Merced Integrated Regional Water Management
Merced Region Grant Proposal

Attachment 2:
Project Justification

Attachment 2 consists of the following items:

- ✓ **Project Summary Table**
  Table showing for each project the applicable project element(s) from both the IRWM Project Element Sections of the table.

- ✓ **Project Description**
  Brief description of each project and discussion of how the project will address a current need of the region.

- ✓ **Regional and Project Maps**
  A regional map and project maps.

- ✓ **Project Physical Benefits**
  Discussion of physical benefits.

- ✓ **Technical Analysis of Physical Benefits Claimed**
  Narrative description of the primary and secondary expected physical benefits, which must address the following items:

  - Recent and historical conditions that provide background for benefits to be claimed.
  - Estimates of without-project conditions.
  - Description of methods used to estimate physical benefits.
  - Identification of all new facilities, policies, and actions required to obtain the physical benefits.
  - Description of any potential adverse physical effects.
  - Description of how the proposed project addresses long-term drought preparedness.

- ✓ **Direct Water-Related Benefit to a DAC**
  Description of the water-related needs of local DACs and how the proposed project will address that need.

- ✓ **Project Performance Monitoring Plan**
  Description of the measures to be monitored to evaluate project performance and benefits achieved, and the tools and means that will be used to evaluate those measures.

- ✓ **Cost Effective Analysis**
  Analysis that evaluates whether physical benefits provided by the project are provided at the least possible cost.

Project Summary Table

Table 2-1: 2015 Merced Region Grant Proposal Summary Table

Table 4 – 2015 IRWM Grant Solicitation Project Summary Table			
		Atwater-McSwain Regulating/Recharge Basin Project	UC Merced Surface Water Augmentation Project
IR.1	Water supply reliability, water conservation, and water use efficiency	X	X
IR.2	Stormwater capture, storage, clean-up, treatment and management	X	X
IR.3	Removal of invasive non-native species, the creation and enhancement of wetlands, and the acquisition, protection and restoration of open space and watershed lands	X	X
IR.4	Non-point source pollution reduction, management and monitoring		
IR.5	Groundwater recharge and management projects	X	X
IR.6	Contaminant and salt removal through reclamation, desalting, and other treatment technologies and conveyance of reclaimed water for distribution to users		
IR.7	Water banking, exchange, reclamation and improvement of water quality	X	X
IR.8	Planning and implementation of multipurpose flood management programs	X	
IR.9	Watershed protection and management	X	X
IR.10	Drinking water treatment and distribution	X	X
IR.11	Ecosystem and fisheries restoration and protection		X

Project Description

Atwater-McSwain Regulating/Recharge Basin Project

Implementing agency – Merced Irrigation District

Brief Description: This project will create a regulating/recharge basin to provide direct and in-lieu groundwater recharge in the Merced Subbasin and new wetlands habitat for migratory birds.

Expanded Description: The Atwater-McSwain Regulating/Recharge Basin Project, sponsored by Merced Irrigation District (MID), is a conjunctive use project that will allow water to be banked in the groundwater basin in two ways:

1. Direct recharge of 1,000 acre-feet per year (AFY) through an unlined basin.
2. In-lieu recharge of up to 2,000 AFY by allowing MID to reduce operational discharges, freeing up additional surface water supply to be provided to customers in-lieu of groundwater pumping for direct use.

This project entails converting an existing unused basin along an MID canal into a regulating/recharge basin. The total property is approximately 20 acres in size and is currently owned by the County of Merced. The County is a partner agency on this project and will provide usage of the land though a permanent easement to MID at no cost. This is not the first project where the agencies cooperated on the most efficient use of a property under the jurisdiction of either agency. The existing basin will be deepened and reshaped, with the final wetted area of the basin covering approximately 12 acres and an additional four acres of the property graded to create approximately 4 acres of new wetland habitat for water fowl and migratory birds.

Currently, MID meets customer demands with untreated surface water delivered by its canal system, which is fed by regularly planned releases from Lake McClure, flood releases, and local precipitation and runoff. Due to a lack of storage in its gravity based distribution system and due to fluctuations in growers demand along the system, MID cannot capture all of the flows diverted and must ultimately convey this water through the canal system and out of the MID distribution system via drains that do not return to the Merced River. This operational discharge is approximately 2,000 AFY and can be more than 3,000 AFY in wet years. This project will provide additional in-system storage capacity, allowing MID to retain additional flood releases which can be provided to customers in-lieu of groundwater pumping. Similar to MID's existing basins, it will provide direct recharge to the Merced Groundwater Subbasin at an estimated rate of 0.4 feet per acre per day over the approximately 7 month irrigation period, for a total of approximately 1,000 AFY. The remaining 1,000 AFY (to 2,000 AF in wet years) of additional stored surface water will be provided to MID customers to offset groundwater pumping from the Merced Subbasin, thereby providing for in-lieu groundwater banking. The total amount realized by the project will help back water into storage in Lake McClure, especially in drier years. The total amount backed up to Lake McClure including losses in a dry year amount to approximately (2,000AF *1.35 (35% system loss) = 2,700 AFY.

By providing direct and in-lieu recharge, the project will contribute to the recovery of groundwater levels in the basin, and will aide in the long-term sustainability of the groundwater basin. The project will alleviate negative impacts of ground-water overdraft such as increased pumping costs, deterioration of water quality, reduction of water in streams and lakes, and land subsidence. In addition, the project will enhance drinking water supplies for DACs. All municipal water purveyors within the Merced Subbasin rely solely on groundwater for water supply. Small rural residential areas have been hit particularly hard during this drought, where Merced County will be distributing water to houses which wells went dry. This project will recharge the basin to assist in meeting drinking water needs of DACs throughout the region, and in particular the City of Atwater, located approximately 1 mile east of the project site.

In addition to the water supply benefits provided by the project, the project will create approximately four acres of new seasonal wetland habitat for migratory birds. California has lost over 90% of its original Central Valley wetlands, which are a vital habitat for migratory birds. Merced and the Central Valley are a major component of the Pacific Flyway, one of the most important regions in North America to migratory birds and wintering shorebirds. The Central Valley Joint Venture Implementation Plan states that the Central Valley supports up to 60% of the waterfowl in the entire Pacific Flyway, supporting 38 species of water birds, 24 of which nest in wetland habitats. Significant efforts have been made to create additional habitat in the region.

UC Merced Surface Water Augmentation Project

Implementing agency – University of California, Merced

Brief Description: This project provides in-lieu groundwater recharge by delivering surface water for irrigation in-lieu of groundwater from the Merced Subbasin, improving water quality and enhancing habitat.

Expanded Description: The UC Merced Surface Water Augmentation Project, sponsored by the University in partnership with MID, will support the interconnection of University's irrigation water supply to MID's Fairfield Canal. Currently irrigation demand is met with chlorinated groundwater supplied to UC Merced from the City of Merced. With this project non-potable water from Lake Yosemite will be conveyed via the Fairfield Canal to a pipeline which will supply Little Lake on the University Campus. An adjacent pump station will be refurbished and brought online to draw water from Little Lake to feed the irrigation system in-lieu of groundwater.

Currently, there is an agricultural delivery gate on the Fairfield Canal, operated by MID, that runs through the University campus. The delivery gate has an 8-inch inch diameter opening and is capable of delivering gravity-fed surface water to Little Lake. The system, however, is incapable of providing sufficient flow to meet future irrigation demand. This project will replace the existing delivery gate with an upright delivery gate to accommodate lower head water. The existing 8-inch inch pipe will be removed and replaced with a 16-inch pipe to accommodate current future irrigation demands. The project will also incorporate a Telemetry System which will control the gate (depending on lake level) and a flow meter and pumps. It will also measure the volume of water and water pressure of deliveries to the lake. The existing Little Lake Pump House on the University's campus will also be refurbished to support equipment replacement, filtration system upgrades, the addition of a pumping system, and electrical components to support the upgraded water infrastructure.

