Application Form for 2024 Local Cooperative Solution for Overlying or Adjudicated Groundwater Rights in Scott River and Shasta River Watersheds

Please complete this form if you plan to implement a groundwater local cooperative solution (LCS) for the 2024 irrigation season under the Scott River and Shasta River watersheds emergency regulation. A separate application should be submitted for each type of groundwater LCS proposal. **The form and attachments are due by April 15, 2024.**

How to Submit: To submit your application and associated required materials (see Section 2) you can:

- Use the online form
- Email: DWR-ScottShastaDrought@waterboards.ca.gov
- Mail:

  State Water Resources Control Board
  Division of Water Rights - Instream Flows Unit 1
  1001 I Street - 14th Floor
  Sacramento, CA 95814

Section 1: Applicant Information

Name	Mark & Shelene Johnson
Name of Farm, Ranch, or Business	
[redacted]	

By typing or signing your name below and submitting this form to the State Water Resources Control Board (State Water Board) you hereby certify that the submitted information is true and correct to the best of your knowledge.

Name: *Shelene Johnson* *Date:* 4/10/24

Section 2: Application Checklist

Below is a list of items to include with your application form:

- Application Form (paper or email submittal accepted).
- If working with a Coordinating Entity (Section 4 of application), submit a signed Binding Agreement (paper or email submittal accepted).
- Supporting Information (electronic submittal only). Submit the applicable information based on selected groundwater LCS.
    - Best Management Practices Groundwater LCS (see Section 7 of application)
        - Description of how you will implement of all required components.
        - Map(s) with each well and field labeled.
    - Graduated Groundwater Cessation Schedule LCS (see Section 8 of application)
        - Description of how you will reduce irrigation compared to standard practices on the property (e.g., practice in a similar unregulated year).
        - Map(s) designating the area where diversions will cease by the required dates and well location(s).
    - Percent Reduction Groundwater LCS (see Section 9 of application)
        - Description of verifiable water reduction actions that will be implemented.
        - Spreadsheet with monthly pumping volumes for baseline year and current year. Use one row per irrigation method per field.
        - Map(s) with each well and field labeled.
- A description of metering (Section 6 of application) in place for groundwater well extractions and an agreement to record such extractions daily and report monthly to your Coordinating Entity and/or State Water Board.
- Groundwater Well Information (see Section 5 of application) (paper or email submittal accepted).
- List of Fields, Assessor's Parcel Numbers (APNs), and Water Rights (see Section 10 of application) (paper or email submittal).

Section 3: Requirements for All Groundwater LCS Proposals

- **Deadline:** Proposals must be submitted to the State Water Board by April 15, 2024.
- **Implementation:** Proposals must be implemented during the entirety of the irrigation season (including prior to approval), unless the applicant withdraws the application.
- **Metering:** Proposals must include a description of metering that will be used to measure groundwater well extractions and information on how extractions will be recorded daily and reported monthly to the Deputy Director or Coordinating Entity, as applicable. Please note the Coordinating Entity is required to provide this data to the State Water Board.
    - *Funding for Meters:* The State Water Board has funding and technical support available for some amount of metering and those interested in such assistance should promptly contact State Water Board staff using the "Contact Information" at the end of this application.
    - *Time Schedule for Metering:* If a meter is not currently installed and may not be installed prior to the start of the irrigation season, the applicant must provide information that substantiates the applicant's efforts and actions taken to get a meter installed, and a timeline for meter installation.
    - *Waivers*: Proposals may include information requesting waiver of the metering provisions in the following instances:
        - Groundwater wells that irrigate less than 30 acres. Information supporting the request to waive metering provisions must be provided, including distance of the groundwater well to surface water. The State Water Board may require other information in lieu of monitoring.
        - Metering is not feasible. Substantiation for the infeasibility of installing a meter must be provided.

Section 4: Coordinating Entity

Select only one (1) box below. Please note that a Coordinating Entity is not required. If a Coordinating Entity is not selected, parties will work directly with the State Water Board to provide metering data and ensure performance of the groundwater local cooperative solution. For more information on Coordinating Entity provisions, refer to Section 875(f)(1)(G) in the emergency regulation.

☐ California Department of Fish & Wildlife
Contact: Crystal Robinson
(530) 340-0767
crystal.robinson@wildlife.ca.gov

☐ Shasta Valley Resource Conservation District
Contact: Rod Dowse
(530) 598-1253
rdowse@svrcd.org

☐ Siskiyou Resource Conservation District
Contact: Evan Senf
(530) 643-1585
evan@siskiyourcd.com

☑ Scott River Water Trust
Contact: Chris Voigt
(916) 396-0131
chrisb.voigt@gmail.com

☐ I select not to work with a coordinating entity.

Section 5: Groundwater Well Information

Complete the table below or upload an attachment for groundwater wells that are part of the proposed groundwater LCS.

Well Name	Well Coordinates [1]
4625	[redacted]

For assistance in finding well coordinates, you can use Google Maps (www.google.com/maps).

Upload Well Information

Section 6: Metering Information

Please describe the metering for all groundwater wells covered by this groundwater LCS. Fill in the box below, upload an attachment, or email a document or spreadsheet with this information.

a. Describe how you will record daily extractions and report monthly pumping volumes. Include a description of all water uses associated with each groundwater well that is part of this groundwater LCS.
For example, "the ranch manager will log meter readings at Well 1 and Well 2 and take a picture of the meters each week. They will note what the water is being used for - Well 1 will irrigate 50 acres of grain on fields A and B, 100 acres of pasture on fields E, G, and Z, and Well 2 will irrigate 75 acres of alfalfa on field Y. The manager will send the logs and photos to the Water Board around the first of each month."

See cover letter

b. For groundwater wells that are NOT currently metered, please describe the time schedule and plan to install meters and efforts to obtain a meter before the initiation of groundwater diversions covered by this groundwater LCS. If you want to file for a waiver to the metering requirement please use the box below and include information on why metering of your well(s) should be waived. Be sure to include total irrigated acres, distance of the well(s) from surface water, description of why metering is infeasible, if applicable, and any additional information that supports your waiver request.

See cover letter

Upload Attachment

Select the type of groundwater LCS you are applying for and complete the corresponding sections of the application.

- [ ] Best Management Practices Groundwater LCS - Complete sections 7 and 10
- [ ] Graduated Groundwater Cessation Schedule LCS - Complete sections 8 and 10
- [x] Percent Reduction Groundwater LCS - Complete sections 9 and 10

Section 7: Best Management Practices Groundwater LCS

1. Provide the total amount of all irrigated acreage (with units) covered under your proposal for a Best Management Practices Groundwater LCS:

2. Upload an attachment, write in the box, and/or email a description of the irrigation system that will be used under this proposal, specifying details of your low-energy precision application system, soil moisture sensors, and any corners that will be irrigated. (Refer to Section 875(f)(4)(D)(vii) of the emergency regulation.)

