

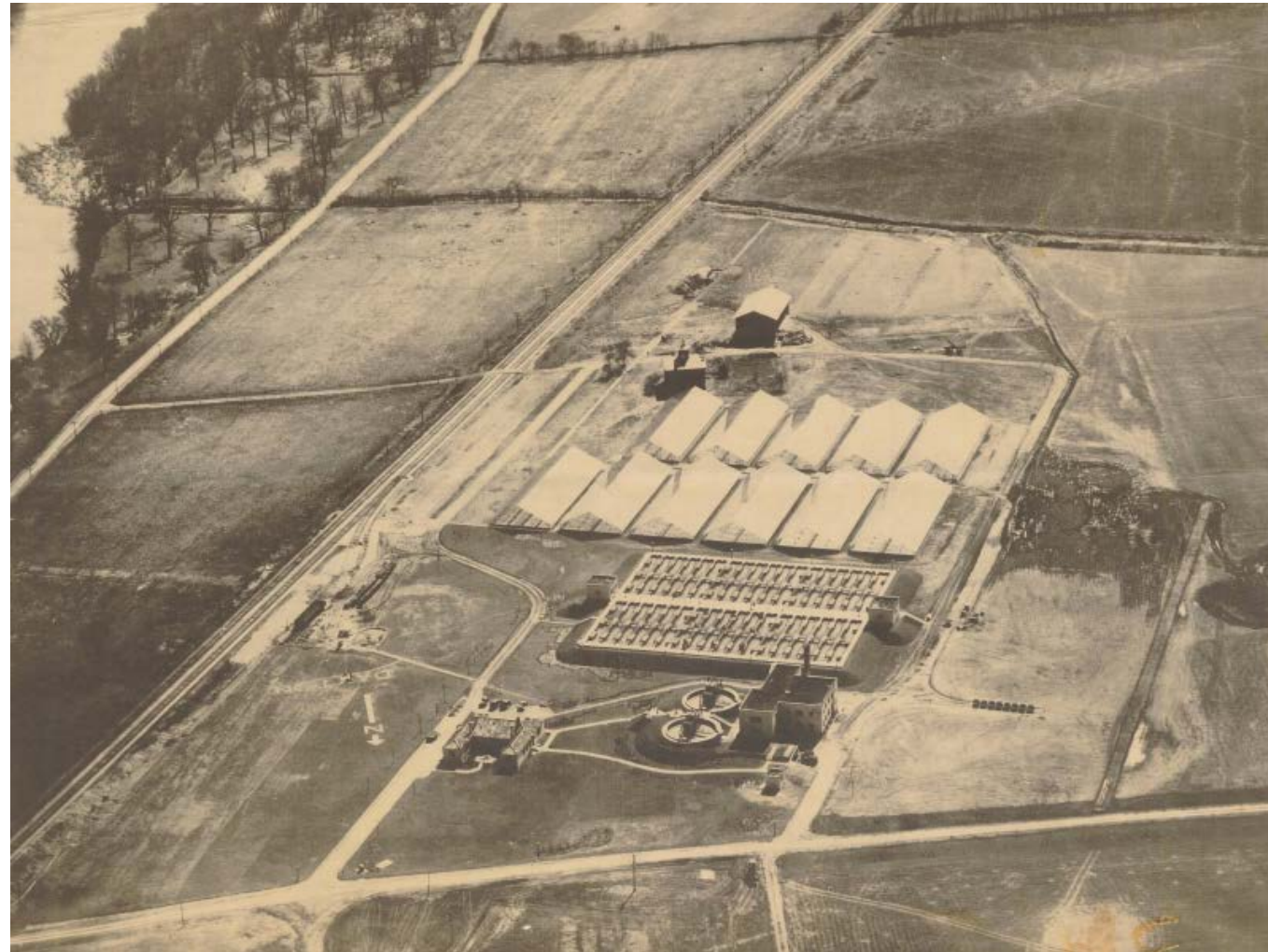
Digging Deeper to Save the City of Dayton Over a Half a Million Dollars

ON THEIR RAS/WAS UPGRADES

Dayton WWT Division Stats

- ▶ Startup date: 1929
- ▶ Service population: 340,000
- ▶ Number of employees: 72
- ▶ Design flow: 72 MGD
- ▶ Average daily flow: 45 MGD
- ▶ Peak flow: 190 MGD
- ▶ Annual operating cost: \$16M

