UC Davis Project Description – Scott Valley Groundwater Recharge Pilot Study

The goal of this pilot groundwater recharge study is fourfold:

1) To estimate the physical and agronomic feasibility of recharging groundwater during winter months when unclaimed excess surface water, in particular flood flows or high flows due to snowmelt, are available using agricultural fields as infiltration basins.
2) To ascertain that winter recharge to a groundwater basin discharging into a nearby gaining stream may support additional streamflow during the critical summer period, by increasing natural groundwater discharge to the stream for several months beyond the recharge operation.
3) To measure the effect of recharge on groundwater aquifer storage dynamics and groundwater levels changes near the recharge site.
4) To estimate the agronomic cost-benefits associated with crop tolerance to winter irrigation/flooding, labor and water pricing.

The groundwater recharge pilot study will be conducted on a 15 acre alfalfa field located on the alluvial fan within Shell Gulch, Scott River Valley, Siskiyou County. The alluvial fan emanates from a small (< 5 sq. mi.) watershed in the mountain range immediately to the east of Scott Valley. The pilot site is near the mouth of the Shell Gulch valley, adjacent to the major alluvial plain of the Scott Valley. The site is located approximately 1 mile east and approximately 40 ft upslope from the south-to-north running Scott River. Depth to groundwater at the study site is typically on the order of 30 feet, and has varied from about 15 ft after a wet winter to about 35 ft in some summers over the past 8 years. Unconsolidated alluvial sediments at the site are part of the Scott Valley alluvial aquifer system and consist of sand and gravel, with embedded finer sediments. Recharge would replenish the local unconfined aquifer, increase the groundwater gradient to the Scott River, and thus temporarily enhance groundwater discharge toward the Scott River. Recharge constraints built into the pilot study include limiting recharge to time periods that meet minimum streamflow requirements below Scott Valley; and minimizing the time period during which the root zone of the alfalfa field is saturated (depth to groundwater larger than 10 ft).

The land owner of the pilot study field site has access to the Scott Valley Irrigation District (SVID) ditch. The SVID ditch runs along the foothills on the eastern side of the Valley and passes immediately to the east of the study site. The 15 acre field is currently divided into 11 checks with a 10 inch irrigation water supply turnout located on the eastern, upslope edge of each check. The turnouts allow for independent application of water to each check (Figure 1). We will group these 11 checks into contiguous areas to test four different water application rates: *i*) near-continuous application (3.13 acres), *ii*) high water application (3.97 acres), *iii*) low water application (4.46 acres), and *iv*) no winter water application. The latter will be our control plot receiving only precipitation until regular spring irrigation begins (sometime after April 15 depending on soil moisture and weather conditions). Table 1 summarizes planned water application rates and estimated maximum recharge volumes for each treatment. Water application rates within each contiguous area are estimated based on field-measured infiltration rates of 1.3 ft per day (using a Decagon mini disk portable tension infiltrometer) and recommendations of alfalfa tolerance to high water application rates. All water application (using Scott River flows via diversion through the SVID ditch) would occur only as long as minimum flow requirements in the Scott River are met

immediately downstream of Scott Valley at USGS gage 11519500 near Fort Jones. The groundwater recharge pilot study will be conducted over a three month period in each of the next two winters, from January 1 to April 1, 2015, and from January 1 to April 1, 2016. If surface water supplies are available throughout the entire 90 day period the maximum total projected surface water demand is 525.5 acre-feet (AF). This recharge volume is on the same order of magnitude as the available storage capacity in the unconsolidated aquifer system (not considering dynamic outflows toward the Scott River). The actual volume may vary depending on Scott River discharge, SVID ditch flows and losses, long-term infiltration conditions, groundwater level response, and crop response. We anticipate that the SVID diversion will, at most, be 3 cfs for the planned study period. This assumes that ditch losses between the SVID diversion and the project site, which are also returned via groundwater to the Scott River, will be minimal. SVID has agreed to supply the projected 3 cfs needed for the groundwater recharge study from their current stockwater deliveries which are estimated at approximately 8-10 cfs during the winter months.

Pilot project monitoring will include measuring the amount of irrigation water diverted from the SVID ditch by installing a flow meter at the inlet of the irrigation pipe diverting water onto the test field. Infiltration rates within each contiguous water application area will be measured with differential temperature sensors installed at the pilot study site. If tail water runoff occurs, it will be monitored with portable weirs and pressure transducers at the southwest corner of each water application area. Groundwater level changes will be monitored with pressure transducers in monitoring wells located between the pilot study side and the Scott River. Based on these measurements and using a coupled groundwater-surface water model currently being developed, we will analyze the recharge induced changes in groundwater flow dynamics between the study site and the Scott River and the magnitude and timing of increased groundwater discharge to the Scott River, particularly during the critical summer period, when streamflow in the Scott Valley largely originates from discharging groundwater at the stream bottom. In Foglia et al. (2013), we estimated that recharge at the study site may significantly increase groundwater discharge to streamflow at the nearby Scott River over a period of 3 to 6 months after recharge seizes.

