

## **Summary Report for the Determination of Conserved Water Associated with the 2009 Webb Tract Water Transfer Pilot Study**

Delta Wetlands Properties (DW), the Metropolitan Water District of Southern California (MWD), and the Department of Water Resources (DWR) executed an agreement providing for the conveyance of water made available by idling land on Webb Tract in the Sacramento-San Joaquin Delta in 2009. Due to the significant amount of uncertainty in the quantity of conserved water generated through crop idling in the Delta, the transfer parties agreed to conduct a pilot study. The goal of the Webb Tract pilot study was to determine the amount of water conserved by idling 4,064 acres of land on Webb Tract in 2009. For this pilot study, conserved water is the amount of evapotranspiration (ET) of corn on Webb Tract, based on measured ET of corn on adjacent Twitchell Island, less soil evaporation and weed ET on the pre-determined Webb Tract acreage.

DW contracted with the University of California, Davis (UCD), to conduct the Webb Tract pilot study. ET estimates on Webb Tract were developed using the Surface Renewal (SR) method. Installation of instrumentation and data collection began on May 14 and ended on September 30. Two stations collected ET data on Webb Tract: a base station on Field 23 set up for the duration of the study period and a roving station that moved to different fields throughout the period, including fields that were primarily bare soil, and fields of significant vegetation.

The results of this data collection effort were daily ET values for the area upwind of the instrumentation, approximately 120 meters by 120 meters. DWR used satellite imagery and image processing techniques to correlate the SR station measured ET with the vegetation grown in the same area upwind of the instrumentation. Landsat 5 and Landsat 7 satellite imagery of Webb Tract were available for 16 dates during the study period. DWR used the satellite data to develop a Normalized Difference Vegetation Index (NDVI). NDVI is a common remote sensing index used to help estimate vegetation characteristics, such as leaf area index and canopy cover. DWR staff developed a regression equation for the Landsat 5 and Landsat 7 datasets using the NDVI and ET data. We used the NDVI/ET regression equations to estimate daily ET for each field. From this data set, we calculated monthly ET depths and volumes for the entire 4,064 acres in the Webb Tract pilot study. See the comparison tables below.

During the same period, DWR collected SR derived ET estimates from corn growing on Twitchell Island as part of an ongoing DWR project that is collecting SR and California Irrigation Management Information System (CIMIS) data throughout California. On Twitchell Island, the SR station is located in a cornfield toward the western side of the island and the CIMIS station is located on pasture approximately 0.6 miles to the east. The Twitchell Island cornfield is approximately 4-5 miles to the northwest of Webb Tract. Due to the close proximity, and the analogous topographic and climatic conditions, we used the measured 2009 ET of corn on Twitchell Island to represent the ET of corn had it been planted on Webb Tract in 2009.

It is important to note that conserved water, or “real water”, for transfer is normally based on the Evapotranspiration of Applied Water (ETA<sub>W</sub>), the amount of crop ET provided by applied irrigation water. ETA<sub>W</sub> is the total ET minus the amount of irrigation water provided by

precipitation (effective precipitation) and seepage. The goal of the Webb Tract pilot study was to evaluate the difference in total ET between corn grown on Webb Tract and that of the idled fields irrespective of the source of the water consistent with the agreement between DW, MWD, and DWR. The agreement defined the calculation of conserved water for transfer as the difference between crop ET and the evaporation and transpiration from idled land. Effective precipitation and seepage rates are not included in these calculations. There is significant seepage from the surrounding waterways that satisfies a portion of the consumptive use, however, the effective precipitation and seepage estimations are beyond the scope of this pilot study. For this pilot study, we assumed both effective precipitation and seepage were the same for the corn and idled land. The SR measurements of ET account for these assumptions on both Webb Tract and Twitchell Islands. However, this assumption may not be correct, as effective precipitation and seepage rates vary throughout the Delta. The seepage component of crop water use in the Delta lowlands is uncertain, resulting in a limitation for using ETAW to calculate real water savings from future crop idling transfer proposals in this region. We recommend that future transfers from property within the Delta lowlands would then necessarily rely on accepted direct measurement techniques, such as the surface renewal method employed on Webb Tract and Twitchell Island, to calculate the amount of conserved water made available.

