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**Ronnean Lund,**  
*Director, Division 1*

**Audie Butcher,**  
*Director, Division 2*

**Garrett Wallis,**  
*Director, Division 3*

**Daniel Ruiz,**  
*General Manager*

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# SPECIAL BOARD MEETING

## Agenda

September 3, 2025, 9:00 a.m.

1887 Howard Street, Anderson (Council Chambers)

### 1. Call To Order

### 2. Flag Salute

### 3. Public Participation

Time is set aside for members of the public who wish to address the Board regarding matters within the District's jurisdiction. Individuals are requested to limit comments to a maximum of three minutes.

### 4. Old Business

- a. Presentation from Danny Kerns, PE Provost & Pritchard on 2<sup>nd</sup> Main Canal Lining Repair

### 5. Closed Session

- a. **Conference with Legal Counsel – Anticipated Litigation (Government Code § 54956.9(d)(4) One Case**

### 6. New Business

- a. Review and Discuss Approving Engineering Services for the Replacement of Damaged Lining at the North Hill St. Canal Reach (Danny Kerns to Present)
- b. Review and Discuss Draft Main Canal & Churn Creek Flow Measurement Program (Danny Kerns to Present)

# PROVOST & PRITCHARD CONSULTING GROUP

3387 Bodero Ln, Chico, CA 95973 • (866) 776-6200  
www.provostandpritchard.com

August 15, 2025

Mr. Dan Ruiz  
Anderson-Cottonwood Irrigation District  
2810 Silver Street  
Anderson, CA

**Subject: Engineering Services for the Replacement of Damaged Lining at the North Hill St. Canal Reach, Anderson, California**

Mr. Ruiz,

Thank you for the opportunity to submit this proposal to provide engineering services for the subject project. This proposal discusses our understanding of the project, recommends a scope of services together with associated fees, deliverables and approximate schedules, sets forth our assumptions and discusses other services that may be of interest as the project proceeds.

## PROJECT UNDERSTANDING

The following task and subtasks are proposed as steps towards the recommendation and design of the repair of the damaged portion of the North Hill concrete lined channel. Approximately 250 feet of the recently constructed lining was damaged when stormwater runoff flows overtopped the canal's right bank and undermined the lining. The goal of the design-related tasks described below is to design a replacement channel lining, considering the possibility of future stormwater runoff events of similar and greater magnitude.

## SCOPE OF SERVICES

Our proposed scope of work for this proposal is described below.

### PHASE NHR: NORTH HILL CONCRETE LINING REPLACEMENT

#### WATERSHED HYDROLOGIC EVALUATION

There is an approximately 1,000-acre watershed which generates and discharges stormwater runoff into the North Hill reach of the ACID Main Canal. A hydrologic evaluation of this natural drainage will be performed to quantify the stormwater runoff generated for various storm frequency intervals (10-yr, 25-yr, 50-yr, and 100-yr storms) and calculate stormwater accumulation in the pasture area adjacent to the ACID Main Canal. Discharge flows through the existing outlet structure will be calculated to quantify stormwater runoff flows metered into the Canal. Hydrographs (runoff vs. time) will be developed for each of the selected storm intervals.

A stage-storage relationship will be developed for the low land pasture area adjacent to the ACID Main Canal based on LiDAR topographical information. The stage-storage relationship quantifies the volume of water retained at varying surface elevations. In conjunction with this, a stage-discharge relationship will be developed for the outlet structure that conveys water from the pasture to the ACID canal.

[https://us-partner-integrations.egnyte.com/msoffice/wopi/files/af739d2a-925c-40fe-8dbe-ae3c986a7372/WOPIServiceld\\_TP\\_EGNYTE\\_PLUS/WOPIDUserld\\_85.ppeng.egnyte.com/Hill Street Lining Repair Design Proposal.docx](https://us-partner-integrations.egnyte.com/msoffice/wopi/files/af739d2a-925c-40fe-8dbe-ae3c986a7372/WOPIServiceld_TP_EGNYTE_PLUS/WOPIDUserld_85.ppeng.egnyte.com/Hill Street Lining Repair Design Proposal.docx)

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With the watershed hydrograph, pasture stage-storage characteristics, and outlet stage-discharge behavior, Provost & Pritchard will conduct a hydraulic analysis to determine the anticipated ponded water elevation for the various storm frequency intervals. This analysis will be used to inform the District's decision-making regarding the modification of existing embankments and canal lining improvements.

## **DESIGN OF REPLACEMENT CONCRETE LINING**

Building on the results from the watershed hydrologic evaluation, a canal lining replacement design approach will be developed and presented to ACID. The results from the watershed analysis will inform design decisions around canal embankment height, the need for additional stormwater discharge or spill capacity from the drainage into the canal, and the replacement lining design. A technical memorandum and/or presentation of the design recommendations will be provided to ACID staff and/or Board of Directors. If the recommendations are approved by ACID, improvement plans, details and, if needed, specifications will be prepared for use in coordination with Contractors and during construction. Provost & Pritchard will also coordinate with Contractors, as necessary, during the design process to develop construction cost estimates and incorporate constructability improvements.

## **ENGINEERING SERVICES DURING CONSTRUCTION**

Provost & Pritchard will also provide engineering services during construction, as needed, to assist the District and Contractor. Services during construction may include:

- Coordination meetings with District staff and Contractors including a preconstruction meeting and weekly meetings during construction activities. Two months of construction activities is assumed.
- Review and response to RFIs and/or submittals.
- Construction review site visits. Once a week for two months of construction activities is assumed.
- Provide construction review for conformance to Contract Documents at a level determined by Provost & Pritchard to be appropriate for the construction, based on the level of activity, ability and reliability of the construction staff, and need for review during specific milestone activities.
- Coordination with the Contractor(s) and ACID staff to assist with issues that may arise during construction.
- Document construction review work by completing construction review reports and taking digital photos of critical phases of the work.

## **PROFESSIONAL FEES**

Provost & Pritchard Consulting Group will perform the services in this Phase on a time and materials basis, in accordance with our Standard Fee Schedule in effect at the time services are rendered. These fees will be invoiced monthly as they are accrued, and our total fees, including reimbursable expenses, will not exceed our estimate of \$60,000 without additional authorization.

## **SCHEDULE**

Once we receive an executed copy of this Proposal and are authorized to proceed, we can begin work immediately. We understand that ACID intends to implement replacement of the damaged North Hill lining during the 2025/26 winter canal shutdown period which is typically November through March. We will prioritize the evaluation and replacement design activities to facilitate this desired construction window.

## ASSUMPTIONS

- ACID intends to change order the North Hill lining repair work into its contract with Steve Manning Inc. No contractor bidding assistance is required.
- Provost & Pritchard CAD standards and title block will be used for the design of this project.
- Provost & Pritchard's current CAD version will be used.

## ADDITIONAL SERVICES

The following services are not included in this proposal, however, these and others can be provided at additional cost, upon request.

- Topographic and Boundary Survey
- Environmental documentation (California Environmental Quality Act/National Environmental Policy Act)
- Pre-construction and/or Post-construction Biological Surveys
- Nesting Bird Surveys in accordance with the Migratory Bird Treaty Act (MBTA)
- Storm Water Pollution Prevention Plan (SWPPP) in compliance with State Water Resources Control Board (SWRCB) Construction General Permit

## TERMS AND CONDITIONS

This project is authorized in accordance with the Consultant Services Agreement (23-293) dated June 5, 2023 between Anderson-Cottonwood Irrigation District and Provost & Pritchard Engineering Group, Inc. (dba Provost & Pritchard Consulting Group). Please sign the proposal and return to Daniel Kerns at [dkerns@ppeng.com](mailto:dkerns@ppeng.com). These documents will serve as our Notice to Proceed. This proposal is valid for 30 days from the date above.

Respectfully,  
Provost & Pritchard Consulting Group



Daniel Kerns, RCE 84100  
Director of Operations



Randy Hopkins, RCE 63538  
Chief Strategic Officer

## TERMS AND CONDITIONS ACCEPTED

By Anderson-Cottonwood Irrigation District

---

Signature

---

Printed Name

---

Title

---

Date



**DRAFT**

**ANDERSON-COTTONWOOD IRRIGATION DISTRICT**  
**MAIN CANAL AND CHURN**  
**CREEK AREA WATER LOSS**  
**EVALUATION**

**SHASTA COUNTY, CALIFORNIA**  
MAY 2025

**PREPARED FOR:**  
ANDERSON-COTTONWOOD IRRIGATION DISTRICT  
SHASTA COUNTY, CALIFORNIA

**PREPARED BY:**  
PROVOST & PRITCHARD CONSULTING GROUP  
3387 BODERO LANE, CHICO, CA 95973

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PRITCHARD**

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**REPORT PREPARED FOR:****ANDERSON-COTTONWOOD IRRIGATION DISTRICT**

2810 Silver Street  
Anderson, CA 96007

**CONTACT:**

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(530) 365-7329

**REPORT PREPARED BY:****Provost & Pritchard Consulting Group**

Daniel Kerns, PE, Project Manager  
Shay Overton, PG, CHG  
Brice Black, EIT

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## ABBREVIATIONS AND ACRONYMS

|                |                                                    |
|----------------|----------------------------------------------------|
| ACID .....     | Anderson-Cottonwood Irrigation District            |
| Canal .....    | Anderson-Cottonwood Irrigation District Main Canal |
| District ..... | Anderson-Cottonwood Irrigation District            |
| ET .....       | Evapotranspiration                                 |
| GDE .....      | Groundwater Dependent Ecosystems                   |
| GSP .....      | Groundwater Sustainability Plan                    |
| Ksat .....     | Saturated Hydraulic Conductivity                   |
| NRCS .....     | Natural Resource Conservation Service              |
| SAGBI .....    | Soil Agricultural Groundwater Banking Index        |

# 1 INTRODUCTION

Anderson-Cottonwood Irrigation District (ACID or District) is located in Shasta County and serves about 32,000 acres of land. ACID's Main Canal (Canal) is approximately 35 miles long, beginning in Redding, California and terminating at Cottonwood Creek south of Cottonwood, California. The Canal is primarily an earthen channel (approximately 2% is lined) allowing for losses due to seepage (Anderson-Cottonwood Irrigation District, 2025). Historically, the decision to concrete line reaches of the Canal was based on locations adjacent to developed or developing areas. Loss of water due to seepage from the Canal has previously had a negative impact on adjacent parcels and on the ability of the District to manage its water supply efficiency. With the likelihood of future droughts and resulting curtailments to the District's water supply, the Main Canal and Churn Creek Area Seepage Loss Evaluation (Study) was performed. Through this Study, ACID is seeking greater clarity regarding locations of potential high seepage loss within the District's distribution system, specifically focused on the Main Canal and the Churn Creek distribution area. Identified areas of potential high water loss will provide a basis for a more site-specific seepage evaluation and potential future seepage mitigation and improvements projects.

ACID's Main Canal construction began in 1914 and was completed in 1917. The Canal was constructed by excavating material along the alignment and using the excavated material as fill to compact the downhill bank. It is not known whether there was additional material imported to construct the Canal embankments but, for the purposes of this study, it is assumed that only excavated material was placed as fill for the banks. This assumption is important as it influences the applicability of the mapped soil information as the material used to construction the embankments.

## 1.1 PREVIOUS WORK

In 2008, CH2M Hill performed an engineering evaluation on ACID's Main Canal. This evaluation included finding potential locations for proposed check structures, completing a hydraulic analysis on specific channel reaches, and completing a seepage analysis on two sections of the Canal. For the seepage analysis, test pits were dug in the Canal to collect samples for sieve analysis and log the pits. A model was then created based on certain criteria from the local aquifer. Models were evaluated for three of the test pits and seepage rates were estimated. The three tests were Spring Gulch TP-1 (595 ac-ft/year/1000 feet), Spring Gulch TP-2 (153 ac-ft/year/1000 feet), and Nut Tree TP-1 (93 ac-ft/year/1000 feet).

In the winter of 2023, ACID lined five reaches of the Canal with geomembrane and shotcrete to reduce seepage loss and potential impacts from irrigation water to neighboring properties along these segments of the Canal. This lining type is estimated to reduce seepage by 95% (Baumgarten, 2019). These 5 reaches were near communities in the Anderson area along the Canal. In total, 0.6 miles of lining was installed. As of 2025, there is a total of approximately 2.6 miles of concrete lining in the Canal.

During ACID's 2024 winter shutdown period, a canal maintenance improvements and embankment compaction project was completed along two reaches of the Canal. The purpose of the canal maintenance was to improve access down the Canal and to reduce water loss from seepage by removing vegetation and trees along the Canal and by compacting the embankment top and side slopes. These reaches were located near Spring Gulch (Canal mile marker 13 to mile marker 14) and Panorama Point (Canal mile marker 18.5 - mile marker 20).

## 2 METHODS AND DATA SOURCES

### 2.1 MAIN CANAL STATIONING

The entire 35-mile Canal length was separated into 0.5-mile sections, and the seepage potential was evaluated in these segments. Stationing was created along the Canal alignment starting at the diversion fish screen near the Sacramento River and ending at Cottonwood Creek. Half mile reaches were created along the Canal to define the study area and aid in communicating locations of interest. Along with stationing along the Canal, the area analyzed extended 1000' in either direction perpendicular to the Canal. The alignment, stationing, and boundary of the analyzed area can be seen in [Appendix A](#) as well as [Table 2-1](#) below, which relates stations with physical landmarks.

Table 2-1. ACID Main Canal Stationing Related to Landmarks

| STATIONING RELATED TO LANDMARKS                               |              |             |
|---------------------------------------------------------------|--------------|-------------|
| LANDMARK                                                      | STATION (FT) | MILE MARKER |
| ACID Fish Screen                                              | 0            | 0           |
| Redding Memorial Park                                         | 2640         | 0.5         |
| Placer Street                                                 | 5280         | 1           |
| South Street                                                  | 7920         | 1.5         |
| Parkview Avenue                                               | 10560        | 2           |
| Ellis Street                                                  | 13200        | 2.5         |
| Rivella Vista Drive                                           | 15840        | 3           |
| North Side of Shasta Valley Public Health Building            | 18480        | 3.5         |
| End of Cerro Lane                                             | 21120        | 4           |
| Eastside Road                                                 | 23760        | 4.5         |
| Cedars Road                                                   | 26400        | 5           |
| Jewell Lane                                                   | 29040        | 5.5         |
| Paso Court                                                    | 31680        | 6           |
| Northwest of the Clear Creek Road and Evans Lane Intersection | 34320        | 6.5         |
| Clear Creek Road                                              | 36960        | 7           |
| End of Redding Rancheria Road                                 | 39600        | 7.5         |
| Intersection of Redbank Road and Canyon Road                  | 42240        | 8           |
| Southwest of Eastside Road and Metz Road                      | 44880        | 8.5         |
| Happy Valley Road                                             | 47520        | 9           |
| East of Sam Hill Drive Corner                                 | 50160        | 9.5         |
| Jessie Road                                                   | 52800        | 10          |
| Nut Tree Lane                                                 | 55440        | 10.5        |
| Private Bridge off Amen Street                                | 58080        | 11          |
| Abandoned Buildings Northwest of Rona Lane                    | 60720        | 11.5        |
| Dolores Avenue                                                | 63360        | 12          |
| Northwest of the B street and Anna Road Intersection          | 66000        | 12.5        |
| Spring Gulch Road                                             | 68640        | 13          |
| 90 Degree Corner of Fairwind Drive                            | 71280        | 13.5        |
| 3 <sup>rd</sup> Street                                        | 73920        | 14          |
| Diamond Street                                                | 76560        | 14.5        |
| Ferry Street                                                  | 79200        | 15          |

|                                                                     |        |      |
|---------------------------------------------------------------------|--------|------|
| Bruce Drive                                                         | 81840  | 15.5 |
| Drainage Crossing North of Pinon Avenue                             | 84480  | 16   |
| Arby Way                                                            | 87120  | 16.5 |
| ACID Main Canal Starts Paralleling Locust Road                      | 89760  | 17   |
| Locust Road                                                         | 92400  | 17.5 |
| Private Bridge over Main Canal                                      | 95040  | 18   |
| West of the Panorama Point Road and Austine Hoy Road Intersection   | 97680  | 18.5 |
| West of the Panorama Point Road and Lone Tree Road Intersection     | 100320 | 19   |
| West of the Panorama Point Road and Spoon Lane Intersection         | 102960 | 19.5 |
| West of the Panorama Point Road and Balls Ferry Road Intersection   | 105600 | 20   |
| Jim Dandy Drive                                                     | 108240 | 20.5 |
| Amberwood Mobile Park                                               | 110880 | 21   |
| West End of the Transformer Plant                                   | 113520 | 21.5 |
| Locus Street                                                        | 116160 | 22   |
| Interstate 5                                                        | 118800 | 22.5 |
| Rhonda Road                                                         | 121440 | 23   |
| West of the end of Della Lane                                       | 124080 | 23.5 |
| Private Bridge South of Gas Point Road                              | 126720 | 24   |
| Smith Bottom Road                                                   | 129360 | 24.5 |
| Margaret Lane                                                       | 132000 | 25   |
| David Way                                                           | 134640 | 25.5 |
| West of Miacarla Lane                                               | 137280 | 26   |
| Granola Way                                                         | 139920 | 26.5 |
| End of Denice Way                                                   | 142560 | 27   |
| End of Cottonwood Creek Siphon                                      | 145200 | 27.5 |
| Start of South Fork Cottonwood Creek Siphon                         | 147840 | 28   |
| Private Bridge North of Evergreen Road and Bowman Road Intersection | 150480 | 28.5 |
| Learning Way                                                        | 153120 | 29   |
| Amen Lane                                                           | 155760 | 29.5 |
| Bowman Road                                                         | 158400 | 30   |
| North of the Broadhurst Road and McCann Road Intersection           | 161040 | 30.5 |
| End of Daisy Court                                                  | 163680 | 31   |
| Floyd Lane                                                          | 166320 | 31.5 |
| Del Mar Drive                                                       | 168960 | 32   |
| Under the Main Transmission Lines                                   | 171600 | 32.5 |
| Lake California Drive                                               | 174240 | 33   |
| Paterson Creek Siphon                                               | 176880 | 33.5 |
| End of Patterson Creek Road                                         | 179520 | 34   |
| West of the End of Sawtooth Drive                                   | 182160 | 34.5 |
| The last drainage into the Canal                                    | 184800 | 35   |

## 2.2 DATA SOURCES

Five data sources were consulted for this Study, including soil saturated hydraulic conductivity, soil texture, evapotranspiration (for several years), and groundwater dependent ecosystems. Note that the Canal alignment passes through numerous soil types with descriptions such as very gravelly sand, very cobbly sand, extremely gravelly sand, etc., which are very coarse-grained soils and have very high saturated hydraulic conductivities. The areas with very high saturated hydraulic conductivity are associated with areas where stream and/or river channel deposits of the Sacramento River and the Olney, Clear, Anderson Olinda, and Anderson Creeks cross the Canal.

