2018 Recharge Master Plan

September 2018

Prepared for:

Chino Basin Watermaster

Inland Empire Utilities Agency

Prepared by:

WEI

Wildermuth Environmental, Inc.

Inland Empire Utilities Agency

A Municipal Water District

Chino Basin Watermaster

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September 6, 2018

Chino Basin Watermaster
Attention: Mr. Peter Kavounas
9641 San Bernardino Road
Rancho Cucamonga, CA 91730

Inland Empire Utilities Agency
Attention: Ms. Halla Razak
6075 Kimball Ave
Chino, CA 91708

Subject: Transmittal of the Final 2018 Recharge Master Plan Update Report

Dear Ms. Razak and Mr. Kavounas:

Wildermuth Environmental, Inc. (WEI) is pleased to submit to you the final *2018 Recharge Master Plan Update* (2018 RMPU). The 2018 RMPU was prepared consistent with the requirements of the Peace Agreement, the Peace II Agreement, the December 2007 Court Order that approved the Peace II Agreement, and the Court order approving the *2013 Amendment to the 2010 Recharge Master Plan Update* (2013 RMPU).

We would like to thank the participants of the Steering Committee, Watermaster and Inland Empire Utilities Agency IEUA staff, for their efforts in the preparation of this report.

Pursuant to Section 8.3 of the Peace II Agreement, Watermaster is obligated to make an annual finding that it is in substantial compliance with the Recharge Master Plan, as it is revised. This requirement exists to ameliorate any long-term risk attributable to reliance upon un-replenished groundwater production by the Desalters, and it is a condition on the annual availability of any portion of the 400,000 acre-feet set aside as controlled overdraft. Section 5.1 of this report contains technical documentation demonstrating that Watermaster has sufficient recharge capacity to meet expected future replenishment obligations through 2050, Watermaster is in substantial compliance with the Recharge Master Plan in Fiscal 2018-19.

If you have any questions, please send them to Carolina Sanchez (csanchez@weiwater.com) and Mark Wildermuth (mwildermuth@weiwater.com).

Very truly yours,

Wildermuth Environmental, Inc.

Mark Wildermuth, PE
President

Carolina Sanchez, PE
Senior Engineer

2018 Recharge Master Plan

Final Report

Prepared for:

Chino Basin Watermaster
Partners in Basin Management

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

Prepared by:

WEI
Wildermuth Environmental, Inc.

September 2018

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Acronyms, Abbreviations, and Initialisms

2001 RMP	2001 Recharge Master Plan
2013 RMPU	2013 Amendment to the 2010 Recharge Master Plan Update
2018 RMPU	2018 Recharge Master Plan Update
af	acre-feet
afy	acre-feet per year
ASR	aquifer storage and recovery
CAMA	Court Approved Management Agreements
CBWCD	Chino Basin Water Conservation District
CDA	Chino Basin Desalter Authority
CIM	California Institution for Men
CVWD	Cucamonga Valley Water District
DYYP	Dry-Year Yield Program
FWC	Fontana Water Company
FY	Fiscal Year
IEUA	Inland Empire Utilities Agency
JCSD	Jurupa Community Services District
Judgment	Chino Basin Stipulated Judgment
Metropolitan	Metropolitan Water District of Southern California
MPI	Material Physical Injury
MS4	municipal separate storm sewer system
MVWD	Monte Vista Water District
MZ1	Management Zone 1
OBMP	Optimum Basin Management Program
SBCFCD	San Bernardino County Flood Control District
SRF	State Revolving Fund
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TVMWD	Three Valleys Municipal Water District
USACE	US Army Corps of Engineers
UWMP	Urban Water Management Plan
Watermaster	Chino Basin Watermaster
WFA	Water Facilities Authority
WVWD	West Valley Water District

This report documents the investigation conducted by the Inland Empire Utilities Agency (IEUA) and the Chino Basin Watermaster (Watermaster) pursuant to the Court's direction to update the 2013 Amendment to the 2010 Recharge Master Plan Update (2013 RMPU) (WEI, 2013). The 2013 RMPU was completed in September 2013, filed with the Court in November 2013, and subsequently approved by the Court in its entirety in April 2014. The 2013 RMPU and this 2018 Recharge Master Plan Update (2018 RMPU) were prepared consistent with the requirements of the Peace Agreement, the Peace II Agreement, the December 2007 Court Order that approved the Peace II Agreement, and the Court orders approving the 2013 RMPU. The 2018 RMPU was completed on time and submitted to the Court in October 2018.

1.1 Background

Figure 1-1 shows the location of the Chino Basin in the Santa Ana Watershed. The basin lies within the Counties of Los Angeles, San Bernardino, and Riverside; includes the Cities of Chino, Chino Hills, Eastvale, Fontana, Ontario, Pomona, Rancho Cucamonga, and Upland, as well as several other communities; and covers about 235 square miles.

The Chino Basin is an integral part of the regional and statewide water supply system. The Chino Basin is one of the largest groundwater basins in Southern California, containing about 5,700,000 acre-feet (af) of water in storage, and has an unused storage capacity of over 1,000,000 af. Multiple cities and other water supply entities pump groundwater from the basin for all or part of their municipal and industrial supplies. Agricultural users also pump groundwater from the basin.

Production and storage rights in the Chino Basin are defined in the Stipulated Judgment[1] (Judgment), issued in 1978 (Chino Basin Municipal Water District vs. the City of Chino et al. [SBSC Case No. RCV RS51010]). Since that time, the basin has been sustainably managed, as required by the Judgment, under the direction of a Court-appointed Watermaster. The Judgment declares that the Safe Yield[2] of the Chino Basin is 140,000 afy[3], which is allocated among three pools of right holders as follows:

Overlying agricultural pool	82,800 afy
Overlying non-agricultural pool	7,366 afy
Appropriative pool	49,834 afy

A fundamental premise of the Judgment is that all Chino Basin water users are allowed to pump sufficient water from the basin to meet their requirements. To the extent that pumping by a

[1] Original judgment in Chino Basin Municipal Water District vs. City of Chino, et al., signed by Judge Howard B. Weiner, Case No. 164327. File transferred August 1989, by order of the Court and assigned new case number RCV51010. The restated Judgment can be found here: http://www.cbwm.org/docs/WatermasterCourtFilings/2012%20Watermaster%20Restated%20Judgment.pdf

[2] "Safe Yield" is a defined term in the Judgment.

[3] The Safe Yield was recalculated in 2015 to be 135,000 afy and the adoption of the recalculated yield is pending Court approval.

party exceeds its share of the Safe Yield, assessments are levied by Watermaster to replace overproduction. The Judgment recognizes that there exists a substantial amount of available unused groundwater storage capacity in the Chino Basin that can be utilized for storage and the conjunctive use of supplemental and basin waters, that makes utilization of this storage subject to Watermaster control and regulation, and that provides that any person or public entity, whether or not a party to the Judgment, may make reasonable beneficial use of the available storage, provided that no such use shall be made except pursuant to a written storage agreement with Watermaster.

1.1.1 Optimum Basin Management Program

The Chino Basin Judgment gave Watermaster the authority to develop an optimum basin management program (OBMP) for the Chino Basin, including both water quantity and quality considerations. Watermaster, with direction from the Court, began the development of the OBMP in 1998 and completed it in July 2000. The OBMP was developed in a public collaborative process, consisting of the development of a set of management goals, the identification of impediments to those goals, and the identification of a series of actions that could be taken to remove the impediments and achieve the management goals. The goals of the OBMP process include:

1. Enhance Basin Water Supplies
2. Protect and Enhance Water Quality
3. Enhance Management of the Basin
4. Equitably Finance the OBMP

The Court approved the OBMP and its implementation agreement, hereafter the Peace Agreement,[4] in October 2000. The OBMP consists of nine program elements or initiatives that contain actions that remove the impediments to the OBMP goals and enable their achievement. These include:

- Program Element 1 – Develop and Implement Comprehensive Monitoring Program
- Program Element 2 – Develop and Implement Comprehensive Recharge Program
- Program Element 3 – Develop and Implement Water Supply Plan for the Impaired Areas of the Basin
- Program Element 4 – Develop and Implement Comprehensive Groundwater Management Plan for Management Zone 1
- Program Element 5 – Develop and Implement Regional Supplemental Water Program
- Program Element 6 – Develop and Implement Cooperative Programs with the Regional Water Quality Control Board, Santa Ana Region (Regional Board) and Other Agencies to Improve Basin Management
- Program Element 7 – Develop and Implement Salt Management Program
- Program Element 8 – Develop and Implement Groundwater Storage Management Program

[4] The Peace Agreement is located here: http://www.cbwm.org/docs/legaldocs/Peace_Agreement.pdf

- Program Element 9 – Develop and Implement Conjunctive-Use Programs

Each program element contains an implementation plan and schedule. The implementation plan and schedule are included in both the OBMP report (WEI, 1999) and the Peace Agreement. The OBMP implementation plan was updated in 2007 and implemented through the Peace II Agreement. The parties to the Peace Agreement and the Peace II Agreement were bound to implement them and have done so under Court supervision.

1.1.2 Recharge Planning

The IEUA, Watermaster, and many other stakeholders have collaborated to implement all of these program elements. Program Element 2 – Develop and Implement Comprehensive Recharge Program is fundamental to achieving the first two OBMP goals (1 Enhance Basin Water Supplies and 2 Protect and Enhance Water Quality). Prior to the OBMP, in response to rapid urbanization, the San Bernardino County Flood Control District (SBCFCD) and the US Army Corps of Engineers (USACE) constructed flood control projects that efficiently capture and convey stormwater to the Santa Ana River to reduce potential flooding, effectively eliminating the groundwater recharge that formerly took place in the stream channels and flood plains of the Chino Basin. These flood control projects consisted of concrete lining of major drainages across the Chino Basin and the construction of retention basins to temporarily store stormwater and release it in 24 hours or less. Some provisions were made to mitigate the loss of recharge from these flood control projects at that time, but these provisions failed to achieve the groundwater recharge that took place prior to the construction of these flood control projects. Figure 1-2 shows the locations of the major channels that drain the Chino Basin area and the time history of their concrete lining. Figure 1-3 shows the time history of stormwater recharge in the channels that cross the Chino Basin from the San Gabriel Mountains to the Santa Ana River. The loss in recharge to the basin due to the construction of concrete-lined channels is estimated to be about 15,000 afy. Also, there were no mitigation efforts to preserve recharge when land use was converted from native and agricultural uses to urban uses. Lining the drainage channels with concrete and changes in land use resulted in a decline in the sustainable yield of the Chino Basin. Program Element 2 was developed to reverse the loss in yield.

Capturing and recharging stormwater and dry-weather runoff improves water quality in the Santa Ana River, reducing the concentrations of metals, nutrients, pathogens, and other constituents of concern. These contaminants are eliminated during recharge through soil-aquifer treatment processes and thus are not a concern for groundwater degradation. In fact, the total dissolved solids (TDS) and nitrogen concentrations in stormwater recharge are very low, and subsequently increasing stormwater recharge lowers the TDS and nitrate concentrations in groundwater. Increasing the recharge of stormwater and dry-weather runoff increases the sustainable yield of the Chino Basin and improves the water quality of both the Chino Basin and the Santa Ana River, the latter being a regional benefit to other Santa Ana River Watershed parties and to Santa Ana River Watershed habitat.

1.1.3 Recharge Master Plan Activities and Project Implementation

Pursuant to the OBMP and the Peace Agreement, the IEUA, Watermaster, the Chino Basin Water Conservation District (CBWCD), and the SBCFCD completed a recharge master plan in 2001 (hereafter the 2001 Recharge Master Plan or 2001 RMP) and began its implementation in

2001 with construction occurring between 2004 and 2014. Seventeen existing flood retention facilities were modified to increase diversion rates, increase conservation storage, and subsequently increase the recharge of stormwater and dry-weather runoff. Two new recharge facilities were also constructed as part of these efforts. Figure 1-4 shows these facilities. The cost of these recharge improvements was about $60 million, of which about half came from grants provided from Proposition 13 bonds and other grants with the remainder paid for by the IEUA and Watermaster.

Watermaster has permits from the State Water Resources Control Board (SWRCB) to divert surface water to the spreading basins shown in Figure 1-4, store the recharged water in the Chino Basin, and subsequently recover it for beneficial use. Watermaster holds these permits in trust for all entities that rely on groundwater from the Chino Basin.

Figure 1-5 shows the estimated annual recharge of stormwater, dry-weather runoff, and recycled water for the period of 2006 through 2017. Figure 1-5 is based on the IEUA's monitoring of the recharge basins[5]; this information is documented in monthly reports prepared by the IEUA and annual reports prepared by the Chino Basin Watermaster, the latter of which are submitted to the SWRCB. Prior to 2004, there was no significant recharge of stormwater or dry-weather runoff, and recycled water recharge was about 500 afy. Based on monitoring recharge performance and numerical model investigations, the aggregate average annual stormwater and dry-weather runoff recharge due to the implementation of the 2001 RMP is estimated to be about 9,500 afy. The total recharge of new stormwater, dry-weather runoff, and recycled water created through the implementation of the 2001 RMP for the twelve-year period of July 2005 through June 2017 was about 210,000 af (averaging about 17,500 afy) and has reduced the demand for imported water from the State Water Project (SWP) by the same amount. During most of this period, stormwater recharge was suppressed by drought, and the recycled system was expanding. The amount of storm and recycled water recharge due to the 2001 RMP will increase with the fullness of time as the land use converts fully to urban uses.

The IEUA, Watermaster, the CBWCD, and the SBCFCD collaborated to develop the 2010 Recharge Master Plan Update and amended it in 2013. The 2010 Recharge Master Plan Update and its 2013 amendment (hereafter, collectively called the 2013 RMPU) were developed in a public, transparent process, including nine workshops for the 2010 Recharge Master Plan Update and 67 steering committee meetings and workshops for the 2013 RMPU. The 2013 RMPU contains two types of recharge projects: yield enhancement and production sustainability projects. The steering committee issued a "call for projects" to all entities with an interest in stormwater and dry-weather runoff management and groundwater management in the Chino Basin. The steering committee developed screening criteria to evaluate and rank the recharge projects. In total, 39 yield enhancement projects and nine production sustainability projects were identified and evaluated by the steering committee to determine average annual stormwater recharge and recycled water recharge capacities. The steering committee meetings were open to all stakeholders with an interest in stormwater and dry-weather runoff management and groundwater management in the Chino Basin.

[5] Several of Watermaster's permitted points of diversion are not monitored and are not included in Figure 1-5; diversion and recharge at these unmeasured points are estimated using the Wasteload Allocation Model (WLAM).

The 2013 RMPU was completed pursuant to a Court order in September 2013 (WEI, 2013), filed with the Court in November 2013, and subsequently approved by the Court in its entirety in April 2014. The 2013 RMPU contains recommendations to construct 10 new recharge facilities and an implementation plan to plan, design, and construct them. Table 1-1 lists the 2013 RMPU projects that were recommended for implementation, and Figure 1-4 shows their location. Since the completion of the 2013 RMPU, the IEUA and Watermaster have entered into Task Orders to plan, design, and construct the recommended facilities. During planning and preliminary design, the recommended 2013 RMPU projects were substantially refined. Some projects were found infeasible and were subsequently not implemented. Table 1-1 also lists the 2013 RMPU projects that will be constructed and their expected annual stormwater recharge and supplemental water recharge capacity. With completion of the 2013 RMPU projects, stormwater recharge is projected to increase by 4,800 afy, and recycled water recharge capacity is projected to increase by 7,100 afy. The IEUA has applied for and been awarded grants and low-interest State Revolving Fund (SRF) loans to pay for some of the construction costs of these projects. As of this writing (July 2018), the 2013 RMPU projects are in the final design phase. The construction cost of the 2013 RMPU projects, after savings from grants acquired by IEUA, is expected to be about $30 million, and the expected unit cost of the new stormwater recharge is about $400 per af.[6] For comparison, the cost to purchase untreated State Water Project water from the Metropolitan Water District of Southern California (Metropolitan) in 2018 is about $760 per af (including readiness to serve charges). When fully implemented, the 2013 RMPU will reduce the demand for SWP water by at least 4,800 afy and possibly by as much as 11,900 afy.

The 2013 RMPU implementation includes a process to create a database of all known local stormwater and dry-weather runoff management projects implemented through the municipal separate storm sewer system (MS4) permits in the Los Angeles, Riverside, and San Bernardino County parts of the Chino Basin. The project types, physical characteristics, and time histories of maintenance are being stored in a relational database for periodic review with the intent of incorporating them into the surface water and groundwater models that Watermaster uses for planning. The surface water models will be used to estimate the new stormwater discharge and dry-weather runoff and the subsequent recharge of these waters in the Chino Basin created by these projects. The groundwater model will be used to evaluate the groundwater basin response and net new recharge to the basin and to subsequently recalculate the basin Safe Yield.

1.2 Scope of Recharge Master Plan Required by the Peace Agreement, Peace II Agreement, and Court Orders

1.2.1 Peace Agreement

Section 5.1 (e) of the Peace Agreement contains Watermaster's commitments regarding the recharge of supplemental water in the Chino Basin. The 2013 RMPU focused on Watermaster's

[6] Recharge Investigations and Projects Committee Meeting, July 25, 2018. https://cbwm.syncedtool.com/1/files/share/384187/Public%20FTP/Special%20Committees/Recharge%20Investigations%20and%20Projects%20Committee%20%28RIPCom%29/Meetings/2018/20180725/20180725%20Status%20Reports.pdf/9abb162877b999?view=1

implementation of Peace Agreement Section 5.1 (e) items (i), (iii), (v), (vii), and (viii), which are stated as follows (see Peace Agreement, pages 20 and 21):

"Watermaster shall exercise Best Efforts[7] to:

(i) protect and enhance the Safe Yield of the Chino Basin through Replenishment and Recharge; […]

(iii) direct Recharge relative to Production in each area and sub-area of the Basin to achieve long term balance and to promote the goal of equal access to groundwater in all areas and sub-areas of the Chino Basin; […]

(v) establish and periodically update criteria for the use of water from different sources for Replenishment purposes; […]

(vii) recharge the Chino Basin with water in any area where groundwater levels have declined to such an extent that there is an imminent threat of Material Physical Injury to any party to the Judgment;

(viii) maintain long-term hydrologic balance between total Recharge and discharge in all areas and sub-areas; […]."

The OBMP Implementation Plan (Exhibit B of the Peace Agreement) contains language identical to that in Peace Agreement Section 5.1 (e), but it is mostly silent as to the schedule for implementing the specific commitments listed above (see OBMP Exhibit B, paragraph 11 on page 20 and the implementation schedule on pages 22 and 23). Paragraph 9 of page 20 of the Implementation Plan includes additional recharge guidelines that Watermaster must consider:

"9. When locating and directing physical recharge, Watermaster shall consider the following guidelines:

(i) provide long-term hydrologic balance within the areas and sub-areas of the basin

(ii) protect and enhance water quality

(iii) improve water levels

(iv) the cost of recharge water

(v) any other relevant factors"

Section 7 of the Rules and Regulations repeats the commitments of Section 5.1 (e) of the Peace Agreement and adds (see Rules and Regulations, page 37, 7.1 [b] [iv]):

"(b) Watermaster shall exercise Best Efforts to: […]

(iv) Make its initial report on the then existing state of Hydrologic Balance by July 1, 2003, including any recommendations on Recharge actions which may be necessary under the OBMP. Thereafter, Watermaster shall make written reports on the long-term Balance in the Chino Basin every two years; […]."

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[7] The capitalized terms in this and other citations in this document are defined terms in the Judgment, Peace Agreements, and Watermaster Rules and Regulations.

1.2.2 Peace II Agreement

The Peace II Agreement[8] states that Watermaster will update the Recharge Master Plan and obtain Court approval of that update to address how the Chino Basin will be managed to secure and maintain hydraulic control and operated at a new equilibrium at the conclusion of the period of reoperation. This plan must reflect an appropriate schedule for planning, design, and physical improvements, as required, to provide reasonable assurance that, following the full beneficial use of groundwater withdrawn in accordance with basin reoperation and authorized controlled overdraft, sufficient replenishment capability exists to meet the reasonable projections of the Desalter replenishment obligations. With the concurrence of the IEUA and Watermaster, the Recharge Master Plan is to be updated and amended as frequently as necessary with Court approval and no less than every five (5) years.

Peace II provides for the reduction of groundwater in storage by 400,000 af for the expressed purpose of achieving hydraulic control. Peace II defines the term Reoperation to mean "the controlled overdraft of the Basin by the managed withdrawal of groundwater Production for the Desalter and the potential increase in the cumulative un-replenished Production of 200,000 af authorized by Paragraph 3 of the Engineering Appendix Exhibit I to the Judgment, to 600,000 af for the expressed purpose of securing and maintaining Hydraulic Control as a component of the Physical Solution.[9]" Reoperation reduces the amount of recharge that will be required through 2030.

Peace II Article 8.4 contains a commitment to recharge 6,500 afy of supplemental water in MZ1. Moreover, the Parties make the following acknowledgments regarding the 6,500 afy supplemental water recharge:

(a) "A fundamental premise of the Physical Solution is that all water users dependent upon Chino Basin will be allowed to pump sufficient waters from the Basin to meet their requirements. To promote the goal of equal access to groundwater within all areas and sub-areas of the Chino Basin, Watermaster has committed to use its best efforts to direct recharge relative to production in each area and subarea of the Basin and to achieve long-term balance between total recharge and discharge. The Parties acknowledge that to assist Watermaster in providing for recharge, the Peace Agreement sets forth a requirement for Appropriative Pool purchase of 6,500 afy of Supplemental Water for recharge in Management Zone 1 (MZ1). The purchases have been credited as an addition to Appropriative Pool storage accounts. The water recharged under this program has not been accounted for as Replenishment water.

(b) Watermaster was required to evaluate the continuance of this requirement in 2005 by taking into account provisions of the Judgment, Peace Agreement and OBMP, among all other relevant factors. It has been determined that other obligations in the Judgment and Peace Agreement, including the requirement of hydrologic balance and projected replenishment obligations, will provide for sufficient wet water recharge to make the separate commitment of Appropriative Pool purchase

[8] The Peace II Agreement is located here: http://www.cbwm.org/docs/legaldocs/Final_Peace_II_Documents.pdf

[9] The capitalized words in this citation are defined terms in the Peace II Agreement.

of 6,500 af unnecessary. Therefore, because the recharge target as described in the Peace Agreement has been achieved, further purchases under the program will cease and Watermaster will proceed with operations in accordance with the provisions of paragraphs (c), (d) and (e) below.

(c) The parties acknowledge that, regardless of Replenishment obligations, Watermaster will independently determine whether to require wet-water recharge within MZ1 to maintain hydrologic balance and to provide equal access to groundwater in accordance with the provisions of this Section 8.4 and in a manner consistent with the Peace Agreement, OBMP and the Long Term Plan for Subsidence. Watermaster will conduct its recharge in a manner to provide hydrologic balance within and will emphasize recharge in MZ1. Accordingly, the Parties acknowledge and agree that each year Watermaster shall continue to be guided in the exercise of its discretion concerning recharge by the principles of hydrologic balance.

(d) Consistent with its overall obligations to manage the Chino Basin to ensure hydrologic balance within each management zone, for the duration of the Peace Agreement (until June of 2030), Watermaster will ensure that a minimum of 6,500 af of wet water recharge occurs within MZ1 on an annual basis. However, to the extent that water is unavailable for recharge or there is no replenishment obligation in any year, the obligation to recharge 6,500 af will accrue and be satisfied in subsequent years.

1. Watermaster will implement this measure in a coordinated manner so as to facilitate compliance with other agreements among the parties, including but not limited to the Dry-Year Yield Agreements.

2. In preparation of the Recharge Master Plan, Watermaster will consider whether existing groundwater production facilities owned or controlled by producers within MZ1 may be used in connection with an aquifer storage and recovery ("ASR") project so as to enhance recharge in specific locations and to otherwise meet the objectives of the Recharge Master Plan.

(e) Five years from the effective date of the Peace II Measures, Watermaster will cause an evaluation of the minimum recharge quantity for MZ1. After consideration of the information developed in accordance with the studies conducted pursuant to paragraph 3 below, the observed experiences in complying with the Dry Year Yield Agreements as well as any other pertinent information, Watermaster may increase the minimum requirement for MZ1 to quantities greater than 6,500 afy. In no circumstance will the commitment to recharge 6,500 afy be reduced for the duration of the Peace Agreement."

1.2.3 Special Referee's December 2007 Report, Sections VI (Assurances Regarding Recharge), VII (Declining Safe Yield), and VIII (New Equilibrium)

In the Final Report and Recommendations on Motion for Approval of the Peace II Documents, the Special Referee stated that "A key element of the proposed Peace II Measures is that Watermaster must develop recharge capability throughout the Basin Reoperation period, to ensure that sufficient recharge capability exists at the end of the period" (Final Report, page 25, [Schneider, 2007]). The Special Referee recommended and the Court ordered that several elements be included within the updated RMP (Motion to Approve Watermaster's Filing in Satisfaction of Condition Subsequent 5; Watermaster Compliance with Condition Subsequent 6, August 21, 2008):

1. Baseline conditions must be clearly defined and supported by technical analysis. The baseline definition should encompass factors such as pumping, demand, recharge capacity, total Basin water demand, and the availability of replenishment water.
2. Safe Yield should be estimated annually; though, it is recognized that it is not to be formally recalculated until 2011. Watermaster should develop a technically defensible approach to estimating Safe Yield annually.
3. Measures should be evaluated to lessen or stop the projected Safe Yield decline. All practical measures should be evaluated in terms of their potential benefits and feasibility.
4. Evaluations and reporting of the impact of Basin Re-Operation on groundwater storage and water levels should be done on an annual basis.
5. Total demand for groundwater should be forecast for 2015, 2020, 2025, and 2030. The availability of imported water for supply and replenishment, and the availability of recycled water should be forecast on the same schedule. The schedules should be refined in each Recharge Master Plan update. Projections should be supported by thorough technical analysis.
6. The Recharge Master Plan must include a detailed technical comparison of current and projected groundwater recharge capabilities and current and projected demands for groundwater. The Recharge Master Plan should provide guidance as to what should be done if recharge capacity cannot meet or is projected not to be able to meet replenishment needs. This guidance should detail how Watermaster will provide sufficient recharge capacity or undertake alternative measures so that Basin operation in accordance with the Judgment and the Physical Solution can be resumed at any time.

These recommendations reflect the requirements described in the Peace II Measures. Peace Agreement II section 8.1 and the Amendment to Judgment Exhibit "I" section 2(b)(5) require that the updated RMP must:

- "Address how the Basin will be contemporaneously managed to secure and maintain Hydraulic Control and subsequently operated at a new equilibrium at the conclusion of the period of Re-Operation.
- Contain recharge estimations and summaries of the projected water supply availability as well as the physical means to accomplish the recharge projections.

- Reflect an appropriate schedule for planning, design, and physical improvements as may be required to provide reasonable assurance that sufficient Replenishment capacity exists to meet the reasonable projections of Desalter Replenishment obligations following the implementation of Basin Re-Operation."

1.3 Scope and Process to Develop the 2018 RMPU

The scope of work and contents of the 2018 RMPU is based on the requirements of the Peace Agreement, Peace II Agreement, and other Court Orders as summarized in Section 1.1 herein. The tasks and their specific objectives are listed below:

Task 1 Scoping and Project Management. Work under this task included finalizing the scope of the 2018 RMPU and performing project management tasks.

Task 2 Collect, Compile and Review Data and Reports. Work under this task included the review of reports and documentation that the 2018 RMPU builds on, such as the Storage Framework Report. Section 7 lists the references used in this report.

Task 3 Develop Groundwater Production and Replenishment Projections. Work under this task included reviewing and summarizing how conditions in the basin have changed since the 2013 RMPU; summarizing groundwater production and replenishment projection; and analyzing the groundwater response to these projections. This work is summarized in Sections 2 and 3 of this report.

Task 4 Describe Existing Recharge Facilities. Work under this task included reviewing legislative and regulatory requirements for stormwater management; reviewing historical operations and performance of existing spreading facilities; reviewing historical operations and performance of ASR facilities; updating recharge; reviewing in-lieu recharge operations and performance for existing facilities; reviewing existing inventory of MS4 facilities that have significant recharge capability; and describing the 2013 RMPU facilities that are being implemented. This work is summarized in Section 4 for this report.

Task 5 Evaluate Recharge Needs to Ensure Future Replenishment Capacity, Balance of Recharge and Discharge and to Meet Other OBMP Requirements. Work under this task included developing projections of future replenishment requirements; developing projections on groundwater level changes; determining local recharge requirements to ensure production sustainability and to manage new land subsidence; evaluating the availability and reliability of supplemental water sources for recharge and Replenishment; determining the available and required supplemental water recharge capacity for each management zone; and preparing recommendations on supplemental water supply plan and improvements as required. This work is summarized in Section 5.

Task 6 Review Potential New Recharge Facilities. Work under this task included identifying and evaluating potential new recharge facilities.

Task 7 Develop Implementation Plan. Work under this task included developing the 2018 RMPU Implementation Plan summarized in Section 6 of this report.

Task 8 Prepare 2018 RMPU Report. Work under this task included preparing the 2018 RMPU report.

The 2018 RMPU was developed through a stakeholder process. Watermaster convened several workshops with the Steering Committee over the course of developing the 2018 RMPU (from February to August 2018). At these workshops, the important assumptions and interim work products of the RMPU were presented. The presentations developed for these workshops were posted on the Watermaster's website.

As part of the stakeholder process, the development of 2018 RMPU was open to comments by all, and all comments were responded to and/or addressed. Appendix C contains the comments and responses.

1.4 Organization of this Report

This report consists of seven sections and two appendices:

Section 1 – Introduction. This section describes the regulatory background leading to and defining the scope of the Recharge Master Plan and the scope and process to develop the 2018 RMPU.

Section 2 – Changed Conditions from the 2013 Recharge Master Plan Update. This section describes changed conditions from those that were understood during the development of the 2013 RMPU and establishes planning assumptions for the completion of the 2018 RMPU. This includes changes in groundwater levels since the 2013 RMPU; updated projections of water supply, recharge, and replenishment; changes in the availability and cost of replenishment sources; and other assumptions.

Section 3 – Groundwater Response to Projected Pumping, Recharge, and Replenishment. This section describes the basin's projected response to the updated conditions described in Section 2. These future groundwater conditions can be used to assess the need for changes in Watermaster's recharge and replenishment practices.

Section 4 – Existing and Planned Recharge Facilities. This section provides an inventory of existing and planned recharge facilities in the Chino Basin that can subsequently be compared to the basin's recharge needs. Existing and planned recharge facilities include spreading basins, ASR wells, and MS4 facilities.

Section 5 – Future Recharge Needs to Ensure Future Replenishment Capability, Balance Recharge and Discharge, and to Meet Other OBMP Requirements. This section identifies future needs for recharge capacity in the Chino Basin and compares the need to the available recharge capacity. Section 5 documents the conclusion that the existing recharge strategy and the facilities on which it relies are sufficient until the next RMPU occurs in 2023.

Section 6 – 2018 Recharge Master Plan. This section defines the 2018 RMPU, including the conclusions of the report, recommendations for future activities, and an implementation plan for the 2018 RMPU.

Section 7 – References.

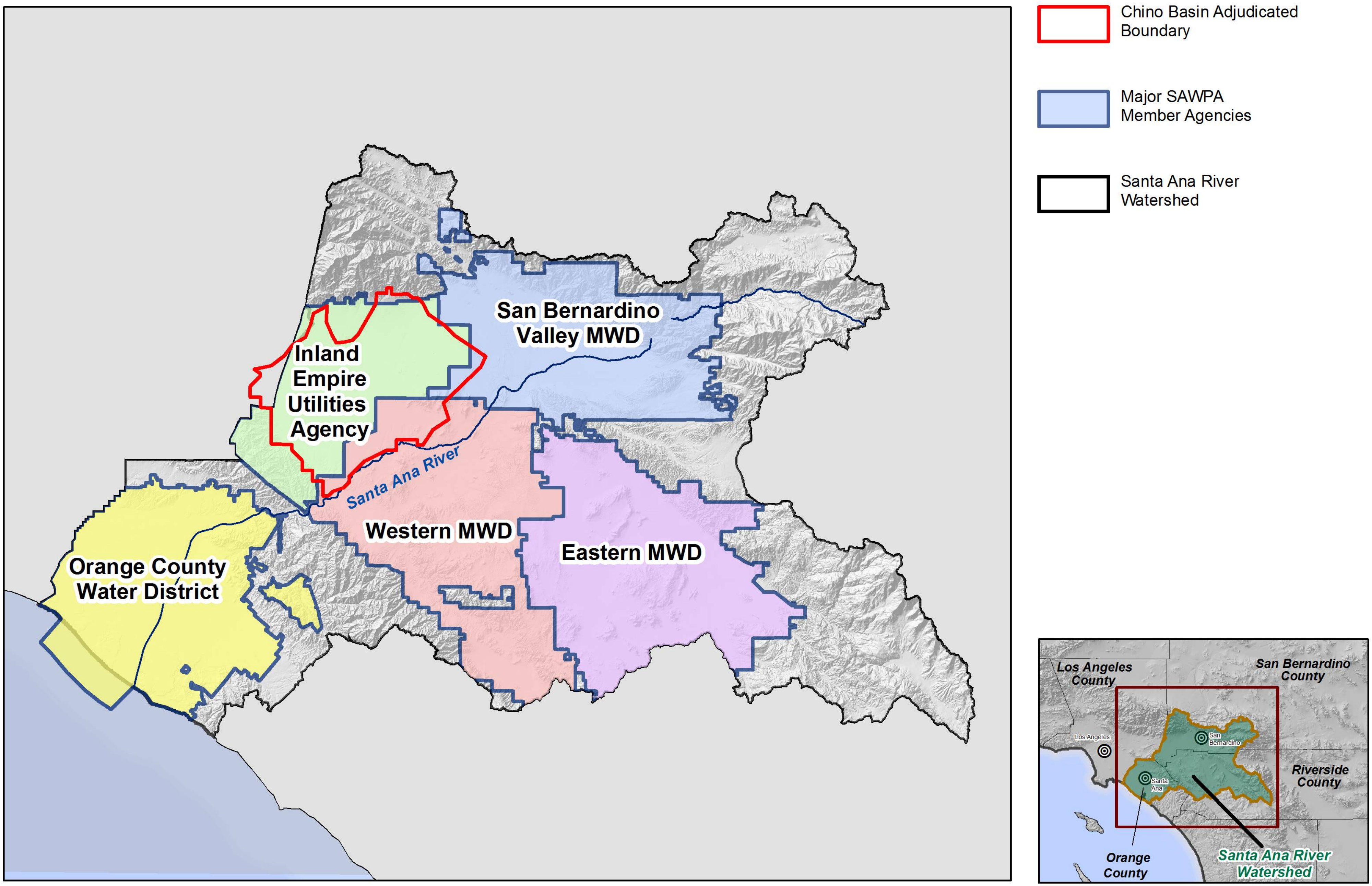
Appendix A – Supplemental Water Recharge Capacity Assessment. Appendix A contains the technical backup for the assessment of the supplemental water recharge capacity for each spreading basin that can be used for supplemental water recharge.

Appendix B – In-Lieu Recharge Capacity Estimates. Appendix B contains tables that show how the in-lieu recharge capacity estimates were made.

Appendix C – Review Comments and Responses. Appendix C contains comments on the draft Storage Framework Investigation Report and responses.

Table 1-1
2013 RMPU Recharge Projects

Project ID	Project Name	2013 RMPU Report: New Stormwater Recharge (afy)	2013 RMPU Report: Recycled Water (afy)	2013 RMPU Report: Stormwater Recharge Unit Cost ($/af)	2013 RMPU Implementation: New Stormwater Recharge (afy)	2013 RMPU Implementation: Recycled Water (afy)	2013 RMPU Implementation: Stormwater Recharge Unit Cost ($/af)
14	Turner Basin	66	0	$ 916	Projects did not move to implementation.		
15a	Ely Basin	221	0	$ 981			
17a	Lower San Sevaine Basin	1,221	0	$ 1,239			
18a	CSI Stormwater Basin	81	0	$ 388			
25a	Sierra Basin	64	0	$ 537			
27	Declez Basin	241	0	$ 1,135			
2	Montclair Basin	248	0	$ 415	96	0	$ 1,384
7	San Sevaine Basins	642	1,911	$ 217	669	4,100	$ 384
11	Victoria Basin	43	120	$ 151	75	120	$ 112
12	Lower Day Basin	789	0	$ 242	993		$ 285
23a	2013 RMPU Proposed Wineville PS to Jurupa, Expanded Jurupa PS to RP3 Basin, and 2013 Proposed RP3 Improvements	3,166	2,905	$ 500	2,921	2,905	$ 406
	Total	6,782	4,936	$ 612	4,754	7,125	$ 391



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Date: 3/30/2018
Name: Figure_1-1_SAR_Watershed

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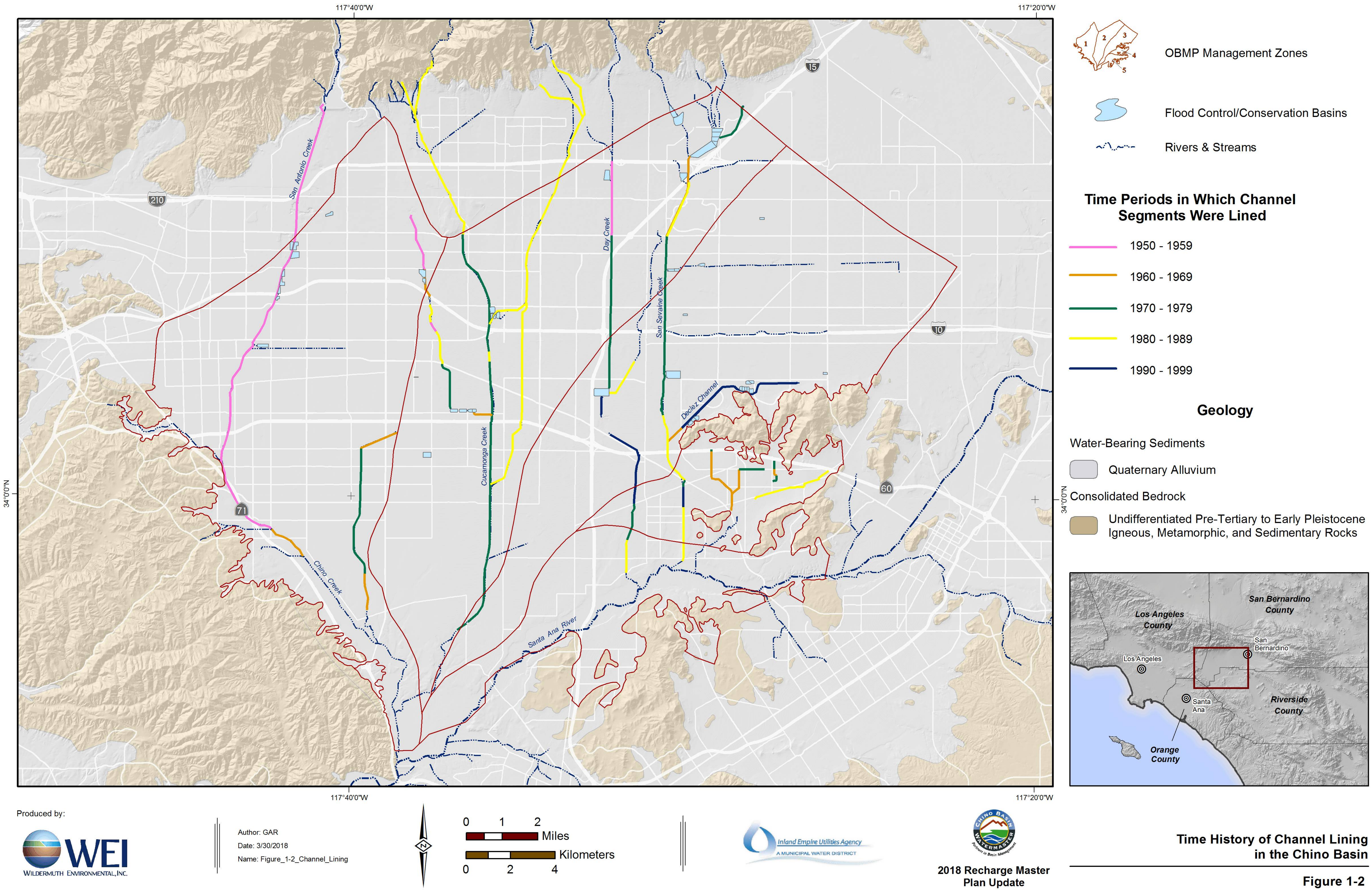
Inland Empire Utilities Agency
A Municipal Water District

Chino Basin Watermaster
Partners in Basin Management

2018 Recharge Master Plan Update

Location of the Chino Basin and the Santa Ana River Watershed

Figure 1-1



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Date: 3/30/2018
Name: Figure_1-2_Channel_Lining

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Chino Basin Watermaster

2018 Recharge Master Plan Update

Time History of Channel Lining in the Chino Basin

Figure 1-2

Figure 1-3
Estimated Streambed Infiltration for the Santa Ana River Tributaries in the Chino Basin and New Recharge Resulting from Recharge Master Plan Implementation, 1961 - 2017

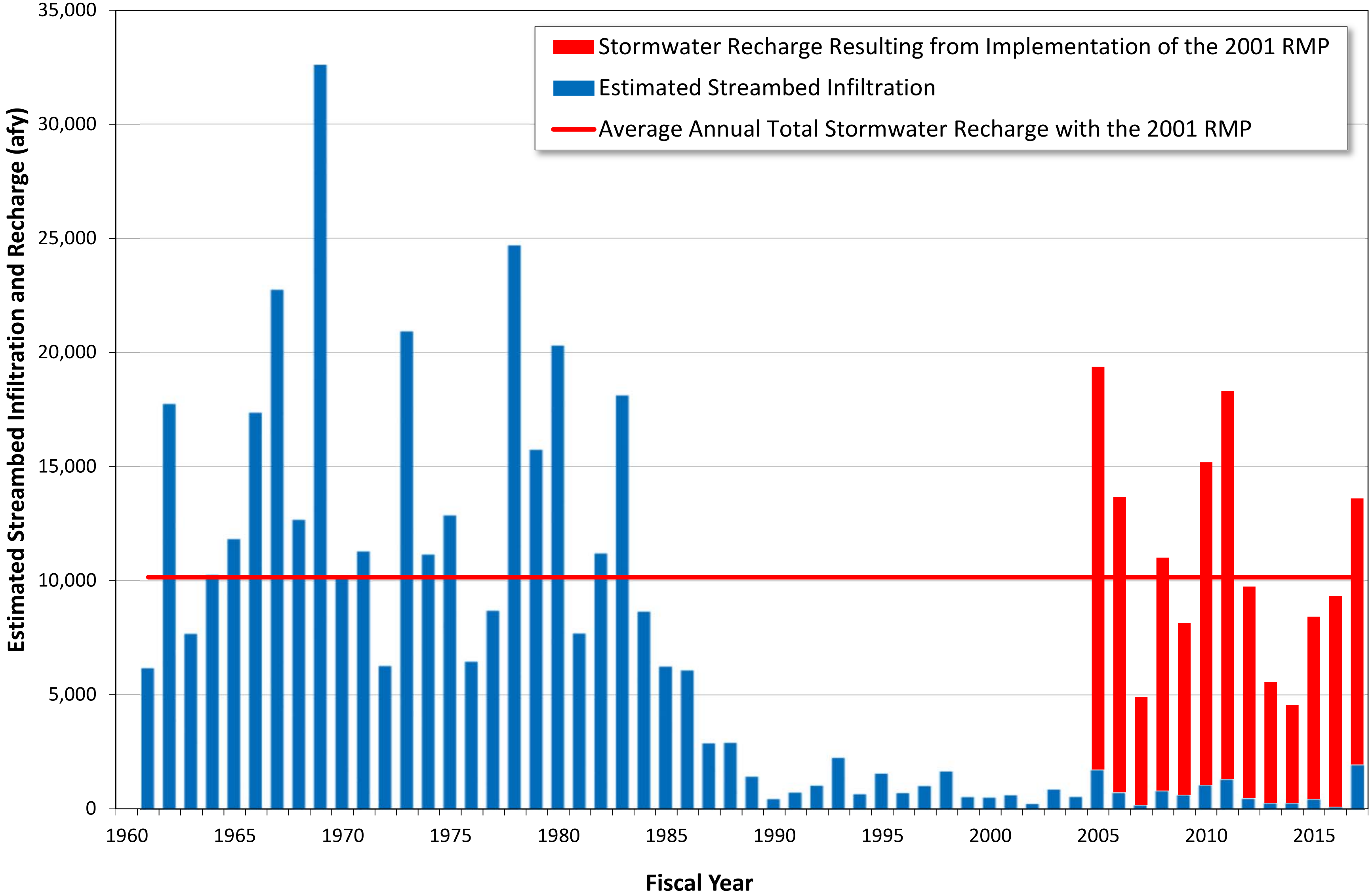
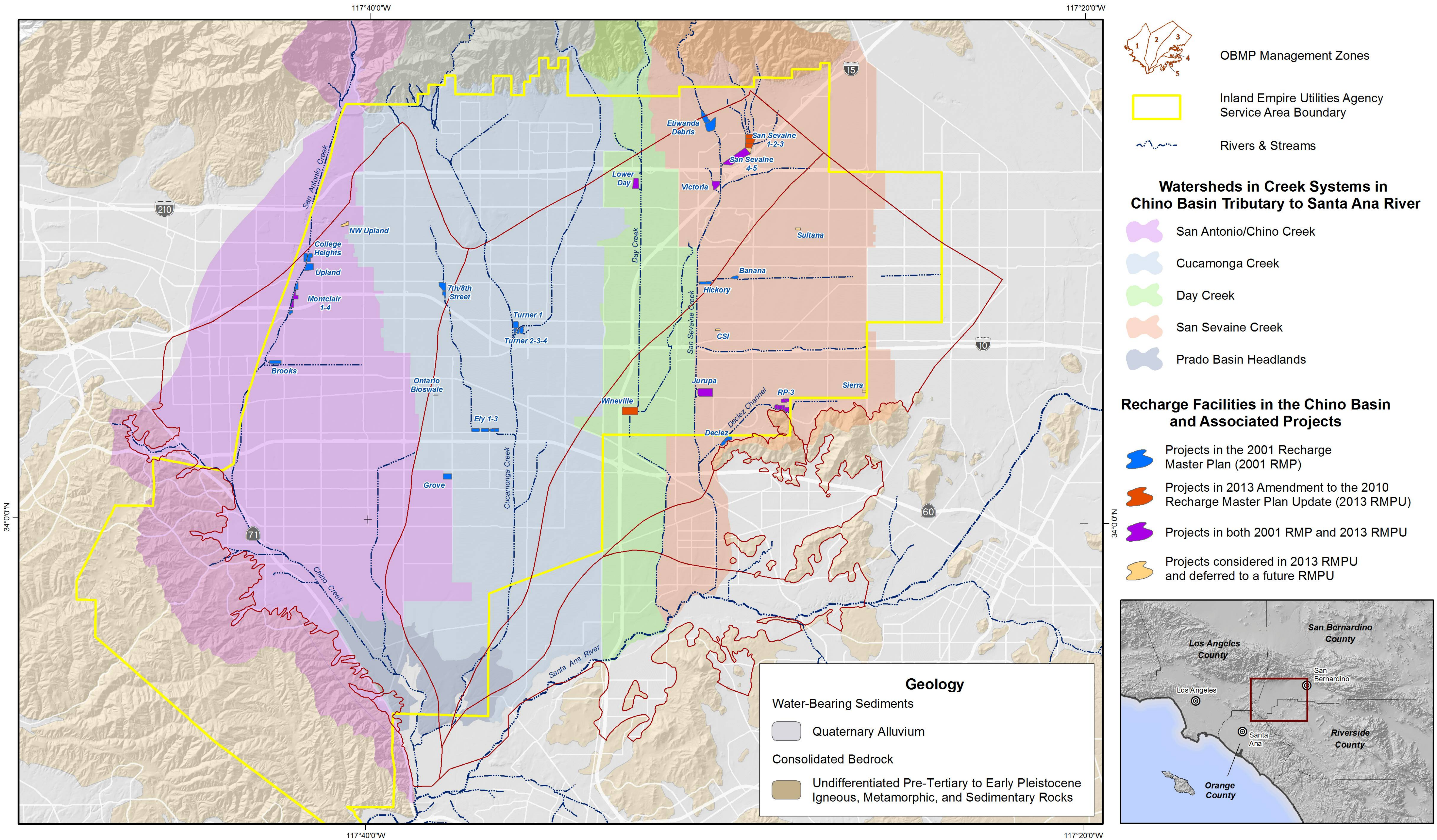


Figure_1-3_streambed_recharge.xlsx
Revised 3/30/2018



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Date: 3/30/2018
Name: Figure_1-4_RMPU_Recharge

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Chino Basin Watermaster

2018 Recharge Master Plan Update

Recharge Improvements in the Chino Basin Since Implementation of the OBMP and the 2001 Recharge Master Plan

Figure 1-4

Figure 1-5
Recycled Water, Stormwater, and Dry-Weather Runoff Recharge in the Chino Basin Since Implementation of the OBMP and the 2001 Recharge Master Plan

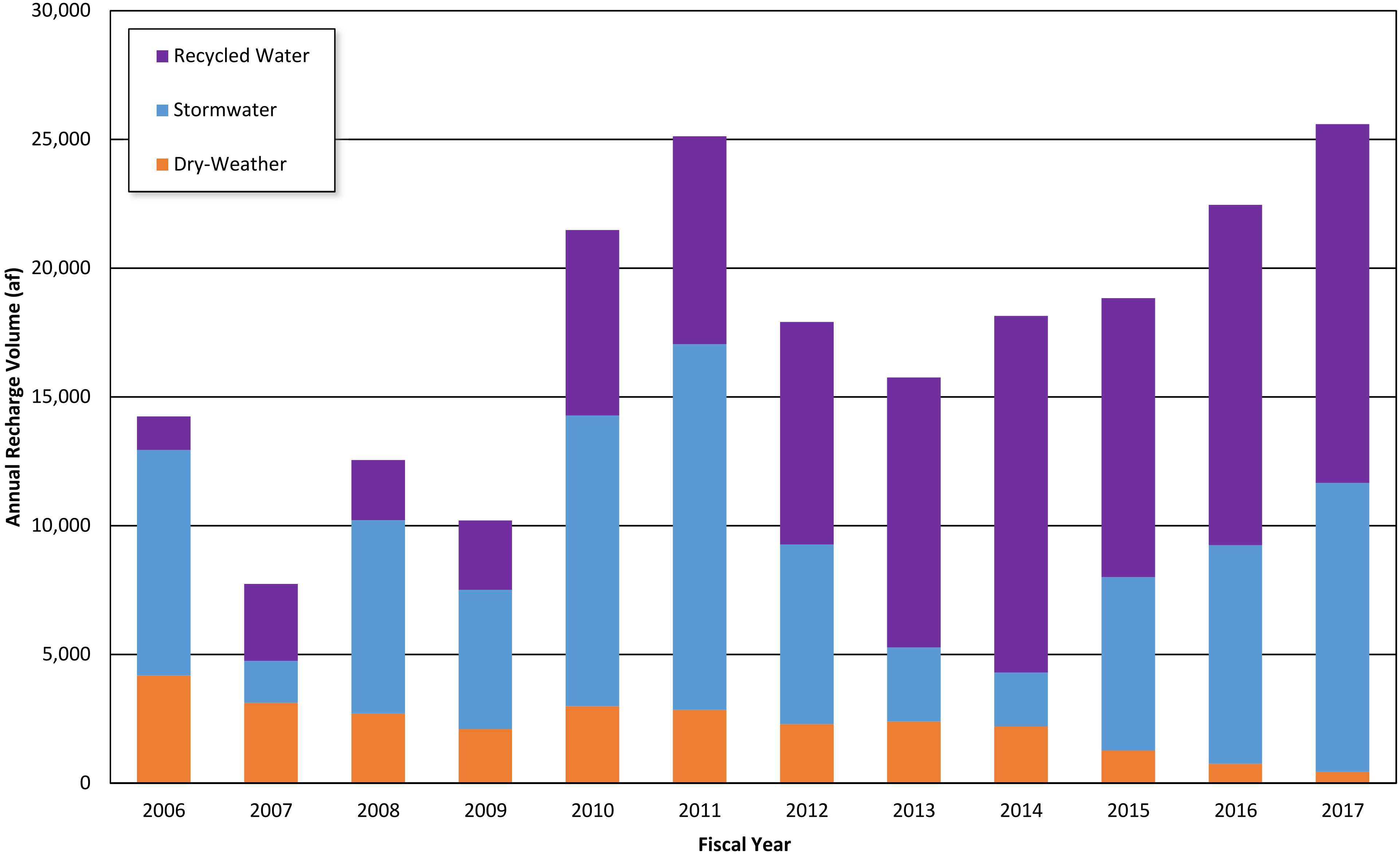


Figure_1-5_Recharge.xlsx -- Figure 1-5
Printed on: 4/12/2018

Section 2 – Changed Conditions from the 2013 Recharge Master Plan Update

This section describes the changed conditions from those understood during the development of the 2013 RMPU and establishes planning assumptions for the completion of the 2018 RMPU. More specifically, this section describes:

- Estimated groundwater level changes since the implementation of the OBMP and changes that have occurred since the 2013 RMPU was completed. This information is used to determine the effectiveness of storm and supplemental water recharge activities in achieving OBMP goals and to inform Watermaster's decision on the location and magnitude of future supplemental water recharge.
- Updated water demands and water supply plans. This information is used to estimate future replenishment obligations and project future groundwater level conditions that inform Watermaster's decision on the location and magnitude of future supplemental water recharge.

2.1 Groundwater Level Changes

Figures 2-1a, 2-1b, and 2-1c are groundwater elevation contour maps for July 2000, July 2013, and July 2017, respectively, based on the 2017 Chino Basin groundwater model.[10] Groundwater generally flows from higher to lower elevations with flow perpendicular to the contours. These maps show that groundwater generally flows in a south-southwest direction from the northern parts of the basin toward the Prado Basin in the south. The main conclusions drawn from these maps are:

- In 2000, there were pumping depressions in the groundwater-level surface that interrupted general flow patterns in the Monte Vista Water District (MVWD), Pomona, and City of Chino service areas, and directly west of the Jurupa Mountains in the northern part of Jurupa Community Services District's (JCSD) service area. Pumping at the Chino Basin Desalter Authority's (CDA) desalter (desalter) wells had not yet begun as of July 2000. There was no hydraulic control in the southern part of the basin.
- In 2013, there were pumping depressions in the groundwater-level surface that interrupted general flow patterns in the MVWD and Pomona service areas, the southern Cucamonga Valley Water District (CVWD) service area, and the area from the northern part of the JCSD service area extending southwest to the California Institution for Men (CIM), an area that includes the JCSD and desalter well fields. Hydraulic control was achieved across the southern part of the basin everywhere except for the area between Chino Hills and the Chino Airport.
- In 2017, there were pumping depressions in the groundwater-level surface that interrupted general flow patterns in the Pomona service area and in the area from

[10] The 2017 Chino Basin groundwater model is based on the model used to recalculate Safe Yield and reported on in *2013 Chino Basin Groundwater Model Update and Recalculation of Safe Yield Pursuant to the Peace Agreement* (WEI, 2015). For the 2017 model, the historical recharge and discharge terms were updated through June 2017.

the northern part of the JCSD service area extending southwest to CIM, an area that includes the JCSD and their desalter well fields. Hydraulic control was achieved everywhere across the southern part of the basin.

The OBMP recognized that there were historical groundwater level challenges and related water quality problems in Management Zone 1 (MZ1) and incorporated a requirement in the Peace Agreement to recharge 6,500 afy therein until 2030. With the Peace II Agreement, this requirement was extended to at least 2030.

Figures 2-2a, 2-2b, and 2-2c show the difference in groundwater elevation between July 2000 and July 2013, July 2013 and July 2017, and July 2000 and July 2017, respectively. These maps were created by subtracting rasterized grids created from the groundwater elevations of each year from one of a prior year. The changes in groundwater elevation are shown by contours of equal change and by a color ramp of yellow-to-green for increasing groundwater elevations and yellow-to-red for decreasing groundwater elevations. The following are the main conclusions from these maps:

- From 2000 to 2013, groundwater levels: decreased in the eastern part of the basin and increased in the western part of the basin; declined by as much as 40 feet in a broad area running from the northern part of the JCSD service area, extending southwest to the Chino Airport, an area that includes the JCSD and desalter well fields; decreased in the CVWD and FWC service areas, ranging from about 10 to 30 feet; and increased in the western part of the basin from about 10 to 40 feet. The groundwater level changes observed in this map are consistent with the pattern of operation in the basin, including: the recharge of 6,500 afy of supplemental water in MZ1, reoperation, and the transfer of stored water and un-pumped rights by the appropriative pool parties in the western part of the basin to the FWC in the eastern part of the basin.
- From 2013 to 2017, groundwater levels: generally remained unchanged or increased; groundwater levels increased in the CVWD service area extending west to the Pomona service area from 0 to 10 feet; and groundwater levels increased in the northern part of the JCSD service area and southwestern part of the FWC service area from 10 to 40 feet. The changes in groundwater levels observed in this map are consistent with the pattern of operation in the basin, including: the recharge of 6,500 afy of supplemental water in MZ1, reoperation, the transfer of stored water and un-pumped rights by the appropriative pool parties in western part of the basin to the FWC in the eastern part of the basin, increased reuse of recycled water for direct uses and recharge, and the initiation of recharge for the Dry-Year Yield program (DYYP).

One of the goals of the OBMP was to use recharge to increase groundwater levels in MZ1 to ensure sustainable pumping and minimize subsidence in the City of Chino. This effort has been successful. The modeled changes in groundwater elevation shown in these figures are consistent with measured data, as shown in the 2016 State of the Basin report (WEI, 2017).

2.2 Current and Projected Water Demands and Supply Plans

In July 2017, Watermaster began to develop planning scenarios to evaluate the parties' use of storage space and storage and recovery programs that are being contemplated by Watermaster parties. This effort, called the Storage Framework, necessitated an update of the water supply planning information to develop baseline scenarios upon which Watermaster could evaluate potential storage and recovery programs. The Storage Framework Report (WEI, 2018) includes a detailed description of the three baseline scenarios developed from the parties' planning information. Scenario 1A represents the parties' best estimates of future demands and how future supplies would be used to meet these demands; the Scenario 1A water supply plans are discussed in Section 2.2.2 and the Storage Framework Report, and the groundwater response to this scenario is discussed in Section 3.

