AGREEMENT TO FORM A JOINT POWERS AUTHORITY

GREATER KAWEAH GROUNDWATER SUSTAINABILITY AGENCY

THIS AGREEMENT ("Agreement") is made August 23, 2016, by and between KAWEAH DELTA WATER CONSERVATION DISTRICT ("KDWCD"), COUNTY OF TULARE ("County"), KINGS COUNTY WATER DISTRICT ("KCWD"), and LAKESIDE IRRIGATION WATER DISTRICT ("LIWD") and ST. JOHNS WATER DISTRICT ("SJWD") (hereinafter referred to individually as "Member" and collectively as "Members"), in light of the following:

RECITALS

A. During September 2014, Governor Brown signed three bills (SB 1168, SB 1319, and AB 1739) into law creating the Sustainable Groundwater Management Act ("SGMA").

B. SGMA authorizes the formation of an entity called a Groundwater Sustainability Agency ("GSA"), one or more of which are authorized to be responsible for implementing provisions of SGMA as to each groundwater basin and subbasin falling within the provisions of SGMA.

C. The Members overlie the Kaweah Subbasin (5-22.11 of the Department of Water Resources Bulletin 118 classifications) ("Subbasin") of the San Joaquin Valley Basin, an unadjudicated groundwater basin, portions of which underlie the jurisdictional boundaries of each Member.

D. Each of the Members to this Agreement is a local government entity with either water supply, water management, or land use responsibilities within the Subbasin and is qualified individually to serve as a GSA under the provisions of SGMA.

E. Under SGMA, a combination of local agencies may elect to form a GSA through a joint powers agreement.

F. The Members intend by this Agreement to create a joint powers authority that will elect to become a GSA for their jurisdictional areas covering a portion of the Subbasin.

G. Under SGMA, each GSA will be responsible for assuming its regulatory role by June 30, 2017, and for submitting a Groundwater Sustainability Plan ("GSP") to the Department of Water Resources by January 31, 2020.

H. The Members intend to work cooperatively with other GSAs in the Subbasin for purposes of developing a GSP and entering into a Coordination Agreement if necessary.

I. The Members desire, once successfully electing to be a GSA, to begin collecting and organizing data, engaging and retaining experts and consultants, and soliciting feedback from beneficial users, users of groundwater and interested parties within the portion of the Subbasin subject to their jurisdiction, for the purpose of preparing a GSP and for the purpose of negotiating Coordination Agreements with the other GSAs in the Subbasin.

J. The Members intend by this Agreement to provide for the management and funding commitments reasonably anticipated to be necessary for the above purposes.

K. The Members intend by this Agreement to provide a framework for cooperative efforts for all entities and individuals within the Authority's jurisdictional area and to implement SGMA in the most effective, efficient, and fair way reasonably possible, and at the lowest reasonable cost.

NOW THEREFORE, in consideration of the promises, terms, conditions, and covenants contained herein, the Members hereby agree as follows:

ARTICLE I

GENERAL PROVISIONS

Section 1.01. Creation of Authority. Pursuant to California Government Code Section 6500 *et seq.*, there is hereby created a public entity to be known as the "Greater Kaweah Groundwater Sustainability Agency" (hereinafter referred to as the "Authority"), which shall be a public entity separate and apart from the Members, and shall administer this Agreement.

Section 1.02. Purpose. The purposes of this Agreement are:

(a) To create a Joint Powers Authority separate from its Members that will elect to be the GSA for a portion of the Subbasin;

(b) To develop, adopt, and implement a GSP in order to implement SGMA's requirements and achieve sustainability goals outlined in SGMA; and

(c) To enter into a Coordination Agreement or similar agreement with other GSAs in order to meet the sustainability requirements outlined in SGMA.

ARTICLE II

POWERS

Section 2.01. Powers. The Authority is hereby authorized, in its own name, to do all acts necessary for the exercise of all powers authorized under SGMA and necessary to satisfy the requirements of SGMA. The Authority shall exercise powers only as authorized by law as identified in Section 2.04 herein.

Section 2.02. Restrictions on the Exercise of Powers. Pursuant to Government Code Section 6509 *et seq*., the powers of the Authority shall be exercised and restricted in the same manner as those imposed upon the County.

Section 2.03. Obligations of the Authority. No debt, liability or obligation of the Authority shall constitute a debt, liability or obligation of any of the Members, appointed members of the Board of Directors, or committee members.

Section 2.04. Water Right. As provided in Water Code Section 10720.5 of SGMA, the Authority and all of its Members confirm that groundwater management under this Authority shall be consistent with Section 2 of Article X of the California Constitution and that any groundwater sustainability plan adopted by the Authority shall not determine or alter surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.

ARTICLE III

GOVERNING BODY

Section 3.01. Governing Board. The Authority shall be administered by a Board of Directors ("Board"), composed of Directors and alternate Directors as described herein, to serve at the pleasure of their appointive governing body. All voting power of the Authority shall reside in the Board.

(a) The Board shall consist of Directors who shall be appointed as follows:

(1) Two elected members of the governing body of KDWCD.

(2) One elected member of the governing body of each Member entity, other than KDWCD.

(3) A representative of California Water Service Company ("Cal Water"), nominated by Cal Water and appointed by the Board.

(4) A representative of the Stakeholder Committee, as hereinafter described, nominated by said committee and appointed by the Board.

(5) A representative of the Rural Communities Committee, as hereinafter described, nominated by said committee and appointed by the Board.

(b) Each Member shall appoint one person, who is either an elected member of the governing body of the Member entity or on the staff of such Member entity, to serve as an alternate Director of the Board in the same manner as the Director is appointed by the Member. Each other entity entitled to a seat on the Board, whether Cal Water, the Stakeholders Committee, or the Rural Communities Committee, shall also nominate a person to serve in like manner as an alternate Director of the Board, subject to Board appointment. Any such alternates shall be empowered to cast votes in the absence of the regular Directors or, in the event of a conflict of interest preventing the regular Director from voting, to vote because of such conflict of interest.

(c) Directors and alternate Directors shall serve at the pleasure of the Board and may be removed or replaced as follows:

(1) Directors appointed by Members may be removed or replaced at any time by their governing board; and

(2) Appointees of the Board may be removed or replaced by the Board for failure to attend at least three (3) consecutive Board meetings without excuse, or may also be removed or replaced at any time by the appointee's governing board or nominating committee.

(3) A Director who is no longer either an elected member of the governing body of the entity or on the staff of such entity that qualified such director to serve on the Board shall be deemed automatically removed from the Board.

Section 3.02. Meetings of the Board. The Board shall provide for calling and conducting its regular meetings and special meetings, in accordance with Government Code Section 54950 *et seq.*

Section 3.03. Minutes. The Secretary shall cause to be kept summary minutes of the meetings of the Board and shall, as soon as possible after each meeting, cause a copy of the summary minutes to be forwarded to each Director and to each of the Members.

Section 3.04. Voting. Each Director shall have one vote.

Section 3.05. Quorum; Required Votes; Approval. A quorum of the Board for convening of any meeting shall consist of a majority of all Directors, or in the absence of a Director, such Director's designated alternate. A quorum of the Board must be present at the time of any vote on any matter before the Board. An affirmative vote of at least a majority of all Directors, or designated alternate Director, present in a quorum of the Board, shall be required for any action of the Board. Notwithstanding the foregoing, approval of certain types of matters shall require the approval of two-thirds of the Directors of the Board. The items requiring approval of two-thirds of the Directors of the Board are agenda items related to budgets, assessments, litigation, the hiring or termination of the chief executive officer, the adoption of the GSP, the addition of new Members, the termination of Members or Cal Water, and amendments of this Agreement. Directors representing a Member who is delinquent in any past or present monetary contributions may be asked to abstain from voting on all matters.

Section 3.06. Bylaws. The Board may adopt bylaws and governing regulations consistent with this Agreement, which may be amended from time to time, for the conduct of its meetings as are necessary for the purposes hereof.

Section 3.07. Terms of Office. The term of office for LIWD, KCWD and SJWD representatives serving on the Board, and the appointed representative from Cal Water, is four (4) years. For the purpose of providing staggered terms of office, the initial term of the Directors appointed by the County and KDWCD, and the Directors appointed by the Stakeholder Committee and the Rural Communities Committee, shall be for a period of two (2) years. Thereafter, the term of office for each representative appointed by the County, KDWCD, the Stakeholder Committee and the Rural Communities Committee, shall be for a period of four (4) years.

