EPA's Optimal Corrosion Control Treatment Technical Recommendations Document and Templates

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Acronyms

- AL - Action Level
- CCT - Corrosion Control Treatment
- DIC - Dissolved Inorganic Carbon
- DO – Dissolved Oxygen
- LCR - Lead and Copper Rule
- LSL - Lead Service Line
- NOM - Natural Organic Matter
- OCCT - Optimal Corrosion Control Treatment
- ORP - Oxidation-Reduction Potential
- OWQP - Optimal Water Quality Parameters
- TDS - Total Dissolved Solids
- WQP - Water Quality Parameter

Background

- Flint, Michigan
- EPA modified the *Revised Guidance Manual for Selecting Lead and Copper Control Strategies* (EPA March 2003)
- Modification released in March 2016 and renamed –

  Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems
  - Explains regulatory requirements
  - Provides technical recommendations in determining the most appropriate treatment for lead and copper control and complying with the CCT requirements of the LCR.
  - Provides background information on CCT techniques.
  - Provides Excel-based templates to organize and document decisions, available at the following EPA website:

https://www.epa.gov/dwreginfo/optimal-corrosion-control-treatment-evaluation-technical-recommendations

Disclaimer

- The technical recommendations in this document reflect the existing Lead and Copper Rule (LCR) as of the date of document publication. The Environmental Protection Agency (EPA) is in the process of reviewing CCT requirements as part of the Long-term Revisions to the Lead and Copper Rule (LCR LTR). These requirements may change based on any final rule revisions that are made. Readers can visit EPA's website for additional information and updates on the long-term revisions: http://water.epa.gov/lawsregs/rulesregs/sdwa/lcr/index.cfm.

Outline

- Brief summary of the OCCT guidance document and templates
- Show how the new document and templates can be used by public water systems to more effectively implement OCCT
- Information required to be submitted to DPH with OCCT recommendation for acceptance
- Link to document and customized templates on DWS website

http://www.ct.gov/dph/publicdrinkingwater located in the Lead and Copper page

Document Organization Chapters

- **Chapter 1**: Introduction
- **Chapter 2**: Background Information
- **Chapter 3**: CCT for Lead and Copper
- **Chapter 4**: Review of CCT Steps under the LCR
- **Chapter 5:** OCCT Start-Up and Monitoring
- **Chapter 6:** Impacts of Source Water and Treatment Changes on Lead and Copper in Drinking Water

→ OCCT Evaluation Templates

Document Organization
Appendices

- **Appendix A**: Glossary
- **Appendix B**: Estimated Dissolved Inorganic Carbon based on Alkalinity and pH
- **Appendix C**: Investigative Sampling to Determine the Source of Lead and Copper
- **Appendix D**: Water Quality Data and Information Collection Forms
- **Appendix E**: OCCT Recommendation Forms for Systems Serving ≤ 50,000 People
- **Appendix F:** Tools for Conducting Corrosion Control Studies
- **Appendix G**: Forms for Follow-up Monitoring and Setting OWQPs

→ OCCT Evaluation Templates

OCCT Evaluation Templates

- Excel-based forms, customizable
  - Can be completed electronically & emailed to DWS
- Templates in DWS webpage are customized.
- 2 templates:
  - For PWS with ≤ 50,000 people
  - For PWS with > 50,000 people
- The numbering in the templates corresponds to the exhibits in the document.

Slide 8

SM1 I would move this slide more to the end, seems out of place here. I would go through the document and then say that we have templates to guide them through the process on our webpage.

Smith, Mandy, 11/3/2016

Chapter 2:
Background Information

- Regulatory Actions to Control Lead and Copper in Drinking Water
- Sources of Lead and Copper
- Water Quality Factors Affecting the Release of Lead and Copper
- Physical and Hydraulic Factors Affecting the Release of Lead and Copper

LCR Trivia Questions

- What is the AL for
  - Lead?
  - Copper?
- What type of system does LCR apply to?