Dayton WWTP Circa 1929



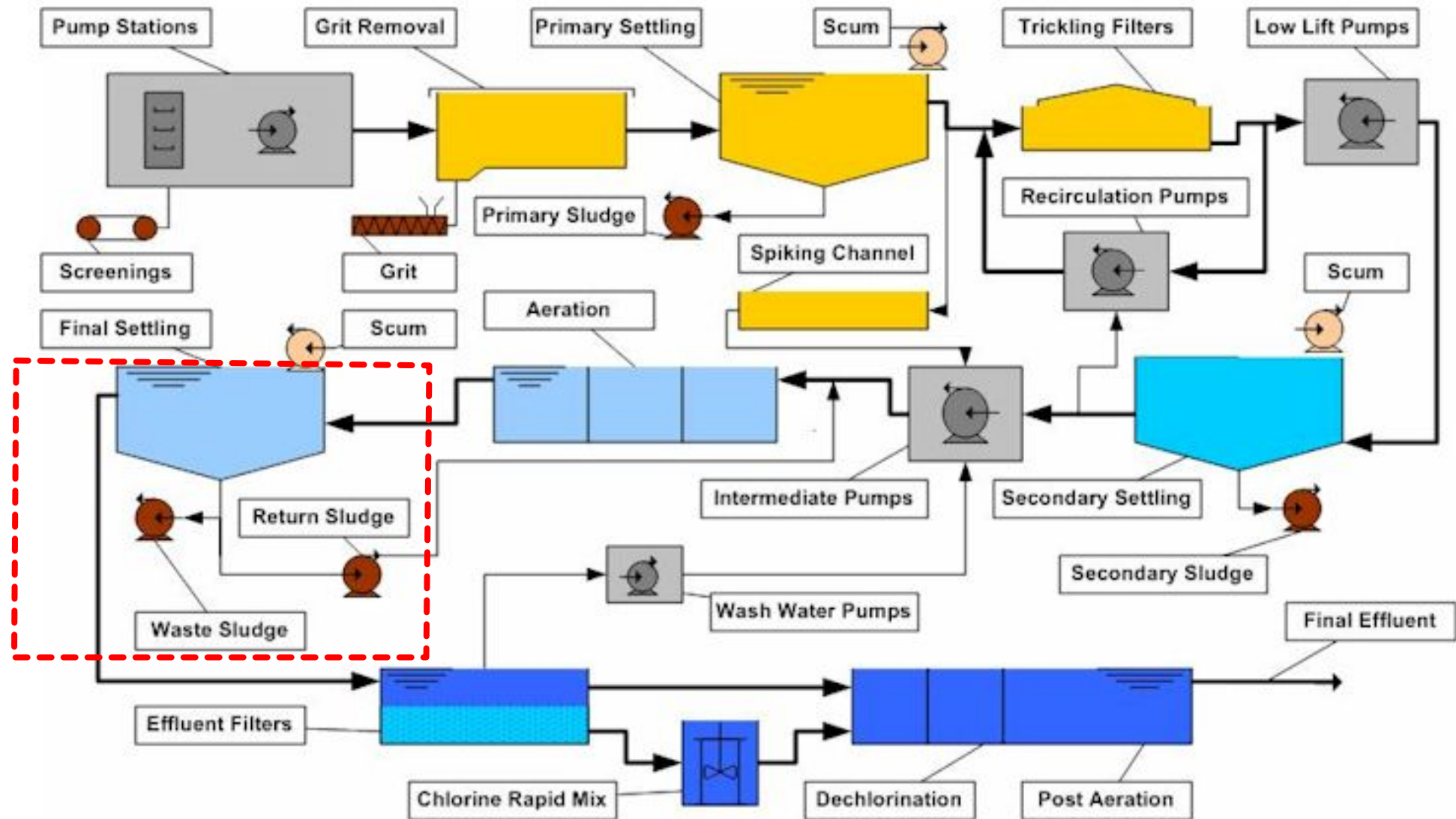
Dayton WWTP Circa 1949



Dayton WWTP Circa 1992



Liquids Process Schematic

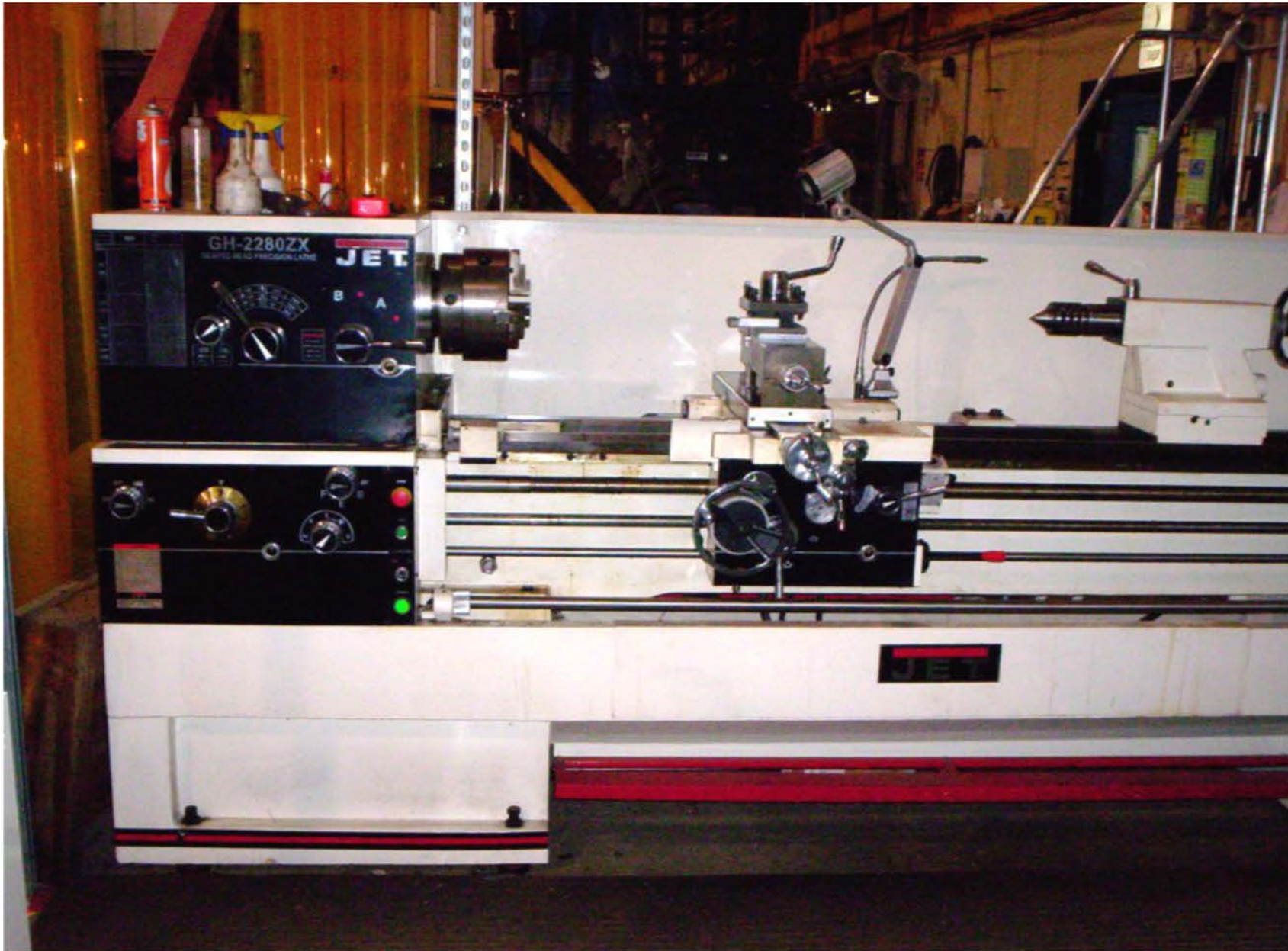


Maintenance Activities



The goal of the maintenance program is preventive maintenance.

- ▶ We use Hansen for generating the PM's and reactive work orders.
- ▶ We have 10 mechanics, 2 construction electricians, 3 electronic electricians and 2 building trades workers, and 1 stock clerk.
- ▶ We have a \$500,000 budget for \$200 million in assets.
- ▶ **Big push is doing as much in house as possible.**

