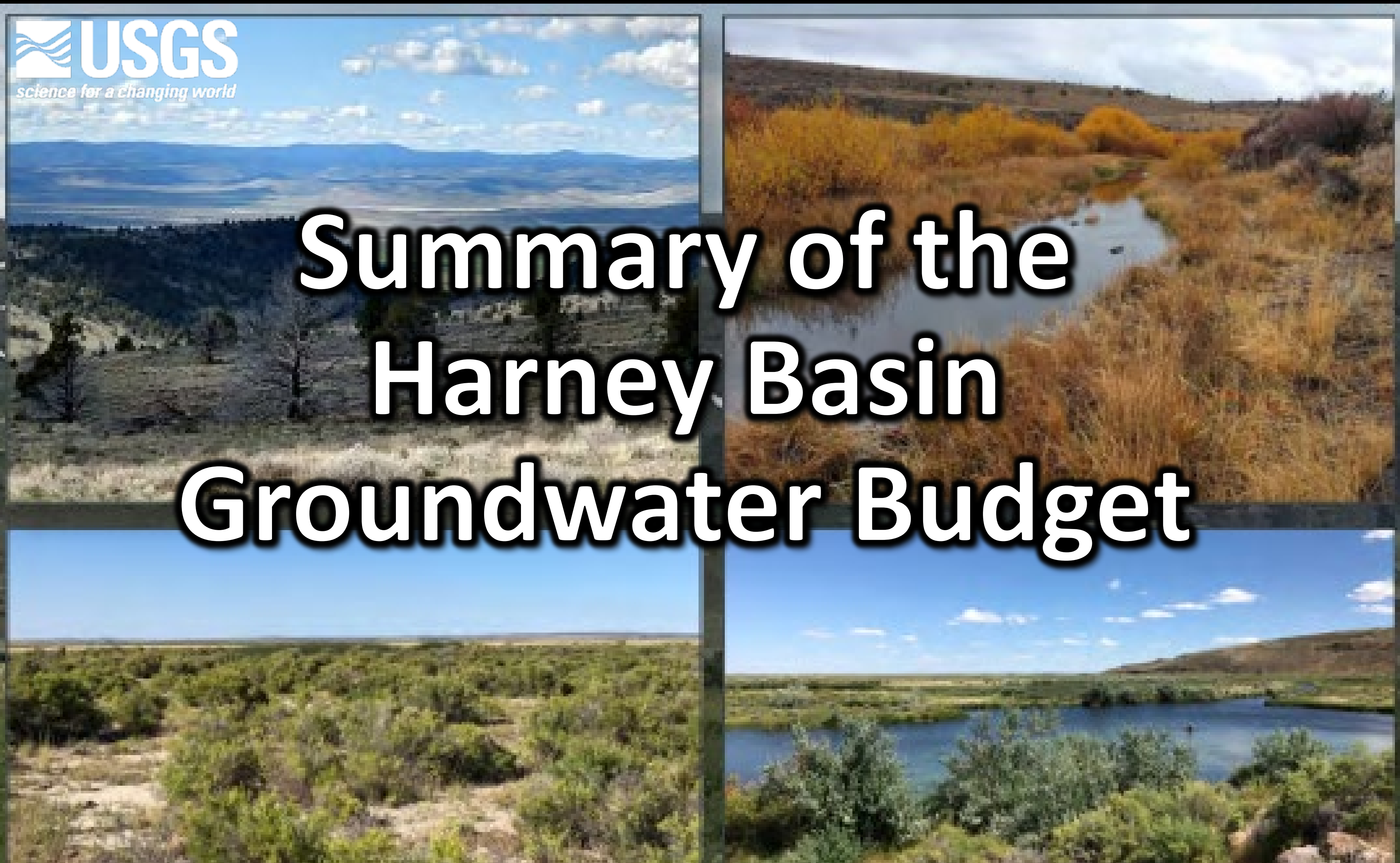


Summary of the Harney Basin Groundwater Budget

U.S. Geological Survey and Oregon Water Resources Department
Groundwater Study Advisory Committee, 10/12/2022

U.S. Department of the Interior
U.S. Geological Survey

Budgets for Upland and Lowland Areas

- Lowland areas
  - Central basin valleys and floodplains
  - Precipitation is generally 9 –11 inches per year
  - Where more than 90% of pumpage occurs
- Upland areas
  - Precipitation is generally more than 11 inches per year
  - All areas beyond lowland boundary

Garcia and others (2022)

USGS

Key Takeaways

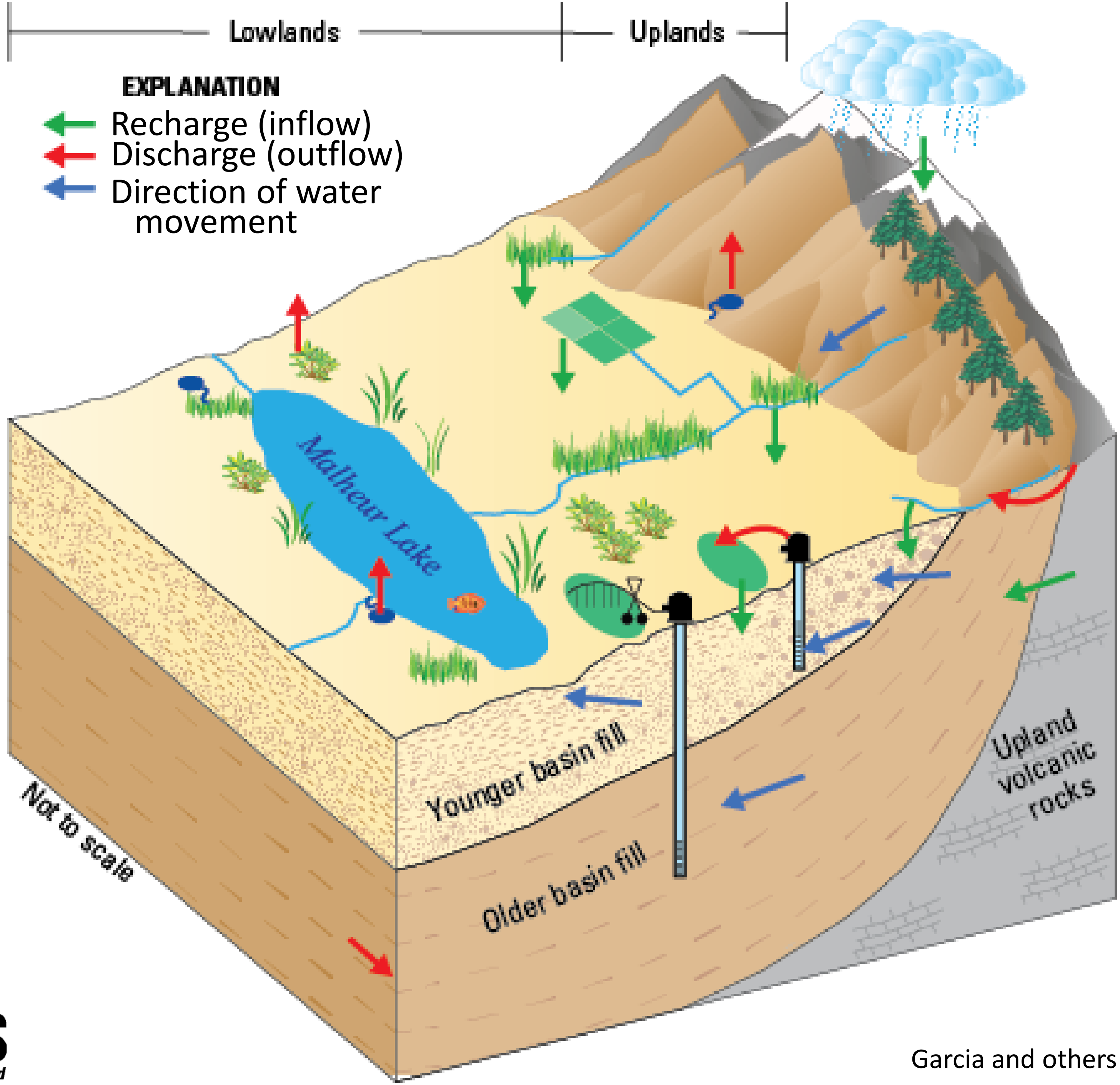
Upland groundwater budget

- Minimally affected by groundwater development
- Generally represents the natural system

Lowland groundwater budget

- Accounts for most groundwater development
- Is out of balance by about –110,000 acre-feet per year
- Current imbalance represents groundwater removed from aquifer storage

Garcia and others (2022)



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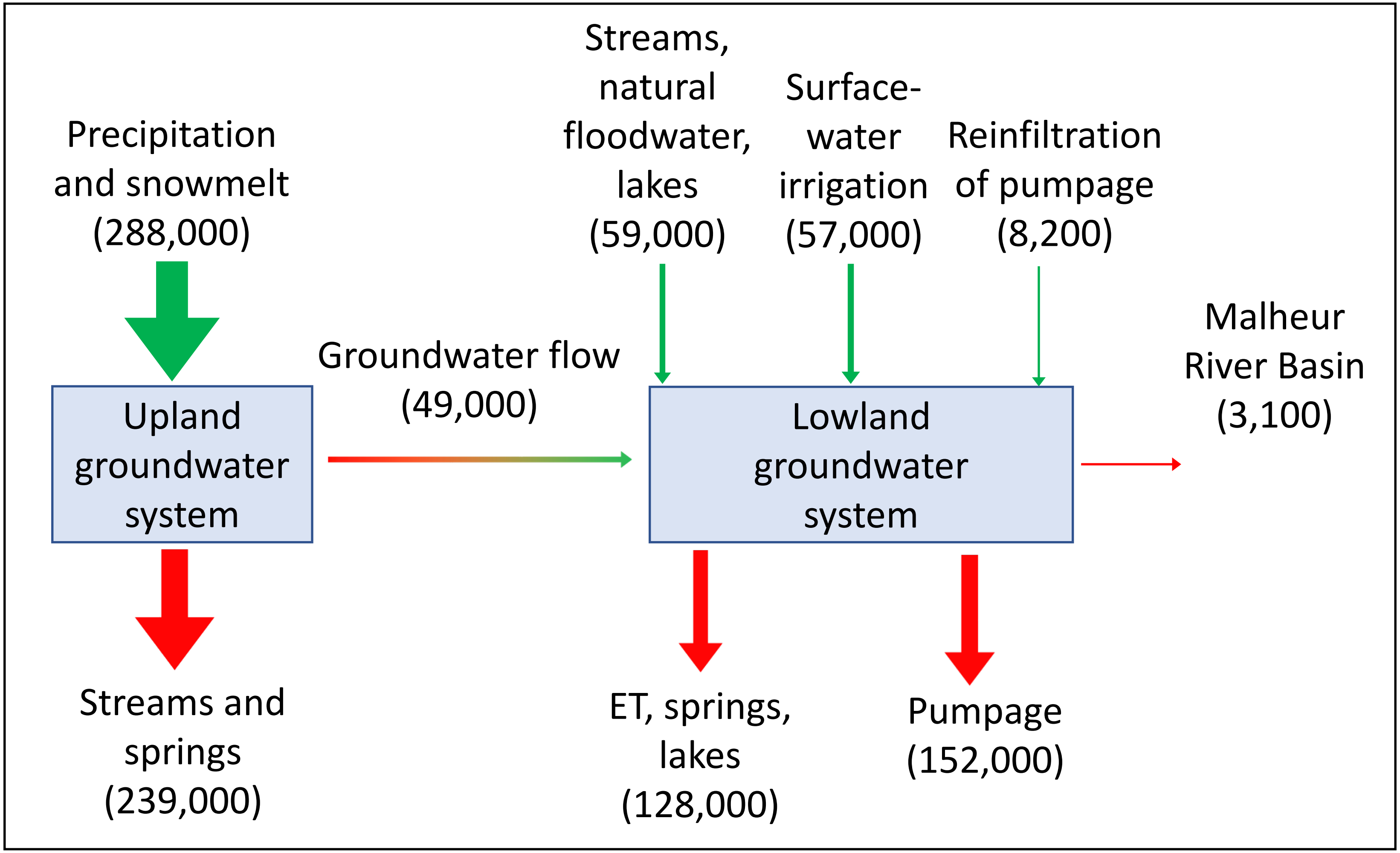
Garcia and others (2022)

Mean Annual Groundwater Budget

(in acre-feet per year)

