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Suggested Responses
Workshop: Major Unit Process Evaluations

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Suggested Responses – Workshop: Major Unit Process Evaluations

Workshop Focus:

This workshop represents a review of the CPE approach to assess the capability of major unit processes (MUPs) to meet optimization goals. The CPE MUP evaluation methodology categorizes MUPs into three types. Type 1 processes are sized properly to meet optimization goals as long as the flow rates through the unit do not exceed the peak instantaneous flow rate selected for the analysis. Type 2 processes are marginally undersized to meet optimization goals under normal conditions but can still be capable of meeting optimization goals with focused operational approaches. Type 3 processes are undersized and not expected to meet the optimization goals unless the peak instantaneous flow can be reduced or infrastructure improvements are undertaken. The CPE MUP evaluation approach is a key part of determining whether optimization might be possible through operations and maintenance, minor design, or administrative avenues, or whether major capital improvements would be required ahead of optimization efforts.

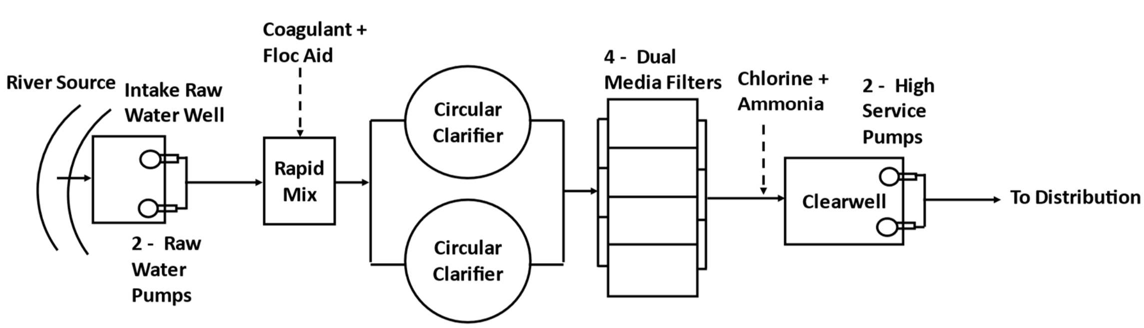
<u>Instructions</u>:

Work with the others at your table to answer the questions related to the scenarios presented. Be prepared to share your answers with the large group at the conclusion of the workshop.

Methodology Review

Plant A is a conventional surface water treatment plant with no history of disinfection by-product issues. A treatment schematic is shown below.

Plant A Treatment Schematic



Flocculation

The circular clarifiers have a flocculation zone isolated from the settling zone by a circular baffle. Water enters the unit through a riser pipe in the center and then proceeds down through the flocculation zone until it passes under the baffle into the sedimentation zone. The diameter of the flocculation zone is 31 feet, and the water depth is judged to be 12 feet. If the volume of the riser where the water enters the clarifier is negligible, determine the total volume available for flocculation at Plant A in gallons. There are 7.48 gallons per cubic foot.

Volume Available for Flocculation in Plant A	$\pi \; x \; \frac{(31\,ft)^2}{4} \; x \; 12\,ft \; x \; 7.48 \frac{gal}{ft^3} \; x \; 2 \; units$ $= 135{,}427\; gal$

Using the following excerpt from Table 4-2 in the CCP handbook, determine an evaluation criterion for the flocculation process. The circular floc chambers each have one turbine mixer; winter water temperature is close to 0ºC, and summer water temperature peaks at 20ºC.

Flocculation		Hydraulic Detention Time
Base		20 minutes
Single-Stage	Temp <=5°C	30 minutes
	Temp >5°C	25 minutes
Multiple Stages	Temp <=5°C	20 minutes
	Temp >5°C	15 minutes

Evaluation Criterion	Rationale
30-min hydraulic detention time	*Flocculators have only one mixer (single stage), and the water temperature worst case is below 5ºC.*

Using the selected evaluation criterion, use Equation 1 to determine the flocculation process capacity in MGD.

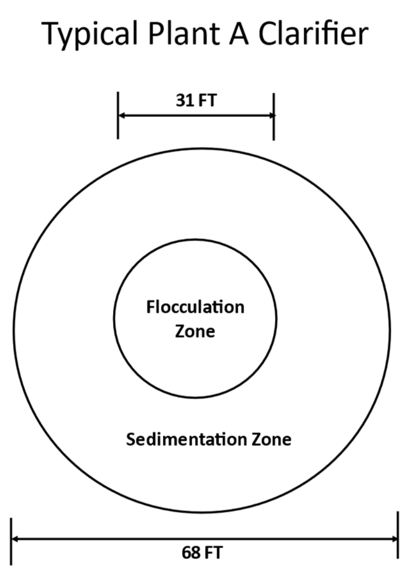
Equation 1:

$$Flocculation\ Capacity\ (MGD) = \frac{Volume\ Available\ (gal)\ x\ 1{,}440 \frac{min}{day}\ x \frac{MG}{(1{,}000{,}000\ gal)}}{Hydraulic\ Detention\ Time\ (min)}$$

$$Flocculation\ Capability\ (MGD) = \frac{135{,}427\ gal\ x\ 1{,}440 \frac{min}{day}\ x \frac{MG}{(1{,}000{,}000\ gal)}}{30\ min} = 6.5$$

Sedimentation

The sedimentation zone in each clarifier has a diameter of 68 feet and the water is about 12 feet deep in each unit. See the diagram below. Determine the surface area of the sedimentation zone in square feet.



Surface Area of Sedimentation in Plant A	*Total Surface Area = 2 units x (Area of outer circle – Area of inner circle)* $Surface\ Area\ (ft^2) = (Area\ of\ outer\ circle - Area\ of\ inner\ circle)\ x\ 2\ units$ $= (\pi\ x\ \frac{(68\ ft)^2}{4} - \pi\ x\ \frac{(31\ ft)^2}{4})\ x\ 2$ $= 5{,}752\ ft^2$

Using the following excerpt from Table 4-2 in the CCP handbook, determine an evaluation criterion for the sedimentation process.

Sedimentation (cold seasonal water <5°C)*				
Conventional (circular and rectangular) and solids contact units				
		Operating Mode		
Conventional Depth (ft)	Solids Contact Depth (ft)	Turbidity Removal SOR (gpm/ft^2)	Softening SOR (gpm/ft^2)	Color Removal SOR (gpm/ft^2)
10	12 - 14	0.5	0.5	0.3
12 - 14	14 - 16	0.6	0.75	0.4
>14	>16	0.7	1.0	0.5

Evaluation Criterion	Rationale
0.6 gpm/ft^2 surface overflow rate.	*The clarifiers are conventional sedimentation units used for turbidity removal and have a depth of 12 feet.*

Using the selected evaluation criterion, use Equation 2 to determine the sedimentation process capacity in MGD.

Equation 2:

$$Sedimentation\ Capacity\ (MGD) = Surface\ Area\ (ft^2)\ x\ SOR\ Evaluation\ Critera\ \left(\frac{gpm}{ft^2}\right)\ x\ 1{,}440\frac{min}{day}\ x\ \frac{MG}{1{,}000{,}000\ gal}$$

$$Sedimentation\ Capability\ (MGD) = 5{,}752\ ft^2\ x\ 0.6\ \left(\frac{gpm}{ft^2}\right)\ x\ 1{,}440\frac{min}{day}\ x\frac{MG}{1{,}000{,}000\ gal} = 4.96\ MGD$$

Filtration

If each of the dual-media filters in Plant A have surface dimensions of 20 ft x 27 ft and there is no history of air binding, use the following excerpt from Table 4-2 in the CCP handbook to determine an evaluation criterion for the filtration process.

Filtration	Air Binding	Loading Rate
Sand Media	None	2.0 gpm/ft^2
	Exists	1.0-1.5 gpm/ft^2
Dual/Mixed Media	None	4.0 gpm/ft^2
	Exists	2.0-3.0 gpm/ft^2
Deep Bed	None	6.0 gpm/ft^2
(Typically anthracite	Exists	3.0-4.5 gpm/ft^2
>60 in. in depth)		

Evaluation Criterion	Rationale
4.0 gpm/ft^2 filter loading rate	*The filters are dual media with no air binding.*

Using the selected evaluation criterion, use Equation 3 to determine the filtration process capacity in MGD. When calculating the filtration surface area, assume one filter is offline for backwash or some other maintenance.

Equation 3:

$$Filtration\ Capacity\ (MGD) = Filtration\ Surface\ Area\ (ft^2)\ x\ Filter\ Loading\ Rate\ Evaluation\ Criterion\ \left(\frac{gpm}{ft^2}\right) x\ 1{,}440\frac{min}{day}\ x\ \frac{MG}{(1{,}000{,}000\ gal)}$$

$$Filtration\ Capacity\ (MGD) = (20\ ft\ x\ 27\ ft\ x\ 3\ filters)\ x\ 4\frac{gpm}{ft^2}\ x\ 1{,}440\frac{min}{day}\ x\ \frac{MG}{(1{,}000{,}000\ gal)} = 9.3\ MGD$$

Disinfection

The plant service line is considered the first customer for Plant A, and chloramine disinfection takes place in the clearwell (all other volumes are considered negligible for chlorine contact calculations). The clearwell is well baffled, and a tracer study performed at the clearwell last year indicated that at maximum flow the baffling factor is 0.6. The clearwell dimensions are 40 ft x 60 ft, and the minimum operating depth is 13 feet. The water temperature in the clearwell at times gets as low as 0.5ºC and the pH sometimes gets as high as 8.0. The public water system oversight agency has determined the disinfection process at Plant A must achieve a minimum of 0.5-log *Giardia* and 2-Log virus inactivation at all times. There have been no historical disinfection by-product concerns at the plant, but the operators have indicated they are only comfortable going up to a combined chlorine residual of 3.0 mg/L at the plant POE tap where disinfection compliance is determined. Using the maximum combined chlorine concentration and the tables taken from the CCP handbook below, determine the required CT (chlorine concentration x contact time) for *Giardia* and for viruses using chloramines under the worst-case water quality conditions at Plant A.

Table D-12. CT Values for Inactivation of *Giardia* Cysts by Chloramine pH 6-9

	Temperature (C)					
	<=1	5	10	15	20	25
0.5-log	635	365	310	250	185	125
1-log	1270	735	615	500	370	250
1.5-log	1900	1100	930	750	550	375
2-log	2535	1470	1230	1000	735	500
2.5-log	3170	1830	1540	1250	915	625
3-log	3800	2200	1850	1500	1100	750

Table D-13. CT Values for Inactivation of Viruses by Chloramine

	Temperature (C)					
	<=1	5	10	15	20	25
2-log	1243	857	643	428	321	214
3-log	2063	1423	1067	712	534	356
4-log	2883	1988	1491	994	746	497

Required CT	Rationale
Giardia:	*Since temperature is ≤ 1°C, required CT for 0.5-log Giardia is 635 mg-min/L.*
Viruses:	*Since temperature is ≤ 1°C, required CT for 2-log virus is 1,243 mg-min/L.*

Using the highest required CT, use Equation 4 to determine the disinfection process capacity in MGD.

Equation 4:

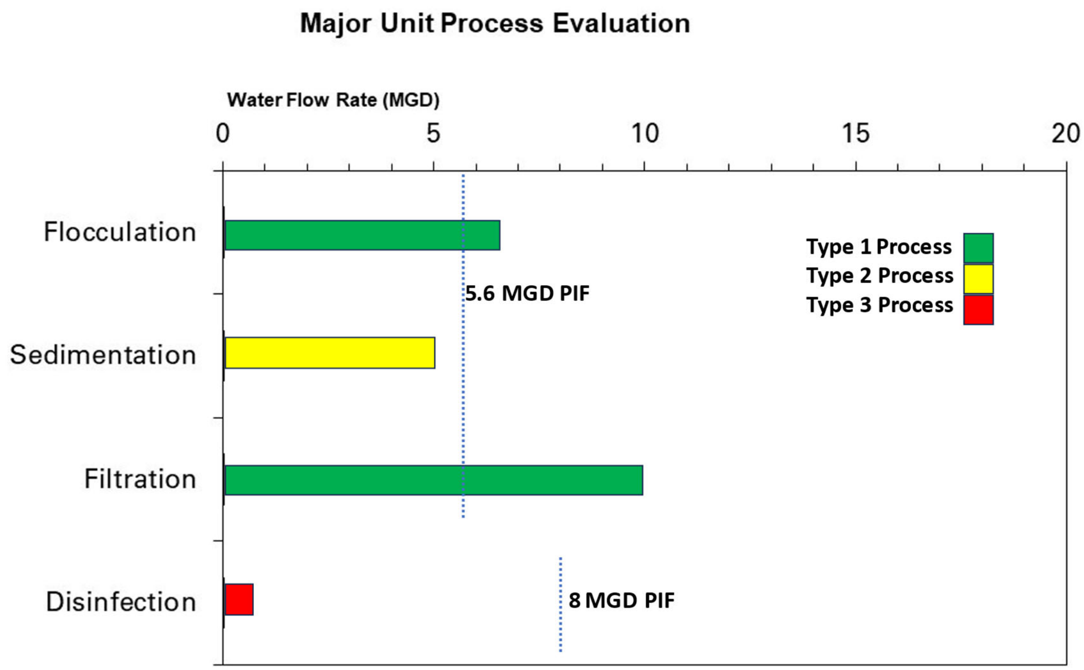
$$Disinfection\ Capacity\ (MGD) = (Maximum\ combined\ chlorine\ residual\ \left(\frac{mg}{L}\right)$$
$$x\ Disinfection\ zone\ volume\ (ft^3)\ x\ baffling\ factor\ x\ 7.48\frac{gal}{ft^3}\ x\ 1{,}440\frac{min}{day})$$
$$x\ (\frac{MG}{1{,}000{,}000\ gal}))/\left(Required\ CT\ (mg - \frac{min}{L})\right)$$

$$Disinfection\ Capacity\ (MGD) = (3\ \frac{mg}{L}\ x\ (40\ ft\ x\ 60\ ft\ x\ 13\ ft) x\ 0.6$$
$$x\ 7.48\frac{gal}{ft^3}\ x\ 1{,}440\frac{min}{day})\ x\ (\frac{MG}{1{,}000{,}000\ gal}))\ /$$
$$1{,}243\ mg - \frac{min}{L} = 0.5\ MGD$$

1. On the following chart, mark the peak flow used to evaluate the processes using a vertical line(s); then draw bars approximating the capacity of each MUP.