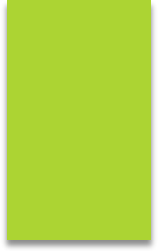
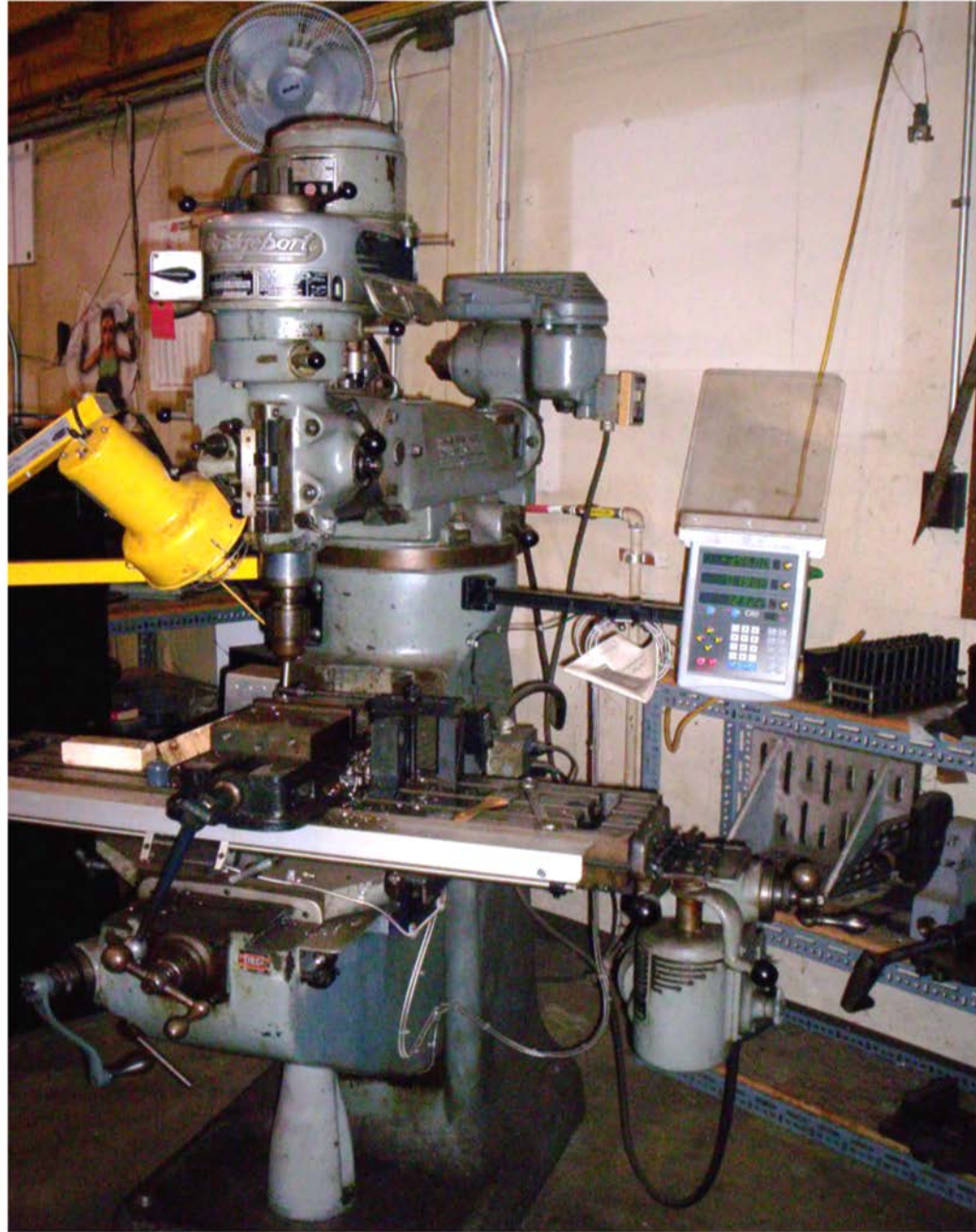


Jet GH-2280ZX, 3-1/8" Spindle Bore Geared Head Lathe/Pass-through Lathe

Staff uses this to service and repair various drive shafts for plant equipment.

Bridgeport Vertical Mill

Staff uses this to
bore holes, bore
counter sink
holes, and
mill/shave parts,
etc.