ARTICLE IV

COMMITTEES

Section 4.01. Committee Formation. Committees shall be formed by the Board in order to advise the Board on matters that fall within the scope of the particular committee's assignment. Committees may be standing committees or *ad hoc* committees. The Board shall appoint one Director or alternate Director to be a member of and the Chair of each committee. Committees shall meet as often as directed by the Board or, if no such direction is given, as often as necessary, as determined by the Chair of the committee. Three standing committees shall be formed as soon as reasonably practical, but in no event later than one hundred and twenty (120) days of formation of the Authority. They are as follows:

(a) Stakeholder Committee. Committee members shall fall within categories of interested persons or representatives of interested entities as described in SGMA. Committee members shall be appointed by the Board from among applicants.

(b) Rural Communities Committee. Committee members shall be representatives of public water systems as defined in California Health & Safety Code §116275, including but not limited to, cities, public utility districts, and community service districts, located within the boundaries of the Authority. Committee members shall be appointed by the Board from among applicants.

(c) Technical Advisory Committee. Each Director shall be entitled to appoint one technical person to be a member of the Technical Advisory Committee.

ARTICLE V

OFFICERS AND EMPLOYEES

Section 5.01. Chair and Vice-Chair. Each year the Board shall elect a Chair and a Vice-Chair from among the Directors. The Chair and the Vice-Chair shall serve at the pleasure of the Board and shall perform the duties normally required of said offices.

(a) The Chair shall (1) preside at and conduct each meeting of the Board, (2) represent the Board as directed by the Board, (3) be an ex-officio member of each committee established by the Board, and (4) perform such other duties as may be imposed by said Board;

(b) The Vice-Chair shall act and perform all of the Chair's duties in the absence of the Chair; and

(c) The Chair or Vice-Chair may sign all contracts and agreements as approved by the Board.

Section 5.02. Secretary. The Board shall appoint a Secretary from among the employees of the Authority, or if no such employees exist, a consultant. The Secretary shall serve at the pleasure of the Board. The Secretary shall act on behalf of the Authority and perform such other duties as may be imposed by the Board. The Secretary may sign agreements for the Authority when authorized by the Board.

Section 5.03. Treasurer and Auditor.

(a) The County Treasurer shall be the depositary, shall have custody of all the money of the Authority from whatever source, and shall have the duties and obligations of the Treasurer as set forth in Government Code Sections 6505 and 6505.5. The County Treasurer shall be responsible for receiving quarterly reports from the Secretary and verifying the balance of this report with respect to the balance as maintained by the records of the County Auditor.

(b) The County Auditor shall assure strict accountability of all receipts and disbursements of the Authority and shall make arrangements with a certified public accountant or firm of certified public accountants for the annual audit of accounts and records of the Authority.

Section 5.03. Officers in Charge of Records; Funds; and Accounts. Pursuant to Government Code Section 6505.1, the County Treasurer shall have charge of, handle and have access to all accounts, funds and money of the Authority and all records of the Authority relating thereto; and the Secretary shall have charge of, handle and have access to all other records of the Authority.

Section 5.04. Employees and Consultants. The Board may hire employees and consultants, including engineers, accountants and attorneys, to provide services and leadership to the Authority to accomplish the purposes of the Authority.

ARTICLE VI

ACCOUNTS AND REPORTS; FUNDS

Section 6.01. Accounts and Reports. The County Auditor shall establish and maintain such funds and accounts as may be required by good accounting practice. The books and records of the Authority shall be open to inspection at all reasonable times by the public and representatives of the Members. The County Auditor, within 120 days after the close of each Fiscal Year, shall give a complete written report of all financial activities for such Fiscal Year to the Members.

Section 6.02. Annual Budget. The Board shall adopt a budget for the Authority. The County shall provide funds as set forth in the adopted budget. Should the County contribute grant funds such funds shall be restricted to the approved grant tasks. Members other than the County, and Cal Water, shall make contributions which shall be included in the budget adopted by the Board. A Director's affirmative vote to approve a budget does not constitute consent to finance or otherwise participate in any project or projects within that budget.

Section 6.03. Intention for Reimbursement for Expenditures from Grant Proceeds. It is the intention of the Members that the advancement of monies by any Members or Cal Water for expenses of the operational needs of the Authority shall be reimbursed from the proceeds of grants, if grant funds are obtained and such reimbursement is allowable under the terms of any grant agreement.

Section 6.04. Assessment of Members. The Board may vote to assess Members and Cal Water for a share of costs incurred by the Authority or which are anticipated to be incurred by the Authority. All assessments shall be paid by Members and Cal Water within sixty (60) days of the approval of the assessment by the Board. Any Member or entity failing to timely pay an assessment may lose its privilege to vote on any item presented to the Board, until such assessment is paid.

ARTICLE VII

MEMBERSHIP

Section 7.01. Other Members. The Board may vote to approve other entities to be a Member of the Authority with representatives serving as Director and alternate Director on the Board. The Board may vote to remove any Member as a member of the Authority and may vote to remove Cal Water's representation on the Board.

ARTICLE VIII

TERM; WITHDRAWL; TERMINATION

Section 8.01. Term. The Members hereby agree to establish the Authority to last in perpetuity. This Agreement may be rescinded and the Authority terminated by unanimous written consent of all Members.

Section 8.02. Withdrawal of Member. A Member may terminate its membership in the Authority at any time upon giving written notice of the withdrawal to the Authority. Cal Water may similarly withdraw its position on the Board of Directors at any time upon giving written notice of the withdrawal to the Authority. Any Member or Cal Water who withdraws shall remain obligated to pay its share of all debts, liabilities, and obligations incurred or accrued prior to the effective date of such withdrawal.

Section 8.03. Disposition of Assets. Upon termination of the Authority, any assets shall be returned to the Members and Cal Water in the same proportion said Members have funded such reserves or surplus, in accordance with California Government Code Section 6512.

ARTICLE IX

MISCELLANEOUS PROVISIONS

Section 9.01. Amendments. This Agreement may be amended by the Board at any time, or from time to time.

Section 9.02. Indemnification. The Authority shall indemnify, defend, and save harmless the Members, their officers, agents, and employees, and appointed members of the Board of Directors, their officers, agents, and employees, and committee members, their officers, agents, and employees, from and against any and all claims and losses whatsoever, occurring or resulting to persons, firms, or corporations furnishing or supplying work, services, materials or supplies to the Authority in connection with the performance of this Agreement, and, except as expressly provided by law, from any and all claims and losses accruing or resulting to any persons, firm or corporation, for damage, injury, or death arising out of or connected with the Authority's performance of its obligations under this Agreement. Nothing herein shall limit the right of the Authority to purchase insurance or to create a self-insurance mechanism to provide coverage for the foregoing indemnity.

Section 9.03. Insurance. The Authority shall obtain insurance for all Members, appointed Board members, and committee members, including but not limited to directors and officers liability insurance and general liability insurance containing policy limits in such amounts as the Board of Directors shall determine will be necessary to adequately insure against the risks of liability that may be incurred by the Authority.

Section 9.04. Severability. If any provision of this Agreement is determined to be invalid or unenforceable, the remaining provisions will remain in force and unaffected to the fullest extent permitted by law and regulation.

Section 9.05. Secretary of State Filing Requirements. The Chairman of the Board of Directors of the Authority shall file a Notice of this Agreement with the Office of the California Secretary of State within thirty (30) days of its effective date, as required by Government Code Section 6503.5 and within seventy (70) days of its effective date as required by Government Code Section 53051.

IN WITNESS WHEREOF, the Members hereto execute this Agreement to be effective on the date first written above.

County: COUNTY OF TULARE By: [signature] Mike Ennis, Chairman Board of Supervisors	KDWCD: KAWEAH DELTA WATER CONSERVATION DISTRICT By: [signature] Don Mills, President
KCWD: KINGS COUNTY WATER DISTRICT By: [signature] Ernie Taylor, President	LIWD: LAKESIDE IRRIGATION WATER DISTRICT By: [signature] Don Mills, President
SJWD: ST. JOHNS WATER DISTRICT By: [signature] Jeff Ritchie, President	

BYLAWS
GREATER KAWEAH GROUNDWATER SUSTAINABILITY AGENCY

Adopted September 11, 2017

PREAMBLE

These Bylaws are adopted and effective as of September 11, 2017, pursuant to the Greater Kaweah Groundwater Sustainability Agency Joint Powers Authority Agreement ("Agreement").

ARTICLE 1. THE AGENCY

1.1. *Name of Agency.* The name of the agency created by the Agreement shall be the Greater Kaweah Groundwater Sustainability Agency Joint Powers Authority ("Authority").

