Greater Harney Valley – Groundwater Study Advisory Committee Meeting

Burns, Oregon
July 27, 2016

Darrick Boschmann, Hydrogeologist
Oregon Water Resources Department

Purpose of this presentation

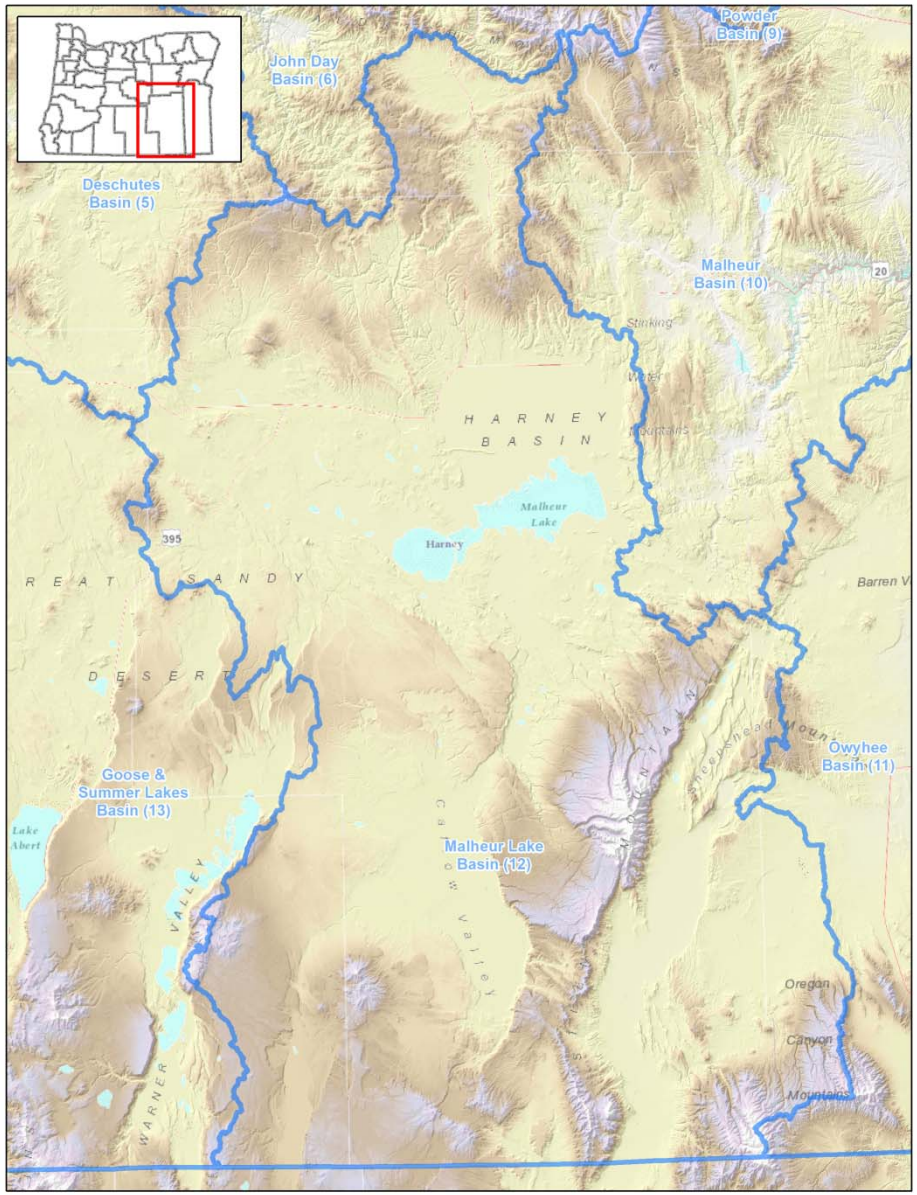
- Study area geography and boundary delineation
- History of groundwater development and OWRD activity in the Harney Basin
- Purpose and scope of the groundwater study
- Development of the observation well network
- OWRD online data access

Geography and boundary delineation

- Malheur Lake Administrative Basin
- Harney Basin
- Greater Harney Valley Groundwater Area of Concern (GHVGAC)

Malheur Lake Administrative Basin

OWRD basins



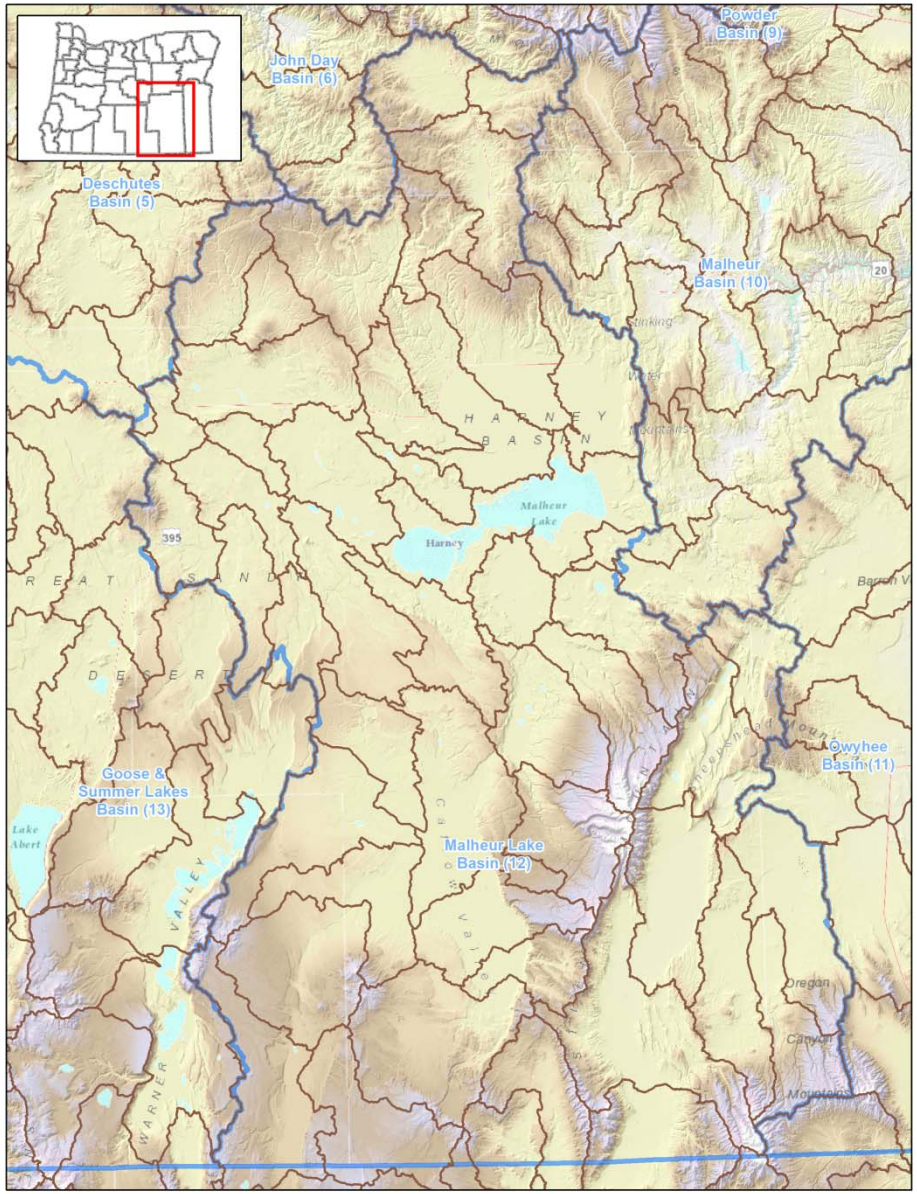
The Malheur Lake Administrative Basin was originally defined by the State Water Resources board in 1967.

While these boundaries were originally derived from hydrologic units, they have become static as administrative boundaries. As hydrologic unit delineation improves, the Administrative Basin boundaries do not change.

10 digit USGS watershed boundaries

OWRD basins

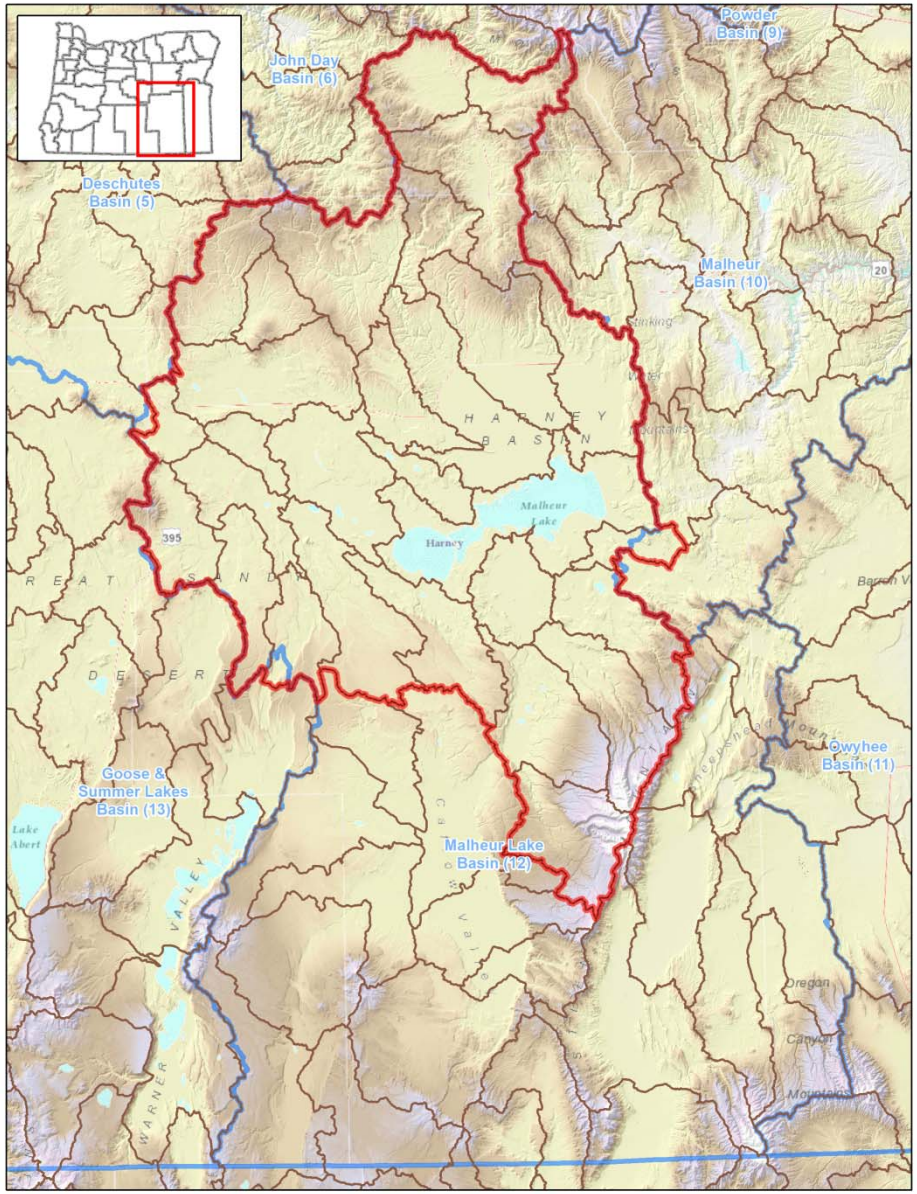
10 digit (watershed)



The Watershed Boundary Dataset (WBD) defines the areal extent of surface water drainage to a point, accounting for all land and surface areas. Watershed Boundaries are determined solely upon science-based hydrologic principles, not favoring any administrative boundaries or special projects, nor particular program or agency.

Harney Basin

OWRD basins
10 digit (watershed)
Harney Basin

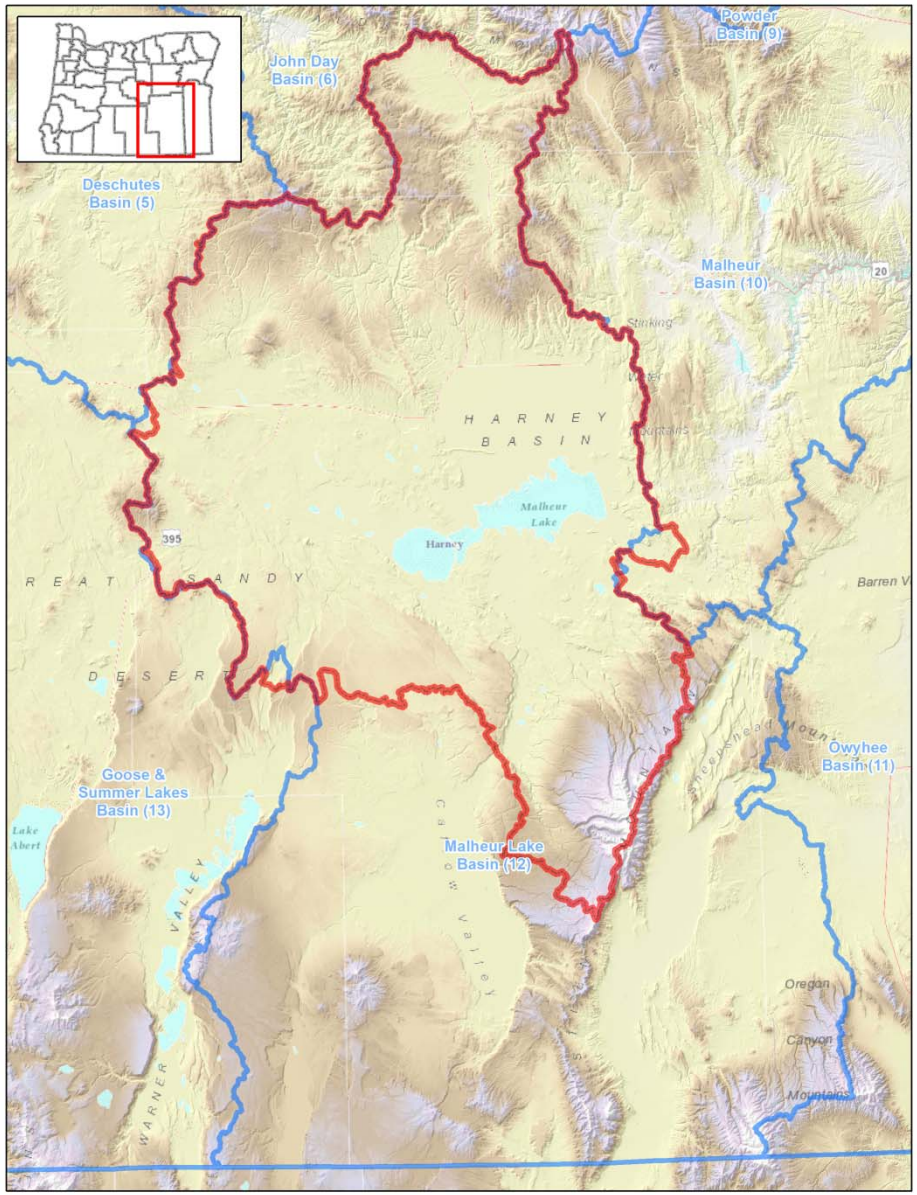


The Harney basin represents the surface-water drainage area of Malheur and Harney Lakes, which are fed by the watersheds of Silver Creek, Silvies River and Donner und Blitzen River.

Basin delineation is based on USGS watershed boundaries.

Harney Basin

OWRD basins
10 digit (watershed)
Harney Basin

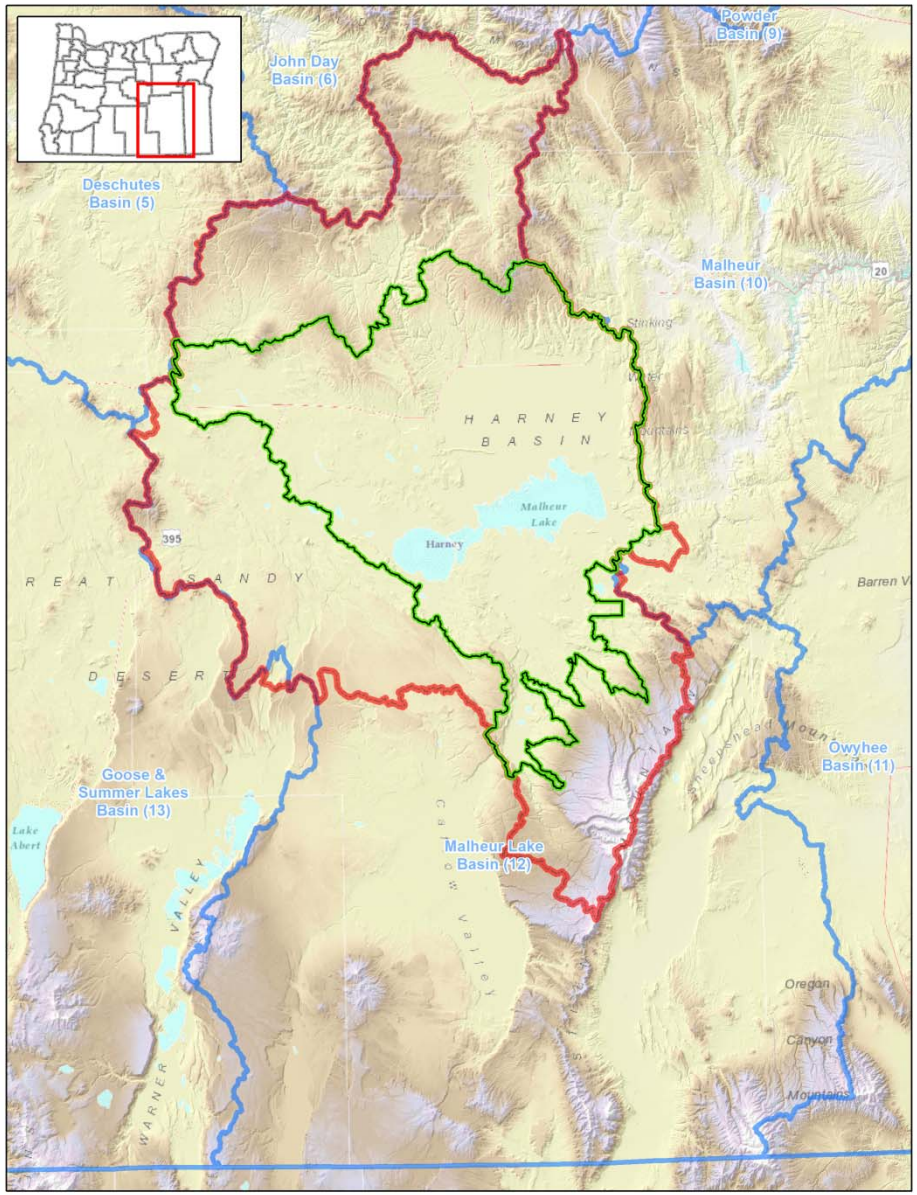


The Harney basin represents the surface-water drainage area of Malheur and Harney Lakes, which are fed by the watersheds of Silver Creek, Silvies River and Donner und Blitzen River.

Basin delineation is based on USGS watershed boundaries.

GHVGAC Boundaries

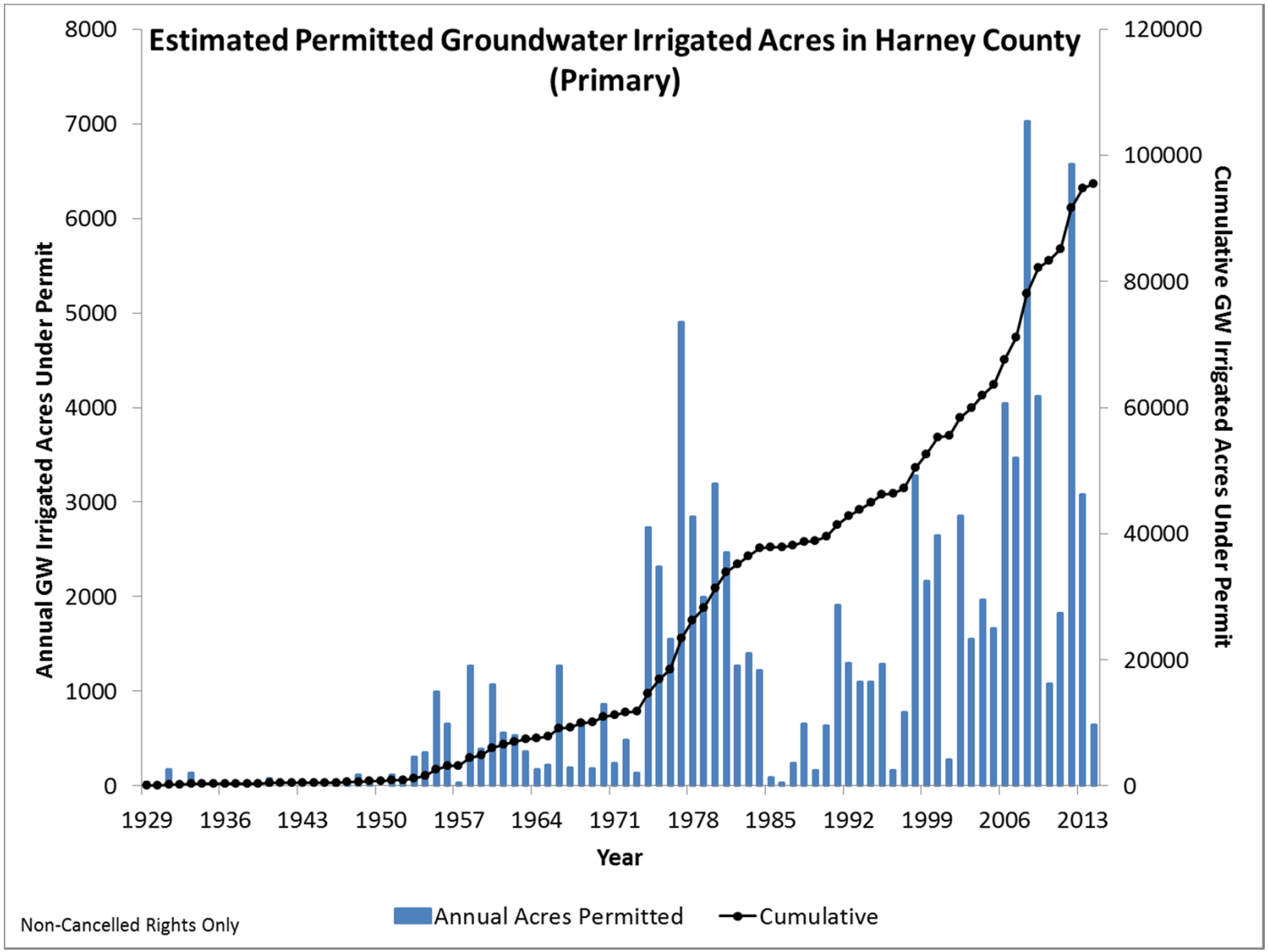
- OWRD basins
- 10 digit (watershed)
- Harney Basin
- GHVGAC



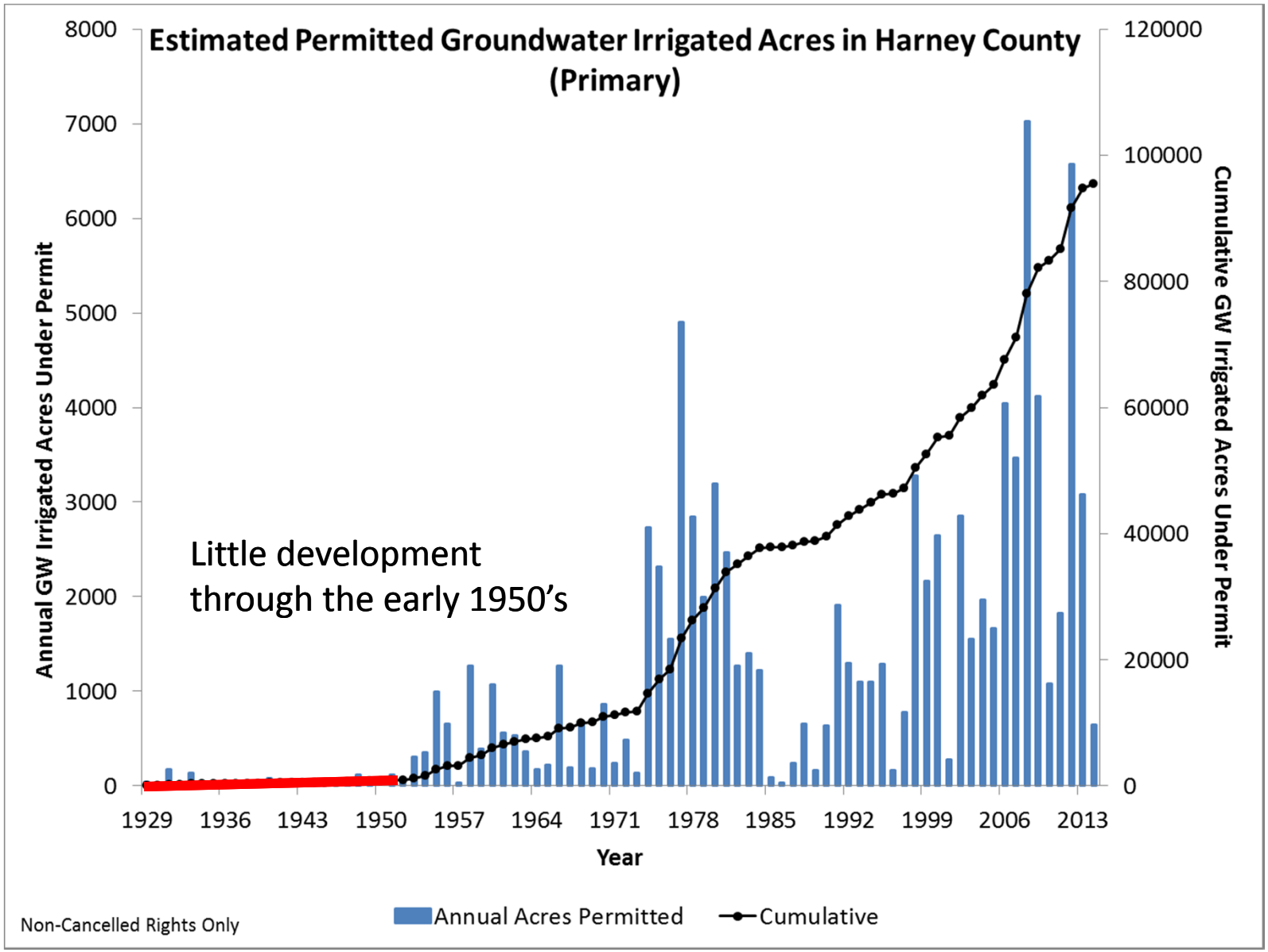
The Greater Harney Valley Groundwater Area of Concern is defined as the area that includes Harney Valley, adjoining valleys, and lower-elevation flanks of uplands facing those valleys.

Administrative area delineated based on 12 digit USGS watershed boundaries, truncated by OWRD administrative boundaries, and modified by Division 512 rule making.

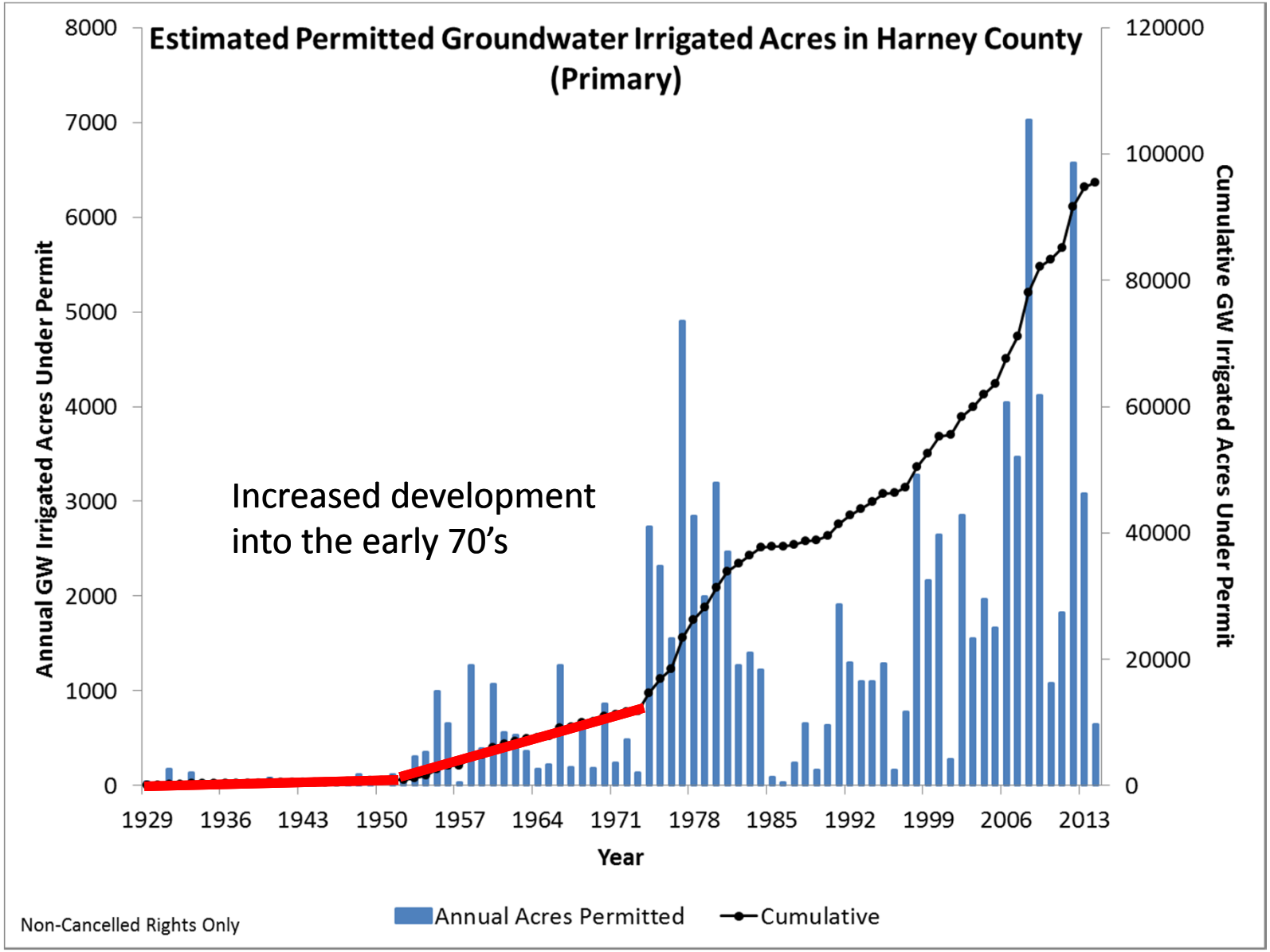
History of groundwater development



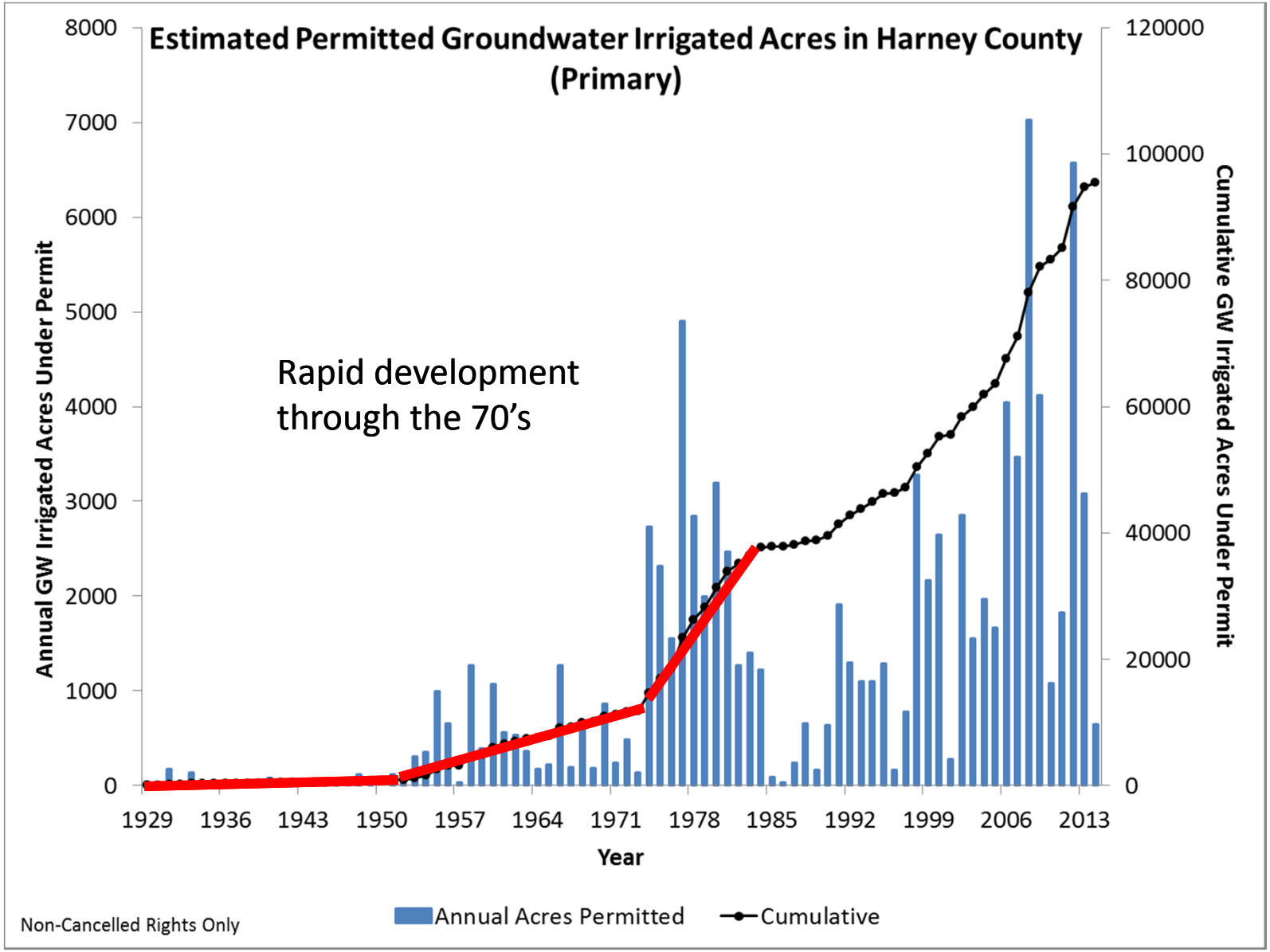
1929 to early 1950's



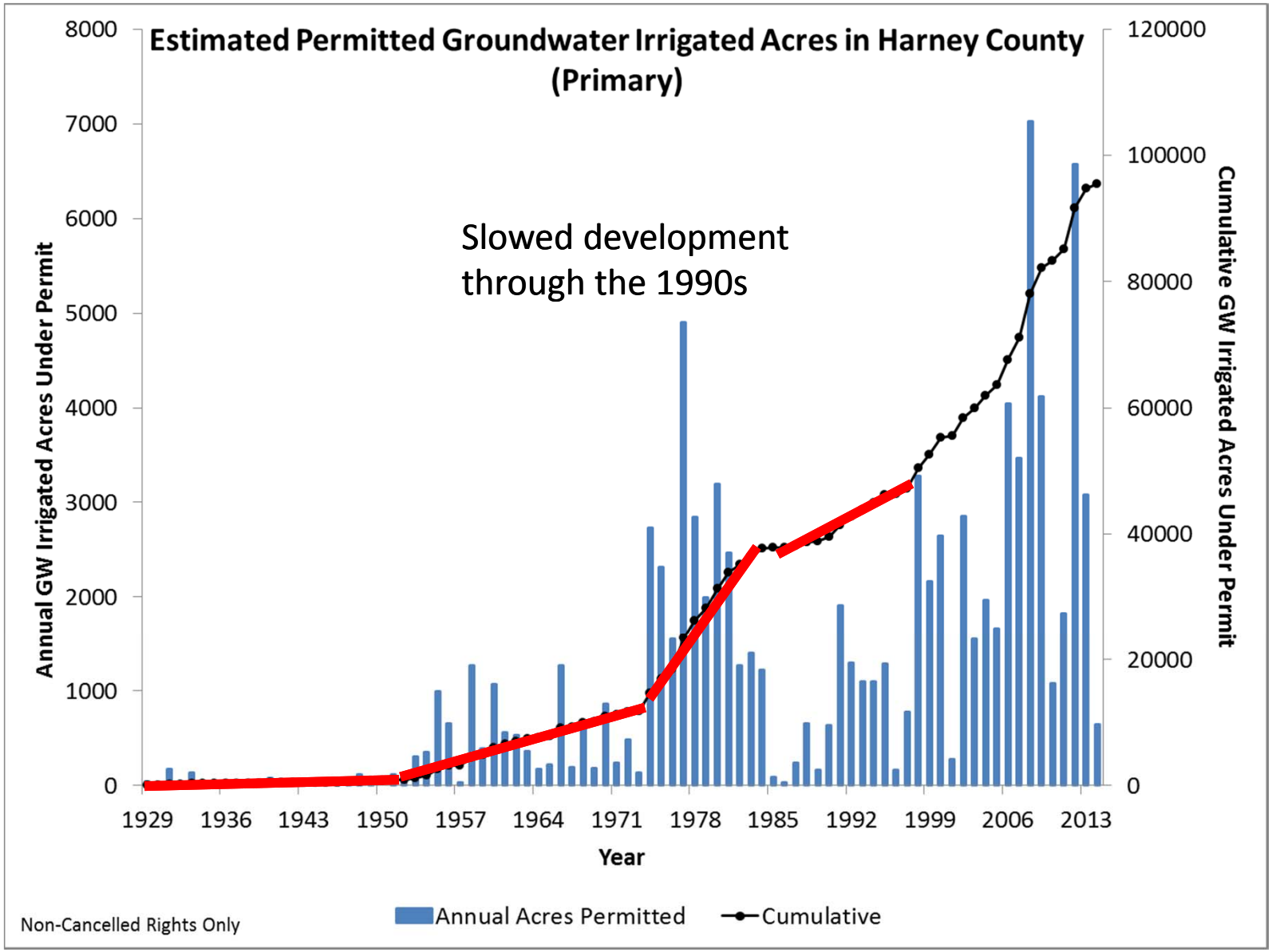
Early 1950's to early 1970's



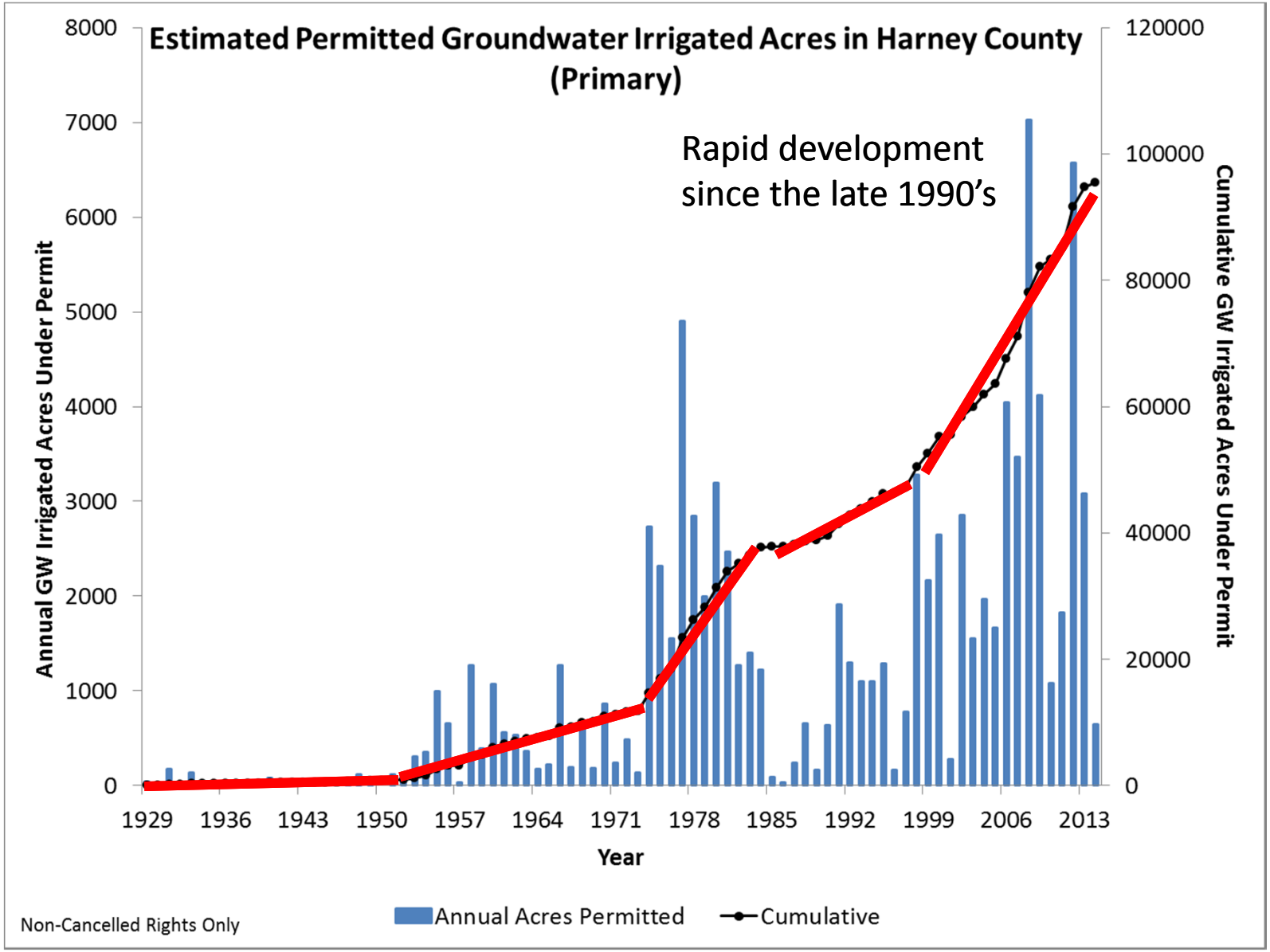
Early 1970's to early 1980's



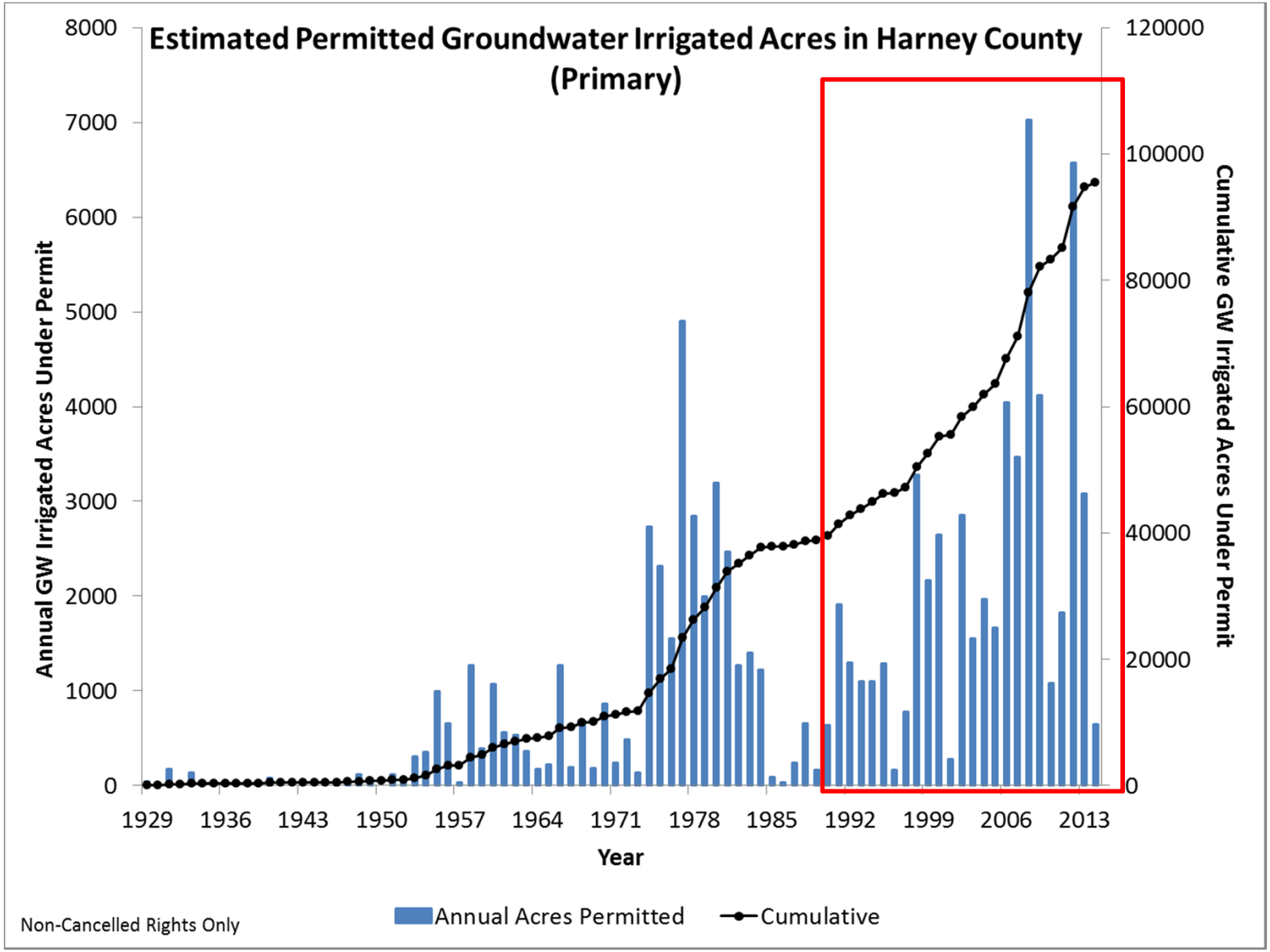
Early 1980's through 1990's

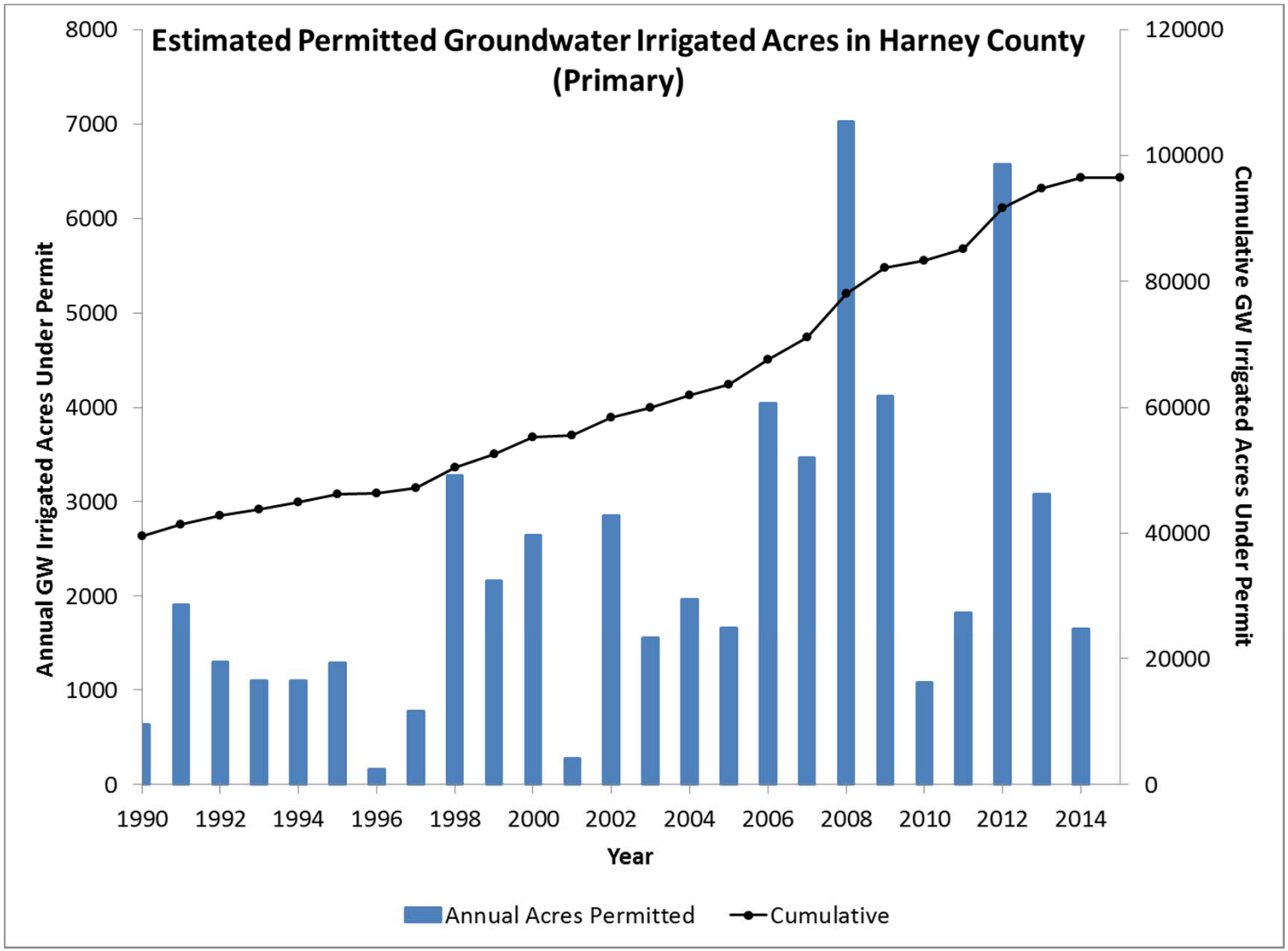


Late 1990's to present

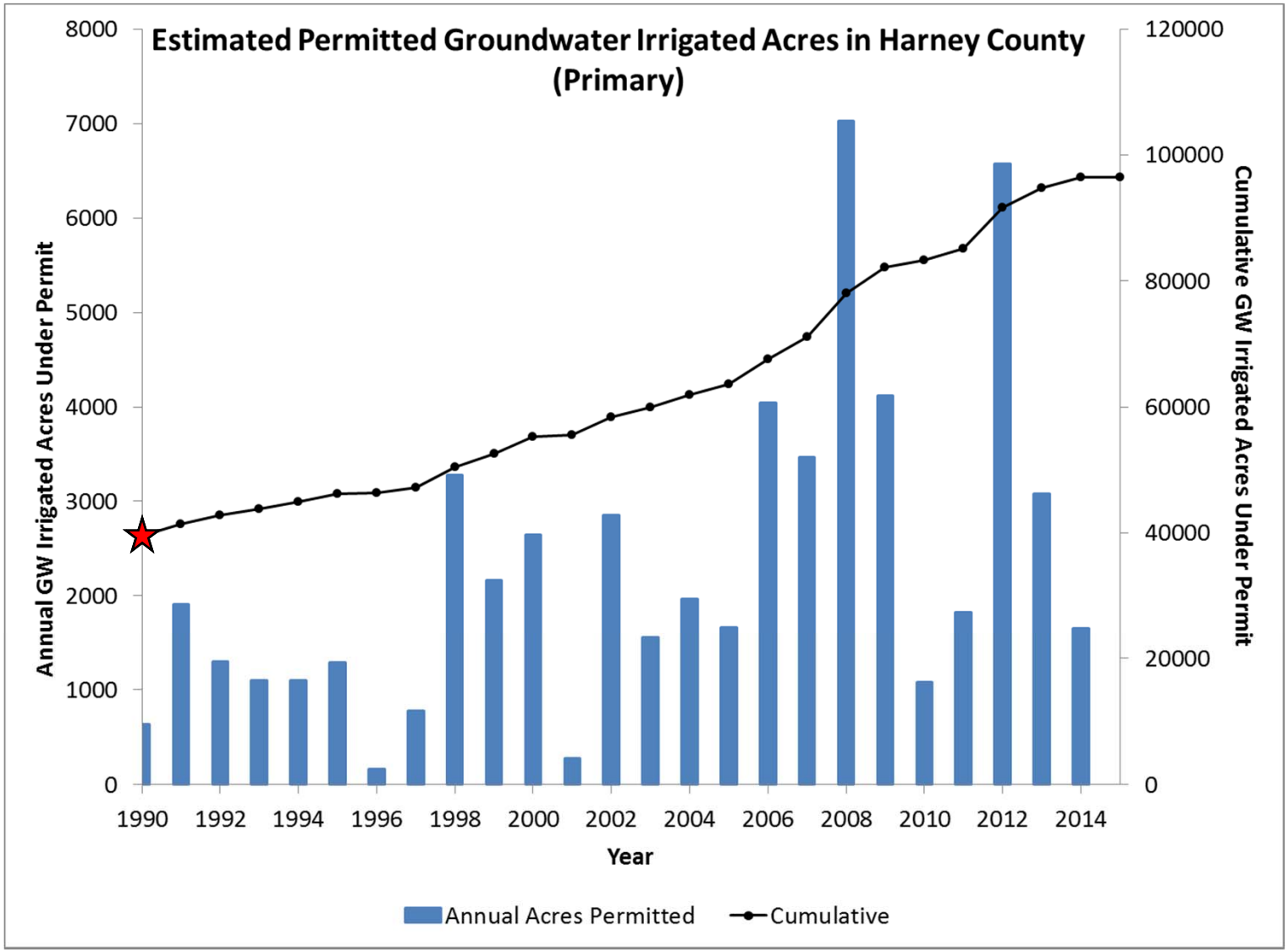


1990 to present

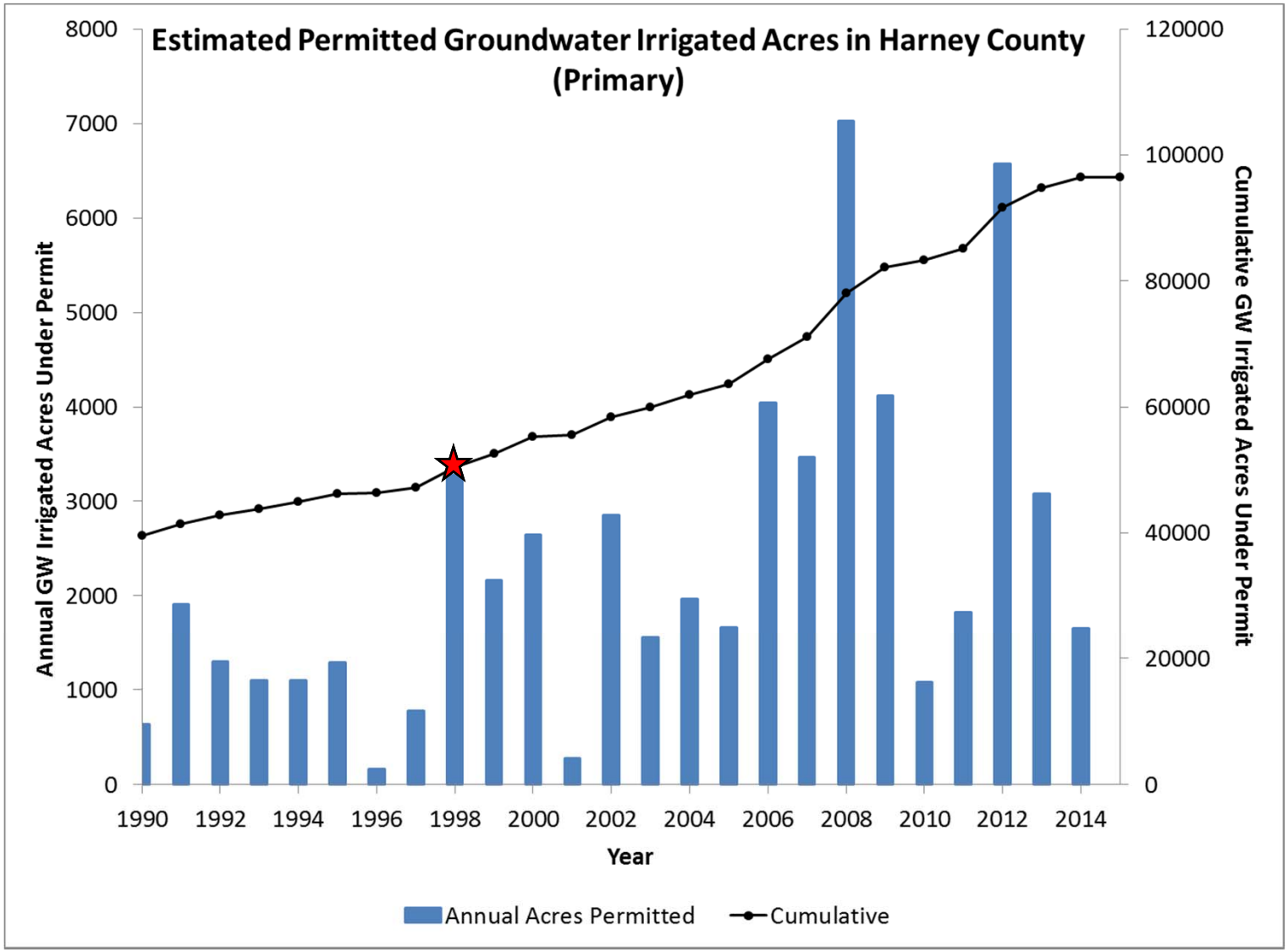




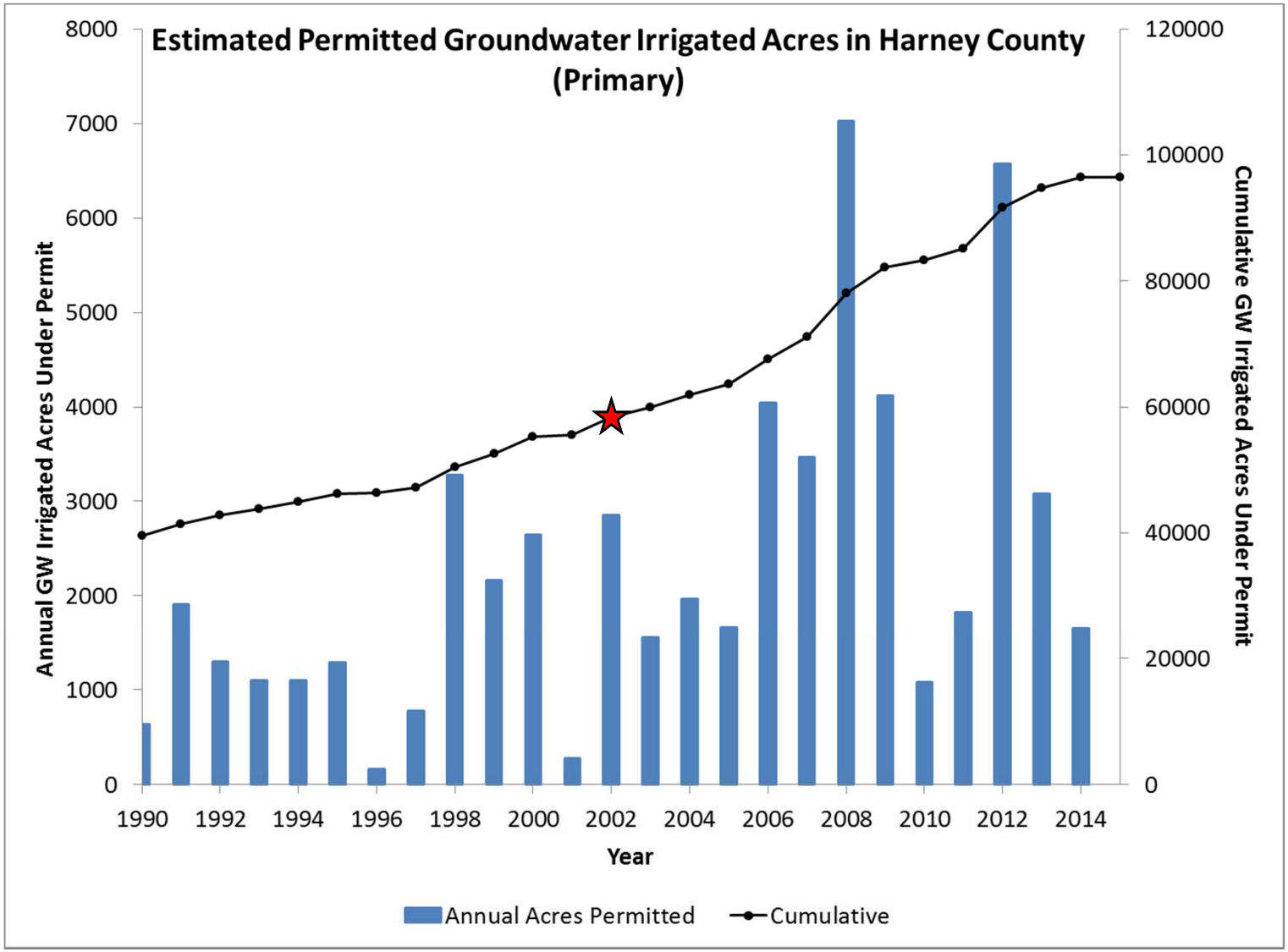
Pre-1990:
- Most groundwater applications are generally approved with minimal conditions or limitations.
- Network of State Observation Wells typically measured quarterly.



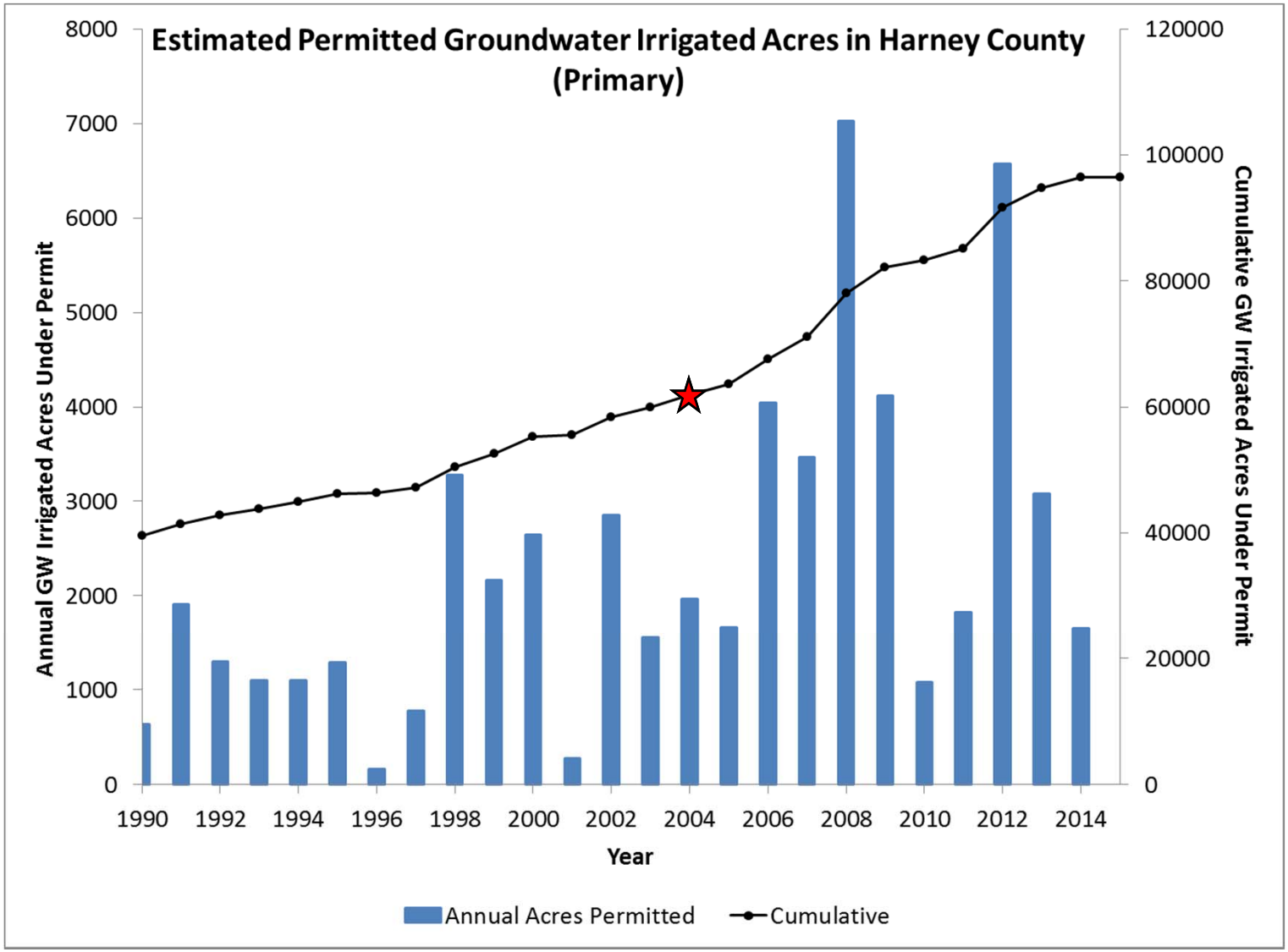
★ 1990: • Measurement, reporting, and decline conditions begin to appear in new permits.



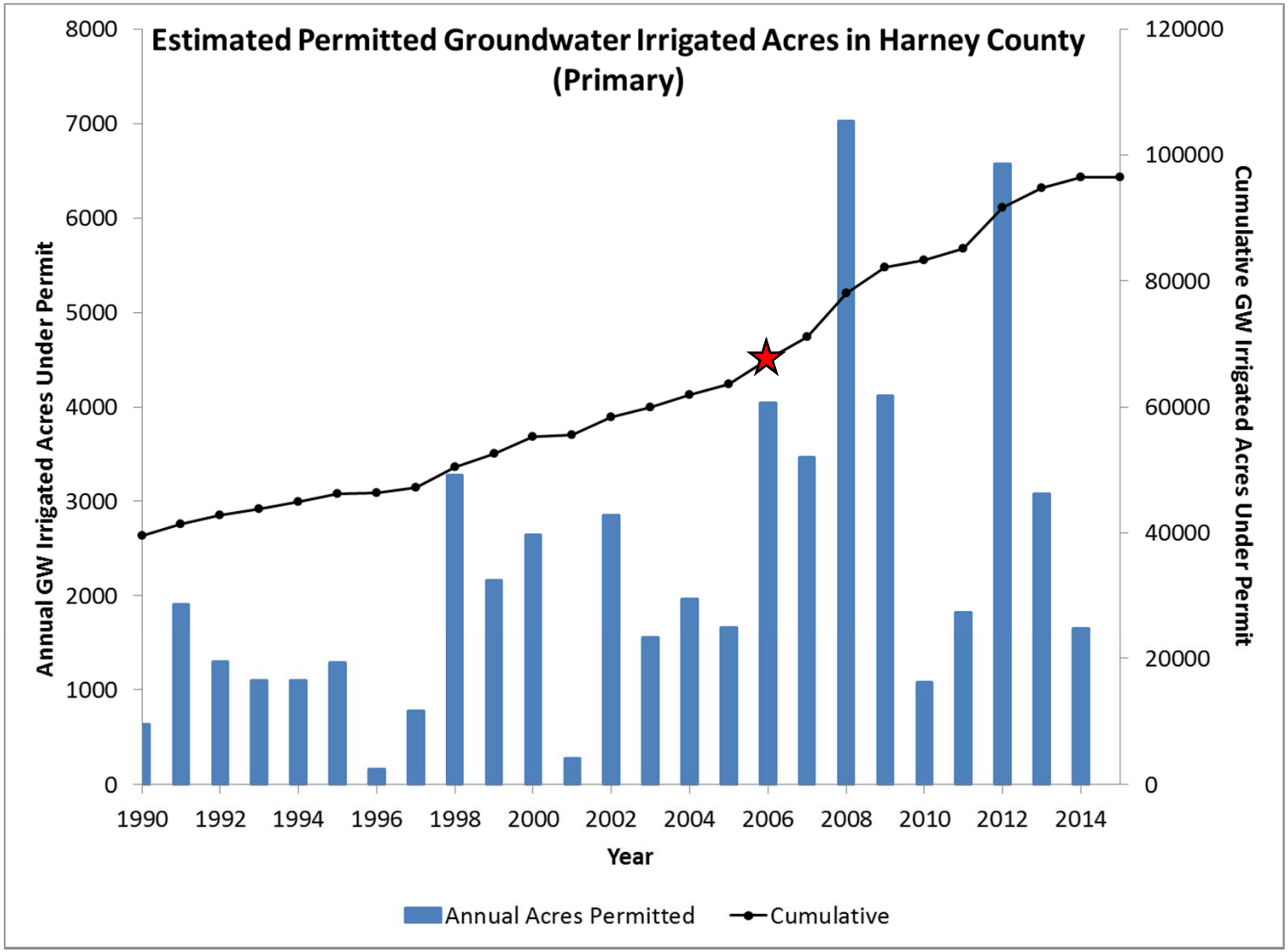
★ 1998: • Increased rate of GW development begins after ~15 year period of slowed development.



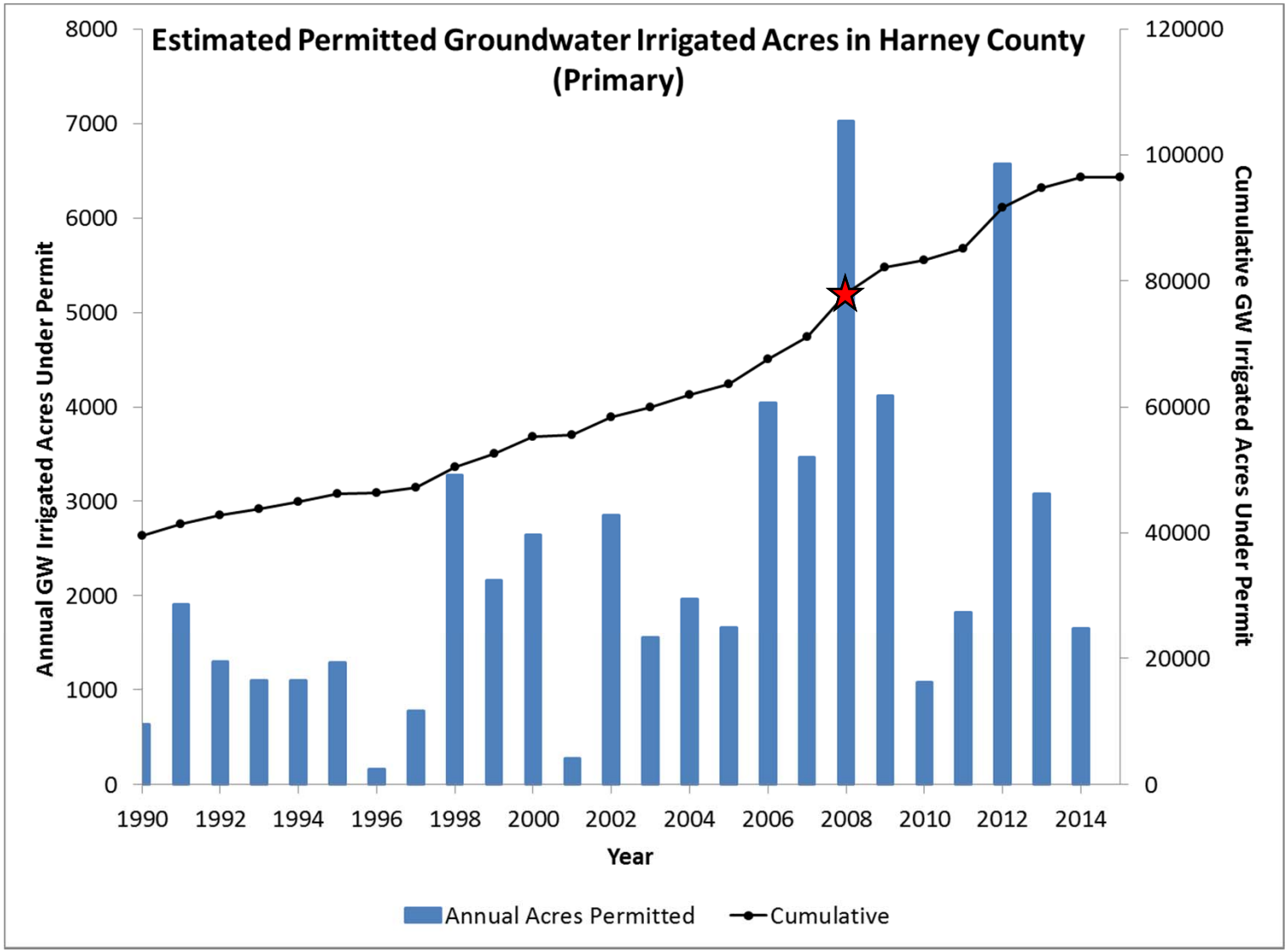
★ 2002: • Measurement, reporting, and decline conditions become common on larger permits.



★ 2004:
- Measurement, reporting, and decline conditions placed on almost all new permits.
- Local concern for overdevelopment near Crane noted.

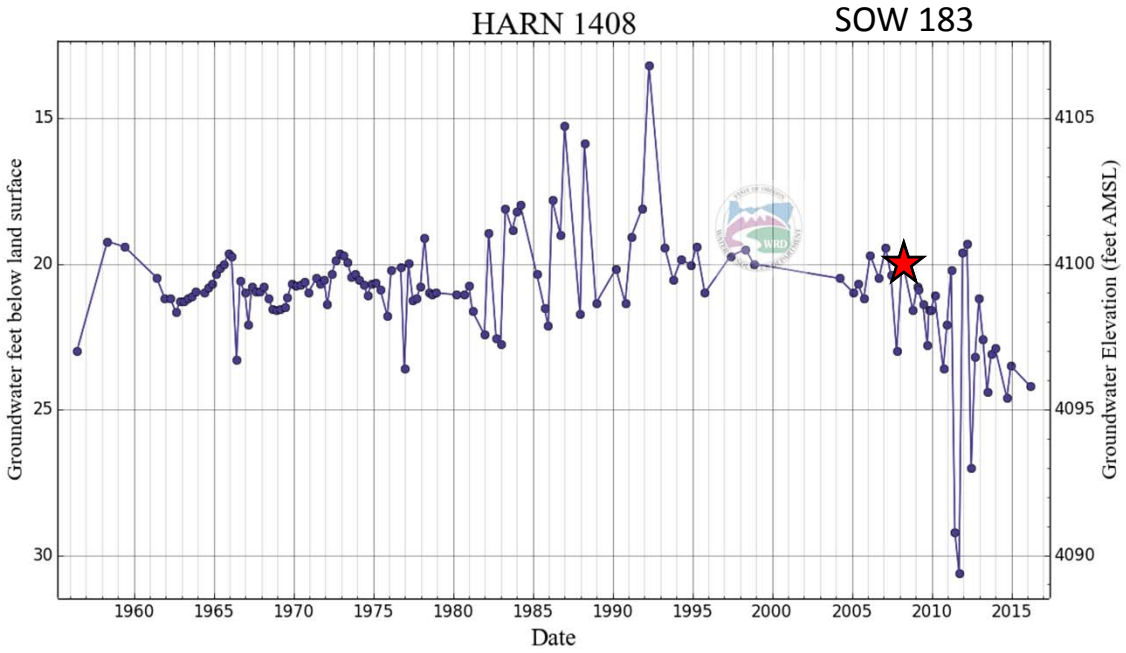


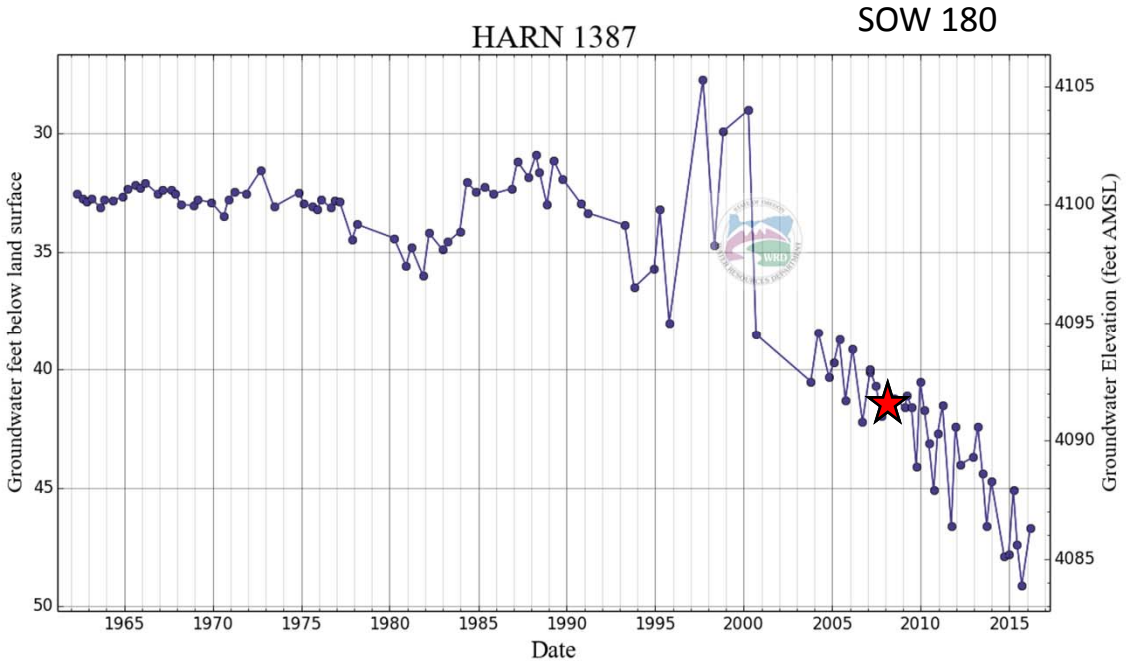
★ 2006: • HARN 1245 recorder installed in response to local concern (Crane area).

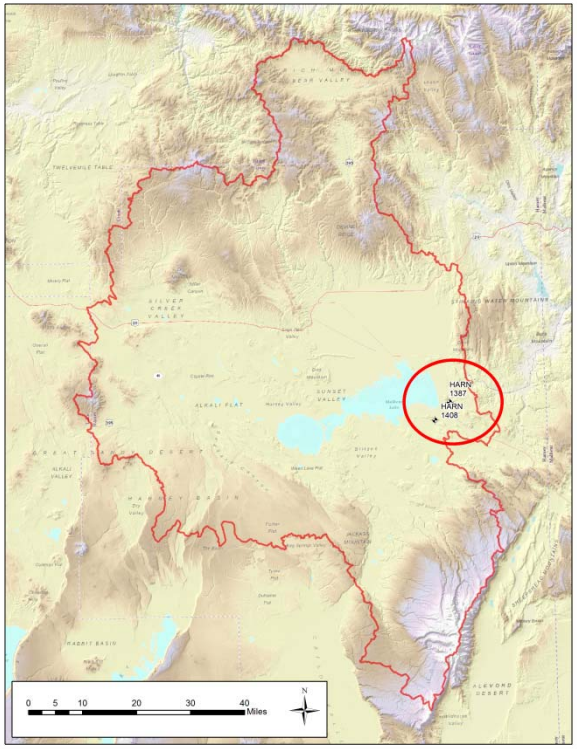


★ 2008:
- Small declines noted in SOWs 183 & 180 (Princeton area).
- Quarterly monitoring of additional wells in the Crane area begins.
- HARN 440 recorder installed (near Burns airport).

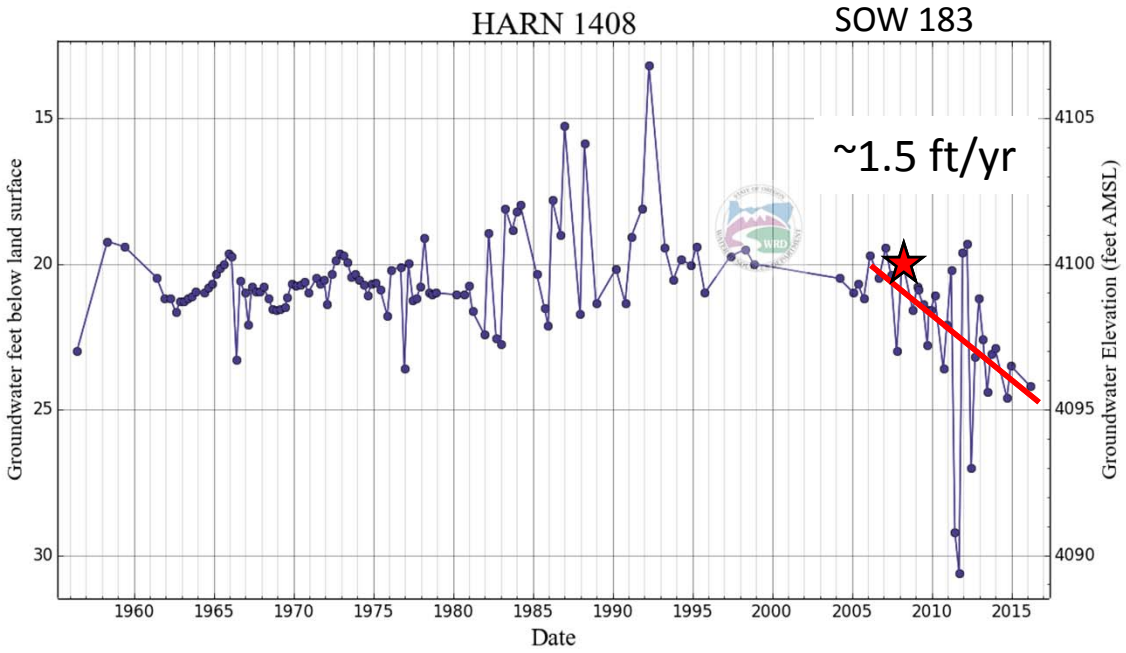
2008

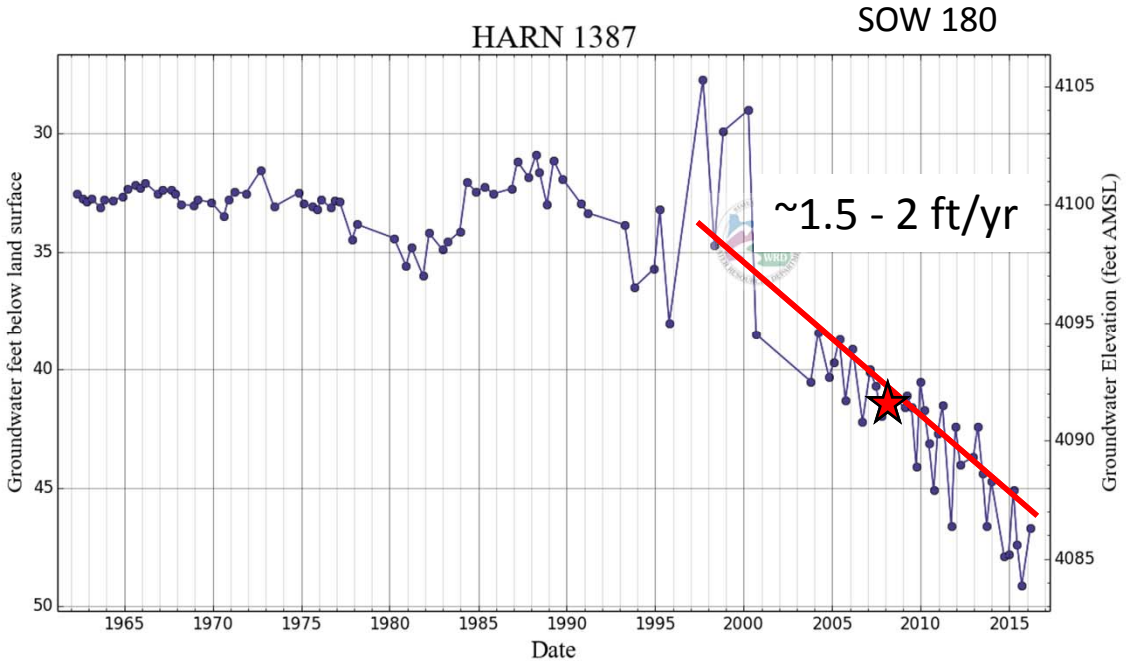

HARN 1408
SOW 183
Groundwater feet below land surface
Groundwater Elevation (feet AMSL)
Date
15
20
25
30
4105
4100
4095
4090
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015

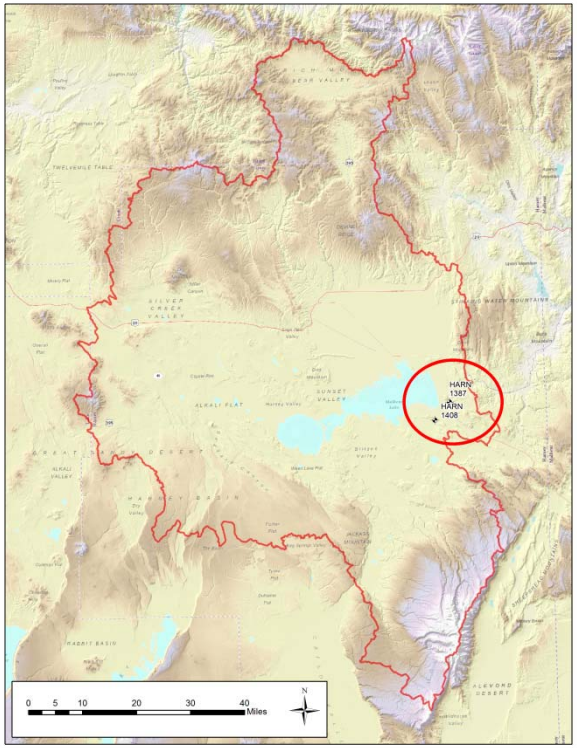

HARN 1387
SOW 180
Groundwater feet below land surface
Groundwater Elevation (feet AMSL)
Date
30
35
40
45
50
4105
4100
4095
4090
4085
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015

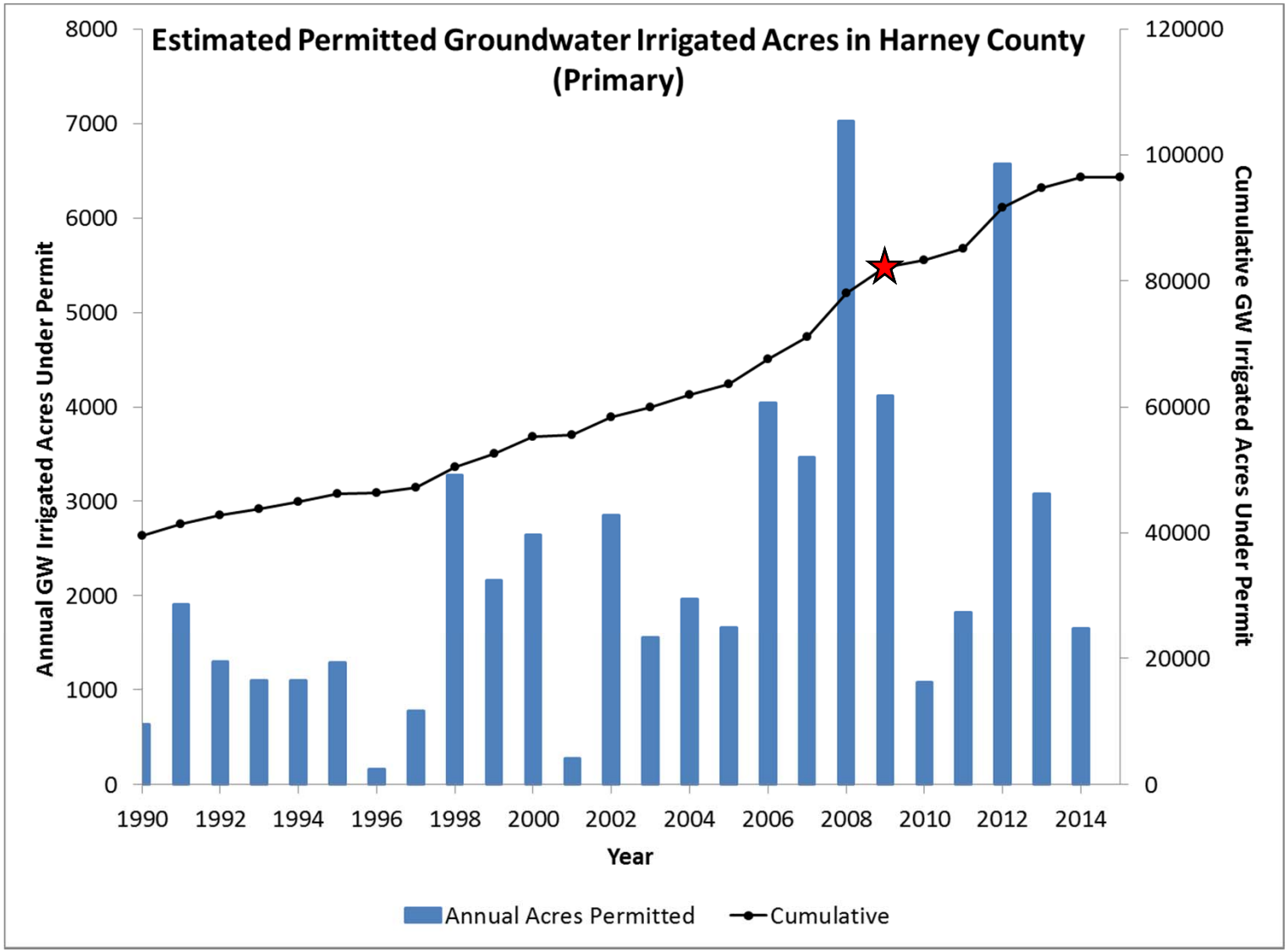

HARN 1387
HARN 1408
0 5 10 20 30 40 Miles
N

2008


HARN 1408
SOW 183
~1.5 ft/yr
Groundwater feet below land surface
Groundwater Elevation (feet AMSL)
Date
15
20
25
30
4105
4100
4095
4090
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015

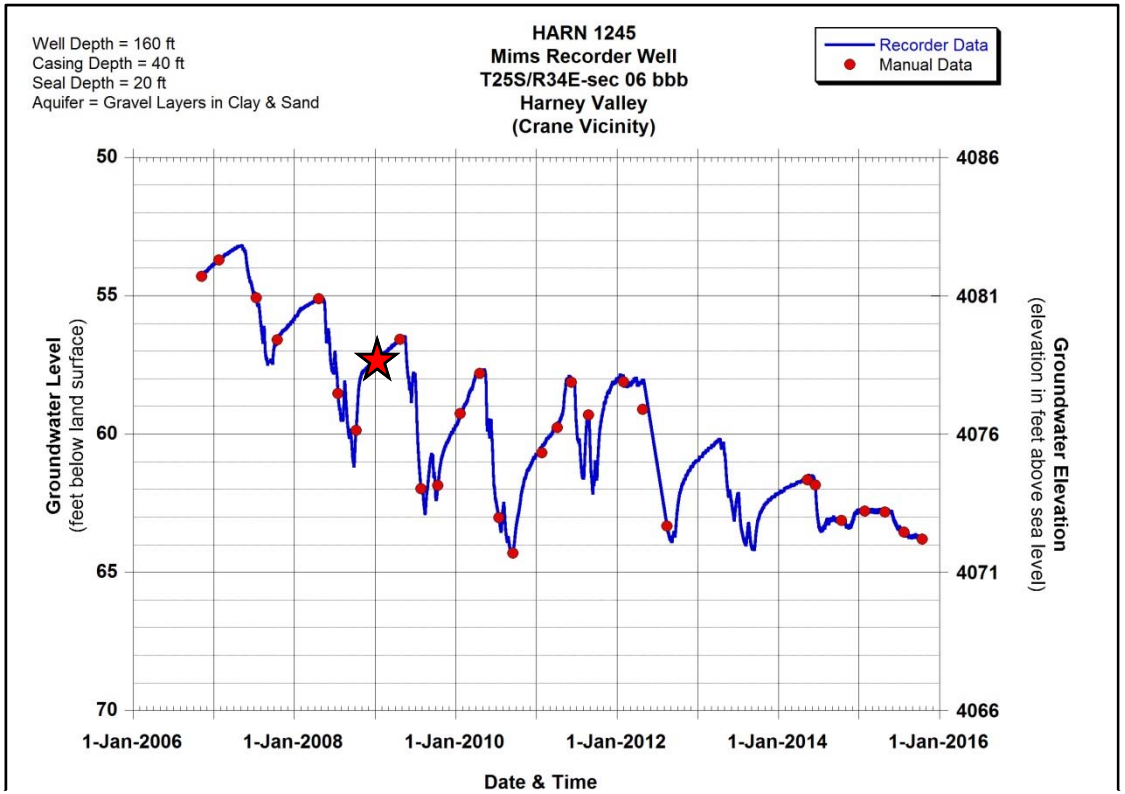

HARN 1387
SOW 180
~1.5 - 2 ft/yr
Groundwater feet below land surface
Groundwater Elevation (feet AMSL)
Date
30
35
40
45
50
4105
4100
4095
4090
4085
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015

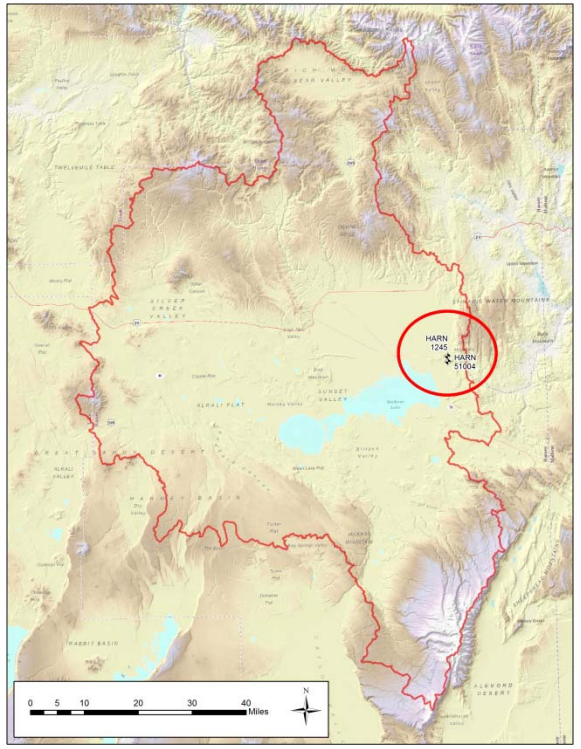

HARN 1387
HARN 1408
0 5 10 20 30 40 Miles
N

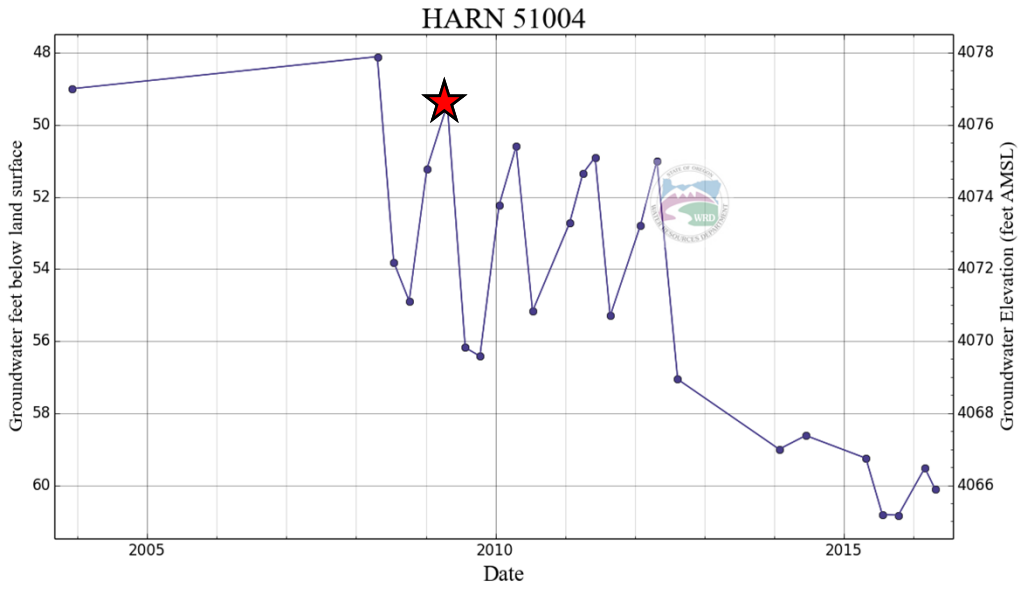


★ 2009:
- ~2 ft/yr decline noted in HARN 1245 recorder well (Crane area).
- Additional wells showing declines in the Crane area.
- Quarterly monitoring at Weaver Springs begins due to rapid development.

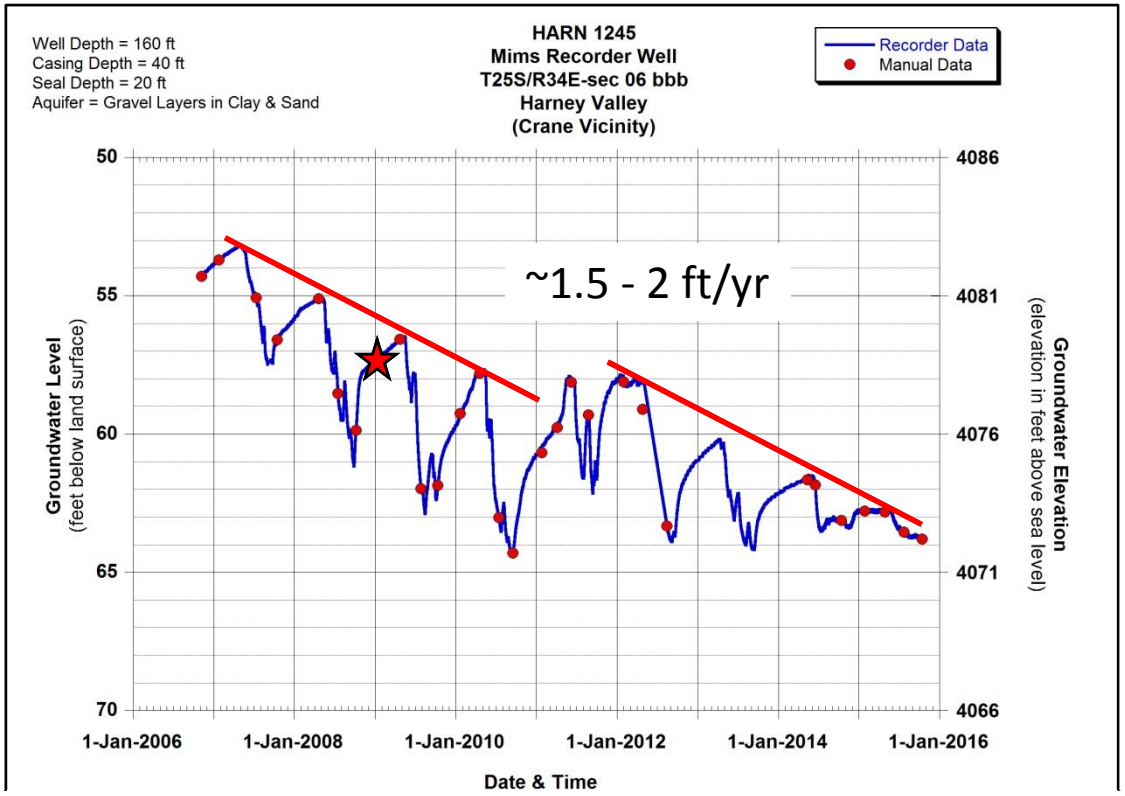
2009

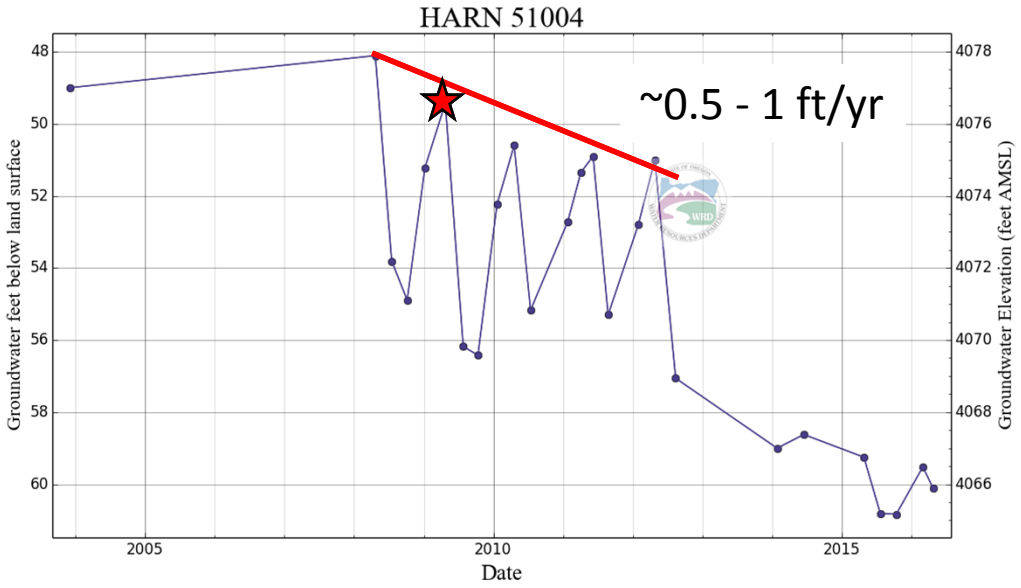

Well Depth = 160 ft
Casing Depth = 40 ft
Seal Depth = 20 ft
Aquifer = Gravel Layers in Clay & Sand
HARN 1245
Mims Recorder Well
T25S/R34E-sec 06 bbb
Harney Valley
(Crane Vicinity)
Recorder Data
Manual Data
Groundwater Level
(feet below land surface)
Groundwater Elevation
(elevation in feet above sea level)
50
55
60
65
70
4086
4081
4076
4071
4066
1-Jan-2006
1-Jan-2008
1-Jan-2010
1-Jan-2012
1-Jan-2014
1-Jan-2016
Date & Time

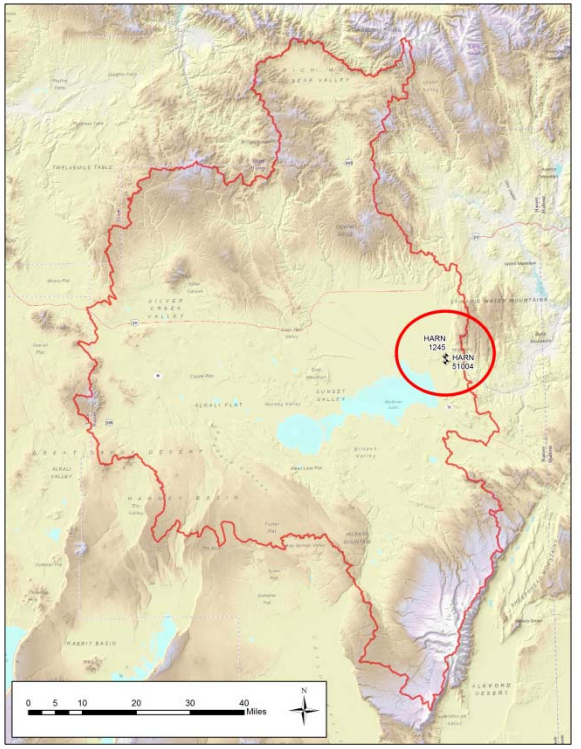

HARN 1245
HARN 51004
0 5 10 20 30 40 Miles
N

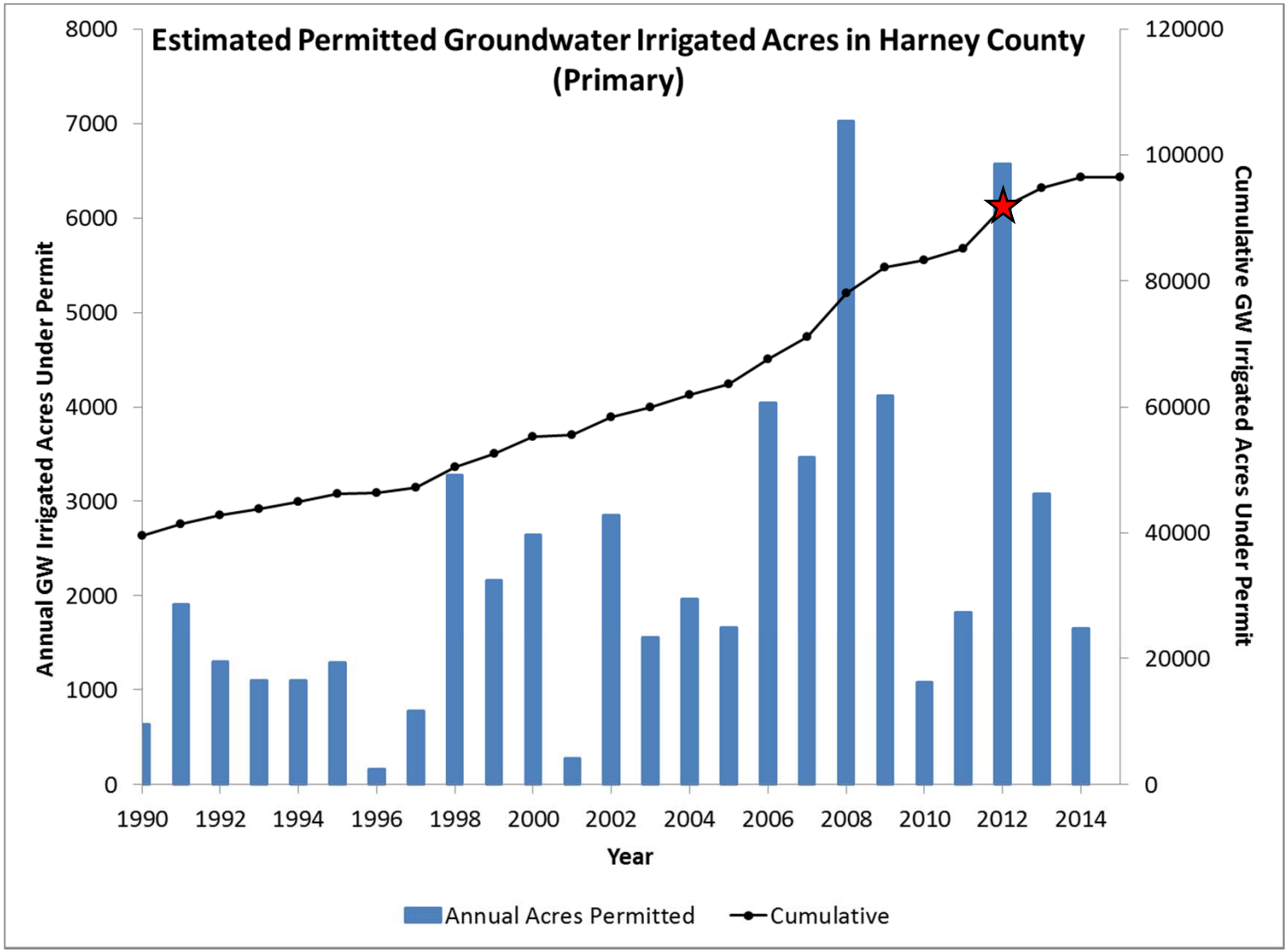

HARN 51004
Groundwater feet below land surface
Groundwater Elevation (feet AMSL)
48
50
52
54
56
58
60
4078
4076
4074
4072
4070
4068
4066
2005
2010
2015
Date

2009

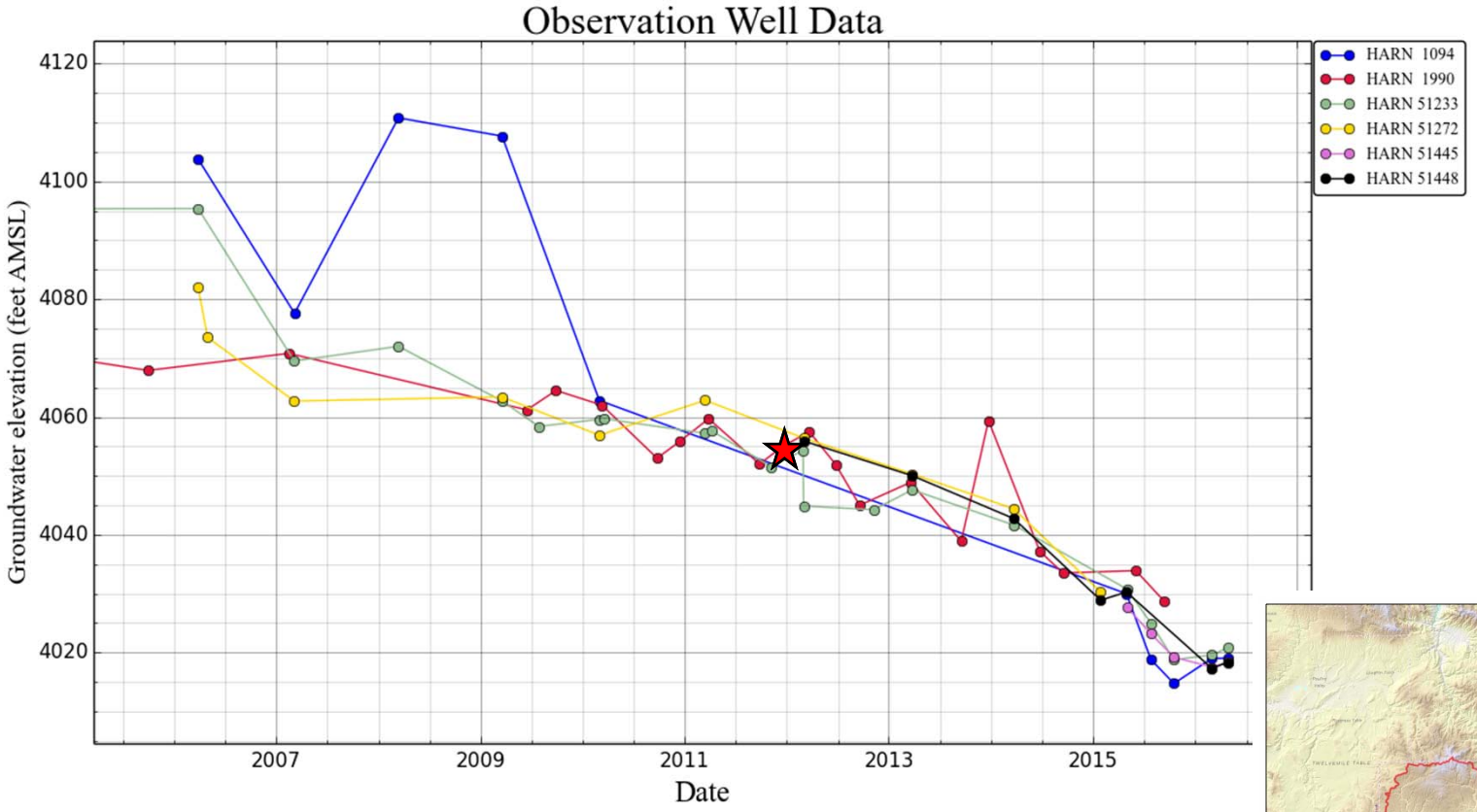

Well Depth = 160 ft
Casing Depth = 40 ft
Seal Depth = 20 ft
Aquifer = Gravel Layers in Clay & Sand
HARN 1245
Mims Recorder Well
T25S/R34E-sec 06 bbb
Harney Valley
(Crane Vicinity)
Recorder Data
Manual Data
~1.5 - 2 ft/yr
Groundwater Level
(feet below land surface)
Groundwater Elevation
(elevation in feet above sea level)
50
55
60
65
70
4086
4081
4076
4071
4066
1-Jan-2006
1-Jan-2008
1-Jan-2010
1-Jan-2012
1-Jan-2014
1-Jan-2016
Date & Time


HARN 51004
~0.5 - 1 ft/yr
Groundwater feet below land surface
Groundwater Elevation (feet AMSL)
48
50
52
54
56
58
60
4078
4076
4074
4072
4070
4068
4066
2005
2010
2015
Date

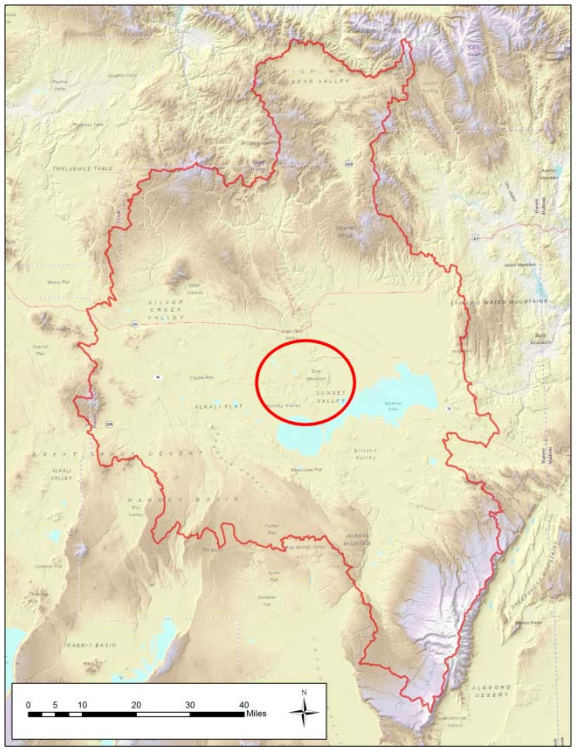

HARN
1245
HARN
51004
0 5 10 20 30 40 Miles
N



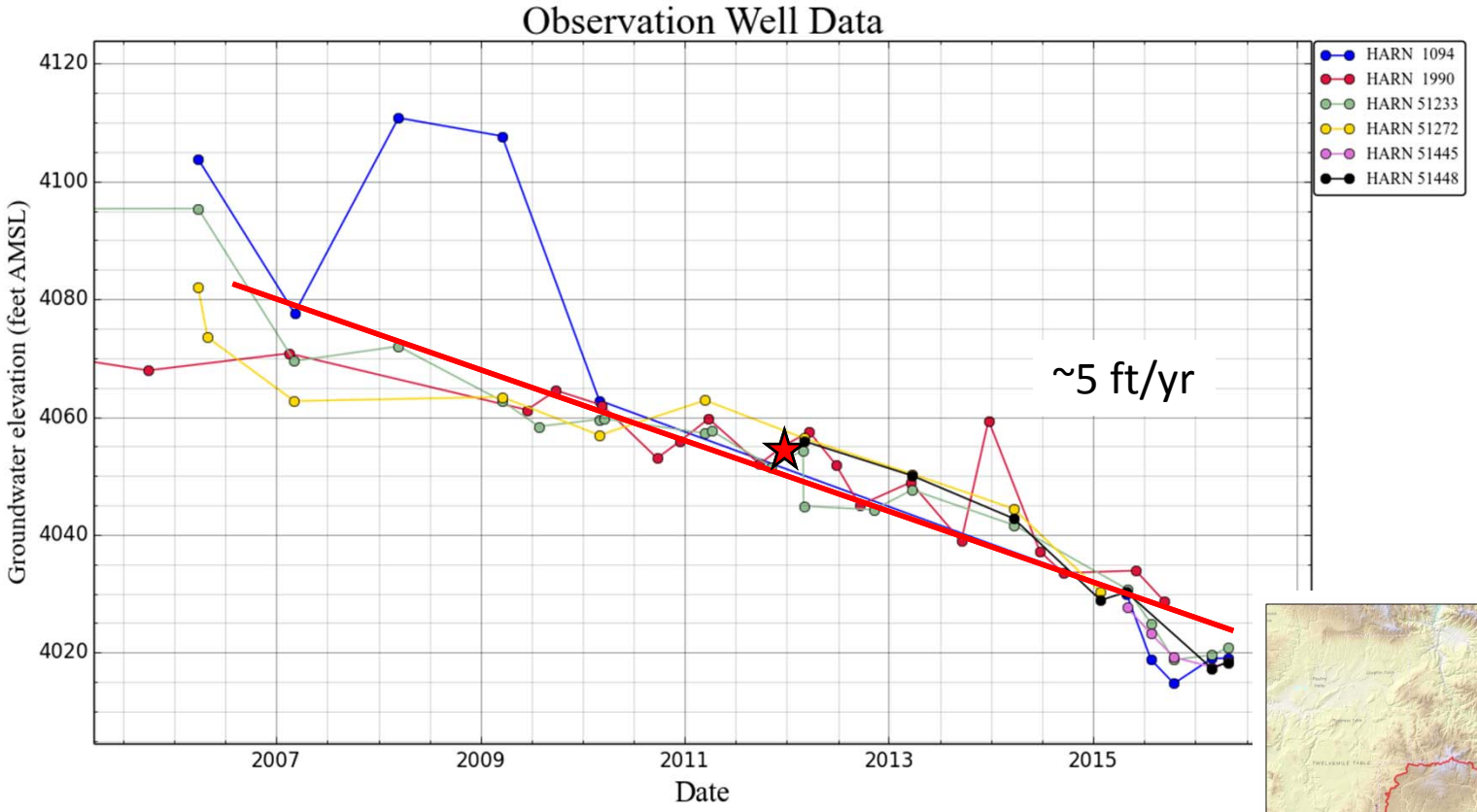
★ 2012:
- Weaver Springs declines/over appropriation are well documented.
- First observation well condition for large application (Buchanan area – 20 cfs).



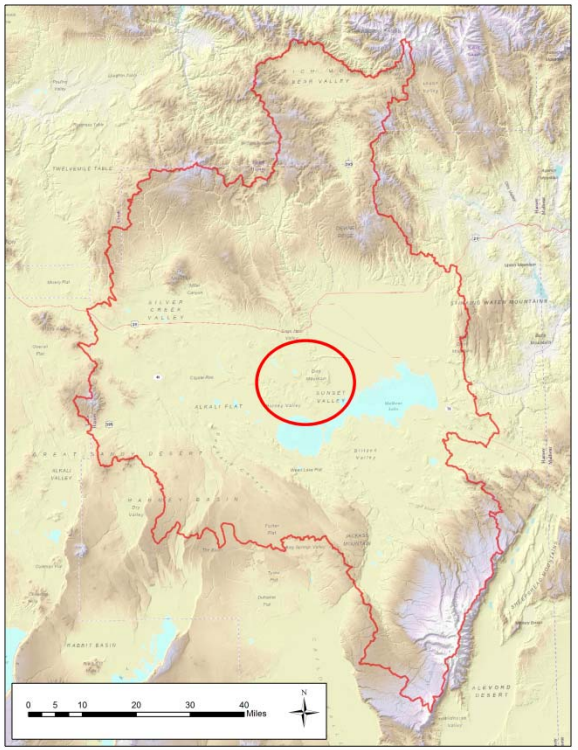
Weaver Springs area wells



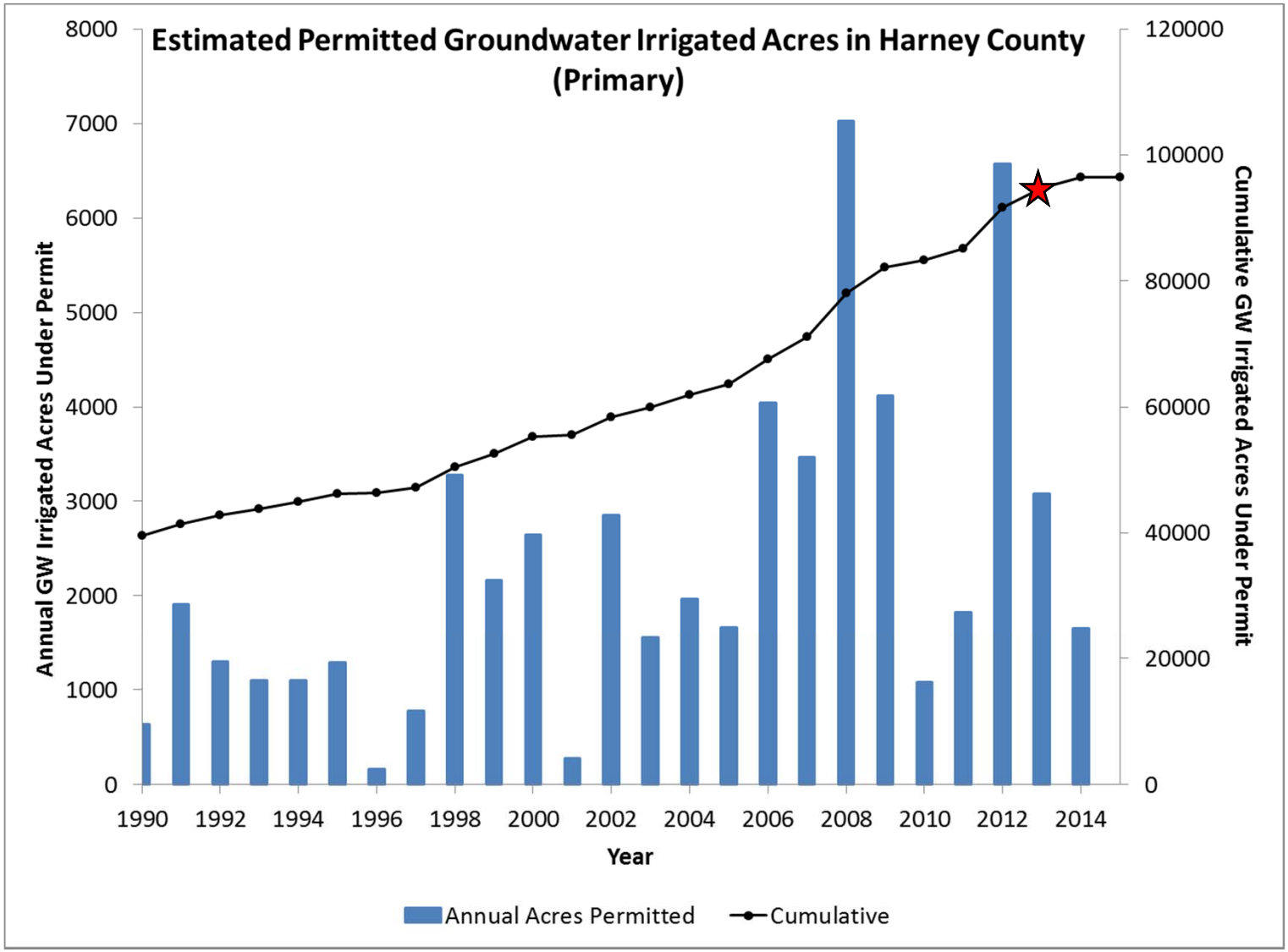
2012



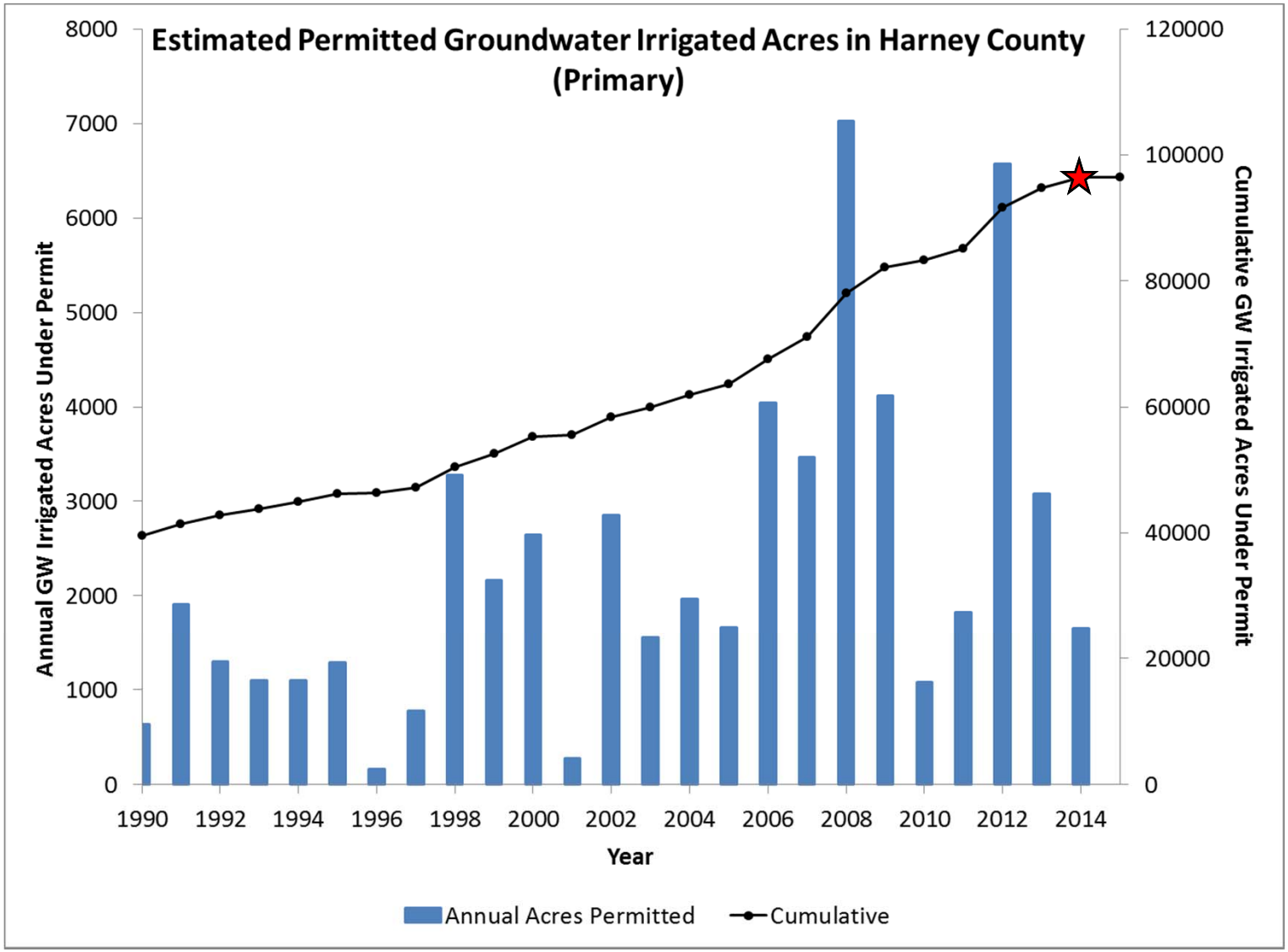
Weaver Springs area wells



2012

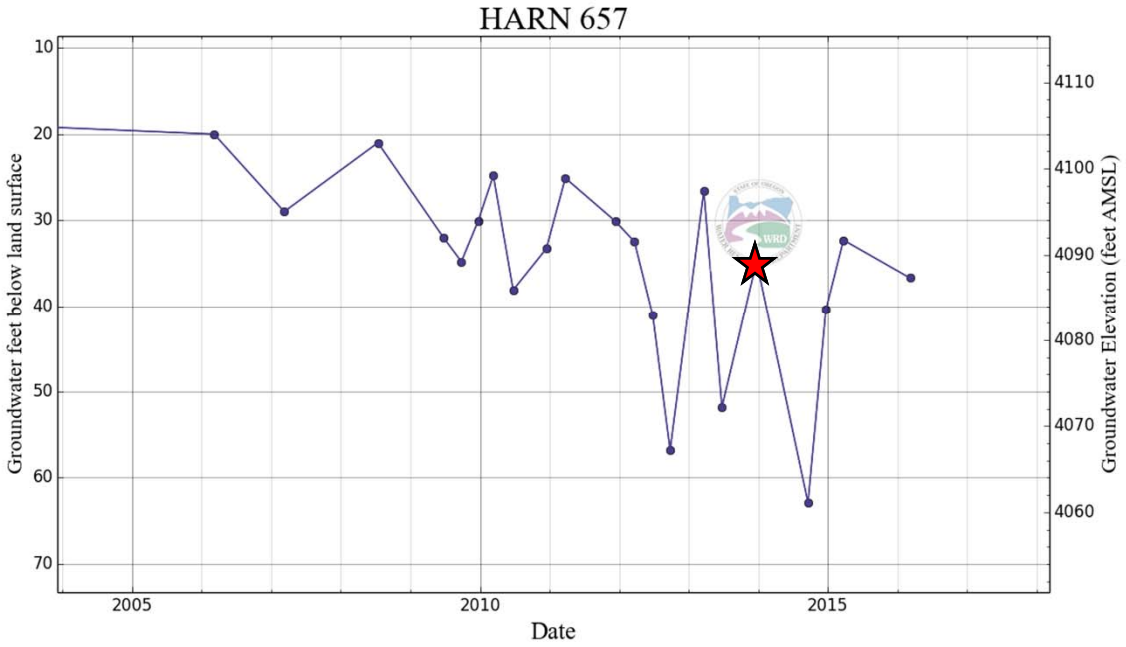


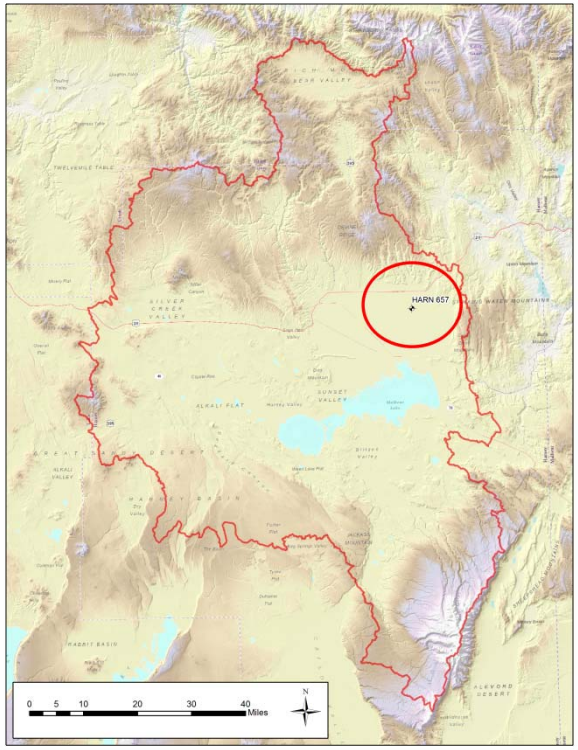
★ 2013: • First "propose to deny" due to capacity/injury (Buchanan area – 10 cfs).



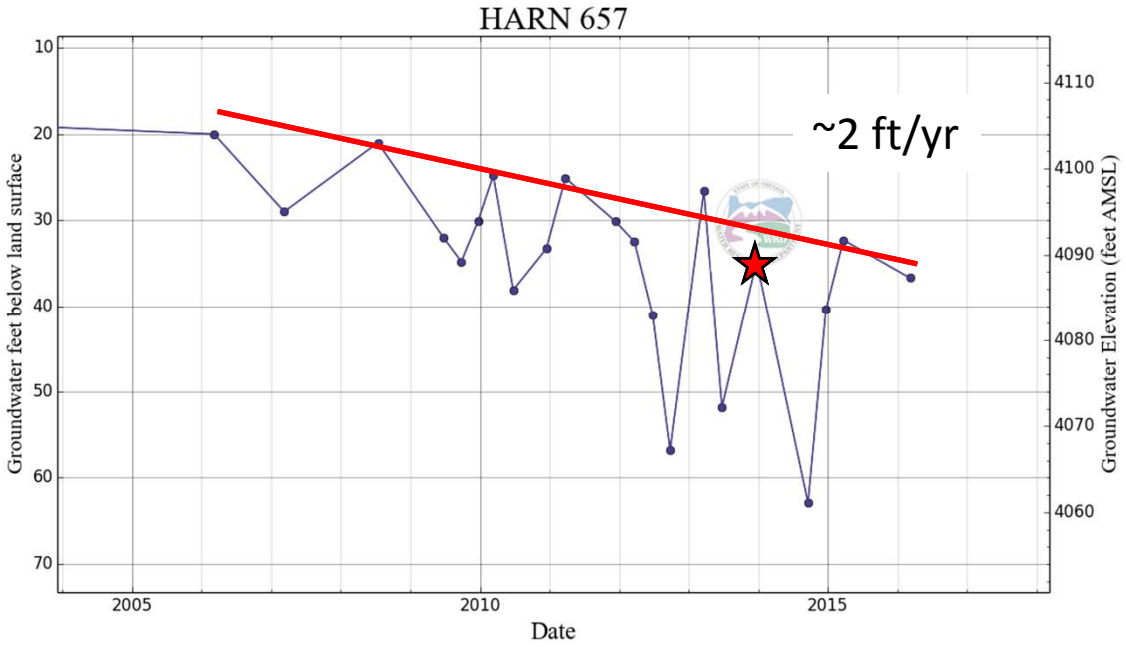
★ 2014:
- First "propose to deny" due to capacity/injury (Silver Creek – 64.7 cfs).
- First "propose to deny" due to capacity/injury (Weaver Springs – 4.62 cfs).
- Declines noted at SOW 1360 (Newton Rd. & Palomino Ln. area).
- Expansion of OWRD monitoring across the basin.

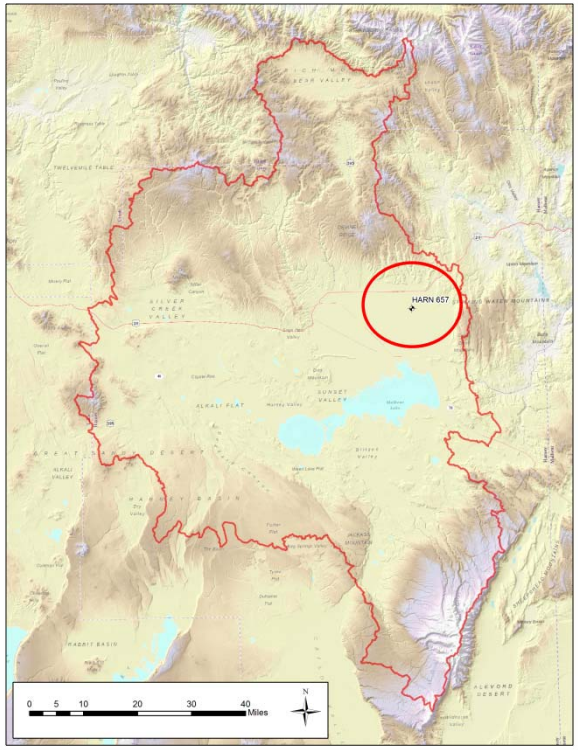
2014

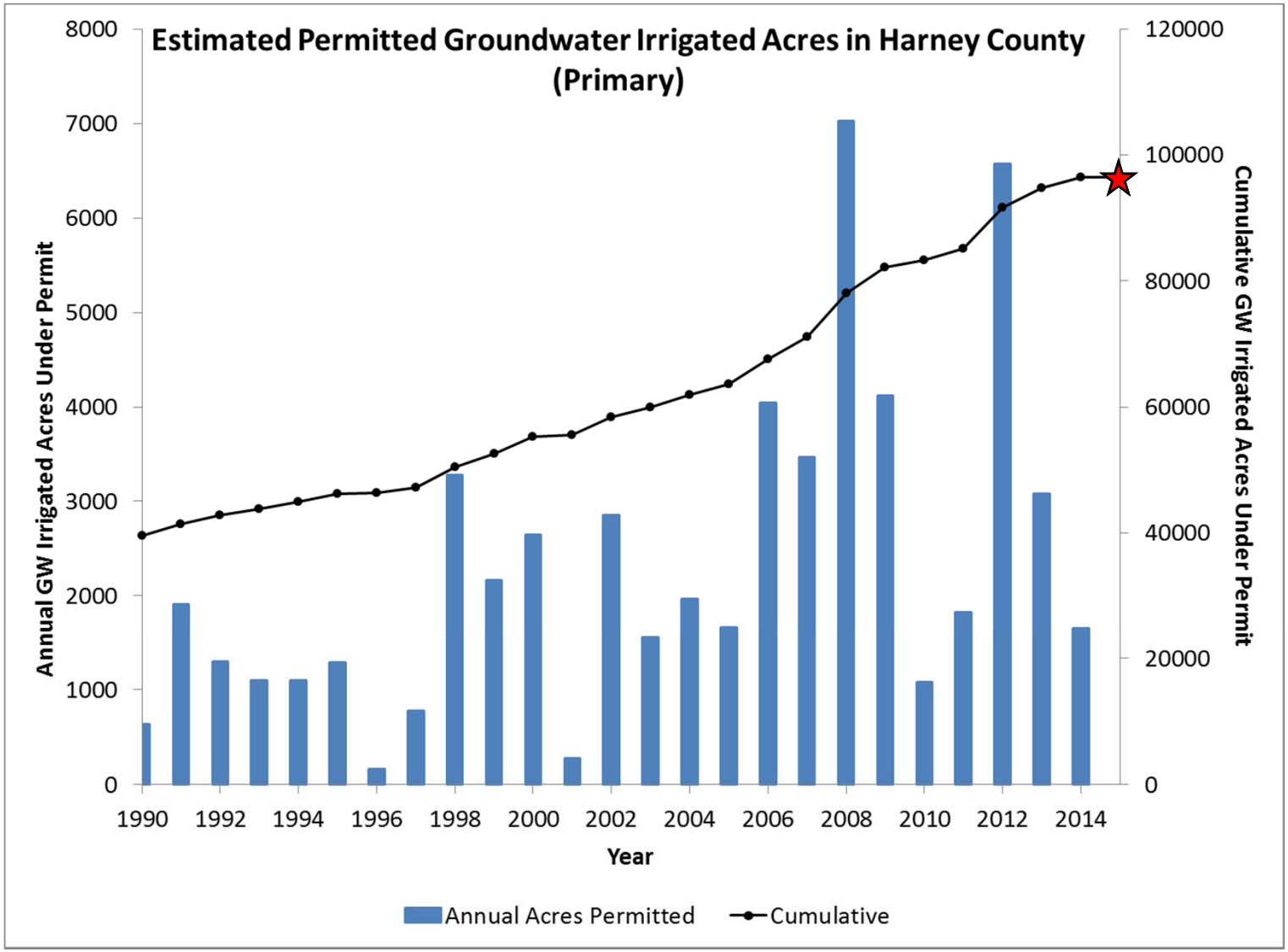

HARN 657
Groundwater feet below land surface
Groundwater Elevation (feet AMSL)
Date
10
20
30
40
50
60
70
4110
4100
4090
4080
4070
4060
2005
2010
2015


HARN 657
0 5 10 20 30 40 Miles
N

2014

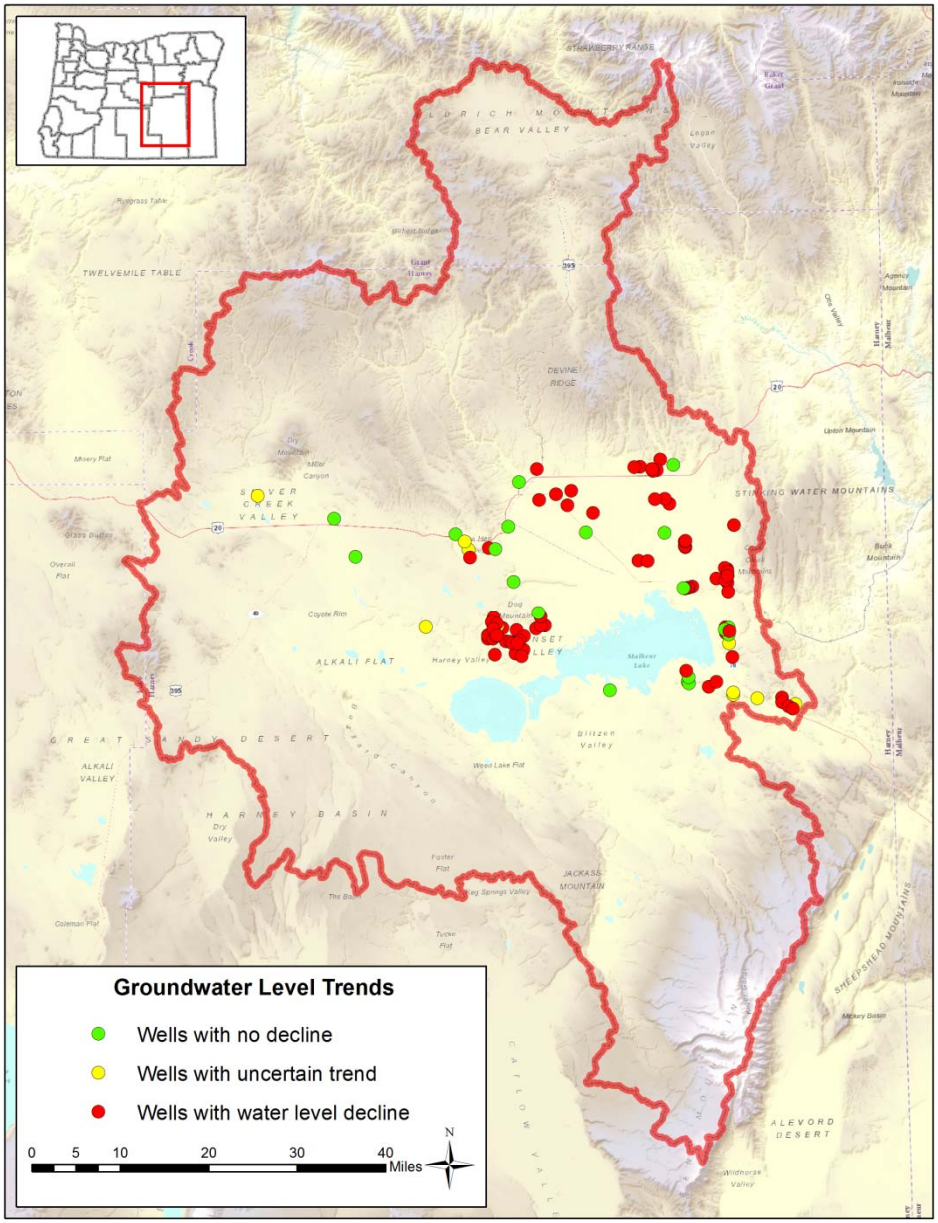

HARN 657
~2 ft/yr
Groundwater feet below land surface
Groundwater Elevation (feet AMSL)
Date
10
20
30
40
50
60
70
4110
4100
4090
4080
4070
4060
2005
2010
2015


HARN 657
0 5 10 20 30 40 Miles
N

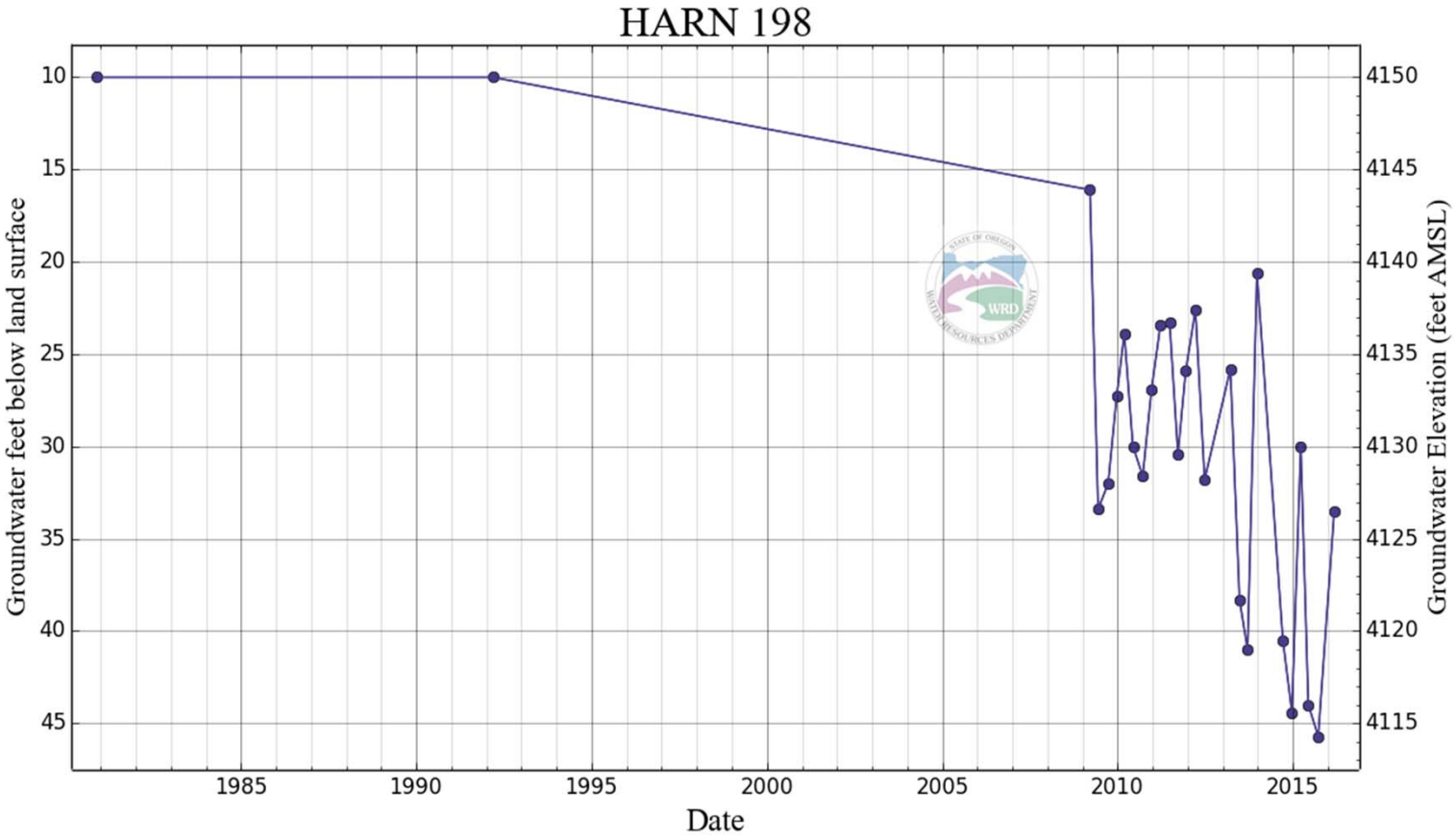


★ 2015:
- Additional water level data analysis points to widespread declines.
- Analysis of recharge vs use points to basin-wide over appropriation.
- First “GHVGAC” type “propose to deny” based on limited resource capacity.

Basin-wide water level trend analysis: 2015

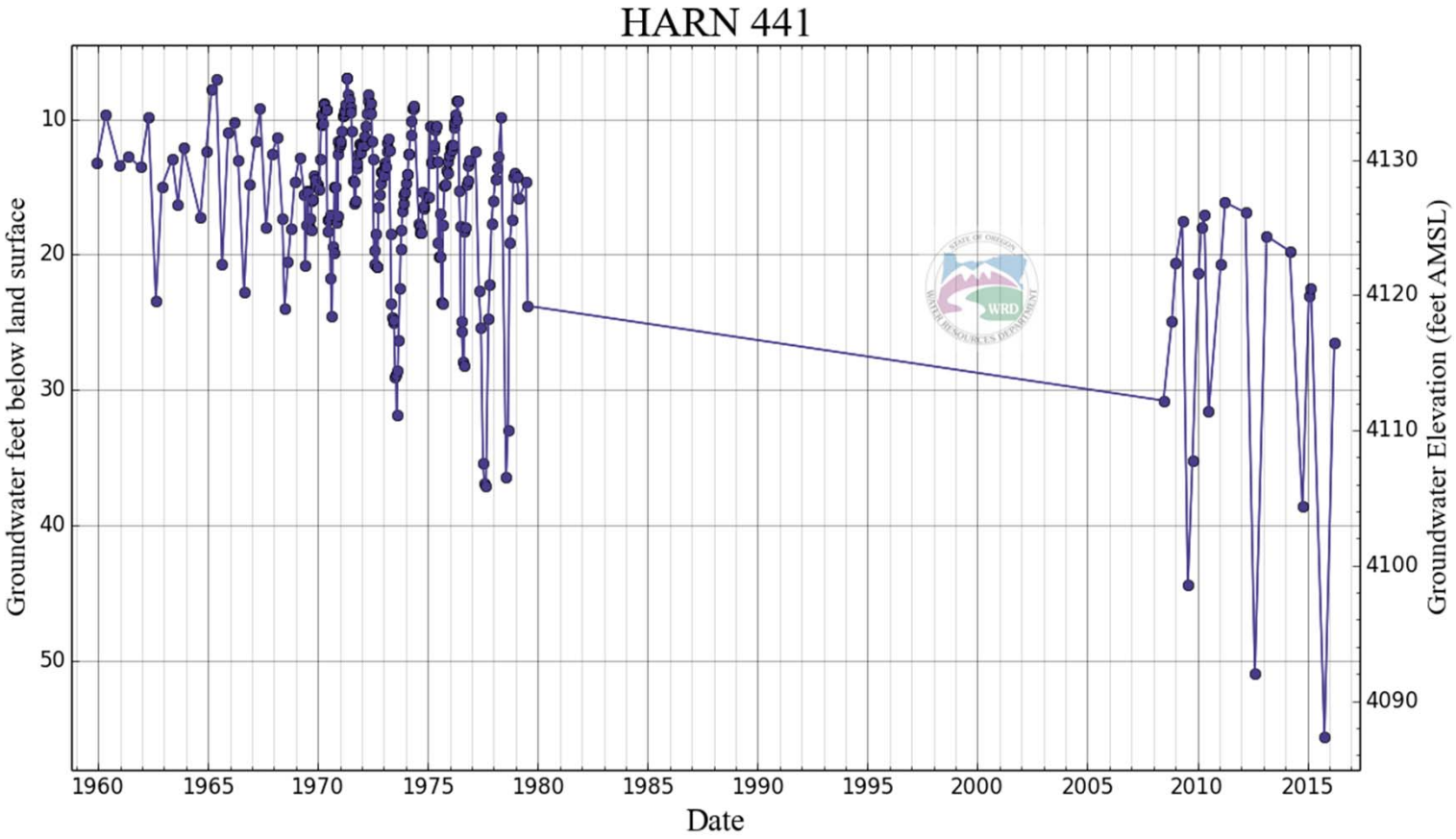


Basin-wide water level trend analysis: 2015



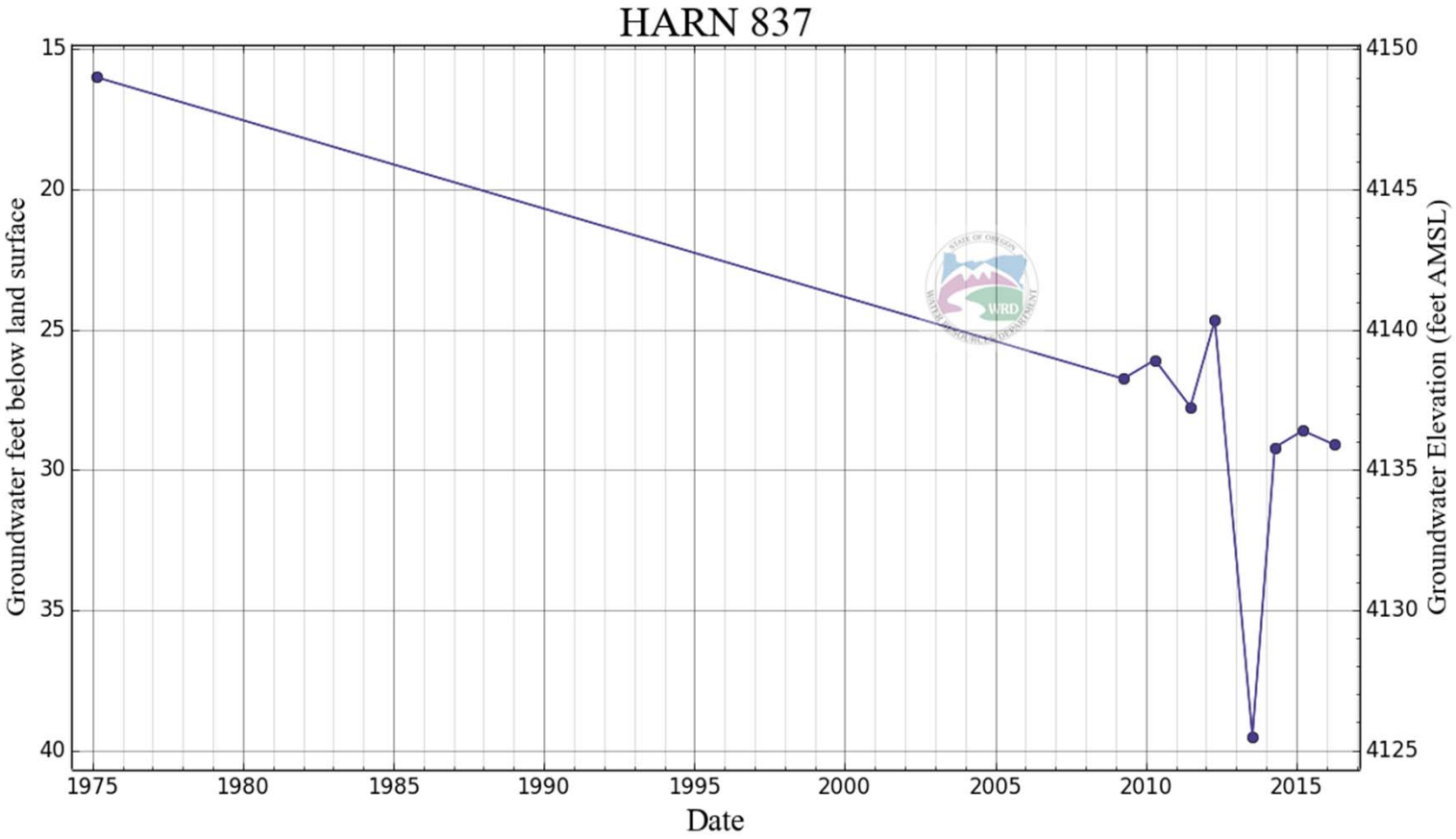
5.5 miles west of Buchanan; north of Hwy 20

Basin-wide water level trend analysis: 2015



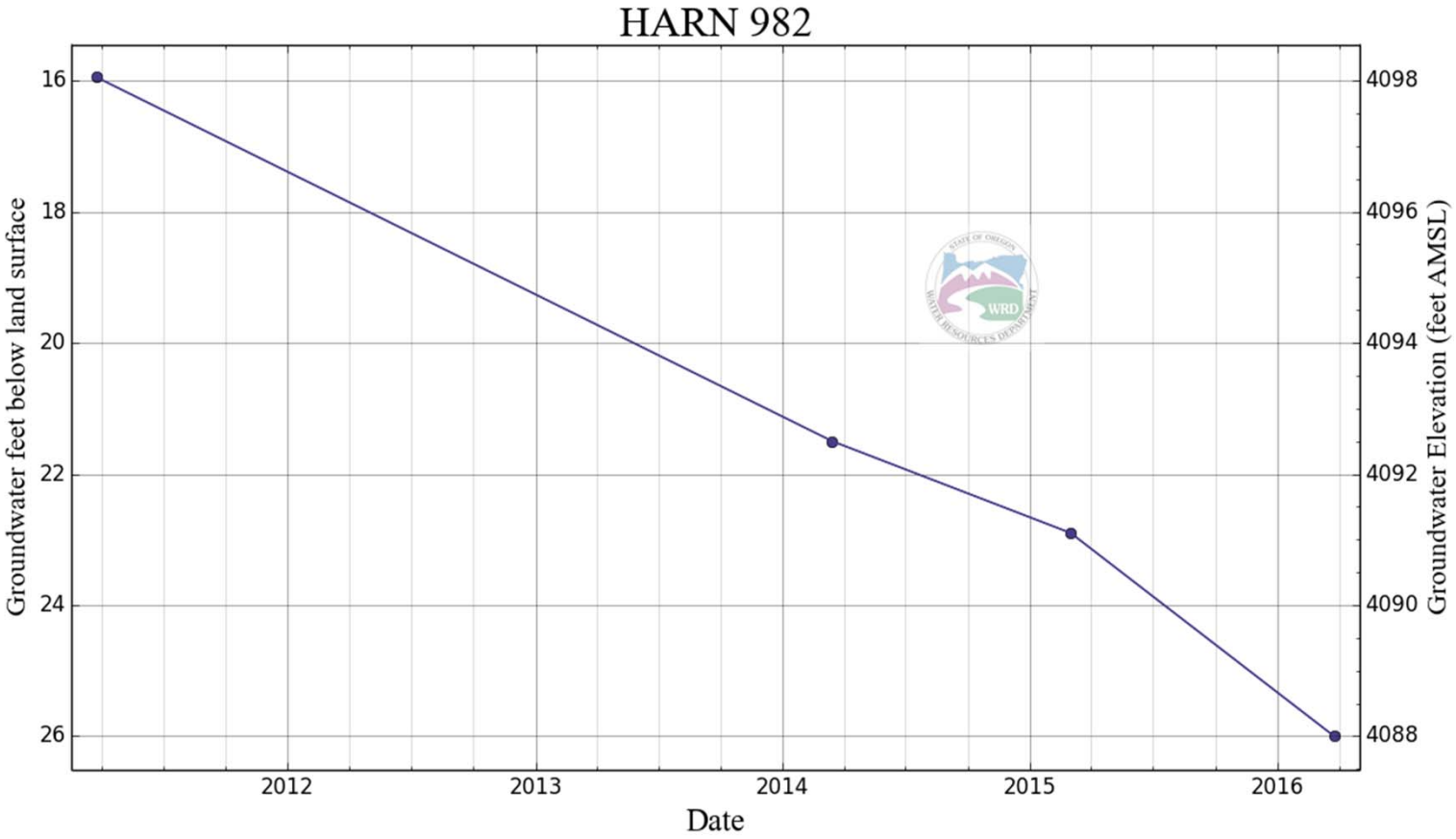
Burns Airport

Basin-wide water level trend analysis: 2015



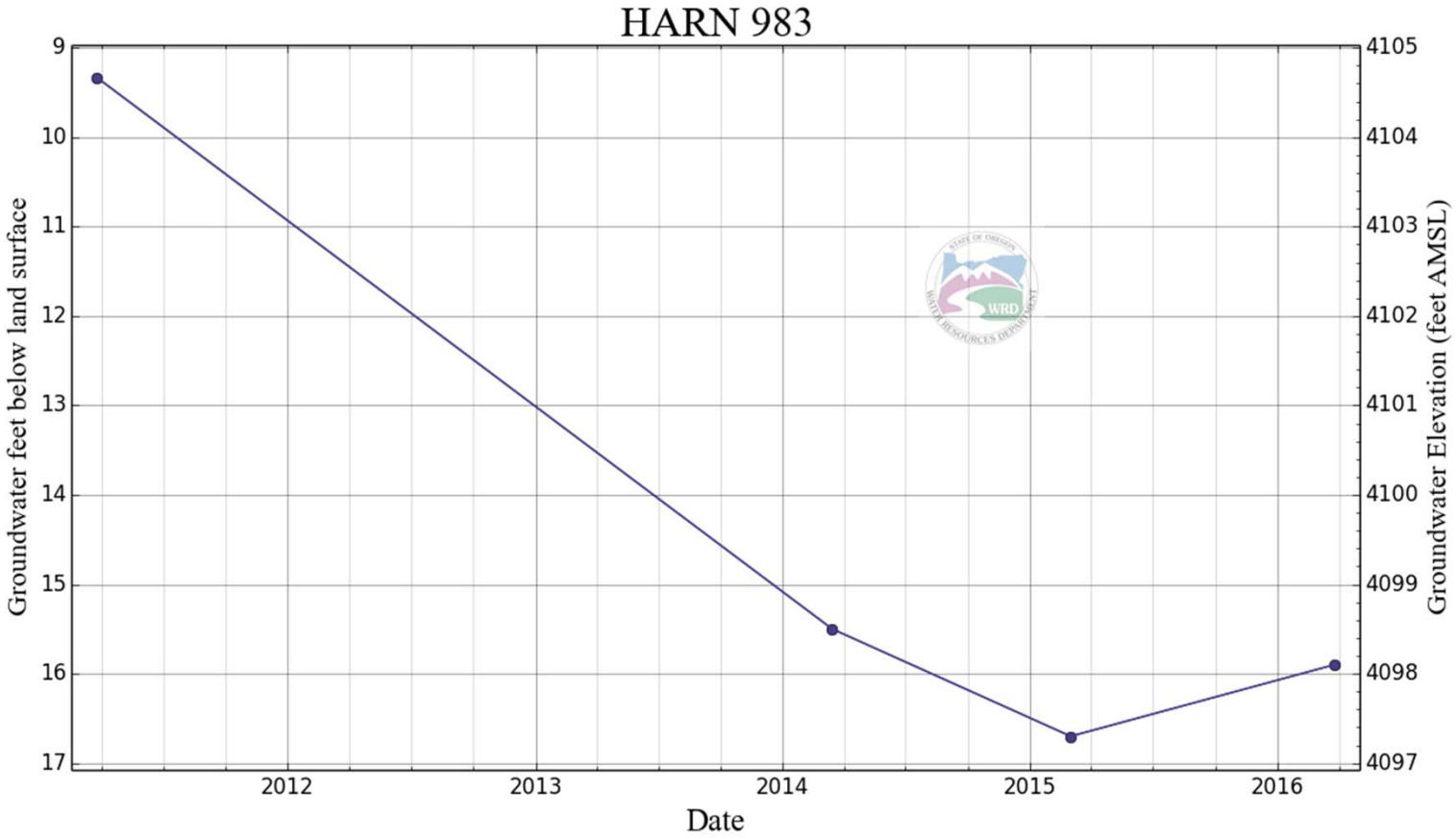
Sage Hen Valley

Basin-wide water level trend analysis: 2015



Central Valley area

Basin-wide water level trend analysis: 2015

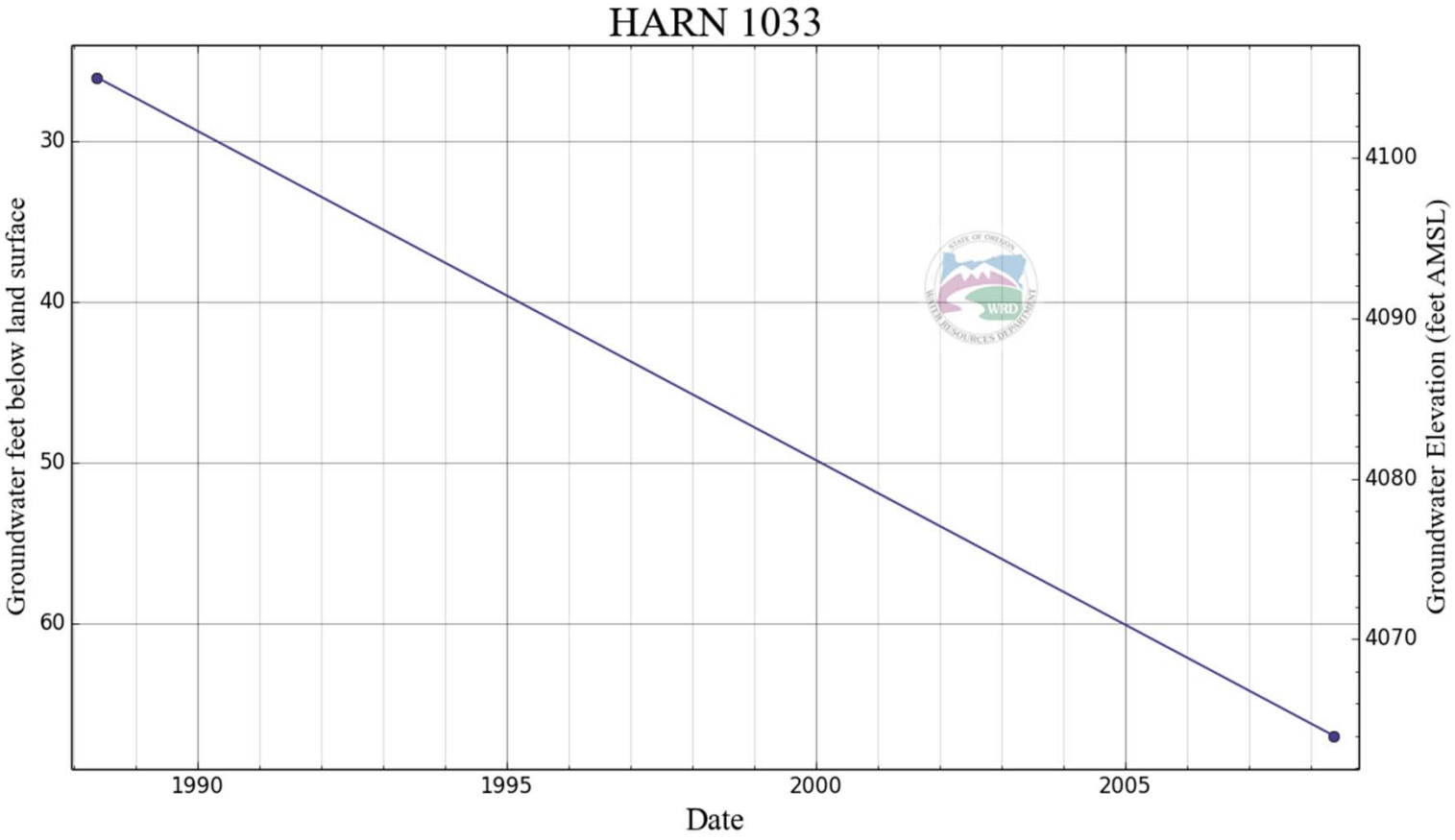


Central Valley area

Basin-wide water level trend analysis: 2015

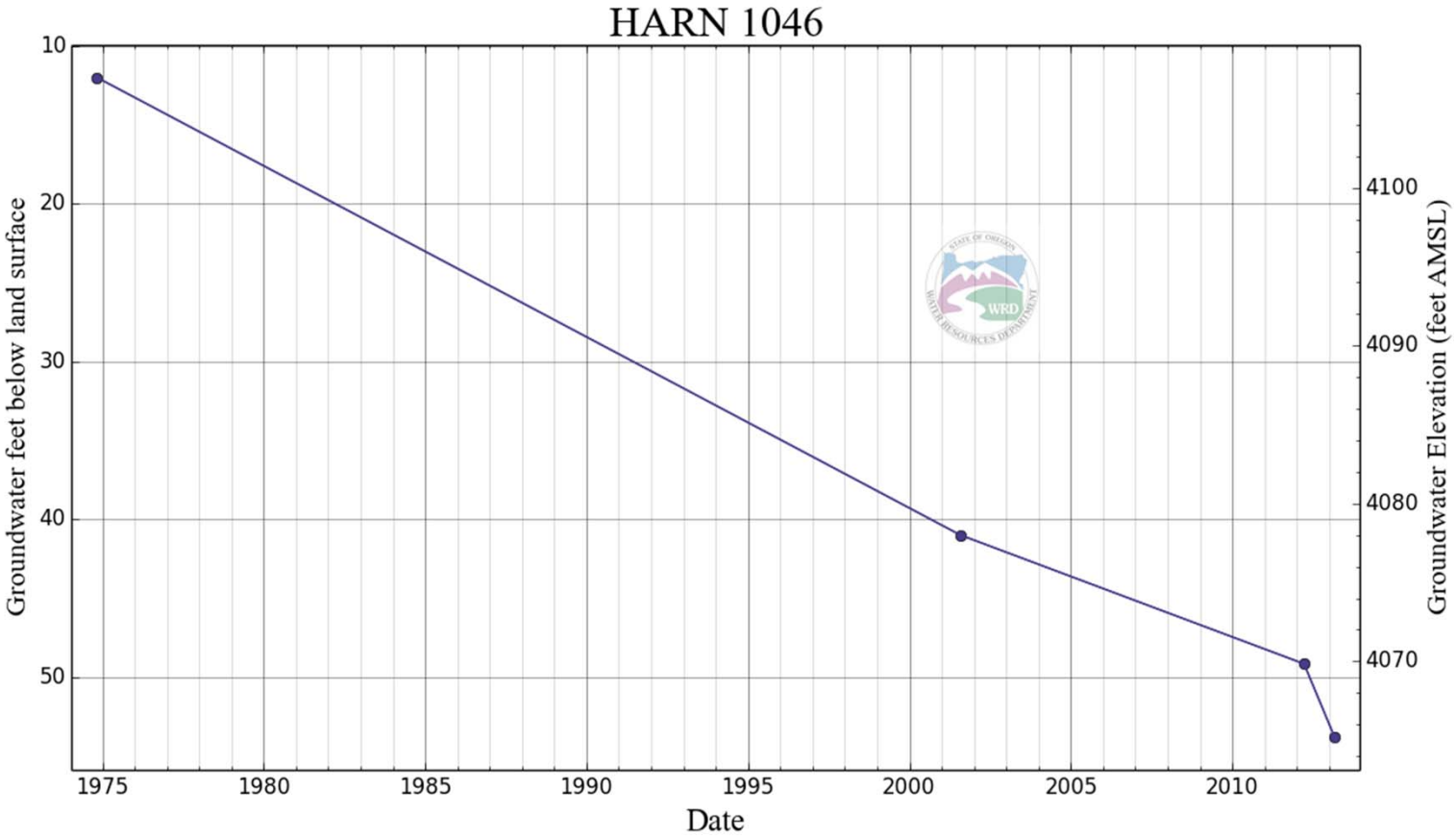
Central Valley area

Basin-wide water level trend analysis: 2015



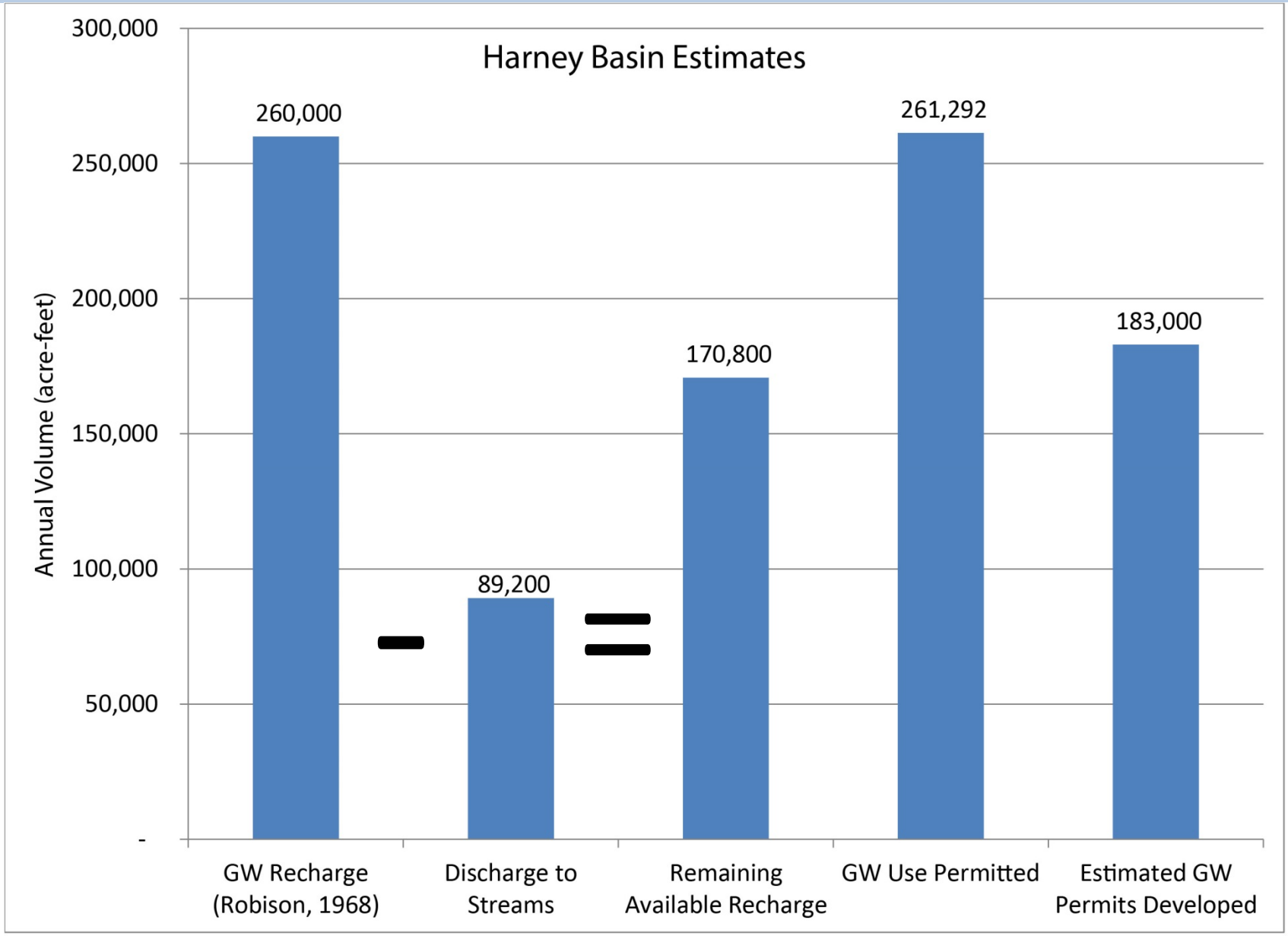
Crane area

Basin-wide water level trend analysis: 2015



Crane area

Aquifer Recharge Compared to Groundwater Permits



Purpose and Scope of the Groundwater Study

Need for the groundwater study

- Available data indicates aquifer recharge is insufficient to balance current use.
- Water level declines already observed over much of the basin.
- ~30% of existing allocations are not yet developed. Development of these acres will exacerbate the declines.

- **Protection of long-term resource sustainability**
- **Protection of senior surface water and groundwater rights**

Purpose & Scope of the Groundwater Study

Cooperators

- Oregon Water Resources Department (OWRD)
- United States Geological Survey (USGS)
- Oregon Department of Geology and Mineral Industries (DOGAMI)
- Local involvement through the Groundwater Study Advisory Committee

Study objectives

- Develop a commonly accepted and accurate understanding of the hydrologic system in the Harney Basin.

- Development of a strategy for water-resources management in the Harney Basin.

Purpose & Scope of the Groundwater Study

Primary Questions

1. What is the effect of historical and current groundwater use on groundwater and surface water supplies?

2. What will be the effects of additional groundwater use on groundwater and surface water supplies?

3. How can existing groundwater use be manages to best meet demand while avoiding or minimizing undesired impacts?

4. What are the effects of climate on the groundwater system?

5. What is the water budget of the Harney basin?

Purpose & Scope of the Groundwater Study

Technical objectives

- Gather existing data and water-resource information, assess the data accuracy and reliability, and enter data into appropriate project databases.
- Collect new data required to define the hydrogeologic system.
- Develop a detailed water budget of the study area.
- Develop an improved conceptual model of the Harney Basin groundwater-flow system.

Purpose & Scope of the Groundwater Study

Geologic Framework

- Delineate stratigraphy of geologic units
- Construct regional lithofacies maps
- Determine location and offset of major structures
- Assess effects of faults and other structures on groundwater movement
- Assess change in permeability with depth due to secondary mineralization
- Assess the relation between the thermal and non-thermal groundwater systems
- Analyze drill cuttings from water wells and OWRD test holes
- Geophysical logging of selected wells
- Construct regional cross sections
- Compile regional geologic map and develop consistent stratigraphic nomenclature
- Define and map regionally significant hydrogeologic units

Purpose & Scope of the Groundwater Study

Hydrologic data collection and flow-system evaluation

- Field inventory existing wells
- Compilation of existing water level
- Collection of new water level data
- Conduct new aquifer tests
- Evaluate and interpret water level data
  - Determine GW flow direction
  - Determine GW response to stresses
- Evaluate geochemistry data
  - Age dating
  - Chemical tracers
- Evaluate possible GW subbasins
- Estimate aquifer properties

Purpose & Scope of the Groundwater Study

Hydrologic budget

- Estimate GW discharge to wells
- Estimate GW discharge to streams
- Estimate GW discharge to springs, lakes, wetlands
- Estimate recharge
  - From precipitation
  - From irrigation return flow
  - From surface water
- Evaluate possible interbasin flow

Purpose & Scope of the Groundwater Study

Study Outcomes

- A peer reviewed technical report that will include:
  - A quantitative conceptual understanding of the groundwater flow system
  - A water-budget model for the basin
  - An extensive database of hydrogeologic information

Development of the observation well network

- Five types of observations wells:
  - State Observation wells
  - Quarterly observation wells
  - Synoptic observation wells
  - Recorder wells
  - OWRD dedicated observation well pairs
- General selection criteria (for all types):
  - Geographic distribution
  - Vertical distribution
  - Accessibility

State Observation Wells

- State Observation Wells:
  - Measured quarterly by field staff
  - Domestic, livestock, irrigation, unused wells.
  - Selection criteria:
    1. Located where water level data is needed
    2. Well construction/completion is known
    3. Accessible long term

Quarterly Wells

- <u>Quarterly observation wells:</u>
  - January, April, July, October
  - Domestic, livestock, unused wells.
  - Selection criteria:
    1. Located where water level data is needed
    2. Well construction/completion is known
    3. Historical record
    4. Generally not pumping
    5. Accessible

Synoptic Wells

- Synoptic observation wells:
  - Twice per year – before and after irrigation season
  - Includes all quarterly obs. wells, SOW's, plus additional permitted irrigation wells and other misc. wells.
  - Selection criteria:
    1. Located where water level data is needed
    2. Well construction/completion is known
    3. Historical record
    4. Accessible

Recorder Wells

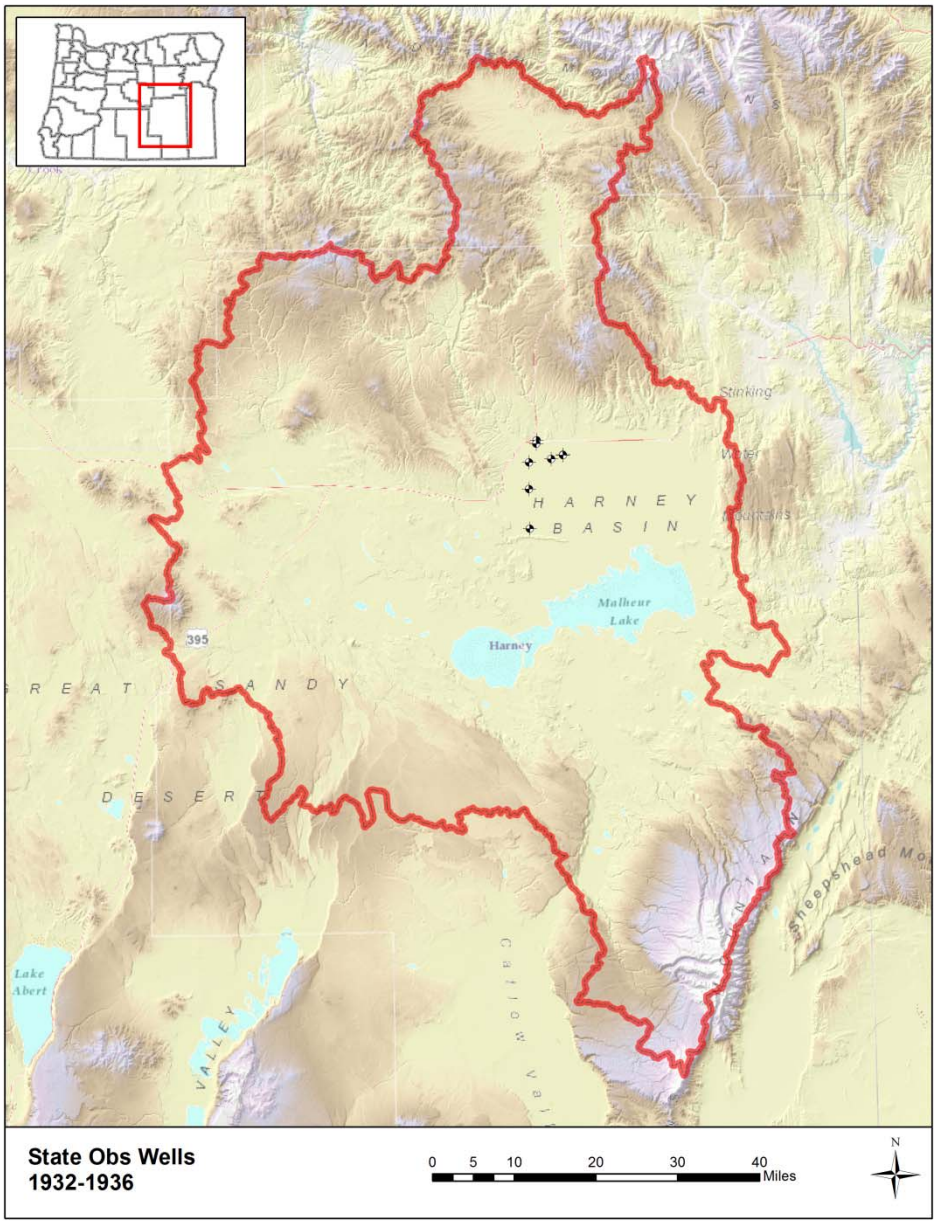
- <u>Recorder wells:</u>
  - Continuous data collection (every 1-2 hours)
  - Selection criteria:
    1. Located where water level data is needed
    2. Well construction/completion is known
    3. Unused well with no pump
    4. Accessible

Dedicated Observation Well Pairs

- <u>OWRD dedicated observation well pairs:</u>
  - Continuous data collection (every 1-2 hours)
  - Shallow/Deep pairs drilled by OWRD contractors
  - Selection criteria:
    1. Located where water level data is needed
    2. Located where stratigraphic data is needed
    3. Located in areas of particular interest
    4. Accessible long term

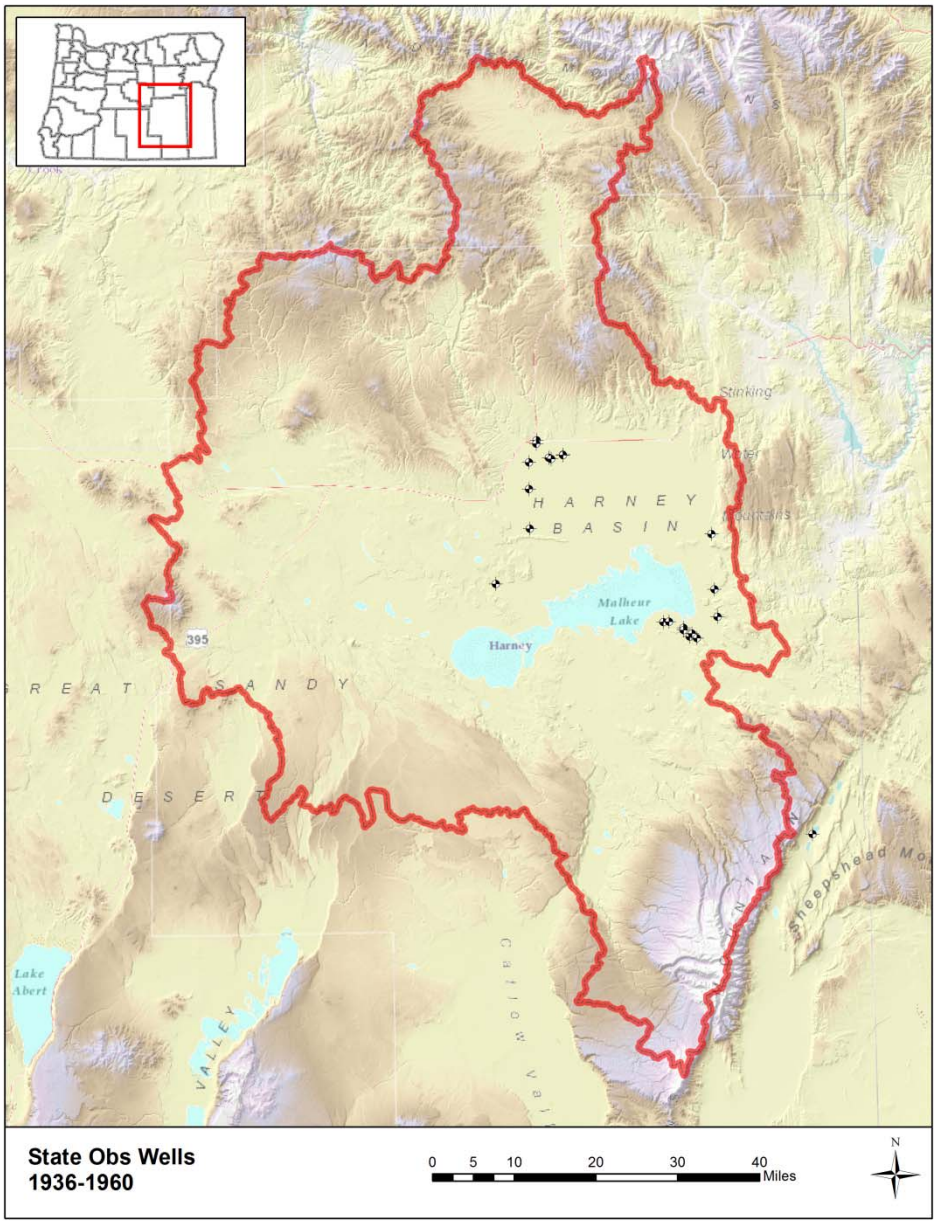
State Observation Wells: 1932-1936

- 1932-1936: 9 State Obs Wells



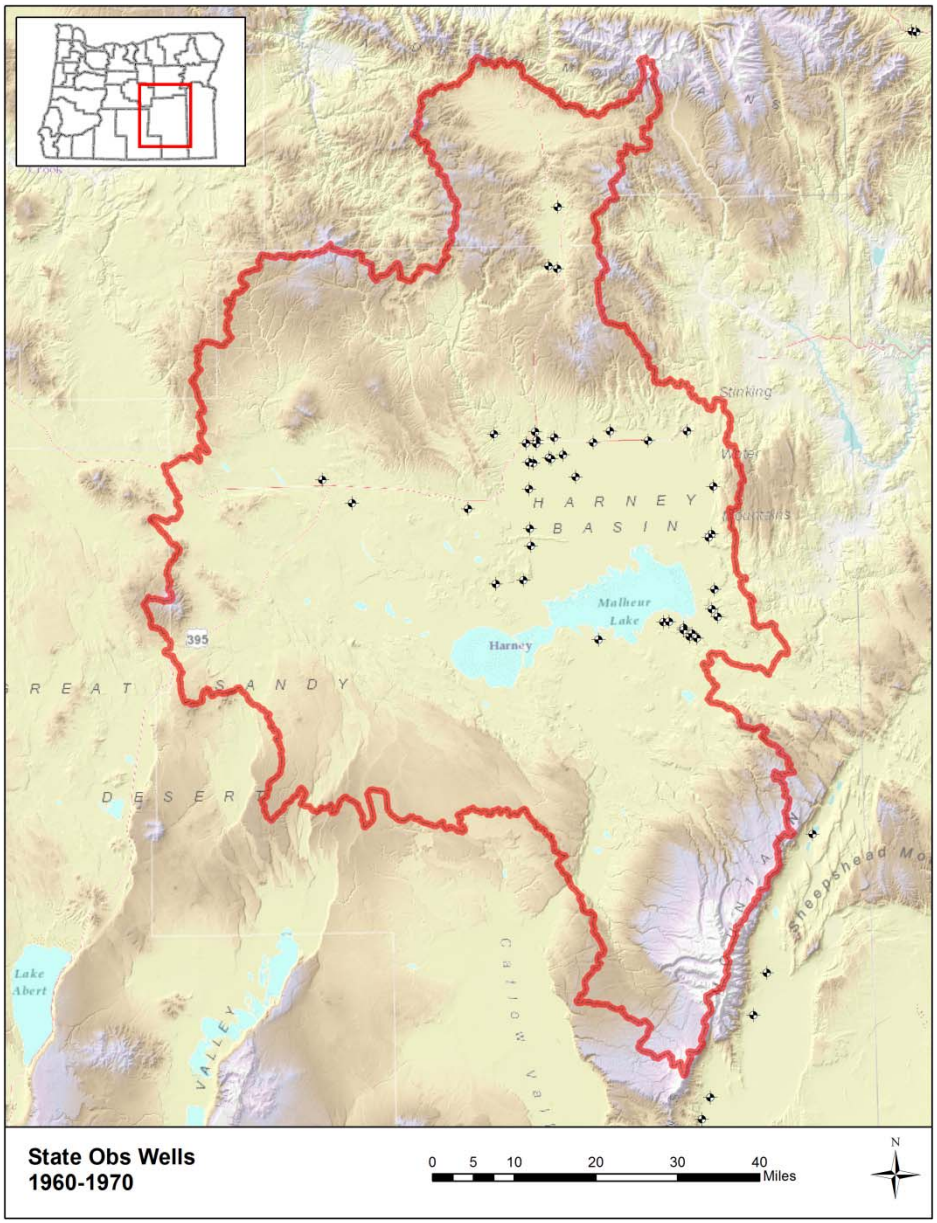
State Observation Wells: 1936-1960

- 1932-1936: 9 State Obs Wells
- 1936-1960: 23 State Obs Wells



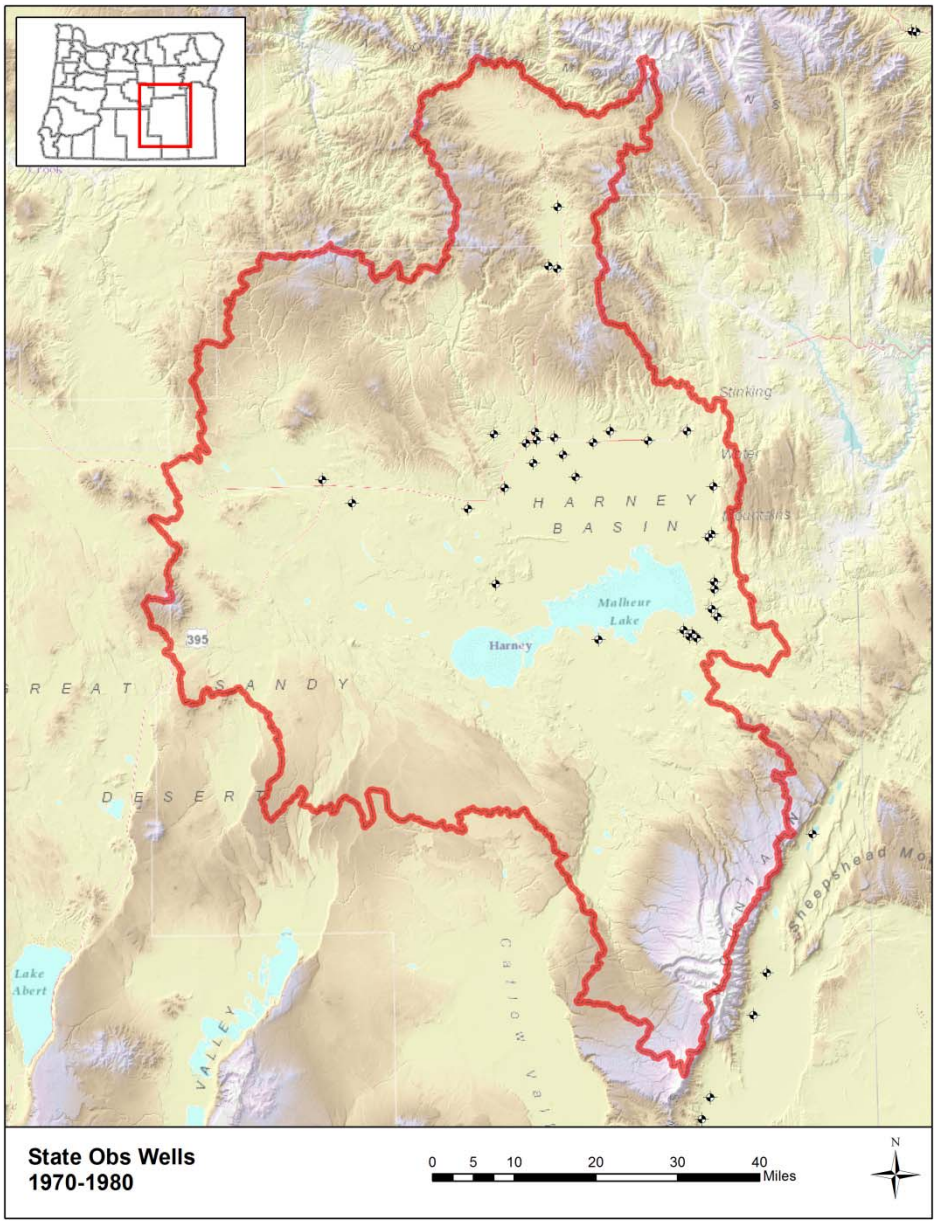
State Observation Wells: 1960-1970

- 1932-1936: 9 State Obs Wells
- 1936-1960: 24 State Obs Wells
- 1960-1970: 53 State Obs Wells



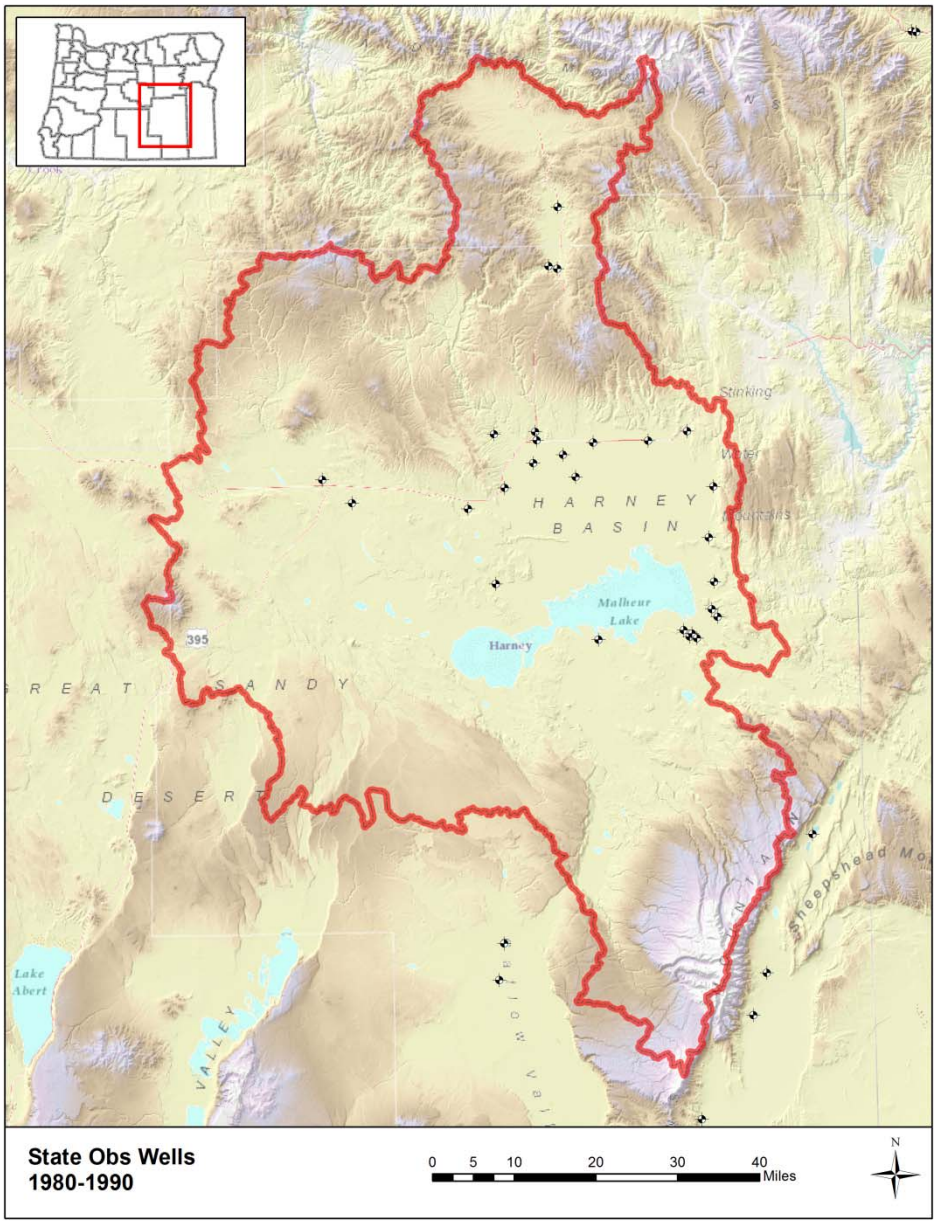
State Observation Wells: 1970-1980

- 1932-1936: 9 State Obs Wells
- 1936-1960: 24 State Obs Wells
- 1960-1970: 53 State Obs Wells
- 1970-1980: 43 State Obs Wells



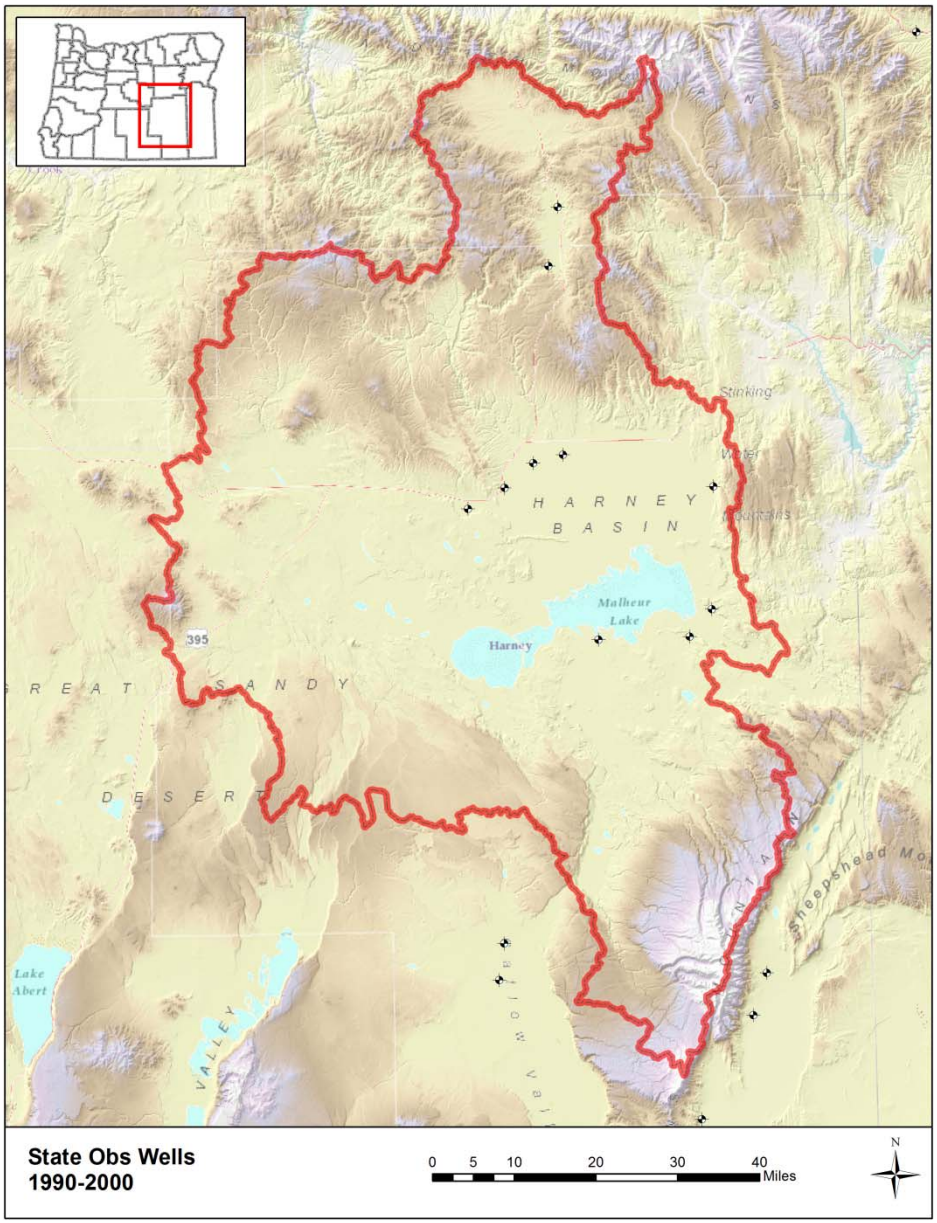
State Observation Wells: 1980-1990

- 1932-1936: 9 State Obs Wells
- 1936-1960: 24 State Obs Wells
- 1960-1970: 53 State Obs Wells
- 1970-1980: 43 State Obs Wells
- 1980-1990: 38 State Obs Wells



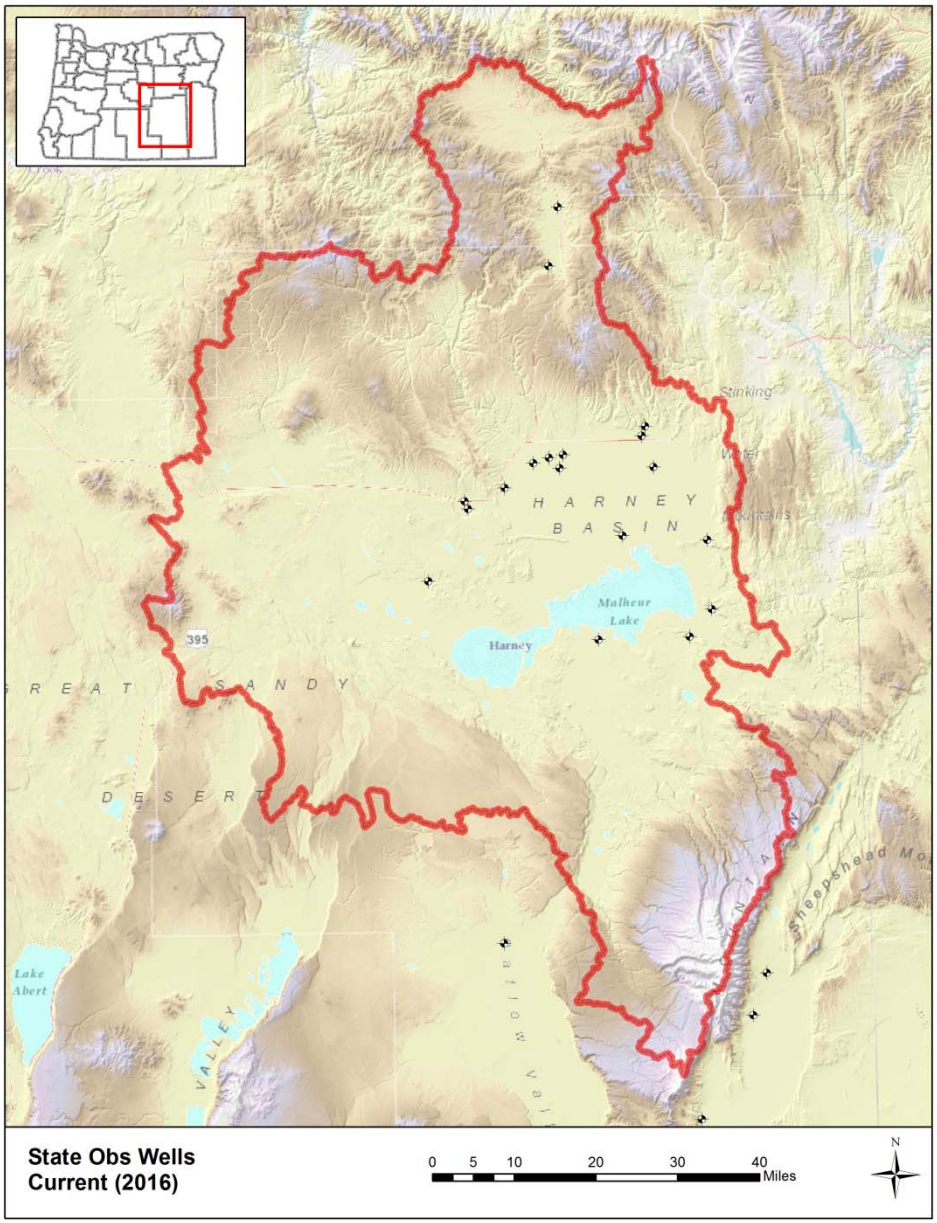
State Observation Wells: 1990-2000

- 1932-1936: 9 State Obs Wells
- 1936-1960: 24 State Obs Wells
- 1960-1970: 53 State Obs Wells
- 1970-1980: 43 State Obs Wells
- 1980-1990: 38 State Obs Wells
- 1990-2000: 16 State Obs Wells
  - 22 SOW's dropped in 1990



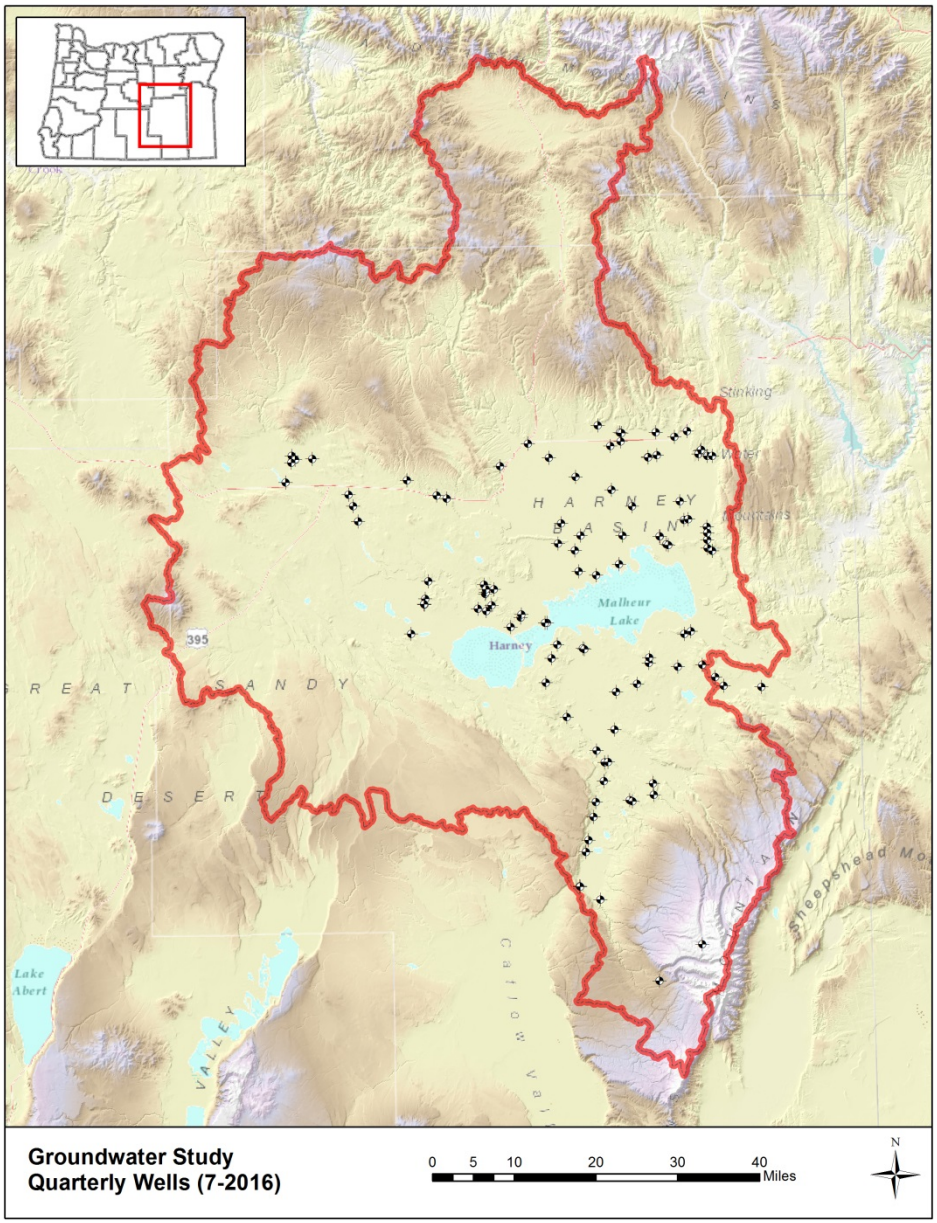
State Observation Wells: 2016

- 1932-1936: 9 State Obs Wells
- 1936-1960: 24 State Obs Wells
- 1960-1970: 53 State Obs Wells
- 1970-1980: 43 State Obs Wells
- 1980-1990: 38 State Obs Wells
- 1990-2000: 16 State Obs Wells
- Current (2016): 25 State Obs Wells



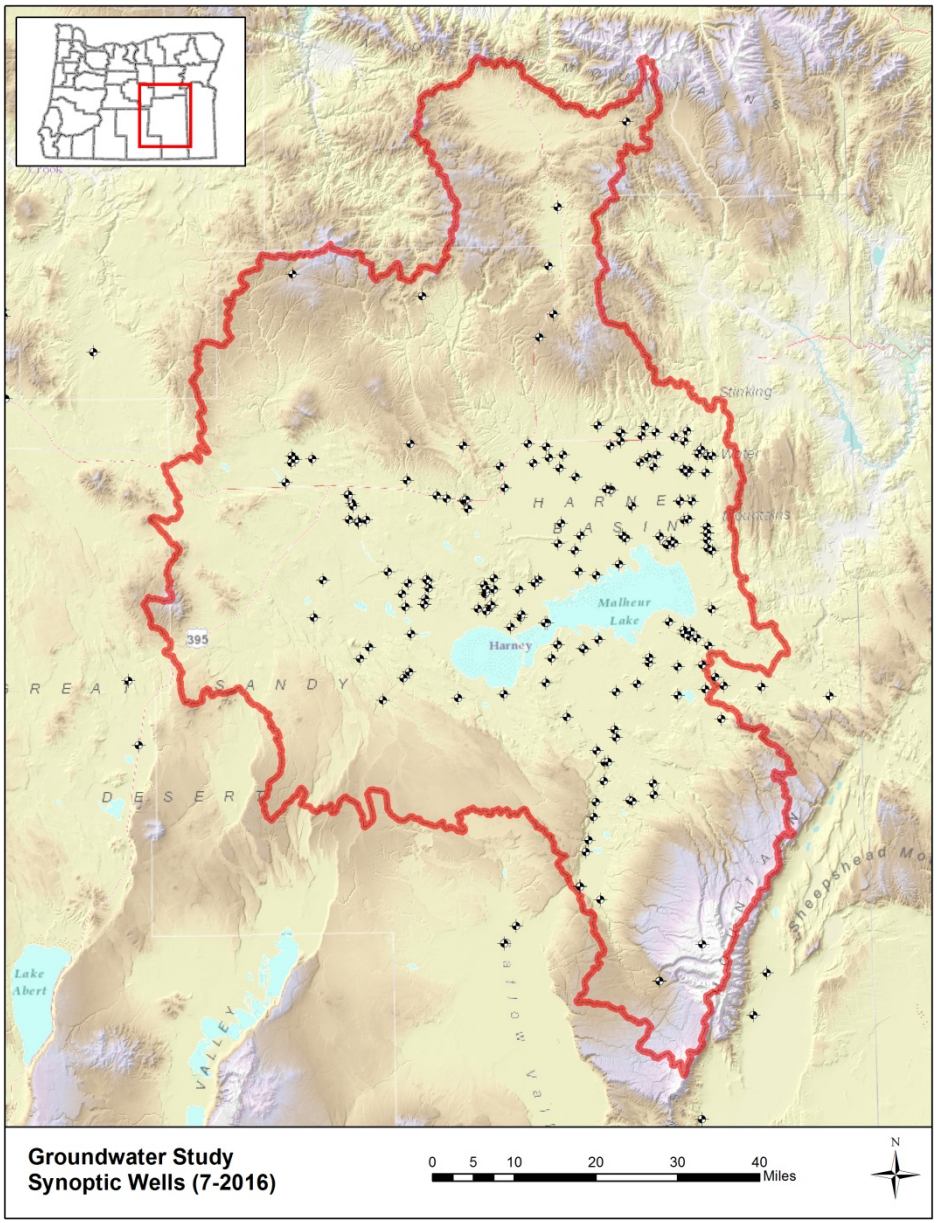
Groundwater Study: Quarterly Wells

- **<u>112 quarterly wells as of July 2016</u>**
- Continue to add wells where needed
- Continue to drop wells as redundancies or other issues are identified



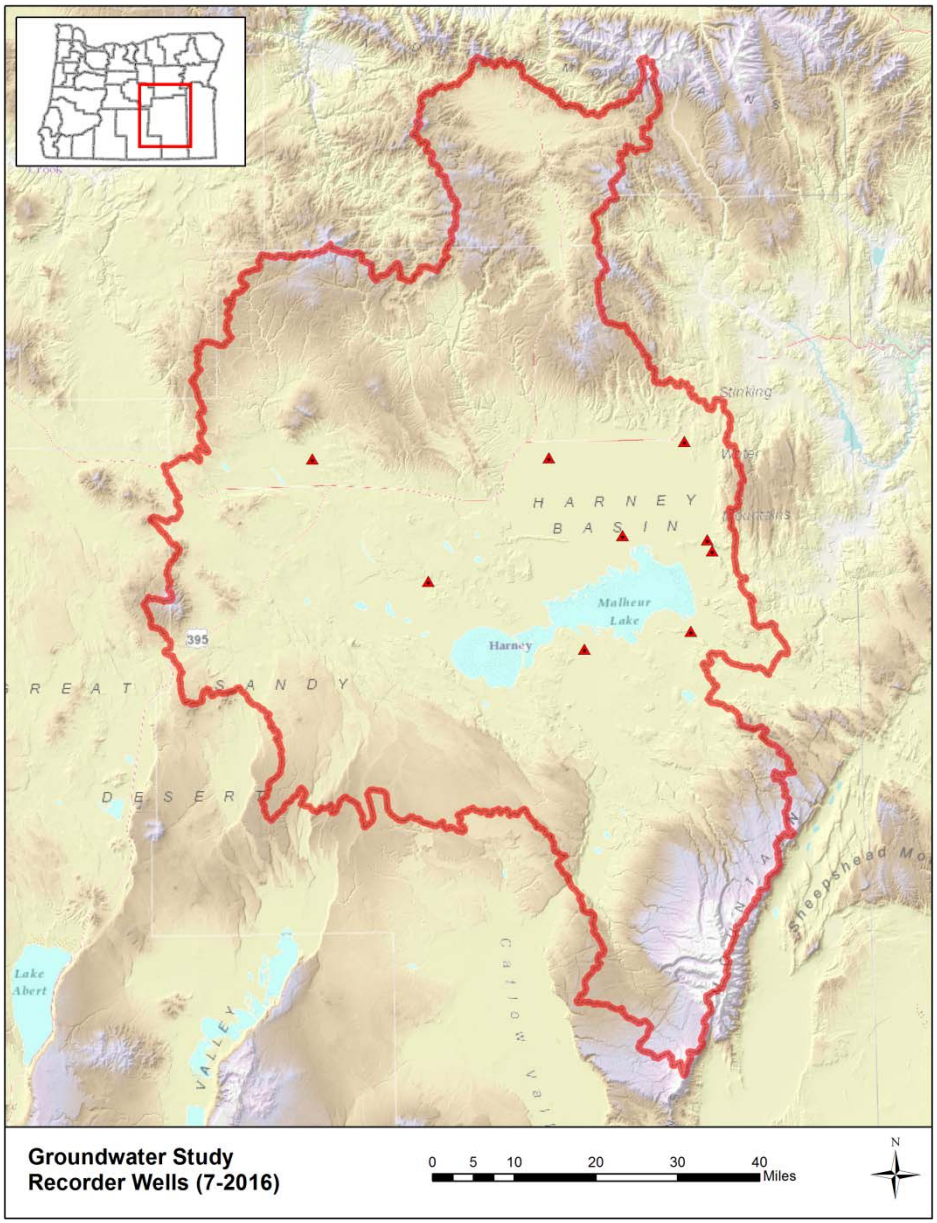
Groundwater Study: Synoptic Wells

- **<u>192 synoptic wells as of July 2016</u>**
- Continue to add wells where needed
- Continue to drop wells as redundancies or other issues are identified



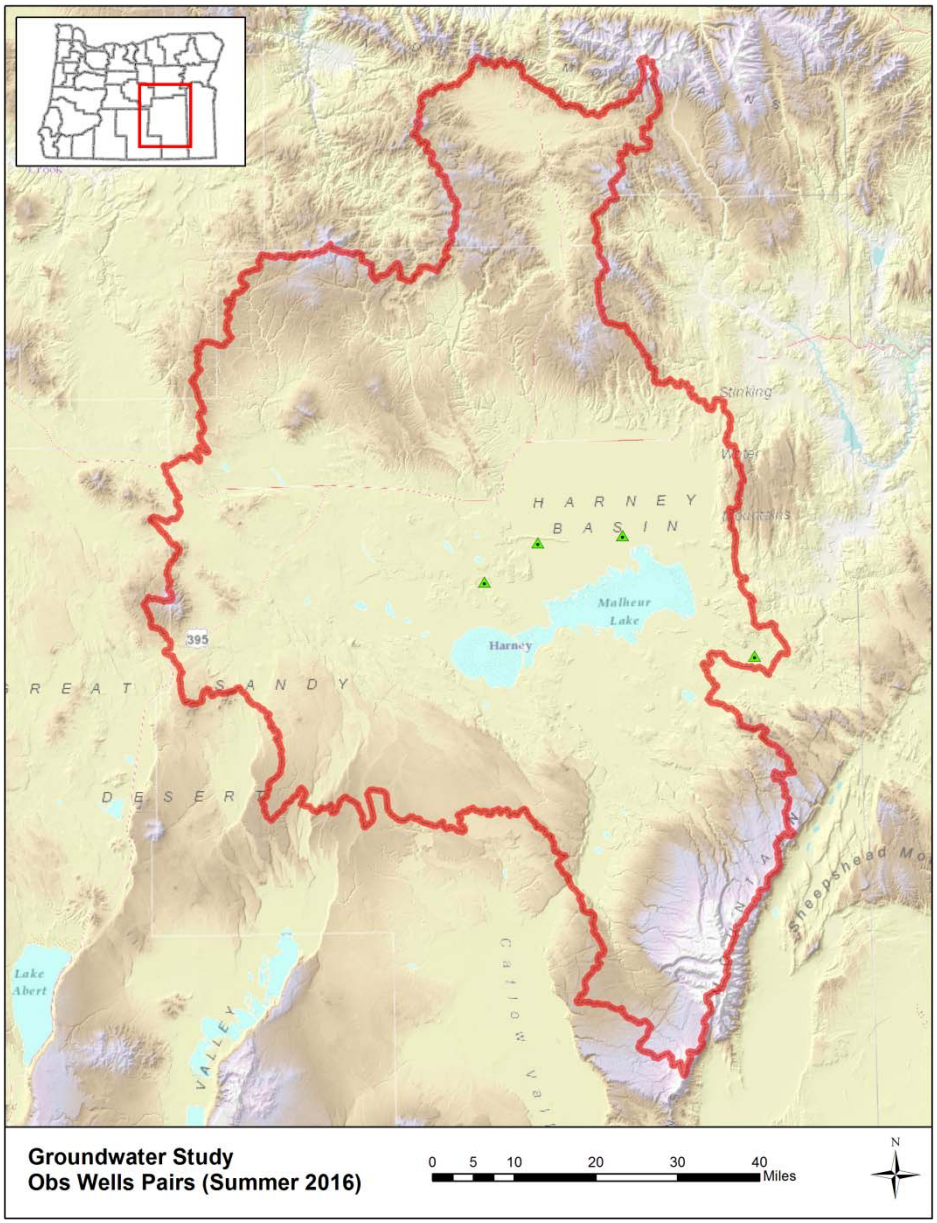
Groundwater Study: Recorder Wells

- **<u>10 recorder wells as of July 2016</u>**
- Continue to add wells where needed
- Continue to drop wells as redundancies or other issues are identified



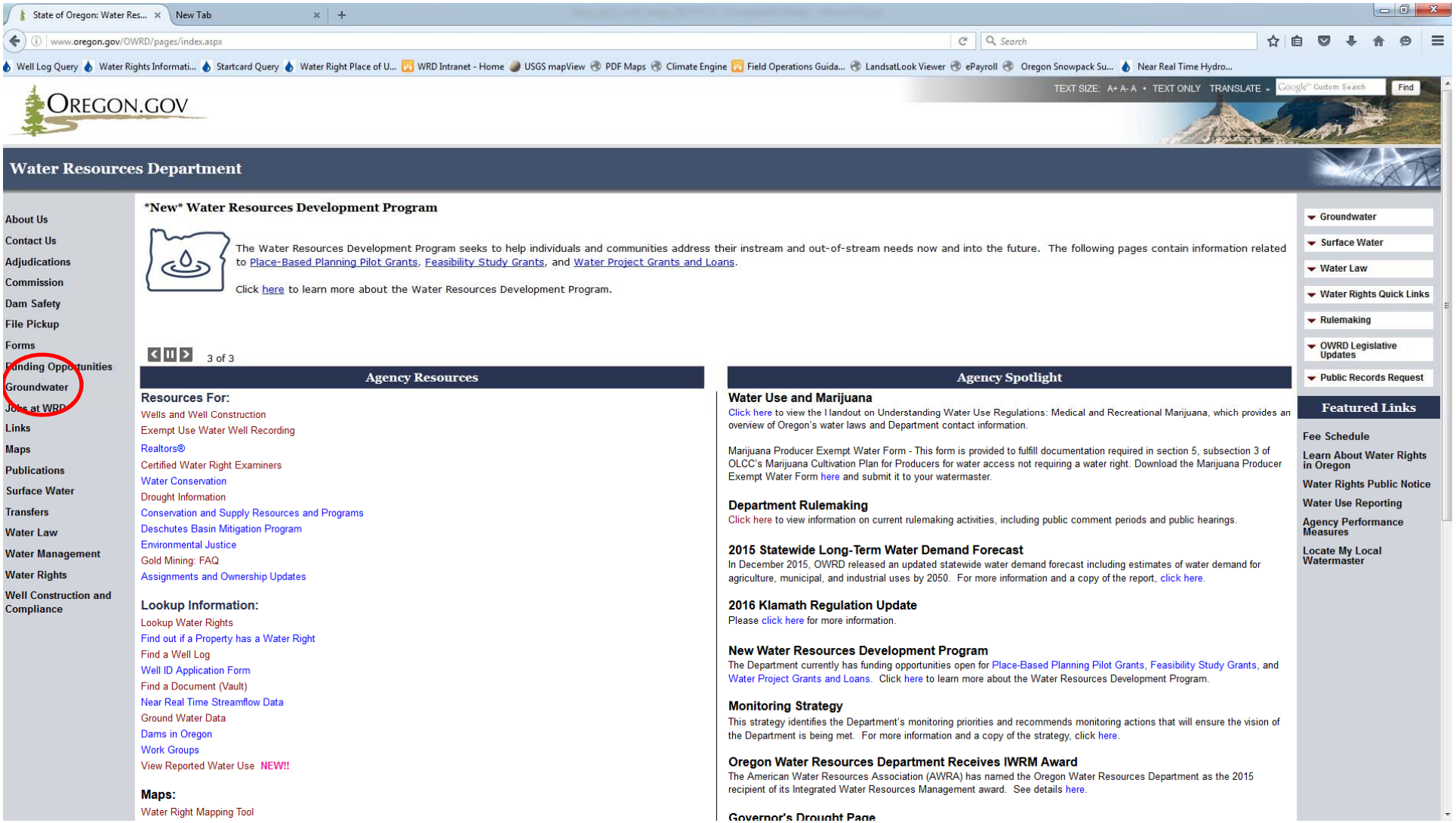
Groundwater Study: Obs Well Pairs

- **<u>1 obs well pair as of July 2016</u>**
- 3 pairs contracted for Summer 2016
- Up to 6 additional pairs pending



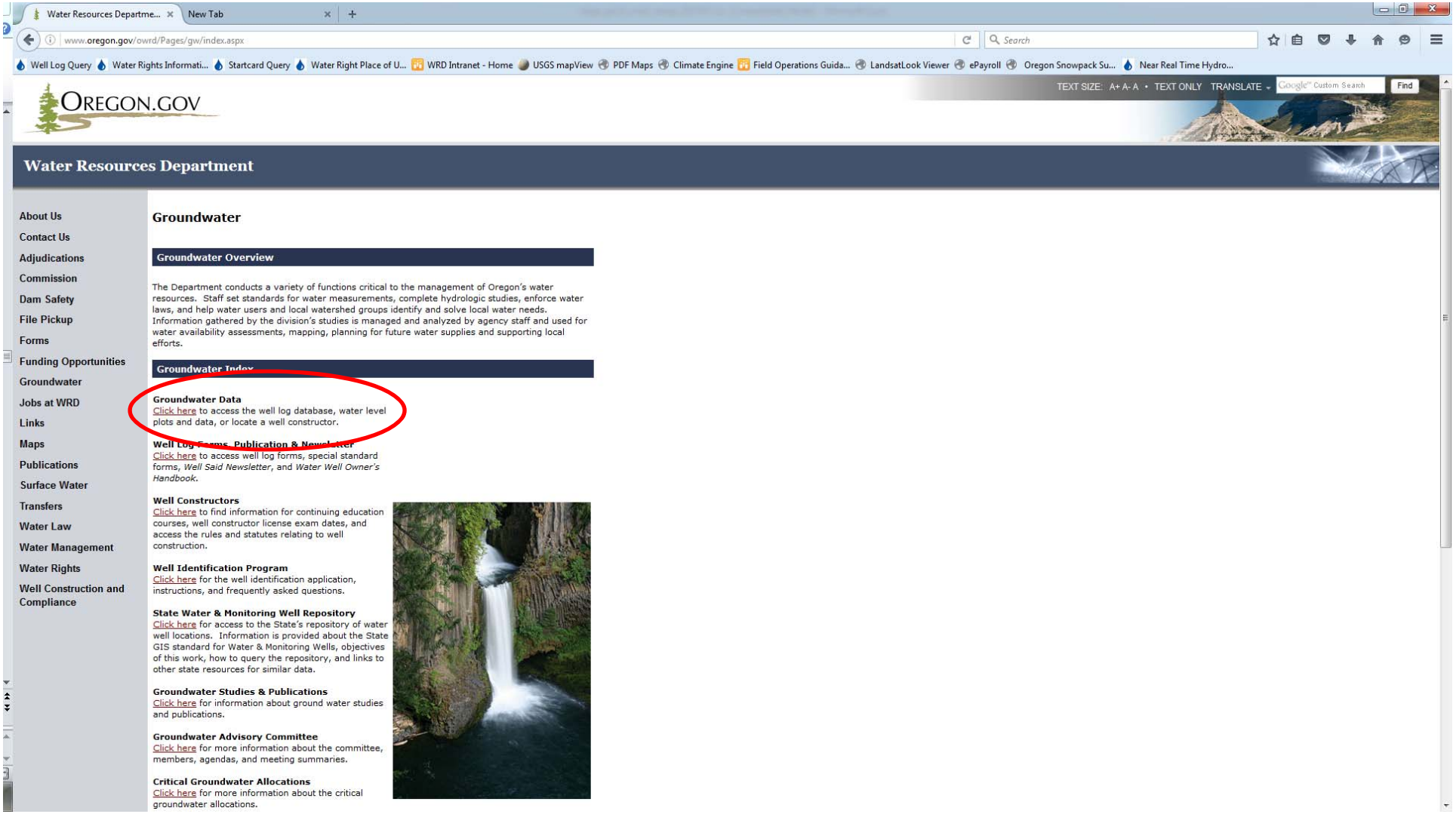
OWRD Data Online

http://www.oregon.gov/owrd/pages/index.aspx



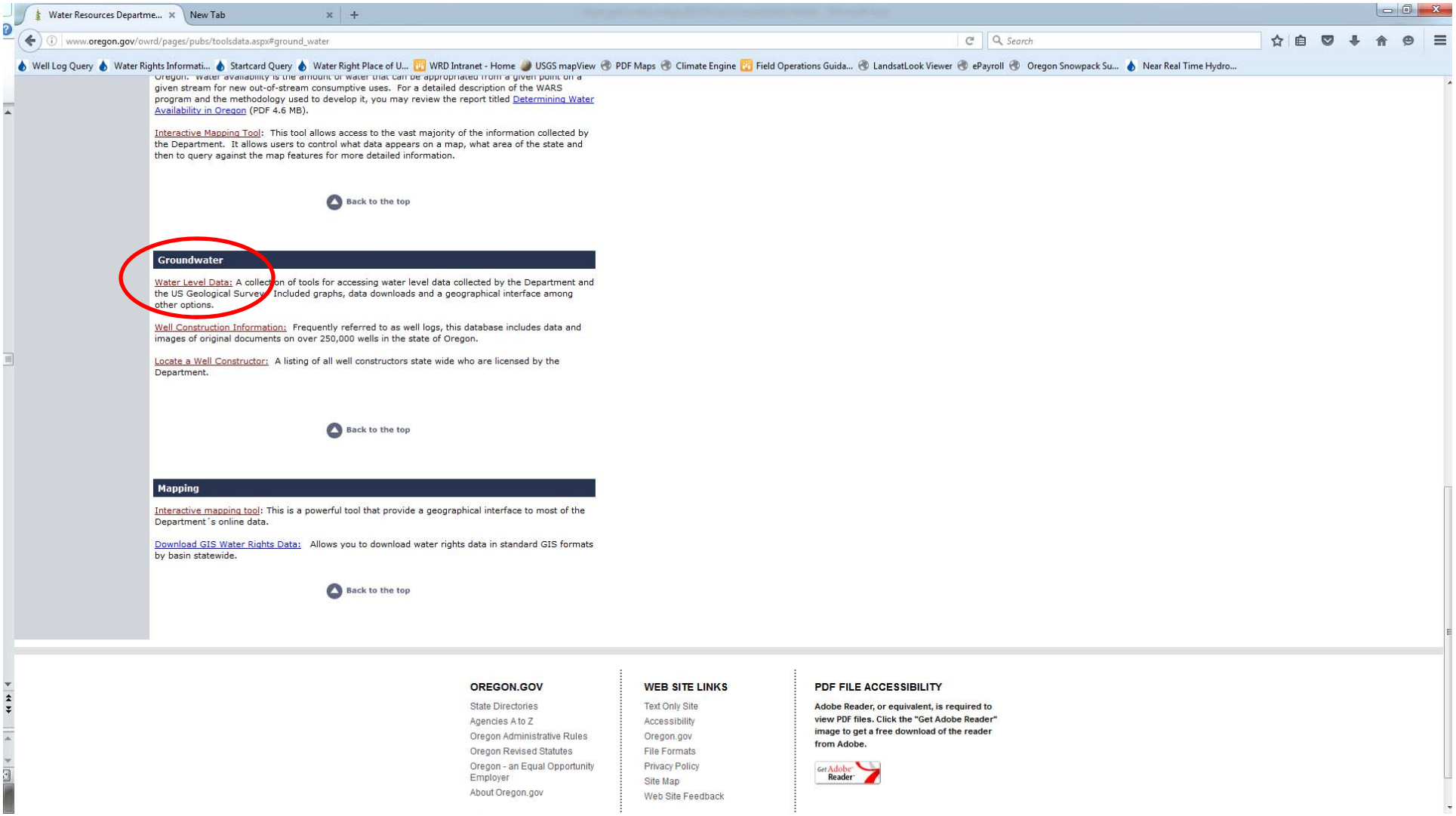
OWRD Data Online

http://www.oregon.gov/owrd/pages/index.aspx



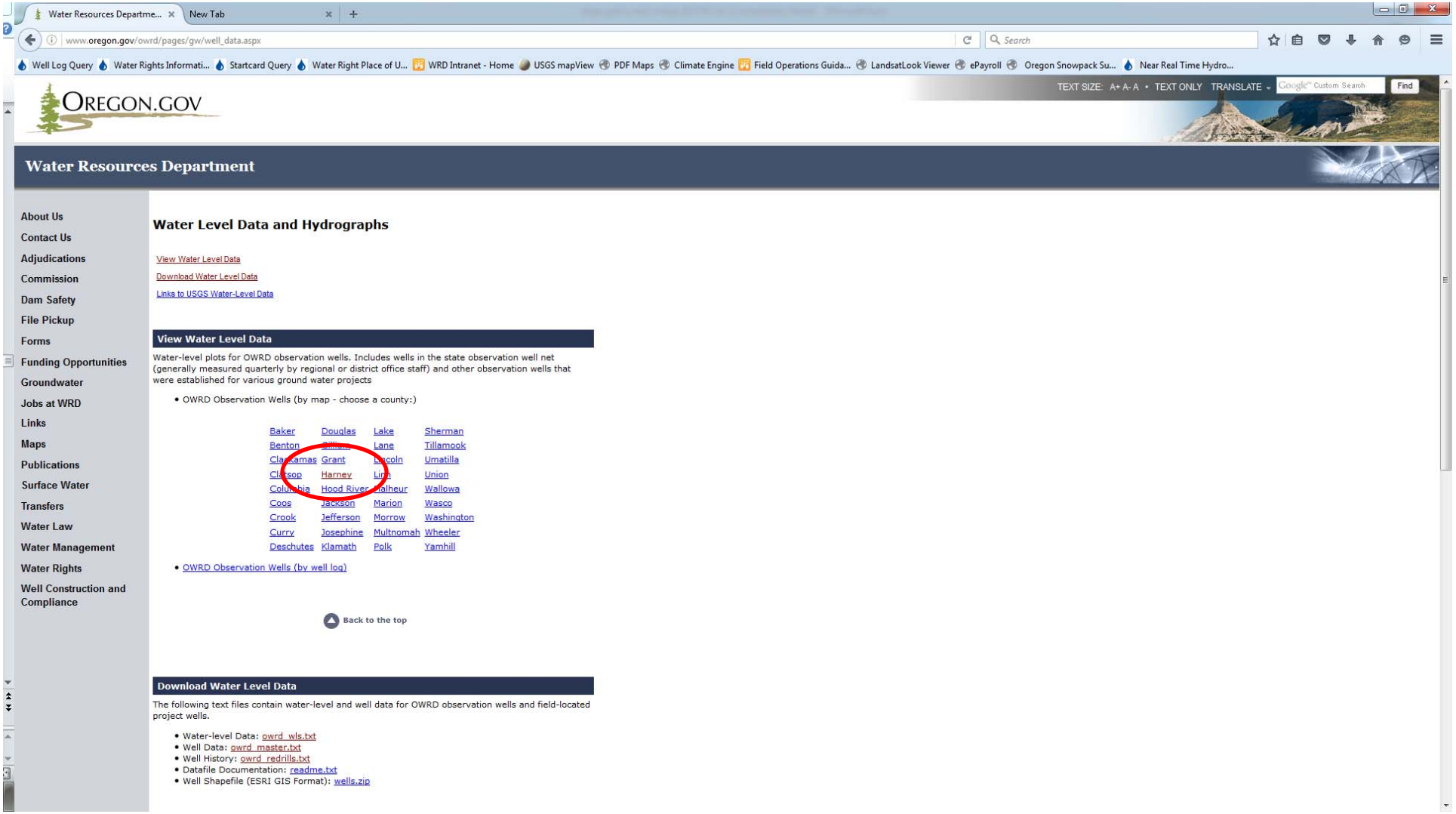
OWRD Data Online

http://www.oregon.gov/owrd/pages/index.aspx



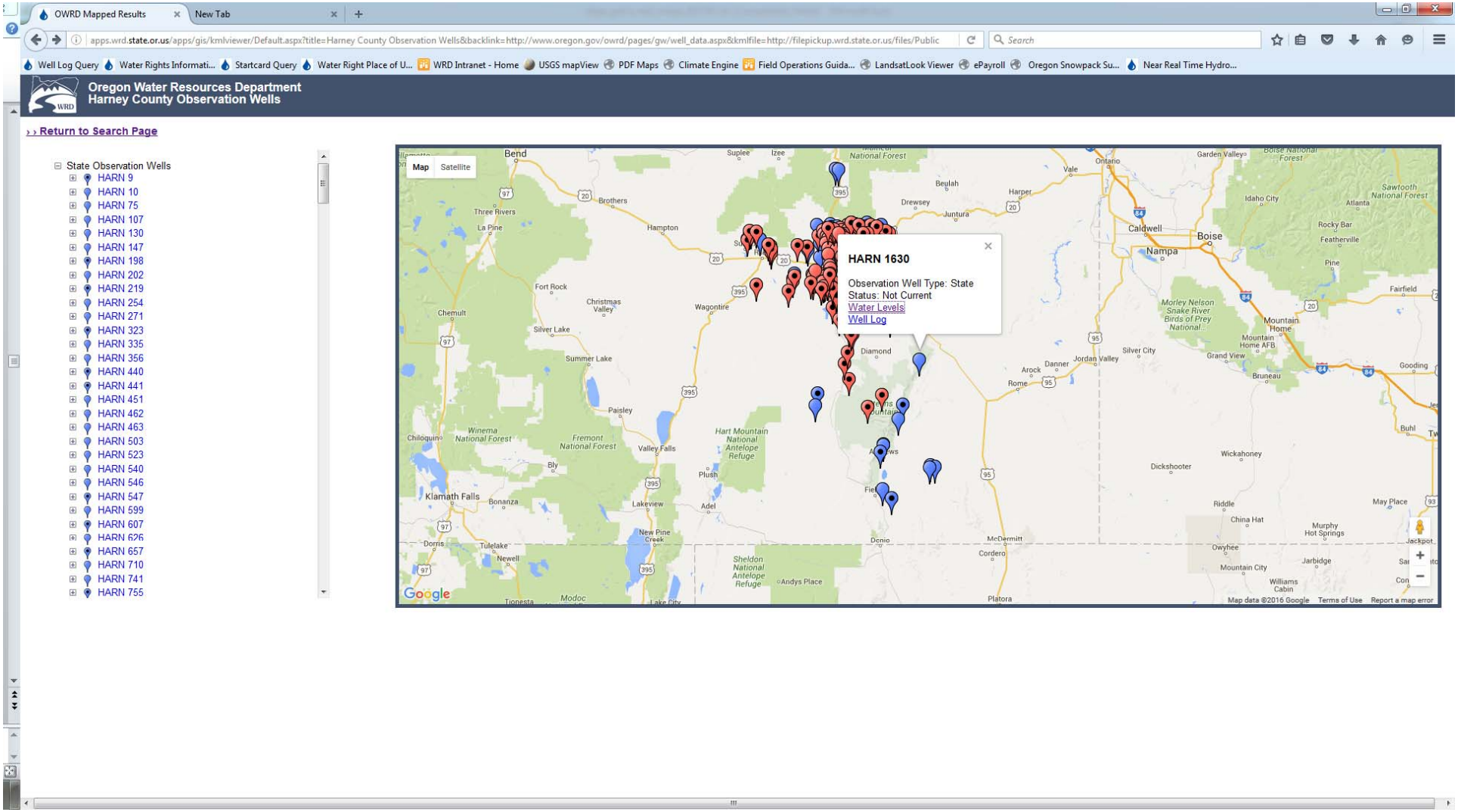
OWRD Data Online

http://www.oregon.gov/owrd/pages/index.aspx



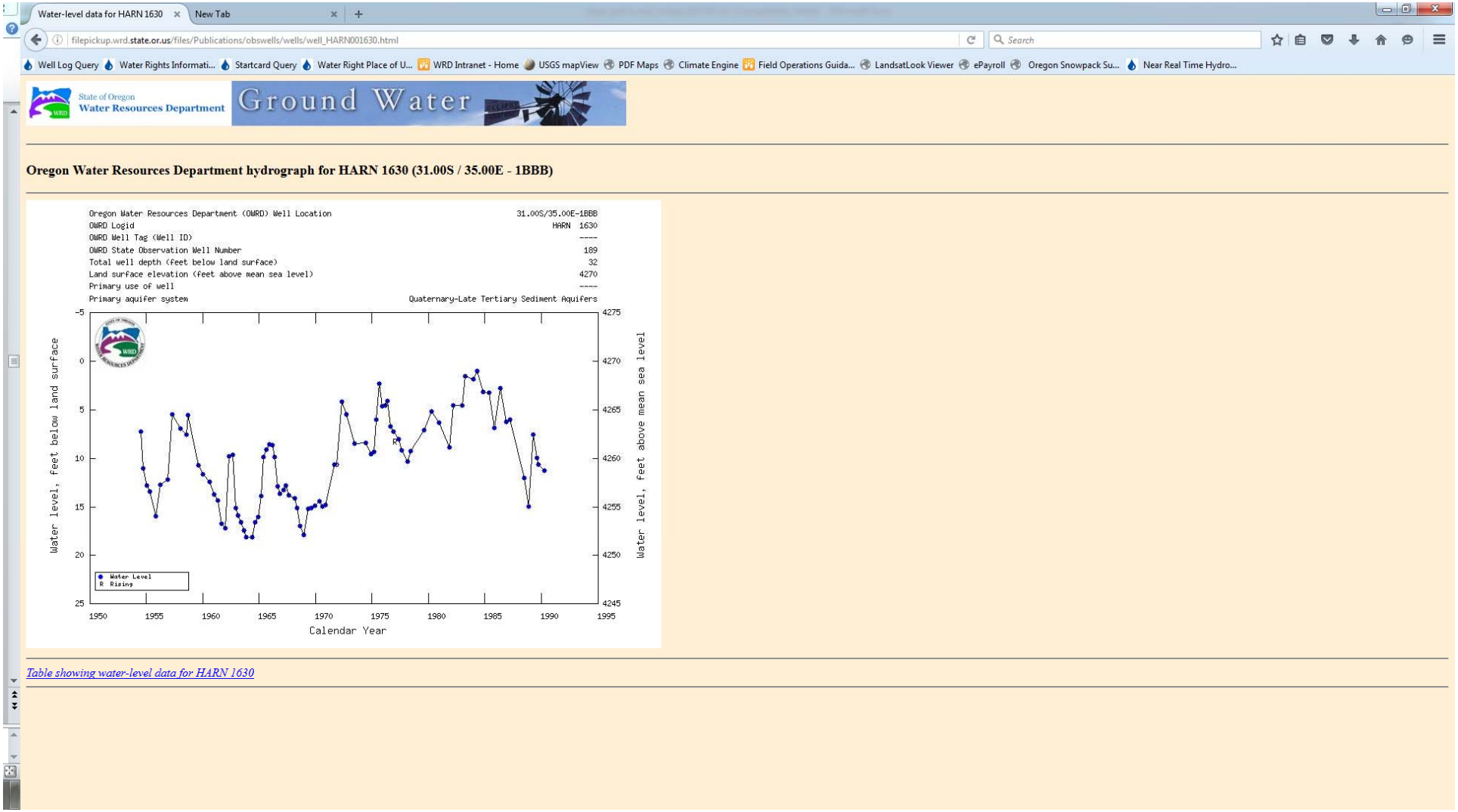
OWRD Data Online

http://www.oregon.gov/owrd/pages/index.aspx



OWRD Data Online

http://www.oregon.gov/owrd/pages/index.aspx



Seeking volunteers

- Observation wells: domestic, stock, irrigation, unused
- Unused wells with no pump
  - Recorder wells
  - Geophysical logging
- Aquifer test wells
  - Higher yield pumping wells
  - Nearby observation wells

Darrick Boschmann, Hydrogeologist
Oregon Water Resources Department

Thank You

Darrick Boschmann, Hydrogeologist
Oregon Water Resources Department