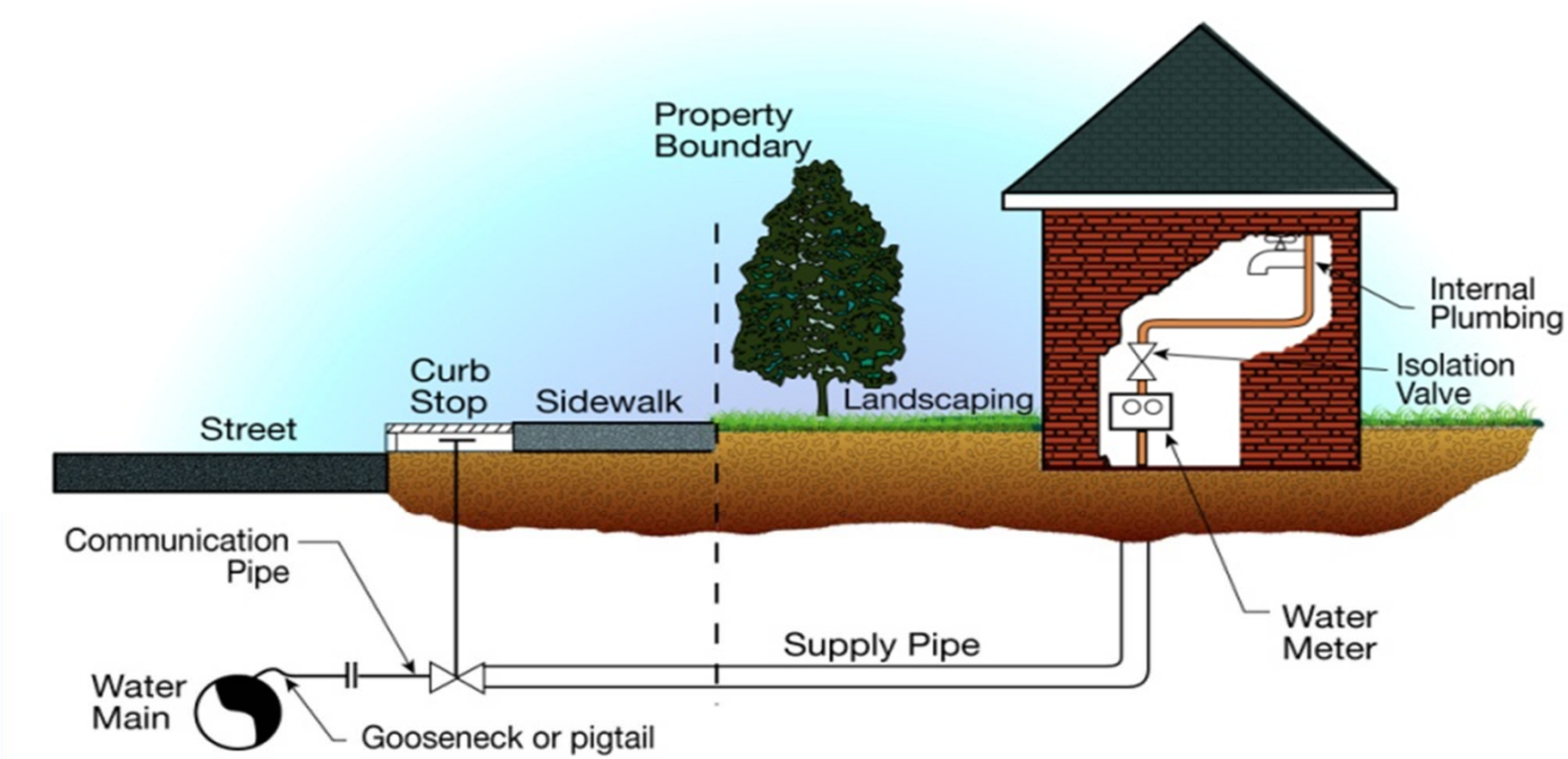
LCR Trivia Questions

- What is the AL for
  - Lead? 0.015 mg/L
  - Copper? 1.3 mg/L
- What type of system does LCR apply to?
  Community and NTNC

LCR Sample Collection

- First draw with minimum 6 hour stagnation
- Aerator stays on faucet
- Cold water kitchen/bathroom tap
- Non-residential: cold water interior tap
- One liter volume
- Wide-mouth bottle

Sources of Lead and Copper



Typical Water Service Connection that May Provide Sources of Lead (Sandvig et al., 2008)

Understanding Corrosion

- Corrosion is a complex series of reactions between the water and metal surfaces and materials
- Corrosion process is an oxidation/reduction reaction that returns refined or processed metal to their more stable ore state.
- Lead and copper release in the form of dissolved, colloidal, or particulate

Scales

- Builds up naturally on metal surface
- Passivating scale – films formed when pipe material and water reacts directly with each other
- Deposited scale – formed when substances (i.e. Fe, Mn, Al, Ca) in the water precipitate out, then build up on the pipe surface
- Characteristics and structure of the scale dictate the amount of lead or copper released into the water
- Can have layers and influenced by treatment history
- Can be vulnerable for lead particulate release following physical disturbance and/or water chemistry change

Dissolved Inorganic Carbon (DIC)

- An estimate of the amount of total carbonates in the form of carbon dioxide gas, bicarbonate ion, and carbonate ion.

  $DIC = CO_2 + H_2CO_3 + CO_3^{2-} + HCO_3^-$

- Closely related to alkalinity

  $Alkalinity = 2CO_3^{2-} + HCO_3^- + OH^- - H^+$

- Why DIC is important?
  - Representing impact of carbonate species on corrosion
  - Predicting corrosive effects at low DIC

WQ Factors Affecting the Release of PBCU

- Alkalinity, pH, and dissolved inorganic carbon (DIC)
- Corrosion inhibitors
- Hardness (calcium and magnesium)
- Buffer intensity
- Dissolved oxygen
- Oxidation reduction potential (ORP)
- Ammonia, chloride, and sulfate
- Natural organic matter (NOM)
- Aluminum, iron, and manganese

Remember, this is about more than just pH!

Physical and Hydraulic Factors Affecting the Release of PBCU

- Physical Disturbances
- Hydraulic Factors
- Water Use
- Water Temperature

Chapter 3:
CCT for Lead and Copper

Technical information on the following:

- Available Corrosion Control Treatment Methods
- Technical Recommendations for Selecting Treatment Alternatives
- Setting the Target Dose and Water Quality
  - Provides recommended targets for controlling release of lead only or lead and copper

CCT Methods

- Summary of chemical processes for pH/Alkalinity/DIC adjustment
- Information on limestone contactors and aeration
- Phosphate-based corrosion inhibitors
  - Orthophosphates
  - Blended phosphates
- Silicate-based corrosion inhibitors
  - Mixture of soda ash and silicon dioxide
  - Mechanism is unclear because silicates also raise the pH of the water
  - More research is needed

Technical Recommendations for Selecting Treatment Alternatives

- Step 1: Review Water Quality Data and Other Information
- Step 2: Evaluate Potential for Scaling
- Step 3: Select One or More Treatment Options
- Step 4: Identify Possible Limitations for Treatment Options
- Step 5: Evaluate Feasibility and Costs of Options that Meet the OCCT Definition

Collection of WQ Data and Other Information

- OCCT Template contains forms for:
  - Raw, treated, and distribution system water quality data
  - Lead and copper data
  - Iron and manganese data
  - Hardness
  - Treatment process information
  - Distribution system materials
  - Lead service line information
  - OCCT recommendation

Exhibits D.1 through D.7 Water Quality Data and Information Collection Forms
To be completed by: Public Water Systems (PWSs), but customizable by Primacy Agencies.
Purpose: To document data and information from a PWS to support its recommendation for Optimal Corrosion Control Treatment (OCCT).

Note: *EPA-approved analytical methods must be used for regulatory sample analysis (§141.89(a)). Primacy Agency-approved analytical methods may be used for analysis of additional samples. In some cases, this may include use of field test kits.*

Exhibit D.1 Water Quality Data - Raw Water [1]

Source Name (if more than one source, copy this section and complete for each source)	
Source ID	
Source Type	

Parameter	Required Monitoring			Recommended Monitoring			System Data						
	No. of Samples	Frequency	Duration of Sampling	No. of Samples	Frequency	Duration of Sampling	No. of Sites	No. of Samples	Date Range When Samples Were Collected		Minimum Value	Maximum Value	Average Value
									Start (dd/mm/yyyy)	End (dd/mm/yyyy)			
Lead (mg/L)				2	2x/year	1 year							
Copper (mg/L)				2	2x/year	1 year							
pH				6	every other month	1 year							
Alkalinity (mg/L as $CaCO_3$)				4	quarterly	1 year							
Hardness (mg/L as $CaCO_3$)				4	quarterly	1 year							
Temperature (˚C)				6	every other month	1 year							
Calcium (mg/L as Ca)				4	quarterly	1 year							
Total Dissolved Solids (mg/L)[2]				4	quarterly	1 year							
Conductivity (as µmho/cm @ 25 ˚C)[2]				6	every other month	1 year							
Total Chlorine (mg/L as Cl_2)				NA	NA	NA							
Free Chlorine (mg/L as Cl_2)				NA	NA	NA							
Chloride (mg/L)				2	2x/year	1 year							
Sulfate (mg/L)				2	2x/year	1 year							
Iron (mg/L)				4	quarterly	1 year							
Manganese (mg/L)				4	quarterly	1 year							
Silica (mg/L as SiO_2)				4	quarterly	1 year							

[1] Under the Lead and Copper Rule, no raw water monitoring is required. However, if raw water monitoring data are available, this may assist the system in selecting the corrosion control treatment that will work best with the system's water quality.

