SEWER MASTER PLAN

Village of Lytton

DRAFT

March 18, 2022

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3	DM	Mar 18, 2022	Revisions to adjust costs for inflation
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1	DM	May 28, 2021	Complete Document

1.0 Executive Summary

The Village of Lytton (Village) has provided sanitary sewerage collection and treatment services for the Lytton Community over the past 5 decades. Presently the Lytton sewerage system serves a permanent local population of around 600, with wastewater collected from residential, commercial, restaurants, and hotels throughout the developed area of the Village as well as on IR17 and IR18.

This plan describes the layout and design of the existing sewerage collection and treatment system and also identifies key infrastructure improvement needs for the sewage collection and treatment facilities in a 20 year planning window, and the estimated cost of these in current dollars.

Detailed aerial drone photography with 50mm pixel size was used to develop base mapping for the 4.5km sewer network. Manholes and water valves were located and painted and ortho-rectified photography was prepared using survey corrections. This mapping can be used for any purpose in the Village. The updated mapping was compiled in Autocad and nomenclature was developed to describe the sewer collection system. Video inspections were carried out on more than 84% of the collection system. The inspections show that while most piping has good structural integrity there are some problems, including serious sag sections and root obstructions in several high flow areas. These problems will place an increased burden on maintenance and there will be increased backup flood events unless these sewers are replaced with larger diameter PVC pipe at increased slope without sag. The estimated cost of improvements to the gravity sewer network is $5.8 Million in Q1-2022 dollars.

A review of the Wastewater Treatment Plant with operators over the study period and existing studies on the plant suggest that the Sequencing Batch Reactor (SBR) plant is operating well and meets current standards, however it is nearing capacity and it is by design vulnerable to disruptive events such as power failure or other failures of the plant. A number of improvements to the plant are called for including complete backup power, preliminary treatment, improved solids handling and improved SCADA facilities. It is also recommended that the Village further explore the feasibility of constructing a facultative lagoon with aeration potential as a safeguard against plant failure. Additional review of possible expansion of the SBR plant should be studied further. The estimated cost of improvements envisioned for the WWTP over the next 20 years is $4.5 Million in Q1-2022 dollars.

Epilogue: *Impacts of the Village fire on June 30, 2021 are not investigated as part of this plan. Fortunately the sewer treatment plant survived without damage. It is believed that there will be operational impacts to gravity sewers such as accumulations of gravel in side sewers and mains but structural damage is not expected. Presently the Village is assessing these impacts.*

2.0 Introduction and Background

The Village of Lytton has desired to better understand the condition of its sewer infrastructure and what needs may present in the future in order for the system to meet regulatory requirements for treatment and provide its function in sewer drainage. To this end the Village asked Mundall Engineering to prepare a “Sewer Master Plan”. It is further hoped that this plan can be useful in setting priorities for improvements and in estimating costs of future improvements.

Work that was carried out in preparing this plan has included:

1. Data collection & Mapping:

   - Field located sewer manhole covers throughout the Village service area as well as IR17, 18. These were marked with green paint. Some manholes were covered and had to be located with a magnetic locator and exposed with shovel. Water valves were also identified. Several known manholes could not be located.

   - Conducted high resolution (45.65mm pixel) color aerial drone photography for the entire Village including IR17, 18 and surrounding areas.

   - Corrected photo base mapping with GPS survey of key points for accuracy and processed these data to produce accurate ortho-rectified imagery for use in design or GIS software.

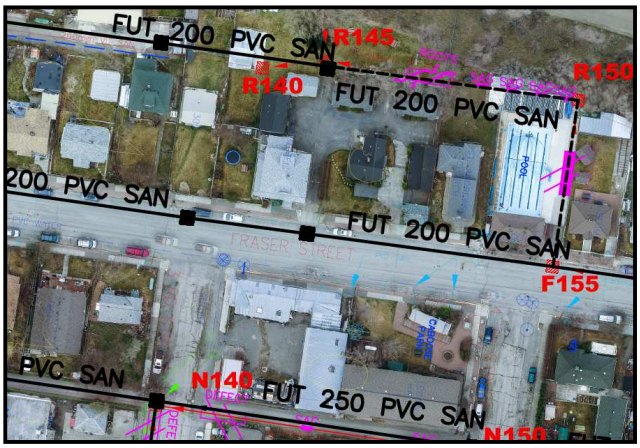
- Conducted video inspection ofnearly all sewer pipes in conjunction with Village staff and then reviewed these and prepared annotation/photos of problem areas. The video findings were summarized in tabular format. Video inspection was made more challenging and most long reaches required two inspections because the Village of Lytton camera didn't have capacity to push the camera sled more than 60m (200 ft).

- Conducted many field inspections of sewer infrastructure with and without Village of Lytton Public Works staff to assess condition and location of these infrastructure and develop solutions for problems.

- Prepared detailed digital and paper maps of sewer piping network that is aligned with photo base mapping

2. Review of previous studies & plans as they may pertain to analysis of collection and treatment systems.

3. Analyzed information and constructed a database of sewer infrastructure and accompanied with mapping at an accuracy that is sufficient to perform water and sewer modeling and conduct detailed asset management planning.



4. An adjustment of manhole and sewer pipe locations was made to align mapping with targets set on the ortho-rectified photo map.

5. Prepared mapping plots of sewer network showing proposed improvements with and without photo-map base for use in system management.

6. Developed nomenclature to describe the sewer manhole network and edited the mapping database to reflect the scheme.
7. Prepared a priority list for improvements and summarized these recommendations for capital improvements along with Class D cost estimates and proposed schedule.
8. Summarized findings and prepared recommendations for further action.

2.1 Previous Studies

An effort was made to collect and summarize historical documents that may be useful in understanding the Lytton Sewerage system. Most of these were scanned into PDF format (see key below) and are included in the appendices here for reference.

#	Title	Date	Source	Pages	Notes	PDF
1	A Sanitary Sewerage Scheme for the Village of Lytton	1964-03	Willis Cunliffe Engineering Ltd. Victoria	9	"Preliminary" covers core Village with map. Original collection and treatment system	Y
2	Sewer Extensions to Ponderosa Heights	1968-09	Willis Cunliffe Engineering Ltd. Victoria	15	Includes map showing proposed extension	Y
3	Sanitary Sewerage System Composite	1984	Urban Systems Ltd.	1	Engineering drawing with est. capacity of collection system by each reach	Y
4	Sewerage Treatment Study	1995-07	T.R. Underwood Engineering	32	Rec. secondary treatment options to replace wood stave Spiragester	Y
5	Water and Sewer Feasibility Study	1998-02	UMA Engineering Ltd., Burnaby	49	Includes appendices. Feasibility level design and ost est. for improvements to collection and treatment.	Y
6	Sewage Treatment and Disposal Options Study	2001-03	Urban Systems, Kamloops	23+	With 50+ page appendices examines options to move facility to Lytton Lumber site	N
7	Environmental Impact Study: Effluent Release into the Fraser River	2001-03	Urban Systems Kamloops	30+	Established discharge criteria for new treatment plant	N
8	WWTP Upgrades	2002-07	Stantec Consulting Ltd.	26+	With cost estimates for plant upgrade from Spiragester	N
9	Feasibility Evaluation Wastewater Monitoring and Mechanical Bar Screen	2018	Mundall Engineering	26	With discussion and cost estimates for plant upgrades including operational monitoring and control as well as an automatic mechanical bar screen for primary solids removal.	Y

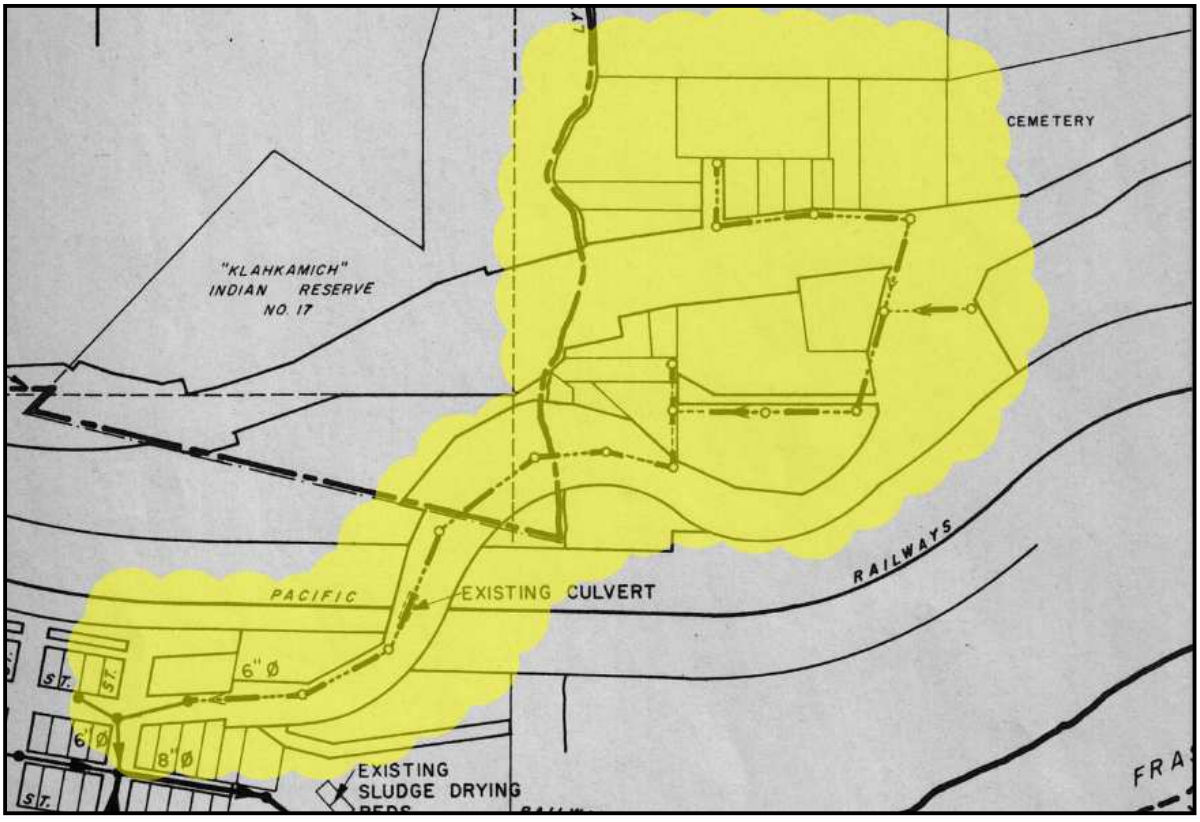
In summary, there was a study for the original Village system and the addition of Ponderosa Heights dating back to the 1960's and then a study in the 1980's by Urban Systems which attempted to describe capacity of each reach in the system. No elevations or other physical data accompanied this study such as elevations and reach lengths. Around the millennium there was a rash of studies on the Treatment Plant that culminated in a design-build construction of the Sequencing Batch Reactor (SBR) plant in use today.

