Lucknow Sewage Treatment Works
Operation and Maintenance - Annual Report
For the 2022 Operating Year

PREPARED BY:
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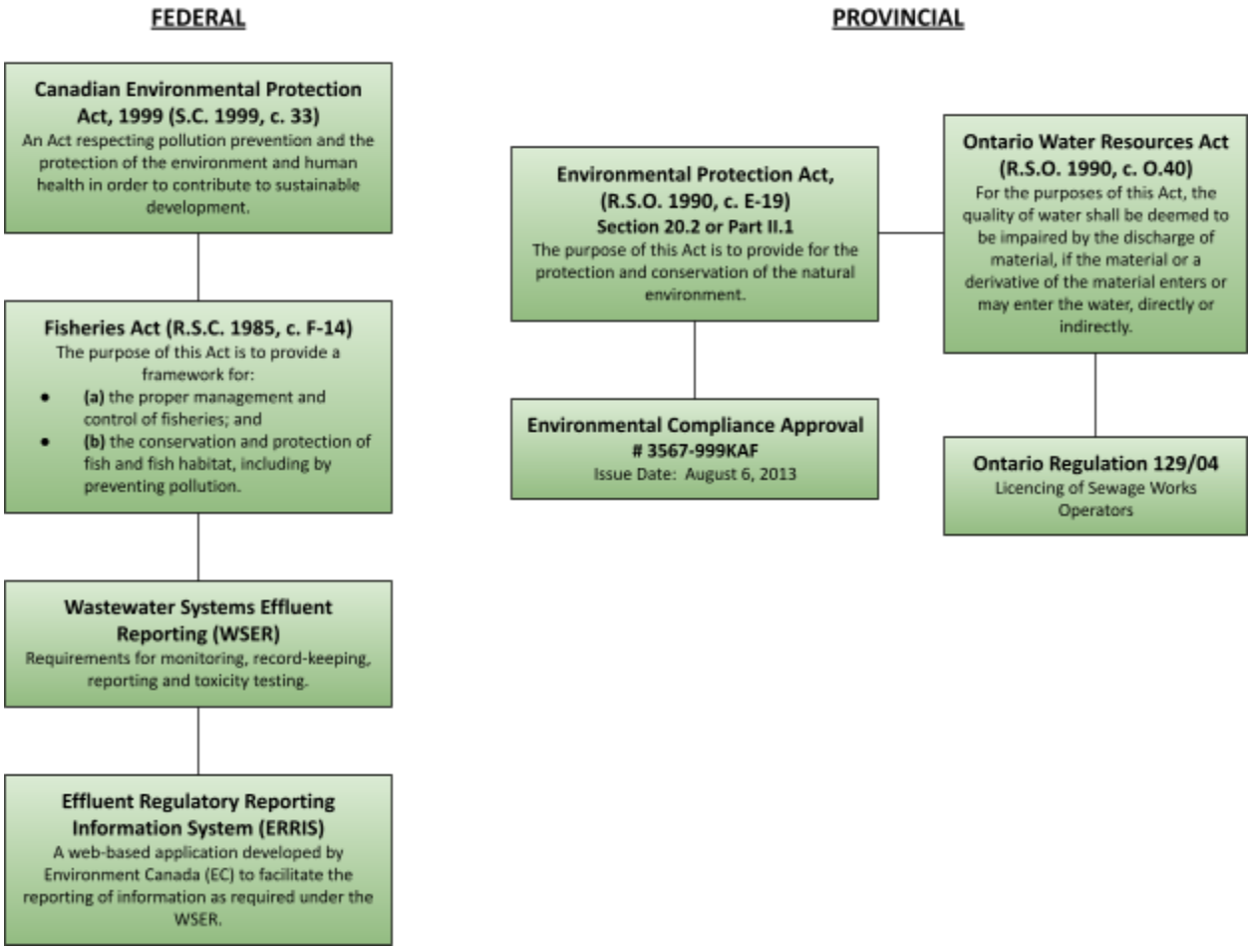
Resourcing the world

Legislative Framework for Lucknow Sewage Treatment Works



EXECUTIVE SUMMARY:

This report is a summary of the Lucknow Sewage Treatment Works performance in accordance with the Ministry of the Environment, Conservation and Parks (MECP) Amended Environmental Compliance Approval (ECA) No. 35667-999KAF, Issued: August 6, 2013 for the 2022 operating year.

DESCRIPTION OF FACILITIES: Works Number: 110002764

Component	Location
Sewage Pumping Station	432 Inglis Street - Northeast of the Ackert Drain
Aerated Ponds (Lagoons)	65 Washington St - Lots 53 and 54, Conc. 1
Winter/Emergency Storage Lagoon	65 Washington St - Lots 54 and 55, Conc. 1
Infiltration Basin System	65 Washington St - Lot 54, Conc. 1
Groundwater Seepage to Swale	65 Washington St - Lot 55, Conc. 1
Collection System	Village of Lucknow

SEWAGE PUMPING STATION

- Wet well structure (4.70 m x 2.10 m x 10.83 m deep)
- One (1) raw sewage pump (15 hp), 8.68 L/s
- Two (2) raw sewage pumps (40 hp each), 32.5 L/s each
- Milltronics level sensor
- Volume totalizer (magnetic flow meter)
- Endress + Hauser data logger for flows
- Standby generator (100 hp), 935 L diesel fuel tank and containment
- Force Main: 2,600 m x 200 mm diameter
- Bypass Pipe: 150 mm diameter, 0.6096 m long, 0.4064 m high

STABILIZATION PONDS (LAGOONS)

- Aluminum sulphate storage tank (27,000 L) and containment
- Alum metering pumps, max. 44 L/hour (one duty, one standby)
- Cell No. 1, 2, and 3: 10,700 m^3 each cell
- 4.0 m liquid depth, 0.9 m freeboard each cell
- Aerators (Cell No. 1 and 2): Flygt submersible pumps, self-aspiring Oxyjet (2 per cell)

WINTER STORAGE LAGOON (EMERGENCY STORAGE)

- Total operating volume: 67,500 m³
- 3.0 m liquid depth, 0.6 m freeboard

INFILTRATION BASIN SYSTEM

- Infiltration basin pumping station
  - 2.4 m precast concrete wet well structure
  - Two (2) submersible sewage pumps, 16.5 L/s (each)
- Splitter box structure
- Six (6) infiltration basins
- Bottom dimensions: 10.0 m x 7.0 m (each)
- Top-of-Berm dimensions: 16.0 m x 13.0 m (each)
- Total depth: 1.0 m (each)

EFFLUENT-GROUNDWATER REGIME

- Groundwater discharge/seepage conduit
- Maximum daily flow rate: 1,000 m³/day
- Sampling location: 100 mm diameter tile

