Lucknow Wastewater Treatment Facility
2023 Operation and Maintenance
Annual Report

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EXECUTIVE SUMMARY:

This report is a summary of the Lucknow Wastewater Treatment Facility's performance in accordance with the Ministry of the Environment, Conservation and Parks (MECP) Amended Certificate of Approval (C. of A) No. 3-0724-88-006, Issued: September 18, 2009, and the Federal Wastewater Systems Effluent Regulations (WSER) for the 2023 operating year.

In late 2022, a new Amended Environmental Compliance Approval No. 0667-C8DN2F, Issued : November 29, 2022, was received. This Amended ECA replaces the Amended C. of A.

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
- Miltronics level sensor
- Volume totalizer (magnetic flow meter)
- Endress + Hauser data logger for flows
- Standby generator (100hp), 935 L diesel fuel tank and containment
- Force Main: 2,600 m x 200 mm diameter
- Bypass Pipe : 150 mm diameter, 06096 m long, 0.4064 m high

WASTE STABILIZATION PONDS (CONVENTIONAL FACULTATIVE LAGOON SYSTEM)

- Aluminum sulphate storage tank (27,000 L) and containment
- Alum metering pumps, max. 44L/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 operative volume : 67,500 m^3
- 3.0 m liquid depth, 0.6 m freeboard

WINTER STORAGE LAGOON (EMERGENCY STORAGE)

- 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 (each)
- Top-of-Berm dimensions : 16.0 m x 13.0 (each)
- Total depth : 1.0 m (each)

EFFLUENT-GROUNDWATER REGIME

- Groundwater discharge/seepage conduit
- Maximum daily flow rate : 1,000 m^3/day
- Sampling location : 100 mm diameter tile

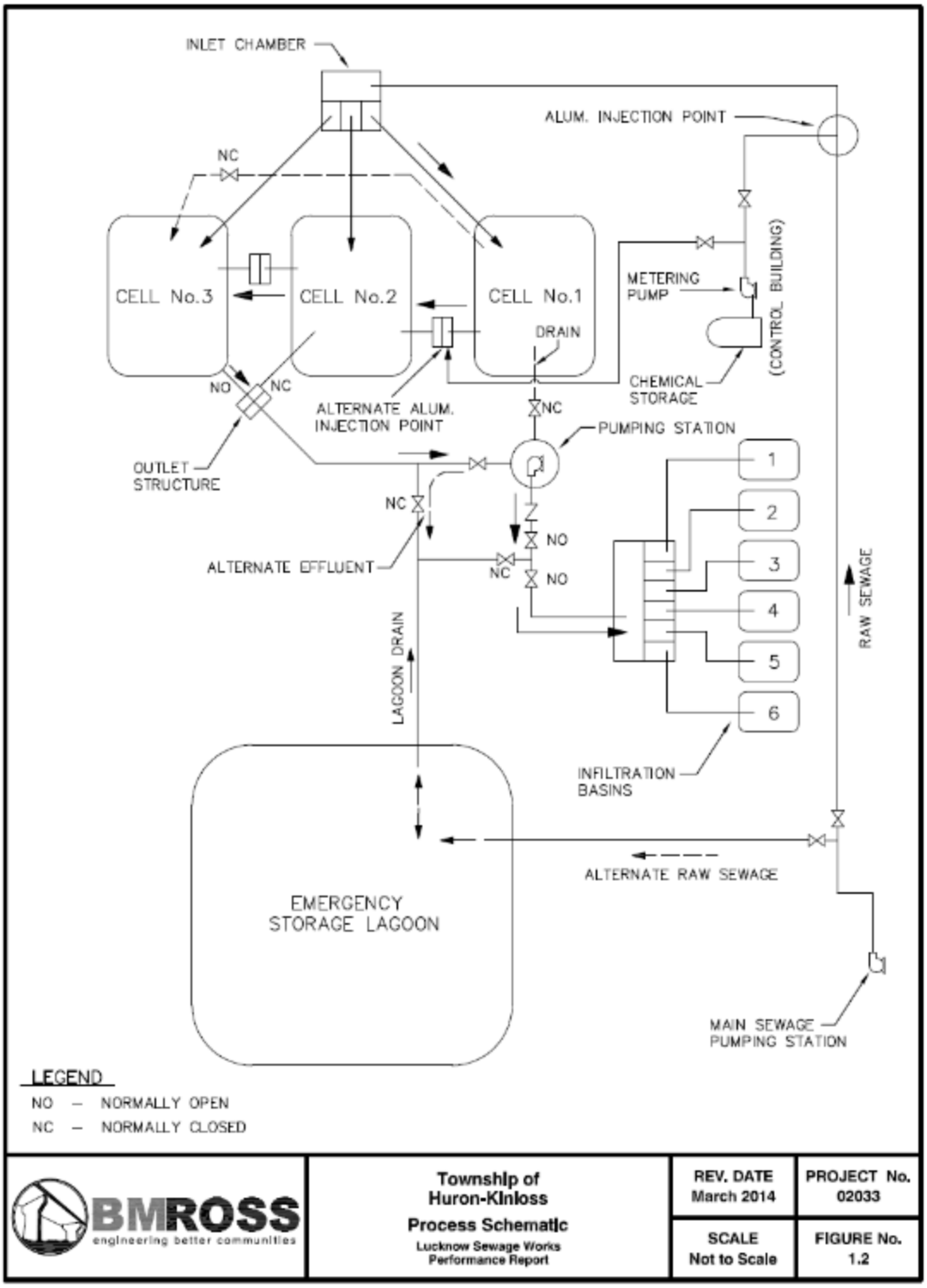
UNIT PROCESS:

In 2023, the Ripley Wastewater Treatment System was operated as follows:

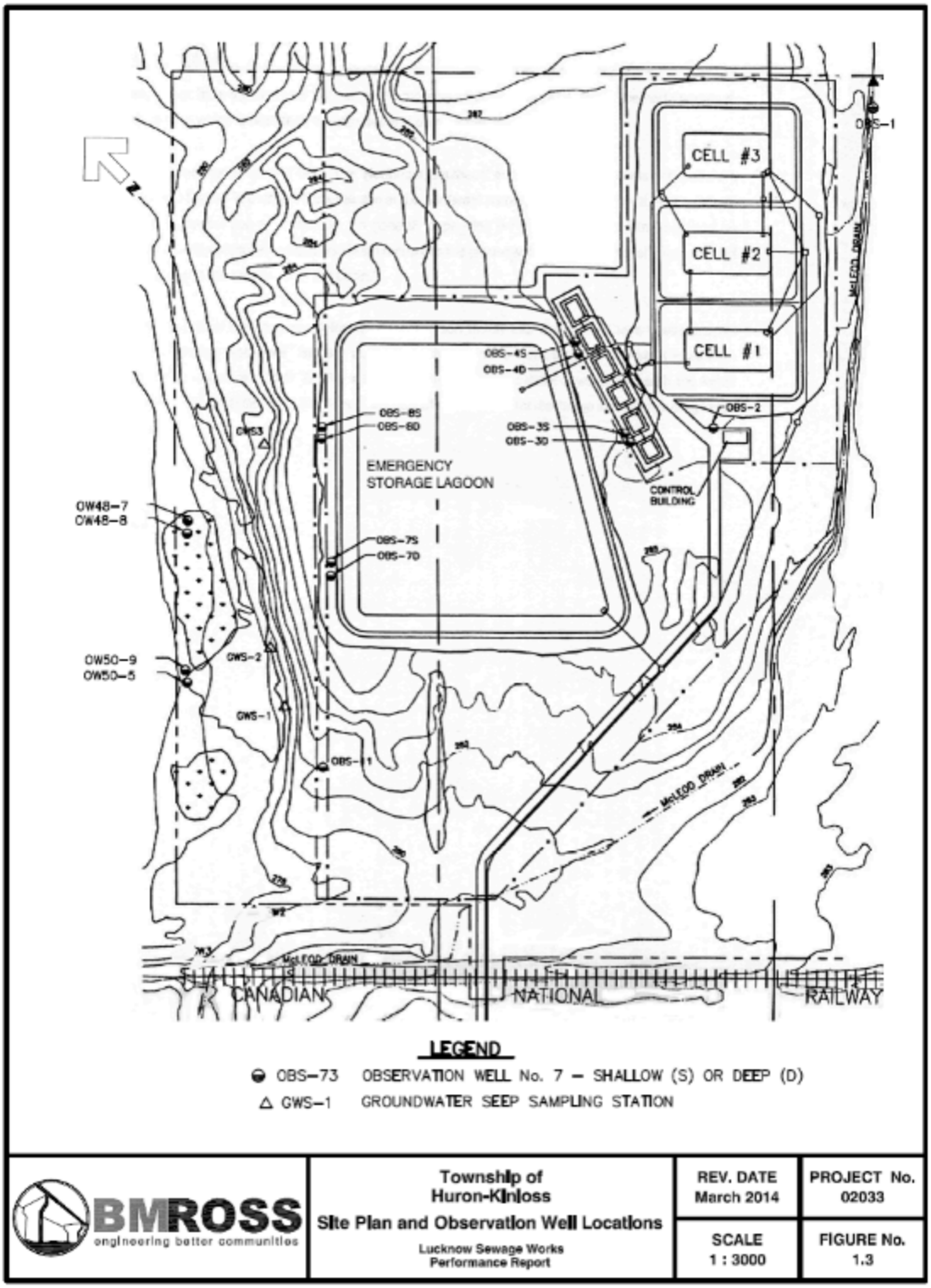
Raw sewage from the collection system flowed to the wet well structure at the Sewage Pumping Station. Aluminum sulphate (alum) was added to promote phosphorus removal before it was pumped to Lagoon Cell No. 1 via the forcemain. The Lagoon Cells worked in series (i.e. Cell 1 --> Cell 2 --> Cell 3), with water depths between 0.3 - 1.8 m..

