

I&I Inflow and Infiltration

PRIVATE PROPERTY SOURCES AND SOLUTIONS



PLANT DESIGN CRITERIA

Parameter	Design Criteria 2026
FLOW, mgd	
Average	0.75
Maximum Month (1.8:1)	1.21
Maximum Day (4:1)	2.68
Peak Hour (4.5:1)	3.00
BOD, lbs/day	
Average	1458
Maximum Month (1.1:1)	1604
Maximum Day (2:1)	2916
TSS, lbs/day	
Average	1661
Maximum Month (1.1:1)	1827
Maximum Day (2:1)	3322
PHOSPHORUS, lbs/day	
Average	47
Maximum Month (1.1:1)	52
Maximum Day (2:1)	94
TKN, lbs/day	
Average	182
Maximum Month (1.1:1)	200
Maximum Day (2:1)	364

Village of
Kewaskum

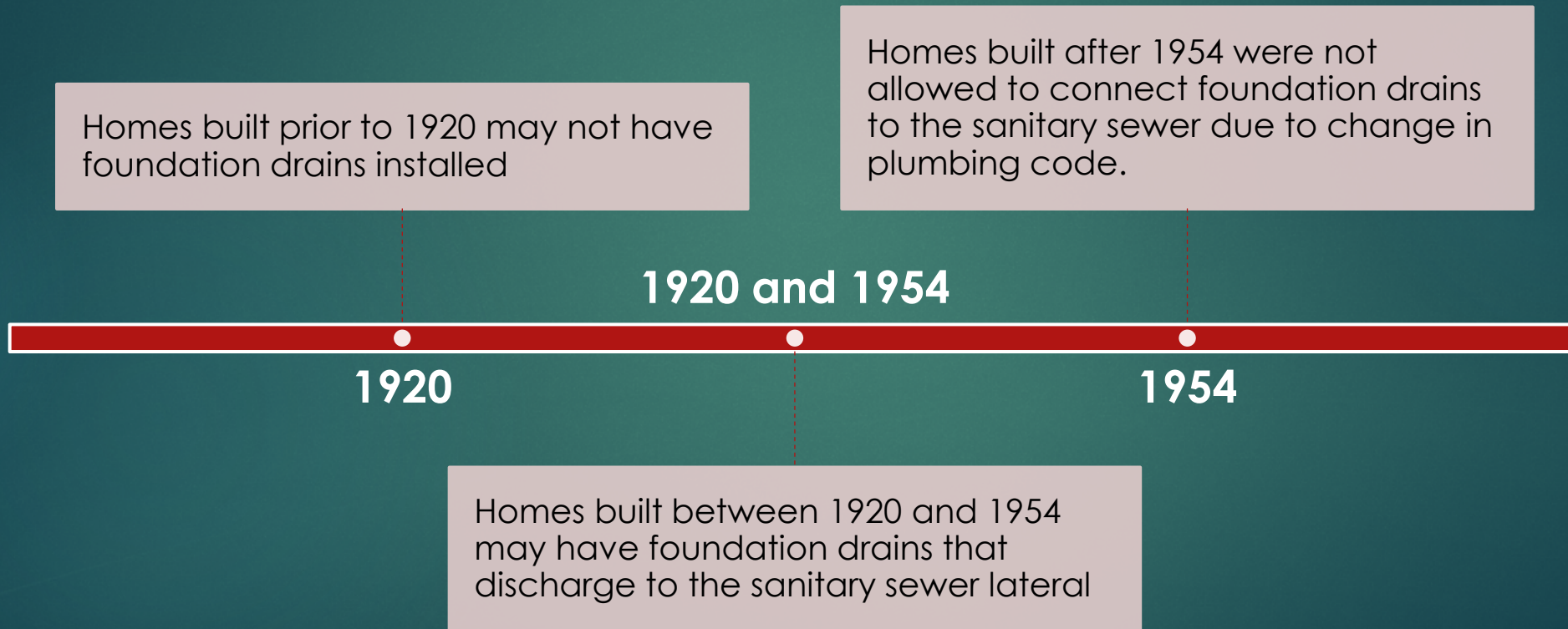
Population
Aprox. 4,000

Average Daily
Flow .4 mgd

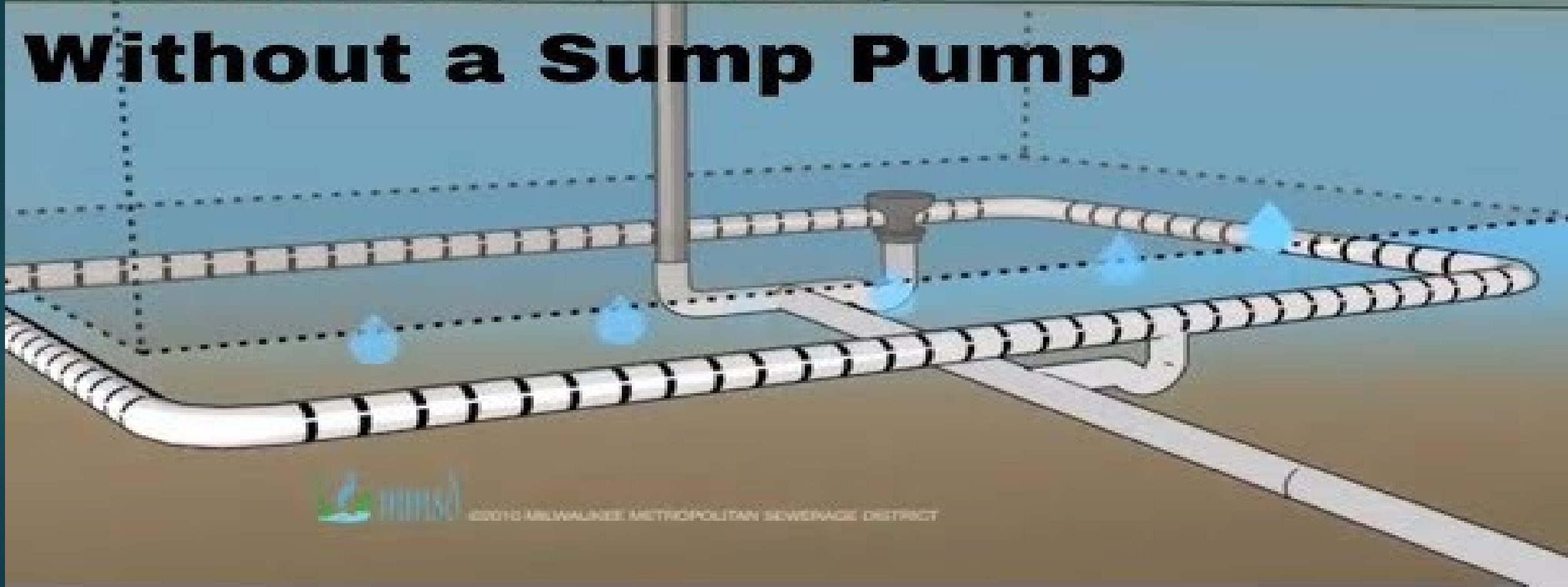
The Problem

- ▶ During significant rain events, storm and ground water can find its way into the sanitary sewer system through inflow and infiltration (I&I). When this excess water enters the sanitary sewer system, it can create the following problems:
- ▶ Overloading of collection system resulting in basement backups
- ▶ Additional cost to treat the higher volume of wastewater
- ▶ Reduced treatment efficiency due to exceedance of treatment process designs.
- ▶ Potentially exceeding permit compliance (TMDL)

Construction Age of Homes Impact on I&I



Foundation Drains Without a Sump Pump

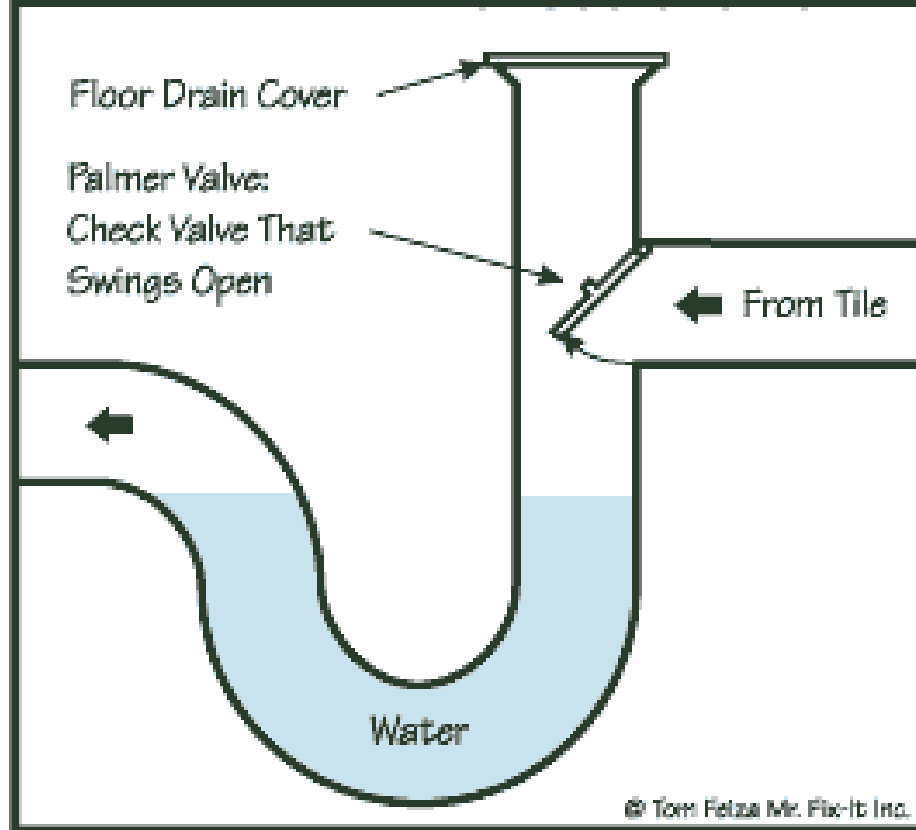


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Drain Tile Cross Connection



Palmer Valve Cross-Section



- Drain tile directly connected to sanitary sewer lateral was common between 1920 and 1954.
- Palmer Valves commonly used for this connection.
- Some directly tied into sanitary lateral at foundation wall
- World War II ended in 1945. Why is this important?

Floor drain with Palmer valve cross connection



The Kewaskum Approach

- ▶ New Sanitary Sewer
- ▶ New Water Main
- ▶ New Storm Sewer
- ▶ Storm Laterals Provided To Each Property.
Connection REQUIRED
- ▶ Pipe Burst Sanitary Laterals
- ▶ Remove Clearwater Cross Connections and
Install Sump Pumps as Needed.

