Paul First Nation Water & Wastewater System Upgrades

Presentation by:

Simon House, Water & Wastewater Operator (Paul First Nation)

Matt Paznar, P.Eng., EP (Neegan Burnside)

Greg Koncan, EIT (ON) (Neegan Burnside)

Wednesday October 23, 2019

Agenda

- Introductions
- Overview of previous water system issues
- Water system design and implementation
- Overview of previous wastewater system issues
- Wastewater system design and implementation
- Impact on community
- Questions

Introductions

Simon House,
Water and Wastewater Operator
(Paul First Nation)

Matt Paznar, P.Eng., EP
(Neegan Burnside)

Greg Koncan, EIT
(Neegan Burnside)

Previous Water System

Overview of Previous Water System:

- Raw water supplied by groundwater wells and was treated using sodium hypochlorite (chlorine)
- Approximately 12 km of watermain servicing 47 homes and the remaining homes serviced using truck haul and cisterns.

Issues:

- Treated water exceeded the health and aesthetic limits outlined in the federal Guidelines for Canadian Drinking Water Quality (GCDWQ)
- The system was missing the following Plans:
  - Source Water Protection Plan
  - Well Head Protection Plan
  - Well Maintenance Plan
- Concern of chemical contamination of the groundwater aquifer from a previous train derailment and associated chemical spill
- High (90+ PSI) water pressure within the Core Area and low (<30 PSI) water pressure in the Subdivision Area

Previous Water System (cont.)

Issues (cont.):

- Upgrades to the Water Treatment Plant (WTP) initiated in 2011 did not appear to be completed and had several concerns:
  - Auto-dialer not connected / operational
  - On-line analyzers were not operational
  - Programmable Logic Control (PLC) and system monitoring was not operational
  - Generator was not operational
  - Chemical feed system was disconnected and a single pump was installed
- Additional Operations and Maintenance (O&M) funding was needed to properly operate the system
- Various plans required such as:
  - O&M Plan
  - Standard Operating Procedures
  - Emergency Response Plan

Previous Water System (cont.)

Issues (cont.):

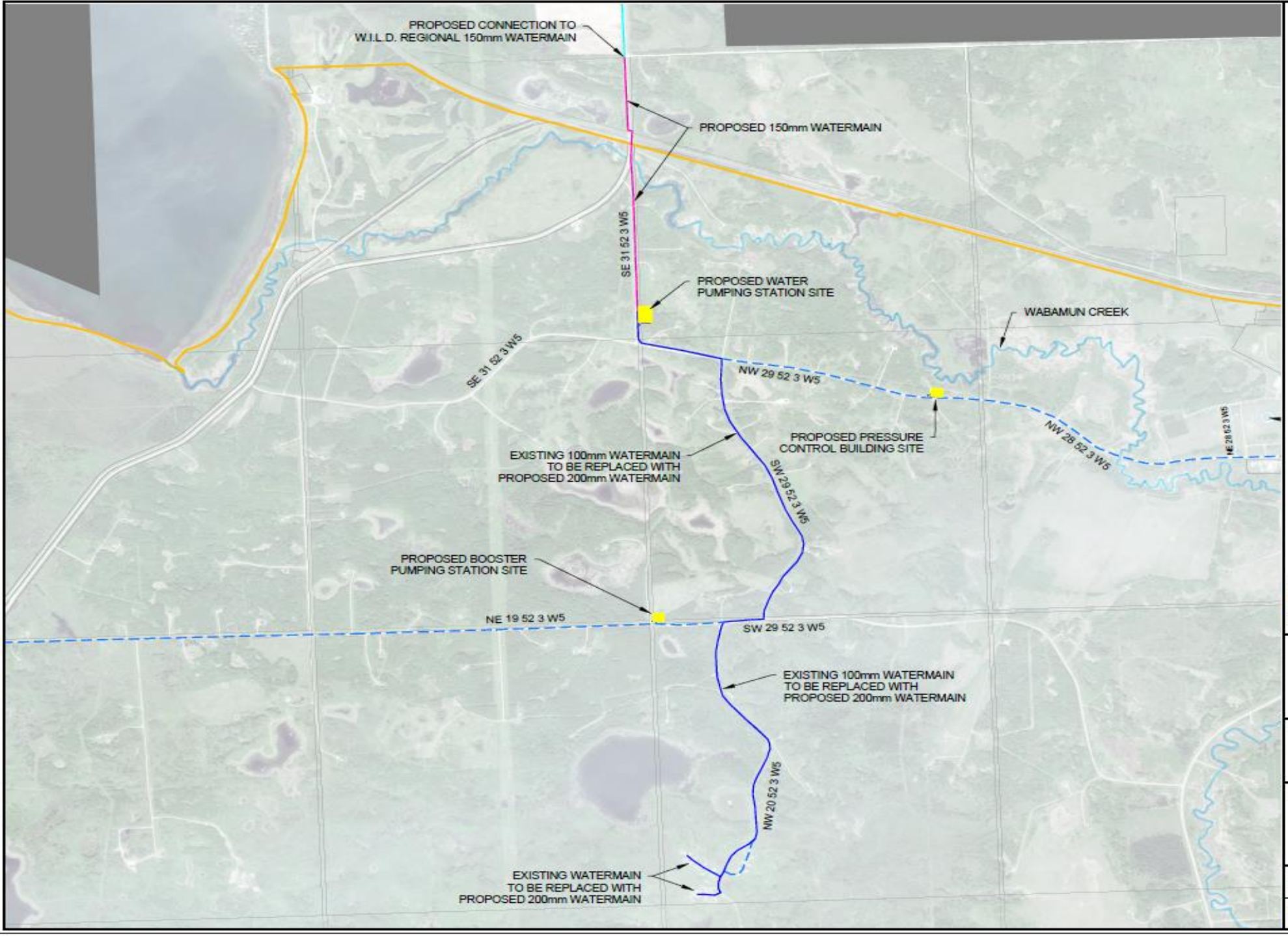
- Concerns regarding the groundwater aquifer being able to support all of the houses on wells as there was a noticeable decline in the groundwater level.
- System had trouble maintaining chlorine residuals and many homes were on Boil Water Advisories (BWA).

Possible Solutions

1) Upgrade the existing treatment system utilizing groundwater; however ,the groundwater quality was expected to be poor (high levels of fluoride, sodium and total dissolved solids), requiring a complex treatment system
2) Change the source of raw water to Wabamun Lake; however, there were large concerns of chemical contamination from the train derailment in 2005 which spilled hydrocarbons and chemicals into Lake Wabamun
3) Connect to the West Inter Lake District (WILD) regional waterline

Water System Upgrades

- Connecting to the West Inter Lake District (WILD) Regional waterline to obtain a potable water supply
- Construction of a new Water Pumping Station (which includes a below grade storage reservoir, a pumping station and a truck fill facility)
- Installation of approximately 2,250 metres of watermain from the WILD regional pipeline to the existing watermain
- Installation of approximately 4,000 metres of watermain to provide adequate fire protection to subdivision area
- Construction of a Pressure Control Building
- Construction of a Booster Pumping Station
- Construction of a two bay Truck Garage to store the Water Delivery Trucks
- Retrofitting the existing WTP into a storage reservoir, pumping station and truck fill facility (referred to as the Core Area Pumphouse)
- Utilizing two of the existing wells for a summer fire supply truck fill
- Decommissioning of one existing well



LEGEND

- RESERVE ADMINISTRATIVE BOUNDARY
- EXISTING WATERMAIN
- EXISTING 150 mm REGIONAL WATERMAIN
- PROPOSED 150 mm WATERMAIN
- PROPOSED 200 mm WATERMAIN

N

0 400 800 1,200 1,600
Metres

Satellite Image Source:
Background June 2011 satellite image obtained from DigitalGlobe© Copyright 2014 DigitalGlobe, Inc., Longmont CO USA 80503