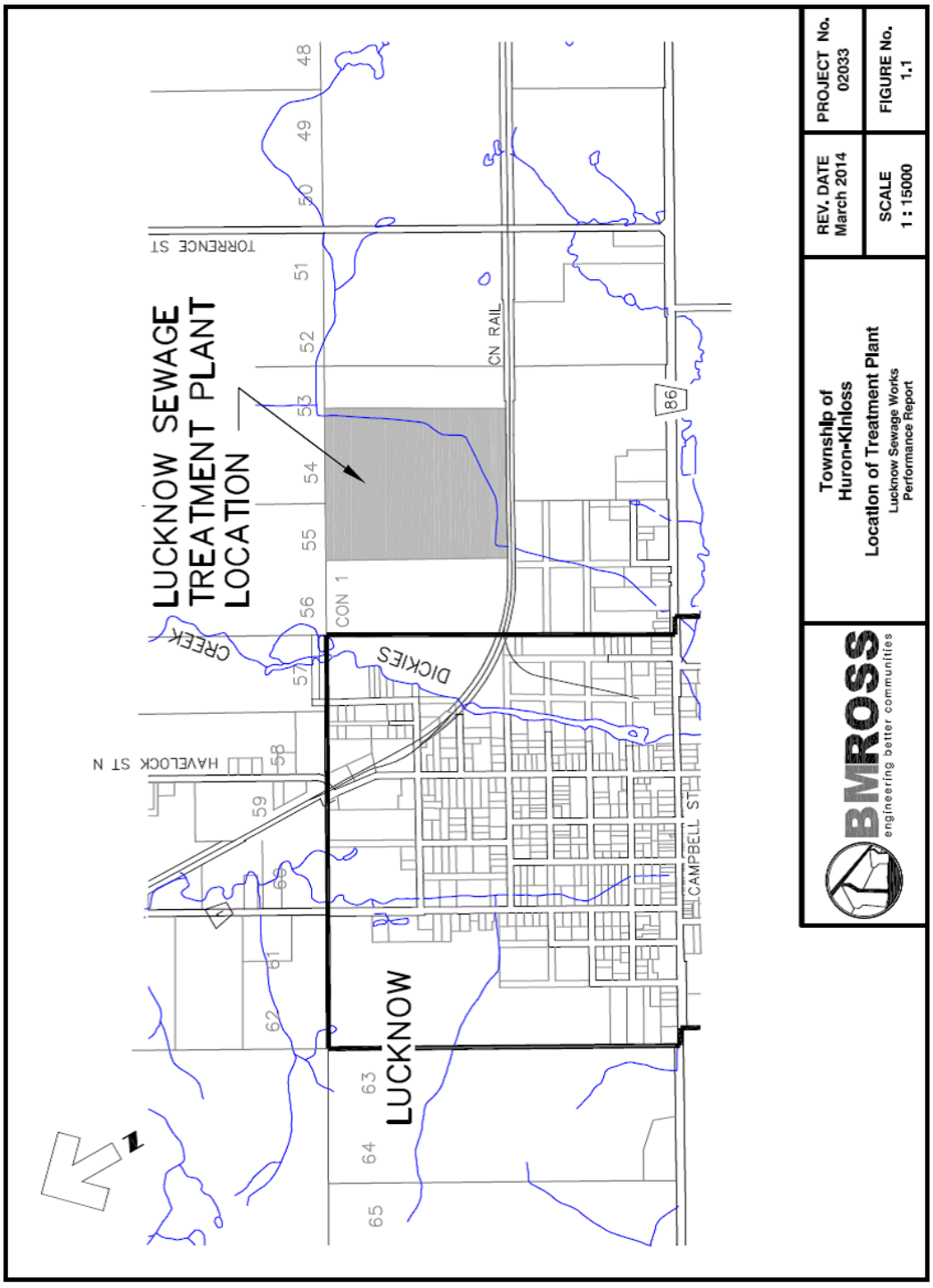
UNIT PROCESS:

In 2022, the sewage treatment works was operated as follows:

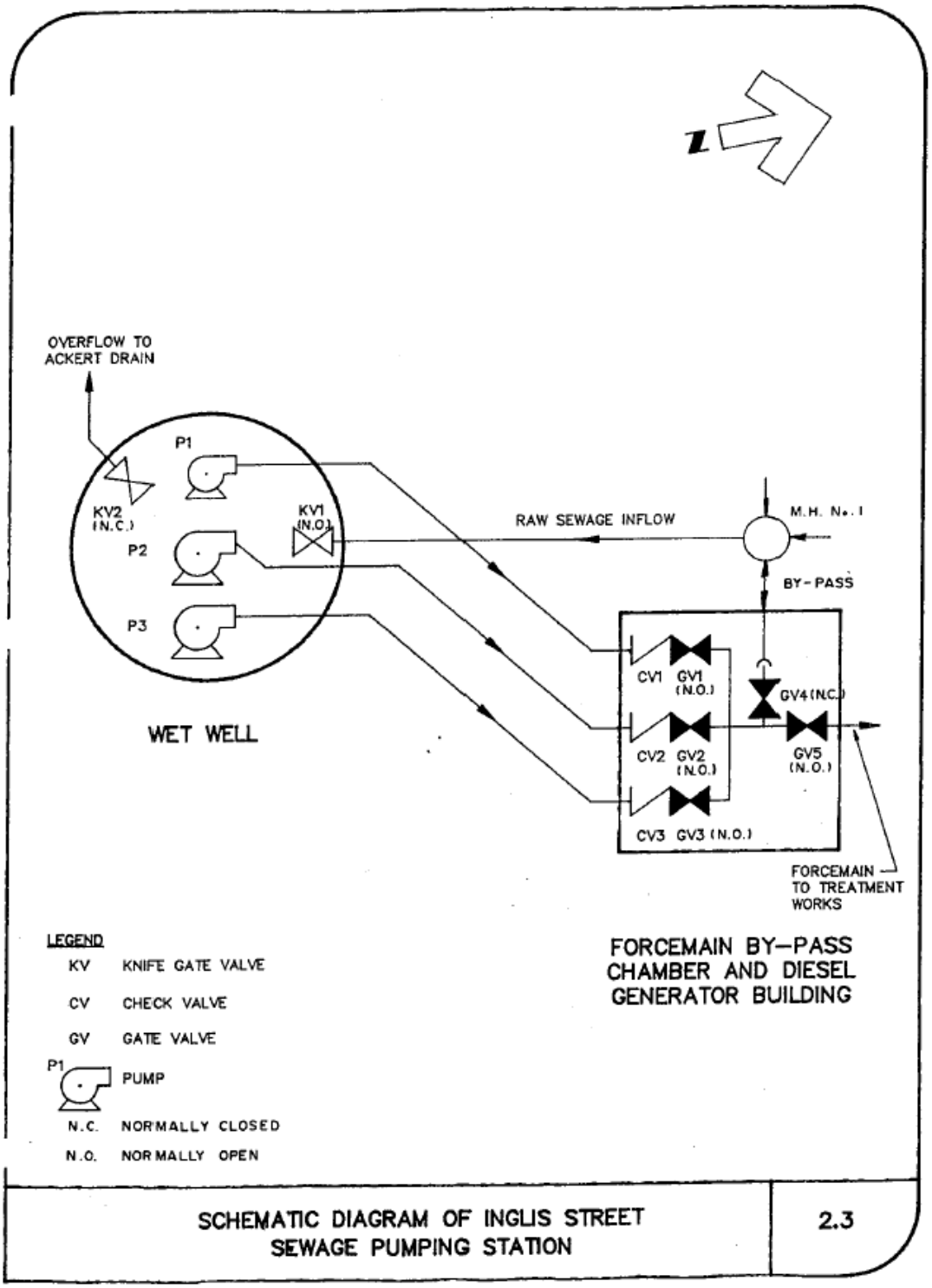
Raw sewage from the Inglis Street Sewage Pumping Station was pumped to Lagoon Cell # 1, where aluminum sulfate is added to aid in phosphorus removal. From Cell # 1 the sewage was fed into Cell # 2, and then finally into Cell # 3 in series configuration. The treated effluent from Cell # 3 was continually discharged to the Infiltration Basin Pumping Station, then on to the Rapid Infiltration Basins (RIBs). The Splitter Box at the Infiltration Basin Pumping Station was manually controlled to distribute the effluent across the Rapid Infiltration Basin, each of which are interconnected with overflow pipes.