3. Provide a map(s) of each field with labels for well(s), type of best management practice, and field crop type. Upload as an attachment or email.

Upload Map(s)

4. Certify the following by initialing or checking each box:

- ☐ a. I certify the use of a low-energy precision application (LEPA) system on all irrigated acreage covered under this groundwater LCS.
- ☐ b. I certify to not use end guns for irrigation for the duration of the season.
- ☐ c. I certify to cease irrigation of corners after June 15, 2024.
- ☐ d. I certify to use soil moisture sensors to inform irrigation timing, and maintenance of such records, which I will make available for inspection by the Coordinating Entity, if applicable, and/or the State Water Board.
- ☐ e. I certify that I will further limit irrigation based on water year, in the event of the hydrologic condition noted in i or ii below. If this requirement is triggered, the State Water Board will inform all Best Management Practices Groundwater LCS applicants for the applicable watershed(s). Please note, a yes certification is required for a Groundwater Best Management Practices LCS to be accepted.

    i. Scott River Watershed: Snow pack of 80% or less of the Department of Water Resources California Data Exchange Center's first May snow water equivalent station average (or the average of the first April measurement if May snow pack measurements are not gathered) in Scott River watershed.

    ii. Shasta River watershed: A water year determination of dry or very dry in the Shasta River watershed, as determined under Table 2 of the March 2021 Montague Water Conservation District water operation plan.

Section 8: Graduated Groundwater Cessation Schedule LCS

A Graduated Groundwater Cessation Schedule LCS may be approved if the applicant provides evidence that irrigated acreage is reduced compared to standard practice on the property (e.g., practice in a similar unregulated year). If applicable, please take crop rotation and number of alfalfa cuttings into account. Under this groundwater LCS type, the applicant must select one of two potential irrigation schedules, listed below. See section 875(f)(4)(D)(vi) of the emergency regulation.

1. Provide the total amount of irrigated acreage (with units) under your proposal for a Graduated Groundwater Cessation Schedule LCS:
2. Select the irrigation schedule you certify to implement.

☐ **Option 1:** By the dates below, pumping to irrigate the following percentages of irrigated acres shall cease:

- 15% by July 15,
- 50% by August 15, and
- 90% by August 31, with a maximum of 8 inches of water to be applied to the remaining 10% of irrigated acres during the remainder of the irrigation season. This 10% can be on land previously fallowed.

☐ **Option 2:** By the dates below, pumping to irrigate the following percentages of irrigated acres shall cease:

- 20% by July 20,
- 50% by August 20, and
- 95% by September 5, with a maximum of 6 inches of water to be applied to the remaining 5% of irrigated acres during the remainder of the irrigation season. This 5% can be on land previously fallowed.

4. Please upload an attachment, write in the box, or email a description that demonstrates that the proposal reduces irrigation as compared to standard practices on the property (e.g., practice in a similar unregulated year). If applicable, please take crop rotation and number of alfalfa cuttings into account.

Upload Attachment

5. Please upload or email a map(s) that identifies which well(s) and field(s) are associated with each cessation date covered by this groundwater LCS.

Upload Map(s)

Section 9: Percent Reduction Groundwater LCS

The applicable percent reduction in groundwater pumping noted below must be demonstrated for the Percent Reduction Groundwater LCS consistent with section 875(f)(4)(D)(v) of the emergency regulation, and summarized below.

- **Scott River Watershed:** A net groundwater pumping reduction of 30% throughout the irrigation season (April 1 – October 31) and a monthly reduction of 30% between July 1 through October 31.
- **Shasta River Watershed:** A net groundwater pumping reduction of 15% throughout the irrigation season (March 1 – November 1) and a monthly reduction of 15% between June 1 through September 30.
- The relevant water use reduction shall be based on a comparison to a baseline irrigation season (i.e., 2020, 2021, 2022, or 2023).
    - BUT, if the previous year baseline is higher than the following applied water rates:
        - 33 inches per year for alfalfa,
        - 14 inches per year for grain, or
        - 30 inches per year for pasture
    - Then the above values shall be used as the baseline UNLESS the applicant provides sufficient additional information supporting an alternative baseline.
- Please provide the total amount of irrigated acreage (with units) under your proposal for a Percent Reduction Groundwater LCS. 92.15 acres
- If you are proposing a Percent Reduction Groundwater LCS, attach or email the following files to the State Water Board and your Coordinating Entity.
    a. A description of practices that reduces groundwater pumping and how the State Water Board (or Coordinating Entity, if applicable) can verify those actions.

See attached cover letter

Upload Attachment

    b. A spreadsheet with monthly pumping volumes for the selected baseline year and current year. Use one row per irrigation method per field.

Upload Baseline Pumping

    c. Map(s) with each field labelled.

Upload Map(s)

Section 10: List of Fields, APNs, and Water Rights

List the fields associated with this groundwater LCS application, if each property is owned or leased, and the assessor's parcel number (APN) that contains each field. If a field is on multiple parcels, provide the APN that contains the majority of the field. Alternatively, you may also electronically submit a document or spreadsheet with this information. Each field can only have **one (1)** type of groundwater LCS associated with it.

Irrigated Field Name(s) or Number(s)	Is the parcel owned or leased?	[redacted]	Water Right(s)	Groundwater LCS Type
Pivot-North	Owned		Overlying	Percent Reduction
Pasture-Pivot	Owned		Overlying	Percent Reduction
Lane	Owned		Overlying	Percent Reduction
Marie's	Owned		Overlying	Percent Reduction
Pasture - kline	Owned		Overlying	Percent Reduction
Corners	Owned		Overlying	Percent Reduction

Upload Attachment

Submission of Groundwater LCS Proposal to State Water Board

A groundwater LCS may require the applicant to attach or email additional information, such as descriptions, spreadsheets, maps, or other relevant information. State Water Board staff request descriptions be submitted as Microsoft Word (.docx, .doc) or Adobe PDF (.pdf) files as these file formats are easiest for staff to work with applicants to review and revise, if needed. For the same reasons, staff request that applicants submit spreadsheets as Microsoft Excel files (.xlsx, .xls).

Submitting documents in other formats, such as photographs of narratives or narratives via traditional mail may lengthen the review process. If you need assistance, please contact your Coordinating Entity (see Section 4) or State Water Board staff identified in the Contact Information section below.

