EXHIBIT F

I. Revegetation Category Criteria

DATE FILED: February 22, 2019 4:55 PM

A Dry-Up Parcel must meet the following criteria to be classified within the following Revegetation Categories:

a. **Irrigated Farming**: The Dry-Up Parcel is irrigated with a source of water described in paragraph 20.2 of this Decree.

b. **Developed Non-Ag Use**: The Dry-Up Parcel has been developed with buildings, grain storage facilities, railways or railroad facilities, oil or gas facilities, wind power generation facilities, power transmission facilities, pump houses, recharge facilities, augmentation stations, feed yards, roads, reservoirs, drains, impervious surfaces, or other facilities or structures that will adequately control weeds and/or erosion of the soil caused by wind; or the Dry-Up Parcel has been developed for a non-agricultural use that is allowed under applicable land-use regulations but that precludes establishing groundcover or dry-land farming on the Dry-Up Parcel, and weeds and/or erosion of the soil caused by wind are adequately controlled in a manner consistent with state and local law.

c. **Established Groundcover**: The Dry-Up Parcel meets the criteria for Class VI or Class VII of the Groundcover Classification Schedule in section III below, with weeds adequately controlled in a manner consistent with state and local law; or groundcover has been established on the Dry-Up Parcel as far as can be reasonably expected and weeds and/or erosion of the soil caused by wind are adequately controlled in a manner consistent with state and local law.

d. **Established Dry-Land Farming**:

1. Definition: Dry-land Farming means the establishment and maintenance of dry-land farming practices with weeds adequately controlled and with soil erosion from wind controlled in a manner consistent with state and local law. Dry-land farming practices include No-Till Dry-Land Farming and Minimum-Tillage Dry-Land Farming, as those terms are defined below.

    i. No-Till Dry-Land Farming means a system of planting seeds into untilled soil by opening a narrow slot, trench or band, of sufficient width and depth to obtain proper seed coverage. Because no soil tillage is utilized, a farmer must rely on herbicides to control the weeds. Both contact and residual herbicides may be used. Periodic fallowing and crop rotation may be used to stabilize the crop yields and allow the soil to rest.

ii. Minimum-Tillage Dry-Land Farming means management of farming operations which seeks to minimize impacts from tilling through the use of a sweep plow, strip-till, or similar technology. Additionally, a farmer may rely on herbicides to control weeds. Both contact and residual herbicides may be used. Periodic fallowing and crop rotation may be used to stabilize the crop yields and allow the soil to rest.

2. Criteria for classification as Established Dry-Land Farming in an Annual Revegetation Status Report: The Dry-Up Parcel has been planted to a dry-land crop or is in a fallow period following a dry-land crop; the crop was planted and farmed without irrigation water, such that it is dependent solely upon precipitation to meet crop water requirements; if other dry-land farming in the region is producing crops, the farm also is producing a dry-land crop with weeds adequately controlled and with soil erosion from wind controlled in a manner consistent with state and local law; and minimum crop residue after harvest of the dry-land crop is as described below, and the crop residue is left on the Dry-Up Parcel until the Dry-Up Parcel is prepared for the next rotation of planting; provided, however, that this requirement for crop residue does not prevent a farmer from controlling weeds by mechanical tillage of the Dry-Up Parcel or using other acceptable methods of weed control that do not disturb the residue on the surface. For grain crops, such as winter wheat or milo, minimum crop residue must be at least thirty percent (30%), determined by the step-point method. For hay or forage crops, crop stubble must measure at least five inches, with row spacing no more than thirty inches.

3. Additional criteria for classification as Established Dry-Land Farming in a Revegetated Parcel(s) Report: In order to be classified as Established Dry-Land Farming in a Revegetated Parcel(s) Report, a Dry-Up Parcel must meet the following criteria in addition to the criteria listed above: The Dry-Up Parcel has been classified as Established Dry-Land Farming in accordance with the criteria in section II.d.2 above for three full crop rotation cycles (one cycle equals two years crop production and one year fallow with appropriate stubble and weed control, for a total of three years).

e. **Not Established**: The Dry-Up Parcel does not meet the criteria to be classified as Irrigated Farming, Developed Non-Ag Use, Established Groundcover, or Established Dry-Land Farming.

f. **Confirmed Revegetated**: The Dry-Up Parcel is the subject of a Revegetated Parcel(s) Report that has been filed and accepted under paragraph 19.3 of this Decree.

II. Groundcover Classification Schedule

a. **CLASS I**: Full seeding and irrigation needed, either first seeding or reapplication of seeding. Desired plants scarce or absent.

b. **CLASS II**: Seeding and irrigation completed. Stand undetermined. Usually this will occur at the beginning of the second growing season following seeding.

c. **CLASS III**: Stand is variable. Part of the field has an adequate stand and part does not. Plants may be juvenile plants to well-developed mature plants. More than 10% of field with an inadequate stand on areas exceeding one acre in size. Plant frequency of desirable plant on deficient areas is less than 10%. Such deficient areas will require reseeding.

d. **CLASS IV-A**: Stand is inadequate; frequency is less than 10% but plants are fairly well distributed over field. Field may need reseeding.

e. **CLASS IV-B**: Stand is inadequate; frequency is between 10% to 15%. Plants are uniformly distributed over the field. No further seeding then recommended as the stand is expected to develop.

g. **CLASS V**: Stand appears adequate, but root system is undeveloped. There are 10% to 15% or more desired plants per count. Good potential for stand establishment. Generally found after the first growing season but possibly the second growing season.

h. **CLASS VI**: Stand adequate. Plants well rooted. Desirable plant frequency range 15% to 20%; no deficient areas larger than one acre in size over 90% of the field. This may occur following second growing season but more likely after the third growing season and beyond.

i. **CLASS VII**: Stand adequate. Plants well rooted with vigorous top growth. Desirable Plant frequencies are 20% to 30% or more over 90% of the field. No deficient areas larger than one acre in size. Generally occurring the third growing season and beyond.

Exhibit C

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

2021 Annual Revegetation Status Report for Case No. 15CW3067

Prepared by: Brad Walker
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I. INTRODUCTION

This report evaluates the dry-up and revegetation status of the "Phase II Land" identified in the Decree entered on February 25, 2019, in Lower Arkansas Water Management Association's ("LAWMA") Case No. 15CW3067 ("Decree"). The purpose of this evaluation is to classify the individual parcels of Phase II Land in one or more of the following "Revegetation Categories": (i) irrigated with a source of water described in paragraph 20.2 of the Decree ("Irrigated Farming"); (ii) developed for non-agricultural use ("Developed Non-Ag Use"); (iii) established and maintained in native grasses or such other self-sustaining (under the conditions prevailing on the land) suitable dry-land cover with weeds adequately controlled ("Established Groundcover"); (iv) established and maintained in dry-land farming practices with weeds adequately controlled ("Established Dry-Land Farming"); or (v) not Irrigated Farming, Developed Non-Ag Use, Established Groundcover, or Established Dry-Land Farming ("Not Established"). Exhibit F to the Decree provides specific criteria for each of the Revegetation Categories.

The parcels that make up the Phase II Land were previously irrigated with the surface water rights that were changed in the Decree, including Lamar Canal shares, Granada Irrigation Company shares, and X-Y Canal water. Some parcels are being reirrigated with ground water consistent with the requirements of paragraph 20.2 of the Decree.

To make my evaluation, I inspected each of the parcels identified as "Phase II" in Exhibits A-3, B-3, and C-3 to the Decree. I conducted my inspections on October 19, 2021.

The Phase II Land that I inspected under each ditch is as follows:

XY Canal	75.8 acres
Lamar Canal	414.7 acres
Granada Irrigation Company Canal	557.7 acres

In compliance with Section III of Decree Exhibit F, parcel-by-parcel observations concerning the state and condition of the Phase II Land are provided in the attached spreadsheets and maps. Each parcel is identified by parcel number, as assigned by the Division Engineer's Office.

Based on my inspections, and using my experience and expertise as a consulting agronomist, I assigned each parcel of the Phase II Land to one or more of the Revegetation Categories. If a parcel is undergoing revegetation, I measured and recorded the percentage of grasses and forbs on the parcel and designated it as Class I – Class VII based on the criteria described in the groundcover classification schedule in Decree Exhibit F. I also identified weed pressure for each of the Phase II Land parcels where applicable. (See Decree Exhibit F, § I.)

None of the Phase II Land was being dry land farmed at the time of my inspections. In any future inspections of parcels that are dry land farmed, I will also record the type of crop planted and the crop residue. (See Decree Exhibit F, § III.e.)

Approximately 14.42 inches of precipitation fell on the Phase II Land between January 2021 and November 2021. LAWMA's consulting engineer estimated the annual precipitation using the published location weather data from the National Weather Service's Lamar Climate Station, which is the closest climate station to the Phase II Land. (See Decree Exhibit F, § III.f.)

Section IIV of this report includes a description of the efforts taken by some of the owners of the Phase II Land during 2021 to revegetate the Phase II Land. (See Decree Exhibit F, §§ III.b, III.d.)

II. ESTABLISHED GROUNDCOVER

To determine whether a parcel should be classified as Established Groundcover, I evaluate the level of desirable basal groundcover on that parcel. The percentage of desirable basal groundcover recorded for each parcel includes grasses and forbs.

Basal groundcover is the surface of the soil actually covered by a plant, as compared to the full spread of the herbage, which in grassland ecology is measured at one inch above the ground. Basically, basal groundcover is only the crown of the grass. Basal groundcover should not be confused with canopy cover, which is the area occupied by the leaves or blades of grass. Percentage canopy cover is almost always higher than percentage basal groundcover in any given parcel. For purposes of this report, a parcel must meet the criteria for Class VI or VII groundcover given in Decree Exhibit F, § II, to be considered Established Groundcover.

A. Methods Used to Determine Desirable Basal Groundcover

Desirable basal groundcover is determined using two different methods. The goal of both methods is to assign a percentage of desirable basal groundcover established on the parcel. The first method is a visual method. When walking the parcel, I rely on my experience and expertise in grass evaluation to assign a percentage of desirable basal groundcover established on the parcel.

The second method used is the Step-Point Method. This method is described in the USDA-NRCS handbook entitled "Interagency Handbook, Interpreting Indicators of Rangeland Health, Technical Reference 1734-6, 2005." With this method, as I walk across the parcel, if the mark on the toe of my boot is on a grass plant or forb, I consider that a hit. I take 100 paces in either a line or transect across the parcel. Each of my paces is approximately 5½ feet. I use a hand-held counter to record each hit. After 100 paces, I look at the counter for an estimated percentage of desirable basal groundcover established on the parcel.

I performed the Step-Point Method on thin stands or questionable stands in a parcel. Therefore, if the thin stand within a parcel meets or exceeds the percentage desirable groundcover described in Section II.B below, it is appropriate to designate the entire parcel as Established Groundcover. The actual percentage of desirable basal groundcover recorded for a parcel also incorporates my visual observations. For example, if I determined that there was 22% desirable basal groundcover using the Step-Point Method, but my visual observations indicated that the parcel was thicker than that, I would record 25% for desirable basal groundcover.

In evaluating whether the basal groundcover is "desirable," I consider desirable grasses to be perennial grasses that are well suited to the semi-arid conditions that exist in the Phase II Land.

While I do not record specific grass species when I am evaluating the parcels, a partial list of desirable grasses includes the following:

Jose Tall Wheatgrass (*Agropyron elongatum)*
Sideoats Grama (*Bouteloua curtipendula)*
Intermediate Wheatgrass (*Thinopyrum intermedium)*
Western Wheatgrass (*Agropyron smithii)*
Big Bluestem (*Andropogan geradi)*
Little Bluestem (*Andropogon scoparius)*
Buffalograss (*Buchloe dactyloides)*
Sand Dropseed (*Sporobolus cryptandrus)*
Blue Grama (*Bouteloua gracilis)*
Switch Grass (*Panicum virgatum)*
Galleta (*Hiaria jamesii)*
Prairie Three Awn (*Aristida olgantha)*
Inland Salt grass (*Distichlis spicata)*
Squirrel Tail (*Elymus elymoides)*
Tall Fescue (*Festuca arundinacea)*
Alkali Sacaton (*Sporobolus airoides)*
Bermuda Grass (*Cynodon dactylon)*
Indian Grass (*Sorghestrum nutan)*
Vine Mesquite (*Panicum obtusum)*
Prairie Beard grass (*Andropogon scoparius)*
Purple love grass (*Eragrostis spectablis)*
False buffalograss (*Munroa squarrosa)*

In addition to desirable grasses, I consider forbs to be desirable broadleaf perennial plants in my evaluation of the Phase II Land. Forbs are important to the plant community and to the wildlife in the area. Forbs provide groundcover and stabilize the soil from wind and water erosion. Some forbs that are legumes fix atmospheric nitrogen and return it to the soil. This is beneficial to the plant community. Broadleaf plants that are included on the state's noxious weed list and annual plants are not considered forbs for purposes of this evaluation. A partial list of desirable forbs is below:

Rabbitbrush (*Chrysothamnus nauseosus)*
Sand Sage Brush (*Artemisia filifolia)*
Yucca (*Yucca glauca)*
White Prairie Aster (*Aster falctus Lindl)*
Broom Snakeweed (*Gutierrezia sarothrae)*
Prickly Pear Cactus (*Opunta polyacantha)*
Bush morning glory (*Ipomoea leptophylla)*
Prairie cone flower (*Ratibida columnifera)*
Pineapple weed (*Matricaria matricaioides)*
Indian paintbrush *(Castilleja Mutis)*
Blue Flax *(Linum perenne)*
White prairie clover *(Dalea candida)*
Blanket flower (*Gaillardia pulchella)*

Sainfoin (*Onobrychis viciifolia)*
Showy milkweed (*Asclepias speciose)*

B. Criteria for Established Groundcover

For the purpose of this report, a designation of Established Groundcover means that the parcel "meets the criteria for Class VI or Class VII of the Groundcover Classification Schedule . . . , with weeds adequately controlled in a manner consistent with state and local law; or groundcover has been established on the [parcel] as far as can be reasonably expected and weeds and/or erosion of the soil caused by wind are adequately controlled in a manner consistent with state and local law." The Groundcover Classification Schedule given in Decree Exhibit F is as follows:

CLASS I: Full seeding and irrigation needed, either first seeding or reapplication of seeding. Desired plants scarce or absent.

CLASS II: Seeding and irrigation completed. Stand undetermined. Usually this will occur at the beginning of the second growing season following seeding.

CLASS III: Stand is variable. Part of the field has an adequate stand and part does not. Plants may be juvenile plants to well-developed mature plants. More than 10% of field with an inadequate stand on areas exceeding one acre in size. Plant frequency of desirable plant on deficient areas is less than 10%. Such deficient areas will require reseeding.

CLASS IV-A: Stand is inadequate; frequency is less than 10% but plants are fairly well distributed over field. Field may need reseeding.

CLASS IV-B: Stand is inadequate; frequency is between 10% to 15%. Plants are uniformly distributed over the field. No further seeding then recommended as the stand is expected to develop.

CLASS V: Stand appears adequate, but root system is undeveloped. There are 10% to 15% or more desired plants per count. Good potential for stand establishment. Generally found after the first growing season but possibly the second growing season.

CLASS VI: Stand adequate. Plants well rooted. Desirable plant frequency range 15% to 20%; no deficient areas larger than one acre in size over 90% of the field. This may occur following second growing season but more likely after the third growing season and beyond.

CLASS VII: Stand adequate. Plants well rooted with vigorous top growth. Desirable Plant frequencies are 20% to 30% or more over 90% of the field. No deficient areas larger than one acre in size. Generally occurring the third growing season and beyond.

III. IRRIGATED FARMING OR DRY-LAND FARMING

A. Irrigated Farming

If a parcel is irrigated with one of the sources of water described in paragraph 20.2 of the Decree, I classify the parcel as "Irrigated Farming." For parcels designated as Irrigated Farming, additional details about the source of irrigation water are included in the attached spreadsheets.

B. Established Dry-Land Farming

Based on my observations of the evidence of dry-land farming, I determine whether a parcel is established and maintained in dry-land farming practices with weeds adequately controlled. Decree Exhibit F defines dry-land farming as "the establishment and maintenance of dry-land farming practices with weeds adequately controlled and with soil erosion from wind controlled in a manner consistent with state and local law."

i. Dry-land Farming Practices – Types

Decree Exhibit F recognizes two types of dry-land farming practices, as follows:

No-Till Dry-Land Farming: No-Till Dry-Land Farming means a system of planting seeds into untilled soil by opening a narrow slot, trench or band, of sufficient width and depth to obtain proper seed coverage. Because no soil tillage is utilized, a farmer must rely on herbicides to control the weeds. Both contact and residual herbicides may be used. Periodic fallowing and crop rotation may be used to stabilize the crop yields and allow the soil to rest.

Minimum-Tillage Dry-Land Farming: Minimum-Tillage Dry-Land Farming means management of farming operations which seeks to minimize impacts from tilling through the use of a sweep plow, strip-till, or similar technology. Additionally, a farmer may rely on herbicides to control weeds. Both contact and residual herbicides may be used. Periodic fallowing and crop rotation may be used to stabilize the crop yields and allow the soil to rest.

ii. Criteria for Established Dry-Land Farming

To classify a parcel as "Established Dry-Land Farming," I inspect the parcel for evidence that the parcel meets the following criteria:

- The parcel has been planted to a dry-land crop or is in a fallow period following a dry-land crop;
- The crop was planted and farmed without irrigation water, such that it is dependent solely upon precipitation to meet crop water requirements;
- If other dry-land farming in the region is producing crops, the farm also is producing a dry-land crop with weeds adequately controlled and with soil erosion from wind controlled in a manner consistent with state and local law;
- Depending on the type of crop, the landowner meets one of the following minimum crop residue requirements after harvest of the dry-land crop: For grain crops, such as winter

wheat or milo, minimum crop residue must be at least thirty percent (30%), determined by the step-point method; or for hay or forage crops, crop stubble must measure at least five inches, with row spacing no more than thirty inches;

- The crop residue is left on the parcel until it is prepared for the next rotation of planting; provided, however, that this requirement for crop residue does not prevent a farmer from controlling weeds by mechanical tillage of the parcel or using other acceptable methods of weed control that do not disturb the residue on the surface.

Using my expertise and experience as an agronomist, I evaluate the management practices for each parcel being farmed without irrigation. If weeds are not adequately controlled on the parcel, and no crop was planted or the parcel is not ready to be planted, I classify the parcel as Not Established. If I observe evidence that the farmer is dry-land farming the parcel and weeds are adequately controlled, I classify the parcel as Established Dry-Land Farming. When a parcel is in a fallow rotation, the weeds must be adequately controlled with the required crop residue for the parcel to be classified as Established Dry-Land Farming.

IV. DEVELOPED NON-AG USE

As described in paragraph 20.1 of the Decree, one of the Revegetation Categories is Developed Non-Ag Use. Decree Exhibit F defines Developed Non-Ag Use as "the Dry-Up Parcel has been developed with buildings, grain storage facilities, railways or railroad facilities, oil or gas facilities, wind power generation facilities, power transmission facilities, pump houses, recharge facilities, augmentation stations, feed yards, roads, reservoirs, drains, impervious surfaces, or other facilities or structures that will adequately control weeds and/or erosion of the soil caused by wind; or the Dry-Up Parcel has been developed for a non-agricultural use that is allowed under applicable land-use regulations but that precludes establishing groundcover or dry-land farming on the Dry-Up Parcel, and weeds and/or erosion of the soil caused by wind are adequately controlled in a manner consistent with state and local law." Based on my observations of development, I determine whether a parcel is developed for a non-agricultural use with weeds adequately controlled

V. WEEDS

For all Phase II Land inspected, I identified weeds and noted the weed pressure wherever applicable. The two most common weeds in the parcels were Kochia and Russian Thistle. I estimate that these two weeds account for over 90% of the weed pressure on the Phase II Land. If a landowner is dry land farming the parcel or the parcel is in desirable grasses or forbs, but the weeds are not adequately controlled, I classify the parcel as Not Established. A partial list of weeds found in the parcels includes the following:

<u>Noxious weed list "B" weeds</u>
Salt Cedar (*Taarix chinesis)*

<u>Noxious weed list "C" weeds</u>
Field Bindweed (*Convolvulus arvensis)*
Johnsongrass (*Sorghum halepense)*

Puncture Vine (*Tribulus terrestris)*
Downy Brome *(Bromus tectorum)*

<u>Weeds not on Colorado's noxious weed list</u>

Kochia (*Kochia scoparia)*
Russian Thistle (*Salsola kali)*
Sunflower (*Helianthus annuus)*
Mares Tail (*Conyza Canadensis)*
Palmer Pigweed (*Amaranthus palmerii)*
Common Milkweed (*Asclepias syriaca)*
Buffalo Bur (*Solanum rostratum)*
Windmill Grass (*Chloris* Sw.)
Stinkgrass (*Eragrostis ciliansis)*
Field Sandbur (*Cenchrus longispinus)*
Bristly foxtail (*Setaria verticillata)*
Giant foxtail (*Setaria faberii)*
Witch Grass (*Panicum capillare)*

VI. GENERAL SUMMARY OF 2021 REVEGETATION STATUS

A. Granada Irrigation Company Ditch

The Phase II Land under the Granada Irrigation Company Ditch, also known as the "Granada Lateral," is made up of parcels that were formerly irrigated by flood irrigation. GP Irrigated Farms, LLC ("GP Irrigated") manages the dry-up and revegetation process for the Phase II Land under the Granada Canal that it and S-D Investments, LLC ("S-D") own or control. In 2016, 2017, and 2020, GP Irrigated planted a mix of grass seeds in the parcels it manages. In February of 2021, GP Irrigated mowed and swathed those same parcels to control weeds. See Section VII.A below for a more detailed description of GP Irrigated's revegetation efforts in 2021. This year I classified 6 parcels as Established Groundcover that were classified as Not Established in 2020 (Parcel Nos. 23440207, 23440215, 23440307, 23440309, 23440324 and 23440325). In total, I classified sixteen parcels as Established Groundcover during this year's inspections. Overall, the stands in most parcels have improved and many should be able to establish adequate ground cover without replanting grass seed. However, I recommend reseeding some parcels in the fall of 2022 or the spring of 2023. Those parcels include Parcel Nos. 23440119, 23440203, 23440209, 23440304, 23440314, 23440315, 23441005, 23441007, 23441014 and 23441109. Additionally, the Kochia and Russian Thistle weeds pressure must be reduced in order for the grass establishment to be successful.

The cover photo was taken on June 25, 2021, and it showed small seedling grass that emerged in an area of heavy seeding Kochia. Unfortunately, the grass seedling probably will not survive to become established plants. The competition for space, moisture, nutrients, and sunlight from the Kochia plants is too much for the grass seedling to survive. I found new grass seedling in six parcels during my inspection. I also saw where grasshoppers were feeding on the grass seedlings. This does not improve the chances of the small grasses becoming established either. The picture below shows a seedling grass emerged and on the way to becoming established without heavy

Kochia and Russian Thistle pressure. I recommend the application of herbicides to reduce the Kochia pressure in the spring of 2022 to improve grass establishment.

Photo G-20; Parcel No. 23440303 - 10/19/2021. Good grass establishment in an area without heavy weed pressure.

Exhibit C

Photo-G-7; Parcel No. 23440207 - 10/19/2021 (Newly Established Groundcover in 2021)

B. XY Canal Lands

GP erected one center pivot sprinkler to irrigate Parcel No. 23440121 and corn was planted in the spring of 2021 and harvested for silage. Then wheat was planted, and wheat is currently growing on the parcel; thus, I classified it as Irrigated Farming. The center pivot sprinkler is supplied by water from a well that was included in LAWMA's plan for augmentation in Case No. 14CW3004. The other parcel I inspected was mainly Kochia with very little established grass. This parcel (Parcel No. 23430712) is owned by Lawrence McMillan. Because Mr. McMillan did not respond to LAWMA's revegetation questionnaire in 2019 or 2020, I am unaware of his revegetation efforts to date. Based on the lack of groundcover and weed control, I classified Mr. McMillan's parcel as Not Established and it is pictured below.

Photo-XY-1; Parcel No. 23430712 – 10/19/2021. (Not Established)

C. Lamar Canal Lands

Parcel Nos. 22443111, 22443211 and 22443201 are irrigated by three wells that were included in LAWMA's plan for augmentation in Case No. 14CW3004. Therefore, I classified those parcels as Irrigated Farming. GP Irrigated manages the dry-up and revegetation process for the Phase II Land under the Lamar Canal that it, S-D, and Don Higbee own or control. In 2016 and 2018, GP Irrigated planted a mix of grass seeds in the parcels it manages. In February of 2021, GP Irrigated planted a mix of grass seeds in some of the parcels it manages. GP Irrigated has mowed and swathed those same parcels to control weeds. See Section VII.A below for a more detailed description of GP Irrigated's revegetation efforts in 2021. This year I classified 3 parcels as Established Groundcover that were classified as Not Established in 2020 (Parcel Nos. 22443101, 22443109, and 23440503). Due to the well-established grass stands, I classified seven of the twelve other parcels not being re-irrigated as Established Groundcover. I saw new seedling grass in three parcels during my inspection. Overall, the stands in most parcels have improved and many should be able to establish adequate ground cover without replanting grass seed. However, I recommend reseeding Parcel Nos. 22443105 and 22453605.

Photo L-2; Parcel No. 23440423 - 10/19/2021 (Established Groundcover)

Photo L-6; Parcel No. 23443201 - 10/19/2021. Corn harvested for silage. 30" rows and stubble height varied but, it was about 8". After harvest wheat was planted into the parcel.

Photo L-7, Parcel No. 22443218 - 10/19/2021. Good grass establishment in an area without heavy weed pressure.

VII. ADDITIONAL INFORMATION FROM THE LANDOWNERS

Section III of Decree Exhibit F requires LAWMA to include information in the Annual Revegetation Status Report that goes beyond what I can observe during my inspections. I met with Joe Hilger on June 25, 2021, to discuss GP Irrigated's revegetation efforts during 2021. Mr. Hilger is the manager for GP Irrigated's revegetation efforts. In the past, LAWMA's attorneys have sent letters to the landowners to gather additional information, but this year I was able to meet with Mr. Hilger in person.

LAWMA's attorneys did not send a letter to Lawrence McMillan. Mr. McMillan owns one of the Phase II Land parcels under the X-Y Canal. Mr. McMillan has not responded to LAWMA's letters in the past, and my inspection of that parcel indicates that Mr. McMillan has done nothing to establish revegetation or dry-land farm on the parcel. LAWMA is in the process of applying for a 1041 permit from Prowers County for the Phase II Lands and will be communicating with Mr. McMillan as part of that process.

A. GP Irrigated Farms, LLC, S-D Investments, LLC, and Donald Higbee

As mentioned above, GP Irrigated manages the revegetation efforts on all the Phase II Lands owned by GP Irrigated, S-D, and Mr. Higbee. Maps showing all the Phase II Lands that GP Irrigated manages are attached as **Exhibits 1 - 3**. GP Irrigated is working to establish revegetation on all the Phase II Lands that it manages, rather than dry-land farming on any parcel. GP Irrigated's revegetation efforts to-date are summarized below.

Seeding: GP Irrigated planted grass seed in the spring of 2021 in the parcels that had thin grass stands. GP Irrigated also planted grass seeds in most of the Phase II Lands in February of 2016 and 2018. GP Irrigated applied seeds to the S-D Dry-Up Parcels at a rate of 17 lbs./acre, and the composition of the seeding blend in each year is described below.

2016:
Wheatgrass Tall: 52.13%
Oats: 38.87%
Wheatgrass Western: 5.24%
Crop / inert / weeds: 3.76%

2018:
AC Saltlander Wheatgrass: 10%
Garrison Creeping Foxtail (Coated): 10%
Hercules Tall Wheatgrass: 20%
Forage Perennial Ryegrass: 20%

Forage Tall Fescue: 20%
Smooth Brome Grass: 20%

2021:
Tall Wheatgrass: 1lb/Ac
Side oats: 1.5lb/Ac
Western Wheatgrass: 2lb/A
Sand dropseed grass: 0.8lb/Ac
Sand lovegrass: 1.3lb/Ac
Alkali Sacaton: 0.5lb/Ac

GP Irrigated is beginning to see a nice stand of mixed grasses become established on some of the Phase II Lands. GP Irrigated did not apply any water to the Phase II Lands it manages to assist in establishing revegetation, nor did it apply any herbicides or pesticides to control weeds or insects. As I stated earlier, the parcels and areas of parcels with thin grass stands were replanted with grass seed this spring. Below are two photos I took during a visit over the summer that show new seedling grasses growing in some of the parcels that were replanted.

Parcel No. 23441109 - 6/25/2021. (Not Established)

Weed Control Efforts: When I met with Mr. Hilger in June, most of the fields with thin grass stands had weeds that were not adequately controlled. However, Mr. Hilger and I discussed the best way to control the weeds. A herbicide application at that time could have injured or even killed some of the emerged seedling grasses. Therefore, it was not a good option. Swathing or cutting the weed was the best option in my opinion. We decided the best time to swathing and bailing the weeds was July 9, 2021. The advantages of delaying the weed control until then were:

1) The grass seedlings will be big enough to withstand the traffic of driving the swathers and bailers on the parcel without damaging or killing the emerged seedling grasses.
2) The established grass will be in the seed formation stage of growth. By delaying the weed control the grass seeds can become viable. Then, after cutting, the seeds can germinate when adequate rain fall occurs, which can increase the grass stands.

By the time I conducted my second inspection in October, GP Irrigated had swathed all of the Phase II Lands except for the McMillan Farm. GP Irrigated had also bailed and stacked the weeds and grasses on almost all of the parcels. The swathing and bailing was sufficient to adequately control weeds. Further, by delaying the weed control efforts, the grass seedlings were well enough established to withstand the swathing and bailing. In many parcels, the grass stands were able to increase. GP Irrigated further reported that the lack of moisture late in the season was a big help in controlling weeds. Accordingly, I was able to classify a number of parcels as Established Groundcover with weeds adequately controlled.

Soil erosion and other factors for revegetation: GP Irrigated reported that it did not have issues with soil erosion caused by wind, due to the amount of cover on the Phase II Land is manages. Thus, GP Irrigated has not taken any actions to prevent soil erosion caused by wind. Finally, GP Irrigated identified weed pressure from Kochia and Russian Thistle after planting in 2021 as the largest inhibitor on its ability to keep the mix of grasses growing on the Phase II Lands it manages.

B. Lawrence L. McMillan

A map showing the Phase II Land owned by Lawrence McMillan is attached as **Exhibit 4** ("McMillan Dry-Up Parcel"). At the time of the inspection, weeds were not adequately controlled on the McMillan Dry-Up Parcel, and I did not observe any evidence that Mr. McMillan did anything to establish revegetation

VIII. CONCLUSION

Based on my annual evaluations, the attached spreadsheets and maps show parcel-specific details for each parcel of the Phase II Land.

Please let me know if you have questions about my annual inspections or evaluations of the Phase II Land.

Brad Walker
Certified Crop Advisor 03219
Certified Professional Crop Consultant 0030

Dated November 23, 2021

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Exhibit C

Exhibit A-3

Revegetation Status of Lamar Canal Phase II Lands

Parcel No.	Picture # (if any)	Acres	Revegetation Category	Irrigated Farming Cat A (acres)	Dev'd Non-Ag Use Cat B (acres)	Est'd Ground Cover Cat C (acres)	Est'd Dry-land Farming Cat D (acres)	Not Est'd Cat E (acres)	Revegetated Cat F (acres)	If Col (4) = A, WDID(s) for source(s) of irrigation water	If Col (11) WDID is a well, permit #(s)	If Col (4) = A, aug plan decree	Weeds adequately controlled? (Y/N)	If Col (4) = E, intended revegetation (RVG) or dry-land farming (DLF)?	If Col (4) = C; or Col (4) = E and Col (15) = RVG, % of groundcover and classification (Classes I-VII)	If Col (4) = D; or Col (4) = E and Col (15) = DLF, whether crop is grain (GR) or hay/forage (HF)	If Col (17) = GR, % crop residue using step-point method	If Col (17) = HF, stubble height and row spacing, in inches	If Col (4) = C, D, or E, was water used in effort to establish groundcover or dry-land farming? (Y/N)	Prior year's revegetation category under Col (4)	2021 notes / comments
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
22443101		7.6	B, C		1.2	6.4							Y-Mowed	RVG	20% (VI)				No	E	A portion of this parcel was developed as a hay stacking area
22443103	L-8	16.3	E					16.3					Y-Mowed	RVG	12% (V)				No	E	
22443105	L-11	46.7	E					46.7					Y-Mowed	RVG	6% (III)				No	E	
22443109	L-10	11.7	C			11.7							Y-Mowed	RVG	22% (VI)				No	E	
22443111		56.7	A	56.7						6705543, 6705545, 6705546	3124-F, 3642-F, 15620-R	14CW3004				HF		8" and 30"		A	Currently growing alfalfa
22443201	L-6	84.2	A	84.2						6705543, 6705545, 6705546	3124-F, 3642-F, 15620-R	14CW3004				HF		8" and 30"		A	Currently growing wheat
22443211		122.1	A	122.1						6705543, 6705545, 6705546	3124-F, 3642-F, 15620-R	14CW3004				HF		8" and 30"		A	Currently growing wheat
22443218	L-7	11.3	E					11.3					Y-Mowed	RVG	30% (V)				No	E	There is excellent grass in 40% of the parcel and no grass in 60% of the parcel.
22453404		7.2	C			7.2							Y-Mowed	RVG	24% (VI)				No	C	
22453605	L-12	8.5	E					8.5					Y-Mowed	RVG	0% (I)				No	E	
22453613	L-13	12.6	C			12.6							Y-Mowed	RVG	26% (VII)				No	C	
23440408	L-1	8.4	C			8.4							Y-Mowed	RVG	20% (VI)				No	C	
23440423	L-2	5.3	C			5.3							Y-Mowed	RVG	55% (VII)				No	C	
23440503	L-5	8.2	C			8.2							Y-Mowed	RVG	24% (VI)				No	E	
23440504	L-3	7.9	E					7.9					Y-Mowed	RVG	10% (IV-A)				No	E	
Total		**414.7**		**263.0**	**1.2**	**59.8**	**0.0**	**90.7**	**0.0**												

Column Notes and Explanations:

(4) Revegetation Categories from Exhibit F to the 15CW3067 Decree: A - Irrigated Farming; B - Developed Non-Ag Use; C - Established Groundcover; D - Established Dry-Land Farming; E - Not Established; F - Confirmed Revegetated.

(15) See attached narrative description of efforts undertaken in the preceding year to establish groundcover or dryland farming.

(19) Shown as (Stubble height) - (row spacing) in inches.

(20) If Y, see attached narrative description of the source of water, the amount applied, and the method of application.

Exhibit C

Exhibit B-3
Revegetation Status of Granada Lateral Phase II Lands

Parcel No. (1)	Picture # (if any) (2)	Acres (3)	Revegetation Category (4)	Irrigated Farming Cat A (acres) (5)	Dev'd Non-Ag Use Cat B (acres) (6)	Est'd Ground Cover Cat C (acres) (7)	Est'd Dry-land Farming Cat D (acres) (8)	Not Est'd Cat E (acres) (9)	Revegetated Cat F (acres) (10)	If Col (4) = A, WDID(s) for source(s) of irrigation water (11)	If Col (11) WDID is a well, permit #(s) (12)	If Col (4) = A, aug plan decree (13)	Weeds adequately controlled? (Y/N) (14)	If Col (4) = E, intended revegetation (RVG)* or dry-land farming (DLF)*? (15)	If Col (4) = C; or Col (4) = E and Col (15) = RVG, % of groundcover and classification (Classes I-VII) (16)	If Col (4) = D; or Col (4) = E and Col (15) = DLF, whether crop is grain (GR) or hay/forage (HF) (17)	If Col (17) = GR, % crop residue using step-point method (18)	If Col (17) = HF, stubble height and row spacing, in inches (19)	If Col (4) = C, D, or E, was water used in effort to establish groundcover or dry-land farming? (Y/N) (20)	Prior year's revegetation category under Col (4) (21)	2021 notes / comments (22)
23440106	G-1	9.7	B, E		2.3			7.4					Y-Mowed	RVG	8% (III)				N	E	A portion of this parcel was developed as a hay stacking area
23440108	G-3	7.9	E					7.9					Y-Mowed	RVG	10% (IV-A)				N	E	
23440119	G-2	9.0	E					9					Y-Mowed	RVG	3% (II)				N	E	
23440203	G-5	18.2	E					18.2					Y-Mowed	RVG	0% (II)				N	E	
23440206	G-8	17.8	E					17.8					Y-Mowed	RVG	18% (IV)				N	E	
23440207	G-7	31.8	C			31.8							Y-Mowed	RVG	20% (VI)				N	E	
23440208	G-15	13.0	C			13							Y-Mowed	RVG	26% (VII)				N	C	
23440209	G-10	41.4	B, E		0.9			40.5					Y-Mowed	RVG	3% (II)				N	E	A portion of this parcel was developed as a hay stacking area
23440211	G-4	7.7	E					7.7					Y-Mowed	RVG	10% (IV-A)				N	E	
23440213	G-9	16.4	C			16.4							Y-Mowed	RVG	26% (VII)				N	C	
23440214	G-6	21.8	C			21.8							Y-Mowed	RVG	20% (VI)				N	C	
23440215	G-16	28.2	C			28.2							Y-Mowed	RVG	20% (VI)				N	E	
23440216	G-17	35.4	E					35.4					Y-Mowed	RVG	14% (IV-B)				N	E	
23440301	G-23	9.4	C			9.4							Y-Mowed	RVG	35% (VII)				N	C	
23440302		8.4	C			8.4							Y-Mowed	RVG	40% (VII)				N	C	
23440303	G-20	7.6	B, C		0.4	7.2							Y-Mowed	RVG	20% (VI)				N	C	A portion of this parcel was developed as a hay stacking area
23440304	G-19	8.6	B, E		1.2			7.4					Y-Mowed	RVG	2% (II)				N	E	A portion of this parcel was developed as a hay stacking area
23440307	G-26	8.6	C			8.6							Y-Mowed	RVG	20% (VI)				N	E	
23440309	G-25	8.1	B, C		2.1	6							Y-Mowed	RVG	20% (VI)				N	E	A portion of this parcel was developed for a hay stacking area
23440314		6.9	E					6.9					Y-Mowed	RVG	4% (III)				N	C	
23440315	G-18	5.2	E					5.2					Y-Mowed	RVG	0% (I)				N	E	
23440320	G-24	7.7	B, C		1.7	6							Y-Mowed	RVG	30% (VII)				N	C	A portion of this parcel was developed as a hay stacking area
23440324	G-27	14.8	C			14.8							Y-Mowed	RVG	26% (VII)				N	E	
23440325	G-21	7.1	C			7.1							Y-Mowed	RVG	32% (VII)				N	E	
23441005	G-29	6.9	B, E		1			5.9					Y-Mowed	RVG	0% (I)				N	E	A portion of this parcel was developed as a hay stacking area
23441007	G-28	21.9	E					21.9					Y-Mowed	RVG	2% (II)				N	E	
23441014		5.9	E					5.9					Y-Mowed	RVG	0% (I)				N	E	
23441101	G-11	20.1	E					20.1					Y-Mowed	RVG	10% (V)				N	C	
23441102	G-13	41.1	E					41.1					Y-Mowed	RVG	14% (V)				N	C	
23441103	G-12	47.3	E					47.3					Y-Mowed	RVG	10% (V)				N	C	
23441107	G-34	29.4	C			29.4							Y-Mowed	RVG	20% (VI)				N	C	
23441109	G-30	15.6	B, E		0.6			15					Y-Mowed	RVG	4% (III)				N	E	A portion of this parcel was developed as a hay stacking area
23441113	G-35	12.8	B, C		0.8	12							Y-Mowed	RVG	35% (VII)				N	C	A portion of this parcel was developed as a hay stacking area
23441118	G-33	6.0	C			6							Y-Mowed	RVG	20% (VI)				N	C	
Total		557.7		0.0	11.0	226.1	0.0	320.6	0.0												

Column Notes and Explanations:

(4) Revegetation Categories from Exhibit F to the 15CW3067 Decree: A - Irrigated Farming; B - Developed Non-Ag Use; C - Established Groundcover; D - Established Dry-Land Farming; E - Not Established; F - Confirmed Revegetated.
(15) See attached narrative description of efforts undertaken in the preceding year to establish groundcover or dryland farming.
(19) Shown as (Stubble height) - (row spacing) in inches.
(20) If Y, see attached narrative description of the source of water, the amount applied, and the method of application.

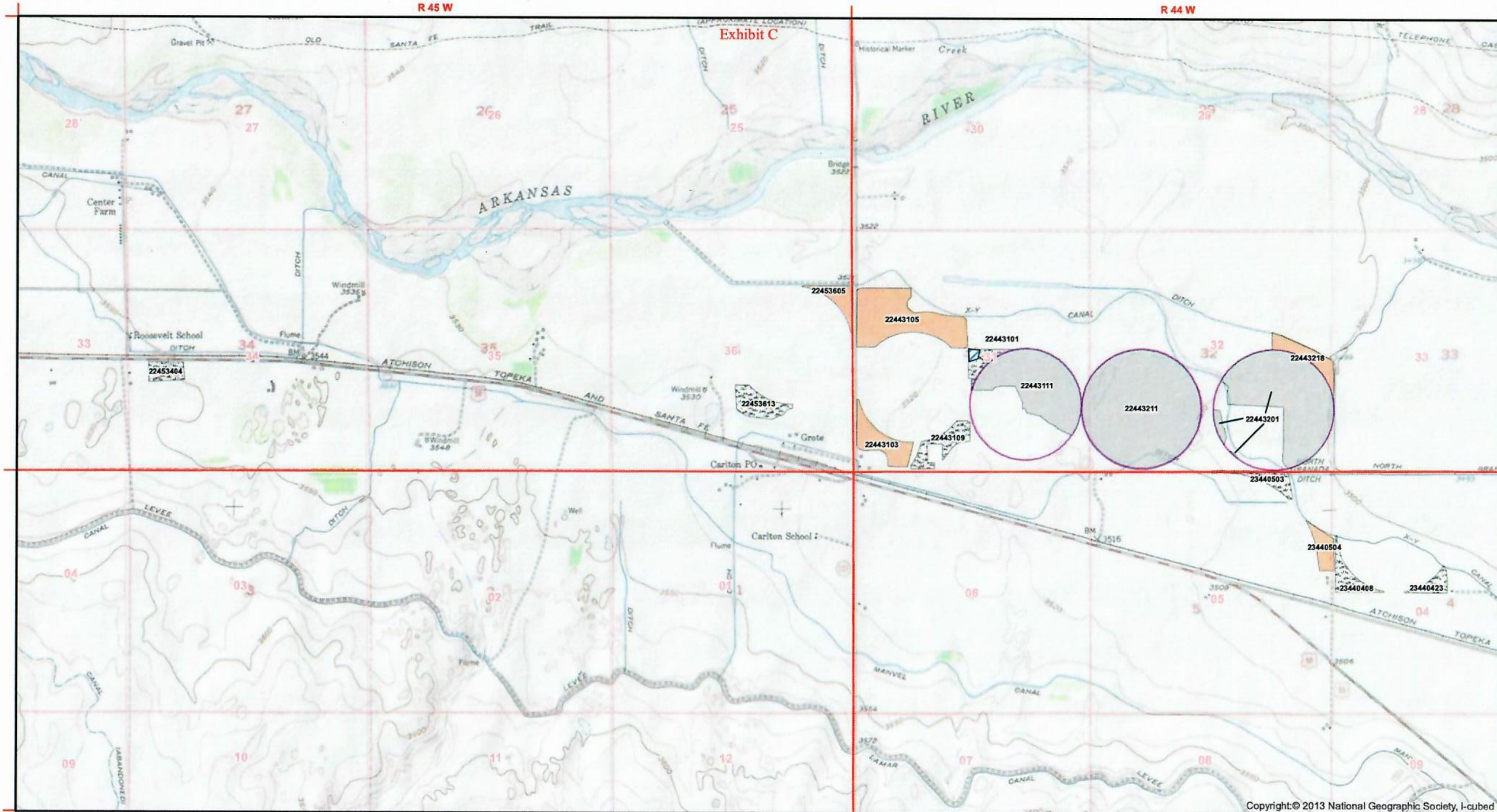
Exhibit C

Exhibit C-3
Revegetation Status of X-Y Canal Phase II Lands

Parcel No.	Picture # (if any)	Acres	Revegetation Category	Irrigated Farming Cat A (acres)	Dev'd Non-Ag Use Cat B (acres)	Est'd Ground Cover Cat C (acres)	Est'd Dry-land Farming Cat D (acres)	Not Est'd Cat E (acres)	Revegetated Cat F (acres)	If Col (4) = A, WDID(s) for source(s) of irrigation water	If Col (11) WDID is a well, permit #(s)	If Col (4) = A, aug plan decree	Weeds adequately controlled? (Y/N)	If Col (4) = E, intended revegetation (RVG) or dry-land farming (DLF)?	If Col (4) = C; or Col (4) = E and Col (15) = RVG, % of groundcover and classification (Classes I-VII)	If Col (4) = D; or Col (4) = E and Col (15) = DLF, whether crop is grain (GR) or hay/forage (HF)	If Col (17) = GR, % crop residue using step-point method	If Col (17) = HF, stubble height and row spacing, in inches	If Col (4) = C, D, or E, was water used in effort to establish groundcover or dry-land farming? (Y/N)	Prior year's revegetation category under Col (4)	2021 notes / comments
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
23430712	XY-1	17.7	E					17.7					No		0% (I)				N	E	Not seeded
23440121		58.1	A	58.1						6705477	12876-R-R	14CW3004	Yes			HF		8" and 30"		A	Currently growing wheat
Total:		75.8		58.1	0.0	0.0	0.0	17.7	0.0												

Column Notes and Explanations:

(4) Revegetation Categories from Exhibit F to the 15CW3067 Decree: A - Irrigated Farming; B - Developed Non-Ag Use; C - Established Groundcover; D - Established Dry-Land Farming; E - Not Established; F - Confirmed Revegetated.
(15) See attached narrative description of efforts undertaken in the preceding year to establish groundcover or dryland farming.
(19) Shown as (Stubble height) - (row spacing) in inches.
(20) If Y, see attached narrative description of the source of water, the amount applied, and the method of application.



Legend

- Phase II - Irrigated Farming
- Phase II - Established Groundcover
- Phase II - Not Established
- Phase II - Developed Non-Agricultural Use

0 1,000 2,000 4,000

Scale in Feet

N W E S

Hendrix Wai Engineering, Inc.

Job No.	L101
Date:	10/2/2020
Revision Date:	11/29/2021
Prepared For:	LAWMA

Exhibit A-3

Phase II Land
Lamar Canal

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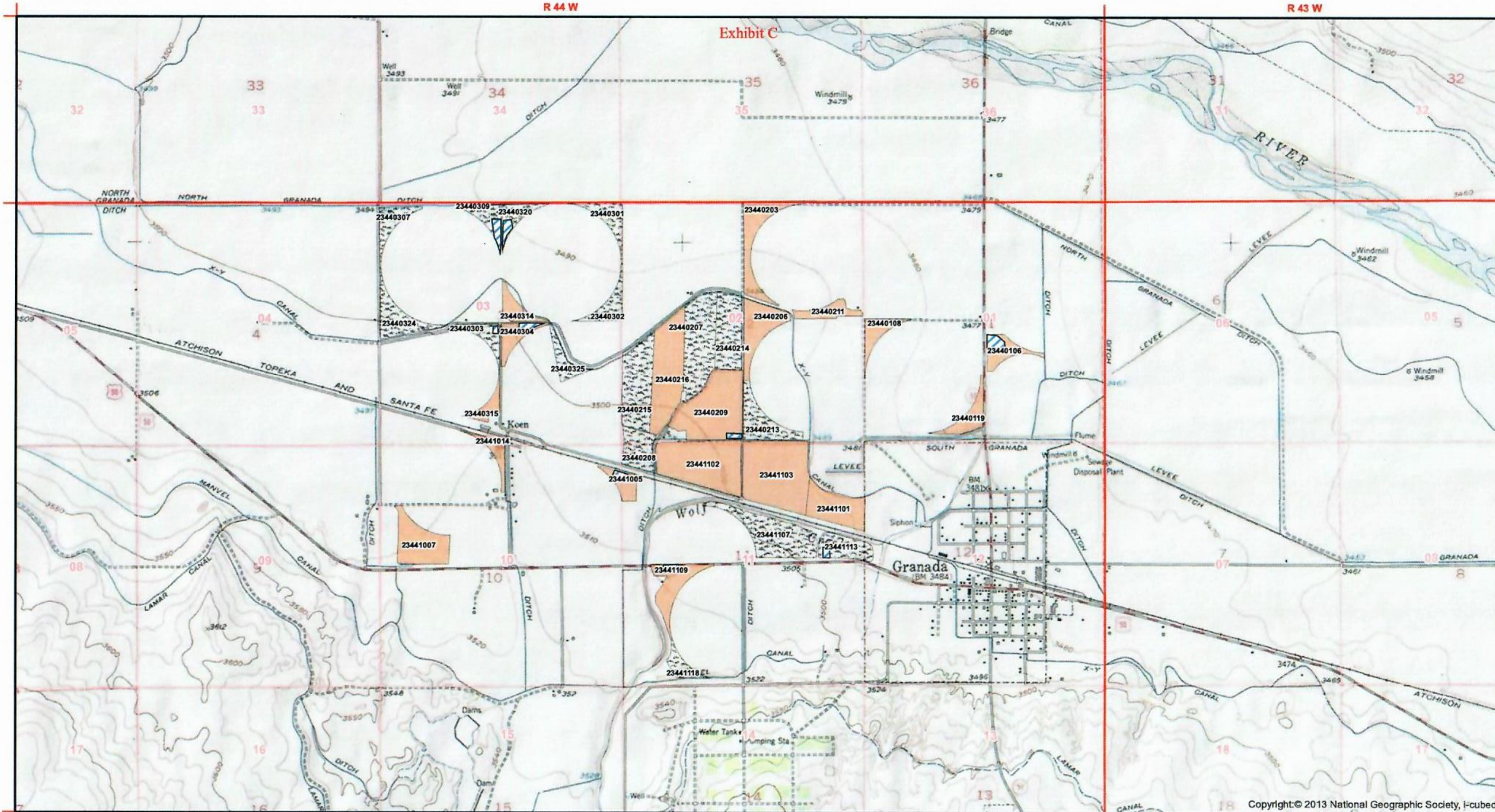

Legend

Phase II - Developed Non-Agricultural Use

Phase II - Established Groundcover

Phase II - Not Established

0 1,000 2,000 4,000

Scale In Feet

N W E S

Hendrix Wai Engineering, Inc.

Job No.	L101
Date:	10/2/2020
Revision Date:	11/30/2021
Prepared For:	LAWMA

Exhibit B-3

Phase II Land
Granada Lateral

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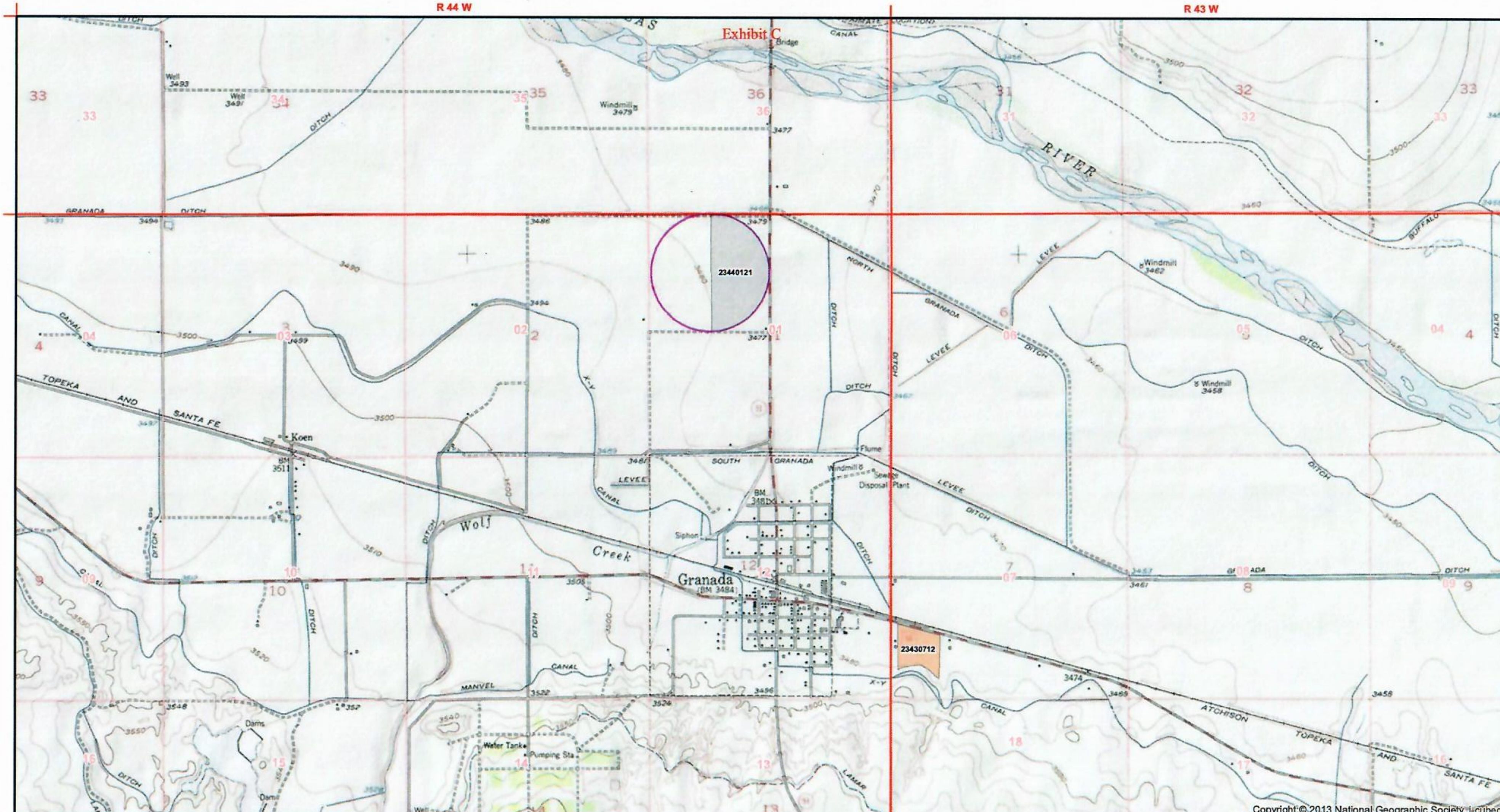

Legend

- Phase II - Irrigated Farming
- Phase II - Not Established

0 1,000 2,000 4,000
Scale in Feet

Hendrix Wai Engineering, Inc.

Job No.	L101
Date:	10/2/2020
Revision Date:	11/29/2021
Prepared For:	LAWMA

Exhibit C-3

Phase II Land
X-Y Irrigating Ditch

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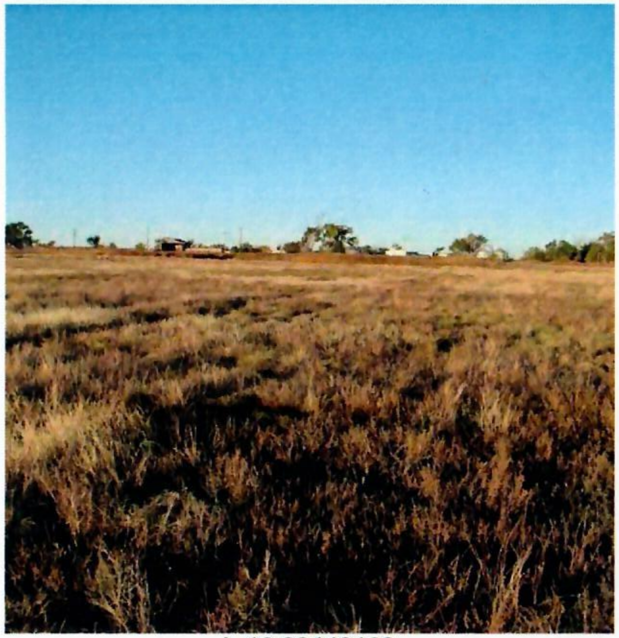
Lamar Canal 10-19-21

Exhibit C



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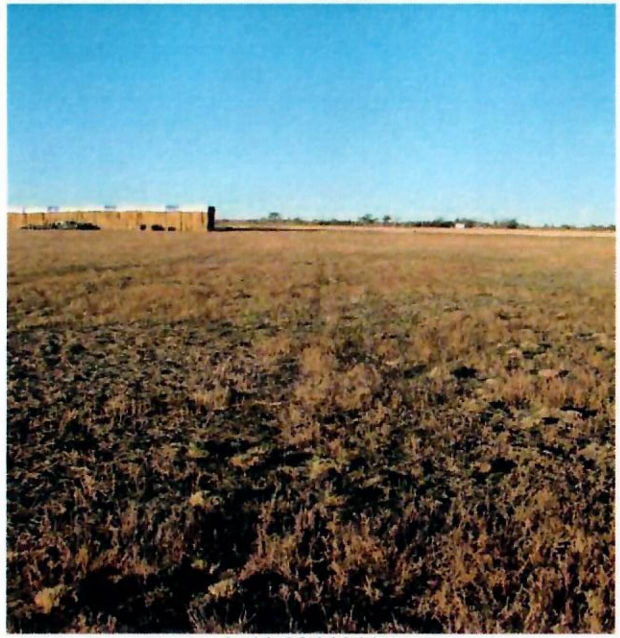

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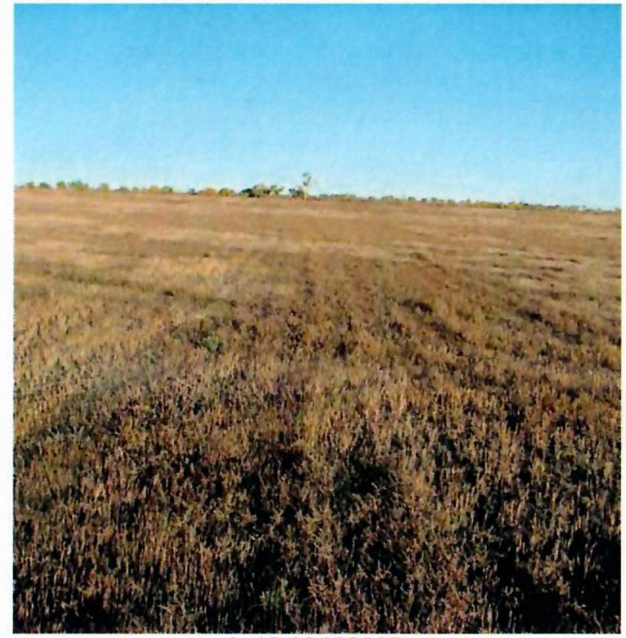

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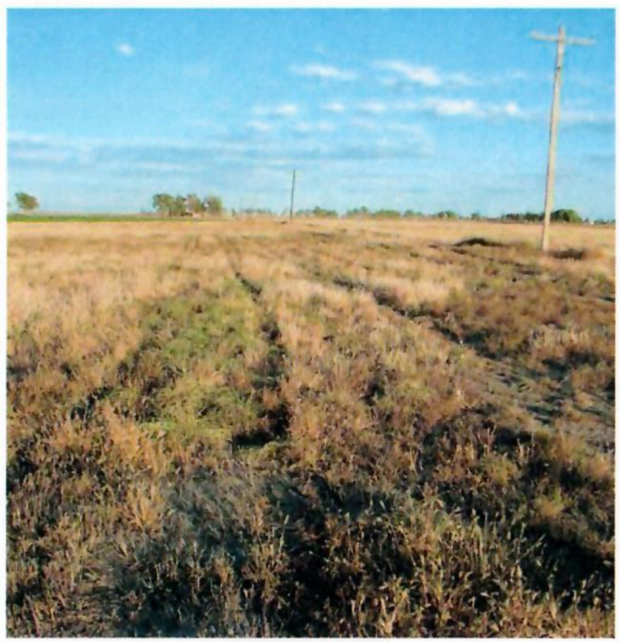

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L-2;23440423

Lamar Canal 10-19-21

Exhibit C

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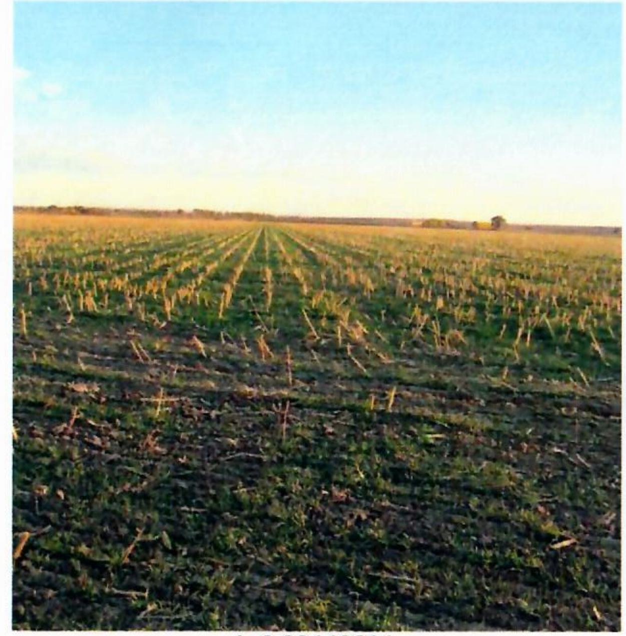
L-5;23440503



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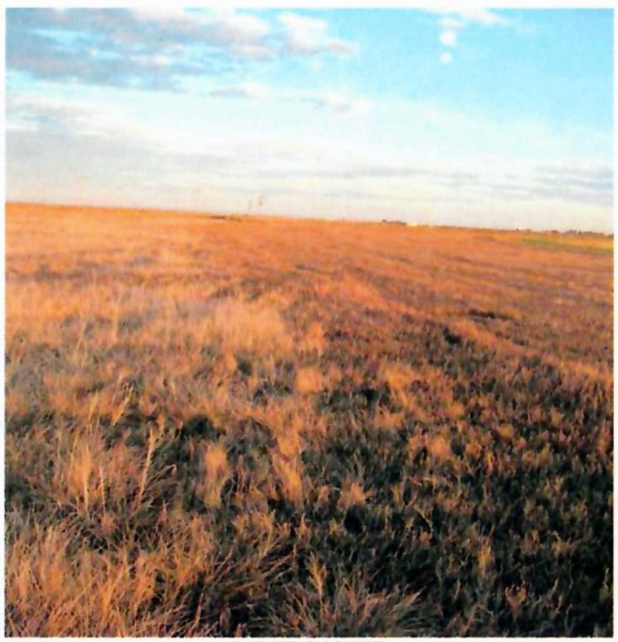

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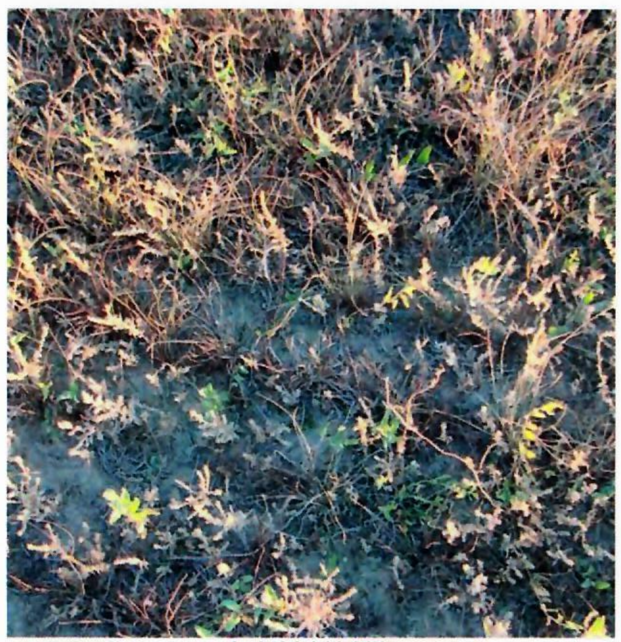

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Granada Lateral 10-19-21

Exhibit C

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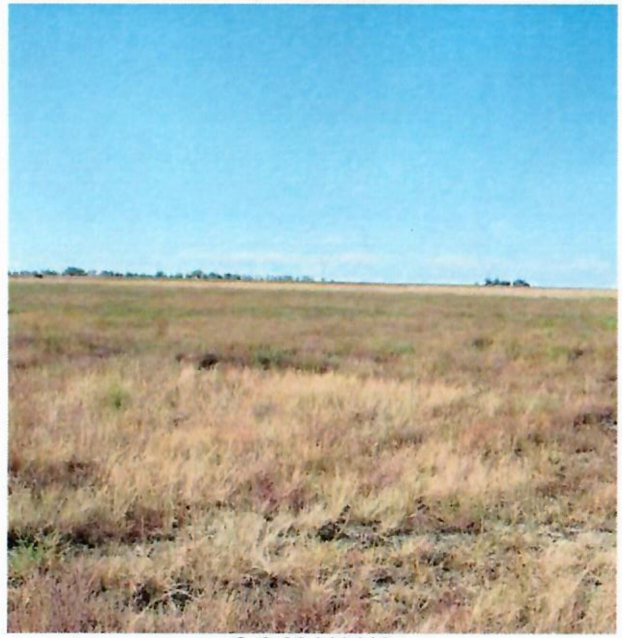

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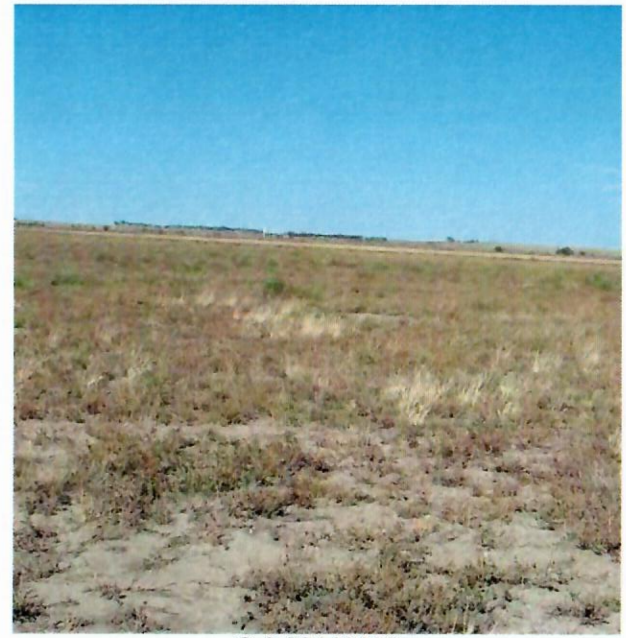

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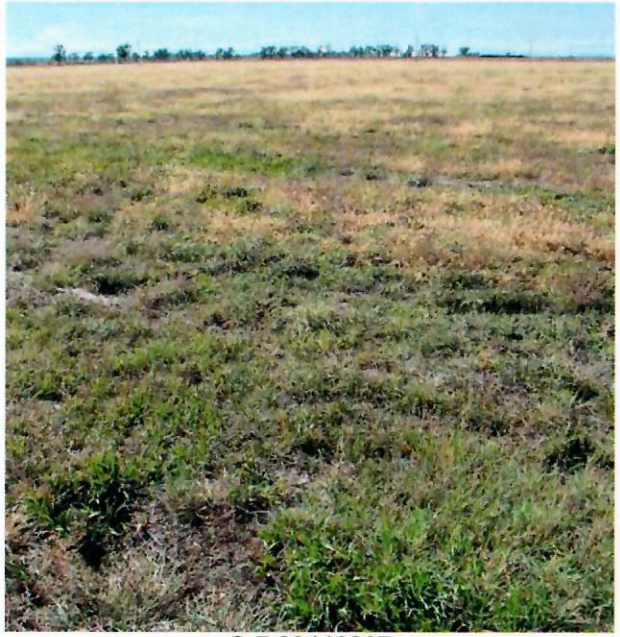
Granada Lateral 10-19-21

Exhibit C



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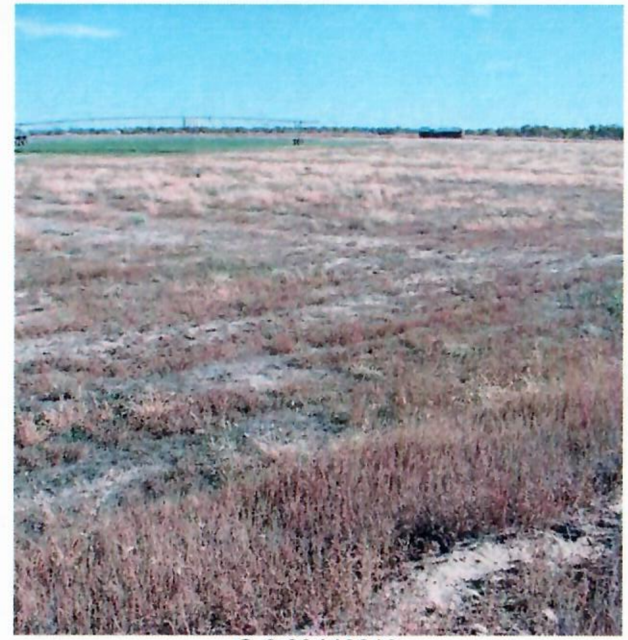

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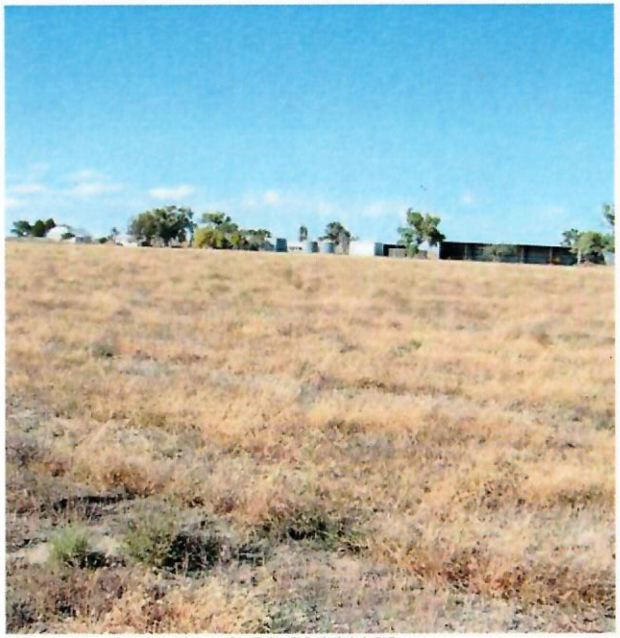
G-11;23441101

G-12;23441103

Granada Lateral 10-19-21

Exhibit C



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G-16;23440215

G-17;23440216

G-18;23440315

Granada Lateral 10-19-21

Exhibit C

G-19;23440304

G-20;23440303

G-21;23440325

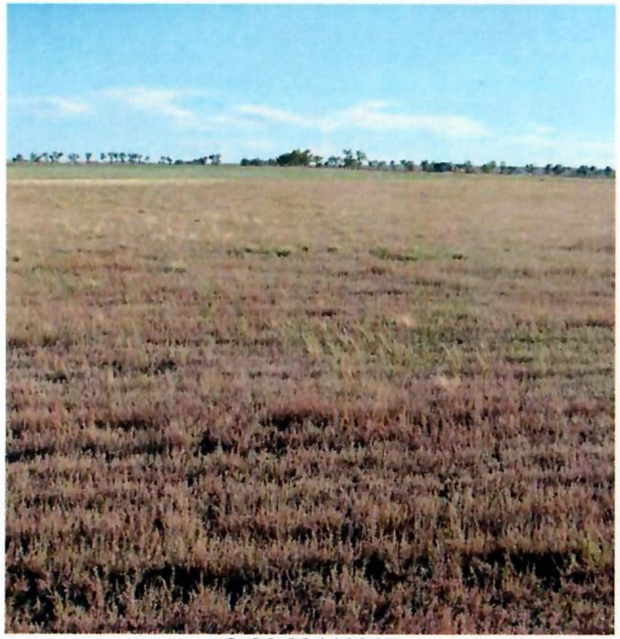
G-23;23440301

G-24;23440320

G-25;23440309

Granada Lateral 10-19-21

Exhibit C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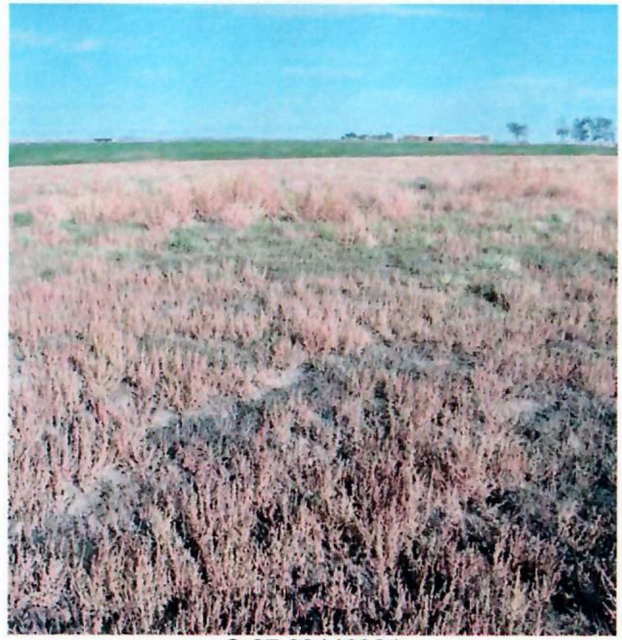
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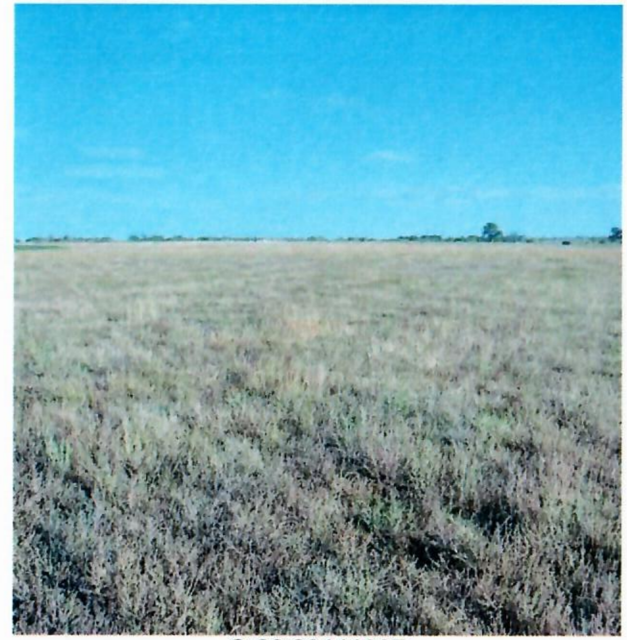
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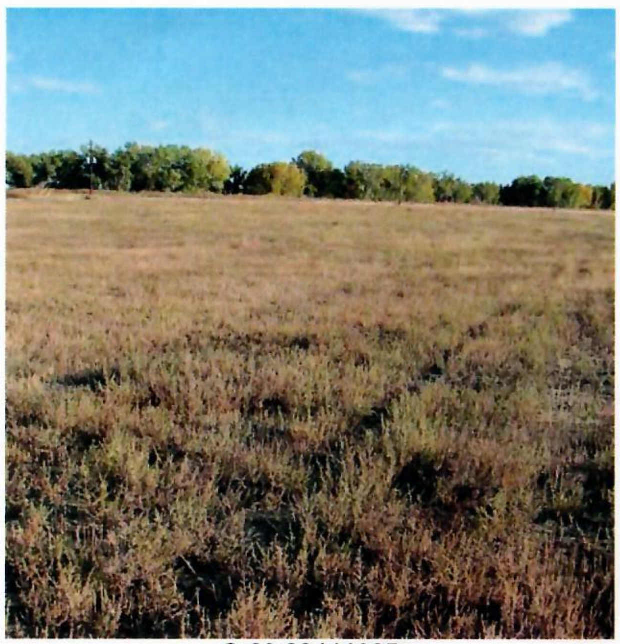
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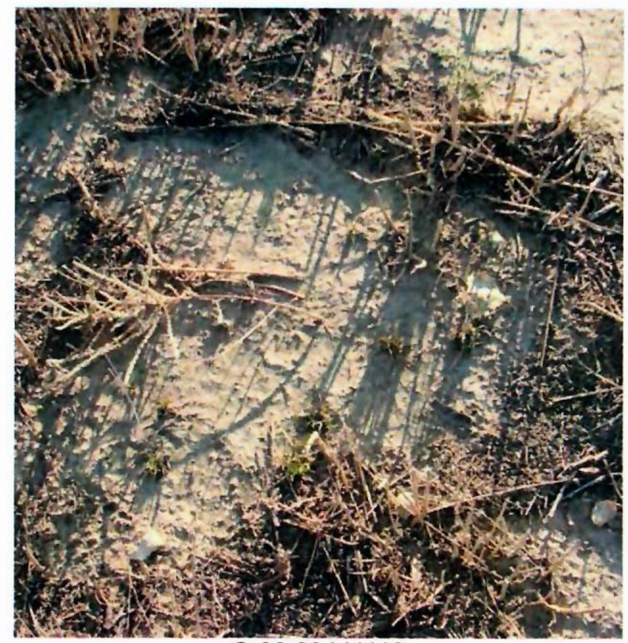
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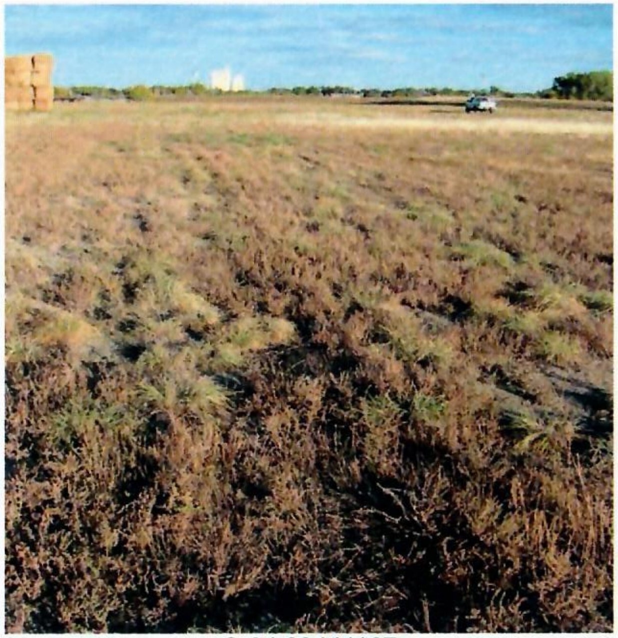
Granada Lateral 10-19-21

Exhibit C



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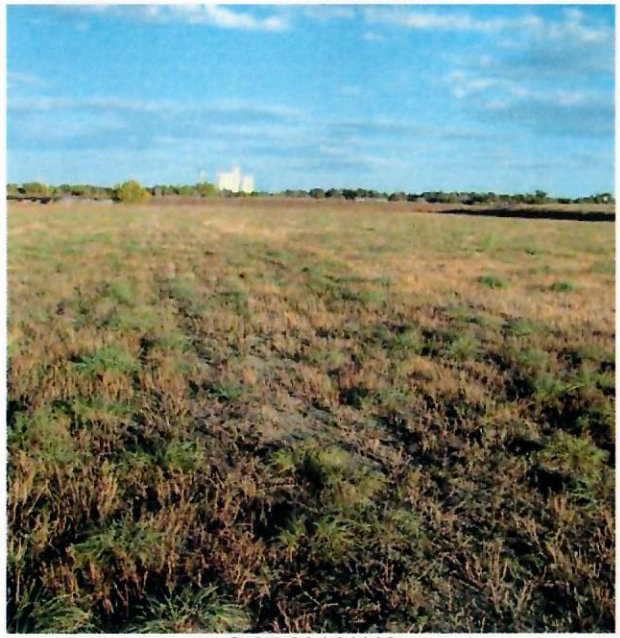


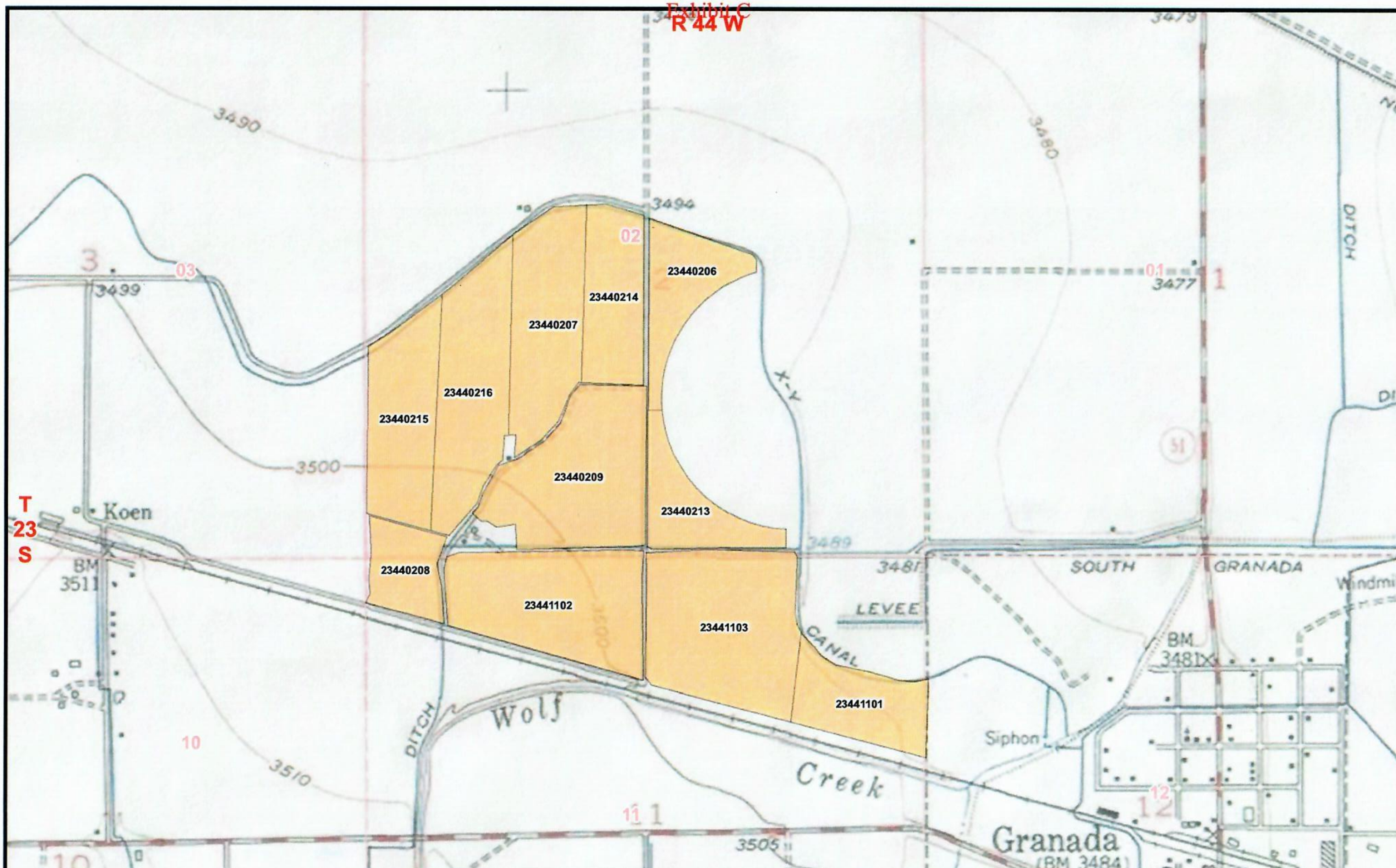
G-35;23441113

XY 10-19-21

Exhibit C

XY-1;23430712

Exhibit C



Legend

S-D Dry-Up Parcels

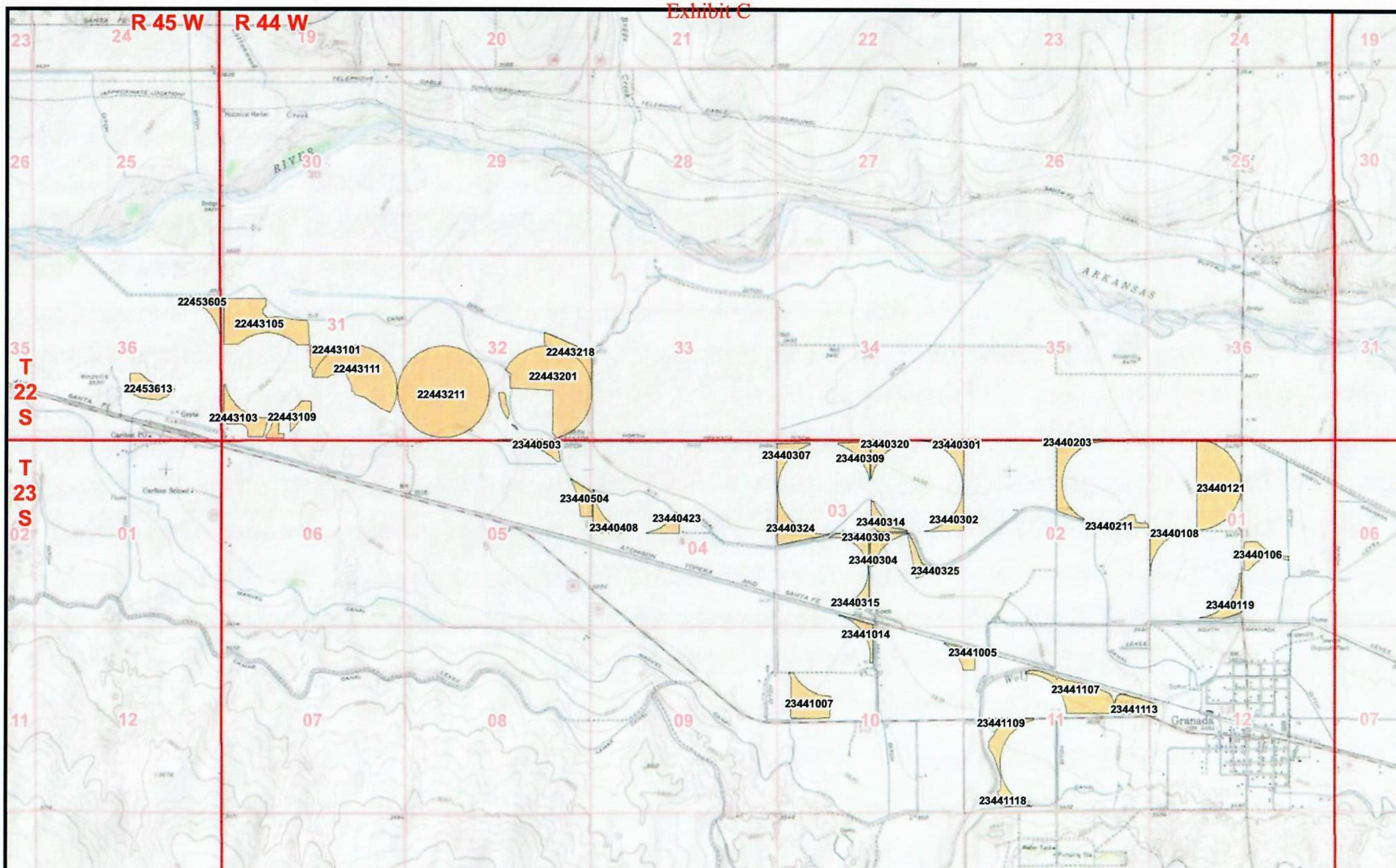
Hendrix Wai Engineering, Inc.

Job No.	L7506
File:	SD Exhibit A.mxd
Date:	10/31/2019
Prepared For:	LAWMA

Exhibit 1

Phase II Land owned by: S-D Investments, LLC

Exhibit C



Job No.	L7506
File:	GP Exhibit A-2.mxd
Date:	12/12/2019
Prepared For:	LAWMA

Exhibit 2

Phase II Land owned by: GP Irrigated Farms, LLC

Hendrix Wai Engineering, Inc.

Legend

GP Dry-Up Parcels

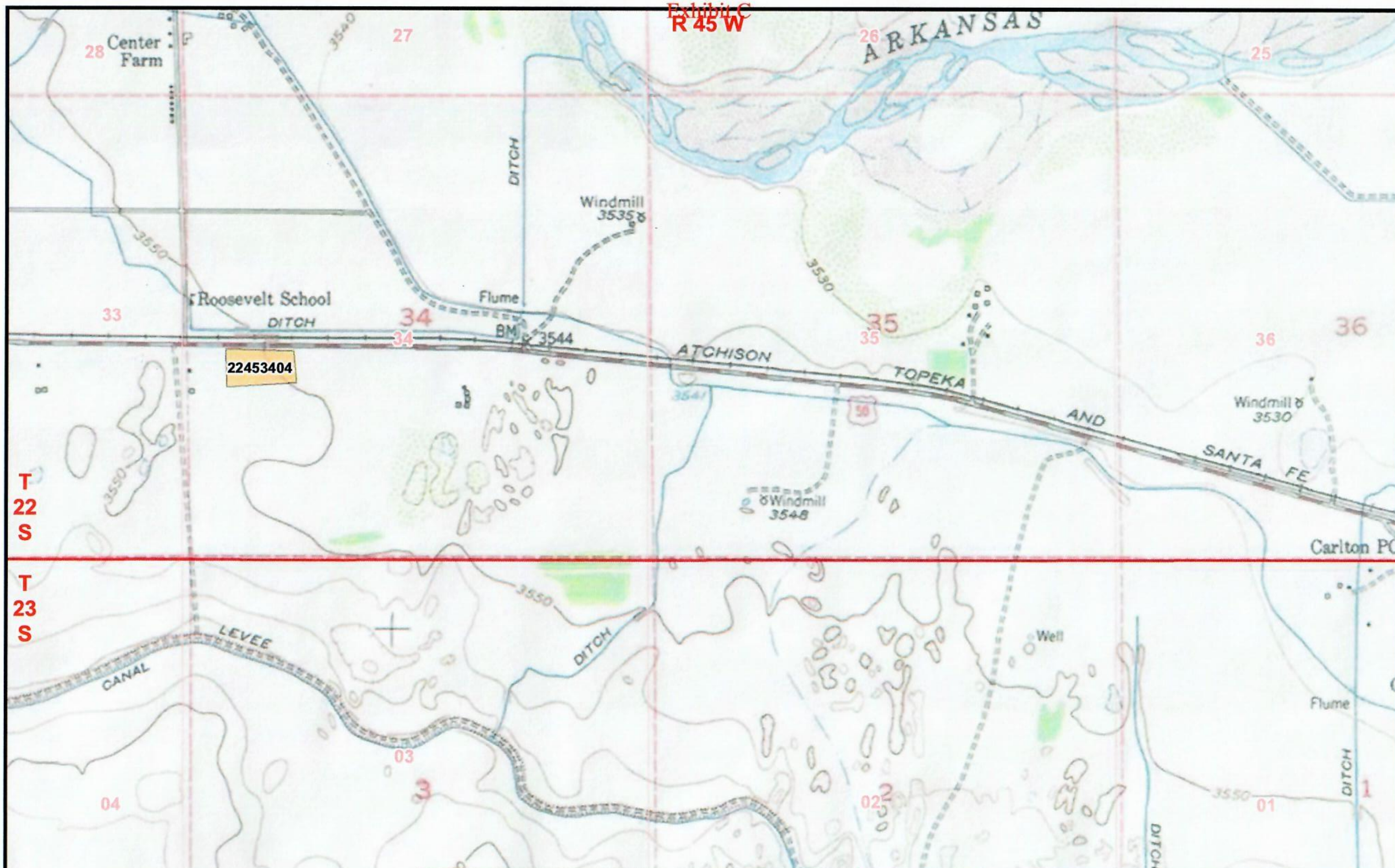


Exhibit 3

Phase II Land owned by: Mr. Higbee

Job No.	L7506
File:	Higbee Exhibit A-2.mxd
Date:	12/12/2019
Prepared For:	LAWMA

Scale in Feet: 0 — 750 — 1,500 — 3,000

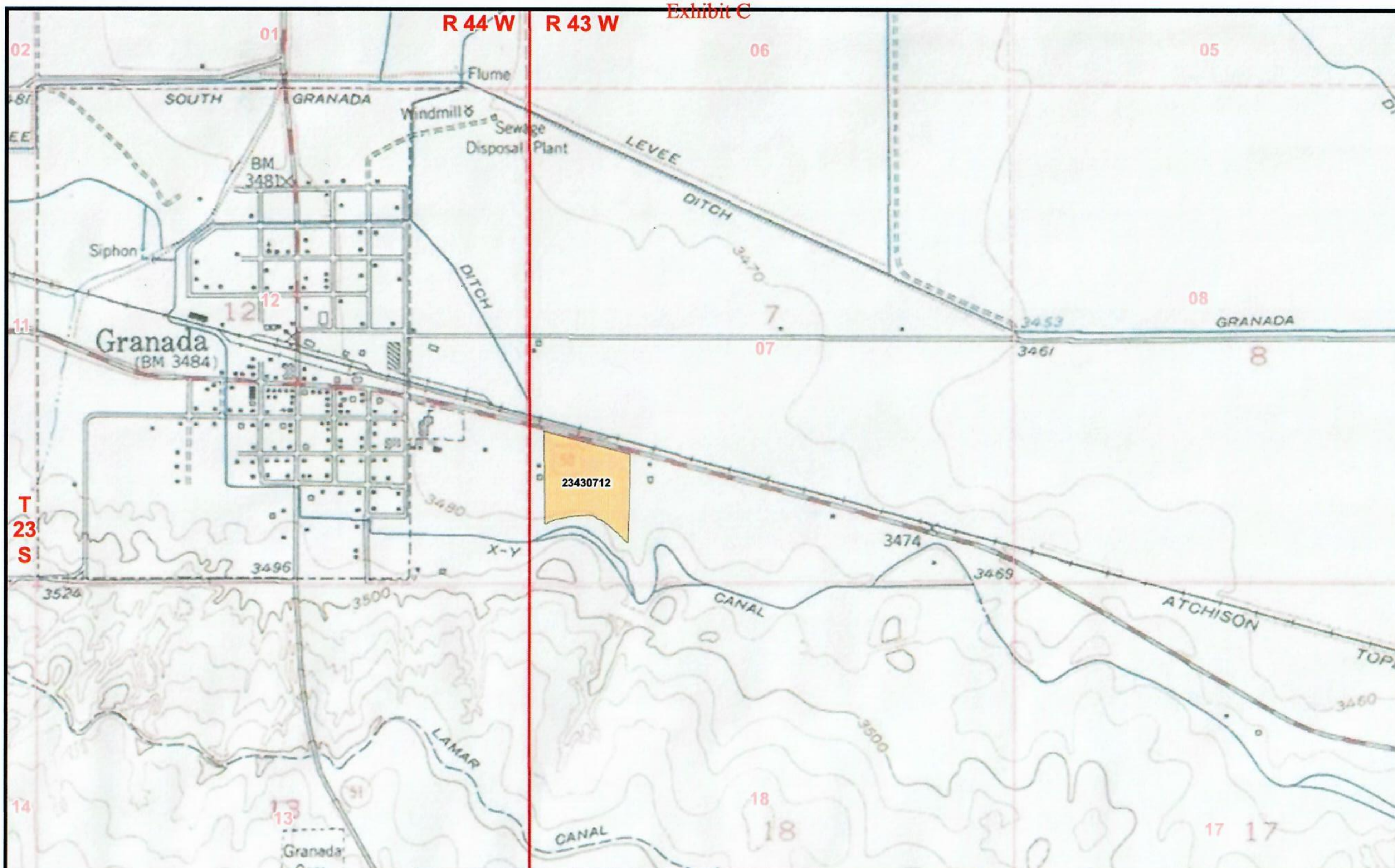
N / E / S / W

Hendrix Wai Engineering, Inc.

Legend

Higbee Dry-Up Parcel

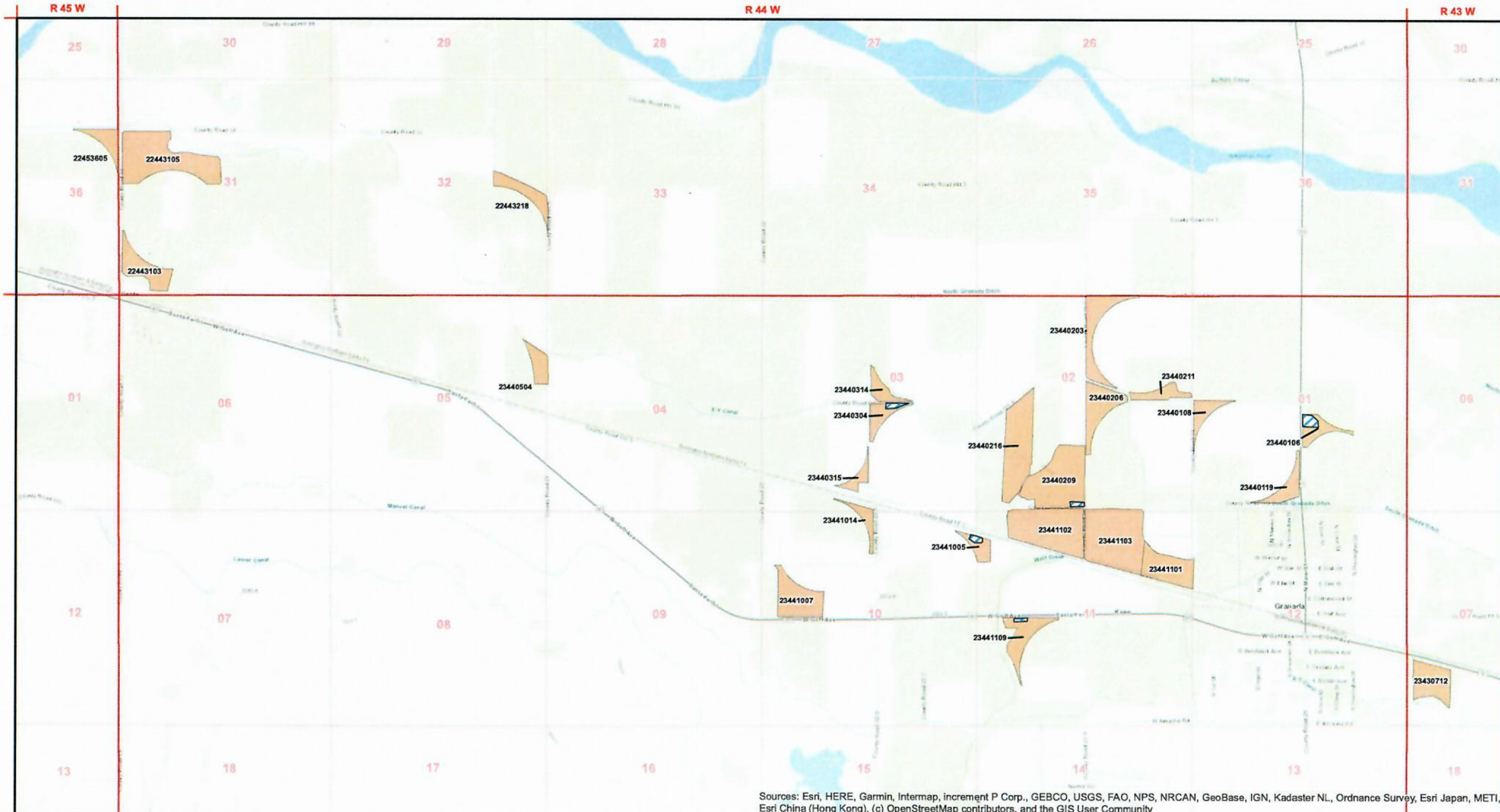
Exhibit C



0 625 1,250 2,500 Scale in Feet	N W E S	Job No. L7506 File: MM Exhibit A.mxd Date: 10/31/2019 Prepared For: LAWMA	**Exhibit 4** **Phase II Land owned by: Mr. McMillan**
	Hendrix Wai Engineering, Inc.		

Legend

McMillan Dry-Up Parcel



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Legend

- Subject Farms Developed for Non-Agricultural Use
- Subject Lands

0 1,125 2,250 4,500
Scale in Feet

N W E S

Hendrix Wai Engineering, Inc.

Job No.	L101
Date:	12/1/2021
Revision Date:	12/1/2021
Prepared For:	LAWMA

Exhibit D

Map of the Subject Lands

Document Path: D:\GIS\L101\Re-vegetation\2021 Report\15CW3067\15CW3067 1041 Permit Map.mxd

Document Name: 15CW3067 1041 Permit Map

Exhibit E
Subject Farms Legal Descriptions

1. Higbee West Farm is located in Section 34 of Township 22 South, Range 45 West, and Section 3 of Township 23 South, Range 45 West of the 6th P.M., Prowers County.

2. DJC-Koehn Farm is located in Section 31 of Township 22 South, Range 44 West and Section 36 of Township 22 South, Range 45 West of the 6th P.M., Prowers County.

3. Grasmick Lamar Farm is located in Sections 31 and 32 of Township 22 South, Range 44 West, and Sections 4 and 5 of Township 23 South, Range 44 West of the 6th P.M., Prowers County.

4. Gass Farm is located in Sections 2 and 11 of Township 23 South, Range 44 West of the 6th P.M., Prowers County.

5. Grasmick Granada Farm is located in Sections 1 through 3, 10 and 11 of Township 23 South, Range 44 West of the 6th P.M., Prowers County.

