Recharge Net Metering (RENEM)

A Cost-Effective Incentive System To Enhance Groundwater Recharge

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Andy Fisher | UC Santa Cruz

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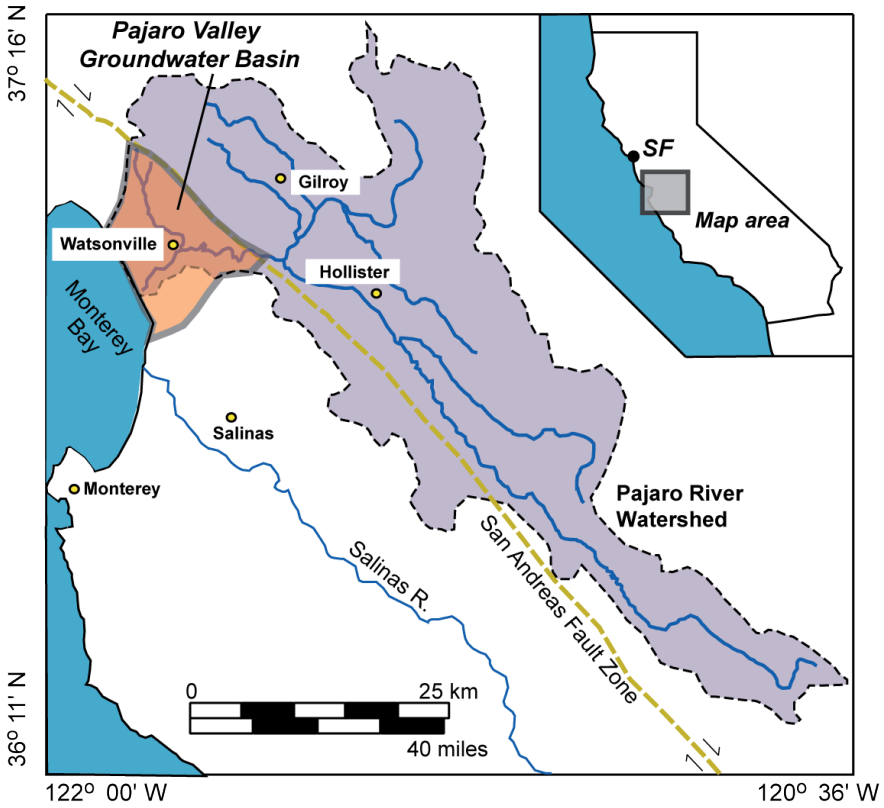
UCSC Hydrogeology — The University of California — 1868 — "Endeavor to persevere..."

Pajaro Valley Water Management Agency

ReNeM | *Invented And Proven In The Pajaro Valley*

Pajaro Valley, like many other regions, faces a groundwater deficit.



- PVGB, lower PR basin, mostly Santa Cruz and northern Monterey Counties
- Primary freshwater resource is **groundwater**
- PVWMA (PV Water, 1984): special act district
- PV Water serves ~70,000 acres, ~30,000 irrigated

Major crops:
Strawberries, cane berries, table crops, organic (30%)

Pumping: *~55,000 ac-ft/yr*

Overdraft: *averages ~12,000 ac-ft/yr*

→$1B farm revenue

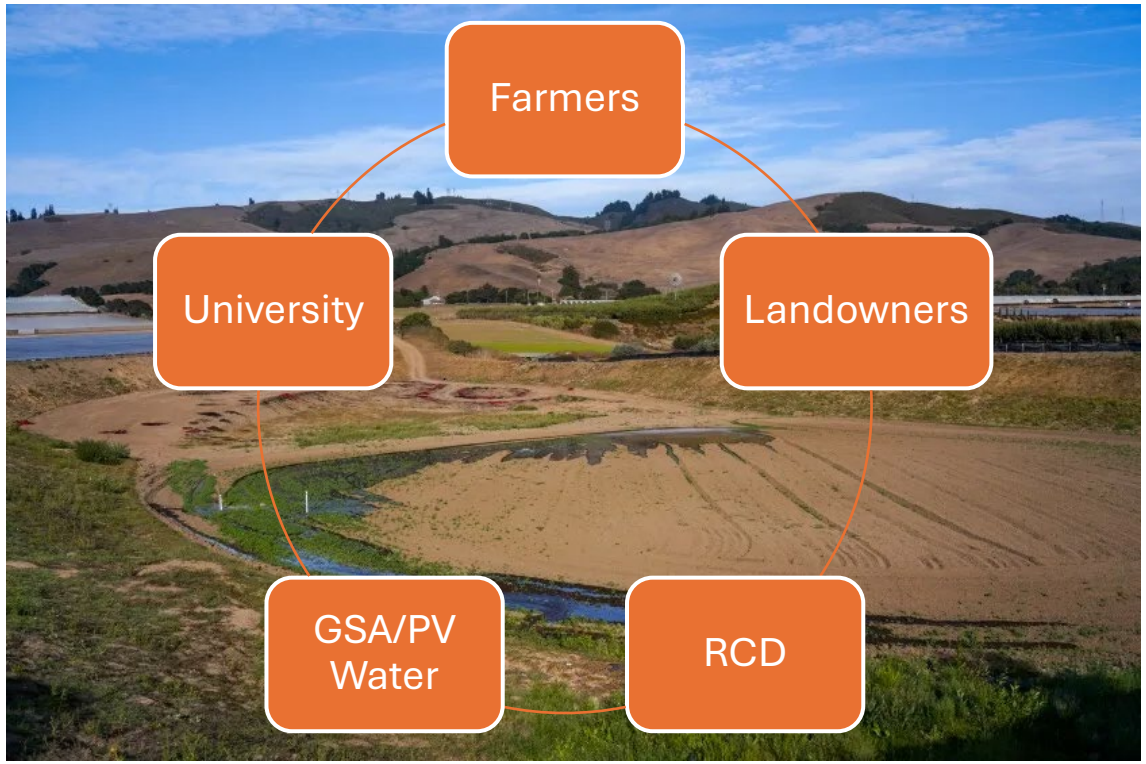
Groundwater sustainability plan includes conservation, improved efficiency, recharge*

* many water agencies want to expand recharge

ReNeM | *Origins*

ReNeM is the result of farmers/landowner's effort to resolve groundwater issues, reinforcing its collaborative, voluntary and community led nature.

- **Recharge** emerges from community dialogue as promising solution for increased groundwater supply.
- Project proponents pitch **ReNeM payment** as percentage of cost of water
- Landowners **volunteer access to property**, host infiltration system
- Success from **creative thought process**, **scientific backing**, neutral third party, **community support**, and **open-minded water agency**



Voluntary | Collaborative | Community Led | Science based

ReNeM | *How It Works In the Pajaro Valley*

ReNeM program participants receive payments in the form of pumping fee rebates, based on the measured volume of water their projects infiltrate each year.

Kelly Thompson Infiltration System & Instruments[1]

1 Recharge systems are designed and installed on selected properties

These systems can use basins, trenches, or active fields to infiltrate excess surface water.

2 Water infiltrates & is metered

ReNeM operators measure and account for flows, determining how much water the project infiltrates.

3 Participant receives credits or rebates on their water bill

Rebates are based on the volume of water infiltrated.

Benefits to the basin and stakeholders

- Sustainable water supply
- Community collaboration
- Financial incentive for recharge
- Improved Water Quality
- Meet SGMA requirements
- Decreased land subsidence/salt water intrusion

Source: [1] ReNeM Implemented Project

ReNeM | *How It Works In the Pajaro Valley*

The RCDSCC and UCSC share leadership in several activities, from technical analysis to administrative/project management, all enabling the implementation of the project and guaranteeing its success.

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Planning

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Construction & Maintenance

UCSC Hydrogeology

Monitoring & Reporting

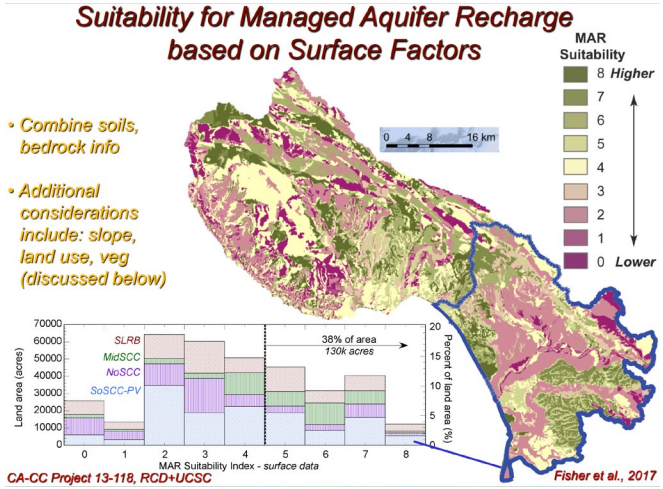
ReNeM | *How It Works In the Pajaro Valley - Planning*

