Sustainable Conservation

On-farm Recharge Pilot Projects Case Study

Grower: Don Cameron, Terranova Ranch

Crop: Almonds

Location: Helm, Fresno County

Project Description

This case study site is a great example of how on-farm recharge on young almond trees during the first years of production on suitable soils can be implemented without affecting yield and crop health. Don Cameron, general manager of Terranova Ranches Inc., had a goal in 2011 to determine how much water can be applied as on-farm recharge without crop damage or yield losses. He decided to start on very small plots of transitional fallow land. In 2017, the ranch expanded recharge efforts to a young almond orchard. Recharge occurred in this orchard for more than two weeks in spring 2017. The almond trees have been growing vigorously since then without any adverse effects on production yields. In 2023, the ranch reported the 10-year-old almond orchard as being a superior producer in yield and quality, averaging more than 2,000 pounds per acre.

Field Description

Category	Details
Acres	76
Type of crop	Almonds (25% Monterey scion, 25% Woody colony scion, 50% Nonpareil scion on the Rootstock Nemaguard).
Age of crop	Planted 2013 (4 years old at time of recharge in 2017).
Average root depth	3–4 feet deep.
Irrigation infrastructure	• Drip irrigation system and original flood irrigation infrastructure was in place. • On-farm recharge water was pumped from district canals, using flow metered pipe, into the field.
Soil amendment	Pre-season poultry compost was applied in the fall and incorporated into the soil in years not receiving floodwater.

Hydrogeology

Category	Details
Soil texture	• Loamy sand on field. • Infiltration rate is about 2.5–3 inches per day.
Land IQ rating	Moderately poor (north field is sandier).
SAGBI rating	Moderately poor.
Restrictive layers	N/A.
Depth to groundwater	230–250 feet below ground surface.

On-Farm Recharge Logistics

Category	Details
Source of water	Liberty Mill Race Ditch Company.
Maximum diversion rate	4–5 cubic feet per second.
Method of diversion	Pumped from Kings River North Fork into Terranova's on-farm canal ditch.
Cost of water	$4 per acre-foot for flood water.
Field preparation and management during recharge	Place berms intermittently in the field every 5–10 rows until entire length of row is inundated up to 12 inches at the end of row, then breach the berm to allow the flood flow to the next 5–10 rows.
Nutrient management	• In order to avoid aggressive spring fertilizer application being delayed by flood conditions, the grower used a fall liquid application of UN 32 at 80–85 pounds per acre of nitrogen through the drip irrigation system at the end of year 2, prior to tree dormancy. • The grower followed his normal nitrogen management plan by applying sequential applications of 30–35 pounds of nitrogen per acre via drip tape from March through June.
Average inundation height	12 inches of water depth.
Duration of inundation	The field was inundated for approximately 1–2 weeks.
Time to dry down	3–4 days after turning off water.

Recharge Events

Dates of recharge (2017)	Duration (days)	Field size (acres)	Water applied (total acre-feet)	Water applied (feet per acre)	ETc (feet)	Net water recharged (total acre-feet	Net water recharged (feet per acre)
April 2–April 15	15	76	52.96	0.70	0.09	44.75	0.59
May 28–June 17	21	76	98.78	1.30	0.21	79.63	1.05
Total			**151.74**	**2.00**	**0.30**	**124.38**	**1.64**

Table notes: Dates of recharge, field size, and water applied sourced from grower.
Crop evapotranspiration (ETc) value sourced from California Irrigation Management Information System station #71C.
Net water recharged = water applied – (1.2 x ETc x acres).

Changes in Field Conditions

Category	Details
Diseases and weeds	No abnormal disease occurrence was noticed by the grower during or after on-farm recharge.
Yields	Almond yields for the recharge field were 2,296 pounds per acre of almond nuts compared to 2,094 pounds per acre of almond nuts for a control plot.
Salinity	No data
Changes to field practices	None.

Grower's Experience

Category	Details
Grower observations	• Mr. Cameron notes that it is important for growers who are planning to plant a new almond orchard to select rootstocks and scions that have low susceptibility to fungal diseases such as *phytophthora* ssp. • Mr. Cameron believes that the oxygen content in saturated soils is related to the water temperature. The warmer the water, the less oxygen that is contained, and the sooner there may be problems with ponding water in fields. He stopped recharging when the water and air temperature became too hot (90 degrees) for the trees and vines to survive. • Being able to move water through the soil quickly is an advantage. Mr. Cameron believes that not all soils are capable of recharging groundwater, and that growers should stick to the lighter, sandier soils.
Grower motivations	• Mr. Cameron is interested in replenishing overdrafted aquifers under his land in compliance with the Sustainable Groundwater Management Act. Also, he wants to prove that on-farm recharge is more cost-effective than irrigation district recharge basin efforts and that collective grower-led on-farm recharge can be more effective at achieving aquifer recharge. • Mr. Cameron believes that it is important to document practical lessons learned to complement scientific research. He encourages more growers to participate in the Kings River basin groundwater recharge efforts to improve the knowledge of field characteristics for recharge suitability.

For more information: contact Rogell Rogers, Agronomist, Sustainable Conservation, at rrogers@suscon.org or 209-576-7729 x346.