6. Grasmick XY Farm is located in Section 1 of Township 23 South, Range 44 West of the 6th P.M., Prowers County.

7. McMillan Farm is located in Section 7 of Township 23 South, Range 43 West of the 6th P.M., Prowers County.

Exhibit F

GP IRRIGATED FARMS, LLC
MANAGING MEMBER'S RESOLUTION

The Undersigned, being the **Managing Member** and **Authorized Representative** of **GP Irrigated Farms, LLC** ("the Company"), hereby unanimously resolves that:

1. GP Irrigated Farms, LLC is a Colorado limited liability company and has been validly created and is existing and in good standing under the laws of the State of Colorado.
2. The Managing Member has the power to act for GP Irrigated Farms, LLC in any way necessary to obtain any 1041 permit approval required by Prowers County.
3. The Company hereby authorizes **Doug Geubelle** to negotiate, make, sign, execute and deliver any documents necessary for 1041 permit approval.
4. This Resolution is pursuant to and consistent with the Bylaws and Articles of Organization of the Company, and does not contravene the Bylaws, Articles of Organization, or any contract to which the Company is a party or any judgment or decree by which the Company is bound.
5. The foregoing resolution and act has been duly adopted by the Authorized Representative of the Company at a meeting held on September 24, 2021 duly convened at which a quorum was present and acting.
6. The acts of **Doug Geubelle** in the foregoing regards are and shall be ratified and approved in all respects, without limitation, and this Resolution is in full force and effect as of the date of this certificate.
7. The person named below is the Authorized Representative of the Company, and the specimen signature above his name is his true signature.

This the 22nd day of October, 2021.

A. Jay Houtsma, Managing Member and
Authorized Representative of GP Irrigated Farms, LLC

Witness

Notary Public

Eliana Tarin
Notary Public
State of Kansas
My Appt. Exp. 3-26-22

Exhibit F

GP IRRIGATED FARMS, LLC
MANAGING MEMBER'S RESOLUTION

The Undersigned, being the **Managing Member** and **Authorized Representative** of **GP Irrigated Farms, LLC** ("the Company"), hereby unanimously resolves that:

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2. The Managing Member has the power to act for GP Irrigated Farms, LLC in any way necessary to obtain any 1041 permit approval required by Prowers County.
3. The Company hereby authorizes **Frank C. Mercurio** to negotiate, make, sign, execute and deliver any documents necessary for 1041 permit approval.
4. This Resolution is pursuant to and consistent with the Bylaws and Articles of Organization of the Company, and does not contravene the Bylaws, Articles of Organization, or any contract to which the Company is a party or any judgment or decree by which the Company is bound.
5. The foregoing resolution and act has been duly adopted by the Authorized Representative of the Company at a meeting held on September 24, 2021 duly convened at which a quorum was present and acting.
6. The acts of **Frank C. Mercurio** in the foregoing regards are and shall be ratified and approved in all respects, without limitation, and this Resolution is in full force and effect as of the date of this certificate.
7. The person named below is the Authorized Representative of the Company, and the specimen signature above his name is his true signature.

This the 22nd day of October, 2021.

A. Jay Houtsma, Managing Member and
Authorized Representative of GP Irrigated Farms, LLC

Witness

Notary Public

Eliana Tarin
Notary Public
State of Kansas
My Appt. Exp. 3.26.22

Exhibit G

S-D INVESTMENTS, LLC
MANAGING MEMBER'S RESOLUTION

The Undersigned, being the **Managing Member** and **Authorized Representative** of **S-D Investments, LLC** ("the Company"), hereby unanimously resolves that:

1. S-D Investments, LLC is a Kansas limited liability company and has been validly created and is existing and in good standing under the laws of the State of Kansas.
2. The Managing Member has the power to act for S-D Investments, LLC in any way necessary to obtain any 1041 permit approval required by Prowers County.
3. The Company hereby authorizes **Doug Geubelle** to negotiate, make, sign, execute and deliver any documents necessary for 1041 permit approval.
4. This Resolution is pursuant to and consistent with the Bylaws and Articles of Organization of the Company, and does not contravene the Bylaws, Articles of Organization, or any contract to which the Company is a party or any judgment or decree by which the Company is bound.
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6. The acts of **Doug Geubelle** in the foregoing regards are and shall be ratified and approved in all respects, without limitation, and this Resolution is in full force and effect as of the date of this certificate.
7. The person named below is the Authorized Representative of the Company, and the specimen signature above his name is his true signature.

This the 22nd day of October, 2021.

A. Jay Houtsma, Managing Member and
Authorized Representative of S-D Investments, LLC

Witness

Eliana Tarin

Notary Public

Eliana Tarin
Notary Public
State of Kansas
My Appt. Exp. 3.26.22

Exhibit G

S-D INVESTMENTS, LLC
MANAGING MEMBER'S RESOLUTION

The Undersigned, being the **Managing Member** and **Authorized Representative** of **S-D Investments, LLC** ("the Company"), hereby unanimously resolves that:

1. S-D Investments, LLC is a Kansas limited liability company and has been validly created and is existing and in good standing under the laws of the State of Kansas.
2. The Managing Member has the power to act for S-D Investments, LLC in any way necessary to obtain any 1041 permit approval required by Prowers County.
3. The Company hereby authorizes **Frank C. Mercurio** to negotiate, make, sign, execute and deliver any documents necessary for 1041 permit approval.
4. This Resolution is pursuant to and consistent with the Bylaws and Articles of Organization of the Company, and does not contravene the Bylaws, Articles of Organization, or any contract to which the Company is a party or any judgment or decree by which the Company is bound.
5. The foregoing resolution and act has been duly adopted by the Authorized Representative of the Company at a meeting held on September 24, 2021 duly convened at which a quorum was present and acting.
6. The acts of **Frank C. Mercurio** in the foregoing regards are and shall be ratified and approved in all respects, without limitation, and this Resolution is in full force and effect as of the date of this certificate.
7. The person named below is the Authorized Representative of the Company, and the specimen signature above his name is his true signature.

This the 22nd day of October, 2021.

A. Jay Houtsma, Managing Member and
Authorized Representative of S-D Investments, LLC

Witness

Notary Public

Eliana Tarin
Notary Public
State of Kansas
My Appt. Exp. 3.26.22

537496

REC # 537496 11/03/2014 08:30:00 AM
AGR Page: 1 of 10 R:56.00 D:0.00
Prowers County, CO

After recording please return to
Lower Arkansas Water Management Association
P.O. Box 1161
Lamar, Colorado 81052

AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS

THIS AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS ("Agreement") is entered into this **17th** day of October, 2014, by and between Lawrence L. McMillan, an individual residing in Colorado whose address is P.O. Box 34, Granada, Colorado, 81041 ("McMillan"), as Grantor, and Lower Arkansas Water Management Association, a Colorado non-profit corporation ("LAWMA"), as Grantee (together, the "Parties").

RECITALS

A. McMillan and LAWMA enter into this Agreement as additional consideration for LAWMA's issuance of 16 shares of common LAWMA stock (the "LAWMA Shares") to McMillan in trade for 0.5 cfs of the 69.0 cfs originally decreed to the X-Y Irrigating Ditch Company's Canal ("X-Y Water Right"), pursuant to the Water Rights Exchange Agreement between the Parties ("Exchange Agreement") and as more particularly described therein.

B. McMillan and his predecessors-in-interest historically have used the X-Y Water Right to irrigate approximately 17 acres of real property located in portions of the Southwest Quarter of Section 7 in Township 23 South, Range 43 West of the Sixth Principal Meridian, as more particularly shown on the map attached as **Exhibit A** (the "Dry-Up Land").

C. McMillan acknowledges that LAWMA intends to use the X-Y Water Right for augmentation and replacement purposes, and that to effect such uses, the X-Y Water Right will need to be changed permanently in a change of water rights proceeding before the Water Court for Division 2 (the "Water Court Change Case"), and temporarily pursuant to a substitute water supply plan ("SWSP") or interruptible water supply agreement ("IWSA") approved by the Office of the State Engineer. McMillan further acknowledges that the Water Court and/or the State Engineer may require, as terms and conditions of such a change, that the Dry-Up Land be dried up and either revegetated or established and maintained in dry-land farming practices.

D. McMillan and LAWMA desire to enter into this Agreement to affirm the permanent cessation of use of the X-Y Water Right on the Dry-Up Land, to confirm McMillan's obligation either to revegetate or to establish and maintain dry-land farming practices on the Dry-

Up Land, and to provide for a right of entry and easements for LAWMA and its agents, and for LAWMA's successors and assigns and their agents, upon the Dry-Up Land for the purposes of enforcing this Agreement and the decree and any orders entered by the Water Court in the Water Court Change Case.

NOW, THEREFORE, in consideration of LAWMA's issuance of the LAWMA Shares in trade for the X-Y Water Right and other consideration, McMillan hereby covenants, agrees, and grants as follows:

SECTION 1 - Real Covenant for Dry-Up

1.1 McMillan covenants and agrees to cease irrigation of the Dry-Up land with the X-Y Water Right.

1.2 McMillan covenants and agrees that the Dry-Up Land will not be irrigated with any source of water unless the water used for such irrigation is ground water that is treated as sole-source pumping and is fully augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division No. 2, or an SWSP or Arkansas River replacement plan approved by the Colorado State Engineer; provided, however, that McMillan is prohibited from performing such irrigation with ground water in a way that reduces the consumptive use credit available to LAWMA from the X-Y Water Right under the terms and conditions of any decree entered in the Water Court Change Case.

1.3 McMillan shall ensure that the Dry-Up Land complies with all terms and conditions included in the *Kansas v. Colorado* Operating Procedures for Administration of Parcels Claimed for Augmentation Credit ("*Kansas v. Colorado* Dry-Up Agreement"), a copy of which is attached to the Exchange Agreement as **Exhibit C**. Those terms and conditions include, without limitation, requirements that a physical separation must exist between any irrigated portion of a parcel and the dry-up portion unless the Division Engineer gives prior approval, that parcels formerly containing alfalfa or alfalfa-grass stands must be deep tilled or chemically killed, and that dry-up parcels must be monumented in accordance with specific standards.

1.4 McMillan covenants and agrees that in addition to the dry-up requirements for the Dry-Up Land imposed by this Real Covenant for Dry-Up, McMillan also shall meet any dry-up obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the X-Y Water Right in any SWSP, IWSA, Arkansas River Replacement Plan pursuant to Rule 14 of the Amended Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the Arkansas River Basin ("Rule 14 Plan"), and/or Compact Compliance Plan pursuant to Rule 10 of the Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado ("Rule 10 Plan").

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Prowers County, CO

1.5 Successful completion of dry-up of the Dry-Up Land will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion. In the event the Water Court retains jurisdiction in the Water Court Change Case to certify successful completion of dry-up of the Dry-Up Land as a condition to transferring the consumptive use credit available to LAWMA for the X-Y Water Right, then the determination of whether dry-up of the Dry-Up Land has been successfully completed will be made by the Water Court.

1.6 This Real Covenant for Dry-Up, with the burdens it imposes, is binding upon and will run with the Dry-Up Land forever, and is forever enforceable against McMillan and his successors and assigns in the Dry-Up Land for the benefit of X-Y Water Right, LAWMA, and LAWMA's successors and assigns.

SECTION 2 - Real Covenant for Revegetation or Dry-Land Farming

2.1 As used in this Agreement, the term "revegetation" means ground cover of plant life demonstrated to be, without irrigation, reasonably capable of sustaining itself under the climatic conditions, soils, precipitation and terrain prevailing on the Dry-Up Land, with weeds adequately controlled; and the term "dry-land farming" means dry-land farming practices with weeds adequately controlled.

2.2 So long as McMillan is irrigating the Dry-Up Land for agricultural production purposes in accordance with the terms and conditions in Section 1.2 above, the revegetation and dry-land farming obligations described in this Section 2 will not apply. Upon cessation of irrigation of the Dry-Up Land for agricultural production purposes pursuant to Section 1.2 above, McMillan immediately shall revegetate or establish and maintain dry-land farming practices on the Dry-Up Land in accordance with the terms and conditions of this Section 2. Within sixty days of ceasing irrigation of the Dry-Up Land for agricultural production purposes, McMillan shall provide LAWMA with written notice of that cessation, by email to lawma@cminet.net, with a copy to rmehren@mwhw.com.

2.3 No later than the end of the third growing season after irrigation for agricultural purposes has ceased on the Dry-Up Land pursuant to Section 1.2 above (the "Revegetation/Dry-Land Farming Deadline"), McMillan shall have established and maintained either revegetation or dry-land farming on the Dry-Up Land. For either revegetation or dry-land farming to be "maintained" on the Dry-Up Land, such revegetation or dry-land farming must have been established for more than one growing season. McMillan shall pay all costs of the revegetation, dry-land farming, and weed control of the Dry-Up Land, including without limitation the payment of all power costs for associated well pumping and leasing of water for the purpose of revegetation.

2.4 The species of grass or other plants used for revegetation may not include grasses or other plants defined as "noxious" under the provisions of the Colorado Weed

Management Act, Article 5.5 of Title 35, C.R.S., and may not include alfalfa or other highly water-consumptive species.

2.5 McMillan covenants and agrees that in addition to the revegetation and dry-land farming requirements imposed by this Real Covenant for Revegetation or Dry-Land Farming, McMillan also shall meet any revegetation or dry-land farming obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the X-Y Water Right in any SWSP, IWSA, Rule 14 Plan, and/or Rule 10 Plan. McMillan also shall take any and all actions as may be necessary to comply with any requirements imposed upon McMillan and/or LAWMA by federal, state, and/or local government authorities due to the removal of the X-Y Water Right from the Dry-Up Land, including without limitation any requirements imposed by a 1041 permit, if any, issued by Prowers County. If a decree is entered in the Water Court Change Case after the Revegetation/Dry-Land Farming Deadline, McMillan shall satisfy any additional terms and conditions for revegetation and/or dry-land farming in that decree.

2.6 Successful completion of revegetation of the Dry-Up Land will be determined by LAWMA and its successors and assigns, using applicable Conservation Reserve Program criteria or the criteria imposed by the Water Court, whichever standards are strictest. Successful establishment and maintenance of dry-land farming of the Dry-Up Land will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion, or by the Water Court. At McMillan's request, the Revegetation/Dry-Land Farming Deadline will be extended by one year for each year that, from the year of closing and up to and including the year of the Revegetation/Dry-Land Farming Deadline, the amount of precipitation measured at the Lamar precipitation station falls below 80% of the March through August average of 10.4 inches (1950-2004 average). Until the decree is entered in the Water Court Change Case, at McMillan's request, LAWMA will extend the Revegetation/Dry-Land Farming Deadline upon a showing by McMillan that his efforts to establish and maintain dry-land farming practices or revegetation have been materially hindered due to circumstances beyond McMillan's control, including fire, hail storms, wind storms, tornadoes, flooding, and freezes after May 15 and before September 15 of any year from the year of closing up to and including the year of the Revegetation/Dry-Land Farming Deadline; after the decree is entered in the Water Court Change Case, at McMillan's request, LAWMA may extend the Revegetation/Dry-Land Farming Deadline upon a showing by McMillan that his efforts to establish and maintain dry-land farming have been materially hindered due to the same circumstances.

2.7 In the alternative to meeting the obligations imposed by Sections 2.2, 2.3, and 2.5 above, McMillan may demonstrate to LAWMA's satisfaction that the Dry-Up Land has been developed with structures and improvements such that the Dry-Up Land is not susceptible to erosion, weeds, or agricultural uses.

2.8 This Real Covenant for Revegetation or Dry-Land Farming, with the burdens it imposes, is binding upon and will run with the Dry-Up Land forever, and is forever enforceable against McMillan and his successors and assigns in the Dry-Up Land for the benefit of the X-Y Water Right, LAWMA, and LAWMA's successors and assigns.

SECTION 3 - Right of Entry and Easements

3.1 McMillan hereby grants to LAWMA a non-exclusive right of entry to, upon, under, and across the Dry-Up Land for the purposes of providing a reasonable means for LAWMA and its agents, as well as the Colorado Division of Water Resources and the Water Court, to take all actions reasonably necessary to ensure that McMillan has met his obligations under this Agreement and the decree or any orders entered in the Water Court Change Case, including without limitation site inspections, installation of observation wells, piezometers, or lysimeters, performance of soil evaporation and plant transpiration tests, and performance of vegetative studies and surveys.

3.2 McMillan hereby further grants to LAWMA and/or its agents easements (i) to construct, operate, and maintain on the Dry-Up Land such facilities as are required by the decree or any orders entered in the Water Court Change Case for replication of historical return flows from irrigation use of the X-Y Water Right, including without limitation storage reservoirs and/or recharge facilities; (ii) to use such portions of the surface and subsurface of the Dry-Up Land as are necessary to replicate historical return flows from irrigation use of the X-Y Water Right; and (iii) to perform all acts necessary, including without limitation engineering and historical consumptive use studies, to prosecute the Water Court Change Case and/or an application for a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA using the X-Y Water Right as a source of supply. McMillan and LAWMA acknowledge and agree that the exact nature, extent, and location of these easements are difficult to define in advance of completion of the Water Court Change Case or any Administrative Proceeding for approval of a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA. McMillan and LAWMA agree that the absence of specified locations for the easements on the Dry-Up Land does not void or render the easements unenforceable. To the extent reasonably practical, any easement that may require the construction of a physical structure on the Dry-Up Land will be located in a manner so as not to interfere unreasonably with McMillan's continued and proposed future use of the Dry-Up Land. Upon identification of an acceptable location for any facilities required under Paragraphs 3.2(i) and (ii), the Parties shall create and record a specific legal description of easements therefor. Upon such recording, the balance of the Dry-Up Land will be automatically released from Paragraphs 3.2(i) and (ii).

3.3 In the event that McMillan defaults in his obligations for dry-up and revegetation or dry-land farming hereunder, this right of entry and these easements also will entitle LAWMA, at McMillan's expense, to take all actions necessary to accomplish the dry-up and revegetation or dry-land farming of the Dry-Up Land, including without limitation constructing drainage and conveyance ditches, monumenting dried-up acreage,

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Prowers County, CO

revegetating with drought-resistant plants, removing alfalfa and other deep-rooted plants, trees, phreatophytes, and tamarisk, and removing and filling in all or portions of irrigation ditches and/or farm laterals; provided, however, that McMillan will not be required to incur out-of-pocket expenses in excess of $200 per acre, for a maximum of $3,400, to complete the actions necessary to dry-up and revegetate or dry-land farm the Dry-Up Land as required by Sections 1 and 2 above.

3.4 This non-exclusive right of entry and these non-exclusive easements, with the burdens they impose, are binding upon and will run with the Dry-Up Land forever, and are forever enforceable against McMillan and his successors and assigns in the Dry-Up Land for the benefit of the X-Y Water Right, LAWMA, and LAWMA's agents, successors, and assigns.

SECTION 4 - General Provisions

4.1 The terms and conditions of this Agreement and the real covenants given and non-exclusive right of entry and non-exclusive easements granted herein are perpetual and will not expire unless specifically released in writing by LAWMA or its successor or assign.

4.2 This Agreement may be enforced by LAWMA or its successor or assign, by any party having any right, title, or interest in the X-Y Water Right, or by the State Engineer of the State of Colorado, through an action at law or in equity.

4.3 McMillan is and will be entitled to use the Dry-Up Land for any purpose not inconsistent with this Agreement, including but not limited to the mining and removal of sand, gravel, and other materials; dry-land grazing; and recreational, residential, commercial, and industrial purposes.

4.4 McMillan shall reasonably cooperate with LAWMA to demonstrate the dry-up and revegetation of the Dry-Up Land, including but not limited to providing affidavits or testimony at no cost to LAWMA.

4.5 Upon LAWMA's transfer of the X-Y Water Right to any party, that party will succeed to LAWMA's interest in this Agreement and will have the right to enforce the terms of the Agreement against McMillan or the then-current owner of the Dry-Up Land.

4.6 All attached exhibits to this Agreement are incorporated herein by this reference.

4.7 LAWMA shall record this Agreement in the real property records of the Prowers County Clerk and Recorder.

Executed and effective as of the date first written above.

Exhibit H

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Prowers County, CO

LAWRENCE L. MCMILLAN

Lawrence L. McMillan

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

William J. Grasmick, President

ATTEST:

Donald F. Higbee, Secretary

00091141-1

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AGR Page: 8 of 10 R:56.00 D:0.00
Prowers County, CO

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this **17th** day of October, 2014, by Lawrence L. McMillan, an individual residing in Colorado.

Witness my hand and official seal.

My commission expires: 12-20-2015

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 12/20/2015

Angela HigBee
Notary Public

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this **17th** day of October, 2014, by William J. Grasmick, President, and Donald F. Higbee, Secretary, of the Lower Arkansas Water Management Association, a Colorado non-profit corporation.

Witness my hand and official seal.

My commission expires: 12-20-2015

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 12/20/2015

Angela HigBee
Notary Public

Exhibit H

REC # 537496 11/03/2014 08:30:00 AM
AGR Page: 9 of 10 R:56.00 D:0.00
Prowers County, CO

0 1,000 2,000 4,000

Scale in Feet

N W E S

Job No. L101		
File: McMillan Exhibit A.mxd		
Date: 08/08/14		
Prepared For: LAWMA		

Slattery & Hendrix Engineering LLC

Exhibit A

McMillan Property X-Y Acreage & Dry-Up

LENDER CONSENT, APPROVAL, SUBORDINATION, AND WAIVER

The undersigned is the beneficiary under that certain Deed of Trust ("Deed of Trust") dated April 2, 2004, recorded on April 20, 2004 at Reception No. 503930, Prowers County, Colorado real property records (the "Deed of Trust"). Consent and approval are hereby given by the undersigned to the foregoing "AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRYLAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS" (the "Dry-Up Covenant") to which this Consent, Approval and Subordination is attached. For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned hereby unconditionally and irrevocably subordinates the lien of its Deed of Trust to the Dry-Up Covenant, agrees that its Deed of Trust shall be subject to the Dry-Up Covenant as the same may be assigned, and waives any claim that the Dry-Up Covenant constitutes a transfer without Lender's prior written consent pursuant to the section of the Deed of Trust, entitled, "Due on Sale – Consent by Lender."

Dated in ____________, ____________, this 22nd day of September, 2014.

By: Martin E Jensen

By: ____________________

Name: Martin E. Jensen

Title: President

Date: 9/22/14

STATE OF COLORADO)
) ss.
COUNTY OF PROWERS)

The foregoing **LENDER CONSENT, APPROVAL, SUBORDINATION, AND WAIVER** was acknowledged before me this 22 day of SEPTEMBER, 2014, by MARTIN E JENSEN as PRESIDENT of COLORADO EAST BANK & TRUST

Witness my hand and official seal

Cathy L. Huerta
Notary Public

My Commission Expires: 6-5-17

SEAL

CATHY L. HUERTA
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20014017027
MY COMMISSION EXPIRES 06/05/2017

AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS

THIS AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS ("Agreement") is entered into this 5 day of June, 2017, by and between S-D INVESTMENTS, LLC, a Kansas limited liability company ("S-D"), as Grantor, and Lower Arkansas Water Management Association, a Colorado non-profit corporation ("LAWMA"), as Grantee (together, the "Parties").

Recitals

A. S-D and LAWMA enter into this Agreement as additional consideration for LAWMA's issuance of 1,000 shares of common LAWMA stock (the "LAWMA Shares") to S-D in trade for 314.5 of the 3,030 shares of capital stock outstanding in the Granada Irrigation Company ("S-D Trade Water") pursuant to that certain Amended and Restated Water Rights Exchange Agreement and Reimbursement Agreement between the Parties dated June 13, 2017 ("Exchange Agreement"), and as more particularly described therein.

B. S-D and its predecessors-in-interest historically have used the S-D Trade Water to irrigate approximately 314.4 acres of real property generally located in portions of the S1/2 NW1/4, SW1/4, SW1/4 NE1/4, and the SE1/4 of Section 2 and the N1/2 NW1/4 and the NE1/4 and the NW 1/4 of Section 11, all in Township 23 South, Range 44 West of the 6th P.M., Prowers County, Colorado, as more particularly shown on the map attached as Exhibit A (the "Gass Farm Dry-Up"). The 314.5 Granada Irrigation Company shares that make up S-D Trade Water are represented by Stock Certificate No. 220, and previously were represented by Stock Certificate No. 219.

C. S-D acknowledges that LAWMA intends to use the S-D Trade Water for augmentation and replacement purposes, and that to effect such uses, the S-D Trade Water will need to be changed permanently in a change of water rights proceeding before the Water Court for Division 2 (the "Water Court Change Case"), and temporarily pursuant to a substitute water supply plan ("SWSP") or an interruptible water supply agreement ("IWSA") approved by the Office of the State Engineer. S-D further acknowledges that the Water Court and/or the State Engineer may require, as terms and conditions of such a change, that the Gass Farm Dry-Up be dried up and either revegetated or established and maintained in dry-land farming practices.

D. S-D and LAWMA desire to enter into this Agreement to affirm the permanent cessation of use of the S-D Trade Water on the Gass Farm Dry-Up, to confirm S-D's obligation either to revegetate or to establish and maintain dry-land farming practices on the Gass Farm Dry-Up, and to provide for a right of entry and easements for LAWMA and its agents, and for LAWMA's successors and assigns and their agents, upon the Gass Farm Dry-Up for the purposes of enforcing this Agreement and the decree and any orders entered by the Water Court in the Water Court Change Case.

NOW, THEREFORE, in consideration of LAWMA's issuance of the LAWMA Shares in trade for the S-D Trade Water and other consideration, S-D hereby covenants, agrees, and grants as follows:

SECTION 1 – Real Covenant for Dry-Up

1.1 S-D covenants and agrees to cease irrigation of the Gass Farm Dry-Up with the S-D Trade Water.

1.2 S-D covenants and agrees that the Gass Farm Dry-Up will not be irrigated with any source of water unless the water used for such irrigation is ground water that is treated as sole-source pumping and is fully augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division 2, or any SWSP or Arkansas River replacement plan approved by the State Engineer; provided, however, that S-D is prohibited from performing such irrigation with ground water in a way that reduces the consumptive use credit available to LAWMA from the S-D Trade Water under the terms and conditions of any decree entered in the Water Court Change Case.

1.3 S-D shall ensure that the Gass Farm Dry-Up complies with all terms and conditions included in the *Kansas v. Colorado* Operating Procedures for Administration of Parcels Claimed for Augmentation Credit ("*Kansas v. Colorado* Dry-Up Agreement"), a copy of which is attached to the Exchange Agreement as **Exhibit C**. Those terms and conditions include, without limitation, requirements that a physical separation must exist between any irrigated portion of a parcel and the dry-up portion unless the Division Engineer gives prior approval, that parcels formerly containing alfalfa or alfalfa-grass stands must be deep tilled or chemically killed, and that dry-up parcels must be monumented in accordance with specific standards.

1.4 S-D covenants and agrees that in addition to the dry-up requirements for the Gass Farm Dry-Up imposed by this Real Covenant for Dry-Up, S-D also shall meet any dry-up obligations imposed by the following: (i) the decree and/or any orders entered by the Water Court in the Water Court Change Case; (ii) the terms and conditions of state water officials' approval of LAWMA's use of the S-D Trade Water in any SWSP, IWSA, Arkansas River Replacement Plan pursuant to Rule 14 of the Amended Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the Arkansas River Basin ("Rule 14 Plan"), and/or Compact Compliance Plan pursuant to Rule 10 of the Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado ("Rule 10 Plan"); and (iii) the Granada Irrigation Company Board of Directors' and/or the Lamar Canal and Irrigation Company Board of Directors' approval of the change of use of the S-D Trade Water.

1.5 Successful completion of dry-up of the Gass Farm Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion. In the event the Water Court retains jurisdiction in the Water Court Change Case to certify successful completion of dry-up of the Gass Farm Dry-Up as a condition to transferring the consumptive use credit available to LAWMA for the S-D Trade Water, then the determination of whether dry-up of the Gass Farm Dry-Up has been successfully completed will be made by the Water Court.

1.6 This Real Covenant for Dry-Up, with the burdens it imposes, is binding upon and will run with the Gass Farm Dry-Up forever, and is forever enforceable against S-D and its successors and assigns in the Gass Farm Dry-Up for the benefit of the S-D Trade Water, LAWMA, and LAWMA's successors and assigns.

SECTION 2 - Real Covenant for Revegetation or Dry-Land Farming

2.1 As used in this Agreement, the term "revegetation" means ground cover of plant life demonstrated to be, without irrigation, reasonably capable of sustaining itself under the climatic conditions, soils, precipitation and terrain prevailing on the Gass Farm Dry-Up, with weeds adequately controlled; and the term "dry-land farming" means dry-land farming practices with weeds adequately controlled.

2.2 So long as S-D is irrigating the Gass Farm Dry-Up for agricultural production purposes in accordance with the terms and conditions in Section 1.2 above, the revegetation and dry-land farming obligations described in this Section 2 will not apply. Upon cessation of irrigation of the Gass Farm Dry-Up for agricultural production purposes pursuant to Section 1.2 above, S-D immediately shall revegetate or establish and maintain dry-land farming practices on the Gass Farm Dry-Up in accordance with the terms and conditions of this Section 2. Within sixty days of ceasing irrigation of the Gass Farm Dry-Up for agricultural production purposes, S-D shall provide LAWMA with written notice of that cessation, by email to lawma@cminet.net, with a copy to rmehren@mwhw.com.

2.3 No later than the end of the third growing season after irrigation for agricultural purposes has ceased on the Gass Farm Dry-Up pursuant to Section 1.2 above (the "Revegetation/Dry-Land Farming Deadline"), S-D shall have established and maintained either revegetation or dry-land farming on the Gass Farm Dry-Up. For either revegetation or dry-land farming to be "maintained" on the Gass Farm Dry-Up, such revegetation or dry-land farming must have been established for more than one growing season. S-D shall pay all costs of the revegetation, dry-land farming, and weed control of the Gass Farm Dry-Up, including without limitation the cost of any water required for establishing and maintaining revegetation and all power costs for associated well pumping and leasing of water for the purpose of revegetation.

2.4 The species of grass or other plants used for revegetation may not include grasses or other plants defined as "noxious" under the provisions of the Colorado Weed Management Act, Article 5.5 of Title 35, C.R.S., and may not include alfalfa or other highly water-consumptive species.

2.5 S-D covenants and agrees that in addition to the revegetation and dry-land farming requirements imposed by this Real Covenant for Revegetation or Dry-Land Farming, S-D also shall meet any lawful revegetation or dry-land farming obligations imposed by the following: (i) the decree and/or any orders entered by the Water Court in the Water Court Change Case; (ii) the terms and conditions of state water officials' approval of LAWMA's use of the S-D Trade Water in any SWSP, IWSA, Rule 14 Plan, and/or Rule 10 Plan; and (iii) the Granada Irrigation Company Board of Directors' and/or the Lamar Canal and Irrigation Company Board of Directors' approval of the change of use of the S-D Trade Water. S-D also shall take any and all actions as may be necessary to comply with any requirements imposed upon S-D and/or LAWMA by federal, state, and/or local government authorities due to the removal of the S-D Trade Water from the Gass Farm Dry-Up, including without limitation any requirements imposed by a 1041 permit, if any, issued by Prowers County. If a decree is entered in the Water Court Change Case after the Revegetation/Dry-Land Farming Deadline, S-D shall satisfy any additional terms and conditions for revegetation and/or dry-land farming in that decree.

2.6 Successful completion of revegetation of the Gass Farm Dry-Up will be determined by LAWMA and its successors and assigns, using applicable Conservation Reserve Program criteria, lawful criteria imposed by the Board of Directors of the Granada Irrigation Company and/or the Board of Directors of the Lamar Canal and Irrigation Company, or the criteria imposed by the Water Court, whichever standards are strictest. Successful establishment and maintenance of dry-land farming of the Gass Farm Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion, or by the Water Court. At S-D's request, the Revegetation/Dry-Land Farming Deadline will be extended by one year for each year that, from the year of closing and up to and including the year of the Revegetation/Dry-Land Farming Deadline, the amount of precipitation measured at the Lamar precipitation station falls below 80% of the March through August average of 10.4 inches (1950-2004 average). Until the decree is entered in the Water Court Change Case, at S-D's request, LAWMA will extend the Revegetation/Dry-Land Farming Deadline upon a showing by S-D that its efforts to establish and maintain dry-land farming practices or revegetation have been materially hindered due to circumstances beyond S-D's control, including fire, hail storms, wind storms, tornadoes, flooding, and freezes after May 15 and before September 15 of any year from the year of closing up to and including the year of the Revegetation/Dry-Land Farming Deadline; after the decree is entered in the Water Court Change Case, at S-D's request, LAWMA may extend the Revegetation/Dry-Land Farming Deadline upon a showing by S-D that its efforts to establish and maintain dry-land farming have been materially hindered due to the same circumstances.

2.7 In the alternative to meeting the obligations imposed by Sections 2.2, 2.3, and 2.5 above, S-D may demonstrate to LAWMA's satisfaction that the Gass Farm Dry-Up has been developed with structures and improvements such that the Gass Farm Dry-Up is not susceptible to erosion, weeds, or agricultural uses.

2.8 To the extent that successful establishment and maintenance of revegetation may require water for an interim period, S-D shall provide such water at its cost. Potential sources of such water may include but are not limited to the following: (i) ground water that is treated as sole-source pumping and is fully augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division 2, or any SWSP or Arkansas River replacement plan approved by the State Engineer; (ii) water available to other Granada Irrigation Company shares owned by S-D; and/or (iii) water available to certain of the Granada Irrigation Company shares that make up the S-D Trade Water, repaid to LAWMA in the form of a pro-rata reduction in allocation to the LAWMA Shares (e.g., if the water available to 31.45 of the Granada Irrigation Company Shares historically used on the Gass Farm Dry-Up is required to establish and maintain revegetation, LAWMA would not allocate water to 100 of the LAWMA Shares during that irrigation season). LAWMA will make the determination as to whether water is required for an interim period to establish and maintain revegetation based on the opinion of its consulting expert in agronomy.

2.9 This Real Covenant for Revegetation or Dry-Land Farming, with the burdens it imposes, is binding upon and will run with the Gass Farm Dry-Up forever, and is forever enforceable against S-D and its successors and assigns in the Gass Farm Dry-Up for the benefit of the S-D Trade Water, LAWMA, and LAWMA's successors and assigns.

SECTION 3 - Right of Entry and Easements

3.1 S-D hereby grants to LAWMA a non-exclusive right of entry to, upon, under, and across the Gass Farm Dry-Up for the purposes of providing a reasonable means for LAWMA and its agents, as well as the Colorado Division of Water Resources and the Water Court, to take all actions reasonably necessary to ensure that S-D has met its obligations under this Agreement and the decree or any orders entered in the Water Court Change Case, including without limitation site inspections, installation of observation wells, piezometers, or lysimeters, performance of soil evaporation and plant transpiration tests, and performance of vegetative studies and surveys.

3.2 S-D hereby further grants to LAWMA and/or its agents easements (i) to construct, operate, and maintain on the Gass Farm Dry-Up such facilities as are required by the decree or any orders entered in the Water Court Change Case for replication of historical return flows from irrigation use of the S-D Trade Water, including without limitation storage reservoirs and/or recharge facilities; (ii) to use such portions of the surface and subsurface of the Gass Farm Dry-Up as are necessary to replicate historical return flows from irrigation use of the S-D Trade Water; and (iii) to perform all acts necessary, including without limitation engineering and historical consumptive use studies, to prosecute the Water Court Change Case and/or an application for a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA using the S-D Trade Water as a source of supply. S-D and LAWMA acknowledge and agree that the exact nature, extent, and location of these easements are difficult to define in advance of completion of the Water Court Change Case or any administrative proceeding for approval of a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA. S-D and LAWMA agree that the absence of specified locations for the easements on the Gass Farm Dry-Up does not void or render the easements unenforceable. To the extent reasonably practical, any easement that may require the construction of a physical structure on the Gass Farm Dry-Up will be located in a manner so as not to interfere unreasonably with S-D's continued and proposed future use of the Gass Farm Dry-Up. Upon identification of an acceptable location for any facilities required under Paragraphs 3.2(i) and (ii), the Parties shall create and record a specific legal description of easements therefor. Upon such recording, the balance of the Gass Farm Dry-Up will be automatically released from Paragraphs 3.2(i) and (ii).

3.3 In the event that S-D defaults in its obligations for dry-up and revegetation or dry-land farming hereunder, this right of entry and these easements also will entitle LAWMA, at S-D's expense, to take all actions necessary to accomplish the dry-up and revegetation or dry-land farming of the Gass Farm Dry-Up, including without limitation constructing drainage and conveyance ditches, monumenting dried-up acreage, revegetating with drought-resistant plants, removing alfalfa and other deep-rooted plants, trees, phreatophytes, and tamarisk, and removing and filling in all or portions of irrigation ditches and/or farm laterals; provided, however, that S-D will not be required to incur out-of-pocket expenses in excess of $200 per acre, for a maximum of $62,880, to complete the actions necessary to dry-up and revegetate or dry-land farm the Gass Farm Dry-Up as required by Sections 1 and 2 above; and provided further that this out-of-pocket expense limitation does not include or apply to any costs S-D may incur in relation to its provision of water for revegetation purposes pursuant to Section 2.8 above.

3.4 This non-exclusive right of entry and these non-exclusive easements, with the burdens they impose, are binding upon and will run with the Gass Farm Dry-Up forever, and are forever enforceable against S-D and its successors and assigns in the Gass Farm Dry-Up for the benefit of the S-D Trade Water, LAWMA, and LAWMA's agents, successors, and assigns.

<u>SECTION 4 - General Provisions</u>

4.1 The terms and conditions of this Agreement and the real covenants given and non-exclusive right of entry and non-exclusive easements granted herein are perpetual and will not expire unless specifically released in writing by LAWMA or its successor or assign.

4.2 This Agreement may be enforced by LAWMA or its successor or assign, by any party having any right, title, or interest in the S-D Trade Water, or by the State Engineer of the State of Colorado, through an action at law or in equity.

4.3 S-D is and will be entitled to use the Gass Farm Dry-Up for any purpose not inconsistent with this Agreement, including but not limited to the mining and removal of sand, gravel, and other materials; dry-land grazing; and recreational, residential, commercial, and industrial purposes.

4.4 S-D shall reasonably cooperate with LAWMA to demonstrate the dry-up and revegetation of the Gass Farm Dry-Up, including but not limited to providing affidavits or testimony at no cost to LAWMA.

4.5 Upon LAWMA's transfer of the S-D Trade Water to any party, that party will succeed to LAWMA's interest in this Agreement and will have the right to enforce the terms of the Agreement against S-D or the then-current owner of the Gass Farm Dry-Up.

4.6 All attached exhibits to this Agreement are incorporated herein by this reference.

4.7 LAWMA shall record this Agreement in the real property records of the Prowers County Clerk and Recorder.

Executed and effective as of the date written below.

S-D INVESTMENTS, LLC

Jay Houtsma
Managing Member

Date: 6.12.17

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

Robert Wilger, Vice-President

Date: __________

ATTEST:

Donald F. Higbee, Secretary

00152419-1

Exhibit H

Ross A. Gaubatz
Notary Public
State of Kansas
My Appt. Expires 5.26.2021

STATE OF ~~COLORADO~~ Kansas)
) ss.
COUNTY OF Hamilton)

The foregoing instrument was acknowledged before me this 12 day of June, 2017, by Jay Houtsma, Managing Member of S-D Investments, LLC, a Kansas limited liability company.

Witness my hand and official seal.

My commission expires: 5.26.2021

Notary Public

STATE OF COLORADO)
) ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this _____ day of June, 2017, by Robert Wilger, Vice-President, and Donald F. Higbee, Secretary, of the Lower Arkansas Water Management Association, a Colorado non-profit corporation.

Witness my hand and official seal.

My commission expires: ______________________

Notary Public

00152419-1

Executed and effective as of the date written below.

S-D INVESTMENTS, LLC

____
Jay Houtsma
Managing Member

Date: ____________________

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

Robert Wilger
Robert Wilger, Vice-President

Date: 6-13-17

ATTEST:

Donald F. Higbee
Donald F. Higbee, Secretary

Exhibit H

STATE OF COLORADO)
) ss.
COUNTY OF ______________)

The foregoing instrument was acknowledged before me this _____ day of June, 2017, by Jay Houtsma, Managing Member of S-D Investments, LLC, a Kansas limited liability company.

Witness my hand and official seal.

My commission expires: ____

____
Notary Public

STATE OF COLORADO)
) ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this 13th day of June, 2017, by Robert Wilger, Vice-President, and Donald F. Higbee, Secretary, of the Lower Arkansas Water Management Association, a Colorado non-profit corporation.

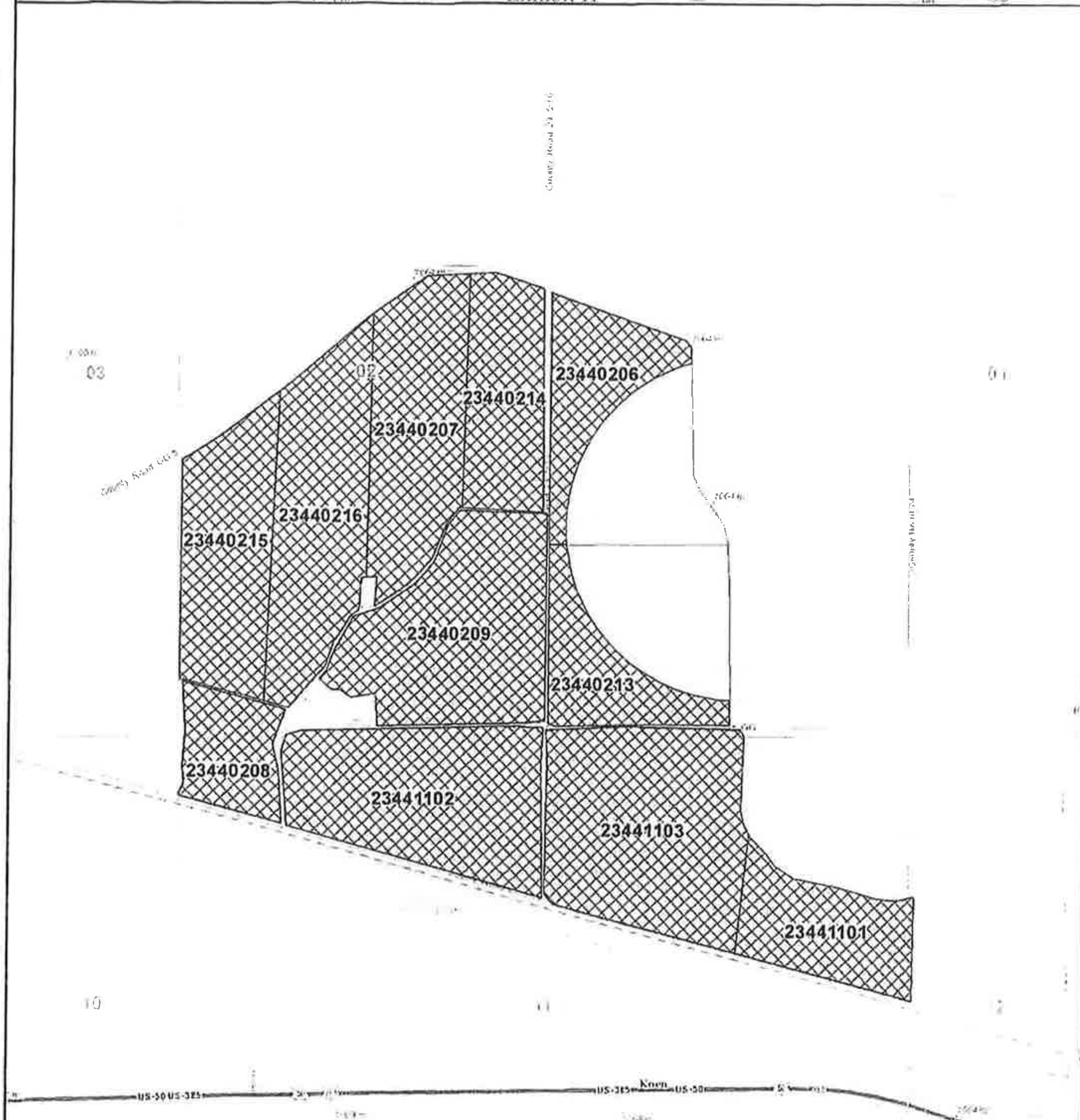
ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20074046402
MY COMMISSION EXPIRES DECEMBER 20, 2019

Witness my hand and official seal.

My commission expires: 12-20-2019

Angela Higbee
Notary Public

Exhibit H



Legend

Gass Farm Dry-Up (314.4 Acres)

Gass Farm Acreage

Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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Scale in Feet

N W E S

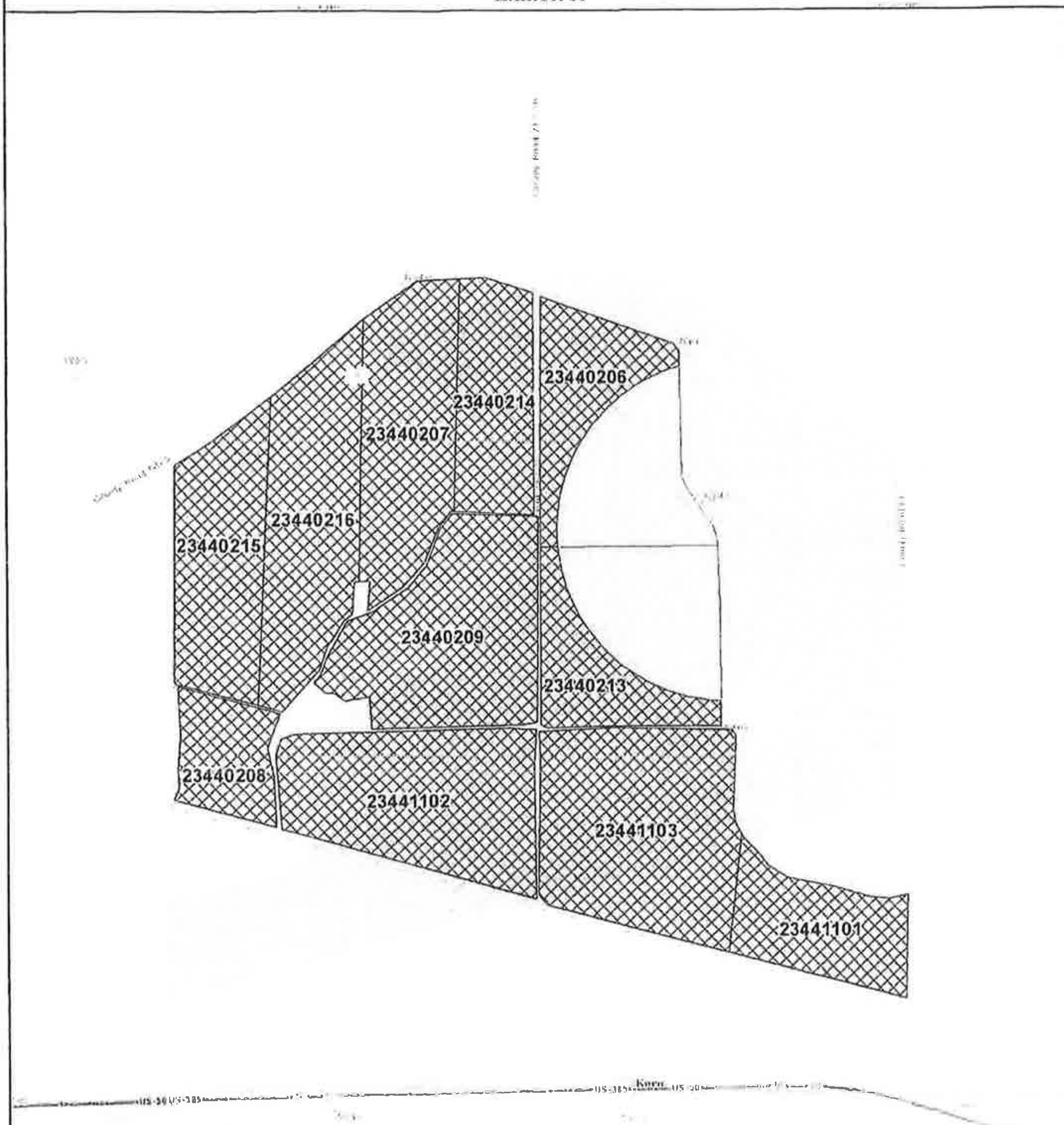
Slattery & Hendrix Engineering LLC

Job No.	L101
File:	Exhibit A Gass Property.mxd
Date:	05/21/15
Prepared For:	LAWMA

Exhibit A

Gass Farm
Acreage & Dry-Up

Exhibit H



Legend

- Gass Farm Dry-Up (314.4 Acres)
- Gass Farm Acreage

Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

0 500 1,000 2,000

Scale in Feet

N W E S

Job No. L101

File: Exhibit A Gass Property.mxd

Date: 05/21/16

Prepared For: LAWMA

Exhibit A

Gass Farm Acreage & Dry-Up

Slattery & Hendrix Engineering LLC

Exhibit H

LENDER CONSENT, APPROVAL, SUBORDINATION, AND WAIVER

(Gass Farm)

The undersigned is the beneficiary under (a) that certain Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing dated May 29, 2013, recorded on May 30, 2013 at Reception No. 533996, Prowers County, Colorado, real property records, as modified by that certain First Modification to Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing dated October 10, 2014, and recorded on October 24, 2014, at Reception No. 537433, as further modified by that certain Modification of Loan Documents dated March 16, 2015, and recorded on March 18, 2015, at Reception No. 538398, and as further modified by that certain Amended and Restated Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing dated May 16, 2017, recorded on May 19, 2017, at Reception No. 543749, and as may be further modified from time to time (collectively, the "2013 Deed of Trust"), and (b) that certain Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing, dated as of March 16, 2015, and recorded March 18, 2015, at Reception No. 538396, and as may be further modified from time to time (collectively, the "2015 Deed of Trust"; the 2013 Deed of Trust and the 2015 Deed of Trust are collectively referred to herein as the "Deed of Trust"). Consent and approval are hereby given by the undersigned to the foregoing "AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHTS OF ENTRY AND EASEMENTS" (the "Dry-Up Covenant") to which this Consent, Approval and Subordination is attached. For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned hereby unconditionally and irrevocably subordinates the lien of its Deed of Trust to the Dry-Up Covenant, agrees that its Deed of Trust shall be subject to the Dry-Up Covenant as the same may be assigned, and waives any claim that the Dry-Up Covenant constitutes a Prohibited Transfer under Article 7 of the Deed of Trust.

Dated this 8th day of June, 2017.

METROPOLITAN LIFE INSURANCE COMPANY

By: [signature]
Name: Kevin J Harshberger
Title: Director

STATE OF KANSAS,
COUNTY OF JOHNSON, SS:

The foregoing instrument was acknowledged before me this 8th day of June, 2017, by Kevin J. Harshberger as Director of Metropolitan Life Insurance Company, a New York corporation.

Witness my hand and official seal

Roberta L Black
Notary Public

My Commission Expires: 08/26/2017

SEAL

ROBERTA L. BLACK
Notary Public - State of Kansas
My Appt. Expires 08/26/2017

9899851_1

Exhibit H
REC # 546443 06/25/2018 03:00:32 PM
AGR Page: 1 of 10 R:58.00 D:0.00
Prowers County, CO

546443

After recording please return to
Lower Arkansas Water Management Association
P.O. Box 1161
Lamar, Colorado 81052

AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS

(Reconfigured Grasmick Farm Granada Dry-Up)

THIS AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS ("Amended Agreement") is entered into this 31 day of December, 2015, by and between GP Irrigated Farms, LLC, a Colorado limited liability company ("GP"), as Grantor, and Lower Arkansas Water Management Association, a Colorado non-profit corporation ("LAWMA"), as Grantee (together, the "Parties").

Recitals

A. On October 17, 2014, GP and LAWMA entered into that certain Agreement for Dry-Up Covenant and for Revegetation or Dry-Land Farming Covenant, and Grant of Non-Exclusive Right of Entry and Easements ("Original Dry-Up Agreement") that was recorded in the real property records of Prowers County, Colorado, on October 24, 2014, at Reception Number 537436.

B. GP and LAWMA entered into the Original Dry-Up Agreement as additional consideration for LAWMA's issuance of 2,069 shares of common LAWMA stock (the "LAWMA Shares") to GP in trade for 897 of the 26,127 shares of capital stock outstanding in the Lamar Canal Company ("Lamar Canal Trade Shares"), 436 of the 3,030 shares of capital stock outstanding in the Granada Irrigation Company ("Granada Trade Shares"), and 1.5 cfs of the 69.0 cfs originally decreed to the XY Irrigating Ditch Company's Canal ("XY 1.5 cfs"), pursuant to the Water Rights Exchange Agreement and Reimbursement Agreement between the Parties, as amended ("Exchange Agreement"), and as more particularly described therein. The Lamar Canal Trade Shares, the Granada Trade Shares, and the XY 1.5 cfs are referred to collectively herein as the "GP Trade Water."

C. Following execution and recording of the Original Dry-Up Agreement, and at the request of the Division Engineer for Water Division 2, GP reconfigured certain of the parcels that were designated in the Original Dry-Up Agreement as the Grasmick Farm Granada Dry-Up. The reconfigured parcels are shown in **Exhibit A** ("Reconfigured Grasmick Farm Granada Dry-Up").

D. GP and its predecessors-in-interest historically used all 436 of the Granada Trade Shares to irrigate the approximately 466.8 acres of the Reconfigured Grasmick Farm Granada Dry-Up in portions of the SW¼, the SE¼, and the NE¼ of Section 1; the E½ of Section 2; the entirety of Section 3; the N½ of Section 10; and the SW¼, the NE¼ of the SE¼, the S½ of the NW¼, and the S½ of the NE¼ of Section 11, all in Township 23 South, Range 44 West of the 6th P.M., in Prowers County, Colorado, as more particularly shown on the map attached as **Exhibit A**. The 436 Granada Trade Shares (the "Grasmick Granada Water") were represented by Stock Certificate No. 215.

E. GP acknowledges that LAWMA intends to use the Grasmick Granada Water for augmentation and replacement purposes, and that to effect such uses, the Grasmick Granada Water will need to be changed permanently in a change of water rights proceeding before the Water Court for Division 2 (the "Water Court Change Case"), and temporarily pursuant to a substitute water supply plan ("SWSP") or interruptible water supply agreement ("IWSA") approved by the Office of the State Engineer. GP further acknowledges that the Water Court and/or the State Engineer may require, as terms and conditions of such a change, that the Reconfigured Grasmick Farm Granada Dry-Up be dried up and either revegetated or established and maintained in dry-land farming practices.

F. GP and LAWMA desire to enter into this Amended Agreement, which will supersede and replace the Original Dry-Up Agreement in its entirety, to affirm the permanent cessation of use of the Grasmick Granada Water on the Reconfigured Grasmick Farm Granada Dry-Up, to confirm GP's obligation either to revegetate or to establish and maintain dry-land farming practices on the Reconfigured Grasmick Farm Granada Dry-Up, and to provide for a right of entry and easements for LAWMA and its agents, and for LAWMA's successors and assigns and their agents, upon the Reconfigured Grasmick Farm Granada Dry-Up for the purposes of enforcing this Agreement and the decree and any orders entered by the Water Court in the Water Court Change Case.

NOW, THEREFORE, in consideration of LAWMA's issuance of the LAWMA Shares in trade for the GP Trade Water and other consideration, GP hereby covenants, agrees, and grants as follows:

Section 1 – Real Covenant for Dry-Up

1.1 GP covenants and agrees to cease irrigation of the Reconfigured Grasmick Farm Granada Dry-Up with the Grasmick Granada Water.

1.2 GP covenants and agrees that the Reconfigured Grasmick Farm Granada Dry-Up will not be irrigated with any source of water unless the water used for such irrigation is ground water that is treated as sole-source pumping and is fully-augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division 2, or any SWSP or Arkansas River replacement plan approved by the State Engineer; provided, however, that GP is prohibited from performing such irrigation with ground water in a way that reduces the consumptive use credit available to LAWMA from the GP Trade Water under the terms and conditions of any decree entered in the Water Court Change Case.

1.3 GP shall ensure that the Reconfigured Grasmick Farm Granada Dry-Up complies with all terms and conditions included in the *Kansas v. Colorado* Operating Procedures for Administration of Parcels Claimed for Augmentation Credit ("*Kansas v. Colorado* Dry-Up Agreement"), a copy of which was attached to the Exchange Agreement as Exhibit G. Those terms and conditions include, without limitation, requirements that a physical separation must exist between any irrigated portion of a parcel and the dry-up portion unless the Division Engineer gives prior approval, that parcels formerly containing alfalfa or alfalfa-grass stands must be deep tilled or chemically killed, and that dry-up parcels must be monumented in accordance with specific standards.

1.4 GP covenants and agrees that in addition to the dry-up requirements for the Reconfigured Grasmick Farm Granada Dry-Up imposed by this Real Covenant for Dry-Up, GP also shall meet any dry-up obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the Grasmick Granada Water in any SWSP, IWSA, Arkansas River Replacement Plan pursuant to Rule 14 of the Amended Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the Arkansas River Basin ("Rule 14 Plan"), and/or Compact Compliance Plan pursuant to Rule 10 of the Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado ("Rule 10 Plan").

1.5 Successful completion of dry-up of the Reconfigured Grasmick Farm Granada Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion. In the event the Water Court retains jurisdiction in the Water Court Change Case to certify successful completion of dry-up of the Reconfigured Grasmick Farm Granada Dry-Up as a condition to transferring the consumptive use credit available to LAWMA for the GP Trade Water, then the determination of whether dry-up of the Reconfigured Grasmick Farm Granada Dry-Up has been successfully completed will be made by the Water Court.

1.6 This Real Covenant for Dry-Up, with the burdens it imposes, is binding upon and will run with the Reconfigured Grasmick Farm Granada Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Reconfigured Grasmick Farm Granada Dry-Up for the benefit of the Grasmick Granada Water, LAWMA, and LAWMA's successors and assigns.

Section 2 – Real Covenant for Revegetation or Dry-Land Farming

2.1 As used in this Agreement, the term "revegetation" means ground cover of plant life demonstrated to be, without irrigation, reasonably capable of sustaining itself under the climatic conditions, soils, precipitation and terrain prevailing on the Reconfigured

Grasmick Farm Granada Dry-Up, with weeds adequately controlled; and the term "dry-land farming" means dry-land farming practices with weeds adequately controlled.

2.2 So long as GP is irrigating the Reconfigured Grasmick Farm Granada Dry-Up for agricultural production purposes in accordance with the terms and conditions in Section 1.2 above, the revegetation and dry-land farming obligations described in this Section 2 will not apply. Upon cessation of irrigation of the Reconfigured Grasmick Farm Granada Dry-Up for agricultural production purposes pursuant to Section 1.2 above, GP immediately shall revegetate or establish and maintain dry-land farming practices on the Reconfigured Grasmick Farm Granada Dry-Up in accordance with the terms and conditions of this Section 2. Within sixty days of ceasing irrigation of the Reconfigured Grasmick Farm Granada Dry-Up for agricultural production purposes, GP shall provide LAWMA with written notice of that cessation, by email to lawma@cminet.net, with a copy to rmehren@mwhw.com.

2.3 No later than the end of the third growing season after irrigation for agricultural purposes has ceased on the Reconfigured Grasmick Farm Granada Dry-Up pursuant to Section 1.2 above (the "Revegetation/Dry-Land Farming Deadline"), GP shall have established and maintained either revegetation or dry-land farming on the Reconfigured Grasmick Farm Granada Dry-Up. For either revegetation or dry-land farming to be "maintained" on the Reconfigured Grasmick Farm Granada Dry-Up, such revegetation or dry-land farming must have been established for more than one growing season. GP shall pay all costs of the revegetation, dry-land farming, and weed control of the Reconfigured Grasmick Farm Granada Dry-Up, including without limitation the payment of all power costs for associated well pumping and leasing of water for the purpose of revegetation.

2.4 The species of grass or other plants used for revegetation may not include grasses or other plants defined as "noxious" under the provisions of the Colorado Weed Management Act, Article 5.5 of Title 35, C.R.S., and may not include alfalfa or other highly water-consumptive species.

2.5 GP covenants and agrees that in addition to the revegetation and dry-land farming requirements imposed by this Real Covenant for Revegetation or Dry-Land Farming, GP also shall meet any revegetation or dry-land farming obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the Grasmick Granada Water in any SWSP, IWSA, Rule 14 Plan, and/or Rule 10 Plan. GP also shall take any and all actions as may be necessary to comply with any requirements imposed upon GP and/or LAWMA by federal, state, and/or local government authorities due to the removal of the Grasmick Granada Water from the Reconfigured Grasmick Farm Granada Dry-Up, including without limitation any requirements imposed by a 1041 permit, if any, issued by Prowers County. If a decree is entered in the Water Court Change Case after the Revegetation/Dry-Land Farming Deadline, GP shall satisfy any additional terms and conditions for revegetation and/or dry-land farming in that decree.

2.6 Successful completion of revegetation of the Reconfigured Grasmick Farm Granada Dry-Up will be determined by LAWMA and its successors and assigns, using applicable Conservation Reserve Program criteria or the criteria imposed by the Water Court, whichever standards are strictest. Successful establishment and maintenance of dry-land farming of the Reconfigured Grasmick Farm Granada Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion, or by the Water Court. At GP's request, the Revegetation/Dry-Land Farming Deadline will be extended by one year for each year that, from the year of closing and up to and including the year of the Revegetation/Dry-Land Farming Deadline, the amount of precipitation measured at the Lamar precipitation station falls below 80% of the March through August average of 10.4 inches (1950-2004 average). Until the decree is entered in the Water Court Change Case, at GP's request, LAWMA will extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming practices or revegetation have been materially hindered due to circumstances beyond GP's control, including fire, hail storms, wind storms, tornadoes, flooding, and freezes after May 15 and before September 15 of any year from the year of closing up to and including the year of the Revegetation/Dry-Land Farming Deadline; after the decree is entered in the Water Court Change Case, at GP's request, LAWMA may extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming have been materially hindered due to the same circumstances.

2.7 In the alternative to meeting the obligations imposed by Sections 2.2, 2.3, and 2.5 above, GP may demonstrate to LAWMA's satisfaction that the Reconfigured Grasmick Farm Granada Dry-Up has been developed with structures and improvements such that the Reconfigured Grasmick Farm Granada Dry-Up is not susceptible to erosion, weeds, or agricultural uses.

2.8 This Real Covenant for Revegetation or Dry-Land Farming, with the burdens it imposes, is binding upon and will run with the Reconfigured Grasmick Farm Granada Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Reconfigured Grasmick Farm Granada Dry-Up for the benefit of the Grasmick Granada Water, LAWMA, and LAWMA's successors and assigns.

Section 3 – Right of Entry and Easements

3.1 GP hereby grants to LAWMA a non-exclusive right of entry to, upon, under, and across the Reconfigured Grasmick Farm Granada Dry-Up for the purposes of providing a reasonable means for LAWMA and its agents, as well as the Colorado Division of Water Resources and the Water Court, to take all actions reasonably necessary to ensure that GP has met its obligations under this Agreement and the decree or any orders entered in the Water Court Change Case, including without limitation site inspections, installation of observation wells, piezometers, or lysimeters, performance of soil evaporation and plant transpiration tests, and performance of vegetative studies and surveys.

3.2 GP hereby further grants to LAWMA and/or its agents easements (i) to construct, operate, and maintain on the Reconfigured Grasmick Farm Granada Dry-Up such facilities as are required by the decree or any orders entered in the Water Court Change Case for replication of historical return flows from irrigation use of the Grasmick Granada Water, including without limitation storage reservoirs and/or recharge facilities; (ii) to use such portions of the surface and subsurface of the Reconfigured Grasmick Farm Granada Dry-Up as are necessary to replicate historical return flows from irrigation use of the Grasmick Granada Water; and (iii) to perform all acts necessary, including without limitation engineering and historical consumptive use studies, to prosecute the Water Court Change Case and/or an application for a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA using the Grasmick Granada Water as a source of supply. GP and LAWMA acknowledge and agree that the exact nature, extent, and location of these easements are difficult to define in advance of completion of the Water Court Change Case or any administrative proceeding for approval of a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA. GP and LAWMA agree that the absence of specified locations for the easements on the Reconfigured Grasmick Farm Granada Dry-Up does not void or render the easements unenforceable. To the extent reasonably practical, any easement that may require the construction of a physical structure on the Reconfigured Grasmick Farm Granada Dry-Up will be located in a manner so as not to interfere unreasonably with GP's continued and proposed future use of the Reconfigured Grasmick Farm Granada Dry-Up. Upon identification of an acceptable location for any facilities required under Paragraphs 3.2(i) and (ii), the Parties shall create and record a specific legal description of easements therefor. Upon such recording, the balance of the Reconfigured Grasmick Farm Granada Dry-Up will be automatically released from Paragraphs 3.2(i) and (ii).

3.3 In the event that GP defaults in its obligations for dry-up and revegetation or dry-land farming hereunder, this right of entry and these easements also will entitle LAWMA, at GP's expense, to take all actions necessary to accomplish the dry-up and revegetation or dry-land farming of the Reconfigured Grasmick Farm Granada Dry-Up, including without limitation constructing drainage and conveyance ditches, monumenting dried-up acreage, revegetating with drought-resistant plants, removing alfalfa and other deep-rooted plants, trees, phreatophytes, and tamarisk, and removing and filling in all or portions of irrigation ditches and/or farm laterals; provided, however, that GP will not be required to incur out-of-pocket expenses in excess of $200 per acre, for a maximum of $93,360, to complete the actions necessary to dry-up and revegetate or dry-land farm the Reconfigured Grasmick Farm Granada Dry-Up as required by Sections 1 and 2 above.

3.4 This non-exclusive right of entry and these non-exclusive easements, with the burdens they impose, are binding upon and will run with the Reconfigured Grasmick Farm Granada Dry-Up forever, and are forever enforceable against GP and its successors and assigns in the Reconfigured Grasmick Farm Granada Dry-Up for the benefit of the Grasmick Granada Water, LAWMA, and LAWMA's agents, successors, and assigns.

Section 4 – General Provisions

4.1 The terms and conditions of this Agreement and the real covenants given and non-exclusive right of entry and non-exclusive easements granted herein are perpetual and will not expire unless specifically released in writing by LAWMA or its successor or assign.

4.2 This Agreement may be enforced by LAWMA or its successor or assign, by any party having any right, title, or interest in the Grasmick Granada Water, or by the State Engineer of the State of Colorado, through an action at law or in equity.

4.3 GP is and will be entitled to use the Reconfigured Grasmick Farm Granada Dry-Up for any purpose not inconsistent with this Agreement, including but not limited to the mining and removal of sand, gravel, and other materials; dry-land grazing; and recreational, residential, commercial, and industrial purposes.

4.4 GP shall reasonably cooperate with LAWMA to demonstrate the dry-up and revegetation of the Reconfigured Grasmick Farm Granada Dry-Up, including but not limited to providing affidavits or testimony at no cost to LAWMA.

4.5 Upon LAWMA's transfer of the Grasmick Granada Water to any party, that party will succeed to LAWMA's interest in this Agreement and will have the right to enforce the terms of the Agreement against GP or the then-current owner of the Reconfigured Grasmick Farm Granada Dry-Up.

4.6 All attached exhibits to this Agreement are incorporated herein by this reference.

4.7 LAWMA shall record this Agreement in the real property records of the Prowers County Clerk and Recorder.

Executed and effective as of the day first written above.

[Remainder of this page deliberately left blank.]

REC # 546443 06/25/2018 03:00:32 PM
AGR Page: 8 of 10 R:58.00 D:0.00
Prowers County, CO

GP IRRIGATED FARMS, LLC

N/A

~~Karl Nyquist~~
~~Managing Member~~

Jay Houtsma
Managing Member

Date: 12/31/2015

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

Robert Wilger, Vice-President

Date: 1-8-16

ATTEST:

Donald F. Higbee, Secretary

KANSAS

STATE OF ~~COLORADO~~)
HAMILTON
ss.
COUNTY ~~OF PROWERS~~)

ROSS GEUBELLE
NOTARY PUBLIC
STATE OF KANSAS
My Commission Expires

The foregoing instrument was acknowledged before me this 31 day of December, 2015, by ~~Karl Nyquist, Managing Member~~, and Jay Houtsma, Managing Member, of GP Irrigated Farms, LLC, a Colorado limited liability company.

Witness my hand and official seal.

My commission expires 7/26/2016.

Notary Public

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this 8th day of ~~December~~ JANUARY, 201~~5~~6, by Robert Wilger, Vice-President, and Donald F. Higbee, Secretary, of the Lower Arkansas Water Management Association, a Colorado non-profit corporation.

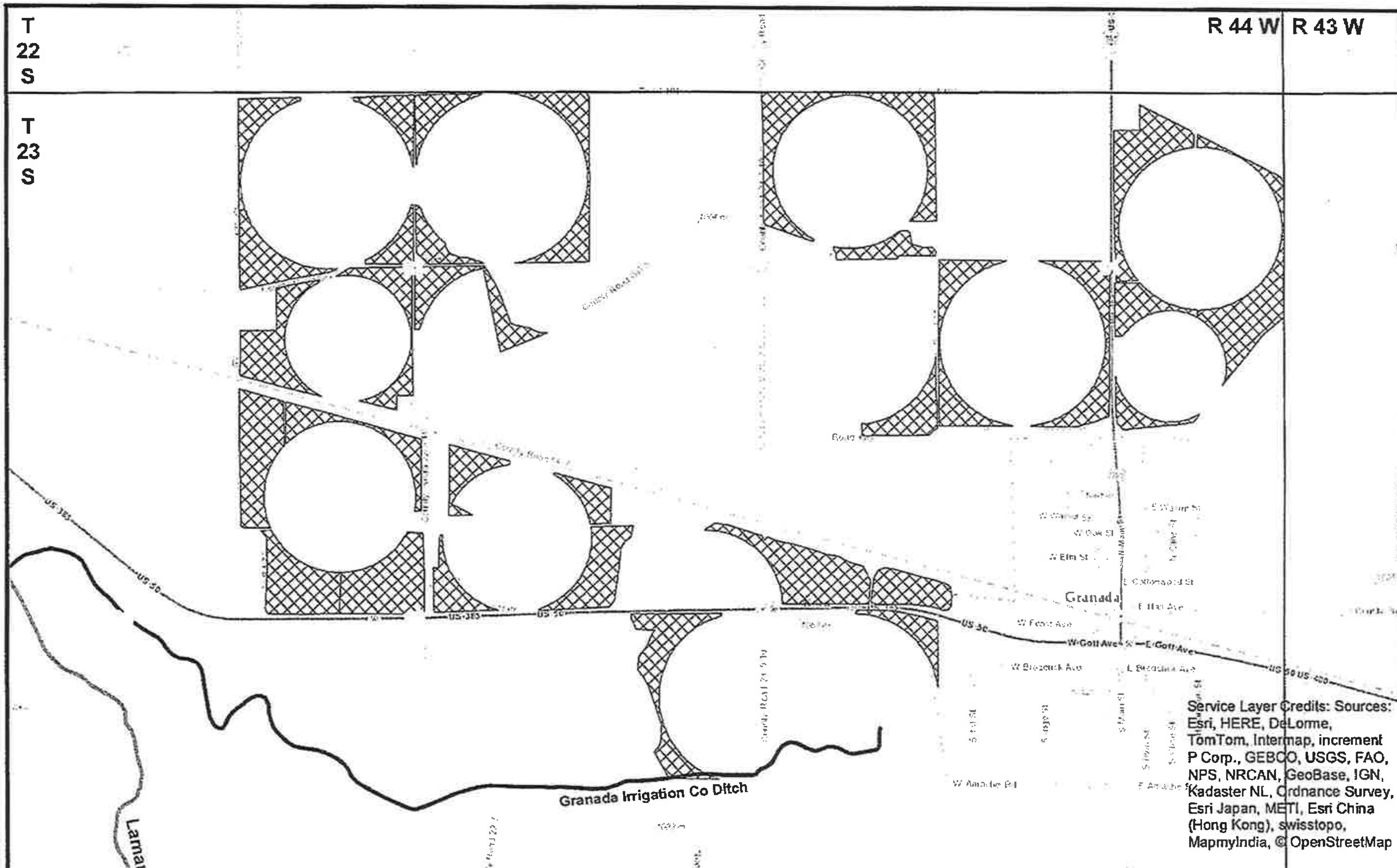
ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20074046492
MY COMMISSION EXPIRES DECEMBER 20, 2019

Witness my hand and official seal.

My commission expires 12-20-2019.

Notary Public

Exhibit H



Legend

Grasmick Farm Granada Dry-up (466.8 Acres)

0 1,000 2,000 4,000

Scale in Feet

N W E S

Slattery & Hendrix Engineering LLC

Job No.	L7501
File:	Grasmick Granada Exhibit A 08-15.mxd
Date:	03/04/14
Prepared For:	LAWMA/GP

Exhibit A - Revised

Grasmick Farm Granada Dry-up

REC # 546444 06/25/2018 03:00:32 PM
CONSENT Page: 1 of 1 R:13.00 D:0.00
Prowers County, CO

LENDER CONSENT, APPROVAL, SUBORDINATION, AND WAIVER

(Reconfigured Grasmick Farm Granada Dry-Up)

The undersigned is the beneficiary under (a) that certain Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing dated May 29, 2013, recorded on May 30, 2013 at Reception No. 533996, Prowers County, Colorado, real property records, as modified by that certain First Modification to Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing dated October 10, 2014, and recorded on October 24, 2014, at Reception No. 537433, as further modified by that certain Modification of Loan Documents dated March 16, 2015, and recorded on March 18, 2015, at Reception No. 538398, and as further modified by that certain Amended and Restated Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing dated May 16, 2017, recorded on May 19, 2017, at Reception No. 543749, and as may be further modified from time to time (collectively, the "2013 Deed of Trust"), and (b) that certain Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing, dated as of March 16, 2015, and recorded March 18, 2015, at Reception No. 538396, and as may be further modified from time to time (collectively, the "2015 Deed of Trust"; the 2013 Deed of Trust and the 2015 Deed of Trust are collectively referred to herein as the "Deed of Trust"). Consent and approval are hereby given by the undersigned to the foregoing "AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRYLAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS (Reconfigured Grasmick Farm Granada Dry-Up)" (the "Amended Dry-Up Covenant") to which this Consent, Approval and Subordination is attached. For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned hereby unconditionally and irrevocably subordinates the lien of its Deed of Trust to the Amended Dry-Up Covenant, agrees that its Deed of Trust shall be subject to the Amended Dry-Up Covenant as the same may be assigned, and waives any claim that the Amended Dry-Up Covenant constitutes a Prohibited Transfer under Article 7 of the Deed of Trust.

Dated this 8th day of June, 2017.

METROPOLITAN LIFE INSURANCE COMPANY

By: ______________________
Name: Kevin J Harshberger
Title: Director

STATE OF KANSAS,
COUNTY OF JOHNSON, SS:

The foregoing instrument was acknowledged before me this 8th day of June, 2017, by Kevin J Harshberger as Director of Metropolitan Life Insurance Company, a New York corporation.

Witness my hand and official seal

Roberta L Black
Notary Public

My Commission Expires: 08/26/2017

SEAL

ROBERTA L. BLACK
Notary Public - State of Kansas
My Appt. Expires 08/26/2017

9899088_2

Exhibit H REC # 546445 06/25/2018 03:00:32 PM
AGR Page: 1 of 10 R:58.00 D:0.00
Prowers County, CO

546445

After recording please return to
Lower Arkansas Water Management Association
P.O. Box 1161
Lamar, Colorado 81052

AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS

(Reconfigured Grasmick Farm Lamar Dry-Up)

THIS AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS ("Amended Agreement") is entered into this 31 day of December, 2015, by and between GP Irrigated Farms, LLC, a Colorado limited liability company ("GP"), as Grantor, and Lower Arkansas Water Management Association, a Colorado non-profit corporation ("LAWMA"), as Grantee (together, the "Parties").

Recitals

A. On October 17, 2014, GP and LAWMA entered into that certain Agreement for Dry-Up Covenant and for Revegetation or Dry-Land Farming Covenant, and Grant of Non-Exclusive Right of Entry and Easements ("Original Dry-Up Agreement") that was recorded in the real property records of Prowers County, Colorado, on October 24, 2014, at Reception Number 537437.

B. GP and LAWMA entered into the Original Dry-Up Agreement as additional consideration for LAWMA's issuance of 2,069 shares of common LAWMA stock (the "LAWMA Shares") to GP in trade for 897 of the 26,127 shares of capital stock outstanding in the Lamar Canal Company ("Lamar Canal Trade Shares"), 436 of the 3,030 shares of capital stock outstanding in the Granada Irrigation Company ("Granada Trade Shares"), and 1.5 cfs of the 69.0 cfs originally decreed to the XY Irrigating Ditch Company's Canal ("XY 1.5 cfs"), pursuant to the Water Rights Exchange Agreement and Reimbursement Agreement between the Parties, as amended ("Exchange Agreement"), and as more particularly described therein. The Lamar Canal Trade Shares, the Granada Trade Shares, and the XY 1.5 cfs are referred to collectively herein as the "GP Trade Water."

C. Following execution and recording of the Original Dry-Up Agreement, and at the request of the Division Engineer for Water Division 2, GP reconfigured certain of the parcels that were designated in the Original Dry-Up Agreement as the Grasmick Farm Lamar Dry-Up. The reconfigured parcels are shown in **Exhibit A** ("Reconfigured Grasmick Farm Lamar Dry-Up").

D. GP and its predecessors-in-interest historically used 440 of the Lamar Canal Trade Shares to irrigate the approximately 431.8 acres of the Reconfigured Grasmick Farm Lamar Dry-Up in portions of the SE¼ of Section 31, the S½ of Section 32, and the S½ of the NE¼ of Section 32, Township 22 South, Range 44 West; and the NW¼ of Section 4, and the E½ of the NE¼ of Section 5, the N½ of the NE¼ of Section 5, and the NE¼ of the NW¼ of Section 5, Township 23 South, Range 44 West; all of the 6th P.M., in Prowers County, Colorado, as more particularly shown on the map attached as **Exhibit A**. The 440 Lamar Canal Trade Shares (the "Grasmick Lamar Water") were represented by Stock Certificate No. 405.

E. GP acknowledges that LAWMA intends to use the Grasmick Lamar Water for augmentation and replacement purposes, and that to effect such uses, the Grasmick Lamar Water will need to be changed permanently in a change of water rights proceeding before the Water Court for Division 2 (the "Water Court Change Case"), and temporarily pursuant to a substitute water supply plan ("SWSP") or interruptible water supply agreement ("IWSA") approved by the Office of the State Engineer. GP further acknowledges that the Water Court and/or the State Engineer may require, as terms and conditions of such a change, that the Reconfigured Grasmick Farm Lamar Dry-Up be dried up and either revegetated or established and maintained in dry-land farming practices.

F. GP and LAWMA desire to enter into this Amended Agreement, which will supersede and replace the Original Dry-Up Agreement in its entirety, to affirm the permanent cessation of use of the Grasmick Lamar Water on the Reconfigured Grasmick Farm Lamar Dry-Up, to confirm GP's obligation either to revegetate or to establish and maintain dry-land farming practices on the Reconfigured Grasmick Farm Lamar Dry-Up, and to provide for a right of entry and easements for LAWMA and its agents, and for LAWMA's successors and assigns and their agents, upon the Reconfigured Grasmick Farm Lamar Dry-Up for the purposes of enforcing this Agreement and the decree and any orders entered by the Water Court in the Water Court Change Case.

NOW, THEREFORE, in consideration of LAWMA's issuance of the LAWMA Shares in trade for the GP Trade Water and other consideration, GP hereby covenants, agrees, and grants as follows:

Section 1 – Real Covenant for Dry-Up

1.1 GP covenants and agrees to cease irrigation of the Reconfigured Grasmick Farm Lamar Dry-Up with the Grasmick Lamar Water.

1.2 GP covenants and agrees that the Reconfigured Grasmick Farm Lamar Dry-Up will not be irrigated with any source of water unless the water used for such irrigation is ground water that is treated as sole-source pumping and is fully-augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division 2, or any SWSP or Arkansas River replacement plan approved by the State

Engineer; provided, however, that GP is prohibited from performing such irrigation with ground water in a way that reduces the consumptive use credit available to LAWMA from the GP Trade Water under the terms and conditions of any decree entered in the Water Court Change Case.

1.3 GP shall ensure that the Reconfigured Grasmick Farm Lamar Dry-Up complies with all terms and conditions included in the *Kansas v. Colorado* Operating Procedures for Administration of Parcels Claimed for Augmentation Credit ("*Kansas v. Colorado* Dry-Up Agreement"), a copy of which was attached to the Exchange Agreement as Exhibit G. Those terms and conditions include, without limitation, requirements that a physical separation must exist between any irrigated portion of a parcel and the dry-up portion unless the Division Engineer gives prior approval, that parcels formerly containing alfalfa or alfalfa-grass stands must be deep tilled or chemically killed, and that dry-up parcels must be monumented in accordance with specific standards.

1.4 GP covenants and agrees that in addition to the dry-up requirements for the Reconfigured Grasmick Farm Lamar Dry-Up imposed by this Real Covenant for Dry-Up, GP also shall meet any dry-up obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the Grasmick Lamar Water in any SWSP, IWSA, Arkansas River Replacement Plan pursuant to Rule 14 of the Amended Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the Arkansas River Basin ("Rule 14 Plan"), and/or Compact Compliance Plan pursuant to Rule 10 of the Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado ("Rule 10 Plan").

1.5 Successful completion of dry-up of the Reconfigured Grasmick Farm Lamar Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion. In the event the Water Court retains jurisdiction in the Water Court Change Case to certify successful completion of dry-up of the Reconfigured Grasmick Farm Lamar Dry-Up as a condition to transferring the consumptive use credit available to LAWMA for the GP Trade Water, then the determination of whether dry-up of the Reconfigured Grasmick Farm Lamar Dry-Up has been successfully completed will be made by the Water Court.

1.6 This Real Covenant for Dry-Up, with the burdens it imposes, is binding upon and will run with the Reconfigured Grasmick Farm Lamar Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Reconfigured Grasmick Farm Lamar Dry-Up for the benefit of the Grasmick Lamar Water, LAWMA, and LAWMA's successors and assigns.

Section 2 – Real Covenant for Revegetation or Dry-Land Farming

2.1 As used in this Agreement, the term "revegetation" means ground cover of plant life demonstrated to be, without irrigation, reasonably capable of sustaining itself under the climatic conditions, soils, precipitation and terrain prevailing on the Reconfigured Grasmick Farm Lamar Dry-Up, with weeds adequately controlled; and the term "dry-land farming" means dry-land farming practices with weeds adequately controlled.

2.2 So long as GP is irrigating the Reconfigured Grasmick Farm Lamar Dry-Up for agricultural production purposes in accordance with the terms and conditions in Section 1.2 above, the revegetation and dry-land farming obligations described in this Section 2 will not apply. Upon cessation of irrigation of the Reconfigured Grasmick Farm Lamar Dry-Up for agricultural production purposes pursuant to Section 1.2 above, GP immediately shall revegetate or establish and maintain dry-land farming practices on the Reconfigured Grasmick Farm Lamar Dry-Up in accordance with the terms and conditions of this Section 2. Within sixty days of ceasing irrigation of the Reconfigured Grasmick Farm Lamar Dry-Up for agricultural production purposes, GP shall provide LAWMA with written notice of that cessation, by email to lawma@cminet.net, with a copy to rmehren@mwhw.com.

2.3 No later than the end of the third growing season after irrigation for agricultural purposes has ceased on the Reconfigured Grasmick Farm Lamar Dry-Up pursuant to Section 1.2 above (the "Revegetation/Dry-Land Farming Deadline"), GP shall have established and maintained either revegetation or dry-land farming on the Reconfigured Grasmick Farm Lamar Dry-Up. For either revegetation or dry-land farming to be "maintained" on the Reconfigured Grasmick Farm Lamar Dry-Up, such revegetation or dry-land farming must have been established for more than one growing season. GP shall pay all costs of the revegetation, dry-land farming, and weed control of the Reconfigured Grasmick Farm Lamar Dry-Up, including without limitation the payment of all power costs for associated well pumping and leasing of water for the purpose of revegetation.

2.4 The species of grass or other plants used for revegetation may not include grasses or other plants defined as "noxious" under the provisions of the Colorado Weed Management Act, Article 5.5 of Title 35, C.R.S., and may not include alfalfa or other highly water-consumptive species.

2.5 GP covenants and agrees that in addition to the revegetation and dry-land farming requirements imposed by this Real Covenant for Revegetation or Dry-Land Farming, GP also shall meet any revegetation or dry-land farming obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the Grasmick Lamar Water in any SWSP, IWSA, Rule 14 Plan, and/or Rule 10 Plan. GP also shall take any and all actions as may be necessary to comply with any requirements imposed upon GP and/or LAWMA by federal, state, and/or local government authorities due to the removal of the Grasmick Lamar Water from the Reconfigured Grasmick Farm Lamar Dry-Up, including without limitation any requirements imposed by a 1041 permit, if any, issued by Prowers County. If a decree is entered in the Water Court Change Case after the Revegetation/Dry-Land Farming Deadline, GP shall satisfy any additional terms and conditions for revegetation and/or dry-land farming in that decree.

2.6 Successful completion of revegetation of the Reconfigured Grasmick Farm Lamar Dry-Up will be determined by LAWMA and its successors and assigns, using applicable Conservation Reserve Program criteria or the criteria imposed by the Water Court, whichever standards are strictest. Successful establishment and maintenance of dry-land farming of the Reconfigured Grasmick Farm Lamar Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion, or by the Water Court. At GP's request, the Revegetation/Dry-Land Farming Deadline will be extended by one year for each year that, from the year of closing and up to and including the year of the Revegetation/Dry-Land Farming Deadline, the amount of precipitation measured at the Lamar precipitation station falls below 80% of the March through August average of 10.4 inches (1950-2004 average). Until the decree is entered in the Water Court Change Case, at GP's request, LAWMA will extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming practices or revegetation have been materially hindered due to circumstances beyond GP's control, including fire, hail storms, wind storms, tornadoes, flooding, and freezes after May 15 and before September 15 of any year from the year of closing up to and including the year of the Revegetation/Dry-Land Farming Deadline; after the decree is entered in the Water Court Change Case, at GP's request, LAWMA may extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming have been materially hindered due to the same circumstances.

2.7 In the alternative to meeting the obligations imposed by Sections 2.2, 2.3, and 2.5 above, GP may demonstrate to LAWMA's satisfaction that the Reconfigured Grasmick Farm Lamar Dry-Up has been developed with structures and improvements such that the Reconfigured Grasmick Farm Lamar Dry-Up is not susceptible to erosion, weeds, or agricultural uses.

2.8 This Real Covenant for Revegetation or Dry-Land Farming, with the burdens it imposes, is binding upon and will run with the Reconfigured Grasmick Farm Lamar Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Reconfigured Grasmick Farm Lamar Dry-Up for the benefit of the Grasmick Lamar Water, LAWMA, and LAWMA's successors and assigns.

Section 3 – Right of Entry and Easements

3.1 GP hereby grants to LAWMA a non-exclusive right of entry to, upon, under, and across the Reconfigured Grasmick Farm Lamar Dry-Up for the purposes of providing a reasonable means for LAWMA and its agents, as well as the Colorado Division of Water Resources and the Water Court, to take all actions reasonably necessary to ensure that GP has met its obligations under this Agreement and the decree or any orders entered in the Water Court Change Case, including without limitation site inspections, installation of observation wells, piezometers, or lysimeters, performance of soil evaporation and plant transpiration tests, and performance of vegetative studies and surveys.

3.2 GP hereby further grants to LAWMA and/or its agents easements (i) to construct, operate, and maintain on the Reconfigured Grasmick Farm Lamar Dry-Up such facilities as are required by the decree or any orders entered in the Water Court Change Case for replication of historical return flows from irrigation use of the Grasmick Lamar Water, including without limitation storage reservoirs and/or recharge facilities; (ii) to use such portions of the surface and subsurface of the Reconfigured Grasmick Farm Lamar Dry-Up as are necessary to replicate historical return flows from irrigation use of the Grasmick Lamar Water; and (iii) to perform all acts necessary, including without limitation engineering and historical consumptive use studies, to prosecute the Water Court Change Case and/or an application for a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA using the Grasmick Lamar Water as a source of supply. GP and LAWMA acknowledge and agree that the exact nature, extent, and location of these easements are difficult to define in advance of completion of the Water Court Change Case or any administrative proceeding for approval of a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA. GP and LAWMA agree that the absence of specified locations for the easements on the Reconfigured Grasmick Farm Lamar Dry-Up does not void or render the easements unenforceable. To the extent reasonably practical, any easement that may require the construction of a physical structure on the Reconfigured Grasmick Farm Lamar Dry-Up will be located in a manner so as not to interfere unreasonably with GP's continued and proposed future use of the Reconfigured Grasmick Farm Lamar Dry-Up. Upon identification of an acceptable location for any facilities required under Paragraphs 3.2(i) and (ii), the Parties shall create and record a specific legal description of easements therefor. Upon such recording, the balance of the Reconfigured Grasmick Farm Lamar Dry-Up will be automatically released from Paragraphs 3.2(i) and (ii).

3.3 In the event that GP defaults in its obligations for dry-up and revegetation or dry-land farming hereunder, this right of entry and these easements also will entitle LAWMA, at GP's expense, to take all actions necessary to accomplish the dry-up and revegetation or dry-land farming of the Reconfigured Grasmick Farm Lamar Dry-Up, including without limitation constructing drainage and conveyance ditches, monumenting dried-up acreage, revegetating with drought-resistant plants, removing alfalfa and other deep-rooted plants, trees, phreatophytes, and tamarisk, and removing and filling in all or portions of irrigation ditches and/or farm laterals; provided, however, that GP will not be required to incur out-of-pocket expenses in excess of $200 per acre, for a maximum of $86,360, to complete the actions necessary to dry-up and revegetate or dry-land farm the Reconfigured Grasmick Farm Lamar Dry-Up as required by Sections 1 and 2 above.

3.4 This non-exclusive right of entry and these non-exclusive easements, with the burdens they impose, are binding upon and will run with the Reconfigured Grasmick Farm Lamar Dry-Up forever, and are forever enforceable against GP and its successors and assigns in the Reconfigured Grasmick Farm Lamar Dry-Up for the benefit of the Grasmick Lamar Water, LAWMA, and LAWMA's agents, successors, and assigns.

Section 4 – General Provisions

4.1 The terms and conditions of this Agreement and the real covenants given and non-exclusive right of entry and non-exclusive easements granted herein are perpetual and will not expire unless specifically released in writing by LAWMA or its successor or assign.

4.2 This Agreement may be enforced by LAWMA or its successor or assign, by any party having any right, title, or interest in the Grasmick Lamar Water, or by the State Engineer of the State of Colorado, through an action at law or in equity.

4.3 GP is and will be entitled to use the Reconfigured Grasmick Farm Lamar Dry-Up for any purpose not inconsistent with this Agreement, including but not limited to the mining and removal of sand, gravel, and other materials; dry-land grazing; and recreational, residential, commercial, and industrial purposes.

4.4 GP shall reasonably cooperate with LAWMA to demonstrate the dry-up and revegetation of the Reconfigured Grasmick Farm Lamar Dry-Up, including but not limited to providing affidavits or testimony at no cost to LAWMA.

4.5 Upon LAWMA's transfer of the Grasmick Lamar Water to any party, that party will succeed to LAWMA's interest in this Agreement and will have the right to enforce the terms of the Agreement against GP or the then-current owner of the Reconfigured Grasmick Farm Lamar Dry-Up.

4.6 All attached exhibits to this Agreement are incorporated herein by this reference.

4.7 LAWMA shall record this Agreement in the real property records of the Prowers County Clerk and Recorder.

Executed and effective as of the day first written above.

[Remainder of this page deliberately left blank.]

GP IRRIGATED FARMS, LLC

N/A

~~Karl Nyquist~~
~~Managing Member~~

Jay Houtsma
Managing Member

Date: 12/31/15

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

Robert Wilger, Vice-President

Date: 1-8-16

ATTEST:

Donald F. Higbee, Secretary

KANSAS
STATE OF ~~COLORADO~~)
HAMILTON ss.
COUNTY OF ~~PROWERS~~)

ROSS GEUBELLE
NOTARY PUBLIC
STATE OF KANSAS
My Commission Expires

The foregoing instrument was acknowledged before me this 31 day of December, 2015, by Karl Nyquist, Managing Member, and Jay Houtsma, Managing Member, of GP Irrigated Farms, LLC, a Colorado limited liability company.

Witness my hand and official seal.

My commission expires 7/26/2016.

Notary Public

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this 8th day of ~~December~~ JANUARY, 201~~5~~6 by Robert Wilger, Vice-President, and Donald F. Higbee, Secretary, of the Lower Arkansas Water Management Association, a Colorado non-profit corporation.

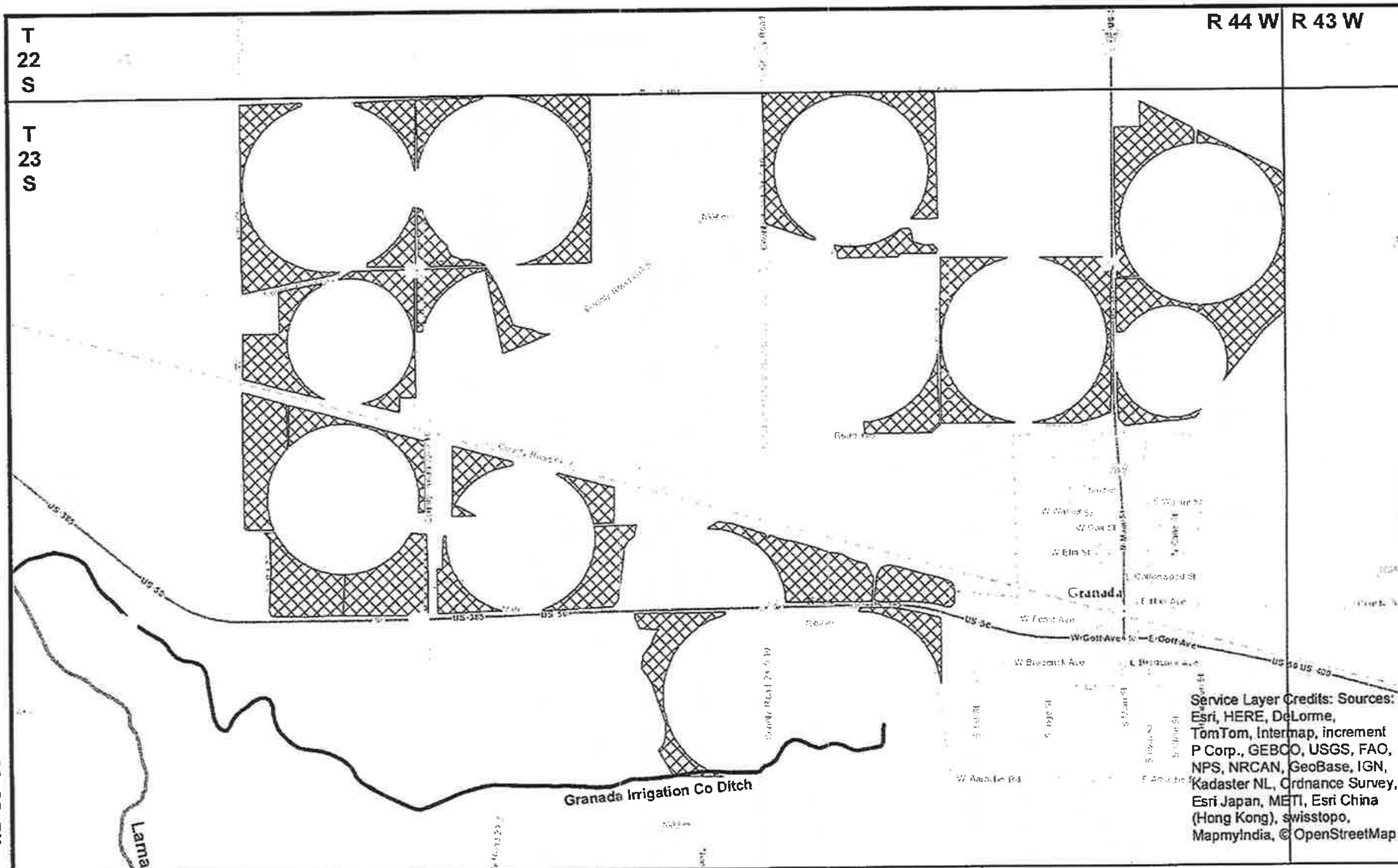
Witness my hand and official seal.

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20074046402
MY COMMISSION EXPIRES DECEMBER 20, 2019

My commission expires 12-20-2019.

Angela Higbee
Notary Public

Exhibit II



Legend

Grasmick Farm Granada Dry-up (466.8 Acres)

0 1,000 2,000 4,000

Scale in Feet

N E S W

Slattery & Hendrix Engineering LLC

Job No.: L7501

File: Grasmick Granada Exhibit A 08-15.mxd

Date: 03/04/14

Prepared For: LAWMA/GP

Exhibit A - Revised

Grasmick Farm Granada Dry-up

LENDER CONSENT, APPROVAL, SUBORDINATION, AND WAIVER

(Reconfigured Grasmick Farm Lamar Dry-Up)

The undersigned is the beneficiary under (a) that certain Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing dated May 29, 2013, recorded on May 30, 2013 at Reception No. 533996, Prowers County, Colorado, real property records, as modified by that certain First Modification to Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing dated October 10, 2014, and recorded on October 24, 2014, at Reception No. 537433, as further modified by that certain Modification of Loan Documents dated March 16, 2015, and recorded on March 18, 2015, at Reception No. 538398, and as further modified by that certain Amended and Restated Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing dated May 16, 2017, recorded on May 19, 2017, at Reception No. 543749, and as may be further modified from time to time (collectively, the "2013 Deed of Trust"), and (b) that certain Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing, dated as of March 16, 2015, and recorded March 18, 2015, at Reception No. 538396, and as may be further modified from time to time (collectively, the "2015 Deed of Trust"; the 2013 Deed of Trust and the 2015 Deed of Trust are collectively referred to herein as the "Deed of Trust"). Consent and approval are hereby given by the undersigned to the foregoing "AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRYLAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS (Reconfigured Grasmick Farm Lamar Dry-Up)" (the "Amended Dry-Up Covenant") to which this Consent, Approval and Subordination is attached. For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned hereby unconditionally and irrevocably subordinates the lien of its Deed of Trust to the Amended Dry-Up Covenant, agrees that its Deed of Trust shall be subject to the Amended Dry-Up Covenant as the same may be assigned, and waives any claim that the Amended Dry-Up Covenant constitutes a Prohibited Transfer under Article 7 of the Deed of Trust.

Dated this 8th day of June, 2017.

METROPOLITAN LIFE INSURANCE COMPANY

By: [signature]
Name: Kevin J. Harshberger
Title: Director

STATE OF KANSAS,
COUNTY OF JOHNSON, SS:

The foregoing instrument was acknowledged before me this 8th day of June, 2017, by Kevin J. Harshberger as Director of Metropolitan Life Insurance Company, a New York corporation.

Witness my hand and official seal

Roberta L Black
Notary Public

My Commission Expires: 08/26/2017

SEAL

ROBERTA L. BLACK
Notary Public - State of Kansas
My Appt. Expires 08/26/2017

9899090_2

546447

After recording please return to
Lower Arkansas Water Management Association
P.O. Box 1161
Lamar, Colorado 81052

AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS
(Reconfigured Koehn Farm Dry-Up)

THIS AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS ("Amended Agreement") is entered into this 31 day of December, 2015, by and between GP Irrigated Farms, LLC, a Colorado limited liability company ("GP"), as Grantor, and Lower Arkansas Water Management Association, a Colorado non-profit corporation ("LAWMA"), as Grantee (together, the "Parties").

Recitals

A. On October 17, 2014, GP and LAWMA entered into that certain Agreement for Dry-Up Covenant and for Revegetation or Dry-Land Farming Covenant, and Grant of Non-Exclusive Right of Entry and Easements ("Original Dry-Up Agreement") that was recorded in the real property records of Prowers County, Colorado, on November 3, 2014, at Reception Number 537505.

B. GP and LAWMA entered into the Original Dry-Up Agreement as additional consideration for LAWMA's issuance of 2,069 shares of common LAWMA stock (the "LAWMA Shares") to GP in trade for 897 of the 26,127 shares of capital stock outstanding in the Lamar Canal Company ("Lamar Canal Trade Shares"), 436 of the 3,030 shares of capital stock outstanding in the Granada Irrigation Company ("Granada Trade Shares"), and 1.5 cfs of the 69.0 cfs originally decreed to the XY Irrigating Ditch Company's Canal ("XY 1.5 cfs"), pursuant to the Water Rights Exchange Agreement and Reimbursement Agreement between the Parties, as amended ("Exchange Agreement"), and as more particularly described therein. The Lamar Canal Trade Shares, the Granada Trade Shares, and the XY 1.5 cfs are referred to collectively herein as the "GP Trade Water."