NEEGAN BURNSIDE

Client
PAUL FIRST NATION

Figure Title
100% DESIGN REPORT FOR WATER SYSTEM UPGRADES

PROPOSED WATER SYSTEM UPGRADES

Drawn	Checked	Date	Figure No.
C.S.	J.D.	2015-02-04	1
Scale		Project No.	
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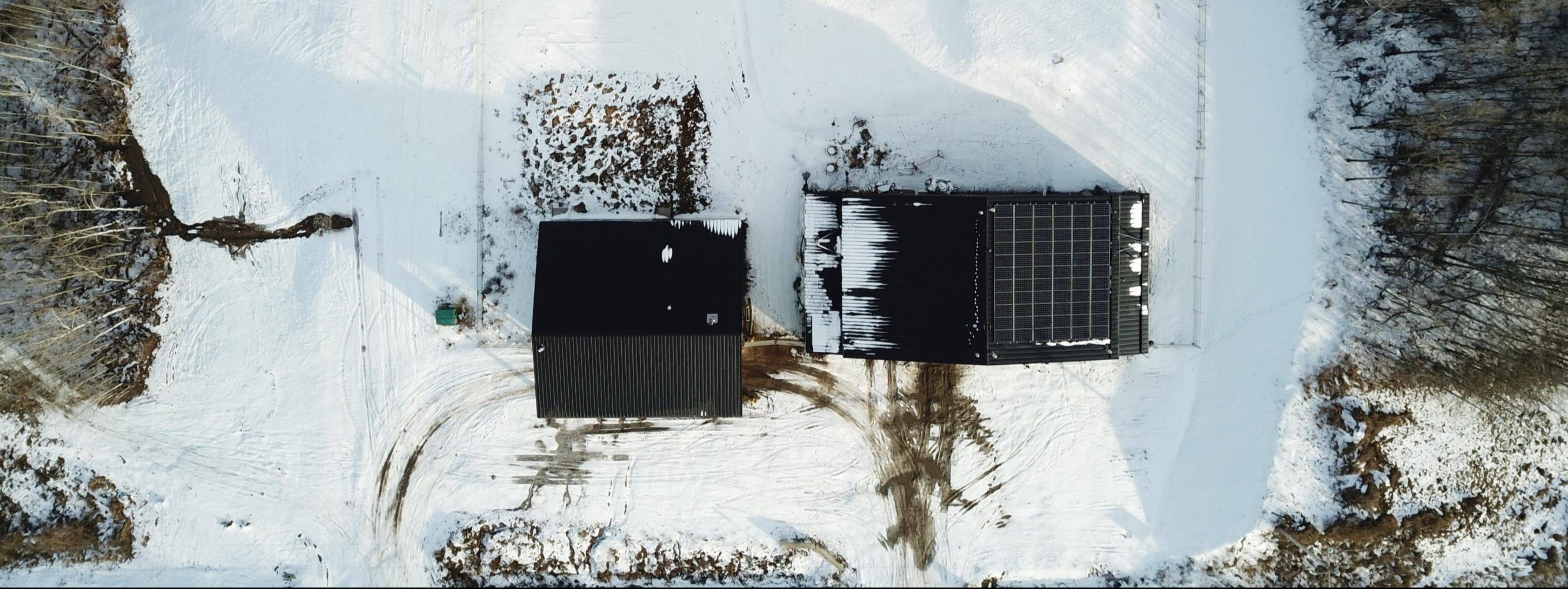
Water Pumping Station (WPS)

Water Pumping Station and Water / Sewage Truck Garages



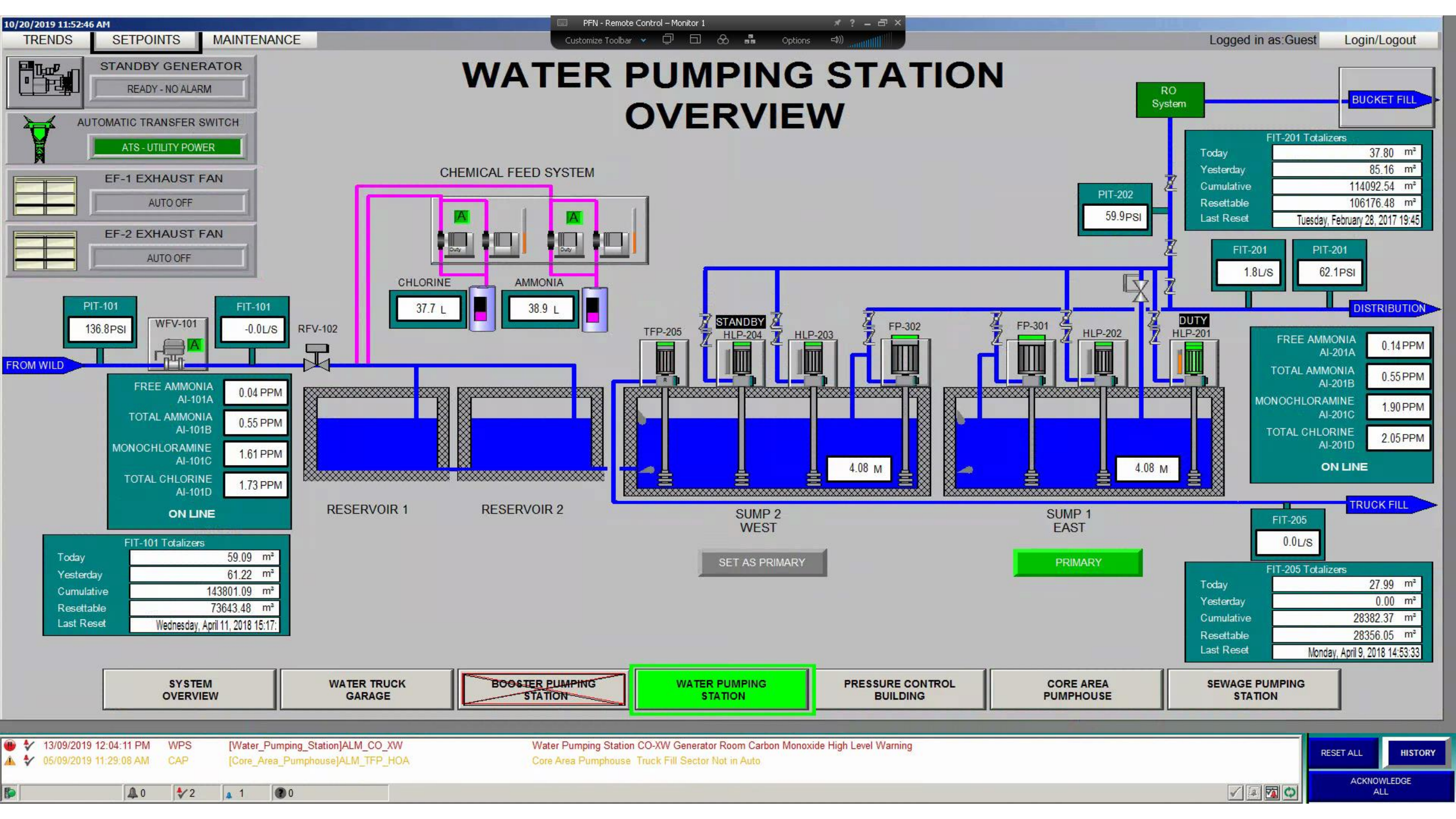
Water Pumping Station and Truck Garage

Construction Photos

Construction Photos (cont.)

Construction Photos (cont.)

Construction Photos (cont.)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PFN - Remote Control – Monitor 1
Customize Toolbar
Options
TRENDS
SETPOINTS
MAINTENANCE
Logged in as:Guest
Login/Logout
WATER PUMPING STATION OVERVIEW
STANDBY GENERATOR
READY - NO ALARM
AUTOMATIC TRANSFER SWITCH
ATS - UTILITY POWER
EF-1 EXHAUST FAN
AUTO OFF
EF-2 EXHAUST FAN
AUTO OFF
CHEMICAL FEED SYSTEM
CHLORINE
37.7 L
AMMONIA
38.9 L
RO System
BUCKET FILL
FIT-201 Totalizers
Today 37.80 m³
Yesterday 85.16 m³
Cumulative 114092.54 m³
Resettable 106176.48 m³
Last Reset Tuesday, February 28, 2017 19:45
PIT-202
59.9PSI
FIT-201
1.8L/S
PIT-201
62.1PSI
DISTRIBUTION
PIT-101
136.8PSI
WFV-101
FIT-101
-0.0L/S
RFV-102
FROM WILD
TFP-205
STANDBY
HLP-204
HLP-203
FP-302
FP-301
HLP-202
DUTY
HLP-201
FREE AMMONIA AI-101A 0.04 PPM
TOTAL AMMONIA AI-101B 0.55 PPM
MONOCHLORAMINE AI-101C 1.61 PPM
TOTAL CHLORINE AI-101D 1.73 PPM
ON LINE
FREE AMMONIA AI-201A 0.14 PPM
TOTAL AMMONIA AI-201B 0.55 PPM
MONOCHLORAMINE AI-201C 1.90 PPM
TOTAL CHLORINE AI-201D 2.05 PPM
ON LINE
RESERVOIR 1
RESERVOIR 2
4.08 M
4.08 M
SUMP 2 WEST
SUMP 1 EAST
TRUCK FILL
FIT-205
0.0L/S
SET AS PRIMARY
PRIMARY
FIT-101 Totalizers
Today 59.09 m³
Yesterday 61.22 m³
Cumulative 143801.09 m³
Resettable 73643.48 m³
Last Reset Wednesday, April 11, 2018 15:17:
FIT-205 Totalizers
Today 27.99 m³
Yesterday 0.00 m³
Cumulative 28382.37 m³
Resettable 28356.05 m³
Last Reset Monday, April 9, 2018 14:53:33
SYSTEM OVERVIEW
WATER TRUCK GARAGE
BOOSTER PUMPING STATION
WATER PUMPING STATION
PRESSURE CONTROL BUILDING
CORE AREA PUMPHOUSE
SEWAGE PUMPING STATION
13/09/2019 12:04:11 PM WPS [Water_Pumping_Station]ALM_CO_XW Water Pumping Station CO-XW Generator Room Carbon Monoxide High Level Warning
05/09/2019 11:29:08 AM CAP [Core_Area_Pumphouse]ALM_TFP_HOA Core Area Pumphouse Truck Fill Sector Not in Auto
RESET ALL
HISTORY
ACKNOWLEDGE ALL
0
2
1
0