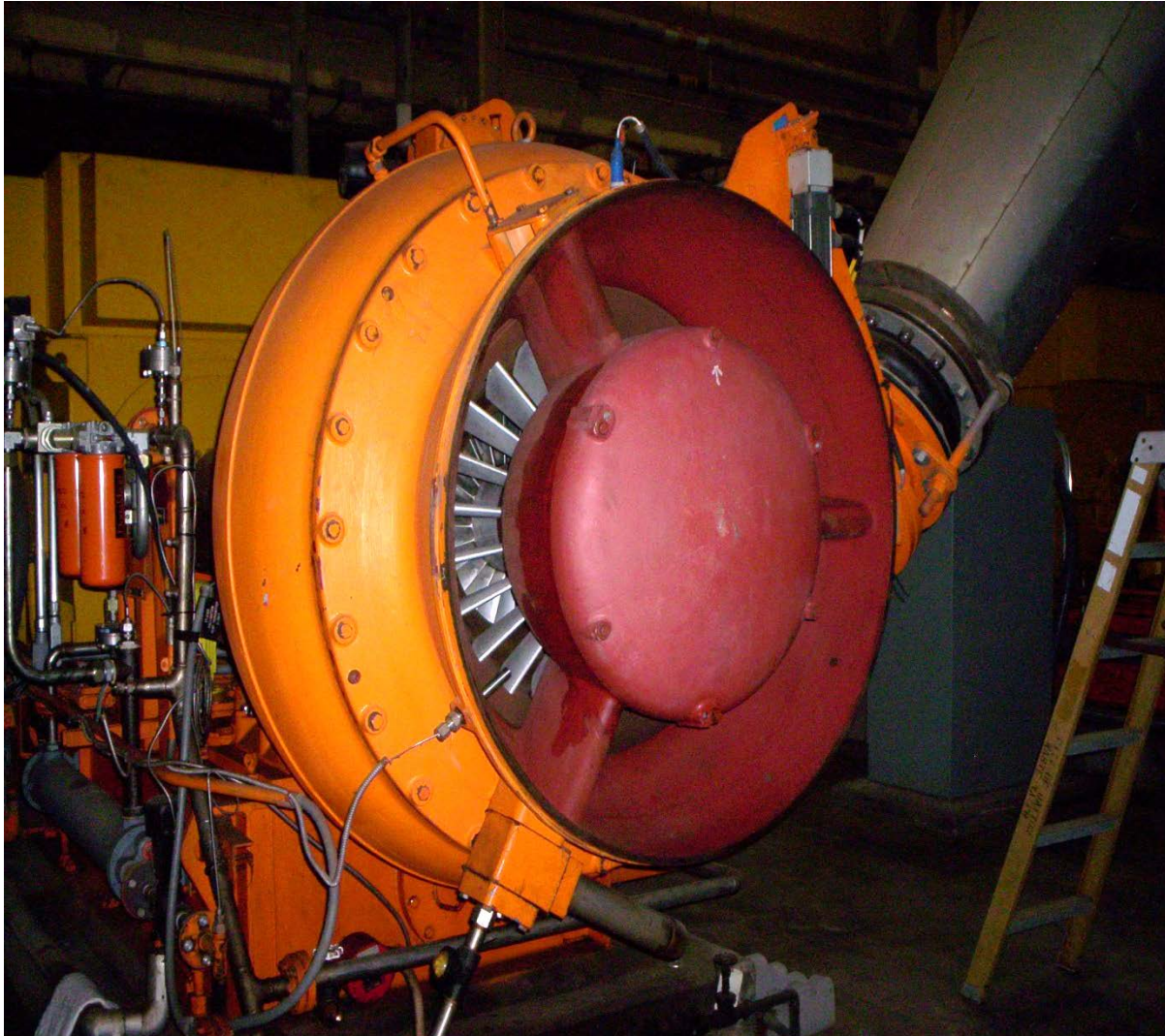


Maintenance Activities



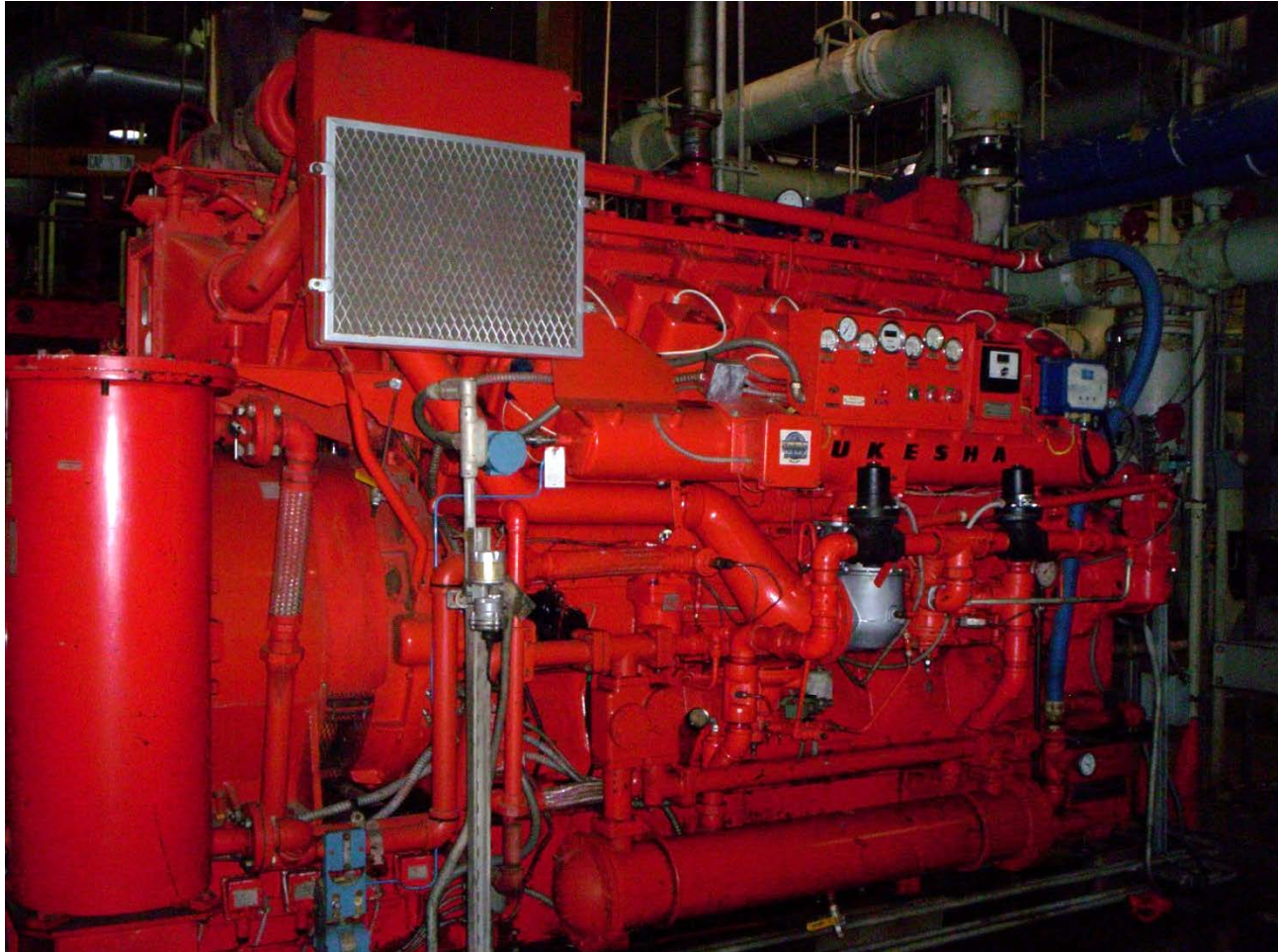
*These are 500 Hp Flygt pumps.
We repaired a plate that was
\$40,000 and 6 months out.*

Maintenance Activities



This is one of our 1500 Hp PAC units. I have a mechanic who is able to go through and rebuild them. This saves the city about \$30,000 plus parts. We have 4 units.

Maintenance Activities



*We also rebuild
our Waukesha
enginators.*

*These are 1,000
Hp / 1,000 Kw.
We have 3 of
these.*

Project Drivers:

- ▶ Final Clarifiers, RAS and WAS
 - ▶ Condition/Age
 - ▶ Reliability
 - ▶ Eye towards the future
 - ▶ Had budget

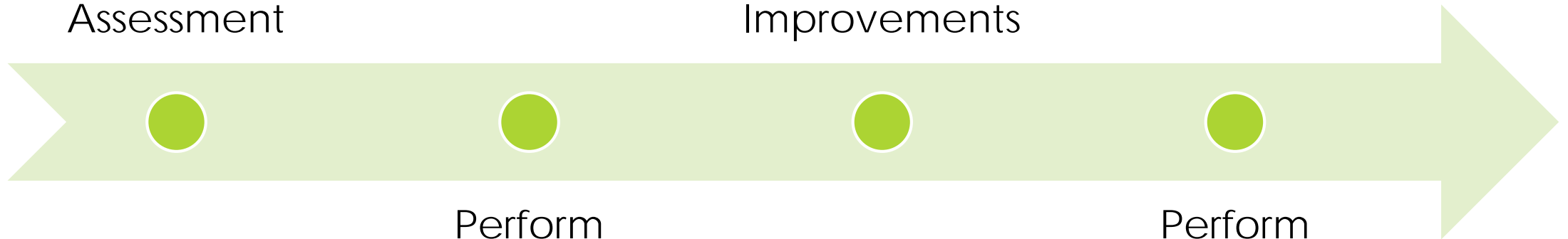
Scope of Services (RAS/WAS)