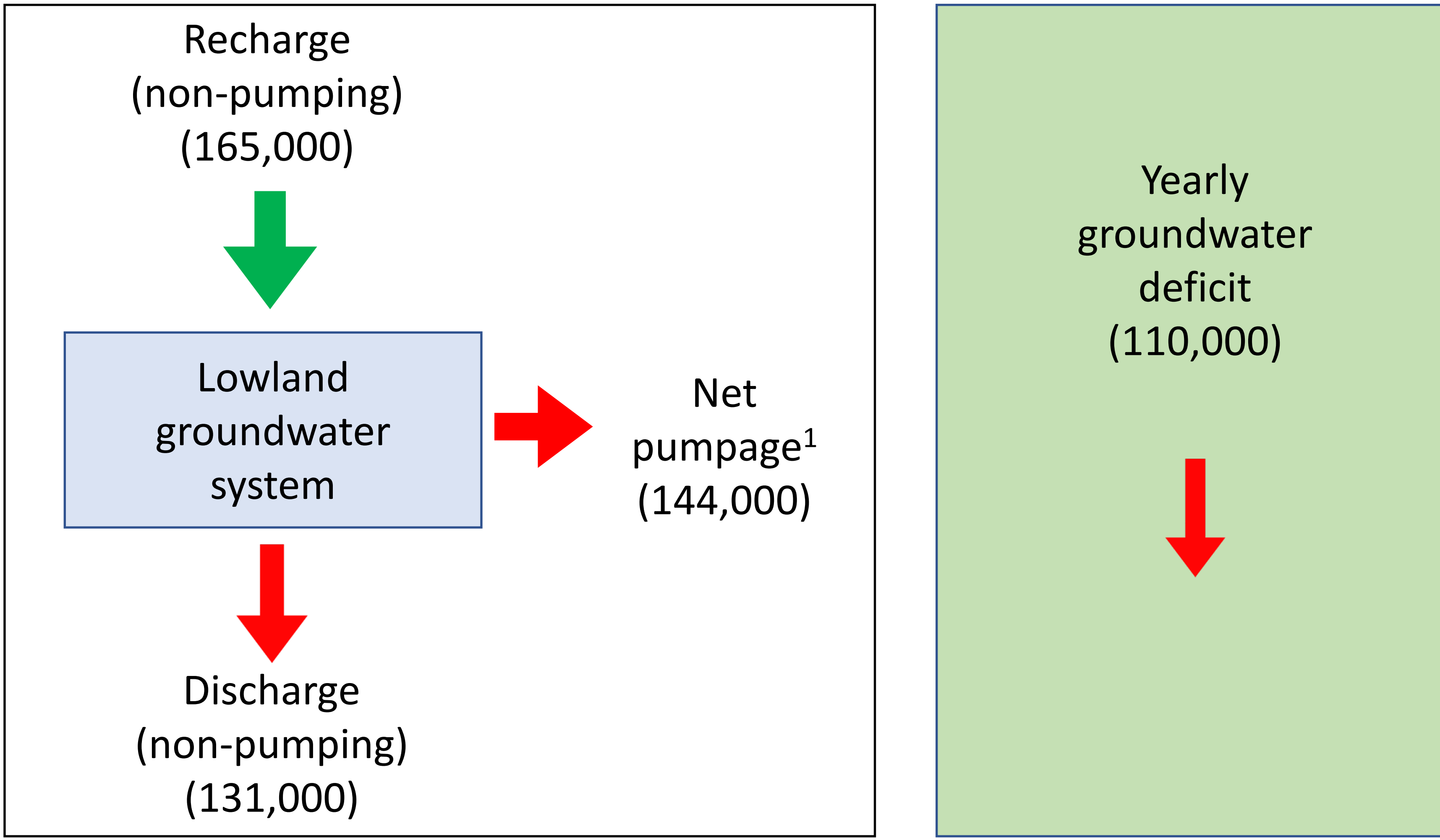


USGS science for a changing world

Garcia and others (2022)

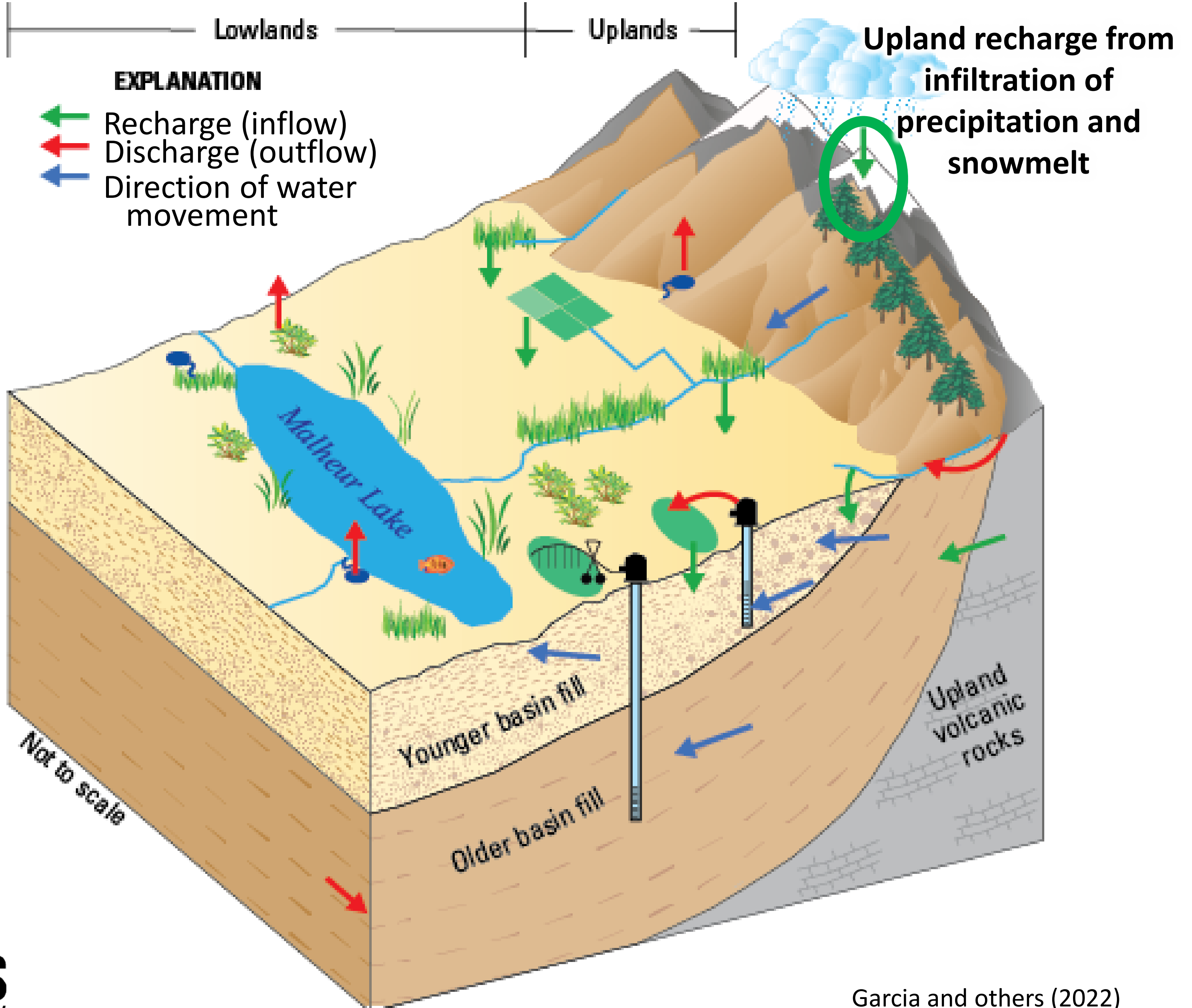
Mean Annual Groundwater Budget

(in acre-feet per year)



[1]Net pumpage = total pumpage – reinfiltration of pumped groundwater

Garcia and others (2022)



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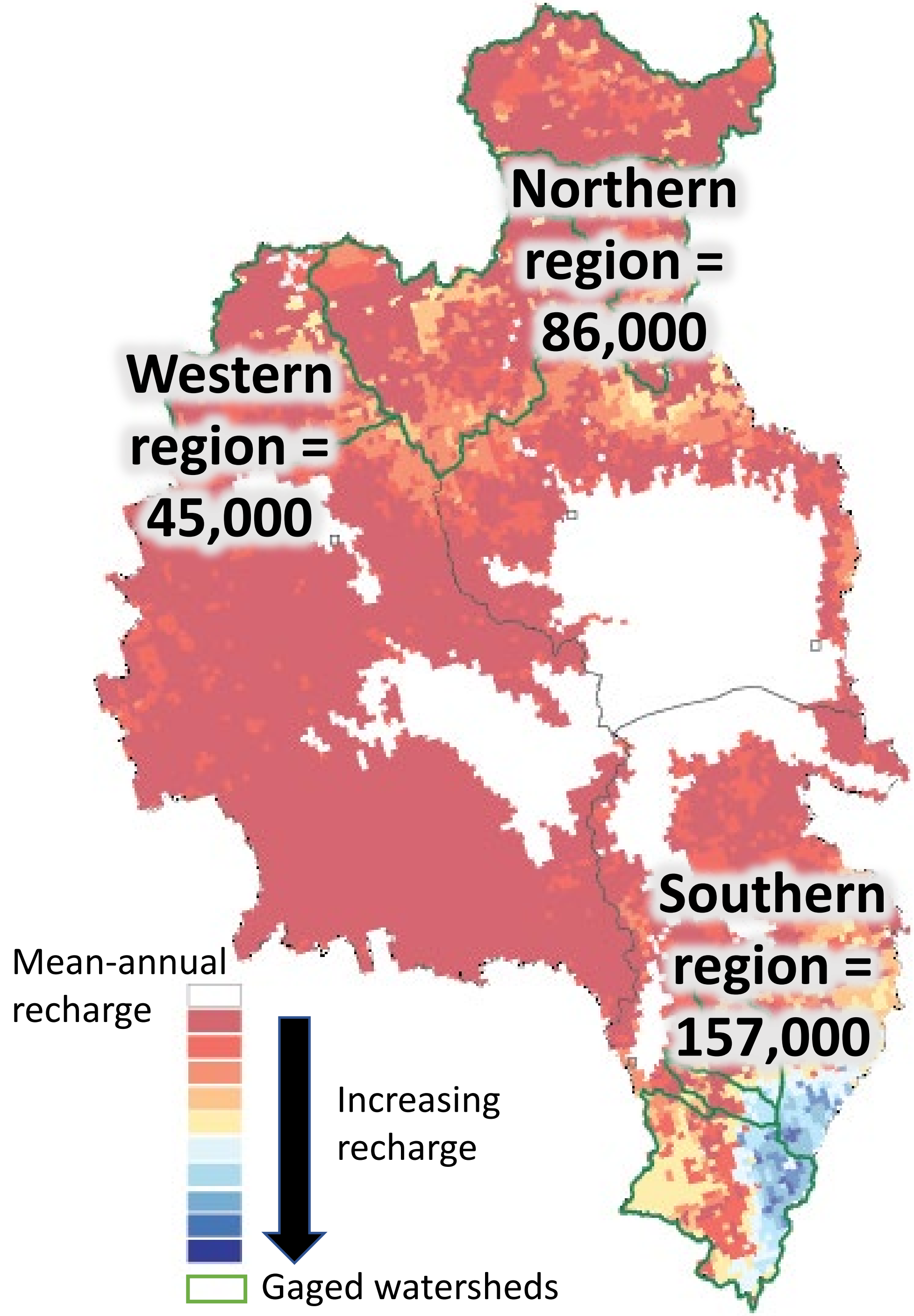
Garcia and others (2022)