WPS Features

- Truck fill
- Heated and sloped concrete pad
- Outdoor bottle / jug fill station connected to a Reverse Osmosis system
- Security cameras

Incoming Water Supply

High Lift Pumping & Truck Fill Header

Fire Pumping System

- National Fire Protection Association (NFPA) rated fire pumping system
- Duty / standby vertical turbine pumps
- Each unit has independent transfer switch that can start the generator
- Low water level shut down

Fire Pump Multi Stage Impellers

Reverse Osmosis System for Bucket Fill

Key Features - Chloramination

- WILD system utilizes chloramines (addition of chlorine and ammonia) for Secondary Disinfection within the Distribution System
- Chloramines persist longer in distribution system in comparison to chlorine
- New Water Pumping Station and Core Area Pumphouse needed to be able to monitor chloramine levels (chloramines degrade in water over time, similarly to chlorine) and add disinfectant to the water supply as needed
- Online monitors and chemical feed equipment with automatic dosing, utilizing a Supervisory Control and Data Acquisition (SCADA) system

Secondary Disinfection Top-up System

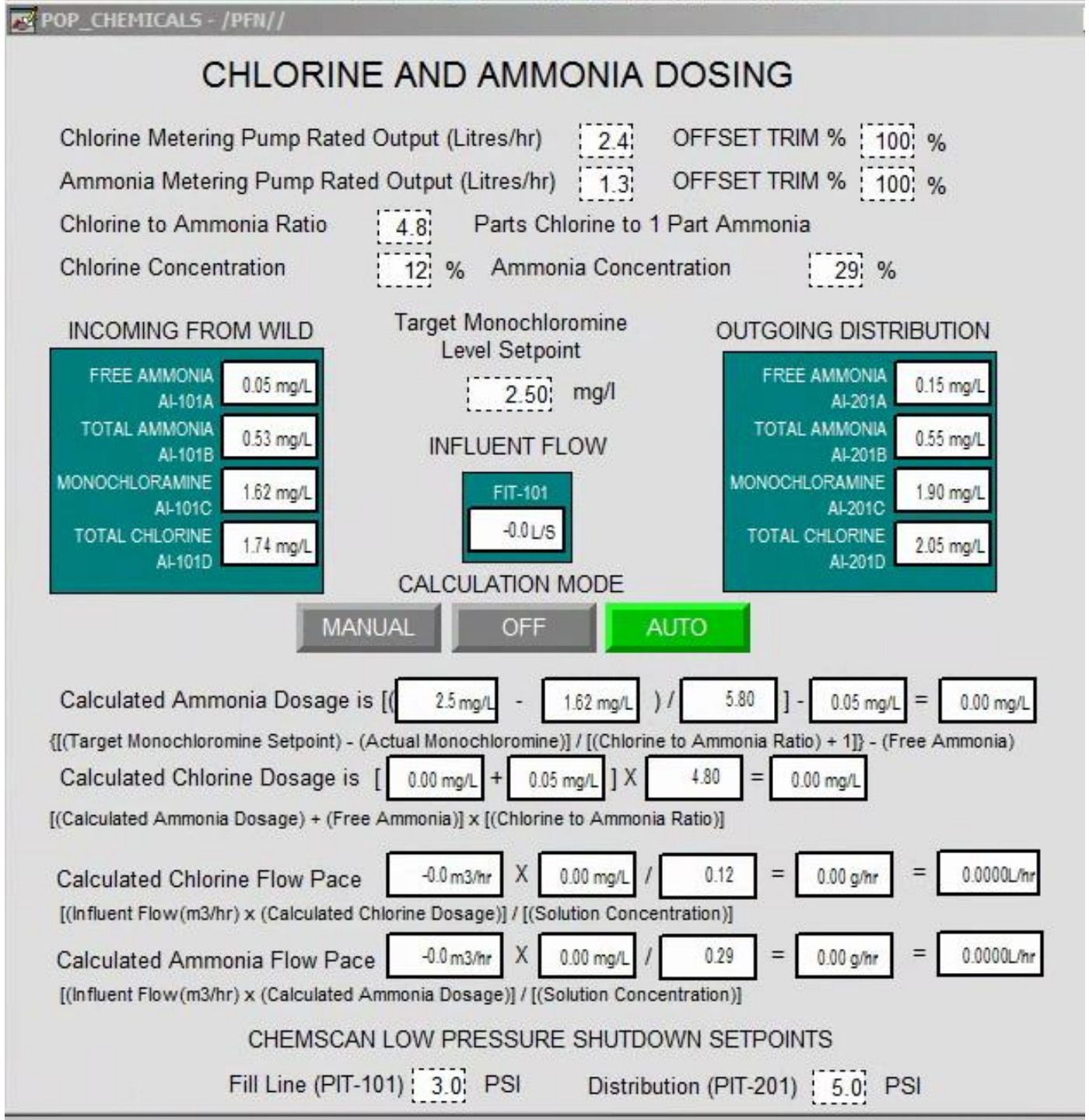
Analyzer

Chemical Feed System

Chemical Feed Dosing Pumps

Chloramine Dosing Calculations

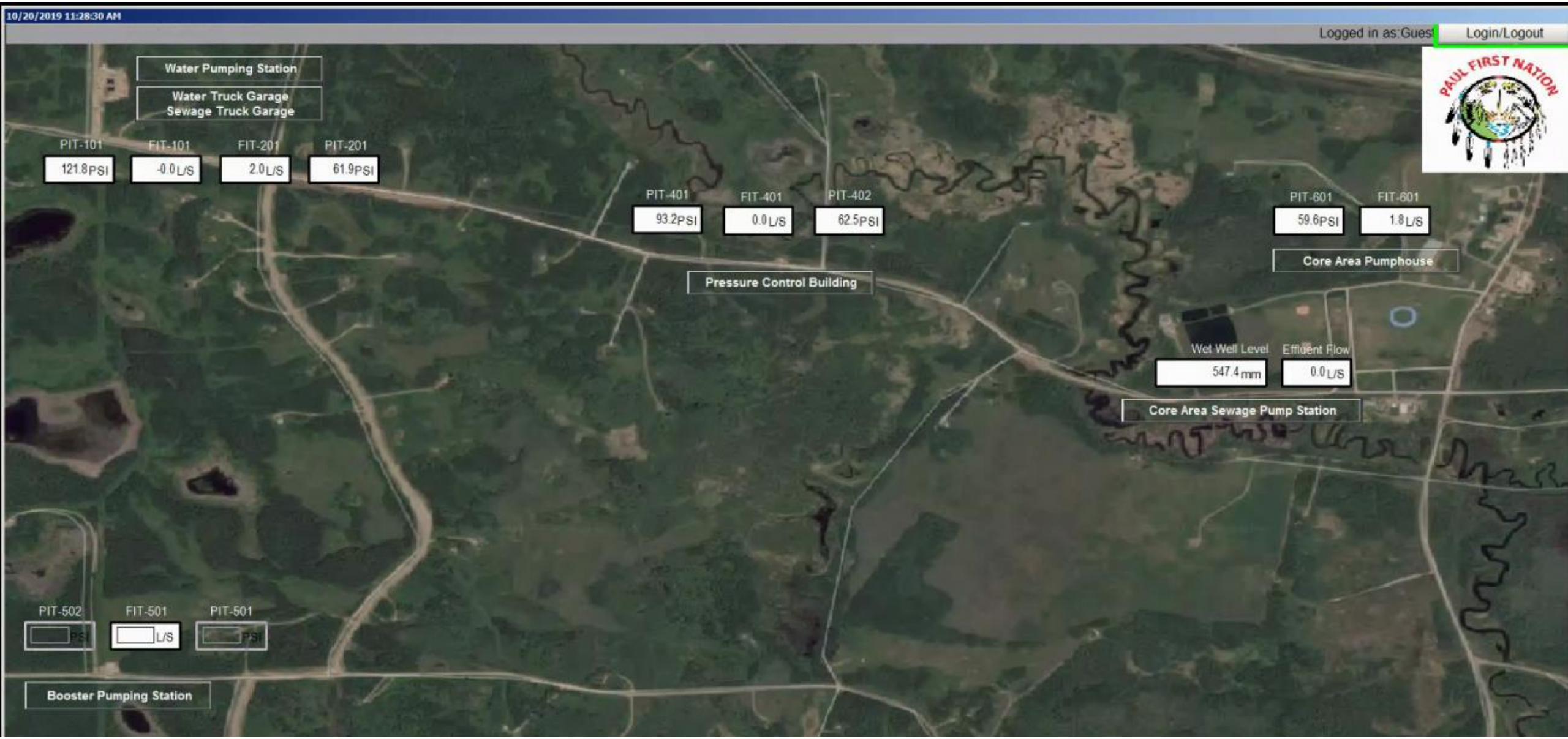
- Top up chloramination is automated through the PLC and SCADA system.
- Chemscan unit analyzes the water and the following calculations are undertaken.
- PLC sends signal to the chemical feeds pumps which adjust the dosage based on the calculations and flow of the water entering the facility.



