



# What does the California MCL for Hexavalent Chromium Mean for your Utility?

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WATER TREATMENT GLOBAL TECHNOLOGY LEAD

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# Overview

- ▶ Regulatory Review
- ▶ Occurrence of Hexavalent Chromium
- ▶ Treatment and Disposal Issues



# Hexavalent Treatment History and Regulations



- ▶ California Drinking Water Regulations
  - ▶ Current MCL: 0.050 mg/L for total chrome
  - ▶ On July 27, 2011, the Office of Environmental Health Hazard Assessment (OEHHA) established a public health goal (PHG) for chromium-6 (hexavalent chromium) of 0.02 micrograms per liter (µg/L).
  - ▶ Draft MCL in 2013: 10 ug/L
  - ▶ Enforceable MCL expected between July 2014 and July 2015

▶ Source: <http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Chromium6.aspx>



## Hexavalent Treatment History and Regulations

- ▶ Current Federal MCL
  - ▶ 0.1 mg/L as Total Chromium
  - ▶ Based on health effects assessment that assumes 100% hexavalent chromium, long term dermatitis
- ▶ USEPA is updating Health Assessment
  - ▶ In a [September 2010 draft human health assessment for chromium-6](#), EPA proposed to classify chromium-6 as likely to be carcinogenic to humans when ingested.
  - ▶ In May 2011, the External Peer Review Group urged EPA to include new information.
  - ▶ September 2010 Draft was archived.
  - ▶ New Schedule Being Developed



# Integrated Risk Information System

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## IRISTrack Detailed Report

### Chromium VI Assessment Milestones and Dates

Milestone	Projected Start Date *	Projected End Date *
Draft Development (hazard identification)	TBD **	FY14/2nd Quarter
Release lit search and evidence tables	FY14/2nd Quarter	TBD
Draft Development (dose-response analysis)	TBD	TBD **
Agency Review	TBD **	TBD **
Interagency Science Consultation	TBD **	TBD **
Public Comment Period	TBD **	FY15/4th Quarter
External Peer Review	FY15/4th Quarter	TBD **
Final Agency Review/Interagency Science Discussion and Posting Final Assessment	TBD **	TBD **

\* For EPA, the Fiscal Year (FY) starts in October and ends in September of the following year. First quarter runs from October through December; the second from January through March; the third from April through June; and the fourth from July through September.

\*\* To be determined.

**Note:** Chromium VI is in early stages of draft development. Literature search and evidence tables will be released for public comment, followed by a public meeting.

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# Modes of Action



- ▶ Mode of Action I
  - ▶ Hexavalent chromium exists as an oxyanion, chromate ( $\text{CrO}_4^{2-}$ ).
  - ▶ Resembles sulfate or phosphate and this anion is taken up by cells.
  - ▶ Reduced in cells leading to mutagenicity
- ▶ Mode of Action II
  - ▶ Formation of reactive oxygen species and chromium intermediates that can damage DNA and cause mutagenicity.
- ▶ It is not yet known which Mode of Action is predominant in humans.

# Hexavalent Treatment History and Regulations



Event	Status
CCL3 Listing	Complete
Occurrence	Underway
Health Assessment	Underway
Determination	Not Done
Assessments	Not Done
Draft Proposed Regulation	Not Done
Proposed Regulation	Not Done
Final Regulation	Not Done

# Hexavalent Chromium Occurrence



- ▶ Unregulated Contaminant Monitoring Rule (UCMR3 ) for hexavalent chromium
  - ▶ Assessment Monitoring
    - ▶ all Public Water Systems (PWSs) serving more than 10,000 people and 800 representative PWSs serving 10,000 or fewer: January 2013 through December 2015.
  - ▶ Screening Survey
    - ▶ All PWSs serving more than 100,000 people, 320 representative PWSs serving 10,001 to 100,000 people, and 480 representative PWSs serving 10,000 or fewer: January 2013 through December 2015.
  - ▶ Pre-Screen Testing
    - ▶ 800 representative PWSs serving 1,000 or fewer people that do not disinfect.: January 2013 through December 2015.