The following tables contain the monthly ET, not ETAW, for corn measured on Twitchell Island and applied to the idled acreage on Webb Tract, the ET measured from the idled land on Webb Tract Island, and the difference, being conserved water, by month. The totals covering the entire study period are included (top table is total volume in acre-feet; bottom table is depth as acre-feet/acre).

**Comparison of Twitchell Corn ET Applied to Webb Idled  
Acreages and Webb Idle ET (acre-feet) 1\_/**

<b>Month</b>	<b>Twitch Corn ET (AF)</b>	<b>Webb Idled Land ET (AF)</b>	<b>Conserved Water (AF) 2_/</b>
May	487.7	690.8	-203.1
June	1,706.8	1,178.5	528.3
July	2,722.8	1,544.2	1,178.6
August	2,478.9	1,584.9	894.0
September	1,747.4	1,381.7	365.7
<b>Total</b>	<b>9,143.6</b>	<b>6,380.1</b>	<b>2,763.5</b>

1\_/ Values are evapotranspiration (ET), not evapotranspiration of applied water (ETAW).

2\_/ The conserved water in May was negative because Twitchell was weed free with corn seedlings, lower ET, and Webb Tract's soil had a rougher surface with varying amounts of vegetation (higher ET).

**Comparison of Twitchell Corn ET Applied to Webb Idled  
Acreages and Webb Idle ET (acre-feet/acre) 1\_/**

<b>Month</b>	<b>Twitch Corn ET (AF/A)</b>	<b>Webb Idled Land ET (AF/A)</b>	<b>Conserved Water (AF/A) 2_/</b>
May	0.12	0.17	-0.05
June	0.42	0.29	0.13
July	0.67	0.38	0.30
August	0.61	0.39	0.21
September	0.43	0.34	0.09
<b><i>Total</i></b>	<b>2.25</b>	<b>1.57</b>	<b>0.68</b>

1\_/ Values are evapotranspiration (ET), not evapotranspiration of applied water (ETAW).

2\_/ The conserved water in May was negative because Twitchell was weed free with corn seedlings, lower ET, and Webb Tract's soil had a rougher surface with varying amounts of vegetation (higher ET).

It is important to note that the above data are for the duration that surface renewal stations operated on Webb Tract, May 15 to September 30, 2009. The conserved water for the period stipulated in the pilot study agreement between DW, MWD, and DWR as potentially transferable, July 1, 2009 through September 30, 2009, is 2438.3 acre-feet or 0.60 acre-feet/acre for the pre-determined 4,063.79 acres fallowed. This report relates to the data and methods employed in the calculation of conserved water. Issues of transferability and export of the conserved water are beyond the scope of this report, but can be found in DWR's pending comprehensive assessment document covering the 2009 Webb Tract crop idling pilot study outcome and recommendations for future Delta crop fallowing water transfers.

**OFFICE MEMO**

<b>TO:</b> Ed Morris Jason Harbaugh	<b>DATE:</b> 22 July 2009
	<b>SUBJECT:</b> Webb Tract visit - July 21, 2009
<b>FROM:</b> Kim Rosmaier	

**Introduction**

'Twas a lovely day for a visit to Webb Tract, warm but breezy. Jason and I performed the Webb Tract monitoring survey on July 21, 2009. Fields in the southeast were being disced.