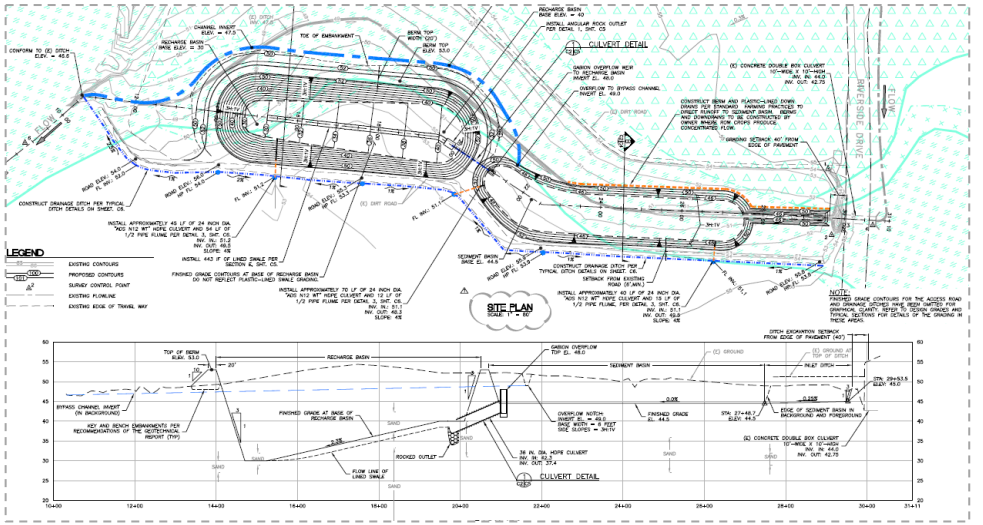
Planning

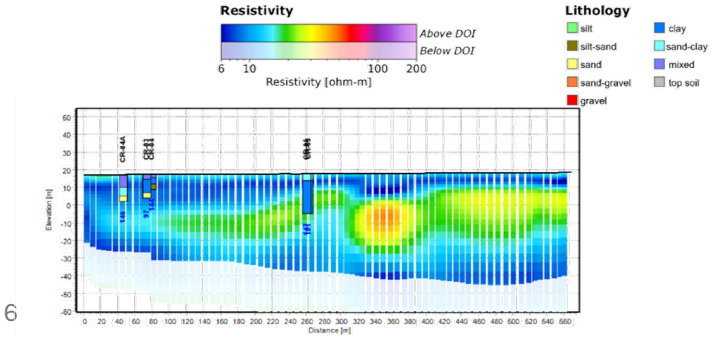
Site Assessment & Characterization

- Regional suitability assessment
- Testing of subsurface geology for reasonableness of basin placement*
- Drainage analysis for water source
- Willing landowner/tenant

Fundraising/ Grant writing | **Project Design** | **Permitting** | **Agreements**







*tTEM; Cone Penetration Tests (CPT)

ReNeM | *How It Works In the Pajaro Valley*

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RESOURCE CONSERVATION DISTRICT OF SANTA CRUZ COUNTY

Construction & Maintenance

ReNeM | *How It Works In the Pajaro Valley*

The RCDSCC and UCSC share leadership in several activities, from technical analysis to administrative/project management, all enabling the implementation of the project and guaranteeing its success.

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Construction & Maintenance

Construction
- Contracting
- Oversight

Adaptive Management

Maintenance

ReNeM | *How It Works In the Pajaro Valley*

RCDSCC and UCSC share leadership in several activities, from technical analysis to administrative/project management, all enabling the implementation of the project and guaranteeing its success.

Monitoring & Reporting

ReNeM | *How It Works In the Pajaro Valley*

The RCDSCC and UCSC share leadership in several activities, from technical analysis to administrative/project management, all enabling the implementation of the project and guaranteeing its success.

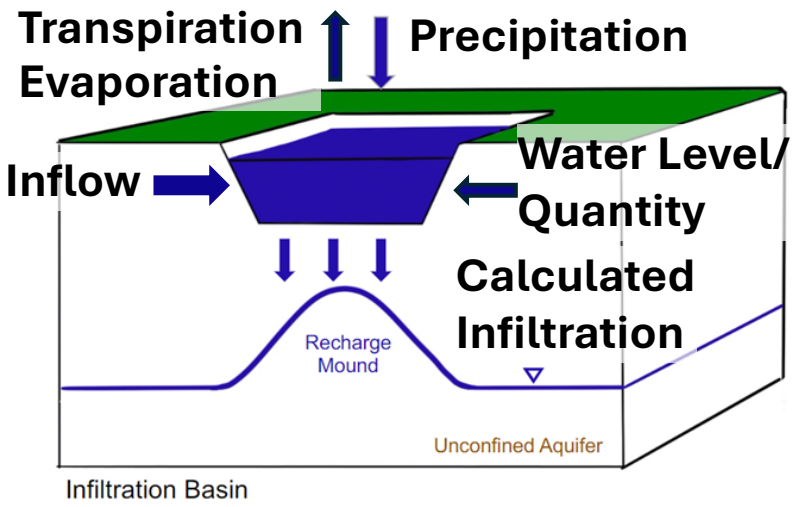
Monitoring & Reporting

Basins equipped each season with sensors, sampling systems

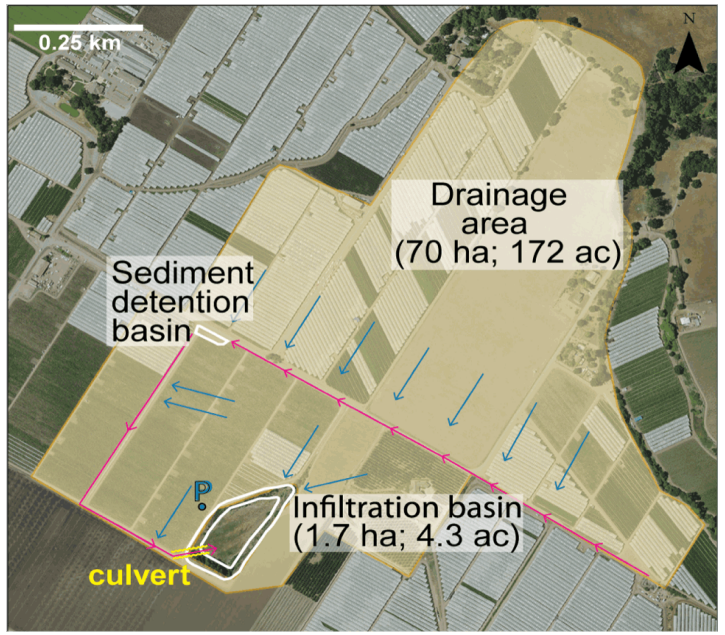
Measurements include:
- Pressure for water level
- Evapotranspiration
- Precipitation

Calculations run and reported

Rebate $$$ = 50% x net infiltration x pumping fee



- Drainage area is distinct from farmed area
- Larger drainage area generates more runoff → more potential for ReNeM (infiltration) benefit
- Flows are measured to determine benefit by the RCD–UCSC team (*third-party certifier*)
- Agency and participants *agree ahead of time* to accept TPC data and calculations



ReNeM | *Initial Projects*

*Since WY2017, three pilot ReNeM projects have demonstrated **efficacy** and all projects to date have infiltrated **better water quality** than ambient groundwater*

- PV Water removed "pilot" designation in 2021, goal = 1,000 af/yr of infiltration (~10% of PV 'overdraft')

ReNeM pilot projects	Bokariza Ranch	Storrs Vineyard/Winery	Kelly Thompson Ranch
Infiltration basin size (ac)	**4**	**0.6**	**4**
ReNeM project since	WY17	WY22	WY20
Cost to design/build (US$)	100k	100k	750k
Average benefit (ac-ft/ yr)	104	5-10	160
Cumulative benefit (ac-ft)	728	10-20	639

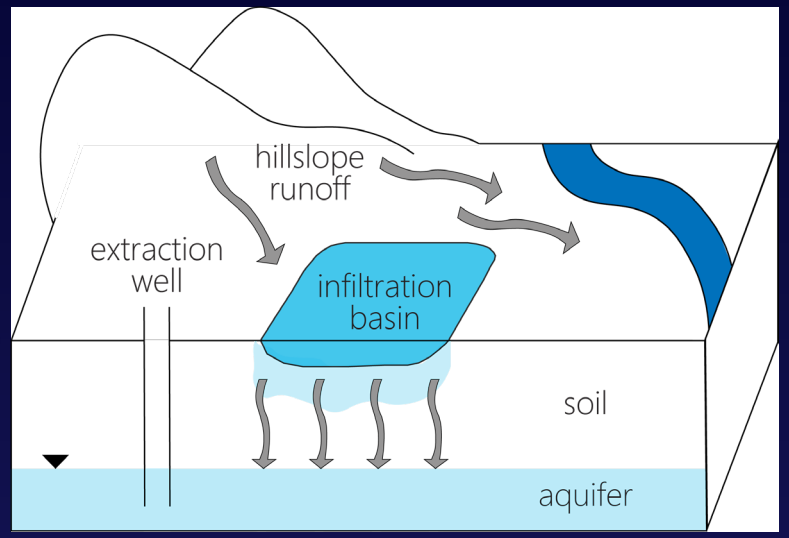
Pre-existing/modified

Built from scratch!