1.2. *Office of Agency.* The principal office of the Authority shall be Kaweah Delta Water Conservation District, 2975 N. Farmersville Blvd, Farmersville, CA 93223, or at such other location as the Board may designate by resolution.

ARTICLE 2. BOARD OF DIRECTORS

2.1. *Board of Directors.* The Authority shall be governed by a Board of Directors (the "Board"). Pursuant to Section 3.01(a) of the Agreement, the Board shall consist of nine (9) Directors as follows: two elected members of the governing body of KDWCD; one elected member of the governing body of each Member entity, other than KDWCD; a representative of California Water Service Company; a representative of the Stakeholder Committee; and a representative of the Rural Communities Committee. Pursuant to Section 3.01(b) of the Agreement, nine (9) Alternate Directors shall be appointed in the same manner as the Directors.

2.2. *Procedure for Appointment of Director and Alternate Director from the Rural Communities Committee and Stakeholder Committee, and Term.* The Rural Communities Committee and Stakeholder Committee (Committee) shall nominate two representatives from board-approved committee members to serve as a Director and Alternate Director on the Board. The Board will receive and consider the recommendations, and then appoint two representatives from the Committee to serve as Director and Alternate Director. Pursuant to Section 3.07 of the Agreement, the term of office for each representative from the Committee shall be four (4) years.

2.3. *Procedure for Appointment of Director from Cal Water.* Cal Water shall nominate two representatives to serves as Director and Alternate Director on the Board. The Board will then appoint two representatives from Cal Water to serve as a Director and Alternate Director on the Board.

2.4. *Vacancies.* Any vacancy in any Director or Alternate Director seat because of death, resignation, removal, disqualification, or any other cause will be filled for the balance of the vacated term in the manner prescribed in these Bylaws or Agreement for regular appointment to that seat; provided, however, that such vacancies may be filled at any regular or special meeting of the Board.

2.5. *Terms of Office.* Pursuant to Section 3.07 of the Agreement, the term of office for the Directors and Alternate Directors representing Lakeside Irrigation Water District, Kings County Water District, St. Johns Water District, and Cal Water shall be four (4) years. The Directors and Alternate Directors for said seats shall be appointed at the first meeting of the Board after January 1, every four (4) years, with the next appointment to occur at the first Board meeting after January 1, 2020. For the purpose of providing staggered terms of office, the initial term of the Directors and Alternate Directors for the County, KDWCD, the Stakeholder Committee, and the Rural Communities Committee shall be for a period of two (2) years. Thereafter, the term of office for each aforementioned Director and Alternate Director shall be four (4) years. The Directors and Alternate Directors for said seats shall next be appointed at the first Board meeting after January 1, 2018. Thereafter, the Directors and Alternates for said seats shall be appointed every four (4) years at the first Board meeting after January 1.

2.6. *Quorum.* Pursuant to Section 3.05 of the Agreement, a quorum of the Board for convening any meeting shall consist of a majority of all Directors, or in the absence of a Director, such Director's alternate. A quorum of the Board must be present at the time of any vote on any matter before the Board. An affirmative vote of at least a majority of all Directors, or designated alternate Director, present in a quorum of the Board, shall be required for any action of the Board. Notwithstanding the foregoing, approval of certain types of matters shall require the approval of two-thirds of the Directors of the Board. The items requiring approval of two-thirds of the Directors of the Board are agenda items related to budgets, assessments, litigation, the hiring or termination of the chief executive officer, the adoption of the GSP, the addition of new Members, the termination of Members or Cal Water, and amendments of this Agreement. Directors representing a Member who is delinquent in any past or present monetary contributions may be asked to abstain from voting on all matters.

ARTICLE 3. BOARD MEETINGS

Meetings. The Board's regular meeting schedule shall be the second Monday of each month at 1:00 P.M. at the Agency's principal office, or at such other time as the Board may designate by resolution. Special meetings of the Board may be called by the Chairman or any Director upon written request.
3.1.

ARTICLE 4. OFFICERS

4.1. *Officers.* The Officers of the Authority are the Chair, Vice-Chair, and Secretary, pursuant to Article V of the Agreement. Only Directors representing Members of the Agreement are eligible to serve as Chair or Vice-Chair.

4.2. *Election of Officers.* At the first meeting of the Board after January 1 each year, nominations for the Officers will be made and seconded by a Director. If more than two (2)

Directors are nominated for any one office, voting shall occur until a nominee receives a majority of the votes cast.

4.3. *Removal of Elected Officers.* An officer may be removed, with or without cause, by a majority vote of the Board at a regular or special meeting.

4.4. *Vacancies.* Any vacancy in the offices because of death, resignation, removal, disqualification, or any other cause will be filled for the balance of the vacated term in the manner prescribed in these Bylaws or Agreement for regular appointments to that office; provided, however, that such vacancies may be filled at any regular or special meeting of the Board.

4.5. *Resignation of Officers.* Any Officer may resign at any time by giving written notice to the Board Chair or Secretary. Any resignation takes effect at the date of the receipt of that notice or at any later time specified in that notice. Unless otherwise specified in that notice, the acceptance of the resignation is not necessary to make it effective.

4.6. *Responsibilities of Officers.* The responsibilities of the Chair and Vice-Chair shall be performed as outlined in Article V of the Agreement. In addition to the duties outlined in Article V of the Agreement, the Secretary shall: 1) keep or cause to be kept, at the principal executive office of the Agency, a book of minutes of all meetings and actions of Directors and Committees of the Agency; 2) Prepare, give, or cause to be given, notice of, and agendas for, all meetings of the Board and committees of the Agency; and 3) exercise and perform such other powers and perform such other duties as may be assigned to him/her by the Board.

ARTICLE 5. BOARD ADVISORY COMMITTEES

5.1. *Board Advisory Committees.* The Board may establish temporary or permanent advisory committees. Through its Agreement, the Board has established three standing advisory committees: the Rural Communities Committee; the Stakeholder Committee; and the Technical Advisory Committee. The purpose of the advisory committees is to provide input, recommendations, and feedback to the Board on specific issues. The Board will seek input, recommendations, and feedback from the advisory committees as needed. All standing committee meetings shall be subject to the Ralph M. Brown Act. Temporary or *ad hoc* committees will be subject to the Ralph M. Brown Act if so required by law.

5.2. *Agenda & Meeting Minutes.* The Secretary of the Authority as identified in Section 4.1 of these Bylaws shall prepare all agendas, agenda packets, and minutes of any committee meetings to ensure compliance with all applicable legal requirements, including but not limited to, the Ralph M. Brown Act.

5.3. *Rural Communities Committee.*

5.3.1. *Purpose.* The purpose of the RCC is to provide advice to the Board on matters related to SGMA, and specifically to represent interests related to public water systems, municipal well operators and local land use planning agencies regarding such advice. The RCC is advisory in nature and has no authority to approve, deny, or require modifications to any matter or project under the committee's consideration.

5.3.2. *Chair and Vice-Chair.* The Board shall appoint one Director or Alternate Director to be a non-voting member of and the Chair of the RCC. The Board shall also appoint one Director or Alternate Director to be a non-voting member of and the Vice-Chair of the RCC. No meetings of the RCC shall take place without the presence of the Chair or Vice-Chair.

5.3.3. *Members.* To qualify, a committee member must be a representative of a public water system as defined in California Health & Safety Code §116275, including but not limited to, cities, public utility districts, and community service districts, located within the boundaries of the Authority. All members must be elected officials of the entity they represent. Potential members shall submit an application to the Board, which identifies a representative, and the Board shall after consideration of all applications received appoint representatives to the RCC. At any time during the member's term should the member no longer be an elected official of the public water system, the member shall be deemed automatically withdrawn from the RCC. Committee members shall serve a term of four (4) years. Appointments shall occur prior to the first meeting of the Board after January 1 every four (4) years, with the next appointments to take place prior to the first Board meeting in January 2020.

5.3.4. *Meetings.* Regular meetings shall be held quarterly. A special meeting may be called by the Chair of the RCC, or any two members of the RCC. A quorum of the committee for convening any meeting shall consist of a simple majority of all members. An affirmative vote of at least a majority of those in attendance at the meeting shall be required for any action of the RCC.

5.3.5. *Attendance.* RCC members shall make every effort to attend regular meetings. Members unable to attend any meeting should contact the committee Chair or staff at least seventy-two (72) hours prior to the meeting, and shall be excused provided a valid reason is given for the failure to attend. Three consecutive unannounced absences, or three unannounced absences within one calendar year, shall be grounds for dismissal from the RCC, subject to the discretion of the Board.

