Instrumentation Based Real-Time Process Optimization

November 13, 2018

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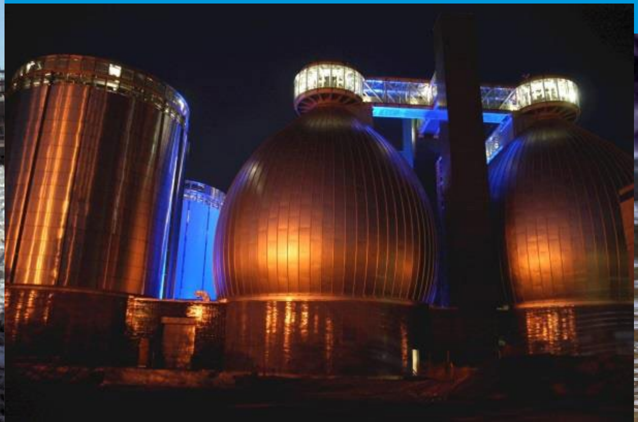
Claros Process Optimization

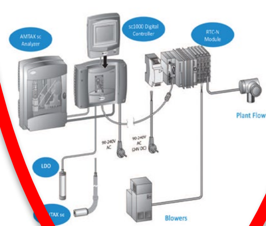
INSTRUMENTATION CONTINUUM

Passive (watch) → Active (control)

- Do Nothing
- Grab Samples
- Online Analysis
- Data: Aggregate Analyze Report
- Decision Support: Detect Diagnose Predict
- Control/ Optimize Processes
- Control/ Optimize Facilities

SERVICE

- Lab Equipment/ Chemistries
- Process Equipment
- WIMS
- Prognosys/ Sensor Verification
- RTC
- Claros



LOTS OF VARIATIONS IN PROCESS CONTROL

Operator Questions -

- What to measure – and why?
- Where to measure it?
- Is a daily grab sample representative, good enough?
  - **Hint: It is not**
- Is my plant running as designed?
- Is my instrument giving me correct readings?
- What do I do with the data?
- Do the chemical, power savings matter?
  - **Hint: Absolutely**

UTILITY MARKET'S BUSINESS ISSUES

- Retiring workforce - Institutional knowledge is leaving the industry
- Grab sample process changes lead to chasing problems & never catching them
- Budget concerns
- Compliance regulations
- Data management

Claros Overview

Instrument Management

Data Management

Process Management

Everyone is being asked to do more with less but how?

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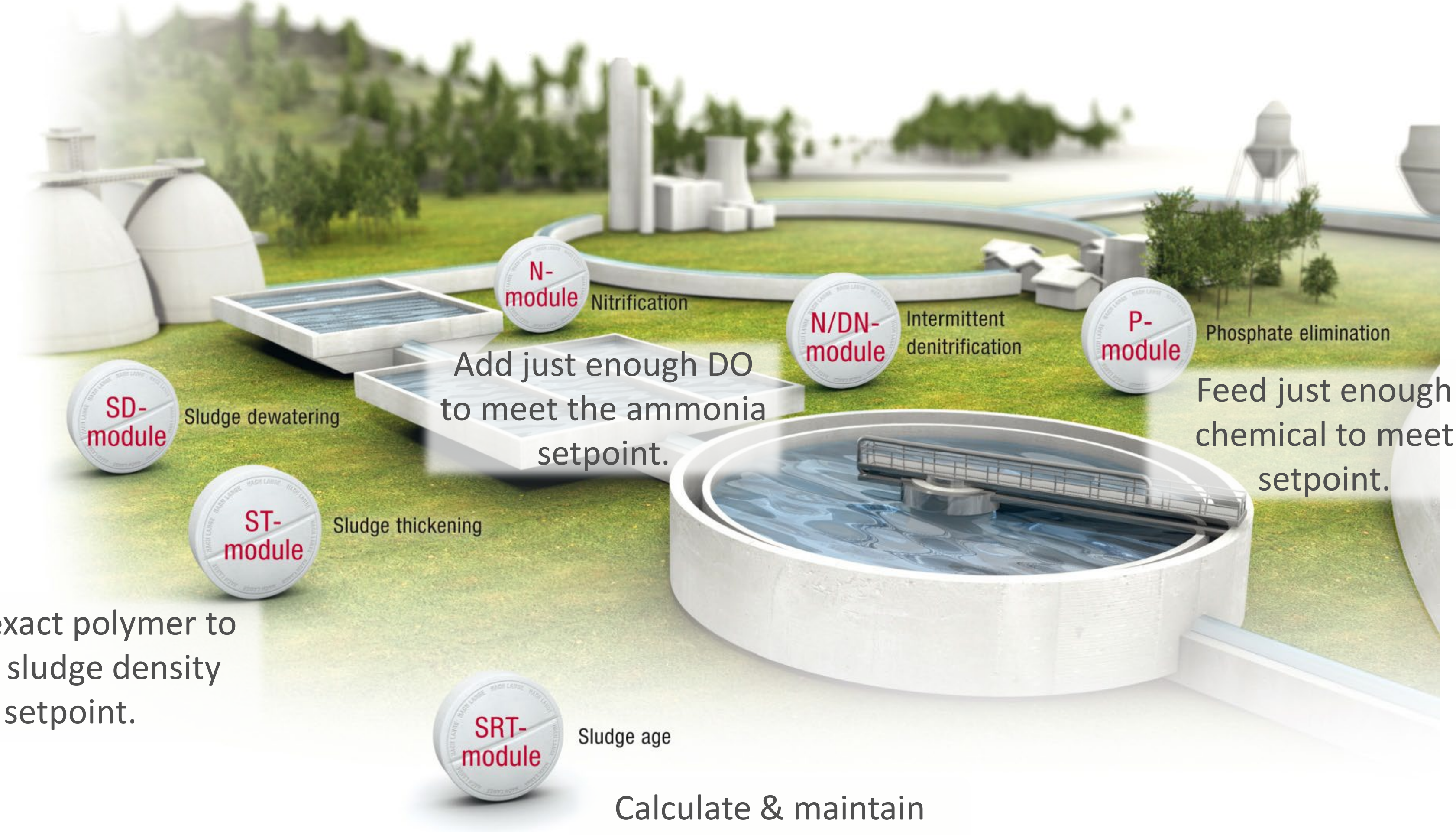
RTC – REAL TIME CONTROL.