To submit your application with all required materials (see Section 2), you can:

- Use the online form **Submit**
- Email DWR- ScottShastaDrought@Waterboards.ca.gov
- Mail:
  State Water Resources Control Board
  Division of Water Rights - Instream Flows Unit
  1001 I Street - 14th Floor
  Sacramento, CA 95814

Contact Information for State Water Board Staff

- Kevin DeLano
  Phone: (916) 319-0631
  Email: Kevin.DeLano@waterboards.ca.gov
- Shahab Araghinejad
  Phone: (916) 319-0975
  Email: shahab.araghinejad@waterboards.ca.gov
- Division of Water Rights – Scott-Shasta Phone Line and Email
  Phone: (916) 327-3113
  Email: ScottShastaDrought@waterboards.ca.gov

What's Next?

State Water Board staff will review each groundwater LCS application. If staff identify errors, a need for additional information, or changes that need to be made, they will contact the applicant. Once staff determine the application is substantially complete, it will be posted as pending on the State Water Board's Local Cooperative website for the Scott River and Shasta River watersheds emergency regulation.

Mark & Shelene Johnson
[redacted]

State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

RE: 2024 Local Cooperative Solution – Mark & Shelene Johnson

To Deputy Director:

As authorized by 23 CCR §§ 875(f)(4)(D), Mark & Shelene are providing this letter to further describe its proposed local cooperative solution (LCS) for the 2024 irrigation season.

Introduction/Historical Irrigation Practices

All of the approximately 108 acres[1] we own and irrigate at the above address have been cultivated as alfalfa and grass as well as permanent pasture (predominantly grasses and clover) since 1994 for seasonal rotational grazing of cattle. Irrigation infrastructure for hay fields and seasonal pasture includes one overlying agricultural well that supplies the following areas and equipment:

(i) **Center Pivots** (approximately 41 acres) - One automated circular center pivot services most of our acreage. It was installed in 2013.

(ii) **Wheel line** (approximately 28 acres) - Wheel lines (i.e. long mobile pipe sets historically moved manually during irrigation season) service approximately 28 acres. Generally, each wheel line is moved manually each day at approximately 6 am and at 6pm resulting in two approximately 11 hour operation periods during a 24 hour period.[2]

(iii) **Corners** (approximately 10 acres) - Since our property is irregularly shaped, certain areas of the property cannot be irrigated with circular pivots or rectangular wheel lines; remainder areas (i.e. "corners") are irrigated using a combination of methods including Irripods/k-lines (daisy chained ground level sprinklers) and handlines.

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[1] For purposes of this letter, all acreage estimates have been estimated in good faith using satellite imagery.

[2] Time is required for wheel line to drain fully and be moved, which can take an hour or so each move. No irrigation occurs during periods required to drain/move wheel line. Hence, the estimation of 11 hour sets.

Irrigation season for seasonal hay ground and pasture across our property, including in 2020 (base year) typically begins for us about April 1 each year and continues into late October, subject to variance depending on annual temperature and precipitation conditions.

Specific 2024 Conservation Practices

Conservation efforts for 2024: Percent Reduction plan.

Pivots - Pivots will be set to apply 30 percent less water on pasture and 50 percent less on grain. On the grain, the pivot will be shut off for the months of August – October.

Wheel line - Reduced set times. We intend to reduce our two daily wheel line set times from approximately 11 hours to 8 hours. Simply by operating wheel lines three hours less each day, we expect to save 30% over historical practices on all wheel line acreage. We intend to maintain a written irrigation log detailing wheel line run times and will present that log to the Cooperating Entity upon request.

Corners - The 5 acres in the grain field corner is reduced by 50% and turned off August – October. The other 5 acres of pasture will be reduced by 30%. This will be done by reduced set times on the k-lines.

Metering- For the time being, we are requesting a waiver from metering. We have submitted a funding application with NRCS for system improvements, including looking into metering options that a technical advisor deems feasible. Currently, our system will not allow for a meter. JW Kerns Inc. stated the saddle flow meter requires 7 feet of straight pipe, which we do not have. Another option is to bury the meter underground on the mainline. However, according to JW Kerns Inc., the meter cannot withstand being in water. Our ranch has groundwater close to the surface in winter months which would destroy the meter. For us to install the saddle meter, we would need to reconstruct the mainlines and well manifold. We cannot dig a mainline or around the pump area in the winter or spring due to high ground water level. Ground water would fill the trenches with water before any work could be accomplished. Summer, late Spring and early fall are when we are in production, so not a feasible time to disrupt irrigation.

Recording & Reporting- We can use the pivot's panel to document how many inches are applied to the pivot-north and pasture pivot fields. This information can be sent monthly. We request a waiver for the wheel line fields (Lane & Marie's), the k-line pasture and corners. I can document which days and for how long the pump runs on those fields.

Resources used for calculating Crop ET's: We calculated our pasture baseline according to AgWA's formulas for determining 2020 baseline for both pasture and alfalfa. See AgWA documents dated 4/15/24. The water we used for our crops in 2020 is reasonable. For questions regarding our 2020 baseline levels, please [redacted]

Each of the above conservation undertakings is at significant cost to us as a small family hay and livestock producer, both in actual costs and in reduced pasture production due to insufficient water. When grazing pastures do not receive reasonably adequate irrigation throughout the normal irrigation season, which is a consequence of this plan, especially in corner acreage, (i) grazing opportunity is significantly reduced, (ii) our grazing season becomes shorter, (iii) additional supplemental fall/winter feed forage must be purchased, and (iv) permanent plant damage and may likely occur and future productivity of pastures may be impaired and invasive weeds will become more prolific.

Please note that this plan is offered in good faith in connection with the 2024 irrigation season only. All rights, claims and defenses with regard to the matters described herein are hereby expressly reserved. Moreover, and as this plan is offered voluntarily (without any current legal obligation to undertake the matters described herein), should any governmental or NGO funds later become available for any forbearance or improvement efforts to which Mark & Shelene Johnson would otherwise be entitled, nothing herein shall be construed to limit the availability of such funds to Mark & Shelene Johnson provided that we materially perform the 2024 undertakings described herein. Water saved under this proposal will not be transferred to parcels not included under the LCS and we will not knowingly or intentionally otherwise take actions outside of the LCS that diminish, in any material way, the overall thirty percent reduction established by this proposal.

We contracted for staff from Scott River Water Trust to act as our Cooperative Entity.

In an effort to minimize any liability claims, we would like to request that the Cooperating Entity or any member of the State Water Resource Control Board be accompanied by a representative from the Mark & Shelene Johnson ranch if they need to access the ranch property to observe our LCS practices.

Please advise as to your decision on the acceptability of this plan in lieu of regulatory curtailment as contemplated by 23 CCR §§ 875 and thank you for your consideration in this matter.

Please feel free to contact me with any questions.