5.3.6. *Voting.* Each member shall be entitled to one (1) vote.

5.3.7. *RCC Nomination to GSA Board of Directors.* Members shall nominate one (1) RCC member to be a director and one (1) RCC member to be an alternate director on the Board.

5.3.8. *RCC Board of Director and Alternate.* The appointed RCC Director and Alternate Director are responsible for representing the interests of RCC members at the Board level. The RCC Director, Alternate Director, Chair and Vice-Chair are responsible for providing regular updates to the RCC of Board activities. The RCC Director and Alternate Director are responsible for soliciting feedback at meetings of the entire committee on matters of shared interest being brought before the Board. On certain occasions the RCC Director or Alternate Director must request to the Chair of the RCC a topic be added to the RCC's regular agenda or a special meeting to be called to discuss and seek action on the following:

5.3.8.1. Potential financial impacts to members by pending Board action; or

5.3.8.2. Potential action by the Board which could affect district or municipal water operations.

5.4. *Stakeholder Committee.*

5.4.1. *Purpose.* The purpose of the Stakeholder Committee is to provide advice to the Board on matters related to SGMA, and specifically to represent interests of all beneficial uses and users of groundwater as identified in Water Code Section 10723.2, except those uses related to public water systems, municipal well operators, and local land use planning agencies. The Stakeholder Committee is advisory in nature and has no authority to approve, deny, or require modifications to any matter or project under the committee's consideration.

5.4.2. *Chair and Vice-Chair.* The Board shall appoint one Director or Alternate Director to be a non-voting member of and the Chair of the Stakeholder Committee. The Board shall also appoint one Director or Alternate Director to be a non-voting member of and the Vice-Chair of the Stakeholder Committee. No meetings of the Stakeholder Committee shall take place without the presence of the Chair or Vice-Chair.

5.4.3. *Members.* Potential members shall submit an application to the Board. The Board shall consider all applications received and then appoint eleven (11) representatives to the Stakeholder Committee. For the purpose of providing staggered terms, seats identified by an even number shall initially serve a term of two (2) years, and thereafter shall serve a term of four (4) years. Seats identified by an odd number shall serve a term of four (4) years upon appointment. Appointments shall occur prior to the first meeting of the Board after January 1 when the term has expired, with the next appointment for the seats identified by an even number to occur prior to the first Board meeting in January 2018, and the seats identified by an odd number to occur prior to the first Board meeting in January 2020.

5.4.4. *Meetings.* Regular meetings shall be held quarterly. A special meeting may be called by the Chair of the Stakeholder Committee, or any two members of the Stakeholder Committee. A quorum of the committee for convening any meeting shall consist of a simple majority of all members. An affirmative vote of at least a majority of those in attendance at the meeting shall be required for any action.

5.4.5. *Attendance.* Stakeholder Committee members shall make every effort to attend regular meetings. Members unable to attend any meeting should contact the committee Chair or staff at least seventy-two (72) hours prior to the meeting, and shall be excused provided a valid reason is given for the failure to attend. Three consecutive unannounced absences, or three unannounced absences within one calendar year, shall be grounds for dismissal from the Stakeholder Committee, subject to the discretion of the Board.

5.4.6. *Voting.* Each member shall be entitled to one (1) vote.

5.4.7. *Nomination to GSA Board of Directors.* Members shall nominate one (1) Stakeholder Committee member to be a director and one (1) Stakeholder Committee member to be an alternate director on the Board.

5.4.8. *Stakeholder Committee Board of Director and Alternate.* The appointed Stakeholder Committee Director and Alternate Director are responsible for representing the interests of committee members at the Board level. The Stakeholder Committee Director and Alternate Director are responsible for providing regular updates to the committee of Board activities and for soliciting feedback at meetings of the entire committee on matters of shared interest being brought before the Board.

5.5. *Technical Advisory Committee.*

5.5.1. *Purpose.* The purpose of the Technical Advisory Committee ("TAC") is to provide technical advice to the Board on matters related to SGMA. The TAC is advisory in nature and has no authority to approve, deny, or require modifications to any matter or project under the committee's consideration.

5.5.2. *Chair and Vice-Chair.* The Board shall appoint one Director or Alternate Director to be a voting member of and the Chair of the TAC. The Board shall also appoint one Director or Alternate Director to be a voting member of and the Vice-Chair of the TAC. No meetings of the TAC shall take place without the presence of the Chair or Vice-Chair.

5.5.3. *Members.* Each Director of the Board shall be entitled to appoint one (1) technical person to be a member of the TAC. Appointed members shall remain so until the appointing Director requests the member be withdrawn or replaced.

5.5.4. *Meetings.* Regular meetings shall be held quarterly. A special meeting may be called by the Chair, or any two members of the TAC. A quorum of the committee for convening any meeting shall consist of a simple majority of all members. An affirmative vote of at least a majority of all members shall be required for any action.

5.5.5. *Voting.* Each member shall be entitled to one (1) vote.

ARTICLE 6. ETHICS AND CONFLICTS OF INTEREST

6.1. The Authority shall be subject to the conflict of interest rules set forth in the Political Reform Act (commencing with Section 81000 of the Government Code of the State of California) and Sections 1090, *et seq*. of the Government Code. The Authority shall adopt a conflict of interest code.

ARTICLE 7. AMENDMENT

7.1. These Bylaws may be amended from time to time by resolution of the Board duly adopted upon majority of the Board at a regular or special meeting of the Board.

ARTICLE 8. DEFINITIONS AND CONSTRUCTION

8.1. Unless specifically defined in these Bylaws, all defined terms shall have the same meaning ascribed to them in the Agreement. If any of the terms within these Bylaws conflict with any tem of the Agreement, the Agreement's terms shall prevail, and these Bylaws shall be amended to eliminate such conflict of terms.

GREATER KAWEAH
GROUNDWATER
SUSTAINABILITY
AGENCY
JOINT POWERS
AUTHORITY

MINUTES OF THE MEETING
OF THE BOARD OF DIRECTORS
HELD SEPTEMBER 11, 2017

At approximately 1:00 p.m. on September 11, 2017, at the office of the Kaweah Delta Water Conservation District ("District"), Don Mills, Chair of the Greater Kaweah GSA, called to order a meeting of the Board of Directors of the Greater Kaweah Groundwater Sustainability Agency Joint Powers Authority ("GKGSA").

Directors:	Don Mills	Brian Watte
	Paul Boyer	Ernie Taylor
	Joe Cardoza, III	Eric Shannon
	Chris Tantau	Kuyler Crocker (Alternate)
	Greg Milleman	Pete Vander Poel (Absent)

Also Present:	Matt Bixler	Bob Ludekens
	Carole Combs	Blake Mauritson
	Shawn Corley	Dennis Mills
	Larry Dotson	Adriana Renteria
	J. Paul Hendrix	Richard Schafer
	Tamara Kelly	Brandon Spain
	Matt Klinchuch	Tricia Stever Blatter
	Mark Larsen	Debbie Vierra

PUBLIC COMMENT
Chairman Don Mills opened the meeting for public comment. No comment was received.

ANNOUNCEMENTS
Current Announcements
Secretary Larsen reported that legal counsel Aubrey Mauritson has had her baby, and that Matt Bixler was present at the meeting today as legal counsel.

Secretary Larsen reported that the entire basin is now covered by a GSA.

MINUTES
Approval of August 14, 2017 Minutes
Director Joe Cardoza moved, and Director Paul Boyer seconded to approve the August 14, 2017 minutes. The Board unanimously approved the motion.

GOVERNING BOARD APPOINTMENTS
Consider Approval of California Water Service Company Director
Greg Milleman of California Water Service Company announced that he was asked to take on a new role at his company. He stated he has resigned as a director and the company has nominated Tamara Kelly (the current alternate director) from the local Cal Water Office as his replacement.

Secretary Larson formally announced Tamara Kelly as the nominee for the director position from California Water Service Company.

Director Ernie Taylor moved, and Director Eric Shannon seconded to approve the appointment of Tamara Kelly as the director for the California Water Service Company. The Board unanimously approved the motion, with Director Greg Milleman abstaining.

FINANCIAL REVIEW

Status Report on Tulare County Treasurer Administration

Secretary Larsen reported that the suggested budget for GKGSA had been submitted to the County of Tulare. Attached hereto and incorporated by reference is a copy of the proposed budget identified as Agenda Item #5b.

Schedule on Assessment for the 2017 Budget

Secretary Larsen suggested that the directors should set a schedule for assessments for the anticipated 2017 costs.