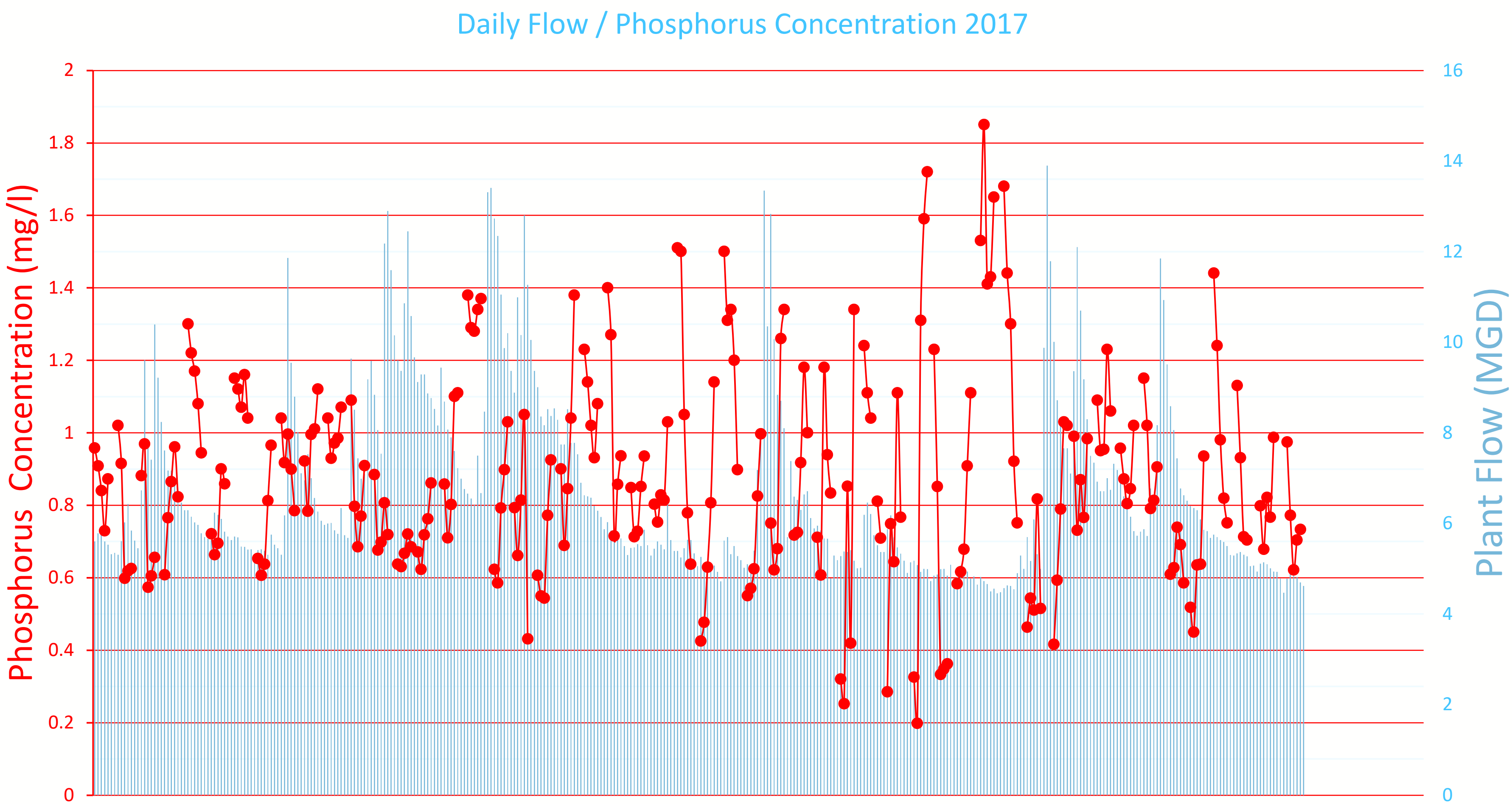
Add just enough DO to meet the ammonia setpoint.

Feed just enough chemical to meet setpoint.

Feed exact polymer to meet sludge density setpoint.

Calculate & maintain the best SRT for your system.

ILLINOIS (CURRENT STATE)



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ILLINOIS PHOSPHORUS LEVELS

Based on 2017 Data

146 days Spent overfeeding Alum

Cost:

22,552 gallons excess used (Actual vs. Target of 0.95 mg/l)

= 5 truckloads of Alum

$27,062

ILLINOIS PHOSPHORUS LEVELS DAILY COMPOSITE TESTING

Over 2.000	1	0.9-0.999	37	0.8-0.899	37
1.5-1.999	9			0.7-0.799	41
1.40-1.499	5			0.6-0.699	39
1.30-1.399	11			0.5-0.599	14
1.2-1.299	11			0.4-0.499	7
1.1-1.199	16			0.3-0.399	5
1.0-1.099	24			Under 0.300	3
	76		37		146

