **Photovoltaic panels** | 50000 W @ $1.5 / W | $75,000 |
| **C2.0** | **Inverters** | 50000 W @ $1.25 / W | $62,500 |
| **C3.0** | **Installation** | 50000 W @ $2.5 / W | $125,000 |
| | **Subtotal: Part C - 50 kW Photovoltaic System** | | $262,500 |
| **Summary** | | | |
| | **Subtotal: Part A - Middle Berm Stabilization** | | $2,468,000 |
| | **Subtotal: Part B - Aeration System Upgrades** | | $842,500 |
| | **Subtotal: Part C - 50 kW Photovoltaic System** | | $262,500 |
| | **Subtotal Parts A - C** | | $3,573,000 |
| | **Contingencies & Engineering (allow 30%)** | | $1,072,000 |
| | **TOTAL (not including GST)** | | $4,645,000 |

## 6.2 Lifecycle Expenditures

Consistent with the Guide to the Amortization of Tangible Capital Assets produced by the Local Government Infrastructure and Finance Division of the BC government in May 2008, the following expected lifespans are presented in relation to components of the Town's aerated treatment system.

**TABLE 6-2: "PUBLISHED" EXPECTED LIFESPANS OF AERATED LAGOON TREATMENT ASSETS**

| ***Asset*** | ***Expected Lifespan*** |
|---|---|
| *Aerators* | *15 years* |
| *Blowers* | *10 years* |
| *Lagoons* | *50 years* |

Both the original aerators and blowers that are in service at the Town's aerated lagoon treatment system are still in operation. Therefore, the "published" expected lifespan for these components can be expected to be conservative. A comparison of these "published" lifespans and "observed" lifespans is therefore provided following. In order to provide an expected lifecyle expenditure, the "observed" lifespans will be utilized.

**TABLE 6-3: "OBSERVED" EXPECTED LIFESPANS OF AERATED LAGOON TREATMENT ASSETS**

| ***Asset*** | ***Expected Lifespan*** |
|---|---|
| *Aerators* | *25 years* |
| *Blowers* | *25 years* |

It is anticipated that the proposed project will result in fully rehabilitated aerated lagoons and therefore it is anticipated that the aerated lagoons will have a new expected lifespan of at least 50 years. Lifecycle capital expenditures for the aerated lagoon system must then include replacement of aerators, replacement of blowers, and desludging operations to match the expected lifespan of the lagoon system. The period between desludging operations is expected to be 25 years which is approximately equivalent to the currently planned desludging operations and the initial lagoon construction date. A projection of these expenditures is presented following. Note that these projected expenditures are presented in 2019 dollars and should be adjusted utilizing the ENR cost index to account for future costs.

**TABLE 6-4: PROJECTED LIFECYCLE EXPENDITURES**

| ***Asset*** | ***Lifecycle Replacements and Unit Rate*** | ***Total Cost including 30% Contingency and Engineering*** |
|---|---|---|
| *Aeration System* | *2 @ $75,000* | *$195,000* |
| *Blowers* | *2 @ $80,000* | *$208,000* |
| *Desludging* | *2 @ $512,500* | *$1,332,500* |
| ***Total Capital Expenditure Cost over 50 years*** | | ***$1,735,500*** |
| ***Cost per year*** | | ***$34,710*** |

## 6.3 Annual Operating Costs

Annual operating costs are expected to include aeration system maintenance requirements and energy costs associated with the blowers. A projection of these annual costs is presented following:

**TABLE 6-5: ANNUAL OPERATING COSTS**

| ***Component*** | ***Unit and Unit Cost*** | ***Cost*** |
|---|---|---|
| *Aeration System Maintenance* | *50 hours @ $60 / hr* | *$3,000* |
| *Blower Electrical Costs* | *60,000 kWh @ 10.195 cents / kWh* | *$6,000* |
| ***Total Annual Expenditures*** | | ***$9,000*** |

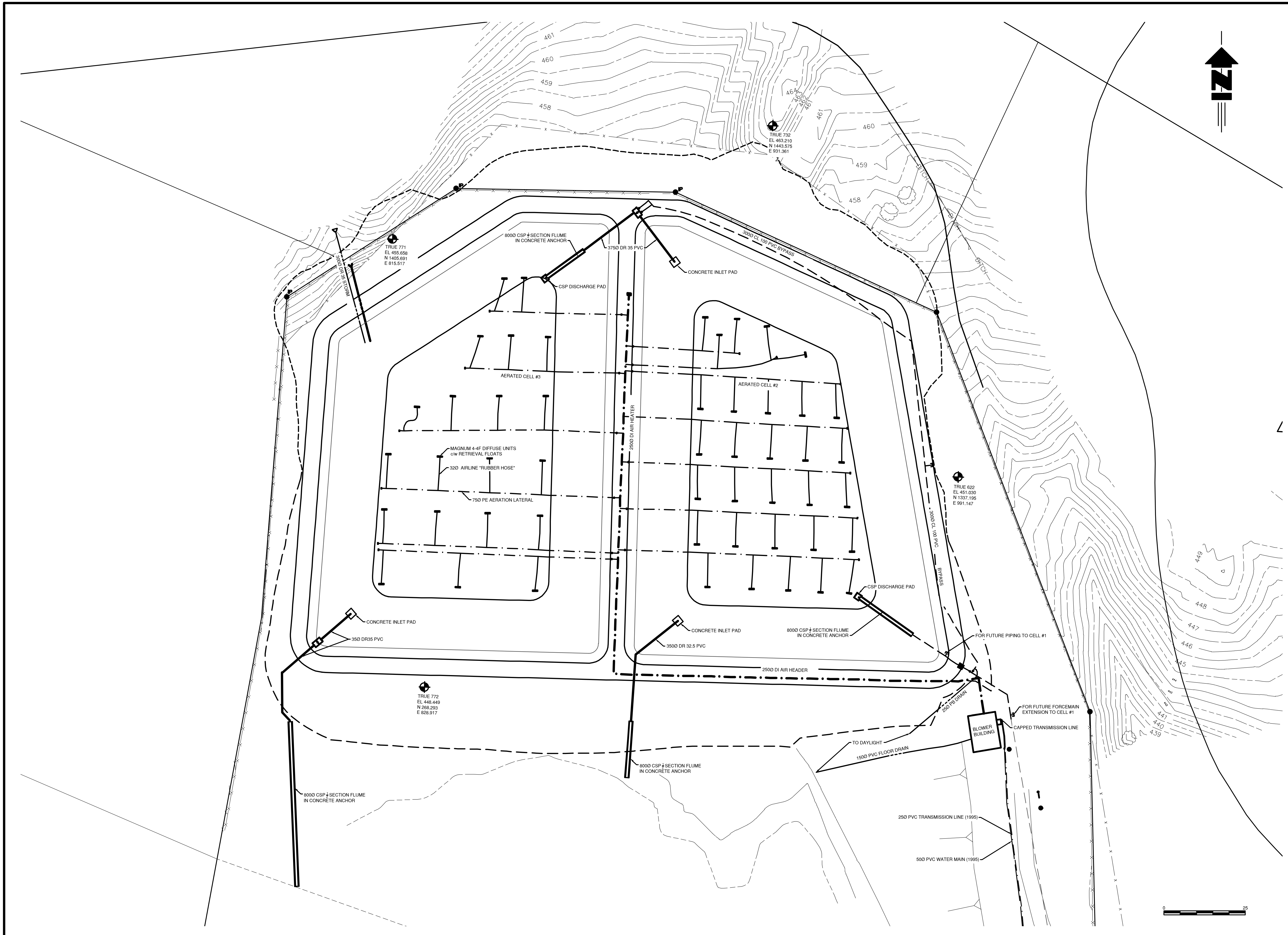
# APPENDIX B

Figure 1-3 - Aerated Lagoon Treatment System Layout and Intercell Piping

306-985 Figure 1 - Proposed Cell No. 1

306-1752 Figure 1 - Overall Site Plan

306-1752 Figure 2 System Layout & Inter Cell Piping




| No. | DATE | DESCRIPTION | BY | APP'D |
|---|---|---|---|---|

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

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info@TRUE.bc.ca

BRITISH COLUMBIA
Town of Oliver

**SANITARY SEWER ANNUAL REPORT**

**AREATED LAGOON TREATMENT SYSTEM LAYOUT AND INTERCELL PIPING**

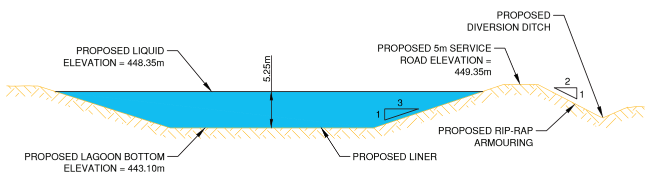
| | |
|---|---|
| SCALE | 1:500 (24x36) |
| DESIGN BY | TRU |
| DRAWN BY | NA |
| DATE | JANUARY 2018 |
| PROJECT REFERENCE No. | 306-088-005 |

DRAWING No.
**FIG 1-3**

SHEET 1 OF 1

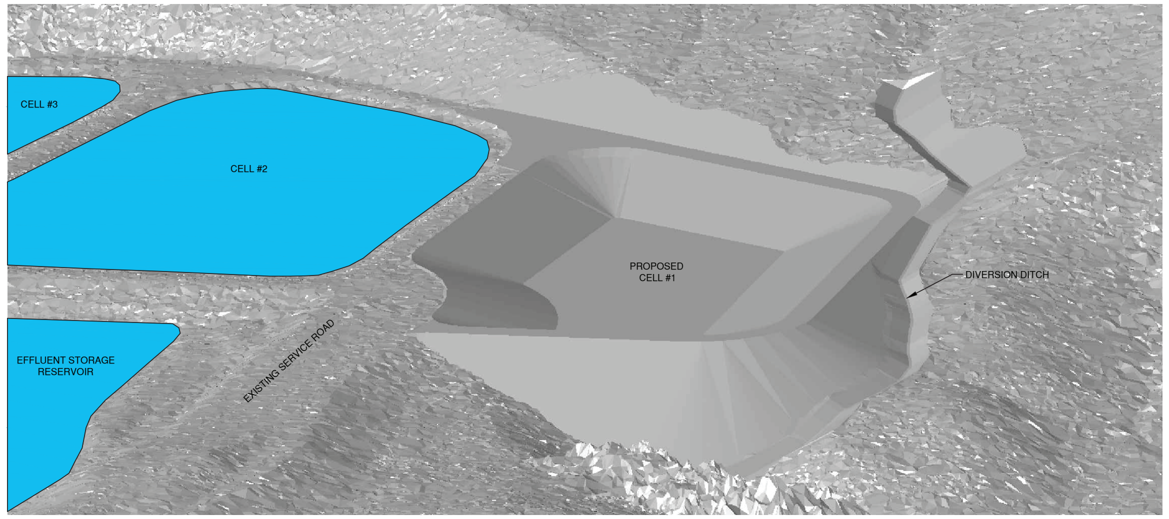
ISSUE/REV.

FILE: r:\clients\300-399\306\306-088-005\03 drawings\cad\02 design drawings\306-088-005 report figures


## SECTION A - PROPOSED CELL #1 & DIVERSION DITCH

*HORIZONTAL & VERTICAL*
*SCALE 1:500*




**CUT/FILL QUANTITIES**

*PROPOSED CELL #1 EARTHWORKS*

24,000 m³ (CUT)
19,500 m³ (FILL)
*NET 4,500 m³ (CUT)*

*NOT INCLUDING STRIPPING*
*APPROXIMATE VOLUME 3,900 m³ (CUT)*

*PROPOSED CELL #1 CAPACITY*
*26,000 m³*

DRAFT

| No. | DATE | DESCRIPTION | BY | APPD |
|---|---|---|---|---|
| 0 | SEPT 07/2017 | ISSUED FOR DISCUSSION | DF | SC |

ISSUES / REVISIONS

CONSULTANT SEAL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info@TRUE.bc.ca


BRITISH COLUMBIA Town of Oliver

**AERATED LAGOON TREATMENT SYSTEM**

**PROPOSED CELL #1**

| | |
|---|---|
| SCALE | 0 — 1:500 — 25 |
| DESIGN BY | SU/SC |
| DRAWN BY | DF |
| DATE | SEPTEMBER, 2017 |
| PROJECT REFERENCE No. | 306-083 & 306-291 |
| DRAWING No. | 306-985 |
| SHEET | 1 OF 1 |
| ISSUE/REV. | 0 |

**Fig. 1**

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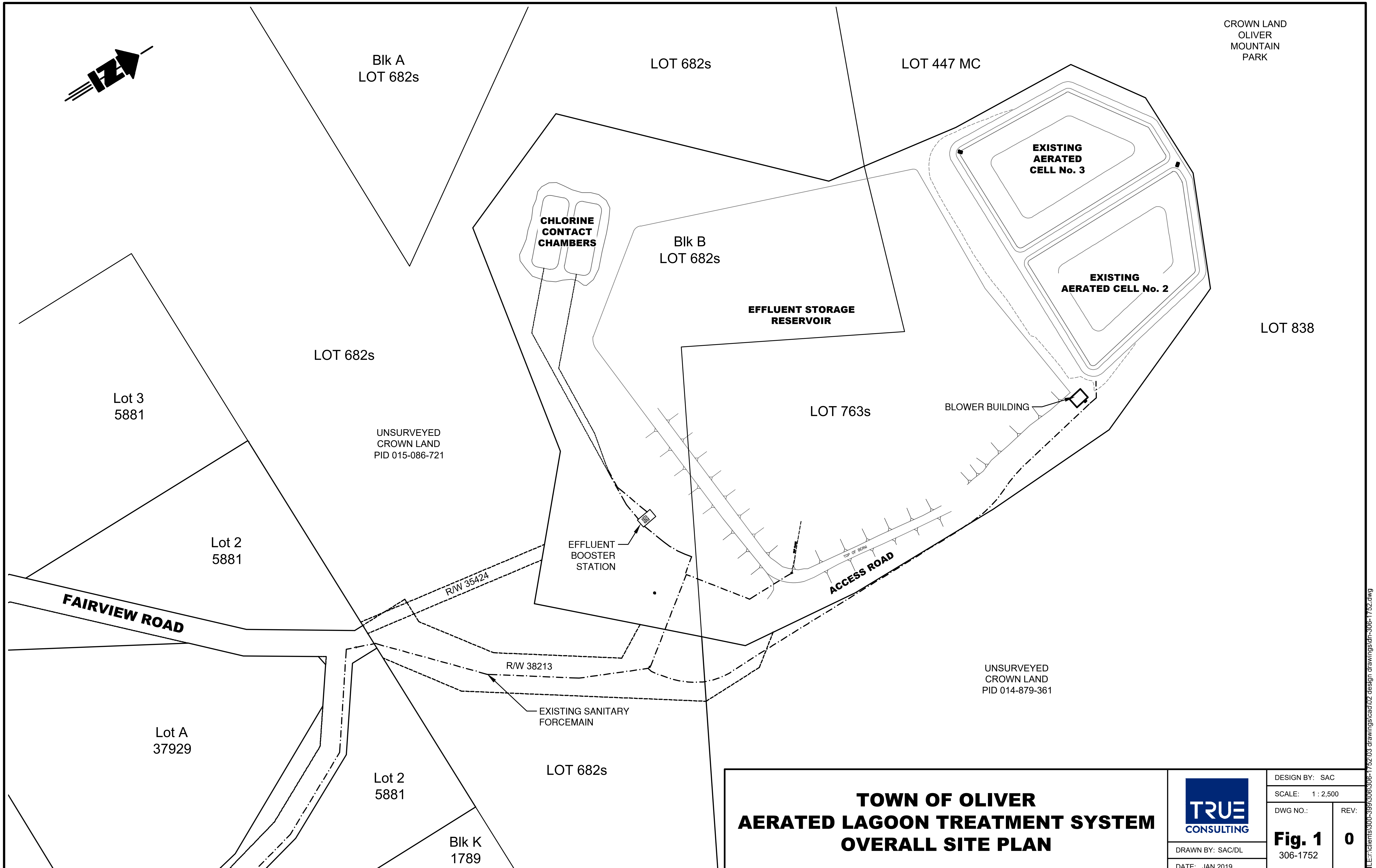

N
Blk A
LOT 682s
LOT 682s
LOT 447 MC
CROWN LAND
OLIVER
MOUNTAIN
PARK
EXISTING
AERATED
CELL No. 3
CHLORINE
CONTACT
CHAMBERS
Blk B
LOT 682s
EXISTING
AERATED CELL No. 2
EFFLUENT STORAGE
RESERVOIR
LOT 838
LOT 682s
Lot 3
5881
LOT 763s
BLOWER BUILDING
UNSURVEYED
CROWN LAND
PID 015-086-721
Lot 2
5881
EFFLUENT
BOOSTER
STATION
TOP OF BERM
ACCESS ROAD
R/W 35424
FAIRVIEW ROAD
R/W 38213
EXISTING SANITARY
FORCEMAIN
UNSURVEYED
CROWN LAND
PID 014-879-361
Lot A
37929
Lot 2
5881
LOT 682s
Blk K
1789
TOWN OF OLIVER
AERATED LAGOON TREATMENT SYSTEM
OVERALL SITE PLAN
TRUE
CONSULTING
DESIGN BY: SAC
SCALE: 1 : 2,500
DWG NO.:
REV:
Fig. 1
306-1752
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DRAWN BY: SAC/DL
DATE: JAN 2019
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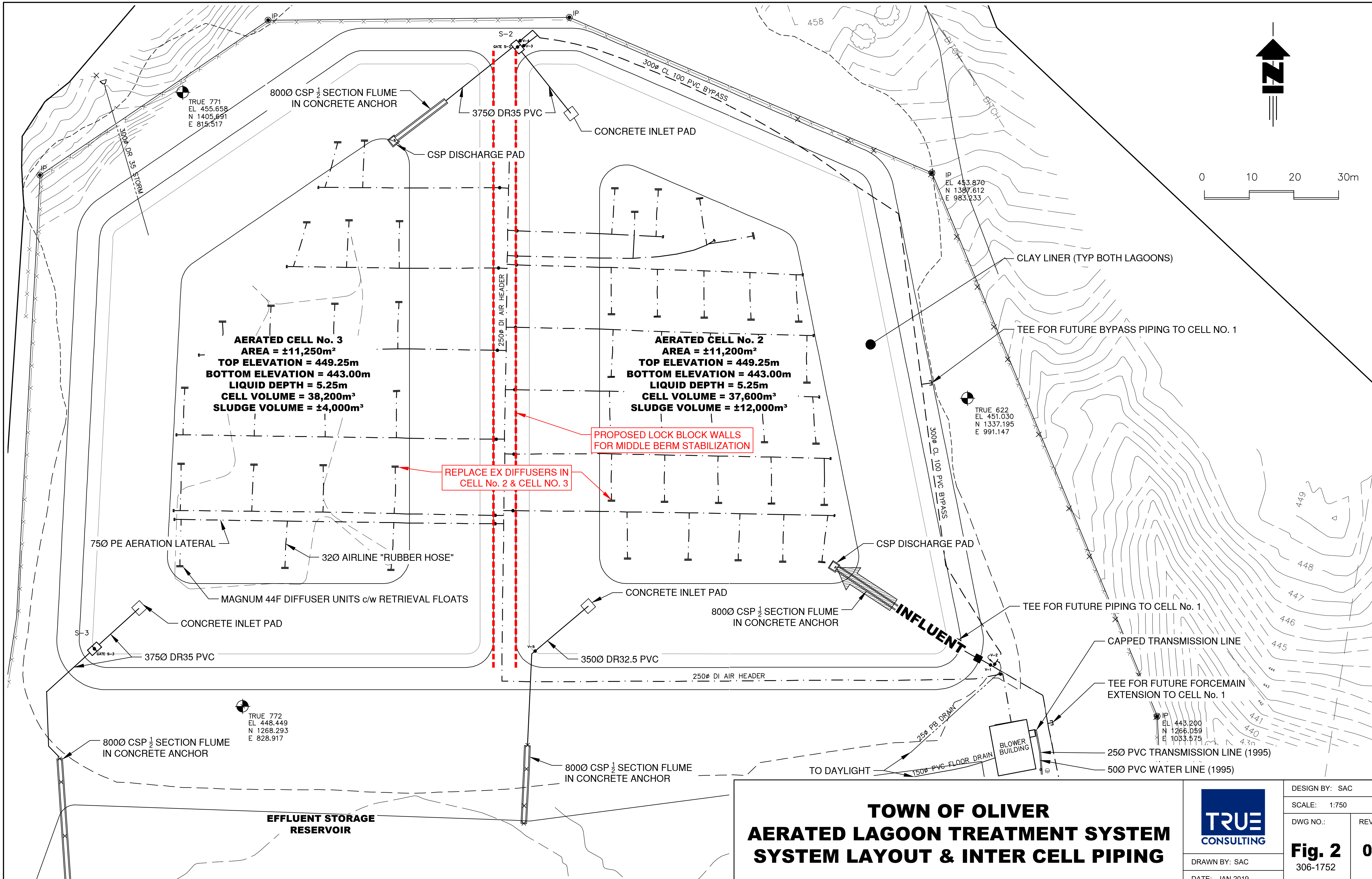


# TOWN OF OLIVER
# AERATED LAGOON TREATMENT SYSTEM
# SYSTEM LAYOUT & INTER CELL PIPING

TRUE CONSULTING

DESIGN BY: SAC
SCALE: 1:750
DWG NO.: Fig. 2 306-1752
REV: 0
DRAWN BY: SAC
DATE: JAN 2019

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# APPENDIX C

## Influent and Effluent Sampling Data

**TOWN OF OLIVER**

**PE - 13717 - Chlorine Contact Chamber Prior to Irrigation - EMS ID E222150**

| | | Calculated Parameters | General Parameters | Microbiological Parameters | | |
|---|---|---|---|---|---|---|
| | **Date** | **Total N** | **Diss P**** | **otal Coliforr** | **ecal Coliform** | **Free CL Res** |
| OC Limit | | n/a | n/a | n/a | .2 MPN/100 m | n/a |
| Unit | | mg/L | mg/L | MPN/100ml | MPN/100ml | mg/L |
| Frequency | | monthly | monthly | monthly | monthly | weekly |
| | | | | | | |
| April | 14 | - | 5.06 | <1.0 | <1.0 | 0.26 |
| May | 4 | - | 4.79 | <1.0 | <1.0 | 0.29 |
| June | 1 | - | - | 6.3 | <1.0 | 0.32 |
| July | 6 | - | - | <1.0 | <1.0 | 0.44 |
| August | 4 | - | - | <1.0 | <1.0 | 0.38 |
| September | 1 | - | - | <1.0 | <1.0 | 0.38 |
| October | 5 | - | - | <1.0 | <1.0 | 0.23 |
| | | | | | | |

* Note:  The operational permit limit for fecal coliform in re-claimed water applied to agricultural land is 200 MPN per 100mL.  Most of the re-claimed water in Oliver is applied on the Fairview Mountain Golf Course which is classified as high public use, hence the lower limit of 2.2 MPN per 100 mL.

**Dissolved Phosphorus was analyzed instead of Total Phosphorus, or no analysis was completed, due to a communication error between the Town and Lab.

***Total Nitrogen analysis was not completed on collected samples due to a communication error between the Town and Lab.

CARO ANALYTICAL SERVICES

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of<br>5971 Sawmill Road, PO Box 638<br>Oliver, BC  V0H 1T0 | | |
| **ATTENTION** | Patti Hannas | **WORK ORDER** | 0041010 |
| **PO NUMBER** | 43166 | **RECEIVED / TEMP** | 2020-04-15 08:45 /  8°C |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-04-22 12:15 |
| **PROJECT INFO** | B.1. | **COC NUMBER** | B52363 |

**Introduction:**

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO 17025:2005 for specific tests listed in the scope of accreditation approved by CALA.

*Big Picture Sidekicks*

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

*We've Got Chemistry*

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*If you have any questions or concerns, please contact me at* acrump@caro.ca

**Authorized By:**

Alana Crump
Team Lead, Client Service

# TEST RESULTS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0041010 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-04-22 12:15 |

| Analyte | Result | RL | Units | Analyzed | Qualifier |
|---|---|---|---|---|---|
| **#Cell 3M (B1) (0041010-01) \| Matrix: Water \| Sampled: 2020-04-14 08:30** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | **29.0** | 2.0 | mg/L | 2020-04-22 | |
| BOD, 5-day Carbonaceous | **10.1** | 2.0 | mg/L | 2020-04-21 | |
| Solids, Total Suspended | **19.6** | 2.0 | mg/L | 2020-04-21 | |
| **#Lake Cl2 (B4) (0041010-02) \| Matrix: Water \| Sampled: 2020-04-14 08:30** | | | | | F1 |
| ***Calculated Parameters*** | | | | | |
| Hardness, Total (as CaCO3) | **336** | 0.500 | mg/L | N/A | |
| ***Dissolved Metals*** | | | | | |
| Lithium, dissolved | **0.0118** | 0.00010 | mg/L | 2020-04-20 | |
| Aluminum, dissolved | < 0.0050 | 0.0050 | mg/L | 2020-04-20 | |
| Antimony, dissolved | **0.00034** | 0.00020 | mg/L | 2020-04-20 | |
| Arsenic, dissolved | **0.00233** | 0.00050 | mg/L | 2020-04-20 | |
| Barium, dissolved | **0.0448** | 0.0050 | mg/L | 2020-04-20 | |
| Beryllium, dissolved | < 0.00010 | 0.00010 | mg/L | 2020-04-20 | |
| Bismuth, dissolved | < 0.00010 | 0.00010 | mg/L | 2020-04-20 | |
| Boron, dissolved | **0.188** | 0.0050 | mg/L | 2020-04-20 | |
| Cadmium, dissolved | **0.000047** | 0.000010 | mg/L | 2020-04-20 | |
| Calcium, dissolved | **93.5** | 0.20 | mg/L | 2020-04-20 | |
| Chromium, dissolved | < 0.00050 | 0.00050 | mg/L | 2020-04-20 | |
| Cobalt, dissolved | **0.00047** | 0.00010 | mg/L | 2020-04-20 | |
| Copper, dissolved | **0.00970** | 0.00040 | mg/L | 2020-04-20 | |
| Iron, dissolved | **0.016** | 0.010 | mg/L | 2020-04-20 | |
| Lead, dissolved | **0.00031** | 0.00020 | mg/L | 2020-04-20 | |
| Magnesium, dissolved | **24.7** | 0.010 | mg/L | 2020-04-20 | |
| Manganese, dissolved | **0.0184** | 0.00020 | mg/L | 2020-04-20 | |
| Molybdenum, dissolved | **0.00497** | 0.00010 | mg/L | 2020-04-20 | |
| Nickel, dissolved | **0.00317** | 0.00040 | mg/L | 2020-04-20 | |
| Phosphorus, dissolved | **5.06** | 0.050 | mg/L | 2020-04-20 | |
| Potassium, dissolved | **23.5** | 0.10 | mg/L | 2020-04-20 | |
| Selenium, dissolved | **0.00126** | 0.00050 | mg/L | 2020-04-20 | |
| Silicon, dissolved | **10.0** | 1.0 | mg/L | 2020-04-20 | |
| Silver, dissolved | < 0.000050 | 0.000050 | mg/L | 2020-04-20 | |
| Sodium, dissolved | **108** | 0.10 | mg/L | 2020-04-20 | |
| Strontium, dissolved | **0.987** | 0.0010 | mg/L | 2020-04-20 | |
| Sulfur, dissolved | **36.7** | 3.0 | mg/L | 2020-04-20 | |
| Tellurium, dissolved | < 0.00050 | 0.00050 | mg/L | 2020-04-20 | |
| Thallium, dissolved | < 0.000020 | 0.000020 | mg/L | 2020-04-20 | |
| Thorium, dissolved | < 0.00010 | 0.00010 | mg/L | 2020-04-20 | |
| Tin, dissolved | < 0.00020 | 0.00020 | mg/L | 2020-04-20 | |
| Titanium, dissolved | < 0.0050 | 0.0050 | mg/L | 2020-04-20 | |

CARO ANALYTICAL SERVICES

# TEST RESULTS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0041010 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-04-22 12:15 |

| Analyte | Result | RL | Units | Analyzed | Qualifier |
|---|---|---|---|---|---|
| **#Lake Cl2 (B4) (0041010-02) \| Matrix: Water \| Sampled: 2020-04-14 08:30, Continued** | | | | | F1 |
| ***Dissolved Metals, Continued*** | | | | | |
| Tungsten, dissolved | < 0.0010 | 0.0010 | mg/L | 2020-04-20 | |
| Uranium, dissolved | **0.0101** | 0.000020 | mg/L | 2020-04-20 | |
| Vanadium, dissolved | **0.0012** | 0.0010 | mg/L | 2020-04-20 | |
| Zinc, dissolved | **0.0473** | 0.0040 | mg/L | 2020-04-20 | |
| Zirconium, dissolved | **0.00018** | 0.00010 | mg/L | 2020-04-20 | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | < 5.8 | 2.0 | mg/L | 2020-04-22 | |
| BOD, 5-day Carbonaceous | < 6.3 | 2.0 | mg/L | 2020-04-21 | |
| Solids, Total Suspended | < 4.0 | 2.0 | mg/L | 2020-04-21 | |
| ***Microbiological Parameters*** | | | | | |
| Coliforms, Total | < 1.0 | 1.0 | MPN/100 mL | 2020-04-15 | |
| Coliforms, Fecal | < 1.0 | 1.0 | MPN/100 mL | 2020-04-15 | |

**Sample Qualifiers:**

F1 The sample was not field-filtered and was therefore filtered through a 0.45 µm membrane in the laboratory and preserved with HNO3 prior to analysis for dissolved metals.

CARO ANALYTICAL SERVICES

# APPENDIX 1: SUPPORTING INFORMATION

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0041010 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-04-22 12:15 |

| Analysis Description | Method Ref. | Technique | Location |
|---|---|---|---|
| Biochemical Oxygen Demand in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | Kelowna |
| Biochemical Oxygen Demand, Carbonaceous in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | Kelowna |
| Coliforms, Fecal in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | Kelowna |
| Coliforms, Total in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | Kelowna |
| Dissolved Metals in Water | EPA 200.8 / EPA 6020B | 0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) | Richmond |
| Hardness in Water | SM 2340 B (2017) | Calculation: 2.497 [diss Ca] + 4.118 [diss Mg] | N/A |
| Solids, Total Suspended in Water | SM 2540 D* (2017) | Gravimetry (Dried at 103-105C) | Kelowna |

*Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method*

**Glossary of Terms:**

| | |
|---|---|
| RL | Reporting Limit (default) |
| < | Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors |
| mg/L | Milligrams per litre |
| MPN/100 mL | Most Probable Number per 100 millilitres |
| EPA | United States Environmental Protection Agency Test Methods |
| SM | Standard Methods for the Examination of Water and Wastewater, American Public Health Association |

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# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of<br>5971 Sawmill Road, PO Box 638<br>Oliver, BC V0H 1T0 | | |
| **ATTENTION** | Patti Hannas | **WORK ORDER** | 0050252 |
| **PO NUMBER** | 43168 | **RECEIVED / TEMP** | 2020-05-05 09:20 / 5°C |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-05-12 14:13 |
| **PROJECT INFO** | B.1. | **COC NUMBER** | B91423 |

**Introduction:**

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*If you have any questions or concerns, please contact me at* acrump@caro.ca

**Authorized By:**

Alana Crump
Team Lead, Client Service

CARO ANALYTICAL SERVICES

# TEST RESULTS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0050252 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-05-12 14:13 |

| Analyte | Result | RL | Units | Analyzed | Qualifier |
|---|---|---|---|---|---|
| **#Cell 3M (B1) (0050252-01) \| Matrix: Water \| Sampled: 2020-05-04 08:00** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | **21.4** | 2.0 | mg/L | 2020-05-11 | |
| BOD, 5-day Carbonaceous | **16.8** | 2.0 | mg/L | 2020-05-12 | |
| Solids, Total Suspended | **21.6** | 2.0 | mg/L | 2020-05-07 | |
| **#Lake Cl2 (B4) (0050252-02) \| Matrix: Water \| Sampled: 2020-05-04 08:30** | | | | | |
| ***Calculated Parameters*** | | | | | |
| Hardness, Total (as CaCO3) | **325** | 0.500 | mg/L | N/A | |
| ***Dissolved Metals*** | | | | | |
| Lithium, dissolved | **0.0124** | 0.00010 | mg/L | 2020-05-08 | |
| Aluminum, dissolved | **0.0062** | 0.0050 | mg/L | 2020-05-08 | |
| Antimony, dissolved | **0.00037** | 0.00020 | mg/L | 2020-05-08 | |
| Arsenic, dissolved | **0.00237** | 0.00050 | mg/L | 2020-05-08 | |
| Barium, dissolved | **0.0480** | 0.0050 | mg/L | 2020-05-08 | |
| Beryllium, dissolved | < 0.00010 | 0.00010 | mg/L | 2020-05-08 | |
| Bismuth, dissolved | < 0.00010 | 0.00010 | mg/L | 2020-05-08 | |
| Boron, dissolved | **0.193** | 0.0050 | mg/L | 2020-05-08 | |
| Cadmium, dissolved | **0.000044** | 0.000010 | mg/L | 2020-05-08 | |
| Calcium, dissolved | **89.7** | 0.20 | mg/L | 2020-05-08 | |
| Chromium, dissolved | < 0.00050 | 0.00050 | mg/L | 2020-05-08 | |
| Cobalt, dissolved | **0.00051** | 0.00010 | mg/L | 2020-05-08 | |
| Copper, dissolved | **0.0103** | 0.00040 | mg/L | 2020-05-08 | |
| Iron, dissolved | **0.033** | 0.010 | mg/L | 2020-05-08 | |
| Lead, dissolved | **0.00042** | 0.00020 | mg/L | 2020-05-08 | |
| Magnesium, dissolved | **24.4** | 0.010 | mg/L | 2020-05-08 | |
| Manganese, dissolved | **0.0212** | 0.00020 | mg/L | 2020-05-08 | |
| Molybdenum, dissolved | **0.00515** | 0.00010 | mg/L | 2020-05-08 | |
| Nickel, dissolved | **0.00325** | 0.00040 | mg/L | 2020-05-08 | |
| Phosphorus, dissolved | **4.79** | 0.050 | mg/L | 2020-05-08 | |
| Potassium, dissolved | **21.6** | 0.10 | mg/L | 2020-05-08 | |
| Selenium, dissolved | **0.00134** | 0.00050 | mg/L | 2020-05-08 | |
| Silicon, dissolved | **10.5** | 1.0 | mg/L | 2020-05-08 | |
| Silver, dissolved | **0.000054** | 0.000050 | mg/L | 2020-05-08 | |
| Sodium, dissolved | **109** | 0.10 | mg/L | 2020-05-08 | |
| Strontium, dissolved | **0.988** | 0.0010 | mg/L | 2020-05-08 | |
| Sulfur, dissolved | **34.8** | 3.0 | mg/L | 2020-05-08 | |
| Tellurium, dissolved | < 0.00050 | 0.00050 | mg/L | 2020-05-08 | |
| Thallium, dissolved | < 0.000020 | 0.000020 | mg/L | 2020-05-08 | |
| Thorium, dissolved | < 0.00010 | 0.00010 | mg/L | 2020-05-08 | |
| Tin, dissolved | < 0.00020 | 0.00020 | mg/L | 2020-05-08 | |
| Titanium, dissolved | < 0.0050 | 0.0050 | mg/L | 2020-05-08 | |

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0050252 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-05-12 14:13 |

| Analyte | Result | RL | Units | Analyzed | Qualifier |
|---|---|---|---|---|---|
| **#Lake Cl2 (B4) (0050252-02) \| Matrix: Water \| Sampled: 2020-05-04 08:30, Continued** | | | | | |
| ***Dissolved Metals, Continued*** | | | | | |
| Tungsten, dissolved | < 0.0010 | 0.0010 | mg/L | 2020-05-08 | |
| Uranium, dissolved | **0.0108** | 0.000020 | mg/L | 2020-05-08 | |
| Vanadium, dissolved | **0.0014** | 0.0010 | mg/L | 2020-05-08 | |
| Zinc, dissolved | **0.0480** | 0.0040 | mg/L | 2020-05-08 | |
| Zirconium, dissolved | **0.00011** | 0.00010 | mg/L | 2020-05-08 | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | < 5.6 | 2.0 | mg/L | 2020-05-11 | |
| Solids, Total Suspended | < 3.3 | 2.0 | mg/L | 2020-05-07 | |
| ***Microbiological Parameters*** | | | | | |
| Coliforms, Total | < 1.0 | 1.0 | MPN/100 mL | 2020-05-05 | |
| Coliforms, Fecal | < 1.0 | 1.0 | MPN/100 mL | 2020-05-05 | |

CARO ANALYTICAL SERVICES

# APPENDIX 1: SUPPORTING INFORMATION

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0050252 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-05-12 14:13 |

| Analysis Description | Method Ref. | Technique | Location |
|---|---|---|---|
| Biochemical Oxygen Demand in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | Kelowna |
| Biochemical Oxygen Demand, Carbonaceous in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | Kelowna |
| Coliforms, Fecal in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | Kelowna |
| Coliforms, Total in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | Kelowna |
| Dissolved Metals in Water | EPA 200.8 / EPA 6020B | 0.45 µm Filtration / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS) | Richmond |
| Hardness in Water | SM 2340 B (2017) | Calculation: 2.497 [diss Ca] + 4.118 [diss Mg] | N/A |
| Solids, Total Suspended in Water | SM 2540 D* (2017) | Gravimetry (Dried at 103-105C) | Kelowna |

*Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method*

**Glossary of Terms:**

| | |
|---|---|
| RL | Reporting Limit (default) |
| < | Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors |
| mg/L | Milligrams per litre |
| MPN/100 mL | Most Probable Number per 100 millilitres |
| EPA | United States Environmental Protection Agency Test Methods |
| SM | Standard Methods for the Examination of Water and Wastewater, American Public Health Association |

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CARO ANALYTICAL SERVICES

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of<br>5971 Sawmill Road, PO Box 638<br>Oliver, BC V0H 1T0 | | |
| **ATTENTION** | Patti Hannas | **WORK ORDER** | 0060115 |
| **PO NUMBER** | 43171 | **RECEIVED / TEMP** | 2020-06-02 09:00 / 10°C |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-06-09 14:35 |
| **PROJECT INFO** | B.1. | **COC NUMBER** | B71244 |

**Introduction:**

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*If you have any questions or concerns, please contact me at* acrump@caro.ca