Excluded from the data analyzed were the geologic features that are within the District. Geologic features were not included in the analysis because there are not significant geologic differences along the Canal alignment and in the Churn Creek area, and any differences noted are already reflected in the specific soil data evaluated. Changes in geologic materials align closely with changes in soil types and with important natural features such as streams and drainages.

### 2.2.1 SOIL SATURATED HYDRAULIC CONDUCTIVITY

Saturated Hydraulic Conductivity (Ksat) data for the study area was collected from the Natural Resource Conservation Service (NRCS). With the assumption that the Canal was constructed from the native materials there should be a correlation between seepage loss potential and the published Ksat for soil in a specific area. Ksat refers to the ease with which pores in a saturated soil transmit water. Ksat is based on soil characteristics observed in the field, particularly structure, porosity, and texture. Ksat is typically a key consideration in the design of soil drainage systems and septic tank absorption fields. The soil structure along the Canal alignment is assumed to have been destroyed during the Canal construction excavation and compaction activities but based on the overall coarseness of the soils along the alignment, it is assumed that these soils probably retain some porosity. While the in-place Ksat is not known, the soil texture (coarse versus fine) is a primary factor of a soil's Ksat and, as a result, seepage loss potential. Soil Ksat rates can be seen in [Appendix B](#).

### 2.2.2 SOIL TEXTURE

Soil texture data for the study area was also collected from the NRCS. The use of soil texture data was also based on the assumption that the Canal was constructed from the native materials along the Canal alignment. Soil texture was used in this Study separately than soil Ksat to rate sections of the Canal by the texture class of the soil. Coarse textured soils contribute to seepage more than fine textured soils due to their inability to retain water or be sealed with compaction. Soil textures along the Canal within the 100' buffer can be seen in [Appendix B](#).

### 2.2.3 OPENET

OpenET is a publicly available database that produces estimates on real time evapotranspiration (ET) rates for most of California. ET is the combination of evaporation from the land and water surfaces and transpiration of water through plants. It is often used as a close approximate for consumptive water use. OpenET provides satellite-based estimates of evapotranspiration by combining data from multiple satellite-driven models and calculating a single ensembled value from those models. High measured ET values along the Canal indicate increased rates of consumptive use of water. If there are no intentional irrigation deliveries occurring in an area of high ET, then the consumptive use is likely supported by seepage from the Canal.



For this Study, the difference between Open ET from August of 2022 and August of 2024 were compared. The month of August was chosen because groundwater levels typically reach an annual low point due to the natural decline in groundwater levels (and potentially increased groundwater pumping) during the hot summer months. With lower groundwater levels, measured ET along the Canal would primarily be influenced from Canal seepage or intentional irrigation deliveries. August of 2022 was selected as the baseline year because ACID did not divert any water to the Canal that year due to drought driven supply curtailments. Therefore, measured ET rates in 2022 are independent from any Canal seepage that may occur when the Canal is in use. August of 2024 was selected because it was a very near average water year; ACID was allotted its full water supply, and the Canal was in use from April until October. A substantial difference in ET between 2022 and 2024 potentially indicates high seepage driven consumptive use of water along the Canal. OpenET data along the Canal can be seen in [Appendix B](#) for 2022 and 2024.

## 2.2.4 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater dependent ecosystems (GDE) are ecological communities that rely on shallow groundwater for their survival. The Enterprise Anderson Groundwater Sustainability Plan (GSP) used GDEs along with shallow groundwater to identify ecosystems that would be affected if groundwater levels decreased significantly. The GDEs are split into two categories: groundwater wetlands and groundwater vegetation. Groundwater wetlands were classified as areas that are commonly associated with the surface expression of groundwater. Groundwater vegetation was classified as areas where the vegetation types are commonly associated with the sub-surface presence of groundwater (phreatophytes).

Within the GSP, there is a defined shallow groundwater basin. This shallow groundwater basin has groundwater levels within 30' of the ground surface and follows along the Sacramento River as well as some of the larger creeks draining into the Sacramento River. GDEs that appear within the defined shallow groundwater basin receive their water supply from the natural shallow groundwater. GDEs located outside of the shallow groundwater basin are fed by other sources of water. These sources could include drainages, small creeks, or seepage from the Canal. GDEs that bordered the Canal were assumed to be fed by seepage from the Canal and not from naturally occurring shallow groundwater. GDEs along the Canal and surrounding area can be seen in [Appendix B](#).

## 2.2.5 SOIL AGRICULTURAL GROUNDWATER BANKING INDEX

The soil agricultural groundwater banking index (SAGBI) is a suitability index for groundwater recharge on agricultural land. SAGBI is based on five major factors that are critical to successful groundwater banking (recharge): deep percolation, root zone residence time, topography, chemical limitations, and soil surface conditions. SAGBI is classified as modified or unmodified SAGBI. Modified SAGBI is different from unmodified SAGBI by assuming that deep ripping has occurred causing the hard pan layers to be disrupted. For this Study, modified SAGBI was used along the Canal assuming that the excavation process while constructing the canal disrupted any existing hardpan horizon.

Based on an established rating scale of 0 to 100, a SAGBI rating of 0 is an area that is rated as very poor for groundwater recharge and a rating of 100 is an area that is rated as excellent for groundwater recharge. For this Study, it was assumed that the higher the SAGBI rating the more potential for seepage losses along the Canal. SAGBI ratings along the canal within the 1000' buffer can be seen in [Appendix B](#).

## 2.3 DATA COMPILATION AND MAPPING

To more easily identify the areas with the highest potential for seepage loss along the 35-mile Canal and compare the five different data sources, the data was compiled into a spreadsheet, given numerical

values, and placed in a scoring system. Each half mile reach was rated for soil texture, hydraulic conductivity, SAGBI, Open ET, and GDEs. The different data sources were then incorporated into a numeric scoring with values from 0 to 5. A ranking of 0 indicates low seepage probability, and a ranking of 5 indicates high seepage probability. The following list describes how each data sources were evaluated and developed into the seepage ranking for each half-mile reach of the Canal.

- **Soil Texture Data:** For each half-mile reach of the Canal, the most prominent soil texture was selected for inclusion in the ranking. Soil textures were then placed on a rating scale with fine grained soils scoring as 0 and coarse grained soils scoring as 5.
- **Saturated Hydraulic Conductivity:** For each half-mile reach along the Canal, a weighted average hydraulic conductivity was calculated. A low hydraulic conductivity scored 0 and a high hydraulic conductivity scored 5.
- **SAGBI:** As previously mentioned, SAGBI is rated from 0-100 with 0 being estimated to be poor and 100 being estimated good for groundwater recharge. For this analysis, it was assumed that a high SAGBI rating of the native soils indicates a high potential for seepage loss from the canal. A weighted average SAGBI value was calculated for each half mile section along the Canal and used for ranking criteria. A low average SAGBI value scored 0 and a high SAGBI value scored 5.
- **OpenET:** OpenET data was selected for August of 2022 and August of 2024, as discussed in [Section 2.2.3](#). The data was not numerical but was placed on a color scale ranging from 0 to 9.5 inches of ET. For each half-mile reach, the average ET value was visually estimated based on the color pallet along the Canal for that reach and used for scoring criteria. This was completed for both August of 2022 and August of 2024. The ET difference between the two dates was computed and placed on a rating scale of 0-5. A substantial difference in ET between August 2022 and August 2024 indicates ET driven by seepage from the Canal, and these areas were given a high score.
- **Groundwater Dependent Ecosystems:** Each reach was only given a ranking for GDEs if the GDE was along the edge of the Canal and did not appear to be directly associated with a natural drainage or creek. Areas that are within canal structures, such as flumes or siphons, were assumed to not support any GDEs from canal seepage and were not selected. GDEs adjacent to the Canal and not associated with a natural drainage were assumed to be, at least in part, supported by seepage from the Canal. A reach with a wetland or vegetation GDE was assigned a score of 3, and a reach with both a wetland and vegetation GDE was assigned a score of 5.

Each half-mile Canal reach was scored using the above five criteria. Scores for each of the criteria were combined to create an overall score between 0 to 5 for each half mile reach. If a reach was scored with 3 or greater, it was evaluated in more detail and identified as a reach with high potential of canal seepage loss.

## 2.4 CHURN CREEK AREA

The Churn Creek area is a secondary study area located on the east side of Interstate 5. This area is supplied with water pumped from the Sacramento River and into a system of ACID canals and laterals. The Churn Creek area can be seen in Figure A.2 – Churn Creek Bottom Area Overview map ([Appendix A](#)). The Churn Creek area was evaluated using the same data sources as were used along the Main Canal. However, rather than evaluating for seepage along a specific canal alignment, the evaluation was performed more generally for the area as a whole. Areas with higher seepage potential are shown on the surface soil texture, SAGBI, and Soil Ksat maps ([Appendix B](#)).

Open ET data was not used to evaluate potential seepage loss areas due to the inability to confidently differentiate ET between irrigated fields and seepage loss from the Churn Creek facilities. GDEs were evaluated for the Churn Creek area, but no GDEs were recorded outside of Churn Creek.

### 3 RESULTS

**Table 3-1** shows the individual criteria ranking and the overall weighted seepage potential score for each half-mile increment. Reaches that had an overall score greater than 3 are highlighted green. Each of these reaches were then closely evaluated to determine if other, site specific factors were causing scores of 3 or higher. An overall score of 3 was chosen as the cutoff as this value identified 8 to 10 reaches that show high seepage loss potential based on the data evaluated for this Study.

It should be noted that while the ranking system described above is helpful in identifying specific portions of the Canal that likely contribute most to water loss from seepage, the whole earthen canal system has water loss to one degree or another. The soils underlying much of the Canal are characterized as gravelly loam. Gravelly loam is a loam soil that has a considerable amount of rock fragments that affect the soil structure. Loam on its own is a balanced mix of sand, silt, and clay. This mix of soil types allows the soil to retain water while still draining well when saturated. When significant amounts of gravel are added to the soil the ability for the soil to drain or seep water is increased. In terms of seepage, the Canal's gravelly loam, while being better than sandy soils, will still have high seepage losses when compared to some finer grained soils.

Table 3-1. ACID Main Canal Ranking

| ACID MAIN CANAL RANKING        |                              |                                      |                              |                                       |                    |            |                                    |                                                                 |
|--------------------------------|------------------------------|--------------------------------------|------------------------------|---------------------------------------|--------------------|------------|------------------------------------|-----------------------------------------------------------------|
| AREA IDENTIFIER                |                              | AVERAGE<br>HYDRAULIC<br>CONDUCTIVITY | AVERAGE<br>MODIFIED<br>SAGBI | GROUNDWATER<br>DEPENDENT<br>ECOSYSTEM | SURFACE<br>TEXTURE | OPEN<br>ET | OVERALL<br>REACH<br>SCORE<br>(0-5) | NOTES                                                           |
| STARTING<br>STATION<br>(MILES) | ENDING<br>STATION<br>(MILES) |                                      |                              |                                       |                    |            |                                    |                                                                 |
| 0                              | 0.5                          | 0                                    | 0                            | 0                                     | 0                  | 0          | 0                                  |                                                                 |
| 0.5                            | 1                            | 5                                    | 5                            | 0                                     | 5                  | 1          | 3                                  | Reach A                                                         |
| 1                              | 1.5                          | 5                                    | 5                            | 0                                     | 5                  | 2          | 3                                  | Reach A                                                         |
| 1.5                            | 2                            | 2                                    | 5                            | 0                                     | 2                  | 3          | 3                                  |                                                                 |
| 2                              | 2.5                          | 1                                    | 3                            | 3                                     | 1                  | 2          | 3                                  | GDE is believed to be driven by the turnout not the ACID canal  |
| 2.5                            | 3                            | 0                                    | 3                            | 0                                     | 1                  | 3          | 2                                  |                                                                 |
| 3                              | 3.5                          | 0                                    | 3                            | 0                                     | 1                  | 3          | 2                                  |                                                                 |
| 3.5                            | 4                            | 1                                    | 3                            | 3                                     | 1                  | 3          | 3                                  | GDE is believed to be driven by the drainage not the ACID canal |
| 4                              | 4.5                          | 0                                    | 2                            | 0                                     | 1                  | 4          | 2                                  |                                                                 |
| 4.5                            | 5                            | 0                                    | 1                            | 0                                     | 1                  | 2          | 1                                  |                                                                 |
| 5                              | 5.5                          | 1                                    | 4                            | 3                                     | 4                  | 2          | 4                                  | GDE is believed to be driven by the drainage not the ACID canal |
| 5.5                            | 6                            | 0                                    | 2                            | 3                                     | 1                  | 3          | 2                                  |                                                                 |
| 6                              | 6.5                          | 1                                    | 3                            | 0                                     | 1                  | 1          | 1                                  |                                                                 |
| 6.5                            | 7                            | 3                                    | 2                            | 5                                     | 5                  | 4          | 5                                  | Reach B                                                         |
| 7                              | 7.5                          | 0                                    | 0                            | 0                                     | 0                  | 0          | 0                                  |                                                                 |
| 7.5                            | 8                            | 0                                    | 3                            | 0                                     | 2                  | 2          | 1                                  |                                                                 |
| 8                              | 8.5                          | 3                                    | 4                            | 5                                     | 4                  | 4          | 5                                  | Reach C                                                         |
| 8.5                            | 9                            | 0                                    | 0                            | 0                                     | 0                  | 0          | 0                                  | Concrete Lined                                                  |
| 9                              | 9.5                          | 0                                    | 2                            | 0                                     | 2                  | 3          | 2                                  | Concrete Lined                                                  |