12 Source: ReNeM Implemented Project; Figures as of 2023

Stormwater as a Source for MAR

Low-impact development (LID)



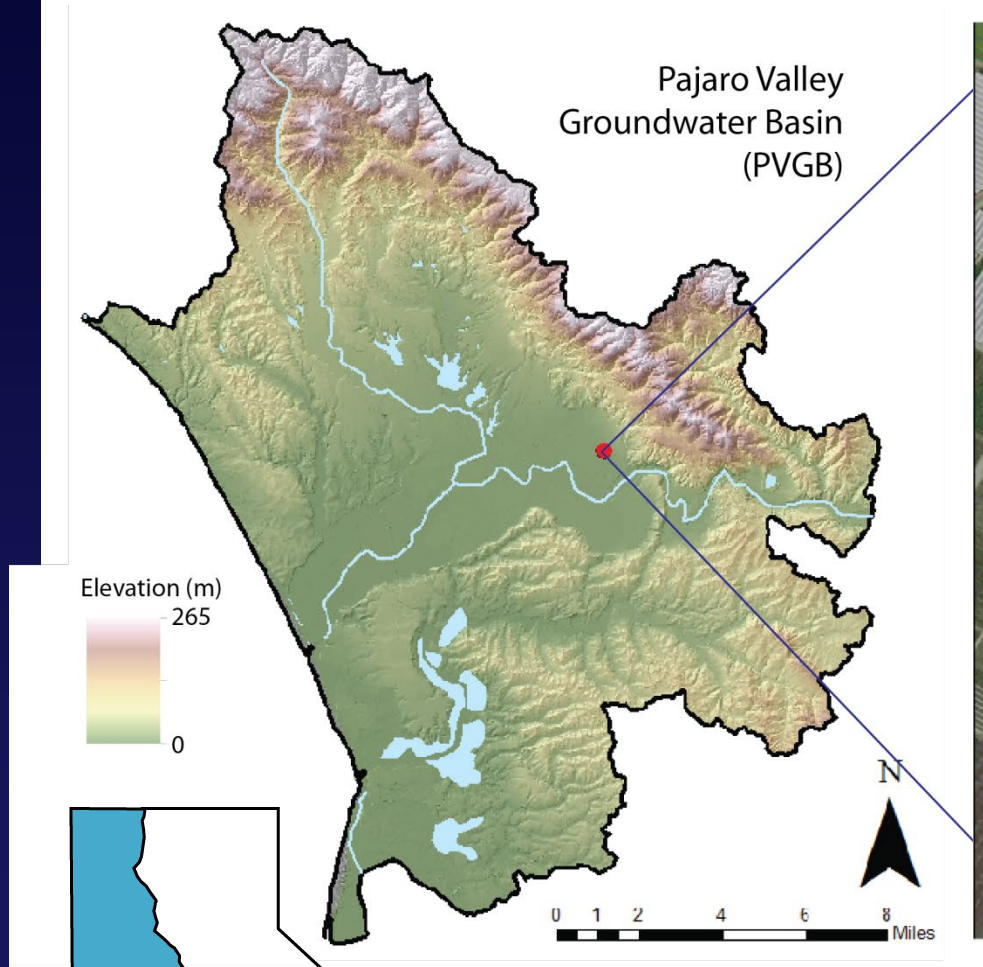
Regional spreading grounds

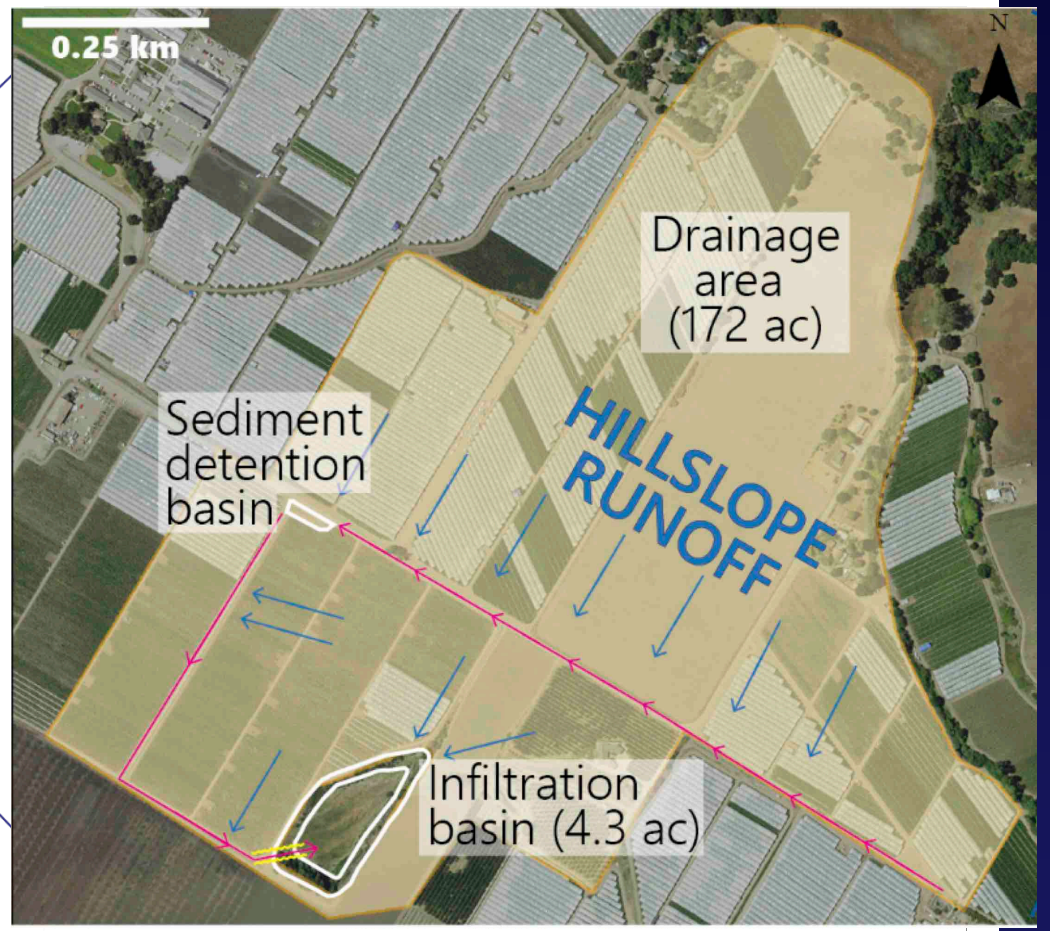
1-10 af/yr per site

10^4-10^5 af/yr per program

100 - 1,000 af/yr per site

Managed Aquifer Recharge with Stormwater (Stormwater-MAR)

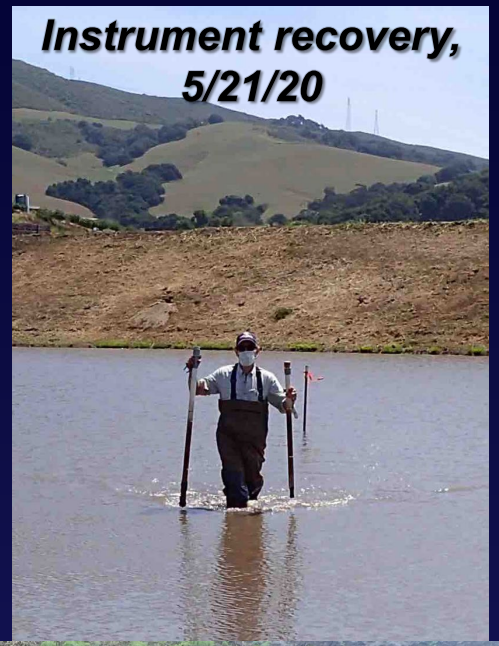




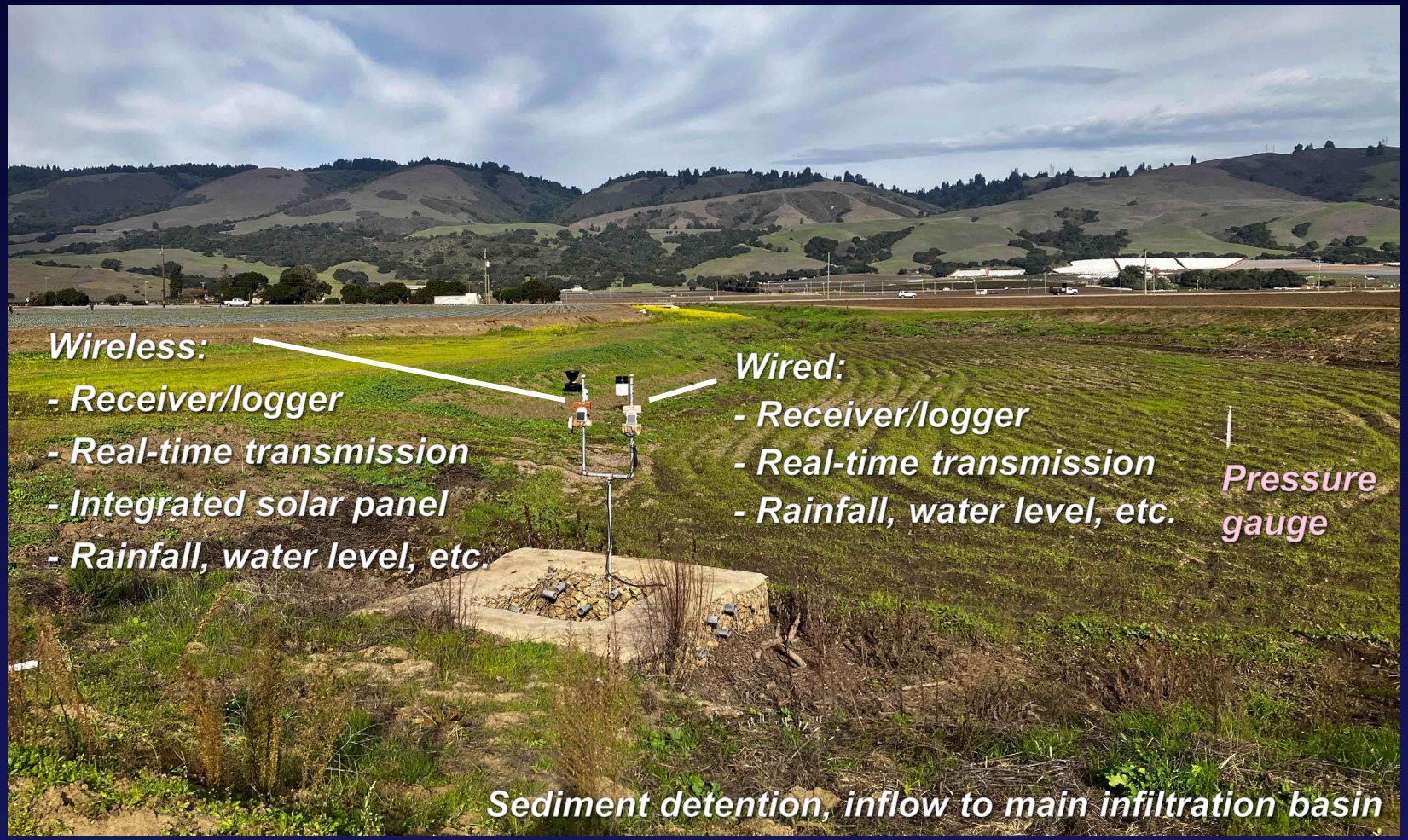
Bokariza Ranch, Project goal: ~100 ac-ft/yr

