ATTACHMENT 4: Project Description
Hydrogeologic Characterization of the Eastern Turlock Subbasin

4.1 Introduction

The Turlock Subbasin of the larger San Joaquin Valley Groundwater Basin has been relied upon for more than 100 years to provide local agricultural irrigation and drinking water to portions of Stanislaus and Merced counties. Most of the available studies and data for the Turlock Subbasin have been focused within irrigation district or city boundaries in the central and western portions of the subbasin, where water supply is a key function of the agencies (**Figure 4-1**). The eastern portion of the subbasin includes large areas outside of these boundaries (e.g., the Foothills non-district area on **Figure 4-1**) where an unknown number of private wells are relied upon for irrigation and domestic supply. The eastern subbasin also includes portions of the Eastside Water District and Merced Irrigation District where groundwater conditions are not well understood (**Figure 4-1**). **Yet, these eastern subbasin areas are critical to effective management of the subbasin.** Some of these upgradient areas contribute substantial recharge to the groundwater system. In addition, these areas are immediately east of documented water level declines associated with local overdraft and may be contributing to overdraft conditions directly. Moreover, an increase in groundwater use in the foothills area is indicated by recent changes in land use. **This application requests funding for a detailed hydrogeologic characterization of the eastern subbasin, referred to as the Project Area as shown on Figure 4-1**.

Significant data gaps exist in the Project Area. Nonetheless, most of these knowledge gaps can be reduced or bridged with comprehensive compilation and systematic analysis of existing data. The largest knowledge gap—and an area of concern with respect to the groundwater supply—occurs in the Project Area east of an area where groundwater levels have been declining for decades. This area of water level declines is illustrated on **Figure 4-2**, a recent water level contour map that also highlights the uncertainties associated with water levels in the Project Area.

To address these data gaps, the Turlock Groundwater Basin Association (TGBA), with the City of Turlock as the Applicant, is proposing a comprehensive hydrogeologic characterization of the eastern Turlock Subbasin (Project) with a focus on non-district areas in the Foothills and eastern district areas where groundwater conditions are not well known (Project Area). The Project will evaluate hydrostratigraphy and aquifer properties, groundwater occurrence and flow, groundwater quantity and quality, changes in groundwater use (and land use) over time, soils and vadose zone permeabilities, restrictive layers (such as duripans), and water budgets. An updated numerical groundwater flow model for the entire subbasin, with a focus on the Project Area, will be developed incorporating data and information from two existing groundwater models; one developed by the Turlock Irrigation District (TID) and the second by the U.S. Geological Survey (USGS). The new Project numerical model will be applied to simulate impacts on groundwater from changing land use. The Project model will also serve as an improved tool for future groundwater assessments in support of the subbasin Groundwater Management Plan (GWMP).

4.2 Project Goals and Objectives

The goal of the Project is to develop an understanding of the hydrogeology of the Project Area – highlighted on **Figure 4-2** – and to apply that understanding to predict impacts of increased groundwater use on subbasin groundwater levels and quality. The Project will accomplish the following objectives:

- Development of a comprehensive, updated hydrogeologic conceptual model that provides an overall understanding of how the groundwater system works in the Project Area
- Evaluation of changing land use and groundwater conditions that supports a better understanding of land use impacts on groundwater resources
- Revision and application of a subbasin-wide numerical groundwater flow model as a tool to assist with land use planning and groundwater management decisions throughout the subbasin
- Support for ongoing groundwater monitoring programs such as the California Statewide Groundwater Elevation Monitoring (CASGEM) program
- Support for management programs associated with the Turlock Groundwater Basin Groundwater Management Plan (GWMP) including recent regulatory requirements for a GWMP such as the mapping of recharge zones as required by Assembly Bill 359 (AB359, 2011).

4.2.1 Steps to Accomplish Objectives

Development of the hydrogeologic conceptual model will first involve compilation of existing data from numerous data sources and development of relational databases and Geographic Information System (GIS) layers. Analysis of available data will focus on the interconnectivity of aquifer systems, recharge potential, surface water-groundwater interactions, and overall groundwater conditions. Water level and water quality data will be compiled into a database to characterize groundwater geochemistry and to examine changes and trends in groundwater levels and quality over time. Water level contour maps and cross sections will be developed to analyze and illustrate relationships of aquifers and groundwater conditions. Contributing watersheds, shallow soils, and vadose zone textures will be examined to estimate recharge areas and rates. A groundwater balance will be prepared to describe inflows and outflows, estimate groundwater in storage, and document changes in storage over time. Data collection efforts will also incorporate data from adjacent subbasins to gain insights on the primary aquifer system in the eastern Turlock Subbasin, the Mehrten Formation. A geologic map and simplified cross section are included as **Figures 4-3 and 4-4**, respectively, to illustrate the Mehrten Formation outcrop and the general dip of the aquifer to the west beneath the subbasin.

Available information on the current and historical land use (and corresponding groundwater use) will be compiled and incorporated into the study; this information provides necessary context to understand changing groundwater conditions. It is also fundamental to consideration of future scenarios and water/land use planning and management options.

Finally, a subbasin-wide numerical model will be developed, based on the hydrogeologic conceptual model, and validated to other data throughout the subbasin. The model will be applied to various scenarios involving potential future changes in land use (and groundwater use). The model will be based

in part on two existing groundwater flow models, only one of which currently covers the Project Area (but is not well-calibrated in that region).

Specifically, there have been two groundwater flow models developed for portions of the Turlock Subbasin:

- a three-dimensional finite element model (steady-state and transient) developed by Timothy J. Durbin, Inc. (consultant for TGBA and TID) using the FEMFLOW3D code (TID Model); and
- a three-dimensional finite difference model of the Northeastern San Joaquin Valley developed by the USGS for using the MODFLOW code (USGS Model). The USGS model includes a calibrated steady-state model and a transient model for the time period 1960 – 2010. The steady-state model has been documented in a USGS scientific report (Phillips, et al., 2007[1]); the transient model is currently in the final stages of calibration (Phillips, personal communication, May 2012).

Model boundaries for the two models are shown on **Figure 4-5**. The TID model covers the entire Turlock Subbasin but the model documentation identified significant knowledge gaps in the Project Area (Durbin, 2005). An evaluation of the model results indicates that the steady-state model accurately represented average conditions, but that transient calibration results had more error. **Because of these results, the TID model, in its current form, may not be useful in simulating future groundwater conditions and management scenarios. The USGS model steady state model accurately represented 2000 average groundwater conditions, but does not cover the Project Area.** The mean and root mean squared errors for the steady-state MODFLOW model were only 2.9 and 7.5 feet, respectively and showed good agreement between measured and simulated groundwater elevations in the TID area. The transient portion of the USGS model is in final calibration stages and will provide a useful updated tool for this Project's numerical model development. Additional details of the models are included in the Project Workplan (Attachment 5).