|             |             |          |          |          |          |          |          |                                                                    |
|-------------|-------------|----------|----------|----------|----------|----------|----------|--------------------------------------------------------------------|
| 9.5         | 10          | 0        | 3        | 0        | 2        | 3        | 2        | Cleaned and Compacted                                              |
| 10          | 10.5        | 0        | 2        | 0        | 2        | 3        | 2        |                                                                    |
| 10.5        | 11          | 3        | 3        | 0        | 2        | 2        | 2        |                                                                    |
| <b>11</b>   | <b>11.5</b> | <b>1</b> | <b>1</b> | <b>3</b> | <b>2</b> | <b>4</b> | <b>3</b> | <b>Reach D</b>                                                     |
| 11.5        | 12          | 0        | 2        | 0        | 2        | 4        | 2        |                                                                    |
| 12          | 12.5        | 0        | 1        | 0        | 0        | 2        | 1        | Concrete Lined                                                     |
| 12.5        | 13          | 0        | 1        | 0        | 2        | 2        | 1        | Concrete Lined/Flume                                               |
| 13          | 13.5        | 5        | 1        | 0        | 2        | 0        | 2        | Cleaned and Compacted                                              |
| 13.5        | 14          | 3        | 5        | 0        | 4        | 4        | <b>4</b> | 450 ft reach that shows relatively high potential for seepage loss |
| 14          | 14.5        | 0        | 3        | 0        | 2        | 3        | 2        | Concrete Lined                                                     |
| 14.5        | 15          | 0        | 0        | 0        | 0        | 0        | 0        | Concrete Lined                                                     |
| 15          | 15.5        | 2        | 5        | 0        | 4        | 1        | 2        | Concrete Lined                                                     |
| 15.5        | 16          | 2        | 5        | 0        | 4        | 2        | <b>3</b> | Flume/Concrete Lined                                               |
| 16          | 16.5        | 0        | 3        | 0        | 2        | 1        | 1        |                                                                    |
| <b>16.5</b> | <b>17</b>   | <b>0</b> | <b>3</b> | <b>3</b> | <b>2</b> | <b>4</b> | <b>3</b> | <b>Reach E</b>                                                     |
| <b>17</b>   | <b>17.5</b> | <b>0</b> | <b>3</b> | <b>3</b> | <b>2</b> | <b>4</b> | <b>3</b> | <b>Reach E</b>                                                     |
| <b>17.5</b> | <b>18</b>   | <b>0</b> | <b>3</b> | <b>3</b> | <b>2</b> | <b>5</b> | <b>4</b> | <b>Reach E</b>                                                     |
| 18          | 18.5        | 0        | 3        | 3        | 2        | 4        | <b>3</b> | Cleaned and Compacted                                              |
| 18.5        | 19          | 0        | 3        | 0        | 2        | 4        | 2        | Cleaned and Compacted                                              |
| 19          | 19.5        | 0        | 3        | 3        | 2        | 3        | <b>3</b> | Cleaned and Compacted                                              |
| 19.5        | 20          | 0        | 3        | 3        | 2        | 4        | <b>3</b> | Cleaned and Compacted                                              |
| <b>20</b>   | <b>20.5</b> | <b>0</b> | <b>2</b> | <b>0</b> | <b>2</b> | <b>5</b> | <b>2</b> | <b>Reach F</b>                                                     |
| <b>20.5</b> | <b>21</b>   | <b>0</b> | <b>3</b> | <b>0</b> | <b>2</b> | <b>4</b> | <b>2</b> | <b>Reach F</b>                                                     |
| <b>21</b>   | <b>21.5</b> | <b>0</b> | <b>3</b> | <b>0</b> | <b>2</b> | <b>4</b> | <b>2</b> | <b>Reach F</b>                                                     |
| <b>21.5</b> | <b>22</b>   | <b>0</b> | <b>3</b> | <b>3</b> | <b>2</b> | <b>4</b> | <b>3</b> | <b>Reach F</b>                                                     |
| 22          | 22.5        | 0        | 2        | 0        | 2        | 2        | 1        |                                                                    |
| 22.5        | 23          | 0        | 2        | 0        | 2        | 1        | 1        |                                                                    |
| <b>23</b>   | <b>23.5</b> | <b>0</b> | <b>2</b> | <b>3</b> | <b>2</b> | <b>5</b> | <b>3</b> | <b>Reach G</b>                                                     |
| <b>23.5</b> | <b>24</b>   | <b>0</b> | <b>2</b> | <b>0</b> | <b>2</b> | <b>5</b> | <b>2</b> | <b>Reach G (near homes)</b>                                        |
| 24          | 24.5        | 0        | 2        | 0        | 2        | 4        | 2        |                                                                    |
| 24.5        | 25          | 0        | 2        | 0        | 2        | 3        | 2        |                                                                    |
| 25          | 25.5        | 0        | 2        | 0        | 2        | 5        | 2        |                                                                    |
| <b>25.5</b> | <b>26</b>   | <b>0</b> | <b>3</b> | <b>0</b> | <b>2</b> | <b>4</b> | <b>2</b> | <b>Reach H</b>                                                     |
| <b>26</b>   | <b>26.5</b> | <b>1</b> | <b>3</b> | <b>5</b> | <b>2</b> | <b>4</b> | <b>4</b> | <b>Reach H</b>                                                     |
| 26.5        | 27          | 1        | 4        | 0        | 2        | 1        | 2        |                                                                    |
| 27          | 27.5        | 0        | 0        | 0        | 0        | 0        | 0        |                                                                    |
| 27.5        | 28          | 0        | 3        | 0        | 2        | 3        | 2        |                                                                    |
| 28          | 28.5        | 0        | 0        | 0        | 0        | 0        | 0        |                                                                    |
| 28.5        | 29          | 0        | 4        | 0        | 2        | 4        | 2        |                                                                    |
| 29          | 29.5        | 0        | 3        | 0        | 1        | 2        | 1        |                                                                    |
| 29.5        | 30          | 1        | 4        | 0        | 1        | 4        | 2        | ET driven by nearby fields                                         |

|      |      |   |   |   |   |   |   |                            |
|------|------|---|---|---|---|---|---|----------------------------|
| 30   | 30.5 | 0 | 3 | 0 | 2 | 3 | 2 | ET driven by nearby fields |
| 30.5 | 31   | 0 | 2 | 0 | 2 | 2 | 1 |                            |
| 31   | 31.5 | 0 | 2 | 0 | 2 | 3 | 2 |                            |
| 31.5 | 32   | 2 | 3 | 0 | 2 | 2 | 2 | ET driven by nearby fields |
| 32   | 32.5 | 0 | 3 | 0 | 1 | 2 | 2 |                            |
| 32.5 | 33   | 0 | 3 | 0 | 1 | 1 | 1 |                            |
| 33   | 33.5 | 0 | 3 | 3 | 2 | 1 | 2 | ET driven by nearby fields |
| 33.5 | 34   | 0 | 4 | 0 | 2 | 2 | 2 | ET driven by nearby fields |
| 34   | 34.5 | 0 | 4 | 0 | 2 | 1 | 2 |                            |
| 34.5 | 35   | 0 | 4 | 3 | 2 | 2 | 3 | ET driven by nearby fields |

### 3.1 EXCLUDED REACHES

In [Table 3-1](#), there are a few reaches that have an overall score higher than 3 that, based on site specific information, were not identified as a canal reach with high seepage potential. These reaches were omitted as other factors, such as GDE's supported by natural drainages or structures, appear to be contributing to a high seepage score. Below is a list of areas that were excluded:

- *Mile Marker 2 – Mile Marker 2.5*
  - *GDE driven by turnout*
- *Mile Marker 3.5 - Mile Marker 4*
  - *GDE driven by natural drainage*
- *Mile Marker 5 - Mile Marker 5.5*
  - *GDE driven by natural drainage*
- *Mile Marker 13.5 - Mile Marker 14*
  - *Most of the reach completed in 2024 canal cleaning and compaction. Only 450' left of potentially high seepage.*
- *Mile Marker 34.5 - Mile Marker 35*
  - *End of canal*

### 3.2 APPARENT HIGHEST SEEPAGE POTENTIAL REACHES

The reaches selected for further evaluation scored 3 or higher and by and large showed the highest seepage potential. The individual scoring criteria can be seen in [Appendix D](#) as well as [Table 3-1](#). Each reach that has been selected for more detailed evaluation has an assumed highest seepage potential and individual maps were prepared that show the soil types and the difference between ET for August 2022 and ET for August 2024.

Note that a majority of the District's Canal alignment has gravelly loam soils with moderately high hydraulic conductivity. Since this is the average soil texture and hydraulic conductivity, these soils do not score as high for potential for seepage loss as areas with high to very high Ksat. This does not mean that there is not the potential for high seepage loss within areas with gravelly loam; rather, there is simply a higher potential for seepage loss with other more coarse soils.

#### 3.2.1 REACH A (MILE MARKER 0.5 – MILE MARKER 1.5)

Reach A is located in Redding, CA and begins at the canal tunnel outlet and continues about one mile down the Canal to Locust Street. Reach A scored very high in hydraulic conductivity, very high in SAGBI, and has very coarse grained soils (very cobble sand). There is not a significant difference between the ET

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in 2022 compared to 2024, likely because this section of the Canal is within the City of Redding with minimal vegetation present. The soils are coarse and have high permeability. See [Appendix D](#) for a map showing Reach A.

### **3.2.2 REACH B (MILE MARKER 6.5 – MILE MARKER 7)**

Reach B is located north of Clear Creek, beginning at mile marker 6.5 and ending at the siphon inlet along Clear Creek Road. Reach B scored high in hydraulic conductivity, has both wetland GDEs and vegetation GDEs, and has a significant difference in ET between 2022 and 2024. The soil type for Reach B is predominantly loam soil that has a relatively fine texture and a moderately low SAGBI score. The low SAGBI score is most likely due to the shallow groundwater levels inhibiting deep percolation, one of the criteria SAGBI is based on. This reach has also been previously identified by the District as possibly having high seepage loss from the Canal.

Reach B is also located adjacent to a gravel quarry and a private groundwater fed pond. To better understand the relationship of groundwater with these ponds and the Canal, an elevation survey was completed in April 2025 measuring relative differences between water surface elevations both in the Canal and in the neighboring ponds. This survey was performed prior to any irrigation diversions into the Canal for this year (see [Appendix C](#) for a map depicting the two neighboring ponds and the Canal). In April 2025, the water level in the adjacent ponds was at a higher elevation than the standing water in the Canal bottom. This indicates that during the winter, groundwater is likely seeping into the Canal. It is recommended that a second elevation survey be performed after the Canal is full to determine if the Canal continues to be influenced by groundwater or if the irrigation water in the Canal contributes to groundwater. The relationship between irrigation water in the Canal and the groundwater table is an important factor in seepage loss from the Canal and would inform future system improvements to reduce seepage.

See [Appendix D](#) for a map showing Reach B.

### **3.2.3 REACH C (MILE MARKER 8 – MILE MARKER 8.5)**

Reach C begins at Canyon Road and ends at the existing concrete lining along Highway 273. Reach C crosses a natural drainage which is intersected by the Canal. Reach C scored high in hydraulic conductivity, high in SAGBI, high in surface texture (very cobbly sand and gravelly sandy loam), high in Open ET, and has both wetland GDEs and vegetation GDEs. This reach is believed to cause water surfacing in a historical drainage that flows down into the Sacramento River. See [Appendix D](#) for a map showing Reach C.

### **3.2.4 REACH D (MILE MARKER 11 – MILE MARKER 11.5)**

Reach D begins at a private bridge along Amen Street and ends where existing concrete lining begins adjacent to Dolores Avenue. The downstream portion of Reach D was considered for concrete lining in 2023, but the lining was not constructed due to high costs and no direct proximity to a residential or commercial development. Reach D had a significant difference in ET between 2022 and 2024 and has a wetland GDE directly adjacent to the Canal. Reach D had gravelly loam soils, moderately high hydraulic conductivity, and moderately poor SAGBI ratings. See [Appendix D](#) for a map showing Reach D.

### **3.2.5 REACH E (MILE MARKER 16.5 – MILE MARKER 17.5)**

Reach E begins at South Barney Road and ends at the upstream limits of the 2024 canal maintenance and compaction project near Panorama Point. Reach E continues adjacent to the railroad corridor for the

entirety of the reach. Reach E scored high in SAGBI, had multiple wetland GDEs, and had a very significant difference in ET between 2022 and 2024. The soil texture is gravelly loam with moderately high hydraulic conductivity. See [Appendix D](#) for a map showing Reach E.

### 3.2.6 REACH F (MILE MARKER 20 – MILE MARKER 22)

Reach F begins where the 2024 canal maintenance and compaction project ended at Panorama Point in 2024 and ends at Locust Street. The reach is adjacent to an existing PG&E substation. Reach F scored high in SAGBI, has a wetland GDE, and had a very apparent difference in ET between 2022 and 2024. The soil texture is gravelly loam and has a moderately high hydraulic conductivity. This section did not rate a 3 or higher for all of the half-mile increments but is a concern of the District and has shown significant signs of seepage losses in the past. See [Appendix D](#) for a map showing Reach F.

### 3.2.7 REACH G (MILE MARKER 23 – MILE MARKER 24)

Reach G begins after the existing canal siphon below the natural drainage next to Phonda Road and ends at Gas Point Road. Reach G had a very significant difference in ET between 2022 and 2024. The soil type is gravelly loam, has moderately poor SAGBI rating, and has a moderately high hydraulic conductivity. This section has been evaluated in the past for concrete canal lining, though it was not completed.

There is an existing groundwater monitoring well adjacent to this portion of the Canal. The monitoring well has five separate casings with varying screen depths to facilitate monitoring groundwater levels at various depths. For this evaluation, the shallowest monitoring well was evaluated with screen depths ranging from 40-60' from the ground surface. In normal and dry years, the groundwater declines through the District's winter shut off period (October-April) and rises through the District's irrigation season (April-October). During wet years the groundwater levels rise to around 430' during the winter and are maintained throughout the year until the District shuts off in October. The historical groundwater monitoring data of the shallow aquifer further supports the soil class and ET data used to understand the Canal's water loss from seepage. There is a direct correlation between shallow groundwater levels and Canal operations.

[Figure 3-1](#) shows the groundwater data for the period of record. Within the boxes (April-October) is ACID's typical operating period. Red boxes are extremely dry years, blue boxes are very wet years, and green boxes are close to average years. During 2022, ACID did not run its Canal, and it was an extreme drought year.



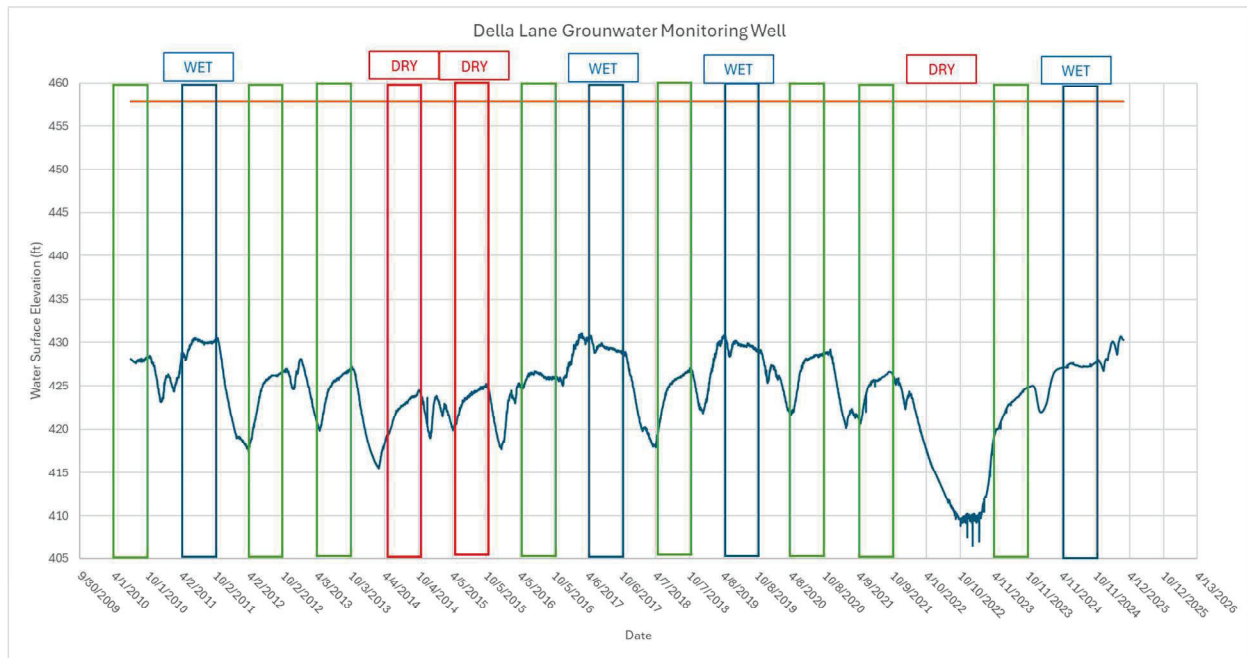


Figure 3-1. Della Lane Grounwater Monitoring Well

The monitoring well includes additional casings that range in depth up to 200' below ground surface elevation. Groundwater levels in these deeper casings do not appear to show fluctuations related to seepage for the Canal. There is data available from June 30<sup>th</sup>, 2010, through March 10<sup>th</sup>, 2025.