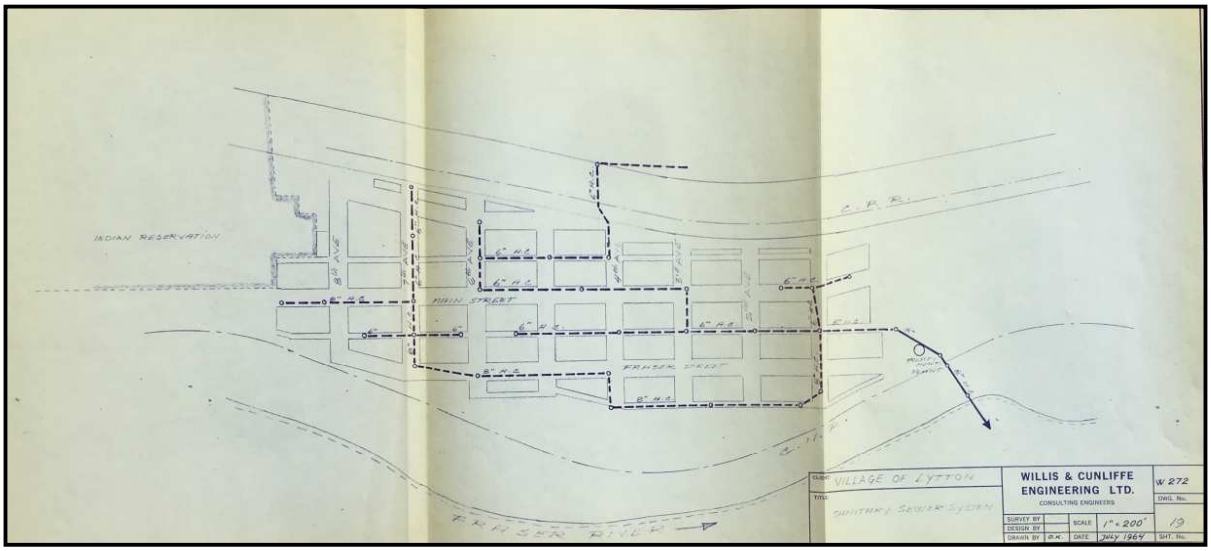
2.1 Background and Early History of Lytton Sewer System

Original System:
The Village of Lytton's sewerage collection and treatment system was first constructed in the mid 1960's based on a 1964 design by Willis and Cunliffe Tait Engineering Ltd of Victoria, BC. (see scan of archive drawing next page and full report in Appendices). The collection system had about 2,200m (7,200 feet) of 150mm (6") and 200mm (8") asbestos cement and clay gravity sewer pipe, one lift station, 27 manholes and about 100 feet of pressure pipe from the CN Railway lift station. The original collection system cost about $52,000 to construct and it replaced individual septic tanks throughout the core Village. Waste water was collected from the town into a dual compartment cedar wood stave tank "Spiragester" treatment unit which cost about $22,000 to build.

Extensions:
1968-1970 Ponderosa Heights – a report by Willis Cunliffe Tait of Victoria BC (see appendix) describes the addition of an area of new development above Trans-Canada Highway #1 known as "Ponderosa Heights". This addition brought about 1,100m (3,600 feet) of 6" asbestos cement sewers and 16 manholes.

1970's Loring Way was developed. There is a paucity of records relating to Loring Way. This extension is asbestos cement construction of varying depths.





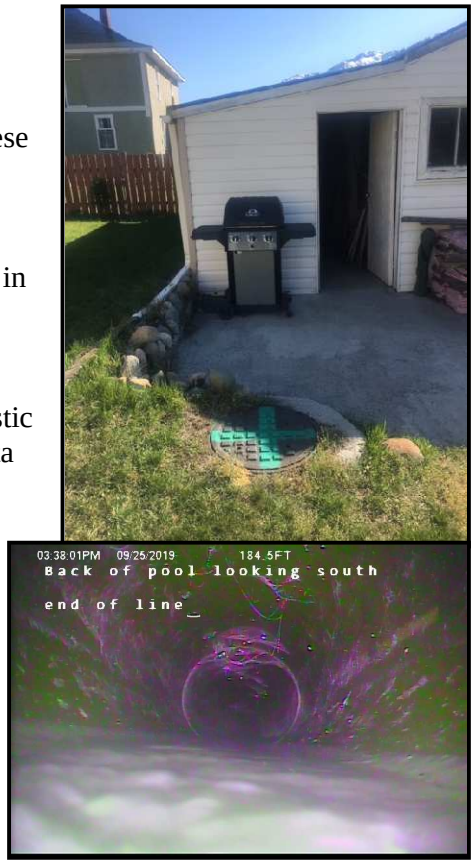
Original Lytton Sewerage Collection System Design 1964

3.0 Description and Analysis

This section describes the existing sewer collection and treatment system and provides analysis and recommendations for improvements.

3.1 Collection System

The Village sewer collection system includes about 4554 lin-m of gravity sewer mains and 73 manholes. All manholes encountered have been concrete construction and 900mm or 1200mm diameter with benching. Several areas in the system have steep slopes so these manholes are fitted with external drop structures to avoid excess velocities and splashing in the manhole.



The table below describes the approximate breakdown of materials in the Village system. Many sections the construction is not obvious from available records and even video inspection didn't make the material of construction clear. Some sections it was possible to determine material by observing pipe length as there are characteristic standard lengths for various materials of each size. Given these data we have:

Material	Lin-m	%	Approximate Age range
Vitrified Clay	1908	42	1960's
PVC	608	13	1970's-present
Asbestos Cement	2038	45	1960's-1970's
TOTAL	**4554**	**100**	

3.11 Nomenclature

A system of nomenclature was needed for analysis of Lytton's sewer system to accurately describe the sewer collection and drainage elements in a way that can be useful for studies, planning, design, construction and asset management. Without it, mistakes will be made, manholes will be lost and inefficient management of the infrastructure will result.

While many different nomenclature systems are in use, the US EPA offers guidance in a circular titled "Developing a Manhole or Catch Basin Numbering System", edited 2017.
Some key elements of this system are:

- Structure manhole numbering to have grouping for drainage sub-areas
- Arrange manhole numbering to increase uphill
- Allow gaps in numbering for additions of new development or allow for manholes that had been covered up.

The following key was developed to describe all areas of the Lytton sewer system which presently includes 72 manholes, not including those on the adjacent IR17 and IR18:

Pfx.	Mnemonic Association	Count	Drainage Area
A	**A**lonzo Way	6 + 1C/O	Manholes on Alonzo and across the CP tracks from the Old Trans-Canada area
B	**B**ridge for Hwy 12	3	Manholes in the area of now vacant hospital site at the bridge
E	**E**lementary School Grounds	3	Manholes on the school playground field
F	**F**raser Street	11	Manholes on Fraser Street, 7th Street over to Station Road
H	**H**ighway 12 up to Trans-Canada	13	Manholes along 12 and up to Trans-Canada
I	**I**ndian Reserve 18	3 (15 on IR18)	Manholes along Main Street to IR18
L	**L**oring Way	8	Manholes on Loring Way and also drains West Loring on easement along the west boundaries of lots
N	**N**oname Lane	5	Manholes along alley/lane that is just west of Main Street
O	**O**utfall to Fraser River	2	Manholes after plant
P	**P**onderosa	3	Manholes on Ponderosa Street
R	**R**iver	6	Manholes on West Lane and is located on west side of lots that abut to CN and Fraser River
T	**T**reatment Plant	3	Manholes that drain entire system to waste water treatment facility in Hobo Hollow
W	**W**omens Shelter	6 (9 on IR 17)	Manholes around shelter and down to Hwy 12. Also drains flow from IR17 and same numbering was applied to IR 17
		72	**TOTAL excluding IR 17,18**

The nomenclature describes 12 distinct areas of the system with mnemonic associations specific to each area. There is an effort to arrange numbering to allow for additions, and also to index by street/block similar to site address locations. All known existing manholes are now referenced with this system and references are made in the design mapping environment. An excel spreadsheet was built to list all manholes and pipe reaches in the network.

Table 3-1 (following page) offers a tabular view of the existing collection system for reference and lists construction details such as:

- Upstream/downstream manhole
- Rim elevations (if known)
- Invert elevations (if known)
- Slope (if known)
- Capacity L/min (if known)
- Length of reach (m)
- Pipe diameter (mm)
- Pipe material
- Year of construction (estimated)
- Description

There is a need for further collection of engineering information to properly manage the system. Rim elevations and invert elevations are quite essential. These data can be collected by the Village field crew with RTK GPS equipment and measuring tools.

Sanitary Sewer Manholes and Pipes

Edit: 2021-04-16

Up-stream MH	Rim Elev, m	Inv Elev, m	Length, m	Pipe Dia, mm	Pipe Matl.	Year Const.	Down-stream MH ID	Rim Elev, m	Slope %	Capacity, Litre/ min	Video Number	Description of stretch	Notes
??			59.10	200	PVC	2003	M145				46	Lyttonnet office back entrance looking North	
A150			78.20				A140				11	4th st going to 3rd st	
A185			81.00	150	VitClay		A175				30	Alonzo and 5th above clinic looking North	Possible roots at pipe joints
A195			70.10	150	VitClay		A185				28	End of Alonzo above stairs looking North	Possible roots at pipe joints
A200			39.80	150	VitClay		A195				27	Alonzo by pocket park looking towards train tracks	
A210			23.52	150	VitClay		A200				NA	near CP railroad & 4th Street	
A220			18.72	150	VitClay		A210				NA	near CP railroad & 4th Street	
A230			26.42	150	VitClay		A220				NA	near CP railroad & 4th Street	
A240			129.77	150	VitClay		A230				NA	long section parallel to CPR serves residences along Old Trans-Canada Hwy	
B190			41.36	200	VitClay		F180				NA	inactive section from Hwy12 to Parish Hall	
B200			40.58	200	PVC		B190				NA		
E197			76.27	150	VitClay		F195				NA	inside old Lytton Elementary ball field inactive	
E199			33.61	150	VitClay		E197				NA	inside old Lytton Elementary ball field inactive	
E200			35.23	150	VitClay		E199				NA	inside old Lytton Elementary ball field inactive	
F155			42.60	200	VitClay	1965	L150				38	4th and Fraser looking to back of pool	Camera couldn't see anything due to the full line
F170			143.50	200	VitClay	1965	F155				59	6th And Fraser going towards the pool	5ft pipe sections -->Clay
F172			9.00	200	VitClay	1965	F170				37	6th and Fraser looking west	
F172			83.85	200	VitClay	1965	F180				36	6th and Fraser looking North	Camera couldn't see anything due to the full line
F180			83.85	200	VitClay	1965	F172				35	Fraser street looking towards stop sign from Parish hall	Camera couldn't see anything due to the full line
F183			39.00	200	VitClay	1965	F180				34	Parish hall looking towards Fraser	Line not sloped well, lots of slow areas appears to be 5ft pipe spools
F185			53.47	150	VitClay		F183				NA	section behind Lytton Hotel flows north to 7th	
F186			13.37	150	VitClay		F183				NA	short section behind post office	
F188			32.00	200	VitClay	1965	F183				33	West side of Hwy 12 and 7th	appears to be 5ft pipe spools -->clay
F190			6.60	200	PVC		F188				NA	short section near post office has a drop	
F195			45.43	150	VitClay		F190				NA	north of RCMP on good slope	
F200			64.37	150	VitClay		F195				NA	Station Road to Alonzo on 7th	
H120			42.40	150	VitClay	1965	T115				43	1rst and main looking towards Westlane	Very full pipe, camera unable to see clearly. Pipe drop near MH#115
H125			39.50	200	PVC	2003	H120		0.40%		44	Main-street by Chinese museum looking South	
H130			17.80	200	PVC	2003	H125				45	Rest inn on main street looking South	Clean pipes
H150			40.25	150	AC		H120				NA	on Hwy12 up the hill.	
H160			93.69	150	AC		H150				NA	on Hwy12 up the hill.	
H180			129.69	150	AC		H160				NA	on Hwy12 up the hill.	
H190			46.78	150	AC		H180				NA	on Hwy12 up the hill.	
H200			57.23	150	AC		H190				NA	on Hwy12 up the hill.	
H210			37.00	150	AC		H200				NA	on Hwy12 up the hill.	
H220			84.95	150	AC		H210				NA	on Hwy12 up the hill.	
H225			45.40	150	AC		H220				21	End of forestry yard going towards hwy 12	
H228			78.71	150	AC		H225				NA	short sewer drains west onto Hwy12 on north side of Forestry	
H250			23.10	150	AC		H255				54	Kent and hwy 12 looking towards secondary school	video is upstream
H255			143.50	150	AC		H260				67	looking towards secondary school from mystery manhole	
H260			126.00	150	AC		H255				55	High school looking back towards mystery manhole	
H270			16.70	200	AC		L300FUT				20	Hwy 1 Ponderosa stop sign	
I195			87.38	200	PVC		F190				NA	on Main Street in fromt of old Lytton Elementary	

