Cloud-Based Solutions for Water Analytics

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Fontus Blue is focused on reducing uncertainty about the treatment processes, and improving outcomes for treated water quality and cost of treatment

Caleb Sprague

- The University of Akron
- 3 Years with Fontus
- ~40 WTP's: Modeling & optimization of treatment processes, DBP assessments, HAB general plans, + more...

Data-Command®

Data-Command provides cloud-based solutions to municipalities and industry to improve the compliance, security, and efficiency of their operations

Glenn King

- The University of Akron
- 25+ Years in Water Industry
- 35+ Years of Automation
- 40+ Years of Software Development Experience

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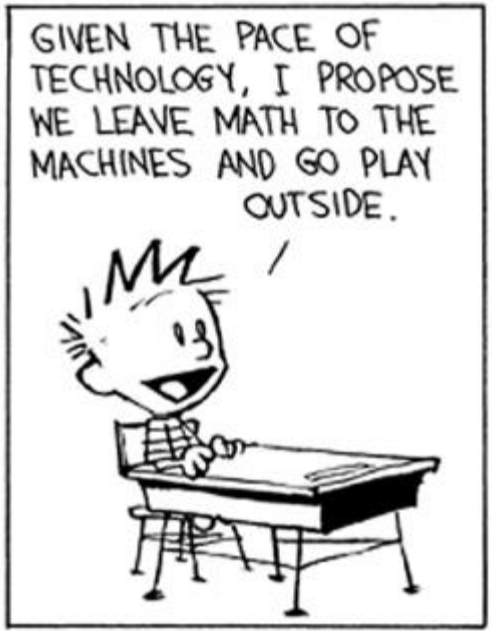
Overview of Presentation

- What is the Cloud?
- The WTP Cloud
  - What should the WTP Cloud do
  - Understanding Your Data Sources
- How to Build a WTP Cloud
  - Ingredients of a Cloud Solution (Secret Sauce)
  - Sending Data to the Cloud
  - Cloud Security, Availability and Reliability
  - User Experience
  - Putting it all together (The Recipe)
- Water Treatment Analysis on the Cloud
  - Why is this better in the cloud?
  - How do you get it there?
  - What does it look like?
- Conclusions
- Q&A



I am not a Caveman

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Entertainment

Online Banking

Search engines

The Cloud!

MILLIONS OF OTHERS

Social Media

Shopping

Travel

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Cloud Concerns

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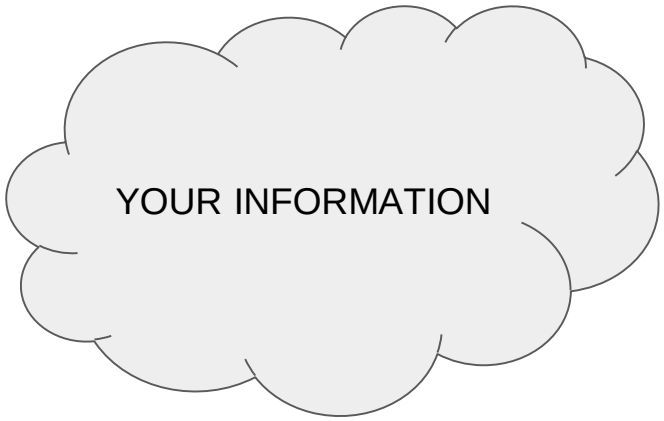
"Is my information safe, will it get lost or stolen?"



"Is my information floating around for anyone to take?"

"Once my data is in the cloud will it stay private."

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We ARE part of the cloud and we like IT!

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Watching Movies

NETFLIX IMDb

Rating Restaurants

yelp

Directions

Event Hours

facebook

A.I. & Algorithms

Helps with Decisions

Household Product reviews

amazon

Vacation

Tripadvisor

Flight Reservations

Expedia

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To Infinity and Beyond

Have Information

Personal Life!!!!

Work Life????