See [Appendix D](#) for a map showing Reach G.

### 3.2.8 REACH H (MILE MARKER 25.5 – MILE MARKER 26.5)

Reach H starts at David Way and ends at Granola Way. Reach H crosses a natural drainage that has coarse soils. Reach H scored high in SAGBI, had a very significant difference in ET between 2022 and 2024, and has both wetland GDEs and vegetation GDEs. The predominate soil texture for Reach H is gravelly loam, and most of the reach has moderately high hydraulic conductivity with a few areas with high hydraulic conductivity. This section did not rate higher than a 3 for all of Mile Marker 25.5 – Mile Marker 26 but was extended to David Way to catch the significant ET areas that do not appear to be supported by intentional irrigation. See [Appendix D](#) for a map showing Reach H.

## 3.3 CHURN CREEK AREA

The Churn Creek area primarily consists of loam or gravelly loam soil. See [Appendix B](#) for Churn Creek area soils map. Loam and gravelly loam soils typically have a moderately high hydraulic conductivity. Most of the Churn Creek area has a SAGBI rating of “moderately poor” to “moderately good”. Earthen canals and laterals throughout this portion of the Churn Creek area will have some water loss from seepage of similar magnitude of the Canal alignment.

However, the western portion of the Churn Creek area, which lies between the Interstate 5 corridor and the Sacramento River, consists of coarse grained soils that are consistent with river alluvial deposits such as cobbly sand and gravelly sandy loam. These soils have high hydraulic conductivity characteristics and have good or excellent SAGBI rating for groundwater recharge potential (refer to [Appendix B](#) for maps of



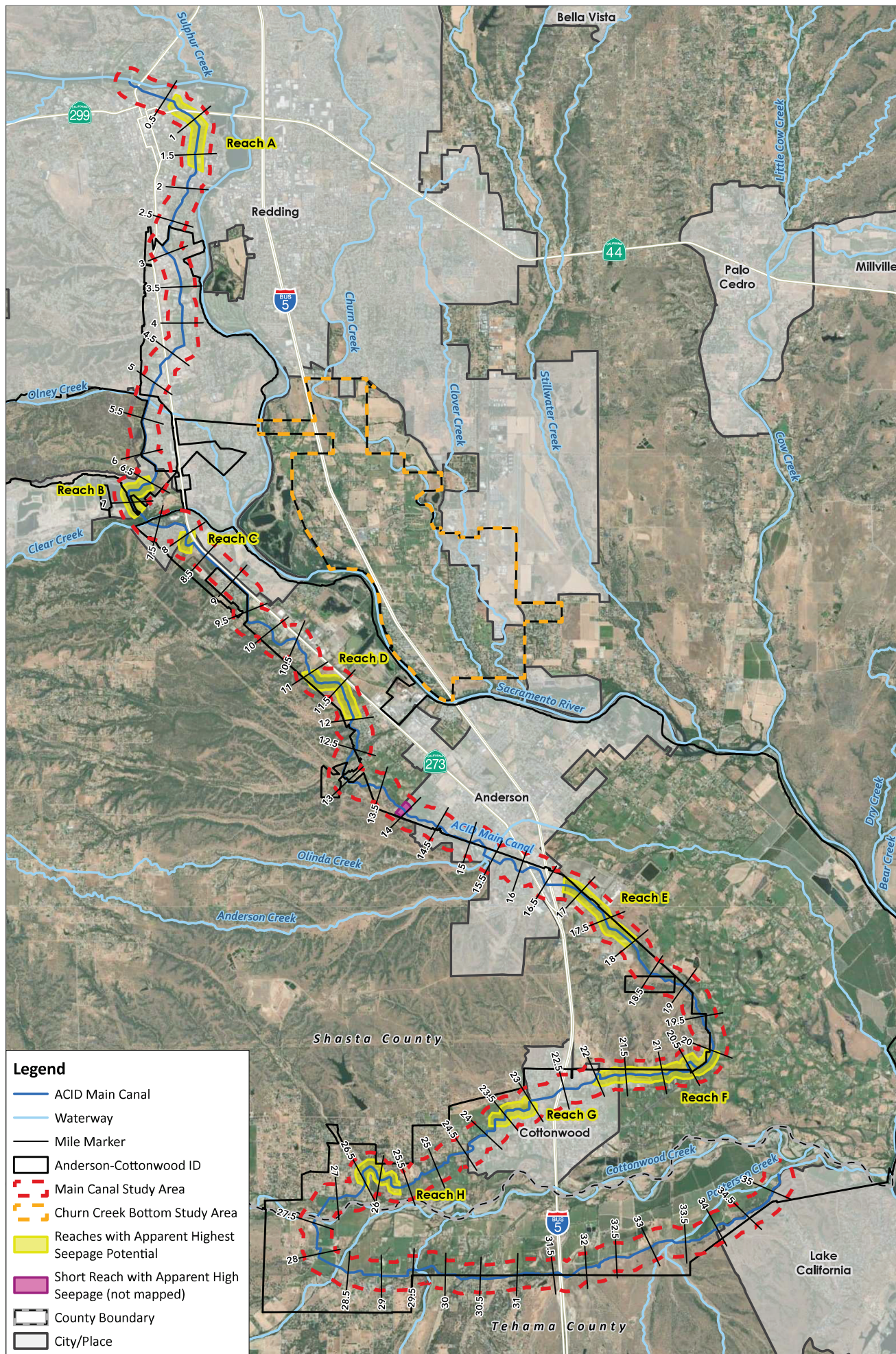
the Churn Creek area). It is expected that open channel irrigation conveyance facilities in this portion of the Churn Creek service area will have significant water loss due to seepage.

## 4 REFERENCES

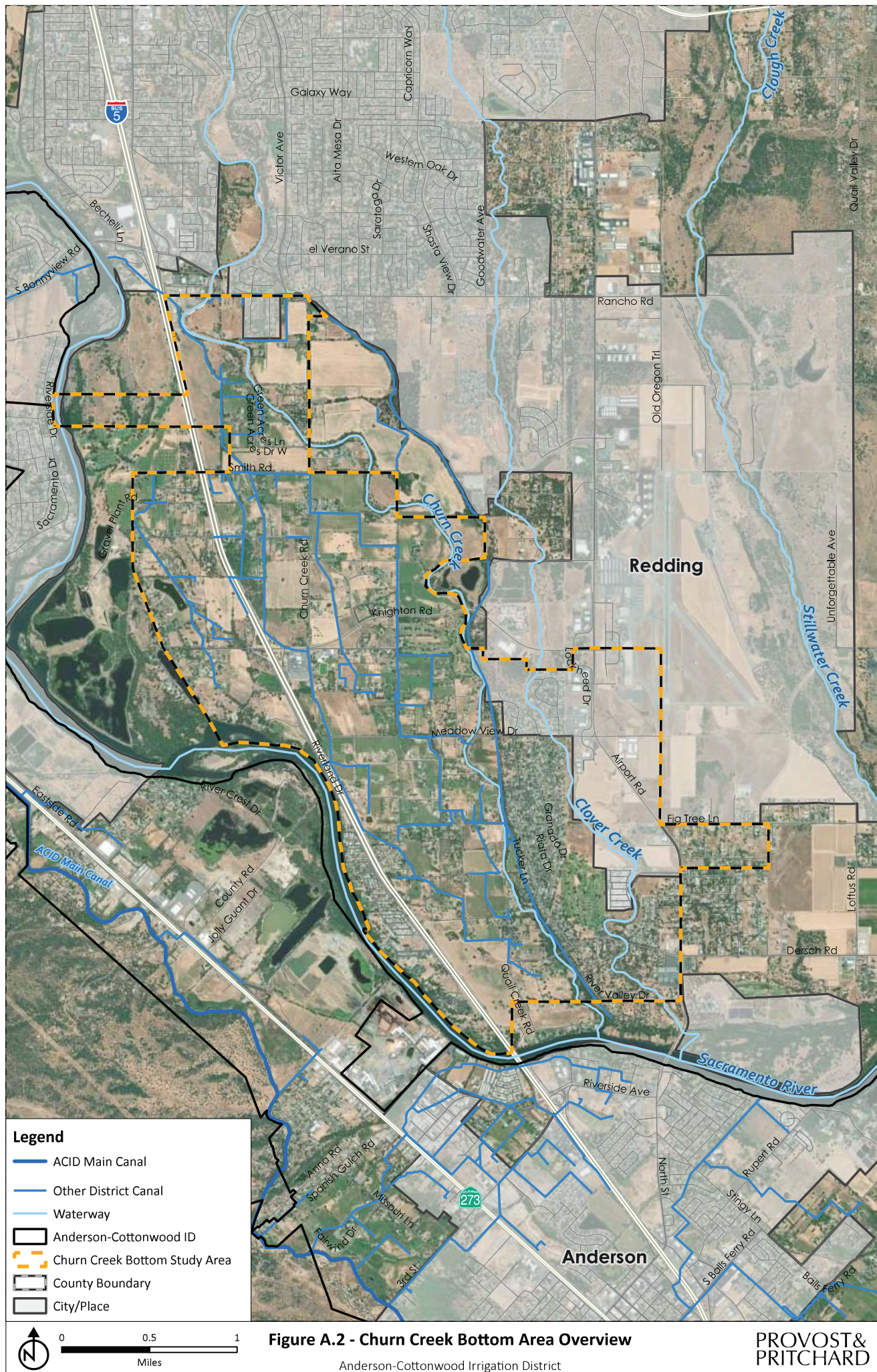
- Anderson-Cottonwood Irrigation District. (2025, 04). About Anderson-Cottonwood Irrigation District. Retrieved from Anderson-Cottonwood Irrigation District:  
<https://www.andersoncottonwoodirrigationdistrict.org/about/>
- Baumgarten, B. (2019). Canal Lining Demonstration Project - Year 25 Durability Report. Denver: U.S. Department of the Interior.