[2] Either total dissolved solids or conductivity can be measured.

NA = not applicable

Review Lead and Copper Tap Data

- Review all lead and copper tap data
  - Collected by the system
  - Part of special studies
- Review locations and dates where sample results > AL (15 ppb for lead, 1.3 ppm for copper)
- Identify water quality and physical factors that may be contributing to lead and/or copper release. (Use info in Chapter 2 to help)
- If cause is unclear, consider additional studies
  - Investigative sampling (250 mL)

OCCT Review Protocol

- DWS Circular Letter #2016-11
- Optimal Corrosion Control Treatment (OCCT) approved based upon PWS justification that the OCCT recommended was selected based on the system's water quality parameters (WQPs) results and the recommended CCT using the EPA's 2016 guidance on OCCT Technical Recommendations
- PWS requires to submit to DWS the completed PWS Data and PWS OCCT Rec forms along with written justification for the recommended OCCT
- WQP min/ranges set by State once OCCT approved
- Revert to standard monitoring: ANY treatment changes: OCCT or other treatment impacting corrosion

Exhibits E.1 through E.3 OCCT Recommendation Forms
To be completed by: Public Water Systems (PWSs)
Purpose: To document the PWS's optimal corrosion control treatment (OCCT) recommendation to the Primacy Agency.

Exhibit E.1: Identification of Potential Corrosion Control Treatment Options					
Refer to Appendix B of the OCCT manual to find the estimated dissolved inorganic carbon (DIC) based on the system's pH and alkalinity obtained from the WQPs at the entry point.			**Refer to Exhibit 3.2 (Chapter 3) in the OCCT manual to find the theoretical saturation pH using the DIC and the calcium level obtained from the WQPs at the entry point.**		
DIC (mg/L as C)			**Saturation pH:**		
Using exhibit 3.3 (Chapter 3) in the OCCT manual to identify the appropriate flowchart for preliminary CCT selection. Using the DIC and the Saturation pH from above to select the potential CCT. Mark down the recommended CCT below.					

CCT Options	Put an X next to all that apply	Identify possible treatment chemicals or processes for the options identified (chemical formula or common name)
Raise pH		
Raise DIC (alkalinity)		
Add orthophosphate[1]		
Add silicate		
Add blended phosphate[1]		

[1] For orthophosphate and blended phosphate, provide in mg/L as P. For blended phosphate, include the percent of the blend that is orthophosphate.

Appendix B – Estimated Dissolved Inorganic Carbon (mg/L as C) based on Alkalinity and pH (with water temperature of 25 degrees C and TDS of 200)[1, 2]

Total Alkalinity	pH																				
	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.8	10.0	10.2	10.4
0	0																				
2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0					
4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0			
6	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0		
8	4	3	3	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	0		
10	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	0	
12	5	4	4	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	
14	6	5	4	4	4	4	4	3	3	3	3	3	3	3	3	3	2	2	1	1	0
16	7	6	5	5	4	4	4	4	4	4	4	4	4	4	3	3	3	2	2	1	0
18	8	7	6	5	5	5	5	4	4	4	4	4	4	4	4	4	3	3	2	2	1
20	9	7	6	6	5	5	5	5	5	5	5	5	5	4	4	4	4	3	3	2	1
22	10	8	7	6	6	6	6	5	5	5	5	5	5	5	5	4	4	4	3	2	1
24	11	9	8	7	7	6	6	6	6	6	6	6	5	5	5	5	4	4	3	2	2
26	11	10	8	8	7	7	7	6	6	6	6	6	6	6	6	5	5	4	4	3	2
28	12	10	9	8	8	7	7	7	7	7	7	7	6	6	6	6	5	5	4	3	2
30	13	11	10	9	8	8	8	7	7	7	7	7	7	7	6	6	6	5	4	3	2
35	15	13	11	10	9	9	9	9	9	8	8	8	8	8	8	7	7	6	5	4	3
40	18	15	13	12	11	10	10	10	10	10	10	9	9	9	9	8	8	7	6	5	4
45	20	16	14	13	12	12	11	11	11	11	11	11	10	10	10	9	9	8	7	6	5
50	22	18	16	14	14	13	13	12	12	12	12	12	12	11	11	10	10	9	8	7	5
55	24	20	18	16	15	14	14	14	13	13	13	13	13	12	12	11	11	10	9	8	6
60	26	22	19	17	16	16	15	15	15	14	14	14	14	14	13	12	12	11	10	8	7
65	29	24	21	19	18	17	16	16	16	16	15	15	15	15	14	14	13	12	10	9	8