Total Upland Recharge by Region

- Total upland recharge = 288,000 acre-feet per year



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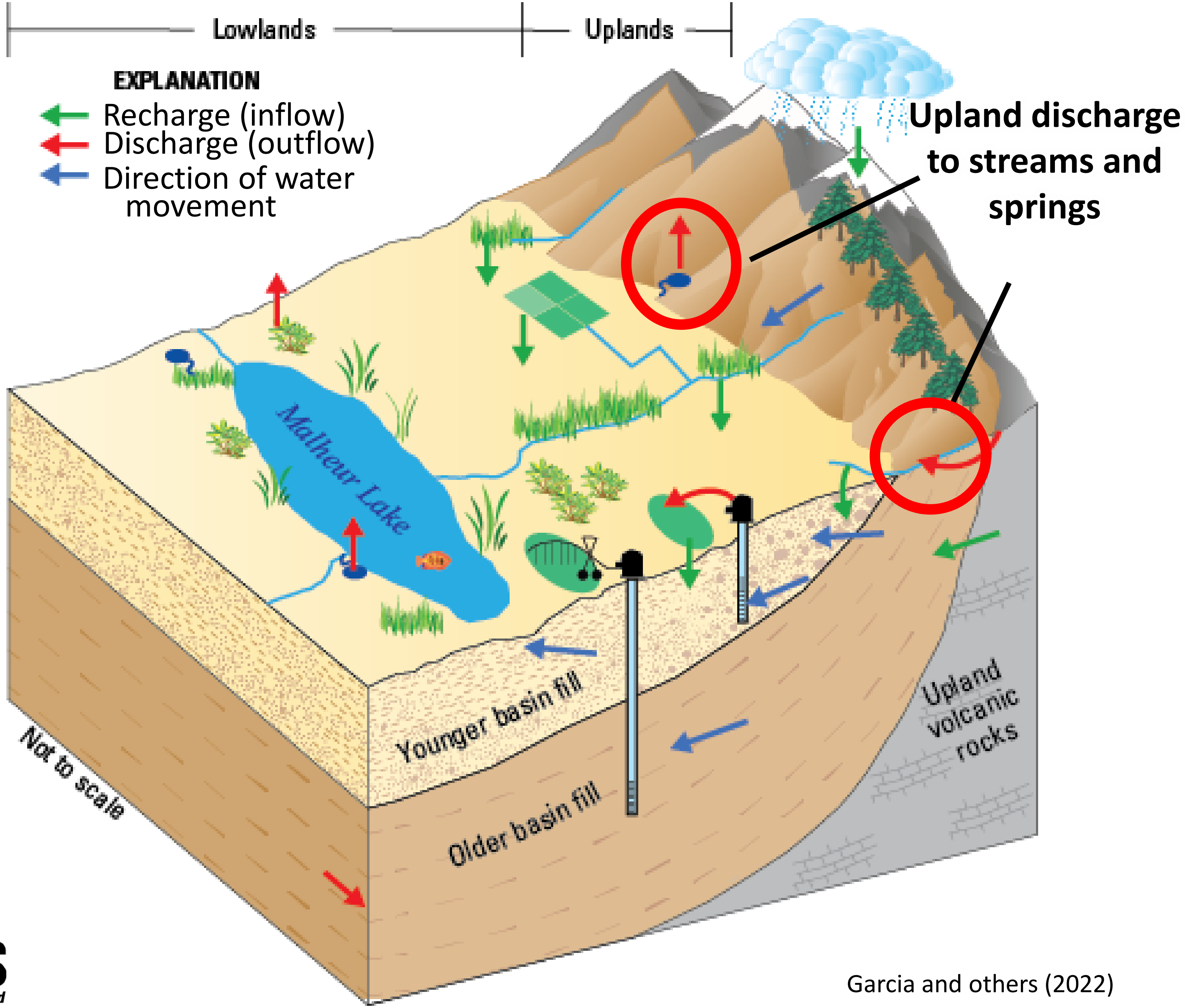
Garcia and others (2022)



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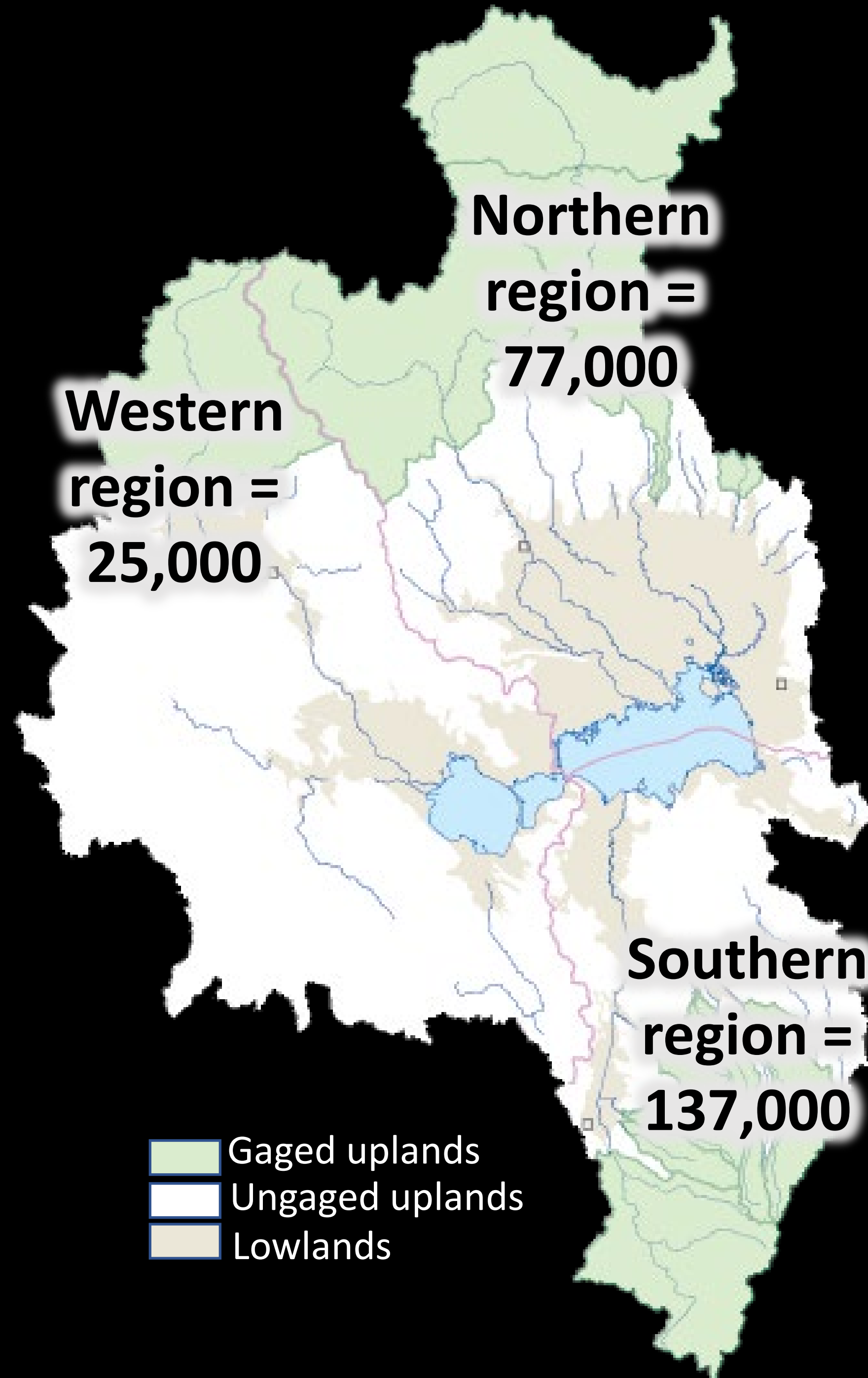
Garcia and others (2022)

Total Upland Discharge by Region

- Total upland discharge = 239,000 acre-feet per year



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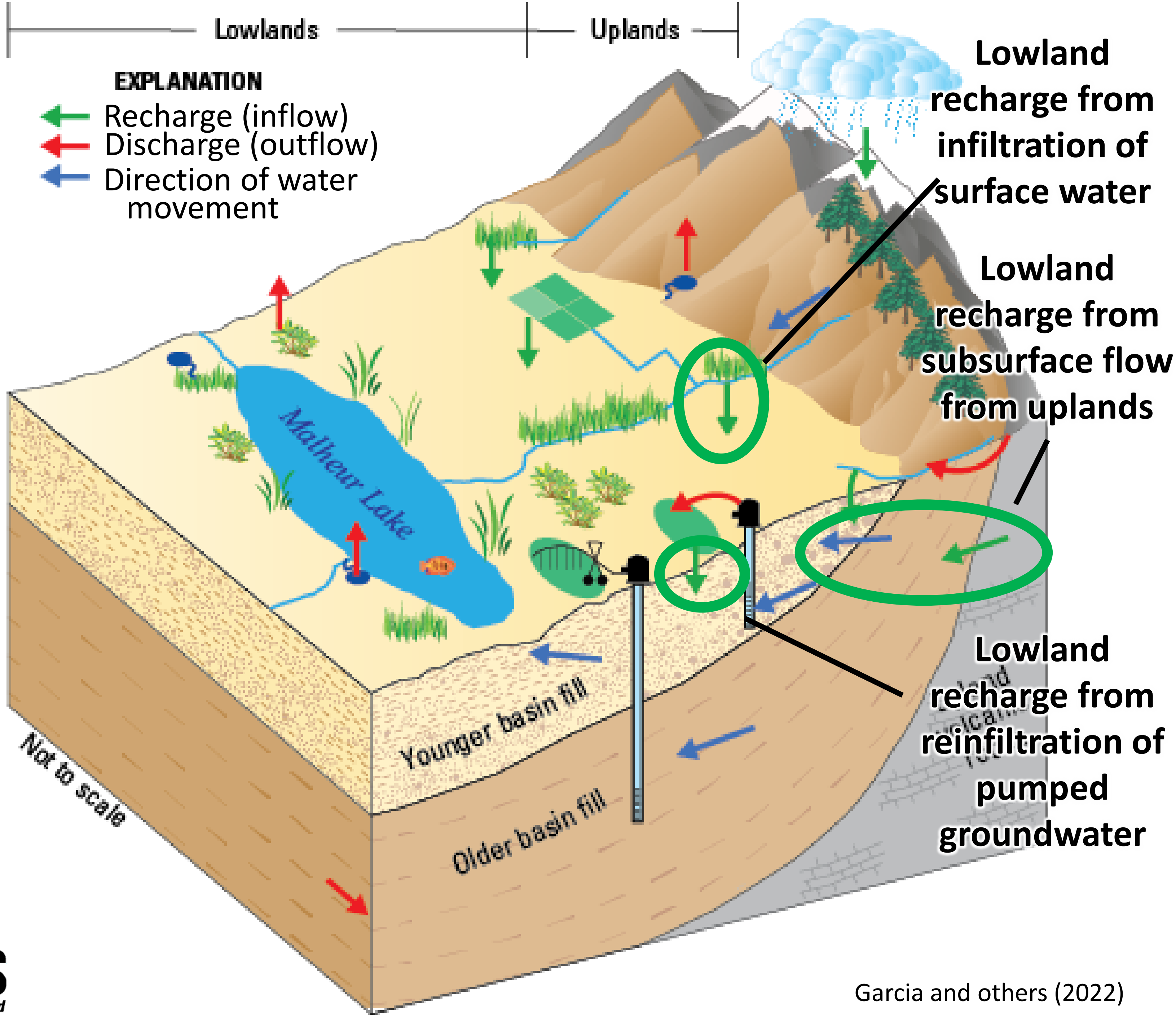
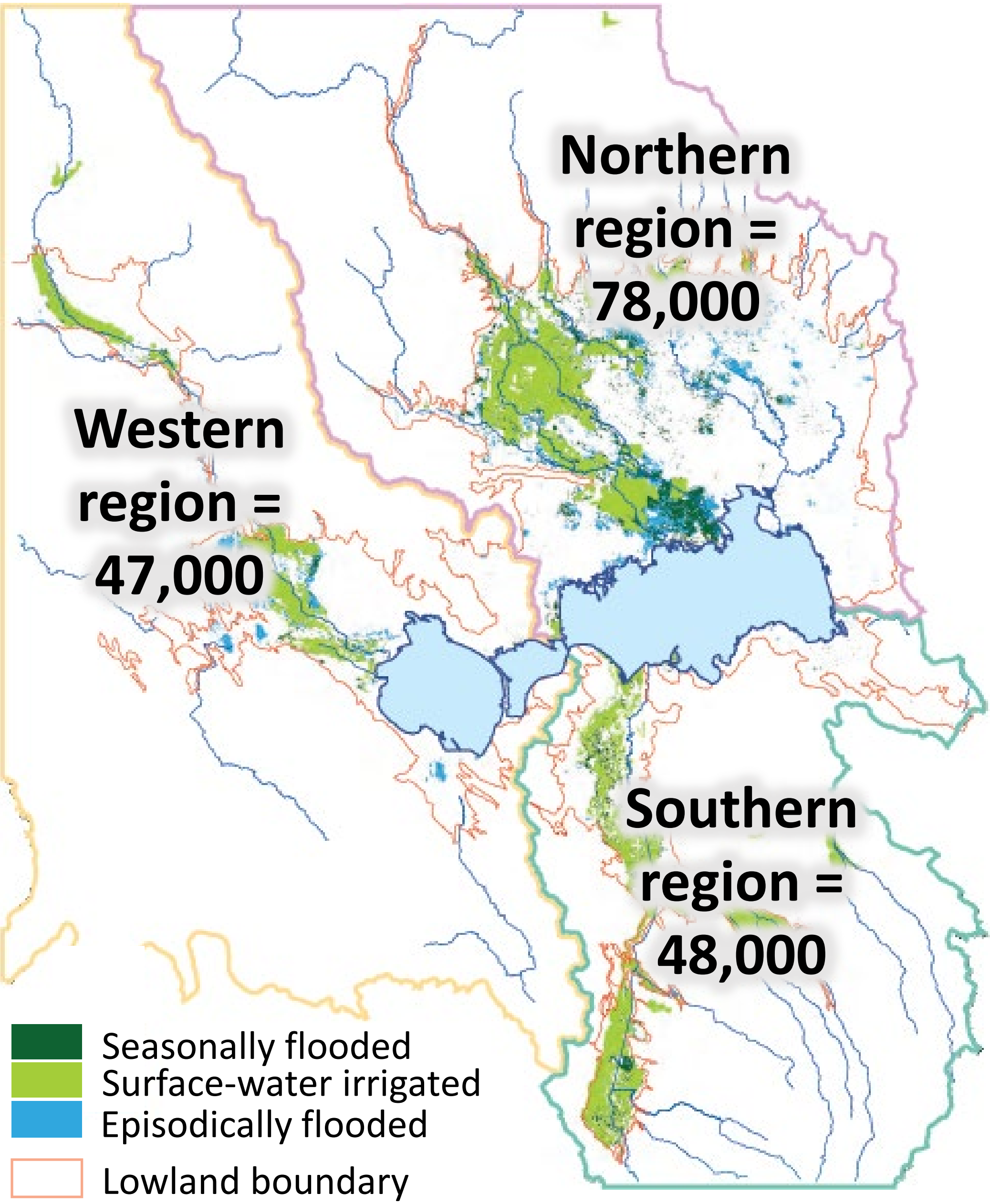
Garcia and others (2022)