In 2008, the TID model was applied to analyze impacts from increased groundwater use in the eastern foothills of the Project Area (Durbin, 2008). The analysis suggested potential adverse impacts over much of the subbasin to the west from pumping in the Project Area; however results contained considerable uncertainty because of data gaps in the eastern subbasin. **This Project will address these data gaps, develop an updated conceptual and numerical model, and analyze realistic scenarios based on current land use information and future trends.** Results of this Project will provide a tool to assist future land use planning and groundwater management decisions throughout the subbasin.

4.2.2 Support of Ongoing Programs

Results of the Project will also be used to support additional groundwater management activities and statewide monitoring programs including CASGEM. TGBA has registered as the monitoring entity for the Turlock Subbasin CASGEM program and a monitoring plan has been submitted by TID on behalf of the

[1] *Title page and abstract documenting the USGS regional flow model is provided as Supporting Documentation-1 to this Attachment 4*

TGBA, which includes monitoring within TID, the City of Turlock (Applicant), other urban areas, and Eastside Water District. Although the plan covers two thirds of the subbasin, only one monitoring well is included currently in the Project Area as part of the CASGEM program. **This study will evaluate additional promising areas for monitoring, and may identify existing wells for potential CASGEM inclusion. In addition, the study will provide more detailed information on potential recharge areas and rates; this information will support satisfaction of the AB359 requirement for mapping recharge and wellhead protection areas.** Project support of the GWMP and Basin Management Objectives are summarized in Section 4.5. Additional information on Project Use is provided in Section 4.7.

4.3 Demonstrated Collaboration

For more than 15 years, local groundwater management has been coordinated in the subbasin through the TGBA. As a member of TGBA, the City of Turlock has volunteered to be the Applicant for this grant on behalf of the association. The TGBA will monitor the progress of the Project and serve as a Project Advisory Committee (PAC) if the grant is awarded. Further, local groundwater managers from TGBA have formed partnerships at the regional level through the East Stanislaus Integrated Regional Water Management Plan (ESIRWMP). This planning region includes the groundwater basin areas between the Stanislaus, Merced, and San Joaquin rivers, including the entire Turlock Subbasin, to ensure coordination across subbasin boundaries of this interconnected groundwater resource. Finally, the Cities of Turlock, Ceres, Hughson, and Modesto have formed a Joint Exercise of Powers Agreement (JPA) to increase surface water supply for conjunctive management of surface water and groundwater. These collaborative efforts are summarized below.

4.3.1 Turlock Groundwater Basin Association

The Turlock Subbasin contains numerous local agencies with authority for groundwater management. In 1995, these agencies formed the Turlock Groundwater Basin Association (TGBA), which formalized their ongoing collaborative groundwater management efforts.

The TGBA completed the subbasin's first Groundwater Management Plan (GWMP) in 1997. Through a Memorandum of Understanding (MOU)[2], the TGBA was renewed in 2001. In 2008, the TGBA updated the GWMP and has continued since to coordinate groundwater management planning activities in support of the GWMP. The GWMP Executive Summary and key excerpts from the document including the MOU are provided as Supporting Documentation in Attachment 3. The planning area for the updated GWMP is the entire Turlock Subbasin shown on **Figure 4-1**.

TGBA continues to coordinate groundwater issues on a regular basis, conducts meetings pursuant to the Brown Act, and maintains meeting minutes. It has an established voting procedure for conducting groundwater management activities, including recharge studies and pilot projects to stabilize water

[2] *A copy of the MOU is provided with excerpts from the GWMP, included as Supporting Documentation in Attachment 3. The MOU is also listed in Q7 of the Applicant Information and Question's tab of this grant application as a document that demonstrates collaboration of public agencies in groundwater management.*

levels, and groundwater remediation activities to protect groundwater quality. **The TGBA voted unanimously to support this Project and to prepare this application for a Local Groundwater Assistance (LGA) grant (approved March 2012).** TGBA members consist of the 13 local agencies listed below:

- City of Turlock
- City of Ceres
- City of Hughson
- City of Modesto
- Keyes Community Services District
- Denair Community Services District
- Hilmar County Water District
- County of Merced
- County of Stanislaus
- Turlock Irrigation District
- Merced Irrigation District
- Eastside Water District
- Ballico-Cortez Water District

In addition to the 13 MOU signatories listed above, two additional agencies, Delhi County Water District (CWD) and Ballico Community Services District (CSD), participate in TGBA meetings and activities. These two agencies also support the effort to prepare this LGA grant application. In addition, the TGBA meetings provide an opportunity for other agencies and interested parties to participate. TGBA will continue to actively collaborate and cooperate with other parties in the subbasin.

As members of the TGBA, the counties of Merced and Stanislaus support this Project because it will provide valuable information with respect to groundwater conditions in the unincorporated areas of both counties. Information derived from the study will provide insights that may be relevant to future land use planning. The two counties also represent a source of key data sets to support the study as summarized below.

The Stanislaus County Department of Planning and Department of Environmental Resources (DER) have oversight responsibilities for land use planning, water well construction and destruction, groundwater contamination remediation, small public water systems, individual on-site sewage disposal systems, and hazardous materials within their jurisdiction. The Merced County Department of Planning and Division of Environmental Health (DEH) provide similar functions within their portion of the subbasin. Merced County also requires a water quality analysis to be conducted on selected new wells and maintains these data in the County files. This Project will access these data to characterize groundwater quality beneath the Project Area. Both counties maintain data on community water systems, although portions of these data sets are confidential. **This Project supports numerous goals from the General Plans of both Stanislaus and Merced counties (Merced County, June 2011; Stanislaus County, 1994).** Both plans designate agriculture as the largest land use in the Project Area with a goal of maintaining the financial

viability of agriculture (which includes a reliable water supply). Merced County's Water Element provides for assurance of long-term groundwater supply and recharge projects (Merced County, 2011).

Water agencies within the Turlock Subbasin, all of which rely upon the groundwater system for all or a part of their water supply, are very supportive of the grant application. Studies have shown that continued groundwater declines could impact water supplies throughout the subbasin. The agencies most impacted by the current groundwater declines are the Eastside and Ballico-Cortez water districts, which represent growers who rely on groundwater as their sole source of water supply. Water levels continue to decline in the area, impacting water quality, agricultural productivity, and pumping costs. Very little data have been collected and analyzed east of these districts and groundwater impacts from additional water use in the eastern subbasin could exacerbate the persistent water level declines in the area. The water level contour map presented on **Figure 4-2** illustrates the area of water level declines and data gaps to the east.