The Lucknow Sewage Treatment Works has been approved to treat sewage at a rated capacity of 750 m³ per day, based on the arithmetic mean of 365 consecutive days flow. During 2022, the Lucknow Sewage Treatment Works was below the Non-Compliance Limits as set forth in the Environmental Compliance Approval, with the exception of a brief period in late fall where the total ammonia monthly average was just over the limit in October and November.

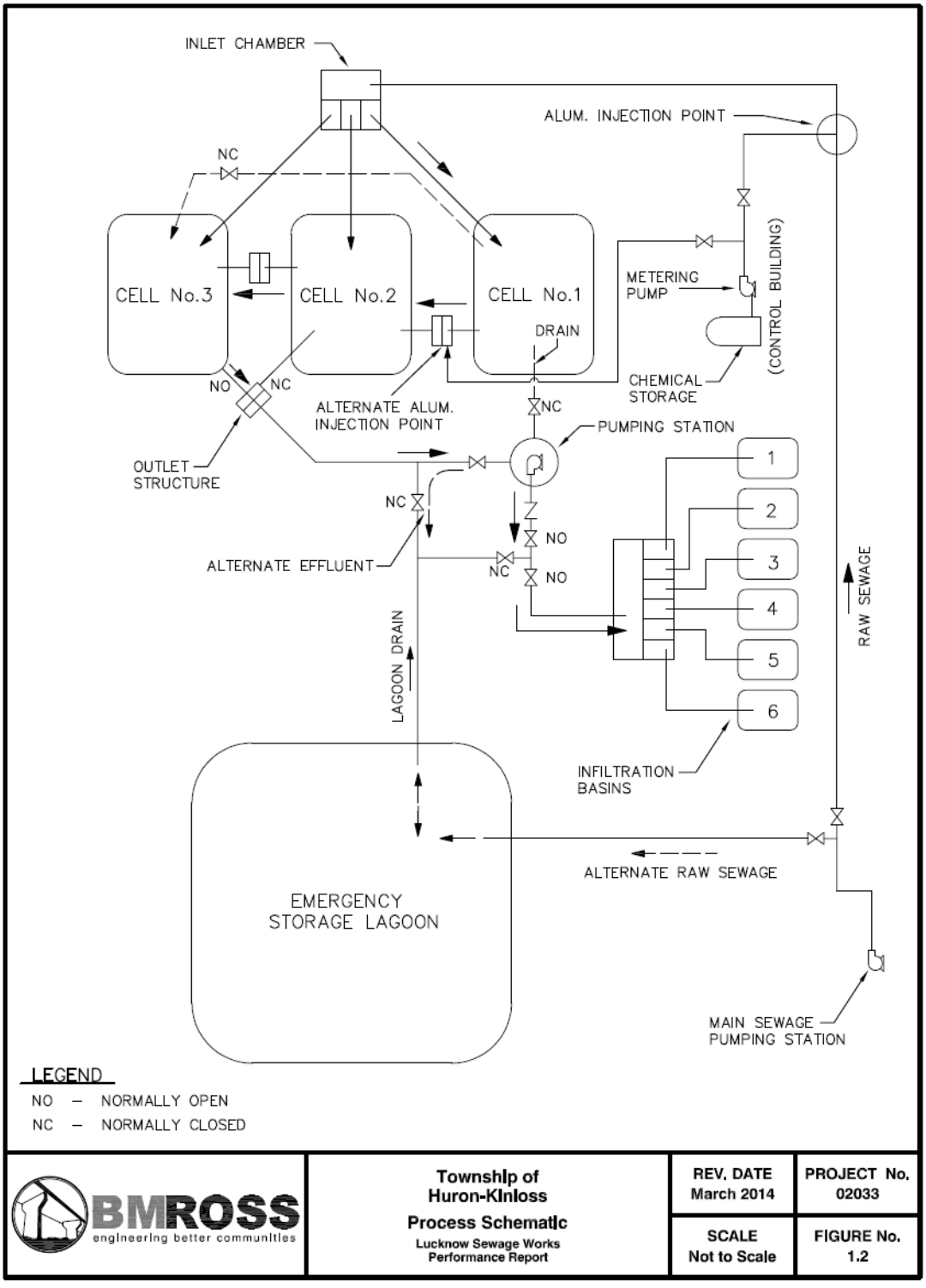
Lucknow Sewage Treatment Plant Map



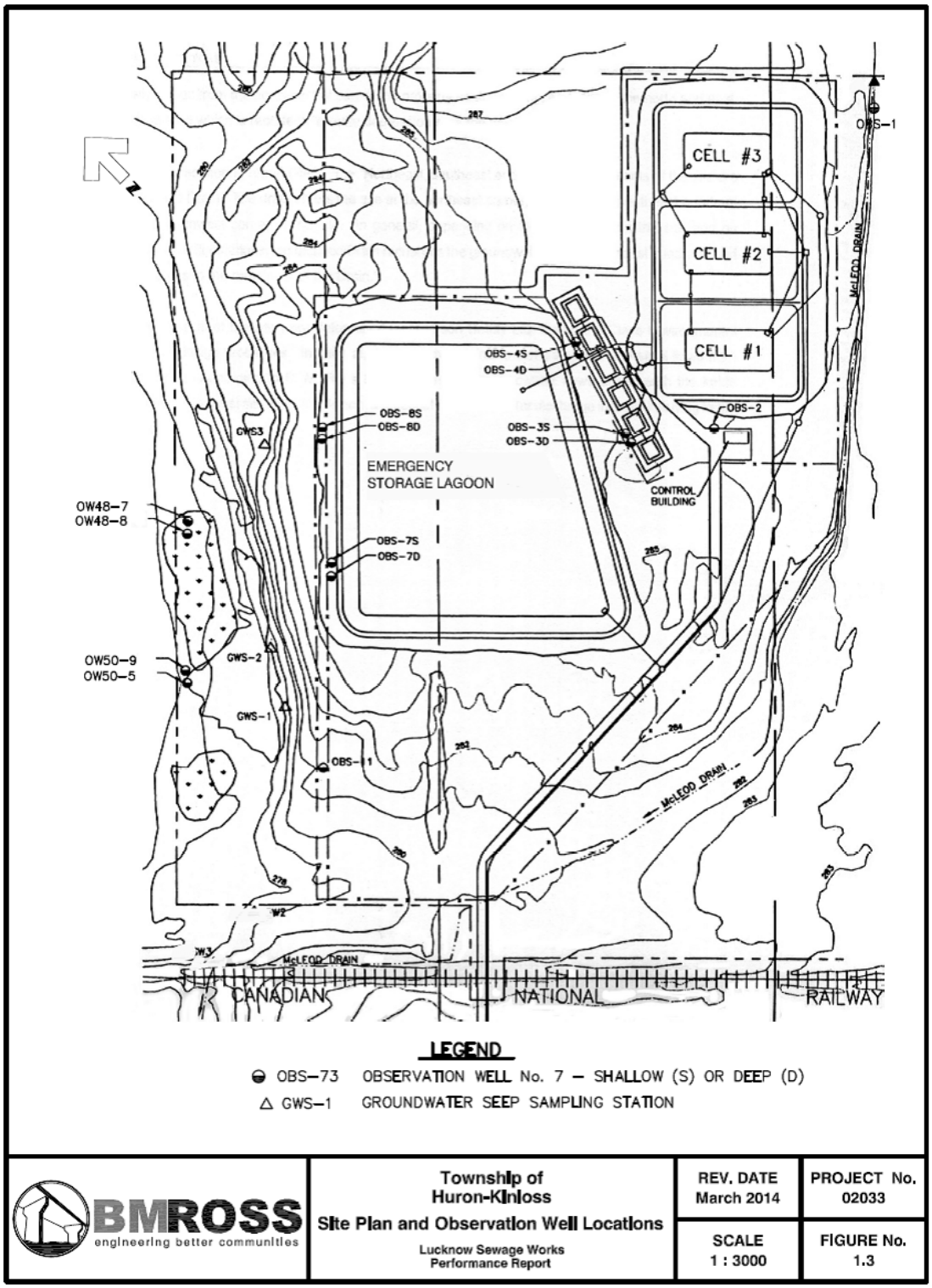
Lucknow Sewage Pumping Station Schematic