Garcia and others (2022)

Total Lowland Recharge by Region

- Total lowland recharge = 173,000 acre-feet per year
  - Infiltration of surface water (67%)
  - Groundwater inflow from uplands (28%)
  - Infiltration of pumped groundwater (5%)



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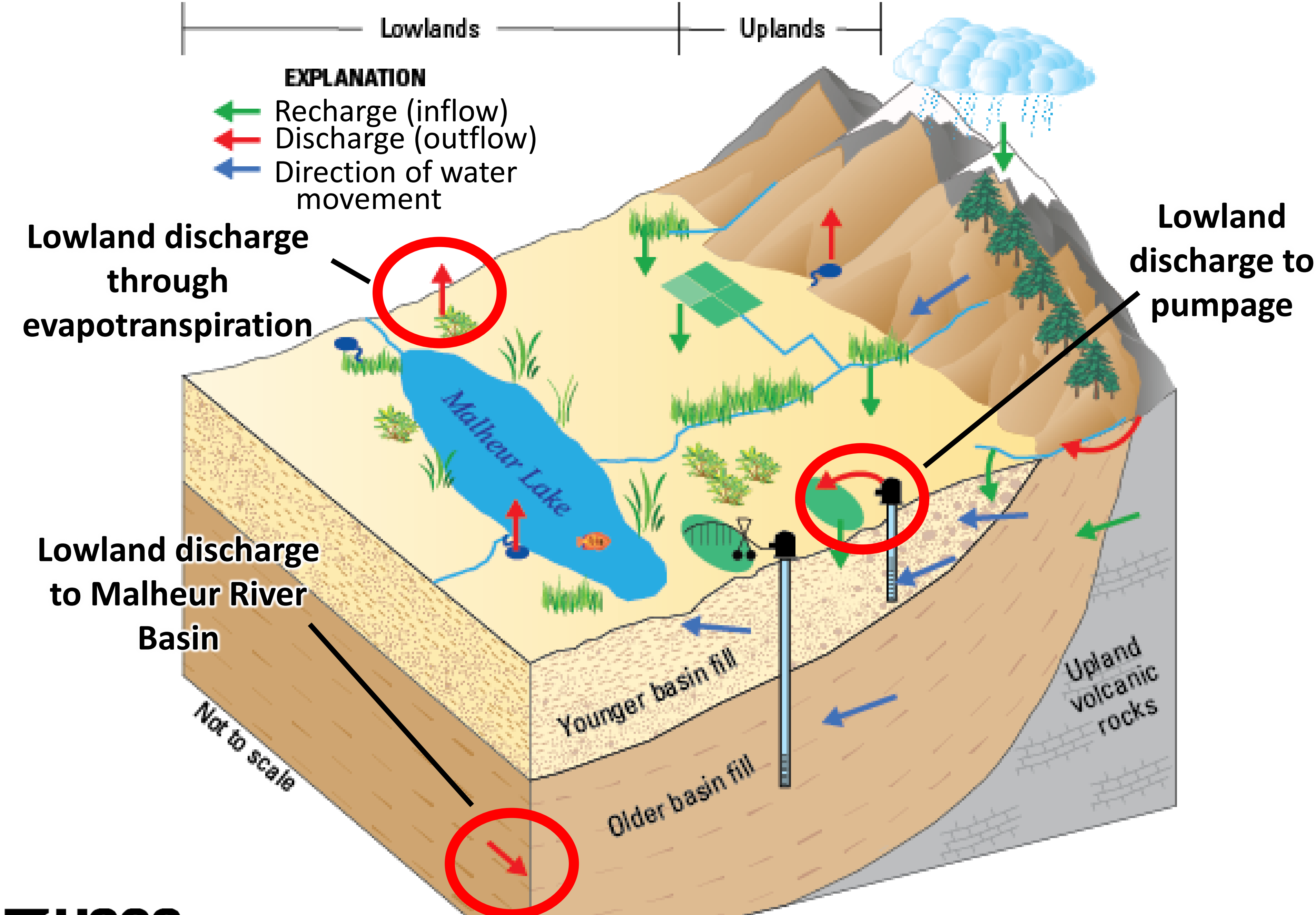
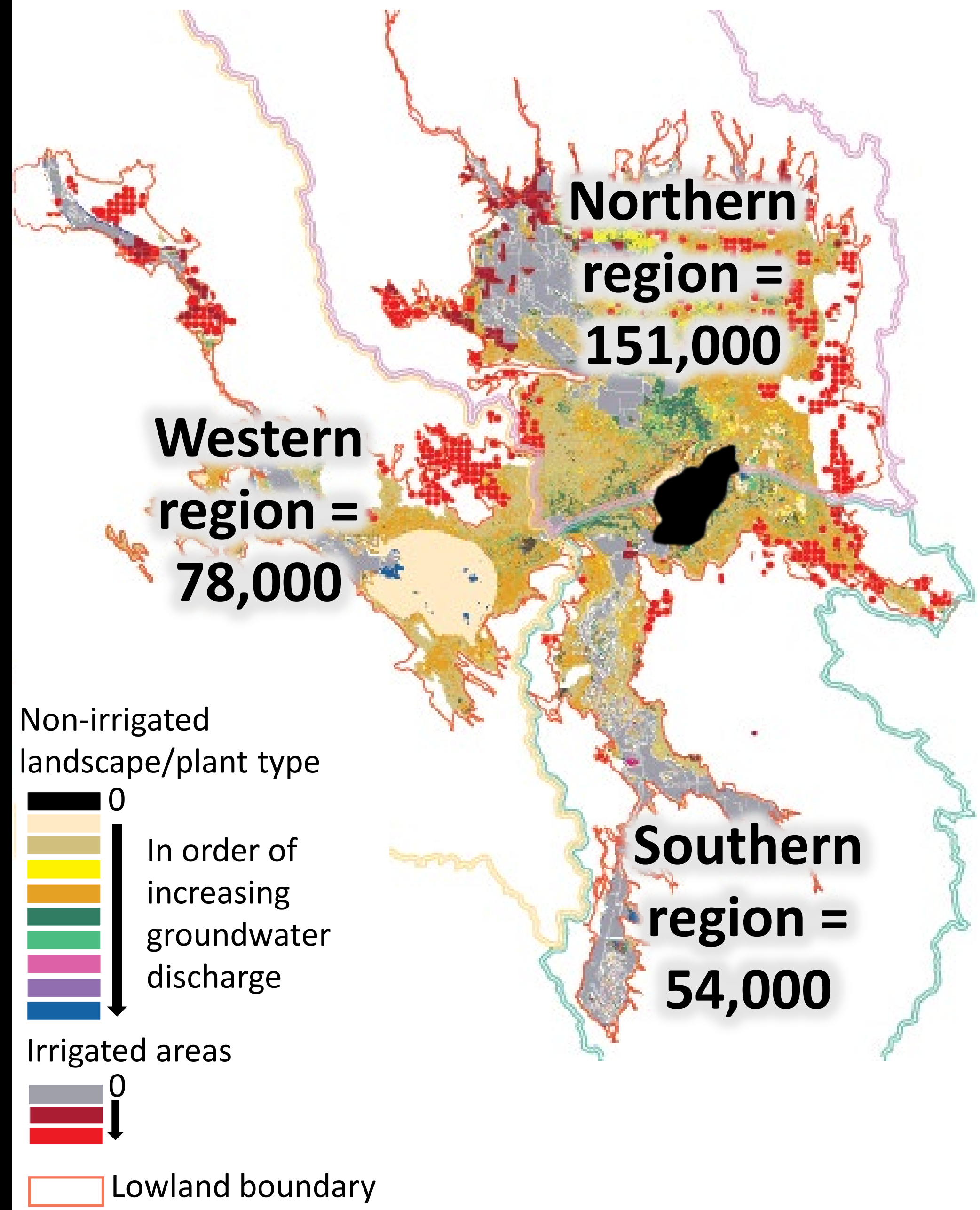


Garcia and others (2022)

Total Lowland Discharge by Region

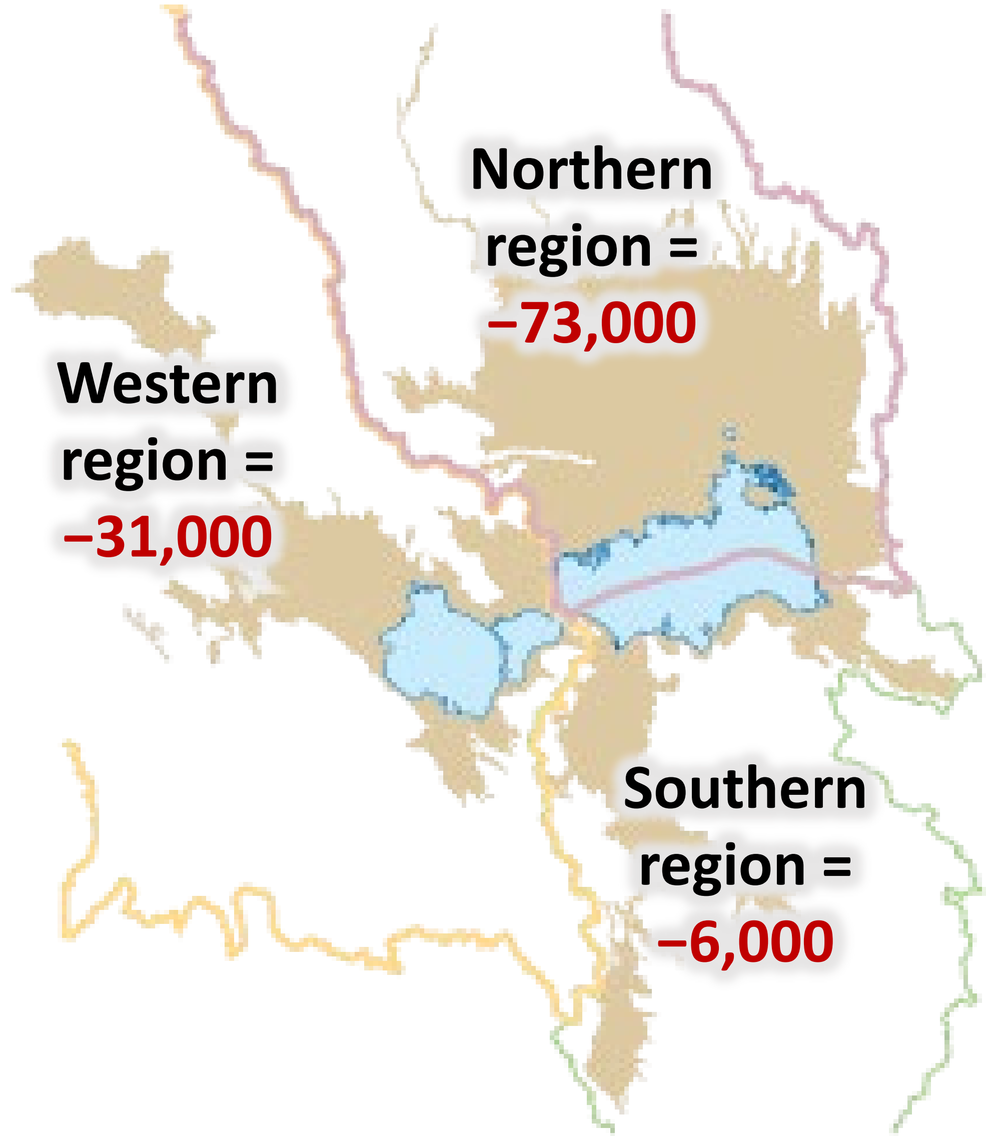
- Total lowland discharge = 283,000 acre-feet per year
    - Groundwater evapotranspiration and spring discharge (45%)
    - Groundwater pumpage (54%)
    - Groundwater flow to Malheur River Basin (1%)