2.2.1 Current and Projected Water Demands

Figure 2-3 shows the projected aggregate water demand developed for the Storage Framework compared to projected aggregate water demands from past investigations, including OBMP development (WEI, 1999), Peace II (WEI, 2009), and the Safe Yield recalculation (WEI, 2015). The projected aggregate demands for the Storage Framework are less than those projected in the prior planning investigations except for in 2040, where the Storage Framework water demand projection is about 5,000 afy greater than what was assumed in the Safe Yield recalculation investigation. Total water demand for the Storage Framework is projected to grow from about 290,000 afy in 2015 to about 422,000 afy by 2040. The projected growth in water demand by the appropriative pool parties drives the increase in aggregate water demand as several appropriative pool parties are projected to serve new urban water demands caused by the conversion of agricultural and vacant land uses to urban uses.

2.2.2 Current and Projected Water Supply Plans

The parties were requested to provide projections of the water sources that they would use to meet their demands on a monthly and annual basis for each planning year through 2050. Several parties' water supply plans had projected water supplies that exceeded their demands. Watermaster staff conducted additional discussions with the parties to determine their projected Chino Basin groundwater pumping and established priorities of their other sources. Figure 2-4 and the table below show the historical (2015) and projected aggregate water demand and supply plan for all Chino Basin parties based on the parties' responses to the data request, their 2015 Urban Water Management Plans (UWMP), and other information obtained for this investigation. Detailed descriptions of these supplies are included in the Storage Framework Report.

Aggregate Water Supply Plan for Watermaster Parties and the CDA (afy)

Water Source	2015	2020	2025	2030	2035	2040
Chino Basin Groundwater	147,238	144,527	149,468	154,302	167,722	176,765
Non-Chino Basin Groundwater	51,398	55,755	63,441	64,999	66,691	68,483
Local Surface Water	8,108	15,932	15,932	18,953	18,953	18,953
Imported Water from Metropolitan	53,784	86,524	93,738	100,196	102,166	109,492
Other Imported Water	8,861	13,884	14,495	15,375	15,400	15,400
Recycled Water for Direct Reuse	20,903	24,136	24,413	26,711	29,964	33,351
Total	**290,292**	**340,759**	**361,487**	**380,536**	**400,896**	**422,444**

2.3 Managed Storage

"Managed storage," as used herein, refers to the total water held in storage accounts plus carryover water.

2.3.1 Quantification of Managed Storage for July 1, 2017

Table 2-1 summarizes the water held in storage accounts and carryover water since the OBMP was implemented. Through June 30, 2017, the water held in storage accounts and carryover was about 528,000 af. This does not account for an expected adjustment to managed storage to account for the pending Safe Yield change that is expected to be implemented next fiscal year and additional adjustments for the desalter replenishment obligation. For planning purposes, the expected adjustment was estimated to be 84,800 af, and the managed storage on July 1, 2017 was estimated to be 443,200 af.

2.3.2 Use of Managed Storage to Offset Replenishment

Pursuant to the Judgment, Watermaster levies and collects assessments each year in amounts sufficient to purchase replenishment water to replace overproduction by a pool during the preceding year. For the overlying pools, overproduction is pumping that exceeds that pool's allocated share of Safe Yield, and for the appropriative pools, overproduction is pumping that exceeds the pool's operating Safe Yield. Parties within the overlying non-agricultural pool can transfer stored water and or unused Safe Yield rights among themselves, with Watermaster approval, to minimize their individual replenishment obligations or for other reasons. Likewise, appropriative pool parties can do the same among the parties in their pool. Parties in both pools can use water in their individual managed storage accounts to satisfy their individual replenishment obligations. After the completion of a fiscal year, Watermaster collects pumping data from all parties and the transfers among the parties to determine replenishment obligations created in the prior year.

An analysis of Watermaster assessment packages for fiscal years 2010/11 through 2016/17 indicated that the replenishment obligation was 80-percent satisfied from the transfers of unused production rights and water from managed storage, and the remaining replenishment obligation was satisfied with wet-water recharge.

2.3.3 Metropolitan Dry-Year Yield Program

Metropolitan's DYYP is a groundwater storage and recovery program where supplemental water is stored in the Chino Basin during surplus years and extracted during years when the availability of supplemental water is limited. The DYYP was developed jointly by Watermaster, the IEUA, TVMWD and Metropolitan. The DYYP has a maximum storage capacity of 100,000 af with maximum puts of 25,000 afy and maximum takes of 33,000 afy. The term of the DYYP agreement expires in 2028. Since its inception, the DYYP storage account has been filled and depleted once. Metropolitan started putting supplemental water in the DYYP storage account in fiscal year 2016/17 and, at the time of this writing, has put about 50,000 af into it. The nexus of the DYYP to the 2018 RMPU is that the DYYP uses existing supplemental water recharge capacity in the basin.

2.3.4 Other Storage Programs

Some of the Watermaster parties are contemplating storage and recovery programs. As of this writing, they are not definitive enough to include in this report. The nexus of these other storage programs to the 2018 RMPU is that they may use existing supplemental water recharge capacity in the basin.

2.4 Current and Projected Recharge and Replenishment

2.4.1 Supplemental Water Recharge Pursuant to Peace Agreements

As stated previously, Watermaster has an obligation pursuant to Section 8.4 of the Peace II Agreement to recharge 6,500 afy of supplemental water in MZ1 for the duration of the Peace Agreement (until June 30, 2030). Table 2-2 shows the time history of supplemental water recharge in MZ1 through July 2017, estimated supplemental water recharge in fiscal 2017/18, and projected supplemental water recharge in fiscal years 2018/19 through 2022/23, and it compares the historical and projected recharge to the 6,500 afy obligation. Historically, the cumulative supplemental water recharge in MZ1 has been equal to or exceeded the cumulative MZ1 obligations. And, at the end of fiscal 2016/17, the last fiscal year with a complete recharge record, the cumulative supplemental water recharge exceeded the cumulative obligation by about 28,000 af.

Table 2-3 shows the recycled water recharge projections provided by the IEUA. For the foreseeable future, the IEUA projects that it will recharge at least 3,490 afy of recycled water in MZ1, yielding a residual MZ1 recharge obligation of 3,010 afy of imported water recharge through 2030. The residual obligation can be satisfied through recharge for replenishment, DYYP recharge, or the purchase of imported water by Watermaster.

Table 2-4 shows the time history of the hydrologic balance for MZ1, MZ2, and MZ3, based on groundwater model simulations of historical data for the period of fiscal 2000/01 through 2016/17 and for Storage Framework Scenario 1A for the period fiscal of 2017/18 through

2022/23. Note that the historical supplemental water recharge in fiscal 2017/18 has not been included in the model projection for the period of 2017/18 through 2022/23. The term hydrologic balance refers to total recharge minus the total discharge: if positive, the storage will be increasing in a management zone, and if negative, it will be decreasing. The cumulative balance of recharge and discharge for MZ1 is positive (storage increased) through 2016/17 at 37,100 af, averaging about 2,300 afy. In contrast, the cumulative balances of recharge and discharge in MZ2 and MZ3 were about -100,000 af and -91,000 af, respectively (storage declining), averaging about -5,900 afy and -5,300 afy, respectively. The theoretical expected decline in storage is due to: the 5,000 afy of controlled overdraft permitted in the Judgment (through 2017), reoperation and other water in storage dedicated to offset the desalter replenishment obligation permitted in the Peace II agreement; and the likely use of managed storage to offset the desalter replenishment obligation. In aggregate, the theoretical expected decline in storage is about -465,000 af[11] through fiscal year 2016/17. The disparity between the computed change in storage and the theoretical expected change in storage is due to the parties pumping groundwater at less than their pumping rights. The existence of controlled overdraft provided for by the Judgment and the controlled overdraft permitted by the Peace II agreement means that it is impossible to maintain a balance of recharge and discharge in each management zone: the balance has to be negative in some of the management zones, and storage needs to decline. The physical decline in storage permitted in the Peace II Agreement is required to achieve hydraulic control (WEI, 2007). The historical and projected state of the balance of recharge and discharge for MZ1 is consistent with the Peace agreements.

2.4.2 Projected Recharge of Recycled Water

The IEUA has been recharging recycled water in the Chino Basin in various amounts since it acquired all of the municipal wastewater plants in the 1970s. Starting in the mid-1970s, the IEUA abandoned most of its recycled water recharge activities and discharged its treated effluent to the Santa Ana River. At the start of the OBMP in 2000, the IEUA was recharging about 500 afy of recycled water in the basin. Beginning in 2005, the IEUA started a new program to increase the recharge of recycled water. The IEUA's basic operating plan prioritizes the use of its recycled water as follows: (1) meet the IEUA's Santa Ana River discharge obligation pursuant to the Santa Ana River Judgment, (2) meet direct reuse demands for recycled water, and (3) recharge the remaining recycled water. Table 2-5 shows the IEUA's projected recycled water recharge by spreading basin through 2030. Recycled water recharge was about 16,000 afy in 2017[12] and is projected to increase to about 16,400 afy in 2020, remaining constant thereafter.

2.4.3 Projected Replenishment Obligation and Recharge of Imported Water to Satisfy It

At the February 2018 meeting of the 2018 RMPU Steering Committee, several parties recommended that a "worst-case scenario" be considered when evaluating the need for future replenishment capacity. To determine the maximum replenishment obligation in a worst-case scenario, WEI extended the projections of production rights, pumping, and replenishment

[11] Estimated for the period 2000/01 through 2016/17 at 5,000 afy of controlled overdraft plus total desalter pumping in that period.

[12] Supplemental and Storm Water Recharge Spreadsheet, IEUA.
https://cbwm.syncedtool.com/shares/folder/9abb162877b999/?folder_id=960

obligations through 2070 to calculate the replenishment obligations for the baseline scenarios when managed storage has been depleted. Figure 2-5 shows the projected replenishment obligations from 2018 through 2070 for Scenarios 1A and 1B. Scenario 1B assumes that the appropriative pool parties pump no less than their pumping rights before using other sources and results in the highest average and ultimate replenishment obligation. Scenario 1B results in the maximum annual replenishment obligation: 32,500 afy in the early 2050s.

2.5 Replenishment Sources, Availability, and Cost

Watermaster has historically met its replenishment obligations through the purchase of SWP water from the IEUA, which obtains this water from Metropolitan, and/or the purchase of water from appropriative pool parties. The sources of supplemental water that could be used for replenishment or other recharge programs include:

- Metropolitan's SWP and Colorado River Aqueduct supplies delivered through Metropolitan facilities
- Groundwater and surface water supplies in the Santa Ana Watershed that can be supplied to the Chino Basin directly through existing or new conveyance facilities or by exchange
- Recycled water from the Western Riverside County Regional Wastewater Authority Plant located in the Chino Basin
- Groundwater and surface water supplies from the Central Valley, conveyed to the Chino Basin through SWP and Metropolitan facilities, San Bernardino Valley Municipal Water District facilities, and San Gabriel Municipal Water District facilities
- Groundwater and surface water supplies from the Colorado River Basin conveyed to the Chino Basin through Metropolitan facilities

This report documents the availability and includes cost estimates for Metropolitan's water. The availability and cost of all other supplemental water sources are unknown at this time.

2.5.1 Availability and Cost of Water Supplied by Metropolitan for Replenishment

In January 2016, Metropolitan completed its 2015 Integrated Resources Plan (IRP) Update (Metropolitan, 2016). In its 2015 IRP, Metropolitan reported that, if the IRP is fully implemented, shortages will occur in Metropolitan supplies of about 9 percent of the time under 2020 conditions, 4 percent of the time under 2025 conditions, and 0 percent under 2030 conditions. "Shortage" is defined herein as Metropolitan's inability to meet its demands; this is therefore considered a situation when Metropolitan will not supply imported water for replenishment. Metropolitan is currently in the process of implementing its 2015 IRP, and in July 2018, it approved $11 billion in funding for the California WaterFix tunnel project, one of the projects recommended in the 2015 IRP. For purposes of the 2018 RMPU, it is assumed that if Metropolitan implements its 2015 IRP, Watermaster will be able to purchase water from Metropolitan for replenishment purposes in nine out of ten years. As of this writing, construction of the tunnels is not certain. If Metropolitan does not fully implement its 2015 IRP, shortages in Metropolitan supplies are projected to occur about 12 percent of the time under 2020 conditions, and the occurrence of a shortage is projected to increase to 80 percent under 2040 conditions. For purposes of the 2018 RMPU, it has been assumed that if Metropolitan does not fully implement its 2015 IRP, Watermaster will be able to purchase water from Metropolitan for replenishment purposes in one out of five years. The implications of these shortage assumptions are discussed in Section 5.1.

Table 2-5 summarizes the projected cost of imported water for untreated direct and replenishment uses. The cost to purchase water for replenishment is projected to increase over time by about 3.4 percent per year from about $760 per af in 2018 to about $1,120 per af in 2028. This cost projection includes Metropolitan's projected Tier 1 and Readiness-to-Serve (RTS) charges and excludes Metropolitan's Capacity charge and the IEUA's administrative cost.[13] This cost projection is based on information obtained from Metropolitan's recent board action[14] (April 2018) to adopt water rates for calendar years 2019 and 2020, recent historical water purchase information from the IEUA, and projected water purchases developed in Watermaster's Storage Framework investigation. This cost projection does not include the projected cost of the California WaterFix tunnel project.

[13] These cost projections are estimates based on assumptions for future Tier 1 costs, RTS charges, and IEUA purchases from Metropolitan.

[14] Letter to the Metropolitan Board dated April 10, 2018, *Adopt CEQA and approve the proposed biennial budget for FY's 2018/19 and 2019/20, revenue requirements, ten-year forecast; resolutions fixing and adopting the water rates and charges for calendar years 2019 & 2020; continue suspension of AV Tax limit.* http://edmsidm.mwdh2o.com/idmweb/cache/MWD%20EDMS/003738347-1.pdf

Table 2-1

Time History of Ending Balances in Managed Storage in the Chino Basin Exclusive of the Dry-Year Yield Activities[1]

(af)

Fiscal Year	Appropriative Pool (Pool 3)				Overlying Non-Ag (Pool 2)			Total in Managed Storage
	Carryover	Excess Carryover (ECO)	Suppl.	Total	Carryover	Local Storage	Total	
2000	28,911	170,342		199,253	6,541	31,031	37,572	236,825
2001	15,940	77,907	92,813	186,660	5,301	32,330	37,631	224,291
2002	13,521	70,103	87,801	171,425	5,285	33,727	39,012	210,437
2003	18,656	71,329	81,180	171,165	6,743	36,850	43,593	214,758
2004	21,204	70,503	80,963	172,670	7,177	40,881	48,058	220,728
2005	21,289	76,080	88,849	186,218	7,227	45,888	53,115	239,333
2006	32,062	56,062	86,170	174,294	7,227	49,178	56,405	230,699
2007	34,552	50,895	83,184	168,631	7,084	51,476	58,560	227,191
2008	41,626	83,962	81,520	207,108	6,819	45,248	52,067	259,175
2009	42,795	101,908	79,890	224,593	6,672	46,600	53,272	277,865
2010	41,263	120,897	90,133	252,293	6,934	47,732	54,666	306,959
2011	41,412	146,074	98,080	285,566	6,959	49,343	56,302	341,868
2012	42,614	209,981	116,138	368,733	6,914	13,993	20,907	389,640
2013	39,413	225,068	116,378	380,859	7,073	15,473	22,546	403,405
2014	41,708	231,679	125,052	398,439	6,478	12,812	19,290	417,729
2015	44,437	254,643	132,791	431,871	6,823	12,225	19,048	450,919
2016	45,683	279,757	144,012	469,452	7,195	9,949	17,144	486,596
2017	43,314	308,100	157,628	509,043	7,226	11,343	18,569	527,612

[1] Account balances are from Watermaster Assessment Packages and do not account for the Desalter Replenishment Obligation or the change in Safe Yield.

Table 2-2
Historical and Projected Supplemental Water Recharge in MZ1, MZ2 and MZ3

Year	Supplemental Water Recharge (af)			
	MZ1	MZ2	MZ3	Total
2001	6,530	500	0	7,030
2002	6,500	505	0	7,005
2003	6,499	185	0	6,684
2004	7,582	49	0	7,631
2005	7,887	4,530	0	12,417
2006	18,923	16,226	722	35,870
2007	22,477	12,050	1,426	35,953
2008	1,054	1,129	157	2,340
2009	1,957	535	192	2,684
2010	7,742	1,518	2,950	12,210
2011	9,103	5,664	2,948	17,715
2012	18,088	8,502	5,493	32,083
2013	3,766	3,845	2,868	10,479
2014	2,736	8,477	3,175	14,388
2015	1,059	5,666	4,116	10,841
2016	2,685	4,180	6,357	13,222
2017	13,766	4,791	8,518	27,076
2018	6,500	5,810	6,700	19,010
2019	6,500	6,230	6,700	19,430
2020	6,500	6,230	6,700	19,430
2021	6,500	6,230	6,700	19,430
2022	6,500	6,230	6,700	19,430
2023	6,500	6,230	6,700	19,430
Historical period through 2017				
Total	138,355	78,351	38,921	255,627
Average	8,139	4,609	2,289	15,037

Gray cells indicate projected supplemental water recharge in Scenario 1A and excludes DYYP puts that occurred in fiscal year 2017/18.

Table 2-3
Recycled Water Recharge Projections[1]

Basin	FY												
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Brooks Street Basin	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
College Heights Basins	0	0	0	0	0	0	0	0	0	0	0	0	0
Montclair Basins 1-4	0	0	0	0	0	0	0	0	0	0	0	0	0
Seventh and Eighth Street Basins	1,490	1,490	1,490	1,490	1,490	1,490	1,490	1,490	1,490	1,490	1,490	1,490	1,490
Upland Basin	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal Management Zone 1	3,490	3,490	3,490	3,490	3,490	3,490	3,490	3,490	3,490	3,490	3,490	3,490	3,490
Ely Basins	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Grove Basin	0	0	0	0	0	0	0	0	0	0	0	0	0
Etiwanda Debris Basin	0	0	0	0	0	0	0	0	0	0	0	0	0
Hickory Basin	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650
Lower Day Basin	0	0	0	0	0	0	0	0	0	0	0	0	0
San Sevaine Basins 1-5	420	840	840	840	840	840	840	840	840	840	840	840	840
Turner Basins 1-2	360	360	360	360	360	360	360	360	360	360	360	360	360
Turner Basins 3-4	750	750	750	750	750	750	750	750	750	750	750	750	750
Victoria Basin	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530
Subtotal Management Zone 2	5,810	6,230	6,230	6,230	6,230	6,230	6,230	6,230	6,230	6,230	6,230	6,230	6,230
Banana Basin	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Declez Basin	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
IEUA RP3 Ponds	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,400
Subtotal Management Zone 3	6,700	6,700	6,700	6,700	6,700	6,700	6,700	6,700	6,700	6,700	6,700	6,700	6,700
Total	16,000	16,420	16,420	16,420	16,420	16,420	16,420	16,420	16,420	16,420	16,420	16,420	16,420

[1] Source - Andy Campbell, IEUA, June 2016

Table 2-4
Historical and Projected Change in Storage in MZ1, MZ2 and MZ3

Year	Change in Storage (af)			
	MZ1	MZ2	MZ3	Total
2001	2,654	-11,555	-10,721	-19,621
2002	-3,710	-13,097	-15,678	-32,485
2003	4,267	-12,315	-6,296	-14,344
2004	4,827	-11,251	-15,949	-22,373
2005	12,080	6,332	-4,775	13,637
2006	19,622	8,050	-3,801	23,871
2007	12,109	-10,649	-12,682	-11,221
2008	-10,044	-9,633	-10,800	-30,476
2009	-11,850	-22,718	-10,099	-44,667
2010	1,600	-7,146	-4,866	-10,413
2011	13,873	1,028	736	15,637
2012	9,499	6,220	5,469	21,187
2013	-12,037	-8,809	-2,406	-23,253
2014	-16,120	-4,671	-7,449	-28,240
2015	-8,409	-3,502	89	-11,821
2016	5,670	-8,801	4,058	928
2017	13,077	2,100	4,466	19,643
2018	2,972	955	-1,360	2,567
2019	-235	12,641	1,311	13,717
2020	-1,464	17,113	2,073	17,722
2021	-916	11,308	4,595	14,988
2022	-670	10,850	3,939	14,118
2023	-351	10,174	3,512	13,334
Historical period through 2017				
Total	37,107	-100,415	-90,704	-154,012
Average	2,183	-5,907	-5,336	-9,060

Gray cells indicate projected supplemental water recharge in Scenario 1A and excludes DYYP puts that occurred in fiscal year 2017/18

Table 2-5

Projected Cost to Purchase Imported Water from Metropolitan Water District of Southern California (Metropolitan)[1,2] Excluding Capacity and Metropolitan Member Agency Imposed Charges

Year	Tier 1 ($/af)	Readiness to Serve (RTS) Charges: Metropolitan System-Wide RTS Charge ($/y)	RTS Cost: IEUA Share of Metropolitan Water Purchased[3]	RTS Cost: Projected 10-yr Rolling Average of Metropolitan Purchases[3,4] (afy)	RTS Cost: Annual IEUA Share of RTS ($/y)	RTS Cost: Projected Water Purchases[4] (afy)	RTS Cost: RTS Unit Cost ($/af)	Total Metropolitan Imported Water Cost ($/af)
2018	$695	$140,000,000	3.49%	37,403	$4,886,000	73,428	$67	$762
2019	$731	$133,000,000	3.60%	37,457	$4,788,000	79,976	$60	$791
2020	$755	$136,000,000	3.60%	41,054	$4,896,000	86,524	$57	$812
2021	$784	$144,000,000	3.67%	44,981	$5,285,000	87,967	$60	$844
2022	$818	$152,000,000	3.66%	49,980	$5,564,000	89,410	$62	$880
2023	$853	$155,000,000	3.69%	55,551	$5,720,000	90,852	$63	$916
2024	$885	$168,000,000	3.72%	61,030	$6,250,000	92,295	$68	$953
2025	$920	$177,000,000	3.79%	66,046	$6,709,000	93,738	$72	$992
2026	$956	$190,000,000	3.79%	70,571	$7,201,000	95,030	$76	$1,032
2027	$994	$202,000,000	3.79%	75,798	$7,656,000	96,321	$79	$1,073
2028	$1,033	$216,000,000	3.79%	82,710	$8,187,000	97,613	$84	$1,117

Notes:

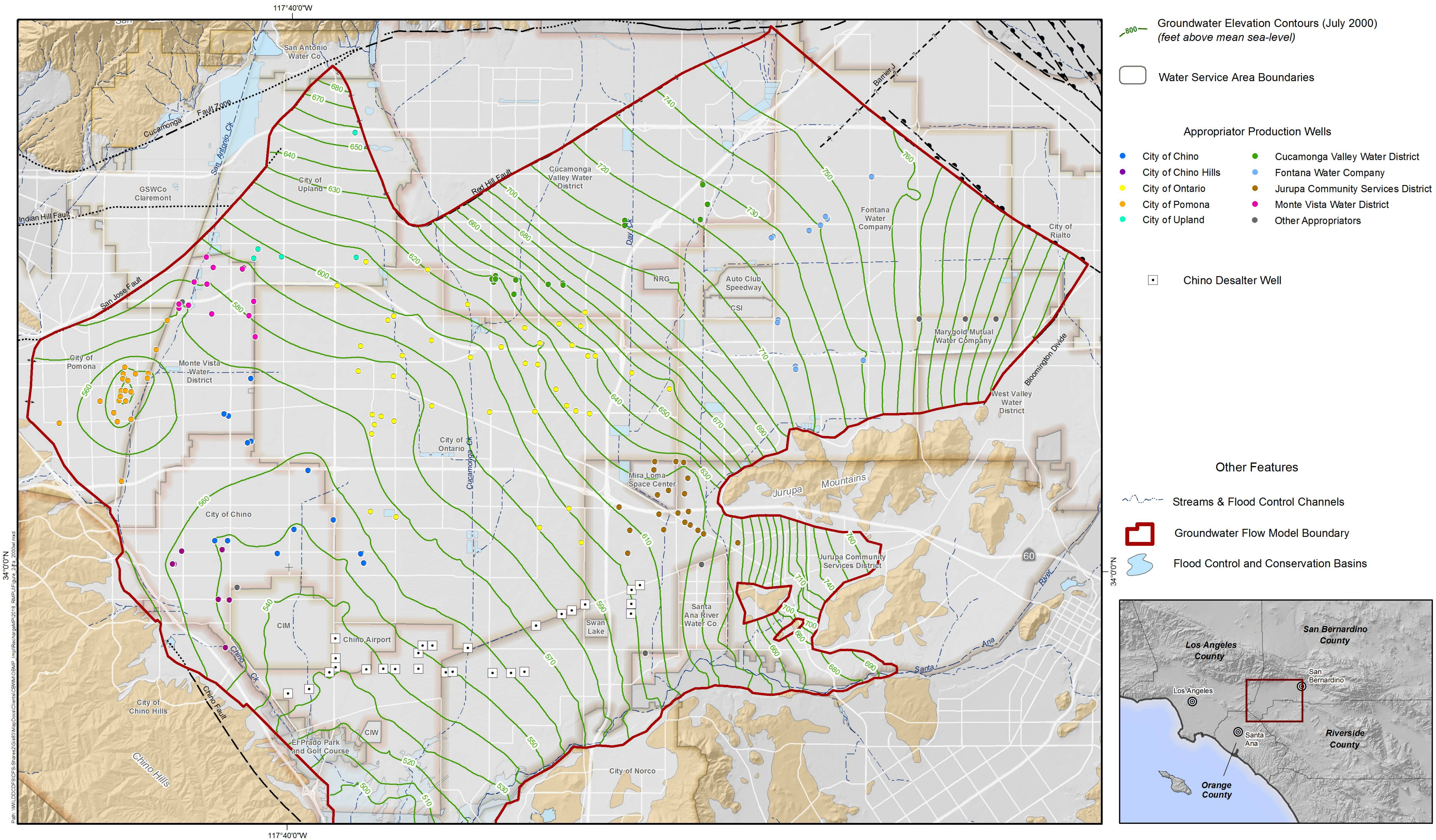
These cost projections are estimates based on assumptions for future Tier 1 costs, RTS charges, and IEUA purchases from Metropolitan.

1 - http://edmsidm.mwdh2o.com/idmweb/cache/MWD%20EDMS/003738460-1.pdf

2 - Metropolitan Board presentation "Updated Ten-Year Forecast" at the May 7, 2018 meeting, item 6b

3 - Estimates were provided by Jason Pivovaroff of IEUA on May 3, 2018.

4 - Imported water purchases based on historical purchases and 2018 Storage Framework investigation imported water projections. Projections include imported water purchases from non-IEUA member agencies.



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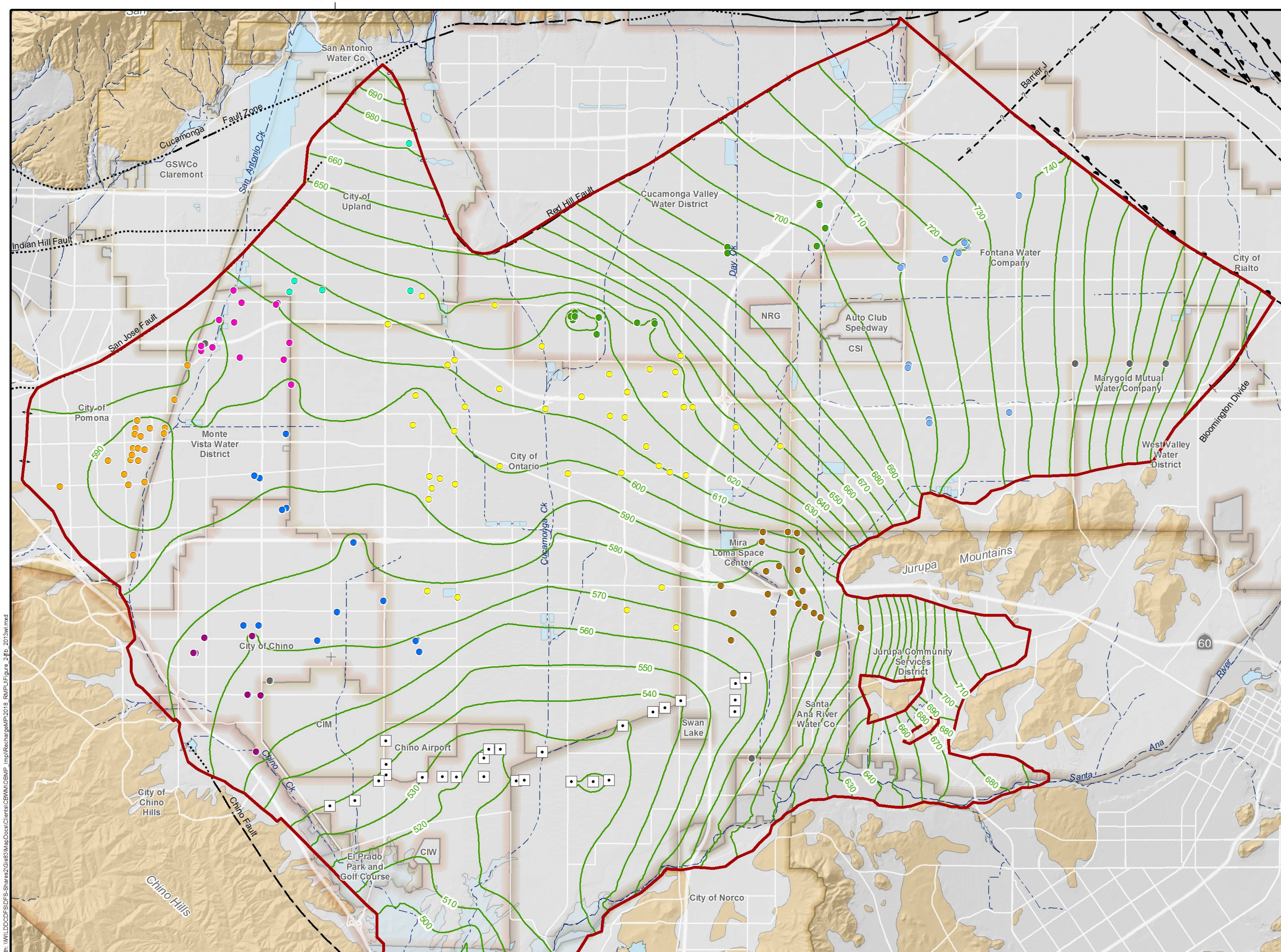
CHINO BASIN WATERMASTER

2018 Recharge Master Plan Update

Groundwater Elevation Contours -- Layer 1
2017 Chino Basin Groundwater Model - July 2000

Figure 2-1a



Groundwater Elevation Contours (July 2013) *(feet above mean sea-level)*

Water Service Area Boundaries

Appropriator Production Wells

- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- City of Upland
- Cucamonga Valley Water District
- Fontana Water Company
- Jurupa Community Services District
- Monte Vista Water District
- Other Appropriators

Chino Desalter Well

Other Features

- Streams & Flood Control Channels
- Groundwater Flow Model Boundary
- Flood Control and Conservation Basins

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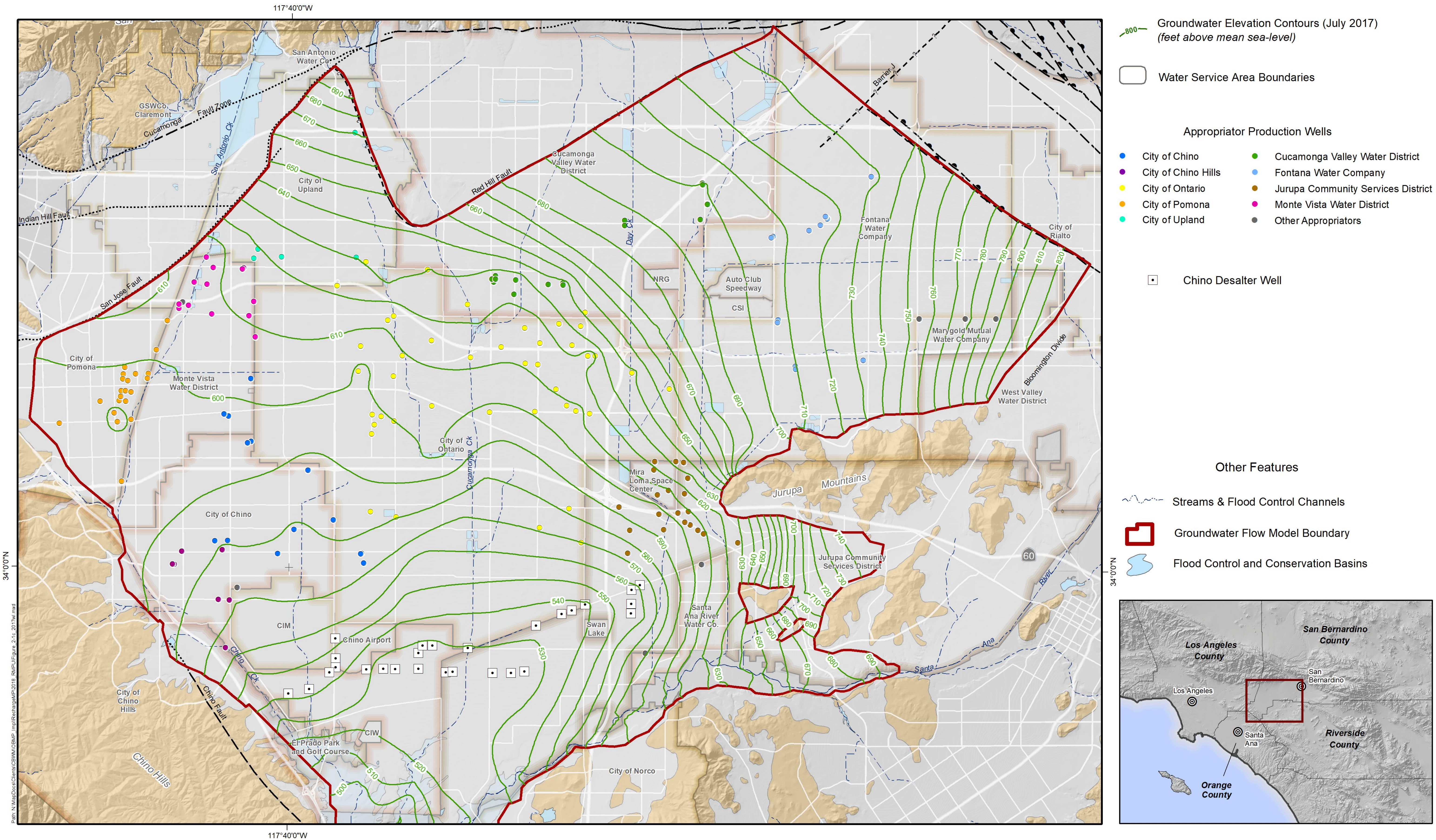
Groundwater Elevation Contours -- Layer 1
2017 Chino Basin Groundwater Model - July 2013

Figure 2-1b



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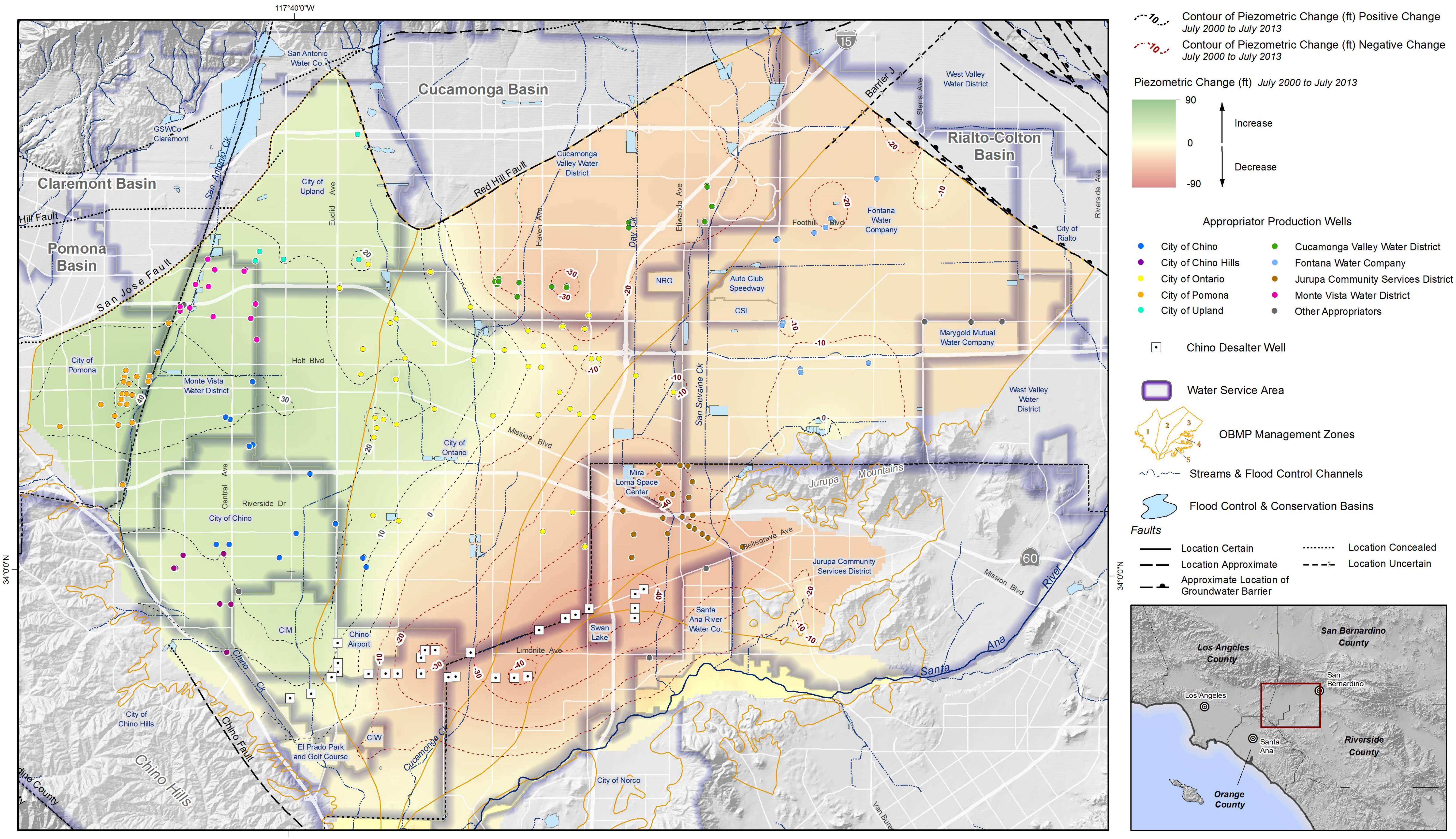
Chino Basin Watermaster

2018 Recharge Master Plan Update

Groundwater Elevation Contours -- Layer 1

2017 Chino Basin Groundwater Model - July 2017

Figure 2-1c



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File: Figure_2-2a_change00_13

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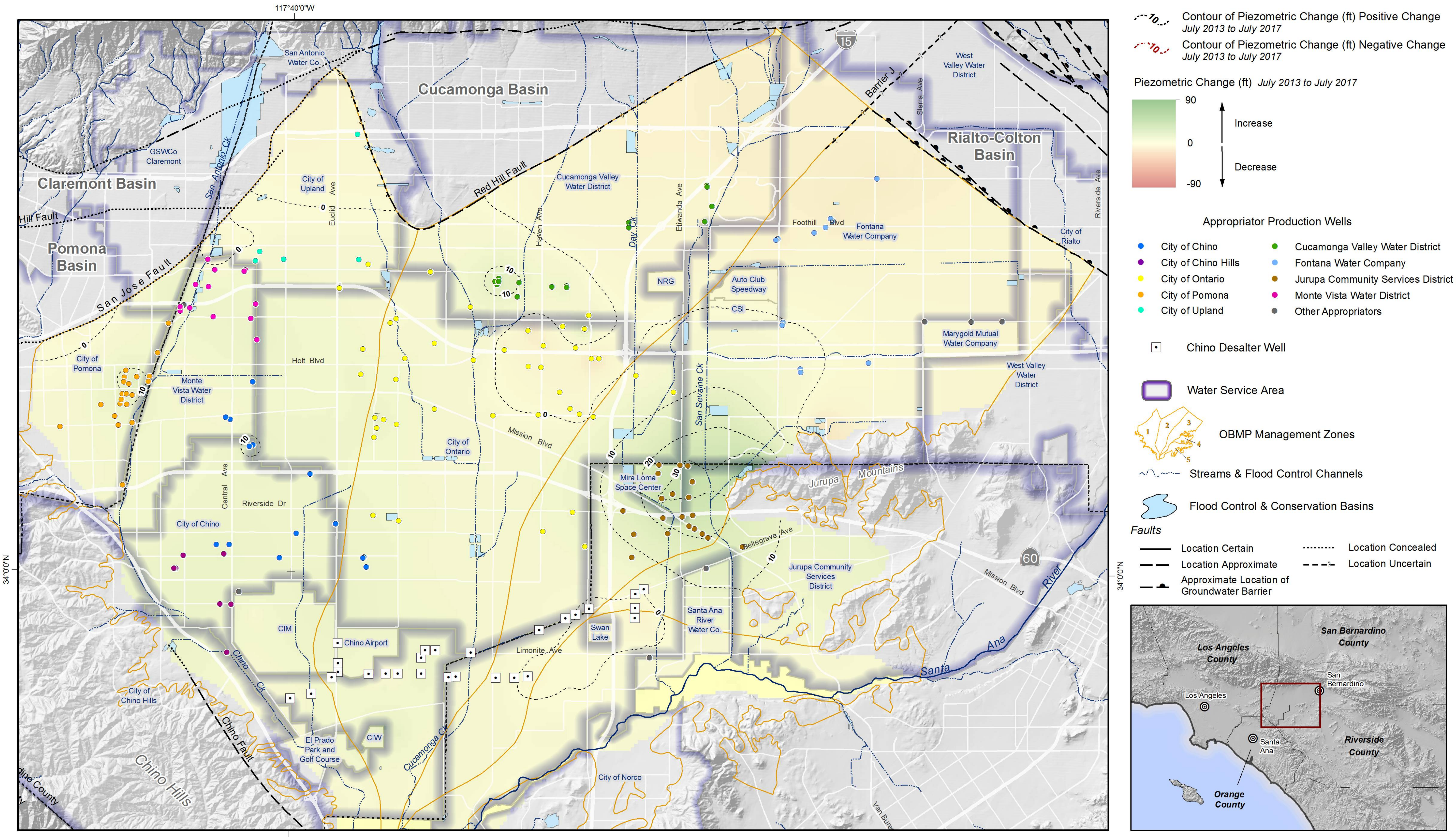
2018 Recharge Master Plan Update

Groundwater Elevation Change -- Layer 1
2017 Chino Basin Groundwater Model - 2000 to 2013

Figure 2-2a



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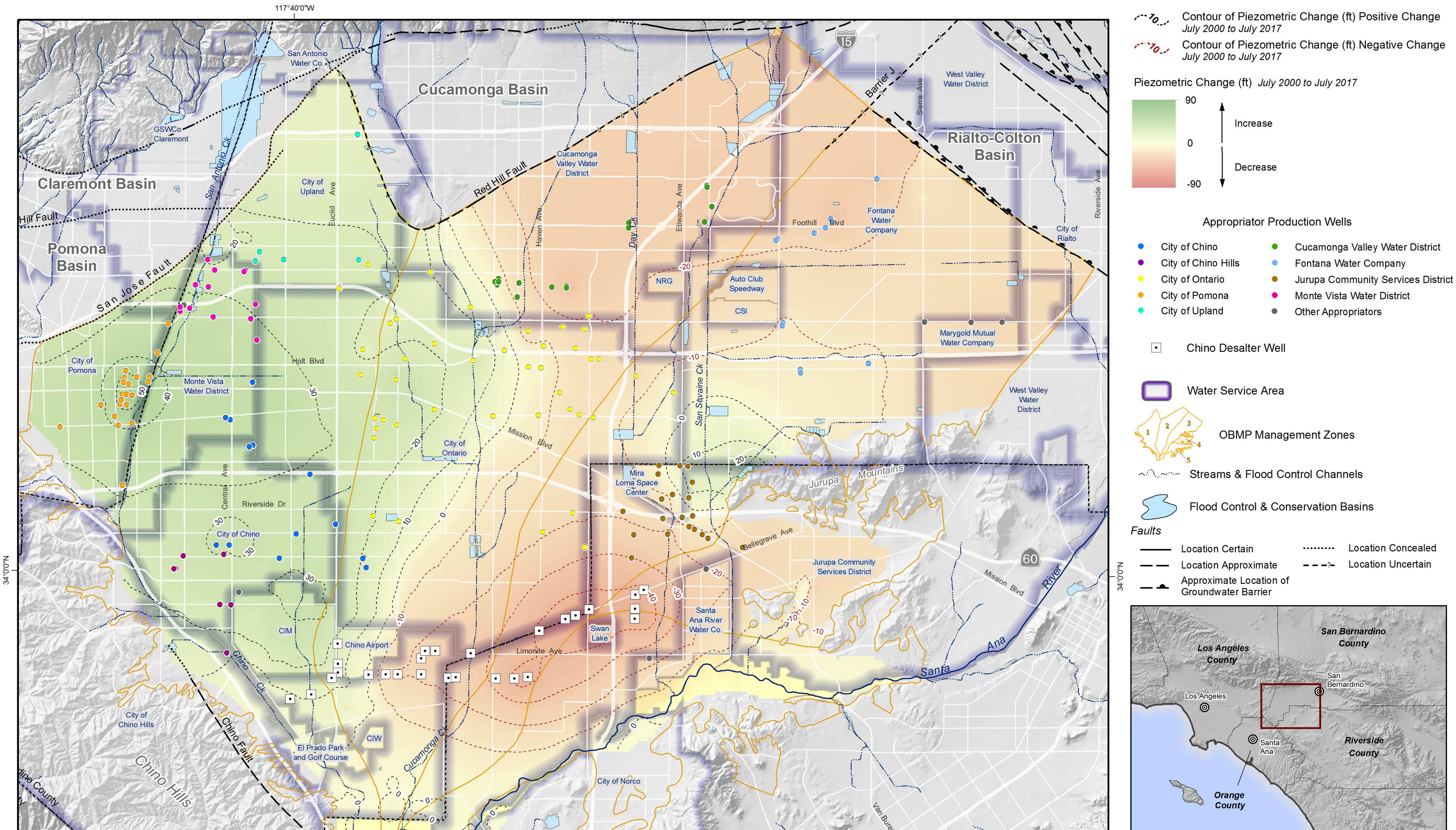
Groundwater Elevation Change -- Layer 1

2017 Chino Basin Groundwater Model - 2013 to 2017

Figure 2-2b



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2018 Recharge Master Plan Update

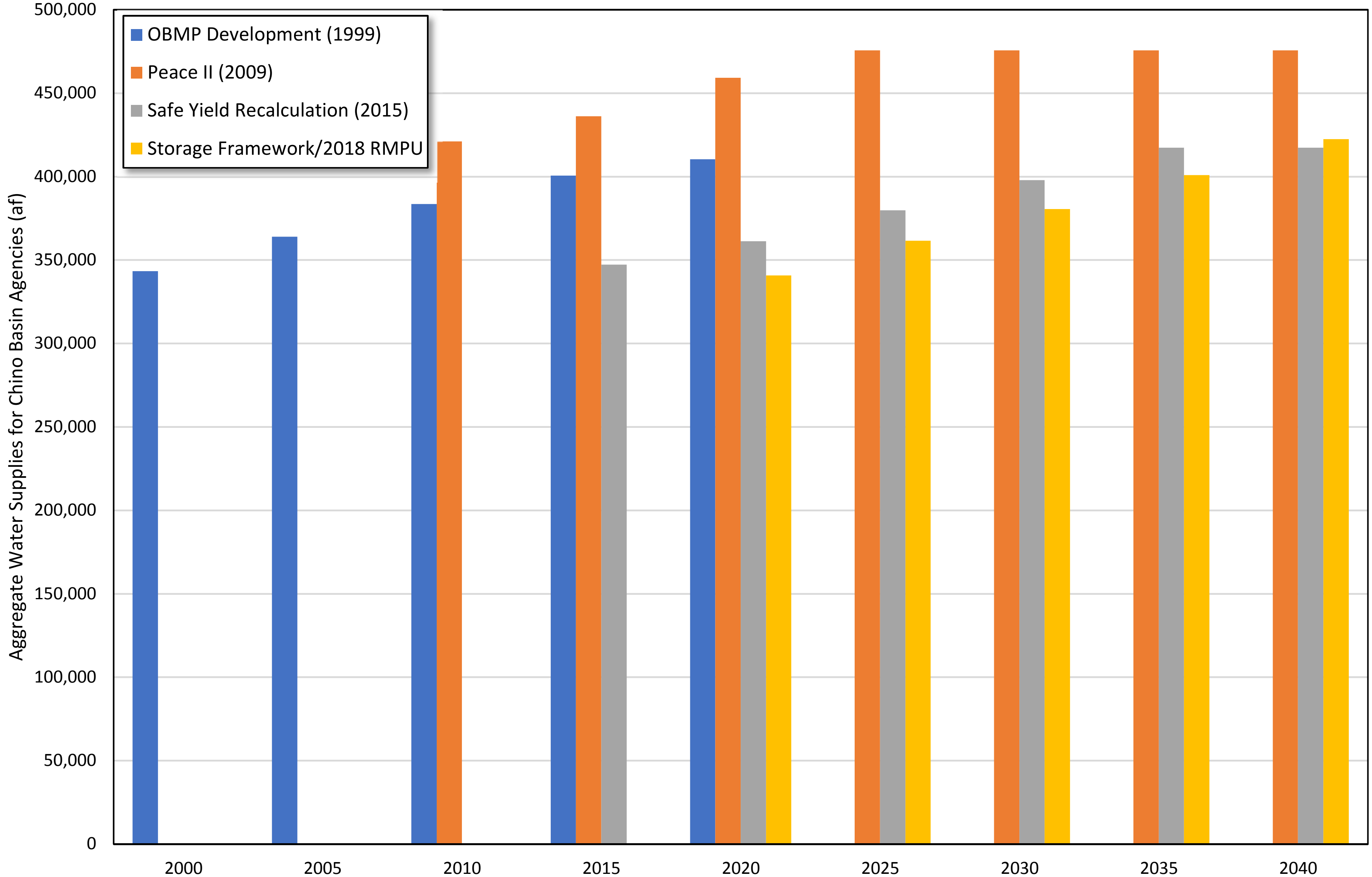
Groundwater Elevation Change -- Layer 1

2017 Chino Basin Groundwater Model - 2000 to 2017

Figure 2-2c

Figure 2-3

Comparison of Aggregate Water Demand Projections in the OBMP (1999), Peace II (2007), 2013 RMPU and Safe Yield (2011), and Storage Framework/2018 RMPU



Master_Supply_Demand_charts_v2.xlsx -- Aggregate_chart
Created on 3/28/2018
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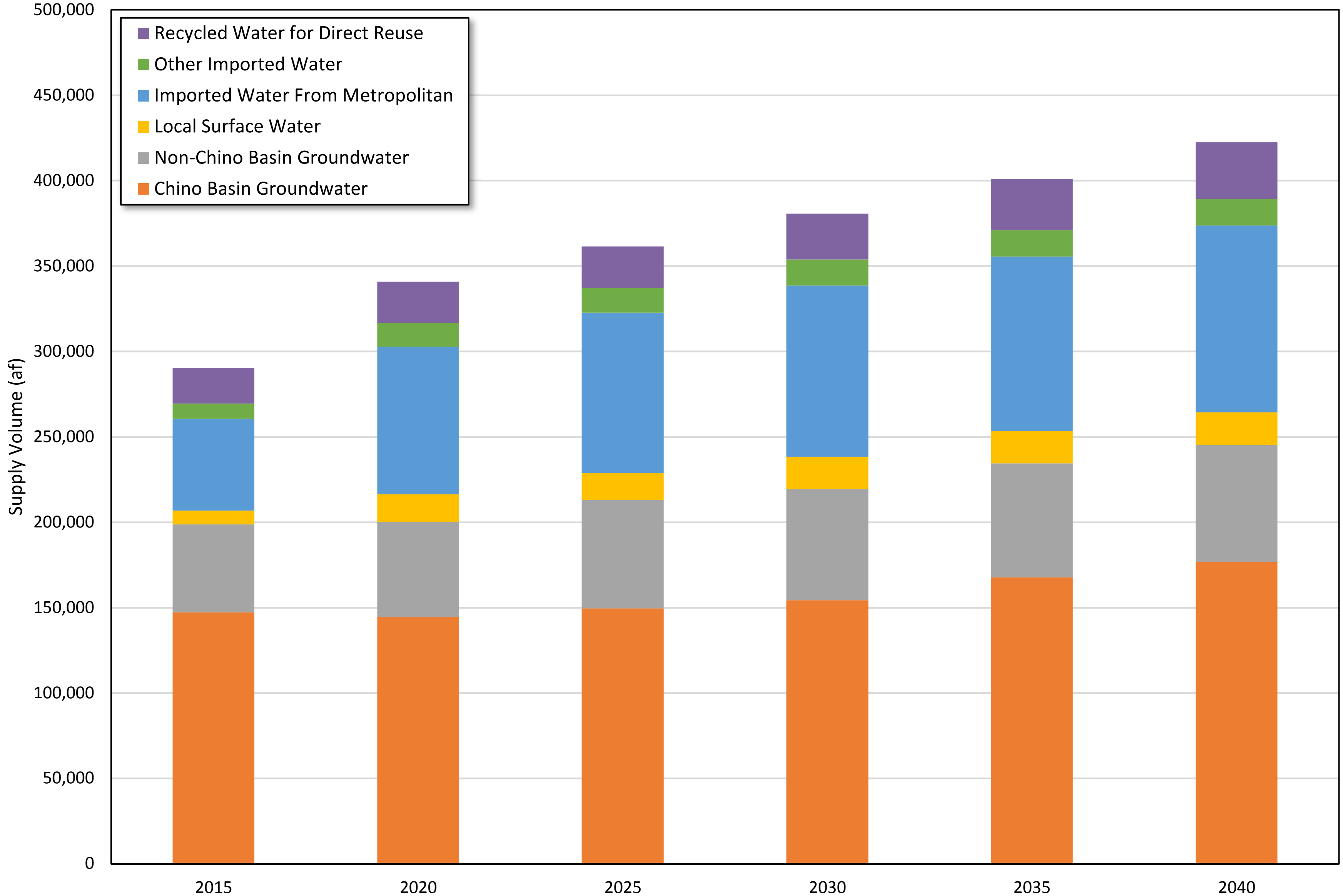
Figure 2-4
Aggregate Water Supply Plan for Chino Basin Parties, Scenario 1A



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Printed on 3/30/2018

Figure 2-5
Projected Annual Replenishment Obligation for Scenarios 1A and 1B, 2018-2070

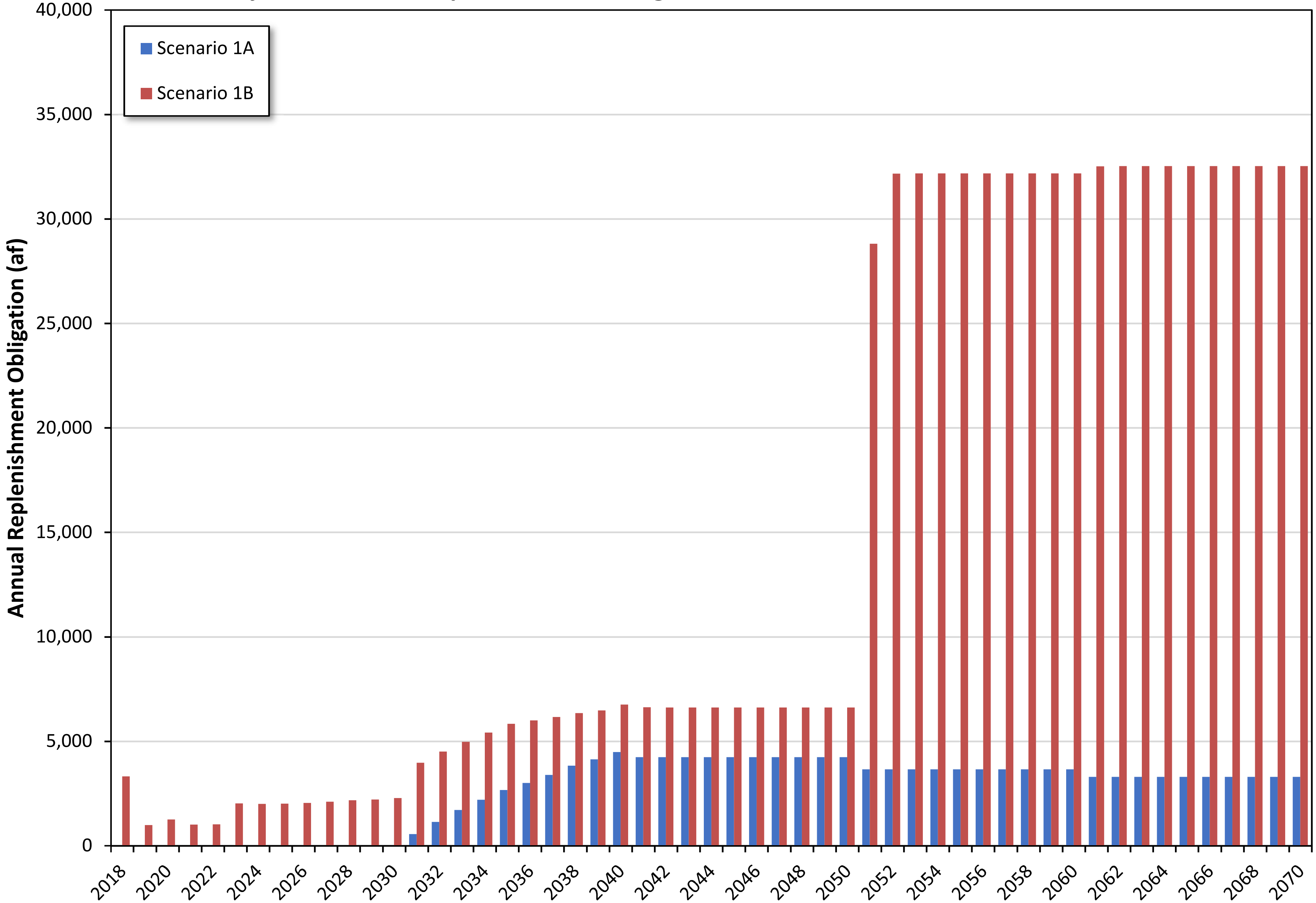

Figure_2-5_replenishment.xlsx -- Fig_2-5 (2)
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Section 3 – Groundwater Response to Projected Pumping, Recharge and Replenishment

The objective of the work presented in this section is to describe future groundwater conditions that can be used to assess the need for changes in Watermaster's recharge and replenishment practices. The evaluation of future groundwater conditions was accomplished by developing planning scenarios that are representative of the parties' future groundwater pumping, simulating the groundwater basin response to these scenarios, and interpreting the model results. This section presents a summary of work completed for the Storage Framework that will be used in subsequent sections of this report to develop findings and recommendations for the future recharge and replenishment actions of Watermaster, consistent with the requirements described in Section 1. The information provided below is based on Storage Framework Scenario 1A, described in Section 2 of this report.

