



The After-Crisis Components of Training Modules for Flint, MI Operators

Nick Pizzi

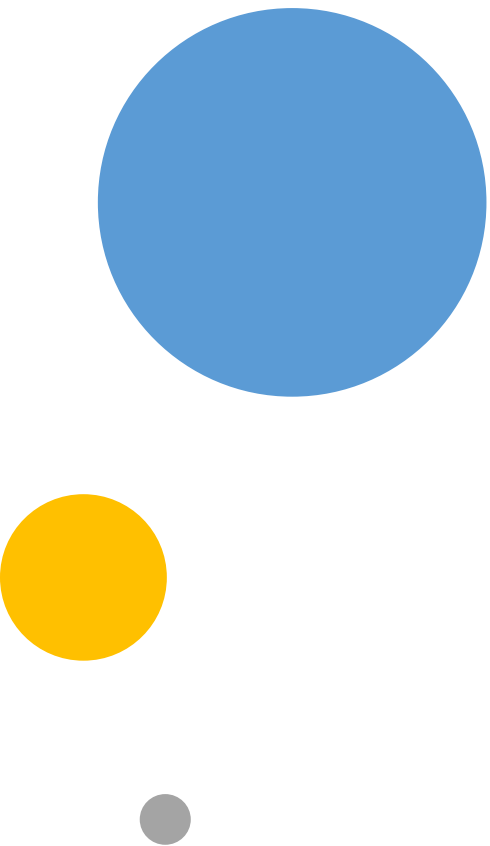
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Presentation Overview

- Flint Timelines
- Training Issues
- Flint WTP Status Pre- and Post- Disaster
- Training Scope Changes
- Conclusions





Flint Timelines

What led to the
need for training in
Flint
How and why the
training scope
evolved over time

Brief History of the Flint Crisis

- April 2014 – After decades of buying finished water from Detroit, and in anticipation of getting raw source water from Lake Huron to treat, Flint stops buying finished water from the Detroit system before the Huron raw water was available
 - The Detroit water source is Lake Huron
 - Flint had been using this water since the 1960's
 - It was treated with orthophosphates since the 1990's
- Unwilling to wait for Huron water, Flint started up its WTP and delivered the water into the distribution system
 - Flint WTP used the Flint River as its source
 - System chemistry changed because:
 - Flint River was high in chlorides
 - Flint operators were using Ferric Chloride
 - Flint did not treat with orthophosphate

Some Consequences of the Crisis

- The treated Flint River water begins to dissolve the insides of the distribution pipes and residents' home plumbing
 - Lead levels in samples from homes skyrocket
 - Children's blood Lead levels double in many cases
 - Taste and odor complaints are coming from most of the system
 - Yellow to brown colored water is found in thousands of homes
 - Tests for coliforms show many positive results
 - An outbreak of Legionnaire's Disease kills at least 12 people
- After 18 months - In October 2015 - Flint reconnects to Detroit under USEPA order
- Flint prepares to treat source water from Huron and plans upgrades for the WTP

There were Two After- Crisis Concurrent Governmental Imperatives

1. The USEPA issues an Emergency Administrative Order
 - EPA made responsible for guiding Flint back into compliance
2. The Governor of Michigan appoints the Flint Water Advisory Task Force (FWATF)
 - Task Force is made responsible for making recommendations to the Governor for crisis remediation

United States Environmental Protection Agency Issues the EMERGENCY ADMINISTRATIVE ORDER

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT AND COMPLIANCE ASSURANCE
WASHINGTON, D.C.