Garcia and others (2022)

Lowland Groundwater Budget Imbalance by Region

- Recharge – discharge
- Total imbalance
  – 110,000 acre-feet per year
- Pumpage is currently removing groundwater from aquifer storage and likely capturing a small amount of natural discharge



Garcia and others (2022)

Conclusions

- More than 70% of upland recharge discharges in the uplands
- Pumpage is currently removing groundwater from aquifer storage and is likely capturing a small amount of natural discharge
- The largest budget deficit is in the northern region where pumpage exceeds recharge

USGS

References

Garcia, C.A., Corson-Dosch, N.T., Beamer, J.P., Gingerich, S.B., Grondin, G.H., Overstreet, B.T., Haynes, J.V., and Hoskinson, M.D., 2022, Hydrologic budget of the Harney Basin groundwater system, southeastern Oregon: U.S. Geological Survey Scientific Investigations Report 2021–5128, 144 p., https://doi.org/10.3133/sir20215128.

Gingerich, S.B., Garcia, C.A., and Johnson, H.M., 2022, Groundwater resources of the Harney Basin, southeastern Oregon: U.S. Geological Survey Fact Sheet 2022–3052, 6 p., https://doi.org/10.3133/fs20223052.

Groundwater Resources of the Harney Basin

Harney Basin Groundwater Study Advisory Committee
October 12, 2022

U.S. Geological Survey/Oregon Water Resources Department

USGS
science for a changing world

U.S. Department of the Interior
U.S. Geological Survey

Key Takeaways

- Most groundwater pumped from lowland wells is ancient and not being replenished at meaningful human timescales.

- The effects of pumping vary across the basin depending on the local geology, the amount of recharge, and the amount of withdrawal

- Pumping large volumes of groundwater from…
  - …low-permeability rocks causes deep drawdown over relatively small areas
  - …high-permeability rocks causes shallow drawdown over large areas

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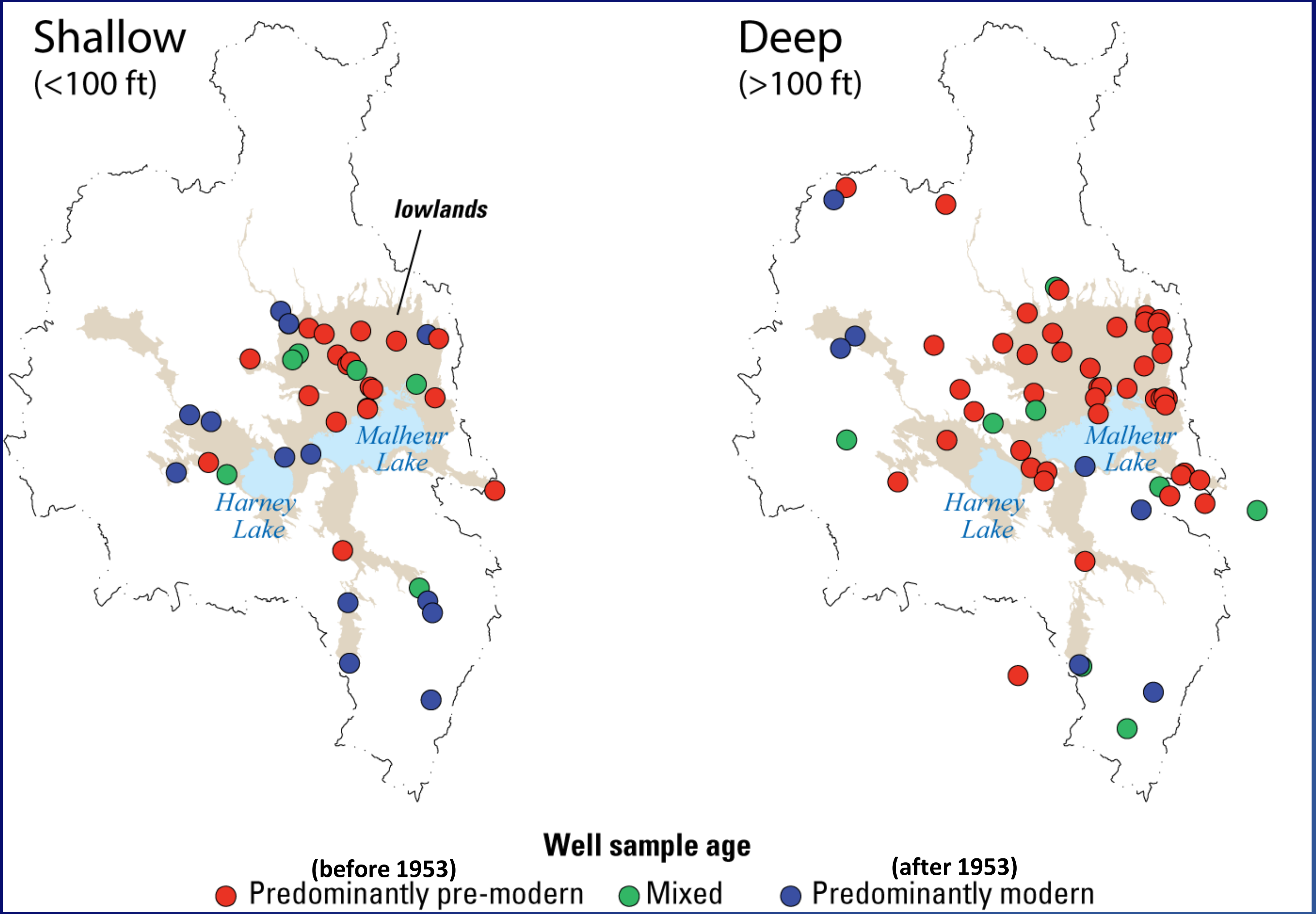
Lowland groundwater is mostly ancient:

recharged 5,000–30,000 years ago

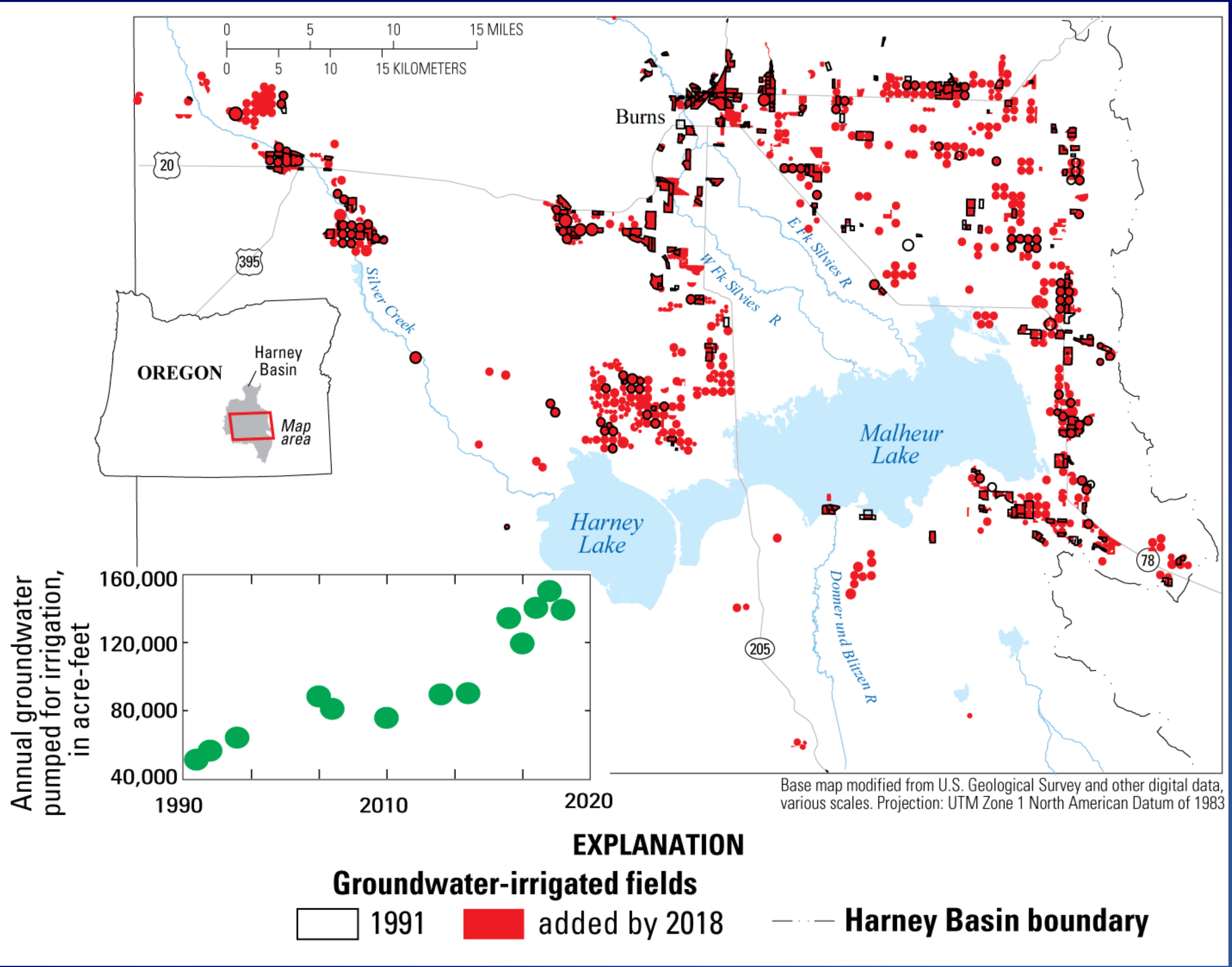


Based on analysis of tritium and carbon-14 ages and stable isotopes of hydrogen

USGS

From Gingerich and others, 2022

Irrigation pumpage tripled since 1991



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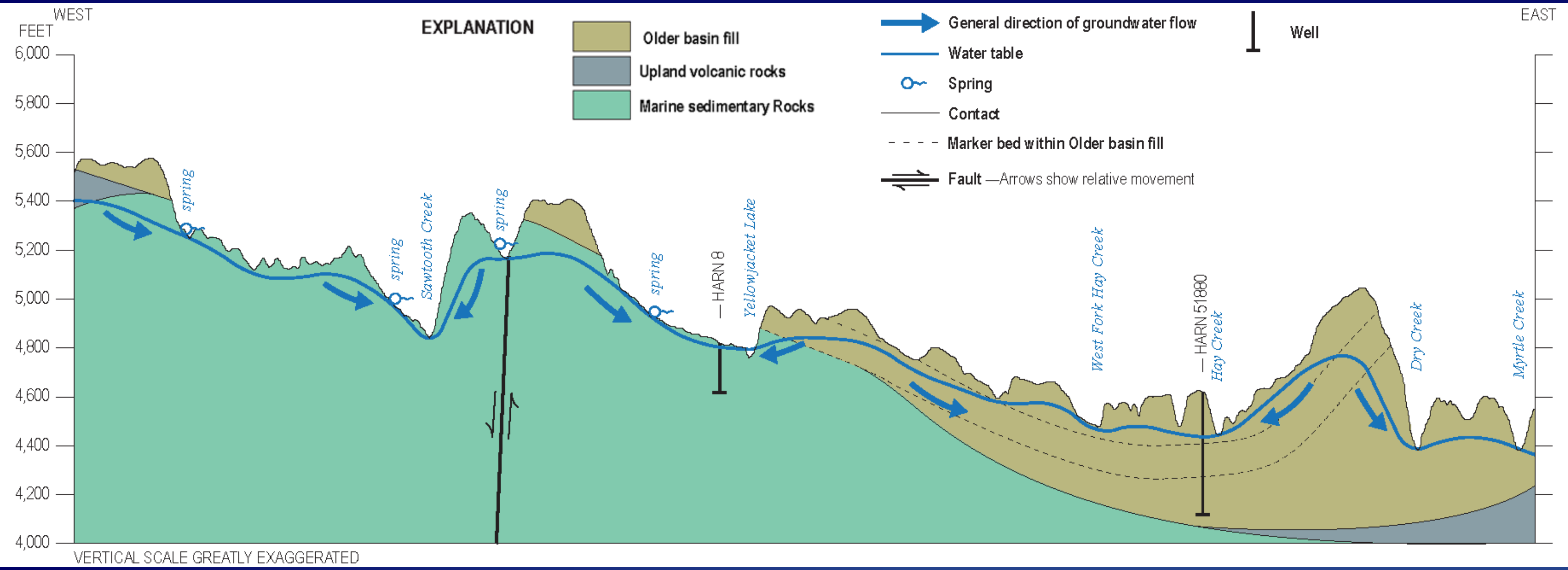
From Gingerich and others, 2022

From Gingerich and others, 2022

Base map modified from U.S. Geological Survey and other digital data, various scales. Projection: UTM Zone 11 North. North American Datum of 1983

USGS

Low-permeability uplands



From Gingerich and others, 2022

- Groundwater flow paths are shallow and limited by low permeability
- About 70 % of upland recharge discharges at the land surface nearby
- Groundwater discharge is the primary source of flow in upland streams, springs, wetlands, and meadows during the dry summer months

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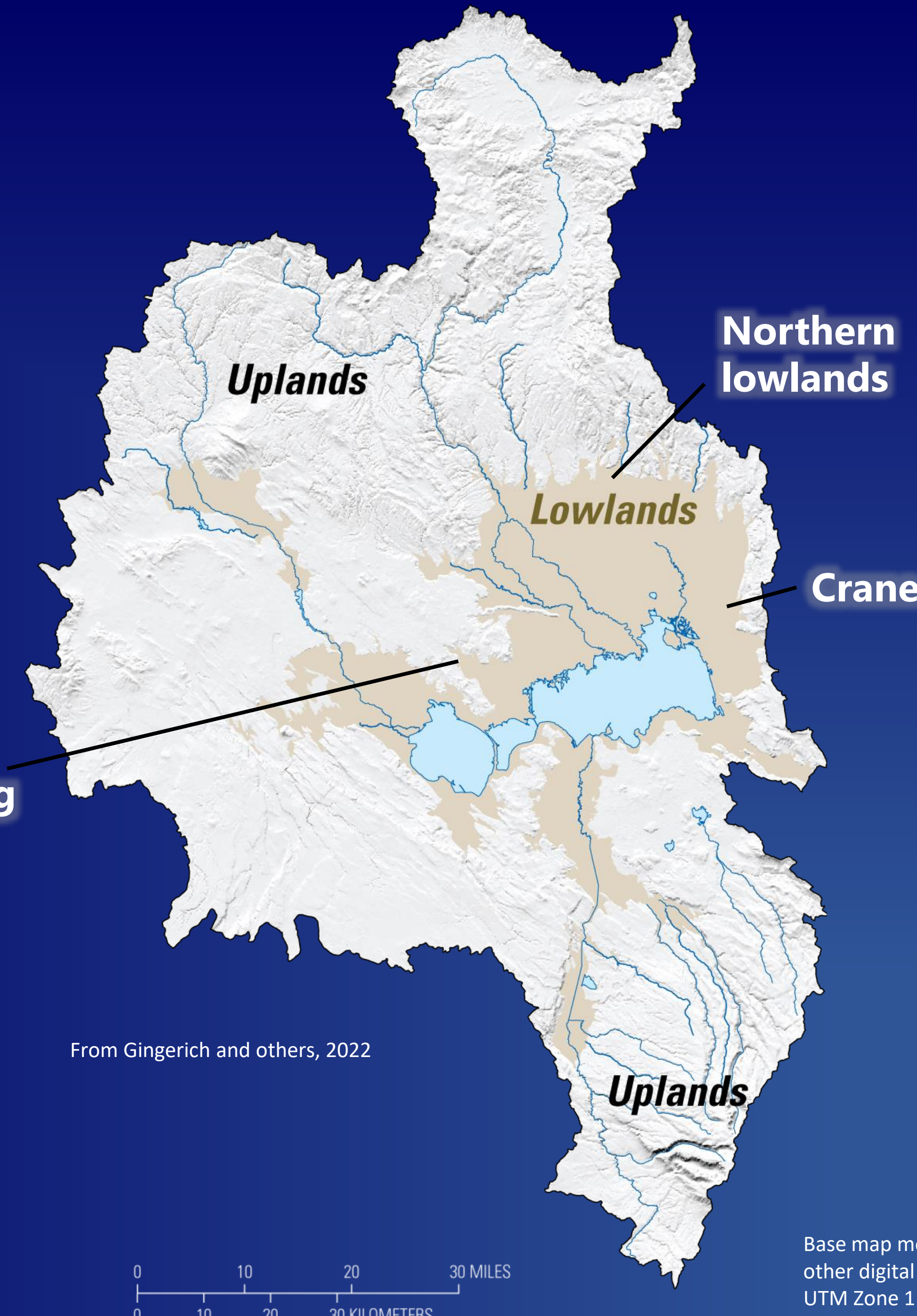
Pumping large volumes of groundwater from low-permeability rocks causes deep drawdown over relatively small areas



From Gingerich and others, 2022

Base map modified from U.S. Geological Survey and other digital data, various scales. Projection: UTM Zone 11 North. North American Datum of 1983

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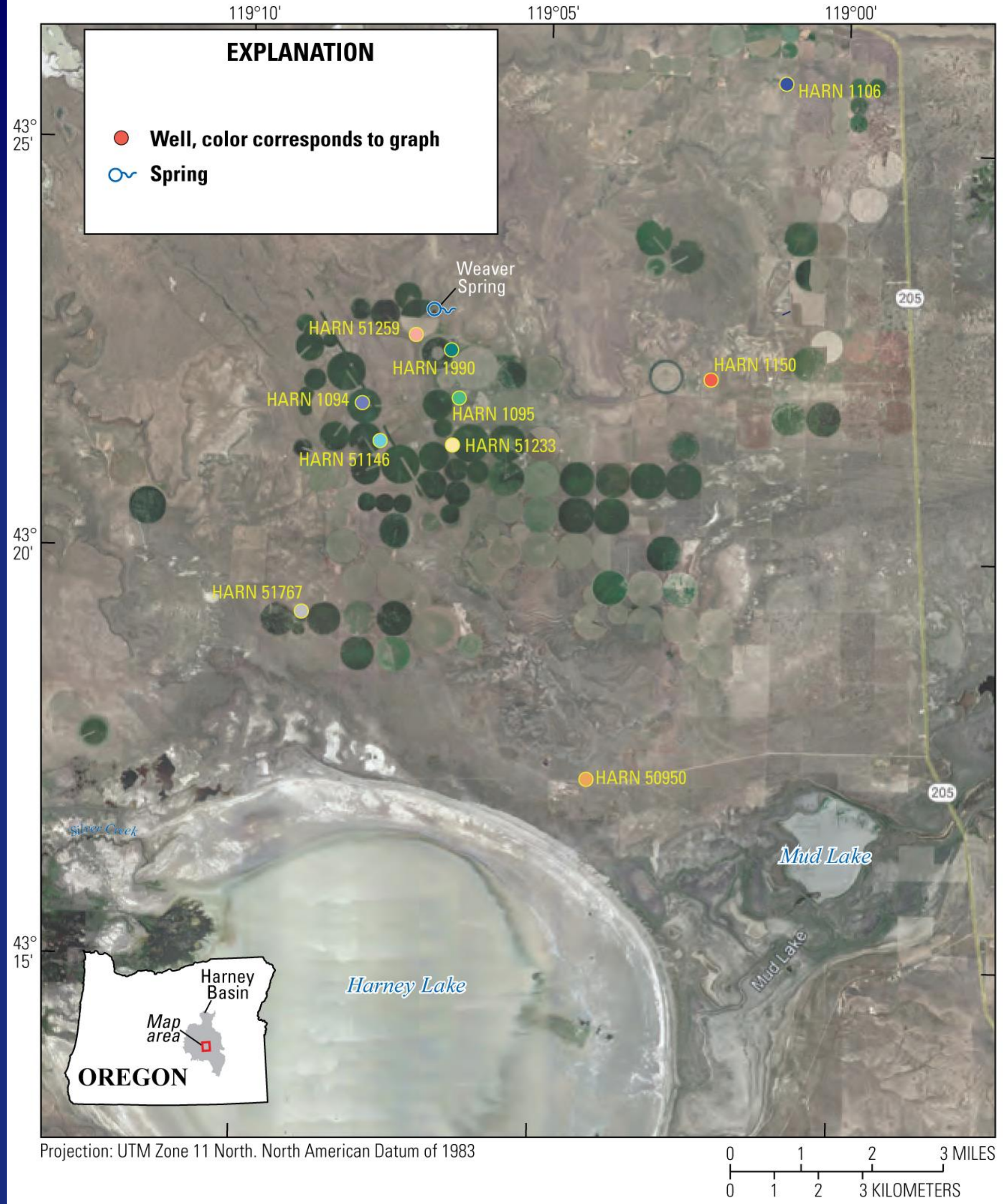
Weaver Spring/Dog Mountain area

- Most water produced from a local area composed of highly permeable rocks surrounded by much less permeable rocks