NOT MONITORED 106

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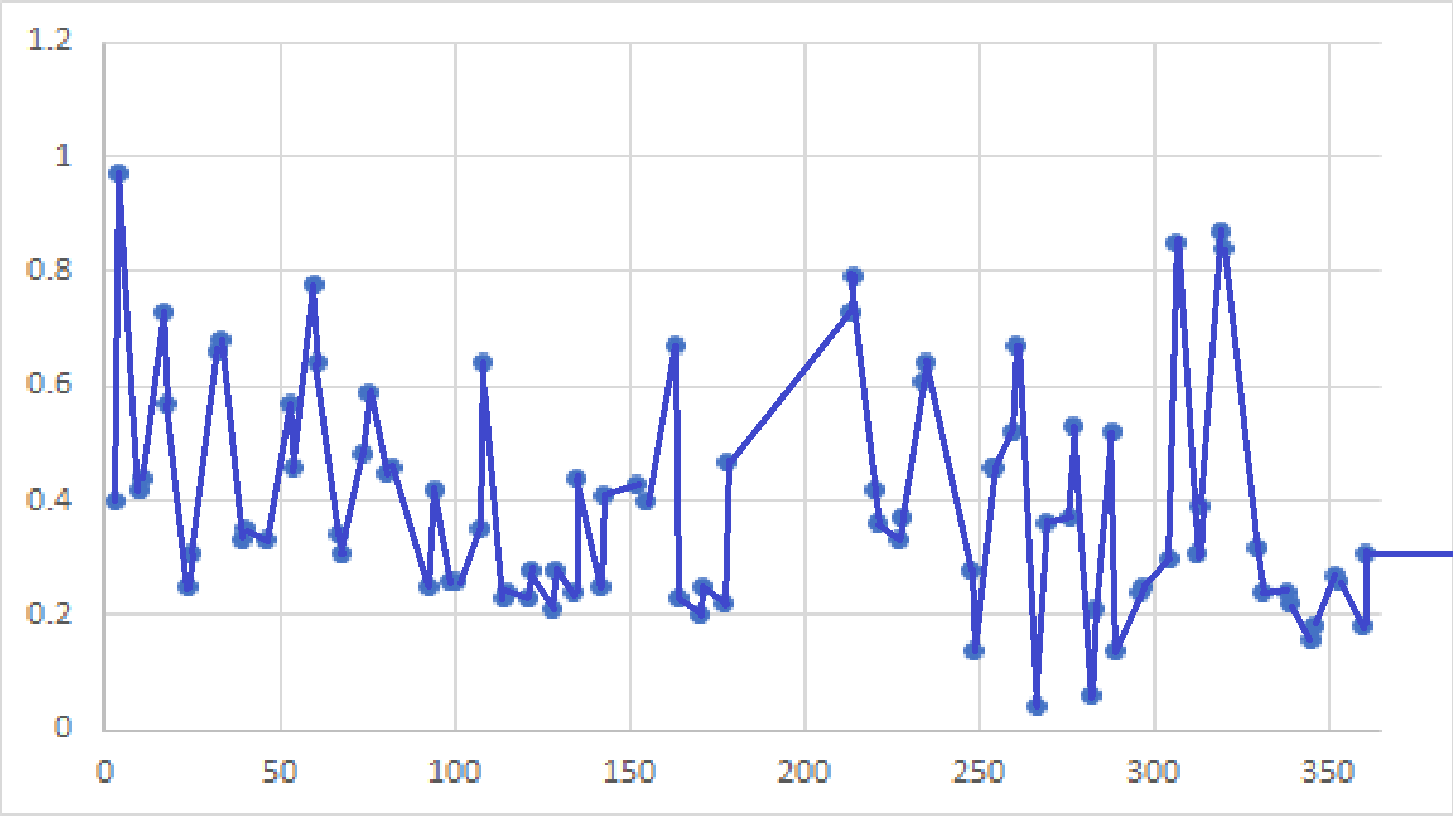
OHIO WWTP (CURRENT STATE)



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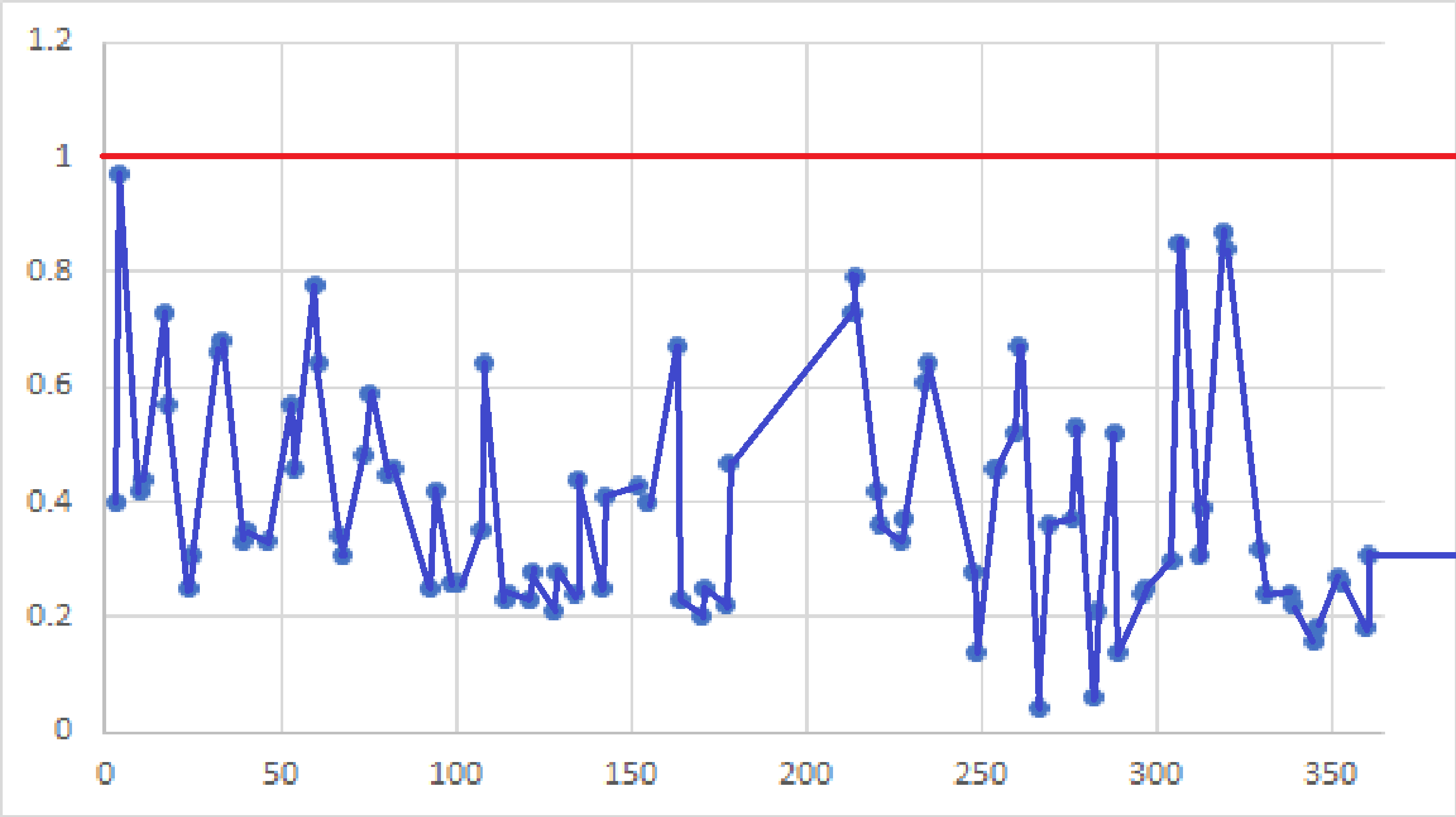