Table 3-1 Sanitary Sewer Manholes and Pipes 1 of 2

Up-stream MH	Rim Elev, m	Inv Elev, m	Length, m	Pipe Dia, mm	Pipe Matl.	Year Const.	Down-stream MH ID	Rim Elev, m	Slope %	Capacity, Litre/ min	Video Number	Description of stretch	Notes
I200			66.74	200	PVC		I195				NA	on Main Street in fromt of old Lytton Elementary	
L350			107.50	200	AC		FUT L300				66	grave yard looking west	
L360			98.40	150	AC		L350				64	below Johnny McKay's house looking towards cemetery	
L370			82.20	150	AC		L360				62	end of west Loring looking back towards cemetery	
L400			57.34	200	AC		L350				17	191 Loring West towards hwy 1	
L410			77.30	200	AC		L400				15	Loring East West split (South)	
L420			88.30	200	AC		L410				13	Lot 157 and 153	
L430			44.50	200	AC		L420				12	Top of 153 going South	Pipe drop at 33.0m from MH L430
M145			48.30	200	AC?	1965	A140				47	3rd and main looking west	Pipe size and type changes from 200PVC to what looks like 150AC
P300			70.49	150	AC		H270				NA	167 Ponderosa Ave	
P310			88.04	150	AC		P300				NA	Ponderosa Ave, at corner near TC#1	
P320			64.90	150	AC		P310				19	top of Ponderosa (Ian hay cleanout)	
R120			68.90	200	VitClay	1965	T115				42	Margo's back yard looking east	Roots starting to grow into pipe joint. Pipe very full, camera cant see much
R125			31.10	200	VitClay	1965	R120				41	Deans west lane going South towards Fraser	Roots starting to grow into pipe joints in several different sections
R150			42.60	200	VitClay	1965	F155				39	looking from back of pool to 4th and Fraser	Camera couldn't see anything due to the full line
R150			64.40	200	VitClay	1965	R145				40	back of pool looking South	Pipe very full for large sections
T110			16.3	250	PVC		WWTP					drains short distance to raw water bay at treatment plant	
T112			20.2	250	PVC		T110					down hill from Lot 5 Blk 28 to WWTP	MH#112 is about 6m south of fence
T115			98.8	150	VitClay		T112					South on lane from 1st Street to Lot 5 Blk 28	
W210			36.50	200	PVC/AC		H200				26	Bottom of hill old trans Canada looking towards hwy 12	Image of pipe transition at 14m 1909191028a1
W220			16.23	200	PVC		W210				25	short sewer with drop MH drains to Old Trans-Canada down the hill from Womens Shelter	
W240			46.45	200	PVC		W220				25	Coming down hill from Women's shelter	
W250			47.35	200	PVC		W240				24	Women's shelter back side going down hill	
W260			78.60	200	PVC		W250				22	Women's shelter (Closest to hwy 1)	

3942.2

Table 3-1 Sanitary Sewer Manholes and Pipes 2 of 2

3.12 Video Inspections 2019

Video inspections were carried out in late 2019 using the digital sewer camera and reel system owned by the Village. About 83% of the total sewer collection network was inspected during this process. Priority was given to reaches where the operations crew had experienced problems. Longer sections were inspected from both ends as the camera reach was inadequate. An extension of the camera cable was purchased by the Village to enable coverage through longer reaches however this proved difficult as the camera sled is not motorized and there are practical limits to push length. Some sections were too long for complete coverage even when inspected both ways, leaving a gap.

Individual videos were annotated in the field with voice and text describing the reach and any other particulars. Still frames were grabbed for problem areas for future reference. Following the video inspections the videos were further reviewed and relevant information was cataloged in an excel spreadsheet and also placed in AutoCAD for geographical reference. The photomap drawing excerpt below illustrates the resulting visual reference – symbols were created and referenced for:

- Roots (usually intrusion at pipe joints)
- Sag (depression section causing stagnant reach where pipe flow is abnormally slow)
- Blockage (rock or other obstruction)
- Defect (pipe construction issue)

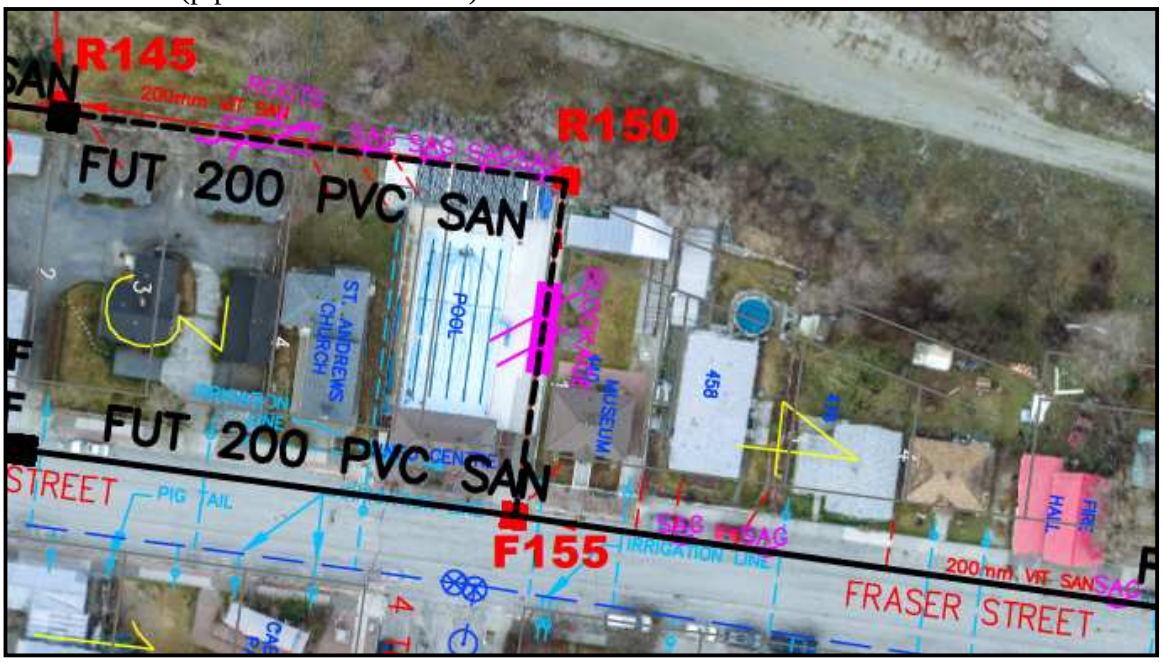


Table 3-2 (following pages) describes the video inspections of the gravity sewers. Every reach is described by:

- Upstream, downstream manhole number
- Length
- Pipe diameter
- Pipe material
- Video reference number and file name for digital access
- Defect observation and other notes