Village Code

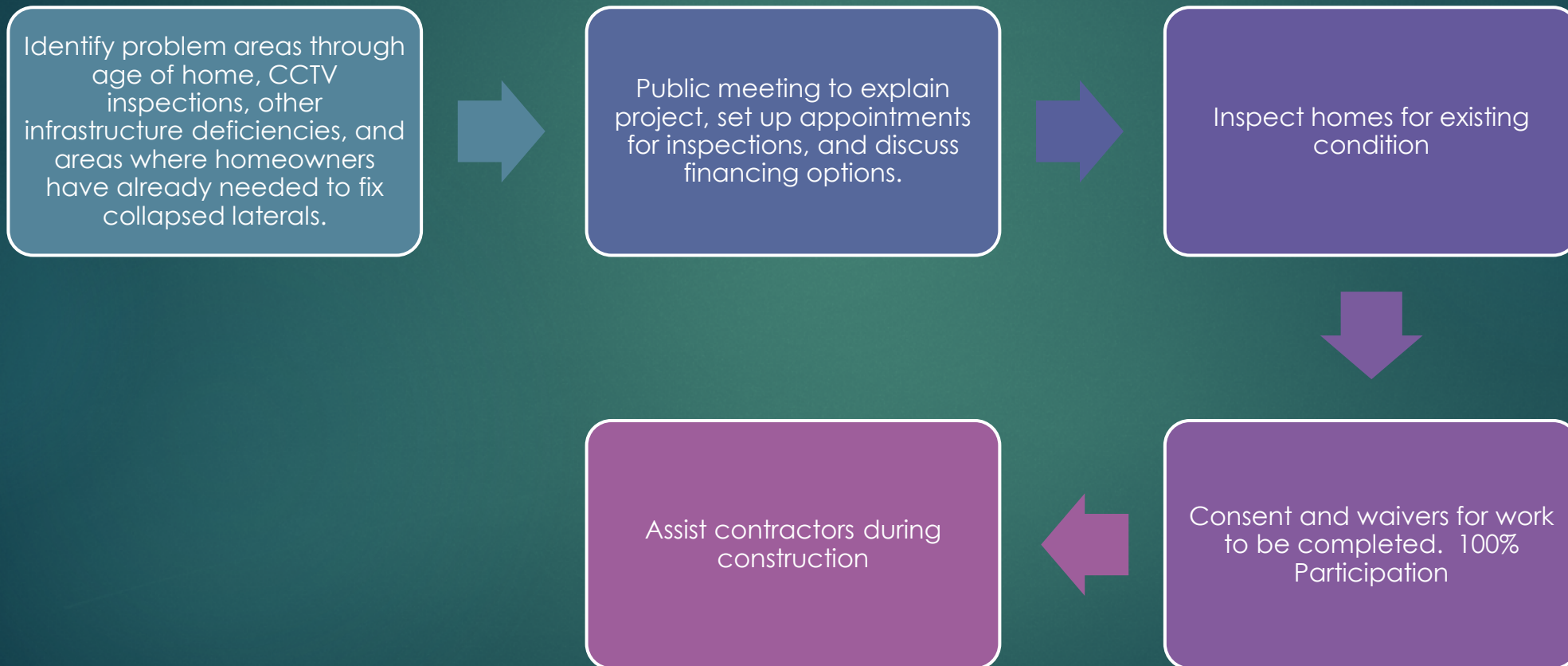
Sec. 14-331. Sump pump regulations.

- (b) *Restrictions.* Except as otherwise provided in this section, where existing sump and storm water drainage lines exist, all sump pump discharges shall be connected directly to a storm sewer by means of an underground closed pipe.
- (c) *Prohibited sanitary sewer discharges.* The connection of roof downspouts, sump pump discharges, exterior foundation drains, area drains, or other sources of surface run off or ground water to a building sewer or drain which discharges directly to a public sanitary sewer is prohibited. The connection of roof down spouts, or other sources of direct surface run off discharge is prohibited to the sump pump discharge piping system.
- (d) *Time for connection.*
 - (1) *New construction connections.*
 - (2) *Existing building connections.*
 - a. In the event of a new installation, or underground piping becoming available, existing sump pump discharge lines shall be connected within 45 days of the lateral being available.

Sec. 94-251. Unpolluted waters and stormwater.

- (a) No person shall discharge or cause to be discharged any unpolluted waters such as stormwater, groundwater, roof runoff, subsurface drainage or cooling water to any sanitary sewer

Private Property Involvement



Project: _____
Report Date: _____
By: _____ Date: _____

The diagram illustrates a home's plumbing layout. The main floor is represented by a large rectangle, and the basement/crawlspace is shown below it. The main floor is divided into rooms. The basement area shows a horizontal line representing a main sewer line, with several vertical lines representing lateral cleanouts. There are also some symbols for floor drains and sump pumps.

Home Inspections

- Sump pump and discharge location
- Number of floor drains and do they have cross connections
- Location of sanitary lateral cleanout
- Any special features to the property

Conclusion

I/I is the single largest contributing component to impending TMDL discharge limits.

Major source of I/I comes from private properties and in particular foundation drains and sump pumps.

Foundation drain cross connection elimination requires a lot of effort but has the greatest return on investment.

Communities are starting to see significant reductions in I/I through partnering with private property owners.



Funding for high flow optimization

FOCUS ON ENERGY ASSISTANCE

Goal

Control	Better control surges in flow to help retain solids in plant during times of high flows
Treat	Treat flows at a reduced cost
Optimize	Optimize to meet TMDL requirements for TSS and Total Phosphorus.

Flow Equalization Through Lift Station VFD Addition

▶ Average plant flow rate 250 GPM

▶ Hwy 45 Lift Station flow rate

▶ *Prior to VFD*

650GPM

▶ *After VFD*

Variable not to exceed 300GPM

Focus on Energy Incentive



VFD Implementation for Lift Station Pumps



- Recently installed variable frequency drives (VFDs) on two 75HP lift station pumps to improve motor efficiency.



- Results: Annual energy savings of 221,911 kWh, reducing energy costs by more than \$24,400.



- Financial Incentives: Received \$6,600 to support the project

Aeration Basin Diffuser Replacement Focus on Energy Incentive

- ▶• Replacing outdated ceramic disk fine-bubble diffusers with new flexible membrane fine-bubble diffusers.
- ▶• Results: Improved oxygen transfer efficiency, reduced blower pressure, and lower airflow requirements.
- ▶• Estimated Savings: 64,191 kWh and 8.43 kW annually.
- ▶• Estimated Incentive: \$4,457.81



Aeration Basin Automated control valves



- Installing automated control valves to optimize air pressure and distribution across the system.



Anticipated incentive \$7,037.43



Blower Building

Orange is a valve
on the main
blower header
that allows us to
make digester
and aeration
basin air line
common or
separate

yellow is digester
airline

Green is Aeration
basin airline

New automated
valve to supply
only required by
DO probe
setpoint amount
of air

Aerobic
Digesters

Red is
wastewater flow
through aeration
basins

Reaeration
Manhole

Eisenbahn State Trail

Eisenbahn State Trail

Eisenbahn State Trail

pass2

pass1

pass3

Project	Cost	Focus Incentive
VFD install at Lift station	\$21,935	\$6,600
Aeration Diffuser replacement	\$19,940	\$4,457
Automated Aeration control Valves	\$22,860	\$7,037
Totals	\$64,735	\$18,094

Project Cost and Incentive Totals

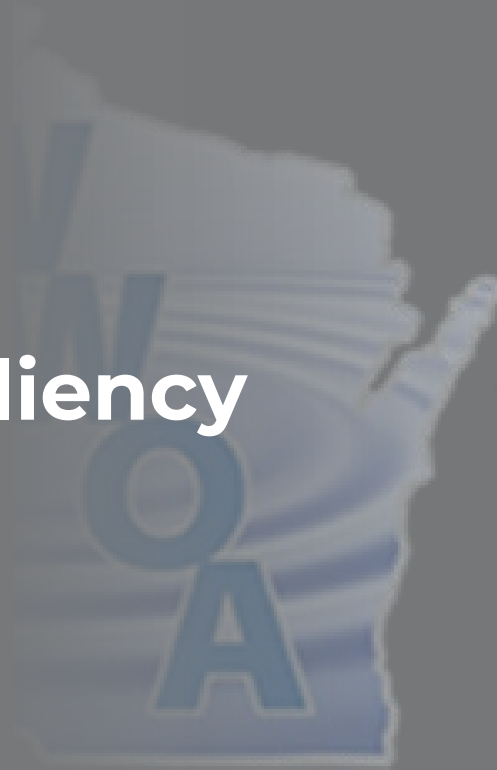
Thank You!

- ▶ Ben Propson
- ▶ Village of Kewaskum WWTF
Supervisor
- ▶ bpropson@kewaskumwi.gov



Wastewater Resiliency

October 17, 2025



WISCONSIN WAST
OPERATORS ASSO

City of Sun Prairie

Jeremy Cramer Wastewater
Conveyance and Treatment Director





Wastewater Treatment Plant

- **1982** Original Facility Built
Population 13,417
- **2005** Liquids and Solids Upgrade
Population 25,173
- **2020** Liquids and Low-Level Phosphorus Upgrade
Population 35,967
- **2025** Solids Upgrade
Population 39,419