   To select peak flow, note that the daily average plant flow is 3.5 MGD and each raw water pump can transfer water through the plant at up to 5.6 MGD; the operators only operate one pump at a time. The high-service pumps located in the clearwell operate in tandem up to a capacity of 8 MGD.

2. Assign a MUP rating to each process based on the following:
   - Type 1 process: Capacity ≥ of peak flow
   - Type 2 process: Capacity = 80 – 100% of peak flow
   - Type 3 process: Capacity < 80% of peak flow



Discussion:

1. How would you characterize this plant and processes when talking about this analysis with the water system managers and staff? If there are any Type 3 processes, what would the state's response be?

***From Table 1*: Based on the evaluation, the PWS is unable to meet disinfection so the state would discuss options to change disinfectant to free chlorine, change to an alternate disinfectant (UV, etc.), slow down the plant or add more detention. The State would work with the PWS staff to see what other processes to adjust, like the baffling factor. The State would also put the PWS on a boil water advisory.**

2. Are there any revisions to the CCP Handbook MUP evaluation section that you would suggest?

***From Table 1*: In the sedimentation portion, it would great to see definitions and more options other than the existing two (e.g., super pulsators, tube/plate settlers, Actiflo, etc.).**

3. How could the MUP evaluation be used to benefit the PWS oversight program in areas in addition to AWOP? If not, what are the constraints and possible approaches to overcome them?

> ***<u>From Table 1</u>: The MUP evaluation could be incorporated into:***
>
> - ***Sanitary surveys***
> - ***Initial permitting and permit modifications***
> - ***Compliance follow-up***

<u>Optional if You Have Time</u>:

If the plant were to be able to discontinue the ammonia feed, thereby switching to free chlorine disinfection, how would it affect the rating of the disinfection process? Assume all flows and dimensions stay the same, the maximum residual is still 3.0 mg/L (free chlorine), and there would not be any disinfection by-product issues caused by the switch at that residual. Use the table taken from the CCP handbook below to determine the required CT for *Giardia* (assume 0.5-log inactivation required) and use Equation 4 to determine the disinfection process capacity.

Table D-1. CT Values for Inactivation of *Giardia* Cysts by Free Chlorine at 0.5 °C or Lower

Chlorine Concentration (mg/L)	pH <= 6.0 Log Inactivation						pH = 6.5 Log Inactivation						pH = 7.0 Log Inactivation						pH = 7.5 Log Inactivation					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	23	46	69	91	114	137	27	54	82	109	136	163	33	65	98	130	163	195	40	79	119	158	198	237
0.6	24	47	71	94	118	141	28	56	84	112	140	168	33	67	100	133	167	200	40	80	120	159	199	239
0.8	24	48	73	97	121	145	29	57	86	115	143	172	34	68	103	137	171	205	41	82	123	164	205	246
1	25	49	74	99	123	148	29	59	88	117	147	176	35	70	105	140	175	210	42	84	127	169	211	253
1.2	25	51	76	101	127	152	30	60	90	120	150	180	36	72	108	143	179	215	43	86	130	173	216	259
1.4	26	52	78	103	129	155	31	61	92	123	153	184	37	74	111	147	184	221	44	89	133	177	222	266
1.6	26	52	79	105	131	157	32	63	95	126	158	189	38	75	113	151	188	226	46	91	137	182	228	273
1.8	27	54	81	108	135	162	32	64	97	129	161	193	39	77	116	154	193	231	47	93	140	186	233	279
2	28	55	83	110	138	165	33	66	99	131	164	197	39	79	118	157	197	236	48	95	143	191	238	286
2.2	28	56	85	113	141	169	34	67	101	134	168	201	40	81	121	161	202	242	50	99	149	198	248	297
2.4	29	57	86	115	143	172	34	68	103	137	171	205	41	82	124	165	206	247	50	99	149	199	248	298
2.6	29	58	88	117	146	175	35	70	105	139	174	209	42	84	126	168	210	252	51	101	152	203	253	304
2.8	30	59	89	119	148	178	36	71	107	142	178	213	43	86	129	171	214	257	52	103	155	207	258	310
3	30	60	91	121	151	181	36	72	109	145	181	217	44	87	131	174	218	261	53	105	158	211	263	316

Chlorine Concentration (mg/L)	pH = 8.0 Log Inactivation						pH = 8.5 Log Inactivation						pH < =9.0 Log Inactivation					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
<=0.4	46	92	139	185	231	277	55	110	165	219	274	329	65	130	195	260	325	390
0.6	48	95	143	191	238	286	57	114	171	228	285	342	68	136	204	271	339	407
0.8	49	98	148	197	246	295	59	118	177	236	295	354	70	141	211	281	352	422
1	51	101	152	203	253	304	61	122	183	243	304	365	73	146	219	291	364	437
1.2	52	104	157	209	261	313	63	125	188	251	313	376	75	150	226	301	376	451
1.4	54	107	161	214	268	321	65	129	194	258	323	387	77	155	232	309	387	464
1.6	55	110	165	219	274	329	66	132	199	265	331	397	80	159	239	318	398	477
1.8	56	113	169	225	282	338	68	136	204	271	339	407	82	163	245	326	408	489
2	58	115	173	231	288	346	70	139	209	278	348	417	83	167	250	333	417	500
2.2	59	118	177	235	294	353	71	142	213	284	355	426	85	170	256	341	426	511
2.4	60	120	181	241	301	361	73	145	218	290	363	435	87	174	261	348	435	522
2.6	61	123	184	245	307	368	74	148	222	296	370	444	89	178	267	355	444	533
2.8	63	125	188	250	313	375	75	151	226	301	377	452	91	181	272	362	453	543
3	64	127	191	255	318	382	77	153	230	307	383	460	92	184	276	368	460	552

NOTE: CT 99.9 = CT for 3-log inactivation.

Required CT	Rationale
64 mg-min/L	*Using the 0.5°C tables provided, chlorine concentration of 3.0 mg/L, and required Giardia log inactivation of 0.5-log.*

Equation 4:

$$Disinfection\ Capacity\ (MGD) = (Maximum\ chlorine\ residual\ \left(\frac{mg}{L}\right)$$
$$x\ Disinfection\ zone\ volume\ (ft^3)\ x\ baffling\ factor\ x\ 7.48\frac{gal}{ft^3}\ x\ 1{,}440\frac{min}{day})$$
$$x\ (\frac{MG}{1{,}000{,}000\ gal}))/\left(Required\ CT\ (mg - \frac{min}{L})\right)$$

$$Disinfection\ Capacity\ (MGD) = (3\ \frac{mg}{L}\ x\ (40\ ft\ x\ 60\ ft\ x\ 13\ ft) x\ 0.6$$
$$x\ 7.48\frac{gal}{ft^3}\ x\ 1{,}440\frac{min}{day})\ x\ (\frac{MG}{1{,}000{,}000\ gal}))\ /$$
$$64\ mg - \frac{min}{L} = 9.45\ MGD$$

What is the MUP rating for this revised disinfection process given that the peak high service flow is 8 MGD?

The major unit process rating would now be Type 1 because the rated capacity (9.45 MGD) is higher that the PIF of the high service pumps (8 MGD).

2023 National AWOP Meeting

Workshop Feedback:
Developing AWOP Resources for Corrosion Control

Workshop: Developing AWOP Resources for Corrosion Control

Table Number: ____________ Participants:____________________________________

Objectives:

The objectives of this workshop are (1) to allow AWOP participants an opportunity to provide feedback on the proposed corrosion control optimization performance goals, (2) to introduce participants to the corrosion control optimization assessment spreadsheet (OAS) that is being developed to assess PWS performance relative to the proposed goals, and (3) provide feedback on the overall approach of developing corrosion control resources for AWOP.

Approach:

Work as a group with others at your table to complete all three portions of this workshop. Assign one person to record feedback from the entire table and be prepared to report out at the end of this session. Also, please provide the group responses to the meeting organizers at the end of the workshop. Feedback from this workshop will be considered as future AWOP resources are developed for corrosion control.

Area-Wide Optimization Program Corrosion Control[1] Optimization Goals[2]

Proposed Performance Goals Summary

Category	Goal/Guideline	Status	Description	Reference
Equilibrium	pH Performance Goals	Proposed	• Adopt system specific targets: Discrete upper and lower limits based on the locational running annual average (LRAA) of each pH monitoring site. ○ Entry point (EP) pH within range of the RAA ±0.20 S.U. ○ Distribution system (DS) pH within range of the LRAA ±0.50 S.U.	EPA 2016
Equilibrium	Alkalinity Performance Goals	Proposed	• Adopt system specific targets: Discrete upper and lower limits based on the RAA of the alkalinity monitoring site. ○ EP alkalinity within range of the RAA ±50 mg/L as $CaCO_3$.	AWWA 2017
Residual Maintenance	Disinfection Performance Goals	Proposed	• For systems that use free chlorine as a secondary disinfectant, adopt system specific targets: Discrete upper and lower limits based on the LRAA of each free chlorine monitoring site. ○ EP free chlorine within range of the RAA ±0.20 mg/L (as Cl_2). ○ DS free chlorine within range of the LRAA ±0.30 mg/L (as Cl_2). • For systems that use chloramines as a secondary disinfectant, adopt system specific targets: Discrete upper and lower limits based on the LRAA of each monochloramine[3] monitoring site. ○ EP monochloramine within range of the RAA ±0.30 mg/L (as Cl_2). ○ DS monochloramine within range of the LRAA ±0.40 mg/L (as Cl_2).	AWWA 2017 AWWA 2013
Residual Maintenance	Corrosion Inhibitor Performance Goals	Proposed	• For systems that use orthophosphate, adopt system specific targets: Discrete upper and lower limits based on the LRAA of each phosphate monitoring site. ○ EP phosphate within range of the RAA ±0.20 mg/L (as o-PO_4). ○ DS phosphate within range of the LRAA ±0.30 mg/L (as o-PO_4). • For systems that use polyphosphate or blended phosphate, adopt system specific targets: Discrete upper and lower limits based on the LRAA of each phosphate monitoring site. ○ EP phosphate within range of the RAA ±0.20 mg/L (as o-PO_4). ○ DS phosphate within range of the LRAA ±0.40 mg/L (as o-PO_4).	EPA 2016 AWWA 2017
Inorganics Removal[4]	Manganese Performance Goals	Proposed	• EP manganese 95th percentile measurements achieve ≤ 0.02 mg/L Mn. • DS manganese 95th percentile measurements achieve ≤ 0.03 mg/L Mn at each monitoring site.	AWWA 2015
Inorganics Removal	Iron Performance Goals	Proposed	• EP iron 95th percentile measurements achieve ≤ 0.10 mg/L Fe. • DS iron 95th percentile measurements achieve ≤ 0.20 mg/L Fe at each monitoring site.	AWWA 2015

[1]Goals are intended to minimize variability of various water quality parameters associated with corrosion control after optimal treatment has been established. [2]Meeting the goals does not eliminate the risk of corrosion but can reduce the risk of corrosion. [3]Total Chlorine monitoring can be used as a substitute to monochloramine monitoring when data is unavailable, although this is not the preferred parameter. [4]Intended to reduce the accumulation of inorganic substrates on a system's pipe walls, based on complexation potential and corrosion impacts.

Part 1 – Feedback on Proposed Corrosion Control Optimization Goals

A suite of optimization performance goals has been proposed by the EPA Technical Support Branch (TSB) Optimization Team to reduce the risk of lead corrosion at a public water system (PWS) after optimized corrosion control treatment (OCCT) has been established[1]. Goals have been proposed for multiple parameters related to corrosion in three categories: (1) equilibrium, (2) residual maintenance, and (3) inorganics removal. These proposed goals are intended to assess water quality stability through analysis of compliance monitoring data and additional monitoring as needed to inform process control decisions. These goals are applicable for PWSs supplied by either surface water or groundwater. The proposed goals are summarized in the table on the previous page.