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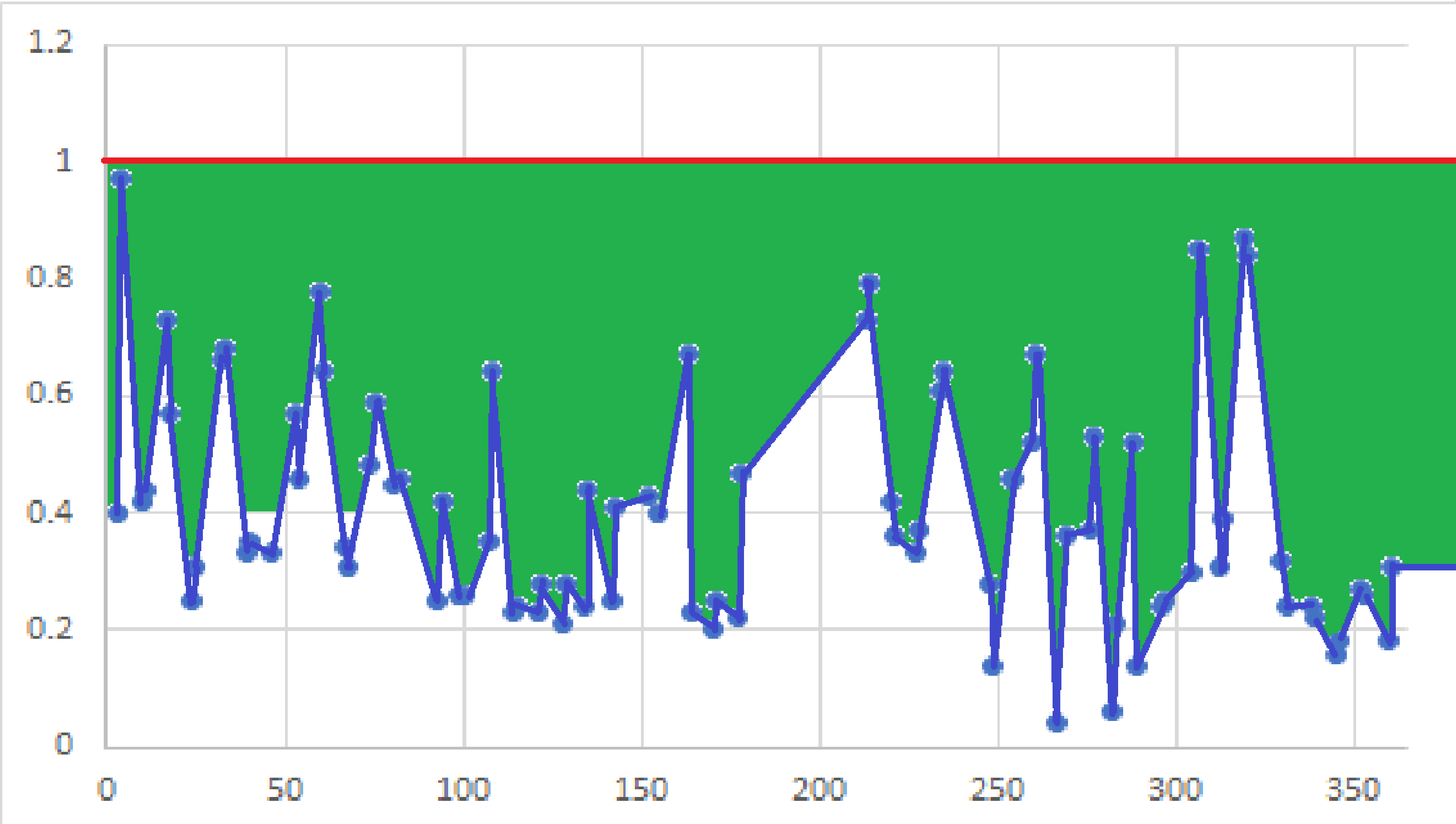

OHIO WWTP PHOSPHORUS LEVELS

Based on 2017 Data:

Phosphorus Discharge permit limit = 1.0 mg/l

Average discharge = 0.40 mg/l

(87 days sampled in 2017)

Alum Overfeeding cost

(based on 0.95 mg/l target)