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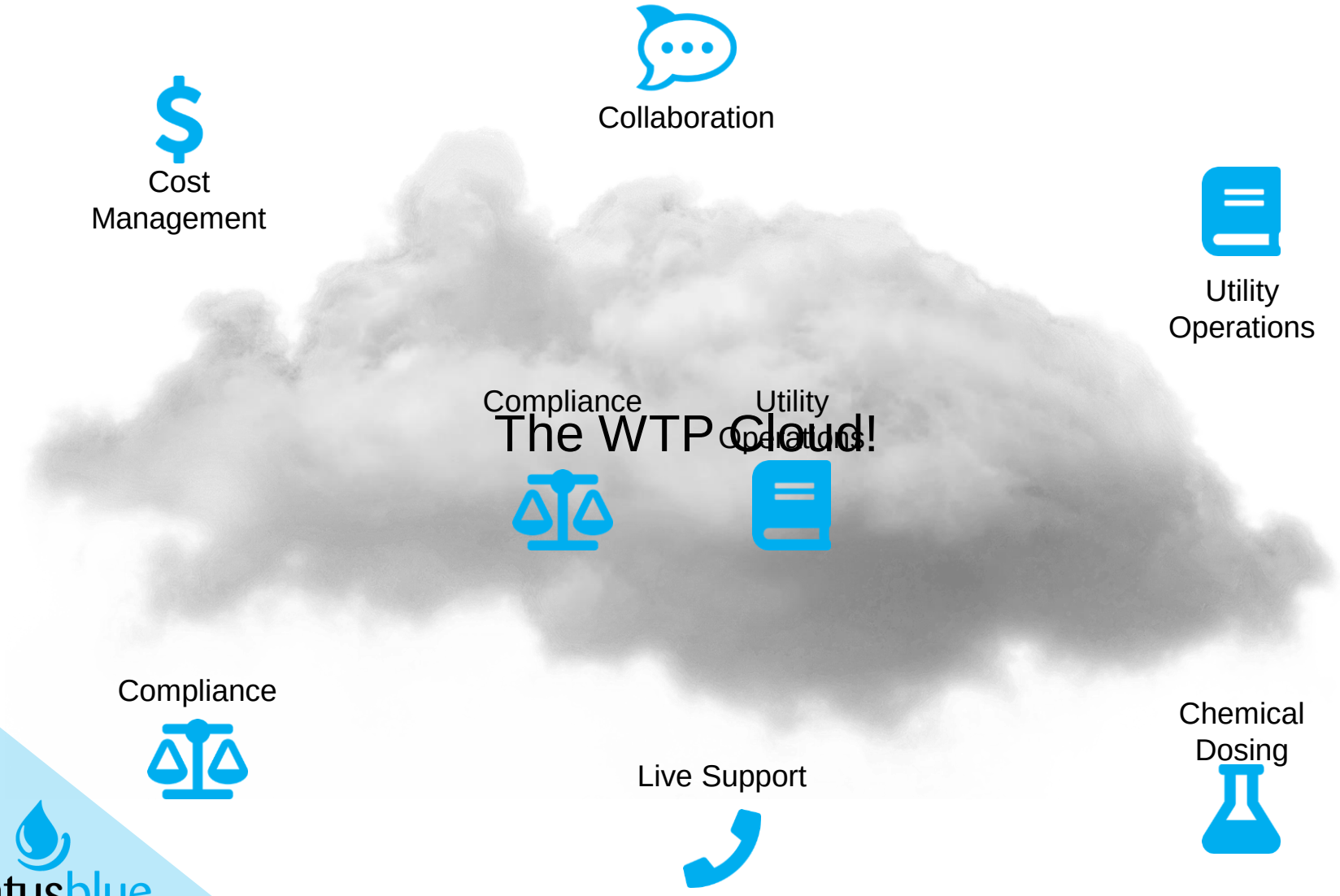
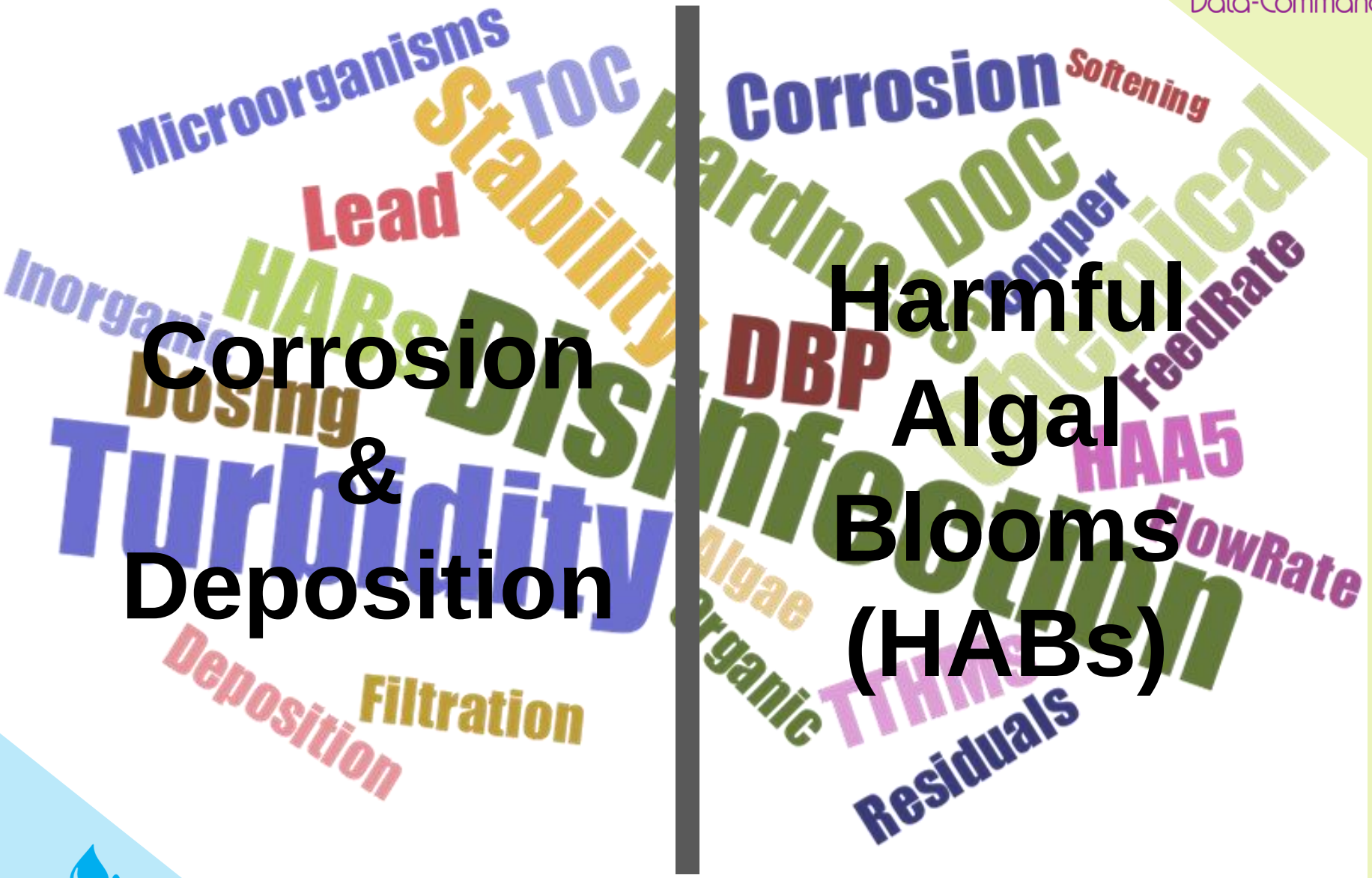
The Cloud and You