There was a general Board discussion regarding the timing of the assessments. After discussion, it was generally agreed that a total assessment of $117,000 was appropriate to cover the 2017 anticipated costs of operation of GKGSA. The assessments should be broken up into two assessments with the first due on January 15, 2018 and the second due on April 15, 2018. It was discussed that the Board would review the actual costs prior to the April 15, 2018 assessment to determine if it needed to be adjusted.

Director Brian Watte moved, and Director Eric Shannon seconded, to impose an anticipated total assessment of $117,000 for the 2017 costs and to break up the assessment into two payments, with the first payment due on January 15, 2018 and the second payment due on April 15, 2018. The Board Unanimously approved the motion.

BYLAWS DEVELOPMENT *

Review Draft Bylaws

Secretary Larsen presented the draft bylaws to the Board for review. Attached hereto and incorporated by reference is a copy of the draft Bylaws identified as Agenda Item #6b. Secretary Larsen conducted a review of the draft bylaws with the Board.

There was discussion about changing the language in Section 5.5.2 of the draft Bylaws to make the chair and vice chair Board voting members of the Technical Advisory Committee rather than non-voting members.

There was discussion about adding quorum requirement language in the Bylaws for the Board that mirrored the quorum language in the Joint Powers Agreement.

Consider Approval of Bylaws for the Greater Kaweah GSA

Director Chris Tantau moved, and Director Joe Cardoza seconded to approve the draft Bylaws for GKGSA as presented with the changes discussed regarding making the Chair and Vice Chair of the TAC voting members rather than non-voting members and adding quorum language for the Board that mirrors the JPA. The Board unanimously approved the motion.

COMMITTEE REPORTS

Stakeholder Committee

Secretary Larsen reported that there was no meeting of the Stakeholder Committee last month. The next meeting of the Stakeholder Committee is scheduled for Oct. 4, 2017 at 10:00 a.m.

Rural Communities Committee

Secretary Larsen reported that there was no meeting of the Rural Communities Committee last month. The next meeting of the Rural Communities Committee is scheduled for Oct. 30, 2017 at 1:30 p.m.

Technical Advisory Committee
Secretary Larsen reported that there was no meeting of the Technical Advisory Committee last month. The next meeting of the Technical Advisory Committee is scheduled for Oct. 2, 2017 at 2:00 p.m.

SGMA GSP – MANAGEMENT AREAS
Discuss and Review the Option of Management Areas in a Groundwater Sustainability Plan
Secretary Larsen gave a presentation on the use of management areas. Attached hereto and incorporated by reference is a copy of the presentation by Secretary Larsen identified as Agenda Item #8.

KAWEAH SUBBASIN COMMITTEE REPORTS
Management Team
Secretary Larsen reported that the management team has not met for a couple of months.

KAWEAH SUBBASIN COMMITTEE REPORTS
Secretary Larsen reported the Kaweah Subbasin TAC had met that morning (Sept. 11, 2017). Secretary Larsen gave a general report on the budgeting and funding for its activities, and the scope of anticipated work.

COORDINATION AGREEMENT DEVELOPMENT
Update on Current Coordination Agreement Efforts on Behalf of Kaweah Subbasin
Secretary Larsen provided an update of Coordination Agreement efforts in the Kaweah Subbasin. Secretary Larsen discussed the proposed Memorandum of Understanding for Cooperation and Coordination of the Kaweah subbasin ("MOU"), which is attached hereto as agenda item #10 and incorporated by reference.

Secretary Larsen reported that not all of the agencies have signed off on this version of the MOU. Secretary Larsen, in conjunction with legal counsel, worked together to simplify the MOU.

The Board generally gave approval for this form of MOU and asked Secretary Larsen to proceed forward along the lines of this proposed MOU so that it can be formally approved at the next Board meeting.

PROPOSITION 1 PSP FOR GROUNDWATER SUSTAINABILITY PLANS AND PROJECTS
Status Report on May 2017 DWR Draft and Application
Secretary Larsen provided a status report on Prop 1 PSP grant monies. The submittal process will open in September and it will end on November 10. They plan to release their award of the grants in November and December. Any Phase 2 money would likely come in June through August of 2018.

KAWEAH SUBBASIN GSP DEVELOPMENT
Update on Mid-Kaweah and East Kaweah GSP Development
Secretary Larsen provided a report on recent Mid-Kaweah and East Kaweah GSP development.

Update on Greater Kaweah GSP Development
Secretary Larsen provided a report on recent Greater Kaweah GSP development.

SET NEXT MEETING DATE
Chairman Mills announced the next meeting of the Groundwater Sustainability Agency will commence at 1:00 p.m. on October 9, 2017, at the office of Kaweah Delta Water Conservation District.

ADJOURNMENT
Since there was no further business to come before the Board of Directors, the meeting was concluded.

Respectfully submitted,

Mark Larsen, Secretary

Appendix 1C

Memorandum of Agreement
Greater Kaweah GSA and California Water Service Company

MEMORANDUM OF AGREEMENT

This Memorandum of Agreement ("Agreement") is made and entered into as of this 13th day of March, 2017, by and between the Greater Kaweah Groundwater Sustainability Agency Joint Powers Authority ("Authority"), a joint exercise of powers agency formed under California Government Code Sections 6500 *et. seq.* (the "Joint Exercise of Powers Act"), and the California Water Service Company ("Cal Water") an investor owned utility and California water corporation authorized to do business in the State of California.

RECITALS

A. On September 16, 2014, Governor Brown signed into law Senate Bills 1168 and 1319 and Assembly Bill 1739, known collectively as the Sustainable Groundwater Management Act (the "Act"), effective January 1, 2015;

B. The Act was amended by Senate Bill 13, effective January 1, 2016;

C. The legislative intent of the Act is to provide sustainable management of groundwater basins, to enhance local management of groundwater, to establish minimum standards for sustainable groundwater management, and to provide local groundwater agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater;

D. The Act requires formation of a Groundwater Sustainability Agency ("GSA"), or multiple GSAs, that will be responsible for developing a Groundwater Sustainability Plan ("GSP") for a groundwater basin, and where multiple agencies are interested in jointly managing groundwater resources, the Act allows multiple local agencies to form and act as a single GSA through a memorandum of agreement, a joint powers agreement, or other legal agreement pursuant to the Act, at Water Code Section 10723(a);

E. The Authority is formed through a Joint Powers Agreement ("JPA") entered into between five local government entities with either water supply, water management, or land use responsibilities within the Kaweah Subbasin (5-22.11 of the Department of Water Resources Bulletin 118 classifications). Attached hereto and hereby incorporated by reference as Exhibit A is a copy of the JPA. The Members to the agreement are Kaweah Delta Water Conservation District, County of Tulare, Kings County Water District, Lakeside Irrigation Water District, and St. Johns Water District (hereinafter referred to individually as "Member" and collectively as "Members");

F. The Authority intends to form and to act as a GSA within the Kaweah Subbasin pursuant to the terms and conditions in the JPA;

G. Pursuant to Water Code Section 10723.6(b), a water corporation regulated by the Public Utilities Commission or a mutual water company may participate in a GSA through a memorandum of agreement or other legal agreement. The Act further provides that the authority provided by Section 10723.6(b) does not confer any additional powers to a nongovernmental entity;

H. Cal Water is a water corporation regulated by the Public Utilities Commission that has groundwater management operations, acts as an urban water supplier, and otherwise holds water rights and water related assets in the Subbasin;

I. Cal Water's full participation in the GSA which will be formed by the Authority and in the management of the Authority in its role as the GSA for the Subbasin is essential and necessary because Cal Water has extensive technical, management and financial expertise and abilities with respect to sustainable groundwater management in the Subbasin, and because Cal Water has substantial rights and interests affected by the technical operation of the Subbasin and policy decisions that will be made by the Authority and the GSA formed by the Authority;

J. The JPA provides that a representative of Cal Water nominated by Cal Water and appointed by the Board of Directors shall serve as a Director on the Board of the Authority and the GSA formed by the Authority, and that Cal Water shall also nominate a person to serve in a like manner as an alternate Director of the Board, subject to Board appointment;

K. The Authority desires to benefit from Cal Water's expertise, experience and abilities through Cal Water's service as a Director on the Board, and subsequently by Cal Water's membership in the GSA that will be formed by the Authority;

L. Cal Water desires to serve as a Director of the Board of the Authority pursuant to the terms of this Agreement.

NOW, THEREFORE, in consideration of the promises, terms, conditions and covenants contained herein, the parties to this Agreement hereby agree as follows:

1. Cal Water Agreement to Comply with the Terms of the Joint Powers Agreement.

Cal Water agrees to comply with the terms, responsibilities, benefits and obligations of the JPA, attached hereto as Exhibit A. The JPA may be amended from time to time as well as bylaws of the Authority. Any amendments to the JPA or bylaws shall be automatically incorporated by reference to this Agreement and made apart hereof, unless Cal Water notifies the Authority in writing it will not accept the amended JPA or bylaws.