$78,999.60

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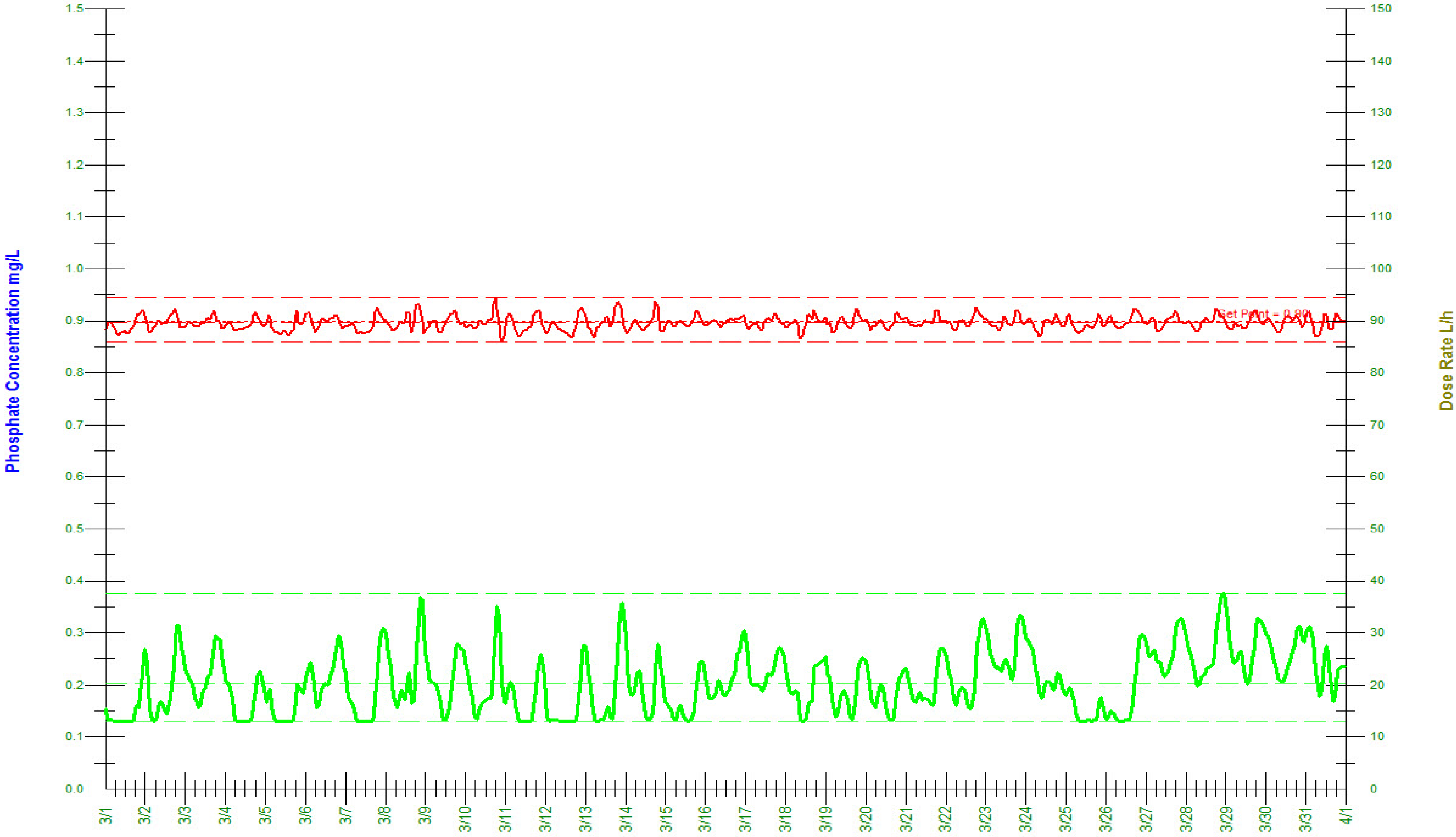
Beaver Dam, WI

5.6 MGD (Design) Activated Sludge Plant

City of 16,000 residents

Limit of 1.0 mg/L Set point of 0.9 mg/L
Never deviates outside of 0.85 – 0.95



Beaver Dam, WI

"If we were high one week, we overfed ferric to make sure the average for the month was below our 1.0 mg/L total phosphorus limit."

The average dose was 300 gpd at 12.5 gph.

Now during months of higher loading, the ferric feed rate may increase

from **3 gph to 10 gph**.

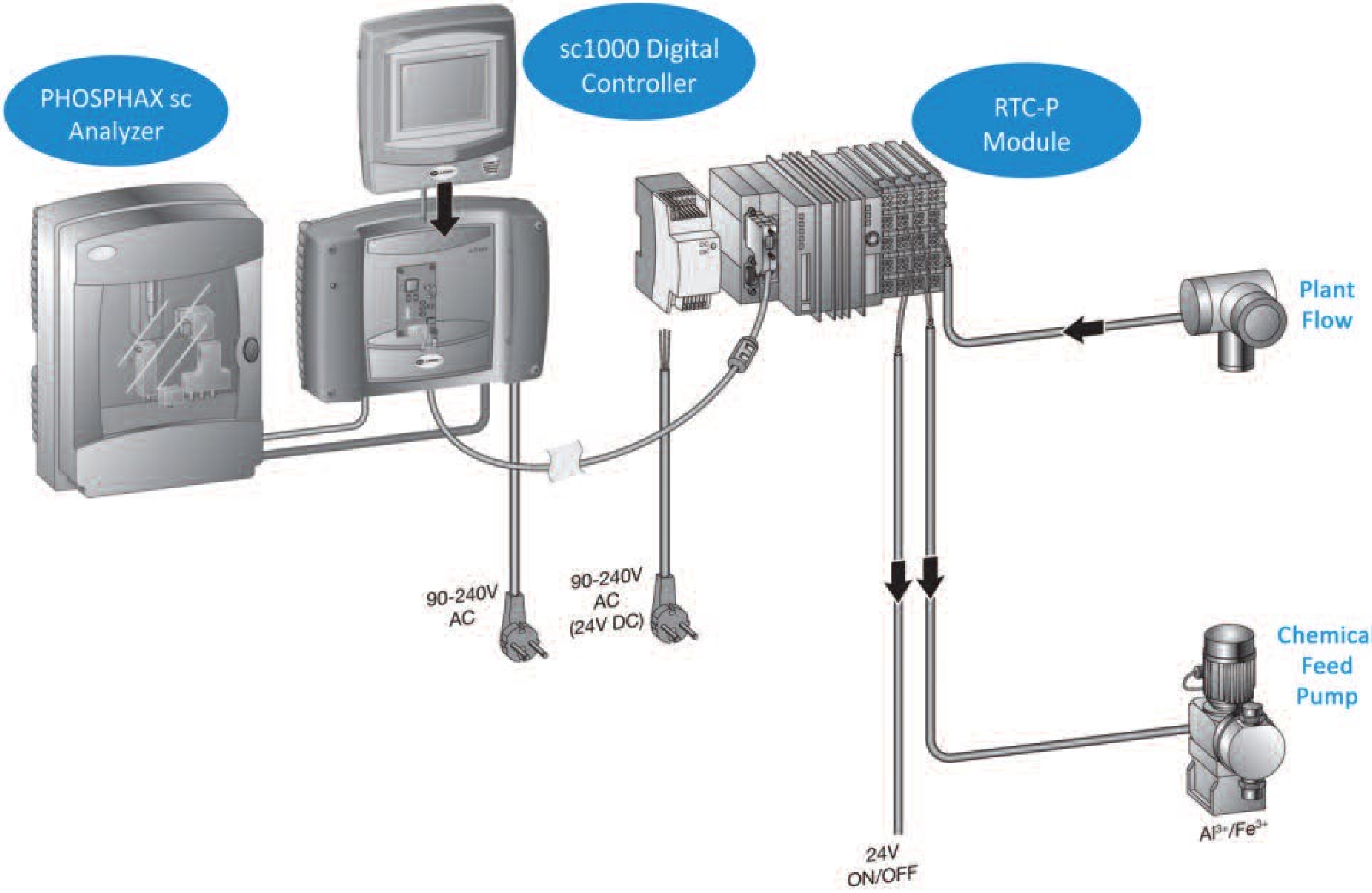
"Estimated annual savings of $50,000 to $70,000 have more than paid for the system."