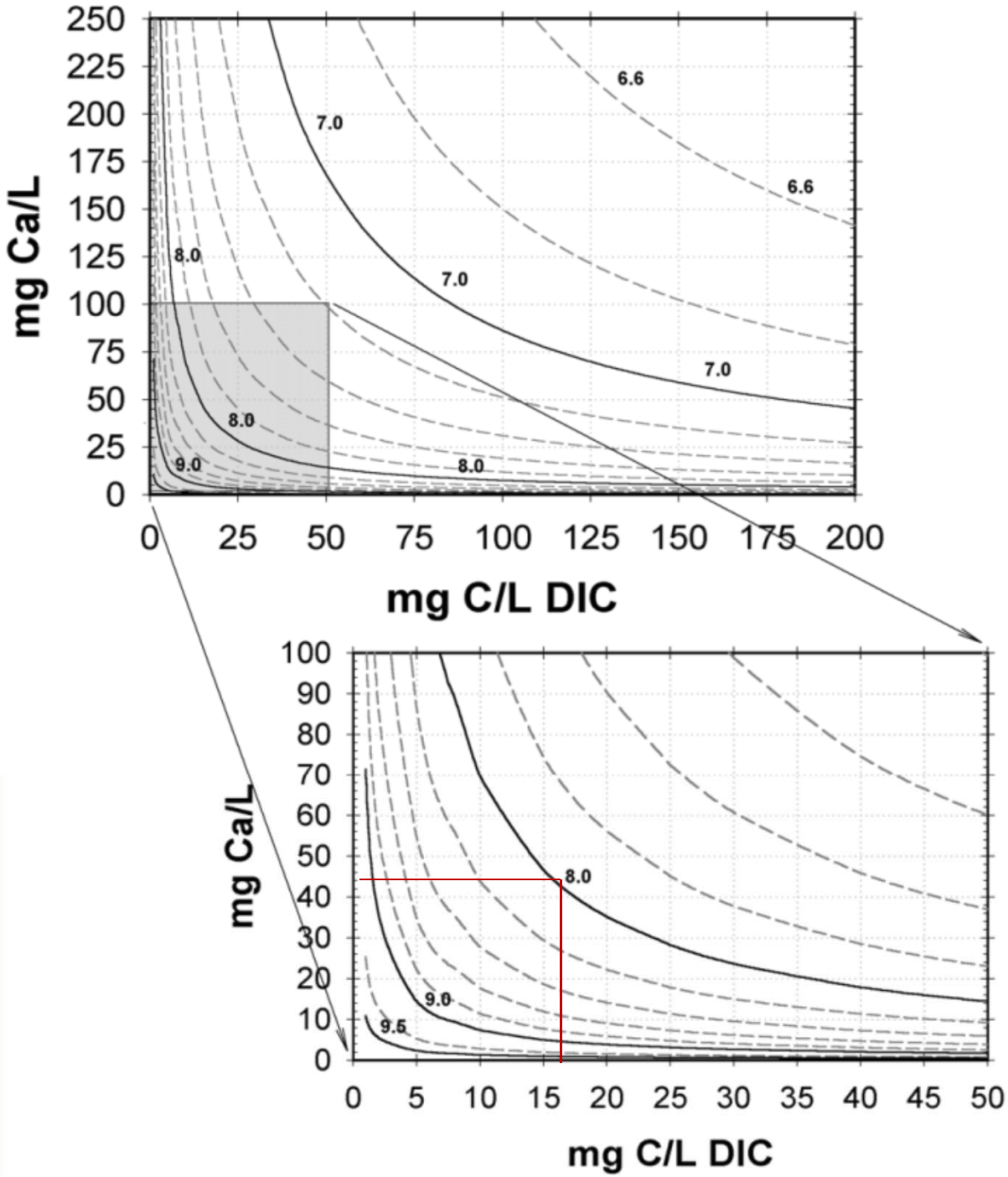
Exhibits E.1 through E.3 OCCT Recommendation Forms
To be completed by: Public Water Systems (PWSs)
Purpose: To document the PWS's optimal corrosion control treatment (OCCT) recommendation to the Primacy Agency.

Exhibit E.1: Identification of Potential Corrosion Control Treatment Options					
Refer to Appendix B of the OCCT manual to find the estimated dissolved inorganic carbon (DIC) based on the system's pH and alkalinity obtained from the WQPs at the entry point.			**Refer to Exhibit 3.2 (Chapter 3) in the OCCT manual to find the theoretical saturation pH using the DIC and the calcium level obtained from the WQPs at the entry point.**		
DIC (mg/L as C)	16		**Saturation pH:**		
Using exhibit 3.3 (Chapter 3) in the OCCT manual to identify the appropriate flowchart for preliminary CCT selection. Using the DIC and the Saturation pH from above to select the potential CCT. Mark down the recommended CCT below.					

CCT Options	**Put an X next to all that apply**	**Identify possible treatment chemicals or processes for the options identified (chemical formula or common name)**
Raise pH		
Raise DIC (alkalinity)		
Add orthophosphate[1]		
Add silicate		
Add blended phosphate[1]		

[1] For orthophosphate and blended phosphate, provide in mg/L as P. For blended phosphate, include the percent of the blend that is orthophosphate.

Evaluating the Potential for Scaling



The theoretical saturation pH level is the curve closest to the intersection of DIC and calcium.

Exhibit 3.2 on page 30

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DIC (mg/L as C)	15		**Saturation pH:**	8.0	

Using exhibit 3.3 (Chapter 3) in the OCCT manual to identify the appropriate flowchart for preliminary CCT selection. Using the DIC and the Saturation pH from above to select the potential CCT. Mark down the recommended CCT below.

CCT Options	Put an X next to all that apply	Identify possible treatment chemicals or processes for the options identified (chemical formula or common name)
Raise pH		
Raise DIC (alkalinity)		
Add orthophosphate[1]		
Add silicate		
Add blended phosphate[1]		

[1] For orthophosphate and blended phosphate, provide in mg/L as P. For blended phosphate, include the percent of the blend that is orthophosphate.