2018-19 Video Inspection Reference

Edit: 2021-04-15

Up-stream MH	Length, m	Pipe Dia, mm	Pipe Matl.	Down-stream MH ID	Video Number	Date of Video	Description of stretch	File name	Marked on Map	Defect Observation	Pipe material breakdown from video inspection 2018-19	Defect reference photos	Call-up in Map	Notes
T115	98.8	150	VitClay	T112			South on lane from 1st Street to Lot 5 Blk 28			not known	VitClay		Yes	
T112	20.2	250	PVC	T110			down hill from Lot 5 Blk 28 to WWTP							MH#112 is about 6m south of fence
T110	16.3	250	PVC	WWTP			drains short distance to raw water bay at treatment plant			A motorized mechanical solids removal screen is planned for the receiving bay at the WWTP				
Side					1	5/11/2017	side sewer	55.MainSt.avi	TRUE	No defects observed	0-3.1m: PVC; 3.1-4m: AC		No	
					2	5/11/2017	160 3rd street	160.3rdSt.avi	FALSE	5.1m: Invasive root growth at pipe junction	0-4.3m: PVC; 4.3-7.6m: AC	160.3rdst_defect	No	
Side					3	5/11/2017	259 station	259.Station.avi	FALSE	5.9m: Root bundle, up to 80% blockage	0-6.4m: PVC;	259.Station_defect	No	
Side				M185	4	5/11/2017	M/H Station & Sixth	Station.Six.avi	TRUE	No defects observed	0-7.6m: AC		No	camera facing east upstream
					5	9/18/2017	N. 625 Station	625.Station.avi	FALSE	41.4m: Slight root growth at pipe junction; 37.5m: Root growth, 20% flow obstruction; 24.4m: Small root beginning to grow; 16.4m: Possible crack at pipe ceiling	0-25.8m: AC; 25.8-28.9m: PVC; 28.9-53m: AC	625.Station_defect; 625.Station_defect_2; 625.Station_defect_3	No	
A167				A165	6	6/12/2018	Lane & 6th (Behind Hotel)	1806121435a.avi	TRUE	5.5m: Low spot creating flow reduction	0-28m: AC; 28-48.3m: Unknown	Lane_6th_lowspot_defect	Yes	some grease buildup
Side					7	7/17/2018	North Lateral Forestry Yard	1807171314a.avi	TRUE	No defects observed	0-9.1m: PVC		No	
Side	36.70			N/A	8	7/17/2018	West Lateral Forestry Yard	1807171336a.avi	TRUE	16.1m: Pipe crown shows unnatural depression, as well as possible crack	0-36.7m: PVC	West_Lateral_defect	Yes	has since been fixed
Side	8.40				9	07/17/18	Forestry Yard to Hwy 12	1807171403a.avi	TRUE	0.9m: Matted roots, has since been fixed	0-?m: PVC		No	has since been fixed
					10	11/23/2018	Main and 3rd street	1811231418a.avi	TRUE	Please Refer to #47	Unknown		Yes	
A150	78.20			A140	11	1/21/2019	4th st going to 3rd st	1901211507a.avi	TRUE	5.2m: unknown mass encroaching from the left side; 6.7-15.5m: Camera view obstructed, condition unknown; 23.9m: upwards of 2% sewer cake buildup; 41.7m: Unknown obstruction, camera unable to proceed further	0-42m: AC	4thto3rd_defect; 4thto3rd_view_obstruction; 4thto3rd_view_buildup; 4thto3rd_view_unknown	Yes	
L430	44.50	200	AC	L420	12	9/17/2019	Top of 153 going South	1909171104b.avi	TRUE	No defects observed	0-44.2m: AC		No	Pipe drop at 33.0m from MH L430
L420	88.30	200	AC	L410	13	9/17/2019	Lot 157 and 153	1909171133a.avi	TRUE	0.8m: roots coming in at side sewer entrance; 21.3m: broken gasket; 47.9m: broken gasket and multiple root bundles	0-19.3m: AC; 19.3-20.7m: PVC; 20.7-56.8m: AC	sidesewer_roots; broken_pipe_seal; gasket_and_roots;	Yes	
L410	88.30	200	AC	L420	14	9/17/2019	Loring East West split	1909171402a.avi	TRUE	Slight ground water seepage into pipe at some pipe joints	0-33.5m: AC		No	video north from downstream to upstream
L410	77.30	200	AC	L400	15	9/17/2019	Loring East West split (South)	1909171415a.avi	TRUE	No defects observed	0-40.8m: AC		No	
L400	77.30	200	AC	L410	16	9/17/2019	191 Loring South of split	1909171435a.avi	TRUE	10.3m: Dense root compaction causing flow reduction;	0-33.2m: AC	1909171437b	Yes	
L400	57.34	200	AC	L350	17	9/17/2019	191 Loring West towards hwy 1	1909171455a.avi	TRUE	16.6m: Roots blocking flow causing impaction	0-16.6m: AC	1909171457b	Yes	
L350	57.34	200	AC	L400	18	9/18/2019	Manhole below Loring looking up towards 191 blockage	1909181039a.avi	TRUE	No defects observed	0-27.8m: AC		No	
P320	64.90	150	AC	P310	19	9/18/2019	top of Ponderosa (Ian hay cleanout)	1909181123a.avi	TRUE	No defects observed	0-56.3m: AC		Yes	
H270	16.70	200	AC	L300FUT	20	9/18/2019	Hwy 1 Ponderosa stop sign	1909181212a.avi	TRUE	No defects observed	0-16.7m: AC		Yes	
H225	45.40	150	AC	H220	21	9/19/2019	End of forestry yard going towards hwy 12	1909191024a.avi	TRUE	45.4m: Lowspot and lip before entering manhole	0-45.4m: PVC	1909191030a	Yes	
W260	78.60	200	PVC	W250	22	9/19/2019	Women's shelter (Closest to hwy 1)	1909191100a.avi	TRUE	No defects observed	0-57.9m: PVC		No	
W250		200	PVC	W260	23	9/19/2019	Women's shelter looking back towards hwy 1	1909191155a.avi	TRUE	No defects observed	0-22.2m: PVC		No	

Table 3-2 Video Inspection Reference 1 of 4

Up-stream MH	Length, m	Pipe Dia, mm	Pipe Matl.	Down-stream MH ID	Video Number	Date of Video	Description of stretch	File name	Marked on Map	Defect Observation	Pipe material breakdown from video inspection 2018-19	Defect reference photos	Call-up in Map	Notes
W250	47.35	200	PVC	W240	24	9/19/2019	Women's shelter back side going down hill	1909191201a.avi	TRUE	No defects observed	0-55.4m: PVC		No	
W240	46.45	200	PVC	W220	25	9/19/2019	Coming down hill from Women's shelter	1909191252a.avi	TRUE	40.8m: Rock in pipe	0-41.4m: AC	1909191307a	No	
W210	36.50	200	PVC/AC	H200	26	9/19/2019	Bottom of hill old trans Canada looking towards hwy 12	1909191435a.avi	TRUE	33.8m: Lowspot in pipe	0-14.0m: PVC; 14.0-36.2: AC	1909191446a	Yes	Image of pipe transition at 14m 1909191028a1
A200	39.80	150	VitClay	A195	27	9/19/2019	Alonzo by pocket park looking towards train tracks	1909191520a.avi	TRUE	No defects observed	0-35.0m: AC		No	
A195	70.10	150	VitClay	A185	28	9/20/2019	End of Alonzo above stairs looking North	1909201036a.avi	TRUE	No defects observed	0-57.3m: AC		No	Possible roots at pipe joints
A185	70.10	150	VitClay	A195	29	9/20/2019	Alonzo and 5th above clinic looking towards stairs	1909201109a.avi	TRUE	6.0m: Small root clump	0-14.3m: AC	Alonzo_roots	Yes	Possible roots at pipe joints
A185	81.00	150	VitClay	A175	30	9/20/2019	Alonzo and 5th above clinic looking North	1909201117a.avi	TRUE	30.2m: Roots growing on pipe side	0-57.9m: AC	Alonzo_5th_roots	Yes	Possible roots at pipe joints
A175	81.00	150	VitClay	A185	31	9/20/2019	6th and Alonzo looking South	1909201139a.avi	TRUE	No defects observed	0-28.3m: AC		No	
					32	9/20/2019	5th and Alonzo looking west towards main street	1909201150a.avi	TRUE	No defects observed	0-36.2m: AC		No	Cobwebs lining pipe
F188	32.00	200	VitClay	F183	33	9/20/2019	West side of Hwy 12 and 7th	1909201452a.avi	TRUE	No defects observed	0-29.5m: AC		No	appears to be 5ft pipe spools -->clay
F183	39.00	200	VitClay	F180	34	9/20/2019	Parish hall looking towards Fraser	1909201508a.avi	TRUE	No defects observed	0-39.0m: Ac		No	Line not sloped well, lots of slow areas appears to be 5ft pipe spools
F180	83.85	200	VitClay	F172	35	9/25/2019	Fraser street looking towards stop sign from Parish hall	1909251052a.avi	TRUE	24.6m: Unknown blockage	Unknown	1909251100a	Yes	Camera couldn't see anything due to the full line
F172	83.85	200	VitClay	F180	36	9/25/2019	6th and Fraser looking North	1909251432a.avi	TRUE	50.5m: Unknown blockage	Unknown	1909251438a	Yes	Camera couldn't see anything due to the full line
F172	9.00	200	VitClay	F170	37	9/25/2019	6th and Fraser looking west	1909251445a.avi	TRUE	No defects observed	0-7.6m: AC		No	
F155	42.60	200	VitClay	L150	38	9/25/2019	4th and Fraser looking to back of pool	1909251500a.avi	TRUE	15.6m: Unknown blockage	0-15.6m: AC	1909251502a	Yes	Camera couldn't see anything due to the full line
R150	42.60	200	VitClay	F155	39	9/25/2019	looking from back of pool to 4th and Fraser	1909251522a.avi	TRUE	26.1m: Unknown blockage	0-26.1m: AC	1909251524a	Yes	Camera couldn't see anything due to the full line
R150	64.40	200	VitClay	R145	40	9/25/2019	back of pool looking South	1909251532a.avi	TRUE	Sag section behind pool for about 20m	0-56.1m: AC		Yes	Pipe very full for large sections
R125	31.10	200	VitClay	R120	41	9/26/2019	Deans west lane going South towards Fraser	1909261042a.avi	TRUE	19.8m: Roots starting to grow in at pipe joint	0-28.7m: AC	westlane_roots	Yes	Roots starting to grow into pipe joints in several different sections
R120	68.90	200	VitClay	115	42	9/26/2019	Margo's back yard looking east	1909261120a.avi	TRUE	20.9m: Roots starting to grow in at pipe joint	Unknown	margo_roots	Yes	Roots starting to grow into pipe joint. Pipe very full, camera cant see much
H120	42.40	150	VitClay	115	43	9/26/2019	1rst and main looking towards Westlane	1909261158a.avi	TRUE	No defects observed	0-45.7m: AC		Yes	Very full pipe, camera unable to see clearly. Pipe drop near MH#115
H125	39.50	200	PVC	H120	44	9/26/2019	Main-street by Chinese museum looking South	1909261346a.avi	TRUE	No defects observed	0-38.1m: PVC		No	
H130	17.80	200	PVC	H125	45	9/26/2019	Rest inn on main street looking South	1909261401a.avi	TRUE	No defects observed	0-17.2m: PVC		No	Clean pipes
??	59.10	200	PVC	M145	46	9/26/2019	Lyttonnet office back entrance looking North	1909261424a.avi	TRUE	No defects observed	0-52.7m: PVC		No	
M145	48.30	200	AC?	A140	47	9/26/2019	3rd and main looking west	1909261456a.avi	TRUE	44.5m: Unknown blockage	0-3m: 200PVC; 3-44.5m:150AC	1909261505a	Yes	Pipe size and type changes from 200PVC to what looks like 150AC
					48	10/9/2019	Loring Raphael's house	1910091219a.avi	TRUE	12.1m: Roots grown in from pipe crown	0-12.1m: AC		No	This and #49 is one issue, my current understanding is that it has been fixed
					49	10/9/2019	Loring Raphael's house	1910091315a.avi	TRUE	12.1m: Broken pipe after cutting out roots	0-12.1m: AC		No	Refer to #48
					50	10/9/2019	Loring towards cemetery	1910091322a.avi	TRUE	16.4m: sewer cake buildup	0-16.4m: AC		No	As far as I know this issue has been resolved