Besides affordability, a major benefit was ***peace of mind***. Previously, staff worried about whether the plant was over or at its limit for the month. "Now, the RTC controls the dose and I know we will be within our limit,"

"it has worked flawlessly."

Rob Minnema, *Director or Utilities Beaver Dam, WI*

RTC1017P MODULE
REAL TIME PHOSPHORUS CONTROL SOLUTION



RTC-P

Components

PHOSPHAX sc + Filtrax

sc1000

- Controls RTC parameters
- Signal validation
- All communication capabilities

RTC

- Calculates set-points in real time
- Interface for dosing pump
- Install in PLC cabinet

Plant Flow

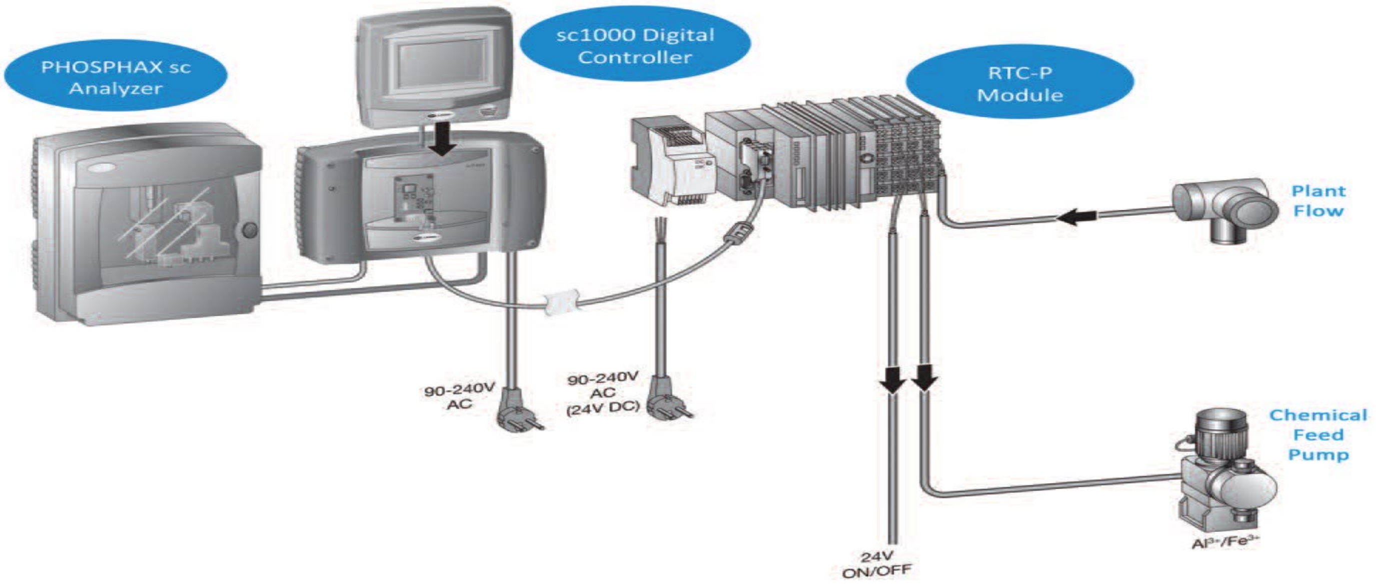
- Needed to determine loading

Dosing Pump

- Control pump feed of precipitant based on PO_4 concentration

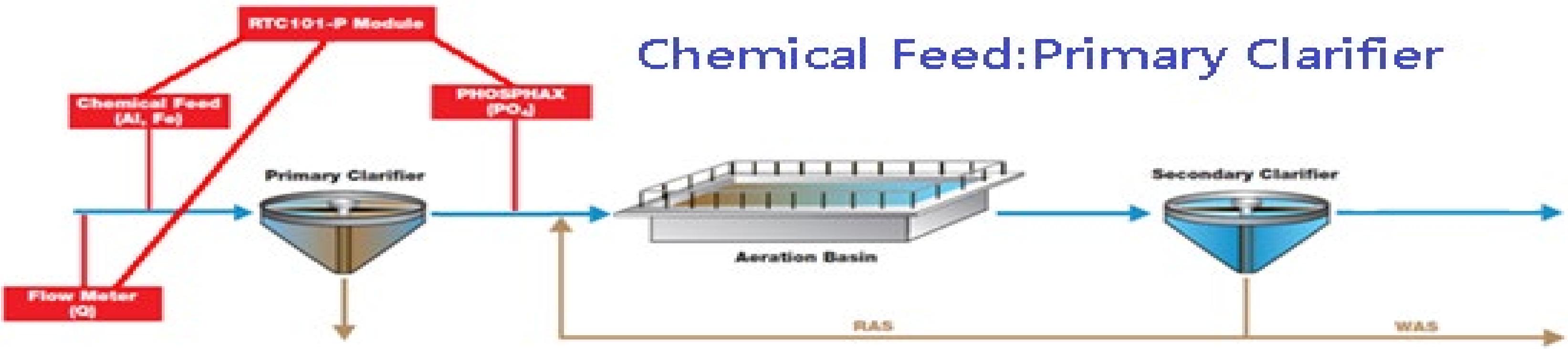
WHY HACH'S RTC FOR PHOSPHORUS CONTROL?

- Treatment Process is Optimized
  - Phosphorus load (Flow x Conc.) vs. Chemical effectiveness
- ROI is proven, can be switched between precipitants
- Cost savings can be redirected
- Compliance worries are gone
- Hach offers packaged integration!

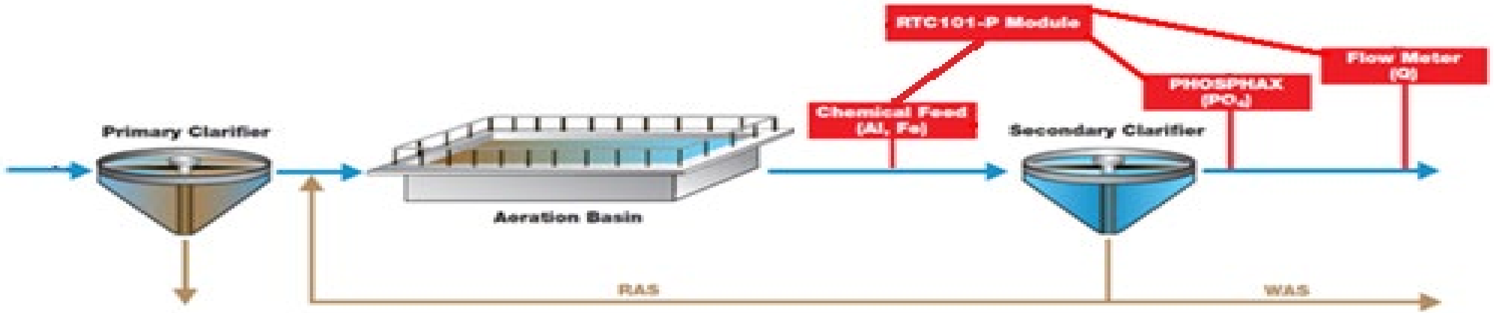


PO4-P PRECIPITANT CONTROL MODULE

Chemical Feed:Primary Clarifier



Chemical Feed: Secondary



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PHOSPHORUS ANALYZER– COLORMETRIC

- Sample Ranges
  - 0.0 – 2.0 mg/L PO4-P
  - 0.05 – 15.00 mg/L PO4-P
  - 1.0 – 50.00 mg/L PO4-P

Phosphax

- 5 – 120 minute measurement interval
  - Faster the interval…faster use of reagents

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SAMPLE CONDITIONING

FILTRATION MODULES

- The Filtration Module prepares sample through two ultra-filtration membranes (0.15 µ)
- Modules are immersed in the process tank.