C. Following execution and recording of the Original Dry-Up Agreement, and at the request of the Division Engineer for Water Division 2, GP reconfigured certain of the parcels that were designated in the Original Dry-Up Agreement as the Koehn Farm Dry-Up. The reconfigured parcels are shown in **Exhibit A** ("Reconfigured Koehn Farm Dry-Up").

D. GP and its predecessors-in-interest historically used 84 of the Lamar Canal Trade Shares to irrigate the approximately 80.0 acres of the Reconfigured Koehn Farm Dry-Up in the

W½ of Section 31, Township 22 South, Range 44 West of the 6th P.M., in Prowers County, Colorado, as more particularly shown on the map attached as **Exhibit A.** The 84 Lamar Canal Trade Shares were represented by Stock Certificate No. 402 (the "Koehn Water").

E. GP acknowledges that LAWMA intends to use the Koehn Water for augmentation and replacement purposes, and that to effect such uses, the Koehn Water will need to be changed permanently in a change of water rights proceeding before the Water Court for Division 2 (the "Water Court Change Case"), and temporarily pursuant to a substitute water supply plan ("SWSP") or interruptible water supply agreement ("IWSA") approved by the Office of the State Engineer. GP further acknowledges that the Water Court and/or the State Engineer may require, as terms and conditions of such a change, that the Reconfigured Koehn Farm Dry-Up be dried up and either revegetated or established and maintained in dry-land farming practices.

F. GP and LAWMA desire to enter into this Amended Agreement, which will supersede and replace the Original Dry-Up Agreement in its entirety, to affirm the permanent cessation of use of the Koehn Water on the Reconfigured Koehn Farm Dry-Up, to confirm GP's obligation either to revegetate or to establish and maintain dry-land farming practices on the Reconfigured Koehn Farm Dry-Up, and to provide for a right of entry and easements for LAWMA and its agents, and for LAWMA's successors and assigns and their agents, upon the Reconfigured Koehn Farm Dry-Up for the purposes of enforcing this Agreement and the decree and any orders entered by the Water Court in the Water Court Change Case.

NOW, THEREFORE, in consideration of LAWMA's issuance of the LAWMA Shares in trade for the GP Trade Water and other consideration, GP hereby covenants, agrees, and grants as follows:

Section 1 – Real Covenant for Dry-Up

1.1 GP covenants and agrees to cease irrigation of the Reconfigured Koehn Farm Dry-Up with the Koehn Water.

1.2 GP covenants and agrees that the Reconfigured Koehn Farm Dry-Up will not be irrigated with any source of water unless the water used for such irrigation is ground water that is treated as sole-source pumping and is fully-augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division 2, or any SWSP or Arkansas River replacement plan approved by the State Engineer; provided, however, that GP is prohibited from performing such irrigation with ground water in a way that reduces the consumptive use credit available to LAWMA from the GP Trade Water under the terms and conditions of any decree entered in the Water Court Change Case.

1.3 GP shall ensure that the Reconfigured Koehn Farm Dry-Up complies with all terms and conditions included in the *Kansas v. Colorado* Operating Procedures for Administration of Parcels Claimed for Augmentation Credit ("*Kansas v. Colorado* Dry-Up Agreement"), a copy of which was attached to the Exchange Agreement as Exhibit G. Those terms and conditions include, without limitation, requirements that a physical separation must exist between any irrigated portion of a parcel and the dry-up portion unless the Division Engineer gives prior approval, that parcels formerly containing alfalfa or alfalfa-grass stands must be deep tilled or chemically killed, and that dry-up parcels must be monumented in accordance with specific standards.

1.4 GP covenants and agrees that in addition to the dry-up requirements for the Reconfigured Koehn Farm Dry-Up imposed by this Real Covenant for Dry-Up, GP also shall meet any dry-up obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the Koehn Water in any SWSP, IWSA, Arkansas River Replacement Plan pursuant to Rule 14 of the Amended Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the Arkansas River Basin ("Rule 14 Plan"), and/or Compact Compliance Plan pursuant to Rule 10 of the Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado ("Rule 10 Plan").

1.5 Successful completion of dry-up of the Reconfigured Koehn Farm Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion. In the event the Water Court retains jurisdiction in the Water Court Change Case to certify successful completion of dry-up of the Reconfigured Koehn Farm Dry-Up as a condition to transferring the consumptive use credit available to LAWMA for the GP Trade Water, then the determination of whether dry-up of the Reconfigured Koehn Farm Dry-Up has been successfully completed will be made by the Water Court.

1.6 This Real Covenant for Dry-Up, with the burdens it imposes, is binding upon and will run with the Reconfigured Koehn Farm Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Reconfigured Koehn Farm Dry-Up for the benefit of the Koehn Water, LAWMA, and LAWMA's successors and assigns.

Section 2 – Real Covenant for Revegetation or Dry-Land Farming

2.1 As used in this Agreement, the term "revegetation" means ground cover of plant life demonstrated to be, without irrigation, reasonably capable of sustaining itself under the climatic conditions, soils, precipitation and terrain prevailing on the Reconfigured Koehn Farm Dry-Up, with weeds adequately controlled; and the term "dry-land farming" means dry-land farming practices with weeds adequately controlled.

2.2 So long as GP is irrigating the Reconfigured Koehn Farm Dry-Up for agricultural production purposes in accordance with the terms and conditions in Section 1.2 above, the revegetation and dry-land farming obligations described in this Section 2 will not apply. Upon cessation of irrigation of the Reconfigured Koehn Farm Dry-Up for agricultural production purposes pursuant to Section 1.2 above, GP immediately shall revegetate or establish and maintain dry-land farming practices on the Reconfigured Koehn Farm Dry-Up in accordance with the terms and conditions of this Section 2. Within sixty days of ceasing irrigation of the Reconfigured Koehn Farm Dry-Up for agricultural production purposes, GP shall provide LAWMA with written notice of that cessation, by email to lawma@cminet.net, with a copy to rmehren@mwhw.com.

2.3 No later than the end of the third growing season after irrigation for agricultural purposes has ceased on the Reconfigured Koehn Farm Dry-Up pursuant to Section 1.2 above (the "Revegetation/Dry-Land Farming Deadline"), GP shall have established and maintained either revegetation or dry-land farming on the Reconfigured Koehn Farm Dry-Up. For either revegetation or dry-land farming to be "maintained" on the Reconfigured Koehn Farm Dry-Up, such revegetation or dry-land farming must have been established for more than one growing season. GP shall pay all costs of the revegetation, dry-land farming, and weed control of the Reconfigured Koehn Farm Dry-Up, including without limitation the payment of all power costs for associated well pumping and leasing of water for the purpose of revegetation.

2.4 The species of grass or other plants used for revegetation may not include grasses or other plants defined as "noxious" under the provisions of the Colorado Weed Management Act, Article 5.5 of Title 35, C.R.S., and may not include alfalfa or other highly water-consumptive species.

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2.6 Successful completion of revegetation of the Reconfigured Koehn Farm Dry-Up will be determined by LAWMA and its successors and assigns, using applicable Conservation Reserve Program criteria or the criteria imposed by the Water Court, whichever standards are strictest. Successful establishment and maintenance of dry-land farming of the Reconfigured Koehn Farm Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion, or by the Water Court. At GP's request, the Revegetation/Dry-Land Farming Deadline will be extended by one year for each year that, from the year of closing and up to and including the year of the Revegetation/Dry-Land Farming Deadline, the amount of precipitation measured at the Lamar precipitation station falls below 80% of the March through August average of 10.4 inches (1950-2004 average). Until the decree is entered in the Water Court Change Case, at GP's request, LAWMA will extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming practices or revegetation have been materially hindered due to circumstances beyond GP's control, including fire, hail storms, wind storms, tornadoes, flooding, and freezes after May 15 and before September 15 of any year from the year of closing up to and including the year of the Revegetation/Dry-Land Farming Deadline; after the decree is entered in the Water Court Change Case, at GP's request, LAWMA may extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming have been materially hindered due to the same circumstances.

2.7 In the alternative to meeting the obligations imposed by Sections 2.2, 2.3, and 2.5 above, GP may demonstrate to LAWMA's satisfaction that the Reconfigured Koehn Farm Dry-Up has been developed with structures and improvements such that the Reconfigured Koehn Farm Dry-Up is not susceptible to erosion, weeds, or agricultural uses.

2.8 This Real Covenant for Revegetation or Dry-Land Farming, with the burdens it imposes, is binding upon and will run with the Reconfigured Koehn Farm Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Reconfigured Koehn Farm Dry-Up for the benefit of the Koehn Water, LAWMA, and LAWMA's successors and assigns.

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3.2 GP hereby further grants to LAWMA and/or its agents easements (i) to construct, operate, and maintain on the Reconfigured Koehn Farm Dry-Up such facilities as are required by the decree or any orders entered in the Water Court Change Case for replication of historical return flows from irrigation use of the Koehn Water, including without limitation storage reservoirs and/or recharge facilities; (ii) to use such portions of the surface and subsurface of the Reconfigured Koehn Farm Dry-Up as are necessary to replicate historical return flows from irrigation use of the Koehn Water; and (iii) to perform all acts necessary, including without limitation engineering and historical consumptive use studies, to prosecute the Water Court Change Case and/or an application for a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA using the Koehn Water as a source of supply. GP and LAWMA acknowledge and agree that the exact nature, extent, and location of these easements are difficult to define in advance of completion of the Water Court Change Case or any administrative proceeding for approval of a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA. GP and LAWMA agree that the absence of specified locations for the easements on the Reconfigured Koehn Farm Dry-Up does not void or render the easements unenforceable. To the extent reasonably practical, any easement that may require the construction of a physical structure on the Reconfigured Koehn Farm Dry-Up will be located in a manner so as not to interfere unreasonably with GP's continued and proposed future use of the Reconfigured Koehn Farm Dry-Up. Upon identification of an acceptable location for any facilities required under Paragraphs 3.2(i) and (ii), the Parties shall create and record a specific legal description of easements therefor. Upon such recording, the balance of the Reconfigured Koehn Farm Dry-Up will be automatically released from Paragraphs 3.2(i) and (ii).

3.3 In the event that GP defaults in its obligations for dry-up and revegetation or dry-land farming hereunder, this right of entry and these easements also will entitle LAWMA, at GP's expense, to take all actions necessary to accomplish the dry-up and revegetation or dry-land farming of the Reconfigured Koehn Farm Dry-Up, including without limitation constructing drainage and conveyance ditches, monumenting dried-up acreage, revegetating with drought-resistant plants, removing alfalfa and other deep-rooted plants, trees, phreatophytes, and tamarisk, and removing and filling in all or portions of irrigation ditches and/or farm laterals; provided, however, that GP will not be required to incur out-of-pocket expenses in excess of $200 per acre, for a maximum of $16,000, to complete the actions necessary to dry-up and revegetate or dry-land farm the Reconfigured Koehn Farm Dry-Up as required by Sections 1 and 2 above.

3.4 This non-exclusive right of entry and these non-exclusive easements, with the burdens they impose, are binding upon and will run with the Reconfigured Koehn Farm Dry-Up forever, and are forever enforceable against GP and its successors and assigns in the Reconfigured Koehn Farm Dry-Up for the benefit of the Koehn Water, LAWMA, and LAWMA's agents, successors, and assigns.

Section 4 – General Provisions

4.1 The terms and conditions of this Agreement and the real covenants given and non-exclusive right of entry and non-exclusive easements granted herein are perpetual and will not expire unless specifically released in writing by LAWMA or its successor or assign.

4.2 This Agreement may be enforced by LAWMA or its successor or assign, by any party having any right, title, or interest in the Koehn Water, or by the State Engineer of the State of Colorado, through an action at law or in equity.

4.3 GP is and will be entitled to use the Reconfigured Koehn Farm Dry-Up for any purpose not inconsistent with this Agreement, including but not limited to the mining and removal of sand, gravel, and other materials; dry-land grazing; and recreational, residential, commercial, and industrial purposes.

4.4 GP shall reasonably cooperate with LAWMA to demonstrate the dry-up and revegetation of the Reconfigured Koehn Farm Dry-Up, including but not limited to providing affidavits or testimony at no cost to LAWMA.

4.5 Upon LAWMA's transfer of the Koehn Water to any party, that party will succeed to LAWMA's interest in this Agreement and will have the right to enforce the terms of the Agreement against GP or the then-current owner of the Reconfigured Koehn Farm Dry-Up.

4.6 All attached exhibits to this Agreement are incorporated herein by this reference.

4.7 LAWMA shall record this Agreement in the real property records of the Prowers County Clerk and Recorder.

Executed and effective as of the day first written above.

[Remainder of this page intentionally left blank.]

Exhibit L
REC # 546447 06/25/2018 03:00:32 PM
AGR Page: 8 of 10 R:58.00 D:0.00
Prowers County, CO

GP IRRIGATED FARMS, LLC

N/A

~~Karl Nyquist~~
~~Managing Member~~

Jay Houtsma
Managing Member

Date: 12/31/2015

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

Robert Wilger, Vice-President

Date: 1-8-16

ATTEST:

Donald F. Higbee, Secretary

Kansas
STATE OF ~~COLORADO~~)
Hamilton ss.
COUNTY ~~OF PROWERS~~)

ROSS GEUBELLE
NOTARY PUBLIC
STATE OF KANSAS
My Commission Expires ________

The foregoing instrument was acknowledged before me this 31 day of December, 2015, by ~~Karl Nyquist, Managing Member~~, and Jay Houtsma, Managing Member, of GP Irrigated Farms, LLC, a Colorado limited liability company.

Witness my hand and official seal.

My commission expires 7/26/2016.

Notary Public

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this 8th day of ~~December,~~ January 2016 by Robert Wilger, Vice-President, and Donald F. Higbee, Secretary, of the Lower Arkansas Water Management Association, a Colorado non-profit corporation.

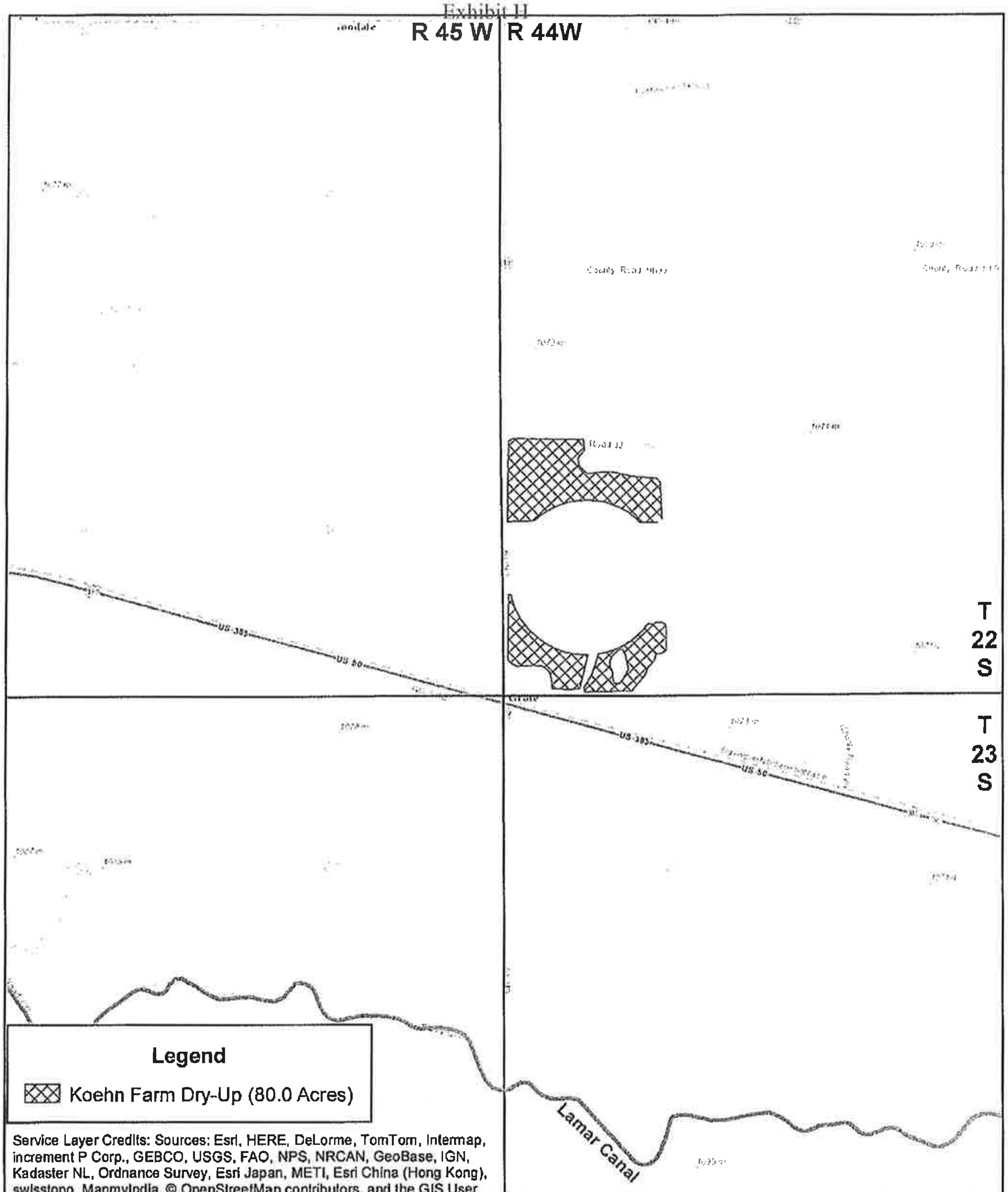
ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20074046492
MY COMMISSION EXPIRES DECEMBER 20, 2019

Witness my hand and official seal.

My commission expires 12-20-2019.

Notary Public

Exhibit H



0 1,000 2,000 4,000

Scale In Feet

N W E S

Job No. L7501

File: Koehn Exhibit A 09-01-15.mxd

Date: 09/01/15

Prepared For: LAWMA/GP

Exhibit A

Koehn Farm Dry-Up

Slattery & Hendrix Engineering LLC

546448

After recording please return to
Lower Arkansas Water Management Association
P.O. Box 1161
Lamar, Colorado 81052

AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS
(Reconfigured GP-DJC Dry-Up)

THIS AMENDED AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS ("Amended Agreement") is entered into this 31 day of December, 2015, by and between GP Irrigated Farms, LLC, a Colorado limited liability company ("GP"), as Grantor, and Lower Arkansas Water Management Association, a Colorado non-profit corporation ("LAWMA"), as Grantee (together, the "Parties").

Recitals

A. On October 17, 2014, GP and LAWMA entered into that certain Agreement for Dry-Up Covenant and for Revegetation or Dry-Land Farming Covenant, and Grant of Non-Exclusive Right of Entry and Easements ("Original Dry-Up Agreement") that was recorded in the real property records of Prowers County, Colorado, on November 3, 2014, at Reception Number 537504.

B. GP and LAWMA entered into the Original Dry-Up Agreement as additional consideration for LAWMA's issuance of 2,069 shares of common LAWMA stock (the "LAWMA Shares") to GP in trade for 897 of the 26,127 shares of capital stock outstanding in the Lamar Canal Company ("Lamar Canal Trade Shares"), 436 of the 3,030 shares of capital stock outstanding in the Granada Irrigation Company ("Granada Trade Shares"), and 1.5 cfs of the 69.0 cfs originally decreed to the XY Irrigating Ditch Company's Canal ("XY 1.5 cfs"), pursuant to the Water Rights Exchange Agreement and Reimbursement Agreement between the Parties, as amended ("Exchange Agreement"), and as more particularly described therein. The Lamar Canal Trade Shares, the Granada Trade Shares, and the XY 1.5 cfs are referred to collectively herein as the "GP Trade Water."

C. Following execution and recording of the Original Dry-Up Agreement, and at the request of the Division Engineer for Water Division 2, GP reconfigured certain of the parcels that were designated in the Original Dry-Up Agreement as the GP-DJC Dry-Up. The reconfigured parcels are shown in **Exhibit A** ("Reconfigured GP-DJC Dry-Up").

D. GP and its predecessors-in-interest historically used 155 of the Lamar Canal Trade Shares to irrigate the approximately 142.5 acres of the Reconfigured GP-DJC Dry-Up in portions of the E½ of Section 36, Township 22 South, Range 45 West of the 6th P.M., in Prowers County, Colorado, as more particularly shown on the map attached as **Exhibit A**. The 155 Lamar Canal Trade Shares (the "GP-DJC Water") were represented by Stock Certificate No. 403.

E. GP acknowledges that LAWMA intends to use the GP-DJC Water for augmentation and replacement purposes, and that to effect such uses, the GP-DJC Water will need to be changed permanently in a change of water rights proceeding before the Water Court for Division 2 (the "Water Court Change Case"), and temporarily pursuant to a substitute water supply plan ("SWSP") or interruptible water supply agreement ("IWSA") approved by the Office of the State Engineer. GP further acknowledges that the Water Court and/or the State Engineer may require, as terms and conditions of such a change, that the Reconfigured GP-DJC Dry-Up be dried up and either revegetated or established and maintained in dry-land farming practices.

F. GP and LAWMA desire to enter into this Amended Agreement, which will supersede and replace the Original Dry-Up Agreement in its entirety, to affirm the permanent cessation of use of the GP-DJC Water on the Reconfigured GP-DJC Dry-Up, to confirm GP's obligation either to revegetate or to establish and maintain dry-land farming practices on the Reconfigured GP-DJC Dry-Up, and to provide for a right of entry and easements for LAWMA and its agents, and for LAWMA's successors and assigns and their agents, upon the Reconfigured GP-DJC Dry-Up for the purposes of enforcing this Agreement and the decree and any orders entered by the Water Court in the Water Court Change Case.

NOW, THEREFORE, in consideration of LAWMA's issuance of the LAWMA Shares in trade for the GP Trade Water and other consideration, GP hereby covenants, agrees, and grants as follows:

Section 1 – Real Covenant for Dry-Up

1.1 GP covenants and agrees to cease irrigation of the Reconfigured GP-DJC Dry-Up with the GP-DJC Water.

1.2 GP covenants and agrees that the Reconfigured GP-DJC Dry-Up will not be irrigated with any source of water unless the water used for such irrigation is ground water that is treated as sole-source pumping and is fully-augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division 2, or any SWSP or Arkansas River replacement plan approved by the State Engineer; provided, however, that GP is prohibited from performing such irrigation with ground water in a way that reduces the consumptive use credit available to LAWMA from the GP Trade Water under the terms and conditions of any decree entered in the Water Court Change Case.

1.3 GP shall ensure that the Reconfigured GP-DJC Dry-Up complies with all terms and conditions included in the *Kansas v. Colorado* Operating Procedures for Administration of Parcels Claimed for Augmentation Credit ("*Kansas v. Colorado* Dry-Up Agreement"), a copy of which was attached to the Exchange Agreement as Exhibit G. Those terms and conditions include, without limitation, requirements that a physical separation must exist between any irrigated portion of a parcel and the dry-up portion unless the Division Engineer gives prior approval, that parcels formerly containing alfalfa or alfalfa-grass stands must be deep tilled or chemically killed, and that dry-up parcels must be monumented in accordance with specific standards.

1.4 GP covenants and agrees that in addition to the dry-up requirements for the Reconfigured GP-DJC Dry-Up imposed by this Real Covenant for Dry-Up, GP also shall meet any dry-up obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the GP-DJC Water in any SWSP, IWSA, Arkansas River Replacement Plan pursuant to Rule 14 of the Amended Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the Arkansas River Basin ("Rule 14 Plan"), and/or Compact Compliance Plan pursuant to Rule 10 of the Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado ("Rule 10 Plan").

1.5 Successful completion of dry-up of the Reconfigured GP-DJC Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion. In the event the Water Court retains jurisdiction in the Water Court Change Case to certify successful completion of dry-up of the Reconfigured GP-DJC Dry-Up as a condition to transferring the consumptive use credit available to LAWMA for the GP Trade Water, then the determination of whether dry-up of the Reconfigured GP-DJC Dry-Up has been successfully completed will be made by the Water Court.

1.6 This Real Covenant for Dry-Up, with the burdens it imposes, is binding upon and will run with the Reconfigured GP-DJC Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Reconfigured GP-DJC Dry-Up for the benefit of the GP-DJC Water, LAWMA, and LAWMA's successors and assigns.

Section 2 – Real Covenant for Revegetation or Dry-Land Farming

2.1 As used in this Agreement, the term "revegetation" means ground cover of plant life demonstrated to be, without irrigation, reasonably capable of sustaining itself under the climatic conditions, soils, precipitation and terrain prevailing on the Reconfigured GP-DJC Dry-Up, with weeds adequately controlled; and the term "dry-land farming" means dry-land farming practices with weeds adequately controlled.

2.2 So long as GP is irrigating the Reconfigured GP-DJC Dry-Up for agricultural production purposes in accordance with the terms and conditions in Section 1.2 above, the revegetation and dry-land farming obligations described in this Section 2 will not apply.

Upon cessation of irrigation of the Reconfigured GP-DJC Dry-Up for agricultural production purposes pursuant to Section 1.2 above, GP immediately shall revegetate or establish and maintain dry-land farming practices on the Reconfigured GP-DJC Dry-Up in accordance with the terms and conditions of this Section 2. Within sixty days of ceasing irrigation of the Reconfigured GP-DJC Dry-Up for agricultural production purposes, GP shall provide LAWMA with written notice of that cessation, by email to lawma@cminet.net, with a copy to rmehren@mwhw.com.

2.3 No later than the end of the third growing season after irrigation for agricultural purposes has ceased on the Reconfigured GP-DJC Dry-Up pursuant to Section 1.2 above (the "Revegetation/Dry-Land Farming Deadline"), GP shall have established and maintained either revegetation or dry-land farming on the Reconfigured GP-DJC Dry-Up. For either revegetation or dry-land farming to be "maintained" on the Reconfigured GP-DJC Dry-Up, such revegetation or dry-land farming must have been established for more than one growing season. GP shall pay all costs of the revegetation, dry-land farming, and weed control of the Reconfigured GP-DJC Dry-Up, including without limitation the payment of all power costs for associated well pumping and leasing of water for the purpose of revegetation.

2.4 The species of grass or other plants used for revegetation may not include grasses or other plants defined as "noxious" under the provisions of the Colorado Weed Management Act, Article 5.5 of Title 35, C.R.S., and may not include alfalfa or other highly water-consumptive species.

2.5 GP covenants and agrees that in addition to the revegetation and dry-land farming requirements imposed by this Real Covenant for Revegetation or Dry-Land Farming, GP also shall meet any revegetation or dry-land farming obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the GP-DJC Water in any SWSP, IWSA, Rule 14 Plan, and/or Rule 10 Plan. GP also shall take any and all actions as may be necessary to comply with any requirements imposed upon GP and/or LAWMA by federal, state, and/or local government authorities due to the removal of the GP-DJC Water from the Reconfigured GP-DJC Dry-Up, including without limitation any requirements imposed by a 1041 permit, if any, issued by Prowers County. If a decree is entered in the Water Court Change Case after the Revegetation/Dry-Land Farming Deadline, GP shall satisfy any additional terms and conditions for revegetation and/or dry-land farming in that decree.

2.6 Successful completion of revegetation of the Reconfigured GP-DJC Dry-Up will be determined by LAWMA and its successors and assigns, using applicable Conservation Reserve Program criteria or the criteria imposed by the Water Court, whichever standards are strictest. Successful establishment and maintenance of dry-land farming of the Reconfigured GP-DJC Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion, or by the Water Court. At GP's request, the Revegetation/Dry-Land Farming Deadline will be extended by one year for each year that, from the year of closing and up to and including the year of the Revegetation/Dry-Land Farming Deadline, the amount of precipitation measured at the Lamar precipitation station falls below 80% of the March through August average of 10.4 inches (1950-2004 average). Until the decree is entered in the Water Court Change Case, at GP's request, LAWMA will extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming practices or revegetation have been materially hindered due to circumstances beyond GP's control, including fire, hail storms, wind storms, tornadoes, flooding, and freezes after May 15 and before September 15 of any year from the year of closing up to and including the year of the Revegetation/Dry-Land Farming Deadline; after the decree is entered in the Water Court Change Case, at GP's request, LAWMA may extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming have been materially hindered due to the same circumstances.

2.7 In the alternative to meeting the obligations imposed by Sections 2.2, 2.3, and 2.5 above, GP may demonstrate to LAWMA's satisfaction that the Reconfigured GP-DJC Dry-Up has been developed with structures and improvements such that the Reconfigured GP-DJC Dry-Up is not susceptible to erosion, weeds, or agricultural uses.

2.8 This Real Covenant for Revegetation or Dry-Land Farming, with the burdens it imposes, is binding upon and will run with the Reconfigured GP-DJC Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Reconfigured GP-DJC Dry-Up for the benefit of the GP-DJC Water, LAWMA, and LAWMA's successors and assigns.

Section 3 – Right of Entry and Easements

3.1 GP hereby grants to LAWMA a non-exclusive right of entry to, upon, under, and across the Reconfigured GP-DJC Dry-Up for the purposes of providing a reasonable means for LAWMA and its agents, as well as the Colorado Division of Water Resources and the Water Court, to take all actions reasonably necessary to ensure that GP has met its obligations under this Agreement and the decree or any orders entered in the Water Court Change Case, including without limitation site inspections, installation of observation wells, piezometers, or lysimeters, performance of soil evaporation and plant transpiration tests, and performance of vegetative studies and surveys.

3.2 GP hereby further grants to LAWMA and/or its agents easements (i) to construct, operate, and maintain on the Reconfigured GP-DJC Dry-Up such facilities as are required by the decree or any orders entered in the Water Court Change Case for replication of historical return flows from irrigation use of the GP-DJC Water, including without limitation storage reservoirs and/or recharge facilities; (ii) to use such portions of the surface and subsurface of the Reconfigured GP-DJC Dry-Up as are necessary to replicate historical return flows from irrigation use of the GP-DJC Water; and (iii) to perform all acts necessary, including without limitation engineering and historical consumptive use studies, to prosecute the Water Court Change Case and/or an application for a Rule 14

Plan, a Rule 10 Plan, an SWSP or an IWSA using the GP-DJC Water as a source of supply. GP and LAWMA acknowledge and agree that the exact nature, extent, and location of these easements are difficult to define in advance of completion of the Water Court Change Case or any administrative proceeding for approval of a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA. GP and LAWMA agree that the absence of specified locations for the easements on the Reconfigured GP-DJC Dry-Up does not void or render the easements unenforceable. To the extent reasonably practical, any easement that may require the construction of a physical structure on the Reconfigured GP-DJC Dry-Up will be located in a manner so as not to interfere unreasonably with GP's continued and proposed future use of the Reconfigured GP-DJC Dry-Up. Upon identification of an acceptable location for any facilities required under Paragraphs 3.2(i) and (ii), the Parties shall create and record a specific legal description of easements therefor. Upon such recording, the balance of the Reconfigured GP-DJC Dry-Up will be automatically released from Paragraphs 3.2(i) and (ii).

3.3 In the event that GP defaults in its obligations for dry-up and revegetation or dry-land farming hereunder, this right of entry and these easements also will entitle LAWMA, at GP's expense, to take all actions necessary to accomplish the dry-up and revegetation or dry-land farming of the Reconfigured GP-DJC Dry-Up, including without limitation constructing drainage and conveyance ditches, monumenting dried-up acreage, revegetating with drought-resistant plants, removing alfalfa and other deep-rooted plants, trees, phreatophytes, and tamarisk, and removing and filling in all or portions of irrigation ditches and/or farm laterals; provided, however, that GP will not be required to incur out-of-pocket expenses in excess of $200 per acre, for a maximum of $28,500, to complete the actions necessary to dry-up and revegetate or dry-land farm the Reconfigured GP-DJC Dry-Up as required by Sections 1 and 2 above.

3.4 This non-exclusive right of entry and these non-exclusive easements, with the burdens they impose, are binding upon and will run with the Reconfigured GP-DJC Dry-Up forever, and are forever enforceable against GP and its successors and assigns in the Reconfigured GP-DJC Dry-Up for the benefit of the GP-DJC Water, LAWMA, and LAWMA's agents, successors, and assigns.

Section 4 – General Provisions

4.1 The terms and conditions of this Agreement and the real covenants given and non-exclusive right of entry and non-exclusive easements granted herein are perpetual and will not expire unless specifically released in writing by LAWMA or its successor or assign.

4.2 This Agreement may be enforced by LAWMA or its successor or assign, by any party having any right, title, or interest in the GP-DJC Water, or by the State Engineer of the State of Colorado, through an action at law or in equity.

4.3 GP is and will be entitled to use the Reconfigured GP-DJC Dry-Up for any purpose not inconsistent with this Agreement, including but not limited to the mining and removal of sand, gravel, and other materials; dry-land grazing; and recreational, residential, commercial, and industrial purposes.

4.4 GP shall reasonably cooperate with LAWMA to demonstrate the dry-up and revegetation of the Reconfigured GP-DJC Dry-Up, including but not limited to providing affidavits or testimony at no cost to LAWMA.

4.5 Upon LAWMA's transfer of the GP-DJC Water to any party, that party will succeed to LAWMA's interest in this Agreement and will have the right to enforce the terms of the Agreement against GP or the then-current owner of the Reconfigured GP-DJC Dry-Up.

4.6 All attached exhibits to this Agreement are incorporated herein by this reference.

4.7 LAWMA shall record this Agreement in the real property records of the Prowers County Clerk and Recorder.

Executed and effective as of the day first written above.

GP IRRIGATED FARMS, LLC

N/A

~~Karl Nyquist~~
~~Managing Member~~

Jay Houtsma
Managing Member

Date: 12/31/2015

REC # 546448 06/25/2018 03:00:32 PM
AGR Page: 8 of 10 R:58.00 D:0.00
Prowers County, CO

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

Robert Wilger

Robert Wilger, Vice-President

Date: 1-8-16

ATTEST:

Donald F. Higbee

Donald F. Higbee, Secretary

KANSAS
STATE OF ~~COLORADO~~)
HAMILTON ss.
COUNTY OF P~~ROWERS~~)

ROSS GEUBELLE
NOTARY PUBLIC
STATE OF KANSAS
My Commission Expires

The foregoing instrument was acknowledged before me this 31 day of December, 2015, ~~by Karl Nyquist, Managing Member,~~ and Jay Houtsma, Managing Member, of GP Irrigated Farms, LLC, a Colorado limited liability company.

Witness my hand and official seal.

My commission expires 7/26/2016

Notary Public

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this 8th day of ~~December,~~ JANUARY 2016, by Robert Wilger, Vice-President, and Donald F. Higbee, Secretary, of the Lower Arkansas Water Management Association, a Colorado non-profit corporation.

A[illegible]A HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20074046402
MY COMMISSION EXPIRES DECEMBER 20, 2019

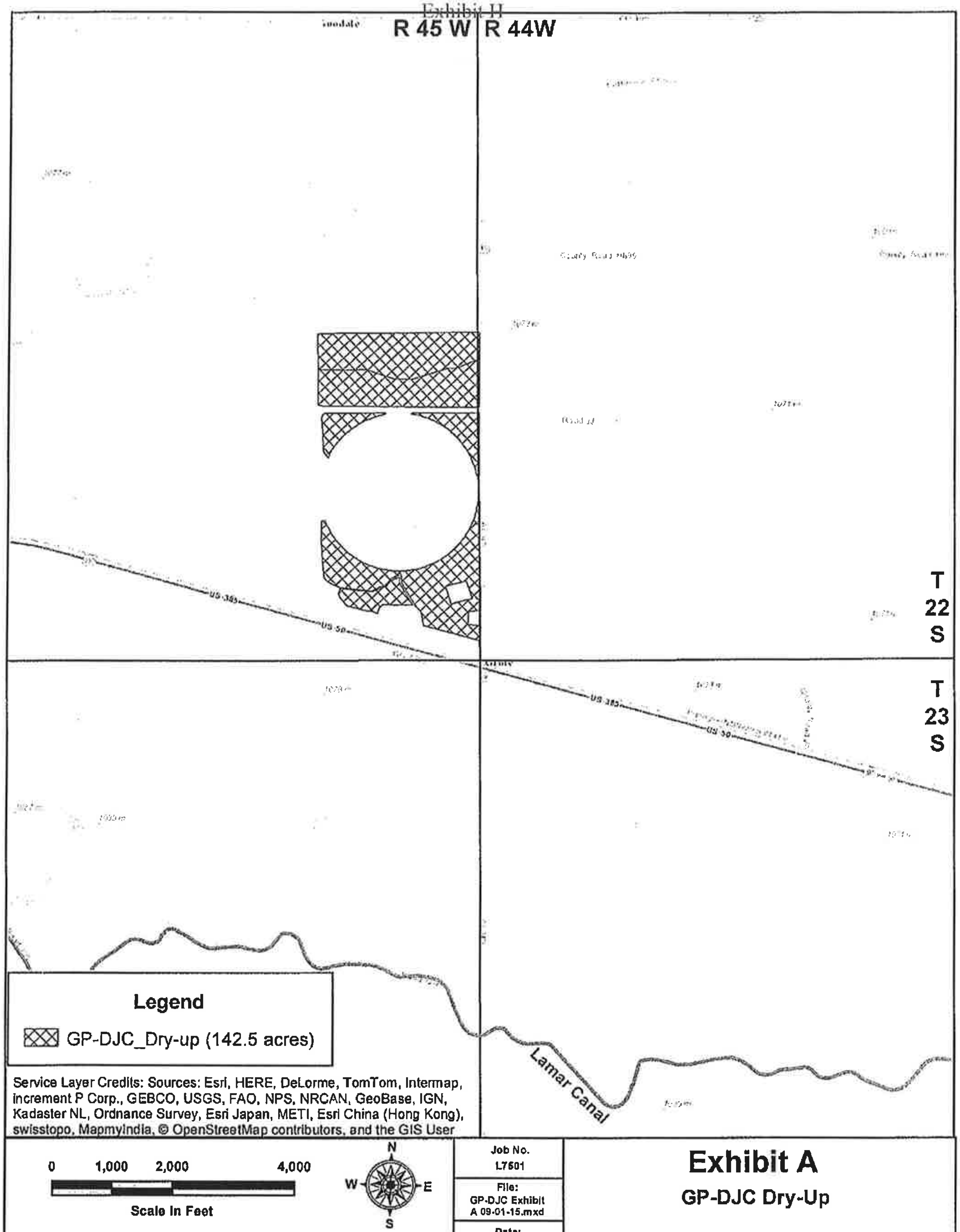
Witness my hand and official seal.

My commission expires 12-20-2019.

Notary Public

REC # 546448 06/25/2018 03:00:32 PM
AGR Page: 9 of 10 R:58.00 D:0.00
Prowers County, CO

Exhibit H



Job No. L7501	**Exhibit A** GP-DJC Dry-Up
File: GP-DJC Exhibit A 09-01-15.mxd	
Date: 09/01/15	
Prepared For: LAWMA/GP	

Slattery & Hendrix Engineering LLC

Exhibit 1 REC # 537631 11/20/2014 01:36:26 PM
ASIGN Page: 1 of 14 R:76.00 D:0.00
Prowers County, CO

537631

After recording please return to
Lower Arkansas Water Management Association
P.O. Box 1161
Lamar, Colorado 81052

No Doc Fee

Assignment of Dry-Up and Revegetation Covenant and Non-Exclusive Easement
(Higbee-DJC Covenants)

This Assignment of Dry-Up and Revegetation Covenant and Non-Exclusive Easement ("Assignment") is made as of this **17th** day of October, 2014 (the "Effective Date"), by and between GP Irrigated Farms, LLC, a Colorado limited liability company whose address is 7991 Shaffer Parkway, Suite 200, Littleton, Colorado 80127 ("GP") and Lower Arkansas Water Management Association, a Colorado non-profit corporation whose address is P.O. Box 1161, Lamar, Colorado 81052 ("LAWMA").

A. LAWMA will acquire 173 shares of the Lamar Canal and Irrigation Company represented by Certificate No. 403, and the water and water rights derived therefrom (the "Lamar Canal Shares"), along with other shares of the Lamar Canal and Irrigation Company and other consideration, pursuant to that certain Water Rights Exchange Agreement and Reimbursement Agreement between GP and LAWMA dated January 24, 2014, as amended ("Exchange Agreement"). LAWMA will issue 2,069 shares of LAWMA common stock (the "LAWMA Shares") to GP under the Exchange Agreement.

B. GP acquired the Lamar Canal Shares, which previously were represented by Certificate Nos. 382 and 383, from Donald F. Higbee, Janet Elaine Higbee, and Carol J. Higbee.

C. After it purchased the Lamar Canal Shares, GP also obtained an Agreement for Dry-Up and Revegetation and Grant of Non-Exclusive Easement from Donald F. Higbee, dated October 17, 2014, and recorded on October 17, 2014 at Reception No. 537507 of the records of the Prowers County, Colorado, Clerk and Recorder (the "Higbee-DJC Covenants"). A copy of the Higbee-DJC Covenants is attached as **Exhibit A**.

NOW, THEREFORE, for the issuance of the LAWMA Shares pursuant to the Exchange Agreement and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, GP covenants and agrees as follows:

1. Assignment of Higbee-DJC Covenants. GP hereby assigns, transfers and conveys to LAWMA all of its right, title and interest in and to the Higbee-DJC Covenants.

In Witness Whereof, this Assignment of Dry-Up and Revegetation Covenant and Non-Exclusive Easement has been entered into as of the Effective Date.

By: ______________________
Karl Nyquist, Managing Member
GP Irrigated Farms, LLC

By: ______________________ for Jay Houtsma
Jay Houtsma, Managing Member
GP Irrigated Farms, LLC

STATE OF COLORADO)
) ss.
COUNTY OF Prowers)

The foregoing instrument was acknowledged before me this **17th** day of October, 2014, by Karl Nyquist, Managing Member, and Jay Houtsma, Managing Member, of GP Irrigated Farms, LLC, a Colorado limited liability company.

Witness my hand and official seal.

My commission expires: 12-20-2015

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 12/20/2015

____
Notary Public

537507

After recording please return to
Karl Nyquist
7991 Shaffer Pkwy., Suite 200
Littleton, CO 80127

AGREEMENT FOR DRY-UP AND REVEGETATION OR DRY-LAND FARMING, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS
(Higbee-DJC Dry-Up)

THIS AGREEMENT FOR DRY-UP AND REVEGETATION OR DRY-LAND FARMING, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS ("Agreement") is entered into this 17th day of October, 2014, by and between GP Irrigated Farms, LLC, a Colorado limited liability company, as Buyer, and Donald F. Higbee, as Seller (together, the "Parties").

Recitals

A. Buyer has entered into a Water Rights Exchange Agreement and Reimbursement Agreement dated January 24, 2014, and amended as of March 6, 2014 ("Exchange Agreement"), with the Lower Arkansas Water Management Association ("LAWMA"). Under the Exchange Agreement, Buyer has agreed to exchange to LAWMA certain water rights, including water rights associated with a portion of 500 shares in the Lamar Canal and Irrigation Company acquired from Seller, Janet Elaine Higbee, and Carol J. Higbee ("Lamar Canal Shares"). Before the sale of the Lamar Canal Shares to Buyer, Seller historically used water attributable to 18 of the Lamar Canal Shares ("Higbee-DJC Water") to irrigate approximately 16.2 acres of real property generally located in the NE ¼ of the NW ¼ of Section 36, Township 22 South, Range 45 West of the 6th P.M., in Prowers County, Colorado, as shown on the map attached as Exhibit A ("Higbee-DJC Dry-Up").

B. Under the Exchange Agreement, Buyer must assign to LAWMA a dry-up and revegetation covenant and easement for the Higbee-DJC Dry-Up. For the consideration stated below, Seller, as the owner of the Higbee-DJC Dry-Up, enters into this Agreement with Buyer.

C. Seller acknowledges that LAWMA intends to use the Higbee-DJC Water for augmentation and replacement purposes, and that to effect such uses, the Higbee-DJC Water will need to be changed permanently in a change of water rights proceeding before the Water Court for Division 2 (the "Water Court Change Case"), and temporarily pursuant to a substitute water supply plan ("SWSP") or interruptible water supply agreement ("IWSA") approved by the Office of the State Engineer. Seller further acknowledges that the Water Court and/or the State Engineer may require, as terms and conditions of such a change, that the Higbee-DJC Dry-Up be dried up and either revegetated or established and maintained in dry-land farming practices.

D. Seller and Buyer desire to enter into this Agreement to affirm the permanent cessation of use of the Higbee-DJC Water on the Higbee-DJC Dry-Up, to confirm Seller's obligation either to revegetate or to establish and maintain dry-land farming practices on the Higbee-DJC Dry-Up, and to provide for a right of entry and easements for Buyer and its agents, and for Buyer's successors and assigns and their agents, upon the Higbee-DJC Dry-Up for the purposes of enforcing this Agreement and the decree and any orders entered by the Water Court in the Water Court Change Case.

NOW, THEREFORE, in consideration of One Hundred Dollars ($100), and other good and valuable consideration, the receipt and sufficiency of which Seller acknowledges, Seller hereby covenants, agrees, and grants as follows:

Section 1 – Real Covenant for Dry-Up

1.1 Seller covenants and agrees to cease irrigation of the Higbee-DJC Dry-Up with the Higbee-DJC Water.

1.2 Seller covenants and agrees that the Higbee-DJC Dry-Up will not be irrigated with any source of water unless the water used for such irrigation is ground water that is treated as sole-source pumping and is fully-augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division 2, or any SWSP or Arkansas River replacement plan approved by the State Engineer; provided, however, that Seller is prohibited from performing such irrigation with ground water in a way that reduces the consumptive use credit available from the Higbee-DJC Water under the terms and conditions of any decree entered in the Water Court Change Case.

1.3 Seller shall ensure that the Higbee-DJC Dry-Up complies with all terms and conditions included in the *Kansas v. Colorado* Operating Procedures for Administration of Parcels Claimed for Augmentation Credit ("*Kansas v. Colorado* Dry-Up Agreement"), a copy of which is attached to the Exchange Agreement as Exhibit G. Those terms and conditions include, without limitation, requirements that a physical separation must exist between any irrigated portion of a parcel and the dry-up portion unless the Division Engineer gives prior approval, that parcels formerly containing alfalfa or alfalfa-grass stands must be deep tilled or chemically killed, and that dry-up parcels must be monumented in accordance with specific standards.

1.4 Seller covenants and agrees that in addition to the dry-up requirements for the Higbee-DJC Dry-Up imposed by this Real Covenant for Dry-Up, Seller also shall meet any dry-up obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of Buyer's or LAWMA's use of the Higbee-DJC Water in any SWSP, IWSA, Arkansas River Replacement Plan pursuant to Rule 14 of the Amended Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the

Arkansas River Basin ("Rule 14 Plan"), and/or Compact Compliance Plan pursuant to Rule 10 of the Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado ("Rule 10 Plan").

1.5 Successful completion of dry-up of the Higbee-DJC Dry-Up will be determined by Buyer before the consummation of the Exchange Agreement, and by LAWMA and its successors and assigns after the consummation of the Exchange Agreement, in the exercise of reasonable discretion. In the event the Water Court retains jurisdiction in the Water Court Change Case to certify successful completion of dry-up of the Higbee-DJC Dry-Up as a condition to transferring the consumptive use credit available from the Lamar Canal Shares, then the determination of whether dry-up of the Higbee-DJC Dry-Up has been successfully completed will be made by the Water Court.

1.6 This Real Covenant for Dry-Up, with the burdens it imposes, is binding upon and will run with the Higbee-DJC Dry-Up forever, and is forever enforceable against Seller and his successors and assigns in the Higbee-DJC Dry-Up for the benefit of the Higbee-DJC Water, Buyer, and, upon the consummation of the Exchange Agreement, LAWMA and LAWMA's successors and assigns.

Section 2 – Real Covenant for Revegetation or Dry-Land Farming

2.1 As used in this Agreement, the term "revegetation" means ground cover of plant life demonstrated to be, without irrigation, reasonably capable of sustaining itself under the climatic conditions, soils, precipitation and terrain prevailing on the Higbee-DJC Dry-Up, with weeds adequately controlled; and the term "dry-land farming" means dry-land farming practices with weeds adequately controlled.

2.2 So long as Seller is irrigating the Higbee-DJC Dry-Up for agricultural production purposes in accordance with the terms and conditions in Section 1.2 above, the revegetation and dry-land farming obligations described in this Section 2 will not apply. Upon cessation of irrigation of the Higbee-DJC Dry-Up for agricultural production purposes pursuant to Section 1.2 above, Seller immediately shall revegetate or establish and maintain dry-land farming practices on the Higbee-DJC Dry-Up in accordance with the terms and conditions of this Section 2. Within sixty days of ceasing irrigation of the Higbee-DJC Dry-Up for agricultural production purposes, Seller shall provide LAWMA with written notice of that cessation, by email to lawma@cminet.net, with a copy to rmehren@mwhw.com.

2.3 No later than the end of the third growing season after irrigation for agricultural purposes has ceased on the Higbee-DJC Dry-Up pursuant to Section 1.2 above (the "Revegetation/Dry-Land Farming Deadline"), Seller shall have established and maintained either revegetation or dry-land farming on the Higbee-DJC Dry-Up. For either revegetation or dry-land farming to be "maintained" on the Higbee-DJC Dry-Up, such revegetation or dry-land farming must have been established for more than one

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Prowers County, CO

growing season. Seller shall pay all costs of the revegetation, dry-land farming, and weed control of the Higbee-DJC Dry-Up, including without limitation the payment of all power costs for associated well pumping and leasing of water for the purpose of revegetation.

2.4 The species of grass or other plants used for revegetation may not include grasses or other plants defined as "noxious" under the provisions of the Colorado Weed Management Act, Article 5.5 of Title 35, C.R.S., and may not include alfalfa or other highly water-consumptive species.

2.5 Seller covenants and agrees that in addition to the revegetation and dry-land farming requirements imposed by this Real Covenant for Revegetation or Dry-Land Farming, Seller also shall meet any revegetation or dry-land farming obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of Buyer's or LAWMA's use of the Higbee-DJC Water in any SWSP, IWSA, Rule 14 Plan, and/or Rule 10 Plan. Seller also shall take any and all actions as may be necessary to comply with any requirements imposed upon Seller, Buyer, and/or LAWMA by federal, state, and/or local government authorities due to the removal of the Higbee-DJC Water from the Higbee-DJC Dry-Up, including without limitation any requirements imposed by a 1041 permit, if any, issued by Prowers County. If a decree is entered in the Water Court Change Case after the Revegetation/Dry-Land Farming Deadline, Seller shall satisfy any additional terms and conditions for revegetation and/or dry-land farming in that decree.

2.6 Successful completion of revegetation of the Higbee-DJC Dry-Up will be determined by Buyer before consummation of the Exchange Agreement, and by LAWMA and its successors and assigns after consummation of the Exchange Agreement, using applicable Conservation Reserve Program criteria or the criteria imposed by the Water Court, whichever standards are strictest. Successful establishment and maintenance of dry-land farming of the Higbee-DJC Dry-Up will be determined by buyer before consummation of the Exchange Agreement, and by LAWMA and its successors and assigns after the consummation of the Exchange Agreement, in the exercise of reasonable discretion, or by the Water Court. At Seller's request, the Revegetation/Dry-Land Farming Deadline will be extended by one year for each year that, from the year of closing and up to and including the year of the Revegetation/Dry-Land Farming Deadline, the amount of precipitation measured at the Lamar precipitation station falls below 80% of the March through August average of 10.4 inches (1950-2004 average). Until the decree is entered in the Water Court Change Case, at Seller's request, Buyer or LAWMA will extend the Revegetation/Dry-Land Farming Deadline upon a showing by Seller that its efforts to establish and maintain dry-land farming practices or revegetation have been materially hindered due to circumstances beyond Seller's control, including fire, hail storms, wind storms, tornadoes, flooding, and freezes after May 15 and before September 15 of any year from the year of closing up to and including the year of the Revegetation/Dry-Land Farming Deadline; after the decree is entered in the Water Court Change Case, at Seller's

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request, Buyer or LAWMA may extend the Revegetation/Dry-Land Farming Deadline upon a showing by Seller that its efforts to establish and maintain dry-land farming have been materially hindered due to the same circumstances.

2.7 In the alternative to meeting the obligations imposed by Sections 2.2, 2.3, and 2.5 above, Seller may demonstrate to LAWMA's satisfaction that the Higbee-DJC Dry-Up has been developed with structures and improvements such that the Higbee-DJC Dry-Up is not susceptible to erosion, weeds, or agricultural uses.

2.8 This Real Covenant for Revegetation or Dry-Land Farming, with the burdens it imposes, is binding upon and will run with the Higbee-DJC Dry-Up forever, and is forever enforceable against Seller and his successors and assigns in the Higbee-DJC Dry-Up for the benefit of the Higbee-DJC Water, Buyer, and upon consummation of the Exchange Agreement, LAWMA and LAWMA's successors and assigns.

Section 3 – Right of Entry and Easements

3.1 Seller hereby grants to Buyer a non-exclusive right of entry to, upon, under, and across the Higbee-DJC Dry-Up for the purposes of providing a reasonable means for Buyer and its agents, as well as the Colorado Division of Water Resources and the Water Court, to take all actions reasonably necessary to ensure that Seller has met its obligations under this Agreement and the decree or any orders entered in the Water Court Change Case, including without limitation site inspections, installation of observation wells, piezometers, or lysimeters, performance of soil evaporation and plant transpiration tests, and performance of vegetative studies and surveys.

3.2 Seller hereby further grants to Buyer and/or its agents easements (i) to construct, operate, and maintain on the Higbee-DJC Dry-Up such facilities as are required by the decree or any orders entered in the Water Court Change Case for replication of historical return flows from irrigation use of the Higbee-DJC Water, including without limitation storage reservoirs and/or recharge facilities; (ii) to use such portions of the surface and subsurface of the Higbee-DJC Dry-Up as are necessary to replicate historical return flows from irrigation use of the Higbee-DJC Water; and (iii) to perform all acts necessary, including without limitation engineering and historical consumptive use studies, to prosecute the Water Court Change Case and/or an application for Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA using the Higbee-DJC Water as a source of supply. Seller and Buyer acknowledge and agree that the exact nature, extent, and location of these easements are difficult to define in advance of completion of the Water Court Change Case or any administrative proceeding for approval of a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA. Seller and Buyer agree that the absence of specified locations for the easements on the Higbee-DJC Dry-Up does not void or render the easements unenforceable. To the extent reasonably practical, any easement that may require the construction of a physical structure on the Higbee-DJC Dry-Up will be located in a manner so as not to interfere unreasonably with Seller's continued and proposed future use of the Higbee-DJC Dry-Up. Upon identification of an acceptable location for any facilities required under Paragraphs 3.2(i) and (ii), the Parties shall create and record a specific legal description of easements therefor. Upon such recording, the balance of the Higbee-DJC Dry-Up will be automatically released from Paragraphs 3.2(i) and (ii).

3.3 In the event that Seller defaults in its obligations for dry-up and revegetation or dry-land farming hereunder, this right of entry and these easements also will entitle Buyer, at Seller's expense, to take all actions necessary to accomplish the dry-up and revegetation or dry-land farming of the Higbee-DJC Dry-Up, including without limitation constructing drainage and conveyance ditches, monumenting dried-up acreage, revegetating with drought-resistant plants, removing alfalfa and other deep-rooted plants, trees, phreatophytes, and tamarisk, and removing and filling in all or portions of irrigation ditches and/or farm laterals; provided, however, that Seller will not be required to incur out-of-pocket expenses in excess of $200 per acre, for a maximum of $3,240, to complete the actions necessary to dry-up and revegetate or dry-land farm the Higbee-DJC Dry-Up as required by Sections 1 and 2 above.

3.4 This non-exclusive right of entry and these non-exclusive easements, with the burdens they impose, are binding upon and will run with the Higbee-DJC Dry-Up forever, and are forever enforceable against Seller and his successors and assigns in the Higbee-DJC Dry-Up for the benefit of the Higbee-DJC Water, Buyer, and upon consummation of the Exchange Agreement, LAWMA and LAWMA's agents, successors, and assigns.

Section 4 – General Provisions

4.1 The terms and conditions of this Agreement and the real covenants given and non-exclusive right of entry and non-exclusive easements granted herein are perpetual and will not expire unless specifically released in writing by Buyer or its successor or assign.

4.2 This Agreement may be enforced by Buyer or its successor or assign, by any party having any right, title, or interest in the Higbee-DJC Water, or by the State Engineer of the State of Colorado, through an action at law or in equity.

4.3 Seller is and will be entitled to use the Higbee-DJC Dry-Up for any purpose not inconsistent with this Agreement, including but not limited to the mining and removal of sand, gravel, and other materials; dry-land grazing; and recreational, residential, commercial, and industrial purposes.

4.4 Seller shall reasonably cooperate with Buyer to demonstrate the dry-up and revegetation of the Higbee-DJC Dry-Up, including but not limited to providing affidavits or testimony at no cost to Buyer or LAWMA.

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Prowers County, CO

4.5 Upon Buyer's transfer of the Higbee-DJC Water to any party, that party will succeed to Buyer's interest in this Agreement and will have the right to enforce the terms of the Agreement against Seller or the then-current owner of the Higbee-DJC Dry-Up.

4.6 All attached exhibits to this Agreement are incorporated herein by this reference.

4.7 Buyer or LAWMA shall record this Agreement in the real property records of the Prowers County Clerk and Recorder.

Executed and effective as of the day first written above.

BUYER:

Karl Nyquist
Managing Member
GP Irrigated Farms, LLC

for Jay Houtsma

Jay Houtsma
Managing Member
GP Irrigated Farms, LLC

Date: 10/17/14

SELLER:

Donald F. Higbee

Date: 10/17/14

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Prowers County, CO

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this 17th day of October, 2014, by Karl Nyquist, Managing Member, and Jay Houtsma, Managing Member, of GP Irrigated Farms, LLC, a Colorado limited liability company.

Witness my hand and official seal.

My commission expires 12-20-2015.

Angela Higbee
Notary Public

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 12/20/2015

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this 17th day of October, 2014, by Donald F. Higbee.

Witness my hand and official seal.

My commission expires 12-20-2015.

Angela Higbee
Notary Public

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 12/20/2015

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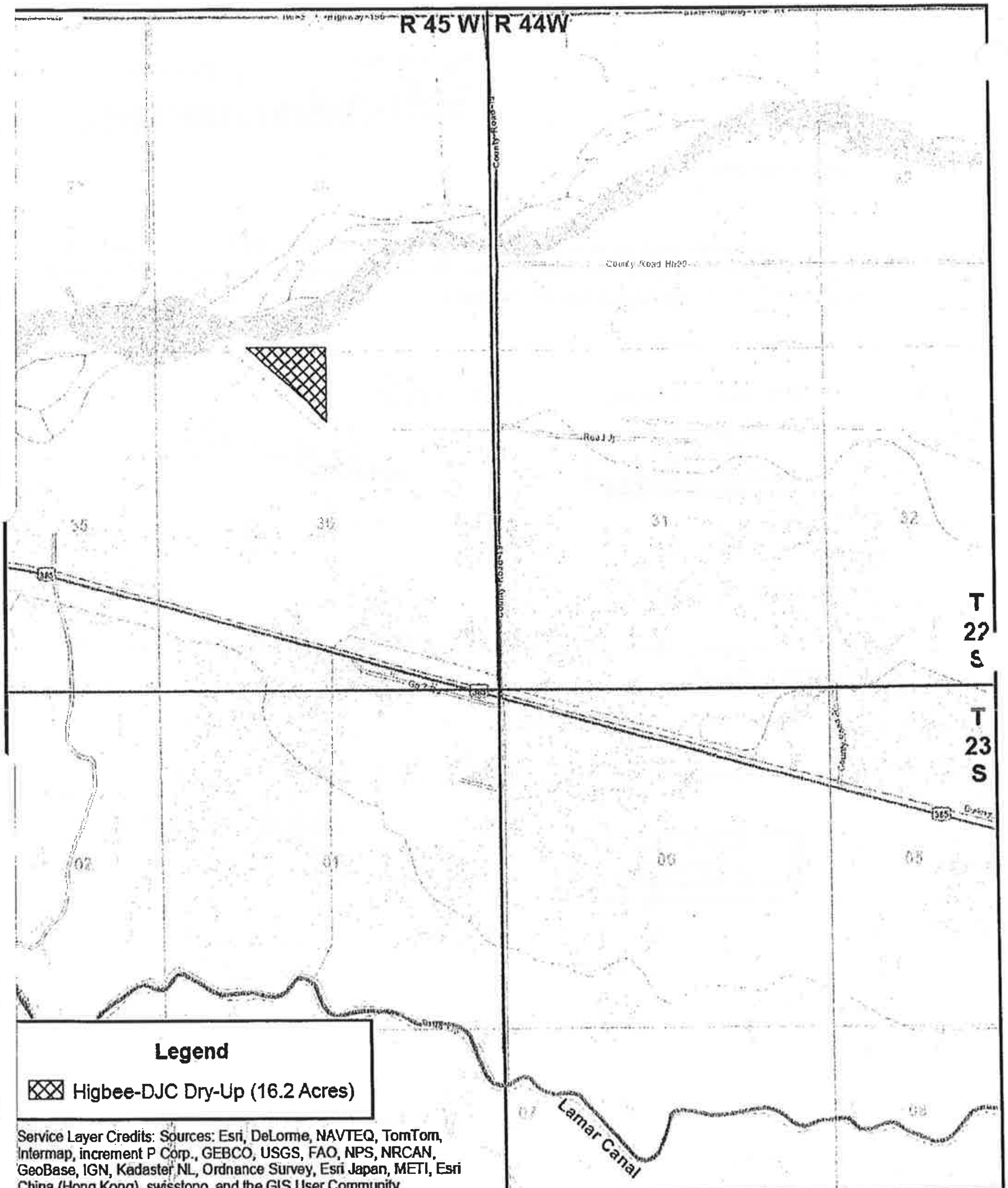
Exhibit H



Legend

Higbee-DJC Dry-Up (16.2 Acres)

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

0 1,000 2,000 4,000

Scale In Feet

N W E S

Job No.
L7501

File:
Higbee-DJC
Exhibit A.mxd

Date:
01/14/14

Prepared For:
LAWMA/GP

Exhibit A

Higbee-DJC Dry-Up

Slattery & Hendrix
Engineering LLC

ACTION BY WRITTEN CONSENT IN LIEU OF MEETINGS OF THE SOLE MANAGER AND SOLE MEMBER OF GP IRRIGATED FARMS, LLC
(a Colorado limited liability company)

The sole manager ("Manager") and sole member ("Member") of **GP IRRIGATED FARMS, LLC**, a Colorado limited liability company (the "Company"), as permitted by the Company's AMENDED & RESTATED LIMITED LIABILITY COMPANY AGREEMENT effective as of April 23, 2013 (the "LLC-Agreement") take the following action by written consent ("Consent") in lieu of meetings, effective as of October 17, 2014 ("Consent Date"):

The Company desires to trade certain water rights owned by the Company relating to the X-Y Canal a/k/a X-Y Irrigating Ditch Company's Ditch; Granada Irrigation Company; Lamar Canal/Lamar Canal and Irrigation Company; Lower Arkansas Water Management Association; well permits and associated groundwater rights owned; and other shares or any rights which the Company, for use on or appurtenant to the Real Property, or the Real Property may receive water, including the shares described in the Contract, including any rights negotiated under the Water Rights Exchange Agreement and Reimbursement Agreement (the "Water Rights Trade").

The Company's Manager and Member have reviewed the proposed documents related to the Water Rights Trade. The sole Manager and Member accordingly have:

RESOLVED: The Water Rights Trade is fair to the Company, will benefit the Company, and is in the Company's best interest.

RESOLVED: The Company is authorized to enter into the Water Rights Trade and to enter into and perform the terms of the Water Rights Trade documents;

RESOLVED: Karl Nyquist (who is the President of Farming Operations of the Company) is hereby designated as an "Authorized Signatory" for the Company in connection with the Water Rights Trade and associated documents;

RESOLVED: Karl Nyquist, as Authorized Signatory for the Company, is specifically authorized to negotiate and prepare the Water Rights Trade documents and all associated, ancillary or incidental documents ("Ancillary Documents" including but not limited to agreements and conveyance and/or transfer instruments relating to the X-Y Canal a/k/a X-Y Irrigating Ditch Company's Ditch; Granada Irrigation Company; Lamar Canal/Lamar Canal and Irrigation Company; Lower Arkansas Water Management Association; well permits and associated groundwater rights owned; and other shares or any rights which the Company, for use on or appurtenant to the Real Property, or the Real Property may receive water, including the shares described in the Contract, including any rights negotiated under the Water Rights Exchange Agreement and Reimbursement Agreement and any other document he deems advisable to consummate the Contract;

RESOLVED: Karl Nyquist, as Authorized Signatory for the Company, is specifically authorized to execute, deliver and cause the performance of the Water Rights Trade and Ancillary Documents;

RESOLVED: Karl R. Nyquist, as Authorized Signatory for the Company, acting alone, is specifically authorized to amend, as he deems advisable, any Water Rights Trade or Ancillary Document, which as amended (collectively, the "Documents") may differ from the forms approved by the Manager and sole Member;

RESOLVED: The execution and delivery of any Water Rights Trade, Ancillary Documents or Document by Karl R. Nyquist, as Authorized Signatory for the Company, shall conclusively establish the approval by the Company of the terms, conditions, execution, delivery and performance of such executed Documents;

RESOLVED: These resolutions shall be conclusive evidence the authority of the Company to enter into, execute, deliver and perform the Water Rights Trade, Ancillary Documents and Documents;

RESOLVED: All actions of the Manager, Officers, sole and the Company's agents taken in connection with the Water Rights Trade are hereby ratified, confirmed and approved;

RESOLVED: Karl R. Nyquist, Officers and the Company's agents are authorized, empowered and directed to take all necessary and reasonable actions on behalf of the Company to implement these resolutions;

RESOLVED: The undersigned acknowledge that others are relying on their signatures below to confirm that the Company has the authority to execute and deliver the Water Rights Trade, Ancillary Documents and Documents to which it is a party;

RESOLVED: This Consent may be executed in counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument and facsimile and electronic "PDF" signatures of this Consent shall be treated as original signatures and given full force and effect for all purposes; and

RESOLVED: Execution of this Consent constitutes full ratification hereof, and further, the foregoing Resolutions shall be effective as of the Consent Date, regardless of the actual date of execution.

The undersigned Manager and sole Member hereby waive all notice of a meeting and the holding of any meeting of the Manager and Member of the Company to act upon the foregoing resolutions and certify that the undersigned are the Manager and sole Member of the Company.

[The signature page follows.]

Exhibit H

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Prowers County, CO

IN WITNESS WHEREOF, the sole Manager and sole Member have signed below to evidence their consent to this Consent.

MANAGER:

S-D COLORADO FARMS, LLC,
a Delaware limited liability company

By: ______________________________
Jay Houtsma, President of Dairy Operations

By: ______________________________
Karl Nyquist, President of Farming Operations

MEMBER:

S-D COLORADO FARMS, LLC,
a Delaware limited liability company

By: ______________________________
Jay Houtsma, President of Dairy Operations

By: ______________________________
Karl Nyquist, President of Farming Operations

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Prowers County, CO

After recording please return to
Lower Arkansas Water Management Association
P.O. Box 1161
Lamar, Colorado 81052

Assignment of Dry-Up and Revegetation Covenant and Non-Exclusive Easement
(Higbee-West Covenants)

This Assignment of Dry-Up and Revegetation Covenant and Non-Exclusive Easement ("Assignment") is made as of this **17th** day of October, 2014 (the "Effective Date"), by and between GP Irrigated Farms, LLC, a Colorado limited liability company whose address is 7991 Shaffer Parkway, Suite 200, Littleton, Colorado 80127 ("GP") and Lower Arkansas Water Management Association, a Colorado non-profit corporation whose address is P.O. Box 1161, Lamar, Colorado 81052 ("LAWMA").

A. LAWMA will acquire 200 shares of the Lamar Canal and Irrigation Company represented by Certificate No. 404, and the water and water rights derived therefrom (the "Lamar Canal Shares"), along with other shares of the Lamar Canal and Irrigation Company and other consideration, pursuant to that certain Water Rights Exchange Agreement and Reimbursement Agreement between GP and LAWMA dated January 24, 2014, as amended ("Exchange Agreement"). LAWMA will issue 2,069 shares of LAWMA common stock (the "LAWMA Shares") to GP under the Exchange Agreement.

B. GP acquired the Lamar Canal Shares, which previously were represented by Certificate Nos. 332 and 364, from Donald F. Higbee.

C. After it purchased the Lamar Canal Shares, GP also obtained an Agreement for Dry-Up and Revegetation and Grant of Non-Exclusive Easement from Donald F. Higbee, dated June 14, 2014, and recorded on June 20, 2014 at Reception No. 536535 of the records of the Prowers County, Colorado, Clerk and Recorder (the "Higbee-West Covenants"). A copy of the Higbee-West Covenants is attached as **Exhibit A**.

NOW, THEREFORE, for the issuance of the LAWMA Shares pursuant to the Exchange Agreement and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, GP covenants and agrees as follows:

1. Assignment of Higbee-West Covenants. GP hereby assigns, transfers and conveys to LAWMA all of its right, title and interest in and to the Higbee-West Covenants.

In Witness Whereof, this Assignment of Dry-Up and Revegetation Covenant and Non-Exclusive Easement has been entered into as of the Effective Date.

By: ______________________
Karl Nyquist, Managing Member
GP Irrigated Farms, LLC

By: ______________________ for Jay Houtsma
Jay Houtsma, Managing Member
GP Irrigated Farms, LLC

STATE OF COLORADO)
) ss.
COUNTY OF Prowers)

The foregoing instrument was acknowledged before me this **17th** day of October, 2014, by Karl Nyquist, Managing Member, and Jay Houtsma, Managing Member, of GP Irrigated Farms, LLC, a Colorado limited liability company.

Witness my hand and official seal.

My commission expires: 12-20-2015

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 12/20/2015

Angela HigBee
Notary Public

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Jana Coen, Prowers County, Colorado
EASE Rec Fee: $51.00 Doc Fee: $0.00 eRecorded

WHEN RECORDED RETURN TO:
Karl Nyquist
7991 Shaffer Pkwy.
Suite 200
Littleton, CO 80127

RESTATED AGREEMENT FOR DRY-UP AND REVEGETATION AND GRANT OF NON-EXCLUSIVE EASEMENT

THIS RESTATED AGREEMENT FOR DRY-UP AND REVEGETATION AND GRANT OF NON-EXCLUSIVE EASEMENT ("Agreement"), dated as of this 17th day of June, 2014, is by and between **GP IRRIGATED FARMS, LLC**, a Colorado limited liability company ("Buyer"), and **DONALD F. HIGBEE** ("Seller").

RECITALS **No Doc Fee **

A. In connection with Buyer's purchase from Seller of 200 of the 262 shares of capital stock in the Lamar Canal and Irrigation Company represented by Stock Certificate No. 332, which are now represented by Stock Certificate No. 398 in the name of Buyer ("Purchased Water Rights"), Seller executed an Agreement for Dry-Up and Revegetation and Grant of Non-Exclusive Easement, dated as of May 29, 2014, recorded on June 3, 2013 at Reception No. 534019, Prowers County real property records (the "Original Agreement"). As represented in the Original Agreement, prior to the sale of the Purchased Water Rights to Buyer, Seller historically used the Purchased Water Rights to irrigate approximately 164 acres of real property located in Prowers County, Colorado, described in the attached Exhibit A ("Historically Irrigated Lands").

B. Buyer has entered into a Water Rights Exchange Agreement and Reimbursement Agreement, dated January 24, 2014 (the "Exchange Agreement"), with the Lower Arkansas Water Management Association ("LAWMA"), under which Buyer has agreed to exchange to LAWMA certain water rights, including the Purchased Water Rights. Under the Exchange Agreement, Buyer must assign to LAWMA a form of dry-up and revegetation covenant and easement for the Historically Irrigated Lands that is different than the Original Agreement. For the consideration stated below, Seller, as the owner of the Historically Irrigated Lands, has agreed to cooperate with the Buyer to provide this restated Agreement to conform to the requirements of the Exchange Agreement.

C. Seller acknowledges that the Purchased Water Rights are intended to be used for all beneficial uses, including augmentation and replacement uses, by Buyer or Buyer's successors, assigns or transferees, and in order to effect such uses, the Purchased Water Rights will need to be changed permanently in an appropriate change of water rights proceeding before the District Court, Water Division No. 2 (the "Water Court Change Case"), and temporarily pursuant to a State Engineer-approved Substitute Water Supply Plan ("SWSP") or State Engineer-approved interruptible water supply agreement ("IWSA"). Seller further acknowledges

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Prowers County, CO

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Prowers County, CO

WHEN RECORDED RETURN TO:
Karl Nyquist
7991 Shaffer Pkwy.
Suite 200
Littleton, CO 80127

RESTATED AGREEMENT FOR DRY-UP AND REVEGETATION AND GRANT OF NON-EXCLUSIVE EASEMENT

THIS RESTATED AGREEMENT FOR DRY-UP AND REVEGETATION AND GRANT OF NON-EXCLUSIVE EASEMENT ("Agreement"), dated as of this 14th day of June, 2014, is by and between **GP IRRIGATED FARMS, LLC**, a Colorado limited liability company ("Buyer"), and **DONALD F. HIGBEE** ("Seller").

RECITALS

A. In connection with Buyer's purchase from Seller of 200 of the 262 shares of capital stock in the Lamar Canal and Irrigation Company represented by Stock Certificate No. 332, which are now represented by Stock Certificate No. 398 in the name of Buyer ("Purchased Water Rights"), Seller executed an Agreement for Dry-Up and Revegetation and Grant of Non-Exclusive Easement, dated as of May 29, 2014, recorded on June 3, 2013 at Reception No. 534019, Prowers County real property records (the "Original Agreement"). As represented in the Original Agreement, prior to the sale of the Purchased Water Rights to Buyer, Seller historically used the Purchased Water Rights to irrigate approximately 164 acres of real property located in Prowers County, Colorado, described in the attached Exhibit A ("Historically Irrigated Lands").

B. Buyer has entered into a Water Rights Exchange Agreement and Reimbursement Agreement, dated January 24, 2014 (the "Exchange Agreement"), with the Lower Arkansas Water Management Association ("LAWMA"), under which Buyer has agreed to exchange to LAWMA certain water rights, including the Purchased Water Rights. Under the Exchange Agreement, Buyer must assign to LAWMA a form of dry-up and revegetation covenant and easement for the Historically Irrigated Lands that is different than the Original Agreement. For the consideration stated below, Seller, as the owner of the Historically Irrigated Lands, has agreed to cooperate with the Buyer to provide this restated Agreement to conform to the requirements of the Exchange Agreement.

C. Seller acknowledges that the Purchased Water Rights are intended to be used for all beneficial uses, including augmentation and replacement uses, by Buyer or Buyer's successors, assigns or transferees, and in order to effect such uses, the Purchased Water Rights will need to be changed permanently in an appropriate change of water rights proceeding before the District Court, Water Division No. 2 (the "Water Court Change Case"), and temporarily pursuant to a State Engineer-approved Substitute Water Supply Plan ("SWSP") or State Engineer-approved interruptible water supply agreement ("IWSA"). Seller further acknowledges that the Water Court and/or State Engineer may require, as terms and conditions of such change, that the Historically Irrigated Lands be dried up and either revegetated or established and maintained in dry-land farming practices.

D. Seller and Buyer desire to enter into this Agreement to affirm the permanent cessation of use of the Purchased Water Rights on the Historically Irrigated Lands, to confirm Seller's obligation either to revegetate or establish and maintain dry-land farming practices on the Historically Irrigated Lands, and to provide a right of entry and easements for Buyer and its agents, and for Buyer's successors and assigns and their agents, upon the Historically Irrigated Lands for the purposes of enforcing this Agreement and the decree and any orders by the Water Court in the Water Court Change Case.

NOW, THEREFORE, in consideration of One-Hundred Dollars ($100), and other good and valuable consideration, the receipt and sufficiency of which Seller acknowledges, Seller hereby covenants, agrees and grants as follows:

Section 1 – Real Covenant for Dry-Up

1.1 Seller covenants and agrees to cease irrigation of the Historically Irrigated Lands with the Purchased Water Rights.

1.2 Seller covenants and agrees that the Historically Irrigated Lands will not be irrigated with any source of water unless the water used for such irrigation is ground water that is treated as sole-source pumping and is fully-augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division 2, or any SWSP or Arkansas River replacement plan approved by the State Engineer; provided, however, that Seller is prohibited from performing such irrigation with ground water in a way that reduces the consumptive use credit available from the Purchased Water Rights under the terms and conditions of any decree entered in the Water Court Change Case.

1.3 Seller shall ensure that the Historically Irrigated Lands comply with all terms and conditions included in the *Kansas v. Colorado* Operating Procedures for Administration of Parcels Claimed for Augmentation Credit ("*Kansas v. Colorado* Dry-Up Agreement"), a copy of which is attached to this Agreement as Exhibit B. Those terms and conditions include, without limitation, requirements that a physical separation must exist between any irrigated portion of a parcel and the dry-up portion unless the Division Engineer gives prior approval, that parcels formerly containing alfalfa or alfalfa-grass stands must be deep tilled or chemically killed, and that dry-up parcels must be monumented in accordance with specific standards.

1.4 Seller covenants and agrees that in addition to the dry-up requirements for the Historically Irrigated Lands imposed by this Real Covenant for Dry-Up, Seller also shall meet any dry-up obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of Buyer's or LAWMA's use of the Purchased Water Rights in any SWSP, IWSA, Arkansas River Replacement Plan pursuant to Rule 14 of the

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Amended Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the Arkansas River Basin ("Rule 14 Plan"), and/or Compact Compliance Plan pursuant to Rule 10 of the Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado ("Rule 10 Plan").

1.5 Successful completion of dry-up of the Historically Irrigated Lands will be determined by Buyer before the consummation of the Exchange Agreement, and by LAWMA and its successors and assigns after the consummation of the Exchange Agreement , in the exercise of reasonable discretion. In the event the Water Court retains jurisdiction in the Water Court Change Case to certify successful completion of dry-up of the Historically Irrigated Lands, then the determination of whether dry-up of the Historically Irrigated Lands has been successfully completed will be made by the Water Court.

1.6 This Real Covenant for Dry-Up, with the burdens it imposes, is binding upon and will run with the Historically Irrigated Lands forever, and is forever enforceable against Seller and his successors and assigns in the Historically Irrigated Lands for the benefit of the Purchased Water Rights and Buyer, and upon the consummation of the Exchange Agreement, LAWMA and LAWMA's successors and assigns.

Section 2 – Real Covenant for Revegetation or Dry-Land Farming

2.1 As used in this Agreement, the term "revegetation" means ground cover of plant life demonstrated to be, without irrigation, reasonably capable of sustaining itself under the climatic conditions, soils, precipitation and terrain prevailing on the Historically Irrigated Lands, with weeds adequately controlled; and the term "dry-land farming" means dry-land farming practices with weeds adequately controlled.

2.2 So long as Seller is irrigating the Historically Irrigated Lands for agricultural production purposes in accordance with the terms and conditions in Section 1.2 above, the revegetation and dry-land farming obligations described in this Section 2 will not apply. Upon cessation of irrigation of the Historically Irrigated Lands for agricultural production purposes pursuant to Section 1.2 above, Seller immediately shall revegetate or establish and maintain dry-land farming practices on the Historically Irrigated Lands in accordance with the terms and conditions of this Section 2. Within sixty days of ceasing irrigation of the Historically Irrigated Lands for agricultural production purposes, Seller shall provide Buyer with written notice of that cessation, by email to bill@grasmickinc.com and karl@cacompanies.com.

2.3 No later than the end of the third growing season after irrigation for agricultural purposes has ceased on the Historically Irrigated Lands pursuant to Section 1.2 above (the "Revegetation/Dry-Land Farming Deadline"), Seller shall have established and maintained either revegetation or dry-land farming on the Historically Irrigated Lands. For either revegetation or dry-land farming to be "maintained" on the Historically Irrigated Lands, such revegetation or dry-land farming must have been established for more than one growing season. Seller shall pay all costs of the revegetation, dry-land farming, and weed control of the Historically Irrigated Lands, including without limitation the payment of all power costs for associated well pumping and leasing of water for the purpose of revegetation.

2.4 The species of grass or other plants used for revegetation may not include grasses or other plants defined as "noxious" under the provisions of the Colorado Weed Management Act, Article 5.5 of Title 35, C.R.S., and may not include alfalfa or other highly water-consumptive species.

2.5 Seller covenants and agrees that in addition to the revegetation and dry-land farming requirements imposed by this Real Covenant for Revegetation or Dry-Land Farming, Seller also shall meet any revegetation or dry-land farming obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of Buyer's or LAWMA's use of the Purchased Water Rights in any SWSP, IWSA, Rule 14 Plan, and/or Rule 10 Plan. Seller also shall take any and all actions as may be necessary to comply with any requirements imposed upon Buyer and/or LAWMA by federal, state, and/or local government authorities due to the removal of the Purchased Water Rights from the Historically Irrigated Lands, including without limitation any requirements imposed by a 1041 permit, if any, issued by Prowers County. If a decree is entered in the Water Court Change Case after the Revegetation/Dry-Land Farming Deadline, Seller shall satisfy any additional terms and conditions for revegetation and/or dry-land farming in that decree.

2.6 Successful completion of revegetation of the Historically Irrigated Lands will be determined by Buyer before consummation of the Exchange Agreement, and by LAWMA and its successors and assigns after consummation of the Exchange Agreement, using applicable Conservation Reserve Program criteria or the criteria imposed by the Water Court, whichever standards are strictest. Successful establishment and maintenance of dry-land farming of the Historically Irrigated Lands will be determined by Buyer before consummation of the Exchange Agreement, and by LAWMA and its successors and assigns after consummation of the Exchange Agreement, in the exercise of reasonable discretion, or by the Water Court. At Seller's request, Buyer or LAWMA will extend the Revegetation/Dry-Land Farming Deadline by one year for each year that, from the year of Buyer's and LAWMA's closing on the Exchange Agreement and up to and including the year of the Revegetation/Dry-Land Farming Deadline, the amount of precipitation measured at the Lamar precipitation station falls below 80% of the March through August average of 10.4 inches (1950-2004 average). Until the decree is entered in the Water Court Change Case, at Seller's request, Buyer or LAWMA will extend the Revegetation/Dry-Land Farming Deadline upon a showing by Seller that its efforts to establish and maintain dry-land farming practices or revegetation have been materially hindered due to circumstances beyond Seller's control, including fire, hail storms, wind storms, tornadoes, flooding, and freezes after May 15 and before September 15 of any year from the year of closing up to and including the year of the Revegetation/Dry-Land Farming Deadline; after the decree is entered in the Water Court Change Case, at Seller's request, Buyer or LAWMA may extend the Revegetation/Dry-Land Farming Deadline

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upon a showing by Seller that its efforts to establish and maintain dry-land farming have been materially hindered due to the same circumstances.

2.7 In the alternative to meeting the obligations imposed by Sections 2.2, 2.3, and 2.5 above, Seller may demonstrate to Buyer's or LAWMA's satisfaction that the Historically Irrigated Lands have been developed with structures and improvements such that the Historically Irrigated Lands are not susceptible to erosion, weeds, or agricultural uses.

2.8 This Real Covenant for Revegetation or Dry-Land Farming, with the burdens it imposes, is binding upon and will run with the Historically Irrigated Lands forever, and is forever enforceable against Seller and his successors and assigns in the Historically Irrigated Lands for the benefit of the Purchased Water Rights, Buyer, and upon consummation of the Exchange Agreement, LAWMA, and LAWMA's successors and assigns.

Section 3 – Right of Entry and Easements

3.1 Seller hereby grants to Buyer a non-exclusive right of entry to, upon, under, and across the Historically Irrigated Lands for the purposes of providing a reasonable means for Buyer and its agents, as well as the Colorado Division of Water Resources and the Water Court, to take all actions reasonably necessary to ensure that Seller has met its obligations under this Agreement and the decree or any orders entered in the Water Court Change Case, including without limitation site inspections, installation of observation wells, piezometers, or lysimeters, performance of soil evaporation and plant transpiration tests, and performance of vegetative studies and surveys.

3.2 Seller hereby further grants to Buyer and/or its agents easements (i) to construct, operate, and maintain on the Historically Irrigated Lands such facilities as are required by the decree or any orders entered in the Water Court Change Case for replication of historical return flows from irrigation use of the Purchased Water Rights, including without limitation storage reservoirs and/or recharge facilities; (ii) to use such portions of the surface and subsurface of the Historically Irrigated Lands as are necessary to replicate historical return flows from irrigation use of the Purchased Water Rights; and (iii) to perform all acts necessary, including without limitation engineering and historical consumptive use studies, to prosecute the Water Court Change Case and/or an application for a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA using the Purchased Water Rights as a source of supply. Seller and Buyer acknowledge and agree that the exact nature, extent, and location of these easements are difficult to define in advance of completion of the Water Court Change Case or any administrative proceeding for approval of a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA. Seller and Buyer agree that the absence of specified locations for the easements on the Historically Irrigated Lands does not void or render the easements unenforceable. To the extent reasonably practical, any easement that may require the construction of a physical structure on the Historically Irrigated Lands will be located in a manner so as not to interfere unreasonably with Seller's continued and proposed future use of Historically Irrigated Lands. Upon identification of an acceptable location for any facilities required under Paragraphs 3.2(i) and (ii), the Parties shall create and record a specific legal description of easements therefor. Upon such recording, the balance of Historically Irrigated Lands will be automatically released from Paragraphs 3.2(i) and (ii).

3.3 In the event that Seller defaults in its obligations for dry-up and revegetation or dry-land farming hereunder, this right of entry and these easements also will entitle Buyer, at Seller's expense, to take all actions necessary to accomplish the dry-up and revegetation or dry-land farming of the Historically Irrigated Lands, including without limitation constructing drainage and conveyance ditches, monumenting dried-up acreage, revegetating with drought-resistant plants, removing alfalfa and other deep-rooted plants, trees, phreatophytes, and tamarisk, and removing and filling in all or portions of irrigation ditches and/or farm laterals; provided, however, that Seller will not be required to incur out-of-pocket expenses in excess of $200 per acre, for a maximum of $32,800, to complete the actions necessary to dry-up and revegetate or dry-land farm the Historically Irrigated Lands as required by Sections 1 and 2 above.

3.4 This non-exclusive right of entry and these non-exclusive easements, with the burdens they impose, are binding upon and will run with the Historically Irrigated Lands forever, and are forever enforceable against Seller and his successors and assigns in the Historically Irrigated Lands for the benefit of the Purchased Water Rights, Buyer, and upon consummation of the Exchange Agreement, LAWMA, and LAWMA's agents, successors, and assigns.

Section 4 – General Provisions

4.1 The terms and conditions of this Agreement and the real covenants given and non-exclusive right of entry and non-exclusive easements granted herein are perpetual and will not expire unless specifically released in writing by Buyer or its successor or assign.

4.2 This Agreement may be enforced by Buyer or its successor or assign, by any party having any right, title, or interest in the Purchased Water Rights, or by the State Engineer of the State of Colorado, through an action at law or in equity.

4.3 Seller is and will be entitled to use the Historically Irrigated Lands for any purpose not inconsistent with this Agreement, including but not limited to the mining and removal of sand, gravel, and other materials; dry-land grazing; and recreational, residential, commercial, and industrial purposes.

4.4 Seller shall reasonably cooperate with Buyer to demonstrate the dry-up and revegetation of the Historically Irrigated Lands, including but not limited to providing affidavits or testimony at no cost to Buyer or LAWMA.

4.5 Upon Buyer's transfer of the Purchased Water Rights to any party, that party will succeed to Buyer's interest in this Agreement and will have the right to enforce the terms of the Agreement against Seller or the then-current owner of the Historically Irrigated Lands.

4.6 All attached exhibits to this Agreement are incorporated herein by this reference.

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4.7 Buyer shall record this Agreement in the real property records of the Prowers County Clerk and Recorder.

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Executed and effective as of the first day written above.

SELLER:

By: ______________________
Donald F. Higbee

STATE OF COLORADO)
) ss.
COUNTY OF PROWERS)

The foregoing RESTATED AGREEMENT FOR DRY-UP AND REVEGETATION AND GRANT OF NON-EXCLUSIVE EASEMENT was acknowledged before me this 14th day of June 2014 by Donald F. Higbee.

Witness my hand and official seal

____
Notary Public

SEAL

My Commission Expires: 12-20-2015

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 12/20/2015

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EXHIBIT A

Description of Historically Irrigated Lands

NW1/4NW1/4 Section 3, T. 23 S., R. 45 W., 6th PM, Prowers County, Colorado

SW1/4, NW1/4SE1/4 Section 34, T. 22 S., R.45 W., 6th PM, Prowers County, Colorado

ACTION BY WRITTEN CONSENT IN LIEU OF MEETINGS OF THE SOLE MANAGER AND SOLE MEMBER OF GP IRRIGATED FARMS, LLC

(a Colorado limited liability company)

The sole manager ("Manager") and sole member ("Member") of **GP IRRIGATED FARMS, LLC**, a Colorado limited liability company (the "Company"), as permitted by the Company's AMENDED & RESTATED LIMITED LIABILITY COMPANY AGREEMENT effective as of April 23, 2013 (the "LLC-Agreement") take the following action by written consent ("Consent") in lieu of meetings, effective as of October 17, 2014 ("Consent Date"):

The Company desires to trade certain water rights owned by the Company relating to the X-Y Canal a/k/a X-Y Irrigating Ditch Company's Ditch; Granada Irrigation Company; Lamar Canal/Lamar Canal and Irrigation Company; Lower Arkansas Water Management Association; well permits and associated groundwater rights owned; and other shares or any rights which the Company, for use on or appurtenant to the Real Property, or the Real Property may receive water, including the shares described in the Contract, including any rights negotiated under the Water Rights Exchange Agreement and Reimbursement Agreement (the "Water Rights Trade").

The Company's Manager and Member have reviewed the proposed documents related to the Water Rights Trade. The sole Manager and Member accordingly have:

RESOLVED: The Water Rights Trade is fair to the Company, will benefit the Company, and is in the Company's best interest.

RESOLVED: The Company is authorized to enter into the Water Rights Trade and to enter into and perform the terms of the Water Rights Trade documents;

RESOLVED: Karl Nyquist (who is the President of Farming Operations of the Company) is hereby designated as an "Authorized Signatory" for the Company in connection with the Water Rights Trade and associated documents;

RESOLVED: Karl Nyquist, as Authorized Signatory for the Company, is specifically authorized to negotiate and prepare the Water Rights Trade documents and all associated, ancillary or incidental documents ("Ancillary Documents" including but not limited to agreements and conveyance and/or transfer instruments relating to the X-Y Canal a/k/a X-Y Irrigating Ditch Company's Ditch; Granada Irrigation Company; Lamar Canal/Lamar Canal and Irrigation Company; Lower Arkansas Water Management Association; well permits and associated groundwater rights owned; and other shares or any rights which the Company, for use on or appurtenant to the Real Property, or the Real Property may receive water, including the shares described in the Contract, including any rights negotiated under the Water Rights Exchange Agreement and Reimbursement Agreement and any other document he deems advisable to consummate the Contract;

RESOLVED: Karl Nyquist, as Authorized Signatory for the Company, is specifically authorized to execute, deliver and cause the performance of the Water Rights Trade and Ancillary Documents;

RESOLVED: Karl R. Nyquist, as Authorized Signatory for the Company, acting alone, is specifically authorized to amend, as he deems advisable, any Water Rights Trade or Ancillary Document, which as amended (collectively, the "Documents") may differ from the forms approved by the Manager and sole Member;

RESOLVED: The execution and delivery of any Water Rights Trade, Ancillary Documents or Document by Karl R. Nyquist, as Authorized Signatory for the Company, shall conclusively establish the approval by the Company of the terms, conditions, execution, delivery and performance of such executed Documents;

RESOLVED: These resolutions shall be conclusive evidence the authority of the Company to enter into, execute, deliver and perform the Water Rights Trade, Ancillary Documents and Documents;

RESOLVED: All actions of the Manager, Officers, sole and the Company's agents taken in connection with the Water Rights Trade are hereby ratified, confirmed and approved;

RESOLVED: Karl R. Nyquist, Officers and the Company's agents are authorized, empowered and directed to take all necessary and reasonable actions on behalf of the Company to implement these resolutions;

RESOLVED: The undersigned acknowledge that others are relying on their signatures below to confirm that the Company has the authority to execute and deliver the Water Rights Trade, Ancillary Documents and Documents to which it is a party;

RESOLVED: This Consent may be executed in counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument and facsimile and electronic "PDF" signatures of this Consent shall be treated as original signatures and given full force and effect for all purposes; and

RESOLVED: Execution of this Consent constitutes full ratification hereof, and further, the foregoing Resolutions shall be effective as of the Consent Date, regardless of the actual date of execution.

The undersigned Manager and sole Member hereby waive all notice of a meeting and the holding of any meeting of the Manager and Member of the Company to act upon the foregoing resolutions and certify that the undersigned are the Manager and sole Member of the Company.

[The signature page follows.]

Exhibit H
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IN WITNESS WHEREOF, the sole Manager and sole Member have signed below to evidence their consent to this Consent.

MANAGER:

S-D COLORADO FARMS, LLC,
a Delaware limited liability company

By: ________________________
Jay Houtsma, President of Dairy Operations

By: ________________________
Karl Nyquist, President of Farming Operations

MEMBER:

S-D COLORADO FARMS, LLC,
a Delaware limited liability company

By: ________________________
Jay Houtsma, President of Dairy Operations

By: ________________________
Karl Nyquist, President of Farming Operations

After recording please return to
Lower Arkansas Water Management Association
P.O. Box 1161
Lamar, Colorado 81052

AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS
(Grasmick Farm XY Dry-Up)

THIS AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRY-LAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS ("Agreement") is entered into this **17th** day of October, 2014, by and between GP Irrigated Farms, LLC, a Colorado limited liability company ("GP"), as Grantor, and Lower Arkansas Water Management Association, a Colorado non-profit corporation ("LAWMA"), as Grantee (together, the "Parties").

Recitals

A. GP and LAWMA enter into this Agreement as additional consideration for LAWMA's issuance of 2,069 shares of common LAWMA stock (the "LAWMA Shares") to GP in trade for 897 of the 26,127 shares of capital stock outstanding in the Lamar Canal Company ("Lamar Canal Trade Shares"), 436 of the 3,030 shares of capital stock outstanding in the Granada Irrigation Company ("Granada Trade Shares"), and 1.5 cfs of the 69.0 cfs originally decreed to the XY Irrigating Ditch Company's Canal ("XY 1.5 cfs"), pursuant to the Water Rights Exchange Agreement and Reimbursement Agreement between the Parties, as amended ("Exchange Agreement"), and as more particularly described therein. The Lamar Canal Trade Shares, the Granada Trade Shares, and the XY 1.5 cfs are referred to collectively herein as the "GP Trade Water."

B. GP and its predecessors-in-interest historically have used the XY 1.5 cfs to irrigate approximately 76.4 acres of real property located in NE¼ of the NW¼ of Section 1, Township 23 South, Range 44 West of the 6th P.M., in Prowers County, Colorado, as more particularly shown on the map attached as **Exhibit A** (the "Grasmick Farm XY Dry-Up").

C. GP acknowledges that LAWMA intends to use the XY 1.5 cfs for augmentation and replacement purposes, and that to effect such uses, the XY 1.5 cfs will need to be changed permanently in a change of water rights proceeding before the Water Court for Division 2 (the "Water Court Change Case"), and temporarily pursuant to a substitute water supply plan ("SWSP") or interruptible water supply agreement ("IWSA") approved by the Office of the State Engineer. GP further acknowledges that the Water Court and/or the State Engineer may require, as terms and conditions of such a change, that the

Grasmick Farm XY Dry-Up be dried up and either revegetated or established and maintained in dry-land farming practices.

D. GP and LAWMA desire to enter into this Agreement to affirm the permanent cessation of use of the XY 1.5 cfs on the Grasmick Farm XY Dry-Up, to confirm GP's obligation either to revegetate or to establish and maintain dry-land farming practices on the Grasmick Farm XY Dry-Up, and to provide for a right of entry and easements for LAWMA and its agents, and for LAWMA's successors and assigns and their agents, upon the Grasmick Farm XY Dry-Up for the purposes of enforcing this Agreement and the decree and any orders entered by the Water Court in the Water Court Change Case.

NOW, THEREFORE, in consideration of LAWMA's issuance of the LAWMA Shares in trade for the GP Trade Water and other consideration, GP hereby covenants, agrees, and grants as follows:

Section 1 – Real Covenant for Dry-Up

1.1 GP covenants and agrees to cease irrigation of the Grasmick Farm XY Dry-Up with the XY 1.5 cfs.

1.2 GP covenants and agrees that the Grasmick Farm XY Dry-Up will not be irrigated with any source of water unless the water used for such irrigation is ground water that is treated as sole-source pumping and is fully-augmented under LAWMA's augmentation plan or other augmentation plan approved by the Water Court for Water Division 2, or any SWSP or Arkansas River replacement plan approved by the State Engineer; provided, however, that GP is prohibited from performing such irrigation with ground water in a way that reduces the consumptive use credit available to LAWMA from the GP Trade Water under the terms and conditions of any decree entered in the Water Court Change Case.

1.3 GP shall ensure that the Grasmick Farm XY Dry-Up complies with all terms and conditions included in the *Kansas v. Colorado* Operating Procedures for Administration of Parcels Claimed for Augmentation Credit ("*Kansas v. Colorado* Dry-Up Agreement"), a copy of which is attached to the Exchange Agreement as Exhibit G. Those terms and conditions include, without limitation, requirements that a physical separation must exist between any irrigated portion of a parcel and the dry-up portion unless the Division Engineer gives prior approval, that parcels formerly containing alfalfa or alfalfa-grass stands must be deep tilled or chemically killed, and that dry-up parcels must be monumented in accordance with specific standards.

1.4 GP covenants and agrees that in addition to the dry-up requirements for the Grasmick Farm XY Dry-Up imposed by this Real Covenant for Dry-Up, GP also shall meet any dry-up obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the XY 1.5 cfs in any SWSP, IWSA, Arkansas

River Replacement Plan pursuant to Rule 14 of the Amended Rules and Regulations Governing the Diversion and Use of Tributary Ground Water in the Arkansas River Basin ("Rule 14 Plan"), and/or Compact Compliance Plan pursuant to Rule 10 of the Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado ("Rule 10 Plan").

1.5 Successful completion of dry-up of the Grasmick Farm XY Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion. In the event the Water Court retains jurisdiction in the Water Court Change Case to certify successful completion of dry-up of the Grasmick Farm XY Dry-Up as a condition to transferring the consumptive use credit available to LAWMA for the GP Trade Water, then the determination of whether dry-up of the Grasmick Farm XY Dry-Up has been successfully completed will be made by the Water Court.

1.6 This Real Covenant for Dry-Up, with the burdens it imposes, is binding upon and will run with the Grasmick Farm XY Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Grasmick Farm XY Dry-Up for the benefit of the XY 1.5 cfs, LAWMA, and LAWMA's successors and assigns.

Section 2 – Real Covenant for Revegetation or Dry-Land Farming

2.1 As used in this Agreement, the term "revegetation" means ground cover of plant life demonstrated to be, without irrigation, reasonably capable of sustaining itself under the climatic conditions, soils, precipitation and terrain prevailing on the Grasmick Farm XY Dry-Up, with weeds adequately controlled; and the term "dry-land farming" means dry-land farming practices with weeds adequately controlled.

2.2 So long as GP is irrigating the Grasmick Farm XY Dry-Up for agricultural production purposes in accordance with the terms and conditions in Section 1.2 above, the revegetation and dry-land farming obligations described in this Section 2 will not apply. Upon cessation of irrigation of the Grasmick Farm XY Dry-Up for agricultural production purposes pursuant to Section 1.2 above, GP immediately shall revegetate or establish and maintain dry-land farming practices on the Grasmick Farm XY Dry-Up in accordance with the terms and conditions of this Section 2. Within sixty days of ceasing irrigation of the Grasmick Farm XY Dry-Up for agricultural production purposes, GP shall provide LAWMA with written notice of that cessation, by email to lawma@cminet.net, with a copy to rmehren@mwhw.com.

2.3 No later than the end of the third growing season after irrigation for agricultural purposes has ceased on the Grasmick Farm XY Dry-Up pursuant to Section 1.2 above (the "Revegetation/Dry-Land Farming Deadline"), GP shall have established and maintained either revegetation or dry-land farming on the Grasmick Farm XY Dry-Up. For either revegetation or dry-land farming to be "maintained" on the Grasmick Farm XY Dry-Up, such revegetation or dry-land farming must have been established for more than one growing season. GP shall pay all costs of the revegetation, dry-land farming, and weed control of the Grasmick Farm XY Dry-Up, including without limitation the payment of all power costs for associated well pumping and leasing of water for the purpose of revegetation.

2.4 The species of grass or other plants used for revegetation may not include grasses or other plants defined as "noxious" under the provisions of the Colorado Weed Management Act, Article 5.5 of Title 35, C.R.S., and may not include alfalfa or other highly water-consumptive species.