The Ministry C. of A. and the new Amended ECA allow the treated effluent to be discharged between October 15th to May 1st. When discharge is permitted, the effluent was directed from Cell 3 to Aeration Cell 4, where a blower was used to supply air through a submersible diffuser system. The treated effluent was then directed to the discharge control structure, where the flow was measured prior to entering the outfall pipe to the South Pine River.

Lucknow Sewage Process Schematic



Lucknow Sewage Lagoon Aeration Cell Schematic



BY-PASSES :

There were no By-passes or Plant-Overflows at the Lucknow Sewage Treatment Works in 2023.

RAW INFLUENT :

Flow data for the reporting period was obtained from the utility monitoring system records maintained by Veolia, the operator of works. The flows are recorded from a magnetic flow meter located in the Sewage Pumping Station at 432 Inglis Street.

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 2023 monthly flows as reported by Veolia. The annual average daily flow during 2023 was 612 m³/day, which is in compliance with the rated capacity of 750 m³/day stated in the ECA.

Influent flow : **Rated Capacity : 750 m³/day**

Date	Volume, m³	Daily Max, m³	Daily Min, m³	Average, m³	Capacity, %
January	24,447	1,484	362	788.6	105.1%
February	21,091	1,374	355	753.3	100.4%
March	23,507	1,331	368	758.3	101.1%
April	24,194	1,443	374	806.5	107.5%
May	16,477	781	302	531.5	70.9%
June	13,216	646	278	440.5	58.7%
July	13,618	682	143	439.3	58.6%
August	14,435	1,047	277	481.2	64.2%
September	14,052	643	303	468.4	62.5%
October	16,726	905	318	539.6	71.9%
November	18,152	890	374	605.1	80.9%
December	22,962	1,162	427	740.7	98.8%
Total	222,877				**81.7%**
Maximum	24,447	1,484			
Minimum	13,216		143		
Average	18,573			612.3	

Raw Sewage Sample Results (collected Quarterly) :

Date	BOD_5	TKN	TP	TSS
January	122.0	19.1	2.16	114.0
April	96.0	9.0	1.26	116.0
July	186.0	30.3	3.95	115.0
October	244.0	37.5	5.0	303.0
Average	**162.0**	**24.0**	**3.09**	**162.0**
# Samples	**4**	**4**	**4**	**4**

Aluminum Sulphate Liquid (48.5%) Usage

Aluminum Sulphate (alum) is added to the raw water at the Lucknow 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.