- Peristaltic pump pulls the sample through one filter at a time, allowing for optimal cleaning.
- Unit automatically cleans by forcing vigorous stream of air bubbles against sides of the filter modules.

Filtrax sc

CONTROLLERS/TRANSMITTERS

sc1000

PROGNOSYS™ READY

Standard Features

- Highly configurable
- Up To 8 Sensors
- Plug And Play Functionality
- C1D2 Certification
- NEMA 4x/Ip66
- 4 Relays
- Up To 12 Ma Outputs
- Up To 12 Ma Inputs
- SD Card For Data log And Configuration
- Networking
- Allows Up To 32 Devices Per Network

Communication Options

- Modbus Rs232/Rs485
- Modbus TCP/IP
- Profibus Dp
- Hart 7.2

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PHOSPHORUS DOSING CONTROL DESIGN QUESTIONS

- Model based or feedback?
- Control or modelling/trending?
- How much Chemical is required to remove the Phosphorus?
- Control the pumps directly, or have a separate SCADA control loop?
- What if something else is limiting reaction?
- How to integrate sensor diagnostics into the controls?
- Who will train everyone on the system?
- How long will it take to write and test the logic?
- What if a sensor fails?
- How to store the data?
- Who will write the O&M Manual?
- Who will fix it if it breaks?

PHOSPHORUS DOSING CONTROL SOLUTIONS

Hach RTC-P Module	
1. What to measure & where	✓ Done
2. Can both model and/or control	✓ Done
3. Definition of control algorithms	✓ Done
4. Programming of control algorithms	✓ Done
5. Implementation on hardware	✓ Done
6. Testing of software and hardware	✓ Done
7. User interface	✓ Done
8. User manual	✓ Done
9. Backup stages	✓ Done
10. Communications interface	✓ Done
11. Data stored on IPC	✓ Done
12. Onsite & remote support	✓ Done
13. Setting of the plant-specific parameters	During commissioning