The project will provide surface water to the University's irrigation system, offsetting groundwater that is currently pumped into the Little Lake for irrigation. The surface water is mainly generated from the local 41,000 acre+ watershed that contribute in almost all years flows to Lake Yosemite in excess of the University's needs. This will allow for the in-lieu banking of groundwater in the Merced Subbasin, which is the sole source of drinking water for all municipal drinking water suppliers in the Region. Recharge activities would contribute to the recovery of regional groundwater levels and aid in long-term groundwater basin sustainability, which will aide in meeting drinking water needs DACs throughout the region.

Little Lake is a terminal reservoir currently fed by storm water and groundwater, with no outflow of the standing water. By connecting the Lake to the Fairfield Canal system and using the Lake to feed the irrigation system, there will be constant inflow and outflow to the lake and the water quality of the lake will be vastly improved, as will that of the marsh areas surrounding the perimeter of the lake. The surface water coming from Lake Yosemite has virtually no total dissolved solids (TDS), while the groundwater in the area is upwards of 500 mg/L TDS (as shown below in **Figure 2-7**) The lake is surrounded by trees and reeds creating beneficial habitat for migratory birds and wintering shorebirds (see **Figure 2-9**). As explained in the Atwater-McSwain project description above, the Central Valley supports up to 60% of waterfowl in the entire Pacific Flyway, but habitat has been in steep decline over the past 150 years.

The intended outcome of the project is to reduce the use of potable groundwater supplies from the Merced Subbasin for nonpotable irrigation use, while supporting recreation and improving water quality to enhance habitat for native plant and animal species.

Grant Administration Project

Implementing agency –Merced Irrigation District

Brief Description: This Project will provide grant administration support for the Merced Irrigation District's Proposition 84, 2015 Grant Solicitation funds.

Expanded Description: The Grant Administration Project will provide administration support for the Merced Irrigation District's Proposition 84, 2015 Grant Solicitation funds as they serve as the contracting agency for DWR.

As this project is intended to provide administration support only, the requirement to meet one of the eleven project elements in Table 4 of the PSP is not applicable.

Project Map
Not applicable

Project Physical Benefit
Not applicable

Technical Analysis of Physical Benefits Claimed
Not applicable

Cost Effectiveness Analysis
Not applicable

Regional Map and Project Map

Regional Map

Figure 2-1 shows the regional map of the area, including the Merced IRWM Region boundary, and locations of the Atwater-McSwain Regulating/Recharge Basin Project and the UC Merced Surface Water Augmentation Project.

Project Maps

Figure 2-2 and **Figure 2-3** show the project maps for each project. Included in the maps are the projects' geographical locations, the surrounding work boundaries, facilities of the projects, and proposed locations where claimed benefits would be monitored. For the Atwater-McSwain Regulating/Recharge Basin Project (**Figure 2-2**), the proposed locations where benefits would be monitored include the groundwater wells located at the corners of the basin and wetland habitat. For the UC Merced Surface Water Augmentation Project (**Figure 2-3**), the proposed locations where benefits would be monitored include the inlet gate from Fairfield canal and within the lake itself.