On behalf of the TGBA, the City of Turlock has volunteered to serve as the Applicant of the Project. The City is reliant on groundwater for its municipal and industrial water supply, and therefore, recognizes the need to better understand and protect the subbasin groundwater resources. This need is documented in the City's resolution to prepare this application (Attachment 1). The City operates 24 water supply wells and more than 200 miles of water distribution lines to serve its 69,000 residents. The City has been active in groundwater management activities including a recent partnership with the State Water Resources Control Board to investigate and remediate elevated concentrations of organic compounds detected within the City's service area. **Additional demonstration of City-led groundwater management activities is provided in this application as Attachment 9**.

Collectively, TGBA members have demonstrated coordination and collaboration on groundwater management in the subbasin for almost 20 years. The TGBA will continue this collaboration through the Project Advisory Committee (PAC) for this Project if the grant is awarded to the City. The TGBA (and Ballico CSD and Delhi CWD), serving as the PAC, represents all of the local agencies engaged in groundwater management. By reporting to the PAC, Project materials will be available to other stakeholders through separate workshops and/or board/city council meetings. Having the 15 PAC members continually updated, and allowing them to update their interested parties, provides for a wide network for Project dissemination. Accordingly, stakeholders will be engaged through the public notices and regular meetings of the TGBA itself and member agencies and through websites.

4.3.2 East Stanislaus Integrated Regional Water Management Plan

The cities of Turlock (Applicant), Modesto, Ceres, and Hughson are signatories on a 2011 MOU[3] for the coordinated development of the East Stanislaus Integrated Regional Water Management Plan

[3] *Documentation of the signatories to the ESIRWMP MOU, along with the MOU goals, is provided as Supporting Documentation-2 to this Attachment. The MOU is also listed in Q7 of the Applicant Information and Question's tab of this grant application as a document that demonstrates collaboration of public agencies in groundwater management*.

(ESIRWMP). The ongoing IRWMP process is currently developing and evaluating projects to address regional issues such as the ones listed below:

- Water supply reliability
- Drinking water quality
- Water quality protection
- Groundwater overdraft/contamination/recharge
- Protection and enhancement of aquatic, riparian, and watershed resources
- Water-related needs of disadvantaged communities
- Flood protection
- Recycled water use
- Water conservation
- Aging infrastructure

Stakeholders and the public are apprised of ESIRWMP activities and invited to participate in the process through workshops as provided on the ESIRWMP website: http://www.eaststanirwm.org/.

The Project proposed in this application directly supports the ESIRWMP planning process. The Project relates to water supply reliability and groundwater overdraft/recharge issues because the Project Area occurs in the subbasin recharge zone immediately adjacent to areas of groundwater overdraft, and may be contributing to overdraft conditions directly. A better understanding of the Project Area allows for improved protection of groundwater quality, directly supporting the ESIRWMP water quality issue. As part of this Project, existing groundwater quality data from eastern wells will be compiled and reviewed systematically for the first time to enhance the collective understanding of water quality in the Mehrten Aquifer system. Finally, a better understanding of the surface water-groundwater interaction beneath the Project Area along the rivers is likely to support protection and enhancement of aquatic and riparian resources, another regional issues identified by the ESIRWMP.

4.3.3 Joint Powers Agreement (JPA) between Cities of Turlock, Ceres, and Modesto

Three cities in the Turlock Subbasin have collaborated to secure an additional surface water supply to augment groundwater resources for drinking water. The JPA[4] provides for the joint participation in planning, designing, constructing, financing, and operating facilities for surface water conveyance and treatment. This JPA will allow for an increase in conjunctive management of surface water and groundwater in the subbasin.

4.4 Need for the Project and Project Merits

In addition to supporting the fundamental understanding of the groundwater subbasin, this Project addresses **three subbasin conditions that best highlight the need for the Project**:

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[4] *The first page of the JPA is provided as Supporting Documentation-3 to this attachment (Attachment 4). The JPA is also listed in Q7 of the Applicant Information and Question's tab of this grant application as a document that demonstrates collaboration of public agencies in groundwater management*.

- persistent water level declines in the eastern subbasin
- significant knowledge gaps in hydrogeologic conditions beneath the eastern subbasin
- changing land use that relies on eastern subbasin groundwater more heavily than ever.

These conditions are discussed in more detail below.

4.4.1 Water Level Declines and Overdraft Conditions

As documented in the GWMP, the eastern subbasin has been experiencing a decline in water levels since the early 1960s. The water level contour map for 2010-2011 conditions on **Figure 4-2** (constructed from DWR and TID water level databases) shows a water level depression of more than 80 feet in the eastern subbasin, immediately west of the Project Area. Groundwater is the primary source of water supply in the area of water level declines (in Eastside and Ballico-Cortez water districts) and in the Project Area where surface water is unavailable. Although it is known that additional groundwater pumping occurs east of the depression, water level data are limited and existing maps do not cover this area. In addition, existing historical data (albeit collected infrequently and over a limited area) have not yet been incorporated into a systematic analysis of water levels in the Project Area. **Analyses of these and other data will provide an improved understanding of groundwater levels, support a revised groundwater flow model, and identify specific areas to optimize future monitoring.**

Overdraft conditions indicated by the water levels are confirmed by a long-term water budget prepared for TGBA (Durbin, 2003[5]). For the period 1953 – 2002, groundwater storage in the subbasin declined an average of about -30,000 acre-feet per year (AFY). As documented in the GWMP, water budgets for more recent time periods indicate continued depletion of groundwater storage[6]. Most of the storage loss has occurred in the eastern half of the subbasin. Losses would have been even more severe if surface water had not been available elsewhere in the subbasin for irrigation supply. Recharge occurring from surface water irrigation accounts for about 72 percent of the total recharge in the basin (TGBA, 2008). Additionally, water quality has been observed to degrade with depth in certain areas, indicating that the eastern subbasin may be more vulnerable to future water quality problems.

4.4.2 Knowledge Gaps in the Project Area

The Project Area contains the most complex geology of the subbasin as indicated on the geologic map on **Figure 4-3**. Although the Project Area contains numerous geologic formations that comprise the aquifer systems, the primary aquifer is the Mehrten formation, which also provides water supply to areas north and south of the Project Area in the eastern San Joaquin Valley Groundwater Basin. The current understanding of the hydrogeology indicates that the Mehrten formation and other aquifer systems that crop out in the eastern Turlock Subbasin also dip beneath the groundwater surface to the west and serve as the deeper water supply for some wells in the subbasin. This is illustrated by the

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[5] *Excerpts from this report are provided as Supporting Documentation-4 with this Attachment (Attachment 4)*

[6] *see GWMP, Executive Summary, highlighted text on p. 3-4, Supporting Documentation, Attachment 3*

simplified cross section shown on **Figure 4-4**. The connectivity of the aquifers and the relationships between water quality and aquifer systems in the Project Area are not well understood.