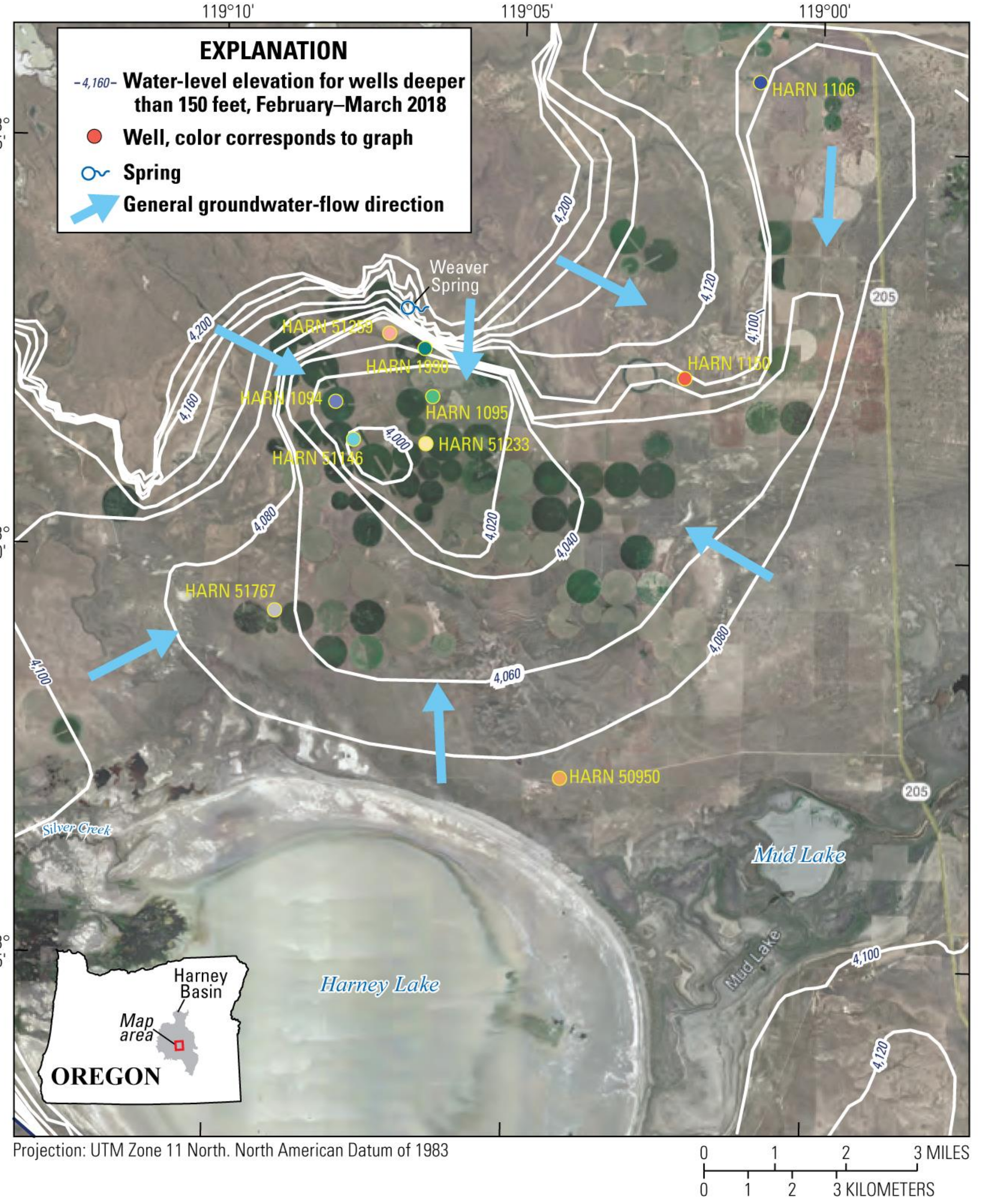


USGS

From Gingerich and others, 2022

Weaver Spring/Dog Mountain area

- Water levels declined more than 140 feet from predevelopment levels
- Now lowest part of hydrologic flow system (previously was Harney Lake)
- Ancient water is being pumped at rate that isn't being replenished by sparse modern recharge

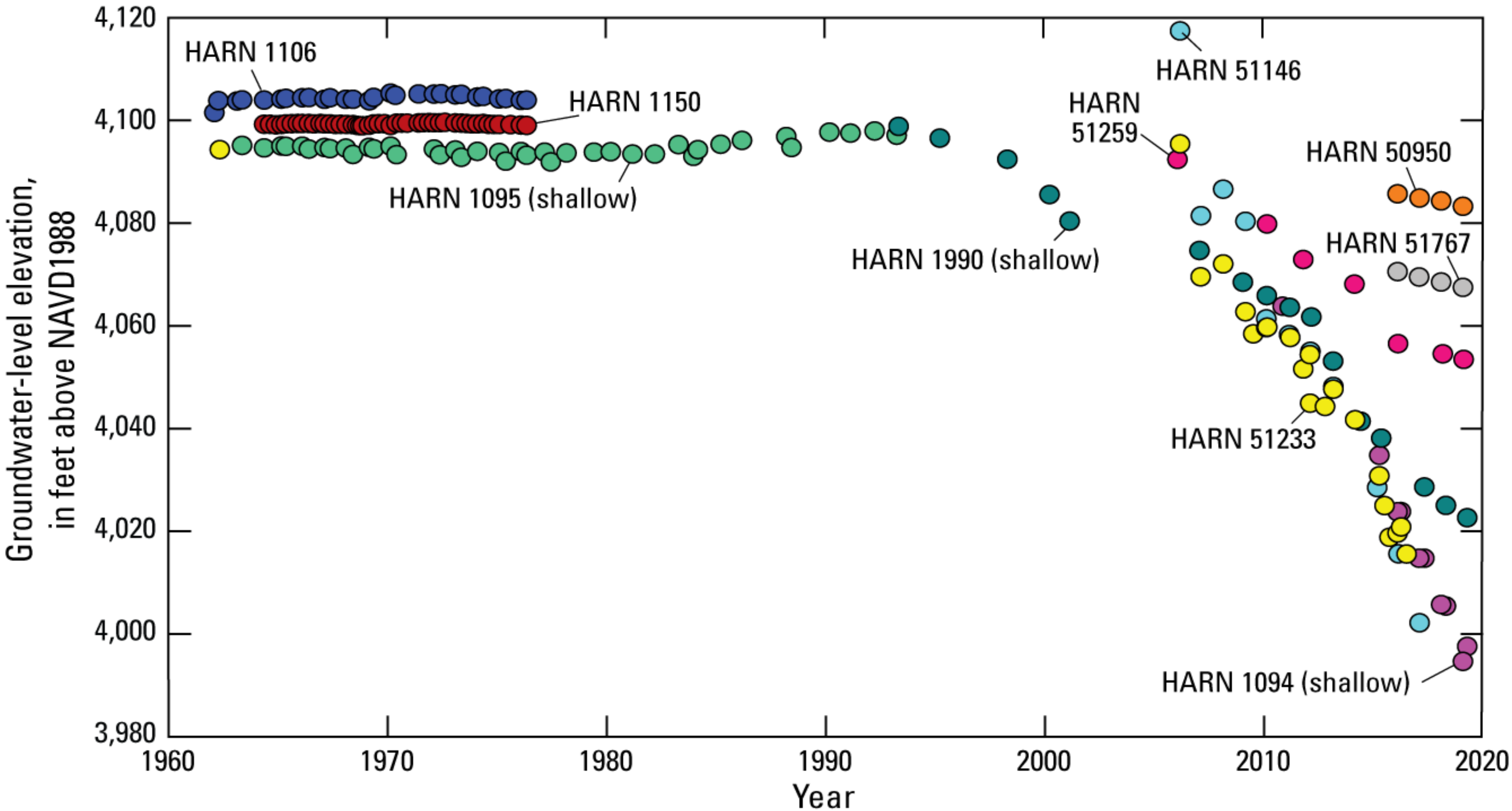


USGS

From Gingerich and others, 2022

Weaver Spring/Dog Mountain area

- Some water levels declined 8 feet per year since 2016



From Gingerich and others, 2022

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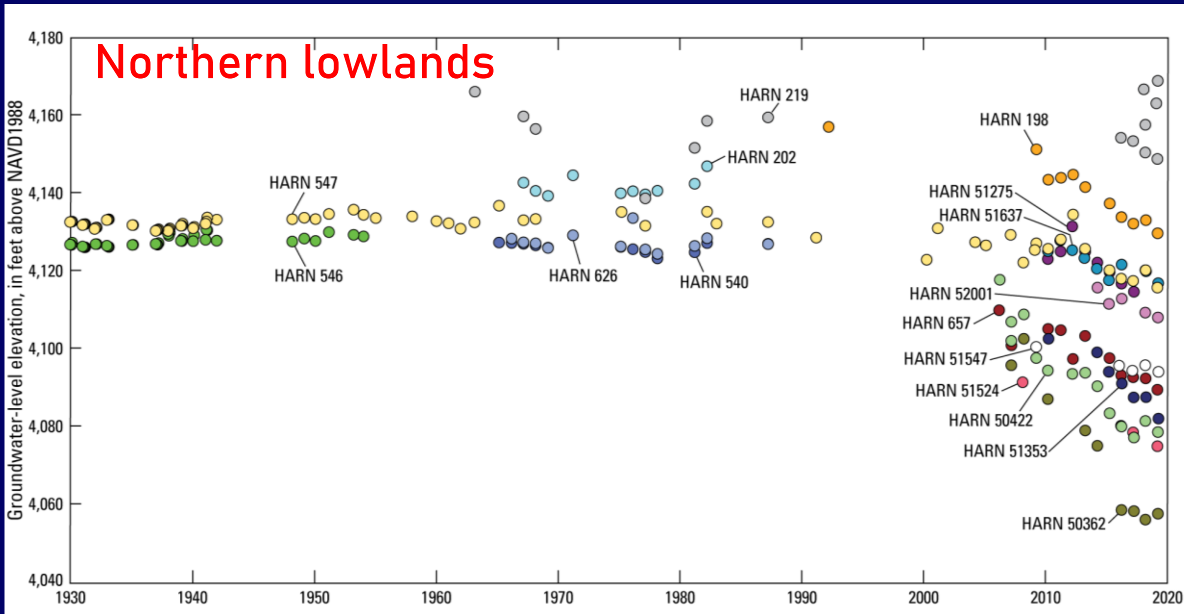
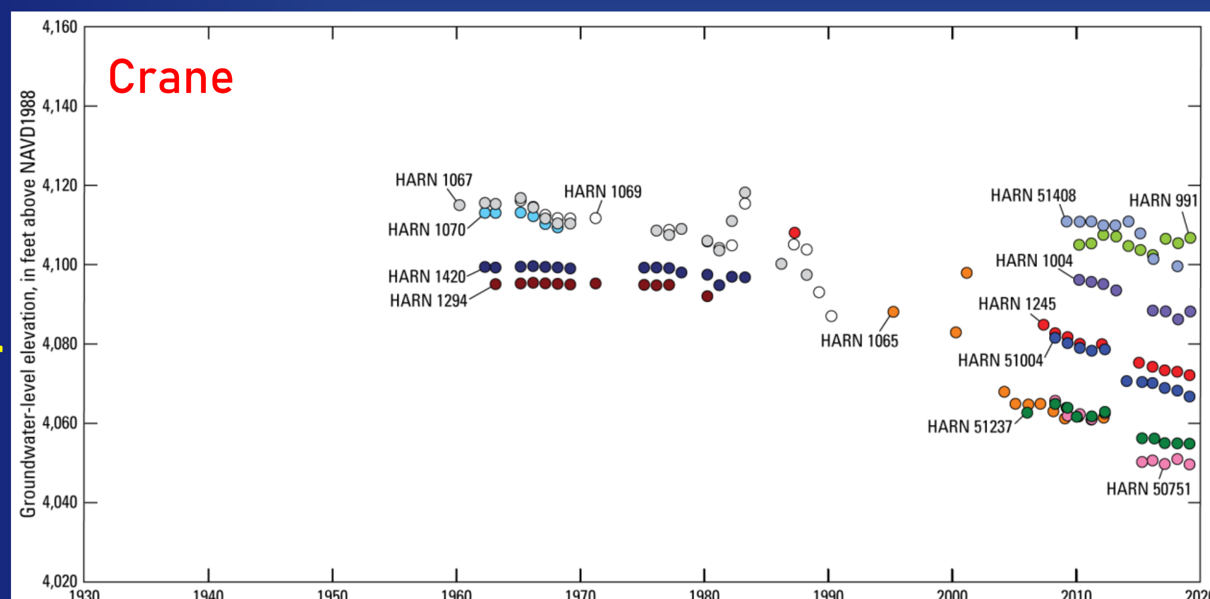
Northern lowlands and Crane are similar cases to WS/DM



Some water levels declined

5 feet per year since 2008



Some water levels

declined 1–2 feet per year

since 2008

USGS

From Gingerich and others, 2022

Pumping large volumes of groundwater from high-permeability rocks causes shallow drawdown over large areas