Regards,
Mark & Shelene Johnson

Siskiyou RCD- LCS Water Use Reduction Calculations

Prepared for: Mark & Shelene Johnson

Irrigation reduction by field:

Field	Acreage	A/F Base	A/F Reduction	Reduction %
Pivot - North	22.80	83.6	56.1	67.0%
Lane	10.40	43.3	14.6	33.8%
Marie's	18.85	78.5	26.5	33.8%
pasture - pivot	18.10	72.4	21.7	30.0%
pasture - kline	12.00	48.0	14.4	30.0%
corners	10.00	36.7	18.3	49.9%

Farm summary	Annual	April	May	June	July	August	Sept	Oct
	47.0%	45.7%	36.0%	36.0%	36.0%	51.1%	51.1%	51.1%

Notes: **Do not change any numbers in the yellow areas. These are all calculated from other numbers.
**In the light yellow area, the applied will be calculated based on the entered reduction percentage.
**If a crop cycle that is different than the base year is used (say alfalfa to grain, or cutting off irrigation early) then leave the % reduction blank and put new monthly applied inches into the light yellow area.
**This change is alters the spreadsheet function. To change back to % reduction for that line you have to copy paste any of the other light yellow cells into the changed cells.............

Base Year 2020				Annual Applied (inches)	Monthly Applied Water 2020 (Inches)							Base A/F Applied	Reduction Method	% Reduction	Annual Applied (inches)	Monthly Applied Water 2024 (Inches)							Annual A/F Applied	A/F Applied							Annual reduction (AF)	Annual Reduction %
Field name	Acreage	Crop	Irrigation Method		A	M	J	J	A	S	O					A	M	J	J	A	S	O		A	M	J	J	A	S	O		
Pivot - North	22.8	alfalfa	pivot	44	6	7	8	8	7	5	3	83.6		0.0%										11.4	13.3	15.2	15.2	13.3	9.5	5.7		
2024	22.8	grain	pivot	44	6	7	8	8	7	5	3	83.6	crop rotation	50.0%	14.5	3	4	4	4	0	0	0	27.6	5.7	6.7	7.6	7.6	0.0	0.0	0.0	56.1	67.0%
2022				44	6	7	8	8	7	5	3	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				44	6	7	8	8	7	5	3	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				44	6	7	8	8	7	5	3	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Field summary	22.8			44								83.6				If reduction method is not percentage across the season change these numbers							27.6	50.0%	50.0%	50.0%	50.0%	100.0%	100.0%	100.0%	56.1	67.0%
Enter base year information on first line. Enter acreages, crop and method for 2024													Enter reduction method and percentage if applicable																			
Field name	Acreage	Crop	Irrigation Method		A	M	J	J	A	S	O					A	M	J	J	A	S	O		A	M	J	J	A	S	O		
Lane	10.4	alfalfa	wheel line	50	7	8	8	8	8	7	4	43.3		0.0%										6.1	6.9	6.9	6.9	6.9	6.1	3.5		
2024	10.4	alfalfa	wheel line	50	7	8	8	8	8	7	4	43.3	reduce set time	30.0%	33.1	3	6	6	6	6	5	3	28.7	2.6	4.9	4.9	4.9	4.9	4.2	2.4	14.6	33.8%
2022				50	7	8	8	8	8	7	4	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				50	7	8	8	8	8	7	4	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				50	7	8	8	8	8	7	4	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Field summary				50								43.3				If reduction method is not percentage across the season change these numbers							28.7	57.1%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	14.6	33.8%
Enter base year information on first line. Enter acreages, crop and method for 2024													Enter reduction method and percentage if applicable																			
Field name	Acreage	Crop	Irrigation Method		A	M	J	J	A	S	O					A	M	J	J	A	S	O		A	M	J	J	A	S	O		
Marie's	18.85	alfalfa	wheel line	50	7	8	8	8	8	7	4	78.5		0.0%										11.0	12.6	12.6	12.6	12.6	11.0	6.3		
2024	18.85	alfalfa	wheel line	50	7	8	8	8	8	7	4	78.5	reduce set time	30.0%	33.1	3	6	6	6	6	5	3	52.0	4.7	8.8	8.8	8.8	8.8	7.7	4.4	26.5	33.8%
2022				50	7	8	8	8	8	7	4	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				50	7	8	8	8	8	7	4	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				50	7	8	8	8	8	7	4	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Field summary	18.85			50								78.5				If reduction method is not percentage across the season change these numbers							52.0	57.1%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	26.5	33.8%
Enter base year information on first line. Enter acreages, crop and method for 2024													Enter reduction method and percentage if applicable																			
Field name	Acreage	Crop	Irrigation Method		A	M	J	J	A	S	O					A	M	J	J	A	S	O		A	M	J	J	A	S	O		
pasture - pivot	18.1	pasture	pivot	48	7	7	7	7	7	7	6	72.4		0.0%										10.6	10.6	10.6	10.6	10.6	10.6	9.1		
2024	18.1	pasture	pivot	48	7	7	7	7	7	7	6	72.4	reduce set time	30.0%	33.6	5	5	5	5	5	5	4	50.7	7.4	7.4	7.4	7.4	7.4	7.4	6.3	21.7	30.0%
2022				48	7	7	7	7	7	7	6	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				48	7	7	7	7	7	7	6	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				48	7	7	7	7	7	7	6	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Field summary	18.1			48								72.4				If reduction method is not percentage across the season change these numbers							50.7	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	21.7	30.0%
Enter base year information on first line. Enter acreages, crop and method for 2024													Enter reduction method and percentage if applicable																			
Field name	Acreage	Crop	Irrigation Method		A	M	J	J	A	S	O					A	M	J	J	A	S	O		A	M	J	J	A	S	O		
pasture - kline	12	pasture	kline	48	7	7	7	7	7	7	6	48.0		0.0%										7.0	7.0	7.0	7.0	7.0	7.0	6.0		
2024	12	pasture	kline	48	7	7	7	7	7	7	6	48.0	reduce set time	30.0%	33.6	5	5	5	5	5	5	4	33.6	4.9	4.9	4.9	4.9	4.9	4.9	4.2	14.4	30.0%
2022				48	7	7	7	7	7	7	6	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				48	7	7	7	7	7	7	6	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				48	7	7	7	7	7	7	6	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Field summary	12			48								48.0				If reduction method is not percentage across the season change these numbers							33.6	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	30.0%	14.4	30.0%
Enter base year information on first line. Enter acreages, crop and method for 2024													Enter reduction method and percentage if applicable																			
Field name	Acreage	Crop	Irrigation Method		A	M	J	J	A	S	O					A	M	J	J	A	S	O		A	M	J	J	A	S	O		
corners	10	alfalfa	pivot	44	6	7	8	8	7	5	3	36.7		0.0%										5.0	5.8	6.7	6.7	5.8	4.2	2.5		
2024	5	grain	pivot	44	6	7	8	8	7	5	3	18.3	crop rotation	50.0%	14.5	3	4	4	4	0	0	0	6.0	1.3	1.5	1.7	1.7	0.0	0.0	0.0	12.3	67.0%
2024	5	pasture	pivot	44	6	7	8	8	7	5	3	18.3	reduce set time	30.0%	29.6	3	5	6	6	5	4	2	12.3	1.3	2.0	2.3	2.3	2.0	1.5	0.9	6.0	32.7%
2022				44	6	7	8	8	7	5	3	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
2022				44	6	7	8	8	7	5	3	0.0			0.0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
Field summary	10			44								36.7				If reduction method is not percentage across the season change these numbers							18.4	50.0%	40.0%	40.0%	40.0%	65.0%	65.0%	65.0%	18.3	49.9%
Enter base year information on first line. Enter acreages, crop and method for 2024													Enter reduction method and percentage if applicable																			