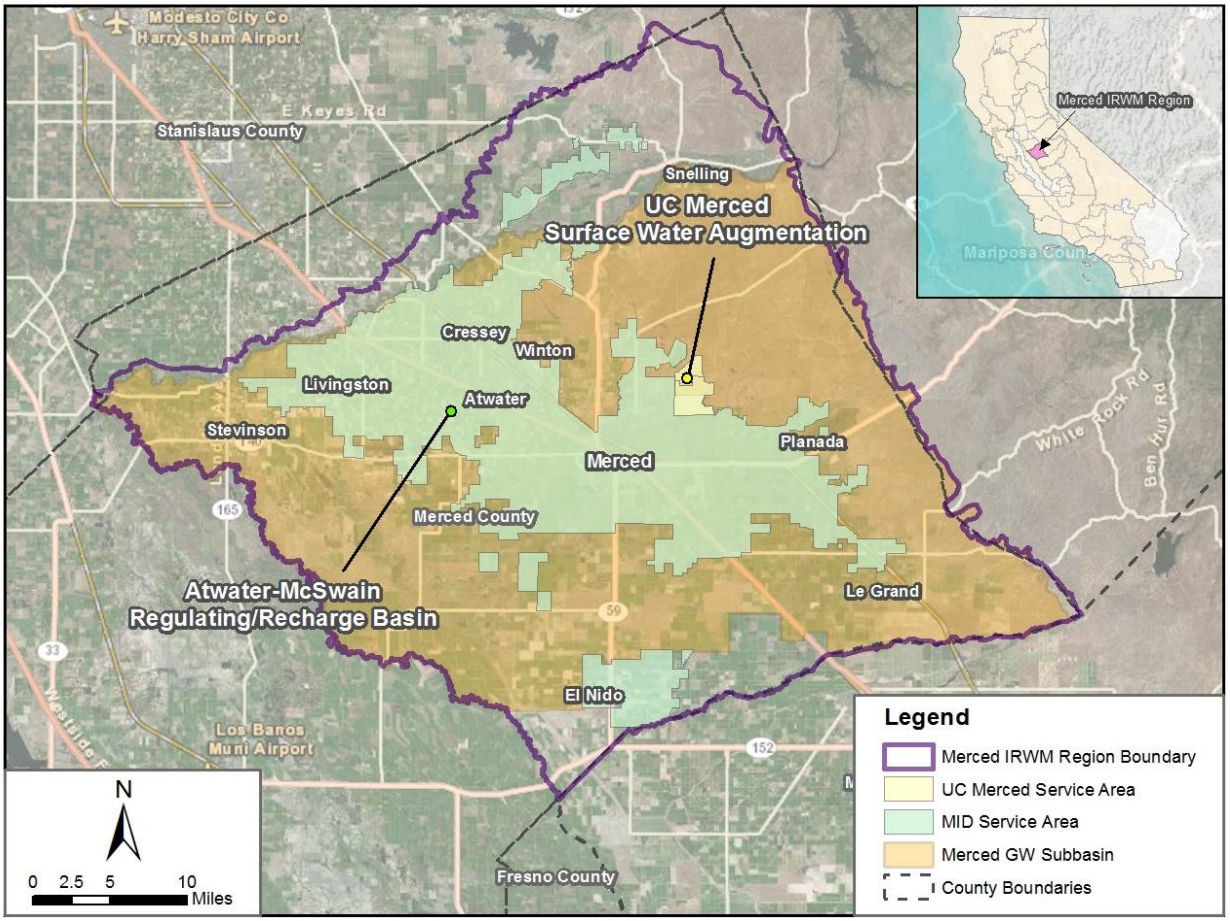


Figure 2-1: Regional Map Project Physical Benefits

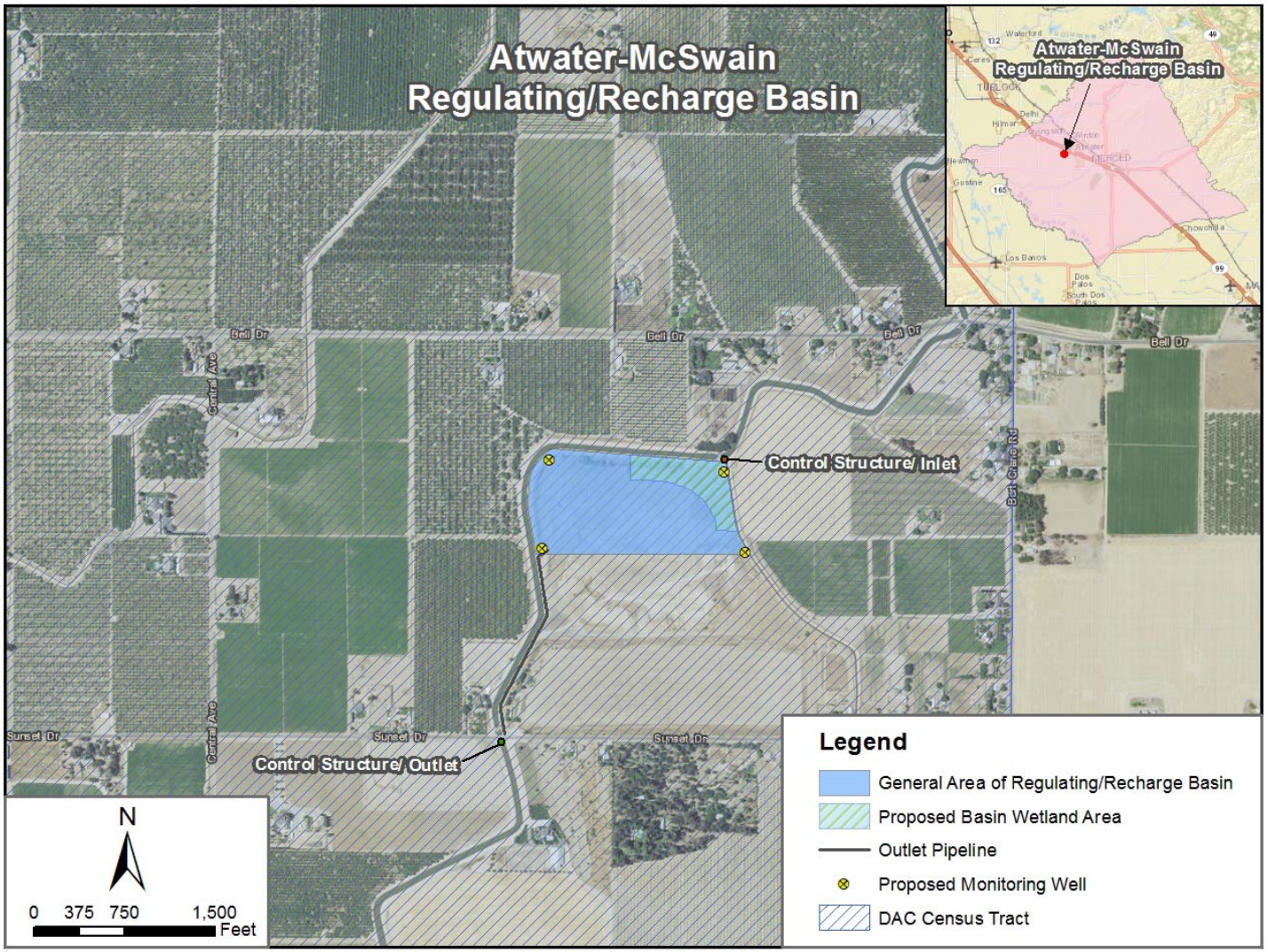


Figure 2-2: Atwater-McSwain Regulating/Recharge Basin Project Map

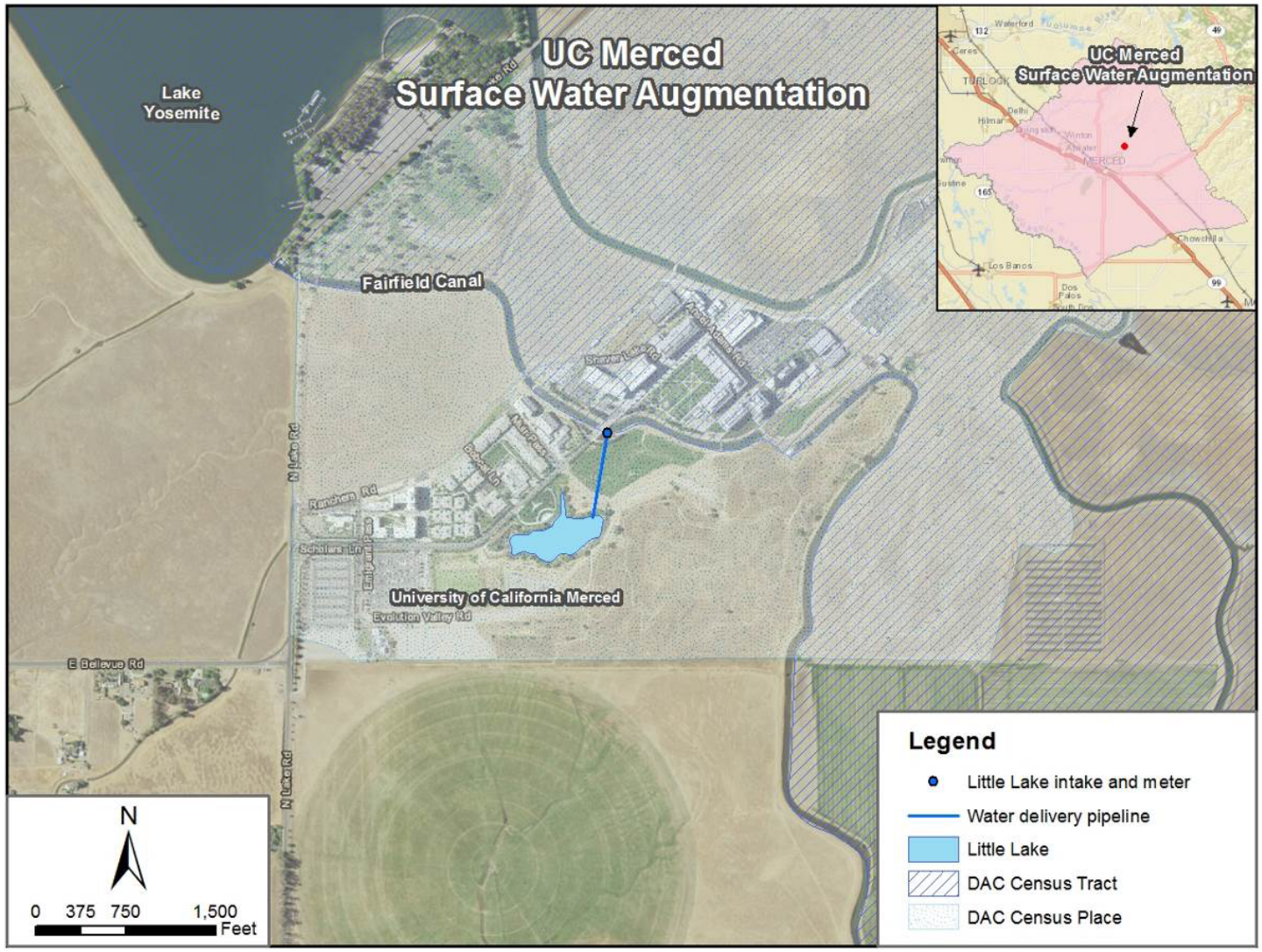


Figure 2-3: UC Merced Surface Water Augmentation Project Map

Project Physical Benefits

Atwater-McSwain Regulating/Recharge Basin Project

This conjunctive use project would allow for direct recharge through the regulating/recharge basin, capture and reuse of tailwater currently lost through drains, and in-lieu recharge of the groundwater basin by providing additional untreated surface water supply to MID customers for irrigation, offsetting the use of groundwater supplies, which are the only source of potable supply in the Merced Region. This will lead to an increase in groundwater elevations over the long term, and a reduction in net electricity consumption and greenhouse gas emissions associated with groundwater pumping. The increase in groundwater levels would combat water quality degradation and reduce subsidence potential typical with groundwater depletion. This project will also create four (4) acres of wetlands in an area that is currently a barren landscape. These benefits are gained from project construction and operation. Annual projected primary and secondary physical benefits are shown in **Tables 2-2** and **2-3**. The justifications and explanations for the benefits claimed are presented in the Technical Analysis of Physical Benefits Claimed section below.