Perform
Condition
Assessment

Design
Improvements

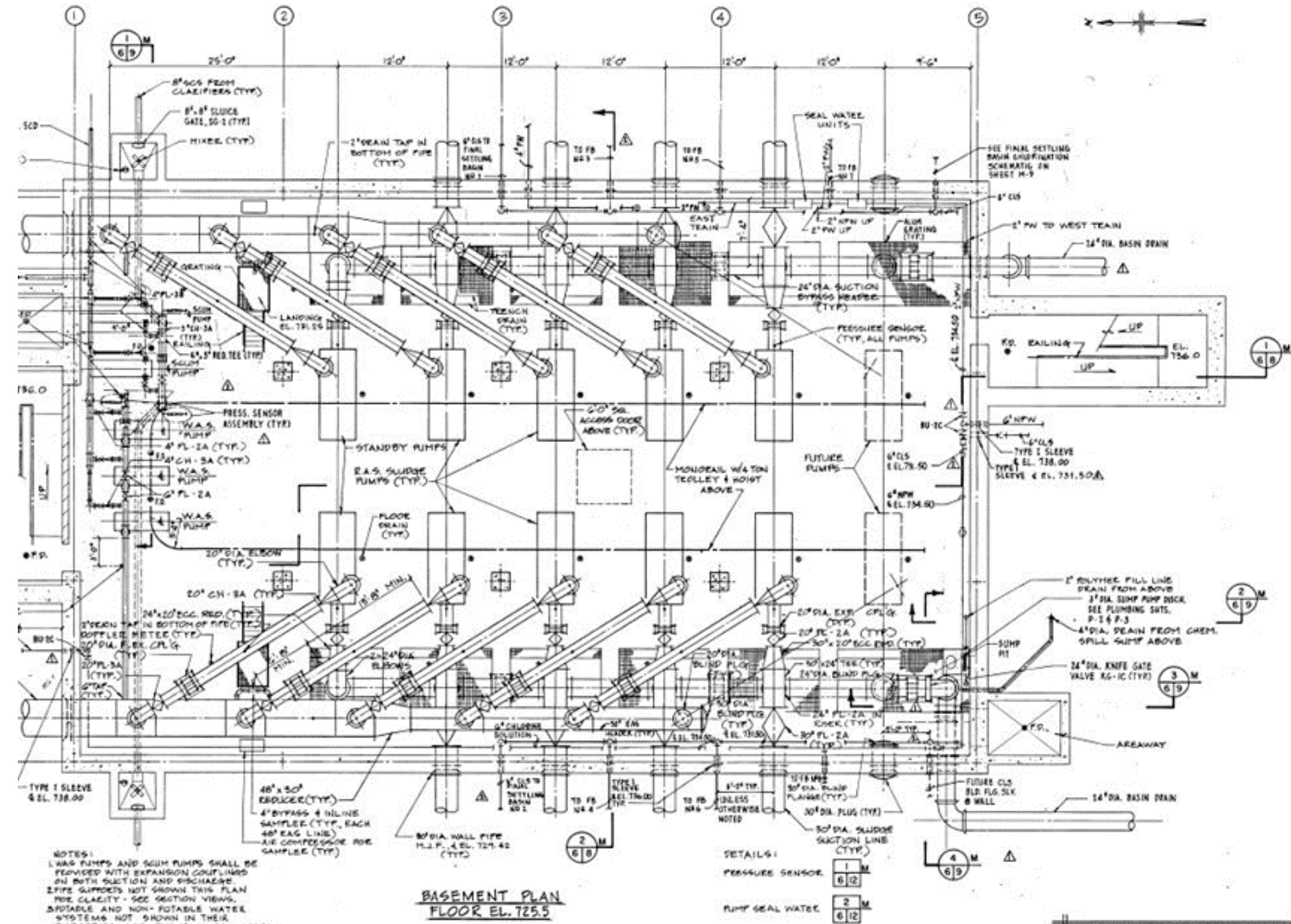
Perform
Analysis of
Alternatives

Perform
Construction
Support
Services



Return Activated Sludge

- Number: 10, includes 2 stand-by units
- Type: Horizontal, non-clog centrifugal
- Drive: Variable speed (Variable frequency drive)
- Capacity: 9,500 GPM (13.7 MGD) at 24.5 feet TDH (average)
- Motor: 75 Hp, 505 RPM, 460 volt, 3 phase
- Suction Diameter: 24 inch
- Discharge Diameter: 20 inch
- Manufacturer: Worthington – Model 20MN24
- Variable Frequency Drives (VFD's): Robicon
- Motors: U.S. Motor



FOR RECORD DRAWING INFORMATION
 COORDINATE THIS DRAWING WITH NBS
 (CONTRACTOR) DRAWINGS LABELED
 PROJECT RECORD DRAWING NOS. 464-7
 4164-PZ # 4164-P7

RAS Condition Assessment - Issues

- Packing/Seal Leakage
- Base Drainage
- Coating/Corrosion



Return Activated Sludge Pumping Rates

- Average Daily Flow: 40 MGD, RAS rate (50 - 150%) 20 MGD – 50 MGD

# Final Clarifiers Operating	RAS Rate Per Pump (GPM) as Varied by Percent of Process Flow @ 40 MGD										
	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%
2	6944	8333	9722	11110	12499	13888	15277	16666	18054	19443	20832
3	4629	5555	6481	7407	8333	9259	10185	11110	12036	12962	13888
4	3472	4166	4861	5555	6250	6944	7638	8333	9027	9722	10416
5	2778	3333	3889	4444	5000	5555	6111	6666	7222	7777	8333
6	2315	2778	3241	3703	4166	4629	5092	5555	6018	6481	6944
7	1984	2381	2778	3174	3571	3968	4365	4762	5158	5555	5952
8	1736	2083	2430	2778	3125	3472	3819	4166	4514	4861	5208

Return Activated Sludge Pumping Rates

- Max Flow: 180 MGD, RAS rate (30 - 50%) 48 MGD – 90 MGD

# Final Clarifiers Operating	RAS Rate Per Pump (GPM) as Varied by Percent of Process Flow @ 180 MGD								
	20%	25%	30%	35%	40%	45%	50%	55%	60%
2	12499.2	15624	18748.8	21873.6	24998.4	28123.2	31248	34372.8	37497.6
3	8332.8	10416	12499.2	14582.4	16665.6	18748.8	20832	22915.2	24998.4
4	6249.6	7812	9374.4	10936.8	12499.2	14061.6	15624	17186.4	18748.8
5	4999.68	6249.6	7499.52	8749.44	9999.36	11249.3	12499.2	13749.1	14999
6	4166.4	5208	6249.6	7291.2	8332.8	9374.4	10416	11457.6	12499.2
7	3571.2	4464	5356.8	6249.6	7142.4	8035.2	8928	9820.8	10713.6
8	3124.8	3906	4687.2	5468.4	6249.6	7030.8	7812	8593.2	9374.4