The need for this Project has been recognized in the past and was documented in 2008 by TGBA's primary investigator of the groundwater basin, Timothy J. Durbin, Inc. At that time, the TGBA commissioned a study titled *Assessment of Future Groundwater Impacts Due to Assumed Water-Use Changes, Turlock Groundwater Basin, California* (Durbin, 2008[7]). That study indicated water supply problems for portions of the subbasin if irrigated agriculture increased at a rate of two percent per year. However, the study noted that the land use changes were occurring in portions of the basin (i.e., the Project Area) that were the least well understood. **Several excerpts from the Durbin 2008 study that highlight this issue are provided below:**

> *"For the eastern region of the Turlock basin, the sparse available data limit the ability to characterize the geologic formations, and that translates into highly uncertain model predictions."*
>
> *"Groundwater quality could become a constraint on groundwater use within the eastern region of the basin, but little information is available to assess the risk."*
>
> *"…the groundwater-level declines within the eastern region of the basin probably have reversed the natural downward groundwater flow" [making the area susceptible to upward migration of poor-quality water].*
>
> *"For the eastern region of the basin, the simulation results suggest possible water-supply problems, depending on the actual physical characteristics of the geologic formations underlying that region."*
>
> *"To enhance the ability to predict future groundwater conditions, better information is needed on hydrogeologic, groundwater, and water-use conditions within the eastern region of the Turlock basin."*

As recognized in the study, data in the Project Area are sparse, but key data sets are known to exist that would contribute to the improved understanding of vertical flow, water level declines, and groundwater quality issues. Water level records are infrequent and sporadically distributed, but have been documented for about 40 wells that have been monitored historically in the eastern subbasin by the Department of Water Resources (DWR). More than 275 drillers' logs and Well Completion Reports for wells in the foothills portion of the non-district areas (**Figure 4-1**) have recently been compiled from DWR files for this grant application. Key data exist on many of these logs, including well tests, specific capacity data, lithologic/texture data, construction information, and drilling dates. Although these files are confidential, the hydrogeologic and groundwater use information can be extracted to support the

[7] *The Executive Summary of the Durbin,2008 report is provided as Supporting Documentation-5 with this Attachment (Attachment 4)*

Project and to significantly increase the collective knowledge of the Project Area. In addition, water quality data (and other data) exist for numerous wells in County files. These data sets exist in paper format at various locations and have been difficult to compile and analyze collectively in the past. **This Project will target these hard-to-obtain data and develop databases to support an updated hydrogeologic conceptual model and a revised Project numerical model.**

4.4.3 Changing Land Use Conditions

Water supply and land use patterns have been intricately linked in the Turlock Subbasin. For 125 years, surface water has provided a reliable irrigation supply to support the agricultural economy within the TID service area (**Figure 4-1**). For many decades, most of the subbasins' irrigated agriculture occurred within the surface water delivery areas. But beginning in about 1962, irrigated agriculture expanded to the east; as a result, groundwater pumping increased substantially and water levels began to decline. In recent years, irrigated agriculture has continued to expand to the east. From 1992 to 2006, the irrigated area in the Foothills portion of the Project Area nearly doubled from about 10,800 acres to about 19,500 acres[8], placing even more reliance on local groundwater resources. The increase is shown on **Figure 4-6**, which has been reproduced from the GWMP (formerly Figure 4d in TGBA, 2008). **The recent increase in groundwater use has occurred in areas where the hydrogeology and groundwater conditions have not yet been studied; this Project is an important step in addressing this knowledge gap.**

4.4.4 Project Merits

Collectively, water level declines in the east, water quality uncertainties, land use changes, and significant knowledge gaps demonstrate clearly the need for this Project. Data sets are known to exist that could address these gaps and improve significantly the understanding of the hydrogeologic and groundwater use/land use conditions of the Project Area. **This improved understanding directly supports the CASGEM program, AB359 recharge requirements, and objectives of the GWMP, as described in more detail below.**

4.5 Support of the Groundwater Management Plan

This Project is linked to numerous Basin Management Objectives (BMOs) in the TGBA GWMP (TGBA, 2008). Stated BMOs are summarized below:

1. Maintain adequate water levels in the groundwater basin to support beneficial uses.
2. Protect groundwater quality and implement measures, where feasible, to reduce the potential movement of existing contaminants.
3. Monitor groundwater extraction to reduce the potential for land subsidence.
4. Promote conjunctive use of groundwater and surface waters.
5. Support and encourage water conservation.
6. Develop alternate water supplies, and educate users on the benefits of water recycling.

[8] *see GWMP Executive Summary, highlighted text on p. 2, Supporting Documentation, Attachment 3*

7. Continue coordination and cooperation between the TGBA members and customers.

It is clear that the proposed Project directly supports the first three BMOs. The Project Area in eastern Turlock Subbasin may have less groundwater in storage, may connect directly with an area of persistent water level declines, may influence the vertical gradients and movement of poor-quality groundwater, and may be subject to local overdraft conditions that could exacerbate the water level declines to the west. **Collectively, these issues highlight the need for an improved understanding of the eastern hydrogeology in order to achieve the stated BMOs (especially BMO 1 and 2).**

Although inelastic subsidence (BMO 3) has not been documented as a problem in the subbasin (GWMP, 2008), groundwater extractions require monitoring to achieve this BMO. Using data from small water systems (as available), well permits, and other land use data, groundwater use can be estimated for the eastern subbasin. In addition, the Project may also assist in achieving BMO 4 by providing fundamental data necessary for evaluation of conjunctive use projects. Specifically, without a better understanding of how this portion of the basin functions with respect to streamflow recharge and subsurface inflow, it is not possible to understand current conditions and evaluate fully the potential for conjunctive use.

4.6 Contact with Federal and State Agencies

This Project will involve contact with Federal and State Agencies. During the data collection tasks, some State Agencies (e.g., Department of Public Health (DPH), Drinking Water Division in Sacramento) will be contacted directly (via telephone and email). Data from the Central Valley Regional Water Quality Control Board (CVRWQCB), Region 5 will be accessed via online databases and/or direct contact. County offices for both Stanislaus and Merced counties will be visited for review and compilation of data.

One objective of this Project is to support ongoing programs such as CASGEM; this project will provide additional potential areas for possible inclusion in the CASGEM monitoring program. Such data will be included in the Project report and also provided to the DWR South Central Region (Fresno) for purposes of supplementing the local monitoring programs as appropriate. Additional information developed in the program, such as mapping of recharge areas, are intended for incorporation into future updates of the GWMP, which would also be provided to DWR.

Development of the numerical model will be based on close coordination with the USGS and the ESIRWMP process. Although the author of the former TID groundwater model, Timothy Durbin, has retired, he has been contacted for coordination of the model revisions. USGS has expressed cooperation for provision of the updated USGS model files (Phillips, personal communication, May 2012).