3.1 Managed Storage

Managed storage includes water stored in the parties' accounts and carryover water. Figure 3-1 shows historical and projected changes in managed storage for the period of July 1, 2000 through June 30, 2050. Managed storage starts at about 237,000 af in 2000, is projected to peak at 695,000 af in 2030, and decline to about 417,000 af by 2050. The difference between historical and projected managed storage in fiscal year 2017 is due to an assumed adjustment in managed storage to account for a decline in Safe Yield of 5,000 afy retroactive to 2014 and to satisfy desalter replenishment obligations.

3.2 Groundwater Levels

3.2.1 Projected Change in Groundwater Levels

The 2017 Chino Basin groundwater model was used to project groundwater levels from July 2017 through June 2050. Figures 3-2a through 3-2d show the projected changes in groundwater levels for 2017 through 2030, 2030 through 2040, 2040 through 2050, and 2017 through 2050, respectively. Recall from Figure 3-1, mentioned above, that the managed storage peaks during the planning period in 2030 and declines thereafter. Managed storage roughly parallels the total storage in the Chino Basin. The increasing managed storage through 2030 can be observed in the change in groundwater levels in Figure 3-2a, and the subsequent decline in managed storage can be seen in Figures 3-2b and 3-2c. The trends in groundwater level changes by period are as follows:

- From 2017 to 2030, groundwater levels: increased in the eastern part of the basin and decreased in the western and southern part of the basin; increased in the CVWD and FWC service areas, ranging from about 10 to 40 feet; decreased in the Pomona service area by about 10 feet; and decreased by about 10 feet in the southern part of the basin near the Chino Airport and CIM.
- From 2030 to 2040, groundwater levels generally remained unchanged or decreased, decreasing in the northeastern part of City of Ontario service area and the southwestern part of the CVWD service area by about 10 feet.

- From 2040 to 2050, groundwater levels generally decreased across the basin between 0 feet in the southern part of the basin to 20 feet in the northern part of the basin.
- Cumulatively, from 2017 to 2050, groundwater levels increased in the eastern part of the basin and decreased in the western part of the basin; decreased by as much as 20 feet in a broad area running from the northern part of the JCSD service area, extending southwest to the Chino Airport, an area that includes the JCSD and desalter well fields; decreased in the City of Pomona and MVWD service areas, ranging from about 20 to 30 feet; and increased in the CVWD and Fontana service areas in the eastern part of the basin about 0 to 20 feet.

Significant concerns with these changes include declines in groundwater levels that would cause new inelastic land subsidence and/or reduce sustainable pumping rates.

3.2.2 New Land Subsidence

Portions of the Chino Basin are susceptible to aquifer-system compaction and associated land subsidence. These areas include most of MZ1 and the central and southern parts of MZ2. Northwest MZ1 and the central portion of MZ2 are currently experiencing inelastic land subsidence believed to be caused by the historical lowering of groundwater levels due to pre-Judgment groundwater pumping (WEI, 2017). In these portions of the basin, the pressure heads in fine-grained sediment layers are greater than the heads in surrounding course-grained sediments, which causes water to discharge from the fine-grained layers to coarse-grained layers with a subsequent reduction in thickness of the fine-grained layers. These areas will likely continue to subside for several years until the pressure heads in the fine-grained layers equilibrate with the pressure heads in the coarse-grained layers. Watermaster is currently investigating this land subsidence and will use the investigation results to develop a plan to manage the land subsidence.

New land subsidence refers to additional land subsidence caused by the reduction of pressure head in the coarse-grain sediments to levels lower than historical lows. Historical groundwater level data and model-estimated historical groundwater levels were reviewed to develop a map of historical minimum groundwater levels for the Chino Basin. This water-level surface was used to assess the potential for new land subsidence. No new land subsidence should occur in the land subsidence prone areas if groundwater levels are maintained above this constraint surface. New land subsidence would likely be initiated in the areas of subsidence concern if groundwater levels fall below the constraint surface. The 2017 Chino Basin model was used to determine the potential for new land subsidence. Figure 3-3 shows the time history of groundwater levels relative to the new land subsidence constraint surface for MZ1. Areas shown in white or blue indicate that groundwater levels are greater than the constraint surface and new land subsidence will not occur. Areas that are pink or red indicate that groundwater levels are lower than the constraint surface and where new land subsidence would be projected to occur. There are no pink or red areas in Figure 3-3, indicating that no new land subsidence is expected with Scenario 1A. In fact, only Scenario 1B indicated that new land subsidence could occur, which was refined in Scenario 1B with Mitigation to eliminate this potential new land subsidence.

3.2.3 Pumping Sustainability

The term pumping sustainability, as used herein, refers to the ability to pump water from a specific well at a desired production rate, given the groundwater level at that well, its specific well construction, and current equipment details. It has no nexus to the Judgment or Peace Agreements. Pumping sustainability metrics are defined for each well by owner and were updated as part of the data request described in Section 2. Groundwater pumping at a well is presumed to be sustainable if the model-projected groundwater level at that well is greater than its sustainability metric. If the groundwater level falls below the sustainability metric, the owner will either need to lower the pumping equipment in their well or reduce the well's pumping rate.

During the development of the OBMP, the parties that pump groundwater from MZ1 expressed concern that more recharge was required for sustainable pumping. To address the concern, the Peace Agreement provided for 6,500 afy of supplemental water recharge in MZ1 (discussed above). Pumping sustainability in MZ3 in the JCSD and desalter well field was a concern expressed during the development of the 2013 RMPU.

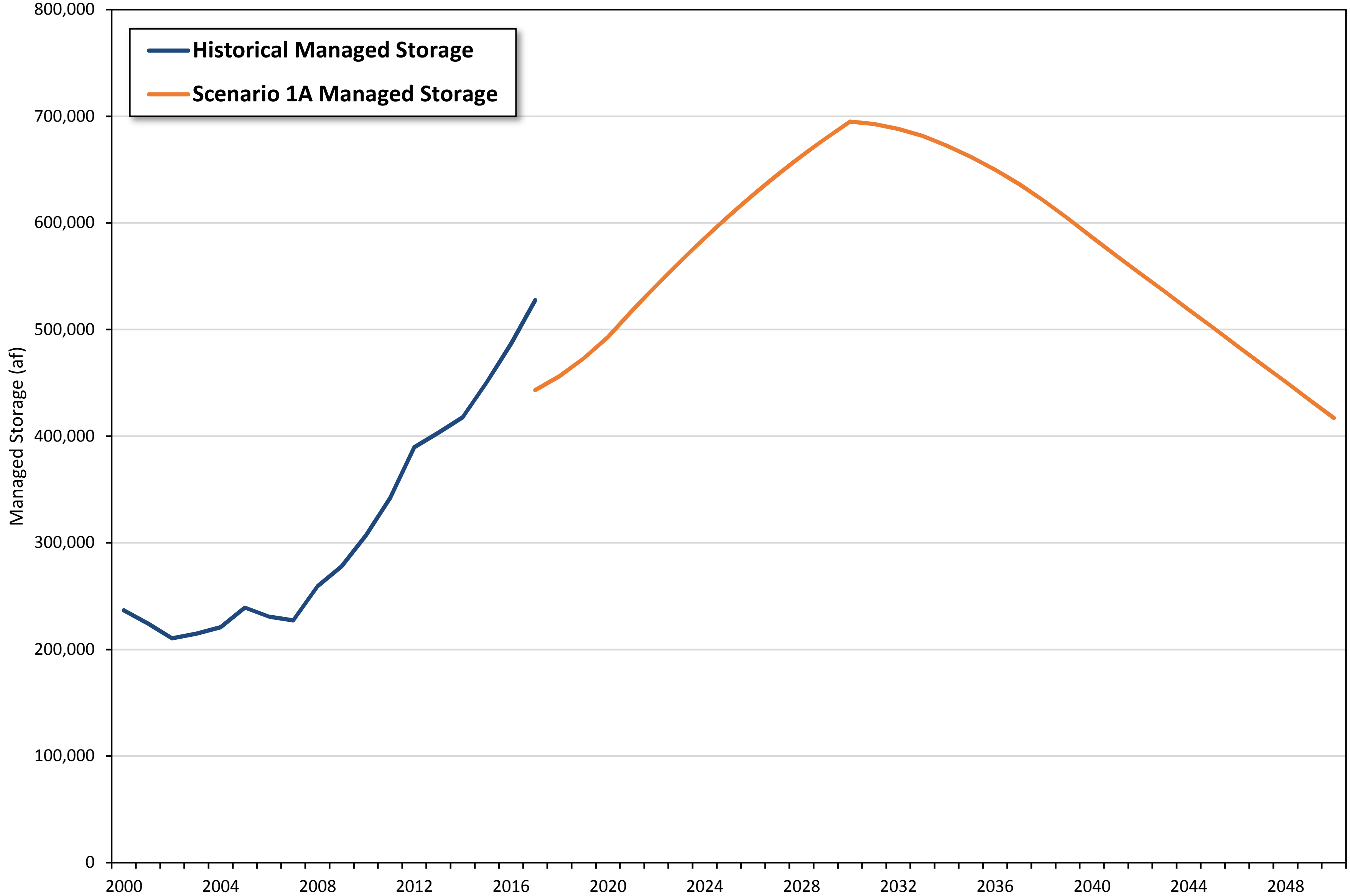
Pumping sustainability was addressed in the Storage Framework in a manner similar to new land subsidence, and this work was incorporated into the 2018 RMPU. Parties provided Watermaster the maximum depth to groundwater required to maintain sustainable pumping rates for each of their wells. A constraint surface was created by interpolating these values at wells throughout the basin. Pumping sustainability is a concern if groundwater levels fall below the pumping sustainability constraint surface. The 2017 Chino Basin model was used to determine the potential for pumping sustainability. Figure 3-4 shows the time history of groundwater levels relative to the pumping sustainability constraint surface for the basin. If the groundwater level is projected to be above the sustainability surface, it is shown on a color spectrum increasing from white to dark blue. If the groundwater level is projected to be below the sustainability surface, it is shown on a color spectrum decreasing from pink to red. Groundwater levels in Scenario 1A are projected to be above the sustainability surface through 2050 over the entire basin except for the CDA well field, the JCSD well field, and one well in the FWC service area. Groundwater levels at wells in these regions are below the sustainability surface in the initial condition in 2017, and the area below the sustainability surface does not change significantly by 2050.

3.3 Projected Hydraulic Control

The attainment of hydraulic control is measured by either demonstrating, based on groundwater elevation data, that all groundwater north of the desalter well fields cannot pass through the desalter well fields (total hydraulic containment standard) or that the groundwater discharge through the desalter well fields is, in aggregate, less than 1,000 afy (de minimis standard). The Regional Board has agreed that compliance with the de minimis standard will be determined from the results of periodic calibrations of the Watermaster groundwater model and interpretations of the calibration results.

Groundwater discharge from the Chino North Management Zone to the Prado Basin Management Zone is projected to not be fully contained by the Chino Creek well field (CCWF) in the area between the Chino Hills and CDA well I-20. Figure 3-5 shows the projected groundwater discharge through the CCWF for Scenario 1A. That said, hydraulic control is projected to be maintained using the de minimis discharge threshold of 1,000 afy and is projected to be maintained through 2050.

Figure 3-1
Historical and Projected Managed Storage, Scenario 1A



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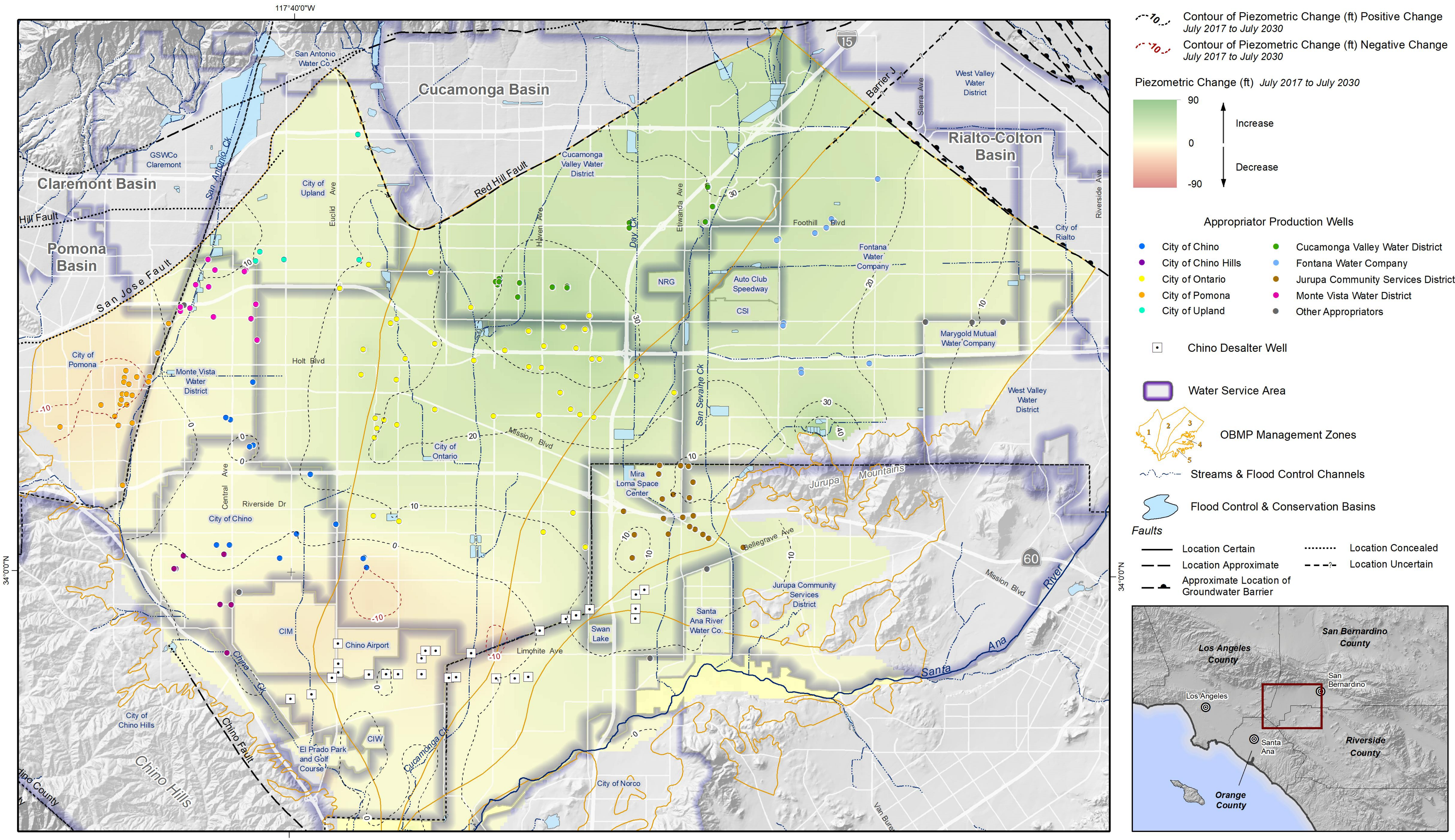

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File: Figure_3-2a_change17_30

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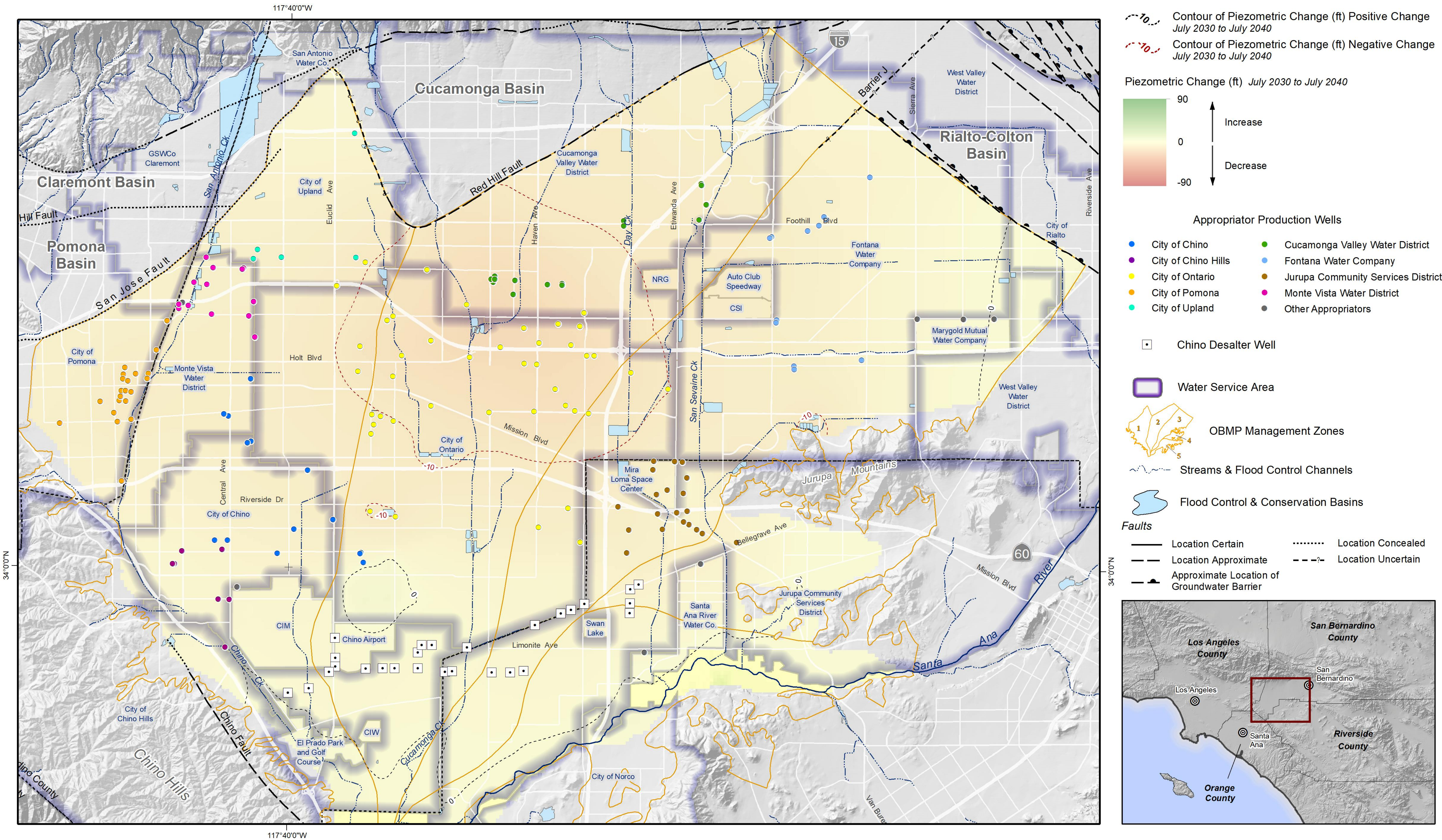
Groundwater Elevation Change -- Layer 1
Scenario 1A - 2017 to 2030

Figure 3-2a



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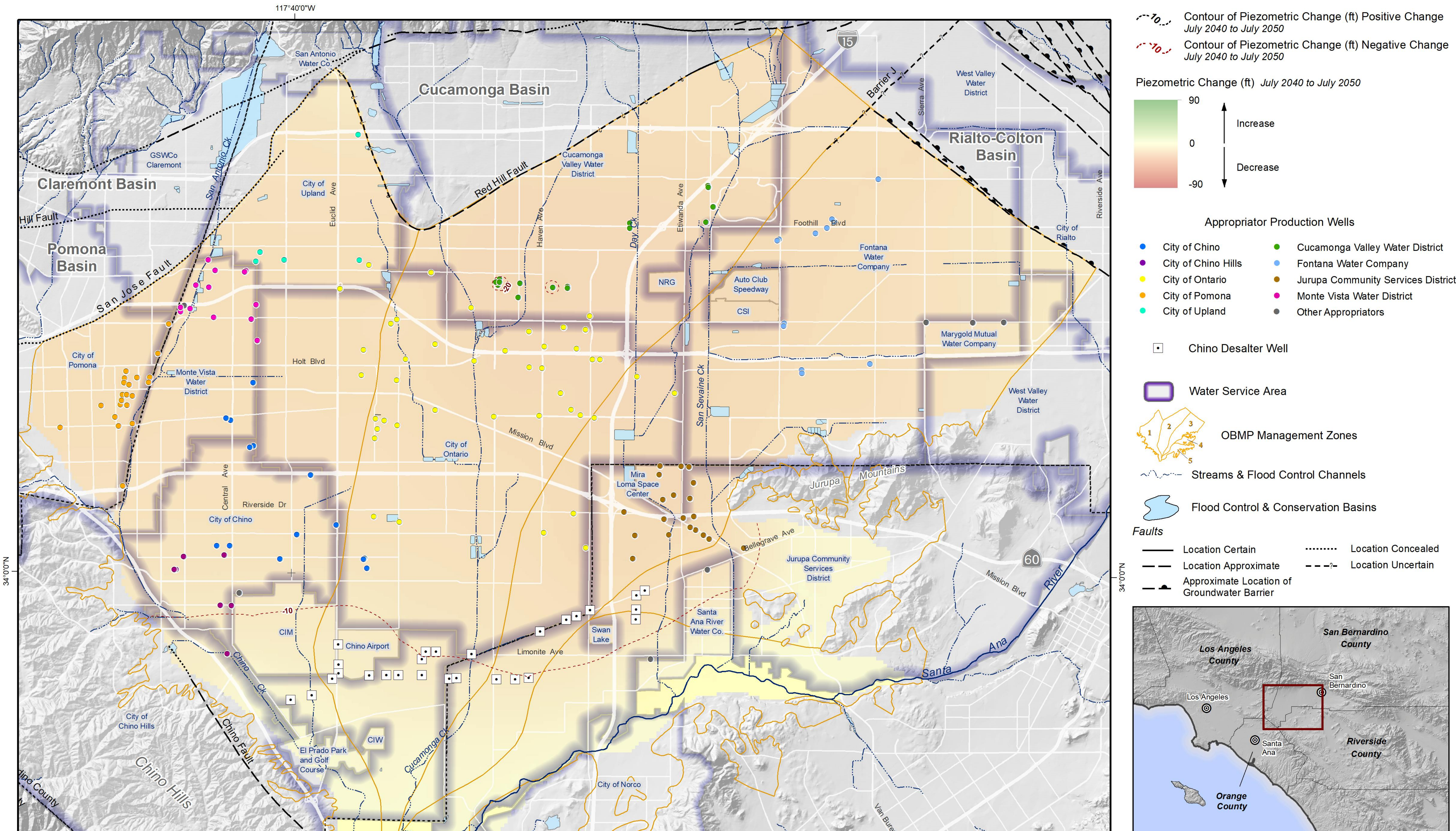
Groundwater Elevation Change -- Layer 1
Scenario 1A - 2030 to 2040

Figure 3-2b



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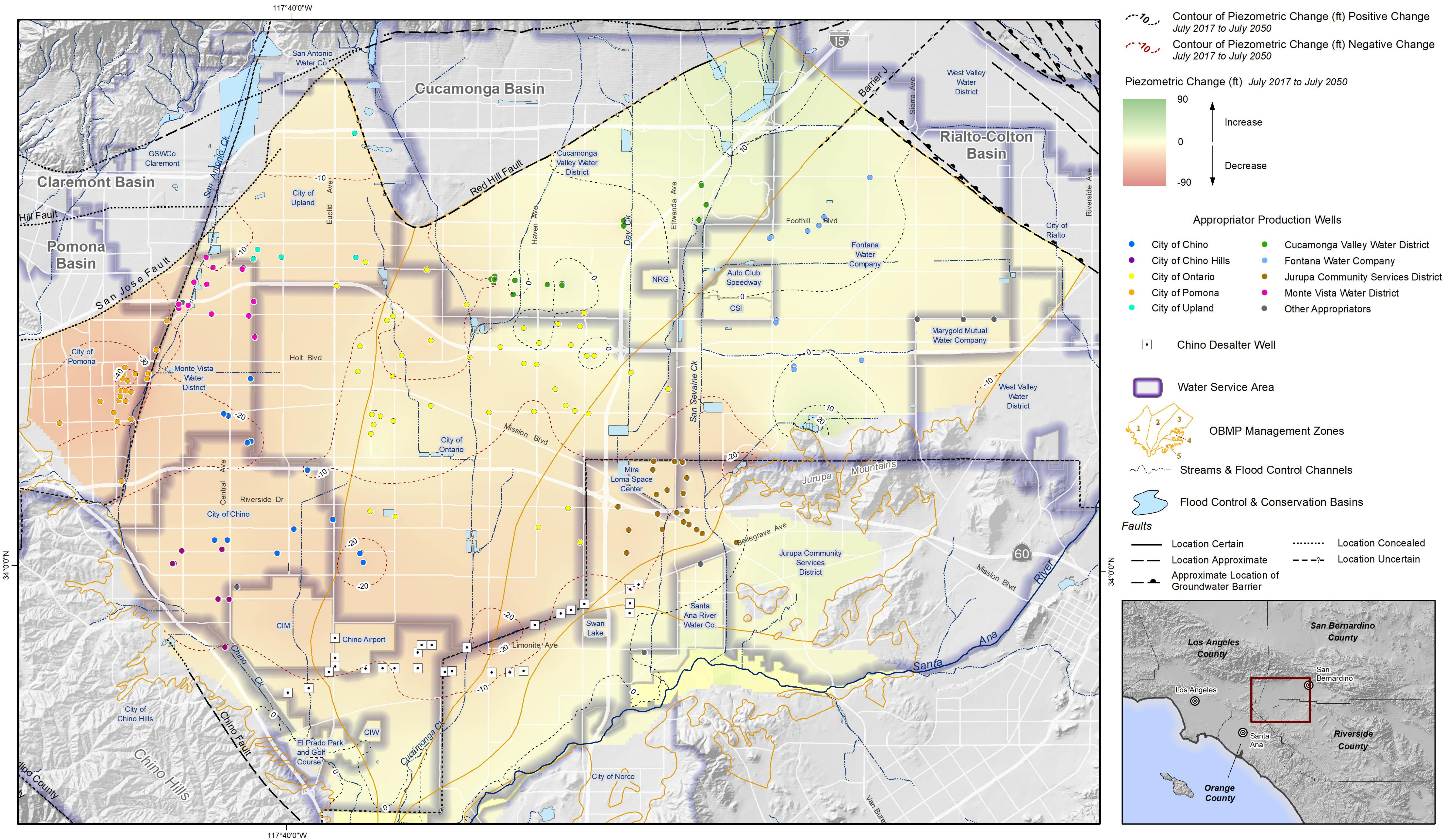
2018 Recharge Master Plan Update

Groundwater Elevation Change -- Layer 1
Scenario 1A - 2040 to 2050

Figure 3-2c



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Date: 201803
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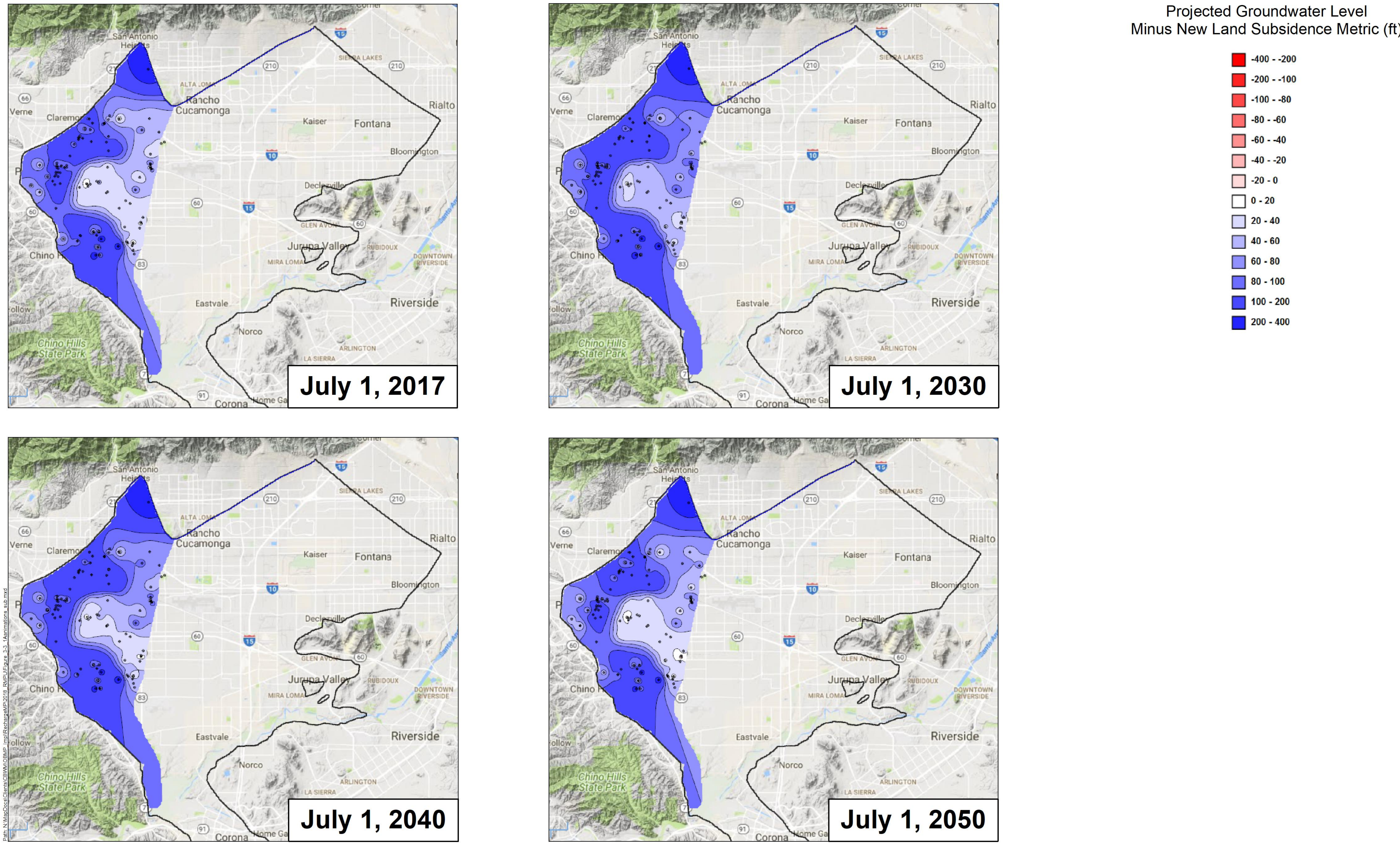
Groundwater Elevation Change -- Layer 1
Scenario 1A - 2017 to 2050

Figure 3-2d



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Date: 8/27/2018

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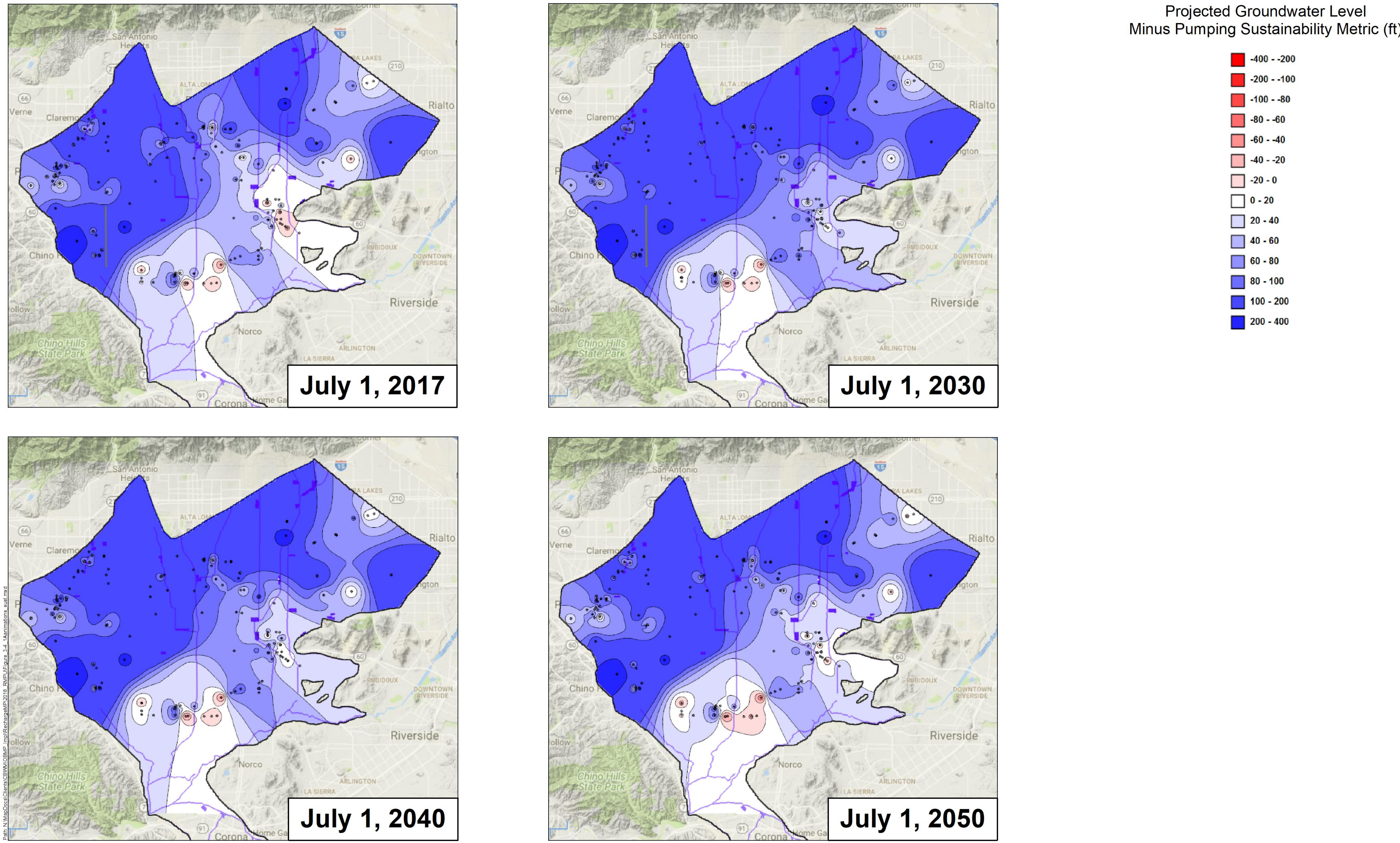
Chino Basin Watermaster

2018 Recharge Master Plan Update

Projected Groundwater Elevations in MZ1 Compared to New Land Subsidence Metric
Scenario 1A

Figure 3-3



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Date: 8/27/2018

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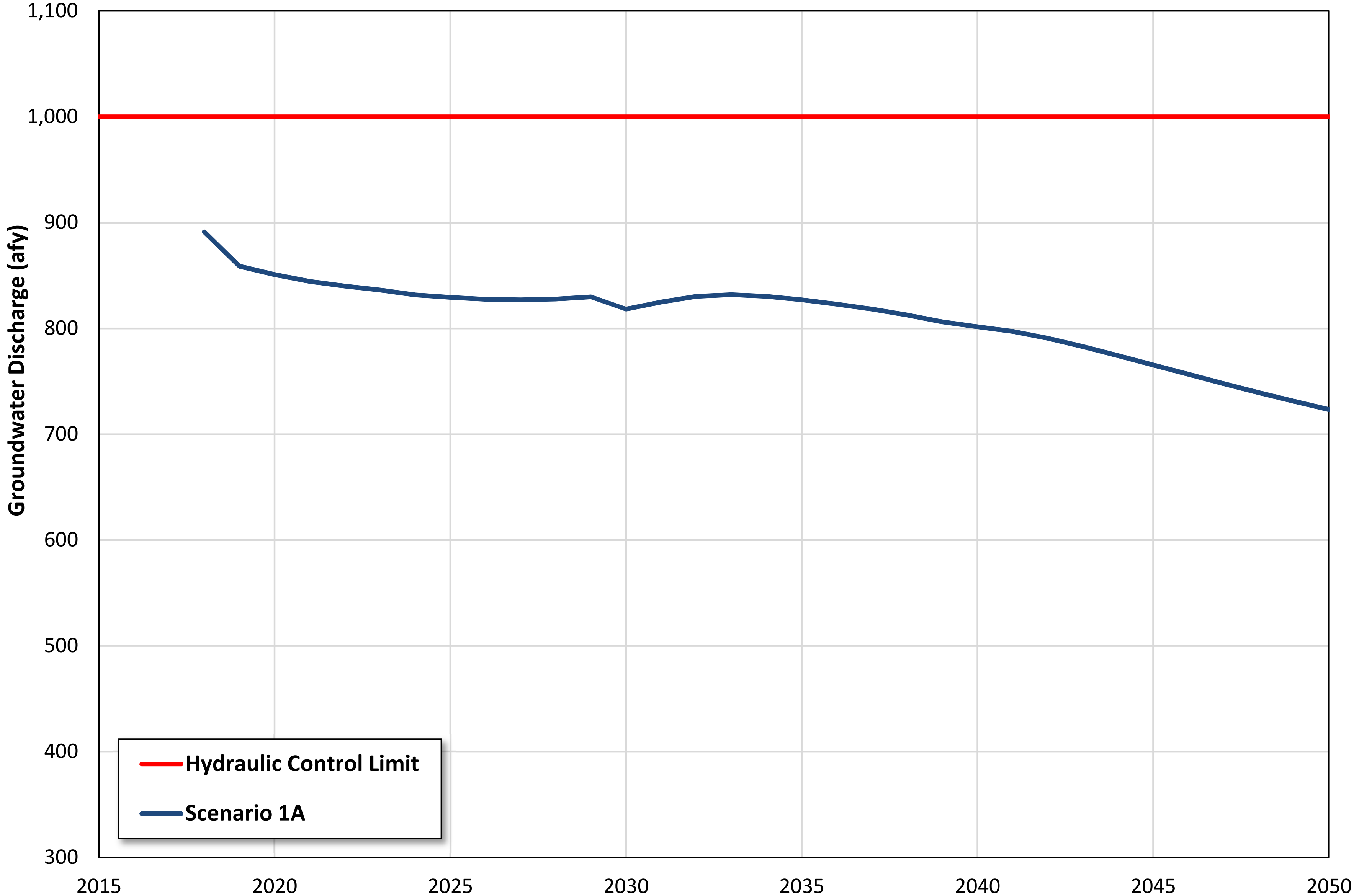
2018 Recharge Master Plan Update

Projected Groundwater Elevations in Chino Basin Compared to Pumping Sustainability Metric
Scenario 1A

Figure 3-4

Figure 3-5
Time History of Projected Groundwater Discharge from CCWF, Scenario 1A



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Section 4 – Existing and Planned Recharge Facilities

This section provides an inventory of existing and planned recharge facilities in the Chino Basin that can subsequently be compared to the basin's recharge needs, discussed in Section 5. Existing and planned recharge facilities include spreading basins, ASR wells, and MS4 facilities. In-lieu recharge capabilities exist when the capacity to treat and serve imported water exceeds the imported water demands of the parties that have pumping rights in the basin. These recharge facilities and in-lieu capabilities are described below.

4.1 Existing Spreading Basins

Pursuant to the OBMP, the Peace Agreement, and other agreements, the IEUA, Watermaster, the CBWCD, and the SBCFCD completed the 2001 RMP (Black and Veatch, 2001) and constructed spreading basin improvements from 2004 through 2014. These improvements were referred to as the Chino Basin Facilities Improvement Program (CBFIP). Seventeen existing flood retention facilities were modified, and two new spreading facilities were constructed. The waters recharged at these facilities include stormwater, recycled water, imported water, and dry-weather runoff. Figure 1-4 shows the location of these facilities. The recharge of dry-weather runoff is intermittent and can occur at most of the spreading basins.

4.1.1 Spreading Basin Descriptions and Recharge Capacities

Table 4-1 lists the spreading basins with the following information: historical average stormwater recharge, average operational availability for supplemental water recharge, recharge capacity limitations, and theoretical maximum supplemental water recharge capacity. From an operational perspective, there are two types of recharge basins within the Chino Basin: conservation and multipurpose basins. Conservation basins do not have a primary flood control function, and they are operated to recharge storm and supplemental water. Multipurpose basins are operated primarily for flood control and secondarily for recharging storm and supplemental water.

Table 4-1 shows the average annual storm and supplemental water recharge capacities of the spreading basins, based on 2018 conditions. Stormwater recharge varies by year, based on hydrologic conditions, and averaged about 10,150 afy from FY 2004/05 through FY 2016/17. Supplemental water recharge occurs during non-storm periods, and the projected supplemental water recharge capacity averages about 56,600 afy. Appendix A documents the information and computations used to estimate these recharge capacities. Table 4-2 shows the average annual storm and supplemental water recharge capacities in 2000 (prior to the implementation of the OBMP), in 2018 (after the 2001 RMP recharge projects were completed in 2004) and the projected increase in stormwater recharge capacity and change in supplemental water recharge capacity after the planned 2013 RMPU projects come online in 2020.

4.1.2 Historical Recharge Activity

Since the installation of SCADA in 2004, data have been tracked for the recharge of all types of water at each spreading basin. Watermaster maintains a database of the monthly recharge volumes by water type and recharge location. Figure 1-5 shows the annual recharge of recycled water, stormwater, and dry-weather runoff since the initiation of the recharge program in FY 2004/05. Table 4-3 is a tabulation of the annual recharge by water type and recharge location for FY 2003/04 through FY 2016/17. Through FY 2016/17, the recharge improvements constructed by Watermaster and the IEUA have enabled them to recharge about 360,000 af of storm and supplemental water into the Chino Basin.

Recycled water has become a significant portion of annual recharge, increasing from about 200 af in FY 2004/05 to about 13,900 af in FY 2016/17 and averaging about 12,400 afy over the five-year period ending in June 2017. The sum of stormwater, recycled water, and dry-weather runoff recharged in the Chino Basin from FY 2004/05 to the present is about 227,000 af.

Historically, imported water recharge has occurred in the Chino Basin for two reasons: replenishment of overproduction and storage and recovery projects. Watermaster meets its replenishment obligations by purchasing and recharging imported water from Metropolitan or by purchasing unproduced production rights or stored water from parties.

The magnitude of imported water recharge fluctuates significantly due to its availability and recharge needs. During the period of FY 2004/05 through 2006/07, imported water recharge was well above average because Metropolitan was putting water into storage for the DYYP. And in FY 2011/12, about 23,500 af of imported water was recharged in the Chino Basin due to the availability of surplus imported water supplies and incentives provided by Metropolitan to purchase imported water.

4.2 Existing ASR Facilities

ASR wells function as injection and recovery wells: imported water treated to drinking water standards is injected into an aquifer and recovered later when needed. The MVWD owns and operates the only active ASR wells in the Chino Basin, and it can recharge up to 5,480 afy at its wells (4, 30, 32, and 33) and subsequently recover a volume of groundwater equal to the injected water within the same year. Figure 4-1 shows the location of the MVWD's ASR wells, and Table 4-4 lists the wells and their respective injection and extraction capacities. The MVWD typically uses these wells for injection in the seven-month period of October through April and for recovery in the five-month period of May through September. Since these wells were installed in 2006, the MVWD has recharged about 1,075 af: 186 af in FY 2010/11 and 889 af in FY 2011/12. The MVWD anticipates recharging about 2,500 af in FY 2017/18.

4.3 In-Lieu Recharge Capability

In-lieu recharge can occur when a Chino Basin party with pumping rights in the Chino Basin elects to use supplemental water directly in lieu of pumping some or all its rights in the Chino Basin. Normally, this type of in-lieu recharge is classified as carryover water and if unused in the subsequent year is reclassified as excess carryover water in the case of the appropriative pool or water in the local storage account for the overlying non-agricultural pool. In certain cases, in-lieu recharge water is classified as supplemental water recharge (e.g. recharge for the Metropolitan Cyclic Storage Program and DYYP).

4.3.1 Facilities Used to Effectuate In-Lieu Recharge

The facilities used to effectuate in-lieu recharge include surface water treatment plants and conveyance facilities that convey imported water to Chino Basin parties. The IEUA is a wholesaler of imported water from Metropolitan to some of the Chino Basin parties. Three agencies purchase untreated imported water from the IEUA: the Water Facilities Authority (WFA), CVWD, and FWC.

- The WFA treats imported water purchased from the IEUA at the Agua de Lejos treatment plant (WFA plant) and delivers it to the cities of Chino, Chino Hills, Ontario, and Upland, and to the MVWD. Each of these WFA member agencies has a contracted share of the plant's total capacity of 81 million gallons per day (mgd) (90,700 afy).
- The CVWD treats imported water purchased from the IEUA at the Royer-Nesbit and Lloyd W. Michael treatment plants. These plants have capacities of 11 mgd (12,300 afy) and 60 mgd (67,200 afy), respectively.
- The FWC treats imported water purchased from IEUA and the San Bernardino Valley Municipal Water District at the Sandhill treatment plant. The Sandhill plant has a total capacity of 29 mgd (32,500 afy).

Pomona receives imported water through the TVMWD. The TVMWD serves Pomona primarily through the Weymouth treatment plant, which has a capacity of 520 mgd (582,000 afy). Pomona's capacity to receive imported water from TVMWD is about 6,800 afy.

4.3.2 Historical In-Lieu Recharge Activity

The IEUA reported in the 2013 RMPU (WEI, 2013) that the total in-lieu recharge for the period of FY 1977/78 through FY 2011/12 was about 350,000 af. Since FY 2011/12, an additional 80,000 af of in-lieu recharge has occurred, bringing the total in-lieu recharge over the Judgment period to about 430,000 af.

4.3.3 In-Lieu Capacity

The projected in-lieu recharge capacity for each agency with access to imported water was estimated based on planning data compiled for the Storage Framework. Each party's in-lieu recharge capacity was limited by the lessor of the following:

- Capacity of treatment plant(s) to treat and serve imported water or party's capacity to receive imported water, less the party's projected imported water demand
- Party's Chino Basin pumping rights
- Party's Chino Basin pumping

The appropriator parties capable of in-lieu recharge include the Cities of Chino, Chino Hills, Ontario, Pomona, and Upland, and the CVWD, FWC and MVWD. Each party's capacity was calculated monthly for planning years 2020, 2025, 2030, 2035, and 2040. Appendix B contains tables that show how the in-lieu recharge estimates were made. These planning estimates were submitted to each party for comment. Table 4-5a shows the estimated annual in-lieu capacities for each of the parties under current conditions. Note that the WFA plant's current capacity is less than its rated capacity of 81 mgd (90,700 afy) due to solids handling limitations.[14] According to WFA, the current capacity of the WFA plant is about 40 mgd in the summer months and about 20 mgd in the winter months. As shown in Table 4-5a the total in-lieu recharge capacity in the Chino Basin, under the current capacity limitations of the WFA plant, ranges from 17,700

[14] Email from Terry Catlin, April 10, 2018.

afy in 2020 to about 20,700 afy in 2030, declining to 19,200 afy in 2040. Table 4-5b shows the in-lieu recharge estimates without the WFA capacity limitations. Without the WFA limitations, the total in-lieu recharge capacity in the Chino Basin ranges from 40,900 afy in 2020 to about 45,700 afy in 2030, declining to 41,900 afy in 2040.

4.4 Existing MS4 Facilities

The Court's Order on April 25, 2014 approved Section 5 of the 2013 RMPU and ordered Watermaster to compile MS4 project-related information from appropriative pool parties within the Chino Basin in order to compute net new stormwater recharge. Net new stormwater recharge (net new recharge) is defined in the 2013 RMPU (WEI, 2013) as follows:

> "The net new recharge from the implementation of the 2010 MS4 permit is equal to the stormwater recharge caused by the implementation of stormwater management projects pursuant to the MS4 permit minus the decrease in recharge at existing stormwater management facilities minus the incidental deep infiltration of precipitation that would have occurred in the pre-project condition.[15]"

This net new stormwater recharge calculation must be completed concurrent with the next recalculation of Safe Yield, which is expected to be completed in 2020. Section 5 of the 2013 RMPU contains three alternatives to compute net new recharge, including the Alternative 3 Hybrid Alternative, recommended by the RMPU Steering Committee and subsequently approved by Watermaster and the Court. The recommended alternative is described in Section 5 as follows:

> "Watermaster staff would annually acquire and store electronic versions of MS4 project-related reports and maintenance verification databases. When scoping a future Safe Yield re-determination, Watermaster would use its judgment and discretion to determine if there has been a significant potential increase in MS4 project-related recharge. If judged significant, the Watermaster would explicitly incorporate significant MS4 projects into the modeling and other technical activities required to re-determine Safe Yield. The calibration process for the groundwater model used in the Safe Yield re-determination would be used to refine the MS4 recharge estimates. Net new recharge would be estimated by rerunning the calibration without the new MS4 facilities and comparing both simulations.[16]"

On July 31, 2014, Watermaster started its first annual MS4 data request and sent a letter to each appropriative pool party requesting MS4-related information. The annual data request includes:

- Water Quality Management Plan (WQMP) reports

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[15] Section 5.1, 2013 Amendment to the 2010 Recharge Master Plan, October 2013: http://www.cbwm.org/docs/engdocs/2013%20Amendment%20to%20the%202010%20RMPU/2013%20Amendment%20to%20the%202010%20RMPU%20%E2%80%93%20Sections%201%20through%208.pdf

[16] Section 5.3.3, 2013 Amendment to the 2010 Recharge Master Plan, October 2013: http://www.cbwm.org/docs/engdocs/2013%20Amendment%20to%20the%202010%20RMPU/2013%20Amendment%20to%20the%202010%20RMPU%20%E2%80%93%20Sections%201%20through%208.pdf

- Design reports
- As-built drawings[17]
- Maintenance verification

Watermaster has continued to request MS4 data each fiscal year since July 31, 2014. The data requests are sent out in July or August, and the data are due in October of each fiscal year.

MS4 projects with WQMP reports submitted to the Watermaster are compiled in a database. WEI reviews the WQMP reports for projects constructed after FY 2010/11[18] and extracts the following information:

- Location of the MS4 project
- Project's overall drainage area
- Project's total drainage area that flows into constructed infiltration feature(s)[19]
- Design capture volume (DCV)[20] of the constructed infiltration feature(s)

At the end of FY 2016/17, Watermaster analyzed the data compiled in the database. Table 4-6 summarizes the information received by Watermaster up to FY 2016/17, and Figure 4-2 shows the locations of the MS4 projects. Table 4-6 shows that at the end of FY 2016/17, Watermaster had received almost 200 WQMP reports for projects constructed during the period of FY 2010/11 to FY 2015/16, of which 163 were within the Chino Basin.

4.4.1 Historical MS4 Recharge Activity

Once the projects within the basin were identified, the projects were separated into two categories: projects compliant with MS4 through infiltration features and projects compliant with MS4 through non-infiltration features. A total of 114 of the 163 projects within the Chino Basin were identified as complying with MS4 through infiltration features. These projects have an aggregate drainage area of 1,733 acres.

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[17] At the March 19, 2015 RMPU Steering Committee meeting, the Appropriator Parties informed Watermaster that they may not be able to provide as-built drawings. As-built drawings are important to Watermaster because they include what was constructed and the construction completion date. In the absence of as-built drawings, Watermaster requires certification that the facilities were constructed as represented in the WQMP and design reports. Watermaster staff has developed a form that can be used by Appropriator Parties if they cannot furnish as-built drawings for an MS4 or other local storm water management project constructed during and after FY 2011. Finally, Watermaster also requires records of maintenance performed on each constructed MS4 project or other local storm water management projects from the Appropriator Parties.

[18] The WQMP approval date was used when the construction date was not available.

[19] Infiltration features are specifically designed to capture and infiltrate storm water runoff to comply with MS4 permits. Infiltration features could include offsite and onsite infiltration basins, infiltration trenches, infiltration pits, underground infiltration, drywells, gravel bedding infiltration, and bioretention with no underdrain.

[20] For San Bernardino and Riverside Counties, design capture volume (DCV) is the volume of storm water runoff resulting from the 85th percentile, 24-hr storm event that the designed infiltration feature is constructed to capture. For LA County, DCV is (1) the 0.75-inch, 24-hour storm event, or (2) the 85th percentile, 24-hour storm event, whichever is greater.

4.4.2 MS4 Recharge Capacities

To prepare a reconnaissance-level estimate of the potential net new recharge of these 114 projects under idealized conditions,[21] WEI assumed that these projects would create net new recharge at the same expected rate developed during the 2013 RMPU for Chino Fire Station No. 1. Based on this analysis, it was determined that the total reconnaissance-level estimate of net new storm water recharge is 381 afy. Note that because precipitation is greater north of Chino Fire Station No.1[22] and the majority of MS4 projects submitted to Watermaster are north of the Fire Station, this estimate is conservatively low. Watermaster will review these projects and estimate their potential net new recharge in the 2020 Safe Yield recalculation.

4.4.3 Deficiencies in MS4 Facilities Documentation and Reporting

To determine the completeness of Watermaster's MS4 projects database, it was compared to the WQMP Inventories from the *NPDES Phase I MS4 Permit Annual Report FY 2014* (SBCFCD, 2015) prepared by San Bernardino and Riverside Counties.[23] This comparison indicated that Watermaster had received a subset of MS4 projects from each of the appropriative pool parties. And, few appropriative pool parties submitted the documentation required by Section 5 of the 2013 RMPU. 58 percent (95 out of 163 MS4 projects within the Chino Basin) of the submitted MS4 projects have confirmed WQMP approval dates, 22 percent (36 out of 163 MS4 projects within the Chino Basin) have documentation on the project construction dates, and 10 percent (17 out of 163 MS4 projects within the Chino Basin) have documentation on the maintenance performed.

The results of the analysis summarized in Table 4-6 were presented at the Recharge Investigations and Projects Committee (RIPCom) meeting on September 21, 2017. The main conclusions and recommendations presented at, and resulting from, this meeting were:

- The appropriative pool parties have not provided a comprehensive dataset of the projects within their service area.
- Watermaster does not have all of the data required to compute the net new recharge created by these projects.[24]
- There is potential for at least 380 afy of net new recharge if these projects are maintained to perform as originally designed.

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[21] Idealized conditions means that the infiltration feature performs as it was designed and that maintenance is performed to ensure that the infiltration feature performs as originally designed.

[22] Section 5.3.1, 2013 Amendment to the 2010 Recharge Master Plan, October 2013.

[23] Watermaster can only use the WQMP Inventory from the *NPDES Phase I MS4 Permit FY 2014 Annual Report* to estimate the number of MS4 projects in San Bernardino and Riverside Counties. Watermaster cannot use the Inventory to determine the new net storm water recharge because the inventory does not contain the information required to estimate storm water recharge.

[24] Per Section 5 of the 2013 RMPU, the Steering Committee recommended that, if the Appropriator Parties do not consistently provide data to Watermaster or if the submitted data are incomplete, Watermaster compute net new recharge using the method described in Alternative 2 in Section 5 of the 2013 RMPU. In this alternative, the net new recharge from determining Safe Yield would be automatically incorporated into the Safe Yield, and the direct estimation of net new recharge would not be made.

- After the 2018 RMPU is published, Watermaster will annually review the time and effort involved in the collection of information on these projects and reassess the value this effort provides.

Watermaster continues to collect and analyze MS4 data in order to determine if there has been a significant potential increase in MS4-project related recharge. If judged significant, Watermaster will explicitly incorporate significant MS4 projects into the modeling and other technical activities required to recalculate Safe Yield; the calibration process for the groundwater model used in the Safe Yield recalculation would be used to refine the MS4 recharge estimates. Net new recharge would be estimated by rerunning the calibration without the new MS4 facilities and comparing both simulations. Watermaster will continue to update Figure 4-2 and Table 4-6 to document available information on MS4 compliance measures. RIPCom will review this information annually.

4.5 Planned Recharge Facilities Currently Being Implemented

The 2013 RMPU contained recommendations to improve 10 recharge facilities and an implementation plan for their planning, design, and construction. Since completion of the 2013 RMPU, the IEUA and Watermaster have entered into agreements to plan, design, and construct five of the recommended facility improvements. Table 1-1 lists the 2013 RMPU projects that could be constructed, their expected annual stormwater recharge, and their supplemental water recharge benefits. With completion of these 2013 RMPU projects, stormwater recharge is projected to increase by 4,800 afy, and recycled water recharge capacity is projected to increase by 7,100 afy.

Table 4-2 shows the projected recharge capacity for various sources of water after the construction of the five 2013 RMPU projects currently being implemented. The projected average stormwater recharge capacity is 15,800 afy, the total imported water capacity is 49,900 afy, and the total recycled water capacity is 20,300 afy.

4.6 Potential New Recharge Facilities Evaluated in the 2018 RMPU

Table 4-7 lists the potential new recharge projects that were evaluated in the scoping process for the 2018 RMPU. The locations of these projects are shown in Figure 4-3. Only new stormwater recharge projects were considered herein because, as demonstrated above, there is adequate recharge capacity for supplemental water recharge through 2050. The projects listed in Table 4-7 include projects that were considered in the 2013 RMPU and determined to be technically and institutionally feasible but whose unit stormwater recharge costs exceeded the economic feasibility threshold established in the 2013 RMPU of $612 per af. The 2013 RMPU included a potential project entitled Regional Recharge Distribution System. This project description was updated during the 2018 RMPU scoping process, and its stormwater recharge and costs were updated for the 2018 RMPU. The projects listed in Table 4-7 were reviewed, and their unit storm water recharge costs were projected to 2023 costs.

At the February 2018 RMPU steering committee meeting, the Watermaster invited all participants to propose projects for consideration in the 2018 RMPU. The CBWCD responded with a stormwater recharge project called the Confluence Project that it was investigating. Watermaster staff proposed a supplemental water recharge concept that would recharge imported water through the flooding of vineyards during the winter. Both of these projects are included in Table 4-7, and they should be evaluated more thoroughly in the future when their project descriptions and operating characteristics are more clearly defined.

The unit cost of new stormwater recharge for the projects listed in Table 4-7 ranges from $2,000 to $6,000 per af. In all cases, the projected unit cost of new stormwater recharge projects listed in Table 4-7 exceeds the projected cost of water that could be supplied by Metropolitan in 2023 at about $900 per af (see Table 2-5). Based on the information developed in the 2018 RMPU effort, no new stormwater recharge projects are recommended for implementation in the 2018 RMPU. This could change when the costs of the WaterFix project are included in cost of imported water supplied by Metropolitan and/or if grant funding could be obtained that would lower the unit cost of stormwater recharge.