modified from *Beganskas and Fisher (2017)*

Bokariza Ranch: WY20

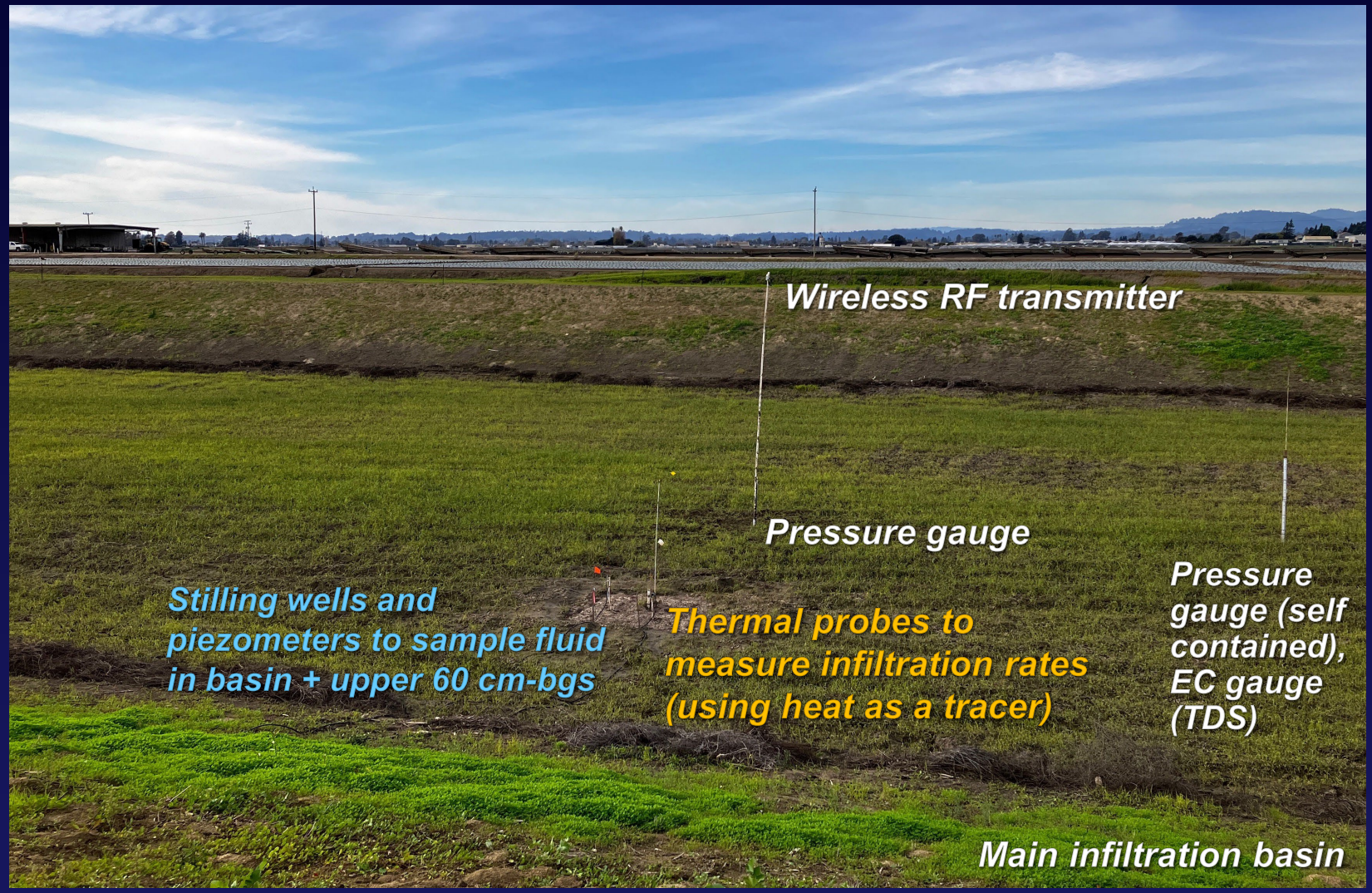


Wireless sensors deployed in 2025



Deployed 12/3/25, for test of reliability, power usage, etc. along with more conventional (wired) system

Wireless sensors deployed in 2025



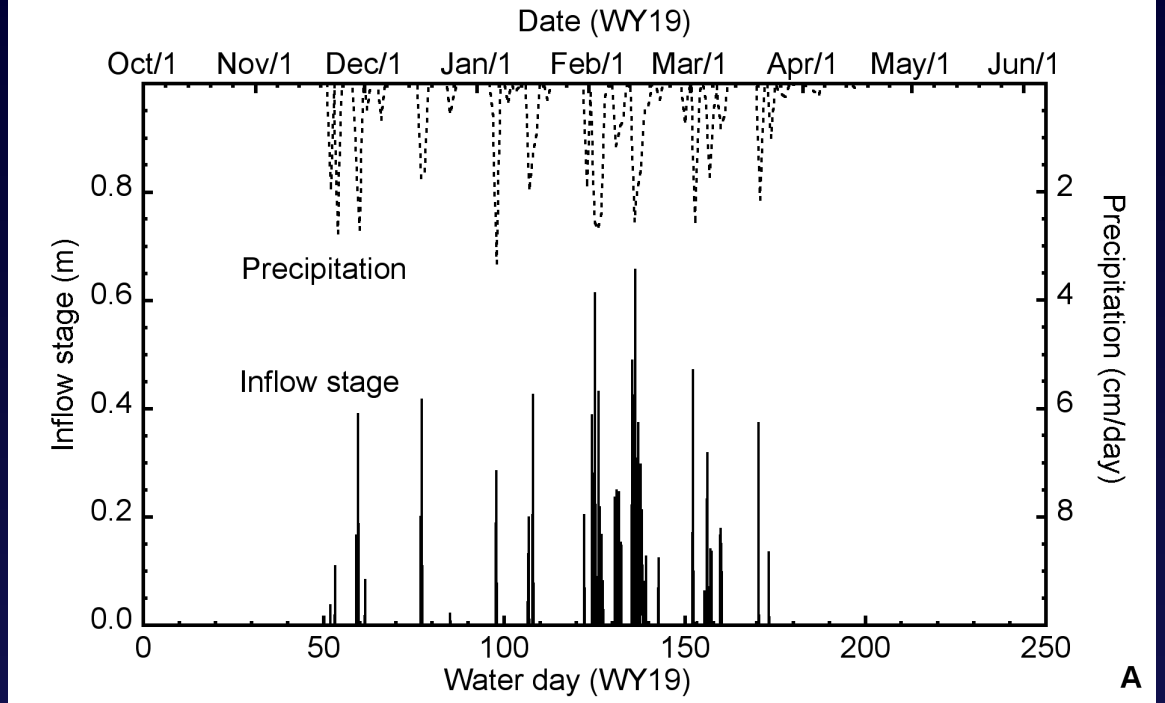
Deployed 12/3/25, for test of reliability, power usage, etc. along with more conventional (wired) system