Alternatives: Rehab/Replacement

- 1A: Pump **Rehabilitation** by Manufacturer
 - 18 Weeks for rehab/batch
 - 4 Pumps at a time
 - 1 year warrantee on parts and labor
- 1B: Pump **Rehabilitation** by Plant Staff
 - 4-6 Weeks/Pump
 - 1 Pumps at a time
 - 1 year warrantee on parts
- 2A: **Replace** Pumps In Kind
 - 40 Weeks to ship pumps (includes shop drawings/review)
 - All pumps shipped at once
 - 1 year warrantee/correction period
- 2B: **Replace** Pumps (Market Competition)
 - 40 Weeks to ship pumps (includes shop drawings/review)
 - All pumps shipped at once
 - 1 year warrantee/correction period

Alternatives

Rehab by Plant \$330k < Manufacturer
 Rehab by Plant \$750k < Replacement.

	Alternative 1A	Alternative 1B	Alternative 2A	Alternative 2B			
	FLOWSERVE	DAYTON	FLOWSERVE	CORNELL		MORRIS	
PUMP	Manufacturer	Plant	20MN24	16NHT32	30NNT-F	7100MF-2024214V	7100MF-2024213V
PUMP REMOVAL	\$ 3,000	-	\$ 1,500	\$ 15,000	\$ 15,000	\$ 15,000	\$ 15,000
PUMP COST	\$ 40,400	\$ 30,000	\$ 71,500	\$ 71,500	\$ 71,500	\$ 71,500	\$ 71,500
MOTOR COST	-	-	-	-	\$ 19,000	\$ 19,000	\$ 19,000
PIPING COST	-	-	-	\$ 8,500	\$ 9,000	\$ 7,500	\$ 7,500
PUMP(/Motor) INSTALL.	\$ 3,000	-	\$ 4,000	\$ 17,875	\$ 22,625	\$ 22,625	\$ 22,625
PIPE INSTALL.	-	-	-	\$ 4,250	\$ 4,500	\$ 3,750	\$ 3,750
TESTING	\$ 5,000	-	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000	\$ 5,000
EST. TOTAL CONSTRUCTION COST	\$ 51,400	\$ 30,000	\$ 82,000	\$ 122,125	\$ 146,625	\$ 144,375	\$ 144,375
Design Contingency (20%)	\$ 10,280	\$ 6,000	\$ 16,400	\$ 24,425	\$ 29,325	\$ 28,875	\$ 28,875
Contractor OH&P	\$ 7,402	-	\$ 11,808	\$ 17,586	\$ 21,114	\$ 20,790	\$ 20,790
Each Pump	\$ 69,082	\$ 36,000	\$ 110,208	\$ 164,136	\$ 197,064	\$ 194,040	\$ 194,040
Total Ten Pumps	\$ 690,816	\$ 360,000	\$ 1,102,080	\$ 1,641,360	\$ 1,970,640	\$ 1,940,400	\$ 1,940,400

Alternatives

ALTERNATIVE	ADVANTAGES	DISADVANTAGES	RISKS
Rehabilitation by Pump Manufacturer	<ul style="list-style-type: none"> • Cost Effective • Plant Staff Familiarity • Reliability • Warrantee 	<ul style="list-style-type: none"> • Longer Lead Time • Higher cost than on-site rehab 	<ul style="list-style-type: none"> • Potential for damage in crating/shipping off-site • Longer lead time than expected
Rehabilitation by Plant Staff	<ul style="list-style-type: none"> • Best Cost Effectiveness • Plant Staff Familiarity • Reliability 	<ul style="list-style-type: none"> • Increased staff workload • Potential for lower quality materials 	<ul style="list-style-type: none"> • Parts warranted, not labor • Potential schedule requirements
Replacement (Worthington)	<ul style="list-style-type: none"> • Completely New Pump • Plant Staff Familiarity • Warrantee 	<ul style="list-style-type: none"> • Less Cost Effective • Longer lead time 	<ul style="list-style-type: none"> • None
Replacement (Competitive Bid)	<ul style="list-style-type: none"> • Warrantee 	<ul style="list-style-type: none"> • Staff prefers current pumps • Potential higher cost 	<ul style="list-style-type: none"> • Issues with maintaining new pumps • Pumps don't perform at same level as existing pumps