Tracer Wire Test Station

Key Features – Pressure Zones

- 3 Pressure Zone System required based on Hydraulic Analysis (to maintain pressures between 345 kPa (50 psi) and 552 kPa (80 psi)
  - Issues of high pressures in the core area (requiring a pressure reducing control building)
  - Issues of low pressures in the sub-division area
  - Issues of low pressures on the west side of the community (requiring a booster pumping station)
- Therefore, there was a need to create 3 pressure zones. The zones are:
  - Zone 1 – Central and Southern Subdivision serviced by the Water Pumping Station (WPS)
  - Zone 2 – Core Area obtaining reduced pressure from the Pressure Reducing Control Building (PCB) and Core Area Pumphouse (CAP)
  - Zone 3 – Western serviced by the Booster Pumping Station (BPS)



Chlorine Pumps in WPS

Key Features – Pressure Zones (cont.)

1) Water Pumping Station

- Water is pumped from the Water Pumping Station reservoir through the new watermain which maintains a system pressure of 414 kPa (60 psi).
- This zone (Zone 1) feeds water into Zone 2 at night to fill the Core Area Pumphouse and also directly provided water to Zone 3 which has it’s pressure boosted through the Booster Pumping Station.
- Water is pumped using four (4) submersible high-lift pumps operated by variable frequency drives.

Key Features – Pressure Zones (cont.)

2) Pressure Control Building

- Simple prefabricated concrete building (2.0 m x 2.5 m x 2.5 m high)
- Heating and ventilation to ensure adequate temperatures, but no plumbing
- 50 mm diameter pressure reducing and pressure sustaining valve (PSV) with upstream and downstream isolation valves to allow for servicing
  - Upstream Isolation Valve: will open if pressure exceeds 552 kPa (80 psi)
  - Downstream Isolation Valve: will close if pressure drops below 345 kPa (50 psi)

Pressure Control Building (PCB)

Key Features – Pressure Zones (cont.)

3) Booster Pumping Station

- Simple prefabricated concrete building (3.0 m x 3.0 m x 2.5 m high)
- Heating and ventilation to ensure adequate temperatures, but no plumbing
- 1.5 HP inline vertical multistage centrifugal booster pump (rated for 1.6 L/s at 30 m TDH)
- Will be set to provide pressure of at least 345 kPa (50 psi) to the homes

Booster Pumping Station (BPS)

Booster Pumping Station

Core Area Pumphouse (CAP)

- Retrofitting of the old Water Treatment Plant into the new Core Area Pumphouse
- Replacement of high lift pumps, piping and valves
  - Pumps operated to maintain pressure of 414 kPa (60 psi) of water leaving the CAP (each pump rated for 3.3 L/s at 52 m TDH)
- Decommissioning of existing wells and obtaining water from the Water Pumping Station and turning them into a summer truckfill
- Filling existing storage reservoir on off-peak demand periods from the Water Pumping Station using an electric solenoid valve
- New truck-fill pump
- Recent Upgrades include:
  - Fire Pumps to provide emergency flows to the new school
  - Generator removed from inside of CAP and installed exterior to the building

Core Area Pumphouse Photos

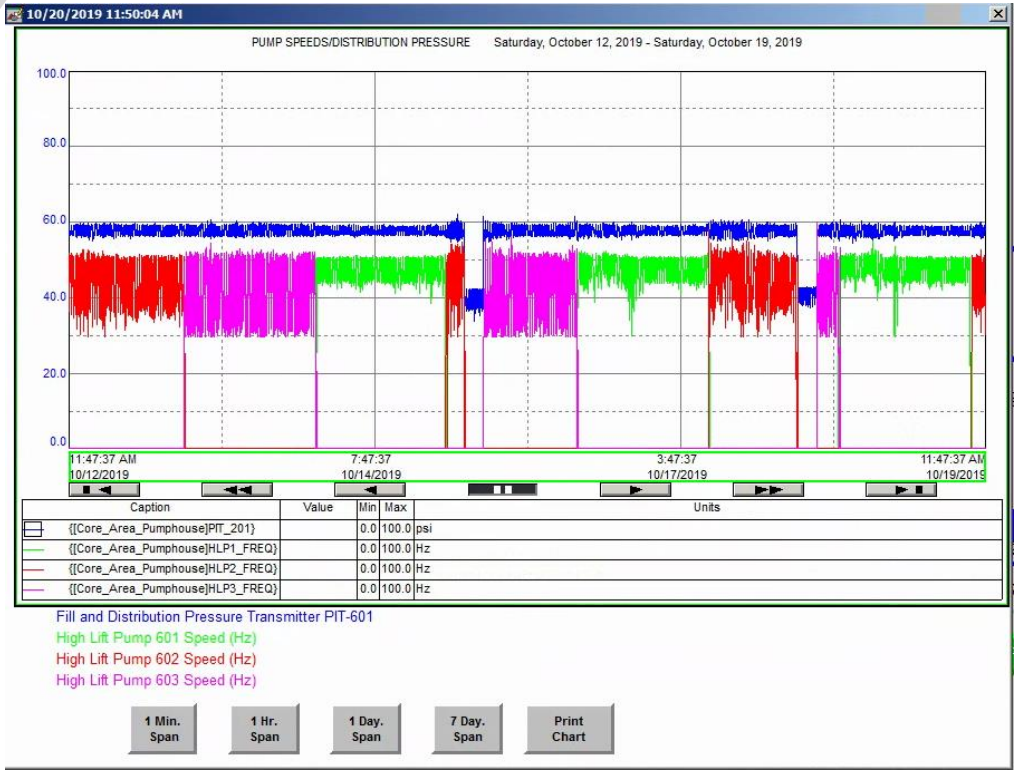
Core Area Pumphouse Photos (cont.)