Table 3-2 Video Inspection Reference 2 of 4

Up-stream MH	Length, m	Pipe Dia, mm	Pipe Matl.	Down-stream MH ID	Video Number	Date of Video	Description of stretch	File name	Marked on Map	Defect Observation	Pipe material breakdown from video inspection 2018-19	Defect reference photos	Call-up in Map	Notes
F145				F140	51	10/21/2019	pool towards the totem	1910211211a.avi	TRUE	No defects observed	0-15.3m: AC		No	Unable to see much in the video because the camera is almost always underwater.
F140				F125	52	10/21/2019	pool towards the totem	1910211536a.avi	TRUE	No defects observed	0-51.5m: AC		No	Unable to see much in the video because the camera is almost always underwater.
F145				F150	53	10/22/2019	Totem going towards pool	1910221214a.avi	TRUE	26.2m: Roots and sewer cake buildup	0-26.2m: AC	totem_issue	Yes	
H250	23.10	150	AC	H255	54	10/23/2019	Kent and hwy 12 looking towards secondary school	1910231240a.avi	TRUE	Blockage or sag near manhole H250	0-17.9m: AC		No	video is upstream
H260	126.00	150	AC	H255	55	10/23/2019	High school looking back towards mystery manhole	1910231447a.avi	TRUE	No defects observed			No	
					56	10/30/2019	Totem Hotel going towards pool	1910301229a.avi	TRUE	31.4m: Roots; 32.2m: Roots	0-1.0m: PVC; 1.0-31.4m: AC		Yes	Next video of the same location, continues further to see the issues
					57	10/30/2019	Totem Hotel going towards pool	1910301237a.avi	TRUE	31.4m: Roots; 32.2m: Roots	0-1.0m: PVC; 1.0-31.4m: AC	side_roots_1; side_roots_2	Yes	Roots not causing much obstruction
					58	10/30/2019	Totem Hotel lateral between units 6 and 7	1910301252a.avi	FALSE	5.6m: Some roots starting to grow in from pipe joint	0-8.5m: PVC; 8.5-25.2m: AC	totem_roots	No	Several short junction made with PVC
F170	143.50	200	VitClay	F155	59	10/30/2019	6th And Fraser going towards the pool	1910301437b.avi	TRUE	Several minor sag sections	0-80.7m: AC		Yes	5ft pipe sections -->Clay
F155		200	VitClay	F170	60	10/30/2019	In front of pool looking back towards 6th	1910301524a.avi	TRUE	Several minor sag sections	0-63.0m: AC		No	from downstream MH up as could not reach from upstream. Still have gap 31m
					61	11/4/2019	old Trans Canada going west towards Chatmen's house	1911041258a.avi	FALSE	1.0m: Roots growing in at pipe joint; 2.2m: Another root bundle; 5.3m: Another pipe joint with roots growing in; 9.4m: Pipe joint has root growth	0-85.3m: AC	old_transcanada_1; old_transcanada_2; old_transcanada_3; old_transcanada_4	No	Multiple root growths at pipe joints
L370	82.20	150	AC	L360	62	11/12/2019	end of west Loring looking back towards cemetery	1911121300a.avi	TRUE	4.4m: Root growth; 60.6m: Roots growing in from pipe joint	0-71.3m: AC	1911121302a; 1911121307a	Yes	
L360		150	AC	L370	63	11/12/2019	looking back to end of west Loring from manhole	1911121349a.avi	TRUE	No defects observed	0-15.8m: AC		No	
L360	98.40	150	AC	L350	64	11/12/2019	below Johnny McKay's house looking towards cemetery	1911121404a.avi	TRUE	33.1m: Some root growth; 56.2m: More roots	0-58.2m: AC	1911121407a; 1911121410a	Yes	
L350		150	AC	L360	65	11/12/2019	Looking back towards Johnny McKay's house	1911121604a.avi	TRUE	No defects observed	0-45.1m: AC		No	
L350	107.50	200	AC	FUT L300	66	11/12/2019	grave yard looking west	1911121629a.avi	TRUE	103.0m: Possible roots or just sewer cake buildup	0-107.5m: AC	1911121637b	Yes	
H255	143.50	150	AC	H260	67	11/13/2019	looking towards secondary school from mystery manhole	1911131636a.avi	TRUE	No defects observed	0-61.2m: AC		No	
B200	40.58	200	PVC	B190	NA	NA								
B190	41.36	200	VitClay	F180	NA	NA	inactive section from Hwy12 to Parish Hall		NA	not inspected				
F186	13.37	150	VitClay	F183	NA	NA	short section behind post office		NA	not inspected				
F185	53.47	150	VitClay	F183	NA	NA	section behind Lytton Hotel flows north to 7th		NA	not inspected				
F190	6.60	200	PVC	F188	NA	NA	short section near post office has a drop		NA	has a drop section				
F195	45.43	150	VitClay	F190	NA	NA	north of RCMP on good slope		NA					
F200	64.37	150	VitClay	F195	NA	NA	Station Road to Alonzo on 7th		NA	good slope, no issues reported				
I195	87.38	200	PVC	F190	NA	NA	on Main Street in fromt of old Lytton Elementary		NA	PVC and no issues reported				
I200	66.74	200	PVC	I195	NA	NA	on Main Street in fromt of old Lytton Elementary		NA	PVC and no issues reported				
E197	76.27	150	VitClay	F195	NA	NA	inside old Lytton Elementary ball field inactive		NA	inactive, not inspected				
E199	33.61	150	VitClay	E197	NA	NA	inside old Lytton Elementary ball field inactive		NA	inactive, not inspected				
E200	35.23	150	VitClay	E199	NA	NA	inside old Lytton Elementary ball field inactive		NA	inactive, not inspected				

Table 3-2 Video Inspection Reference 3 of 4

Up-stream MH	Length, m	Pipe Dia, mm	Pipe Matl.	Down-stream MH ID	Video Number	Date of Video	Description of stretch	File name	Marked on Map	Defect Observation	Pipe material breakdown from video inspection 2018-19	Defect reference photos	Call-up in Map	Notes
A210	23.52	150	VitClay	A200	NA	NA	near CP railroad & 4th Street		NA	Could not locate manhole				
A220	18.72	150	VitClay	A210	NA	NA	near CP railroad & 4th Street		NA	Could not locate manhole				
A230	26.42	150	VitClay	A220	NA	NA	near CP railroad & 4th Street		NA	finally located A230 but after work was done				
A240	129.77	150	VitClay	A230	NA	NA	long section parallel to CPR serves residences along Old Trans-Canada Hwy		NA	Could not locate manhole				
H150	40.25	150	AC	H120	NA	NA	on Hwy12 up the hill.		NA	Not inspected, no issues reported				
H160	93.69	150	AC	H150	NA	NA	on Hwy12 up the hill.		NA	No issues reported, couldn't find MH H160				
H180	129.69	150	AC	H160	NA	NA	on Hwy12 up the hill.		NA	No issues reported, couldn't find MH H160				
H190	46.78	150	AC	H180	NA	NA	on Hwy12 up the hill.		NA	Could not locate MH H190				
H200	57.23	150	AC	H190	NA	NA	on Hwy12 up the hill.		NA	Could not locate MH H190				
H210	37.00	150	AC	H200	NA	NA	on Hwy12 up the hill.		NA	Could not locate MH H210				
H220	84.95	150	AC	H210	NA	NA	on Hwy12 up the hill.		NA	Could not locate MH H210				
H228	78.71	150	AC	H225	NA	NA	short sewer drains west onto Hwy12 on north side of Forestry		NA	no issues reported				
W220	16.23	200	PVC	W210	25		short sewer with drop MH drains to Old Trans-Canada down the hill from Womens Shelter		NA	was partially captured with video in another section				
P310	88.04	150	AC	P300	NA	NA	Ponderosa Ave, at corner near TC#1		NA	no issues reported				
P300	70.49	150	AC	H270	NA	NA	167 Ponderosa Ave		NA	no issues reported				

Table 3-2 Video Inspection Reference 4 of 4

Data collected from video inspections demonstrated a need for numerous repairs, upgrades and replacements to the collection system for reliable service in the future. These are described in the following section.

3.13 Sewer Collection Upgrade Recommendations

In general, video inspections revealed that the gravity sewer collection system is mostly in good condition structurally, excepting a few breaks. Crown corrosion or other material degradation was not observed in video inspections nor have these been reported by operators. However several other deficiencies are seen that call for replacement of 2476 lin-m (about 54%) of gravity sewers in the Village over the next 20 years. The remainder of clay and asbestos cement (AC) sewers, including minor branch sections should also be considered for replacement beyond this horizon.

Noted deficiencies that require attention are summarized here:

- Many of the clay and A/C sewer pipes have root intrusion at the joints . This can be remedied by upgrading the sewer with slip-lining or pipe bursting technologies but is not recommended for most areas because the size, slope or depth of the existing sewers are also inadequate .
- Clay/AC sewers with inadequate slope and sagging sections that have ponding are accumulating solids on key sewers in the Village. The sagging may be caused by ground subsidence or construction irregularity but these sections cause solids to build up and result in clogged sewers that frequently require scour and purge with municipal hydro-vac equipment.
- There is inadequate depth in some areas to allow adequate slope.
- Inadequate size – 150mm sewers are easily plugged and are inadequate for critical trunk flow. It is recommended to replace these with 200mm PVC as a minimum for sewer mains and 250mm PVC or even 300mm PVC for trunk sections.
- Infiltration/exfiltration potential exists with all clay sewers but according to plant operators infiltration has not been a problem and has never increased flow above licensed treatment capacity. It is likely this is due to the low water table in the Village and the prevalence of gravelly well drained soils. Exfiltration (leakage) is more likely and the impact on nearby wells should be considered in replacement efforts. This is one reason for replacement of sewer piping along Alonzo Way where the Village has an active water supply well.

A 1998 study of the sewer system by UMA Engineering made similar recommendations regarding the gravity sewer collection network:

> Once across the highway, some of the downstream sewers will need to be increased in size in order to handle the additional flows, as shown on Figure 3. The newer PVC pipe from the highway to the 150 mm asbestos cement (AC) line is adequate for future flows. The first two sections of 150 mm AC lines are *nominally* adequate, i.e. they have sufficient capacity, but with higher future flows and solids loadings, plugging problems may occur. It would be desireable to replace these lines with a new 200 mm sewer. The section of AC pipe just upstream of the first section of vitrified clay pipe will definitely be inadequate and must be replaced with a new 200 mm sewer. The 150 and 200 mm vitrified clay pipe along Main Street, 1st Street, down the alley between Fraser and Main, and all the way to the new treatment plant should all be replaced with new 250 mm pipe.

Figures 3-A1 and 3-A2 (attached drawings both with and without photomap) show the Village sewer collection network and highlight observed problems and sections that are recommended for replacement in the next 10 years.

Table 3-3 (below) summarizes the recommended upgrades to the Lytton gravity sewer collection system over the next 20 years by project and presents corresponding Class "D" estimates of the cost to construct. These estimates include provision for greater depth in some areas and 4m asphalt overlay where applicable, as well as provision for lateral sewer connections and manholes.

Replacement sewer sections were ranked in priority by:

a) Operational history of problems as reported by staff.
b) Video inspection findings of problems (break, root intrusion, sag section etc).
c) Probable impact of failure – an arterial sewer has a much greater chance of causing basement flooding or environmental pollution in the event of a failed main.

More detailed calculations appear in the corresponding cost calculation sheets. All costing here is in Q1-2022 dollars and should be adjusted for inflation. Very small repairs/replacements are deemed operational in nature and are not reflected here.