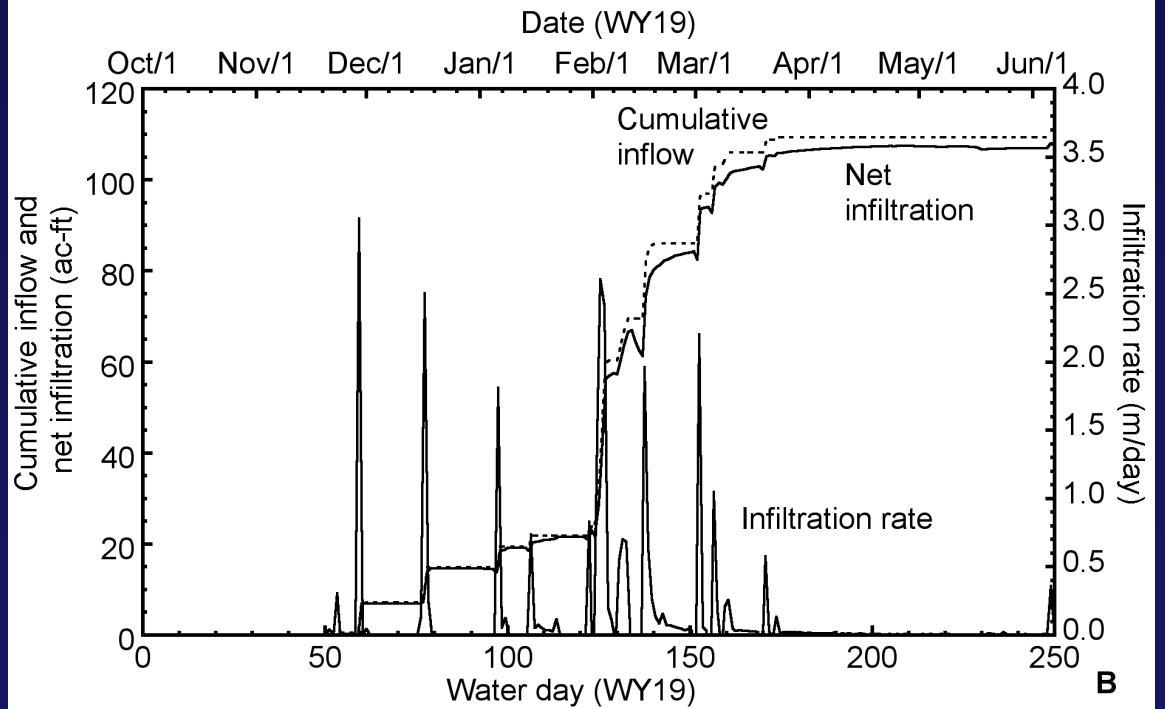
Bokariza Ranch: Water Balance

$$I_V = Q_{\text{inflow}} + P - Evap - \Delta S$$

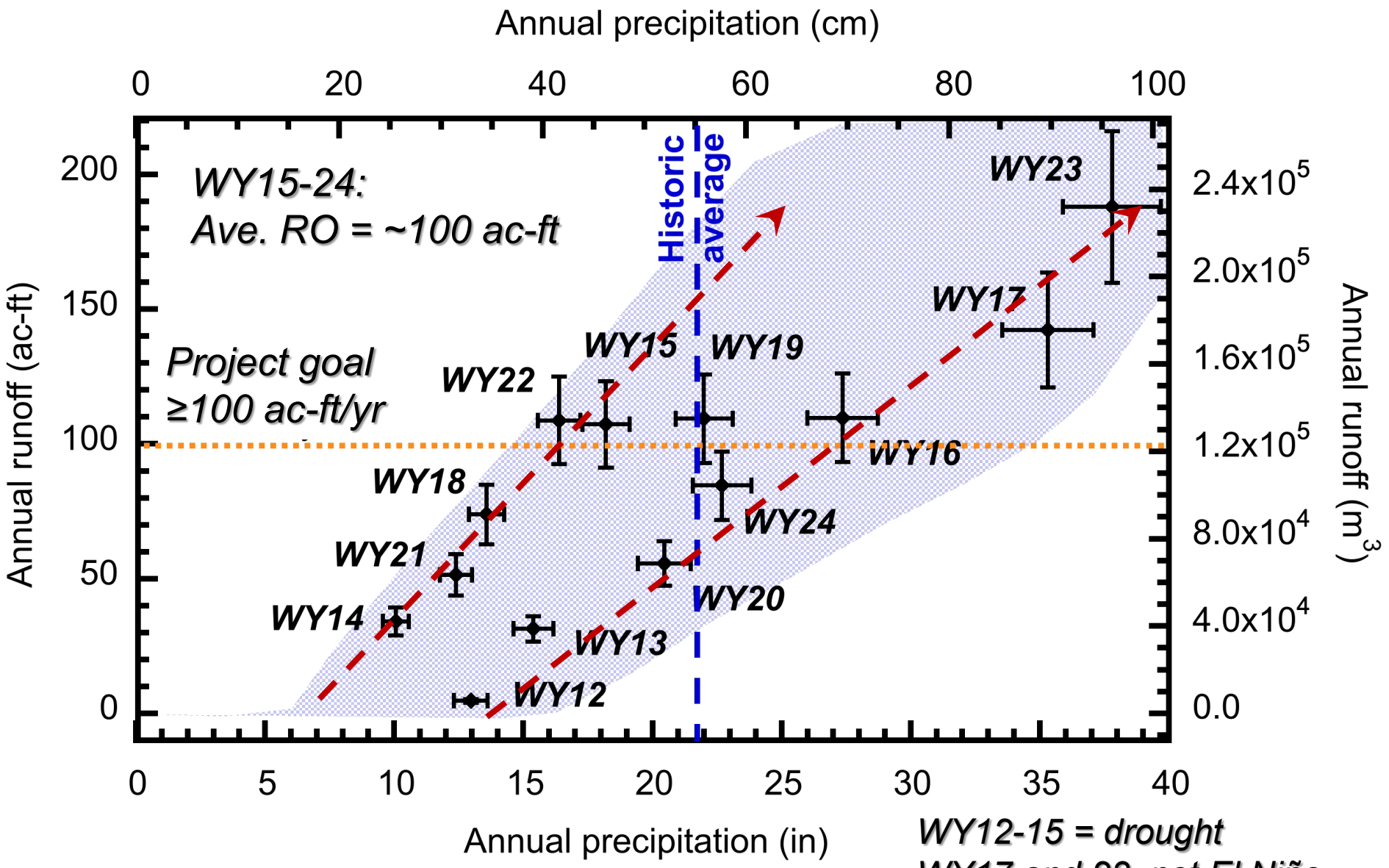
I_V = infiltration (volume)
Q_{inflow} = runoff in
P = rain on basin
$Evap$ = evaporation
ΔS = change in basin storage (volume)

- Example from WY19: Net infiltration ≈107 ac-ft





Bokariza Ranch: 13 Years of Infiltration and Recharge

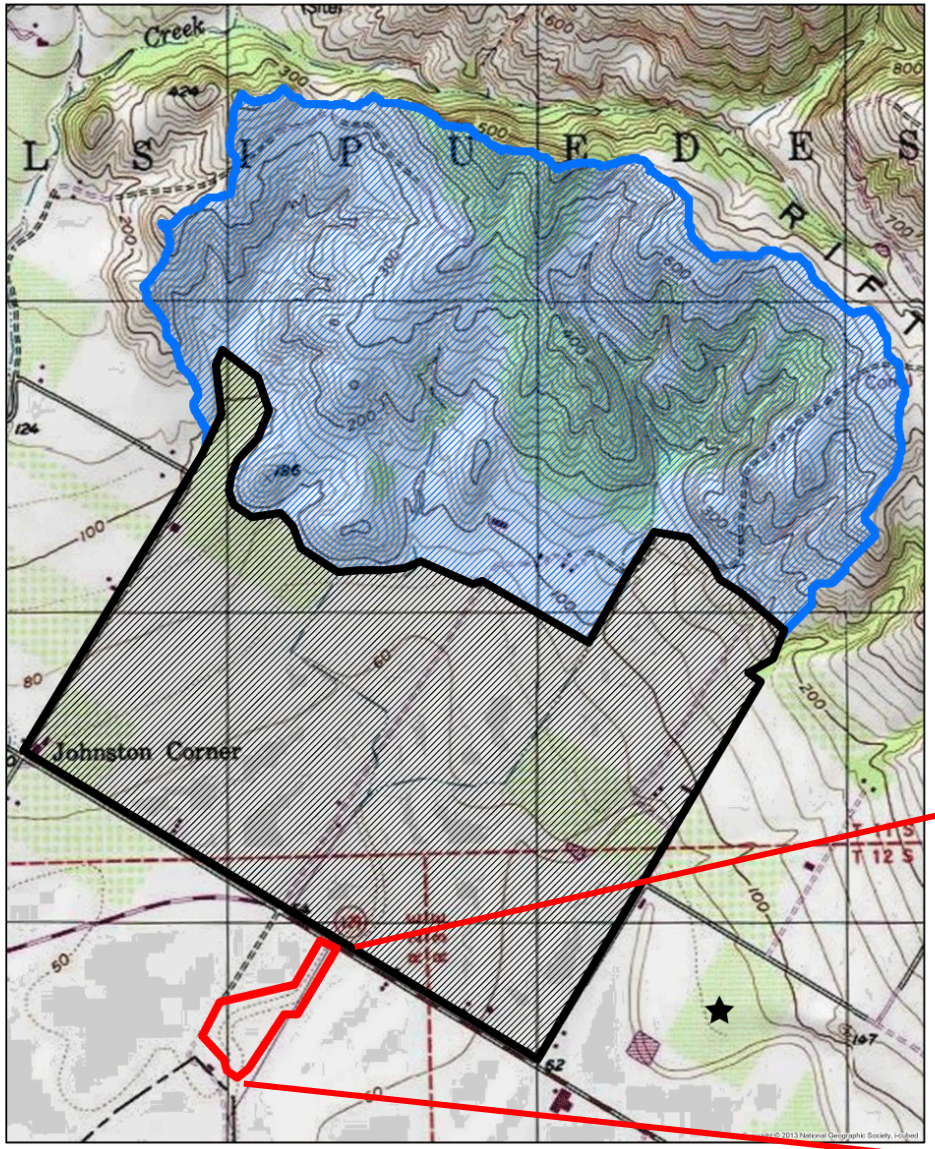


WY12-15 = drought
WY17 and 23, not El Niño
WY18 and WY21, pretty dry

Modified and updated from
Beganskas and Fisher (2017), Serrano et al. (*in prep.*)

Kelly-Thompson Ranch

- *Working ranch and rangeland*
- *>1300 acres draining into ~15 acres*
- *Infiltrating and improving stormwater*



Locations and areas (approximate)

Developed (620 acres)

