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Ukiah Valley Basin Groundwater Sustainability Agency Technical Advisory Committee Meeting

Development of Sustainable Management Criteria for Ukiah Valley Groundwater Basin

March 11, 2020

LARRY WALKER ASSOCIATES GEI Consultants WATER MANAGEMENT LAB SCIConsultingGroup

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Agenda

- GSP Development: technical work update
- Sustainability Goal → **Group discussion**
- Review of Sustainable Management Criteria (SMC)
  - What will our process look like?
- Current Groundwater conditions: Water Quality
  - How can we set SMC for water quality? → **Group discussion**
- Current conditions: Subsidence
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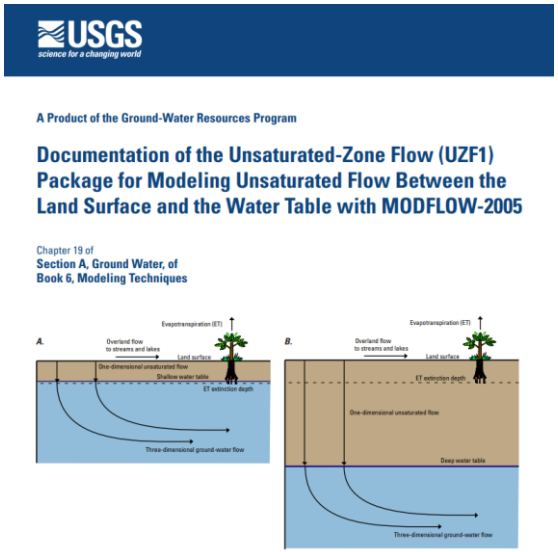
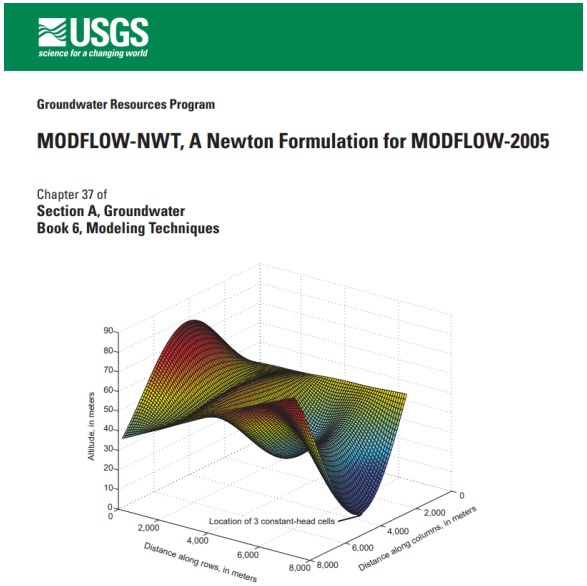
Integrated model updates

- MODFLOW updates
  - Newton Solver (NWT) → needed for GSFLOW coupling.
  - Unsaturated zone flow (UZF) → needed for GSFLOW coupling.
  - Initial calibration → refined hydraulic properties and water budgets prior to coupling with GSFLOW.
  - Review CLSI continuous well data → Inform temporal water-level trends





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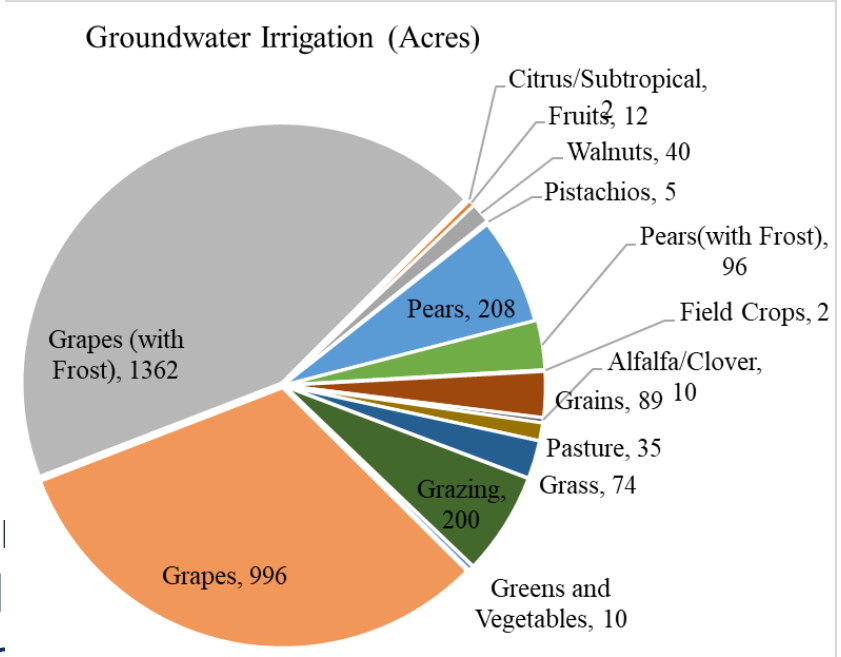
Integrated model updates

- PRMS updates
  - Inclusion of ponds → improved representation of SW diversion timing.
  - Review CLSI tributary stream gage data → Informs wet/dry behavior of tributaries.
  - Updated irrigation patterns based o previous meeting was implemented and will be used for the Ag Package.



	No Frost Protection		With Frost Protection		Total	
	Groundwater	Surfae Water	Groundwater	Surface Water	Groundwater	Surfae Water
Grapes	996	3005	1362	3074	2357	6079
	11.8%	35.6%	16.1%	36.4%	27.9%	72.1%
Pears	208	395	96	455	304	850
	18.0%	34.3%	8.4%	39.4%	26.3%	73.7%

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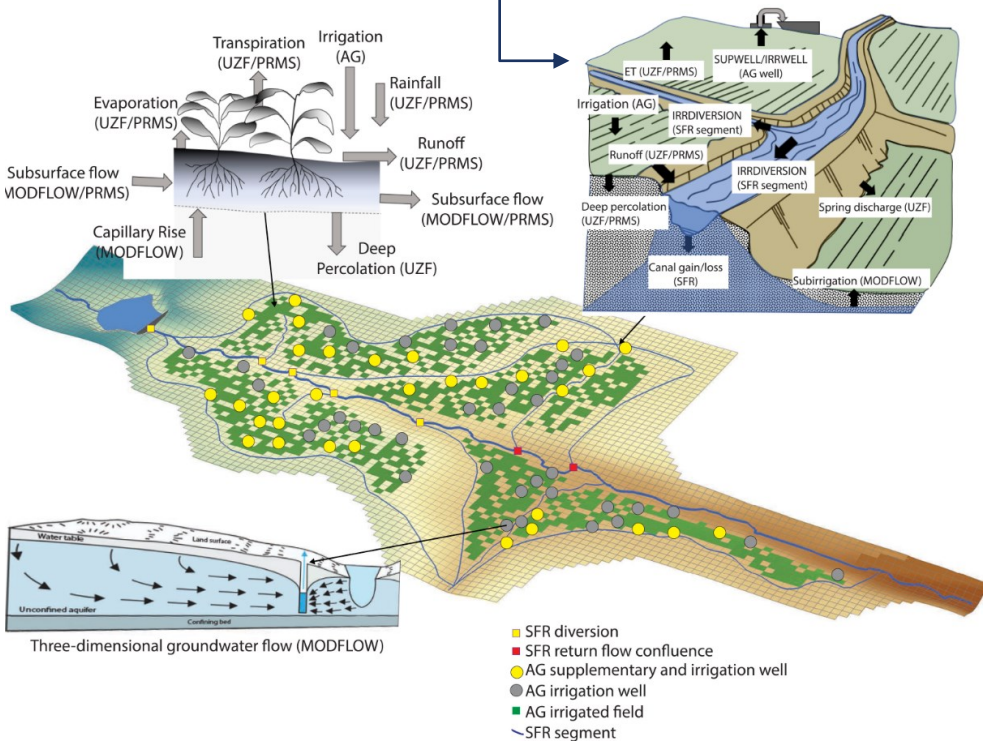
Integrated model updates

- GSFLOW updates
  - Migrating MODFLOW and PRMS to GSFLOW executable
  - Acquisition of GSFLOW Ag. Package from USGS → Currently reviewing workflow and capabilities.



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Surface Water Working Group update

- Leverage local expertise to inform development of "interconnected surface water" SMC
- 1st Meeting 2/24/2020
  - Definitions of a "healthy" and "unhealthy" surface water system
  - Identifying existing studies and data sets
  - Options for prioritizing monitoring locations and data collection
  - Develop a plan for future SW Working Group meetings

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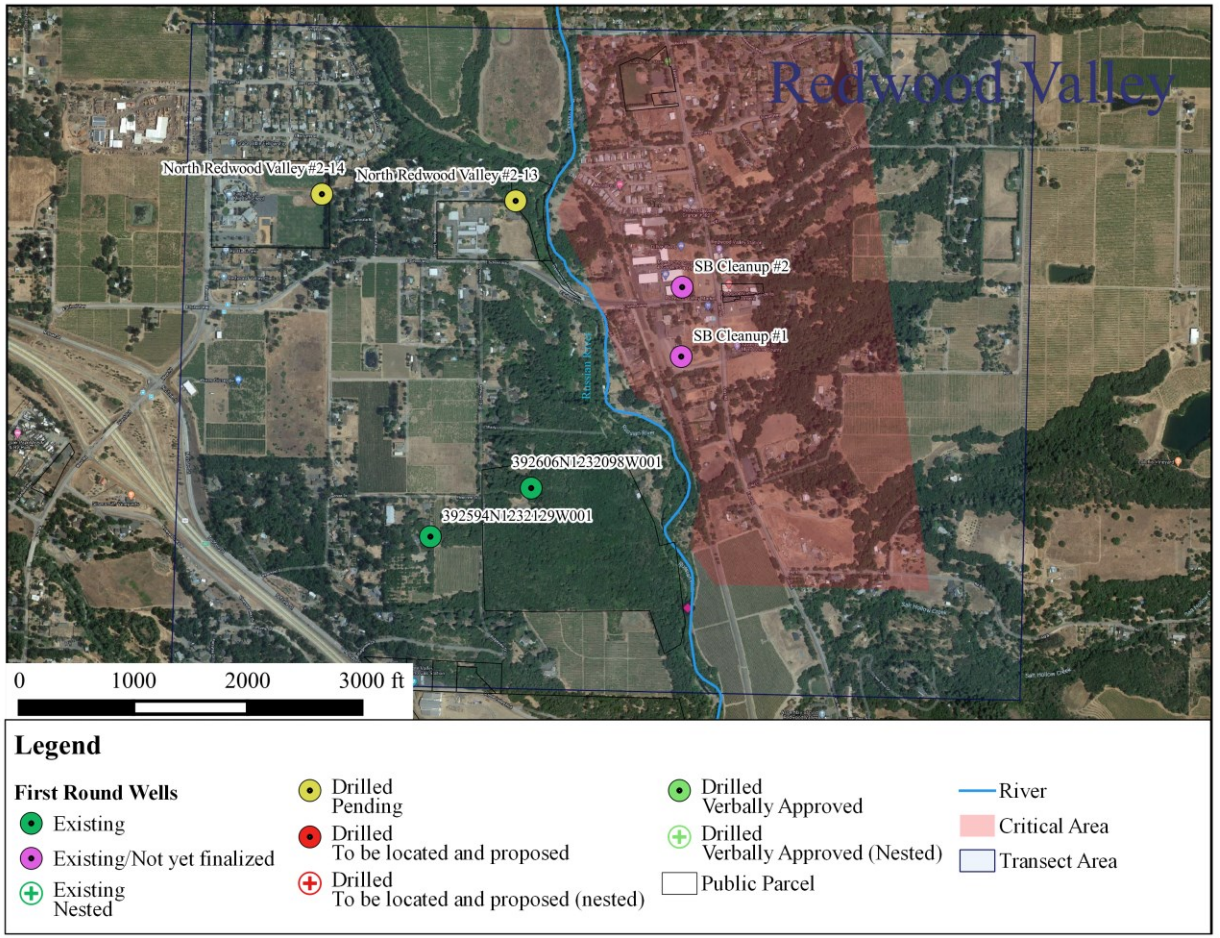
TSS and continuous measurements

- First round of wells are identified.
- Agreements are being pursued.
- First visit to be made late March and instrumentation begin in April.



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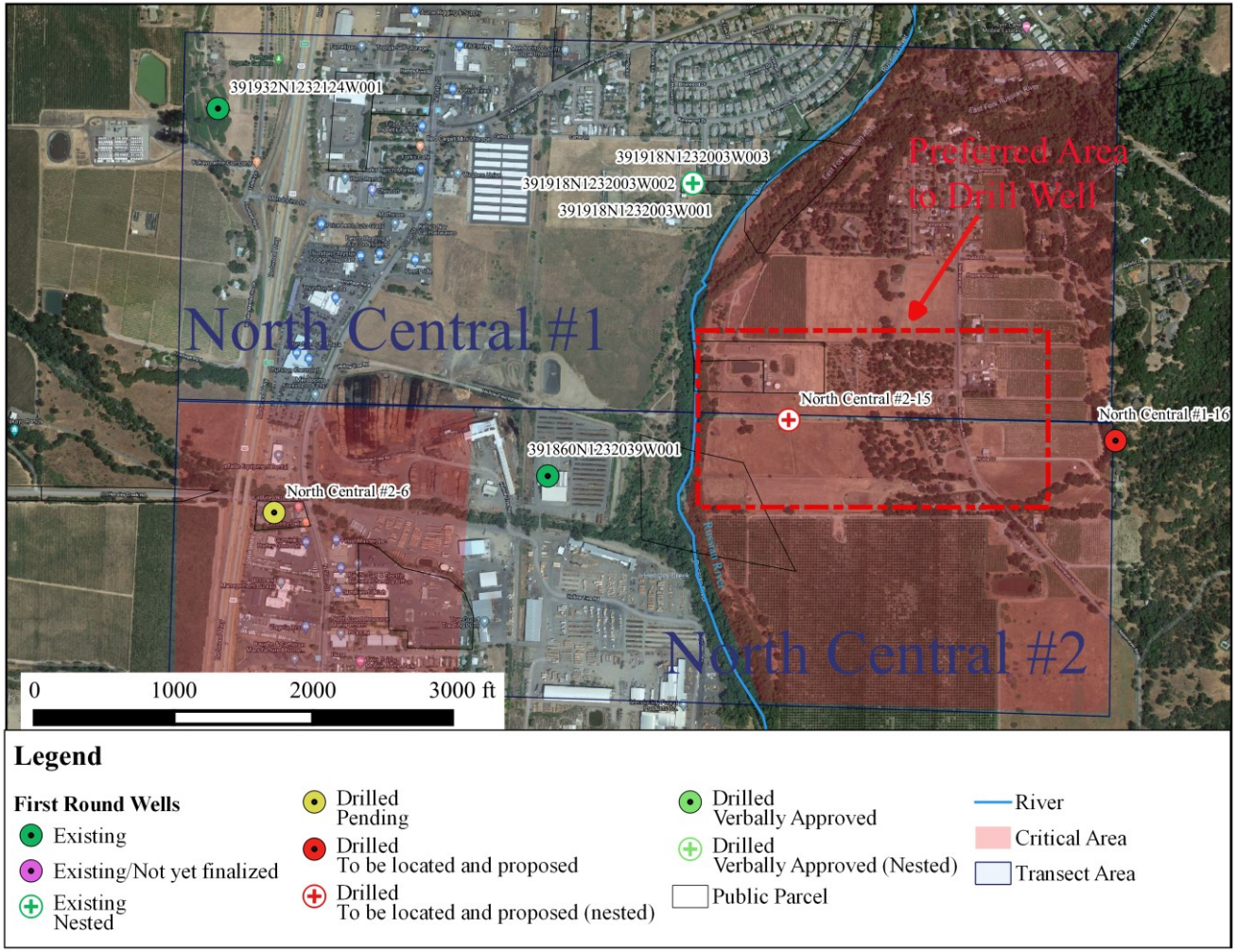
TSS and continuous measurements



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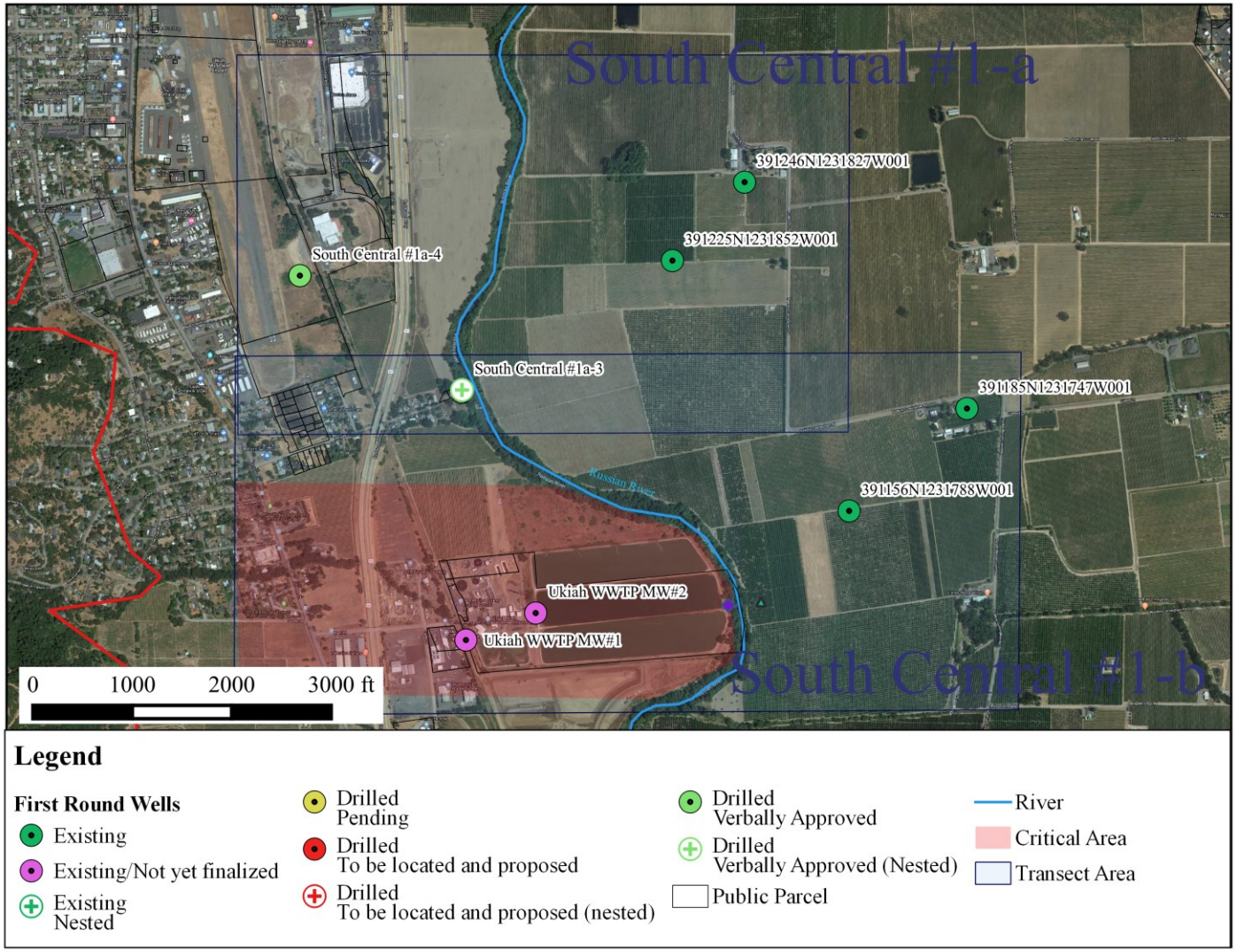
TSS and continuous measurements



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Overview of GSP Structure

A GSP has five chapters:

1. Introduction 
2. Plan Area and Basin Setting 
3. Sustainable Management Criteria 
4. Projects and Management Actions 
5. Plan Implementation 

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Initial Exploration of a Sustainability Goal

Key SGMA text (GSP Emergency Regulations 354.24)

"Each agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results"

Initial Exploration of a Sustainability Goal

1. If groundwater is sustainably managed in Ukiah Valley, what has it achieved and what does it look like?

2. What does the worst-case scenario look like in Ukiah Valley if groundwater is not managed sustainably?

3. Give us your perspective but also think about how others view the issue?

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Examples of Sustainability Goals from Other GSPs

- **Mid-County Santa Cruz GSP:**
  - Manage the groundwater Basin to ensure beneficial uses and users have access to a safe and reliable groundwater supply that meets current and future Basin demand without causing undesirable results to:
    - Ensure groundwater is available for beneficial uses and a diverse population of beneficial users;
      Protect groundwater supply against seawater intrusion;
    - Prevent groundwater overdraft within the Basin and resolves problems resulting from prior overdraft;
    - Maintain or enhance groundwater levels where groundwater dependent ecosystems exist;
    - Maintain or enhance groundwater contributions to streamflow;
    - Support reliable groundwater supply and quality to promote public health and welfare;

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Examples of Sustainability Goals from Other GSPs

- **Mid-County Santa Cruz GSP (cont.):**
  - Manage the groundwater Basin to ensure beneficial uses and users have access to a safe and reliable groundwater supply that meets current and future Basin demand without causing undesirable results to:
    - Ensure operational flexibility within the Basin by maintaining a drought reserve;
    - Account for changing groundwater conditions related to projected climate change and sea level rise in Basin planning and management;
    - Do no harm to neighboring groundwater basins in regional efforts to achieve groundwater sustainability.
- **Salinas GSP:**
  - The goal of this GSP is to manage the groundwater resources of the 180/400-Foot Aquifer Subbasin for long-term community, financial, and environmental benefits to the Subbasin's residents and businesses. This GSP will ensure long-term viable water supplies while maintaining the unique cultural, community, and business aspects of the Subbasin. It is the express goal of this GSP to balance the needs of all water users in the Subbasin.

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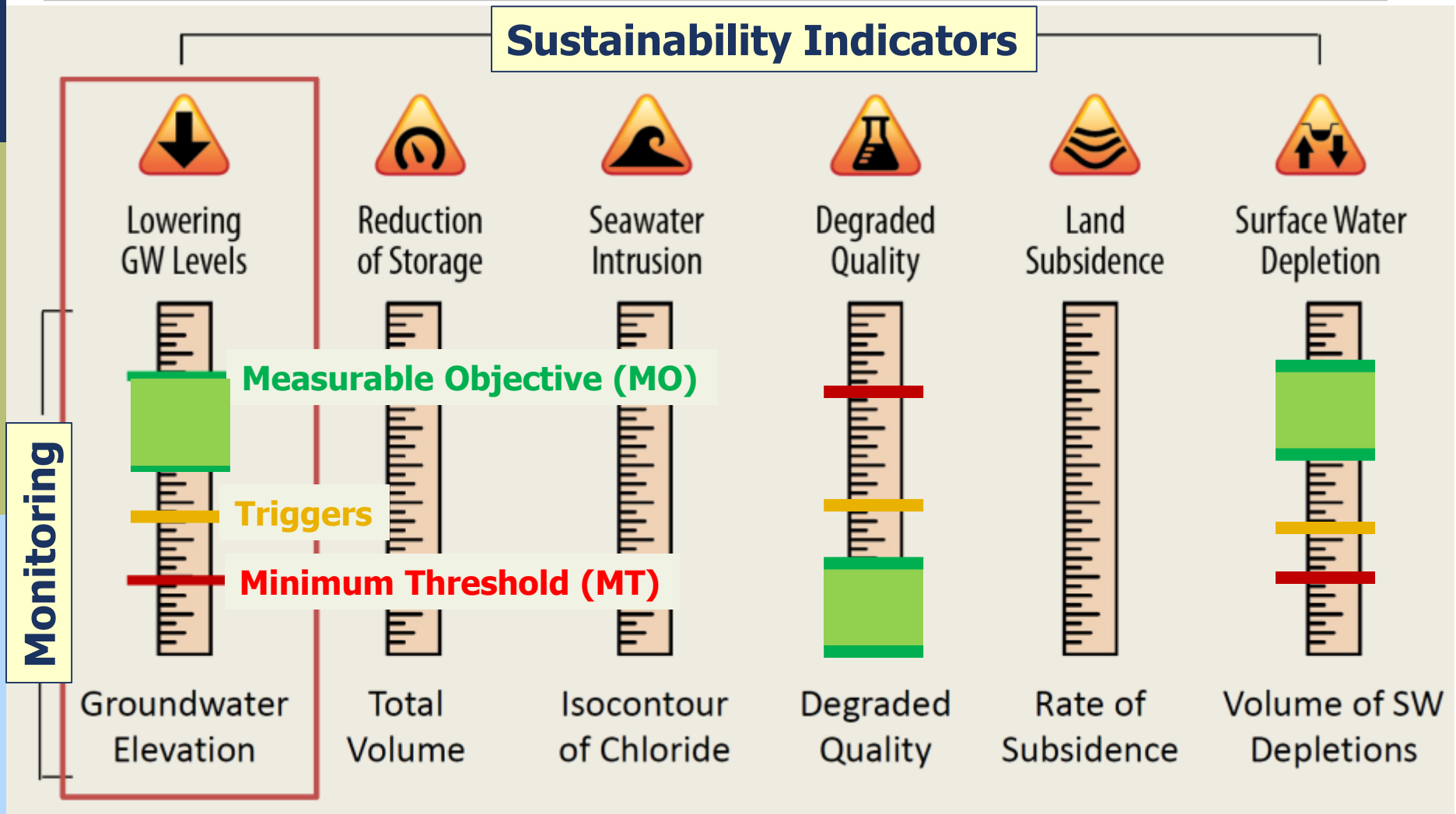
GSP: Monitoring and Managing Sustainability



modified from Ca DWR 2016

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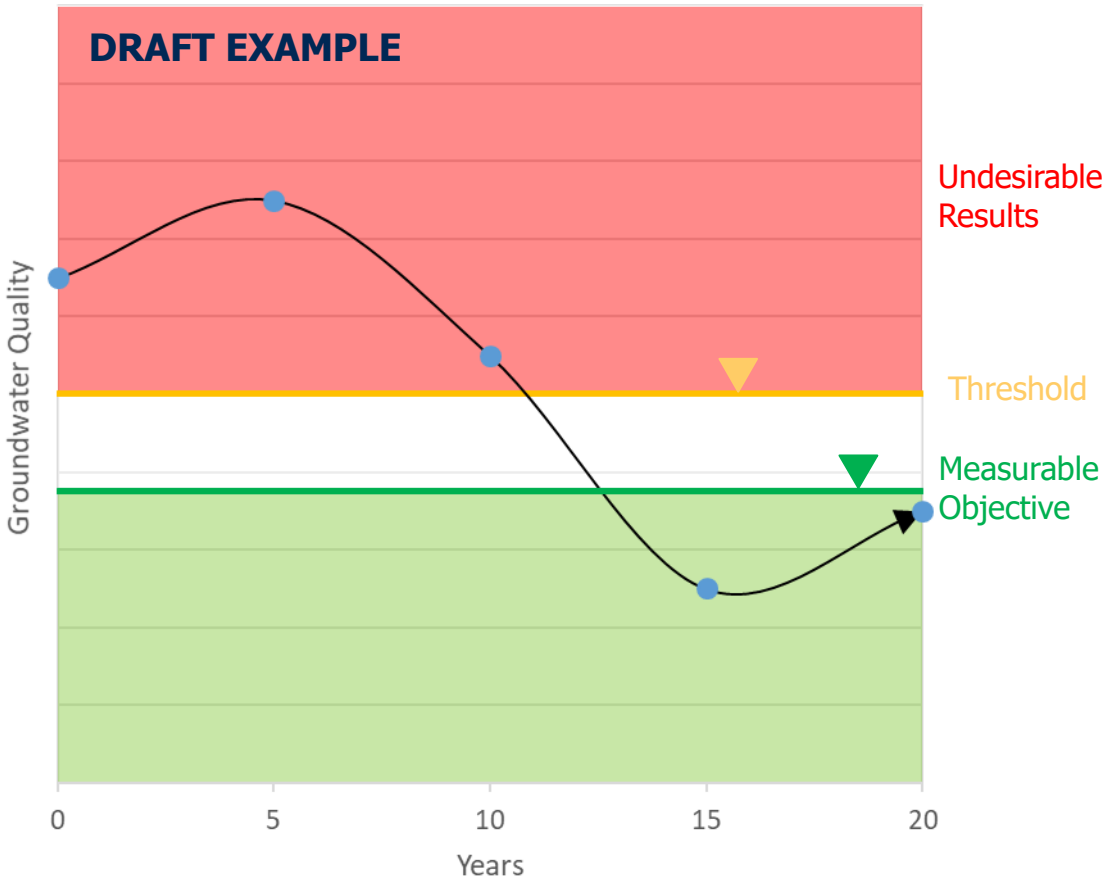
Review of Sustainable Management Criteria Components

- Undesirable Results
- Minimum Thresholds
- Measurable Objectives
- Sustainability Goal



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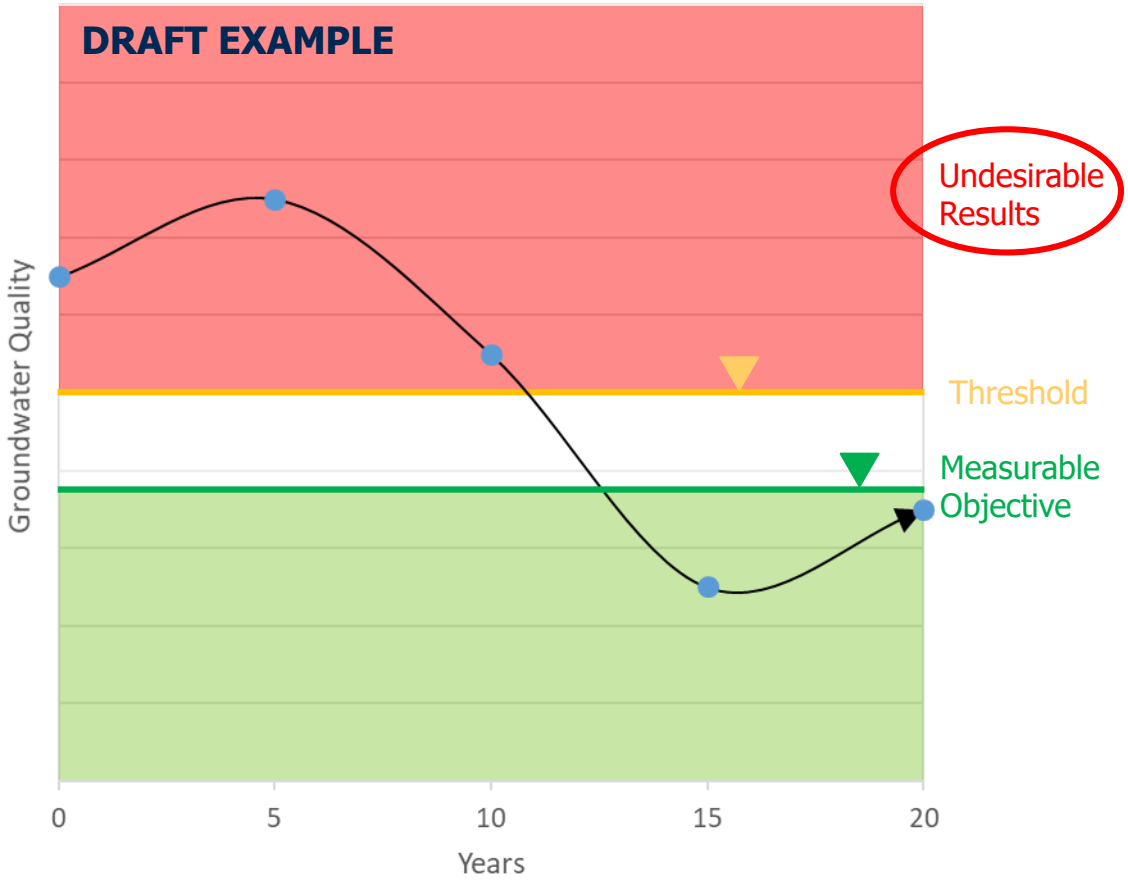
Review of Sustainable Management Criteria Components

- Undesirable Results
  - Must be "Significant and Unreasonable"
  - Statement that describes conditions that we do not want to happen
  - Defined for each sustainability indicator
    - (e.g. groundwater levels, groundwater quality, etc.)