Performance goals are the foundation of an optimization program because performance is assessed relative to goals and process control changes are made to achieve the goals. When optimization goals are developed, they should be technically sound *and* implementable by the primacy agency and PWS. These proposed goals were initially developed based on an extensive literature review. They have been refined based on a combination of piloting the goals through a series of site visits at PWSs in Kentucky, input from EPA ORD researchers, and a corrosion control workshop that was conducted with the participants of the Region 4 Multistate AWOP.

The following three questions are offered to gather feedback on the proposed goals. Specifically, are they implementable by both primacy agencies and PWSs? **Please answer the questions on the following page. Also, for those of you who represent PWS Surveillance programs, please complete Tables 1 and 2 (*separate handout*) to indicate the availability of data in your program for both surface water and groundwater system to assess performance relative to the proposed goals. Tables 1 and 2 may be completed after the workshop and returned to meeting organizers before the end of the meeting.**

[1] Proposed performance goals assume that optimized corrosion control treatment has been established based on inventory of service line materials and system specific background water quality conditions using the most current version of *EPA's Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems*.

Questions:

1. Are there any additional parameters (e.g., aluminum, zinc, magnesium, chloride, sulfate) or different water quality targets that should be considered in the proposed goals?

> Chloride and sulfate (CSMR calculated for PWSs with galvanic corrosion concerns), calcium (for PWSs with excessive scaling concerns), aluminum (for PWSs that use an aluminum-based coagulant), zinc (for PWSs that use a zinc-based corrosion inhibitor), temperature, carbon dioxide (for GW PWSs and/or PWSs that add carbon dioxide), and consideration for ORP Special Studies at relevant PWSs. DIC calculation and tracking would additionally benefit the evaluation process with the OCCT recommended guidance.

2. As these goals were initially developed, various technical references mentioned the use of silicates as a corrosion inhibitor. Briefly describe the extent of the use of silicates as a corrosion inhibitor in your jurisdiction. Should an optimization goal be considered for silicates?

> Very few, if any, PWSs using silicates were known of and noted by the states in attendance of the meeting. Very few community water supplies, but some secondary supplies, use silicates, i.e., hospitals feeding silicates into a hot water system. Having a goal for silicates would be helpful if a PWS ever wanted to switch to silicates, but it was noted that silicates should only be included if they are considered an effective corrosion inhibitor nationally.

3. Do you anticipate any challenges with assessing PWS performance relative to these proposed goals?

Some of the challenges listed were data integrity (i.e., method detection limits, interferences, improper sampling, improper reporting), data management, data availability (i.e., collection and reporting), data variability (i.e., seasonal changes that influence the RAA calculation could misrepresent assessment against the goal), and data formatting variations. One suggestion was to apply the goal on a seasonal basis or account for seasonal variability in the goal qualifications. Clarification is needed to address data outliers (i.e., does one outlier mean that the PWS doesn't meet the goal?). Guidance on monitoring frequency and implementing new distribution system monitoring locations would be helpful in applying the performance goals.

Part 2 – Feedback on Proposed Corrosion Control OAS

An OAS has been developed to generate performance summaries and optimization trends to assess water quality data against the proposed corrosion control optimization goals. Review the example data summaries and trends generated by the OAS that are presented below and answer the following questions.

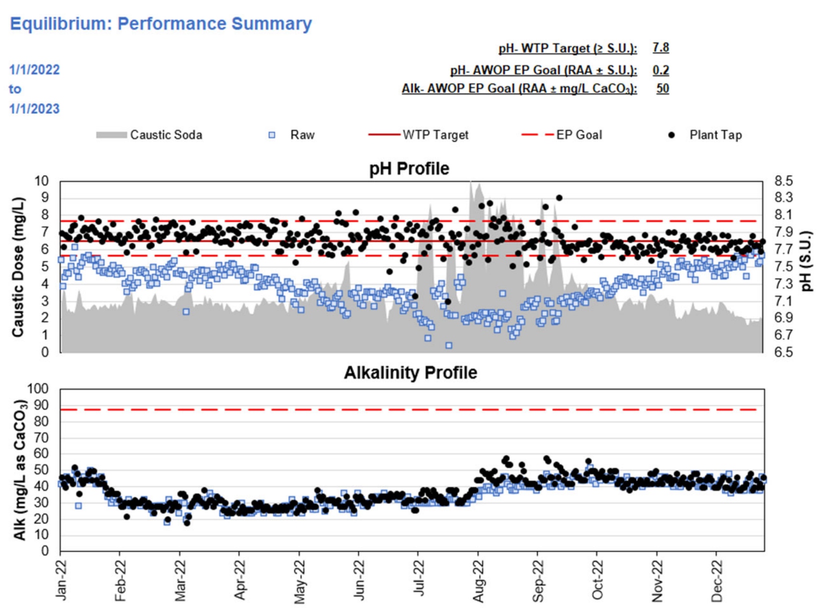


Figure 1: Example Equilibrium Performance Summary in OAS

4. The equilibrium performance summary in Figure 1 shows that caustic soda dose was adjusted throughout the year to maintain a consistent pH during the seasonal decrease in raw water pH. The annual average of EP pH measurements achieved the system-defined target (≥7.8 S.U.) and met the proposed EP goal (RAA ±0.20 S.U.) in 89% of measurements during this time. Although this system does not add a chemical to control alkalinity, assessing the variability of EP alkalinity relative to the proposed goal (RAA ±50 mg/L as $CaCO_3$) can provide additional insight (source water quality changes and unintended treatment impacts).

   The proposed goal for alkalinity is to maintain an EP concentration within a range of ±50 mg/L as $CaCO_3$ of the RAA. For systems with alkalinity RAAs ≤ 100 mg/L as $CaCO_3$, similar to this example, should an alternative goal be considered? Should an additional chemical be added to increase alkalinity (or dissolved inorganic carbon)?

   The goal could be better chosen based on the recommended OCCT and OWQP for the PWS. The RAA might be biased if the system is consistently trending on one side of the average (could the moving average be calculated monthly instead of annually?). There could be a large shift over time, which would result in data trends deviating from the initial annual average value. The PWS might need to review the OCCT decision tree again, based on this finding. There can be significant raw water variability which creates challenges for assessing the goal. Some systems can have very low raw water alkalinity (<25 mg/L), so a separate lower alkalinity goal should be considered.

   The discussion presented conflicting views on whether low or high alkalinity is generally *"better"* for corrosion control in a PWS. When alkalinity levels are too high, copper in the system can experience a dramatic increase in solubility, but a minimum was still suggested as potentially implementable.

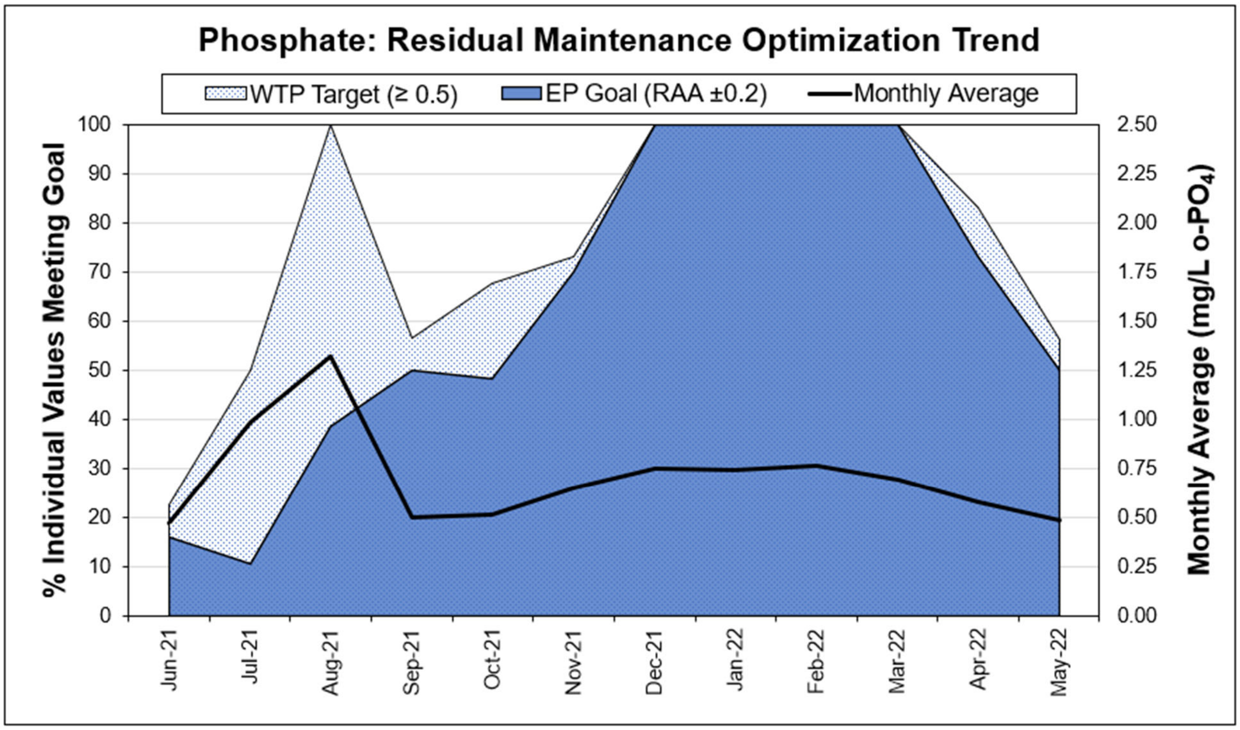


Figure 2: Example Residual Maintenance Optimization Trend in OAS

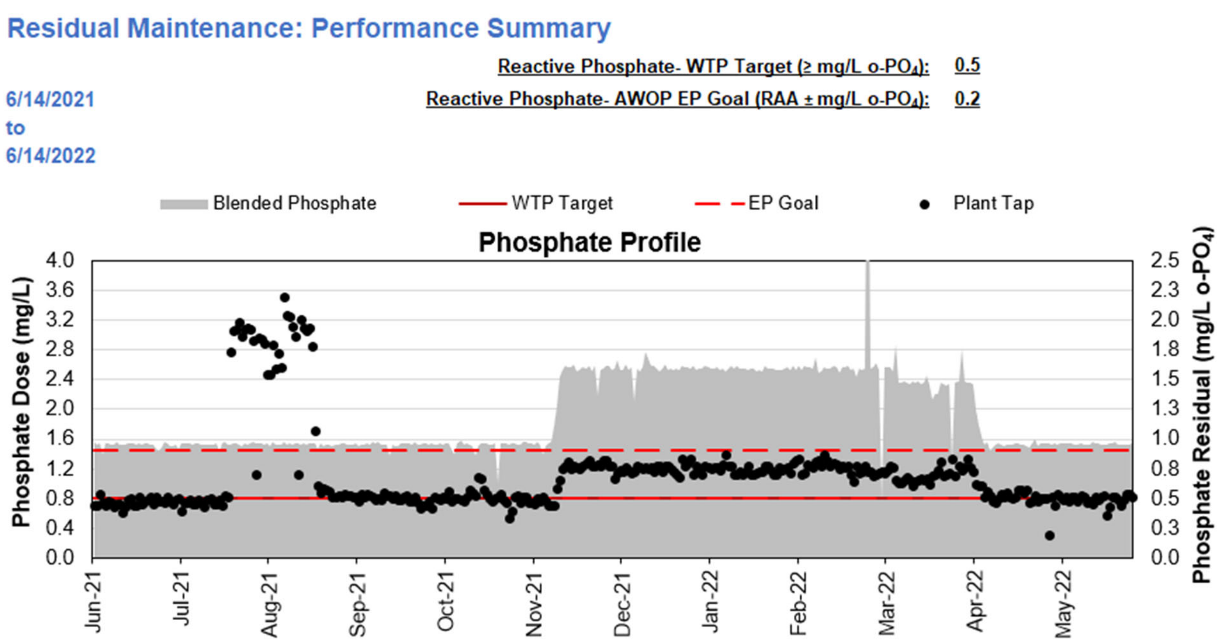


Figure 3: Example Residual Maintenance Performance Summary in OAS

5. The example residual maintenance optimization trend in Figure 2 shows that the monthly values met the proposed EP goal (RAA ± 0.20 mg/L o-PO_4) and the system-defined target (≥ 0.50 mg/L o-PO_4) from January through March but was challenged other times of the year. Figure 3 shows that phosphate residual was up to three times greater than the RAA during an extended period in August despite consistent phosphate dosing. This could indicate that there was a deviation in performance (i.e., originating from source or treatment) or that there was a data integrity issue.

   What supplemental information (e.g., additional data, questions for the operator) would you consider in effort to investigate this deviation in performance (i.e., unexplained increase in EP phosphate residual)?