Lucknow Sewage Lagoon Schematic



Lucknow Sewage Lagoon Aeration Cell Schematic



BY-PASSES:

There were no By-passes or Plant Overflows at the Lucknow Sewage Treatment Works in 2022.

RAW INFLUENT:

Flow data for the reporting period was obtained from the utility monitoring system records maintained by Veolia, the operator of the works. The flows are recorded from a magnetic flow meter located in the Sewage Pumping Station at 432 Inglis Street. The flow meter was not calibrated in 2022.

All of the influent flow from the Village of Lucknow is pumped to the Sewage Treatment Facility via the Sewage Pumping Station. Below is a summary of the 2022 monthly flows as reported by Veolia. The annual average daily flow during 2022 was 609 m^3/day, which is in compliance with the rated capacity of 750 m^3/day stated in the ECA.

Influent Flow: **Rated Capacity: 750 m^3/day**

Date	Volume, m^3	Daily Max, m^3	Daily Min, m^3	Average, m^3	Capacity, %
January	16,303	746	331	525.9	70.1%
February	22,524	1,552	398	804.43	107.3%
March	29,054	1,380	479	937.23	125.0%
April	24,760	1,200	390	825.33	110.0%
May	18,504	817	339	596.90	79.6%
June	18,275	1,010	321	609.17	81.2%
July	14,248	611	331	459.61	61.3%
August	14,816	713	272	477.94	63.7%
September	13,606	676	242	453.53	60.5%
October	17,343	1,050	182	559.45	74.6%
November	15,146	789	302	504.87	67.3%
December	17,584	1,061	344	567.23	75.6%
Total	222,163				**81.2%**
Maximum	29,054	1,552			
Minimum	13,606		182		
Average	18,514			608.67	

Raw Sewage Sample Results (collected Quarterly):

Date	BOD_5	Total Kjeldahl Nitrogen	Total Phosphorus	Total Suspended Solids
January	347	37.4	4.60	283
April	111	12.7	1.38	240
July	380	26.0	2.96	155
October	200	18.3	2.01	176
Average	260	23.6	2.74	214
Total # Samples	4	4	4	4

Aluminum Sulfate Liquid (48.5%) Usage

Aluminum Sulphate (alum) is added to the raw water at the Luckow Lagoon facility. Alum acts as a coagulant and flocculant that adsorbs and precipitates soluble phosphorus and other compounds such as organic matter, forming clumps that settle to the bottom of the lagoon. Typical alum dosages for wastewater treatment are between 50 - 200 mg/L.

Aluminum Sulfate Usage:

Month	Volume, L	kg	Dosage, mg/L
January	1,914	1,239	79.1
February	1,538	995	47.8
March	1,680	1,088	8.8
April	1,743	1,129	45.4
May	1,386	897	47.8
June	1,722	1,115	63.3
July	1,575	1,020	71.6
August	1,640	1,184	83.0
September	1,890	1,224	92.0
October	2,373	1,536	96.6
November	1,791	1,160	79.7
December	1,909	1,236	71.4
Total	21,160	13,822	---
Average	58 L/day	37.9 kg/day	68.2 mg/L / day

EFFLUENT OBJECTIVES:

The *Owner* shall use best efforts to design, construct and operate the *Works* with the objective that the concentrations of the materials named below as effluent parameters are not exceeded in the effluent from the aerated lagoon system (Cell # 3):

Aerated Lagoon Effluent Objectives (Cell # 3)	
Effluent Parameter	**Average Concentration (mg/L)**
$CBOD_5$	20.0
Total Suspended Solids	20.0
Total Phosphorus	1.0

The *Owner* shall use best efforts to:

(a) maintain the pH of the effluent from the *Works* within the range of 6.5 - 8.5, inclusive, at all times;
(b) operate the *Works* within the *Rated Capacity* of the *Works*;
(c) ensure that the effluent from the *Works* is essentially free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film or sheen or foam or discolouration on the receiving waters.

Aerated Lagoon Effluent (Cell # 3) Sample Results (collected Monthly):

Date	Total Ammonia	Free Ammonia	$CBOD_5$	E. Coli	TP	TSS	Field DO	Field pH	Field Temp. °C
January	9.0	0.062	12	470	0.13	11	8.90	7.56	5.7
February	15.8	0.048	5	460	0.28	5	4.81	7.26	6.2
March	16.8	0.030	6	510	0.26	7	6.73	7.29	7.9
April	11.2	0.101	4	52	0.08	9	11.91	7.80	11.5
May	10.9	1.02	17	30	0.10	12	7.50	8.01	17.6
June	14.2	0.175	9	74	0.15	16	6.75	7.58	20.6
July	4.2	0.109	15	60	0.19	**38**	6.33	7.72	22.2
August	4.0	0.041	15	630	0.16	**27**	3.85	7.42	22.5
September	2.0	0.027	12	280	0.13	**34**	4.11	7.51	19.7
October	1.8	0.028	10	268	0.08	16	10.46	8.12	15.3
November	4.8	0.346	16	320	0.10	**22**	12.58	8.41	10.4
December	10.6	0.183	14	520	0.11	**31**	11.86	8.15	6.8
Average	8.2	0.169		211*	0.14	19	7.84	7.72	14.2
Objectives	--	--	20.0	--	1.0	20.0	--	6.5-8.5	--

*Average Monthly Geometric Mean Density

NOTE: The laboratory reports Provincial Unionized Ammonia which is calculated from total ammonia, field pH and field temperature provided on the Chain of Custody form and is the same as Free Ammonia.

EFFLUENT LIMITS

The *Owner* shall operate and maintain the *Works* such that the concentrations of the materials named below as groundwater parameters are not exceeded in the groundwater monitoring well no. GWS-3 (GWSS):

Groundwater Limits	
Effluent Parameter	**Average Concentration (mg/L)**
$CBOD_5$	5.0
Total Suspended Solids	5.0
Total Phosphorus	0.1
Total Ammonia Nitrogen	2.5
Unionized Ammonia	0.1
E. Coli	100 cfu/100 mL (monthly geometric mean density)

For the purposes of determining compliance with and enforcing subsection (1):

(a) The *Monthly Average Concentration* of a parameter shall not exceed the corresponding maximum concentration.