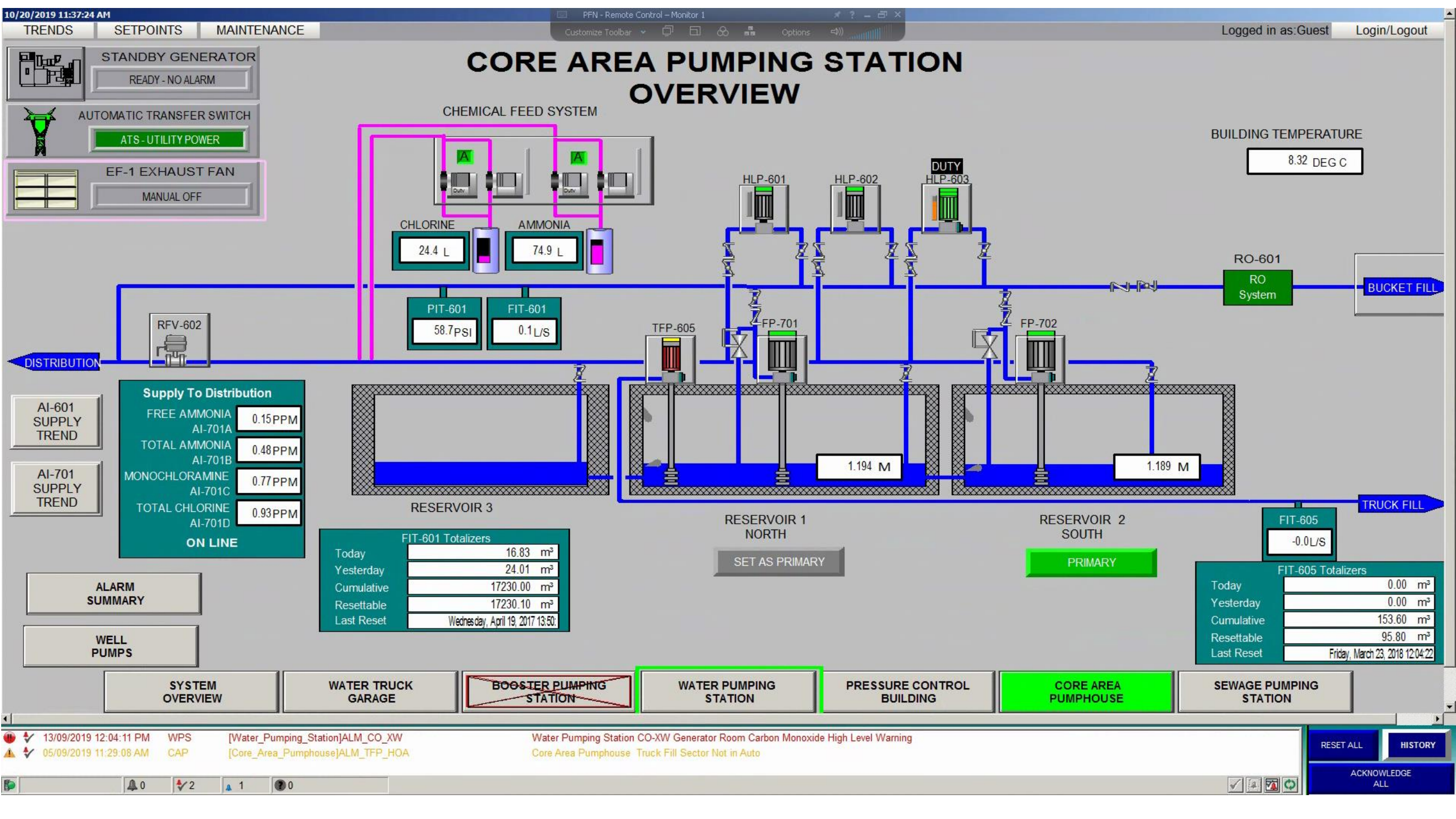
Key Feature – Potable Water Storage Requirements

- WILD regional waterline could potentially be offline for 48 hours; therefore the community requires adequate storage to maintain water availability for domestic use and fire suppression:
  - Design for 2 hours of fire flow to hydrants plus 2 Maximum Demand Days or 5 average days of use.

SCADA System

- Full integrated supervisory control and data acquisition (SCADA) system for the water and wastewater system.
- Allows the Operators to monitor and control the system.
- Enables the Operators to remotely access the system from anywhere in the world that there is an internet connection on devices such as an iPad, smart phone or laptop.
- Win911, a software based autodialer, calls out any alarms with each station having a back-up physical autodialer for critical alarms