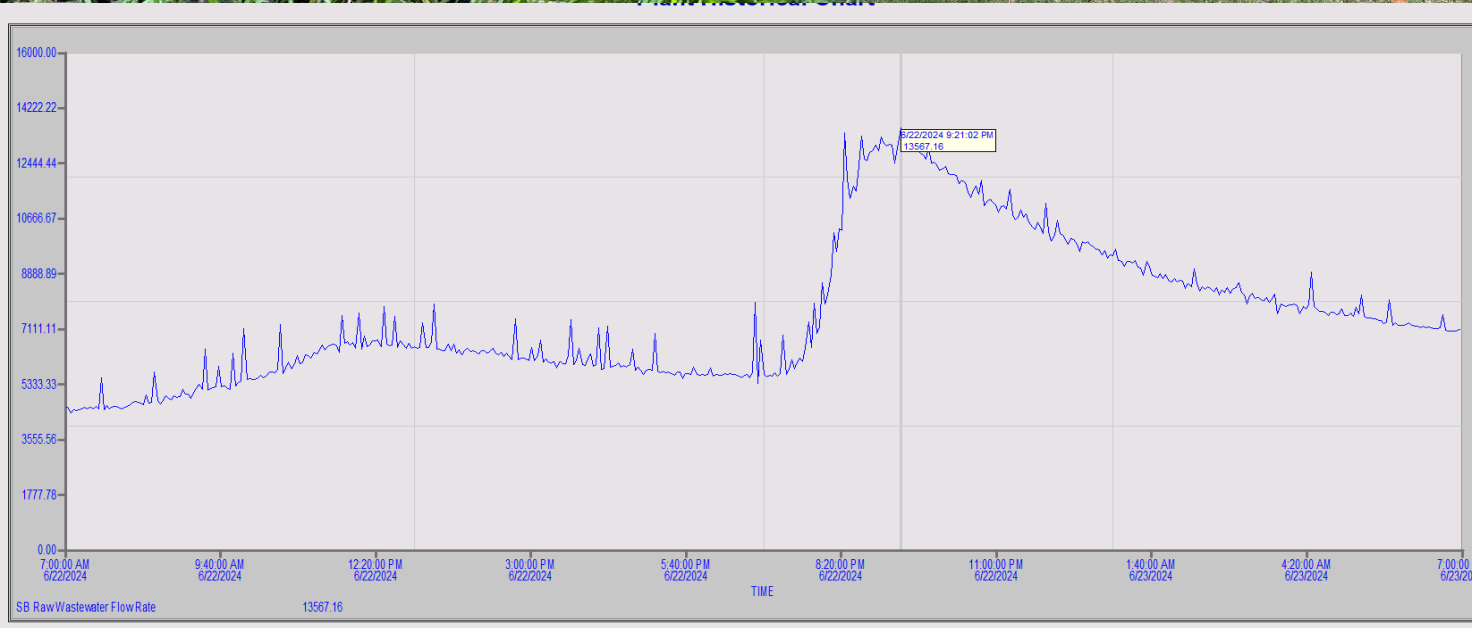
10 Liftstations



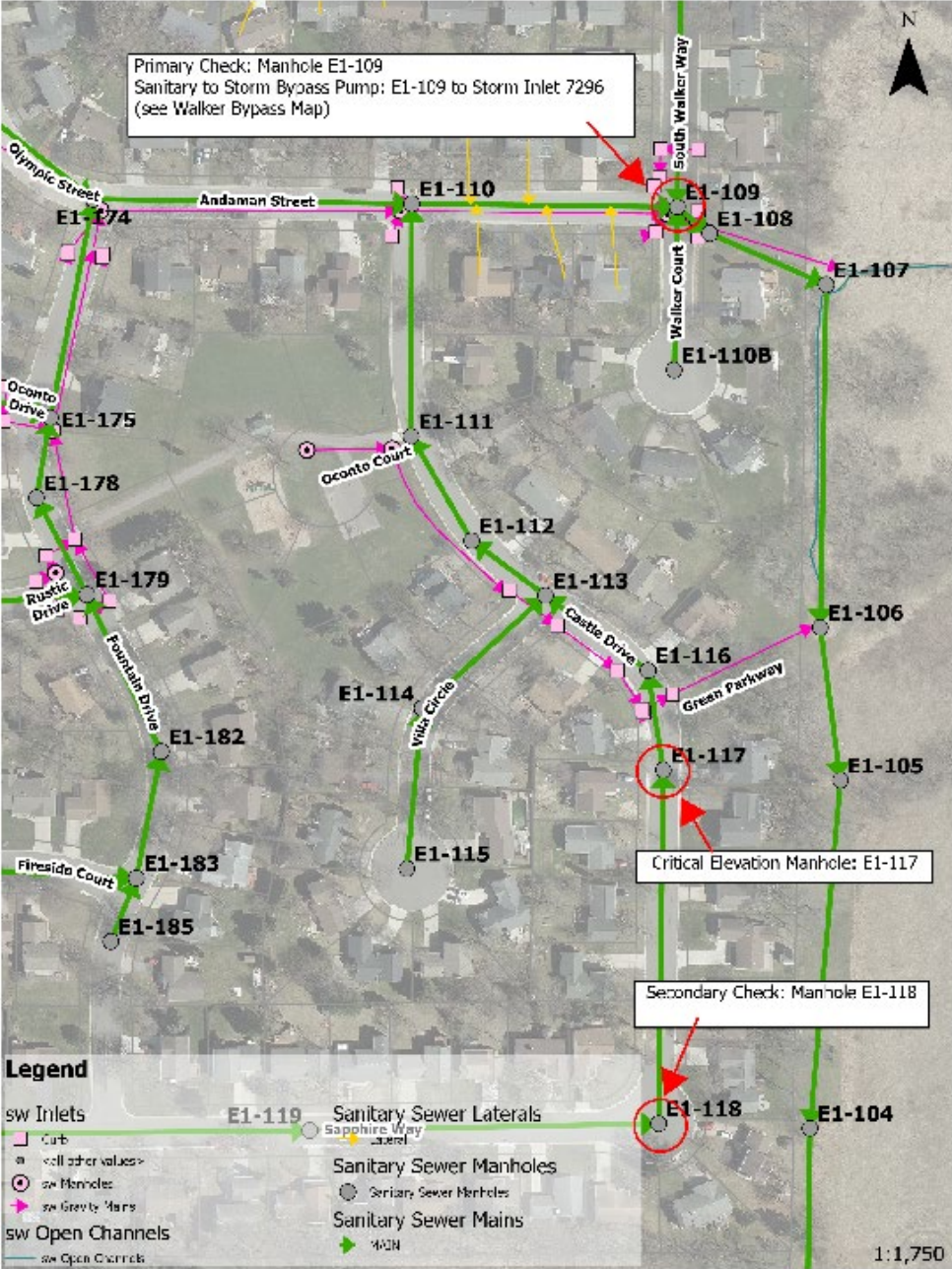
Collection System

Stormwater

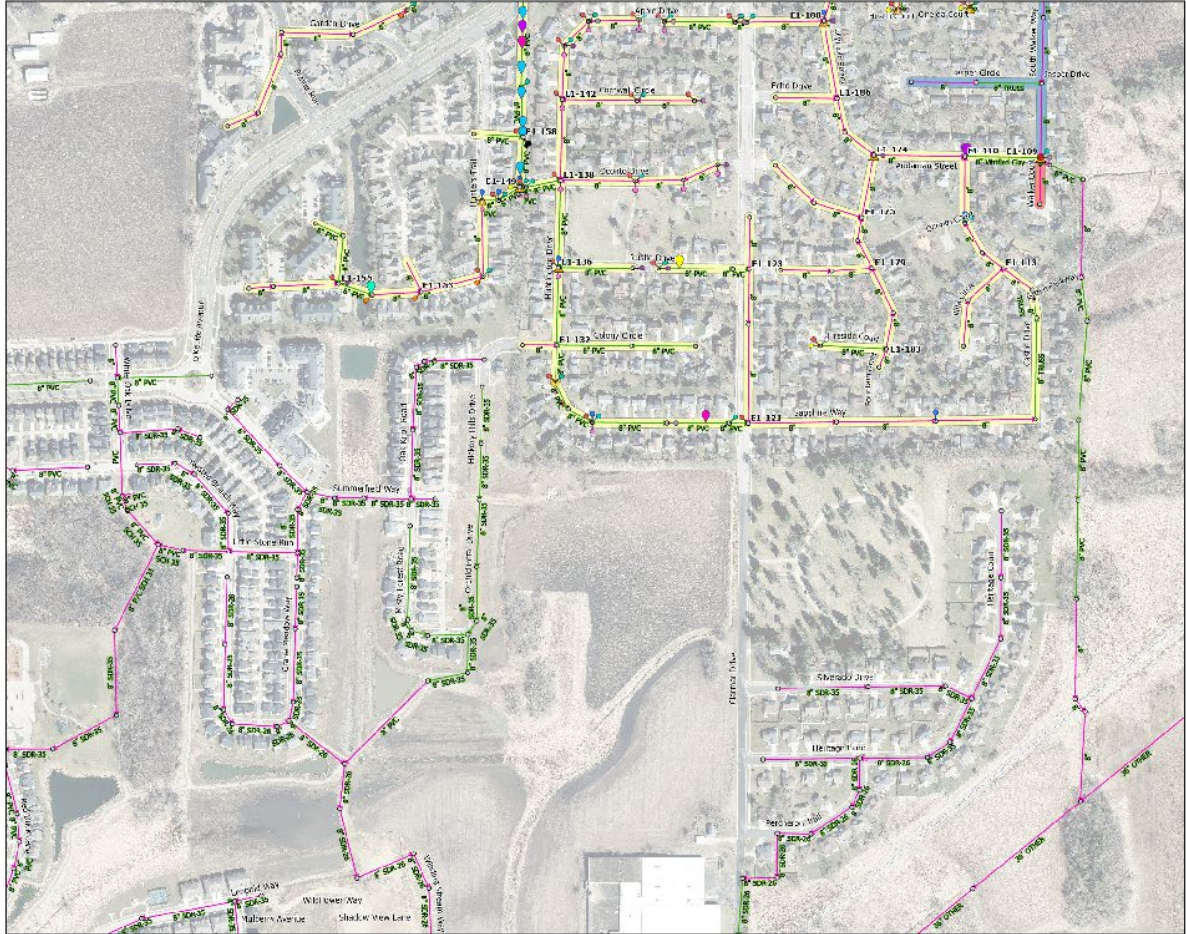




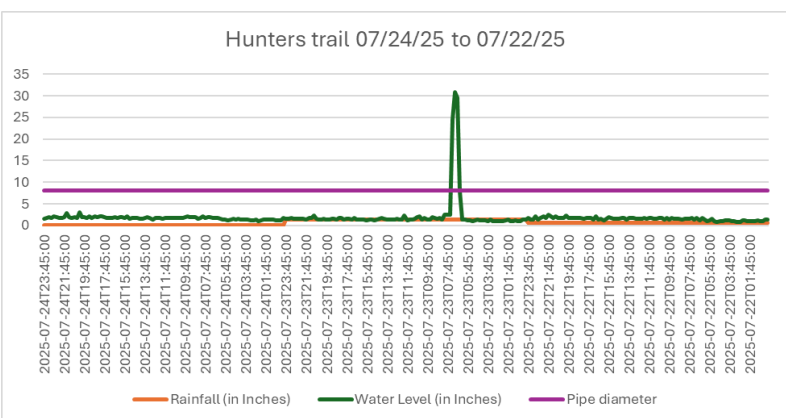
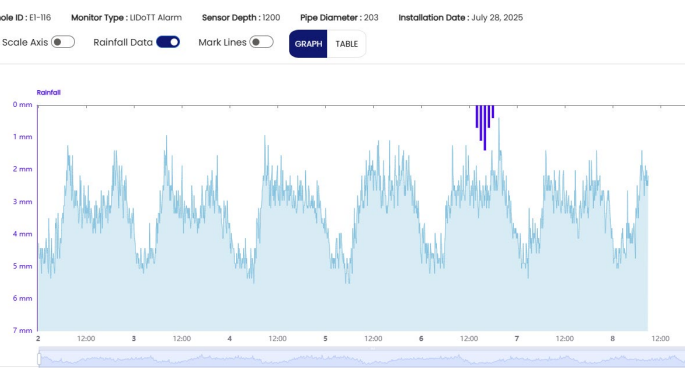