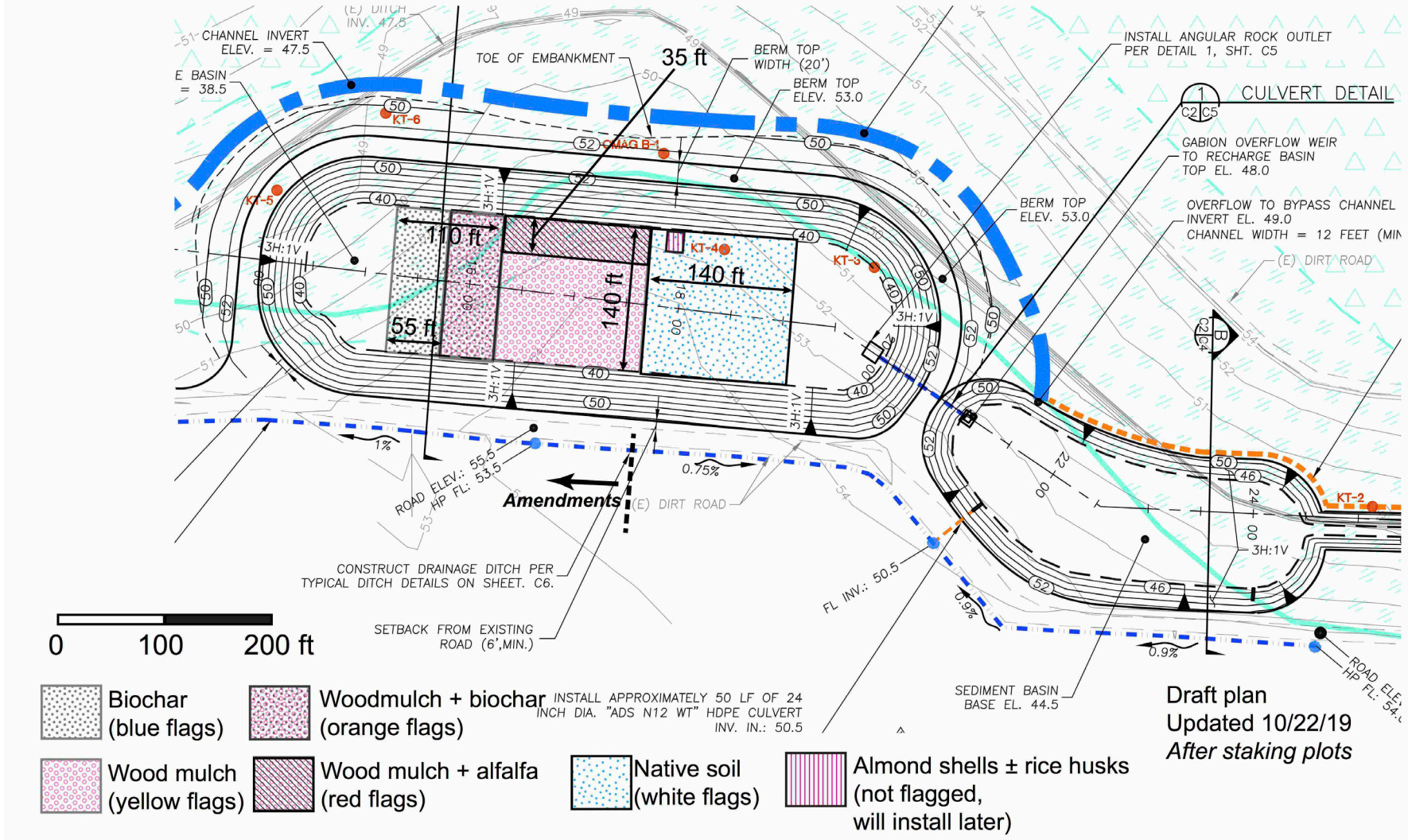
Undeveloped/less developed (700 acres)

Potential infiltration area

Nearby infiltration project

Stormwater infiltration system location

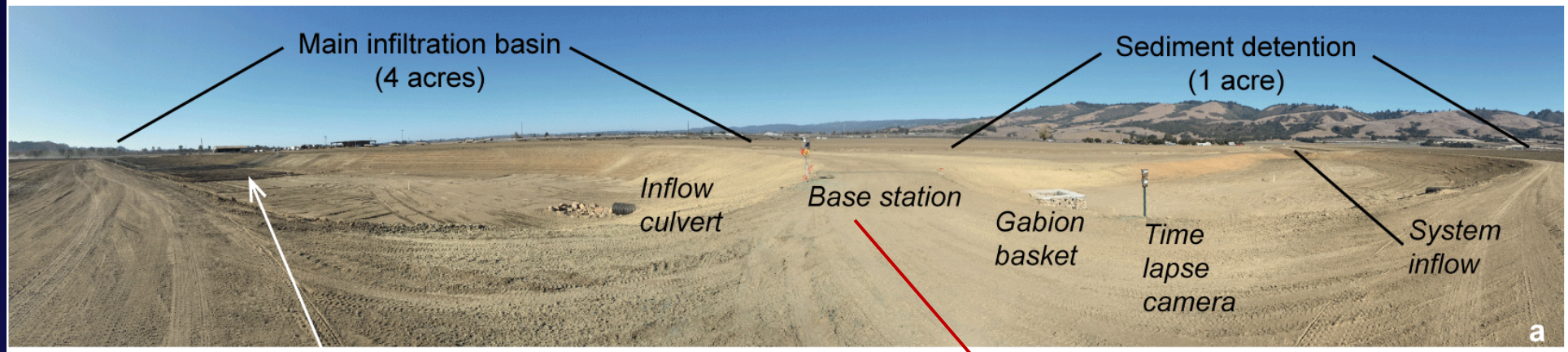
Kelly-Thompson Ranch

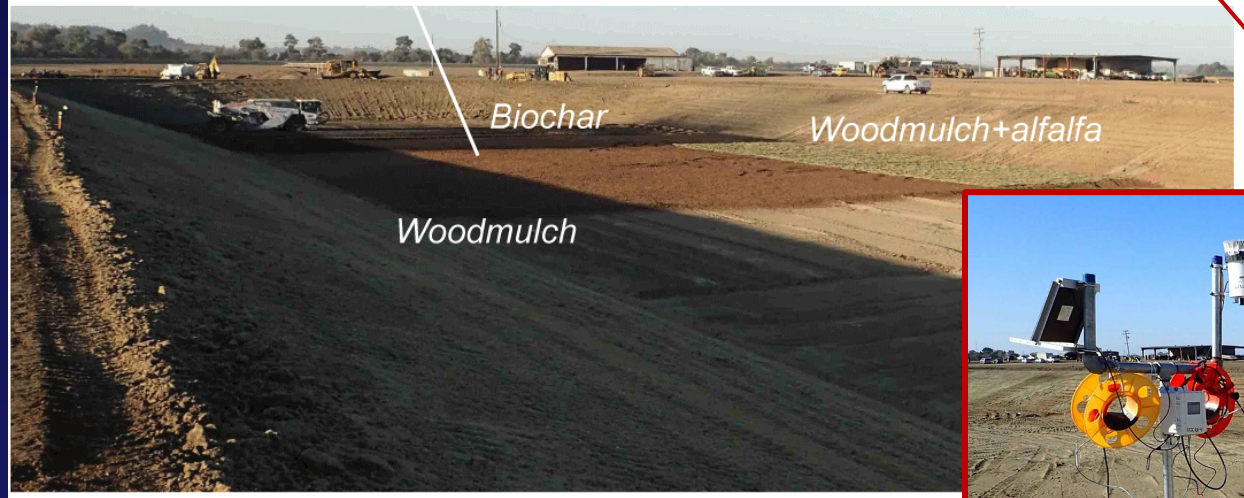


Carbon-rich soil amendments

Kelly-Thompson Ranch

Under construction





Adding carbon-rich soil amendments

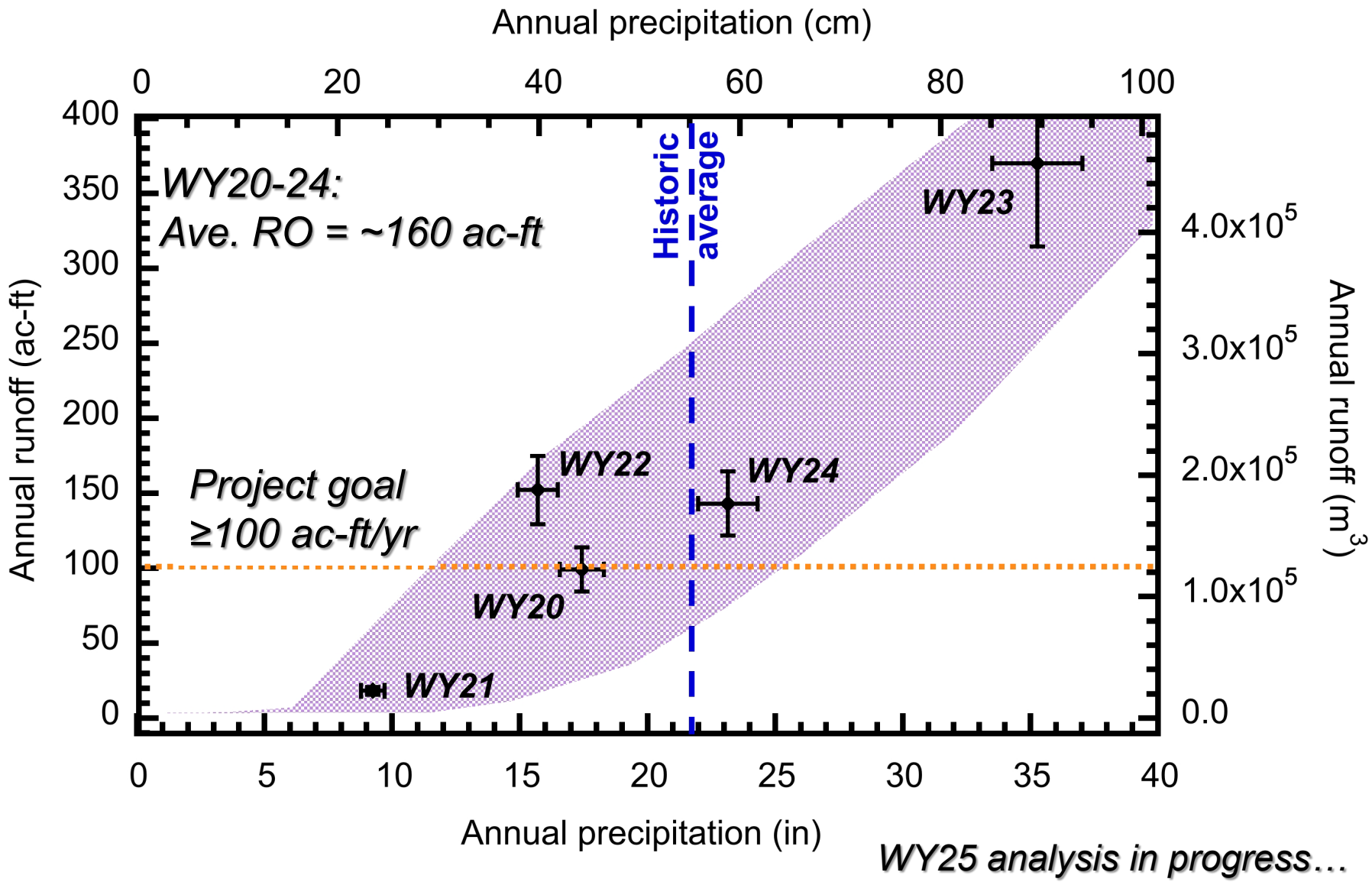
Full-scale, field validation of improvements to water quality