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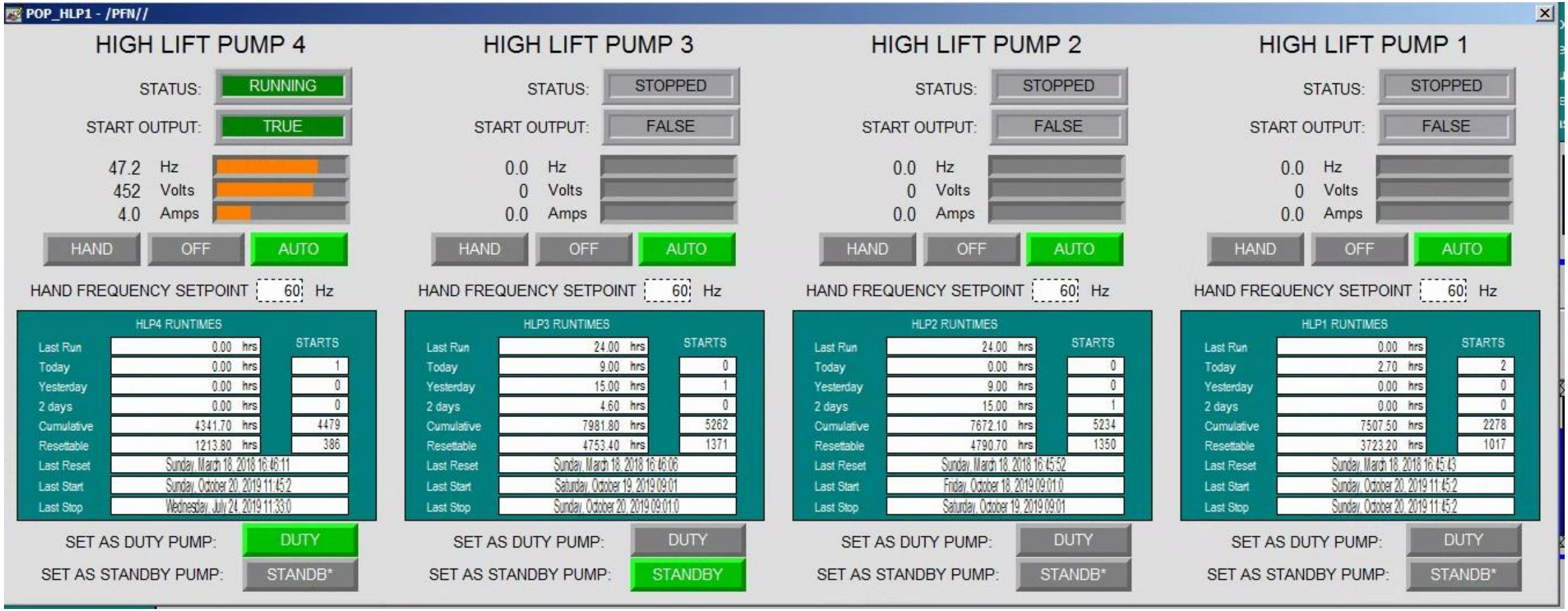
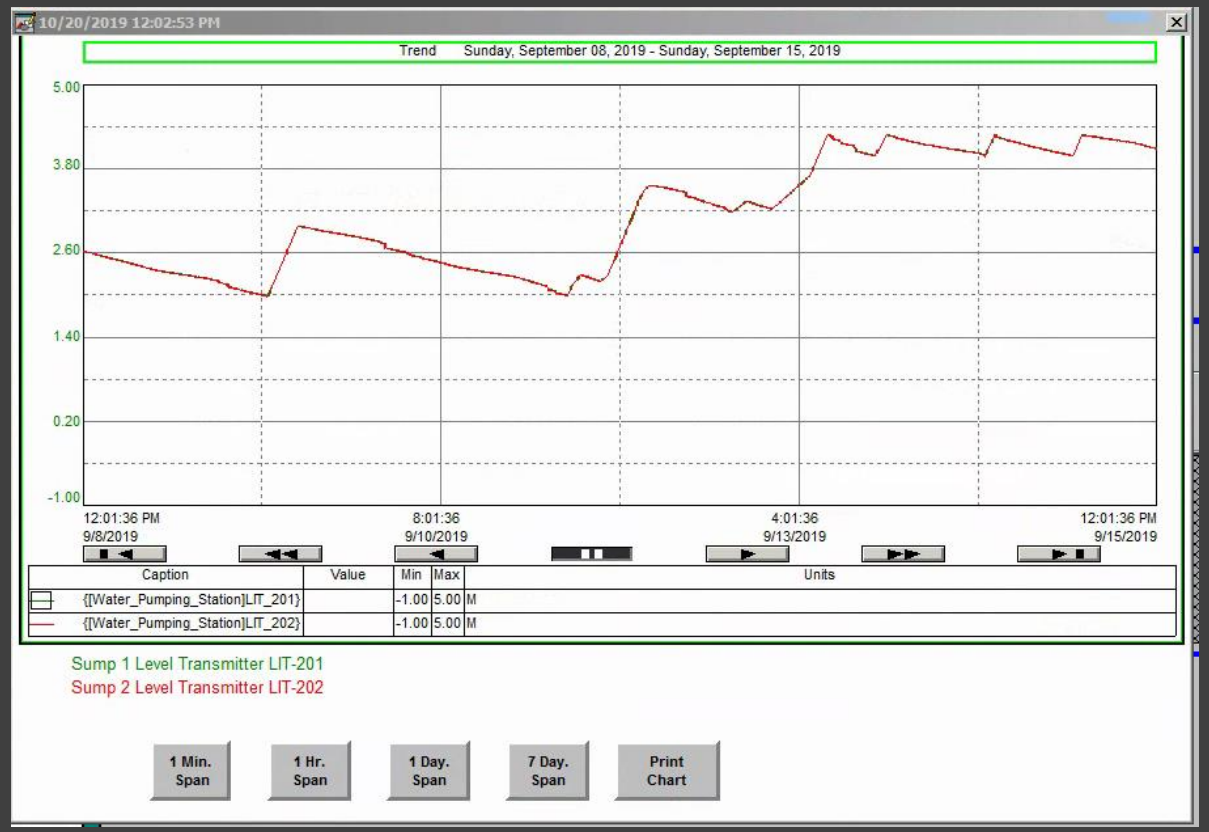
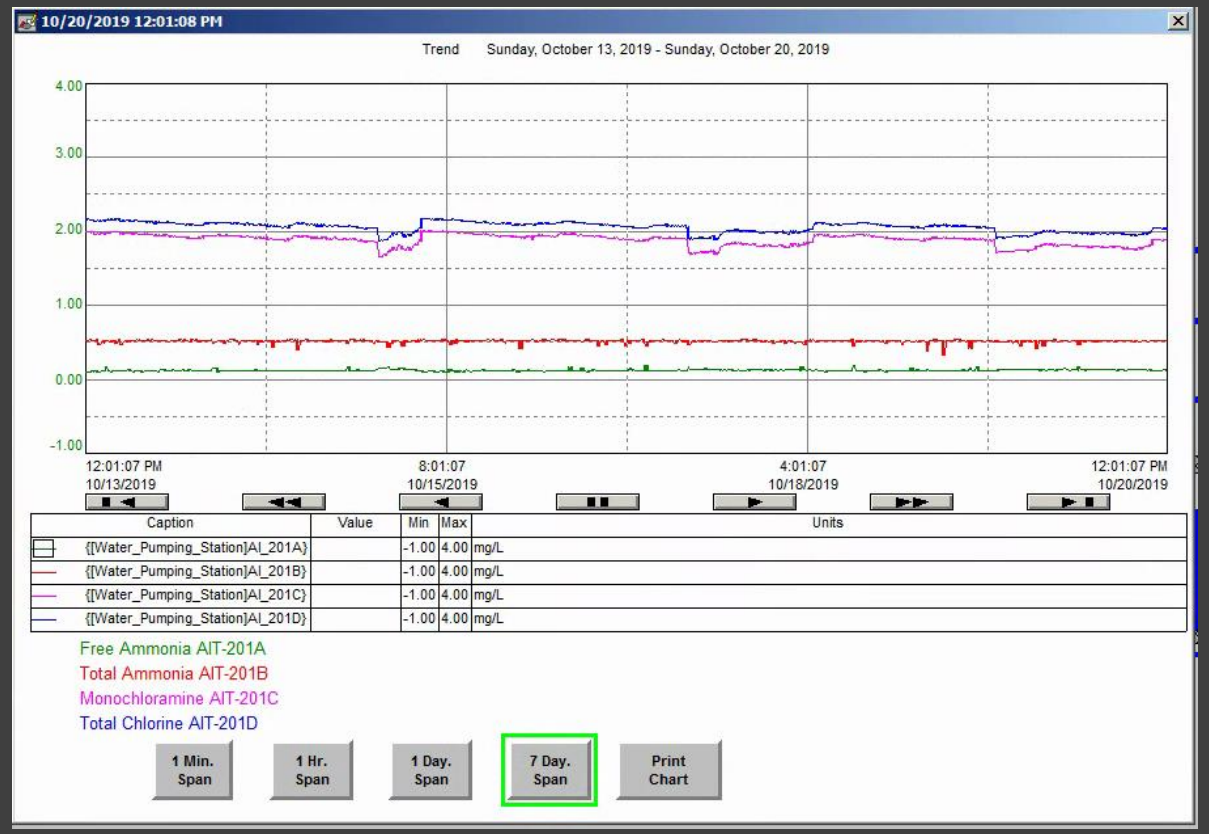
PFN - Remote Control – Monitor 1
TRENDS
SETPOINTS
MAINTENANCE
Logged in as:Guest
Login/Logout
CORE AREA PUMPING STATION OVERVIEW
STANDBY GENERATOR
READY - NO ALARM
AUTOMATIC TRANSFER SWITCH
ATS - UTILITY POWER
EF-1 EXHAUST FAN
MANUAL OFF
CHEMICAL FEED SYSTEM
CHLORINE
24.4 L
AMMONIA
74.9 L
PIT-601
58.7 PSI
FIT-601
0.1 L/S
BUILDING TEMPERATURE
8.32 DEG C
HLP-601
HLP-602
DUTY
HLP-603
RO-601
RO System
BUCKET FILL
RFV-602
DISTRIBUTION
TFP-605
FP-701
FP-702
AI-601 SUPPLY TREND
AI-701 SUPPLY TREND
Supply To Distribution
FREE AMMONIA AI-701A 0.15 PPM
TOTAL AMMONIA AI-701B 0.48 PPM
MONOCHLORAMINE AI-701C 0.77 PPM
TOTAL CHLORINE AI-701D 0.93 PPM
ON LINE
RESERVOIR 3
1.194 M
1.189 M
TRUCK FILL
FIT-605
-0.0 L/S
RESERVOIR 1 NORTH
SET AS PRIMARY
RESERVOIR 2 SOUTH
PRIMARY
FIT-601 Totalizers
Today 16.83 m³
Yesterday 24.01 m³
Cumulative 17230.00 m³
Resettable 17230.10 m³
Last Reset Wednesday, April 19, 2017 13:50:
FIT-605 Totalizers
Today 0.00 m³
Yesterday 0.00 m³
Cumulative 153.60 m³
Resettable 95.80 m³
Last Reset Friday, March 23, 2018 12:04:22
ALARM SUMMARY
WELL PUMPS
SYSTEM OVERVIEW
WATER TRUCK GARAGE
BOOSTER PUMPING STATION
WATER PUMPING STATION
PRESSURE CONTROL BUILDING
CORE AREA PUMPHOUSE
SEWAGE PUMPING STATION
13/09/2019 12:04:11 PM WPS [Water_Pumping_Station]ALM_CO_XW Water Pumping Station CO-XW Generator Room Carbon Monoxide High Level Warning
05/09/2019 11:29:08 AM CAP [Core_Area_Pumphouse]ALM_TFP_HOA Core Area Pumphouse Truck Fill Sector Not in Auto
RESET ALL
HISTORY
ACKNOWLEDGE ALL

SCADA Pump Controls







SCADA Trends

SCADA Communications

- Internet provided to the CAP through Arrow Technology Group (ATG) fiber connection.
- Fiber connection to the SPS.
- Wireless ethernet radios used to communicate between all other facilities.
- Firewall installed to protect from cyber intrusion and allow for remote virtual private network (VPN) access

Previous Wastewater System

Overview of System:

- Combination of individual and communal wastewater collection / treatment systems:
  - Shoot-outs (two thirds of the community), Holding tanks and Septic Tanks
  - Piped wastewater
- Wastewater from piped system and holding tanks treated in either Core Area Lagoon or Subdivision Lagoon

Issues:

- Core Area Lagoon operating at or above design capacity and too close to the community
  - Lagoon was overflowing partially treated wastewater into the environment
  - Guidelines require separation distance of 300 m from community buildings and homes whereas it was only 75 m
- Two thirds of the community using Shoot-outs (Not approved method of discharge to the environment), therefore need to account for this additional capacity
- Subdivision sewage pumping station backing up and not able to keep up with the demand