## **APPENDIX A**



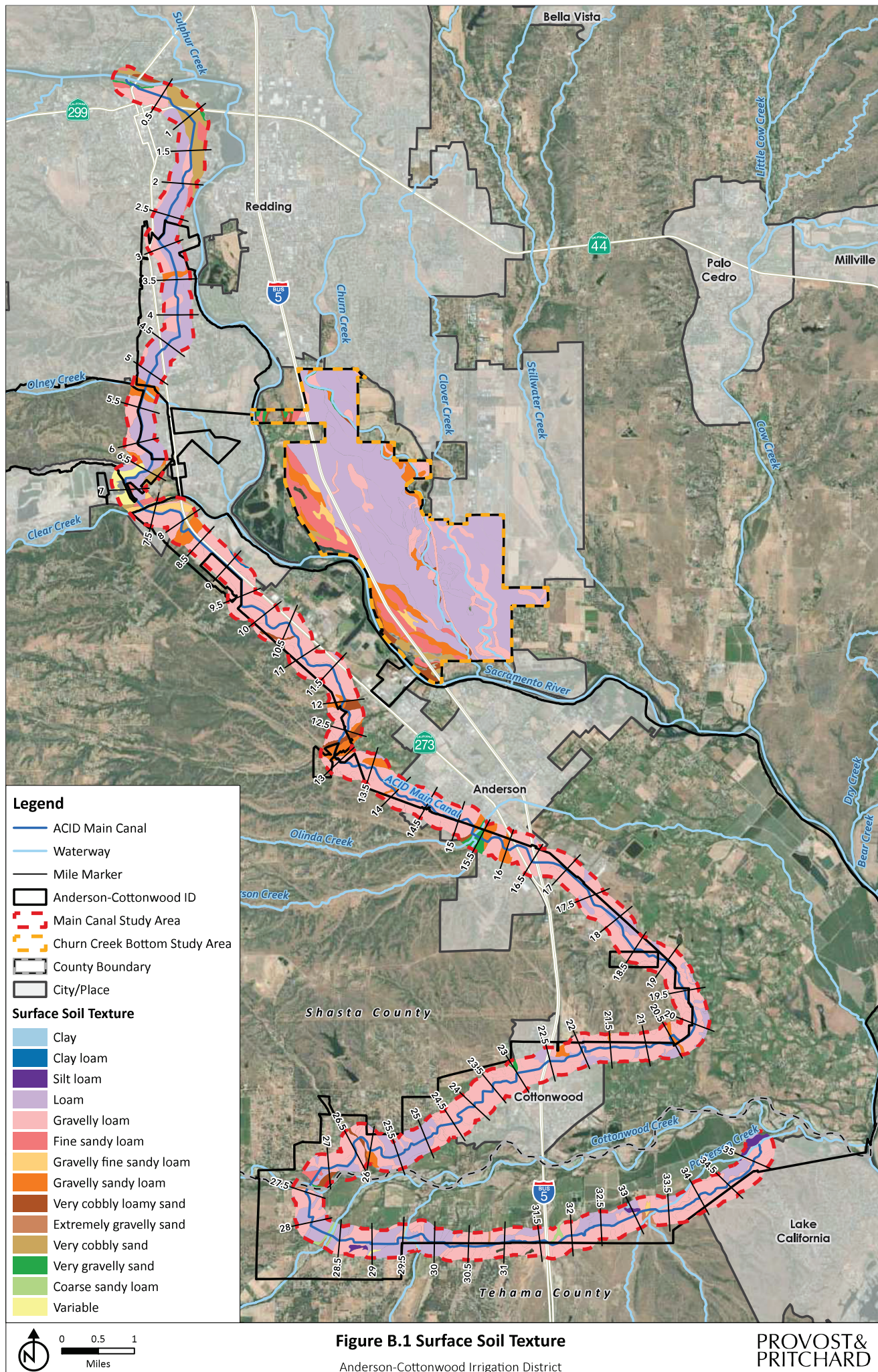




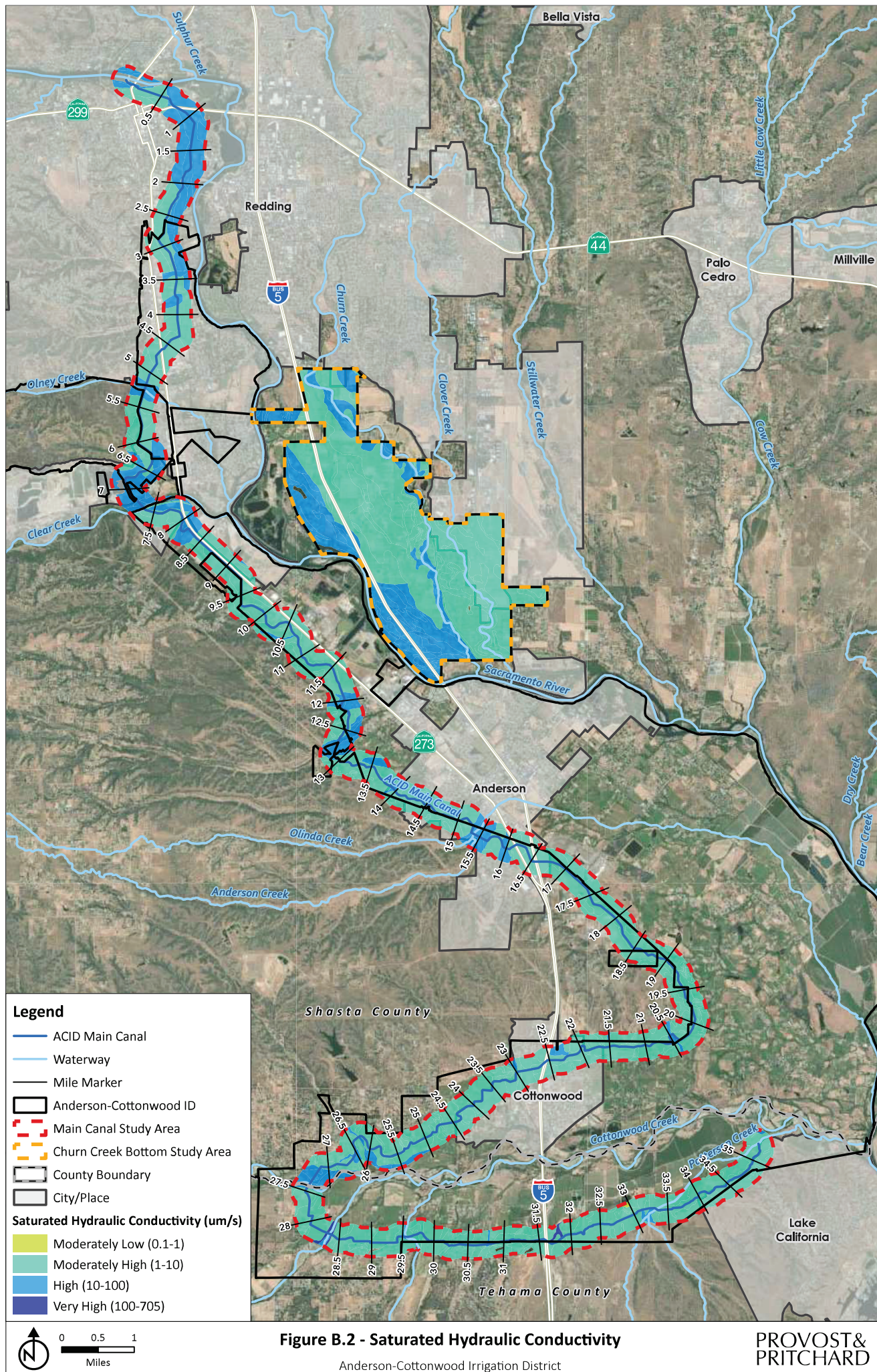




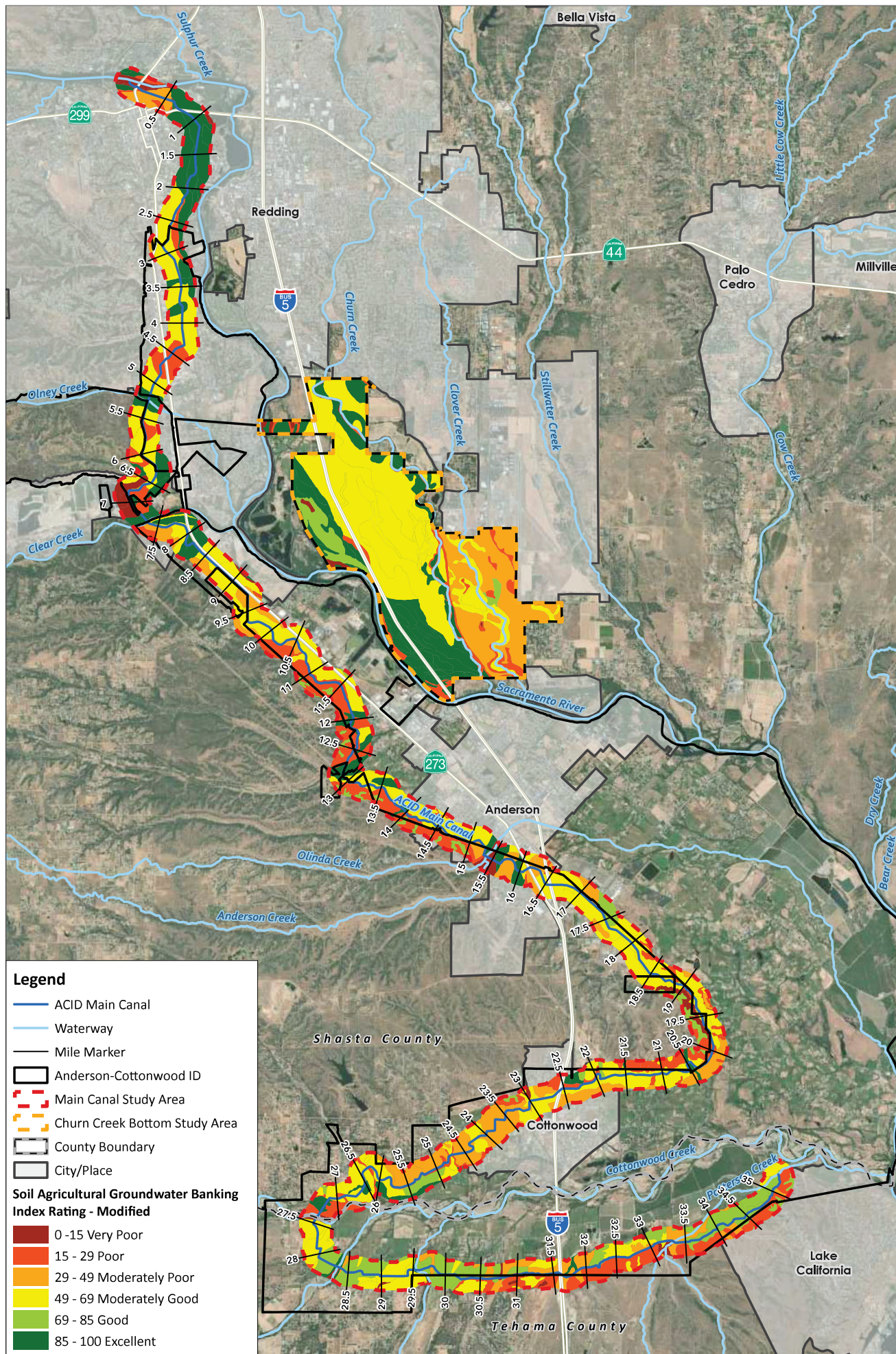
## **APPENDIX B**



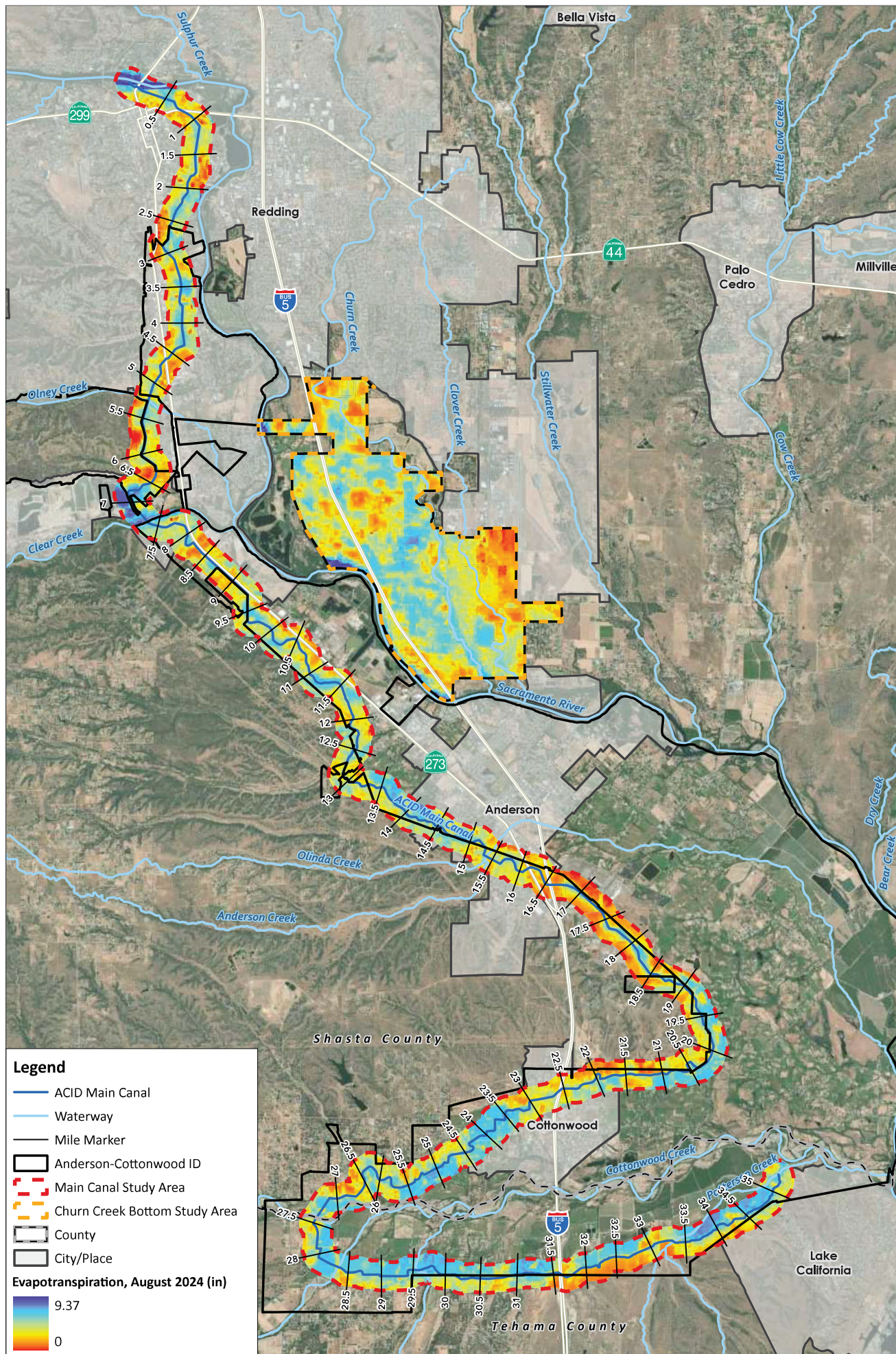




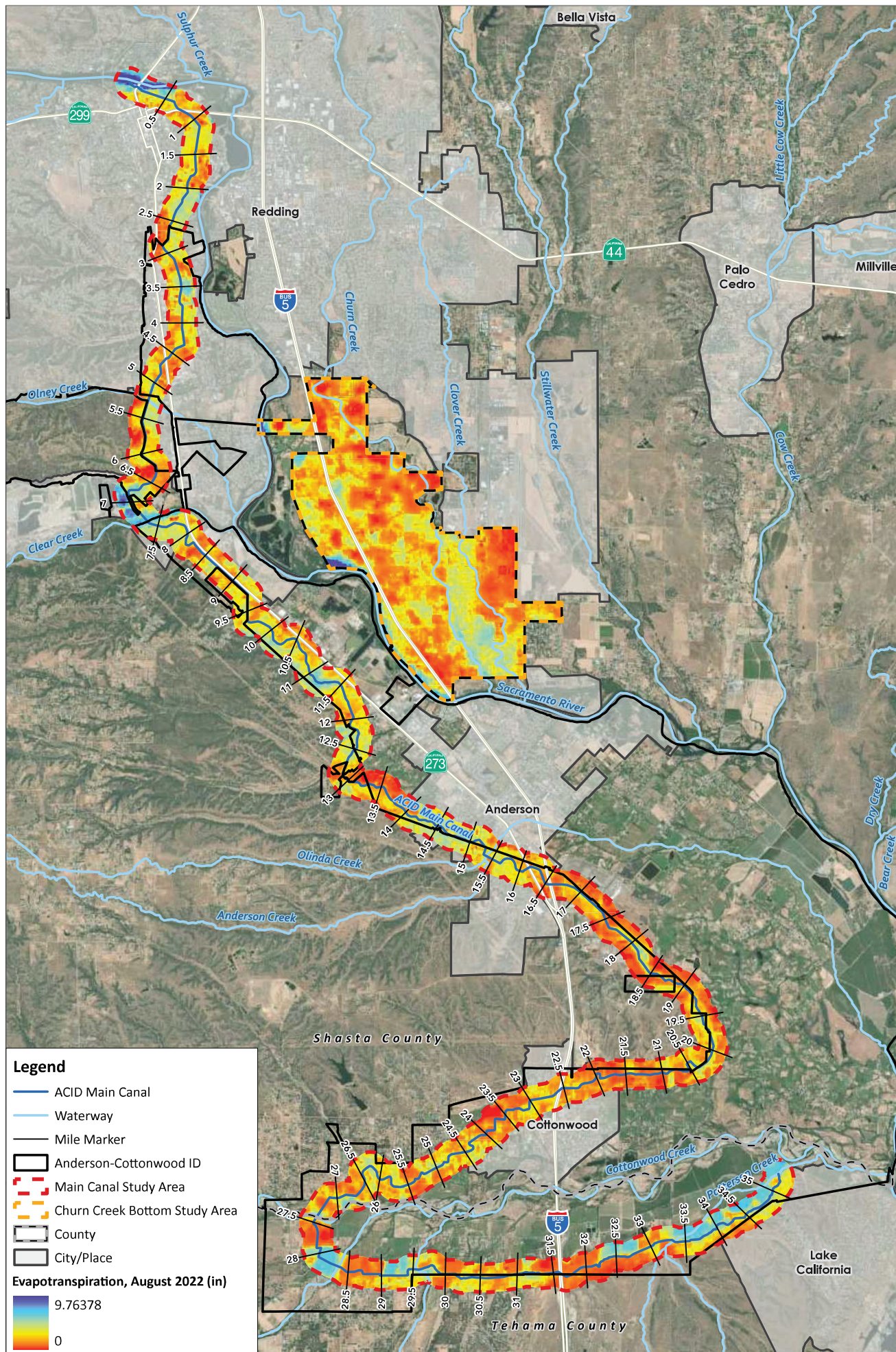




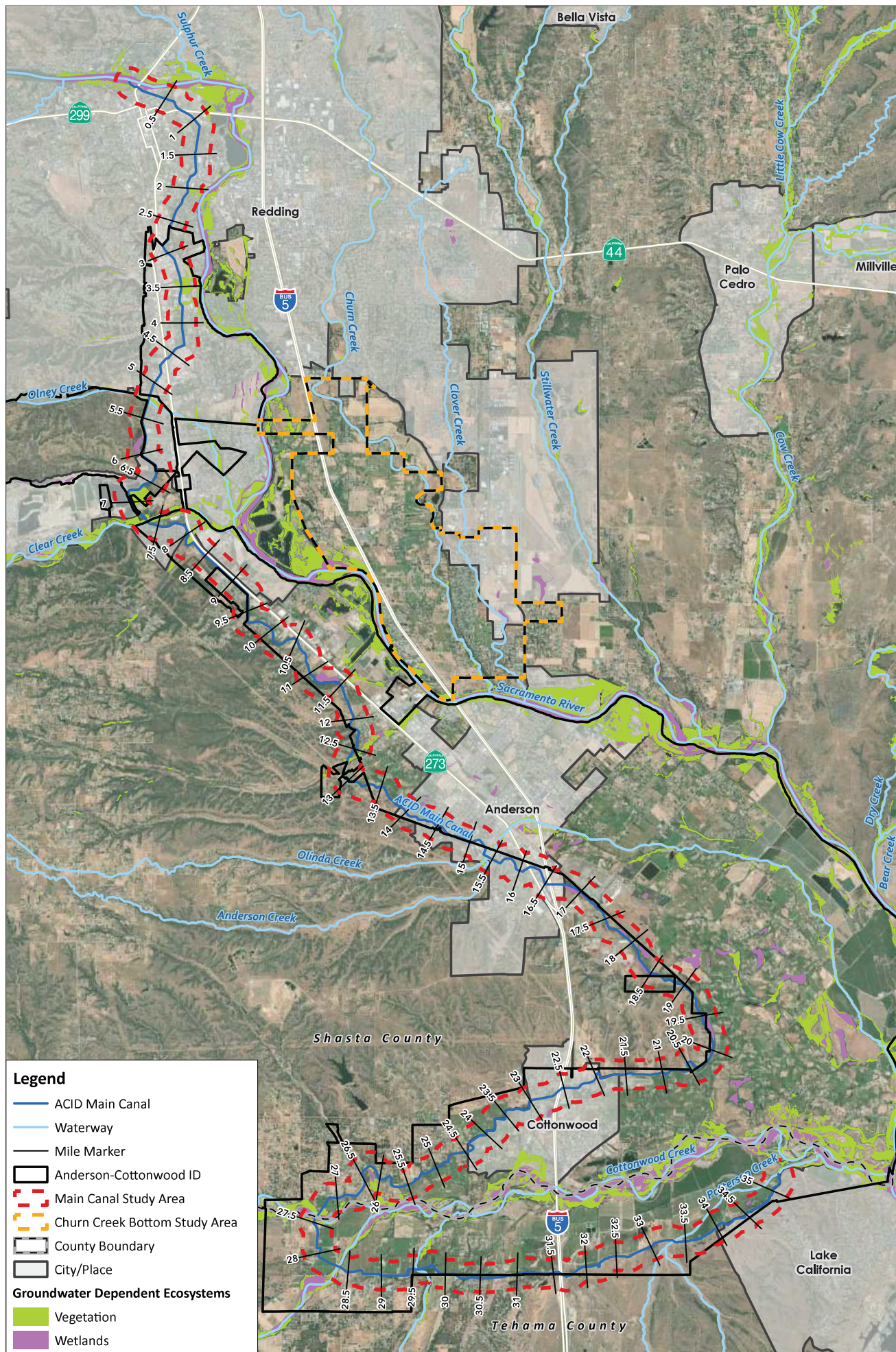