Infiltration basin in operation

- ~160 ac-ft/yr of net infiltration benefit in WY20-24
- Improvements to water quality during infiltration

Serrano et al. (2025 - *in review*)

Kelly Thompson Ranch: 5 Years of Infiltration and Recharge



Serrano et al. (*in prep.*)

ReNeM | *Cost Effective*

In the Pajaro Valley, ***cost-benefit considerations*** *for ReNeM are* ***favorable*** *compared to alternative water sources…****ReNeM*** *is also* ***highly complementary to demand management*** *(in many GSPs)*

nature water
Article
https://doi.org/10.1038/s44221-023-00141-1

Recharge net metering (ReNeM) is a novel, cost-effective management strategy to incentivize groundwater recharge

Received: 27 December 2022
Accepted: 7 September 2023

Molly Bruce[1], Luke Sherman[2], Ellen Bruno[3], Andrew T. Fisher[4] & Michael Kiparsky[1]

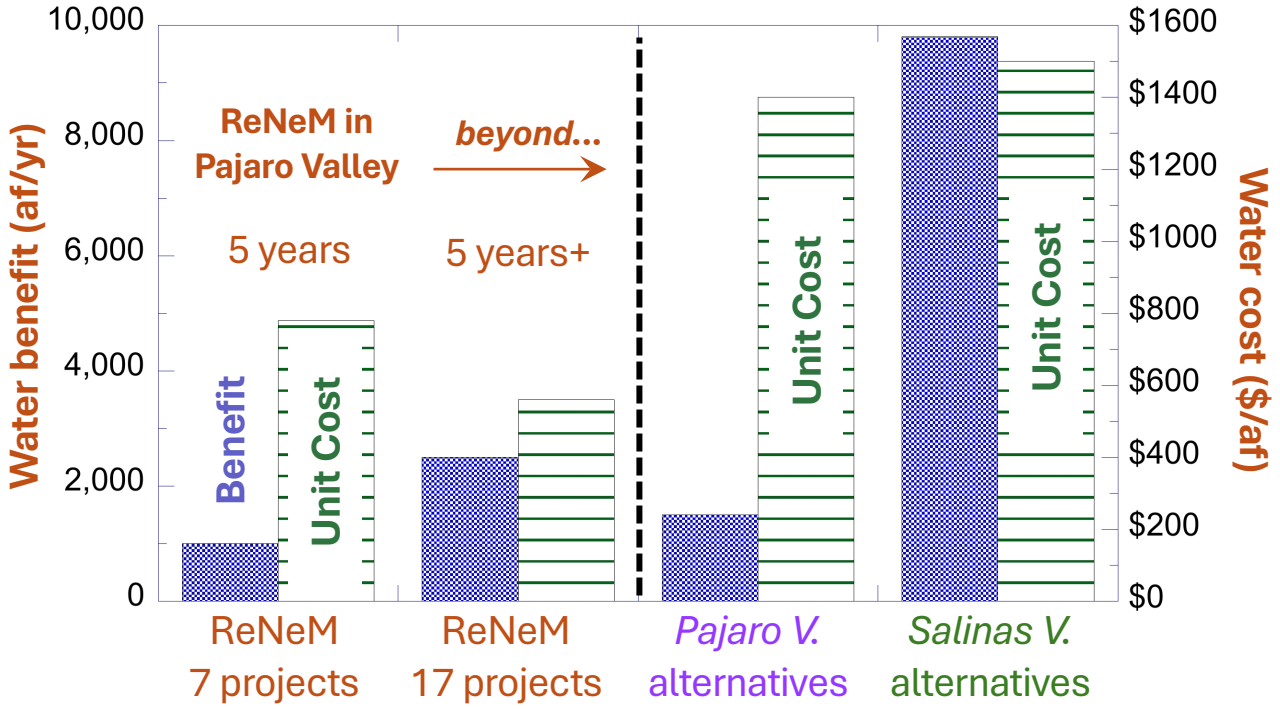
News & views
Managed aquifer recharge
https://doi.org/10.1038/s44221-023-00140-2

Financial incentives can leverage existing infrastructure to replenish groundwater

Melissa M. Rohde

Paying private landowners to increase infiltration on their land is a cost-effective strategy to offset groundwater depletion.

*ReNeM costs compared**



* ***Rounded***, based only on cost of water. ***Both ReNeM and alternatives may have more benefits***, e.g., improve water quality, reduce SW intrusion

ReNeM | *Adaptability At Its Core*

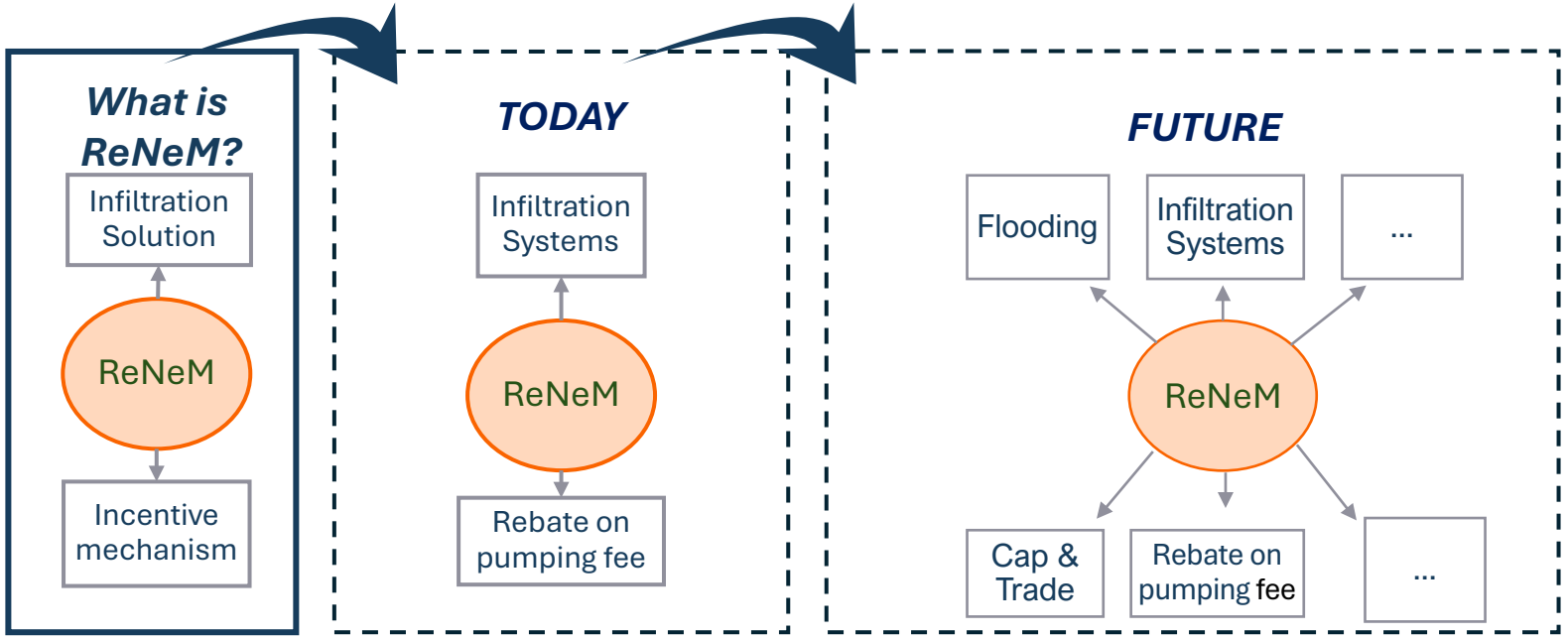
*Besides its proven cost-effectiveness, the structure of ReNeM - including its partners, infiltration solutions, and incentives - is **flexible** and can be **adapted** to different context.*

GOVERNANCE

The proposed structure serves as a framework. Roles may vary based on existing organizations, power dynamics, and project stages.

INFILTRATION SOLUTION AND INCENTIVES

ReNeM can compensate participants based on measured infiltration through the most suitable practices for each project site (e.g. infiltration basins, field flooding, levee setbacks, cover crops, etc.)



[1] Participants include landowners and tenant farmer(s)

ReNeM | *Adaptability At Its Core*

Existing ReNeM

Distributed Stormwater Collection

Extended ReNeM

Flood MAR

Extended ReNeM

Recharge in Levee Setbacks

Extended ReNeM

Recharge in built environments

Extended ReNeM

Alternate/cover cropping

ReNeM | *Adaptability At Its Core*

*The **adaptability** of ReNeM is an important attribute of the program, specially when looking into Groundwater Sustainability Agencies' (GSAs) needs on developing projects to bring basins into balance. **Recharge is popular!***

GSAs across CA are struggling to identify and advance projects to balance groundwater budgets.