Month	Total Alum Usage, L	Total Alum Usage, kg	Average Alum Dosage, mg/L
January	1,959	1,268	59.8
February	1,746	1,130	59.8
March	2,331	1,509	73.7
April	1,749	1,132	49.5
May	1,785	1,156	78.0
June	2,274	1,472	115,3
July	1,821	1,179	98.6
August	1,975	1,279	89.9
September	1,827	1,183	87.6
October	1,911	1,237	79.0
November	2,100	1,360	83.2
December	3,201	2,073	101.8
Total	24,679	15,978	- -
Average	2,057 L/day	1,332 kg/day	78.3 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 affluent 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 of 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	17.4	0.1280	12.0	3,200	0.29	12.0	7.68	7.76	7.76
February	14.2	0.0800	8.0	1,530	0.19	11.0	7.07	7.58	8.63
March	14.5	0.1400	4.0	320	0.18	13.0	5.84	7.60	9.45
April	13.3	0.0370	10.0	540	0.17	11.0	9.98	7.87	12.48
May	4.7	0.2165	11.5	460	0.11	12.0	8.82	8.12	17.84
June	5.4	0.0750	10.0	40	0.10	14.0	8.31	7.89	21.15
July	0.2	0.0080	8.5	100	0.09	13.0	9.74	8.01	23.35
August	0.9	0.0123	5.0	477	0.07	8.8	6.37	7.48	17.53
September	0.4	0.0065	14.5	130	0.10	7.7	6.85	7.67	19.05
October	0.7	0.0080	3.0	200	0.07	7.5	5.71	7.59	14.84
November	0.6	0.0030	7.0	1,820	0.23	11.0	8.97	7.58	10.53
December	10.9	0.1135	13.5	2,330	0.24	16.5	10.68	7.78	7.75
Average	5.2	0.0602	8.7	875*	0.13	11.1	7.95	7.75	14.23
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 concentration 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 the 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	1.12	0.0068	< 2.0	0	< 0.03	< 1.0	5.49	7.38	12.20
February	0.55	0.0025	< 2.0	0	< 0.03	< 1.0	4.93	7.24	13.38
March	0.23	0.0015	< 2.0	0	< 0.03	< 1.0	5.42	7.41	12.40
April	0.17	0.0047	< 2.0	0	< 0.03	< 1.0	5.64	7.66	12.73
May	< 0.1	< 0.0010	< 2.0	0	< 0.03	< 1.0	7.25	7.63	13.94
June	< 0.1	< 0.0010	< 2.0	0	< 0.03	< 1.25	7.93	7.42	16.30
July	< 0.1	< 0.0010	< 2.0	0	< 0.03	< 2.4	7.70	7.46	17.84
August	0.3	0.0018	< 2.0	0	**< 0.03**	< 1.0	9.55	7.33	11.08
September	0.48	0.002	< 2.0	0	< 0.03	< 1.0	7.21	7.47	13.65
October	0.7	0.0055	< 2.0	0	< 0.03	< 1.0	7.70	7.47	14.68
November	0.98	0.0045	< 2.0	0	< 0.03	< 1.0	24.9	7.21	13.63
December	0.53	0.0023	< 2.0	0	< 0.03	< 1.25	7.31	7.28	11.55
Annual Average	< 0.45	< 0.0031	< 2.0	0*	< 0.03	< 1.18	8.31	8.76	8.76
Objectives	2.5	0.1	5.0	100*	0.1	5.0	--	6.5 - 8.5	--

*Average Monthly Geometric Mean Density

SLUDGE ACCUMULATION :

Sludge accumulates in the bottom of the aerated cells. No sludge was removed from the lagoon in 2023. The amount of sludge accumulated for 2023 was estimated based on the average amount of solids processed through treatment.
The annual average sludge accumulation is approximately 40 mm total. With this information, it was estimated that the running total accumulation since the sludge was removed in 2004 is approximately 856 mm (Cell#1 : 686 mm, Cell#2 : 129 mm, Cell#3 : 43 mm).

"SLUDGE JUDGE"TESTING

"Sludge Judge"testing was not conducted in 2023. The last testing was performed near the end of 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.