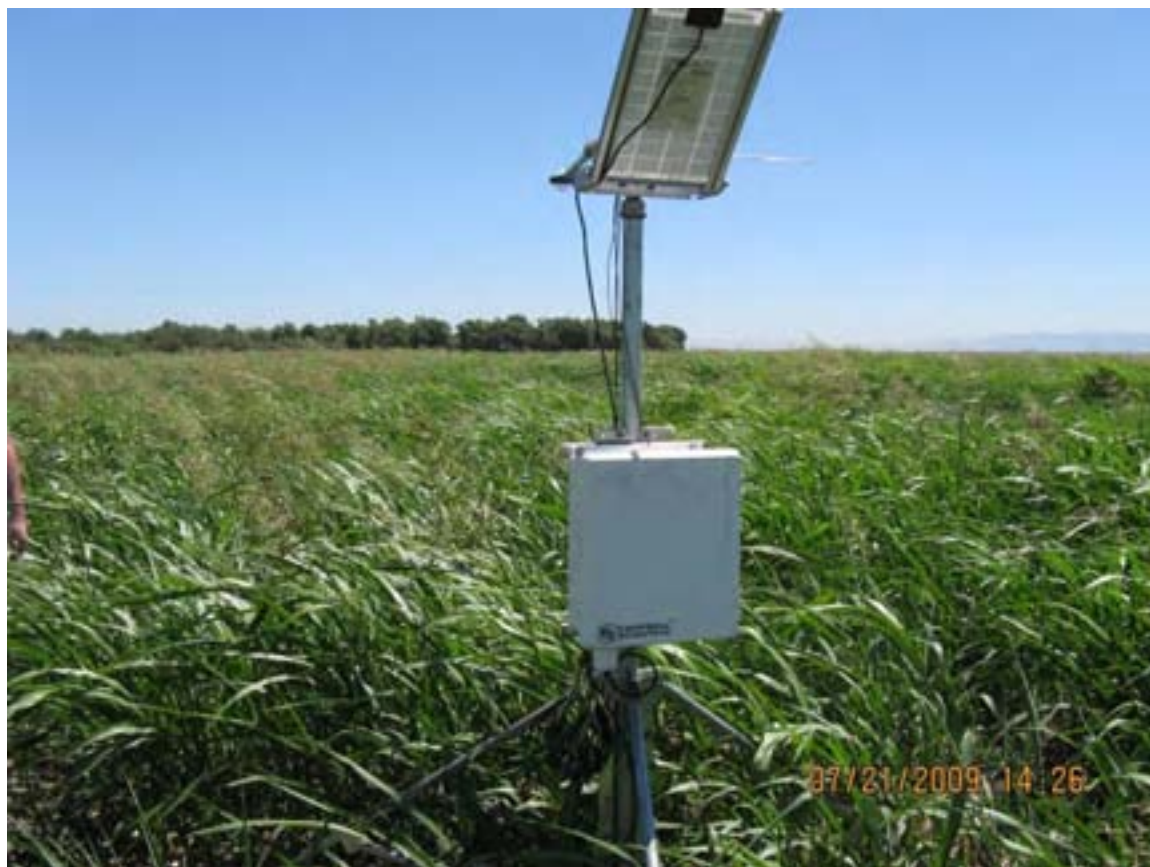
**Observations**

– The permanent SR station, SR1, is located in Field 23. The field continues to have slow growth of vegetation.



SR1 looking west 7/21/09

The roving SR station, SR2, is located in a field of Johnson grass.



SR2 looking south

When the station was installed on 7/14/09, the average height of JG appeared to be 24-40 inches with a maximum height of 5 feet. During this visit it was noted the JG has grown on average 6 inches, thus having a range of 30-46 inches, with considerable infill of vacant land. This growth has established a canopy coverage of approximately 85-90%.

– As stated in a previous report, the amount of vegetation within a single field makes it difficult to assess the field as a one land use. The following three photos show Field 44 as we traveled from south to north on the west side.



– Fields in the southeast, east of the pump, were being disced. The following photo, taken 07/21/06, is of fields 34, 35, and 36 (looking NE) after discing.



This photo, taken on 7/14/09, is of fields 34, 35, and 36 (looking NE) provides a comparison of pre- and post-discing. The vegetation in this photo was approximately 2-4 feet in height.



– This photo shows the interface between disced and undisced fields 36 and 60, respectively. This also provides a comparison of disced and undisced fields.



– There is a wide range of vegetation on the tract and the lack of irrigation has not deterred the growth of vegetation. The pigweed in field 46 has now reached heights greater than 2 feet and canopy coverage is 85-95%.





– The use of 50% each for nF-F and nI1 is only to indicate the field is not completely fallow or completely idle. It does not indicate the actual percentage of either attribute. We identified this field as nF-F+nI1, but the 50% designation is not accurate for either classification.



– We are also being generous in identifying some fields as fallow (F-F), as some would be considered idle in a “typical” land use survey but we use F-F to indicate discing is evident.



**OFFICE MEMO**

<b>TO:</b> Ed Morris Jason Harbaugh	<b>DATE:</b> 06 August 2009
	<b>SUBJECT:</b> Webb Tract visit - July 30, 2009
<b>FROM:</b> Kim Rosmaier	

**Introduction**

Jason and I performed the Webb Tract monitoring survey on July 30, 2009.