Scott River Water Trust

P.O. Box 591 ~ Etna, CA 96027
530-643-2395 scottwatertrust@gmail.com

Month, Day, Year
4/11/24

Binding Agreement

Contractor Contact Information:

Business:	Scott River Water Trust
Contact Person:	Chris Voigt
Address:	9933 South State Highway 3, Callahan CA
Phone:	(916) 396-0131
Email:	chrisb.voigt@gmail.com

Landowner Contact Information:

Business:	Mark & Shelene Johnson
Contact Person:	Shelene Johnson
[redacted]	

Background

On December 19, 2023, the State Water Board adopted a new emergency regulation for the Scott and Shasta River Watersheds. The Office of Administrative Law approved the emergency regulation on February 1, 2024 and is in effect for one year, unless re-adopted or rescinded. Under the 2021 drought emergency regulation instated by the State Water Resources Control Board (SWRCB) that established drought emergency minimum flows in the Scott River, a Local Cooperative Solution (LCS) may be proposed by individuals or groups to submit by petition to the Deputy Director of the SWRCB as an alternative means of reducing water use to meet or preserve drought emergency minimum flows and provide fishery benefits, in lieu of curtailment. This binding agreement between the (Landowner) Scott River Water Trust (SRWT) will monitor the SRWCB approved LCS to achieve 1) a net reduction of water use of 30 percent throughout the irrigation season; and 2) a monthly reduction of at least 30 percent in the July through October 31 period, as compared to 2020, 2021, 2022 or 2023.

Recitals

1. *Local cooperative solutions by individuals or groups may be proposed by petition to the Deputy Director as an alternative means of reducing water use to meet or preserve drought emergency minimum flows, or to provide other fishery benefits (such as cold-water refugia, localized fish passage,or redd protection), in lieu of curtailment as described in this section.*

   (A) Petitions to implement local cooperative solutions that coordinate diversions, share water, strategically manage groundwater and/or surface water for fisheries benefits, reduce annual water use, or engage in similar activities may be submitted to the Deputy Director at any time, except as noted in subsection (f)(4)(D)(ii).

   (G) A coordinating entity for the purposes of this section shall refer to an entity which possesses the expertise and ability to evaluate and require performance of the commitments made in a local cooperative solution, and which commits that:

      (i) Evaluation of local cooperative solution proposals and inspections shall be conducted by representatives who lack a financial or close personal interest in the outcome, and

      (ii) Information collected on compliance with local cooperative solutions is provided to the State Water Board monthly and upon request. The entity shall undertake data collection (including metering data) and inspections, either by itself or in coordination with State Water Board staff, sufficient to ensure implementation of local cooperative solutions, including inspection or data collection targeted within two weeks of completion of commitments to cease pumping as of a date certain.

2. *For overlying or adjudicated groundwater diversions for irrigated agriculture described under in section 875.5, subdivision (a)(1)(A)(ix) [Scott River] or section 875.5, subdivision (b)(1)(C) [Shasta River] the Deputy Director may approve a groundwater basin-wide, groundwater-sub-basin-wide, or any number of individual local cooperative solutions where:*

   (i) The proposal may be based on a binding agreement made with a coordinating entity with primary responsibility to verify implementation of the local cooperative solution.

   (ii) For individual proposals, the proposal must be submitted no later than April 15 and must be implemented during the entirety of the irrigation season (including during pendency of approval), unless the proponent withdraws.

   (iii) The proposal includes a description of metering in place for groundwater well extractions, and a proposal to meter and record such extractions daily and report monthly to the Deputy Director or the coordinating entity, as applicable, except as described below. The State Water Board has funding and technical support available to

support some amount of metering, and those interested in such assistance are encouraged to promptly contact the State Water Board.

3. *For percent-based reduction in pumping local cooperative solutions:*
   a. *For the Scott River: The proposal provides at least:*

      (i) A net reduction of water use of 30 percent throughout the irrigation season (April 1 – October 31); and

      (ii) A monthly reduction of 30 percent in the July through October time period.

   b. *The relevant water use reduction shall generally be based on a comparison to the 2020, 2021, 2022, or 2023 irrigation season, and may be demonstrated by evidence that provides a reasonable assurance that the change in farming practice or other action results in at least the relevant proportionate reduction in water use. Such evidence may include but is not limited to: pumping reports; actions that will be taken to reduce water use; estimation of water saved from conservation measures or changes in irrigation or planting decisions; and electric bills. However, if evidence for the amount of water applied for the 2020, 2021, 2022, or 2023 irrigation seasons indicates a base rate of applied water that is higher than 33 inches per year for alfalfa, 14 inches per year for grain, or 30 inches per year for pasture, then the base rate of applied water shall be the aforementioned values unless the proponent makes an additional showing that a higher base rate number is an appropriate comparison in light of relevant information that can include but is not limited to multi-year practices, soil type, and irrigation methods.*

Proposed Local Cooperative Solution: (*Specific action plan to be completed by landowner, see attached LCS application form and/or specific landowner curtailment plan)*

Binding Agreement Terms

The Landowner is required to adhere to the LCS, as approved by SWRCB. The Landowner has requested that SRWT serve as the coordinating entity. As such, both parties agree to the following:

- For the duration of this binding agreement where SRWT is the coordinating entity, the Landowner shall give SRWT the right to reasonably access the included parcels for the limited purpose of verifying execution of the LCS. Any individual not directly employed or contracted by SRWT shall provide pre-notification to, and shall obtain approval by the Landowner before accessing the property,

- SRWT will strive to notify the Landowner a day in advance of visiting the parcels and shall provide the Landowner or designee the ability to participate in monitoring activities,