Possible Treatment Solutions

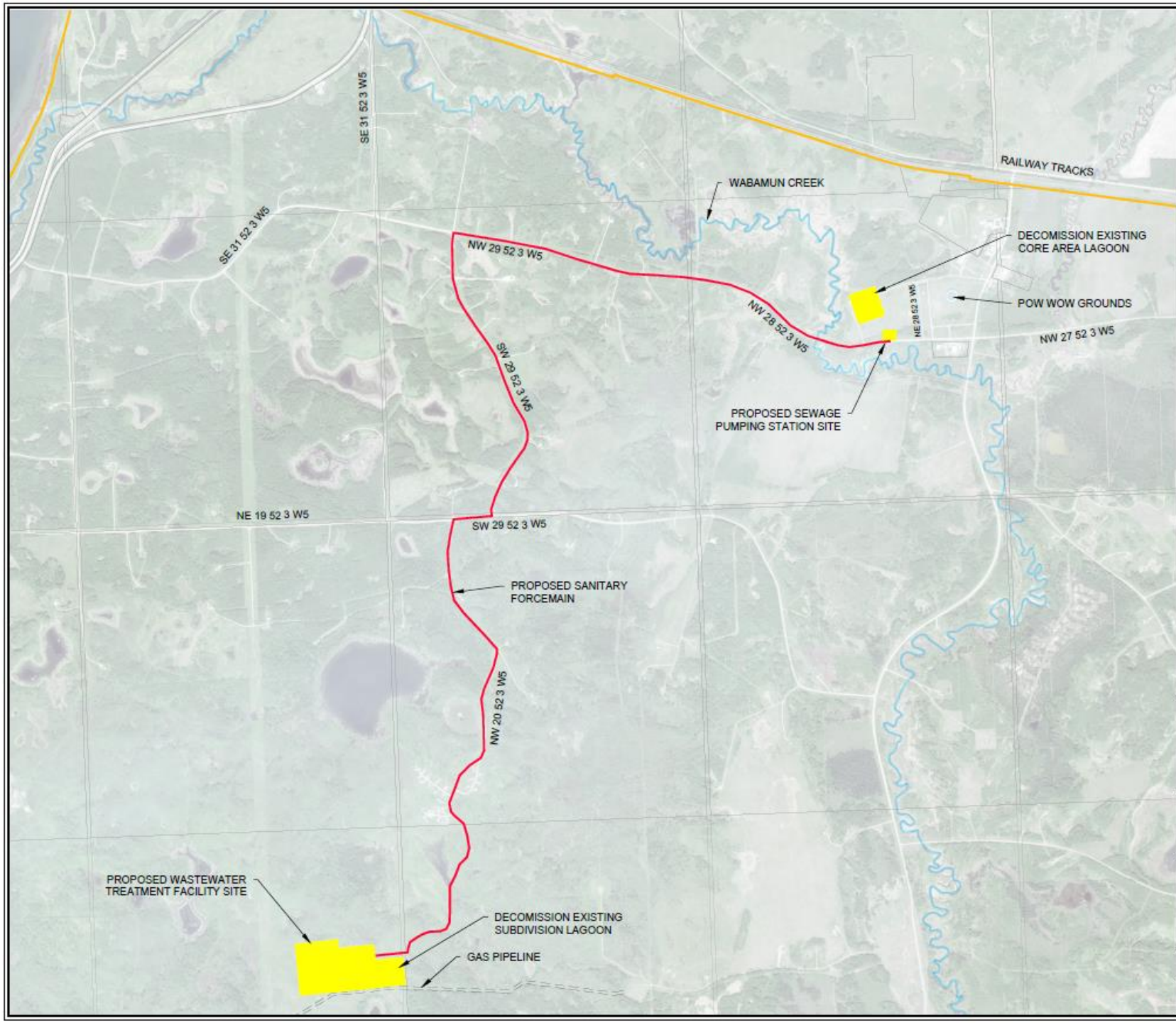
1. Alum addition, an aerated lagoon, a Submerged Activated Growth Reactor (SAGR), and an ultraviolet (UV) disinfection system discharging effluent seasonally with a five-month effluent storage pond being used throughout the winter

2. Same treatment as Option 1, however this option discharges continuously throughout the year

3. Facultative lagoon system similarly to what was being currently used at the proposed site, however with sufficient capacity to meet the future needs of the community

Wastewater System Upgrades

- New Sewage Pumping Station (SPS) in the Core Area to convey wastewater to the proposed lagoon
- 7,500 metres of forcemain to carry the wastewater from the Core Area to the proposed Lagoon
- Construction of Proposed Lagoon adjacent to the existing Subdivision Lagoon area
- Construction of a two-bay truck garage expansion at the Water Pumping Station to house the wastewater collective trucks
- Construction of a new Subdivision SPS to carry flows to the new Lagoon site



LEGEND

RESERVE ADMINISTRATIVE BOUNDARY

PROPOSED SANITARY FORCEMAIN

N

0 400 800 1,200 1,600

Metres

Satellite Image Source:

Background June 2011 satellite image obtained from DigitalGlobe© Copyright 2014 DigitalGlobe, Inc., Longmont CO USA 80503

NEEGANBURNSIDE

Client

PAUL FIRST NATION

Figure Title

100% DESIGN REPORT FOR WASTEWATER SYSTEM UPGRADES

PROPOSED WASTEWATER SYSTEM UPGRADES

Drawn	Checked	Date	Figure No.
C.S.	J.D.	2015-03-05	1
Scale		Project No.	
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Sewage Pumping Station (SPS)

Sewage Pumping Station Features

Wet well (sewage containment area) designed for the peak 20-year wastewater flow of 1,721 m^3/day

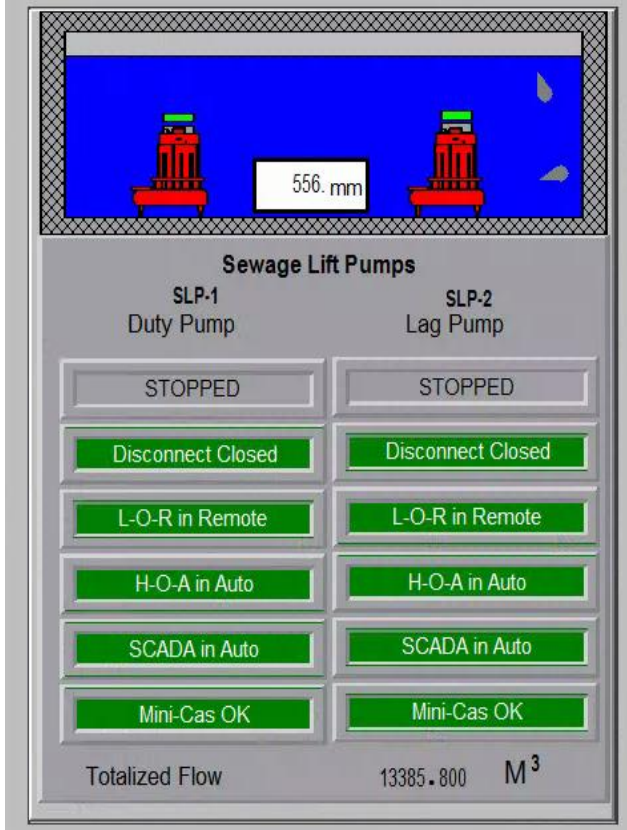
2 Submersible pumps (1 duty, 1 standby) designed for peak 10-year wastewater flow (intended to be replaced for 20-year flow eventually)