Dave Forkel met us on the island and asked about the June report that was to come from DWR. Since this was the first I heard that DWR was to provide a report (NCRO staff did not receive a copy of the contract until July 28 2009) I told him I didn't know. He also asked about the PRC Byron transfer. I told him I thought it was still under discussion, again not knowing the final decision on that transfer.

**Observations**

– The permanent SR station, SR1, is located in Field 23. The field continues to have slow growth of vegetation.



SR1 looking west 7/30/09

The roving SR station, SR2, is located in a field of Johnson grass. There is considerable growth of Johnson grass. The average height of the grass is 4 feet. Infill of open space has continued and canopy coverage is 90-100%. The station is to be moved on July 31<sup>st</sup>.



SR2 looking south 07/30/09

Although there is no irrigation taking place on the island, water does seep into the deeper ditches. Unfortunately, I was not able to measure the depth of water, but the following photo shows water in the ditch west of Field 23 looking south.



Fields 16 thru 20 in the north are being disced.



The fallow fields show evidence of being disced but have considerable vegetation remaining. This field shows the discing but also has vegetation.



Field 5 designated as F-F, fallow field

**OFFICE MEMO**

<b>TO:</b> Ed Morris Jason Harbaugh	<b>DATE:</b> 24 August 2009
<b>FROM:</b> Kim Rosmaier	<b>SUBJECT:</b> Webb Tract visit - Aug 18, 2009

**Introduction**

Staff took Nancy Quan, Maureen Sergent, and Ed Diamond (all SWPAO) to Webb Tract. This is not a vegetation monitoring survey; its intent is to provide the SWPAO staff with information on the condition of the fields.

Although unplanned, Dave Forkel (Delta Wetlands Asst Mgr) and Ralph Heringer (Consultant) and Tom Shapland (UCD) were also on Webb.

Tom Shapland had two persons with him, both of whom are going to take over the study due to Tom leaving for Spain for three months. At the roving station, SR2, Tom provided a brief discussion on the biometeorology concepts behind the surface renewal study.

Nancy, Maureen, and Ed were quite astounded by the vegetative condition of most of the fields as well as the poor results of the current discing activities.

**Observations**

Discing is ongoing but due to the extensive volume and bulk of the weeds, there is considerable vegetation that remains standing and uncut.



Weeds continue to be a problem on the island, especially in the southwest section of the island. This photo is taken from the east levee by Field 80, looking west, shows vegetation from east to west.



Finally, the following photo shows depth to moisture is approximately 5 inches at field 66, the location of the roving SR station (SR2). This field has remained somewhat clear of vegetation, although infill is occurring.



**OFFICE MEMO**

<b>TO:</b> Ed Morris Jason Harbaugh	<b>DATE:</b> 7 September 2009
<b>FROM:</b> Kim Rosmaier	<b>SUBJECT:</b> Webb Tract visit - Aug 20, 2009

**Introduction**

Ed Morris and I did a vegetation survey on Webb Tract on August 20, 2009.

Upon departure, we had the good fortune to meet up with Jaime again at the ferry. We discussed with him the current discing activities.

We first discussed the cost of discing on Webb Tract. He indicated the tractors use 12 gallons of diesel fuel per hour, discing for a ten hour day, currently discing 7 days a week with three tractors. If the island were to be kept vegetation-free, it would need to be disced continuously. To disc the complete island takes about two weeks. Assuming \$3.00 per gallon (according to the Energy Information Administration (U S Govt) the current cost of diesel fuel in California is 3.03) the fuel cost of discing the island would be approximately \$15,000 per cycle. This does not include the costs of transport of the fuel onto Webb, payroll and any additional costs.

We also discussed the discing activity. Due to the substantial size of the stalks of some of the vegetation (pigweed, cheeseweed, jimsonweed, and others) they need to use the 20ft disc which is heavier and is more effective; however, this also requires more time to clear a field when compared to the 28ft or 30ft disc. To keep the island clear, there should be continuous discing activity.

**Observations**

Field 62 was being disced. The area closest to the levee (from where the photo was taken) is the disced area. As can be seen, discing does not cut all the vegetation.





The weeds have continued to grow in both height and diameter of stalk.  
The pigweed in field 79 are at a height of 5 to 6 feet



and the Johnson grass in field 101 is 4 to 5 feet



Field 64 was disced within the last week. Ed suggests we photo-document this site to provide a good example of regrowth of vegetation, due to the amount of vegetation left standing.