IN THE MATTER OF: : Proceedings Pursuant To
: : Section 1431 of the Safe Drinking
City of Flint, Michigan; Michigan : : Water Act, 42 U.S.C. § 300i
Department of Environmental : :
Quality; and the State of Michigan, : : EMERGENCY
Respondents. : : ADMINISTRATIVE ORDER

Date

1/21/16



CYNTHIA GILES
Assistant Administrator
Office of Enforcement and Compliance Assurance
United States Environmental Protection Agency
William Jefferson Clinton South Building
1200 Pennsylvania Avenue N.W.
Washington, DC 20460

- The 18-page EAO lumps together the State of Michigan (State), The Michigan Department of Environmental Quality (MDEQ) and the City of Flint (City) – AKA “The Respondents”
- EAO requires many changes and milestones. Among them are:
 - Flint must replace all Lead service lines
 - Flint must add additional phosphates to supplement that which is in Detroit water
 - Flint must re-start the plant when Lake Huron-KWA water is made available, and perform a 90-day test period to prove treatment viability

Paragraph 61 of USEPA Order

“Within 15 days of the effective date of this Order, the City must demonstrate, and the MDEQ and the State must ensure, the City has the necessary, capable, and qualified personnel required to perform duties and obligations to ensure the PWS complies with SDWA and the NPDWRS.”

Flint Water Advisory Task Force

Commissioned by the MI Governor

“While the cascade of poor decisions, failures, and indifference in Flint was startling and ultimately heartbreaking, we cast it as an anomaly at our peril, and the peril of those whose health we serve to protect.”

“THE ISSUES IN FLINT WILL BE LONG-LASTING LOCALLY, BUT THE SITUATION ALSO HAS FAR-REACHING IMPLICATIONS FOR THE WATER UTILITY INDUSTRY AS A WHOLE.”

Governor's Water Advisory Task Force Recommendations

- **The report issues 36 findings and 44 recommendations in early 2016**
 - The Governor makes the recommendations mandatory for State agencies
 - FWICC sub - committees are formed - 1 am appointed to one of them – we are assigned following:
- **R2 (MDEQ)** - “Establish an apprenticeship/certification program for MDEQ, ODWMA, and employees that requires direct, hands-on experience with public water system operations. MDEQ, ODWMA, and employees responsible for water system regulation and Safe Drinking Water Act enforcement should be, or have access to, certified operators and subject matter experts”
- **R23 (City of Flint)** – “Establish and fund a team of Subject Matter Experts in water system operations to support and train water system personnel, guide safe system operation under current conditions, and prepare for successful conversion to KWA” (source water)
 - As mentioned, a 90 day test period will be required by USEPA once KWA Lake Huron Water arrives