2.5 GP covenants and agrees that in addition to the revegetation and dry-land farming requirements imposed by this Real Covenant for Revegetation or Dry-Land Farming, GP also shall meet any revegetation or dry-land farming obligations imposed by the decree and/or orders entered by the Water Court in the Water Court Change Case, or imposed by the terms and conditions of state water officials' approval of LAWMA's use of the XY 1.5 cfs in any SWSP, IWSA, Rule 14 Plan, and/or Rule 10 Plan. GP also shall take any and all actions as may be necessary to comply with any requirements imposed upon GP and/or LAWMA by federal, state, and/or local government authorities due to the removal of the XY 1.5 cfs from the Grasmick Farm XY Dry-Up, including without limitation any requirements imposed by a 1041 permit, if any, issued by Prowers County. If a decree is entered in the Water Court Change Case after the Revegetation/Dry-Land Farming Deadline, GP shall satisfy any additional terms and conditions for revegetation and/or dry-land farming in that decree.

2.6 Successful completion of revegetation of the Grasmick Farm XY Dry-Up will be determined by LAWMA and its successors and assigns, using applicable Conservation Reserve Program criteria or the criteria imposed by the Water Court, whichever standards are strictest. Successful establishment and maintenance of dry-land farming of the Grasmick Farm XY Dry-Up will be determined by LAWMA and its successors and assigns in the exercise of reasonable discretion, or by the Water Court. At GP's request, the Revegetation/Dry-Land Farming Deadline will be extended by one year for each year that, from the year of closing and up to and including the year of the Revegetation/Dry-Land Farming Deadline, the amount of precipitation measured at the Lamar precipitation station falls below 80% of the March through August average of 10.4 inches (1950-2004 average). Until the decree is entered in the Water Court Change Case, at GP's request, LAWMA will extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming practices or revegetation have been materially hindered due to circumstances beyond GP's control, including fire, hail storms, wind storms, tornadoes, flooding, and freezes after May 15 and before September 15 of any year from the year of closing up to and including the year of the Revegetation/Dry-Land Farming Deadline; after the decree is entered in the Water Court Change Case, at GP's request, LAWMA may extend the Revegetation/Dry-Land Farming Deadline upon a showing by GP that its efforts to establish and maintain dry-land farming have been materially hindered due to the same circumstances.

2.7 In the alternative to meeting the obligations imposed by Sections 2.2, 2.3, and 2.5 above, GP may demonstrate to LAWMA's satisfaction that the Grasmick Farm XY Dry-Up has been developed with structures and improvements such that the Grasmick Farm XY Dry-Up is not susceptible to erosion, weeds, or agricultural uses.

2.8 This Real Covenant for Revegetation or Dry-Land Farming, with the burdens it imposes, is binding upon and will run with the Grasmick Farm XY Dry-Up forever, and is forever enforceable against GP and its successors and assigns in the Grasmick Farm XY Dry-Up for the benefit of the XY 1.5 cfs, LAWMA, and LAWMA's successors and assigns.

Section 3 – Right of Entry and Easements

3.1 GP hereby grants to LAWMA a non-exclusive right of entry to, upon, under, and across the Grasmick Farm XY Dry-Up for the purposes of providing a reasonable means for LAWMA and its agents, as well as the Colorado Division of Water Resources and the Water Court, to take all actions reasonably necessary to ensure that GP has met its obligations under this Agreement and the decree or any orders entered in the Water Court Change Case, including without limitation site inspections, installation of observation wells, piezometers, or lysimeters, performance of soil evaporation and plant transpiration tests, and performance of vegetative studies and surveys.

3.2 GP hereby further grants to LAWMA and/or its agents easements (i) to construct, operate, and maintain on the Grasmick Farm XY Dry-Up such facilities as are required by the decree or any orders entered in the Water Court Change Case for replication of historical return flows from irrigation use of the XY 1.5 cfs, including without limitation storage reservoirs and/or recharge facilities; (ii) to use such portions of the surface and subsurface of the Grasmick Farm XY Dry-Up as are necessary to replicate historical return flows from irrigation use of the XY 1.5 cfs; and (iii) to perform all acts necessary, including without limitation engineering and historical consumptive use studies, to prosecute the Water Court Change Case and/or an application for Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA using the XY 1.5 cfs as a source of supply. GP and LAWMA acknowledge and agree that the exact nature, extent, and location of these easements are difficult to define in advance of completion of the Water Court Change Case or any administrative proceeding for approval of a Rule 14 Plan, a Rule 10 Plan, an SWSP or an IWSA. GP and LAWMA agree that the absence of specified locations for the easements on the Grasmick Farm XY Dry-Up does not void or render the easements unenforceable. To the extent reasonably practical, any easement that may require the construction of a physical structure on the Grasmick Farm XY Dry-Up will be located in a manner so as not to interfere unreasonably with GP's continued and proposed future use of the Grasmick Farm XY Dry-Up. Upon identification of an acceptable location for any facilities required under Paragraphs 3.2(i) and (ii), the Parties shall create and record a specific legal description of easements therefor. Upon such recording, the balance of the Grasmick Farm XY Dry-Up will be automatically released from Paragraphs 3.2(i) and (ii).

3.3 In the event that GP defaults in its obligations for dry-up and revegetation or dry-land farming hereunder, this right of entry and these easements also will entitle LAWMA, at GP's expense, to take all actions necessary to accomplish the dry-up and revegetation or dry-land farming of the Grasmick Farm XY Dry-Up, including without limitation constructing drainage and conveyance ditches, monumenting dried-up acreage, revegetating with drought-resistant plants, removing alfalfa and other deep-rooted plants, trees, phreatophytes, and tamarisk, and removing and filling in all or portions of irrigation ditches and/or farm laterals; provided, however, that GP will not be required to incur out-of-pocket expenses in excess of $200 per acre, for a maximum of $15,280, to complete the actions necessary to dry-up and revegetate or dry-land farm the Grasmick Farm XY Dry-Up as required by Sections 1 and 2 above.

3.4 This non-exclusive right of entry and these non-exclusive easements, with the burdens they impose, are binding upon and will run with the Grasmick Farm XY Dry-Up forever, and are forever enforceable against GP and its successors and assigns in the Grasmick Farm XY Dry-Up for the benefit of the XY 1.5 cfs, LAWMA, and LAWMA's agents, successors, and assigns.

Section 4 – General Provisions

4.1 The terms and conditions of this Agreement and the real covenants given and non-exclusive right of entry and non-exclusive easements granted herein are perpetual and will not expire unless specifically released in writing by LAWMA or its successor or assign.

4.2 This Agreement may be enforced by LAWMA or its successor or assign, by any party having any right, title, or interest in the XY 1.5 cfs, or by the State Engineer of the State of Colorado, through an action at law or in equity.

4.3 GP is and will be entitled to use the Grasmick Farm XY Dry-Up for any purpose not inconsistent with this Agreement, including but not limited to the mining and removal of sand, gravel, and other materials; dry-land grazing; and recreational, residential, commercial, and industrial purposes.

4.4 GP shall reasonably cooperate with LAWMA to demonstrate the dry-up and revegetation of the Grasmick Farm XY Dry-Up, including but not limited to providing affidavits or testimony at no cost to LAWMA.

4.4 Upon LAWMA's transfer of the XY 1.5 cfs to any party, that party will succeed to LAWMA's interest in this Agreement and will have the right to enforce the terms of the Agreement against GP or the then-current owner of the Grasmick Farm XY Dry-Up.

4.6 All attached exhibits to this Agreement are incorporated herein by this reference.

4.7 LAWMA shall record this Agreement in the real property records of the Prowers County Clerk and Recorder.

Executed and effective as of the day first written above.

GP IRRIGATED FARMS, LLC

Karl Nyquist
Managing Member

for Jay Houtsma

Jay Houtsma
Managing Member

Date: 10/17/14

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

Robert Wilger, Vice-President

Date: 10/17/14

ATTEST:

Donald F. Higbee, Secretary

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this **17th** day of October, 2014, by Karl Nyquist, Managing Member, and Jay Houtsma, Managing Member, of GP Irrigated Farms, LLC, a Colorado limited liability company.

Witness my hand and official seal.

My commission expires 12-20-2015.

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 12/20/2015

Angela Higbee
Notary Public

STATE OF COLORADO)
ss.
COUNTY OF PROWERS)

The foregoing instrument was acknowledged before me this **17th** day of October, 2014, by Robert Wilger, Vice-President, and Donald F. Higbee, Secretary, of the Lower Arkansas Water Management Association, a Colorado non-profit corporation.

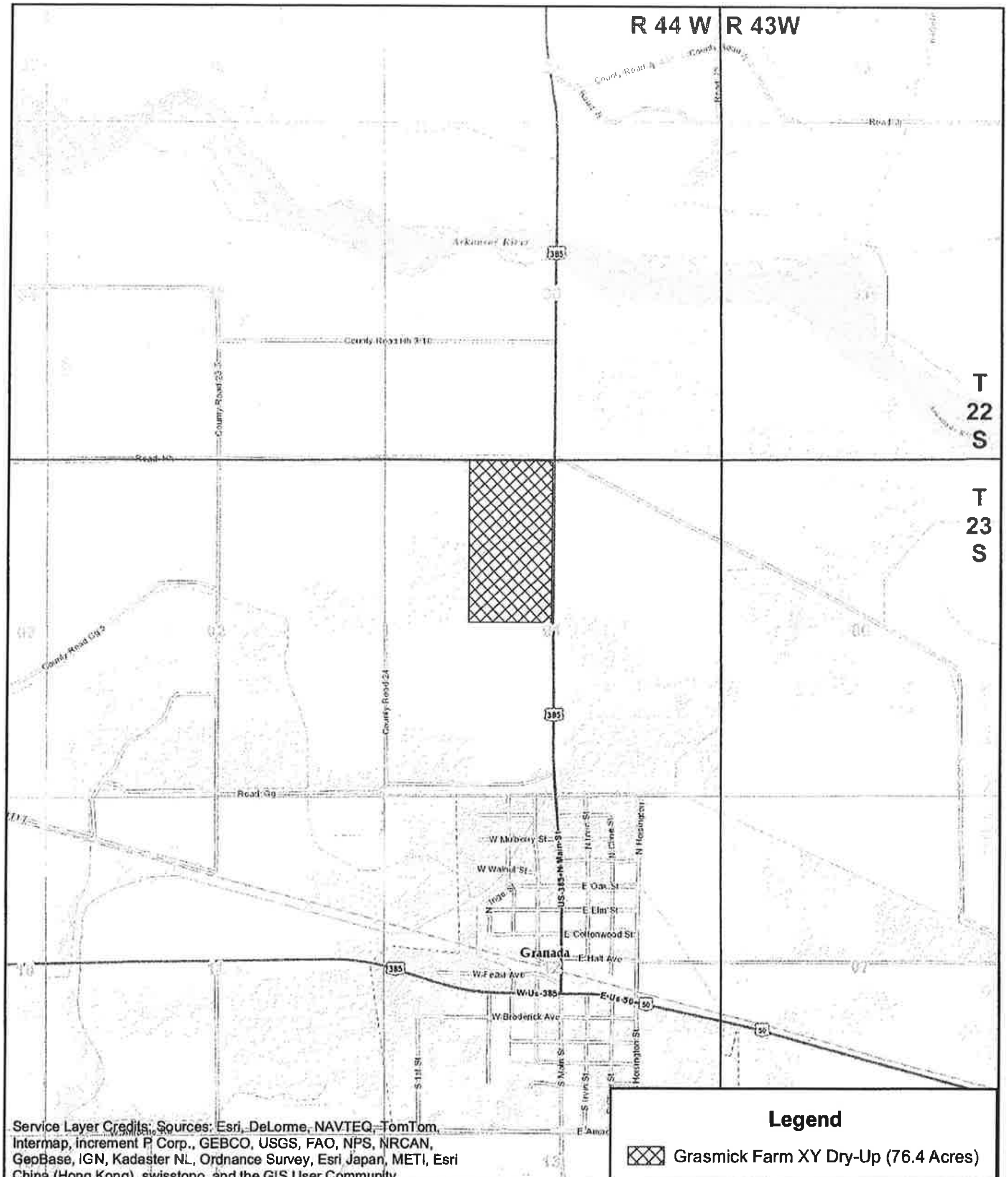
Witness my hand and official seal.

My commission expires 12-20-2015.

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
MY COMMISSION EXPIRES 12/20/2015

Angela Higbee
Notary Public

Exhibit H



0 1,000 2,000 4,000 Scale in Feet	Job No. L7501	**Exhibit A**
	File: Grasmick XY Exhibit A.mxd	**Gramsick Farm XY Dry-Up**
Slattery & Hendrix Engineering LLC	Date: 01/14/14	
	Prepared For: LAWMA/GP	

Exhibit H

LENDER CONSENT, APPROVAL, SUBORDINATION, AND WAIVER

(Grasmick Farm XY Dry-Up)

The undersigned is the beneficiary under that certain Deed of Trust, Assignment of Rents, Security Agreement, and Fixture Filing ("Deed of Trust") dated May 29, 2013, recorded on May 30, 2013 at Reception No. 533996, Prowers County, Colorado real property records (the "Deed of Trust"). Consent and approval are hereby given by the undersigned to the foregoing "AGREEMENT FOR DRY-UP COVENANT AND FOR REVEGETATION OR DRYLAND FARMING COVENANT, AND GRANT OF NON-EXCLUSIVE RIGHT OF ENTRY AND EASEMENTS (Grasmick Farm XY Dry-Up)" (the "Dry-Up Covenant") to which this Consent, Approval, Subordination and Waiver is attached. For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned hereby unconditionally and irrevocably subordinates the lien of its Deed of Trust to the Dry-Up Covenant, agrees that its Deed of Trust shall be subject to the Dry-Up Covenant as the same may be assigned, and waives any claim that the Dry-Up Covenant constitutes a Prohibited Transfer under Section 7.07 of the Deed of Trust.

BENEFICIARY:
METROPOLITAN LIFE INSURANCE COMPANY
a New York corporation

By: [signature]
Name: Kevin J. Harshberger
Title: Director

STATE OF Kansas)
) ss.
COUNTY OF Johnson)

The foregoing instrument was acknowledged before me this 10th day of October, 2014, by Kevin J Harshberger as Director of Metropolitan Life Insurance Company, a New York corporation.

Witness my hand and official seal.

My commission expires: 8/26/2017.

Roberta L Black
Notary Public

ROBERTA L. BLACK
Notary Public - State of Kansas
My Appt. Expires 8/26/2017

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ACTION BY WRITTEN CONSENT IN LIEU OF MEETINGS OF THE SOLE MANAGER AND SOLE MEMBER OF GP IRRIGATED FARMS, LLC
(a Colorado limited liability company)

The sole manager ("Manager") and sole member ("Member") of **GP IRRIGATED FARMS, LLC**, a Colorado limited liability company (the "Company"), as permitted by the Company's AMENDED & RESTATED LIMITED LIABILITY COMPANY AGREEMENT effective as of April 23, 2013 (the "LLC-Agreement") take the following action by written consent ("Consent") in lieu of meetings, effective as of October 17, 2014 ("Consent Date"):

The Company desires to trade certain water rights owned by the Company relating to the X-Y Canal a/k/a X-Y Irrigating Ditch Company's Ditch; Granada Irrigation Company; Lamar Canal/Lamar Canal and Irrigation Company; Lower Arkansas Water Management Association; well permits and associated groundwater rights owned; and other shares or any rights which the Company, for use on or appurtenant to the Real Property, or the Real Property may receive water, including the shares described in the Contract, including any rights negotiated under the Water Rights Exchange Agreement and Reimbursement Agreement (the "Water Rights Trade").

The Company's Manager and Member have reviewed the proposed documents related to the Water Rights Trade. The sole Manager and Member accordingly have:

RESOLVED: The Water Rights Trade is fair to the Company, will benefit the Company, and is in the Company's best interest.

RESOLVED: The Company is authorized to enter into the Water Rights Trade and to enter into and perform the terms of the Water Rights Trade documents;

RESOLVED: Karl Nyquist (who is the President of Farming Operations of the Company) is hereby designated as an "Authorized Signatory" for the Company in connection with the Water Rights Trade and associated documents;

RESOLVED: Karl Nyquist, as Authorized Signatory for the Company, is specifically authorized to negotiate and prepare the Water Rights Trade documents and all associated, ancillary or incidental documents ("Ancillary Documents" including but not limited to agreements and conveyance and/or transfer instruments relating to the X-Y Canal a/k/a X-Y Irrigating Ditch Company's Ditch; Granada Irrigation Company; Lamar Canal/Lamar Canal and Irrigation Company; Lower Arkansas Water Management Association; well permits and associated groundwater rights owned; and other shares or any rights which the Company, for use on or appurtenant to the Real Property, or the Real Property may receive water, including the shares described in the Contract, including any rights negotiated under the Water Rights Exchange Agreement and Reimbursement Agreement and any other document he deems advisable to consummate the Contract;

RESOLVED: Karl Nyquist, as Authorized Signatory for the Company, is specifically authorized to execute, deliver and cause the performance of the Water Rights Trade and Ancillary Documents;

RESOLVED: Karl R. Nyquist, as Authorized Signatory for the Company, acting alone, is specifically authorized to amend, as he deems advisable, any Water Rights Trade or Ancillary Document, which as amended (collectively, the "Documents") may differ from the forms approved by the Manager and sole Member;

RESOLVED: The execution and delivery of any Water Rights Trade, Ancillary Documents or Document by Karl R. Nyquist, as Authorized Signatory for the Company, shall conclusively establish the approval by the Company of the terms, conditions, execution, delivery and performance of such executed Documents;

RESOLVED: These resolutions shall be conclusive evidence the authority of the Company to enter into, execute, deliver and perform the Water Rights Trade, Ancillary Documents and Documents;

RESOLVED: All actions of the Manager, Officers, sole and the Company's agents taken in connection with the Water Rights Trade are hereby ratified, confirmed and approved;

RESOLVED: Karl R. Nyquist, Officers and the Company's agents are authorized, empowered and directed to take all necessary and reasonable actions on behalf of the Company to implement these resolutions;

RESOLVED: The undersigned acknowledge that others are relying on their signatures below to confirm that the Company has the authority to execute and deliver the Water Rights Trade, Ancillary Documents and Documents to which it is a party;

RESOLVED: This Consent may be executed in counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument and facsimile and electronic "PDF" signatures of this Consent shall be treated as original signatures and given full force and effect for all purposes; and

RESOLVED: Execution of this Consent constitutes full ratification hereof, and further, the foregoing Resolutions shall be effective as of the Consent Date, regardless of the actual date of execution.

The undersigned Manager and sole Member hereby waive all notice of a meeting and the holding of any meeting of the Manager and Member of the Company to act upon the foregoing resolutions and certify that the undersigned are the Manager and sole Member of the Company.

[The signature page follows.]

Exhibit H

IN WITNESS WHEREOF, the sole Manager and sole Member have signed below to evidence their consent to this Consent.

MANAGER:

S-D COLORADO FARMS, LLC,
a Delaware limited liability company

By: ______________________________
Jay Houtsma, President of Dairy Operations

By: ______________________________
Karl Nyquist, President of Farming Operations

MEMBER:

S-D COLORADO FARMS, LLC,
a Delaware limited liability company

By: ______________________________
Jay Houtsma, President of Dairy Operations

By: ______________________________
Karl Nyquist, President of Farming Operations

RESOLUTION OF THE BOARD OF DIRECTORS OF THE LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION AUTHORIZING REPRESENTATIVES TO OBTAIN A 1041 PERMIT FROM PROWERS COUNTY

RECITALS

WHEREAS, the Lower Arkansas Water Management Association ("LAWMA") is a Colorado non-profit corporation that was formed and is in good standing under the laws of the State of Colorado;

WHEREAS, LAWMA was organized for the purposes of replacing depletions caused by the pumping of its members' wells as required by law, and providing water to its members directly or by means of augmentation and replacement for all manner and types of uses;

WHEREAS, LAWMA, as a co-applicant with GP Irrigated Farms, LLC and S-D Investments, LLC, intends to file an application with Prowers County under the Guidelines and Regulations for Areas and Activities of State Interest for approval of the permanent dry-up of 1,704 acres on 7 farms in Prowers County that were historically irrigated with LAWMA's 897 shares of stock in the Lamar Canal Company, 750.5 shares of stock in the Granada Irrigation Company, and 2.0 cfs decreed to the XY Irrigating Ditch Company's Canal ("1041 Permit Application");

WHEREAS, Article IV, Section 5 of LAWMA's Bylaws vests in the Board of Directors ("Board") the authority to act for LAWMA, which authority the Board may delegate as may be necessary and advisable; and

WHEREAS, the Board desires to adopt this resolution to authorize representiatives to seek Prowers County's approval of the 1041 Permit Application on LAWMA's behalf.

NOW, THEREFORE, be it resolved by the Board as follows:

1. The Board authorizes LAWMA, through its authorized representatives, to apply for, negotiate, and pursue Prowers County's approval of the 1041 Permit Application.

2. The Board designates LAWMA's President, William Grasmick, and LAWMA's Manager, Donald Higbee, to act as LAWMA's authorized representatives to negotiate, make, sign, execute, and deliver any documents necessary to obtain Prowers County's approval of the 1041 Permit Application.

This Resolution is adopted and approved this 10th day of December, 2021, by a majority of the Directors of the Board.

LOWER ARKANSAS WATER MANAGEMENT ASSOCIATION

William Grasmick, President

ATTEST:

Donald F. Higbee, Secretary

Exhibit J
Chapter 4
Regulations for Development in Areas Containing or Having a Significant Impact Upon Natural Resources of Statewide Importance

Submission Requirements

The text in bold is copied from Chapter 4 of the County's Guidelines and Regulations, and the text in regular typeface is Applicants' response to each requirement. Capitalized terms that are used but not defined have the meaning given to them in the Application. For your reference, a few definitions are included bellow:

"Subject Shares" means LAWMA's 897 shares of stock in the Lamar Canal and Irrigation Company, 750.5 shares of stock in the Granada Irrigation Company, and 2.0 cfs decreed to the XY Irrigating Ditch Company's Canal that were changed for LAWMA's augmentation and replacement uses by the 15CW3067 Decree.

"Subject Farms" means the portions of the Higbee West Farm, DJC Farm, Koehn Farm, Grasmick Lamar Farm, Gass Farm, Grasmick Granada Farm, Grasmick XY Farm, and McMillan Farm that were historically irrigated with the Subject Shares.

(1) An abstract of the proposal indicating the scope and need for the major development;

See the Application at paragraph 2.

(2) Preliminary review and comment on the proposal by the appropriate agency of the Colorado Department of Natural Resources and/or the Colorado Department of Public Health & Environment, as applicable;

N/A

(3) For the purpose of assisting in evaluation of the applicant's selected development alternative only, a listing of alternative development and general degree of feasibility of each or, at the option of the applicant, the environmental analyses, assessments and statements developed under any required review pursuant to the National Environmental Policy Act (NEPA);

LAWMA issued LAWMA common shares to GP Irrigated, S-D, and Mr. McMillan in exchange for the Subject Shares because of the value of those water rights to LAWMA's augmentation portfolio. No comparable water rights were available for exchange, so no alternatives were considered. No NEPA review is required for the development because no federal action is involved in the development.

(4) Proponents of proposal:

(a) **Names and addresses of all interests proposing the activity.**

GP Irrigated Farms, LLC
751 SE County Road 36
Syracuse, Kansas 67878

S-D Investments, LLC
751 SE County Road 36
Syracuse, Kansas 67878

Lower Arkansas Water Management Association
310 South 6th Street
P. O. Box 1161
Lamar, Colorado 81052

(b) **Name and qualifications of the person(s) responding to the requirements detailed in these Regulations.**

GP Irrigated and S-D Representatives:
Doug Geubelle, Member
Frank Mercurio, P.E
751 SE County Road 36
Syracuse, Kansas 67878
douglas@syracusedairy.com
frank@syracusedairy.com

LAWMA Representatives:
Bill Grasmick, President
Don Higbee, Manger
310 South 6th Street
Lamar, Colorado 81052
bill@grasmickinc.com
lawma@cminet.net

Counsel for GP Irrigated, S-D, and LAWMA:
Richard Mehren
2595 Canyon Blvd, Suite 300
Boulder, CO 80302
rmehren@mwhw.com

(5) Scope of proposal:

(a) **Describe the source and rights for any water subject to transfer by decree as a part of the development, including a copy of the transfer decree;**

The Subject Shares were historically used to irrigate the Subject Farms. The Subject Shares were severed from the Subject Farms and changed for LAWMA's various augmentation and replacement uses by the 15CW3067 Decree. A copy of the 15CW3067 Decree is attached as **Exhibit A**. Copies of LAWMA's recorded dry-up covenants or assignments of recorded dry-up covenants for each of the Subject Farms are attached as **Exhibit H**. The Subject Shares represent the following water rights:

1. Lamar Canal: 897 shares of the 26,127 shares outstanding of the capital stock of the Lamar Canal and Irrigation Company ("Lamar Canal Company").

1.1. Appropriation date; priority; amount; and LAWMA's pro-rata portion changed by the 15CW3067 Decree:

1.1.1. November 30, 1875; Priority No. 3; 15.75 cfs; 0.54 cfs of the 15.75 cfs.

1.1.2. November 4, 1886; Priority No. 6½; 72.09 cfs; 2.48 cfs of the 72.09 cfs.

1.1.3. April 16, 1887; Priority No. 7½; 13.64 cfs; 0.47 cfs of the 13.64 cfs.

1.1.4. July 16, 1890; Priority No. 13; 184.27 cfs; 6.33 cfs of the 184.27 cfs.

1.2. Original decree: Adjudication of Priorities to the Use of Water for Irrigation in District Number 67, dated July 1, 1895, in the Bent County District Court ("District 67 General Adjudication").

1.3. Source: Arkansas River and, pursuant to the decree entered in Case No. W-1836, Water Division No. 2, ground water tributary to the Arkansas River.

2. Granada Irrigation Company: 750.5 of the 3,030 shares outstanding of the capital stock of the Granada Irrigation Company ("Granada Company"). The Granada Company owns 10,600 shares of the capital stock of the Lamar Canal Company; therefore, one share of the capital stock of the Granada Company equates to approximately 3.498 shares of capital stock of the Lamar Canal Company.

2.1. LAWMA's pro-rata portion changed by the 15CW3067 Decree: The 750.5 Granada Shares represent 2,625.51 shares of stock in the Lamar Canal Company. Therefore, the 750.5 Granada Shares equate to the following pro-rata interest in the Lamar Canal Company water rights described in paragraph 1 above:

2.1.1. Priority No. 3: 1.58 cfs of the 15.75 cfs.

2.1.2. Priority No. 6½: 7.24 cfs of the 72.09 cfs.

2.1.3. Priority No. 7½: 1.37 cfs of the 13.64 cfs.

2.1.4. Priority No. 13: 18.52 cfs of the 184.27 cfs.

3. XY Canal: 2.0 cfs of the 69.0 cfs decreed to the XY Irrigating Ditch Company's Canal.

3.1. Appropriation date; priority; amount; and LAWMA's pro-rata portion changed by the 15CW3067 Decree: July 22, 1889; Priority No. 11; 69.0 cfs; 2.0 cfs of the 69.0 cfs.

3.2. Original decree: The District 67 Original Adjudication.

3.3. Source: Arkansas River.

4. Article II Storage Account Water: Section II of the Resolution Concerning an Operating Plan for John Martin Reservoir, adopted on April 24, 1980, and as amended, provides that 60% of the water attributable to conservation storage in John Martin Reservoir is allocated to storage accounts for Colorado Water District 67 ditches including, among others, the Lamar Canal. Water stored in such accounts is commonly referred to as "Article II Water." As part of the change of water rights approved by the 15CW3067 Decree, LAWMA changed its pro-

rata share of the Article II Water associated with the 897 shares of capital stock in the Lamar Canal Company and the 750.5 shares of capital stock in the Granada Irrigation Company.

(b) **Describe existing water utilization including historic yield from rights and use by category such as agricultural, municipal and industrial and supply obligations to other systems; and**

Table 1 below summarizes the Water Court's findings on the historical use of the Subject Shares by ditch. The Subject Shares were historically used to flood irrigate the Subject Farms. For a complete description of the Water Court's findings on the historical yield of the Subject Shares, see paragraphs 8-14 of the 15CW3067 Decree attached as **Exhibit A**.

Table 1

	Average annual historically irrigated acres between 1950 and 2013	Average annual historical farm headgate deliveries	Average annual historical depletions
897 Lamar Canal Company Shares	779 acres	1,204.1 acre-feet/year	855 acre-feet/year
750.5 Granada Company Shares	716 acres	3,524.3 acre-feet/year	1,550.34 acre-feet/year
XY Canal 2.0 cfs	186 acres	131.0 acre-feet/year	89.8 acre-feet/year

As part of LAWMA's 2021 Augmentation Plan projection and Rule 14 Replacement Plan application, it estimated that it would deliver approximately 19,377 acre-feet of augmentation water to the lower Arkansas River basin to replace out-of-priority depletions caused by its shareholders' past and projected uses. LAWMA projected that its portfolio of augmentation water would yield approximately 27,247 acre-feet of augmentation water, including the water attributable to the Subject Shares.

Of the approximately 739 active structures augmented under the Augmentation Plan or Rule 14 Replacement Plan in 2021, 534 (approximately 72%) are agricultural irrigation wells, 70 (approximately 9%) are municipal wells, 77 (approximately 10%) are commercial wells, and the remaining 58 structures (approximately 8%) are gravel pits, ponds, and wells pumped for other uses.

(c) **Provide a description and sufficiently detailed engineering plans and specifications, prepared by a registered professional engineer, of the proposed construction of structures, buildings and improvements associated with the project and the financial, environmental and social impacts thereof on the community or surrounding areas within the development area and source development area.**

The development includes the permanent dry-up of 1,704 acres on the Subject Farms. On the DJC-Koehn Farm, Grasmick Lamar Farm, Grasmick Granada Farm, and

Grasmick XY Farm, GP Irrigated has installed center-pivot sprinkler irrigation systems. Maps showing the center-pivot sprinkler systems, holding ponds, and pump systems installed on the Subject Farms and the Holly Farm are attached as **Exhibit K**. As shown in Applicants' responses to Section 6 below, the development will not cause any adverse environmental or social impacts. Section 7 below describes the financial impacts of the development.

(6) Environmental impact analysis:

(a) **Land Use:**

(i) Provide a map (at an appropriate scale) detailing existing land uses of the development area which may be impacted. The land use map should include, but not necessarily be restricted to the following categories: residential, commercial, industrial, open space, outdoor recreation, agricultural, forest land and water bodies (surface and subsurface);

Please see **Exhibit L.**

(ii) All immediately affected public land boundaries should be indicated on the map. Potential impacts of the proposed development upon public lands will be visually illustrated on the map as well as described in textual form;

Please see **Exhibit L.**

(iii) Specify whether the proposed development conforms to this County's planning policies, including, without limitation, the Prowers County Master Plan;

The development conforms to Prowers County's planning policies, including the Prowers County Master Plan. *See* Prowers County Master Plan, Goals 2, 3, 4, and 9; and Objectives 3.3, 3.4, 4.1 and 9.4.

(iv) Describe the relationship, if any, of the proposed development to formally adopted regulations and policies of federal, state, regional or county governments, which regulations or policies would govern the use of land or water resources impacted by the project;

N/A

(v) Describe the present use and zoning of the land in the development area;

The Subject Farms are zoned as either A-1 Irrigated Land or F-1 Floodplain, and Applicants' development is consistent with the current zoning.

(vi) Describe the agricultural productivity capability of the land in the development area (NRCS classification);

Table 2 below summarizes the historical use and agricultural capacity of the Subject Farms. The historical use analysis of the Subject Shares completed by LAWMA's water resources engineers at Hendrix Wai Engineering, Inc. in support of the 15CW3067 Decree is available upon request.

Table 2					
Farm Name	Dry-up acres	Historical operations	Revegetation, dry-land farming, or re-irrigation	Soil type	NRCS capability classification*
Higbee West Farm	164	Flood irrigation	Revegetation	Clay Loam	Class 3
DJC-Koehn Farm	234.5	Flood irrigation	Revegetation	Clay Loam	Class 3
Grasmick Lamar Farm	431.6	Flood irrigation	Revegetation and re-irrigation	Clay Loam	Class 3
Gass Farm	314.4	Flood irrigation	Revegetation	Clay Loam	Class 3
Grasmick Granada Farm	466.8	Flood irrigation	Revegetation	Clay Loam	Class 3
Grasmick XY Farm	75.1	Flood irrigation	Revegetation and re-irrigation	Clay Loam	Class 3
McMillan Farm	17.7	Flood irrigation	Revegetation	Clay Loam	Class 3

*Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.
Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.
Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.
Class 5 soils are subject to little or no erosion but have other limitations, impractical to remove, that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
Class 6 soils have severe limitations that make them generally unsuitable for cultivation and that restrict their use mainly to pasture, rangeland, forestland, or wildlife habitat.
Class 7 soils have very severe limitations that make them unsuitable for cultivation and that restrict their use mainly to grazing, forestland, or wildlife habitat.
Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

(vii) Describe the potential adverse impact of the proposed development on the soil of the source development area, including impact upon soil productivity, potential soil loss from air or water erosion, and degradation from susceptibility to noxious weed invasion.

As required by the 15CW3067 Decree and the dry-up covenants encumbering the Subject Farms, the Subject Farms will be established in revegetation or dry-land farming by the landowner in a manner that prevents soil degradation or loss, blowing dust, and development of noxious weeds on the Subject Farms. Therefore, the development will not cause any adverse impacts on the Subject Farms' soil.

(b) **Water Resources**

(i) Describe and indicate on an appropriate map relevant surface water bodies (streams, lakes and reservoirs) and groundwater aquifers in the source development area and their uses;

Please see **Exhibit L.**

(ii) On the same, or other appropriate map, indicate any floodplain associated with the proposed development. Documentation of historical flooding activity should be included;

Please see **Exhibit L**. The most recent significant flood event affecting the Subject Farms occurred in 1965. The 1965 flood caused extensive damage throughout the lower Arkansas River Basin below John Martin Reservoir. Since the 1965 flood, the Subject Farms have not been impacted by a major flood event.

(iii) Describe potential effects of the proposed development on eutrophication, wasteload allocations and water quality of rivers, streams, aquifers and/or any existing or proposed reservoirs in this County;

The development will not have any negative effect on water quality or water quality standards.

(iv) Describe potential effects of the proposed development on the above-described water features in the source development area, including the effects on present water quality and current uses. Include a detailed statement of impacts of the proposed project upon water quality standards including, but not limited to antidegradation standards, and all applicable basic or numeric standards for physical, biological, organic, inorganic, and metals pollutants; and

LAWMA's use of the Subject Shares and the development will not have an adverse effect on the water features shown on **Exhibit L.** As required by the 15CW3067 Decree, LAWMA's use of the Subject Shares for augmentation and replacement uses includes volumetric limitations based on historical use and requirements for maintaining historical return flows in time, amount, and location. Accordingly, the historical stream regime will be maintained.

There is evidence to suggest that drying up historically irrigated lands and establishing them in revegetation improves water quality by decreasing the amount of salt delivered to the river through farm return flows. *See,* Irrigation Practices, Water Consumption, & Return Flows in Colorado's Lower Arkansas River Valley (Garcia et. al. 2012), which is attached as **Exhibit M**. Since Applicants' development is to dry-up the Subject Farms and establish them in revegetation or dry-land farming, it is not anticipated that there will be any adverse effects on water quality.

(v) Describe the potential adverse effects of the proposed development upon plant and animal life dependent upon the water resources in the development area and source development area.

As required by the 15CW3067 Decree, LAWMA must replicate the historical use and return flow components of the Subject Shares in time, amount, and location. Accordingly, LAWMA's use of the Subject Shares for augmentation and replacement purposes will not have an adverse impact on the amount or location of water available for plant and animal life.

(c) **Air Quality**

Detail the impact of the proposed development on ambient air quality of the source development area and its environs. Specifically include description of impacts associated with airborne dust.

As required by the 15CW3067 Decree and the dry-up and revegetation covenants encumbering the Subject Farms, the Subject Farms will be established in revegetation or dry-land farming by the landowner in a manner that prevents soil degradation or loss, blowing dust, and development of noxious weeds on the Subject Farms. Therefore, the development will not cause any adverse impacts on ambient air quality.

(d) **Significant Environmentally Sensitive Factors**

Identify and locate on a map of an appropriate scale each of the following features present in the source development area and its environs and detail the potential impact of the proposed development upon each feature:

Please see the map attached as **Exhibit L.**

(i) Marshlands and wetlands,

The development will not affect marshlands or wetlands.

(ii) Groundwater recharge areas,

The development will not affect existing groundwater recharge areas.

(iii) Potential natural hazards,

The development will not affect potential natural hazards.

(iv) Forests and woodlands,

The development will not affect forests or woodlands.

(v) Critical wildlife habitat or other wildlife protection areas,

As required by the 15CW3067 Decree, LAWMA must replicate the historical use and return flow components of the Subject Shares in time, amount, and location. Further, the 15CW3067 Decree and the dry-up and revegetation covenants encumbering the Subject Farms require the landowners to establish the farms in revegetation or dry-land farming in a manner that prevents soil degradation or loss, blowing dust, and development of noxious weeds. Because the changed use of the Subject Shares will not adversely impact the amount of water available for wildlife or wildlife habitat, the development is not expected to have any adverse effects on wildlife habitat or other wildlife protection areas. In fact, because LAWMA issued shares of LAWMA common stock in exchange for the Subject Shares, and due to the increased water efficiency on farms with center-pivot sprinkler irrigation systems, GP Irrigated and S-D are irrigating more acres than they were before the exchange. The additional irrigated acres provide new wildlife habitat and forage.

(vi) Public outdoor recreation areas,

The development will not affect public outdoor recreation areas.

(vii) Critical aquatic life habitat, and

The development will not affect critical aquatic life habitat.

(viii) Agricultural lands.

As required by the 15CW3067 Decree and the dry-up and revegetation covenants encumbering the Subject Farms, the Subject Farms will be established in revegetation or dry-land farming by the landowner in a manner that prevents soil degradation or loss, blowing dust, and development of noxious weeds on the Subject Farms. Therefore, the Subject Farms will retain their agricultural character.

Further, by exchanging the Subject Shares for shares of LAWMA common stock, GP Irrigated and S-D are irrigating additional acres.

(e) Visual Aesthetics and Nuisance Factors:

Identify any significant deterioration of existing natural aesthetics, creation of visual blight, noise pollution or obnoxious odors which may stem from the proposed development, including airborne dust and noxious weed invasion.

As required by the 15CW3067 Decree and the dry-up and revegetation covenants encumbering the Subject Farms, the Subject Farms will be established in revegetation or dry-land farming by the landowner in a manner that prevents soil degradation or loss, blowing dust, and development of noxious weeds on the Subject Farms. Accordingly, the development will not cause any significant deterioration of existing natural aesthetics, no creation of visual blight, no noise pollution or obnoxious odors, and no airborne dust or noxious weed invasion.

(f) **Revegetation Plan:**

All applications must include a detailed revegetation plan for all land areas from which historic [sic] irrigation practices will be removed. Describe all revegetation plans or efforts proposed as part of the development, including any such plans required as a condition of any Water Court decree pertaining to the developments. Such plan shall include, at a minimum:

- **(i) Description of all lands included.**
- **(ii) Plant and seed material to be used and the method and timing of their application.**
- **(iii) Source, amount, timing and seasonal duration of irrigation water to be applied to establish the intended revegetation, for a period no less than two (2) growing seasons.**
- **(iv) Whether the plan is required as a part of any Water Court transfer decree, and if so whether the plan has been approved by the Water Court (include a copy of the decree and plan as so approved).**
- **(v) Proposed security to guarantee implementation of the revegetation plan.**

The Permit Authority may, but is not required to consider a Water Court approved revegetation plan as partial or full satisfaction of the requirements of this Section 4.03(6)(f).

The Subject Farms will be established by the landowner in revegetation, dry-land farming, re-irrigated, or developed for non-agricultural uses by the landowner in accordance with the revegetation category criteria and groundcover classifications from the 15CW3067 Decree, which are attached as **Exhibit B**. The Water Court found that these criteria and classifications were reasonable standards for establishing the Subject Farms in revegetation or dry-land farming in a manner that prevents soil degradation or loss, blowing dust, and development of noxious weeds. To prevent conflicting overlap in regulatory requirements, Applicants propose that Prowers County adopt the same revegetation category criteria and groundcover classifications for the 429 acres on Subject Farms that are yet to be classified as established in groundcover, dry-land farming, developed for a non-agricultural use, or re-irrigated, as more particularly described in page 3 of the application and shown on **Exhibit D**. Additionally, the proposed criteria and classifications are consistent with other recently approved 1041 permits in Prowers County.

Applicants' revegetation efforts to date, including the amount spent seeding the Subject Farms, mowing, and applying herbicides, and information on the various seeding mixes planted on the Subject Farms are summarized in the attached **Exhibit N**.

(g) **The Application shall demonstrate how the applicant will meet the applicable habitat needs listed below by the identified wildlife species and will avoid conflict with these needs. Where conflicts are unavoidable, the applicant shall present proposals to minimize the extent and degree of the conflict, including revegetation and/or compensation through replacement or enhancement of habitat on an alternative site.**

As required by the 15CW3067 Decree, LAWMA must maintain the historical return flows associated with the Subject Shares in time, amount, and location. Accordingly, the historical regime of the stream for wildlife habitat needs will be maintained. Further, the 15CW3067 Decree and the dry-up and revegetation covenants encumbering the Subject Farms require the landowner to establish the Subject Farms in revegetation or dry-land farming in a manner that prevents soil degradation or loss, blowing dust, and development of noxious weeds. Because most of the Subject Farms are established in revegetation, the native grasses and forbs provide wildlife species with their native habitat needs. Finally, due to the development, GP Irrigated and S-D are irrigating more acres than they were before the exchange and have added storage ponds to certain farms. The additional irrigated acres provide new wildlife habitat and forage, and the storage ponds provide a water source and new habitat for wildlife. Because the changed use of the Subject Shares will not adversely impact the amount of water available for wildlife or wildlife habitat, the development is not expected to have any adverse effects on the habitat needs described in Chapter 4, Section 4.303(6)(g)(i-xi) of the County's 1041 Guidelines and Regulations.

(7) **Financial impact analysis, including but not limited to the following:**

(a) **Review and summary of any assessed taxable property valuations, property tax collection experience, and all other matters of aid in determining the impact of the proposed development upon the County.**

<u>Capital Investments in the County</u>

GP Irrigated spent approximately $80,000,000 purchasing the land and installing irrigation improvements on the Subject Farms and the Holly Farm to support the Holly Dairy. GP Irrigated and S-D have also spent approximately $30,000,000 making capital investments in the Holly Dairy. In addition, GP Irrigated and S-D project that they will spend $20,000,000 acquiring livestock for the Holly Dairy. These significant investments in the County support local business.

Impact on assessed taxable property valuations

GP Irrigated and S-D pay approximately $320,000 in annual property taxes for the Holly Dairy. GP Irrigated pays approximately $165,000 in annual property taxes for the Subject Farms and Holly Farm. Given that there has been more than $110,000,000 invested in the Subject Farms, the Holly Farm, and the Holly Dairy, it is GP Irrigated's and S-D's expectation that the development has increased assessed taxable property valuations of GP Irrigated's and S-D's property.

Projected annual revenue and job creation

The dairy component of the Holly Dairy is anticipated to generate $18,000,000 in annual gross income based on current milk prices. When the feedlot component of the Holly Dairy is fully developed, it is estimated that the sale of beef will generate approximately $21,000,000 in annual sales based on current prices. Accordingly, the Holly Dairy will be a significant economic driver within the County.

GP Irrigated's and S-D's farming operations, including the Holly Farm and the Subject Farms, employ 22 people, and the Holly Dairy employs 43 people, for a combined 65 jobs in the County that are directly linked to the development.

Development effect on irrigation in the County

Currently, GP Irrigated and its related entities are irrigating approximately 7,767.3 acres under center pivot sprinkler systems in Prowers County while the development has resulted in the permanent dry-up of approximately 1,382.9 acres on the Subject Farms. On the Holly Farm alone, GP Irrigated uses its LAWMA shares from the exchange of the Subject Shares to continue irrigating approximately 2,175 acres that were historically irrigated and to irrigate approximately 2,256 new acres with well pumping replaced under LAWMA's plan for augmentation. Accordingly, in part due to the permanent dry-up of the Subject Farms and change of use for the Subject Shares, GP Irrigated has been able to irrigate a significant number of new acres within the County.

A summary fact sheet of the economic impacts from the development is attached as **Exhibit O**.

(b) **Proposed security to guarantee revegetation.**

Applicants petition the County to waive the requirement for financial security to guarantee revegetation. When the 15CW3067 Decree was entered, the Water Court determined that approximately 655.8 acres of the 1,704 acres being dried up on the Subject Farms meet the criteria and classifications for being established in groundcover or developed for a non-agricultural use. An additional 321.1 acres are being re-irrigated by augmented well pumping in accordance with the criteria in **Exhibit B**. As documented in the report prepared by Applicant's revegetation expert attached as **Exhibit C**, 298.1 acres that were considered not established at the time the 15CW3067 Decree was entered now meet the criteria to be classified as established groundcover or developed for a non-agricultural use. Because many of the Subject

Farms already meet the criteria and classifications described in **Exhibit B** for established groundcover, developed for a non-agricultural use, or re-irrigation, and Applicants have demonstrated their sustained and successful efforts to establish revegetation on the Subject Farms as shown in **Exhibit N**, full compliance with the requirement to provide financial security to guarantee revegetation would be unreasonably burdensome on Applicants with marginal benefit to the County. For the same reasons, waiver of the requirement to provide the County with financial security to guarantee revegetation would not address or disclose a substantial impact on the County or its residents.

(8) The benefits of the project, both in natural and socioeconomic terms, and the degree to which benefits, both within the County and to the applicant, outweigh the adverse impacts of the project within the County.

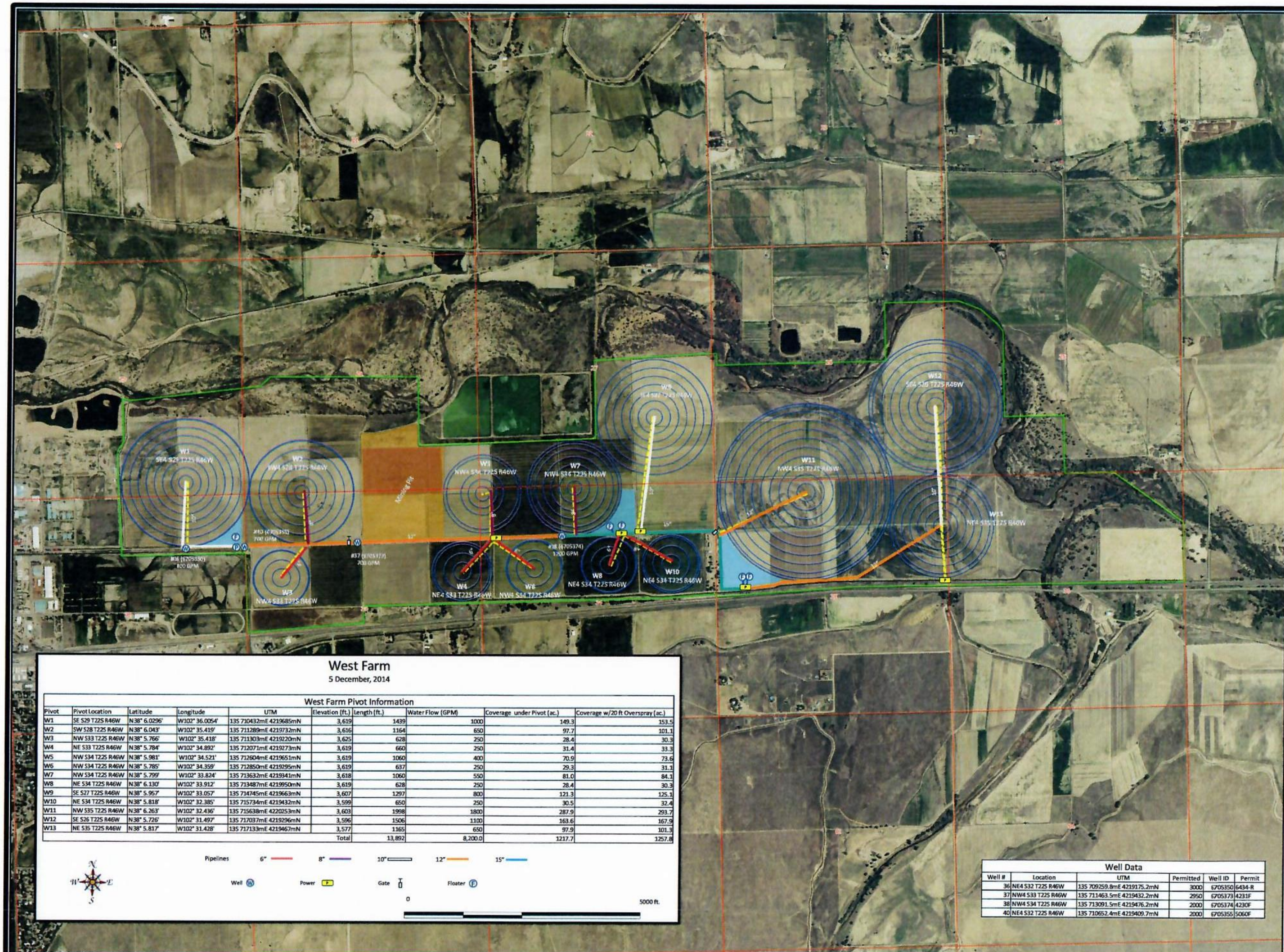
LAWMA's shareholders have benefited from adding the Subject Shares to LAWMA's portfolio of augmentation water supplies.

GP Irrigated and S-D have benefitted from trading the Subject Shares for shares of LAWMA common stock because they were able to convert water applied to inefficient farms into a reliable and transferable augmentation supply. In fact, GP Irrigated and S-D are using their LAWMA common shares to expand the number of acres they irrigate in Prowers County.

Prowers County has benefited from the development because it is receiving the economic benefits of projects that rely on GP Irrigated's and S-D's LAWMA common shares, such as the Holly Farm and the Holly Dairy; GP Irrigated and S-D have made substantial capital investments in the County, which increased the tax base; and the development preserves the agricultural nature of the Subject Farms.

For all these reasons and more, the benefits of the development significantly outweigh any potential adverse impacts.

Exhibit K



West Farm

5 December, 2014

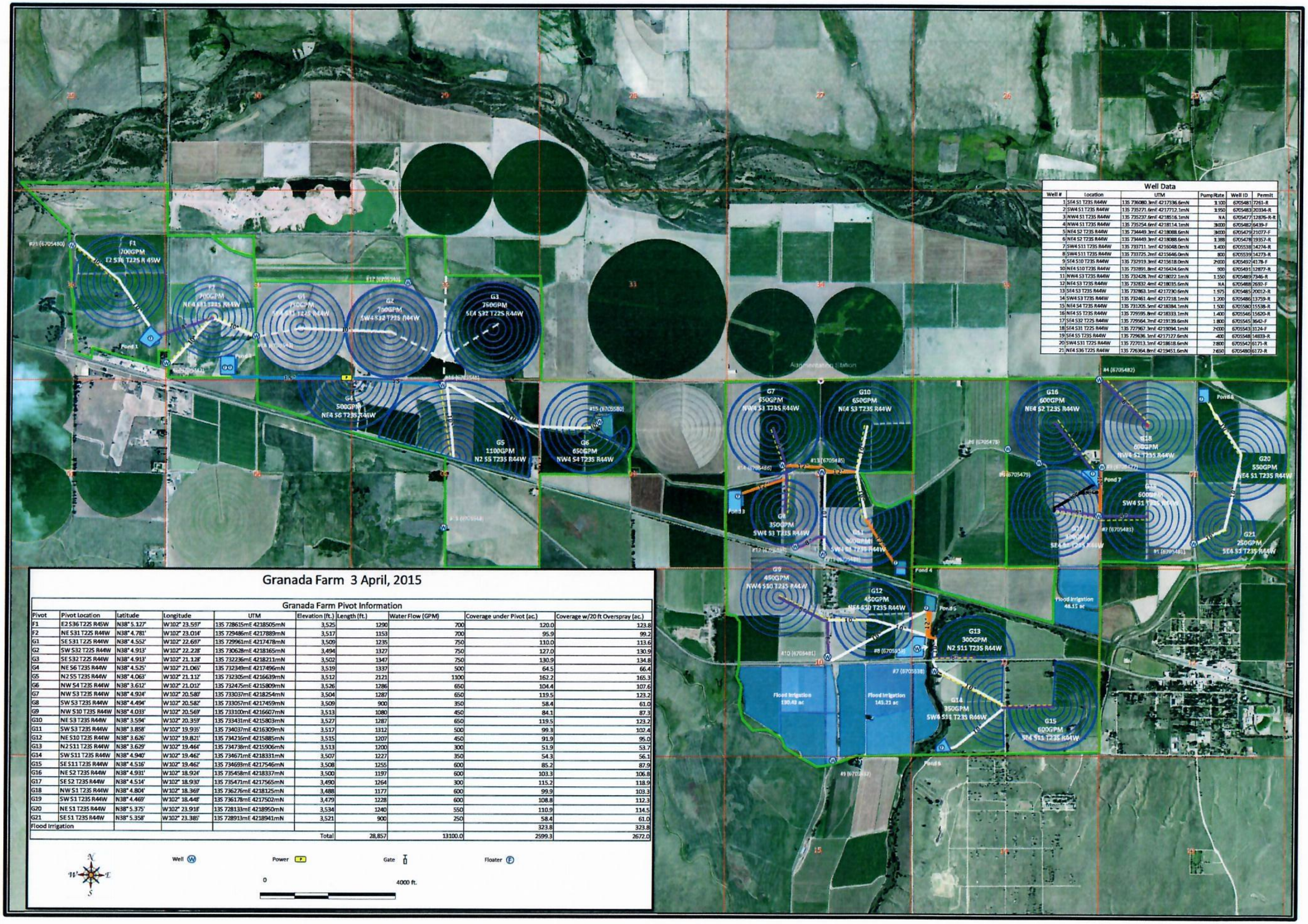
West Farm Pivot Information

Pivot	Pivot Location	Latitude	Longitude	UTM	Elevation (ft.)	Length (ft.)	Water Flow (GPM)	Coverage under Pivot (ac.)	Coverage w/20 ft Overspray (ac.)
W1	SE S29 T22S R46W	N38° 6.0296'	W102° 36.0054'	13S 710432mE 4219685mN	3,619	1439	1000	149.3	153.5
W2	SW S28 T22S R46W	N38° 6.043'	W102° 35.419'	13S 711289mE 4219732mN	3,616	1164	650	97.7	101.1
W3	NW S33 T22S R46W	N38° 5.766'	W102° 35.418'	13S 711303mE 4219220mN	3,625	628	250	28.4	30.3
W4	NE S33 T22S R46W	N38° 5.784'	W102° 34.892'	13S 712071mE 4219273mN	3,619	660	250	31.4	33.3
W5	NW S34 T22S R46W	N38° 5.981'	W102° 34.521'	13S 712604mE 4219651mN	3,619	1060	400	70.9	73.6
W6	NW S34 T22S R46W	N38° 5.785'	W102° 34.359'	13S 712850mE 4219295mN	3,619	637	250	29.3	31.1
W7	NW S34 T22S R46W	N38° 5.799'	W102° 33.824'	13S 713632mE 4219341mN	3,618	1060	550	81.0	84.1
W8	NE S34 T22S R46W	N38° 6.130'	W102° 33.912'	13S 713487mE 4219950mN	3,619	628	250	28.4	30.3
W9	SE S27 T22S R46W	N38° 5.957'	W102° 33.057'	13S 714745mE 4219663mN	3,607	1297	800	121.3	125.1
W10	NE S34 T22S R46W	N38° 5.818'	W102° 32.385'	13S 715734mE 4219432mN	3,599	650	250	30.5	32.4
W11	NW S35 T22S R46W	N38° 6.263'	W102° 32.436'	13S 715638mE 4220253mN	3,603	1998	1800	287.9	293.7
W12	SE S26 T22S R46W	N38° 5.726'	W102° 31.497'	13S 717037mE 4219296mN	3,596	1506	1100	163.6	167.9
W13	NE S35 T22S R46W	N38° 5.817'	W102° 31.428'	13S 717133mE 4219467mN	3,577	1165	650	97.9	101.3
					Total	13,892	8,200.0	1217.7	1257.8

Well Data

Well #	Location	UTM	Permitted	Well ID	Permit
36	NE4 S32 T22S R46W	13S 709259.8mE 4219175.2mN	3000	6705350	6434-R
37	NW4 S33 T22S R46W	13S 711463.5mE 4219432.2mN	2950	6705373	4231F
38	NW4 S34 T22S R46W	13S 713091.5mE 4219476.2mN	2000	6705374	4230F
40	NE4 S32 T22S R46W	13S 710652.4mE 4219409.7mN	2000	6705355	5060F

Exhibit K



Granada Farm 3 April, 2015

Granada Farm Pivot Information									
Pivot	Pivot Location	Latitude	Longitude	UTM	Elevation (ft.)	Length (ft.)	Water Flow (GPM)	Coverage under Pivot (ac.)	Coverage w/20 ft Overspray (ac.)
F1	E2 S36 T22S R45W	N38° 5.127'	W102° 23.597'	13S 728615mE 4218505mN	3,525	1290	700	120.0	123.8
F2	NE S31 T22S R44W	N38° 4.781'	W102° 23.014'	13S 729486mE 4217889mN	3,517	1153	700	95.9	99.2
G1	SE S31 T22S R44W	N38° 4.552'	W102° 22.697'	13S 729961mE 4217478mN	3,509	1235	750	110.0	113.6
G2	SW S32 T22S R44W	N38° 4.913'	W102° 22.228'	13S 730628mE 4218165mN	3,494	1327	750	127.0	130.9
G3	SE S32 T22S R44W	N38° 4.913'	W102° 21.128'	13S 732236mE 4218211mN	3,502	1347	750	130.9	134.8
G4	NE S6 T23S R44W	N38° 4.525'	W102° 21.065'	13S 732349mE 4217496mN	3,519	1337	500	64.5	66.4
G5	N2 S5 T23S R44W	N38° 4.063'	W102° 21.112'	13S 732305mE 4216639mN	3,512	2121	1100	162.2	165.3
G6	NW S4 T23S R44W	N38° 3.612'	W102° 21.012'	13S 732475mE 4215809mN	3,526	1286	650	104.4	107.6
G7	NW S3 T23S R44W	N38° 4.924'	W102° 20.580'	13S 733037mE 4218254mN	3,504	1287	650	119.5	123.2
G8	SW S3 T23S R44W	N38° 4.494'	W102° 20.582'	13S 733057mE 4217459mN	3,509	900	350	58.4	61.0
G9	NW S10 T23S R44W	N38° 4.033'	W102° 20.569'	13S 733100mE 4216607mN	3,513	1080	450	84.1	87.3
G10	NE S3 T23S R44W	N38° 3.594'	W102° 20.359'	13S 733431mE 4215803mN	3,527	1287	650	119.5	123.2
G11	SW S3 T23S R44W	N38° 3.858'	W102° 19.935'	13S 734037mE 4216309mN	3,517	1312	500	99.3	102.4
G12	NE S10 T23S R44W	N38° 3.626'	W102° 19.821'	13S 734216mE 4215885mN	3,515	1207	450	91.9	95.0
G13	N2 S11 T23S R44W	N38° 3.629'	W102° 19.464'	13S 734738mE 4215906mN	3,513	1200	300	51.9	53.7
G14	SW S11 T23S R44W	N38° 4.940'	W102° 19.462'	13S 734671mE 4218331mN	3,507	1227	350	54.3	56.1
G15	SE S11 T23S R44W	N38° 4.516'	W102° 19.462'	13S 734693mE 4217546mN	3,508	1255	600	85.2	87.9
G16	NE S2 T23S R44W	N38° 4.931'	W102° 18.924'	13S 735458mE 4218337mN	3,500	1197	600	103.3	106.8
G17	SE S2 T23S R44W	N38° 4.514'	W102° 18.930'	13S 735471mE 4217565mN	3,490	1264	300	115.2	118.9
G18	NW S1 T23S R44W	N38° 4.804'	W102° 18.369'	13S 736276mE 4218125mN	3,488	1177	600	99.9	103.3
G19	SW S1 T23S R44W	N38° 4.469'	W102° 18.448'	13S 736178mE 4217502mN	3,479	1228	600	108.8	112.3
G20	NE S1 T23S R44W	N38° 5.375'	W102° 23.918'	13S 728133mE 4218950mN	3,534	1240	550	110.9	114.5
G21	SE S1 T23S R44W	N38° 5.358'	W102° 23.385'	13S 728913mE 4218941mN	3,521	900	250	58.4	61.0
Flood Irrigation								323.8	323.8
					Total	28,857	13100.0	2599.3	2672.0

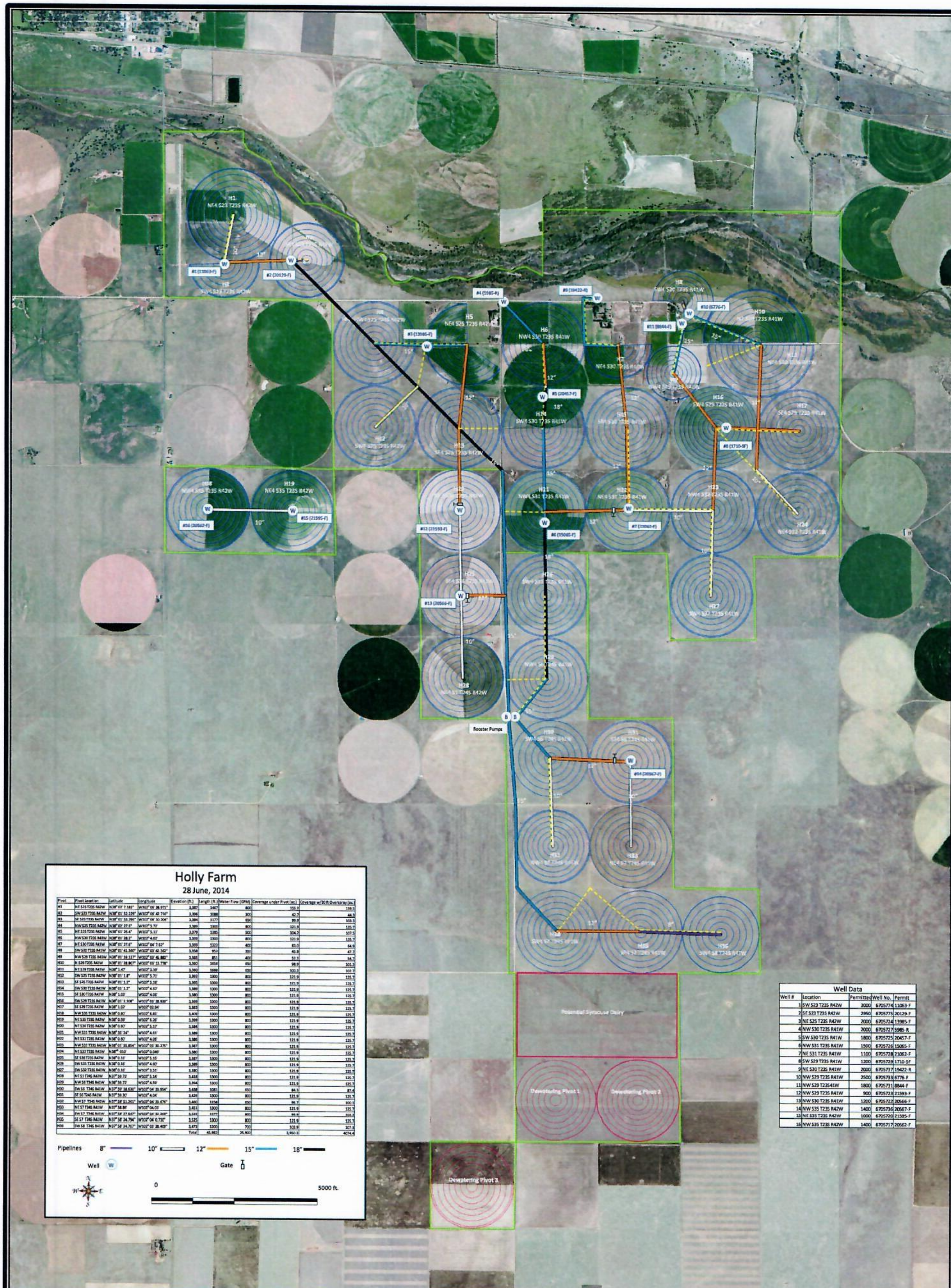
N W E S

Well W Power P Gate Floater F

0 4000 ft.

Well Data					
Well #	Location	UTM	Pump Rate	Well ID	Permit
1	SE4 S1 T23S R44W	13S 736080.3mE 4217336.6mN	1,100	6705481	7261-R
2	SW4 S1 T23S R44W	13S 735271.6mE 4217712.1mN	1,950	6705483	20334-R
3	NW4 S1 T23S R44W	13S 735237.6mE 4218516.1mN	NA	6705477	12876-R-R
4	NW4 S1 T23S R44W	13S 735254.6mE 4218114.1mN	3,000	6705482	6439-F
5	NE4 S2 T23S R44W	13S 734449.3mE 4218088.6mN	3,000	6705479	21077-F
6	NE4 S2 T23S R44W	13S 734449.3mE 4218088.6mN	1,388	6705478	19357-R
7	SW4 S11 T23S R44W	13S 733711.1mE 4216048.0mN	1,400	6705538	14274-R
8	SW4 S11 T23S R44W	13S 733725.2mE 4215646.0mN	800	6705539	14273-R
9	SE4 S10 T23S R44W	13S 732919.3mE 4215618.0mN	2,000	6705492	4178-F
10	NE4 S10 T23S R44W	13S 732891.8mE 4216424.6mN	500	6705491	12877-R
11	NW4 S3 T23S R44W	13S 732428.7mE 4218022.1mN	1,550	6705489	7346-R
12	NE4 S3 T23S R44W	13S 732832.4mE 4218035.6mN	NA	6705488	2692-F
13	SE4 S3 T23S R44W	13S 732863.1mE 4217230.6mN	1,975	6705485	20012-R
14	SW4 S3 T23S R44W	13S 732461.4mE 4217218.1mN	1,200	6705486	13759-R
15	NE4 S4 T23S R44W	13S 731205.5mE 4218384.1mN	1,500	6705580	15538-R
16	NE4 S5 T23S R44W	13S 729595.8mE 4218333.1mN	1,400	6705546	15620-R
17	SE4 S32 T22S R44W	13S 729564.7mE 4219139.6mN	1,800	6705545	3642-F
18	SE4 S31 T22S R44W	13S 727967.3mE 4219094.1mN	2,000	6705543	3124-F
19	SE4 S5 T23S R44W	13S 729636.1mE 4217127.6mN	400	6705548	14833-R
20	SW4 S31 T22S R44W	13S 727013.1mE 4218618.6mN	2,800	6705542	6171-R
21	NE4 S36 T22S R44W	13S 726364.8mE 4219451.6mN	2,650	6705480	6172-R

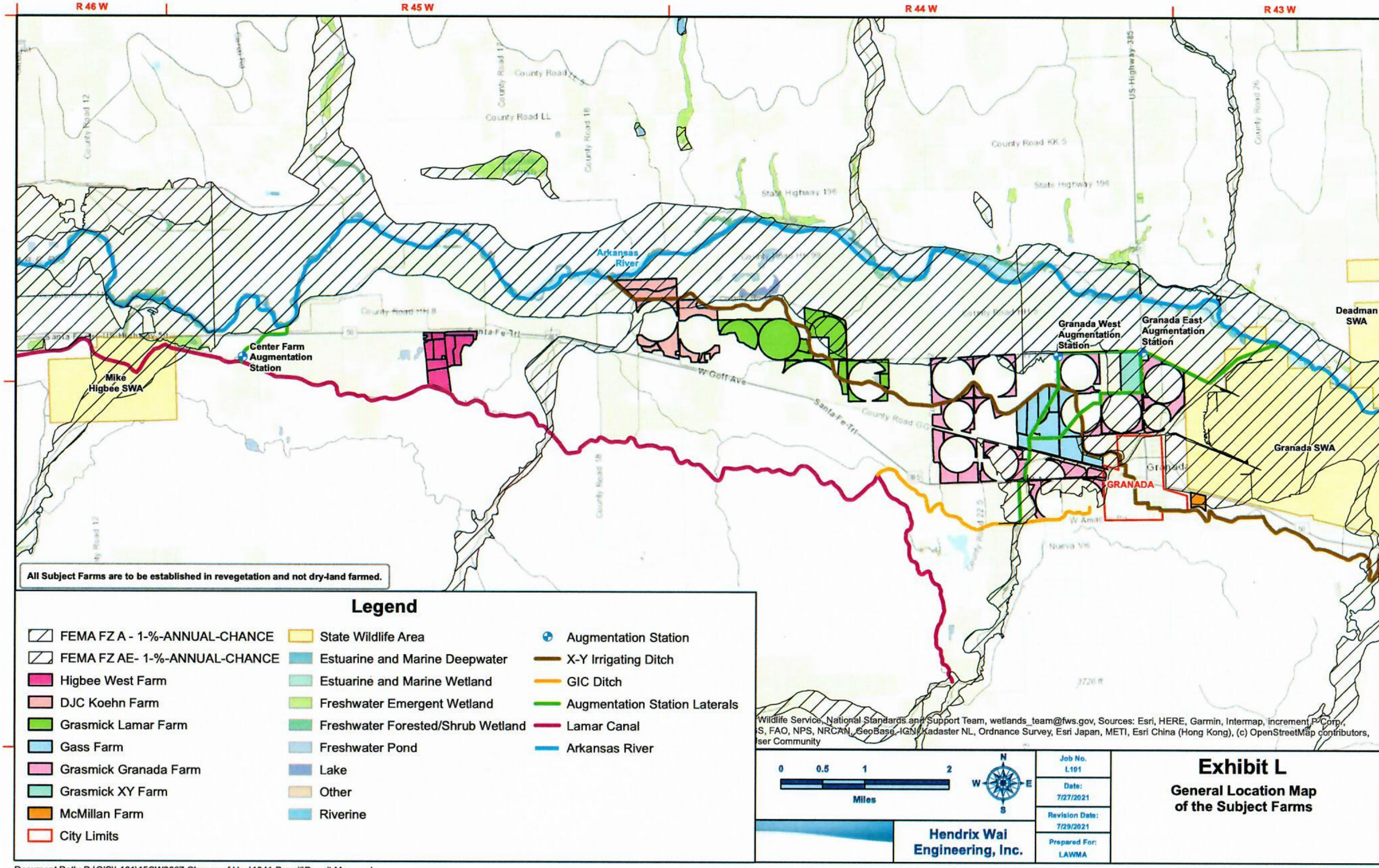
Exhibit K



Pivot	Pivot Location	Latitude	Longitude	Elevation (ft.)	Length (ft.)	Water Flow (GPM)	Coverage under Pivot (ac.)	Coverage w/20 ft Overspray (ac.)
H1	NE S23 T23S R42W	N38° 02' 7.583"	W102° 05' 38.971"	3,387	1467	800	155.2	159.5
H2	SW S23 T23S R42W	N38° 01' 52.229"	W102° 05' 42.716"	3,396	1088	300	42.7	44.3
H3	SE S23 T23S R42W	N38° 01' 53.396"	W102° 06' 10.304"	3,384	1177	650	99.9	103.3
H4	NW S25 T23S R42W	N38° 02' 27.6"	W102° 5.72'	3,389	1300	800	121.9	125.7
H5	NE S25 T23S R42W	N38° 01' 26.4"	W102° 5.11'	3,379	1285	500	104.2	107.5
H6	NW S30 T23S R41W	N38° 01' 28.2"	W102° 4.62'	3,389	1300	800	121.9	125.7
H7	NE S30 T23S R41W	N38° 01' 27.6"	W102° 04' 7.67"	3,389	1322	400	63.0	64.9
H8	SW S30 T23S R41W	N38° 01' 41.380"	W102° 03' 42.362"	3,358	952	350	45.8	47.7
H9	NW S29 T23S R41W	N38° 01' 38.137"	W102° 03' 45.880"	3,366	851	400	52.2	54.7
H10	N S29 T23S R41W	N38° 01' 28.807"	W102° 03' 13.778"	3,360	1056	650	98.9	101.5
H11	NE S29 T23S R41W	N38° 1.47'	W102° 3.19'	3,390	1088	650	100.3	103.7
H12	SW S25 T23S R42W	N38° 01' 1.8"	W102° 5.71'	3,397	1300	800	121.9	125.7
H13	SE S25 T23S R42W	N38° 01' 1.2"	W102° 5.18'	3,395	1300	800	121.9	125.7
H14	SW S30 T23S R41W	N38° 01' 1.2"	W102° 4.62'	3,389	1300	800	121.9	125.7
H15	SE S30 T23S R41W	N38° 1.03'	W102° 4.06'	3,380	1300	800	121.9	125.7
H16	SW S29 T23S R41W	N38° 01' 2.108"	W102° 03' 28.930"	3,389	1300	800	121.9	125.7
H17	SE S29 T23S R41W	N38° 1.02'	W102° 02.94'	3,383	1300	800	121.9	125.7
H18	NW S35 T23S R42W	N38° 0.60'	W102° 6.81'	3,409	1300	800	121.9	125.7
H19	NE S35 T23S R42W	N38° 0.59'	W102° 6.26'	3,399	1300	800	121.9	125.7
H20	NE S36 T23S R42W	N38° 0.60'	W102° 5.17'	3,384	1300	800	121.9	125.7
H21	NW S31 T23S R41W	N38° 36' 24"	W102° 4.61'	3,389	1300	800	121.9	125.7
H22	NE S31 T23S R41W	N38° 0.60'	W102° 4.06'	3,386	1300	800	121.9	125.7
H23	NW S32 T23S R41W	N38° 01' 35.854"	W102° 03' 30.275"	3,387	1300	800	121.9	125.7
H24	NE S32 T23S R41W	N38° 0.10'	W102° 0.049'	3,380	1300	800	121.9	125.7
H25	SE S36 T23S R42W	N38° 0.10'	W102° 5.15'	3,387	1300	800	121.9	125.7
H26	SW S31 T23S R41W	N38° 0.10'	W102° 4.60'	3,389	1300	800	121.9	125.7
H27	SW S32 T23S R41W	N38° 0.10'	W102° 3.51'	3,380	1300	800	121.9	125.7
H28	NE S1 T24S R42W	N37° 59.73'	W102° 5.14'	3,418	1300	800	121.9	125.7
H29	NW S6 T24S R41W	N38° 59.72'	W102° 4.59'	3,394	1300	800	121.9	125.7
H30	SW S6 T24S R41W	N37° 59' 18.630"	W102° 04' 35.954"	3,438	1081	650	84.1	87.4
H31	SE S6 T24S R41W	N37° 59.30'	W102° 4.04'	3,426	1300	800	121.9	125.7
H32	NW S7 T24S R41W	N37° 58' 51.261"	W102° 04' 35.676"	3,460	1158	650	96.7	100.1
H33	NE S7 T24S R41W	N37° 58.86'	W102° 04.03'	3,451	1300	800	121.9	125.7
H34	SW S7 T24S R41W	N37° 58' 27.647"	W102° 04' 32.309"	3,522	1177	800	99.9	103.3
H35	SE S7 T24S R41W	N37° 58' 24.794"	W102° 04' 0.710"	3,525	1300	800	121.9	125.7
H36	SW S8 T24S R41W	N37° 58' 24.707"	W102° 03' 28.409"	3,473	1300	700	103.9	107.3
				Total	45,987	25,900	3,950.3	4074.4

Well Data

Well #	Location	Permitted	Well No.	Permit
1	SW S23 T23S R42W	3000	6705774	11063-F
2	SE S23 T23S R42W	2950	6705775	20129-F
3	NE S25 T23S R42W	2000	6705724	13985-F
4	NW S30 T23S R41W	2000	6705727	5985-R
5	SW S30 T23S R41W	1800	6705725	20457-F
6	NW S31 T23S R41W	1500	6705726	15065-F
7	NE S31 T23S R41W	1100	6705728	21062-F
8	SW S29 T23S R41W	1200	6705729	1710-SF
9	NE S30 T23S R41W	2000	6705737	19422-R
10	NW S29 T23S R41W	2500	6705733	6776-F
11	NW S29 T23S41W	1800	6705731	8844-F
12	NW S29 T23S R41W	900	6705723	21593-F
13	NW S30 T23S R41W	1200	6705722	20566-F
14	NW S35 T23S R42W	1400	6705736	20567-F
15	NE S35 T23S R42W	1000	6705720	21595-F
16	NW S35 T23S R42W	1400	6705717	20562-F



Document Path: D:\GIS\L101\15CW3067 Change of Use\1041 Permit\Permit Map.mxd

Document Name: Permit Map




Irrigation Practices, Water Consumption, & Return Flows in Colorado's Lower Arkansas River Valley

Colorado State University

Field and Model Investigations

By Timothy K. Gates, Luis A. Garcia, Ryan A. Hemphill, Eric D. Morway, and Aymn Elhaddad

CWI Completion Report No. 221 CAES Report No. TR12-10

Irrigation Practices, Water Consumption, & Return Flows in Colorado's Lower Arkansas River Valley

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Additional copies of this report can be obtained from:

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Technical Completion Report No. 221
Colorado Water Institute

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June 2012

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Colorado State University
Colorado Agricultural Experiment Station

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Design by Lindsey Middleton and Jena J. Thompson

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Acronyms and Variables

Λ_i : Instantaneous evaporative fraction
ΔS_{SW}: The change in volume of water stored in soil root zone
ρ_w : Density of water
θ: Actual soil water content
θ_{fc}: Soil-water content at -⅓ bar matric potential (field capacity) expressed as a fraction of the bulk soil volume
θ_{wp}: Soil-water content at -15 bar matric potential (permanent wilting point) expressed as a fraction of the bulk soil volume
τ: Difference between the time of recession and the time of advance for any given point along the length of the field, or intake opportunity time
$\hat{a}$, $\hat{b}$, $\hat{c}$, and $\hat{d}$: Empirical coefficients for S-curve determined using a least-squares optimization
a, a_1 and b_1, a_2 and b_2, *etc.*: empirical parameters that depend on soil texture
AOI: Area of interest
ARIDAD: Arkansas River Irrigation Data and Analysis Disc
CAES: Colorado Agricultural Experiment Station
CD: Concrete Ditch Water Delivery
CDPHE: Colorado Department of Public Health and Environment
CDWR: Colorado Division of Water Resources
CN: Curve number
CoAgMet: Colorado Agricultural Meteorological Network
CP: Center Pivot
CSU: Colorado State University
CV: Coefficient of variation
CWCB: Colorado Water Conservation Board
CWI: Colorado Water Institute
DP: Deep percolation
DPF: Deep percolation fraction
DS/Downstream: Downstream of the John Martin Reservoir
D_{wt}: Water table depth
D_{wt_c} : Critical water table depth
D_{rz}: Depth of soil root zone below ground surface
E_a: Irrigation application efficiency
EC: Specific conductance (electrical conductivity at 25oC)
EC_e: Saturated paste extract soil salinity
ED: Earthen Ditch Water Delivery
EM_H: Horizontal orientation measurement with EM83 tool
EM_V: Vertical orientation measurement with EM83 tool
ET: Evapotranspiration
ET_a: Actual evapotranspiration
ET_i: Instantaneous actual evapotraspration
ET_p: Potential crop ET at a particular time
ET_r: Reference crop evapotranspiration
f_0: Steady-state infiltration rate
G_i: Heat conduction to the ground
GIS: Geographic information system
GP: Gated Pipe Water Delivery
GPS: Global Positioning System
GUI: Graphical User Interface
H_i: Sensible heat flux
IDS: Integrated Decision Support
IDSCU: Integrated Decision Support Consumptive Use Model
k: Empirical coefficient for infiltration
k_c: Crop coefficient
LARV: Lower Arkansas River Valley
LAVWCD: Lower Arkansas Valley Water Conservancy District
L_v: Latent heat of vaporization
NASS: National Agricultural Statistics Service
NRCS: Natural Resources Conservation Service
NVDI: Normalized difference vegetation index
PVC: Polyvinyl chloride
Q_A: Net volume of water applied to the field by irrigation over Δt
Q_{DP}: Volume of water leaving the root zone by deep percolation over Δt
Q_{ET}: Volume of water leaving the root zone by evapotranspiration over Δt
Q_I: Volume of water infiltrated into the soil root zone from irrigation over Δt
Q_P: Volume of water infiltrated into the soil from effective rainfall over Δt
Q_{PT}: Total volume of rainfall over Δt
Q_R: Volume of precipitation runoff over Δt
Q_{TW}: Tailwater runoff volume over Δt
Q_U: Volume of water entering the root zone by upflux from the groundwater table over Δt
q_u: Rate of water entering root zone by upflux from the groundwater table
$q_{u_{max}}(D_{wt}, ET_P)$: Maximum potential groundwater upflux rate (mm/day) as a function of D_{wt} and ET_p
$R_{n,i}$: Net radiation
SECWCD: Southeastern Colorado Water Conservancy District
S_R: Maximum soil retention volume per unit area
S_{SW}: Volume of water stored in the root zone
$S_{SW_c}(D_{wt})$: Critical soil water content at which upflux is initiated and, a function of D_{wt}
$S_{SW_{FC}}$: Water content in the root zone at field capacity
$S_{SW_s}(D_{wt})$: Steady soil water content (mm), a function of D_{wt}
$S_{SW_{WP}}$: Water content in the root zone at wilting point
TAW: Total available water
TDS: Total dissolved solids
TRF: Tailwater runoff fraction
USDA: U.S. Department of Agriculture
US/Upstream: Upstream of the John Martin Reservoir
W_{bag}: Weight of plastic bag (used in WC_{AD} analysis)
WBC: Water balance component
WC_{AD}: Air-dried gravimetric water content
W_{can}: weight of metal can (used in WC_{OD} analysis)
WC_{OD}: Oven-dried gravimetric water content
W_{ds}: Weight of dry soil sample (including bag) (used in WC_{AD} and WC_{OD} analysis)
W_{ws}: Weight of wet soil sample (including bag) (used in WC_{AD} and WC_{OD} analysis)
z: Infiltration depth

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Acknowledgements

This study was funded primarily by grants from the Colorado Water Conservation Board, the Colorado Division of Water Resources, the Colorado Department of Public Health and Environment, the Southeastern Colorado Water Conservancy District, the Lower Arkansas Valley Water Conservancy District, and the Colorado Agricultural Experiment Station. Financial support also was provided by the Colorado Water Institute, the United States Department of Agriculture (USDA), the United States Bureau of Reclamation, and the United States Geological Survey. Valuable in-kind support was provided by the La-Junta Area Office of the USDA Natural Resources Conservation Service, and the attentive and able assistance of Lorenz Sutherland in that office especially is appreciated. The study could not have been conducted without the interested cooperation of more than 120 landowners in the LARV, including about 40 who allowed intensive monitoring of their irrigation practices. Numerous students, technicians, and professionals lent their care and capabilities to the monitoring and analysis of irrigated fields and to project management. The authors particularly are indebted to the able assistance of Nathan Baker who helped with literature review, data analysis, modeling runs, and documentation. They also thank Roberto Arranz, J.J. Autry, Mike Bartolo, Adam Berrada, Chad Bohac, Mallory Cline, Morgan Cline, Tyler Curley, Ginger Davidson, Jeff Davidson, Ahmed Eldeiry, Patrick Greenbank, Jack Goble, Lenay Goble, Andres Jaramillo, Matthew Klein, Paula Miller, Dave Patterson, Ryan Pelton, Bret Schafer, Grant Seeley, Samantha Stuart, Matthew Vandiver, Ben Weber, Mike Weber, and Corda Williams. The authors are very grateful for all of this support and cooperation.

Photo Credits:

Cover: From top left, irrigation, Fort Lyon Canal, a field, and sprinkler in the Lower Arkansas River Valley. *Photos by Bill Cotton, CSU Photography*

Title page & 80: Catlin Canal. *Photo by Bill Cotton, CSU Photography*

Table of Contents & 116: Aerial view of the Fort Lyon Canal in the Lower Arkansas River Basin. *Photo by Bill Cotton, CSU Photography*

This page: Irrigation in the Arkansas River valley. *Photo by Bill Cotton, CSU Photography*

Page 11, Page 96: Lower Arkansas River Valley. *Photo by Bill Cotton, CSU Photography*

Page 15: Aerial view of the Fort Lyon Canal in the Lower Arkansas River Basin. *Photo by Bill Cotton, CSU Photography*

Page 18-19: John Martin Reservoir in the Lower Arkansas River Basin. *Photo by Bill Cotton, CSU Photography*

Page 22-23 & 45: Field in Lower Arkansas River Valley. *Photo by Bill Cotton, CSU Photography*

Page 26-27 & 75: Bents Old Fort National Historic Site. *Photo by J. Stephen Conn*

Page 40: Water ripples. *Photo by Jeremy Reid*

Page 43: Aerial view of the Lower Arkansas River Basin. *Photo by Bill Cotton, CSU Photography*

Page 47: Field irrigation. *Photo by Kay Ledbetter*

Page 60: Canal in the Lower Arkansas River Valley. *Photo by Bill Cotton, CSU Photography*

Page 68, Page 76-77: Irrigation on Roger Maddox Farm near Swink, Colorado. *Photo by Bill Cotton, CSU Photography*

Page 83, Page 93, Page 98, Page 110: Fields in the Lower Arkansas River Valley. *Photo by Bill Cotton, CSU Photography*
Page 88: Farm in Lower Arkansas River Valley. Photo by Bill Cotton, CSU Photography

Page 103: Aerial view of the Arkansas River between La Junta and Las Animas, Colorado. *Photo by Bill Cotton, CSU Photography*

Back Cover: Aerial view of the Fort Lyon Canal in the lower Arkansas River basin. *Photo by Bill Cotton, CSU Photography*

Exhibit M

Summary

The Lower Arkansas River Valley (LARV) in Colorado has a long history of rich agricultural production, but is facing the challenges of soil salinity and waterlogging from saline shallow groundwater tables, high concentrations of salts and minerals in the river and its tributaries, water lost to non-beneficial consumption, and competition from municipal water demands. Significant improvements to the irrigated stream-aquifer system are possible, but they are constrained by the need to comply with the Arkansas River Compact. Making the best decisions about system improvements and ensuring compact compliance require thorough baseline data on irrigation practices in the LARV. This report summarizes the methods, analysis, results, and implications of an extensive irrigation monitoring study conducted by Colorado State University (CSU) during the 2004-2008 irrigation seasons in representative study regions upstream and downstream of John Martin Reservoir (referenced herein as Upstream and Downstream). A total of 61 fields (33 surface-irrigated, 28 sprinkler-irrigated) were investigated. Results from 523 monitored irrigation events on these fields are presented. Data and modeling results from more extensive studies conducted by CSU between 1999 and 2008 also are provided.

Data on applied irrigation, field surface water runoff, precipitation, crop evapotranspiration (ET), irrigation water salinity, soil water salinity, depth and salinity of groundwater tables, upflux from shallow groundwater, crop yield, return flows to streams, and salt loads to streams are presented. Deep percolation and application efficiency for irrigation events on each field are estimated using a water balance method implemented within the CSU Integrated Decision Support Consumptive Use (IDSCU) Model. Tailwater runoff (surface water runoff at the end of a field) fraction ranges from zero to 69 percent on surface irrigated fields, averaging about eight percent, while deep percolation fraction ranges from zero to 90 percent, averaging about 24 percent. Application efficiency ranges from two to 100 percent on surface irrigated fields, with an average of about 68 percent. No significant runoff is observed on sprinkler-irrigated fields, and estimated deep percolation typically is negligible. On sprinkler-irrigated fields average application efficiency is about 82 percent, but in many cases these fields are under-irrigated. Upflux from shallow groundwater tables below irrigated fields is estimated to average about six percent of crop ET, ranging between zero percent and 40 percent. Average measured total dissolved solids concentration of applied surface irrigation water is 532 mg/L Upstream and 1,154 mg/L Downstream. Average estimated salt load applied per surface irrigation event is 997 lb/acre Upstream and 2,480 lb/acre Downstream. Average estimated salt load applied per sprinkler irrigation event is 1,217 lb/acre Upstream and 446 lb/acre Downstream. Soil saturated paste electrical conductivity averaged over all Upstream fields ranges from 3.7-4.7 deciSeimens per meter (dS/m) over the monitored seasons and from 4.5-6.4 dS/m over Downstream fields. Water table depth averaged over Upstream fields varies from 7.8-12.1 feet over the monitored seasons and average specific conductance (EC) of groundwater varies from 1.8-2.3 dS/m. Water table depth averaged over Downstream fields varies from 12.6-15.0 feet with average EC from 2.3-3.0 dS/m. Analysis reveals trends of decreasing crop ET with increasing soil salinity on several investigated fields. Trends of decreasing relative crop yield with increasing soil salinity on corn and alfalfa fields also are detected.

Calibrated regional groundwater models indicate an average recharge rate to shallow groundwater of 0.10 in/day and 0.06 in/day over modeled irrigation seasons 1999-2007 Upstream and 2002-2007 Downstream, respectively. Upflux to non-beneficial ET in the regions is estimated to be about 26,000 ac-ft/year Upstream and 35,000 ac-ft/year Downstream, with an approximation for the entire LARV being 82,000 ac-ft/year. Average groundwater return flow rate to the Arkansas River within the Upstream and Downstream regions is estimated as 30.9 ac-ft/day per mile and 12 ac-ft/day per mile along the river, respectively. Salt load in return flow to the river over the modeled years is estimated at about 93 tons/week per mile Upstream and about 62 tons/week per mile Downstream.

The significance and implications of these findings are discussed. Also, a number of specific questions of concern to water managers and regulatory agencies are addressed.


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Introduction

Irrigation in the Arkansas River Valley

The LARV in Colorado has long been known for its valuable agricultural production. The introduction of extensive irrigation to the fertile alluvial soils in the valley in the late 19th century has created a widespread agriculturally based economy with important benefits not only on a regional scale, but also to the state of Colorado (Sherow 1990). Over the years, however, groundwater tables in the basin have risen in elevation and in salt concentration due to excessive irrigation, seepage from earthen canals, and inefficient drainage systems, creating a number of challenging problems. These high-saline water tables have in turn salinized and waterlogged much of the rich soil of the river valley, causing reductions in crop yield. High water tables also produce high hydraulic gradients that drive subsurface flows back to tributaries, open drains, and to the river.

In some locations along the LARV, these return flows can dissolve salts and minerals (like selenium and uranium) that naturally occur in the Arkansas Valley's marine shale outcrops and bedrock and from shale-derived soils as the water moves through the underlying aquifer, further increasing constituent loads as they make their way back to streams (Gates et al. 2009). In other locations along the LARV, particularly east of La Junta, precipitation of calcium sulfate (gypsum), calcium carbonate (lime), and other salts may serve to mitigate these salt loading problems. Lastly, high groundwater tables extend out under uncultivated and fallow land where substantial amounts of water are non-beneficially consumed and groundwater solute concentrations rise due to evaporative upflux from the shallow water table (Niemann et al. 2011).

There are a total of about 270,000 irrigated acres in the LARV, with irrigation practiced on about 14,000 fields. Water supply is provided by 25 canals that divert water from the river in accordance with Colorado water law and from about 2,400 wells that pump from the alluvial groundwater. The vast majority of fields are irrigated using surface-irrigation methods with less than about five percent irrigated with sprinklers (typically, center-pivot sprinklers) or drip lines.

The LARV irrigation system's operation is severely constrained by the Arkansas River Compact (with Kansas), which prohibits changes to the system that would increase the irrigated acreage of the return flow patterns (amount, spatial pattern, and timing) so as to cause the flow in the Arkansas River to be "materially depleted in usable quantity or availability for use to the water users in Colorado and Kansas." Hence, reductions in excess surface or subsurface flows that result from increases in irrigation efficiency, with the aim of mitigating the problems described above, are prohibited unless otherwise augmented. Improvements in irrigation application efficiency (by reducing surface runoff and/or deep percolation, DP) and/or in conveyance efficiency (by reducing canal seepage) that diminish return flows to the river must be offset by appropriate changes in river operation, such as with amended releases from reservoir storage. If improved irrigation efficiency can indeed be achieved in conjunction with such offsetting measures, then crop yields can be increased, river water quality can be improved, and water can be conserved (Triana et al. 2010a, 2010b).

An evaluation of on-going water use practices and the potential impacts of improvements to any water resources system requires the establishment of an accurate description of the current state, or the baseline, of the system. In the irrigated alluvial lands of the LARV, such a baseline needs to be determined for irrigation practices and efficiency, with consideration to interventions that could address current irrigation problems while complying with the Arkansas River Compact. A baseline evaluation involves estimating the various features and water balance components of field irrigation systems, including the following:

- Irrigation timing, total water applied, water consumed for crop evapotranspiration (ET), tailwater runoff, DP below the root zone, and upflux returned from the shallow water table
- Salinity of irrigation and drainage water
- The movement and accumulation of dissolved salts on irrigated fields
- General soil characteristics
- Groundwater table characteristics
- Crop yields that result from irrigation practices

Such data may provide insight into the effect of soil water salinity, as affected in part by irrigation water salinity, and irrigation practices on crop yield and ET. Analysis of such data would show the fraction of irrigation diversions from the river that are consumed beneficially by crops, as compared to the fractions that return to the river system via surface and groundwater flows as well as those that are non-beneficially consumed.

Background and Scope of This Study

During the irrigation seasons over the period 2004-2008, CSU conducted an extensive field investigation of current irrigation practices in the LARV, primarily under funding from the Colorado Water Conservation Board (CWCB), the Colorado Division of Water Resources (CDWR), the Colorado Department of Public Health and Environment (CDPHE), the Southeastern Colorado Water Conservancy District (SECWCD), the Lower Arkansas Valley Water Conservancy District (LAVWCD), and the Colorado Agricultural Experiment Station (CAES). Additional support was provided from other agencies listed in the "Acknowledgments" section at the end of this report.

Data were gathered from numerous fields, spread across two study regions under both conventional surface irrigation methods and sprinkler irrigation technologies (such as sprinkler and drip irrigation). The first study region was located upstream of John Martin Reservoir (Upstream), extending between Fowler and Las Animas, and the second region was downstream of the reservoir (Downstream), extending between McClave and the Colorado-Kansas state line (Figure 1). These two areas generally coincide with the study regions where CSU has been conducting intensive field-scale and regional-scale studies of the irrigated stream-aquifer system of the LARV since 1999 (Burkhalter and Gates 2005, Gates et al. 2006).

During the 2004, 2005, and 2006 irrigation seasons, CSU collected data from a total of 33 fields, 14 in the Upstream Study Region and 19 in the Downstream Study Region. Three of the Upstream fields were served by a sprinkler, three were supplied with surface water, and one was supplied with groundwater. Sprinklers supplied with surface water served five of the fields in the downstream area—four from the Fort Lyon Canal, and one from the Amity Canal.

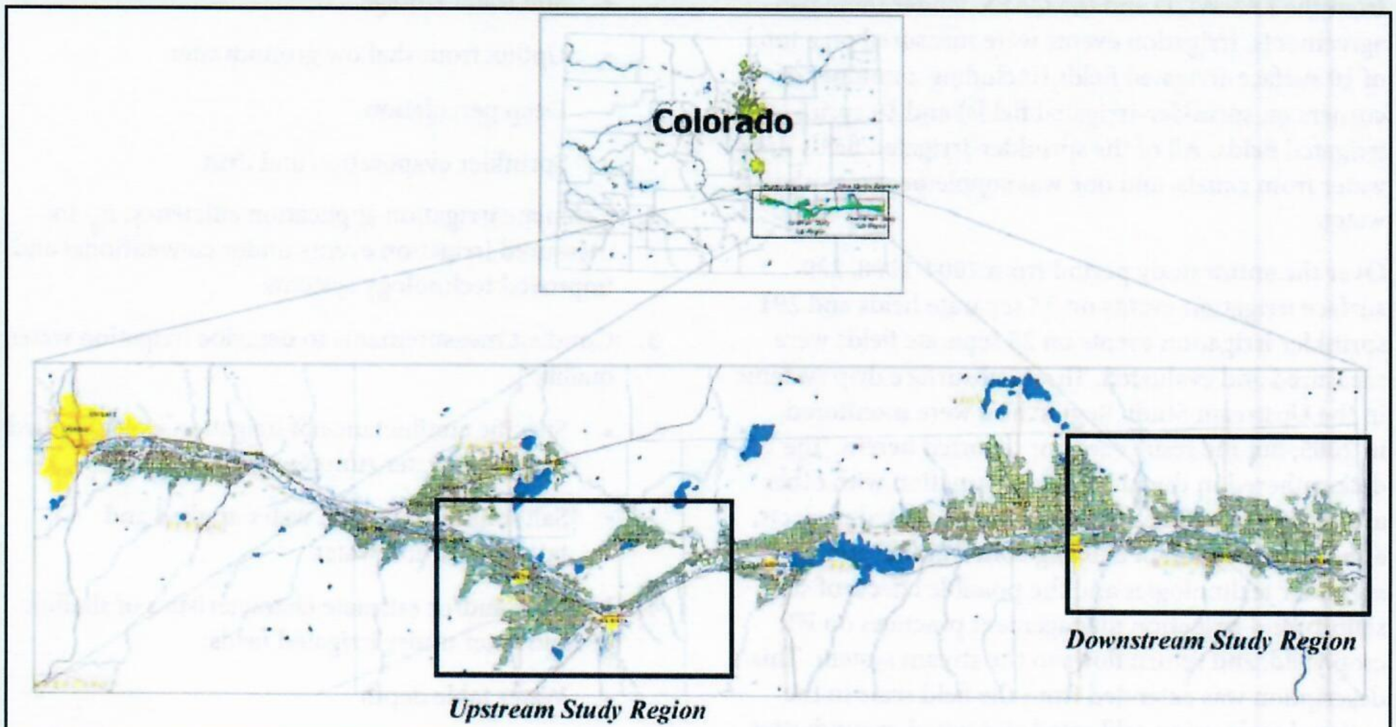


Figure 1. *LARV in Colorado highlighting the upstream and downstream study regions*

This work was performed primarily under a contract with the CWCB entered in May 2004, to address questions raised in the Kansas v. Colorado litigation before the U.S. Supreme Court regarding whether and how salinity and/or irrigation timing and amount affect crop yield and ET in the LARV. Major support also was provided for these efforts from the CDPHE, the SECWCD, the LAVWCD, and the CAES. As part of this effort, CSU conducted measurements on participating farmers' fields regarding their irrigation practices and salinity conditions.

In 2007, with funding primarily from the CDPHE, the SECWCD, the LAVWCD, and the CAES, measurements were made only in the Downstream region, where eight surface-irrigated fields and five sprinkler-irrigated fields were monitored. In 2008, data from a larger sample size were desired to improve confidence in the conclusions that could be drawn from the 2004-2007 data, and to examine more carefully the differences between sprinkler irrigation and surface irrigation. CSU conducted this research largely under a contract funded by CDWR for "Early-Season Monitoring of Irrigation Practices under Conventional and Improved Technologies in Colorado's Lower Arkansas River Valley" and a purchase order funded by CWCB for "Late Season Monitoring" of the same type, with assistance from the LAVWCD and the CAES. Under these two agreements, irrigation events were measured on a total of 10 surface-irrigated fields (including a number of corners on sprinkler-irrigated fields) and 19 sprinkler-irrigated fields. All of the sprinkler-irrigated fields drew water from canals, and one was supplemented with well water.

Over the entire study period from 2004-2008, 229 surface irrigation events on 33 separate fields and 291 sprinkler irrigation events on 28 separate fields were measured and evaluated. Three subsurface drip systems in the Upstream Study Region also were monitored in 2005, but the results are not reported herein. The data gathered in this study, in conjunction with other available data gathered by CSU under related projects, allow a description of existing conventional and sprinkler technologies and the possible effects of soil salinity and irrigation management practices on ET, crop yield, and return flows to the stream system. This description was extended from the field scale to the regional scale using calibrated and tested groundwater models.

This document describes the study objectives, setting, methodology, and results. Broad conclusions and implications are drawn regarding baseline irrigation practices in the LARV. Questions that still remain, and recommendations for addressing them, are presented.