4.7 Summary of Existing and Planned Recharge Capacity

Table 4-8 summarizes the existing recharge capacity, the recharge capacity expected when the planned 2013 RMPU projects are online in 2020, and the expected recharge capacity based on 2020 conditions if the WFA treatment plant capacity is restored to its original design capacity. The supplemental water recharge capacity is about 79,800 afy in 2018 and will not change after the planned 2013 RMPU projects are online. If the original capacity of the WFA plant were restored, the total supplemental water recharge capacity would increase to about 103,000 afy.

Table 4-1
Average Stormwater Recharge and Supplemental Water Recharge Capacity Estimates

Recharge Facility	Average Stormwater Recharge FY 2004/05 through FY 2016/17	Average Operational Availability for Supplemental Water Recharge: Quarter 3			Quarter 4			Quarter 1			Quarter 2			Recharge Capacity Limitations for Supplemental Water Recharge Facilities: Spillway, Outlet, Cons. Berm or Inlet Controlled		Freeboard	Maximum Operating Level	Wetted Area at Maximum Operating Level	Assumed Number of Years Between Maintenance[2]	Theoretical Maximum Supplemental Water Recharge Capacity: Parameter Values for Estimating Infiltration Rate[3]: Continuous Percolation Rate Function[4]			Long-Term Average Infiltration Rate	Maximum Theoretical One-Month Recharge Total[5]	Maximum Theoretical Three-Month Recharge Total[6]	Maximum Theoretical Annual Recharge Total[7]	Maximum Average Theoretical Annual Recharge Between Maintenance Periods[8]
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Elevation	Control Structure[1]					Alpha	Maximum Infiltration Rate	R-Square Goodness of Fit					
	(afy)													(ft-amsl)		(ft)	(ft-amsl)	(acres)			(ft/day)		(ft/day)	(af)			
Brooks Street Basin	489	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	889.5	a	1.5	888.0	9.6	3	0.0003	1.8	0.674	-	385	1,031	2,825	1,658
College Heights Basin - East	78	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1242.0	a	1	1241.0	6.2	10	-	-	-	3.0	558	1,552	5,932	5,816
College Heights Basin - West		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1242.0	a	16	1226.0	3.3	10	-	-	-	2.0	198	551	2,105	2,064
Montclair Basin 1		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1128.2	b	1	1127.2	7.4	4	0.002	3.8	0.879	-	302	608	1,097	409
Montclair Basin 2	953	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1097.0	b	0	1097.0	11.6	4	0.0002	4.4	0.622	-	1,188	2,923	6,702	2,940
Montclair Basin 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1057.0	b	0	1057.0	4.3	4	0.002	3.2	0.625	-	280	572	1,052	400
Montclair Basin 4		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1037.0	b	2	1035.0	5.5	4	0.0005	1.4	0.720	-	270	702	1,856	915
Eighth Street Basin	1,069	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1144.5	b	0	1144.5	17.0	2	-	-	-	0.7	357	993	3,795	3,426
Seventh Street Basin		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1130.0	c	0	1130.0	5.6	3	-	-	-	0.7	118	327	1,250	1,170
Upland Basin	430	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1210.0	f	30	1180.0	13.2	10	0.00022	1.3	0.986	-	283	801	2,490	891
Subtotal Management Zone 1	3,019																							3,939	10,058	29,102	19,689
Ely	1,120	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	838.0	b	3	835.0	33.0	3	0.0001	1.2	0.511	-	948	2,578	7,375	4,501
Grove Basin	305	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Etiwanda Debris Basin	212	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1605.0	d	0	1605.0	15.5	10	-	-	-	0.6	279	776	2,966	2,908
Hickory Basin East	361	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1117.0	d	3	1114.0	4.1	3	-	-	-	0.7	86	239	915	856
Hickory Basin West		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1115.0	d	1	1114.0	6.8	3	-	-	-	0.7	143	397	1,518	1,420
Lower Day Basin Cell 1		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1379.8	e	1	1377.0	3.6	5								
Lower Day Basin Cell 2	513	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1379.8	e	1	1372.0	4.9	5	0.0005	1.8	0.909	-	438	1,088	2,547	983
Lower Day Basin Cell 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1379.8	e	1	1373.0	6.3	5								
San Sevaine No. 1		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1488.7	d	0	1488.7	9.7	5	0.01	3.4	0.732	-	231	324	437	114
San Sevaine No. 2	816	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1472.5	f	0	1472.5	8.5	5	0.0001	2.8	1.000	-	647	1,774	5,455	2,869
San Sevaine No. 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1458.0	f	0	1458.0	5.3	5	0.0001	2.8	1.000	-	403	1,132	3,745	2,226
Turner Basin No. 1		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1000.0	b	2	998.0	12.7	3	0.002	2.0	0.698	-	424	785	1,305	577
Turner Basin No. 2		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	990.5	b	1	989.5	3.9	3	0.0045	1.8	0.505	-	139	276	494	227
Turner Basin No. 3	1,527	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	980.5	a	2	978.5	2.8	3	-	-	-	0.5	42	117	446	418
Turner Basin No. 4A		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	980.5	a	2	978.5	6.6	3	-	-	-		99	274	1,049	981
Turner Basin No. 4B		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	980.5	a	2	978.5	1.1	3	-	-	-	0.5	17	46	175	164
Turner Basin No. 4C		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	980.5	a	2	978.5	1.3	3	-	-	-		19	53	204	191
Victoria Basin	309	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1323.9	b	1	1322.9	19.1	3	-	-	-	0.4	229	637	2,436	2,279
Subtotal Management Zone 2	5,163																							4,144	10,497	31,068	20,713
Banana Basin	258	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1143.0	b	0	1143.0	7.5	3	-	-	-	0.8	180	501	1,913	1,790
Declez Basin Cell 1		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	833.2	d	0	833.2	6.9	3	-	-	-	0.6	124	345	1,320	1,235
Declez Basin Cell 2	582	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	831.0	d	1	830.0	4.6	3	-	-	-	0.6	83	230	880	823
Declez Basin Cell 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	831.0	d	1	830.0	4.3	3	-	-	-		77	215	823	770
IEUA RP3 Basin Cell 1		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	961.0	d	3	958.0	10.4	3	-	-	-	1.5	468	1,301	4,975	4,653
IEUA RP3 Basin Cell 3	1,129	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	950.0	d	0	950.0	7.3	3	-	-	-	1.5	329	913	3,492	3,266
IEUA RP3 Basin Cell 4		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	945.0	d	1	944.0	8.2	3	-	-	-	1.5	369	1,026	3,923	3,669
Subtotal Management Zone 3	1,969																							1,630	4,532	17,326	16,204
Totals	10,151																							9,713	25,088	77,497	56,606

1 - Limiting control structure types include: a = inlet, b = spillway, c = flood control restriction, d = conservation berm, e = outlet, and f = other restriction.
2 - The term maintenance as used in the table means maintenance activities that restore infiltration rates (removal of clogging layers followed by ripping or functionally equivalent activities).
3 - Infiltration rates were based either on a Continuous Percolation Rate Function (CPRF) if data were available to develop such a function and their R^2 values were greater than 0.5 **or** the average long-term infiltration rate; both are based on IEUA data and reported infiltration rates.
4 - Details on the calculation of the Continuous Percolation Rate Functionare provided in Appendix A.
5 - Assumes recharge facility has been cleaned over the period of July to August and is filled to operating level on September 1st.
6 - Maximum Theoretical Three-Month Recharge Total is the total recharge from the three-month period directly after a cleaning.
7 - Maximum Theoretical Annual Recharge Total is the total recharge from the 10-month period directly after a cleaning.
8 - Average annual recharge over the span between maintenance. When recharge facilities are not being cleaned, operational availability is 1.0 for July and August. The average cleaning frequency of each recharge facility was provided by the IEUA.

Table 4-2

Historical and Projected Storm and Wet-Water Supplemental Water Recharge Capacity in the Chino Basin

(afy)

Water Type	Pre-OBMP Recharge Capacity in 2000	Capacity after 2001 RMP Recharge Projects Were Completed in 2004	Capacity after 2013 RMPU Recharge Projects Are Completed
Storm[1]	~2,000	11,000	15,800
Recycled	500	13,200	20,300
Imported	28,500	43,400	36,300
Total	31,000	67,600	72,400

1 - Stormwater recharge capacity in 2000 is defined as the average historical stormwater recharge. Stormwater recharge after 2000 is defined as the average expected stormwater recharge.

Table 4-3
Summary of Annual Wet-Water Recharge Records in the Chino Basin
(af)

Basin Name	FY 2003/2004				FY 2004/2005				FY 2005/2006				FY 2006/2007				FY 2007/2008				FY 2008/2009				FY 2009/2010			
	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total
MVWD ASR Well	NM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
College Heights Basins	NM	0	0	0	0	0	0	0	108	5,326	0	5,434	1	3,125	0	3,126	172	0	0	172	0	0	0	0	65	382	0	447
Upland Basin	NM	0	0	0	989	0	0	989	214	5,985	0	6,199	195	7,068	0	7,263	312	0	0	312	274	0	0	274	532	0	0	532
Montclair Basins	NM	3,558	0	3,558	3350	7,887	0	11,237	1,296	5,579	0	6,875	355	10,681	0	11,036	859	0	0	859	611	0	0	611	937	4,592	0	5,529
Brooks Street Basin	NM	0	0	0	1776	0	0	1,776	524	2,032	0	2,556	205	1,604	0	1,809	475	0	0	475	434	0	1,605	2,039	666	0	1,695	2,361
7th and 8th Street Basins	NM	0	0	0	620	0	0	620	1,271	0	0	1,271	640	0	0	640	959	0	1,054	2,013	1,139	0	352	1,491	1,744	6	1,067	2,817
Ely Basins	NM	0	49	49	2010	0	158	2,168	1,531	0	188	1,719	631	0	466	1,097	1,603	0	562	2,165	927	0	364	1,291	1,164	0	246	1,410
Grove Basin	NM	0	0	0	0	0	0	0	133	0	0	133	166	0	0	166	326	0	0	326	405	0	0	405	351	0	0	351
Turner Basins	NM	0	0	0	1428	310.2	0	1,738	2,575	346	0	2,921	406	313	1,237	1,956	1,542	0	0	1,542	1,200	0	171	1,371	2,220	0	397	2,617
Lower Day Basin	NM	0	0	0	2798	107	0	2,905	624	2,810	0	3,434	78	2,266	0	2,344	303	0	0	303	168	0	0	168	540	3	0	543
Etiwanda Debris Basins	NM	2,812	0	2,812	0	2137	0	2,137	20	2,488	0	2,508	0	1,160	0	1,160	10	0	0	10	28	0	0	28	775	7	0	782
Victoria Basin	NM	0	0	0	0	0	0	0	330	0	0	330	260	0	0	260	427	0	0	427	250	0	0	250	494	2	0	496
San Sevaine	NM	1,211	0	1,211	2830	1620.7	0	4,451	2,072	9,172	0	11,244	244	5,749	0	5,993	749	0	0	749	225	0	0	225	993	0	0	993
Hickory Basin	NM	0	0	0	298	197	0	495	438	636	586	1,660	536	212	647	1,395	949	0	567	1,516	199	0	46	245	700	7	856	1,563
Banana Basin	NM	0	0	0	425	0	0	425	300	193	529	1,022	226	783	643	1,653	278	0	157	435	383	0	40	423	416	0	898	1,314
RP-3 Basins	NM	0	0	0	1105	0	0	1,105	767	0	0	767	802	0	0	802	511	0	0	511	613	0	106	719	1,902	1	2,051	3,954
Declez Basin	NM	0	0	0	19	0	0	19	737	0	0	737	0	0	0	0	730	0	0	730	656	0	0	656	774	0	0	774
Totals:	NM	7,582	49	7,631	17,648	12,258	158	30,065	12,940	34,567	1,303	48,810	4,745	32,960	2,993	40,698	10,205	0	2,340	12,545	7,512	0	2,684	10,196	14,273	5,000	7,210	26,483

Basin Name	FY 2010/2011				FY 2011/2012				FY 2012/2013				FY 2013/2014				FY 2014/2015				FY 2015/2016				FY 2016/2017			
	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total	SW	IW	RW	Total
MVWD ASR Well	0	186	0	186	0	889	0	889	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
College Heights Basins	593	559	0	1,152	4	578	0	582	0	0	0	0	4	0	0	4	0	0	0	0	0	0	0	0	70	0	0	0
Upland Basin	1,308	899	0	2,207	222	2,118	0	2,340	119	0	0	119	95	0	0	95	325	0	0	325	425	0	0	425	583	2,179	0	2,762
Montclair Basins	1,762	3,672	0	5,434	703	11,893	0	12,596	204	0	0	204	416	0	0	416	411	0	0	411	441	0	0	441	1,046	2,575	0	3,621
Brooks Street Basin	628	0	1,373	2,001	363	561	836	1,760	115	0	1,505	1,620	112	0	1,308	1,420	198	0	1,011	1,209	182	0	1,215	1,397	674	6,150	0	6,824
7th and 8th Street Basins	1,583	543	1,871	3,997	1,047	572	641	2,260	751	0	2,261	3,012	441	5	1,423	1,869	1,751	0	48	1,799	921	0	1,470	2,391	1,034	188	385	1,607
Ely Basins	1,415	83	757	2,255	1,096	885	393	2,374	568	0	1,378	1,946	548	0	3,298	3,846	183	0	1,751	1,934	1,506	0	1,012	2,518	1,378	18	2,291	3,687
Grove Basin	431	0	0	431	400	0	0	400	177	0	0	177	258	0	0	258	481	0	0	481	471	0	0	471	363	0	1,491	1,854
Turner Basins	2,308	0	53	2,361	1,879	199	1,034	3,112	1,120	0	176	1,296	596	0	1,565	2,161	1,289	0	948	2,237	1,616	0	1,958	3,574	1,667	290	1,236	3,193
Lower Day Basin	703	894	0	1,597	158	1,439	0	1,597	106	0	0	106	114	28	0	142	341	0	0	341	281	0	0	281	449	292	0	741
Etiwanda Debris Basins	1,213	147	0	1,360	100	567	0	667	33	0	0	33	45	0	0	45	27	0	0	27	83	0	0	83	426	281	0	707
Victoria Basin	461	69	773	1,303	221	281	665	1,167	94	0	842	936	192	0	1,379	1,571	306	0	931	1,237	343	0	635	978	642	128	1,621	2,391
San Sevaine	1,049	1,707	396	3,152	436	1,228	513	2,177	147	0	575	722	162	0	274	436	330	0	1	331	585	0	0	585	785	540	0	1,325
Hickory Basin	371	10	776	1,157	258	515	783	1,556	199	0	874	1,073	171	13	1,920	2,104	243	0	2,034	2,277	184	0	575	759	142	0	136	278
Banana Basin	149	0	267	416	247	0	1,915	2,162	114	0	670	784	87	24	1,071	1,182	197	0	1,148	1,345	365	0	2,106	2,471	166	0	500	666
RP-3 Basins	2,201	882	1,799	4,882	1,339	1,724	1,789	4,852	1,021	0	2,198	3,219	717	350	1,355	2,422	1,030	0	2,968	3,998	1,226	0	3,282	4,508	1,437	386	5,770	7,593
Declez Basin	877	0	0	877	798	0	65	863	530	0	0	530	341	374	0	715	895	0	0	895	607	0	969	1,576	607	99	514	1,220
Totals:	17,052	9,650	8,065	34,767	9,271	23,449	8,634	41,354	5,298	0	10,479	15,777	4,299	795	13,593	18,687	8,007	0	10,840	18,847	9,236	0	13,222	22,458	11,469	13,127	13,944	38,470

NM - Not measured SW - Surface Water IW - Imported Water RW - Recycled Water FY - Fiscal Year

Table 4-4
MVWD ASR Injection and Extraction Capacity[1]

ASR Well	Injection Capacity[2]		Extraction Capacity[2]	
	(gpm)	(afm)	(gpm)	(afm)
MVWD-4	400	53	400	53
MVWD-30	1,000	133	2,000	265
MVWD-32	1,000	133	2,000	265
MVWD-33	1,000	133	2,000	265
Total	3,400	451	6,400	849

1. All of the existing ASR wells are owned by the Monte Vista Water District with the exception being MVWD-33, which is co-owned by the City of Chino.

2. The injection and extraction capacities assume the wells are operating 24 hours a day for 30 days.

Table 4-5a
Estimated In-Lieu Recharge Capacities for Appropriative Pool Parties
Under Current Conditions
(afy)

Appropriative Pool Party	Treatment Plant	Maximum In-Lieu Recharge Capacity				
		2020	2025	2030	2035	2040
CVWD	CVWD	11,383	13,687	13,859	13,938	13,938
Pomona	TVMWD	6,321	6,787	6,800	6,587	5,307
Chino	WFA	0	0	0	0	0
Chino Hills	WFA	0	0	0	0	0
MVWD	WFA	0	0	0	0	0
Ontario	WFA	0	0	0	0	0
Upland	WFA	0	0	0	0	0
Total		17,704	20,474	20,659	20,525	19,245

Note: The WFA plant's current capacity is less than its rated capacity of 81 mgd due to solids handling limitations, therefore it is assumed that parties that receive water from WFA have no in-lieu recharge capacity under current conditions.

Table 4-5b
Estimated In-Lieu Recharge Capacities for Appropriative Pool Parties
Under Design Capacity Conditions
(afy)

Appropriative Pool Party	Treatment Plant	Maximum In-Lieu Recharge Capacity				
		2020	2025	2030	2035	2040
CVWD	CVWD	11,383	13,687	13,859	13,938	13,938
Pomona	TVMWD	6,321	6,787	6,800	6,587	5,307
Chino	WFA	1,449	1,191	946	818	750
Chino Hills	WFA	2,570	3,600	3,600	3,600	3,600
MVWD	WFA	4,420	4,413	4,471	4,379	4,259
Ontario	WFA	12,006	12,829	13,348	13,017	11,490
Upland	WFA	2,800	2,798	2,641	2,545	2,545
Total		17,704	20,474	20,659	20,525	19,245

Note: This assumes the WFA plant capacity is restored to design capacity.

Table 4-6
Summary of Compliance with Section 5 of the 2013 Amendment to the 2010 RMPU for Projects Constructed during FY 2010/11 to FY 2015/16

Appropriative Pool Party	All MS4 Projects		MS4 Projects that Utilize Infiltration Features for MS4 Compliance [5]				Confirmed Approval Date	Confirmed Construction Date	Confirmed Maintenance
	Number of Projects	Total Drainage Area (acres)	Number of Projects	Total Drainage Area (acres)	Design Capture Volume[6] (af)	Reconnaissance Estimate of Stormwater Recharge under Idealized Conditions (afy)			
All MS4 Projects Submitted to Watermaster									
Chino, City of	18	890	5	445	24	98	11	3	0
Chino Hills, City of [1]	0	0	0	0	0	0	0	0	0
Ontario, City of	38	396	36	376	32	83	24	13	16
Pomona, City of [2]	28	144	16	100	5	22	4	0	0
Upland, City of	6	23	5	23	1	5	1	5	0
CVWD [2]	0	0	0	0	0	0	0	0	0
FWC	60	584	46	501	45	110	48	0	0
JCSD	18	879	10	472	14	104	1	3	0
MMWC	1	3	0	0	0	0	0	1	1
MVWD	12	59	7	27	2	6	12	11	0
Riverside County [3,4]	0	0	0	0	0	0	0	0	0
San Bernardino County	6	10	2	7	1	2	0	0	0
SAWCo [1]	0	0	0	0	0	0	0	0	0
Total	187	2,988	127	1,951	124	428	101	36	17
Submitted MS4 Projects within the Chino Basin									
Chino, City of	18	890	5	445	24	98	11	3	0
Chino Hills, City of [1]	0	0	0	0	0	0	0	0	0
Ontario, City of	38	396	36	376	32	83	24	13	16
Pomona, City of [2]	11	61	10	55	3	13	2	0	0
Upland, City of	6	23	5	23	1	5	1	5	0
CVWD [2]	0	0	0	0	0	0	0	0	0
FWC	53	394	39	328	28	72	44	0	0
JCSD	18	879	10	472	14	104	1	3	0
MMWC	1	3	0	0	0	0	0	1	1
MVWD [3]	12	59	7	27	2	6	12	11	0
Riverside County [4,5]	0	0	0	0	0	0	0	0	0
San Bernardino County	6	9	2	7	1	2	0	0	0
SAWCo [1]	0	0	0	0	0	0	0	0	0
Total	163	2,714	114	1,733	105	381	95	36	17

Notes:

CVWD: Cucamonga Valley Water District
FWC: Fontana Water Company
JCSD: Jurupa Company Services District
MMWC: Marygold Mutual Water Company
MVWD: Monte Vista Water District
SAWCo: San Antonio Water Company

1. Not required to comply with the court order because their service area is mostly located outside of the Chino Basin boundary.
2. The CVWD informed Watermaster that they are in communication with the City of Rancho Cucamonga, and their data collection is in process.
3. Riverside County provided a GIS database, showing Riverside County's drainage facilities within the Chino Basin, which include all drainage facilities, not just MS4 facilities. The county informed Watermaster that they do not have specific data on MS4 projects and that Watermaster should request MS4 data from the cities within the county.
4. Riverside and San Bernardino Counties prepare annual reports that include a database of all MS4 projects within their jurisdiction. A comparison of these databases to the data submitted to Watermaster indicates that Watermaster has received only a subset of MS4 projects in each Appropriator Party service area. Watermaster cannot use these county databases directly because they do not contain the information required to estimate stormwater recharge.
5. Infiltration features could include offsite or onsite infiltration basins, infiltration trenches, infiltration pits, underground infiltration, drywells, gravel bedding infiltration, and bioretention with no underdrain.
6. For San Bernardino and Riverside Counties, design capture volume (DCV) is the volume of storm water runoff resulting from the 85th percentile, 24-hr storm event that the designed infiltration feature is constructed to capture. For LA County, DCV is either the 0.75-inch, 24-hour storm event, or the 85th percentile, 24-hour storm event, whichever is greater.
7. Estimated based on the assumption that all projects are similar to the Chino Fire Station No. 1 and Training Center MS4 project evaluated in Section 5 of the 2013 Amendment to the 2010 RMPU. Note that because precipitation is expected to increase north of Chino Fire Station No.1 and the majority of MS4 projects submitted to Watermaster are north of the Fire Station, this estimate is conservatively low. Idealized conditions mean that the infiltration feature performs as it was designed and that maintenance is performed to ensure that the infiltration feature performs as originally designed.

Table 4-7

Projects Considered and Not Recommended Due to Cost in the 2013 RMPU and New Conceptual Recharge Projects Considered in the 2018 RMPU[1]

PID[2]	Project	Source	New Stormwater Recharge (afy)	2013 RMPU Estimated Unit Stormwater Recharge Cost ($/af)	Projected Costs in 2023	
					2018 RMPU Estimated Unit Stormwater Recharge Cost ($/af)	2018 RMPU Estimated Capital Cost
1a	Montclair Basins - Transfer water between Montclair Basins and deepen MC 4	2013 RMPU	71	$4,997	$5,980	$6,526,000
5	North West Upland Basin - Increase drainage area and basin enlargement	2013 RMPU	93	$3,858	$4,620	$6,574,000
15	Ely Basin - Basin enlargement and increased drainage area	2013 RMPU	101	$2,726	$1,990	$3,017,000
24	Vulcan Basin - Construct new inflow and outflow structures	2013 RMPU	857	$2,140	$2,560	$33,168,000
26	Sultana Avenue - Deepen basin by 10 feet	2013 RMPU	7	$4,697	$5,620	$601,000
n/a	Regional Recharge Distribution System	2013 RMPU	5,000	$2,600	$2,810	$184 million
n/a	Vineyard Managed Aquifer Recharge	2018 RMPU	n/a	n/a	n/a	n/a
n/a	CBWCD Confluence Project[3]	2018 RMPU	n/a	n/a	n/a	n/a

[1] With the exception of the last two projects listed, projects in this table were included in the 2013 RMPU and were considered in the 2018 RMPU based on the following criteria: projected yield is greater than zero (excluding projects for which yield was not quantified); project was not already implemented; project was determined to be technically and institutionally feasible; project was not recommended for final implementation in the 2013 RMPU

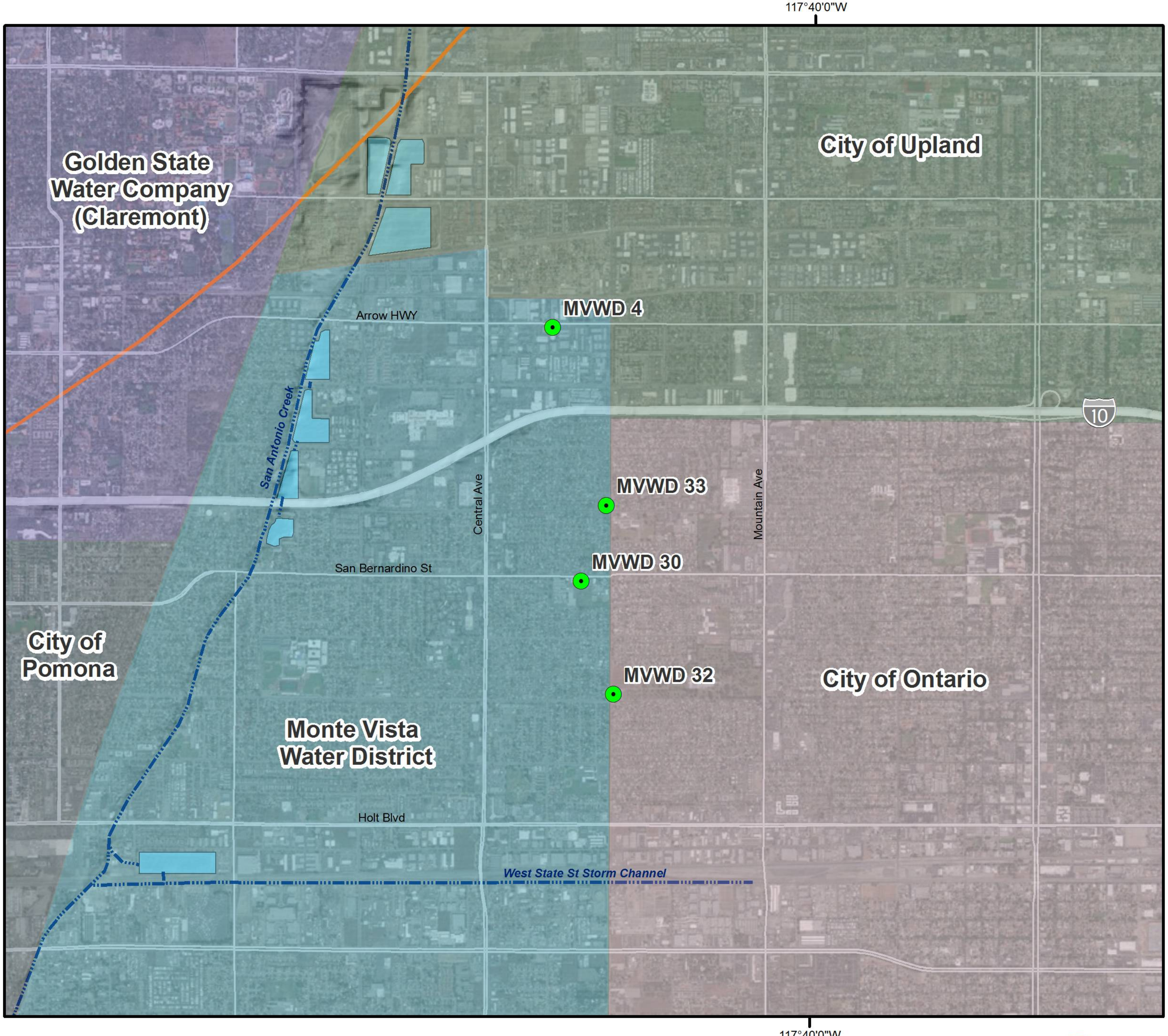
[2] 2013 Project Identification (PID) number; n/a - No PID assigned.

[3] Per an email from Steve Sentes at CBWCD dated August 16, 2018, the potential new stormwater recharge for the Confluence Project is 2,940 afy at a cost of about $17 million (excluding land acquisition costs). The estimated unit stormwater recharge cost is $650/af. This information was not vetted through the CBWM Steering Committee process during the development of the 2018 RMPU.

Table 4-8
Estimated Recharge Capacities in the Chino Basin
(afy)

Water Type	Recharge Type	2018 Conditions	2018 Conditions Plus Current Recommended 2013 RMPU Projects	2018 Conditions Plus Current Recommended 2013 RMPU Projects and Restoration of WFA Capacity
Stormwater	Average Stormwater Recharge in Spreading Basins	10,150	14,950	14,950
	Average Expected Recharge of MS4 Projects	380	380	380
	Subtotal	10,530	15,330	15,330
Supplemental Water	Spreading Capacity for Supplemental Water	56,600	56,600	56,600
	ASR Injection Capacity	5,480	5,480	5,480
	In-Lieu Recharge Capacity[1]	17,700	17,700	40,900
	Subtotal	79,780	79,780	102,980
	Total	90,310	95,110	118,310

[1] In-lieu recharge capacity is based on 2020 estimates. See Tables 4-5a and 4-5b.

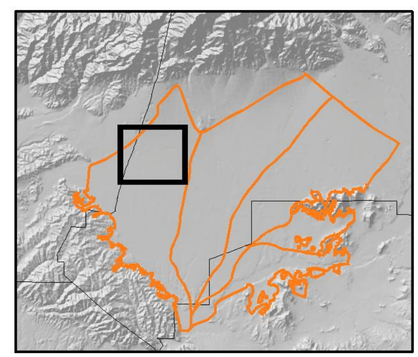


MVWD ASR Well

Streams & Flood Control Channels

Flood Control & Conservation Basins

OBMP Management Zones



Prepared by:

WEI
WILDERMUTH ENVIRONMENTAL, INC.

Author: SO
Date: 4/23/2018
Name: Figure_4-1_MVWD_ASR

0 1,250 2,500 Feet

0 460 920 Meters

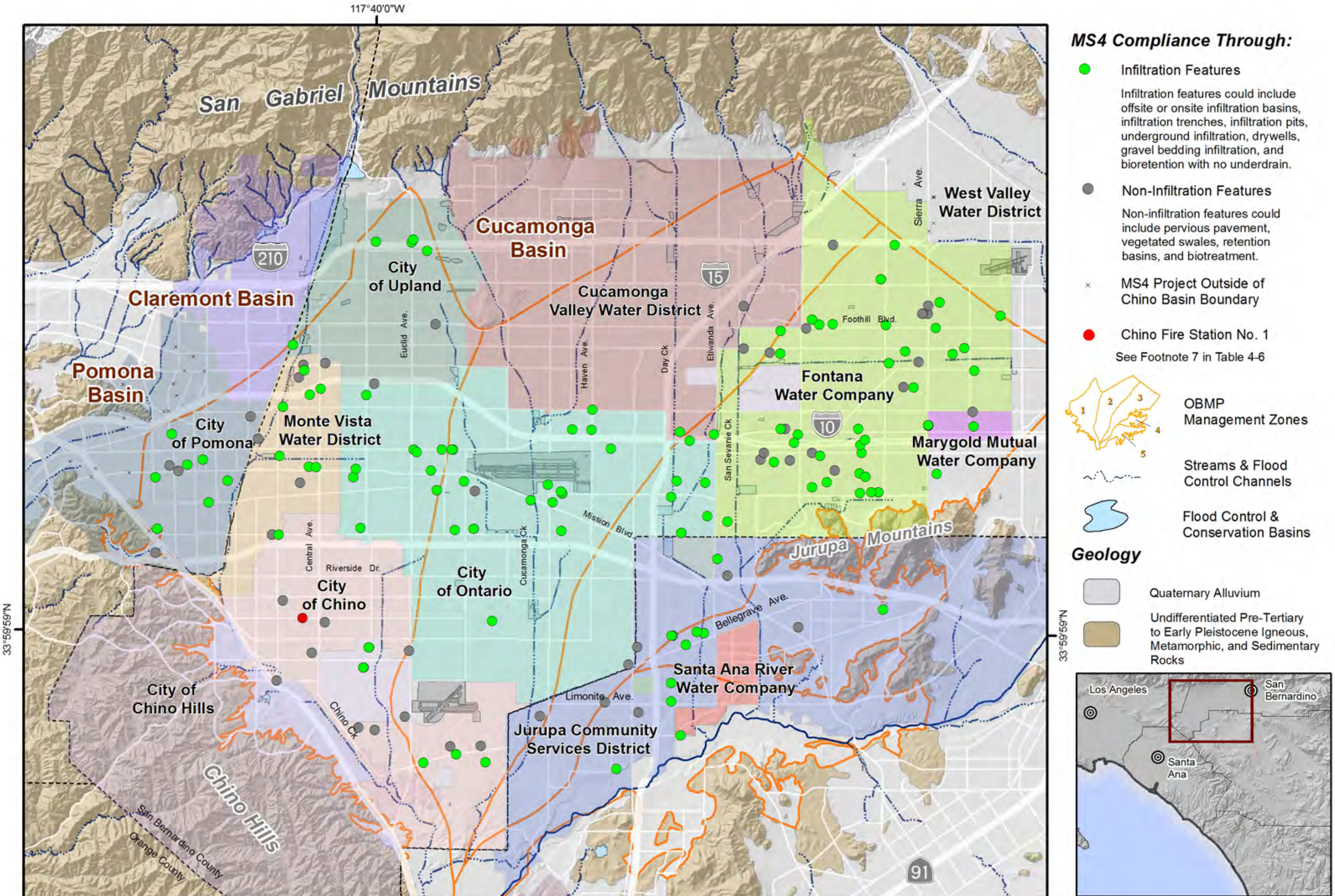
Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

CHINO BASIN WATERMASTER
Partners in Basin Management

2018 Recharge Master Plan Update

MVWD Aquifer Storage and Recovery Wells

Figure 4-1



117°40'0"W

Prepared by:

WEI
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Author: SO
Date: 5/16/2018
Name: Figure_4-2_MS4_CB_Final

0 1 2 Miles

0 2 4 Kilometers

Inland Empire Utilities Agency
A MUNICIPAL WATER DISTRICT

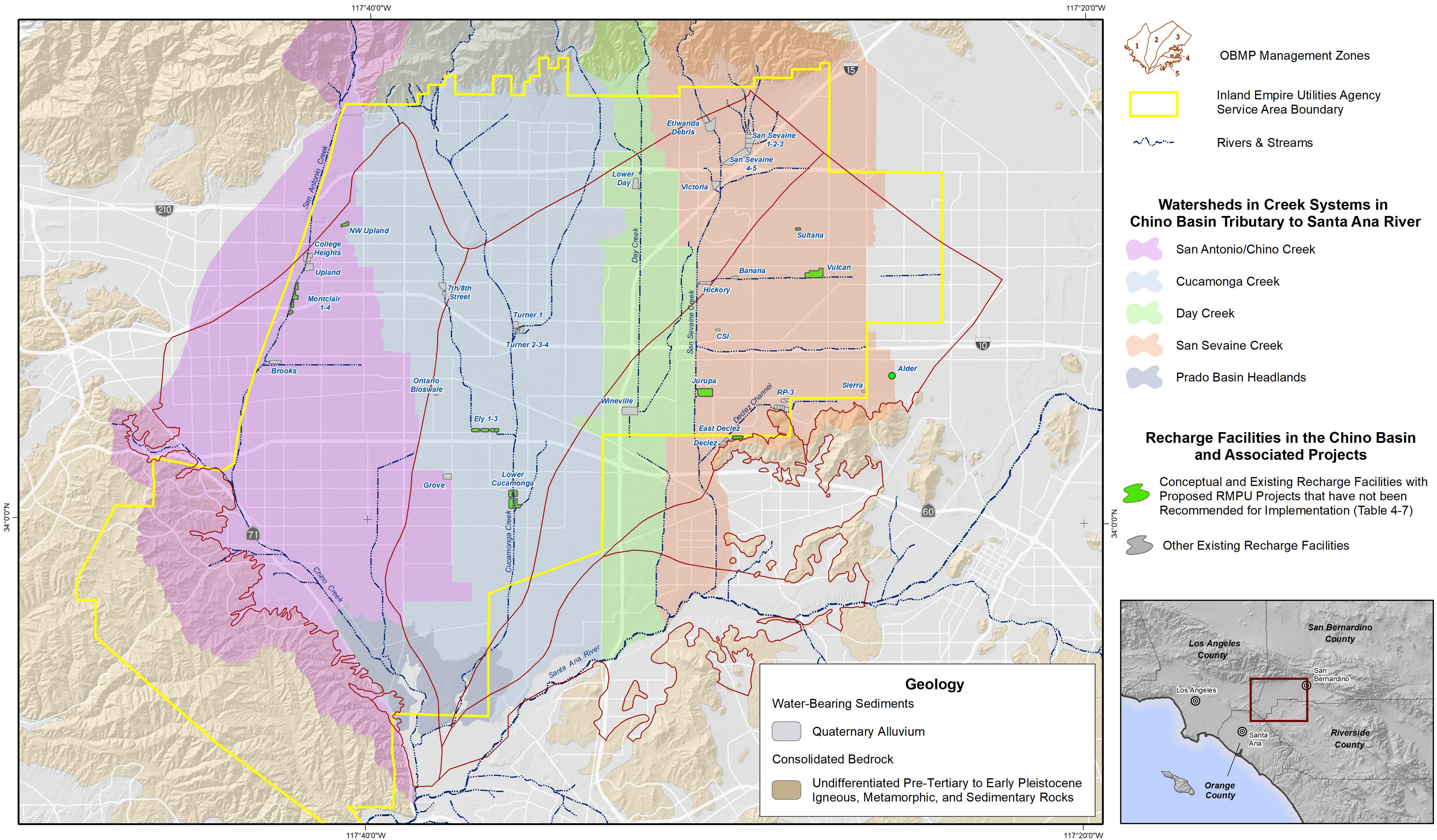
Chino Basin Watermaster

2018 Recharge Master Plan Update

MS4 Projects Submitted to Watermaster

FY 2010/11 through FY 2016/17

Figure 4-2



Produced by:

WEI
Wildermuth Environmental, Inc.

Author: CS
Date: 7/16/2018
Name: Figure_4-3_Potential new facilities

0 1 2 Miles
0 2 4 Kilometers

Inland Empire Utilities Agency
A Municipal Water District

2018 Recharge Master Plan Update

Potential New Spreading Facilities Evaluated in the 2018 RMPU

Figure 4-3

Section 5 – Future Recharge Capacity to Meet Future Recharge and Replenishment Obligations, Balance Recharge and Discharge, and Other OBMP Requirements

5.1 2017 Projection of Future Recharge Capacity Requirements

This section of the report describes the need for new recharge capacity. The need for new recharge capacity is based on a comparison of projected future recharge requirements and physical capacity to achieve the required recharge. As with all planning projections, uncertainty increases with longer horizons. As, mentioned in Section 2.6, extending water management projections beyond 2050 is not meaningful considering the many variables that affect these projections.

5.1.1 Future Recharge and Replenishment Projections

Section 2 describes the updated projected water demands, water supply plans, and associated replenishment obligations. Independent of replenishment obligations, Watermaster is obligated to recharge at least 6,500 afy of supplemental water in MZ1 through 2030 per the Peace II Agreement. A portion of the 6,500 afy of supplemental water obligation is projected to be satisfied through recycled water recharge. The remainder of the water that must be recharged in MZ1 can also be used to satisfy a replenishment obligation. The sum of the projected replenishment obligation and the additional supplemental water that must be recharged in MZ1 (through 2030) is Watermaster's total projected recharge obligation.

In its 2015 IRP, Metropolitan developed supply availability estimates through 2040. For the purposes of the 2018 RMPU, it has been assumed that the availability of imported water from Metropolitan for the period 2040 through 2050 is the same as Metropolitan's 2040 estimate. Figure 5-1 shows Watermaster's projected total recharge obligations from 2018 through 2050 for Storage Framework Scenarios 1A and 1B. Through 2050, the maximum annual recharge and replenishment obligation (Scenario 1B) is about 6,800 afy.

5.1.2 Availability of Supplemental Water for Replenishment

Section 2.4.2 described the availability of recycled and imported water available to meet Watermaster's recharge and replenishment obligations. About 16,400 afy of recycled water is projected to be available currently and through 2050.

Imported water to meet recharge and replenishment obligations is ultimately supplied by Metropolitan and consists entirely of SWP water. If Metropolitan fully implements its 2015 IRP, Watermaster will be able to purchase water to meet its replenishment obligations in nine out of ten years. If the 2015 IRP is not fully implemented, Watermaster will be able to purchase water to meet its replenishment obligations in one out of five years. Based on the Steering Committee's recommendation to evaluate Watermaster's recharge capability under a worst-case scenario, it has been assumed in the 2018 RMPU that Metropolitan's 2015 IRP is not fully implemented and that imported water available from Metropolitan for recharge and replenishment will be available one out of five years.

5.1.3 Future Recharge Capacity Requirements for Supplemental Water

Requirements for future supplemental water recharge capacity are estimated by assessing the future supplemental water recharge projections in the context of the availability of supplemental water for recharge. Recycled water is assumed 100-percent reliable, and therefore the recharge capacity requirement to recharge recycled water is equal to its projected supply. The Metropolitan supply is assumed to be 20 percent reliable without full implementation of its 2015 IRP and 90 percent reliable with it. Therefore, the recharge capacity required to meet recharge and replenishment obligations with imported water supplied by Metropolitan is five times the projected recharge and replenishment requirement without full implementation of the 2015 IRP and about 1.1 times the projected recharge and replenishment requirement with full implementation of the 2015 IRP. Figure 5-2 shows the recharge capacity available at spreading basins (less that used for recycled water recharge), in-lieu recharge capacity, and ASR recharge capacity as a stacked bar chart—the total supplemental capacity being the sum of these recharge capacities. Figure 5-2 also shows the time history of the supplemental water recharge capacity required to recharge imported water from Metropolitan for without and with full implementation of Metropolitan's 2015 IRP. The projected maximum required recharge capacity is shown below for the period 2018 through 2050.

Projected Required Recharge Capacity for Imported Water to Satisfy Watermaster's Projected Recharge and Replenishment Obligations (af)

Period	2015 IRP Not-Fully Implemented	2015 IRP Fully Implemented
2018 - 2030	15,100	3,300
2030 – 2035	29,200	6,500
2035 – 2050	33,800	7,500

Whether or not Metropolitan fully implements its 2015 IRP, Watermaster and IEUA are projected to have enough recharge capacity available to them to meet all their recharge and replenishment obligations through 2050.

5.2 Recharge to Manage Land Subsidence and Pumping Sustainability

Projections of new land subsidence and pumping sustainability were evaluated in the Storage Framework investigations for a range of potential groundwater pumping and recharge scenarios. New land subsidence refers to land subsidence caused by lowering groundwater levels below historical low groundwater levels in areas susceptible to land subsidence. Pumping sustainability refers to maintaining groundwater levels high enough to ensure that the planned pumping from wells can be achieved. No potential new land subsidence was projected to occur with Scenarios 1A and 1C. Potential new land subsidence was projected with Scenario 1B. There were no new projected pumping sustainability challenges that could be practically managed with recharge.

The existing land subsidence challenge in MZ1 is being investigated. Even with the recharge that has occurred in MZ1 since the start of OBMP implementation and the increase in storage that has occurred there, land subsidence appears to continue in northwest MZ1. Interim work (WEI, 2017) suggests that land subsidence in northwest MZ1 could be reduced if the recharge in northwest MZ1 is increased by at least 20,000 afy, pumping is decreased by at least 20,000 afy, or some combination of both totaling about 20,000 afy. This land subsidence management strategy and perhaps other strategies will be further evaluated in the next few years by the Ground Level Monitoring Committee; included in a new long-term land subsidence management plan for Northwest MZ1; and recharge requirements, if any, incorporated into future RMPUs.

5.3 Recharge Required to Ensure the Balance of Recharge and Discharge

For the period of FY 1999/00 through FY 2016/17, the balance of recharge and discharge averaged about 2,200 afy, -5,900 afy, and -5,300 afy for MZ1, MZ2, and MZ3, respectively. A positive balance means that recharge exceeds discharge. The positive balance in MZ1 is, in part, the result of the 6,500 afy supplemental water recharge provided for in the Peace agreements. The negative balances for MZ2 and MZ3 are the result, in part, of planned and permitted reductions in storage.

The balance of recharge and discharge for FY 2017/18 through FY 2022/23 (2022/23 is the year the next RMPU will be completed) is projected to average -100 afy, 10,600 afy, and 2,300 afy for MZ1, MZ2, and MZ3, respectively. These balances are based on Storage Framework Scenario 1A, which does not account for the recharge associated with the DYYP that was done in 2017/18. The implication of not including the DYYP recharge in FY 2017/18 is that the projected balance estimates are biased low. The changes in balances from the historical period are due to projected pumping by the parties.

WEI's recommendation to Watermaster regarding the location and magnitude of supplemental water recharge for replenishment has been to maximize recharge to MZ1 up to its spreading capacity, then to maximize recharge in MZ3 up to its recharge capacity, and then to recharge in MZ2. This strategy was developed during the safe yield recalculation and subsequently reevaluated in the Storage Framework investigation. Given that the long-term land subsidence management plan for Northwest MZ1 has not yet been completed and there are no projected recharge-related pumping substantiality challenges that can be practically mitigated through recharge, the existing strategy and the facilities on which it relies are sufficient at least until the next RMPU occurs in 2023. This includes continuing the recharge of 6,500 afy of supplemental water in MZ1 until the next RMPU occurs in 2023.

Figure 5-1
Projected Annual Supplemental Water Recharge Requirement for Scenarios 1A and 1B

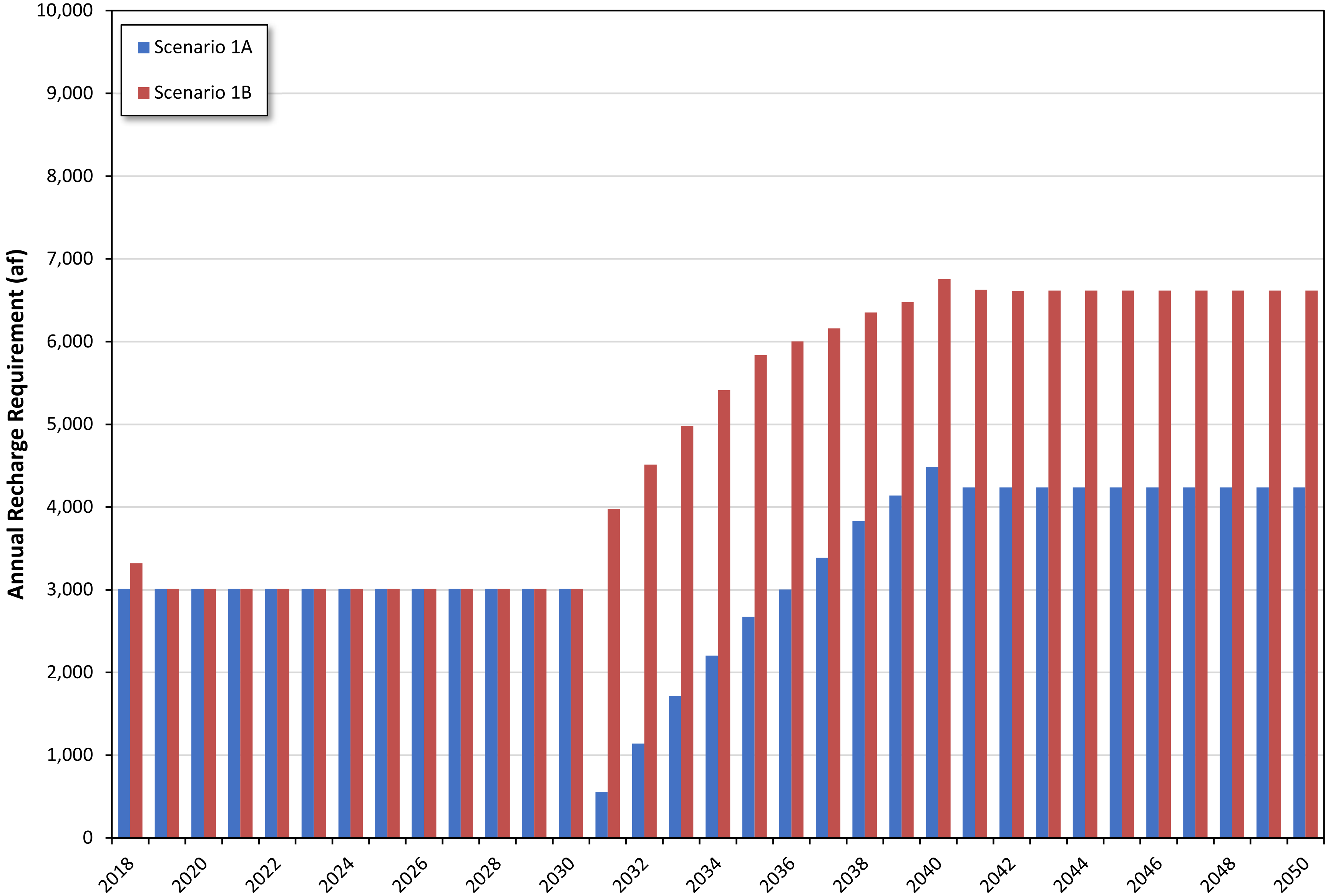


Figure_2-5_replenishment.xlsx -- Fig_5-1 (2)
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Printed on 6/18/2018

Figure 5-2
Comparison of Projected Annual Recharge and Replenishment Obligation to Supplemental Water Recharge Capacity

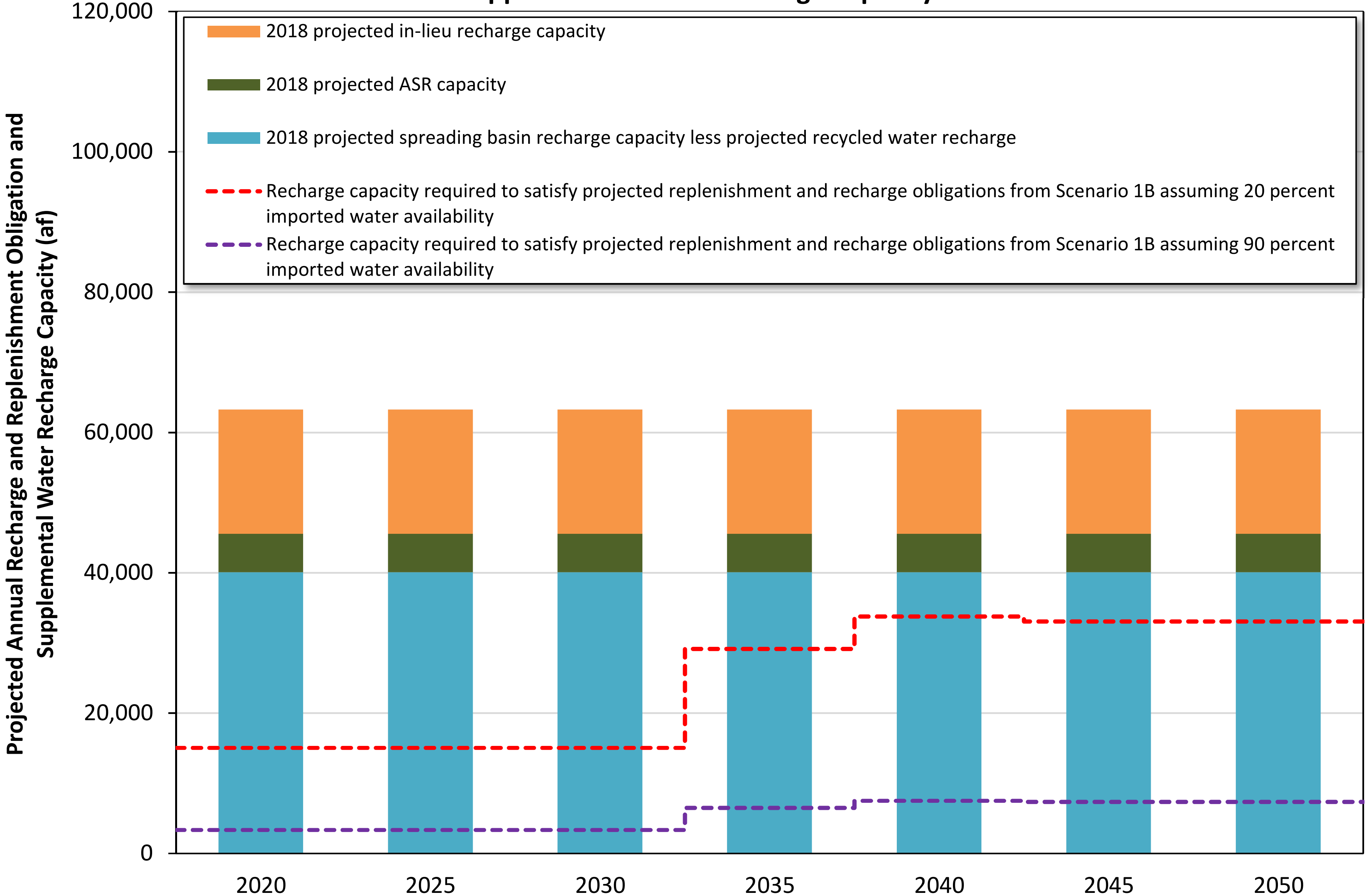

Table_5-2_Replenishment_Projections_20180803.xlsx -- 5-2
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Printed on 8/7/2018

This section summarizes the conclusions from the 2018 RMPU and includes the Steering Committee's recommendations for future actions and an implementation plan for the 2018 RMPU.

6.1 Conclusions from the 2018 RMPU

The following are the primary conclusions from the 2018 RMPU:

1. Based on the planning data provided by the parties, Metropolitan, and the IEUA, Watermaster has access to enough wet-water recharge capacity to meet its supplemental recharge obligations through 2050.

2. No changes are recommended for the 6,500 afy supplemental water recharge obligation in MZ1 (Peace II Agreement) or in the current Watermaster prioritization of supplemental water recharge locations and amounts to meet balance of recharge and discharge requirement (Peace Agreement).

3. The MS4 information collection program included in Section 5 of the 2013 RMPU has been partially implemented. Based on the information collected through June 2017, stormwater recharge in the basin may have increased by about 380 afy.

4. Based on a reconnaissance-level review of the potential new recharge projects identified in the 2018 RMPU effort or identified in the 2013 RMPU and not implemented due to cost or other reasons, no new stormwater recharge projects are recommended for implementation in the 2018 RMPU.

6.2 Recommendations

The following are the Steering Committee' recommendations from the 2018 RMPU effort:

1. Continue implementation of the final recommended 2013 RMPU yield enhancement projects.

2. Monitor Metropolitan's IRP implementation progress and the actions of others that could impact future imported water supply reliability for both direct uses and replenishment.

3. Review the 6,500 afy recharge obligation in MZ1 in the 2023 RMPU or sooner if the GLMC recommends increasing recharge in MZ1 to mitigate land subsidence.

4. Review the development of CBWCD's Confluence project and consider including it in future RMPUs. Review other potential new stormwater and supplemental water recharge projects in the 2023 RMPU.

5. Annually review the time and effort involved in the collection of information on MS4 project implementation and reassess the value this effort provides.

6.3 2018 RMPU Implementation Plan

The 2018 RMPU implementation plan includes the following:

1. Continue the implementation of the final recommended projects from the 2013 RMPU. The projected completion of these projects will occur in FY 2020/21. No new stormwater or supplemental water projects are recommended for implementation in the 2018 RMPU.

2. In FY 2021/22, initiate a "call for projects" for the 2023 RMPU and conduct a review and update of RMPU requirements.

3. Develop the scope and budget for the 2023 RMPU in FY 2021/22.

4. Complete the 2023 RMPU in FY 2022/23, and file the 2023 RMPU report with the Court in October 2023.

5. Continue collecting information on MS4 project implementation, assess the likely new stormwater recharge created by these projects in the 2020 Safe Yield recalculation, and annually reassess the value this effort provides.

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Appendix A

Supplemental Water Recharge Capacity Assessment

Appendix A – Supplemental Water Recharge Capacity Assessment

A.1 Introduction

A.2 Background

A.3 Proposed Continuous Percolation Rate Function

A.4 Estimation of Continuous Percolation Rate Function Parameters

A.5 Estimation of Supplemental Water Recharge Capacity

A.1 Introduction

As part of the 2018 Recharge Master Plan Update (2018 RMPU), Wildermuth Environmental, Inc. (WEI) assessed the supplemental water recharge capacity of existing facilities within the Chino Basin. This Appendix describes the methodology developed by WEI for this purpose and its implementation.

A.2 Background

There are currently 17 recharge facilities with a total of 36 basins within the Chino Basin (Figure A-1), all of which are operated and managed by Inland Empire Utilities Agency (IEUA). IEUA has historically used the following two-point equation to estimate the instantaneous infiltration rate for these basins:

$$i_t = -\frac{d_2 - d_1}{t_2 - t_1} \qquad (1)$$

Where: i_t = infiltration rate (ft/day)
d_1, d_2 = water depth at time t_1 and t_2 (ft)
t_1, t_2 = time (day)

This equation correctly estimates the infiltration rate between times t_1 and t_2 provided there is no inflow or outflow which affects water levels in the basin over the given period. However, the equation is not able to provide any information on basin behavior under continuous operation.

Infiltration rates are dynamic and in constant flux due to variations in moisture condition in the soil, clogging over time, water depth within the basin, and several other factors. As such, both instantaneous and continuous infiltration rate data are essential in evaluating the performance of any recharge facility. Assuming the degree of infiltration rate decay is characteristic of a specific recharge basin and associated inflow water quality, it is possible to define an algorithm to characterize the dynamic basin performance based on observed data.

A.2.1 Definitions of Infiltration and Percolation

Infiltration is the downward entry of water through the soil surface into a porous medium under gravity action and pressure effects. The infiltration capacity is the maximum rate at which water can enter the soil (Linsley, 1979, USGS, 1989). Hence the infiltration rate is the ratio of depth of water infiltrated during a given time and given as:

$$I_t = \frac{dL}{dT} \qquad (2)$$

Where: I_t= infiltration rate at time t, under the given condition (L/T)
dL= depth of water infiltrated (L)
dT= duration of time (T)

As defined, this equation provides a constant rate of infiltration over the period of observation but does not give insight into the rate of change as a function of time.

While closely related to infiltration rate, the percolation rate is the rate at which soil moisture moves down through the soil or permeable rock and is typically calculated over an area (FEMA, 2010).

A.2.2 Horton's Equation

The most widely referenced and used technique for computing infiltration capacity of precipitation into the soil as a function of time is Horton's equation (Horton, 1940) and is given as:

$$i_t = i_\infty + (i_0 - i_\infty)e^{-at} \quad (3)$$

Where:
i_t = infiltration capacity into soil (ft/sec)
i_∞ = minimum or ultimate value of i_t (at t = infinity) (ft/sec)
i_0 = maximum or initial value of i_t (at t=0) (ft/sec)
t = elapsed time from beginning
a = decay coefficient (sec-1)

This equation indicates that if the rainfall supply exceeds infiltration capacity (i.e. a standing head is developed), infiltration tends to decrease in an exponential manner with time. While simple in form, the equation can be applied to recharge basins with proper modification.