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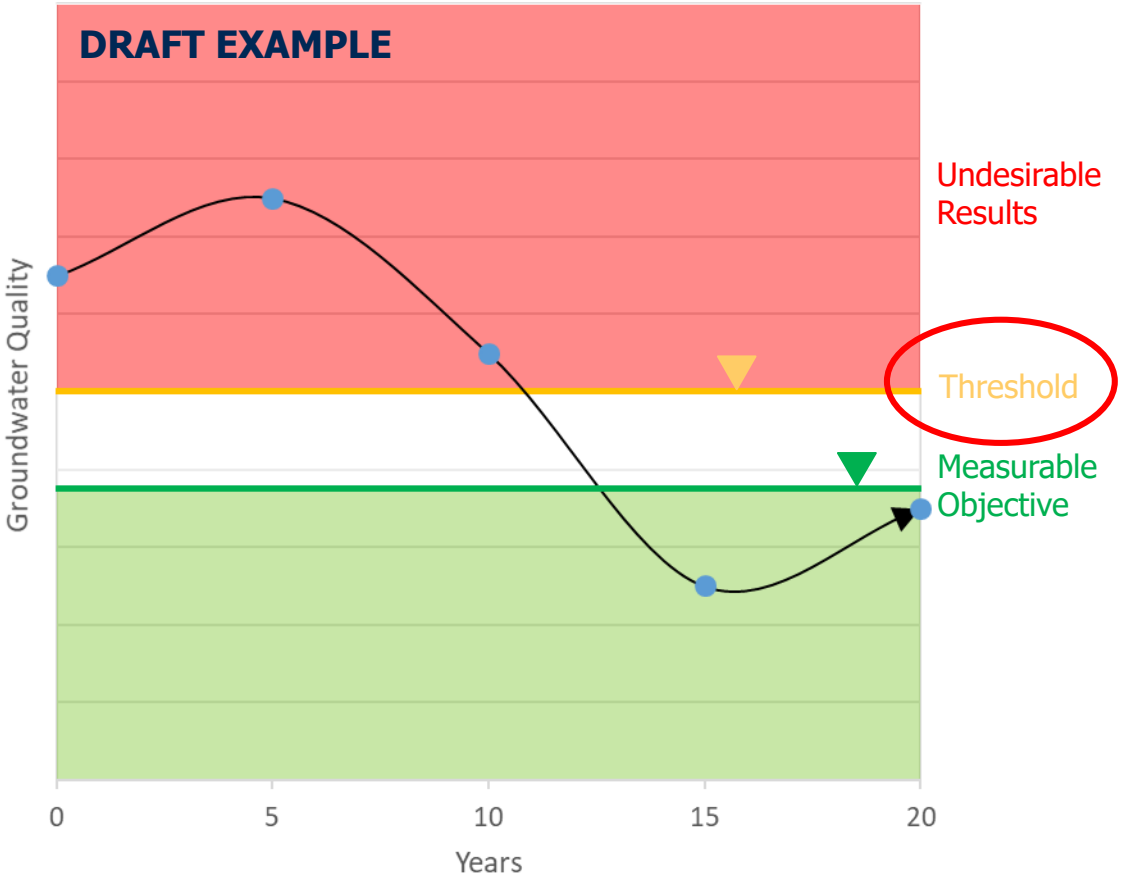
Review of Sustainable Management Criteria Components

- Minimum Thresholds
  - Anything worse is considered an "undesirable result"
  - The lowest a basin can go without something significant and unreasonable happening to groundwater



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Review of Sustainable Management Criteria Components

- Measurable Objectives
  - A management target that provides a usable buffer for use during droughts, etc.
  - Establishes the upper targeted boundary for basin management
  - Should provide a reasonable margin of operational flexibility

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Today's Objectives

- Begin development of Sustainable Management Criteria (SMC) for the Ukiah Valley Groundwater Basin, a key SGMA requirement
- Review/ensure broad understanding of SGMA concepts
  - Sustainability Indicators
  - Undesirable Results
  - Measurable Objectives, Triggers, Thresholds, Interim Milestones
  - Overarching Sustainability Goal
- Introduce/discuss a proposed SMC development process
- Describe and initially discuss key sustainability indicator: **Water Quality**

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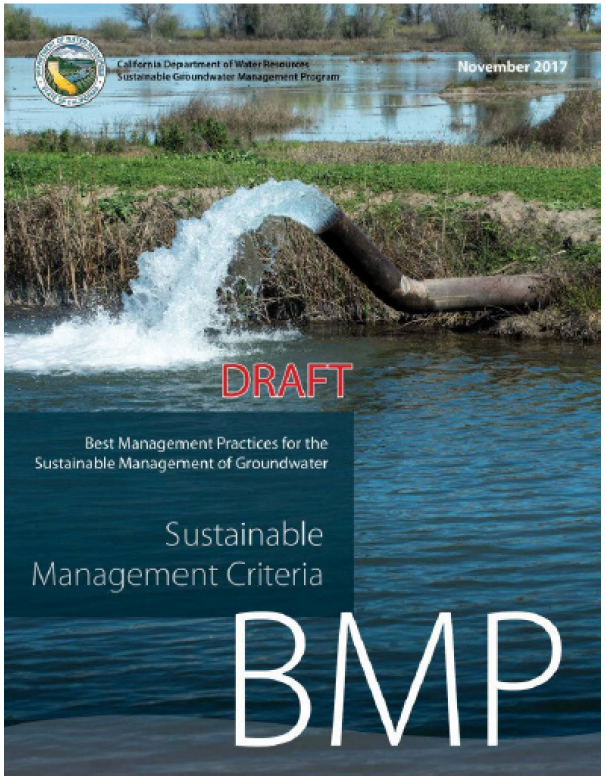
Related SGMA Activities that Inform Sustainable Management Criteria

- Understand the basin setting:
  - Hydrogeologic conceptual model
  - Current and historical conditions
  - Estimated water budget
  - Potential management areas
- Inventory existing monitoring programs and evaluate and build potential representative monitoring points
- Engage interested parties (i.e. beneficial uses and users of groundwater)



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Proposed SMC Development Process

- Assess which of the ***six sustainability indicators*** are applicable for the Ukiah Valley Groundwater Basin
- Develop narrative (qualitative) descriptions of what constitutes ***significant and unreasonable conditions*** (i.e. locally unacceptable conditions)
- Translate narrative descriptions into quantitative values = ***undesirable results*** and ***minimum thresholds***
- Determine desirable conditions = ***measurable objectives***
- Set ***interim milestones*** in order to achieve ***measurable objectives***
- Define an overarching ***sustainability goal***

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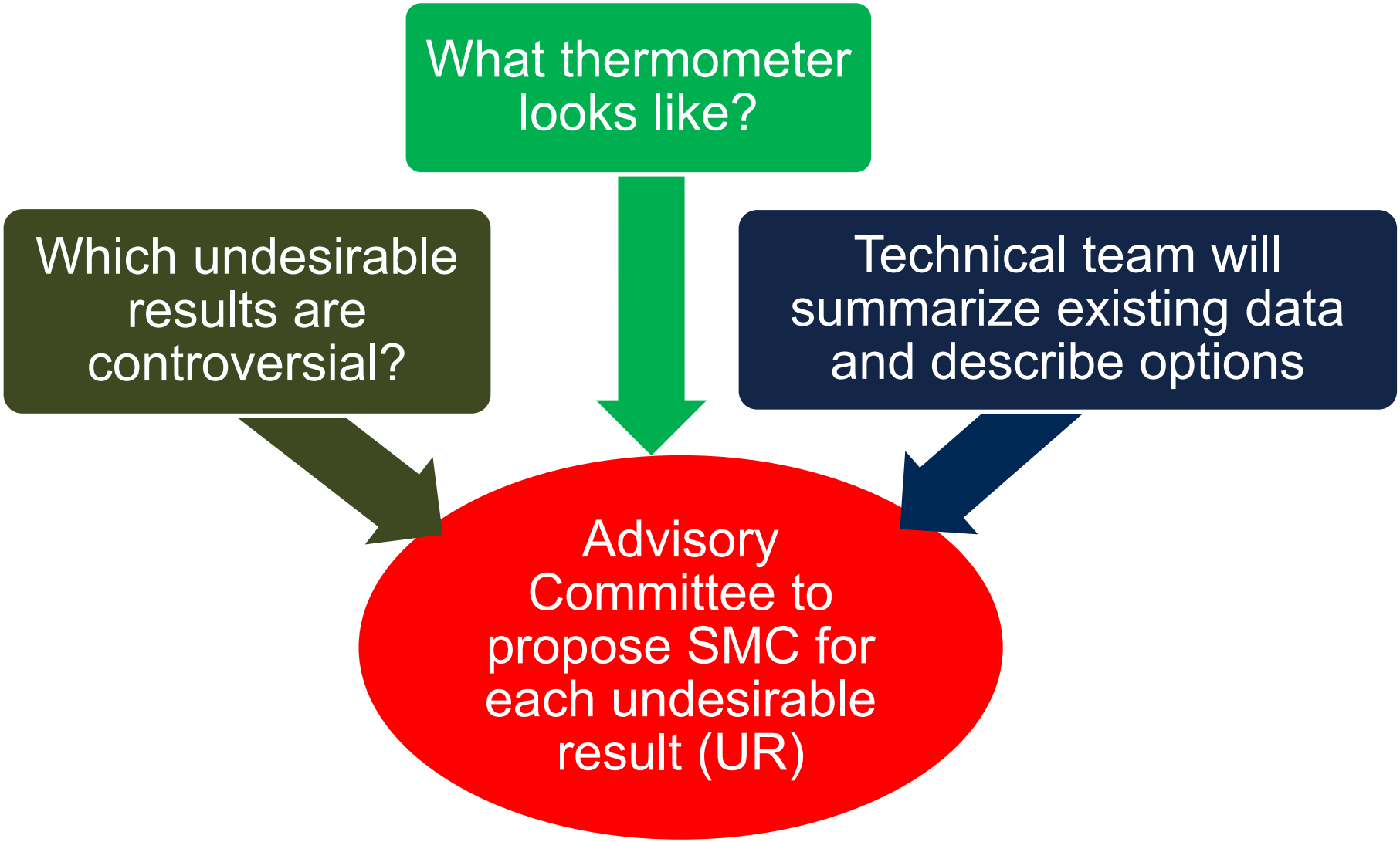
Proposed SMC Development Process



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Culmination of Process and Next Steps

- **GOAL:** Ukiah Valley Sustainable Management Criteria developed
  - Issues around each topic (indicator) identified and explored
  - Interests of beneficial uses and users considered
  - Measurable objectives, triggers, thresholds, and interim milestones defined
  - Buy in to overarching sustainability goal
- Technical GSP pieces complete (e.g. hydrology)
- Groundwater management responses developed if triggers or thresholds are crossed (next phase of work)
- Stakeholder communication and engagement throughout entire process

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Preliminary SMC Development Schedule

March 2020

- Sustainability goal
- Water Quality SMC: Build thermometer, what's healthy/what's unhealthy

May 2020

- Water quality SMC: Refine discussion as needed, focus on scenarios and actions, close on the thermometer
- Subsidence SMC: Build the thermometer, what's healthy and what's unhealthy → quick discussion
- SW depletion SMC: terrestrial GDEs → Build thermometer, what's healthy/what's unhealthy

July 2020

- SW depletion SMC: SW/GW interactions→ Build thermometer, what's healthy/what's unhealthy

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Questions and Comments

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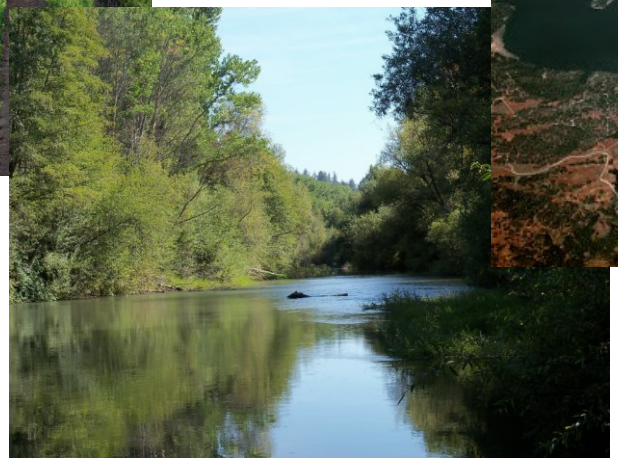

SUSTAINABLE MANAGEMENT CRITERIA – WATER QUALITY

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GEI Consultants

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Outline

- What do we need to do?
- Water Quality Regulatory Framework
- Technical Approach, gathered data, and information
- Example Sustainable Management Criteria development process

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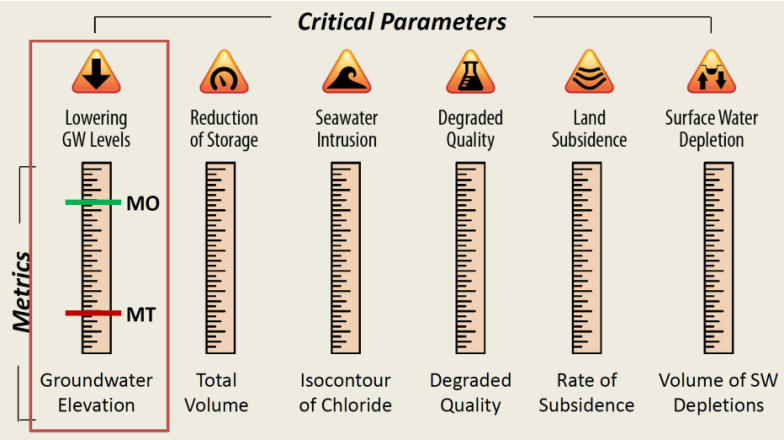
What will we need to do?

- What to measure
- Where to measure
- When to measure
- Who will measure

- What is healthy vs. unhealthy for our basin?



1. Decide MOs "Healthy" range

2. Decide trigger levels: "warning"

3. Decide minimum threshold: "critical unhealthy" level

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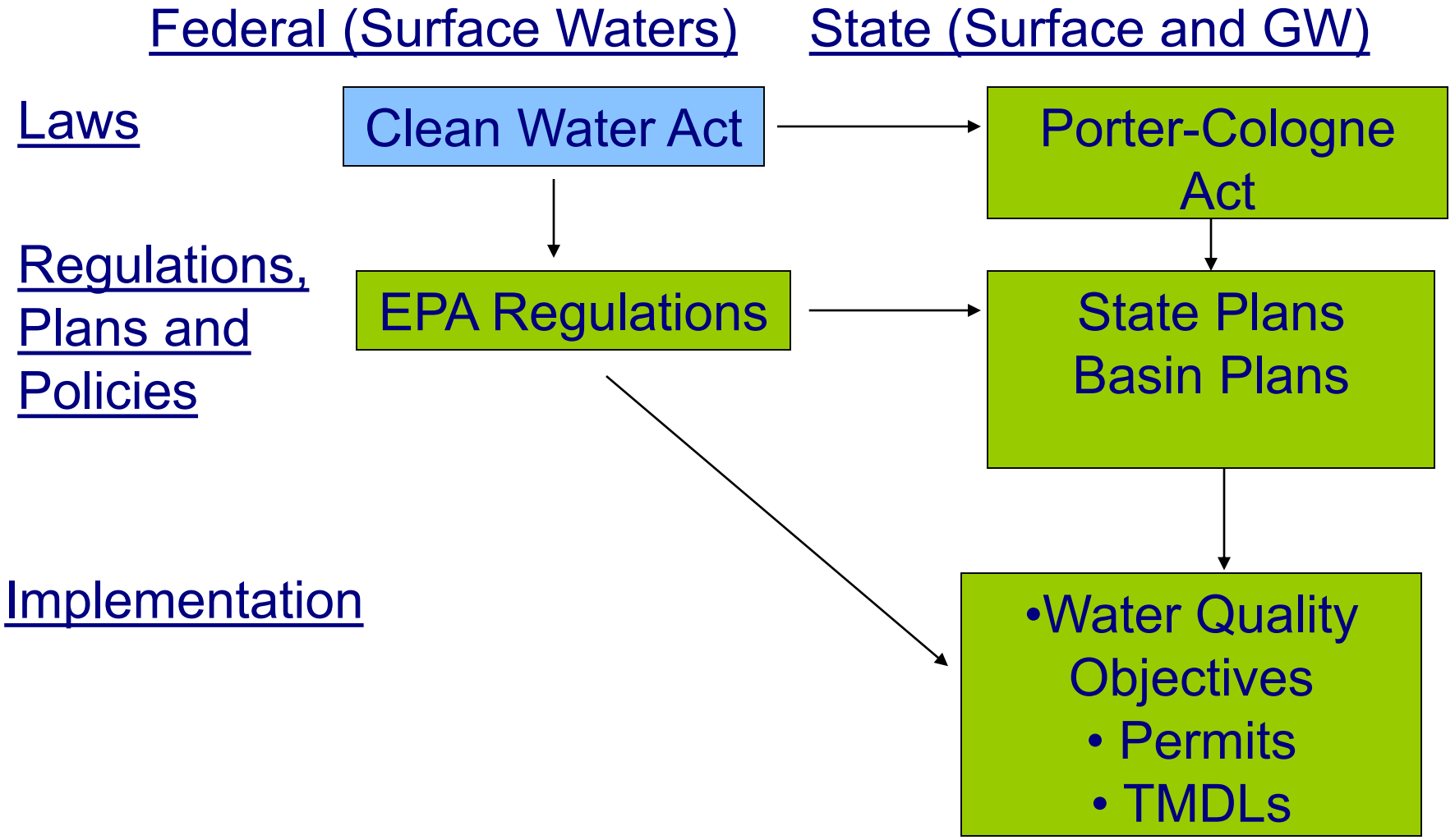
Water Quality Regulatory Framework



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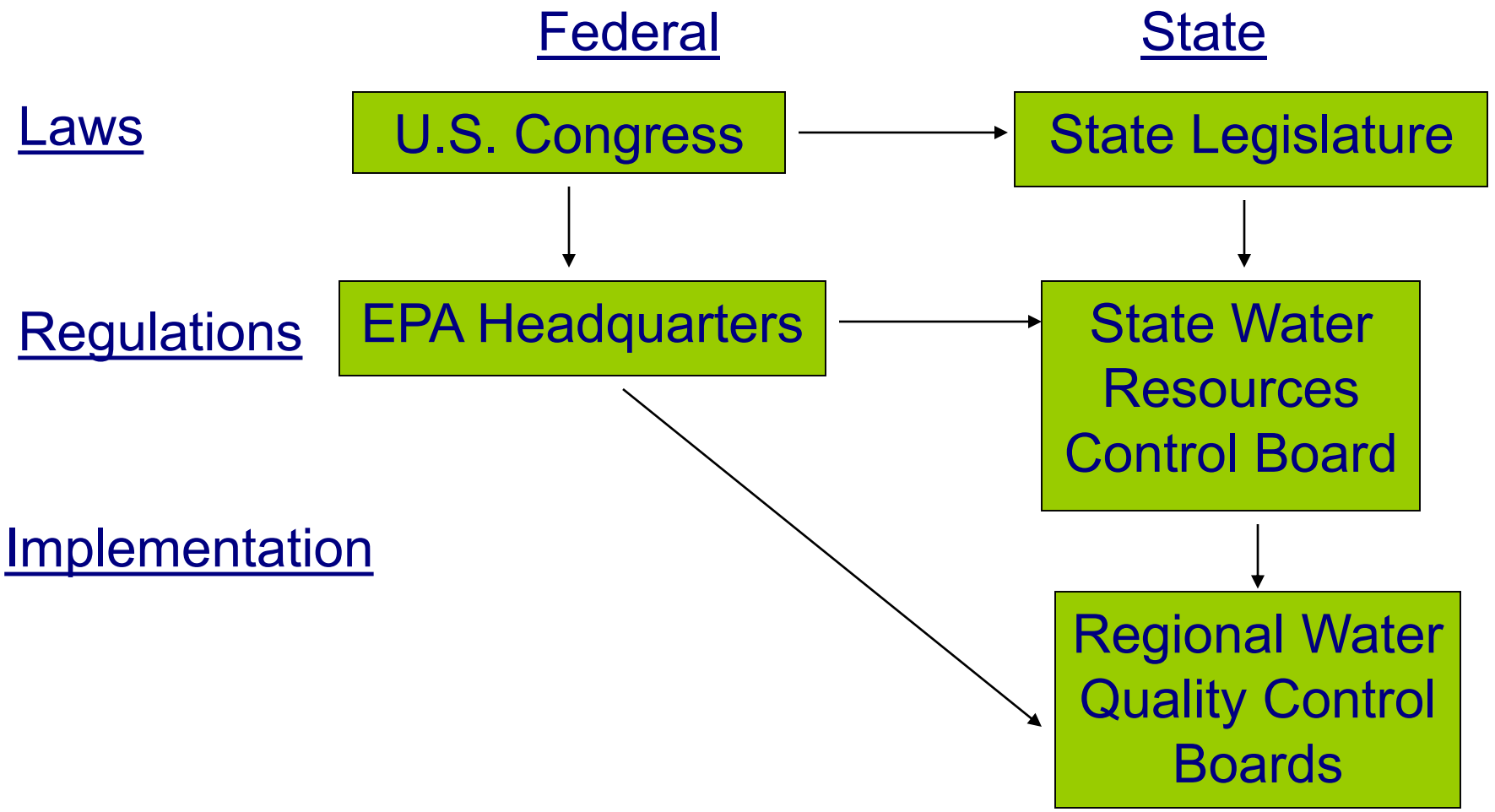
Water Quality Responsibilities



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SGMA Requirement

- §345.28 (c) (4) Degraded Water Quality.

"The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. **In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin**."

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Our Focus now: provide recommendations on SMC for Water Quality

- What is a “significant and unreasonable undesirable result”
- Monitoring & Metrics:
  - Review and approve shortlist of constituents to be included in the GSP
  - Are we still missing existing data?
  - Review existing and potential future groundwater quality monitoring network programs available to be used in GSP
- Review and discuss options to set SMC for the shortlisted constituents
  - Thresholds
  - Measurable objectives
  - Projects and management actions

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Existing Groundwater Quality Monitoring Programs and Networks

- Public water supply wells
  - Monitored regularly for key water constituents
- State small public water supply wells
  - Monitored regularly, but less frequent than PWS wells for some water constituents
- Domestic wells
  - Only sporadic monitoring, if any
- Agricultural/irrigation wells
  - Only sporadic monitoring, if any
- Monitoring wells
  - At contamination sites to guide/assess remediation

Existing Water Quality Data Repositories

- SWRCB GAMA Groundwater Information System

- County environmental health department
- Public water supply systems
- USGS (NWIS)
- U.S. EPA (STORET)
- California DWR
- California DPR

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What is already included in GAMA

- The Department of Pesticide Regulation (DPR)
- Department of Water Resources (DWR)
- GAMA - Domestic Wells
- GAMA – Special Studies
- GAMA – Priority Basin Project
- Monitoring Wells (Water Board Regulated Sites)
- Public Water System Wells (State Water Board - Division of Drinking Water)
- U.S. Geological Survey (USGS) National Water Information System

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California Water Quality Regulations pertinent to Groundwater in Ukiah Valley

- North Coast Basin Plan Water Quality Objectives refer to the Title 22 Regulations for MUN use, but add criteria for Bacteria, Radioactivity, and Taste and Odors.

CHAPTER 3. WATER QUALITY OBJECTIVES

3.4 WATER QUALITY OBJECTIVES FOR GROUNDWATERS16

The following objectives shall apply to groundwaters of the North Coast Region. Waterbody-specific objectives contained in Table 3-1 also apply.

3.4.2 Chemical Constituents

Groundwaters shall not contain concentrations of chemical constituents in amounts that cause nuisance or adversely affect beneficial uses.

In no case shall groundwaters designated for use as MUN contain concentrations of chemical constituents in excess of the following MCL and SMCL provisions specified in title 22 of the California Code of Regulations:

a) Table 64431-A, MCLs - Inorganic Chemicals (§ 64431)
b) Table 64444-A, MCLs - Organic Chemicals (§ 64444)
c) Table 64449-A, SMCLs - "Consumer Acceptance Contaminant Levels" (§ 64449)
d) Table 64449-B, SMCLs - "Consumer Acceptance Contaminant Level Ranges" (§ 64449)
e) Table 64442, Radionuclide MCLs and Detection Levels for Purposes of Reporting (DLRs) (§ 64442)
f) Table 64443, Radionuclide MCLs and
g) DLRs (§ 64443)

No Groundwater objectives

TABLE 3-1
SPECIFIC WATER QUALITY OBJECTIVES FOR THE NORTH COAST REGION

Waterbody[1]	Specific Conductance (micromhos) @ 77°F		Total Dissolved Solids (mg/L)		Hydrogen Ion (pH)		Hardness (mg/L)	Boron (mg/L)	
	90% Upper Limit[3]	50% Upper Limit[2]	90% Upper Limit[3]	50% Upper Limit[2]	Max	Min	50% Upper Limit[2]	90% Upper Limit[3]	50% Upper Limit[2]
Navarro River	285[5]	250[5]	170[5]	150[5]	8.5	6.5			
Garcia River	-	-	-	-	8.5	6.5			
Gualala River	-	-	-	-	8.5	6.5			
Russian River HU									
(upstream)[7]	320	250	170	150	8.5	6.5			
(downstream)[8]	375[5]	285[5]	200[5]	170[5]	8.5	6.5			
Laguna de Santa Rosa	-	-	-	-	8.5	6.5			

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California Water Quality Regulations pertinent to Groundwater in Ukiah Valley

Maximum Contaminant Levels (MCLs) to protect drinking water

- Primary MCLs – e.g. Nitrate
  - Not-to-exceed standards to protect human health
- Secondary MCLs – e.g. Iron
  - Non-enforceable guidelines to achieve consumer acceptance (e.g. taste, odor, or color)
  - May have a range of acceptable values (e.g. Recommended, Upper, Short Term)

Notification Level (NL) for Boron set by California Division of Drinking Water

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Ukiah Valley: Data Selection and Approach to Create preliminary list of Constituents

- MCL, Basin Plan water quality objective, or human health-related level exists for the constituent
- Consider only data from the last 30 years
- Focus on water quality parameters confirmed by multiple measurements
- Constituent either (a) shows exceedances of a threshold, (b) shows a strong likelihood of exceeding a threshold, or (c) is commonly addressed in other GSPs.