   The monitoring deviation is off by a factor of three, and this could account for the difference in total phosphorus monitoring opposed to orthophosphate monitoring. There appears to be a data integrity issue.

   Additional investigations could include checking that the feed pumps are calibrated, checking that the analysis instruments are calibrated, checking the quality of the chemical supply, reviewing the data logs for possible reporting issues, and investigating possible source water quality changes (including assessing previous years data for seasonal changes). Moving forward, operator calculation and unit consistency checks could be implemented as well as chemical feed calibration and dosing control SOPs.

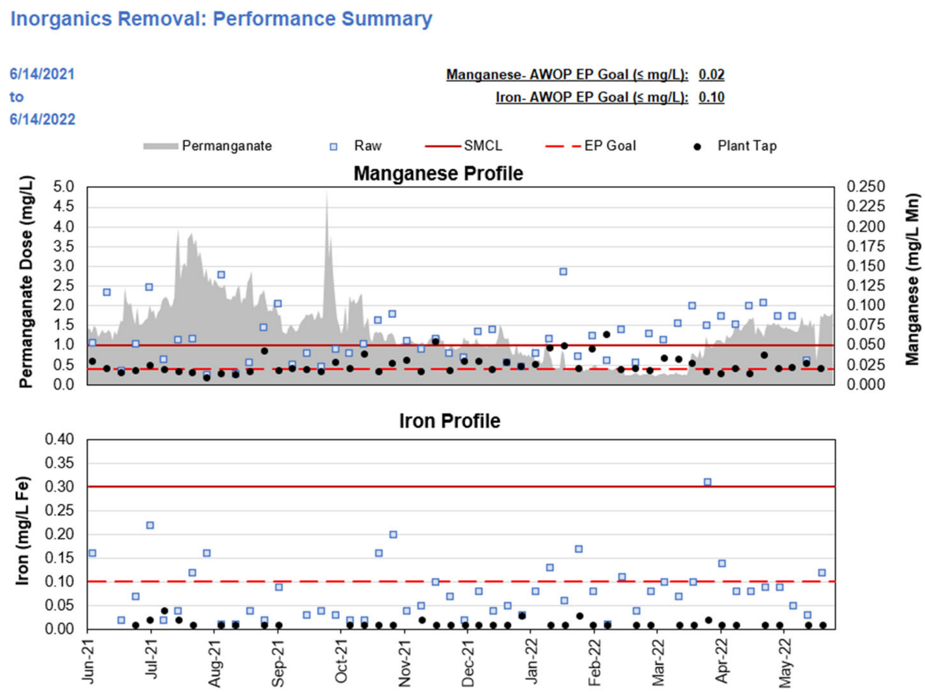


Figure 4: Example Inorganic Removal Performance Summary in OAS

6. The example inorganics removal performance summary in Figure 4 shows that EP manganese levels exceeded the proposed EP goal (≤ 0.02 mg/L Mn) in 60% of measurements and the EPA secondary maximum contaminant level (SMCL ≤ 0.05 mg/L Mn) in 4% of measurements. However, iron levels at the EP met the SMCL (≤ 0.3 mg/L Fe) and the proposed EP goal (≤ 0.10 mg/L Fe) in 100% of measurements. This system monitored manganese and iron biweekly.

   Besides the raw water, what additional sources of manganese and/or iron should be considered (i.e., both in the WTP and DS)? What sampling frequency and additional monitoring locations would you suggest to better characterize these additional sources?

   Overfeeding permanganate in the WTP could carry over into the DS, there could be legacy accumulation of iron and manganese in the DS, and some materials in the DS may contribute (e.g., unlined cast iron). A good recommendation would be to monitor weekly in the DS and daily at the WTP (raw and finished) for both iron and manganese.

   If over-feeding is eliminated with tighter process control, then distribution carry-over could be minimized as well as saving money on chemicals.

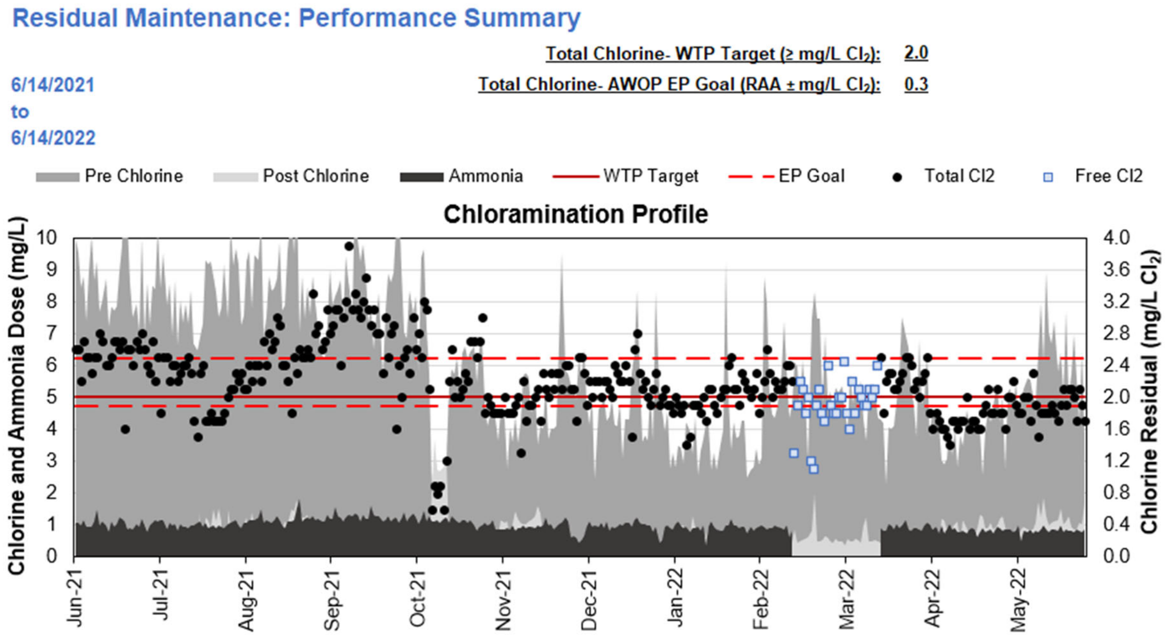


Figure 5: Example Disinfection Performance Summary in OAS

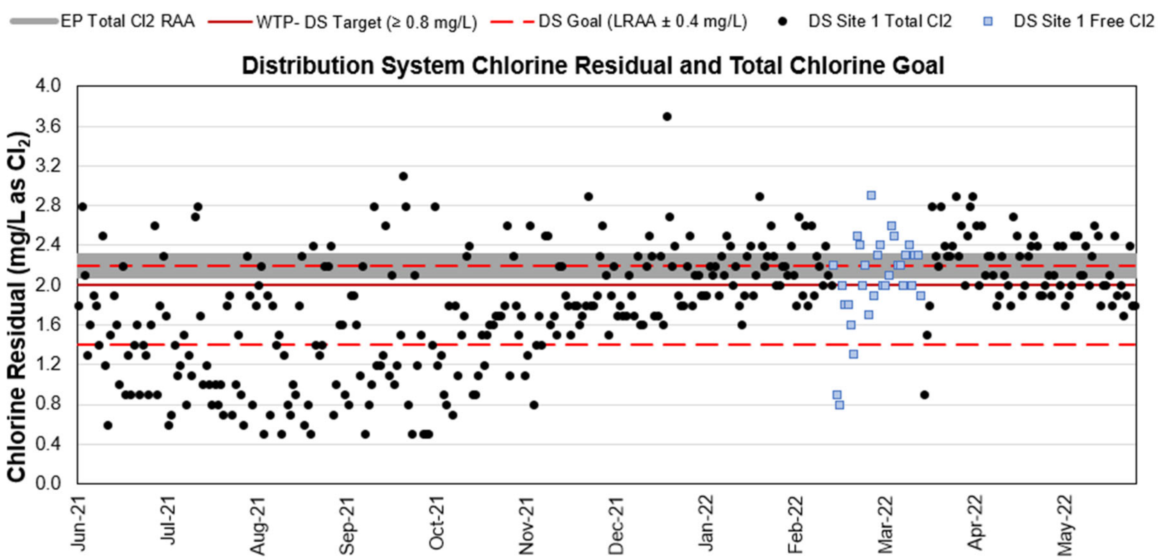


Figure 6: Example DS Chlorine Residual Performance Summary in OAS

7. The example residual maintenance performance summary in Figure 5 shows the proposed EP total chlorine goal[2] (RAA± 0.30 mg/L Cl_2) was met in 50% of measurements. Figure 6 shows disinfectant residual measured at a DS sample site not meeting the proposed DS total chlorine

[2] Total chlorine residual was used to assess performance because monochloramine data was not available.

goal (LRAA± 0.40 mg/L Cl_2) 66% of the year. Disinfectant residual directly correlates with the oxidation reduction potential (ORP) of the water. Since chemical corrosion is an oxidation reduction reaction, disinfectant loss reduces ORP and increases corrosion potential (depending on pipe material, pipe scale, legacy accumulation, inorganics speciation, biological and hydraulic events).

What operational changes should be considered (e.g., treatment, distribution system) to maintain disinfectant residual and ORP? What additional data should be considered for systems that chloraminates? Additionally, what sampling locations and frequency should be considered for all systems in the development of corrosion control monitoring goals?

This system could examine water age and nitrification potential (look through additional years of data and determine if there were previous seasonal nitrification events).

Keeping low TOC, consistent chlorine dosing, monitoring chlorine demand in the plant, keeping low water age by maintaining flushing, optimizing storage tank operations, performing residential tap sampling, as well as nitrate, nitrite, and ammonia monitoring could help provide a more robust assessment.

Part 3 – Feedback on Next Steps of AWOP Corrosion Control Development

As described in the presentation, the following next steps are being considered to continue to the development of additional AWOP resources or tools to support corrosion control:

- Establish an AWOP Corrosion Control workgroup.

- Conduct Copper Corrosion Control Workshops during autumn 2023 AWOP Region 4 and AWOP West meetings. Newer service areas are typically impacted by copper corrosion, opposed to lead corrosion. Minimizing water quality variability and removing inorganics applies broadly to both copper and lead corrosion, but the corrosion rate for each metal is governed by different dissolution equilibrium. System-defined targets (i.e., pH, and orthophosphate) will differ based on the specific metal corrosion addressed as well as the system-specific water profile and treatment (i.e., alkalinity, disinfection).

- Continue to enhance the corrosion control OAS based on ongoing experience.
- Develop monitoring goals (e.g., location, frequency) to complement proposed performance goals for corrosion control.
- Formally adopt performance goals for corrosion control.

Please answer the following questions to provide input on the development of additional AWOP resources to support corrosion control.

8. How could the corrosion control OAS be applied to other primacy agency regulatory and optimization activities (e.g., sanitary surveys, reevaluation of CCT for LCRR, data integrity evaluations)?

Integration with sanitary surveys would be helpful to evaluate how effective a PWSs feed process might or might not be and could be used for reevaluation of OCCT or in conjunction with long term treatment changes.

9. In general, what enhancements could be made to the corrosion control OAS to support both optimization and additional primacy agency activities?

Regulatory values could be added onto the plots in the OAS and text boxes could be used to note system changes during specific time periods. The *"optimization assessment"* chart needs better clarification and some guidance to understand more effectively what is being displayed. A *"7 period moving average"* could be considered with *Excel*, and OAS could be used as/ at a DSO.

10. What suggestions do you have on next steps and future activities for the development of AWOP resources for corrosion control (*see list of planned activities above*)?

The Corrosion Control Optimization workshop could be applied in different areas of the country to see what differences there are and what changes may occur.

The state corrosion control experts should be engaged for feedback; the optimization goals for corrosion control are welcome, but they are still in need of being refined.

Guidance on data monitoring, benchtop study procedures, and pipe loop demonstrations would be helpful.

Applying Optimization Training to Prepare for Water Quality Events

AWOP National Meeting
Cincinnati, Ohio
August 8 – 9, 2023

Workshop Documentation:
Water Quality Event Preparedness

Prepared by:

Process Applications, Inc.
2627 Redwing Road, Suite 340
Fort Collins, Colorado 80526

Workshop Documentation: Water Quality Event Preparedness

Group 2

Participants: Chris Affeldt, Joe McNally, Janine Morris, Joe Uliasz, Tom Waters

What you will be doing during this workshop:

1. Brainstorm water quality events impacting your state/region (~ 10 min.) ☐
2. Review water system background to plan a water quality event training activity (~ 10 min.) ☐
3. Complete assigned areas to develop onsite activities at host water system (~ 20 min.) ☐
4. Provide feedback on workshop experience and next steps for your state/region (~ 10 min.) ☐

Part 1 – Brainstorming water quality events impacting your state/region

The purpose of this workshop is to gain experience setting up a training activity on water quality event preparedness at a host water system. In the first part of the workshop your group is to discuss water quality events that have impacted or could impact water systems in your state and region. The overview presentation provided ideas based on events that have recently impacted AWOP states and regions. Your group may have other location-specific examples to discuss. List your ideas below.