2. Cal Water Membership on Board of Directors of Authority.

In accordance with the provisions of the JPA, Cal Water shall have the right to appoint a representative to serve as a Director on the Board of the Authority, and shall have the right to appoint a representative to serve as an alternate Director of the Board, each of whom shall have the right to cast a vote on behalf of Cal Water. Cal Water shall notify Authority of Cal Water's appointment of a Director to the Authority Board of Directors, and its appointment of an alternate Director, in accordance with the provision for notification of appointment to the Board of Directors in Section 3.01 of the JPA.

3. Cal Water Membership on Board of Directors of GSA and Participation in GSA.

Authority additionally agrees that Cal Water shall have the right to participate in the GSA that will be formed by the Authority pursuant to the terms, responsibilities, benefits and obligations of the JPA and any adopted bylaws.

4. No Conferral of Additional Powers.

Nothing contained in this Agreement shall confer on Cal Water the right to exercise any legislative powers of the Authority or individual powers of its Members that are independent of the powers granted to the Authority or the GSA formed by the Authority.

5. Payment of Authority Assessments.

Cal Water agrees to pay its portion of the Authority's annual general operating and administrative expenses at the rate determined from time to time by the Authority's Board of Directors, provided that the share of such costs allocated to Cal Water on a pro rata basis pursuant to Article VI, or other applicable Articles of the joint powers agreement shall not be greater than the rate charged to other Members of the Authority.

However, that in no event shall Cal Water be required to fund any such Authority costs of litigation or indemnification in connection with this Agreement.

6. Term.

This Agreement shall remain in effect for the term of the joint powers agreement, unless sooner terminated in the manner provided for in this Agreement.

7. Termination and Withdrawal.

7.1 <u>Termination by Cal Water</u>.

Cal Water may terminate this Agreement for any reason or no reason, effective upon 30 days prior written notice to the Authority. Upon termination, Cal Water shall remain responsible for its share of expenses and obligations of the Authority incurred by Cal Water under this Agreement prior to the effective date of such termination. No refund or repayment of the initial commitment of funds (as determined by the Board of Directors) shall be made to Cal Water upon

Cal Water's termination of this Agreement. The refund or repayment of any other contribution shall be made in accordance with the terms and conditions upon which the contribution was made by Cal Water, or other agreement of the Authority and Cal Water. The representative on the Authority Board of Directors appointed by Cal Water shall be deemed to have withdrawn from the Authority's Board of Directors effective concurrent with termination of this Agreement.

7.2 Termination by Authority.

The Authority may terminate this Agreement in the event Cal Water fails to perform a material obligation under this Agreement that remains uncured after expiration of a 30 day period following written notice of such failure from the Authority to Cal Water, by delivering 30 days prior written notice of termination to Cal Water.

8. Amendments.

This Agreement may be amended only by a subsequent writing, approved and signed by Cal Water and the Authority. Approval by the Authority is valid only after a majority of the Board of Directors of the Authority approves the amendment.

9. Assignment; Binding on Successors.

Except as otherwise provided in this Agreement, the rights and duties of the parties under this Agreement may not be assigned or delegated without the written consent of the other party. Any attempt to assign or delegate such rights or duties in contravention of this Agreement shall be null and void.

10. Notice.

Any and all notices permitted or required to be given hereunder shall be in writing and (a) delivered personally, or (b) sent by certified mail (return receipt requested), or (c) sent by a recognized overnight mail or courier service, with delivery receipt requested, or (d) sent by email communication followed by a mailed copy to the following addresses (or to such other address as may from time to time be specified in writing by such person) at the addresses set forth below as follows:

To Authority:

2975 N. Farmersville Blvd.
Farmersville, CA 93223
Attn: Mark Larsen, Secretary
Phone: 559-747-5601

To Cal Water:

216 North Valley Oaks Drive
Visalia, Ca 93292-6717
Attn: District Manager
Phone: (559)624-1600

Notices shall be deemed received when actually received in the office of the addressee or when delivery is refused, as shown on the receipt of the U.S. Postal Service, private carrier or other person making the delivery, except that notices sent electronically shall be deemed received on the first business day following delivery.

11. Defined Terms.

Capitalized terms used but not separately defined in this Agreement have the meanings assigned such terms in the joint powers agreement.

12. Counterparts.

This Agreement may be executed by the parties in separate counterparts, each of which when so executed and delivered shall be an original. All such counterparts shall together constitute but one and the same instrument.

13. Choice of Law; Venue; Informal Dispute Resolution.

This Agreement shall be governed by and construed in accordance with the laws of the State of California. The venue for any dispute concerning this Agreement shall be in the Superior Court of Tulare County. In the event of a dispute, prior to initiating any litigation or dispute resolution process, the Authority and Cal Water shall meet and confer in person in a good faith attempt to resolve such dispute.

14. Severability.

The invalidity or unenforceability of any portion of this Agreement shall not affect the validity or enforceability of any other portion or provision to the fullest extent permitted by law. Any invalid or unenforceable portion or provision shall be deemed severed from this Agreement and the balance hereof shall be construed and enforced as if this Agreement did not contain such invalid or unenforceable portion or provision.

IN WITNESS WHEREOF, the Authority and Cal Water execute this Agreement effective as of the date first written above.

AUTHORITY:

Greater Kaweah Groundwater Sustainability Agency Joint Powers Authority,

By: [signature]

Name: Don Mills

Title: President

Date: 4/4/17

ATTEST:

[signature]

Date: 4/5/17

UTILITY:

California Water Services Company, a California corporation

By: [signature]

Name: TIM TREUMAR

Title: VICE PRESIDENT

Date: 3/21/17

EXHIBIT A

KAWEAH GROUNDWATER SUSTAINABILITY AGENCY JOINT POWERS AUTHORITY AGREEMENT

AGREEMENT TO FORM A JOINT POWERS AUTHORITY
GREATER KAWEAH GROUNDWATER SUSTAINABILITY AGENCY

THIS AGREEMENT ("Agreement") is made August 23, 2016, by and between KAWEAH DELTA WATER CONSERVATION DISTRICT ("KDWCD"), COUNTY OF TULARE ("County"), KINGS COUNTY WATER DISTRICT ("KCWD"), and LAKESIDE IRRIGATION WATER DISTRICT ("LIWD") and ST. JOHNS WATER DISTRICT ("SJWD") (hereinafter referred to individually as "Member" and collectively as "Members"), in light of the following:

RECITALS

A. During September 2014, Governor Brown signed three bills (SB 1168, SB 1319, and AB 1739) into law creating the Sustainable Groundwater Management Act ("SGMA").

B. SGMA authorizes the formation of an entity called a Groundwater Sustainability Agency ("GSA"), one or more of which are authorized to be responsible for implementing provisions of SGMA as to each groundwater basin and subbasin falling within the provisions of SGMA.

C. The Members overlie the Kaweah Subbasin (5-22.11 of the Department of Water Resources Bulletin 118 classifications) ("Subbasin") of the San Joaquin Valley Basin, an unadjudicated groundwater basin, portions of which underlie the jurisdictional boundaries of each Member.

D. Each of the Members to this Agreement is a local government entity with either water supply, water management, or land use responsibilities within the Subbasin and is qualified individually to serve as a GSA under the provisions of SGMA.

E. Under SGMA, a combination of local agencies may elect to form a GSA through a joint powers agreement.

F. The Members intend by this Agreement to create a joint powers authority that will elect to become a GSA for their jurisdictional areas covering a portion of the Subbasin.

G. Under SGMA, each GSA will be responsible for assuming its regulatory role by June 30, 2017, and for submitting a Groundwater Sustainability Plan ("GSP") to the Department of Water Resources by January 31, 2020.

H. The Members intend to work cooperatively with other GSAs in the Subbasin for purposes of developing a GSP and entering into a Coordination Agreement if necessary.

I. The Members desire, once successfully electing to be a GSA, to begin collecting and organizing data, engaging and retaining experts and consultants, and soliciting feedback from beneficial users, users of groundwater and interested parties within the portion of the Subbasin subject to their jurisdiction, for the purpose of preparing a GSP and for the purpose of negotiating Coordination Agreements with the other GSAs in the Subbasin.