Training Issues

Operator Training as it relates to Flint

Explaining My Involvement with Flint Issues

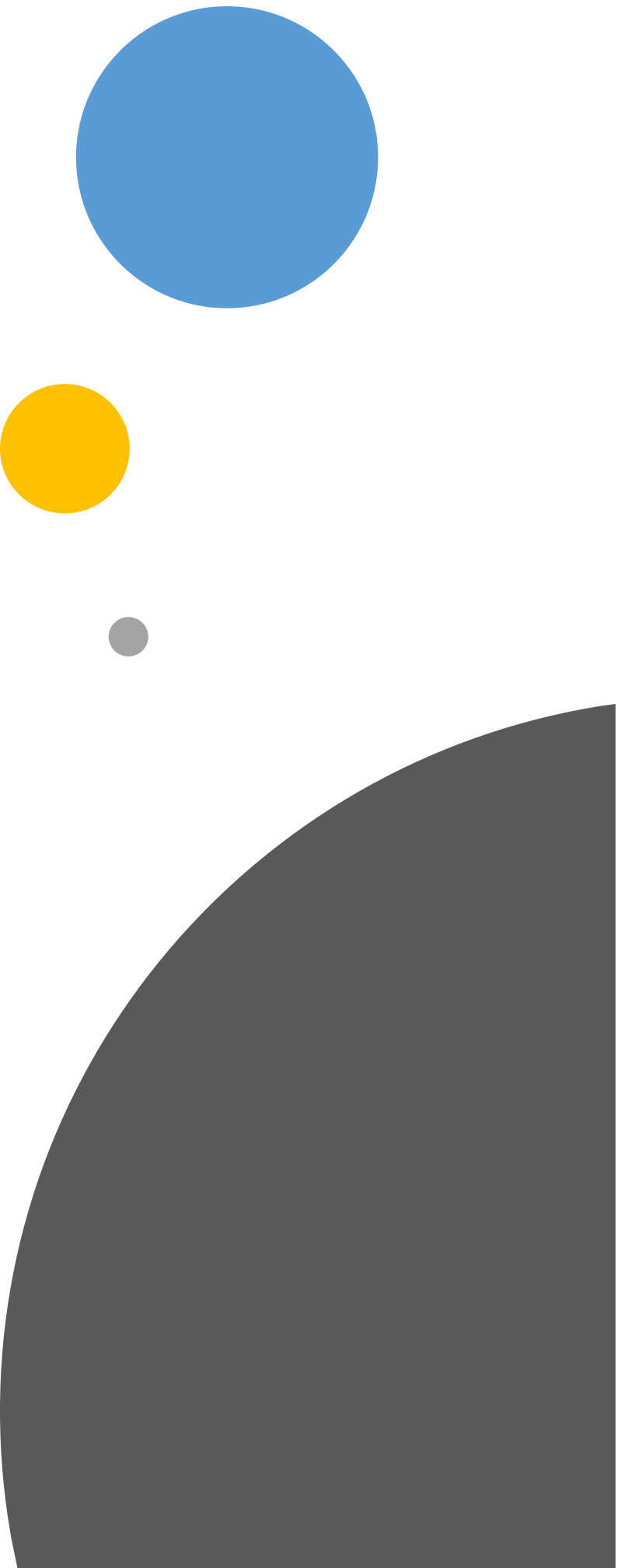
- In March of 2016, I was working as a member of the FWICC sub-committee whose purpose is to assist MDEQ and the City with FWATF recommendations
- In September of 2016, I entered into a contract with the MDEQ to provide “Operator Trainer” services
 - The contract states: “Provide training and advisement for all staff, including operators and managers, involved in the City of Flint drinking water operations”
- I begin teaching classes to a group comprised of MDEQ staff and Flint WTP operating staff
 - I make a verbal commitment to be on site during the USEPA mandated 90-day test period for plant startup when KWA water is available to be treated
 - I begin to teach filtration, rapid mix and flocculation and associated coagulant use, and sedimentation, and produce an EPA-mandated SOP for the WTP. We perform jar-tests in class on our likely treatment scenario
- But in early 2017, Flint decides to scrap the idea of treating KWA water and signs a long term contract with GLWA (Detroit) for its water supply, and Michigan DEQ reclassifies the Flint WTP from “F” to “D”

My Thoughts on Operator Training

- Operator Training - important management component found at successful water systems
 - It can prepare operators for unit process control steps – setting goals, SOPs
 - It provides a sense of responsibility to operators by helping them understand their contribution to the overall health of their community
 - It can break down the parochial operational habits that can develop at a Utility
 - It can foster a sense of “team” – working together to be the best at what they do
 - It can remove fear of failure
 - It can help operators pass certification exams which may lead to better pay
 - It helps identify future leaders – and future shift operators
- Lack of operator training can be a cause of problems that can lead to non-compliance and disaster

Flint Plant Manager View of Operator Training

- In an email sent April 17, 2014 -- eight days before Flint switched its water source – Flint WTP Manager Mike Glasgow mentions problems with the monitoring schedule and his staffing ahead of the switch:
 - "I do not anticipate giving the OK to begin sending water out anytime soon. If water is distributed from this plant in the next couple weeks, it will be against my direction," Glasgow wrote to state officials. "**I need time to adequately train additional staff** and to update our monitoring plans before I will feel we are ready. I will reiterate this to management above me, but they seem to have their own agenda."