**Authorized By:**

Alana Crump
Team Lead, Client Service

# TEST RESULTS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0060115 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-06-09 14:35 |

| Analyte | Result | RL | Units | Analyzed | Qualifier |
|---|---|---|---|---|---|
| **#Cell 3M (B1) (0060115-01) \| Matrix: Water \| Sampled: 2020-06-01 08:30** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | **27.9** | 2.0 | mg/L | 2020-06-09 | |
| BOD, 5-day Carbonaceous | **90.6** | 2.0 | mg/L | 2020-06-08 | |
| Solids, Total Suspended | **30.8** | 2.0 | mg/L | 2020-06-06 | |
| **#Lake Cl2 (B4) (0060115-02) \| Matrix: Water \| Sampled: 2020-06-01 08:30** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | < 5.8 | 2.0 | mg/L | 2020-06-09 | |
| BOD, 5-day Carbonaceous | **18.1** | 2.0 | mg/L | 2020-06-08 | |
| Solids, Total Suspended | < 4.0 | 2.0 | mg/L | 2020-06-06 | |
| ***Microbiological Parameters*** | | | | | |
| Coliforms, Total | **6.3** | 1.0 | MPN/100 mL | 2020-06-02 | |
| Coliforms, Fecal | < 1.0 | 1.0 | MPN/100 mL | 2020-06-02 | |

CARO ANALYTICAL SERVICES

# APPENDIX 1: SUPPORTING INFORMATION

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0060115 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-06-09 14:35 |

| Analysis Description | Method Ref. | Technique | Location |
|---|---|---|---|
| Biochemical Oxygen Demand in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | Kelowna |
| Biochemical Oxygen Demand, Carbonaceous in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | Kelowna |
| Coliforms, Fecal in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | Kelowna |
| Coliforms, Total in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | Kelowna |
| Solids, Total Suspended in Water | SM 2540 D* (2017) | Gravimetry (Dried at 103-105C) | Kelowna |

*Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method*

### Glossary of Terms:

| | |
|---|---|
| RL | Reporting Limit (default) |
| < | Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors |
| mg/L | Milligrams per litre |
| MPN/100 mL | Most Probable Number per 100 millilitres |
| SM | Standard Methods for the Examination of Water and Wastewater, American Public Health Association |

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ANALYTICAL SERVICES

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of<br>5971 Sawmill Road, PO Box 638<br>Oliver, BC V0H 1T0 | | |
| **ATTENTION** | Patti Hannas | **WORK ORDER** | 0070453 |
| **PO NUMBER** | 43172 | **RECEIVED / TEMP** | 2020-07-07 09:10 / 14°C |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-07-14 14:20 |
| **PROJECT INFO** | B.1. | **COC NUMBER** | B66260 |

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**Authorized By:**

Alana Crump
Team Lead, Client Service

CARO ANALYTICAL SERVICES

# TEST RESULTS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0070453 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-07-14 14:20 |

| Analyte | Result | RL | Units | Analyzed | Qualifier |
|---|---|---|---|---|---|
| **#Cell 3M (B1) (0070453-01) \| Matrix: Water \| Sampled: 2020-07-06 08:30** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | **10.3** | 2.0 | mg/L | 2020-07-13 | |
| BOD, 5-day Carbonaceous | < 7.2 | 2.0 | mg/L | 2020-07-13 | |
| Solids, Total Suspended | **25.3** | 2.0 | mg/L | 2020-07-08 | |
| **#Lake Cl2 (B4) (0070453-02) \| Matrix: Water \| Sampled: 2020-07-06 08:45** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | < 5.7 | 2.0 | mg/L | 2020-07-13 | |
| BOD, 5-day Carbonaceous | < 7.2 | 2.0 | mg/L | 2020-07-13 | |
| Solids, Total Suspended | < 4.0 | 2.0 | mg/L | 2020-07-08 | |
| ***Microbiological Parameters*** | | | | | |
| Coliforms, Total | < 1.0 | 1.0 | MPN/100 mL | 2020-07-07 | |
| Coliforms, Fecal | < 1.0 | 1.0 | MPN/100 mL | 2020-07-07 | |

# APPENDIX 1: SUPPORTING INFORMATION

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0070453 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-07-14 14:20 |

| Analysis Description | Method Ref. | Technique | Accredited | Location |
|---|---|---|---|---|
| Biochemical Oxygen Demand in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | ✓ | Kelowna |
| Biochemical Oxygen Demand, Carbonaceous in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | ✓ | Kelowna |
| Coliforms, Fecal in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | ✓ | Kelowna |
| Coliforms, Total in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | ✓ | Kelowna |
| Solids, Total Suspended in Water | SM 2540 D* (2017) | Gravimetry (Dried at 103-105C) | ✓ | Kelowna |

*Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method*

**Glossary of Terms:**

| | |
|---|---|
| RL | Reporting Limit (default) |
| < | Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors |
| mg/L | Milligrams per litre |
| MPN/100 mL | Most Probable Number per 100 millilitres |
| SM | Standard Methods for the Examination of Water and Wastewater, American Public Health Association |

**General Comments:**

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Results in **Bold** indicate values that are above CARO's method reporting limits. Any results that are above regulatory limits are highlighted **red**. Please note that results will only be highlighted red if the regulatory limits are included on the CARO report. Any Bold and/or highlighted results do not take into account method uncertainty. If you would like method uncertainty or regulatory limits to be included on your report, please contact your Account Manager:acrump@caro.ca

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CARO ANALYTICAL SERVICES

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of<br>5971 Sawmill Road, PO Box 638<br>Oliver, BC V0H 1T0 | | |
| **ATTENTION** | Patti Hannas | **WORK ORDER** | 0080254 |
| **PO NUMBER** | 43173 | **RECEIVED / TEMP** | 2020-08-05 09:25 / 17°C |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-08-12 13:12 |
| **PROJECT INFO** | B.1. | **COC NUMBER** | B83520 |

**Introduction:**

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*If you have any questions or concerns, please contact me at* acrump@caro.ca

**Authorized By:**

Alana Crump
Team Lead, Client Service

CARO ANALYTICAL SERVICES

# TEST RESULTS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0080254 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-08-12 13:12 |

| Analyte | Result | RL | Units | Analyzed | Qualifier |
|---|---|---|---|---|---|
| **#Cell 3M (B1) (0080254-01) \| Matrix: Water \| Sampled: 2020-08-04 08:00** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | **9.0** | 2.0 | mg/L | 2020-08-11 | |
| BOD, 5-day Carbonaceous | **7.5** | 2.0 | mg/L | 2020-08-12 | |
| Solids, Total Suspended | **17.3** | 2.0 | mg/L | 2020-08-09 | |
| **#Lake Cl2 (B4) (0080254-02) \| Matrix: Water \| Sampled: 2020-08-04 08:30** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | < 5.9 | 2.0 | mg/L | 2020-08-11 | |
| BOD, 5-day Carbonaceous | < 7.4 | 2.0 | mg/L | 2020-08-12 | |
| Solids, Total Suspended | < 4.0 | 2.0 | mg/L | 2020-08-09 | |
| ***Microbiological Parameters*** | | | | | |
| Coliforms, Total | < 1 | 1 | MPN/100 mL | 2020-08-05 | |
| Coliforms, Fecal | < 1 | 1 | MPN/100 mL | 2020-08-05 | |

CARO ANALYTICAL SERVICES

# APPENDIX 1: SUPPORTING INFORMATION

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0080254 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-08-12 13:12 |

| Analysis Description | Method Ref. | Technique | Accredited | Location |
|---|---|---|---|---|
| Biochemical Oxygen Demand in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | ✓ | Kelowna |
| Biochemical Oxygen Demand, Carbonaceous in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | ✓ | Kelowna |
| Coliforms, Fecal in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | ✓ | Kelowna |
| Coliforms, Total in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | ✓ | Kelowna |
| Solids, Total Suspended in Water | SM 2540 D* (2017) | Gravimetry (Dried at 103-105C) | ✓ | Kelowna |

*Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method*

**Glossary of Terms:**

| | |
|---|---|
| RL | Reporting Limit (default) |
| < | Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors |
| mg/L | Milligrams per litre |
| MPN/100 mL | Most Probable Number per 100 millilitres |
| SM | Standard Methods for the Examination of Water and Wastewater, American Public Health Association |

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# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of<br>5971 Sawmill Road, PO Box 638<br>Oliver, BC V0H 1T0 | | |
| **ATTENTION** | Patti Hannas | **WORK ORDER** | 0090328 |
| **PO NUMBER** | 43174 | **RECEIVED / TEMP** | 2020-09-02 09:30 / 16°C |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-09-09 09:56 |
| **PROJECT INFO** | B.1. | **COC NUMBER** | B86902 |

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*If you have any questions or concerns, please contact me at acrump@caro.ca*

**Authorized By:**

Alana Crump
Team Lead, Client Service

CARO ANALYTICAL SERVICES

# TEST RESULTS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0090328 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-09-09 09:56 |

| Analyte | Result | RL | Units | Analyzed | Qualifier |
|---|---|---|---|---|---|
| **#Cell 3M (B1) (0090328-01) \| Matrix: Water \| Sampled: 2020-09-01 09:35** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | **22.5** | 2.0 | mg/L | 2020-09-08 | |
| BOD, 5-day Carbonaceous | < 7.3 | 2.0 | mg/L | 2020-09-08 | |
| Solids, Total Suspended | **15.5** | 2.0 | mg/L | 2020-09-06 | |
| **#Lake Cl2 (B4) (0090328-02) \| Matrix: Water \| Sampled: 2020-09-01 09:45** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | < 6.1 | 2.0 | mg/L | 2020-09-08 | |
| BOD, 5-day Carbonaceous | < 7.3 | 2.0 | mg/L | 2020-09-08 | |
| Solids, Total Suspended | **5.0** | 2.0 | mg/L | 2020-09-06 | |
| ***Microbiological Parameters*** | | | | | |
| Coliforms, Total | < 1 | 1 | MPN/100 mL | 2020-09-03 | HT1 |
| Coliforms, Fecal | < 1 | 1 | MPN/100 mL | 2020-09-03 | HT1 |

**Sample Qualifiers:**

HT1 The sample was prepared and/or analyzed past the recommended holding time.

# APPENDIX 1: SUPPORTING INFORMATION

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 0090328 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-09-09 09:56 |

| Analysis Description | Method Ref. | Technique | Accredited | Location |
|---|---|---|---|---|
| Biochemical Oxygen Demand in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | ✓ | Kelowna |
| Biochemical Oxygen Demand, Carbonaceous in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | ✓ | Kelowna |
| Coliforms, Fecal in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | ✓ | Kelowna |
| Coliforms, Total in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | ✓ | Kelowna |
| Solids, Total Suspended in Water | SM 2540 D* (2017) | Gravimetry (Dried at 103-105C) | ✓ | Kelowna |

*Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method*

**Glossary of Terms:**

| | |
|---|---|
| RL | Reporting Limit (default) |
| < | Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors |
| mg/L | Milligrams per litre |
| MPN/100 mL | Most Probable Number per 100 millilitres |
| SM | Standard Methods for the Examination of Water and Wastewater, American Public Health Association |

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# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of<br>5971 Sawmill Road, PO Box 638<br>Oliver, BC V0H 1T0 | | |
| **ATTENTION** | Patti Hannas | **WORK ORDER** | 20J0250 |
| **PO NUMBER** | 45176 | **RECEIVED / TEMP** | 2020-10-06 09:10 / 14°C |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-10-13 13:33 |
| **PROJECT INFO** | B.1. | **COC NUMBER** | B58235 |

**Introduction:**

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*If you have any questions or concerns, please contact me at* acrump@caro.ca

**Authorized By:**

Alana Crump
Team Lead, Client Service

# TEST RESULTS

| | | | |
|---|---|---|---|
| **REPORTED TO** | Oliver, Town of | **WORK ORDER** | 20J0250 |
| **PROJECT** | Effluent Cell #3- Monthly | **REPORTED** | 2020-10-13 13:33 |

| Analyte | Result | RL | Units | Analyzed | Qualifier |
|---|---|---|---|---|---|
| **#Cell 3M (B1) (20J0250-01) \| Matrix: Water \| Sampled: 2020-10-05 09:00** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | < 5.9 | 2.0 | mg/L | 2020-10-12 | |
| BOD, 5-day Carbonaceous | < 6.0 | 2.0 | mg/L | 2020-10-12 | |
| Solids, Total Suspended | **16.0** | 2.0 | mg/L | 2020-10-08 | |
| **#Lake Cl2 (B4) (20J0250-02) \| Matrix: Water \| Sampled: 2020-10-05 08:50** | | | | | |
| ***General Parameters*** | | | | | |
| BOD, 5-day | < 5.9 | 2.0 | mg/L | 2020-10-12 | |
| BOD, 5-day Carbonaceous | < 6.0 | 2.0 | mg/L | 2020-10-12 | |
| Solids, Total Suspended | < 3.3 | 2.0 | mg/L | 2020-10-08 | RS2 |
| ***Microbiological Parameters*** | | | | | |
| Coliforms, Total | < 1 | 1 | MPN/100 mL | 2020-10-06 | |
| Coliforms, Fecal | < 1 | 1 | MPN/100 mL | 2020-10-06 | |

**Sample Qualifiers:**

RS2 The Reporting Limits for this sample have been raised due to limited sample volume.

CARO ANALYTICAL SERVICES

# APPENDIX 1: SUPPORTING INFORMATION

**REPORTED TO** Oliver, Town of
**PROJECT** Effluent Cell #3- Monthly
**WORK ORDER** 20J0250
**REPORTED** 2020-10-13 13:33

| Analysis Description | Method Ref. | Technique | Accredited | Location |
|---|---|---|---|---|
| Biochemical Oxygen Demand in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | ✓ | Kelowna |
| Biochemical Oxygen Demand, Carbonaceous in Water | SM 5210 B (2017) | Dissolved Oxygen Meter | ✓ | Kelowna |
| Coliforms, Fecal in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | ✓ | Kelowna |
| Coliforms, Total in Water | NA / SM 9223 (2017) | Quanti-Tray / Enzyme Substrate Endo Agar | ✓ | Kelowna |
| Solids, Total Suspended in Water | SM 2540 D* (2017) | Gravimetry (Dried at 103-105C) | ✓ | Kelowna |

*Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method*

**Glossary of Terms:**

| | |
|---|---|
| RL | Reporting Limit (default) |
| < | Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors |
| mg/L | Milligrams per litre |
| MPN/100 mL | Most Probable Number per 100 millilitres |
| SM | Standard Methods for the Examination of Water and Wastewater, American Public Health Association |

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## Town of Oliver Sewer Flows - PE - 13717

| | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| January | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 1,476 | | | | | 0 | | |
| 2 | 1,477 | | | | | 0 | | |
| 3 | 1,330 | | | | | 0 | | |
| 4 | 2,452 | | | | | 0 | | |
| 5 | 1,693 | | | | | 0 | | |
| 6 | 661 | | | | | 0 | | |
| 7 | 1,605 | | | | | 0 | | |
| 8 | 1,563 | | | | | 0 | | |
| 9 | 1,497 | | | | | 0 | | |
| 10 | 1,607 | | | | | 0 | | |
| 11 | 2,155 | | | | | 0 | | |
| 12 | 1,450 | | | | | 0 | | |
| 13 | 768 | | | | | 0 | | |
| 14 | 1,533 | | | | | 0 | | |
| 15 | 1,557 | | | | | 0 | | |
| 16 | 1,581 | | | | | 0 | | |
| 17 | 1,771 | | | | | 0 | | |
| 18 | 2,260 | | | | | 0 | | |
| 19 | 1,553 | | | | | 0 | | |
| 20 | 825 | | | | | 0 | | |
| 21 | 1,695 | | | | | 0 | | |
| 22 | 1,593 | | | | | 0 | | |
| 23 | 1,654 | | | | | 0 | | |
| 24 | 1,659 | | | | | 0 | | |
| 25 | 2,517 | | | | | 0 | | |
| 26 | 1,688 | | | | | 0 | | |
| 27 | 482 | | | | | 0 | | |
| 28 | 1,649 | | | | | 0 | | |
| 29 | 1,677 | | | | | 0 | | |
| 30 | 1,578 | | | | | 0 | | |
| 31 | 1,659 | | | | | 0 | | |
| | | 48666 | 1570 | 0.0 | 0 | | 0.0 | 0 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2 & 3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| February | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 2,752 | | | | | 0 | | |
| 2 | 1,492 | | | | | 0 | | |
| 3 | 636 | | | | | 0 | | |
| 4 | 1,639 | | | | | 0 | | |
| 5 | 1,685 | | | | | 0 | | |
| 6 | 1,659 | | | | | 0 | | |
| 7 | 1,804 | | | | | 0 | | |
| 8 | 2,138 | | | | | 0 | | |
| 9 | 1,556 | | | | | 0 | | |
| 10 | 789 | | | | | 0 | | |
| 11 | 1,669 | | | | | 0 | | |
| 12 | 1,580 | | | | | 0 | | |
| 13 | 1,661 | | | | | 0 | | |
| 14 | 1,646 | | | | | 0 | | |
| 15 | 2,373 | | | | | 0 | | |
| 16 | 1,779 | | | | | 0 | | |
| 17 | 588 | | | | | 0 | | |
| 18 | 1,696 | | | | | 0 | | |
| 19 | 1,653 | | | | | 0 | | |
| 20 | 1,565 | | | | | 0 | | |
| 21 | 1,661 | | | | | 0 | | |
| 22 | 2,440 | | | | | 0 | | |
| 23 | 1,699 | | | | | 0 | | |
| 24 | 804 | | | | | 0 | | |
| 25 | 1,598 | | | | | 0 | | |
| 26 | 1,642 | | | | | 0 | | |
| 27 | 1,671 | | | | | 0 | | |
| 28 | 1,620 | | | | | 0 | | |
| 29 | 2,362 | | | | | 0 | | |
| 30 | | | | | | 0 | | |
| 31 | | | | | | 0 | | |
| | | | | | | | | |
| | | 47858 | 1650 | 0.0 | 0 | | 0.0 | 0 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| March | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 2,361 | | | | | 0 | | |
| 2 | 1,621 | | | | | 0 | | |
| 3 | 753 | | | | | 0 | | |
| 4 | 1,663 | | | | | 0 | | |
| 5 | 1,585 | | | | | 0 | | |
| 6 | 1,652 | | | | | 0 | | |
| 7 | 1,723 | | | | | 0 | | |
| 8 | 2,707 | | | | | 0 | | |
| 9 | 2,208 | | | | | 0 | | |
| 10 | 253 | | | | | 0 | | |
| 11 | 1,691 | | | | | 0 | | |
| 12 | 1,642 | | | | | 0 | | |
| 13 | 1,587 | | | | | 0 | | |
| 14 | 1,670 | | | | | 0 | | |
| 15 | 2,617 | | | | | 0 | | |
| 16 | 1,723 | | | | | 0 | | |
| 17 | 562 | | | | | 0 | | |
| 18 | 1,605 | | | | | 2 | | |
| 19 | 1,648 | | | | | 19 | | |
| 20 | 1,635 | | | | | 4 | | |
| 21 | 1,594 | | | | | 2 | | |
| 22 | 2,587 | | | | | 21 | | |
| 23 | 1,640 | | | | | 20 | | |
| 24 | 1,077 | | | | | 11 | | |
| 25 | 1,646 | | | | | 3,023 | | |
| 26 | 1,582 | | | | | 66 | | |
| 27 | 1,607 | | | | | 0 | | |
| 28 | 1,622 | | | | | 565 | | |
| 29 | 2,590 | | | | | 0 | | |
| 30 | 1,765 | | | | | 0 | | |
| 31 | 1,608 | | | | | 0 | | |
| | | | | | | | | |
| | | 52224 | 1685 | 0.0 | 0 | | 3734.1 | 120 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

# Town of Oliver Sewer Flows - PE - 13717

| April | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 1,570 | | | | | 662 | | |
| 2 | 1,714 | | | | | 0 | | |
| 3 | 1,588 | | | | | 670 | | |
| 4 | 2,553 | | | | | 0 | | |
| 5 | 1,717 | | | | | 0 | | |
| 6 | 1,018 | | | | | 830 | | |
| 7 | 1,557 | | | | | 2,721 | | |
| 8 | 1,585 | | | | | 1,719 | | |
| 9 | 1,555 | | | | | 2,210 | | |
| 10 | 1,561 | | | | | 1,894 | | |
| 11 | 2,543 | | | | | 1,239 | | |
| 12 | 1,653 | | | | | 1,348 | | |
| 13 | 1,027 | | | | | 993 | | |
| 14 | 1,596 | | | | | 1,279 | | |
| 15 | 1,535 | | | | | 1,673 | | |
| 16 | 1,541 | | | | | 1,241 | | |
| 17 | 1,621 | | | | | 1,800 | | |
| 18 | 2,463 | | | | | 2,239 | | |
| 19 | 1,752 | | | | | 2,014 | | |
| 20 | 729 | | | | | 1,801 | | |
| 21 | 1,575 | | | | | 1,709 | | |
| 22 | 1,547 | | | | | 898 | | |
| 23 | 1,667 | | | | | 1,488 | | |
| 24 | 1,636 | | | | | 1,870 | | |
| 25 | 2,591 | | | | | 2,057 | | |
| 26 | 1,458 | | | | | 2,054 | | |
| 27 | 1,069 | | | | | 2,419 | | |
| 28 | 1,609 | | | | | 2,017 | | |
| 29 | 1,618 | | | | | 2,176 | | |
| 30 | 1,611 | | | | | 1,057 | | |
| 31 | | | | | | | | |
| | | | | | | | | |
| | | 49259 | 1642 | 0.0 | 0 | | 44077.2 | 1469 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| May | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 1,978 | | | | | 3,039 | | |
| 2 | 2,386 | | | | | 2,891 | | |
| 3 | 2,015 | | | | | 1,822 | | |
| 4 | 1,052 | | | | | 2,229 | | |
| 5 | 1,661 | | | | | 2,504 | | |
| 6 | 1,525 | | | | | 1,046 | | |
| 7 | 1,686 | | | | | 1,246 | | |
| 8 | 1,711 | | | | | 2,120 | | |
| 9 | 2,702 | | | | | 2,263 | | |
| 10 | 1,944 | | | | | 2,514 | | |
| 11 | 736 | | | | | 3,319 | | |
| 12 | 1,780 | | | | | 2,515 | | |
| 13 | 1,730 | | | | | 558 | | |
| 14 | 1,916 | | | | | 1,114 | | |
| 15 | 1,720 | | | | | 1,266 | | |
| 16 | 2,679 | | | | | 1,999 | | |
| 17 | 2,575 | | | | | 1,862 | | |
| 18 | 372 | | | | | 1,451 | | |
| 19 | 2,004 | | | | | 957 | | |
| 20 | 1,595 | | | | | 1,147 | | |
| 21 | 2,156 | | | | | 2,133 | | |
| 22 | 1,994 | | | | | 2,438 | | |
| 23 | 2,362 | | | | | 752 | | |
| 24 | 2,375 | | | | | 2,463 | | |
| 25 | 1,154 | | | | | 3,108 | | |
| 26 | 1,948 | | | | | 1,241 | | |
| 27 | 1,955 | | | | | 910 | | |
| 28 | 2,334 | | | | | 2,281 | | |
| 29 | 2,468 | | | | | 3,292 | | |
| 30 | 2,504 | | | | | 2,344 | | |
| 31 | 2,172 | | | | | 1,568 | | |
| | | | | | | | | |
| | | 59189 | 1909 | 0.0 | 0 | | 60392.5 | 1948 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| June | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 1,145 | | | | | 2,450 | | |
| 2 | 1,914 | | | | | 2,517 | | |
| 3 | 2,003 | | | | | 2,119 | | |
| 4 | 1,902 | | | | | 2,954 | | |
| 5 | 2,550 | | | | | 3,068 | | |
| 6 | 3,293 | | | | | 2,197 | | |
| 7 | 2,497 | | | | | 2,033 | | |
| 8 | 983 | | | | | 2,750 | | |
| 9 | 2,001 | | | | | 3,098 | | |
| 10 | 1,915 | | | | | 1,680 | | |
| 11 | 2,112 | | | | | 2,377 | | |
| 12 | 2,427 | | | | | 1,035 | | |
| 13 | 3,385 | | | | | 560 | | |
| 14 | 2,478 | | | | | 528 | | |
| 15 | 1,013 | | | | | 528 | | |
| 16 | 2,037 | | | | | 513 | | |
| 17 | 2,359 | | | | | 497 | | |
| 18 | 2,279 | | | | | 1,065 | | |
| 19 | 2,411 | | | | | 1,788 | | |
| 20 | 3,196 | | | | | 2,211 | | |
| 21 | 2,748 | | | | | 2,108 | | |
| 22 | 1,327 | | | | | 2,475 | | |
| 23 | 2,176 | | | | | 2,131 | | |
| 24 | 2,268 | | | | | 1,975 | | |
| 25 | 2,143 | | | | | 1,795 | | |
| 26 | 2,354 | | | | | 2,704 | | |
| 27 | 3,365 | | | | | 2,715 | | |
| 28 | 2,782 | | | | | 2,471 | | |
| 29 | 612 | | | | | 3,522 | | |
| 30 | 2,679 | | | | | 3,057 | | |
| 31 | | | | | | | | |
| | | | | | | | | |
| | | 66356 | 2212 | 0.0 | 0 | | 60921.6 | 2031 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| July | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 1,614 | | | | | 1,619 | | |
| 2 | 1,990 | | | | | 2,029 | | |
| 3 | 2,299 | | | | | 3,484 | | |
| 4 | 3,633 | | | | | 3,030 | | |
| 5 | 2,344 | | | | | 3,474 | | |
| 6 | 975 | | | | | 4,645 | | |
| 7 | 2,038 | | | | | 3,007 | | |
| 8 | 2,164 | | | | | 4,119 | | |
| 9 | 2,186 | | | | | 4,320 | | |
| 10 | 2,332 | | | | | 4,497 | | |
| 11 | 2,915 | | | | | 3,346 | | |
| 12 | 2,724 | | | | | 3,778 | | |
| 13 | 1,176 | | | | | 4,491 | | |
| 14 | 1,813 | | | | | 4,365 | | |
| 15 | 2,154 | | | | | 4,237 | | |
| 16 | 2,205 | | | | | 5,258 | | |
| 17 | 2,142 | | | | | 4,357 | | |
| 18 | 3,390 | | | | | 3,336 | | |
| 19 | 2,799 | | | | | 3,548 | | |
| 20 | 407 | | | | | 3,929 | | |
| 21 | 2,204 | | | | | 4,854 | | |
| 22 | 2,139 | | | | | 3,485 | | |
| 23 | 1,908 | | | | | 4,132 | | |
| 24 | 2,309 | | | | | 4,494 | | |
| 25 | 3,232 | | | | | 3,674 | | |
| 26 | 2,217 | | | | | 3,626 | | |
| 27 | 881 | | | | | 3,314 | | |
| 28 | 1,905 | | | | | 4,203 | | |
| 29 | 2,063 | | | | | 5,271 | | |
| 30 | 2,031 | | | | | 3,532 | | |
| 31 | 2,097 | | | | | 5,232 | | |
| | | | | | | | | |
| | | 66286 | 2138 | 0.0 | 0 | | 120684.4 | 3893 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| August | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 3,222 | | | | | 4,071 | | |
| 2 | 2,691 | | | | | 5,019 | | |
| 3 | 152 | | | | | 5,812 | | |
| 4 | 1,835 | | | | | 4,371 | | |
| 5 | 2,227 | | | | | 5,150 | | |
| 6 | 1,946 | | | | | 3,164 | | |
| 7 | 1,968 | | | | | 1,838 | | |
| 8 | 3,283 | | | | | 2,726 | | |
| 9 | 2,589 | | | | | 2,181 | | |
| 10 | 227 | | | | | 2,624 | | |
| 11 | 2,108 | | | | | 3,163 | | |
| 12 | 1,911 | | | | | 3,426 | | |
| 13 | 1,922 | | | | | 3,577 | | |
| 14 | 1,965 | | | | | 4,436 | | |
| 15 | 3,075 | | | | | 3,432 | | |
| 16 | 2,125 | | | | | 3,978 | | |
| 17 | 535 | | | | | 4,913 | | |
| 18 | 2,144 | | | | | 4,491 | | |
| 19 | 1,637 | | | | | 4,572 | | |
| 20 | 2,031 | | | | | 4,125 | | |
| 21 | 1,952 | | | | | 5,354 | | |
| 22 | 3,183 | | | | | 3,187 | | |
| 23 | 2,000 | | | | | 3,696 | | |
| 24 | 654 | | | | | 4,766 | | |
| 25 | 1,685 | | | | | 3,954 | | |
| 26 | 1,620 | | | | | 4,497 | | |
| 27 | 2,128 | | | | | 3,104 | | |
| 28 | 1,826 | | | | | 4,989 | | |
| 29 | 3,119 | | | | | 3,349 | | |
| 30 | 1,908 | | | | | 3,162 | | |
| 31 | 1,914 | | | | | 3,992 | | |
| | | | | | | | | |
| | | 61583 | 1987 | 0.0 | 0 | | 121117.9 | 3907 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| September | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 1,914 | | | | | 3,992 | | |
| 2 | 1,766 | | | | | 3,277 | | |
| 3 | 1,882 | | | | | 4,638 | | |
| 4 | 1,945 | | | | | 3,594 | | |
| 5 | 2,549 | | | | | 4,481 | | |
| 6 | 2,397 | | | | | 3,731 | | |
| 7 | 375 | | | | | 3,530 | | |
| 8 | 1,696 | | | | | 4,736 | | |
| 9 | 1,903 | | | | | 3,741 | | |
| 10 | 1,426 | | | | | 4,537 | | |
| 11 | 2,140 | | | | | 3,791 | | |
| 12 | 3,513 | | | | | 3,608 | | |
| 13 | 1,437 | | | | | 2,388 | | |
| 14 | 852 | | | | | 3,008 | | |
| 15 | 1,480 | | | | | 2,695 | | |
| 16 | 1,867 | | | | | 95 | | |
| 17 | 1,710 | | | | | 927 | | |
| 18 | 1,773 | | | | | 858 | | |
| 19 | 2,585 | | | | | 546 | | |
| 20 | 2,103 | | | | | 0 | | |
| 21 | 462 | | | | | 828 | | |
| 22 | 1,734 | | | | | 1,054 | | |
| 23 | 1,706 | | | | | 1,224 | | |
| 24 | 1,730 | | | | | 743 | | |
| 25 | 1,703 | | | | | 0 | | |
| 26 | 2,261 | | | | | 565 | | |
| 27 | 2,071 | | | | | 1 | | |
| 28 | 555 | | | | | 747 | | |
| 29 | 1,728 | | | | | 1,907 | | |
| 30 | 1,708 | | | | | 1,473 | | |
| 31 | | | | | | | | |
| | | | | | | | | |
| | | 52971 | 1766 | 0.0 | 0 | | 66714.2 | 2224 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| October | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 1,708 | | | | | 1,575 | | |
| 2 | 1,712 | | | | | 972 | | |
| 3 | 1,732 | | | | | 829 | | |
| 4 | 2,631 | | | | | 1,051 | | |
| 5 | 1,667 | | | | | 962 | | |
| 6 | 669 | | | | | 945 | | |
| 7 | 1,704 | | | | | 0 | | |
| 8 | 1,705 | | | | | 1,181 | | |
| 9 | 1,673 | | | | | 656 | | |
| 10 | 1,698 | | | | | 1,155 | | |
| 11 | 2,640 | | | | | 301 | | |
| 12 | 1,698 | | | | | 0 | | |
| 13 | 714 | | | | | 0 | | |
| 14 | 1,708 | | | | | 0 | | |
| 15 | 1,691 | | | | | 500 | | |
| 16 | 1,700 | | | | | 936 | | |
| 17 | 1,723 | | | | | 806 | | |
| 18 | 2,648 | | | | | 0 | | |
| 19 | 1,726 | | | | | 0 | | |
| 20 | 458 | | | | | 0 | | |
| 21 | 1,703 | | | | | 0 | | |
| 22 | 1,694 | | | | | 696 | | |
| 23 | 1,672 | | | | | 2 | | |
| 24 | 2,752 | | | | | 1 | | |
| 25 | 1,680 | | | | | 0 | | |
| 26 | 521 | | | | | 0 | | |
| 27 | 1,710 | | | | | 0 | | |
| 28 | 1,729 | | | | | 0 | | |
| 29 | 1,954 | | | | | 0 | | |
| 30 | 1,693 | | | | | 0 | | |
| 31 | 2,643 | | | | | 0 | | |
| | | | | | | | | |
| | | 53356 | 1721 | 0.0 | 0 | | 12564.8 | 405 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2) These flows are read at two, 2 inch water meters located at the rapid infiltration site.

(3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| November | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 1,296 | | | | | 0 | | |
| 2 | 1,109 | | | | | 0 | | |
| 3 | 1,612 | | | | | 0 | | |
| 4 | 1,689 | | | | | 0 | | |
| 5 | 1,673 | | | | | 0 | | |
| 6 | 1,542 | | | | | 0 | | |
| 7 | 2,453 | | | | | 0 | | |
| 8 | 1,573 | | | | | 0 | | |
| 9 | 664 | | | | | 0 | | |
| 10 | 1,598 | | | | | 0 | | |
| 11 | 1,690 | | | | | 0 | | |
| 12 | 1,665 | | | | | 0 | | |
| 13 | 1,747 | | | | | 0 | | |
| 14 | 2,701 | | | | | 0 | | |
| 15 | 1,779 | | | | | 0 | | |
| 16 | 599 | | | | | 0 | | |
| 17 | 1,659 | | | | | 0 | | |
| 18 | 1,702 | | | | | 0 | | |
| 19 | 1,675 | | | | | 0 | | |
| 20 | 1,602 | | | | | 0 | | |
| 21 | 2,709 | | | | | 0 | | |
| 22 | 1,728 | | | | | 0 | | |
| 23 | 637 | | | | | 0 | | |
| 24 | 1,606 | | | | | 0 | | |
| 25 | 1,594 | | | | | 0 | | |
| 26 | 1,682 | | | | | 0 | | |
| 27 | 1,754 | | | | | 0 | | |
| 28 | 2,602 | | | | | 0 | | |
| 29 | 1,750 | | | | | 0 | | |
| 30 | 534 | | | | | 0 | | |
| 31 | | | | | | | | |
| | | | | | | | | |
| | | 48623 | 1621 | 0.0 | 0 | | 0.0 | 0 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2 & 3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

## Town of Oliver Sewer Flows - PE - 13717

| | High Lift Station | | | Chlorine Booster Station | | | | |
|---|---|---|---|---|---|---|---|---|
| December | Daily Flow m3/day | Total Monthly m3/day | Monthly Average m3/day | Irrigation m3/day (1) | Rapid Infiltration m3/day (2) | Total Daily m3/day (3) | Total Monthly m3/day | Monthly Average m3/day |
| 1 | 1,661 | | | | | 0 | | |
| 2 | 1,660 | | | | | 0 | | |
| 3 | 1,508 | | | | | 0 | | |
| 4 | 1,537 | | | | | 0 | | |
| 5 | 2,337 | | | | | 0 | | |
| 6 | 1,640 | | | | | 0 | | |
| 7 | 610 | | | | | 0 | | |
| 8 | 1,609 | | | | | 0 | | |
| 9 | 1,613 | | | | | 0 | | |
| 10 | 1,684 | | | | | 0 | | |
| 11 | 1,638 | | | | | 0 | | |
| 12 | 2,622 | | | | | 0 | | |
| 13 | 1,700 | | | | | 0 | | |
| 14 | 519 | | | | | 0 | | |
| 15 | 1,584 | | | | | 0 | | |
| 16 | 1,620 | | | | | 0 | | |
| 17 | 1,600 | | | | | 0 | | |
| 18 | 1,630 | | | | | 0 | | |
| 19 | 2,621 | | | | | 0 | | |
| 20 | 1,646 | | | | | 0 | | |
| 21 | 523 | | | | | 0 | | |
| 22 | 1,661 | | | | | 0 | | |
| 23 | 1,637 | | | | | 0 | | |
| 24 | 1,605 | | | | | 0 | | |
| 25 | 1,577 | | | | | 0 | | |
| 26 | 2,437 | | | | | 0 | | |
| 27 | 1,628 | | | | | 0 | | |
| 28 | 568 | | | | | 0 | | |
| 29 | 1,638 | | | | | 0 | | |
| 30 | 1,584 | | | | | 0 | | |
| 31 | 1,586 | | | | | 0 | | |
| | | | | | | | | |
| | | 49481 | 1596 | 0.0 | 0 | | 0.0 | 0 |
| | OC Limit | n/a | 2050m3/day | | | | n/a | n/a |

Notes:

(1) These readings have been calculated by subtracting the flows read at the rapid infiltration site, from the flows read on the main meter in the Chlorine Booster Station. Both the irrigation flows and the rapid infiltration flows travel through this meter.

(2 & 3) These are the flows that have been read at the main meter located in the Chlorine Booster Station.