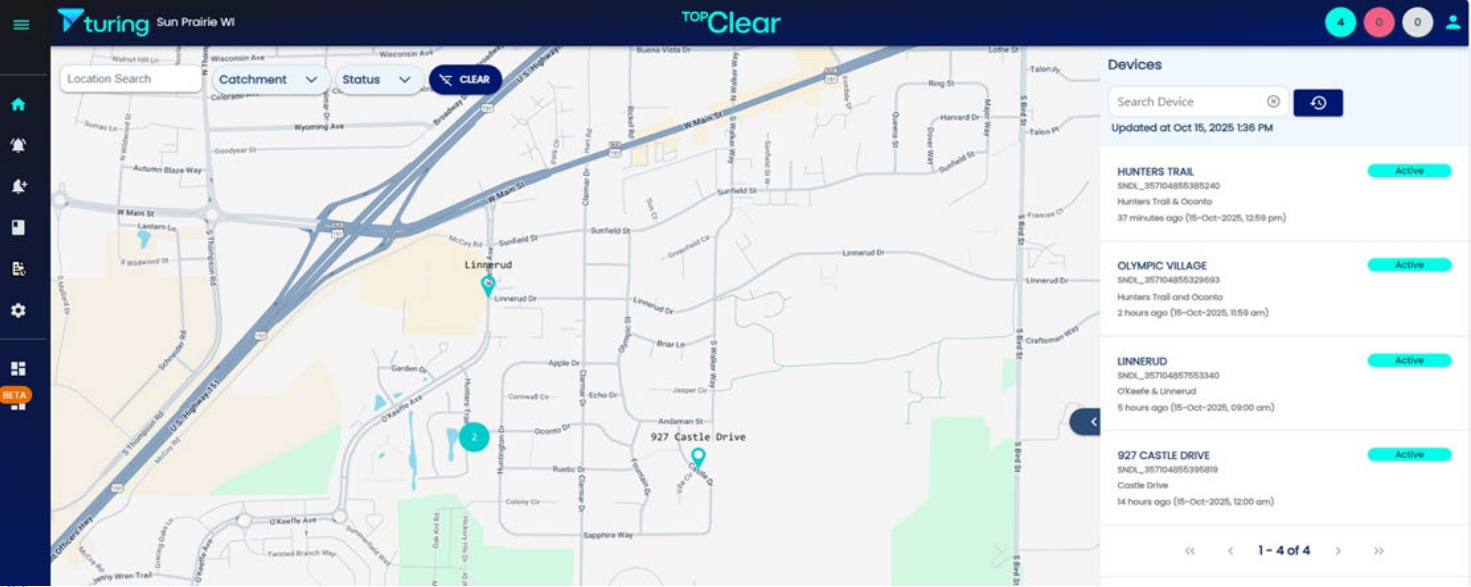
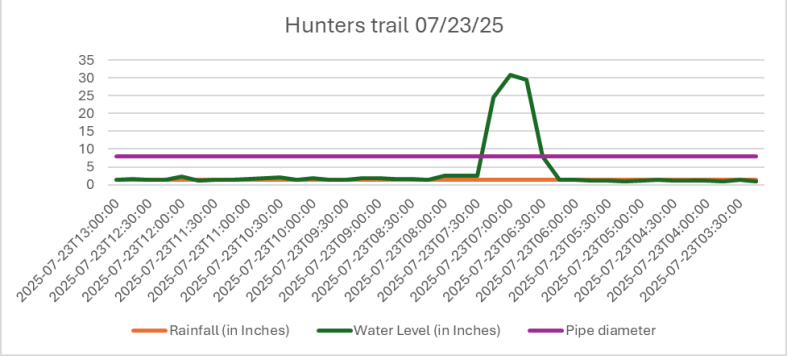
Walker/Castle Inflow Event Plan



Area South of Sewersheds for Manhole E1-109



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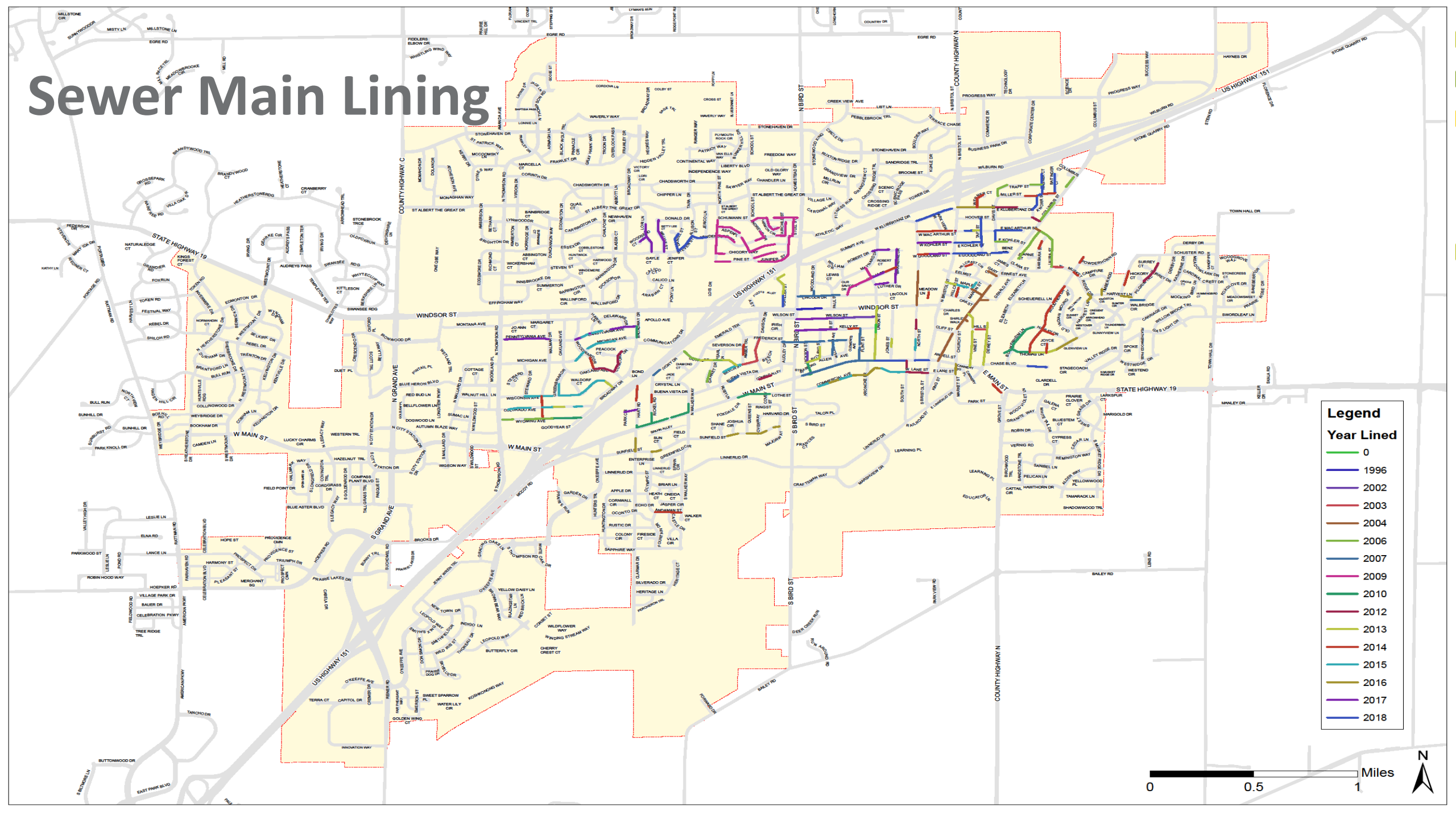