Table 2-2: Atwater-McSwain Regulating/Recharge Basin Project – Primary Benefit – *Groundwater Recharge*

Table 5 – Annual Project Physical Benefits Project Name: *Atwater-McSwain Regulating/Recharge Basin Project* Type of Benefit Claimed: *In-Lieu and Direct Groundwater Recharge* Units of Benefit Claimed: *Acre-feet per year (AFY)* Anticipated Useful Life of Project (Years): *50 years*			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Difference
2017-2067	0	2,000 Dry Year 3,000 Wet Year	2,000-3,000 AFY of tailwater and stormwater capture with 1,000 AFY recharged directly and 1,000-2,000 AFY surface water recirculated for irrigation use in-lieu of groundwater
Comments: *This benefit includes the amount of direct groundwater recharge through the basin as well as in-lieu recharge from the additional surface water retained by the basin and available for distribution to MID customers in lieu of groundwater use.*			

Table 2-3: Atwater-McSwain Regulating/Recharge Basin Project – Secondary Benefit – *Habitat Improvement*

Table 5 – Annual Project Physical Benefits Project Name: *Atwater-McSwain Regulating/Recharge Basin Project* Type of Benefit Claimed: *Habitat Improvement* Units of Benefit Claimed: *Acres (ac)* Anticipated Useful Life of Project (Years): *50 years*			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Difference
2017-2067	0	4	4 acres of wetlands
Comments: *This benefit includes creation of seasonal wetland and water habitat for migratory birds along the Pacific Flyway.*			

UC Merced Surface Water Augmentation Project

This conjunctive use project would allow for in-lieu recharge of the groundwater basin through the use of untreated surface water for irrigation at the campus (offsetting the use of groundwater supplies, which are the only source of potable water in the Merced Region). This will lead to an increase in groundwater elevations over the long term, and a reduction in net electricity consumption and greenhouse gas emissions associated with groundwater pumping. The increase in groundwater levels would combat water quality degradation and reduce subsidence potential typical with groundwater depletion. By connecting Little Lake to the Canal and the irrigation system, the water quality and habitat surrounding the lake will be improved through the inflow and outflow of surface water. These benefits are gained from project construction and operation. Annual projected physical benefits are shown in **Tables 2-4** and **2-5**. The justifications and explanations for the benefits claimed are presented in the Technical Analysis of Physical Benefits Claimed section below.

Table 2-4: UC Merced Surface Water Augmentation Project – Primary Benefit, *Groundwater Recharge*

Table 5 – Annual Project Physical Benefits Project Name: *UC Merced Surface Water Augmentation Project* Type of Benefit Claimed: *In-Lieu Groundwater Recharge* Units of Benefit Claimed: *Acre-feet per year (AFY)* Anticipated Useful Life of Project (Years): *50 years*			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Difference
2017	0	105	105 AFY of surface water used in-lieu of groundwater pumping
2018	0	122	122 AFY of surface water used in-lieu of groundwater pumping
2019	0	139	139 AFY of surface water used in-lieu of groundwater pumping
2020-2067	0	157	157 AFY of surface water used in-lieu of groundwater pumping
Comments: *This benefit includes the amount of in-lieu groundwater recharge from the use of surface water for lake fill and irrigation on campus. The value increase over time until the campus is built out in 2020.*			

Table 2-5: UC Merced Surface Water Augmentation Project – Secondary Benefit, *Improved Habitat*

Table 5 – Annual Project Physical Benefits Project Name: *UC Merced Surface Water Augmentation Project* Type of Benefit Claimed: *Habitat Improvement* Units of Benefit Claimed: *Acres (ac)* Anticipated Useful Life of Project (Years): *50 years*			
(a)	(b)	(c)	(d)
	Physical Benefits		
Year	Without Project	With Project	Difference
2017-2067	0	4.5	4.5 acres of habitat improved
Comments: *This benefit includes improvement of Little Lake and the shoreline habitat totaling 4.5 acres.*			

Technical Analysis of Physical Benefits Claimed

Atwater-McSwain Regulating/Recharge Basin Project

Need for Project

The Merced Region, which is primarily comprised of DACs, relies exclusively on groundwater to meet all drinking water needs. Prolonged drought conditions have exacerbated historical groundwater overdraft, resulting in declining groundwater elevations and abandoned wells throughout the Region, degraded water quality with some areas in danger of not meeting drinking water MCLs, and land subsidence which threatens critical infrastructure. MID delivers untreated surface water for irrigation to portions of the Merced Region, which recharges the groundwater basin and offsets groundwater pumping. This project is needed to maximize use of untreated surface water for nonpotable use to further recharge the basin and reduce groundwater overdraft, preserving critical groundwater supplies to meet drinking water needs, preventing further water quality degradation, and minimizing potential for land subsidence. In addition, this project is needed to provide an additional 4 acres of critical habitat for migratory birds along the Pacific Flyway. Project benefits are described below.

The projected project benefits include:

- **Water Supply (primary benefit):** The project is estimated to provide 2,000 – 3,000 AFY of groundwater recharge to the Merced Subbasin, including 1,000 AFY of direct recharge through the basin and 1,000 – 2,000 AFY of in-lieu recharge by providing additionally surface water provisions to MID customers.
- **Habitat Improvement (secondary benefit)**: The project will create four (4) acres of habitat in an area that is currently dry and barren.

Water Supply and Subsidence Benefits. The Merced Subbasin has been in a state of mild groundwater level decline with a cumulative decrease in storage of approximately 720,000 AF from 1980 to 2007[1], accelerated during drought years and continuing today. The Merced Groundwater Basin has been designated as a high priority basin under CASGEM by the DWR. Lack of rain in recent years has caused a reduction in basin recharge. In addition, increased pumping activities needed to sustain agricultural crops during this drought have resulted in a significant decline in groundwater levels. Between 2010 and 2013, the average groundwater level in the MID service area declined more than 10 feet (see **Figure 2-4**). As of December 2014, the groundwater level has dropped by 62 feet since 1970 in this area. Localized decline groundwater levels exceeded 40 feet during this four-year drought, in the general vicinity of the project. Merced County will be distributing water to residents in the vicinity of the project that cannot use their groundwater wells this summer. Subsidence has been identified in the southwest corner of the groundwater basin (see **Figure 2-5**) resulting from increasing groundwater extractions from below the Corcoran Clay layer, and various agencies are collaborating to stem further subsidence. The drought has compounded regional groundwater challenges in terms of dropping static water levels, water quality and subsidence. The recharge provided by this project will provide direct benefit to the Merced Subbasin and help with long-term groundwater basin sustainability.

[1] AMEC Geomatrix, Inc. 2008. Merced Groundwater Basin Groundwater Management Plan Update. Merced County. July 29. [pages 20 and 22)