Table 1: Estimation of maximum water volumes required for the pilot recharge study. Total volumes are calculated assuming surface water supplies are continuously available over a 90-day period ranging from Jan. 1 to Apr. 1 2015.

Treatment	Area [acres]	Water application rate	Daily volume [ac-ft/day]	Total volume [ac-ft]
Continued	3.13	9.1 ft/week	4.1	366.2
High	3.97	2 ft/week	1.13	101.7
Low	4.46	1 ft/week	0.64	57.6
No	3.34			
			TOTAL	**525.5**

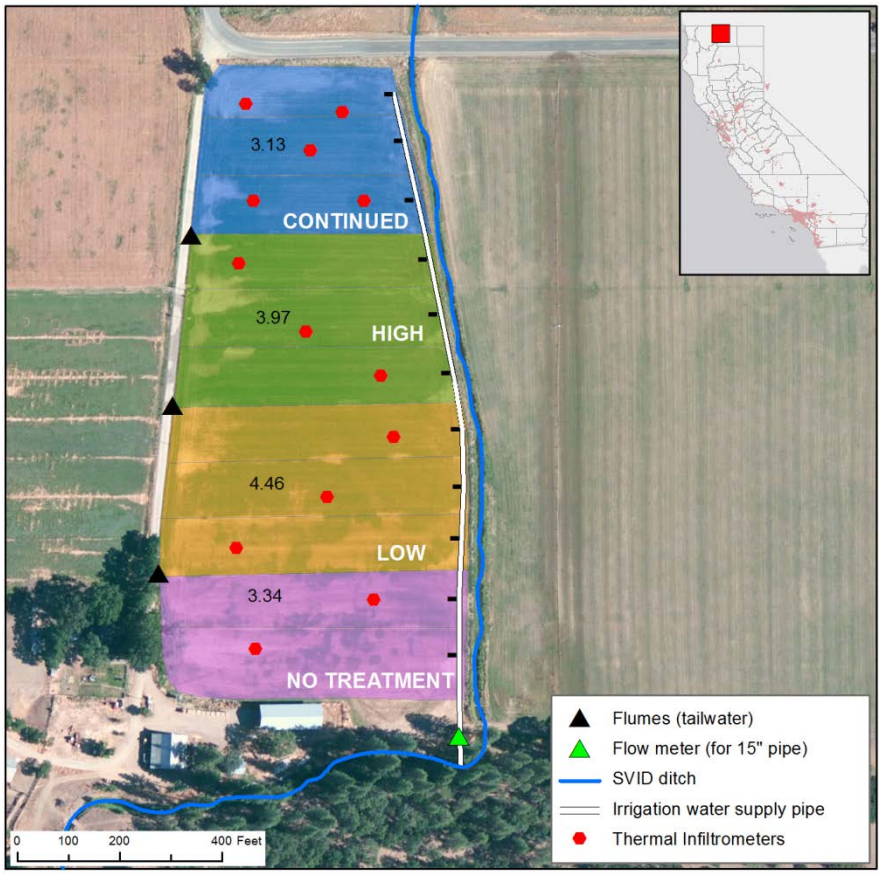

Figure 1: Overview of instrumentation and water diversion infrastructure of the pilot study site in Siskiyou County. Numbers indicate the size of each water application area in acres.