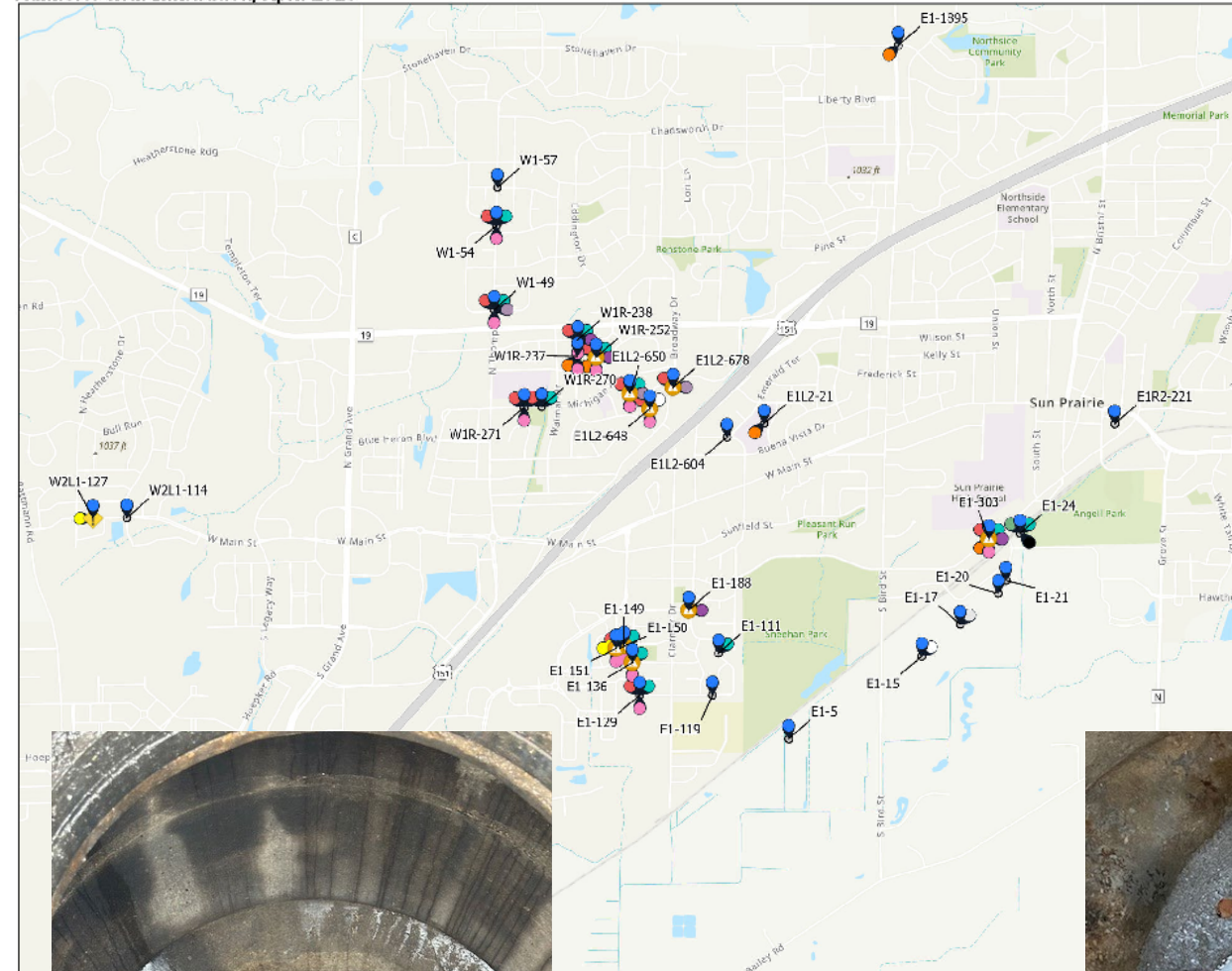




Sewer Main Lining

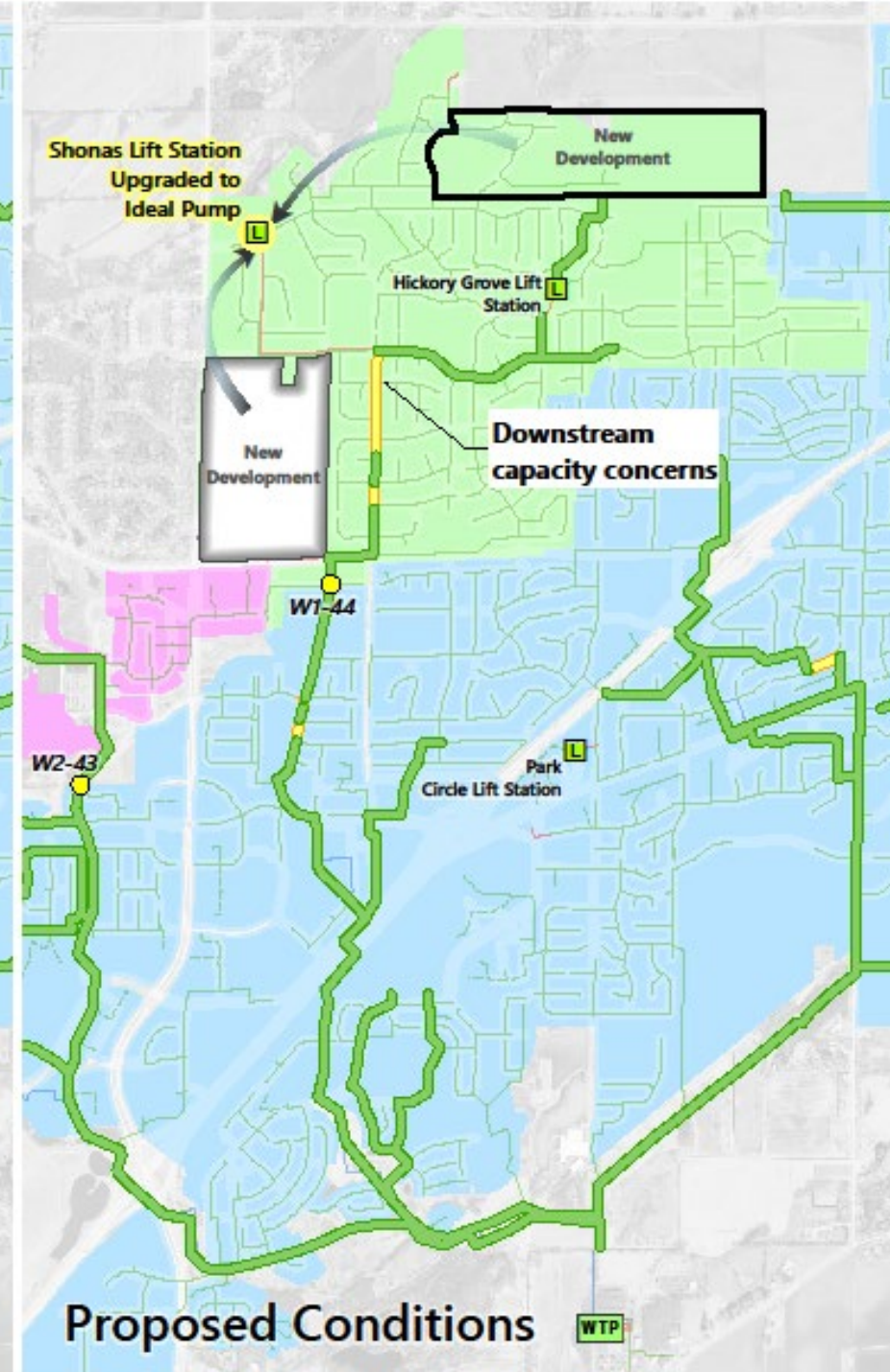
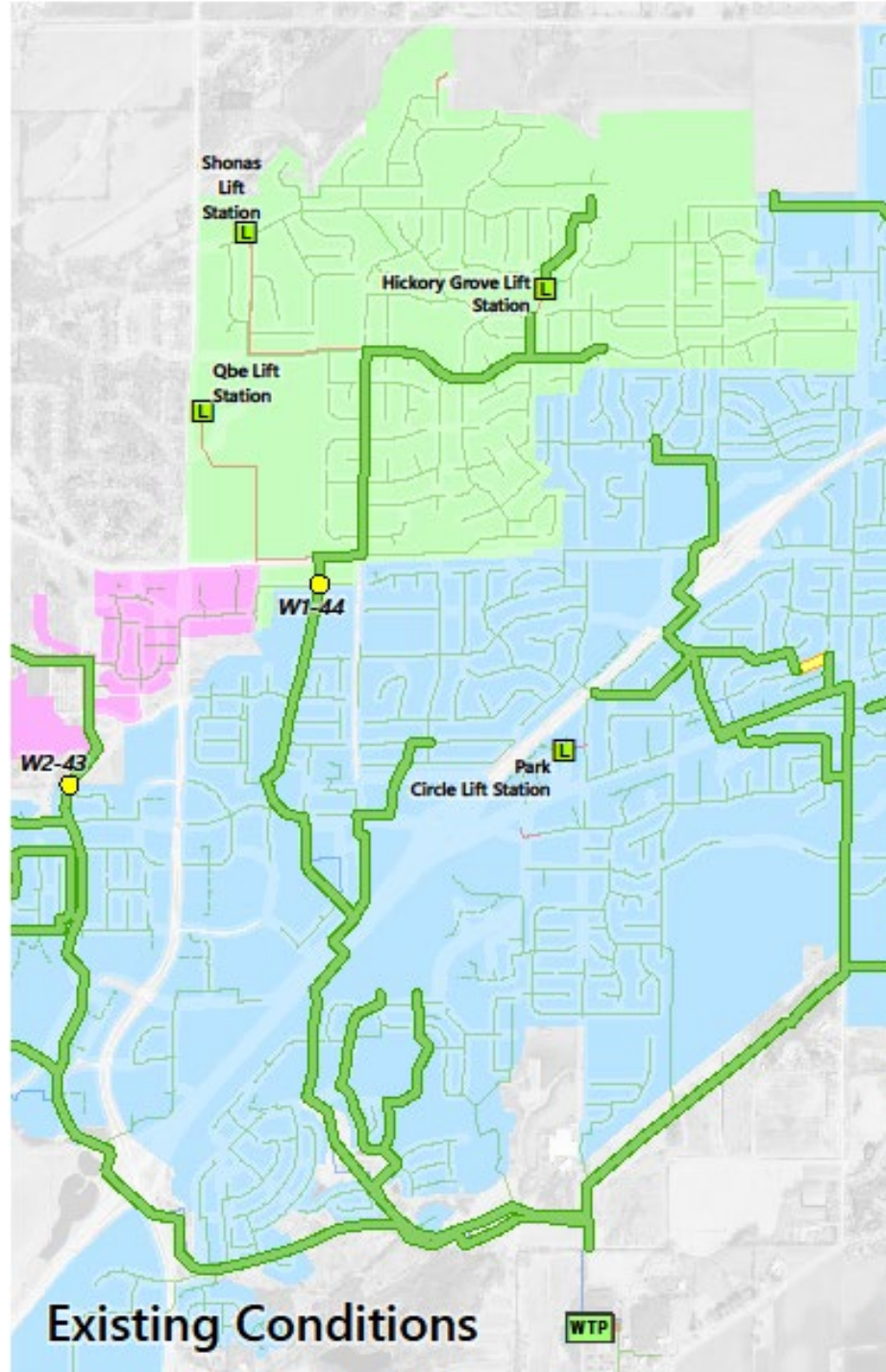


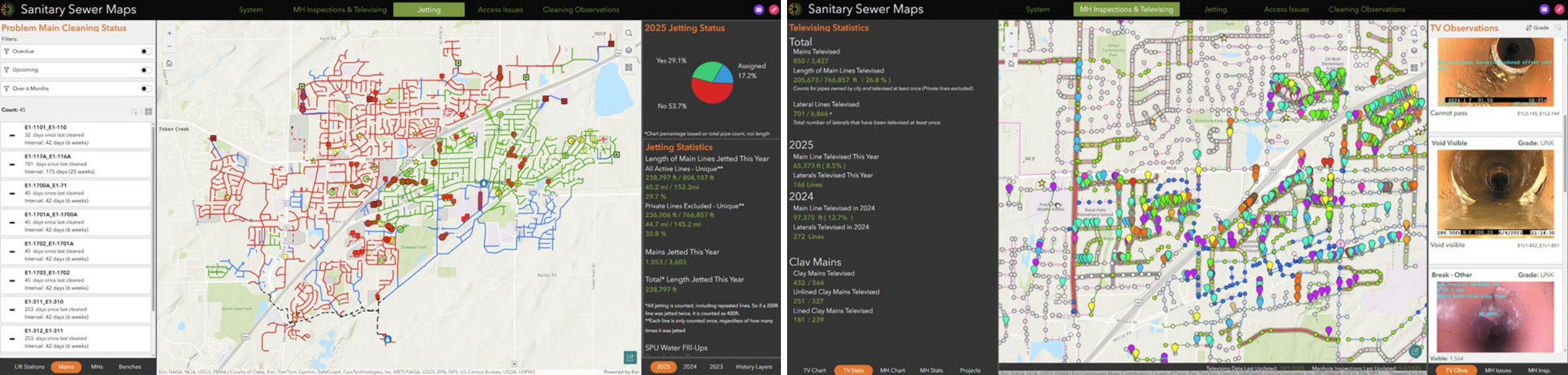
- Grouting manholes
- Bench repairs
- Road and ring repairs