Flint WTP Status

Pre and Post
conditions for the
physical plant and
the staffing

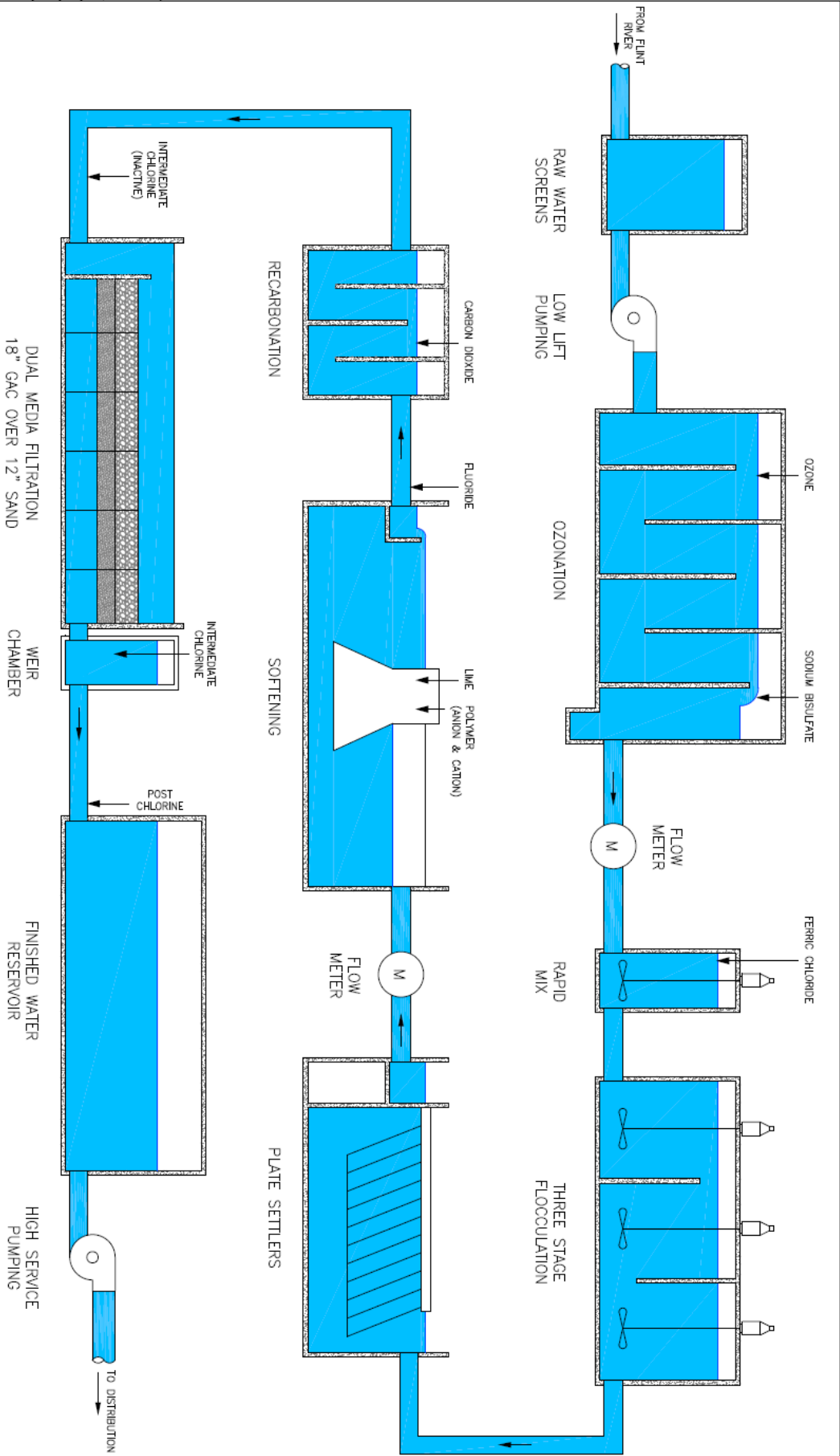
Plant operations prior to 2014 start

- The WTP/ Flint River was classified as the 2nd source of drinking water for Flint as per MDEQ regulations
 - The WTP was supposed to have been operating periodically in order to keep it in viable condition for use as needed
 - Operating that secondary source periodically is how operators stay sharp
 - They maintain the skills necessary to handle emergencies
 - Regulators were supposed to have been checking on this periodically
 - It does not appear that either was being done effectively

City of Flint WTP status in 2016

The WTP is a surface water treatment plant with two trains in series

- The first part of the series utilizes rapid mixing and coagulation with metal salt coagulant, followed by flocculation, then by sedimentation with plate settlers
- The second part of the series is a Lime softening stage with Lime addition and CO₂ for re-carbonation, and dual media filtration with GAC caps
- The classification of the WTP is as an “F” facility as per MDEQ findings
 - Operators can obtain credit towards F license