NOTE: Free Ammonia is the same as the provincial Unionized Ammonia calculated from field pH and temperature provided on the Chain of Custody form.

Groundwater Seepage to Swale Sample Results (collected Weekly):

Date	Total Ammonia	Free Ammonia	$CBOD_5$	E. Coli	TP	TSS	DO	pH	Temp. °C
January	0.85	0.003	3	0	< 0.03	2	7.52	7.27	11.1
February	0.55	0.003	< 2	1	< 0.03	1	6.86	7.38	10.8
March	0.78	0.003	< 2	0	< 0.03	3	6.01	7.19	11.2
April	0.68	0.003	< 2	0	< 0.03	1	7.57	7.30	11.8
May	0.48	0.003	< 2	0	< 0.03	1	8.26	7.34	13.2
June	0.80	0.006	< 2	0	< 0.03	1	6.79	7.40	14.8
July	0.80	0.006	< 2	0	< 0.03	1	7.54	7.37	17.0
August	0.70	0.008	< 2	0	< 0.03	1	6.65	7.42	18.2
September	0.90	0.011	< 2	3	< 0.03	1	8.14	7.58	17.0
October	**2.52**	0.019	2	0	0.03	1	7.19	7.45	13.9
November	**3.08**	0.023	3	0	0.03	1	7.17	7.52	12.6
December	2.43	0.012	< 2	0	< 0.03	1	7.06	7.35	11.5
Average	1.21	0.008	2	0	0.03	1	7.21	7.38	13.6
Objectives	2.5	0.1	5.0	100*	0.1	5	---	6.5-8.5	---
Compliant	**NO**	**YES**	**YES**	**YES**	**YES**	**YES**	---	**YES**	---

*Average Monthly Geometric Mean Density, cfu/100 mL.

In October and November, the monthly averages for Total Ammonia were in exceedance of 2.5. The total ammonia exceedances were reported to the Ministry Inspector. There was no obvious explanation for the elevated total ammonia levels.

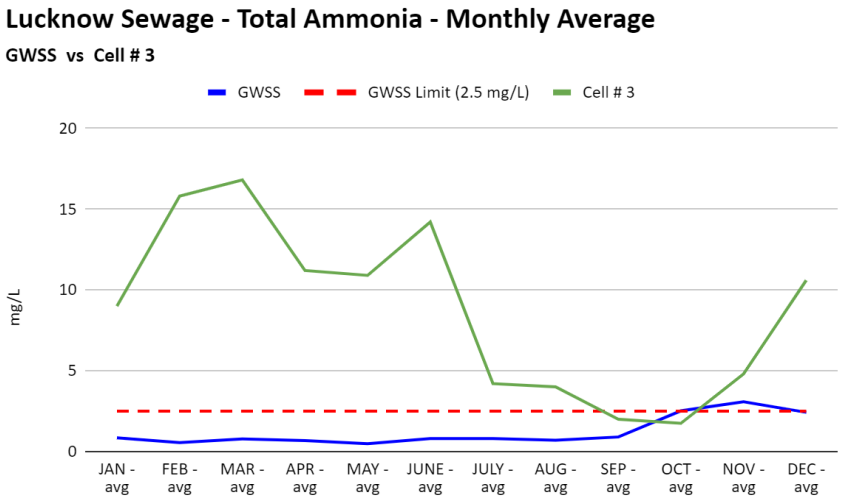


Figure 1

SLUDGE ACCUMULATION:

Sludge accumulates in the bottom of aerated cells. No sludge was removed from the lagoon. The amount of sludge accumulated for 2022 was estimated based on the average amount of solids processed through treatment. The following calculation is taken from the *US Army Corps and Engineers Cold Region Research & Engineering Laboratory, Special Report 84-8, Accumulation, Characterization, and Stabilization of Sludges for Cold Region Lagoons, April 1984.*

Assumptions:
- 65% of Total Suspended Solids in volatile (35% is the actual Total Solids)
- 80% of solids accumulate in Cell # 1
- 15% of solids accumulate in Cell # 2
- 5% of solids accumulate in Cell # 3
- Concentration of solids is 30% by mass (300 kg/m³)
- Lagoon Retention Time is 12 days each cell (36 days total)
- Sludge Specific Gravity is 1.3

Known:

Lagoon Cell Count:	3
RIB Cell Count:	6
TSS - Raw:	231 mg/L
TSS - Cell # 3:	17 mg/L
TSS - GWSS:	1.3 mg/L
Average Flow:	573 m³/day

Density of water:	1,000 kgm^{-3}
Lagoon Cell Surface Area:	973.75 m^2 each (47.5 m x 20.5 m at bottom)
RIB Cell Surface Area:	70.0 m^2 each (10.0 m x 7.0 m at bottom)

Calculations:

Annual Accumulated Solids:

$$TS_i = SS_i \times Q \times t(365)\ 10^{-3}$$

Where
TS_i = total solids into lagoon over operating time, t, (kg)
SS_i = influent suspended solids concentration, (mg/L)
Q = average daily inflow, (m^3/day)
t = operating time of lagoon, (year)

Raw TS_i = 231 mg/L x 573 m^3 x 1(365) 10^{-3}
= 48,312 kg
Subtract 65% volatiles (31,403 kg)
= 16,909 kg Total Raw Solids

Cell # 3 TS_i = 17 mg/L x 573 m^3 x 1(365) 10^{-3}
= 3,555 kg
Subtract 65% volatiles (2,311 kg)
= 1,244 kg Total Solids at Cell # 3

GWSS TS_i = 1.3 mg/L x 573 m^3 x 1(365) 10^{-3}
= 272 kg
Subtract 65% volatiles (177 kg)
= 95 kg Total Solids Lost in Final Effluent

Solids Removed:

Total Solids Removed = Total Raw Solids - Total Remaining Solids
= 16,909 kg - 1,244 kg
= 15,665 kg Total Solids Removed by Lagoon Cells

Total Solids to RIBs = Total Solids at Cell # 3 - Total Solids at GWSS
= 1,244 kg - 95 kg
= 1,149 kg Total Solids to RIBs

Total Solids Removed (kg) converted to Total Solids Removed (m^3):

Total Solids Removed = 15,665 kg Total Solids Removed ÷ 300 kg/m^3
= 52.2 m^3 Total Solids Removed by Cells
(Assume concentration of solids is 30% by mass)

Annual Accumulation of Sludge:

Sludge Added At Cells	= 52.2 m^3 ÷ 973.75 m^2 (Cell surface area) x 1000
	= 53.6 mm Annual increase of Sludge
	= 42.9 mm in Cell # 1 (80%)
	= 8.0 mm in Cell # 2 (15%)
	= 2.7 mm in Cell # 1 (5%)
Sludge Added At RIBs	= 1,149 kg Total Solids to RIBs ÷ 300 kg/m^3
	= 3.8 m^3 Total Sludge Depth to RIBs
	= 1.3 m^3 ÷ 70.0 m^2 (RIB surface area) x 1000
	= 54.3 mm Annual Increase of Sludge
	= 9.1 mm in each RIB (54.3 ÷ 6 RIBs)

Using this calculation, values were reviewed from 2008 to 2022, and the annual average sludge accumulation is approximately 43 mm total. With this information, it was estimated that the running total accumulation since the sludge was removed in 2004 is approximately 816 mm (Cell # 1: 654 mm, Cell # 2: 123 mm, Cell # 3: 41 mm). See **Figure 2** for historical trending of estimated average annual accumulation of sludge. **Figure 3** illustrates the running total of estimated annual accumulation of sludge.