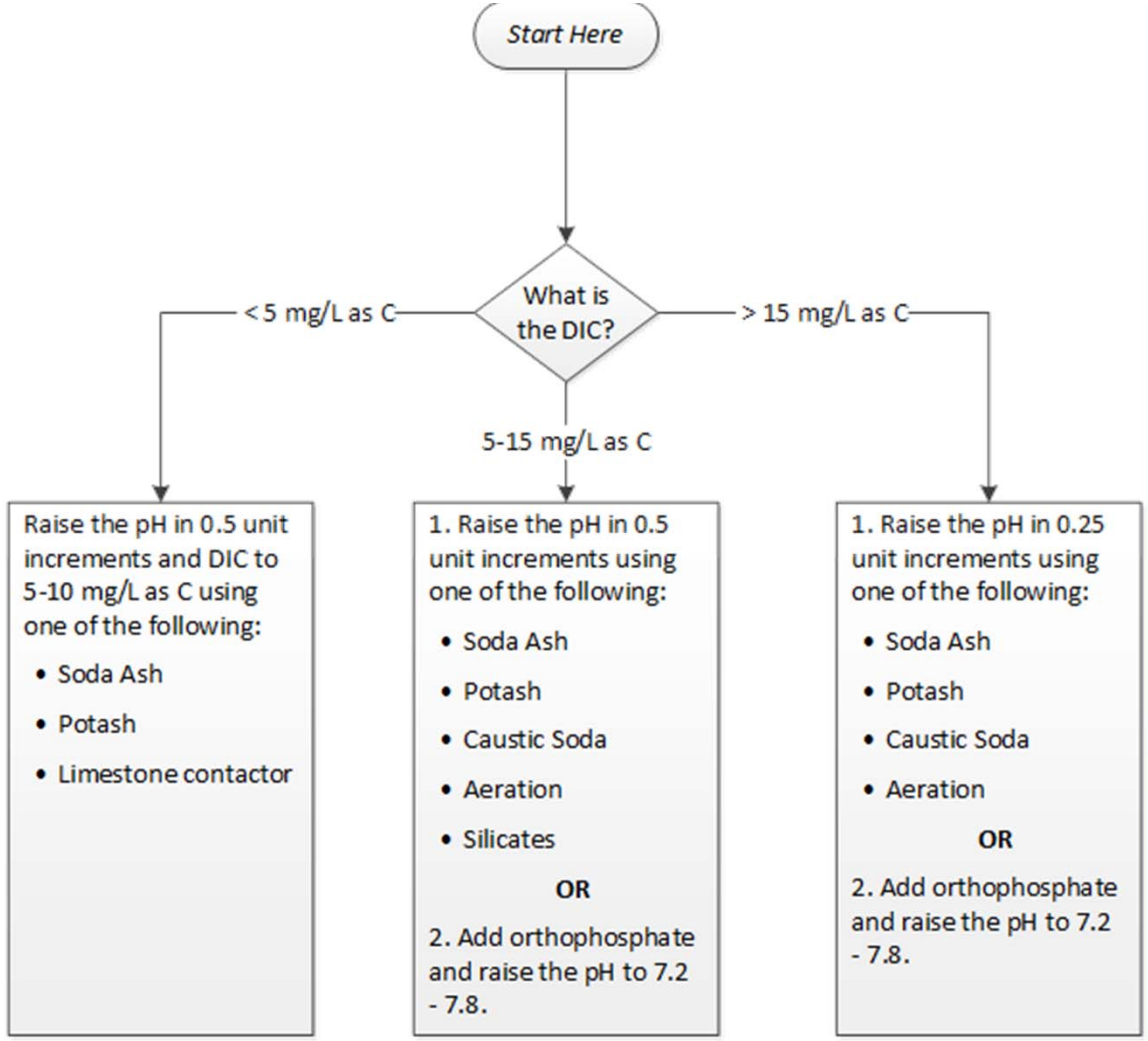
Select Treatment

Exhibit 3.3: Identifying the Appropriate Flowchart for Preliminary CCT Selection

Is iron or manganese present in finished water?	What is the contaminant to be addressed?	What is the finished water pH?	Use This Flowchart
No	Lead only, or Both Lead and Copper	< 7.2	**1a**
		7.2 - 7.8	**1b**
		>7.8 - 9.5	**1c**
		>9.5	**1d**
	Copper only	< 7.2	**2a**
		7.2 - 7.8	**2b**
		>7.8	**2c**
Yes[1]	Lead and/or Copper	< 7.2	**3a**
		≥ 7.2	**3b**

Select Treatment (cont.)

Flowchart 1a: Selecting Treatment for Lead only or Lead and Copper with pH < 7.2



KEY:
AL = Action Level
Caustic soda = sodium hydroxide (NaOH)
DIC = Dissolved Inorganic Carbon
mg/L as C = milligrams per liter as carbon
Potash = potassium carbonate (K_2CO_3)
Soda ash = sodium carbonate (Na_2CO_3)

Exhibits E.1 through E.3 OCCT Recommendation Forms
To be completed by: Public Water Systems (PWSs)
Purpose: To document the PWS's optimal corrosion control treatment (OCCT) recommendation to the Primacy Agency.

Exhibit E.1: Identification of Potential Corrosion Control Treatment Options

Refer to Appendix B of the OCCT manual to find the estimated dissolved inorganic carbon (DIC) based on the system's pH and alkalinity obtained from the WQPs at the entry point.			**Refer to Exhibit 3.2 (Chapter 3) in the OCCT manual to find the theoretical saturation pH using the DIC and the calcium level obtained from the WQPs at the entry point.**		
DIC (mg/L as C)	15		**Saturation pH:**	8.0	

Using exhibit 3.3 (Chapter 3) in the OCCT manual to identify the appropriate flowchart for preliminary CCT selection. Using the DIC and the Saturation pH from above to select the potential CCT. Mark down the recommended CCT below.

CCT Options	Put an X next to all that apply	Identify possible treatment chemicals or processes for the options identified (chemical formula or common name)
Raise pH	X	Soda ash, potash, caustic soda, aeration
Raise DIC (alkalinity)		
Add orthophosphate[1]	X	
Add silicate	X	
Add blended phosphate[1]		

[1] For orthophosphate and blended phosphate, provide in mg/L as P. For blended phosphate, include the percent of the blend that is orthophosphate.

Exhibit E.2: Evaluation of Secondary Impacts[1]					
Source Name (if more than one source, copy this section and complete for each source)					
Source ID					
Source Type					
Questions	**Adjust pH**	**Adjust DIC (Alkalinity)**	**Add Orthophosphate**	**Add Silicate**	**Add Blended Phosphate**
Is the chemical available (YES or NO)?					
Do you feel your current operators will have difficulty using this chemical and operating the treatment?					
What are the relative costs for each treatment option? (High, Medium, Low) (Provide your best estimate, which should include cost for the chemical, any equipment that needs to be purchased, increased operator time, etc…) (Indicate what dosage cost comparisons are based on.)					
Will this treatment change potentially cause excessive scaling (See OCCT Manual Exhibit 3-2)?					
Additional Notes/Comments					

[1] Complete for each corrosion control treatment option identified in Exhibit E.1.

Exhibit E.3: Documentation of OCCT Recommendation					
Source Name (if more than one source, copy this section and complete for each source)					
Source ID					
Source Type					
Identify Recommended Treatment Approach	**Adjust pH**	**Adjust DIC (Alkalinity)**	**Add Orthophosphate**	**Add Silicate**	**Add Blended Phosphate**
Recommended Chemical or Process	potash				
Recommended Dosage	10 mg/L				
Recommended Levels at the Entry Point	**pH**	**Alkalinity (mg/L as $CaCO_3$)**	**Inhibitor[1]**		
Minimum	7.3				
Maximum	7.8				
Average	7.5				
Recommended Levels in the Distribution System	**pH**	**Alkalinity (mg/L as $CaCO_3$)**	**Inhibitor[1]**		
Minimum	7.1				
Maximum	7.8				
Average	7.4				

[1] For orthophosphate and blended phosphate, provide in mg/L as P.

Connecticut Department of Public Health

CCT Flowchart Workshop

Flowchart Workshop: Pleasant Valley Water System

Goal: Use the treatment selection flowcharts to select possible treatment approaches for corrosion control.