Results



\$336k for Parts, \$12k for labor = \$348k total vs. \$360k estimated

3 days for pump rebuild (2 week outage total) vs. 4-6 weeks estimated

Waste Activated Sludge

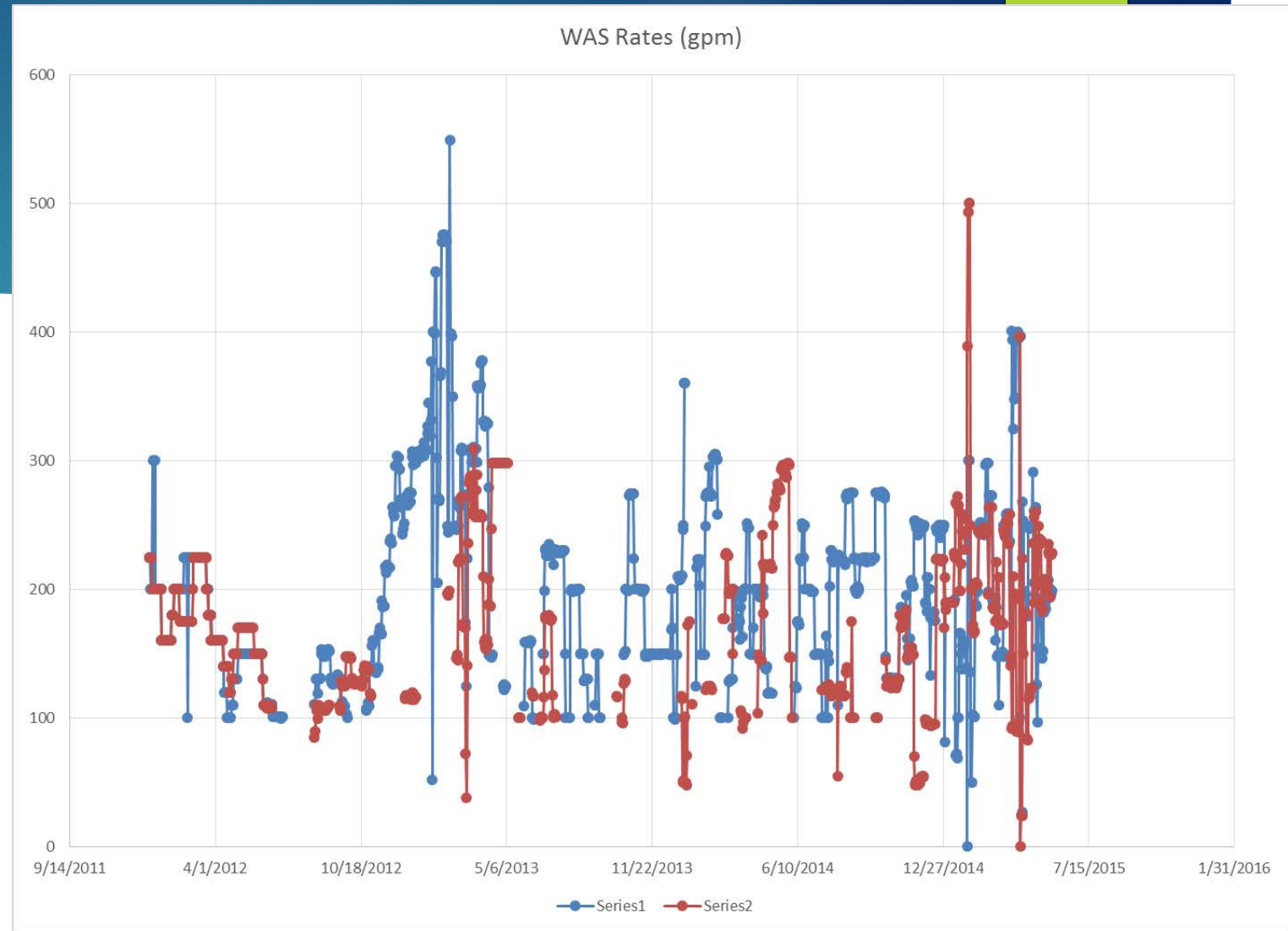
- Number: 3
- Type: Progressing Cavity positive displacement
- Drive: Variable speed (Variable frequency drive)
- Capacity: 250 GPM at 80 feet TDH (average)
- Motor: 20 Hp
- Suction Drive: 6 inch
- Discharge Diameter: 6 inch
- Pump Manufacturer: Moyno (Robbins and Meyers) 1H175G1
- VFDs: Robicon
- Drive: SEW (6.2 gear reducer)
- Motor: Baldor (1760 rpm)



Waste Activated Sludge

	WAS East	WAS West	Total
Ave	200	172	267
Median	198	170	273
25th percentile	149	123	159.6
50th Percentile	198	170	273
75th Percentile	246	218	368
90th Percentile	298.8	259	450
95th Percentile	325.8	293.6	492
99th Percentile	431.6	298	593.2

Pumps sized for 250 gpm each
 Currently run three pumps at times
 May not be adequate for phosphorus removal



WAS System Improvements

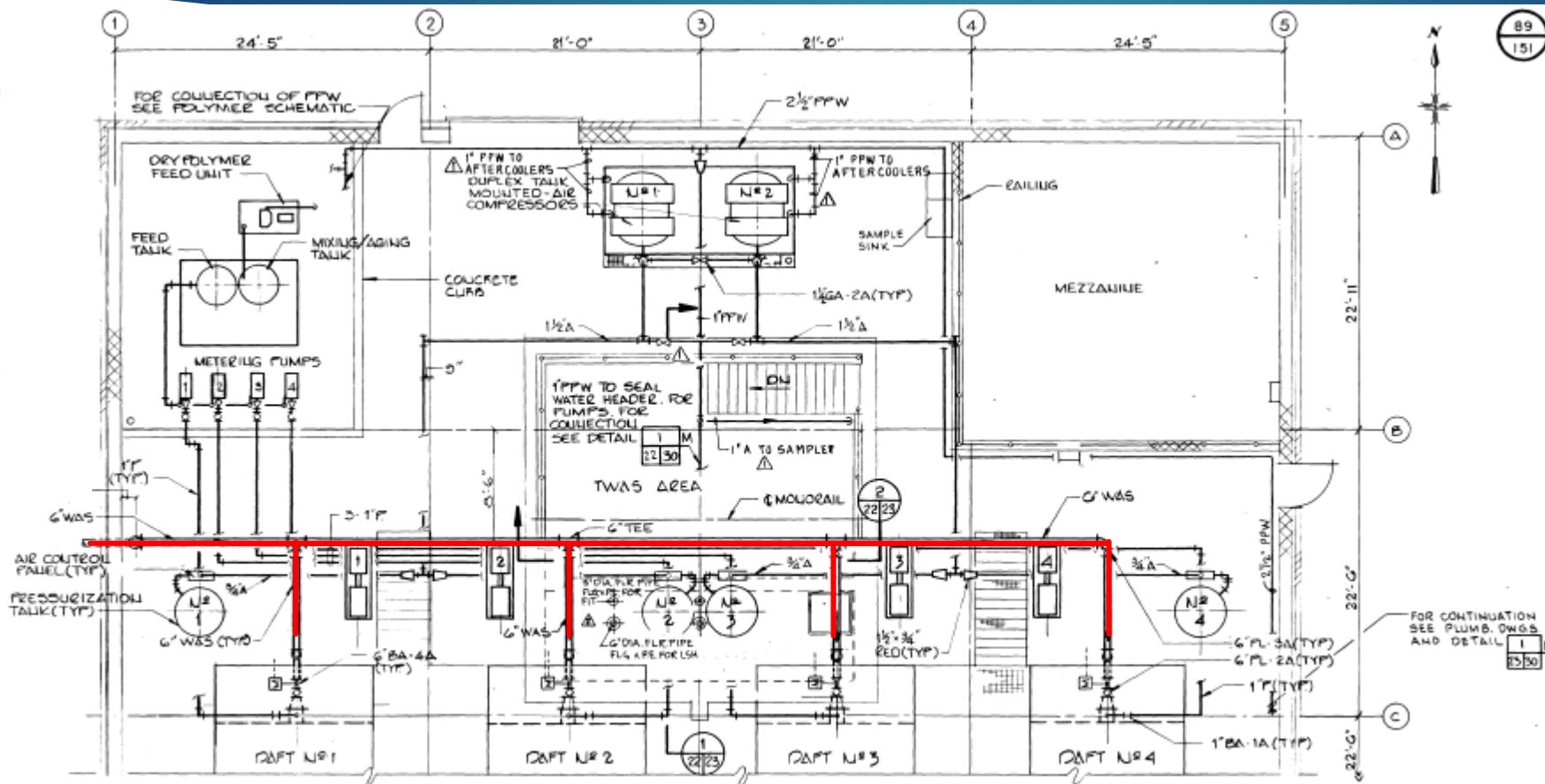
- **Add a WAS Pump**
- Upsize existing WAS Pumps
- Perform additional field testing