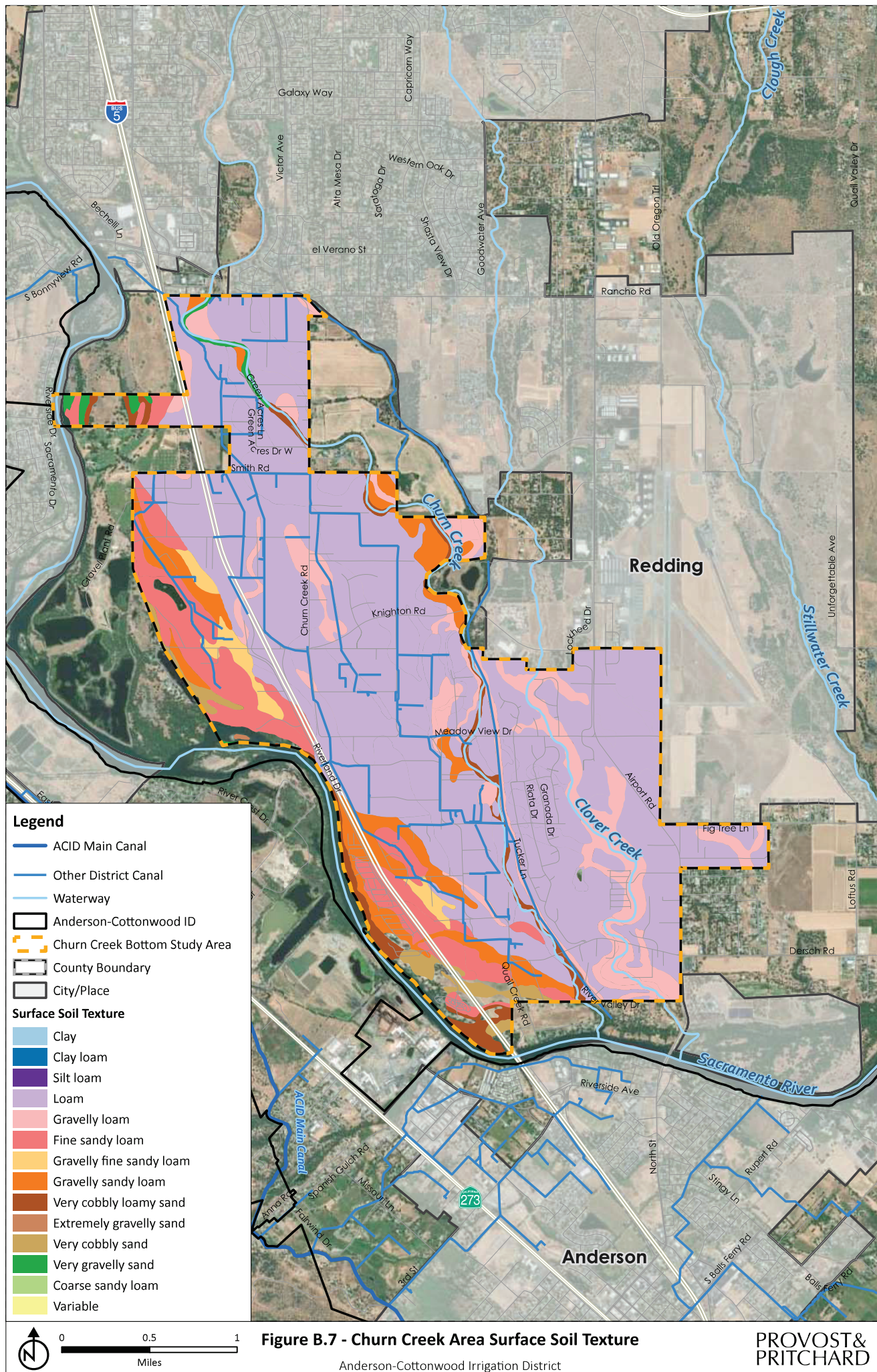


**Figure B.6 - Groundwater Dependent Ecosystems**

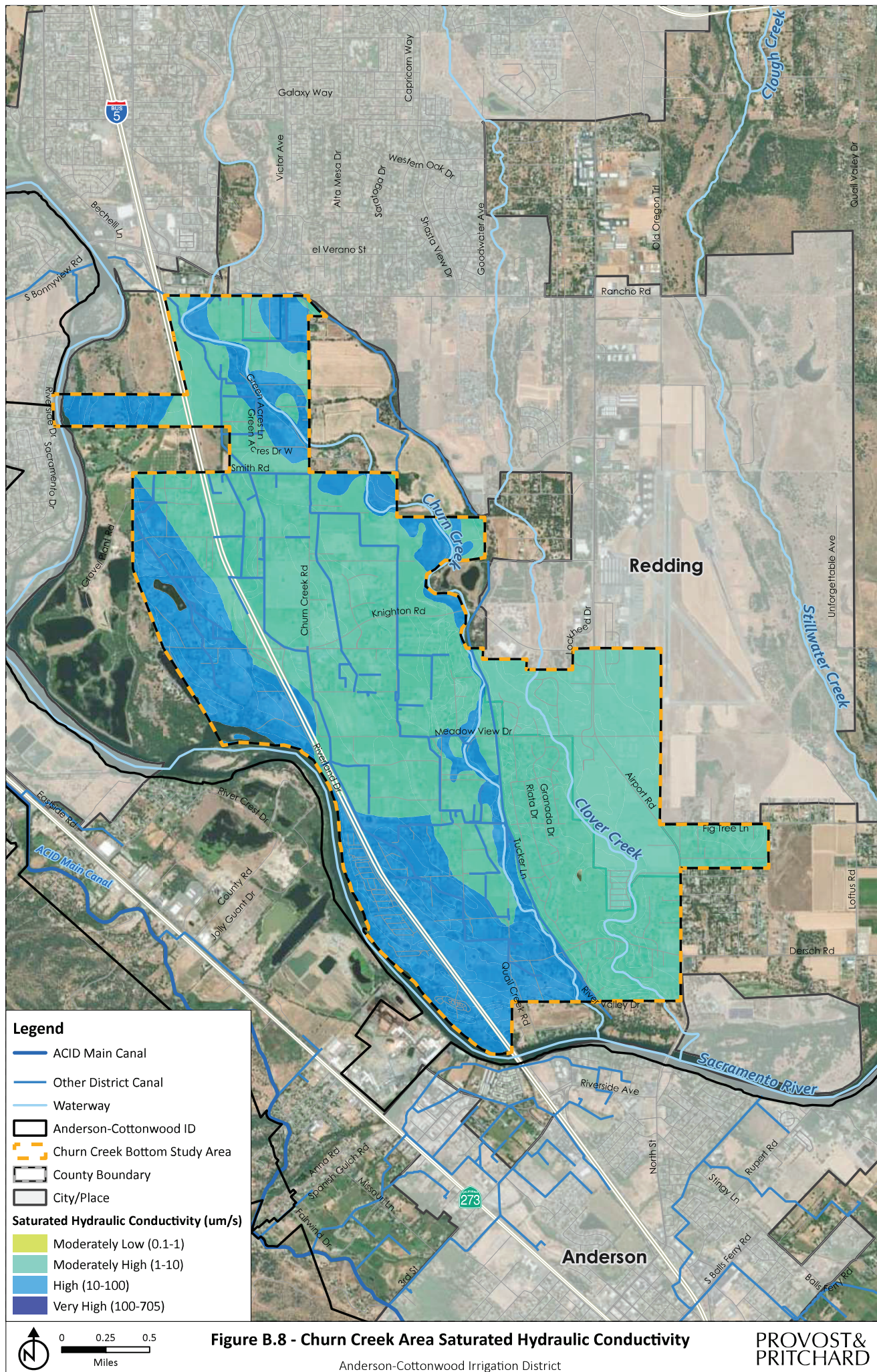
Anderson-Cottonwood Irrigation District

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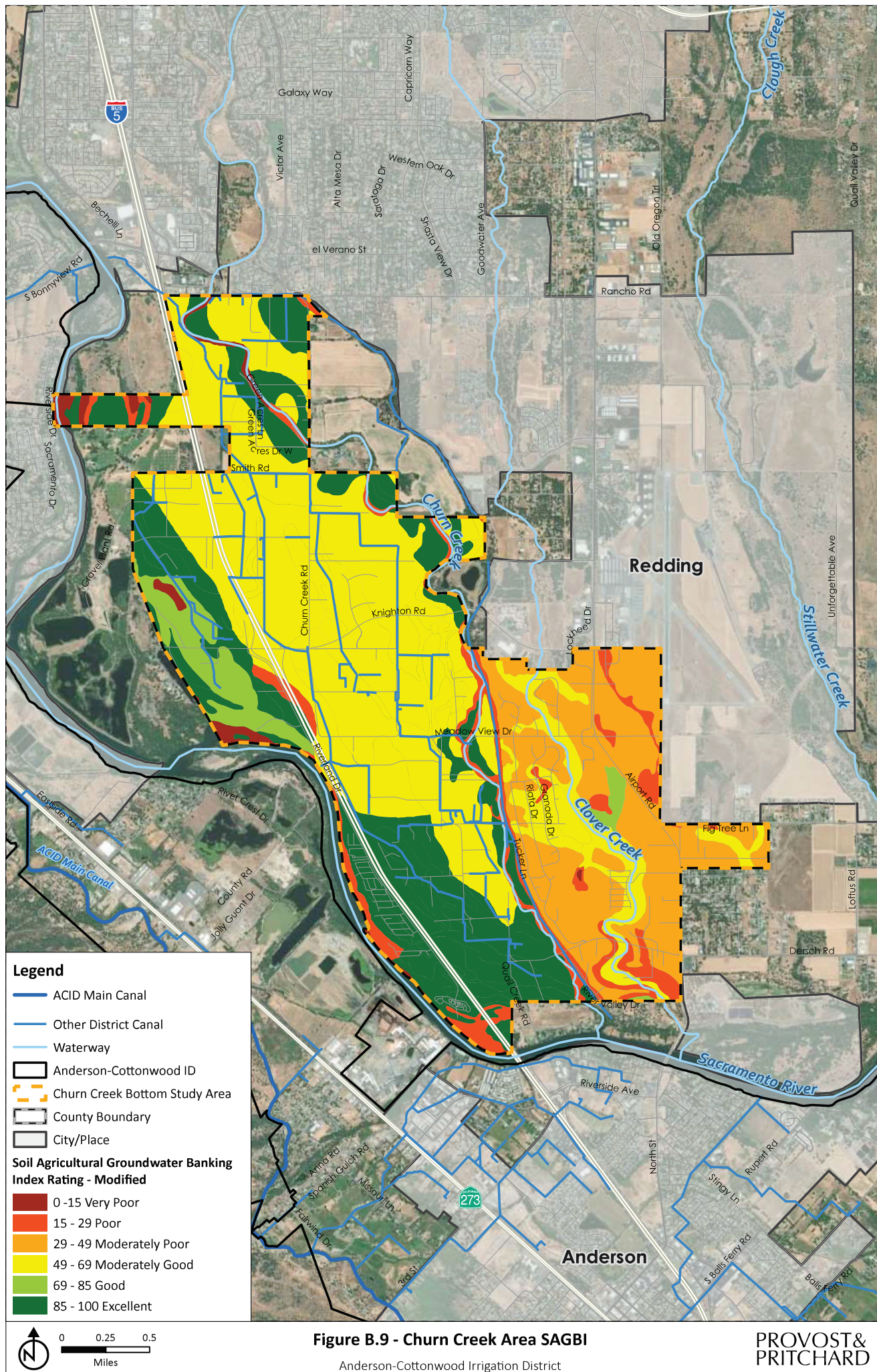