**TOWN OF OLIVER**

**PE-13717 - Effluent Sampling - Cell #3, prior to storage reservoir - EMS ID E222151**

| | Date | BOD5 | BOD5 Carbonaceous | TSS | Nitrate | Nitrite | Phosphate | Nitrate & Nitrite | Nitrogen | Nitrogen | Ammonia | Kjeldahl | Phosphorus | Phosphorus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OC Limit | | 45 mg/L | | 60 mg/L | (as N) | (as N) | (as P) | (as N) | (Total) | (Organic) | Total (as N) | | Total (as P) | Total Dissolved |
| Units | | mg/L | | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L | mg/L |
| Frequency | | monthly | monthly | monthly | semi-annually | semi-annually | semi-annually | semi-annually | semi-annually | semi-annually | semi-annually | semi-annually | semi-annually | semi-annually |
| | | | | | | | | | | | | | | |
| January | 6 | 25.3 | | 15.6 | | | | | | | | | | |
| February | 3 | 20.3 | | 18.8 | | | | | | | | | | |
| March | 2 | | | | 1.20 | 0.178 | 3.91 | 1.37 | 35.30 | 8.76 | 25.20 | 33.90 | 5.33 | 4.76 |
| March | 2 | 69.5* | | 34.0 | | | | | | | | | | |
| March | 2 | | | | | | 1.89 | | | | | | | 4.97 |
| April | 14 | 29 | 10.1 | 19.6 | | | | | | | | | | |
| May | 4 | 21.4 | 16.8 | 21.6 | | | | | | | | | | |
| June | 1 | 27.9 | 90.6 | 30.8 | | | | | | | | | | |
| July | 6 | 10.3 | <7.2 | 25.3 | | | | | | | | | | |
| August | 4 | 9 | 7.5 | 17.3 | | | | | | | | | | |
| September | 1 | | | | 2.36 | 1.16 | 4.87 | 352 | 21.9 | 2.75 | 15.6 | 18.4 | 5.96 | 5.8 |
| September | 1 | | | | | | 2.09 | | | | | | | 5.45 |
| September | 1 | 22.5 | <7.3 | 15.5 | | | | | | | | | | |
| October | 5 | <5.9 | <6.0 | <3.3 | | | | | | | | | | |
| November | 9 | 10.8 | 8.2 | 9.6 | | | | | | | | | | |
| December | 2 | 19.6 | 8.7 | 14.0 | | | | | | | | | | |

PE - 13717 - Influent Sampling - Equalization Basin - EMS ID E222152
Influent Sampling

Semi- Annual

* Friday, February 28, 2020 - Cell 2 & 3 ponds were lowered 3", BOD testing done on March 2, 2020 resulted in a bad sample

WWTP Compliance Testing - Comparison with Operational Certificate Criteria

| Location | **Influent** | | **Cell #3 Outlet** | | | | | | | | | | | | **Chlorine Contact Chamber Outlet** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.E.A.M. site number | E222152 | | E222151 | | | | | | | | | | | | E222150 | | | | | | | | | |
| Parameter | Total phosphorus as P, mg/L | Ortho phosphorus as P, mg/L | Total suspended solids | Biochemical oxygen demand | Carbonaceous biochemical oxygen demand | Total phosphorus as P, mg/L | Ortho phosphorus as P, mg/L | Total dissolved phosphorus as P, mg/L | Total nitrogen, mg/L | Ammonia nitrogen, mg/L | Nitrate nitrogen, mg/L | Nitrite nitrogen, mg/L | Organic nitrogen, mg/L | Total Kjeldahl nitrogen, mg/L | Faecal coliforms, MPN/100mL | Total coliforms, MPN/100mL | Chlorine residual, mg/L | Total suspended solids | Biochemical oxygen demand | Carbonaceous biochemical oxygen demand | Total phosphorus, mg/L | Total nitrogen, mg/L | Chloride, mg/L | Sodium, mg/L |
| Frequency (Operational Certificate) | semi-annual | semi-annual | monthly | Not required | monthly | semi-annual | semi-annual | semi-annual | semi-annual | semi-annual | semi-annual | semi-annual | semi-annual | Not required | monthly | monthly | weekly | Not required. MWR Only | Not required | Not required. MWR Only | monthly | monthly | Not required | Not required |
| Sample type | Grab | Grab | Grab | - | Grab | Grab | Grab | Grab | Grab | Grab | Grab | Grab | Grab | - | Grab | Grab | On-site | Grab | - | Grab | Grab | Grab | | |
| Limit | | | **<60** | | **<45** | | | | | | | | | | **<2.2 MPN** | | | | | | | | | |
| 2020-01-06 | | | 15.6 | 25.3 | *** | | | | | | | | | | | | | | | | | | | |
| 2020-02-03 | | | 18.8 | 20.3 | *** | | | | | | | | | | | | | | | | | | | |
| 2020-03-02 | 4.97 | 1.89 | 34 | 69.5 | *** | 5.33 | 3.91 | 4.76 | 35.3 | 25.2 | 1.2 | 0.178 | 8.76 | 33.9 | | | | | | | | | | |
| 2020-04-14 | | | 19.6 | 29 | 10.1 | | | | | | | | | | <1.0 | <1.0 | 0.26 | | | | *** | *** | | |
| 2020-05-04 | | | 21.6 | 21.4 | 16.8 | | | | | | | | | | <1.0 | <1.0 | 0.29 | | | | *** | *** | | |
| 2020-06-01 08:30 | | | 30.8 | 27.9 | 90.6 | | | | | | | | | | <1.0 | 6.3 | 0.35 | <4.0 | <5.8 | 18.1 | *** | *** | | |
| 2020-07-06 08:30 | | | 25.3 | 10.3 | <7.2 | | | | | | | | | | <1.0 | <1.0 | 0.4 | <4.0 | <5.7 | <7.2 | *** | *** | | |
| 2020-08-04 08:00 | | | 17.3 | 9.0 | 7.5 | | | | | | | | | | | | | | | | | | | |
| 2020-08-04 08:30 | | | | | | | | | | | | | | | <1.0 | <1.0 | 0.32 | <4.0 | <5.9 | <7.4 | *** | *** | | |
| 2020-09-01 09:35 | 5.45 | 2.09 | 15.5 | 22.5 | <7.3 | 5.96 | 4.87 | 5.8 | 21.9 | 15.6 | 2.36 | 1.16 | 2.75 | 18.4 | | | | | | | | | | |
| 2020-09-01 09:45 | | | | | | | | | | | | | | | <1.0 | <1.0 | 0.23 | 5 | <6.1 | <7.3 | *** | *** | | |
| 2020-10-05 08:50 | | | | | | | | | | | | | | | | | | <3.3 | <5.9 | <6.0 | | | | |
| 2020-10-05 09:00 | | | 16 | <5.9 | <6.0 | | | | | | | | | | <1.0 | <1.0 | 0.1 | | | | *** | *** | | |
| 2020-11-09 08:00 | | | 9.6 | 10.8 | 8.2 | | | | | | | | | | | | | | | | | | | |
| 2020-12-02 00:00 | | | 14 | 19.6 | 8.7 | | | | | | | | | | | | | | | | | | | |

*** Analysis not completed. See accompanying annual report for details.

# APPENDIX D

## Reclaimed Water Storage Reservoir Level and Flow Data & Volume Calibration Curve

**TOWN OF OLIVER**

**RECLAIMED WATER USE BY CUSTOMER**
**(Readings in m3)**

| LOCATION | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AIRPORT | 221400.0 | 238400.0 | 203100.0 | 161600.0 | 131800.0 | 201050.0 | 147688.3 | 153841.2 | 185686.70 | 124891.7 | 115743.3 | 98510.9 | 101779.8 | 99601.3 | 69142.8 | - |
| CEMETERY | 14015 | 14125 | 17325 | 17000 | 18215 | 13311.2 | 16338.73 | 14607.36 | 19159.94 | 15996.1 | 14354.03 | 14843.27 | 13399.67 | 12651.17 | 16986.46 | 17498.75 |
| PUBLIC WORKS YARD | 7720 | 12535 | 7580 | 5575 | 5795 | 6155.8 | 5163.96 | 6408.64 | 7085.72 | 7393.22 | 7380.1 | 8094.8 | 8340.74 | 6260.65 | 5939.63 | 8319.96 |
| 103 STREET PARK | 4555 | 9255 | 7090 | 5280 | 6345 | 5377.24 | 6232.1 | 6621.86 | 8051.37 | 8749.04 | 7647.12 | 8359.52 | **1030.6*** | 5927.68 | 8858.46 | 1244.97 |
| SOSS | | | | | | | | | | 48457 | 4873.58 | 0 | 1.55 | 0 | 25743.75 | 27419.66 |
| ALONSO | | | | | | 3495.31 | 1670.9 | 7014.59 | 6714.65 | 3892.74 | 3850.51 | 2364.03 | 2498.39 | 1794.43 | 9240 | 6012.39 |
| HUGGINS | | | | | | 15536.5 | 3787.05 | 2872.33 | 1290.33 | meter off | 8554.16 | 0 | 0 | 0 | 4614.7 | 0 |

*September and October only (2017)

**Other Users Not Metered:**
- Aiport Meter not in service May - September 2020
- Fairview Mountain Golf Course
- Fairview Park (new 2015)

**TOWN OF OLIVER**
**STORAGE RESERVOIR**
**LEVEL DATA**

| DAY | JANUARY ELEVATION | JANUARY VOLUME IN STORAGE* | FEBRUARY ELEVATION | FEBRUARY VOLUME IN STORAGE* | MARCH ELEVATION | MARCH VOLUME IN STORAGE* | APRIL ELEVATION | APRIL VOLUME IN STORAGE* |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | | | | | 445.47 | 343,000 | | |
| 3 | | | 444.86 | 306,000 | | | | |
| 4 | 444.22 | 259,000 | | | | | | |
| 5 | | | | | | | | |
| 6 | 444.25 | 262,000 | | | | | 445.89 | 364,000 |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | 445.87 | 363,000 | | |
| 10 | | | 445.03 | 318,000 | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | 444.39 | 272,000 | | | | | | |
| 14 | | | | | | | 445.72 | 356,000 |
| 15 | | | | | | | | |
| 16 | | | | | 445.89 | 364,000 | | |
| 17 | | | 445.17 | 327,000 | | | | |
| 18 | | | | | | | | |
| 19 | | | | | | | | |
| 20 | 444.55 | 284,000 | | | | | 445.57 | 348,000 |
| 21 | | | | | | | | |
| 22 | | | | | | | | |
| 23 | | | | | 446.00 | 370,000 | | |
| 24 | | | 445.30 | 335,000 | | | | |
| 25 | | | | | | | | |
| 26 | | | | | | | | |
| 27 | 444.72 | 294,000 | | | | | 445.49 | 344,000 |
| 28 | | | | | | | | |
| 29 | | | | | | | | |
| 30 | | | | | 445.86 | 362,000 | | |
| 31 | | | | | | | | |

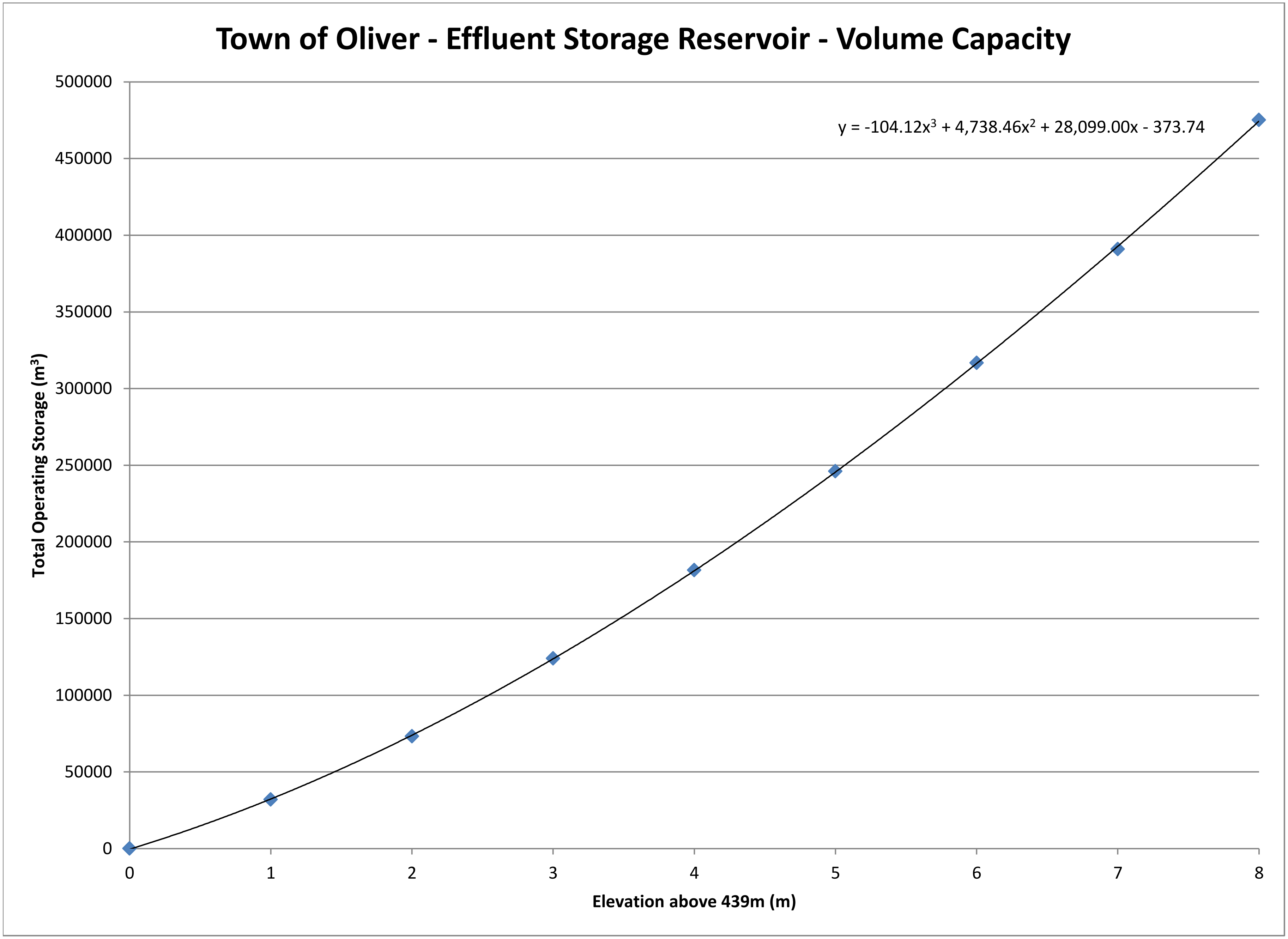
* Volume in Storage above Elevation 439.00
Elevation 439.00 is minimum 60 day average operating level

| DAY | MAY | | JUNE | | JULY | | AUGUST | |
|---|---|---|---|---|---|---|---|---|
| | ELEVATION | VOLUME IN STORAGE* | ELEVATION | VOLUME IN STORAGE* | ELEVATION | VOLUME IN STORAGE* | ELEVATION | VOLUME IN STORAGE* |
| 1 | | | 445.14 | 324,000 | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | 443.49 | 213,000 |
| 4 | 445.39 | 339,000 | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | 444.81 | 301,000 | | |
| 7 | | | | | | | | |
| 8 | | | 445.00 | 316,000 | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | 445.28 | 334,000 | | | | | 443.16 | 193,000 |
| 12 | | | | | | | | |
| 13 | | | | | 444.52 | 281,000 | | |
| 14 | | | | | | | | |
| 15 | | | 445.05 | 319,000 | | | | |
| 16 | | | | | | | | |
| 17 | | | | | | | 442.93 | 177,000 |
| 18 | 445.26 | 333,000 | | | | | | |
| 19 | | | | | | | | |
| 20 | | | | | 444.20 | 258,000 | | |
| 21 | | | | | | | | |
| 22 | | | 445.10 | 322,000 | | | | |
| 23 | | | | | | | | |
| 24 | | | | | | | 442.55 | 157,000 |
| 25 | 445.19 | 329,000 | | | | | | |
| 26 | | | | | | | | |
| 27 | | | | | | | | |
| 28 | | | | | 443.76 | 229,000 | | |
| 29 | | | 444.99 | 316,000 | | | | |
| 30 | | | | | | | | |
| 31 | | | | | | | 442.18 | 134,000 |

* Volume in Storage above Elevation 439.00
Elevation 439.00 is minimum 60 day average operating level

| DAY | SEPTEMBER | | OCTOBER | | NOVEMBER | | DECEMBER | |
|---|---|---|---|---|---|---|---|---|
| | ELEVATION | VOLUME IN STORAGE* | ELEVATION | VOLUME IN STORAGE* | ELEVATION | VOLUME IN STORAGE* | ELEVATION | VOLUME IN STORAGE* |
| 1 | | | | | | | | |
| 2 | | | | | 442.67 | 163,000 | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | 441.77 | 112,000 | | | | |
| 6 | | | | | | | | |
| 7 | 441.84 | 115,000 | | | | | 443.34 | 203,000 |
| 8 | | | | | | | | |
| 9 | | | | | 442.66 | 163,000 | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | 441.89 | 118,000 | | | | |
| 14 | 441.55 | 102,000 | | | | | 443.73 | 227,000 |
| 15 | | | | | | | | |
| 16 | | | | | 442.84 | 173,000 | | |
| 17 | | | | | | | | |
| 18 | | | | | | | | |
| 19 | | | | | | | | |
| 20 | | | | | | | | |
| 21 | | | 442.06 | 127,000 | | | 443.89 | 237,000 |
| 22 | 441.65 | 107,000 | | | | | | |
| 23 | | | | | 443.04 | 184,000 | | |
| 24 | | | | | | | | |
| 25 | | | | | | | | |
| 26 | | | | | | | | |
| 27 | | | | | | | | |
| 28 | 441.77 | 112,000 | | | | | 444.01 | 246,000 |
| 29 | | | | | | | | |
| 30 | | | | | 443.21 | 195,000 | | |
| 31 | | | | | | | | |

* Volume in Storage above Elevation 439.00
Elevation 439.00 is minimum 60 day average operating level




R:\Clients\300-399\306\306-084\04 Design\Effluent Storage Reservoir Calculation.xlsx

## Town of Oliver - Effluent Storage Reservoir - Volume Capacity

| Reservoir Elevation (m) | Elevation above 439m (m) | Measured Volume ($m^3$) | Calculated Volume ($m^3$) | % Difference from Measured |
|---|---|---|---|---|
| 439 | 0 | 0 | -374 | N/A |
| 440 | 1 | 32000 | 32360 | 1% |
| 441 | 2 | 73300 | 73945 | 1% |
| 442 | 3 | 124000 | 123758 | 0% |
| 443 | 4 | 181600 | 181174 | 0% |
| 444 | 5 | 246000 | 245568 | 0% |
| 445 | 6 | 316800 | 316315 | 0% |
| 446 | 7 | 391000 | 392791 | 0% |
| 447 | 8 | 475200 | 474370 | 0% |

# APPENDIX E

## Irrigation Plan

December 13, 2018

Our File: 306-088-005

Ministry of Environment & Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Regional Waste Manager

Dear Sir/Madam:

**RE: *Town of Oliver – Update to Reclaimed Water Irrigation Plan - OC PE-13717***

The Town of Oliver requests approval from the Ministry for expansion of their reclaimed water irrigation system as authorized in Operational Certificate PE-13717. The current works authorized within this Operational Certificate are outlined in Site Plan A, dated December 14, 1995. The areas include:

| Location | Legal Description |
|---|---|
| Fairview Mountain Golf Course | Lot 1, Plan KAP62023, DL2450S, SDYD |
| Alonso | Lot A, Plan KAP37929, Sec 12, Township 54, SDYD |
| Huggins | Lot 3, Plan KAP5881, Sec 12, Township 54, SDYD |

The Town requests authorization for expansion of the irrigation system. The expansion areas are shown in Figure 1 enclosed herein. They are identified as Reclaimed Water Irrigation Expansion Areas (2006). Their location and legal descriptions of the expansion areas are as follows.

| Location | Legal Description |
|---|---|
| High School Park | - Lot 2H, DL 2450S, SDYD, Townsite of Oliver<br>- Southern portion of Block C, DL 2450S, SDYD, Irrigation Lateral SRW shown on PL 330, Lot 2G BLF52 on Oliver Townsite map |
| Fairview Park | - Lot 2J, DL 2450S, SDYD, Townsite of Oliver<br>- Block 34, DL 2450S, SDYD, Townsite of Oliver, Incl Closed Rd PL B7567 |
| Oliver Secondary School | Block 32, Plan KAP4297, DL 2450S, SDYD |
| Public Works | Lot 2, Plan KAP54258, DL 2450S, SDYD |
| Airstrip | Lot 2, Plan KAP38137, DL 2450S, SDYD |
| Cemetery | Lot 1, Plan KAP 24065, DL 2450S, SDYD, Portion L 203A |

Total reclaimed water use is measured by a flow meter located at the booster station, adjacent to the reclaimed water storage reservoir. Meters have also been installed at the Cemetery, Airport, Public Works Yard, Alonso Property, Southern Okanagan Secondary School, High School Park and Huggins Property for the purposes of measuring total reclaimed water use at each location. There is no flow meter on the irrigation service to the Fairview Mountain Gold Course. Usage is calculated as the total annual irrigation, less all other metered usage. Annual reporting of the irrigated areas will be consistent with the reporting requirements as outlined in PE-13717 and include the total usage, crop type, irrigated area, irrigation application rate, and irrigation period.

Groundwater monitoring plans are established for the airport and Fairview Mountain Gold Course sites, the two largest users of reclaimed water. Sampling data is included in annual reporting.

As per the operational certificate, no reclaimed wastewater will be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water. Additionally, no reclaimed wastewater is irrigated within 30 metres of any well or inground reservoir for domestic supply.

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

Yours truly,

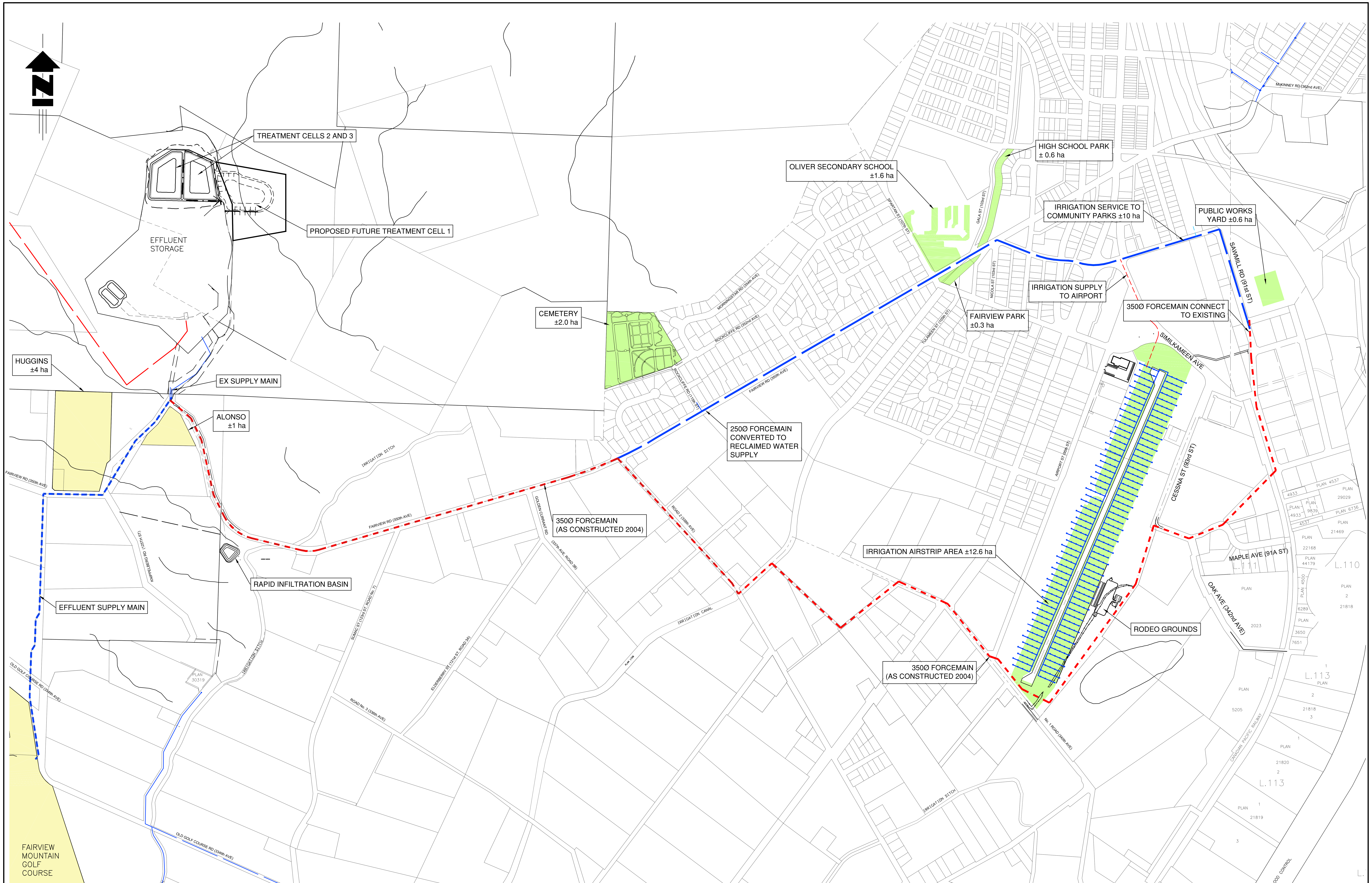
**TRUE CONSULTING**

Steve Underwood, P. Eng.

Enclosures

NA/

R:\Clients\300-399\306\306-088-005\02 Correspondence\Outgoing\To MoE\306-088-005-MoE-Oliver Treated Effluent Irrigation Area Expansion Notification-2018 12 13.docx




LEGEND

RECLAIMED WATER IRRIGATION EXPANSION AREAS (2006)

IRRIGATION AREAS AUTHORIZED BY PE-13717

| No. | DATE | DESCRIPTION | BY | APP'D |
|---|---|---|---|---|

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

British Columbia Town of Oliver

**SANITARY SEWER SYSTEM**

**OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS**

SCALE N.T.S. (11x17)

PROJECT REFERENCE No. 306-088-005

DRAWING No. **FIG 1**

SHEET 1 OF 1

ISSUE/REV.

January 17, 2019 Our File: 306-088-005

Ministry of Environment & Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Jen Pape, Environmental Protection Officer, Municipal Liquid Waste

Dear Ms. Pape:

**RE: *Town of Oliver – Irrigation Area Expansion Notification - OC PE-13717***

In response to your email dated January 10, 2018, the following supplemental information is provided to support the Update to Reclaimed Water Irrigation Plan submitted to the Ministry on December 13, 2018.

1. The Town currently provides treated reclaimed water to the Alonso and Huggins vineyards for irrigation purposes. The Huggins service is turned off, but this service provides a backup source to the user in the event of a drought period. Both vineyards use drip irrigation to water crops. There are no supplemental food crops in the irrigation area.

2. The following drawings of the Town of Oliver Effluent Infiltration Basin are enclosed herein:
    a. General Location Map (Dwg. No. 306-1201-05)
    b. Effluent Infiltration Basin Plan and Profile (Dwg. No. 306-1322-03)

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

Yours truly,

**TRUE CONSULTING**

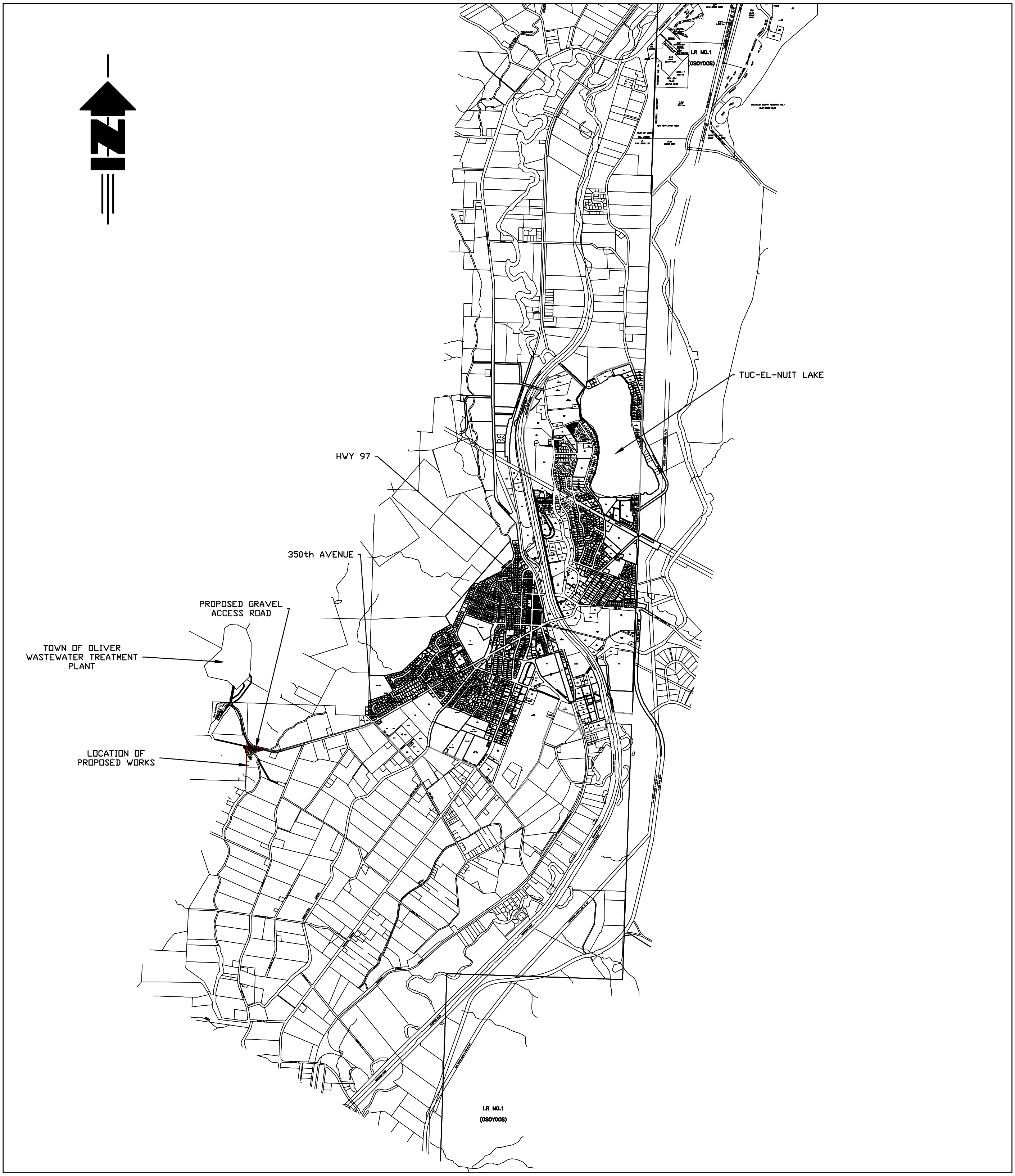
Natalie Alteen

Natalie Alteen, EIT

Enclosures

NA

R:\Clients\300-399\306\306-088-005\02 Correspondence\Outgoing\To MoE\Irrigation Area Expansion Notification\306-088-005-MoE-Oliver Treated Effluent Irrigation Area Expansion Notification-2019 01 17.docx




X:\LandProjects2007\306-1201p\dwg\306-1201.dwg, 02/12/2011 8:52:50 AM, CutePDF Writer

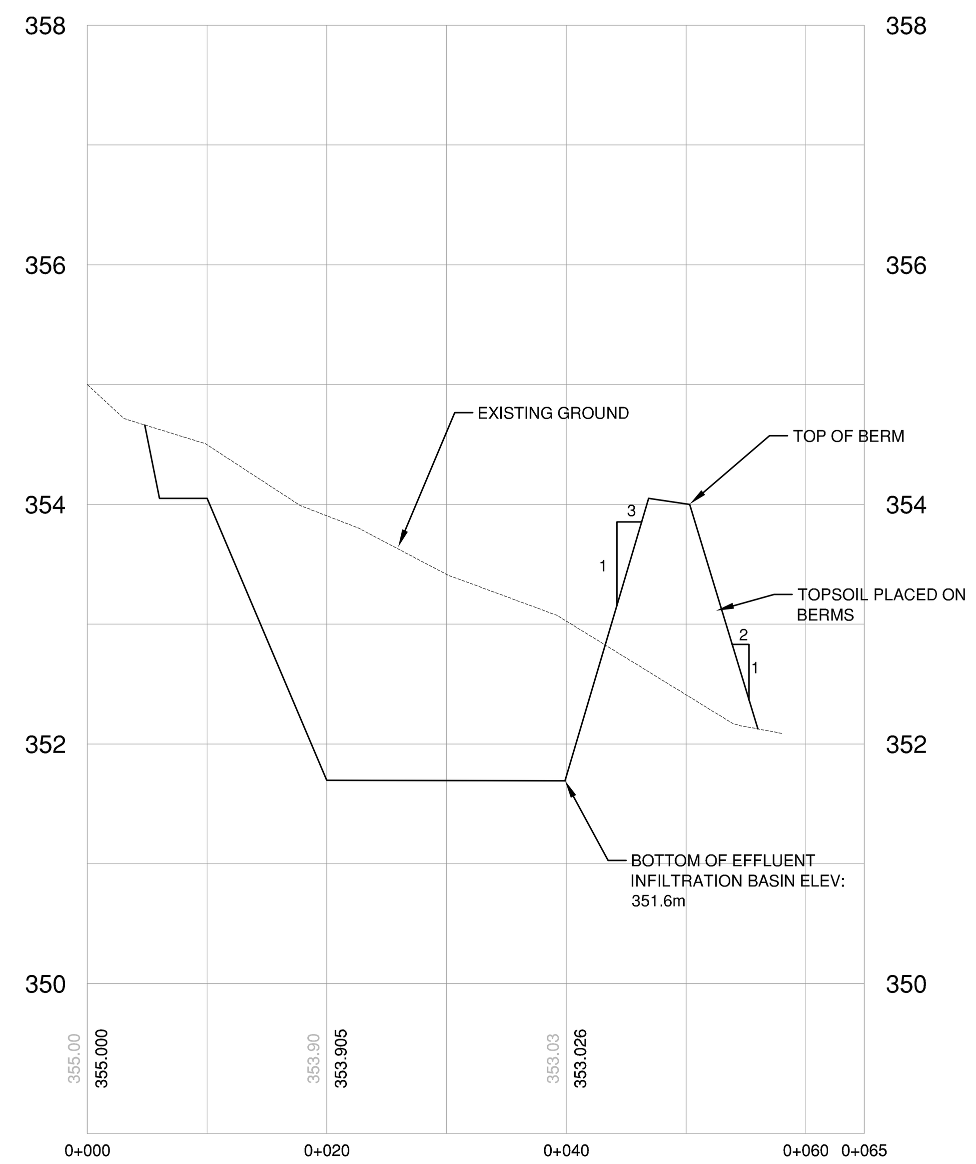
# TOWN OF OLIVER

## GENERAL LOCATION MAP

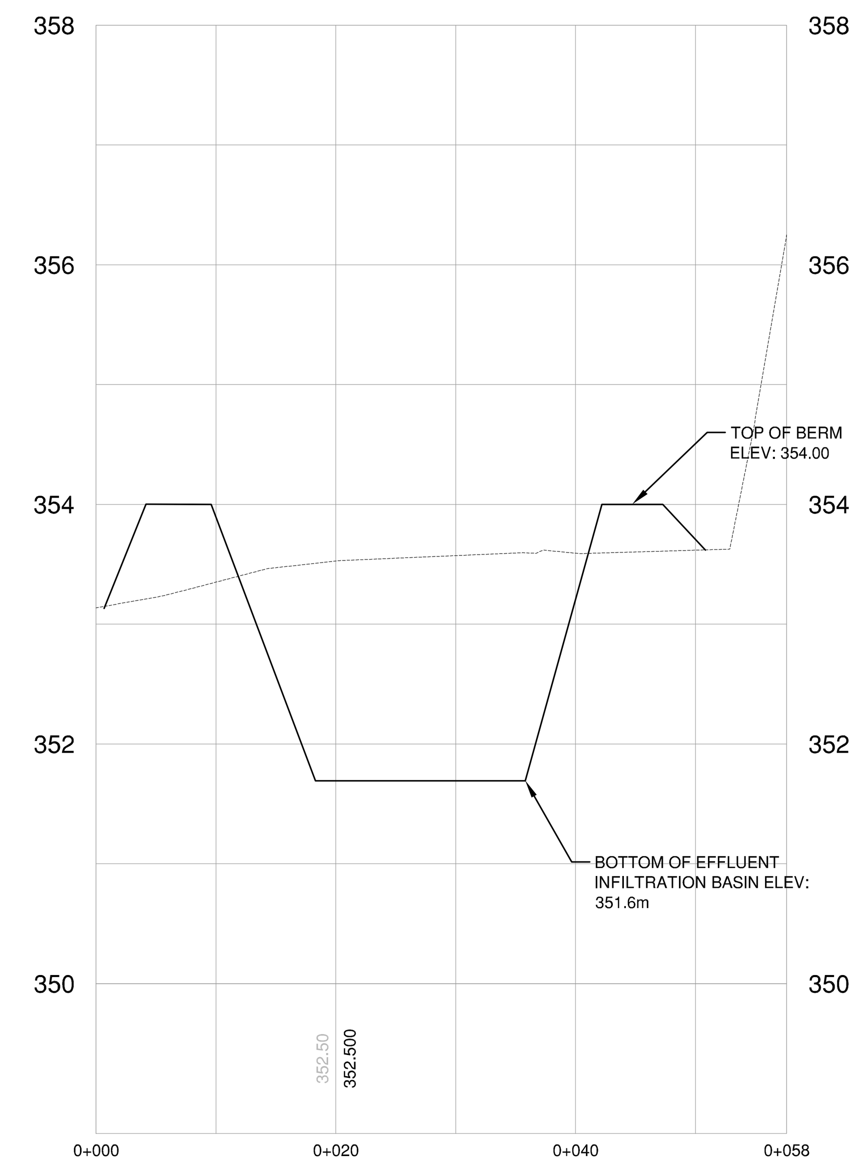
TRUE CONSULTING

| | |
|---|---|
| DSGN. BY: | |
| SCALE: | 1:50,000 |
| DWG. NO.: 306-1201-05 | REV.: |
| DWN. BY: | KK |
| DATE: | NOV 2011 |