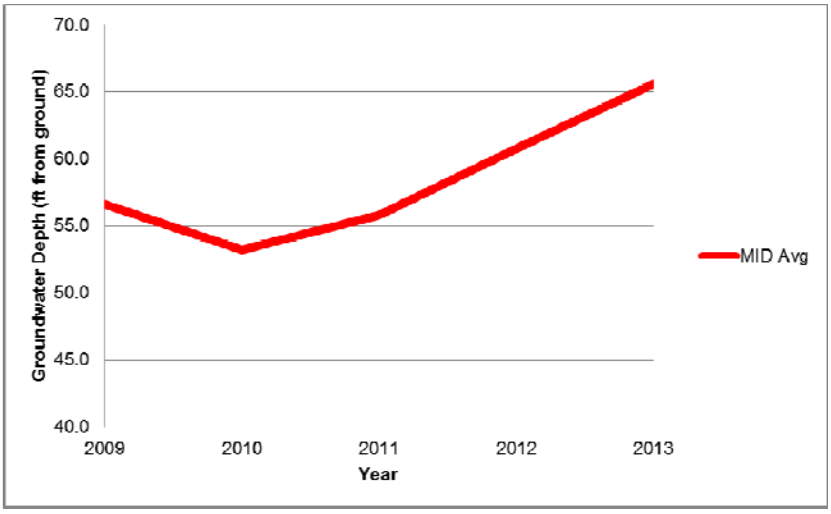
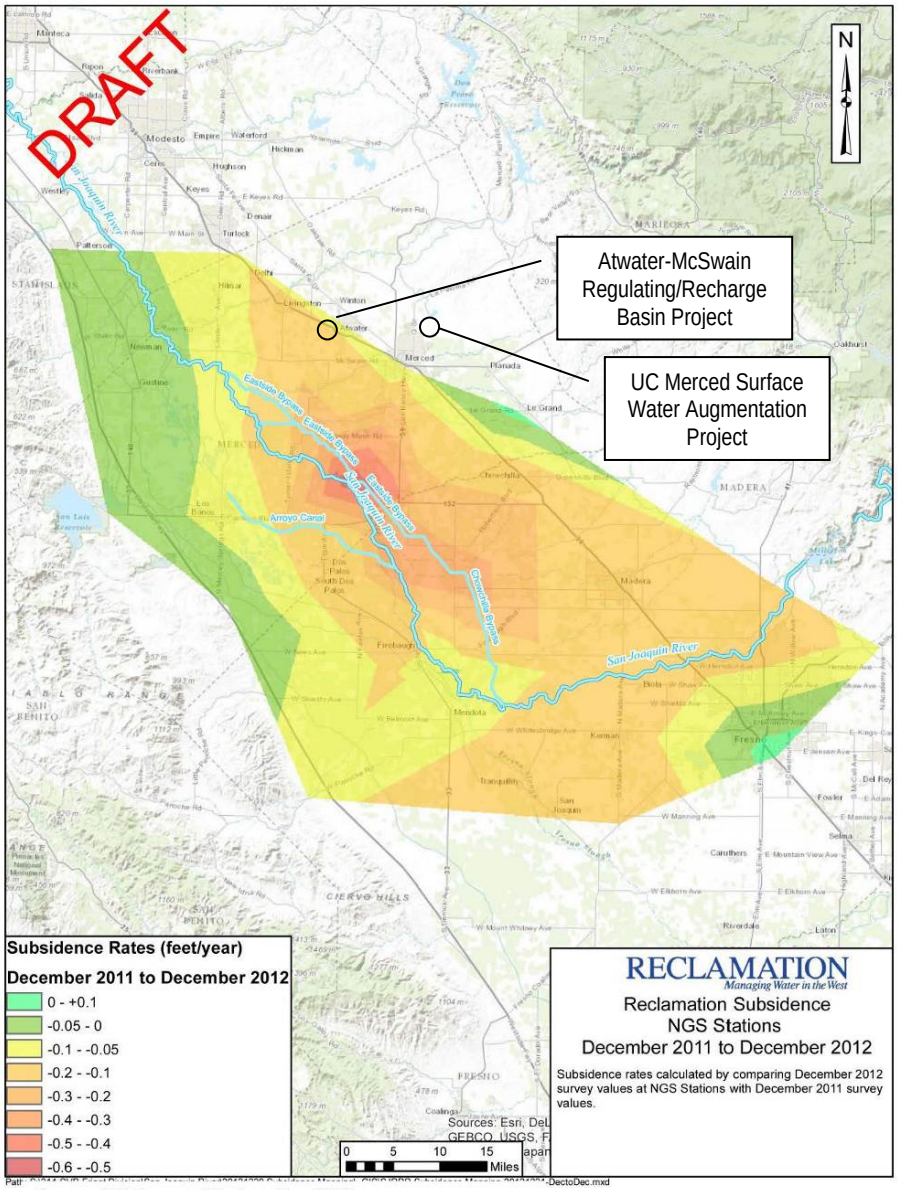


Figure 2-4: Increase in Average MID Depth to Groundwater from 2009-2013



Source: (US Bureau of Reclamation, 2012)

Figure 2-5: Land Subsidence in the San Joaquin River Area, December 2011-December 2012

Habitat Improvement. California has lost over 90% of its original wetlands, which provide vital habitat for migratory birds. Merced and the Central Valley are a major component of the Pacific Flyway (see **Figure 2-6**), one of the most important regions in North America for migratory birds and wintering shorebirds. The Central Valley Joint Venture Implementation Plan states that the Central Valley supports up to 60% of the waterfowl in the entire Pacific Flyway, including 38 species of water birds, 24 of which nest in wetland habitats. Significant efforts have been made to create additional habitat in the region. This project will provide additional habitat for migratory birds traveling through the region.

Figure 2-6: Pacific Flyway Map

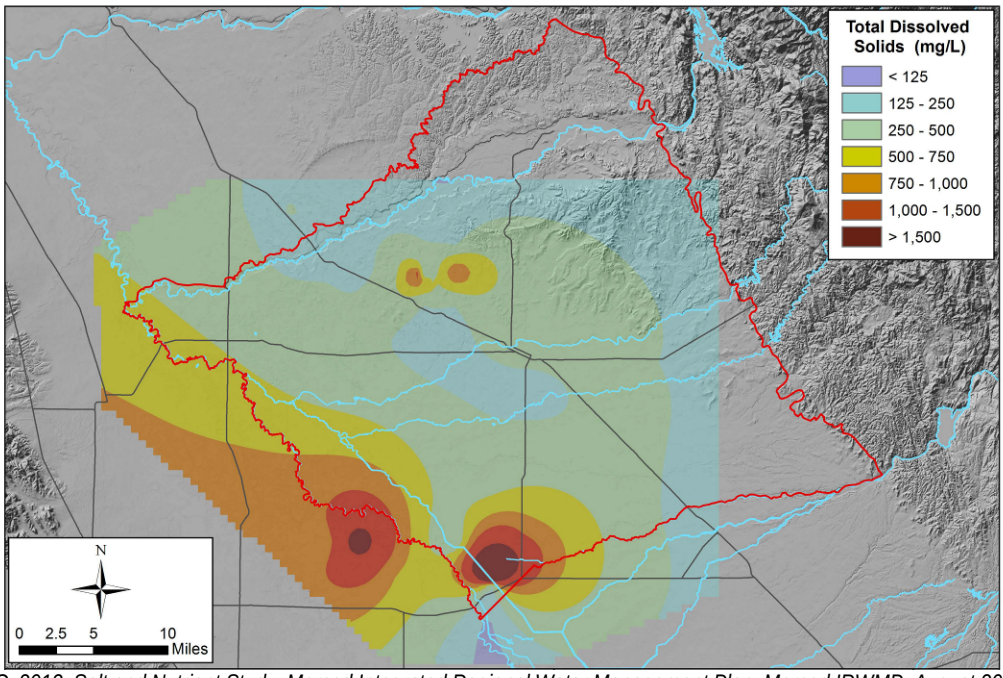
Energy Benefits. By increasing the groundwater levels, the District will save energy associated with groundwater pumping. Additionally, by providing surface water in-lieu of groundwater, there will be additional pumping savings directly through the associated reduction in pumping. In the Merced region, it take approximately 990kWhr per 1 million gallons (MG) pumped. By providing up to 2,000 AFY (652 MGY) of surface water in-lieu of groundwater, this project would generate up to 645,185 kWh of annual energy savings.

Greenhouse Gas Benefits. Reduced energy use for pumping will also lead to a net reduction in greenhouse gas production. The GHG emission factor associated with power production is derived from the California Energy Commission (CEC) and EPA's eGRID data. Per the CEC's Energy Almanac, California produces 70 percent of its

energy and imports 10 percent from the Pacific Northwest, and 20 percent from the Pacific Southwest. USEPA eGRID data provides information about the GHGs associated with each of the energy supplies (calculated as carbon dioxide equivalent units or CO2e) as 613.28 pounds of CO2e per MWH (lbs/MWh), 846.97 lbs/MWh, and 1,182 lbs/MWh, respectively (http://www.epa.gov/cleanenergy/energy-resources/egrid/). Averaging each of these CO2e emissions factors shows that California energy supplies have a combined CO2e emissions factor of 750.57 lbs/MWh, or 0.34 metric tons (MT) of CO2e per MWh. As noted above, this project would generate up to 645,185 kWh of annual energy savings, which would save approximately 220 metric tons of CO2e per year.