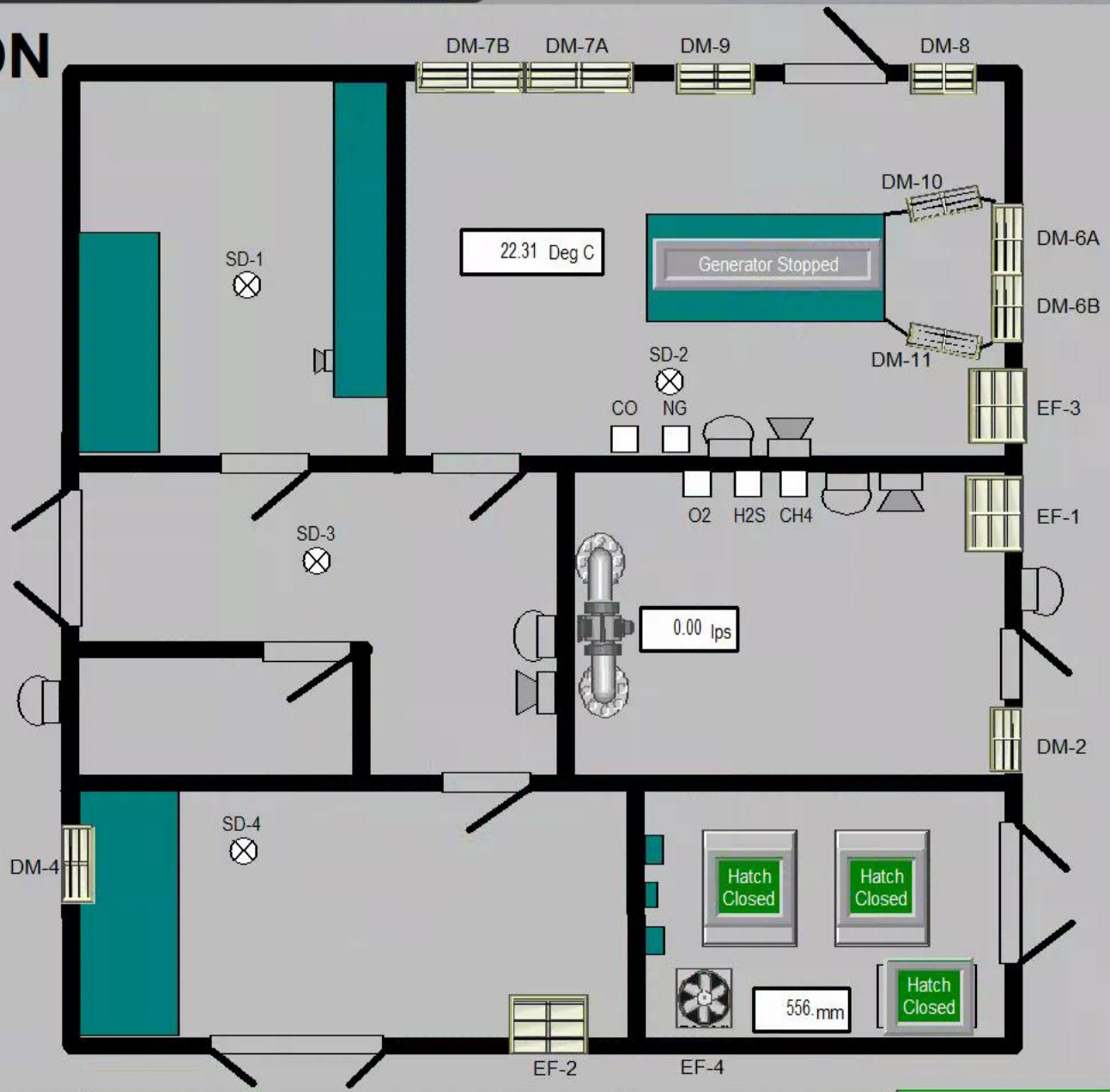
150 kW standby Natural Gas Generator with an Automatic Transfer Switch (ATS)

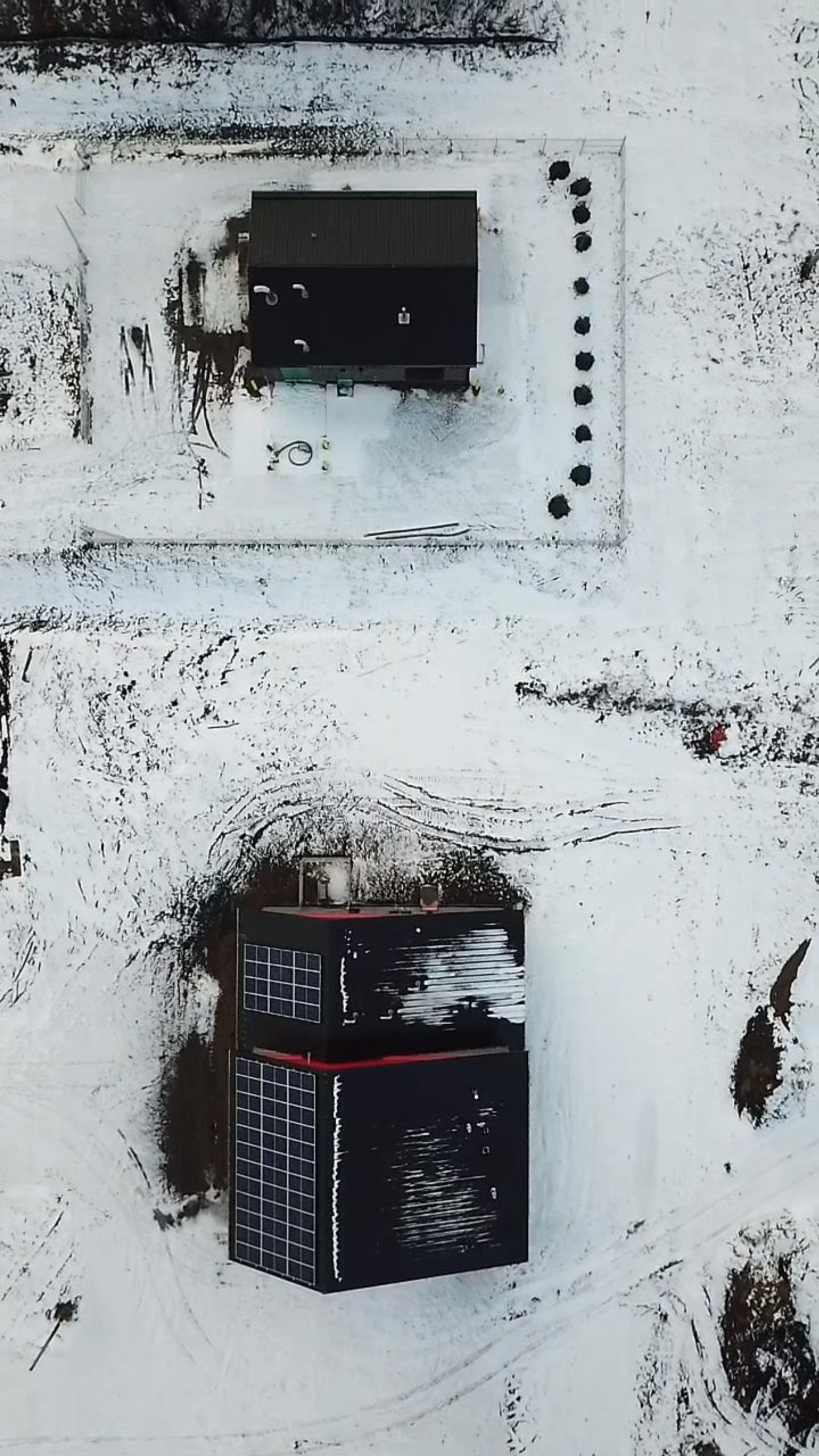
SEWAGE PUMPING STATION OVERVIEW

STANDBY GENERATOR
READY - NO ALARM

AUTOMATIC TRANSFER SWITCH
ATS - UTILITY POWER








PAUL FIRST NATION
(780)892-2293


SEWAGE


SEWA


DOMESTIC COLD WATER

Sewage Lagoon

Sewage Lagoon Features

- Initial anaerobic treatment cells provides two days retention of liquid and retains the heavy solids
- Facultative treatment cells provides 60 days of retention
  - This is where most of the Carbonaceous Biochemical Oxygen Demand (cBOD), Suspended Solids (SS), and phosphorus reduction occurs
- Storage lagoon provides 12 months of storage
- Discharge of effluent once per year into naturally occurring wetland after undertaking testing.

Anaerobic Cells and Truck Dump

Subdivision Sewage Pumping Station (SPS)

Subdivision SPS Features

- Prefabricated Sewage Pumping Station (SPS) from Xlyem
- Duty / Standby pumps
- Trash basket
- Blower / Heater
- Standby generator
- Camlock Connection for pump truck


2016/07/14 09

Submersible Sewage Pump for the Subdivision and School Lift Stations

Cellular SCADA

Benefits

- Water system is no longer on boil water advisory.
- Community members have access to a safe and reliable potable water supply.
- Fire protection provided in more populated areas.
- Operators are able to remotely manage the system and are alerted to any issues.
- Community members do not need to leave the community to fill up jugs of water.
- Wastewater is no longer harming the local environment or backing up into homes.
- Core area can be used for development.

THANK YOU!

Questions?

Simon House

Water & Wastewater Operator

water@paulfirstnation.com

Matt Paznar, P.Eng., EP

Vice President & Consultant Project Manager

matt.paznar@neeganburnside.com

1-800-595-9149