# Hexavalent Chromium Occurrence



## California Chromium-6 peak detections in drinking water sources (2000 - 2012)

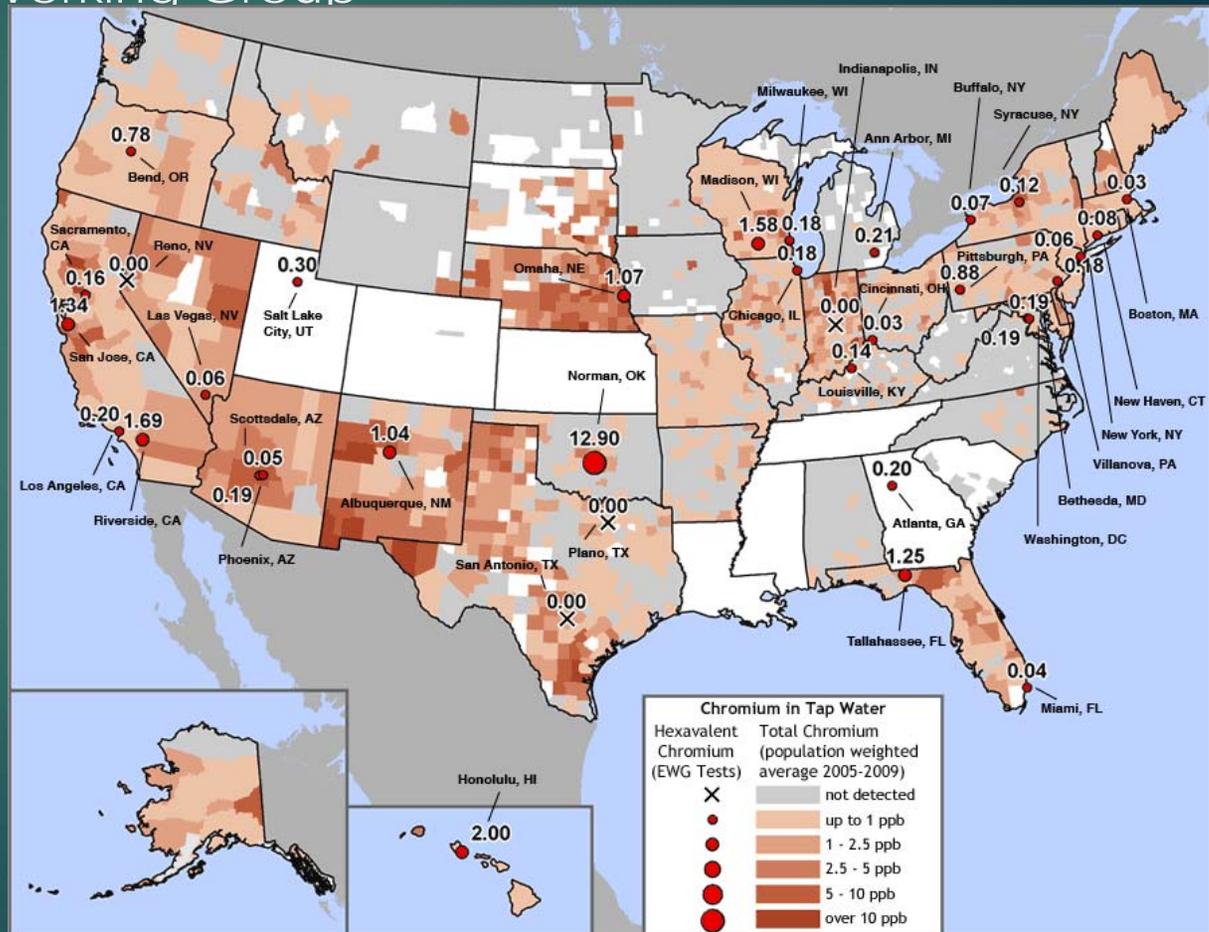
Peak level (µg/L)	No. of Sources	% of Detections
1 - 5	1,596	66
6 - 10	496	20
11 - 20	247	10
21 - 30	66	3
31 - 40	17	< 1
41 - 50	5	< 1
> 50	4	< 1
<b>Total</b>	<b>2,432</b>	<b>--</b>

Source: California Department of Public Health:

<http://www.cdph.ca.gov/certlic/drinkingwater/pages/chromium6sampling.aspx>

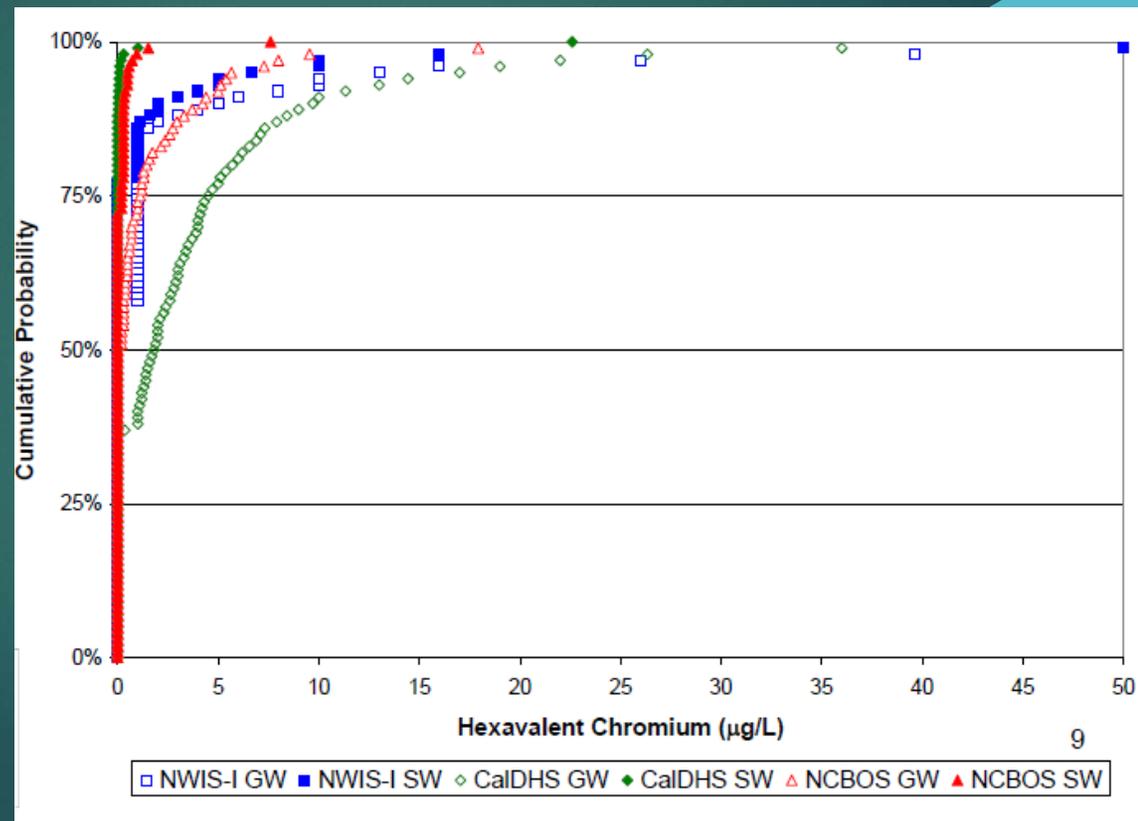
# Hexavalent Chromium Occurrence

Source – Environmental Working Group



# Hexavalent Chromium Occurrence

Source – Water Research Foundation 2759



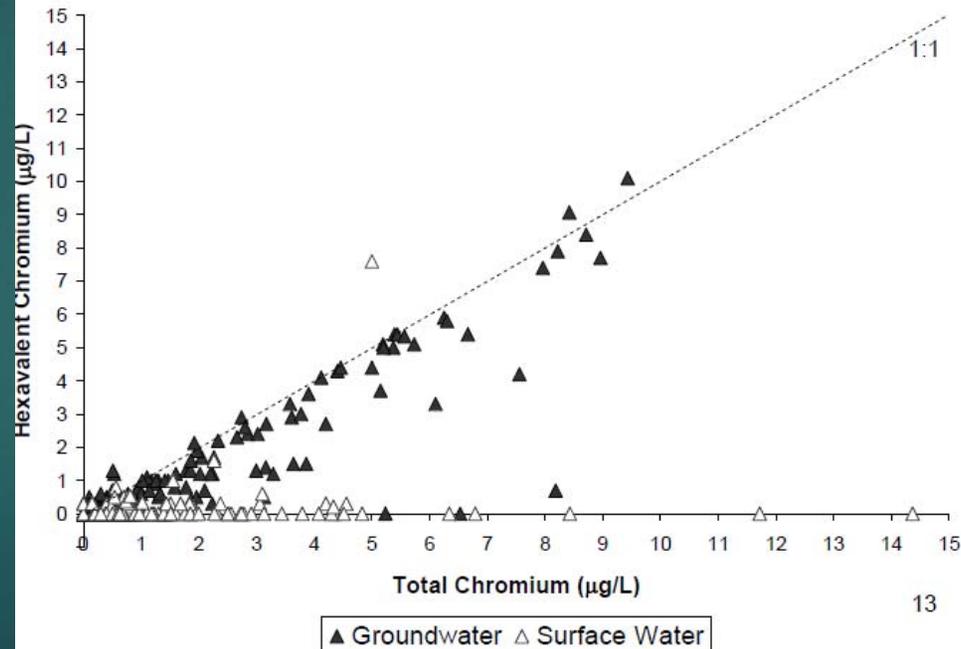
# Hexavalent Chromium Treatment Alternatives