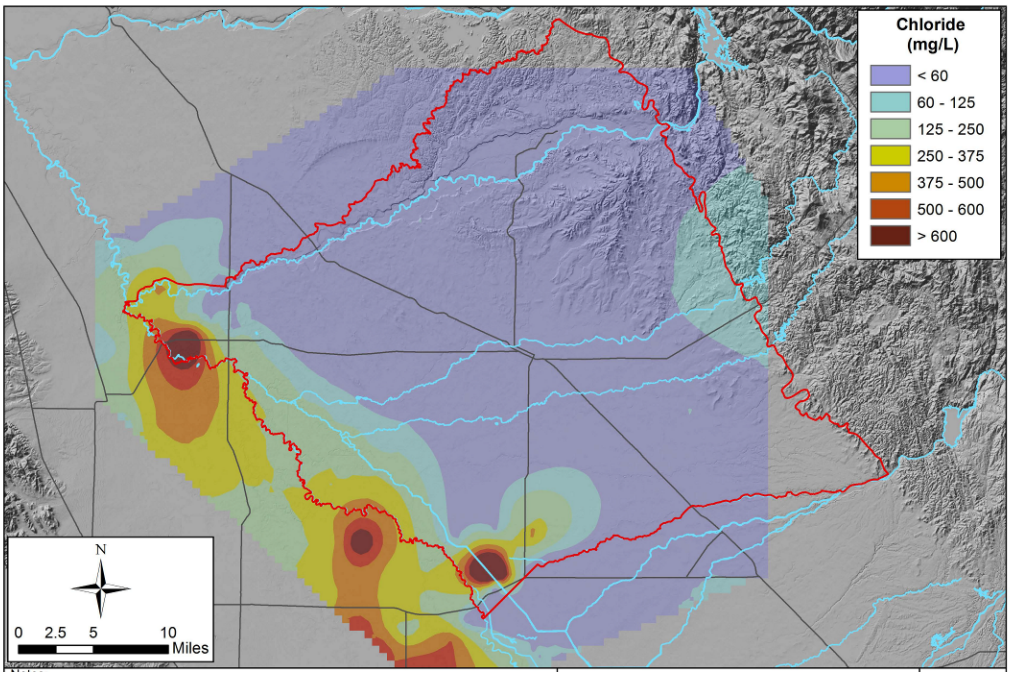
Water Quality Benefits It is expected that increases in groundwater levels resulting from direct and in-lieu recharge would generate substantial water quality benefits, counteracting water quality degradation typically experienced as groundwater levels decline. As discussed in the *Salt and Nutrient Study*, prepared as part of the Integrated Regional Water Management Plant in 2013, elevated TDS and chloride concentrations have been observed in the southwest part of the groundwater basin and are slowly expanding further into the basin. Maintaining groundwater elevations in the middle portion of the basin will assist in preventing saline water from migrating east, reducing the potential for damage to crops and drinking water impacts resulting from TDS and chloride concentrations in excess of the MCLs.

Water Quality Benefits It is expected that increases in groundwater levels resulting from direct and in-lieu recharge would generate substantial water quality benefits, counteracting water quality degradation typically experienced as groundwater levels decline. As discussed in the *Salt and Nutrient Study*, prepared as part of the Integrated Regional Water Management Plant in 2013, elevated TDS and chloride concentrations have been observed in the southwest part of the groundwater basin (see **Figure 2-7** and **Figure 2-8**) and are slowly expanding further into the basin. Maintaining groundwater elevations in the middle portion of the basin will assist in preventing saline water from migrating east, reducing the potential for damage to crops and drinking water impacts resulting from TDS and chloride concentrations in excess of the MCLs.



Source: AMEC. 2013. Salt and Nutrient Study. Merced Integrated Regional Water Management Plan. Merced IRWMP. August 2013.

Figure 2-7: TDS in Merced Region Groundwater from 2007-2012



Source: AMEC. 2013. Salt and Nutrient Study. Merced Integrated Regional Water Management Plan. Merced IRWMP. August 2013.

Figure 2-8: Chloride in Merced Region Groundwater from 2007-2012

Without-Project Conditions

Water Supply. Without the proposed project, the existing regulating basin will not be converted to a regulating/recharge basin and will remain unused; therefore, there would be no additional groundwater recharge, or conservation of water that is not released from Lake McClure. Surface water would continue to be lost through operational and flood related discharges from Merced Irrigation District and not returning to the Merced River, and groundwater would continue to be diminished as additional stress on the Merced Subbasin is incurred from increased groundwater pumping activity in the Merced Subbasin.

Water quality impacts caused by declining water levels would be expected to worsen. As the entire region relies solely on groundwater for its potable supply, groundwater depletion would have devastating effects. The nearby communities of Atwater and McSwain are particularly feeling the pinch of this drought through unprecedented rate of groundwater decline. These effects could be just as dire for the agricultural economy as for the urban centers; if groundwater quality worsens, agricultural crops will be damaged from the increasing salinity of the source water. The impact to the agricultural economy will be further magnified when considering the combined effect of MID water supply curtailments and dwindling surface water and groundwater supplies.

Without the project, subsidence would be expected to worsen in the future, particularly due to the increased groundwater extraction from below the Corcoran clay, resulting in the dewatering of sensitive clay units. Thus, uniform and differential subsidence could occur, with differential subsidence potentially damaging infrastructure.

Finally, without the proposed project, the risk of not meeting drinking water and agricultural water demands would continue, and groundwater quality could be compromised. These conditions could results in economic impacts to the region.

Methods used to Estimate Physical Benefits

Water Supply Benefits. Water supply benefits were calculated based on historical data from MID's existing system. The operational losses at the end of the system have been estimated by MID to be 2,000 AFY based on historical data captured by the District's spill recorders. The regulating/recharge basin will allow MID to retain this water for use in the system, providing additional surface water to use in place of groundwater for in-lieu recharge. The direct recharge component of the project is estimated at 0.4 acre-feet per acre per day over 12 acres based on previous seepage/loss rates and local soil conditions from studies performed on various MID canals and reservoirs and conservatively assuming the basin is full for only the 210 day irrigation period.

Direct recharge = 0.4 acre-ft/acre * 12 acres * 210 days/year ≈ 1,000 AFY

In-lieu recharge = 2,000-3,000 AFY storage – 1,000 AFY direct recharge = 1,000-2,000 AFY

Habitat Improvement. The District will section off a portion of the property to create 4 acres of wetlands for migratory birds and waterfowl.

New Facilities, Policies, and Actions Required to Obtain Physical Benefits

The following new facilities are necessary to obtain physical benefits:

- Grading and shaping of 12 acre basin and 4 acre wetlands;
- Installation of pipelines gates/control structures;
- Installation of monitoring wells; and
- Installation of SCADA control.

No policies are required to obtain the physical benefits.

The actions necessary to obtain the physical benefits above are completion of design, environmental compliance, and construction of the project. MID will complete required environmental documentation and design for the facilities described above.

Potential Adverse Physical Effects of the Project

Proposed facilities would be constructed within existing disturbed areas (e.g., the unused basin). Implementation of the project would have primarily temporary, construction-related impacts. MID will comply with CEQA and prepare an environmental document (anticipated to be an Initial Study / Mitigated Negative Declaration) to analyze the project and to reduce any potential impacts through appropriate mitigation measures. Thus, long-term adverse physical effects are not anticipated to result from project implementation.

Long-Term Drought Preparedness

This project promotes conjunctive management of available water resources. The project will replenish and bank groundwater supplies, which can be called upon during years of drought. The project improves irrigation efficiencies as the regulating basin will allow for more precise irrigation deliveries and minimize operational discharges. The project will improve groundwater reliability from both a quantity and quality standpoint. Any recharge in the MID boundaries helps combat elevated levels of saline water that is slowly encroaching from a saline water sink below the San Joaquin River.

UC Merced Surface Water Augmentation Project

Need for Project

The Merced Region, which is primarily comprised of DACs, relies exclusively on groundwater to meet all drinking water needs. Prolonged drought conditions have exacerbated historical groundwater overdraft, resulting in declining groundwater elevations and abandoned wells throughout the Region, degraded water quality with some areas in danger of not meeting drinking water MCLs, and land subsidence which threatens critical infrastructure. MID delivers untreated surface water for irrigation to portions of the Merced Region, which recharges the groundwater basin and offsets groundwater pumping. This project is needed to maximize use of untreated surface water for nonpotable use to further recharge the basin and reduce groundwater overdraft, preserving critical groundwater supplies to meet drinking water needs, preventing further water quality degradation, and minimizing potential for land subsidence. In addition, this project is needed to protect 4.5 acres of existing migratory bird habitat at Little Lake that is currently threatened by water quality degradation. Project benefits are described below.