Study Objectives

The objectives of the study described in this report are summarized as follows:

1. Measure, estimate, or calculate each major irrigation water balance component (WBC) and associated properties for a few irrigation events on each of several representative irrigated fields over the study period. Fields irrigated by both conventional and improved technology (sprinkler) systems are considered. Considered WBCs include:
   - Irrigation flow onto the field
   - Irrigation surface flow off the field (tailwater runoff)
   - Precipitation
   - Infiltration
   - Evapotranspiration
   - Soil water storage
   - Upflux from shallow groundwater
   - Deep percolation
   - Sprinkler evaporation and drift
2. Calculate irrigation application efficiency, E_a, for measured irrigation events under conventional and improved technology systems
3. Conduct measurements to describe irrigation water quality:
   - Specific conductance of irrigation water applied and in tailwater runoff water
   - Salt ions in irrigation water applied and tailwater runoff water
4. Measure and/or estimate characteristics of shallow groundwater under irrigated fields:
   - Water table depth
   - Specific conductance of groundwater
   - Salt ions in groundwater

5. Conduct measurements to estimate soil water salinity distributed over irrigated fields
6. Conduct measurements to estimate crop yields over irrigated fields
7. Address issues associated with uncertainty in the data
8. Use calibrated regional-scale models to perform a preliminary extension of the results of field-scale studies to regional-scale conditions for the LARV in regard to crop ET, upflux from water tables to ET, return flows and salt loads to streams, and other processes that vary over LARV regions that are representative of conditions Upstream and Downstream
9. Use data derived from measurements, estimation, and calculation to address some questions of concern to water managers and regulatory agencies, including the following:
   - How do the characteristic irrigation WBC and E_a values for sampled conventional surface irrigation systems compared to those for improved technology (especially sprinkler) systems?
   - Do the characteristic WBC and E_a values for irrigation events seem to vary significantly from canal to canal; which is to say, do the values appear to be affected by total water supply available from one canal to another, within a single year?
   - Do the characteristic WBC and E_a values vary significantly from year to year within the same canal system; i.e., are they affected by total water supply available within a canal?
   - Do the characteristic WBC and E_a values differ between surface-water supplied sprinklers and groundwater-supplied systems?
   - Is there any indication of intentional bias introduced into the study by irrigators hoping to demonstrate that the achievable WBC and E_a values using surface-supplied sprinklers is no different than that associated with flood and furrow methods?
   - Do the data indicate any effect of soil salinity on crop yield? If so, what conclusions can be reached with these data, and what additional information is necessary to adequately quantify the impact of soil salinity on crop yield in the LARV?
   - Do the data indicate any effect of irrigation timing or amount on crop yield? If so, what conclusions can be reached with these data, and what additional information is necessary to adequately quantify the impact of irrigation management practices on crop yield in the LARV?
   - What are the known or assumed possibilities and limitations for correlating crop yield and soil salinity to ET for the fields included in this study?
   - Does crop type appear to affect WBC and E_a under sprinkler systems?
   - Do sprinkler irrigators typically apply sufficient volumes of water necessary to meet the ET requirement of crops?
   - Do sprinkler irrigators apply sufficient water to meet the salt leaching requirement for the soil root zone?
   - What is the difference in the WBC and E_a values for sprinkler systems that practice leaching and those that do not?
   - Are there significant differences in deep percolation and leaching fraction for various types of sprinkler systems?
   - How do alfalfa crop yields from sprinkler irrigated fields compare with those irrigated by flood and furrow irrigation methods?
   - How do water table depth and salinity, soil salinity, and crop yields relate to WBC and E_a?

Exhibit M

Study Sites and Conditions

Field Locations and Layouts

A total of 22 separate field units in the Upstream Study Region and 39 in the Downstream Study Region were included in the 2004-2008 study. Monitored fields were selected based upon the following criteria: (1) a distribution over the spatial extent of the monitored regions, including a variety of types of irrigation systems and water sources; (2) cooperation of land owners/operators with study objectives and methods; and (3) accessibility and layout that facilitated feasible and accurate measurement of desired components. Figures 2 and 3 show the locations of the monitored fields within the Upstream and Downstream regions, respectively.

Monitored fields are identified based upon which study region they are part of (US for Upstream and DS for Downstream) and by a number, usually assigned in the order in which the field was included in the study (Figures 2 and 3). For fields that are part of the same farm unit and share the same water right, a letter is added following the identification number (e.g., DS6A, DS6B). Separate fields were defined on the same farm unit when they contained different crops, were irrigated by different methods, and/or were separated by physical boundaries. Field US13 (Figure 4) is an example of a singular field parcel selected for monitoring within a farm. An example of a case where several fields make up portions of the same farm unit is shown in Figure 5. Fields DS18A, DS18B, DS18C, and DS18D were defined as separate fields within the same center pivot sprinkler circle because they contained different crops. Fields DS18E, DS18F, DS18G, and DS18H form the corners of the quarter section block containing the center pivot sprinkler. These corner fields were each independently surface irrigated. Maps showing layouts of all of the study fields are available on an accompanying Arkansas River Irrigation Data and Analysis Disc (ARIDAD) upon request from the Colorado Water Institute at CSU (CWI@ColoState.edu).

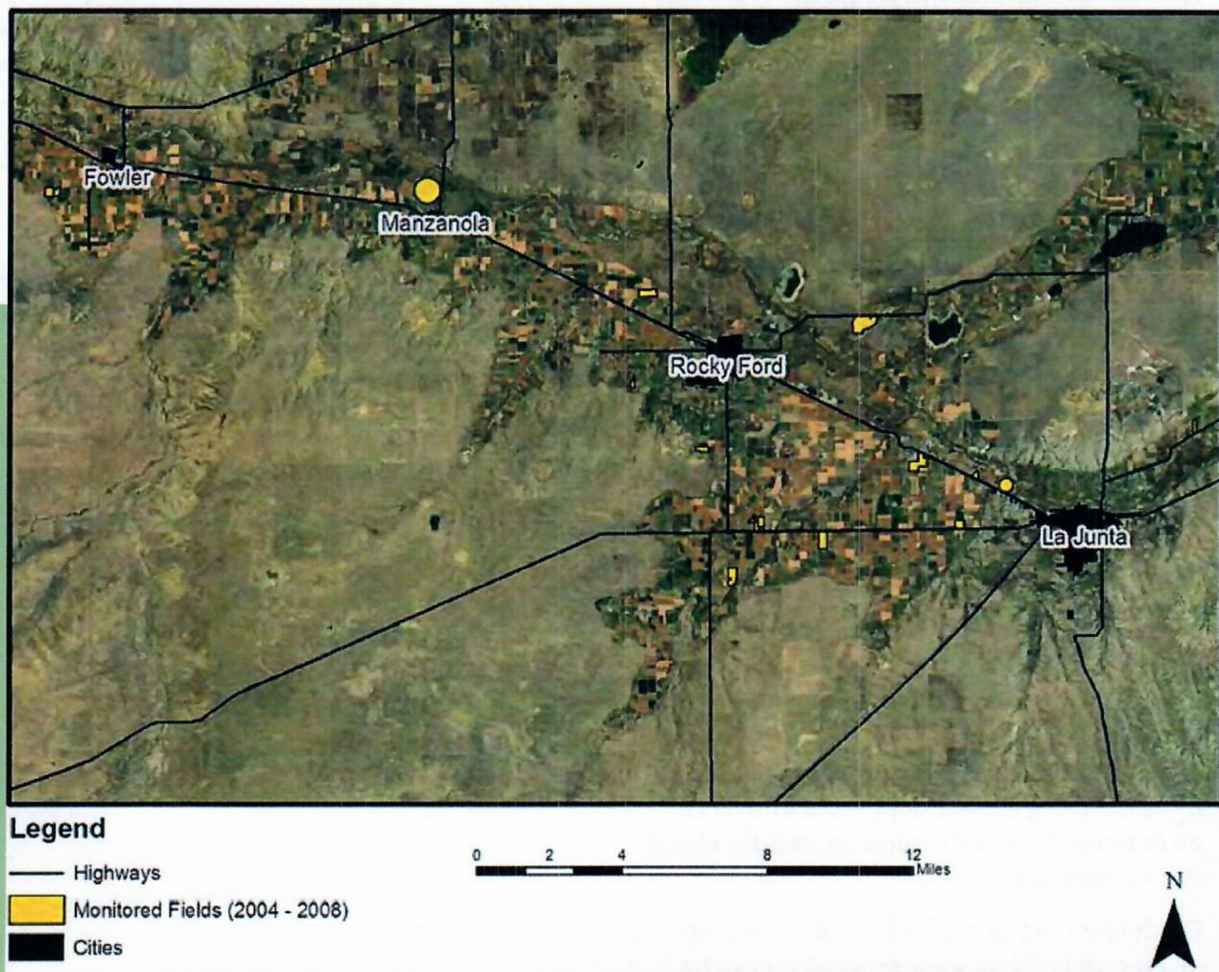


Figure 2. *Monitored fields in Upstream Study Region*

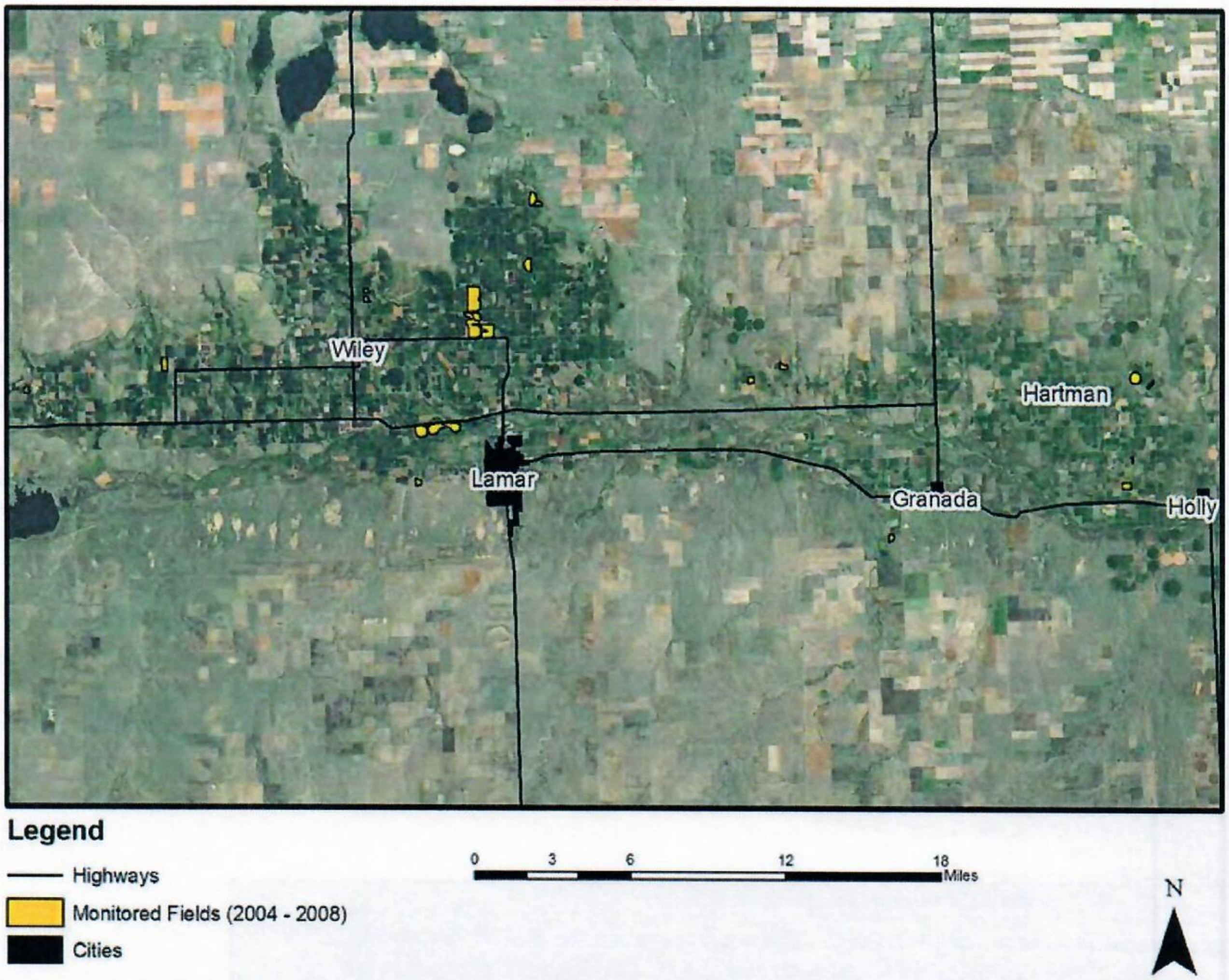
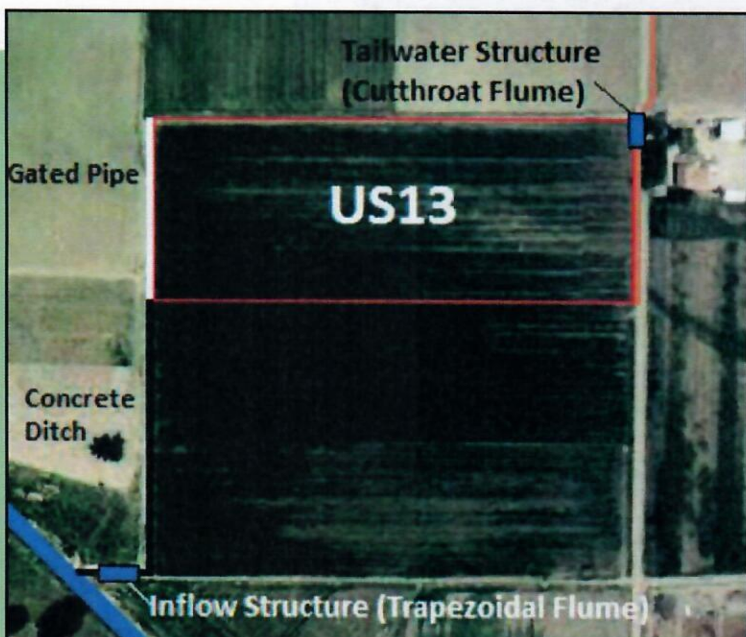


Figure 3. *Monitored fields in Downstream Study Region*



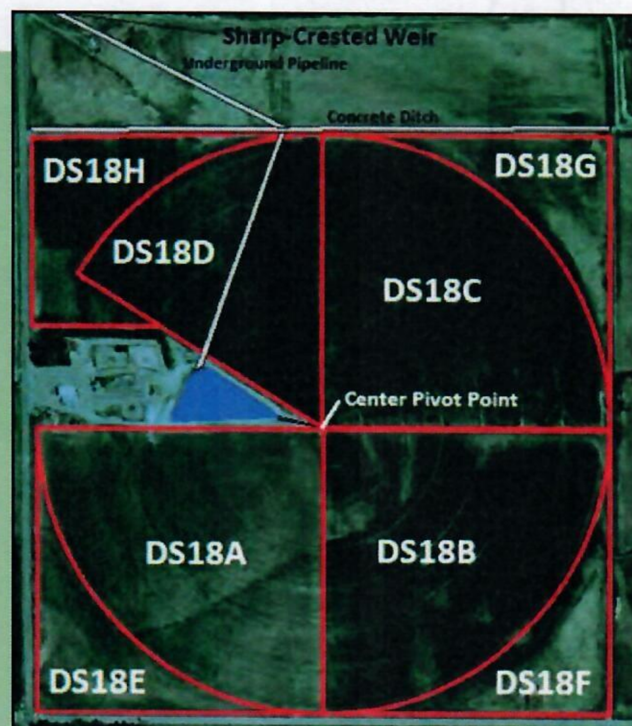


Figure 4 (left). *Layout of field US13*
Figure 5. *Layout of fields DS18A, DS18B, DS18C, DS18D, DS18E, DS18F, DS18G, and DS18H within the same farm unit*

In many fields, particularly those utilizing surface water from canal systems with rotational water allotment operations, the duration of an irrigation event was too short to irrigate the entire field area. During dry periods, these fields often went several weeks between irrigation events, so that irrigation of the entire field spanned a period of several weeks or longer. Similarly, for fields under canal systems with more junior water rights, or during drought conditions, irrigation water often was directed away from the monitored field to another field containing a higher-valued crop in need of water application. The most typical case was to direct water from alfalfa crops to corn or sorghum crops. These practices created differences in infiltrated water, soil-water content, and actual ET rates across the field area over time. Hence, fields monitored in this study often were subdivided into cells, or subfields, for the purpose of measuring and modeling irrigation events. In many irrigation events, available irrigation water was applied to only one cell. In other events, multiple cells within a field were irrigated simultaneously. For example, field US9 was divided into two cells, as seen in Figure 6.

For center-pivot sprinkler irrigated fields utilizing surface water, especially for rotational allotment canal systems, the difference in starting and ending locations of the rotating sprinkler line during an irrigation event often created "wedges" within a field that received different applied irrigation amounts than did other parts of the field over time. In many cases, the frequency of irrigation events dampened the effect of differences in

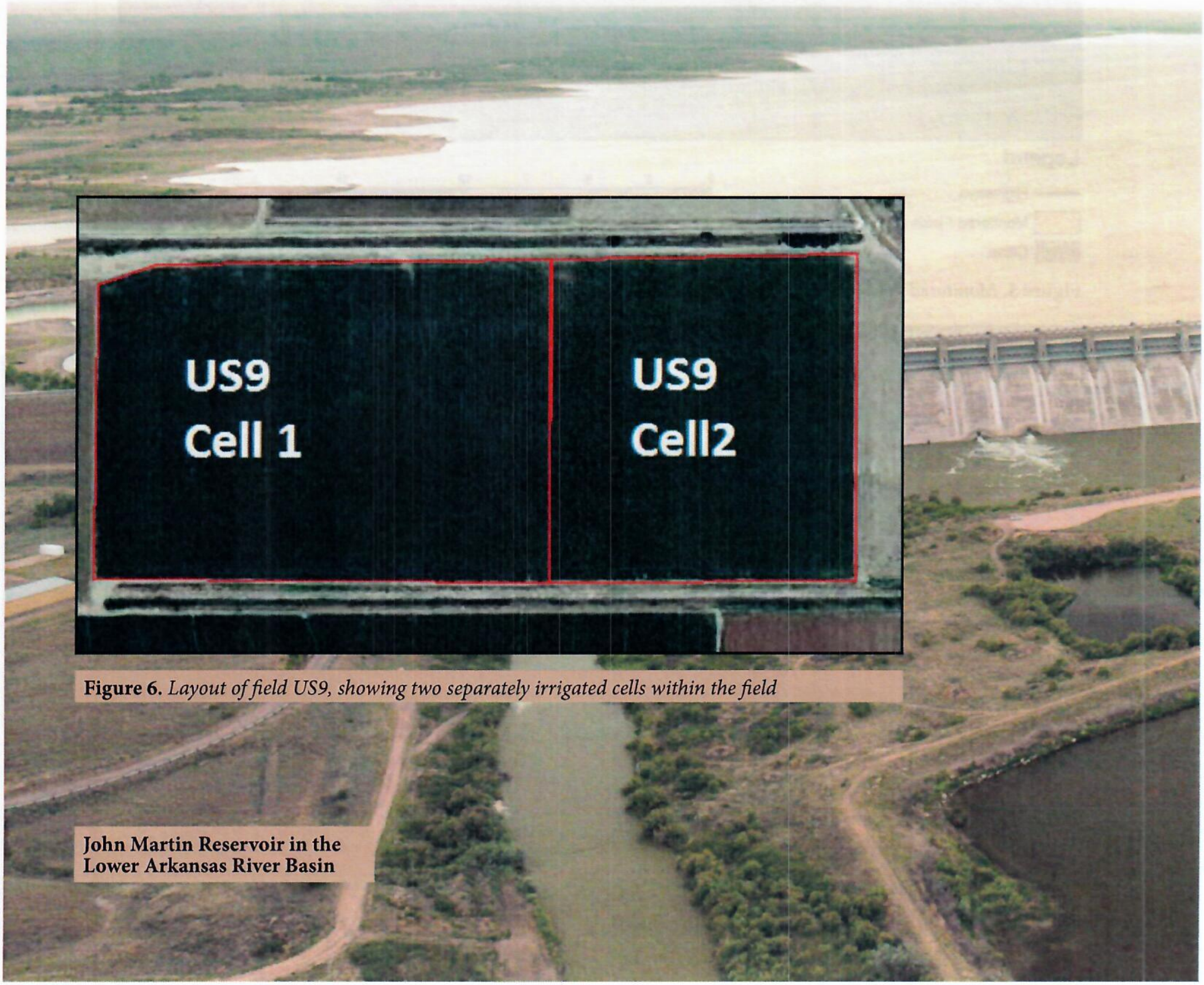


Figure 6. *Layout of field US9, showing two separately irrigated cells within the field*

John Martin Reservoir in the Lower Arkansas River Basin

irrigation timing on actual ET across the field area, but in some cases it did not.

Several fields were dropped from the study along the way for various reasons (such as physical changes to an irrigation system making it infeasible to monitor). A number of fields received no application of irrigation water during some seasons, due to water availability situations or the timing of the study, and data collection on these fields was limited to soil textural analysis, precipitation, ET, and soil salinity surveys.

Hydrological Setting

The hydrological conditions in the LARV during the period of this study (2004-2008) in relation to long-term hydrological conditions can be inferred from the plots in Figures 7 through 9. Figure 7 shows plots of the daily average flow rate in the Arkansas River at the Catlin Dam Near Fowler, Colorado (Station ID 07119700) gauging station, located near the upstream end of the Upstream Study Region, and at the gauging station Below John Martin Reservoir (Station ID 07130500), located near the upstream end of the Downstream region. A plot is shown for average conditions over the period 1975 (first year of Pueblo Reservoir)-2010 along with corresponding plots for each year within the period of this study. Cumulative daily precipitation recorded at the Colorado Agricultural Meteorological Network (CoAgMet) Stations at Rocky Ford (RFD01) in the Upstream Study Region averaged over 1992-2010

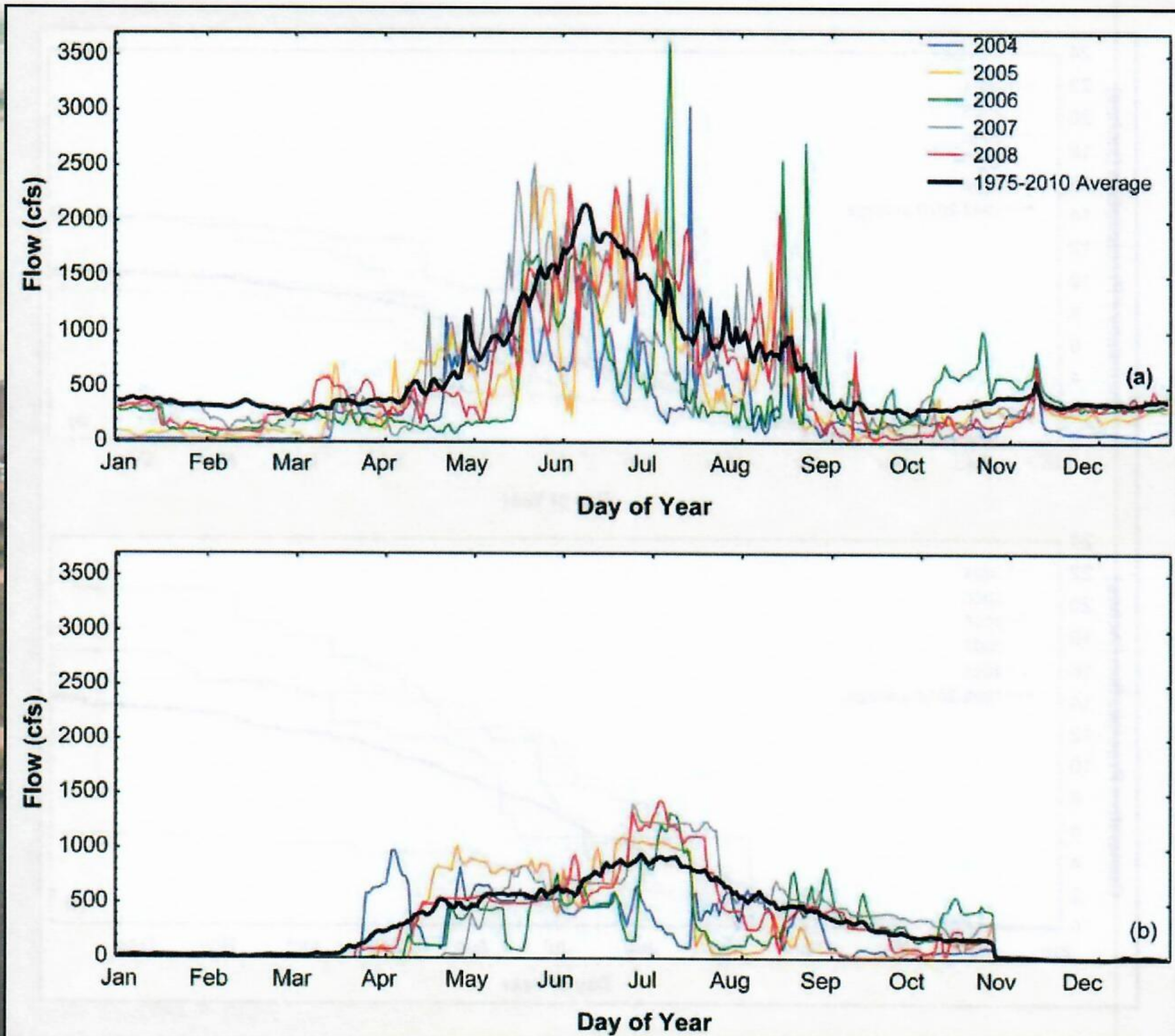


Figure 7. *Daily average flow rate in Arkansas River at (a) Catlin Dam Near Fowler, CO gauge and at (b) Below John Martin Reservoir gauge for study years compared to mean daily average flow rate for period 1975-2010*

and at Lamar (LAM02/LAM04) in the Downstream Study Region, averaged over 1998-2010, are plotted in Figure 8 with comparison precipitation plots for each of the years of this study. Cumulative daily reference crop evapotranspiration (ET_r) calculated using the Penman-Monteith method (Allen 2005) for each of the study years, compared with the 1992-2010 average, are plotted for the Rocky Ford (RFD01) CoAgMet station in Figure 9a. Similar plots for the Lamar (LAM02/LAM04) station for the years 2006 and 2007 (data were incomplete for the other study years) are compared with the 1999-2010 average in Figure 9b.

Comparison of the regulated river flow at the Catlin Dam Near Fowler, Colorado and Below John Martin Reservoir gauges during the study period to mean regulated flow rates over 1975-2010 reveal that the study period generally represents a relatively dry period of record in terms of streamflow, although there are times within each year when conditions were wetter than average. The 2004-2006 seasons were particularly dry, with 2007 and 2008 being closer to normal. Total annual flow volumes at the Catlin Dam Near Fowler, Colorado gauge on the Arkansas River for 2004, 2005, 2006, 2007, and 2008 were 50 percent, 73 percent, 71 percent, 90 percent, and 86 percent, respectively, of the mean annual flow volume over 1975-2010. Total annual flow volumes at the Below John Martin Reservoir gauge for 2004, 2005, 2006, 2007, and 2008 were 69 percent, 81 percent, 75 percent, 103 percent, and 96 percent, respectively, of the mean annual flow volume over 1975-2010.

Though the study period was relatively dry in relation to river flows available for diversion, the data in Figures 8 indicate that rainfall in the study regions over this period was close to normal or above normal with the

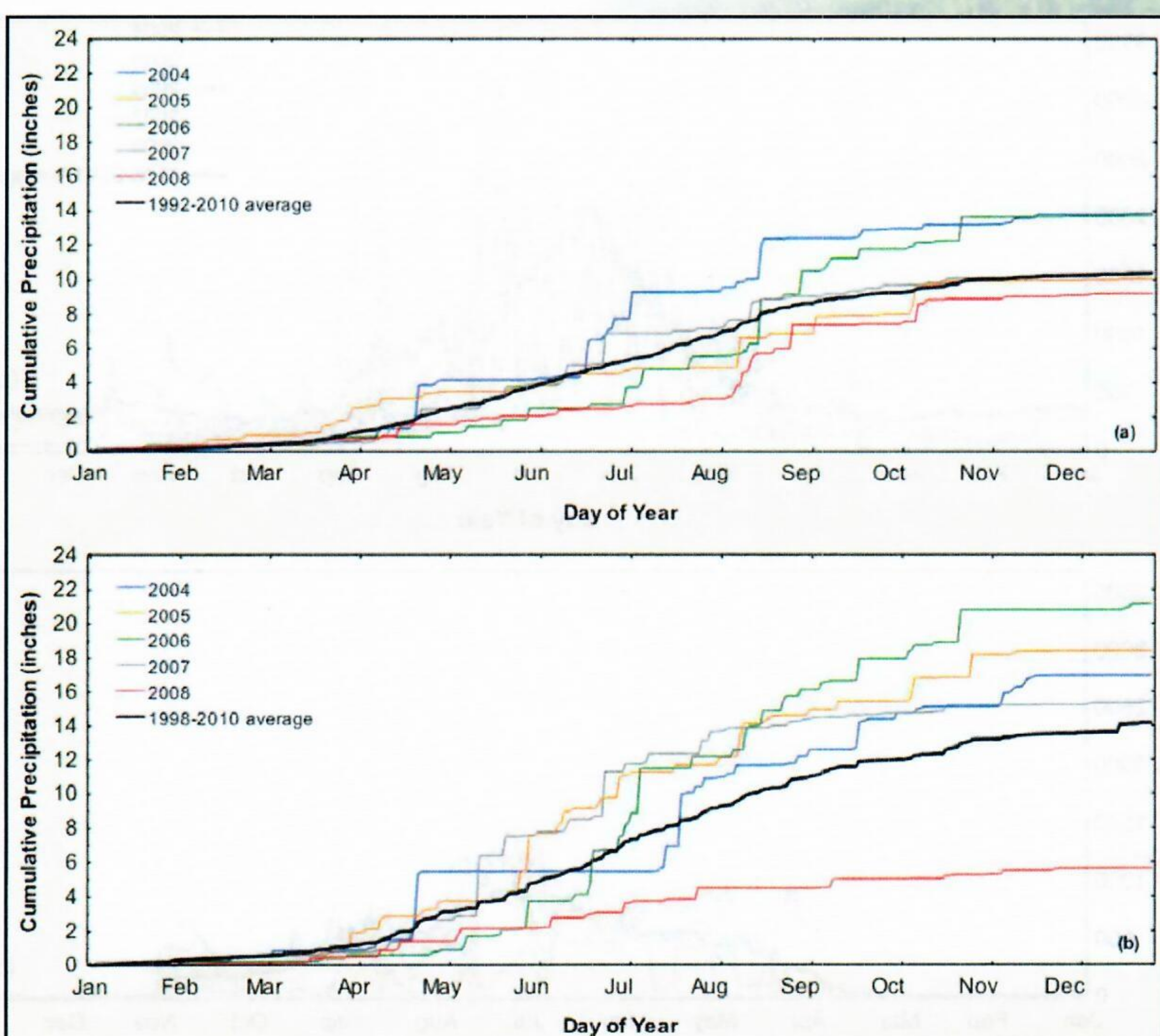


Figure 8. *Cumulative precipitation recorded for each of the study years 2004-2008 and (a) averaged over the years 1992-2010 at the CoAgMet Rocky Ford (RFD01) weather station, and (b) averaged over the years 1998-2010 at the CoAgMet Lamar (LAM02/LAM04) weather station*

exception of 2008. Precipitation at the Rocky Ford (RFD01) weather station in years 2004, 2005, 2006, and 2007 was 133 percent, 96 percent, 132 percent, and 100 percent, respectively, of the 1992-2010 average, while 2008 precipitation was 89 percent of the 1992-2010 average. At the Lamar (LAM02/LAM04) weather station, precipitation in years 2004, 2005, 2006, and 2007 was 120 percent, 130 percent, 150 percent, and 109 percent, respectively, of the 1998-2010 average, while 2008 precipitation was only 40 percent of the 1998-2010 average.

Also, from Figure 9, ET_r over the study period appears to be generally below the average over recent years. ET_r estimated from data at the Rocky Ford (RFD01) weather station in years 2004, 2005, 2006, 2007, and 2008 was 91 percent, 97 percent, 100 percent, 87 percent, and 98 percent, respectively, of the 1992-2010 average. At the Lamar (LAM02/LAM04) weather station, estimated ET_r for 2006 and 2007 was 96 percent and 89 percent, respectively, of the 1999-2010 average.

Irrigation Characteristics

For each field (or farm collection of fields), the irrigation water source, the type of irrigation system, and the number of irrigations measured during each season are summarized in Tables 1 and 2 for the Upstream and Downstream Study Regions, respectively. Most of the fields were supplied water from one of seven different canals. Groundwater wells provided water to 10 of the fields studied. A total of 33 conventional surface irrigated fields were studied. The 28 sprinkler-irrigated fields (eight Upstream, 20 Downstream) analyzed for this report were irrigated by 14 different center-pivot sprinkler systems (four Upstream, 10 Downstream).

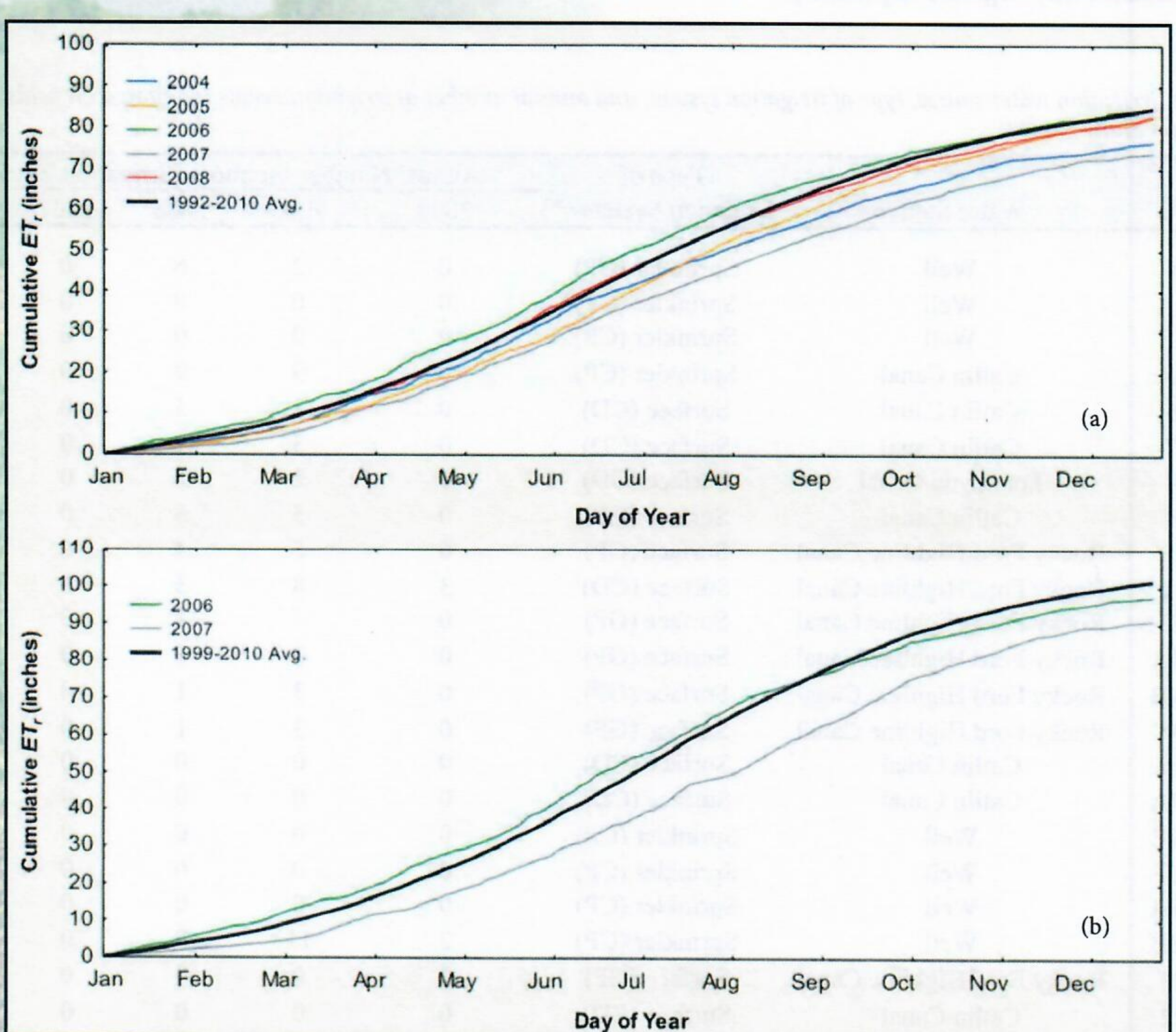


Figure 9. *Cumulative ET_r calculated for (a) each of the study years 2004-2008 and averaged over the years 1992-2010 at the CoAgMet Rocky Ford (RFD01) weather station, and (b) for study years 2006 and 2007 and averaged over the years 1999-2010 at the CoAgMet Lamar (LAM02/LAM04) weather station*

Exhibit M

The larger number of sprinkler-irrigated fields in the Downstream region was the result of a larger population of center-pivot irrigation systems available to study in that area. Canals may divert water rights for irrigation from the Arkansas River over the period March 15 to November 15. The average earliest date of monitored irrigation events across all fields in this study was May 17, and the average latest date was September 6.

Crops

Major crops in the LARV in order of cropped area are alfalfa, corn, grass hay, wheat, sorghum, dry beans, cantaloupe, watermelon, and onions (USDA NASS Colorado Field Office 2009). The crop type on each monitored field in this study for each irrigation season is summarized in Tables 3 and 4 for the Upstream and Downstream Study Regions, respectively.

Soil Conditions

Soils within the LARV generally consist of a variety of clay loam, loam, silty clay loam, silty loam, and sandy loam textural classes. Tables 5 and 6 present soil texture data and estimated total available water (TAW) for the surveyed fields derived from soil samples collected in the field and from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soil surveys (USDA 2010) in the Upstream and Downstream Study Regions, respectively. Figure 10 illustrates overlays of the irrigated fields in the vicinity of the Upstream and Downstream Study Regions onto the variety of general textural classes from USDA NRCS soil surveys.

Table 1. *Irrigation water source, type of irrigation system, and annual number of irrigation events monitored on fields in the Upstream Study Region*

Field	Water Source	Type of Irrigation System (*)	Annual Number Monitored Irrigation Events 2004	2005	2006	2007	2008
US4	Well	Sprinkler (CP)	0	2	6	0	0
US4A	Well	Sprinkler (CP)	0	0	0	0	7
US4B	Well	Sprinkler (CP)	0	0	0	0	0
US5A	Catlin Canal	Sprinkler (CP)	0	9	9	0	12
US6	Catlin Canal	Surface (CD)	0	3	5	0	0
US7	Catlin Canal	Surface (CD)	0	3	7	0	0
US8	Fort Lyon Canal	Surface (CD)	1	2	2	0	2
US9	Catlin Canal	Surface (GP)	0	5	5	0	0
US10	Rocky Ford Highline Canal	Surface (GP)	0	5	4	0	0
US12	Rocky Ford Highline Canal	Surface (CD)	3	8	3	0	3
US13	Rocky Ford Highline Canal	Surface (GP)	0	7	4	0	5
US14A	Rocky Ford Highline Canal	Surface (GP)	0	3	1	0	2
US14B	Rocky Ford Highline Canal	Surface (GP)	0	3	1	0	4
US14C	Rocky Ford Highline Canal	Surface (GP)	0	3	1	0	3
US15	Catlin Canal	Surface (ED)	0	0	0	0	2
US17A	Catlin Canal	Surface (CD)	0	0	0	0	3
US17E	Well	Sprinkler (CP)	0	0	0	0	5
US17F	Well	Sprinkler (CP)	0	0	0	0	2
US18A	Well	Sprinkler (CP)	0	0	0	0	7
US18B	Well	Sprinkler (CP)	2	11	0	0	3
US20	Rocky Ford Highline Canal	Surface (GP)	2	0	0	0	0
US22	Catlin Canal	Surface (CD)	0	0	0	0	0
Total			8	64	48	0	60

*CD-Concrete Ditch Water Delivery, CP-Center Pivot, ED-Earthen Ditch Water Delivery, GP-Gated Pipe Water Delivery

Exhibit M

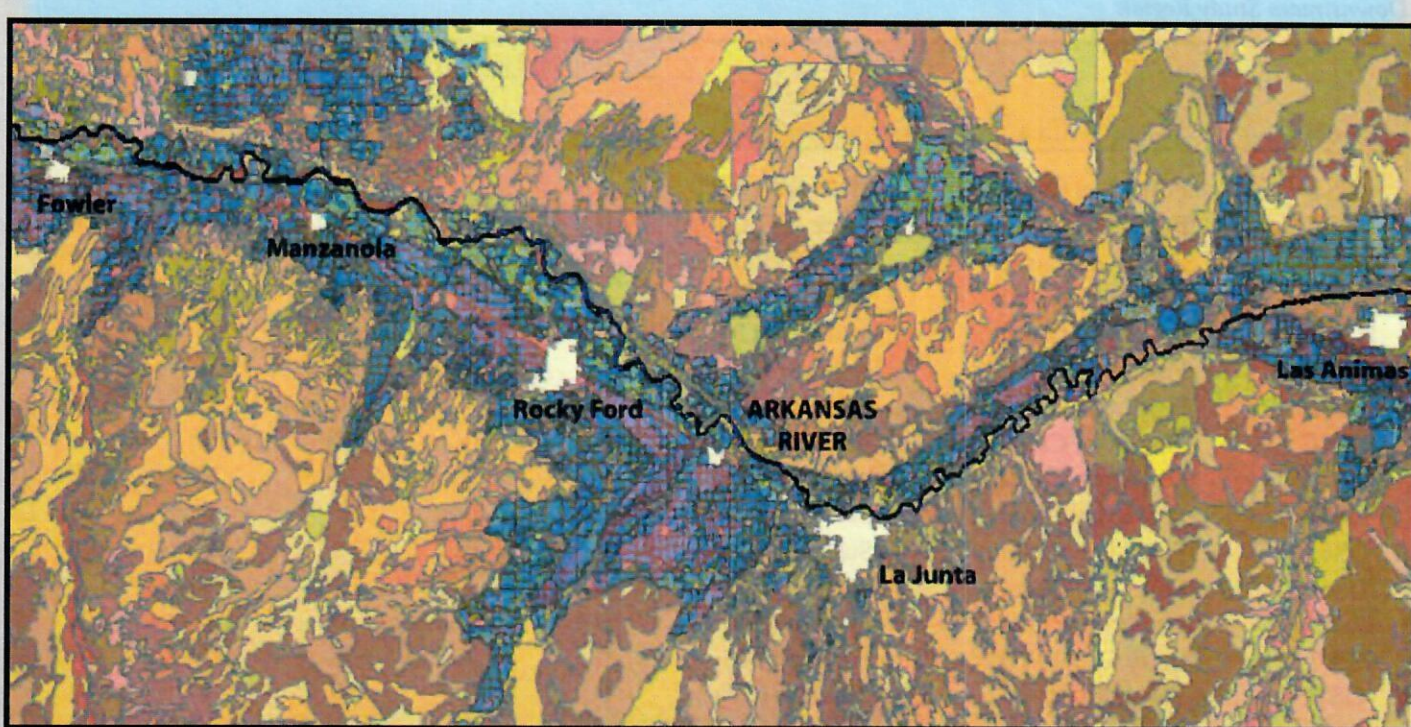
Table 2. *Irrigation water source, type of irrigation system, and annual number of irrigation events monitored on fields in the Downstream Study Region*

Field	Water Source	Type of Irrigation System	Annual Number Monitored Irrigation Events 2004	2005	2006	2007	2008
DS1	Fort Lyon Canal	Surface (ED, GP)	2	5	6	8	6
DS2	Fort Lyon Canal	Surface (ED,CD)	0	3	6	9	6
DS3	Fort Lyon Canal	Surface (ED)	0	4	3	3	0
DS4A	Fort Lyon Canal	Surface (CD)	1	0	0	0	0
DS4A1	Fort Lyon Canal	Sprinkler (CP)	0	0	9	9	8
DS4A2	Fort Lyon Canal	Sprinkler (CP)	0	8	0	0	0
DS4B	Fort Lyon Canal	Surface (CD)	2	0	0	0	6
DS4C	Fort Lyon Canal	Surface (CD)	0	0	0	0	1
DS5A	Fort Lyon Canal	Sprinkler (CP)	0	9	7	12	5
DS5B	Fort Lyon Canal	Surface (ED)	0	0	0	0	3
DS6A	Fort Lyon Canal	Surface (ED)	0	0	0	0	4
DS6B	Fort Lyon Canal	Surface (GP)	0	1	2	4	0
DS6Ba	Fort Lyon Canal	Surface (GP)	0	0	0	0	3
DS7	Amity Canal/Well	Surface (ED)	0	3	0	1	0
DS7s	Amity Canal	Sprinkler (CP)	0	0	0	0	4
DS8	Well	Surface (ED)	0	2	0	0	0
DS9	Amity Canal	Sprinkler (CP)	0	2	0	3	3
DS10	Amity Canal	Surface (ED)	0	1	0	1	0
DS11	Buffalo Canal	Surface (ED)	0	1	0	0	2
DS12	Fort Bent Canal	Surface (CD)	0	1	3	0	0
DS13	Lamar Canal	Surface (ED)	0	4	0	0	0
DS14	Fort Lyon Canal	Surface (GP)	0	2	0	4	0
DS15	Well	Surface (ED,CD)	0	0	5	2	3
DS16	Fort Lyon Canal	Sprinkler (CP)	0	0	9	8	7
DS17A	Fort Lyon Canal	Sprinkler (CP)	0	0	0	12	8
DS18A	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	7
DS18B	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	9
DS18C	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	5
DS18D	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	7
DS19A	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	12
DS19B	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	8
DS19C	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	2
DS19D	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	13
DS19M	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	11
DS20A	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	5
DS20B	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	7
DS20G	Fort Lyon Canal	Sprinkler (CP)	0	0	0	0	2
DS21	Amity Canal	Surface (CD)	0	0	0	0	1
DS22	Amity Canal	Sprinkler (CP)	0	0	0	0	5
Total			5	46	50	76	163

*CD-Concrete Ditch Water Delivery, CP-Center Pivot, ED-Earthen Ditch Water Delivery, GP-Gated Pipe Water Delivery

Exhibit M

a.



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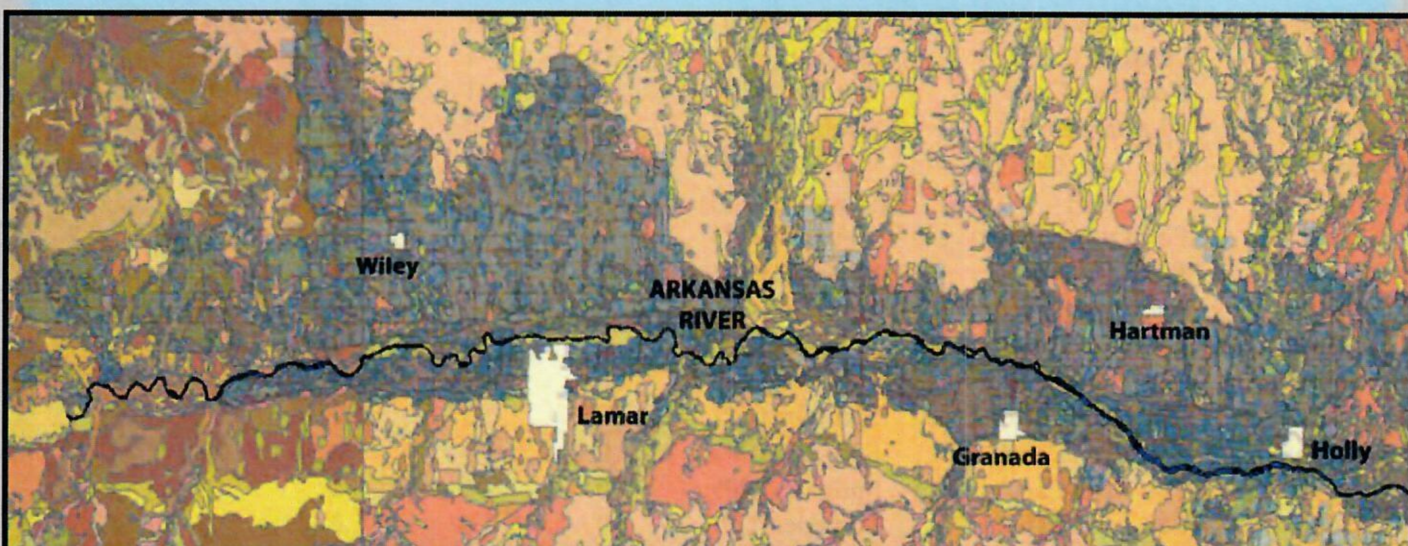


Figure 10. *Overlay of irrigated fields in the vicinity of the (a) Upstream and (b) Downstream Study Regions on the USDA NRCS soil textural classes, illustrating the variety of soil textures in the areas. For detailed information regarding soil textural class names and characteristics see http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm*

Table 3. *Crops on fields in the Upstream Study Region*

Field	Crop by Year 2004	2005	2006	2007	2008
US4		A	A		
US4A					WS,CG
US4B					A
US5A		ON	ON		ON
US6		A	A		
US7		A	A		
US8	SS	G	G		G
US9		A	A		
US10		A	A		
US12	A	A	A		A
US13		CG	CG		CG
US14A		G	G		G
US14B		G/A	G/A		G/A
US14C		G	G		G
US15					G
US17A					A
US17E					CG
US17F					FS
US18A					S, W
US18B					W,C
US20	A	A			
US22	A				

Abbreviations: A – alfalfa, C – canola, CT – cantaloupe, CG – corn grain, CS – corn sillage, FS – forage sorghum, G – grass, G/A – grass/alfalfa mix, O – oats, ON – onions, S – sunflowers, SG – sorghum grain, SS – sorghum silage, W – wheat, WG – wheat grain, WS – wheat silage.

Table 4. *Crops on fields in the Downstream Study Region*

Field	Crop by Year 2004	2005	2006	2007	2008
DS1	CG	A	A	A	A
DS2		A	A	A	A
DS3		CS	SS	SS	
DS4A	A				
DS4A1			A	A	A
DS4A2		A			
DS4B	SG				A
DS4C					A
DS5A		CG	FS	CG	A
DS5B					A
DS6A					CG
DS6B		A	A	A	
DS6Ba					A
DS7		CS		WS	
DS7s					CS
DS8		CG			
DS9		CG		CG	CG
DS10		CG		CG	
DS11		A			A
DS12		A	A		
DS13		CS		O	
DS14		FS		CG	
DS15			CS	CG	CG
DS16			FS	A	A
DS17A				A	A
DS18A					WG,CS
DS18B					A
DS18C					WG
DS18D					A
DS19A					A
DS19B					WG
DS19C					WG
DS19D					A
DS19M					A, CS
DS20A					A
DS20B					CG
DS20G					WG
DS21					A
DS22					CS,WG

Abbreviations: A – alfalfa, C – canola, CT – cantaloupe, CG – corn grain, CS – corn sillage, FS – forage sorghum, G – grass, G/A – grass/alfalfa mix, O – oats, ON – onions, S – sunflowers, SG – sorghum grain, SS – sorghum silage, W – wheat, WG – wheat grain, WS – wheat silage.

Table 5. *Soil textural class and total available water (TAW) for monitored irrigated fields in the Upstream Study Region*

	Field Survey					NRCS				
Field	Soil Type	Avg % Clay	Avg % Sand	Avg % Silt	Avg TAW (in/ft)	Soil Type	Avg % Clay	Avg % Sand	Avg % Silt	Avg TAW (in/ft)
US1	No Field Samples Collected					SCL	26.54%	11.16%	62.30%	2.01
US2	No Field Samples Collected					SaL, L	18.77%	43.87%	37.33%	1.73
US3	No Field Samples Collected					SCL	47.17%	6.60%	46.23%	2.04
US4	L	11.51%	54.43%	34.06%	1.45	L	18.06%	43.56%	36.33%	1.52
US4A	SaL	10.57%	58.10%	31.34%	1.36	L	17.04%	47.04%	28.38%	1.47
US4B	L	12.45%	50.77%	36.78%	1.53	L	19.28%	39.31%	36.57%	1.58
US5A	L	22.85%	31.34%	45.81%	1.87	SCL	27.20%	8.40%	64.40%	2.04
US6	No Field Samples Collected					L	22.07%	29.75%	48.18%	1.84
US7	No Field Samples Collected					L	25.83%	14.08%	60.08%	1.99
US8	L	17.83%	34.29%	47.88%	1.89	SCL	27.20%	8.40%	64.40%	2.04
US9	No Field Samples Collected					L	15.71%	59.02%	25.27%	1.59
US10	No Field Samples Collected					L	26.73%	16.20%	57.08%	1.99
US12	SL, L	18.26%	38.16%	43.58%	1.79	SCL	25.60%	8.80%	65.70%	2.04
US13	SaL	14.37%	50.29%	35.34%	1.53	SCL	25.60%	8.80%	65.70%	2.04
US14A	L	15.28%	40.14%	44.58%	1.78	SCL	27.20%	8.40%	64.40%	2.04
US14B	L	17.58%	46.15%	36.27%	1.63	SCL	27.39%	21.97%	50.67%	2.04
US14C	SaL, L	17.41%	44.99%	37.60%	1.63	CL	27.63%	38.39%	34.06%	2.04
US15	L	20.25%	41.68%	38.07%	1.66	SCL	27.20%	8.40%	64.40%	2.04
US17A	No Field Samples Collected					SCL	49.19%	20.32%	30.47%	1.94
US17E	SL, L	19.27%	29.81%	50.92%	1.98	SCL	36.55%	8.54%	54.91%	2.04
US17F	SL, L	19.27%	29.81%	50.92%	1.98	C, SCL	37.59%	8.39%	54.02%	2.04
US18A	No Field Samples Collected					L, SCL	25.59%	15.11%	59.30%	1.98
US18B	No Field Samples Collected					L, SCL	21.15%	33.59%	45.26%	1.80
US20	No Field Samples Collected					SCL	26.86%	9.83%	63.31%	2.03
US22	No Field Samples Collected					SCL	25.80%	13.30%	60.90%	1.96

Key: CL = clay loam, L = loam, SCL = silty clay loam, SaL = sandy loam, SL = silty loam

Table 6. *Soil textural class and total available water (TAW) for monitored irrigated fields in the Downstream Study Region*

	Field Survey					NRCS				
Field	Soil Type	Avg % Clay	Avg % Sand	Avg % Silt	Avg TAW (in/ft)	Soil Type	Avg % Clay	Avg % Sand	Avg % Silt	Avg TAW (in/ft)
DS1	SL, L	16.62%	34.14%	49.23%	1.92	CL	25.60%	11.10%	63.30%	2.16
DS2	SL, L	17.22%	34.65%	48.13%	1.89	CL	26%	11%	63%	2.16
DS3	No Field Samples Collected					CL	25.68%	16.00%	58.32%	2.06
DS4A	SL, L	16.70%	33.97%	49.32%	1.92	CL	25.30%	14.80%	59.90%	2.04
DS4A1	SL, L	16.70%	33.97%	49.32%	1.92	CL	25.30%	14.80%	59.90%	2.04
DS4A2	SL, L	16.70%	33.97%	49.32%	1.92	CL	25.30%	14.80%	59.90%	2.04
DS4B	SL	13.96%	35.63%	50.40%	1.93	CL	25.30%	14.80%	59.90%	2.04
DS4C	L	21.26%	33.32%	45.42%	1.83	CL	25.30%	14.80%	59.90%	2.04
DS5A	SL, L	19.76%	29.08%	51.16%	1.98	CL	25.82%	14.28%	59.90%	2.04
DS5B	No Field Samples Collected					CL	29.00%	8.10%	63.20%	2.28
DS6A	SL	10.10%	37.59%	52.30%	1.95	CL	25.30%	14.80%	59.90%	2.04
DS6B	SL	13.36%	36.11%	50.52%	1.98	CL	23.86%	22.86%	53.30%	2.06
DS6Ba	SL	13.36%	36.11%	50.52%	1.98	CL	21.74%	34.74%	43.56%	2.09
DS7	L	21.28%	31.68%	47.04%	1.89	CL	29.21%	45.43%	27.79%	1.75
DS7s	L	21.28%	31.68%	47.04%	1.89	CL	29.96%	39.57%	30.48%	1.61
DS8	No Field Samples Collected					CL	25.30%	14.80%	59.90%	2.04
DS9	L	13.27%	42.79%	43.94%	1.75	CL	24.67%	14.67%	61.85%	2.06
DS10	L	11.77%	39.62%	48.61%	1.87	CL	25.61%	36.37%	38.01%	1.94
DS11	No Field Samples Collected					CL	22.52%	44.45%	33.07%	1.98
DS12	No Field Samples Collected					CL	23.48%	20.96%	56.10%	1.97
DS13	L	14.08%	42.29%	43.63%	1.728	CL	23.95%	12.24%	66.30%	2.04
DS14	No Field Samples Collected					CL	26.07%	17.20%	56.73%	2.08
DS15	SL	16.30%	26.80%	56.90%	2.12	CL	25.30%	14.80%	59.90%	2.04
DS16	SL	13.56%	36.13%	13.56%	1.92	CL	25.30%	14.80%	59.90%	2.04
DS17A	SL	19.35%	29.17%	51.49%	2.00	CL	26.11%	13.99%	59.90%	2.04
DS18A	L, SL, CL	20.44%	31.03%	48.54%	1.92	CL	25.23%	14.17%	60.59%	1.99
DS18B	SL	14.45%	30.93%	54.61%	2.06	CL	25.26%	14.43%	60.31%	2.01
DS18C	SL, L	14.58%	36.46%	48.95%	1.90	CL	25.29%	16.04%	58.69%	2.04
DS18D	SL, L	16.39%	34.97%	48.64%	1.90	CL	25.30%	15.56%	59.16%	2.04
DS19A	L	17.22%	36.64%	46.14%	1.84	CL	26.12%	16.05%	57.83%	2.09
DS19B	SL, L	16.61%	30.63%	52.76%	2.01	CL	25.31%	14.82%	59.87%	2.04
DS19C	SL, L	15.89%	33.47%	50.64%	1.96	CL	25.30%	14.80%	59.90%	2.04
DS19D	SL	12.73%	30.43%	56.84%	2.10	CL	25.39%	14.93%	59.68%	2.05
DS19M	L, CL	26.72%	30.71%	42.57%	1.80	CL	26.06%	15.95%	57.99%	2.09
DS20A	L	18.35%	33.63%	48.02%	1.90	CL	25.40%	15.89%	58.72%	2.05
DS20B	SL	15.80%	32.47%	51.73%	1.99	CL	25.57%	15.06%	59.37%	2.03
DS20G	L	18.12%	32.14%	49.74%	1.94	CL	25.30%	14.80%	59.90%	2.04
DS21	SL	16.90%	32.49%	50.61%	1.96	CL	25.30%	14.80%	59.90%	2.04
DS22	L	17.21%	45.00%	37.79%	1.62	CL	17.63%	61.88%	20.56%	1.92

Key: CL = clay loam, L = loam, SCL = silty clay loam, SaL = sandy loam, SL = silty loam

Exhibit M

Methodology

Field Water Balance

Assuming constant fluid density, the water balance within the soil root zone of an irrigated field over a time period Δt can be represented by the following equation (Figure 11):

$$Q_I + Q_P + Q_U - Q_{ET} - Q_{DP} = \Delta S_{SW} \tag{1}$$

wherein Q_I = the volume of water infiltrated into the soil root zone from irrigation over Δt, Q_P = the volume of water infiltrated into the soil from effective precipitation over Δt, Q_U = the volume of water entering the root zone by upflux from the groundwater table over Δt, Q_{ET} = the volume of water leaving the root zone by evapotranspiration over Δt, Q_{DP} = the volume of water leaving the root zone by deep percolation over Δt, and ΔS_{SW} = the change in volume of water stored in the root zone over Δt. The value of Q_I is calculated as:

$$Q_I = Q_A - Q_{TW} \tag{2}$$

wherein Q_A = the net volume of water applied to the field by irrigation over Δt, and Q_{TW} = the tailwater runoff volume over Δt. The terms in Equations (1) and (2) can be expressed in units of volume or depth (volume per unit field area).

Flow Onto and Off of Fields

The irrigation water volume diverted to each surface-irrigated field were measured using Parshall, trapezoidal, EZ Flow Ramp™, and cutthroat flumes, as well as weir structures, all equipped with stilling wells and automatic water-level loggers. Flumes in these types of applications are estimated to have measurement accuracy of about ±15 percent. This diverted volume, less any transit losses in small delivery ditches, provided an estimate of the applied volume, Q_A, flowing onto a field. Such structures also were used to measure tailwater volume, Q_{TW}, flowing off of surface-irrigated fields. In most cases, portable flume structures were installed and used (e.g., Figure 12). Whenever possible, however, permanent flow measurement structures owned by a cooperator or the canal company were used (e.g., Figure 13). In-line McPropeller® flow meters (by McCrometer®) equipped with an instantaneous flow rate indicator and totalized flow volume odometer were used to measure water

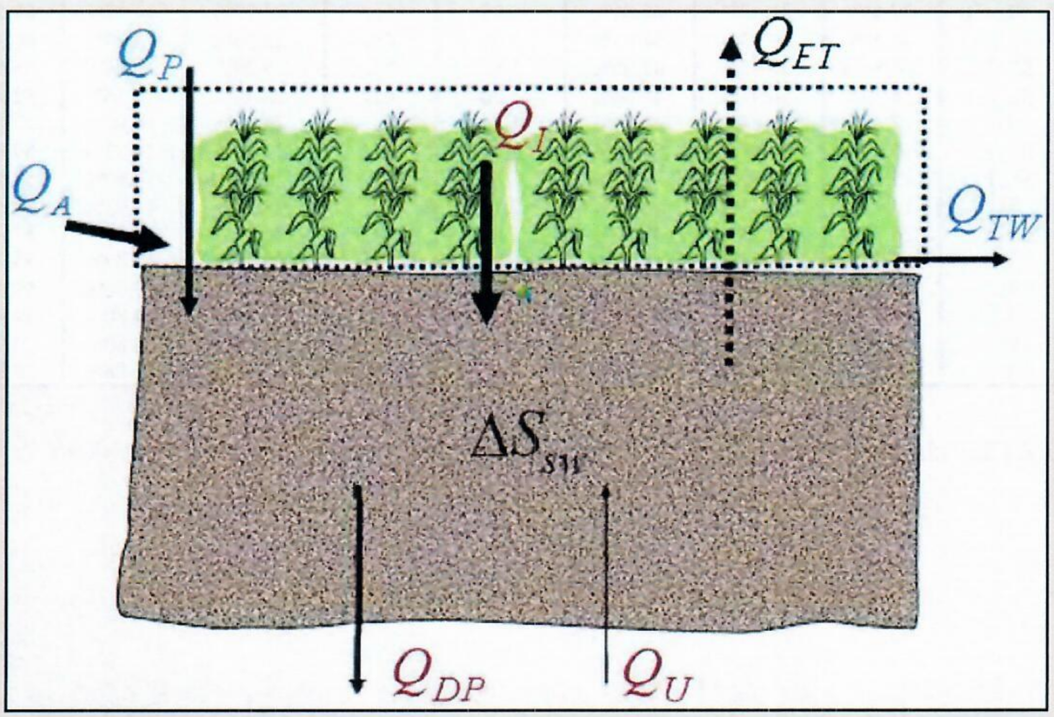


Figure 11. *The field water balance showing the surface components and the root zone components*

applied to sprinkler-irrigated fields. These meters have a rated accuracy of ±2 percent of reading and a repeatability of ±0.25 percent, and were installed by certified professionals. Significant tailwater runoff was never observed on monitored sprinkler-irrigated fields during this study. The different flow measurement structures used on the monitored fields are described in files available on the ARIDAD.

The following guidelines were used in the selection and installation of portable flumes:

1. Location was chosen so that (a) free (modular) flow conditions (Bos 1989) were present through the structure at all times (for this reason, installation in headland ditches was not attempted, since water level regulation during the irrigation process usually creates submerged (drowned) flow conditions for a period of time), and (b) the length of earthen transit channel between the structure and the irrigated field was minimized
2. Structure was sized suitable to the expected range of flow rates
3. Structure floor was raised six to 12 inches (depending on upstream channel bank elevation) from channel floor using packed soil to discourage submerged flow conditions

Figure 12. *EZ Flow Ramp™ flume used to measure tailwater from field DS14 during 2005 and 2007*

Exhibit M

Figure 13. *Permanent measurement structure for inflow to Field DS6, provided by Fort Lyon Canal Company during seasons 2005-2008*

4. Structure was installed such that the horizontal portion of the floor was level in directions parallel and perpendicular to flow
5. Area between the channel and the structure sidewalls was packed with soil to discourage movement or shifting of the structure
6. Canvas material was placed under downstream end of structure extending into downstream channel to prevent erosion of soil and shifting of structure
7. Area between sidewalls of upstream face of the structure and the channel was packed with soil (to the same height as the top of the structure) and overlain with canvas material to prevent leakage and erosion of soil (except in the case of trapezoidal flumes)
8. Structure was equipped with a staff gage, polyvinyl chloride (PVC) stilling well (no less than four inch diameter, except for trapezoidal flumes which were 2.5 inch diameter), vented cap, and vinyl delivery tube (three-fourths inch diameter). Stilling wells were used to house automatic water level recorders while delivery tubes were used to connect the stilling well to the inside of the flume structure (at the staff gage) in order to maintain an equivalent net water depth between the two. Stilling well floor typically was lowered at least 4 inches below the flume floor to maintain water level recording accuracy in the event of low flow conditions. Stilling wells were not lowered beneath the flume floor in the case of trapezoidal flumes.

Permanent flow measurement structures were used if the following conditions were met:

1. Structure was sound (no leaks, level in directions parallel and perpendicular to flow, no deformities)
2. Structure was appropriate for measuring expected flow rates (proper size, dimensions, and type)
3. Structure was suitable for the construction of a stilling well (and in some cases a delivery tube) for water level measurement
4. Free flow conditions were present through structure
5. Flow approach to the structure was appropriate (to discourage improper flow velocities or turbulence through the structure)

6. Structure was located a short distance (less than one-fourth mile) from field boundaries in situations where an earthen transit channel was used (in order to minimize error in transit water losses)

7. Water was not divided between multiple fields downstream of the flow measurement structure

For this study, HOBO® U20-001-01 water-level recorders (pressure transducers) manufactured by Onset™ were used to continuously record pertinent water levels in each flow measurement structure during irrigation events on surface-irrigated fields. HOBO™ U20-001-01 water-level recorders have an operating range of zero to 30 ft of water (at sea level) and a typical error of ±0.015 ft of water. They were programmed to record absolute pressure readings every five minutes over the duration of an irrigation event. Flow rate values and total applied/tailwater volumes later were derived from these pressure readings using appropriate rating equations for each flow measurement device. Early in the study in 2004, Level TROLL® 300 water level recorders by In-Situ, Inc. were used to measure water levels associated with water measurement structures on several fields. Another type of pressure transducer also was used in 2004, but problems were discovered with these devices and data were deemed to be unreliable. Localized barometric pressure was recorded at a five minute interval throughout the duration of the irrigation season using a HOBO® U20-001-01 water level recorder installed in a free-draining, ventilated PVC tube buried at the ground surface in a regionally centralized location (in both the Upstream and the Downstream regions).

Transit loss is defined as the amount of irrigation water that seeps or evaporates from an earthen transit channel between the flow measurement structure (inflow or tailwater) and the point of inflow to or outflow from a monitored irrigated field. Transit losses were considered negligible in concrete ditch and pipeline systems. Transit loss amounts were not considered in earthen headland or tailwater ditches directly adjacent to a field area; instead, this flow was assumed to be part of the irrigation amount applied to the field. Transit loss amounts were estimated based upon prior CSU studies on canal seepage rates in the LARV (Susfalk et al. 2008), using estimated wetted perimeter values for the transit channel, length of the transit channel between flow-measurement structure and the irrigated field, and the duration of flow in the transit channel. Since the location of each flow measurement structure location was carefully considered when selecting fields, transit loss calculations were required for a total of only five fields during the study.

To account for changes in the water destination or switching of water to neighboring fields, CSU personnel associated with this project maintained communication with cooperating farmers in addition to visually inspecting fields on a daily basis during irrigation events. Care was taken to insure that flow-measurment structures remained unsubmerged during operation. Figures 14-16 show some of the different flow-measurement devices employed over the period of the study. The center pivot irrigation system shown in Figure 17 was metered and used to irrigate fields DS5, DS6, and DS17.

Figure 14. *Weir structure for flow measurement onto fields DS4 and DS16 in 2008*

Figure 15. *Cutthroat flume for measurement of tailwater runoff from field US14C in 2008*

Figure 16. *Parshall flume for measurement of flow to field DS1 in 2008*

Figure 17. *Center pivot sprinkler system used to irrigated fields DS5, DS6, and DS17 in 2008*

The procedure followed in the measurement and calculation of applied irrigation and tailwater depths on surface irrigated fields is summarized as follows:

1. Manual readings of water depth at the gauging location for each flow measurement structure were taken throughout the duration of each irrigation event (daily if possible). These were used as a means of calibration and comparison of the water level recorder data. In addition, flow measurement structures were checked daily to insure that equipment was functioning properly and that all inflows and outflows were being accounted for.

2. Flow measurement structures were inspected daily during irrigation events to insure that:

   - Structure was sealed (no leakage around sides or underneath)
   - Structure was level in directions parallel and perpendicular to the flow
   - Structure, approach channel, and immediate downstream channel were free of debris
   - Stilling well and delivery tube were free of sediment (stilling wells were pumped during and after each irrigation)
   - Stilling well, delivery tubes, and fittings were secured in proper location and not leaking
   - Stilling well cap was secure and properly ventilated
   - Staff gage was secured in proper location
   - Canvas material was in proper location and not hindering flow through structure
   - Bottom of water-level sensor was resting on floor of stilling well
   - String was connected to water-level sensor cap and tied to stilling well

- Flow meters were recording instantaneous flow rate and totalized volume where applicable

3. The net water pressure (at the gauging location) was calculated by subtracting the recorded regional barometric pressure value and an elevation pressure correction from the absolute pressure value was obtained from the water level recorder in the structure for each five minute interval during the irrigation event. The net water level (at the staff gauge) was determined by converting the pressure values into water depth values and then subtracting an average of the calculated offsets (which were determined from the manual readings).

4. The net water level values were converted into flow rate values using the appropriate rating equations for each measurement structure for each five-minute interval. The volume of water passing through the measurement structure during each five-minute interval was determined by averaging the flow rate values at the start and end of the interval and multiplying them by the interval length. The total volume passing through

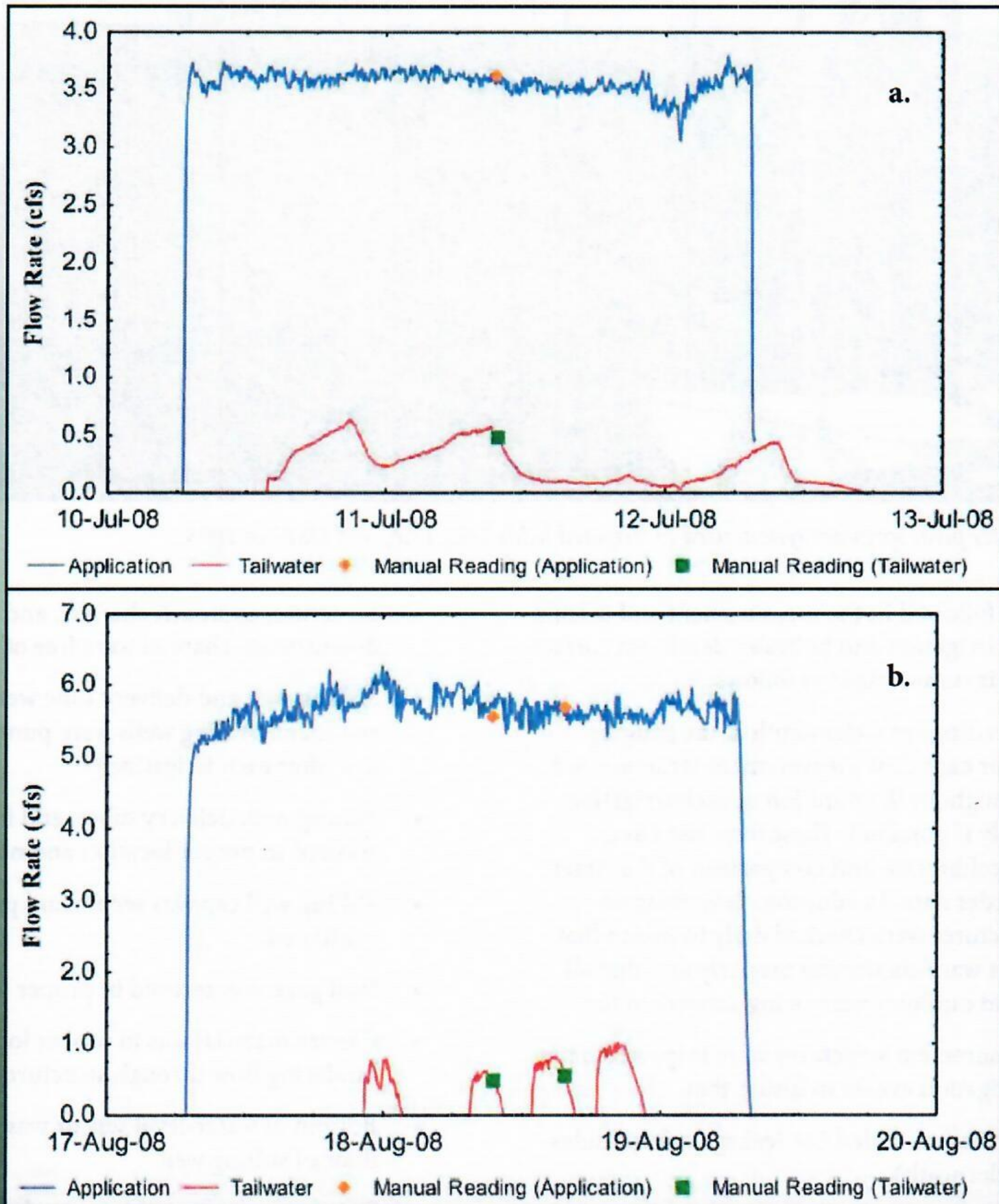


Figure 18. *Applied and tailwater hydrographs for (a) field US8, 10-12 July 2008 irrigation event, and (b) field DS2, 17-19 August 2008 irrigation event*

the structure during the irrigation event was determined by summing all of the five-minute volumes.

5. After the conclusion of an irrigation event, Garmin eTrex™ GPS units in conjunction with software from GPS Trackmaker® and ArcView® (from ESRI) were used to manually record irrigation boundaries and subsequently to calculate irrigated area values for each irrigation event. Garmin eTrex™ global positioning system (GPS) units have horizontal accuracy specifications of ± 9.8 ft (3m).
6. A hydrograph depicting applied irrigation flow rates and tailwater flow rates was generated for each irrigation event on each field. Figure 18 shows examples for fields US8 and DS2 for the 2008 season, including plots of manual readings.
7. Infiltrated irrigation depth was calculated as $Q_I = (Q_A - Q_{TW})$/Irrigated Area.
8. Tailwater fraction (TRF) = Q_{TW}/Q_A, was computed for each irrigation event and reported in units of percent.

The dates of the irrigation events measured on each of the fields reported herein are summarized in files on the ARIDAD.

Totalizing flow meters on center pivot sprinkler irrigation systems were read regularly during each irrigation event (daily if possible). Since significant tailwater runoff was not observed from any of the sprinkler-irrigated fields, no tailwater measurement structures were required. As with surface irrigation events, irrigated areas were calculated using GPS points taken around the irrigated boundaries following each irrigation event.

An additional component unique to the analysis of sprinkler–irrigated fields using water from canals was the need to estimate stabilization pond seepage losses using measured flow rate on inflow ditches, flow meter readings from pivots, local precipitation data, pond area measurements, and regional free water surface evaporation data. Two of these ponds are shown in Figure 19.

Figure 19. *Stabilization pond for center pivot sprinkler on field DS19 in 2008*

Precipitation

Rain gauges were installed at or near all monitored fields during the irrigation season. The rain gauges were equipped with a tipping bucket (HOBO™ RG2) and data logger (HOBO™ Event Data Logger) (Figure 20). Because of localized variability in precipitation during the summer months, one rain gauge was installed on or directly adjacent to each monitored field except in cases where several monitored fields were conglomerated in close proximity (less than one mile) to one another. In these cases, the rain gauge was installed at a central location between the fields. The rain gauges were calibrated prior to installation in the fields and were mounted on four inch diameter PVC pipe posts per manufacturer's recommendations. Special care was taken to ensure that rain gauges were not installed near vertical obstructions (e.g., trees, power poles, buildings) or near areas irrigated by sprinkler systems. They were maintained on a weekly basis by CSU personnel. Maintenance included inspection of electrical wiring from the rain gauge to the data logger, verification of battery life, and removal of dirt/debris from collection cone and tipping bucket. Batteries were replaced in data loggers once during the summer (typically in late July). In cases where rain gauge/data logger malfunction occurred, precipitation data were taken from another CSU rain gauge or CoAgMet station depending on which was in closer proximity. Rain gauges were removed from the field at the end of each monitored irrigation season.

Figure 20. *HOBO® rain gauge in Field US17E in 2008*

Data loggers on the rain gauges generally were downloaded mid-season (late July) and at the end of the season (mid-November) using HOBO® BoxCar 3.7 software on a laptop computer. Downloaded files were converted to Microsoft® Excel files with output containing precipitation depth over time (month, day, year, hour and minute). Analyses for daily and cumulative precipitation were carried out. Figure 21 displays a typical graph showing cumulative rainfall for a selected field US20 in 2005. For water balance analysis, total rainfall depth was computed over the selected period Δt and reduced using the SCS model described below to account for surface runoff to estimate Q_P.

To reduce total rainfall to effective infiltrated rainfall, Q_P, the SCS runoff model empirical method was used (USDA 1986). In this method, total rainfall is adjusted to account for three factors: soil water content, rainfall intensity, and rainfall amount. Soil water content is used to find a curve number (CN) that is in turn used to calculate the effective rainfall. The "average" CN used for the fields in this study area is 82; as found in tables of soil data provided in USDA (1986). The CN is adjusted based on the volume of water per unit area (depth), W_5, that has entered the system in the five days before a rainfall event by the following:

$$\mathrm{CN} = \begin{cases} 66 \text{ for } W_5 < 1.42 \text{ in} \\ 82 \text{ for } 1.42 \text{ in} < W_5 < 2.09 \text{ in} \\ 95 \text{ for } W_5 > 2.09 \text{ in} \end{cases}$$

Once a CN as been determined, the maximum soil retention volume per unit area (depth), S_R, can be calculated as follows:

$$S_R = 1000/\mathrm{CN} - 10 \qquad (3)$$

S_R represents the volume that the soil profile can receive before surface runoff occurs.

To calculate the volume of precipitation runoff per unit area (depth), Q_R, caused by a rainfall event the following equation is used:

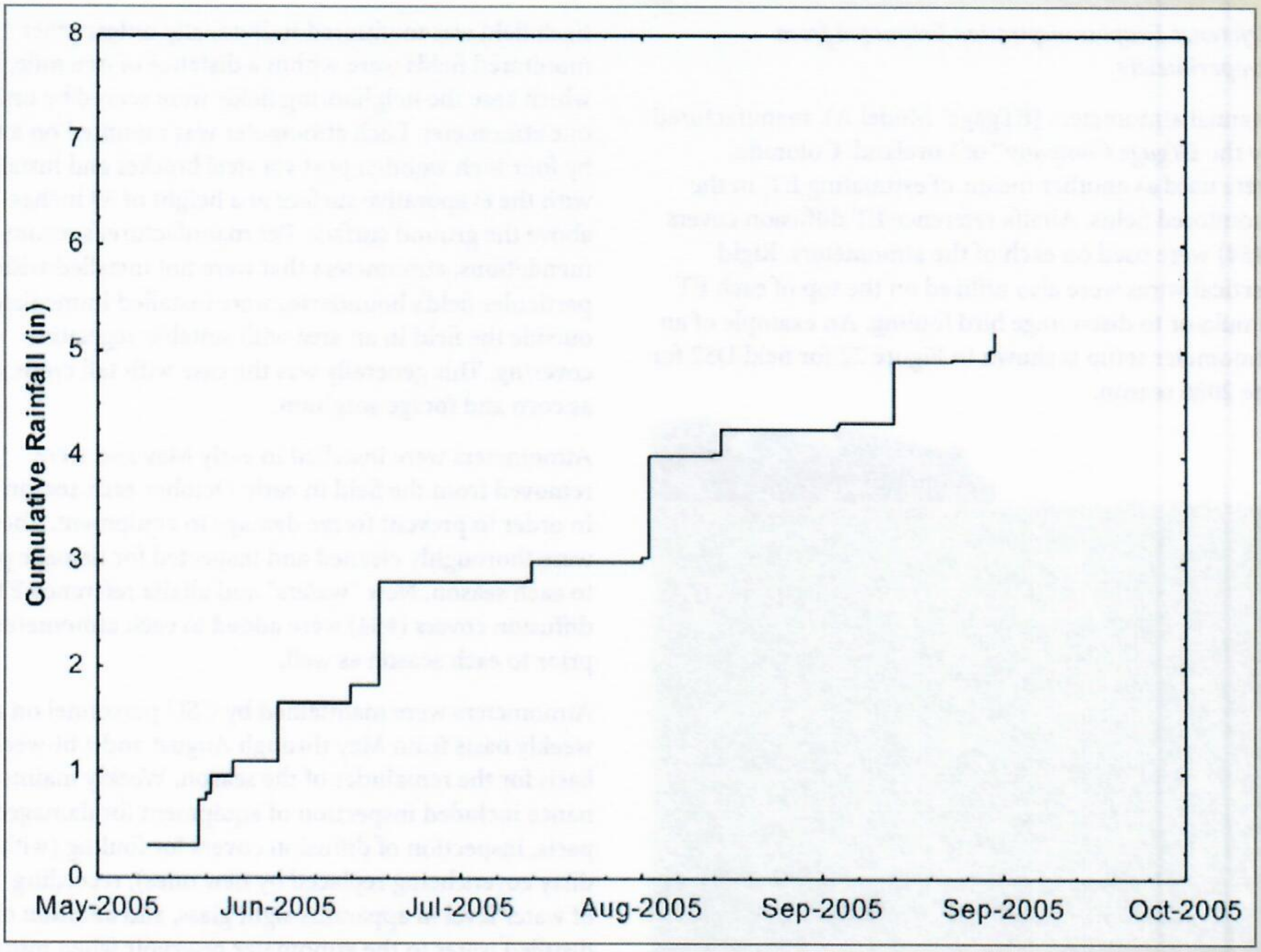


Figure 21. *Cumulative precipitation for field US20 during the 2005 irrigation season*

$$Q_R = \begin{cases} \dfrac{(Q_{PT} - 0.2S_R)^2}{(Q_{PT} + 0.8S_R)} \; for \; Q_{PT} > 0.2S_R \\ 0 \; for \; Q_{PT} \leq 0.2S_R \end{cases} \tag{4}$$

wherein Q_{PT} is the total depth (in inches) of the rainfall event. Once Q_R has been calculated the effective rainfall (Q_P) can be calculated as follows:

$$Q_P = Q_{PT} - Q_R \tag{5}$$

Evapotranspiration

Reference Evapotranspiration Calculated from ASCE Standardized Equation

The ASCE Standardized Reference Evapotranspiration Equation is based on a combination equation which combines an energy component and an advection component. The methodology depends upon net solar radiation, soil heat flux density, mean daily air temperature, mean daily wind speed, saturation vapor pressure, mean actual vapor pressure as well as other physical parameters, and is described in detail in Allen et al (2005). The ET calculated by the ASCE equation for each crop is based on the ET of a long reference crop, referred to as ET_r. In this study alfalfa was used as the long reference crop. The ET of a particular crop at a particular time is then calculated as a fraction of the ET_r at that time. If the crop is healthy, well-watered, and not adversely affected by salinity or other hazards, this fraction of the ET_r may be assumed to be a function of the growth stage of the crop and is called the crop coefficient, k_c. Since the growth stage of a crop changes throughout the growing season the k_c value changes as well. This variation of k_c with time usually can be represented by a linear equation or a third-order polynomial depending on the growth stage. The potential crop ET at a particular time is calculated as $ET_p = k_c ET_r$.

Exhibit M

Reference Evapotranspiration Estimated from Evaporimeters

Manual atmometers (ETgage® Model A), manufactured by the *ETgage Company*™ of Loveland, Colorado, were used as another means of estimating ET_r in the monitored fields. Alfalfa reference ET diffusion covers (#54) were used on each of the atmometers. Rigid vertical wires were also utilized on the top of each ET simulator to discourage bird fouling. An example of an atmometer setup is shown in Figure 22 for field DS2 for the 2006 season.

Each field was monitored individually unless other monitored fields were within a distance of one mile, in which case the neighboring fields were served by only one atmometer. Each atmometer was mounted on a two by four inch wooden post via steel bracket and installed with the evaporative surface at a height of 39 inches above the ground surface. Per manufacturer's recommendations, atmometers that were not installed within a particular field's boundaries were installed immediately outside the field in an area with suitable vegetative covering. This generally was the case with tall crops such as corn and forage sorghum.

Atmometers were installed in early May and were removed from the field in early October each season in order to prevent freeze damage to equipment. They were thoroughly cleaned and inspected for damage prior to each season. New "wafers" and alfalfa reference ET diffusion covers (#54) were added to each atmometer prior to each season as well.

Atmometers were maintained by CSU personnel on a weekly basis from May through August and a bi-weekly basis for the remainder of the season. Weekly maintenance included inspection of equipment for damaged parts, inspection of diffusion covers for fouling (with dirty covers being replaced by new ones), recording of water level in apparatus sight glass, and addition of distilled water to the atmometer reservoir when more than 2/3 empty. Damage to atmometers was rare but occasionally sight tubes were damaged by large hail or ceramic cups were cracked from freezing temperatures. In cases where atmometer equipment damage occurred, ET_r data were taken from the closest CSU atmometer.

Recorded atmometer data included water level in the sight glass as well as time (month, day, year, hour and minute). Values of total ET_r between readings were estimated as the difference between the recorded water levels.

Actual Evapotranspiration Estimated from Remote Sensing

Daily average values of actual ET (ET_a) over the study regions were estimated using the ReSET land surface energy balance model (Elhaddad and Garcia 2008) to process available satellite images of the study regions.

Figure 22. *ETgage® Model A atmometer in field DS2 during the 2006 season*

Summing up values of ET_a over a study period Δt, and multiplying by the area of an irrigated field provided an estimate of Q_{ET} for use in the field water balance. The ReSET model is built on the same theoretical basis of its two predecessors, METRIC (Allen et al. 2007 a.b) and SEBAL (Bastiaanssen et al 1998 a,b) with the additional ability to handle data from multiple weather stations. This enhances regional ET_a estimates by taking into consideration the spatial variability of weather conditions through data acquired from different weather stations (across the area covered by the remote sensing system/imagery). ReSET can be used in both the calibrated and the un-calibrated modes. The calibrated mode is similar to METRIC in which ET_r calculated from weather station data is used to set the maximum ET_a value in the processed area, while in the un-calibrated mode the model follows a procedure similar to SEBAL where no maximum ET_a value is imposed.

Satellite images from the Landsat 5 or Landsat 7 satellites were used in this study. Multispectral images including the visible (bands 1-3), infrared (bands 4, 5, and 7), and thermal (band 6) ranges of spectrum are captured by these satellites. All bands have a linear spatial resolution of 30 m except for the thermal band. The thermal band has a 120 m resolution for Landsat 5 and a 60 m for Landsat 7. Images of the two study regions are captured every 16 days by these satellites. The cycles of the two satellites are offset by eight days for an image over a given region, and are offset by nine days between the two regions. When clouds occur over the monitored field sites or extensively throughout the regions, satellite images cannot be used to estimate ET_a. Images processed by the ReSET method yielded estimated patterns of ET_a at a 30 m × 30 m resolution. It has been estimated that ReSET and similar methods produce daily average values on the satellite date with errors on the order of 5-15 percent (Bastiaanssen et al. 1998a, Elhaddad and Garcia 2008).

For a given instant of time, the land surface energy balance equation can be written as:

$$R_{n,i} = L_v \rho_w ET_i + H_i + G_i \qquad (6)$$

wherein $R_{n,i}$ is the net radiation, L_v is the latent heat of vaporization, ρ_w is the density of water, ET_i is the instantaneous actual ET, H_i is the sensible heat flux, and G_i is the heat conduction to the ground (the subscript i denotes instantaneous values). The value of $R_{n,i}$ is computed from the surface albedo, surface temperature, digital elevation models, normalized difference vegetation index (NDVI), and surface roughness using the method developed by Bastiaanssen (2000). The visible bands (1, 2, and 3) and infrared bands (4, 5, and 7) are used to compute the surface albedo, and surface temperature is calculated from band 6. NDVI is calculated from bands 3 and 4, and G_i is computed using NDVI, albedo, surface temperature, and the sensible heat flux. H_i is calculated by selecting and processing "wet" and "dry" pixels within the satellite image. A "wet" pixel is one where ET_i occurs at the atmospheric requirement, implying that $H_i = 0$. A "dry" pixel occurs where ET_i is assumed to be zero, so that $H_i = R_{n,i} - G_i$. Once the wet and dry H_i values are known, the values for H_i at other pixels within the satellite image can be calculated.

After values of $R_{n,i}$, G_i, and H_i have been estimated, Eq. (6) is used to calculate the latent heat flux ($L_v \rho_w ET_i$) (Bastiaanssen et al. 1998). The following equation is then used to compute the instantaneous evaporative fraction (Λ_i):

$$\Lambda_i = \frac{L_v \rho_w ET_i}{L_v \rho_w ET_i + H_i} = \frac{L_v \rho_w ET_i}{R_{n,i} - G_i} \qquad (7)$$

The daily average value of is computed through the following equation, assuming that ET_a remains constant throughout the entire day:

$$ET_a = \frac{86,400 \Lambda_i R_n}{L_v \rho_w} \qquad (8)$$

The value of R_n in this equation is the 24-hour net radiation, which can be estimated using the approach of Duffie and Beckman (1991), and 86,400 is the time conversion from one second to 24 hours. It is assumed in Eq. (8) that the net soil heat flux over the 24-hr period is zero.

An additional adjustment to the seasonal ET_a calculated with ReSET for alfalfa fields was implemented for this study to account for alfalfa cutting. The ReSET model generates a seasonal ET_a value by interpolating between Landsat image dates using a ratio based on ET_r and the ReSET ET_a at the date of the two Landsat images that bound a period and the ET_r values for each day between the Landsat image dates. As part of the current project, alfalfa cutting dates were collected. In order to improve the seasonal ReSET ET_a estimates an additional adjustment was implemented to account for the alfalfa cuttings. To model the effect of cutting on ET_a the following equation was used:

$$ET_a = k_c ET_r$$

Exhibit M

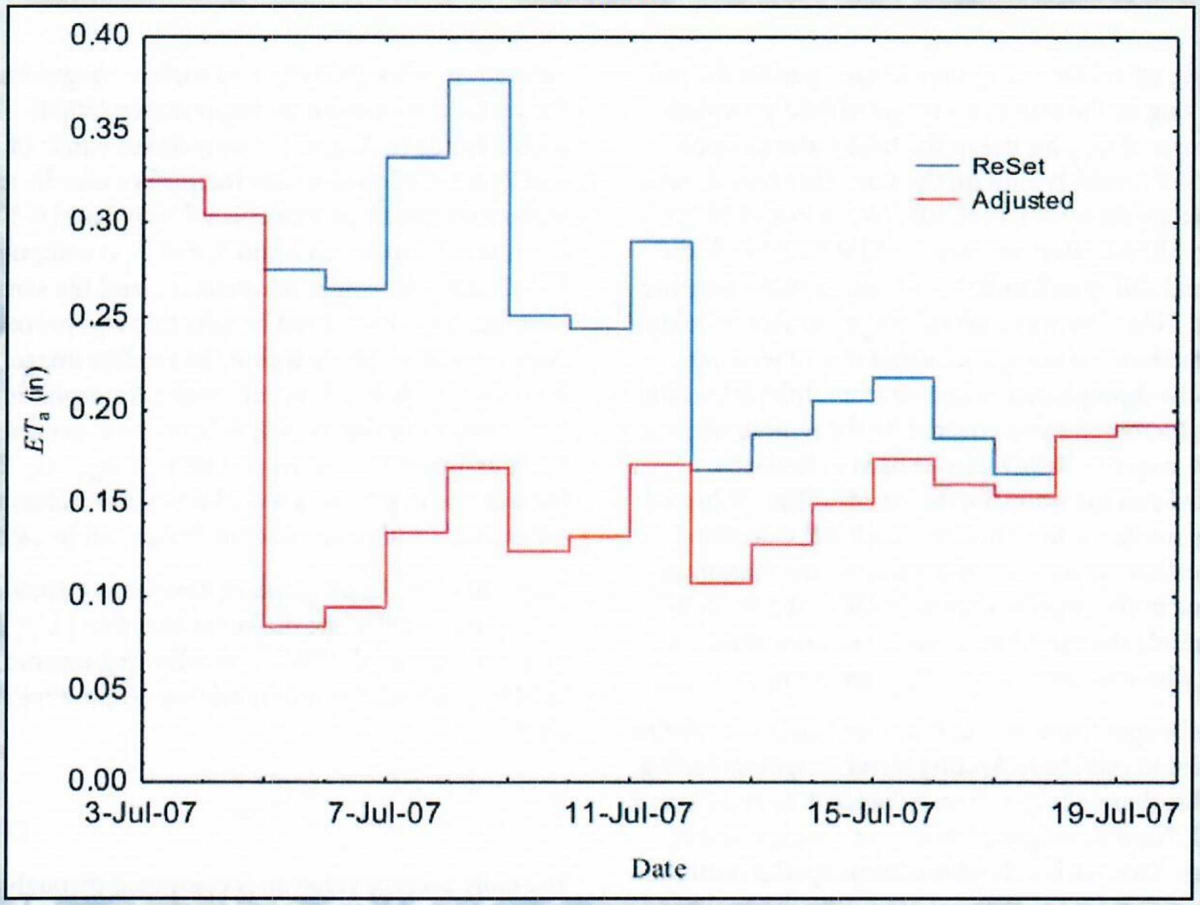


Figure 23. *Alfalfa ET_a adjusted for cutting compared to ReSET ET_a*

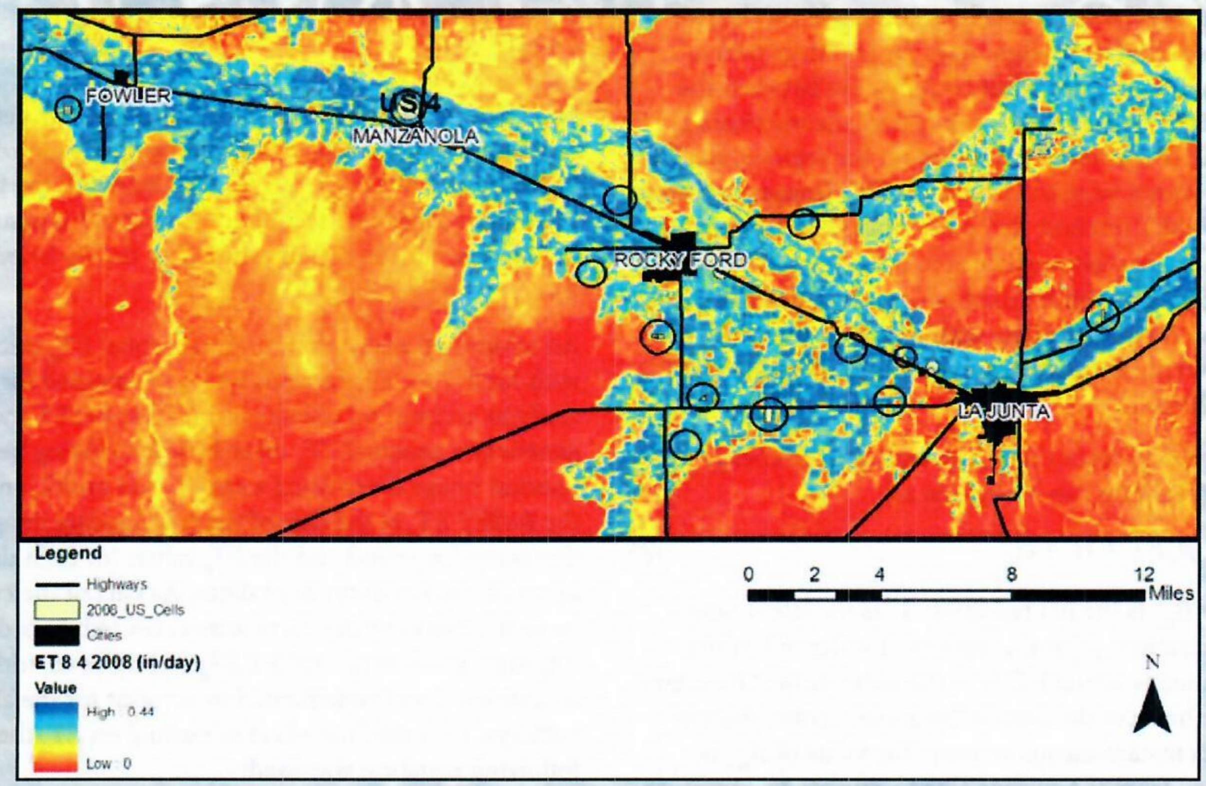


Figure 24. *ReSET-calculated ET_a in the Upstream Study Region on 4 August 2008 with study fields circled*

Where k_c is the crop coefficient. k_c for alfalfa just after cutting was assumed as 0.3 and was increased linearly until the next Landsat image date to simulate crop growth. Additional investigation is being conducted to determine the best procedure to account for alfalfa cutting dates in the seasonal ReSET ET_a estimate.

An example raster image of ReSET-calculated values of ET_a at 30 m × 30 m resolution is shown in Figure 24 for the Upstream Study Region for 19 July 2008. Figure 25 illustrates a close-up of field US4 within this image, illustrating the variability of ET_a within the field. A similar image for 28 July 2008 is shown in Figure 26 for the Downstream Study Region. A close-up view of fields DS8 and DS15 within this image is presented in Figure 27. Values of ET_a were averaged over the pixels within each monitored field cell to obtain estimates for use within the field water balance calculations.