J. The Members intend by this Agreement to provide for the management and funding commitments reasonably anticipated to be necessary for the above purposes.

K. The Members intend by this Agreement to provide a framework for cooperative efforts for all entities and individuals within the Authority's jurisdictional area and to implement SGMA in the most effective, efficient, and fair way reasonably possible, and at the lowest reasonable cost.

NOW THEREFORE, in consideration of the promises, terms, conditions, and covenants contained herein, the Members hereby agree as follows:

ARTICLE I

GENERAL PROVISIONS

Section 1.01. Creation of Authority. Pursuant to California Government Code Section 6500 *et seq.*, there is hereby created a public entity to be known as the "Greater Kaweah Groundwater Sustainability Agency" (hereinafter referred to as the "Authority"), which shall be a public entity separate and apart from the Members, and shall administer this Agreement.

Section 1.02. Purpose. The purposes of this Agreement are:

(a) To create a Joint Powers Authority separate from its Members that will elect to be the GSA for a portion of the Subbasin;

(b) To develop, adopt, and implement a GSP in order to implement SGMA's requirements and achieve sustainability goals outlined in SGMA; and

(c) To enter into a Coordination Agreement or similar agreement with other GSAs in order to meet the sustainability requirements outlined in SGMA.

ARTICLE II

POWERS

Section 2.01. Powers. The Authority is hereby authorized, in its own name, to do all acts necessary for the exercise of all powers authorized under SGMA and necessary to satisfy the requirements of SGMA. The Authority shall exercise powers only as authorized by law as identified in Section 2.04 herein.

Section 2.02. Restrictions on the Exercise of Powers. Pursuant to Government Code Section 6509 *et seq*., the powers of the Authority shall be exercised and restricted in the same manner as those imposed upon the County.

Section 2.03. Obligations of the Authority. No debt, liability or obligation of the Authority shall constitute a debt, liability or obligation of any of the Members, appointed members of the Board of Directors, or committee members.

Section 2.04. Water Right. As provided in Water Code Section 10720.5 of SGMA, the Authority and all of its Members confirm that groundwater management under this Authority shall be consistent with Section 2 of Article X of the California Constitution and that any groundwater sustainability plan adopted by the Authority shall not determine or alter surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.

ARTICLE III

GOVERNING BODY

Section 3.01. Governing Board. The Authority shall be administered by a Board of Directors ("Board"), composed of Directors and alternate Directors as described herein, to serve at the pleasure of their appointive governing body. All voting power of the Authority shall reside in the Board.

(a) The Board shall consist of Directors who shall be appointed as follows:

(1) Two elected members of the governing body of KDWCD.

(2) One elected member of the governing body of each Member entity, other than KDWCD.

(3) A representative of California Water Service Company ("Cal Water"), nominated by Cal Water and appointed by the Board.

(4) A representative of the Stakeholder Committee, as hereinafter described, nominated by said committee and appointed by the Board.

(5) A representative of the Rural Communities Committee, as hereinafter described, nominated by said committee and appointed by the Board.

(b) Each Member shall appoint one person, who is either an elected member of the governing body of the Member entity or on the staff of such Member entity, to serve as an alternate Director of the Board in the same manner as the Director is appointed by the Member. Each other entity entitled to a seat on the Board, whether Cal Water, the Stakeholders Committee, or the Rural Communities Committee, shall also nominate a person to serve in like manner as an alternate Director of the Board, subject to Board appointment. Any such alternates shall be empowered to cast votes in the absence of the regular Directors or, in the event of a conflict of interest preventing the regular Director from voting, to vote because of such conflict of interest.

(c) Directors and alternate Directors shall serve at the pleasure of the Board and may be removed or replaced as follows:

(1) Directors appointed by Members may be removed or replaced at any time by their governing board; and

(2) Appointees of the Board may be removed or replaced by the Board for failure to attend at least three (3) consecutive Board meetings without excuse, or may also be removed or replaced at any time by the appointee's governing board or nominating committee.

(3) A Director who is no longer either an elected member of the governing body of the entity or on the staff of such entity that qualified such director to serve on the Board shall be deemed automatically removed from the Board.

Section 3.02. Meetings of the Board. The Board shall provide for calling and conducting its regular meetings and special meetings, in accordance with Government Code Section 54950 *et seq.*

Section 3.03. Minutes. The Secretary shall cause to be kept summary minutes of the meetings of the Board and shall, as soon as possible after each meeting, cause a copy of the summary minutes to be forwarded to each Director and to each of the Members.

Section 3.04. Voting. Each Director shall have one vote.

Section 3.05. Quorum; Required Votes; Approval. A quorum of the Board for convening of any meeting shall consist of a majority of all Directors, or in the absence of a Director, such Director's designated alternate. A quorum of the Board must be present at the time of any vote on any matter before the Board. An affirmative vote of at least a majority of all Directors, or designated alternate Director, present in a quorum of the Board, shall be required for any action of the Board. Notwithstanding the foregoing, approval of certain types of matters shall require the approval of two-thirds of the Directors of the Board. The items requiring approval of two-thirds of the Directors of the Board are agenda items related to budgets, assessments, litigation, the hiring or termination of the chief executive officer, the adoption of the GSP, the addition of new Members, the termination of Members or Cal Water, and amendments of this Agreement. Directors representing a Member who is delinquent in any past or present monetary contributions may be asked to abstain from voting on all matters.

Section 3.06. Bylaws. The Board may adopt bylaws and governing regulations consistent with this Agreement, which may be amended from time to time, for the conduct of its meetings as are necessary for the purposes hereof.

Section 3.07. Terms of Office. The term of office for LIWD, KCWD and SJWD representatives serving on the Board, and the appointed representative from Cal Water, is four (4) years. For the purpose of providing staggered terms of office, the initial term of the Directors appointed by the County and KDWCD, and the Directors appointed by the Stakeholder Committee and the Rural Communities Committee, shall be for a period of two (2) years. Thereafter, the term of office for each representative appointed by the County, KDWCD, the Stakeholder Committee and the Rural Communities Committee, shall be for a period of four (4) years.

ARTICLE IV

COMMITTEES

Section 4.01. Committee Formation. Committees shall be formed by the Board in order to advise the Board on matters that fall within the scope of the particular committee's assignment. Committees may be standing committees or *ad hoc* committees. The Board shall appoint one Director or alternate Director to be a member of and the Chair of each committee. Committees shall meet as often as directed by the Board or, if no such direction is given, as often as necessary, as determined by the Chair of the committee. Three standing committees shall be formed as soon as reasonably practical, but in no event later than one hundred and twenty (120) days of formation of the Authority. They are as follows:

(a) Stakeholder Committee. Committee members shall fall within categories of interested persons or representatives of interested entities as described in SGMA. Committee members shall be appointed by the Board from among applicants.

(b) Rural Communities Committee. Committee members shall be representatives of public water systems as defined in California Health & Safety Code §116275, including but not limited to, cities, public utility districts, and community service districts, located within the boundaries of the Authority. Committee members shall be appointed by the Board from among applicants.

(c) Technical Advisory Committee. Each Director shall be entitled to appoint one technical person to be a member of the Technical Advisory Committee.

ARTICLE V

OFFICERS AND EMPLOYEES

Section 5.01. Chair and Vice-Chair. Each year the Board shall elect a Chair and a Vice-Chair from among the Directors. The Chair and the Vice-Chair shall serve at the pleasure of the Board and shall perform the duties normally required of said offices.

(a) The Chair shall (1) preside at and conduct each meeting of the Board, (2) represent the Board as directed by the Board, (3) be an ex-officio member of each committee established by the Board, and (4) perform such other duties as may be imposed by said Board;

(b) The Vice-Chair shall act and perform all of the Chair's duties in the absence of the Chair; and

(c) The Chair or Vice-Chair may sign all contracts and agreements as approved by the Board.

Section 5.02. Secretary. The Board shall appoint a Secretary from among the employees of the Authority, or if no such employees exist, a consultant. The Secretary shall serve at the pleasure of the Board. The Secretary shall act on behalf of the Authority and perform such other duties as may be imposed by the Board. The Secretary may sign agreements for the Authority when authorized by the Board.

Section 5.03. Treasurer and Auditor.

(a) The County Treasurer shall be the depositary, shall have custody of all the money of the Authority from whatever source, and shall have the duties and obligations of the Treasurer as set forth in Government Code Sections 6505 and 6505.5. The County Treasurer shall be responsible for receiving quarterly reports from the Secretary and verifying the balance of this report with respect to the balance as maintained by the records of the County Auditor.