Fields 48 and 49 were also disced within the last week and today have been attributed as FF+nC, fallow field, not clear. This designation is necessary due to the poor results of the discing activity.



Field 23, the location of the base station, has undergone growth and the area around the base station is now completely vegetated, as is the fetch downwind of the station. This will influence the data at the SR1. This photo is looking west.



Field 66, the location of SR2, has had some growth but is still considered a fallow field by the surveyors. This photo is looking west.



For the next location of the roving SR, the researchers have requested a field that is heavily vegetated with Bermuda grass. Field 79 is attributed as NV, with primarily Bermuda grass in the south of the field and pigweed, Johnson grass, Bermuda grass, and jimsonweed in the north. This photo is in the southwest corner of the field, looking northeast.



This photo is in the north part of the field, looking east.



**OFFICE MEMO**

<b>TO:</b> Ed Morris Jason Harbaugh	<b>DATE:</b> 7 September 2009
<b>FROM:</b> Kim Rosmaier	<b>SUBJECT:</b> Webb Tract visit - Aug 26, 2009

**Introduction**

A new attribute was established today NV+D indicating the field is fully vegetated (NV) but is currently being disced (+D).

**Observations**

Field 75 was disced but large stands of Bermuda grass remain and the residue indicates the size of the stalks of the vegetation.



Field 23, location of base SR1 has full vegetation in the area of the station which will influence the data. These two photos were taken facing west, the wind direction.



The below picture of the field was taken while standing in the bed of the pickup in order to get another perspective of the vegetation coverage.



Field 66, the current location of the rover SR2 has undergone vegetative infill. The station will be moved from this location on August 27<sup>th</sup>.



The depth to moisture in this field at the location between the SR and the sonic anemometer was two inches.



The field attributed as T9+NV on 12 August 2009 has been disked.





**OFFICE MEMO**

<b>TO:</b> Ed Morris Jason Harbaugh	<b>DATE:</b> 27 September 2009
<b>FROM:</b> Kim Rosmaier	<b>SUBJECT:</b> Webb Tract visit - Sept 9, 2009

**Observations**

Discing activities continued this week.

There is considerable amount of Bermuda grass which hinders the discing activities. This poses a problem in the discing activities.



**Field 99 looking east from levee.**

The location of the permanent SR, field 23, was disced last week. To avoid damage to the SR equipment, the vegetation around the station was not disced. To decrease the influence on the SR data, staff attempted to lessen the height of the vegetation.



**Approaching the SR1 in Field 23.**

Considerable amount of weed residue remains on the field. Most weeds were cut but some were only flattened.

The rover SR is in field 79 and is surrounded by pigweed, jimsonweed, Bermuda grass, Johnson grass, and other unidentified vegetation.



**This is the SR2 in field 79, looking west. The photo was taken at a height of approximately 5 feet.**

Growth of vegetation is not hindered by lack of irrigation. Fields 16-20 were disced on August 5 have become heavily vegetated within one month



**OFFICE MEMO**

<b>TO:</b> Ed Morris Jason Harbaugh	<b>DATE:</b> 27 September 2009
<b>FROM:</b> Kim Rosmaier	<b>SUBJECT:</b> Webb Tract visit - Sept 17, 2009

**Observations**

No discing activity is occurring this week.

The rover SR remains in the north portion of field 79 and is surrounded by vegetation, heaviest to the west of the station, with less to the east.



**This is the location of SR2, looking from the south.**

The location of SR1, Field 23, was disced last week.



SR1 in field 23, looking west.

DWR staff cut down the pigweed surrounding the station. The picture below is of a stalk of cut pigweed. As can be seen, the diameter of the stalk is equivalent to that of the shovel.



Field 21 was disced on August 26 and was attributed as NV+D (native vegetation being disced) and is now attributed at FF+I1 due to the vegetation growth.



Due to extensive amount of Bermuda grass, some newly disced fields are not evaluated as fallow. Field 98 was disced on September 9th and was attributed as FF+I1, providing recognition that the field was partially fallow but also indicating sufficient vegetation (Bermuda grass) existed in some areas to be considered idle. Due to the increase in Bermuda grass, the field was attributed as I1 this week, indicating minimal bare soil.



Field 18 was disced on August 5<sup>th</sup> and attributed as fallow. Due to the growth of pigweed, the field is now idle. The pigweed is approximately 12-18 inches in height.