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Where do we find Insight?

Corrosion & Deposition

- Treatment Data
  - pH, alkalinity, hardness...
- Specialized Testing
  - Marble Test
- Data Analysis
  - LSI
  - CCPP

Harmful Algal Blooms (HABs)

- Treatment Data
  - pH, chlorine, temperature...
- Specialized Testing
  - ELIZA
  - qPCR
- Data Analysis
  - Oxidation Kinetics

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Using Cloud Power on Real Problems

Data to Analyze

Corrosion & Deposition

- Alkalinity
- Unsaturated Alkalinity
- Saturated Alkalinity
- Hardness
- pH
- Temperature
- Chloride
- Sulfate
- Phosphate Chemicals

Search "***AWWA WSO playlist***" on Google...

Harmful Algal Blooms (HABs)

- Microcystin
- Saxitoxin
- Anatoxin
- qPCR
- Phycocyanin
- Chlorophyll-a
- Geosmin & MIB
- Temperature
- pH
- Hydraulics (Flow rates, time)
- Pre-Oxidants (Ex. KMnO4)
- Chlorine
- Activated Carbon

Using Cloud Power on Real Problems

Data Sources: *Internal Lab / Chemical Inventory*

Corrosion & Deposition

- ***Alkalinity***
- ***Unsaturated Alkalinity***
- ***Saturated Alkalinity***
- ***Hardness***
- ***pH***
- ***Temperature***
- Chloride
- Sulfate
- ***Phosphate Chemicals***

Harmful Algal Blooms (HABs)

- Microcystin
- Saxitoxin
- Anatoxin
- qPCR
- ***Phycocyanin***
- ***Chlorophyll-a***
- ***Geosmin & MIB***
- ***Temperature***
- ***pH***
- Hydraulics (Flow rates, time)
- ***Pre-Oxidants (Ex. KMnO4)***
- ***Chlorine***
- ***Activated Carbon***

Using Cloud Power on Real Problems

Data Sources: *External Lab*

Corrosion & Deposition

- Alkalinity
- Unsaturated Alkalinity
- Saturated Alkalinity
- Hardness
- pH
- Temperature
- ***Chloride***
- ***Sulfate***
- Phosphate Chemicals

Harmful Algal Blooms (HABs)

- ***Microcystin***
- ***Saxitoxin***
- ***Anatoxin***
- ***qPCR***
- ***Phycocyanin***
- ***Chlorophyll-a***
- ***Geosmin & MIB***
- Temperature
- pH
- Hydraulics (Flow rates, time)
- Pre-Oxidants (Ex. KMnO4)
- Chlorine
- Activated Carbon

Using Cloud Power on Real Problems

Data Sources: ***Automation System***

Corrosion & Deposition

- Alkalinity
- Unsaturated Alkalinity
- Saturated Alkalinity
- Hardness
- ***pH***
- ***Temperature***
- Chloride
- Sulfate
- ***Phosphate Chemicals***

Harmful Algal Blooms (HABs)

- Microcystin
- Saxitoxin
- Anatoxin
- qPCR
- ***Phycocyanin***
- ***Chlorophyll-a***
- Geosmin & MIB
- ***Temperature***
- ***pH***
- ***Hydraulics (Flow rates, time)***
- ***Pre-Oxidants (Ex. KMnO4)***
- ***Chlorine***
- ***Activated Carbon***

Using Cloud Power on Real Problems

Data Sources: ***External Party Data (GLOS)***

Corrosion & Deposition

- Alkalinity
- Unsaturated Alkalinity
- Saturated Alkalinity
- Hardness
- pH
- Temperature
- Chloride
- Sulfate
- Phosphate Chemicals

Harmful Algal Blooms (HABs)

- Microcystin
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- ***Phycocyanin***
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- ***Temperature***
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- Hydraulics (Flow rates, time)
- Pre-Oxidants (Ex. KMnO4)
- Chlorine
- Activated Carbon

Now we have The whole picture

Building The whole picture

Lots of Data from lots of different sources, stored in a lot of different locations

The Cloud!