- ▶ Reduction-Coagulation-Filtration
- ▶ Weak Base Anion Exchange
- ▶ Reverse Osmosis



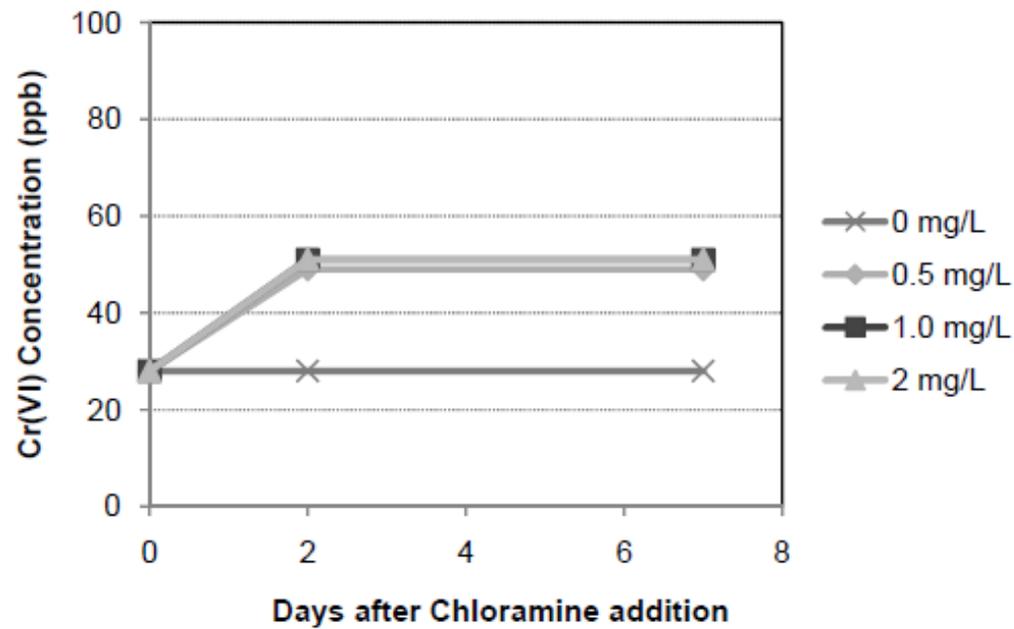
# Hexavalent Chromium Treatment

WaterRF 2759 NCBOS:  
Speciation by source water



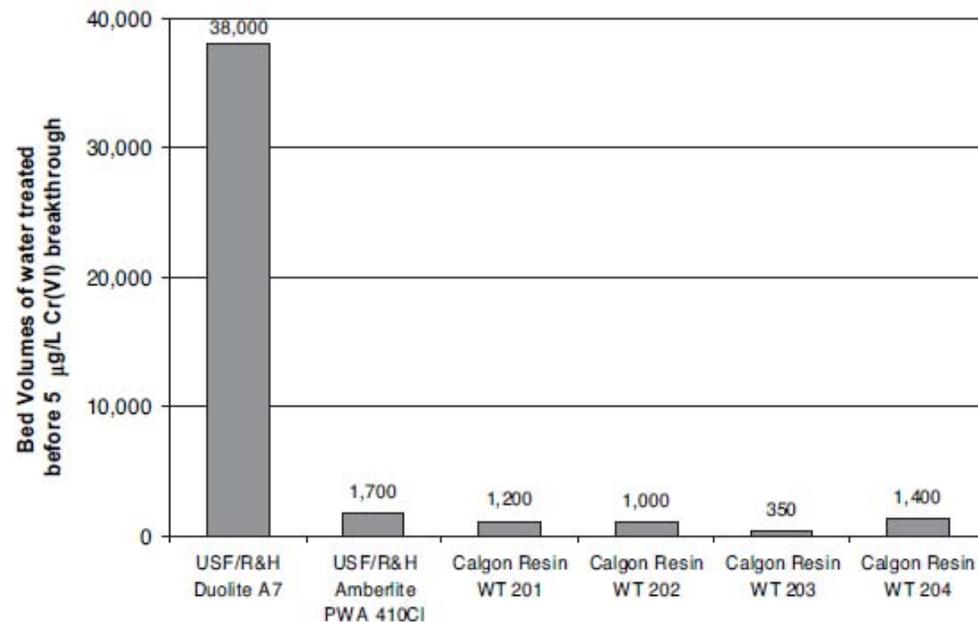
# Hexavalent Chromium Treatment

Source: Water Research Foundation: Hexavalent Chromium Removal with Reduction Coagulation and Filtration