- It is anticipated that SRWT representatives will visit the property approximately twice per month to monitor the approved LCS, unless inadequacies are discovered, in which case additional field visits will occur until inadequacies are rectified. A monitoring inspection may include verification of any or all of the actions described in the conservation plan and may include inspection checklist/notes/reports and photo verification,

- SRWT will submit the information regarding the verification materials and actions described in this agreement, and conservation plan incorporated by reference, to the State Water Board upon request, for the purposes of verifying compliance with the LCS,

- This binding agreement is not intended to preclude, harm, or otherwise interfere with the landowner's ability to secure any funding to mitigate the financial impacts imposed by the emergency regulation or proposed conservation practices. SRWT supports the use of funding programs to ameliorate the costs of implementing the conservation practices described in the proposed conservation plan: planning and cooperation under a voluntary LCS should not undermine the ability to receive such funding,

- This binding agreement may be terminated by either party at any time. Both parties agree to take reasonable measures to resolve any concerns related to the performance of the LCS, negative interpersonal interaction, or any unforeseen circumstance prior to invoking termination,

- As the irrigation season unfolds, there may be reason to change the terms of the LCS or this binding agreement with respect to its implementation and verification. Any such changes to the LCS or service agreement will need to be agreed upon by the Landowner and SRWCB. If a Landowner requests SRWT assistance with an updated LCS, the SRWT and Landowner will enter into a new Binding Agreement and,

Payment

In consideration for the services to be performed by SRWT, the Landowner agrees to pay SRWT at the rate of $75.00 per hour for initial consultation and $75.00 per hour for all services rendered after signing of the binding agreement.

Expenses

The Landowner will reimburse SRWT for expenses that are attributable directly to work performed under this Agreement. Any expenses incurred will be approved by the Landowner beforehand. SRWT will submit an itemized statement of Contractor's expenses attached with invoicing.

Terms of Payment

Upon completion of SRWT services under this binding agreement, SRWT will submit an invoice. The Landowner will pay SRWT the compensation described within 30 days of receiving SRWT's invoice.

Term of Agreement

This agreement will become effective when signed by both parties and will terminate on:

- November 1, 2024, or
- The date a party terminates the binding agreement.
- Monitoring information will be collected by the SRWT and shared with State Water Board as a field report in accordance with their reporting schedule or upon request
- SRWT is not authorized to and will not distribute data or other information regarding work done under this contract to any third party without previous written approval by the Landowner
- Landowner agrees that water saved under the LCS will not be transferred to parcels not included under the LCS, and Landowner will not knowingly or intentionally otherwise take actions outside of the LCS that diminish, in any material way, the overall thirty percent reduction establish by the actions described ion the LCS

Signatures

Christopher Voigt

SRWT Representative

Shelene Johnson

Shelene Johnson (Apr 11, 2024 19:38 PDT)

Landowner

Signature: Shelene Johnson

Shelene Johnson (Apr 11, 2024 19:38 PDT)

Email: sjohnson2998@gmail.com

Calculating Baseline Irrigation Application Amounts
FOR WATER YEAR 2020 - Scott Valley Irrigated ALFALFA

Scott Valley Agriculture Water Alliance

4/15/24

Sources:

1. *California Water Data Exchange Center (CDEC). Department of Water Resources. Monthly average precipitation at Fort Jones, CA.* www.cdec.water.ca.gov.
2. *Orloff, S., Harter, T., Snyder, R., and Hanson, B. UC Cooperative Extension Siskiyou County and LAWR UC Davis. Alfalfa Water Use in the Scott Valley: Resolving the Discrepancy Between Theory and Practice.* PowerPoint presentation. 2011-2012.
3. *University of California Agriculture and Natural Resources. Drought Tip: Field Irrigation Water Management in a Nutshell. September 2019.*
4. *Zaccaria, Daniele, PhD. Agriculture Water Management Specialist, UC Davis. Personal communication, 4/12/24.*

Overview: Approximate irrigation baselines for Scott Valley irrigated alfalfa can be determined based on four factors:

1. The evapotranspiration (ET) of alfalfa (how much water the plants use) during growing season.
2. Rainfall occurring during the growing season (and resulting infiltrated rainfall into the crop root zone).
3. Soil moisture that can be accessed by the roots.
4. Irrigation application efficiency rates for different irrigation systems.

Approximate baseline for water application can be determined by dividing crop ET (minus effective rainfall, minus existing stored soil moisture) by the application efficiency rate.

Establishing Alflafl evapotranspiration (ET): Alfalfa ET was determined in 8 fields across 4 years in the Scott and Shasta valleys by Orloff et al. (2007-2010). See Figure 1 below. The average cumulative alfalfa ET for Scott and Shasta was on average 37 inches for the growing season over the course of the study period.

Region	Site	Year	Age of Alfalfa	Seasonal ET (inches)	Reference ET (inches)
Scott Valley/Shasta Valley	EN	2007	2	39.6	44
	EN	2008	3	32.8	42.6
	EN	2009	4	33.8	40.4
	FI	2009	5	36.1	37.4
	SH	2009	4	38.8	40.4
	AP	2010	5	37.3	37.4
	FI	2010	2	34.7	37.4
	FA	2010	6	38.8	41.1
				Ave: 36.5	Ave. 40.1

Figure 1. Orloff et al recordings of Alfalfa ET and Reference grass ET (ETo) for Scott and Shasta valleys at 8 sites between 2007-2010.

Establishing application efficiency: The UC Davis Drought Tips Fact Sheet titled "Irrigation water management in a nutshell" outlines application efficiency rates for various irrigation systems. See Figure 2 below. Efficiencies range from 90 percent (LEPA pivot systems) to 45 percent (furrow irrigation). "Side-roll" refers to "wheel line" systems.

Box 1 – Application Efficiency

Some extra water must be added to the soil in addition to the amount needed to adequately replenish water used by the crop since the last irrigation or rainfall. Such extra water is required to compensate for losses from the irrigation systems that occur through deep percolation, surface runoff, evaporation, wind-drift, and nonuniform water application. Because of losses occuring during irrigation application, application efficiency is always less than 100 percent.

Application efficiency is defined as the ratio of ***water beneficially used by the crop to the total water applied***, where "beneficial use" includes water used for crop evapotranspiration, frost protection, salt leaching, canopy cooling, etc. Application efficiency provides an indication of how well an irrigation system performs its objective of applying water in adequate amounts and uniformly throughout the field, and allowing it to be stored in the crop root zone to meet the crop water requirements. No irrigation system can achieve 100% application efficiency, but adequate system design, regular maintenance, and careful irrigation management can minimize water losses, thus increasing the relative portion of applied water that is beneficially used by plants. Some irrigation methods perform relatively better than others in terms of the water application rate matching the soil intake rate and for the evenness with which water is distributed throughout the field (distribution uniformity). Table 3 shows potential values of application efficiency for properly-designed and well-managed irrigation systems.