- Plant Automation and SCADA
- Water Tanks for other communities
- External Data Sources (NOAA, GLOS)
- External Lab Data (Alloway)
- Internal Lab / Chemical Inventory
- Contacts/Employee Info
- Lift Station Information
- Multiple plants feeding the same system
- Distribution Samples, MORs And more...

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The Secret Sauce

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Ingredients need to create a cloud base solution

1. A lot of Data!
2. A world class cloud service providers
3. Delivering an awesome user experience
4. Deep knowledge of security
5. Enhance the solution with partners

3 biggest Cloud service provider:

1. Microsoft Azure
2. Amazon Web Services (AWS)
3. Google Cloud Platform

Developer Requirements:

1. Passion
2. Skills
3. Multitude of languages to include: HTML5, XML, asp.net, java, angular, postgres, SQL, APIs, C++, Visual basic

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Some Acronyms and Terms to Know

PLC-Programmable Logic Controller

Brains of the process controls

SCADA-Supervisory Control And Data Acquisition

Communications with PLC network for Visualization, Setpoint changes and Data Storage

Plant Automation platform

The network of PLCs, SCADA, Historians, Dedicated Network Switches...

OT-Operation Technology

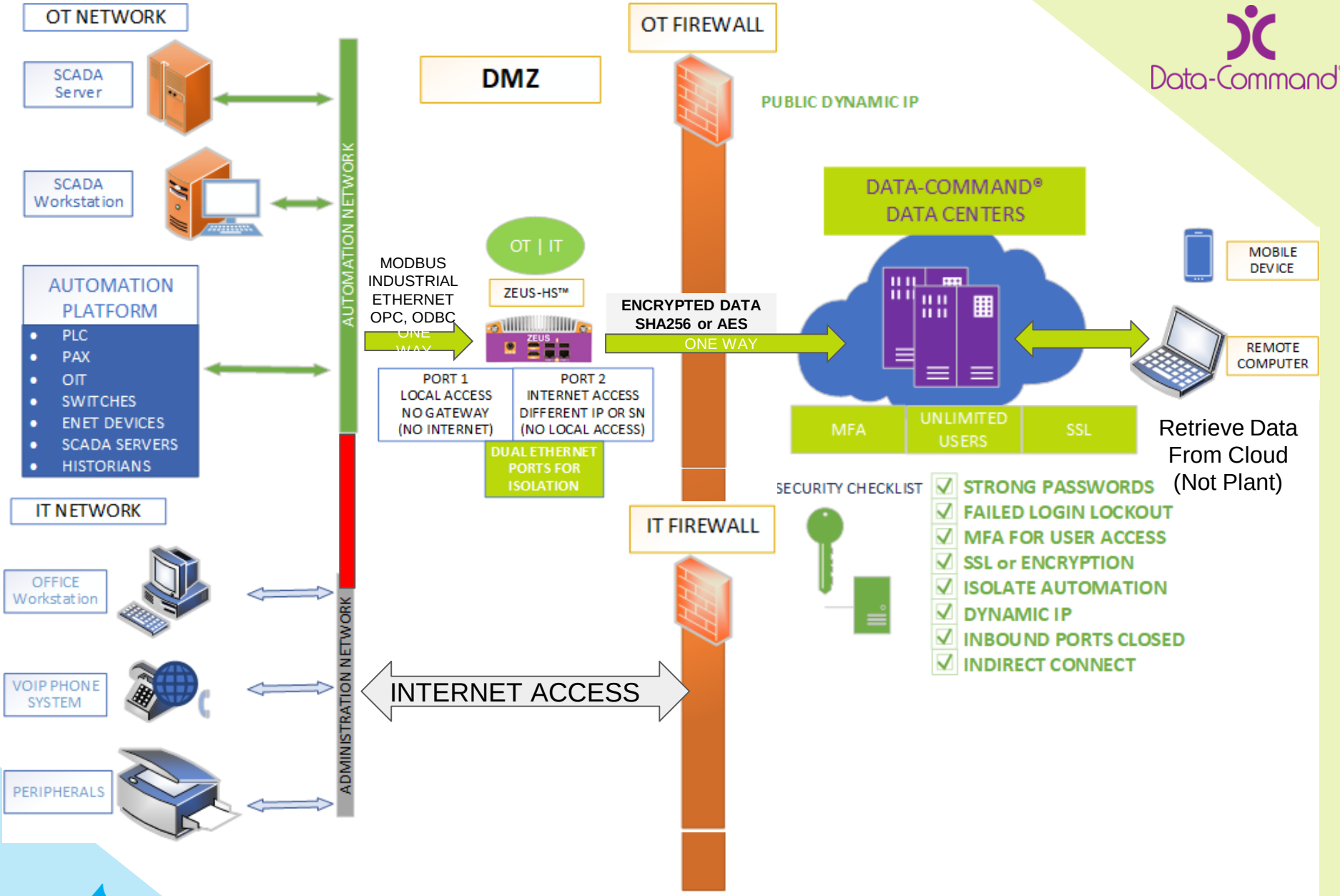
Plant Automation platform network

IT-Information Technology

Administrative Network (Office computers, email, printers, phones, cameras…)