Project Title	Proj #	Project Description	Est. Cost. 2022 $$	Year
Sewer Collection Upgrades Ph I - Downtown	T110 – F190	Replace sanitary sewer trunk pipe in Back Alley between WWTP and 7th Street and install new laterals at 1st, 3rd and 7th St.	$1,964,125	2022-2027
Sewer Collection Upgrades Ph II - Downtown	T115 - F183	Replace sanitary sewer trunk pipes on 1st Street, Fraser Street, West Lane and 7th Street. New sewer on Fraser between 1st Street and 4th Street.	$1,984,034	2022-2031
Sewer Collection Upgrades Ph III – Various	PH3A	Replace sanitary sewer pipes on Alonzo Way, Loring Way, West Loring and Misc. others.	$1,711,137	2030-2041
Soft Costs: GIS Data Collection and compilation	SSGIS1	- Field data collection of rim and invert elevations of all sewers and - Field location and marking of lost/buried manholes - Raise buried manhole rims to grade	$105,218	2022-2031
		TOTAL	**$5,764,513**	

Table 3-3 Lytton Sewer Collection System Improvement Plan Summary 2022-2041

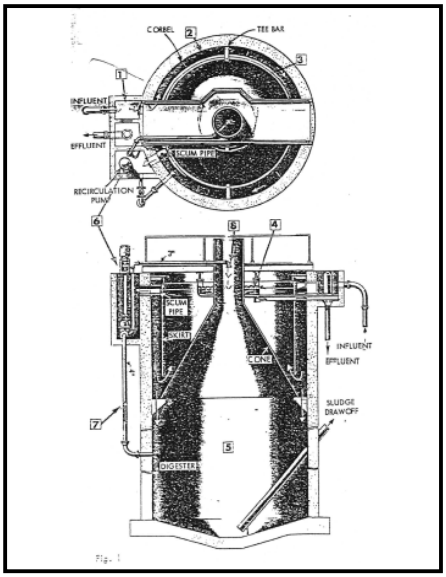
3.2 Waste Water Treatment Plant (WWTP)

Village of Lytton presently operates a secondary treatment plant using SBR technology which meets or exceeds all current regulations. There is a sludge drying bed and aerated sludge treatment in the facility. Discharge is disinfected by UV before outfall to the Fraser River.

This section briefly describes the history of the current plant and infrastructure needs are assessed for the future.

3.21 Early History

In the mid 1990's the Village began looking for replacement of its aging Spiragester treatment reactor with a modern secondary treatment plant. The Spiragester was 30 years old then and while functional it failed to meet new guidelines of the Waste Management Permit and was considered near end of life at the time. A 1995 report by TR Underwood Engineering titled "Village of Lytton Sewage Treatment Study" provides background on the Spiragester unit and contemplated replacement. Some excerpts from this study are noted here:



- Spiragester was recommended by Willis Cunliffe Engineering of Victoria in their 1963 report
- Was sold by Lakeside Engineering Corporation
- Was enclosed in a wood stave tank about 10metres high
- Design allowed heavier sludge to settle to the bottom of the tank with a cone separating the sludge from the main settling compartment.
- Provided about 35-50% removal efficiency for BOD_5 and TSS

TR Underwood also looked at several upgrade options for secondary treatment including Activated Sludge Treatment, Contact Stabilization Process, Rotating Biological Contactor (RBC) and Sequencing Batch Reactor (SBR).

3.22 Upgrade to SBR in 2004

A 2002 report by Stantec established basic design criteria for the new WWTP. Some of these are included here:

- Monthly average of daily inflow (Dec 1997 - June 2000) = 147 cu-m/d
- Maximum daily inflow rate in period of record was 190 cu-m/d
- Estimated population 570
- Average per capita 258 L/cap-d or peak month rate 350 L/cap-d
- Design population 940 for design inflow 220 cu-m/d
- Design BOD_5 = 200 mg/L
- TSS = 200 mg/L
- TKN 35 mg/L
- TP 10 mg/L

Stantec compared several technology options for the new plant including:

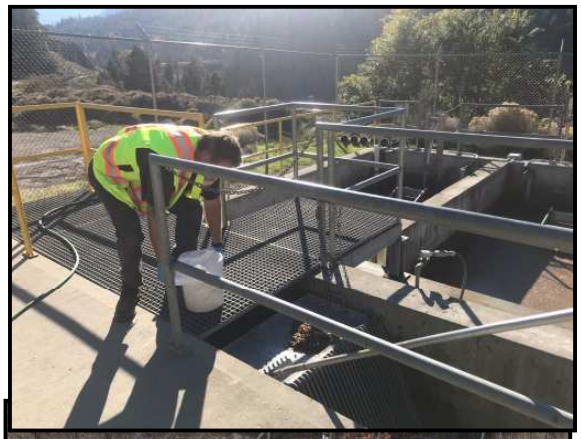
- Sequential Batch Reactor (SBR) vs Extended Aereation (EA) for secondary treatment
- Chlorination vs Ultraviolet (UV) disinfection for disinfection of effluent
- Aerobic Digestion vs Autothermophillic Digestion (ATAD)

In 2003-2004 the Village engaged EPCOR in a design-build contract to construct a new SBR facility and this was commissioned in 2004. The photo of a commemorative plaque below summarizes political details:

3.23 Description of 2004 SBR Facility

The 2004 Sequencing Batch Reactor (SBR) facility includes these principal components:

- **Preliminary Treatment**: Manually cleaned bar screen removing solids > 25mm (1”). See photo →



- **Primary Treatment**: Sedimentation, hydrovac grit removal from SBR and recycle to aerated sludge reactor.

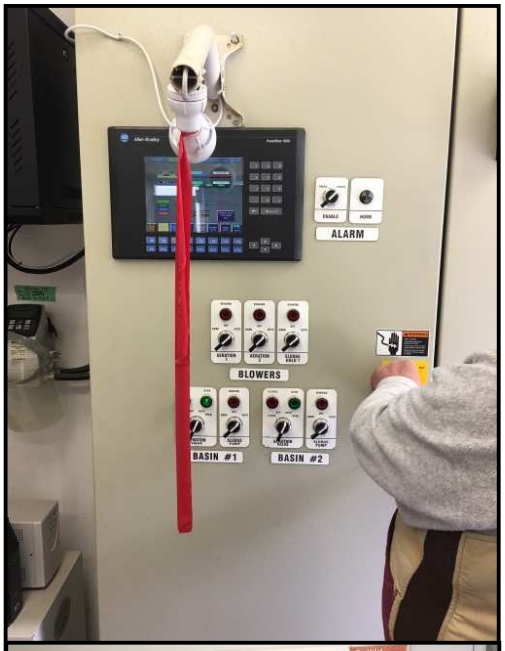
- **Secondary Treatment**: 2 SBR tanks, aerated sludge reactor, UV disinfection of plant discharge. See photo →

- **Sludge drying bed**
  Outdoor earthen drying bed is scraped and emptied to landfill as needed.

- **Compressor Room (see photo below right) →**
  Two compressors feed air to Reactor #1,2 and the third compressor provides air to the sludge reactor.

- **PLC Control Cabinet and HMI Interface (photo →)**

Upgrades are underway on PLC integration to SCADA. An interim operator workaround network video camera on interface panel with red ribbon so operators don't bang their heads.



- **Plant Operator Room**
  The plant is visited at least once per day for about 2 hours to perform routine inspection and maintenance tasks and record operational information. The facility also contains a lab sink and restroom and is ample for the needs it serves. (photo →)

- **Flow Metering**
  Flow leaving the plant is directed through a 150mm (6") mag type meter with totalizer capacity. Records are manually logged by the operator. (photo →)

- **UV Treatment of effluent**
  A UV treatment reactor is located just downstream from the mag flow meter (see photo below Right →). Records of lamp performance are logged by the operator.

3.24 Timeline of Improvements 2004 - 2021

- The 2004 SBR plant has had very little changes over the intervening 17 years
- 2008 Installation of replacement air Auma brand electric actuator valves from compressors
- 2009 Installation of residual chlorine monitoring for potable water system complete with internet connectivity and SCADA link to server.
- 2009 Repairs to conduit piping damaged by settlement near Reactors #1,2
- 2019 Replacement of air lines to reactors as steel lines had rusted
- 2019 Repairs to PLC and restore operating program after power failure damaged operating system. Installed backup power for PLC controls. Standby generator is in-place for plant but requires full installation.
- Other

3.25 Plant Process Information

Relevant plant information reported here includes:

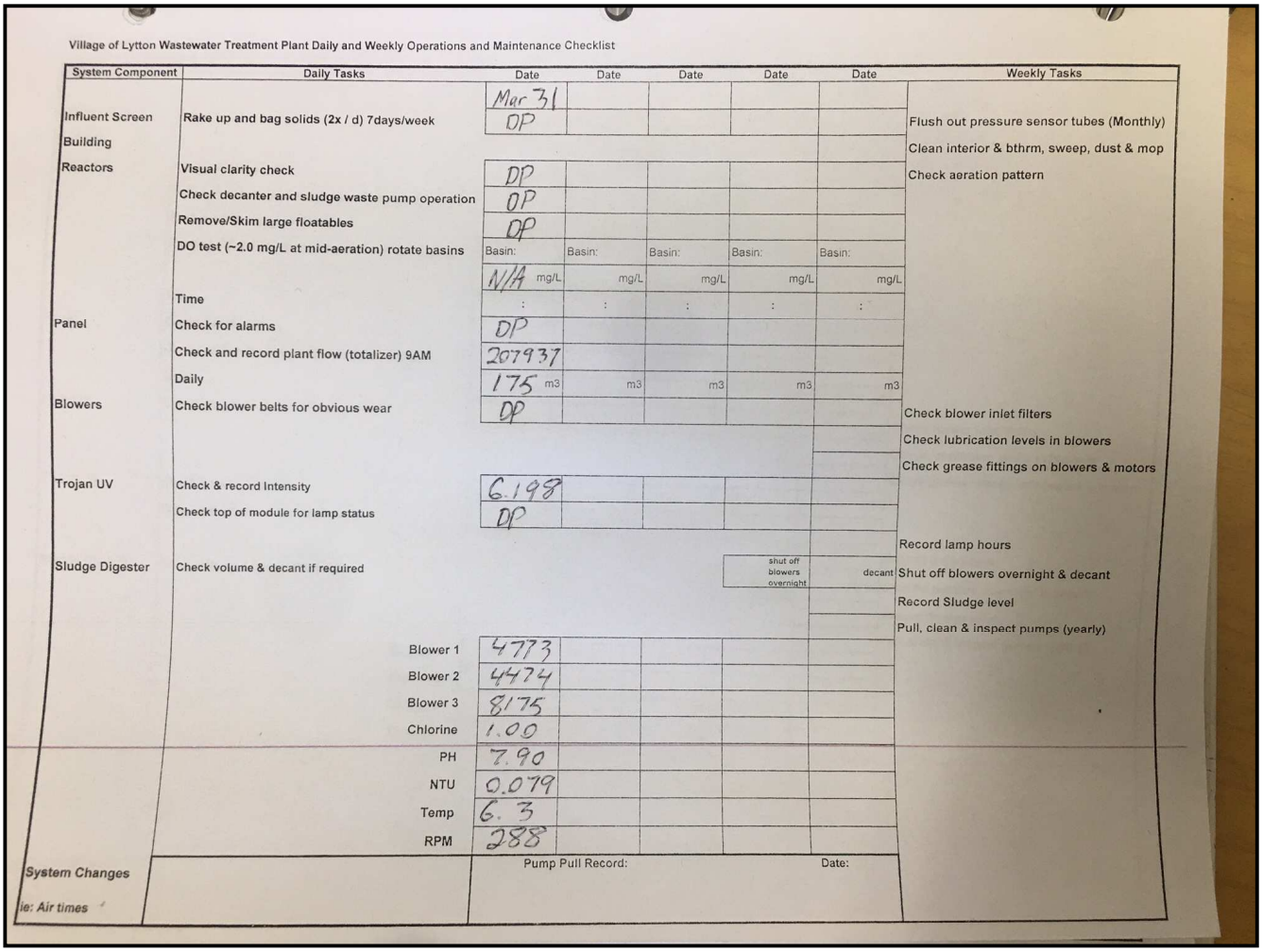
- Typical peak recorded daily flow 337 cu-m.
- Output violations reported: None
- Operator: 7 days/week shared between other municipal utility operations. Operator on-site about 2 hours/day including weekends.
- Backup power installed: None