The projected project benefits include:

- **Water Supply (primary benefit):** The project will provide up to 157 AFY of in-lieu groundwater recharge by using surface water for campus irrigation in place of groundwater.
- **Habitat Improvement (secondary benefit)**: The project will convert the terminal groundwater-fed lake into a thriving waterbody connected to the Fairfield Canal, improving the water quality and therefore protecting the 4.5 acres of marsh habitat surrounding the lake.

Water Supply. As discussed in the Atwater-McSwain Regulating Recharge Basin Project, the Merced Subbasin has been in a state of mild groundwater level decline has been designated as a high priority basin by the DWR. This project would replace the use of groundwater for irrigation at UC Merced with untreated surface water, reducing groundwater use and providing in lieu groundwater recharge.

Habitat Improvement. California has lost over 90% of its original wetlands, which are a vital habitat for migratory birds. Merced and the Central Valley are a major component of the Pacific Flyway, one of the most important regions in North America to migratory birds and wintering shorebirds. The Central Valley Joint Venture Implementation Plan states that the Central Valley supports up to 60% of the waterfowl in the entire Pacific Flyway, including 38 species of water birds, 24 of which nest in wetland habitats. Significant efforts have been made to create additional habitat in the region. Currently all of the stormwater from the campus is collected and discharged into Little Lake. Groundwater is used to maintain the lake Level from losses due to evaporation or percolation. Introducing fresh water into Little Lake, with no measureable solids (TDS), and using the water for campus irrigation by refurbishing the Little Lake pump house will allow for constant inflow and outflow to the lake. This project will improve the available habitat for migratory birds traveling through the region.

Education Benefits. This project provides an opportunity to engage UC Merced students and faculty through a campus living laboratory capstone. Students would be able to monitor the effects of surface water usage on the Little Lake ecosystem and actively engage in learning about how smart choices with water might improve the environment. There are two aspects to this: first, students would learn, real-time, how water quality affects the ecology and food webs of organisms. And second, students would learn how the engineering aspects of such a project, such as the pumping and discharge, can improve an ecosystem. Both aspects could be studied in real time. Undergraduate natural science and environmental engineering majors, the life and environmental sciences faculty and graduate students, technical staff, and lecturers would have the opportunity to take part in hands-on sampling and monitoring, wildlife walks, and other outreach projects to learn firsthand what smart use of water means for improving ecosystems and groundwater basins.

Energy Benefits. By using surface water in lieu of groundwater, the University will directly reduce energy used to pump groundwater to the lake. Additionally, increasing groundwater levels will provide additional reductions in energy use throughout the region by decreasing the total head requirements for groundwater pumping. In the Merced region, it take approximately 990kWhr per 1 million gallons (MG) pumped. By providing up to 157 AFY (51 MGY) of surface water in-lieu of groundwater, this project would generate up to 50,647 kWh of annual energy savings.

Greenhouse Gas Benefits. Reduced energy use associated with groundwater pumping will lead to a net reduction in greenhouse gas production. The GHG emission factor associated with power production is derived from the California Energy Commission (CEC) and EPA's eGRID data. Per the CEC's Energy Almanac, California produces 70 percent of its energy and imports 10 percent from the Pacific Northwest, and 20 percent from the Pacific Southwest. USEPA eGRID data provides information about the GHGs associated with each of the energy supplies (calculated as carbon dioxide equivalent units or CO2e) as 613.28 pounds of CO2e per MWH (lbs/MWh), 846.97 lbs/MWh, and 1,182 lbs/MWh, respectively (http://www.epa.gov/cleanenergy/energy-resources/egrid/). Averaging each of these CO2e emissions factors shows that California energy supplies have a combined CO2e emissions factor of 750.57 lbs/MWh, or 0.34 metric tons (MT) of CO2e per MWh. As noted above, this project would generate up to 50,647 kWh of annual energy savings, which would save approximately 17 metric tons of CO2e per year.

Water Quality Benefits. The groundwater and stormwater currently used to fill little lake has a higher TDS concentration (upwards of 500 mg/L) than the fresh surface water supply coming from Lake Yosemite, which has no measureable level of TDS. In addition, it is expected that increases in groundwater levels resulting from in-lieu recharge would generate substantial water quality benefits the groundwater basin. Elevated TDS and chloride concentrations have been observed in the southwest part of the groundwater basin and are slowly encroaching on the groundwater basin. Maintaining elevated groundwater levels in the middle portion of the basin will assist in preventing saline water from migrating east, reducing the potential for damage to crops and drinking water from elevated TDS and chloride in excess of the MCLs.

Subsidence Benefits. Managing water levels reduces future subsidence, particularly with regard to dewatering of sensitive clay units. This project would therefore reduce possible impacts to infrastructure due to differential subsidence, though this benefit cannot be quantified.

Without-Project Conditions

Water Supply. Without the proposed project, the University would continue to use groundwater for irrigation and no in-lieu groundwater recharge will be achieved. Groundwater levels would continue to be diminished as additional stress on the Merced Subbasin is incurred from increased groundwater pumping activity in the Merced Subbasin.

Water quality impacts caused by declining groundwater levels would be expected to worsen, and improved habitat resulting from the use of lower TDS surface water in Little Lake would not be realized. As the entire region relies solely on groundwater for its potable supply, further degradation of groundwater quality, potentially resulting in inability to comply with drinking water MCLs for TDS and chloride, could have devastating effects. These effects could be just as dire for the regional agricultural economy if water quality of the groundwater were to worsen such that damage to agricultural crops and landscapes are incurred due to increased salinity of the groundwater.

Without the project, subsidence would be expected to worsen in the future, particularly due to the increased groundwater extraction and resulting dewatering of sensitive clay units. Thus, uniform and differential subsidence could occur, with differential subsidence potentially causing damage to infrastructure.

Habitat Improvement. Without the project, there would be no improvement to the habitat for waterfowl and migratory birds. Nearby Lake Yosemite does not have wetland habitat, so the Little Lake habitat is crucial to bird species in the area.

Figure 2-9: Little Lake and Surrounding Shoreline Habitat

Methods used to Estimate Physical Benefits

Water Supply Benefits. Water supply benefits were calculated based on projections of current and future campus irrigation demands. Based on existing consumption data, approximately 40% of water consumption is for irrigation purposes.

Habitat Improvement. The project will convert the terminal groundwater-fed lake into a thriving waterbody connected to the Fairfield Canal, improving the water quality and surrounding marsh habitat for the 4.5 acre lake area. The area of the lake and shoreline habitat was measured using Google Earth aerial images.

New facilities, Policies, and Actions Required to Obtain Physical Benefits

The following new facilities are necessary to obtain physical benefits:

- Installation of the 16-inch pipe;
- Upgrades to the MID Gate at the Fairfield Canal;
- Upgrades to the Little Lake Pump House; and
- Installation of associated telemetry equipment.

No policies are required to obtain the physical benefits.

In order to achieve the benefits summarized above, the final design, environmental compliance, and construction of the project must be completed. The University will retain a consultant to complete the environmental documentation and design for proposed facilities described above.

Potential Adverse Physical Effects of the Project

Proposed facilities would be constructed within the existing campus, replacing an existing 8-inch pipe with a 16-inch pipe. Implementation of the project would have primarily temporary, construction-related impacts. The University will comply with CEQA and prepare an environmental document (anticipated to be a Categorical Exemption) to analyze the project and to reduce any potential impacts through appropriate mitigation measures. Thus, adverse physical effects are not anticipated to occur as a result of project implementation.

Long-Term Drought Preparedness

This project promotes conjunctive management of available water resources. It will replenish the groundwater basin by using surface water in-lieu of groundwater pumping. This replenished groundwater can then be called upon during years of drought. The project will improve the groundwater reliability from both a quantity and quality standpoint. Recharge within the middle portion of the basin assists in preventing the saline water wedge below the San Joaquin River from encroaching further into the basin.