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Ukiah: Data Selection and Approach

- Databases pulled from
  - Groundwater Ambient Monitoring and Assessment Program (GAMA)
  - California Integrated Water Quality System (CIWQS)
- Total number of wells
  - 629 wells with water quality data
  - 384 wells with water quality data from 1990-2020
- Parameters
  - 207 unique analytes
- Time period (earliest to latest)
  - 11/11/1950 – 11/25/2019

Chemicals of Concern: Examples

- Screen parameters down to a reasonable number for further analysis and for setting minimum thresholds and measurable objectives
  - Boron
  - Iron
  - Manganese
  - Nickel
  - Nitrate
  - Specific Conductance
  - Other Basin-specific analytes ?

Constituent
Arsenic
Nitrate as N
Chromium-VI
Dibromochloropropane (DBCP)
1,2,3-Trichloropropane (TCP)
Tetrachloroethene (PCE)
Chloride
Sodium
Total Dissolved Solids
Perchlorate

Chemical of Concern
Arsenic
Chromium (Total)
Fluoride
Gross Alpha
Lead *
Nitrate
1,2,3-Trichloropropane
Uranium
Aluminum
Iron
Manganese
Total Dissolved Solids

Constituent of Concern
Total dissolved solids
Chloride
Iron
Manganese
Arsenic
Chromium (Total)
Chromium VI
Nitrate as Nitrogen
Perchlorate
Organic compounds

Other draft GSP examples

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MCLs, NLs, and WQOs for a handful of Chemicals of Concern

Constituent	Units	Applicable Regulation	Regulatory Threshold
Boron, Total	mg/L	DW Notification Level	1.0
Iron, Total	µg/L	Secondary MCL	300
Manganese, Total	µg/L	Secondary MCL	50
Nickel, Total	µg/L	Primary MCL	100
Nitrate	mg/L as N	Primary MCL	10
Specific Conductance	µmhos/cm	Secondary MCL	900 (Recommended) 1,600 (Upper) 2,200 (Short Term)

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Background on Constituents of Concern Found in Groundwater

- **Boron** – Naturally occurring element found in groundwater primarily as a result of leaching from rocks and soils containing borates and borosilicates.
- **Iron** – Abundant element in the earth's crust that is found in groundwater in its dissolved form; concentrations can be elevated due to mining operations, industrial waste, and corroding metal.
- **Nitrate** – Nitrogen is very prevalent in the earth's crust; nitrates are found in groundwater as a result of the applications of nitrate-containing fertilizers, feedlot discharges, treated and untreated sewage, and emissions from industrial processes; nitrates/nitrites affect the oxygen carrying capacity of hemoglobin, thyroid gland function, and vitamin A retention.

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Background on Constituents of Concern Found in Groundwater

- **Manganese** – Occurs naturally as a mineral from sediment and rocks or from mining and industrial waste.
- **Specific Conductivity** – The salinity of water is commonly measured indirectly as a water's ability to pass electrical flow. Conductivity measured at – or normalized to – 25º Celsius is called specific conductivity. Salinity is the total concentration of all dissolved salts in water.
- **Nickel** – is naturally occurring in soil and surface water but some activities like industrialization, sewage, use of chemical fertilizer, pesticides etc. increase the concentration in environment.

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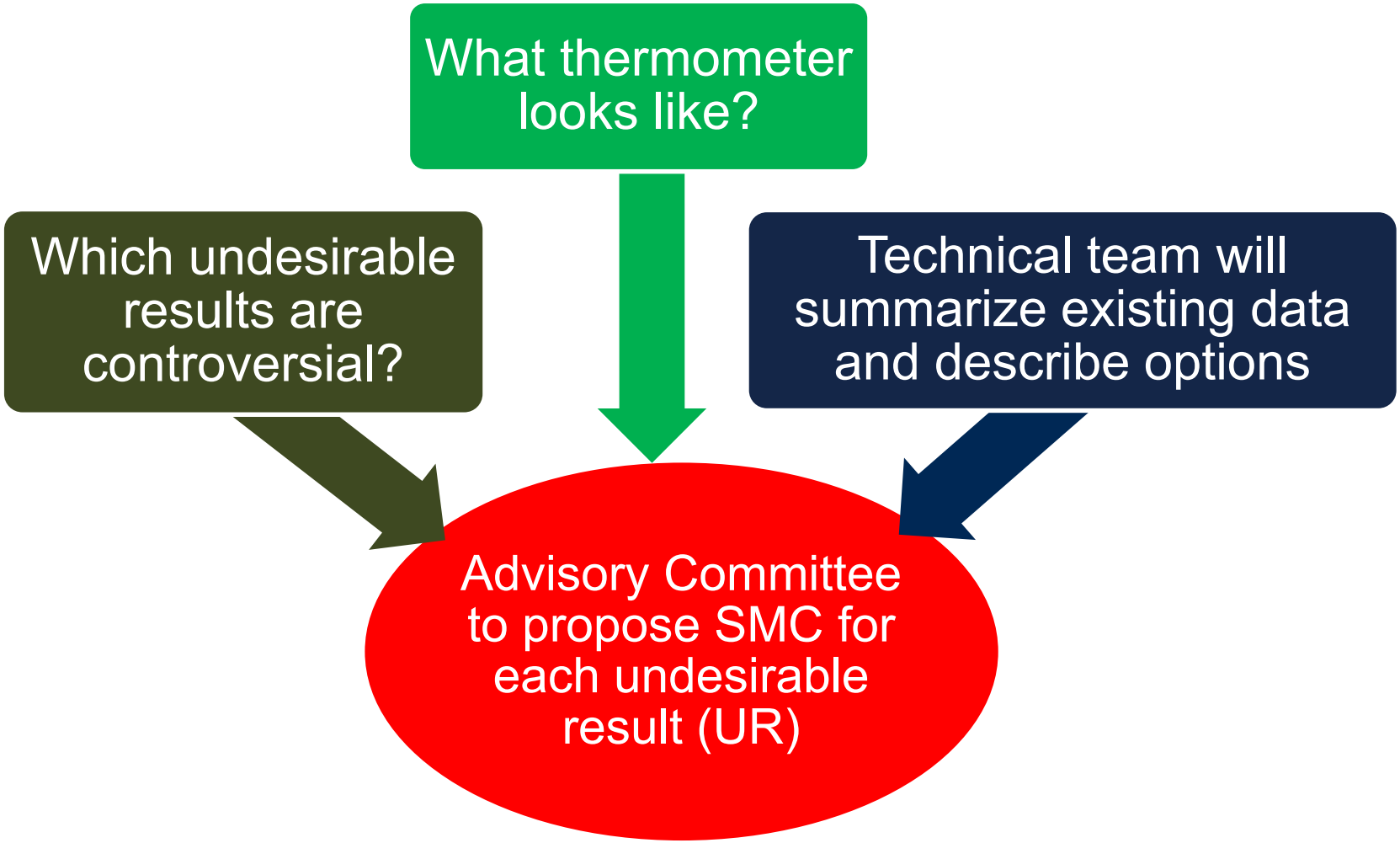
What will our process look like?



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Who Measures and When to Measure What Monitoring Network

- Options for GSP:

  A. GSA uses public supply well and contaminant site monitoring well data reported by to SWRCB under existing WQ monitoring program

  B. Option A PLUS expanded ambient monitoring network to address data gaps

What makes a good monitoring network?

- What is a monitoring network?
- Established for each sustainability indicator:
  - Groundwater levels and quality
  - Subsidence
  - Surface water-groundwater interaction
- Includes monitoring wells, stream gauges, subsidence measurements
- Will have spatial and temporal components:
  - How many wells and how spread out are they?
  - How frequently are they measured?
- Able to provide data relative to undesirable results

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What to Measure - Constituents of Concern

- Existing example Draft GSP screening process (i.e. how some other GSPs identified their “list”)
  - Utilized existing Regional Monitoring Program (RMP) constituents of concern
  - Evaluated all regulated drinking water constituents to determine only constituents with known water quality issues within the sub-basin
  - Evaluated only a select number of water quality constituents based on review of data, local stakeholder input, and regulatory agency input
  - All screening processes included known groundwater contamination sites and plumes

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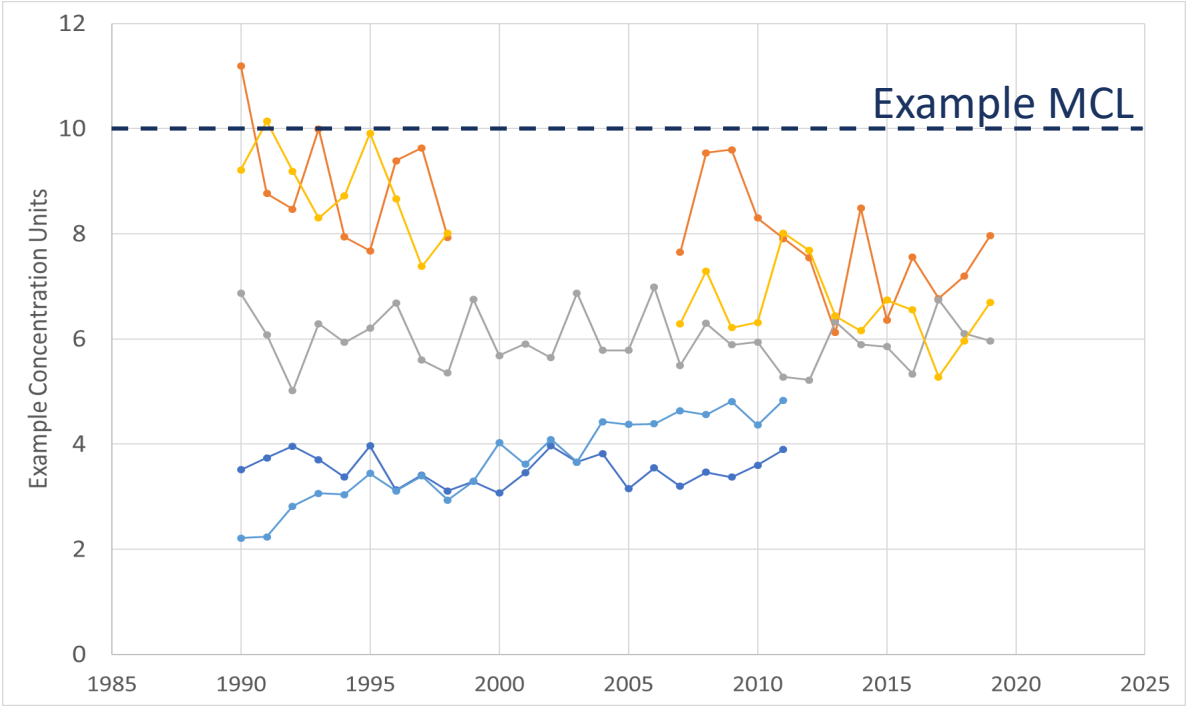
What Metric to Use for the "Thermometer"



Example Dataset

Options:

- Averages
- Medians
- Statistical trends over time
- Number of wells with exceedances
- Volume fraction of groundwater basin with exceedances

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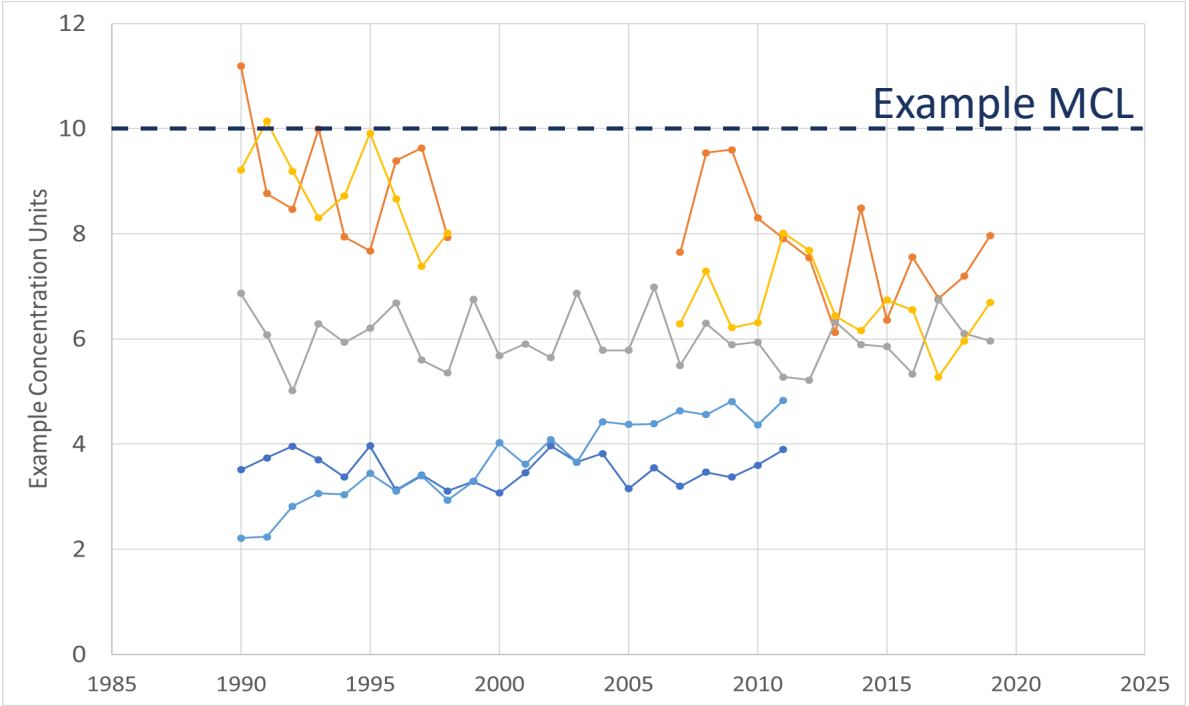
What Metric to Use for the "Thermometer"



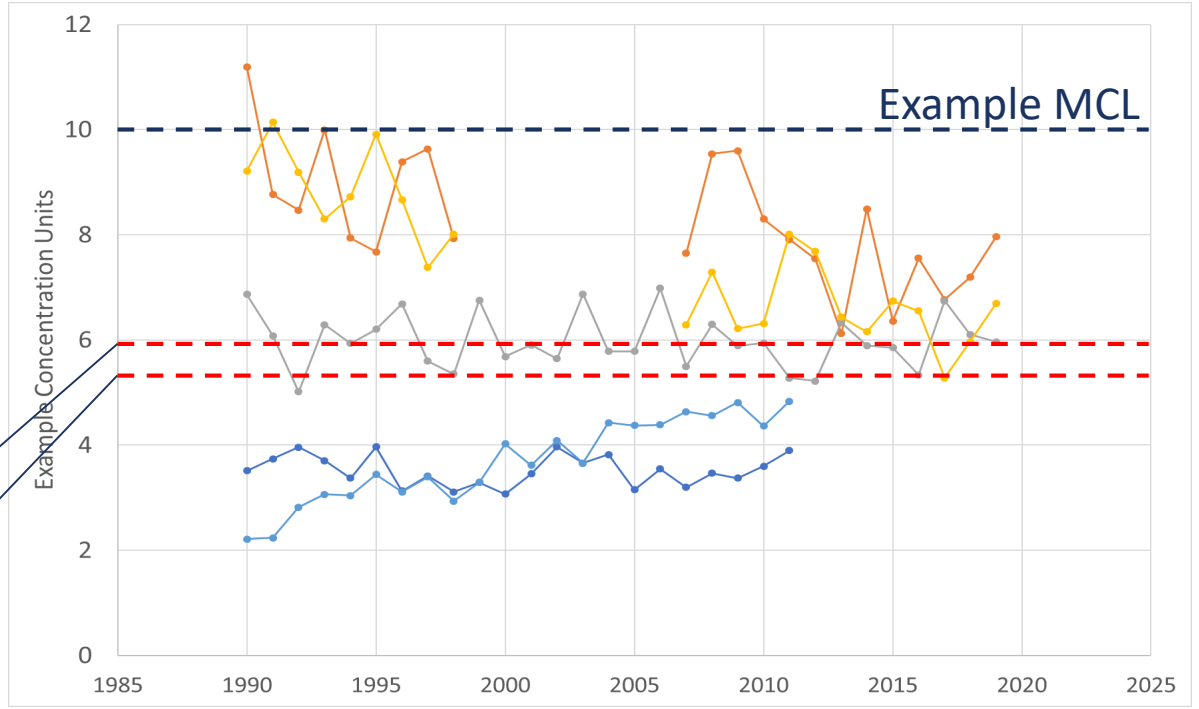
Example Dataset

Options:

- Averages
- Medians
- Statistical trends over time
- Number of wells with exceedances
- Volume fraction of groundwater basin with exceedances

DRAFT

What Metric to Use for the "Thermometer"

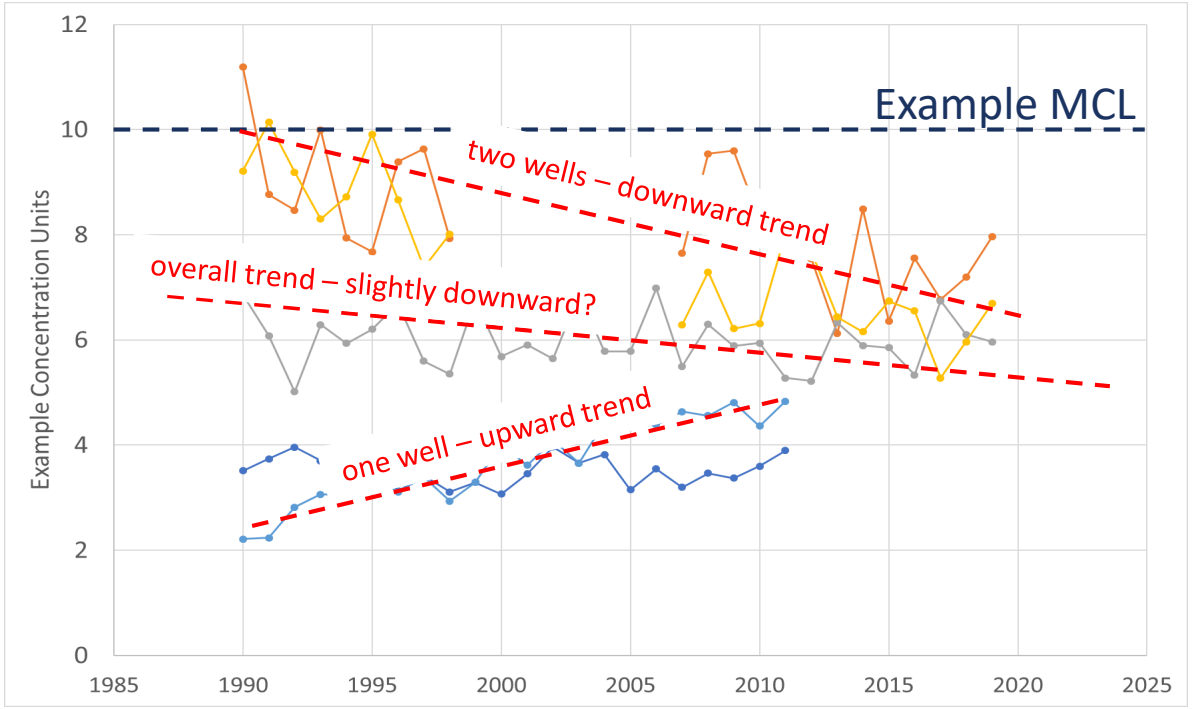


Example Dataset

Options:

- Average
- Median
- Statistical trends over time
- Number of wells with exceedances
- Volume fraction of groundwater basin with exceedances

What Metric to Use for the "Thermometer"



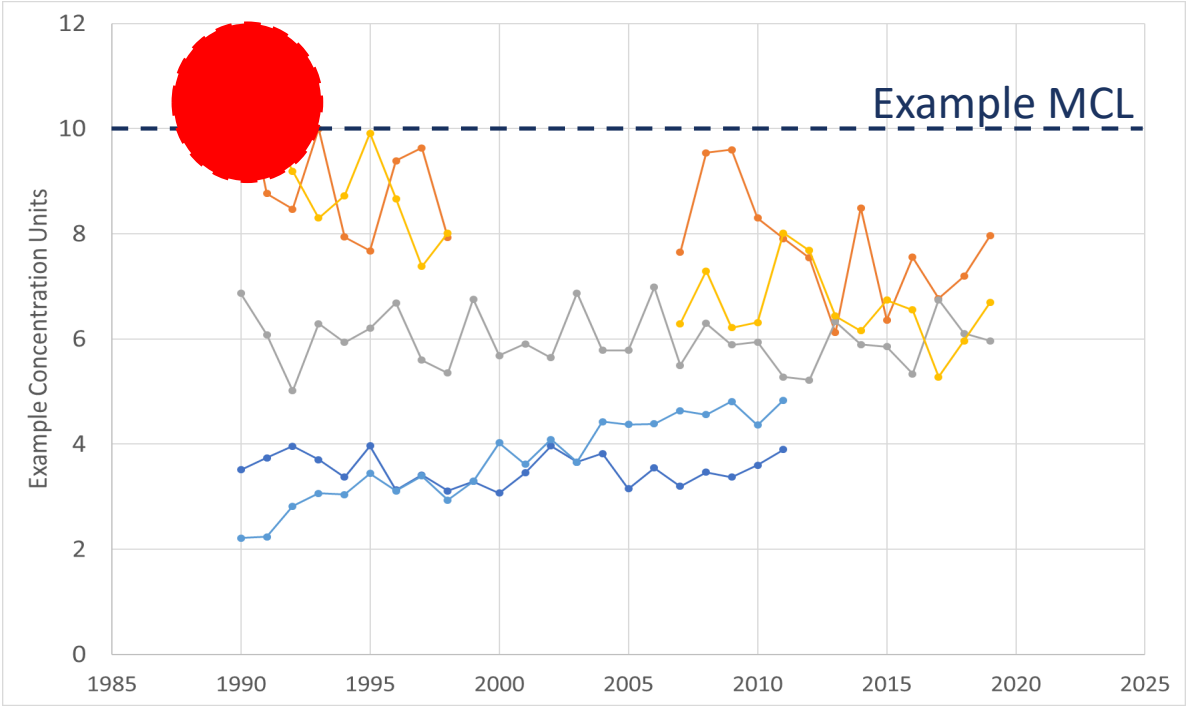
Example Dataset

Options:

- Averages
- Medians
- Statistical trends over time
- Number of wells with exceedances
- Volume fraction of groundwater basin with exceedances

DRAFT

What Metric to Use for the "Thermometer"



Example Dataset

Options:

- Averages
- Medians
- Statistical trends over time
- Number of wells with exceedances
- Volume fraction of groundwater basin with exceedances

DRAFT

What Metric to Use for the "Thermometer"

- Example from Salinas Valley GSP
  - Minimum Threshold = # of exceedances of drinking water standards
  - Measurable Objective = Minimum Threshold

Sustainability Indicator	Minimum Threshold	Measurement	Measurable Objective	Undesirable Result	Interim Milestones
Degraded groundwater quality	[redacted] Exceedances are only measured in supply wells that regularly test for the parameters. See Tables 8-2 and 8-3 for the list of constituents.	Groundwater quality data downloaded annually from state and local sources.	[redacted]	On average during any 1 year, no groundwater quality minimum threshold shall be exceeded as a direct result of projects or management actions taken as part of GSP implementation.	Identical to current conditions

DRAFT

What Metric to Use for the "Thermometer"

- Example from Mid County Santa Cruz GSP
  - Minimum Threshold = state drinking water standards

3.7.2.2 Degraded Groundwater Quality Minimum Thresholds

[redacted] Table 3-19 lists the constituents of concern in the Basin together with why it is of concern and their state drinking water standards that represent minimum thresholds.

Table 3-19. Constituents of Concern with Minimum Thresholds

Constituent of Concern	Reason for Concern	Minimum Threshold/ Drinking Water Standard
Total dissolved solids	basic health of basin	1,000 mg/L
Chloride	basic health of basin	250 mg/L
Iron	naturally elevated	300 µg/L
Manganese	naturally elevated	50 µg/L
Arsenic	naturally elevated	10 µg/L
Chromium (Total)	naturally elevated	50 µg/L
Chromium VI	naturally elevated	none set yet
Nitrate as Nitrogen	septic systems & agriculture	10 mg/L
Perchlorate	agriculture related	6 µg/L
Organic compounds	human introduced	various

DRAFT

What Metric to Use for the "Thermometer"

- Example from Mid County Santa Cruz GSP
  - Measurable Objectives = Multi-year trends at individual wells in network

[redacted] Table 3-20 summarizes the measurable objectives for each RMP. If a representative monitoring well does not have groundwater quality data during this period, the most recent concentrations are used.

Aquifer Unit	Well Name	Total Dissolved Solids, mg/L	Chloride, mg/L	Iron, µg/L	Manganese, µg/L	Arsenic, µg/L	Chromium (Total), µg/L	Chromium VI, µg/L	Nitrate as Nitrogen, mg/L	Perchlorate, µg/L	Organic compounds
	Minimum Threshold	**1,000**	**250**	**300**	**50**	**10**	**50**	**NA**	**10**	**6**	**various**
Aromas	Altivo PW	209	18.9	41	4	0.2	26.5	22	1	0.2	ND
	CWD-10 PW	340	26	ND	ND	ND	11	ND	25	ND	ND
	SC-A1C	348	29	232	1378	ND	ND	ND	1	ND	ND
	SC-A2RC	355	41	114	11	ND	6	ND	4	ND	ND

DRAFT

What Metric to Use for the "Thermometer"

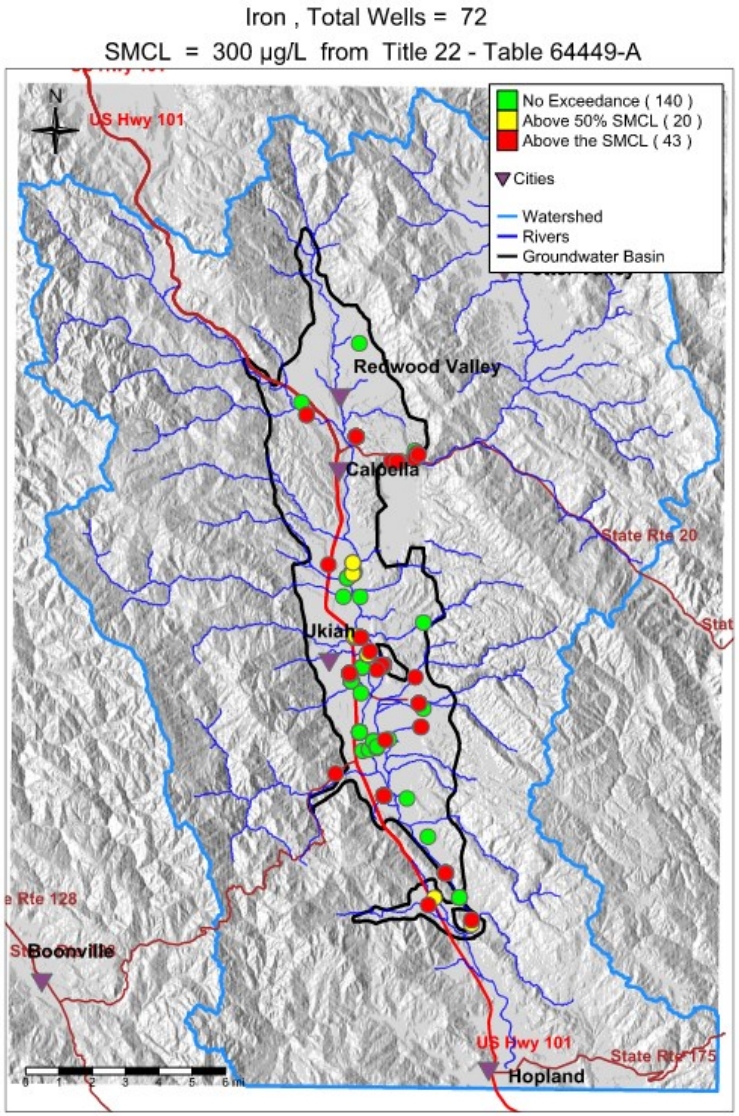
- Promising Options for GSP

  A. Threshold sets at the MCL

  B. Long-term trends at individual wells in network

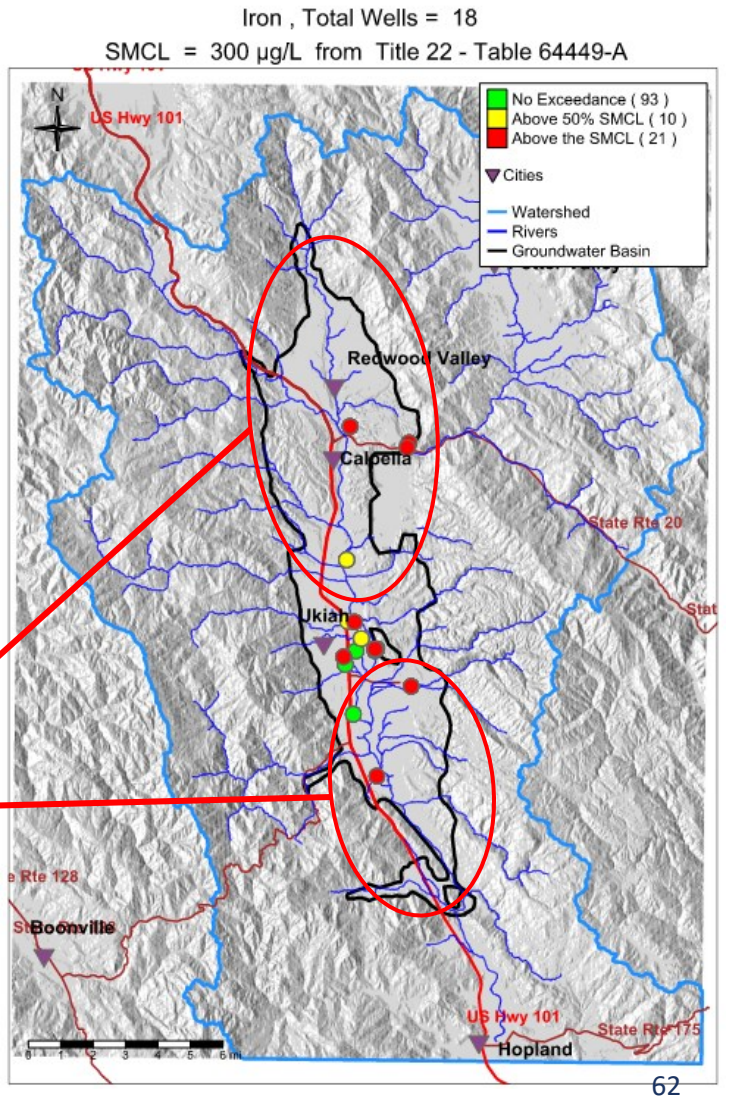
DRAFT

Where to Measure (monitoring network)



Limiting to at least 5 data points per well for illustrative purposes

Data?



DRAFT

Groundwater Quality in Ukiah Valley

Historical Conditions for the Six Constituents of Concern (COCs)

DRAFT

Ukiah
Iron

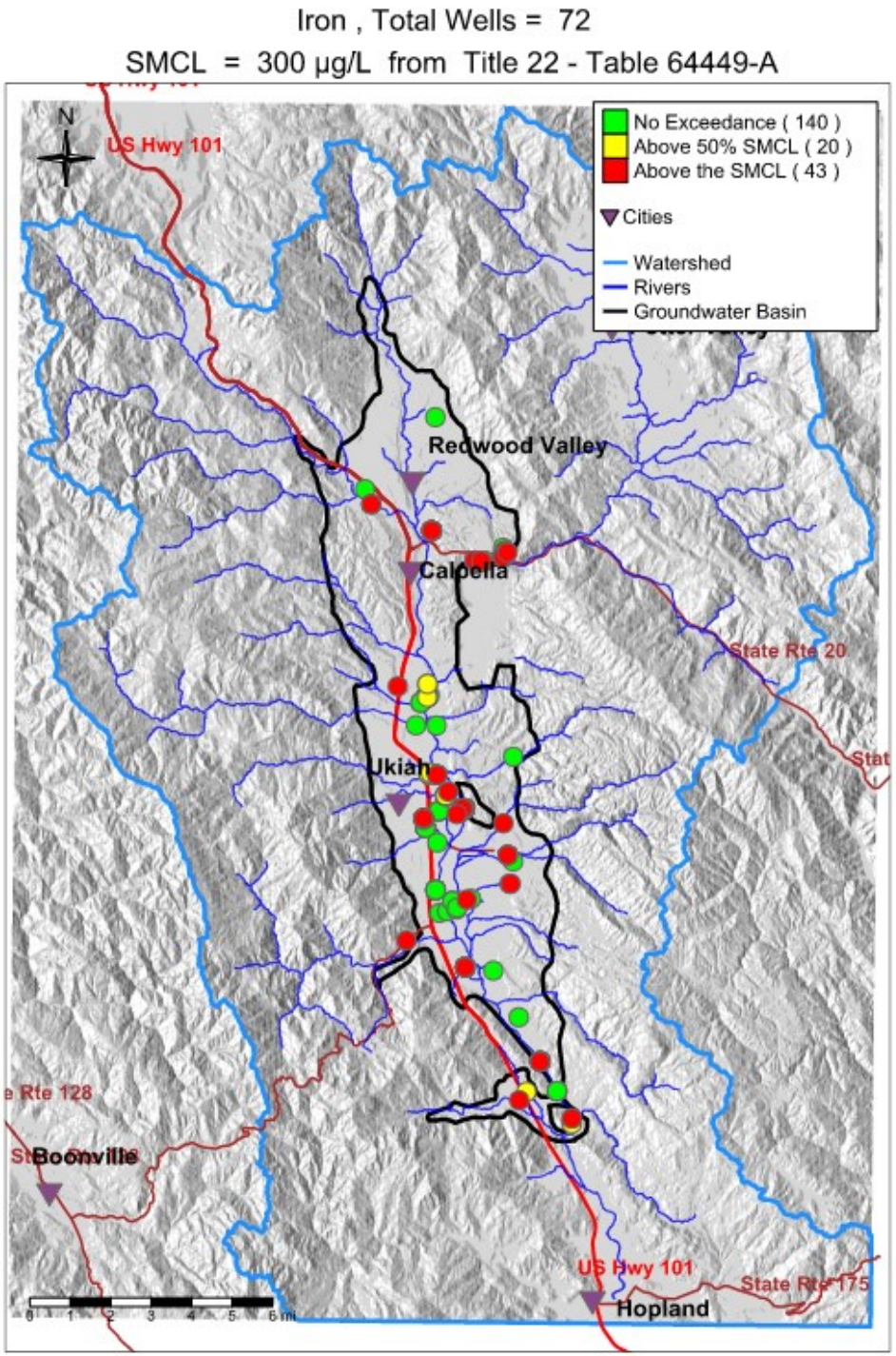
1) All wells with data within the basin (72 wells)

Colors based on Primary MCL for Iron; highest measured value in well

Red = Above 300 µg/L (43)

Yellow = 150 – 300 µg/L (20)

Green = Below 150 µg/L (140)



DRAFT

Ukiah
Iron

1) All wells with data within the basin (72 wells)

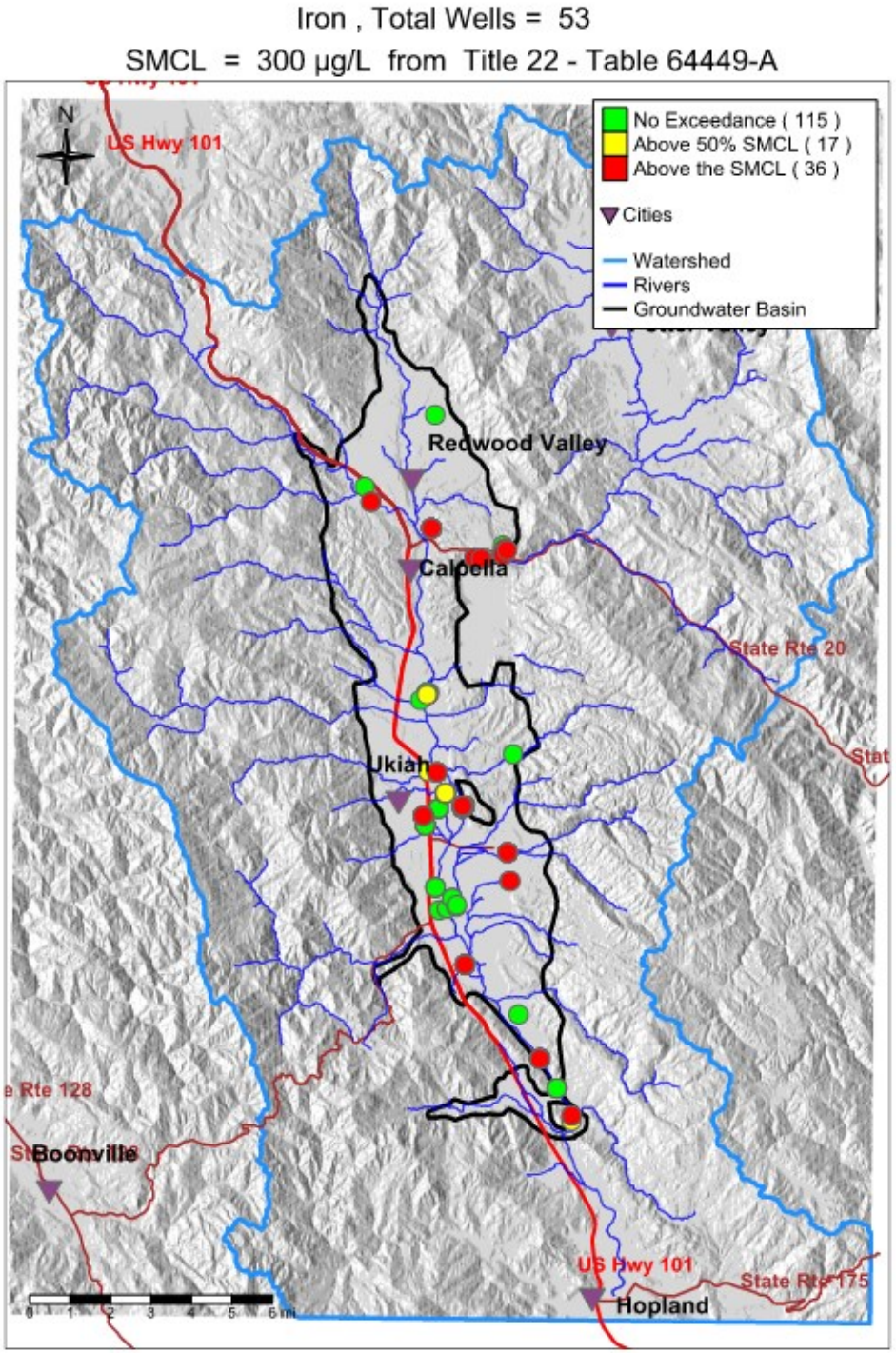
2) Restrict data to within the past 30 years (53 wells)

Colors based on Primary MCL for Iron; highest measured value in well

Red = Above 300 µg/L (36)

Yellow = 150 – 300 µg/L (17)

Green = Below 150 µg/L (115)



DRAFT

Ukiah
Iron

1) All wells with data within the basin (72 wells)

2) Restrict data to within the past 30 years (53 wells)

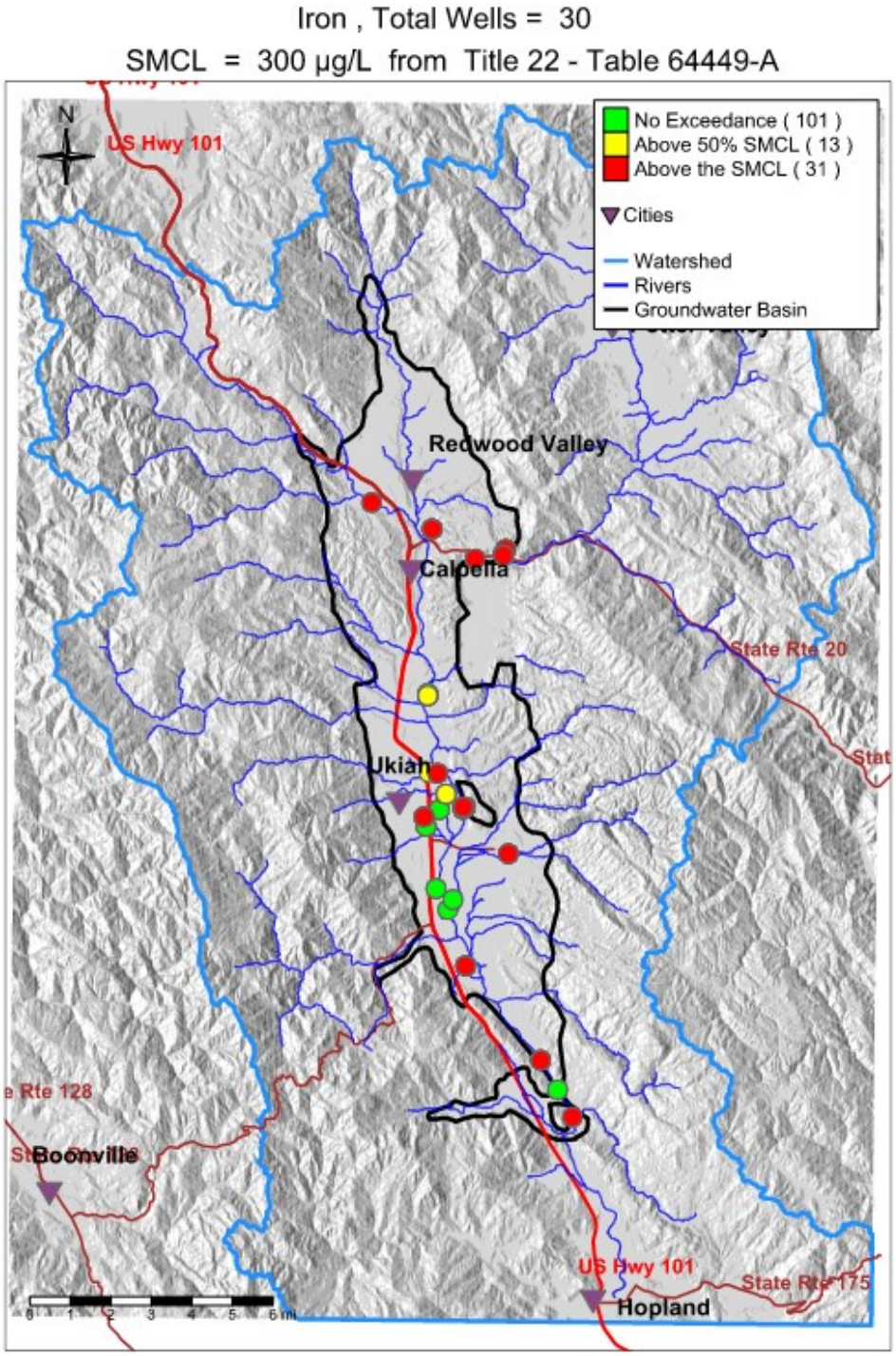
3) Restrict data to wells with 2 or more data points (30 wells)

Colors based on Primary MCL for Iron; highest measured value in well

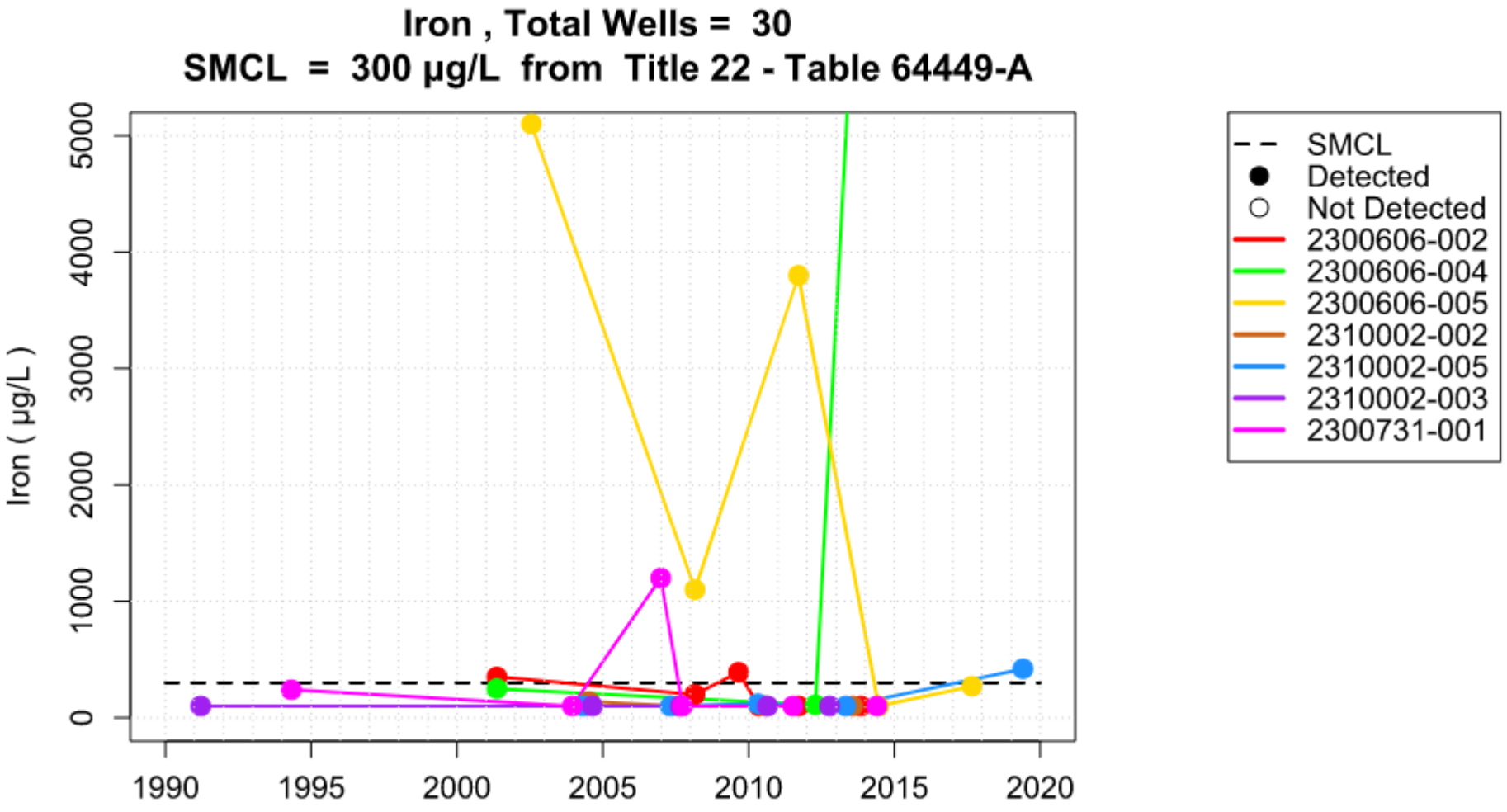
Red = Above 300 µg/L (31)

Yellow = 150 – 300 µg/L (13)

Green = Below 150 µg/L (101)

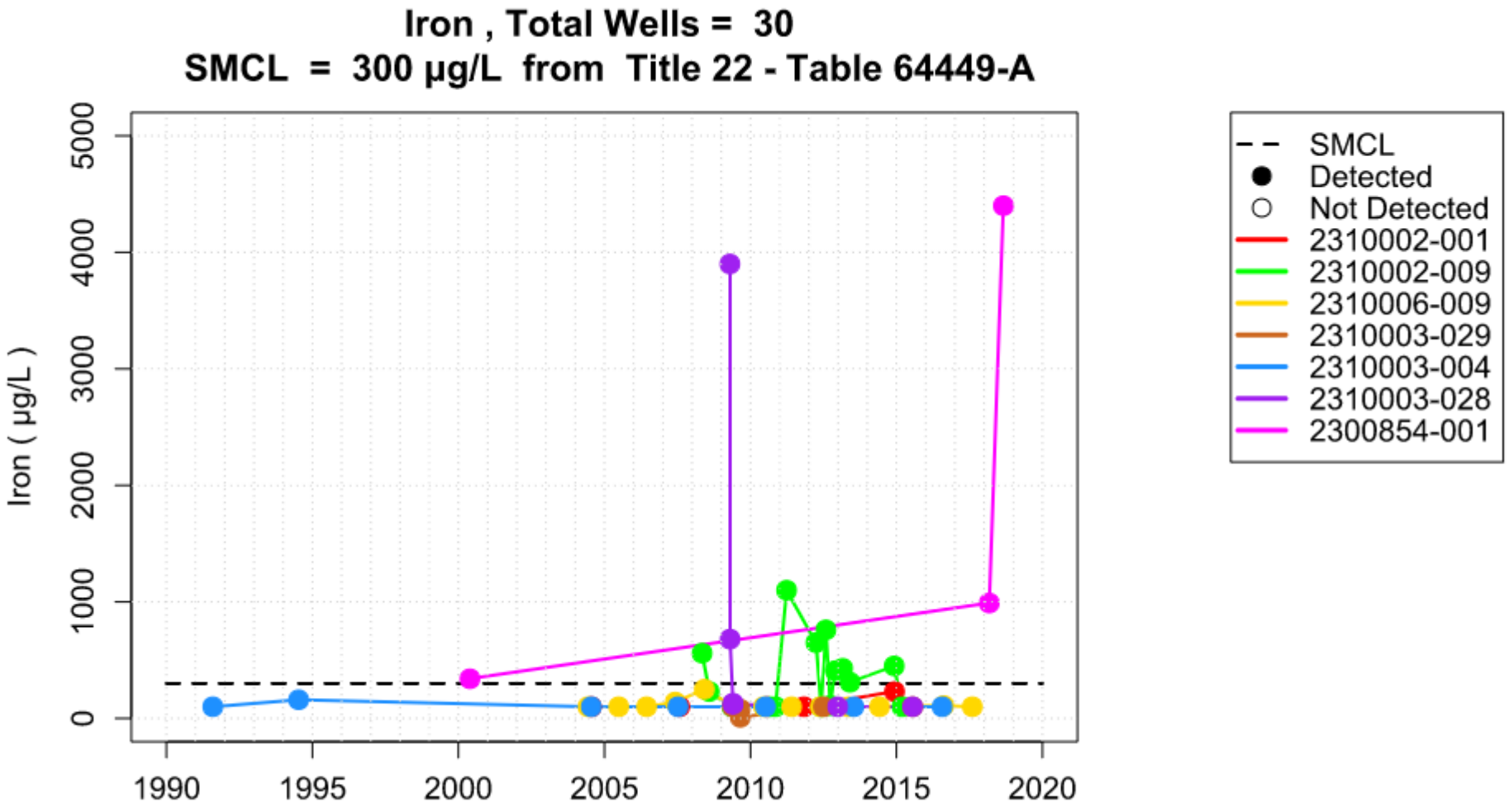


DRAFT

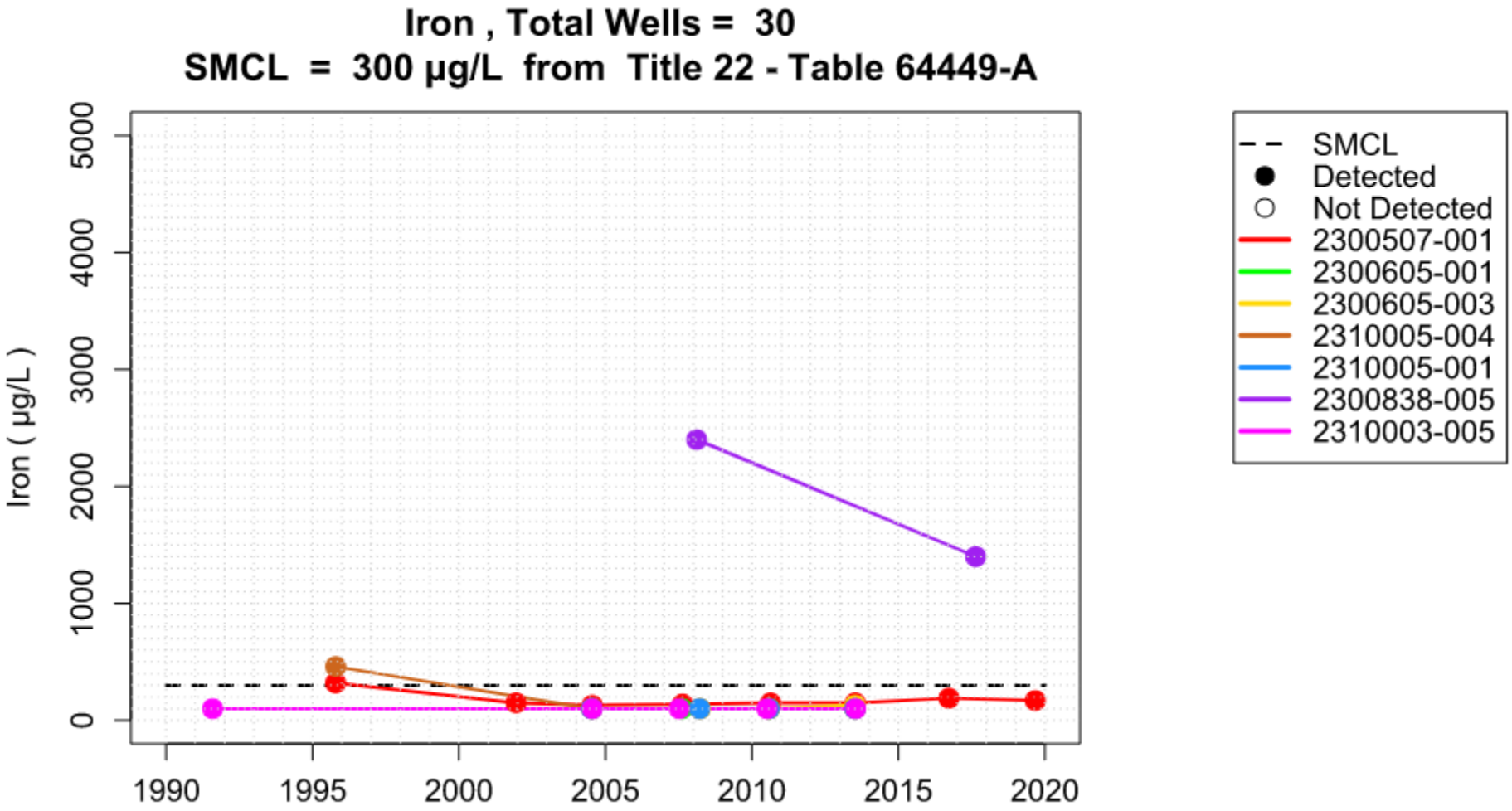


* Iron concentration in Well 2300606-004 in 2015 is about 15,000 µg/L.

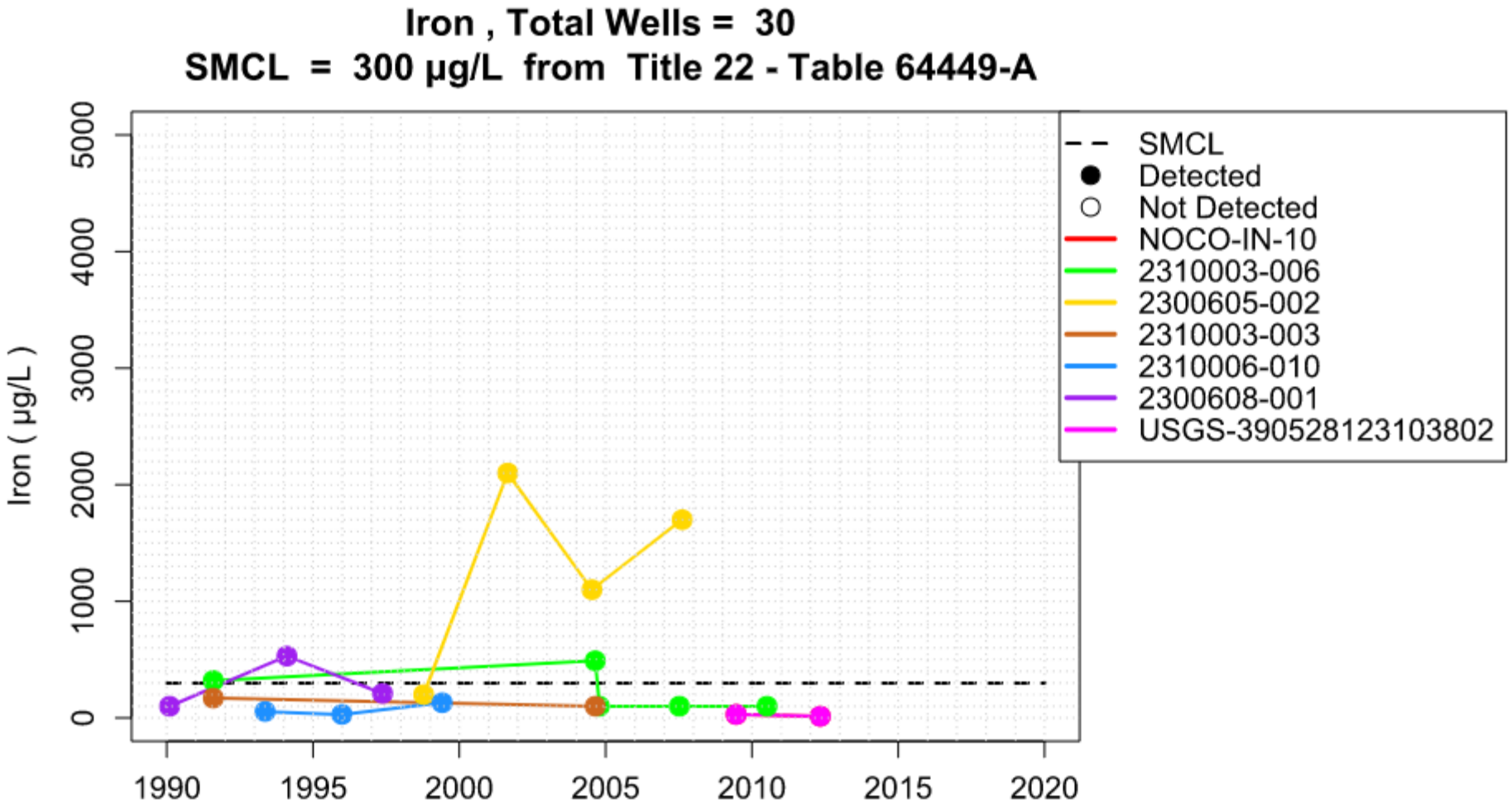
DRAFT


Iron , Total Wells = 30
SMCL = 300 µg/L from Title 22 - Table 64449-A
Iron (µg/L)
0
1000
2000
3000
4000
5000
1990
1995
2000
2005
2010
2015
2020
SMCL
Detected
Not Detected
2310002-001
2310002-009
2310006-009
2310003-029
2310003-004
2310003-028
2300854-001

DRAFT


Iron , Total Wells = 30
SMCL = 300 µg/L from Title 22 - Table 64449-A
Iron (µg/L)
0
1000
2000
3000
4000
5000
1990
1995
2000
2005
2010
2015
2020
SMCL
Detected
Not Detected
2300507-001
2300605-001
2300605-003
2310005-004
2310005-001
2300838-005
2310003-005

DRAFT


Iron , Total Wells = 30
SMCL = 300 µg/L from Title 22 - Table 64449-A
Iron (µg/L)
0
1000
2000
3000
4000
5000
1990
1995
2000
2005
2010
2015
2020
SMCL
Detected
Not Detected
NOCO-IN-10
2310003-006
2300605-002
2310003-003
2310006-010
2300608-001
USGS-390528123103802

DRAFT

Ukiah
Nitrate as N

- Nitrogen is very prevalent in the earth's crust; nitrates are found in groundwater as a result of the applications of nitrate-containing fertilizers, feedlot discharges, treated and untreated sewage, and emissions from industrial processes; nitrates/nitrites affect the oxygen carrying capacity of hemoglobin, thyroid gland function, and vitamin A retention.

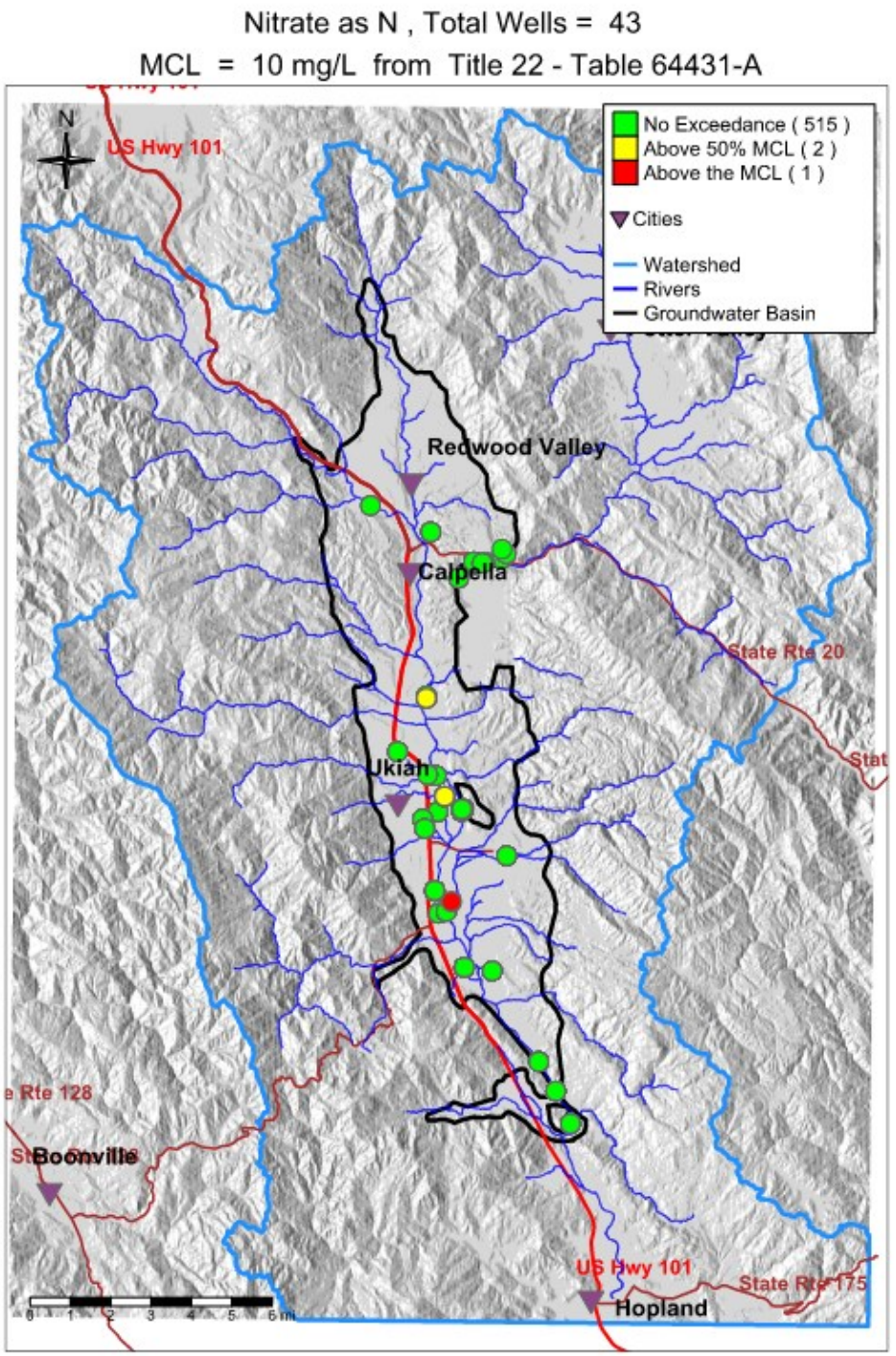
- All wells with data within the basin (43 wells)

Colors based on Primary MCL for Nitrate; highest measured value in well

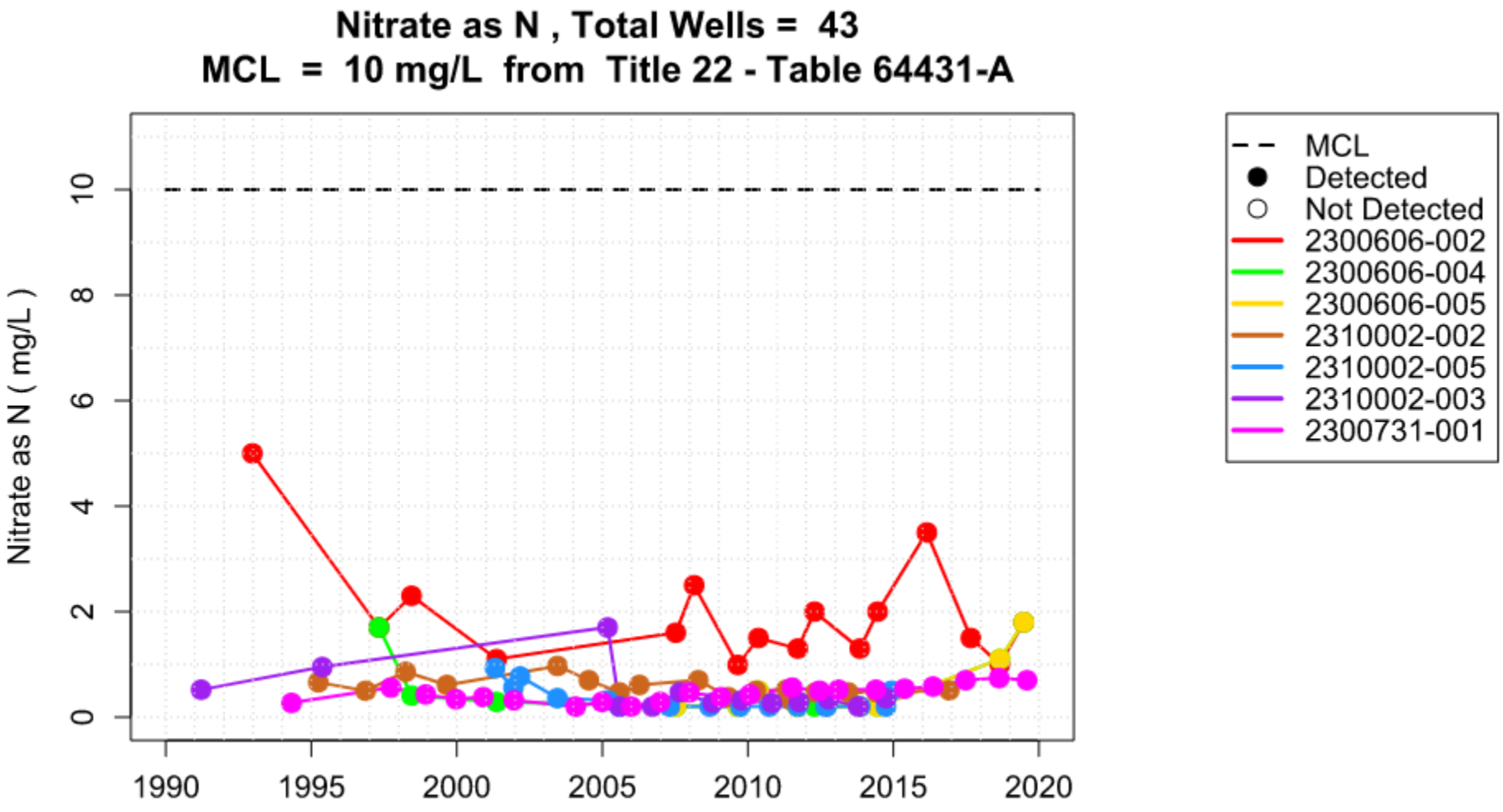
Red = Above 10 mg/L (1)

Yellow = 5 – 10 mg/L (2)

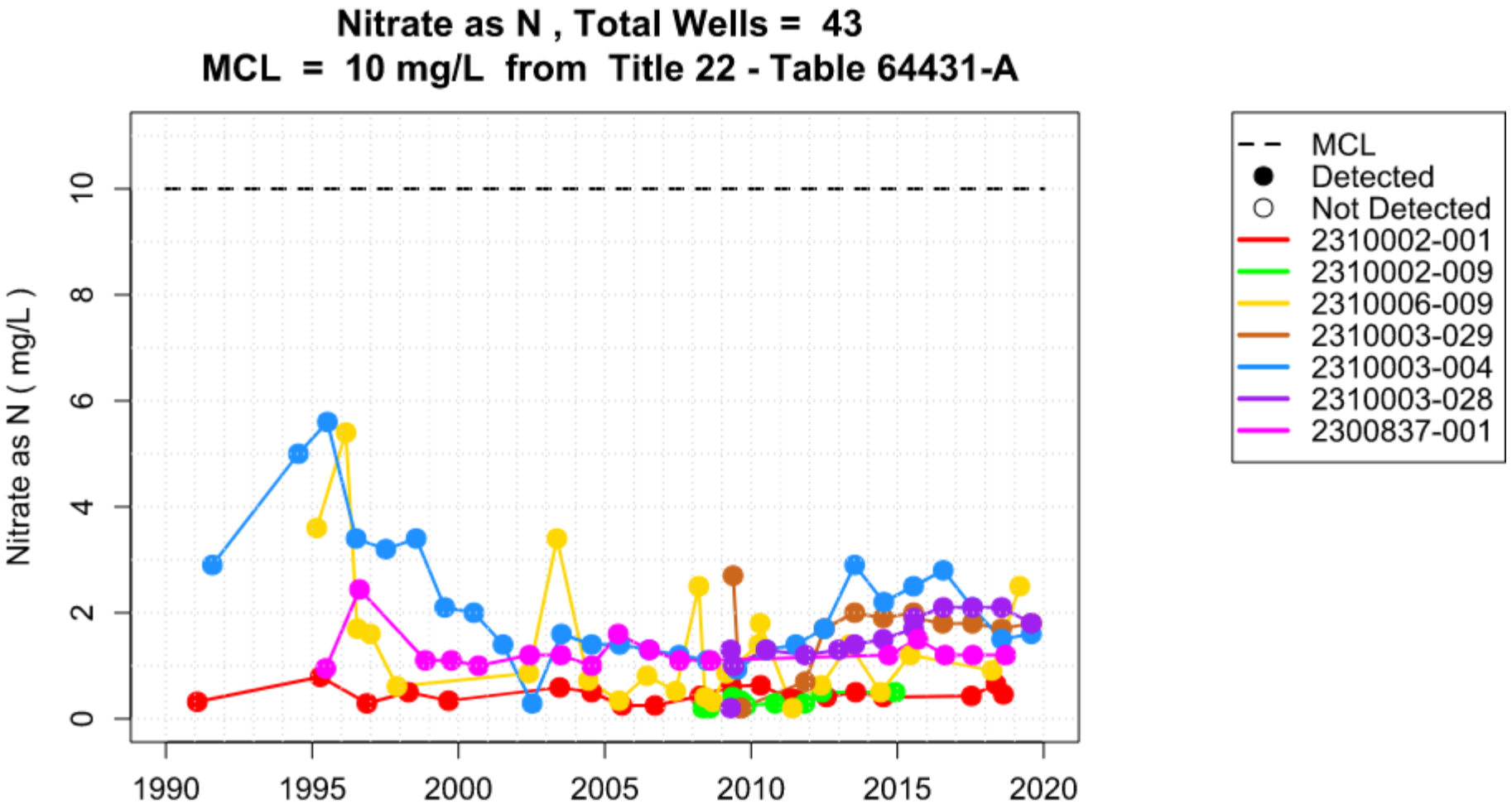
Green = Below 5 mg/L (515)



DRAFT


Nitrate as N , Total Wells = 43
MCL = 10 mg/L from Title 22 - Table 64431-A
Nitrate as N (mg/L)
0
2
4
6
8
10
1990
1995
2000
2005
2010
2015
2020
MCL
Detected
Not Detected
2300606-002
2300606-004
2300606-005
2310002-002
2310002-005
2310002-003
2300731-001

DRAFT


Nitrate as N , Total Wells = 43
MCL = 10 mg/L from Title 22 - Table 64431-A
Nitrate as N (mg/L)
0
2
4
6
8
10
1990
1995
2000
2005
2010
2015
2020
MCL
Detected
Not Detected
2310002-001
2310002-009
2310006-009
2310003-029
2310003-004
2310003-028
2300837-001

DRAFT

Ukiah Boron

- Naturally occurring element found in groundwater primarily as a result of leaching from rocks and soils containing borates and borosilicates.

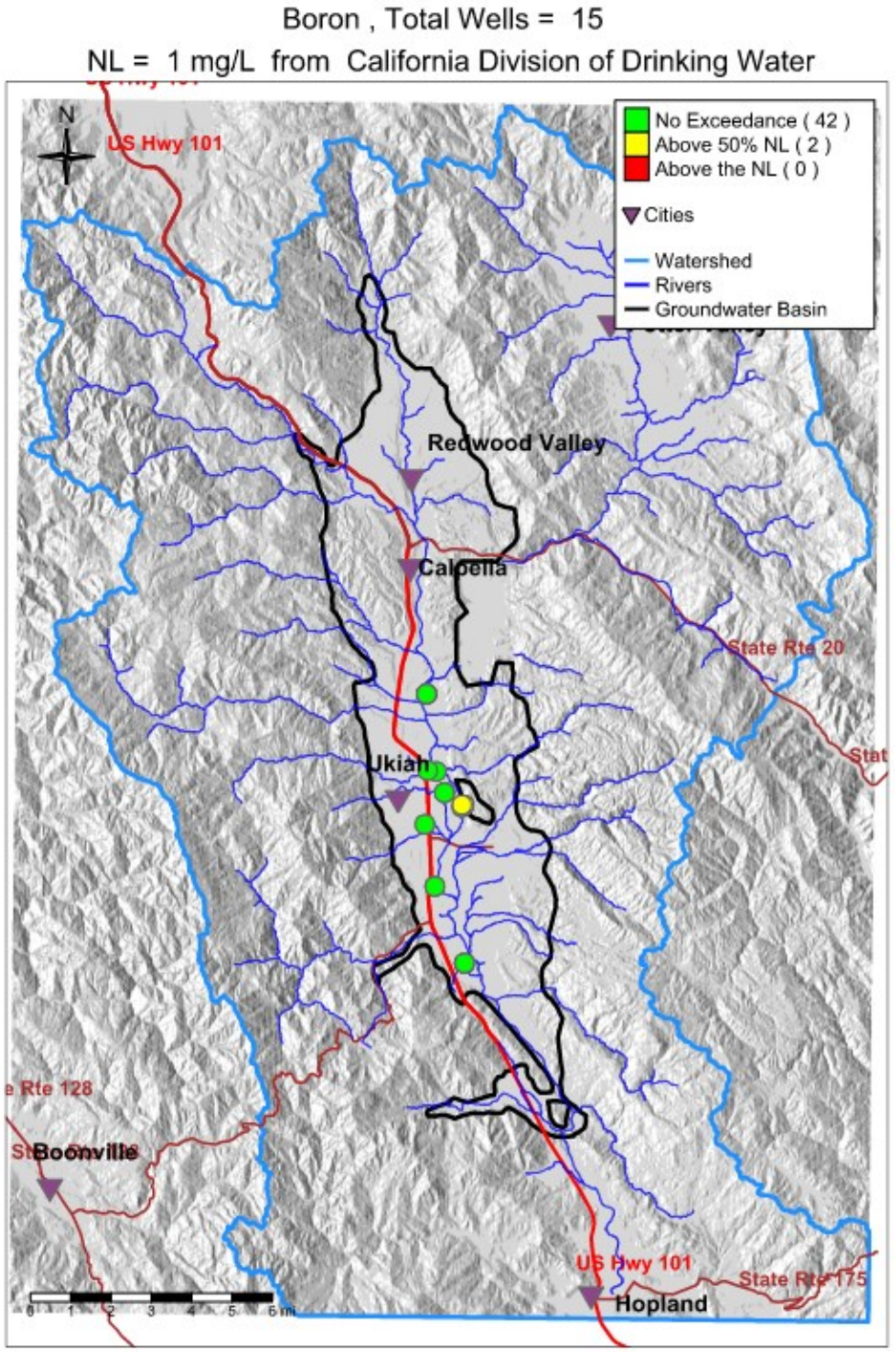
- All wells with data within the basin (15 wells)

Colors based on Notification Levels demonstrated in California Division of Drinking Water; highest measured value in well

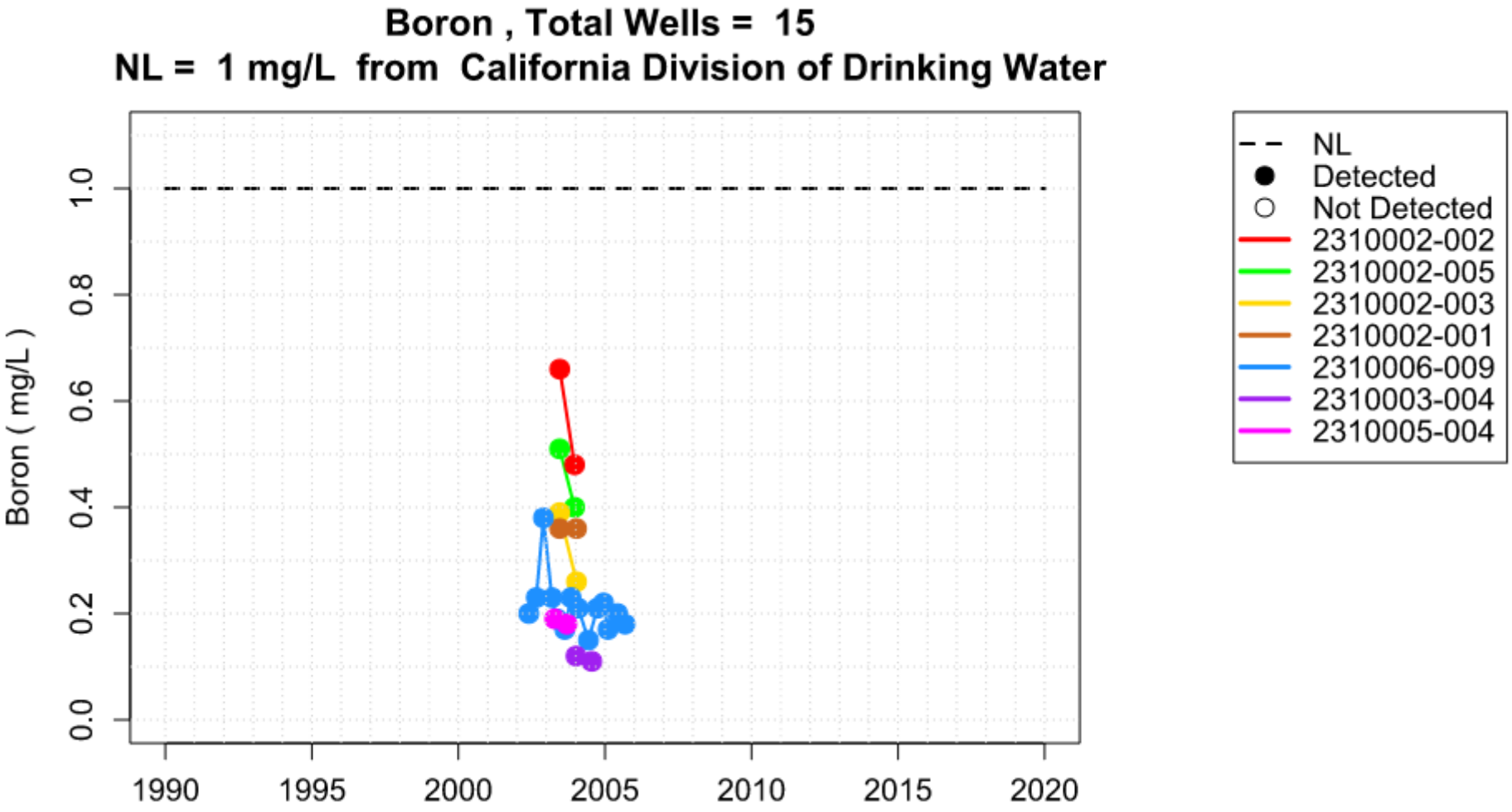
Red = Above 1 mg/L (0)

Yellow = Above 0.5 mg/L (2)

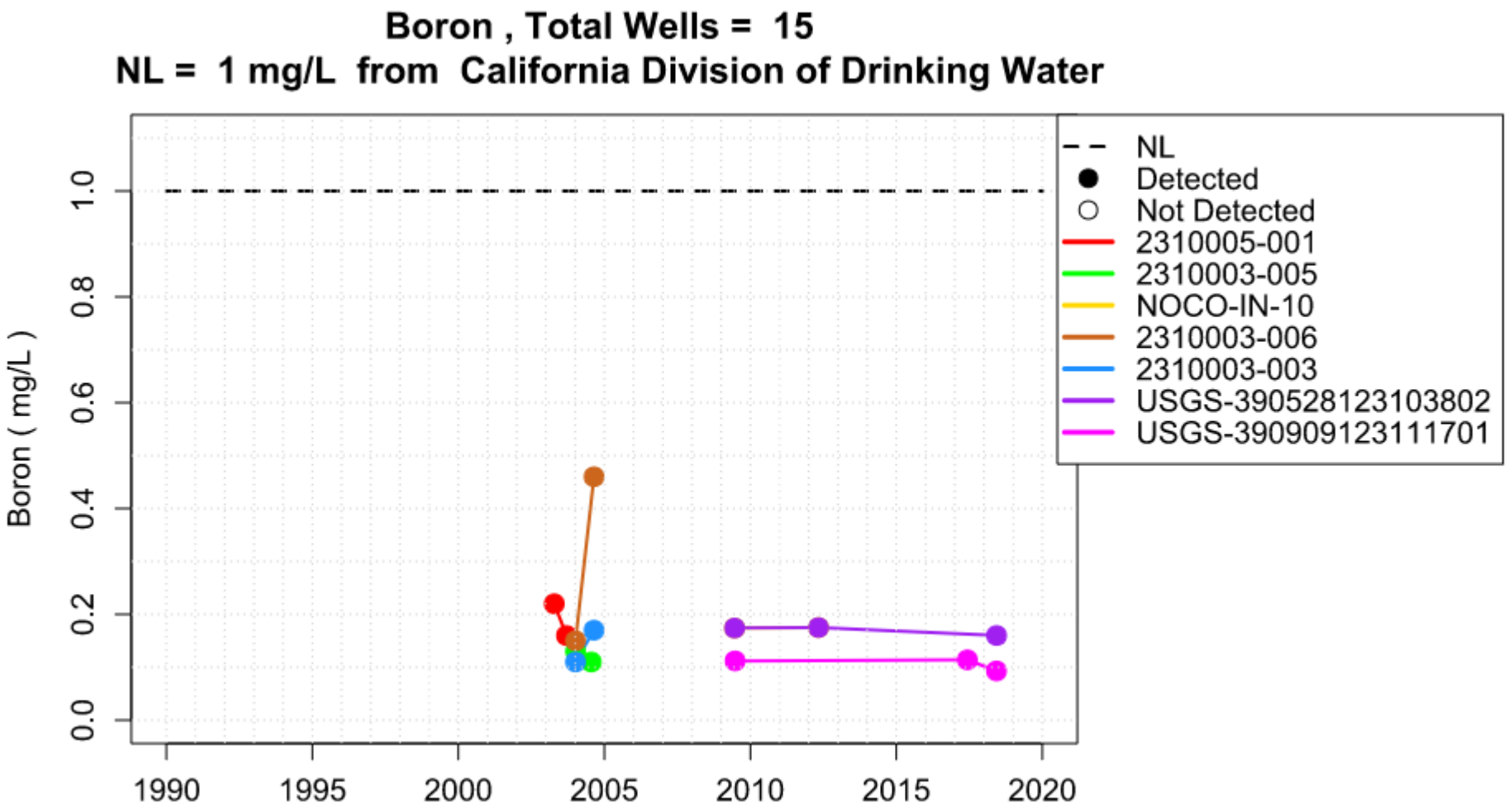
Green = No exceedance (42)



DRAFT


Boron , Total Wells = 15
NL = 1 mg/L from California Division of Drinking Water
Boron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1990
1995
2000
2005
2010
2015
2020
NL
Detected
Not Detected
2310002-002
2310002-005
2310002-003
2310002-001
2310006-009
2310003-004
2310005-004

DRAFT


Boron , Total Wells = 15
NL = 1 mg/L from California Division of Drinking Water
Boron (mg/L)
0.0
0.2
0.4
0.6
0.8
1.0
1990
1995
2000
2005
2010
2015
2020
NL
Detected
Not Detected
2310005-001
2310003-005
NOCO-IN-10
2310003-006
2310003-003
USGS-390528123103802
USGS-390909123111701

DRAFT

Ukiah Manganese

- Occurs naturally as a mineral from sediment and rocks or from mining and industrial waste.

- All wells with data within the basin

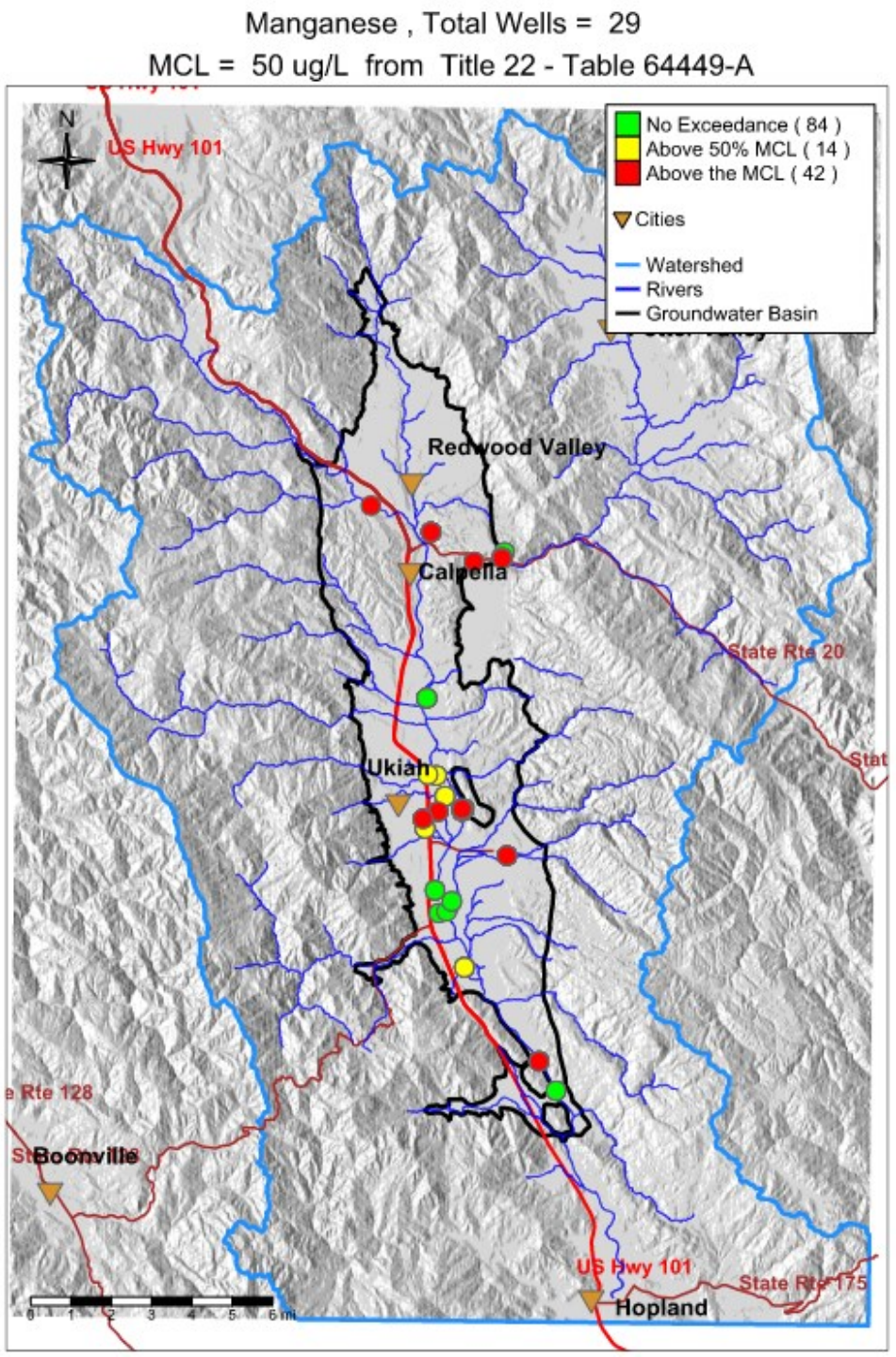
(29 wells)

Colors based on CCR Title 22; highest measured value in well

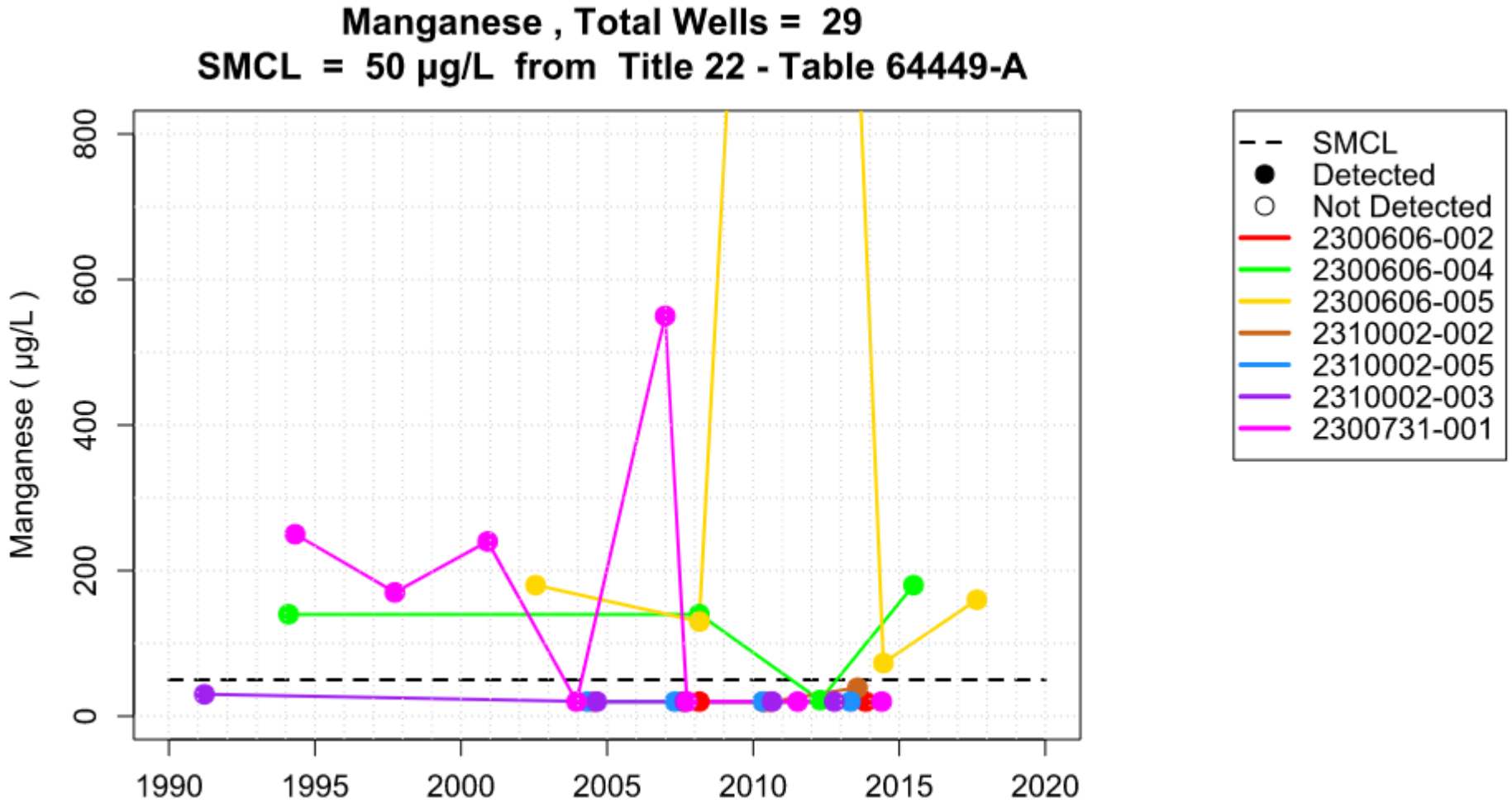
Red = Above 50 ug/L (42)

Yellow = Above 25 ug/L (14)

Green = No exceedance (84)

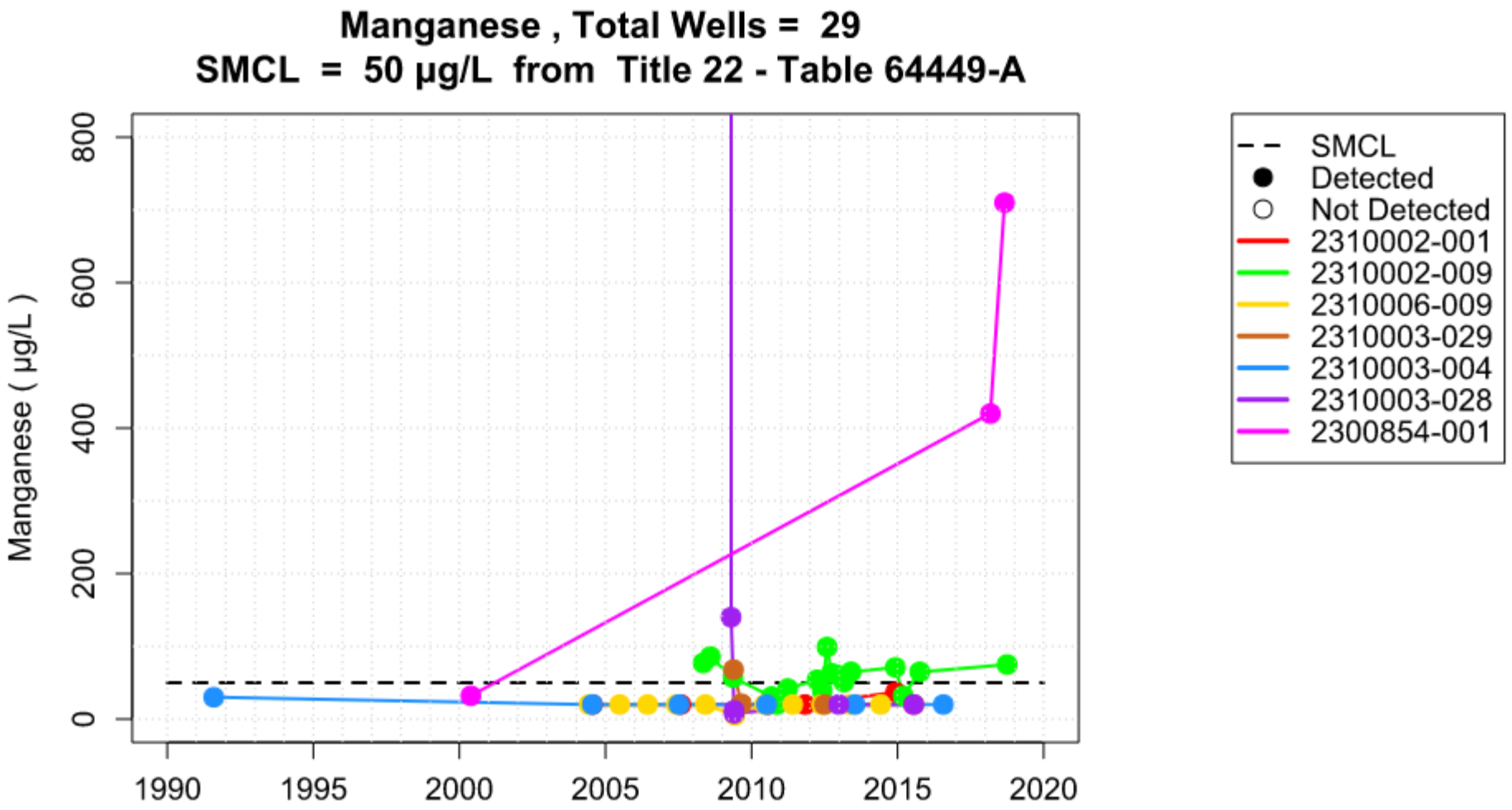


DRAFT



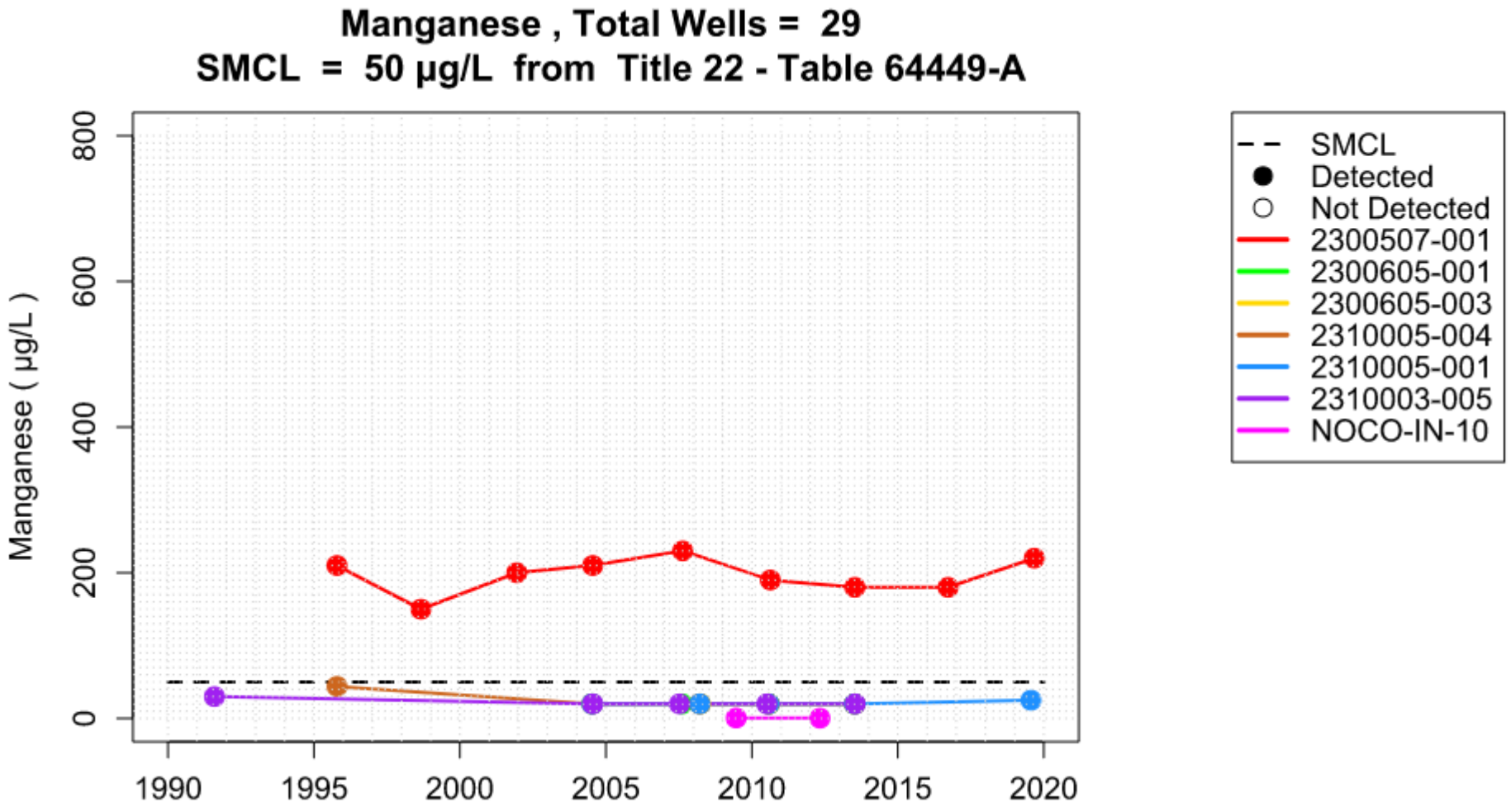
* Manganese concentration in Well 2300606-005 in 2012 is about 2,800 µg/L.

DRAFT

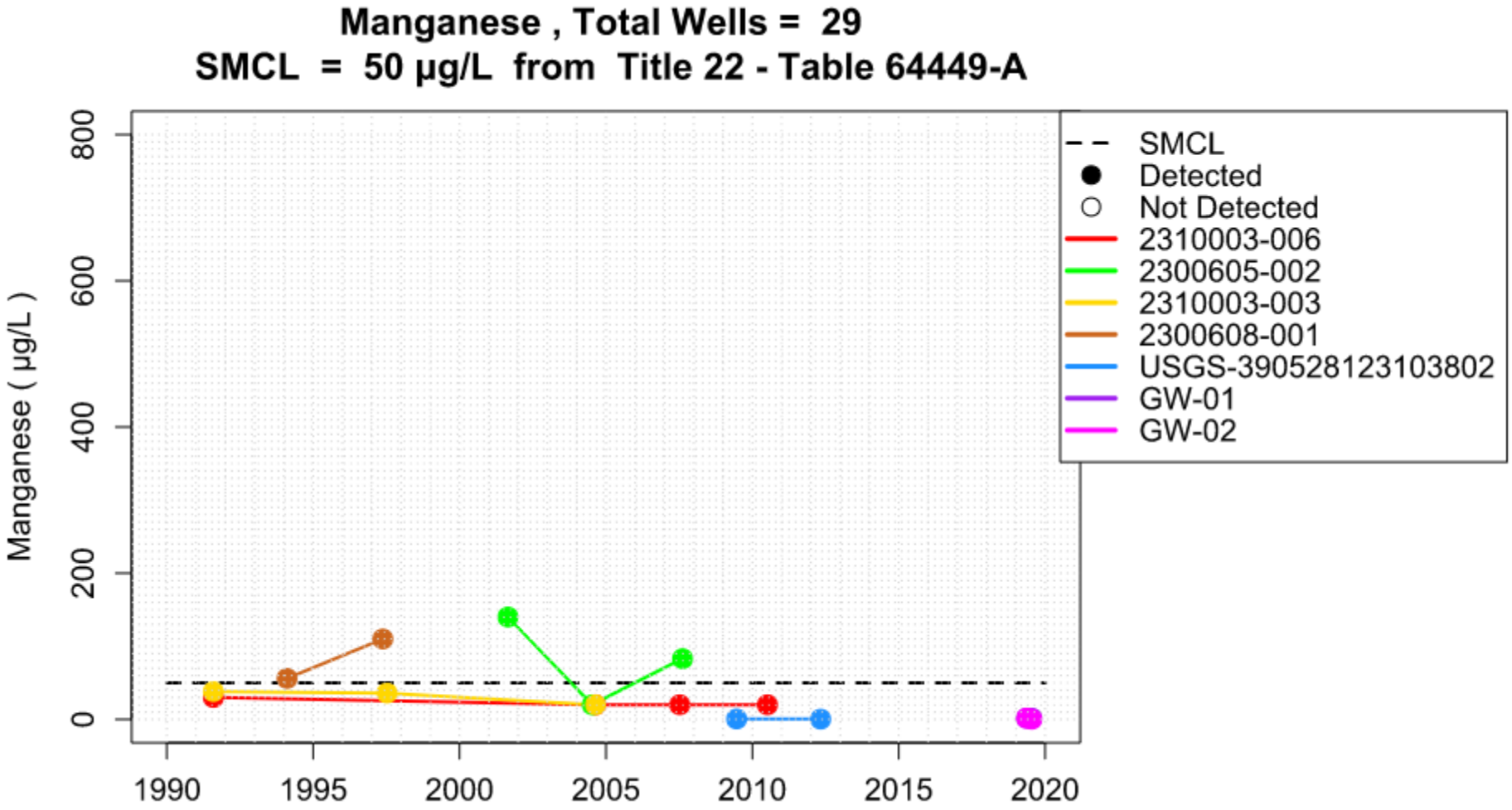


* Manganese concentration in Well 2310003-028 in 2009 is about 1,300 µg/L.

DRAFT


Manganese , Total Wells = 29
SMCL = 50 µg/L from Title 22 - Table 64449-A
Manganese (µg/L)
0
200
400
600
800
1990
1995
2000
2005
2010
2015
2020
SMCL
Detected
Not Detected
2300507-001
2300605-001
2300605-003
2310005-004
2310005-001
2310003-005
NOCO-IN-10

DRAFT


Manganese , Total Wells = 29
SMCL = 50 µg/L from Title 22 - Table 64449-A
Manganese (µg/L)
0
200
400
600
800
1990
1995
2000
2005
2010
2015
2020
SMCL
Detected
Not Detected
2310003-006
2300605-002
2310003-003
2300608-001
USGS-390528123103802
GW-01
GW-02

DRAFT

Ukiah
Nickel

- Nickel is naturally occurring in soil and surface water but some activities like industrialization, sewage, use of chemical fertilizer, pesticides etc. increase the concentration in environment.

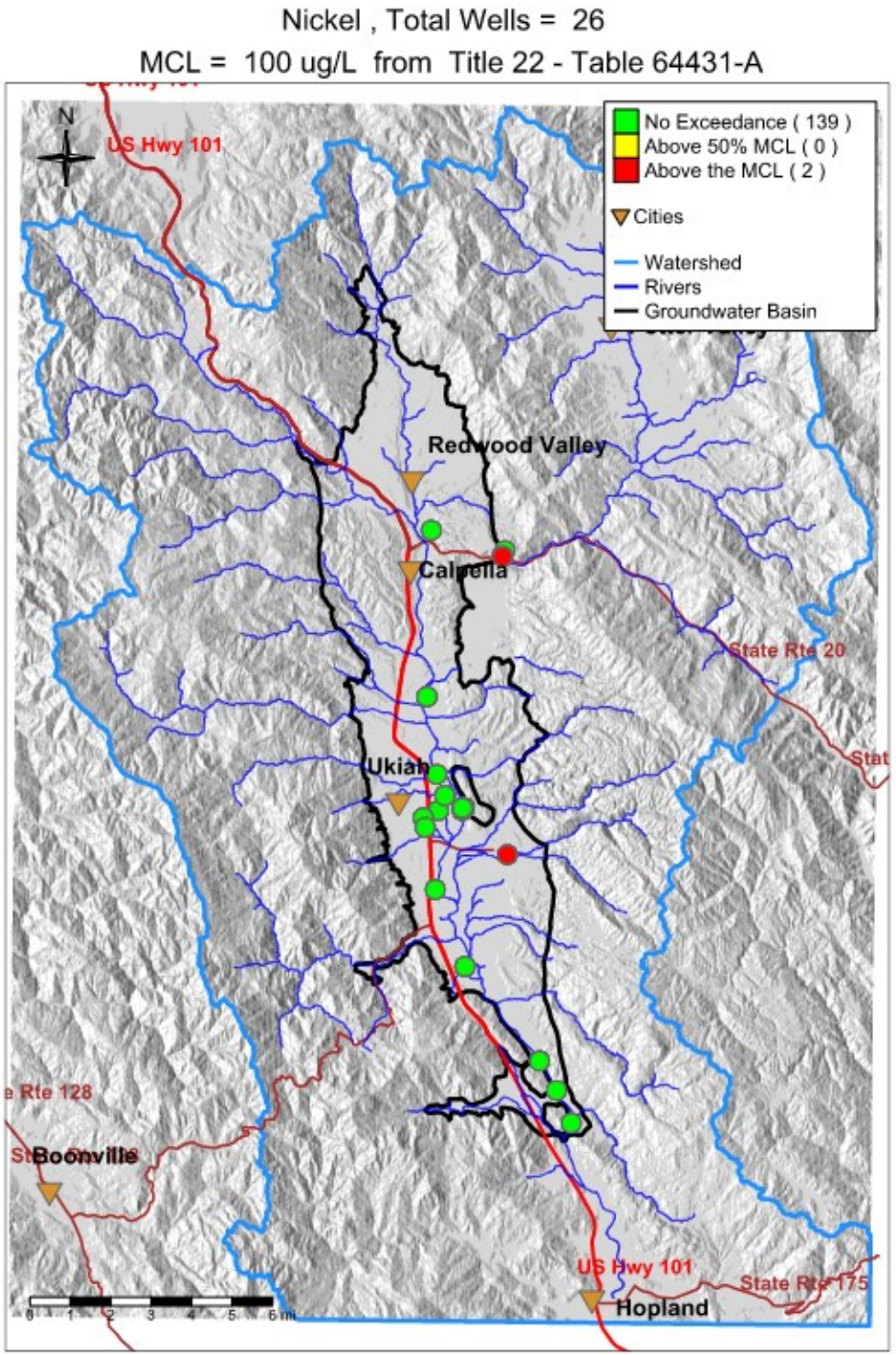
- All wells with data within the basin (26 wells)

Colors based on CCR Title 22; highest measured value in well

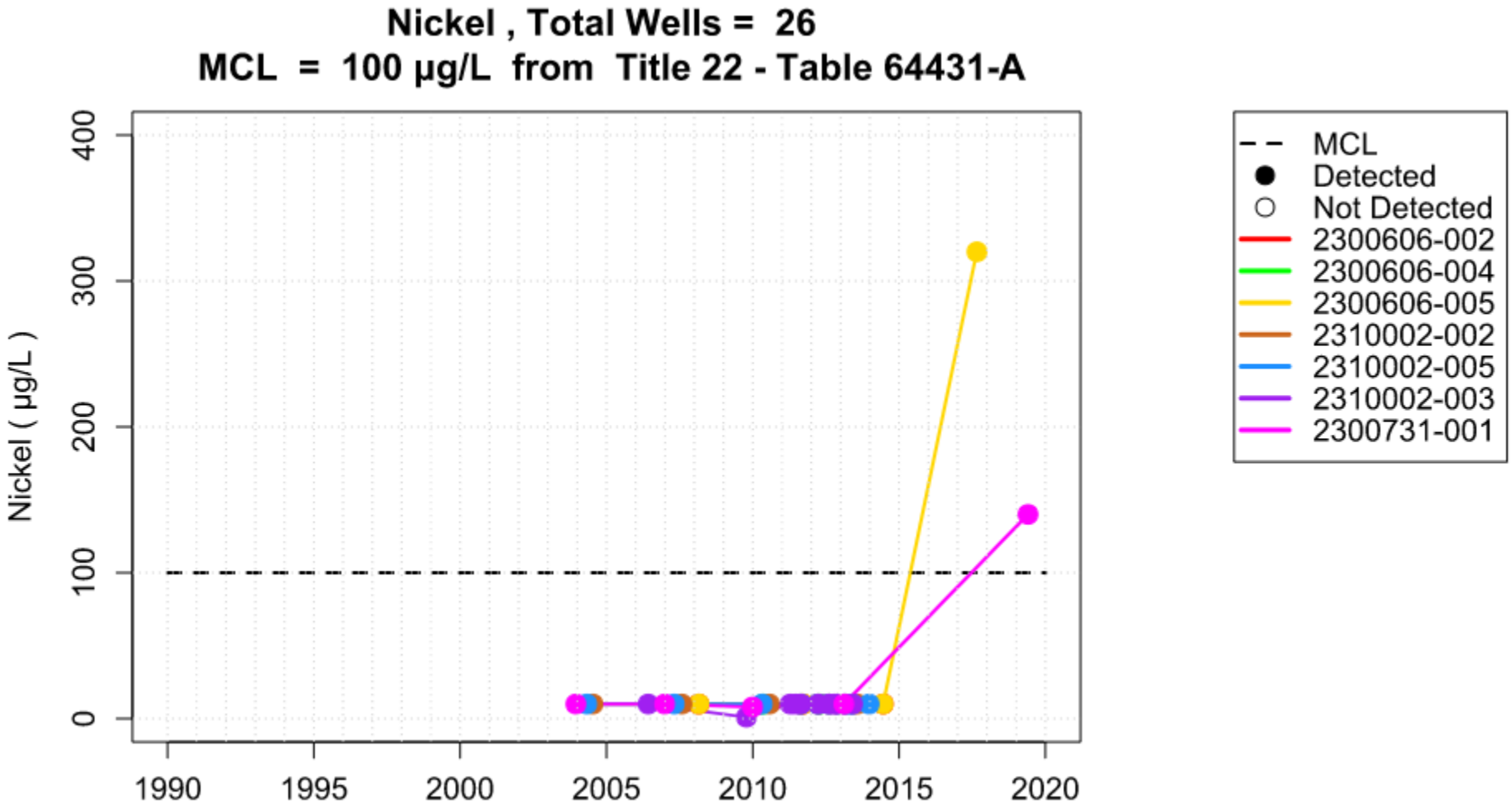
Red = Above 0.2 ug/L (2)

Yellow = Above 0.1 ug/L (0)

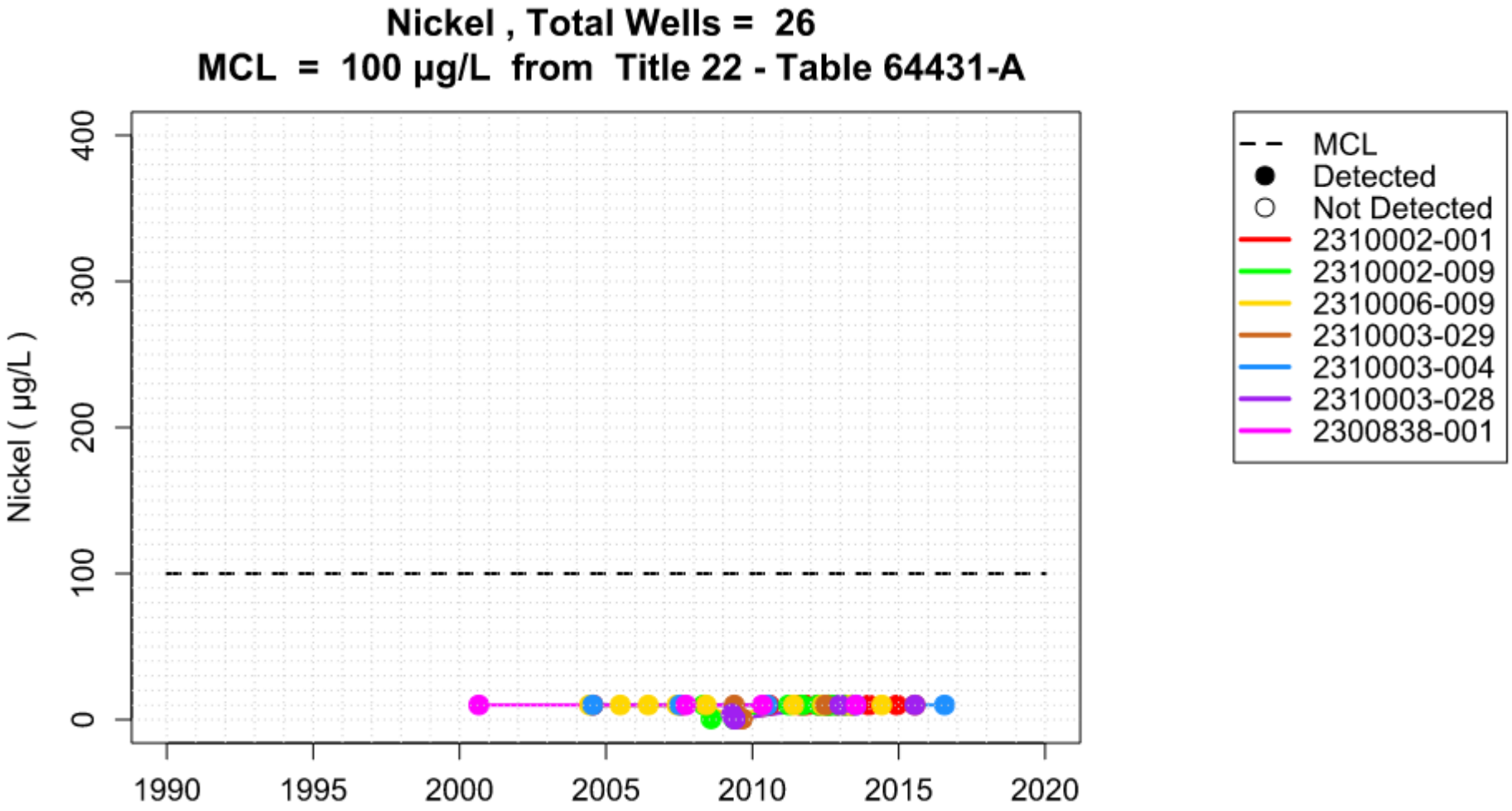
Green = No exceedance (139)



DRAFT


Nickel , Total Wells = 26
MCL = 100 µg/L from Title 22 - Table 64431-A
Nickel (µg/L)
0
100
200
300
400
1990
1995
2000
2005
2010
2015
2020
MCL
Detected
Not Detected
2300606-002
2300606-004
2300606-005
2310002-002
2310002-005
2310002-003
2300731-001

DRAFT


Nickel , Total Wells = 26
MCL = 100 µg/L from Title 22 - Table 64431-A
Nickel (µg/L)
0
100
200
300
400
1990
1995
2000
2005
2010
2015
2020
MCL
Detected
Not Detected
2310002-001
2310002-009
2310006-009
2310003-029
2310003-004
2310003-028
2300838-001

DRAFT

Ukiah
Specific Conductivity

- The salinity of water is commonly measured indirectly as a water's ability to pass electrical flow. Conductivity measured at – or normalized to – 25º Celsius is called specific conductivity. Salinity is the total concentration of all dissolved salts in water.

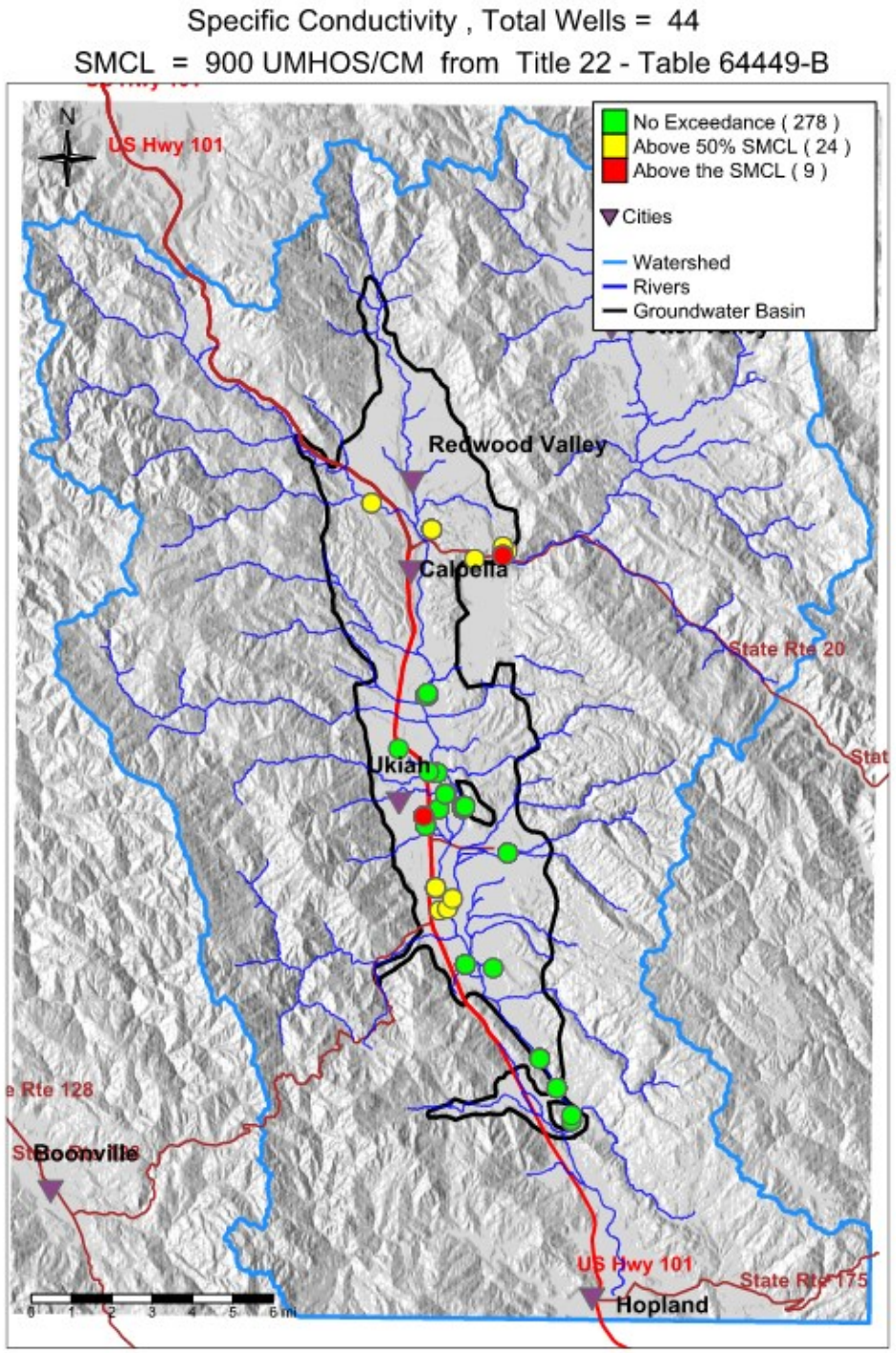
- All wells with data within the basin (44 wells)

Colors based on CCR Title 22; highest measured value in well

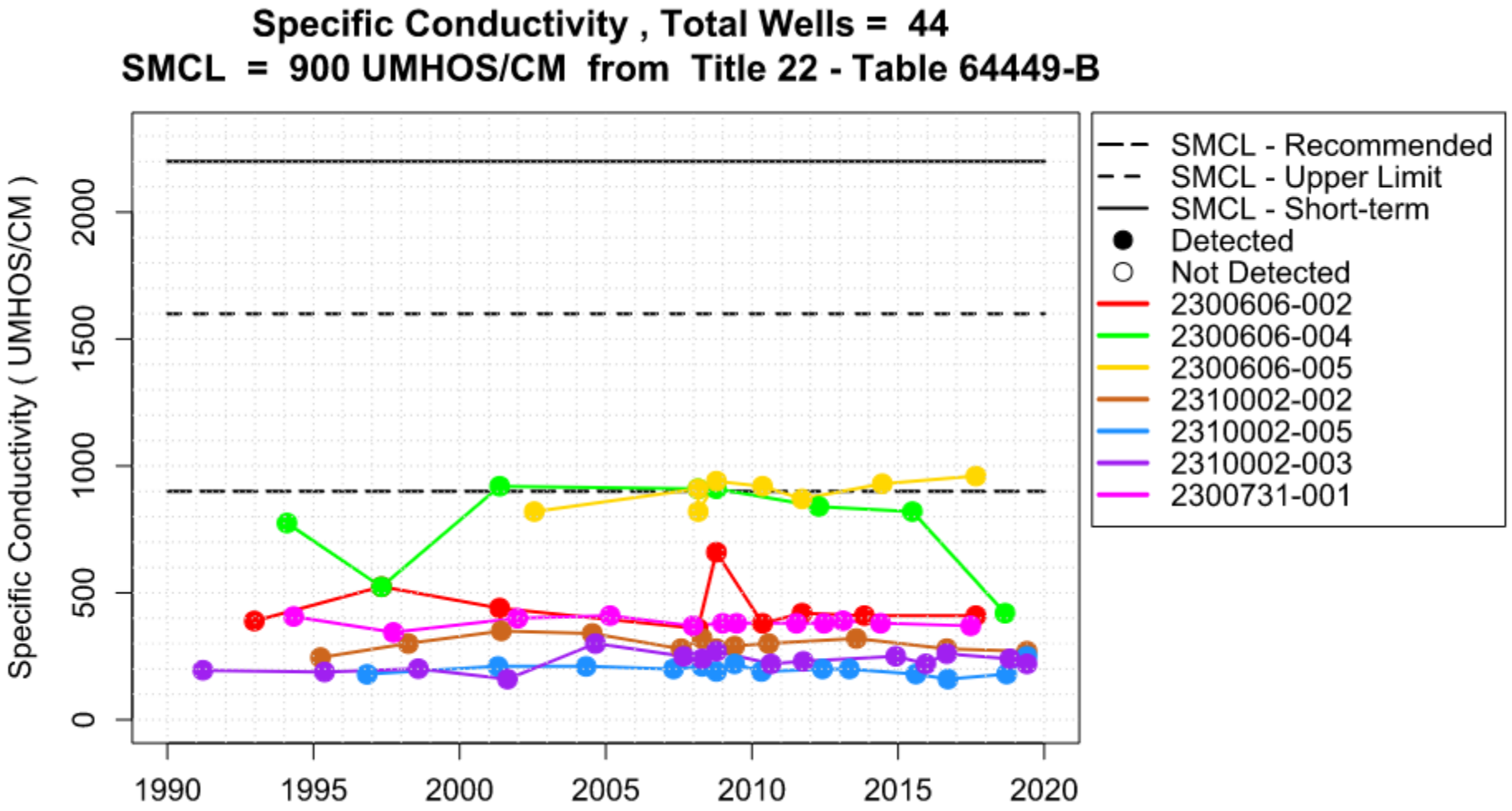
Red = Above 1000 mg/L (9)

Yellow = Above 500 mg/L (24)

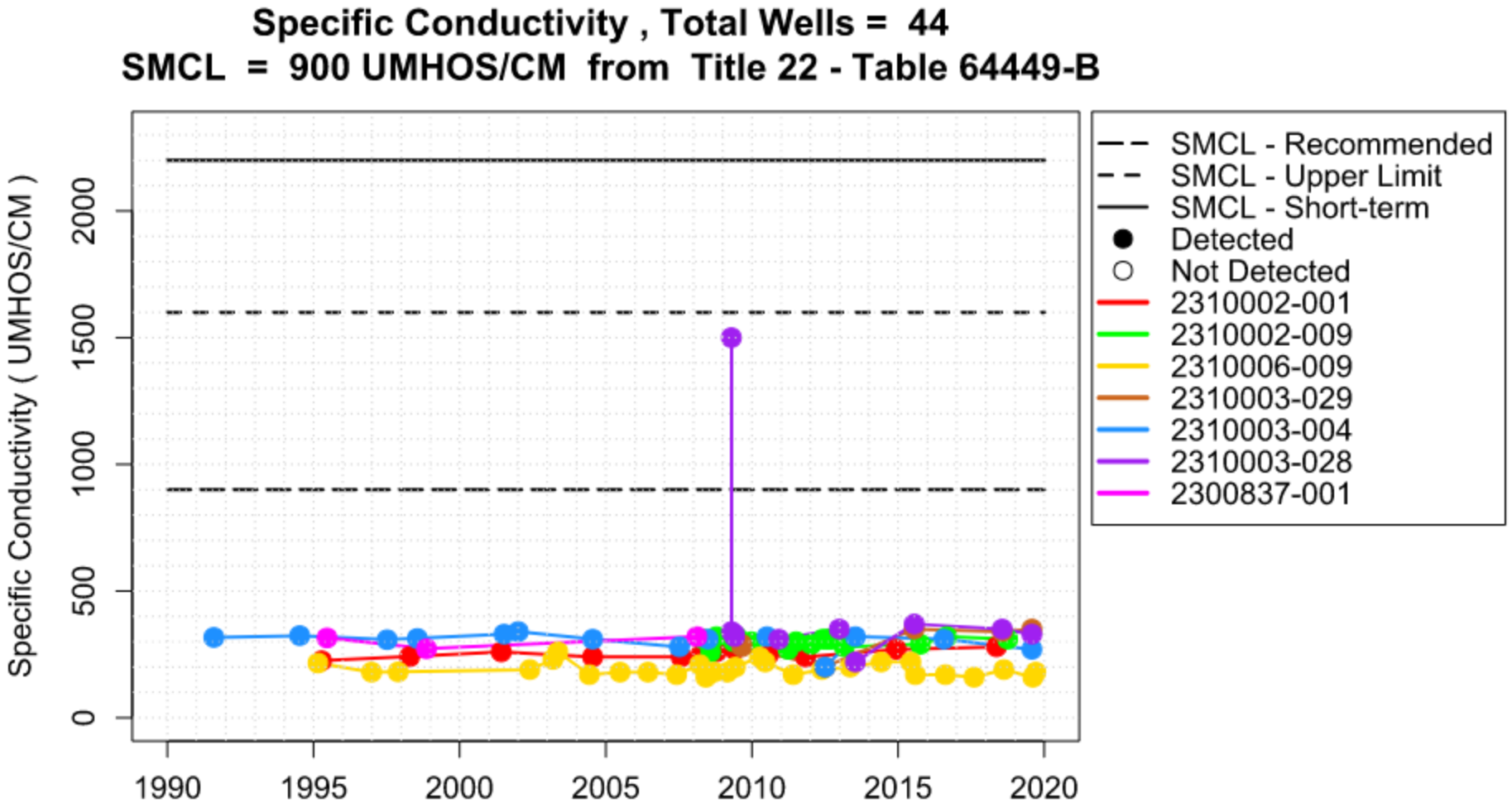
Green = No exceedance (278)



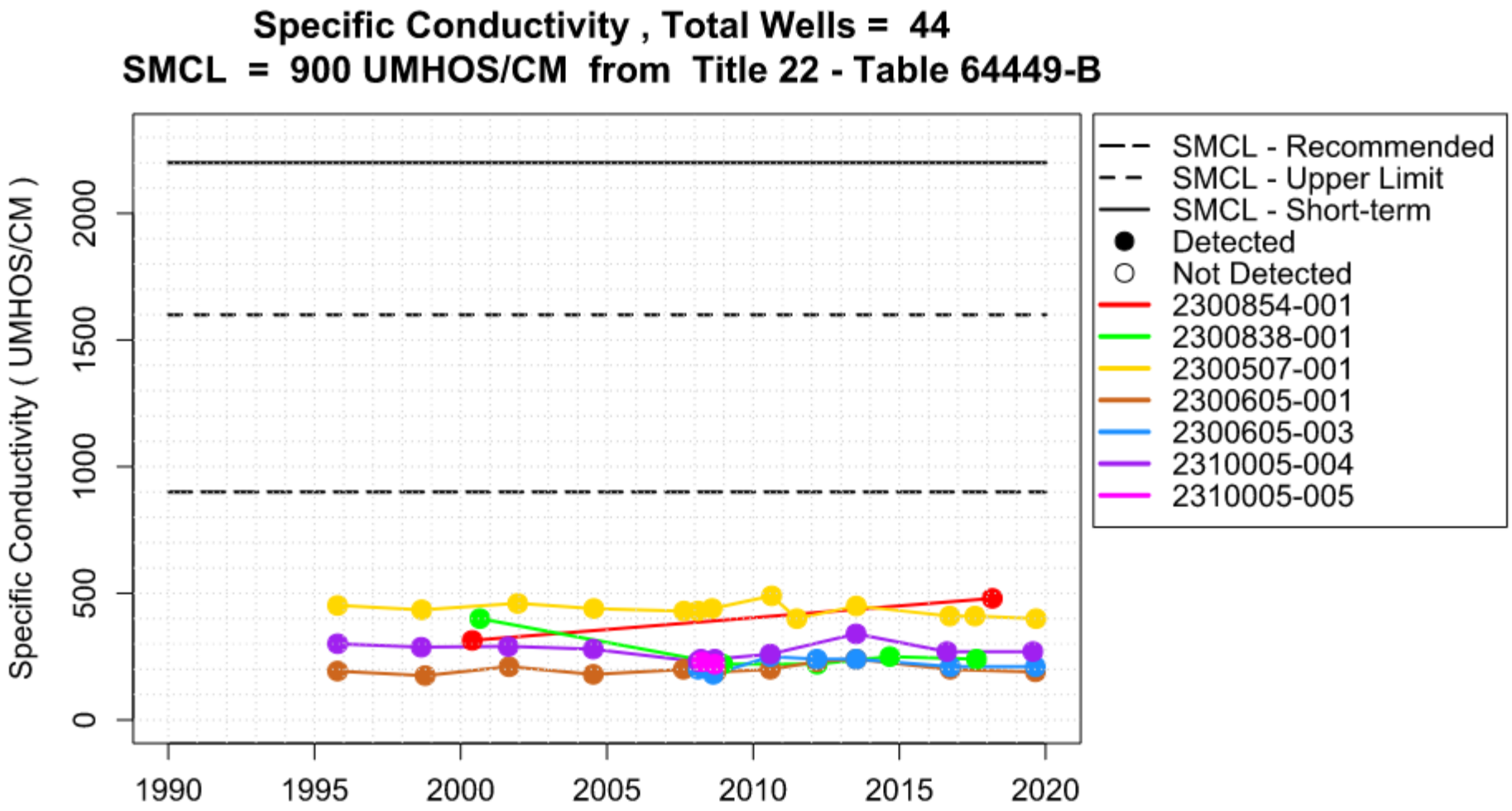
DRAFT


Specific Conductivity , Total Wells = 44
SMCL = 900 UMHOS/CM from Title 22 - Table 64449-B
Specific Conductivity (UMHOS/CM)
0
500
1000
1500
2000
1990
1995
2000
2005
2010
2015
2020
SMCL - Recommended
SMCL - Upper Limit
SMCL - Short-term
Detected
Not Detected
2300606-002
2300606-004
2300606-005
2310002-002
2310002-005
2310002-003
2300731-001

DRAFT


Specific Conductivity , Total Wells = 44
SMCL = 900 UMHOS/CM from Title 22 - Table 64449-B
Specific Conductivity (UMHOS/CM)
0
500
1000
1500
2000
1990
1995
2000
2005
2010
2015
2020
SMCL - Recommended
SMCL - Upper Limit
SMCL - Short-term
Detected
Not Detected
2310002-001
2310002-009
2310006-009
2310003-029
2310003-004
2310003-028
2300837-001

DRAFT


Specific Conductivity , Total Wells = 44
SMCL = 900 UMHOS/CM from Title 22 - Table 64449-B
Specific Conductivity (UMHOS/CM)
0
500
1000
1500
2000
1990
1995
2000
2005
2010
2015
2020
SMCL - Recommended
SMCL - Upper Limit
SMCL - Short-term
Detected
Not Detected
2300854-001
2300838-001
2300507-001
2300605-001
2300605-003
2310005-004
2310005-005

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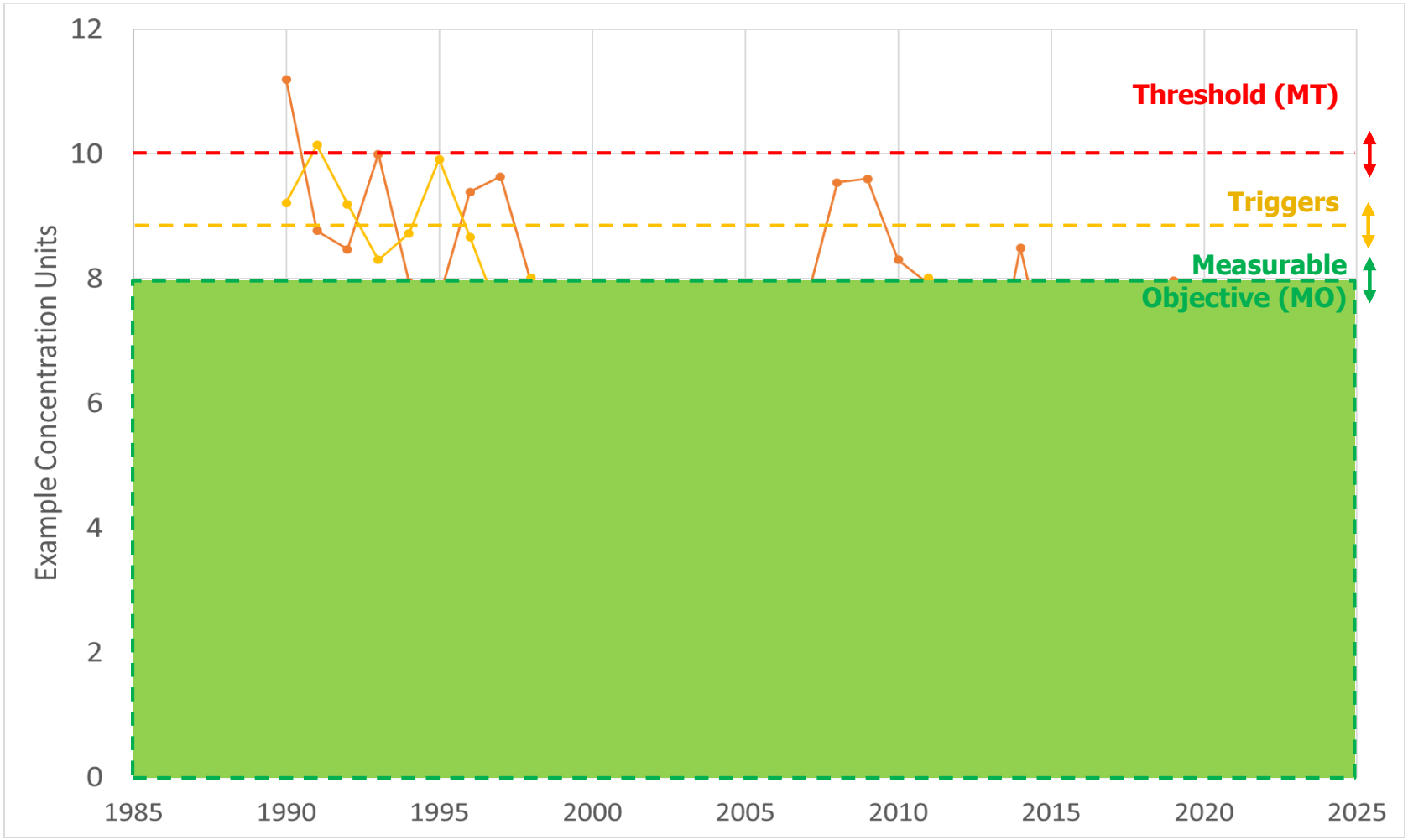
Example Dataset SMC Option A: Threshold = MCL



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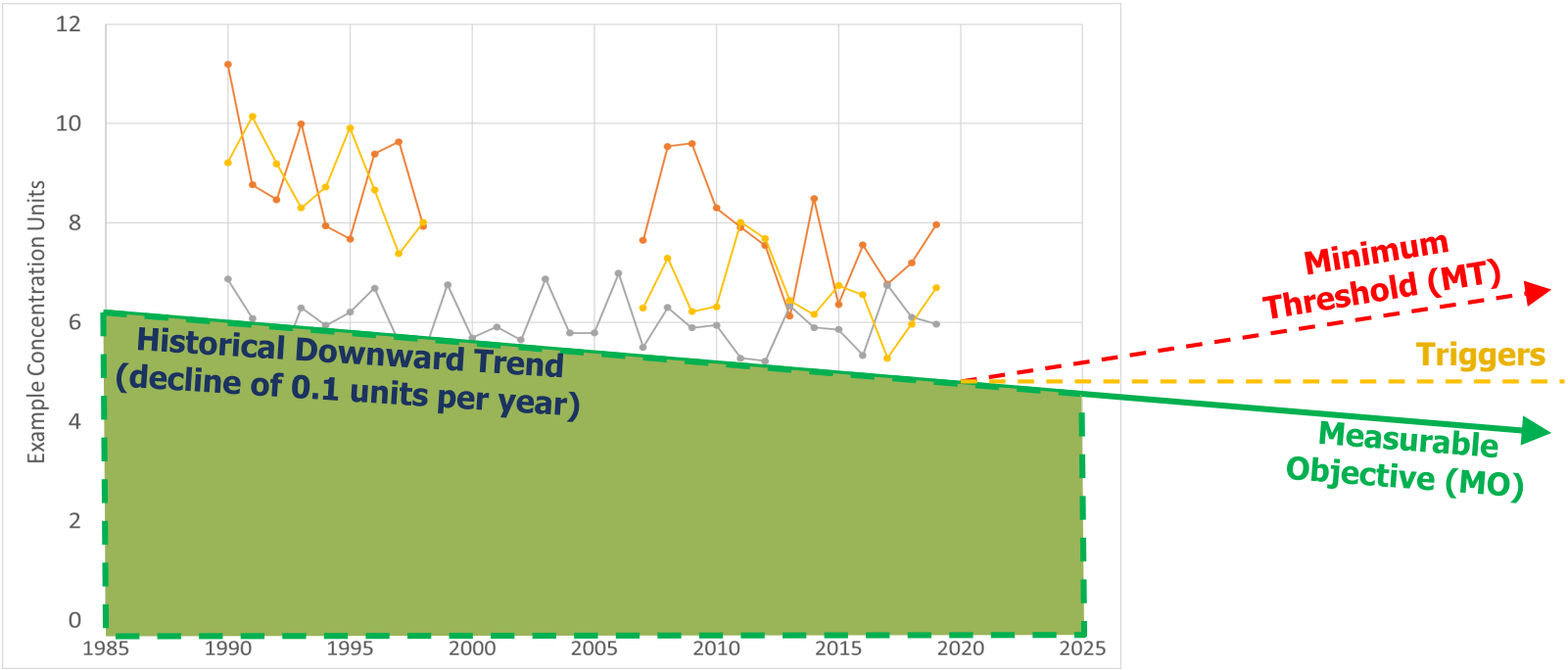
Example Dataset SMC Option B

- Long-term (30 year) trend
  - Is either negative (downward)
  - Or does not increase by more than 0.1 unit-per-year over the current (1990-2020) trend



Key Tasks/Needed Input

- Think about what's important in the valley and what we need to examine. Which are the parameters that need to be considered in this basin? Brainstorms are valuable.
- How would you like this data to be represented?
- We need to decide which groundwater wells to monitor.
- We need to determine minimum threshold (maximum), trigger and measurable objectives.
- What to measure, where, when, and who will measure (and how to measure).