Monitoring and Reporting Requirements (current):

Monitoring Parameter	**Value**
Plant Flow	Weekly record
BOD, TSS, Fecal Coliform sampling and lab analysis	Quarterly
Reporting to Ministry of Env. (ERRIS)	4X / year, annual summary rpt.
Reporting to Fisheries	Fish Lethality test annual
BOD limit	45 mg/L
TSS limit	45 mg/L
Fecal Coliform limit	200cfu/100ml
Flow Limit	350cu-m/day

Table 3-4 WTTP Monitoring and Reporting Schedule

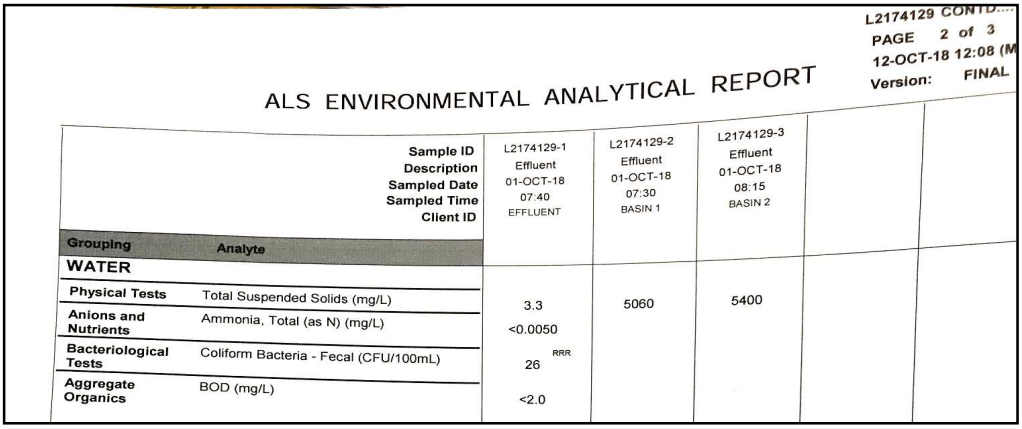
Table 3-5 below is a recent copy of operator log entries for the plant which illustrates typical activities of operators at the plant.



Village of Lytton Wastewater Treatment Plant Daily and Weekly Operations and Maintenance Checklist

System Component	Daily Tasks	Date	Date	Date	Date	Date	Weekly Tasks
		Mar 31					
Influent Screen	Rake up and bag solids (2x / d) 7days/week	DP					Flush out pressure sensor tubes (Monthly)
Building							Clean interior & bthrm, sweep, dust & mop
Reactors	Visual clarity check	DP					Check aeration pattern
	Check decanter and sludge waste pump operation	DP					
	Remove/Skim large floatables	DP					
	DO test (~2.0 mg/L at mid-aeration) rotate basins	Basin:	Basin:	Basin:	Basin:	Basin:	
		N/A mg/L	mg/L	mg/L	mg/L	mg/L	
	Time	:	:	:	:	:	
Panel	Check for alarms	DP					
	Check and record plant flow (totalizer) 9AM	207937					
	Daily	175 m3	m3	m3	m3	m3	
Blowers	Check blower belts for obvious wear	DP					Check blower inlet filters
							Check lubrication levels in blowers
							Check grease fittings on blowers & motors
Trojan UV	Check & record Intensity	6.198					
	Check top of module for lamp status	DP					
							Record lamp hours
Sludge Digester	Check volume & decant if required				shut off blowers overnight	decant	Shut off blowers overnight & decant
							Record Sludge level
							Pull, clean & inspect pumps (yearly)
	Blower 1	4773					
	Blower 2	4474					
	Blower 3	8175					
	Chlorine	1.00					
	PH	7.90					
	NTU	0.079					
	Temp	6.3					
	RPM	288					
System Changes ie: Air times		Pump Pull Record:				Date:	

Table 3-5 Operator Log Entry Form



L2174129 CONTD....
PAGE 2 of 3
12-OCT-18 12:08 (M
Version: FINAL

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2174129-1	L2174129-2	L2174129-3		
	Description	Effluent	Effluent	Effluent		
	Sampled Date	01-OCT-18	01-OCT-18	01-OCT-18		
	Sampled Time	07:40	07:30	08:15		
	Client ID	EFFLUENT	BASIN 1	BASIN 2		
Grouping	Analyte					
WATER						
Physical Tests	Total Suspended Solids (mg/L)	3.3	5060	5400		
Anions and Nutrients	Ammonia, Total (as N) (mg/L)	<0.0050				
Bacteriological Tests	Coliform Bacteria - Fecal (CFU/100mL)	26 RRR				
Aggregate Organics	BOD (mg/L)	<2.0				

Table 3-6 Most Recent Lab Analysis of Plant Effluent

The WWTP site is located on leased land from CN Rail at the south end of the Village and is shown in drawing D1 (following page). The area nearby is also known as "Hobo Hollow" to locals. A copy of a recent lease renewal correspondence is shown in the appendices for reference. It was not clear from the records reviewed which land this lease pertains to but it is believed to be land west of Lot 2. Lot 2 is outlined in purple on the WWTP plan and measures 0.1483ha.

Some relevant facts pertaining to the lease agreement with CN Rail include:

- Annual fee under the lease agreement is $1000.00
- Term: 5 year renewal
- Last renewal date: Dec. 1, 2019

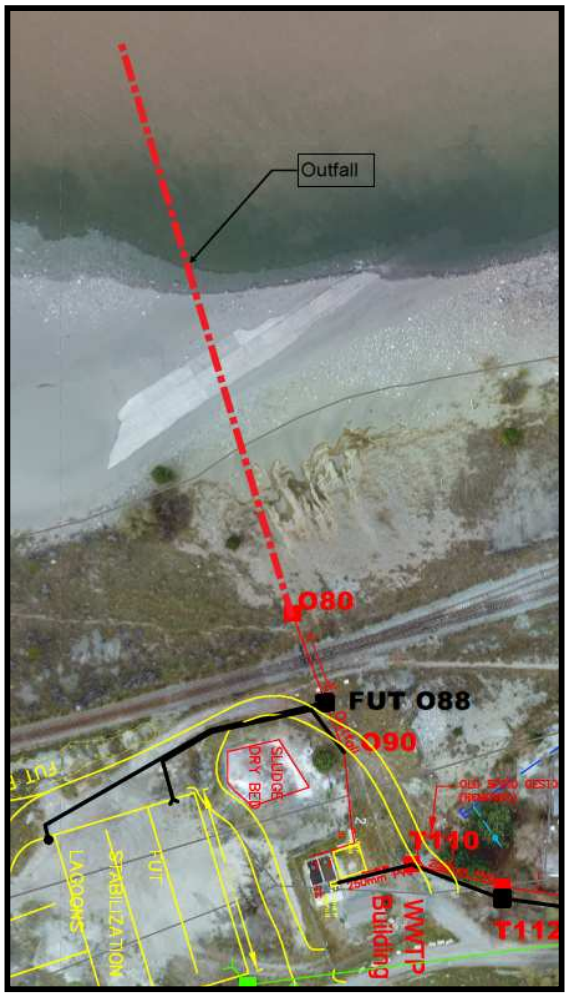
It is evident in the overlay drawing D1 that construction of the plant does not conform to the cadastral as the WWTP facility appears to be spread across CN Rail land as well as Lot 2 and Village Right-of-way.

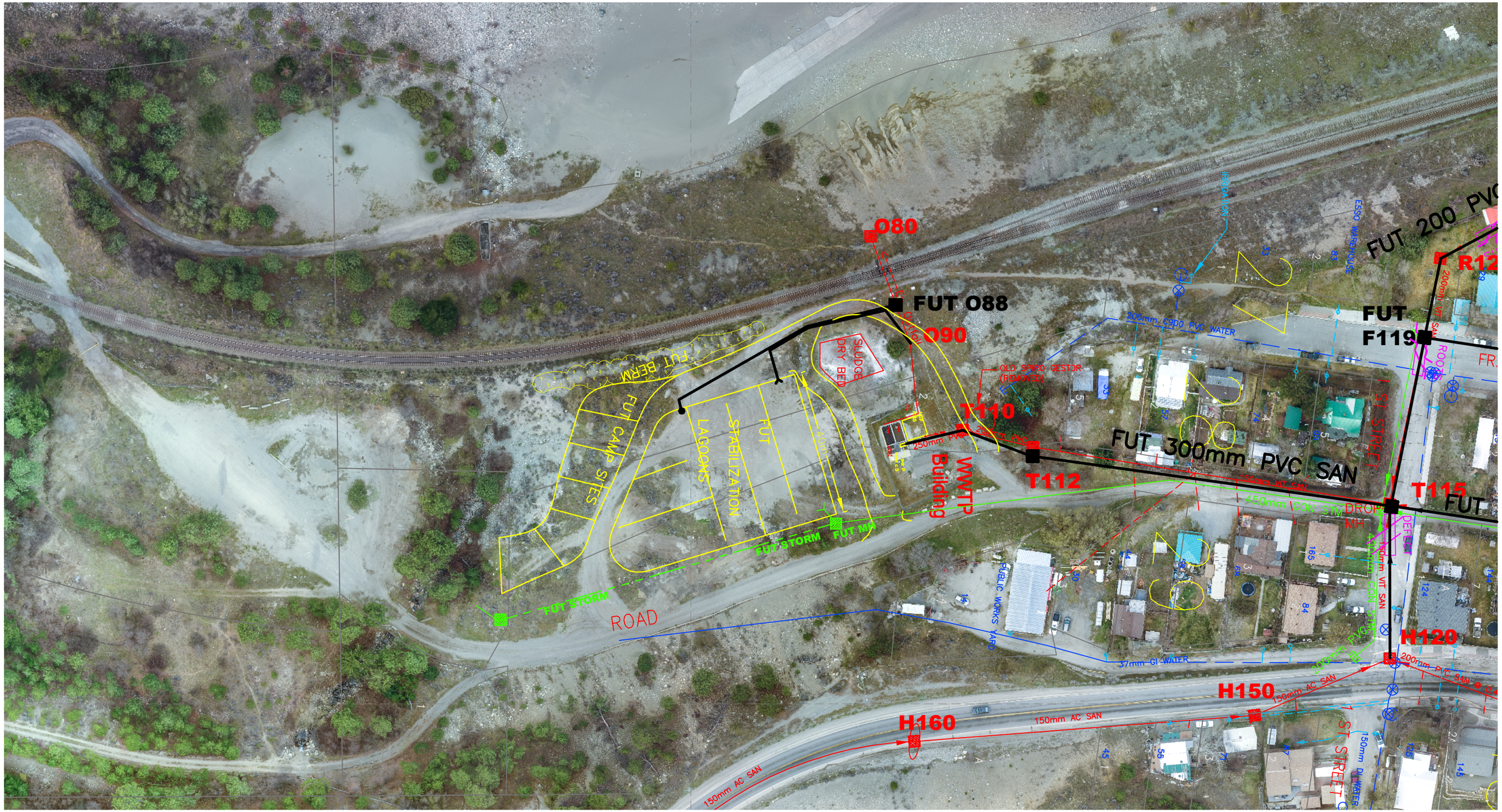
3.27 Treated Waste Outfall

An outfall pipe conveys treated effluent to the Fraser River. This pipe is believed to have been constructed in the 1960's and we do not have as-built records of exact location but plan sheets have indicated the outfall is indicated as in the photomap below. MH080 is located from the aerial photo map base. There is also another manhole west of MH080 but this could not be referenced.