Direct Water-Related Benefit to a DAC

Atwater-McSwain Regulating/Recharge Basin Project

The Merced Region includes the incorporated cities of Atwater, Livingston, and Merced, and the unincorporated communities of Cressey, El Nido, Franklin/Beachwood, Le Grand, Planada, Snelling, Stevinson, UC Merced, and Winton. Using the GIS data from the California Department of Water Resources (DWR) IRWM website, a DAC analysis was performed for the Merced IRWM Region, which concluded that the majority of the Merced Region is categorized as a DAC. With the exception of Livingston and Cressey, all of Merced's communities meet the State's definition of a DAC using either Census Tracts or Census Places. All municipal water purveyors within the Merced Subbasin rely solely on groundwater for water supply.

The project's recharge and groundwater banking activities will contribute to the recovery of groundwater levels in the basin, and will aide in the long-term sustainability of the groundwater basin as a supply. Recharge will combat the negative effects of ground-water depletion such as increased pumping costs, deterioration of water quality, reduction of water in streams and lakes, or land subsidence. All municipal water purveyors within the Merced Subbasin rely solely on groundwater for water supply. This project will recharge the basin to aide in meeting drinking water needs of DACs throughout the region, and in particular the City of Atwater which is 1 mile east of the project site. Water recharged by this project and stored in the groundwater basin could be extracted under future dry conditions to minimize the impacts of reduced agricultural and ecosystem water deliveries (potentially by limiting MID's cutbacks to growers and Merced National Wildlife Refuge or by extending the supply during multiple dry years). Any reduction in water delivery impacts growers and the local ecosystem; minimizing these reductions will minimize the associated economic impacts for agriculture, the ecosystem, and the community as a whole.

The Merced Groundwater Basin has been designated as a high priority basin under CASGEM by the DWR. The drought has compounded regional groundwater challenges in terms of dropping static water levels, water quality and subsidence. The recharge provided by this project will provide direct benefit to the Merced Subbasin and help with long-term groundwater basin sustainability. It is expected that increases in groundwater levels resulting from direct and in-lieu recharge would generate substantial water quality benefits, counteracting water quality degradation typically experienced as groundwater levels decline. Keeping water levels high in the middle portion of the basin will keep the saline water from migrating east, reducing the potential for damage associated with irrigation of crops and drinking water concerns from elevated TDS and chloride in excess of the MCLs.

UC Merced Surface Water Augmentation Project

As discussed above, groundwater banking activities will contribute to the recovery of groundwater levels in the basin, and will aide in the long-term sustainability of the groundwater basin as a supply. A majority of the Merced Region is categorized as a DAC and all municipal water purveyors within the Merced Subbasin rely solely on groundwater for water supply.

The Merced Groundwater Basin has been designated as a high priority basin under CASGEM by the DWR. The southern portion of the Merced IRWM Region includes portions of the Chowchilla Groundwater Subbasin, which has been designated as a critically over-drafted basin since 1980. The drought has compounded regional groundwater challenges in terms of dropping static water levels, water quality and subsidence. The recharge provided by this project will provide direct benefit to the Merced Subbasin and help with long-term groundwater basin sustainability. It is expected that increases in groundwater levels resulting from direct and in-lieu recharge would generate substantial water quality benefits, counteracting water quality degradation typically experienced as groundwater levels decline. Keeping water levels high in the middle portion of the basin will keep the saline water from migrating east, reducing the potential for damage associated with irrigation of crops and drinking water concerns from elevated TDS and chloride in excess of the MCLs.

Project Performance Monitoring Plan

Atwater-McSwain Regulating/Recharge Basin Project

This project would allow for direct groundwater recharge through construction of a recharge basin and in-lieu recharge through the provision of additional untreated surface water supplies for MID customers to offset groundwater pumping. These benefits will lead to an increase in groundwater elevations over the long term, and a resultant reduction in net electricity consumption and greenhouse gas emissions. The increase in groundwater levels will improve water quality and reduce subsidence potential. This project will also create 4 acres of wetlands in an area that is currently a barren landscape. **Table 2-6** presents the Project Performance Monitoring Plan for this project.

Table 2-6: Atwater-McSwain Regulating/Recharge Basin Project – Project Performance Monitoring Plan

Table 6 – Project Performance Monitoring Plan Project: Atwater-McSwain Regulating/Recharge Basin Project		
Proposed Physical Benefits	Targets	Measurement Tools and Methods
Primary benefit: groundwater recharge (AFY)	Groundwater Levels	Use of water level transducers and data loggers in monitoring wells
Secondary benefit: habitat improvement (Acres)	Wetlands habitat created	Acres of wetlands created

UC Merced Surface Water Augmentation Project

This project will provide in-lieu recharge of the groundwater basin through the use of untreated surface water for irrigation at the campus in lieu of groundwater pumping. This will result in an increase in groundwater elevations over the long term, and an associated reduction in net electricity consumption and greenhouse gas emissions resulting from the cessation of groundwater pumping for irrigation. The increase in groundwater levels will also improve water quality and reduce subsidence potential. By connecting the lake to the Canal, the habitat value surrounding the lake will be improved through the introduction of higher-quality surface water. **Table 2-7** presents the Project Performance Monitoring Plan for this project.

Table 2-7: UC Merced Surface Water Augmentation Project – Project Performance Monitoring Plan

Table 6 – Project Performance Monitoring Plan Project: UC Merced Surface Water Augmentation Project		
Proposed Physical Benefits	Targets	Measurement Tools and Methods
Primary benefit: groundwater recharge (AFY)	Use of surface water to fill Little Lake in-lieu of groundwater	Metering of diversions from Fairfield Canal into Little Lake Measurement of regional groundwater elevations via monitoring wells
Secondary benefit: habitat improvement (Acres)	Wetlands and lake habitat improved	Measure general water quality constituents Species counts conducted at Little Lake

Cost Effectiveness Analysis

Table 2-8 and **Table 2-9** provide a cost effective analysis for the two projects, in accordance with Table 7 of the PSP.

Atwater-McSwain Regulating/Recharge Basin Project

Table 2-8: Atwater-McSwain Regulating/Recharge Basin Project

Table 7 – Cost Effective Analysis Project Name: *Atwater-McSwain Regulating/Recharge Basin Project*	
Question 1	The types of benefits achieved by this project include immediate and long-term groundwater recharge and an associated reduction in groundwater basin over draft, reduction in net consumption of electricity and net production of greenhouse gases, water quality improvements, and reductions in subsidence potential. Additionally, the project achieves habitat restoration along the Pacific Flyway in an area that is currently barren.
Question 2	A groundwater recharge feasibility was completed for the Merced Region in August 2013[2], which identified opportunity areas for artificial recharge in the basin but did not evaluate site-specific locations nor include any estimated costs. Other areas would require extensive excavation to make the recharge basin. This project will utilize the already excavated site, saving substantial costs to the project.
Question 3:	There are no other alternatives that would achieve the objective of providing groundwater recharge at a lower cost.

UC Merced Surface Water Augmentation Project

Table 2-9: UC Merced Surface Water Augmentation Project

Table 7 – Cost Effective Analysis Project Name: *UC Merced Surface Water Augmentation Project*	
Question 1	The types of benefits achieved by this project include immediate and long-term groundwater recharge and an associated reduction in groundwater basin over draft, reduction in net consumption of electricity and net production of greenhouse gases, water quality improvements, and reductions in subsidence potential. Additionally, this project improves the lake and surrounding marsh habitat.
Question 2	The University has looked into utilizing recycled water for irrigation, but there are no facilities currently in place and no costs were estimated for this alternative. This project would take advantage of the existing campus irrigation infrastructure and the Fairfield Canal running through the campus.
Question 3	There are no other alternatives that would replace the use of groundwater at a lower cost.

[2] RMC. 2013. Merced Integrated Regional Water Management Plan. Groundwater Recharge Feasibility Study. August.