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 www.in-engineering.com

CITY OF FLINT
WATER TREATMENT PLANT

REVISIONS

NO.	DATE	BY	DESCRIPTION

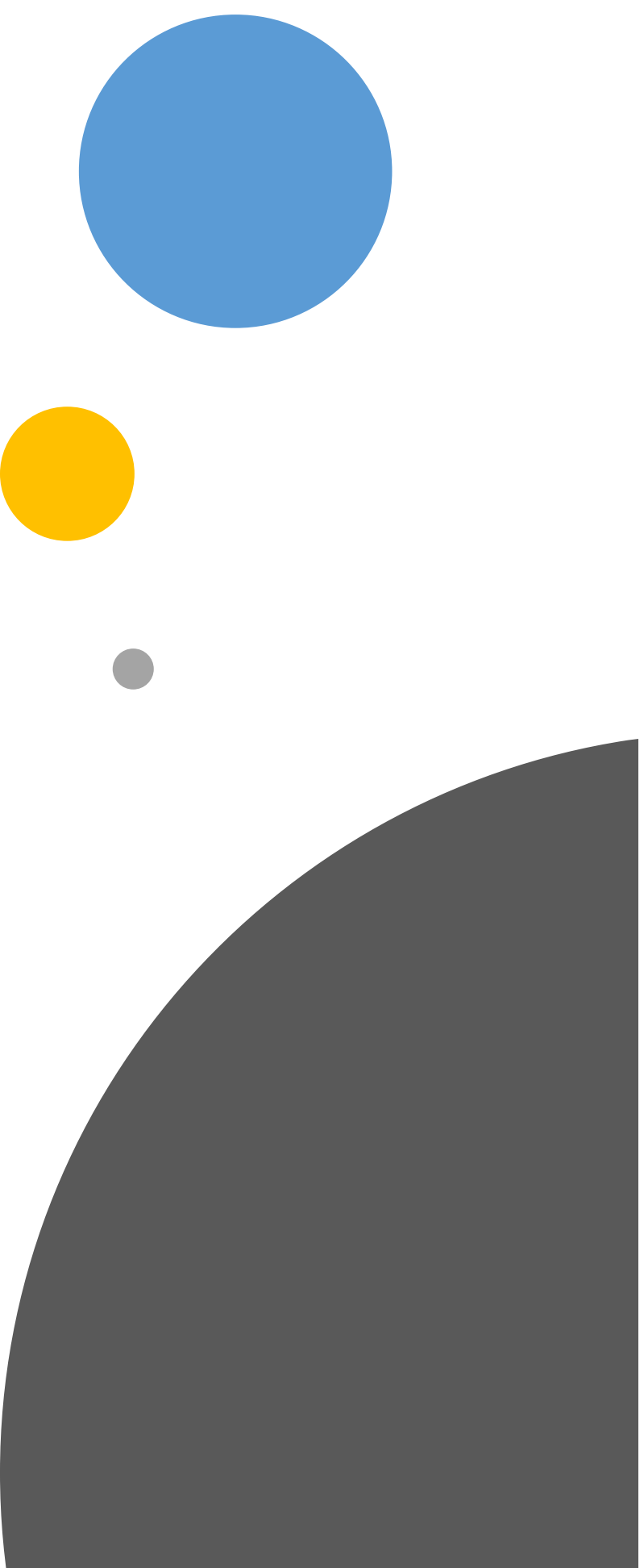
WATER TREATMENT PLANT
PROCESS DIAGRAM

WTP staffing status as of early 2016

- There is a new Plant Manager (PM) in charge who holds an F1 certification and an MS degree in Chemistry
 - This individual had replaced the previous PM who was indicted
- There is a Plant Supervisor with long-tenured “in house” experience
- There are four shift groups in rotation, each led by a licensed Foreman with licensed assistants and a helper
- There is a laboratory staffed with a degreed chemist and several lab analysts with chemical and bacteriological certifications