Water Quality Event Brainstorming: *Identify and discuss water quality event(s) that you have experienced in your state or region that presented challenges to your water systems. What other types of events could impact your systems? Document your list of water quality events along with comments on experience gained, likelihood of occurrence, types of vulnerable water systems.*

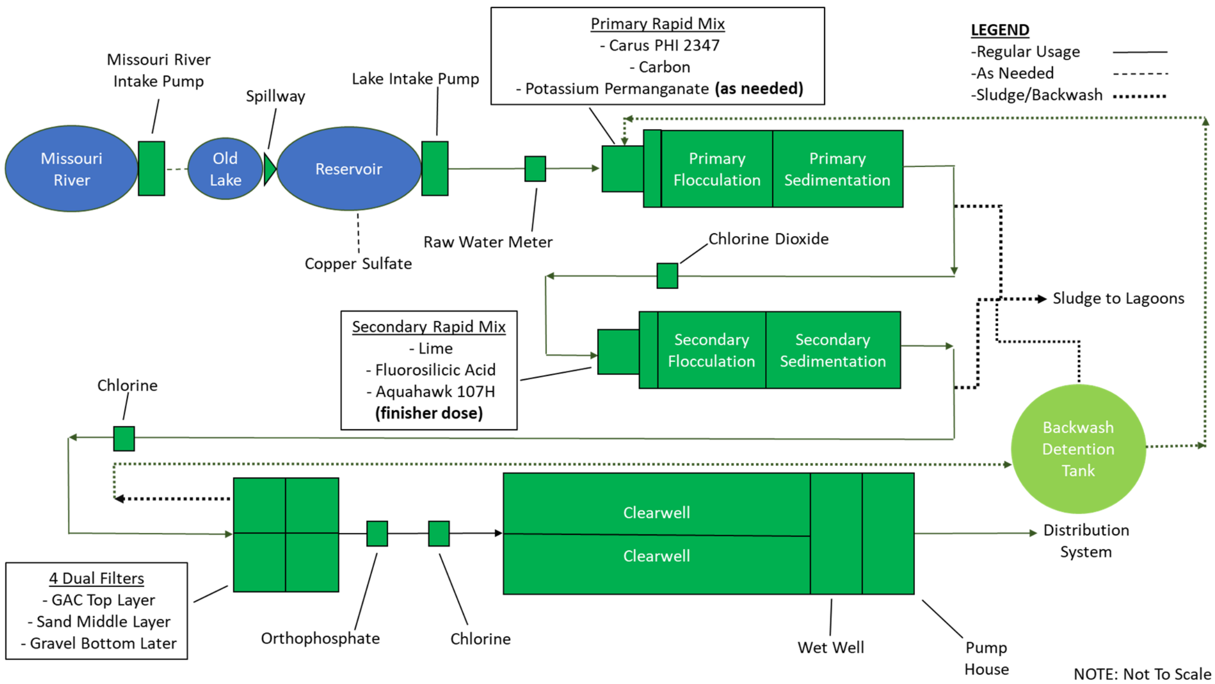
- Flooding/storms – Water quality, infrastructure
- Tornados – infrastructure
- Chemical spills
- Hurricanes
- HABs
- Wildfires
- Drought
- Cold weather – especially Kentucky in our group

Part 2 – Setup for water quality event preparedness training

The second part of this workshop provides background on a proposed host water system where training on water quality event preparedness will be conducted. The proposed host water system information is based on a CPE conducted in an AWOP state. As described in the overview presentation, this type of training is part of an approach to improve the readiness of water system managers and operators for water quality events with which they have limited experience. The following background provides information for your group to use in developing a workshop approach on this topic.

- This water system serves a community of about 5,000 residents, and their primary water source is a reservoir.
- Water production from the plant varies from 1.5 to 1.8 MGD (2 MGD design).
- The Missouri River provides a backup water source for the plant; however, it is seldom utilized, and the current operating staff have no recent experience treating this source. Recent drought trends in the area indicate that this alternate source will be needed to meet plant water demands.
- In anticipation of treating this alternative source, consider variability in turbidity, organics, nutrients, and water chemistry (alkalinity, pH, hardness).
- The plant is operated by a supervisor and three shift operators. Some staffing limitations have been identified, i.e., inadequate coverage during extended operation hours (summer), high turnover of night shift operator position, heavy dependence on the plant supervisor as the *"knowledge base"* among the staff.
- A plant schematic is shown below. Major unit processes include primary stage coagulation/ flocculation/sedimentation, secondary stage coagulation/flocculation/sedimentation, filtration, and disinfection.
- The following chemicals are currently fed at the plant unless otherwise noted:
  - Coagulant – Carus PHI 2347 (blended product including aluminum and polyamines)
  - Carbon – taste and odor control
  - Chlorine dioxide – pre-oxidation
  - Potassium permanganate – seldom used, limited operator experience
  - Lime – alkalinity addition
  - Fluorosilicic acid – dental protection
  - Orthophosphate – corrosion control
  - Chlorine – disinfection
- The plant has a good-sized process control lab that includes standard surface water treatment analytical equipment.

- A jar test mixer and jars are available. The operators collect daily samples of the primary and secondary stage coagulated water and run a jar test using established jar test settings. Settled water turbidity results are recorded. Operators do not make stock solutions and do not have experience conducting jar testing other than following their standard protocol.



Part 3 – Planning for water quality event preparedness training

AWOP training on water quality event preparedness is being planned based on the water system needing to utilize their alternative water supply. AWOP workshops typically have three or more small groups working on different aspects of the training topic. The following areas have been identified to support training on this topic:

1. Alternative source water and intake
2. Multiple barrier assessment and treatability
3. Operational skills
4. Management support and resources
5. Communication

AWOP training events typically emphasize hands-on activities, and this approach is especially important for this topic. To make this water quality event as realistic as possible, it is important to fully test capabilities given the plant operations flexibility and available time, i.e., utilize actual system data, conduct bench scale

studies, conduct full-scale studies when possible. A list of activities for the training group and plant staff to follow up on after the training is an expected outcome of the workshop.

For your group's assigned area(s), work through the questions in the development template below, thinking about the results and impacts of the switch to the alternative source. Develop an approach to confirm treatment plant capabilities, identify weak links, and motivate plant staff to proactively engage in water quality event preparedness. Discuss your assigned area(s) and document your key points and approach. Each group will be asked to provide feedback on their workshop results. Make sure that you have good documentation! Group results will be compiled and can be used to develop future training on water quality event preparedness for your state or region.

1. Alternative Source Water & Intake: What approach can be used to assess the alternative source water quality and intake? Consider availability of alternative source water quality information, missing data, and related decision making.

- Watershed or monitoring locations, data types, and access
- Raw water monitoring locations, data types
- Water quality triggers to establish treatment changes
- Raw water pumping assessment
- Types of studies that could be conducted during the workshop to assess this area

Insert your group results in the blank template provided below (page 7).

2. Multiple Barrier Assessment & Treatability: What approach can be taken to assess the plant multiple barriers (or targeted barriers) and their ability to treat the alternative water source? Consider the following:

- Treatment types and processes (refer to schematic)
- Available oxidants (e.g., permanganate, chlorine dioxide, chlorine)
- Coagulants and/or polymers
- Chemical feed capabilities (feed rates, dosages)
- Disinfection CT
- Solids handling
- Secondary impacts of changing source water, e.g., corrosion control
- Types of studies that could be conducted during the workshop to assess this area

Insert your group results in the blank template provided below (page 7).

3. Operational Skills: What approach can be taken to consider operational skills needed to assess process and treatability options when using an alternative source water? How will these skills be demonstrated or developed?

Consider the following areas:

- Sampling and testing capabilities (in-house or contract lab, depending on type of monitoring required)
- Ability to jar test for multiple applications (e.g., particle removal, TOC removal, iron and manganese oxidation, powdered activated carbon addition)
- Ability to develop and conduct Special Studies
- Types of studies that could be conducted during the workshop to assess this area

Insert your group results in the blank template provided below (page 7).

4. Management Support and Resources: What approach can be taken to consider management factors that could impact the successful use of an alternative source water? Consider the following:

- Support for operator preparedness training
- Approach for conducting full-scale scenario testing
- Operator availability (time to work on the approach)
- Budget needs / impacts
- Bringing in outside perspectives, such as AWOP staff, local utilities facing similar issues, etc.
- Types of activities or studies that could be conducted during the workshop to assess this area – think about activities that play to the strengths of a management staff member, e.g., facility walk-through, planning and conducting full-scale testing.

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5. Communication: What approach can be taken to consider communication factors that could impact the effectiveness and outcomes of using an alternative source water? Consider:

- Internal communication – within organization, workgroups (operations, maintenance)
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- Approvals from regulatory agencies to set up a full-scale trial
- Consider the communications aspects of unintended consequences. How will communication be handled if something goes wrong with the switch in sources?
- Types of activities or studies that could be conducted during the workshop to assess this area – think about existing communication protocols and the need for new ones with a staff member that would support this water quality event.

Insert your group results in the blank template provided below (page 7).

Use the templates below to document your training approach ideas:

Assigned training area: **2 – Multiple barrier assessment and treatability**
• Jar testing → permanganate demand)) training → coagulant optimization) • Investigate: closing locations, e.g., move point of MnO_4 separate closing locations for more effective process control • Understand chemical usage and optimize dosing locations. • Work with local technical schools to recruit more staff. • If change in water quality, understand equipment. Get trained on it (e.g., don't currently use MnO_4), so if jar testing shows it is needed, operators need to be ready and know how to operate their processes.
Assigned training area:

Part 4 – Workshop feedback and next steps

Wrap up this workshop by discussing and documenting your observations from this activity. Finally, think about and document how training on water quality event preparedness could be introduced in your AWOP. Observations from participating in this activity: Obstacles to introducing water quality event preparedness training and possible approaches to overcoming obstacles: • Operator reluctance to changing treatment or chemicals processes. Next steps for your state or region:

Group 4

Participants:

What you will be doing during this workshop:

1. Brainstorm water quality events impacting your state/region (~ 10 min.) ☐
2. Review water system background to plan a water quality event training activity (~ 10 min.) ☐
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- Floodings
- Drought
- Hurricane
- Power outages
- Staff shortages
- Spills
- Antiquated infrastructure failure
- Freezing
- Chemical feed failure or spillage
- Alternative chemical suppliers

Part 2 – Setup for water quality event preparedness training

The second part of this workshop provides background on a proposed host water system where training on water quality event preparedness will be conducted. The proposed host water system information is based on a CPE conducted in an AWOP state. As described in the overview presentation, this type of training is part of an approach to improve the readiness of water system managers and operators for water quality events with which they have limited experience. The following background provides information for your group to use in developing a workshop approach on this topic.

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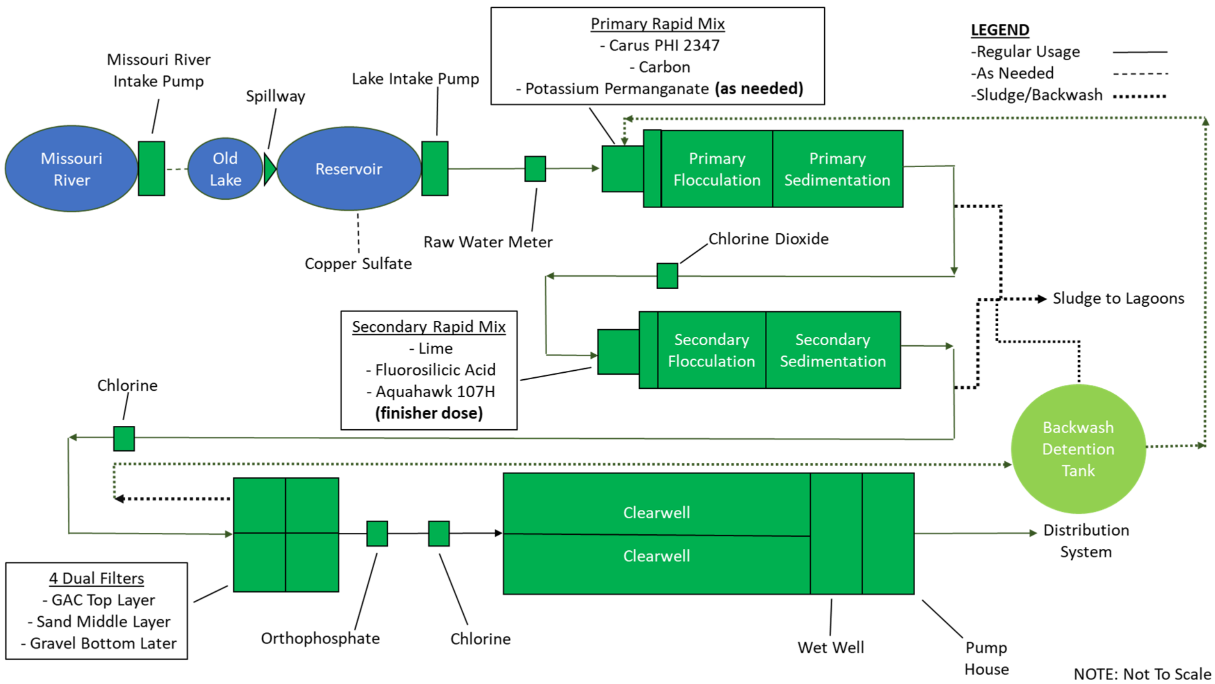

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Use the templates below to document your training approach ideas:

Assigned training area: **3 – Operational skills**
• Chemical feed drawdowns – are there alternatives to using the river? • SOP development. • Water quality sampling to see what the river is like. Call neighboring systems and ask for data. • Jar testing training (stock solutions, understanding the goals of jar testing). • Test valve, intake, pump. • Test chemical injection points. • Practice potassium permanganate? • Focus on particulate removal short term. • Can backwash waters be diverted during an event? • AWOP tools for jar tests. • Should be able to sample from the river for jar tests. • Test alarms. • "Special Study" – corrosion control effects.
Assigned training area:

Part 4 – Workshop feedback and next steps

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Next steps for your state or region:

Group Number is unknown.