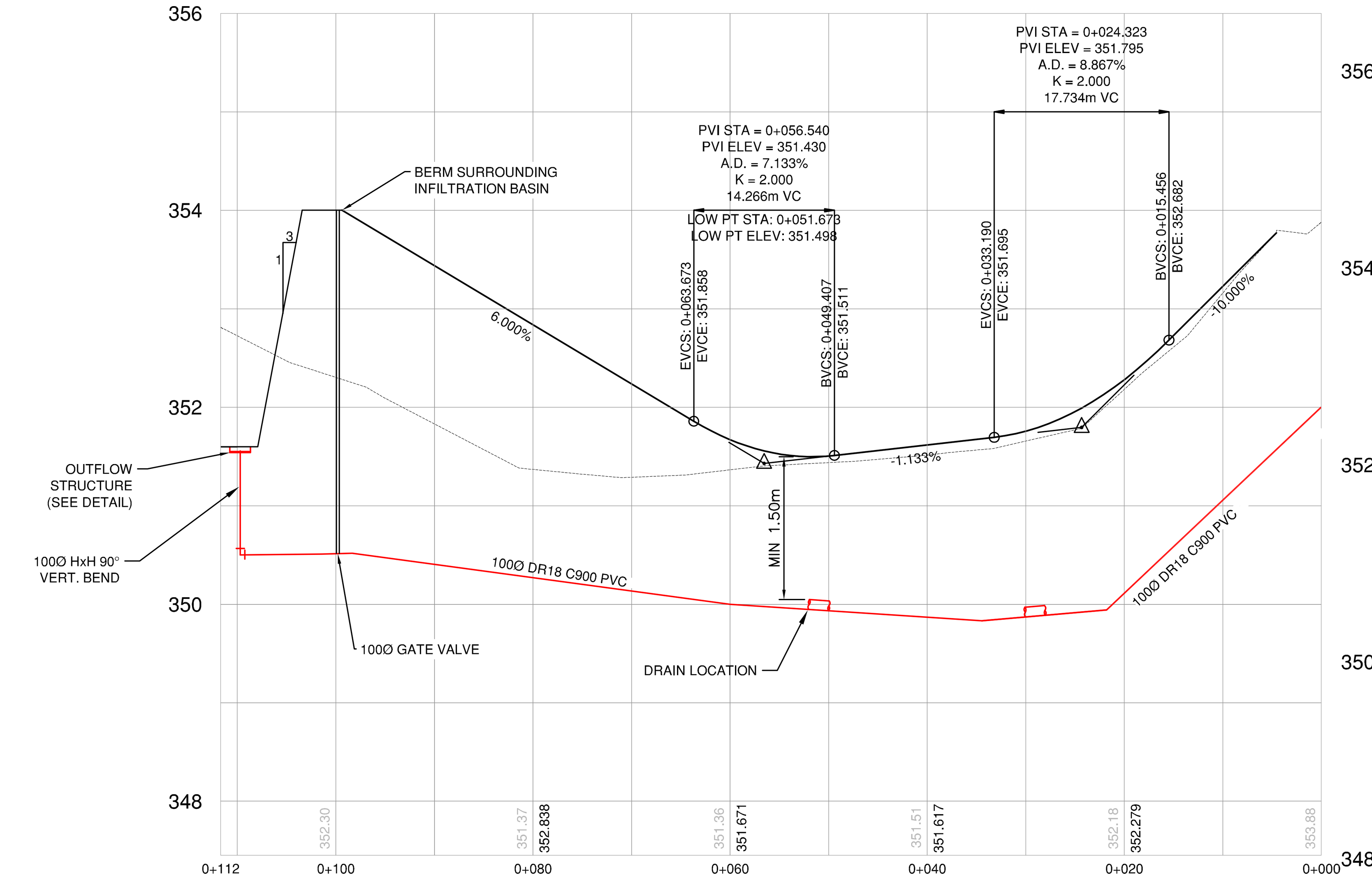
FILE: x:\landprojects2007\306-1201p\dwg\306-1201.dwg

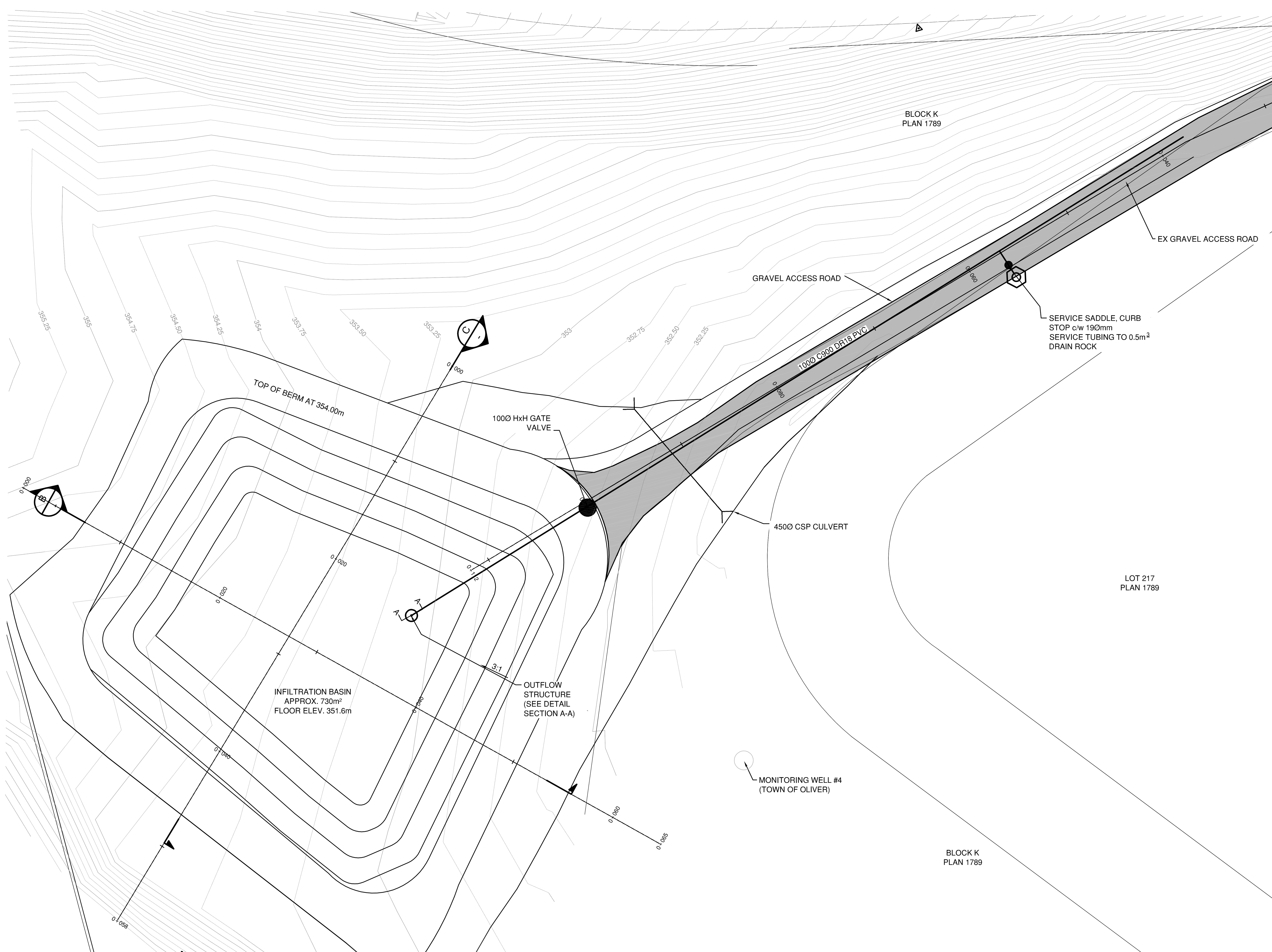


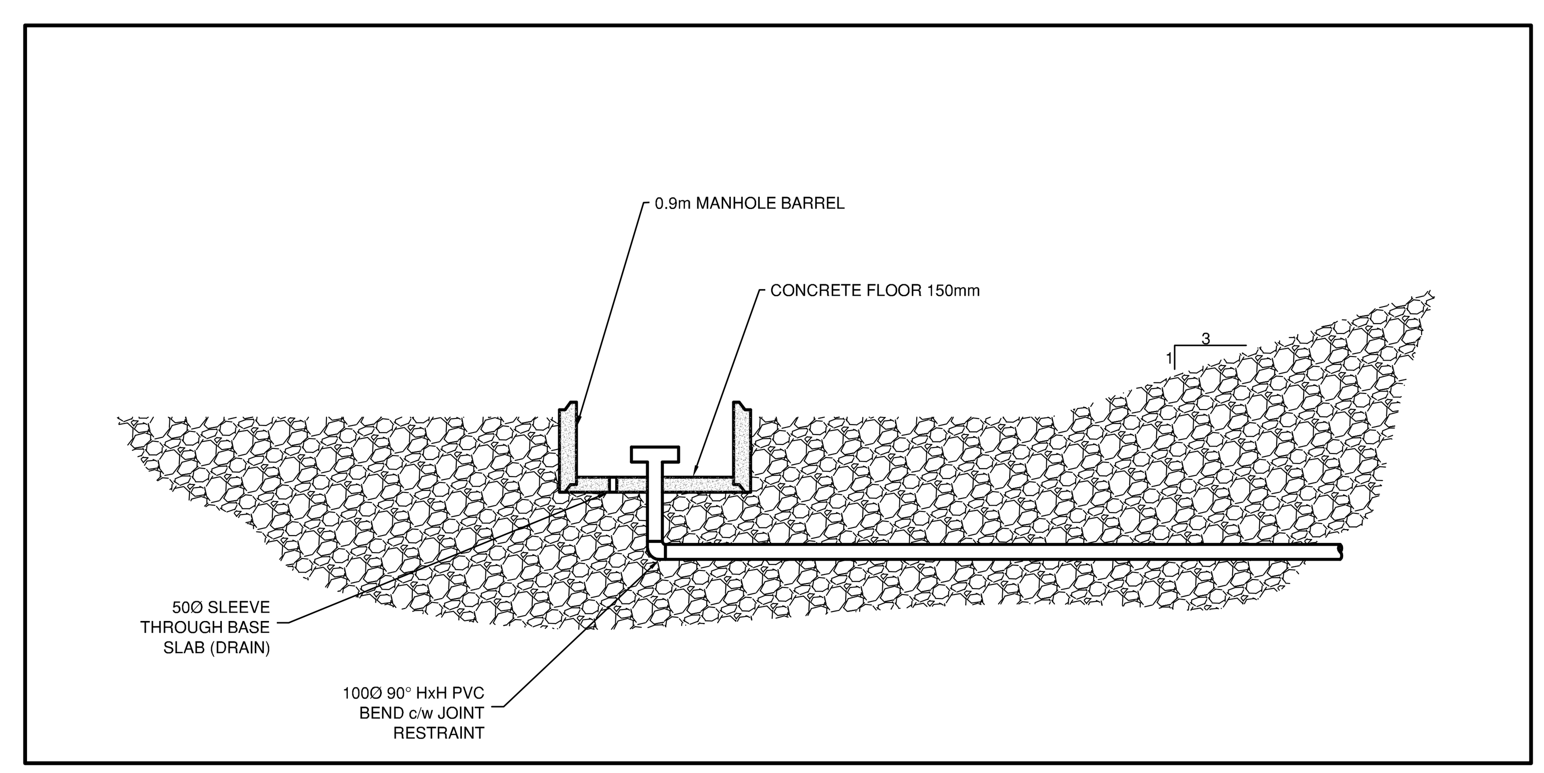

B EFFLUENT INFILTRATION BASIN SECTION B-B
SCALE - 1:50




C EFFLUENT INFILTRATION BASIN SECTION C-C
SCALE - 1:50




A DETAIL A-A
SCALE - NTS

| No. | DATE | DESCRIPTION | BY | APP'D |
|---|---|---|---|---|
| 2 | SEPT 25/14 | RECORD DRAWING | SP | SU |
| 1 | SEPT 25/13 | ISSUED FOR TENDER | SP | SU |

ISSUES / REVISIONS

CONSULTANT SEAL


TRUE CONSULTING
201 - 2079 Falcon Road ▪ Kamloops BC ▪ V2C 4J2
tel 250.828.0881 ▪ fax 250.828.0717
info@TRUE.bc.ca


# TOWN OF OLIVER

# EFFLUENT INFILTRATION BASIN

## PLAN AND PROFILE

| | |
|---|---|
| SCALE | 1:250<br>1:50 |
| DESIGN BY | TRU/SU |
| DRAWN BY | WF/SP |
| DATE | SEPTEMBER 2013 |
| PROJECT REFERENCE No. | 306-1201 |
| DRAWING No. | 306-1322 03 |
| SHEET | 03 OF 03 |
| REVISION | 02 |

February 25, 2020 Our File: 306-088-007

Ministry of Environment and Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Jen Pape, Environmental Protection Officer, Municipal Liquid Waste

Dear Ms. Pape:

**RE: *Town of Oliver – Update to Reclaimed Water Irrigation Plan – OC-PE-13717***

The Town of Oliver submitted an approval request to the Ministry for expansion of their reclaimed water irrigation system as authorized in Operational Certificate ("OC") PE-13717 on December 13, 2018 (please see attached). This letter serves as a notification for additional expansion.

## CURRENT WORK AUTHORIZED WITHIN PE-13717 (ISSUED: DECEMBER 14, 1995)

Works authorized within the OC, as described in Site Plan A of the permit, are outlined in the Table 1.

**TABLE 1 AUTHORIZED WORKS WITHIN OC PE-13717 SITE PLAN A (DATED DECEMBER 14, 1995)**

| Location | Legal Description |
|---|---|
| Fairview Mountain Golf Course | Lot 1, Plan KAP62023, DL2450S, SDYD |
| Alonso | Lot A, Plan KAP37929, Sec 12, Township 54, SDYD |
| Huggins | Lot 3, Plan KAP5881, Sec 12, Township 54, SDYD |

As described in the response letter submission to the Ministry on January 17, 2019 (please see attached), the Alonso and Huggins properties utilize reclaimed water irrigation for their vineyards. The Huggins service is turned off but provides a backup source to the user in the event of a drought period. Both vineyards utilize drip irrigation to water crops and there are no supplemental food crops in the irrigation area.

## EXPANSION AREA NOTIFICATION (DECEMBER 13, 2018)

On December 13, 2018, the Town requested authorization for expansion of the irrigation system as described in Table 2. These areas are currently being irrigated.

…/2

201-2079 Falcon Road ■ Kamloops BC ■ V2C 4J2 ■ www.true.bc.ca ■ tel 250.828.0881 ■ fax 250.828.0717
ENGINEERING ■ PLANNING ■ URBAN DESIGN ■ LAND SURVEYING

**TABLE 2 PROPSED EXPANSION AREA BY TOWN IN NOTIFICATION TO MINISTRY (DATED DECEMBER 13, 2018)**

| Location | Legal Description; |
|---|---|
| Gala Street Linear Park | Lot 2H, DL 2450S, SDYD, Townsite of Oliver;<br>Southern portion of Block C, DL 2450S, SDYD, Irrigation Lateral SRW shown on PL 330, Lot 2G BLF52 on Oliver Townsite map |
| Fairview Park | Lot 2J, DL 2450S, SDYD, Townsite of Oliver;<br>Block 34, DL 2450S, SDYD, Townsite of Oliver, Incl Closed Rd PL B7567 |
| South Okanagan Secondary School | Block 32, Plan KAP4297, DL 2450S, SDYD;<br>Block 48, Plan KAP2507, DL2450S, SDYD |
| Public Works | Lot 2, Plan KAP54258, DL 2450S, SDYD |
| Oliver Municipal Airport | Lot 2, Plan KAP38137, DL 2450S, SDYD |
| Cemetery | Lot 1, Plan KAP 24065, DL 2450S, SDYD, Portion L 203A |

## EXPANSION AREA NOTIFICATION

The Town wishes to notify the Ministry of an expansion to the South Okanagan Secondary School irrigation area. This irrigated area has increased from ± 1.6 ha to ± 5.4 ha as show on Figure 1-1 enclosed herein.

## SYSTEM METERING

To date, total reclaimed water use is measured by a flow meter located at the booster station, adjacent to the reclaimed water storage reservoir. To measure total reclaimed water use at each location meters have been installed at the Cemetery, Oliver Municipal Airport, Public Works Yard, Alonso Property, Southern Okanagan Secondary School, Gala Street Linear Park, Huggins Property and most recently at Fairview Park.

There is no flow meter on the irrigation service to the Fairview Mountain Golf Course therefor usage is calculated as the total annual irrigation, less all other metered usage. Annual reporting of the irrigated areas is consistent with the reporting requirements as outlined in PE-13717 and include the total usage, crop type, irrigated area, irrigation application rate, and irrigation period.

## GROUNDWATER MONITORING

Groundwater monitoring plans are established for the airport and Fairview Mountain Golf Course sites, the two largest users of reclaimed water. Sampling data is included in annual reporting.

As per the operational certificate, no reclaimed wastewater will be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water. Additionally, no reclaimed wastewater is irrigated within 30 metres of any well or inground reservoir for domestic supply.

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

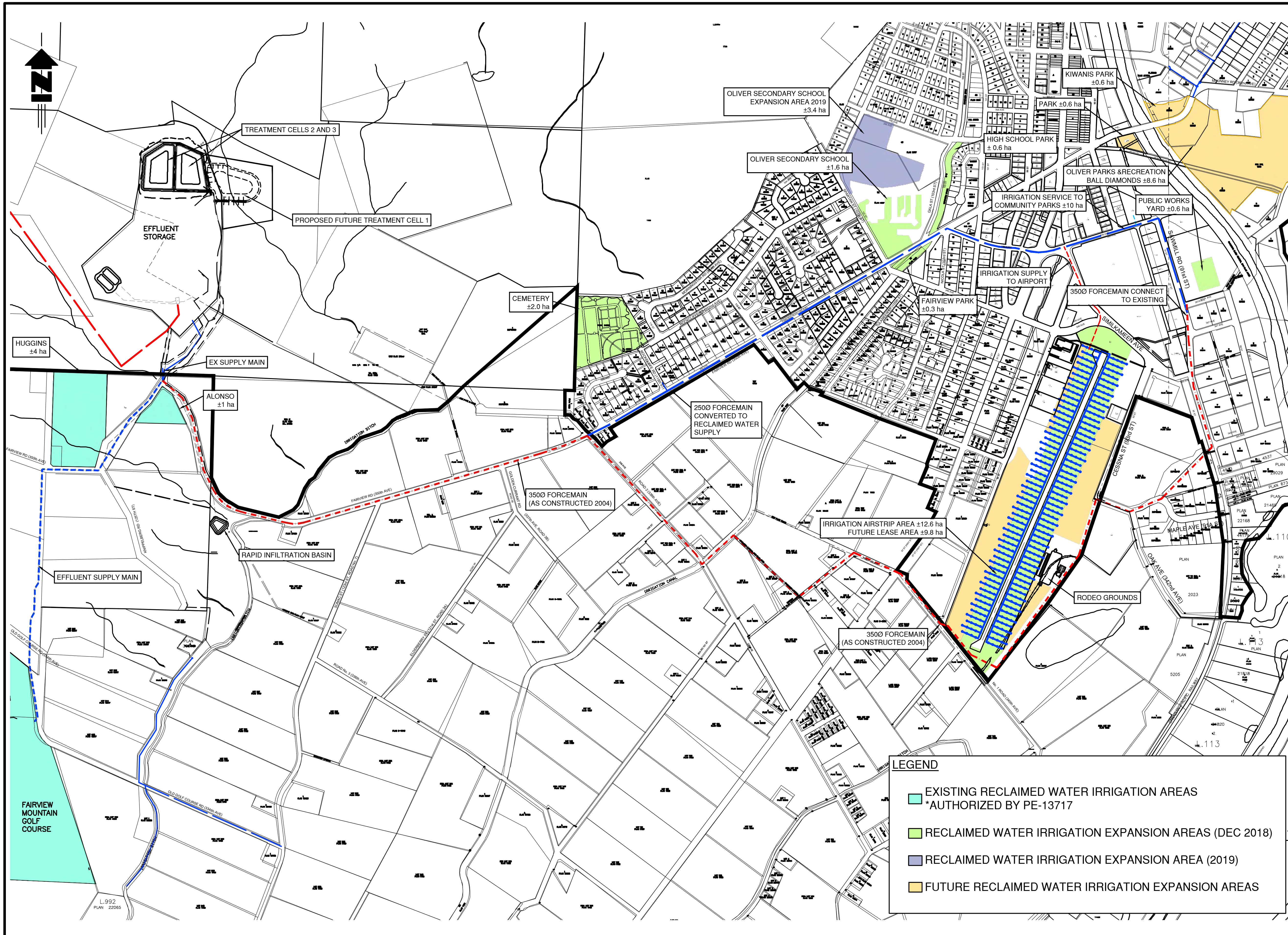
Yours truly,

**TRUE CONSULTING**

Natalie Alteen

Natalie Alteen, EIT

Enclosures
NA/slf




| No. | DATE | DESCRIPTION | BY | APP |
|---|---|---|---|---|

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING
201 - 2079 Falcon Road ▪ Kamloops BC ▪ V2C 4J2
tel 250.828.0881 ▪ fax 250.828.0717
info@TRUE.bc.ca

Town of Oliver
CANADA'S WINE CAPITAL

**SANITARY SEWER ANNUAL REPORT**

**OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS**

| | |
|---|---|
| SCALE | N.T.S. (11x17) |
| DESIGN BY | TRU |
| DRAWN BY | NA |
| DATE | JANUARY 2018 |
| PROJECT REFERENCE No. | 306-088-005 |
| DRAWING No. | FIG 1-1 |
| SHEET | 1 OF 1 |
| ISSUE REV. | |

December 13, 2018 Our File: 306-088-005

Ministry of Environment & Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Regional Waste Manager

Dear Sir/Madam:

**RE: *Town of Oliver – Update to Reclaimed Water Irrigation Plan - OC PE-13717***

The Town of Oliver requests approval from the Ministry for expansion of their reclaimed water irrigation system as authorized in Operational Certificate PE-13717. The current works authorized within this Operational Certificate are outlined in Site Plan A, dated December 14, 1995. The areas include:

| Location | Legal Description |
|---|---|
| Fairview Mountain Golf Course | Lot 1, Plan KAP62023, DL2450S, SDYD |
| Alonso | Lot A, Plan KAP37929, Sec 12, Township 54, SDYD |
| Huggins | Lot 3, Plan KAP5881, Sec 12, Township 54, SDYD |

The Town requests authorization for expansion of the irrigation system. The expansion areas are shown in Figure 1 enclosed herein. They are identified as Reclaimed Water Irrigation Expansion Areas (2006). Their location and legal descriptions of the expansion areas are as follows.

| Location | Legal Description |
|---|---|
| High School Park | - Lot 2H, DL 2450S, SDYD, Townsite of Oliver<br>- Southern portion of Block C, DL 2450S, SDYD, Irrigation Lateral SRW shown on PL 330, Lot 2G BLF52 on Oliver Townsite map |
| Fairview Park | - Lot 2J, DL 2450S, SDYD, Townsite of Oliver<br>- Block 34, DL 2450S, SDYD, Townsite of Oliver, Incl Closed Rd PL B7567 |
| Oliver Secondary School | Block 32, Plan KAP4297, DL 2450S, SDYD |
| Public Works | Lot 2, Plan KAP54258, DL 2450S, SDYD |
| Airstrip | Lot 2, Plan KAP38137, DL 2450S, SDYD |
| Cemetery | Lot 1, Plan KAP 24065, DL 2450S, SDYD, Portion L 203A |

.../2

Total reclaimed water use is measured by a flow meter located at the booster station, adjacent to the reclaimed water storage reservoir. Meters have also been installed at the Cemetery, Airport, Public Works Yard, Alonso Property, Southern Okanagan Secondary School, High School Park and Huggins Property for the purposes of measuring total reclaimed water use at each location. There is no flow meter on the irrigation service to the Fairview Mountain Gold Course. Usage is calculated as the total annual irrigation, less all other metered usage. Annual reporting of the irrigated areas will be consistent with the reporting requirements as outlined in PE-13717 and include the total usage, crop type, irrigated area, irrigation application rate, and irrigation period.

Groundwater monitoring plans are established for the airport and Fairview Mountain Gold Course sites, the two largest users of reclaimed water. Sampling data is included in annual reporting.

As per the operational certificate, no reclaimed wastewater will be applied to the ground any closer than 15 metres from the edge of flowing streams or bodies of water. Additionally, no reclaimed wastewater is irrigated within 30 metres of any well or inground reservoir for domestic supply.

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

Yours truly,

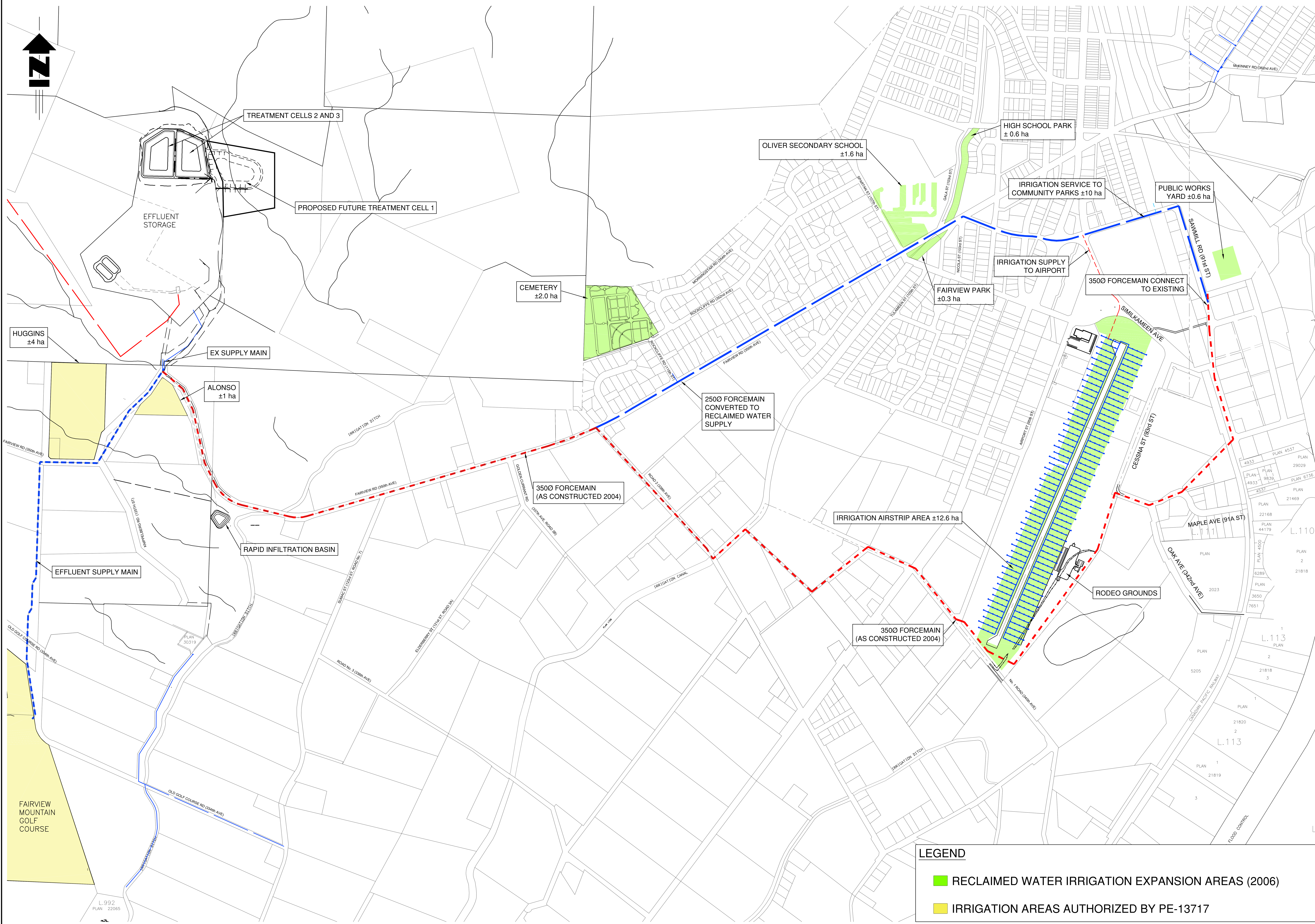
**TRUE CONSULTING**

Steve Underwood, P. Eng.

Enclosures

NA/

R:\Clients\300-399\306\306-088-005\02 Correspondence\Outgoing\To MoE\306-088-005-MoE-Oliver Treated Effluent Irrigation Area Expansion Notification-2018 12 13.docx




## LEGEND

- RECLAIMED WATER IRRIGATION EXPANSION AREAS (2006)
- IRRIGATION AREAS AUTHORIZED BY PE-13717

| No. | DATE | DESCRIPTION | BY | APPD |
|---|---|---|---|---|

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING
201 - 2079 Falcon Road ■ Kamloops BC ■ V2C 4J2
tel 250.828.0881 ■ fax 250.828.0717
info@TRUE.bc.ca

British Columbia — Town of Oliver

**SANITARY SEWER SYSTEM**

**OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS**

SCALE N.T.S. (11x17)

PROJECT REFERENCE No. 306-088-005

DRAWING No. **FIG 1**

SHEET 1 OF 1

ISSUE/REV.

January 17, 2019 Our File: 306-088-005

Ministry of Environment & Climate Change Strategy
102 Industrial Place
Penticton, B.C.
V2A 7C8

Attn: Jen Pape, Environmental Protection Officer, Municipal Liquid Waste

Dear Ms. Pape:

**RE: *Town of Oliver – Irrigation Area Expansion Notification - OC PE-13717***

In response to your email dated January 10, 2018, the following supplemental information is provided to support the Update to Reclaimed Water Irrigation Plan submitted to the Ministry on December 13, 2018.

1. The Town currently provides treated reclaimed water to the Alonso and Huggins vineyards for irrigation purposes. The Huggins service is turned off, but this service provides a backup source to the user in the event of a drought period. Both vineyards use drip irrigation to water crops. There are no supplemental food crops in the irrigation area.

2. The following drawings of the Town of Oliver Effluent Infiltration Basin are enclosed herein:
    a. General Location Map (Dwg. No. 306-1201-05)
    b. Effluent Infiltration Basin Plan and Profile (Dwg. No. 306-1322-03)

Should questions arise or for additional information, please do not hesitate to contact the undersigned.

Yours truly,

**TRUE CONSULTING**

Natalie Alteen

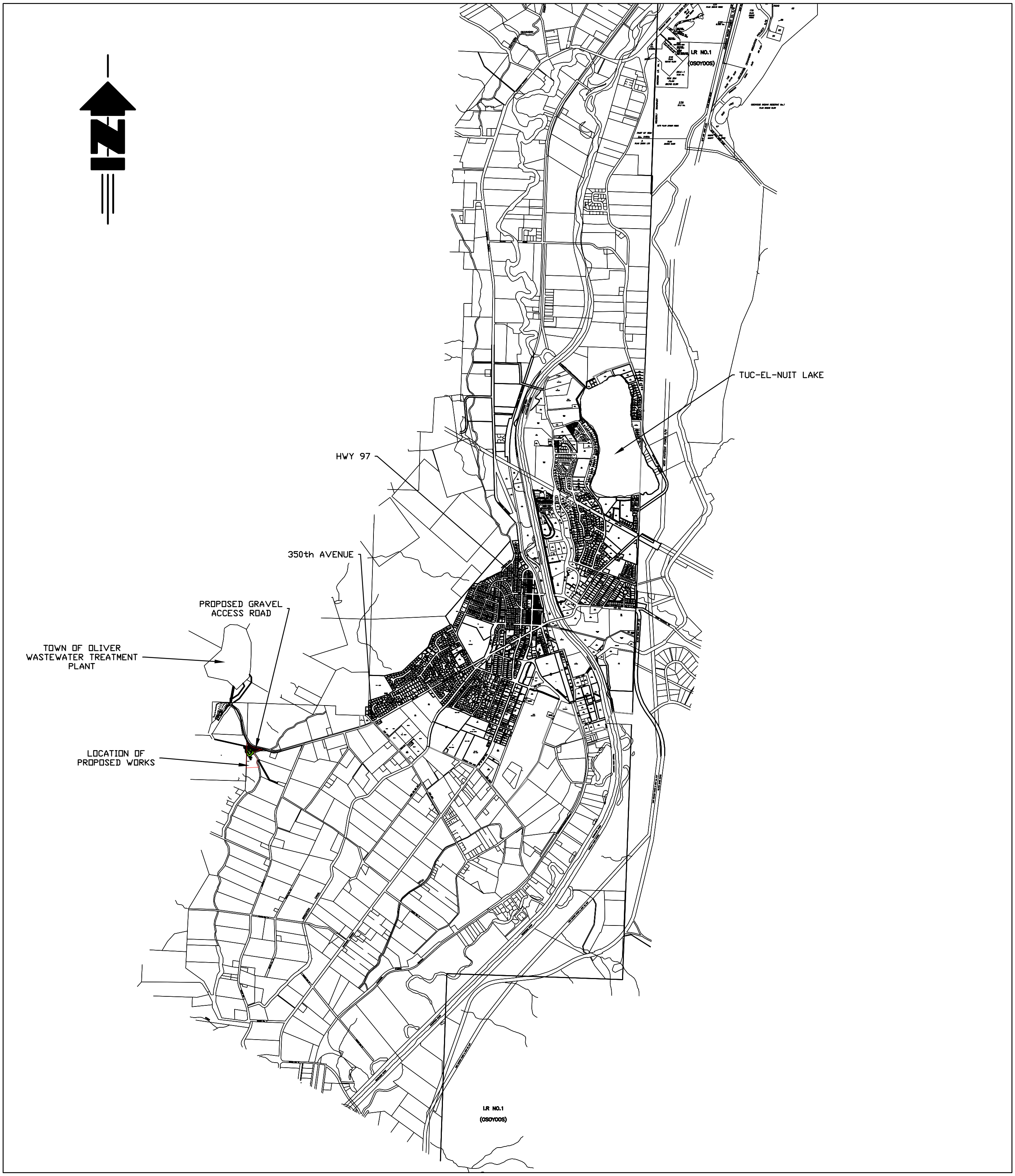
Natalie Alteen, EIT

Enclosures

NA

R:\Clients\300-399\306\306-088-005\02 Correspondence\Outgoing\To MoE\Irrigation Area Expansion Notification\306-088-005-MoE-Oliver Treated Effluent Irrigation Area Expansion Notification-2019 01 17.docx

201-2079 Falcon Road ■ Kamloops BC ■ V2C 4J2 ■ www.true.bc.ca ■ tel 250.828.0881 ■ fax 250.828.0717

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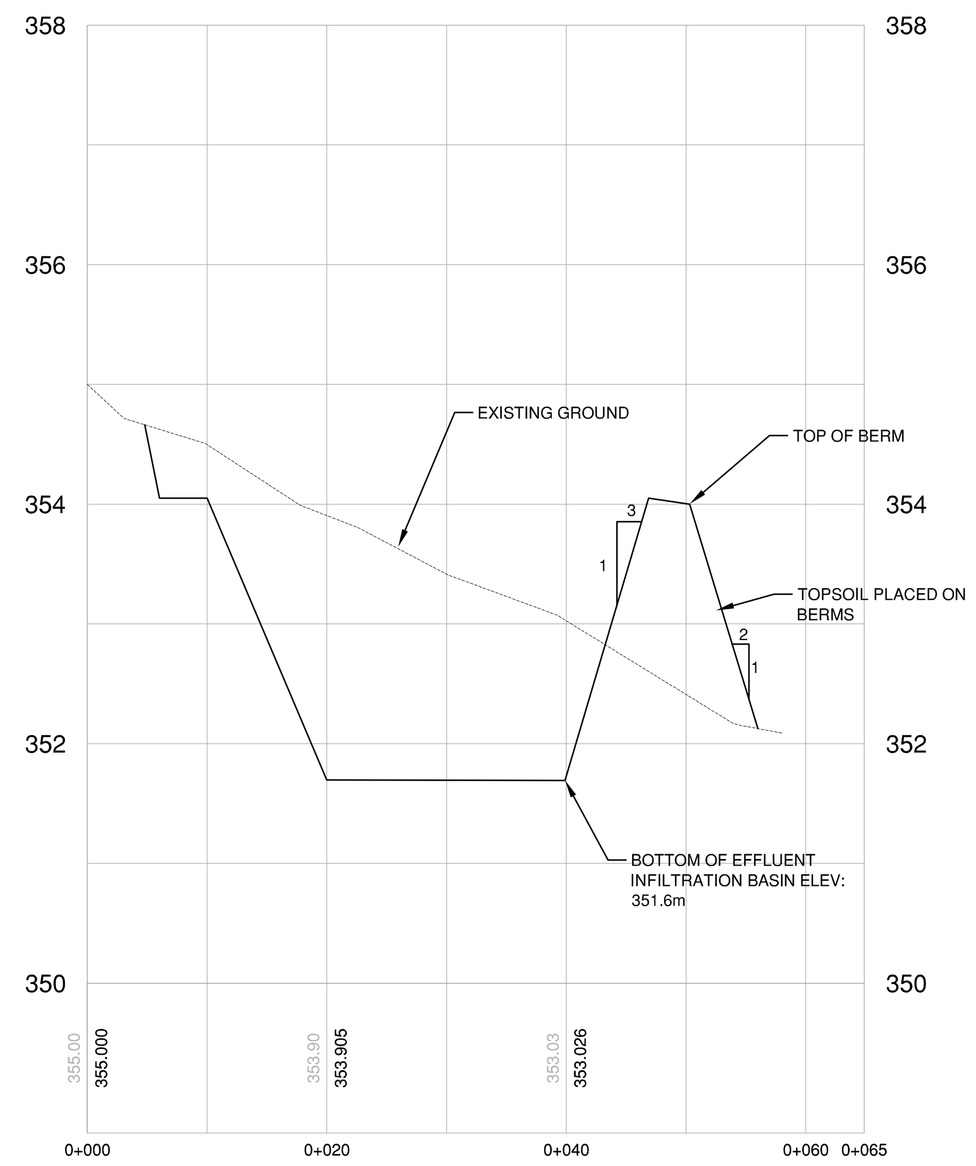
# TOWN OF OLIVER

# GENERAL LOCATION MAP

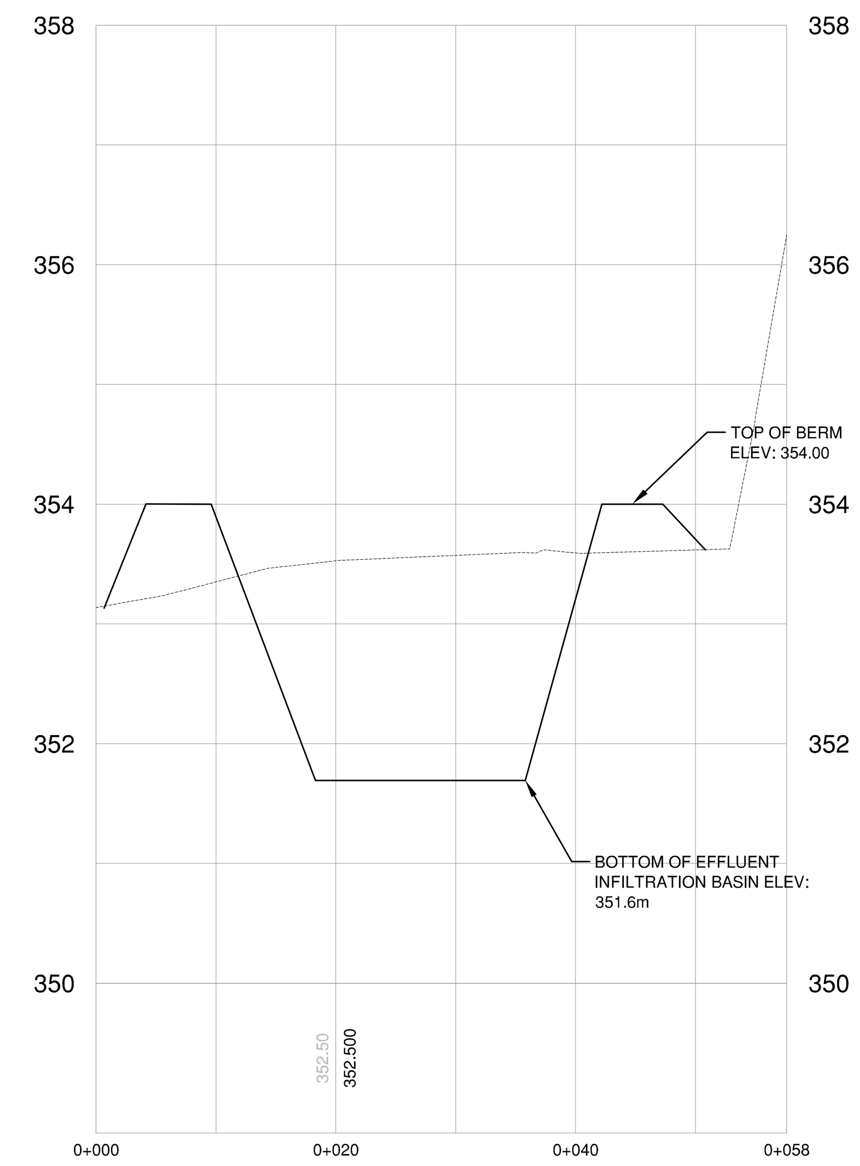
TRUE CONSULTING

| | |
|---|---|
| DSGN. BY: | |
| SCALE: | 1:50,000 |
| DWG. NO.: 306-1201-05 | REV.: |
| DWN. BY: | KK |
| DATE: | NOV 2011 |