# Hexavalent Chromium Treatment

Source: Water Research Foundation: Hexavalent Chromium Removal with Reduction Coagulation and Filtration



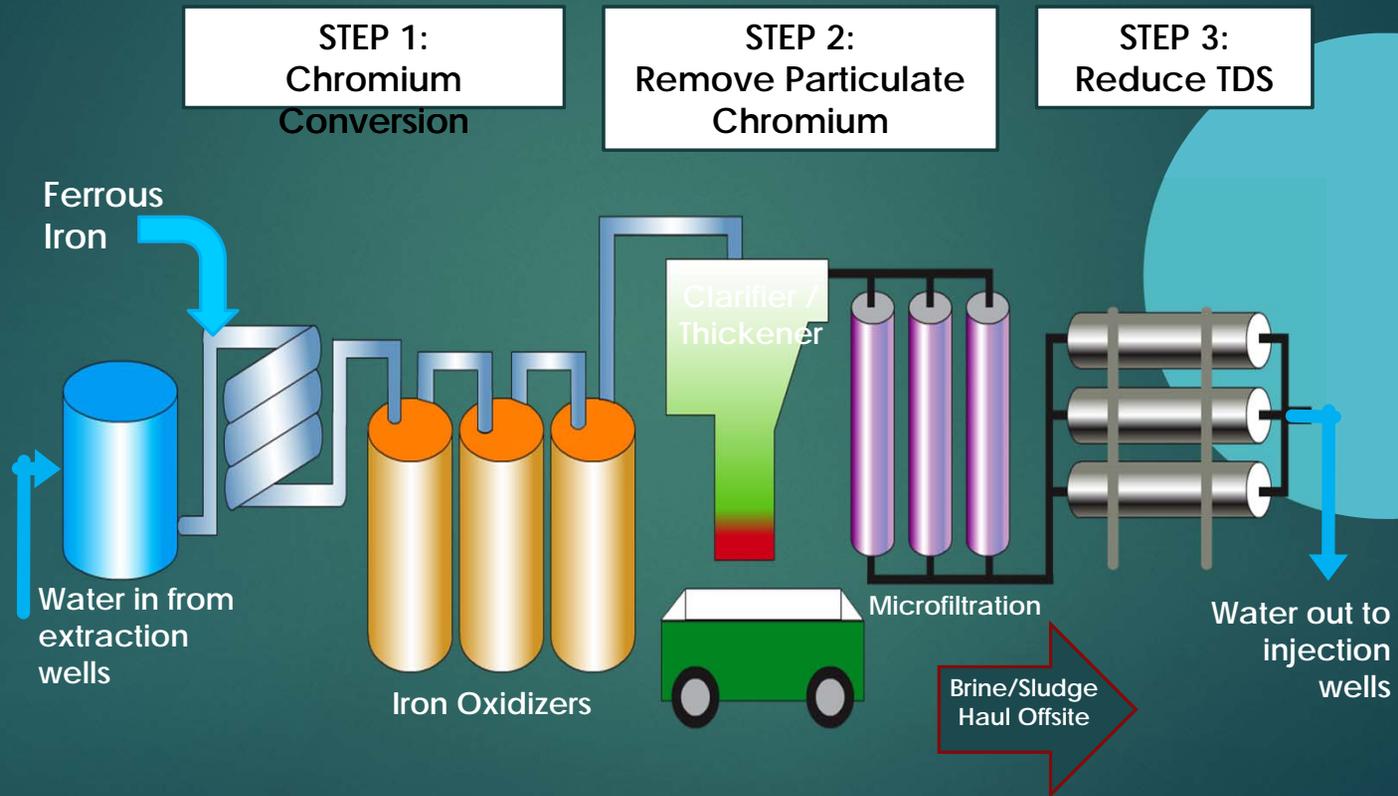
Notes:

1. Results correspond to treatment of an influent Cr(VI) concentration of 100 µg/L.
2. Except WBA Duolite A7, all other resins were SBA resins.