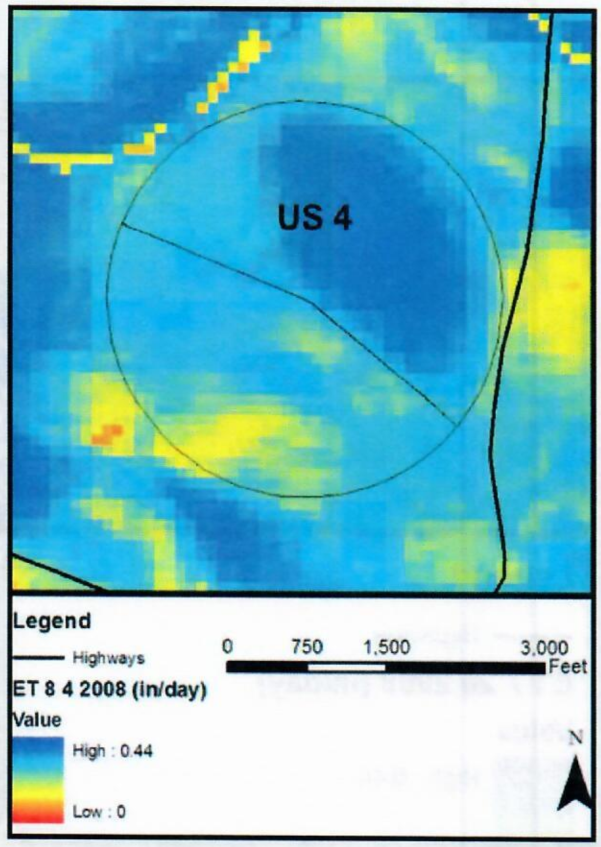


Figure 25. *ReSET-calculated ET_a in vicinity of field US4 on 4 August 2008*

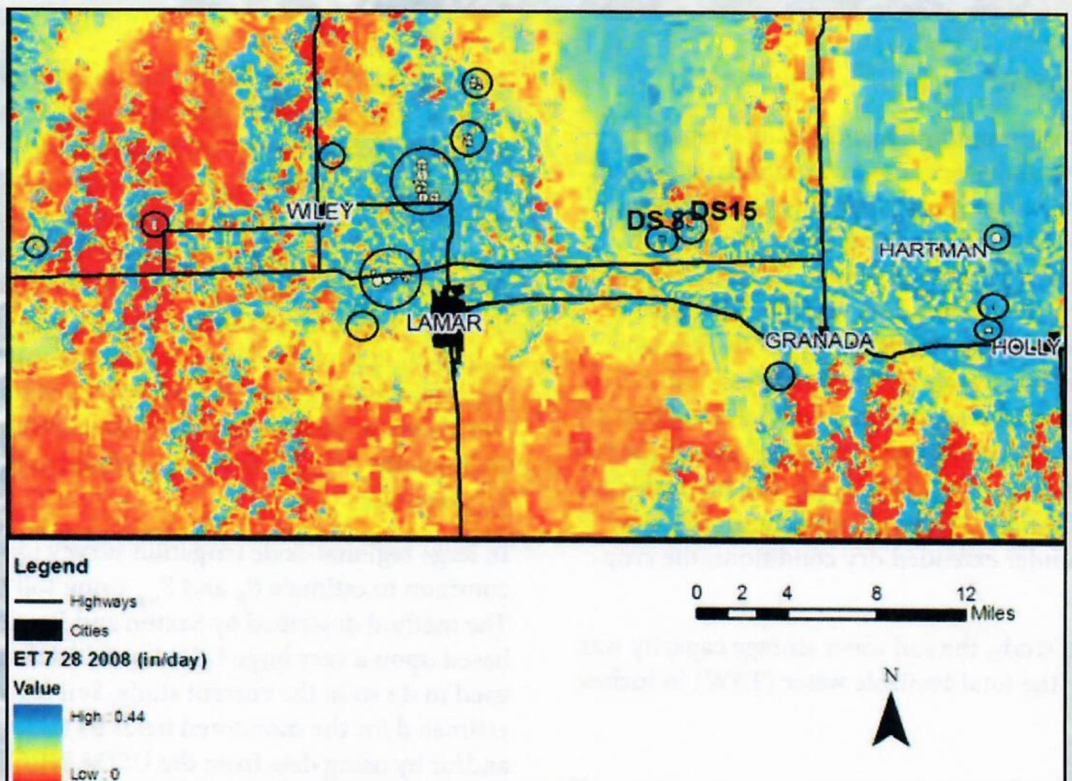


Figure 26. *ReSET-calculated ET_a in the Downstream Study Region on 28 July 2008 with study fields circled*

Exhibit M

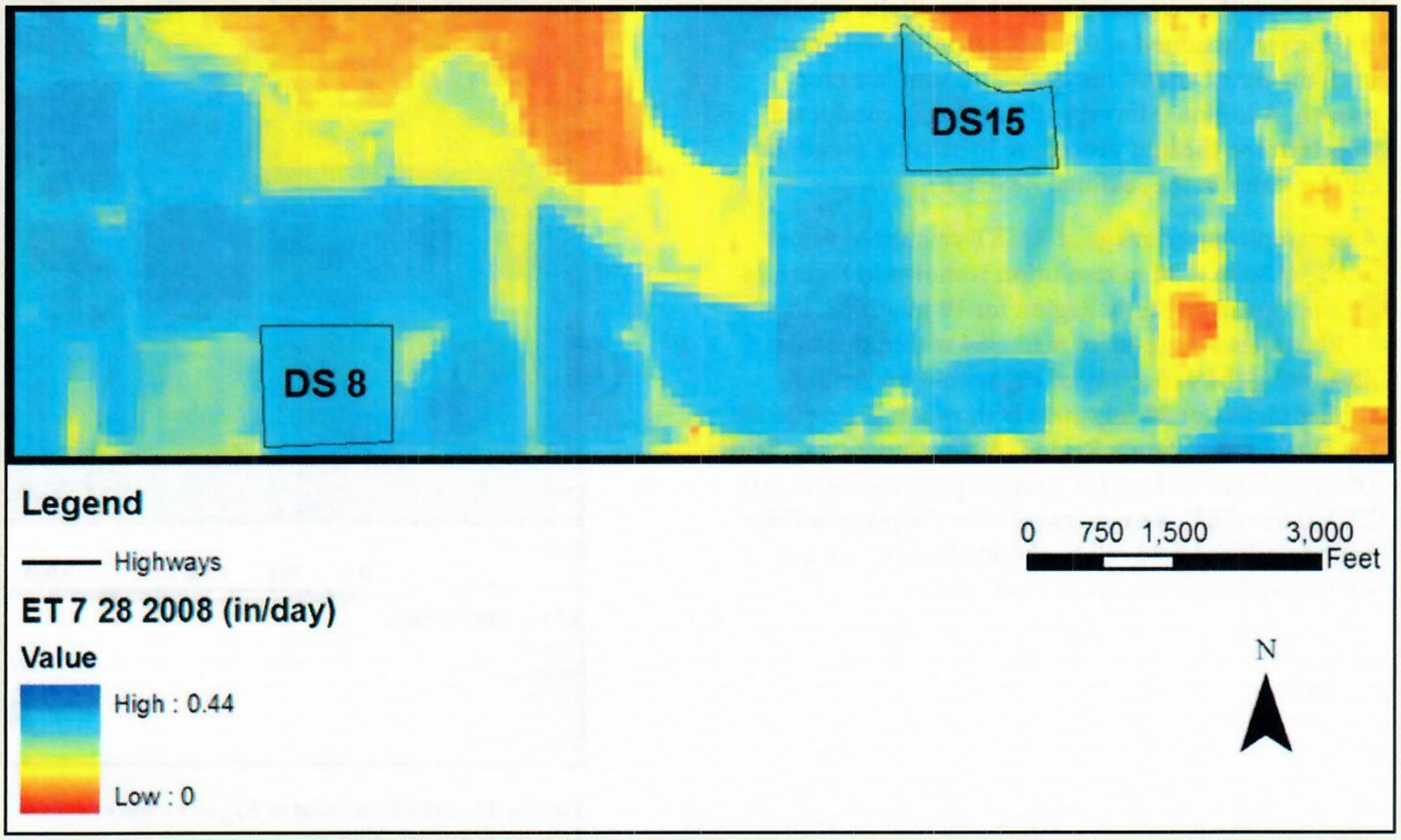


Figure 27. *ReSET-calculated ET_a in vicinity of fields DS8 and DS15 on 28 July 2008*

Soil Water Storage

One of the most important properties in evaluating irrigation water balance components and application efficiency is the water storage capacity of the soil root zone. When infiltrated irrigation water exceeds the soil water storage capacity at a given location in a field, excess water will percolate downward below the root zone as Q_{DP} and move toward the groundwater table. Between irrigation events the root zone soil water content will vary in response to ET, Q_P, and Q_U but is assumed to be limited by the storage capacity. If the soil water content drops too low, the crop will be unable to transpire sufficient water, crop growth and yield may decline and, under extended dry conditions, the crop will perish.

In the current study, the soil water storage capacity was defined using the total available water (TAW) in inches:

$$\mathrm{TAW} = D_{rz}\,(\theta_{fc} - \theta_{wp}) \qquad (9)$$

wherein D_{rz} = depth of soil root zone below ground surface, θ_{fc} = soil-water content at -⅓ bar matric potential (field capacity) expressed as a fraction of the bulk soil volume, and θ_{wp} = soil-water content at -15 bar matric potential (permanent wilting point) expressed as a fraction of the bulk soil volume. The actual stored volume of soil water (S_{SW}) at any given time, expressed in inches (volume per unit field area), was defined as $S_{SW} = D_{rz}\,\theta$ wherein θ = the actual soil water content, expressed as a fraction of the bulk soil volume. In calculating a water balance for a field over a time period Δt, the term ΔS_{SW} in Eq. (1) is defined as the change in S_{SW} over Δt.

In large regional-scale irrigation survey projects, it is common to estimate θ_{fc} and θ_{wp} using soil texture data. The method described by Saxton and Rawls (2006), based upon a very large USDA soils database, was used to do so in the current study. Soil textures were estimated for the monitored fields by taking soil samples and/or by using data from the USDA NRCS Soil Survey.

Estimation of Soil Texture from Field Samples

Samples for soil texture were gathered from six locations within each of about 44 of the monitored fields in 2008. The following procedure was used to determine the sample locations within a given field:

1. The USDA-NRCS Soil Survey Geographic (SSURGO) Database was used to create an "Area of Interest" (AOI) for each monitored field (USDA 2010). The subsequent soil map was used to determine the locations of soil samples collected on each field.
2. For fields with one primary soil type, samples were collected at locations near the midpoints of six sections of similar size within the field.
3. For fields with multiple soil types, soil sampling locations were distributed based generally upon a spatially weighted average of primary soil types within the field. For example, if a particular field contained two primary soil types (e.g., RoB, RoC) with soil type RoB comprising two-thirds of the field area and RoC comprising one-third of the field area, four soil samples were collected from within the RoB area and two soil samples were collected from within the RoC area.
4. For fields consisting of more than six primary soil types, soil samples were collected from the six soil type areas comprising the largest proportion of the total field area.
5. Soil types comprising less than 10 percent of the total field area generally were not sampled.

At each sampling location within a field the following procedure was used to collect soil samples for textural analysis:

1. The soil surface at each location was cleared of crop residue by hand or with a spade.
2. A Stihl® gas-powered earth auger (Figure 28) with an 18 inch by 1.5 inch diameter auger and two 18 inch extensions were utilized to bore to a depth of approximately 48 inches at each location. The auger generally was pulled from the hole five times per location to either remove soil from the auger flighting or to add extensions to the auger.
3. All soil augered to the ground surface (approximately 500 grams per location) was collected by hand or using a small spade and placed in a plastic double-lock freezer bag.

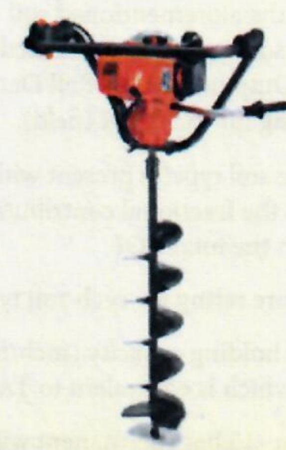


Figure 28. *Stihl® gas-powered earth auger used for soil sampling*

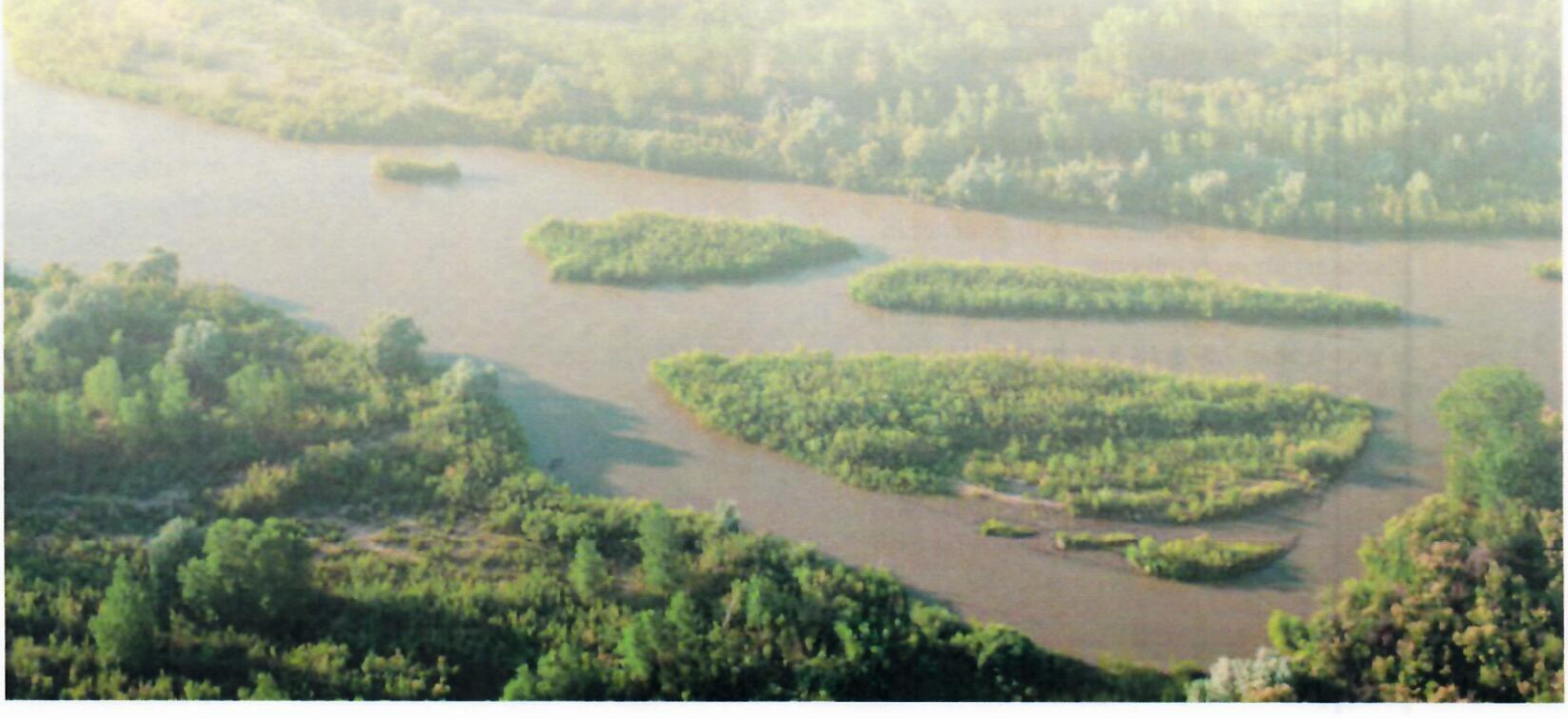


Exhibit M

The hydrometer method of mechanical analysis was used in the soils laboratory at CSU to determine the fraction of clay, silt, and sand for each soil sample (Klute 1986). Soil texture classification then was determined based upon these relative fractions.

Estimation of Soil Texture from NRCS Soil Survey

Data from the USDA-NRCS Soil Survey Geographic (SSURGO) Database, using the Soil Data Mart web-based application, were extracted for each monitored field. These data include estimated soil texture, θ_{fc}, θ_{wp}, available water holding capacity (in inches of water per ft of soil), and bulk density.

Through the Soil Data Mart web-based application, satellite imagery of each field was overlain with a field boundary map to create an area of interest (AOI). For this AOI, weighted representative averages for each of the aforementioned soil properties and each soil type were calculated to a depth of 48 inches. Output from the Soil Data Mart included the following for each AOI (field):

- Summary of the soil type(s) present within the AOI (field) and the fractional contribution of each soil type to the total AOI
- USDA soil texture rating for each soil type
- Available water holding capacity (inch/inch) for each soil type, which is equivalent to TAW/D_{rz}
- Water content at -15 bar (permanent wilting point) expressed as percent of total volume at saturation for each soil type
- Water content at -⅓ bar (or field capacity) expressed as percent of total volume at saturation for each soil type
- Bulk density at -⅓ bar for each soil type
- Clay content (percent by weight of the soil material that is less than 7.87 x 10-5 inches in diameter) for each soil type
- Silt (percent by weight of the soil material that is greater than 7.87 x 10-5 inches and less than 1.97 x 10-3 inches in diameter) for each soil type
- Sand content (percent by weight of the soil material that is greater than 1.97 x 10-3 inches and less than 0.08 inches in diameter) for each soil type

Estimation of Average TAW

For fields in which soil samples were gathered, the models developed by Saxton and Rawls (2006) were used to estimate θ_{fc}, θ_{wp}, and other soil properties for each sample based upon texture. An average value of TAW was estimated for each monitored field using the values computed for all soil samples collected in each field.

Average soil water properties also were calculated for each monitored field using the data extracted from the USDA-NRCS Soil Survey Geographic (SSURGO) Database through the Soil Data Mart application. Average values for each soil property for each field then were calculated as weighted averages based upon the fractional contribution of each soil type to the total AOI.

Estimation of Soil Water Content

Estimation of average S_{SW} over areas encompassing several acres, where textural and structural characteristics often vary substantially, is a very difficult and expensive task. A large number of samples, across the areal extent of the field and with depth, usually are required for an accurate estimate at any given time. Such an effort was beyond the scope of this project; however, limited sampling of the monitored irrigated fields was conducted periodically over the course of the study. Typically, soil samples were collected in conjunction with soil salinity surveys that were conducted on each monitored field two to three times during each irrigation season. The methodology is described in a sequel section entitled "Soil Water Salinity and Soil Water Content Surveys".

Upflux from Shallow Groundwater

Shallow groundwater tables can provide substantial upflux of water to the root zone of crops (Ayars et al 2006, Grismer and Gates 1988). The rate of upflux depends upon the ET rate, soil characteristics, soil water content, crop root characteristics, and depth to the water table. Following Liu et al (2006), the rate of upflux, q_u (mm/day), from a shallow water table to the root zone of an irrigated field was estimated as:

$$q_u = \begin{cases} q_{u_{max}}(D_{wt}, ET_p) \ \text{if} \ S_{SW} < S_{SW_s}(D_{wt}) \\ q_{u_{max}}(D_{wt}, ET_p)\left(\dfrac{S_{SW_c}(D_{wt}) - S_{SW}}{S_{SW_c}(D_{wt}) - S_{SW_s}(D_{wt})}\right) \ \text{if} \ S_{SW_s}(D_{wt}) \le S_{SW} \le S_{SW_c}(D_{wt}) \\ 0 \ \text{if} \ S_{SW} > S_{SW_c}(D_{wt}) \end{cases} \tag{10}$$

wherein $q_{u_{max}}(D_{wt}, ET_p)$ is the maximum potential groundwater upflux rate (mm/day) and is a function of D_{wt} and ET_p, D_{wt} is the average water table depth (m) for the current time step, ET_p is the daily average potential crop evapotranspiration (ET) rate (mm/day) for the given crop and the current time step, S_{SW} is the average soil water content (mm) for the preceding time step, $S_{SW_s}(D_{wt})$ is the steady soil water content (mm) and is a function of D_{wt}, and $S_{SW_c}(D_{wt})$ is the critical soil water content at which upflux is initiated and is a function of D_{wt}. Note that variable names used herein are different than those used in Liu et al (2006). Values of q_u can be integrated over a selected time period Δt to obtain Q_U for water balance analysis.

In the current study, the value of $q_{u_{max}}$ in Eq. (10) was modeled as a function of D_{wt} and ET_a computed by ReSET:

$$q_{u_{max}}(D_{wt}, ET_p) = \begin{cases} ET_a \text{ if } D_{wt} < D_{wt_c} \\ a_1 D_{wt}^{b_1} \text{ if } D_{wt} > D_{wt_c} \end{cases} \quad (11)$$

wherein a_1 and b_1 are empirical parameters that depend upon soil texture, as presented in Table 7.

The critical water table depth, D_{wt_c}, may be estimated as the following linear function of ET_p:

$$D_{wt_c} = \begin{cases} a_2 ET_p + b_2 \text{ if } ET_p \le 4\ mm/day\ [0.157\ in/day] \\ 1.4 \text{ if } ET_p > 4\ mm/day\ [0.157\ in/day] \end{cases} \quad (12)$$

The value of S_{SW_S} depends upon D_{wt} and the water content in the root zone at wilting point, $S_{SW_{WP}}$ (mm), and may be estimated from:

$$S_{SW_S}(D_{wt}) = \begin{cases} a_3 D_{wt}^{b_3} \text{ if } D_{wt} \le 3m\ [9.84\ ft] \\ S_{SW_{WP}} \text{ if } D_{wt} > 3m\ [9.84\ ft] \end{cases} \quad (13)$$

Liu et al (2006) indicate that the parameter a_3 may be estimated as equal to $1.1(S_{SW_{FC}} + S_{SW_{WP}})/2$ where $S_{SW_{FC}}$ (mm) is the water content in the root zone at field capacity and $S_{SW_{WP}}$ (mm) is the water content at wilting point. The value of the parameter b_3 depends upon soil texture, as presented in Table 7.

Similarly, S_{SW_c} depends upon D_{wt} and may be estimated from:

$$S_{SW_c}(D_{wt}) = a_4 D_{wt}^{b_4} \quad (14)$$

Liu et al (2006) indicate that the parameter a_4 may be estimated as the value of $S_{SW_{FC}}$ for the given root zone depth. The value of the parameter b_4 depends upon soil texture, as presented in Table 7.

Infiltration Uniformity

During a typical surface irrigation event, water is introduced at the head end of the field where it begins its advance over the length of the field toward the tail end. At the tail end of the field, water ponds if the field is diked, or exits the field as tailwater runoff if the field is not diked. The surface flow finally recedes after the inflow at the head is cut off. The depth of infiltrated irrigation water at any point along the length of the field is directly related to the length of time that irrigation water is in contact with the soil surface and the soil infiltration properties at that location. This duration of time commonly is referred to as the intake opportunity time (τ) (Figure 29). Mathematically, τ is defined as the difference between the time of recession and the time of advance for any given point along the length of the field. At a given location, infiltration generally decreases from a maximum rate at the beginning of the infiltration process to a constant rate as the intake opportunity time increases. This constant rate of infiltration is called the steady-state (or basic) infiltration rate. In some cases, the duration of an irrigation event may not be long enough for the basic infiltration rate to be reached. A model commonly used to predict infiltration is the modified Kostiakov-Lewis equation:

$$z = k\tau^a + f_0\tau \quad (15)$$

wherein z = infiltration depth (inches), τ = intake opportunity time (minutes), f_0 = steady-state infiltration rate (inches/minute), and k, a = empirical coefficients (Elliott and Walker 1982).

Steady-state infiltration rate can be determined by 1) conducting infiltration tests in the field immediately prior to the irrigation, 2) subtracting the tailwater runoff flow rate from the inflow (applied irrigation) rate just prior to shutoff of inflow (assuming that the tailwater runoff flow rate has reached a relatively constant value), or 3) referencing published infiltration data based upon the soil type of the field. Using the inflow and tailwater hydrographs from the irrigation itself generally is considered the most accurate method of determining f_0 but only if the duration of the irrigation is long enough for the tailwater flow rate to reach a constant value. The coefficients k and a can be determined by 1) referencing published data based upon general soil characteristics in the field, 2) solving irrigation mass balance equations simultaneously for two points along the field length using field data for advance time, application rate, and f_0, as well as assumed values for subsurface flow shape

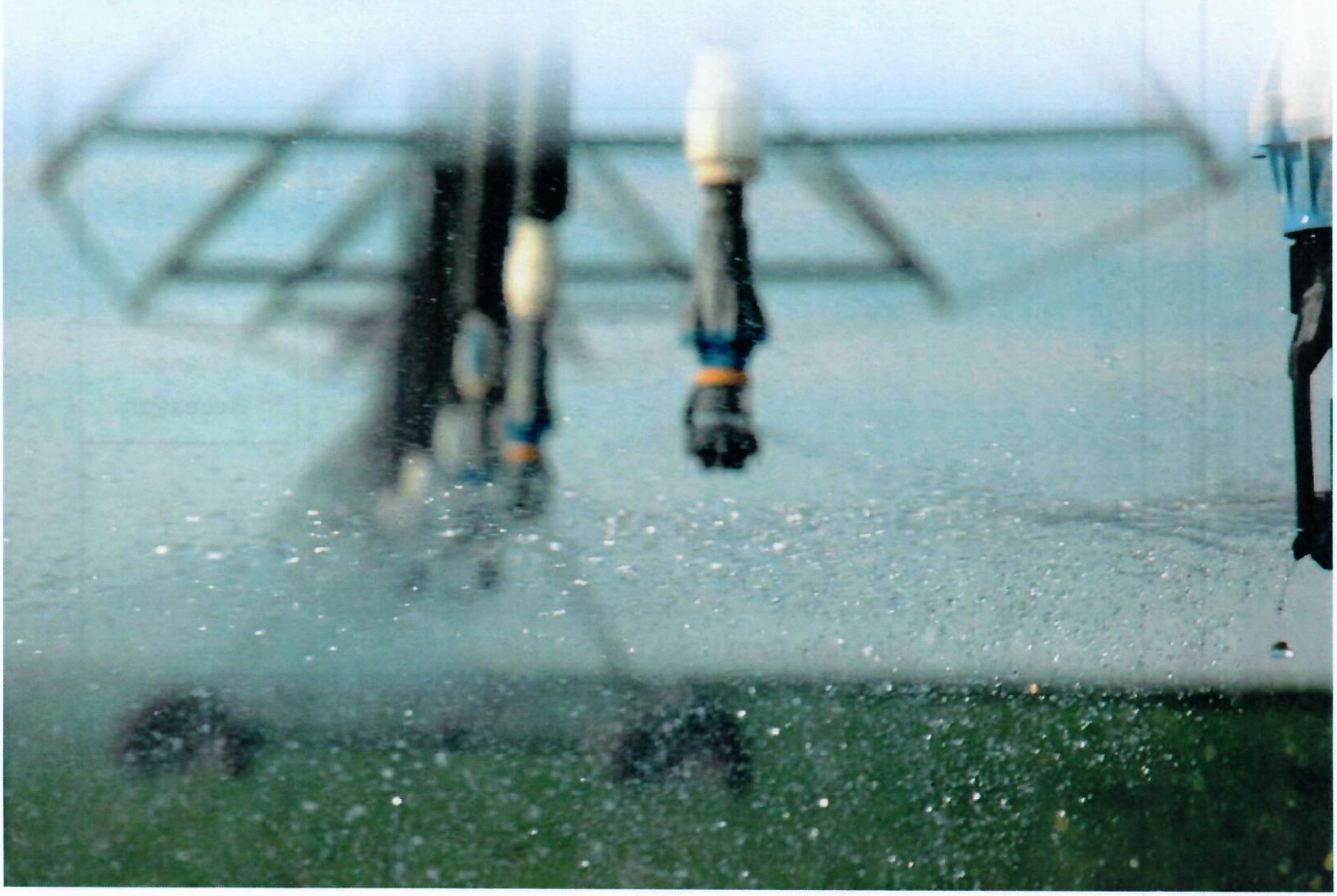
Table 7. *Parameter values for use in estimating q_u for three different soil textures (Liu et al., 2006)*

Parameter	Value for Silt Loam Soil	Value for Sandy Loam Soil	Value for Clay Loam Soil
a_1	4.6	7.55	1.11
b_1	-0.65	-2.03	-0.98
a_2	-1.3	-0.15	-1.4
b_2	6.6	2.1	6.8
b_3	-0.27	-0.54	-0.16
b_4	-0.17	-0.16	-0.32

and Manning's roughness coefficient, or 3) using an optimization algorithm that calibrates k and a values by minimizing the difference between measured parameters (such as advance time, tailwater hydrograph points, and recession times) and simulated parameters (found through solving equations of mass conservation and momentum conservation) (this method also can be used to solve for f_0) (Walker 2005). After measuring advance and recession times along the length of the field and determining k, a, and f_0, the infiltrated depth then can be calculated for any point along the length of the field.

The time, personnel, equipment, and financial requirements associated with collecting and analyzing field data for determining the parameters k, a, and f_0 for use in the Modified Kostiakov equation were infeasible for a large-scale study of this type. Instead, a more simplified approach was followed in which infiltration depth was considered to approximate a linear function of intake opportunity time.

The validity of the linear infiltration assumption was tested by comparing results from the SIRMOD® model of



surface irrigation which uses an optimization algorithm (Walker 2003) for seven closely monitored corn furrows in 2004. After comparison it was concluded that the most accurate application of the linear approximation was for irrigation events where set cutoff times, advance times, and recession times trended toward lower values. As these times increased, the accuracy in infiltrated depths near the head end of the field and near the tail end of the field decreased when modeled using a linear approximation. Based upon the scope of the current study and the infeasibility of calibrating empirical coefficients based upon measured data, the linear infiltration approximation was deemed suitable to meet the study objectives. However some sensitivity analysis was done and is presented in a section below.

The procedure for calculating infiltrated depths across surface-irrigated subfields is described below:

1. The following data for each irrigation event were entered into an Excel® spreadsheet:
   - Irrigation event start time (month, day, year, hour, minute)
   - Irrigation event end time (month, day, year, hour, minute)
   - Net applied volume (total diverted volume minus transit losses and pond losses where applicable)
   - Net tailwater runoff (total tailwater runoff volume minus transit losses where applicable)
   - Number of irrigation sets completed during the irrigation event [This value was (i) based upon examination of the tailwater runoff hydrograph when tailwater loss occurred, or (ii) calculated by dividing the total irrigated area width by generalized set widths when no tailwater loss occurred]
   - General advance time to tail end of field for each set [This value was (i) based upon examination of the tailwater hydrograph when tailwater loss occurred, or (ii) calculated as the sum of the average set cutoff time, which was calculated by dividing the irrigation duration by the number of completed sets, and the average

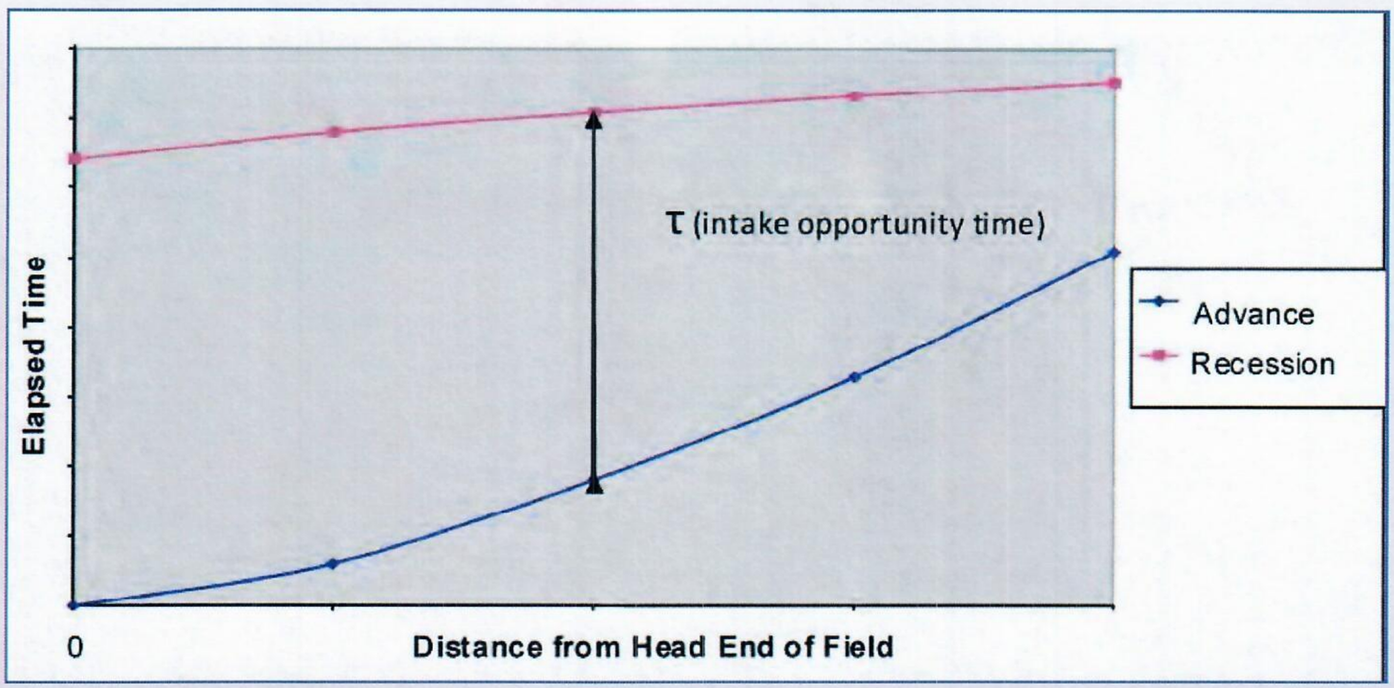


Figure 29. *Example plots of time of advance and time of recession of an irrigation stream along a field and the intake opportunity time*

recession time when no tailwater loss occurred. This calculation assumes that the advancing water front just reaches the tail end of the field, without creating tailwater runoff, before receding because of cutoff].

- Area irrigated during irrigation event
- Cells (subfields) irrigated during irrigation event
- General set width estimation
- Average recession time to bottom end of field (This value was based upon field length. The range of average recession times across all monitored fields was 20 minutes to 60 minutes based upon observations from CSU personnel).

2. The following parameters were calculated for the irrigation event assuming a linear infiltration depth function from the head end to the tail end of the field, lateral uniformity across the irrigated area, and linear advance and recession from the head to the tail end of the field (Figure 30):

- Average intake opportunity time at head end of field (τ_0)
- Average intake opportunity time at ⅓ of field length ($\tau_{L/3}$)
- Average intake opportunity time at ⅔ of field length ($\tau_{2L/3}$)
- Average intake opportunity time at tail end of field (τ_L)
- Infiltrated depth at field head end (z_0)
- Infiltrated depth at ⅓ of field length ($z_{L/3}$)
- Infiltrated depth at ⅔ of field length ($z_{2L/3}$)
- Infiltrated depth at tail end of field (z_L)

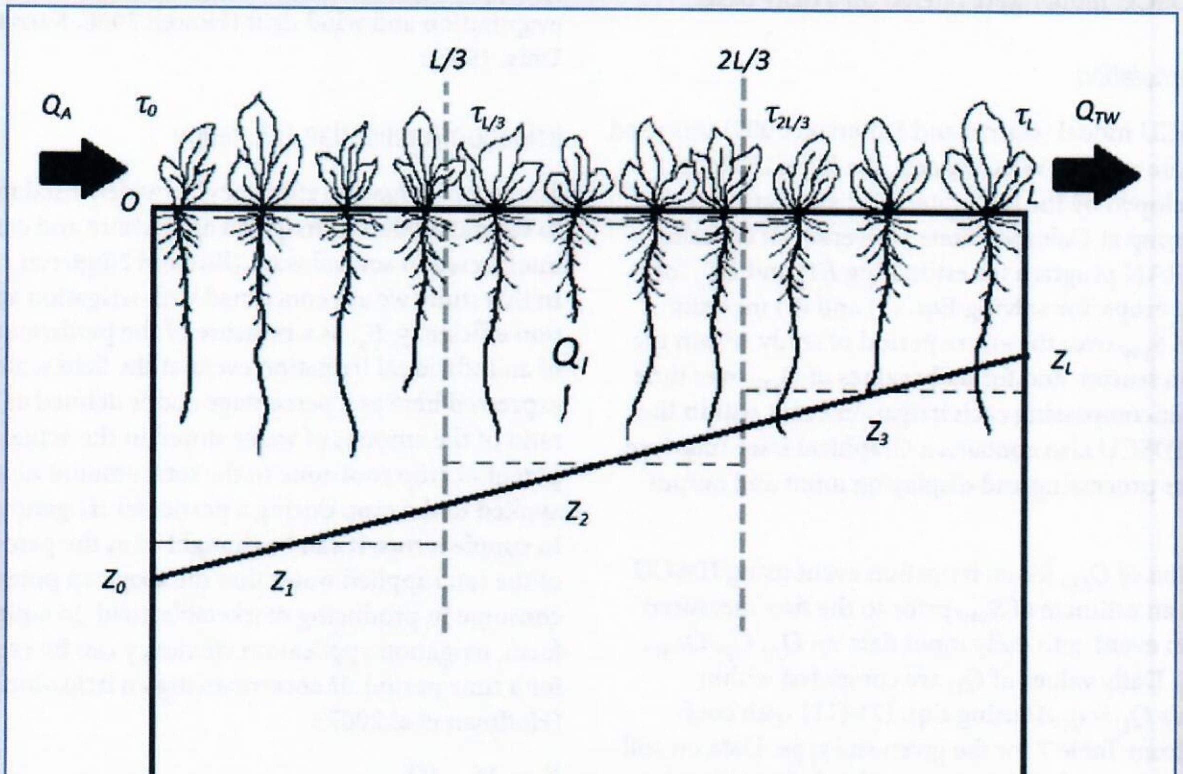


Figure 30. *Illustration of linear infiltration distribution approximation used in this study*

The calculation process consisted of solving for z_0 by changing values of z_L subject to the following constraints: $(z_L/z_0) = (\tau_L/\tau_0)$, and calculated total infiltrated volume equaled infiltrated volume estimated as the difference between field measurements of total applied irrigation volume, Q_A, and total tailwater runoff volume, Q_{TW}. This insured that mass balance was preserved throughout the calculation steps. Finally, average infiltrated depth (z_1, z_2, z_3) values were calculated for each ⅓ segment of the field based upon the geometric relationships between the infiltrated depths previously calculated.

The results that were transferred into the IDSCU irrigation mass balance model, described in the following section, included (1) average infiltrated depth values for each ⅓ segment of the field, (2) cells irrigated during an event, and (3) date of irrigation. For irrigation events spanning more than one day (for surface-irrigated fields) the first day of the irrigation was used for input into the IDSCU model. For sprinkler irrigated fields (for which irrigation events sometimes spanned several weeks or more) total infiltrated depth was divided by irrigation duration so that infiltrated depth values used in the IDSCU model were offered on a daily basis.

Deep Percolation

The IDSCU model (Garcia and Patterson 2009) was used to estimate various WBC values. The IDSCU Model was developed by the Integrated Decision Support (IDS) Group at Colorado State University. It contains a FORTRAN program for estimating ET_r and ET_p for specified crops, for solving Eqs. (1) and (2) for daily values of S_{SW} over the entire period of study within the irrigation season, and for daily values of Q_{DP} over time periods encompassing each irrigation event within the season. IDSCU also contains a Graphical User Interface (GUI) for processing and displaying input and output data.

Estimation of Q_{DP} for an irrigation event using IDSCU requires an estimate of S_{SW} prior to the first measured irrigation event, and daily input data on Q_A, Q_P, Q_{TW}, and Q_{ET}. Daily values of Q_U are computed within IDSCU as $Q_U = q_U \Delta t$ using Eqs. (7)-(11) with coefficients from Table 7 for the given soil type. Data on soil characteristics and crop root zone depth for determining TAW also are required. In IDSCU, if the total amount of Q_I during the period Δt of an irrigation event is enough to create a value of ΔS_{SW} that causes S_{SW} to exceed the value at field capacity $D_{rz}\theta_{fc}$, then Q_{DP} is assumed to occur as a result of the irrigation event and is calculated as $Q_{DP} = S_{SW} - D_{rz}\theta_{fc}$. In other words, it is assumed that gravity drainage will occur as deep percolation below the crop root zone to bring S_{SW} back to $D_{rz}\theta_{fc}$. To account for nonuniform infiltration, which typically occurs on surface irrigated fields, this water balance calculation is subdivided to different portions of the field as described in the preceding section.

To calibrate the IDSCU model, values for initial soil water content and TAW were adjusted to obtain a reasonable match between predicted and measured values of average S_{SW} on days when measured data from soil water surveys were available. Typically, data for one or two days of soil water surveys were available. On the average, the percent difference of predicted values of average S_{SW} from measured values was -15 percent over all fields and all irrigation seasons.

Sprinkler Evaporation and Drift

In the analysis described here, Q_I for sprinkler-irrigated fields was assumed to be equivalent to Q_A (exiting the sprinkler nozzles) less an assumed five percent loss to evaporation and wind drift (Howell 2006, Kansas State Univ. 1997).

Irrigation Application Efficiency

The term "irrigation efficiency" is widely used in relation to several aspects of irrigated agriculture and can be interpreted in several ways (Bos and Nugteren 1990). In this study we are concerned with irrigation application efficiency, E_a, as a measure of the performance of an individual irrigation event at the field scale. It is expressed here as a percentage and is defined as "The ratio of the amount of water stored in the actual or potential crop root zone to the total amount of water applied to the crop during a particular irrigation event." In simple terms, it can be thought of as the percentage of the total applied water that the crop can potentially consume in producing marketable yield. In equation form, irrigation application efficiency can be expressed for a time period Δt encompassing an irrigation event as (Hoffman et al 2007):

$$E_a = \Delta S_{SW}/Q_A \qquad (16)$$

There is no irrigation system that can apply water without water losses at the field scale. These losses may occur due to evaporation and wind drift during application, tailwater surface runoff, and DP. E_a is an indicator of efficiency on a field-scale level only; it does not consider conveyance losses from the water source to the irrigated fields. It may or may not consider the transit losses from small ditches within a field.

Irrigation Water Quality Sampling

Periodically, measurements were made of the EC (as specific conductance at 25°C) and temperature of the irrigation water stream applied to a field and/or the tail water stream running off a field. A YSI® 30 Handheld Conductivity Meter (Figure 31), calibrated daily using a standard saline solution of known concentration, was used to make the measurements and the probe was rinsed with distilled water between measurements. Usually, only one measurement of irrigation water and tail water were made during a single irrigation event, but occasionally two measurements were made and averaged.

Total dissolved solids (TDS) were estimated from EC readings using equations developed from a companion CSU project in the LARV. This project collected water samples from numerous groundwater wells in the Upstream Study Region over the period 2006-2009 and in the Downstream Study Region over the period 2003 - 2009. About 142 surface water samples from Upstream and 427 surface water samples from Downstream were analyzed in the laboratory for specific salt ions and TDS, and regression equations were developed relating lab-determined TDS to field-measured EC in dS/m. The resulting power equations (statistically significant at a significance level $\alpha = 0.05$) used, for the Upstream and Downstream regions respectively, were:

$$TDS = 868EC\text{-}124.1,\ r^2 = 0.94 \tag{17}$$

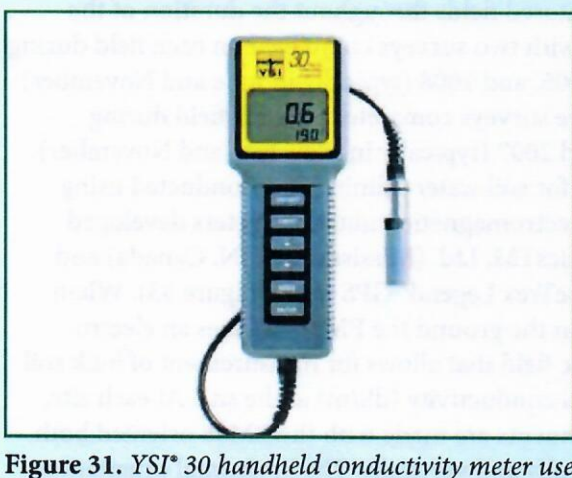


Figure 31. *YSI® 30 handheld conductivity meter used for measuring EC and temperature*

$$TDS = 797EC\text{-}111.0,\ r^2 = 0.77 \tag{18}$$

Whenever possible, if EC measurements were not taken in the irrigation water stream during an irrigation event, the EC of the irrigation stream was assumed to be equal to the EC measured with a YSI® 30 meter by the companion CSU project in the supply canal at a sampling location nearest to the irrigated field and on a date closest to the irrigation event. For fields supplied from pumping wells, the EC measured in a groundwater monitoring well located in or near the field and closest to the supply well was used to estimate the EC of the irrigation water.

Shallow Groundwater Monitoring

The alluvial groundwater table generally is quite shallow in the LARV. Observation wells were drilled on or near each monitored field to measure the D_{wt}, EC (specific conductance at 25°C), and temperature of the water table. These data provide information about the response of the groundwater to deep percolation from irrigation and about upflux of saline groundwater into the crop root zone.

A minimum of one observation well was installed within or adjacent to each monitored field except in cases where several monitored fields were immediately adjacent to one another. In such cases one well could serve to represent multiple fields. Over 50 percent of fields contained two or more observation wells. Observation well locations were chosen based upon the following criteria: (1) sites where vehicle/farm equipment traffic was minimal, (2) sites where surface water intrusion from irrigation channels, drainages, or pot holes was minimal, and (3) sites where wells could be located within a cropping area without searching for long periods of time (especially important in the case where observation wells were located within the cultivated field area and where well casings were level with the ground surface).

Observation wells were drilled to a maximum depth of 30 ft and with an average depth of approximately 20 ft. Well casing consisted of 2½" slotted (0.016 inch slot width with 3.1 in^2 slot area per lineal foot) schedule 40 PVC pipe with a removable female cap fitting placed at the top. Wells located outside of the field area were allowed casing heights that extended above the ground surface by several inches to several feet. Wells located within the field area typically were allowed casing heights level with the ground surface to deter damage to and from farm equipment. Soil surrounding each well casing was packed with a tamping bar and covered with bentonite clay on an annual basis to impede surface water intrusion.

Measurement of Water Table Depth

Observation wells generally were monitored on a bi-weekly basis from May through September and a monthly basis for the rest of the year. The value of D_{wt} was measured from the top of the well casing using a 100 ft open-spool tape with a small weight and calibrated Styrofoam float attached to the end (Figure 32). The casing height above the ground surface also was measured each time. Where applicable, D_{wt} data from other concurrent CSU groundwater studies were used to complement data collected in this project.

Figure 32. *CSU field technician measuring depth to water table in well on Field DS12 using an open-spool tape, 2005*

Measurement of Specific Conductance in Groundwater

Groundwater temperature and EC measurements were made using a YSI® 30 Handheld Conductivity Meter which was calibrated daily using a standardized saline solution. The probe was rinsed with distilled water between observation well readings. Typically, three sets of EC measurements were taken: near the water table, near the bottom of the well, and midway between the water table and the bottom of the well. The average of these three measurements was used to estimate EC of the groundwater in the well.

Total dissolved solids (TDS), or total salt ions in solution, were estimated from EC readings using equations developed from the companion CSU project in the LARV. About 363 groundwater samples from Upstream and 898 groundwater samples from Downstream were analyzed in the laboratory for specific salt ions and TDS, and regression equations were developed relating lab-determined TDS in mg/L to field-measured EC in dS/m. The resulting power equations (statistically significant at a significance level $\alpha = 0.05$) used, for Upstream and Downstream regions respectively, were:

$$TDS = 847.6EC^{1.06}, \quad r^2 = 0.93 \tag{19}$$

$$TDS = 1066.7EC^{0.93}, r^2 = 0.83 \tag{20}$$

Soil Water Salinity and Soil Water Content Surveys

Field Measurement with Electromagnetic Induction Meters

Surveys to estimate soil water salinity were conducted on monitored fields throughout the duration of the project with two surveys completed on each field during 2004, 2005, and 2008 (typically in June and November) and three surveys completed on each field during 2006 and 2007 (typically in May, July, and November). Surveys for soil water salinity were conducted using EM38 electromagnetic induction meters developed by GeonicsTM, Ltd. (Mississauga, ON, Canada) and Garmin eTrex Legend® GPS units (Figure 33). When placed on the ground the EM38 induces an electromagnetic field that allows for measurement of bulk soil electrical conductivity (dS/m) at the site. At each site, measurements are made with the EM38 oriented both horizontally and vertically. The horizontal orientation measurement, EM_H, renders a bulk conductivity measurement to an effective depth of about 0.75 m and the vertical orientation measurement, EM_V, to an effective depth of about 1.5 m. The readings have an accuracy of about plus five percent at 30 mS/m.

EM38 meters were calibrated according to manufacturer's specifications prior to the start of surveying on each field. Battery levels were checked periodically throughout the surveying process and generally changed after about 15 hours of continuous use. During the surveying process, special care was taken by CSU personnel to wear attire that would not alter ground conductivity readings. This included the use of footwear not containing metal and the removal of metallic objects from their attire.

For fields rectangular or square in shape, geo-referenced soil water salinity surveys were initiated near one corner of the field with EM38 readings and GPS coordinates were obtained, using a Garmin eTrex Legend handheld GPS unit, at each point on a 150-ft square grid pattern throughout the field area. For fields with a total area less than 10 acres, EM38 readings and GPS coordinates were obtained at each point on a 100-ft square grid pattern throughout the field area. Surveys typically were started near one corner and followed a path adjacent to one field boundary to the opposite end of the field. A new path was started either 150 ft or 100 ft adjacent to the initial path and continued to the opposite end of the field. This process was continued from the starting field boundary to the opposite field boundary. For fields circular in shape (center pivots), geo-referenced soil water salinity surveys were initiated at a point between the two outside sprinkler towers with EM38 readings and GPS coordinates obtained each 150 ft on a circular-shaped path around the field area. Following the completion of the initial path, a new path was initiated at a point about 150 ft inwards from the first path. This process was continued from the outside boundary to the center point of the field.

Soil Water Content Measurements

Soil samples were collected for gravimetric soil water content analysis immediately following the completion of each soil salinity survey. The procedure below was followed:

1. Soil sampling locations were determined by visually dividing the field into four quadrants and identifying a location near the approximate midpoint of each quadrant as a sampling location.
2. The soil surface at each location was cleared of crop residue by hand or spade.
3. During the 2004-2007 seasons, Oakfield tube samplers (Figure 34) were used to extract soil samples from a depth of approximately 24 inches at each location. During the 2008 season, a Stihl® gas-powered earth auger with an 18 inch by 1.5 inch diameter auger and two 18 inch extensions was used to bore to a depth of approximately 48 inches at each location. The auger was generally pulled from the hole five times per location either to remove soil from auger flighting or to add extensions to the auger. For each sampling location, all extracted soil was collected from the sampler by hand or using a small spade, placed in a plastic double-lock freezer bag, and labeled.
4. In most cases, each sample was weighed within one hour following collection using a portable, electronic scale (ACCULAB® PP401).
5. Soil temperature at a six inch depth from the ground surface was measured at each sampling location using a digital thermometer (ACURITE® 00645W2).
6. Soil samples were allowed to air dry in a low humidity greenhouse environment at the CSU-Arkansas Valley Research Center near Rocky Ford, Colorado for approximately three weeks. Soil samples were not transferred from plastic bags for the drying process; the bags were simply opened and exposed to air.
7. Following the drying period, soil samples were weighed again, as were empty plastic sampling bags.
8. Air-dried gravimetric water content (WC_{AD}) was estimated for each sample using the following equation:

$$WC_{AD} = (W_{ws} - W_{ds})/(W_{ds} - W_{bag}) \tag{21a}$$

wherein W_{ws} = weight of wet soil sample (including bag),
W_{ds} = weight of dry soil sample (including bag), and
W_{bag} = weight of plastic bag.

9. Oven-dried gravimetric water content (WC_{OD}) was estimated from WC_{AD} for each sample using the following method.
   - Values of WC_{AD} were determined for a portion of 297 soil samples in 2008. Another portion of each of the same samples was placed in a can and dried in an oven to determine oven-dried water content as

     $$WC_{OD} = (W_{ws} - W_{ds})/(W_{ds} - W_{can}) \quad (21b)$$

     wherein W_{ws} = weight of wet soil sample (including can),
     W_{ds} = weight of dry soil sample (including can), and
     W_{can} = weight of metal can
   - Statistical analysis revealed that on average, WC_{OD} exceeded WC_{AD} by 0.013 (about 8.8 percent). Thus, the following was used to estimate WC_{OD} from measured values of WC_{AD}:

     $$WC_{OD} = WC_{AD} + 0.013 \quad (22)$$

Estimation of EC_e from EM38 Measurements

EM38 readings are affected by soil water content and soil temperature and must be adjusted. Values of EM_V measured in dS/m with the EM38 were converted to adjusted values, EM_V', using a temperature correction factor, f_{tc} (Richards 1954):

$$EM_V' = (f_{tc})EM_V \quad (23)$$

with f_{tc} =

$$1.8509 - 0.0516951(T) + 0.000858442(T^2) - 0.0000613535(T^3) \quad (24)$$

where T is the soil temperature (°C) measured in the field in °C. Finally, saturated paste extract soil salinity, EC_e was estimated using calibration equations developed by Wittler et al. (2006) for the Upstream and Downstream Study Regions. For fields in the Upstream region, EC_e in dS/m was estimated from: EC_e =

$$2.33 + 7.16(EM_V'/100)^{1.44} + 9.41WC - 23.18(EM_V'/100)(WC) \quad (25)$$

For fields in the Downstream region, EC_e in dS/m was estimated from: EC_e =

$$0.45 + 7.23(EM_V'/100)^{1.78} + 19.54WC - 34.06(EM_V'/100)(WC) \quad (26)$$

Figure 33. *CSU technician conducting EM38 survey on a field in the LARV*

Preparing Soil Salinity Maps

The ArcGIS 9.3 geographic information systems software was used to generate maps of EC_e for each field survey using kriging interpolation techniques. Kriging methods depend on mathematical and statistical models that rely on the notion of correlation between EC_e values at locations within a field based upon the distance between the locations. The procedure is described in Eldeiry and Garcia (2008).

Crop Yield Measurements

To estimate crop yield, crop biomass samples were collected on each of the monitored fields one to three times per season for the duration of the project. The procedure for collecting crop biomass samples is outlined below:

1. Crop biomass sampling locations were determined for each field in two ways:
   - If previous soil water salinity survey data were available for the field, six separate locations were chosen based upon the three areas of highest soil water salinity concentration and the three areas of lowest soil water salinity concentration.
   - If soil water salinity survey data were not available, the field was divided into six equal-sized areas with the approximate midpoint of each area considered the crop biomass sampling location.
2. For each sampling location, three different types of data were collected: crop biomass, EM38 measurements, and samples for soil water content. Methods used in taking EM38 measurements and gathering soil samples for estimating gravimetric soil water content are described in the section "Soil Water Salinity and Soil Water Content Surveys". Biomass sampling was conducted as follows:
   - For alfalfa and alfalfa/grass mix crops, biomass samples were collected at each sampling location by either of the two following methods:
     i. If the crop had not been cut, a 3.3-ft (1 meter) square frame constructed of ½ inch thick steel rod was placed on the ground and all vegetation was hand-cut with scissors and hedge trimmers to a height of about one inch above ground level. All cut vegetation was then placed in a mesh onion sack (bushel size) for greenhouse drying. Biomass samples for wheat crops also were collected in this manner.
     ii. If the crop had been cut into windrows by the grower, a length of windrow (ranging from one ft to five ft) was measured, collected by hand, and placed in a mesh onion sack for greenhouse drying. In addition, the distance from the centerline of the windrow to the centerline of an adjacent windrow was measured and recorded for the purpose of calculating biomass/area values. For each sample within a given field, the length of windrow collected for drying was the same. Sampled areas varied between fields only and never between samples within a given field.
   - For row crops including corn (for grain or ensilage) and sorghum (for grain, ensilage, or forage), crop biomass samples were collected as follows:
     i. For each sampling location a number of plants were hand-cut (using a hacksaw) at a height of about one inch above the ground surface and placed into a mesh onion sack for greenhouse drying. For each sample within a given field, the number of plants collected for drying was the same. Sample sizes varied between fields only and never between samples within a given field.

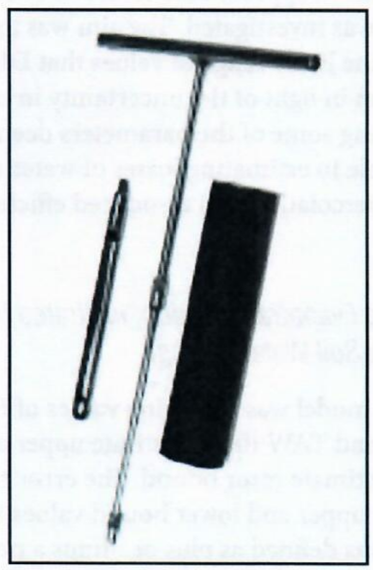


Figure 34. *Oakfield tube sampler.*

   ii. For each sampling location, a plant population count was conducted by measuring a 10-ft length of row and then counting the number of plants growing in that span.

3. Following the completion of sampling, crop biomass samples were allowed to air dry for a minimum of three weeks in a low humidity greenhouse environment at the CSU Arkansas Valley Research Center near Rocky Ford, Colorado. Following drying, crop samples were weighed.

The crop biomass data were normalized in order to make comparisons between fields. For alfalfa, the data were normalized by dividing measured yields by an estimated maximum yield per cutting of tons per acre. Colorado Agricultural Experiment Station (2008) provides data on the crop yields for a number of alfalfa variety trials from 2004-2006. On the average, the total yields from entire fields for three cuttings were found to be about 2.3 tons/acre per cutting. Therefore a maximum of three tons/acre was selected since in order to obtain an average of 2.3 tons/acre over an entire field the maximum for any one small plot in the field could be higher. Colorado Agricultural Experiment Station (2008) also reports the average biomass yields for corn silage planted on small plots to be about 32.8 tons/acre. Thus, a maximum of 33 tons/acre was used to normalize the corn biomass data obtained in this report

Sensitivity Analysis

Sensitivity of values of the deep percolation fraction, DPF = Q_{DP}/Q_A (percent), and E_a estimated by the IDSCU model to approximate errors in selected input parameters was investigated. The aim was to provide an estimate of the likely range of values that DPF and E_a could take on in light of the uncertainty in measuring and estimating some of the parameters deemed to play a key role in estimating losses of water due to downward percolation and associated efficiency of water application.

Sensitivity to Evapotranspiration, Infiltrated Irrigation Volume, and Soil Water Storage

The IDSCU model was run using values of ET_a, Q_I, initial S_{SW}, and TAW that constitute upper and lower ends of an estimate error bound. The error range between the upper and lower bound values for each parameter was defined as plus or minus a percentage of defined baseline parameter values, considered the best estimates, for each monitored field and each season. The error bound used for each of the considered input parameters was +/- 20% for ET_a, +/- 20% for Q_I, +/- 20% for initial S_{SW}, and +/- 20% for TAW. Adjustments to considered input parameters were conducted independently, with all other parameters maintained at their baseline values. Average values of DPF and E_a over all surface irrigation events and all sprinkler irrigated events were computed for both the upper and lower bound values of each considered input parameter. These values could be compared to those previously computed by IDSCU using baseline values for all parameters.

Sensitivity to Infiltration Distribution Pattern

Sensitivity to the infiltration distribution pattern on surface-irrigated fields also was investigated. To estimate sensitivity to the assumed linear distribution pattern, reasonable upper and lower bounds of the slope of the infiltration depth function were calculated. The upper bound was found by increasing the infiltrated irrigation depth for the baseline condition, computed as described in the section "Infiltration Uniformity", on the first third of the irrigated cell by 30 percent while simultaneously decreasing the infiltrated depth on the last third of the irrigated cell by 30 percent. The lower bound was defined in a similar fashion but with the increase and decrease occurring on opposite ends of the irrigated cell. Average values of E_a were calculated for each bound for all the surface irrigated events. Figure 35 depicts the assumed linear distribution associated with the upper and lower bounds, compared to that for the baseline condition.

Regional-Scale Modeling of Irrigation-Affected Flow and Salt Loading Processes

Though the number of irrigated fields monitored in this study was relatively large for an effort of this type, it was quite small compared to the total number of irrigated fields in the LARV. To examine the behavior of the irrigated stream-aquifer system over regional scales, a revised version of a computational groundwater model described by Burkhalter and Gates (2005, 2006) was applied to the Upstream and Downstream study regions. The modeled area in the Upstream Study Region encompassed about 125,000 ac, of which about 65,300 ac are irrigated. Downstream the modeled area covered about 136,300 ac, of which about 81,600 ac are irrigated. The flow component of the revised model, used in this study, uses an amended version of the MODFLOW saturated zone groundwater flow model (Harbaugh 2005) coupled with the UZF unsaturated zone model (Niswonger et al 2006). The governing flow equations are solved using finite-difference approximations applied to a computational grid size of 250 m by 250 m with two vertical layers and time steps of one week. The model has been calibrated and tested against a large data set gathered over the period 1999-2007 in the Upstream region and 2002-2007 in the Downstream region. The calibration targets include depth to the groundwater table at 88 sites Upstream and at 99 sites Downstream, groundwater return flows to tributaries and streams estimated by water balance calculations using stream flows measured at numerous gaging sites, measured seepage from irrigation canals, estimates of ET_a using ReSET and satellite data, and measured upflux from shallow groundwater tables under naturally-vegetated fields. Baseline estimates of Q_{DP} from the IDSCU model were used to estimate targets for recharge to the shallow water table aquifer computed by the regional models. Also, estimates of tailwater runoff fraction, TRF = Q_{TW}/Q_A (percent), from the field study were used to guide the estimation of values of Q_I for the regional model. The calibration period was April 1999 to March 2004 and the test period was April 2004 to October 2007 for the Upstream Study Region. For the Downstream region, the calibration period was April 2002 to March 2006 and the test period was April 2006 to October 2007. Distributed values of the following model parameters were adjusted by optimization using the UCODE automated parameter estimation software and/or by manual adjustment: horizontal saturated hydraulic conductivity, effective vertical saturated hydraulic conductivity in the unsaturated zone, soil saturated water content, specific yield, canal conductance, and tributary and stream conductance. Manual methods were used to adjust values of the following parameters: aquifer thickness, ET extinction depth (D_{wt} value at which groundwater upflux to ET ceases), ET_p adjustment factor, etc. Histograms of the residual differences between simulated and observed

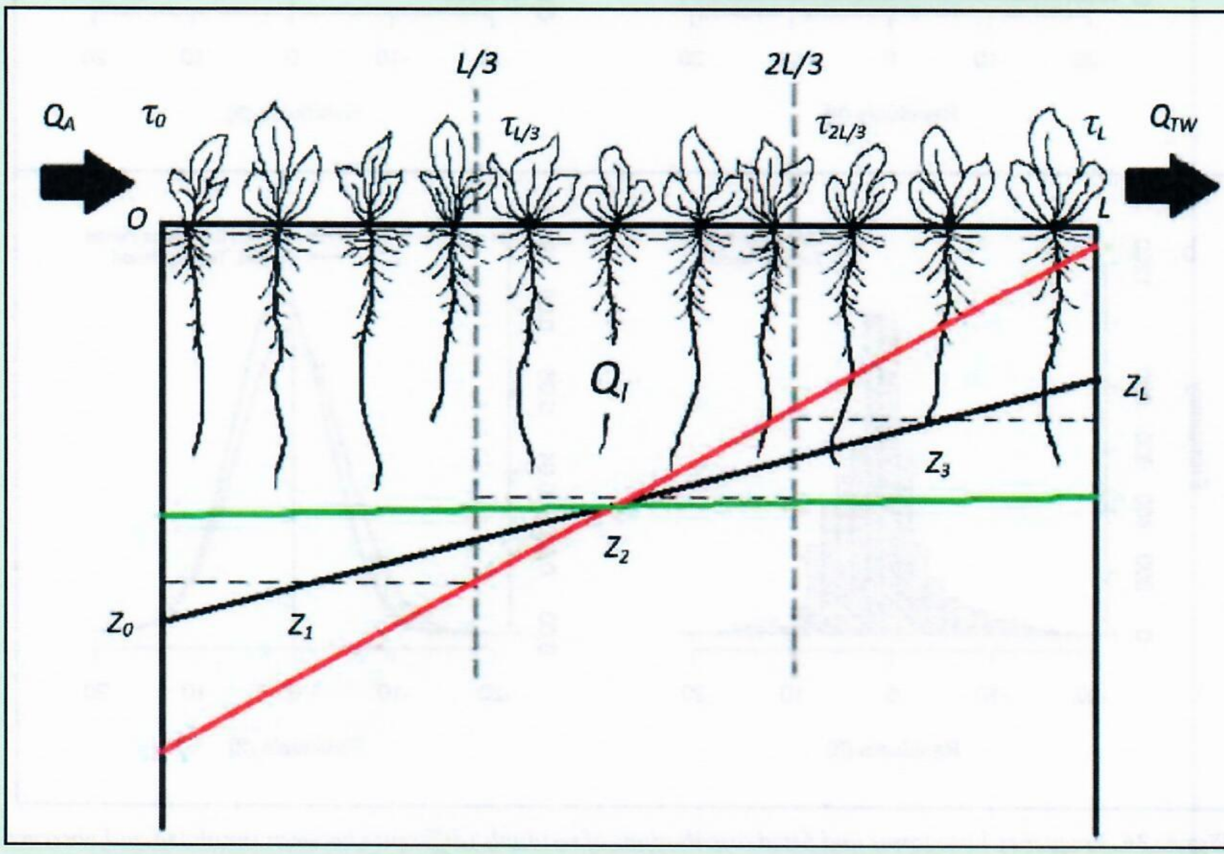


Figure 35. *Distribution Sensitivity: Assumed, upper (red) and lower (green) bounds for the slope of the linear infiltration distribution, compared to the assumed baseline (black) distribution*

values of D_{wt} for both calibration and test periods for the Upstream and Downstream region are shown in Figure 36. Figure 37 shows plots of simulated values of groundwater return flow along reaches of the Arkansas River, compared to estimates of total unaccounted-for return flow (which includes both groundwater and unaccounted-for surface water return flows) for both calibration and test periods for the Upstream and Downstream region. These figures reveal that the model is reasonably accurate in predicting groundwater head and groundwater return flow for the period of study. Work is currently underway to refine estimates of groundwater return flow. Detailed descriptions of the model will be available in an article under preparation by Morway et al. (2012).

For the current study, focus was given to regional model predictions of spatial and temporal distributions of recharge to the shallow aquifer as affected

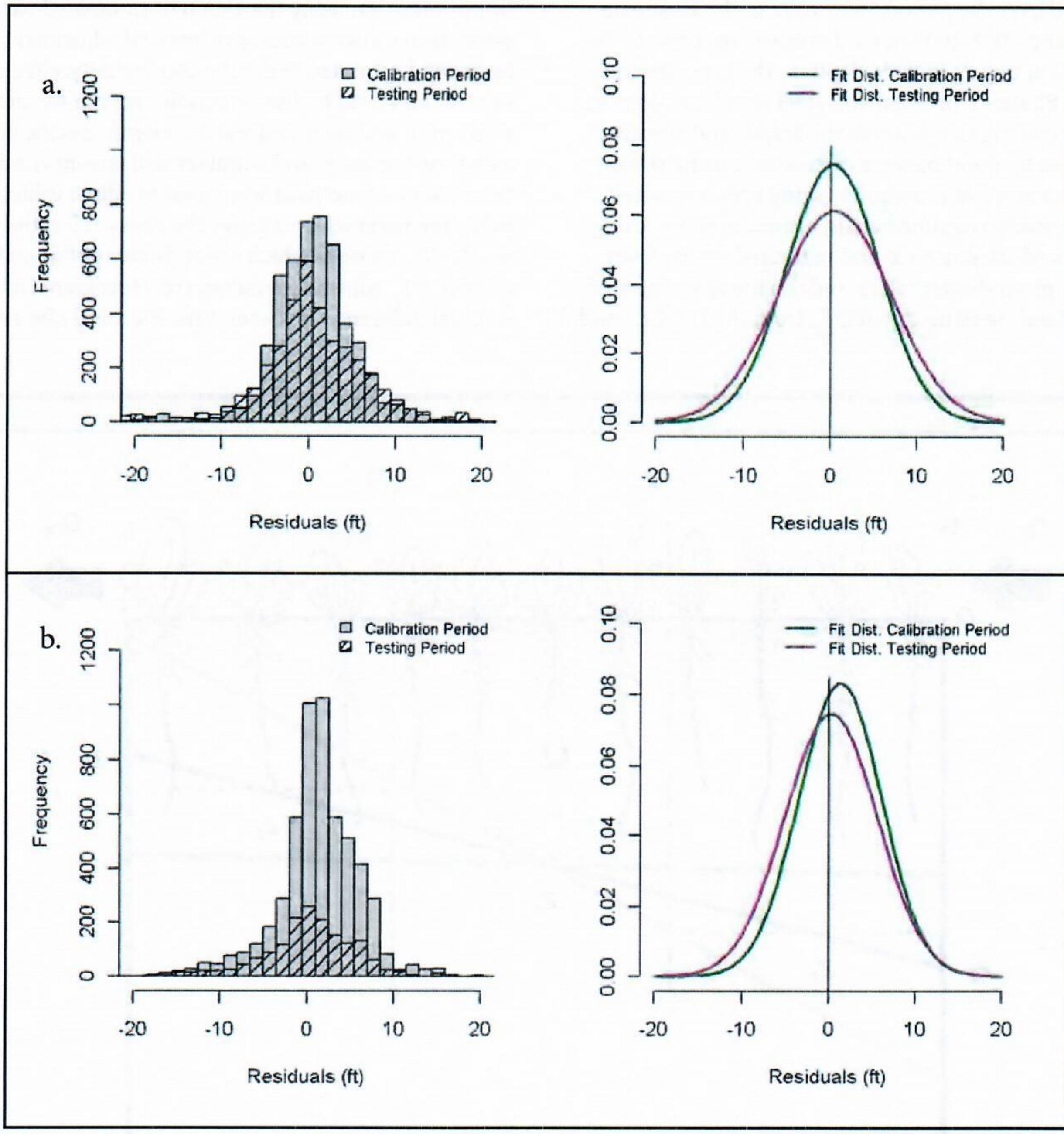


Figure 36. *Frequency histograms and fitted distributions of residuals (difference between simulated and observed values) of D_{wt} for (a) Upstream Study Region, and (b) Downstream Study Region*

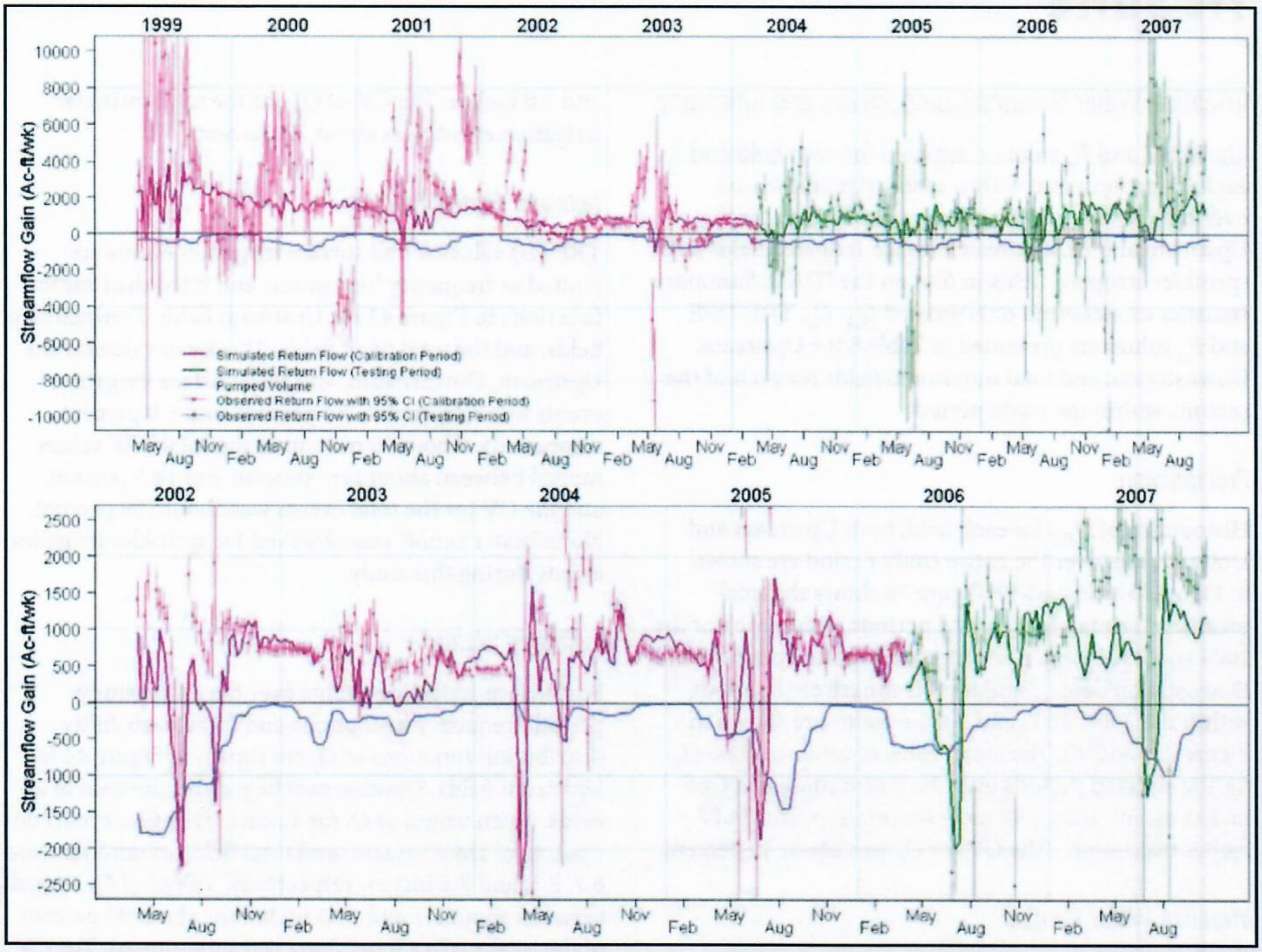


Figure 37. *Simulated weekly groundwater return flow to the Arkansas River compared to total unaccounted-for return flow (with 95 percent confidence intervals) estimated using stream gauges for calibration and testing periods for river reaches along the (a) Upstream Study Region, and (b) Downstream Study Region*

by deep percolation, non-beneficial water consumption due to upflux from the shallow aquifer under naturally-vegetated and fallow fields, and return flows and salt loads from groundwater to the main stem of the Arkansas River within the two study regions. These are key variables to understanding the effect of irrigation practices on the stream-aquifer system and on compliance with the Arkansas River Compact.

Salt loads in groundwater return flow to the Arkansas River were estimated for this study by multiplying predicted groundwater return flow rates by groundwater salt concentrations interpolated for each respective computational link along the river. Groundwater salt concentrations were extrapolated from measurements made by a companion CSU study in multiple observation wells distributed over the study regions. Current work is underway to improve salt load estimates through the use of calibrated and tested MT3D solute transport models in conjunction with the MODFLOW-UZF models of the study regions.

Results

Irrigation Water Balance Components and Efficiency

The WBC and E_a values computed for each field and each irrigation event within each irrigation season over the entire study period are summarized for the Upstream and Downstream surface-irrigated fields and sprinkler-irrigated fields in files on the IDAD. Summary statistics of measured or estimated Q_A, Q_I, TRF, DPF, and E_a values are presented in Table 8 for Upstream, Downstream, and total monitored fields for each of the seasons within the study period.

Precipitation

Histograms of Q_{PT} for each field, both Upstream and Downstream, over the entire study period are shown in Figures 38, 39 and 40. Figure 38 shows the total measured rainfall for selected periods within each of the 2004 and 2005 irrigation seasons for both Upstream and Downstream fields. Similar plots for selected periods within the 2006, 2007 and 2008 seasons are shown in Figures 39 and 40. The mean value of total seasonal Q_P for the selected periods over the entire study was 6.60 inches mean value, 1.98 inches minimum, and 14.87 inches maximum. The CV for Q_P was about 40 percent.

Irrigation Water Applied

Frequency histograms and fitted probability distribution functions of Q_A for surface-irrigation events over the entire study period are shown in Figure 41 for Upstream fields, Downstream fields, and the total of all fields. The mean values of Q_A for surface irrigation events on Upstream, Downstream, and total fields monitored were 7.4 inches, 9.1 inches, and 8.2 inches, respectively. For about 90 percent of the total surface irrigation events monitored, Q_A, ranged between 4.0 inches and 13.41 inches. The CV of Q_A for the total surface irrigation events was about 51 percent.

Histograms and fitted probability distribution functions of Q_A for sprinkler-irrigation events over the entire study period are shown in Figure 42 for Upstream fields, Downstream fields, and the total of all fields. For sprinkler irrigation events the mean values of Q_A on Upstream, Downstream, and total fields monitored were 2.0 inches, 2.3 inches, and 2.2 inches, respectively. Values of Q_A for about 90 percent of the total sprinkler irrigation events monitored ranged between 1.1 inches and 3.0 inches. The CV of Q_A for the total sprinkler irrigation events was about 72 percent.

Tailwater Runoff Fraction

TRF (%) values for all surface irrigation events are plotted as frequency histograms and fitted distribution functions in Figure 43 for Upstream fields, Downstream fields, and the total of all fields. The mean value for the Upstream, Downstream, and total surface irrigation events was 8.4 percent, 7.4 percent, and 8.0 percent, respectively. About 90 percent of the total TRF values ranged between about zero percent and 18.5 percent, and the CV for the total events was about 109 percent. No tailwater runoff was observed for sprinkler irrigation events during this study.

Infiltrated Water

For surface-irrigation events over the entire study period, frequency histograms and fitted probability distribution functions of Q_I are shown in Figure 44 for Upstream fields, Downstream fields, and the total of all fields. Mean values of Q_I for surface irrigation events on Upstream, Downstream, and total fields monitored were 6.7, 8.3, and 7.5 inches, respectively. Values of Q_I ranged between about 3.7 and 12.3 inches for about 90 percent of the total surface irrigation events monitored. The CV of Q_I for the total surface irrigation events was about 52 percent. Since there was no observed tailwater runoff for any of the sprinkler irrigation events, Q_I for sprinkler events were estimated as 95 percent of corresponding Q_A values accounting for air evaporation and wind drift losses.

Histograms and fitted probability distribution functions of Q_I for sprinkler-irrigation events over the entire study period are shown in Figure 45 for Upstream fields, Downstream fields, and the total of all fields. The mean values of Q_I for sprinkler irrigation events monitored on Upstream, Downstream, and total fields were 1.8 inches, 2.1 inches, and 2.1 inches, respectively. For about 90 percent of the total sprinkler irrigation events monitored values of Q_I ranged between 1.1 inches and 2.9 inches. The CV of Q_I for the total sprinkler irrigation events was about 72 percent.

Table 8. *Summary statistics for Q_A, Q_I, TRF, DPF, and E_a for all seasons over the study period*

	2004				2005				2006				2007				2008			
	Mean	*Min*	*Max*	*CV (%)*	*Mean*	*Min*	*Max*	*CV (%)*	*Mean*	*Min*	*Max*	*CV (%)*	*Mean*	*Min*	*Max*	*CV (%)*	*Mean*	*Min*	*Max*	*CV (%)*
Upstream																				
Surface Irrigation Events																				
No. of events	8				53				33				0				24			
Q_A (in)	7.4	3.7	13.8	49.5	6.9	2.2	16.4	46.6	7.9	2.0	14.9	50.0	-	-	-	-	7.9	0.9	18.7	49.6
Q_I (in)	6.8	3.6	13.6	52.7	6.2	2.2	14.3	43.2	7.1	1.8	14.5	51.3	-	-	-	-	7.2	0.9	17.2	45.9
TRF (%)	8.8	0.4	32.4	121.7	8.0	0.0	28.7	100.1	10.1	0.0	33.2	84.1	-	-	-	-	6.7	0.0	27.0	103.6
DPF (%)	35.9	0.0	73.6	75.7	15.8	0.0	81.6	115.8	18.0	0.0	58.2	105.0	-	-	-	-	24.4	0.0	64.9	86.3
E_a (%)	55.3	24.3	99.6	53.3	76.2	16.4	100.0	26.7	71.9	39.5	100	26.7	-	-	-	-	69.0	34.8	100.0	31.6
Sprinkler Irrigation Events																				
No. of events	0				11				15				0				36			
Q_A (in)	-	-	-	-	1.7	1.0	2.6	24.8	1.7	0.9	2.3	26.8	-	-	-	-	2.1	0.5	10.7	95.0
Q_I (in)	-	-	-	-	1.6	1.0	2.5	24.8	1.7	0.9	2.2	26.8	-	-	-	-	2.0	0.5	9.7	92.5
TRF (%)	-	-	-	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-	-	-	-	-	0.0	0.0	0.0	-
DPF (%)	-	-	-	-	7.9	0.0	50.0	207.1	11.5	0.0	55.4	208.8	-	-	-	-	24.1	0.0	95.2	132.6
E_a (%)	-	-	-	-	87.1	45.0	95.0	18.8	83.5	29.6	95.0	28.6	-	-	-	-	71.0	4.8	95.0	44.7
Downstream																				
Surface Irrigation Events																				
No. of events	5				27				25				32				35			
Q_A (in)	3.2	2.7	4.5	24.0	9.5	2.2	23.3	43.8	7.8	1.6	21.7	57.7	10.3	4.5	26.3	52.4	9.2	2.7	16.2	36.4
Q_I (in)	3.1	2.7	4.2	21.0	8.2	2.0	19.4	45.9	7.3	1.5	21.7	60.8	9.5	4.4	26.0	55.9	8.6	1.4	16.2	41.7
TRF (%)	1.2	0.0	6.1	223.6	13.1	0.0	68.7	104.8	6.4	0.0	21.9	89.9	8.0	0.0	21.4	85.3	4.6	0.0	27.0	162.9
DPF (%)	0.0	0.0	0.0	-	26.9	0.0	67.7	85.2	34.2	0.0	89.1	85.4	26.8	0.0	86.3	87.6	31.1	0.0	86.1	82.0
E_a (%)	98.8	93.9	100.0	2.7	60.0	18.3	100.0	39.3	59.4	6.4	100.0	47.5	65.2	2.8	100.0	35.3	64.2	13.9	100.0	37.9
Sprinkler Irrigation Events																				
No. of events	0				19				25				44				128			
Q_A (in)	-	-	-	-	2.5	0.7	12.7	104.2	2.2	1.1	3.3	28.2	2.2	0.6	13.2	88.6	2.3	0.8	11.4	61.3
Q_I (in)	-	-	-	-	2.4	0.6	12.2	105.3	2.1	1.1	3.1	28.1	2.1	0.5	12.3	87.8	2.2	0.8	11.2	61.9
TRF (%)	-	-	-	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-
DPF (%)	-	-	-	-	7.8	0.0	49.0	181.8	17.2	0.0	92.2	158.4	3.0	0.0	69.9	391.6	14.0	0.0	66.2	158.1
E_a (%)	-	-	-	-	87.2	46.0	95.0	16.3	78.2	2.8	95.0	34.6	92.0	25.4	95.0	12.7	81.0	16.9	95.0	27.2
Total																				
Surface Irrigation Events																				
No. of events	13				80				58				32				59			
Q_A (in)	5.8	2.7	13.8	61.3	7.8	2.2	23.3	48.2	7.9	1.6	21.7	52.9	10.3	4.5	26.3	52.4	8.7	0.9	18.7	41.7
Q_I (in)	5.4	2.7	13.6	61.6	6.9	2.0	19.4	46.7	7.2	1.5	21.7	55.3	9.6	4.4	26.0	55.9	8.1	0.9	17.2	41.8
TRF (%)	5.8	0.0	32.6	158.2	9.7	0.0	68.8	108.0	8.5	0.0	33.3	90.1	8.0	0.0	21.4	85.4	5.6	0.0	27.2	129.9
DPF (%)	22.1	0.0	73.6	124.9	19.5	0.0	81.6	105.0	25.0	0.0	89.0	100.4	26.8	0.0	86.3	87.6	28.4	0.0	86.1	84.0
E_a (%)	72.1	24.5	100.0	42.7	70.8	16.5	100.0	32.1	66.5	6.5	100.0	36.2	65.1	2.8	100.0	35.3	66.0	13.9	100.0	35.1
Sprinkler Irrigation Events																				
No. of events	0				30				40				44				164			
Q_A (in)	-	-	-	-	2.2	0.7	12.7	95.1	2.0	0.9	3.3	29.5	2.2	0.6	13.2	88.6	2.3	0.5	11.4	68.8
Q_I (in)	-	-	-	-	2.1	0.6	12.2	96.2	1.9	0.9	3.1	29.4	2.1	0.5	12.3	87.8	2.2	0.5	11.2	68.5
TRF (%)	-	-	-	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-	0.0	0.0	0.0	-
DPF (%)	-	-	-	-	7.8	0.0	50.0	188.0	15.1	0.0	92.2	172.1	3.0	0.0	69.6	391.6	16.2	0.0	95.2	153.4
E_a (%)	-	-	-	-	87.2	45.0	95.0	16.9	80.2	2.8	95.0	32.1	92.0	25.4	95.0	12.7	78.8	4.8	95.0	31.4

Exhibit M

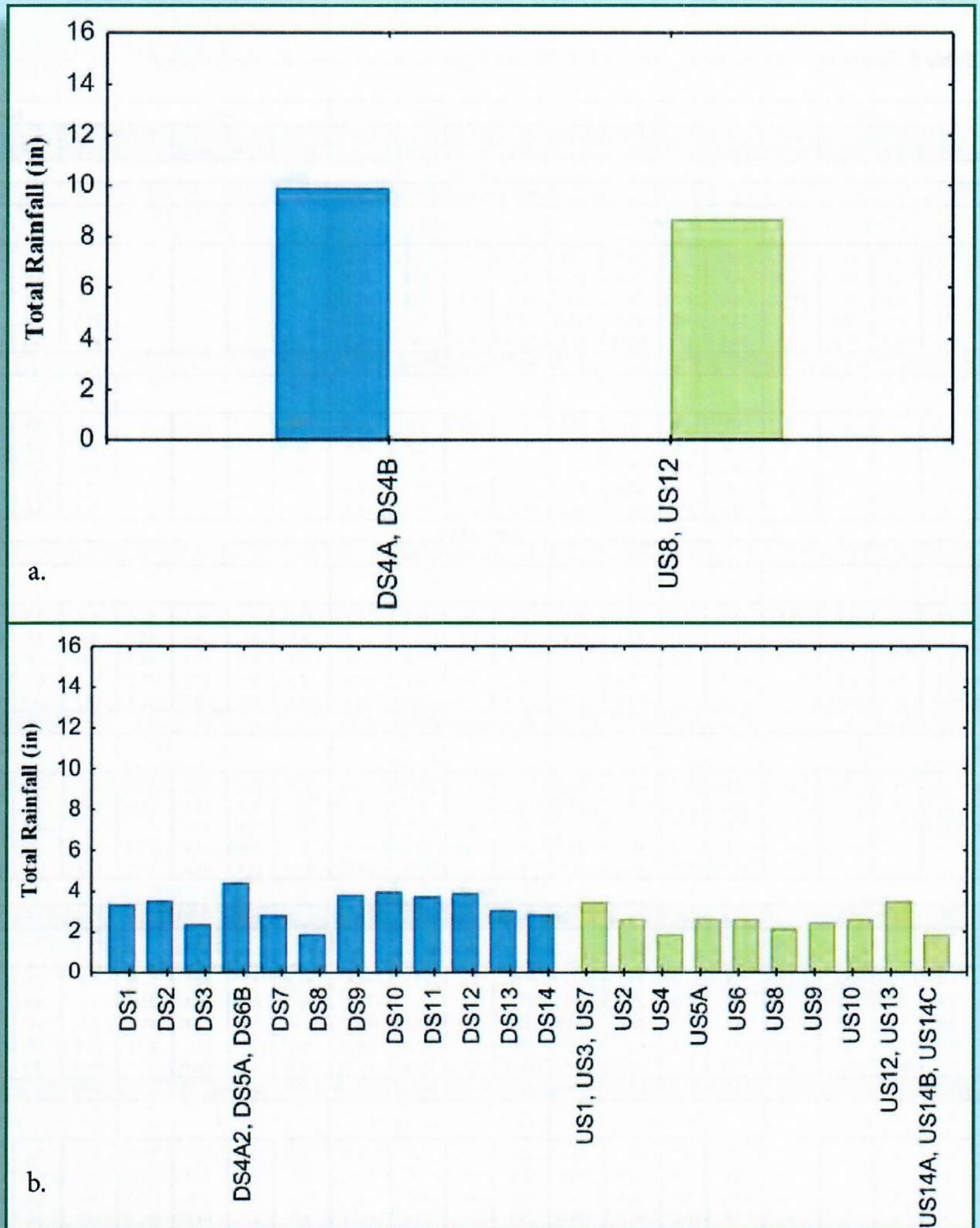


Figure 38. *Total rainfall measured on monitored fields for (a) 25 May-30 Sep 2004, (b) 30 Jun-28 Sep 2005*

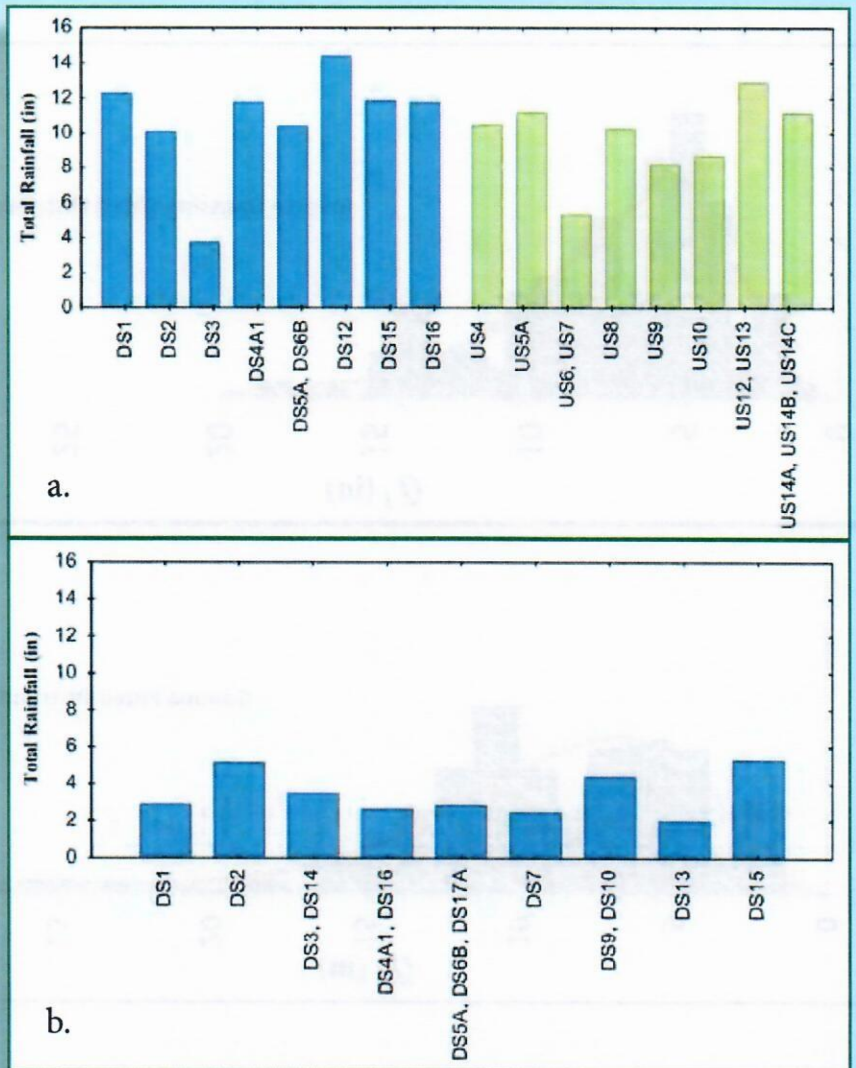


Figure 39. *Total rainfall measured on monitored fields for (a) 8 Apr-11 Oct 2006, and (b) 17 May-9 July 2007*

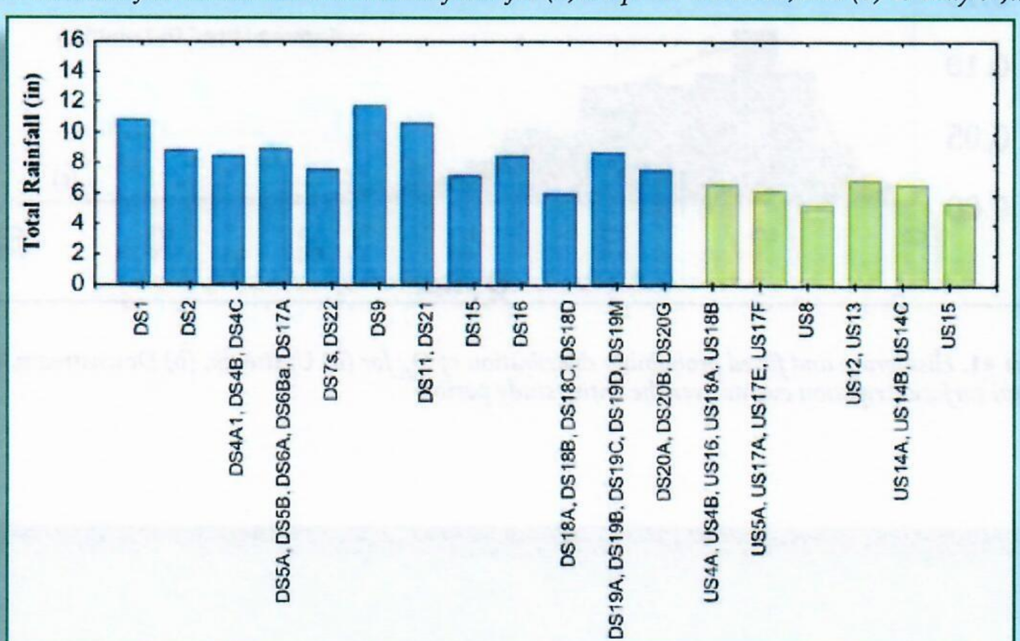


Figure 40. *Total rainfall measured on monitored fields for 12 Jun-29 Nov 2008*

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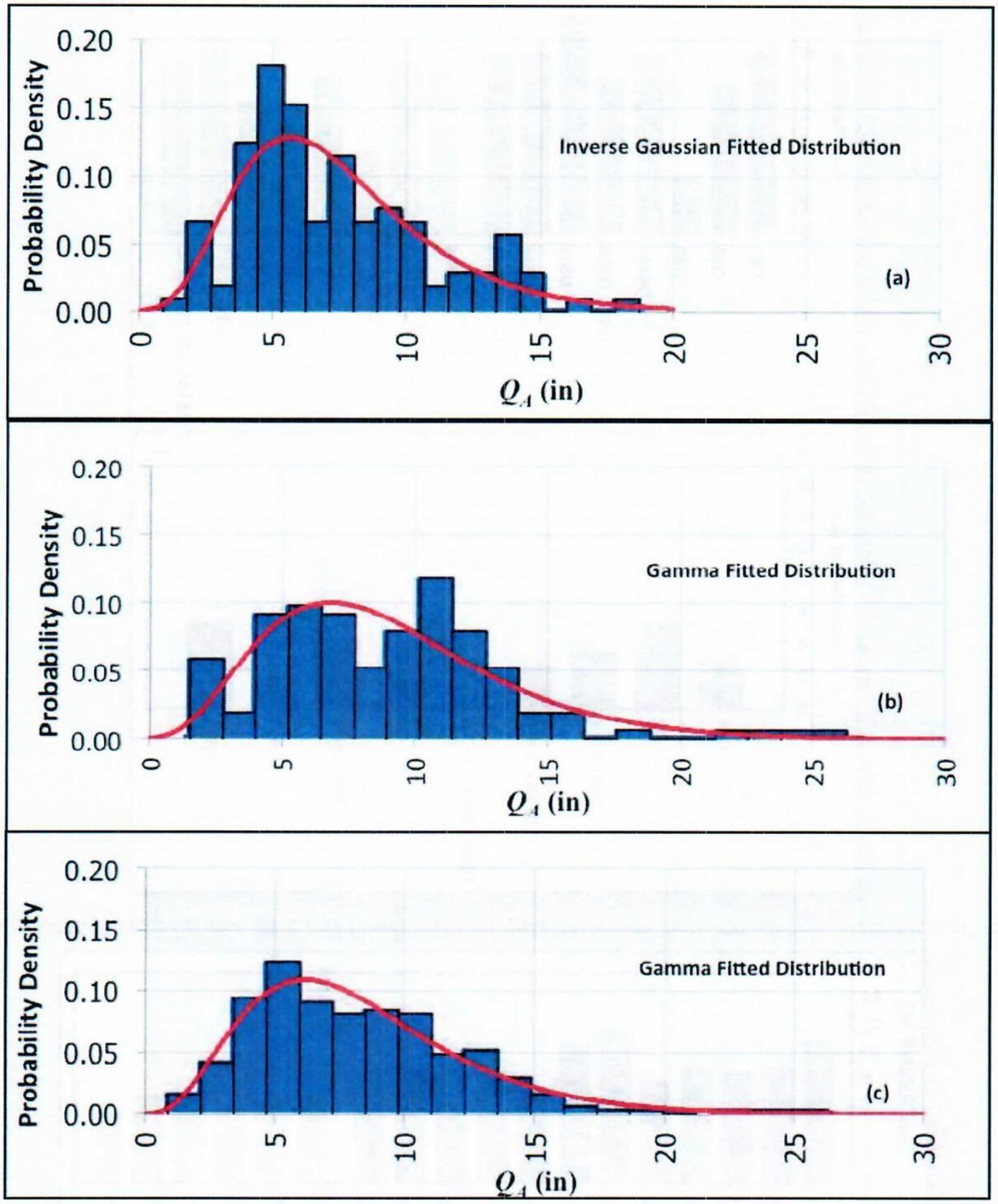


Figure 41. *Histogram and fitted probability distribution of Q_A for (a) Upstream, (b) Downstream, and (c) total surface irrigation events over the entire study period*

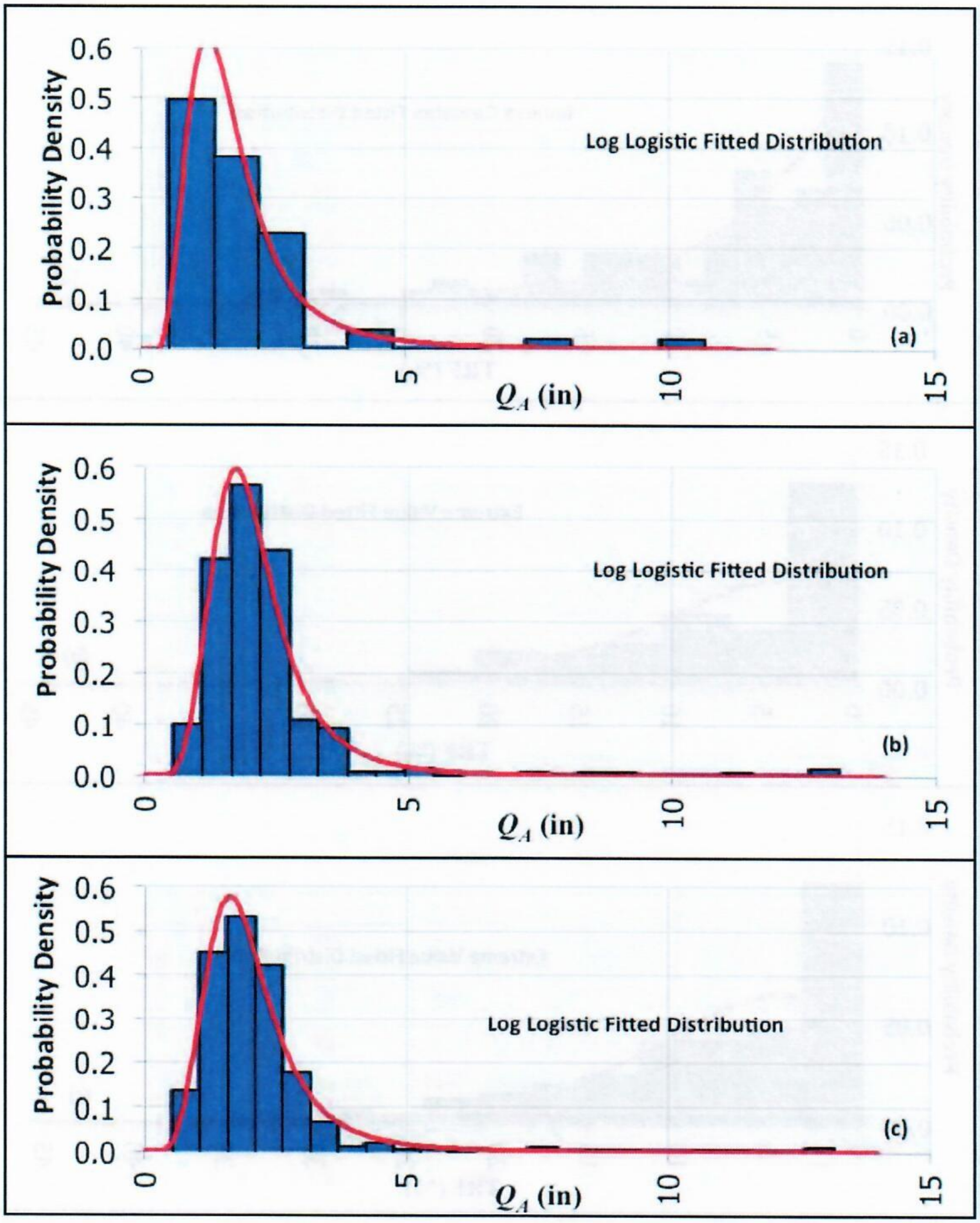


Figure 42. *Histogram and fitted probability distribution of Q_A for (a) Upstream, (b) Downstream, and (c) total sprinkler irrigation events over the entire study period*

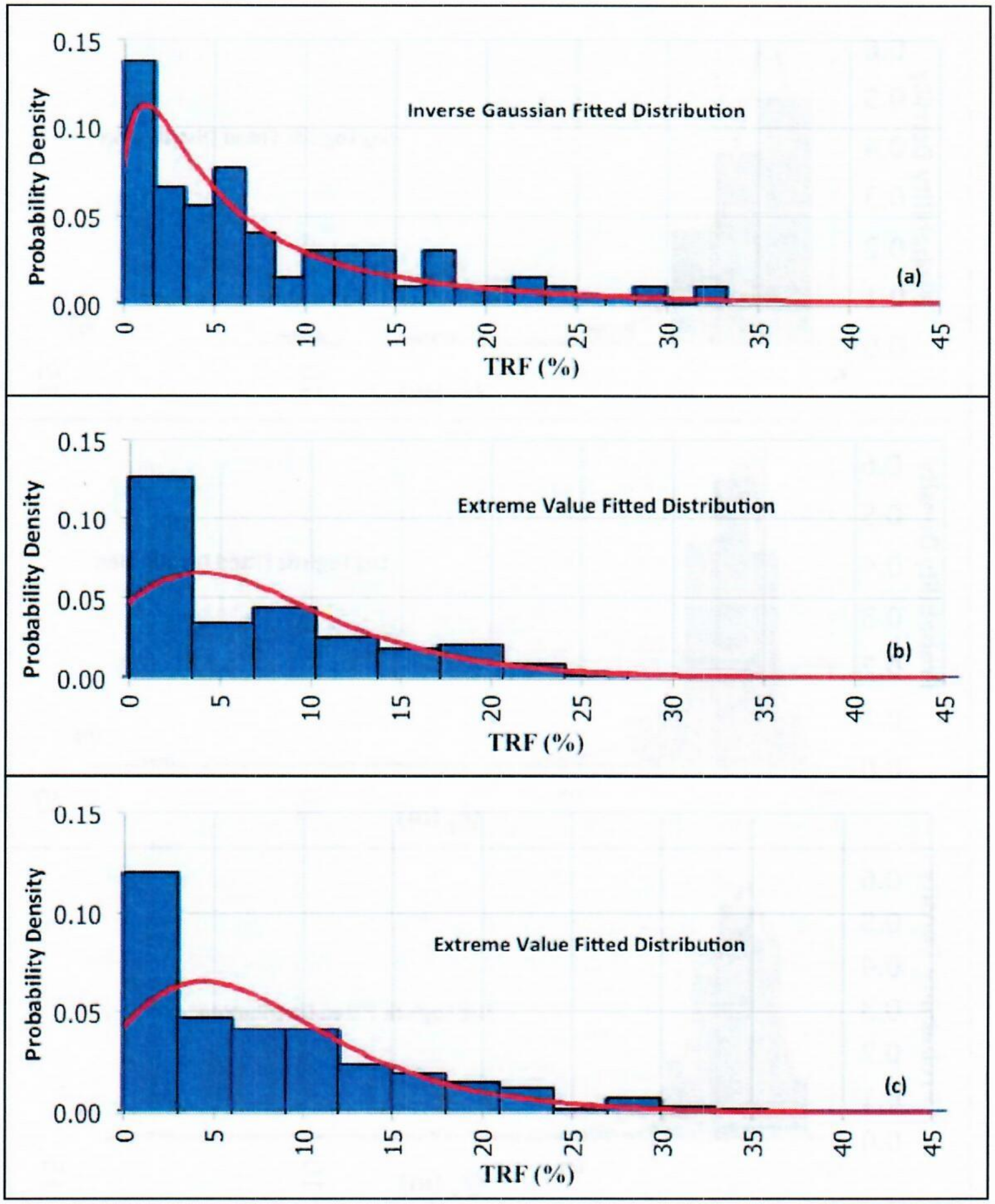


Figure 43. *Histogram and fitted probability distribution of TRF for (a) Upstream, (b) Downstream, and (c) total surface irrigation events over the entire study period*

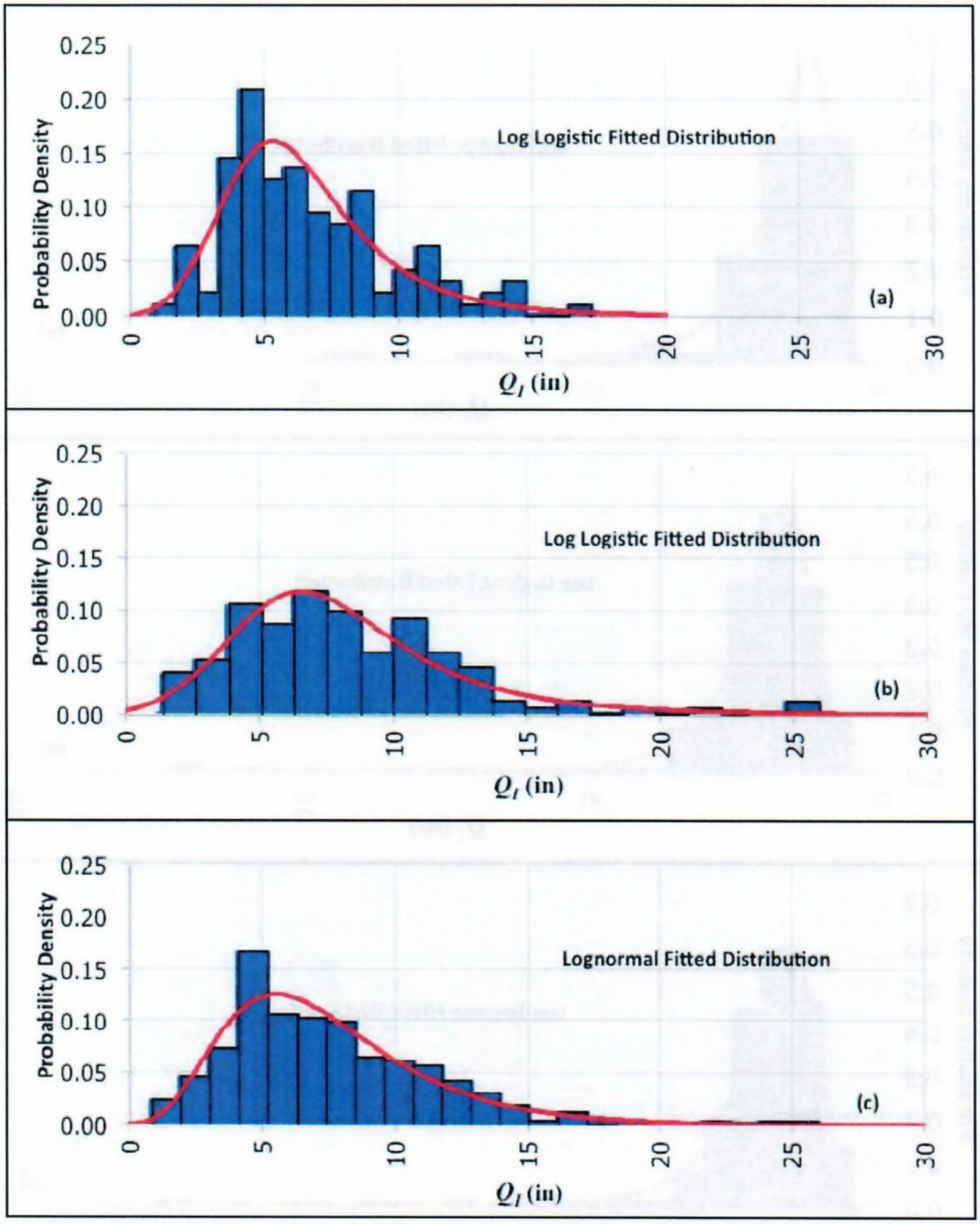


Figure 44. *Histogram and fitted probability distribution of Q_I for (a) Upstream, (b) Downstream, and (c) total surface irrigation events over the entire study period*

Exhibit M

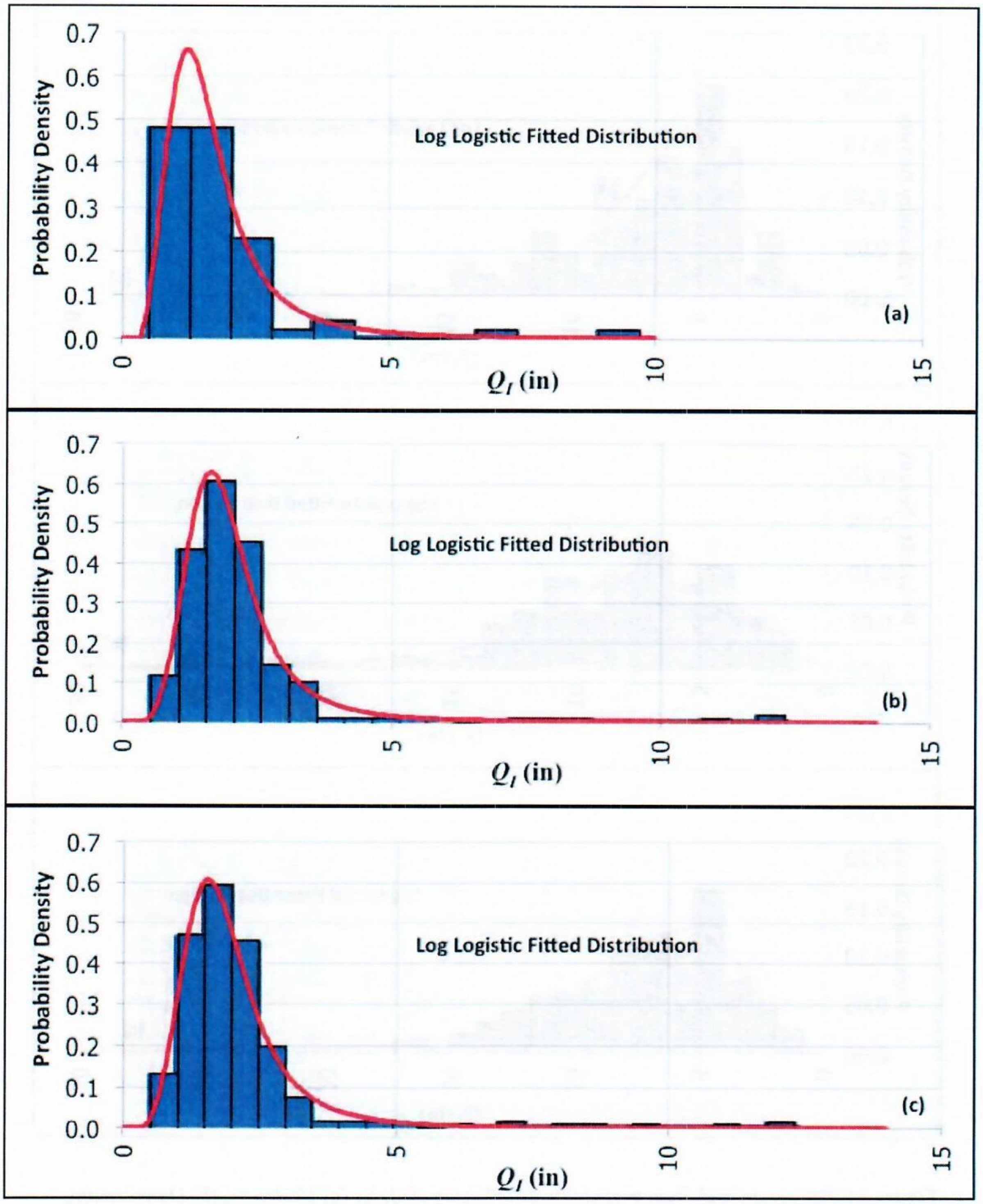


Figure 45. *Histogram and fitted probability distribution of Q_I for (a) Upstream, (b) Downstream, and (c) total sprinkler irrigation events over the entire study period*

Deep Percolation Fraction

Values of DPF (percent) for all surface irrigation events are plotted as frequency histograms and fitted distribution functions in Figure 46 for Upstream fields, Downstream fields, and for all fields. The mean value for the Upstream, Downstream, and total surface irrigation events was 19.5 percent, 27.7 percent, and 24.1 percent, respectively. About 90 percent of total DPF values ranged between about 0.0 percent and 60.0 percent, and the CV for the total events was about 97 percent.