Materials

From OCCT Technical Recommendations document:

- **Appendix B:** Estimated Dissolved Inorganic Carbon (mg/L as C) based on Alkalinity and pH (with water temperature of 25 degrees C and TDS of 200)
  - Units of alkalinity in Appendix B: mg/L as $CaCO_3$
- **Exhibit 3.2:** Theoretical Saturation pH for Calcium Carbonate Precipitation
- **Exhibit 3.3:** Identifying the Appropriate Flowchart for Preliminary CCT Selection
- **Flowcharts:** To Select Candidates for CCT

Background

Pleasant Valley Water System was on reduced monitoring when they exceeded the lead action level in 2015.

- Their 90th percentile lead was 23 ppb, and 90th percentile copper was 0.5 ppm.
- They are a surface water system that uses conventional filtration:
  - pH of the finished water at the entry point to the distribution = 7.5
  - Alkalinity = 35 mg/L
  - Calcium = 50 mg/L
  - Iron < 0.3 mg/L
  - Manganese < 0.05 mg/L

Directions

To identify candidate treatment options:

1. Determine DIC using the tables from **Appendix B** of the OCCT document
2. Determine saturation pH using **Exhibit 3.2** (page 30) of the OCCT document
3. Pick your flowchart using **Exhibit 3.3**
4. Use the **flowchart** to select candidate treatment options
5. Fill in the table below and **Exhibit E.1** (attached OCCT Rec Form) with your answers.

1. Estimate DIC	Your Answer:
2. Saturation pH	Your Answer:
3. Flowchart	Your Answer:

Appendix B – Estimated Dissolved Inorganic Carbon (mg/L as C) based on Alkalinity and pH (with water temperature of 25 degrees C and TDS of 200)[1, 2]

Total Alkalinity	pH																			
	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.8	10.0	10.2	10.4
0	0																				
2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0					
4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0			
6	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0		
8	4	3	3	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	0		
10	4	4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	0	
12	5	4	4	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1	
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16	7	6	5	5	4	4	4	4	4	4	4	4	4	4	3	3	3	2	2	1	0
18	8	7	6	5	5	5	5	4	4	4	4	4	4	4	4	4	3	3	2	2	1
20	9	7	6	6	5	5	5	5	5	5	5	5	5	4	4	4	4	3	3	2	1
22	10	8	7	6	6	6	6	5	5	5	5	5	5	5	5	4	4	4	3	2	1
24	11	9	8	7	7	6	6	6	6	6	6	6	5	5	5	5	4	4	3	2	2
26	11	10	8	8	7	7	7	6	6	6	6	6	6	6	6	5	5	4	4	3	2
28	12	10	9	8	8	7	7	7	7	7	7	7	6	6	6	6	5	5	4	3	2
30	13	11	10	9	8	8	8	7	7	7	7	7	7	7	6	6	6	5	4	3	2
35	15	13	11	10	9	9	9	9	9	8	8	8	8	8	8	7	7	6	5	4	3
40	18	15	13	12	11	10	10	10	10	10	10	9	9	9	9	8	8	7	6	5	4
45	20	16	14	13	12	12	11	11	11	11	11	11	10	10	10	9	9	8	7	6	5
50	22	18	16	14	14	13	13	12	12	12	12	12	12	11	11	10	10	9	8	7	5
55	24	20	18	16	15	14	14	14	13	13	13	13	13	12	12	11	11	10	9	8	6
60	26	22	19	17	16	16	15	15	15	14	14	14	14	14	13	12	12	11	10	8	7
65	29	24	21	19	18	17	16	16	16	16	15	15	15	15	14	14	13	12	10	9	8