The outfall is believed to be a 150mm (6") diameter pipe and it is believed to extend beyond the Thompson-Fraser mixing zone.

Recently Environment Canada has requested a survey of the pipe to assure its physical integrity and the Village will consider this in capital improvments.





MUNDALL ENGINEERING & CONSULTING

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WATER RESOURCES WASTEWATER CIVIL AGRICULTURAL

Village of Lytton

PO Box 100 400 Main Street
Lytton, BC V0K 1Z0

D1

WWTP Facilities

Utilities with Proposed Sanitary System Improvements

Scale 1:1000

Edit: April 23, 2021

3.27 WWTP Facility and Site Capital Improvements

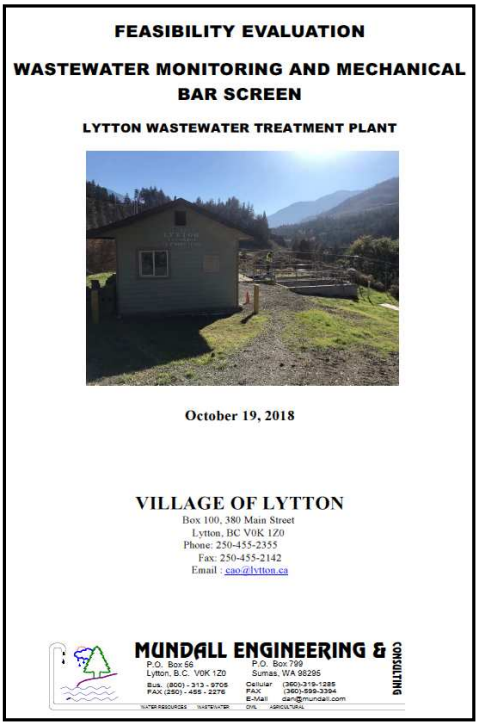
Sequencing Batch Reactor (SBR) technology is well established for small wastewater treatment facilities such as Lytton. These facilities offer compact plant size and excellent performance. SBR systems were an early driver for computer controlled process using Programmable Logic Controller (PLC) technology. The Lytton facility has performed very well over the past 17 years with one exception; the plant is vulnerable to disruption.

For instance some disruptions are described here:

- **Mechanical failure** – a 2008 failure of an air control valve led to temporary exceedance of effluent parameters. The valve had to be sourced out of the country and even with rush shipment and temporary manual intervention there was violation of the discharge permit. A Ministry of Environment officer remarked at the time that "the old Spirogester was more resilient...". An air feed pipe failure was also disruptive although the plant operator quickly intervened and improvised a temporary fix.
- **Process disruption** has been a reoccurring problem – several events of odor, foam and other disruptions are believed to have originated with biota breakdown resulting from sani-dump chemicals and medical antibiotics. Enzyme additions have been used on many occasions to restore normal process with some success.
- **Power Disruption** – Electrical grid outages are fairly common in Lytton. However without backup these disruptions completely shut down aeration and process functions, contributing to discharge violations.
- **PLC and Relay Failure** – A PLC failure was initiated during a power outage in 2019. A power surge damaged the EEPROM (memory) and this required restoration of the operating code.

The Village of Lytton engaged Mundall Engineering in 2018 to look at the feasibility of several upgrades to the plant to make it more resilient. A copy of this study is included in the appendix. Originally the scope of the study was focused on preliminary screening. However over the course of the study a number of other improvements were considered essential. The final scope of improvements included:

1. Preliminary automatic screening treatment – automatic mechanical bar screen with 6mm (1/4") openings to replace manually cleaned bar screen with 25mm (1") openings and thus limit the chance of solids causing disruption of the plant.
2. SCADA development systems for remote monitoring and control of plant. Includes backup battery power
3. Screened Solids (grit) management
4. Facultative Stabilization lagoons 2100 sq-m x 2.4m deep with circulation and on-demand aeration.
5. Standby Generator backup power for the plant
6. Odor Control system
7. Grit Removal system
8. SBR Reactors #3,4 or other improved secondary treatment as may be required in the future.



FEASIBILITY EVALUATION

WASTEWATER MONITORING AND MECHANICAL BAR SCREEN

LYTTON WASTEWATER TREATMENT PLANT

October 19, 2018

VILLAGE OF LYTTON
Box 100, 380 Main Street
Lytton, BC V0K 1Z0
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WATER RESOURCES WASTEWATER DIKE AGRICULTURAL

Some additional conceptual design or construction of these items has been carried out and is discussed here:

Item #1 Preliminary Automatic Screening – upon further review a different manufacturer is preferred
Item #4 Deeper Facultative Lagoons are now preferred . A Conceptual design is presented in Drawing D-2 based on design information from the USEPA design manual "Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers, and Managers", 2011 and other sources. Some design data are presented here:

- The design would normally receive very light loading of treated plant discharge but could provide treatment during a plant disruption.
- The suggested area of these lined earthen lagoons is 2,100 sq-m based on the available area of the site.
- Recommended depth is 2.4m.
- Water volume is 2.4 x 2,100 = 5,040 cu-m
- Residence time (design flow) = 5,040cu-m /350 cu-m/day = 14 days (at current design capacity)
- The lagoons will be fitted with a circulation pump and a floating aerator that is activated on demand.
- Treated effluent leaving the plant will be routed to the lagoons and then returned to the outfall pipe with option for recycle to process if needed.
- Potential exists for a small RV park in the immediate vicinity. Note that the lagoons will receive clarified, disinfected water unless a plant disruption occurs.
- Site is on reclaimed land and is not infringing on adjacent development
- Property agreements needed with CN
- Freeboard 0.6 to 0.9m
- Plastic baffling with clay liner and clay is preferred
- Aqueous plants
- Ramps for maintenance access to be provided

Table 3-7 below summarizes recommended improvements related to the WWTP through 2035. The focus of these improvements is reliability and increased capacity.

Development Description*	**Rationale**	**Est. Time frame**	**Projected Cost $ 2022**	**Est. Class**
- Preliminary automatic screening to ¼" (6mm) upgrade from 1" (25mm) manual clean bar screen	Improve plant reliability and reduce operator time. Reduce operator risk from handling raw sewage when raking screen.	2023	$205,680	C
- SCADA development & battery backup power. Also includes process instrumentation such as DO meters	to allow remote internet access to plant performance and limited control. Alert to problems.	2022	$91,076	C
- Screened Solids Management spray down and dewatering, storage, handling	Remove treatable solids from screened waste, improve handling of solids to save operator time and improve safety.	2024	$53,128	C
- Effluent Facultative lagoons for standby treatment	Minimize pollution risk to Fraser River in case of irregularities in plant output	2028	$1,138,448	D
- Standby Generator propane or diesel capable of entire plant operation.	Increase reliability of plant, protect from overflows, pollution events and freezing damage.	2022	$37,948	D
- Odor Control system for SBR reactors	Eliminate odor complaints in Village	2028	$455,379	D
- Grit removal system	Improve capacity of plant to handle sand or other heavy insoluble solids	2026	$121,434	D
- SBR3,4 or other improved secondary treatment reactors with cover	Increase secondary treatment capacity from 350cu-m/day	2035	$2,276,897	D
- Video inspect and locate/map outfall into Fraser River	Required by Environment Canada	2022	$45,538	D
- Other site improvements, land scaping, access, storm drainage as indicated on plan D-2	Improve aesthetics and access to site	2026	$60,717	D
			$4,486,245	

Table 3-7 Summary of Plant Improvements

4.0 Conclusions and Recommendations

The Village of Lytton has operated waste water collection and treatment facilities for over 50 years. Presently there are over 4.5km of gravity sewers throughout the Village along with 73 manholes. The system also collects sewer from adjacent IR17 and IR18. Base mapping of the system allowed the preparation of accurate mapping to show locations of all sewers where manholes could be located and a nomenclature system was developed to describe manholes and pipe reaches.

Video inspection of about 84% of the gravity sewers was carried out in 2019. Most sewer piping is vitrified clay, asbestos cement or PVC. All the piping appears in nominally good condition although there are several serious sag problems and major root infestations in clay piping where it is near trees. Several major reaches are recommended for replacement by open trench, with minor sections by pipe bursting or slip lining where open trench may not be feasible.

A summary of replacements over the next 20 years was prepared. The figures show about $5.8 Million (‘2022 dollars) investment in gravity sewers is needed to upgrade the size and materials in priority reaches – mostly in the core Village but also in the Ponderosa-Loring Way development.

The Village has a modern SBR facility providing secondary treatment since 2004. This facility has performed well although its compact design has made it vulnerable to discharge permit violations when there are power failures, equipment problems or disruptions in raw sewage. Several upgrades to this facility are recommended over the next 20 years including improved preliminary treatment, grit removal, backup power, SCADA, and a facultative lagoon system to buffer plant output. Moreover it is anticipated that growth in the Village will drive the construction of two additional SBR reactors within the next 10 years as capacity is nearing permit limits. The total cost of improvements to the Waste Water Treatment Plant (WWTP) and site is estimated at $4.5 Million in 2022 dollars.

It is recommended that:

- Village carries out more detailed data collection of gravity sewer system for mapping and engineering design use.
- Village further explore the feasibility and cost of the upgrades envisioned for the plant. For instance, land use agreements need to be in place for expansions and lagoon construction and some further consideration should be given to plant expansion phasing.

APPENDICES:

- **Appendix A** Related Project Reports (scanned)
    1. Sanitary Sewerage Scheme, Willis Cunliffe Tait, 1964
    2. Sewer Extensions to Ponderosa Heights, 1968
    3. Water and Sewer Feasibility Study, UMA Engineering Ltd., 1998
    4. Feasibility Evaluation Wastewater Monitoring and Mechanical Bar Screen, Mundall Engineering, 2018
- **Appendix B** Cost Calculation Sheets – Sewer Infrastructure Improvements
- **Appendix C** Sewer System Drawings A1, A2 (Aerial Photo and CAD) 11x17
- **Appendix D** Lytton Sewer Regulation Bylaws