For sprinkler-irrigation events, histograms and fitted probability distribution functions of DPF over the entire study period are shown in Figure 47 for Upstream fields, Downstream fields, and the total of all fields. The mean values of DPF for sprinkler irrigation events monitored on Upstream, Downstream, and total fields were 18.2 percent, 11.6 percent, and 13.0 percent, respectively. For about 90 percent of the total sprinkler irrigation events monitored values of DPF ranged between 0.0 percent and 55.1 percent. The CV of DPF for the total sprinkler irrigation events was about 176 percent.

Crop Evapotranspiration

Daily values of ET_r, ET_p, and ET_a estimated for the overall periods modeled by IDSCU for each irrigated field are summarized in files the available ARIDAD. Example plots of cumulative seasonal ET_r estimated with field atmometers, ET_p calculated using the ASCE Standardized Equation, and ET_a estimated from ReSET, are shown for portions of the 2008 season for fields US4B, US8, and US12 in Figure 48. Figure 49 presents similar plots for fields DS1, DS6B, and DS16. The plots reveal that typically seasonal values of ET_p for particular crops are less than seasonal values of ET_r, reflecting the effects of varying crop types and stages of growth. Also, values of ET_a are less than values of ET_p, possibly indicating the effects of salinity, available soil water, and cultural practices on limiting crop ET.

Upflux from Shallow Groundwater Table

Mean values of Q_U for Upstream, Downstream, and total fields are 8.8 percent, 3.3 percent and 5.5 percent of ET_a, respectively. In about 97 percent of Upstream fields Q_U was estimated to contribute to ET_a. In the Downstream region 84 percent of the monitored fields had Q_U that contributed to ET_a.

Irrigation Application Efficiency

About 90 percent of monitored surface irrigation events had computed values of E_a between 35.2 percent and 97.8 percent. For surface-irrigation events over the entire study period, frequency histograms and fitted probability distribution functions of E_a are shown in Figure 50 for Upstream fields, Downstream fields, and the total of all fields. The mean values for the Upstream, Downstream, and total surface irrigation events were 72.1 percent, 64.9 percent, and 67.9 percent, respectively. There were a number of deficit surface irrigations that were observed during the study, which yielded very little deep percolation and high values of E_a. Values of E_a for sprinkler irrigation events were routinely very high, averaging about 76.9 percent Upstream and 83.5 percent Downstream with an overall average of 82.0 percent, since there were no observed tailwater runoff losses and estimated DP losses typically were very low. Values of E_a for surface and sprinkler irrigation in the LARV are comparable to typical average values of 65 percent for surface graded furrow irrigation and 85 percent for center pivot sprinklers (with spray heads without end guns) reported by Howell (2003). Howell (2003) reports "attainable" efficiencies of 75 percent and 95 percent for these respective irrigation methods.

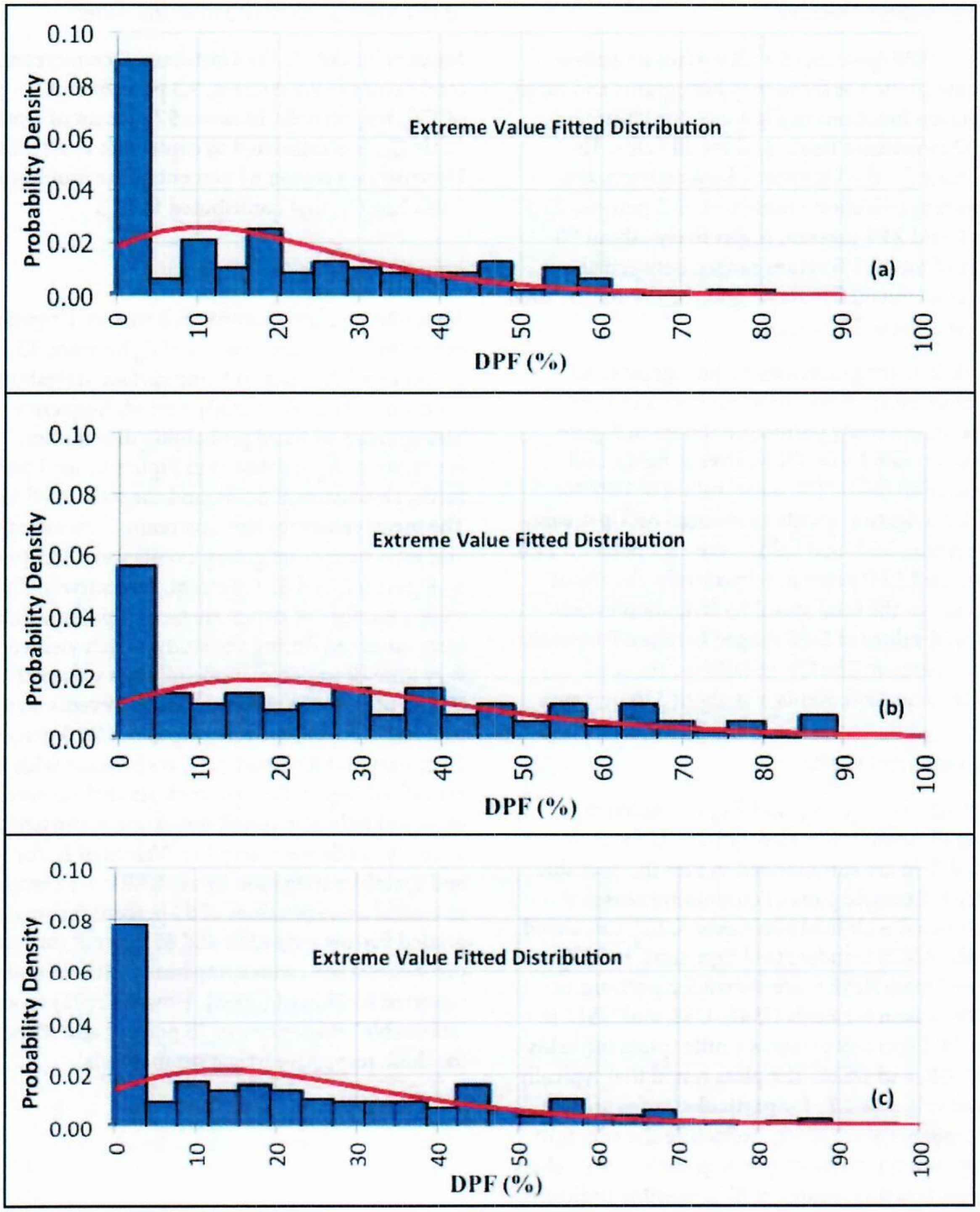


Figure 46. *Histogram and fitted probability distribution of DPF for (a) Upstream, (b) Downstream, and (c) total surface irrigation events over the entire study period*

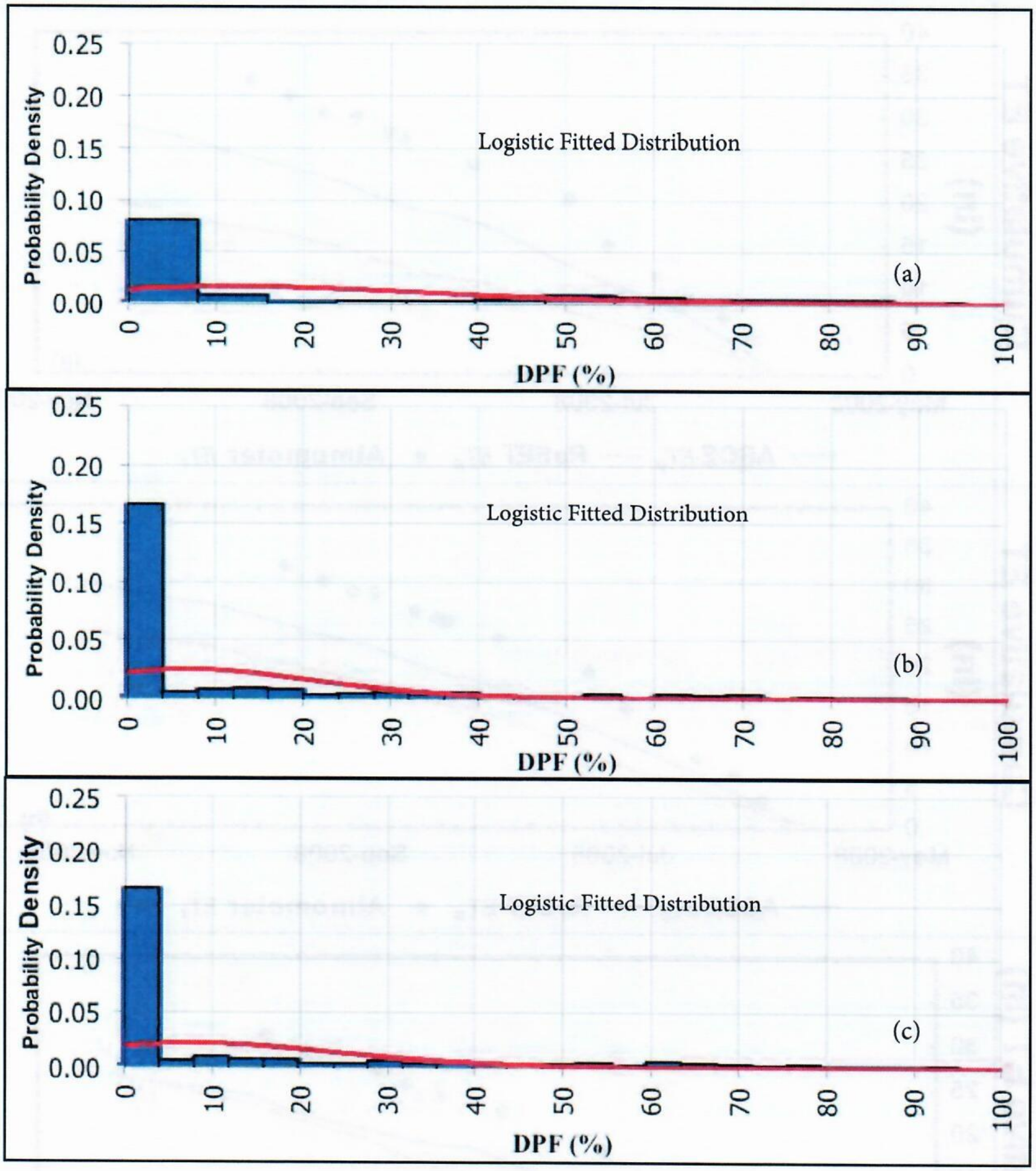


Figure 47. *Histogram and fitted probability distribution of DPF for (a) Upstream, (b) Downstream, and (c) total sprinkler irrigation events over the entire study period*

Exhibit M

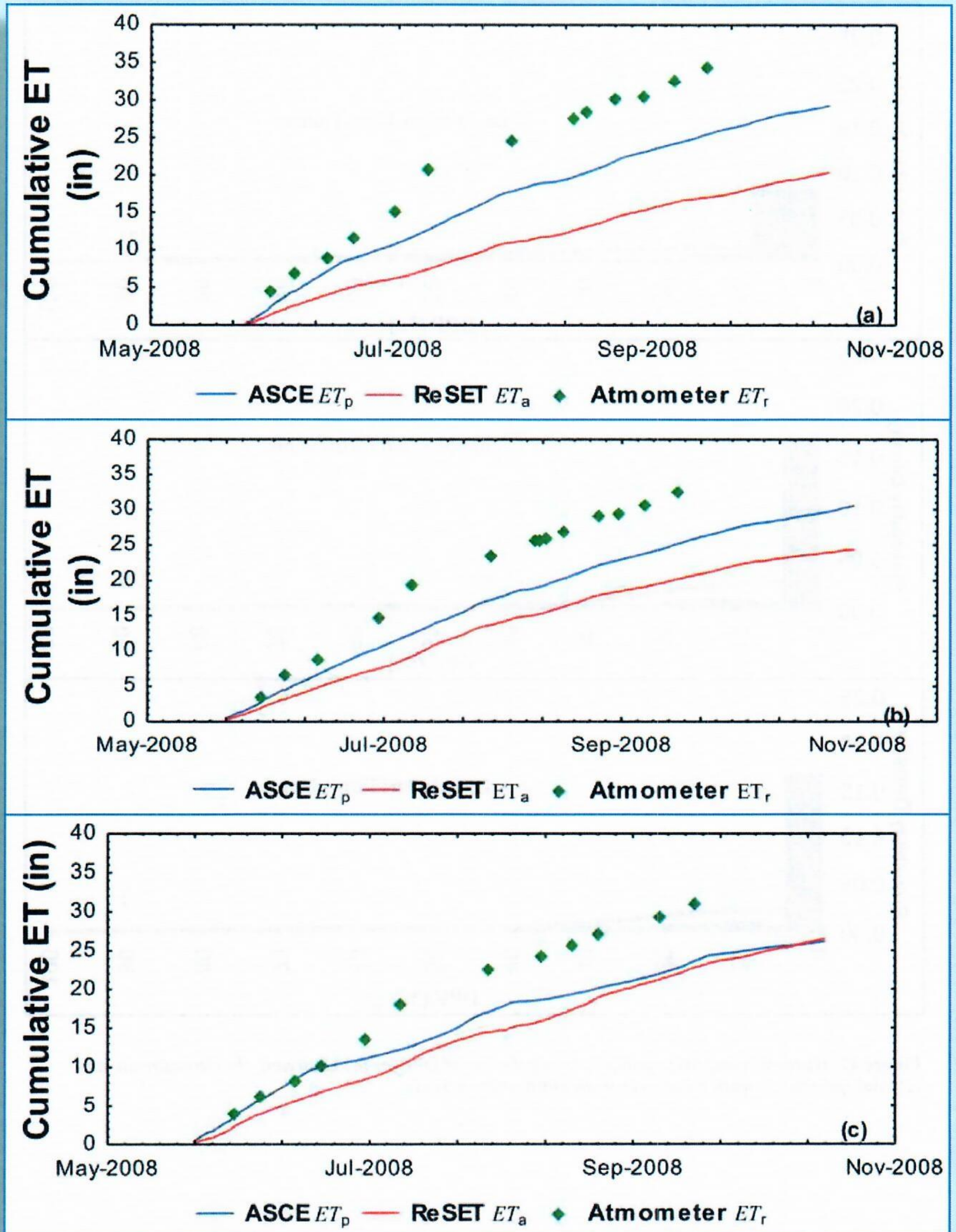


Figure 48. *ET_r estimated from field atmometers, ET_p calculated with the ASCE Standardized Equation, and ET_a estimated with ReSET, for portions of the 2008 irrigation season for (a) field US4B (b) field US8, and (c) field US12*

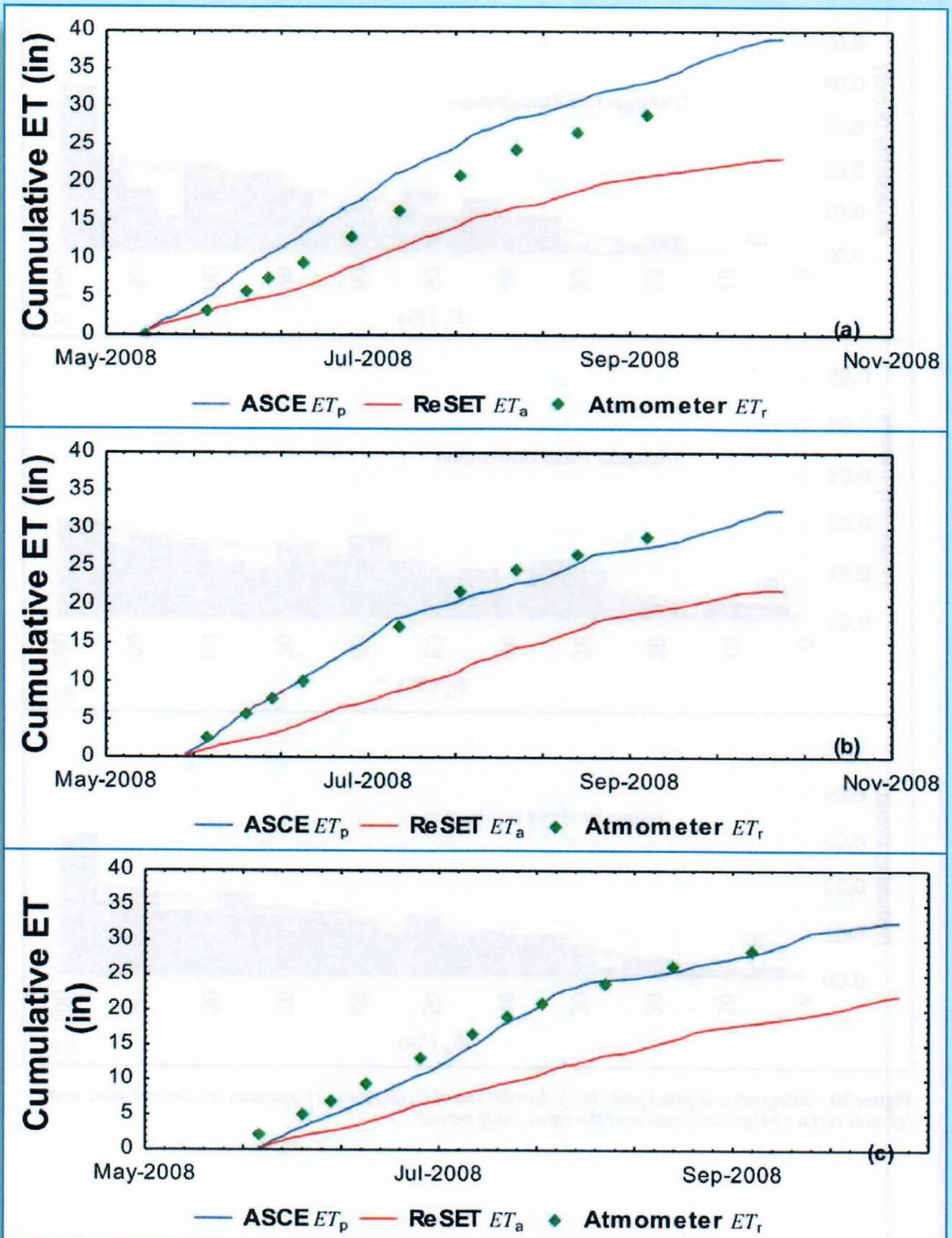


Figure 49. *ET_r estimated from field atmometers, ET_p calculated with the ASCE Standardized Equation, and ET_a estimated with ReSET, for portions of the 2008 irrigation season for (a) field DS1, (b) field DS6B, and (c) field DS16*

Exhibit M

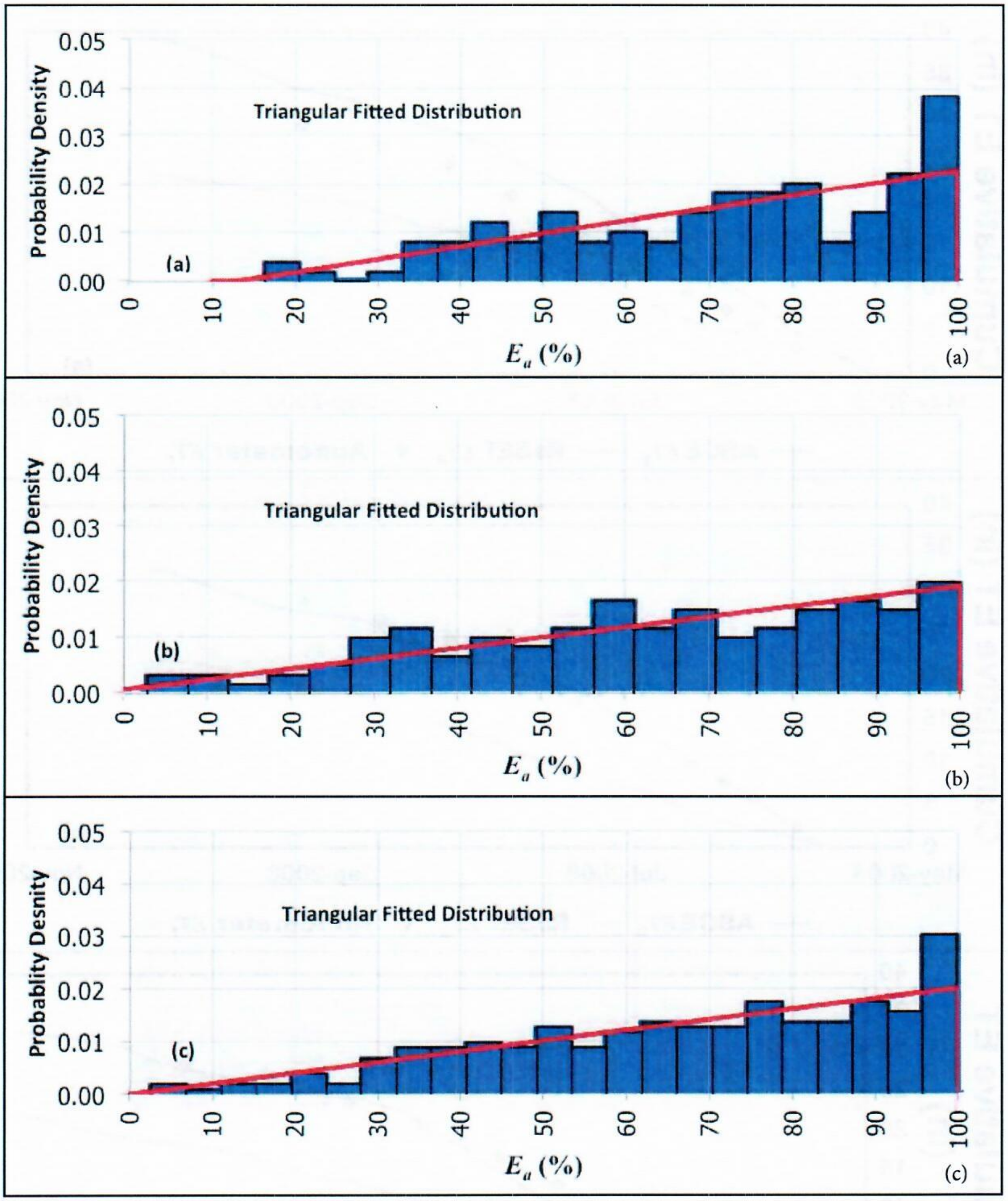


Figure 50. *Histogram and fitted probability distribution of E_a (%) for (a) Upstream, (b) Downstream, and (c) total surface irrigation events over the entire study period*

Salt Concentration and Loading to and from Fields

Summary statistics of estimated TDS concentrations in applied irrigation water and in tail water are presented in Table 9 for a number of surface irrigation events Upstream and Downstream. Similar statistics for sprinkler irrigation events are given in Table 10. TDS levels in sprinkler irrigation water in the Upstream region are markedly higher than those in surface water since the source for all but one of the eight sprinklers is groundwater pumping wells. On the other hand, the sprinklers in the Downstream region are supplied by canal water.

The higher the DPF value for a given irrigation event, the greater is the potential for leaching of salts out of the root zone soil profile. In fact, DPF often is referred to as the "leaching fraction" (Hoffman and Shalhevet 2007). Assuming the overall average DPF value of about 24 percent for surface irrigation, TDS levels in applied surface irrigation in the study regions typically would be acceptable for moderately sensitive crops under well-drained conditions (Pratt and Suarez 1990). However, many of the fields are underlain by shallow saline water tables which contribute upflux of dissolved salt back into the soil root zone. For sprinkler irrigated fields, with average DPF of only 13.0 percent and with higher TDS levels in applied irrigation water, the hazard to crop productivity is even greater, especially for fields irrigated from groundwater pumping wells.

Table 11 presents statistics of estimated salt loads in applied irrigation water, tail water runoff, and infiltrated water for surface irrigation events Upstream and Downstream. Average applied salt load per irrigation event was about 997 lb/ac over all investigated surface irrigated fields Upstream and about 2,480 lb/ac Downstream. Similar statistics are presented in Table 12 for sprinkler irrigation events. Over all investigated sprinkler irrigated fields, average applied salt load per irrigation event was about 1,217 lb/ac Upstream and about 446 lb/ac Downstream.

Field Soil Water Salinity

Box and whisker summary plots of the statistics of EC_e values estimated from EM38 surveys conducted midseason (typically July or August) on Upstream fields are presented in Figures 51 and 52. Figures 53 - 55 present the EC_e estimated from midseason EM38 surveys conducted on Downstream fields. Figure 56 presents example contour maps of EC_e for two surveyed fields. Similar maps of soil water salinity for surveys on the other fields are provided in files on the available ARIDAD.

The average EC_e in monitored fields within the Upstream Study Region ranged from 1.8 dS/m to 9.3 dS/m over all surveys conducted during the study period. Averages in Downstream fields were considerably higher, ranging from 2.7 dS/m to 12 dS/m. Figures 51 - 55 indicate that many of the fields contained areas where soil salinity exceeded the threshold of three to five dS/m above which crop yields typically are reduced for corn and alfalfa. Preliminary data on crop yields in relation to EC_e are presented in a following section.

Exhibit M

Table 9. *TDS in applied irrigation water and tail water for investigated surface irrigation events Upstream and Downstream*

Year	Number of Irrigation Events	TDS (mg/L) Minimum	Maximum	Average
Upstream Study Region				
Applied Irrigation Water				
2004	8	521.7	975.7	633.9
2005	57	300.4	710.1	424.6
2006	41	172.8	5421.9	795.1
2008	24	115.5	1059.5	304.5
All Years	130	115.5	5421.9	532.2
Tail Water				
2004	-	-	-	-
2005	-	-	-	-
2006	-	-	-	-
2008	20	160.6	1040.8	409.7
All Years	20	160.6	1040.8	409.7
Downstream Study Region				
Applied Irrigation Water				
2004	5	842.5	1078.4	975.1
2005	29	692.7	3107.3	1308.0
2006	33	628.2	2657.3	1340.2
2007	37	158.9	3140.4	1090.2
2008	44	525.8	3175.3	987.7
All years	148	158.9	3175.3	1154.3
Tail Water				
2004	-	-	-	-
2005	-	-	-	-
2006	-	-	-	-
2007	9	756.5	1419.1	1037.3
2008	11	471.2	1354.9	969.2
All years	20	471.2	1419.1	999.9

Table 10. *TDS in applied irrigation water and tail water for investigated sprinkler irrigation events Upstream and Downstream*

Year	Number of Irrigation Events	TDS (mg/L) Minimum	Maximum	Average
Upstream Study Region				
Applied Irrigation Water				
2004	-	-	-	-
2005	15	511.3	4157.2	1264.9
2006	15	336.8	3509.5	1239.6
2008	38	298.6	2888.6	1692.2
All Years	68	298.6	4157.2	1498.1
Tail Water				
2004	-	-	-	-
2005	-	-	-	-
2006	-	-	-	-
2008	-	-	-	-
All Years	-	-	-	-
Downstream Study Region				
Applied Irrigation Water				
2004	N/A	N/A	N/A	N/A
2005	12	691.9	899.1	783.7
2006	27	628.2	1559.8	1031.7
2007	54	67.5	1592.4	864.5
2008	150	483.1	2884.2	816.0
All years	243	67.5	2884.2	849.1
Tail Water				
2004	-	-	-	-
2005	-	-	-	-
2006	-	-	-	-
2007	-	-	-	-
2008	-	-	-	-
All years	-	-	-	-

Exhibit M

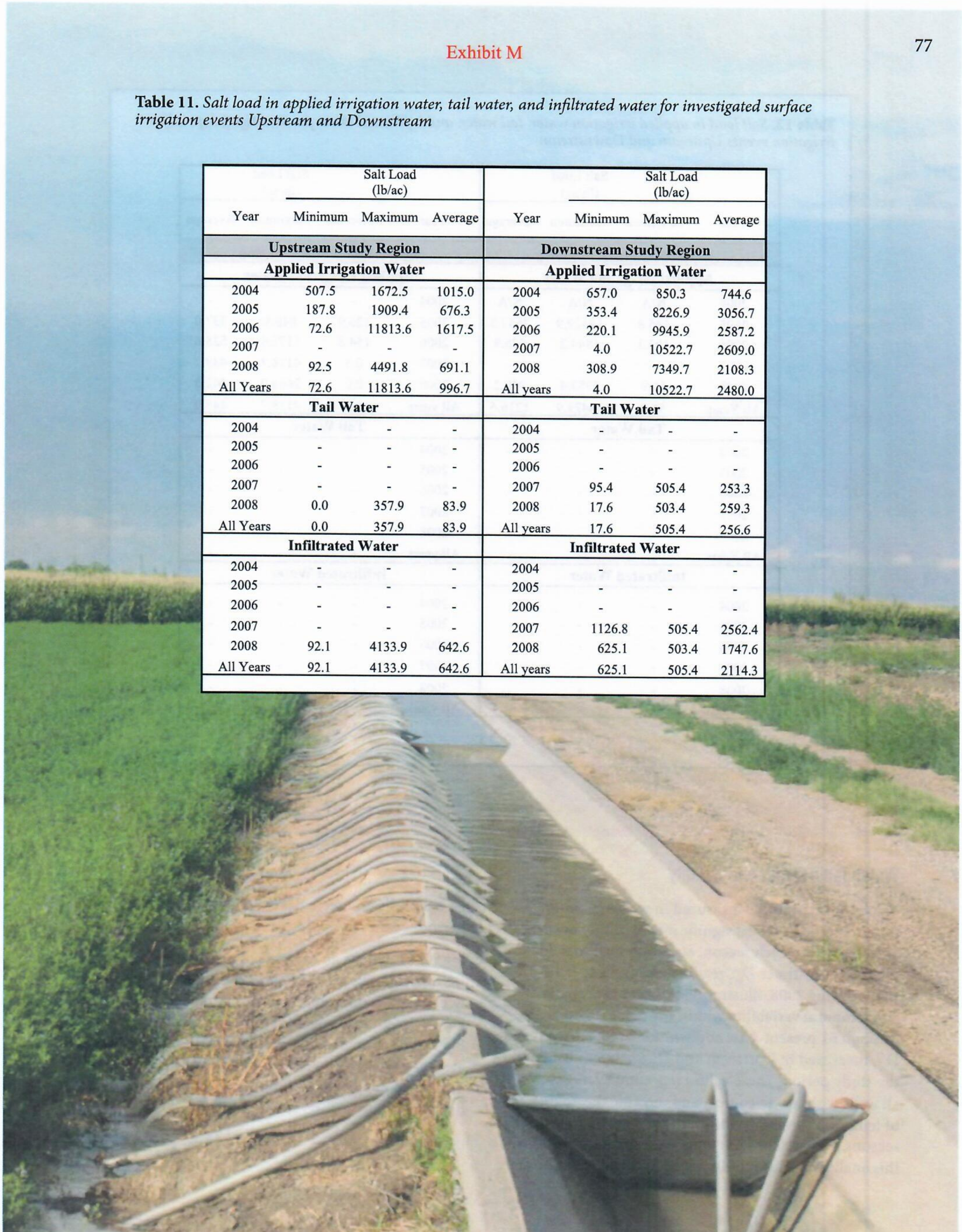


Table 11. *Salt load in applied irrigation water, tail water, and infiltrated water for investigated surface irrigation events Upstream and Downstream*

Year	Salt Load (lb/ac) Minimum	Maximum	Average	Year	Salt Load (lb/ac) Minimum	Maximum	Average
Upstream Study Region				**Downstream Study Region**			
Applied Irrigation Water				**Applied Irrigation Water**			
2004	507.5	1672.5	1015.0	2004	657.0	850.3	744.6
2005	187.8	1909.4	676.3	2005	353.4	8226.9	3056.7
2006	72.6	11813.6	1617.5	2006	220.1	9945.9	2587.2
2007	-	-	-	2007	4.0	10522.7	2609.0
2008	92.5	4491.8	691.1	2008	308.9	7349.7	2108.3
All Years	72.6	11813.6	996.7	All years	4.0	10522.7	2480.0
Tail Water				**Tail Water**			
2004	-	-	-	2004	-	-	-
2005	-	-	-	2005	-	-	-
2006	-	-	-	2006	-	-	-
2007	-	-	-	2007	95.4	505.4	253.3
2008	0.0	357.9	83.9	2008	17.6	503.4	259.3
All Years	0.0	357.9	83.9	All years	17.6	505.4	256.6
Infiltrated Water				**Infiltrated Water**			
2004	-	-	-	2004	-	-	-
2005	-	-	-	2005	-	-	-
2006	-	-	-	2006	-	-	-
2007	-	-	-	2007	1126.8	505.4	2562.4
2008	92.1	4133.9	642.6	2008	625.1	503.4	1747.6
All Years	92.1	4133.9	642.6	All years	625.1	505.4	2114.3

Exhibit M

Table 12. *Salt load in applied irrigation water, tail water, and infiltrated water for investigated sprinkler irrigation events Upstream and Downstream*

Year	Salt Load (lb/ac) Minimum	Maximum	Average	Year	Salt Load (lb/ac) Minimum	Maximum	Average
Upstream Study Region				**Downstream Study Region**			
Applied Irrigation Water				**Applied Irrigation Water**			
2004	N/A	N/A	N/A	2004	-	-	-
2005	145.8	18429.9	2657.3	2005	126.9	848.8	337.0
2006	103.3	1844.2	475.9	2006	154.8	1172.8	525.6
2007	-	-	-	2007	0.3	4118.7	439.7
2008	56.9	6983.4	940.2	2008	0.0	2666.0	442.5
All Years	56.9	18429.9	1216.6	All years	0.0	4118.7	445.9
Tail Water				**Tail Water**			
2004	-	-	-	2004	-	-	-
2005	-	-	-	2005	-	-	-
2006	-	-	-	2006	-	-	-
2007	-	-	-	2007	-	-	-
2008	-	-	-	2008	-	-	-
All Years	-	-	-	All years	-	-	-
Infiltrated Water				**Infiltrated Water**			
2004	-	-	-	2004	-	-	-
2005	-	-	-	2005	-	-	-
2006	-	-	-	2006	-	-	-
2007	-	-	-	2007	-	-	-
2008	-	-	-	2008	-	-	-
All Years	-	-	-	All years	-	-	-

Water Table Depth and Salinity

Values of D_{wt} and EC measured in wells within the monitored fields reveal significant variability over the seasons, within each season, and from field to field. Figure 57 illustrates D_{wt} readings for wells in field DS11 during 2008, illustrating the degree of spatial and temporal variability within the fields. Figures 58 through 61 present "box and whisker" plots of averaged D_{wt} measured in Upstream and Downstream fields over the study period. These values represent averages over all wells within a given field and indicate the degree of temporal variability within the respective irrigation seasons. Dry well observations were not considered in this analysis. Fields not displayed on Figures 58 through 61 had wells that were dry for the entire observation period.

Figure 62 depicts an example of seasonal variation of EC among wells for field DS11 during 2008. Box and whisker plots of average EC measured on Upstream and Downstream fields over the study period are given in Figures 63 through 66, respectively. These EC values are averaged among all wells in a particular field. Fields not displayed on Figures 63 through 66 had wells that were dry for the entire observation period.

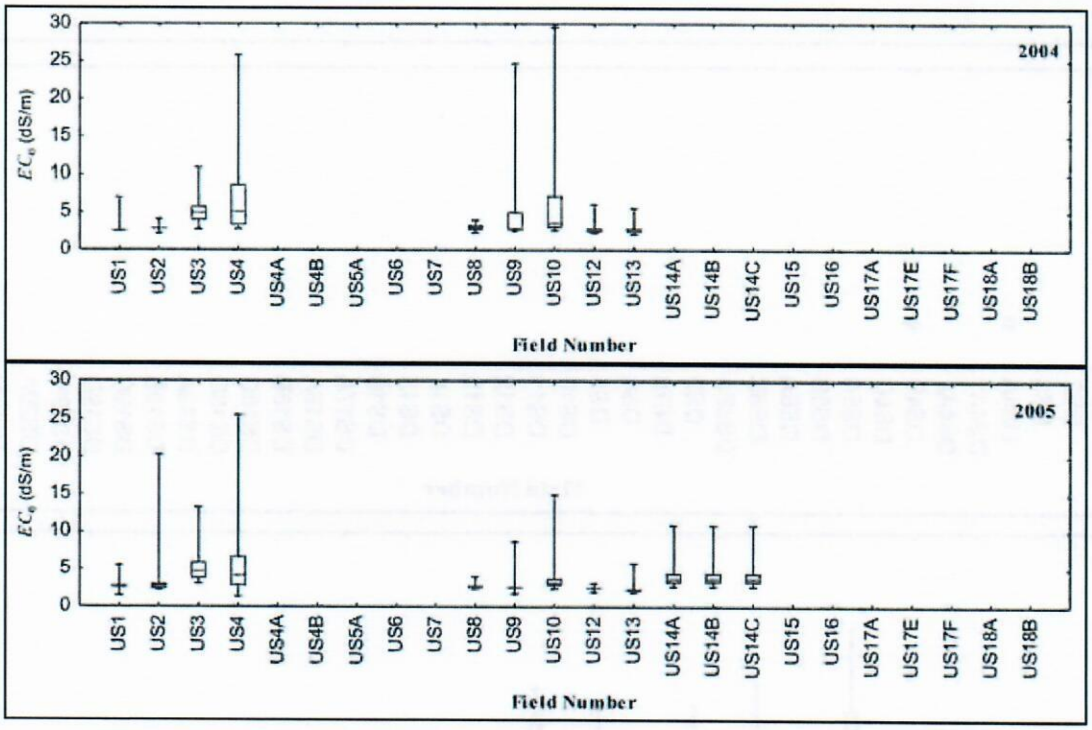


Figure 51. *Box and whisker plots of EC_e estimated from midseason EM38 surveys on monitored fields in the Upstream Study Region in 2004 and 2005. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

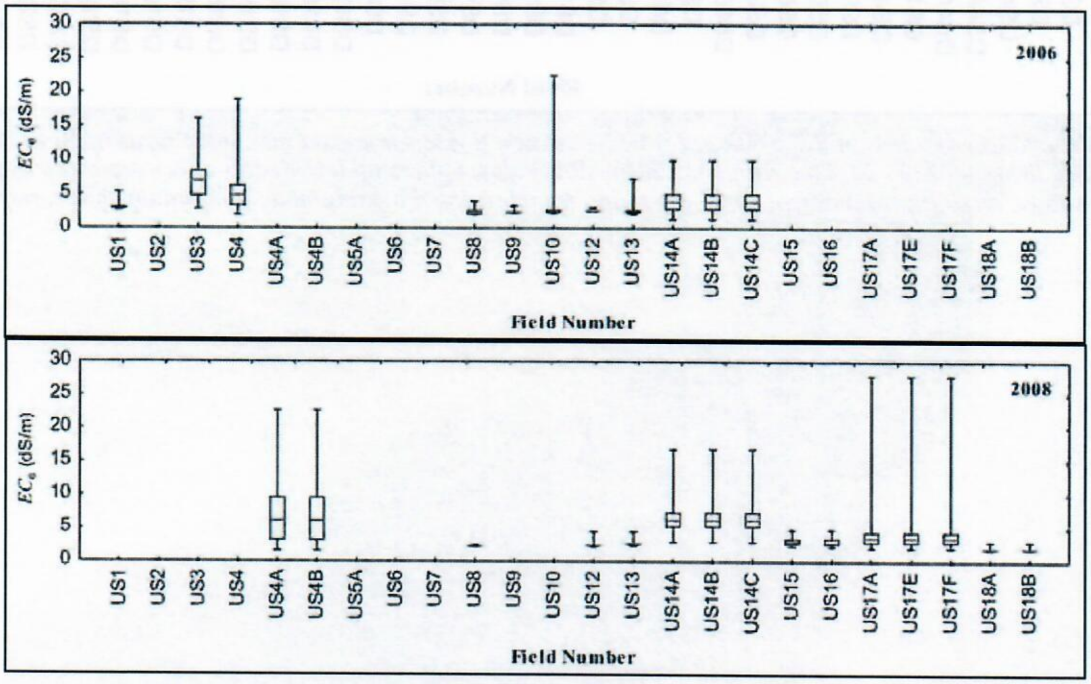


Figure 52. *Box and whisker plots of EC_e estimated from midseason EM38 surveys on monitored fields in the Upstream Study Region in 2006 and 2008. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively. Plots for fields US4, US5A, US9, US12, US14A, US14B, and US14C for 2006 are for values surveyed in June (July or August surveys were not available). The plot for field US7 for 2006 is based upon values surveyed during November.*

Exhibit M

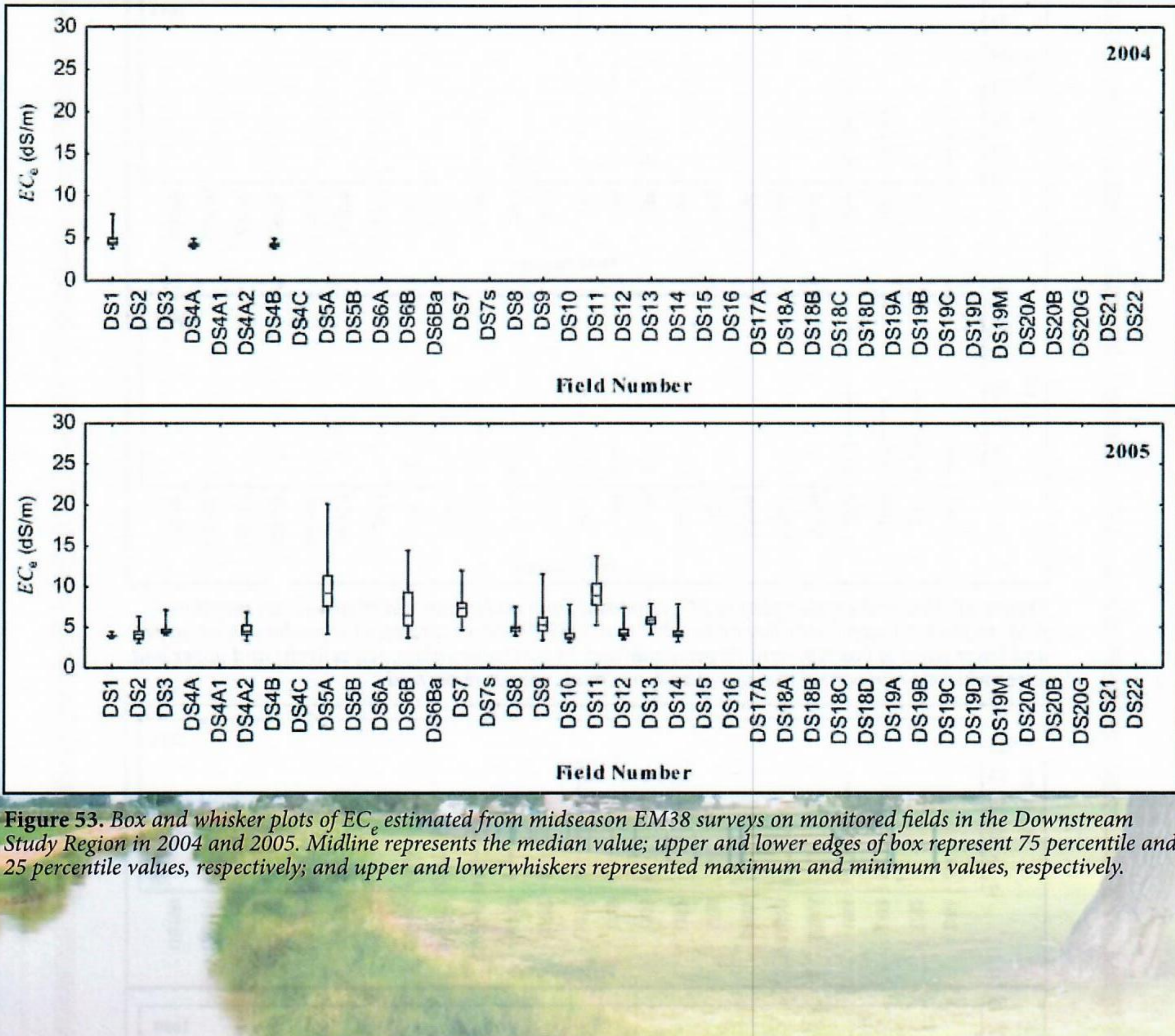


Figure 53. *Box and whisker plots of EC_e estimated from midseason EM38 surveys on monitored fields in the Downstream Study Region in 2004 and 2005. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lowerwhiskers represented maximum and minimum values, respectively.*

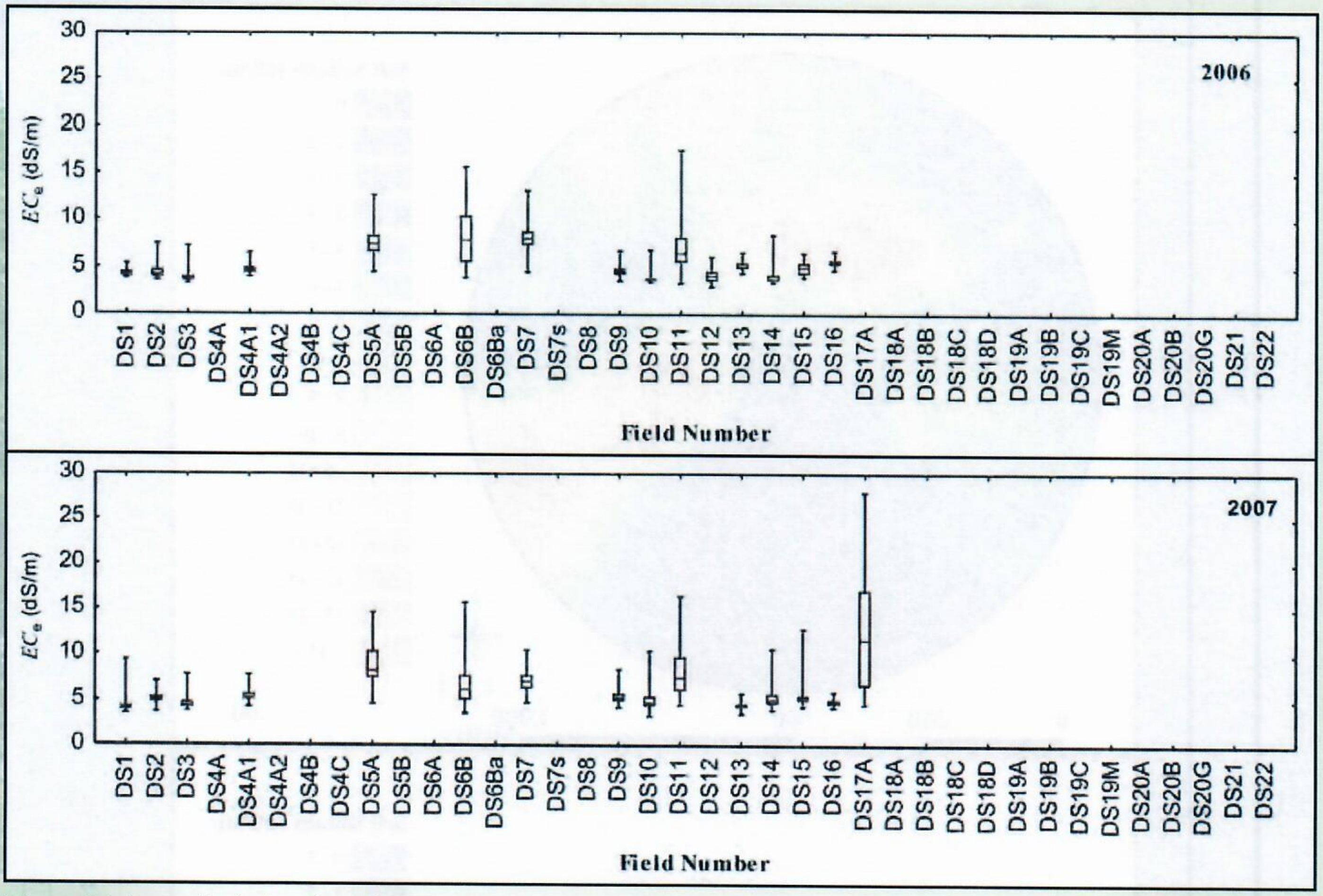


Figure 54. *Box and whisker plots of EC_e estimated from midseason EM38 surveys on monitored fields in the Downstream Study Region in 2006 and 2007. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively. The plot for field DS1 for 2006 are for values surveyed in June (July or August surveys were not available), for field DS13 for values surveyed during May, and for fields DS15 and DS16 for values surveyed during December.*

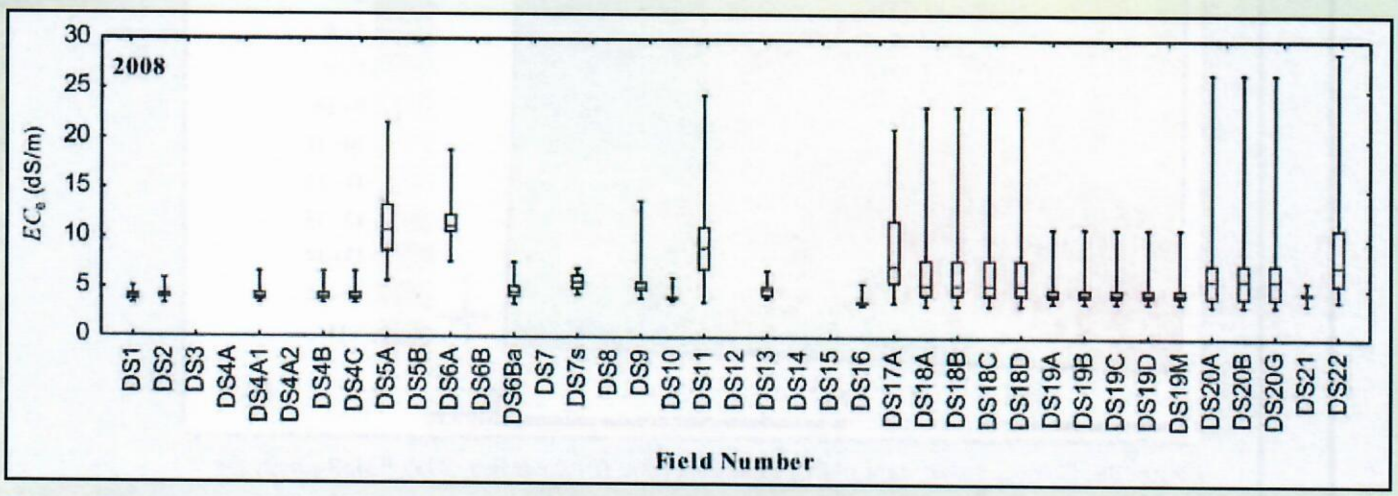


Figure 55. *Box and whisker plots of EC_e estimated from midseason EM38 surveys on monitored fields in the Downstream Study Region in 2008. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

Exhibit M

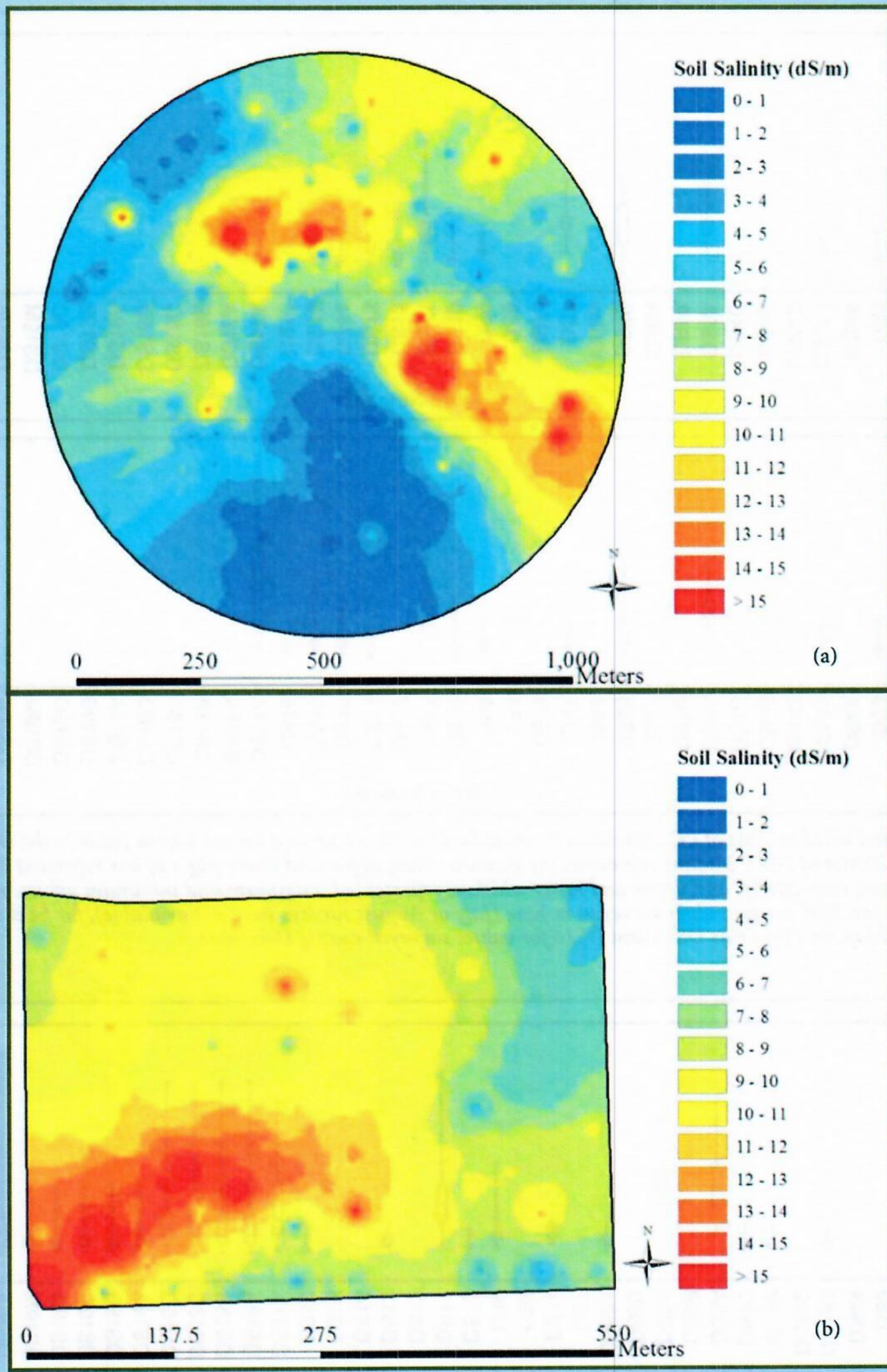


Figure 56. *Color contour maps of EC_e estimated from (a) the July 8, 2008 EM38 survey for field US04, and (b) the June 3, 2008 EM38 survey for field DS11*

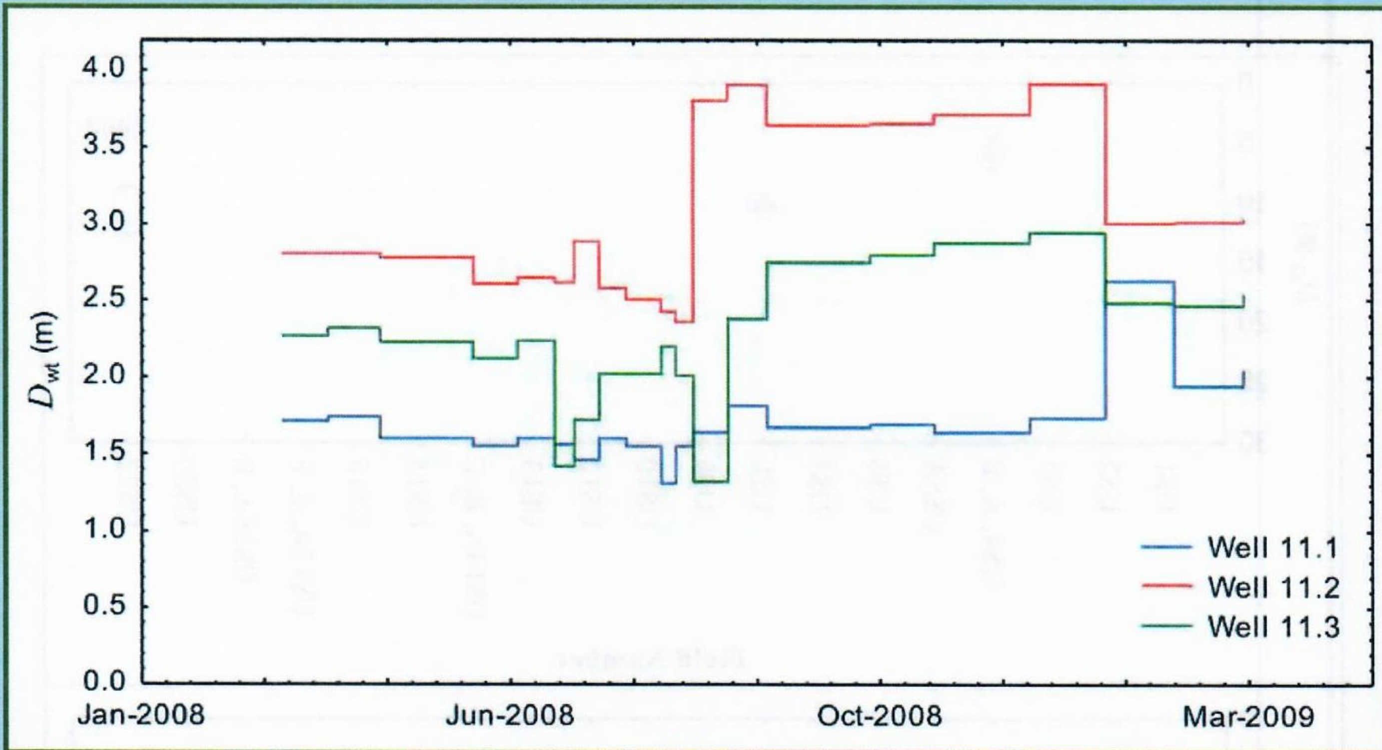
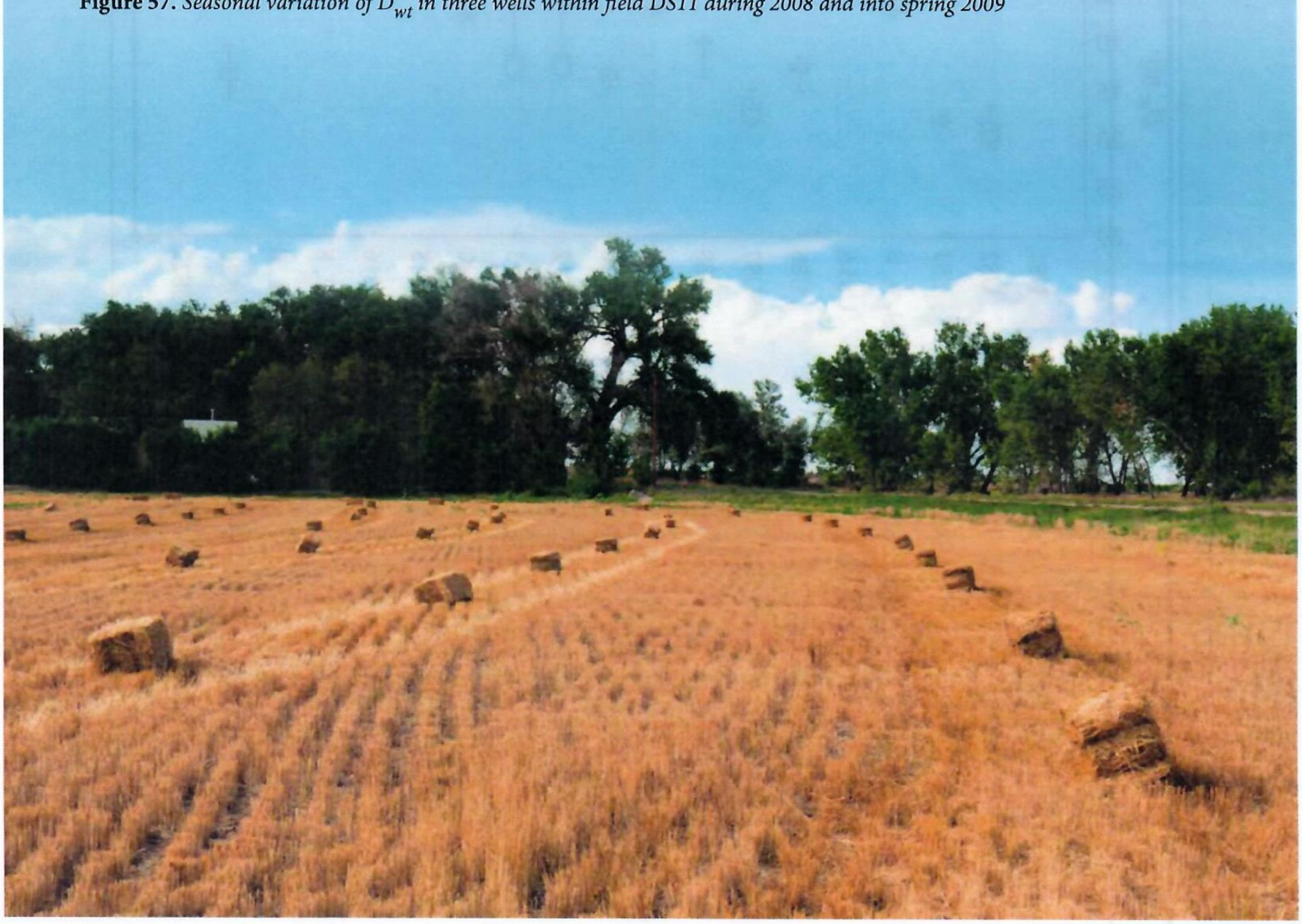


Figure 57. *Seasonal variation of D_{wt} in three wells within field DS11 during 2008 and into spring 2009*



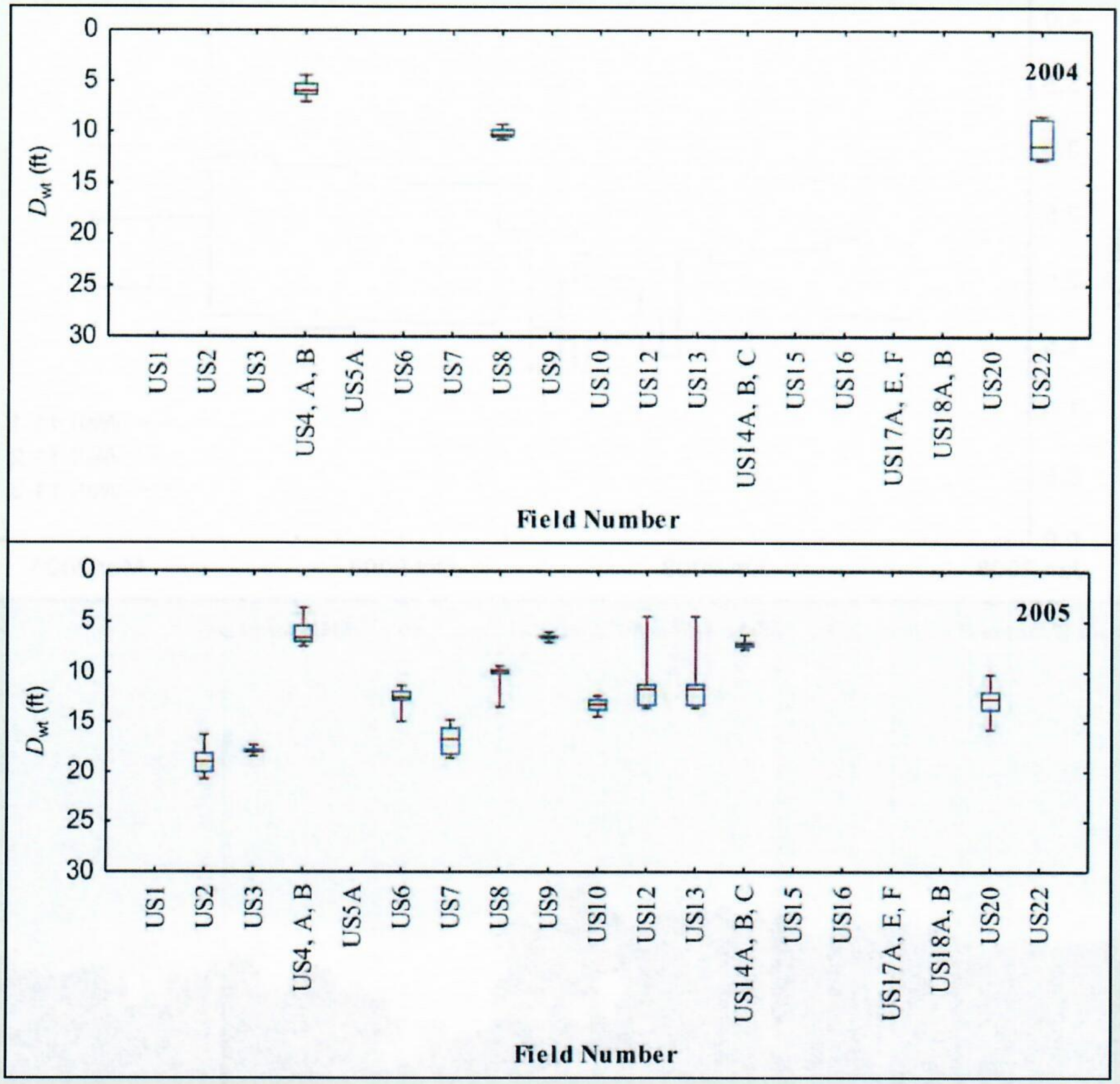


Figure 58. *Box and whisker plots of D_{wt} values measured on fields in the Upstream Study Region for years 2004 and 2005. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

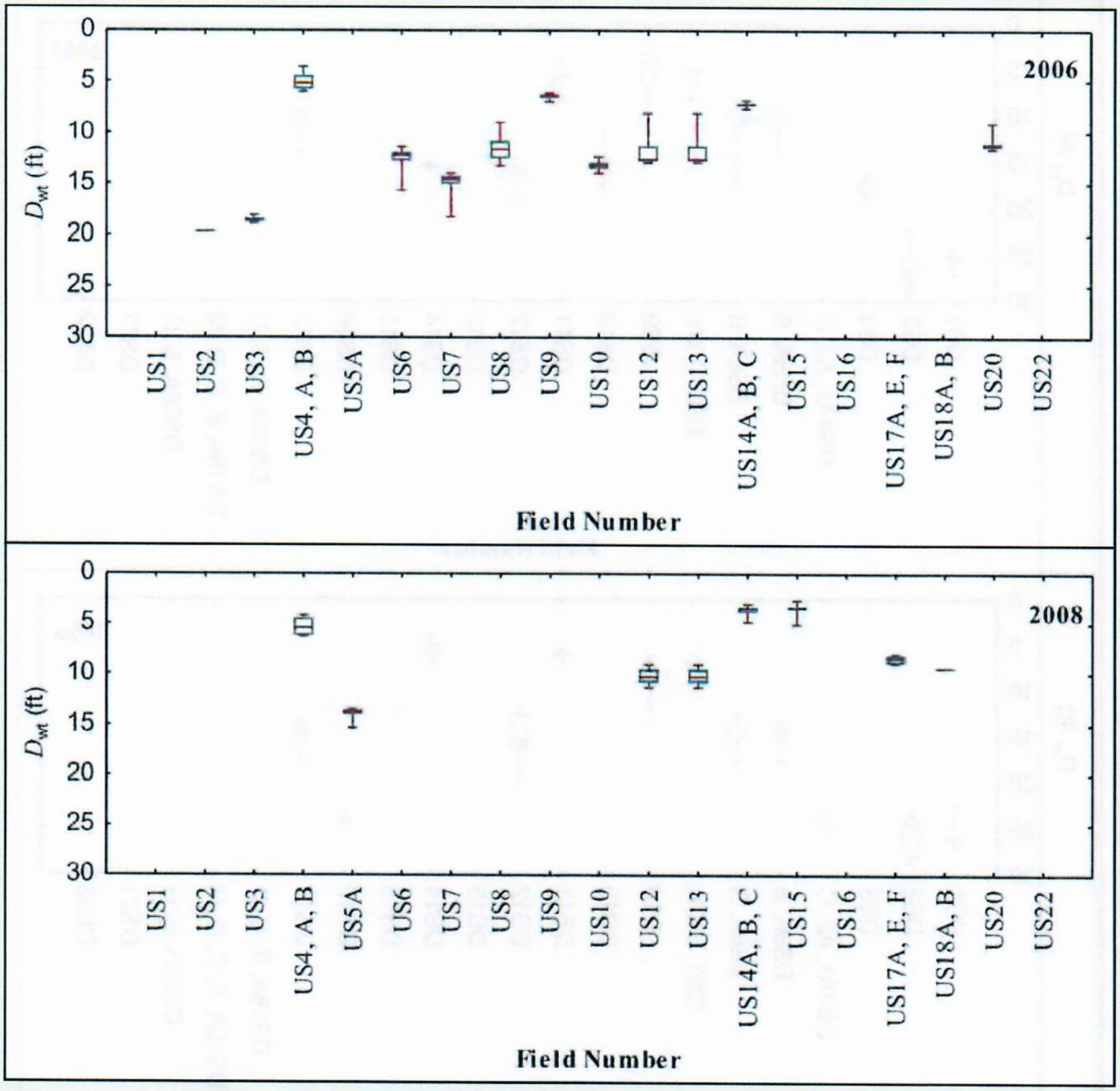


Figure 59. *Box and whisker plots of D_{wt} values measured on fields in the Upstream Study Region for years 2006 and 2008. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

Exhibit M

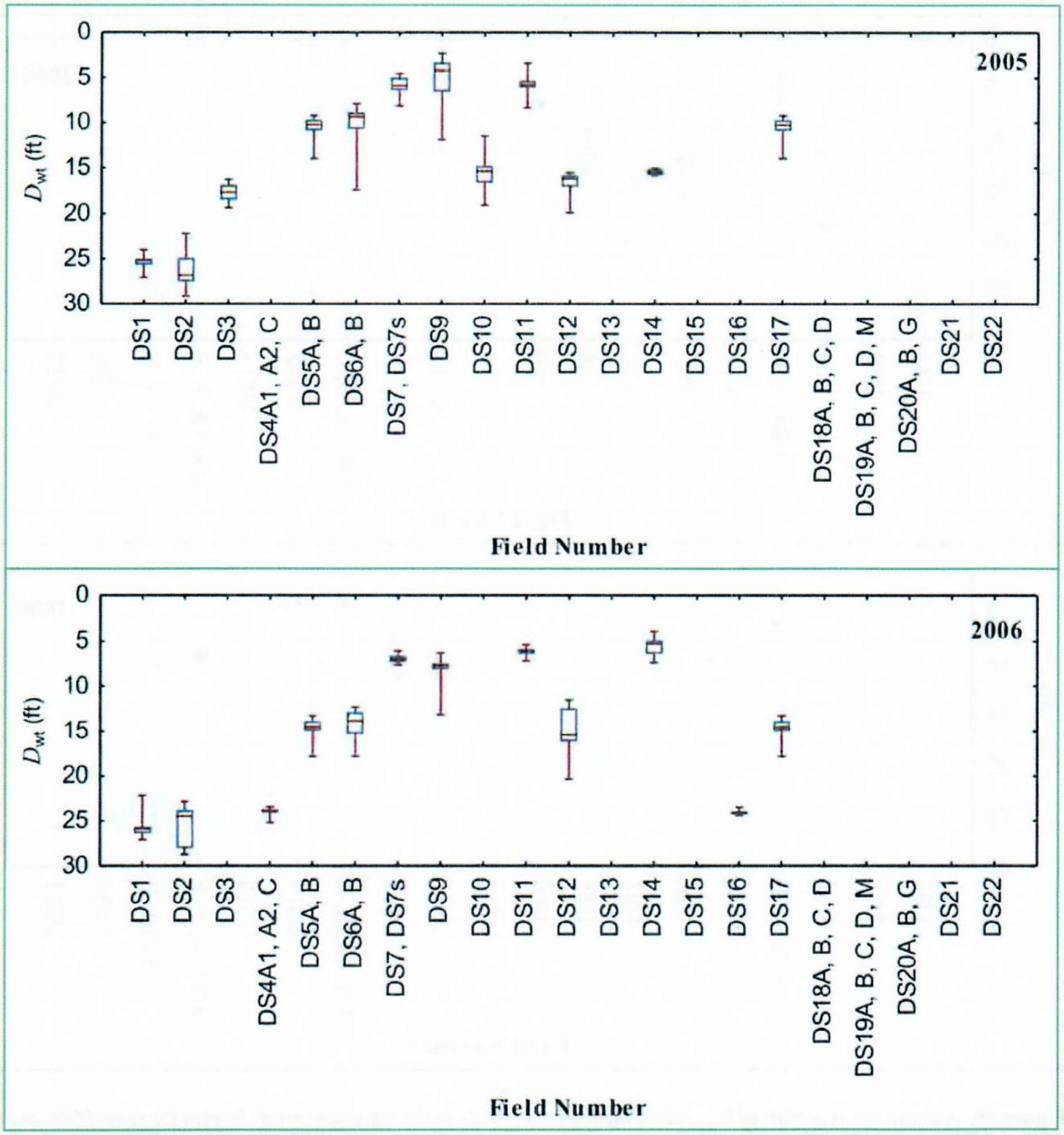


Figure 60. *Box and whisker plots of D_{wt} values measured on fields in the Downstream Study Region for years 2005 and 2006. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

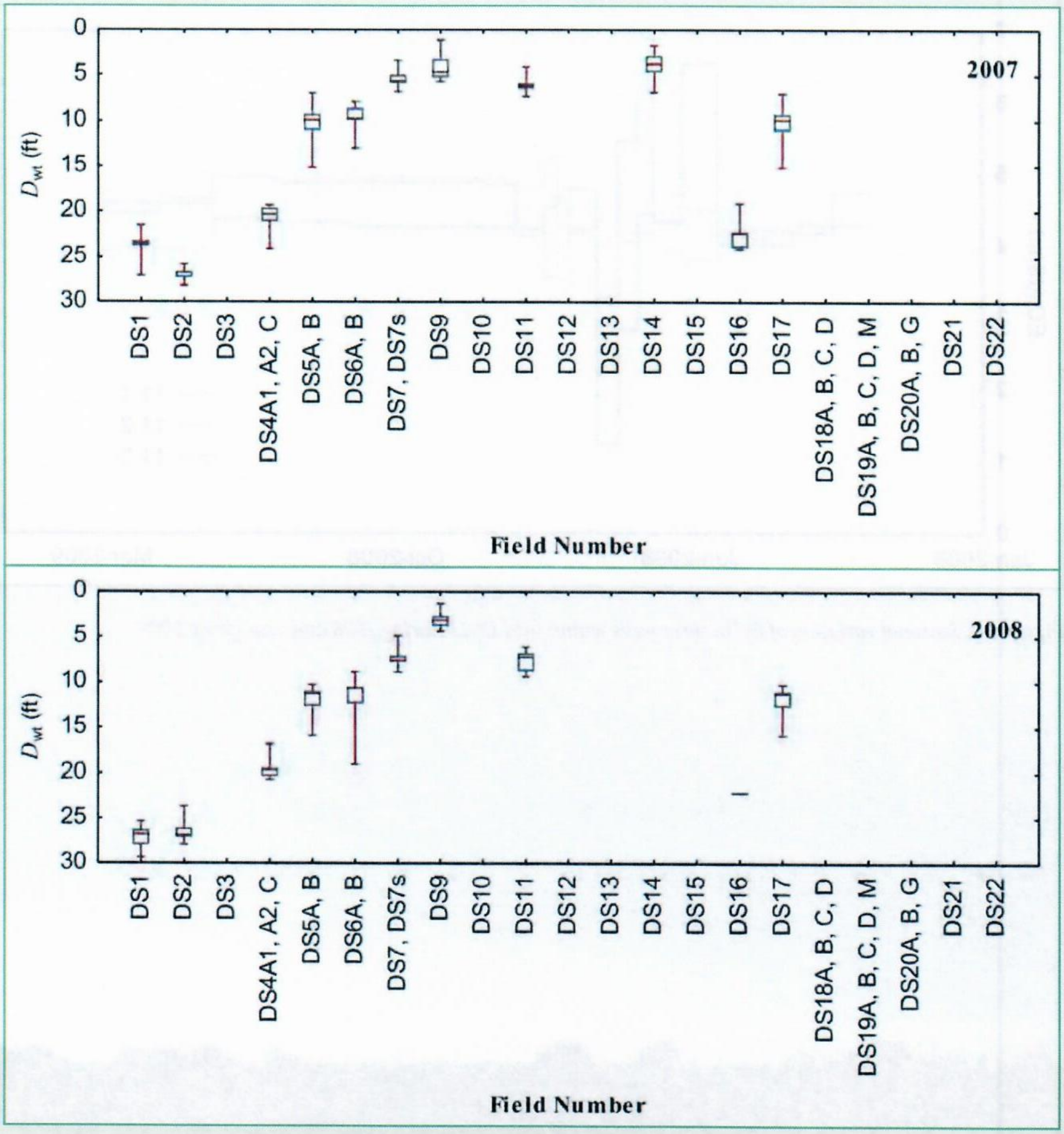


Figure 61. *Box and whisker plots of D_{wt} values measured on fields in the Downstream Study Region for years 2005, 2006, 2007, and 2008. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

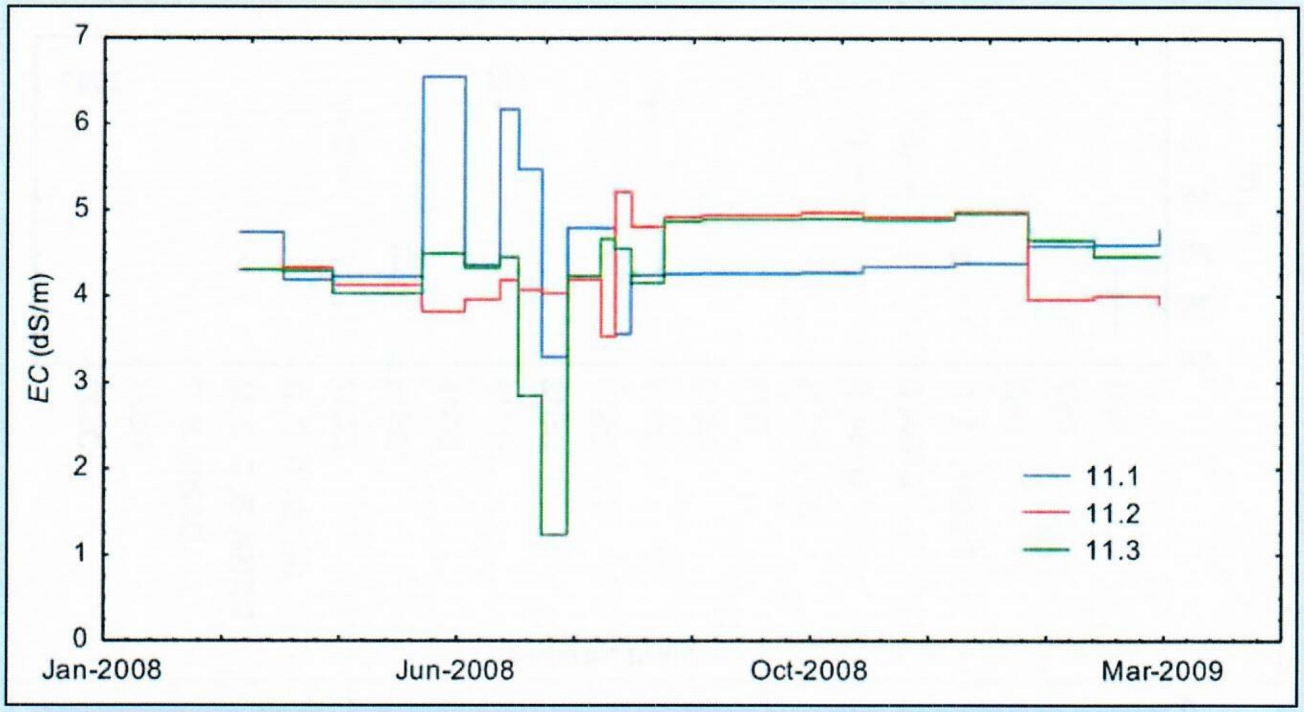


Figure 62. *Seasonal variation of EC in three wells within field DS11 during 2008 and into spring 2009*

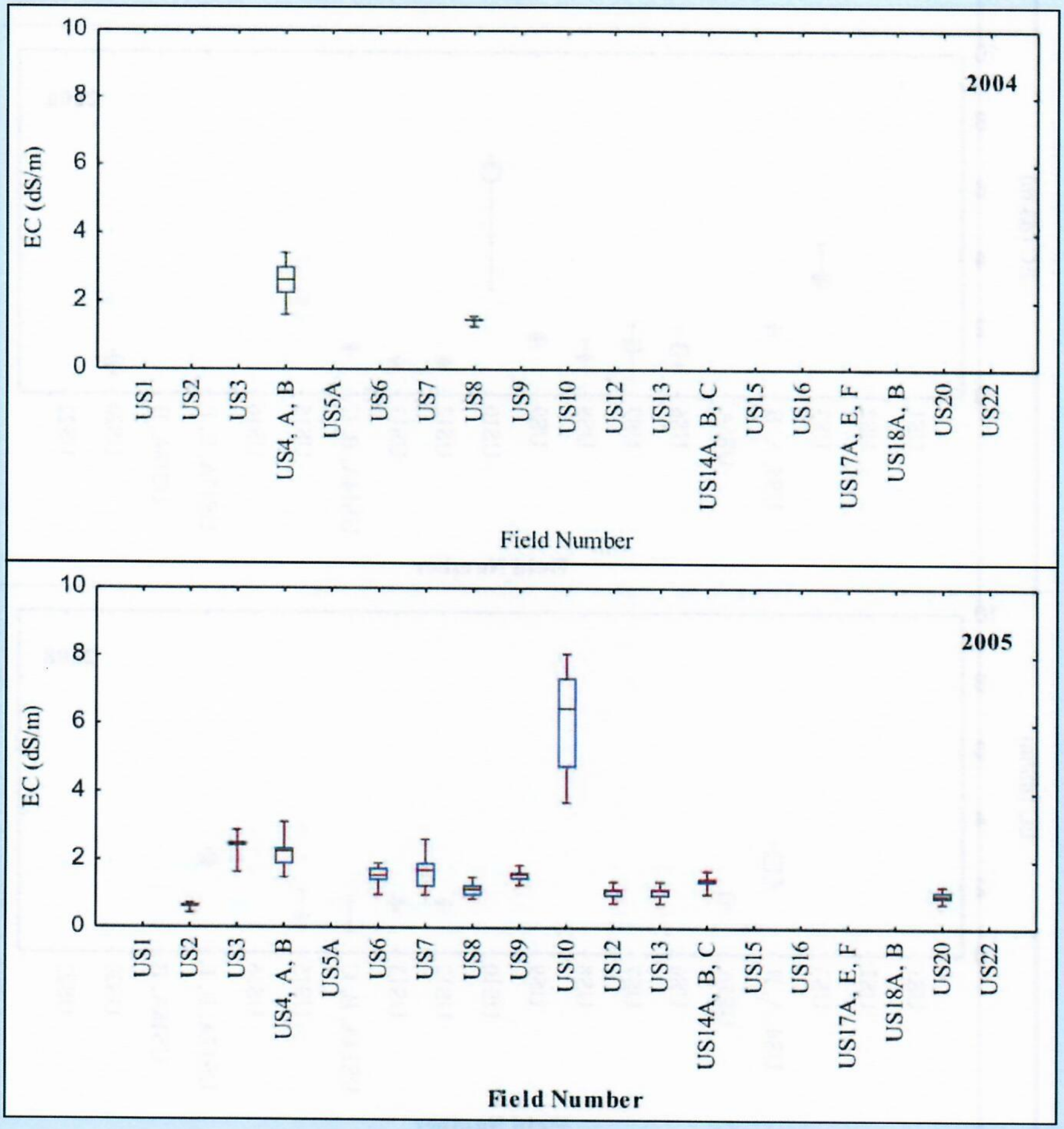


Figure 63. *Box and whisker plots of EC values measured on fields in the Upstream Study Region for years 2004 and 2005. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

Exhibit M

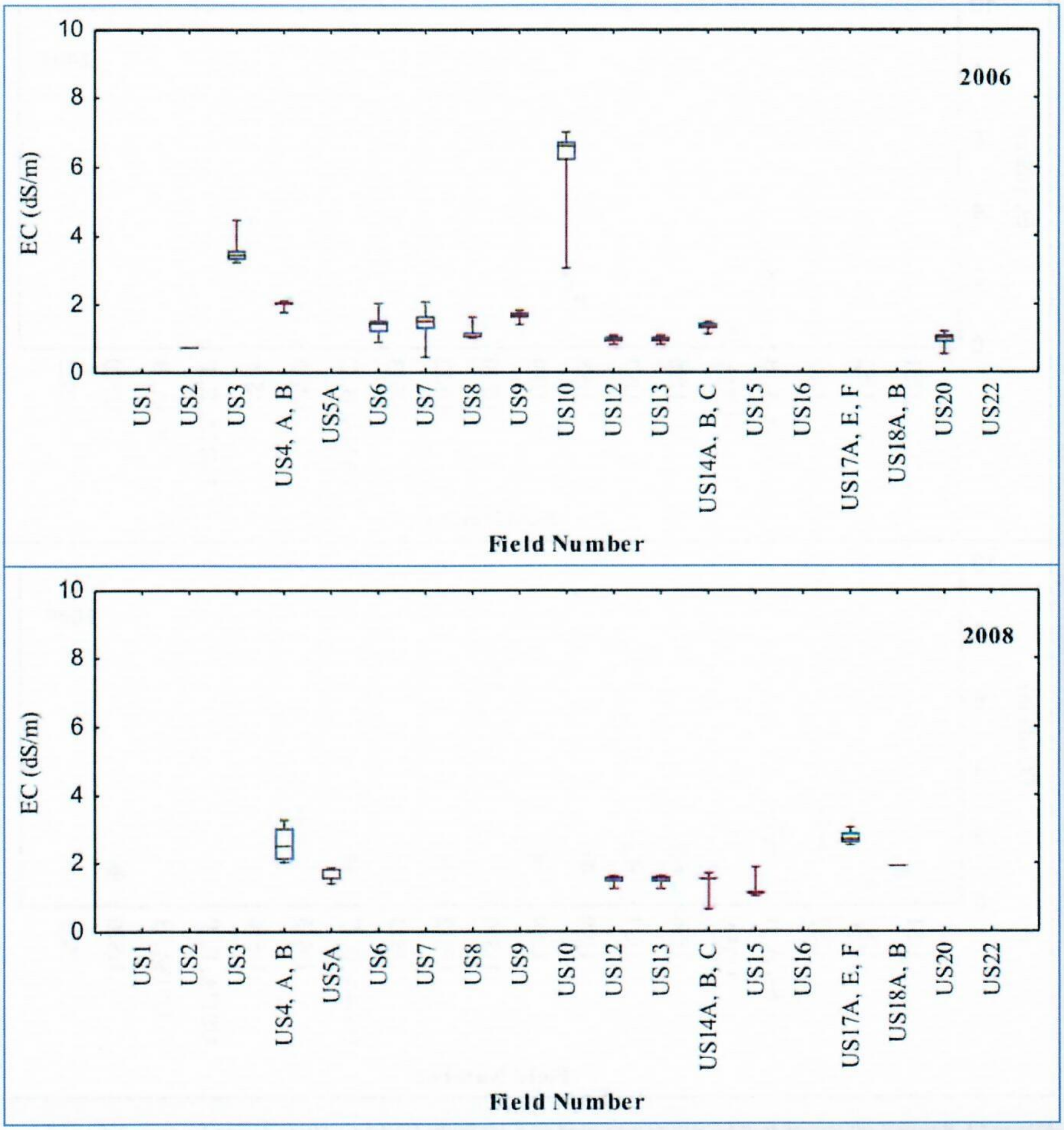


Figure 64. *Box and whisker plots of EC values measured on fields in the Upstream Study Region for years 2006 and 2008. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

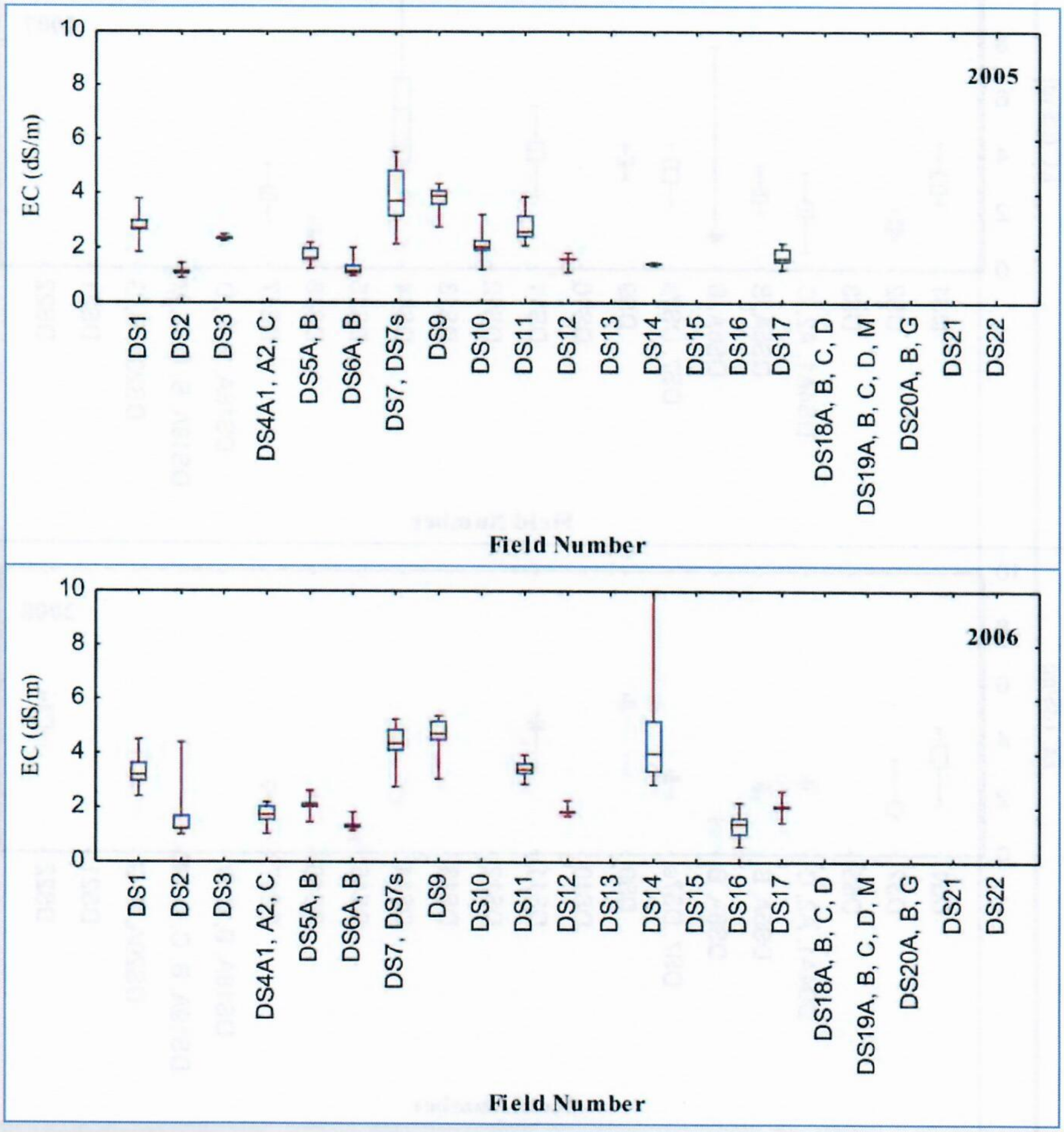


Figure 65. *Box and whisker plots of EC values measured on fields in the Downstream Study Region for years 2005 and 2006. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

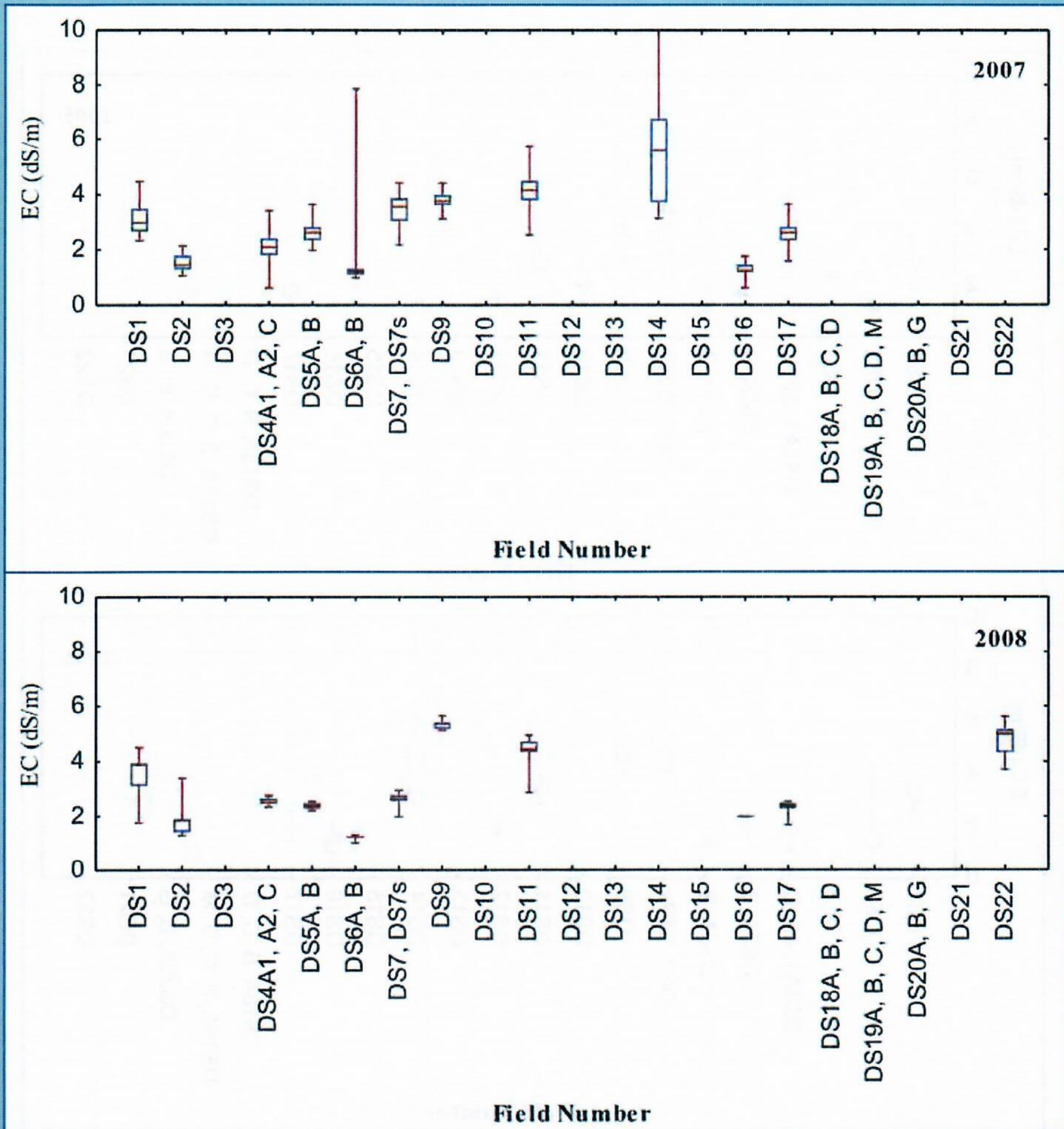


Figure 66. *Box and whisker plots of EC values measured on fields in the Downstream Study Region for years 2007 and 2008. Midline represents the median value; upper and lower edges of box represent 75 percentile and 25 percentile values, respectively; and upper and lower whiskers represented maximum and minimum values, respectively.*

Crop Yield and ET in Relation to Soil Water Salinity and Irrigation

Crop Biomass in Relation to Soil Water Salinity

Based upon controlled field experiments, the marketable yield of agricultural crops is well-known to be adversely affected by high concentrations of soil salt. This primarily is due to depressed osmotic potential that inhibits the ability of the crop roots to extract water from the soil pores, thereby reducing ET_a, but also is due to nutritional inhibition and toxic effects of certain soil salts on crop physiology (Wallender and Tanji 2012). The current study allowed the effects of soil water salinity on crop yield to be investigated for farmer-managed irrigated fields. Normalized crop biomass measured at locations within sampled fields, used as an indicator of relative crop yield, is plotted in Figure 67 against corresponding EC_e values estimated from EM38 measurements at the same locations for corn fields in the Upstream and Downstream Study Regions. Similar plots for alfalfa fields are presented in Figure 68. The relationships displayed in each plot indicate a general trend of decreasing crop yield with increasing EC_e. There is considerable scatter in the data due, especially at lower EC_e values (2-4 dS/m), to a number of other factors that influence crop yield such as crop variety, amount of fertilizer applied, type of soils, pest management, weed management, irrigation amount, etc. Crop yield appears to clearly diminish for $EC_e > 4$ to 6 dS/m.