Table 3. **Ranges of potential application efficiency (Eff_A) of well-designed and well-managed irrigation systems**

Irrigation method/system	Potential Eff_A (%)
Sprinkler	
LEPA	80–90
linear move	75–85
center pivot	75–90
traveling gun	65–75
side-roll	65–85
hand-move	65–85
solid-set	70–85
Surface	
furrow (conventional)	45–65
furrow (surge)	55–75
furrow (with tailwater reuse)	60–80
basin	60–75
precision level basin	65–80
Microirrigation	
bubbler (low head)	80–90
microspray	85–90
micropoint source	85–90
microline source	85–90
surface drip	85–95
subsurface drip	90–95

Source: Adapted from Howell 2003.

Figure 2. Application efficiency rates as found in UC-ANR Drought Tips Fact Sheet published in 2019.

Establishing total water needs of alfalfa: The equation for calculating total water needs during the growing season is: alfalfa ET (which Orloff et al established as 37 inches during the growing season) minus "effective rainfall" (the rain that percolates and doesn't run-off), minus stored soil moisture.

Establishing effective rainfall for Scott Valley during 2020 growing season: According to California Data Exchange Center, 2020 was a very dry year: 7.38 inches total for the water year (Oct 2019-Oct 2020) (see Figure 3). During the growing season we got 3.08 inches. That means effective rainfall of 1.8 inches (60% of total in-season rainfall).

Water Year (WY)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	WY Total
2017				7.44	6.65	2.57	1.86	0.58	0.58	0.01	1.00	0.16	20.85
2018	0.36	2.42	0.59	2.21	0.63	1.91	1.83	2.17	0.04	0.02	0.00	0.00	12.18
2019	0.46	2.83	3.36	3.42	5.30	1.20	1.38	1.27	0.00	0.00	0.58	1.01	20.81
2020	0.32	0.65	2.54	0.79	0.00	0.00	0.58	1.08	0.88	0.40	0.14	0.00	7.38
2021	0.00	1.95	2.22	2.70	1.83	0.97	0.15	0.14	0.20	0.26	0.02	0.86	11.30
2022	2.32	0.94	3.48	1.38	0.06	0.74	1.26	1.60	0.98	0.22	0.04	0.18	13.20
2023	0.04	1.21	4.85	4.33	1.38	4.57	0.78	1.15	0.50	0.00	0.42	0.64	19.87
2024	0.46	1.00	2.23	4.64									8.33

Water Years 2023 and 2024 (to date) in Fort Jones (bottom two rows), according to CDEC.

Establishing water supplied through existing soil moisture: Soil moisture content could reasonably be expected to be 60% of the winter rainfall, which was 8.3 inches. 60% of 8.3= 5 inches. Alfalfa roots systems can vary, but 4 feet can be used as an estimate. Orloff determined root systems extract about 2 inches of water per foot of roots. Thus, alfalfa could reasonably be expected to extract all the soil moisture available (5 inches) in the 2024 growing season.

Calculating applied water needs for alfalfa: crop ET – effective rainfall – soil moisture / application efficiency rate.

Scenario 1: alfalfa irrigated by a wheel line sprinkler system that is 75% efficient. This % can vary.

Crop ET: 37 inches
Total water need (subtracting rain and soil moisture): 37 inches – 1.8 inches – 2.6 inches = 32.6 inches.
Application efficiency rate: 75%
Total irrigation water needed for growing season (32.6 / .75) = 43.5 inches

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Scenario 2: alfalfa irrigated by center pivot sprinkler system that is 80% efficient. This % can vary.

Crop ET: 37 inches
Total water need (subtracting rain and soil moisture): 37 inches – 1.8 inches – 2.6 inches = 32.6 inches.
Application efficiency rate: 80%
Total irrigation water needed for growing season (32.6 / .80) = 40.8 inches

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Scenario 3: alfalfa irrigated by flood irrigation (basin irrigation)* that is 55% efficient. This % can vary.

Crop ET: 37 inches
Total water need (subtracting rain and soil moisture): 37 inches – 1.8 inches – 2.6 inches = 32.6 inches.
Application efficiency rate: 55%
Total irrigation water needed for growing season (32.6 / .55) = 59.3 inches

*Note that flood irrigation often applies more water, but has no wind drift and can have low evaporation loss. If runoff rates are low, then a high percentage of water unused as ET will percolate back into the water table.

Scenario 4: alfalfa corners irrigated by K-line or traveling gun that is 75% efficient. This % can vary.

Crop ET: 37 inches
Total water need (subtracting rain and soil moisture): 37 inches – 1.8 inches – 2.6 inches = 32.6 inches.
Application efficiency rate: 75%
Total irrigation water needed for growing season (32.6 / .75) = 43.5 inches

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Calculating Baseline Irrigation Application Amounts
FOR WATER YEAR 2020 - Scott Valley Irrigated PASTURE

Scott Valley Agriculture Water Alliance

4/15/24

Sources:

1. *California Water Data Exchange Center (CDEC). Department of Water Resources. Monthly average precipitation at Fort Jones, CA.* www.cdec.water.ca.gov.
2. *Orloff, S., Harter, T., Snyder, R., and Hanson, B. UC Cooperative Extension Siskiyou County and LAWR UC Davis. Alfalfa Water Use in the Scott Valley: Resolving the Discrepancy Between Theory and Practice.* PowerPoint presentation. 2011-2012.
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4. *Zaccaria, Daniele, PhD. Agriculture Water Management Specialist, UC Davis. Personal communication, 4/12/24.*

Overview: Approximate irrigation baselines for Scott Valley irrigated pasture can be determined based on four factors:

1. The evapotranspiration (ET) of pasture (how much water the plants use) during growing season.
2. Rainfall occurring during the growing season (and resulting infiltrated rainfall into the crop root zone).
3. Soil moisture that can be accessed by the roots.
4. Irrigation application efficiency rates for different irrigation systems.

Approximate baseline for water application can be determined by dividing crop ET (minus effective rainfall, minus existing stored soil moisture) by the application efficiency rate.

Establishing Pasture evapotranspiration (ET): Pasture ET was determined in 8 fields across 4 years in the Scott and Shasta valleys by Orloff et al. (2007-2010). See Figure 1 below. Because "Reference ET" (far right column) is a determination of well-watered, unstressed, irrigated grass pasture, it can be used synonymously with "pasture ET." The average cumulative pasture ET for Scott and Shasta was on average 40 inches for the growing season over the course of the study period. This is the amount of water the irrigated grass pasture used during the growing season under well-watered, non-stressed conditions.