A.2.3 OCWD-RFM Model

More recently, a method to estimate infiltration rates over time within a recharge basin based on historical percolation data was developed for the Orange County Water District (OCWD) and their Recharge Facilities Model (RFM) (CH2M Hill, 2009). The OCWD owns and operates 17 major recharge facilities below Prado Dam and uses the RFM to evaluate system performance under different inflow scenarios. The model utilizes two exponential decay functions (one using depth and cumulative recharge, the other using maximum percolation rate and time since the last cleaning), two linear regression functions, and two other methods not detailed here to model percolation in the individual basins.

The linear regression functions have limited application since the calculated rate could become negative after a period of time. The exponential decay function with elapsed time can be applied to basins where water is always filled to the operational level. If the basin is dedicated to storm water recharge and is emptied frequently, the function cannot be applied. This is because, when a basin is empty, the percolation rate will recover as soil dries rather than keep decaying.

The exponential decaying function with cumulative recharge volume is defined in the RFM as:

$$P = \frac{Depth}{Depth_{Max}} \left(d * e^{(-Q_t^a * b)} + c\right) \quad (4)$$

Where:
P = percolation rate (cubic feet per second [cfs])
$Depth$ = depth of water at time t
$Depth_{Max}$ = maximum operational depth for the basin
a, b, c, d = empirical coefficients

Q_t= previous cumulative percolation volume (acre-feet [af]) – acts as a surrogate for accumulated sediment

As presented, this equation contains four empirical coefficients which can be very difficult to estimate or assign a meaningful value.

A.3 Proposed Continuous Percolation Rate Function

While Equation 4 was generally capable of modeling historical percolation rates for the OCWD basins which had sufficient record of observed data, there were nuances in the percolation rates that were missed. WEI believes this to be predominantly an artifact of the difficulties in estimating the four empirical coefficients. To resolve this issue, WEI modified the equation to minimize the number of empirical elements and streamline the process by which they are estimated. The proposed new function, named the Continuous Percolation Rate Function (CPRF), is:

$$P = \frac{D}{D_{Max}}(\gamma * P_{Max} * e^{(-\alpha * Q_t)}) \qquad (5)$$

Where:
P= percolation rate (cfs)
P_{Max}= maximum percolation rate (cfs) (i.e. maximum infiltration rate * wetted surface area at D_{Max})
D= depth of water at time t
D_{Max}= maximum operational depth for the basin
Q_t= cumulative percolation volume since the previous cleaning (af)
γ= recovery factor (maximum value of 1.0)
α= infiltration decay coefficient (1/af)

The maximum water depth (D_{Max}) can be determined from observed data, basin construction data, or by a management decision. The maximum percolation rate (P_{Max}) at water depth D_{Max} can be determined from the measured infiltration rate versus water depth data. The recovery factor (γ) is introduced here. If the recharge basin underwent full maintenance (i.e. was completely drained, fully dried, and the base reconditioned), the recovery factor should be close to one, and cumulative percolation volume (Q_t) should be reset to zero. However, if the basin received less than full maintenance, the percolation rate may not recover to the maximum rate and the recovery factor can be set to a value less than one. The empirical coefficient 'α', or the infiltration decay factor, should be determined to match observed water level or percolation rate data for the basin in question. The advantage of the CPRF equation is that all parameters are clearly defined with physical property.

It should be noted that equation 5 is similar in form to Horton's equation (equation 3); however, the decay parameters are very different, and the recommended values for Horton's equation should not be used in the CPRF.

A.4 Estimation of Continuous Percolation Rate Function Parameters

The following sections present two examples to illustrate the method used in estimating CPRF parameter values for the recharge basins. Specifically, the Upland and Brooks Basins were selected for this demonstration because both basins: have relatively simple configurations; both consist of a single basin as opposed to the multiple basins at the Montclair and RP3 facilities, and; both are essentially terminal basins and as such remove unknown outflow loss from consideration.

Table A-1 summarizes the parameters of the CPRF equation for basins which had sufficient inflow and water level data to estimate initial values. The parameter values presented in Table A-1 should not be considered final and should be updated as additional and/or higher quality data are collected. Note that the recovery factor, Υ, is not listed in the table because the general relationship between the length of a dry period and associated recovery factor could not be determined from the available data. In estimation of the parameters in the table, some recovery factors were used other than 1.0, to fit measured water level, but they are meaningful only for data points over a short period. When the basins were dry for some period, usually more than one month, the recovery factor of 1.0 worked well. When more data are available, the general relationship between the length of dry period and recovery factor can be developed.

A.4.1 Upland Basin

The Upland Basin is located near the northwestern boundary of the Chino Basin along San Antonio Creek (Figure A-1). It is approximately 65 ft deep at the lowest uncontrolled outlet and has approximately 850 af of storage when filled to this level. IEUA measures the infiltration rate as described in Section A.2 when the basin is filled. Figure A-2 shows all the measured infiltration rates versus the corresponding water level for the period between January 2007 and January 2011. The distribution of data points indicates that the infiltration rate generally increases with increased water depth.

Upon further review of the data, six distinct time-series of measurements were identified (Figure A-3). Each of these time-series were measured during a period when the basin was filled relatively full and then allowed to percolate. If a recharge facility is in continuous operation, the infiltration rate should decline with time and decreasing water depth as described in Horton's equation. The decline should follow a smooth exponential decay line. If there is additional inflow, which reduces the decline of water level, the infiltration rate estimated by the two-point method will be lower than it should be. Three such incidents were identified as shown in green on Figure A-3.

Figure A-3 also includes a curve which approximates the maximum infiltration rate for a given water depth. The line was drawn to include most of data points that are part of continuous measurements. Single-measurement points were given less consideration than the continuous measurement points when constructing the maximum infiltration line. Based on the best fit "*maximum infiltration rate curve*", the estimated maximum infiltration rate at D_{Max} of 65 ft water depth is 1.3 ft/day. The wetted surface area of the Upland basin at 65 ft water depth is 21.7 acres, and the percolation rate is estimated as 21.7 * 1.3 / 1.9835 = 14.2 cfs (i.e. P_{Max}).

With D_{Max} and P_{Max} defined, the empirical decay coefficient (α) can now be estimated. Figure A-4 shows the operational data received from IEUA for the Upland Basin. IEUA staff estimated daily inflow in af. The SCADA system for the basin recorded water level data every 30 minutes. Figure A-5 illustrates the procedure to estimate α. The red line in the chart is the SCADA-recorded water level in the Upland Basin for the period between July 2011 and July 2014. Initially the value 0.0001 was tested for α, but the decay of the infiltration rate from this value was too slow. This was evidenced by the modeled water level not increasing as fast as the observed data, then declining too fast when inflow stopped. The second attempt used a value for α of 0.001. In this case, the higher value tested for α caused the instantaneous infiltration rate to decline too fast and water stayed in the basin much longer than the observed data. The value, 0.0005, was then tested for α. While the simulated water level responses were closer to the observed than the second attempt it remained higher than the observed data. This iterative narrowing of α values was continued until a reasonable approximation of the observed data was obtained. Figure A-6 shows the final calibrated model for the Upland Basin with α set at 0.00022.

A.4.2 Brooks Basin

The procedure described in A.4.2 was also applied to the Brooks basin data. Figure A-7 shows infiltration rate data observed between September 2005 and January 2017. Ten distinct time-series of measurements, where the basin was filled relatively full and then allowed to percolate, were identified (Figure A-7). An enclosing "*maximum infiltration rate curve*" was drawn to define maximum infiltration rate, which is 1.63 ft/day at a D_{Max} of 30 ft. The wetted surface area of the basin at D_{Max} is approximately 10 acres. The maximum percolation rate (P_{Max}) was therefore calculated to be 8.22 cfs. Figure A-8 compares observed water level with simulated water level using a value of 0.0003 for α. The figure also contains daily inflow data. Note that between January 2013 and January 2016 the SCADA Water Level data does not respond to the reported inflows as would normally be expected. During this period, the observed water level typically ranged between approximately 25 and 28 ft and does not respond to large changes in inflow, while the simulated water level as calculated using the inflow data provided fluctuated with inflow changes and ranged between approximately 15 to 30 ft water depth. However, when the observed water level increases or drops rapidly, the calculated water level follows observed data very closely.

Because of the discrepancy between observed and simulated water levels, a secondary calibration of the CPRF parameters determined above was performed. Between 1999 and 2003, Chino Basin Water Conservation District (CBWCD) installed water level sensors on Brooks basin to collect imported water inflow and water level data (WEI, 2004). This data was used to compare simulated water level data to the observed water level data for this period because it was a distinctly separate data set from that provided by IEUA. This secondary calibration showed excellent agreement between measured and simulated water levels using the parameters defined above (Figure A-9).

A.5 Estimation of Supplemental Water Recharge Capacity

The theoretical water recharge capacity was estimated for each basin using either the CPRF equation or, in instances where the CPRF could not be determined or was deemed unreliable, a constant long-term average infiltration rate. To determine the theoretical supplemental water recharge capacity, the data was adjusted to account for lost capacity due to rainfall. The following sections detail the methodology used for these calculations.

A.5.1 Precipitation Frequency and Basin Availability for Supplemental Water Recharge

To estimate the average operational availability of a basin for supplemental water recharge, the following long-term rainfall data were used.

1. Claremont Pomona College - Station 1034 started July 1896 but the data collection ends on April 1989. Montclair Fire Department Station gage 1137 by SBCFCD, which started recording in 1965, was used to fill in missing data. Data from 1/1/1900 to 12/31/2016 was used from these stations for the analysis.
2. San Bernardino County Hospital – Station 2146 of the SBCFCD started in water year 1884. Early data collection was intermittent or only recorded monthly. Therefore, data from 1/1/1900 to 12/31/2016 was used from this station for the analysis.
3. Riverside-South Station - Station 179 of the RCFCD&WCD, has a daily precipitation record from 1/10/1897 to present. To match the other data sets being used, data from 1/1/1900 to 12/31/2016 was used from this station for the analysis.

The procedure used for calculating the available number of days for supplemental water recharge was:

1. Count all days in each month with rainfall that can generate runoff on impervious area (i.e. 0.04 inch/day per the recommended value in the Curve Number Method).
2. Count the number of storm events. When consecutives days are rainy, they are counted as a single storm event. One day was added to the duration of each storm event because the recharge basin must be emptied prior to the storm.
3. Calculate the percentage of days that are available for supplemental water recharge within a month. To do so, sum the number of rainy days and number of storm events; subtract this sum from the number of days in the month; and then divide the total by the number of days in the month. For example, precipitation of more than 0.04 inch is recorded 5 days in January of a given year, and 3 storm events were observed, then (31 – (5+3)) / 31 = 23 / 31 = 0.74. In other word, 23 days are available on average for supplemental water recharge, which is 74% of 31 days.

Long-term monthly availabilities were calculated from the precipitation station data by determining the mean value over the period from 1/1/1900 to 12/31/2016 for each month. The calculated mean value for each month of the year is shown on Table A-2. The data indicate that long term basin availability for recharge of supplemental water varies from 74% in January to 100% in summer months. Note that in the summer months of June to August, rainfall events never happened in enough quantity to generate meaningful runoff over the entire data period evaluated. The data also indicated that a rainfall event may happen one day in September, or less than two days in October. This suggests the basins can be cleaned and dried from June to September without interfering with storm water recharge.

A.5.2 Application of the Continuous Percolation Rate Function

Of the basins where the CPRF parameters could be estimated, if the R-square value to observed data was less than 0.5 it was deemed unreliable and not used for calculation of recharge capacity. Based on this criterion, the CPRF equation was ultimately applied to simulate recharge capacity for 13 basins. The time period modeled for each was equal to the IEUA basin specific maintenance schedule (e.g. 3 years for the Brooks Basin, 4 years for the Montclair Basins, 10 years for the Upland Basin, etc.). The following assumptions were made for each simulation:

1. The basin must be totally emptied before initiation of maintenance operations.
2. It takes a total of two months to dry the soil and complete maintenance operations (average period estimated by IEUA).
3. When performed, the two months required for drying and maintenance of the basin occurred in July and August.
4. No recharge occurs during the maintenance period.
5. After the maintenance, the basin attained a full operational water level in approximately 5 days.
6. There is sufficient water supply to keep the basin in constant operation at the full operational water depth until the next cleaning occurs.

After a facility is cleaned, by definition, the cumulative percolation volume (Q_t) and the recovery factor (γ) in equation 5, are set to 0 and 1, respectively. At this point the basin is capable of its theoretical maximum rate of percolation.

As an example, Figure A-10 shows the CPRF simulated decay in percolation rates based on the IEUA scheduled maintenance frequency (i.e. every 3 years). In the simulation, the maximum inflow rate of about 25 cfs, or 50 af/day was maintained for 4 days. The inflow rate was then adjusted to maintain the water level at an operation level (D_{Max}) of approximately 28 ft. The cumulative percolation and evaporation was calculated daily and the CPRF equation updated daily until the next scheduled maintenance. At some time before the maintenance cycle, the inflow was turned off, and the water level allowed to decline until the remaining water can be pumped out at same rate as the initial inflow rate in a day.

Based on the data, the maximum theoretical recharge capacity was 5,760 af over the current maintenance schedule of every 3 years (average of 1,920 acre-feet per year [afy]). Note this value does not differentiate between the source of inflow water and represents the total recharge capacity of the basin over 3 years. To determine the maximum theoretical supplemental water recharge capacity, the volumes must be adjusted for the basin availability as detailed in Section A.5.1. Accordingly, the simulated recharge capacity was summed monthly and then reduced based on the average operational availability for supplemental water recharge for the given month (refer to Table A-2 for specific values). Based on the adjusted data, the Brooks Basin has maximum theoretical supplemental water recharge capacity over the current 3-year cleaning of 4,974 af (average of 1,658 afy).

The maximum theoretical supplemental water recharge capacities were also calculated for one-month (385 af), three-month (1,031 af), and annual (2,825 af) time periods (Table A-2).

Note that the maximum annual supplemental water recharge capacity (2,825 af) is greater than the maximum average theoretical annual recharge between maintenance periods (1,658 af). This is because the former is the total volume recharged for a 12-month period following maintenance activities and the later has no recharge occurring during the two-month period at the start of the 3-year cycle (i.e. is an average of the total volume recharged over 34 months).

Note that since inflow data to San Sevaine Basins 1 and 2 were not available, the inflow amount was estimated during the simulations from the water level data. This resulted in unreasonable high R-square values. However, the purpose of the simulation was focused to match the declining water level below the conservation water level 6 feet. Given that a reasonable match was attained for these periods, the CPRF function was applied to these basins to estimate the maximum theoretical supplemental water recharge capacities. When inflow data becomes available, the equation should be reevaluated.

A.5.3 Basins Where the Continuous Percolation Rate Function was not Applied

For basins where insufficient data was available to estimate initial values for the CPRF equation or those that did not meet the minimum R-square criteria, the monthly maximum theoretical supplemental water recharge capacity was calculated as follows:

$$P_m = I_a * A_s * N_d * F_m$$

Where:
- P_m= monthly maximum percolation rate (cfs)
- I_a= long-term average infiltration rate (ft/day)
- A_s= wetted surface area at operating level
- N_d= number of days in the month
- F_m= fraction of the month available for supplemental recharge

The maximum theoretical one-month supplemental water recharge capacity was calculated for a month where the basin was 100% available for supplemental recharge. The maximum theoretical 3-month supplemental water recharge capacity was estimated by summing P_m for the months of June, July, and August as these three months have historically had insufficient rainfall to impact the operational availability for supplemental water recharge. The annual theoretical supplemental water recharge capacity can be estimated using the same method over a 12-month period. Note that for basins where this was applied, the maintenance schedule was assumed to be accounted for in the long-term percolation rates and no further adjustments were made. Table A-2 shows the calculated maximum theoretical recharge totals.

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Table A-1 Long-Term Percolation Function Parameter Estimation

Spreading Basin	Long-Term Percolation Estimation Method	Data Analysis	Exponential Decay Function Parameters					
			Maximum Operation Water Depth	Wetted Area	Infiltration Rate	Maximum Percolation Rate		Exponent
			(ft)	(acres)	(ft/day)	(af/day)	(cfs)	
Management Zone 1								
Brooks Street Basin	Exponential Decay Function		30	10	1.63	16.3	8.2	0.0003
College Heights Basins - East	Long-Term Average Rate	No SCADA WL data is available						
College Heights Basins - West	Long-Term Average Rate	No SCADA WL data is available						
Montclair Basin 1	Exponential Decay Function	No SCADA WL data is available	30	7.6	3.8	28.9	14.6	0.002
Montclair Basin 2	Exponential Decay Function	Use CBWCD 2000-2002 data	27	11	4.4	48.4	24.4	0.0002
Montclair Basin 3	Exponential Decay Function		20	20	3.2	64.0	32.3	0.002
Montclair Basin 4	Exponential Decay Function		25	25	1.4	35.0	17.6	0.0005
Upland Basin	Exponential Decay Function		65	21.7	1.3	28.2	14.2	0.00022
Eighth Street Basin	Long-Term Average Rate	The operation of north and south cells are unclear. Release to Seventh St basin is not known. Daily inflow and output data are not available						
Seventh Street Basin	Long-Term Average Rate							
Management Zone 2								
Ely	Exponential Decay Function		20	37.4	1.18	44.1	22.2	0.0001
Grove Basin	Long-Term Average Rate	No connection for supplemental water						
Etiwanda Debris Basin	Long-Term Average Rate	No SCADA WL data is available						
Hickory Basin	Long-Term Average Rate	East cell water level data is unusable						
Lower Day	Exponential Decay Function		15	15.3	1.8	27.5	13.9	0.0005
San Sevaine No. 1	Exponential Decay Function		5	10.47	3.39	35.5	17.9	0.01
San Sevaine No. 2	Exponential Decay Function		5	8	2.8	22.4	11.3	0.0001
San Sevaine No. 3	Exponential Decay Function		5	5.3	2.8	14.8	7.5	0.0001
San Sevaine Nos. 5	Exponential Decay Function		10	45	0.27	12.2	6.1	0.003
Turner Basins Nos. 1	Exponential Decay Function		35	13.2	2	26.4	13.3	0.002
Turner Basins Nos. 2			22	4	1.8	7.2	3.6	0.0045
Turner Basins Nos. 3			25	3.6	1.8	6.5	3.3	0.003
Turner Basins Nos. 4a	Exponential Decay Function		22	8.4	1.8	15.1	7.6	0.005
Victoria Basin	Exponential Decay Function		15	19.4	0.92	17.8	9.0	0.0006
Management Zone 3								
Banana Basin	Long-Term Average Rate	Need more WL data						
Declez Basin Cell 1	Exponential Decay Function		7	6.8	0.84	5.7	2.9	0.002
Declez Basin Cell 2&3	Exponential Decay Function		9	8.9	0.87	7.7	3.9	0.002
IEUA RP3 Cell 1	Exponential Decay Function		11	10.6	2	21.2	10.7	0.0001
IEUA RP3 Cell 3	Exponential Decay Function		10.4	7.5	3	22.5	11.3	0.0001
IEUA RP3 Cell 4	Exponential Decay Function		10.3	8.7	2.5	21.8	11.0	0.0001

Table A-2
Average Stormwater Recharge and Supplemental Water Recharge Capacity Estimates

Recharge Facility	Average Stormwater Recharge FY 2004/05 through FY 2016/17 (afy)	Average Operational Availability for Supplemental Water Recharge: Quarter 3 Jan	Quarter 3 Feb	Quarter 3 Mar	Quarter 4 Apr	Quarter 4 May	Quarter 4 Jun	Quarter 1 Jul	Quarter 1 Aug	Quarter 1 Sep	Quarter 2 Oct	Quarter 2 Nov	Quarter 2 Dec	Recharge Capacity Limitations: Spillway, Outlet, Cons. Berm or Inlet Controlled Elevation (ft-amsl)	Control Structure[1]	Freeboard (ft)	Maximum Operating Level (ft-amsl)	Wetted Area at Maximum Operating Level (acres)	Assumed Number of Years Between Maintenance[2]	Theoretical Maximum Supplemental Water Recharge Capacity: Parameter Values for Estimating Infiltration Rate[3]: Continuous Percolation Rate Function[4] Alpha	Maximum Infiltration Rate (ft/day)	R-Square Goodness of Fit	Long-Term Average Infiltration Rate (ft/day)	Maximum Theoretical One-Month Recharge Total[5] (af)	Maximum Theoretical Three-Month Recharge Total[6] (af)	Maximum Theoretical Annual Recharge Total[7] (af)	Maximum Average Theoretical Annual Recharge Between Maintenance Periods[8] (af)
Brooks Street Basin	489	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	889.5	a	1.5	888.0	9.6	3	0.0003	1.8	0.674	-	385	1,031	2,825	1,658
College Heights Basin - East	78	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1242.0	a	1	1241.0	6.2	10	-	-	-	3.0	558	1,552	5,932	5,816
College Heights Basin - West		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1242.0	a	16	1226.0	3.3	10	-	-	-	2.0	198	551	2,105	2,064
Montclair Basin 1	953	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1128.2	b	1	1127.2	7.4	4	0.002	3.8	0.879	-	302	608	1,097	409
Montclair Basin 2		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1097.0	b	0	1097.0	11.6	4	0.0002	4.4	0.622	-	1,188	2,923	6,702	2,940
Montclair Basin 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1057.0	b	0	1057.0	4.3	4	0.002	3.2	0.625	-	280	572	1,052	400
Montclair Basin 4		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1037.0	b	2	1035.0	5.5	4	0.0005	1.4	0.720	-	270	702	1,856	915
Eighth Street Basin	1,069	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1144.5	b	0	1144.5	17.0	2	-	-	-	0.7	357	993	3,795	3,426
Seventh Street Basin		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1130.0	c	0	1130.0	5.6	3	-	-	-	0.7	118	327	1,250	1,170
Upland Basin	430	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1210.0	f	30	1180.0	13.2	10	0.00022	1.3	0.986	-	283	801	2,490	891
Subtotal Management Zone 1	3,019																							3,939	10,058	29,102	19,689
Ely	1,120	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	838.0	b	3	835.0	33.0	3	0.0001	1.2	0.511	-	948	2,578	7,375	4,501
Grove Basin	305	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Etiwanda Debris Basin	212	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1605.0	d	0	1605.0	15.5	10	-	-	-	0.6	279	776	2,966	2,908
Hickory Basin East	361	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1117.0	d	3	1114.0	4.1	3	-	-	-	0.7	86	239	915	856
Hickory Basin West		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1115.0	d	1	1114.0	6.8	3	-	-	-	0.7	143	397	1,518	1,420
Lower Day Basin Cell 1		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1379.8	e	1	1377.0	3.6	5								
Lower Day Basin Cell 2	513	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1379.8	e	1	1372.0	4.9	5	0.0005	1.8	0.909	-	438	1,088	2,547	983
Lower Day Basin Cell 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1379.8	e	1	1373.0	6.3	5								
San Sevaine No. 1	816	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1488.7	d	0	1488.7	9.7	5	0.01	3.4	0.732	-	231	324	437	114
San Sevaine No. 2		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1472.5	f	0	1472.5	8.5	5	0.0001	2.8	1.000	-	647	1,774	5,455	2,869
San Sevaine No. 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1458.0	f	0	1458.0	5.3	5	0.0001	2.8	1.000	-	403	1,132	3,745	2,226
Turner Basin No. 1	1,527	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1000.0	b	2	998.0	12.7	3	0.002	2.0	0.698	-	424	785	1,305	577
Turner Basin No. 2		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	990.5	b	1	989.5	3.9	3	0.0045	1.8	0.505	-	139	276	494	227
Turner Basin No. 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	980.5	a	2	978.5	2.8	3	-	-	-	0.5	42	117	446	418
Turner Basin No. 4A		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	980.5	a	2	978.5	6.6	3	-	-	-		99	274	1,049	981
Turner Basin No. 4B		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	980.5	a	2	978.5	1.1	3	-	-	-	0.5	17	46	175	164
Turner Basin No. 4C		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	980.5	a	2	978.5	1.3	3	-	-	-		19	53	204	191
Victoria Basin	309	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1323.9	b	1	1322.9	19.1	3	-	-	-	0.4	229	637	2,436	2,279
Subtotal Management Zone 2	5,163																							4,144	10,497	31,068	20,713
Banana Basin	258	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	1143.0	b	0	1143.0	7.5	3	-	-	-	0.8	180	501	1,913	1,790
Declez Basin Cell 1	582	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	833.2	d	0	833.2	6.9	3	-	-	-	0.6	124	345	1,320	1,235
Declez Basin Cell 2		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	831.0	d	1	830.0	4.6	3	-	-	-	0.6	83	230	880	823
Declez Basin Cell 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	831.0	d	1	830.0	4.3	3	-	-	-		77	215	823	770
IEUA RP3 Basin Cell 1	1,129	0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	961.0	d	3	958.0	10.4	3	-	-	-	1.5	468	1,301	4,975	4,653
IEUA RP3 Basin Cell 3		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	950.0	d	0	950.0	7.3	3	-	-	-	1.5	329	913	3,492	3,266
IEUA RP3 Basin Cell 4		0.74	0.74	0.75	0.83	0.92	1.00	1.00	1.00	0.96	0.91	0.84	0.78	945.0	d	1	944.0	8.2	3	-	-	-	1.5	369	1,026	3,923	3,669
Subtotal Management Zone 3	1,969																							1,630	4,532	17,326	16,204
Totals	10,151																							9,713	25,088	77,497	56,606

1 - Limiting control structure types include: a = inlet, b = spillway, c = flood control restriction, d = conservation berm, e = outlet, and f = other restriction.

2 - The term maintenance as used in the table means maintenance activities that restore infiltration rates (removal of clogging layers followed by ripping or functionally equivalent activities).

3 - Infiltration rates were based either on a Continuous Percolation Rate Function (CPRF) if data were available to develop such a function and their R^2 values were greater than 0.5 **or** the average long-term infiltration rate; both are based on IEUA data and reported infiltration rates.

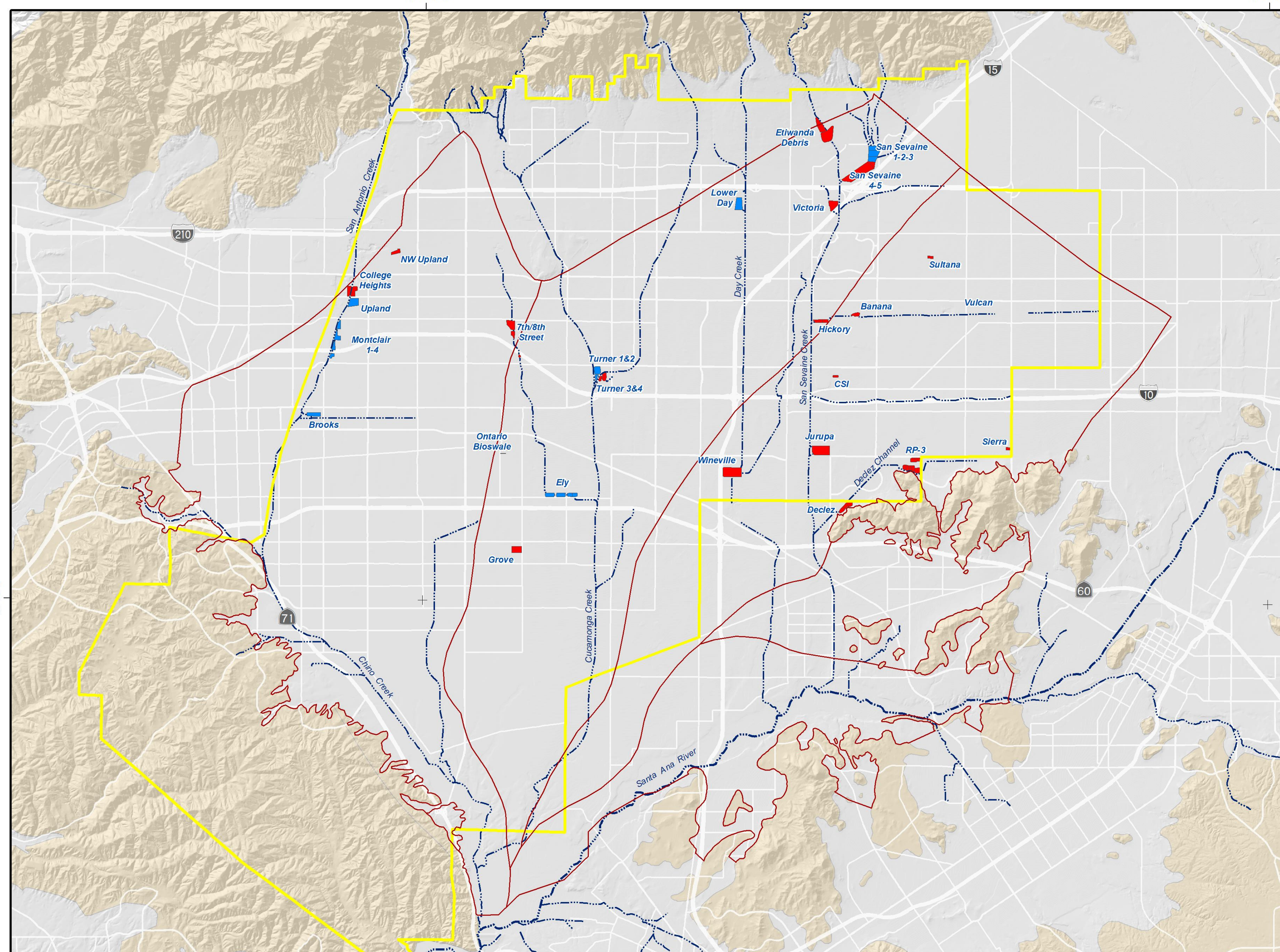
4 - Details on the calculation of the Continuous Percolation Rate Functionare provided in Appendix A.

5 - Assumes recharge facility has been cleaned over the period of July to August and is filled to operating level on September 1st.

6 - Maximum Theoretical Three-Month Recharge Total is the total recharge from the three-month period directly after a cleaning.

7 - Maximum Theoretical Annual Recharge Total is the total recharge from the 12-month period directly after a cleaning.

8 - Average annual recharge over the span between maintenance. When recharge facilities are not being cleaned, operational availability is 1.0 for July and August. The average cleaning frequency of each recharge facility was provided by the IEUA.



Recharge Facilities in the Chino Basin

Recharge Capacity Evaluated with CPRF

Recharge Capacity Not Evaluated with CPRF

CPRF - Continuos Percolation Rate Function

OBMP Management Zones

Inland Empire Utilities Agency Service Area Boundary

Rivers & Streams

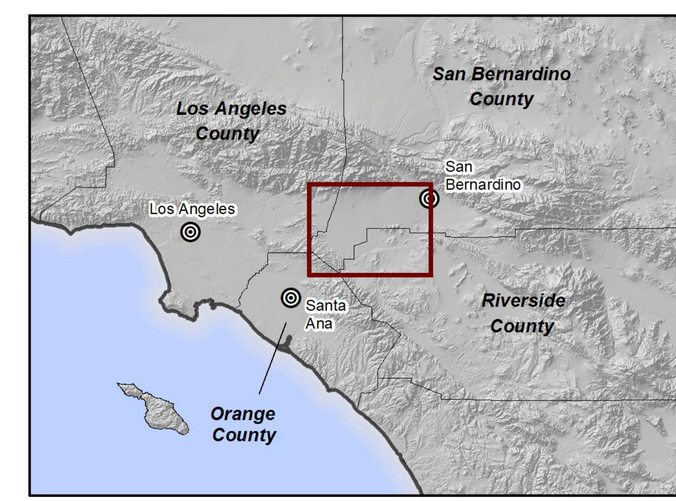
Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks



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0 1 2 Miles

0 2 4 Kilometers

Inland Empire Utilities Agency
A Municipal Water District

Chino Basin Watermaster

2018 Recharge Master Plan Update

Recharge Facilities in the Chino Basin
Supplemental Water Recharge Capacity Estimation

Figure A-1

Figure A-10
Conceptual Simulation
Brooks Basin (3-Year Maintenance Cycle)

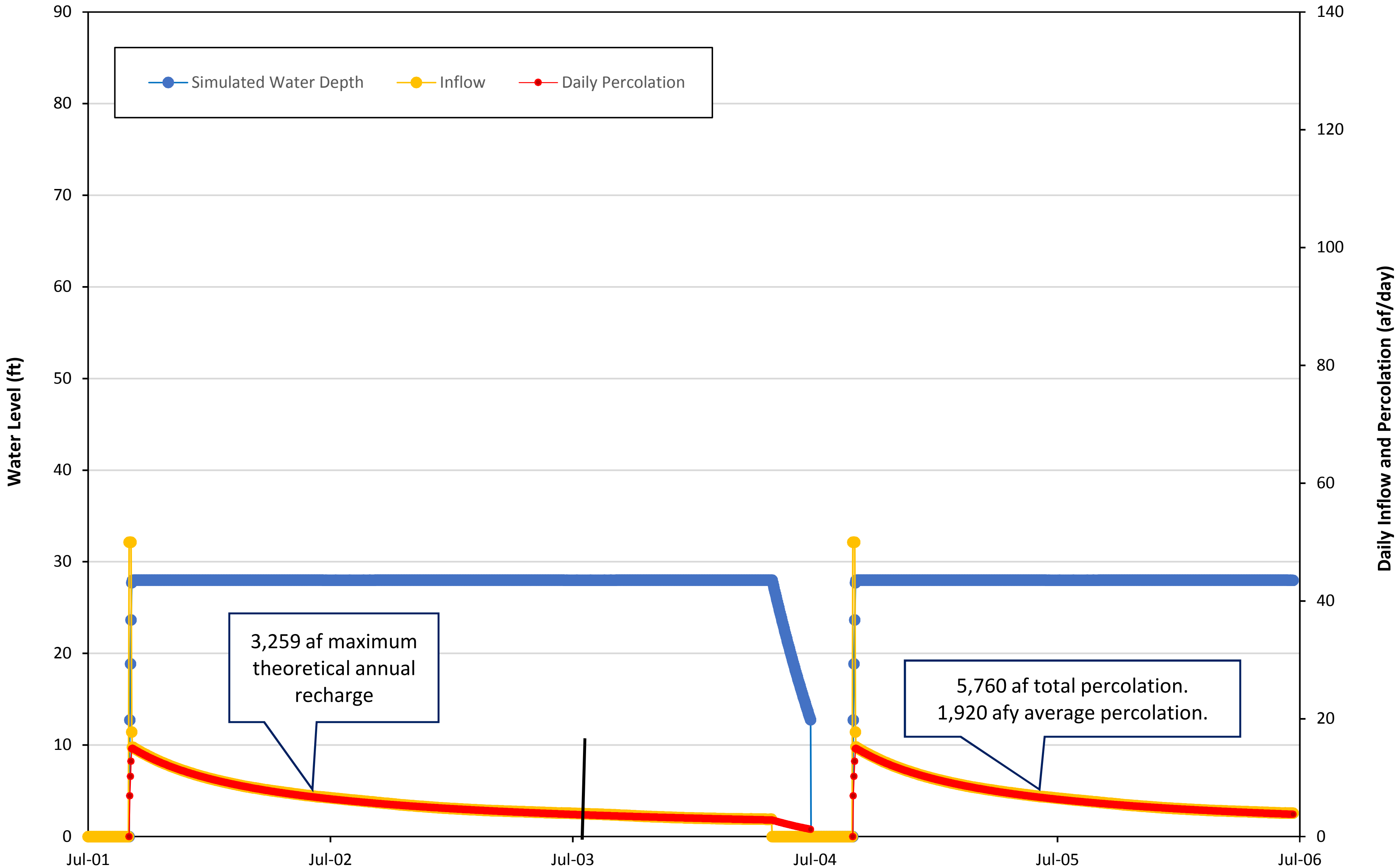

Figure A-2
Scatter Plot of Observed Water Level Versus Infiltration Rate
Upland Basin

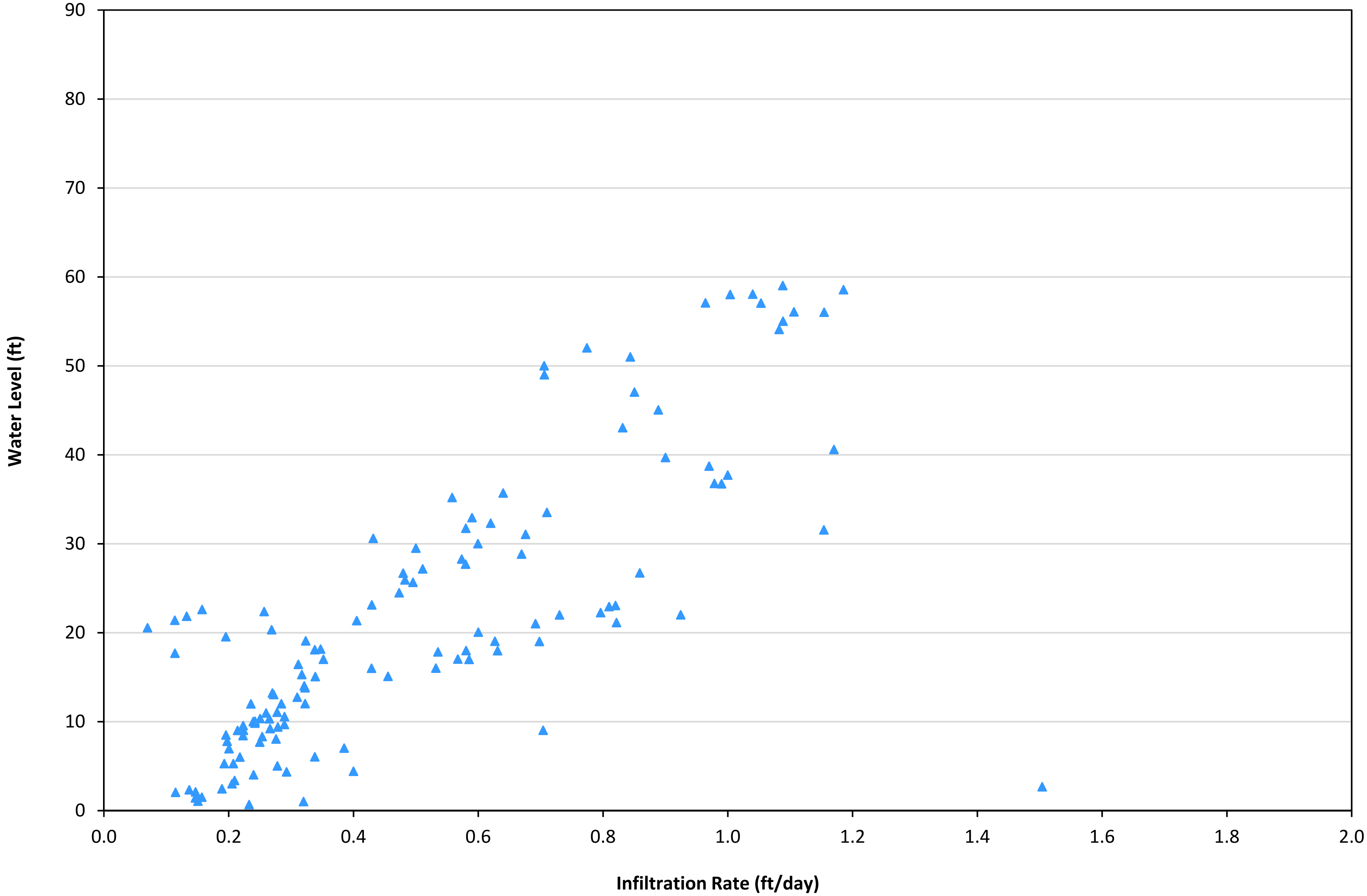

Figure A-3
Infiltration Rate in Upland Basin

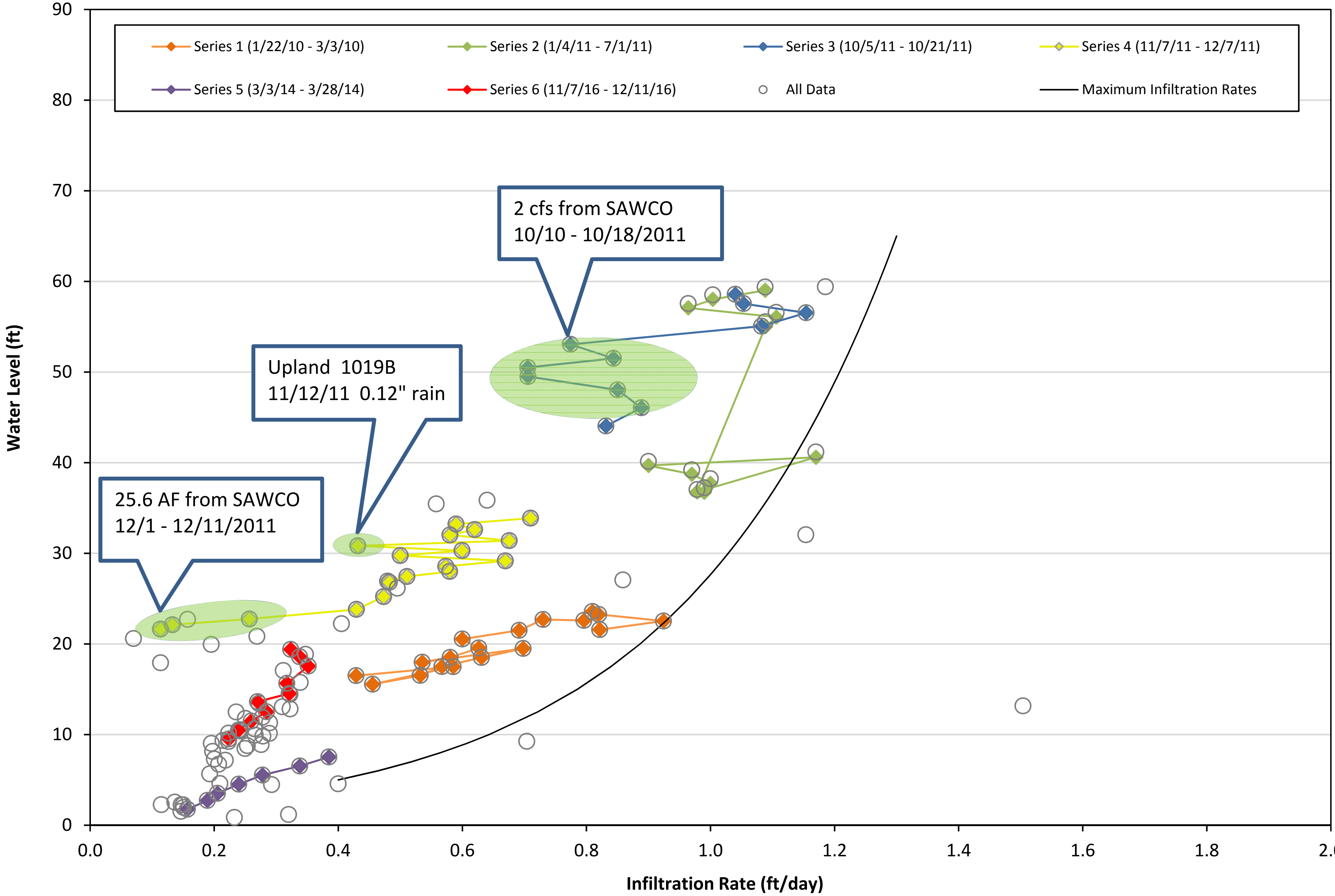

Figure A-4
IEUA Recharge Basin Operation Data
Upland Basin

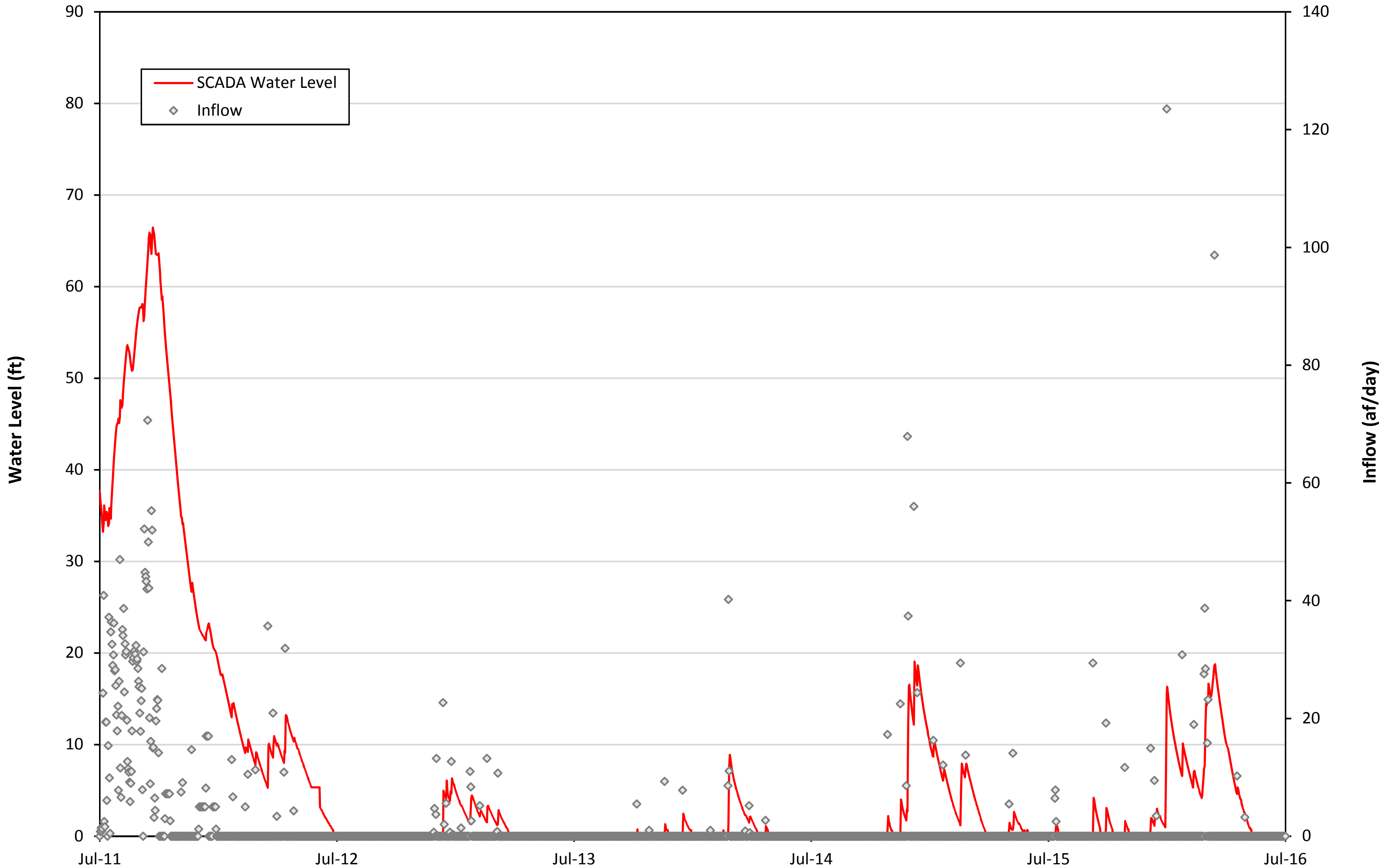

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Figure A-5
Estimation of Exponential Coefficient α

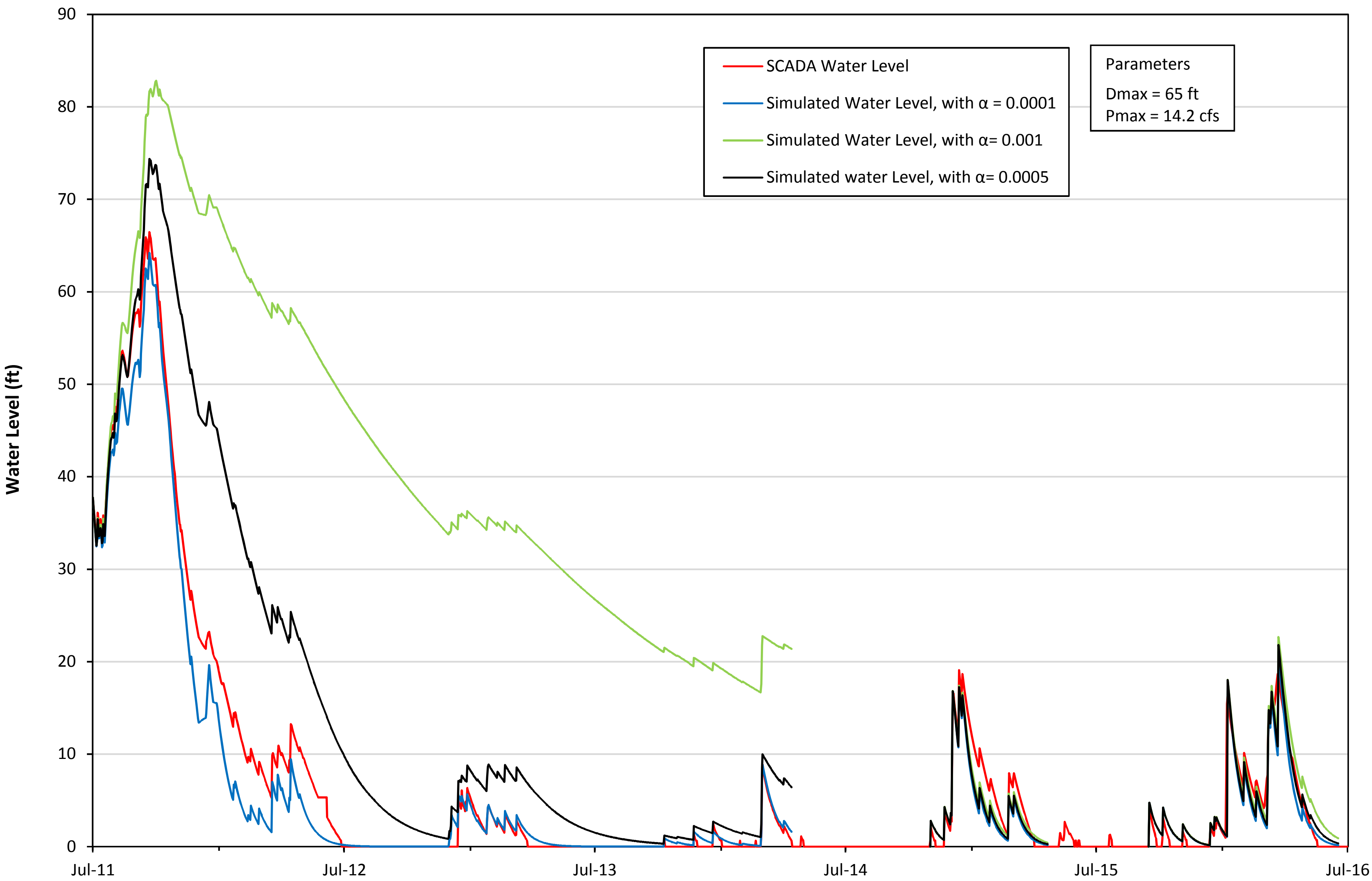


Figure A-6
Comparison of Measured and Simulated Water Levels in Upland Basin, FY 2012-2016