DMZ-DeMilitarized Zone

Internal network meets an untrusted network such as the Internet



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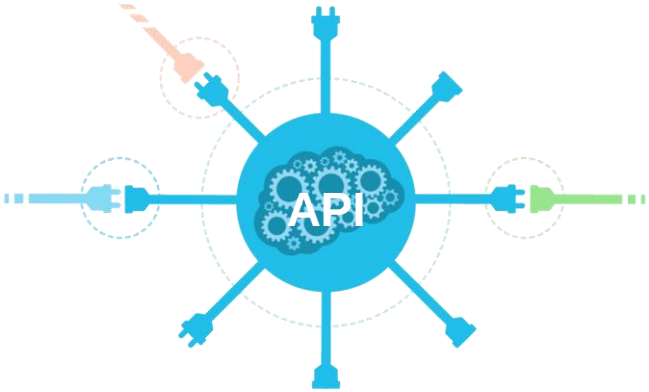
Information from Plant Automation

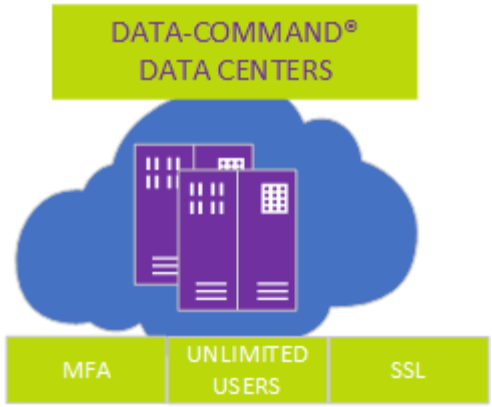
Many Other Data Sources

- Manual Data entry for Ancillary information not collect by the SCADA
  - Chemical Inventory sheets
  - Lab Bench sheets entered into an electronic solution must include chain of Custody
    - User tracking
    - Change management
    - Auditing
- Connecting to external websites and sources
  - RESTful API (Application Program Interface) (GLOS, NOAA)
  - SOAP (Simple Object Access Protocol) (obsolete)



Security/Reliability/Availability

- Data Packet Encryption through a Secure Hash Algorithm like SHA256, AES or better
- Browser Encryption through SSL (Secure Socket Layer) - The lock in the address bar of favorite web browser
- Individual User login and strong passwords
- Multi-Factor Authentication for each user device
- Geo Replication for Data backup and integrity
- High Availability-through the combination of highly redundant hardware with clustered software.



THE 9's

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Availability %	Downtime per year[note 1]	Downtime per month	Downtime per week	Downtime per day
55.5555555% ("nine fives")	162.33 days	13.53 days	74.92 hours	10.67 hours
90% ("one nine")	**36.53 days**	**73.05 hours**	**16.80 hours**	**2.40 hours**
95% ("one and a half nines")	18.26 days	36.53 hours	8.40 hours	1.20 hours
97%	10.96 days	21.92 hours	5.04 hours	43.20 minutes
98%	7.31 days	14.61 hours	3.36 hours	28.80 minutes
99% ("two nines")	**3.65 days**	**7.31 hours**	**1.68 hours**	**14.40 minutes**
99.5% ("two and a half nines")	1.83 days	3.65 hours	50.40 minutes	7.20 minutes
99.8%	17.53 hours	87.66 minutes	20.16 minutes	2.88 minutes
99.9% ("three nines")	**8.77 hours**	**43.83 minutes**	**10.08 minutes**	**1.44 minutes**
99.95% ("three and a half nines")	4.38 hours	21.92 minutes	5.04 minutes	43.20 seconds
99.99% ("four nines")	**52.60 minutes**	**4.38 minutes**	**1.01 minutes**	**8.64 seconds**
99.995% ("four and a half nines")	26.30 minutes	2.19 minutes	30.24 seconds	4.32 seconds
99.999% ("five nines")	**5.26 minutes**	**26.30 seconds**	**6.05 seconds**	**864.00 milliseconds**
99.9999% ("six nines")	**31.56 seconds**	**2.63 seconds**	**604.80 milliseconds**	**86.40 milliseconds**

Water is always flowing. Is your data?