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CLAROS PROCESS MANAGEMENT

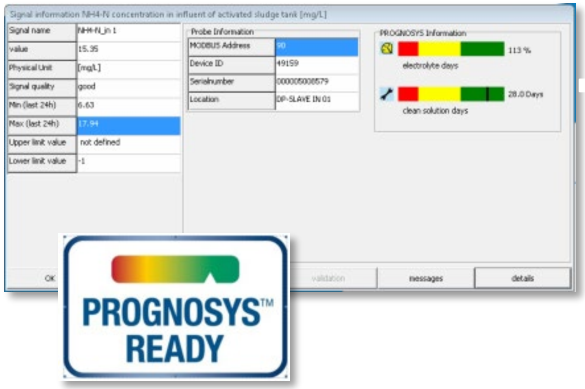
PROCESS MANAGEMENT

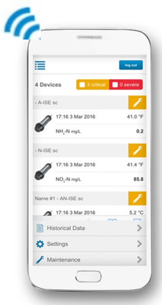
Standardized RTC control modules

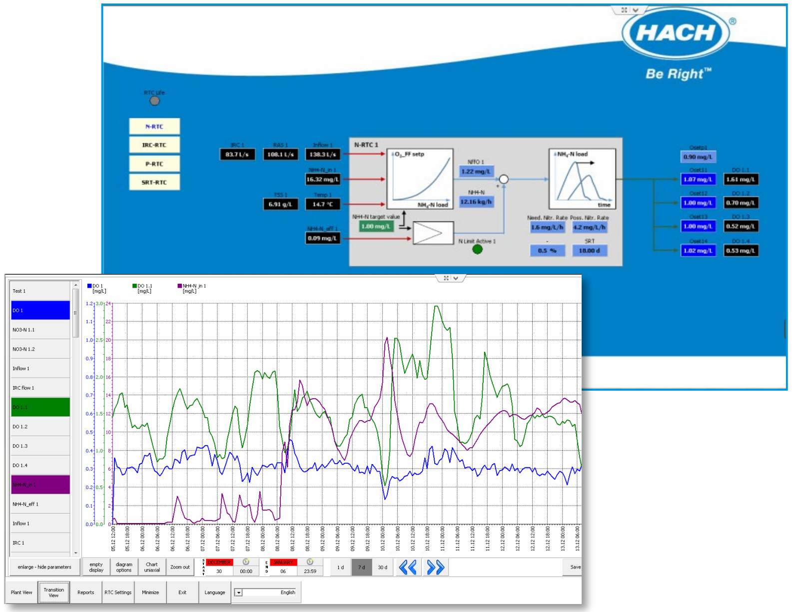
- Adapt asset plant operation to varying load situations and plant performance
  - Improved compliance (minimize risk)
  - Reduced OPEX / Short ROI (economically viable)
  - Improved process transparency

All analytical input signals **validated** by *Instrument Management* / PROGNOSYS®

- High reliability, high uptime



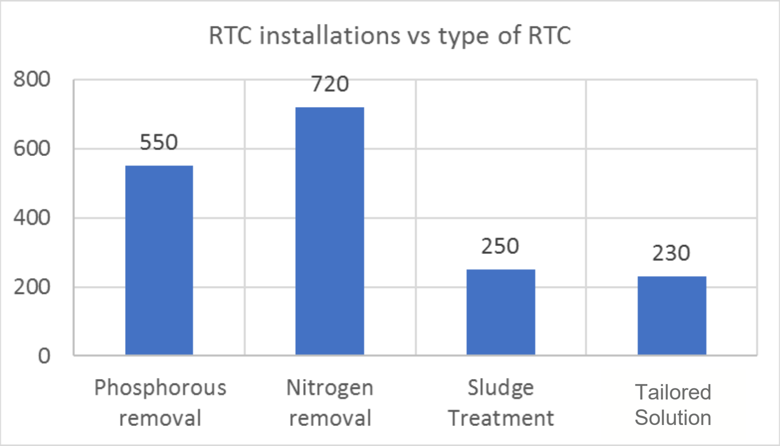




PROCESS MANAGEMENT EXPERIENCE

Large number of installations

- **1850 sites** in EU, US, China operating an RTC
  - 70 % of plants between 2-8 MGD
- **3150 control modules** in operation
- Growing number of industrial RTC



Experienced Global RTC Team

- Growing team of RTC consultants
  - 28 in EU, 5 in US
- Sales & Service NA: 250 associates
- Centralized (US and EU) RTC Service/Commissioning experts providing remote support & monitoring

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PROCESS MANAGEMENT RTC MODULES

Standardized modules for

- Nitrification / Denitrification
  - 10 - 20% aeration energy savings above conventional NH3 trim optimization
  - Improved alkalinity
  - Reduced denitrification in Secondary Clarifiers
- Chemical phosphorous removal
  - Savings on precipitant (10 - 50%) and sludge disposal
  - Process stability by reducing loss in alkalinity
- Sludge treatment
  - Savings on polymer (15 - 20%)
  - Increased gas yield (5 - 10%)
  - Less sludge disposal cost (10 - 15%)
  - Reduced maintenance work

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REAL TIME CONTROL MODULES

Type	RTC	Application	Compliance	Direct Savings on
Nutrient Removal	**P**	Chemical P-elimination	P_{tot}	- Precipitant - Sludge treatment /disposal
	N	Nitrification (plug flow)	NH_4-N	- Energy (aeration *intensity*)
	DN	Denitrification (IRC / Ext. C)	N_{tot}	- Energy (DO recovery, *IRC*) - External Carbon
	SZ	Swing zone adjustment	N_{tot}	- Energy (aerated *volume*)
	N/DN	Intermittent denitrification	N_{tot} NH_4-N	- Energy (aeration *time/volume,* DO recovery)
	OXD	Simultaneous denitrification		
	DO	Aeration	NH_4-N	- Energy (controlled DO)
	SF	Nitrification (step feed)	NH4-N	- Energy (aeration intensity)
	MOV	DO Control	NA	- Energy (aeration intensity)
Sludge Mgmt.	**SRT**	Sludge age	NH_4-N	- Energy (for BOD removal)
	ST	Sludge thickening		- Polymer, - Increased gas yield
	SD	Sludge dewatering		- Polymer - Sludge disposal
Industry	**DOS**	Nutrient dosing	N_{tot}, P_{tot}, NH_4	- Urea - Phosphoric acid
	DAF*1	Dissolved Air flotation	COD, TSS	- Coagulant, Polymer

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COMMITTED TO SUPPORT YOU FROM DESIGN TO OPERATION

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