Participants:

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- Flooding
- Drought
- Fires
- Spill

- - - - - - - - -

- Storms (high wind)
- Power outages
- HABs

Part 2 – Setup for water quality event preparedness training

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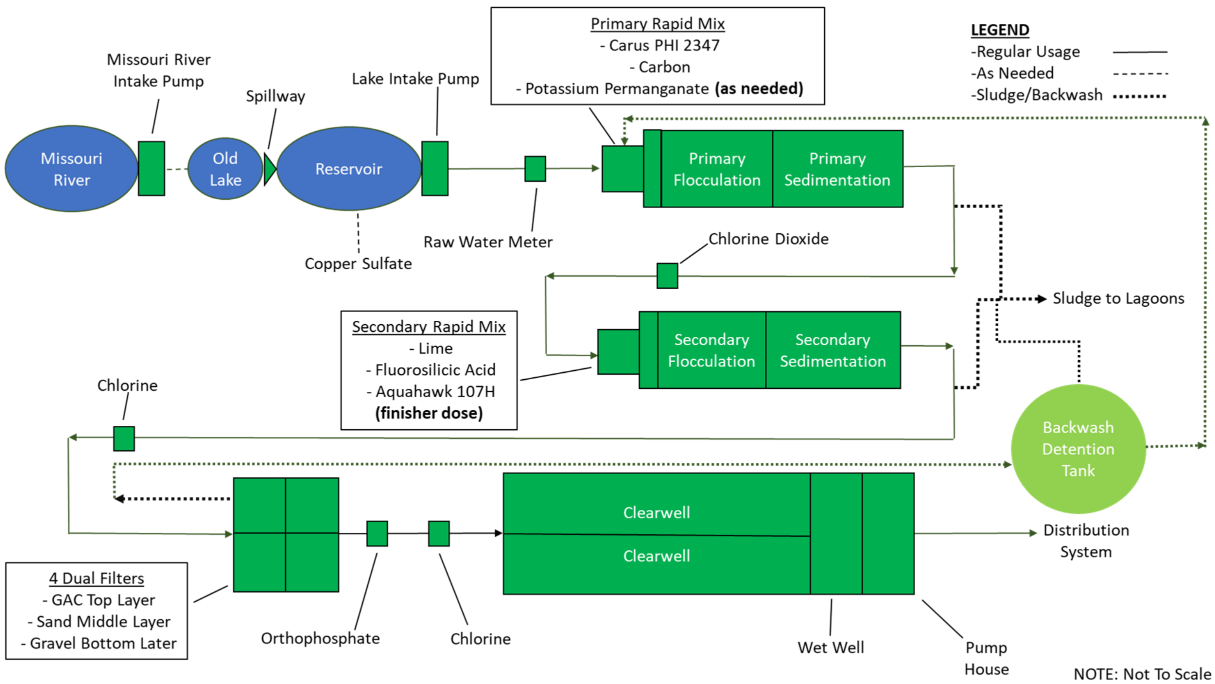
- A jar test mixer and jars are available. The operators collect daily samples of the primary and secondary stage coagulated water and run a jar test using established jar test settings. Settled water turbidity results are recorded. Operators do not make stock solutions and do not have experience conducting jar testing other than following their standard protocol.



Part 3 – Planning for water quality event preparedness training

AWOP training on water quality event preparedness is being planned based on the water system needing to utilize their alternative water supply. AWOP workshops typically have three or more small groups working on different aspects of the training topic. The following areas have been identified to support training on this topic:

1. Alternative source water and intake
2. Multiple barrier assessment and treatability
3. Operational skills
4. Management support and resources
5. Communication

AWOP training events typically emphasize hands-on activities, and this approach is especially important for this topic. To make this water quality event as realistic as possible, it is important to fully test capabilities given the plant operations flexibility and available time, i.e., utilize actual system data, conduct bench scale

studies, conduct full-scale studies when possible. A list of activities for the training group and plant staff to follow up on after the training is an expected outcome of the workshop.

For your group's assigned area(s), work through the questions in the development template below, thinking about the results and impacts of the switch to the alternative source. Develop an approach to confirm treatment plant capabilities, identify weak links, and motivate plant staff to proactively engage in water quality event preparedness. Discuss your assigned area(s) and document your key points and approach. Each group will be asked to provide feedback on their workshop results. Make sure that you have good documentation! Group results will be compiled and can be used to develop future training on water quality event preparedness for your state or region.

1. Alternative Source Water & Intake: What approach can be used to assess the alternative source water quality and intake? Consider availability of alternative source water quality information, missing data, and related decision making.

- Watershed or monitoring locations, data types, and access
- Raw water monitoring locations, data types
- Water quality triggers to establish treatment changes
- Raw water pumping assessment
- Types of studies that could be conducted during the workshop to assess this area

Insert your group results in the blank template provided below (page 7).

2. Multiple Barrier Assessment & Treatability: What approach can be taken to assess the plant multiple barriers (or targeted barriers) and their ability to treat the alternative water source? Consider the following:

- Treatment types and processes (refer to schematic)
- Available oxidants (e.g., permanganate, chlorine dioxide, chlorine)
- Coagulants and/or polymers
- Chemical feed capabilities (feed rates, dosages)
- Disinfection CT
- Solids handling
- Secondary impacts of changing source water, e.g., corrosion control
- Types of studies that could be conducted during the workshop to assess this area

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<u>3. Operational Skills</u>: What approach can be taken to consider operational skills needed to assess process and treatability options when using an alternative source water? How will these skills be demonstrated or developed?

Consider the following areas:

- Sampling and testing capabilities (in-house or contract lab, depending on type of monitoring required)
- Ability to jar test for multiple applications (e.g., particle removal, TOC removal, iron and manganese oxidation, powdered activated carbon addition)
- Ability to develop and conduct Special Studies
- Types of studies that could be conducted during the workshop to assess this area

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<u>4. Management Support and Resources</u>: What approach can be taken to consider management factors that could impact the successful use of an alternative source water? Consider the following:

- Support for operator preparedness training
- Approach for conducting full-scale scenario testing
- Operator availability (time to work on the approach)
- Budget needs / impacts
- Bringing in outside perspectives, such as AWOP staff, local utilities facing similar issues, etc.
- Types of activities or studies that could be conducted during the workshop to assess this area – think about activities that play to the strengths of a management staff member, e.g., facility walk-through, planning and conducting full-scale testing.

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<u>5. Communication</u>: What approach can be taken to consider communication factors that could impact the effectiveness and outcomes of using an alternative source water? Consider:

- Internal communication – within organization, workgroups (operations, maintenance)
- External communication – with customers, press, social media messaging
- Approvals from regulatory agencies to set up a full-scale trial
- Consider the communications aspects of unintended consequences. How will communication be handled if something goes wrong with the switch in sources?
- Types of activities or studies that could be conducted during the workshop to assess this area – think about existing communication protocols and the need for new ones with a staff member that would support this water quality event.

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Use the templates below to document your training approach ideas:

Assigned training area: **2 – Multiple barrier assessment and treatability**
• Jar test (coagulant) over long period of time • Forecasting and coordination with polymers • Raw water pump usability and capacity • Chemical feed pump (permanganite) usability and capacity/sizing • Chemical age and availability (permanganite) • Jar test SOP development • Sludge removal capacity • Operator training and readiness • Water restriction process • Water temperature variability • Chemical monitoring with chemical changes • Updated monitoring locations (pre & during) • SCADA review (update alarms)
Assigned training area:
• Chemical source for higher amounts of chemical • Mixing speeds for floc/sed • Chlorine demand changes • Backwash water SOP • Chlorine dioxide for CT (pre-chlorine) • Benchmark rate increase with increased loading • Capacity impacts with filter benchmark rate • Trial with blended water

Part 4 – Workshop feedback and next steps

Wrap up this workshop by discussing and documenting your observations from this activity. Finally, think about and document how training on water quality event preparedness could be introduced in your AWOP.

Observations from participating in this activity:

- Immensely useful.
- Extremely complex when you start going through the treatment process from multiple angles.

Obstacles to introducing water quality event preparedness training and possible approaches to overcoming obstacles:

- Standard issues with finding voluntary systems to work with.
- Availability of data and treatment staff.

Next steps for your state or region:

- Set up AWOP style workshops and evaluations.
- Challenges with source changes. Start with preparedness training with surface water systems.

Group Number is unknown.

Participants:

What you will be doing during this workshop:

1. Brainstorm water quality events impacting your state/region (~ 10 min.) ☐
2. Review water system background to plan a water quality event training activity (~ 10 min.) ☐
3. Complete assigned areas to develop onsite activities at host water system (~ 20 min.) ☐
4. Provide feedback on workshop experience and next steps for your state/region (~ 10 min.) ☐

Part 1 – Brainstorming water quality events impacting your state/region

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Water Quality Event Brainstorming: *Identify and discuss water quality event(s) that you have experienced in your state or region that presented challenges to your water systems. What other types of events could impact your systems? Document your list of water quality events along with comments on experience gained, likelihood of occurrence, types of vulnerable water systems.*

- HABs – more likely to occur in future; shallow sources most likely, but could occur anywhere.
- Drought – has happened in past; systems on small sources/reservoirs.
- Intense rainfall events – occurs frequently; systems on small rivers.
- Wildfires – change to pH, TOC, increase in turbidity.

Part 2 – Setup for water quality event preparedness training

The second part of this workshop provides background on a proposed host water system where training on water quality event preparedness will be conducted. The proposed host water system information is based on a CPE conducted in an AWOP state. As described in the overview presentation, this type of training is part of an approach to improve the readiness of water system managers and operators for water quality events with which they have limited experience. The following background provides information for your group to use in developing a workshop approach on this topic.

- This water system serves a community of about 5,000 residents, and their primary water source is a reservoir.
- Water production from the plant varies from 1.5 to 1.8 MGD (2 MGD design).
- The Missouri River provides a backup water source for the plant; however, it is seldom utilized, and the current operating staff have no recent experience treating this source. Recent drought trends in the area indicate that this alternate source will be needed to meet plant water demands.
- In anticipation of treating this alternative source, consider variability in turbidity, organics, nutrients, and water chemistry (alkalinity, pH, hardness).
- The plant is operated by a supervisor and three shift operators. Some staffing limitations have been identified, i.e., inadequate coverage during extended operation hours (summer), high turnover of night shift operator position, heavy dependence on the plant supervisor as the *"knowledge base"* among the staff.
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  - Coagulant – Carus PHI 2347 (blended product including aluminum and polyamines)
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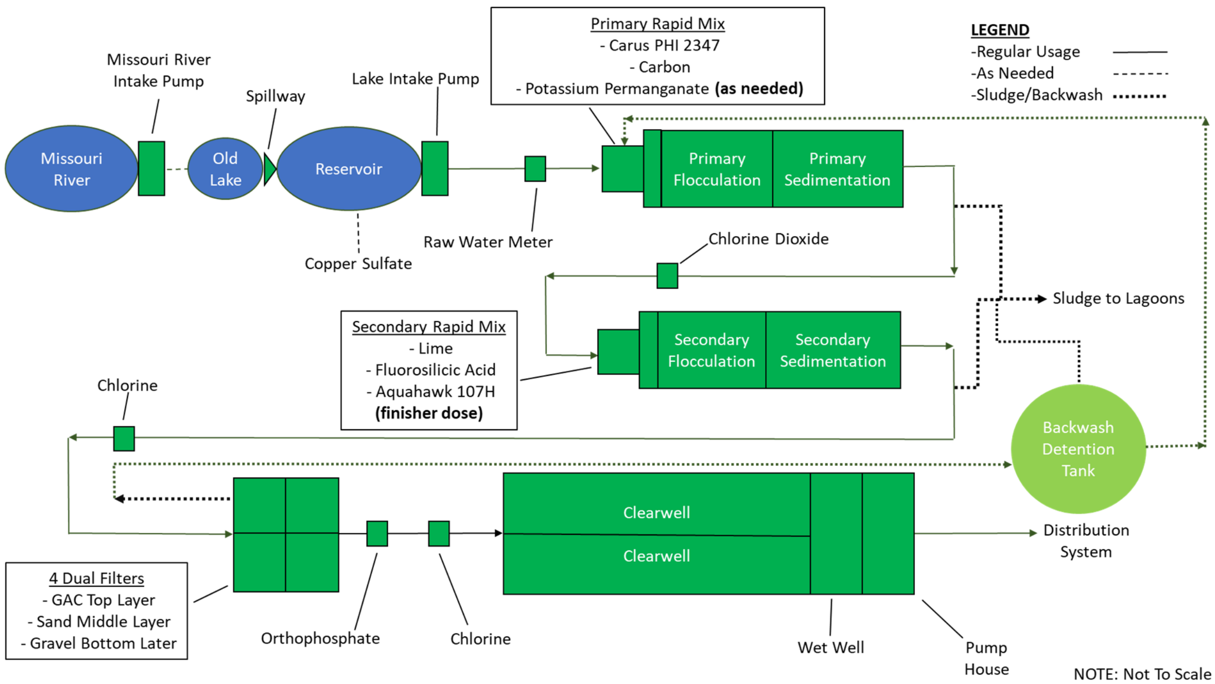

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Use the templates below to document your training approach ideas:

Assigned training area: **2 – Multiple barrier assessment and treatability**
• Background data on Missouri River water quality and water quality after reservoir. • Water quality testing would determine what chemicals may be needed. • Conducting training and testing on Jar Testing to determine what level of chemicals to feed. • Monitoring after each basin (floc/sed) would consist of turbidity, pH, after secondary chlorine dioxide. • With shortage of staff, determination of pump capacity on chemical feeders. • Dosing locations.
Assigned training area:

Part 4 – Workshop feedback and next steps

Wrap up this workshop by discussing and documenting your observations from this activity. Finally, think about and document how training on water quality event preparedness could be introduced in your AWOP.