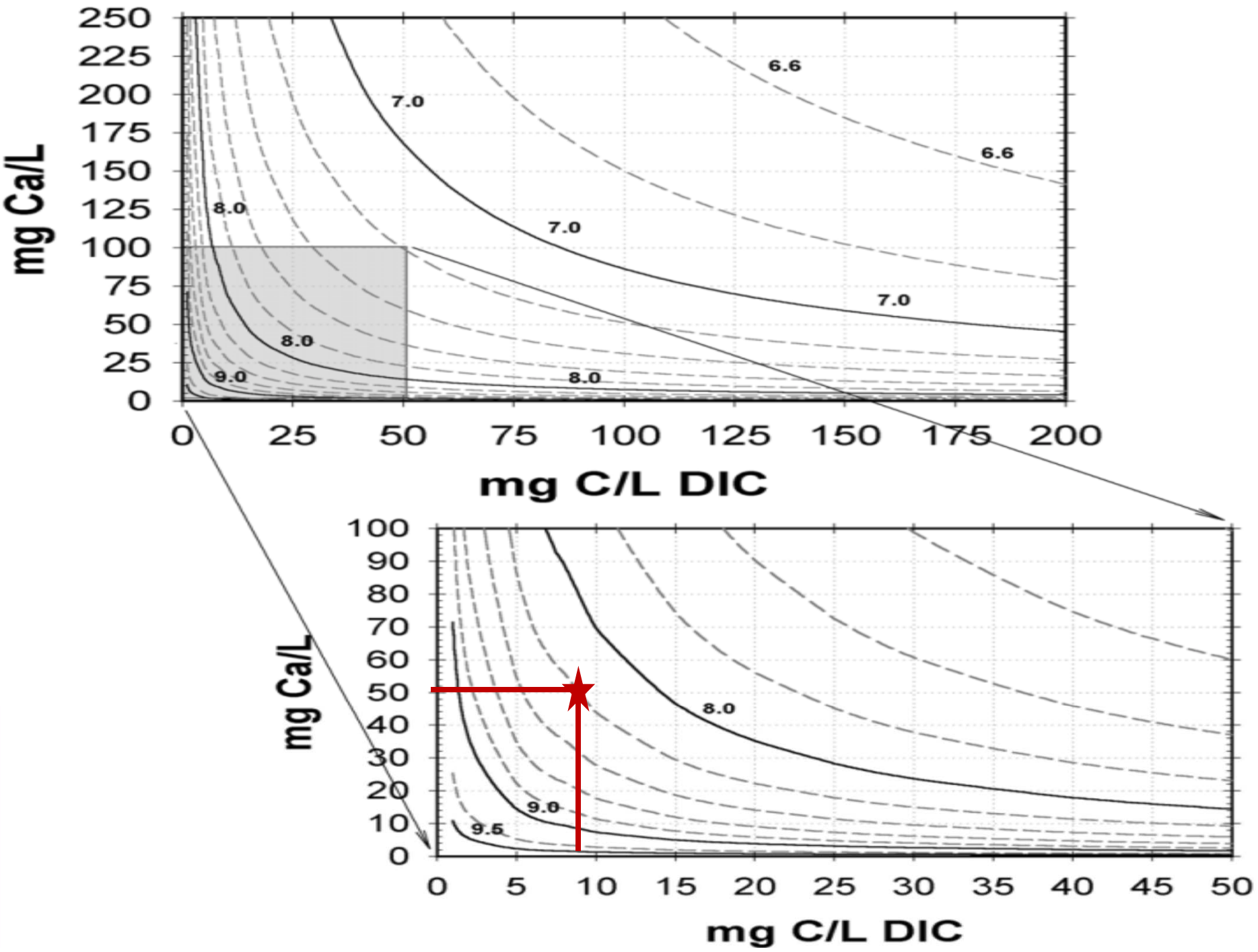

mg Ca/L
250
225
200
175
150
125
100
75
50
25
0
6.6
7.0
8.0
9.0
0
25
50
75
100
125
150
175
200
mg C/L DIC
mg Ca/L
100
90
80
70
60
50
40
30
20
10
0
8.0
9.0
9.5
0
5
10
15
20
25
30
35
40
45
50
mg C/L DIC

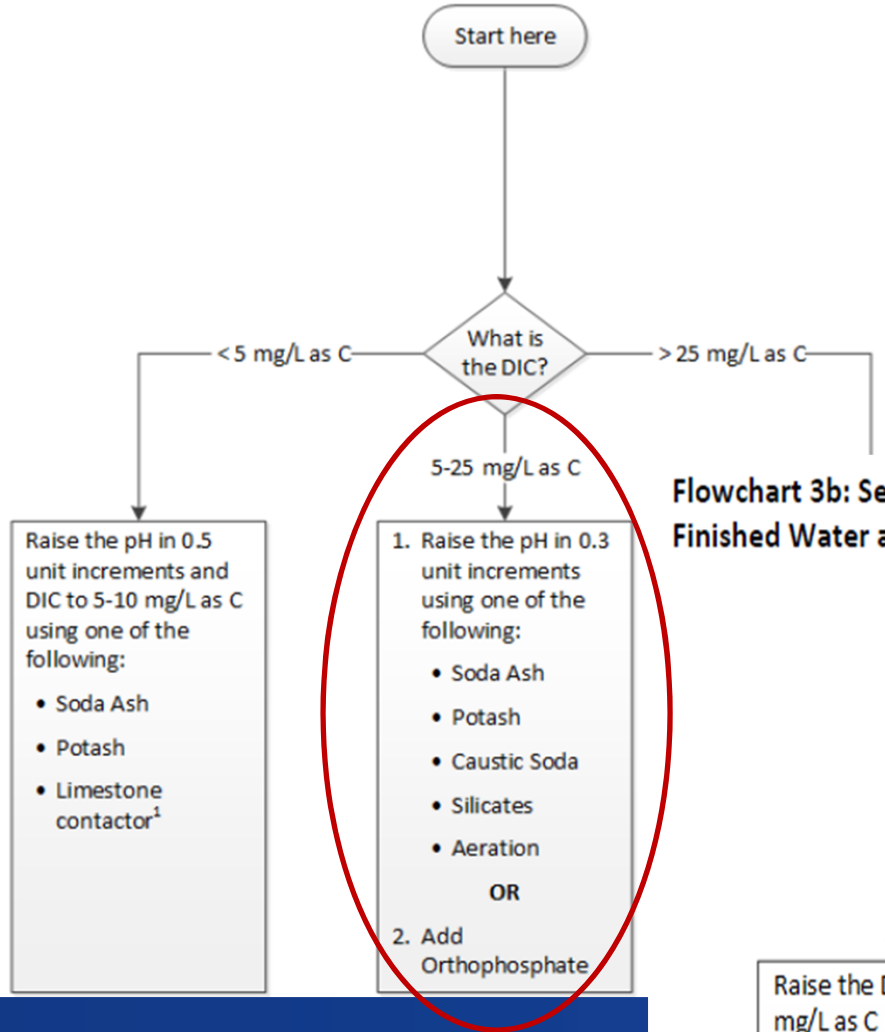
Exhibit 3.3: Identifying the Appropriate Flowchart for Preliminary CCT Selection

Is iron or manganese present in finished water?	What is the contaminant to be addressed?	What is the finished water pH?	Use This Flowchart
No	Lead only, or Both Lead and Copper	< 7.2	**1a**
		7.2 - 7.8	**1b**
		>7.8 - 9.5	**1c**
		>9.5	**1d**
	Copper only	< 7.2	**2a**
		7.2 - 7.8	**2b**
		>7.8	**2c**
Yes[1]	Lead and/or Copper	< 7.2	**3a**
		≥ 7.2	**3b**

1. Estimate DIC	Your Answer: 9
2. Saturation pH	Your Answer: 8.2
3. Flowchart	Your Answer: without FEMN: 1b with FEMN: 3b

er Section

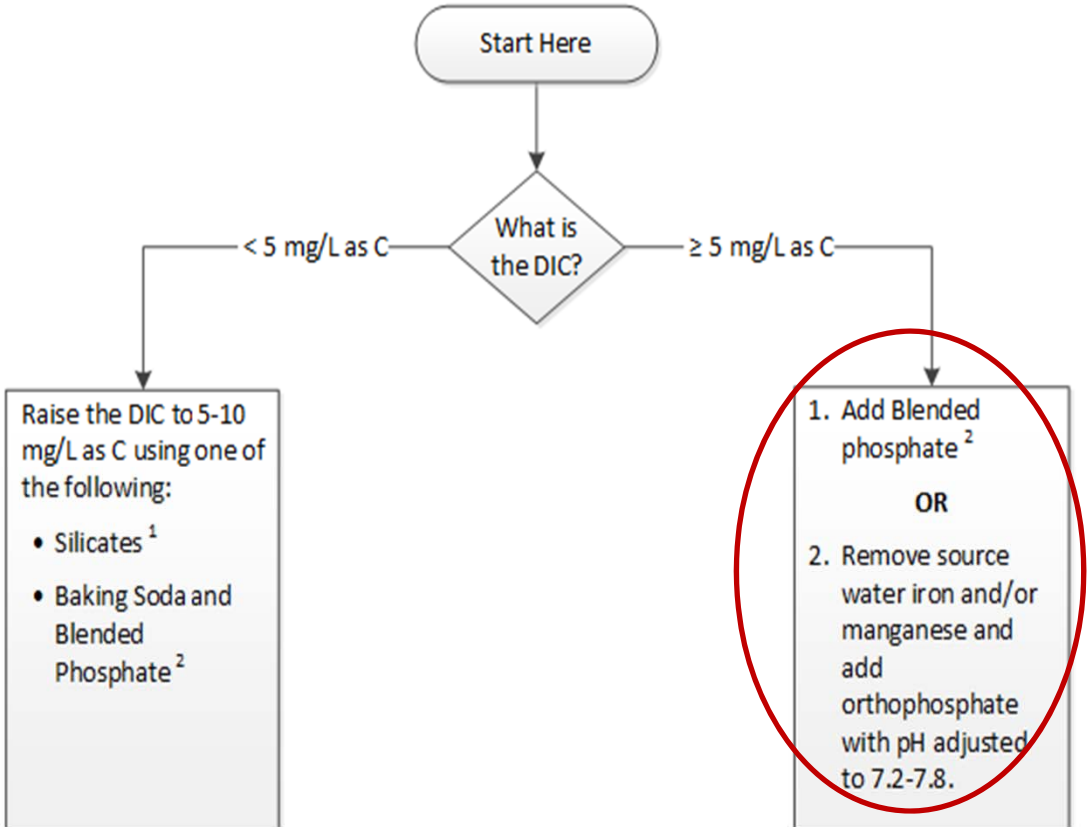
Flowchart 1b: Selecting Treatment for Lead only or Lead and Copper with pH from 7.2 to 7.8