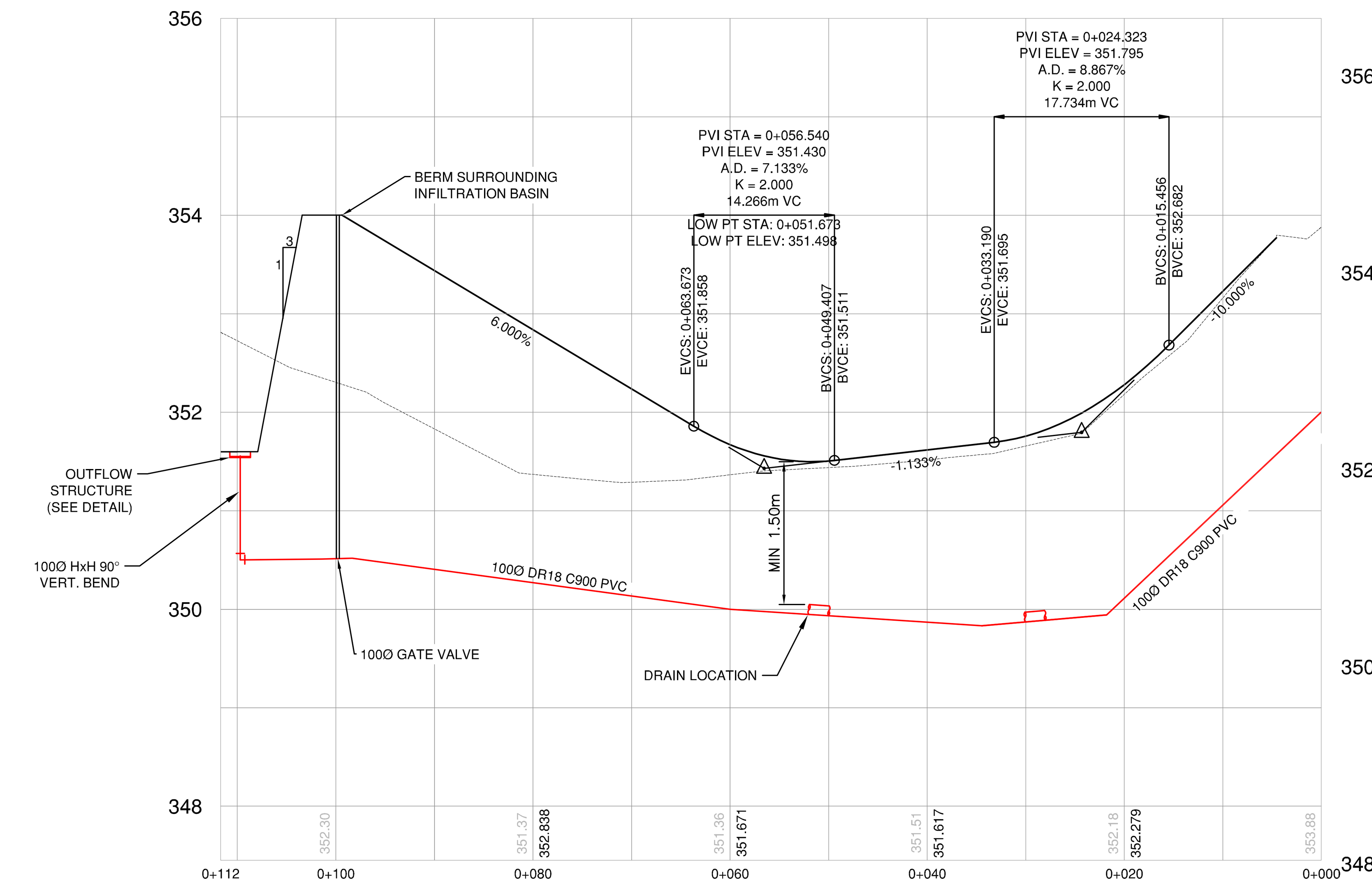
FILE: x:\landprojects2007\306-1201p\dwg\306-1201.dwg

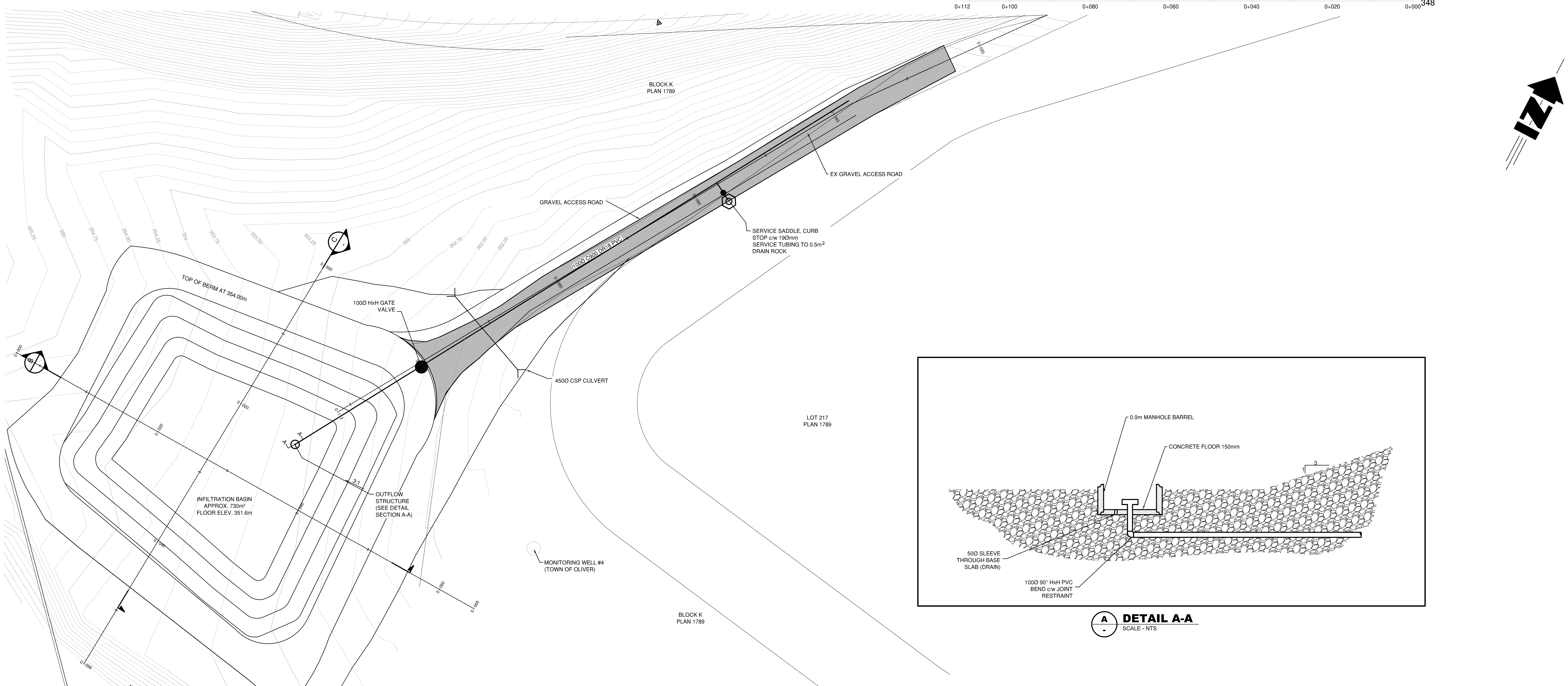



B - **EFFLUENT INFILTRATION BASIN SECTION B-B**
SCALE - 1:50




C - **EFFLUENT INFILTRATION BASIN SECTION C-C**
SCALE - 1:50




A - **DETAIL A-A**
SCALE - NTS

| No. | DATE | DESCRIPTION | BY | APP'D |
|---|---|---|---|---|
| 2 | SEPT 25/14 | RECORD DRAWING | SP | SU |
| 1 | SEPT 25/13 | ISSUED FOR TENDER | SP | SU |

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

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tel 250.828.0881 ▪ fax 250.828.0717
info@TRUE.bc.ca

**TOWN OF OLIVER**

**EFFLUENT INFILTRATION BASIN**

**PLAN AND PROFILE**

| | |
|---|---|
| SCALE | 1:250 1:50 |
| DESIGN BY | TRU/SU |
| DRAWN BY | WF/SP |
| DATE | SEPTEMBER 2013 |
| PROJECT REFERENCE No. | 306-1201 |

DRAWING No. 306-1322 **03**
SHEET 03 OF 03
REVISION 02

BRITISH COLUMBIA

May 4, 2020 Authorization Number: 13717

**VIA EMAIL:** sgoodsell@oliver.ca; JTrottier@oliver.ca; NAlteen@true.bc.ca; sunderwood@true.bc.ca

The Corporation of the Village of Oliver
PO Box 638
Oliver, BC V0H 1T0

Dear Authorization Holder:

**Re: Clause 1.8 of OC 13717 - Authorizaton of Irrigation Plan for All New Areas**

This letter is in response to a letter dated February 25, 2020 from TRUE Consulting, sent on behalf of the Corporation of the Village of Oliver with Operational Certificate (OC) 13717, that requested authorization of an irrigation plan of all new areas of land to be irrigated. An updated site plan was included to support the request. The Ministry of Environment and Climate Change Strategy acknowledges receipt and has found the submission of the irrigation plan adequate.

In accordance with Clause 1.8 of OC 13717, the director authorizes the irrigation plan of all new areas of land identified in the letter from February of 2020.

If there are any questions about this letter, please contact Kristina Moseley at 250.490.2239 or email kristina.moseley@gov.bc.ca.

Yours truly,

Bryan Vroom
for director, *Environmental Management Act*

BRITISH COLUMBIA



Reference: 66483

AUG 0 6 2002

Her Worship Mayor Linda Larson
and Councillors
Town of Oliver
PO Box 638
Oliver BC V0H 1T0

Dear Mayor Larson and Councillors:

I am pleased to inform you that the update to the Town of Oliver's Liquid Waste Management Plan (LWMP) is hereby approved in principle in accordance with section 18 of the *Waste Management Act*.

I recognize that your LWMP update was rather complicated and required the concerted efforts of your staff and your consultant to complete. I commend your efforts and those of your consultant and wish you well in the continued implementation of your LWMP.

The implementation and administration of the LWMP will require resolution of details involving financial, engineering, operational and administrative elements, and I request that you continue to work closely with ministry staff on plan implementation details. I am sending a copy of this letter to my colleague, the Minister of Community, Aboriginal and Women's Services (formerly Municipal Affairs), the Honourable George Abbott so that he is aware of my support for your funding request for the continued implementation of this plan.

Best regards,

Joyce Murray
Minister

cc: The Honourable George Abbott, Minister of Community, Aboriginal and Women's Services

# APPENDIX F

## Seasonal Precipitation Data

## Seasonal Precipitation Summary

**Oliver STP**

| YEAR | APR | MAY | JUNE | JULY | AUG | SEPT | OCT | SEASON TOTAL (mm) |
|---|---|---|---|---|---|---|---|---|
| 1992 | 41.4 | 8.0 | 64.8 | 62.0 | 9.8 | 2.2 | 11.8 | 200.0 |
| 1993 | 50.6 | 34.5 | 48.0 | 67.9 | 39.5 | 18.4 | 14.8 | 273.7 |
| 1994 | 42.4 | 30.8 | 37.8 | 12.2 | 33.9 | 17.4 | 24.8 | 199.3 |
| 1995 | 17.5 | 17.9 | 37.6 | 10.2 | 22.6 | 7.5 | 10.6 | 123.9 |
| 1996 | 15.8 | 62.2 | 27.9 | 24.2 | 5.2 | 52.3 | 28.2 | 215.8 |
| 1997 | 35.3 | 41.8 | 87.9 | 47.6 | 18.5 | 63.4 | 29.0 | 323.5 |
| 1998 | 29.4 | 79.1 | 31.2 | 25.1 | 12.3 | 2.9 | 33.7 | 213.7 |
| 1999 | 20.1 | 28.9 | 40.3 | 15.5 | 44.1 | 1.2 | 11.7 | 161.8 |
| 2000 | 10.4 | 24.8 | 25.8 | 26.7 | 4.5 | 14.4 | 19.6 | 126.2 |
| 2001 | 37.6 | 16.4 | 39.4 | 32.2 | 15.0 | 13.6 | 24.1 | 178.3 |
| 2002 | 8.7 | 43.0 | 4.8 | 9.8 | 0.3 | 9.4 | 7.3 | 83.3 |
| 2003 | 29.4 | 18.4 | 12.9 | 0 | 0.0 | 11.4 | 21.7 | 93.8 |
| 2004 | 27.9 | 30.7 | 56.0 | 7.8 | 27.7 | 32.3 | 48.9 | 231.3 |
| 2005 | 12.4 | 41.1 | 48.4 | 2.9 | 1.3 | 2.9 | 22.4 | 131.4 |
| 2006 | 20.8 | 52.0 | 36.0 | 14.2 | 0.1 | 8.7 | 12.4 | 144.2 |
| 2007 | 4.9 | 3.2 | 24.1 | 29.0 | 2.8 | 12.2 | 11.6 | 87.8 |
| 2008 | 5.0 | 3.65 | 27.5 | 5.0 | 19.9 | 2.7 | 9.9 | 73.7 |
| 2009 | 4.8 | 26.8 | 13.4 | 28.6 | 27.8 | 20.2 | 39.5 | 161.1 |
| 2010 | 20.0 | 55.9 | 68.3 | 14.6 | 9.1 | 38.9 | 13.7 | 220.5 |
| 2011 | 12.5 | 69.6 | 24.4 | 18.7 | 0.0 | 3.4 | 22.4 | 151.0 |
| 2012 | 39.9 | 14.8 | 78.7 | 46 | 0.3 | 2 | 40.8 | 222.5 |
| 2013 | 16.5 | 30.5 | 35.0 | 8.6 | 36.6 | 47.5 | 5.6 | 180.3 |
| 2014 | 15.3 | 24.4 | 42.8 | 25 | 12.2 | 19.3 | 35.9 | 174.9 |
| 2015 | 2.2 | 54.4 | 13.2 | 17 | 19.9 | 3 | 26.3 | 136.0 |
| 2016 | 5.8 | 14.9 | 38.5 | 25.9 | 1.2 | 16.4 | 62.8 | 165.5 |
| 2017 | 40.5 | 61.2 | 21.2 | 0 | 0.0 | 4.8 | 5.3 | 133.0 |
| 2018 | 50.4 | 31.3 | 53.2 | 31.4 | 1.5 | 9.4 | 33.1 | 210.3 |
| 2019 | 8.0 | 3.7 | 6.9 | 10.4 | 6.1 | 80.9 | 11.1 | 127.1 |
| 2020 | 20.5 | 57.6 | 61.3 | 7.9 | 2.8 | 5.8 | 30.2 | 186.1 |
| Avg. | 22.3 | 33.8 | 38.2 | 21.6 | 12.9 | 18.1 | 23.1 | 170.0 |

1992 to 1996 data from Environment Canada
1997 - present data compiled from Town of Oliver daily records

# APPENDIX G

## Sludge Management Plan

## Sludge Monitoring (Quality) Data

**TOWN OF OLIVER**
**PE-13717 - Effluent Sludge - Cell #2**

**ANALYTICAL REPORT - Sampled on September 28, 2020**

| *Parameter* | *Unit* | CELL 2 EFF SLUDGE-1 | WALP Guidelines | | | |
|---|---|---|---|---|---|---|
| | | | Agricultural Low Grade | Agricultural High Grade | Retail Low Grade | Retail High Grade |
| Aluminum | ug/g | 10,600 | | | | |
| Antimony | ug/g | 3.19 | | | | |
| Arsenic | ug/g | 12.2 | 75 | 75 | 75 | 75 |
| Barium | ug/g | 246 | | | | |
| Beryllium | ug/g | 0.32 | | | | |
| Bismuth | ug/g | 28.1 | | | | |
| Cadmium | ug/g | 12.9 | 25 | 20 | 20 | 5-20 |
| Calcium | ug/g | 19,100 | | | | |
| Chromium | ug/g | 53.1 | | | | |
| Cobalt | ug/g | 3.71 | 150 | 150 | 150 | 150 |
| Copper | ug/g | 1,690 | | | | |
| Iron | ug/g | 11,200 | | | | |
| Lead | ug/g | 39.9 | 1000 | 500 | 500 | 500 |
| Magnesium | ug/g | 3,860 | | | | |
| Manganese | ug/g | 195 | | | | |
| Mercury | ug/g | 4.68 | 10 | 5 | 5 | 5 |
| Molybdenum | ug/g | 29.6 | 20 | 20 | 20 | 20 |
| Nickel | ug/g | 26.4 | 200 | 180 | 180 | 180 |
| Phosphorus | ug/g | 9,700 | | | | |
| Potassium | ug/g | 1,280 | | | | |
| Selenium | ug/g | 19.2 | 14 | 14 | 14 | 14 |
| Silver | ug/g | 23.3 | | | | |
| Sodium | ug/g | 2,150 | | | | |
| Strontium | ug/g | 296 | | | | |
| Tellurium | ug/g | <0.10 | | | | |
| Thallium | ug/g | 0.10 | | | | |
| Tin | ug/g | 14 | | | | |
| Titanium | ug/g | 18.6 | | | | |
| Vanadium | ug/g | 28.6 | | | | |
| Zinc | ug/g | 1,550 | 2500 | 1850 | 1850 | 1850 |
| Zirconium | ug/g | 2.2 | | | | |

| | | |
|---|---|---|
| Total Solids | % | 5.9 |
| Volatile Solids | % | 44.3 |

# APPENDIX H

## Groundwater Monitoring Data

**TOWN OF OLIVER**

**GROUND WATER MONITORING WELL READINGS**
**(Note: The value recorded indicates the measurement from the top of casing to the water level expressed in meters.)**

| Month | Day | Air Cadet (Well #1) | Rodeo Grounds (Well #2) | Maple Ave (Well #3) | Test Well #2 (Corner 350th/T.L.) | Test Well #4 (Sand Pit) | Test Well #5 | Test Well #6 (Golf Course) | Test Well #7 (Road #5 West) |
|---|---|---|---|---|---|---|---|---|---|
| January | 17 | 10.4 | 7.07 | 1.4 | fenced off | 8.95 | 9.8 | 3.92 (dry) | 25.91 (dry) |
| February | 20 | 10.48 | 7.08 | 1.18 | fenced off | 7.97 | 9.95 | 3.92 (dry) | 25.91 (dry) |
| March | 4 | 10.48 | 7.11 | 1.24 | fenced off | 8.06 | 10.00 | 3.92 (dry) | 25.91 (dry) |
| April | 2 | 10.5 | 7.18 | 1.28 | fenced off | 7.80 | 10.1 | 3.92 (dry) | 25.91 (dry) |
| May | 15 | 10.51 | 7.28 | 1.37 | fenced off | 8.6 | 10.10 | 3.92 (dry) | 25.91 (dry) |
| June | 10 | 10.39 | 7.34 | 1.37 | fenced off | 8.6 | 10.10 | 3.92 (dry) | 25.91 (dry) |
| July | 20 | 10.3 | 7.35 | 1.48 | fenced off | 9.26 | 7.36 | 3.92 (dry) | 25.91 (dry) |
| August | 26 | 10.13 | 7.35 | 1.69 | fenced off | 10.34 | 7.51 | 3.92 (dry) | 25.91 (dry) |
| September | 21 | 9.62 | 7.32 | 1.72 | fenced off | 10.43 | 7.76 | 3.92 (dry) | 25.91 (dry) |
| October | 14 | 9.73 | 7.35 | 1.65 | fenced off | 10.11 | 7.96 | 3.92 (dry) | 25.91 (dry) |
| November | 16 | 10 | 7.4 | 1.5 | fenced off | 9.08 | 8.57 | 3.92 (dry) | 25.91 (dry) |
| December | 14 | 10.04 | 7.46 | 1.45 | fenced off | 9.1 | 8.80 | 3.92 (dry) | 25.91 (dry) |

**TOWN OF OLIVER**
**GROUNDWATER MONITORING WELL #1 (AIR CADET)**

| | Anions | | | Calculated Parameters | | General Parameters | | | | | Total Metals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Chloride | Nitrate (as N) | Nitrite (as N) | Hardness Total (as CaCO3) | Nitrate+Nitrite (as N) | Ammonia Total (as N) | BOD 5-day Carbonaceous | Conductivity (EC) | Phosphorus Total (as P) | Phosphorus Total Dissolved | Calcium Total | Magnesium Total | Sodium Total |
| April 6 | 10.30 | 13.0 | <0.010 | 331 | 13.0 | <0.050 | 13.5 | 715 | 0.116 | 0.0713 | 101 | 19.1 | 18.8 |
| Sept 1 | 9.31 | 11.1 | <0.010 | 378 | 11.1 | <0.050 | <7.3 | 759 | 0.0579 | 0.0445 | 117 | 20.4 | 19.4 |

**GROUND WATER MONITORING WELL #2 (RODEO GROUNDS)**

| | Anions | | | Calculated Parameters | | General Parameters | | | | | Total Metals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Chloride | Nitrate (as N) | Nitrite (as N) | Hardness Total (as CaCO3) | Nitrate+Nitrite (as N) | Ammonia Total (as N) | BOD 5-day Carbonaceous | Conductivity (EC) | Phosphorus Total (as P) | Phosphorus Total Dissolved | Calcium Total | Magnesium Total | Sodium Total |
| April 6 | 6.44 | 0.212 | <0.010 | 394 | 0.212 | 0.101 | <2.0 | 505 | 3.13 | 0.0072 | 118 | 24 | 17.2 |
| Sept 1 | 6.86 | 0.173 | <0.010 | 1540 | 0.173 | 0.081 | 11 | 552 | 72.2 | <0.0050 | 475 | 85.4 | 18.9 |

**GROUND WATER MONITORING WELL #3 (MAPLE AVENUE)**

| | Anions | | | Calculated Parameters | | General Parameters | | | | | Total Metals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Chloride | Nitrate (as N) | Nitrite (as N) | Hardness Total (as CaCO3) | Nitrate+Nitrite (as N) | Ammonia Total (as N) | BOD 5-day Carbonaceous | Conductivity (EC) | Phosphorus Total (as P) | Phosphorus Total Dissolved | Calcium Total | Magnesium Total | Sodium Total |
| April 6 | 8.03 | 0.315 | <0.010 | 371 | 0.315 | 0.095 | 16.1 | 669 | 0.081 | 0.0063 | 89.7 | 35.7 | 16.3 |
| Sept 1 | 8.47 | 0.093 | <0.010 | 443 | 0.0929 | <0.050 | <7.3 | 739 | 4.47 | 0.0144 | 114 | 38.4 | 16.5 |

**GROUND WATER MONITORING WELL #4 (SAND PIT)**

| | Anions | | | Calculated Parameters | | General Parameters | | | | | Total Metals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Chloride | Nitrate (as N) | Nitrite (as N) | Hardness Total (as CaCO3) | Nitrate+Nitrite (as N) | Ammonia Total (as N) | BOD 5-day Carbonaceous | Conductivity (EC) | Phosphorus Total (as P) | Phosphorus Total Dissolved | Calcium Total | Magnesium Total | Sodium Total |
| ***April 6 | 119 | 7.98 | 0.047 | 659 | 8.03 | 0.091 | 27.5 | 1600 | 1.14 | 0.482 | 174 | 54.5 | 92.2 |
| Sept 1 | 101 | 1.11 | <0.010 | 1120 | 1.11 | 0.072 | <7.3 | 1750 | 2.39 | 0.189 | 301 | 90.4 | 86.9 |

*** Draining reclaimed water to infiltration basin two weeks before sample was collected.

**GROUND WATER MONITORING WELL #5 (Choke Cherry)**

| | Anions | | | Calculated Parameters | | General Parameters | | | | | Total Metals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample Date | Chloride | Nitrate (as N) | Nitrite (as N) | Hardness Total (as CaCO3) | Nitrate+Nitrite (as N) | Ammonia Total (as N) | BOD 5-day Carbonaceous | Conductivity (EC) | Phosphorus Total (as P) | Phosphorus Total Dissolved | Calcium Total | Magnesium Total | Sodium Total |
| April 6 | 16.7 | 1.6 | <0.010 | 409 | 1.6 | <0.050 | 15.6 | 770 | 0.246 | 0.0139 | 118 | 27.5 | 14 |
| Sept 1 | 17.7 | 2.28 | <0.010 | 419 | 2.28 | <0.050 | <7.3 | 781 | 0.174 | 0.0114 | 124 | 26.3 | 17.7 |

January 28, 2021 WWAL Project: 20-046-01VR

Town of Oliver
c/o TRUE Consulting Ltd.
201-2079 Falcon Road,
Kamloops, B.C. V2C 4J2

Attn: Natalie Alteen, EIT

**Re: Hydrogeological Review of the Town of Oliver Reclaimed Wastewater Irrigation Groundwater Monitoring Program**

Western Water Associates Ltd. (WWAL) is pleased to provide this hydrogeological review of the Town of Oliver's (the Town) reclaimed wastewater irrigation groundwater monitoring program. The Town has been utilizing reclaimed wastewater to irrigate several properties since the mid 1980's and the wastewater treatment and reclaimed water irrigation is permitted by the Ministry of Environment (ENV) under Operational Certificate PE-13717 (last amended 1995).

## 1.0 PROJECT BACKGROUND

The Town of Oliver collects wastewater from the community and pumps it to two aerated lagoons for treatment. The operational certificate requires that effluent in the treatment lagoons meet 45 mg/L $BOD_5$ and 60 mg/L Total Suspended Solids (TSS) criteria before the treated effluent is transferred to a storage lagoon. The results of monthly sampling provided in previous annual monitoring reports indicates that these criteria are typically met.

Between 1997 and 2019, annual effluent flows into the treatment lagoons ranged from 625,911 $m^3$ to 829,413 $m^3$.

Treated wastewater is stored over the winter in the storage lagoon. In the spring through fall, the stored treated wastewater is disinfected and beneficially reused as reclaimed irrigation water at several properties inside and outside the Town of Oliver boundary, and this has been occurring since the mid-1980s. Properties originally permitted to be irrigated with reclaimed under PE-13717 water include the Fairview Mountain Golf Course, the Huggins and Alonso properties.

Over time, the Town has expanded irrigation to additional lands, and plans to further expand this land base in the future (see attached figures). Over the years irrigation was expanded to include:

- Fairview Park,
- Gala Street Linear Park,
- South Okanagan Secondary School,
- the Town's Public Works Yard,
- lands surrounding the Oliver Municipal Airport, and
- the Cemetery.

The Town received Ministry approval by letter to irrigate the above-listed areas in May 2020. Future expansion of the irrigated area at the airport is proposed, as is irrigation of the Oliver Parks and Recreation Ball Diamonds, Kiwanis Park and another small park, all along or east of the Okanagan River. TRUE Consulting's Figure 1-1 (attached) illustrates the illustrates where and how irrigation has expanded to over time.

Total annual reclaimed water use for irrigation has been fairly constant between 2011 and 2019, ranging from approximately 407,000 $m^3$ to 504,000 $m^3$. The Fairview Mountain Golf Course is the largest consumer of reclaimed irrigation water, using 50-70% of the total volume in a given year. The airport is the second largest consumer of reclaimed water using approximately 15-25% of the annual total.

Table 1-10 below summarizes 2019 reclaimed water quality testing results which provide an indication of the water quality being used for irrigation.

**TABLE 1-10: SUMMARY OF RECLAIMED WATER QUALITY DATA**

| | Fecal Coliforms | Total Coliforms | Total P | Total N | Chloride | Sodium | Free CL Res |
|---|---|---|---|---|---|---|---|
| **OC Limit** | **<2.2 MPN/100 ml** | **n/a** | **n/a** | **n/a** | **n/a** | **n/a** | **n/a** |
| **Unit** | **MPN/100ml** | **MPN/100ml** | **mg/L** | **mg/L** | **mg/L** | **mg/L** | **mg/L** |
| April 15, 2019 | <2.2 | <2.2 | 4.6 | 22.2 | 143 | 99.2 | 0.19 |
| May 6, 2019 | <2.2 | <2.2 | 4.99 | 23.8 | 157 | 112 | 0.35 |
| June 11, 2019 | <2.2 | <2.2 | 5.1 | 22.5 | 162 | 121 | 0.35 |
| July 2, 3019 | <2.2 | <2.2 | 4.02 | 20.3 | 168 | 111 | 0.4 |
| August 12, 2019 | <2.2 | <2.2 | 4.49 | 14.5 | 171 | 113 | 0.32 |
| September 3, 2019 | <2.2 | <2.2 | 4.27 | 13.3 | 170 | 120 | 0.23 |
| October 2, 2019 | <2.2 | <2.2 | 4.41 | 13.9 | 166 | 111 | 0.1 |

Data Source: TRUE 2020.

In addition to reclaimed wastewater irrigation, the Town constructed a Rapid Infiltration Basin and has the ability to discharge treated wastewater to ground. The RIB is utilized to maintain appropriate water levels in the storage lagoon to accommodate wastewater inflows during the non-irrigation season. From 2017 to 2019, between 16,858 $m^3$/yr and 38,391 $m^3$/yr of reclaimed water has been infiltrated into the RIB.

WWAL was requested to complete this hydrogeological review of the current groundwater monitoring program and to make recommendations for modifications to the monitoring plan to reflect the newly permitted and future irrigation areas. In concert with this hydrogeological review, WWAL coordinated and participated in a soil investigation and reclaimed water irrigation suitability assessment of the new irrigation areas (Hamilton and Associates 2020).

## 2.0 SCOPE OF WORK

WWAL's work program was outlined in our accepted proposal P20-077 dated May 7, 2020. We completed the following scope of work for this assessment:

- Reviewed pertinent background information on the wastewater system. This included Operational Certificate PE-13717, several annual sanitary sewer system monitoring reports prepared by TRUE Consulting (2015 – 2020), previous hydrogeological reports (Golder 1998a and b), well logs for monitoring wells, and the results of the current groundwater monitoring program.
- Reviewed available information on area geology and hydrogeology, including aquifer mapping, data from provincial groundwater observation wells in the area, and well logs for reported water wells in the area.
- Completed a site visit to view the monitoring well sites, the location of the rapid infiltration facility and the new irrigation areas.
- Compiled water level and water quality data from annual monitoring reports, and created time series plots for water levels and key indicators of wastewater influence in groundwater.
- Prepared this report outlining the results of our assessment including recommendations to modify or update the annual monitoring program.

## 3.0 SITE DESCRIPTION, PHYSIOGRAPHY AND GEOLOGY

### 3.1 Site Description

Oliver, B.C. is located in the South Okanagan valley, straddling the Okanagan River between Vaseux Lake to the north and Osoyoos Lake to the south. The largest surface water bodies in the Oliver area are the Okanagan River and Tugulnuit Lake. The Okanagan River flows north-south through Oliver and Tugulnuit Lake is located in the northeast of the Town. Highway 97 transects the Town, roughly following the Okanagan River. Oliver is bounded by mountainous terrain to its east and west with land in the area generally sloping towards the river valley bottom. Elevations in the Town of Oliver range from approximately 600 m above sea level (asl) in upland areas to 300 m asl in the valley bottom.

The bulk of the Town's wastewater treatment and storage infrastructure, including the aerated treatment lagoons, effluent storage reservoir and RIB are located in the Fairview area to the west of the Town boundary (Figure 1). Currently permitted, newly permitted and future irrigation areas are shown on TRUE's Figure 1.1 and other figures provided as an attachment. A summary of each irrigation area is provided below.

<u>Fairview Mountain Golf Course:</u>

The Fairview Mountain Golf Course is located along the hillside southwest of the Town boundary and approximately 1 km south of the aerated lagoons and effluent storage reservoir. An area of approximately 45 ha is irrigated with reclaimed water at the golf course and irrigation volumes range from approximately 250,000 $m^3$ to 350,000 $m^3$ per year. Land to the north, south and west of the golf course is largely undeveloped rocky/forested hillside with land to the east being agricultural in use.

Huggins Property:

The Huggins irrigation area is a 3.7 ha vineyard located along Fairview Road south of the aerated lagoons and effluent storage. Service to the Huggins property is currently turned off with reclaimed water being used to meet irrigation demands in case of drought. The Town's WWTP is located to the north of the Huggins property, to the east is the Alonso property and areas to the west and south area largely undeveloped with some agricultural land use to the south.

Alonso Property:

The Alonso property is located on Fairview Road directly to the east of the Huggins vineyard. The Town's WWTP is located to the north of the Alonso Property and undeveloped land followed by agricultural land borders the property to the east and south. The irrigated lands at the Alonso property encompass a 1 ha vineyard that receives approximately 1,600 $m^3$ to 9,200 $m^3$ of reclaimed water annually during the irrigation season. The RIB is located approximately 100 m southeast of the Huggins vineyard.

Fairview Park:

Fairview park is located within the Town of Oliver, just south of South Okanagan Secondary School. 0.3 ha of land are irrigated at Fairview park and reclaimed water flows are not yet metered in this location.

Gala Street Linear Park:

Gala Street Linear park is located along Gala Street to the east of South Okanagan Secondary School. To the north, east and south Gala Street Linear Park is bordered by residential areas. Gala Street Linear Park receives approximately 6,200 $m^3$ to 8,900 $m^3$ of reclaimed water via spray irrigation annually over an area of 0.8ha.

South Okanagan Secondary School:

South Okanagan Secondary School is located at 6140 Gala Street. Land use surrounding the school is largely residential. 5.4 ha of land are irrigated at South Okanagan Secondary School, receiving 25,700 $m^3$ of reclaimed water for irrigation in 2019.

Cemetery:

The Cemetery is located along the Town's west boundary, is bordered by agricultural land and a gravel pit to the west, the Town to the east and south and undeveloped hillslopes to the north. An area of 0.74 ha is irrigated with reclaimed water at the cemetery, receiving on the order of 13,400 $m^3$ to 17,000 $m^3$ of reclaimed water annually.

Public Works Yard:

The Town's Public Works Yard is located to the northeast of the airport along the west shore of the Okanagan River at 5971 Sawmill Road. Approximately 5,100 $m^3$ to 8,300 $m^3$ of reclaimed water are applied to an area of 0.6 ha annually. In addition to utilizing reclaimed water for irrigation at the Public Works Yards, reclaimed water is applied to compost piles.

Oliver Community Parks and Recreation Ball Diamonds/Kiwanis Park:

These parks cover an area of 8.6 ha along the east shore of the Okanagan River and is bordered by Fairview Road to its northwest. Kiwanis Park (0.6 ha) is located to the north of Fairview Road and another small section of park (0.6 ha) is located across the Okanagan River. The Oliver Community Park area is not yet irrigated with reclaimed water but is proposed as a future expansion area.

Oliver Municipal Airport:

The Oliver Municipal airport is located southeast of the Town's core and to the west of the Okanagan River. Currently 12.6 ha of land are irrigated with reclaimed water at the airport with the irrigation area being proposed to be expanded by an additional 9.8 ha. The airport receives approximately 69,000 $m^3$ to 186,000 $m^3$ of reclaimed water yearly. To the east and south west the airport is bordered by agricultural land and by commercial properties to the north and west.

### 3.2 Geological Setting

In northern and southern areas, including the southern extent of the airport, Oliver is underlain by metamorphic rocks of the Grand Forks Gneiss/Monashee Complex from the Proterozoic era (2500-570 million years before present). Bedrock of this complex includes quartz-biotite gneiss, quartzite, marble and amphibolite. In areas underlying the aerated lagoon, RIB and Fairview Mountain Golf Course, bedrock is mapped as metamorphic rocks of the Kobau Group described as schist, chlorite schist, quartzite, amphibolite and minor marble, Carboniferous to Permian in age (362.5 to 245 million years before present). The remainder of Oliver, mainly the Town centre as well as areas to the east and west of the Town centre, are underlain by bedrock of the Okanagan Batholith Group. Rocks of the Okanagan Batholith Group are described as granodioritic intrusive rocks from the Middle Jurassic, 178-157.1 million years before present (ENV, 2020).

Surficial geology in the Okanagan Valley was extensively mapped and described by Hugh Nasmith in Bulletin No. 46 *Late Glacial History and Surficial Deposits of the Okanagan Valley British Columbia* (1962). Surficial geology in the upland areas underlying in the Fairview Mountain Golf Course and RIB is characterized by outwash terrace deposits consisting of stratified glacial drift material deposited from meltwater streams and lakes during glacial retreat. The remainder of the upland areas are mapped as raised alluvial fans, terraces and deltas. Modern day Okanagan River floodplain deposits are found along the Okanagan River. Surficial geology underlying the town centre to the west of the Okanagan River is characterized by raised alluvial fans and deltas.

## 4.0 HYDROGEOLOGICAL SETTING

There are four provincially-mapped aquifers underlying the Oliver area, of which three are present beneath some or all of the irrigation areas (ENV, 2020). The mapped aquifers include Aquifers 254 IIA, 255 IA, 256 IIA and 1108 IIA, select details for which are provided in Table 4.1. The extent of these aquifers is shown on Figure 2. The two primary aquifers over which the bulk of reclaimed water irrigation occurs are Aquifer 256 and 254.