Observations from participating in this activity:

- Good activity to practice; could see doing this as a workshop in our state next time we host.

Obstacles to introducing water quality event preparedness training and possible approaches to overcoming obstacles:

- Knowledge of alternative water source water quality – conduct periodic background sampling.
- Having to use different equipment that operators may not be familiar with on a day-to-day basis, i.e., generators, jar testing.

Next steps for your state or region:

- Promote emergency preparedness.
- Host a workshop on Water Quality Event Preparedness.

Group Number is unknown.

Participants:

What you will be doing during this workshop:

1. Brainstorm water quality events impacting your state/region (~ 10 min.) ☐
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- Droughts/dry weather
- Flooding
- Nutrient runoff
- Chemical spills
- Supply chain disruptions

Part 2 – Setup for water quality event preparedness training

The second part of this workshop provides background on a proposed host water system where training on water quality event preparedness will be conducted. The proposed host water system information is based on a CPE conducted in an AWOP state. As described in the overview presentation, this type of training is part of an approach to improve the readiness of water system managers and operators for water quality events with which they have limited experience. The following background provides information for your group to use in developing a workshop approach on this topic.

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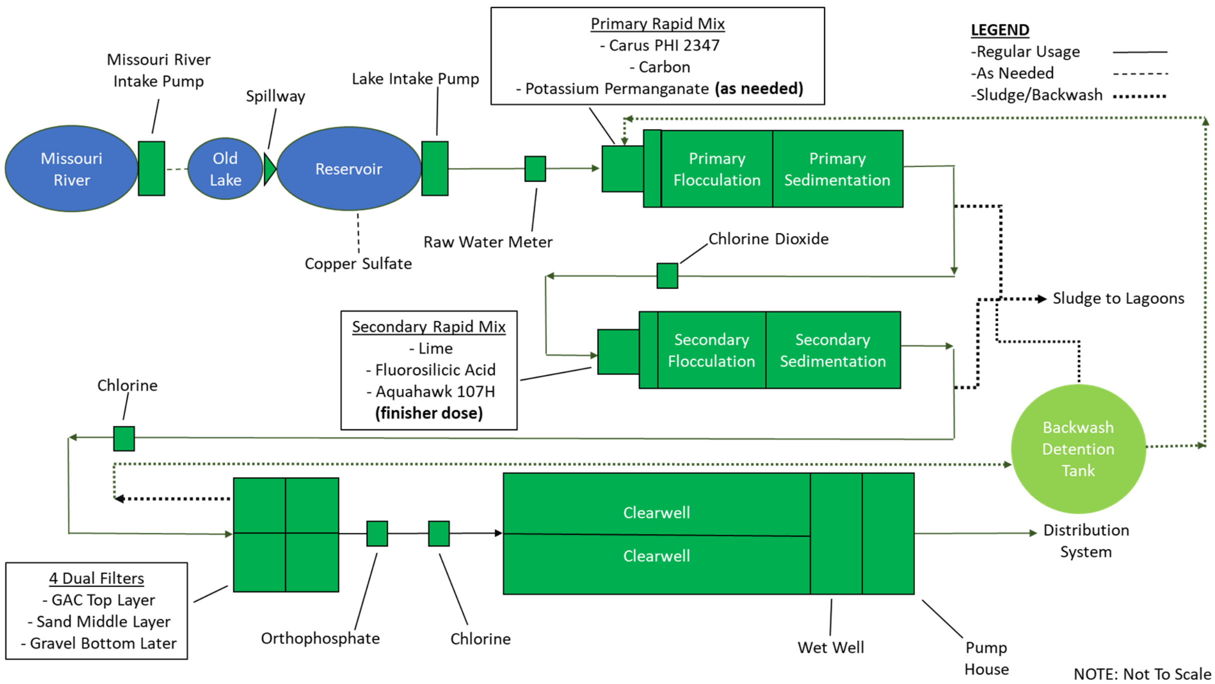

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3. Operational Skills: What approach can be taken to consider operational skills needed to assess process and treatability options when using an alternative source water? How will these skills be demonstrated or developed?

Consider the following areas:

- Sampling and testing capabilities (in-house or contract lab, depending on type of monitoring required)
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4. Management Support and Resources: What approach can be taken to consider management factors that could impact the successful use of an alternative source water? Consider the following:

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- Approach for conducting full-scale scenario testing
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- Types of activities or studies that could be conducted during the workshop to assess this area – think about existing communication protocols and the need for new ones with a staff member that would support this water quality event.

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Use the templates below to document your training approach ideas:

Assigned training area: **4 – Management support and resources**
1 - Begin with more jar testing of the surface water sources. Reach out to nearby systems that already treat the surface water. Potentially connect with existing systems. Bring in training session for surface water treatment. 3 – Ensure there is enough time/operators for training and operations. 2 – Do a water flow-through test to make sure all equipment is working. Work with senior operator to write down all operating procedures. Review emergency management plan with all employees. 4 – May need to increase additives and hire more staff and bring in more training (and pay overtime) to attend. Look into grant options.
Assigned training area:

Part 4 – Workshop feedback and next steps

Wrap up this workshop by discussing and documenting your observations from this activity. Finally, think about and document how training on water quality event preparedness could be introduced in your AWOP. Observations from participating in this activity: Obstacles to introducing water quality event preparedness training and possible approaches to overcoming obstacles: Next steps for your state or region:

Group Number is unknown.

Participants:

What you will be doing during this workshop:

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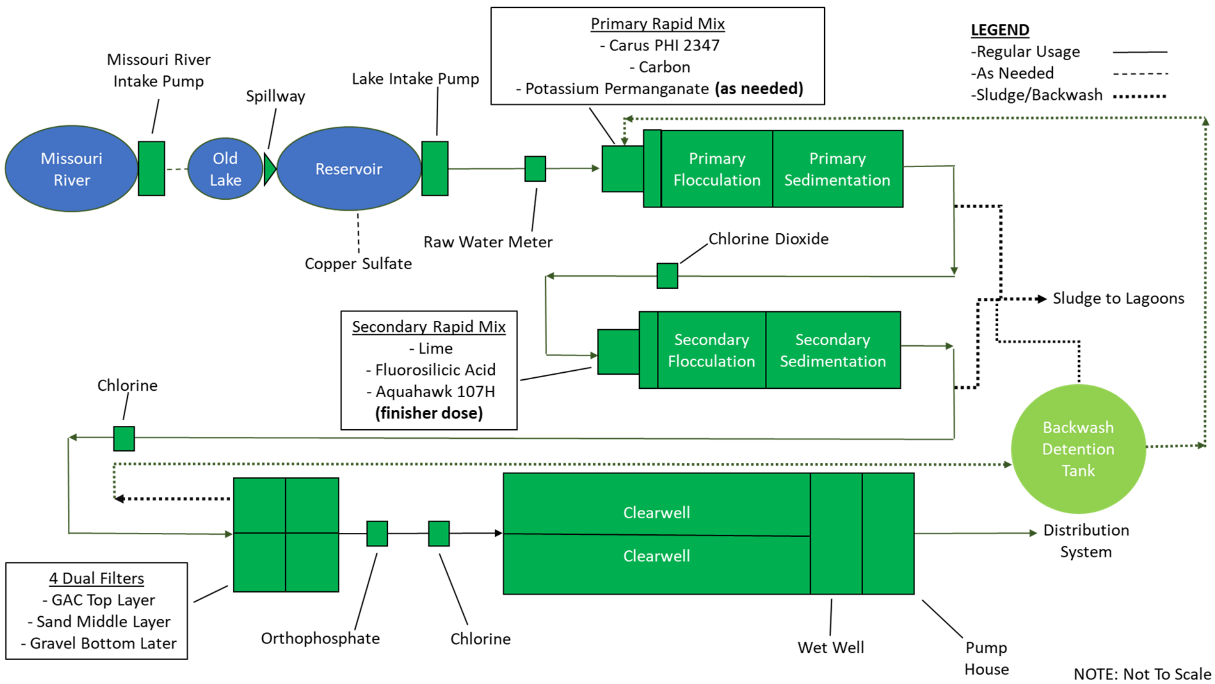

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- Ability to develop and conduct Special Studies
- Types of studies that could be conducted during the workshop to assess this area

Insert your group results in the blank template provided below (page 7).

4. Management Support and Resources: What approach can be taken to consider management factors that could impact the successful use of an alternative source water? Consider the following:

- Support for operator preparedness training
- Approach for conducting full-scale scenario testing
- Operator availability (time to work on the approach)
- Budget needs / impacts
- Bringing in outside perspectives, such as AWOP staff, local utilities facing similar issues, etc.
- Types of activities or studies that could be conducted during the workshop to assess this area – think about activities that play to the strengths of a management staff member, e.g., facility walk-through, planning and conducting full-scale testing.

Insert your group results in the blank template provided below (page 7).

5. Communication: What approach can be taken to consider communication factors that could impact the effectiveness and outcomes of using an alternative source water? Consider:

- Internal communication – within organization, workgroups (operations, maintenance)
- External communication – with customers, press, social media messaging
- Approvals from regulatory agencies to set up a full-scale trial
- Consider the communications aspects of unintended consequences. How will communication be handled if something goes wrong with the switch in sources?
- Types of activities or studies that could be conducted during the workshop to assess this area – think about existing communication protocols and the need for new ones with a staff member that would support this water quality event.

Insert your group results in the blank template provided below (page 7).

Use the templates below to document your training approach ideas:

<u>Assigned training area</u>: Management support and resources
• Jar testing for changing conditions and training. • Train other operators. • Jar testing training and chemicals: - Stock solution – coagulant ≈ polymer - Carbon – recalculate chemical feed rates. Hire outside help. Near utility. Temp. changes. • SOP to switch source. Add to ERD. Include training. • Equipment – inspected – does it work? Routine maintenance. • Hire TA provider – consultant. • Reserves include emergency situation. • Operator staffing/rotating.
<u>Assigned training area</u>:

Part 4 – Workshop feedback and next steps

Wrap up this workshop by discussing and documenting your observations from this activity. Finally, think about and document how training on water quality event preparedness could be introduced in your AWOP. Observations from participating in this activity: Obstacles to introducing water quality event preparedness training and possible approaches to overcoming obstacles: • Operator reluctance to changing treatment or chemicals processes.

Next steps for your state or region:

Group Number is unknown.

Participants:

What you will be doing during this workshop:

1. Brainstorm water quality events impacting your state/region (~ 10 min.) ☐
2. Review water system background to plan a water quality event training activity (~ 10 min.) ☐
3. Complete assigned areas to develop onsite activities at host water system (~ 20 min.) ☐
4. Provide feedback on workshop experience and next steps for your state/region (~ 10 min.) ☐

Part 1 – Brainstorming water quality events impacting your state/region

The purpose of this workshop is to gain experience setting up a training activity on water quality event preparedness at a host water system. In the first part of the workshop your group is to discuss water quality events that have impacted or could impact water systems in your state and region. The overview presentation provided ideas based on events that have recently impacted AWOP states and regions. Your group may have other location-specific examples to discuss. List your ideas below.

Water Quality Event Brainstorming: *Identify and discuss water quality event(s) that you have experienced in your state or region that presented challenges to your water systems. What other types of events could impact your systems? Document your list of water quality events along with comments on experience gained, likelihood of occurrence, types of vulnerable water systems.*

- New Mexico – Wildfires:
  Higher turbidity, surface WS vulnerable.
  Better understanding and communication from above.