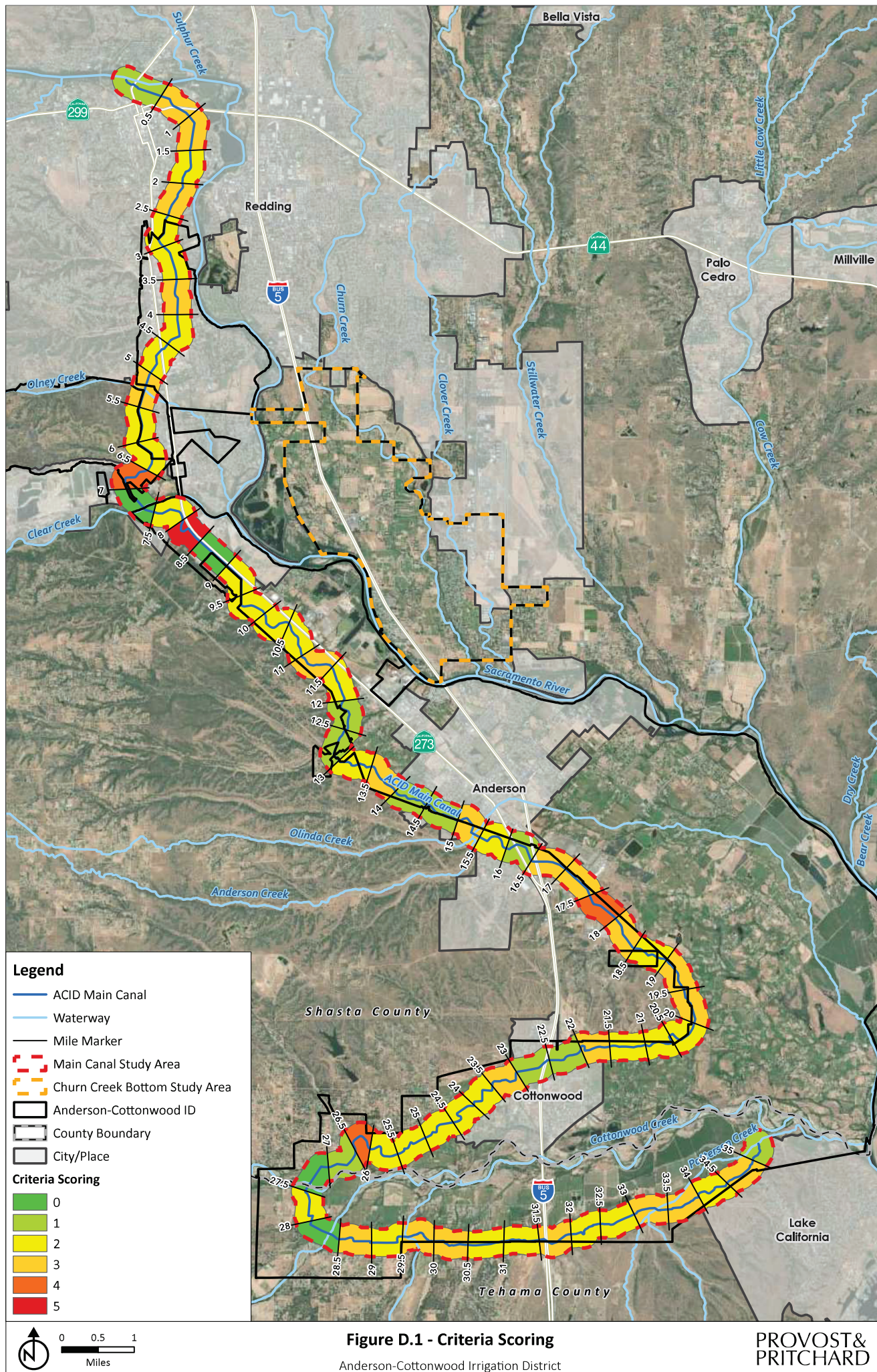


## APPENDIX C

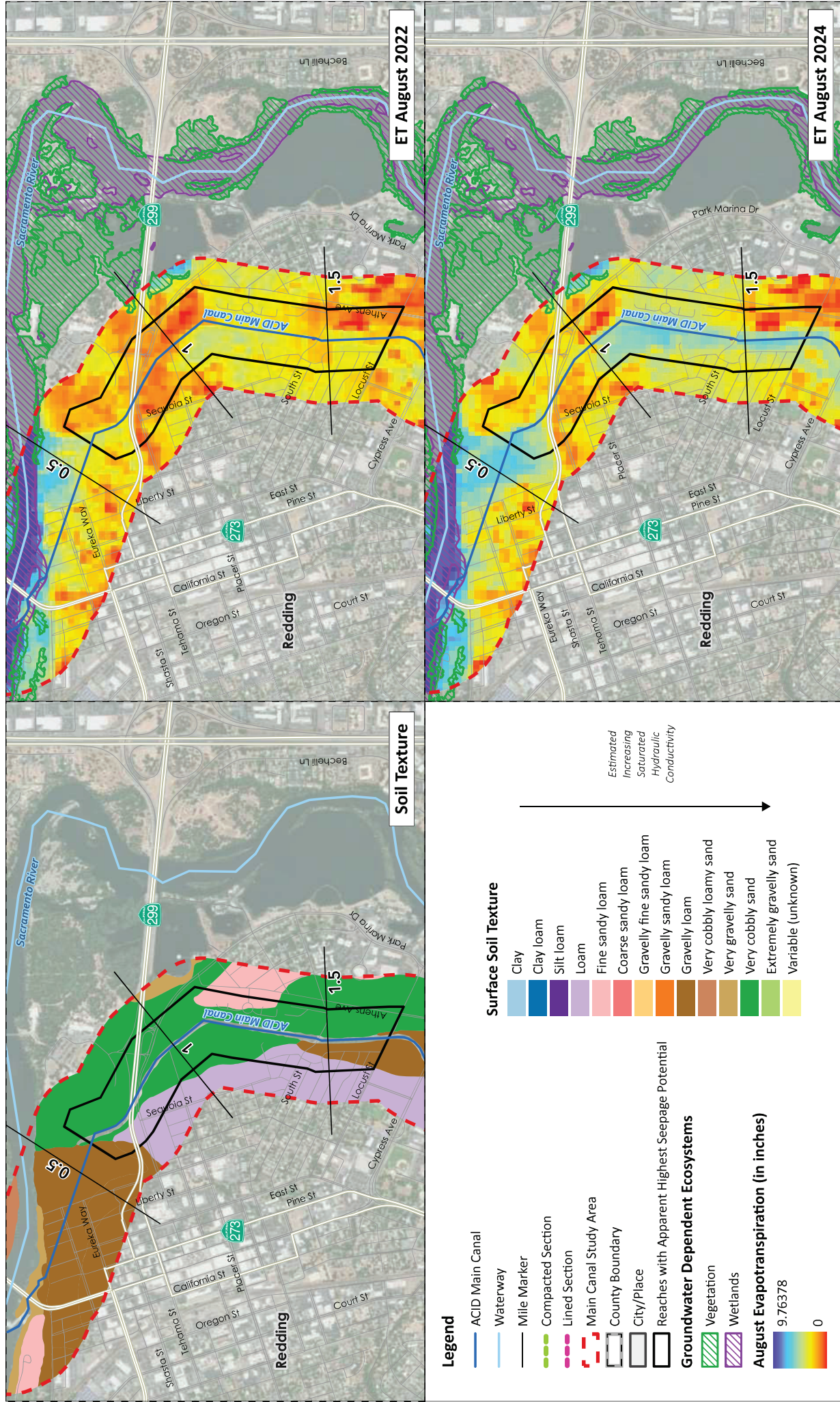




## APPENDIX D





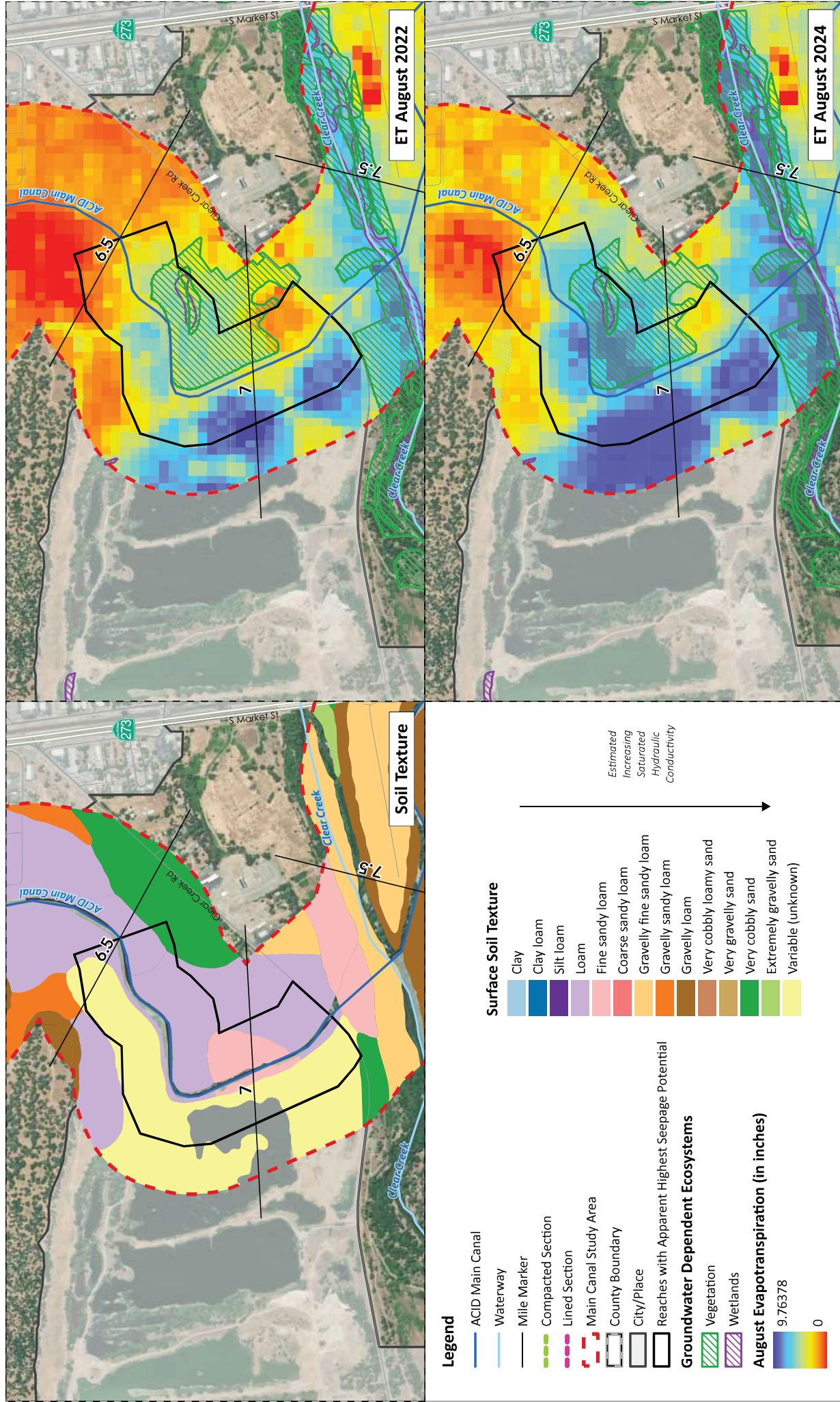


**Figure D.2 - Reach A**

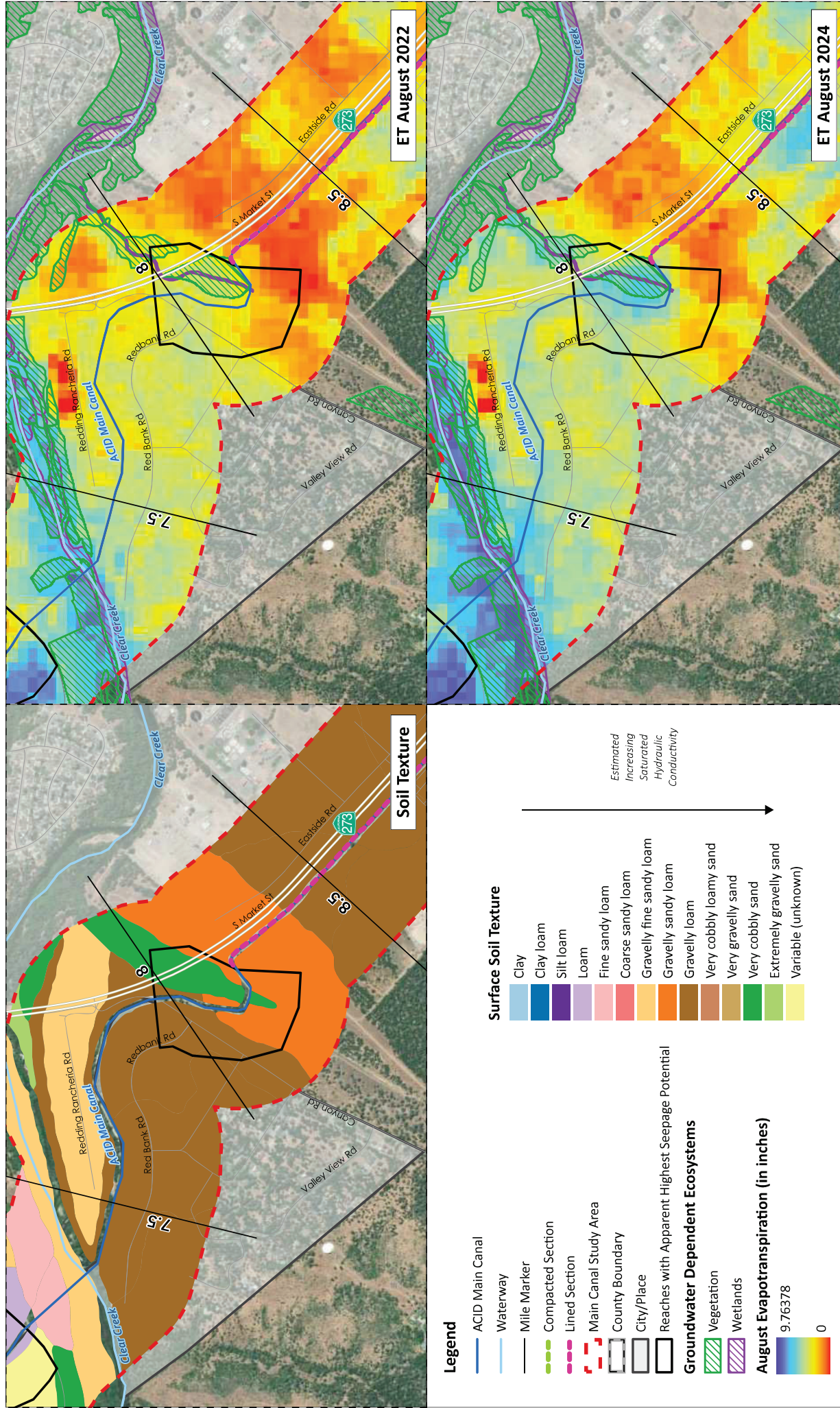
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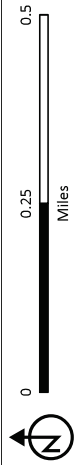
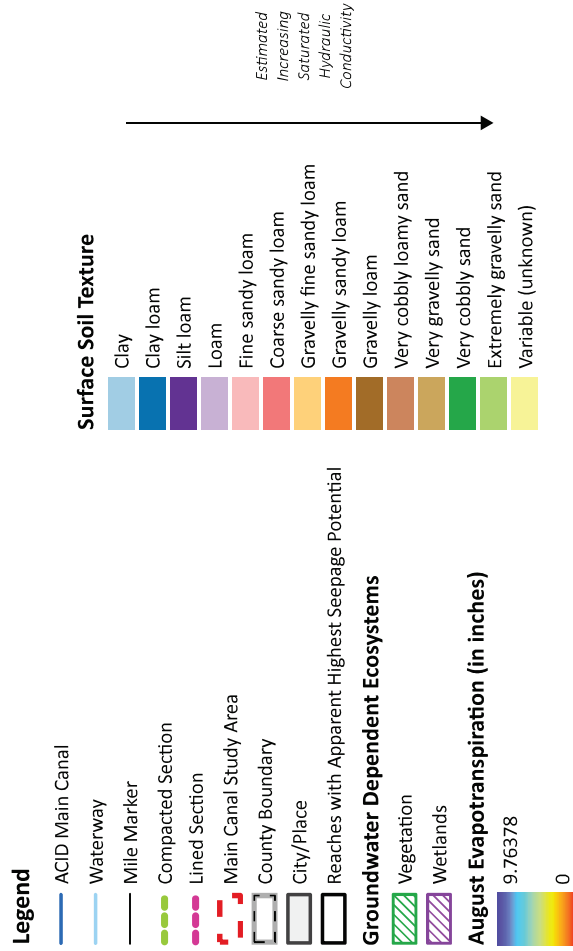
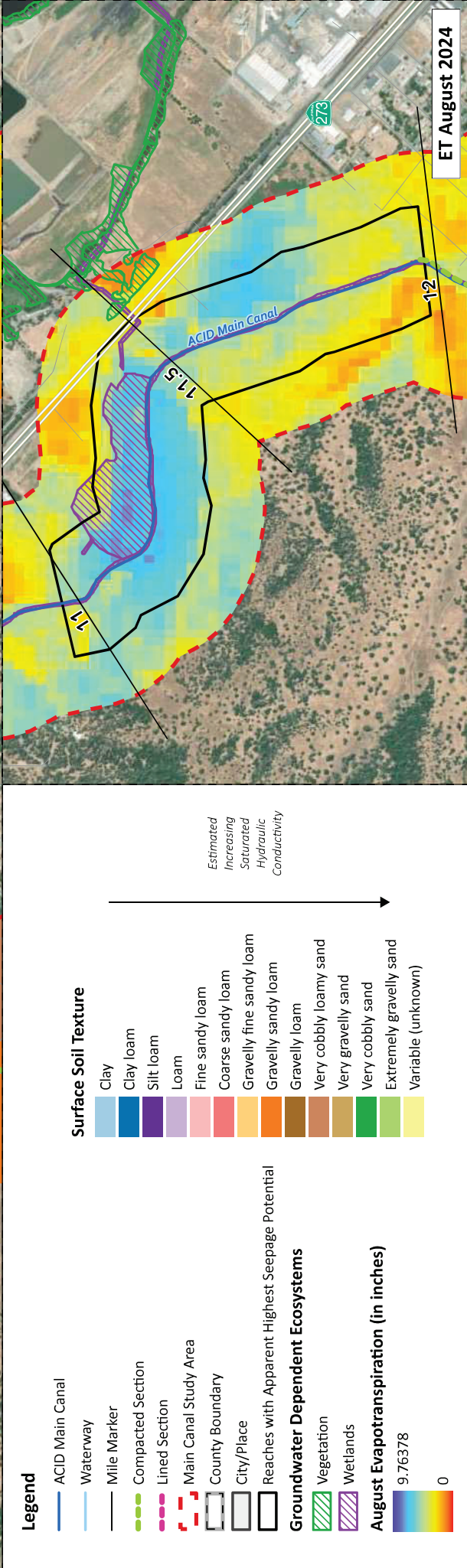
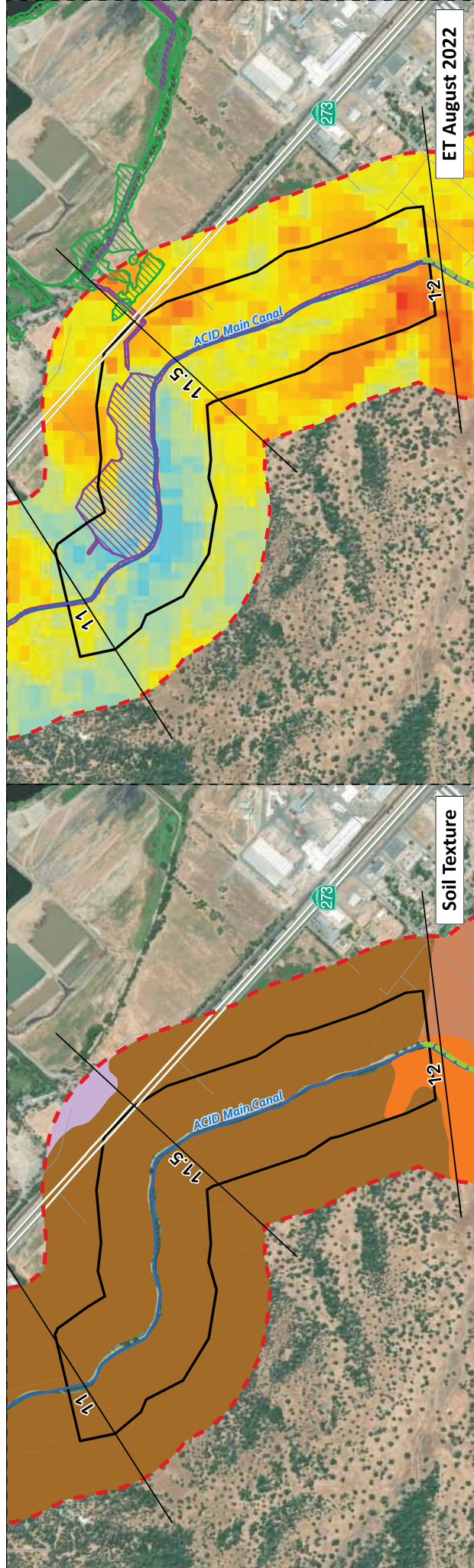