Average values of D_{wt}, groundwater EC, EC_e, and normalized crop biomass were computed over all measurements within an irrigation season for each monitored field. Pearson correlation, r, between these averages for each variable was computed using the Statistica® 9.0 software. The value of *r* can vary between -1 and 1 with $r = -1$ indicating perfect inverse correlation and $r = 1$ indicating perfect direct correlation between two variables. A statistically significant value of *r* (at $p = 0.05$) between average normalized crop biomass and average D_{wt} was computed as 0.40, which is moderate. Statistically significant weak to moderate *r* values of -0.28 and -0.31 were computed between average normalized crop yield and average groundwater EC and between average normalized crop yield and average EC_e, respectively. These results reveal the tendency of crop yield to be adversely affected by shallow water tables, and high groundwater and soil water salinity concentrations.

Crop Biomass in Relation to Irrigation

Values of *r* also were computed between average values of Q_A, E_a, DPF, and TRF, and average normalized crop yield on monitored fields. Values of *r* between average E_a, DPF, and TRF and average normalized crop yield were not statistically significant. The *r* between average Q_A and average normalized crop yield was statistically significant with a weak to moderate value of 0.25. This indicated that, in general, for the fields and seasons studied, crop yield tended to increase with increased average applied irrigation depth.

Exhibit M

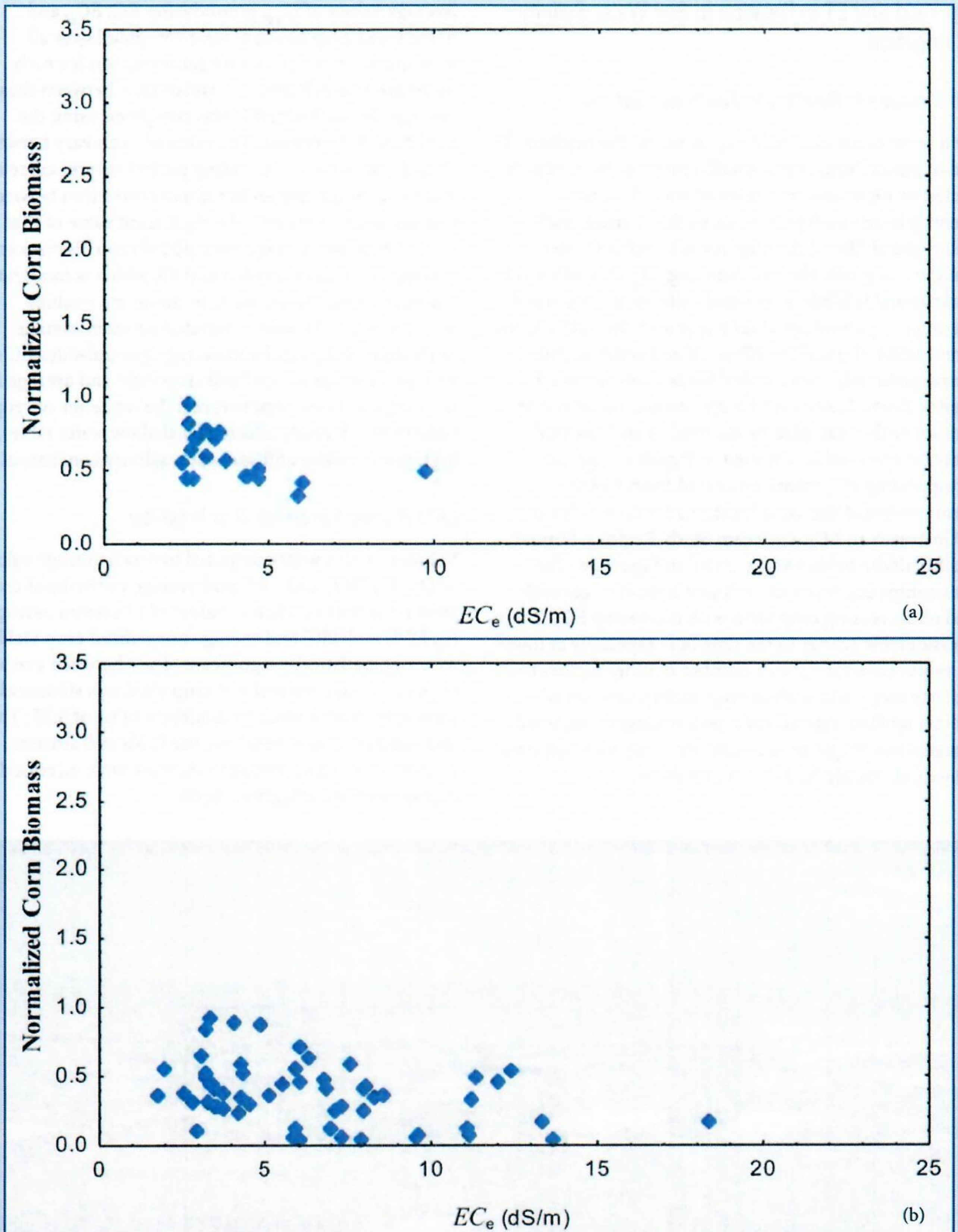


Figure 67. *Normalized corn biomass versus EC_e measured at locations within surveyed fields in (a) Upstream Study Region, and (b) Downstream Study Region*

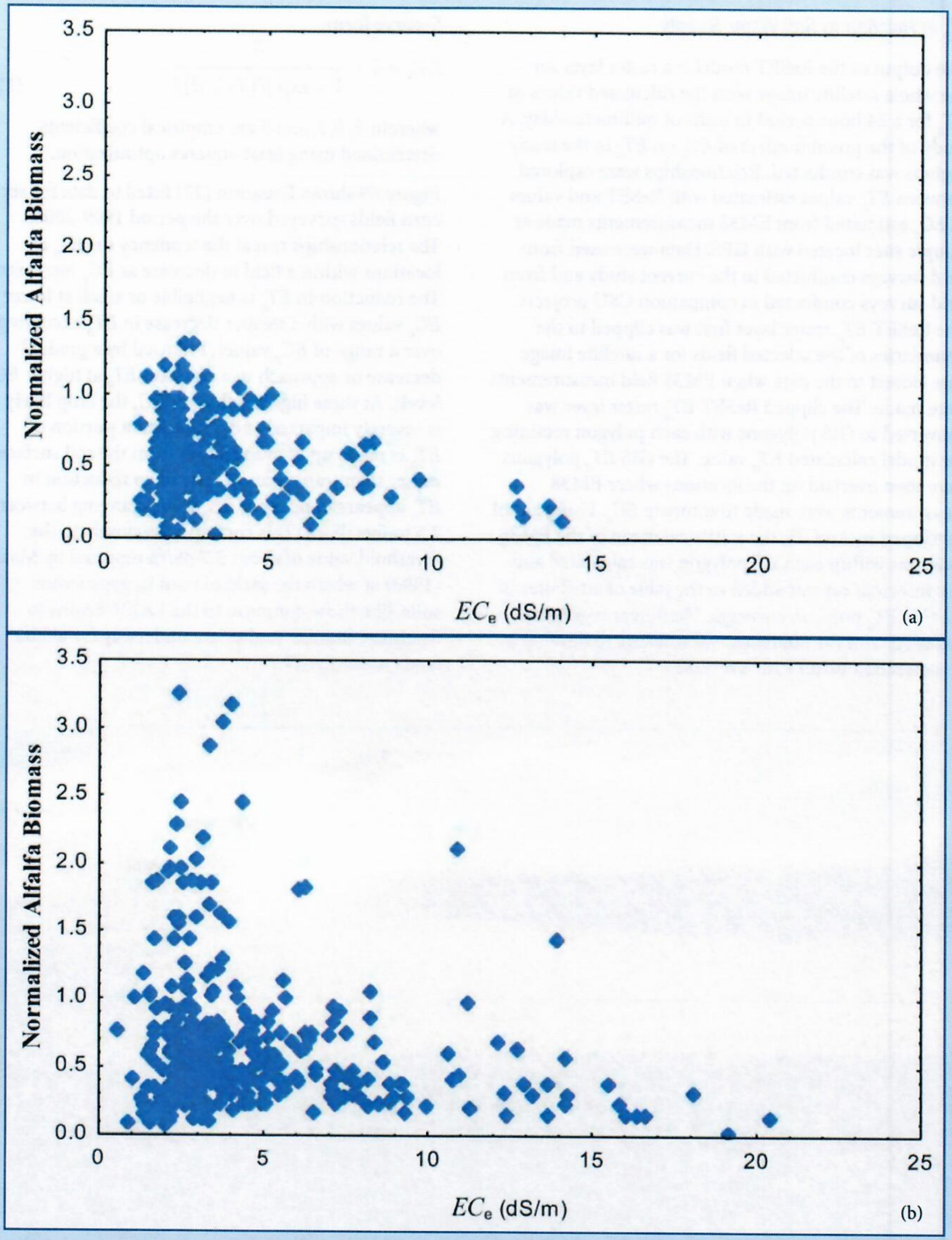


Figure 68. *Normalized alfalfa biomass versus EC_e measured at locations within surveyed fields in (a) Upstream Study Region, and (b) Downstream Study Region*

Exhibit M

ET_a in Relation to Soil Water Salinity

The output of the ReSET model is a raster layer for the whole satellite image with the calculated values of ET_a for a 24 hour period in units of millimeters/day. A study of the possible effect of EC_e on ET_a in the study regions was conducted. Relationships were explored between ET_a values estimated with ReSET and values of EC_e estimated from EM38 measurements made at sample sites located with GPS. Data were used from field surveys conducted in the current study and from field surveys conducted in companion CSU projects. The ReSET ET_a raster layer first was clipped to the boundaries of the selected fields for a satellite image date closest to the date when EM38 field measurements were made. The clipped ReSET ET_a raster layer was converted to GIS polygons with each polygon retaining the model calculated ET_a value. The GIS ET_a polygons were then overlaid on the locations where EM38 measurements were made to estimate EC_e. Using a tool developed in ArcGIS, the statistical mean of the EM38 locations within each ET polygon was calculated and this information was added to the table of attributes of the GIS ET_a polygon coverage. Nonlinear regression was used with the Statistica® 9.0 software to develop a best-fit relationship with a reverse S-curve form:

$$ET_a = \hat{a} + \frac{\hat{b}}{1 + exp\,[\hat{c}(EC_e\text{-}\hat{d})]} \qquad (27)$$

wherein $\hat{a}$, $\hat{b}$, $\hat{c}$, and $\hat{d}$ are empirical coefficients determined using least-squares optimization.

Figure 69 shows Equation (27) fitted to data for six corn fields surveyed over the period 1999-2006. The relationships reveal the tendency for ET_a at locations within a field to decrease as EC_e increases. The reduction in ET_a is negligible or small at lower EC_e values with a steeper decrease in ET_a occurring over a range of EC_e values, followed by a gradual decrease or approach to a constant ET_a at higher EC_e levels. At these higher values of EC_e the crop likely is severely impacted and a significant portion of ET_a is made up of evaporation from the soil surface rather than transpiration. The steep reduction in ET_a appears to occur at EC_e values ranging between 2.5 to five dS/m. This corresponds closely to the threshold value of about 3.7 dS/m reported by Maas (1990) at which the yield of corn in gypsiferous soils, like those common to the LARV, begins to diminish. Similar studies are underway for alfalfa fields in the LARV.

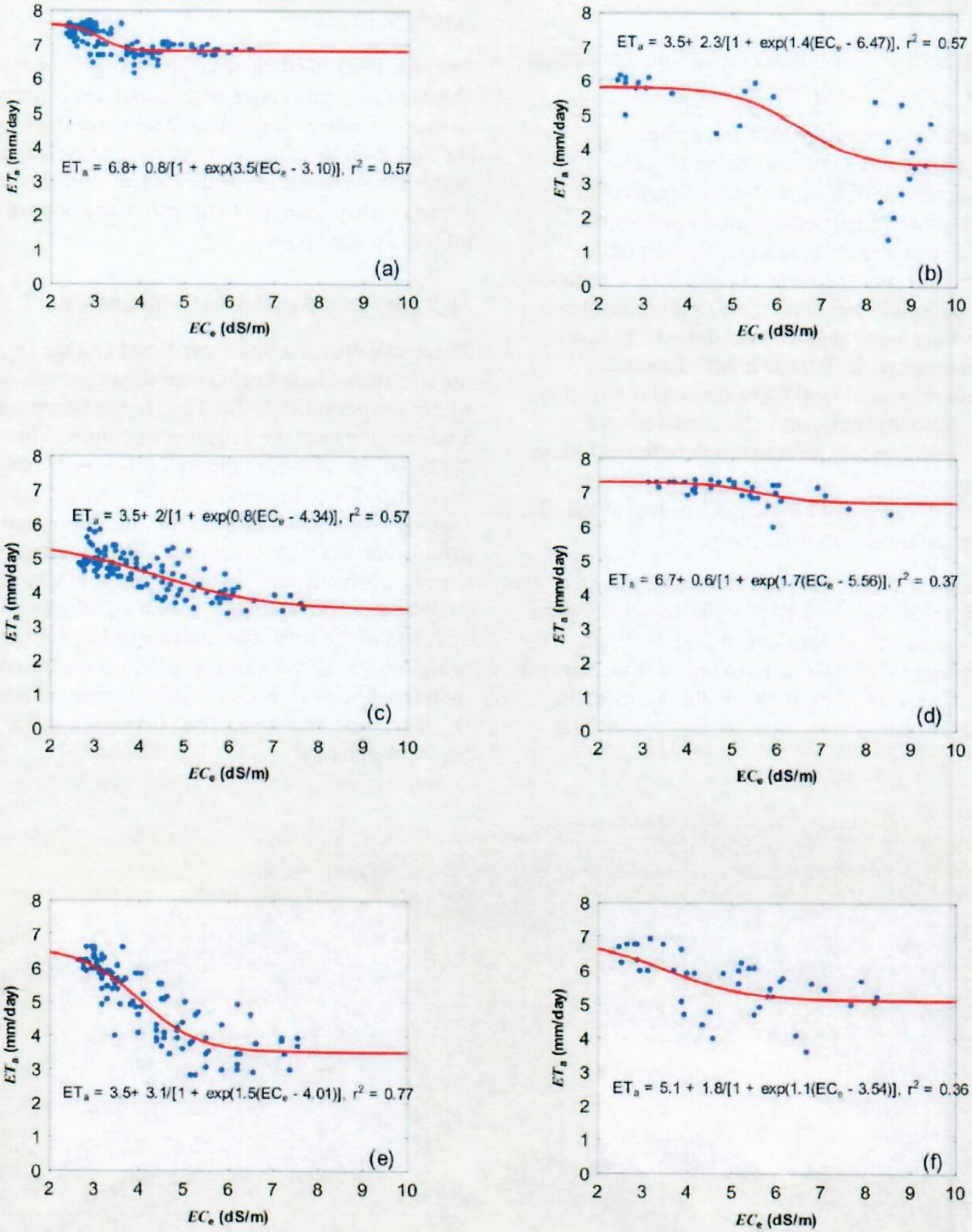


Figure 69. *ET_a estimated with ReSET from satellite imagery versus measured EC_e for (a) field US17, July 1999; (b) field US20, July 2001; (c) field US80, June 2001; (d) field DS106, July 2005; (e) field US80, July 2001; and (f) field US38, July 2006. Fitted regression curves with r^2 values are shown on each plot.*

Exhibit M

Sensitivity Analysis

Sensitivity of Deep Percolation Fraction and Application Efficiency to Parameter Errors

The sensitivity of estimated DPF for surface and sprinkler irrigation events to errors in ET_a, Q_I, initial S_{SW}, and TAW is illustrated in Figure 70 for all monitored surface irrigation events and for all monitored sprinkler irrigation events. The plots in this figure illustrates the range of average DPF values calculated over all irrigation events for the considered range of values associated with possible errors in each input parameter to the IDSCU model. Generally, DPF values calculated by IDSCU are most sensitive to expected independent errors in the sink and source parameters, ET_a and Q_I, than to errors in the soil water storage parameters, S_{SW} and TAW. Estimated values of DPF could be expected to vary as much as about 12 percentage points due to these errors.

Similar plots illustrating the sensitivity of E_a for to errors in ET_a, Q_I, initial S_{SW}, and TAW is illustrated in Figure 71 for all monitored surface and sprinkler irrigation events. Similar to DPF, ET_a is most sensitive to expected errors in ET_a and Q_I, indicating possible variation in estimated ET_a values as much as about 12 percentage points.

Sensitivity of Application Efficiency to Infiltration Distribution Pattern

The sensitivity of estimated E_a to errors in the estimated slope of linear infiltration distribution for surface irritation events is as much as three percentage points for Upstream fields and as much as 2.5 percentage points for Downstream fields. Hence, estimates of E_a are relatively insensitive to the estimated slope of linear infiltration distribution.

Recharge to and Upflux from Groundwater

The spatial distributions of predicted average D_{wt} in the Upstream Study Region over the irrigation seasons within the period 1999-2007 and in the Downstream Study Region over the irrigation seasons within 2002-2007 are shown in Figure 72. Figure 73 presents the spatial distribution of predicted total average recharge to the groundwater table, resulting from deep percolation and from canal seepage, for corresponding seasons Upstream and Downstream. Similarly, Figure 74 illustrates corresponding spatial distributions of upflux from the groundwater table to ET_a. Comparison of Figures 73 and 74 with Figure 72 reveals the correspondence between higher recharge rates and lower D_{wt} (shallower water table) and between lower D_{wt} and higher upflux rates.

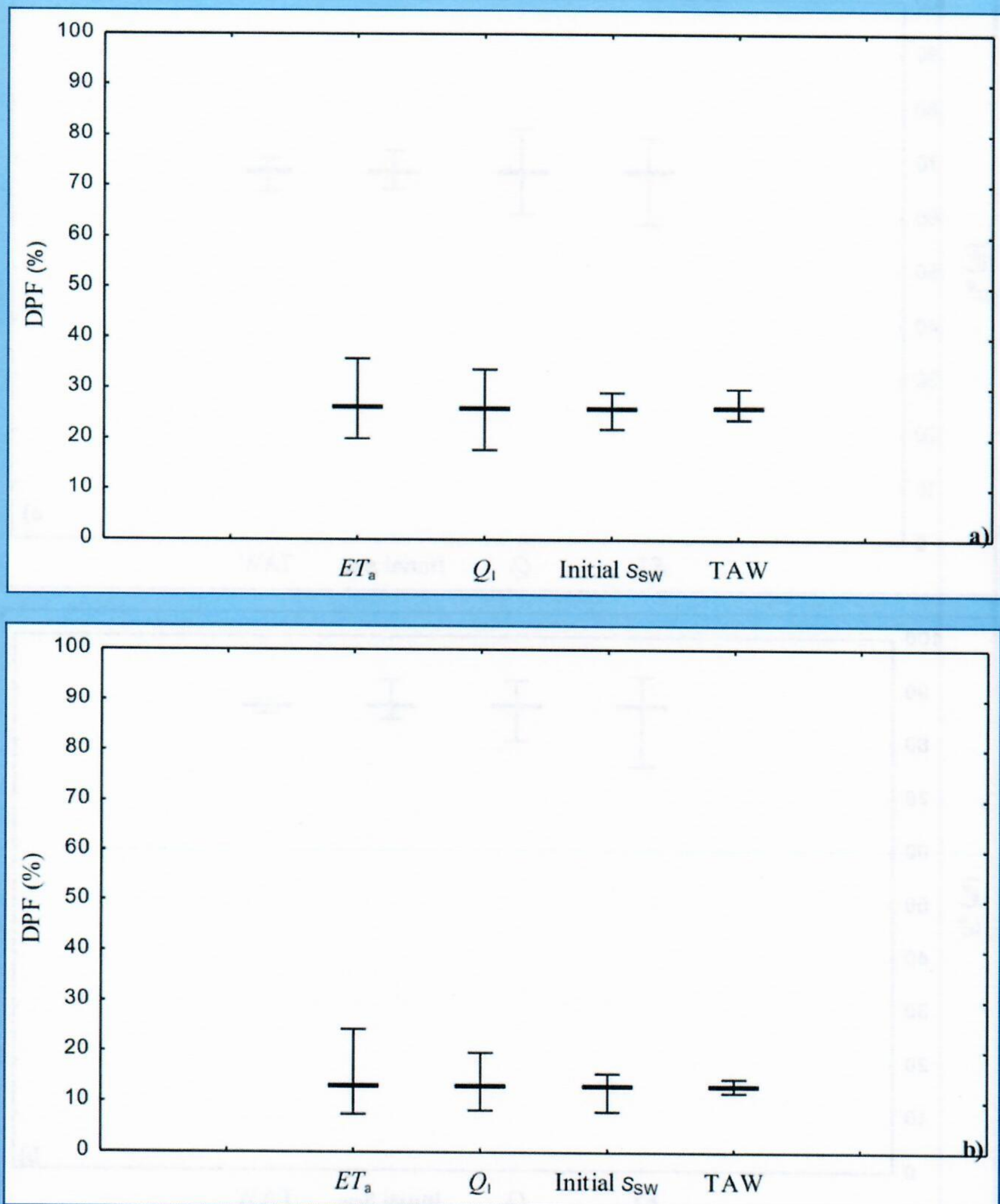
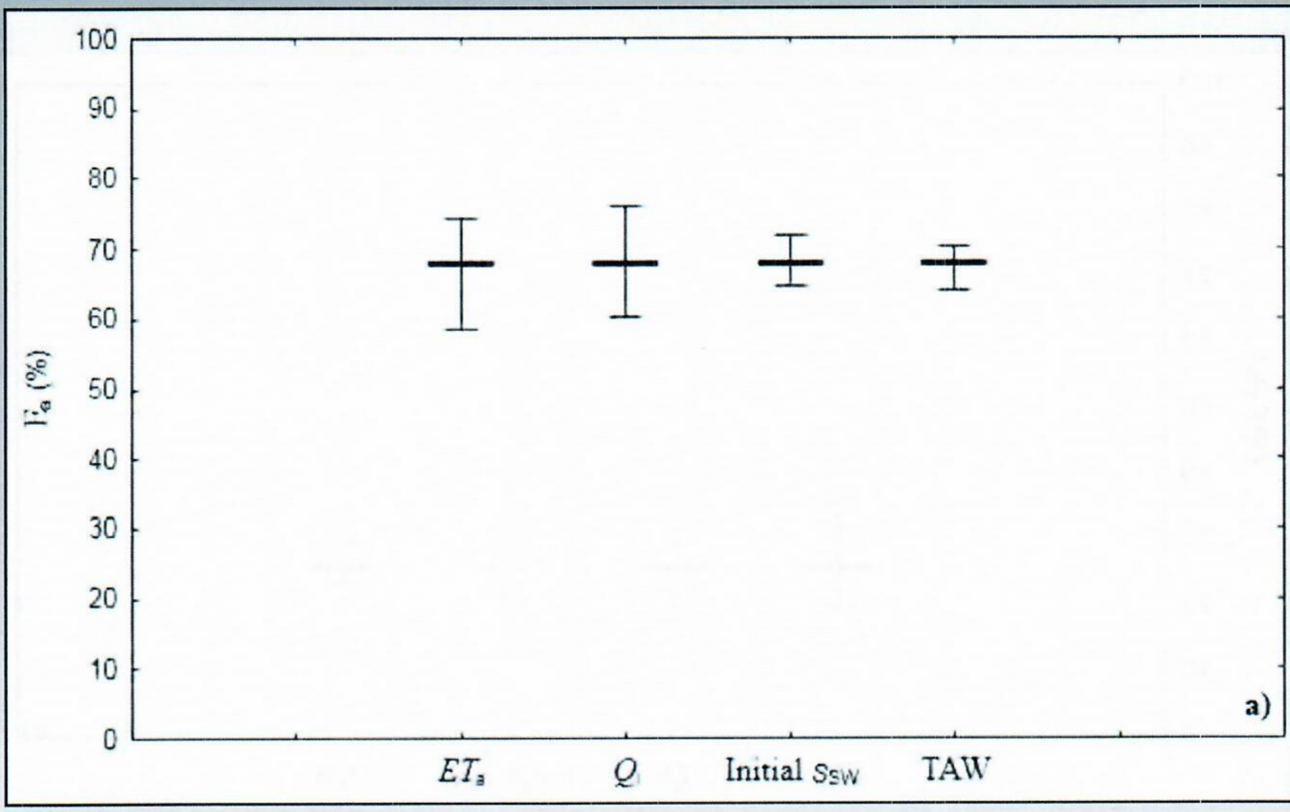


Figure 70. *Range and baseline average values (horizontal bar) of DPF calculated over the considered range of values associated with errors in ET_a, Q_I, initial S_{SW}, and TAW for (a) all surface irrigation events Upstream and Downstream, and (b) all sprinkler irrigation events Upstream and Downstream*

Exhibit M



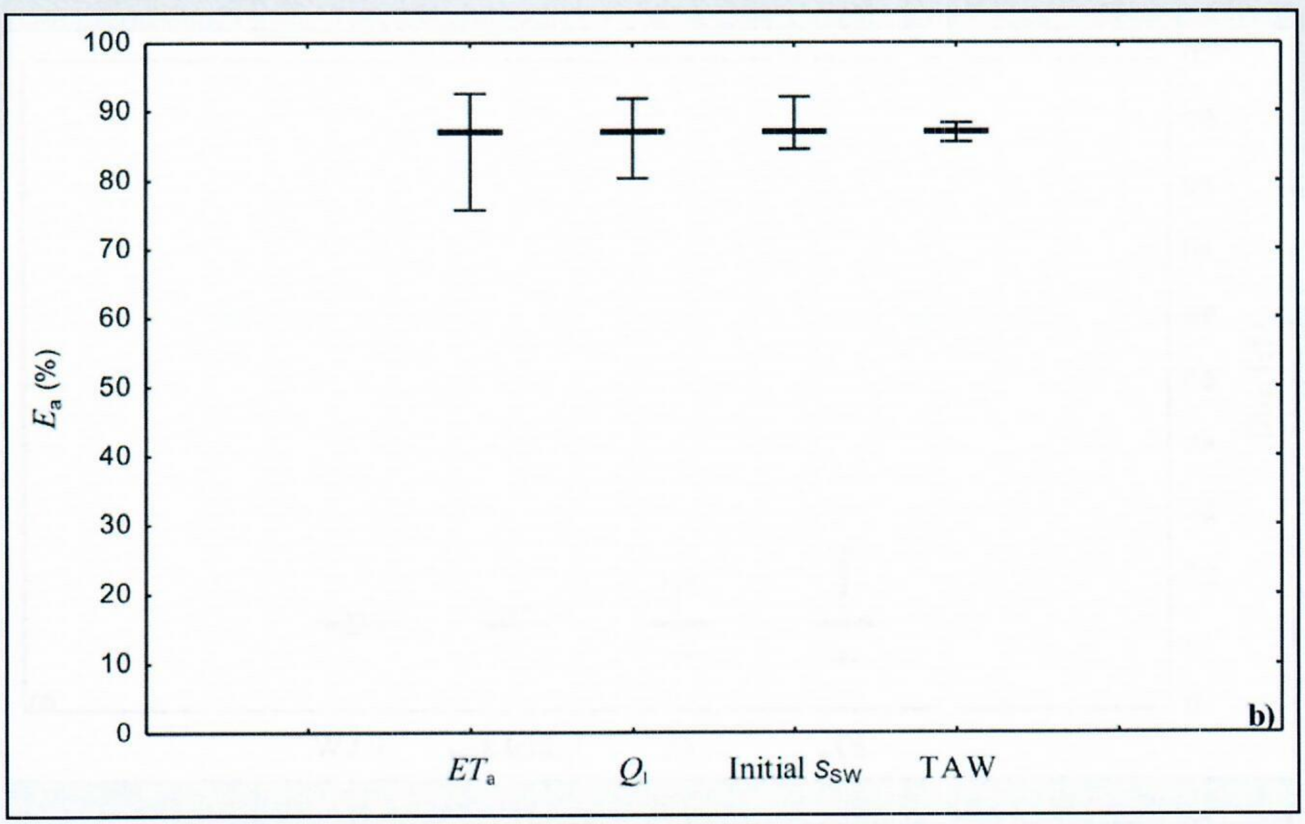


Figure 71. *Range and baseline average values (horizontal bar) of E_a calculated over the considered range of values associated with errors in ET_a, Q_P initial S_{SW}, and TAW for (a) all surface irrigation events Upstream and Downstream, and (b) all sprinkler irrigation events Upstream and Downstream*

Plots of spatial average infiltrated water ($Q_I + Q_P$) and recharge to the groundwater table are shown in Figure 75 for the modeled periods for the Upstream and Downstream Study Regions. Predicted recharge rates to the groundwater table under irrigated fields average 0.10 in/day over irrigation seasons within 1999-2007 Upstream. Average predicted recharge rates over the seasons 2004, 2005, 2006, and 2007 are 0.08, 0.11, 0.09, and 0.16 in/day, respectively. This represents about 39 percent, 47 percent, 39 percent, and 53 percent of infiltrated water, respectively, over these irrigation seasons. In the Downstream region, predicted recharge rates averaged 0.06 in/day over the irrigation seasons within 2002-2007. Over 2004, 2005, 2006, and 2007 predicted recharge rates Downstream are 0.05, 0.07, 0.05, and 0.08 in/day, respectively, which are about 30 percent, 41 percent, 31 percent, and 41 percent of infiltrated water, respectively.

The regional scale models estimate that upflux from the groundwater table to non-beneficial ET_a under naturally-vegetated and fallow fields is substantial in relation to total crop ET_a, as seen in the plot in Figure 76. Cumulative predicted upflux to non-beneficial ET_a under naturally-vegetated and fallow fields is plotted in Figure 77 for the Upstream and Downstream Study Regions. Also, shown is the estimated cumulative upflux to non-beneficial ET_a under naturally-vegetated and fallow fields over the entire LARV. This was estimated using land survey data from 2003, assuming that the ratio of naturally-vegetated and fallow land to total land in the Upstream and Downstream Study Regions applies to the entire LARV, and also assuming that conditions determining upflux over the entire LARV are similar to those within the study regions.

Return Flows and Salt Loads to Streams

Figure 78 shows groundwater return flow predicted by the regional models to the Arkansas River along the Upstream and Downstream study regions. The average predicted return flow rate over the period April 1999-October 2007 is 30.9 ac-ft/week per mile along the modeled 48.6 miles of river Upstream. Downstream, the average predicted return flow rate over the period April 2002-October 2007 is 12.0 ac-ft/week per mile along the modeled 43.8 miles of river. Average predicted return flow rate over the years 2004, 2005, 2006, and 2007 is 19.4, 22.8, 22.8, and 35.3 ac-ft/week per mile, respectively, along the Upstream Study Region, and is 9.3, 8.9, 6.3, and 16.2 ac-f/week per mile, respectively, along the Downstream Study Region.

Salt load in groundwater return flow to the river within the Upstream and Downstream Study Regions was estimated using the regional models and is plotted in Figure 79. The loads are substantial, ranging from less than 1,000 tons/week (20.6 tons/week per mile) to more than 17,500 tons/week (359.8 tons/week per mile) Upstream, and from about 1,400 tons/week (32.0 tons/week per mile) to about 11,000 tons/week (251.2 tons/week per mile) Downstream.

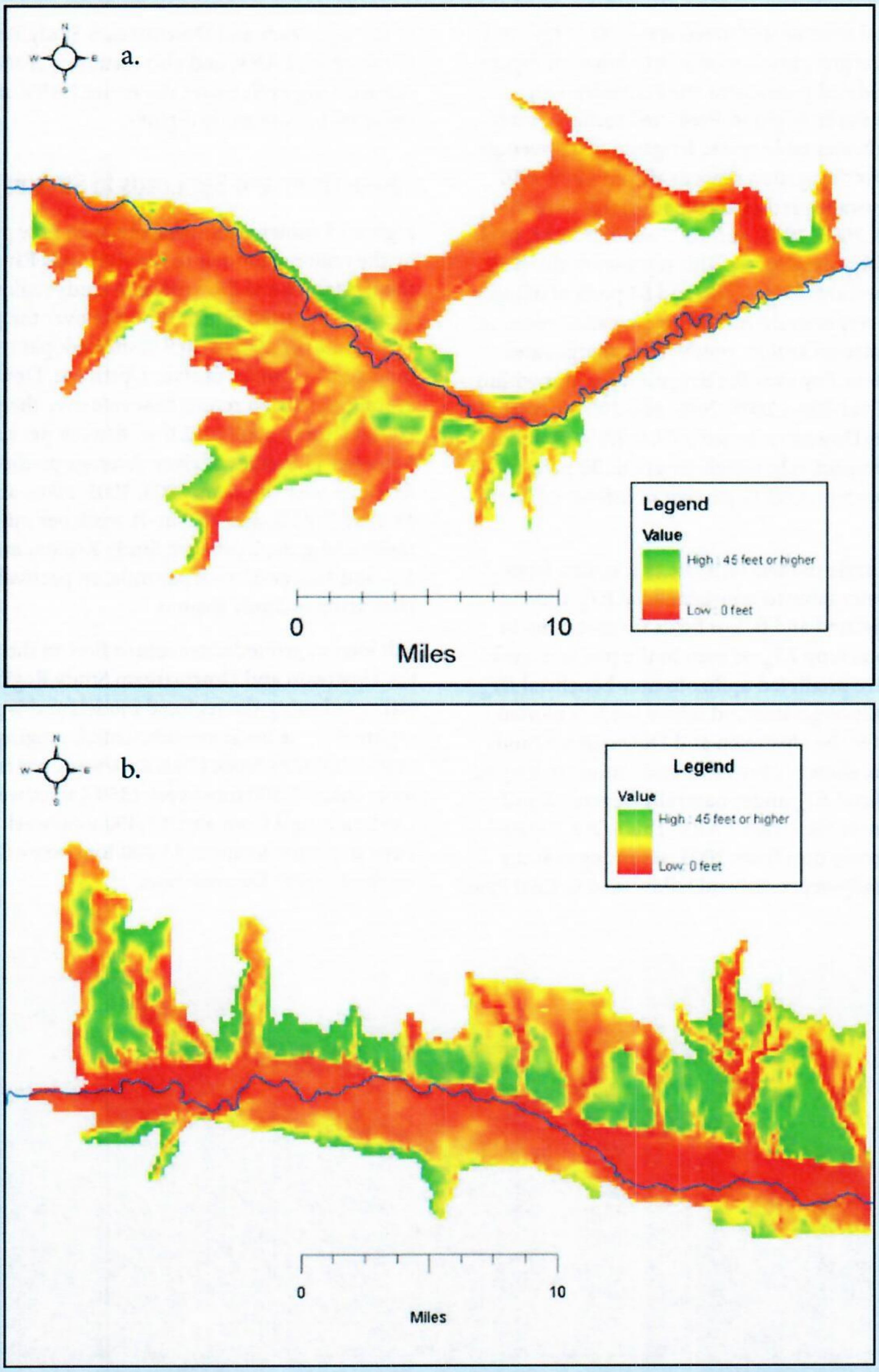
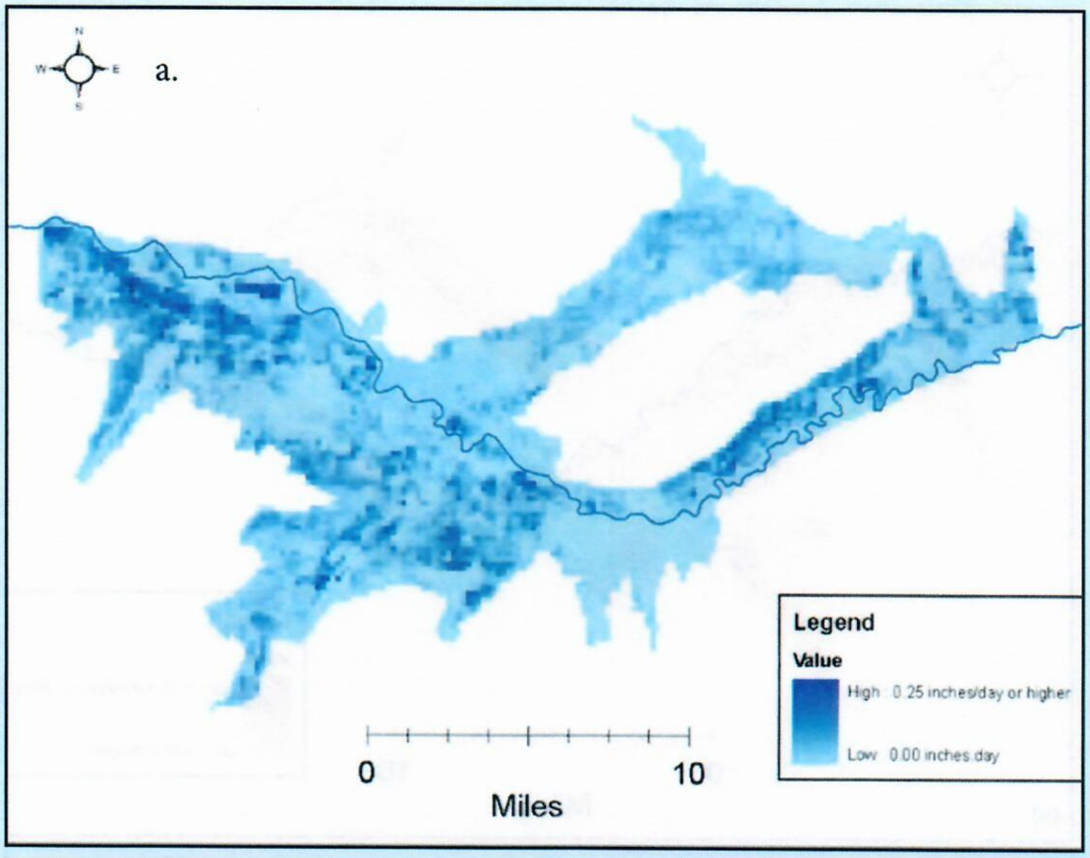


Figure 72. *Average D_{wt} computed over irrigation seasons (a) 1999-2007 in the Upstream Study Region, and (b) 2002-2007 in the Downstream Study Region*



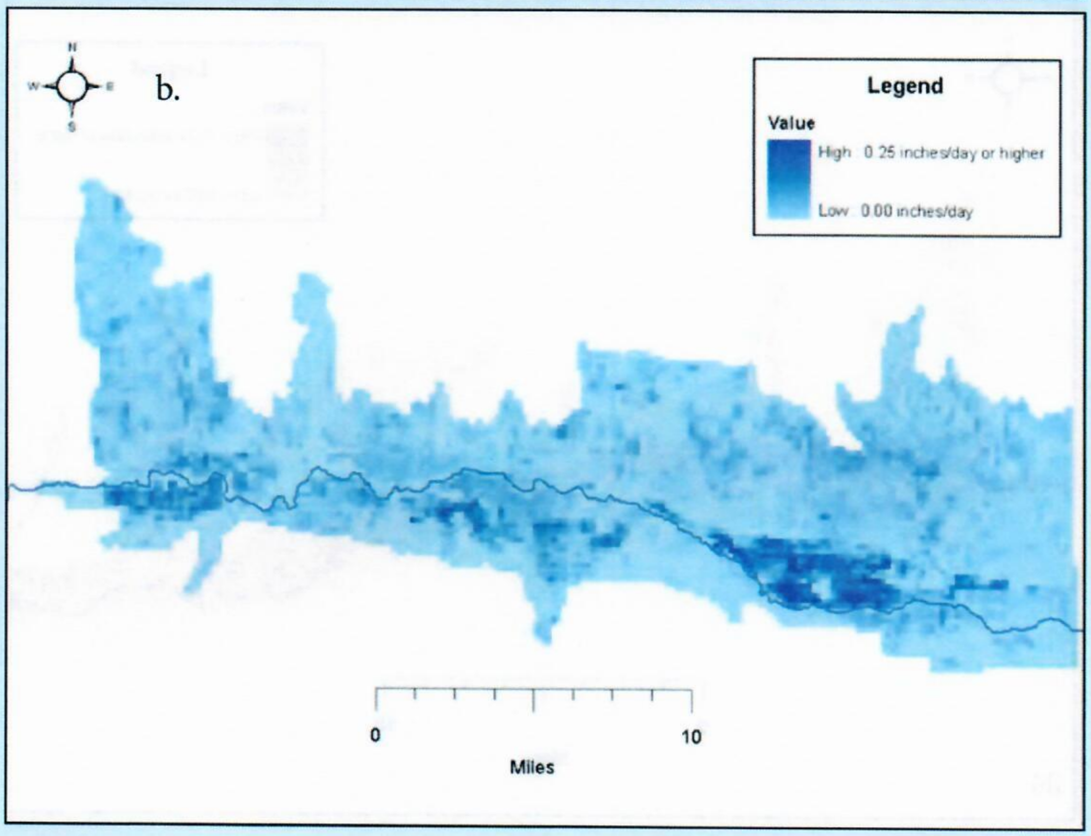


Figure 73. *Average recharge rate to the water table computed over irrigation seasons (a) 1999-2007 in the Upstream Study Region, and (b) 2002-2007 in the Downstream Study Region*

Exhibit M

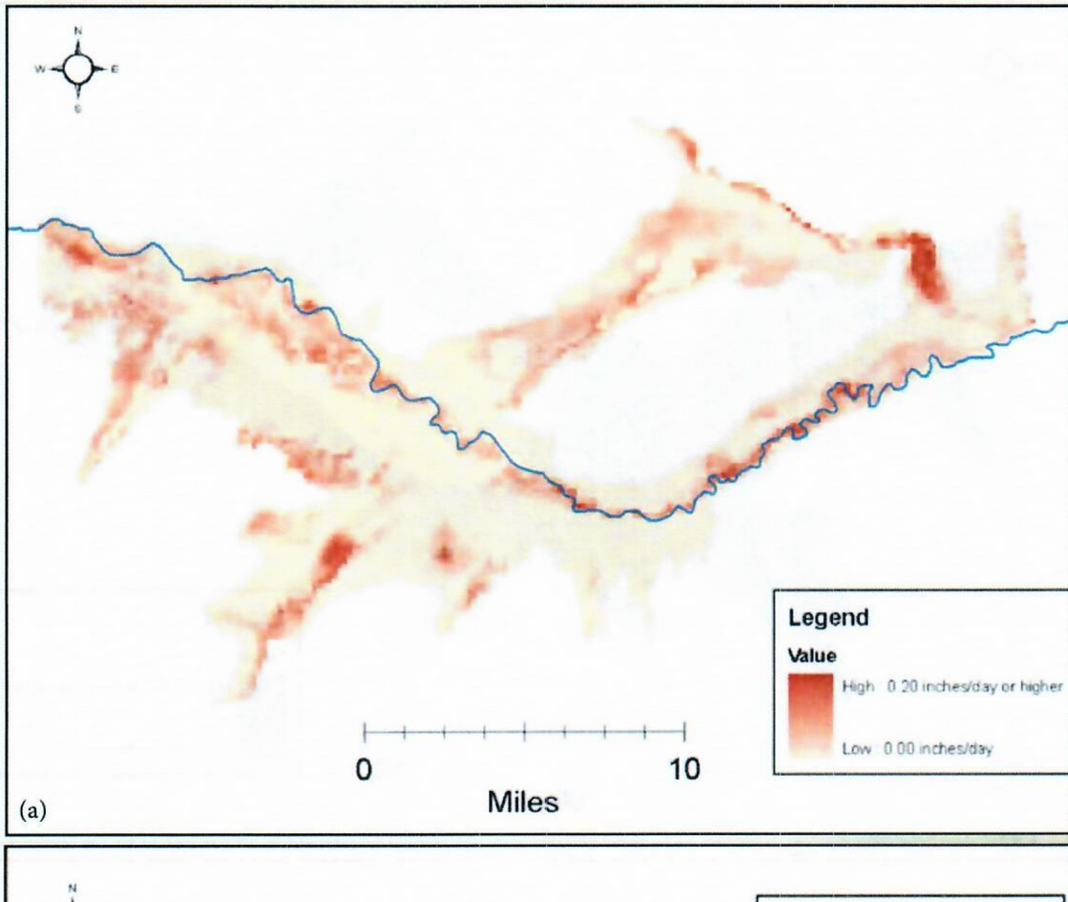
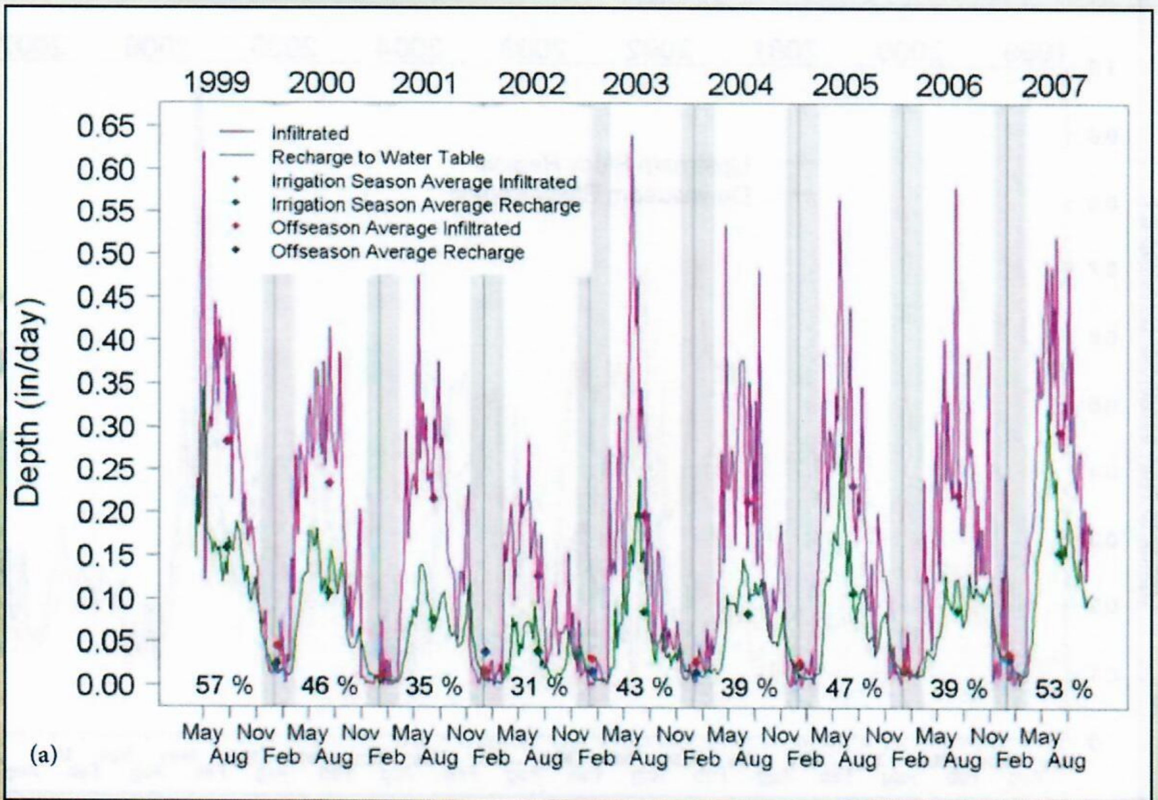


Figure 74. *Average ground water upflux rate to ET_a computed over irrigation seasons (a) 1999-2007 in the Upstream Study Region, and (b) 2002-2007 in the Downstream Study Region*



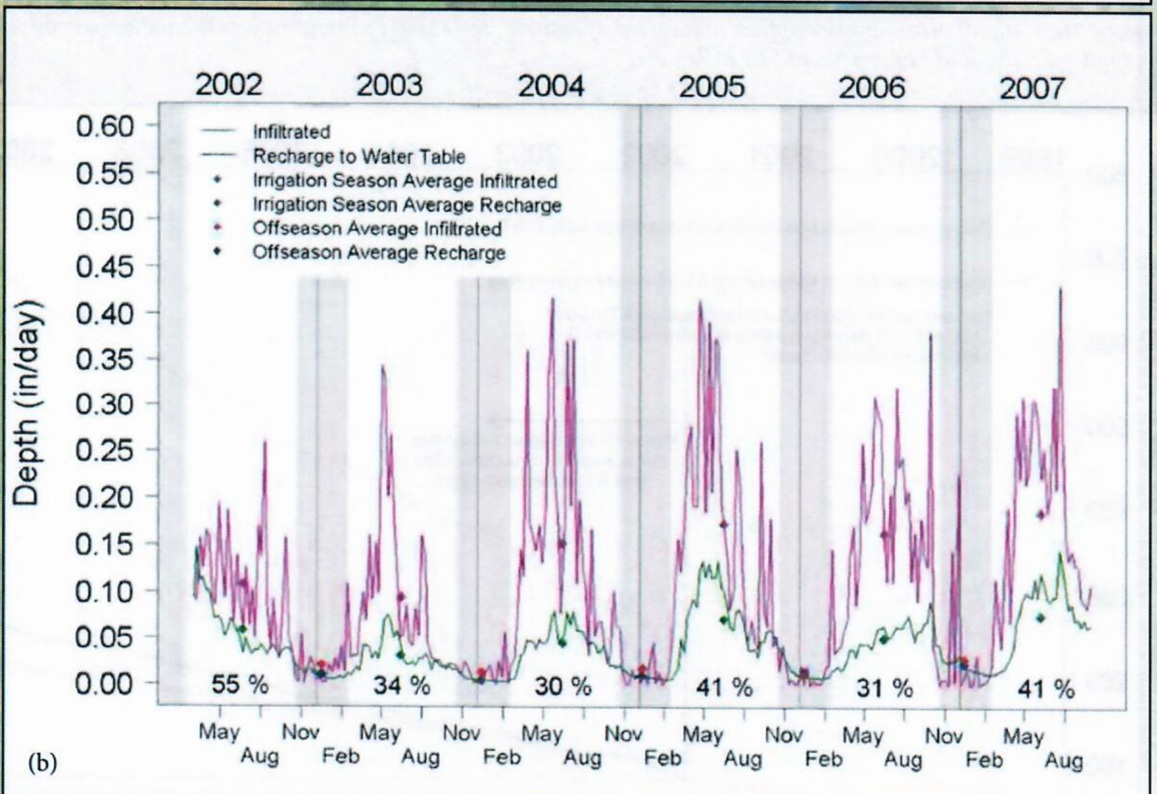


Figure 75. *Infiltrated water ($Q_I + Q_P$) and recharge to the groundwater table, showing average values during the off seasons and during the irrigation seasons as plotted points and ratios of recharge to infiltrated water over the irrigation seasons as written percentages for (a) Upstream Study Region and (b) Downstream Study Region*

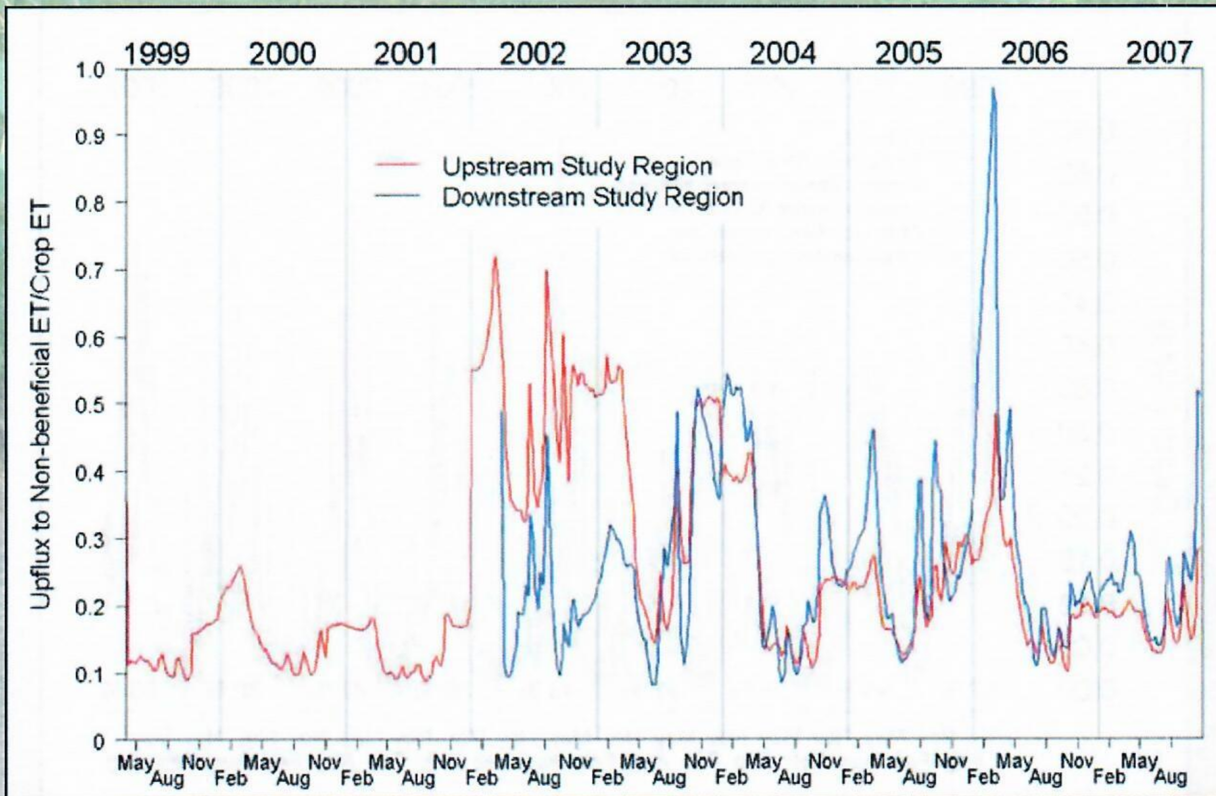


Figure 76. *Ratio of groundwater upflux to non-beneficial ET_a to crop ET_a computed by the regional models for the Upstream and Downstream Study Regions*

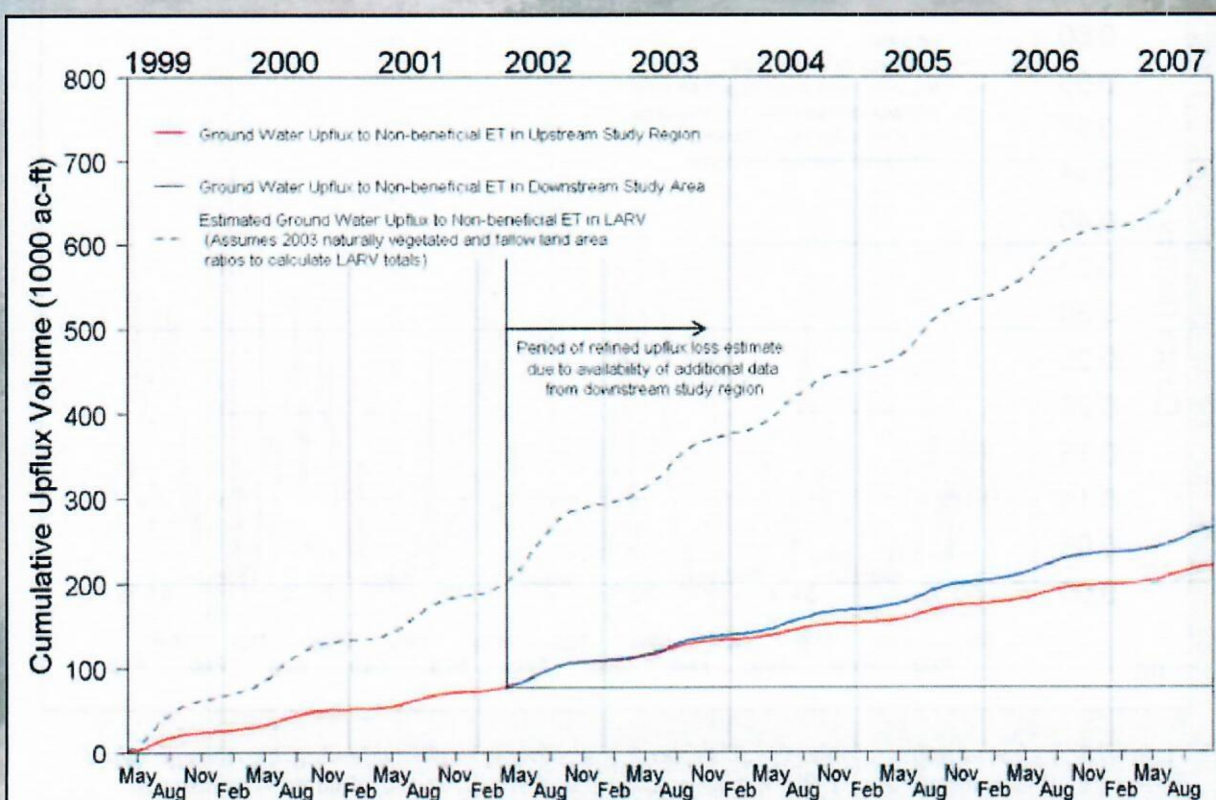


Figure 77. *Cumulative groundwater upflux to non-beneficial ET_a computed by the regional models for the Upstream and Downstream Study Regions and estimated for the entire LARV*

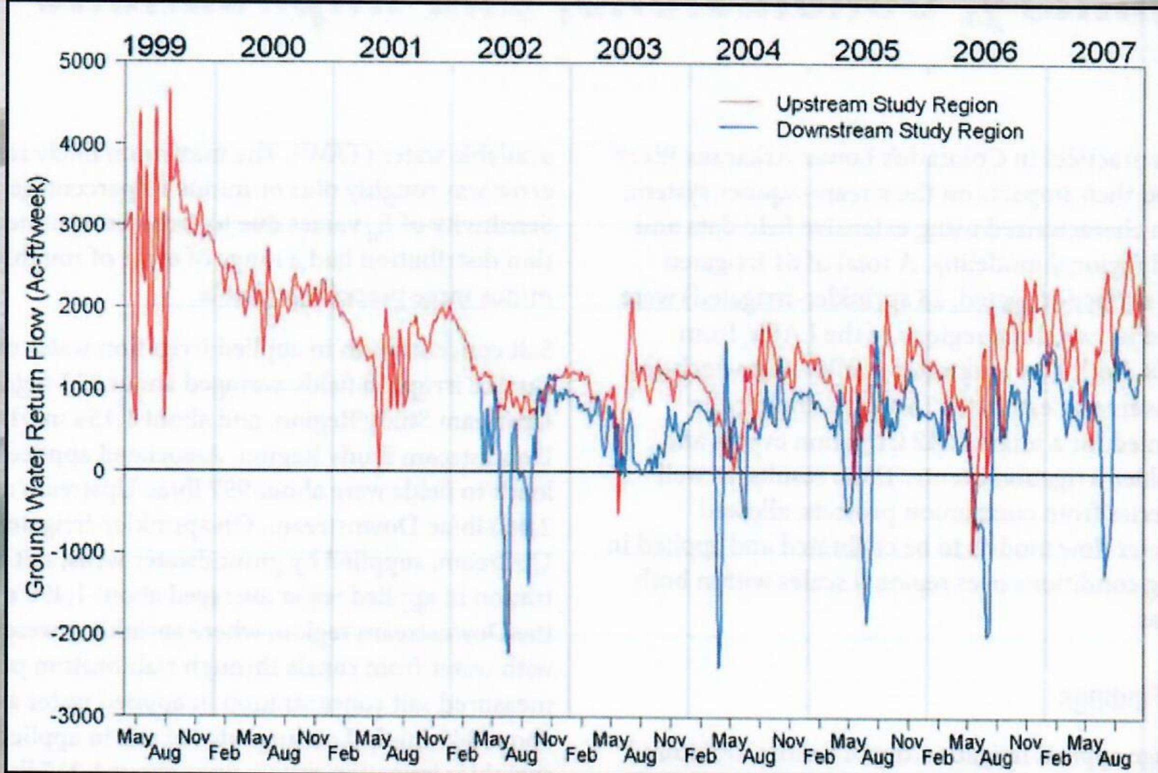


Figure 78. *Groundwater return flow to the Arkansas River within the Upstream and Downstream Study Regions estimated with the regional models (negative values indicate net loss of water from the river to the groundwater aquifer)*

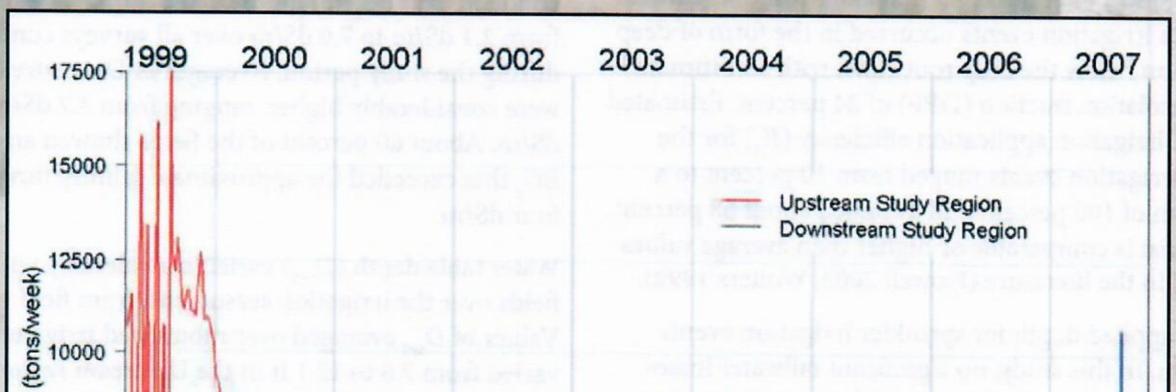


Figure 79. *Salt load in groundwater return flow to the Arkansas River within the Upstream and Downstream Study Regions estimated with the regional models*

Exhibit M

Summary, Conclusions, and Implications

Irrigation practices in Colorado's Lower Arkansas River Valley, and their impacts on the stream-aquifer system, have been characterized using extensive field data and calibrated regional modeling. A total of 61 irrigated fields (33 surface-irrigated, 28 sprinkler-irrigated) were monitored in two study regions of the LARV from 2004-2008. Both flow and water quality characteristics were measured or estimated. Analysis and results are presented for a total of 242 irrigation events and 279 sprinkler irrigation events. These results, as well as discoveries from companion projects, allowed groundwater flow models to be calibrated and applied in describing conditions over regional scales within both study areas.

General Findings

The average applied irrigation depth for the monitored surface irrigation events was 8.2 in. Water losses in the form of tailwater runoff were found to be quite low on surface-irrigated fields, with an average tailwater fraction (TRF) of about eight percent. Most of the losses in surface irrigation events occurred in the form of deep percolation below the crop root zone, with an estimated deep percolation fraction (DPF) of 24 percent. Estimated values of irrigation application efficiency (E_a) for the surface-irrigation events ranged from 10 percent to a maximum of 100 percent and averaged about 68 percent, a value that is comparable or higher than average values reported in the literature (Howell 2003, Wolters 1992).

Average applied depth for sprinkler irrigation events was 2.2 in. In this study, no significant tailwater losses were observed for any of the sprinkler irrigation events. Average DPF on monitored sprinkler-irrigated fields was about 13 percent, indicating that deep percolation on sprinkler-irrigated fields was only about 37 percent of that estimated for surface-irrigated fields. The average E_a for sprinkler irrigation events was about 82 percent. Losses from sprinkler spray to direct evaporation and wind drift were estimated to be about 5 percent for the types of sprinkler systems used in the LARV.

A limited sensitivity analysis provided insight into the range of errors in estimated average DPF and E_a values independently derived from likely errors in actual evapotranspiration (ET_a), infiltrated irrigation volume (Q_I) initial soil water storage volume (S_{SW}), and total available water (TAW). The maximum likely range of error was roughly plus or minus 10 percentage points. Sensitivity of E_a values due to errors in assumed infiltration distribution had a range of error of roughly plus or minus three percentage points.

Salt concentration in applied irrigation water on surface irrigated fields averaged about 532 mg/L in the Upstream Study Region, and about 1,154 mg/L in the Downstream Study Region. Associated applied salt loads to fields were about 997 lb/ac Upstream and about 2,480 lb/ac Downstream. On sprinkler-irrigated fields Upstream, supplied by groundwater wells, salt concentration in applied water averaged about 1,498 mg/L. In the Downstream region, where sprinklers were supplied with water from canals through stabilization ponds, measured salt concentration in applied water averaged about 849 mg/L. Loading rates of salt in applied sprinkler irrigation waters were about 1,217 lb/ac and 446 lb/ac Upstream and Downstream, respectively.

Average soil salinity as saturated paste extract electrical conductivity (EC_e) in monitored fields Upstream ranged from 2.1 dS/m to 7.0 dS/m over all surveys conducted during the study period. Averages in Downstream fields were considerably higher, ranging from 3.7 dS/m to 12.5 dS/m. About 60 percent of the fields showed an average EC_e that exceeded the approximate salinity threshold of four dS/m.

Water table depth (D_{wt}) varied considerably within fields over the irrigation season and from field to field. Values of D_{wt} averaged over monitored irrigated fields varied from 7.8 to 12.1 ft in the Upstream region, with an overall average value of 9.9 ft. In the Downstream region, D_{wt} averaged over monitored irrigated fields ranged from 12.6 to 15.0 ft, with an overall average of 13.8 ft. About four fields in the Upstream Study Region and 21 fields in the Downstream Study Region had values of D_{wt} exceeding the 20 to 25 ft depth to the bottom of available monitoring wells. Average electrical conductivity (EC) of groundwater varied from 1.8 to 2.3 dS/m Upstream and from 2.3-3.1 dS/m Downstream. The finding of deeper and more saline water tables in fields within the Downstream region compared to those within the Upstream region was corroborated by regional modeling results.

Data gathered on numerous fields were explored to evaluate the impact of soil water salinity on crop water use and crop yield. Crop ET_a and crop yield (biomass) were found to diminish when values of EC_e in the soil exceeded about three to five dS/m. These results closely correspond to the threshold value of about 3.7-4 dS/m, reported by Maas (1990), beyond which yields of corn and alfalfa will decline in gypsiferous soils. Since numerous fields throughout the Upstream and Downstream Study Regions show EC_e values exceeding this threshold, actual evapotranspiration (ET_a) values over the LARV are expected to be lower than potential evapotranspiration (ET_p) values calculated using the ASCE Standardized Equation with published crop coefficients.

Much of the deep percolation that occurs on irrigated fields in the LARV, in addition to seepage from earthen canals (Susfalk et al 2008) and effective precipitation, flows downward to recharge the underlying groundwater table. Calibrated regional groundwater models predicted an average recharge rate to shallow groundwater of 0.10 in/day and 0.06 in/day over modeled irrigation seasons within the period 1999-2007 Upstream and within the period 2002-2007 Downstream, respectively. Over these same respective periods the regional model predicted that recharge to the groundwater table during the irrigation season was equivalent to 31 percent to 57 percent of $Q_I + Q_P$ Upstream and to 30 percent to 55 percent of $Q_I + Q_P$ Downstream, where Q_P = effective precipitation volume.

A portion of the alluvial groundwater in the LARV returns to the unsaturated zone and contributes to ET_a via capillary rise from shallow water tables. The current study revealed that between zero and 40 percent (with an average of 5 percent) of beneficial crop ET_a on monitored irrigated fields was provided by groundwater upflux. This upflux also brings salt into the root zone, contributing to the deleterious effects of EC_e. In addition, the calibrated regional groundwater models predict that about 26,000 ac-ft/year in the Upstream region and 35,000 ac-ft/year in the Downstream region flows upward to non-beneficial ET_a demand on naturally-vegetated and fallow fields. This water loss is equivalent to about 20 to 25 percent of annual crop ET_a on the average.

Much of the remaining saline groundwater in the LARV eventually returns to tributaries and to the main stem of the Arkansas River by flow through the alluvial aquifer, dissolving additional salts and minerals along its path. Average return flow rates to the Arkansas River within the Upstream and Downstream regions were estimated by the regional models to be 30.9 ac-ft/day per mile and 12 ac-ft/day per mile along the river, respectively. Salt load in this return flow to the river over the modeled years was estimated as about 93 tons/week per mile Upstream and about 62 tons/week per mile Downstream. This is considerably more than the estimated salt loading to irrigated fields, indicating substantial dissolution of additional salts from shale and shale-derived soils, which occurs as groundwater makes its way to the streams.

Exhibit M

Answers to Specific Questions of Concern to Water Managers and Regulatory Agencies

When possible, answers are provided to a number of specific questions that were raised during different stages of this study:

1. *How do the characteristic irrigation water balance component (WBC) and E_a values for sampled conventional surface irrigation systems compare to those for improved technology (especially sprinkler) systems?*

   There is a significant difference in the WBC and E_a values for sampled conventional surface irrigation systems compared to those for sprinkler systems.

   The estimated mean value of Q_I for all monitored surface irrigation events was almost four times larger than that for sprinkler irrigation events. The mean value of DPF for all surface irrigation events was about 1.9 times greater than for sprinkler irrigation events. Water balance calculations indicated that little to no deep percolation occurred on several monitored sprinkler-irrigated fields. Average E_a for monitored surface irrigation events was 20 percentage points lower than for sprinkler irrigation events. No tailwater runoff was observed on sprinkler-irrigated fields. On surface-irrigated fields TRF averaged about eight percent.

2. *Do the characteristic WBC and E_a values for irrigation events seem to vary significantly from canal to canal; which is to say, do the values appear to be affected by total water supply available from one canal to another, within a single year?*

While this study monitored a substantial total number of irrigation events, there were not enough observed events under the command of different canal systems to answer this question with statistical significance.

3. *Do the characteristic WBC and E_a values vary significantly from year to year within the same canal system; i.e., do WBC and E_a appear to be affected by total water supply available within a canal?*

   While this study monitored a substantial total number of irrigation events, there were not enough observed events within different irrigation seasons under the command of different canal systems to answer this question with statistical significance.

4. *Do the characteristic WBC and E_a values differ between surface-water supplied sprinklers as compared to groundwater-supplied systems?*

   The project focused on sprinkler-irrigated fields mainly in 2008. For that year, in the Upstream region seven monitored sprinkler-irrigated fields were supplied from groundwater pumping wells while one was supplied from surface water. On the other hand, the 19 sprinkler-irrigated fields in the Downstream region were all supplied by canal water through stabilization ponds. The average Q_A, Q_I, TRF, DPF and E_a values for the Upstream fields were 2.0 in, 1.8 in, 0.0 percent, 12.2 percent, and 82.8 percent while for the Downstream fields the respective values were 2.3 in, 2.1 in, 0.0 percent, 7.1 percent, 87.8 percent. There was no statistically significant difference between the WBC and E_a values estimated for surface-water supplied and groundwater-supplied sprinkler systems.

5. *Is there any indication of intentional bias introduced into the study by irrigators hoping to demonstrate that the achievable WBC and E_a values using surface-supplied sprinklers is no different than that associated with flood and furrow methods?*

   No intentional bias was detected. The irrigated fields that were monitored in this study were selected based on their suitability to the study objectives and their convenience (location, ability to monitor, source of water, etc) rather than by a broad request for volunteers from among irrigators.

6. *Do the data indicate any effect of soil salinity on crop yield? If so, what conclusions can be reached with these data, and what additional information is necessary to adequately quantify the impact of soil salinity on crop yield in the LARV?*

   Yes, based on the crop biomass samples collected on corn and alfalfa fields there appears to be a clear trend of decreasing crop yield as EC_e increases above a threshold value of three to five dS/m. There are many factors that affect crop yield (so such as irrigation amount, fertilizer application, pest management, crop variety, etc.). Additional data on these factors should be collected in order to remove that variability from the data. Measurements on a larger number of fields also would strengthen understanding of the crop yield – EC_e relationship for various crops.

7. *Do the data indicate any effect of irrigation timing or amount on crop yield? If so, what conclusions can be reached with these data, and what additional information is necessary to adequately quantify the impact of irrigation management practices on crop yield in the LARV?*

   A statistically significant weak correlation was detected between average crop yield and average total Q_A on monitored fields. However, not enough data were collected on irrigation timing (given that all irrigation events on fields typically were not monitored) and spatial uniformity of irrigation applications to definitively answer these questions. To do so would require monitoring of a much larger number of fields and irrigation events, under more carefully controlled conditions.

8. *What are the known or assumed possibilities and limitations for correlating crop yield and soil salinity to ET for the fields included in this study?*

   As stated above, clear trends of decreasing crop biomass with increasing EC_e were detected on a number of fields investigated in this study. Also, using the ReSET model with satellite imagery, estimates of the impact of EC_e on crop ET_a were developed for a number of corn fields. There appears to be a clear trend of decreasing ET_a as EC_e increases above threshold values of roughly three to five dS/m, corresponding to the thresholds detected for impact on crop yield.

9. *Does crop type appear to affect WBC and E_a under sprinkler systems?*

An examination of differences in DPF and E_a for sprinkler-irrigated events on corn and alfalfa fields revealed no statistically significant difference.

10. *Do sprinkler operators typically apply sufficient volumes of water necessary to meet the ET requirement of crops?*

This has not yet been thoroughly examined. However, the fact that no deep percolation occurred for about 72 percent of sprinkler irrigation events indicates that fields are likely being under-irrigated.

11. *Do sprinkler irrigators apply sufficient water to meet the salt leaching requirement for the soil root zone?*

Water balance calculations indicated that no deep percolation occurred on about 72 percent of monitored sprinkler irrigation events, indicating no salt leaching occurred during these events. If this practice continues, problems associated with increased soil salinity are to be expected.

12. *What is the difference in the WBC and E_a of sprinkler systems that practice leaching to those that do not?*

Given that very little leaching (very little deep percolation) was observed on the sprinkler-irrigated fields that were monitored, this question cannot be answered with the data that were collected.

13. *Are there significant differences in deep percolation and leaching fraction for various types of sprinkler systems?*

Given that very little leaching was observed (very little deep percolation) on the sprinkler-irrigated fields that were monitored, this question cannot be answered with the data that were collected.

14. *How do alfalfa crop yields from sprinkler irrigated fields compare with those irrigated by flood and furrow irrigation methods?*

There were an inadequate number of monitored fields to provide a statistically significant evaluation of this question.

15. *How do water table depth and salinity, soil salinity, and crop yields relate to WBC and E_a?*

No statistically significant relationships could be detected using the data from this study.

Exhibit M

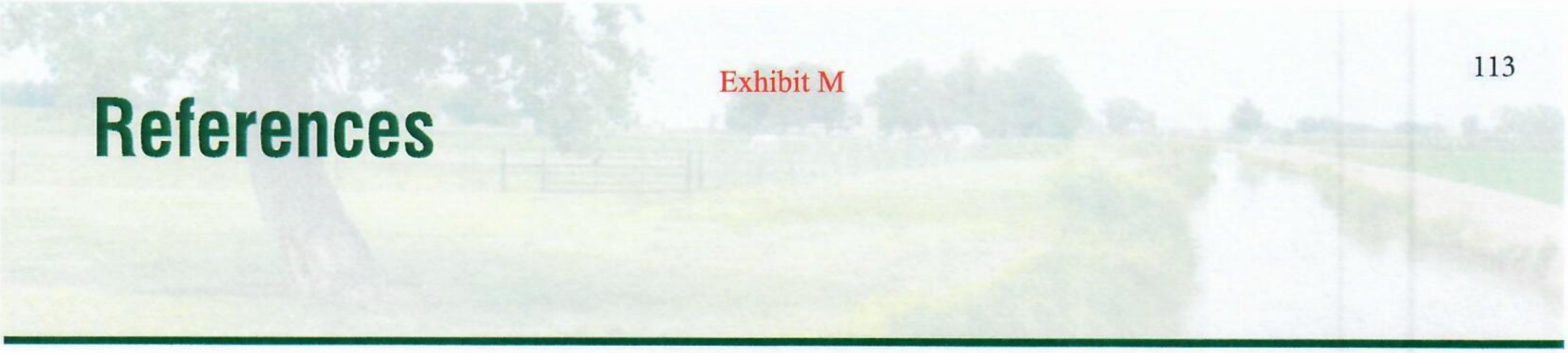


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Exhibit M

Exhibit N

GP IRRIGATED FARMS, LLC

PROWERS COUNTY REVEGETATION COST SUMMARY

SEEDING COST

YEAR	ACRES SEEDED	COST/ACRE	TOTAL COST
2016	1,704	$75	$127,800
2018	1,452	$75	$108,900
2020-2021	770	$75	$57,750
		TOTAL SEEDING COST TO DATE:	**$294,450**

MAINTENANCE COST

YEAR	ACRES	NO. OF TIMES PER YEAR		TOTAL COST
		MOWING $15/ ACRE	HERBICIDE APPLICATION $15/ ACRE	
2016	1,704	2	2	$102,240
2017	1,704	2	2	$102,240
2018	1,704	2	2	$102,240
2019	1,704	2	2	$102,240
2020	1,704	2	2	$102,240
2021	1,704	2	2	$102,240
			TOTAL MAINTENANCE COST TO THRU 2021:	**$613,440**

TOTAL REVEGETATION COST THRU 2021: **$907,890**

Exhibit N
SUMMARY OF SEED MIXES USED FOR REVEGETATION PROJECT

ARKANSAS VALLEY SEED: DRYLAND PASTURE SEED MIX

Seeding Rate:

New Seeding Broadcast: 20-25 lbs/acre Drilled: 15-20 lbs/acre

Over-seeding Broadcast: 10-15 lbs/acre Drilled: 5-10 lbs/acre

Mix contains:

20% Tetraploid Perennial Rye (*Lolium Perenne)*

20% Smooth Brome, Lincoln (*Bromus inermis*)

15% Paiute Orchardgrass (*Dactylis glomerata*)

15% Hycrest Crested Wheatgrass (*Agropyron cristatum*)

15% Pubescent Wheatgrass (*Agropyron trichophorum*)

15% Dahurian Wildrye (*Elymus dahuricus*)

ARKANSAS VALLEY SEED: SALTY/ALKALI PASTURE MIX

Mix Contains:

10% AC Saltlander Wheatgrass

10% Garrison Creeping Foxtail (coated)

20% Hercules Tall Wheatgrass

20% Forage Perennial Ryegrass

20% Forage Tall Fescue

20% Smooth Brome

SHARP BROS. SEED CO.: CUSTOM MIX FOR SITE-SPECIFIC REVEGETATION CONDITIONS

1.45 PLS lbs/ac (20%) Sideoats Grama

2.00 PLS lbs/ac (29%) Western Wheatgrass

1.30 PLS lbs/ac (19%) Sand Lovegrass

1.00 PLS lbs/ac (14%) Tall Wheatgrass

0.75 PLS lbs/ac (11%) Sand Dropseed

0.50 PLS lbs/ac (7%) Alkali Sacaton

Note: this all native grass mix was custom-formulated by Sharp Bros. Seed Co. to be adapted to the most difficult site and soil conditions encountered in this revegetation project. All seeding completed after 2019 used this mix.

Exhibit O

GP IRRIGATED FARMS, LLC & S-D INVESTMENTS, LLC

ECONOMIC IMPACT SUMMARY OF PROWERS COUNTY FARM & LIVESTOCK PROJECT

CATEGORY	FINANCIAL IMPACT
IRRIGATED FARM CAPITAL INVESTMENT	$ 80,000,000
DAIRY & FEEDLOT CAPITAL INVESTMENT	$ 30,000,000
TOTAL INFRASTRUCTURE CAPITAL INVESTMENT	$ 110,000,000
LIVESTOCK ACQUISITION COST	$ 20,000,000
ANNUAL DAIRY GROSS INCOME*	$ 18,000,000
ANNUAL DAIRY PROPERTY TAXES	$ 320,000
FARM EMPLOYMENT	22
DAIRY & FEEDLOT EMPLOYMENT	43
TOTAL EMPLOYMENT	65

* BASED ON CURRENT MILK PRICES

Supplemental report for GP Irrigated Farms, LLC, S-D Investments, LLC, and Lower Arkansas Water Management Association 1041 permit application in Prowers County

May 17, 2022

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The Lower Arkansas Water Management Association ("LAWMA") acquired and changed for augmentation and replacement uses 897 shares of stock in the Lamar Canal Company, 750.5 shares of stock in the Granada Irrigation Company, and 2.0 cfs decreed to the XY Irrigating Ditch Company's Canal. Those water right interests were historically used to flood irrigate portions of the Higbee West Farm, DJC-Koehn Farm, Grasmick Lamar Farm, Gass Farm, Grasmick Granada Farm, Grasmick XY Farm (collectively, the "GP/S-D Farms"), and the McMillan Farm. LAWMA acquired the shares from GP Irrigated Farms, LLC ("GP Irrigated"), S-D Investments, LLC ("S-D") and Lawrence McMillan in exchange for LAWMA's issuance of 2,069 shares of LAWMA common stock to GP Irrigated; 1,000 shares of LAWMA common stock to S-D; and 16 shares of LAWMA common stock to Mr. McMillan. A map of showing the locations of the GP/S-D Farms and the McMillan Farm is attached as **Exhibit L** to the 1041 Permit Application that GP Irrigated, S-D and LAWMA have submitted to Prowers County. Some of the fields on the GP/S-D Farms have been converted into fields that are irrigated by center pivot sprinklers and some of the fields on the GP/S-D Farms and the McMillan Farm have had the water removed from them. In the GP/S-D Farms' fields where the water has been removed, the land has been planted to grass several times. From 2017 to the present, I have inspected the GP/S-D Farms and the McMillan Farm at least once a year. During my inspections I determine the percent perennial grass species present in each field on the GP/S-D Farms and the McMillan Farm. I also determine the percent of desirable perennial broadleaf species present. In addition, I inspect for undesirable plant species, ("weeds").

I also have inspected some of the fields irrigated with center pivot sprinklers on the GP-S/D Farms. From 1985 to 2010, I scouted (inspected crops for insects, weeds, and plant disease) fields with growing crops on most of the land that comprises the GP/S-D Farms. The GP/S-D Farms historically were used to grow corn, wheat, sorghum, alfalfa, pumpkins, watermelons, and onions. I am very familiar with the GP/S-D Farms and the McMillan Farm including the current status of the land use and the plant species present. I have observed some of the wildlife present in the area as well.

I took the Cover photo of a Lesser prairie chicken (*Tympanuchus pallidicinctus),* south of Holly Colorado, on May 6, 2010. The Lesser prairie chicken is on Colorado's State Threatened list. It is my hope that the establishment of grass on the GP/S-D Farms and the McMillan Farm will create habitat that is suitable to the Lesser prairie chicken and other wildlife species.

Table 1. Below is a summary of the common vegetation found on GP/S-D Farms and the McMillan Farm in fields or pastures or irrigation canals or drainage ditches.

Table 1. Vegetation Found on the GP/S-D Farms and the McMillan Farm

Common Name	Scientific Name	Location*
Alfalfa	*Medicago sativa*	Field
Alkali sacaton	*Sporobolus airoides*	Ditches
Barnyard grass	*Echinochloa crusgalli*	Fields
Bermuda grass	*Cynodon dactylon*	Ditches
Big Blue Stem	*Andropogan geradi*	Pasture
Blue flax	*Linum sp.*	Pasture
Bristly foxtail	*Setaria verticillata*	Fields
Buffalobur	*Solanum rostratum*	Fields
Buffalo grass	*Buchloe dactyloides*	Pasture
Canada thistle	*Circium arvense*	Pasture
Canada wild rye	*Elymus canadensis*	Ditches
Common cattail	*Typha latfolia*	Ditches
Common lambs quarter	*Chenopodium album*	Fields
Common milkweed	*Asclepias syriaca*	Ditches
Curlycup gumweed	*Grindelia squarrosa*	Ditches
Field bindweed	*Convolvulus arvensis*	Fields
Flix weed	*Descuraina sophia*	Fields
Foxtail barley	*Hordeum jubatum*	Field, Ditch
Giant foxtail	*Setaria faberii*	Fields
Heath aster	*Aster ericoides*	Pasture
Horseweed	*Conyza Canadensis*	Ditches
Indiangrass	*Sorghestrum nutan*	Fields
Inland Saltgrass	*Distichlis spicata*	Ditches
Johnsongrass	*Sorghum halepense*	Ditches, Fields
Kochia	*Kochia scoparia*	Fields, Ditches
Many Flowered Aster	*Symphyotrichum ericoides*	Ditches
Pigweed	*Amaranthus palmerii*	Fields, Ditches
Plains cottonwoods	*Populus deltroides*	Ditches
Prairie cord grass	*Spartna pectinata*	Ditches
Prairie golden rod	*Solidago missouriensis*	Ditches
Prairie threeawn	*Aristida olgantha*	Pasture
Prickly lettuce	*Lactuca scariola*	Ditches
Russian olive	*Elaeagnus umbellata*	Ditches
Russian thistle	*Salsola kali*	Ditches, Fields
Salt Cedar	*Taarix chinesis*	Ditches
Sand dropseed	*Sporobolus cryptandrus*	Pasture
Sand sagebrush	*Artemisia filifolia*	Pasture
Sandbur	*Cenchrus longispinus*	Field, Ditch
Siberian elm	*Ulmus pumila*	Ditches
Side oats grama	*Bouteloua curtipendula*	Pasture

Spreading dogbane	*Apocynum androsaemifolium*	Riparian
Stink grass	*Eragrostis ciliansis*	Ditches
Sulfur cinquefoil	*Potentilla recta*	Ditches
Sunflower	*Helianthus annuus*	Fields, Ditches
Swamp smartweed	*Polygonum coccineum*	Ditches
Switchgrass	*Panicum virgatum*	Pasture
Tall fescue	*Festuca arundinacea*	Ditches
Ten peddle mentzelia	*Mentzelia decpatala*	Ditches
Tumble grass	*Schedonnardus Paniclatus*	Pasture
Venice Mallow	*Hibicus triolnum*	Fields
Vine Mesqueite	*Panicum obtusum*	Pasture
Virginia Ground cherry	*Physalis virginiana*	Ditches
Western rag weed	*Ambrosia psilotachya*	Ditches
Western Wheat grass	*Agropyron smithii*	Pasture
Western whorled milkweed	*Asclepias subverticillata*	Ditches
White prairie aster	*Aster falctus Lindl.*	Ditches
Yellow nut sedge	*Cyperus esculentus*	Fields, Ditches

***Ditches** – includes canals, laterals of the canals. Irrigation ditches, seep ditches, and return flow ditches. This includes the riparian land next to the ditches.
*__Fields__ – cultivated fields on the farm where perennial or annual crops are grown.
*__Pasture -__ land that is not cultivated but where Cattle at times graze on the land. Including revegetated land.

Beginning in 2016, GP Irrigated planted grass in fields that comprise the GP/S-D Farms that were formerly irrigated and not re-irrigated with other approved sources of water. I have summarized below the grass species that were planted along with the year they were planted. Some of these grass species were already present in 2016.

2016:
Wheatgrass Tall (*Thinopyrum ponticum*): 52.13%
Oats (*Avena sativa)*: 38.87%
Wheatgrass Western (*Agropyron smithii)*: 5.24%

2018:
AC Saltlander Wheatgrass (*Agropyron smithii)*: 10%
Garrison Creeping Foxtail (Alopecurus arundinaceus): 10%
Hercules Tall Wheatgrass: 20%
Forage Perennial Ryegrass (*Lolium perenne*): 20%
Forage Tall Fescue (*Festuca arundinacea)*: 20%
Smooth Bromegrass (*Bromus inermis L*.): 20%

2021:
Tall Wheatgrass *(Thinopyrum ponticum)*: 1lb/Ac

Side oats grama (*Bouteloua curtipendula)*: 1.5lb/Ac
Western Wheatgrass (*Agropyron smithii)*: 2lb/A
Sand dropseed grass (*Sporobolus cryptandrus)*: 0.8lb/Ac
Sand lovegrass (*Eragrostis trichodes)*: 1.3lb/Ac
Alkali Sacaton (*Sporobolus airoides)*: 0.5lb/Ac

I have observed the following grass species being introduced on the GP/S-D Farms based on my annual inspections:

Wheatgrass Tall (*Thinopyrum ponticum*)
Garrison Creeping Foxtail (Alopecurus arundinaceus)
Perennial Ryegrass (*Lolium perenne)*
Sand lovegrass (*Eragrostis trichodes)*

During my inspections, I have not observed any plants that are included on the Colorado endangered plant list on the GP/S-D Farms and McMillan Farm, and I don't believe any were present when the farms were irrigated cropland. GP Irrigated continues to try to improve the grass stands on the GP/S-D Farms. In addition to planting grass seed, weed control is an important land management practice that GP Irrigated does annually. GP Irrigated's weed control consists of mowing and baling the weeds. Last year, I instructed GP Irrigated to wait until July to swath and bail the weeds on the GP/S-D Farms. The advantages of delaying the weed control until then were as follows: (1) the grass seedlings were well established enough to withstand the traffic of driving the swathers and bailers on the farms without damaging or killing the emerged seedling grasses; and (2) the established grass was in the seed formation stage of growth at that point. By delaying the weed control the grass seeds had a chance to become viable. Then, after cutting, the seeds can germinate when adequate rain fall occurs, which can increase the grass stands.

When a farm is used as irrigated cropland, it does not create a good habitat for most wildlife species. All wildlife species benefit when there is diverse vegetation in the area. Irrigated cropland, such as the GP/S-D Farms and McMillan Farms when they were historically irrigated, creates large tracks of land with only one or two different plant species. All wildlife species need water, food, and shelter. When a farm is converted from irrigated farming to native revegetation, it creates diversity of plant species on the farm, which causes wildlife populations in the area to increase. On the GP/S-D Farms, the portions that are being revegetated have increased the plant diversity and has increased the wildlife habitat on the farms. According to a report authored by Melvin DePra (Retried Area Manager for Colorado Parks and Wildlife Department), grasses such as Perennial Ryegrass (*Lolium perenne*), Smooth Bromegrass ((*Bromus inermis L*.) and Hycrest Crested wheatgrass provide "increased opportunity for wildlife nesting for native songbirds, small rodents and upland game along with brood rearing cover" The seed mixtures GP Irrigated planted on the GP/S-D Farms included some of those grass species and similar wheatgrasses such as Wheatgrass Tall (*Thinopyrum ponticum*), and Western Wheatgrass (*Agropyron smithii*). Accordingly, the revegetated areas on the GP/S-D Farms and the McMillan Farm provide increased plant diversity and better habitat to many of the wildlife species in Prowers County. In addition, GP Irrigated has constructed settling ponds near the portions of the GP/S-D Farms that are being irrigated to supply water to the center pivot sprinkler used for irrigation. These ponds are a source of water for terrestrial wildlife species and are excellent habitat for waterfowl that inhabit the county.

Table 2. is a list of the of the Threatened and Endangered Species in Colorado. There are 350 terrestrial species and 35 fish known to occur, or likely to occur, in Prowers County. A complete list is available from the author.

Table 2. Threatened and Endangered Species in Colorado

COMMON NAME	SCIENTIFIC NAME	STATUS*
AMPHIBIANS		
Boreal Toad	Bufo boreas boreas	SE
Couch's Spadefoot	Scaphiopus couchii	SC
Great Plains Narrowmouth Toad	Gastrophryne olivacea	SC
Northern Cricket Frog	Acris crepitans	SC
Northern Leopard Frog	Rana pipiens	SC
Plains Leopard Frog	Rana blairi	SC
Wood Frog	Rana sylvatica	SC
BIRDS		
American Peregrine Falcon	Falco peregrinus anatum	SC
Bald Eagle	Haliaeetus leucocephalus	SC
Burrowing Owl	Athene cunicularia	ST
Columbian Sharp-Tailed Grouse	Tympanuchus phasianellus columbianus	SC
Ferruginous Hawk	Buteo regalis	SC
Greater Sage Grouse	Centrocercus urophasianus	SC
Greater Sandhill Crane	Grus canadensis tabida	SC
Gunnison Sage-Grouse	Centrocercus minimus	FT, SC
Least Tern	Sterna antillarum	SE
Lesser Prairie-Chicken	Tympanuchus pallidicinctus	ST
Long-Billed Curlew	Numenius americanus	SC
Mexican Spotted Owl	Strix occidentalis lucida	FT, ST
Mountain Plover	Charadrius montanus	SC
Plains Sharp-Tailed Grouse	Tympanuchus phasianellus jamesii	SE
Piping Plover	Charadrius melodus circumcinctus	FT, ST
Southwestern Willow Flycatcher	Empidonax traillii extimus	FE, SE
Western Snowy Plover	Charadrius alexandrinus	SC
Western Yellow-Billed Cuckoo	Coccyzus americanus	SC, FT
Whooping Crane	Grus americana	FE, SE

FISH		
Arkansas Darter	Etheostoma cragini	ST
Bonytail	Gila elegans	FE, SE
Brassy Minnow	Hybognathus hankinsoni	ST
Colorado Pikeminnow	Ptychocheilus lucius	FE, ST
Colorado River Cutthroat Trout	Oncorhynchus clarki pleuriticus	SC
Colorado Roundtail Chub	Gila robusta	SC
Common Shiner	Luxilus cornutus	ST
Flathead Chub	Platygobio gracilis	SC
Greenback Cutthroat Trout	Oncorhynchus clarki stomias	FT, ST
Humpback Chub	Gila cypha	FE, ST
Iowa Darter	Etheostoma exile	SC
Lake Chub	Couesius plumbeus	SE
Mountain Sucker	Catostomus playtrhynchus	SC
Northern Redbelly Dace	Phoxinus eos	SE
Plains Minnow	Hybognathus placitus	SE
Plains Orangethroat Darter	Etheostoma spectabile	SC
Rio Grande Chub	Gila pandora	SC
Rio Grande Cutthroat Trout	Oncorhynchus clarki virginalis	SC
Rio Grande Sucker	Catostomus plebeius	SE
Razorback Sucker	Xyrauchen texanus	FE, SE
Southern Redbelly Dace	Phoxinus erythrogaster	SE
Stonecat	Noturus flavus	SC
Suckermouth Minnow	Phenacobius mirabilis	SE
MAMMALS		
Black-Footed Ferret	Mustela nigripes	FE, SE
Black-Tailed Prairie Dog	Cynomys ludovicianus	SC
Botta's Pocket Gopher	Thomomy bottae rubidus	SC
Gray Wolf	Canis lupus	SE, FE
Grizzly Bear	Ursus arctos	FT, SE
Kit Fox	Vulpes macrotis	SE
Lynx	Lynx canadensis	FT, SE
Northern Pocket Gopher	Thomomys talpoides macrotis	SC
Preble's Meadow Jumping Mouse	Zapus hudsonius preblei	FT, ST
River Otter	Lontra canadensis	ST
Swift fox	Vulpes velox	SC
Townsend's Big-Eared Bat	Corynorhinus townsendii pallescens	SC
Wolverine	Gulo gulo	SE

REPTILES		
Triploid Checkered Whiptail	Cnemidophorus neotesselatus	SC
Midget Faded Rattlesnake	Crotalus viridis concolor	SC
Longnose Leopard Lizard	Gambelia wislizenii	SC
Yellow Mud Turtle	Kinosternon flavescens	SC
Common King Snake	Lampropeltis getula	SC
Texas Blind Snake	Leptotyphlops dulcis	SC
Texas Horned Lizard	Phrynosoma cornutum	SC
Roundtail Horned Lizard	Phrynosoma modestum	SC
Massasauga	Sistrurus catenatus	SC
Common Garter Snake	Thamnophis sirtalis	SC
MOLLUSKS		
Rocky Mountain Capshell	Acroloxus coloradensis	SC
Cylindrical Papershell	Anodontoides ferussacianus	SC

[1]Status Codes:

FE = Federally endangered
FT = Federally threatened
FC= Federal Candidate Species
SE = State Endangered
ST = State Threatened
SC = State Special Concern (not a statutory category)

It is my opinion that as the GP/S-D Farms and McMillan Farm are established in revegetation, these grasslands will provide better and more diverse habitat for many of the species listed in Prowers County including deer, elk, pronghorn, snakes and other reptiles, mammals, and many bird species. In addition, the endangered of threatened species listed in Table 2. will benefit from improved habitat or be unaffected. Below are a few photos of wildlife I have taken over the years I have been on the GP/S-D Farms and McMillan Farm.


Mule deer, 2020

Coyote 2018

Summary

In summary, the development of the GP/S-D Farms and the McMillan Farm that is proposed in the 1041 permit application will increase the habitat diversity on the farms. This, in turn, will increase the wildlife on the GP/S-D Farms and the McMillan Farm.

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