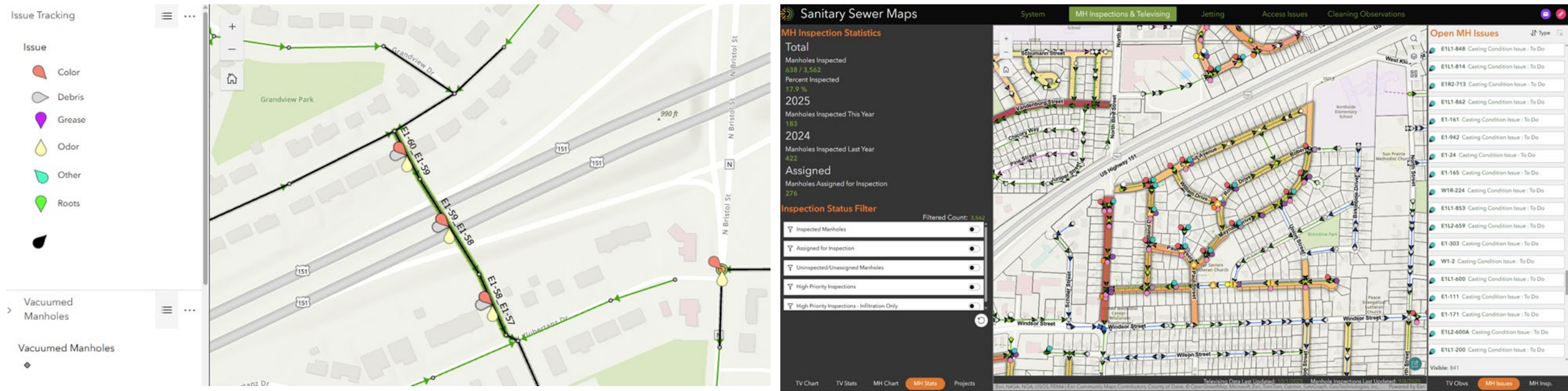
Manhole Issues	
	Manhole Hoiling - To Do
	Manhole Hoiling - Watch
	Pavement Issue - To Do
	Ring/Adjustment Issue - To Do
	Ring/Adjustment Issue - Watch
	Bench Cleaning - To Do
	Bench Repair - To Do
	Infiltration - To Do
	Grade Issue - To Do
	Casting Condition Issue - To Do
	Close Brush/Trees - To Do
	Access Issue - To Do
	Sign Repair/Replace - To Do
	Other - To Do
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GIS



The background is a solid teal color. It features several abstract, organic shapes in a slightly lighter shade of teal. On the left side, there are several elongated, rounded rectangular shapes of varying lengths and orientations. On the right side, there are larger, curved, concentric-like shapes that resemble stylized waves or the outer edges of a spiral.

Treatment Plant



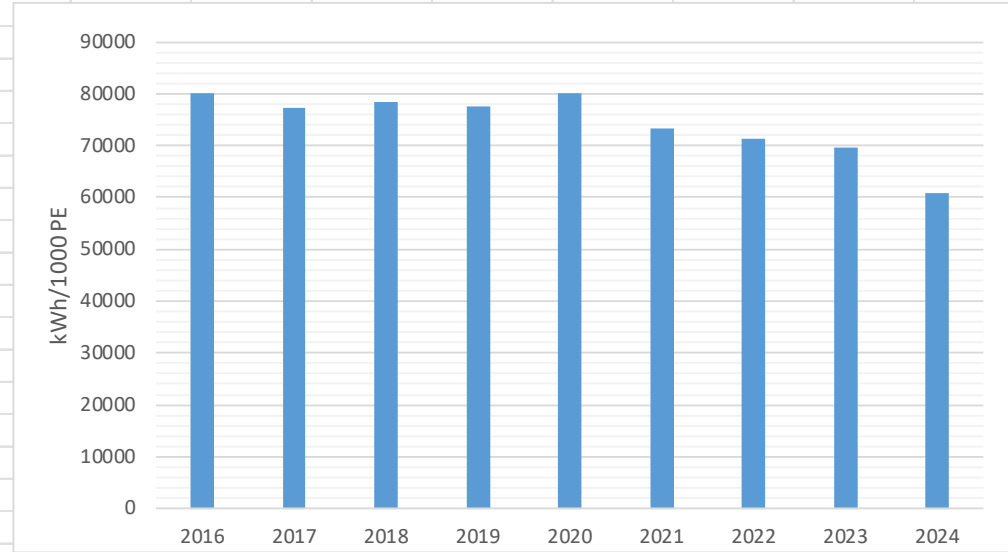
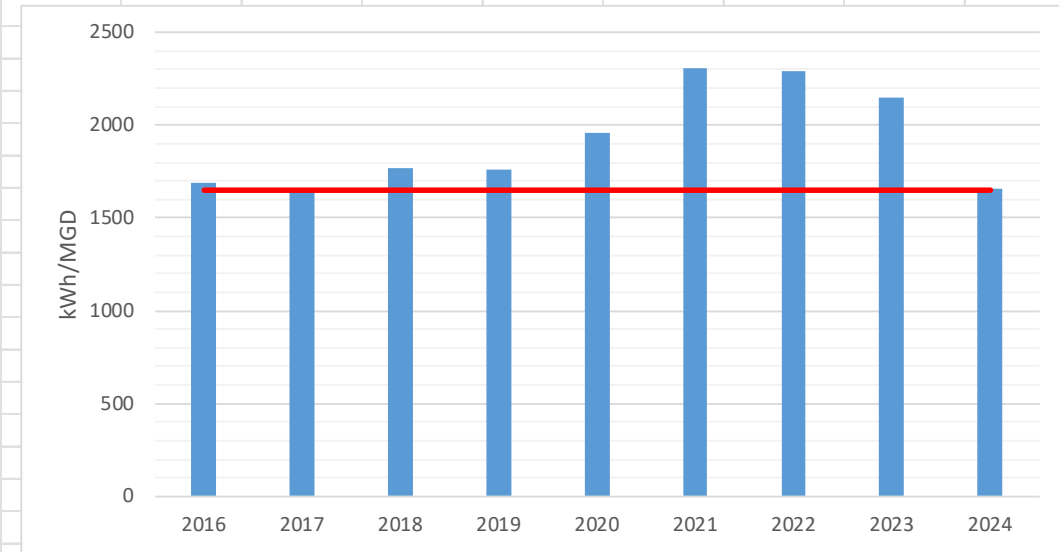
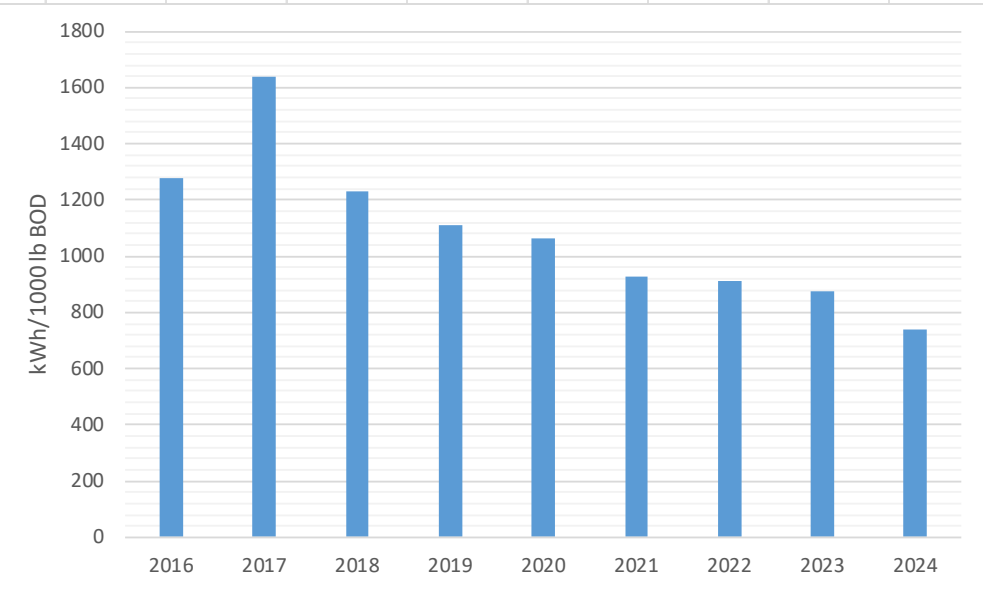
	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>
Population				34926	35895	36394	37304	38387	39149
Cost per lb BOD removed	\$0.091	\$0.088	\$0.084	\$0.074	\$0.073	\$0.067	\$0.072	\$0.064	\$ 0.054
Average kWh per day	6780	6799	7096	7387	7754	7277	7298	7307	6559
Total charges per kWh	\$0.070	\$0.074	\$0.066	\$0.066	\$0.068	\$0.073	\$0.079	\$0.073	0.072
kWh per 1000 PE	80045	77339	78488	77672	80225	73198	71406	69490	60736
MWh/MG	1.69	1.64	1.77	1.76	1.96	2.31	2.29	2.15	1.66
kWh/1000lb of BOD/yr	1279	1640	1229	1110	1065	929	909	873	742
MG/Year	1,466	1,509	1,461	1,545	1,450	1,144	1,163	1,241	1445
kWh/MG/Year	1693	1640	1773	1759	1957	2309	2290	2148	1657
\$/MG/Year	\$118.89	\$120.98	\$117.84	\$116.11	\$133.41	\$167.69	\$181.17	\$157.31	\$ 119.01
kWh/person/year	80.04	77.34	78.49	77.67	80.22	73.20	71.41	69.49	60.74
Focus on Energy Benchmark	1650	1650	1650	1650	1650	1650	1650	1650	1650