ReNeM addresses multiple challenges that GSAs face, can help to meet SGMA obligations.

Groundwater/Recharge Challenges	ReNeM Solutions
Skeptical community	Increases GW supply, engages community
Unsure of site suitability	Regional and specific site assessments
Unclear project costs and benefits	Costs are known/knowable, participants agree to terms up front
Variable financial and legal concerns	Program can be tailored to local conditions, costs, requirements
Lack access to private land	Incentives for recharge on all kinds of land

ReNeM | *Planning For The Future*

*ReNeM's successes to date highlight the opportunity for further scaling. Developing a **ReNeM Program** will enable a transition from **opportunistic to strategic expansion**.*

Where We Are Now

SUCCESSFUL RENEM PROJECTS IN PAJARO VALLEY

- Cost effective
- Adaptable and Flexible to different needs
- Parties outside the PV expressed interest in deploying a ReNeM-type program in their areas

Where We Are Going

ACHIEVE SCALE WITHIN THE PAJARO VALLEY

- Establish additional recharge basins within the Pajaro Valley - deliver ~10% of groundwater shortfall.
- Test other ReNeM implementation concepts, such as FloodMAR and/or recharge within Levee Setbacks

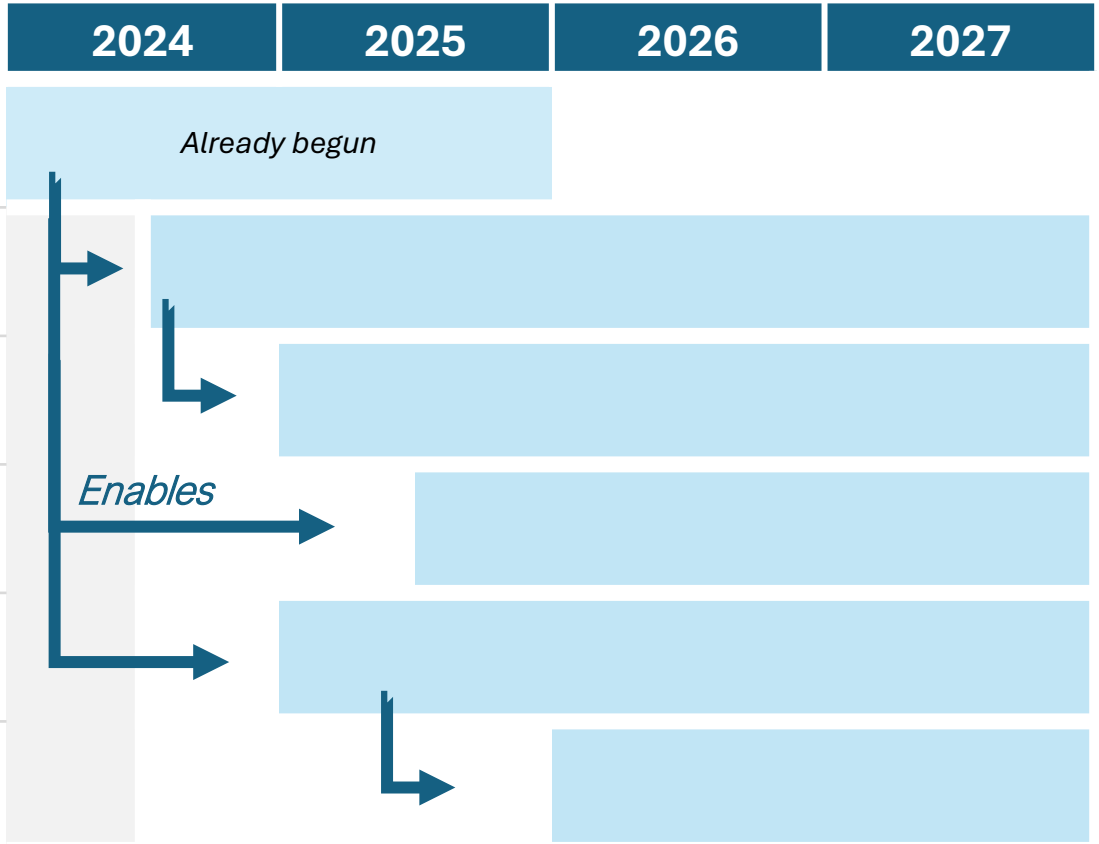
IMPLEMENTATION BEYOND THE PAJARO VALLEY

- Establish processes;
- Build staff capacity: mentor, guide and support the adoption of ReNeM across California;
- Help GSAs and communities achieve their sustainability goals.

Program Development enables projects' scalability

ReNeM | Roadmap

Near-term priorities are to establish and staff a core team and continue targeted project outreach. 2026 will involve further site development in the Pajaro Valley, and intentional mentoring of GSAs and RCDs outside the Valley.



Formalising, establishing and staffing a core ReNeM team to manage and scale the program

Targeted, science-based outreach and project development within the Pajaro Valley

Development of new MAR sites within the Pajaro Valley

Exploring potential new MAR options *(e.g. FloodMAR, levee setbacks, urban storm runoff)*

Motivating for ReNeM beyond the PV, e.g. by mentoring additional GSAs and RCDs

Developing **MAR sites in additional parts of CA** with science and through local orgs

ReNeM | A flexible, practical, proven incentive-based solution

ReNeM addresses needs, creates opportunities, builds partnerships, generates value.

Cost-effective and complementary (*augments other activities*)

Adaptable and scalable (*different approaches will work in other basins*)

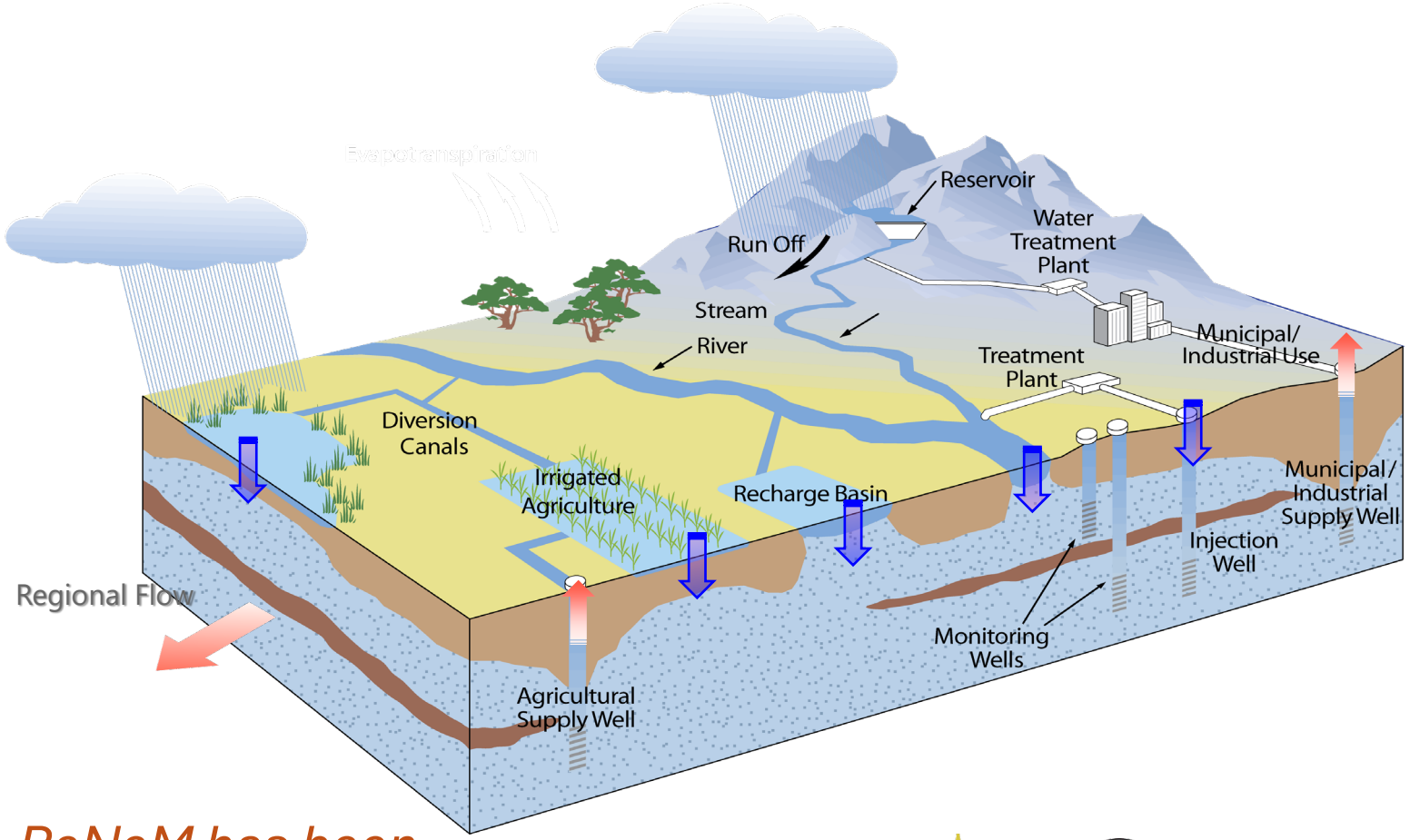
Encourages community participation and engagement

Aligns individual and organizations (*creates collaboration*)
GSAs, RCDs, Land Trusts, Open Space Authorities, cities, tenants and landowners

There is great need and considerable interest

Thank you for your time!

Thank you to many project partners…



Want To Further Engage? Feel Free To Contact us!

Inquiries welcome!

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State of California Coastal Conservancy
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California Department of Conservation