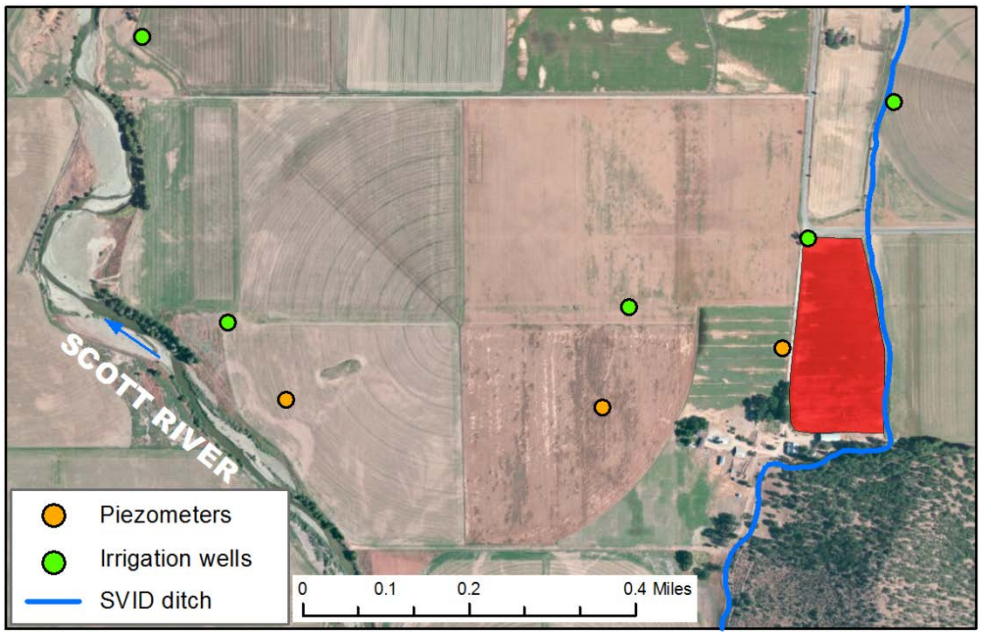

Figure 2: Location of the project site (red area) relative to the Scott River.

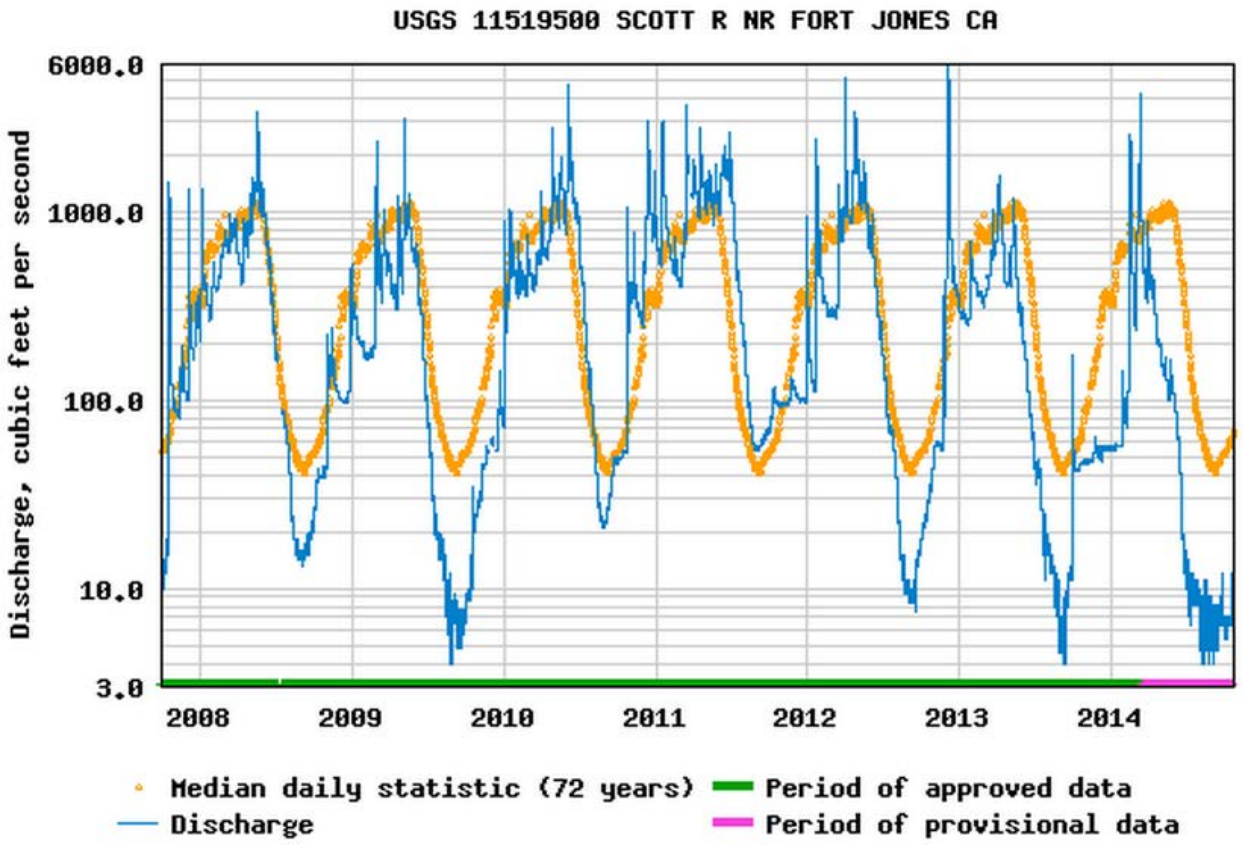

Figure 3: Scott River discharge (blue) at USGS gage 11519500 (Ft. Jones), immediately below Scott Valley, hydrologic years 2008-2014. Daily average flows (1940-2014) shown in orange (from USGS NWIS, downloaded 10/20/2014).