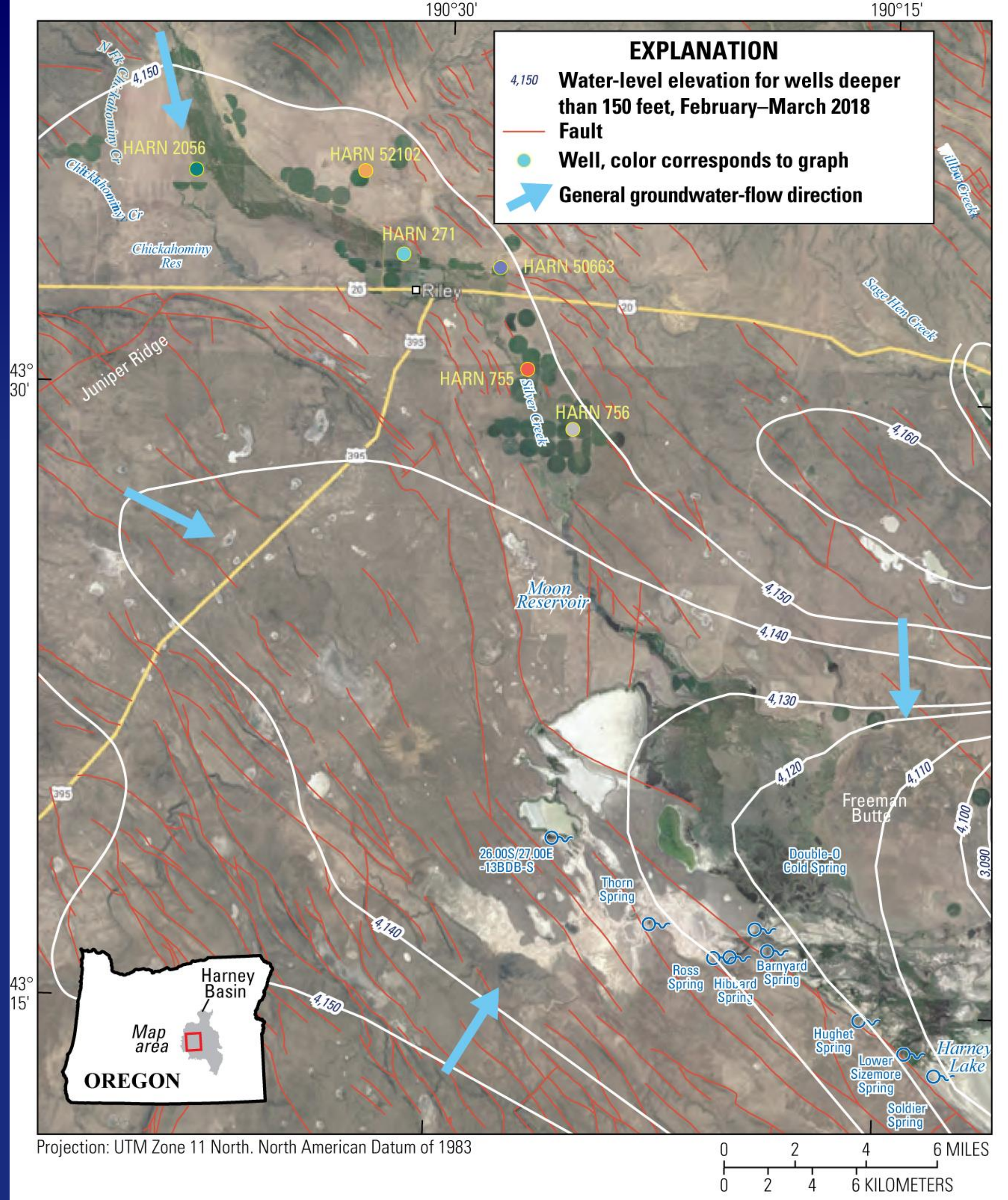
From Gingerich and others, 2022

Base map modified from U.S. Geological Survey and other digital data, various scales. Projection: UTM Zone 11 North. North American Datum of 1983

USGS

Silver Creek floodplain area

- Most water produced from a widespread highly permeable zone of rocks
- Water levels declined about 10 feet from predevelopment levels
- Small groundwater-level declines over a large area
- Groundwater withdrawal likely will affect Warm Springs Valley and may affect lower Silver Creek water levels



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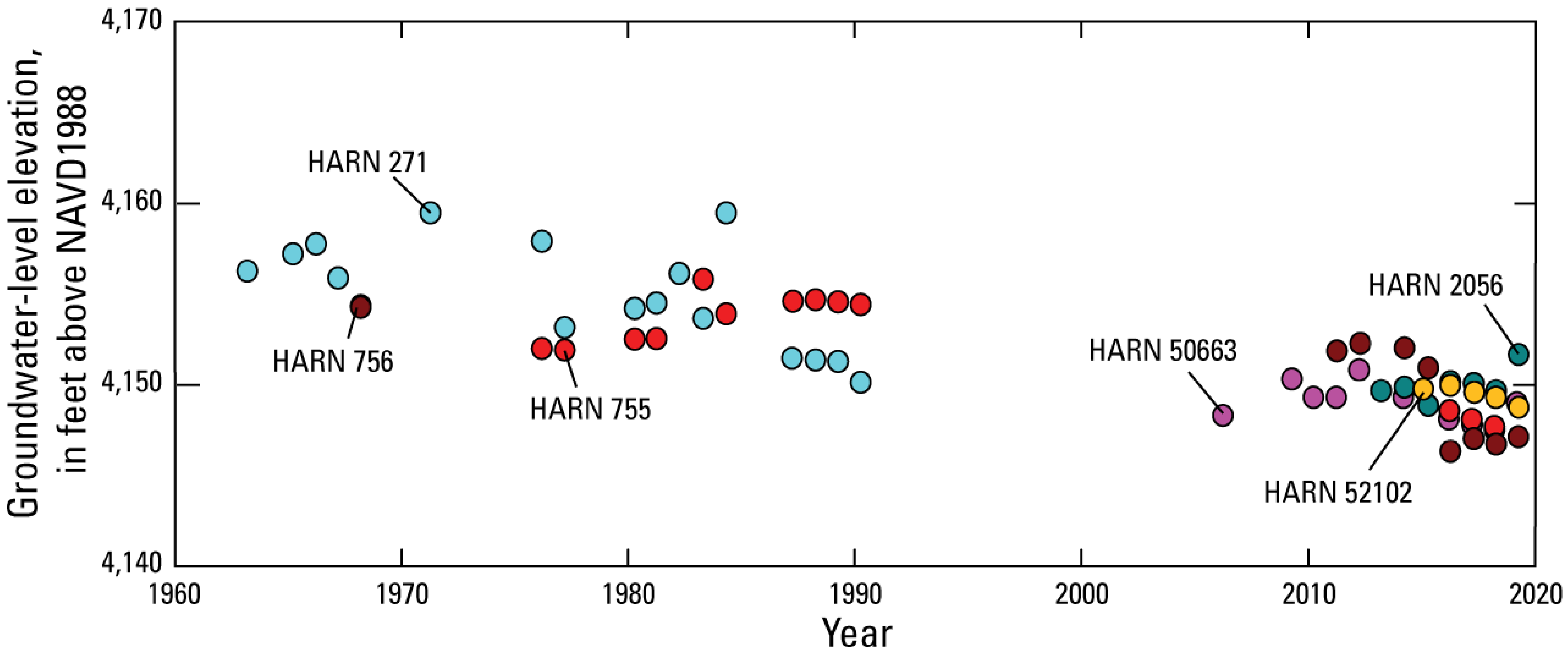
From Gingerich and others, 2022

Silver Creek floodplain area

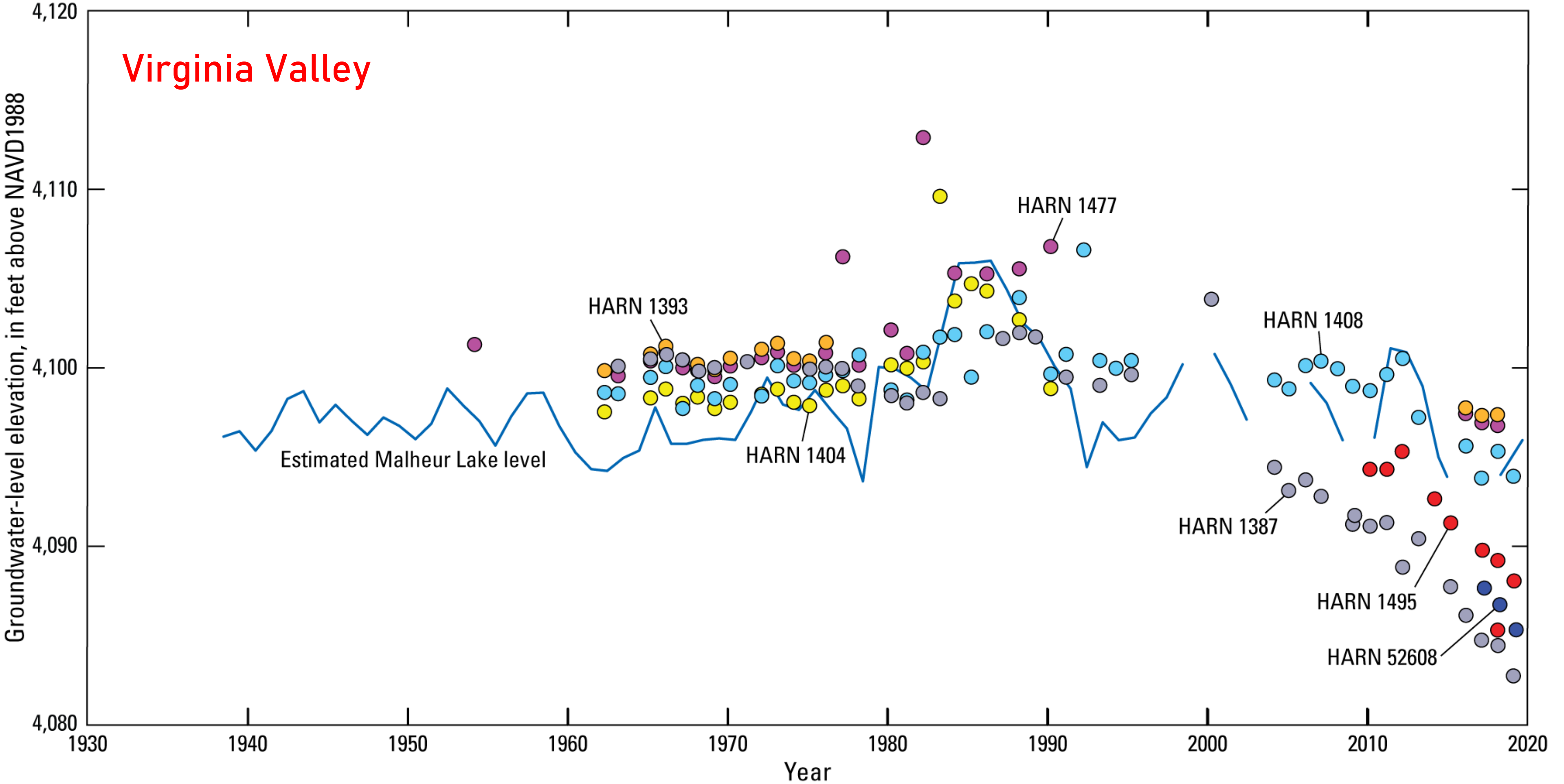
Some water levels declined 0.5 feet per year since 2015



From Gingerich and others, 2022

Virginia Valley is a similar case to Silver Creek Valley

Some water levels declined 1 feet per year since 2010



From Gingerich and others, 2022

USGS

Areas with less drawdown mainly due to higher recharge and less groundwater withdrawal

From Gingerich and others, 2022

Base map modified from U.S. Geological Survey and other digital data, various scales. Projection: UTM Zone 11 North. North American Datum of 1983

USGS

Key Takeaways–again

- **Most groundwater pumped from lowland wells is ancient and not being replenished at meaningful human timescales.**

- **The effects of pumping vary across the basin depending on the local geology, the amount of recharge, and the amount of withdrawal**

- **Pumping large volumes of groundwater from…**

  - **…low-permeability rocks causes deep drawdown over relatively small areas**

  - **…high-permeability rocks causes shallow drawdown over large areas**

USGS

References and related reports

- Beamer, J.P., and Hoskinson, M.D., 2021, Historical irrigation water use and groundwater pumpage estimates in the Harney Basin, Oregon, 1991–2018: Oregon Water Resources Department Open File Report 2021–02, 53 p. [Also available at https://www.oregon.gov/owrd/wrdreports/OWRD_OFR_2021-02_Harney_Basin_METRIC_Irrigation_Use_Report.pdf.]
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USGS

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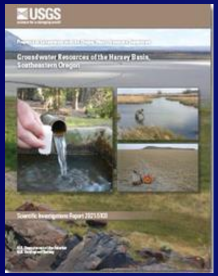

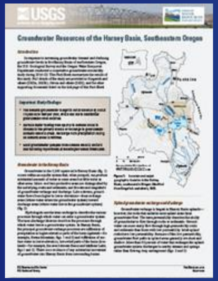

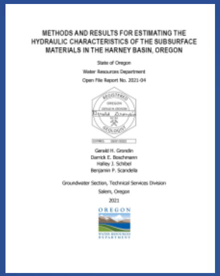

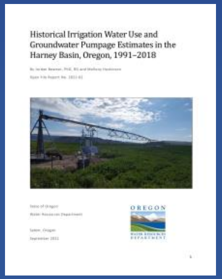

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