Classroom Interactions

- I begin to see a relationship develop between DEQ staff and Flint OPS staff
 - I am getting good questions from members of each staff
- A learning atmosphere is apparent
 - People are taking notes
 - Operators ask for help for their exams
- DEQ staff members AND seasoned Flint operators begin to volunteer comments anecdotes and advice to each other
- I am following a concentrated approach aimed at WTP re-start
- We are beginning to act as a team as we approach the start-up date and 90-day test period



Getting ready to treat water

Steps we took to prepare the staff to take on the new raw water source from Lake Huron and prove to USEPA that we can handle the task for 90 days, and then onward

Example modules I prepare for staff in anticipation of WTP re-start 90 day test period
emphasizing unit process control based on Partnership for Safe Water Principles

Rapid Mixing, Flocculation and Sedimentation

Strategies we can use when the plant is started up, including use
of design criteria for predicting performance, and the jar testing
methodology which will be helpful

FLINT WATER TREATMENT PLANT OPERATOR CLASSES

THE CITY OF FLINT OPERATIONS, MANAGEMENT, AND
TRAINING ASSISTANCE GRANT AGREEMENT

PROJECT # 900061-17

Flocculation

Flocculation is a physical process where the floc particles collide gently with one another and stick together

Sweep flocculation is the practice of adding much more coagulant than is necessary to reach charge neutralization in source water particles

Tip speed of the flocculator is controllable and should be set to rotate at somewhere around 1 fps in last compartment



Example module

Motor control
and gear reducer

propeller

Flocculator Calculations

- Volume of 1 unit = 10,041 ft³
 - 10,041 ft³ X 7.48 gal / ft³ = 63,617 gals per flocculator
 - Each stage, or compartment is 1/3 of that*, or 3,347 ft³
- Flow rate of 14 mgd is 9,722 gpm
 - With four flocs online, each would receive ¼ of the flow, or 2,430 gpm
 - DT for floc stage = (3,347 ft³/stage X 7.48 gal/ft³) / 2,430 gal / min = 10.3 mins

*** The stages are not all the same size, but for calculation example, we are using the 1/3 calc**

- Example module

Flocculator tip speed

Example module

The flocculator drive mechanisms are equipped with VFDs that can be set to a specific speed

The circle that the tip of the paddle travels has a diameter of 5.75 feet, and so a perimeter of 18.06 feet

View the travel of the paddle in the water, and use a watch to measure the amount of time it takes for 1 complete revolution