Additional Field Testing

- ▶ Performed tests to cycle through various speeds and record the flow rates and pressures.
- ▶ Check flow rates to Dissolved Air Flootation (DAF) units
- ▶ Identified two issues:
 - ▶ Pump Controls were configured such that 100% speed = 40 Hz
 - ▶ 40 Hz ~ 260 gpm
 - ▶ Based on Gear/Wet End/Motor combination, pumps should produce close to 500 gpm each
 - ▶ DAF flow distribution was not working
 - ▶ System designed with modulating valves/flow control loop to distribute equally
 - ▶ System not working, valves were set in "permanent" position

Operations – Flow Distribution

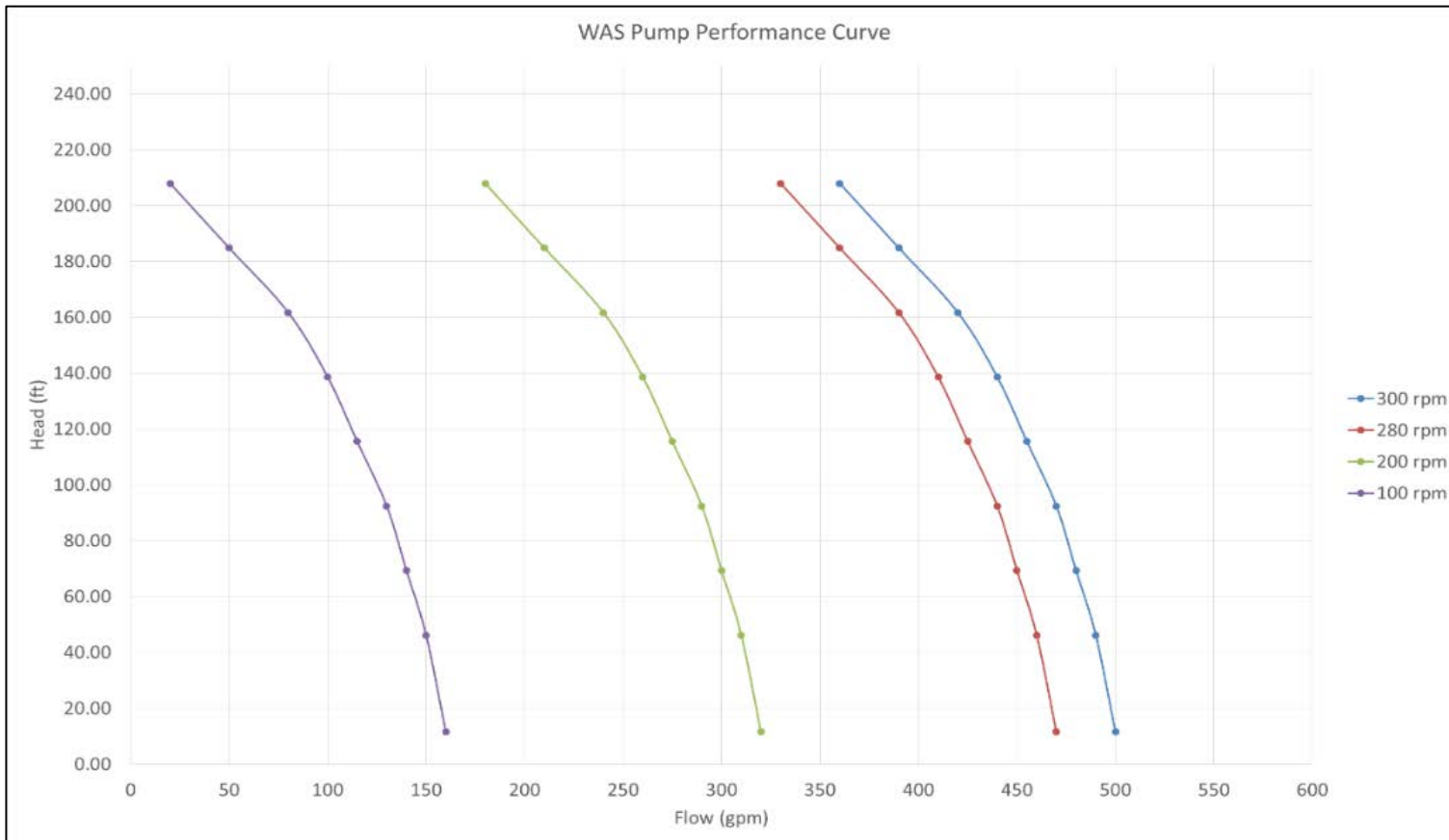


PARTIAL FIRST FLOOR PLAN - ELEVATED PIPING
1 FOR FULL PLAN VIEW OF FIRST FLOOR SEE SHEET M-22

DAF Tank	Control Valve % Open Set Point
1	48%
2	61%
3	80%
4	100%

Replace motor operated V-port Ball Valves and actuators (modulating).

Waste Activated Sludge Pumping



Design Flow Rate: 300 gpm per pump.

Current pumps limited to 188 rpm (~260 gpm) due to VFD programming.

Recommend rescaling the VFD to allow 60 hz operation (288 rpm).

WAS Alternatives

- 1: Pump Rehabilitation by Plant Staff (Pumps 1 and 3)
 - 4-6 Weeks/Pump
 - 1 Pumps at a time
 - 1 year warrantee on parts
- 2: Replace Pumps In Kind (Pumps 1 and 3)
 - 40 Weeks to ship pumps (includes shop drawings/review)
 - All pumps shipped at once
 - 1 year warrantee/correction period

WAS Alternatives

	Alternative 1	Alternative 2
	REHAB	MOYNO
PUMP	Plant	1H175G1
PUMP REMOVAL		\$ 1,500
PUMP COST	\$ 13,500	\$ 18,500
MOTOR COST		-
PIPING COST		-
PUMP(/Motor) INSTALL		\$ 4,000
PIPE INSTALL		-
TESTING		\$ 5,000
EST. TOTAL CONSTRUCTION COST	\$ 13,500	\$ 29,000
Design Contingency	\$ 2,700	\$ 5,800
Contractor OH&P		\$ 4,176
Each Pump	\$ 16,200	\$ 38,976
Total Two Pumps	\$ 32,400	\$ 77,952

Conclusions

- ▶ Teamwork is critical to project success
- ▶ Major process efficiency improvements
- ▶ Field Testing is critical to identifying the correct problems to fix
- ▶ Rehab is a great alternative to replacement
- ▶ Dayton maintenance staff are highly skilled and fairly unique
- ▶ Self performance and rehab options save money to allow for additional plant improvements

Questions

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