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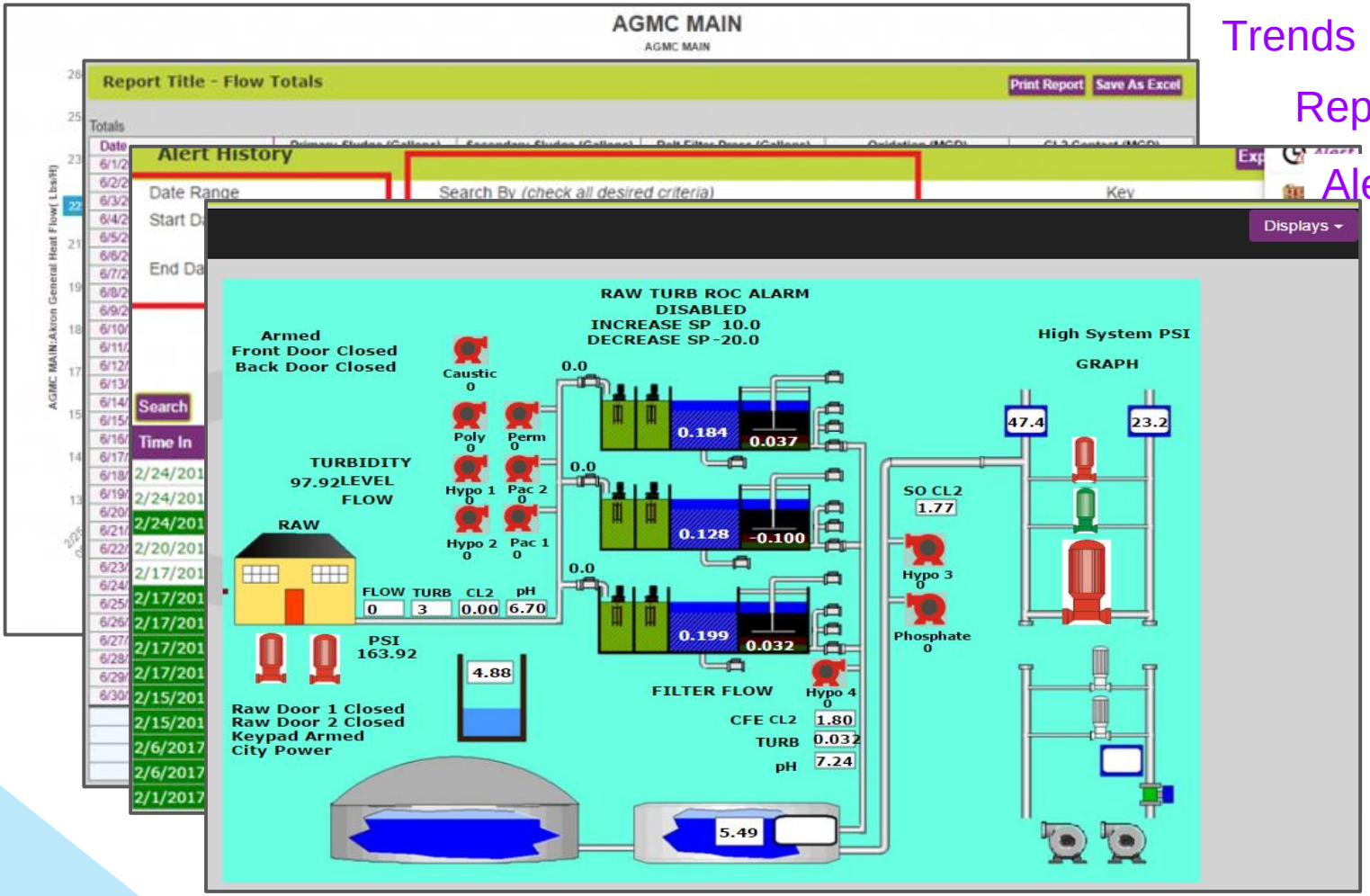
User Friendly Information Presentation



Trends

Reports

Alert History

Displays

The Recipe

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Your WTP

LAB DATA

SCADA

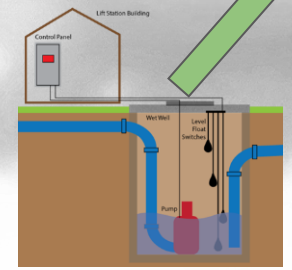
Other Municipalities

External LAB DATA

Azure, AWS, Google Cloud Services

Http Https

Lift Stations



NOAA

GLOS

Partner Solutions

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The Recipe

- Constantly update the user experience
- Allow municipalities to collaborate, intact and benefit from other municipality's Information
- Establish great Partnerships for products and services like analytics

Key Performance Indicators

Overall Understanding

Why

- **Complex & complicated issues**
- **Variable water / chemistry**
- **Issues are often too Labor and Time intensive**

How

- **Leverage aggregated cloud data**
- **Single Measure or Calculated from Multiple**
- **Visual and Intuitive User Interface**

What

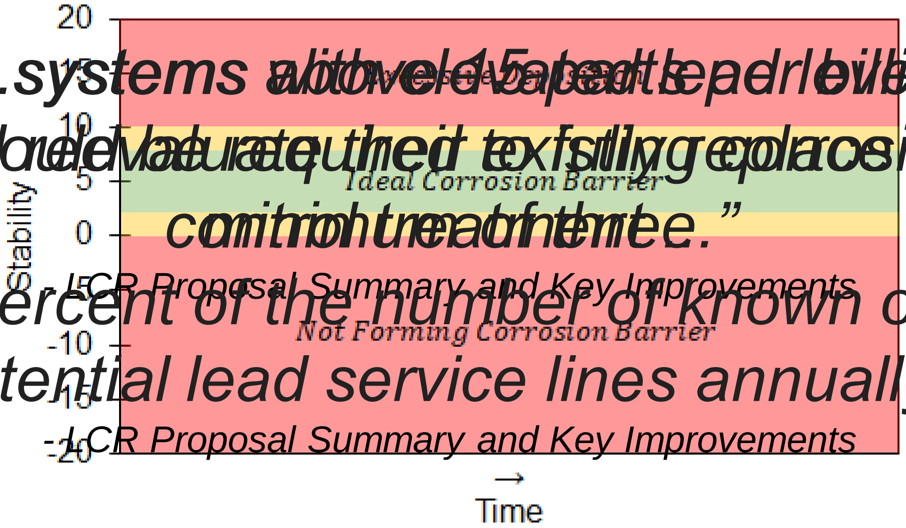
- ***Specific Insights that Reduce Uncertainty around a Focus Issue***