Flowchart 1b:

Flowchart 3b

Flowchart 3b: Selecting Treatment for Lead and/or Copper with Iron and Manganese in Finished Water and pH ≥ 7.2



- Can consider remove FEMN first, then use Flowchart 1b to select treatment for PBCU control.

Treatment Selection w/o FEMN

Exhibit E.1: Identification of Potential Corrosion Control Treatment Options

Refer to Appendix B of the OCCT manual to find the estimated dissolved inorganic carbon (DIC) based on the system's pH and alkalinity obtained from the WQPs at the entry point.			Refer to Exhibit 3.2 (Chapter 3) in the OCCT manual to find the theoretical saturation pH using the DIC and the calcium level obtained from the WQPs at the entry point.		
DIC (mg/L as C)	**9**		**Saturation pH:**	**8.2**	

Using exhibit 3.3 (Chapter 3) in the OCCT manual to identify the appropriate flowchart for preliminary CCT selection. Using the DIC and the Saturation pH from above to select the potential CCT. Mark down the recommended CCT below.

CCT Options	Put an X next to all that apply	Identify possible treatment chemicals or processes for the options identified (chemical formula or common name)
Raise pH	XX	soda ash, potash, caustic soda, silicates, aeration
Raise DIC (alkalinity)		
Add orthophosphate[1]	XX	
Add silicate	XX	
Add blended phosphate[1]		

Treatment Selection with FEMN

Exhibit E.1: Identification of Potential Corrosion Control Treatment Options

Refer to Appendix B of the OCCT manual to find the estimated dissolved inorganic carbon (DIC) based on the system's pH and alkalinity obtained from the WQPs at the entry point.			Refer to Exhibit 3.2 (Chapter 3) in the OCCT manual to find the theoretical saturation pH using the DIC and the calcium level obtained from the WQPs at the entry point.		
DIC (mg/L as C)	9		Saturation pH:	8.2	

Using exhibit 3.3 (Chapter 3) in the OCCT manual to identify the appropriate flowchart for preliminary CCT selection. Using the DIC and the Saturation pH from above to select the potential CCT. Mark down the recommended CCT below.

CCT Options	Put an X next to all that apply	Identify possible treatment chemicals or processes for the options identified (chemical formula or common name)
Raise pH	XX (maybe)	depending on the pH requirement for the type of orthophosphate selected
Raise DIC (alkalinity)		
Add orthophosphate[1]	XX	and pH between 7.2 - 7.8
Add silicate		
Add blended phosphate[1]	XX	

Chapter 4: Review of CCT Steps under the LCR

- Organized into 2 main sections:
  - For systems serving ≤ **50,000 people** that **exceed the lead and/or copper AL.**
  - For systems ***newly*** serving **> 50,000 people**
    - can also be used when an existing system **serving > 50,000 people** with CCT has a subsequent **AL exceedance**
- Includes requirements and technical recommendations
- Includes CCT steps up to primacy agency designation of OCCT

Chapter 5:
OCCT Start-Up and Monitoring

- CCT Start-up
- Follow-up Monitoring During the First Year of Operation
- Evaluating OCCT and Setting OWQPs
- Required and Recommended Long-Term CC Monitoring

CCT Startup

- Changes in finished water quality (pH, DIC, addition of orthophosphate) can have temporary adverse impacts
  - Red water from sloughing of corrosion scale
  - Microbial changes

- Recommendations to minimize impacts
  - Gradually increase the pH over time
  - Consider adding phosphate-based corrosion inhibitors in increments

Follow-Up Monitoring

- The LCR requires systems to conduct two types of follow-up monitoring:
  - Lead and copper tap monitoring
  - WQP monitoring at entry points and taps
- Must occur during the two consecutive 6-month periods directly following installation of OCCT.
- Can use the forms in Appendix G and in the OCCT evaluation templates to document results.

Evaluating OCCT and Setting OWQPs

- Requirements for designating Optimal Water Quality Parameters (minimums or ranges).
- Primacy agencies can designate values for additional WQPs that reflect optimal corrosion control for the system.
- Technical recommendations for evaluating follow-up monitoring data and setting OWQPs are in Appendix G and the templates.

Required CC Monitoring

- Required monitoring
  - WQP at taps and entry points
    - ≤50K, 2 consecutive 6-month period
    - ≥50K, long-term
  - pH, alkalinity, orthophosphate when used, and silicate when used
  - Minimum number of locations and frequency specified in the LCR

Recommended Long-Term CC Monitoring

- Technical recommendations for additional monitoring
  - Monitoring for additional WQPs
  - Oxidation-Reduction Potential (ORP)
  - Ammonia
  - Aluminum
  - Chloride and sulfate
  - Iron and manganese
  - Customer complaint tracking
  - Monitoring associated with lead source replacement programs
  - Increase frequency of WQP tap monitoring
  - Continue to evaluate the effectiveness of the OCCT regularly

Chapter 6: Impacts of Source Water and Treatment Changes on Lead and Copper in Drinking Water

- Review of LCR Requirements
- Impacts of Source Water Changes
- Impacts of Treatment Changes

Thank You!

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