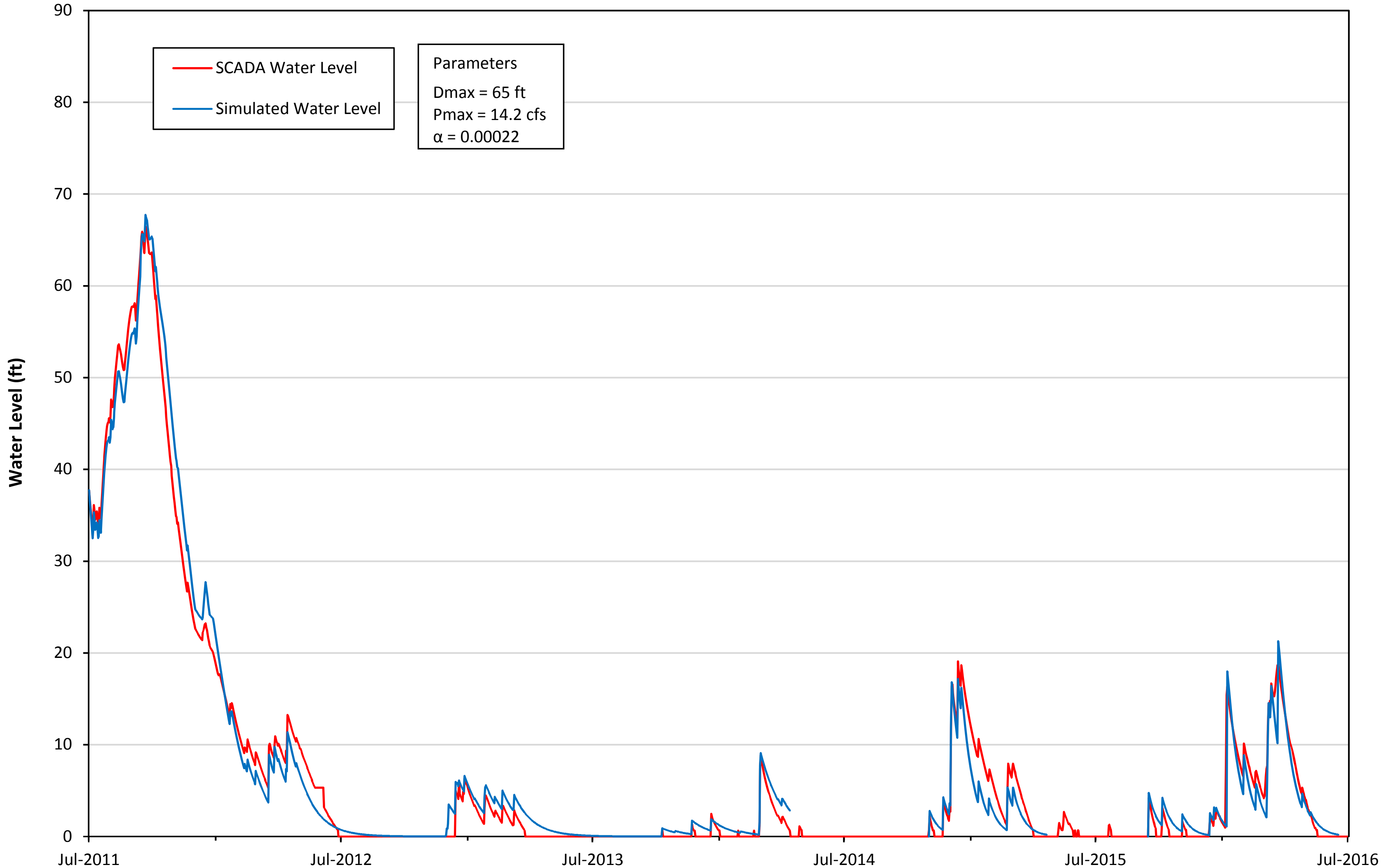


Figure A-7
Infiltration Rate in Brooks Basin

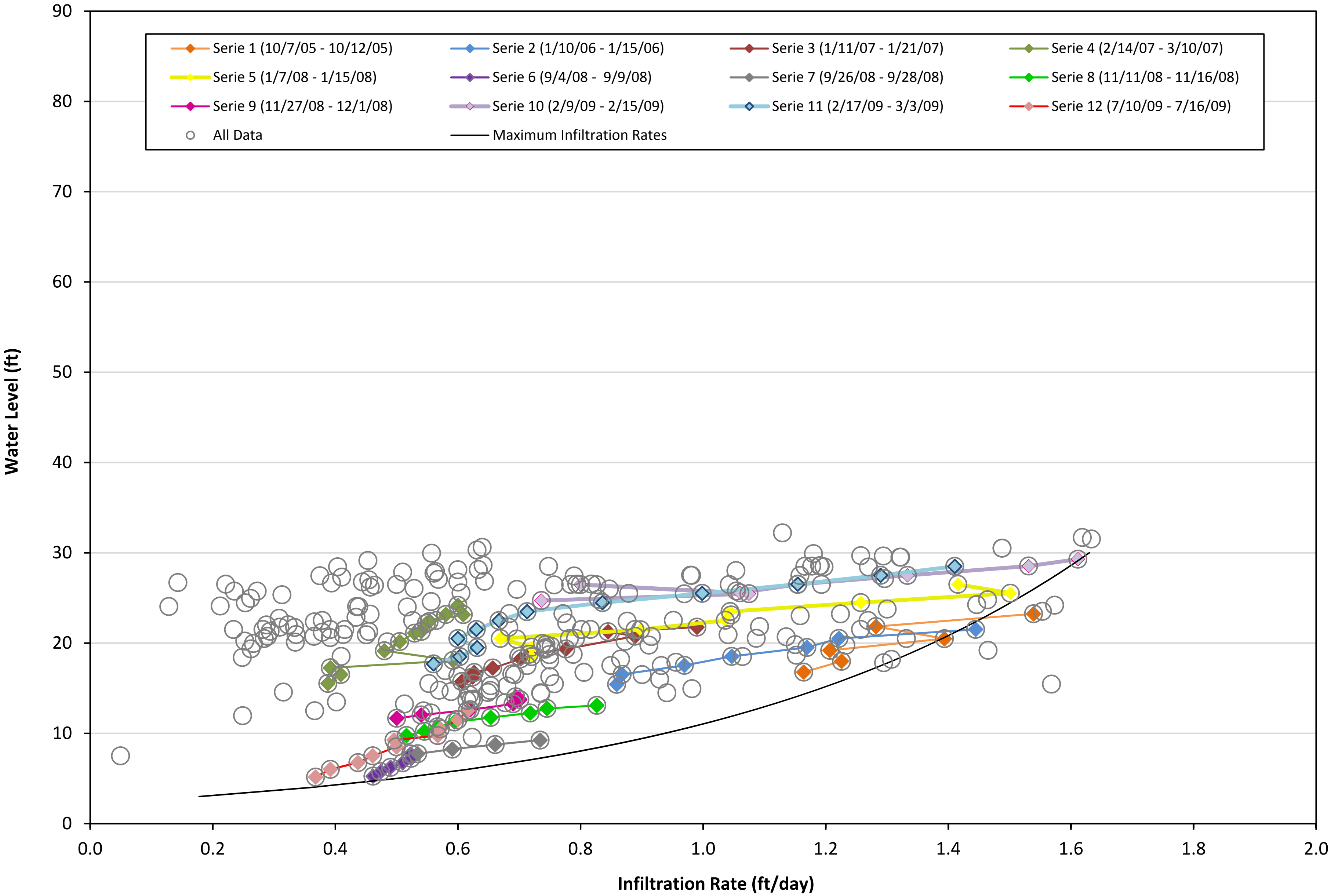


Figure A-8
Comparison of Measured and Calculated Water Levels
Brooks Basin

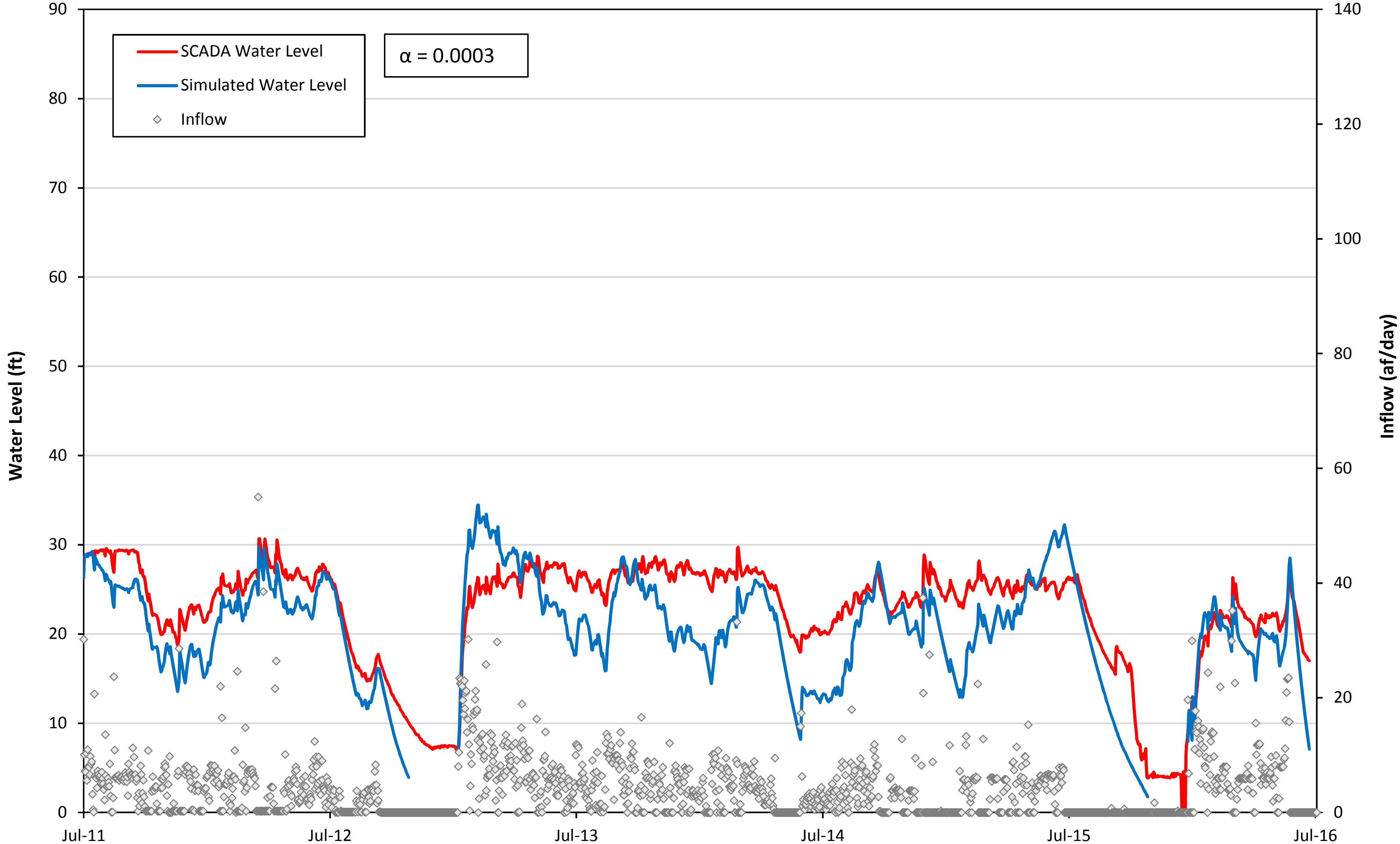
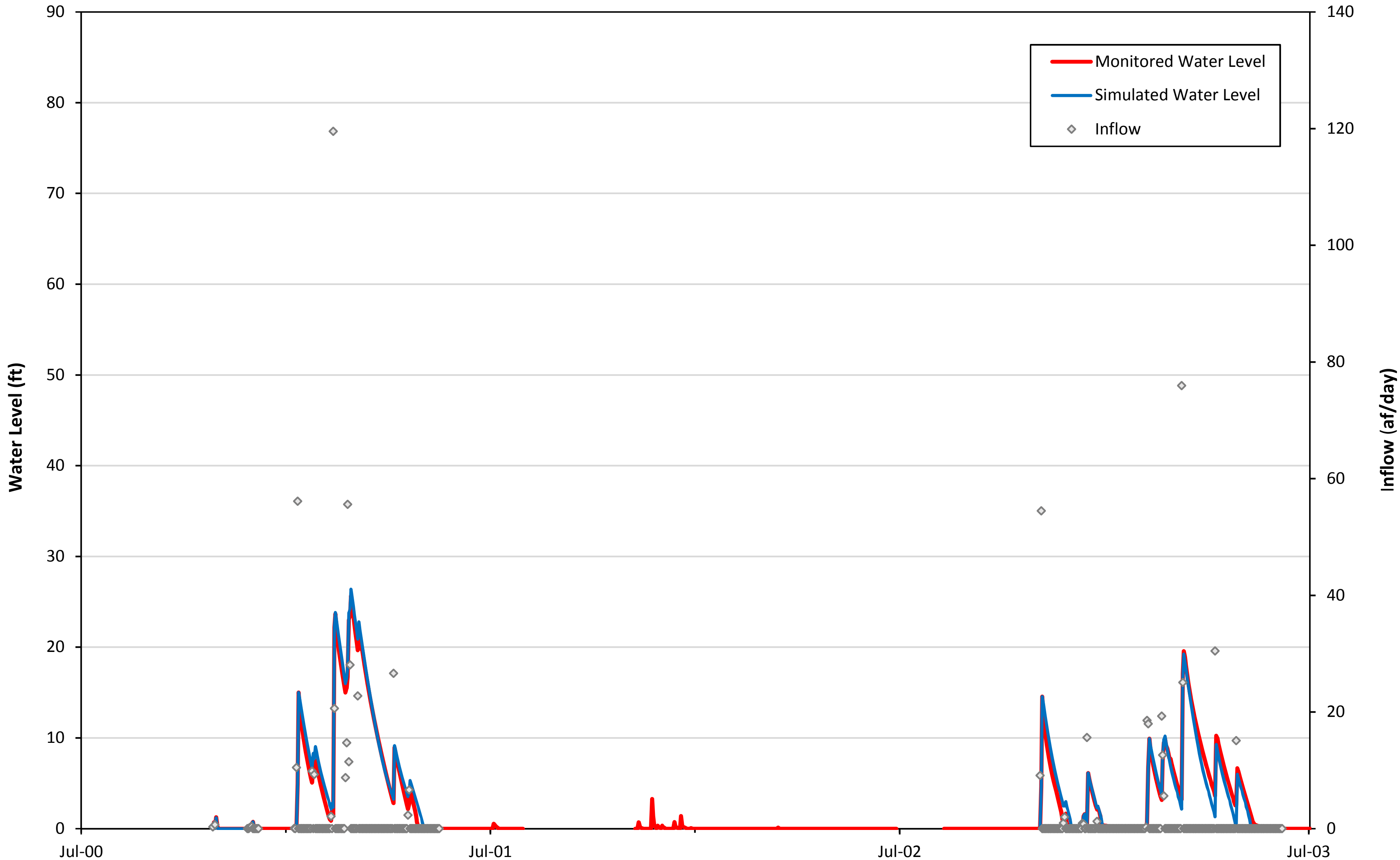


Figure A-9
Comparison of Measured and Simulated Water Levels
Brooks Basin, FY 2000 to 2003 Data



20180731_RMPU-Appendix-A_Fig-9 -- Figure A-9
8/2/2018

Appendix B

In-Lieu Recharge Capacity Estimates

Appendix B – In-Lieu Recharge Capacity Estimates

Section 4.3 of the 2018 RMPU discusses the calculations of the Chino Basin parties to effectuate in-lieu recharge. The following parties have access to imported water and are assumed to be able to facilitate in-lieu recharge:

- City of Chino (Tables and Figures C-1a through C-1e)
- City of Chino Hills (Tables and Figures C-2a through C-2d)
- City of Ontario (Tables and Figures C-3a through C-3e)
- City of Pomona (Tables and Figures C-4a through C-4e)
- City of Upland (Tables and Figures C-5a through C-5d)
- CVWD (Tables and Figures C-6a through C-6d)
- MVWD (Tables and Figures C-7a through C-7e)

Each party's capacity was calculated monthly for future planning years (2020, 2025, 2030, 2035 and 2040 if provided) based on the planning information provided for the Storage Framework. The tables and figures referenced above for each party show the calculations of monthly in-lieu recharge for each planning year. These tables and figures were submitted to each party for their review and comment. A summary of the discussions and adjustments made to the in-lieu capacity calculations can be found in Section 4.3.3.

Table B-1a
Calculation of the City of Chino's In-Lieu Recharge Capacity in Fiscal Year 2020
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Chino[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Chino[2]	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	455	475	0	915	915	0
August	455	488	0	940	940	0
September	440	468	0	832	832	0
October	455	371	84	772	772	84
November	440	257	183	625	625	183
December	455	218	237	399	399	237
January	455	203	252	435	435	252
February	411	180	230	422	422	230
March	455	241	214	544	544	214
April	440	289	151	754	754	151
May	455	356	99	785	785	99
June	440	446	0	848	848	0
Total	5,353	3,991	1,449	8,271	8,271	1,449

[1] 5.9 percent of the WFA Plant capacity is allocated to the City of Chino.

[2] Cannot be less than zero.

[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-1b

Calculation of the City of Chino's In-Lieu Recharge Capacity in Fiscal Year 2025

(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Chino[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Chino[2]	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	455	527	0	1,016	1,016	0
August	455	542	0	1,044	1,044	0
September	440	520	0	925	925	0
October	455	414	40	862	862	40
November	440	289	151	701	701	151
December	455	246	208	451	451	208
January	455	229	226	491	491	226
February	411	204	207	476	476	207
March	455	271	184	612	612	184
April	440	323	117	843	843	117
May	455	397	58	875	875	58
June	440	496	0	943	943	0
Total	5,353	4,458	1,191	9,238	9,238	1,191

[1] 5.9 percent of the WFA Plant capacity is allocated to the City of Chino.

[2] Cannot be less than zero.

[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-1c
Calculation of the City of Chino's In-Lieu Recharge Capacity in Fiscal Year 2030
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Chino[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Chino[2]	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	455	577	0	1,112	1,112	0
August	455	593	0	1,142	1,142	0
September	440	569	0	1,012	1,012	0
October	455	455	0	947	947	0
November	440	319	121	773	773	121
December	455	274	181	501	501	181
January	455	254	200	544	544	200
February	411	226	185	528	528	185
March	455	300	155	677	677	155
April	440	356	84	927	927	84
May	455	436	19	960	960	19
June	440	543	0	1,033	1,033	0
Total	5,353	4,901	946	10,157	10,157	946

[1] 5.9 percent of the WFA Plant capacity is allocated to the City of Chino.

[2] Cannot be less than zero.

[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-1d
Calculation of the City of Chino's In-Lieu Recharge Capacity in Fiscal Year 2035
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Chino[1] (1)	Imported Water Supply to Meet Demand (2)	Excess WFA Plant Capacity Allocated to Chino[2] (3) = (1) - (2)	Projected Pumping from Chino Basin (4)	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3] (5)	(6) = min[(3), (5)]
July	455	610	0	1,174	1,174	0
August	455	626	0	1,205	1,205	0
September	440	601	0	1,069	1,069	0
October	455	482	0	1,002	1,002	0
November	440	338	102	821	821	102
December	455	292	163	534	534	163
January	455	271	184	579	579	184
February	411	241	170	562	562	170
March	455	318	136	719	719	136
April	440	377	63	981	981	63
May	455	461	0	1,015	1,015	0
June	440	574	0	1,091	1,091	0
Total	5,353	5,190	818	10,755	10,755	818

[1] 5.9 percent of the WFA Plant capacity is allocated to the City of Chino.

[2] Cannot be less than zero.

[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-1e
Calculation of the City of Chino's In-Lieu Recharge Capacity in Fiscal Year 2040
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Chino[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Chino[2]	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	455	626	0	1,414	1,414	0
August	455	643	0	1,450	1,450	0
September	440	620	0	1,291	1,291	0
October	455	497	0	1,211	1,211	0
November	440	349	91	993	993	91
December	455	306	148	657	657	148
January	455	282	172	708	708	172
February	411	250	160	687	687	160
March	455	330	125	874	874	125
April	440	386	54	1,180	1,180	54
May	455	473	0	1,222	1,222	0
June	440	590	0	1,315	1,315	0
Total	5,353	5,353	750	13,002	13,002	750

[1] 5.9 percent of the WFA Plant capacity is allocated to the City of Chino.

[2] Cannot be less than zero.

[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-2a
Calculation of the City of Chino Hills' In-Lieu Recharge Capacity in Fiscal Year 2020
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to Chino Hills[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Chino Hills	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,210	343	867	350	350	350
August	1,210	369	841	361	361	361
September	1,171	359	811	280	280	280
October	1,210	282	928	215	215	215
November	1,171	229	942	157	157	157
December	1,210	160	1,050	92	92	92
January	1,210	120	1,090	95	95	95
February	1,093	134	959	84	84	84
March	1,210	247	963	131	131	131
April	1,171	305	865	235	235	235
May	1,210	320	890	274	274	274
June	1,171	352	819	295	295	295
Total	14,245	3,220	11,025	2,570	2,570	2,570

[1] 15.7 percent of the WFA Plant capacity is allocated to the City of Chino Hills.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-2b
Calculation of the City of Chino Hills' In-Lieu Recharge Capacity in Fiscal Year 2025
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to Chino Hills[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Chino Hills	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,210	470	740	486	486	486
August	1,210	505	705	501	501	501
September	1,171	496	675	390	390	390
October	1,210	395	815	304	304	304
November	1,171	326	845	227	227	227
December	1,210	232	977	135	135	135
January	1,210	171	1,038	138	138	138
February	1,093	188	904	119	119	119
March	1,210	345	865	186	186	186
April	1,171	419	752	327	327	327
May	1,210	438	771	380	380	380
June	1,171	481	690	408	408	408
Total	14,245	4,467	9,778	3,600	3,600	3,600

[1] 15.7 percent of the WFA Plant capacity is allocated to the City of Chino Hills.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-2c
Calculation of the City of Chino Hills' In-Lieu Recharge Capacity in Fiscal Year 2030
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to Chino Hills[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Chino Hills	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,210	516	694	487	487	487
August	1,210	554	656	501	501	501
September	1,171	542	629	390	390	390
October	1,210	432	777	304	304	304
November	1,171	358	813	227	227	227
December	1,210	255	955	135	135	135
January	1,210	189	1,021	139	139	139
February	1,093	206	887	119	119	119
March	1,210	376	834	185	185	185
April	1,171	457	713	326	326	326
May	1,210	480	730	380	380	380
June	1,171	526	645	408	408	408
Total	14,245	4,892	9,353	3,600	3,600	3,600

[1] 15.7 percent of the WFA Plant capacity is allocated to the City of Chino Hills.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-2d
Calculation of the City of Chino Hills' In-Lieu Recharge Capacity in Fiscal Year 2035 and Beyond
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to Chino Hills[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Chino Hills	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,210	611	599	489	489	489
August	1,210	655	554	503	503	503
September	1,171	638	533	389	389	389
October	1,210	510	699	305	305	305
November	1,171	424	747	228	228	228
December	1,210	302	907	136	136	136
January	1,210	225	985	140	140	140
February	1,093	243	850	119	119	119
March	1,210	439	771	183	183	183
April	1,171	537	634	324	324	324
May	1,210	565	645	379	379	379
June	1,171	619	552	406	406	406
Total	14,245	5,769	8,476	3,600	3,600	3,600

[1] 15.7 percent of the WFA Plant capacity is allocated to the City of Chino Hills.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-3a
Calculation of the City of Ontario's In-Lieu Recharge Capacity in Fiscal Year 2020
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Ontario[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Ontario	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	2,420	1,015	1,405	1,524	1,524	1,405
August	2,420	1,126	1,294	1,498	1,498	1,294
September	2,342	1,090	1,251	1,286	1,286	1,251
October	2,420	828	1,591	1,104	1,104	1,104
November	2,342	816	1,526	871	871	871
December	2,420	683	1,737	603	603	603
January	2,420	568	1,852	563	563	563
February	2,186	651	1,535	665	665	665
March	2,420	718	1,702	725	725	725
April	2,342	778	1,563	981	981	981
May	2,420	803	1,617	1,144	1,144	1,144
June	2,342	925	1,417	1,400	1,400	1,400
Total	28,490	10,000	18,490	12,363	12,363	12,006

[1] 31.4 percent of the WFA Plant capacity is allocated to the City of Ontario.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-3b
Calculation of the City of Ontario's In-Lieu Recharge Capacity in Fiscal Year 2025
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Ontario[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Ontario	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	2,420	1,109	1,311	1,779	1,779	1,311
August	2,420	1,231	1,189	1,749	1,749	1,189
September	2,342	1,195	1,147	1,505	1,505	1,147
October	2,420	910	1,510	1,296	1,296	1,296
November	2,342	902	1,439	1,030	1,030	1,030
December	2,420	763	1,657	720	720	720
January	2,420	634	1,786	671	671	671
February	2,186	722	1,464	788	788	788
March	2,420	795	1,624	858	858	858
April	2,342	853	1,488	1,150	1,150	1,150
May	2,420	878	1,542	1,336	1,336	1,336
June	2,342	1,009	1,333	1,631	1,631	1,333
Total	28,490	11,000	17,490	14,514	14,514	12,829

[1] 31.4 percent of the WFA Plant capacity is allocated to the City of Ontario.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-3c
Calculation of the City of Ontario's In-Lieu Recharge Capacity in Fiscal Year 2030
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Ontario[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Ontario	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	2,420	1,300	1,119	2,187	2,187	1,119
August	2,420	1,443	977	2,150	2,150	977
September	2,342	1,404	938	1,853	1,853	938
October	2,420	1,074	1,346	1,602	1,602	1,346
November	2,342	1,074	1,268	1,284	1,284	1,268
December	2,420	920	1,500	910	910	910
January	2,420	762	1,658	845	845	845
February	2,186	862	1,323	986	986	986
March	2,420	947	1,472	1,071	1,071	1,071
April	2,342	1,005	1,337	1,418	1,418	1,337
May	2,420	1,030	1,389	1,643	1,643	1,389
June	2,342	1,180	1,162	1,998	1,998	1,162
Total	28,490	13,000	15,490	17,947	17,947	13,348

[1] 31.4 percent of the WFA Plant capacity is allocated to the City of Ontario.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-3d
Calculation of the City of Ontario's In-Lieu Recharge Capacity in Fiscal Year 2035
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Ontario[1] (1)	Imported Water Supply to Meet Demand (2)	Excess WFA Plant Capacity Allocated to Ontario (3) = (1) - (2)	Projected Pumping from Chino Basin (4)	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2] (5)	(6) = min[(3), (5)]
July	2,420	1,483	937	2,861	2,861	937
August	2,420	1,649	771	2,819	2,819	771
September	2,342	1,610	731	2,440	2,440	731
October	2,420	1,235	1,185	2,114	2,114	1,185
November	2,342	1,250	1,092	1,716	1,716	1,092
December	2,420	1,089	1,331	1,236	1,236	1,236
January	2,420	898	1,521	1,144	1,144	1,144
February	2,186	1,009	1,177	1,324	1,324	1,177
March	2,420	1,106	1,314	1,434	1,434	1,314
April	2,342	1,153	1,188	1,869	1,869	1,188
May	2,420	1,177	1,243	2,154	2,154	1,243
June	2,342	1,341	1,001	2,606	2,606	1,001
Total	28,490	15,000	13,490	23,715	23,715	13,017

[1] 31.4 percent of the WFA Plant capacity is allocated to the City of Ontario.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-3e
Calculation of the City of Ontario's In-Lieu Recharge Capacity in Fiscal Year 2040
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Ontario[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Ontario	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	2,420	1,661	758	3,706	3,361	758
August	2,420	1,852	568	3,660	3,361	568
September	2,342	1,817	525	3,182	3,182	525
October	2,420	1,394	1,026	2,760	2,760	1,026
November	2,342	1,429	913	2,267	2,267	913
December	2,420	1,264	1,156	1,659	1,659	1,156
January	2,420	1,038	1,381	1,528	1,528	1,381
February	2,186	1,158	1,027	1,757	1,757	1,027
March	2,420	1,267	1,153	1,899	1,899	1,153
April	2,342	1,301	1,041	2,437	2,437	1,041
May	2,420	1,321	1,099	2,794	2,794	1,099
June	2,342	1,498	843	3,367	3,361	843
Total	28,490	17,000	11,490	31,016	30,366	11,490

[1] 31.4 percent of the WFA Plant capacity is allocated to the City of Ontario.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-4a
Calculation of the City of Pomona's In-Lieu Recharge Capacity in Fiscal Year 2020
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	Imported Water Capacity Allocated to City of Pomona[1]	Imported Water Supply to Meet Demand	Excess Imported Water Capacity Allocated to Pomona	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	578	33	544	1,837	1,246	544
August	578	52	526	1,844	1,246	526
September	559	46	513	1,657	1,246	513
October	578	30	547	1,602	1,246	547
November	559	16	543	1,567	1,246	543
December	578	18	559	1,413	1,246	559
January	578	11	566	1,327	1,246	566
February	522	30	491	1,066	1,066	491
March	578	28	549	1,043	1,043	549
April	559	58	501	932	932	501
May	578	82	496	1,003	1,003	496
June	559	74	484	1,427	1,246	484
Total	6,800	479	6,321	16,716	14,011	6,321

[1] 6,800 afy allocation, per City of Pomona's 2011 Integrated Water Supply Plan

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-4b
Calculation of the City of Pomona's In-Lieu Recharge Capacity in Fiscal Year 2025
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	Imported Water Capacity Allocated to City of Pomona[1]	Imported Water Supply to Meet Demand	Excess Imported Water Capacity Allocated to Pomona	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	578	1	577	1,837	1,374	577
August	578	1	576	1,844	1,374	576
September	559	1	558	1,657	1,374	558
October	578	1	577	1,602	1,374	577
November	559	0	558	1,567	1,374	558
December	578	1	577	1,413	1,374	577
January	578	0	577	1,327	1,327	577
February	522	1	521	1,066	1,066	521
March	578	1	577	1,043	1,043	577
April	559	2	557	932	932	557
May	578	2	575	1,003	1,003	575
June	559	2	557	1,427	1,374	557
Total	6,800	13	6,787	16,716	14,986	6,787

[1] 6,800 afy allocation, per City of Pomona's 2011 Integrated Water Supply Plan

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-4c
Calculation of the City of Pomona's In-Lieu Recharge Capacity in Fiscal Year 2030
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	Imported Water Capacity Allocated to City of Pomona[1] (1)	Imported Water Supply to Meet Demand (2)	Excess Imported Water Capacity Allocated to Pomona (3) = (1) - (2)	Projected Pumping from Chino Basin (4)	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2] (5)	(6) = min[(3), (5)]
July	578	0	578	1,837	1,380	578
August	578	0	578	1,844	1,380	578
September	559	0	559	1,657	1,380	559
October	578	0	578	1,602	1,380	578
November	559	0	559	1,567	1,380	559
December	578	0	578	1,413	1,380	578
January	578	0	578	1,327	1,327	578
February	522	0	522	1,066	1,066	522
March	578	0	578	1,043	1,043	578
April	559	0	559	932	932	559
May	578	0	578	1,003	1,003	578
June	559	0	559	1,427	1,380	559
Total	6,800	0	6,800	16,716	15,030	6,800

[1] 6,800 afy allocation, per City of Pomona's 2011 Integrated Water Supply Plan

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-4d
Calculation of the City of Pomona's In-Lieu Recharge Capacity in Fiscal Year 2035
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	Imported Water Capacity Allocated to City of Pomona[1]	Imported Water Supply to Meet Demand	Excess Imported Water Capacity Allocated to Pomona	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	578	16	561	1,837	828	561
August	578	25	552	1,844	828	552
September	559	22	537	1,657	828	537
October	578	14	564	1,602	828	564
November	559	8	551	1,567	828	551
December	578	9	569	1,413	828	569
January	578	5	573	1,327	828	573
February	522	13	508	1,066	828	508
March	578	12	566	1,043	828	566
April	559	22	537	932	828	537
May	578	33	544	1,003	828	544
June	559	33	526	1,427	828	526
Total	6,800	213	6,587	16,716	9,934	6,587

[1] 6,800 afy allocation, per City of Pomona's 2011 Integrated Water Supply Plan

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-4e
Calculation of the City of Pomona's In-Lieu Recharge Capacity in Fiscal Year 2040
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	Imported Water Capacity Allocated to City of Pomona[1]	Imported Water Supply to Meet Demand	Excess Imported Water Capacity Allocated to Pomona	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	578	116	462	1,837	816	462
August	578	178	400	1,844	816	400
September	559	157	402	1,657	816	402
October	578	100	477	1,602	816	477
November	559	56	503	1,567	816	503
December	578	62	516	1,413	816	516
January	578	36	541	1,327	816	541
February	522	94	428	1,066	816	428
March	578	83	494	1,043	816	494
April	559	155	404	932	816	404
May	578	226	352	1,003	816	352
June	559	229	330	1,427	816	330
Total	6,800	1,493	5,307	16,716	9,796	5,307

[1] 6,800 afy allocation, per City of Pomona's 2011 Integrated Water Supply Plan

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-5a
Calculation of the City of Upland's In-Lieu Recharge Capacity in Fiscal Year 2020
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Upland[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Upland	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,772	851	921	257	257	257
August	1,772	1,126	647	341	341	341
September	1,715	1,226	490	369	369	369
October	1,772	654	1,118	285	285	285
November	1,715	404	1,312	229	229	229
December	1,772	202	1,571	173	173	173
January	1,772	241	1,532	173	173	173
February	1,601	220	1,381	173	173	173
March	1,772	318	1,455	145	145	145
April	1,715	484	1,231	173	173	173
May	1,772	720	1,052	257	257	257
June	1,715	743	972	229	229	229
Total	20,868	7,188	13,680	2,800	2,800	2,800

[1] 23 percent of the WFA Plant capacity is allocated to the City of Upland.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-5b
Calculation of the City of Upland's In-Lieu Recharge Capacity in Fiscal Year 2025
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Upland[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Upland	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,772	936	836	257	257	257
August	1,772	1,238	534	341	341	341
September	1,715	1,348	367	369	369	367
October	1,772	729	1,043	285	285	285
November	1,715	453	1,262	229	229	229
December	1,772	228	1,544	173	173	173
January	1,772	271	1,501	173	173	173
February	1,601	248	1,353	173	173	173
March	1,772	355	1,418	145	145	145
April	1,715	536	1,179	173	173	173
May	1,772	798	974	257	257	257
June	1,715	819	897	229	229	229
Total	20,868	7,961	12,907	2,800	2,800	2,798

[1] 23 percent of the WFA Plant capacity is allocated to the City of Upland.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-5c
Calculation of the City of Upland's In-Lieu Recharge Capacity in Fiscal Year 2030
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Upland[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Upland	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,772	1,046	727	257	257	257
August	1,772	1,383	389	341	341	341
September	1,715	1,505	210	369	369	210
October	1,772	827	945	285	285	285
November	1,715	519	1,196	229	229	229
December	1,772	264	1,509	173	173	173
January	1,772	313	1,460	173	173	173
February	1,601	286	1,314	173	173	173
March	1,772	403	1,369	145	145	145
April	1,715	604	1,112	173	173	173
May	1,772	898	874	257	257	257
June	1,715	915	800	229	229	229
Total	20,868	8,964	11,904	2,800	2,800	2,641

[1] 23 percent of the WFA Plant capacity is allocated to the City of Upland.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-5d

Calculation of the City of Upland's In-Lieu Recharge Capacity in Fiscal Year 2035 and Beyond

(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to City of Upland[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to Upland	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[2]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,772	1,098	674	257	257	257
August	1,772	1,453	320	341	341	320
September	1,715	1,581	134	369	369	134
October	1,772	875	897	285	285	285
November	1,715	551	1,164	229	229	229
December	1,772	281	1,491	173	173	173
January	1,772	333	1,439	173	173	173
February	1,601	305	1,296	173	173	173
March	1,772	427	1,346	145	145	145
April	1,715	636	1,079	173	173	173
May	1,772	946	826	257	257	257
June	1,715	961	754	229	229	229
Total	20,868	9,448	11,420	2,800	2,800	2,545

[1] 23 percent of the WFA Plant capacity is allocated to the City of Upland.

[2] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-6a
Calculation of Cucamonga Valley Water District's In-Lieu Recharge Capacity in Fiscal Year 2020
(af)

Month	Imported Water and Treatment Constraints				Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	LM/RN Plant Capacity	Imported Water Supply to Meet Demand	Surface Water Treated at LM/RN Plants	Excess Plant Capacity	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[1]	
	(1)	(2)	(3)	(4) = (1) - [(2)+(3)]	(5)	(6)	(7) = min[(4), (5), (6)]
July	6,456	3,630	273	2,553	1,771	1,220	1,220
August	6,456	3,744	243	2,469	1,676	1,220	1,220
September	6,248	3,582	205	2,461	1,328	1,220	1,220
October	6,456	2,720	214	3,522	1,282	1,220	1,220
November	6,248	2,169	221	3,858	958	958	958
December	6,456	1,768	162	4,526	478	478	478
January	6,456	1,966	262	4,228	468	468	468
February	5,831	1,256	309	4,266	641	641	641
March	6,456	1,898	415	4,143	737	737	737
April	6,248	2,474	428	3,346	823	823	823
May	6,456	3,112	367	2,977	1,178	1,178	1,178
June	6,248	3,285	300	2,662	1,415	1,220	1,220
Total	76,018	31,605	3,400	41,013	12,755	11,383	11,383

[1] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-6b
Calculation of Cucamonga Valley Water District's In-Lieu Recharge Capacity in Fiscal Year 2025
(af)

Month	Imported Water and Treatment Constraints				Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	LM/RN Plant Capacity	Imported Water Supply to Meet Demand	Surface Water Treated at LM/RN Plants	Excess Plant Capacity	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[1]	
	(1)	(2)	(3)	(4) = (1) - [(2)+(3)]	(5)	(6)	(7) = min[(4), (5), (6)]
July	6,456	3,799	268	2,389	1,891	1,891	1,891
August	6,456	3,918	237	2,302	1,792	1,792	1,792
September	6,248	3,747	199	2,302	1,425	1,425	1,425
October	6,456	2,847	210	3,399	1,371	1,371	1,371
November	6,248	2,271	220	3,757	1,026	1,026	1,026
December	6,456	1,849	162	4,445	520	520	520
January	6,456	2,057	265	4,135	512	512	512
February	5,831	1,316	315	4,200	688	688	688
March	6,456	1,988	422	4,046	794	794	794
April	6,248	2,589	435	3,224	888	888	888
May	6,456	3,256	369	2,831	1,265	1,265	1,265
June	6,248	3,438	298	2,512	1,515	1,515	1,515
Total	76,018	33,073	3,400	39,545	13,687	13,687	13,687

[1] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-6c
Calculation of Cucamonga Valley Water District's In-Lieu Recharge Capacity in Fiscal Year 2030
(af)

Month	Imported Water and Treatment Constraints				Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	LM/RN Plant Capacity	Imported Water Supply to Meet Demand	Surface Water Treated at LM/RN Plants	Excess Plant Capacity	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[1]	
	(1)	(2)	(3)	(4) = (1) - [(2)+(3)]	(5)	(6)	(7) = min[(4), (5), (6)]
July	6,456	4,057	268	2,131	1,911	1,911	1,911
August	6,456	4,177	237	2,042	1,812	1,812	1,812
September	6,248	3,980	199	2,069	1,443	1,443	1,443
October	6,456	3,045	210	3,202	1,386	1,386	1,386
November	6,248	2,429	220	3,599	1,039	1,039	1,039
December	6,456	1,967	162	4,328	529	529	529
January	6,456	2,189	265	4,003	522	522	522
February	5,831	1,429	315	4,088	697	697	697
March	6,456	2,136	422	3,898	806	806	806
April	6,248	2,761	435	3,052	902	902	902
May	6,456	3,467	369	2,621	1,281	1,281	1,281
June	6,248	3,665	298	2,284	1,533	1,533	1,533
Total	76,018	35,301	3,400	37,317	13,859	13,859	13,859

[1] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-6d
Calculation of Cucamonga Valley Water District's In-Lieu Recharge Capacity in Fiscal Year 2035 and Beyond
(af)

Month	Imported Water and Treatment Constraints				Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	LM/RN Plant Capacity	Imported Water Supply to Meet Demand	Surface Water Treated at LM/RN Plants	Excess Plant Capacity	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[1]	
	(1)	(2)	(3)	(4) = (1) - [(2)+(3)]	(5)	(6)	(7) = min[(4), (5), (6)]
July	6,456	3,429	268	2,760	2,539	1,268	1,268
August	6,456	3,546	237	2,674	2,443	1,268	1,268
September	6,248	3,412	199	2,637	2,011	1,268	1,268
October	6,456	2,564	210	3,683	1,867	1,268	1,268
November	6,248	2,043	220	3,984	1,424	1,268	1,268
December	6,456	1,681	162	4,614	815	815	815
January	6,456	1,867	265	4,325	843	843	843
February	5,831	1,155	315	4,362	971	971	971
March	6,456	1,775	422	4,259	1,167	1,167	1,167
April	6,248	2,343	435	3,471	1,320	1,268	1,268
May	6,456	2,954	369	3,133	1,794	1,268	1,268
June	6,248	3,111	298	2,838	2,086	1,268	1,268
Total	76,018	29,878	3,400	42,740	19,282	13,938	13,938

[1] Future production rights calculated as part of Scenario 1B of the Storage Framework model. Estimated production rights beyond 2035 vary between 13,400 afy and 14,000 afy.

Table B-7a
Calculation of the Monte Vista Water District's In-Lieu Recharge Capacity in Fiscal Year 2020
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to MVWD[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to MVWD[2]	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,849	1,764	85	625	625	85
August	1,849	1,855	0	524	524	0
September	1,790	1,891	0	373	373	0
October	1,849	1,276	574	476	476	476
November	1,790	674	1,116	586	586	586
December	1,849	321	1,529	485	485	485
January	1,849	498	1,351	483	483	483
February	1,670	399	1,271	395	395	395
March	1,849	636	1,214	442	442	442
April	1,790	915	875	458	458	458
May	1,849	1,099	750	647	647	647
June	1,790	1,426	364	590	590	364
Total	21,776	12,755	9,128	6,084	6,084	4,420

[1] 24 percent of the WFA Plant capacity is allocated to MVWD.

[2] Cannot be less than zero.

[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-7b
Calculation of the Monte Vista Water District's In-Lieu Recharge Capacity in Fiscal Year 2025
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to MVWD[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to MVWD[2]	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,849	1,835	15	641	641	15
August	1,849	1,928	0	537	537	0
September	1,790	1,963	0	382	382	0
October	1,849	1,327	522	489	489	489
November	1,790	706	1,084	605	605	605
December	1,849	337	1,512	503	503	503
January	1,849	521	1,328	498	498	498
February	1,670	417	1,253	408	408	408
March	1,849	663	1,186	455	455	455
April	1,790	952	838	470	470	470
May	1,849	1,144	705	664	664	664
June	1,790	1,483	307	605	605	307
Total	21,776	13,276	8,751	6,257	6,257	4,413

[1] 24 percent of the WFA Plant capacity is allocated to MVWD.

[2] Cannot be less than zero.

[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-7c
Calculation of the Monte Vista Water District's In-Lieu Recharge Capacity in Fiscal Year 2030
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to MVWD[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to MVWD[2]	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,849	1,857	0	656	656	0
August	1,849	1,952	0	550	550	0
September	1,790	1,989	0	391	391	0
October	1,849	1,344	506	500	500	500
November	1,790	714	1,075	618	618	618
December	1,849	342	1,508	515	515	515
January	1,849	527	1,322	509	509	509
February	1,670	422	1,248	417	417	417
March	1,849	671	1,179	465	465	465
April	1,790	963	827	480	480	480
May	1,849	1,157	692	678	678	678
June	1,790	1,501	289	619	619	289
Total	21,776	13,440	8,646	6,397	6,397	4,471

[1] 24 percent of the WFA Plant capacity is allocated to MVWD.

[2] Cannot be less than zero.

[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-7d
Calculation of the Monte Vista Water District's In-Lieu Recharge Capacity in Fiscal Year 2035
(af)

Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to MVWD[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to MVWD[2]	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,849	1,880	0	670	590	0
August	1,849	1,977	0	562	562	0
September	1,790	2,015	0	400	400	0
October	1,849	1,360	489	511	511	489
November	1,790	723	1,067	632	590	590
December	1,849	346	1,503	527	527	527
January	1,849	533	1,316	520	520	520
February	1,670	427	1,243	426	426	426
March	1,849	678	1,171	475	475	475
April	1,790	974	816	490	490	490
May	1,849	1,170	680	693	590	590
June	1,790	1,518	272	632	590	272
Total	21,776	13,601	8,557	6,537	6,271	4,379

[1] 24 percent of the WFA Plant capacity is allocated to MVWD.

[2] Cannot be less than zero.

[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Table B-7e

Calculation of the Monte Vista Water District's In-Lieu Recharge Capacity in Fiscal Year 2040

(af)

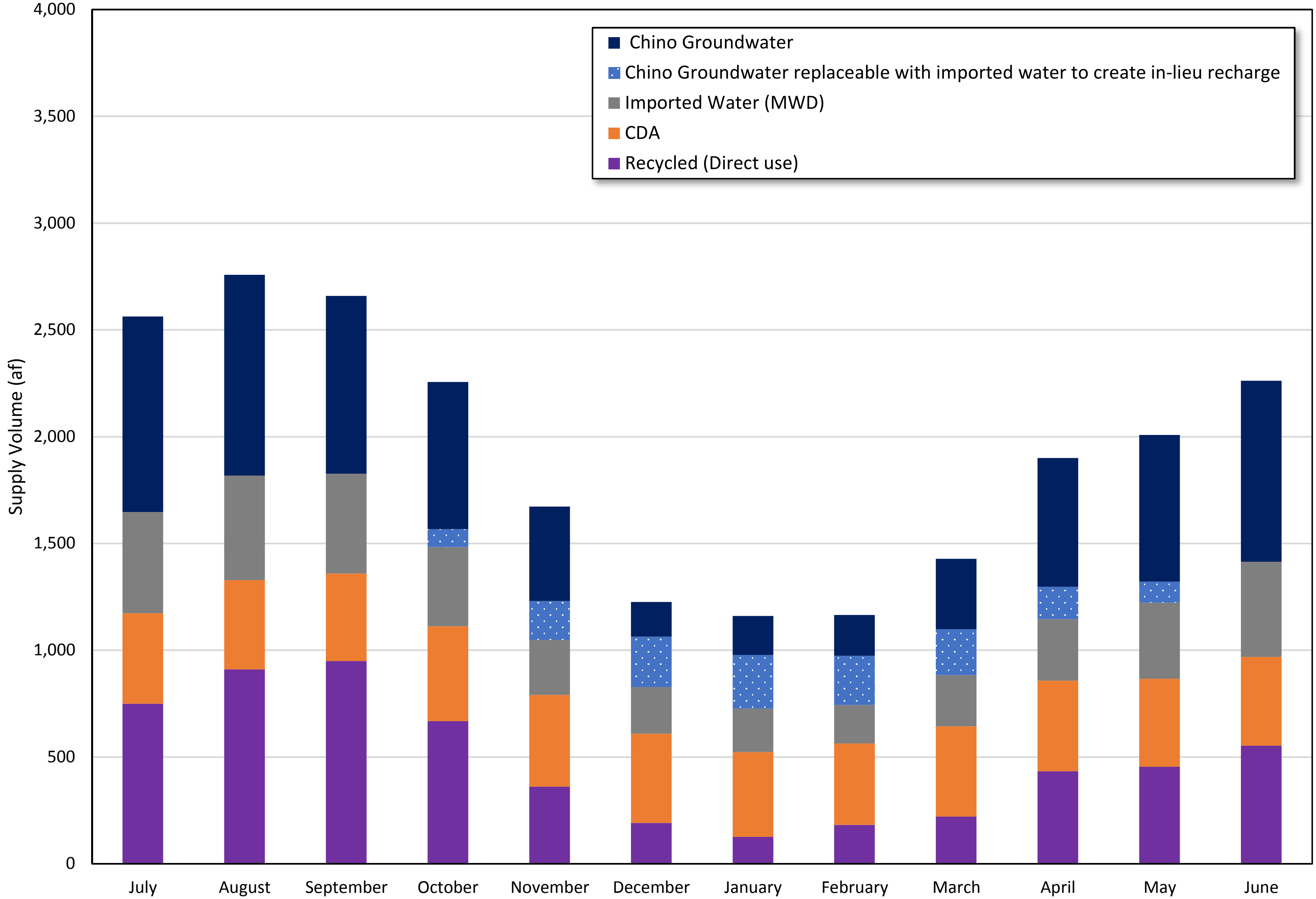
Month	Imported Water and Treatment Constraints			Groundwater Right Constraints		Maximum In-Lieu Capacity Based on Overriding Constraint
	WFA Plant Capacity Allocated to MVWD[1]	Imported Water Supply to Meet Demand	Excess WFA Plant Capacity Allocated to MVWD[2]	Projected Pumping from Chino Basin	Adjusted Pumping in Chino Basin Limited to Not Exceed Production Rights[3]	
	(1)	(2)	(3) = (1) - (2)	(4)	(5)	(6) = min[(3), (5)]
July	1,849	1,901	0	684	528	0
August	1,849	2,000	0	574	528	0
September	1,790	2,039	0	408	408	0
October	1,849	1,375	474	521	521	474
November	1,790	731	1,059	644	528	528
December	1,849	350	1,499	538	528	528
January	1,849	539	1,310	530	528	528
February	1,670	432	1,239	434	434	434
March	1,849	686	1,164	484	484	484
April	1,790	985	805	500	500	500
May	1,849	1,182	668	706	528	528
June	1,790	1,535	255	645	528	255
Total	21,776	13,754	8,472	6,668	6,043	4,259

[1] 24 percent of the WFA Plant capacity is allocated to MVWD.

[2] Cannot be less than zero.

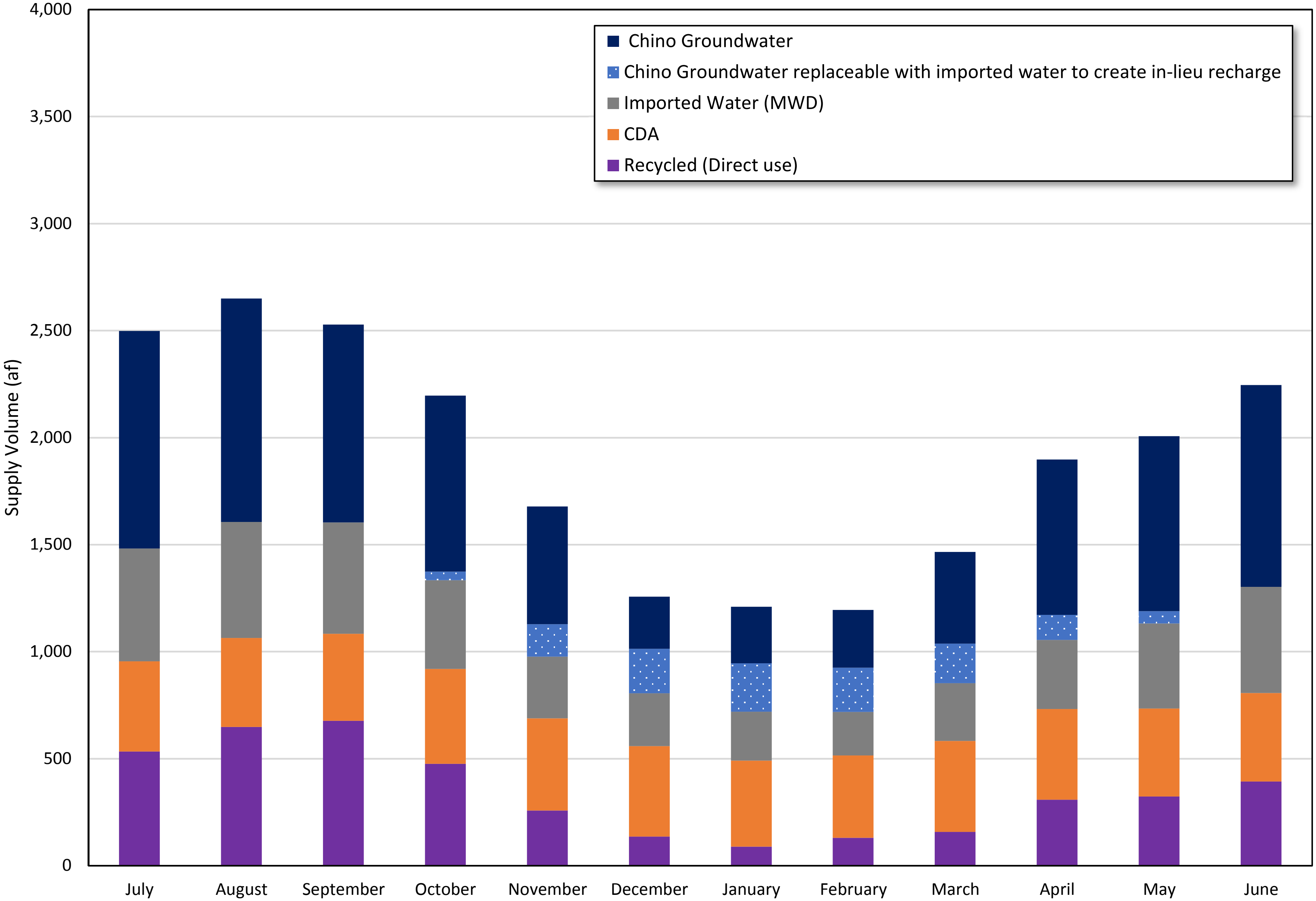
[3] Future production rights calculated as part of Scenario 1B of the Storage Framework model.

Figure B-1a
Projected Monthly Water Supply Plan for the City of Chino with In-Lieu Recharge, 2020



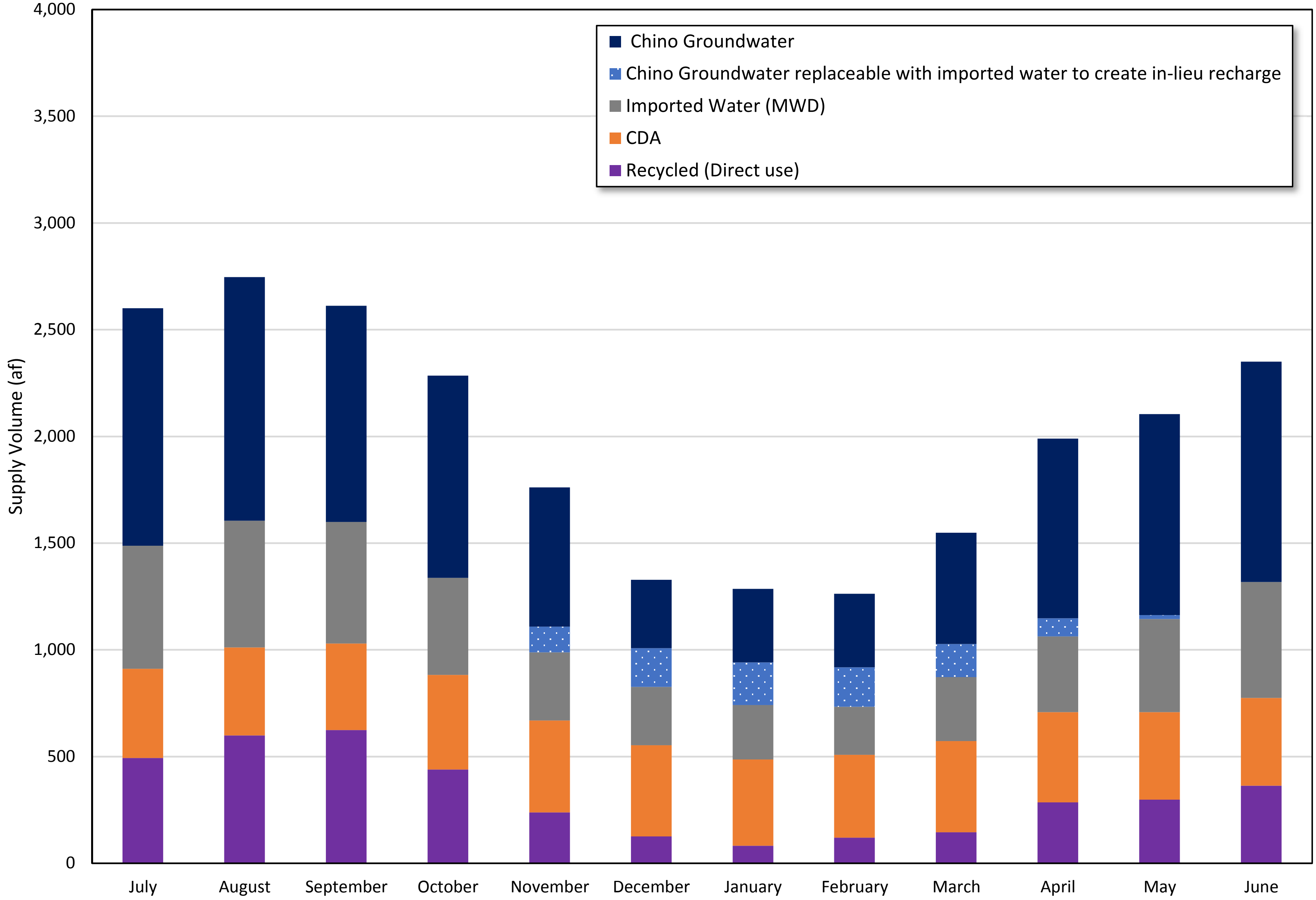
Chino_watersupply.xlsx -- Chino_2020
Created on 2/1/2018
Printed on 4/24/2018

Figure B-1b
Projected Monthly Water Supply Plan for the City of Chino with In-Lieu Recharge, 2025



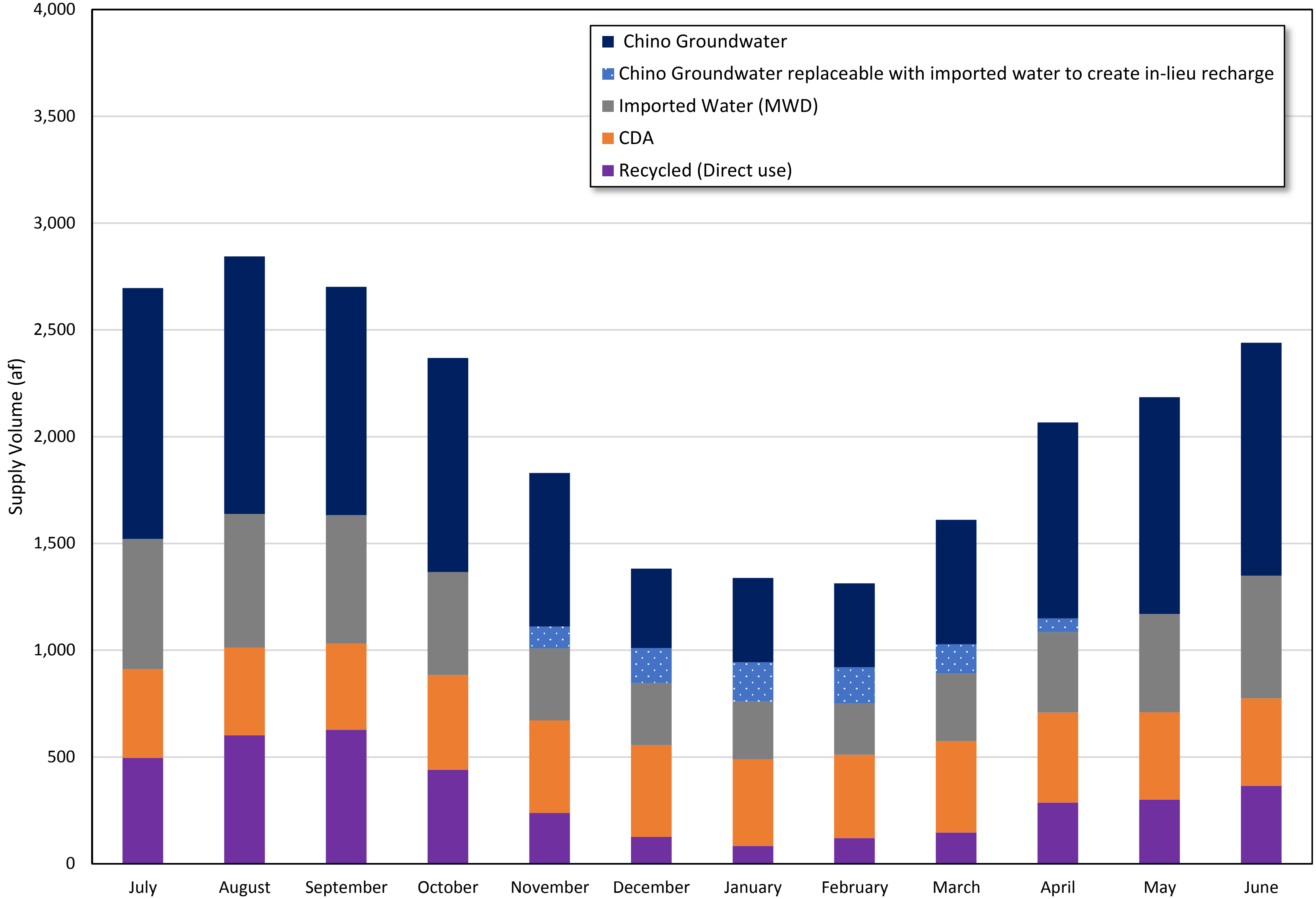
Chino_watersupply.xlsx -- Chino_2025
Created on 2/1/2018
Printed on 4/24/2018

Figure B-1c
Projected Monthly Water Supply Plan for the City of Chino with In-Lieu Recharge, 2030

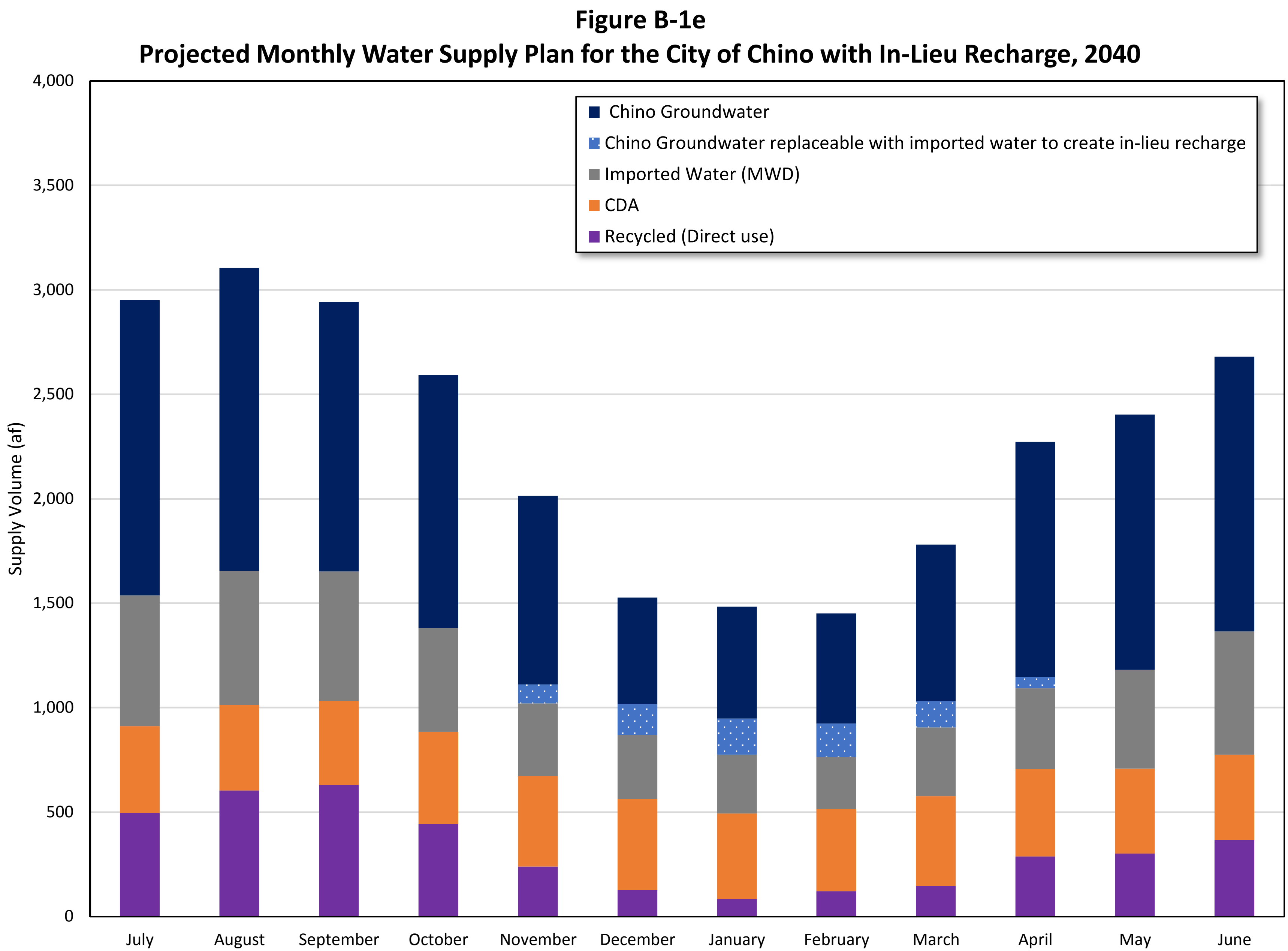


Chino_watersupply.xlsx -- Chino_2030
Created on 2/1/2018
Printed on 4/24/2018

Figure B-1d
Projected Monthly Water Supply Plan for the City of Chino with In-Lieu Recharge, 2035