Sustainable Conservation

On-farm Recharge Pilot Projects Case Study

Grower: Don Cameron, Terranova Ranch

Crop: Wine Grapes

Location: Helm, Fresno County

Project Description

This case study site provided the opportunity to test on-farm recharge on wine grapes planted in moderately poor soil and subsurface conditions as rated by Soil agricultural Groundwater Banking Index (SAGBI) and the Land IQ soil suitability index. It also demonstrated the feasibility of applying recharge water during the wine grapes growing season, thereby increasing the total possible volume of annual on-farm recharge when excess surface water is not available until springtime, as occurred in 2017 and 2023.

The farm began experimenting with on-farm recharge in 2011. This was one of the pioneering recharge test plots to begin establishing guidelines for on-farm recharge in the San Joaquin Valley. In 2016, Mr. Cameron added his perennial crops such as almonds, olives, pistachios, grapes, and walnuts to the targeted list of crops for on-farm recharge.

Field Description

Category	Details
Acres	77.5 acres
Type of crop	Ruby red wine grapes.
Age of crop	Planted in 1998.
Average root depth	6–7 feet.
Irrigation infrastructure	• Flood with single check at end of plant row and intermittent berms between plant lines as needed. • Flow meters at turnouts.
Soil amendment	Periodic gypsum applications and light soil tillage done based on need.

Hydrogeology

Category	Details
Soil texture	Sandy-silt loam.
Land IQ rating	• Moderately poor. • Grower did not agree with the rating. He believes the soil has a higher rating because of long-term application of soil amendments which will increase infiltration over time.
SAGBI rating	Moderately poor.
Restrictive layers	N/A
Depth to groundwater	Unknown.

On-Farm Recharge Logistics

Category	Details
Source of water	Liberty Mill Race Ditch Company
Maximum diversion rate	4–5 cubic feet per second.
Method of diversion	Pumped into the Terranova canal ditch from the 4-gate turnout at the Kings River North Fork.
Cost of water	$4 per acre-foot of surface water.
Field preparation and management during recharge	Berm the field every 10 rows at a time until the entire field is inundated 8–12 inches. This resulted in an enclosure that was about 100 feet wide and 0.25 mile long.
Nutrient management	The grower applies nitrogen (UN 32) in the fall prior to dormancy to promote higher nitrogen carryover into the spring. This enables him to avoid the need for initial fertilizer applications (or allow for lower inputs) in anticipation of potential recharge opportunities that typically occur in the spring in the Tulare Basin.
Average inundation height	6–8 inches.
Duration of inundation	Duration of flood condition was approximately 1 week.
Time to dry down	7–10 days

Recharge Events

Dates of recharge (2017)	Duration (days)	Field size (acres)	Water applied (total acre-feet)	Water applied (feet per acre)	ETc (feet)	Net water recharged (total acre-feet	Net water recharged (feet per acre)
March 30–April 8	10	77.5	92.4	1.19	0.05	87.75	1.13

Table notes: Dates of recharge, field size, and water applied sourced from grower.
Crop evapotranspiration (ETc) value sourced from California Irrigation Management Information System station #71C.
Net water recharged = water applied -)1.2 x ETc x acres).

Changes in Field Conditions

Category	Details
Diseases and weeds	The grower made an aerial fungicide prevention application on the grapes because of his concerns of contracting bunch rot from the extra moisture. The grower was also concerned about latent Fusarium root rot because of the flooded conditions. After the fungicide application, no disease was seen.
Yields	10.31 tons per acre.
Salinity	The grower said the on-farm recharge helps dilute the salinity in the soil profile. The plants appear to respond with vigorous growth during the spring
Changes to field practices	The grower delayed in-season applications of fertilizer because of on-farm recharge or intentional flooded conditions. Some fertilizer was applied just prior to dormancy in anticipation of springtime recharge and to avoid the need for an aggressive fertilizer program during the growing season while conducting recharge events.

Grower's Experience

Category	Details
Grower observations	• The grower believes that the oxygen content in saturated soils is related to the water temperature. The warmer the water, the less oxygen that is contained, and the sooner there may be problems with ponding water in fields. He stopped recharging when the water and air temperature became too hot (90 degrees) for the trees and vines to survive. • Being able to move water through the soil quickly is an advantage. Mr. Cameron believes that not all soils are capable of recharging groundwater, and that growers should restrict on-farm recharge to the lighter, sandier soils.
Grower motivations	• Mr. Cameron is interested in replenishing overdrafted aquifers under his land in compliance with Sustainable Groundwater Management Act. He also wants to prove that on-farm recharge is more cost-effective than irrigation district recharge basin efforts and that on-farm recharge can be more effective at achieving aquifer recharge. • Mr. Cameron believes that it is important to document practical lessons learned to complement scientific research. He encourages more growers to participate in the Kings River basin groundwater recharge efforts in order to improve the knowledge of field characteristics for recharge suitability.

Year 2023 On-Farm Recharge Photographs

Above photo note: Mr. Cameron started recharging this field in late-March 2023 and has included it in his goal to recharge 30,000 acre-feet at Terranova Ranch. Ruby red wine grapes seen here on April 21, 2023.

Above photo note: Ruby red wine grapes on-farm recharge in mid-April 2023 with a 3-foot berm on the outer perimeter of the orchard to ensure water stays in the targeted field. The water has a head height of approximately 1 foot.

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