- Missouri – Tornadoes:
  Loss of power, unknown preparedness.

- EPA Region 6 – HAB:
  ORSANCO assisted in Ohio, lessons learned.

- Missouri – Earthquakes:
  Definitely unprepared. Many changes and dangers. Extremely rare, but devastating.

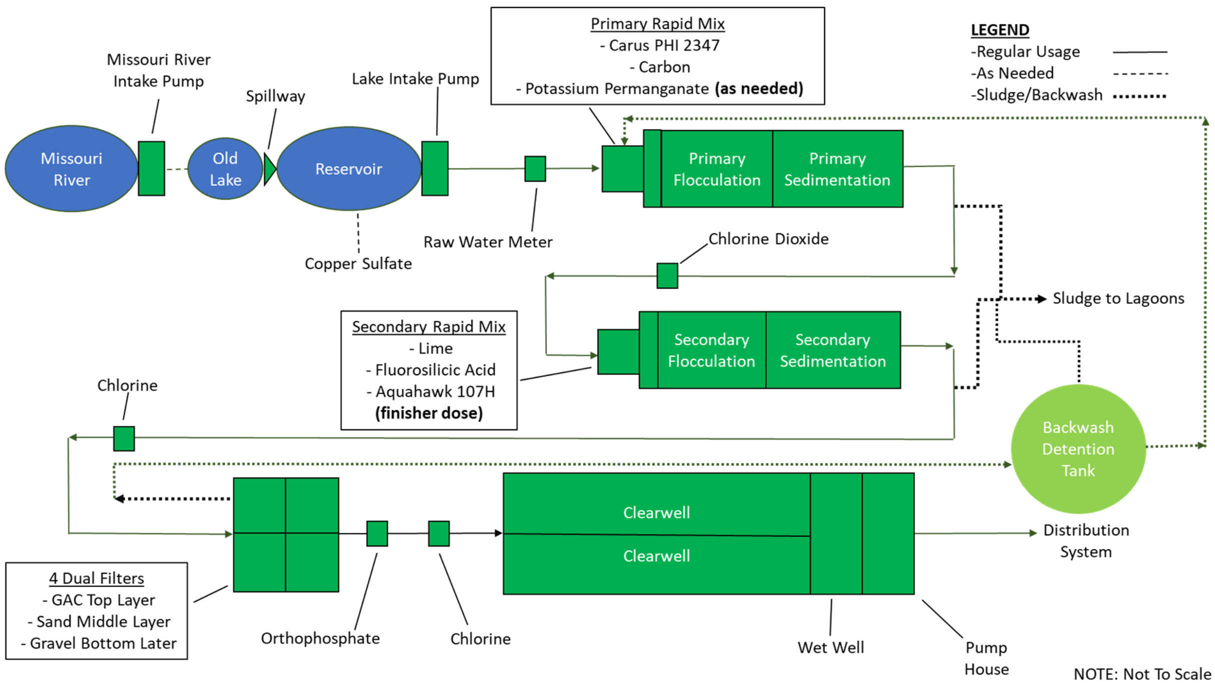
- New Mexico and Missouri: Droughts.
  Already covered extensively.

Part 2 – Setup for water quality event preparedness training

The second part of this workshop provides background on a proposed host water system where training on water quality event preparedness will be conducted. The proposed host water system information is based on a CPE conducted in an AWOP state. As described in the overview presentation, this type of training is part of an approach to improve the readiness of water system managers and operators for water quality events with which they have limited experience. The following background provides information for your group to use in developing a workshop approach on this topic.

- This water system serves a community of about 5,000 residents, and their primary water source is a reservoir.
- Water production from the plant varies from 1.5 to 1.8 MGD (2 MGD design).
- The Missouri River provides a backup water source for the plant; however, it is seldom utilized, and the current operating staff have no recent experience treating this source. Recent drought trends in the area indicate that this alternate source will be needed to meet plant water demands.
- In anticipation of treating this alternative source, consider variability in turbidity, organics, nutrients, and water chemistry (alkalinity, pH, hardness).
- The plant is operated by a supervisor and three shift operators. Some staffing limitations have been identified, i.e., inadequate coverage during extended operation hours (summer), high turnover of night shift operator position, heavy dependence on the plant supervisor as the *"knowledge base"* among the staff.
- A plant schematic is shown below. Major unit processes include primary stage coagulation/flocculation/sedimentation, secondary stage coagulation/flocculation/sedimentation, filtration, and disinfection.
- The following chemicals are currently fed at the plant unless otherwise noted:
    - Coagulant – Carus PHI 2347 (blended product including aluminum and polyamines)
    - Carbon – taste and odor control
    - Chlorine dioxide – pre-oxidation
    - Potassium permanganate – seldom used, limited operator experience
    - Lime – alkalinity addition
    - Fluorosilicic acid – dental protection
    - Orthophosphate – corrosion control
    - Chlorine – disinfection
- The plant has a good-sized process control lab that includes standard surface water treatment analytical equipment.

- A jar test mixer and jars are available. The operators collect daily samples of the primary and secondary stage coagulated water and run a jar test using established jar test settings. Settled water turbidity results are recorded. Operators do not make stock solutions and do not have experience conducting jar testing other than following their standard protocol.



Part 3 – Planning for water quality event preparedness training

AWOP training on water quality event preparedness is being planned based on the water system needing to utilize their alternative water supply. AWOP workshops typically have three or more small groups working on different aspects of the training topic. The following areas have been identified to support training on this topic:

1. Alternative source water and intake
2. Multiple barrier assessment and treatability
3. Operational skills
4. Management support and resources
5. Communication

AWOP training events typically emphasize hands-on activities, and this approach is especially important for this topic. To make this water quality event as realistic as possible, it is important to fully test capabilities given the plant operations flexibility and available time, i.e., utilize actual system data, conduct bench scale

studies, conduct full-scale studies when possible. A list of activities for the training group and plant staff to follow up on after the training is an expected outcome of the workshop.

For your group's assigned area(s), work through the questions in the development template below, thinking about the results and impacts of the switch to the alternative source. Develop an approach to confirm treatment plant capabilities, identify weak links, and motivate plant staff to proactively engage in water quality event preparedness. Discuss your assigned area(s) and document your key points and approach. Each group will be asked to provide feedback on their workshop results. Make sure that you have good documentation! Group results will be compiled and can be used to develop future training on water quality event preparedness for your state or region.

1. Alternative Source Water & Intake: What approach can be used to assess the alternative source water quality and intake? Consider availability of alternative source water quality information, missing data, and related decision making.

- Watershed or monitoring locations, data types, and access
- Raw water monitoring locations, data types
- Water quality triggers to establish treatment changes
- Raw water pumping assessment
- Types of studies that could be conducted during the workshop to assess this area

Insert your group results in the blank template provided below (page 7).

2. Multiple Barrier Assessment & Treatability: What approach can be taken to assess the plant multiple barriers (or targeted barriers) and their ability to treat the alternative water source? Consider the following:

- Treatment types and processes (refer to schematic)
- Available oxidants (e.g., permanganate, chlorine dioxide, chlorine)
- Coagulants and/or polymers
- Chemical feed capabilities (feed rates, dosages)
- Disinfection CT
- Solids handling
- Secondary impacts of changing source water, e.g., corrosion control
- Types of studies that could be conducted during the workshop to assess this area

Insert your group results in the blank template provided below (page 7).

3. Operational Skills: What approach can be taken to consider operational skills needed to assess process and treatability options when using an alternative source water? How will these skills be demonstrated or developed?

Consider the following areas:

- Sampling and testing capabilities (in-house or contract lab, depending on type of monitoring required)
- Ability to jar test for multiple applications (e.g., particle removal, TOC removal, iron and manganese oxidation, powdered activated carbon addition)
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Use the templates below to document your training approach ideas:

Assigned training area: 1 – Alternative source water and intake
• Compile historical and current record of river hydraulics and water quality. Some data may be available from other organizations. River water could be considered the worst case scenario. Sample river to fill in missing data. • Jar testing – train operators on proper techniques. Investigate the river water and other variables. • Check river intake equipment maintenance and integrity. • Develop high level plan (final step – conduct MPV Eval.).
Assigned training area:

Part 4 – Workshop feedback and next steps

Wrap up this workshop by discussing and documenting your observations from this activity. Finally, think about and document how training on water quality event preparedness could be introduced in your AWOP. Observations from participating in this activity: Obstacles to introducing water quality event preparedness training and possible approaches to overcoming obstacles: • Some of the provided information in the example would be hard to know before the workshop (familiarity with Jar Tests). • Be flexible and ready in CPEs to transition to preparedness topics if a need is identified. Next steps for your state or region:

Group Number is unknown.

Participants:

What you will be doing during this workshop:

1. Brainstorm water quality events impacting your state/region (~ 10 min.) ☐
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- Flooding – Vermont (boil orders) → power outages; loss of pressure; flooding of well heads.
- Chemical spills → Railroad! (SW sources).
- HABs (surface water systems).
- Severe storms → microbial; power loss.
- Supply chain disruptions (all systems).
- Airborne deposition – o acid rain, wildfire smoke (surface waters)

* Spill notification system → improved warming system.

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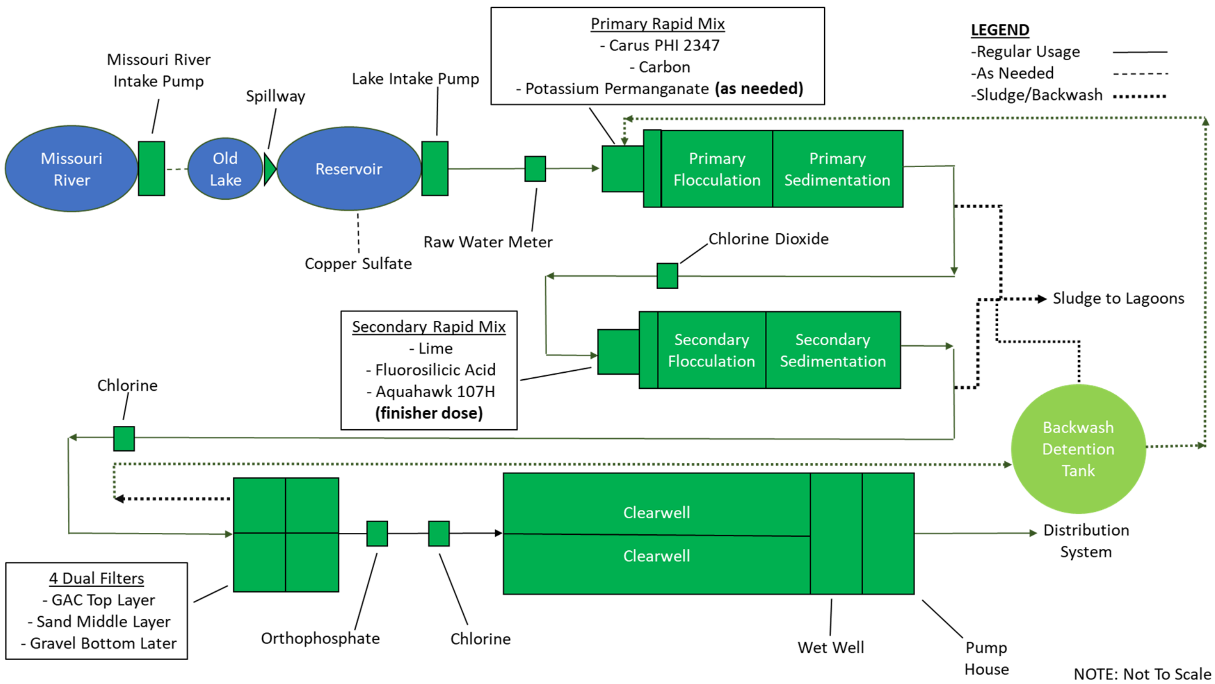

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Insert your group results in the blank template provided below (page 7).

Use the templates below to document your training approach ideas:

Assigned training area: 3 – Operational skills and 5 - Communication
3 – Operational skills: • Stock solution preparation for chemicals – SOP. • Alternate water quality sampling → pH, alkalinity, TOC > SOPs turbidity, Mn, UV 254. • Jar Test procedure – SOP →.conduct Special Studies (seasonally) and develop trends for alternate source. • Treatment basics – knowledge → understanding of treatment basics, chemical feed, treatment goals. • Water quality analysis in lab – SOP. • Water quality blending. • Recycle backwash – eliminate this practice? • Test alarms – if no shift operator present at night. **5 – Communication:** • Public communication → change in source notification. • Emergency response. • WARN.
Assigned training area:

Part 4 – Workshop feedback and next steps

Wrap up this workshop by discussing and documenting your observations from this activity. Finally, think about and document how training on water quality event preparedness could be introduced in your AWOP. Observations from participating in this activity: Obstacles to introducing water quality event preparedness training and possible approaches to overcoming obstacles: Next steps for your state or region: