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Harney Basin Groundwater Study Wrap-Up

Oregon Water Resources Commission Meeting

June 16, 2022

Item J

Justin Iverson, Groundwater Section Manager

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Presentation Outline

- Pre-study background
- Basin knowledge then and now
- Key Points
- Next Steps

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Why conduct a groundwater study?

Concern about declining water levels across the basin led to Division 512 Rule changes in 2016

Interest from basin stakeholders to collect more information and refine understanding of the groundwater system prior to further Department action

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Study Objectives

Study objective: Develop a commonly accepted and accurate understanding of the hydrologic system in the Harney Basin.

Technical objectives:

- Gather and assess existing data
- Collect new data to better define the hydrogeologic system
- Develop a detailed water budget
- Develop an improved conceptual model of the Harney Basin groundwater-flow system

Study Cooperators & Complimentary Studies

Study Cooperators

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

Complimentary Studies

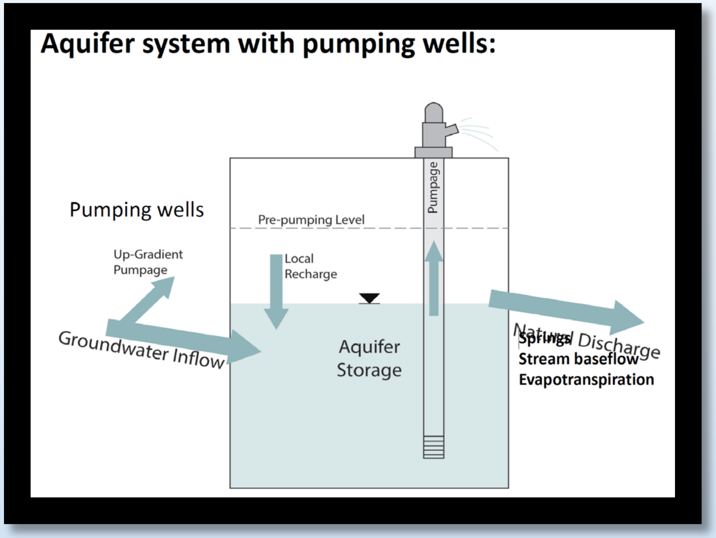
- UNR-Desert Research Institute / NASA-ROSES remote sensing of evapotranspiration study
- DEQ groundwater quality survey
- TNC groundwater dependent ecosystem study
- PSU geologic mapping theses (in coordination with DOGAMI and USGS EdMAP program)

Overview

- Geologic Deposits and Their Hydraulic Properties
- Groundwater Flow System from Recharge to Discharge
- Quantification of the Hydrologic Budget
- Groundwater System Response to Development

Figures Generally Show…

- Knowledge before the study (~2015)
- Knowledge after the study (2022)



16 Hydrologic Budget of the Harney Basin Groundwater System, Southeastern Oregon

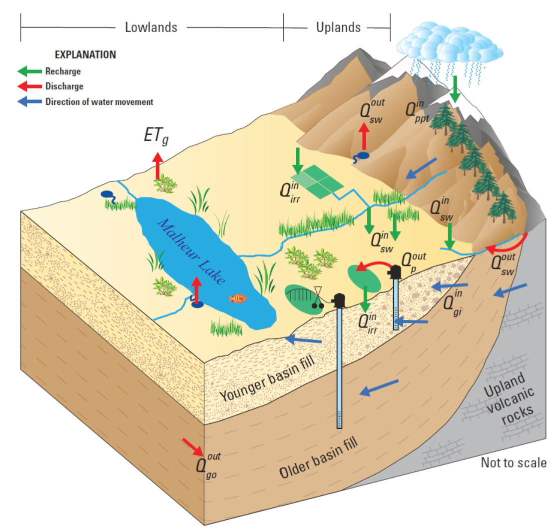


Figure 6. Groundwater recharge and discharge, Harney Basin, southeastern Oregon. Modified from Masbruch and others (2011). Recharge and discharge components are from equations 2-3 and include: Q^{in}_{ppt}, upland recharge from precipitation and snowmelt; Q^{in}_{gi}, groundwater inflow from uplands to lowlands; Q^{in}_{sw}, lowland recharge from surface water; Q^{in}_{irr}, lowland recharge from irrigation water and other non-irrigation water use; ET_g, groundwater discharge through evapotranspiration; Q^{out}_{sw}, groundwater discharge to surface water; Q^{out}_{p}, groundwater discharge through pumpage; and Q^{out}_{go}, groundwater outflow to the Malheur River Basin.

Geologic Deposits

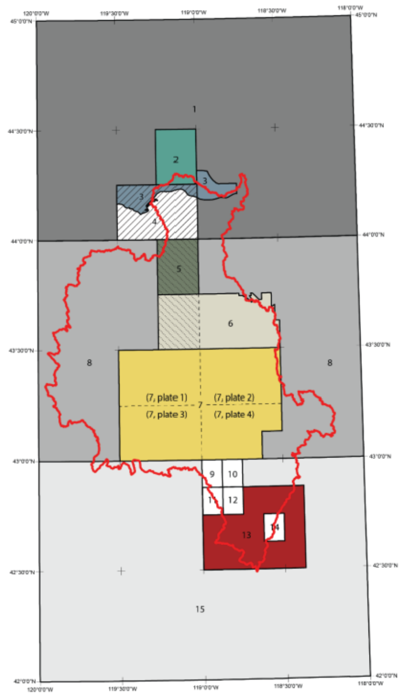
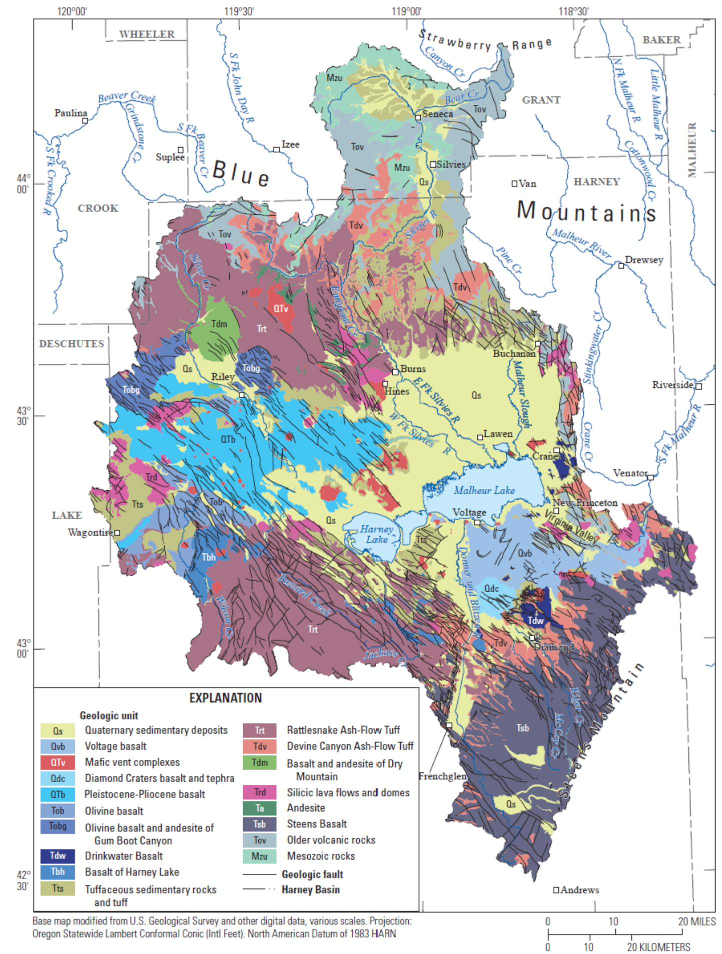


Figure 2: Index map showing the extent of source publication maps. Red line is compilation area. 1 – Brown and Thayer, 1966a; 2- Brown and Thayer, 1966b; 3 – Brown and Thayer, 1977; 4 – Wallace and Calkins, 1956 (full extent of plate hachured); 5 – Greene, 1972 (full extent of plate stippled); 6 – Brown and others, 1980a; 7 – Brown and others, 1980b; 8 – Greene and others, 1972; 9 – Sherrod and Johnson, 1994; 10 – Johnson, 1994; 11 – D.R Sherrod, in Evans and Geisler, 2001; 12 – Johnson, 1996, in Evans and Geisler, 2001; 13 – Evans and Geisler, 2001; 14 – Minor and others, 1987; 15 – Walker and Repenning, 1965. Red line is compilation area. See table 1 for additional publication details.



Base map modified from U.S. Geological Survey and other digital data, various scales. Projection: Oregon Statewide Lambert Conformal Conic (Intl Feet). North American Datum of 1983 HARN

Figure 6. Generalized (*A*) geologic map and (*B*) time-rock chart for generalized geologic map units in the Harney Basin, southeastern Oregon. Map from Boschmann (2021).

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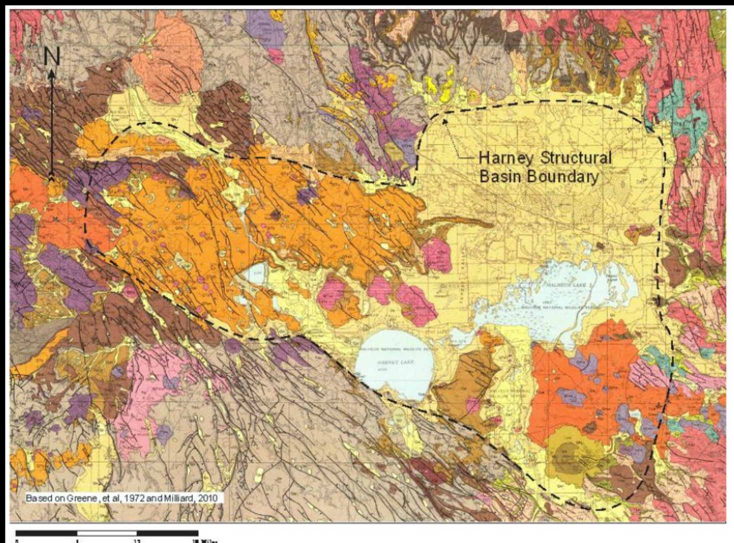
Hydrogeologic Properties



Hydrogeologic Units	Specific Capacity (gal/ft)	Estimated Hydraulic Conductivity (gal/day/ft^2)	Lithology
Basin Fill	0.4 to 41	243 to 728	Gravel, Sand, silt, clay, sandy-clay, clayey-sand, gravel, and clayey-gravel
Diamond/Voltage Basalt, includes Mafic vent complexes	81 to 200	2,727 to 7,843	Lavas flows, cinders, and vent complexes
Intra-Basin basalts and cinders, includes: flows within Basin-fill, Harney Formation and Tuffaceous and volcaniclastic sediments	33.3	995	Lavas flows, pyroclastics, palagonite, cinders
Harney Formation	0.1 to 3.3	28.6 to 76.9	Sandstone, claystone, conglomerate, sand and gravel
Tuffaceous and volcaniclastic sediments	0.1 to 50	1.7 to 610	Clay, claystone, minor sand, sandstone, pumiceous
Volcaniclastic sedimentary rocks	1.5 to 7.5	20 and 600	Rhyolitic siltstone, claystone, sandstone, conglomerate
Steens Basalt	1.7 to 510	333 to 46,364	Lava flows

Aquaveo (2012)

18 Groundwater Resources of the Harney Basin, Southeastern Oregon

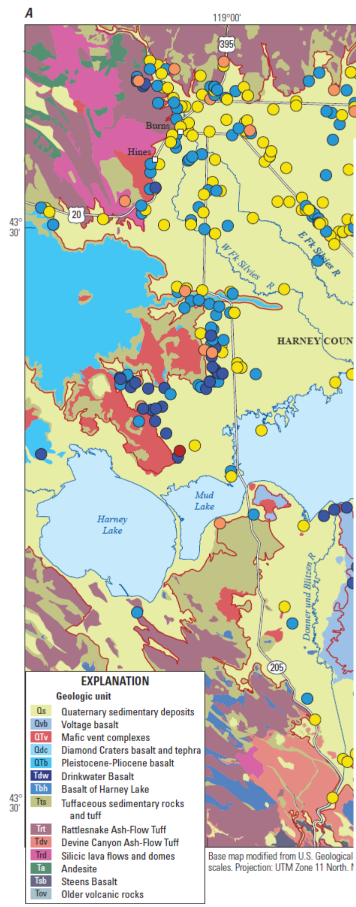


Figure 7. Transmissivity estimates from wells in and around the ... than 150 feet; B, wells deeper than 150 feet.

22 Groundwater Resources of the Harney Basin, Southeastern Oregon

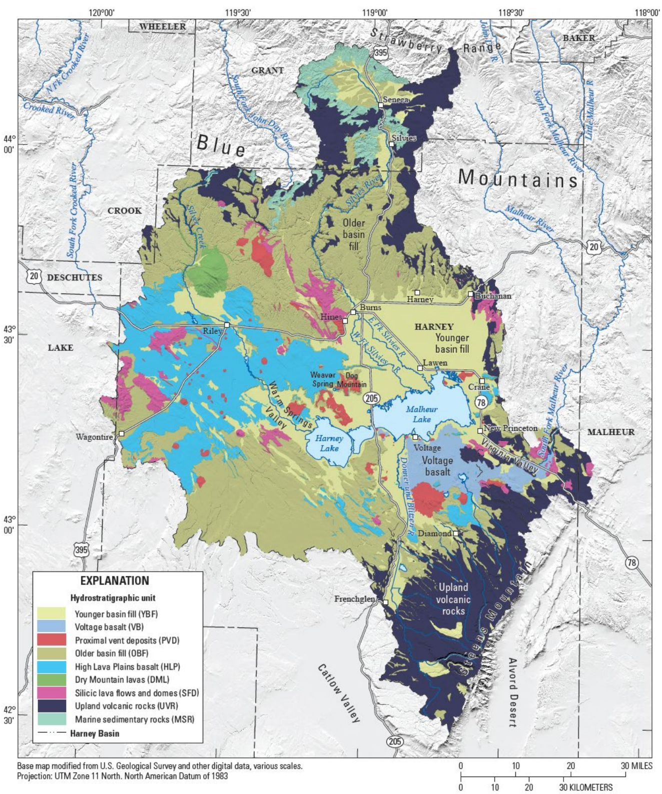


Figure 9. Surficial distribution of the hydrostratigraphic units, Harney Basin, southeastern Oregon.

Groundwater Flow Systems

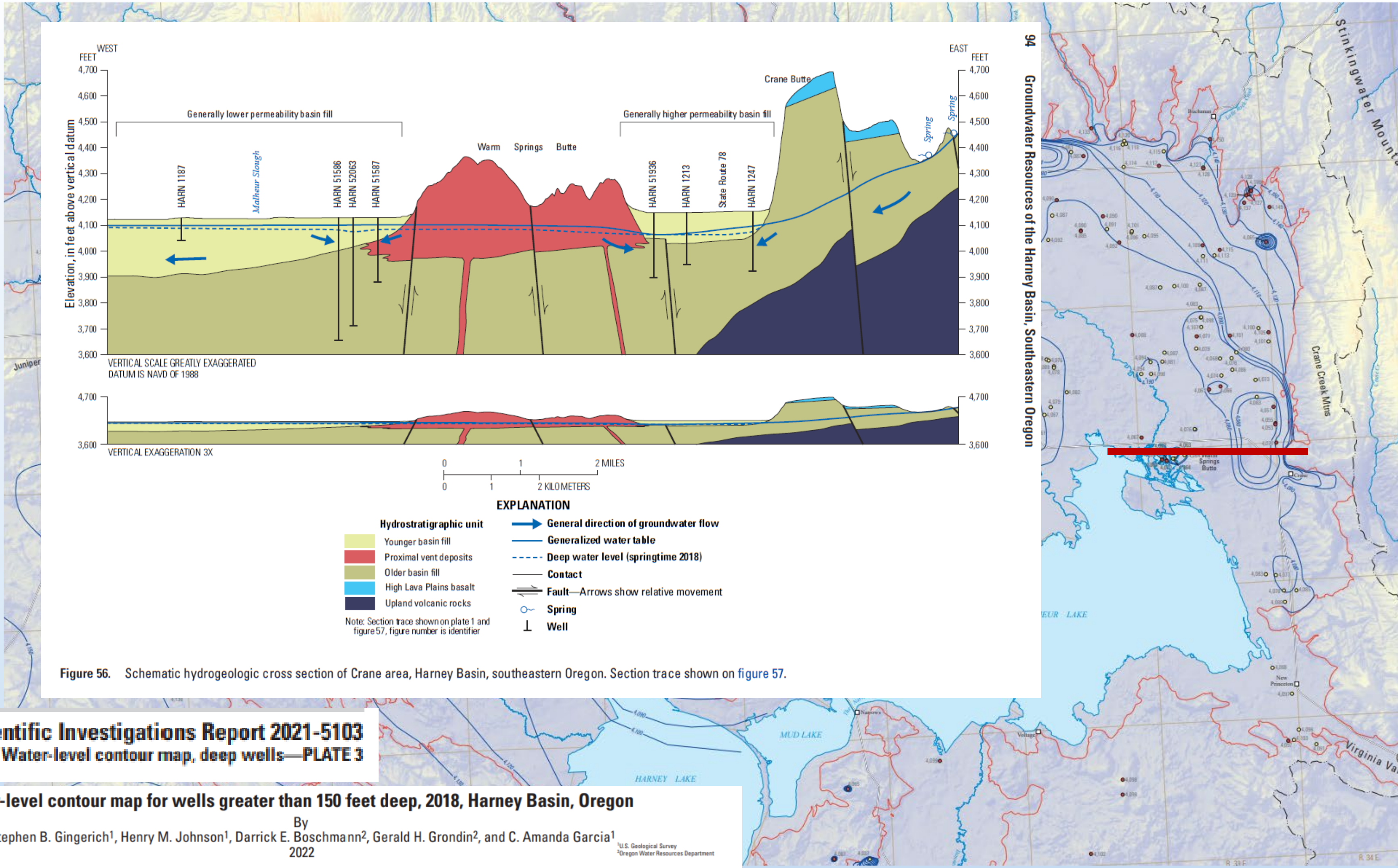


Figure 56. Schematic hydrogeologic cross section of Crane area, Harney Basin, southeastern Oregon. Section trace shown on figure 57.

Scientific Investigations Report 2021-5103
Water-level contour map, deep wells—PLATE 3

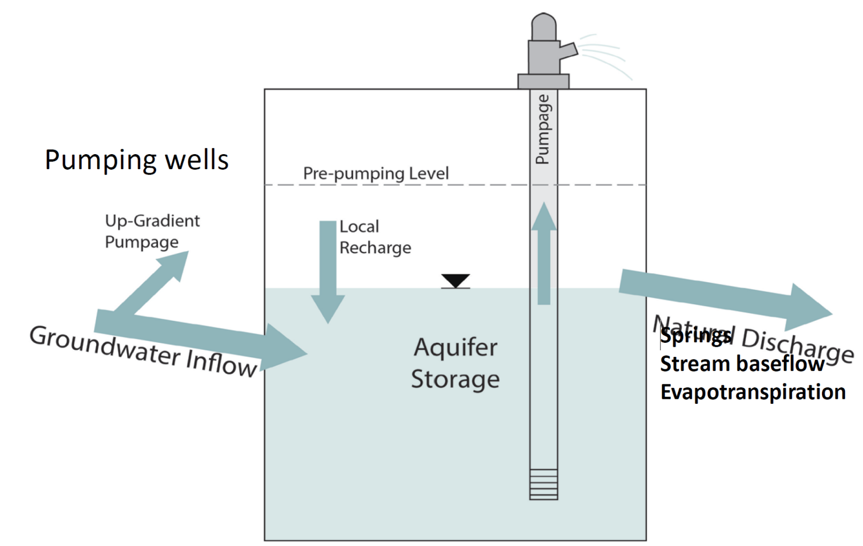
Water-level contour map for wells greater than 150 feet deep, 2018, Harney Basin, Oregon

By
Stephen B. Gingerich[1], Henry M. Johnson[1], Darrick E. Boschmann[2], Gerald H. Grondin[2], and C. Amanda Garcia[1]
2022

[1]U.S. Geological Survey
[2]Oregon Water Resources Department

Hydrologic Budget

Aquifer system with pumping wells:



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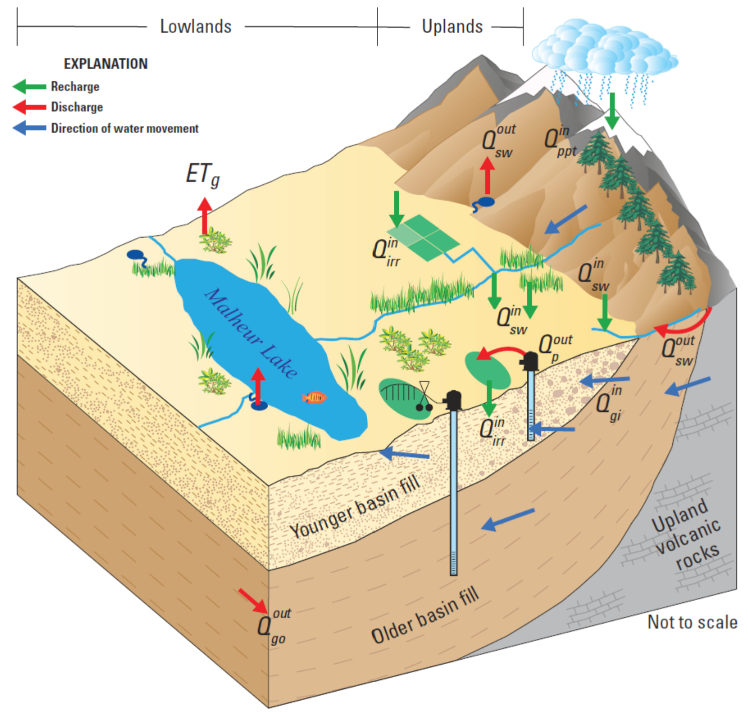

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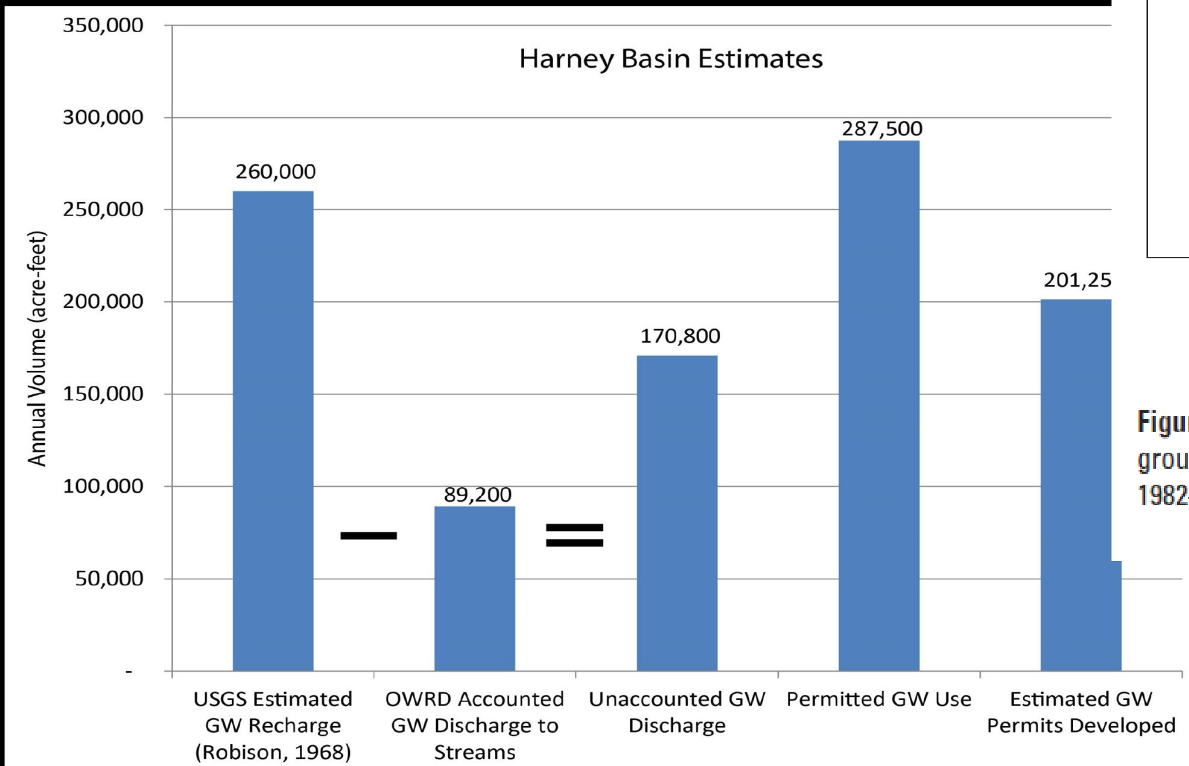
Hydrologic Budget



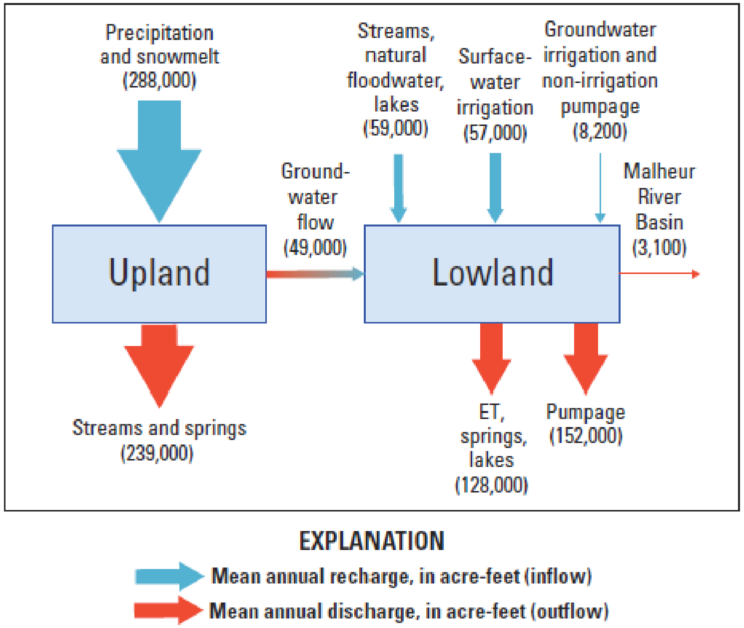


Figure 36. Estimated mean annual upland and lowland groundwater budgets, Harney Basin, southeastern Oregon, 1982–2016.

Also refer to:

Table 24. Estimated mean annual upland and lowland groundwater budgets

Hydrologic Budget

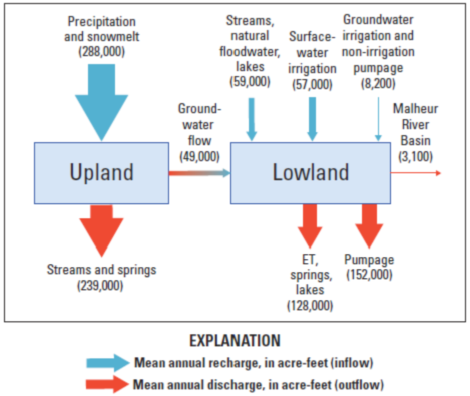
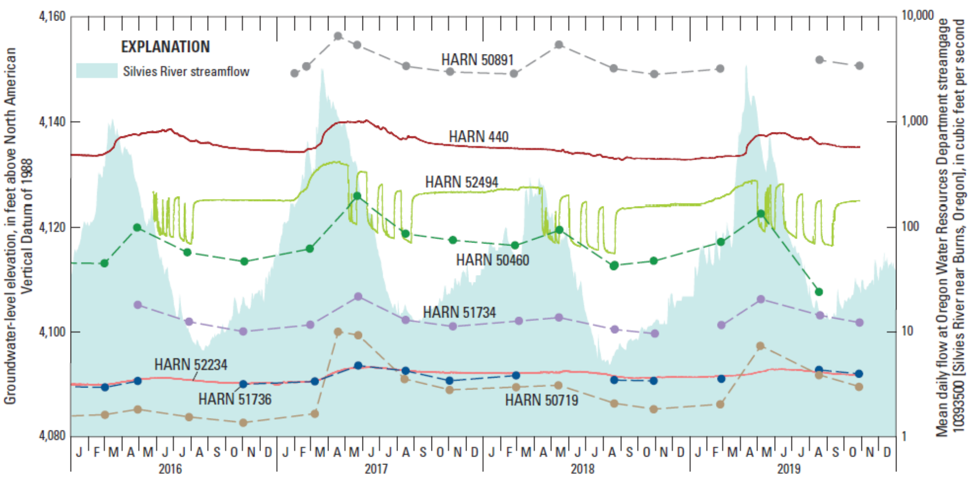


Figure 36. Estimated mean annual upland and lowland groundwater budgets, Harney Basin, southeastern Oregon, 1982–2016.



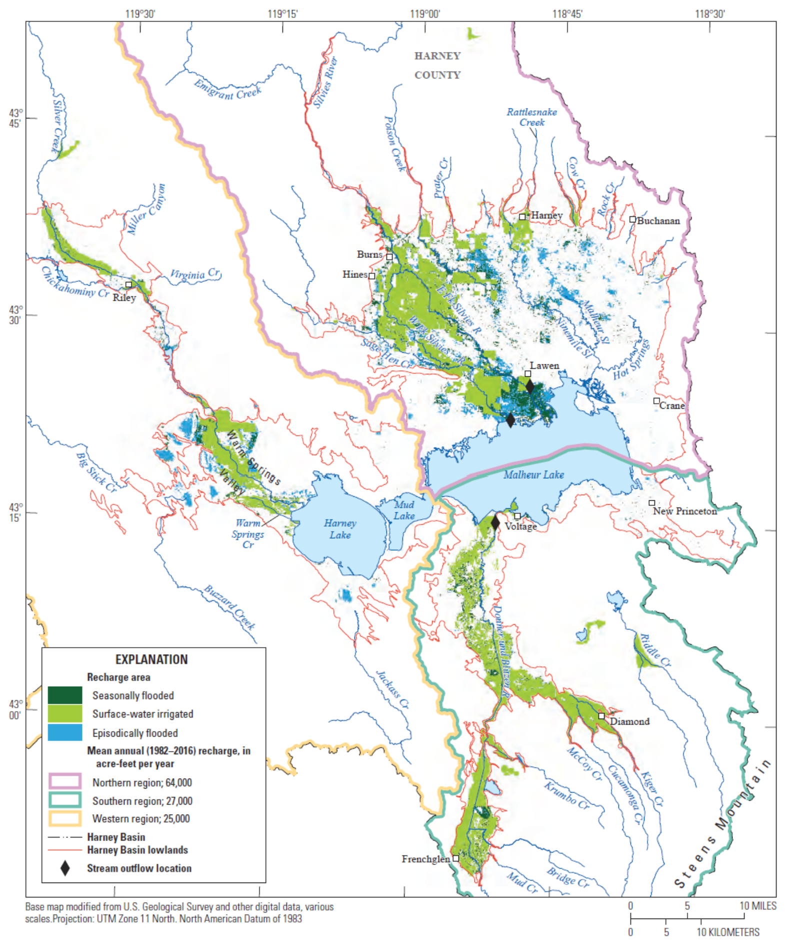


Figure 35. Locations of groundwater recharge from streams, seasonal and episodic floodwater, and surface-water irrigation, Harney Basin, southeastern Oregon.

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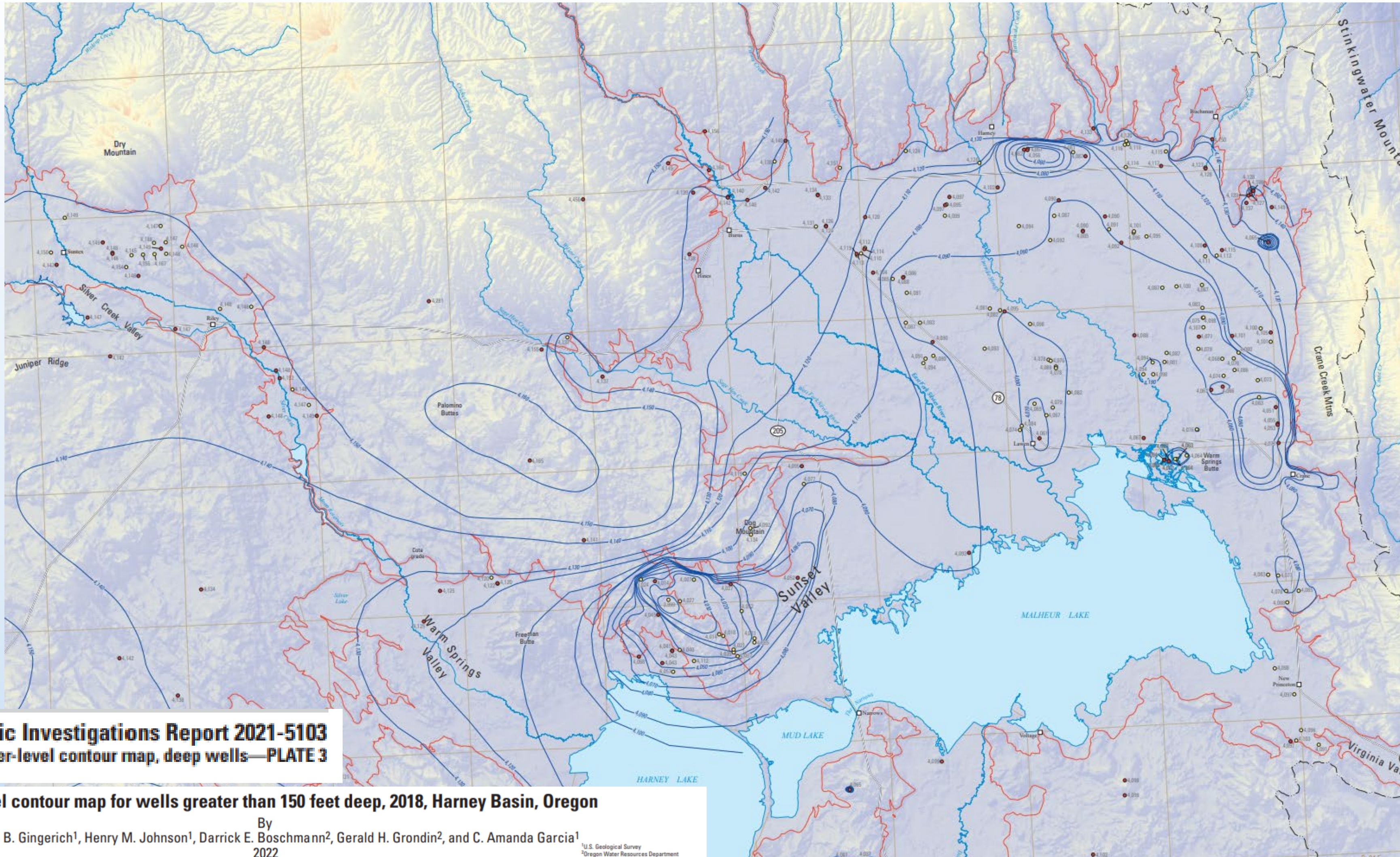
Response to Development



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Response to Development

78 Groundwater Resources of the Harney Basin, Southeastern Oregon

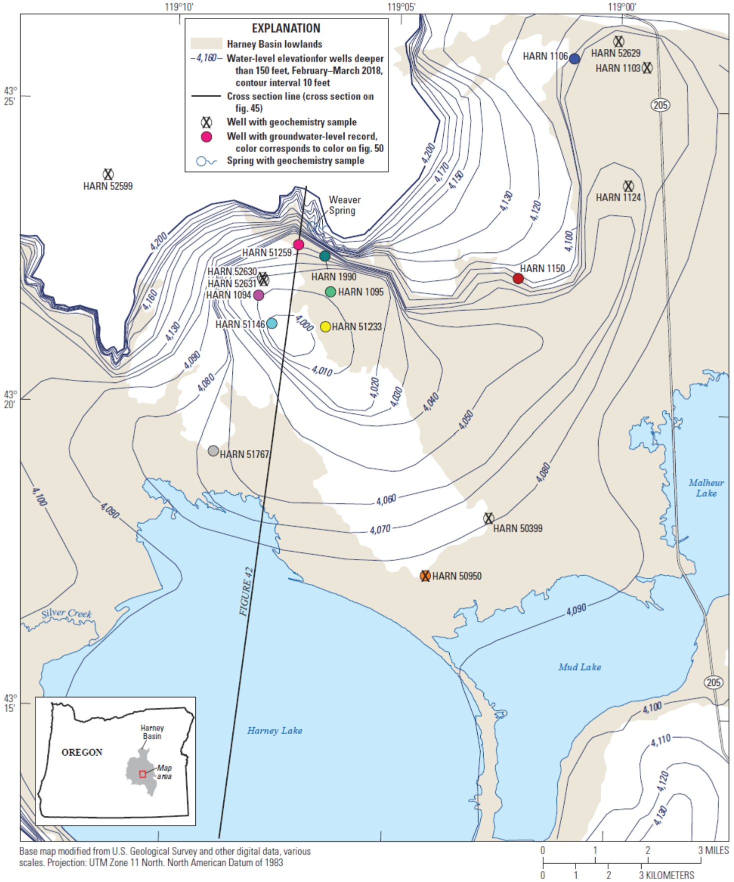


Figure 43. Locations of selected groundwater-level and geochemistry sites, Weaver Spring/Dog Mountain area, Harney Basin, southeastern Oregon.

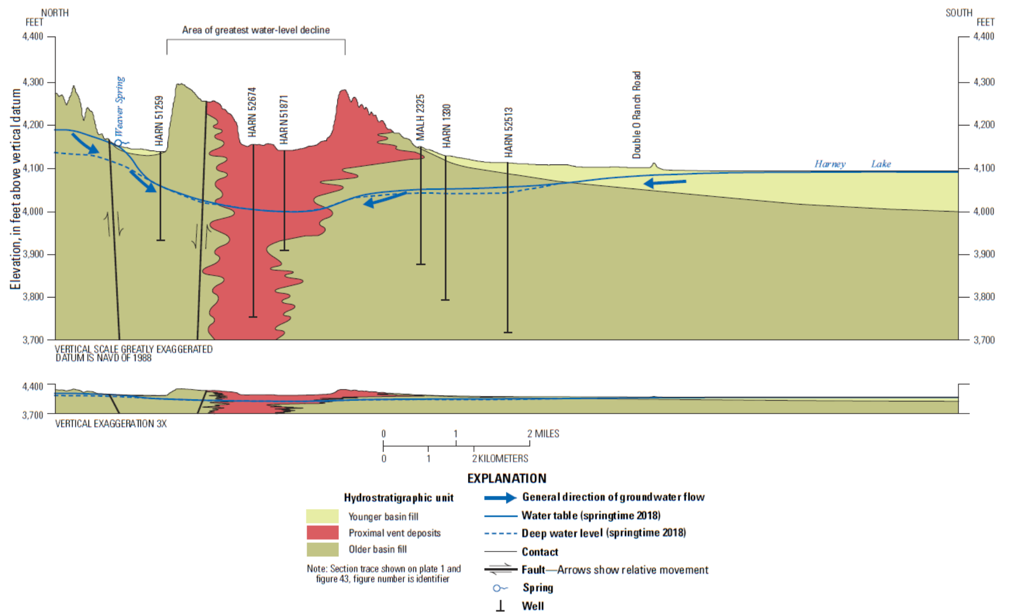


Figure 42. Schematic hydrogeologic cross section of the Weaver Spring Area, Harney Basin, southeastern Oregon. Section trace shown on figure 43.

Response to Development

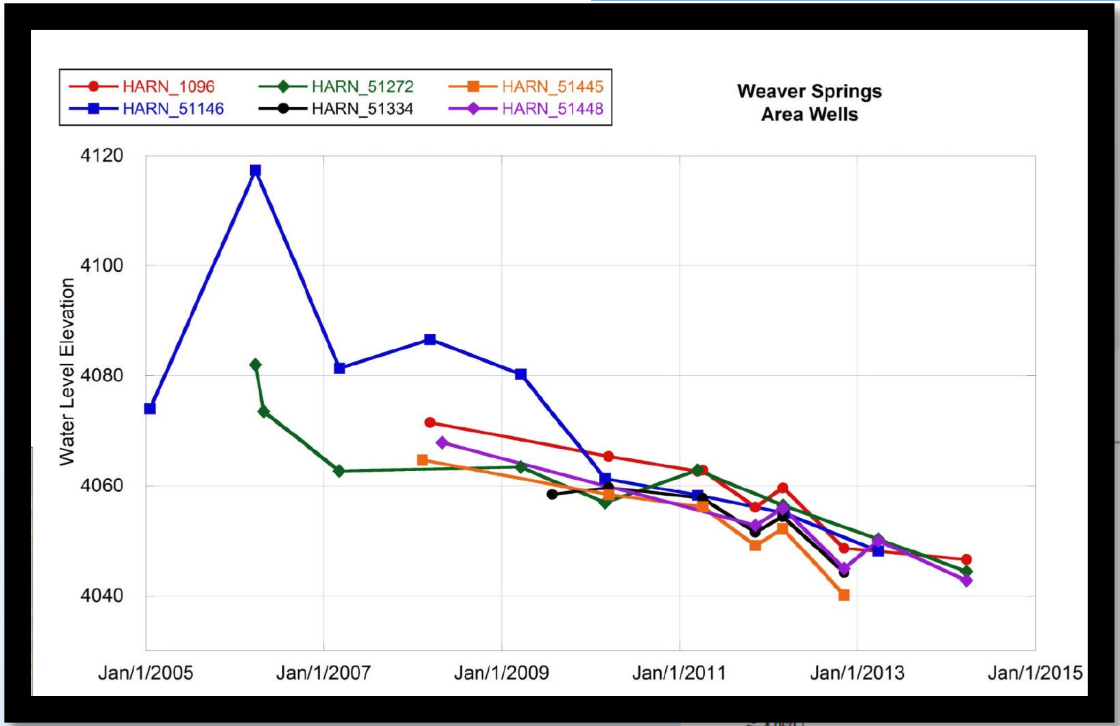
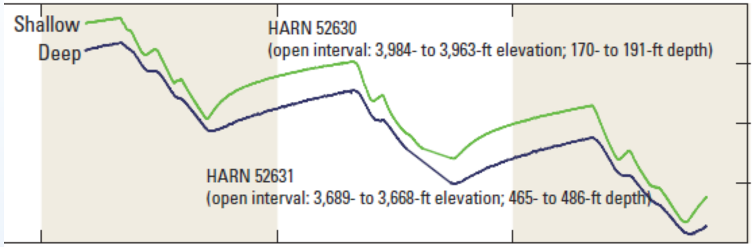


Figure 17. Groundwater levels at selected well pairs showing vertical gradients during 2015–19



Description of the Harney Basin Groundwater-Flow System 79

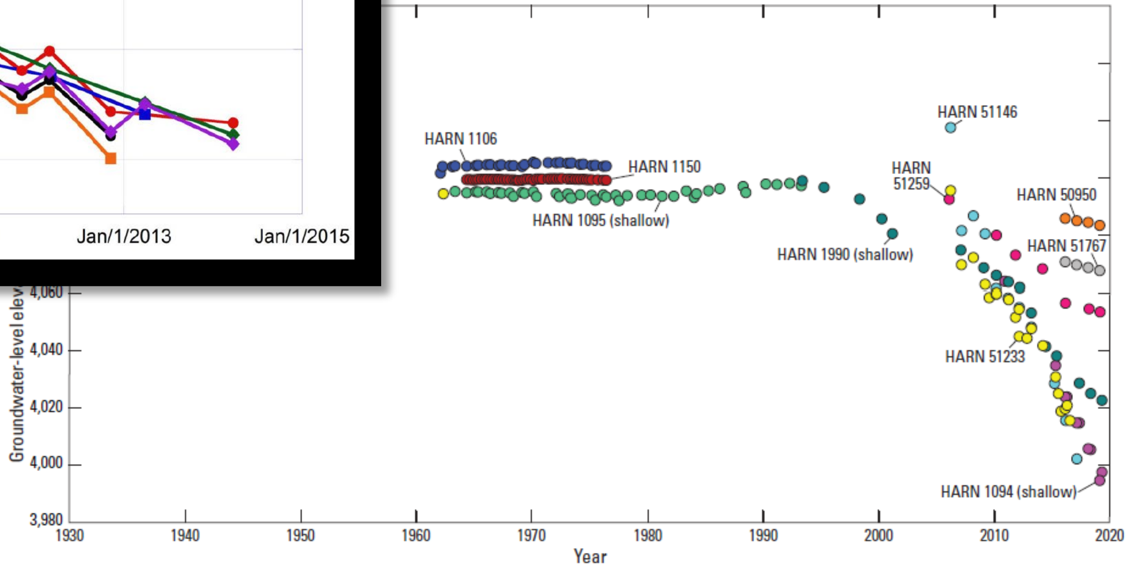


Figure 44. Groundwater levels during January–April at selected wells in the Weaver Spring/Dog Mountain area, Harney Basin, southeastern Oregon. Colored dots correspond to well locations shown on figure 43.

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Key Points

- Study provides better quantitative estimates, better spatial detail, better temporal understanding.
- And the ultimate conclusion remains that the basin is overallocated.
- Impacts are not evenly distributed; some areas of the basin have more acute water level declines than others.
- Likely want to focus on the most problematic areas first.

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Next Steps

- Public meetings with the full study team.
- Work with the GWSAC and collaborative to help identify strategies with greatest likelihood and/or magnitude of impact for level of effort.
- Revise Division 512 rules to implement those strategies that require rules.
- Continue to provide technical support for community-lead strategy implementation.

Thank you.

Hydrologic Budget

Table 24. Estimated mean annual upland and lowland groundwater budgets (1982–2016), Harney Basin, southeastern Oregon.

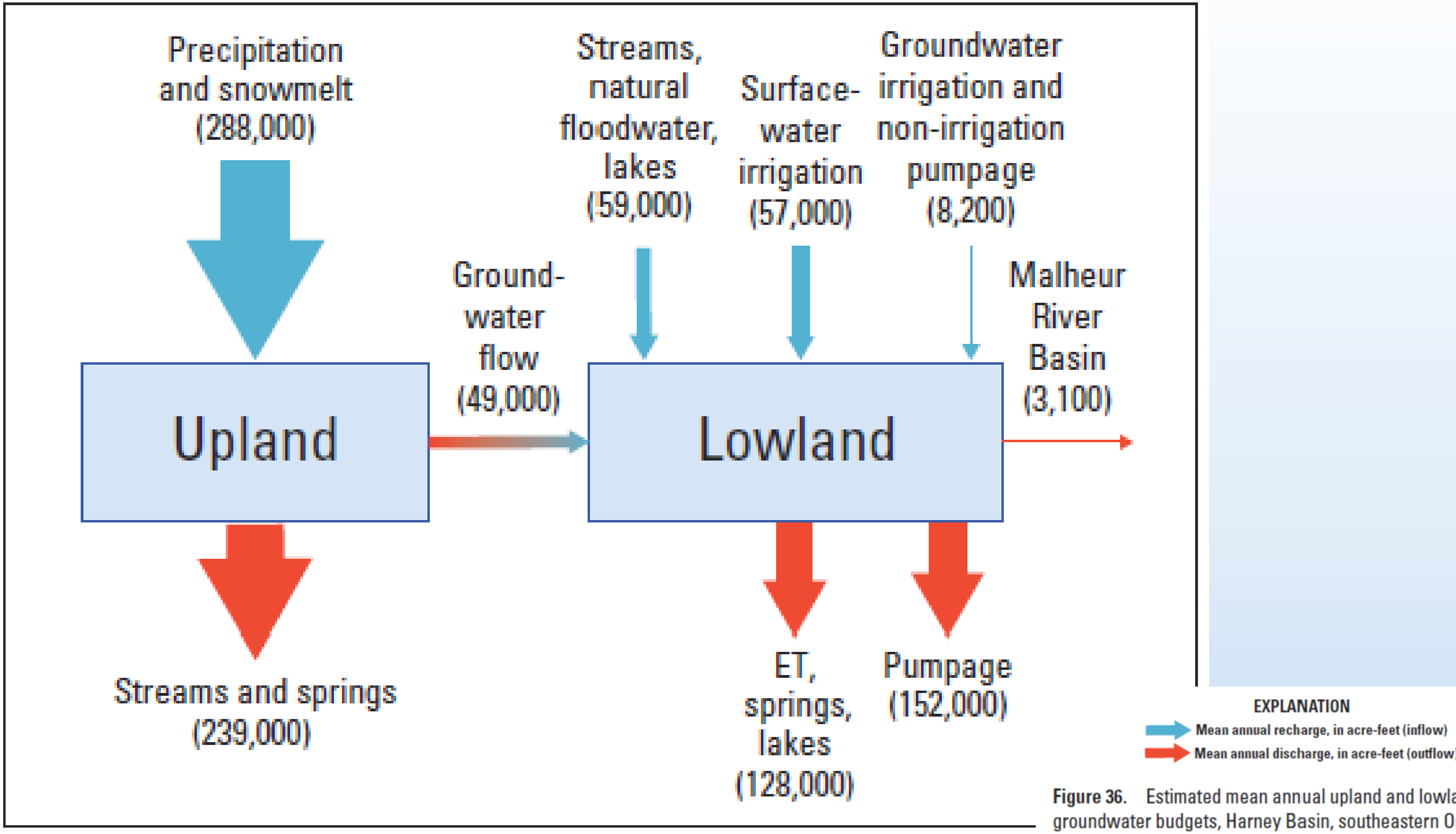
[Regions are shown on figure 1. **Component**: Recharge (table 23) and discharge (table 17) represent non-pumpage components. Net budget is recharge minus discharge. Net pumpage is total pumpage (table 17) minus recharge from pumpage (table 23). Estimates are rounded to two significant figures for values below 100,000, and three significant figures for values above 100,000]

Region	Component	Mean annual budget components by region (acre-feet)			
		Northern	Southern	Western	Harney Basin
Upland	Recharge	86,000	157,000	45,000	288,000
	Discharge	77,000	137,000	25,000	239,000
	Net recharge[1]	9,000	20,000	20,000	49,000
Lowland	Recharge (no pumpage)	73,000	47,000	45,000	165,000
	Discharge (no pumpage)	64,000	32,000	35,000	131,000
	Net recharge (no pumpage) [2]	9,000	15,000	10,000	34,000
	Net pumpage	82,000	21,000	41,000	144,000
	Net pumpage exceeding net recharge	73,000	6,000	31,000	110,000

[1]Values represent groundwater inflow from upland to lowland areas.

[2]Values mostly represent estimate uncertainty with a smaller proportion attributed to discharge capture by pumpage.

Hydrologic Budget



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