"SLUDGE JUDGE" TESTING

"Sludge Judge" testing was not conducted in 2022. The last testing was performed near the end of the summer in 2016. At that time, all three lagoon cells were probed using a core sampling device to measure the actual depth of biosolids contained in each of the three lagoon cells.

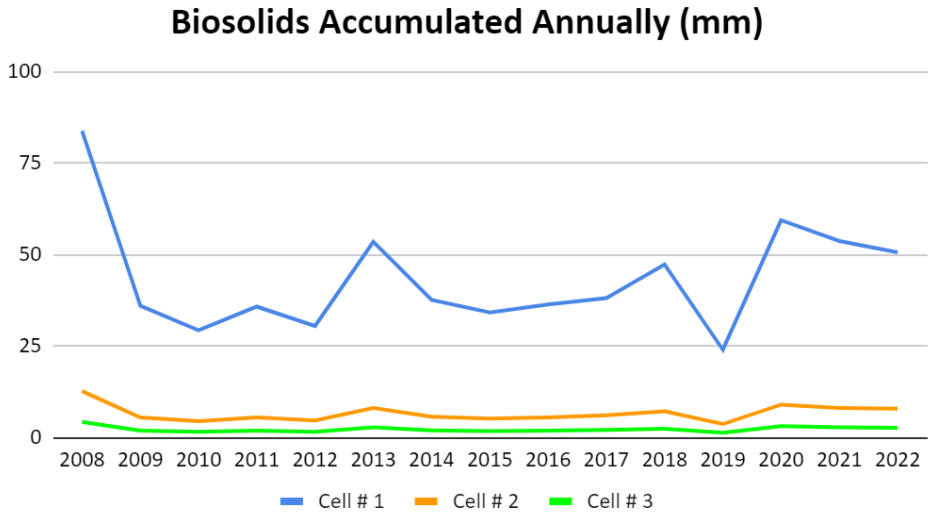


Figure 2

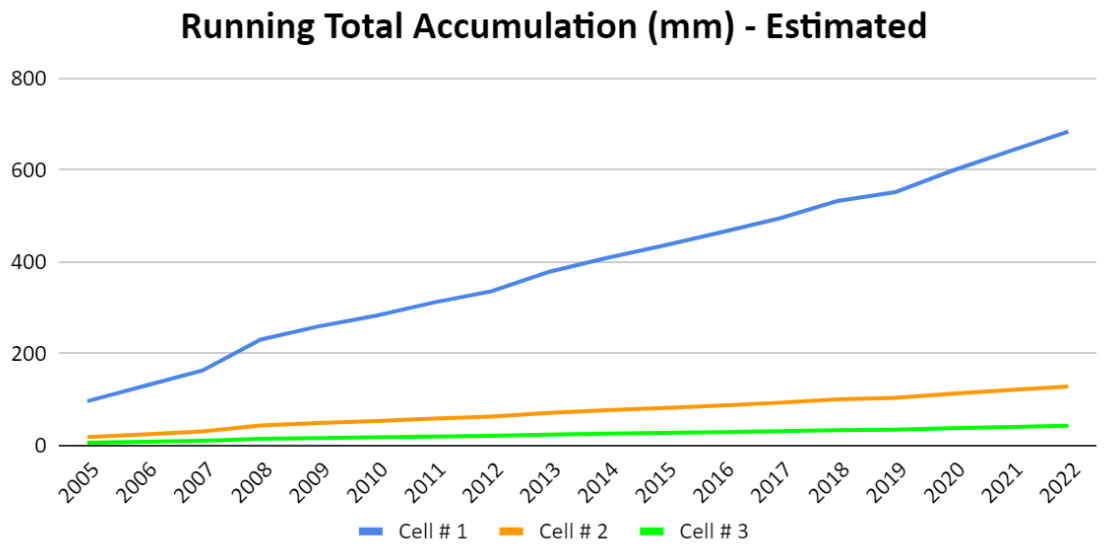


Figure 3

Other Observations:

- No complaints were reported for the period under review
- No sewage bypasses were reported for the period under review
- No modifications to the treatment system were carried out during the period under review, however, aerator issues persisted for most of the year resulting in 2 aerators being replaced. A third aerator will be replaced in 2022.
- There were several significant precipitation events in 2022 (>15 mm/24 h):
    - February 2, 17
    - March 23
    - June 7
    - July 20, 27
    - August 3, 25, 29
    - September 4, 26, 27
    - October 18, 19
- High flows combined with the degrading performance of the Rapid Infiltration Basins resulted in diverting the effluent from Cell # 3 to the Winter Storage Lagoon in October. During this time, Cell # 3 was sampled during the weeks that diversion was taking place. The RIBs were excavated during this time and the media was replaced.

Infiltration Analysis:

Wastewater flows were compared to the drinking water flows in an effort to estimate the amount of infiltration observed within the sewage collection system. Higher summer drinking water flows are likely related to lawn watering endeavours. Higher sewage flows in February were related to heavy rain events, and a spring thaw occurred in March.

Historical maximum day flows for each month provide some indication that direct inflow from storm water is occurring at times. Action should be considered to identify and remove any illegal sanitary connections that exist.

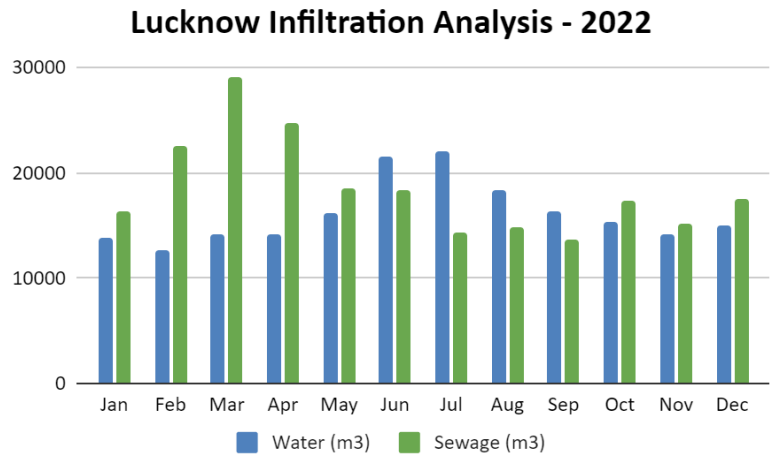


Figure 4

Weather and Precipitation: (source: Environment Canada)

Month	Goderich			Mount Forest		
	Temp, °C Min	Temp, °C Max	Precip Total, mm	Temp, °C Min	Temp, °C Max	Precip Total, mm
Jan	-21.9	3.3	25.9	-27.2	2.0	31.0
Feb	-21.1	7.7	54.0	-27.1	6.3	95.6
Mar	-11.4	18.3	58.1	-15.0	16.8	81.5
Apr	-4.4	25.2	54.2	-5.8	24.6	69.0
May	1.1	27.9	52.6	2.2	29.5	52.6
Jun	4.0	30.4	77.4	4.3	31.5	53.4
Jul	8.2	30.8	19.7	8.8	30.6	65.8
Aug	8.6	30.2	98.4	6.8	30.3	110.9
Sep	3.0	28.3	59.6	1.9	28.2	66.9
Oct	-1.3	23.7	87.6	-1.6	22.0	46.8
Nov	-5.3	22.8	44.3	-9.1	21.2	55.3
Dec	-11.5	11.8	54.1	-14.8	8.2	88.0
TOTAL			**685.9**			**816.8**