Key Performance Indicators

Corrosion & Deposition KPI's

Why

- **Health impact for children & adults**
- **Pipe Failure and Performance - Economics**
- **Complicated chemistry**
- **Insight into a variable process**
- **Problems on both ends...**



"...systems

percent of the number of known or potential lead service lines annually

- LCR Proposal Summary and Key Improvements

- LCR Proposal Summary and Key Improvements

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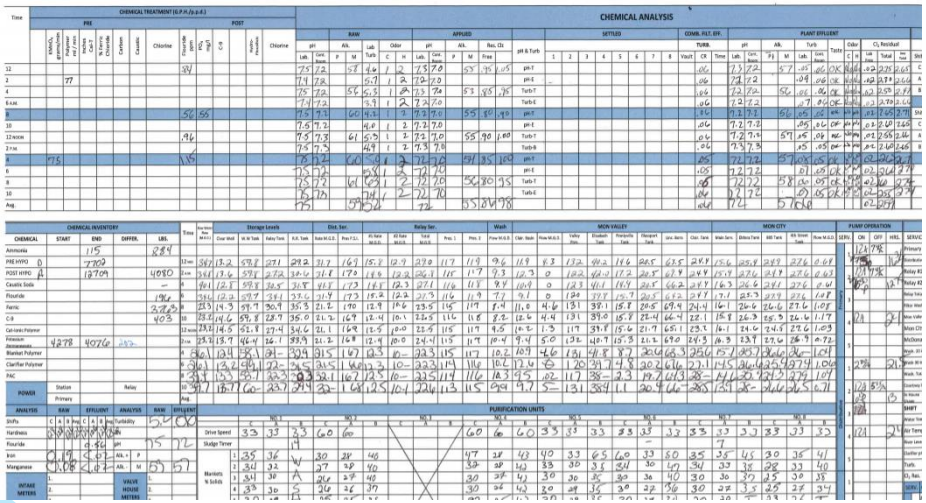
Key Performance Indicators

Corrosion & Deposition KPI's

The Difference

- Leverage aggregated cloud data
- Single Measure or Calculated from Multiple
- Visual and Intuitive User Interface



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Key Performance Indicators

Corrosion & Deposition KPI's

The Difference

Marble Test

$$CCPP = Unsat.Alk - Sat.Alk$$

- Low frequency lab tests
- Qualifying metric (negative, zero, positive)

Simulated CCPP

$$CCPP = 50045 * \frac{t_{eq}}{p_{eq}}\left[\left(\left(\frac{TALK_i + s_i}{t_i}\right)p_i + s_i\right) - s_{eq}\right] + s_{eq}$$

- Daily lab bench inputs
- Quantifying metric (*how* negative, zero, *how* positive)

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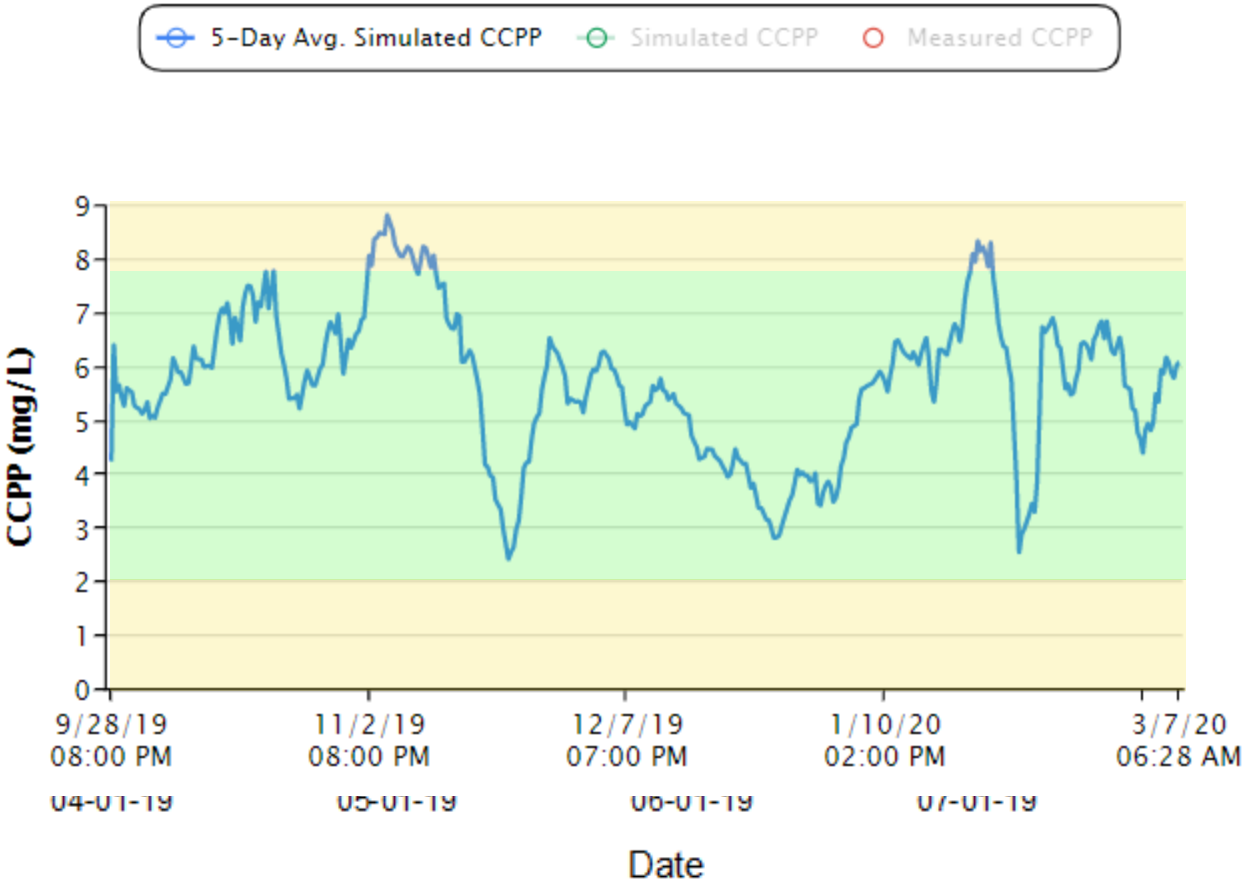
Key Performance Indicators