The Project will also result in provision of the final report and databases to DWR, which will include the data compilation efforts including older data from out-of-circulation documents.

4.7 Future Project Use

This Project will establish numerous databases that can append other databases maintained by TGBA, such as the existing water level database. The Project report will contain extensive documentation on

data collection efforts and sources so that future users know which data sets have been incorporated. Data tables will be included in the report to support effective use of databases in future studies.

The analysis of land use changes and resulting impacts on the groundwater basin will inform future groundwater management and land use decisions in the subbasin. As members of the Project Advisory Committee (PAC), Merced and Stanislaus counties will be provided quantitative impacts of future groundwater use to incorporate into updates of the General Plan and to assist with overall land use planning.

The update of the numerical model will provide TGBA with an ongoing tool to analyze future issues and evaluate proposed groundwater management strategies. The model update will build on the current TID groundwater model and a more-recent regional model developed by the USGS, which is anticipated to be available before December 2012 (Phillips, personal communication, May 2012). The TID model covers the entire subbasin (**Figure 4-5**), but is not well-calibrated to transient conditions. The USGS regional model updates the transient conditions in the Turlock Subbasin, but does not include all of the Project Area (**Figure 4-5**). Although the USGS model is regional in scale, new insights and analysis of local conditions will be derived from that effort. A subbasin-wide Project model will be developed by incorporating and expanding the USGS model into the Project Area and by building on the data sets and understanding developed through the modeling efforts of both the TID and USGS.

Ongoing use of the databases and the numerical model will be funded in the future through the TGBA, local public agencies, and other sources where available. **TGBA explicitly included financial planning for the GWMP implementation.** While emphasizing the importance of grant funding, TGBA recognized that the full implementation would include local agency budgeting. The enabling MOU for the TGBA provided a funding mechanism whereby funding contributions may be made by one Party or a subgroup of the Parties.

In summary, this Project will provide the hydrogeologic context, the foundational databases, and a powerful numerical tool to support groundwater management decisions into the future.

Reference List:

California Assembly Bill 359 (AB359), 2011, Groundwater management plans (Huffman), filed October 8.

Durbin (Timothy J. Durbin, Inc.), 2008, Assessment of Future Groundwater Impacts Due to Assumed Water-Use Changes, Turlock Groundwater Basin, California, prepared for Turlock Groundwater Basin Association, September.

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Merced County, 2011, 2030 Merced County General Plan, Planning Commission Review Draft, June.

Phillips, S.P., Green, C.T., Burrow, K.R., Shelton, J.L., and Rewis, D.L., 2007, Simulation of Multiscale Ground-water Flow in Part of the Northeastern San Joaquin Valley, California, U.S. Geological Survey Scientific Investigations Report 2007-5009, 43p.

Stanislaus County, 2011, General Plan, adopted December 20.

Turlock Groundwater Basin Association (TGBA), 2008, Turlock Groundwater Basin, Groundwater Management Plan, prepared for Turlock Irrigation District, March.

Turlock Groundwater Basin Association (TGBA), 2001, Memorandum of Understanding Establishing the Turlock Groundwater Basin Association (also included as Appendix C in the TGBA GWMP, 2008).