Divide 18.06 feet by the time in seconds for one revolution

This will give you the tip speed in fps

Make adjustments when necessary



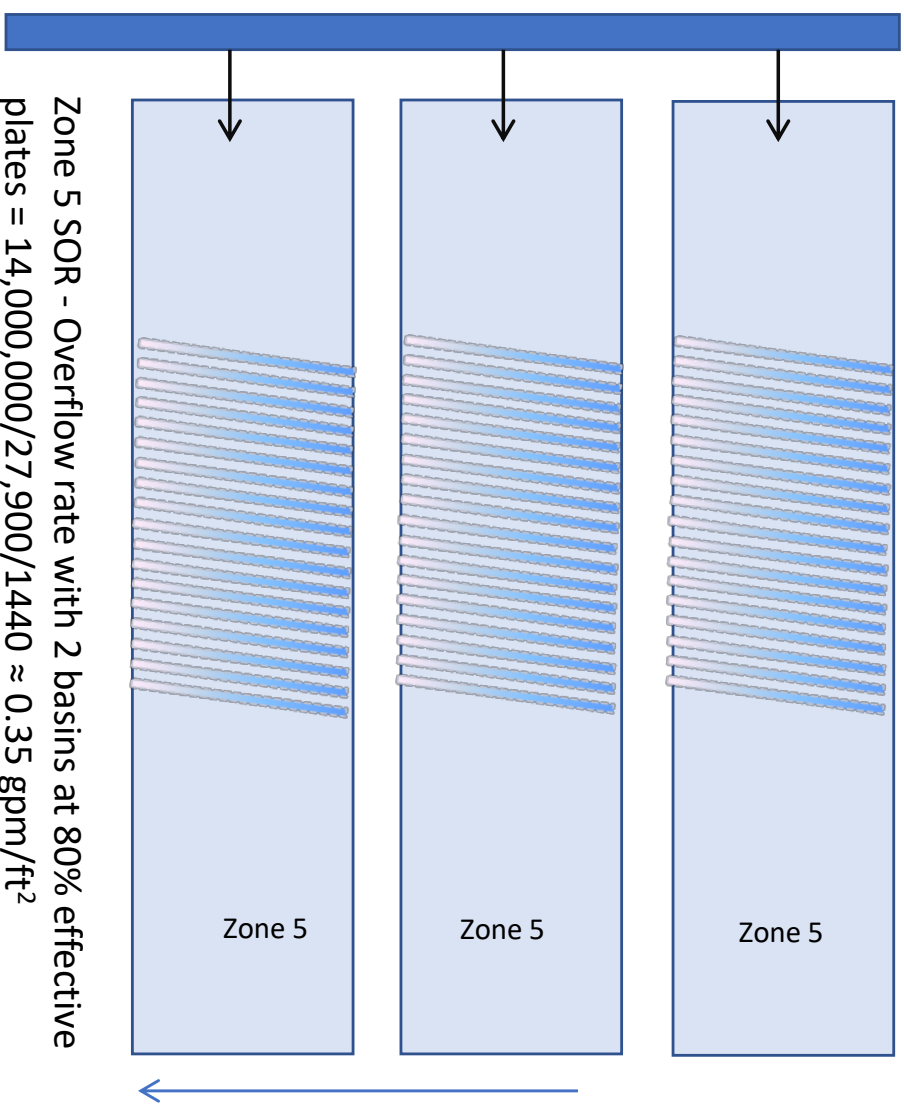
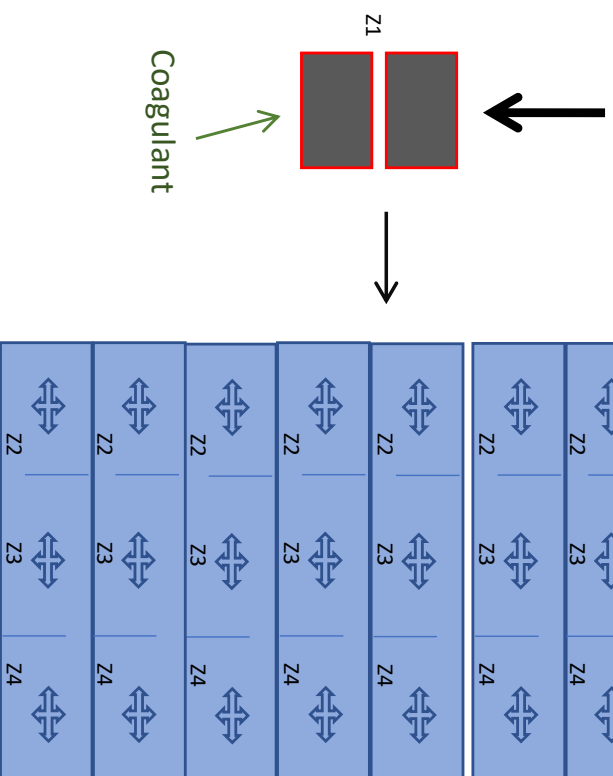
Jar Test calculations

Example module

G values for Zones 2, 3 and 4 have max G of 107 in warm water, and 70 in cold water

Each Sedimentation Basin has approximately 13,950 ft² of EFFECTIVE plate surface area rated at 0.3 gpm/ft²

Zone 1 - 2 Mixers
 @ 5' x 5' x 14.25' =
 431 ft³ or 3,224
 gals each – g value
 – 300 sec⁻¹



Zone 5 SOR - Overflow rate with 2 basins at 80% effective plates = 14,000,000/27,900/1440 ≈ 0.35 gpm/ft²

We would need to “dial-in” the desirable G and taper it from zone to zone.

CDM-Smith is proposing that just 4 Flocculators are needed.

Zone 2, 3, and 4 - flocculation is baffled – each flocculator is staged into 3 zones. Each zone is 3,347 cubic feet.