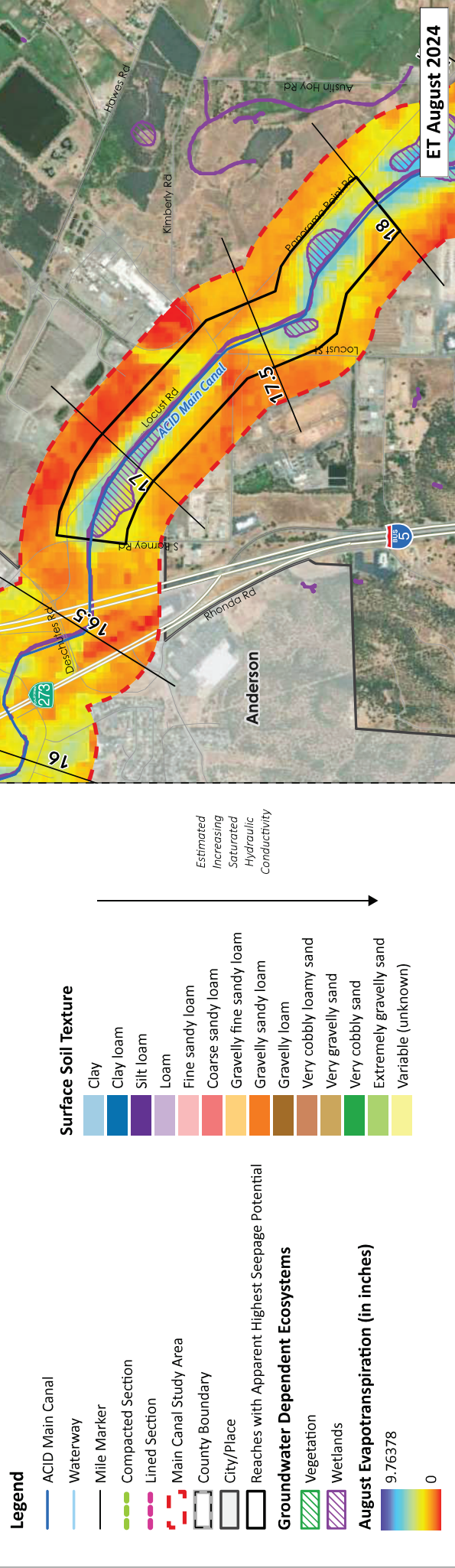
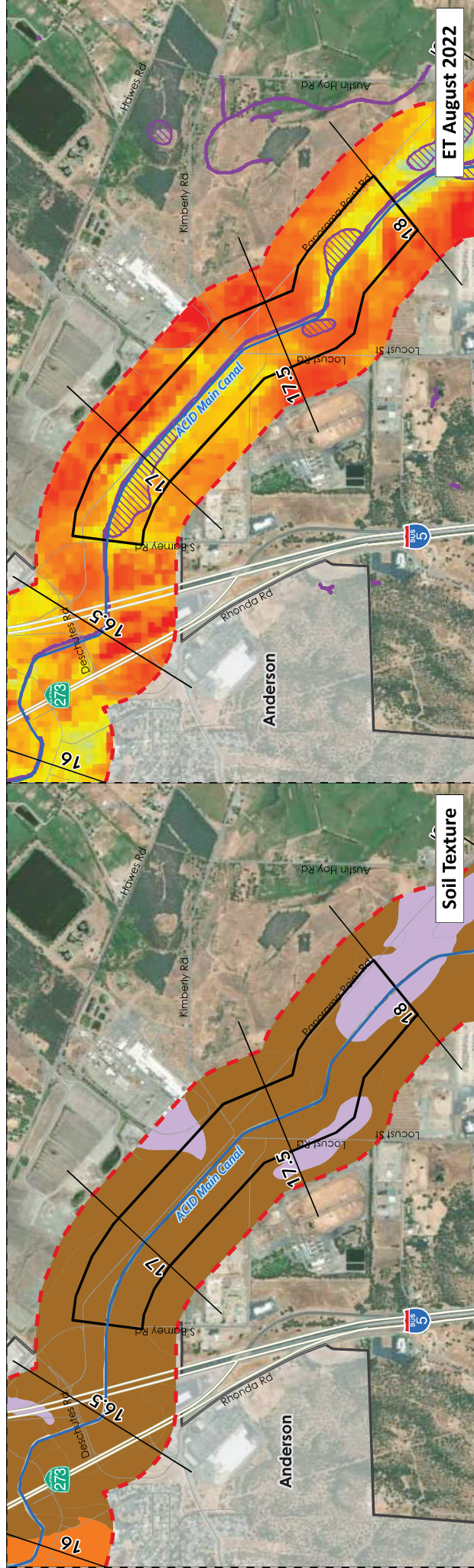




**Figure D.5 Reach D**  
Anderson-Cottonwood Irrigation District

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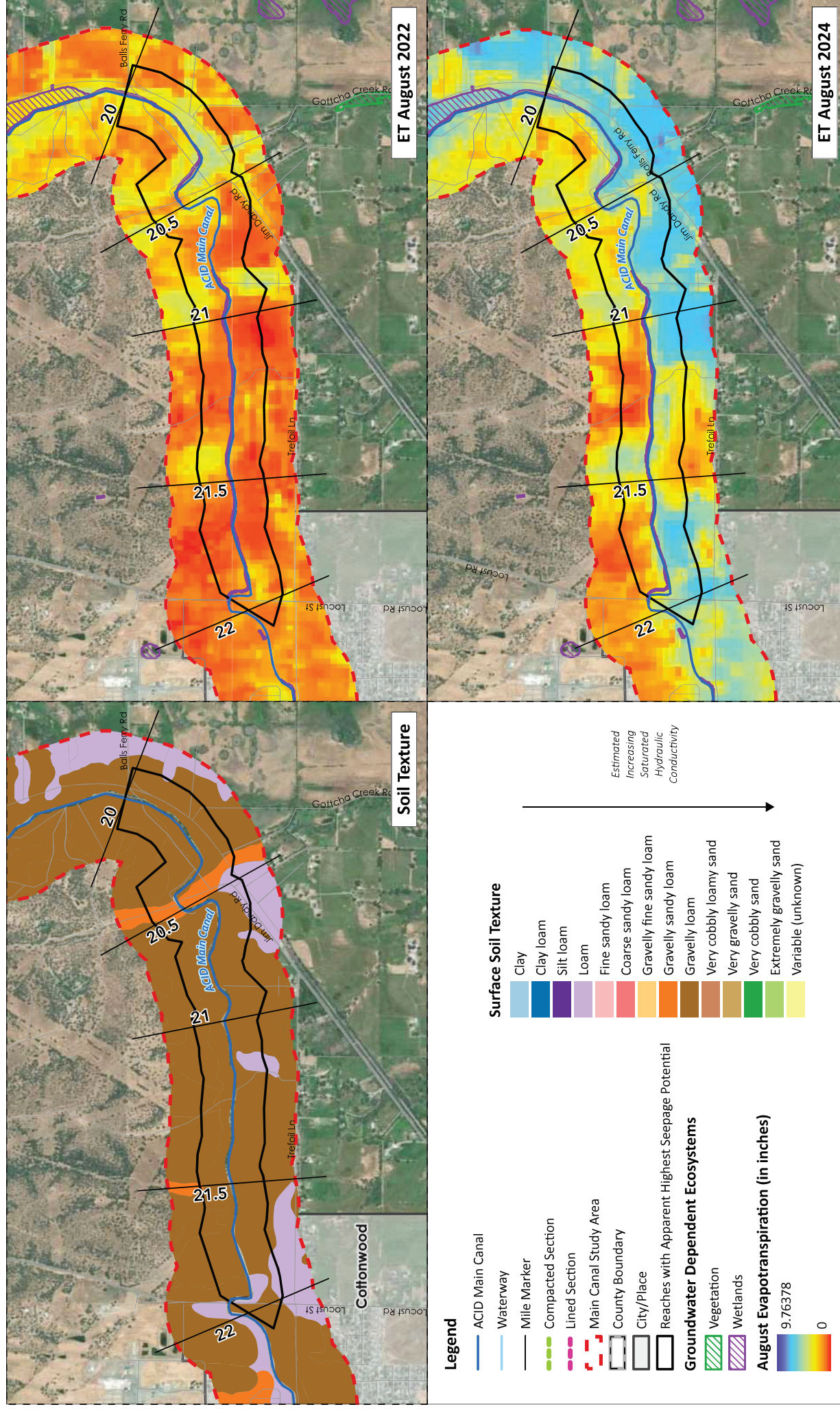




**Figure D.6 Reach E**  
Anderson-Cottonwood Irrigation District

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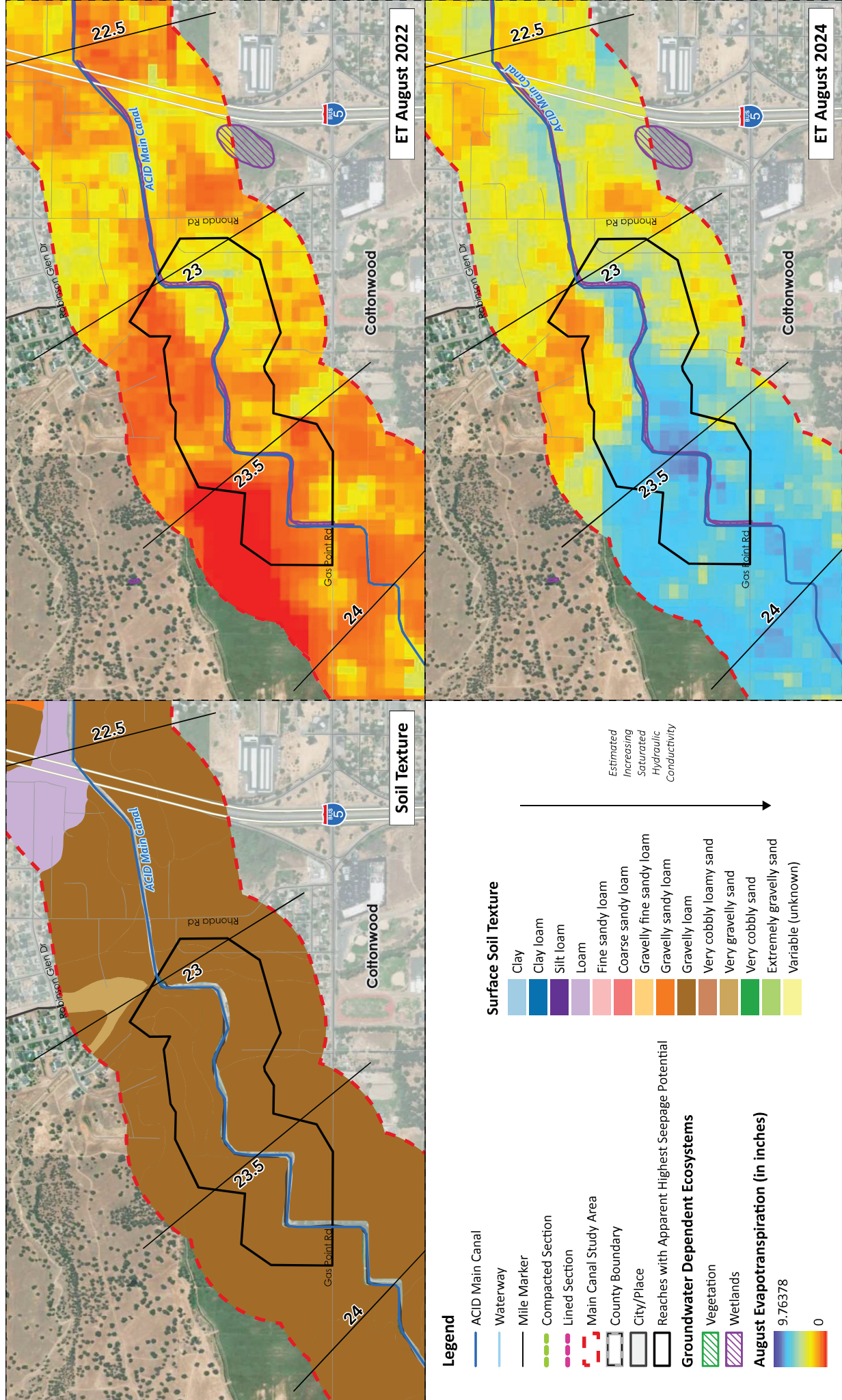


**Figure D.7 Reach F**  
: Anderson-Cottonwood Irrigation District

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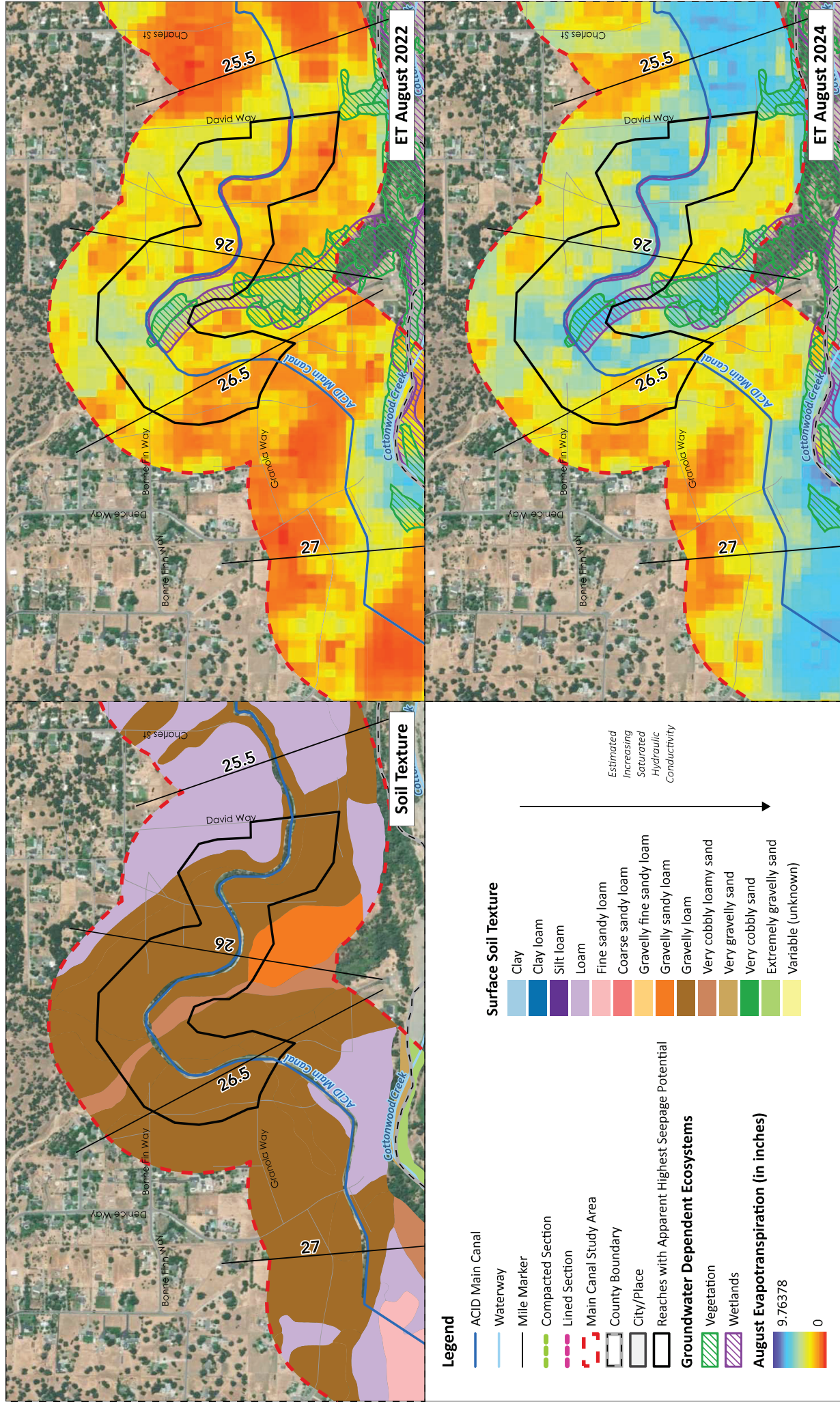
5/2/2025 G:\Anderson Cottonwood ID-4191\419125001-Main Canal Water Loss Eval Eng Swcs\400 GIS\Map\MemoMaps.aprx





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**Figure D.9 Reach H**

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