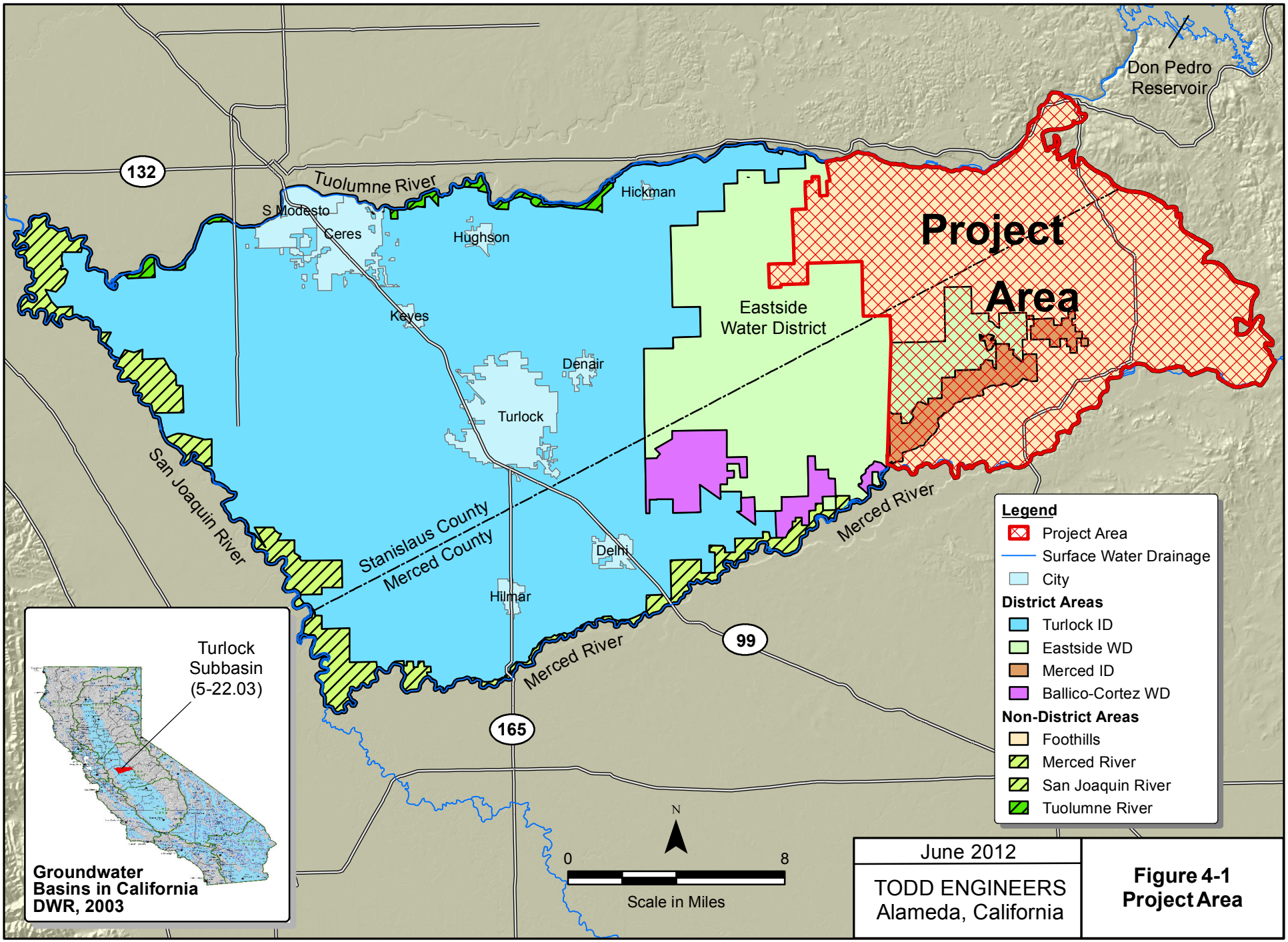
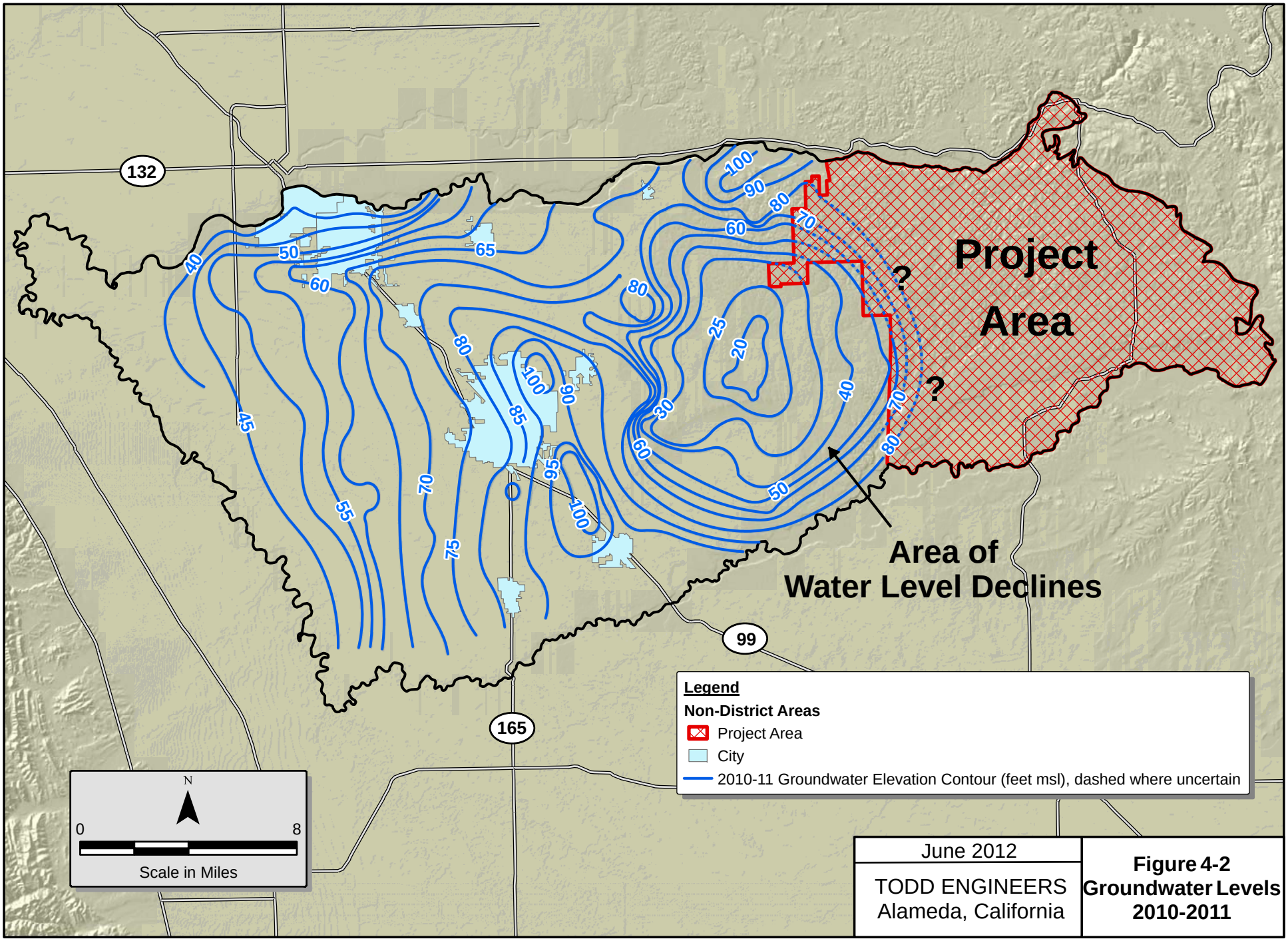