Region	Site	Year	Age of Alfalfa	Seasonal ET (inches)	Reference ET (inches)
Scott Valley/Shasta Valley	EN	2007	2	39.6	44
	EN	2008	3	32.8	42.6
	EN	2009	4	33.8	40.4
	FI	2009	5	36.1	37.4
	SH	2009	4	38.8	40.4
	AP	2010	5	37.3	37.4
	FI	2010	2	34.7	37.4
	FA	2010	6	38.8	41.1
				Ave: 36.5	Ave. 40.1

Figure 1. Orloff et al recordings of Alfalfa ET and Reference grass ET (ETo) for Scott and Shasta valleys at 8 sites between 2007-2010.

Establishing application efficiency: The UC Davis Drought Tips Fact Sheet titled "Irrigation water management in a nutshell" outlines application efficiency rates for various irrigation systems. See Figure 2 below. Efficiencies

range from 90 percent (LEPA pivot systems) to 45 percent (furrow irrigation). “Side-roll” refers to “wheel line” systems.

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Some extra water must be added to the soil in addition to the amount needed to adequately replenish water used by the crop since the last irrigation or rainfall. Such extra water is required to compensate for losses from the irrigation systems that occur through deep percolation, surface runoff, evaporation, wind-drift, and nonuniform water application. Because of losses occuring during irrigation application, application efficiency is always less than 100 percent.

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side-roll	65–85
hand-move	65–85
solid-set	70–85
Surface	
furrow (conventional)	45–65
furrow (surge)	55–75
furrow (with tailwater reuse)	60–80
basin	60–75
precision level basin	65–80
Microirrigation	
bubbler (low head)	80–90
microspray	85–90
micropoint source	85–90
microline source	85–90
surface drip	85–95
subsurface drip	90–95

Source: Adapted from Howell 2003.

Figure 2. Application efficiency rates as found in UC-ANR Drought Tips Fact Sheet published in 2019.

Establishing total water needs of pasture: The equation for calculating total water needs during the growing season is: pasture ET (which Orloff et al established as 40 inches during the growing season) minus “effective rainfall” (the rain that percolates and doesn’t run-off), minus stored soil moisture.

Establishing effective rainfall for Scott Valley during 2020 growing season: According to California Data Exchange Center, 2020 was a very dry year: 7.38 inches total for the water year (Oct 2019-Oct 2020) (see Figure 3). During the growing season we got 3.08 inches. That means effective rainfall of 1.8 inches (60% of total in-season rainfall).

Water Year (WY)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	WY Total
2017	6.19	2.34	4.10	7.44	6.65	2.57	1.86	0.58	0.58	0.01	1.00	0.16	33.48
2018	0.36	2.42	0.59	2.21	0.63	1.91	1.83	2.17	0.04	0.02	0.00	0.00	12.18
2019	0.46	2.83	3.36	3.42	5.30	1.20	1.38	1.27	0.00	0.00	0.58	1.01	20.81
2020	0.32	0.65	2.54	0.79	0.00	0.00	0.58	1.08	0.88	0.40	0.14	0.00	7.38
2021	0.00	1.95	2.22	2.70	1.83	0.97	0.15	0.14	0.20	0.26	0.02	0.86	11.30
2022	2.32	0.94	3.48	1.38	0.06	0.74	1.26	1.60	0.98	0.22	0.04	0.18	13.20
2023	0.04	1.21	4.85	4.33	1.38	4.57	0.78	1.15	0.50	0.00	0.42	0.64	19.87

Water Year (WY)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	WY Total
2017				7.44	6.65	2.57	1.86	0.58	0.58	0.01	1.00	0.16	20.85
2018	0.36	2.42	0.59	2.21	0.63	1.91	1.83	2.17	0.04	0.02	0.00	0.00	12.18
2019	0.46	2.83	3.36	3.42	5.30	1.20	1.38	1.27	0.00	0.00	0.58	1.01	20.81
2020	0.32	0.65	2.54	0.79	0.00	0.00	0.58	1.08	0.88	0.40	0.14	0.00	7.38
2021	0.00	1.95	2.22	2.70	1.83	0.97	0.15	0.14	0.20	0.26	0.02	0.86	11.30
2022	2.32	0.94	3.48	1.38	0.06	0.74	1.26	1.60	0.98	0.22	0.04	0.18	13.20
2023	0.04	1.21	4.85	4.33	1.38	4.57	0.78	1.15	0.50	0.00	0.42	0.64	19.87
2024	0.46	1.00	2.23	4.64									8.33

Figure 3. CDEC rainfall data for Water Year 2020 at Fort Jones. Not pictured here is rainfall for October 2020, which was 0.

Establishing water supplied through existing soil moisture: Soil moisture content could reasonably be expected to be 60% of the winter rainfall, which was 4.3 inches. Pasture roots systems can vary, but 12 inches can be used as an estimate. Orloff determined root systems extract about 2 inches of water per foot of roots.

Calculating applied water needs for pasture: crop ET – effective rainfall – soil moisture / application efficiency rate.

Scenario 1: pasture irrigated by a wheel line sprinkler system that is 75% efficient. This % can vary.

Crop ET: 40 inches
Total water need (subtracting rain and soil moisture): 40 inches – 1.8 inches – 2 inches = 36.2 inches.
Application efficiency rate: 75%
Total irrigation water needed for growing season (36.2 / .75) = 48.3 inches

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Scenario 2: pasture irrigated by center pivot sprinkler system that is 80% efficient. This % can vary.

Crop ET: 40 inches
Total water need (subtracting rain and soil moisture): 40 inches – 1.8 inches – 2 inches = 36.2 inches.
Application efficiency rate: 80%
Total irrigation water needed for growing season (36.2 / .80) = 45.3 inches

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Scenario 3: pasture irrigated by flood irrigation (basin irrigation)* that is 55% efficient. This % can vary.

Crop ET: 40 inches
Total water need (subtracting rain and soil moisture40 inches – 1.8 inches – 2 inches = 36.2 inches.
Application efficiency rate: 55%
Total irrigation water needed for growing season (36.2 / .55) = 65.8 inches

*Note that flood irrigation often applies more water, but has no wind drift and can have low evaporation loss. If runoff rates are low, then a high percentage of water unused as ET will percolate back into the water table.

Scenario 4: pasture corners irrigated by K-line or traveling gun that is 75% efficient. This % can vary.

Crop ET: 40 inches
Total water need (subtracting rain and soil moisture): 40 inches – 1.8 inches – 2 inches = 36.2 inches.
Application efficiency rate: 75%
Total irrigation water needed for growing season (36.2 / .75) = 48.3 inches