WI Avg WWTP Energy Use

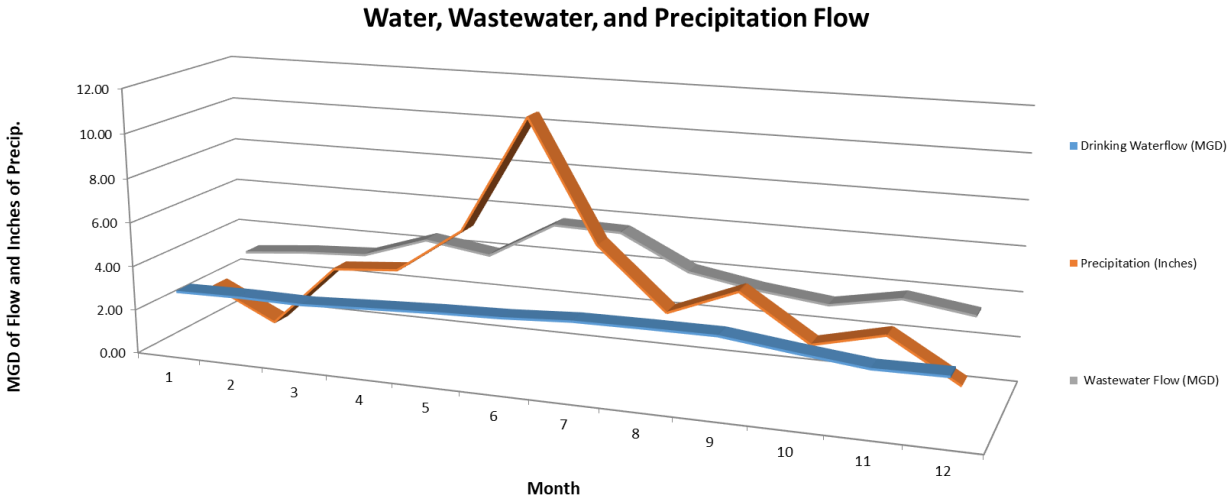
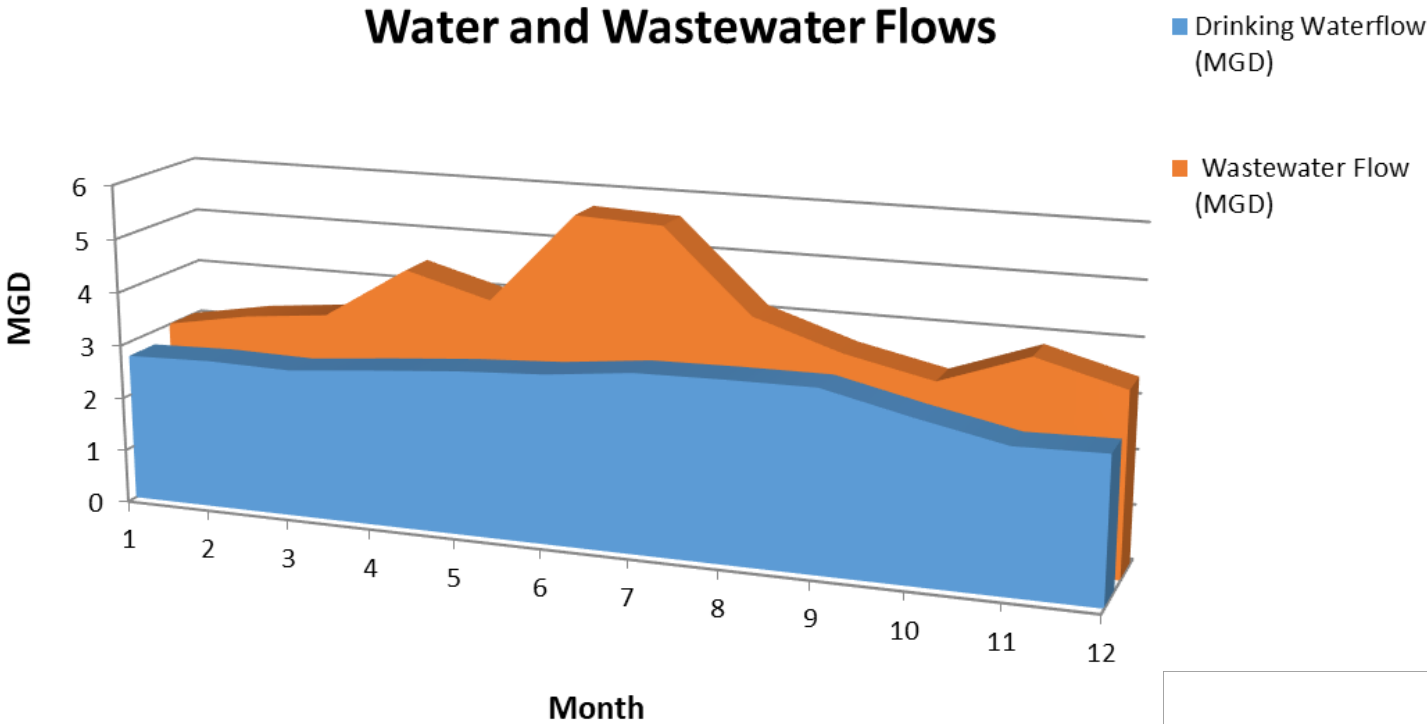
Activated $\leq$ 1-5 mgd 1426 kW/1000 lb BOD
2503 kw/MGD
88465 kWh/1000 PE

Best Practices Benchmark

Activated $\leq$ 1-5 mgd 2503 kw/MGD Avg
1510 Top 25%
1650 Best Practices Benchmark



Monitor Influent Flow vs Drinking Water pumped







15% Biosolids

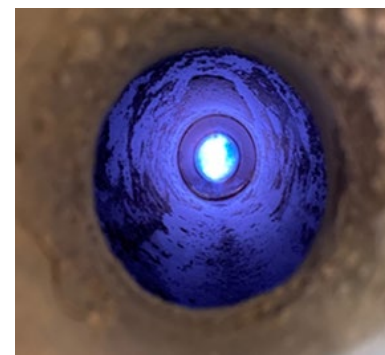
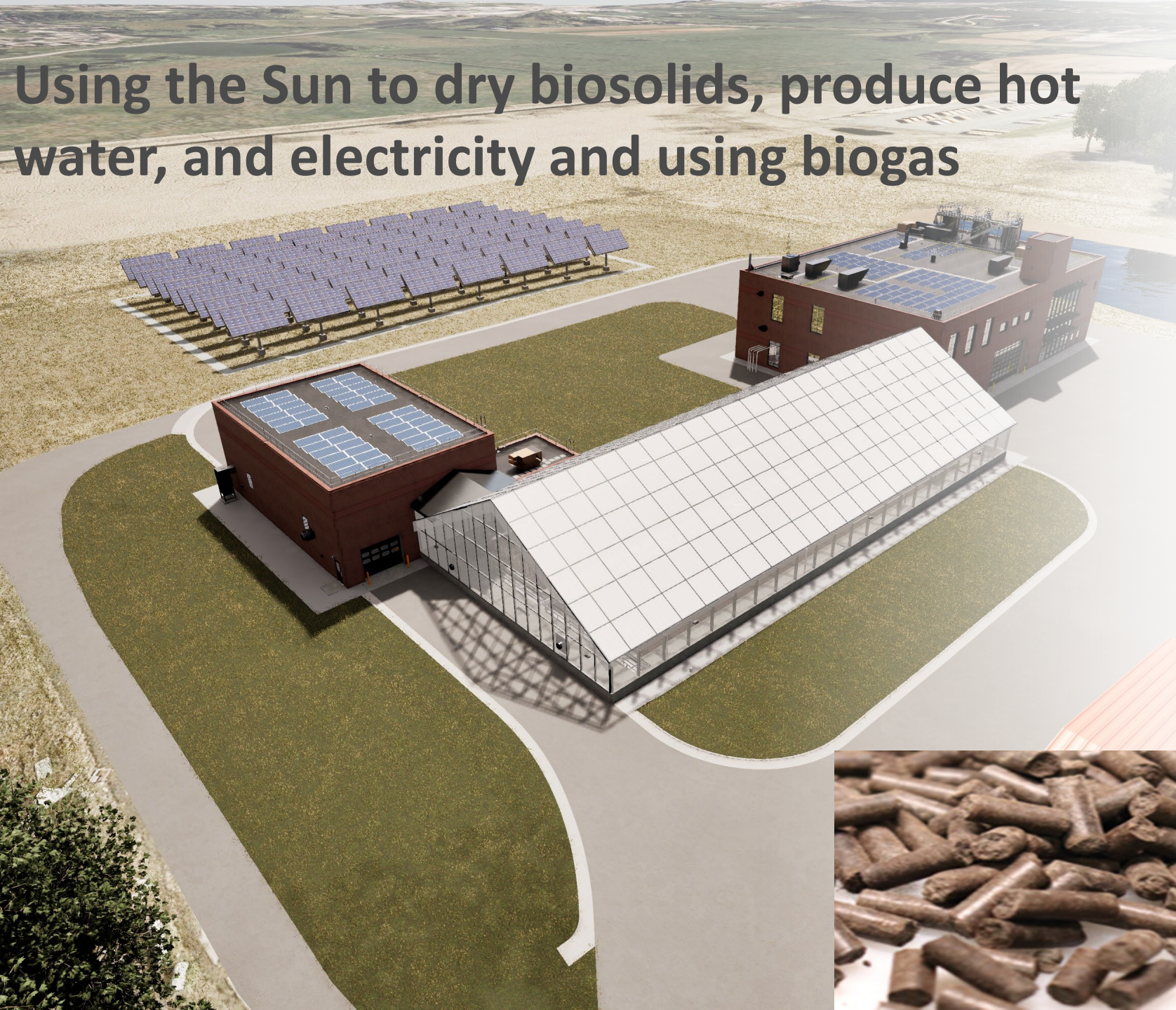
200 semi loads annually



Cost Avoidance

- Avoid building another open sided biosolids storage space (\$3.5M avoided)
- Hauling Costs (\$5.25M avoided)
 - No hauling costs (\$0 anticipated after project is complete) Currently \$125,000/yr and expected to be \$400,000+/yr by 2045
- Class A pre digestion process will help increase digestion capacity and will allow for longer span of time before needing to add digestion capacity/third digester (\$7.5M)
- Sustainable Practices (\$1.75M avoided)
 - Solar dryer using sun and biogas heated water vs conventional dryer utilizing natural gas (\$87,500 per year savings)
- Volume Reduction and Street Maintenance (\$ avoided)
 - Currently hauling out 200+ semi loads a year at 80,000 lbs (would reduce down to approximately 20 semi loads)

Using the Sun to dry biosolids, produce hot water, and electricity and using biogas



SUNSTAINABLE
BIOSOLIDS

Addresses Single Points of Failure

Provides

- Redundancy
- Efficiency
- Many Class A options to off ramp at

No extra staff needed



Farming Practices Have Changed –
(Soil loss, compaction and lack of organic matter a major issue)