# Hexavalent Chrome Removal Plant Design Summary

- ▶ 140 gpm (0.2 MGD) plant for groundwater treatment
- ▶ Groundwater is brackish
- ▶ Plant location – desert southwest
- ▶ Plant designed and built in 2004-2005
- ▶ Started in August 2005
- ▶ Raw water has changed in quality from almost 5 mg/L to current 0.8 mg/L
- ▶ Brackish water – TDS was 6,000 mg/L; now 4,500 -5,000; chlorides 2,000 to 3,000 mg/L.
- ▶ Effluent requirements – <0.008 mg/L Cr(VI), <0.025 mg/L Cr(T)
- ▶ Treated water is injected into wells

# Hexavalent Chromium Treatment Plant Schematic



## STEP 1: Chromium Conversion



Pipe Reactor with  
Recycle

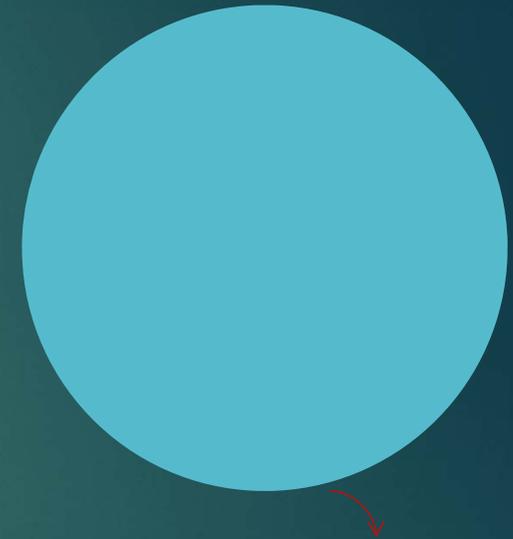
Stirred Tank  
Reactor



## STEP 1: Chromium Conversion



### Iron Oxidation Tanks



## STEP 2: Remove Particulate Chromium

Lamella Clarifier



Microfilter



## STEP 3: Reduce TDS

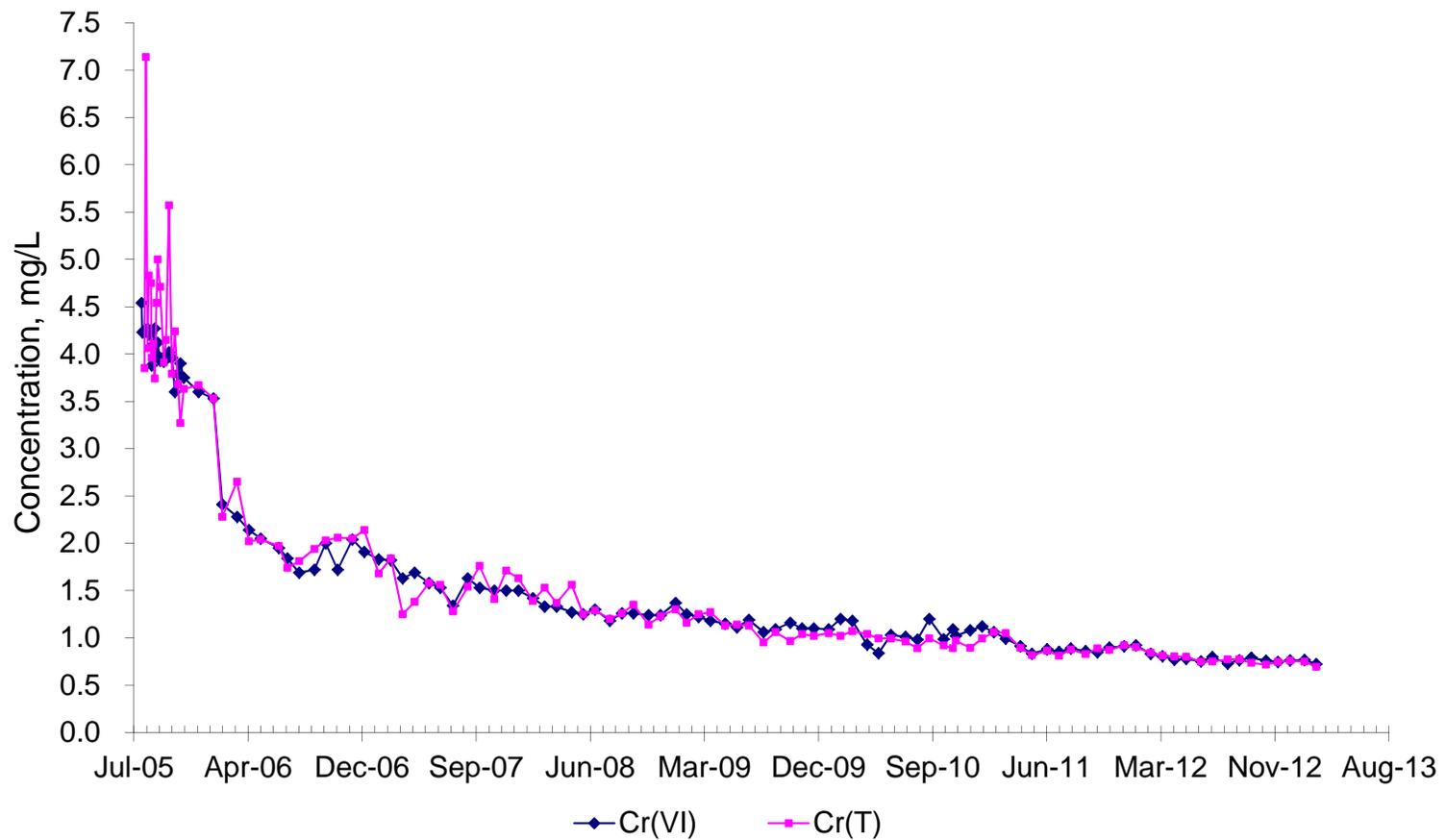
1<sup>st</sup> Stage RO