Training Scope Changes

While we are training, Flint abandons the idea of obtaining and treating Lake Huron water

Let's examine how the signing of a long-term water purchase agreement with GLWA changed the staff incentives

We begin transitioning from intense full-treatment preparations to the idea that the WTP won't be treating source water from Lake Huron

Staffing changes take place

- **Three main drivers begin to erode the staffing levels when the GLWA contract renews**

1. Friction between the PM and staff is apparent in 2016-17
 - The long-tenured Plant Supervisor is reprimanded by the PM and he resigns
 - The PM resigns – her replacement (from within) – works three months and resigns
2. The State reclassifies the WTP from F1 to D1
 - The prospect for young operators to obtain an F license and move up is eliminated
3. The County builds a modern WTP and pays higher wages and better benefits
 - The new plant requires lots of operators with F classification
 - The new plant is situated only 10 miles from Flint WTP
 - Many experienced Flint Operators leave to fill these slots

By 2018 there are only a few seasoned operators aboard with lower classification licenses

- The City has entered in contract with a firm that provides an “operator of record” and several lab analysts – viewed as “ceding” control of the operation by staff

Flint classroom strategies in recent times

- Many new operators begin to show up
 - None have licenses or experience
 - Older staff members who remain do not have incentive to gain the needed D1 license to become the Plant Manager
- My teaching changes to:
 - Basic math courses for operators
 - A basic distribution system course for the outside crews
 - Standard Operating Procedures (SOPs) produced by a contractor for staff

List of SOPs

- **For WTP Personnel**
 - SOP # 111 – Phosphoric Acid Addition
 - SOP # 121 – Caustic Addition
 - SOP # 131 – Hypo Addition
 - SOP # 132 – Hypo Addition at
Distribution Storage
 - SOP # 133 – Hypo Strength Testing



List of SOPs

- **For Distribution Personnel**

- SOP #321 – Hydrant Testing
- SOP #331 – Valve Inspection & Maintenance
- SOP #341 – Backflow Preventer Testing
- SOP #351 – Meter Installation And Testing
- SOP #421 – Customer Complaint Tracking
- SOP #422 – Control Charting of WQ Parameters
- SOP #431 – Conventional Flushing
- SOP #432 – Unidirectional Flushing



Educational Barriers

- The plant and distribution crews are in a perpetual state of “reaction mode”
- When I teach the required Standard Operating Procedures (SOPs) that were produced by another contractor
 - I get frequent comments e.g., “we like this stuff but don’t have time”
 - O&M techniques must wait until the crew is seasoned
 - For the future its probably better to create a specialized crew for O&M if talent can be had rather than to try to teach it to all staff

Differences in operator culture

- Surface water treatment plant operators have the water in their possession about 6 – 8 hours
 - During that time, they monitor it continuously for Cl2 residual and turbidity routinely around the clock
 - They make rounds each hour and run tests, wash filters, check chemical feeds, handle flow changes – continual testing
 - They have but one customer – the distribution system
 - When I teach the SOPs, they sign-off as requested
- Distribution system operators have the water in their possession many days
 - They are more oriented to “react” rather than “prevent”
 - They feel that preventive measures often cause more work
 - They work day shift – overtime usually means emergency work
 - They typical don’t monitor unless there is a problem
 - They have many customers who complain a lot
 - When I teach SOPs, many decline to sign off

Conclusions

- The decision to not restart the Flint WTP coupled with the poor manager-operator relationship in 2016-17, and other factors demoralized the remaining staff
 - Loss of plant control to a private contractor is viewed as a negative
 - Lower wages compared to neighboring Utilities takes its toll
 - Staff was aware of their reputation from the national publicity
 - Those that could leave did - those that stayed express frustration
 - Newly hired staff suffered from lack of a full-time experienced city-employed Plant Manager
- This created a need for remedial education efforts for new staff members
 - Flint needs more diverse training that will help both older and the newer staff members
 - But this results in a perpetual cycle of training new staff hires who leave when they get a license, and the cycle repeats
 - Reaction-mode training for Flint distribution staff is more logical than preventive-mode short term, but will delay much needed preventive measures



QUESTIONS?

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