Not conducive to Class B biosolids application

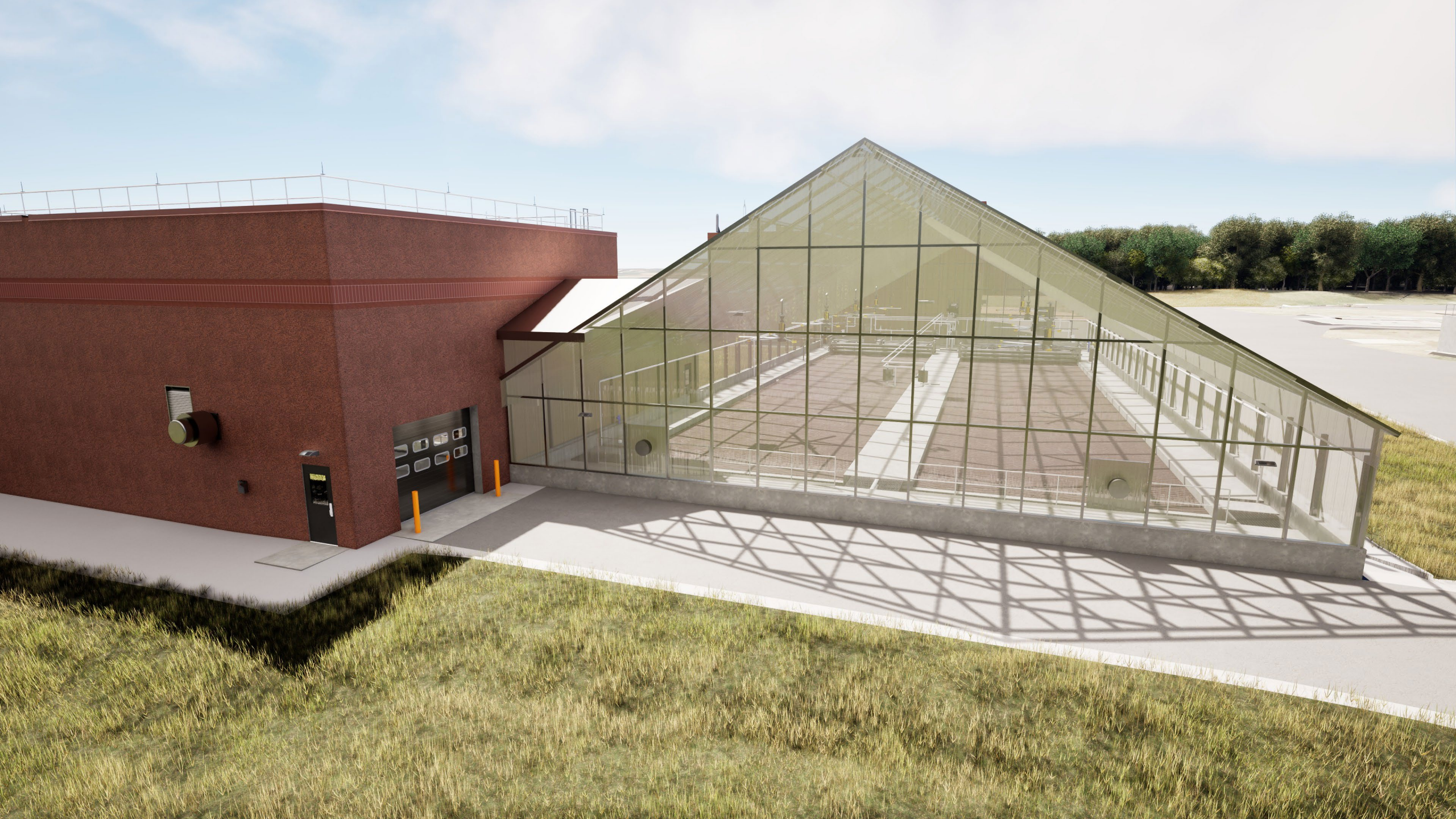
- No till
- Minimum till
- Strip till

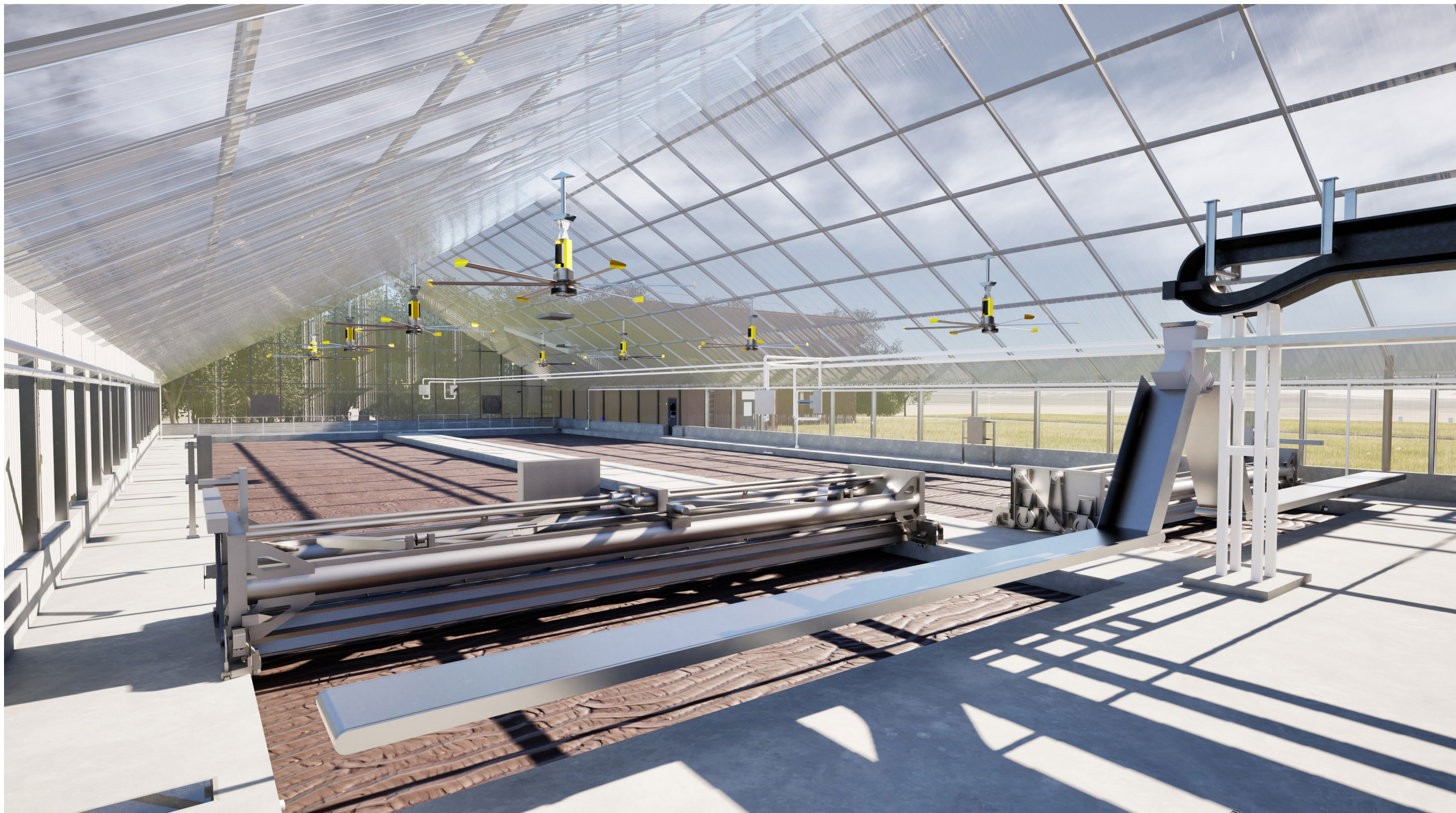


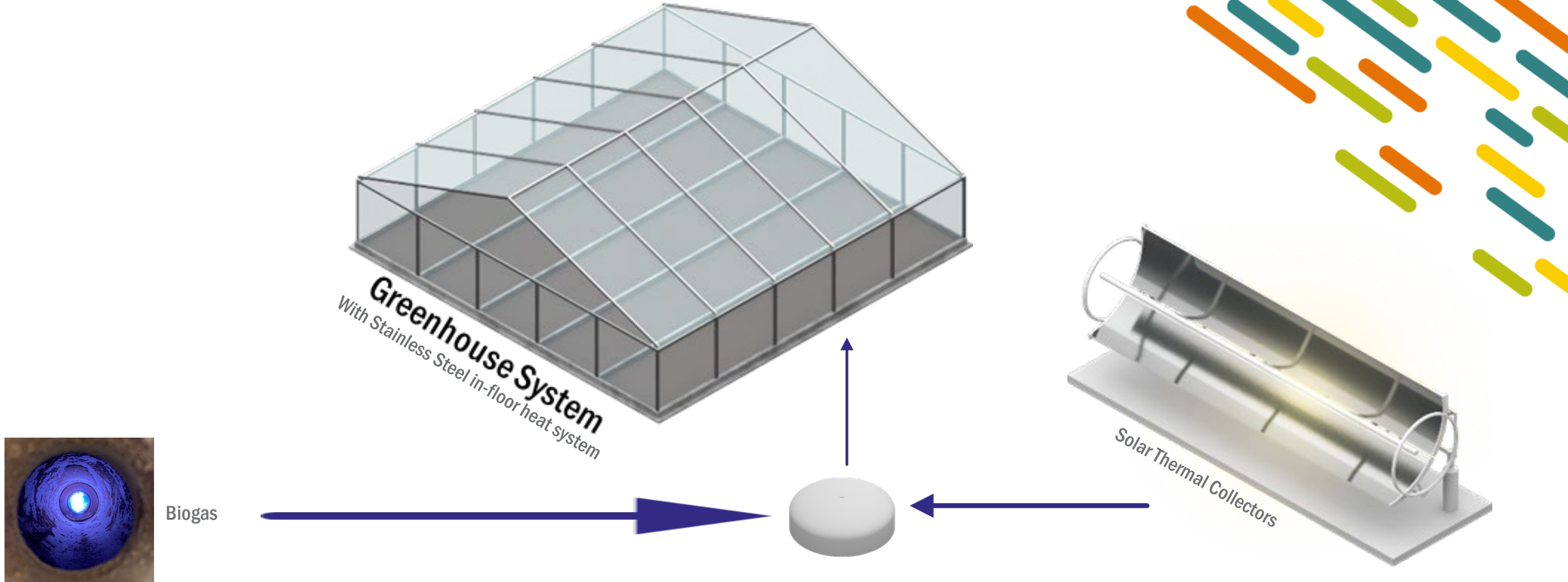












Make Hot Water to dry Biosolids

Use the sun





Class A Biosolids

Uniform size and density



The background is a solid yellow color. It features several abstract, light-yellow shapes. On the left side, there are several straight, elongated shapes of varying lengths and orientations, some pointing towards the center. On the right side, there are several curved, arc-like shapes that sweep across the frame. The overall composition is minimalist and modern.

In the field

Work out in the field - Source and Blueprint







Thank you