GOAL

- Work on summary tables and development of SMC!

Question?

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Agenda

- GSP Development: technical work update
- Sustainability Goal → **Group discussion**
- Review of Sustainable Management Criteria (SMC)
  - What will our process look like?
- Current Groundwater conditions: Water Quality
  - How can we set SMC for water quality? → **Group discussion**
- Current conditions: Subsidence
  - How can we set SMC for Subsidence? → **Group discussion**

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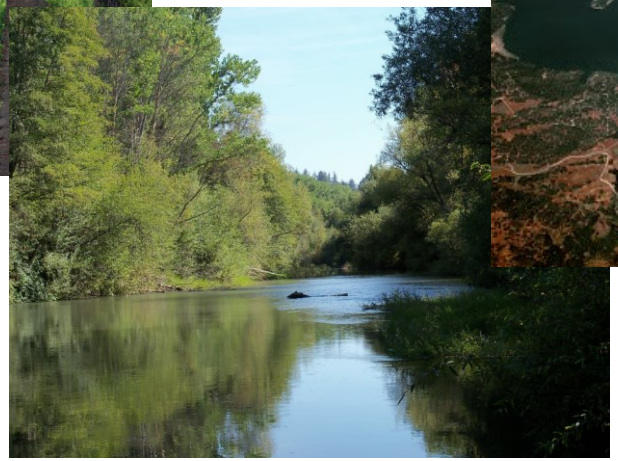

SUSTAINABLE MANAGEMENT CRITERIA – SUBSIDENCE

LARRY WALKER ASSOCIATES
UCDAVIS UNIVERSITY OF CALIFORNIA
SCIConsultingGroup
GEI Consultants

Subsidence of the land surface is an *undesirable result for SGMA*

Lowering groundwater levels

Reduction in storage

Seawater intrusion

Degraded water quality

Land subsidence

Surface water depletion

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Subsidence data available for Mendocino Co.

InSAR satellite-derived subsidence data product is the only known dataset for Mendocino Co. to use for GSPs

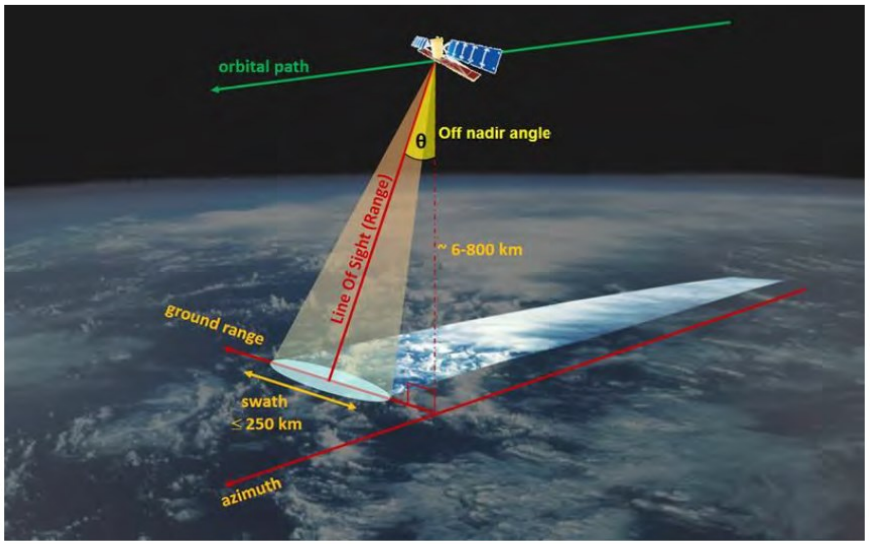

Figure 4: Schematic of the SAR satellites acquisition geometry. The Line of Sight (LOS) θ angle is different for each satellite track.

Data available from mid 2015-2018

Additional 2018-2019 data expected by April 2019

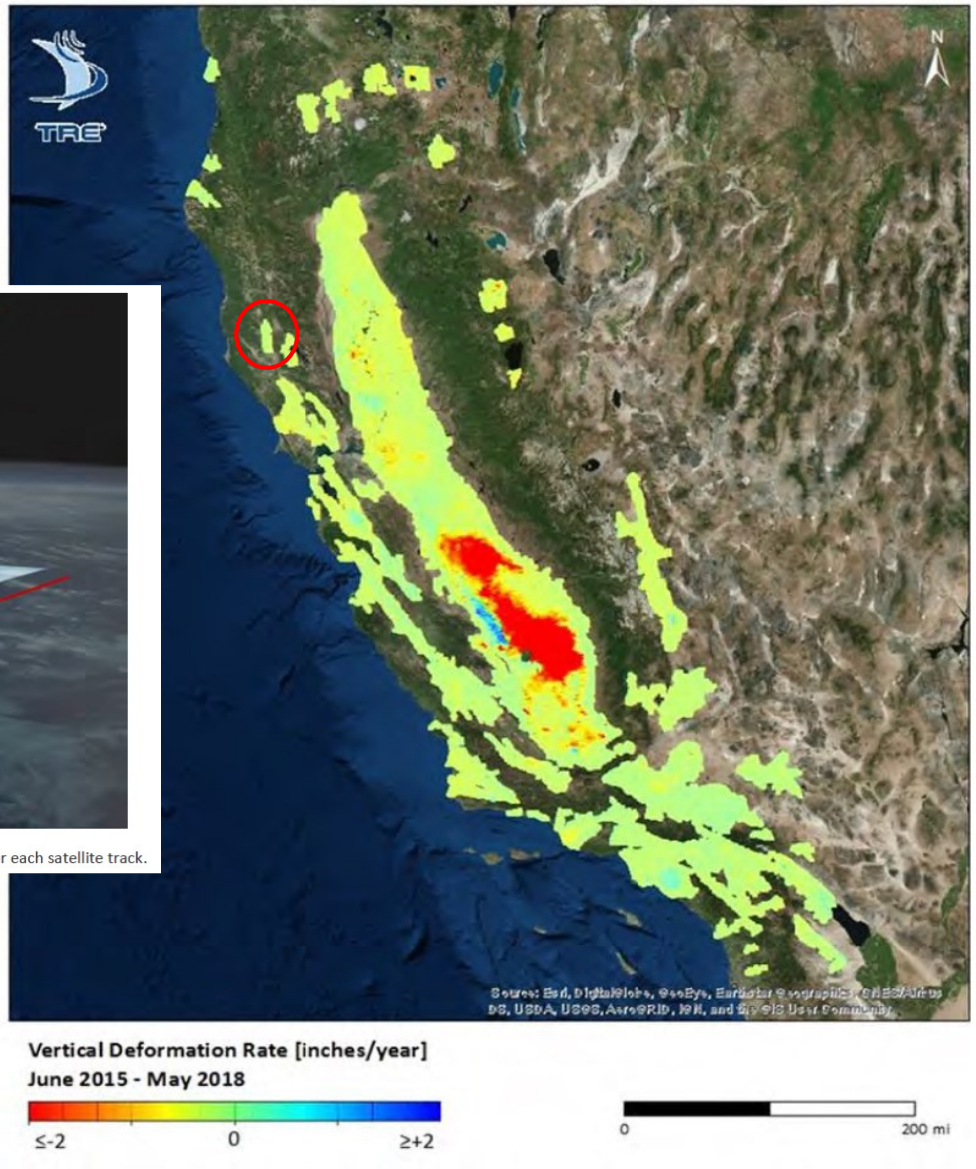

Figure 13: Vertical deformation rate map over the AOI. The sMP are colour coded according to their annual deformation rate (inches/year) within the common period (June 2015 – May 2018).

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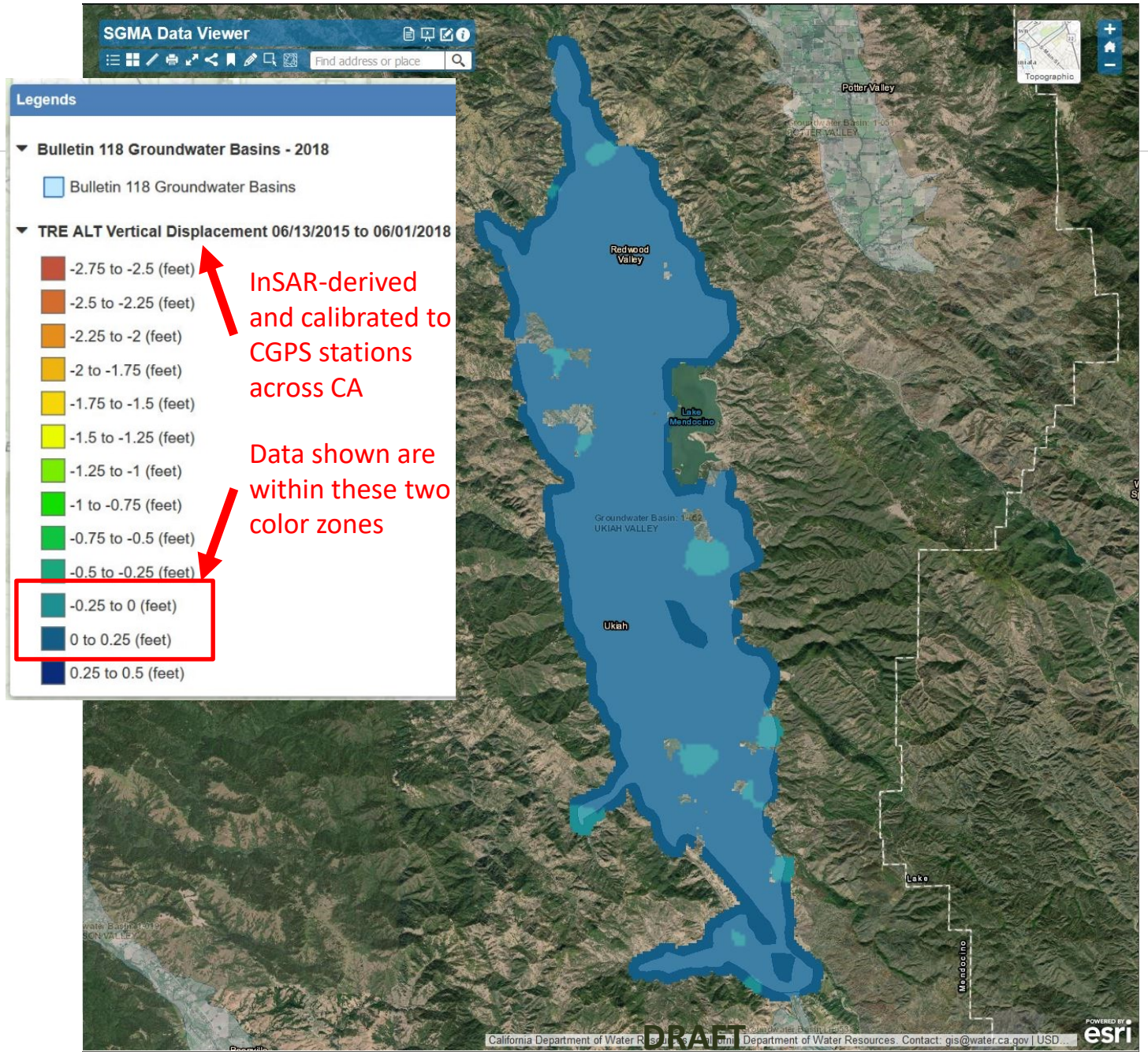
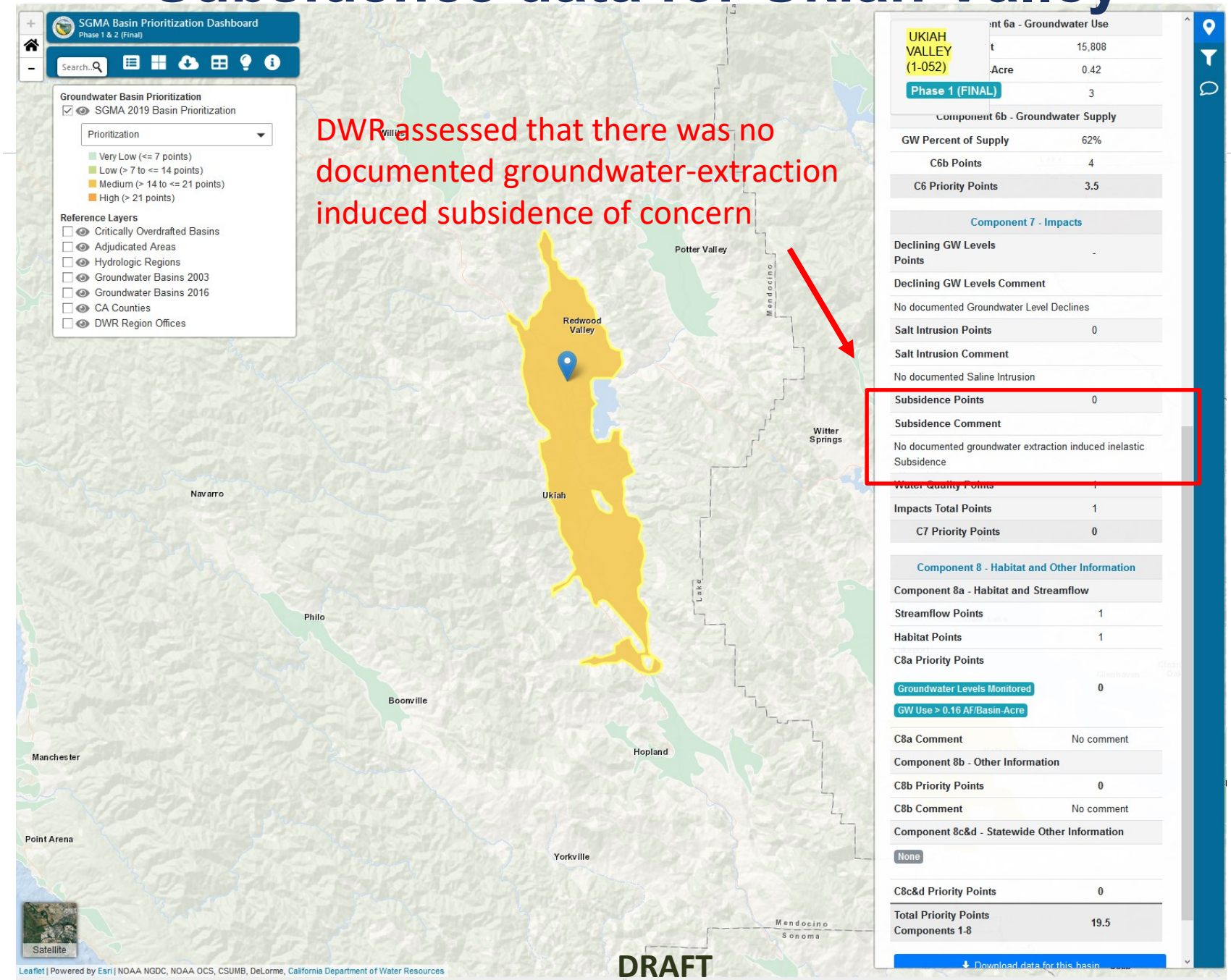
Subsidence data available for Mendocino Co.



DRAFT Subsidence data for Ukiah Valley



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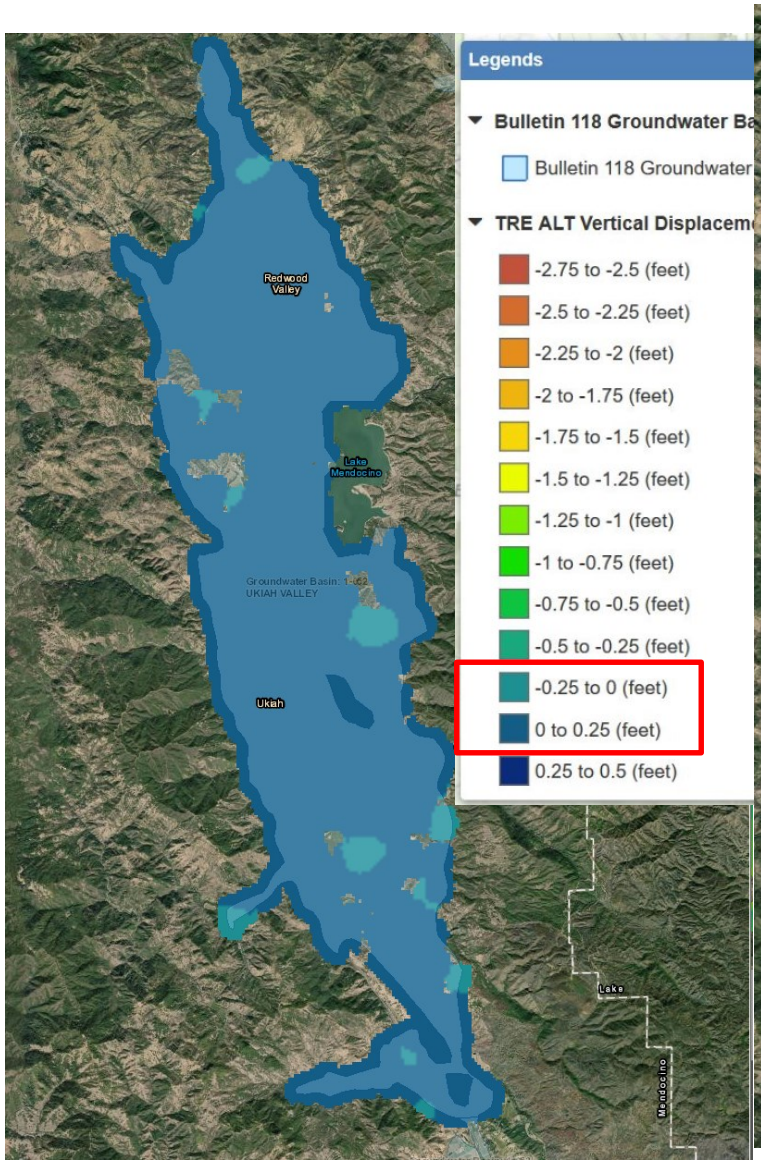
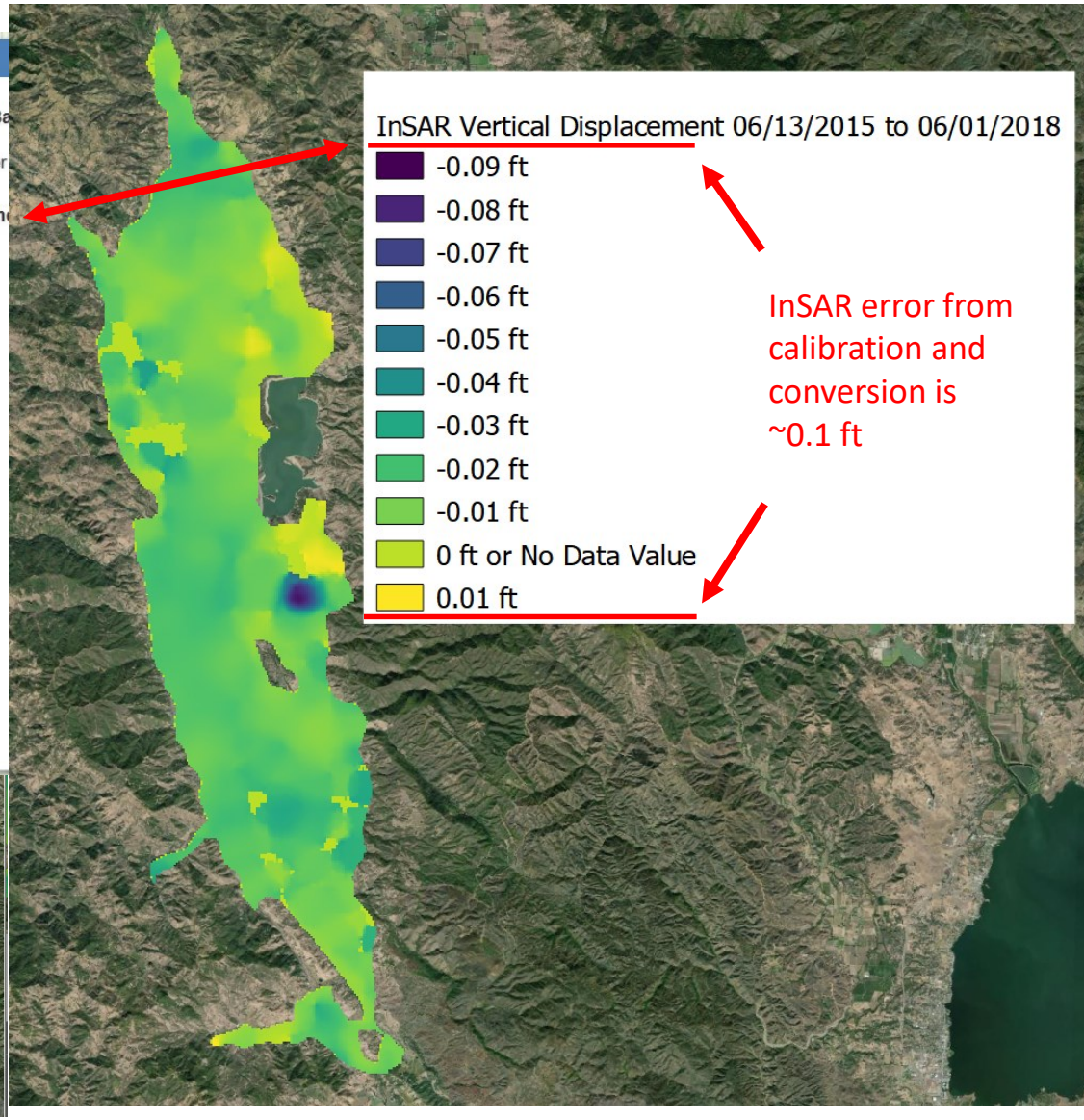
Subsidence data for Ukiah Valley 2015-2018





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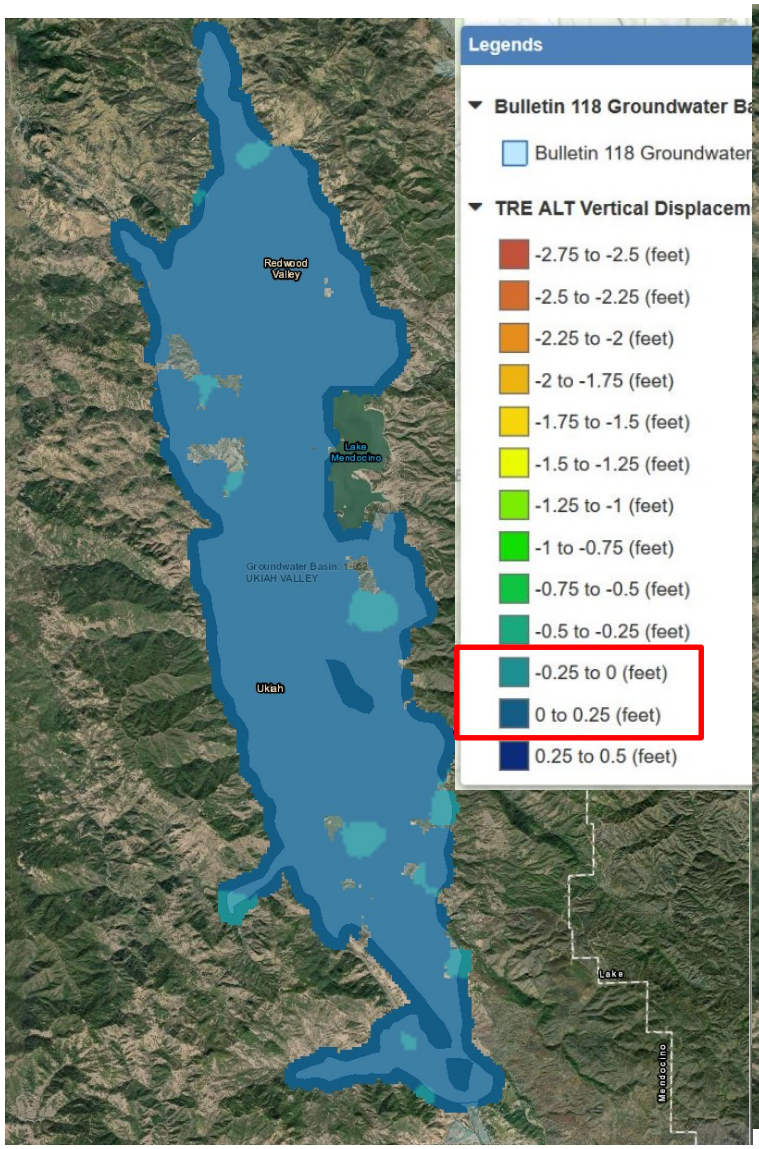
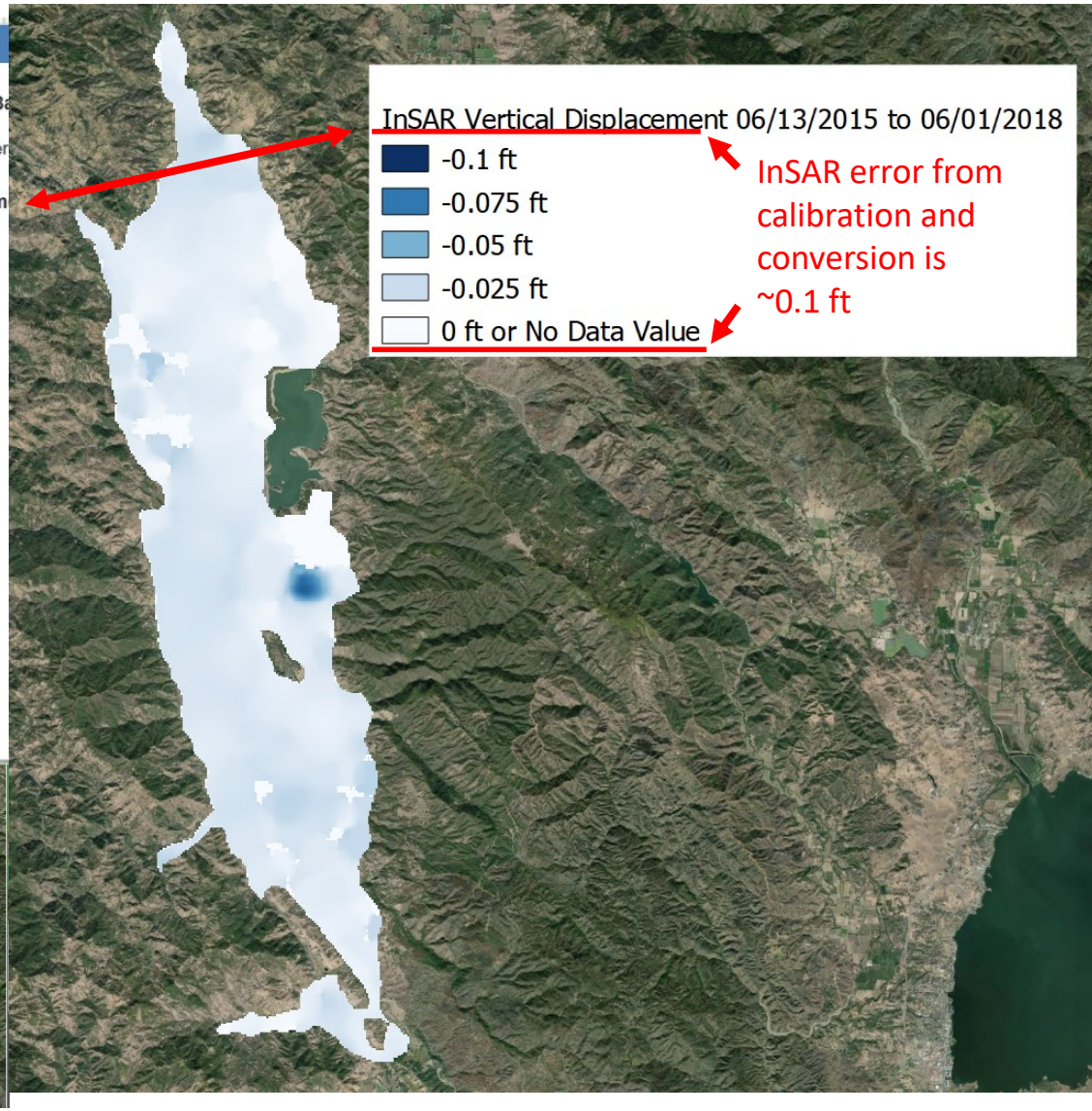
Subsidence data for Ukiah Valley 2015-2018





Data display largely noise considering the range of both the data and the error are equivalent

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Questions?

Thank you!