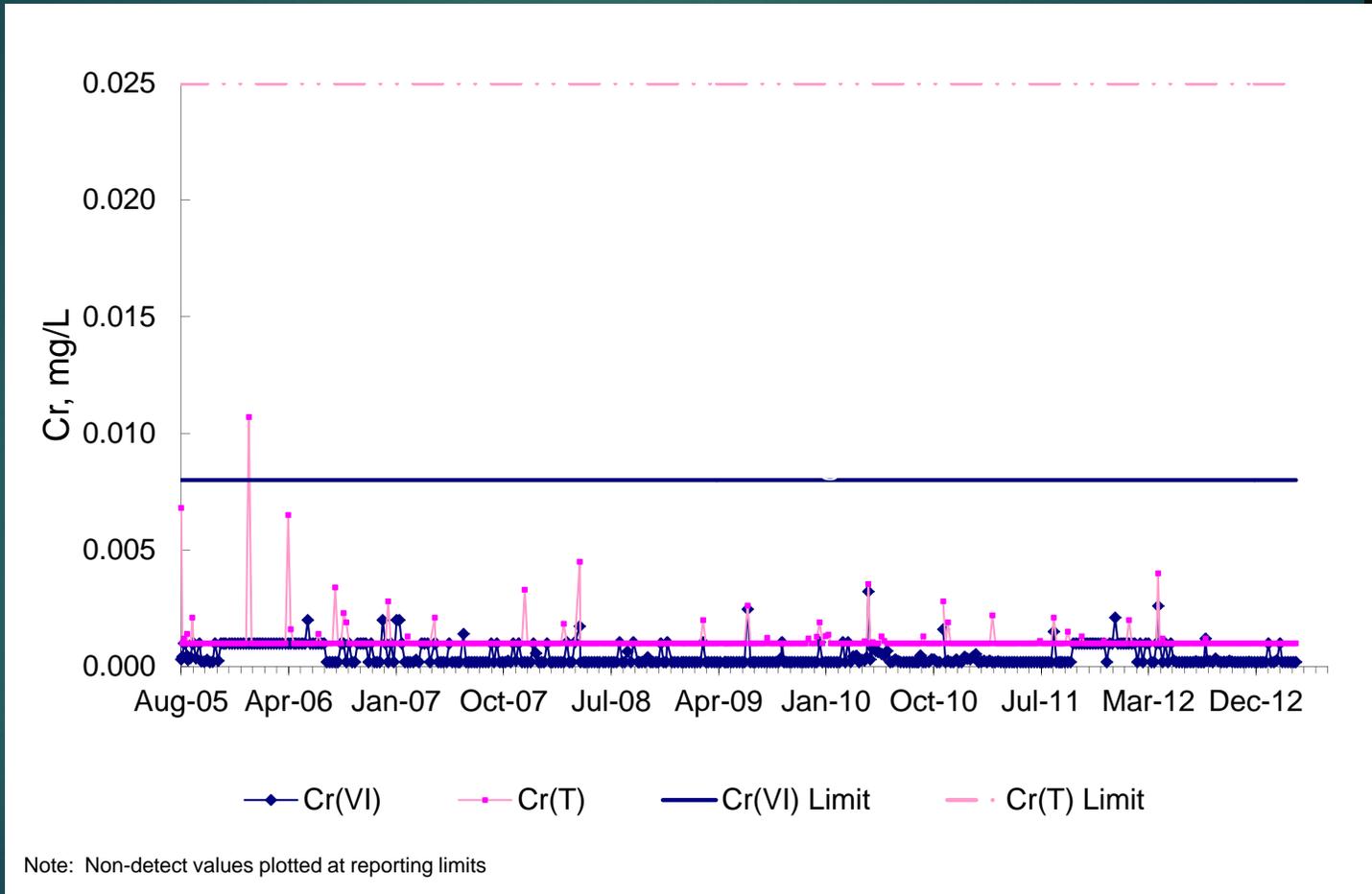
2<sup>nd</sup> Stage RO



# Influent Chromium Concentrations



# Treatment Performance – Effluent Concentrations

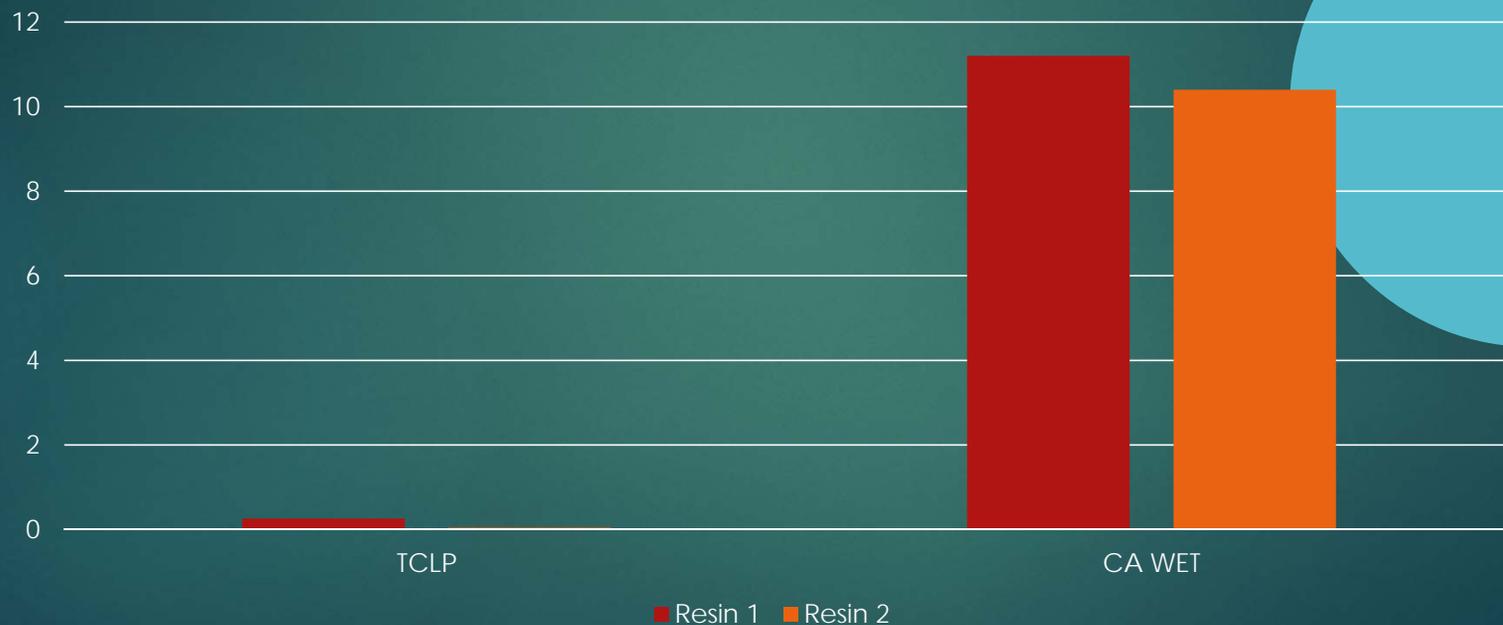


# Hexavalent Chromium Treatment

Source: Water Research Foundation: Hexavalent Chromium Removal with Reduction Coagulation and Filtration



Hex Chrome Concentrations in Residuals Characterization





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