Figure 4-1
Project Area



June 2012

TODD ENGINEERS
Alameda, California

Figure 4-2
Groundwater Levels
2010-2011

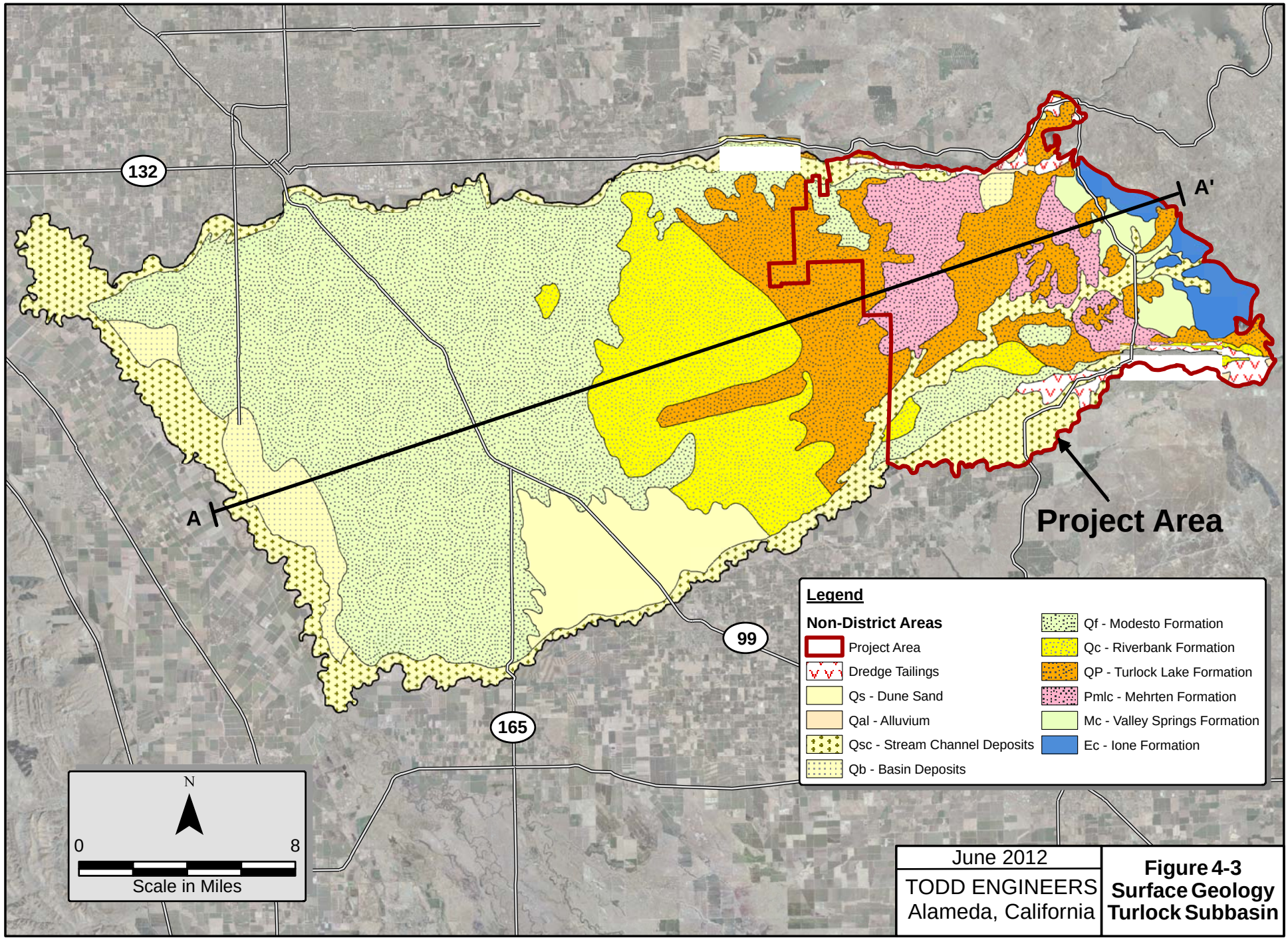


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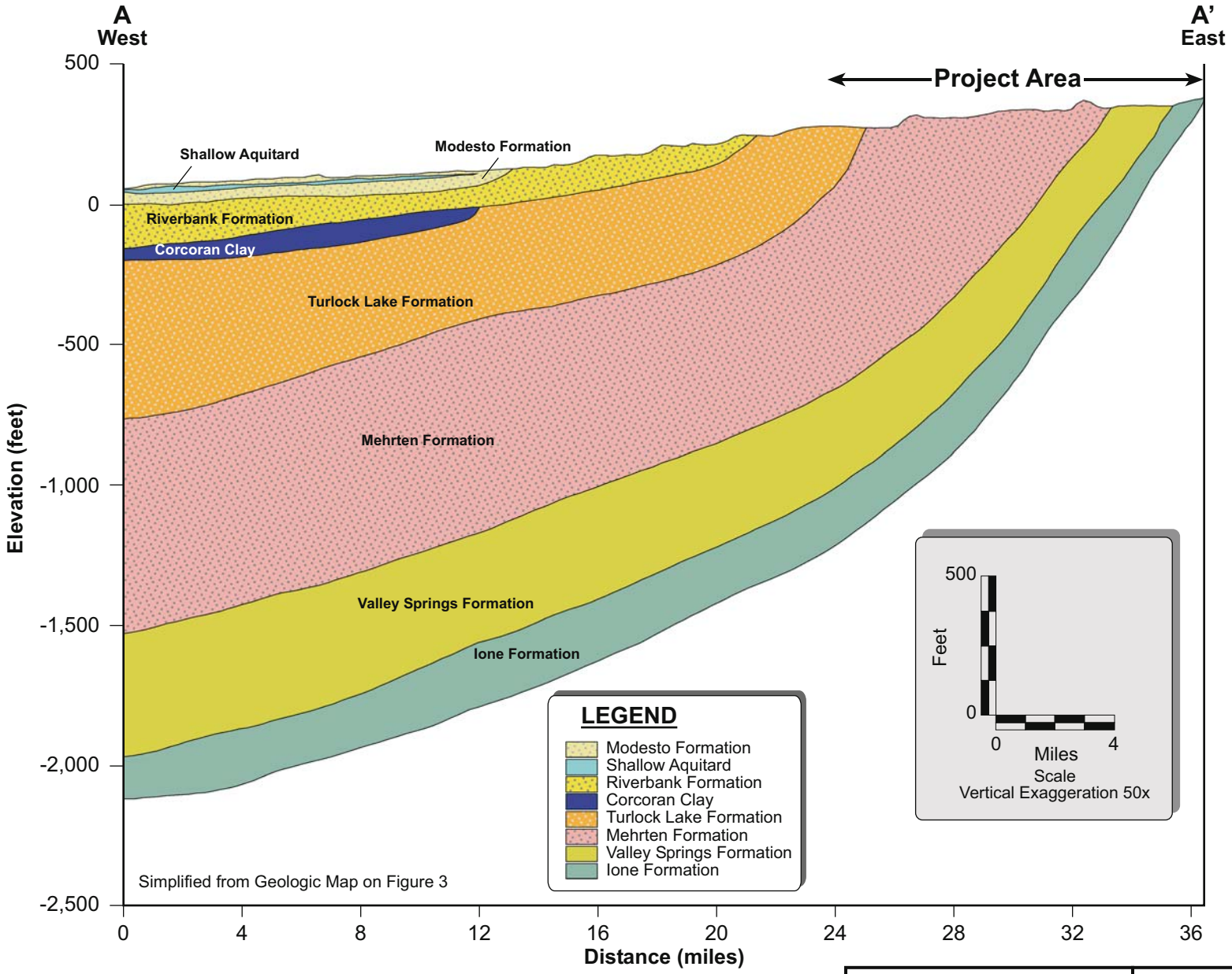
Figure 4-3
Surface Geology
Turlock Subbasin



Source: Durbin, 2005.

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Figure 4-4
Generalized East-West Cross Section
Turlock Subbasin