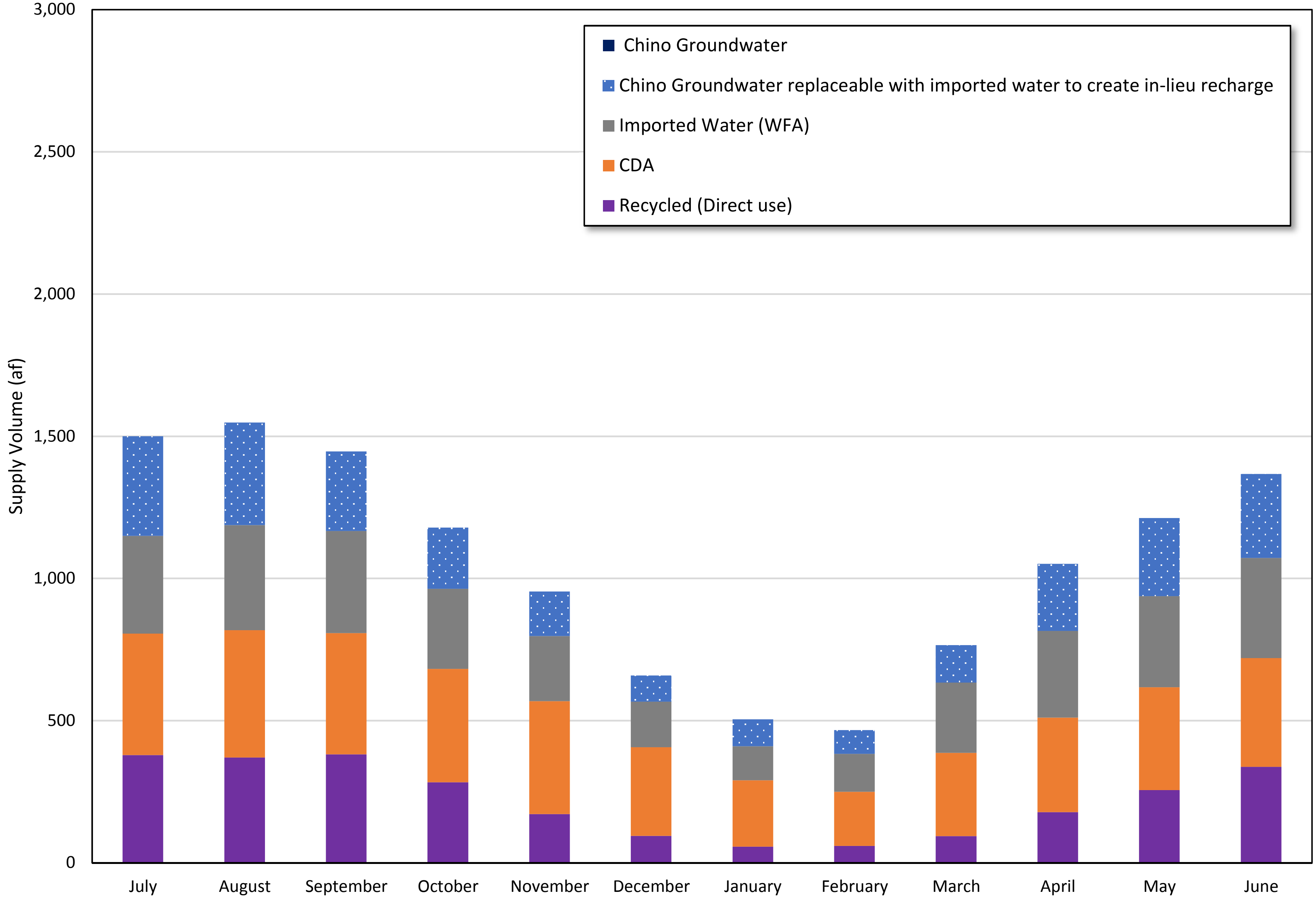


Chino_watersupply.xlsx -- Chino_2035
Created on 2/1/2018
Printed on 4/24/2018



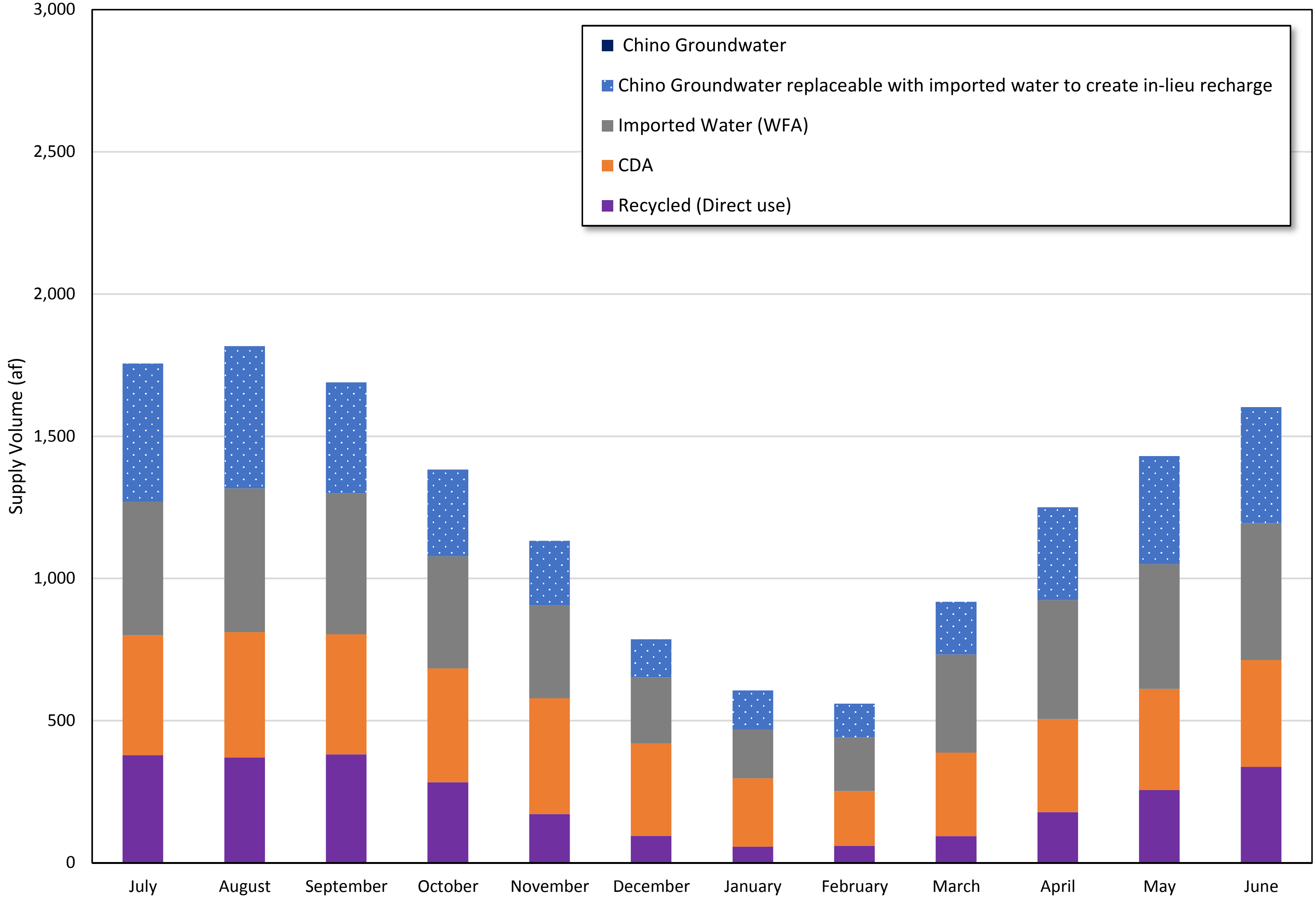
Chino_watersupply.xlsx -- Chino_2040
Created on 2/1/2018
Printed on 4/24/2018

Figure B-2a
Projected Monthly Water Supply Plan for Chino Hills with In-Lieu Recharge, 2020



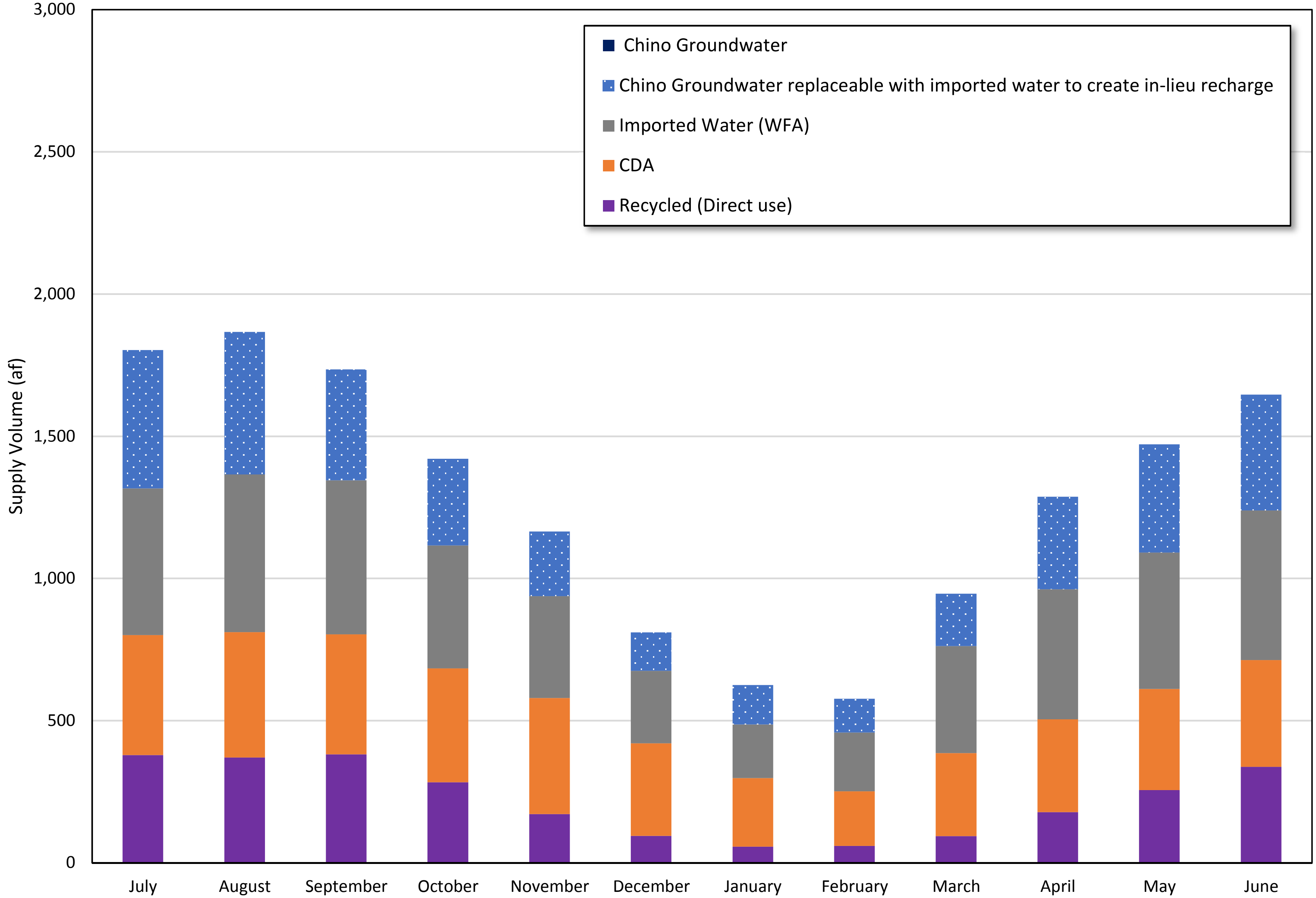
ChinoHills_watersupply.xlsx -- CH_2020
Created on 2/1/2018
Printed on 4/24/2018

Figure B-2b
Projected Monthly Water Supply Plan for Chino Hills with In-Lieu Recharge, 2025



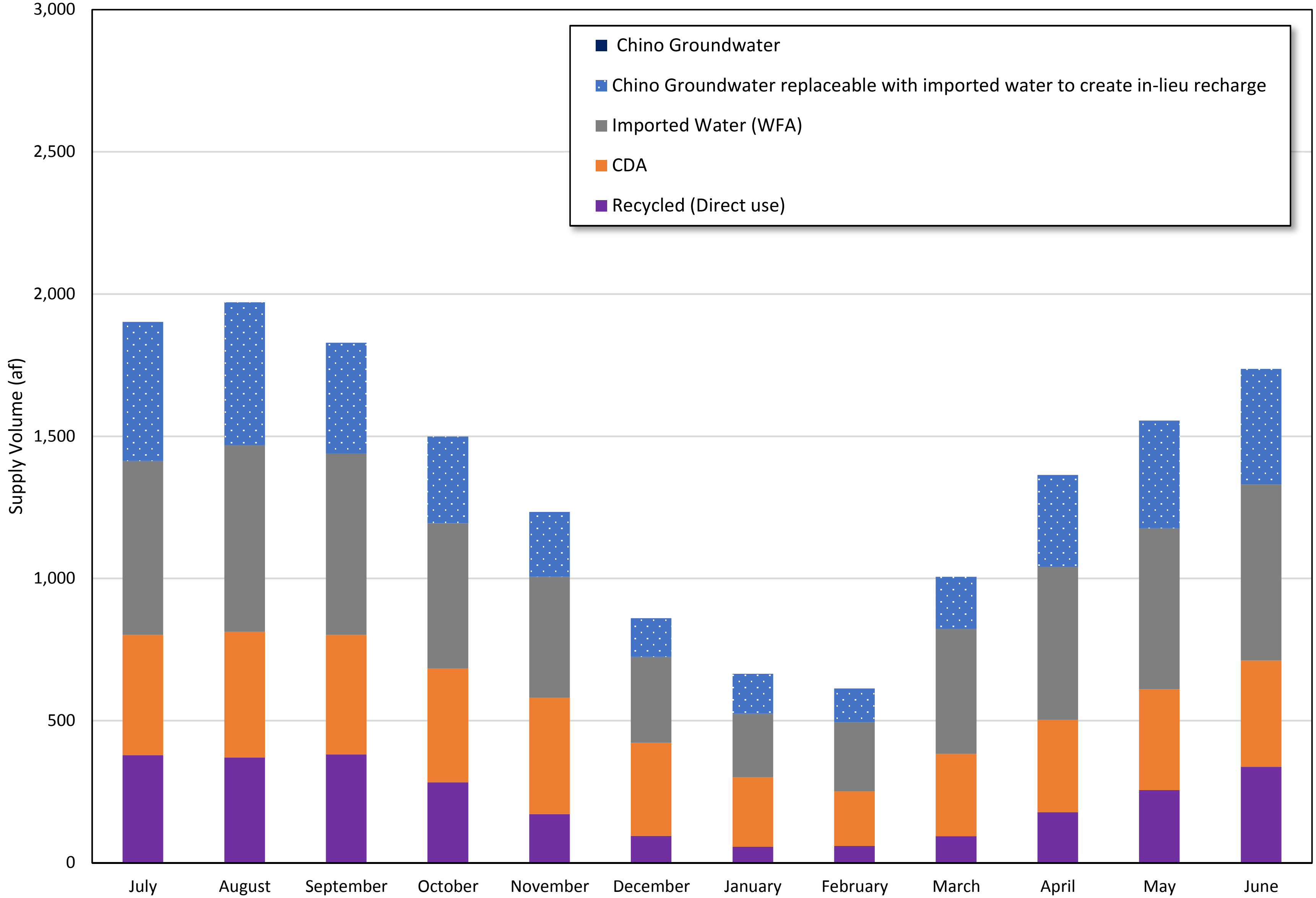
ChinoHills_watersupply.xlsx -- CH_2025
Created on 2/1/2018
Printed on 4/24/2018

Figure B-2c
Projected Monthly Water Supply Plan for Chino Hills with In-Lieu Recharge, 2030

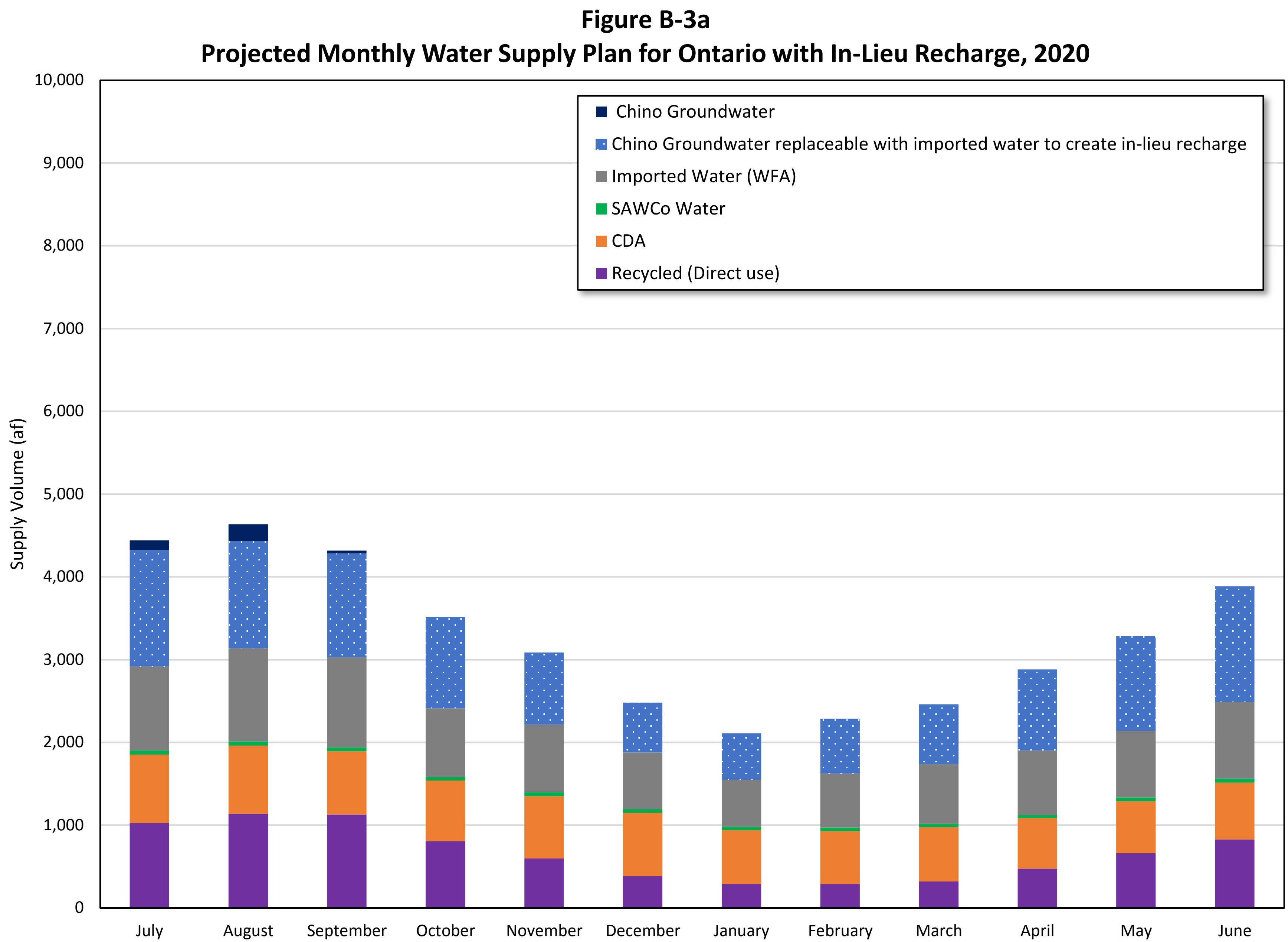


ChinoHills_watersupply.xlsx -- CH_2030
Created on 2/1/2018
Printed on 4/24/2018

Figure B-2d
Projected Monthly Water Supply Plan for Chino Hills with In-Lieu Recharge, 2035 and Beyond

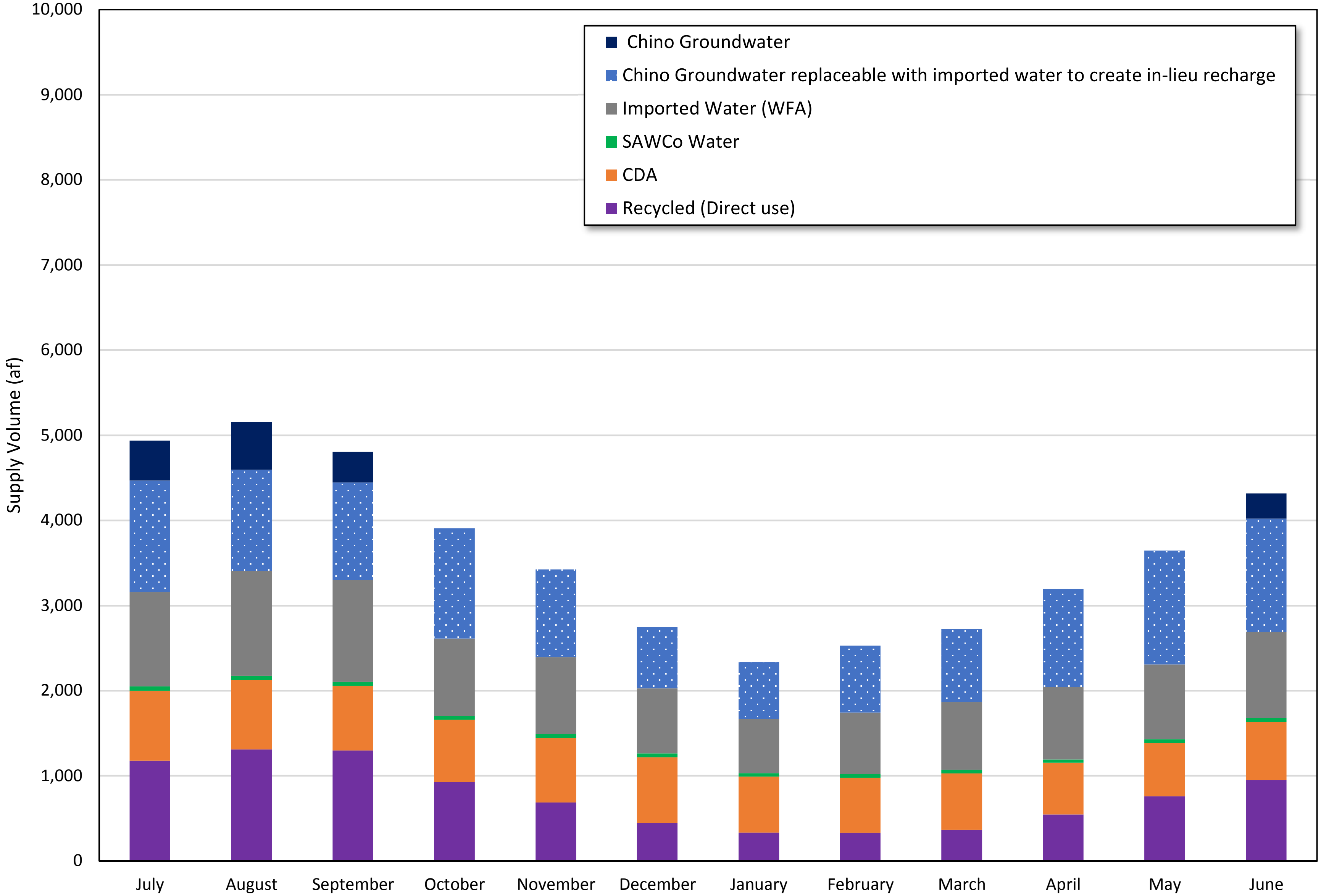


ChinoHills_watersupply.xlsx -- CH_2035
Created on 2/1/2018
Printed on 4/24/2018



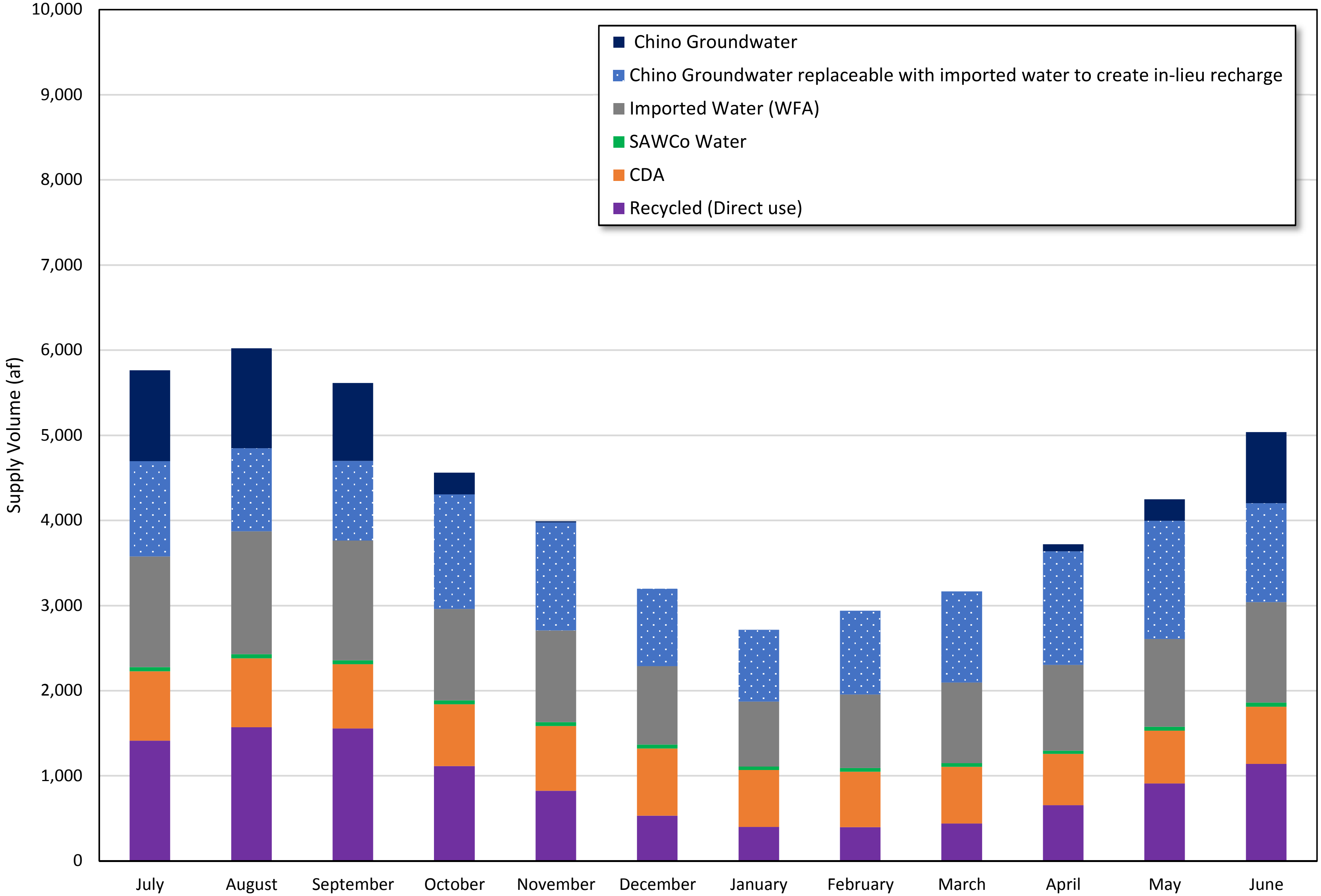
Ontario_watersupply.xlsx -- Ontario_2020
Created on 2/1/2018
Printed on 4/24/2018

Figure B-3b
Projected Monthly Water Supply Plan for Ontario with In-Lieu Recharge, 2025



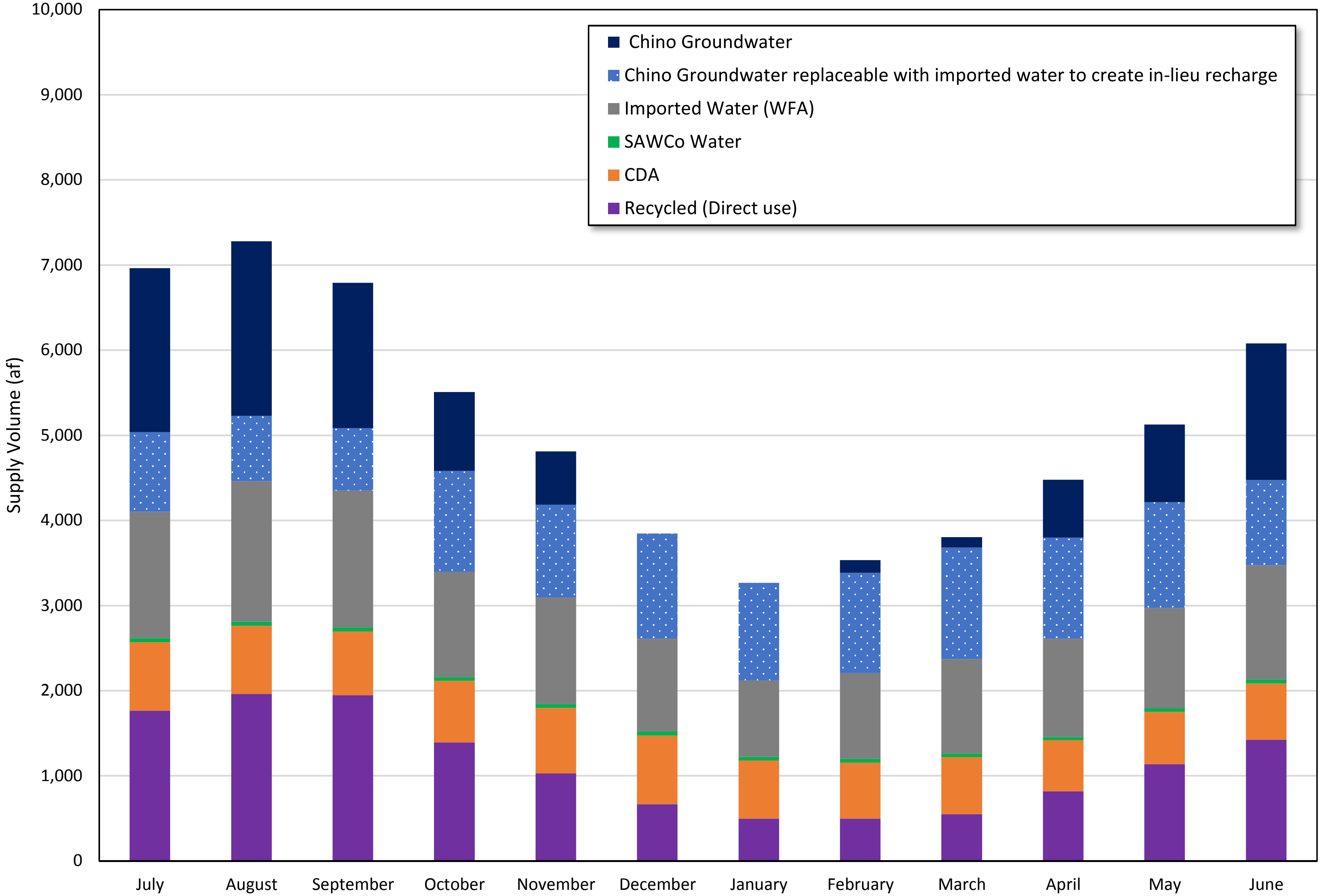
Ontario_watersupply.xlsx -- Ontario_2025
Created on 2/1/2018
Printed on 4/24/2018

Figure B-3c
Projected Monthly Water Supply Plan for Ontario with In-Lieu Recharge, 2030



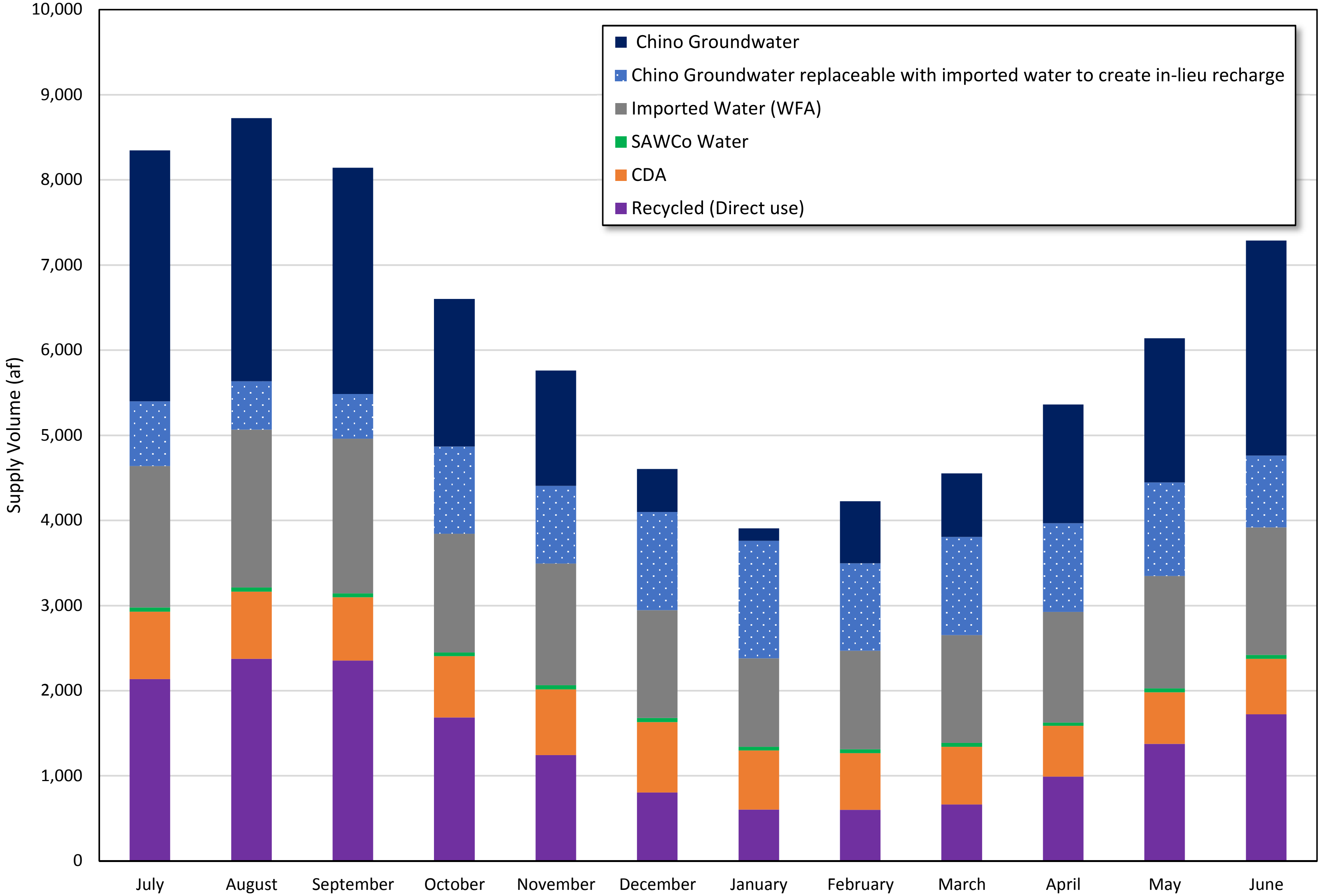
Ontario_watersupply.xlsx -- Ontario_2030
Created on 2/1/2018
Printed on 4/24/2018

Figure B-3d
Projected Monthly Water Supply Plan for Ontario with In-Lieu Recharge, 2035

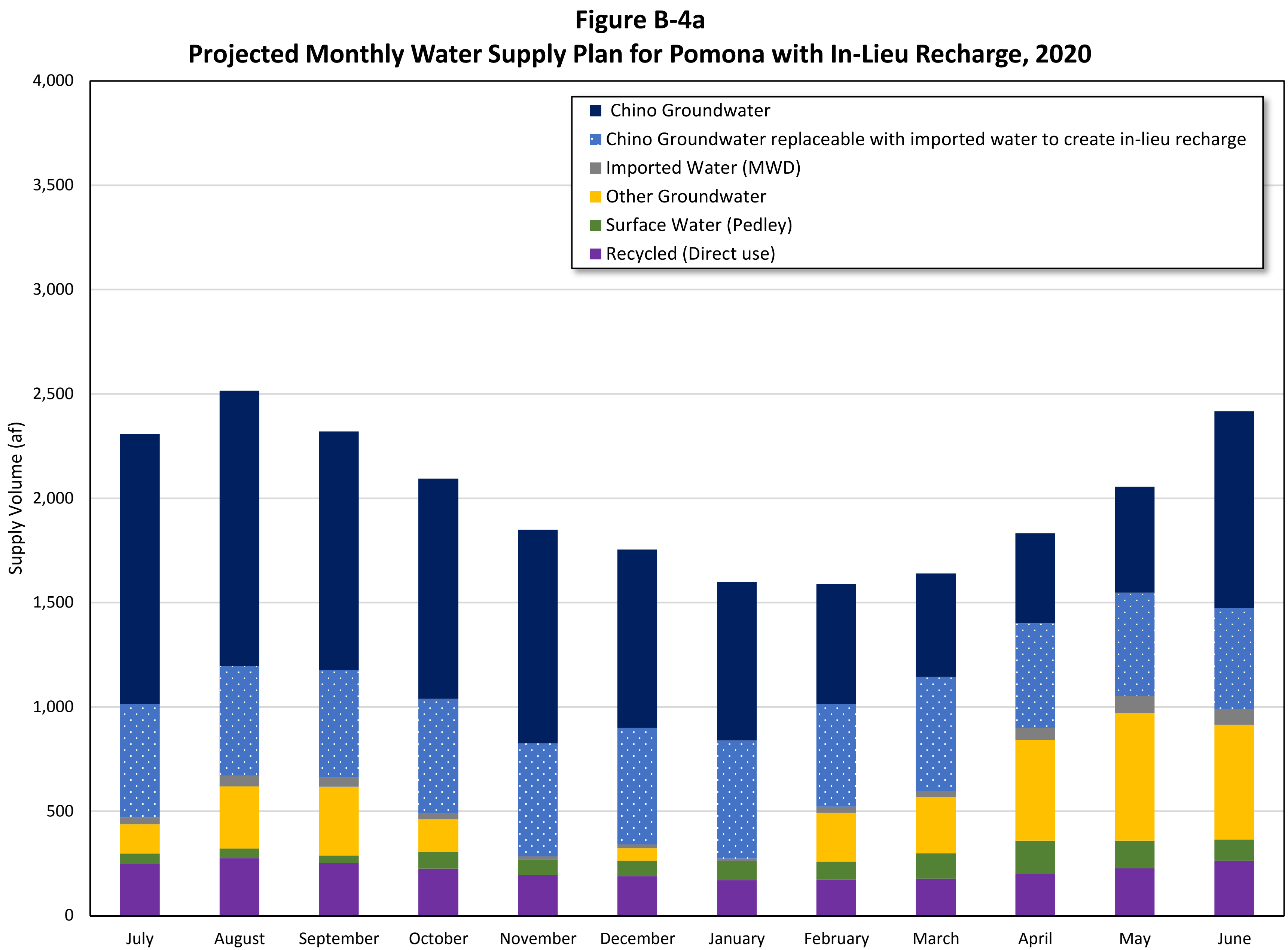


Ontario_watersupply.xlsx -- Ontario_2035
Created on 2/1/2018
Printed on 4/24/2018

Figure B-3e
Projected Monthly Water Supply Plan for Ontario with In-Lieu Recharge, 2040

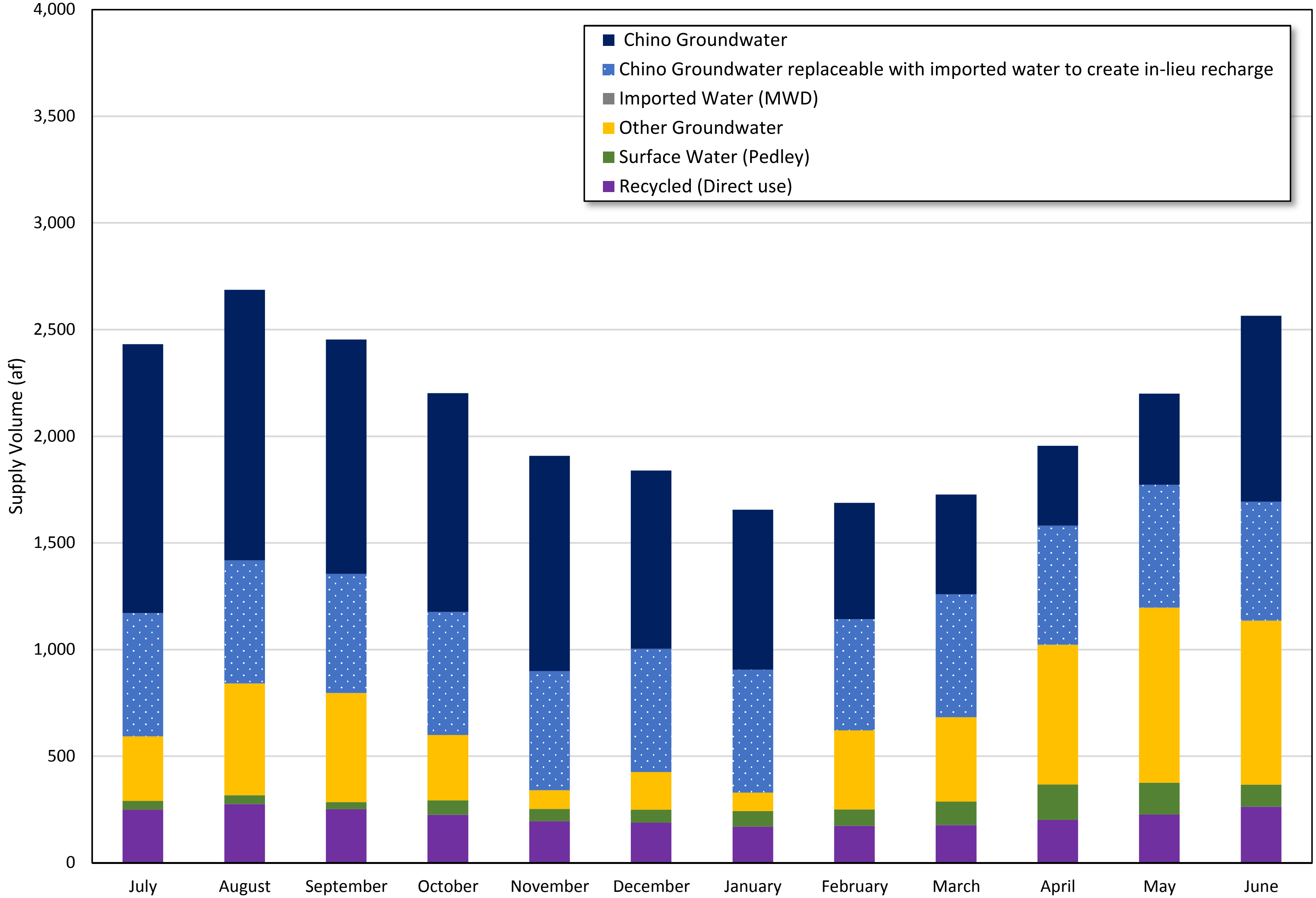


Ontario_watersupply.xlsx -- Ontario_2040
Created on 2/1/2018
Printed on 4/24/2018



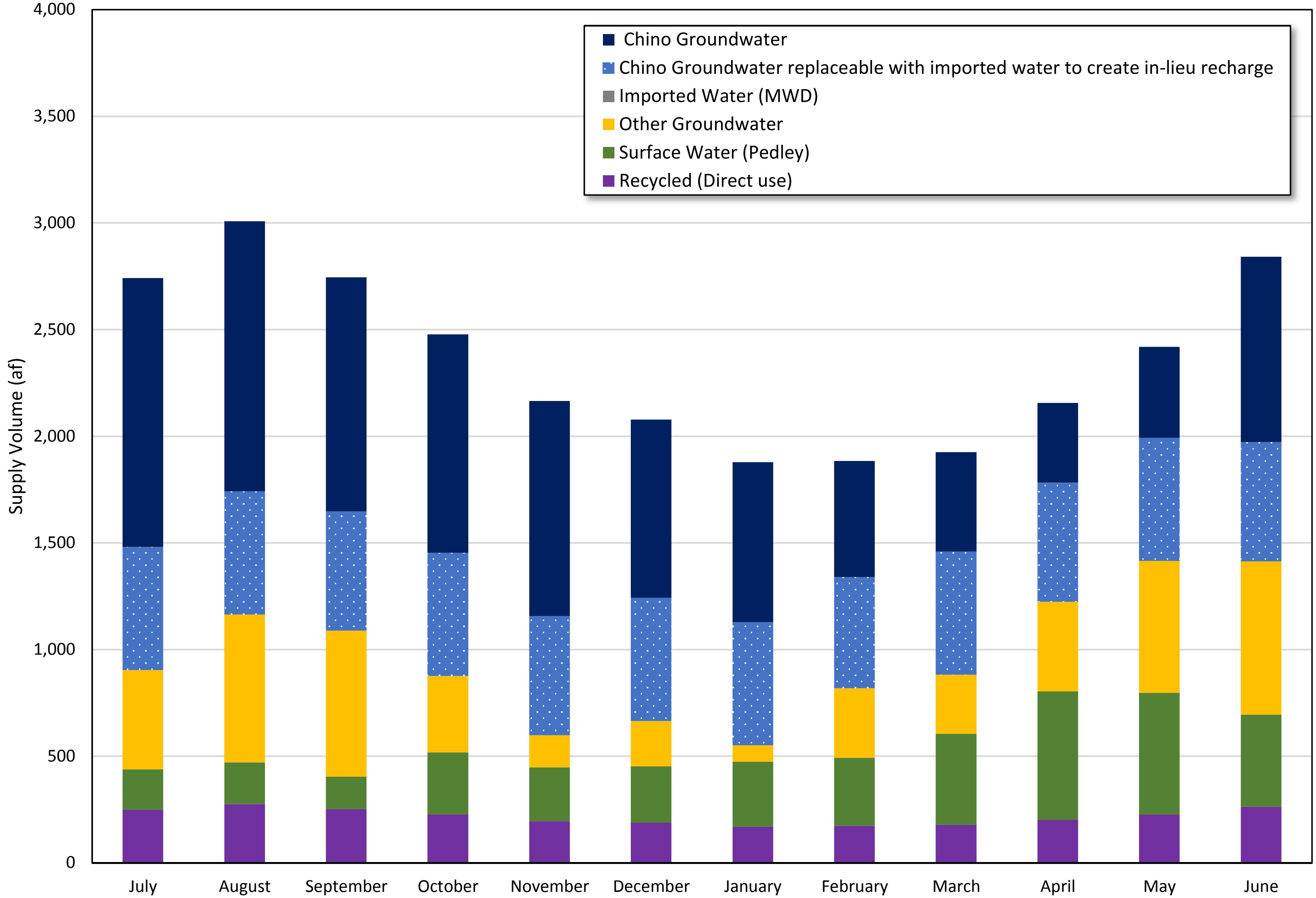
Pomona_watersupply.xlsx -- Pomona_2020
Created on 2/1/2018
Printed on 4/24/2018

Figure B-4b
Projected Monthly Water Supply Plan for Pomona with In-Lieu Recharge, 2025



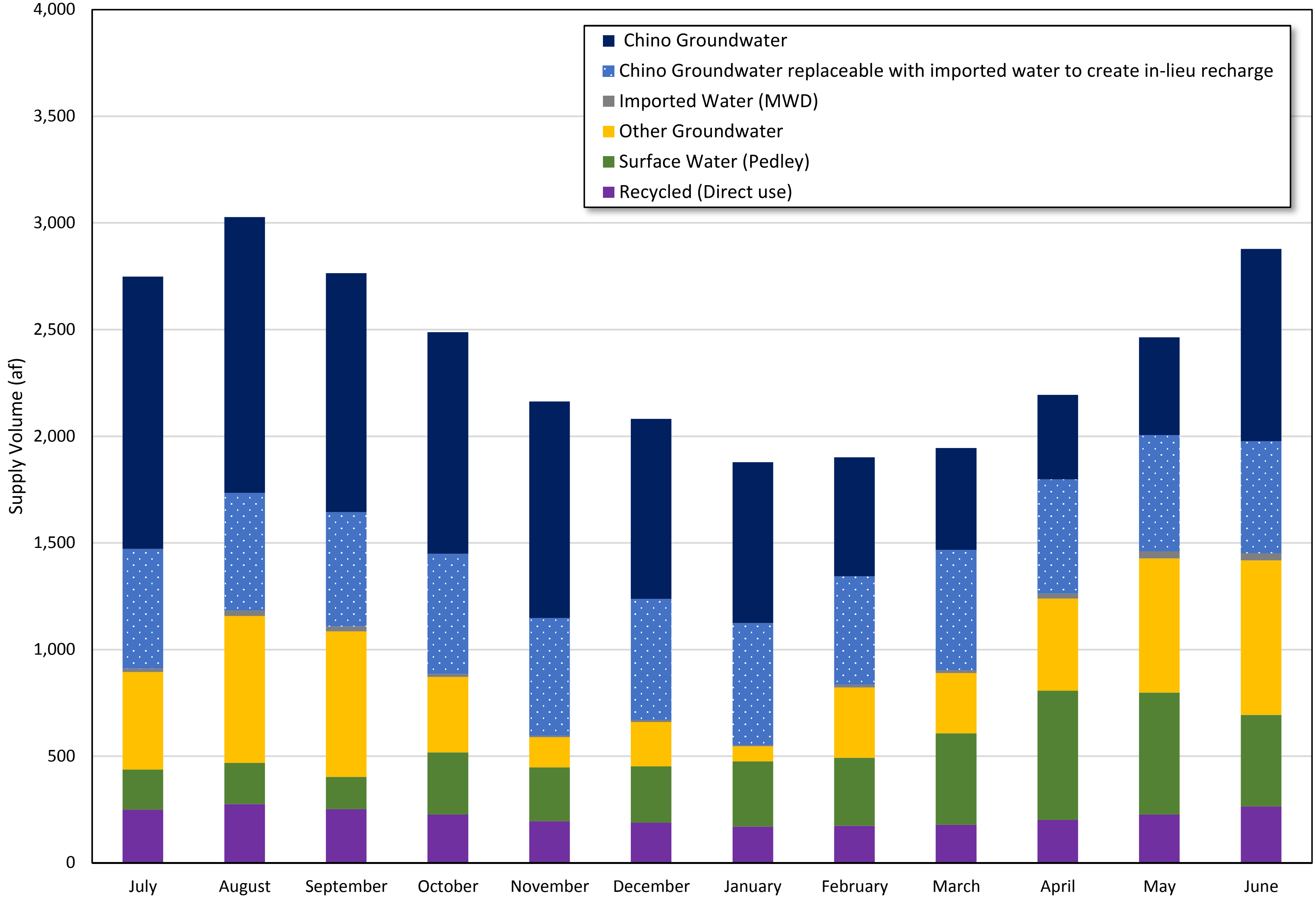
Pomona_watersupply.xlsx -- Pomona_2025
Created on 2/1/2018
Printed on 4/24/2018

Figure B-4c
Projected Monthly Water Supply Plan for Pomona with In-Lieu Recharge, 2030



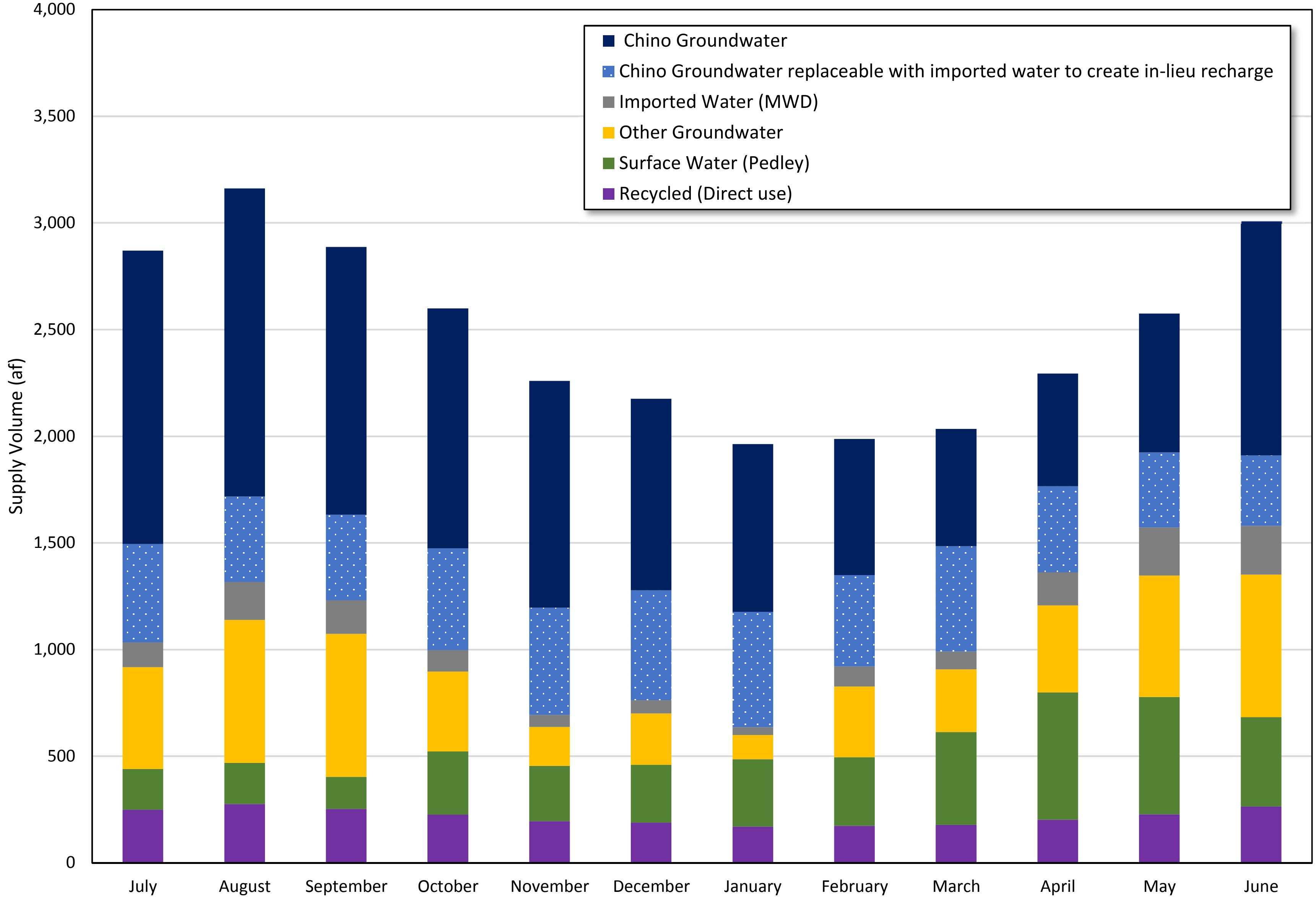
Pomona_watersupply.xlsx -- Pomona_2030
Created on 2/1/2018
Printed on 4/24/2018

Figure B-4d
Projected Monthly Water Supply Plan for Pomona with In-Lieu Recharge, 2035



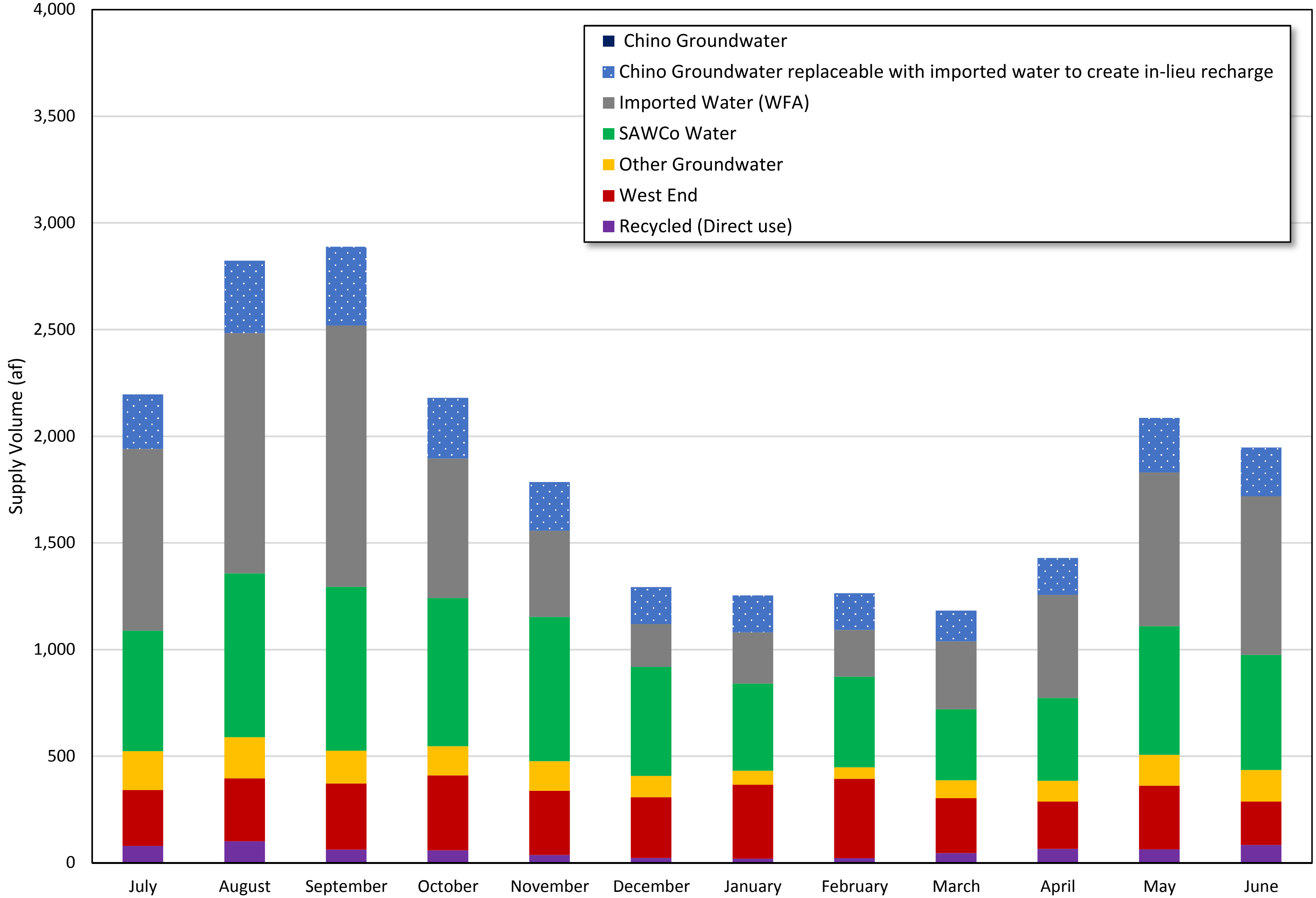
Pomona_watersupply.xlsx -- Pomona_2035
Created on 2/1/2018
Printed on 4/24/2018

Figure B-4e
Projected Monthly Water Supply Plan for Pomona with In-Lieu Recharge, 2040