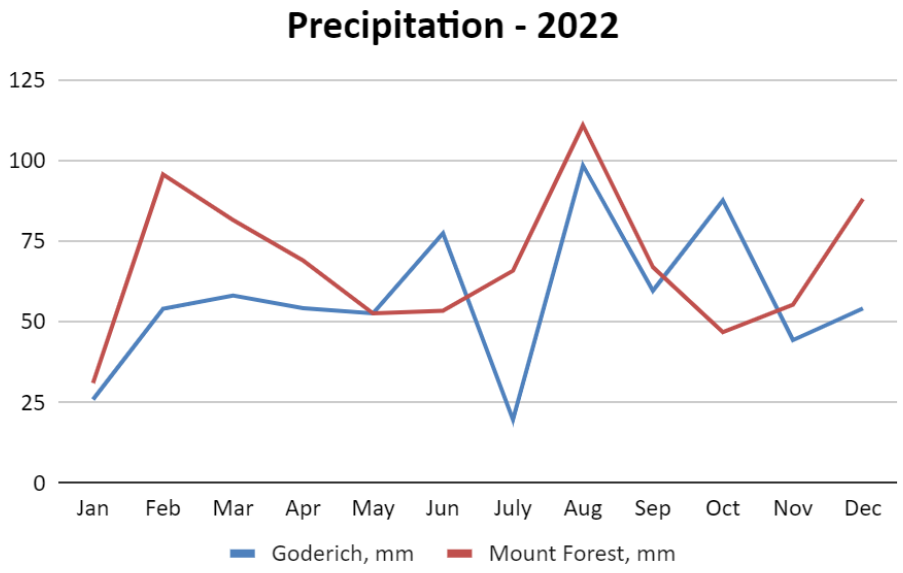


Figure 5

Lucknow River Flows: (source: Government of Canada Real-Time Hydrometric Data)

Summary	m³/s		
Month	**Min**	**Max**	**Avg**
Jan	0.251	18.90	1.545
Feb	0.360	28.70	1.625
Mar	0.322	17.40	2.509
Apr	0.310	21.10	2.235
May	0.203	2.25	0.676
Jun	0.094	10.40	0.602
Jul	0.026	5.84	0.294
Aug	0.059	6.00	0.258
Sep	0.056	22.50	0.420
Oct	0.056	7.56	0.652
Nov	0.108	10.70	1.318
Dec	0.286	22.60	1.514
Min	0.026		
Max		28.70	
Avg			1.137

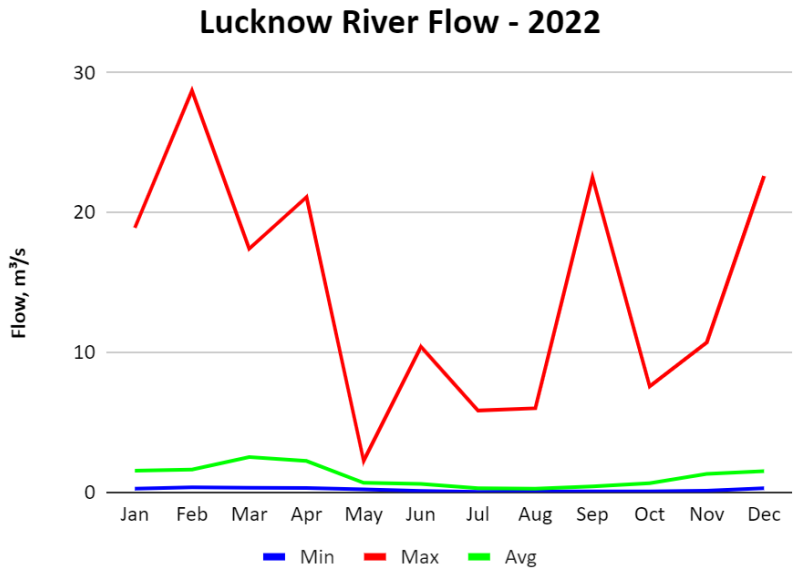


Figure 6

Operational Problems, Corrective Actions, and Maintenance:

Date	Site	Comments
Feb 10	Lift Station	RSP 2 failed; removed from service (short in the motor)
Feb 17	LIft Station and Lagoon	High flows
Mar 2	Lift Station	Installed RSP 1; removed RSP 2 - sent to Cornish Industries for rebuild
Mar 7	Lift Station	Hooked up emergency rental pump
Mar 8	Lift Station	CT Environmental onsite to clean out wet well
Mar 16	Lift Station	High level alarm - 20.46% - manhole checked (not above red line)
Apr 13	Lagoon	Cell # 1 South aerator #2 close to bank edge (cable snapped)
Apr 14	Lagoon	Install new cable on aerator # 2 in south cell
May 22	Lagoon	Aerator # 2 not working - will not reset
May 24	Lift Station	Power outage
May 26	Lagoon	North cell aerator # 1 - remove from service
Jun 3	Lift Station	Install RSP 2
Jul 13	Lift Station	Diesel generator annual service (Sommers); CT Environmental onsite to clean out wet well
Jul 13	Lagoon	CT Environmental onsite to dump contents of wet well
Jul 21	LIft Station and Lagoon	Pollock Electric onsite to replace lights
Jul 27	Lagoon	Work on new Aerator installation
Jul 28	Lagoon	Pollock Electric onsite RE connections for Aerator # 3
Aug 3	Lagoon	Aerator # 2 and 4 off - overload - reset ok
Aug 4	Lift Station	Backflow preventer inspection (Ferguson's)
Aug 4	Lagoon	Pollock Electric - Aerator # 2 and 3 - check equipment/area - ok
Aug 6	Lagoon	Pollock Electric to restart aerator # 3 and wire # 2 - install temp contactor # 2
Sep 12	Lagoon	Septic tank repair

Operational Problems, Corrective Actions, and Maintenance - Continued

Date	Site	Comments
Oct 4	Lagoon	Aerator # 3 failed
Oct 13	Lagoon	FE pump tripped - overload - reset ok
Oct 17	Lagoon	Kempton/Township onsite for RIB dig
Oct 24	Lagoon	Switch FE flow to RIBs
Nov 4	Lift Station	RSP 2 failure - offline - changed autodialer delay to 3 min (was 20 min)
Nov 6	Lagoon	Power outage
Nov 16	Lift Station	Dale Pump onsite to pull RSP 2 - reinstall and return to service
Nov 19	Lagoon	Aerator # 3 failed - could not reset
Dec 24 - 27	Lagoon	No site visits - roads closed, access road not plowed

Performance Summary Based on Annual Averages:

Below is a summary of the overall effectiveness of the treatment of raw sewage from its entry to the Works though the groundwater regime.