**Table 4.1 Mapped Aquifers in the Oliver Area**

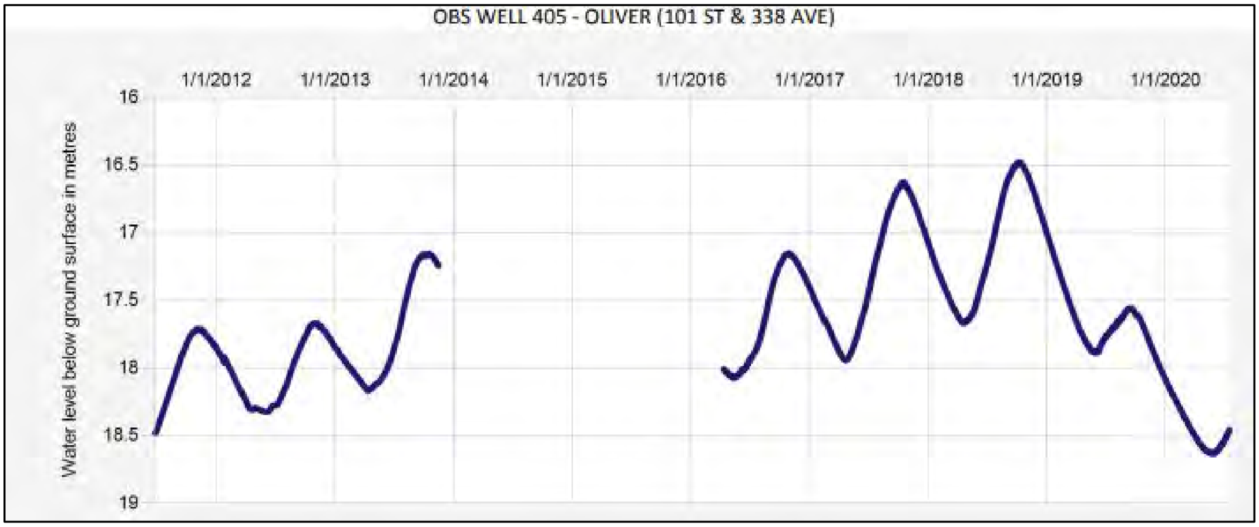
| Aquifer Number | Aquifer Type | Description | Vulnerability | Productivity | Demand | Irrigated Areas Overlying |
|---|---|---|---|---|---|---|
| 254 IIA | Sand And Gravel | Unconfined valley bottom alluvial aquifer, generally east of Highway 97 extending from Tugulnuit Lake to Osoyoos Lake | High | High | Moderate | • Airport<br>• Public Works Yard<br>• Oliver community Park |
| 255 IA | Sand And Gravel | Unconfined valley bottom alluvial aquifer, extending from Tugulnuit Lake north to Vaseaux Lake | High | Moderate | High | |
| 256 IIA | Sand And Gravel | Predominantly confined aquifer system comprised of alluvial or colluvial deposits, occupying the terraces and hillsides west of Highway 97 | Low | Low | Moderate | • Fairview Mountain GC<br>• Allonso/Huggins<br>• S. Okanagan Secondary School<br>• Fairview Park<br>• Gala Linear Park<br>• Cemetery<br>• RIBs |
| 1108 IIA | Bedrock | Predominantly unconfined fractured crystalline bedrock aquifer, underlies the Oliver Town core and mountainous areas to the west. | High | Low | Low | A bedrock aquifer underlies all areas receiving reclaimed water, but overburden aquifers overly bedrock in most areas. |

The mapped overburden aquifers (Aquifers 254 IIA, 255 IA, 256 IIA) form an unconfined to semi-confined valley bottom aquifer system along the Okanagan River receiving recharge from upland bedrock areas, Vaseux Lake, the Okanagan River and irrigation. Elevated nitrate levels have long been reported in the aquifer system (Hodge 1992) and are likely caused by agricultural activity (Geller, D. and B. Manwell, 2016). Groundwater flow direction in Aquifers 254 IIA and 255 IA is inferred to follow the Okanagan River southwards towards Osoyoos Lake. In Aquifer 256 IIA groundwater flow is inferred to be eastwards towards the Okanagan River from upland areas, with Aquifer 256 discharging into the valley bottom Aquifer 254 system.

The Town of Oliver relies on a network of groundwater supply wells to provide potable water to the community. In addition to supplying potable water the Town supplies irrigation water to approximately 5,200 acres of farmland and 455 acres of non-farmland. The majority of irrigation water is sourced from surface water with a small portion being provided by groundwater. The potable water supply well located closest to the irrigation areas is the Rockcliffe Well (WTN82376), approximately 400 m west of the airport. The Town's Fairview irrigation well is located approximately 1,300 m east of the golf course. The location of the Town's municipal supply wells (within the extent of the map area) are shown on Figure 1.

Provincial observation well # 405 (OW 405) is located approximately 770 m west of the southern extent of the airport. OW405 is completed in Aquifer 256 IIA and water levels for OW405 are available from 2011 on, although a data gap exists from November 2013 to April 2016. Water level data for OW 405 (Figure 4.1), indicates annual water level fluctuations in the aquifer are on the order of 0.3 m to 1.3 m, with highest water levels being observed in the fall (October or November) and lowest levels occurring in the spring (April, May). The annual water level trend in Aquifer 256 differs from that of other monitoring wells in the interior completed in sand and gravel aquifers, where annual groundwater highs typically occur in the late spring/early summer and are typically associated with freshet induced recharge to aquifers. Higher aquifer levels in the fall indicate that Aquifer 256 is likely receiving recharge from irrigation return flows as the high water levels correspond with the end of the typical irrigation season (May to October). Aquifer levels appear to have been stable or slightly increasing from 2011 to 2018. Recent data suggests that aquifer levels are declining with the lowest aquifer levels on record being observed in early 2020.

**Figure 4.1 Water Levels in Observation Well 405 (July 2011 – July 2020)**




## 5.0 CURRENT GROUNDWATER MONITORING AND SAMPLING PROGRAM

The current groundwater monitoring program includes seven monitoring wells (Figure 1), of which five intercept groundwater and can be sampled.

Four of the monitoring wells are located in the Fairview area and were constructed in 2000. Town MWs 5, 6 and 7 are located east of the Fairview Golf Course and Town MW4 is located further north, in close proximity to the currently used RIB. Town MW4 and MW5 reportedly always contain water, while MW6 has reportedly been dry since 2003 and MW 7 has reportedly been dry since 2006. Well logs for the monitoring wells in the Fairview area indicate that the area is underlain by sand and gravel with varying silt content followed by clayey silt. These monitoring wells are typically completed with screens just above the clayey silt, but some of the screens are located within the clayey silt and do not contain groundwater.

Three monitoring wells (referred to as Wells #1, #2 and #3) located east of the airport are inferred to have been constructed in 2005 around the time reclaimed water irrigation began at the airport. No well logs are available for these wells, however these wells consistently intercept groundwater and are sampled.

Table 5.1 provides a summary of construction details for the wells in the current monitoring program.

**Table 5.1 Summary of Monitoring Well Construction Details**

| Well ID | Well Depth m (ft) | Screened Interval m (ft) bgs | Diameter mm (in) | Top of Casing Elevation m asl | Location |
|---|---|---|---|---|---|
| Well #1 (Air Cadet) | 10.52 (34.5) btoc | unknown | 50 (2) | 308.52 | East (Downgradient) of Airport |
| Well #2 (Rodeo Grounds) | 8.08 (26.5) btoc | unknown | 50 (2) | 306.56 | East (Downgradient) of Airport |
| Well #3 (91A Street) | 4.1 (13.5) btoc | unknown | 50 (2) | 295 | East (Downgradient) of Airport |
| Town MW4 (near RIB) | 10.98 (36) btoc | | 50 (2) | 351.906 | Downgradient of RIB |
| Town MW5 ($125^{th}$ Street) | 13.25 (43.5) btoc | | 50 (2) | 363.361 | Assumed Background |
| Town MW6 | 18.29 (60) bgs | 13.29-18.29 (43.6-60) | 50 (2) | 362.702 | Downgradient of Golf Course |
| Town MW7 (Road No. 5) | 25.91 (85) bgs | 20.91-25.91 (68.6-85) | 50 (2) | 362.859 | Downgradient of Golf Course |

In addition to the above, the Town has three monitoring wells located between the Huggins and Alonso properties, just south of the wastewater treatment and storage lagoons. These wells were installed in 1997 as part of hydrogeological investigation supporting the design and commissioning of a RIB in the area (this RIB was only used for a few years in the late 1990s and early 2000s and is no longer in use). These three wells are not currently monitored.

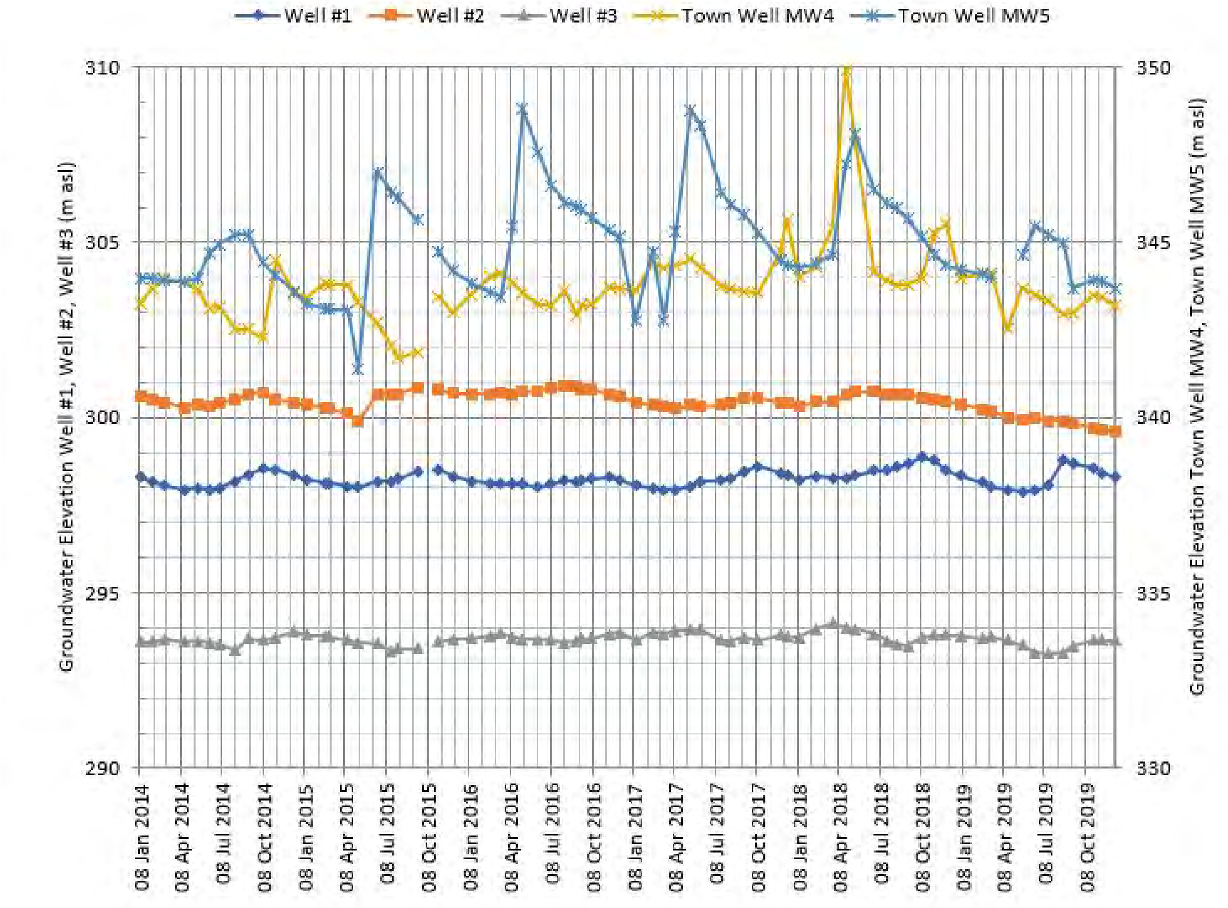
The current monitoring program sees groundwater levels measured in each of the seven active wells monthly, and water quality samples collected biannually in April and September. Monitoring wells are sampled for the following parameters:

- Nitrogen species (nitrate, nitrite, ammonia)
- Total and dissolved phosphorous
- Chloride, sodium, calcium and magnesium
- Hardness
- conductivity

## 6.0 HISTORICAL GROUNDWATER LEVEL DATA

WWAL was provided monitoring well water level data collected from 2014 to 2019. Annual Sanitary Sewer Systems Reports prepared by TRUE indicate that Town MW6 has been dry since at least 2003 and Town MW7 was first noted to be dry in 2006 (TRUE, 2020). Monitoring well logs indicated that Town MW's 4, 5 and 7 are screened either above or across the clayey silt unit whereas Town MW6 is screened within the clay unit which could be the reason for this well being dry. Figure 6.1 illustrates water levels in the monitoring wells from 2014 to 2019.

**Figure 6.1 Groundwater Elevation Oliver Spray Irrigation Monitoring Wells**




The monitoring wells near the airport (Wells #1 to #3, completed in Aquifer 254) show a different pattern of water level fluctuations than Town MW4 and MW5, which are completed in Aquifer 256. Wells #1 to #3 fluctuate on the order of 0.5 to 1 m annually and are relatively stable. Water levels in Well #1, Well #2 and Well #3 appear to be at their highest near the end of the irrigation season suggesting that irrigation return flows are contributing recharge to the aquifer.

Water levels in Town MW4 and MW5 display greater fluctuations in water levels when compared to the monitoring wells installed near the airport. MW5, the assumed program background well, shows the most annual fluctuation, on the order of 3 to 6 m. Seasonal peaks tend to occur in May or June. This contrasts with the pattern observed at provincial observation well #405 (discussed in Section 4), where seasonal highs occur in October, presumably in response to irrigation return flows. Town MW5 is located hydraulically upgradient of most of the irrigated areas and the pattern of fluctuation is more indicative of the typical freshet influenced aquifer recharge response observed in the Okanagan.

Town MW4 displays less seasonal fluctuation than Town MW5 but still more than the wells near the airport. A noticeable spike in water levels is evident in May 2018, and is assumed to be the result of use of the RIB at that time. As water level measurements are only collected monthly, the full impact of use of the RIB (which may only occur for a week or two) is likely not being captured.

## 7.0 HISTORICAL GROUNDWATER QUALITY DATA

The current groundwater monitoring program assesses impacts of reclaimed water disposal on the receiving environment in locations downgradient of the two areas receiving the greatest amounts of reclaimed irrigation water (Fairview Mountain Golf Course and Airport) along with impacts of effluent infiltration through the RIB. Environmental receptors of concern include aquifers downgradient of the irrigation areas and RIB where wells may be used, as well as downgradient aquatic receiving environments, mainly the Okanagan River. Aside from groundwater being utilized for drinking water the area south of Oliver is largely agricultural in use, therefore groundwater may also be used for irrigation and livestock watering.

Considering the above receptors of concern, water quality results were compared to the B.C. Contaminated Sites Regulation, Schedule 3.2, Generic Numerical Water Standards for Drinking Water (CSR DW), Aquatic Life (CSR AW), Livestock Watering (LW) and Irrigation (IW) (ENV, 1997).

Water quality results for parameters sampled at the monitored wells are discussed in the sections below along with time series plots, illustrating concentrations of each parameter over time.

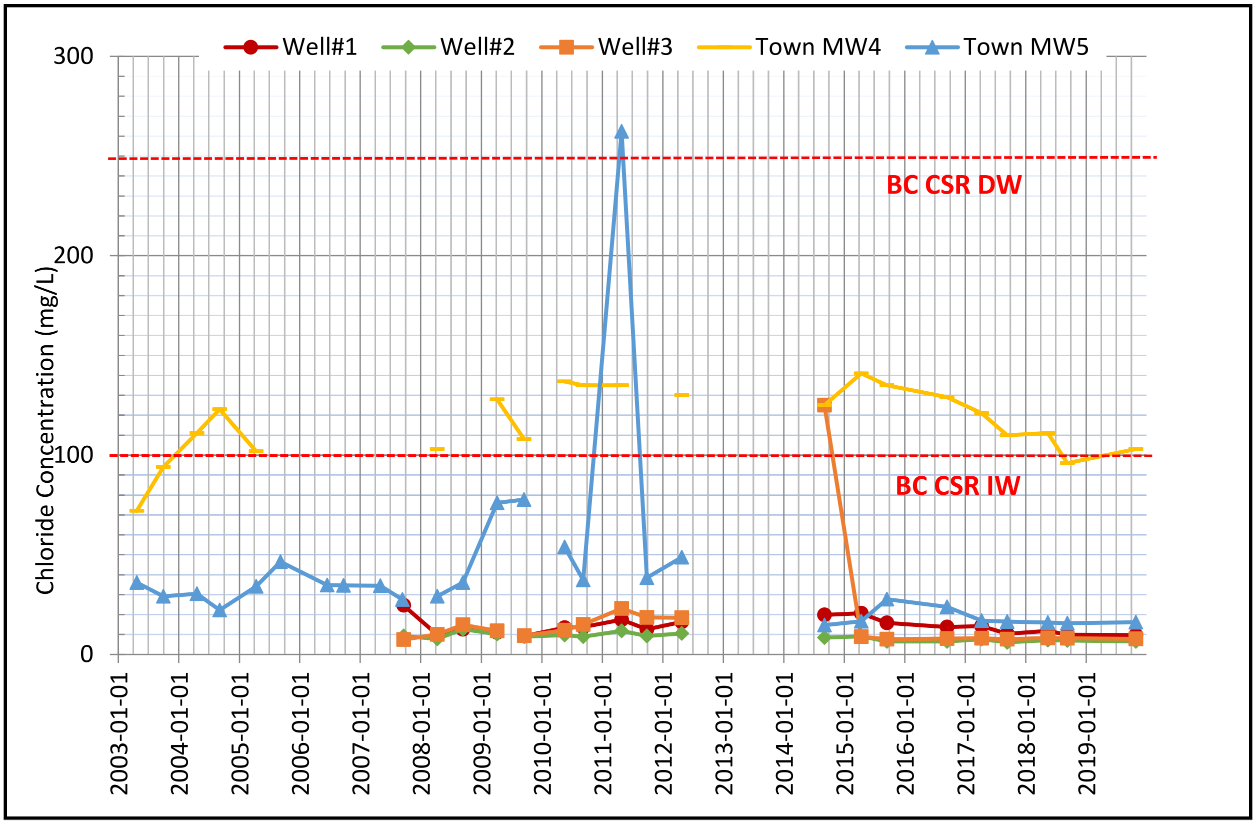
### 7.1 Chloride

Chloride is regarded as a conservative ion, meaning it does not biogeochemically degrade and is indicative of the degree of anthropogenic input. While chloride is typically present in low concentrations in freshwater aquifer systems, elevated chloride can be due to anthropogenic activities such as reclaimed water irrigation, wastewater effluent disposal to ground, road salting, industrial processes, and agricultural activity. Figure 5.1 illustrates a time series plot of chloride concentrations in monitoring well samples. For context, chloride concentrations in the reclaimed water used for irrigation in 2019 was in the 140 to 170 mg/L range.

Overall chloride levels in Well #1, Well #2 and Well #3 appear relatively stable in recent years and are generally found below 30 mg/L with the exception of a spike in chloride at Well #3 in September 2014. Town MW4 generally displays the highest chloride concentrations out of all monitored wells, which is likely associated with the downgradient location of Town MW4 with respect to the RIB and surrounding agricultural activity.

Town MW5 is used as a background well as reclaimed water irrigation is no longer practiced upgradient of this well. Over the last 5 years chloride concentrations in Town MW5 were relatively stable and similar to concentrations at wells #1-3. Prior to 2012, when irrigation with reclaimed water was presumably occurring upslope, chloride concentrations were higher.

**Figure 7.1 Chloride Time Series Plot**




## 7.2 Sodium

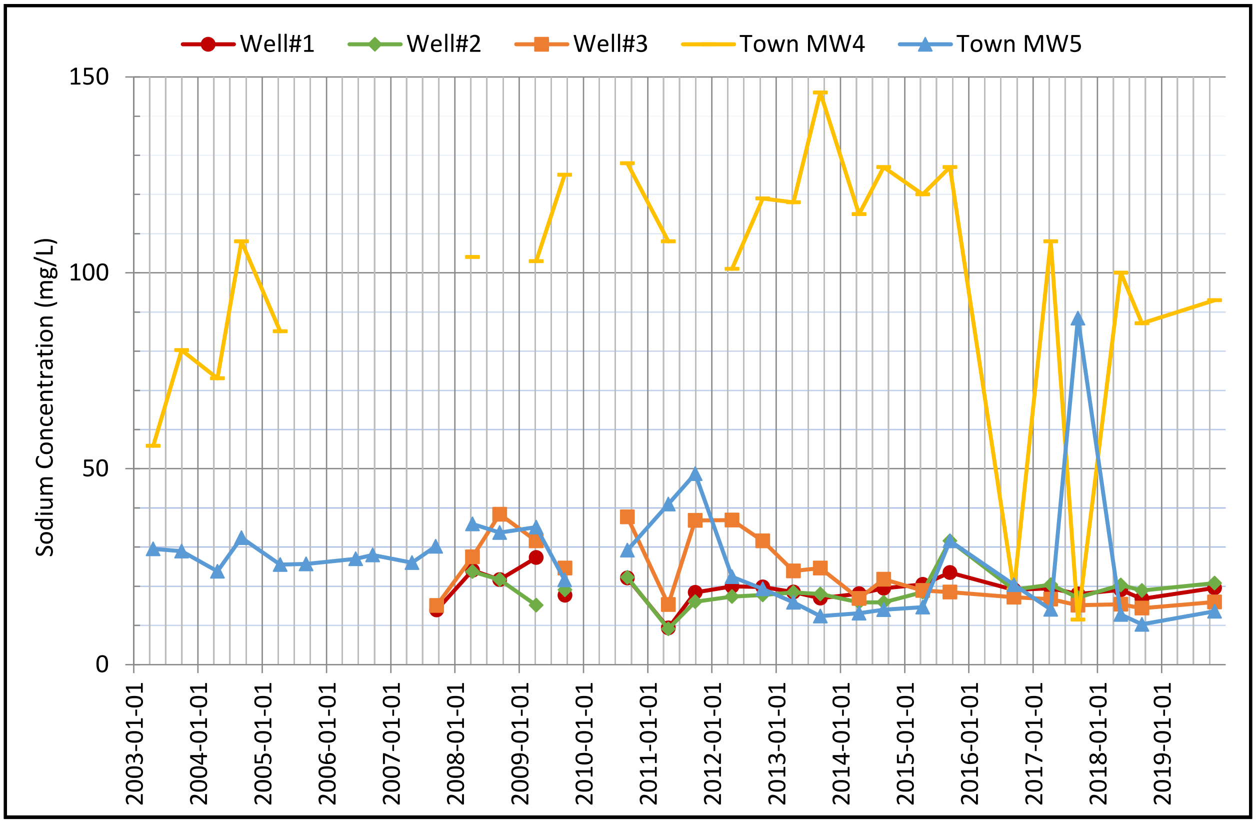
The presence of sodium above background concentrations can indicate wastewater impacts on groundwater. Sodium can also be present due to anthropogenic activities such as road salting, industrial effluents, home water softener use, and agricultural activity.

Sodium concentrations in Well #1, Well #2 and Well #3 remained relatively stable since 2014, showing some moderate fluctuations prior to 2014

Town MW4 displays the highest sodium concentrations and sizeable fluctuations in sodium concentrations. Sodium levels in Town MW4 declined rapidly in the fall of 2016 after which spikes in concentrations were observed in samples collected in the spring. These observed spikes are likely the result of reclaimed water infiltration through the RIB as the RIB was in use during the winters of 2017, 2018 and 2019. MW4 and the RIB are located within a draw, which may also convey waters impacted by upgradient agricultural activities towards the area.

Town MW5 shows relatively large variations in sodium concentrations, with concentrations generally being below Town MW4 and in the same range as the airport monitoring wells.

**Figure 7.2 Total Sodium Time Series Plot**



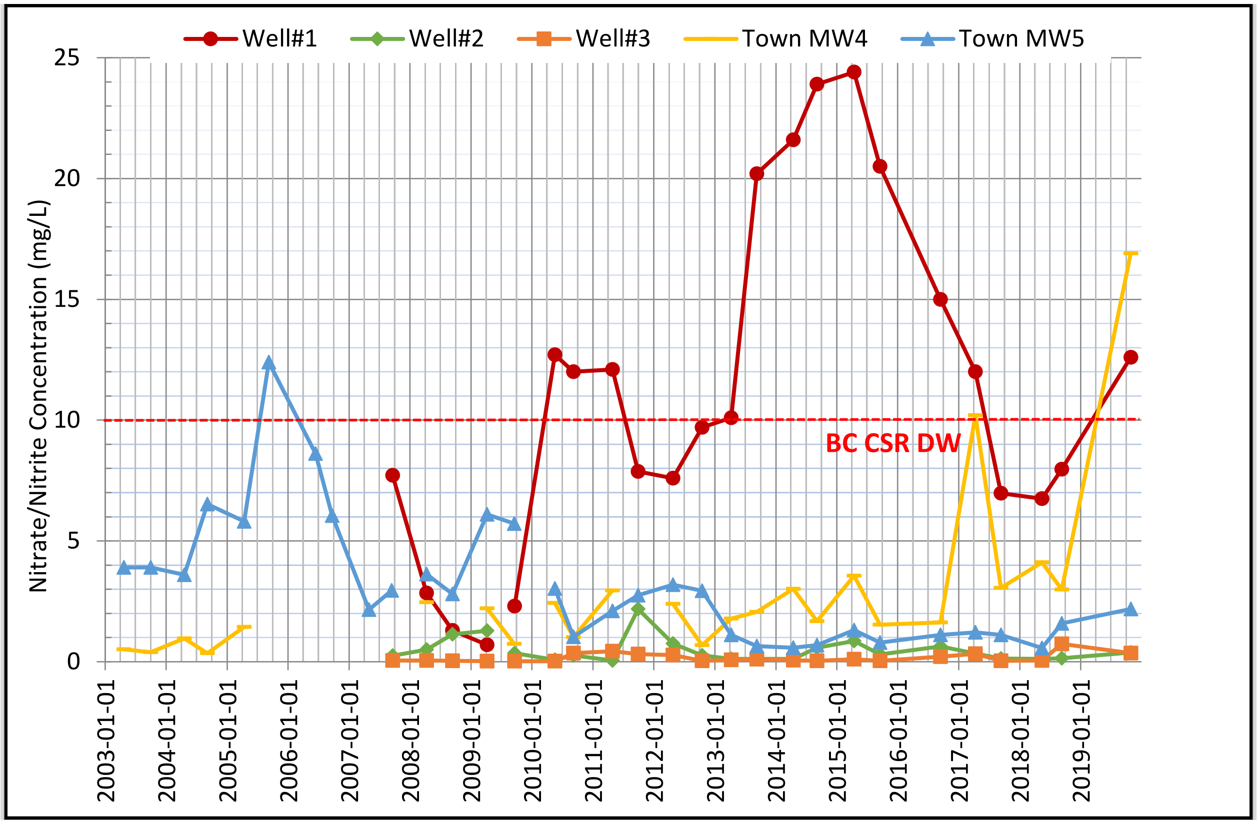

## 7.3 Nitrate/Nitrite

Nitrate rarely occurs naturally in water and generally occurs in water due to anthropogenic activities. Nitrate concentrations greater than 3 mg/L are considered by the Province to reflect human impacts (ENV, 2007). The most common anthropogenic sources of nitrates include agricultural activities, wastewater disposal to ground, and discharge from industrial processes and mining (blast residuals from ammonium-nitrate or other explosives). Nitrite is an unstable form of nitrogen that rapidly oxidizes to nitrate or reduces to nitrogen gas, as such nitrite is typically found at low concentrations in the environment (ENV, 1998).

Overall, Well #1 displays the highest nitrate/nitrite levels with concentrations frequently exceeding the BC CSR DW standard. Nitrate/nitrite concentrations appear to have peaked in Well #1 in 2015 at close to 25 mg/L, decreasing until late 2018, then rising again. The concentration and pattern of nitrate concentrations in Well #1 is anomalous, and suggests there may be another point source of nitrate being added to the aquifer near this location. Nitrate/nitrite concentrations in Well #2 and Well #3 have remained relatively stable and mostly below 1 mg/L.

An increasing trend in nitrate/nitrite concentrations is apparent in Town MW4 with the sample collected in the fall of 2019 exceeding the BC CSR DW standard. Again, water quality in Town MW4 appears to be influenced by the RIB. Nitrate and nitrite concentrations in Town MW5 show a decreasing trend although some impact is still evident and likely due to agricultural activity in the surrounding area.

**Figure 7.3 Nitrate/Nitrite Time Series Plot**



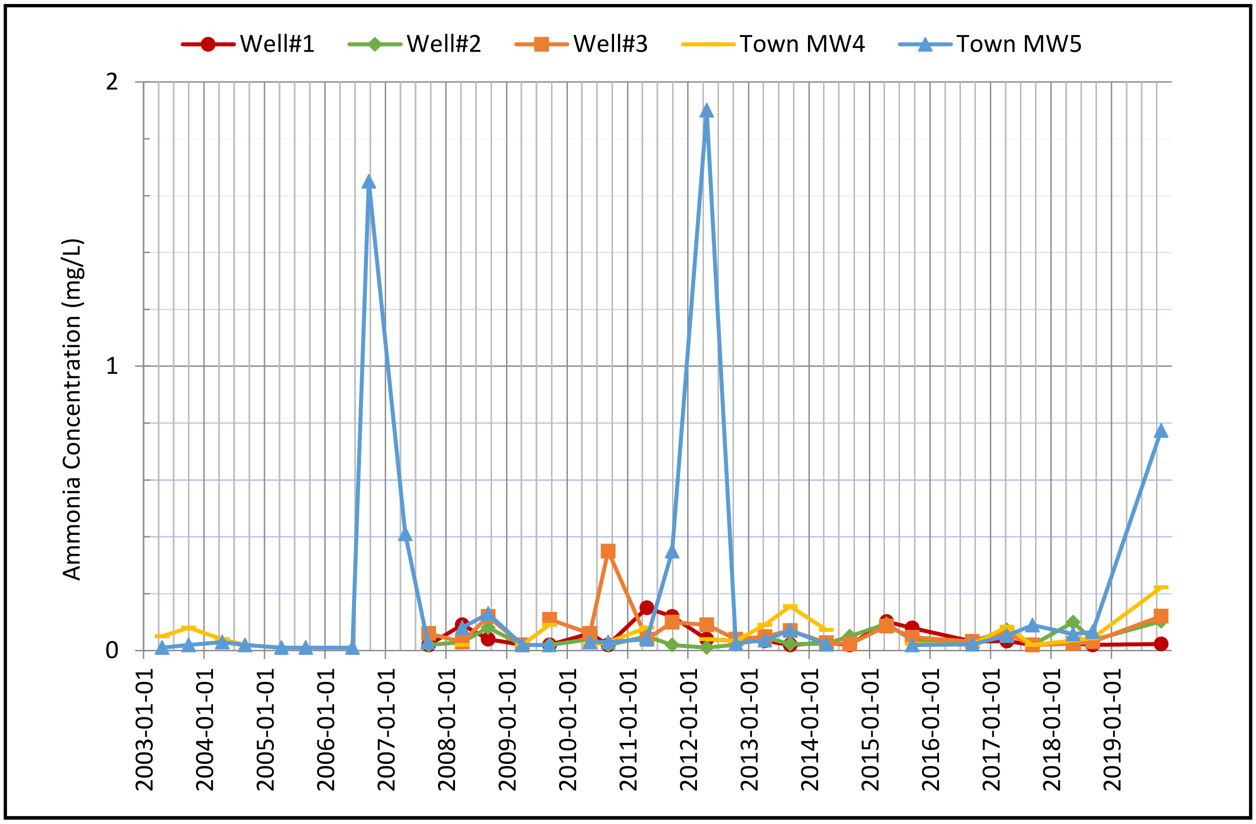

## 7.4 Ammonia

Ammonia is the primary form of nitrogen in raw wastewater but is quickly converted to nitrite and eventually nitrate during wastewater treatment (MoE 1998). When ammonia or nitrite are present in groundwater, it indicates that the source of nitrogen is close by, and that the nitrification process was not completed prior to nitrogen reaching the groundwater table. Anthropogenic sources of ammonia include wastewater effluent, agriculture and urban development, industrial effluents, and mining (blast residuals).

Ammonia concentrations in all wells except MW5 have been relatively stable since 2011. Several spikes in ammonia concentration in MW5 have occurred which do not correspond to spikes at other locations and is considered anomalous. The ammonia data indicate a point source other than the reclaimed irrigation water may be impacting MW5.

The ammonia concentration in most monitoring wells trended upward in the fall sample collected in 2019.

**Figure 7.4 Ammonia Time Series Plot**




## 8.0 CONCLUSIONS

Based on our assessment, we provide the following conclusions:

**C1** The current groundwater monitoring program includes seven monitoring wells, three downgradient of the airport (Well #1, Well #2, Well #3), two downgradient of the Fairview Mountain Golf Course (MW6 and MW7), one downgradient of the RIB (MW4) and one background well (MW5). Water levels in the monitoring wells are checked monthly and samples are collected from the monitoring wells semi-annually, usually in the spring and fall.

**C2** MW6 and MW7 which are intended to monitor impacts from irrigation of the Fairview Mountain Golf Course have been dry for more than a decade, so no monitoring of the impacts of golf course irrigation is currently completed.

**C3** The monitoring wells near the airport (Well #1, #2 and #3) are completed in valley bottom Aquifer 254, while the remaining wells which are completed at higher elevation in the Fairview area are completed in Aquifer 256. The pattern of groundwater level fluctuation in these two groups of monitoring wells are different and evident in the data being collected. Airport monitoring wells show a small magnitude of seasonal fluctuation on the order of 0.5 to 1.0 m, with peaks occurring in the fall suggesting the influence of irrigation recharge. MW5, the assumed program background well, shows the highest magnitude of fluctuation in the 3 – 6 m range, with peaks in the spring typical of an aquifer response to freshet induced recharge. MW4, located immediately downgradient of the RIB shows moderate seasonal fluctuations of 2 – 3 m and the data indicate groundwater level spikes occur in response to loading of the RIB, which is to be expected.

**C4** Water quality results from the groundwater monitoring program indicate the following:

- Water quality in MW4 shows elevated sodium, chloride and nitrate/nitrite concentrations, with the most recent nitrate sample collected being 17 mg/L, above the drinking water quality guideline of 10 mg/L. MW4 is located immediately downgradient of the RIB, and in a draw leading from the Alonso and Huggins properties located upslope. MW4 is impacted by the RIB and likely upslope land uses, and a plume of nitrate-impacted groundwater is expected to migrate away from the area following loading of the RIB. The geometry and extent of that plume is not known. It is likely that the current monitoring program does not capture the full range of impacts from use of the RIB, as the RIB is typically loaded continuously for a period weeks while water levels are measured monthly and water quality samples are only collected biannually.
- Town MW5, which is utilized as the program background well shows water quality impacts. Of note are recurring spikes in ammonia concentrations at levels not seen in other monitoring wells. As lands near MW5 are not currently irrigated with reclaimed water, the observed water quality impacts may be due to other point sources.
- Well #2 and Well #3 located downgradient of the airport generally display the lowest impacts on groundwater quality, with concentrations of chloride, sodium, nitrate and ammonia at what are likely background levels for Aquifer 254. Well #1 is an exception, as it is characterized by very high nitrate concentrations often above 10 mg/L, and reaching as high as 25 mg/L in 2015. The data suggest a point source of nitrate in the area other than the reclaimed water may be impacting groundwater at Well #1. The Air Cadet building is located very close to Well #1, and we noted a vineyard and BC Tree Fruits facility across the street to the east.

**C5** The current reclaimed water irrigation monitoring program appears to adequately assess impacts of the reclaimed water irrigation and disposal system downgradient of the airport, however the data for Well #1 indicates a significant impact to groundwater and warrants additional investigation.

Town MW4 is well sited to monitor impacts from reclaimed water infiltration at the RIB, however the frequency of monitoring at this well is not sufficient to adequately characterize the impact to groundwater.

Town MW5, the program background well, displays some indication of impacts to groundwater, even though reclaimed water irrigation no longer occurs upslope.

Lastly, as the two wells sited to assess impacts from irrigation of the Fairview Mountain Golf Course have been dry since at least 2007, the impacts of golf course irrigation are not being assed in the current program.

## 7. RECOMMENDATIONS

**R1** WWAL recommends continued monthly monitoring of water levels and bi-annual sampling at Wells #1, #2, #3 and Town MW5.

**R2** We recommend an increased level of monitoring at Town MW4 located near the RIB. We recommend that a transducer be installed in this well to better characterize the effect on water levels when the RIB is utilized. We also recommend that for one full year, groundwater quality samples from Town MW4 be collected monthly.

**R3** We recommend incorporating the three wells between the Huggins and Alonso properties into the monitoring program for 1 year if the wells are still present. Groundwater levels should be measured monthly and water quality samples collected biannually on the same schedule as the other wells. After reviewing the results of the one year of monitoring, it may be found that one of these wells would serve as a better program background well.

**R4** Well #1 located near the Air Cadet building near the airport shows significant nitrate impacts, the source of which is not known and is inconsistent with the data obtained from the other airport monitoring wells which demonstrate little impact. The source of this nitrate contamination should be investigated. Possible sources include the nearby vineyard, BC Tree Fruits facility, possible septic field for the Air Cadet building, or leaking wastewater or reclaimed irrigation water mains. Depending on the results of this investigation, additional monitoring wells in the area may be required to further investigate the source of the nitrate in groundwater.

**R5** Several additional monitoring wells are required to adequately monitor the “new” areas receiving or slated to receive reclaimed irrigation water, and to monitor impacts from the current largest consumer of reclaimed water, the Fairview Mountain Golf Course. The following monitoring wells are recommended:

1. One monitoring well in the Gala Street Liner Park, sited to monitor the impacts of irrigation in the park and at the Secondary School.
2. One monitoring well in the southern end of Oliver Community park.
3. One monitoring well in the southern end of the Public Works Yard.
4. One monitoring well along the southern property boundary of the cemetery. The need for this well can be discussed further, as there may be public opposition to drilling in a cemetery. In addition, a monitoring well at this location may be influenced by the cemetery as well as the reclaimed water irrigation.

5. Two monitoring wells east of the Fairview Mountain Golf Course to replace MW6 and MW7.

Ideally these monitoring wells would be installed before the April 2021 sampling event, and after installation, would be monitored and sampled at the same frequency as the other monitoring wells.

**R6** After the new wells have been monitored for one year, the data should be compiled, reviewed and interpreted by a hydrogeologist. Modifications to the monitoring plan can be made after that.