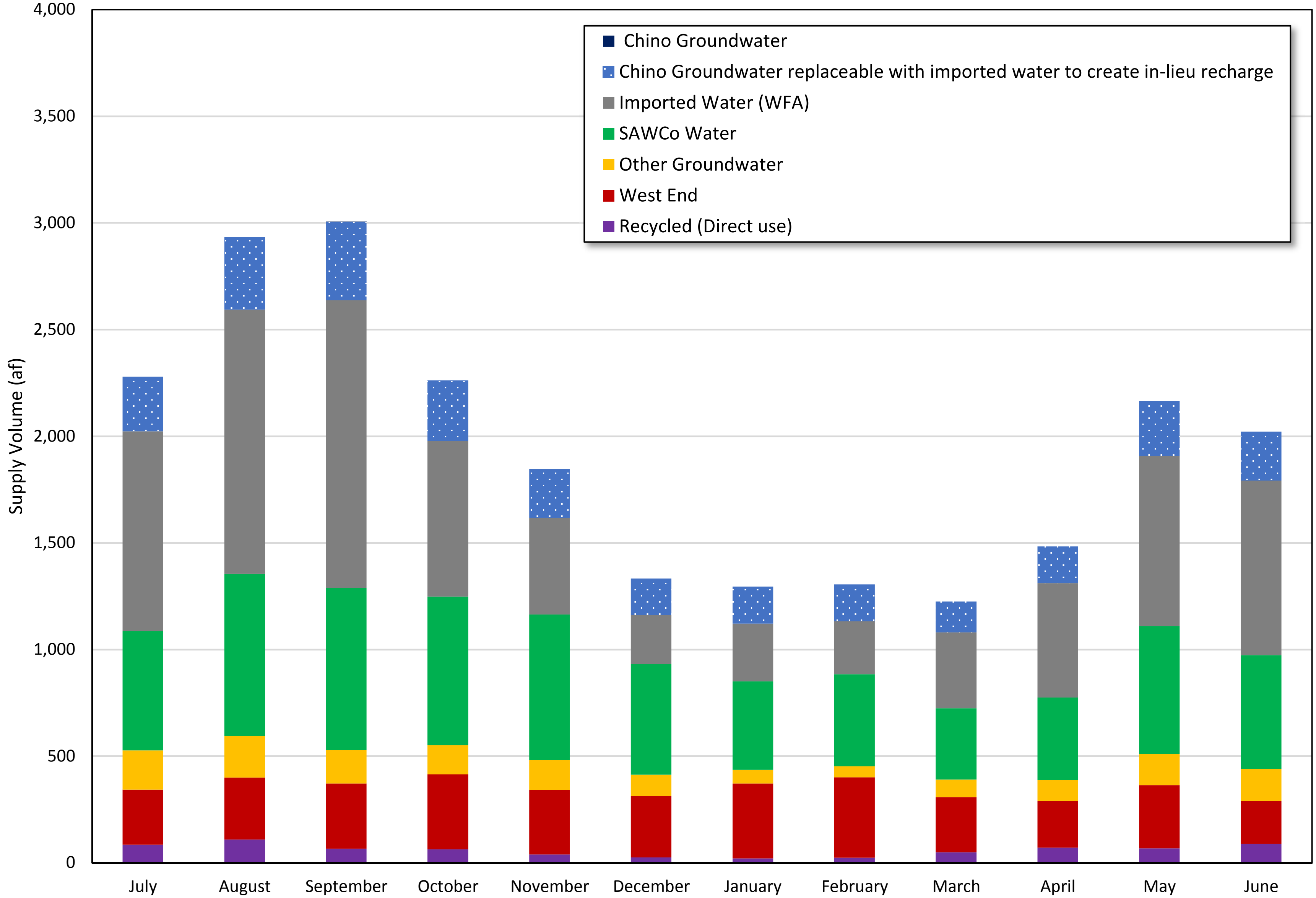
Pomona_watersupply.xlsx -- Pomona_2040
Created on 2/1/2018
Printed on 4/24/2018

Figure B-5a
Projected Monthly Water Supply Plan for Upland with In-Lieu Recharge, 2020



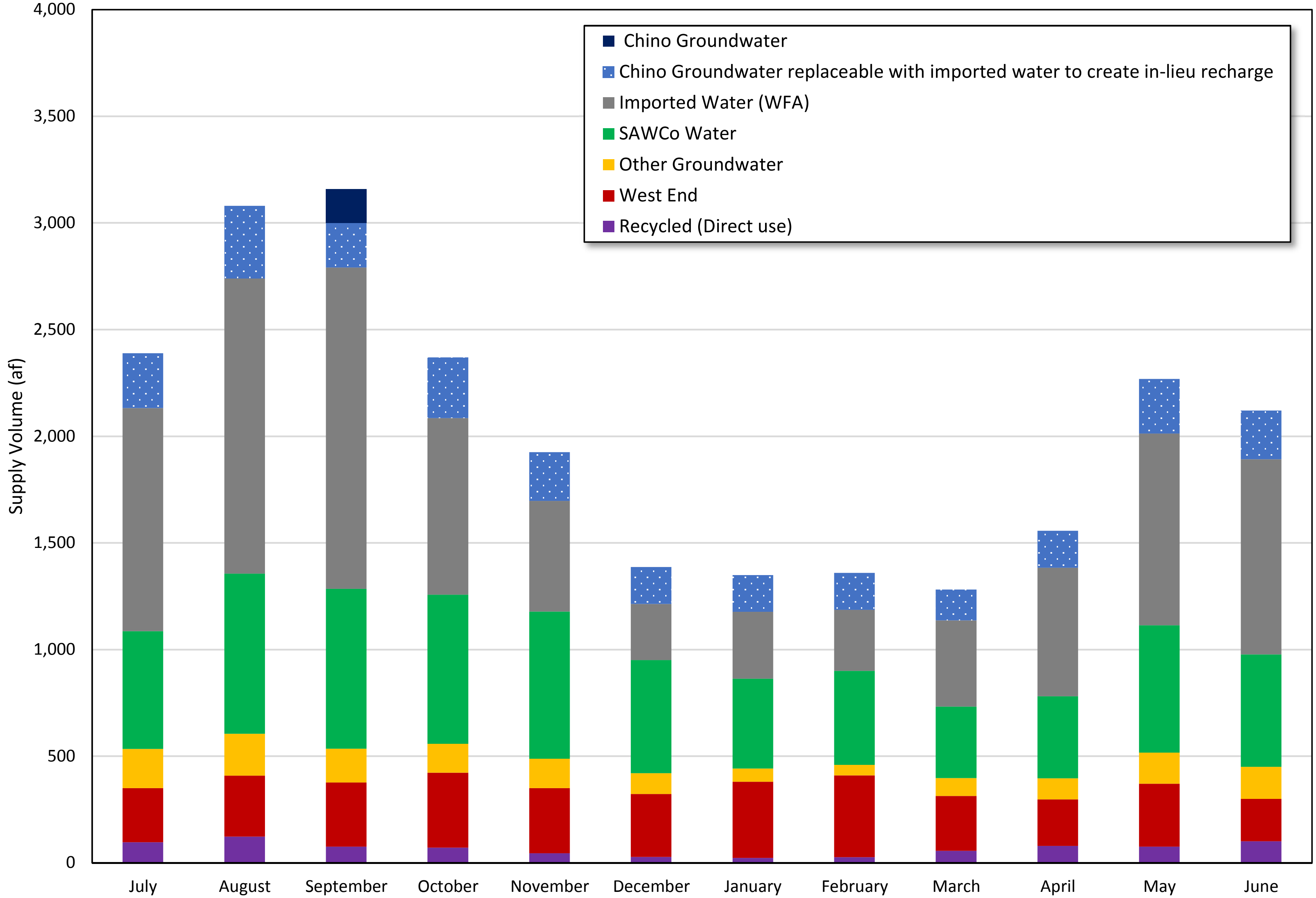
Upland_watersupply.xlsx -- Upland_2020
Created on 2/1/2018
Printed on 4/24/2018

Figure B-5b
Projected Monthly Water Supply Plan for Upland with In-Lieu Recharge, 2025



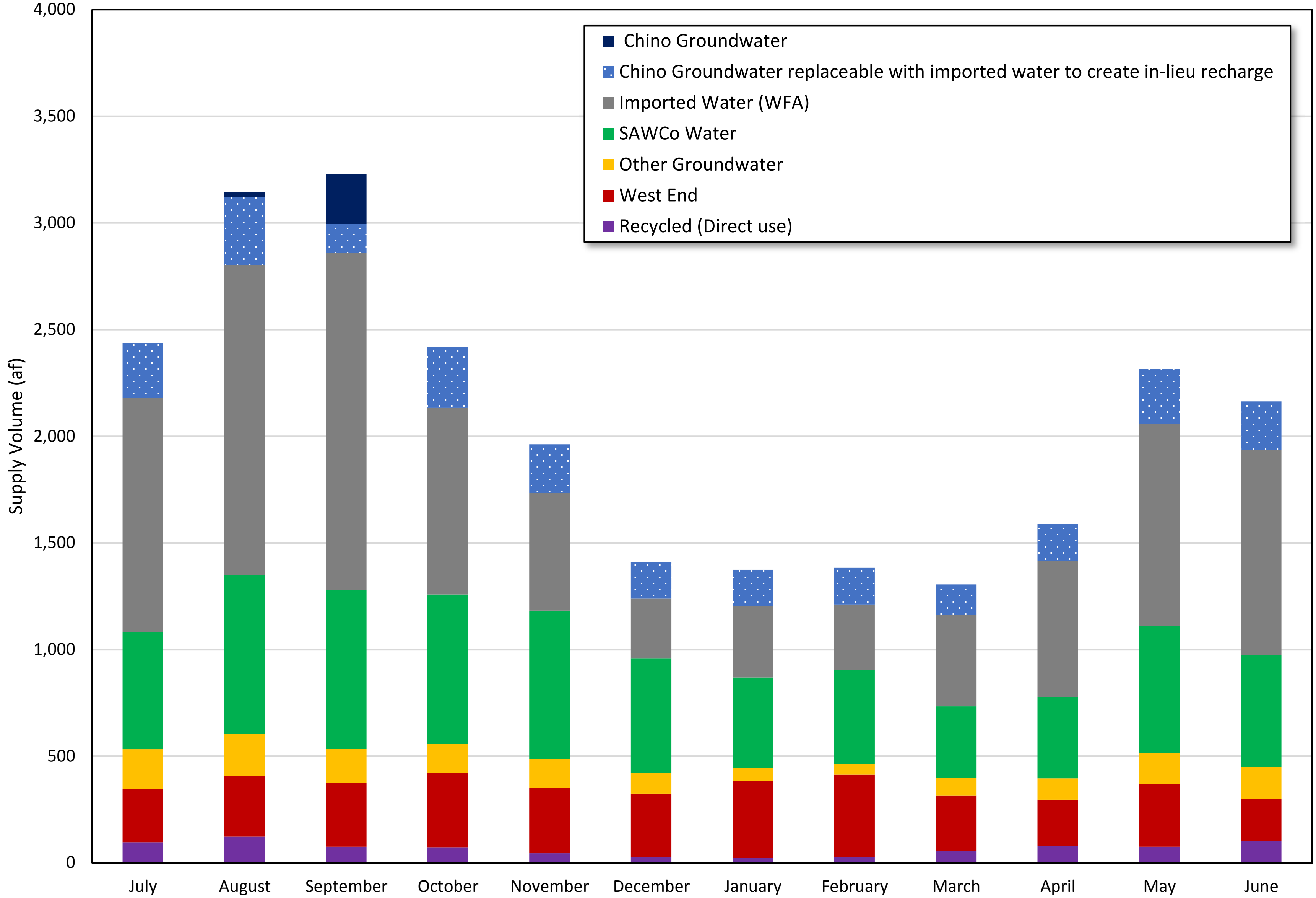
Upland_watersupply.xlsx -- Upland_2025
Created on 2/1/2018
Printed on 4/24/2018

Figure B-5c
Projected Monthly Water Supply Plan for Upland with In-Lieu Recharge, 2030



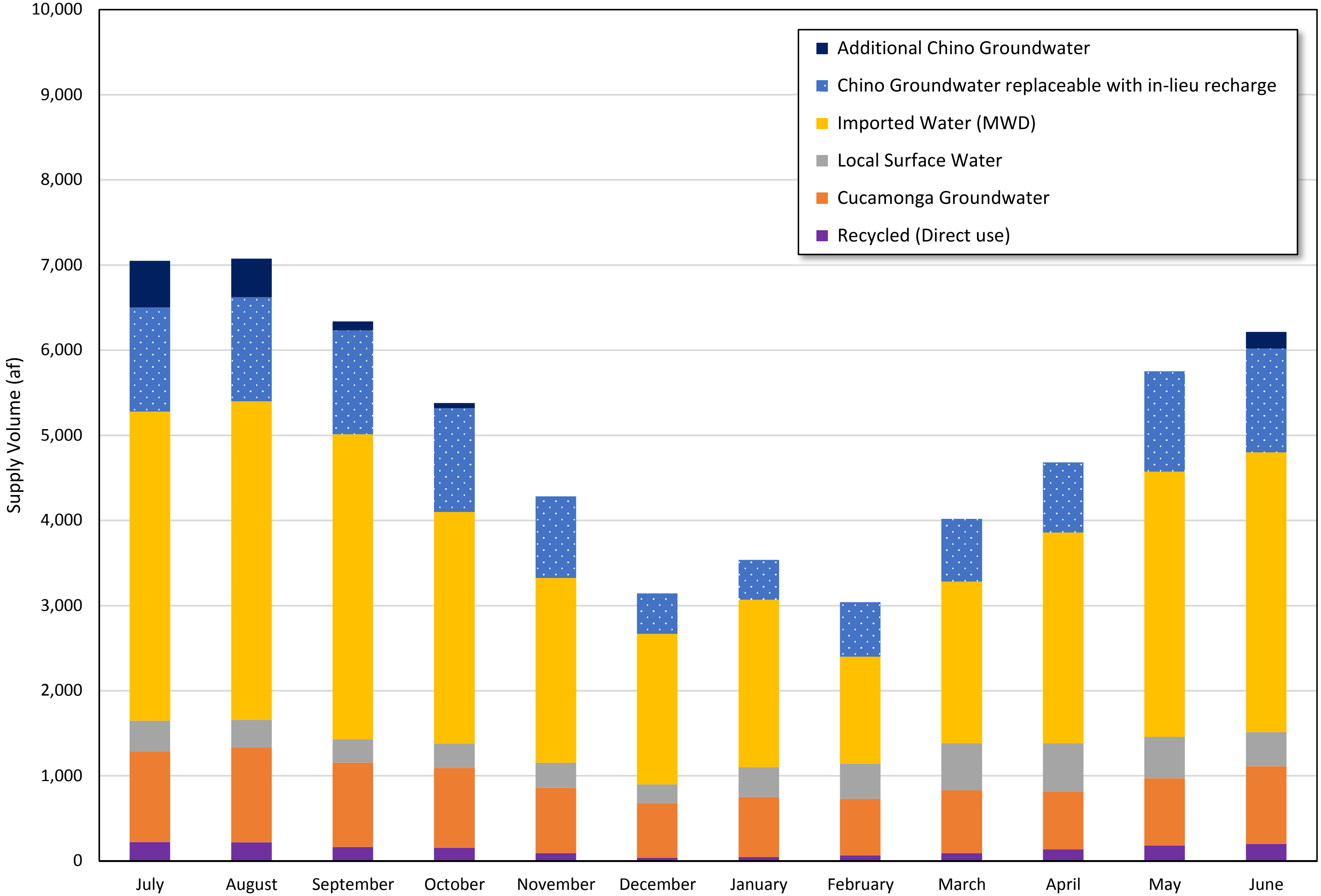
Upland_watersupply.xlsx -- Upland_2030
Created on 2/1/2018
Printed on 4/24/2018

Figure B-5d
Projected Monthly Water Supply Plan for Upland with In-Lieu Recharge, 2035 and Beyond



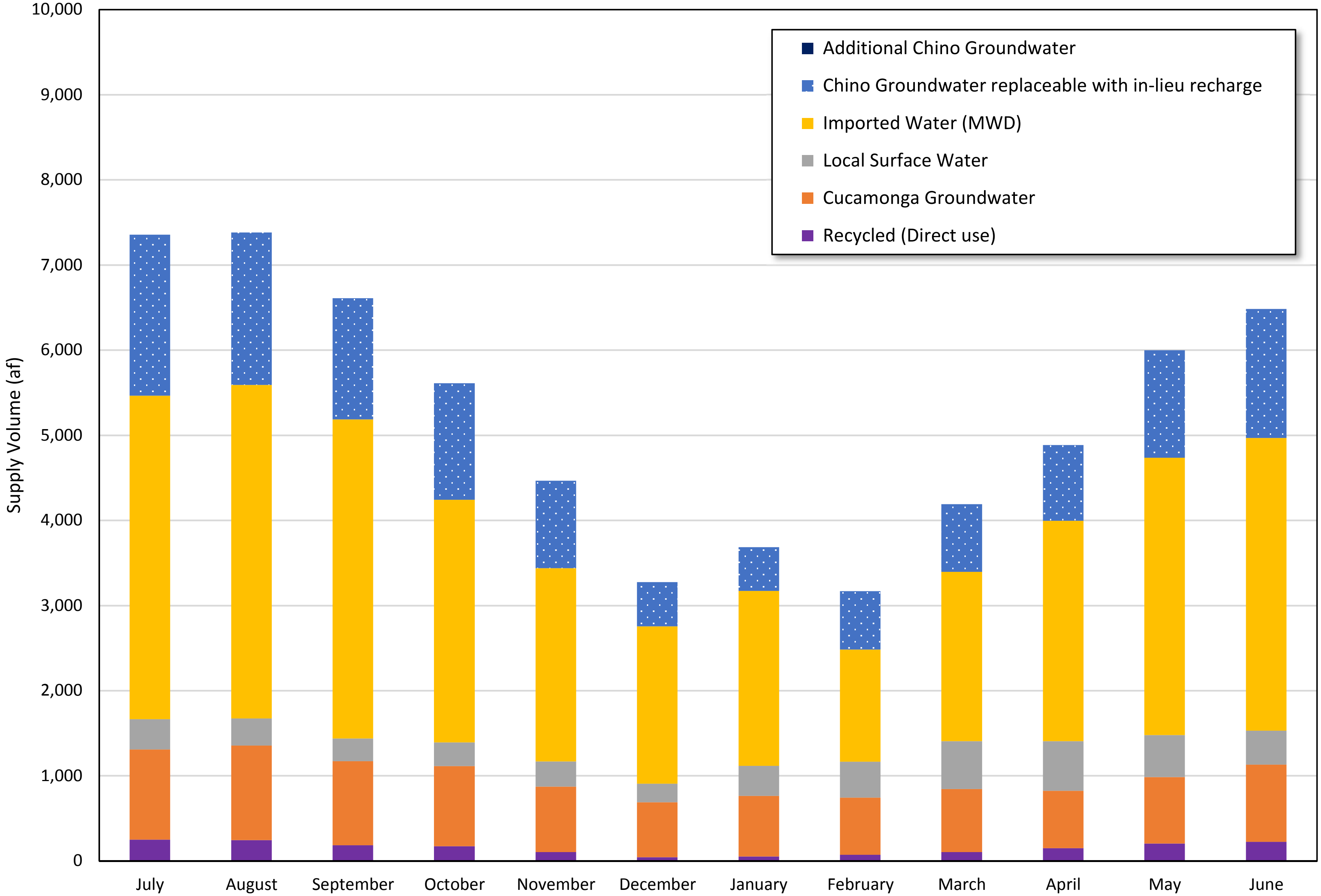
Upland_watersupply.xlsx -- Upland_2035
Created on 2/1/2018
Printed on 4/24/2018

Figure B-6a
Projected Monthly Water Supply Plan for CVWD with In-Lieu Recharge, 2020



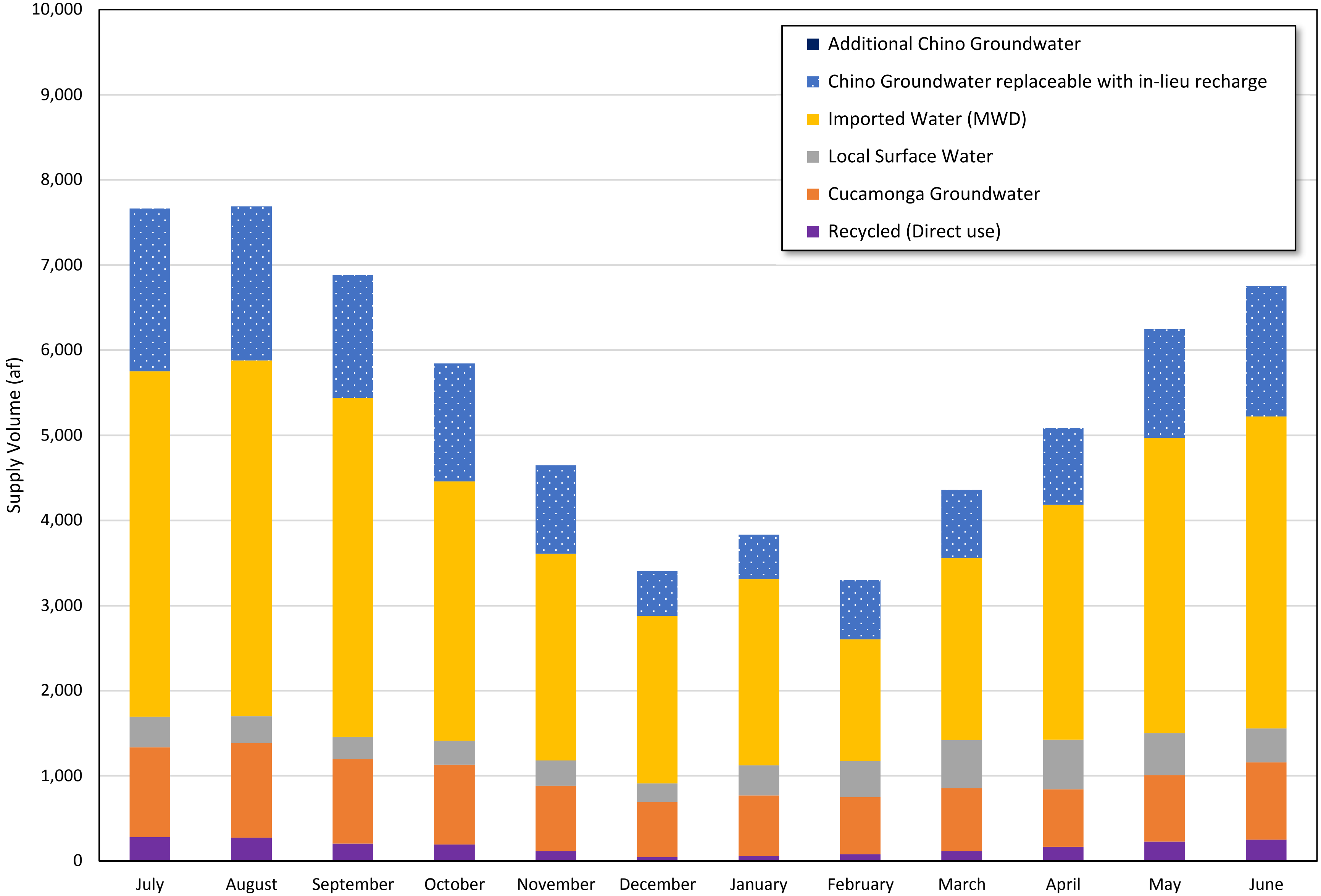
CVWD_watersupply.xlsx -- CVWD_2020
Created on 2/1/2018
Printed on 4/24/2018

Figure B-6b
Projected Monthly Water Supply Plan for CVWD with In-Lieu Recharge, 2025



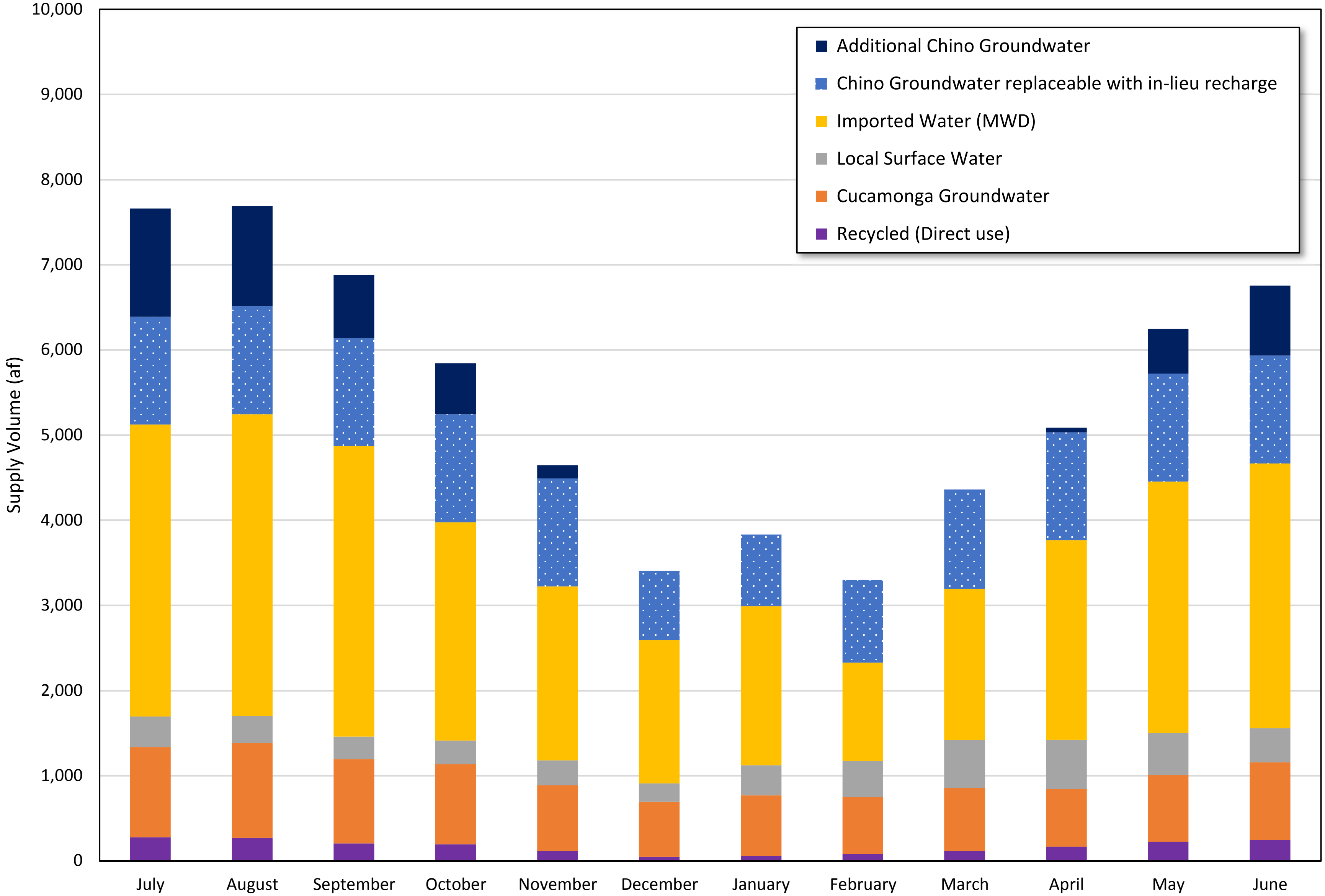
CVWD_watersupply.xlsx -- CVWD_2025
Created on 2/1/2018
Printed on 4/24/2018

Figure B-6c
Projected Monthly Water Supply Plan for CVWD with In-Lieu Recharge, 2030



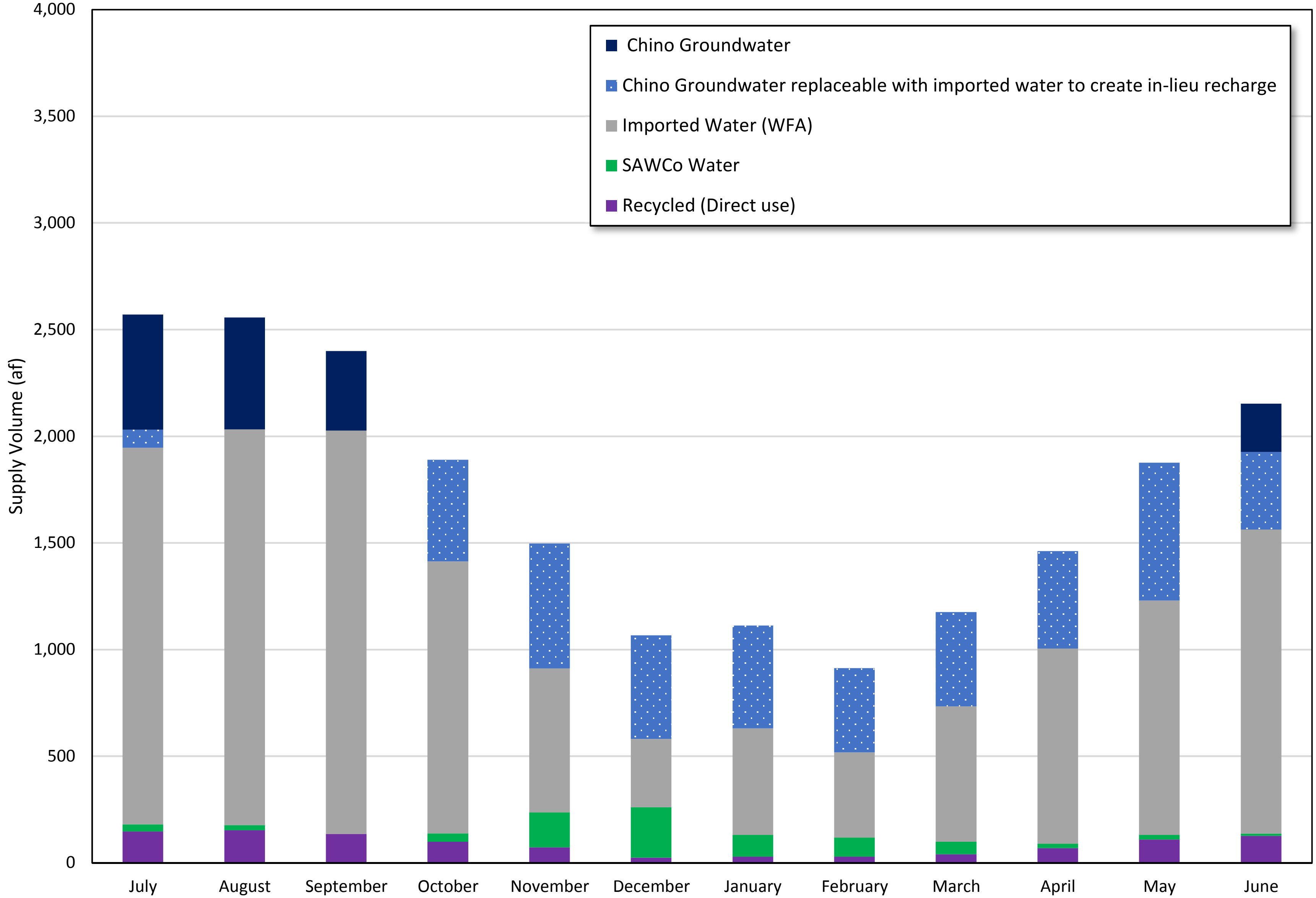
CVWD_watersupply.xlsx -- CVWD_2030
Created on 2/1/2018
Printed on 4/24/2018

Figure B-6d
Projected Monthly Water Supply Plan for CVWD with In-Lieu Recharge, 2035 and Beyond

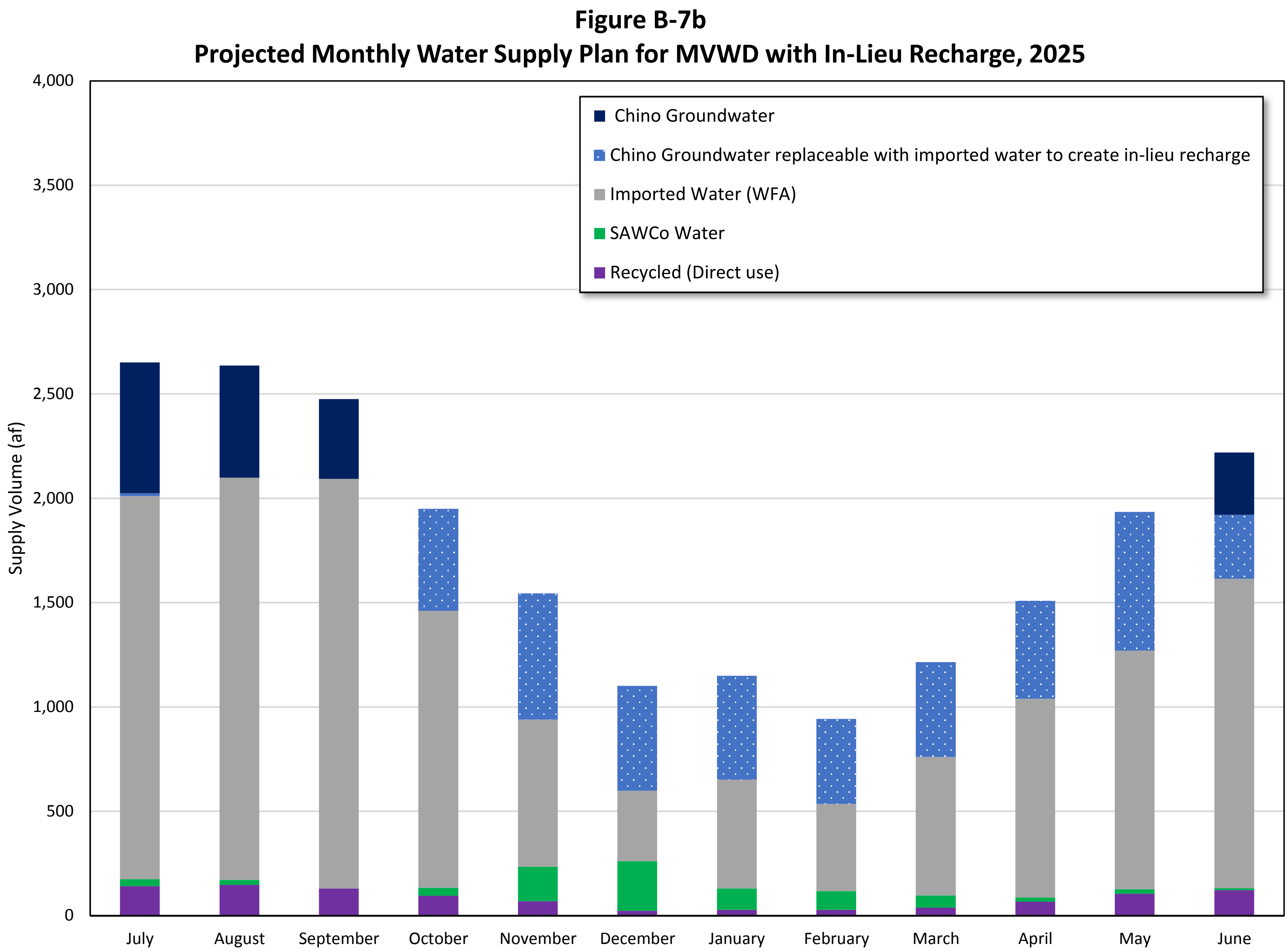


CVWD_watersupply.xlsx -- CVWD_2035
Created on 2/1/2018
Printed on 4/24/2018

Figure B-7a
Projected Monthly Water Supply Plan for MVWD with In-Lieu Recharge, 2020

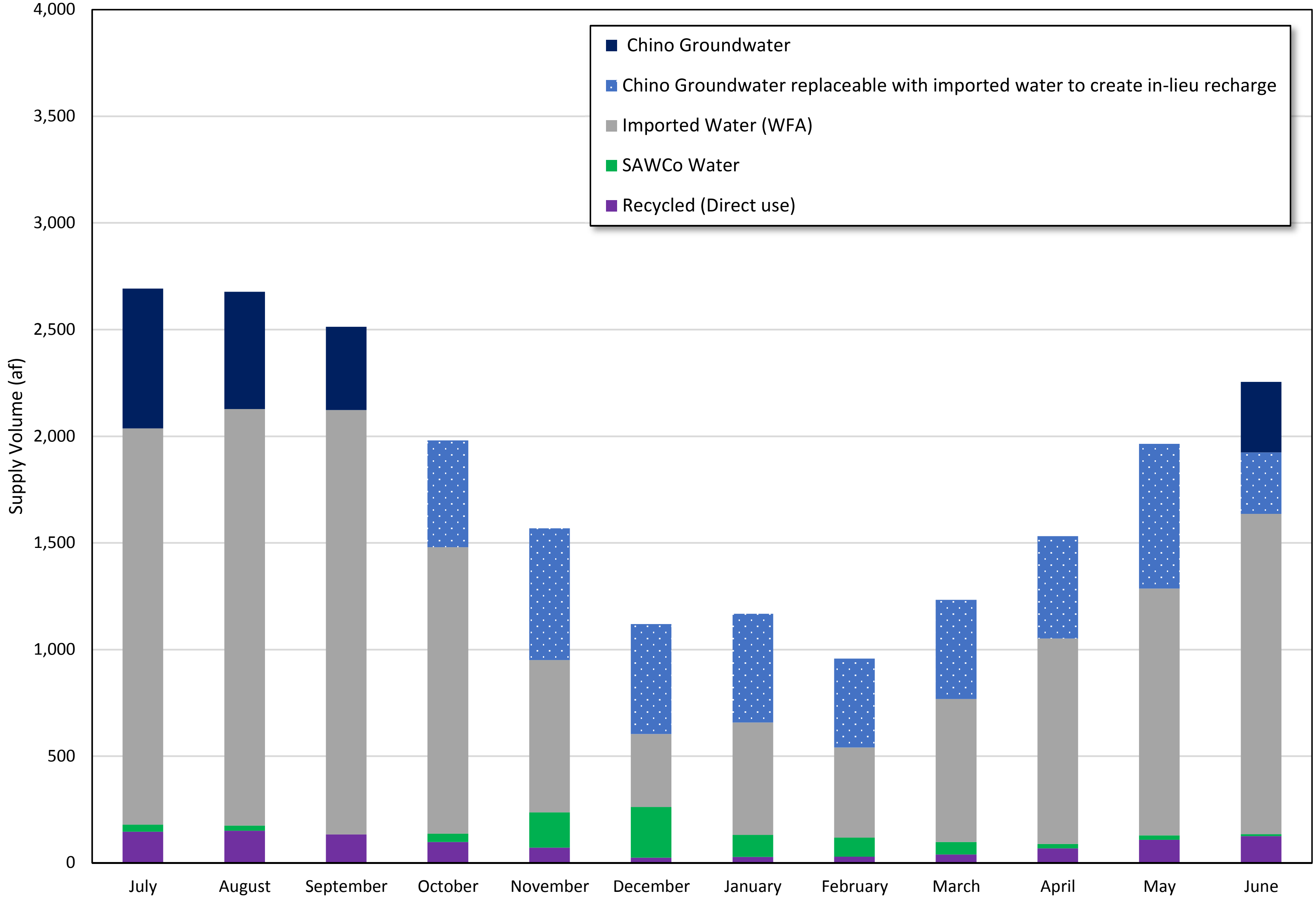


MVWD_watersupply.xlsx -- MVWD_2020
Created on 2/1/2018
Printed on 4/24/2018



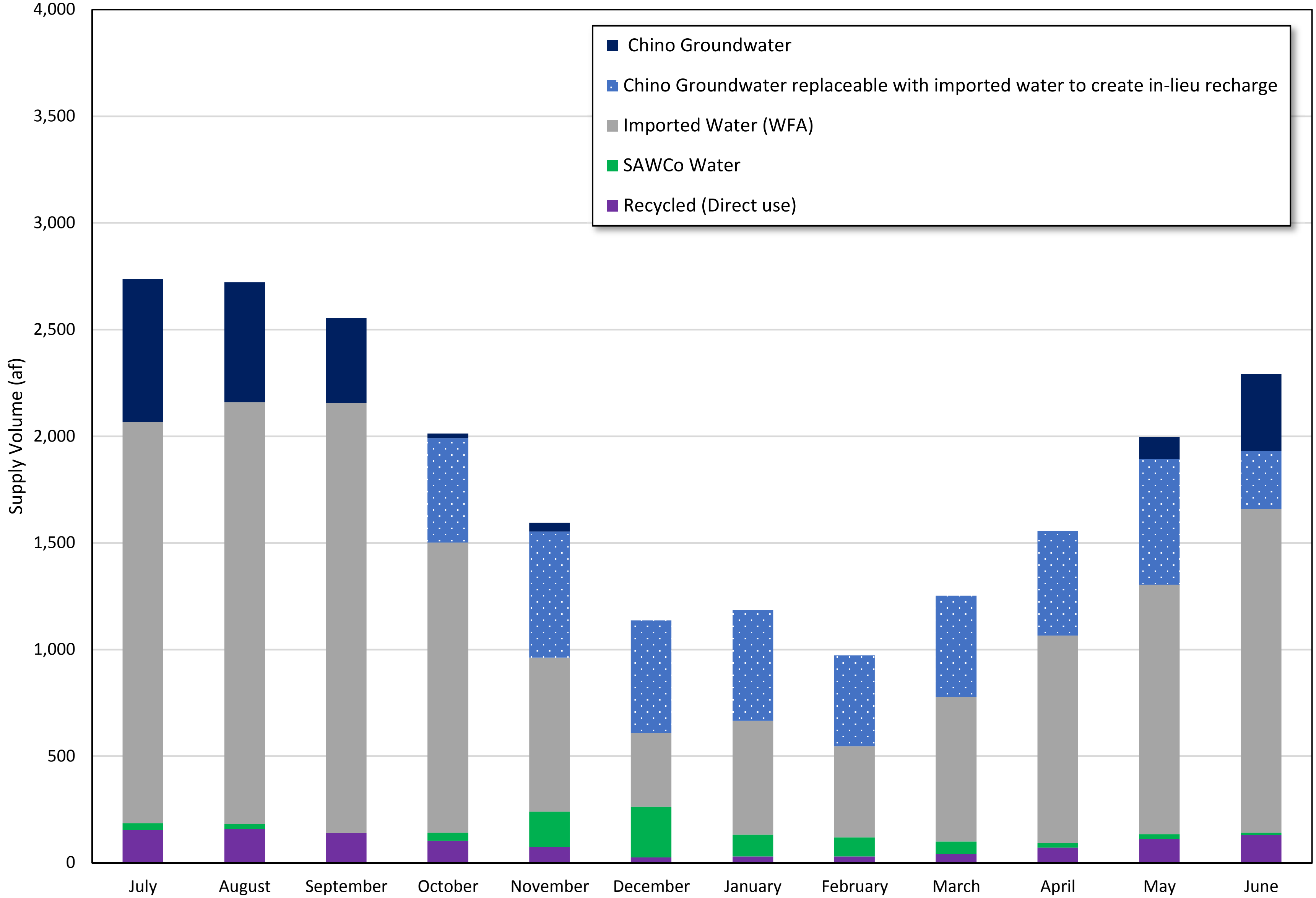
MVWD_watersupply.xlsx -- MVWD_2025
Created on 2/1/2018
Printed on 4/24/2018

Figure B-7c
Projected Monthly Water Supply Plan for MVWD with In-Lieu Recharge, 2030



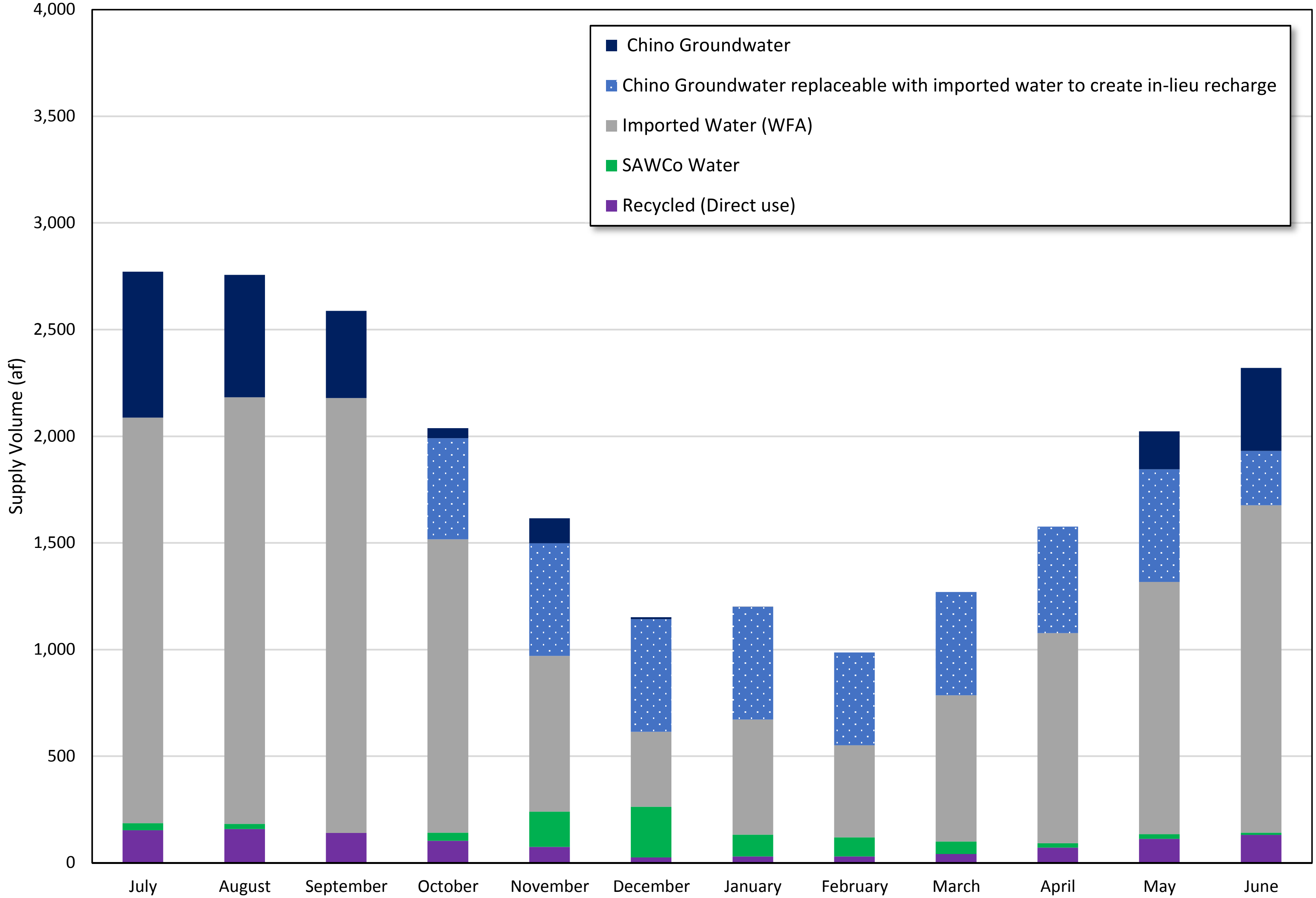
MVWD_watersupply.xlsx -- MVWD_2030
Created on 2/1/2018
Printed on 4/24/2018

Figure B-7d
Projected Monthly Water Supply Plan for MVWD with In-Lieu Recharge, 2035



MVWD_watersupply.xlsx -- MVWD_2035
Created on 2/1/2018
Printed on 4/24/2018

Figure B-7e
Projected Monthly Water Supply Plan for MVWD with In-Lieu Recharge, 2040



MVWD_watersupply.xlsx -- MVWD_2040
Created on 2/1/2018
Printed on 4/24/2018

Appendix C

Review Comments and Responses

City of Chino – Comments Provided by Amanda Coker

1. **Page 1-5. We suggest inclusion of a reference source for the cost information described in the 1st paragraph.**

   The reference has been added as a footnote.

2. **Section 2.1. The 1st bullet point appearing on page 2-1 describing pumping by the CDA includes a typo. CDA is an abbreviation for the Chino Basin Desalter Authority. The abbreviation list item should also be revised.**

   The text has been updated in Section 2.1 and in the List of Abbreviations.

3. **Section 2.1. The 2nd bullet point beginning on page 2-1 and continuing on page 2-2 identifies CIM incorrectly. CIM is an abbreviation for California Institution for Men. The abbreviation list item should also be revised.**

   The text has been updated in Section 2.1 and in the list of acronyms, abbreviations and initialisms.

4. **Section 2.4.2. We suggest inclusion of source reference(s) for the information describing volumes of recharged recycled water in 2017 and projected future volumes.**

   The reference has been added as a footnote.

5. **Section 3.2.2 We suggest consideration for a refinement of the 3rd sentence of the 1st paragraph to read "Northwest MZ1 and the central portion of MZ2 are currently experiencing inelastic land subsidence believed to be caused by the historical lowering of groundwater levels due to pre-judgment groundwater pumping."**

   The text has been adjusted to include the words "believed to be."

City of Chino – Comments Provided by David Crosley

6. **Section 4.3.2. Typo.**

   The typo has been fixed.

7. **Table 4-6, Footnote 4, and related text in Section 4.4.3. The sentence "in each Appropriator Party service area" is too broad in consideration of Footnote 4 appears to apply to Riverside County and not to San Bernardino County.**

   The text applies to projects within both Riverside and San Bernardino Counties.

Inland Empire Utilities Agency – Comments Provided by Joel Ignacio

8. **Section 1.1.3 (pg 1-5): review costs of 2013 RMPU - the costs should reflect the planned costs and ensure that adjusted costs (with grant benefits) is clearly stated. This is a spot to recognize the grant contribution and significantly lower unit costs ... make sure the parties see the benefit**

   The text has been updated to say: "The IEUA has applied for and been awarded grants and low-interest State Revolving Fund (SRF) loans to pay for some of the construction costs of these projects. As of this writing (July 2018), the 2013 RMPU projects are in the final design phase. The construction cost of the 2013 RMPU projects, after savings from grants acquired by IEUA, is expected to be about $30 million, and the expected unit cost of the new stormwater recharge is about $400 per af."

9. **Section 2.2.2 (pg 2-4): review table against planning projections. I understand that this is for Chino Basin, not IEUA service area ... we should ensure alignment.**

   During the initial stages of the Storage Framework investigation in the Fall of 2017, we developed water demand and supply plans initially based on the IEUA and parties' UWMPs and then updated the water demands and supply plans based on discussions with parties. The intent was to have the most up to date planning information incorporated into the Storage Framework. These same water demand and water supply plan projections were used in the 2018 RMPU.

10. **Section 2.4.2 (pg 2-5): don't use "waste water", use treated effluent.**

    The text has been updated to say: "treated effluent."

11. **Figure 1-3: not sure what this really means - would like someone to explain it to me.**

    As discussed on Section 1.1.2 shows the estimated streambed recharge from the Santa Ana River tributaries into the Chino Basin (in blue). In the 1980's the SBCFCD and the USACE constructed flood control projects, lining these streambed channels, and reducing recharge by about 15,000 afy. The OBMP Program Element 2 was developed to reverse the loss in yield. To comply with Project Element 2, IEUA, Watermaster, the CBWCD, and the SBCFCD developed and implemented the 2001 RMP, resulting in an increase in stormwater recharge (shown in red).

12. **Figure 2-3: would like to see (perhaps not for this report), what actual water demand looks like plotted on this graphic - I think adding it would be a good reference for the report. If Wei doesn't want to add, have them add it for us to see (outside of report).**

    This request is not within our scope of work.

13. **Figure 3-1: would like to better understand exactly what has driven the +300k AF increase in managed storage over the last 10-years.**

    The increase in managed storage is due to groundwater pumping being less than production rights.

14. **The projections for section 2.2.2 are pretty different from what we have in the UWMP across all the different supply types. Unless there are other projections we aren't aware of, I would recommend that the projections be consistent with the UWMP.**

    See response to Comment 9.

Monte Vista Water District – Comments Provided by Van Jew

15. **Page 1-5: first paragraph states untreated MWD water in 2018 goes for about $900 per AF. Actually, untreated MWD is currently going for $695 per AF.**

    The value was updated to reflect the 2018 cost of untreated SWP water including readiness to serve charges, $760 per af (see Table 2-3).

16. **Page 2-4: "Managed Storage" – this term, wherever it appears in the doc, can it be updated to a more apt term that excludes the word "storage" in it?? The term is defined to also include carryover water. Though carryover water is physical water in the basin, it is not recognized by the CAMA as stored water or water in storage, hence this request to update "Managed Storage" to a more apt term that excludes the word "storage."**

    The term managed storage all the water that is stored in the basin by discretionary acts of the parties and is a more accurate metric to describe storage and subsequently the impacts of the parties' storage activities.

17. **Page 4-8 and Table 4-7: To maintain their neutrality, perhaps WM staff should not be the one bringing forth projects. Hence, remove [the Vineyard Managed Aquifer Recharge] project until such time as another project proponent is identified.**

    Per the Peace agreement (Section 5.1) and OBMP Implementation Plan, Watermaster shall exercise best efforts to protect and the enhance the safe yield of the Chino Basin through Replenishment and Recharge. We believe this includes and does not limit Watermaster's ability to recommend projects into the open forum. Furthermore, as listed in Section 6.3, no new projects are being recommend for the 2018 RMPU.

18. **Section 6.1. Isn't [item #2] based on #1 only? In which case, just combine them.**

    Item 2 is based on the ability to balance recharge and discharge.

City of Pomona – Comments Provided by Raul Garibay

1. **Page 1-4, third full paragraph. Were there that many [67 steering committee meetings and workshops for the 2013 RMPU] held?**

   Yes.

2. **Page 1-5, second full sentence. Task Orders?**

   The text has been updated to say "Task Orders."

3. **Section 2.3.3. Add TVMWD.**

   The text has been updated to add: "TVMWD".

4. **Table 2-4. Positive indicates an increase in storage?**

   Yes.

5. **Section 4.2, paragraph 1. I assumed that the extraction amount is about twice the injection volume. Is this still true?**

   The text refers to the ability to inject and recharge in the same year. The relationship of the injection *rate* and extraction *rate* was not investigated.

6. **Section 4.3, paragraph 1. I thought this program (Metropolitan Cyclic Storage Program) has been defunct for a while now, correct??**

   There is no active Cyclic Storage program.

7. **Section 4.3.2. Typo.**

   The typo has been fixed.

8. **Section 4.3.3. This is the maximum in-lieu capacity of agencies regardless of what we might in-lieu we might given the latest DYY restrictions?**

   This is the maximum in-lieu recharge capacity based on treatment plant capacity, production rights and water demands.

9. **Tables 4-5a and 4-5b. Is this misleading given the Pomona gets its water from Miramar plant?**

   Tables 4-5a and 4-5b have been updated to include a column indicating the water treatment plant the imported water is sourced from.

10. **Section 4.4.2, Were there any projects located in Pomona (Chino Basin) that contributed to this number?**

    Yes, see Figure 4-2 that shows the location of projects and water service areas.

11. **Section 4.6. What impacts does the restoration of WFA have on the recharge basin?**

    The WFA capacity has no impact on the capacity of the recharge basins.

12. **Table 4-1. Does this mean that the Brooks basin will be available for 74% of the time for supplemental water during January of any given year?**

    Yes. The "Average Operational Availability of Supplemental Water Recharge" is the fraction of time within a certain month that a basin is available for supplemental water recharge. Appendix A – Supplemental Water Recharge Capacity Assessment summarizes the methodology used to estimate this.

13. **Table 4-3. I like this chart; it could be expanded to include the projects that are currently underway**

    The last column of Table 4-2 (formerly Table 4-3) includes the recharge capacity after the 2013 RMPU recharge projects are completed.

14. **Table 4-5a. Not sure if the numbers for Pomona include the most recent addition of wells in Chino Basin after activation of the GAC well head treatment systems in January 2018.**

    The numbers in Table 4-5a and 4-5b are based in part on the planned groundwater pumping in the Chino Basin in the Fall of 2017 as provided by the City of Pomona.

San Bernardino County Flood Control District – Comments Provided by James McKenzie, Jr.

15. **Section 1.1.2: Propose the following edits for section 1.1.2 Recharge Planning of the 2018 RMPU beginning with the third sentence "Prior to the OBMP…":**

    "Prior to the OBMP, the Chino Basin underwent significant land use changes as many of the cities in the region experienced a surge in their population. According to U.S. census data, cities overlying the Chino Basin saw a combined increase in population of over 469 thousand people in the period from 1980 to 2010. The increase in population resulted in the urbanization of areas that previously were predominantly agricultural and rural.

    The Chino Basin is part of the Santa Ana River Watershed, which has historically experienced flooding events, causing some loss of life and extensive property damage. In response to the rapid urbanization of the area, the San Bernardino County Flood Control District (SBCFCD) in cooperation with the cities, land developers, the US Army Corps of Engineers (USACE) and other Federal agencies constructed major flood control projects in the Santa Ana River Watershed, in an effort to protect life and property. Due to the characteristics of the Watershed, some of the flood control projects necessitated the hard lining of some of the water courses that traverse the Chino Basin. However, water conservation features, such as, conservation berms, basins, and drop inlet structures were made a part of the flood control projects. The increase in population, rapid urbanization, change of

> *land use, and the hard lining of watercourses traversing the Chino Basin affected the amount of stormwater that was available for groundwater recharge. The change in recharge due to the aforementioned factors is estimated to be approximately 15,000 acre-feet per year."*

The text has been updated to say (the changes to the original text are in redline):

> *"Prior to the OBMP, in response to rapid urbanization, the San Bernardino County Flood Control District (SBCFCD) and the US Army Corps of Engineers (USACE) constructed flood control projects that efficiently capture and convey stormwater to the Santa Ana River to reduce potential flooding, effectively eliminating the groundwater recharge that formerly took place in the stream channels and flood plains of the Chino Basin. These flood control projects consisted of concrete lining of ~~all the~~ major drainages ~~in~~ across the ~~basin~~ Chino Basin and the construction of ~~passive~~ retention basins to temporarily store stormwater and release it in 24 hours or less. ~~Insufficient~~ Some provisions were made to mitigate the loss of recharge from these flood control projects at that time, but these provisions failed to achieve the groundwater recharge that took place prior to the construction of these flood control projects. Figure 1-2 shows the locations of the major channels that drain the Chino Basin area and the time history of their concrete lining. Figure 1-3 shows the time history of stormwater recharge in the channels that cross the Chino Basin from the San Gabriel Mountains to the Santa Ana River. The loss in recharge to the basin due to the construction of concrete-lined channels is estimated to be about 15,000 afy. Also, there were no mitigation efforts to preserve recharge when land use was converted from native and agricultural uses to urban uses. Lining the drainage channels with concrete and changes in land use resulted in a decline in the sustainable yield of the Chino Basin. Program Element 2 was developed to reverse the loss in yield."*

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