Performance Summary:

Parameter	Raw Sewage	Cell # 3 Effluent	Design Objective	Groundwater Seepage	Non-Compliance Criteria	% Reduction Plant	% Reduction Groundwater	% Reduction Overall
BOD_5	260	14	–	2.3	–	94.8%	4.3%	99.1%
$CBOD_5$	260	11	20.0	2	5.0	95.7%	3.5%	99.2%
TSS	214	19	20.0	1	5.0	91.2%	8.1%	99.4%
Total Ammonia	—	8.2	--	1.21	2.5	--	--	--
Total Phosphorus	2.74	0.14	1.0	0.03	0.10	94.8%	4.1%	98.9%
E. Coli (CFU/100 mL)	—	211	--	0	100*	--	--	--
Free (Unionized) Ammonia	—	0.169	--	0.017	0.10	--	--	--

*Average Monthly Geometric Mean Density

CONCLUSIONS AND RECOMMENDATIONS

The following are the conclusions and recommendations resulting from the analysis of operating and monitoring data for the Lucknow Sewage Treatment Facility during 2022:

1. The annual average sewage influent flow was 609 m³/day in 2022, as determined by the flow measuring instrumentation in the Lucknow Sewage Pumping Station. Given that the approved flow to the works is 750 m³/day, the works operated at 81.2% of the design capacity. The 2022 average daily flow is 5.7% higher than the average flow during the previous four years (576 m³/day).

   Historically, maximum day flows will typically be greatest during spring months and be lowest during the summer months. During 2022, the maximum day trend was characteristic, with the maximum day flow of 1,552 m³/day occurring in February.

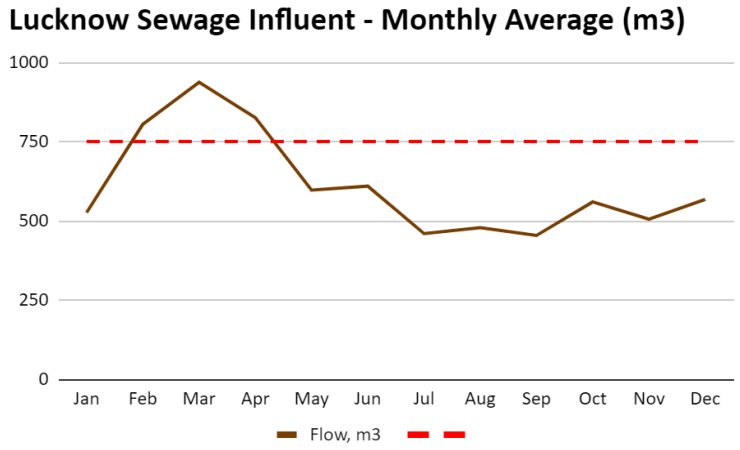


Figure 7

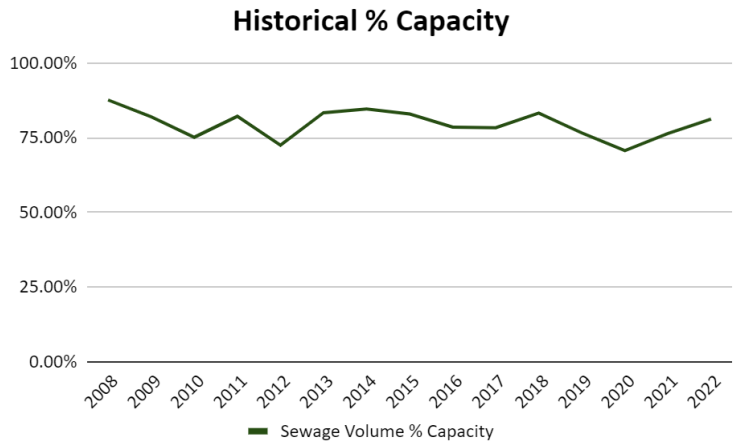


Figure 8

HISTORICAL FLOW SUMMARY (Precipitation source: Environment Canada)

Year	Max Volume	Avg Volume	% Capacity	Total Volume	Mount Forest	Goderich
	m3	m3		m3	Total Precip, mm	Total Precip, mm
2008	2,884	662	87.6%	240,376	1,251.8	1,269.6
2009	2,968	613	82.0%	224,328	990.7	767.7
2010	1,534	563	75.1%	205,574	926.9	736.1
2011	1,698	618	82.1%	224,811	1,102.2	1,018.0
2012	1,056	545	72.4%	198,836	693.4	600.3
2013	2,131	627	83.3%	228,012	1,174.5	944.5
2014	3,195	638	84.6%	231,469	908.6	812.2
2015	1,500	623	82.9%	226,994	773.5	663.5
2016	2,442	597	78.5%	215,455	933.5	895.0
2017	1,949	592	78.3%	214,370	1,044.3	981.2
2018	3,005	627	83.2%	227,710	912.7	915.6
2019	1,618	575	76.5%	209,540	332.5	777.8
2020	2,282	530	70.6%	193,892	745.7	675.2
2021	2,164	572	76.4%	209,068	941.8	909.8
2022	1,552	609	81.2%	222,163	816.8	685.9
4-Year Average	**2,267**	**576**	**76.7%**	**210,053**	**733.2**	**819.6**

2. Raw sewage concentrations and loadings for BOD_5, TKN, TP and TSS have remained relatively consistent since 2016, however, in 2022, loadings were slightly higher than typical domestic sewage loadings on a per capita basis, with the exception of Total Phosphorus:

Parameter	Typical Loadings (mg/L)	2022 Loadings (mg/L)	% Difference
BOD_5	170	260	53% higher
TKN	35	23.6	—
TP	7	2.74	61% lower
TSS	200	214	7% higher

3. Effluent quality, as measured at the effluent structure (GWSS), remained excellent throughout 2022, however an upward trend in Total Ammonia was observed in late summer and into the fall. Recent results indicate that it is trending back down.

4. Based on the calculated removal rates of 98.9% to 99.4%, it is concluded that the Lucknow Sewage Treatment Facility provided excellent treatment of sewage in 2022.

Additional Information:

Municipal Utility Monitoring Program Reports (MUMP)

The monthly compilation forms of discharge data are submitted annually to the Ministry. The Ministry uses these forms to publicly report Municipal monitoring data. Please note that the Ministry has revised the format in which this data is uploaded to their website. The Ministry is no longer accepting locally generated reports to be submitted by email. Instead, Operators are required to use the Ministry-provided on-line forms available in the MECP form repository. These forms are populated with appropriate data for submission directly to the Ministry's database and are not included with this report.

Infiltration-Inflow Investigations

In the fall of 2019, the Municipality retained the services of BM Ross and initiated sanitary sewer flow monitoring, and a comprehensive in-sewer flow metering program was conducted from October 2020 to June 2021. During that period, 149 of the 168 manholes were inspected; 19 were inaccessible. Debris was removed from the north quadrant (45 manholes) on November 18, 2020.

The following results were reported:

- The existing annual average Infiltration-Inflow (I-I) flows are lower than expected extraneous values for older collection systems.
- Extraneous flow issues were obvious in the northeast and southwest edges of Lucknow.
- Infiltration (groundwater seepage into the collection system) was more significant than inflow (water entering from the surface, any conduits and illegal connections).
- 38 manholes (23%) were identified as contributing infiltration.
- Inflow (directly related to precipitation) is not significant, and infiltration in general is not significant, but is widely dispersed throughout the collection system.

BM Ross Infiltration-Inflow Recommendations:

1. On-going efforts to locate and address contributing locations.
2. An on-going program of investigation and maintenance will prevent the collection system from worsening with age:
    a. CCTV Inspections: These should take place in spring or fall when infiltration and inflow is expected to be present.
    b. Manhole Repairs: A program of manhole repairs should be developed, starting with the areas suspected to have the most infiltration and inflow.