GSP Milestones

Today

Final Draft to AC for final recommendation

Final Draft GSP

- Public workshop/open for public review
- Notice & consultation with cities/agencies

GSA Board Adopt GSP

Public Hearing

GSP Submittal

Yearly Report

June

July

November

January 31

April 1

2021

2022

45 Day Public Review

DWR 2 Year Review

GSP Development & Review

GSP Implementation (Review every 5 years until 2042)

Groundwater Sustainability Plan (GSP) [Butte]

1. Introduction
   - GSA staff/tech team in progress
2. Plan Area and Basin Setting
   - Draft form, 2 reviews, awaiting additional updates (water budget, current mgmt. practices). Communication & Engagement Plan complete/approved
3. Sustainable Management Criteria (Monitoring network included)
   - Chronic Lowering of Groundwater Levels – Current
   - Reduction of Groundwater Storage - Current
   - Depletion of Interconnected Surface Waters – Ongoing by tech team
   - Degraded Groundwater Quality – Draft complete, AC reviewed, GSA staff review before submitting to GSA Board
   - Subsidence – Draft complete, GSA staff review for submitting to GSA Board
   - Seawater Intrusion – Completed, N/A

Butte Valley Representative Monitoring Points

Butte Valley GSA Advisory Committee

January 28, 2021

Bill Rice, P.G.

LARRY WALKER ASSOCIATES

science | policy | solutions

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DAVIDS ENGINEERING, INC

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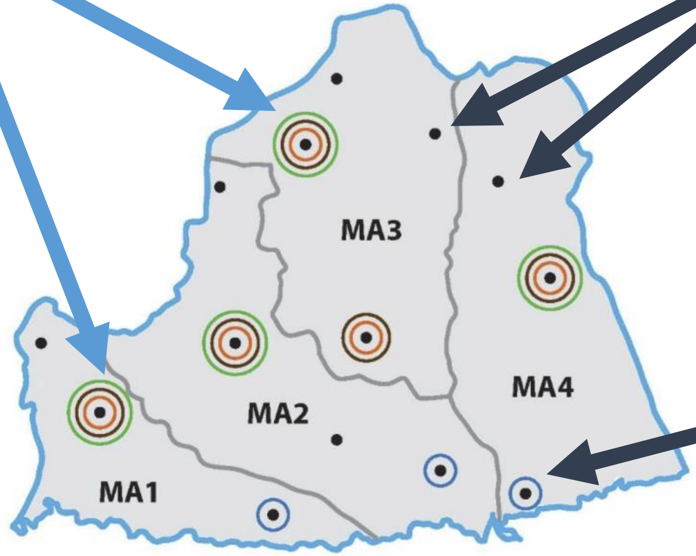
Historical vs New Network Wells

Historical Network Wells	New Network Wells
Has historical data	Lacks historical data
Good for representative monitoring thanks to past records	Not good for representative monitoring without historical data
Historically monitored by government agencies	Part of a voluntary network of continuous loggers

RMPs for initial network



Possible Future RMPs

Number of Wells From Historical Network

- Butte Valley is 125 miles^2
- Initial water budget show 70-80,000 ac-ft pumped
- Targeted between 4 and 8 wells per 100 miles^2

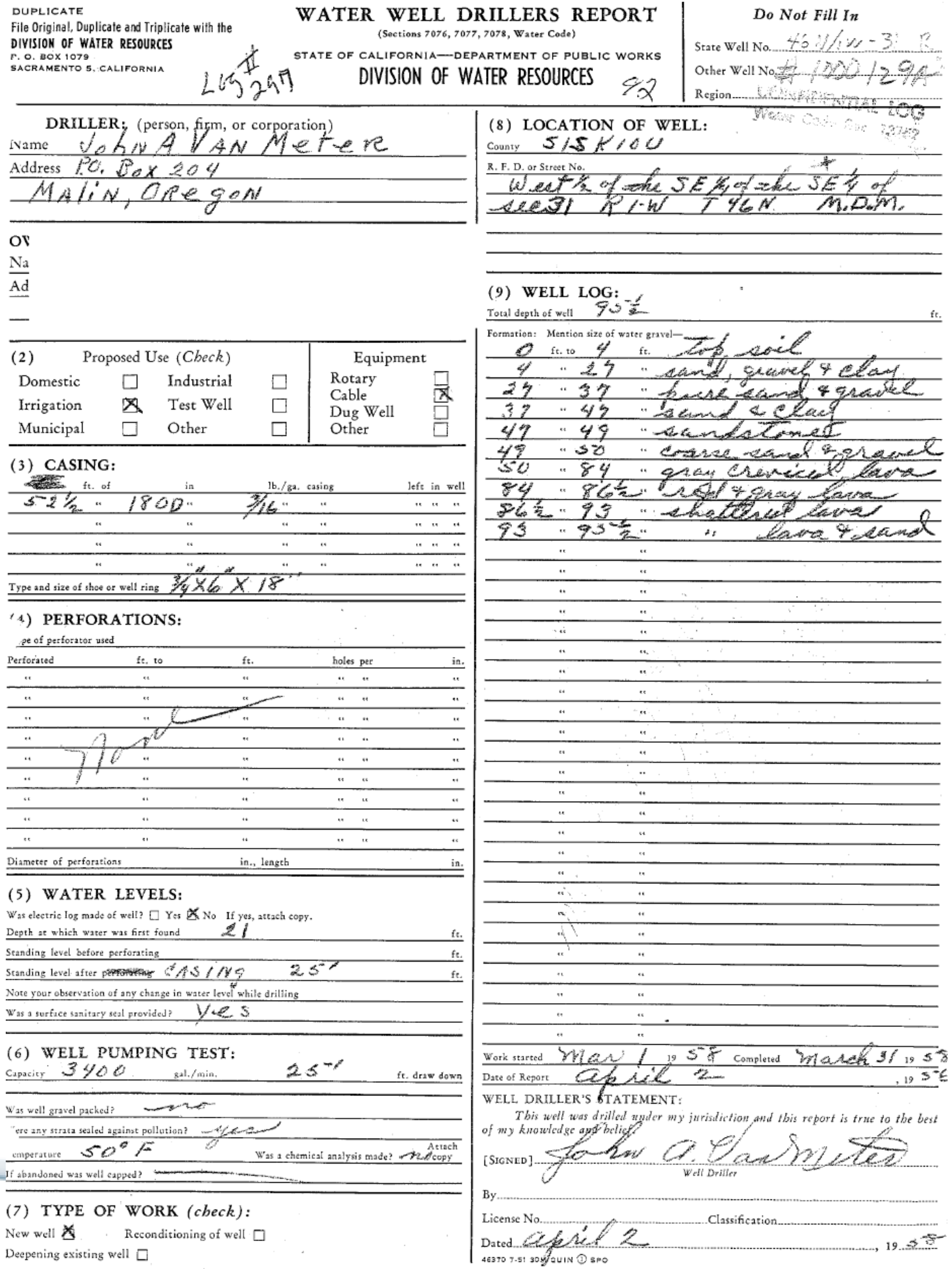
Table 1. Monitoring Well Density Considerations

Reference	Monitoring Well Density (wells per 100 miles^2)
Heath (1976)	0.2 - 10
Sophocleous (1983)	6.3
Hopkins (1984)	4.0
Basins pumping more than 10,000 acre-feet/year per 100 miles^2	
Basins pumping between 1,000 and 10,000 acre-feet/year per 100 miles^2	2.0
Basins pumping between 250 and 1,000 acre-feet/year per 100 miles^2	1.0
Basins pumping between 100 and 250 acre-feet/year per 100 miles^2	0.7

DWR BMP Monitoring Networks and Identification of Data Gaps, December 2016

Considerations in Choosing Wells

- Quality of historical data
- Location of wells
- Data on well construction



DUPLICATE
File Original, Duplicate and Triplicate with the
DIVISION OF WATER RESOURCES
P. O. BOX 1079
SACRAMENTO 5, CALIFORNIA

Log # 297

WATER WELL DRILLERS REPORT
(Sections 7076, 7077, 7078, Water Code)
STATE OF CALIFORNIA—DEPARTMENT OF PUBLIC WORKS
DIVISION OF WATER RESOURCES

92

Do Not Fill In
State Well No. 46N/1W-31 B
Other Well No. # 1800 1298
Region

DRILLER: (person, firm, or corporation)
Name John A Van Meter
Address P.O. Box 204
Malin, Oregon

OW
Na
Ad

(2) Proposed Use (Check)

Domestic ☐	Industrial ☐		
Irrigation ☒	Test Well ☐		
Municipal ☐	Other ☐		

Equipment
Rotary ☐
Cable ☒
Dug Well ☐
Other ☐

(3) **CASING:**

ft. of	in	lb./ga. casing	left in well
52½	18 OD	3/16	

Type and size of shoe or well ring 3/4 X 6 X 18"

(4) **PERFORATIONS:**
Type of perforator used
Perforated ft. to ft. holes per in.
None
Diameter of perforations in., length in.

(5) **WATER LEVELS:**
Was electric log made of well? ☐ Yes ☒ No If yes, attach copy.
Depth at which water was first found 21 ft.
Standing level before perforating ft.
Standing level after ~~perforating~~ casing 25' ft.
Note your observation of any change in water level while drilling
Was a surface sanitary seal provided? yes

(6) **WELL PUMPING TEST:**
Capacity 3400 gal./min. 25' ft. draw down
Was well gravel packed? no
Were any strata sealed against pollution? yes
Temperature 50° F Was a chemical analysis made? no Attach copy
If abandoned was well capped?

(7) **TYPE OF WORK** (*check*):
New well ☒ Reconditioning of well ☐
Deepening existing well ☐

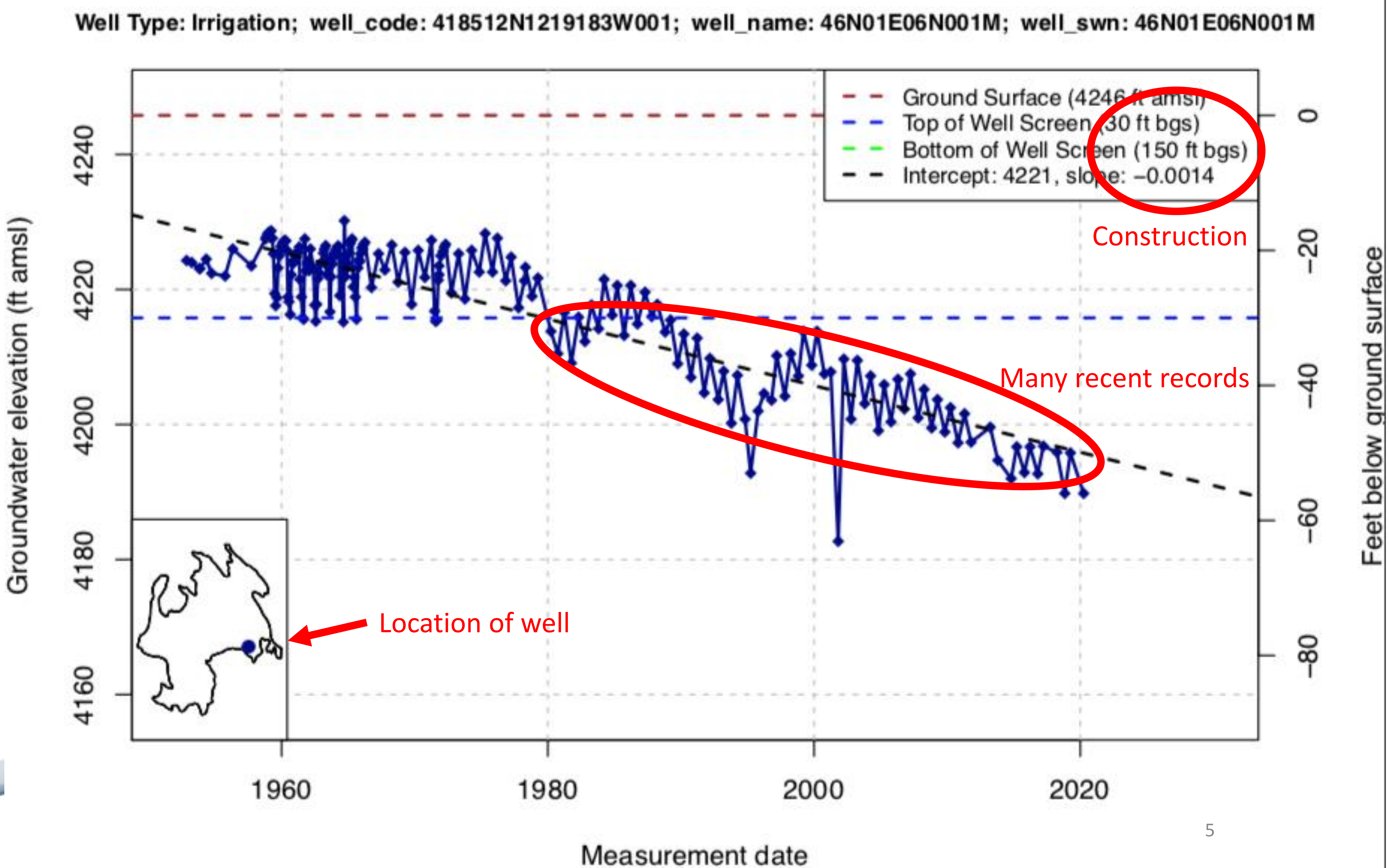
(8) **LOCATION OF WELL:**
County Siskiou
R. F. D. or Street No.
West ½ of the SE ¼ of the SE ¼ of sec 31 R1W T46N M.D.M.

(9) **WELL LOG:**
Total depth of well 93½ ft.
Formation: Mention size of water gravel—

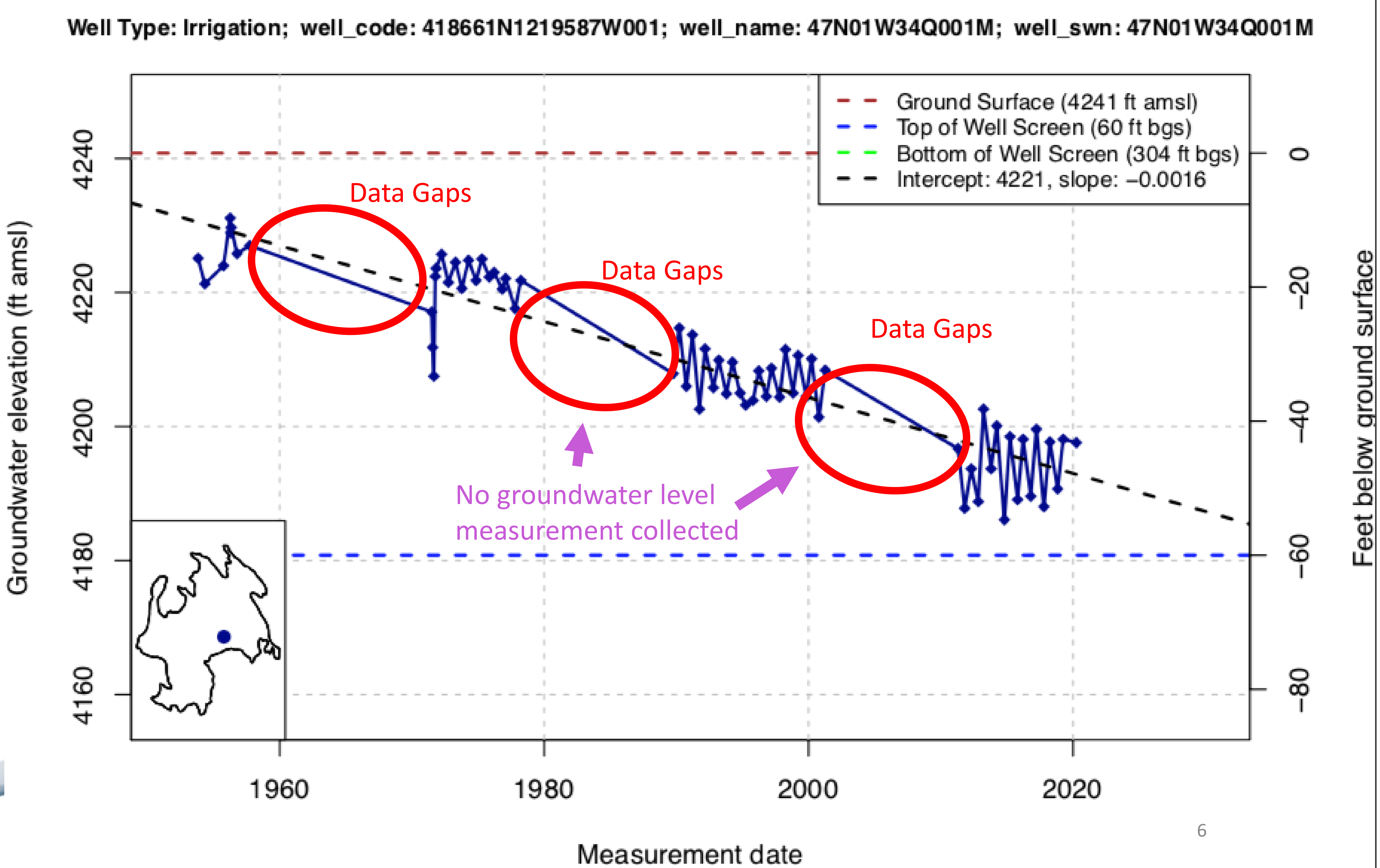
ft. to	ft.	
0	4	Top soil
4	27	sand, gravel & clay
27	37	loose sand & gravel
37	47	sand & clay
47	49	sandstone
49	50	coarse sand & gravel
50	84	gray creviced lava
84	86½	red & gray lava
86½	93	shattered lava
93	93½	" lava & sand

Work started Mar 1 1958 Completed March 31 1958
Date of Report April 2, 1958

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
[Signed] John A. Van Meter
Well Driller
By
License No. Classification
Dated April 2, 1958



Well Type: Irrigation; well_code: 418512N1219183W001; well_name: 46N01E06N001M; well_swn: 46N01E06N001M
Ground Surface (4246 ft amsl)
Top of Well Screen (30 ft bgs)
Bottom of Well Screen (150 ft bgs)
Intercept: 4221, slope: −0.0014
Construction
Many recent records
Location of well
Groundwater elevation (ft amsl)
4240
4220
4200
4180
4160
Feet below ground surface
0
−20
−40
−60
−80
1960
1980
2000
2020
Measurement date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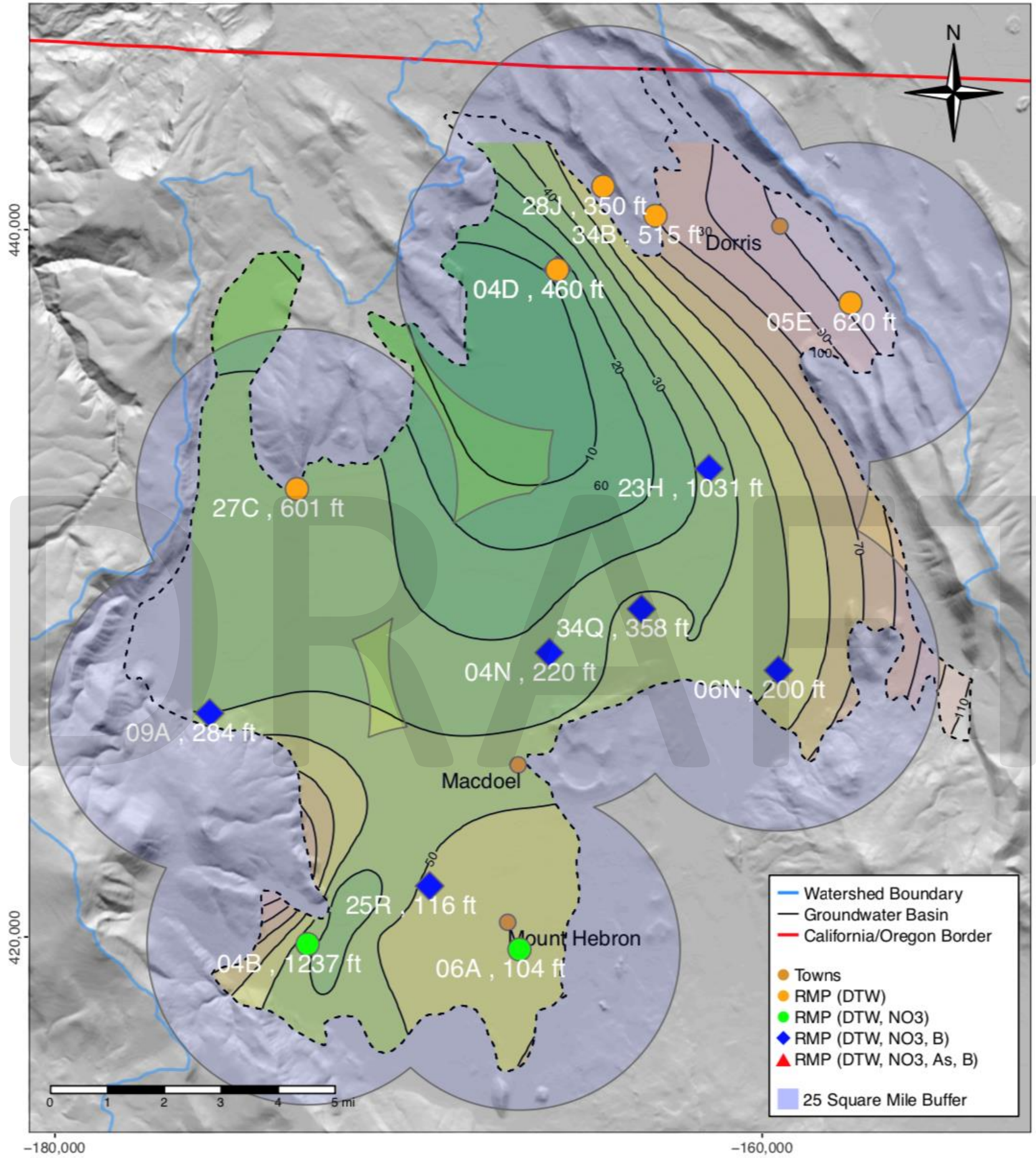
Ground Surface (4241 ft amsl)
Top of Well Screen (60 ft bgs)
Bottom of Well Screen (304 ft bgs)
Intercept: 4221, slope: −0.0016
Data Gaps
Data Gaps
Data Gaps
No groundwater level measurement collected
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
4160
4180
4200
4220
4240
0
−20
−40
−60
−80
1960
1980
2000
2020

Target Area	Sample Schedule	Sampling Plan	Data Logger	Currently Installed With Telemetry	State Well Number	Site Code	Short Name From Map	Start of record	Principal Formations(s)	Well Depth (ft)	Inferred Perforations	First Perforated Top (ft)	First Perforated Bottom (ft)	Second Perforated Top (ft)	Second Perforated Bottom (ft)
Meiss Lake	Twice Annual*	DTW	DTW, Precipitation		47N02W27C001M	418948N1220832W001	27C	10/14/1993	Deep Lake Sediment, High Cascade Volcanics	601		160	410	435	599
Mount Hebron	Twice Annual*	DTW, NO3	DTW, SC, Precipitation		45N01W06A001M	417786N1220041W001	06A	10/28/1971	Butte Valley Basalt	104		40	104		
South West Butte Valley	Twice Annual*	DTW, NO3	DTW, SC, Precipitation		45N02W04B001M	417789N1220759W001	04B	10/24/1980	UNKNOWN	1237		Data Gap	Data Gap		
Butte Valley Irrigation District	Twice Annual*	DTW, NO3, B	DTW, SC, Precipitation		46N02W25R002M	417944N1220350W001	25R	11/06/1952	Butte Valley Basalt	116	Yes	70	116		
South Mid Valley	Twice Annual*	DTW, NO3, B	DTW, Precipitation		46N01W04N002M	418544N1219958W001	04N	10/12/1976	Lake Deposits	220		Data Gap	Data Gap		
South Mid Valley	Twice Annual*	DTW, NO3, B	DTW, SC, Precipitation		47N01W34Q001M	418661N1219587W001	34Q	10/30/1953	Lake Deposits	358		60	304		
East Valley	Twice Annual*	DTW, NO3, B	DTW, SC, Precipitation		46N01E06N001M	418512N1219183W001	06N	11/10/1952	Lake Deposits	200		30	150		
City of Dorris Well #6	Monthly	DTW, NO3, As, B	DTW, Precipitation		NA	NA	NA	NA	High Cascade Volcanics	1238		840			
West of City of Dorris	Twice Annual*	DTW			48N01W34B001M	419662N1219633W001	34B	10/24/1980	High Cascade Volcanics	515		38	515		
NW Butte, Mahogany Mtn F.Z.	Twice Annual*	DTW			48N01W28J001M	419755N1219785W001	28J	04/06/1977	High Cascade Volcanics	350		180	240		
North Mid Valley Nested	Twice Annual*	DTW, NO3, B	DTW, Precipitation		47N01W04D002M	419519N1219958W001	04D	10/7/1970	Lake Deposits	460		Data Gap	200		
North Mid Valley Nested	Twice Annual*	DTW	DTW, Precipitation		47N01W04D001M	419520N1219959W001	04D	6/30/1971	Lake Deposits	460		Data Gap	460		
Meiss Lake	Twice Annual*	DTW, NO3, B	DTW, Precipitation	Yes	NA	418371N1221105W001	09A	04/09/2014	Alluvium and High Cascade Volcanics	284		0	284		
East of Dorris	Twice Annual*	DTW	DTW, Precipitation		47N01E05E001M	419451N1218967W001	05E	04/27/1979		620		87	185	Data Gap	Data Gap
East Valley	Twice Annual*	DTW, NO3, B	DTW, Precipitation		47N01W23H002M	419021N1219431W001	23H	07/20/1978		1031		Data Gap	Data Gap		

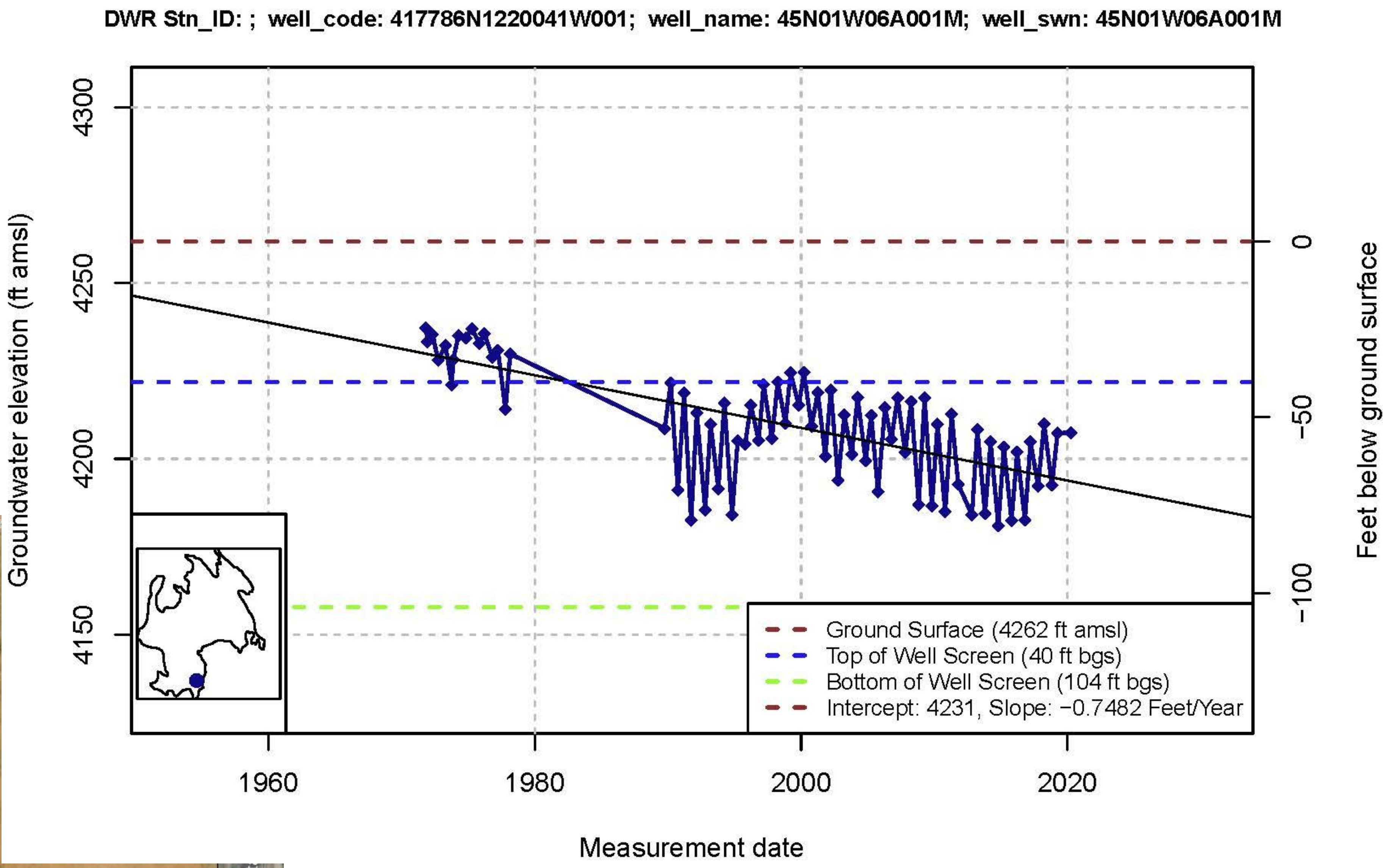


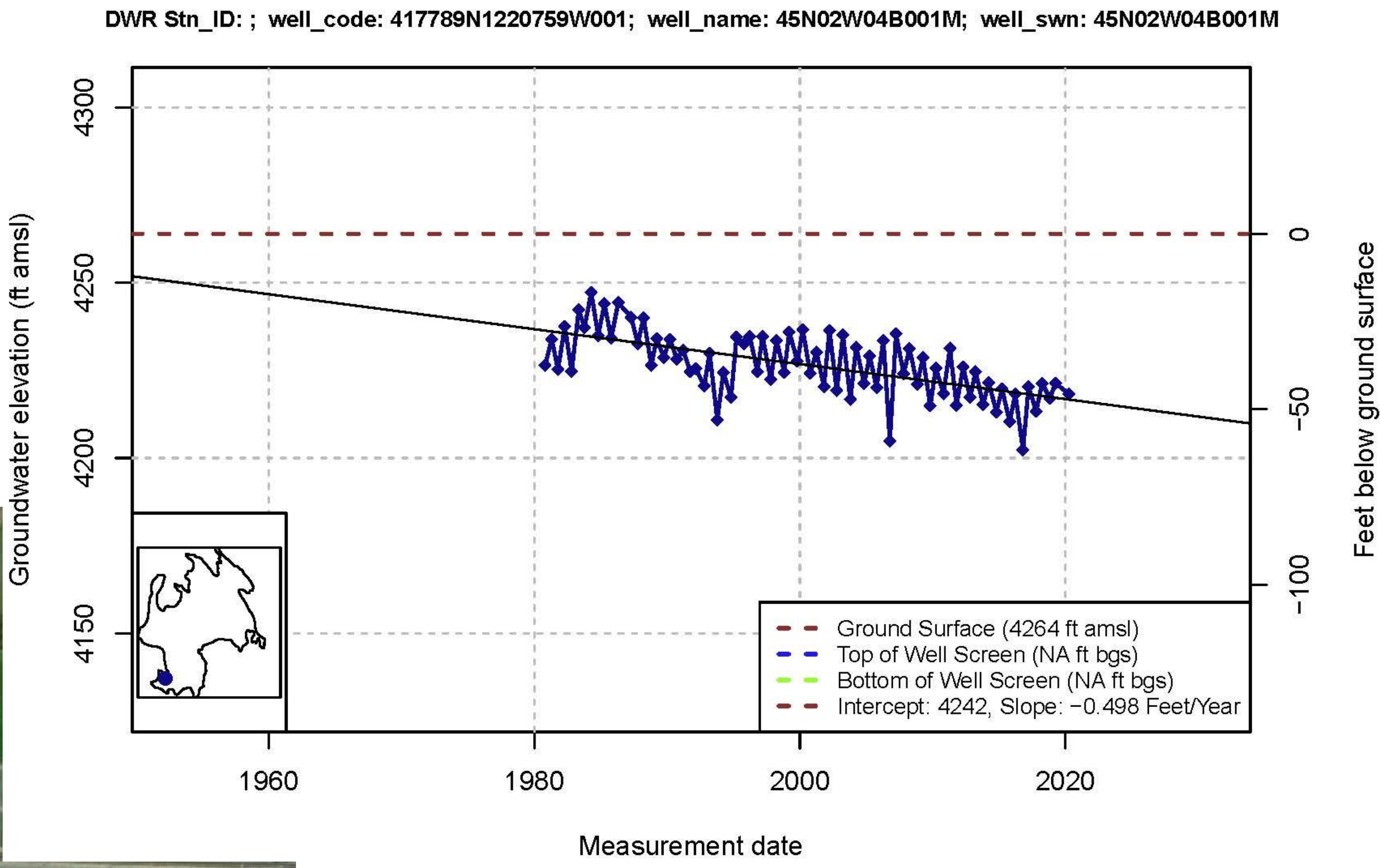
RMP Locations and types

- ID from State Well Number
- Total Depth in feet
- 25 mile^2 buffer
- 14 wells selected (13+ Dorris)
- At least 9 wells in the final network

Hydrographs for RMPs


Mount H
Meiss Lake Rd
E Ball Mountain Little Shasta Rd
417786N1220041W001
Old St
Old State Hwy


DWR Stn_ID: ; well_code: 417786N1220041W001; well_name: 45N01W06A001M; well_swn: 45N01W06A001M
Groundwater elevation (ft amsl)
4300
4250
4200
4150
Feet below ground surface
0
−50
−100
Ground Surface (4262 ft amsl)
Top of Well Screen (40 ft bgs)
Bottom of Well Screen (104 ft bgs)
Intercept: 4231, Slope: −0.7482 Feet/Year
1960
1980
2000
2020
Measurement date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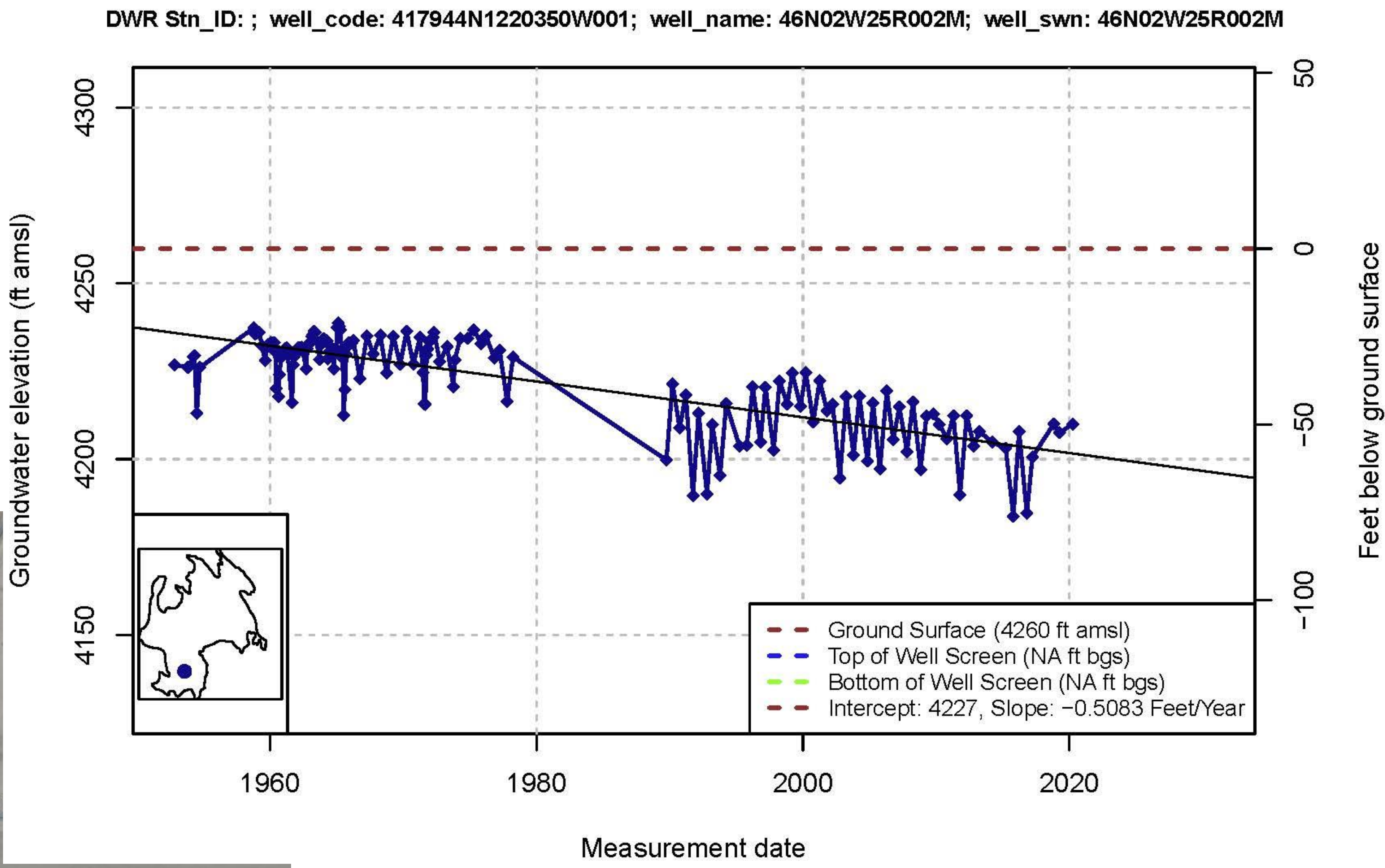
Groundwater elevation (ft amsl)
4300
4250
4200
4150
0
−50
−100
Feet below ground surface
1960
1980
2000
2020
Measurement date
Ground Surface (4264 ft amsl)
Top of Well Screen (NA ft bgs)
Bottom of Well Screen (NA ft bgs)
Intercept: 4242, Slope: −0.498 Feet/Year


W Ball Mountain Little Shasta Rd
417789N1220759W001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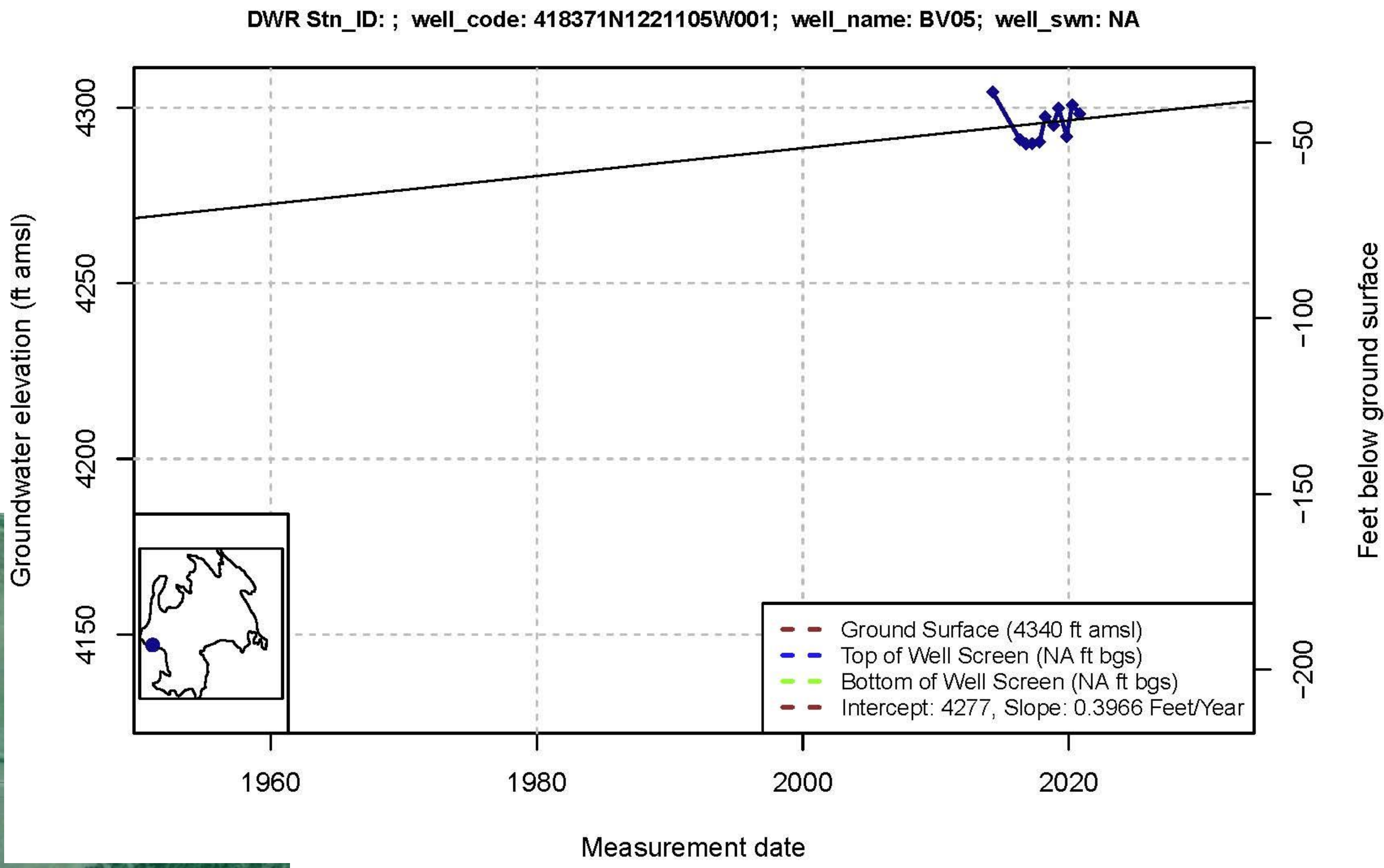
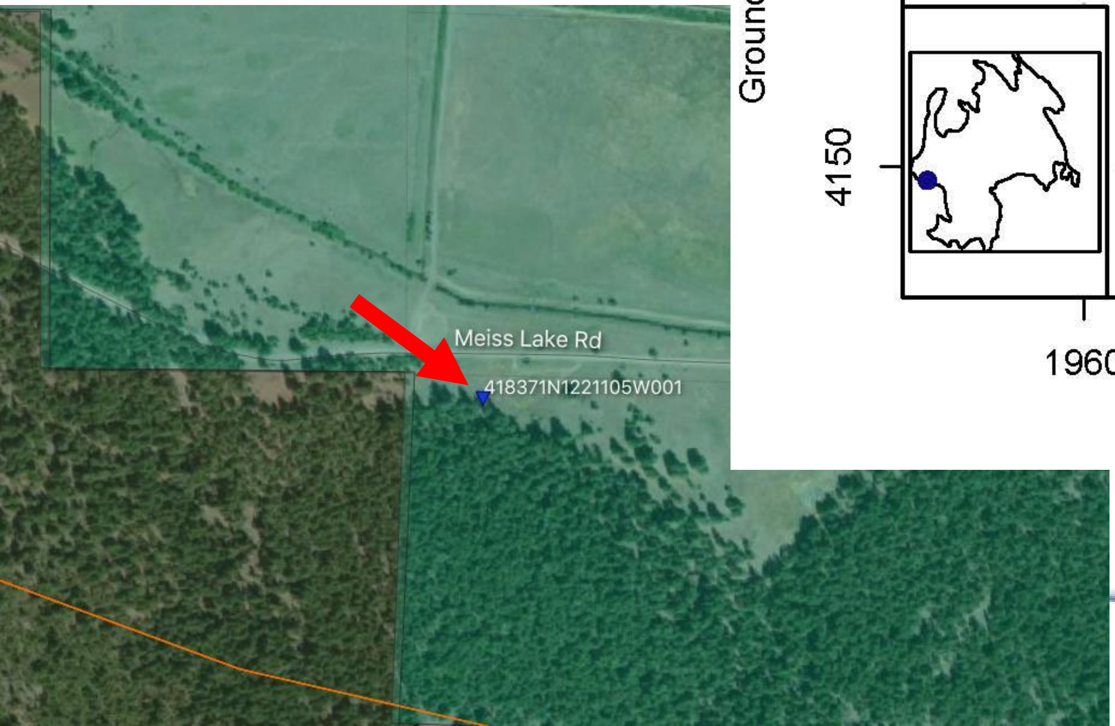
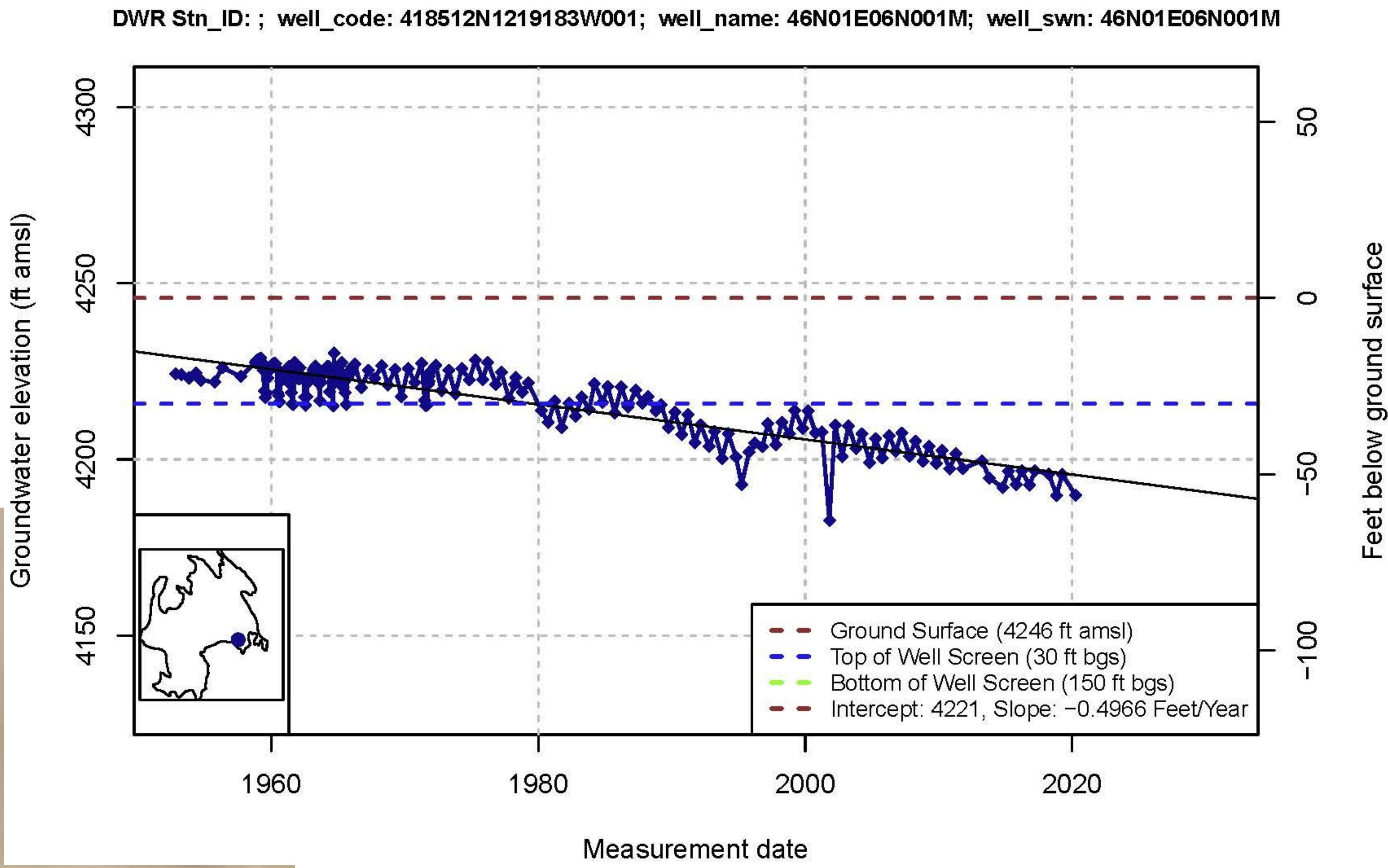
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
4300
4250
4200
4150
50
0
−50
−100
1960
1980
2000
2020
Ground Surface (4260 ft amsl)
Top of Well Screen (NA ft bgs)
Bottom of Well Screen (NA ft bgs)
Intercept: 4227, Slope: −0.5083 Feet/Year


417944N1220350W001
US Hwy 97
W Macdoel District Rd
E


DWR Stn_ID: ; well_code: 418371N1221105W001; well_name: BV05; well_swn: NA
Groundwater elevation (ft amsl)
4300
4250
4200
4150
Feet below ground surface
-50
-100
-150
-200
1960
1980
2000
2020
Measurement date
Ground Surface (4340 ft amsl)
Top of Well Screen (NA ft bgs)
Bottom of Well Screen (NA ft bgs)
Intercept: 4277, Slope: 0.3966 Feet/Year


Meiss Lake Rd
418371N1221105W001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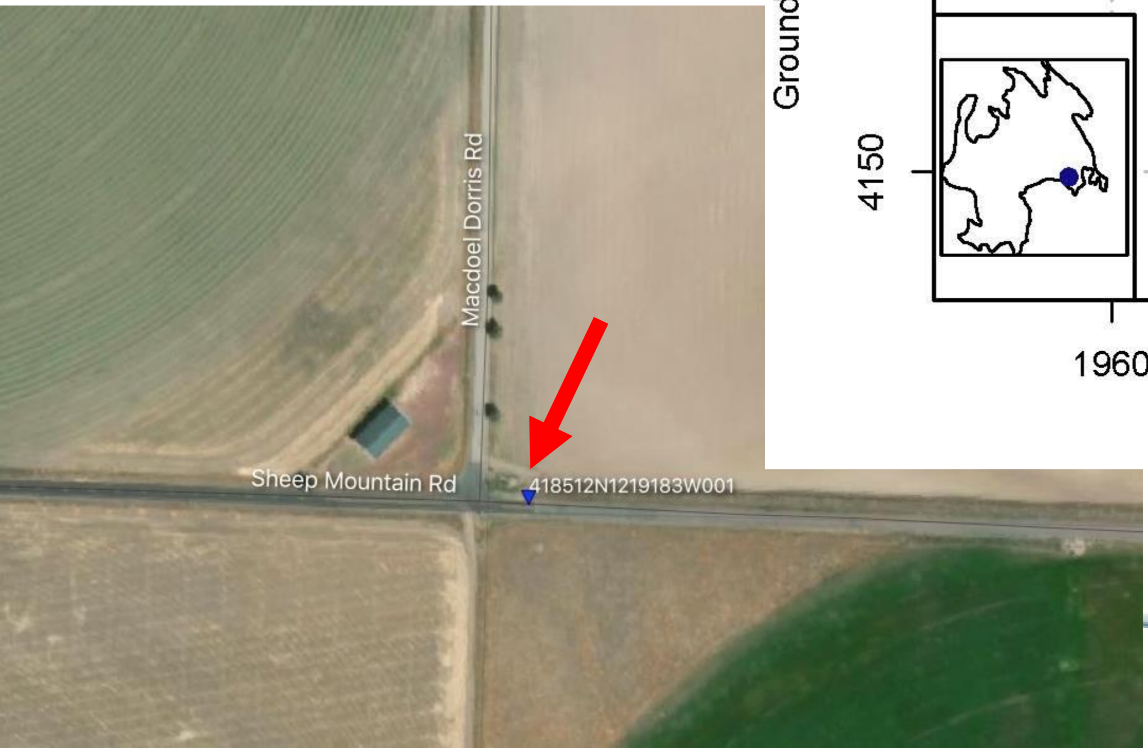
Groundwater elevation (ft amsl)
4300
4250
4200
4150
Feet below ground surface
50
0
−50
−100
1960
1980
2000
2020
Measurement date
Ground Surface (4246 ft amsl)
Top of Well Screen (30 ft bgs)
Bottom of Well Screen (150 ft bgs)
Intercept: 4221, Slope: −0.4966 Feet/Year


Macdoel Dorris Rd
Sheep Mountain Rd
418512N1219183W001

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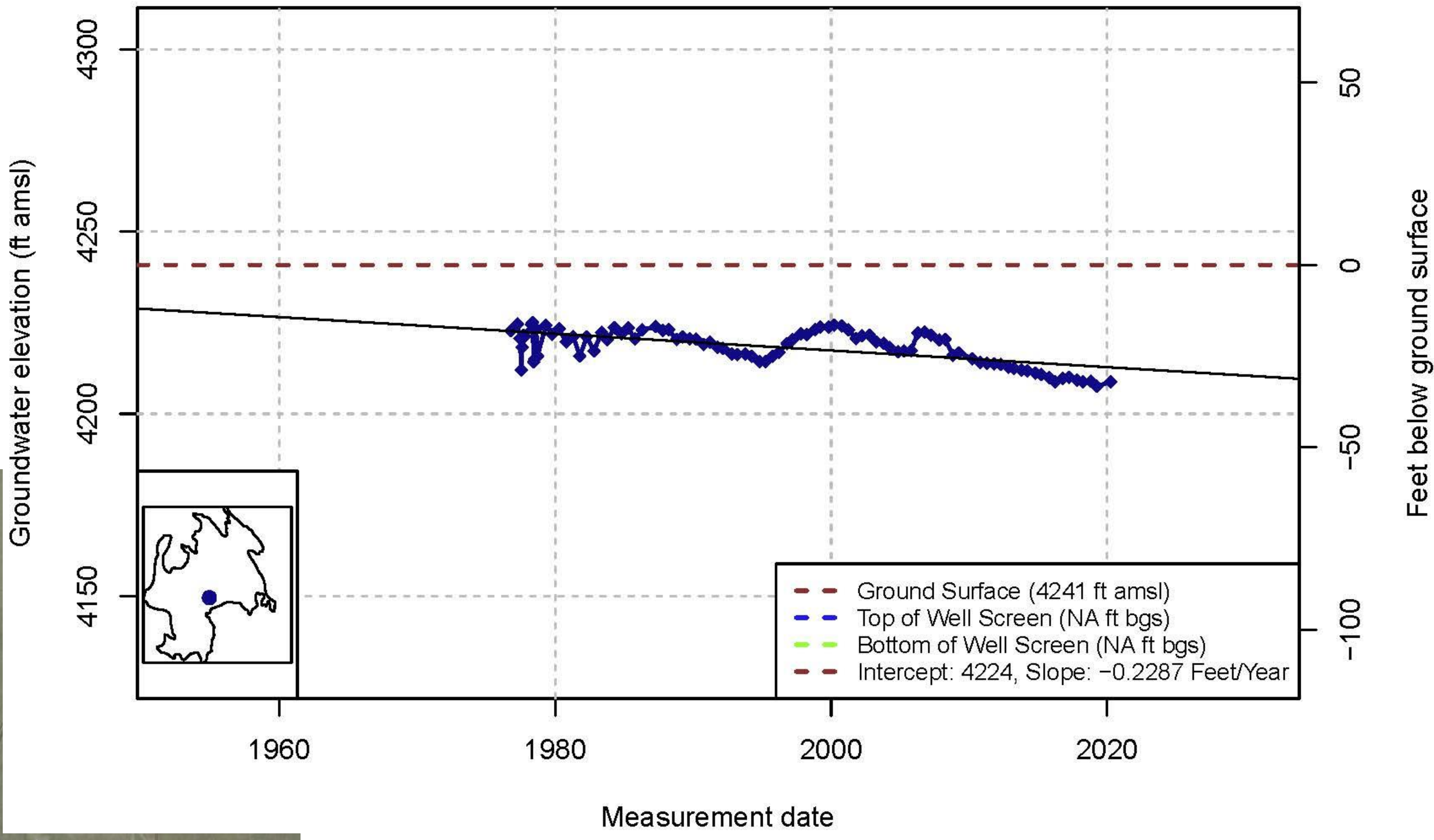

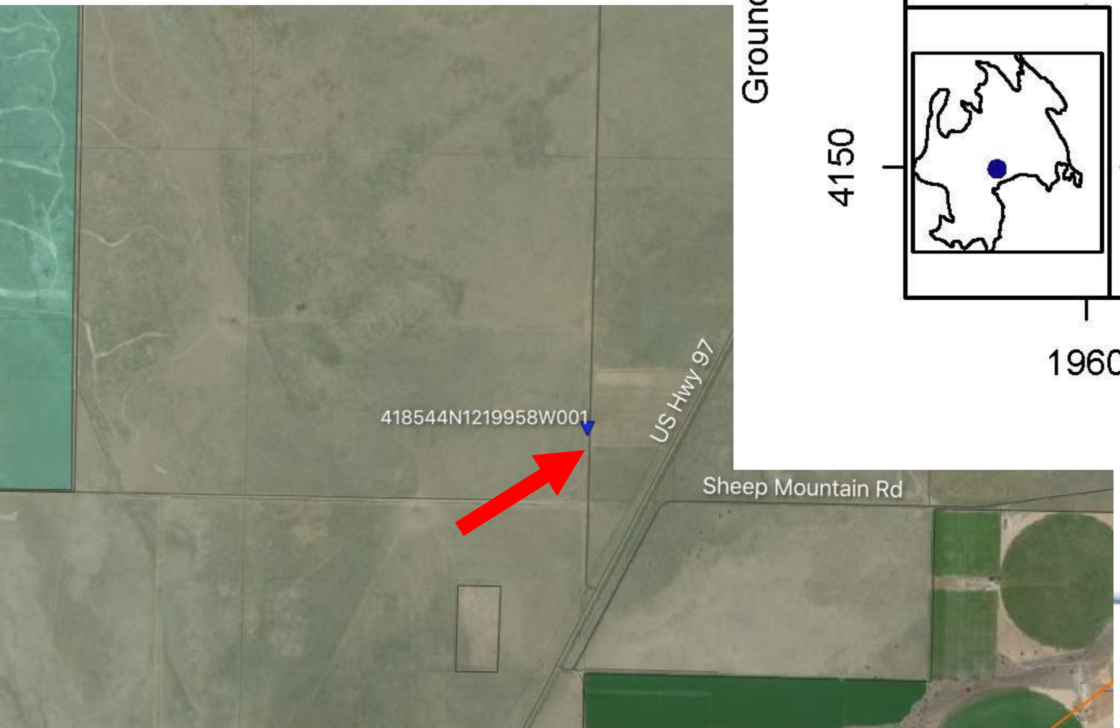

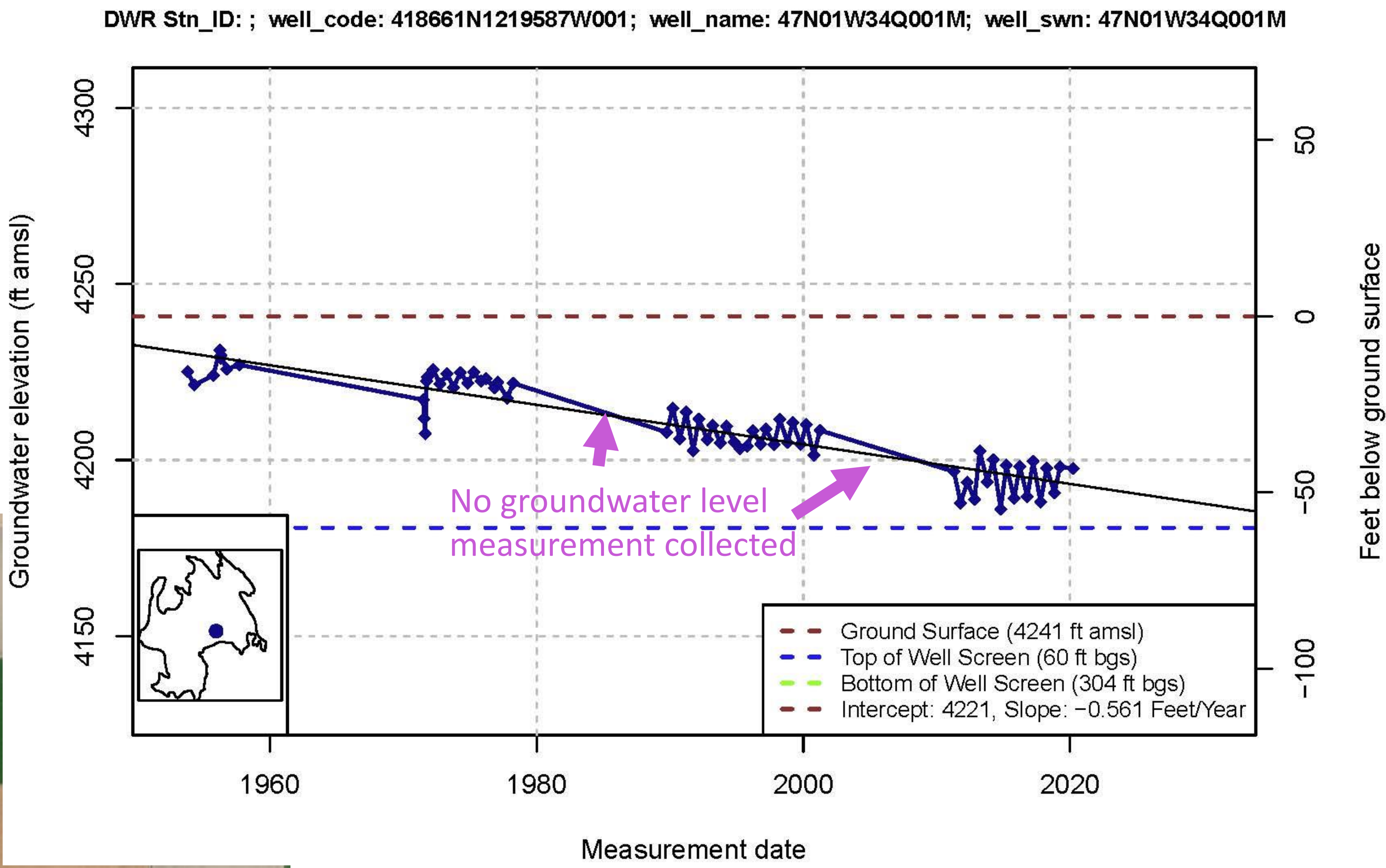
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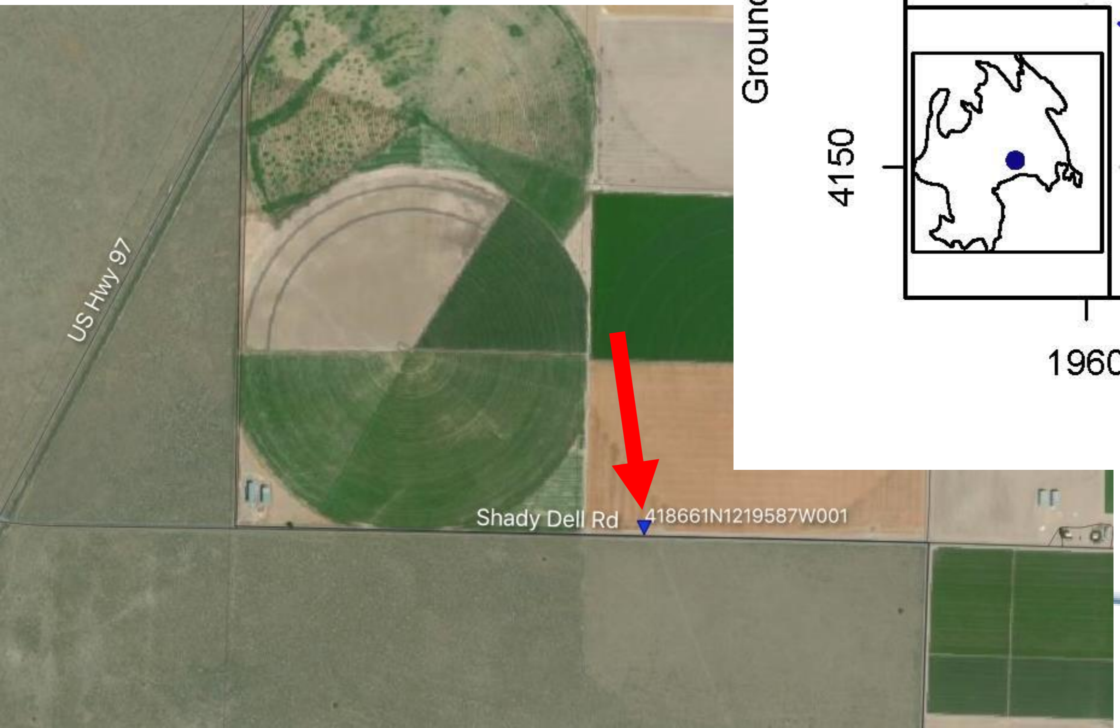
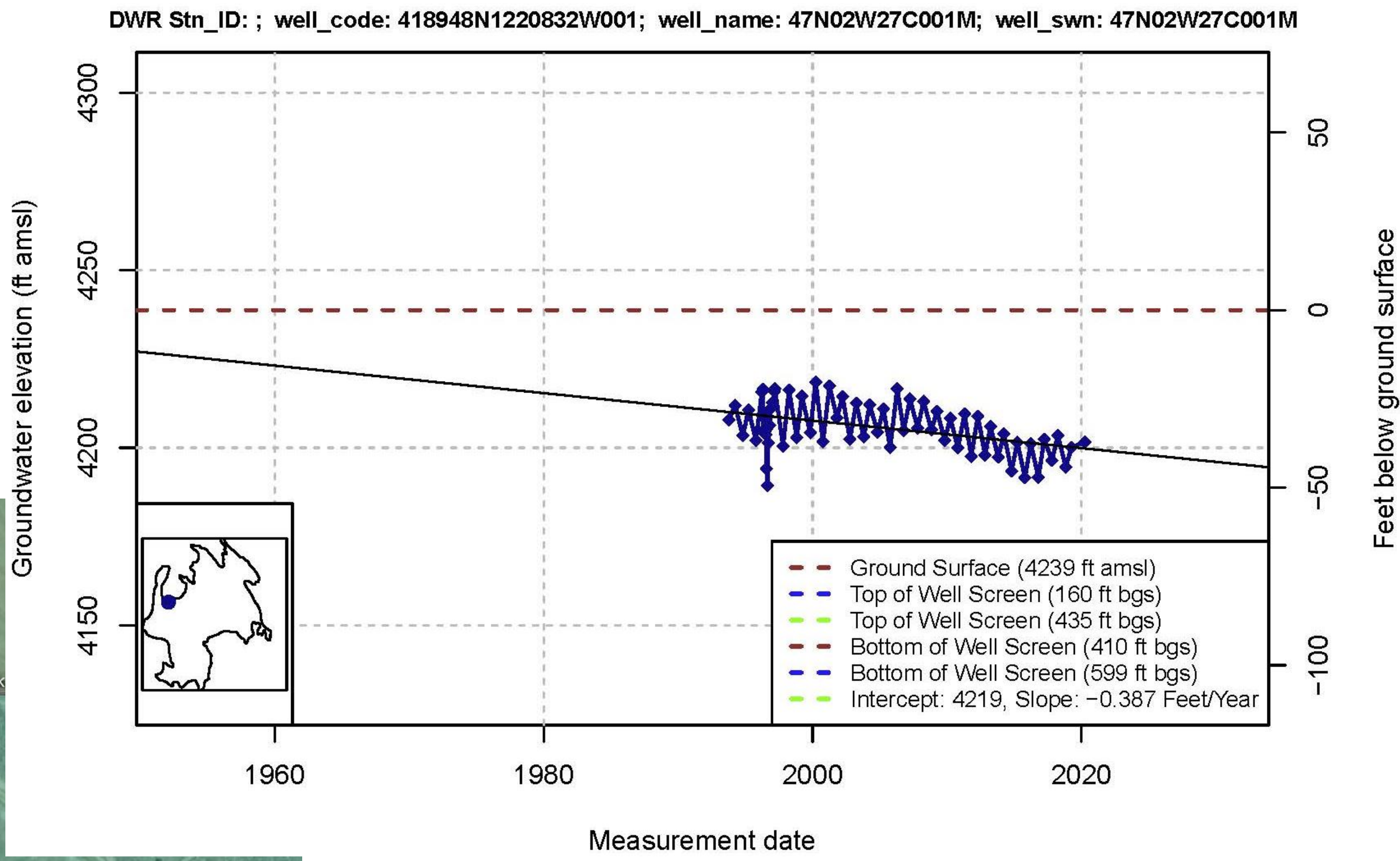
Groundwater elevation (ft amsl)
Feet below ground surface
4300
4250
4200
4150
50
0
−50
−100
1960
1980
2000
2020
Measurement date
No groundwater level measurement collected
Ground Surface (4241 ft amsl)
Top of Well Screen (60 ft bgs)
Bottom of Well Screen (304 ft bgs)
Intercept: 4221, Slope: −0.561 Feet/Year


US Hwy 97
Shady Dell Rd
418661N1219587W001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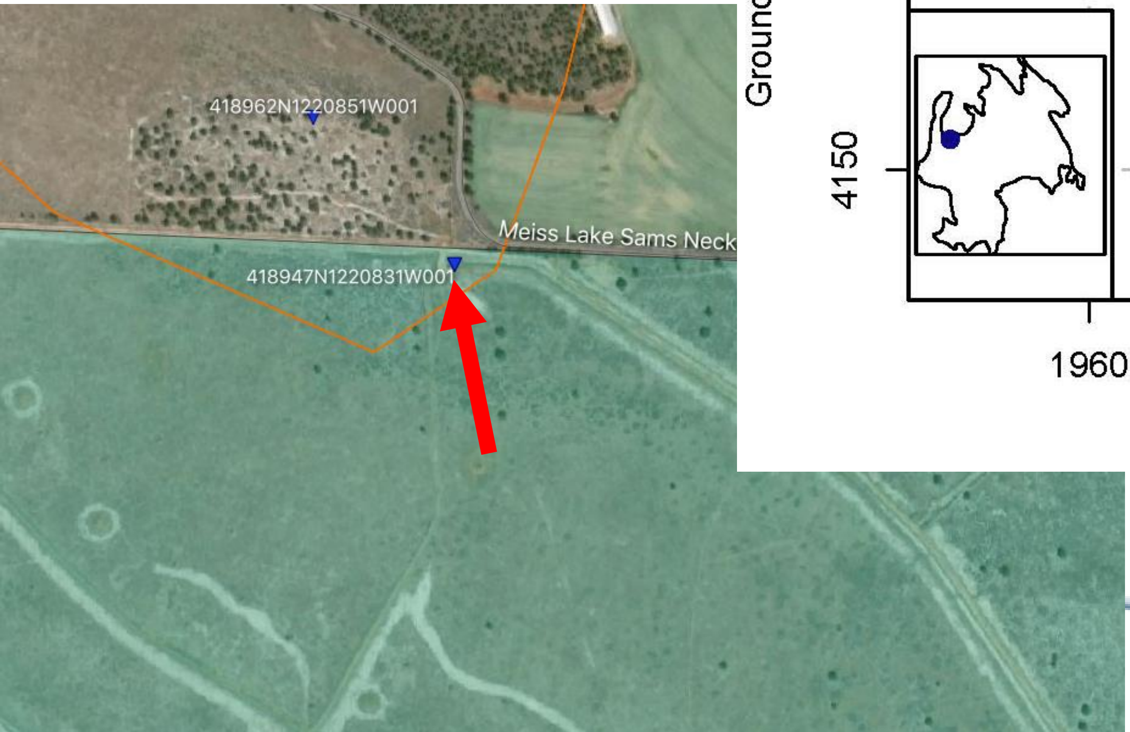
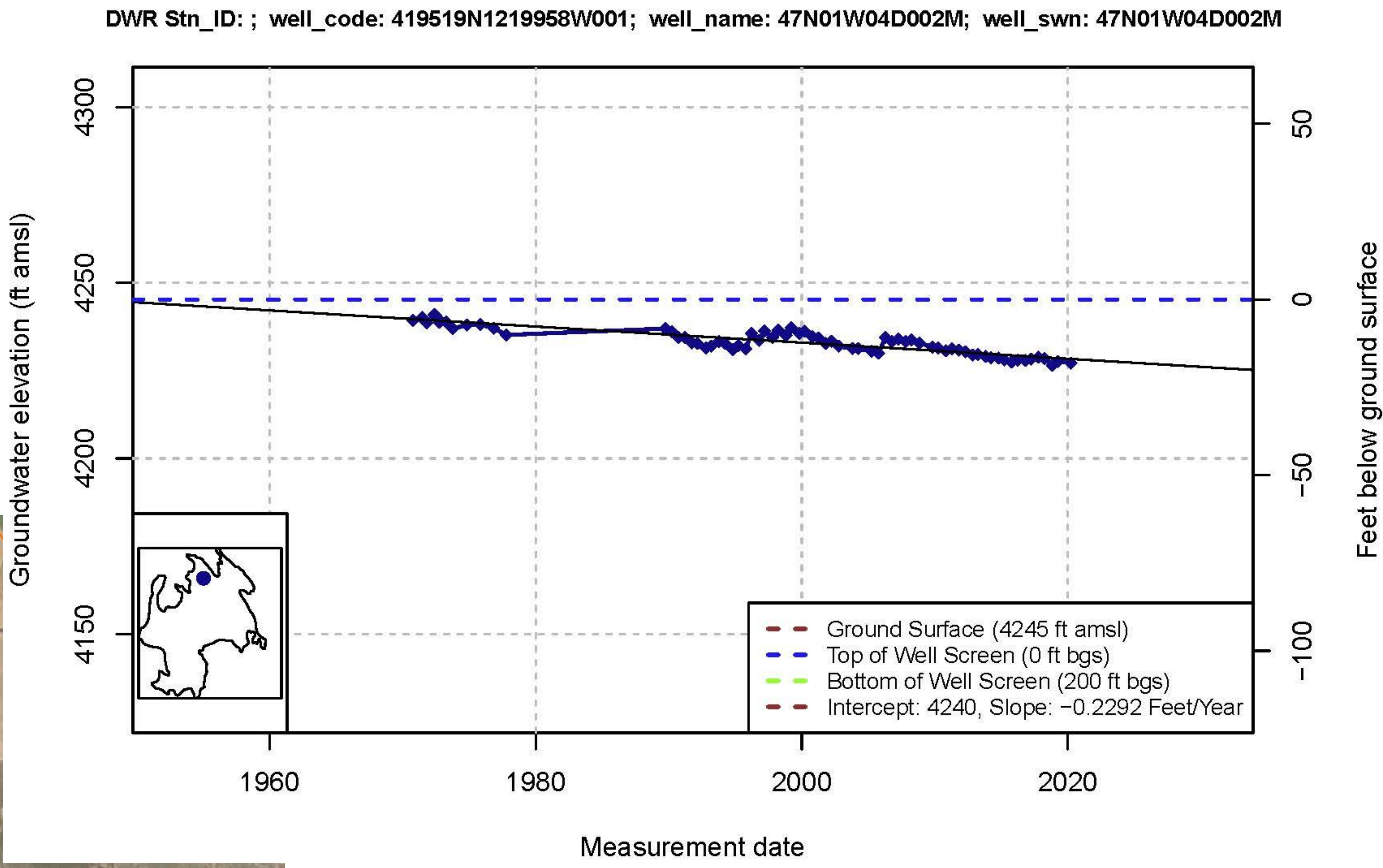
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
4300
4250
4200
4150
50
0
−50
−100
1960
1980
2000
2020
Ground Surface (4239 ft amsl)
Top of Well Screen (160 ft bgs)
Top of Well Screen (435 ft bgs)
Bottom of Well Screen (410 ft bgs)
Bottom of Well Screen (599 ft bgs)
Intercept: 4219, Slope: −0.387 Feet/Year


418962N1220851W001
Meiss Lake Sams Neck
418947N1220831W001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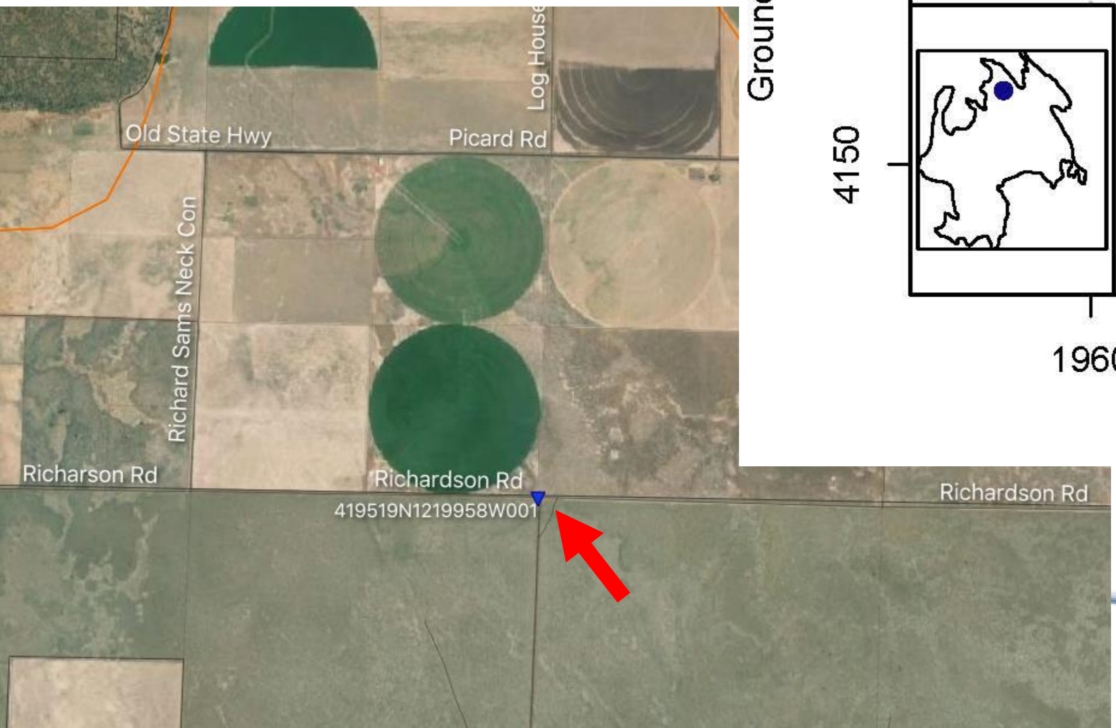
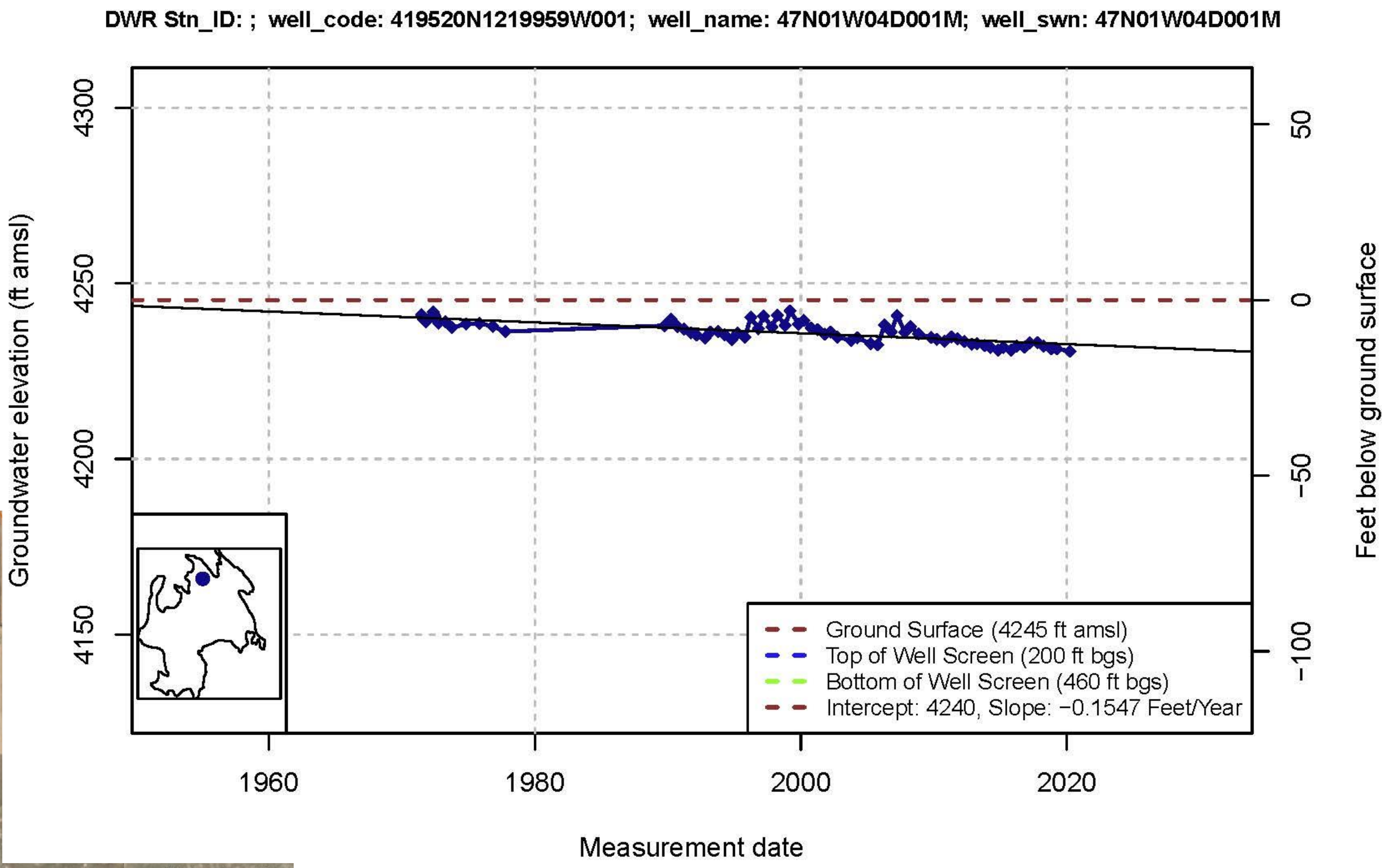
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
4300
4250
4200
4150
50
0
−50
−100
1960
1980
2000
2020
Ground Surface (4245 ft amsl)
Top of Well Screen (0 ft bgs)
Bottom of Well Screen (200 ft bgs)
Intercept: 4240, Slope: −0.2292 Feet/Year


Old State Hwy
Picard Rd
Log House
Richard Sams Neck Con
Richarson Rd
Richardson Rd
419519N1219958W001
Richardson Rd



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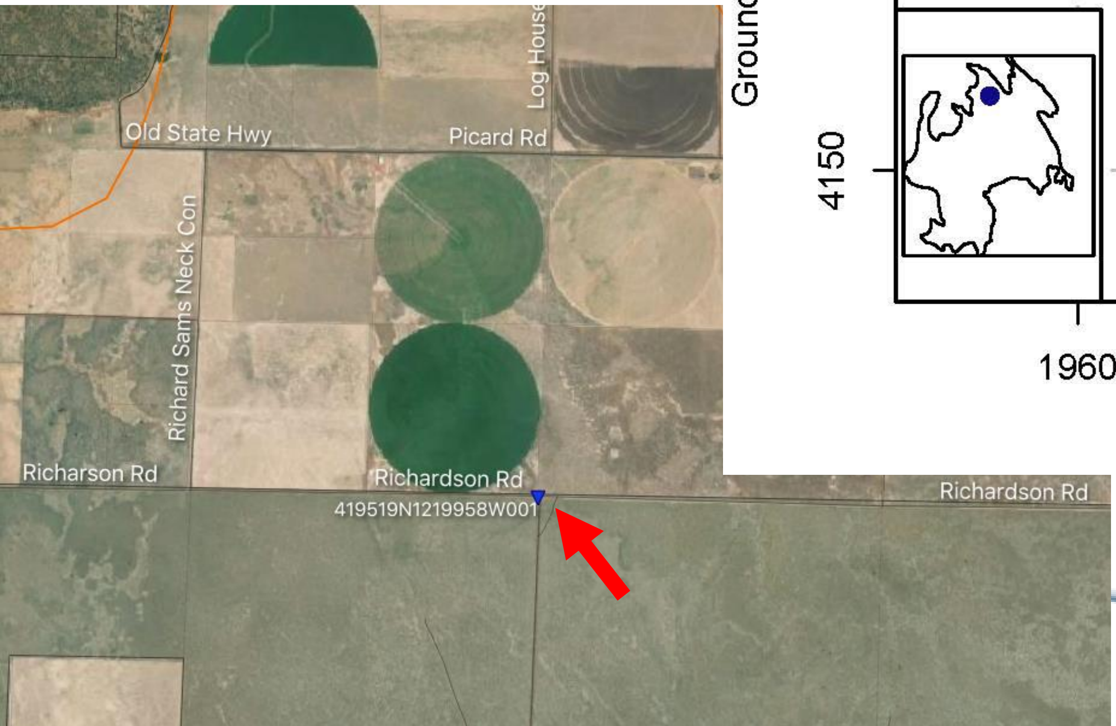
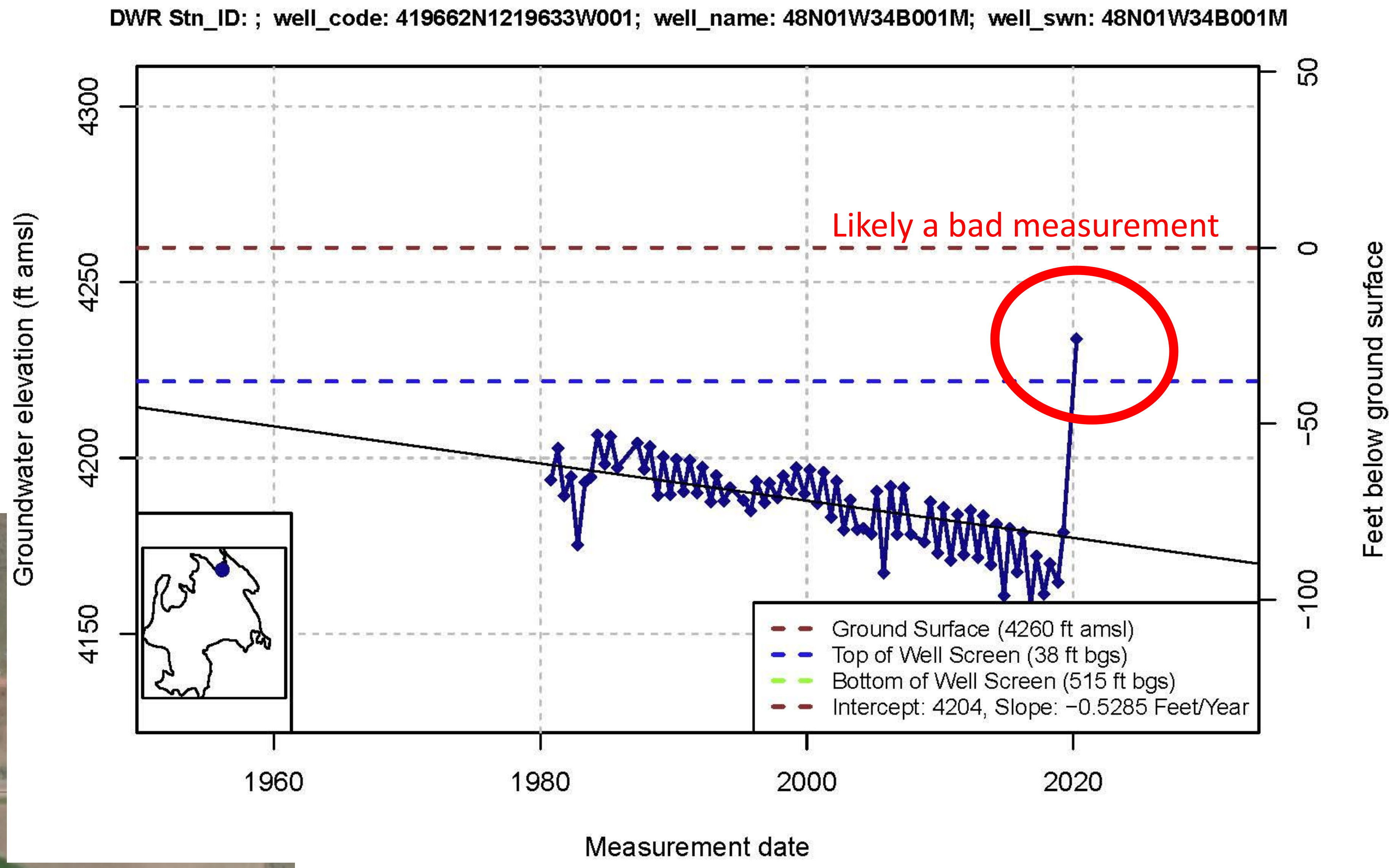
Groundwater elevation (ft amsl)
Feet below ground surface
Measurement date
4300
4250
4200
4150
50
0
−50
−100
1960
1980
2000
2020
Ground Surface (4245 ft amsl)
Top of Well Screen (200 ft bgs)
Bottom of Well Screen (460 ft bgs)
Intercept: 4240, Slope: −0.1547 Feet/Year



Old State Hwy
Picard Rd
Log House
Richard Sams Neck Con
Richarson Rd
Richardson Rd
419519N1219958W001
Richardson Rd



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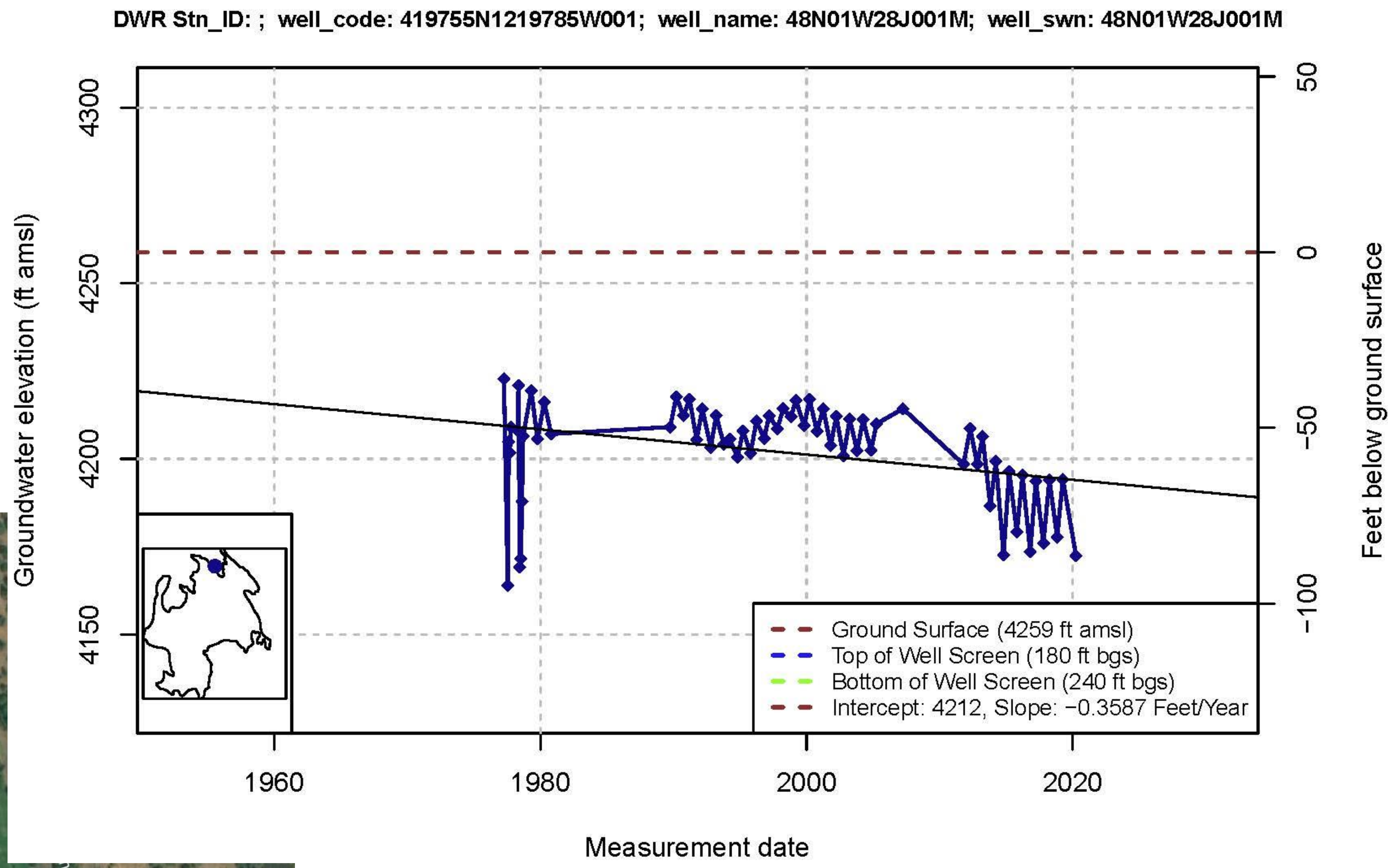
Groundwater elevation (ft amsl)
4300
4250
4200
4150
Feet below ground surface
50
0
−50
−100
1960
1980
2000
2020
Measurement date
Likely a bad measurement
Ground Surface (4260 ft amsl)
Top of Well Screen (38 ft bgs)
Bottom of Well Screen (515 ft bgs)
Intercept: 4204, Slope: −0.5285 Feet/Year

Mrgudich Rd
Johnson Rd
Picard Rd
419662N1219633W001


DWR Stn_ID: ; well_code: 419755N1219785W001; well_name: 48N01W28J001M; well_swn: 48N01W28J001M
Groundwater elevation (ft amsl)
4300
4250
4200
4150
Feet below ground surface
50
0
−50
−100
1960
1980
2000
2020
Measurement date
Ground Surface (4259 ft amsl)
Top of Well Screen (180 ft bgs)
Bottom of Well Screen (240 ft bgs)
Intercept: 4212, Slope: −0.3587 Feet/Year


419737N1219817W001
419755N1219785W001

Butte Valley Water Level SMC Development

Butte Valley GSA Advisory Committee

November 19, 2020 and January 28, 2021

LARRY WALKER ASSOCIATES
science | policy | solutions

Stantec

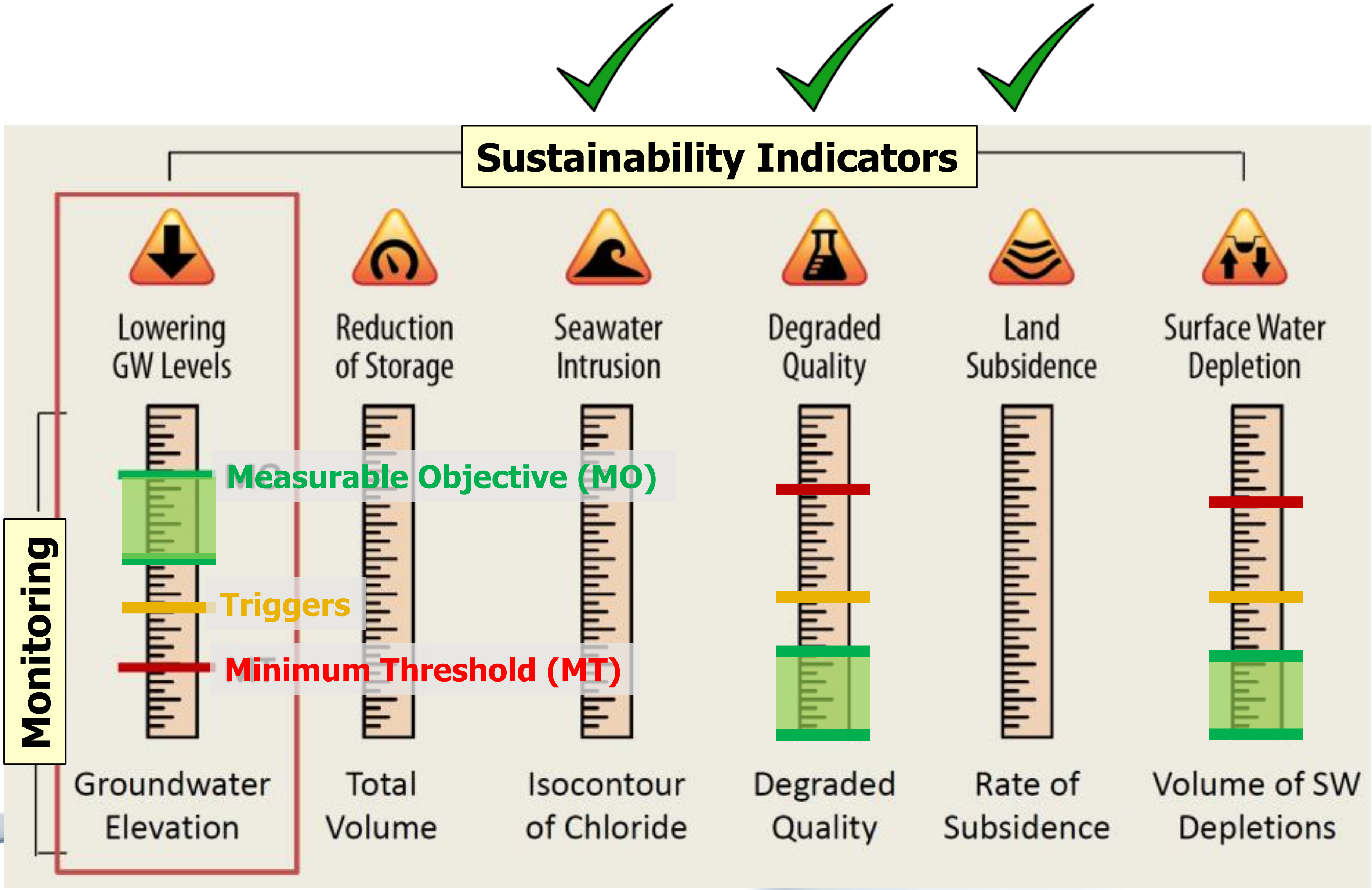
DAVIDS ENGINEERING, INC

UC DAVIS UNIVERSITY OF CALIFORNIA

GSP Chapters

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

Where we are….. (roadmap)

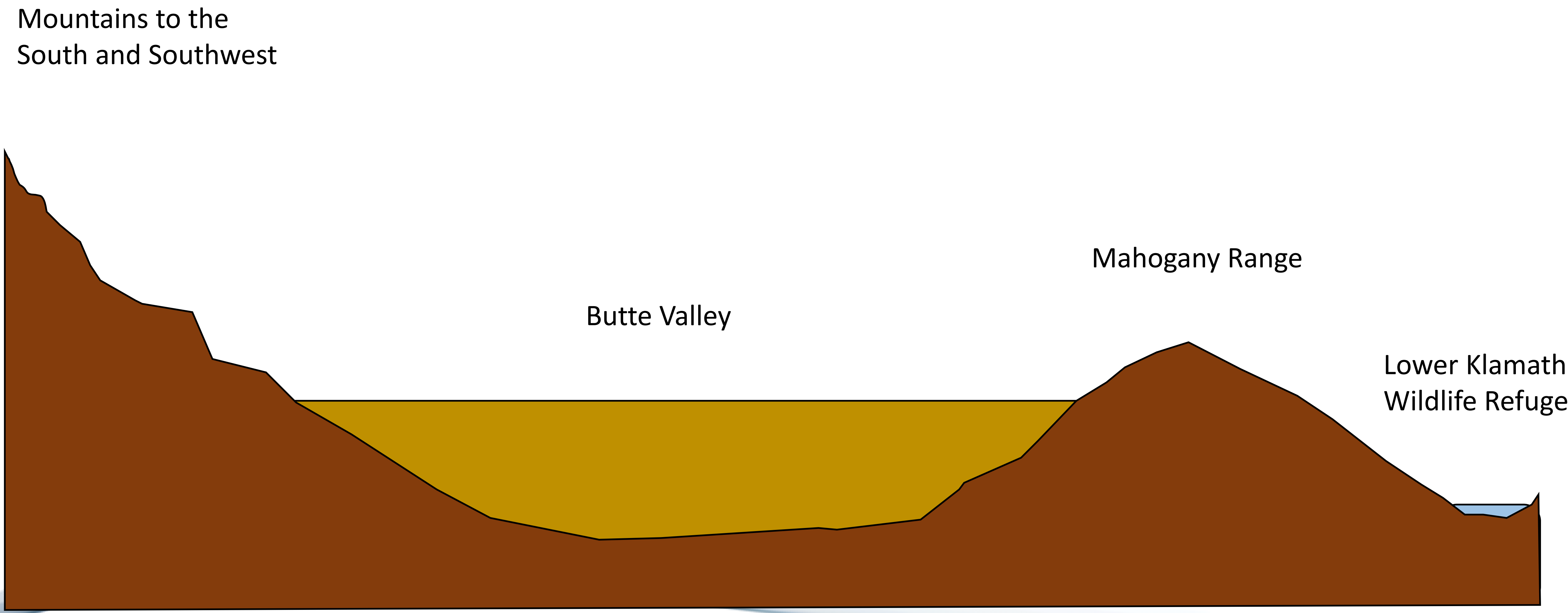


modified from Ca DWR 2016

Agenda

- **Developing a "water level " Sustainable Management Criteria (SMC) – following up on last months discussion**
- Preliminary Strawman for Undesirable Results, Minimum Threshold, Measurable Objectives, and Projects & Management Actions
- Feedback and brainstorming

South to North Cross-Section Butte Valley



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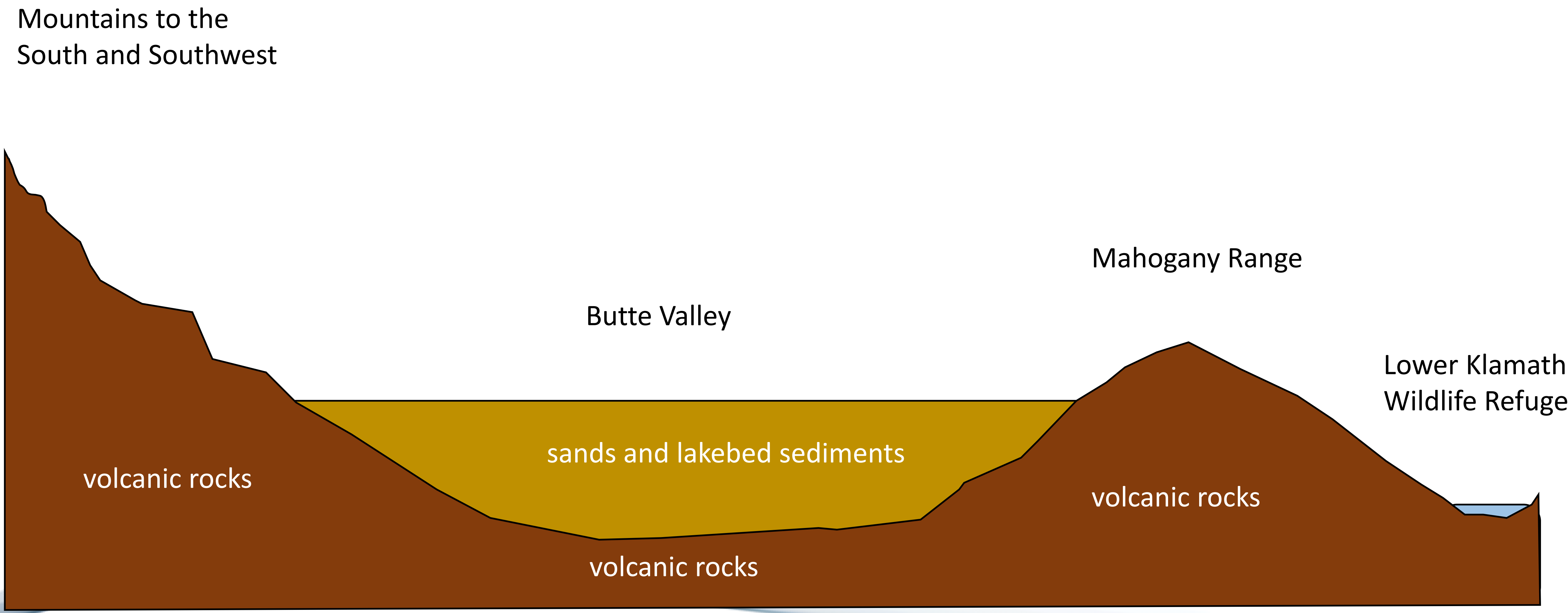

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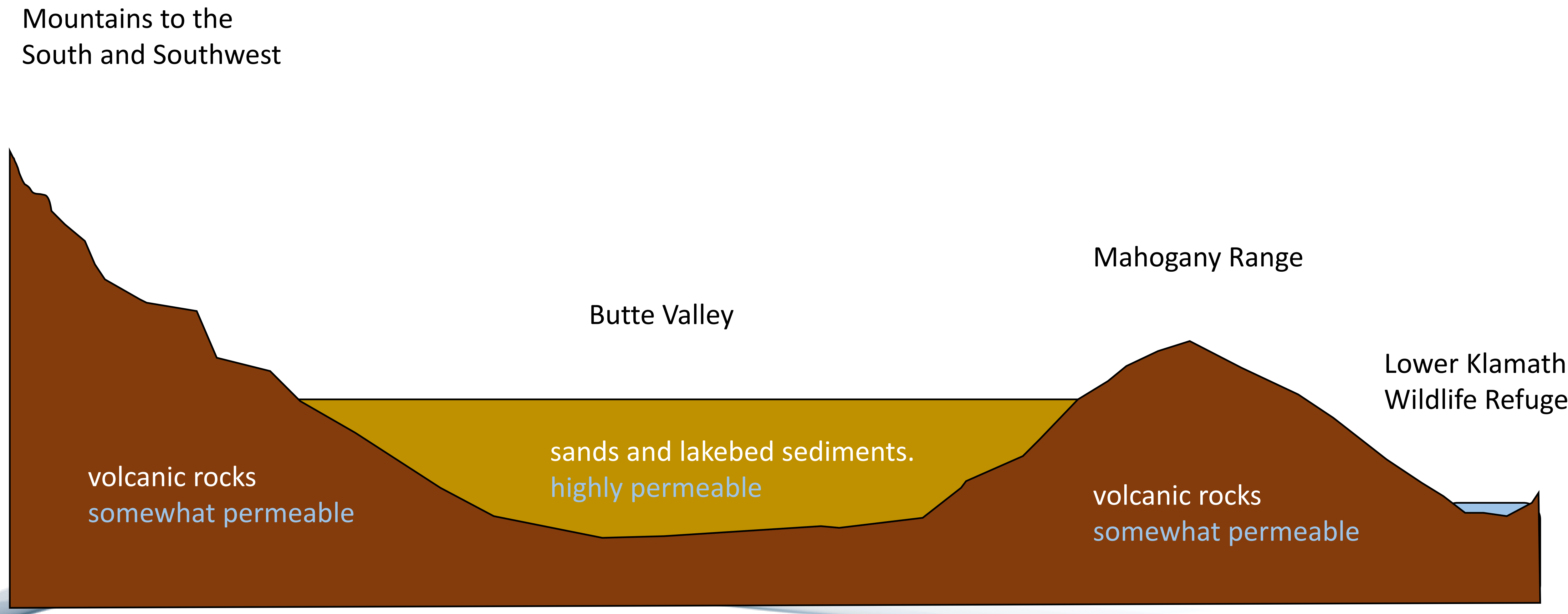

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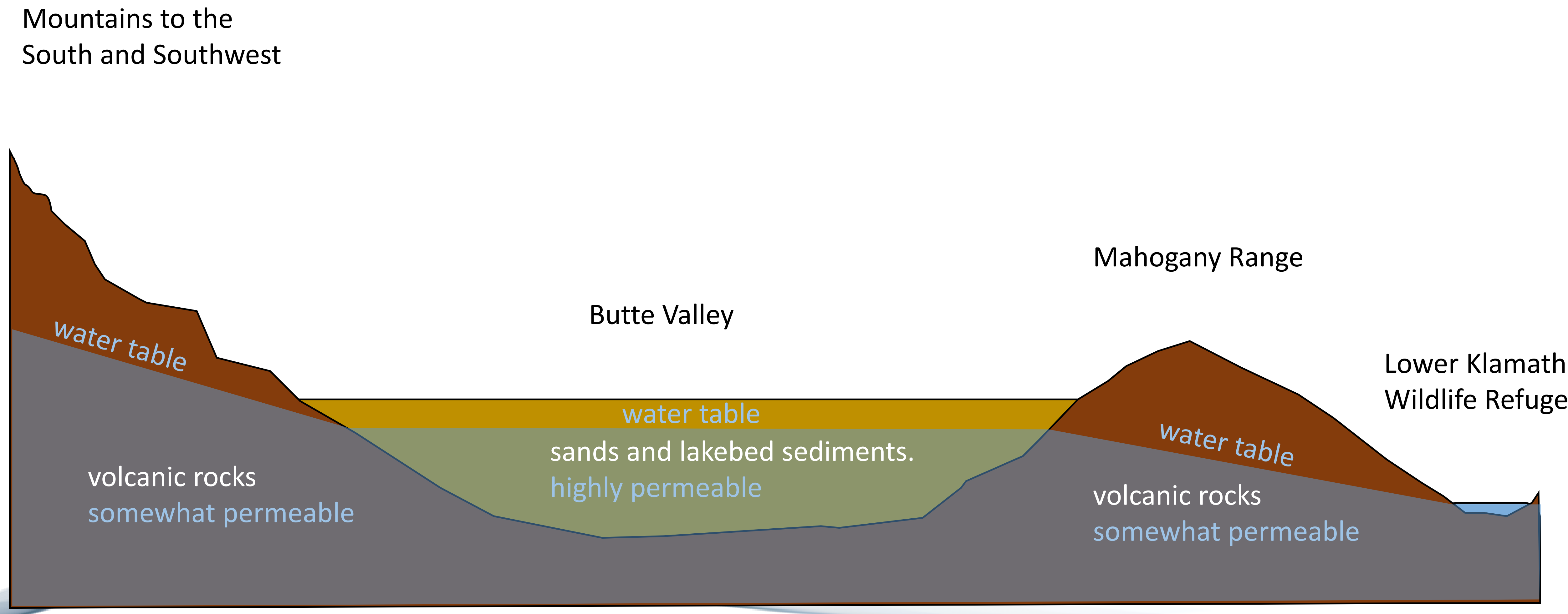

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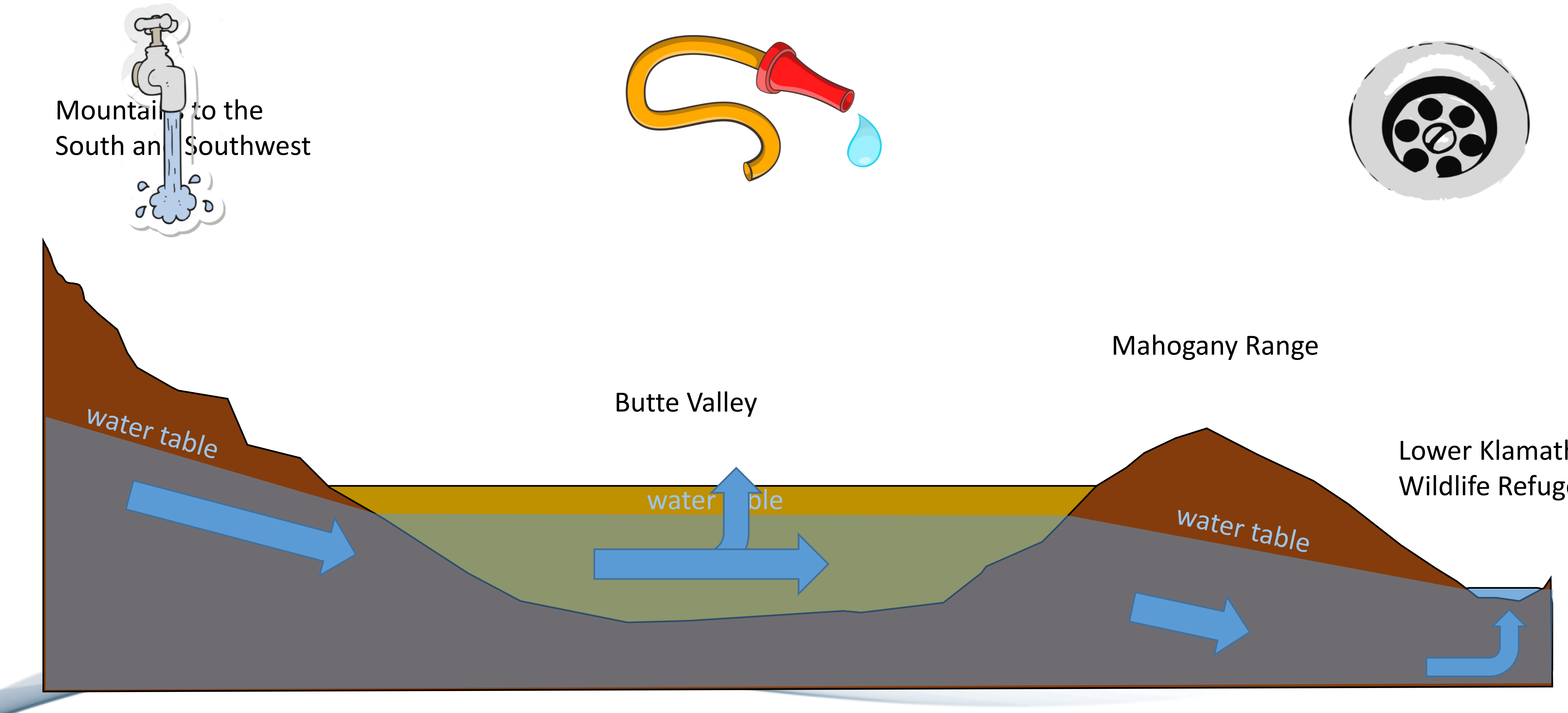
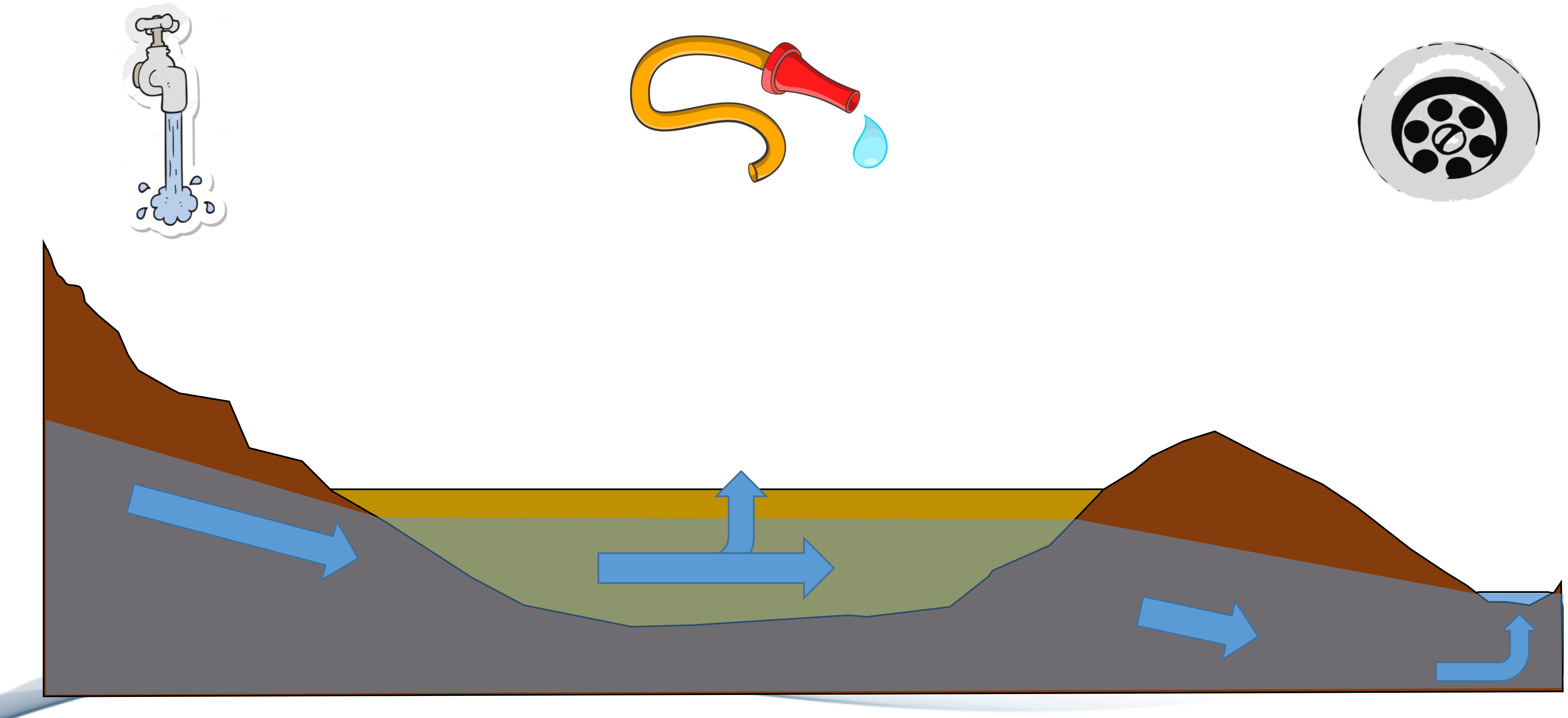
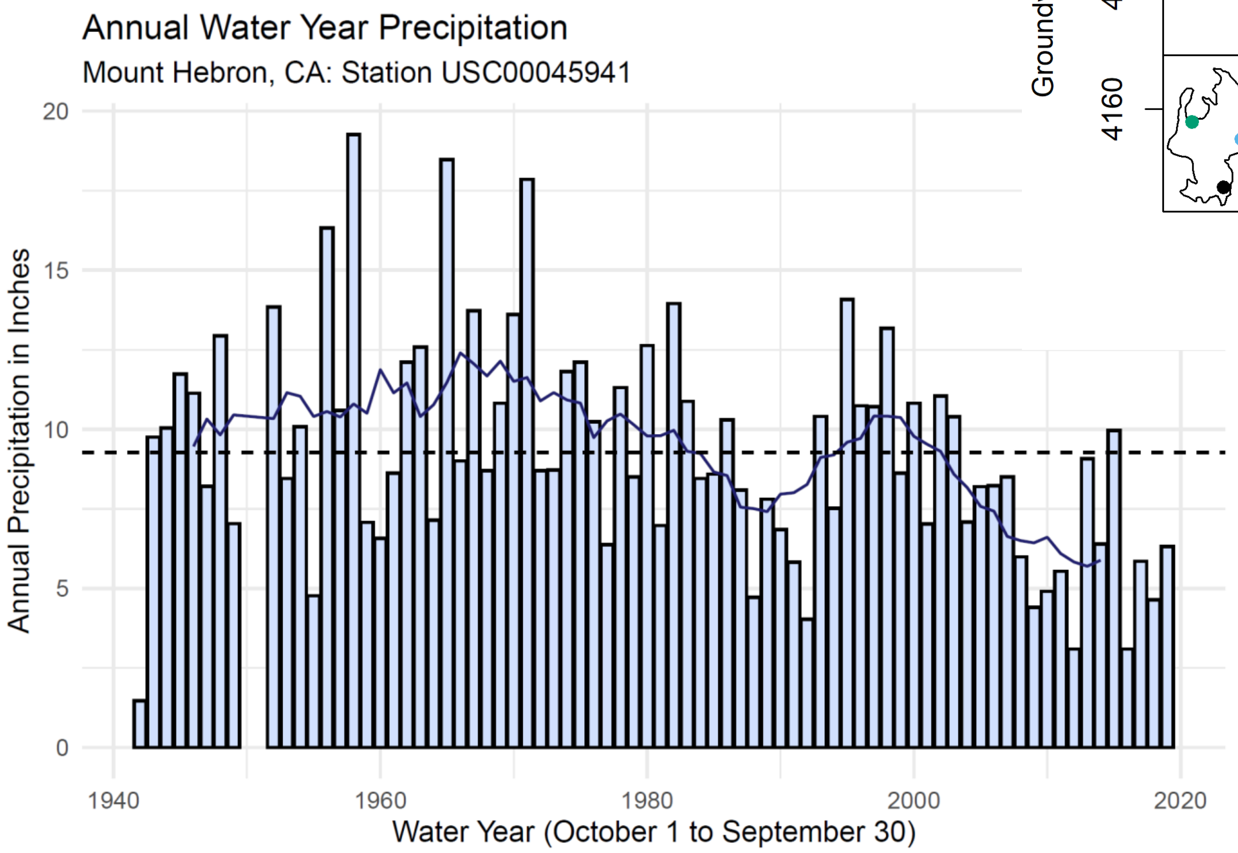


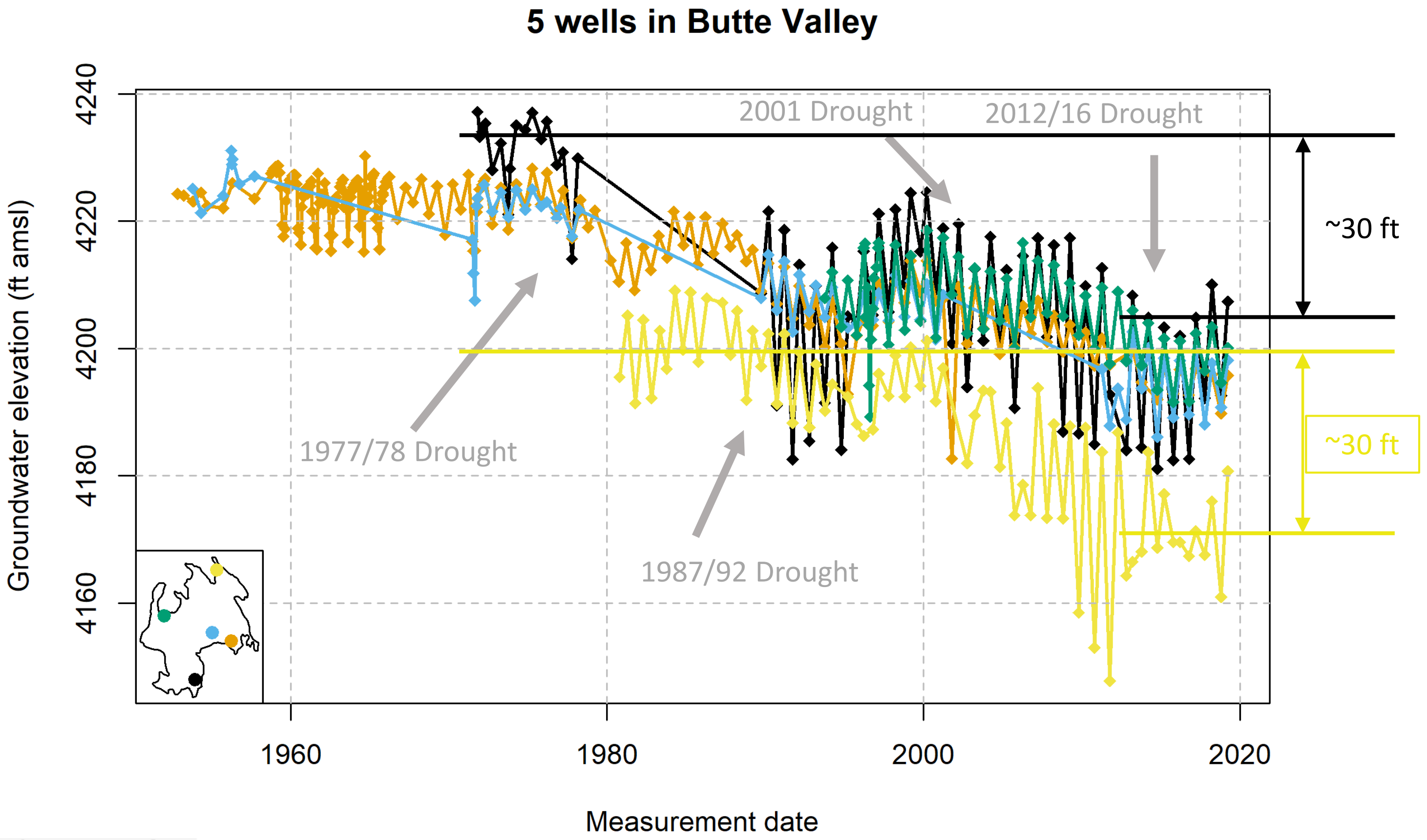
How Does Water Level Elevation Change in Such a System?



Precipitation Decline

Climate change or natural variation?





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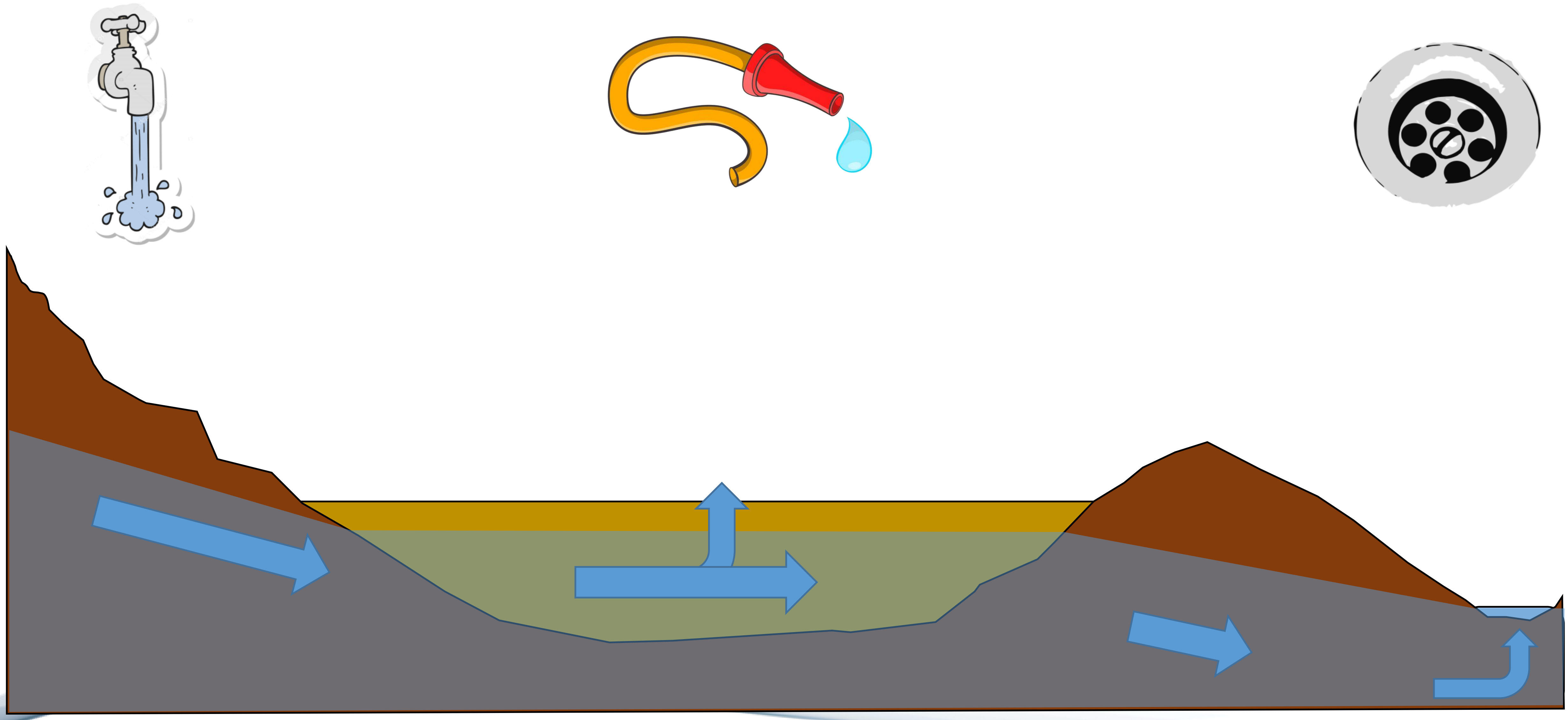
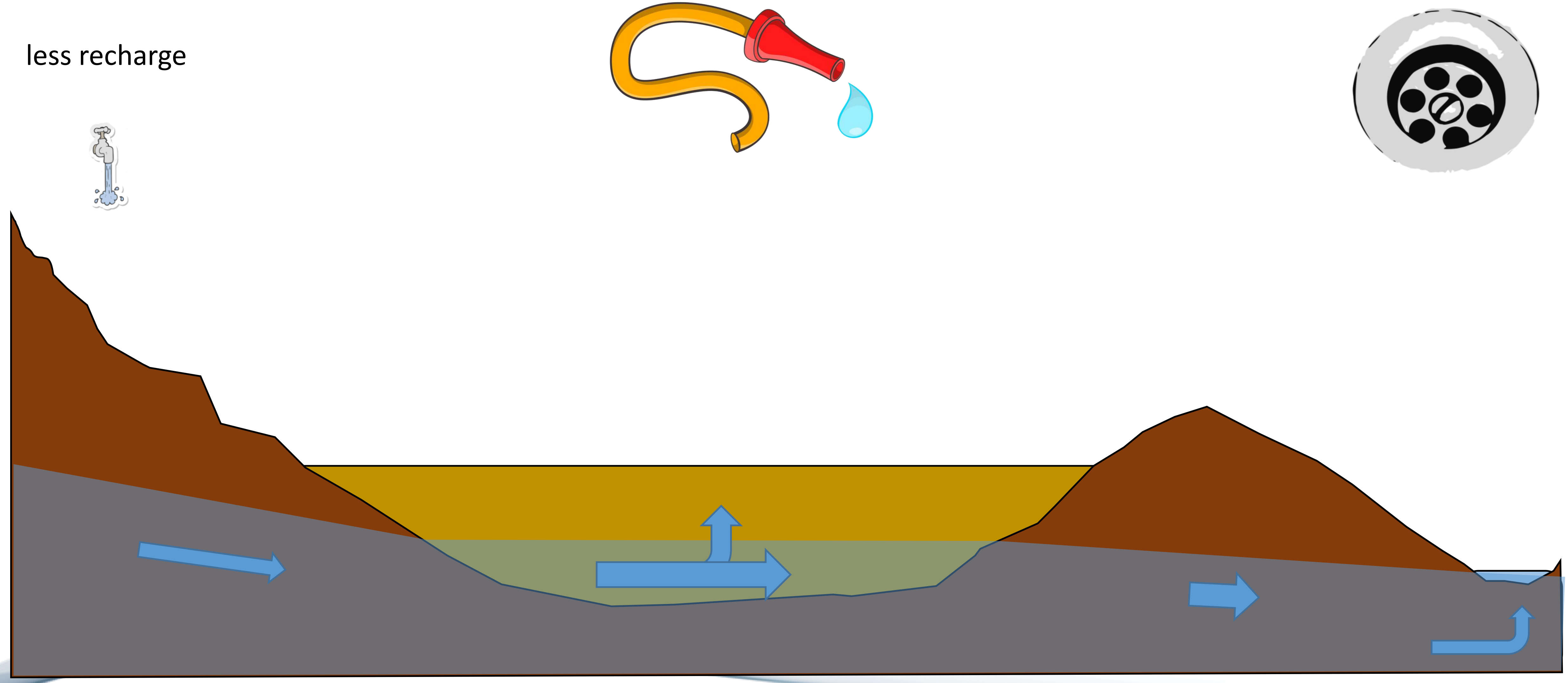
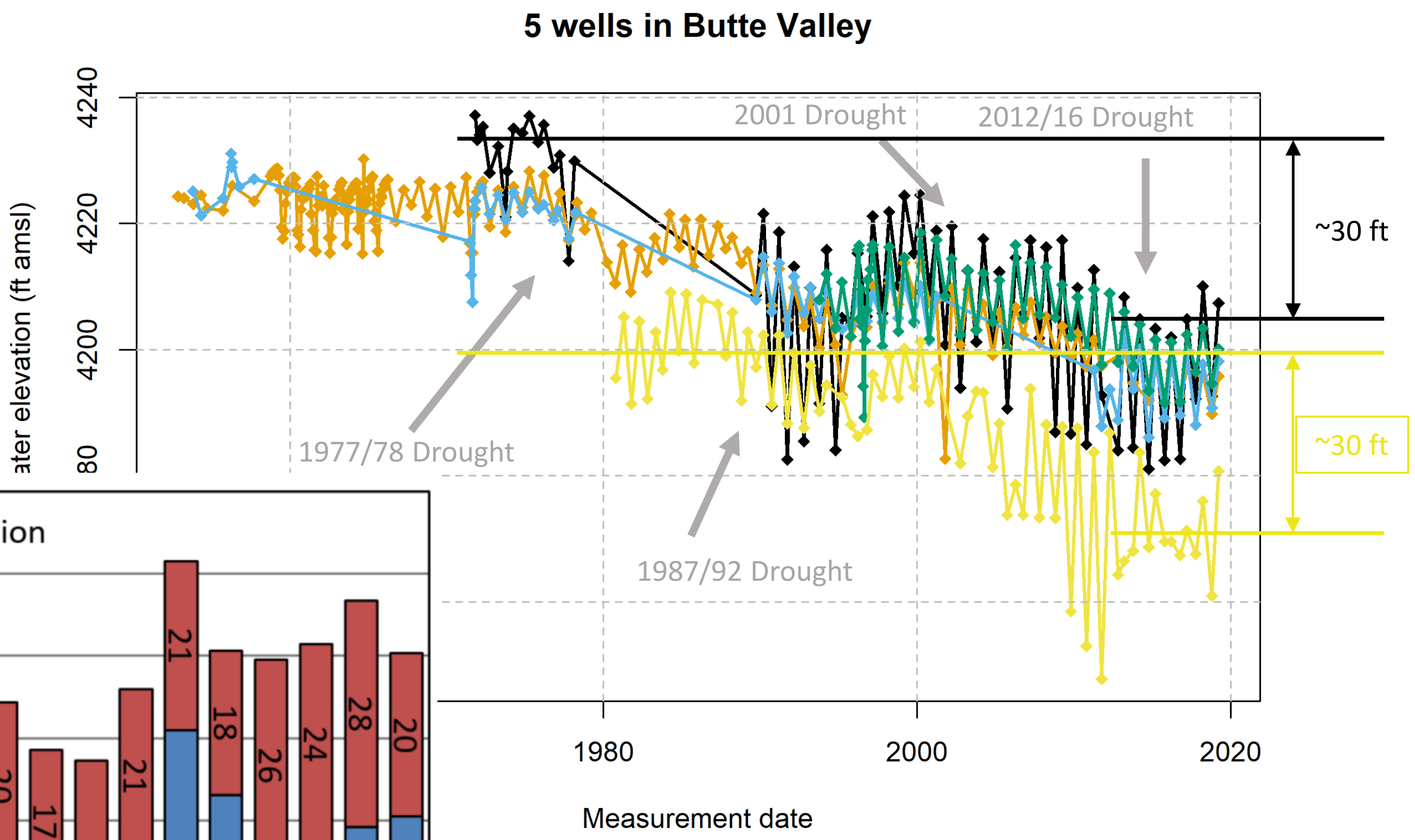


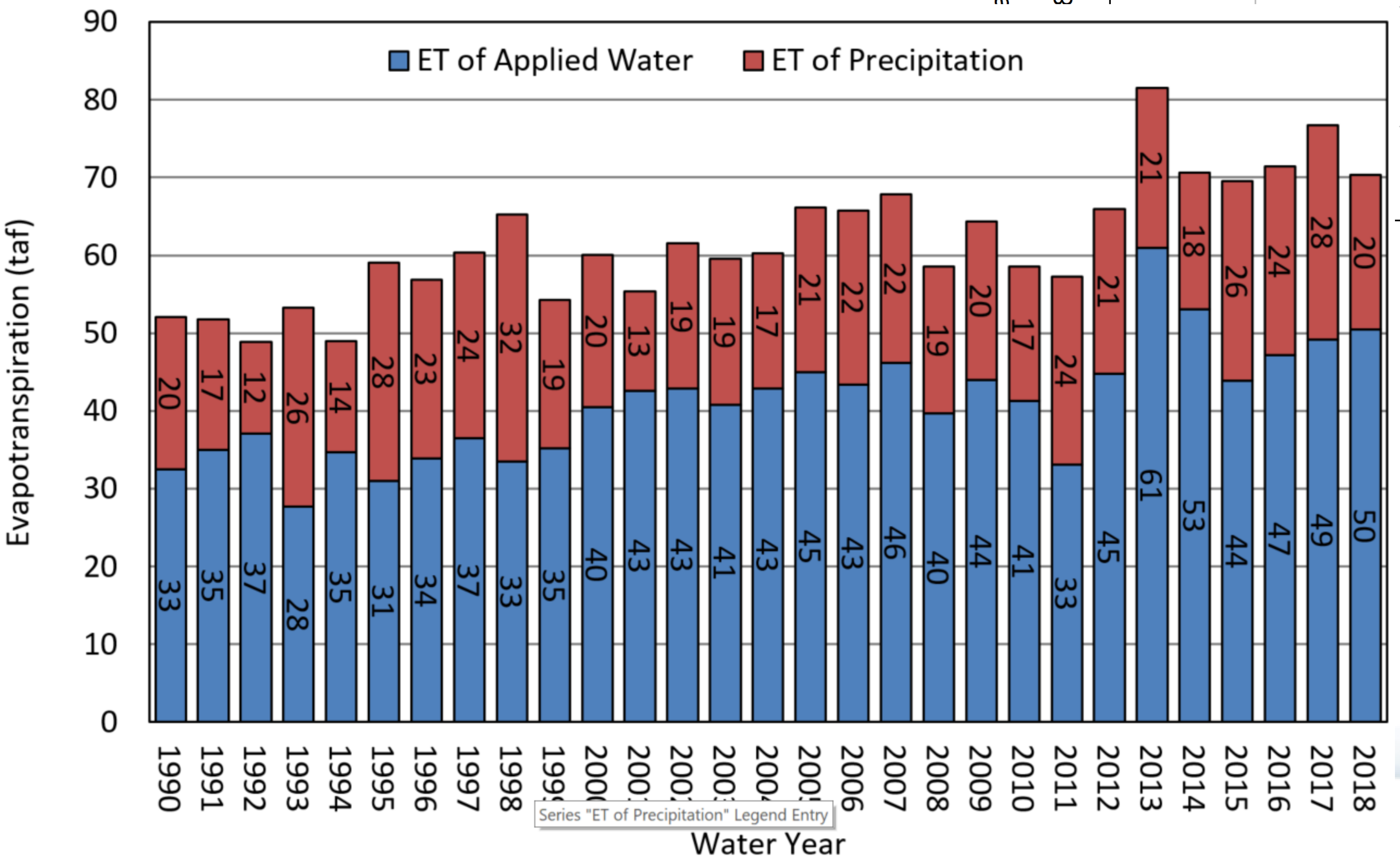
Less recharge, same amount of pumping => less outflow from Butte Valley to "drain"

less recharge



ET from Groundwater Increase 1989 - 2018





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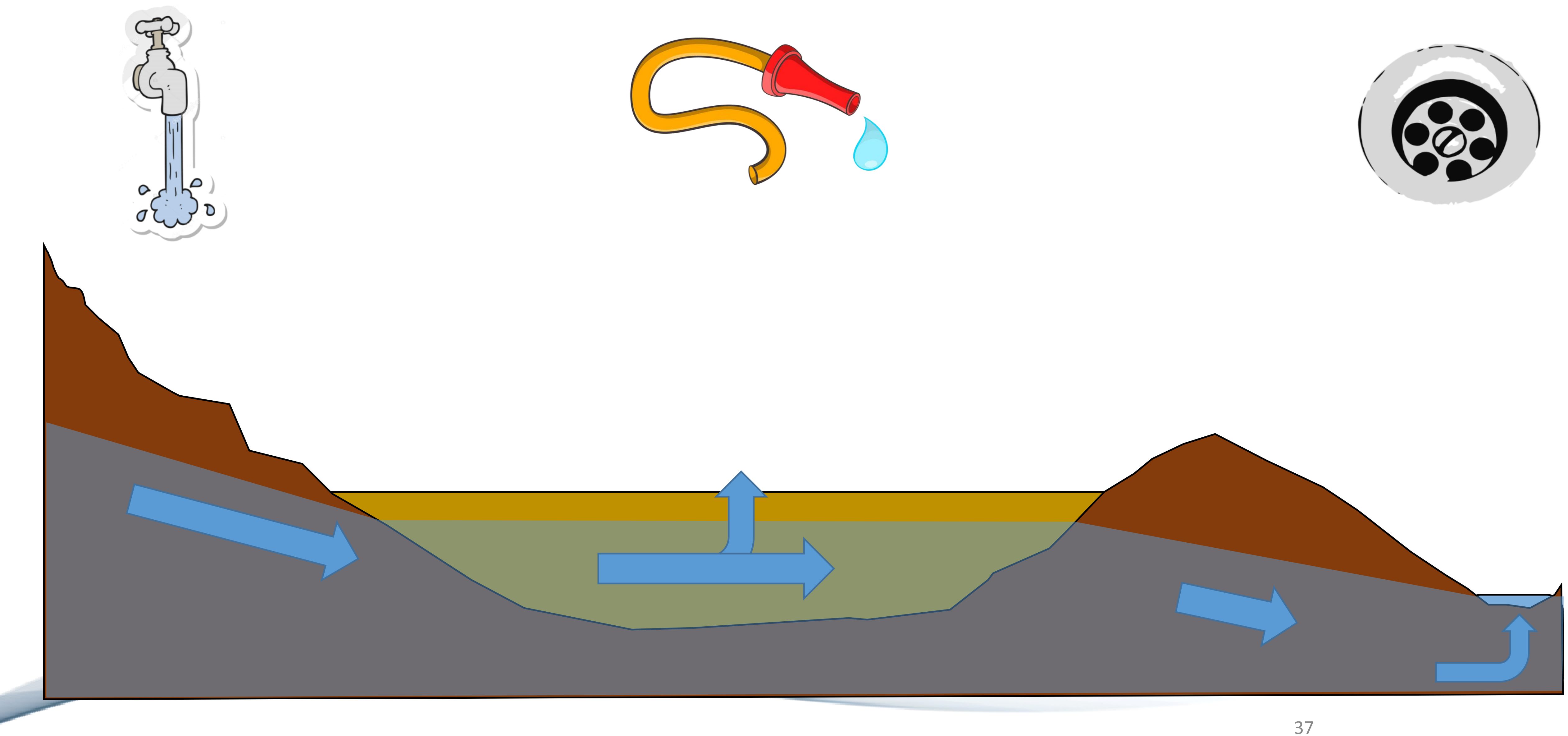
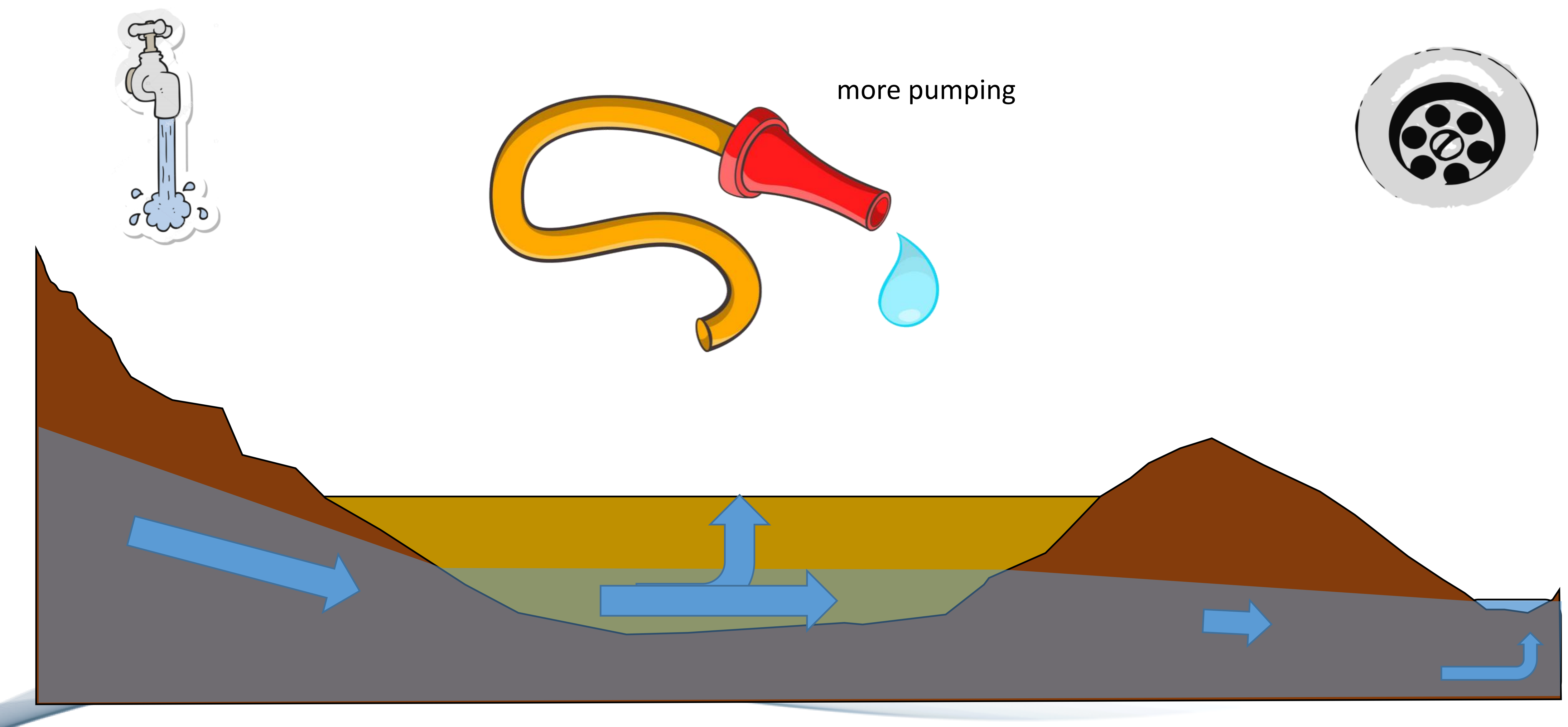


Same recharge, more pumping => less outflow from Butte Valley to "drain"



Summary: Drivers of Water Levels in Butte Valley

- INCREASE / DECREASE in groundwater pumping in Butte Valley

- CLIMATE CHANGE => use groundwater model to evaluate

- WATER LEVEL CHANGES TO THE NORTH-EAST of BUTTE => use groundwater model to evaluate

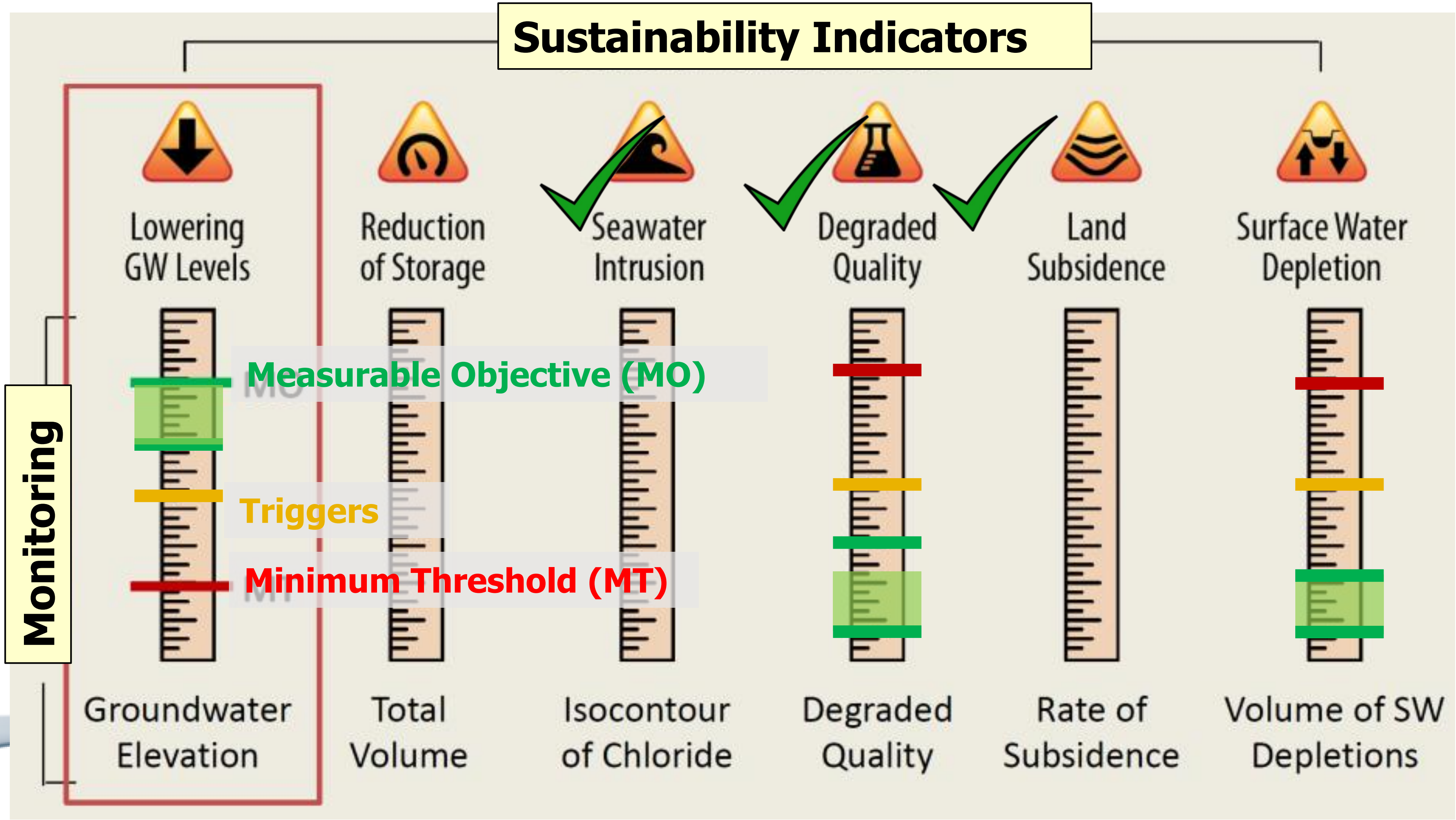
- CURRENT UNDERSTANDING UNCERTAINTY => reduce with groundwater model currently being developed, future monitoring, model improvement

Clarification Questions?

Agenda

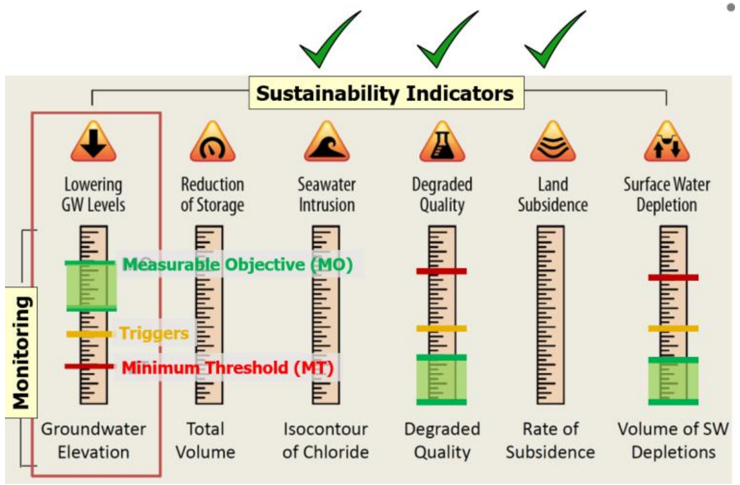
- Developing a "water level " Sustainable Management Criteria (SMC) – following up on last months discussion
- **Preliminary Strawman for Undesirable Results, Minimum Threshold, Measurable Objectives, and Projects & Management Actions**
- Feedback and brainstorming

The "thermometer" for water level has to build on water level measurements in selected **representative wells** across Butte Valley

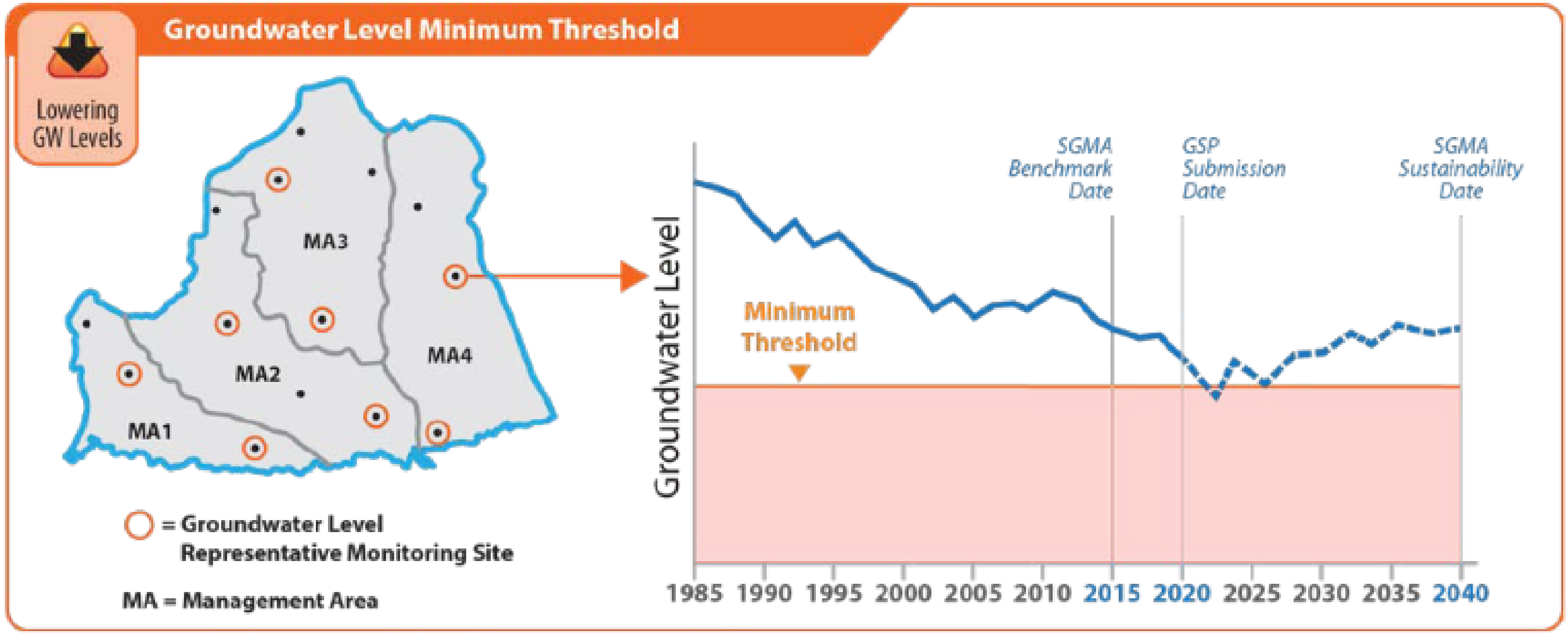


modified from Ca DWR 2016

Sustainable Management Criteria for Water Level
- Outline of the Approach -



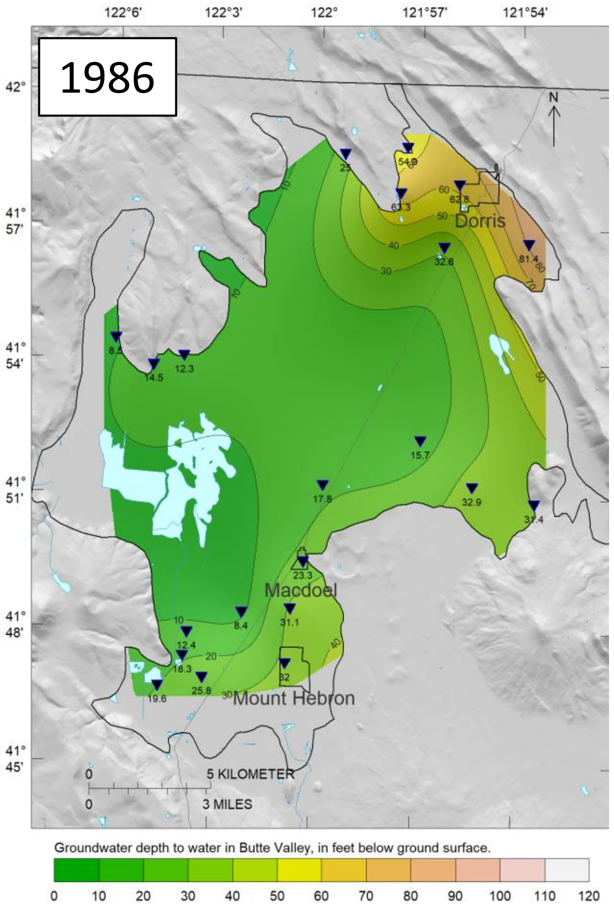
DWR example Minimum Threshold

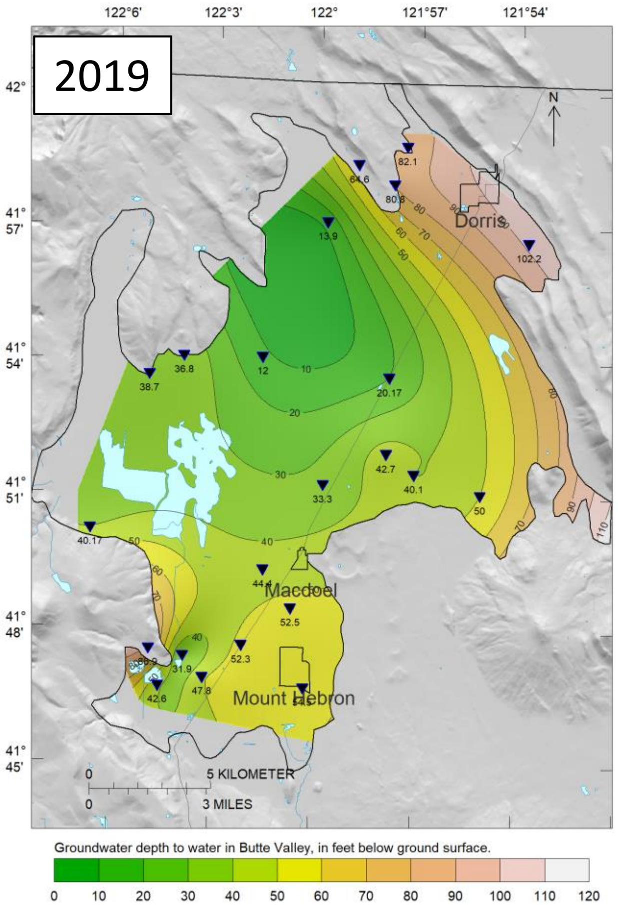


https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf

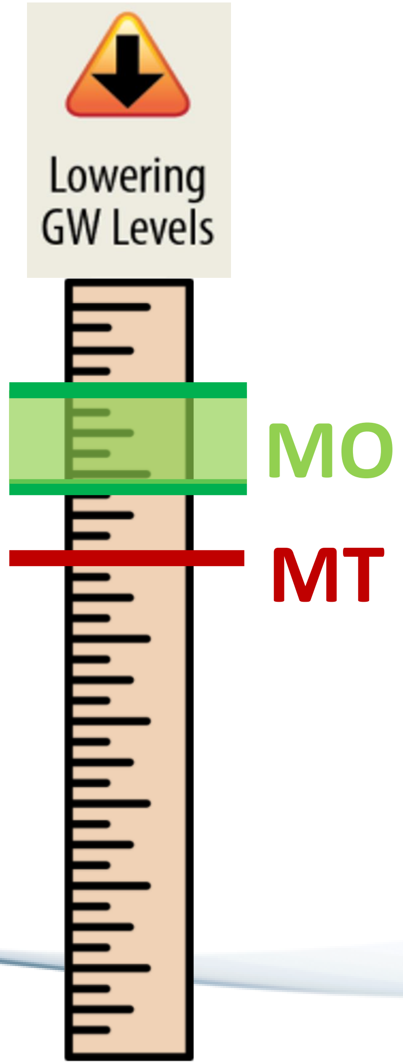
Example Distribution of Representative Monitoring Points (RMP)

- for illustration only, exact RMPs to be discussed another time -



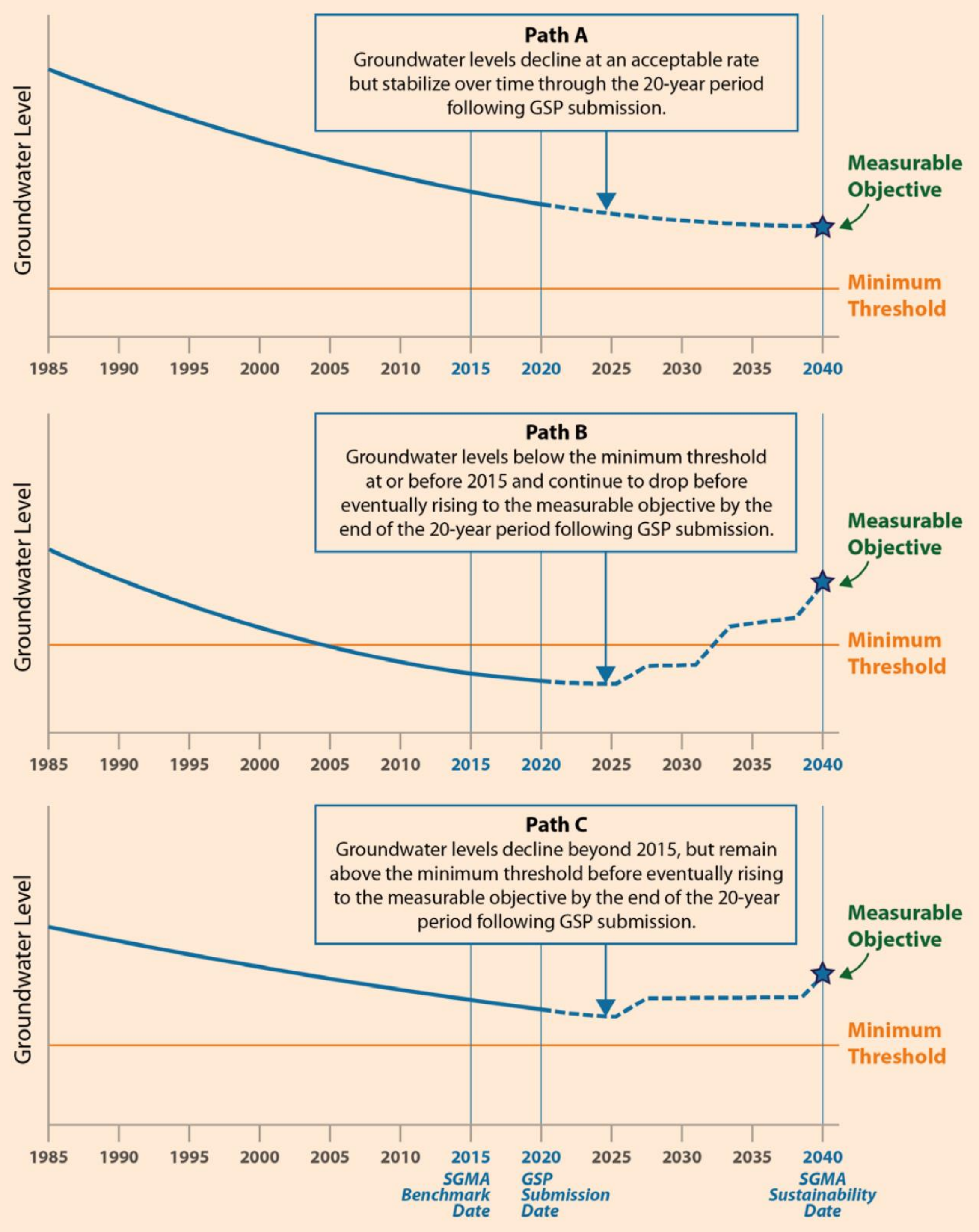


Setting the Minimum Threshold (MT) for Water Levels



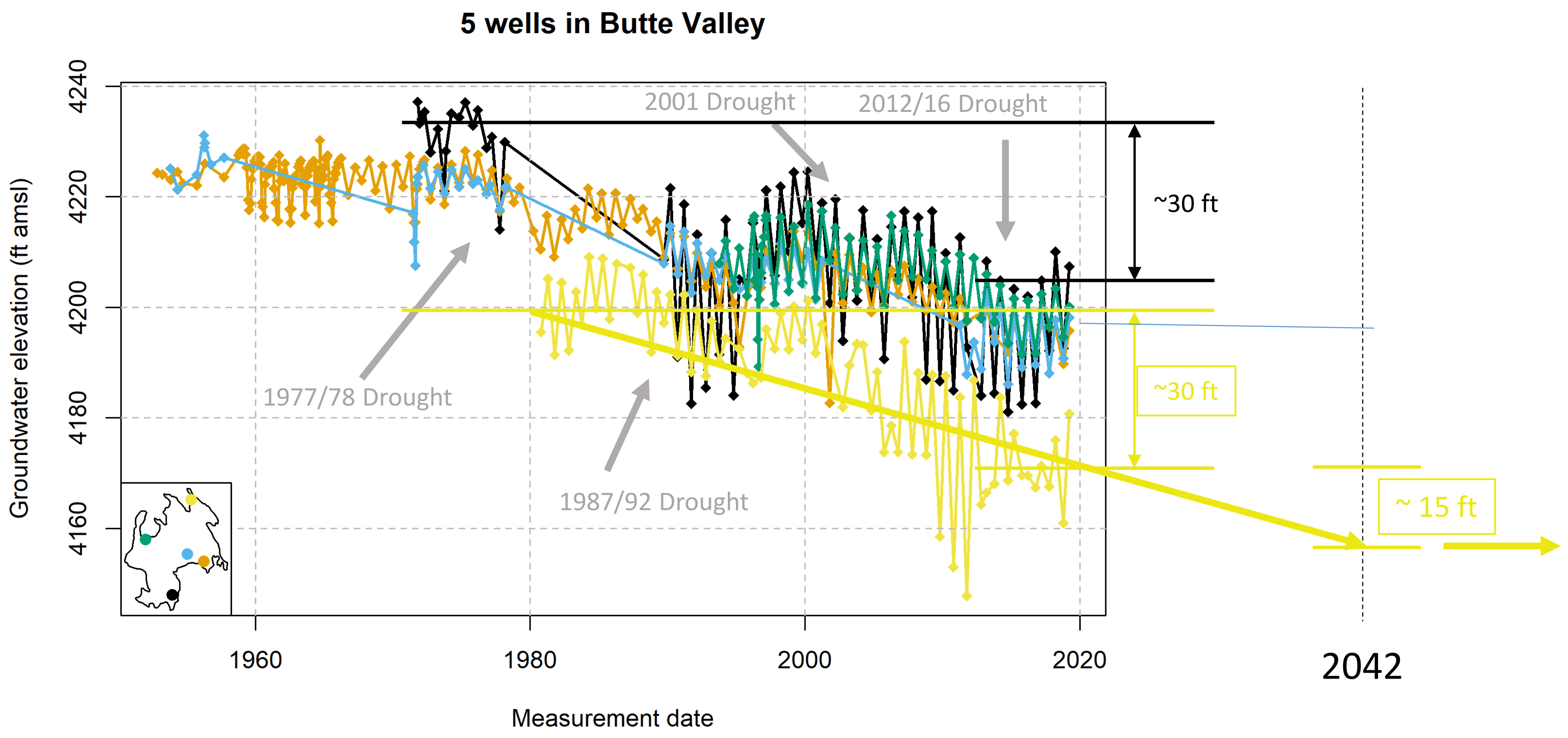
Constraints on Setting Water Level SMC:

Consider how to “bend” long-term water level decline



from: DWR, Sustainable Management Criteria Draft Guidelines

Constraints on Water Level SMC Design: No further decline after 2042



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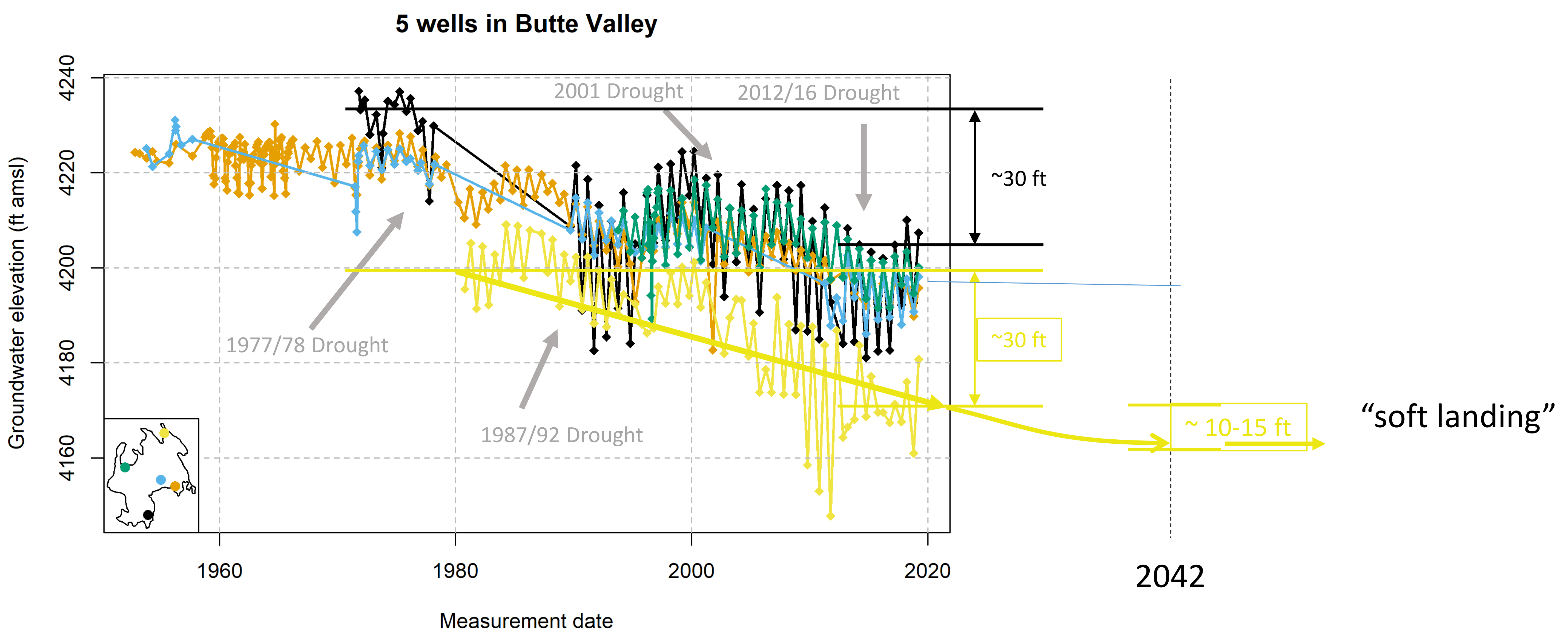
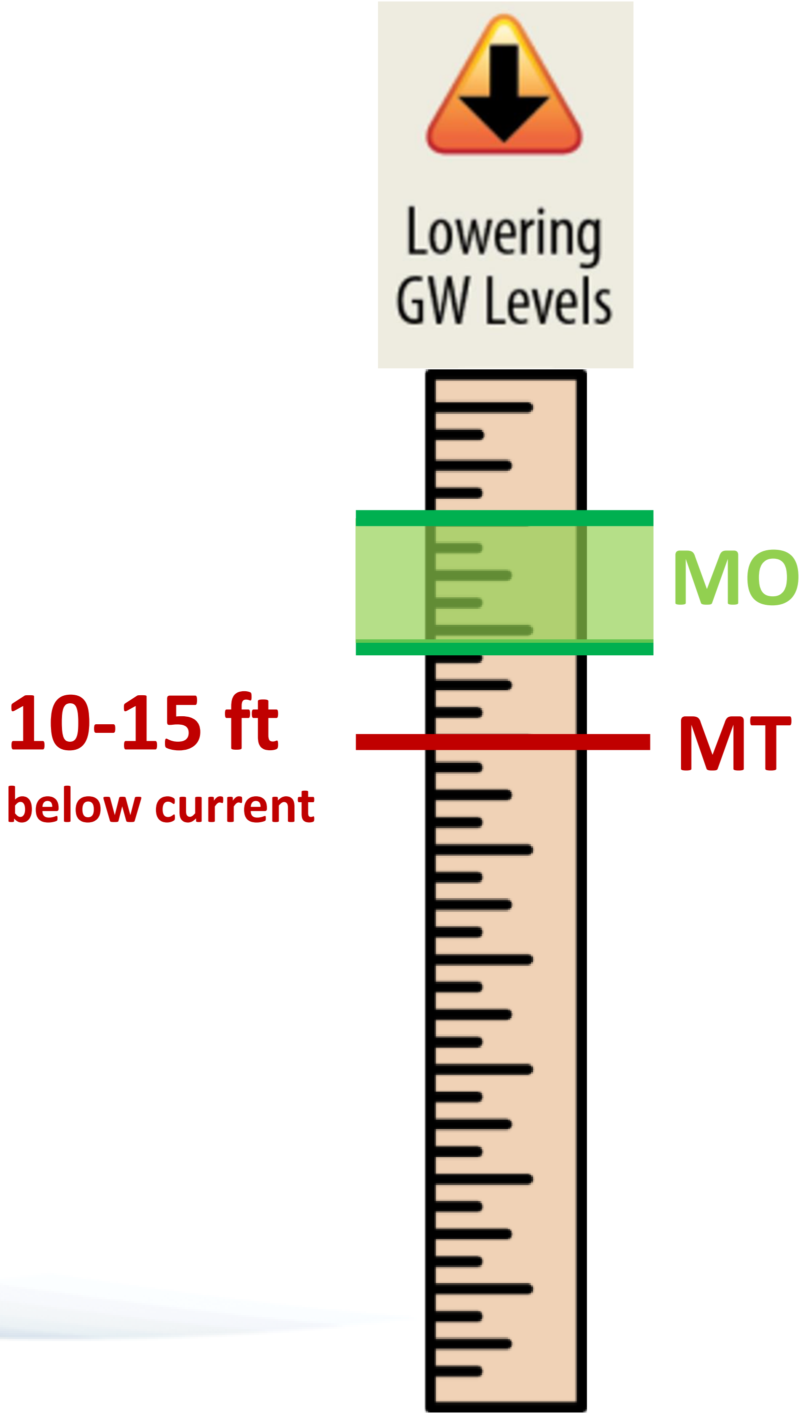


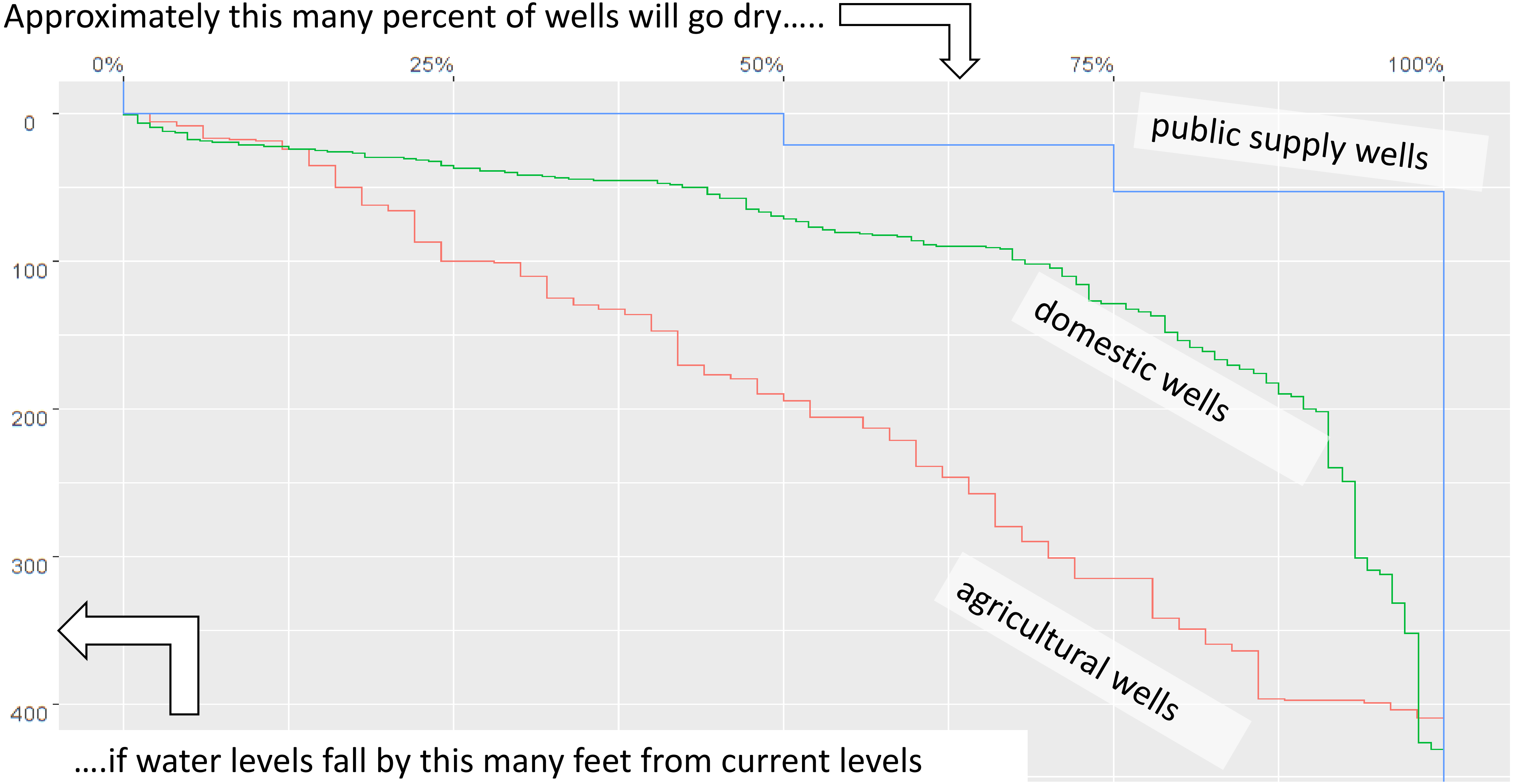
Constraints on Setting Water Level SMC:

- “soft landing”



The deeper we set the MT, the more well outages occur and the higher the pumping cost (more undesirable results that are not avoided by a deeper MT)

Approximately this many percent of wells will go dry.....



....if water levels fall by this many feet from current levels

Note: The vertical axis represents the depth from the current water level to within 20 ft (domestic wells) or 50 ft (ag, public supply wells) of the bottom of the well. Here, we use this depth as a rough indicator for well outage because many wells in Butte Valley may have pumps below the top of the screen or in open basalt. Many actual well outages may occur even at higher water levels.

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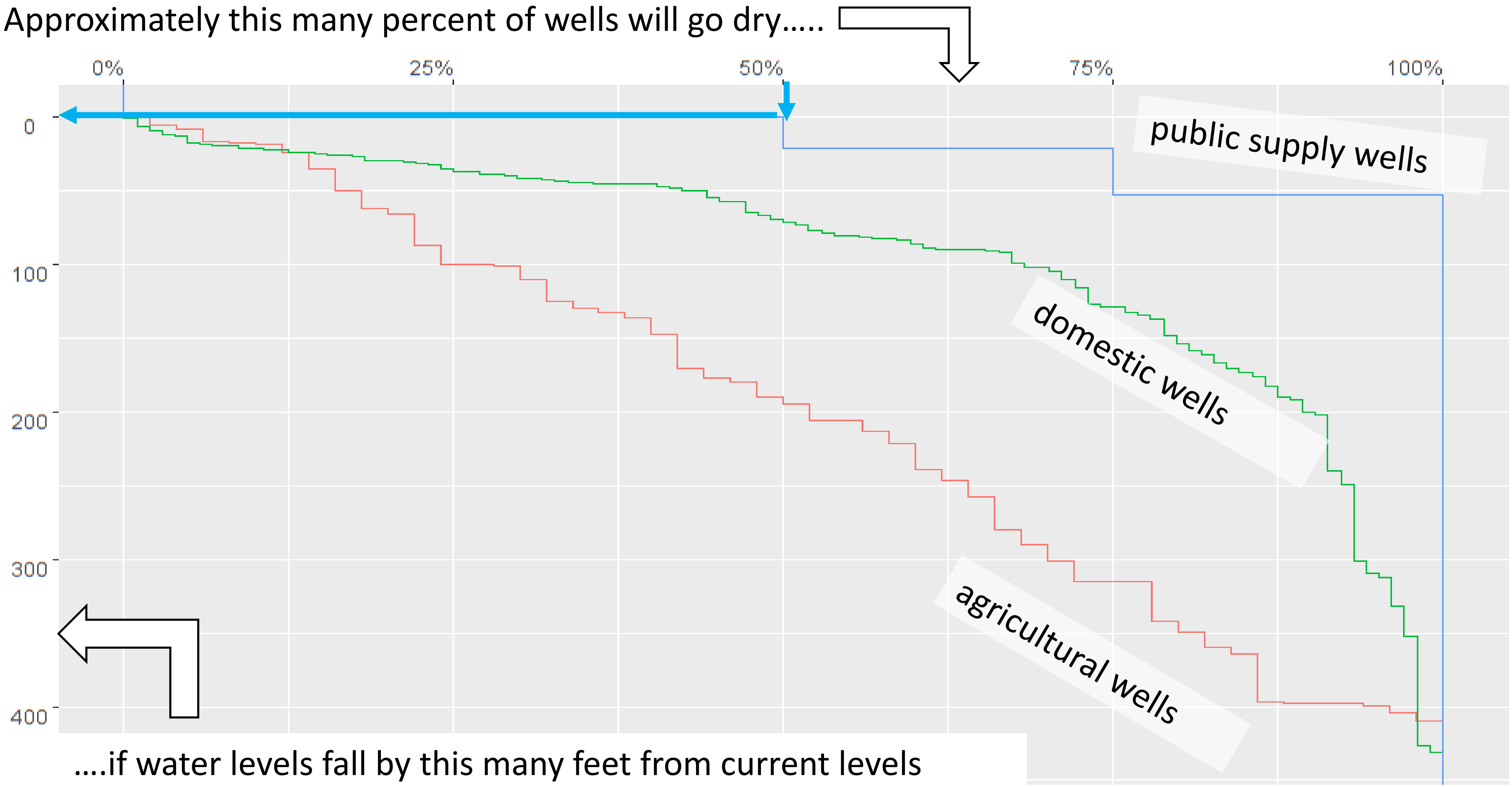

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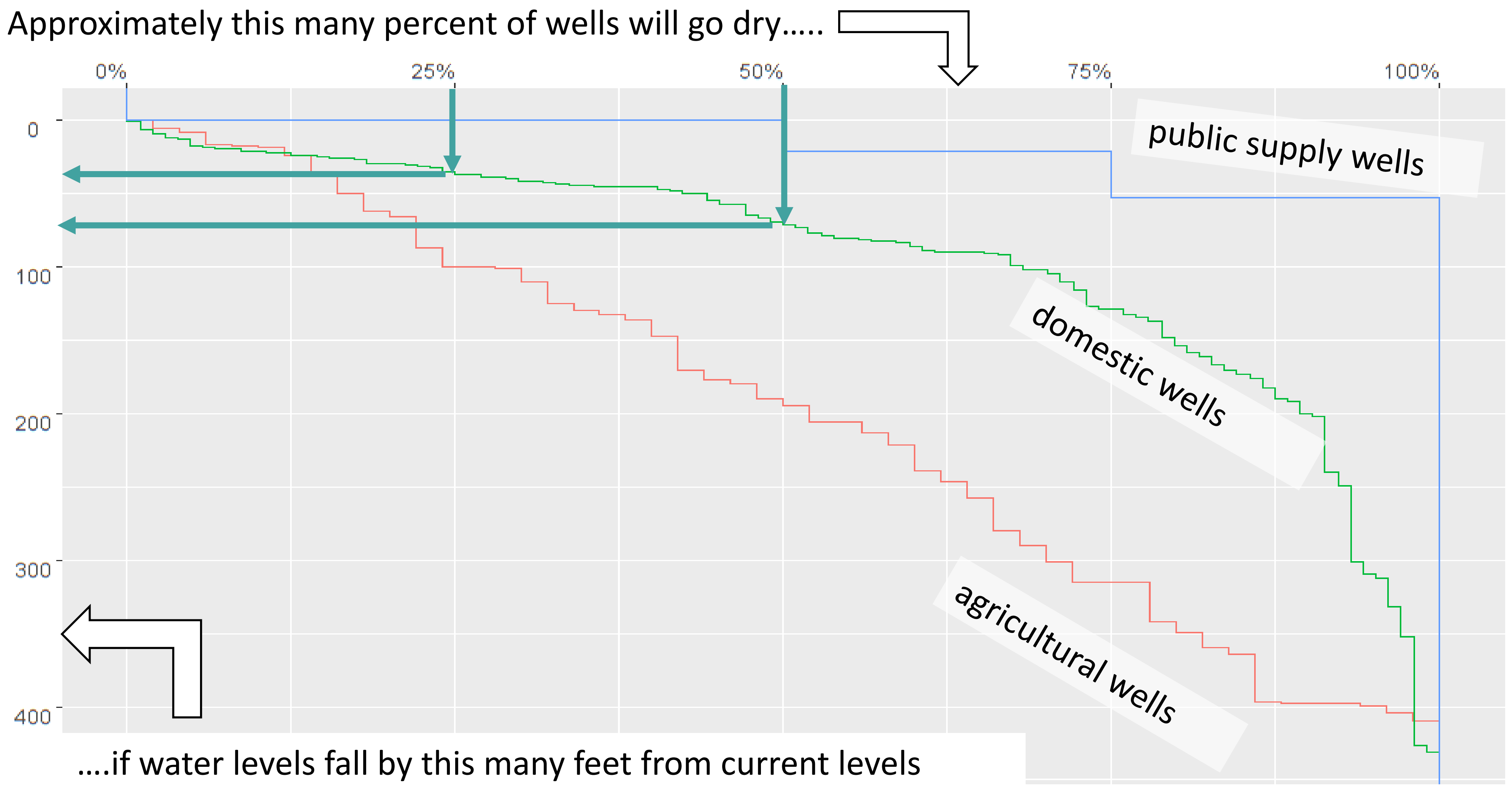

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Constraints on Setting Water Level SMC:

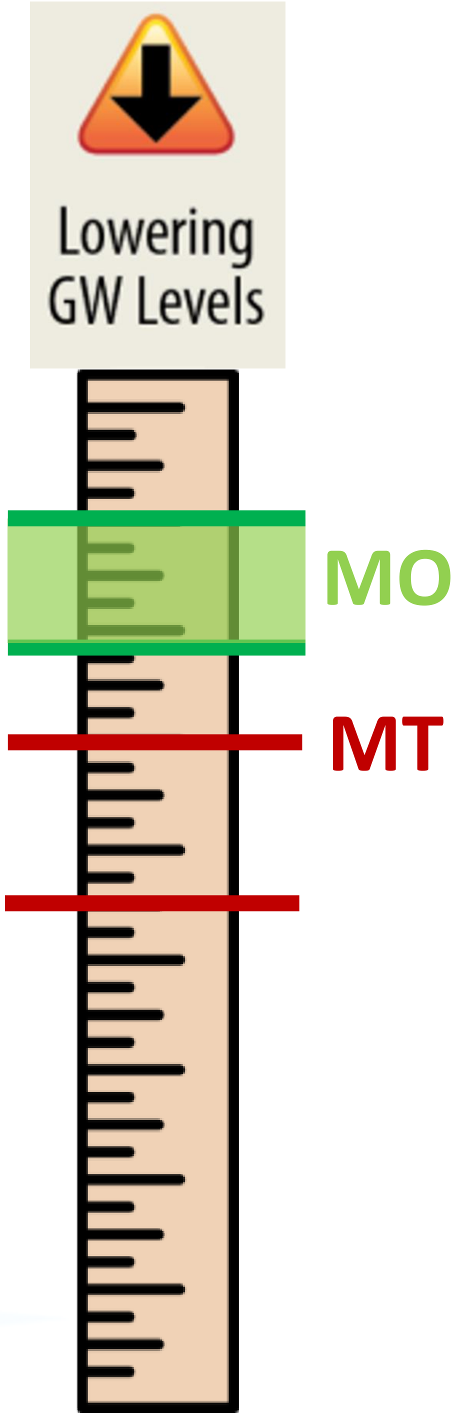
- "soft landing"
- well outage, pumping cost

10-15 ft

below current

0-30 ft

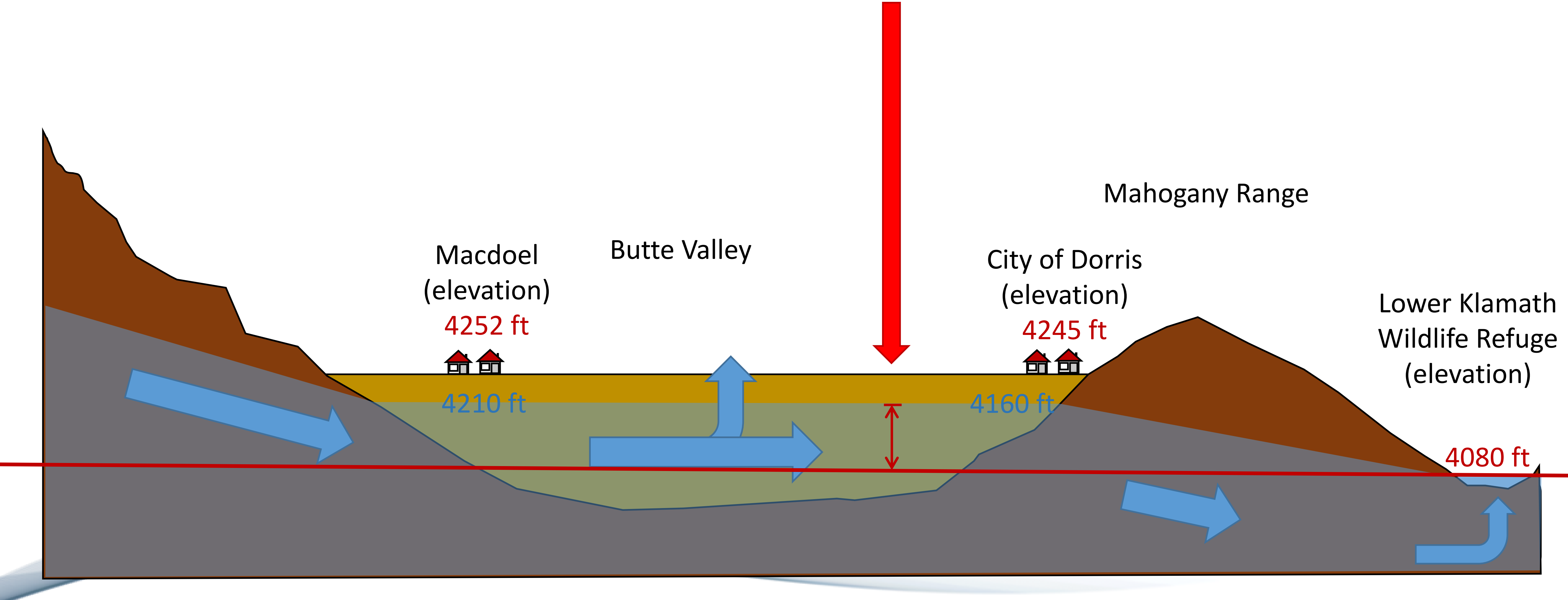
below current



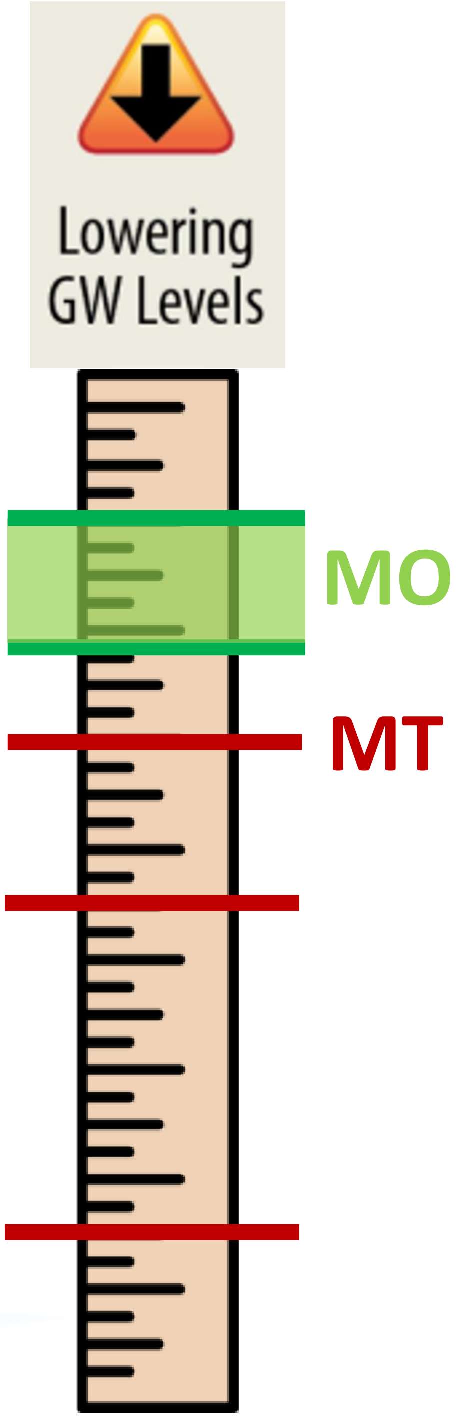
Constraints on setting the Minimum Threshold for Water Level:

Water needs to continue to flow toward Lower Klamath

=> water levels need to be much higher than 4080 feet elevation



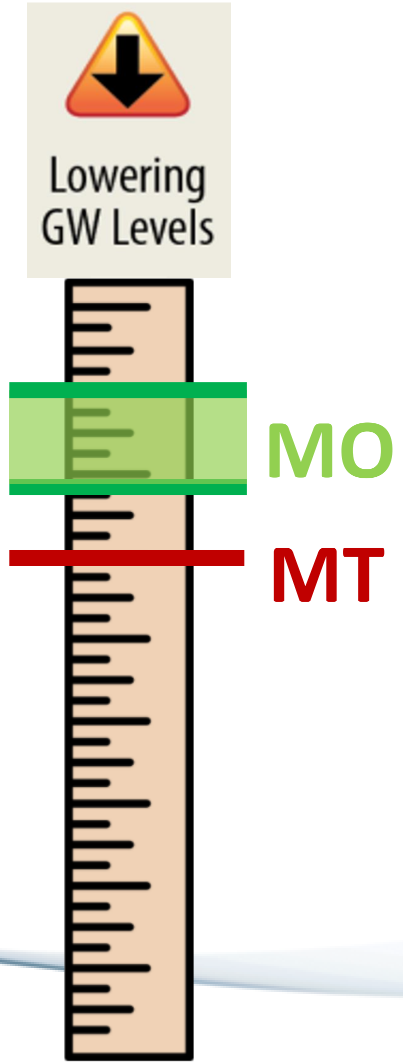
Constraints on Setting Water Level SMC:



- "soft landing" — **10-15 ft below current**
- well outage, pumping cost — **0-30 ft below current**
- Lower Klamath elevation — **> 50 ft below current**

Clarification Questions?

Setting the Measurable Objective (MO) for Water Levels

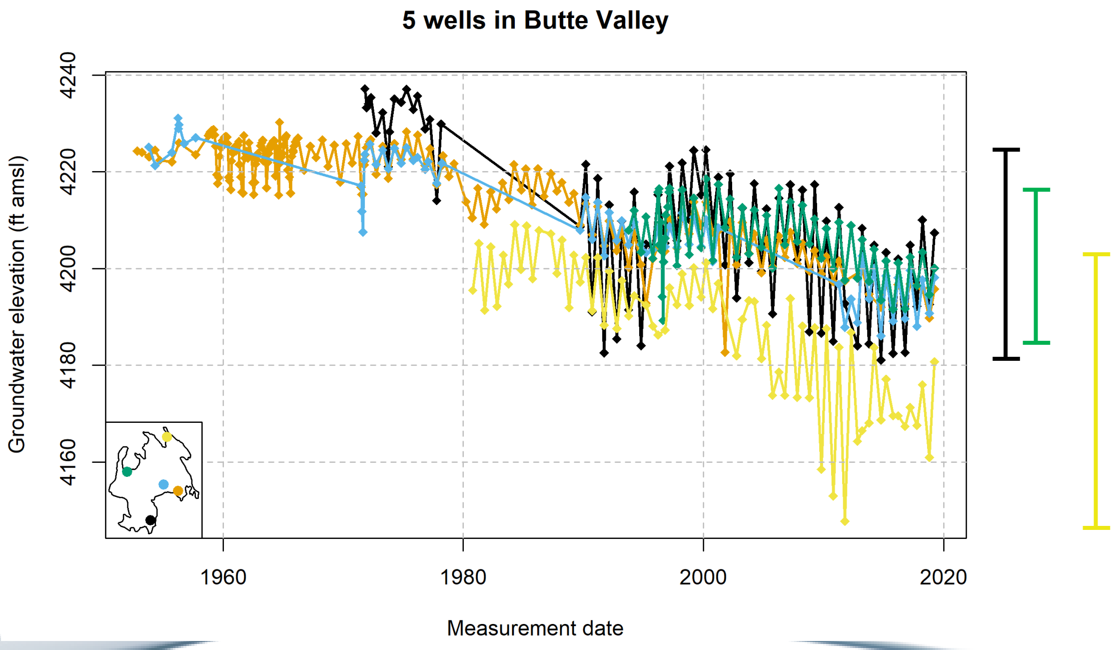


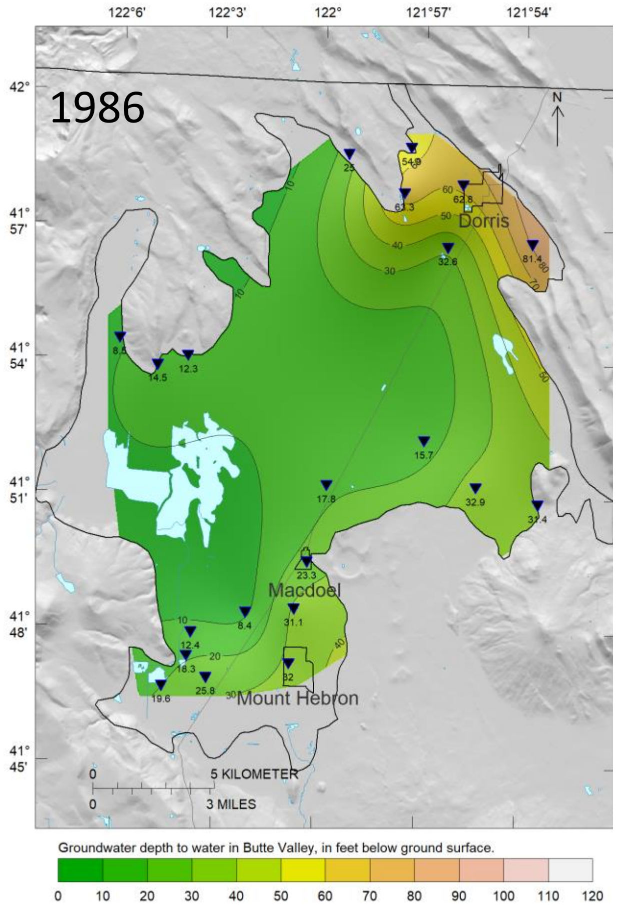
Possible Measurable Objectives:

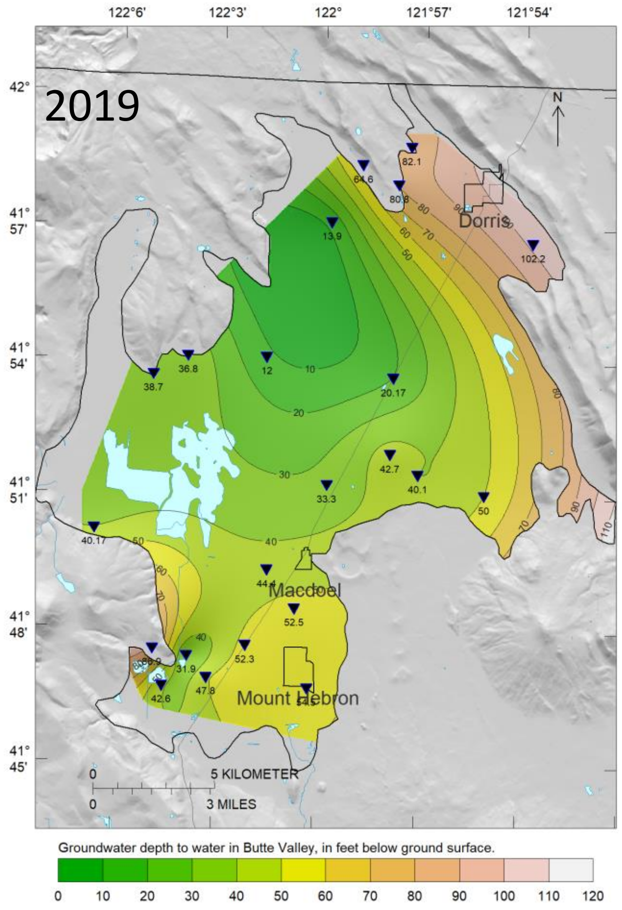
- Water level within the range observed 1990 – 2015

Alternatives:

- Water level within the range observed prior to 1990?
- Water level within the range observed 1960-1990?
- …..







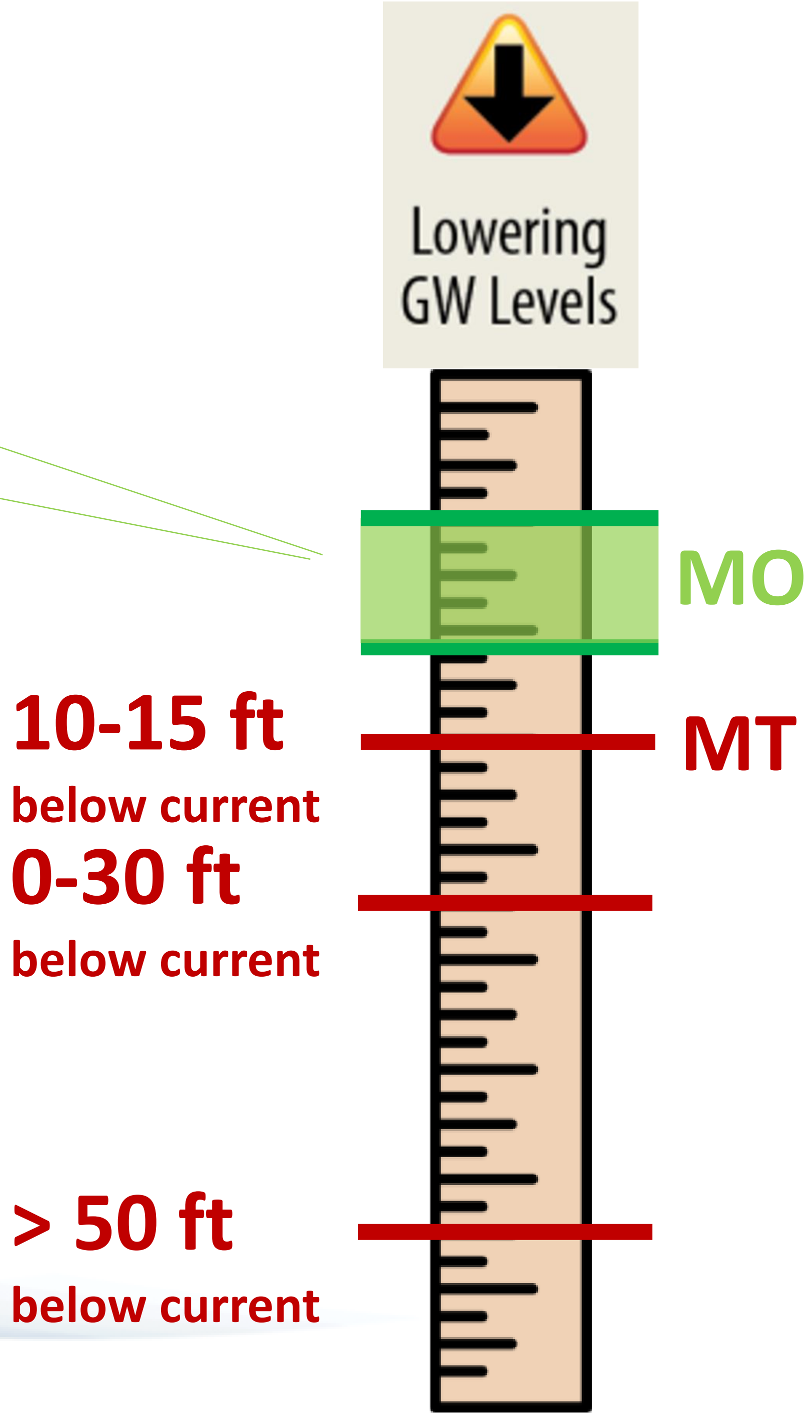
Constraints on Setting Water Level SMC:

- 1990 – 2014 water levels
- 1980 – 2014 water levels

- “soft landing”

- well outage, pumping cost

- Lower Klamath elevation



Clarification Questions?

Identifying Possible Projects and Management Actions

Projects and Management Actions

- Why do we need projects and management actions (PMAs)?
  - To **achieve the sustainability goal** by 2042 and avoid undesirable results through 2072
  - To respond to **changing conditions** in the Basin
  - Each of the PMAs may support achieving sustainability for **one or more sustainability indicators**
- Can be categorized into
  - Existing PMAs
  - Proposed or planned PMAs to reach sustainability
  - PMAs to be evaluated in the future

Projects and Management Actions

- Can be categorized into
  - Existing PMAs
  - Proposed or planned PMAs to reach sustainability
  - PMAs to be evaluated in the future

- Key Information
  - Project Goal(s)
  - Costs – Capital and O&M
  - Completion status/date
  - Impacts on the system
  - Single or multiphase
  - Targeted sustainability indicator(s)

PROJECTS & MANAGEMENT ACTIONS				
Date				
Project Title				
PROJECT PROPONENT				
Agency Name				
Key Contact				
Email				
Phone				
PROJECT LOCATION				
Map				
PROJECT DESCRIPTION				
Description of Project Elements				
Actions				
Project Goals				
Project Benefits				
Project Impacts				
Project Costs/Financing				
PROJECT STATUS				
Concept ☐	Planned ☐	In-Design ☐	Under Construction ☐	Completed ☐
Project Schedule				

Integrated Model and PMAs

- What the Integrated Model Provides:
  - Simulates existing and potential PMAs to assess their impact in terms of the relative change between baseline and projected conditions.
  - Helps evaluate how such impacts would translate to SMC settings and achieving the sustainability goal
  - Final projected model will include all relevant PMAs agreed upon for the GSP that allow maintenance of SMCs over the 50-year planning and implementation horizon.
- What It Needs:
  - Detailed information that quantifies projects in a manner that is implementable in the model

Butte Valley Brainstorm List of Projects/Management Actions

- Cap on consumptive water use
- Change in recharge point from Butte Creek
- Explore recharge benefits in National Grasslands from Meiss Lake overflow
- Irrigation efficiency measures or on-ground projects
- Soft landing
  - Funding strategy for deeper wells
  - Strategic reductions in groundwater pumping (timing)
- Upland management

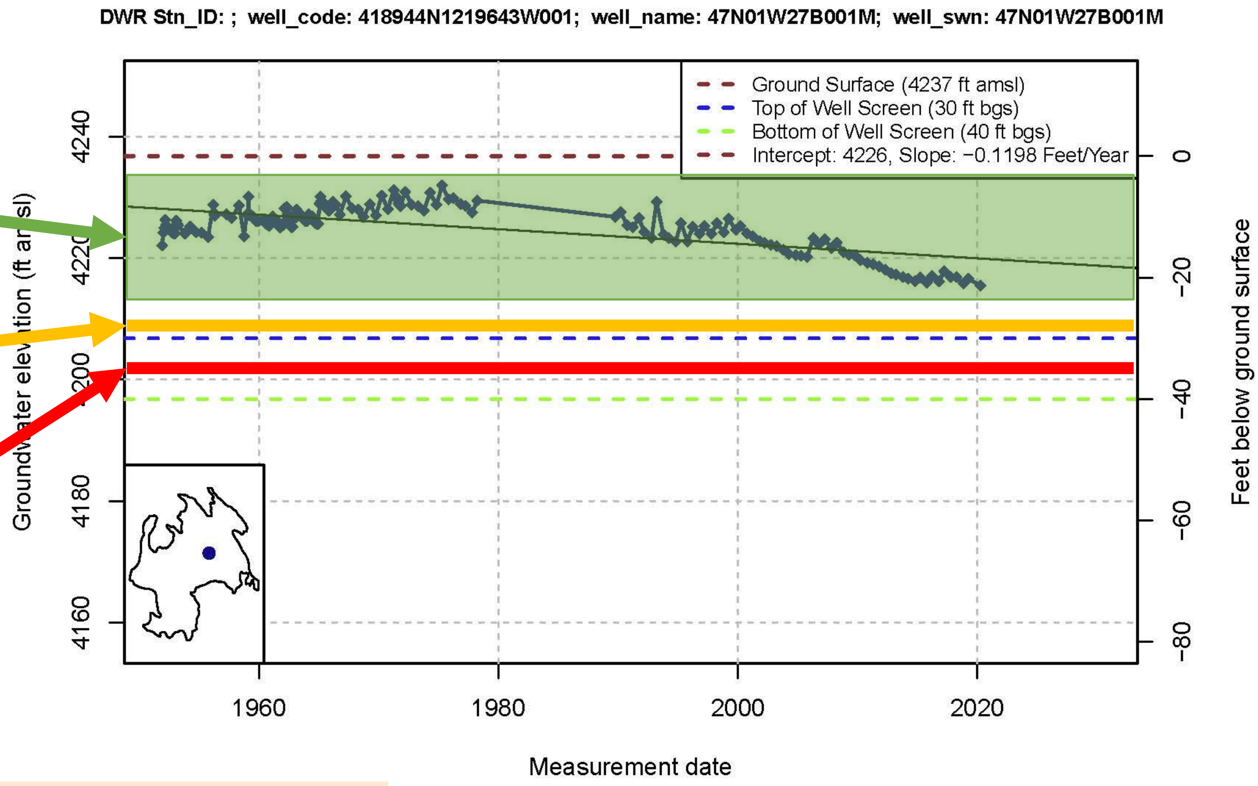
Why Projects and Management Actions?

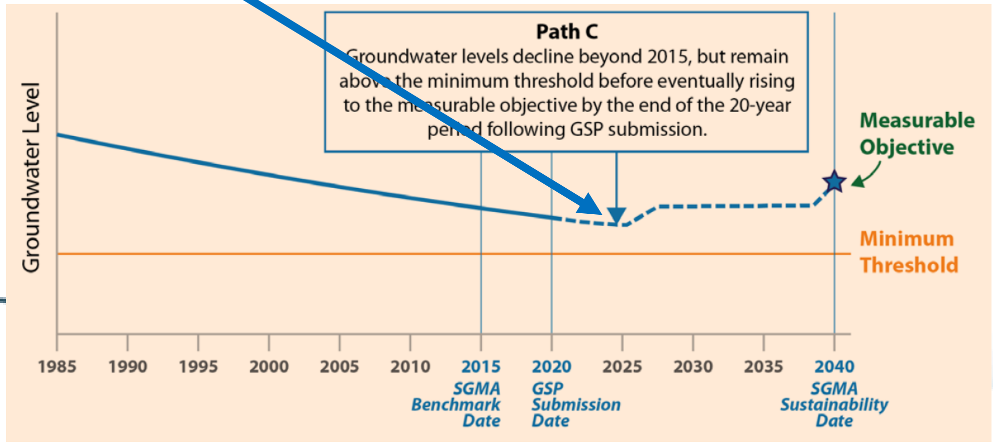
- MO: Establish an acceptable operating range
- **Corrective projects and management action**, at trigger levels, to avoid MT and achieve MO
- MT: Establish a Minimum Threshold where levels must not be allowed to drop

Measurable Objective (MO)

Triggers

Minimum Threshold (MT)

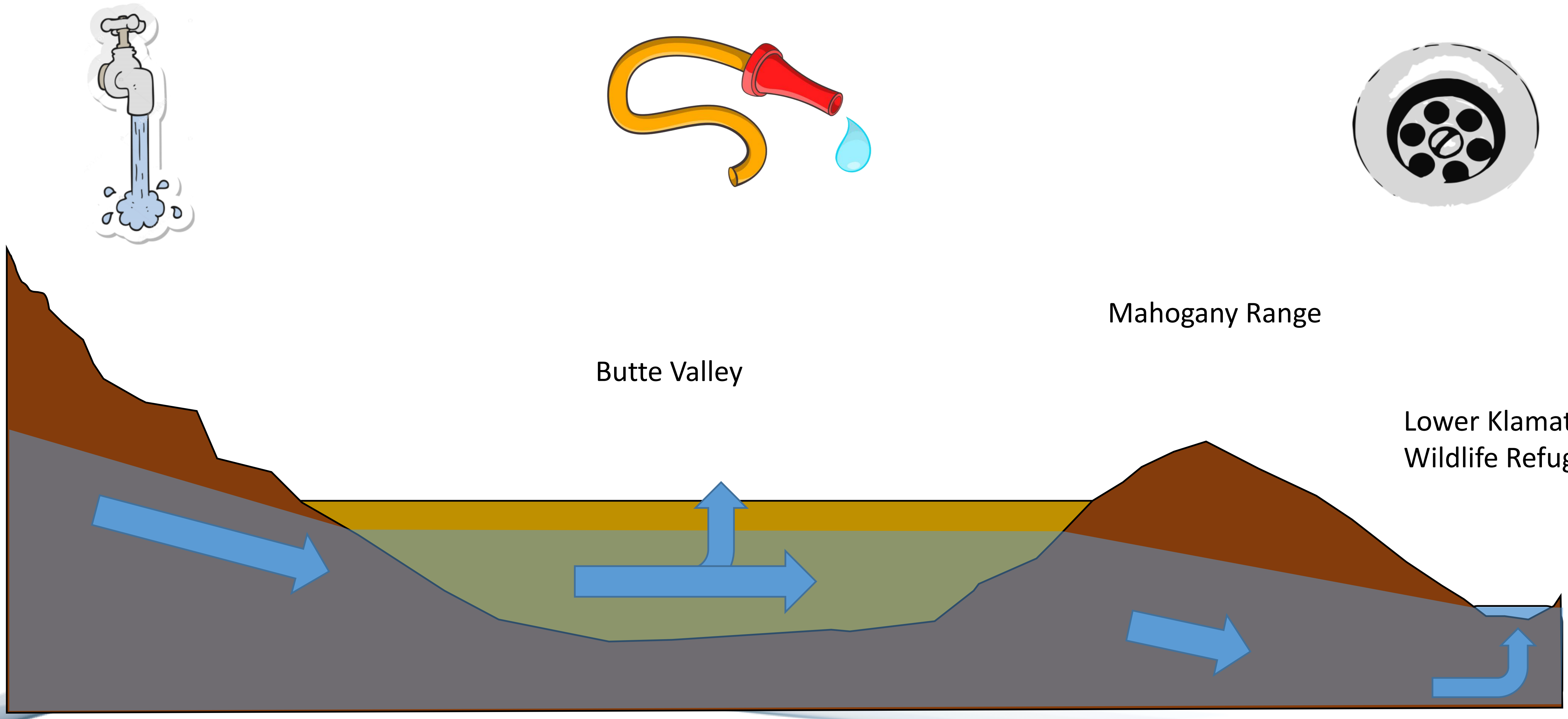




Strawman for Projects and Management Actions

- Starting in 2022: Cap consumptive water use (ET) at present rate

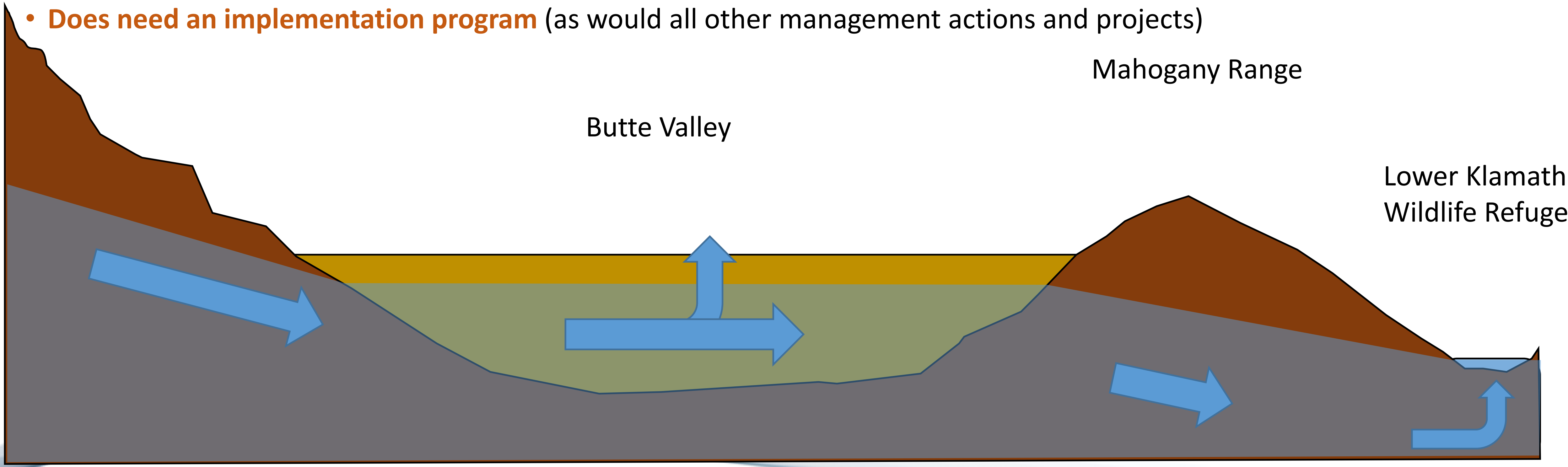
Why Cap Consumptive Water Use?



Why Cap Consumptive Water Use?

- IF there is: “no overdraft – no change in recharge – no change in water levels in Lower Klamath”
  => no decline in water level
- IF there is overdraft, reduction in recharge, lowering of water levels in Lower Klamath
  => a cap reduces speed of decline in water level => helps with soft landing
- **Economically least painful** action.
- **Easily monitored** by satellite observations / DWR ET mapping program

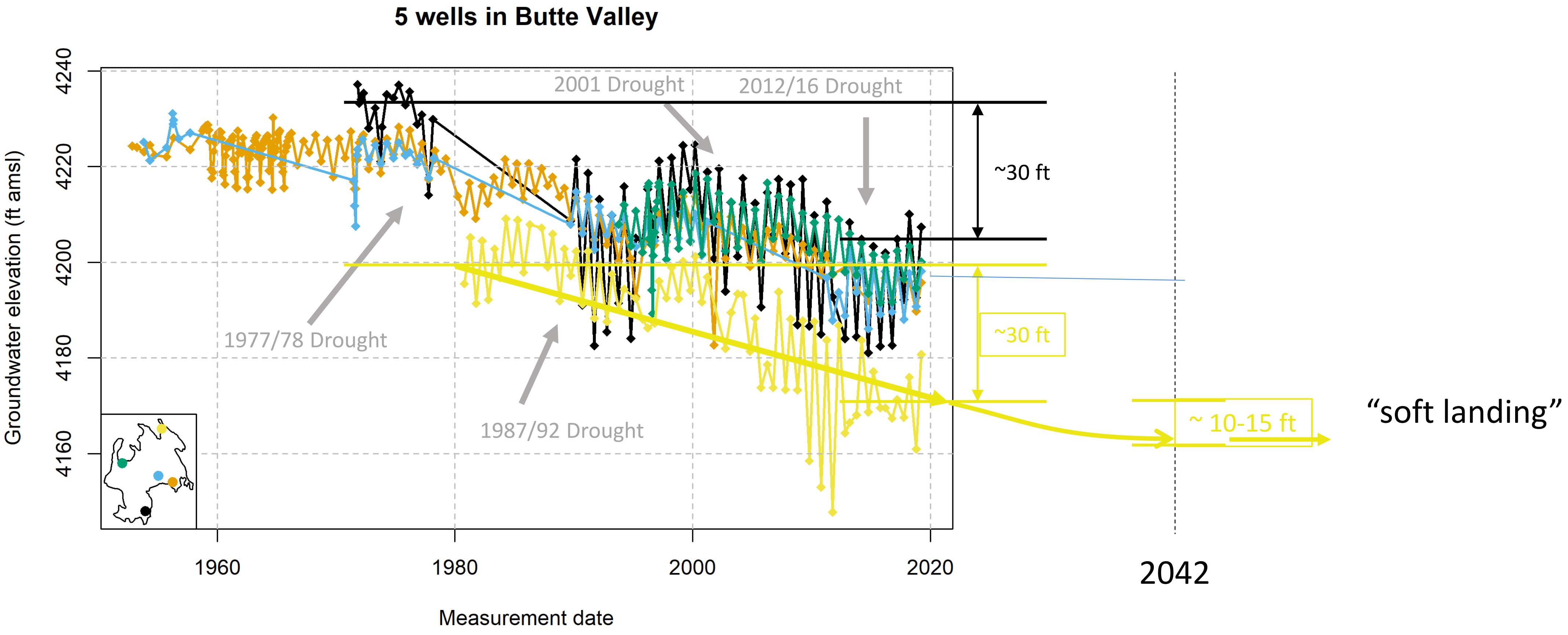
- **Does need an implementation program** (as would all other management actions and projects)



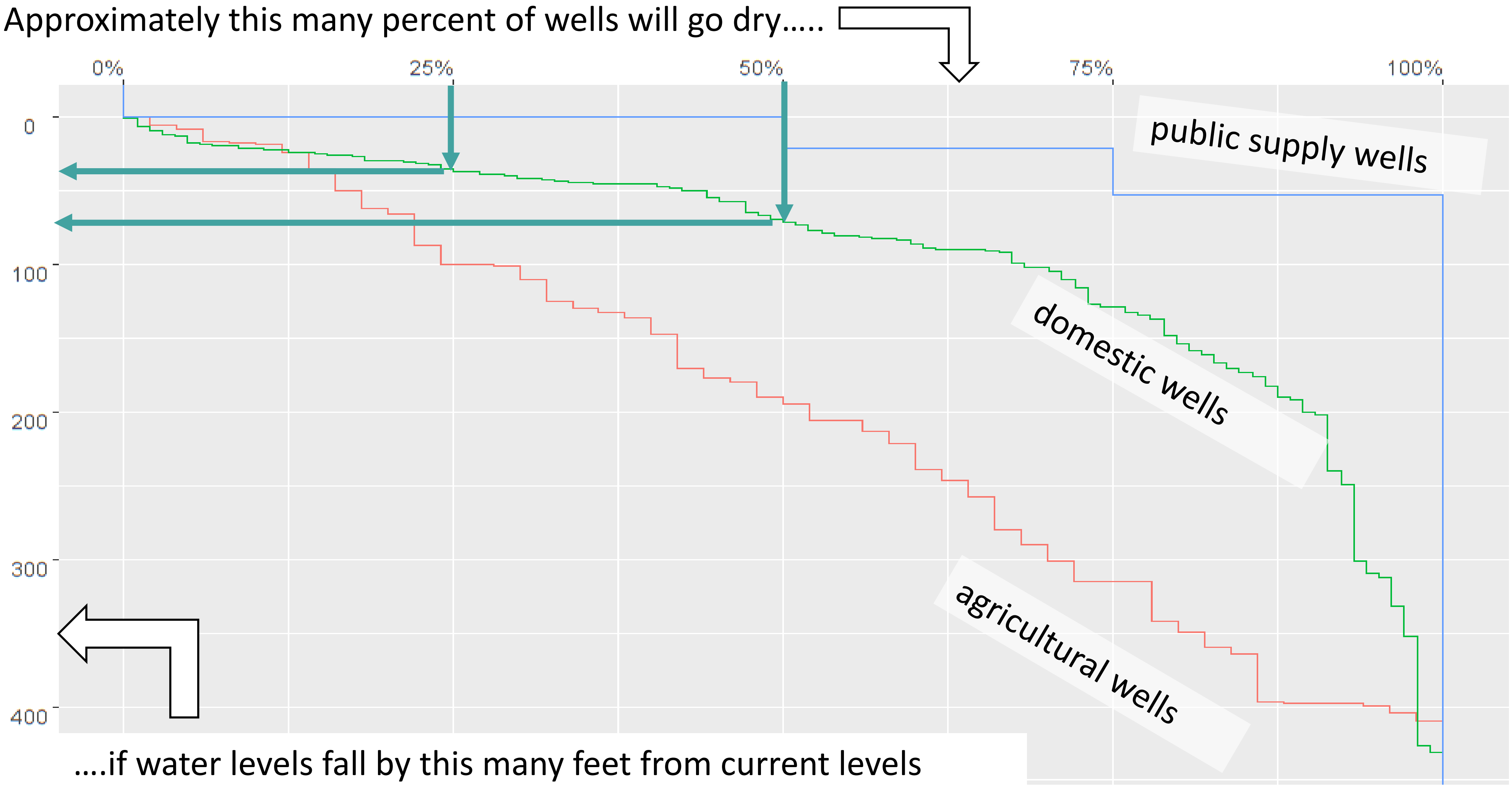
Strawman for Projects and Management Actions

- Starting in 2022: Cap consumptive water use (ET) at present rate
- When/if reaching trigger levels or approaching MT for water levels:
  - Reduce net use of groundwater in Butte Valley => reduce ET
    - Improve agricultural irrigation efficiency to reduce evaporative losses (reduction in consumptive use)
    - Reduce crop ET
      - Less cropped acreage
      - Less crop ET through reduction in irrigation (deficit irrigation)
      - Alternative crops with lower ET
  - Increase recharge:
    - ~~Cloud seeding~~ (unlikely to yield additional recharge)

How do we get more operational flexibility than 10-15 ft, IF NEEDED?



The deeper we set the MT, the more well outages occur and the higher the pumping cost (more undesirable results that are not avoided by a deeper MT)



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Constraints on Setting Water Level SMC:

- "soft landing"
- well outa… …mping cost
- "expanded soft landing"
- Lower Klamath elevation

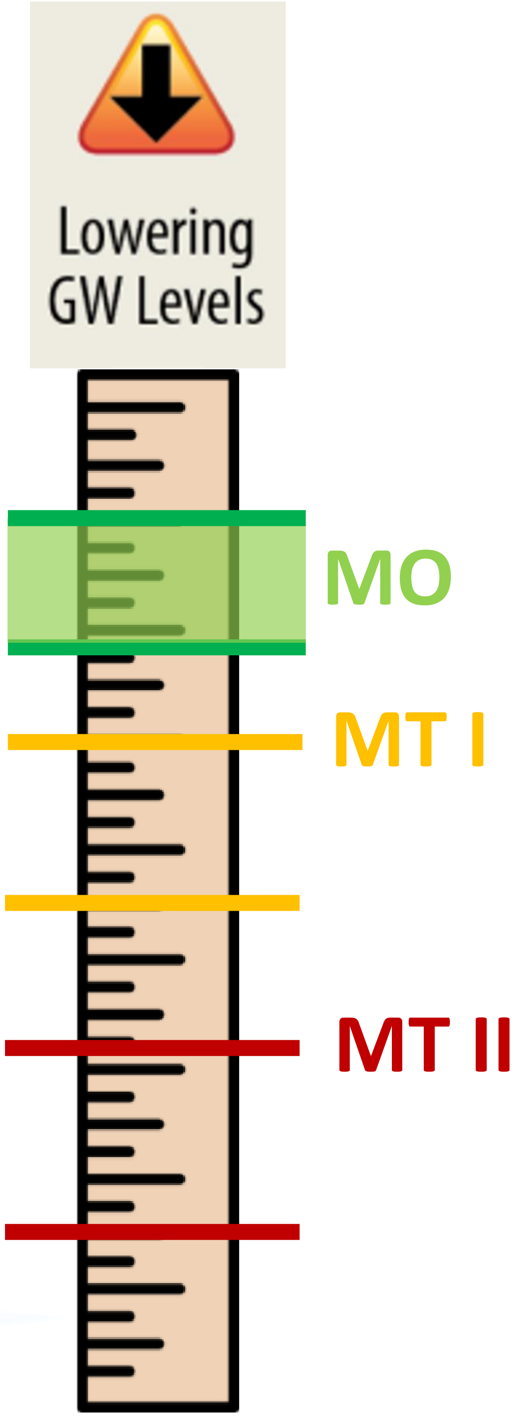
$$ support for well replacement

10-15 ft
below current

10-20 ft
below current

20-50 ft
below current

> 50 ft
below current

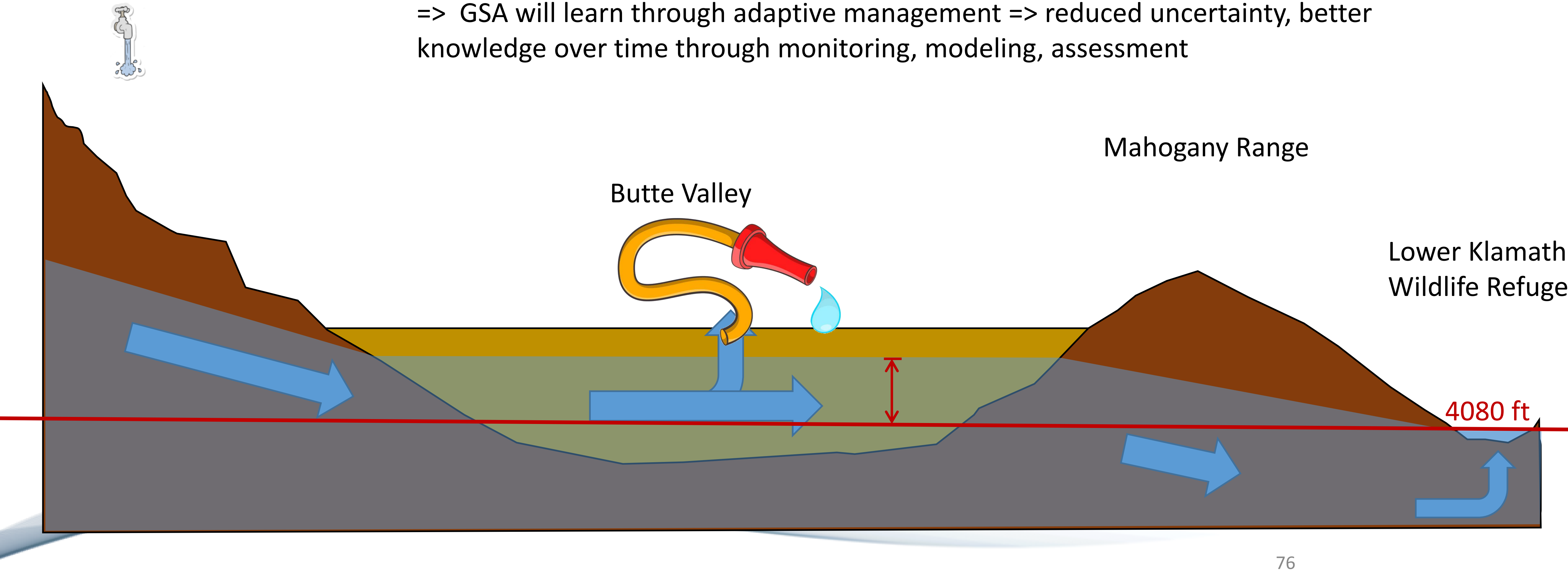


How to tackle the uncertainty about whether or not there is overdraft?

How to tackle the uncertainty about whether or not there is overdraft?

Set MT to be well above Lower Klamath => insurance to DWR that any existing overdraft conditions would be corrected in time

=> GSA will learn through adaptive management => reduced uncertainty, better knowledge over time through monitoring, modeling, assessment



Possible Future Outcomes with Step 1 Implemented

1 No Overdraft
Same Recharge

Water levels will stabilize, MO achieved, no further actions needed

2 No Overdraft
Less Recharge

Water levels will decline to new equilibrium level

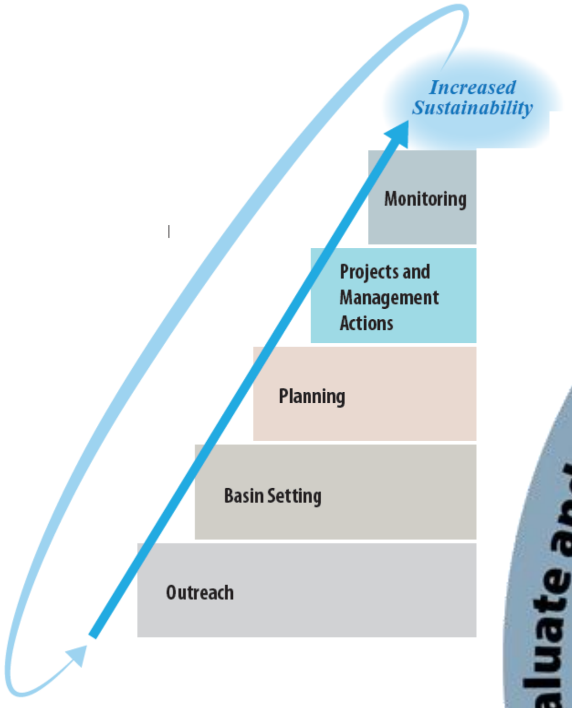
=> if new equilibrium level is above MT => no further actions needed

=> if new equilibrium level is above “expanded soft landing” MT
=> actions needed to address outages
=> no action needed to drastically lower pumping

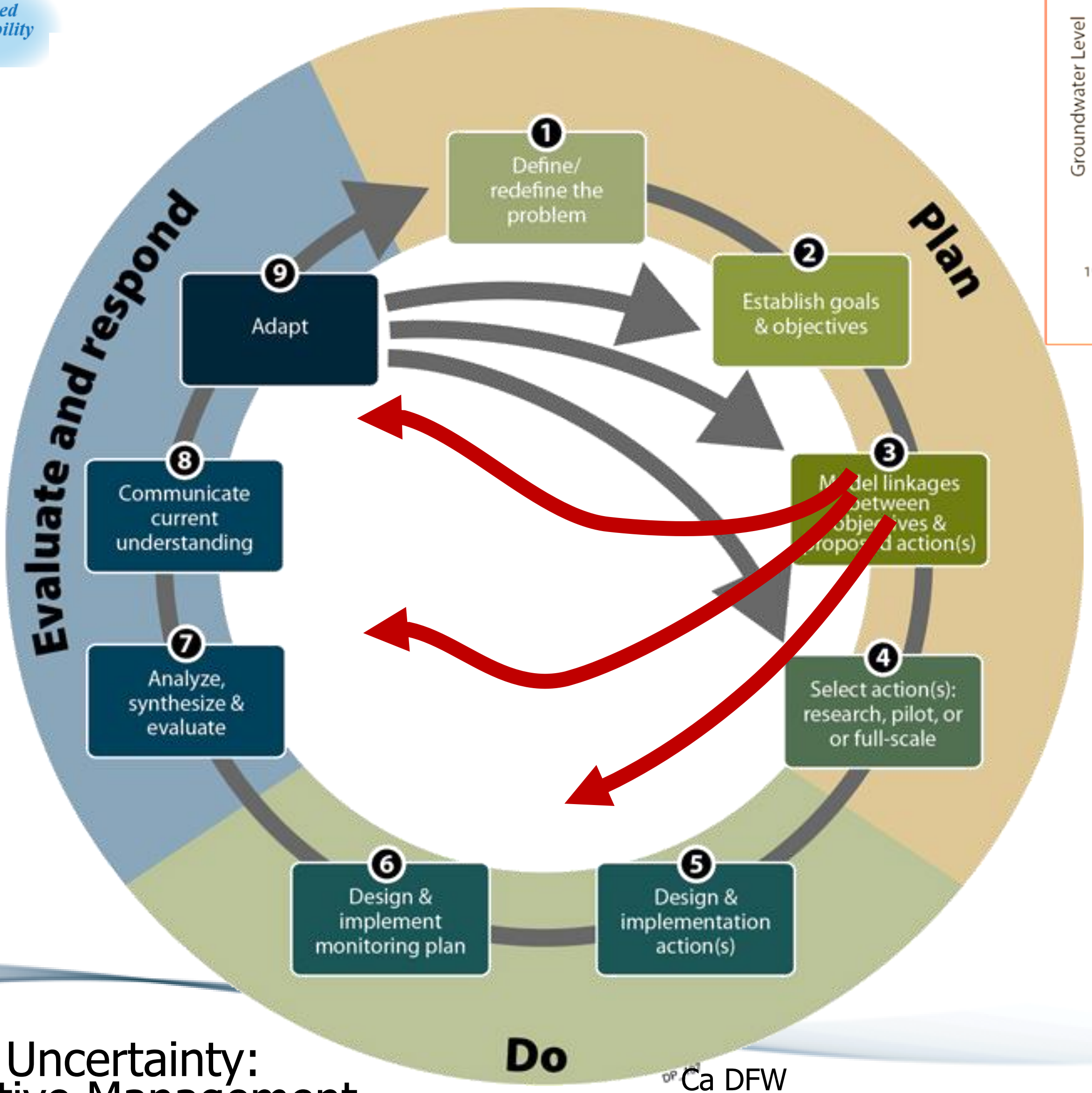
3 Overdraft

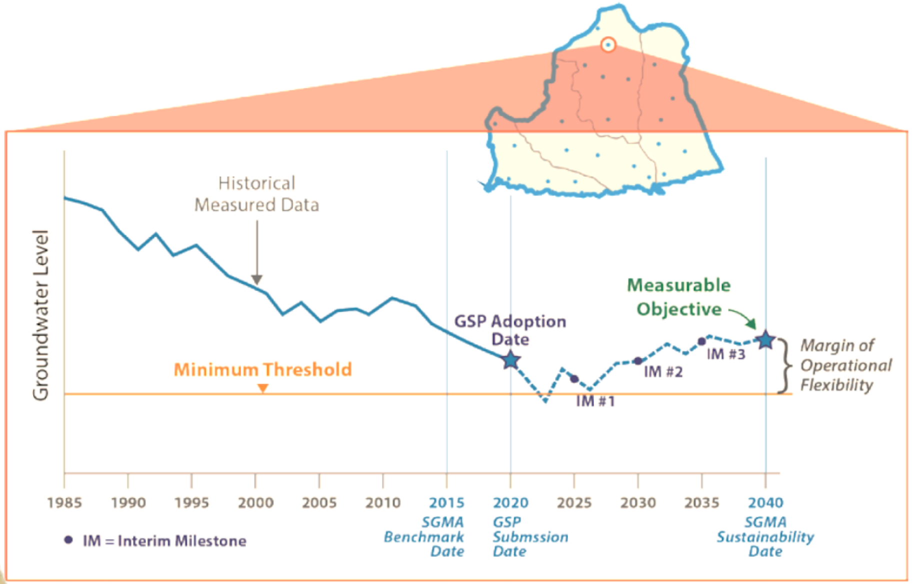
Water levels continue to decline unabatedly
=> action needed to lower pumping (less ET!)

Adaptive Management Timeline



Ca DWR BMP
Framework 2017





Combating Uncertainty:
Smart Adaptive Management

Ca DFW

Agenda

- Developing a “water level “ Sustainable Management Criteria (SMC) – following up on last months discussion
- Preliminary Strawman for Undesirable Results, Minimum Threshold, Measurable Objectives, and Projects & Management Actions
- **Feedback and brainstorming**

Solicited Feedback

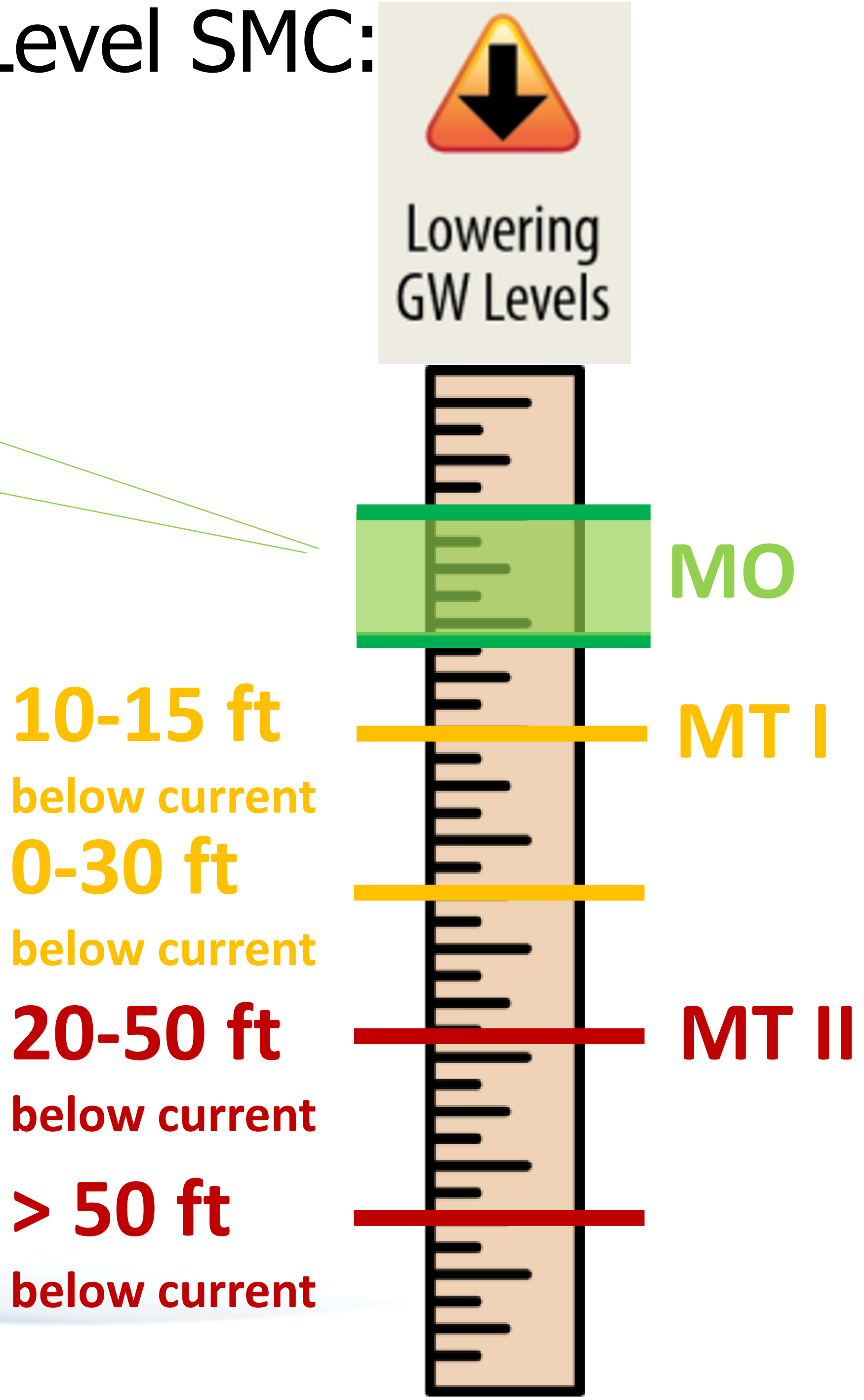
- Concerns about setting the MT at 10-15 ft below current levels
- Concern about well outages if setting the MT much lower than 10 ft (20-50 ft) below current
- Thoughts on the feasibility of an “expanded soft landing” program
- Concerns about setting the MO the recent historic range of water levels
- Thoughts on the proposed projects and management actions

Proposed MO and MT Options for Water Level SMC:

- 1990 – 2014 water levels
- 1980 – 2014 water levels
- "soft landing"
- well outa… …mping cost

$$ support for well replacement

- "expanded soft landing"
- Lower Klamath elevation



Proposed projects and management actions

STEP 1

cap on consumptive use at current levels

STEP 2 only if water level decline continues

support for well replacement

more efficient irrigation equipment

investment in conversion to new crops with lower ET