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 (pump replacements)

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

m^3/s	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Min	0.524	0.483	0.596	0.672	0.308	0.179	0.150	0.172	0.111	0.105	0.541	1
Max	7.93	6.81	6.53	6.25	1.57	0.347	0.648	0.917	0.455	4.03	2.66	5.90
Total	57.2	53.8	61	50.3	22	7.34	8.57	10.5	6.32	28.7	30.3	69.60

Operational Problems, Corrective Actions and Maintenance

Date	Site	Comments
Feb. 11	Lagoons	High Flows due to rain
March 17	Lagoons	High Flows due to rain
Mar. 22-Apr. 5	Lagoons	All RIBs full due to high flows
Apr. 5	Lagoons	Power Outage - aerators were off
Apr. 13	Lagoons	Aerator #2 repaired By Pollock Electric
Apr. 19	Lagoons	Alarm
May 4	Lagoons	Sand imaging was completed by an outside company
June 7	Lift Station	Power outage
June 30	Lift Station	High level alarm
June 30	Lagoons	Planned power outage - aerators were off
July 1	Lagoons	Aerator #3 cell 2, south failed
July 5	Lift Station	Advanced Meter Services calibrated flow meter
July 12	Lift Station	Pump #2 - overload
July 13	Lift Station	Pump #2 removed for repairs (impeller had fallen off) -Pollock Electric
July 16	Lift Station	Bolt replaced on the sewage pump
July 18	Lift Station	Pump # 2 installed (working as it should)
July 31	Lift Station	Pump #2 failed
July 24	Lagoons	Switched to winter storage - MECP notified
July 31	Lagoons	2 RIBs have dried out, still using winter storage for the other 4
Aug. 1	Lift Station	Pump #2 pulled (impeller fell off and bolt broke)
Aug. 4	Lagoons	BMRoss onsite
Aug 28	Lift Station	40HP installed by Pollock Electric
Sept. 29	Lift Station	Caldecott Pulled out pump #1, #2 was rebuilt and #3 is a rental
Nov.1	Lagoons	Aerators #1, 3 and 4 failed -reset
Nov. 2-4,6	Lagoons	Aerator #2 is not working

Nov. 4-7	Lagoons	Pump #1 not working
Dec. 10	Lagoons	Aerator fail light is on but aerator is running fine
Dec . 11 -19	Lagoons	Switched to winter storage, sewage pump not working, replaced a timer
Dec. 16	Lift Station	Wet wells cleaned by CT Environmental
Dec. 28	Lagoons	Aerator #4 failed - reset overload in panel

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	162	11.0	--	2.2	--	93.2%	3.4%	98.6%
$CBOD_5$	148.3	8.7	20.0	2.0	5.0	94.1%	4.6%	98.7%
TSS	162	11.1	20.0	1.18	5.0	93.1%	6.2%	99.3%
Total Ammonia	--	5.2	--	0.45	2.5	--	--	--
Total Phosphorus	3.09	0.13	1.0	0.03	0.1	95.8%	4.2%	99.0%
E.Coli (CFU/100 mL)	--	875	--	0	100*	--	--	--
Free (Unionized) Ammonia	--	0.0602	--	0.0031	0.1	--	--	--

*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 Ripley Wastewater Treatment Facility during 2023:

1. The annual average sewage influent flow was 612 m^3/day in 2023, as determined by the flow measuring instrumentation in the Lucknow Sewage Pumping Station. Given that the approved flow to the works is 750 m^3/day, the works operated at 81.7% of the design capacity. Historically, maximum day flows will typically be greatest during spring months and be lowest during the summer months. During 2023, the maximum day trend was characteristic, with the maximum day flow of 1,484 m^3/day occurring in January.

2. Raw sewage concentrations and loadings for BOD_5, TSS, TKN and TP have remained relatively consistent since 2016, however, in 2023, loadings were lower than typical domestic sewage loadings on a per capita basis :

Parameter	Typical Loadings (mg/L)	2023 Loadings (mg/L)	% Difference
BOD_5	170	162	4.7% lower
TKN	35	24	31.4% lower
TP	7	3.09	55.9% lower
TSS	200	162	19% lower

3. Effluent quality, as measured at the effluent structure (GWSS), remained excellent throughout 2023.

4. Based on the calculated removal rates of 98.6% to 99.3%, it is concluded that the Lucknow Sewage Treatment Facility provided excellent treatment of sewage in 2023.

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.

- **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 the 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.