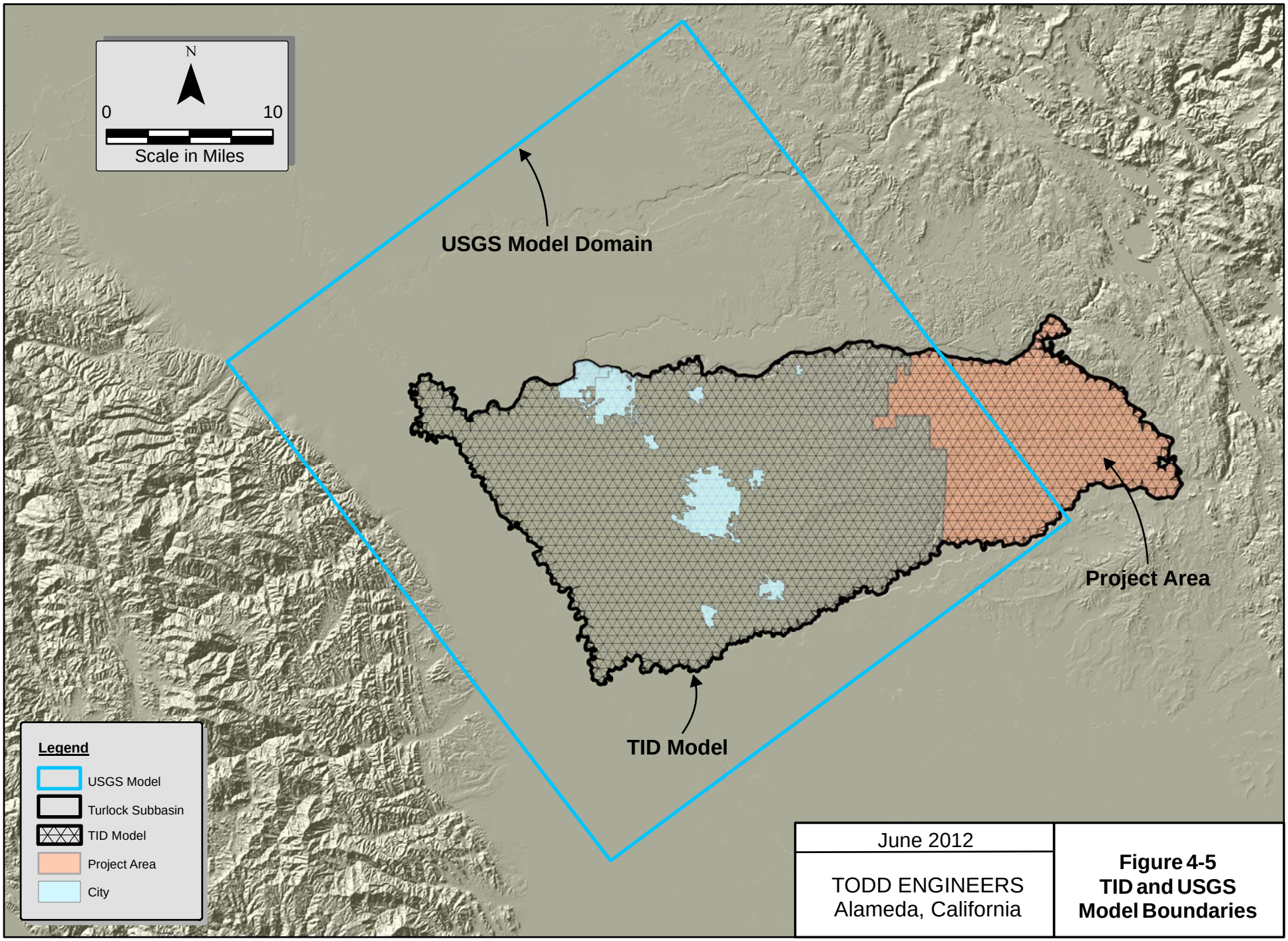

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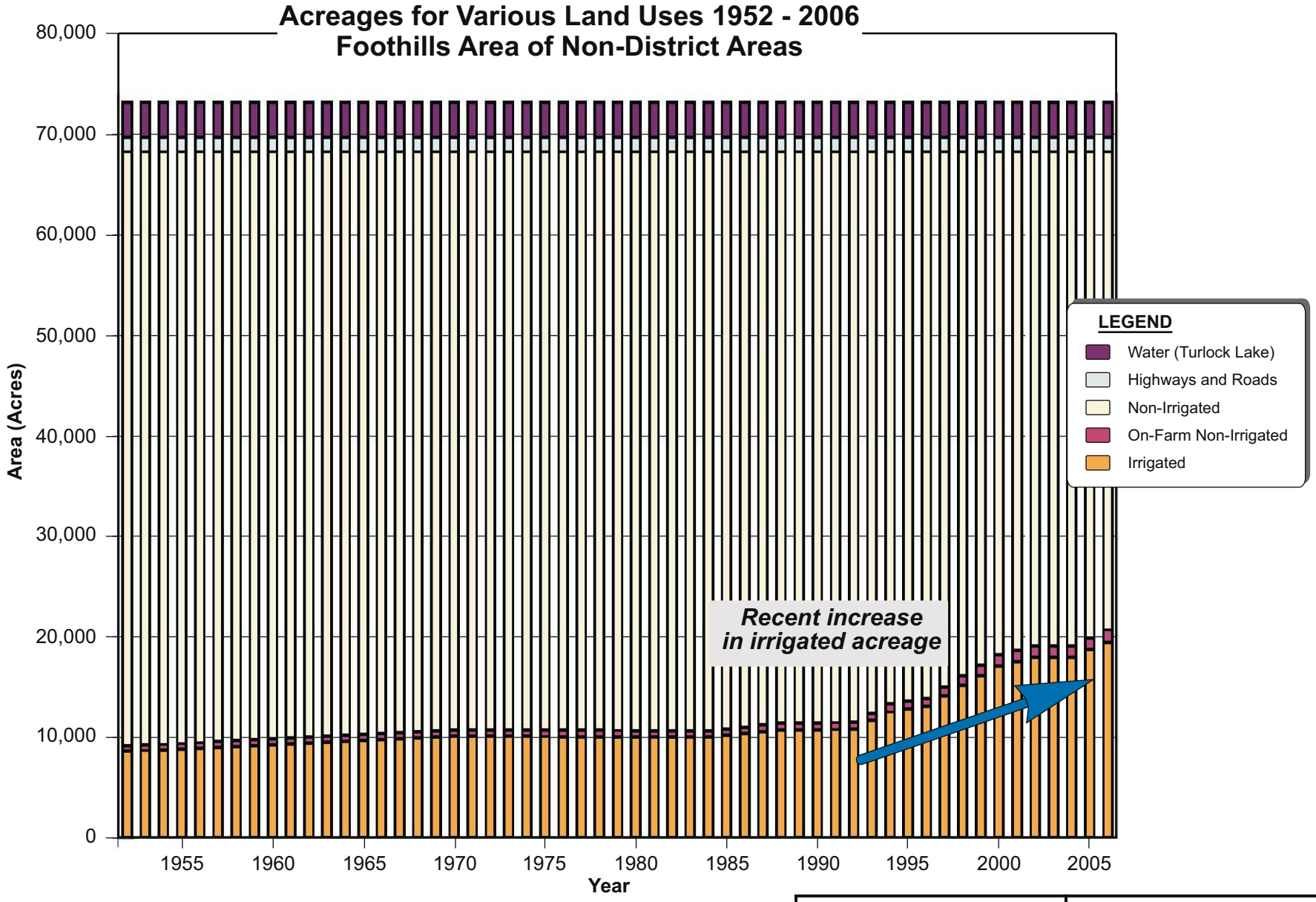
Figure 4-5
TID and USGS Model Boundaries



Note: Foothills Non-District Areas shown as part of the Project Area on Figure 4-1

Source: TGBA, 2008, Figure 4d.

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