**Table 8.1 Summary of Recommended Modifications to Groundwater Monitoring Program**

| Recommendation | Details |
|---|---|
| Increased level of Monitoring at MW4 | Install a transducer, or increase the frequency of manual water level measurements to weekly. Increase the frequency of water quality sampling to monthly for one year. |
| Incorporate the existing three monitoring wells near the Alonso and Huggins Property into the monitoring program for one year. | Monitor/sample on the same schedule as the other wells in the program |
| Install one monitoring well in the Gala Street Liner Park, sited to monitor the impacts of irrigation in the park and at the Secondary School. | Monitor/sample on the same schedule as the other wells in the program |
| Install one monitoring well in the southern end of Oliver Community park. | Monitor/sample on the same schedule as the other wells in the program |
| Install one monitoring well in the southern end of the Public Works Yard. | Monitor/sample on the same schedule as the other wells in the program |
| Install one monitoring well along the southern property boundary of the cemetery. POSSIBLE | Monitor/sample on the same schedule as the other wells in the program |
| Install two monitoring wells east of the Fairview Mountain Golf Course to replace MW6 and MW7. | Monitor/sample on the same schedule as the other wells in the program |

## 9.0 COST ESTIMATES

WWAL has prepared a high-level cost estimate to complete the above recommended tasks. Table 9.1 below summarized the estimates by task.

**Table 9.1: Cost estimates to complete recommended tasks.**

| Contractor | Cost Estimate |
|---|---|
| Environmental Drilling Contractor – 6 monitoring wells | $25,000 |
| WWAL – Core well installation program: Confirmation of well sites, utility locates. Field oversight of monitoring well drilling. Well development and initial sampling. Provide well logs and a map. | $10,000 |
| WWAL – Expanded program. Purchase and install recommended transducer in Town MW4 near RIB. Investigate source of high nitrate in Air Cadet well (Well #1). Compile and review data collected during 2021 and make recommendation for refinement of monitoring program moving forward. | $10,000 |

Notes:

1) Costs in Table 9.1 do not include costs for monthly water level sampling and bi-annual sampling of the existing and proposed expanded monitoring well network. This routine monitoring is currently completed by Town public works staff. WWAL costs do include initial development and sampling (April 2021) of the recommended new monitoring wells (up to 6).
2) Costs to install six new monitoring wells based on a quote from Mud Bay Drilling (attached). We suggest adding a $5,000 contingency to this estimate to account for variability in well depths.

## 10.0 CLOSURE

We trust this letter provides the information you require. If you have any questions or would like to discuss these findings further, do not hesitate to contact the undersigned.

**WESTERN WATER ASSOCIATES LTD.**

Lisa Gardiner

**Lisa Gardiner, P.Eng.**
**Environmental Engineer**

PROFESSIONAL GEOSCIENTIST PROVINCE OF BRITISH COLUMBIA R. M. RHODES #32839
28-Jan-2021

**Ryan Rhodes P.Geo.**
**Hydrogeologist**

Attachments:
Figures 1 and 2; Mud Bay Drilling Quote

## 11.0 REFERENCES

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TRUE. (2020). Sanitary Sewer System 2019 Annual Report Town of Oliver. Kamloops, BC.

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2. The scope and the period of service provided by Western Water Associates Ltd are subject to restrictions and limitations outlined in subsequent numbered limitations.
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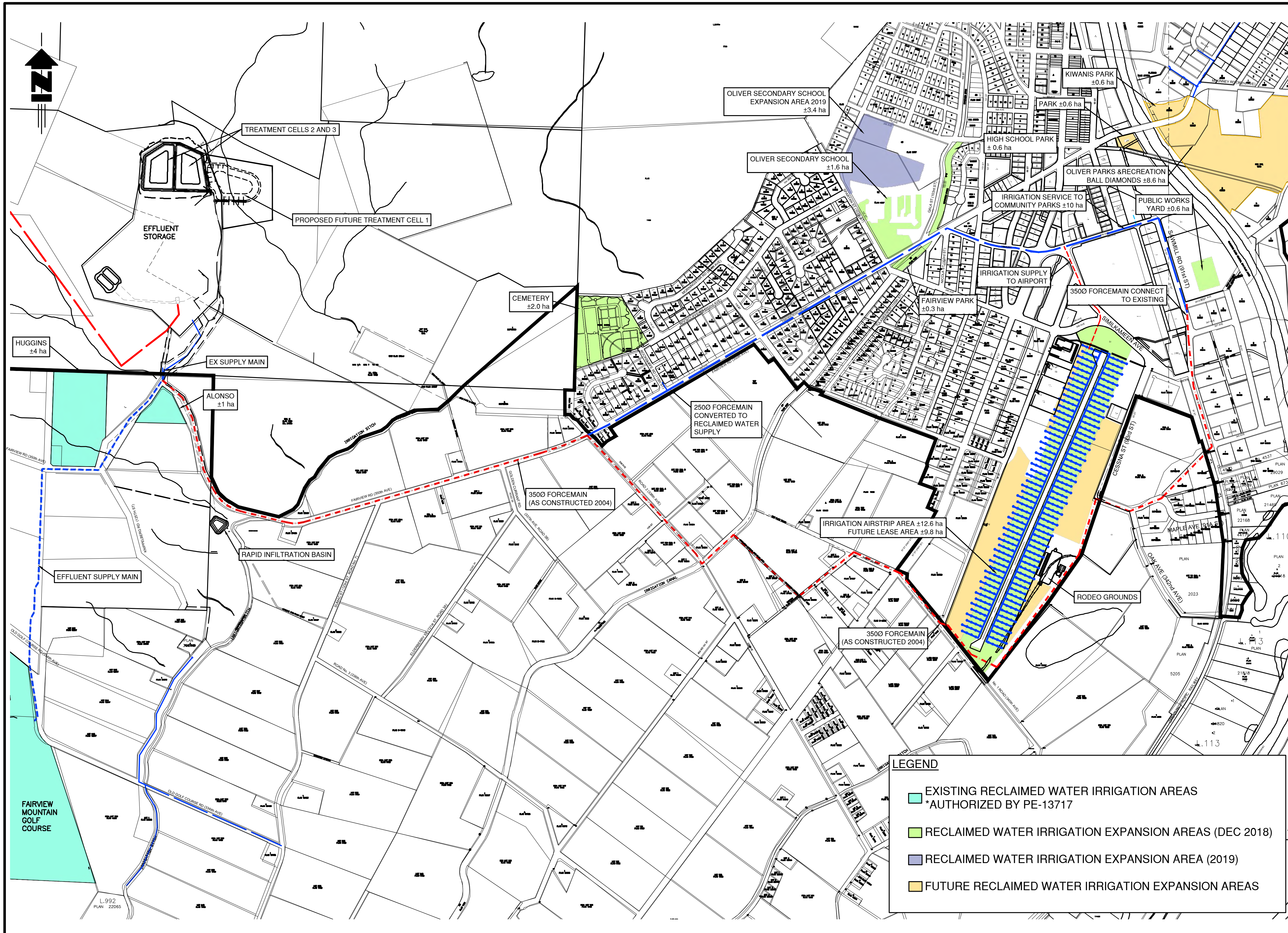



| No. | DATE | DESCRIPTION | BY | APP |
|---|---|---|---|---|

ISSUES / REVISIONS

CONSULTANT SEAL

TRUE CONSULTING

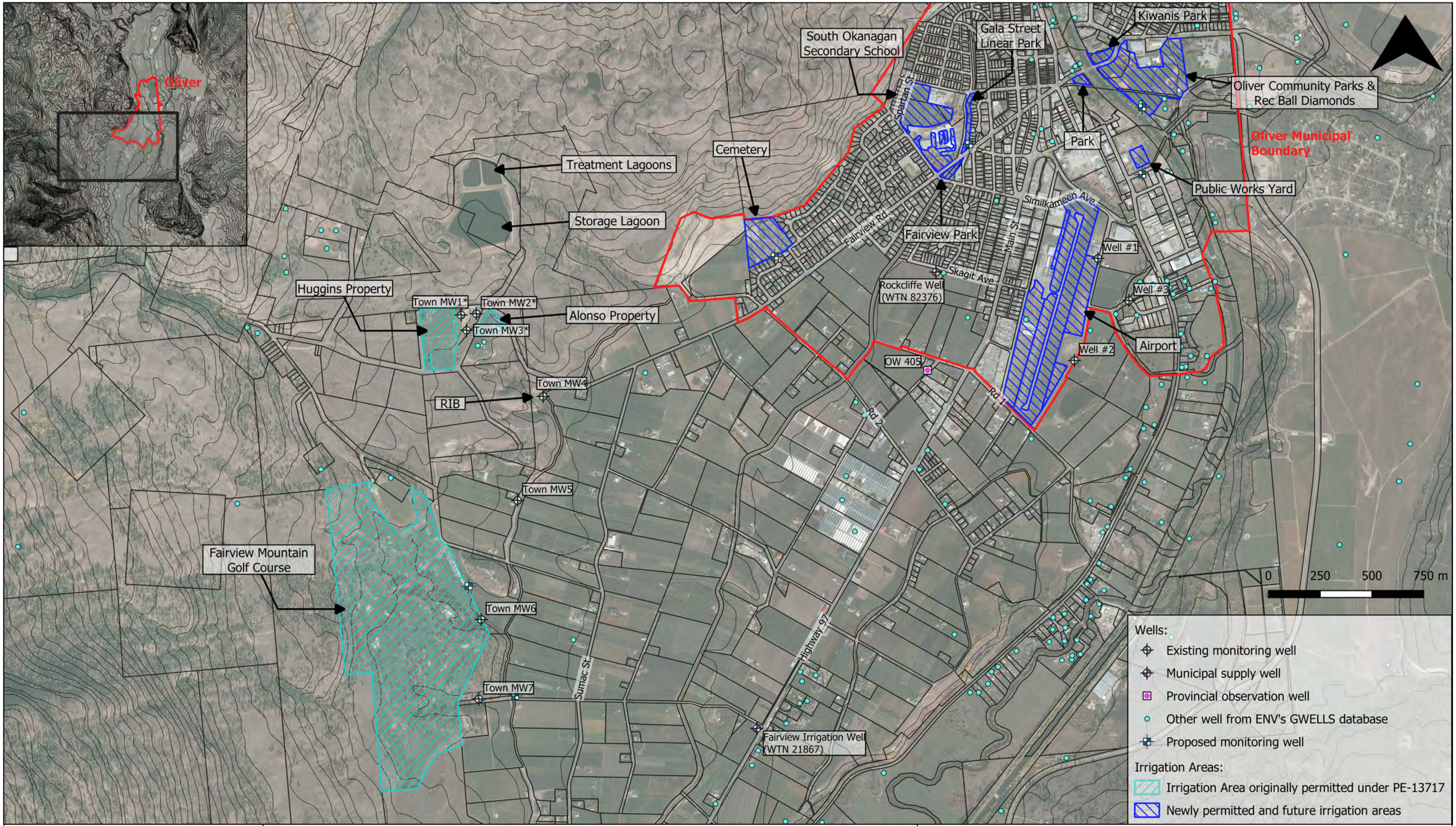
201 - 2079 Falcon Road ▪ Kamloops BC ▪ V2C 4J2
tel 250.828.0881 ▪ fax 250.828.0717
info@TRUE.bc.ca

Town of Oliver
CANADA'S WINE CAPITAL

**SANITARY SEWER ANNUAL REPORT**

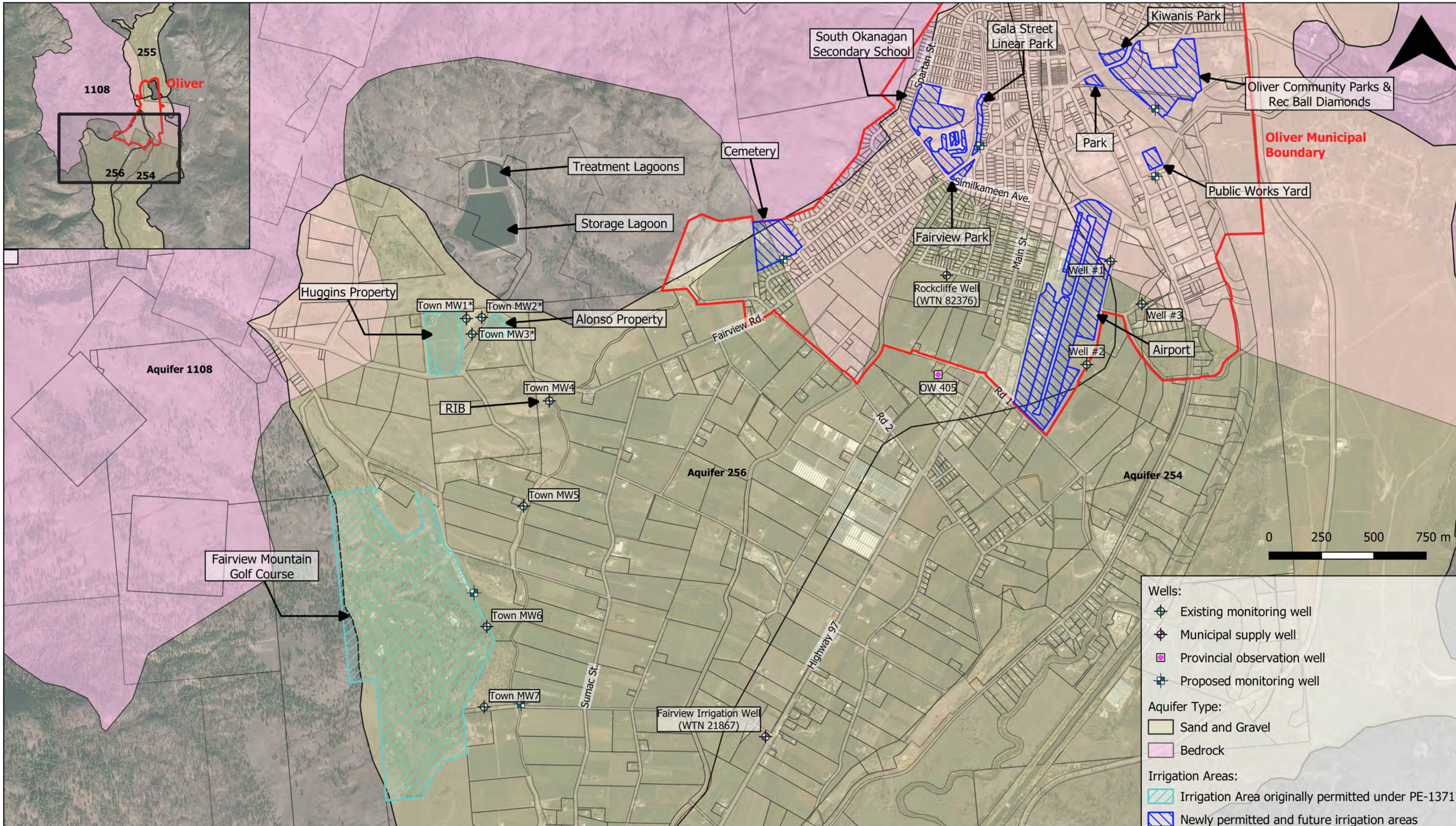
**OVERALL PLAN RECLAIMED WATER SYPPLY SYSTEM AND IRRIGATION AREAS**

SCALE: N.T.S. (11x17)
DESIGN BY: TRU
DRAWN BY: NA
DATE: JANUARY 2018
PROJECT REFERENCE No.: 306-088-005
DRAWING No.: **FIG 1-1**
SHEET: 1 OF 1
ISSUE REV.




| **Oliver Reclaimed Water Irrigation Review** | TITLE **Figure 1** Monitoring Well Locations and Reclaimed Water Irrigation Areas | | |
|---|---|---|---|
| western water ASSOCIATES LTD | DRAWN Tim Sivak | DATE January 28, 2021 | CLIENT TRUE Consulting Ltd. |
| | REVIEWED | PROJECT NO. 20-046-01VR | REVISION NO. E |

Data Sources: Base plan from publicly available data sources.
Contour interval: 20 m
Map Projection: NAD83 BC Albers (EPSG 3005)
Other notes: Current and future spray irrigation areas from TRUE Consulting Ltd.
*location is approximate




**Oliver Reclaimed Water Irrigation Review**

western water ASSOCIATES LTD

TITLE **Figure 2** Mapped Aquifers in the Oliver Area

| | | |
|---|---|---|
| DRAWN Tim Sivak | DATE January 29, 2021 | CLIENT TRUE Consulting Ltd. |
| REVIEWED | PROJECT NO. 20-046-01VR | REVISION NO. B |

Data Sources: Base plan from publicly available data sources.
Contour interval: -
Map Projection: NAD83 BC Albers (EPSG 3005)
Other notes: Current and future spray irrigation areas from TRUE Consulting Ltd.
*location is approximate.

MUD BAY DRILLING

9015B Jim Bailey Road
Kelowna, BC V4V 2W4

T: 250-765-2210
F: 604-888-4206

info@mudbaydrilling.com
mudbaydrilling.com

| | |
|---|---|
| **Contact:** | Ryan Rhodes |
| **Company:** | Western Water Associates |
| **Address:** | 106-5145 26th St |
| | Vernon, BC, V1T 8G4 |
| **Phone:** | 250-541-1030 |
| **Email:** | ryan@westernwater.ca |
| **Date:** | Wednesday, August 26, 2020 |
| **Site:** | Oliver |

| | |
|---|---|
| **Estimate Number:** | 20-1207497 |
| **Revision Number:** | 20-1207497.2 |
| **Prepared By:** | BSEY |
| **Proposed Rig:** | Sonic DB320 |

## Scope

2 mw's to 80' and 4 mw's to 40'

| Item | Description | Rate | Unit | Qty | Extended |
|---|---|---|---|---|---|
| **Mobilization** | Equipment and crew | $800.00 | Lump sum | 1 | $800.00 |
| **Drilling, sampling, and Installations** | All operations on site | $475.00 | Hours | 29 | $13,775.00 |
| **Overtime** | Over 8 hours on site | $75.00 | Hours | 5 | $375.00 |
| **Crew travel** | Crew only to / from site | $185.00 | Hours | 2 | $370.00 |
| **Living allowance** | | $750.00 | Shift | 2 | $1,500.00 |
| **Support unit** | | $350.00 | Shift | 3 | $1,050.00 |
| **Bit and casing Wear** | | $45.00 | Meter | 54.88 | $2,469.60 |
| **PVC screen** | 2" SCHD40 | $21.00 | Meter | 18.3 | $384.30 |
| **PVC blank** | 2" SCHD40 | $14.00 | Meter | 27.43 | $384.02 |
| **PVC fittings** | J-Plug and sand point | $41.00 | Set | 6 | $246.00 |
| **Silica sand** | | $16.00 | Bags | 36 | $576.00 |
| **Bentonite chips** | | $21.00 | Bags | 44 | $924.00 |
| **Concrete** | | $16.00 | Bags | 6 | $96.00 |
| **45 gal. Drums with lids** | | $70.00 | Each | 10 | $700.00 |
| **Well covers** | Flush mount or stick-up | $145.00 | Each | 6 | $870.00 |
| **Core boxes** | 10' per box | $60.00 | Each | | $0.00 |

**Total (CAD $): $ 24,519.92**

## Notes and Assumptions

- Client is responsible for all locates and permits
- ConeTec and Mud Bay will not be responsible for damage to any underground utilities
- Client will provide suitable access for truck mounted equipment and transport truck and trailers
- Water must be available on site, or provisions made for prior to mobilization
- No allowances made for insitu testing or sampling
- No allowances made for disposal of cuttings or waste
- Client will be responsible for creating and submitting well closure reports
- Assumes secure site for overnight equipment parking
- Based on 10 hour work days + daily crew travel
- Weekend or night work premium will apply if required
- Traffic control and flaggers will be provided by the client if required

# APPENDIX I

## Soil Classification and Description

# CAWSTON SOILS (CA)

## GENERAL COMMENTS

Cawston soils occur on the floodplain of the Similkameen River near Keremeos and Cawston and on the Okanagan River floodplain between Osoyoos Lake and Penticton. These Rego Humic Gleysol soils occupy slightly depressional to very gently sloping lower fluvial terraces, usually in association with Kinney, Chopaka, Gillanders and Keremeos soils.

Cawston soils have developed in medium textured recent fluvial deposits generally between 50 and 100 cm thick overlying moderately coarse textured materials. Surface and subsurface textures are silt loam or loam. Subsoil texture are usually gravelly sandy loam or gravelly loamy sand. The soils are poorly to imperfectly drained. They are moderately pervious, have a high water holding capacity and slow surface runoff.

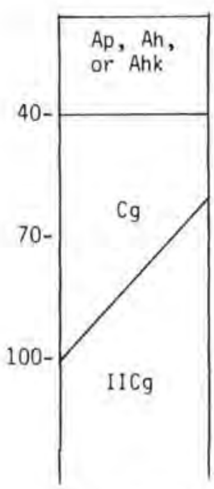
Cawston soils in association with Chopaka and Keremeos soils occupy the gently undulating middle portion of the photo.

Cawston soils are suited for most agricultural crops, particularly if artificial drainage is installed. Most areas are now cleared and cultivated. The more poorly drained areas are mostly used for forage production while the somewhat higher-lying, imperfectly drained areas are used for tree fruits, forages and vegetables. The few, uncleared areas support grasses, cattails, reeds and black cottonwood.

Cawston soils are constrained for urban and similar uses by moderately high water tables which impede basement and other excavations and restrict the operation of septic tank disposal fields.

## GENERALIZED CAWSTON SOIL PROFILE

DEPTH (cm)



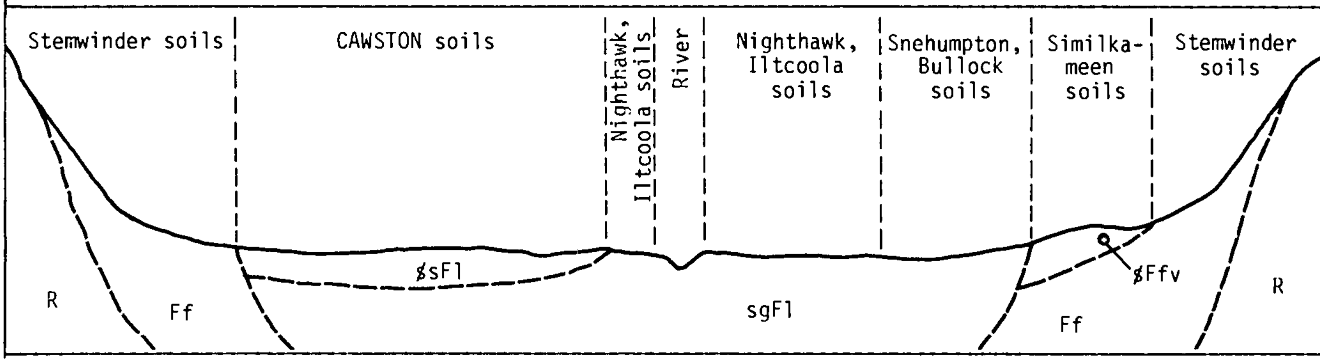

Ap, Ah, or Ahk: Dark grayish brown (10YR 4/2) to very dark grayish brown (10YR 3/2), silt loam or loam; weak to moderate, very fine subangular blocky structure; very friable consistence; weakly to moderately calcareous; none or few, fine, faint mottles.

Cg: Dark grayish brown or very dark grayish brown (10YR 3.5/2), sandy loam to silt loam; weak, fine pseudo-subangular blocky structure; very friable consistence; few, fine, faint mottles.

IICg: Dark brown (10YR 3/3) or brown (10YR 4/3), gravelly sandy loam to very gravelly loamy sand; weak, medium, pseudo-angular blocky structure or single-grain; loose or very friable consistence; few, coarse, prominent mottles.

TAXONOMIC SOIL CLASSIFICATION: Rego Humic Gleysol

## CAWSTON SOIL LANDSCAPE CROSS SECTION




## SOIL CHARACTERISTICS

| | | |
|---|---|---|
| DEPTH TO BEDROCK (m) | : | >2 |
| PARENT MATERIAL | : | recent fluvial floodplain deposits |
| DEPTH TO FREE LIME (cm) | : | weakly to moderately calcareous in surface layer |
| SURFACE STONINESS CLASS | : | 0 |
| DEPTH TO WATERTABLE (m) | : | fluctuating, ranges from 50 cm to >1 m. |
| PERVIOUSNESS CLASS | : | moderate |
| SOIL DRAINAGE CLASS | : | dominantly poor, ranging to imperfect |
| DEPTH TO ROOT RESTRICTION (cm) | : | 80; water table |
| TOPOGRAPHY | : | nearly level and very gentle slopes |

| PHYSICAL SOIL PROPERTIES | SOIL DEPTH | | |
|---|---|---|---|
| | 0-40 cm | 40-80 cm | >80 cm |
| UNIFIED TEXTURE SYMBOL | ML-CL | SM-ML | GP, GM |
| AASHO TEXTURE SYMBOL | A-6; A-4 | A-6; A-4; A-2-4 | A-1 |
| LIQUID LIMIT | 30-35 | 25-35 | NP |
| PLASTICITY INDEX | 1-15 | 1-12 | NP |
| SHEAR STRENGTH | medium to low | low to medium | high |
| SOIL TEXTURE | loam, silt loam | silt loam to sandy loam | very gravelly loamy sand, gravelly sandy loam |
| PERMEABILITY | moderate | moderate | rapid |
| AWSC | moderate | moderate to low | very low |
| COARSE FRAGMENTS >7.5 cm (%) | 0 | 0 | 5-10 |
| COARSE FRAGMENTS <7.5 cm (%) | 0 | 0-5 | 35-60 |
| PASSING SIEVES # 4 | 100 | 100 | 5-10 |
| PASSING SIEVES # 40 | 60-80 | 60-80 | <5 |
| PASSING SIEVES #200 | 40-60 | 50-70 | <2 |

| CHEMICAL SOIL PROPERTIES | SOIL DEPTH | | |
|---|---|---|---|
| | 0-40 cm | 40-80 cm | >80 cm |
| SOIL REACTION (pH) 1:1 $H_2O$ | 7.9-8.0 | 7.7-8.0 | 7.8-8.4 |
| SOIL REACTION (pH) 1:2 0.01M $CaCl_2$ | 7.6-8.0 | 7.4-7.6 | 7.6-8.0 |
| SALINITY CLASS | non to very weakly saline | non-saline | non-saline |
| ORGANIC CARBON | moderate | very low | very low |
| NITROGEN | medium to high | very low | very low |
| EXCHANGE CAPACITY | high | medium | low to very low |
| EXCHANGEABLE CATIONS - Ca | high | high | high |
| - Mg | high | medium to high | low |
| - Na | low | low | low |
| - K | high | moderately high | low |
| BASE SATURATION (%) | 100 | 100 | 100 |
| PHOSPHOROUS | very low | very low | very low |
| SULFUR | moderately high | moderately high | moderately high |

# PONDEROSA SOILS (PO)

## GENERAL COMMENTS

Ponderosa soils occur only in the vicinity of Oliver. They occupy nearly level to moderately sloping areas in association with Rutland, Glenfir, Ratnip and Burnell Lake soils.

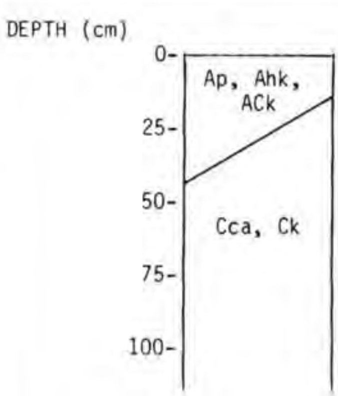
Ponderosa soils have developed in a gravelly, moderately coarse textured fluvial veneer between 10 and 50 cm thick, overlying gravelly coarse textured fluvial fan deposits. Surface and subsurface textures are gravelly or very gravelly sandy loam or gravelly loam; subsoils are very gravelly loamy sand. These Rego Dark Brown: calcareous phase soils are well to rapidly drained, rapidly pervious and have low water holding capacity.

Almost all areas of Ponderosa soils are cleared, cultivated and planted to tree fruits and vineyards. Small, scattered, uncleared areas located on steep slopes support scattered Ponderosa pine, sagebrush and grass in the understory.

Except for a few steeply sloping areas, Ponderosa soils are moderately well suited for most urban and related uses. Incomplete septic tank effluent filtration may occur in the coarse-textured subsoils.

A typical view of moderately sloping Ponderosa soils near Oliver.

## GENERALIZED PONDEROSA SOIL PROFILE

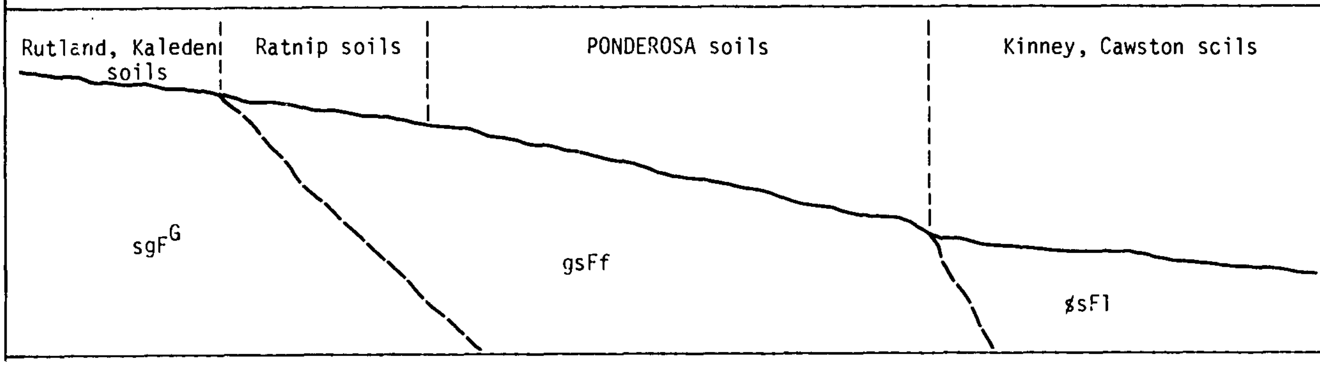



Dark grayish brown (10YR 4.5/2.5), gravelly sandy loam; weak, fine to very fine, granular structure; very friable consistence; moderately calcareous.

Pale brown (10YR 5.5/3 - 6/3.5), very gravelly loamy sand; weak, fine subangular blocky structure; very friable to firm consistence; strongly calcareous.

TAXONOMIC SOIL CLASSIFICATION: Rego Dark Brown: calcareous phase

## PONDEROSA SOIL LANDSCAPE CROSS SECTION




## SOIL CHARACTERISTICS

| | |
|---|---|
| DEPTH TO BEDROCK (m) | : >2 |
| PARENT MATERIAL | : fluvial fan deposits |
| DEPTH TO FREE LIME (cm) | : calcareous to surface |
| SURFACE STONINESS CLASS | : 0-3 |
| DEPTH TO WATERTABLE (m) | : >2 |
| PERVIOUSNESS CLASS | : rapid |
| SOIL DRAINAGE CLASS | : well to rapid |
| DEPTH TO ROOT RESTRICTION (cm) | : none |
| TOPOGRAPHY | : nearly level to moderate slopes |

| PHYSICAL SOIL PROPERTIES | SOIL DEPTH 0-50 cm | SOIL DEPTH >50 cm |
|---|---|---|
| UNIFIED TEXTURE SYMBOL | GM-GC | GM-GP |
| AASHO TEXTURE SYMBOL | A-1 | A-1 |
| LIQUID LIMIT | 15-25 or NP | NP |
| PLASTICITY INDEX | 0.1-5 or NP | NP |
| SHEAR STRENGTH | high to medium | high to medium |
| SOIL TEXTURE | very gravelly sandy loam to gravelly loam | very gravelly loamy sand |
| PERMEABILITY | rapid | very rapid |
| AWSC | moderate to low | low |
| COARSE FRAGMENTS >7.5 cm (%) | 5-15 | 20-40 |
| COARSE FRAGMENTS <7.5 cm (%) | 20-75 | 30-60 |
| PASSING SIEVES (%) # 4 | 50-80 | 30-50 |
| PASSING SIEVES (%) # 40 | 20-30 | 5-20 |
| PASSING SIEVES (%) #200 | 5-10 | <2 |

| CHEMICAL SOIL PROPERTIES | SOIL DEPTH 0-50 cm | SOIL DEPTH >50 cm |
|---|---|---|
| SOIL REACTION (pH) 1:1 $H_2O$ | 7.8-8.1 | 8.0-8.5 |
| SOIL REACTION (pH) 1:2 0.01M $CaCl_2$ | 7.4-7.6 | 7.5-7.8 |
| SALINITY CLASS | non-saline | non-saline |
| ORGANIC CARBON | moderate | low |
| NITROGEN | low to very low | very low |
| EXCHANGE CAPACITY | low | low to very low |
| EXCHANGEABLE CATIONS - Ca | high | high |
| - Mg | low | medium to high |
| - Na | very low | very low |
| - K | medium | moderately high |
| BASE SATURATION (%) | 100 | 100 |
| PHOSPHOROUS | very low | very low |
| SULFUR | low | medium |

**Hamilton & Associates**
3909 16th Street
Vernon, BC, V1T 7N5

June 23, 2020

Town of Oliver
c/o Western Water Associates Ltd.
#106-5145 26 Street,
Vernon, BC V1T 8G4

**RE: OPERATIONAL CERTIFICATE NUMBER PE-13717**
**SOIL ASSESSMENT PROGRAM – NEW RECLAIMED WATER IRRIGATION AREAS**

**Attention**: Ryan Rhodes, P.Geo.

## 1. INTRODUCTION

The Town of Oliver (the Town) currently discharges the reclaimed municipal wastewater from its wastewater treatment facility (WWTF) to ground by irrigation under the authorization of Operational Certificate (OC) PE-13717. The Town wishes to expand the area that is authorized for irrigation with reclaimed municipal wastewater and will therefore require an amendment to the OC. Hugh Hamilton, P.Ag., of Hamilton and Associates was retained by Western Water Associates Ltd., on behalf of the Town, to complete a soil assessment to determine whether the lands on planned new irrigation areas are capable of accepting reclaimed wastewater for irrigation purpose. The requirements for the soils assessment are specified in Section 6.9 of the OC.

The assessment was completed through a combination of a review of background information (including soil maps and reports, climate data, land use zoning maps, and aerial photographs), a field reconnaissance completed on June 3, 2020, and data analyses and interpretation. Additional information on methods is contained in Section 4.

## 2. DESCRIPTION OF THE PLANNED NEW IRRIGATION AREAS

Four irrigation areas are to be added to the approved land base for reclaimed water irrigation:

- The playing fields and park land located between Oliver Elementary School and South Okanagan High School (Figure 1 – maps and photos are at end of report). All of this parcel is currently covered with turfgrass and is irrigated with an underground sprinkler system (Photo 1). There are mature trees around the edges of the fields.
- Oliver Cemetery (Figure 2). The cemetery grounds are primarily vegetated with turfgrass (Photos 3 and 4) and are irrigated with underground sprinklers. Trees (mostly cedar) are planted around the property boundary, and there are some deciduous tree among the monuments.
- Oliver Community Park located immediately east of the Okanagan River on Fairview Road (Figure 3). The park includes three baseball/softball fields, a lawn bowling green, and areas for walking and sitting. The ground cover is turfgrass and there are a number of mature trees in the

areas outside the ball fields and on the small area on the north side of Fairview Road (Photo 5). The park is irrigated with an underground sprinkler system.

- Oliver Municipal Airport (Map 4). The new irrigation area is the strip of industrial-zoned land on the east side of the runway (Photo 7). The fields surrounding the runway to the west are already authorized for reclaimed water irrigation. The new irrigation area is mostly unoccupied although some parts are used for storage and there is one building. It appears that the topsoil was stripped from parts of the site and transported off-site. Vegetation cover is limited (about 25-50% on average) and includes alfalfa, agronomic and native grasses, and invasive species (see Section 4). It is not currently irrigated.

## 3. EXISTING SOILS, LAND USE AND EXPOSURE POTENTIAL

Soil information for the subject property was obtained from the BC Soil Information Finder Tool (SIFT). Figures 1 to 4 show the spatial distribution of soil types on the planned irrigation sites, and the soil properties are summarized in Table 1. Soils at the school and airport sites are mapped by BC as 100% Rutland soils, which are classified as Orthic Dark Brown Chernozems, developed on glacio-fluvial deposits. They typically are gravelly with a sandy or sandy loam surface texture (Photo 2). Soils at the cemetery are Ponderosa soils developed on alluvial fan deposits with a fluvial veneer. They are classified as Rego Dark Brown Chernozems and are also gravelly within sandy loam. The soils in the park have been developed on fluvial and floodplain deposits. About 90% of the irrigated area is classified as Kinney soils and are Gleyed Regosols (signifying that they are relatively young and that the soil profile is routinely saturated for an extended period). The northwest part of the park as mapped as Cawston soils, a Rego Gleysol (indicating somewhat greater soil profile development but also routinely saturated). The Kinney soils have a sandy loam or loam texture with some silt lenses, while the Cawston soil is a silt loam (Photo 6).

Because the sites are all located within the municipal boundaries, there are no published agricultural capability maps. All of the sites are located outside of the BC Agricultural Land Reserve.

The school grounds are used by the school students of sports and general play when school is in session, and by the public for recreation without restriction at all other times. The cemetery is open to the public and family visits every day during specified hours. Oliver Community Park is always open to public use. The airport lands are located behind a locked gate, so public access is unlikely. Based on the definitions in the BC Reclaimed Water Guidelines (BC Ministry of Environment 2013), the school grounds, park and cemetery would be considered “High Exposure Potential” while the airport is “Low Exposure Potential”. The school, park and cemetery also would be considered “high public use lands” as per Section 5.1.2 of the OC, while the airport is “low public use lands”. The treatment standard for use of reclaimed water on these sites varies slightly between the regulatory documents (Table 2). The OC requirements are understood to take precedence over the other documents, although Section 5.1.2 says that irrigation shall conform to guidelines developed by BC, so the Reclaimed Water guidelines should also apply (note that it sets limits for *E. coli*, not fecal coliforms).