Corrosion & Deposition KPI's

The Difference



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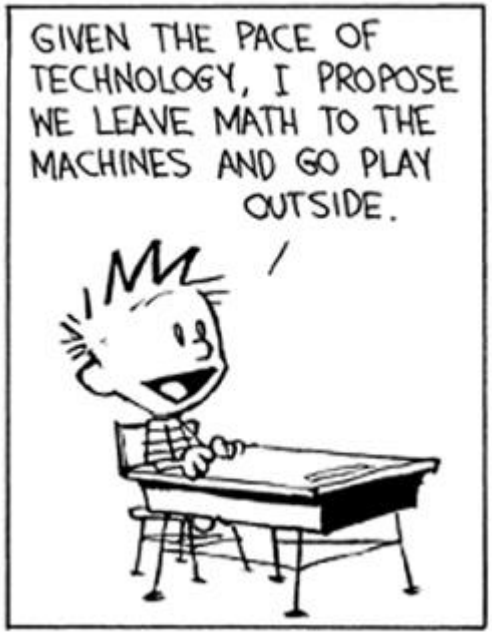
Cloud Workflows



- Aggregating Data Sources
- Turn Raw Data to Insights
- Alerts & Notifications
- Track Operator Logs
- Auditing and Reporting

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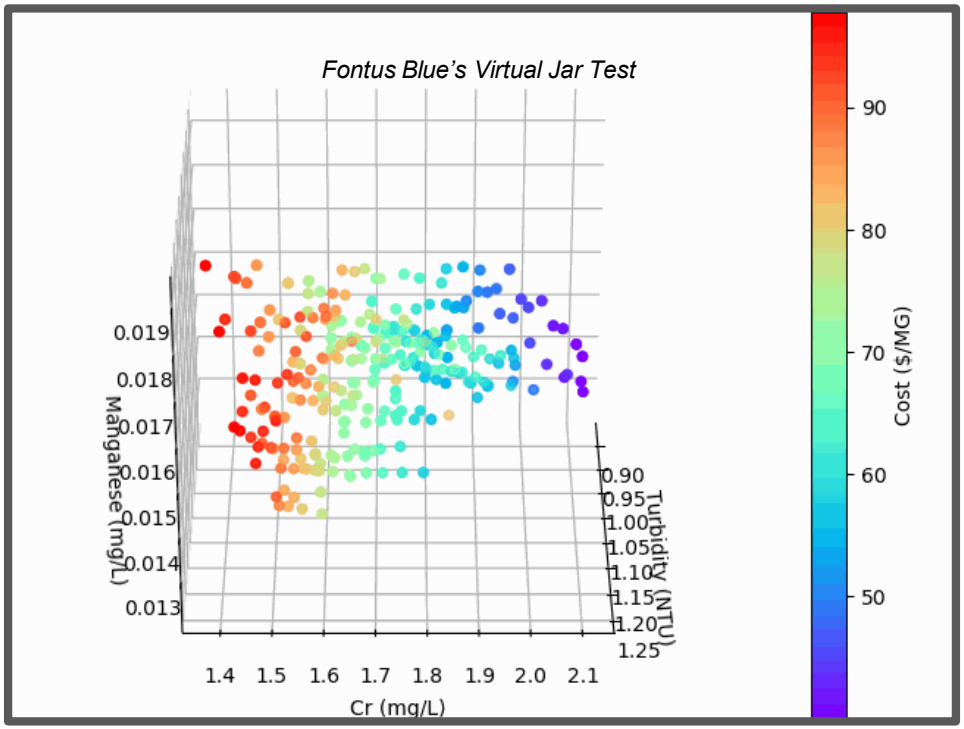
Building a Bright Future in the Cloud

Water Quality Forecasting
Artificial Intelligence
Stress Test Simulations
Cost & Quality Optimal Chemical Dosing



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Summary/Conclusion

Advantages of Cloud-based

- Access from any location/Remote access to information
- Aggregation of data from many different data sources
- User experience updates and upgrades are part of solutions
- Costs of system aggregate amongst many municipalities
- Many things are virtually impossible to achieve through an on premise solution

Cloud-Based Solutions for Water Analytics

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Questions?