**Table 1 – Soils on the Planned Irrigation Sites**

| **Soil Name** | **Rutland** | **Kinney** | **Cawston** | **Ponderosa** |
|---|---|---|---|---|
| Sites where present | **Airport** (AP), **Schools** (SC) | **Oliver Community Park** (PK) | **Oliver Community Park** | **Cemetery** (CM) |
| Approximate coverage on sites | AP-100%, SC-100% | PK – 90% | PK- 10% | CM - 100% |
| Classification | Orthic Dark Brown Chernozem | Gleyed Regosol | Rego Humic Gleysol | Rego Dark Brown Chernozem |
| Parent material | Sandy veneer over glacial-fluvial deposits | Loamy fluvial veneer over sandy floodplain deposits | Fluvial deposits | Fluvial veneer over fluvial fan deposits |
| Texture | Sandy loam, loamy sand | Sandy loam/loam with some silt lenses | Silt loam or loam | Gravelly/very gravelly sandy loam or gravelly loam |
| Drainage | Rapid | Imperfect | Poor to imperfect | Well to rapid |
| Water holding capacity | Low | Moderate to low | High | Low |
| Major soil limitations for crops | Stoniness, low available moisture holding capacity, low natural fertility | High water tables near Okanagan River; moderate salinity | Short duration fluctuating groundwater table in sandy & gravelly subsoils during spring freshet | Stoniness; susceptible to soil acidification after several years or irrigation & fertilization |

Sources: Government of British Columbia. (2019); Wittneben (1986); Gough et al. (1994).

**Table 2**
**Standards for bacteriological quality of reclaimed water for irrigation**

| Regulatory Document | School grounds, cemetery & park | Airport |
|---|---|---|
| Operational Certificate PE-13717 | Maximum 2.2 MPN/100 mL fecal coliforms | Maximum 200 MPN/100 mL fecal coliforms |
| Reclaimed Water Guideline (BC MoE 2013) | 1 CFU/100 mL or 2 MPN/ 100 mL *E. coli* | Not specified |
| Municipal Wastewater Regulation | Median <1 CFU/100 mL or <2.2 MPN fecal coliforms; maximum 14 CFU/100 mL | Median <200 CFU/100 mL fecal coliforms; maximum 1,000 CFU/100 mL |

## 4. RESULTS OF THE ASSESSMENT

### 4.1 Soil Properties

The field assessment took place on June 3, 2020. The weather was clear and sunny although there had been some rainfall over the previous several days. The field work was completed by Hugh Hamilton, P.Ag. with the assistance of Ryan Rhodes, P.Geo., of Western Water. At each site, several boreholes were completed with a hand auger to a depth of between approximately 0.3 and 0.7 metres. The characteristics of the soil at each location were noted including the thickness of the upper (A or Ap) horizon, presence/depth of roots, soil texture (by hand), soil colour, presence/absence of mottles (iron staining), and the amount of gravel (based on the Soil Classification Working Group, 1998). In most cases it was not possible to auger beyond about 0.5 m depth because of the amount of gravel in the soil. In addition to the boreholes, we noted the vegetation cover and general drainage patterns, and looked for evidence of water ponding or running off the sites from previous irrigation or rainfall.

The soil properties observed in the field were consistent with the existing BC mapping, indicating that the published soil information (SIFT) can be relied upon for irrigation planning. The key exception is the land on the airport site where the topsoil (likely the Ap horizon[1] or the combined A and B horizons appear to have been stripped off in places, exposing the underlying gravelly BC or C horizon that is characteristic of the Rutland soil (Wittneben 1986). This was confirmed by digging a soil pit or the west side of the fence in the alfalfa field that surrounds the runway, where a dark brown Ap horizon (~0.3 m thick) was present (Photo 8). At the airport site there is considerable gravel exposed on the surface among pockets of thin sandy soil. The vegetation cover is sparse (Photos 7, 9 and 10).

The soils in Oliver Community Park were moist but not saturated at the time of the site visit, and no free water was encountered in any of the auger holes. At depths beyond about 0.15 m the soils were grey-brown in colour with faint mottling, indicating periodic saturation and reducing conditions. These properties may reflect conditions prior to creation of the park and construction of the dike along the Okanagan River. However, a high water table is likely during spring freshet when the river level is high.

[1] The “p” in the Ap soil horizon descriptor represent the plow layer, where previous cultivation has typically blended the natural A and part of the natural B horizons.

### 4.2 Capability for Irrigation

Table 3 shows the monthly average irrigation demand for the soils on the planned irrigation sites. These estimates were generated using the BC Irrigation Calculator[2] for the soil textures confirmed in the field. At the school, cemetery, and park sites the crop is grass, while the crop at the airport was assumed to be alfalfa, like the neighbouring field (alfalfa is currently sporadically present on the new fields – Photo 10). Sprinkler was selected as the irrigation method except at the airport, where a solid set gun was assumed (consistent with the method used on the fields around the runway). The irrigation demand values in Table 3 are presented as cubic metres per hectare per day for the specified month as well as a total volume per hectare for the core May 1 to September 30 irrigation season.

Based on the soil assessment and the irrigation capacity calculations, the school, cemetery, and park sites are all suitable for irrigation with reclaimed water, subject to the regulatory requirements for reclaimed water and assuming best practices are followed for irrigation on public lands (Section 4.3).

It is important to note that the irrigation demand values shown are estimates of average rates based on modelling data and should be used for guidance only. Specific sites may be capable of using more or less water in any specific year depending on the weather. Except for the new areas at the airport, the other sites are currently irrigated, and the Town of Oliver and School Board operators have considerable experience managing the irrigation regime on their sites. In general, the irrigation volumes should be managed to optimize crop growth while meeting the regulations and best practices for the use of reclaimed water. Additional guidance on irrigation operations is provided in the next section.

[2] On-line at: http://bcwatercalculator.ca/agriculture/irrigation

**Table 3**
**Estimated Average Irrigation Rate by land parcel**

| Site | Community Park – N. Part | Community Park – Middle Part | Community Park – S. Part | Airport* | Cemetery | Schools – N. Side | Schools – S. Side |
|---|---|---|---|---|---|---|---|
| **PID** | 001486683 | 006278159 | 026967201 | 007629583 | n/a | 001486683 | 010562401 |
| **Dominant Soil** | Cawston | Kinney | Kinney | Rutland | Ponderosa | Rutland | Rutland |
| **Irrigation Period**** | Apr 27 – Oct 1 | Apr 27 – Oct 1 | Apr 27 – Oct 1 | Apr 26 – Oct 1 | Apr 27 – Oct 1 | Apr 29 – Oct 1 | Apr 29 – Oct 1 |
| **VOLUME PER HECTARE** | **$m^3$/ha/day** | **$m^3$/ha/day** | **$m^3$/ha/day** | **$m^3$/ha/day** | **$m^3$/ha/day** | **$m^3$/ha/day** | **$m^3$/ha/day** |
| April | 0.68 | 0.88 | 0.85 | *0.88* | zero | 1.75 | 0.00 |
| May | 32 | 42 | 42 | *56* | 35 | 42 | 37 |
| June | 56 | 72 | 72 | *96* | 77 | 72 | 71 |
| July | 71 | 91 | 91 | *121* | 99 | 91 | 90 |
| August | 59 | 75 | 75 | *100* | 82 | 75 | 75 |
| September | 37 | 48 | 48 | *64* | 52 | 48 | 48 |
| October | 53 | 67 | 68 | *90* | 75 | 67 | 67 |
| **TOTAL MAY-SEPT ($m^3$/ha)** | **7,833** | **10,042** | **10,042** | ***13,407*** | **10,575** | **10,043** | **9,822** |

*Airport values in Italics would apply if the topsoil were intact. Values shown are not appropriate under current conditions and should not be used. See text Section 4.3 for recommendations.

**Irrigation period is from the BC Agriculture Water Calculator.  Note that irrigation typically occurs on few days in both April and October. The total volume per hectare for the core May 1 to September 30 irrigation season is intended to provide guidance for irrigation planning purposes.

### 4.3 Operational Considerations

Irrigation must follow the conditions specified in the OC. Following are the key clauses that apply to new reclaimed water irrigation on the four sites:

- Section 5.1.2 - Disinfection must meet the requirements of the OC (≤2.2 MPN/100 mL fecal coliforms) and the Reclaimed Water Guideline ≤1 CFU/100 mL or ≤2 MPN/ 100 mL *E. coli)*.
- Section 5.2 – The irrigation period is March 15 to October 31.
- Section 5.3 – No reclaimed water shall be applied within 15 m of a stream (e.g. Okanagan River at the park site) or waterbody, or within 30 m of a well used for domestic supply.
- Sections 5.4 and 5.5 – No surface runoff of irrigated runoff shall occur, and no water should emerge from slopes located downgradient of the irrigated areas (known as tail water).
- Section 4.5 – Spray irrigation water must not drift in the air off-site, e.g. as an aerosol.
- Section 5.7.2 – Irrigation should not cause the soils to become saturated or cause soil erosion or instability.

Section 5.7.1 of the OC states that the irrigation rates should follow the 1989 BC Sprinkler Irrigation Manual. That manual was published before the province developed its current irrigation demand models or the BC Agriculture Water Calculator. The irrigation rates shown above in Table 3 are preferred over the single value given for Oliver in the 1989 manual because they are customized for each soil polygon.

In addition, the following practices from the BC Reclaimed Water Guideline (p. 20) should be followed at the **school, cemetery, and park sites**.

- No direct contact shall occur between the reclaimed water and any person while irrigation is underway.
- Residual chlorine should be present in the reclaimed water at the point of use at a concentration of at least 0.5 mg/L.
- There should be signs indicating that reclaimed water is used for irrigation (as per OC Section 3.12.1).
- The movement of irrigation water below the rooting zone to groundwater must be minimized.
- Periodic sampling (i.e. annually) and testing of the reclaimed water for metals and ions (specifically sodium and chloride) should take place, with the results compared to the applicable BC and Canadian water quality guidelines. This is in addition to the testing for BOD, TSS and nutrients under the OC.

At the **airport**, special irrigation management is necessary because of the lack of topsoil and the sparse vegetative cover on the site, which could result in excessive volumes of reclaimed water moving to groundwater rather than being evapotranspired. Irrigation of this site should begin in a limited fashion until it can be demonstrated that irrigation can meet the same guidelines and standards for the other sites, as listed above. The recommended approach is as follows:

- Irrigation of the site should not start before June 15 and should finish by September 10.

- Start with about one-half the prescribed monthly rate from the BC calculator (Table 3; e.g. maximum 60 $m^3$/ha/day in July). Monitor the to see if the alfalfa and grasses on-site respond with increased growth and expanded surface coverage.
- If feasible, apply a layer (approximately 10 cm) of soil, compost or biosolids before beginning irrigation in the first year. This is to improve water and nutrient retention and to promote vegetative growth. This could begin with a pilot test program on several plots (e.g. three 20 m × 20 m plots) to fine-tune the methodology.
- All other conditions in the OC and the Reclaimed Water Guideline must also apply.

If the vegetation cover becomes better established and an organic litter layer builds up on the surface, the length of the irrigation season and the irrigation rate may be increased at the new airport site until they approach the guidelines for a Rutland soil.

## 5. CONCLUSIONS AND RECOMMENDATIONS

To conclude, the schoolyard, cemetery, and park sites are all suitable for irrigation with reclaimed water, subject to the regulatory requirements for reclaimed water and assuming best practices are followed for irrigation on public lands (as listed in Section 4.3). The airport lands located east of the existing irrigated lands will require special management if they are to be irrigated with reclaimed water, due to the lack of topsoil and the sparse vegetation. Irrigation can proceed within a limited season only (June 15 to September 10), initially using rates that are about one-half of the BC Agriculture Water Calculator. If the vegetative cover improves and a layer of organic litter develops on the surface, then the schedule and irrigation rates may be re-evaluated. If possible, a layer of soil, biosolids or compost should be applied prior to irrigation to improve water and nutrient retention.

## 6. CLOSURE

This report was prepared exercising the standard of care, skill and diligence which is reasonably expected within the agrology profession involved in the assignment, in the location of the assignment, as measured by professional standards applicable during the performance of the services. No other warranty or guarantee, expressed, implied or statutory, is made or intended by this report.

I trust this completes this assignment to your satisfaction. Please contact the undersigned at (250) 938-3408 if you have any questions or require additional information.

Sincerely,
**Hamilton and Associates**

BRITISH COLUMBIA INSTITUTE OF AGROLOGISTS
B.C.I.A.
Hugh Hamilton, P.Ag.
311

Hugh Hamilton, Ph.D., P.Ag.
Senior Scientist

Attachments: Figures 1-4 and Photographs.

## REFERENCES

BC Ministry of Environment 2013. Reclaimed Water Guideline: A companion document to the Municipal Wastewater Regulation. Victoria. 44 pp.

Gough, N., G. Hughes-Games, and D. Nikkel. 1994. Soil Management Handbook for the Okanagan and Similkameen Valleys. 1st Edition. B.C. Ministry of Agriculture, Fisheries and Food.

Government of British Columbia. 2019. Soil Information Finder Tool (SIFT). On-line at: https://www2.gov.bc.ca/gov/content/environment/air-land-water/land/soil/soil-information-finder

Soil Classification Working Group. 1998. The Canadian System of Soil Classification. 3rd Edition. Agriculture and Agri-Food Canada. Ottawa.

Wittneben, U. 1986. Soils of the Okanagan and Similkameen Valley. Report no. 52, BC Soil Survey. Ministry of Environment. Victoria. 229 pp.

## PHOTOGRAPHS

**Photo 1.** Sports field with turfgrass cover between elementary and high schools.

**Photo 2:** Typical surface soil (~4-20 cm below surface) at school site.

**Photo 3:** Lawn area along cemetery boundary, currently irrigated.

**Photo 4**: Cemetery overview showing unirrigated and irrigated (background) areas.

**Photo 5**:  Oliver Community Park from dike looking northeast.


**Photo 6**: Example of silty soil in north part of Oliver Community Park

**Photo 7**: Proposed new irrigation area at airport. Note exposed sub-soil and relatively spare vegetative cover [Land on right side of photo may receive some irrigation water from fields near runway (yellow flowers)].

**Photo 8**: Surface soil in irrigated fields. Note intact dark upper horizon and presence of gravel throughout.

**Photo 9**: Soil pit on proposed irrigation area at airport. At this location, a residual A/Ap horizon is present. Note fine roots in upper 10 cm.

**Photo 10**: Ground surface at new airport irrigation area where topsoil may have been partially removed. Note how alfalfa plants are green as their roots obtain moisture from deep within soil.

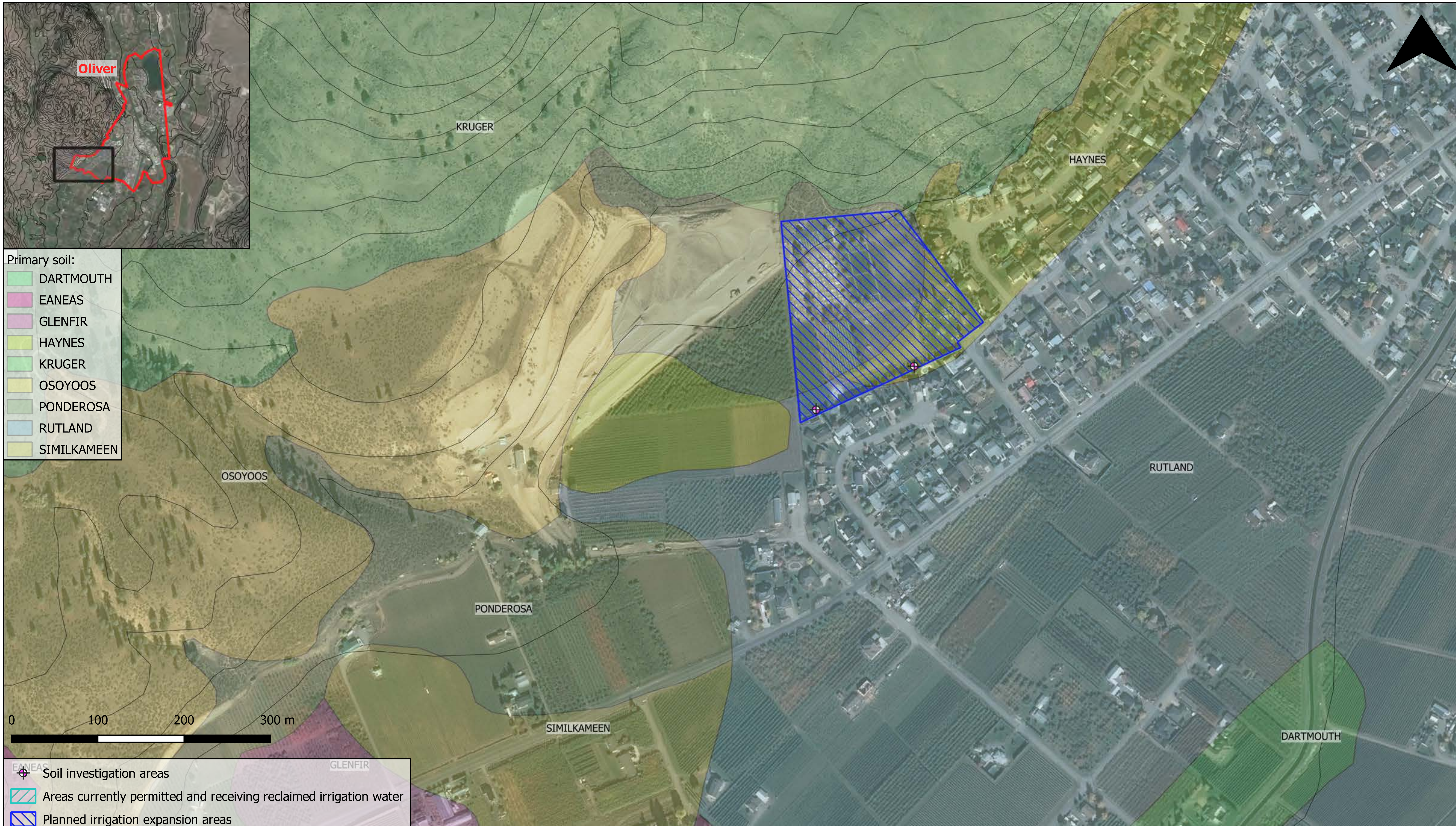

**Oliver Spray Irrigation Review**

western water ASSOCIATES LTD

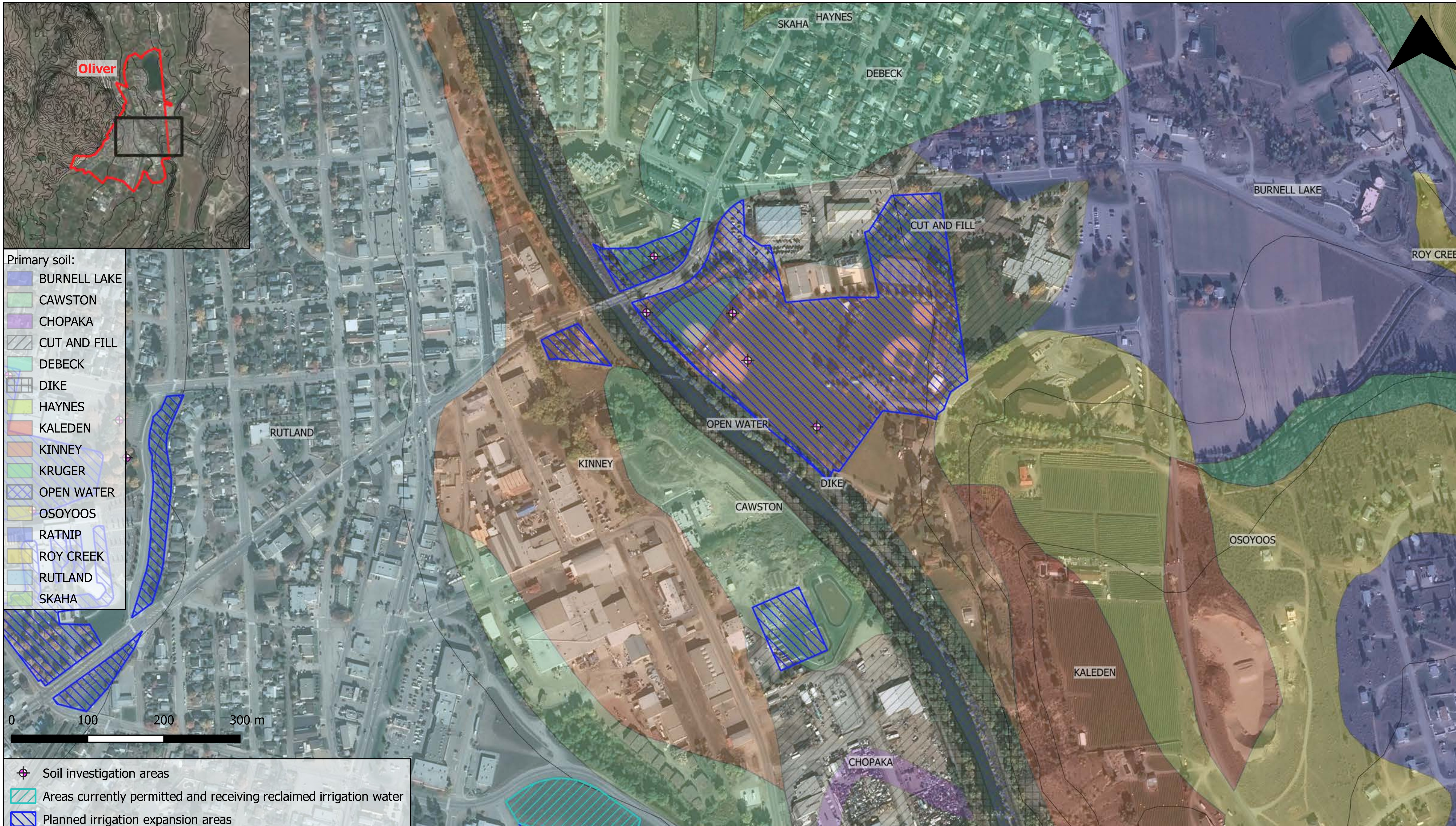
TITLE **Figure 1:** School Area

| | | |
|---|---|---|
| DRAWN Tim Sivak | DATE June 29, 2020 | CLIENT TRUE Consulting Ltd. |
| REVIEWED Ryan Rhodes | PROJECT NO. 20-046-01VR | REVISION NO. C |

Data Sources: Base plan from publicly available data sources. Soils mapping from National Soils Database.
Contour interval: 20 m
Map Projection: NAD83 BC Albers (ESPG 3005)
Other notes: Soil investigation areas recorded with handheld GPS. Current and future spray irrigation areas from TRUE Consulting Ltd.




| | | | | |
|---|---|---|---|---|
| **Oliver Spray Irrigation Review** | TITLE **Figure 2:** Oliver Cemetery Area | | | Data Sources: Base plan from publicly available data sources. Soils mapping from National Soils Database. |
| western water ASSOCIATES LTD | DRAWN Tim Sivak | DATE June 29, 2020 | CLIENT TRUE Consulting Ltd. | Contour interval: 20 m<br>Map Projection: NAD83 BC Albers (ESPG 3005) |
| | REVIEWED Ryan Rhodes | PROJECT NO. 20-046-01VR | REVISION NO. C | Other notes: Soil investigation areas recorded with handheld GPS. Current and future spray irrigation areas from TRUE Consulting Ltd. |



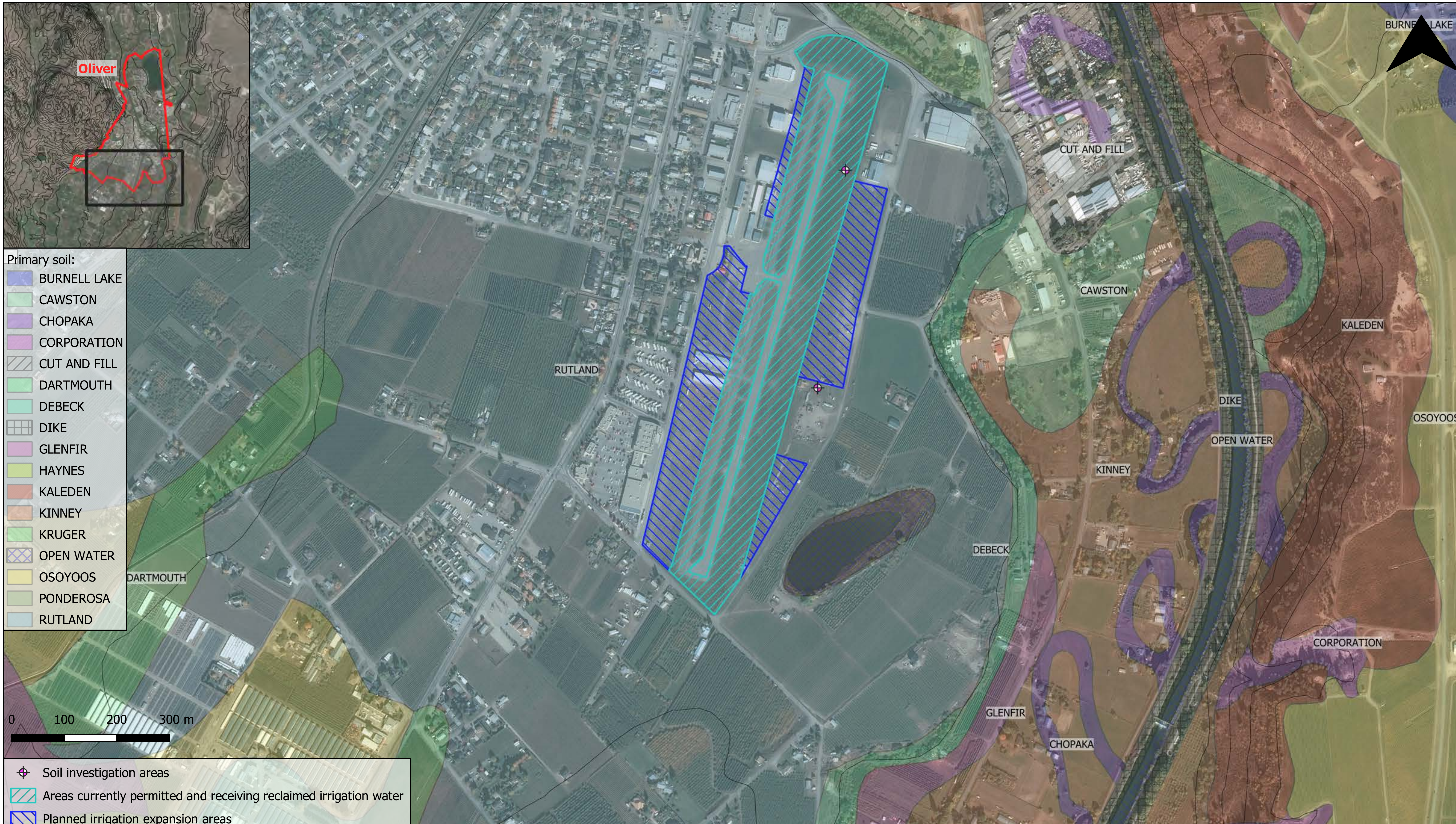

**Oliver Spray Irrigation Review**

western water ASSOCIATES LTD

TITLE **Figure 3:** Oliver Community Park & Area

| | | |
|---|---|---|
| DRAWN Tim Sivak | DATE June 29, 2020 | CLIENT TRUE Consulting Ltd. |
| REVIEWED Ryan Rhodes | PROJECT NO. 20-046-01VR | REVISION NO. C |

Data Sources: Base plan from publicly available data sources. Soils mapping from National Soils Database.
Contour interval: 20 m
Map Projection: NAD83 BC Albers (ESPG 3005)
Other notes: Soil investigation areas recorded with handheld GPS. Current and future spray irrigation areas from TRUE Consulting Ltd.




**Oliver Spray Irrigation Review**

western water ASSOCIATES LTD

TITLE **Figure 4:** Aiport Area

| | | | | | |
|---|---|---|---|---|---|
| DRAWN | Tim Sivak | DATE | June 29, 2020 | CLIENT | TRUE Consulting Ltd. |
| REVIEWED | Ryan Rhodes | PROJECT NO. | 20-046-01VR | REVISION NO. | C |

Data Sources: Base plan from publicly available data sources. Soils mapping from National Soils Database.
Contour interval: 20 m
Map Projection: NAD83 BC Albers (ESPG 3005)
Other notes: Soil investigation areas recorded with handheld GPS. Current and future spray irrigation areas from TRUE Consulting Ltd.

# RUTLAND SOILS (R)

## GENERAL COMMENTS

Rutland soils occupy significant areas throughout the Okanagan Valley portion of the map area and also near Keremeos in the Similkameen Valley. Topography is usually level to gently sloping although some terrace scarps are extremely sloping. Soils commonly associated with Rutland soils include Faulder, Dartmouth, Keremos, Oyama and Skaha.

The parent material of Rutland soils is a moderately coarse textured veneer between 10 and 25 cm thick which overlies gravelly and stony, very coarse textured glaciofluvial deposits. Surface soil textures are dominantly sandy loam or loamy sand while subsurface and subsoil textures are gravelly sand or gravelly loamy sand. Stones and cobbles are also common. Rutland soils are classifed as Orthic Dark Brown. They are rapidly drained, rapidly pervious, have slow surface runoff and low water holding capacity.

A very gently sloping area of undeveloped Rutland soils northeast of Oliver.

The main agricultural limitations are gravelly and stony textures, rapid permeability and low water holding capacity. Tree fruits and grapes are presently grown in most cultivated and irrigated areas. Typical native vegetation consists of a variety of grasses, sagebrush, rabbitbrush and scattered Ponderosa pine.

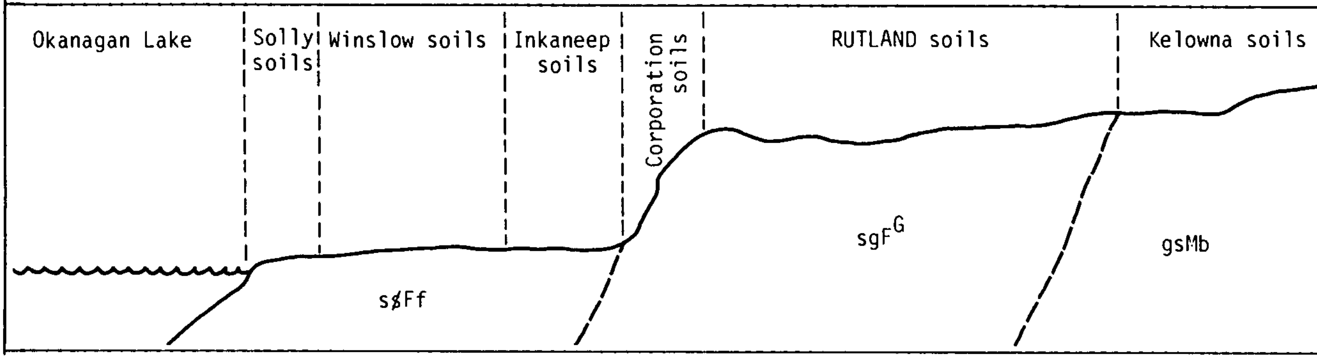
Rutland soils are well suited for urban and related uses. They are rapidly drained, have high bearing capacity and generally level topography. The depth of topsoil is shallow. Effluent from septic field installations may be incompletely filtered by the very gravelly, coarse-textured subsoil.

## GENERALIZED RUTLAND SOIL PROFILE

| DEPTH (cm) | Horizon | Description |
|---|---|---|
| 0–25 | AP, Ah | Dark grayish brown or brown (10YR 4/2.5), sandy loam or loamy sand; weak, fine subangular blocky structure; soft consistence. |
| 25–70 | IIBm, IIBC | Brown (10YR 5/3), very gravelly sand or very gravelly loamy sand; weak, very fine subangular blocky structure; soft consistence. |
| 70–100 | IIC, IICk | Light gray to brownish-yellow (10YR 7/1-6/6), very gravelly sand; single-grain; loose consistence; weakly calcareous in upper part, grading to moderately calcareous at depth. |

TAXONOMIC SOIL CLASSIFICATION: Orthic Dark Brown

## RUTLAND SOIL LANDSCAPE CROSS SECTION

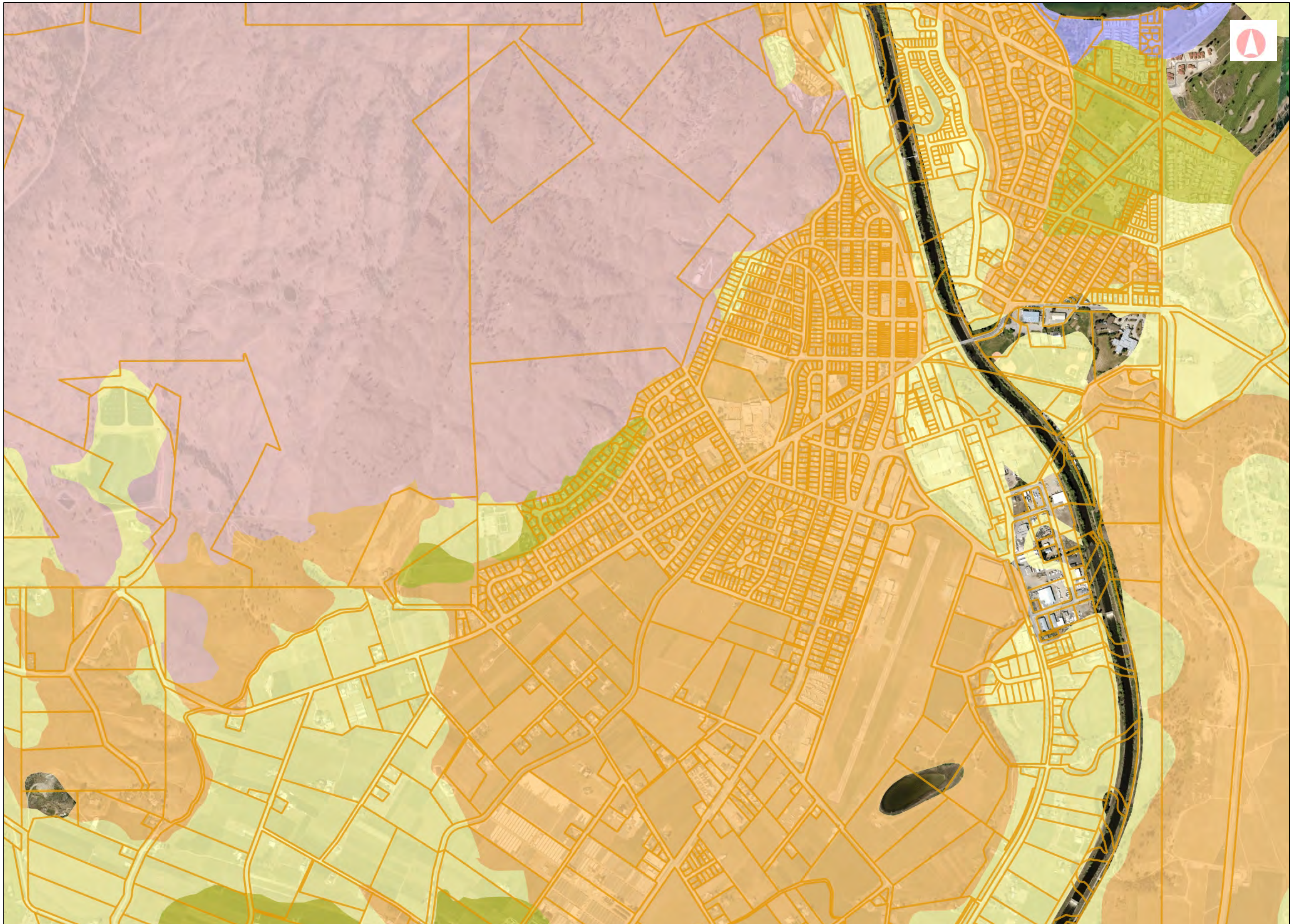



## SOIL CHARACTERISTICS

| | |
|---|---|
| DEPTH TO BEDROCK (m) | : >2 |
| PARENT MATERIAL | : fluvioglacial deposits |
| DEPTH TO FREE LIME (cm) | : >80 |
| SURFACE STONINESS CLASS | : 1-4 |
| DEPTH TO WATERTABLE (m) | : >2 |
| PERVIOUSNESS CLASS | : rapid |
| SOIL DRAINAGE CLASS | : rapid |
| DEPTH TO ROOT RESTRICTION (cm) | : none, other than that due to gravelly and strong subsurface textures |
| TOPOGRAPHY | : mostly nearly level to gentle slopes; some terrace scarps may be extremely sloping |

| PHYSICAL SOIL PROPERTIES | SOIL DEPTH 0-20 cm | SOIL DEPTH >20 cm |
|---|---|---|
| UNIFIED TEXTURE SYMBOL | SM | GW-GP |
| AASHO TEXTURE SYMBOL | A-2-4 | A-1 |
| LIQUID LIMIT | NP | NP |
| PLASTICITY INDEX | NP | NP |
| SHEAR STRENGTH | medium | high |
| SOIL TEXTURE | sandy loam, loamy sand | gravelly loamy sand, very gravelly sand |
| PERMEABILITY | rapid | very rapid |
| AWSC | low | very low |
| COARSE >7.5 cm (%) | 0-5 | 10-30 |
| FRAGMENTS <7.5 cm (%) | 0-10 | 30-80 |
| PASSING # 4 | 60-100 | 50-80 |
| SIEVES (%) # 40 | 40-80 | 1-5 |
| #200 | 10-40 | <4 |

| CHEMICAL SOIL PROPERTIES | SOIL DEPTH 0-20 cm | SOIL DEPTH >20 cm |
|---|---|---|
| SOIL REACTION (pH) 1:1 $H_2O$ | 6.6-7.4 | 7.2-8.0 |
| 1:2 0.01M $CaCl_2$ | 6.1-6.8 | 6.8-7.5 |
| SALINITY CLASS | non-saline | non-saline |
| ORGANIC CARBON | moderate | very low |
| NITROGEN | low | very low |
| EXCHANGE CAPACITY | medium | low to very low |
| EXCHANGEABLE CATIONS - Ca | high | high |
| - Mg | high | high |
| - Na | very low | medium |
| - K | high | low |
| BASE SATURATION (%) | 90-100 | 100 |
| PHOSPHOROUS | medium | variable |
| SULFUR | low | low |



BRITISH COLUMBIA

iMapBC Mapping

***Legend***

PMBC Parcel Cadastre - Ou

Soil Polygons - Parent Mate

MDEP_1

<Null>

-

Anthropogenic

Colluvial

Eolian

Fluvial

Organic - Fen Peat

Organic - Forest Peat

Glaciofluvial

Glaciolacustrine

Glaciomarine

Lacustrine

Marine

Organic - Spaghnum Peat

Till

Undifferentiated Mineral

Organic - Undifferentiated

Volcanic

0 0.41 0.8 km

1: 20,000



Datum: NAD83

Projection: WGS_1984_Web_Mercator_Auxiliary_Sphere

## Key Map of British Columbia