(b) The County Auditor shall assure strict accountability of all receipts and disbursements of the Authority and shall make arrangements with a certified public accountant or firm of certified public accountants for the annual audit of accounts and records of the Authority.

Section 5.03. Officers in Charge of Records; Funds; and Accounts. Pursuant to Government Code Section 6505.1, the County Treasurer shall have charge of, handle and have access to all accounts, funds and money of the Authority and all records of the Authority relating thereto; and the Secretary shall have charge of, handle and have access to all other records of the Authority.

Section 5.04. Employees and Consultants. The Board may hire employees and consultants, including engineers, accountants and attorneys, to provide services and leadership to the Authority to accomplish the purposes of the Authority.

ARTICLE VI

ACCOUNTS AND REPORTS; FUNDS

Section 6.01. Accounts and Reports. The County Auditor shall establish and maintain such funds and accounts as may be required by good accounting practice. The books and records of the Authority shall be open to inspection at all reasonable times by the public and representatives of the Members. The County Auditor, within 120 days after the close of each Fiscal Year, shall give a complete written report of all financial activities for such Fiscal Year to the Members.

Section 6.02. Annual Budget. The Board shall adopt a budget for the Authority. The County shall provide funds as set forth in the adopted budget. Should the County contribute grant funds such funds shall be restricted to the approved grant tasks. Members other than the County, and Cal Water, shall make contributions which shall be included in the budget adopted by the Board. A Director's affirmative vote to approve a budget does not constitute consent to finance or otherwise participate in any project or projects within that budget.

Section 6.03. Intention for Reimbursement for Expenditures from Grant Proceeds. It is the intention of the Members that the advancement of monies by any Members or Cal Water for expenses of the operational needs of the Authority shall be reimbursed from the proceeds of grants, if grant funds are obtained and such reimbursement is allowable under the terms of any grant agreement.

Section 6.04. Assessment of Members. The Board may vote to assess Members and Cal Water for a share of costs incurred by the Authority or which are anticipated to be incurred by the Authority. All assessments shall be paid by Members and Cal Water within sixty (60) days of the approval of the assessment by the Board. Any Member or entity failing to timely pay an assessment may lose its privilege to vote on any item presented to the Board, until such assessment is paid.

ARTICLE VII

MEMBERSHIP

Section 7.01. Other Members. The Board may vote to approve other entities to be a Member of the Authority with representatives serving as Director and alternate Director on the Board. The Board may vote to remove any Member as a member of the Authority and may vote to remove Cal Water's representation on the Board.

ARTICLE VIII

TERM; WITHDRAWL; TERMINATION

Section 8.01. Term. The Members hereby agree to establish the Authority to last in perpetuity. This Agreement may be rescinded and the Authority terminated by unanimous written consent of all Members.

Section 8.02. Withdrawal of Member. A Member may terminate its membership in the Authority at any time upon giving written notice of the withdrawal to the Authority. Cal Water may similarly withdraw its position on the Board of Directors at any time upon giving written notice of the withdrawal to the Authority. Any Member or Cal Water who withdraws shall remain obligated to pay its share of all debts, liabilities, and obligations incurred or accrued prior to the effective date of such withdrawal.

Section 8.03. Disposition of Assets. Upon termination of the Authority, any assets shall be returned to the Members and Cal Water in the same proportion said Members have funded such reserves or surplus, in accordance with California Government Code Section 6512.

ARTICLE IX

MISCELLANEOUS PROVISIONS

Section 9.01. Amendments. This Agreement may be amended by the Board at any time, or from time to time.

Section 9.02. Indemnification. The Authority shall indemnify, defend, and save harmless the Members, their officers, agents, and employees, and appointed members of the Board of Directors, their officers, agents, and employees, and committee members, their officers, agents, and employees, from and against any and all claims and losses whatsoever, occurring or resulting to persons, firms, or corporations furnishing or supplying work, services, materials or supplies to the Authority in connection with the performance of this Agreement, and, except as expressly provided by law, from any and all claims and losses accruing or resulting to any persons, firm or corporation, for damage, injury, or death arising out of or connected with the Authority's performance of its obligations under this Agreement. Nothing herein shall limit the right of the Authority to purchase insurance or to create a self-insurance mechanism to provide coverage for the foregoing indemnity.

Section 9.03. Insurance. The Authority shall obtain insurance for all Members, appointed Board members, and committee members, including but not limited to directors and officers liability insurance and general liability insurance containing policy limits in such amounts as the Board of Directors shall determine will be necessary to adequately insure against the risks of liability that may be incurred by the Authority.

Section 9.04. Severability. If any provision of this Agreement is determined to be invalid or unenforceable, the remaining provisions will remain in force and unaffected to the fullest extent permitted by law and regulation.

Section 9.05. Secretary of State Filing Requirements. The Chairman of the Board of Directors of the Authority shall file a Notice of this Agreement with the Office of the California Secretary of State within thirty (30) days of its effective date, as required by Government Code Section 6503.5 and within seventy (70) days of its effective date as required by Government Code Section 53051.

IN WITNESS WHEREOF, the Members hereto execute this Agreement to be effective on the date first written above.

County: COUNTY OF TULARE By: [signature] Mike Ennis, Chairman Board of Supervisors	KDWCD: KAWEAH DELTA WATER CONSERVATION DISTRICT By: [signature] Don Mills, President
KCWD: KINGS COUNTY WATER DISTRICT By: [signature] Ernie Taylor, President	LIWD: LAKESIDE IRRIGATION WATER DISTRICT By: [signature] Don Mills, President
SJWD: ST. JOHNS WATER DISTRICT By: [signature] Jeff Ritchie, President	

Appendix 1D

2022 First Amended Kaweah Subbasin Coordination Agreement

2022 FIRST AMENDED KAWEAH SUBBASIN COORDINATION AGREEMENT

GREATER KAWEAH GROUNDWATER SUSTAINABILITY AGENCY
MID-KAWEAH GROUNDWATER SUSTAINBILITY AGENCY
EAST KAWEAH GROUNDWATER SUSTAINABILITY AGENCY

Plan Manager: Eric Osterling
eosterling@greaterkaweahgsa.org

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DEFINITIONS

1. "Agency" or "GSA": refers to a groundwater sustainability agency as defined in SGMA.

2. "Agreement": refers to this Coordination Agreement, unless indicated otherwise.

3. "Annual Report": refers to the report required by California Water Code Section 10728.

4. "Basin": means the Kaweah Subbasin within the Tulare Lake Hydrologic Region, San Joaquin Valley Groundwater Basin, defined in DWR's 2016 Bulletin 118 Interim Update as Basin 5-22.11, as same may be amended from time to time.

5. "Basin setting": refers to the information about the physical setting, characteristics, and current conditions of the Basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and water budget, and Management Areas (if applicable) pursuant to California Code of Regulations, title 23, Sections 354.12-354.20.

6. "Confidential Information": as discussed in Section 3.3 of this Agreement, refers to data, information, modeling, projections, estimates, plans, and other information that are not public and in which the Party has a reasonable expectation of confidentiality, regardless of whether such information is designated as "Confidential Information" at the time of its disclosure. Confidential Information also includes information which is, at the time provided, (a) disclosed as such in writing and marked as confidential (or with other similar designation) at the time of disclosure and/or (b) disclosed in any other manner and identified as confidential at the time of disclosure and is also summarized and designated as confidential in a written memorandum delivered within thirty (30) days of disclosure.

7. "DWR": refers to the California Department of Water Resources.

8. "Groundwater": means water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water that flows in known and definite channels.

9. "Groundwater flow": refers to the volume and direction of groundwater movement into, out of, or throughout a basin.

10. "Management Team Committee": refers to the governing body originally established in the Parties' MOU that is charged with making recommendations regarding this Agreement and other Kaweah Subbasin related compliance issues to each GSA.

11. "Measurable objectives": refers to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted GSP to achieve the sustainability goal for the Basin.

12. "Memorandum of Understanding" or "MOU": refers to the November 1, 2017 Memorandum of Understanding signed by the Parties concerning GSP-related cooperation and coordination in the Kaweah Subbasin.

13. "Minimum Thresholds": refers to a numeric value for each sustainability indicator used to define undesirable results.

14. "Plan" or "GSP": refers to a groundwater sustainability plan as defined by SGMA.

15. "Plan Manager": refers to an employee or authorized representative of the Parties appointed by the Coordination Committee to perform the role of the Plan Manager set forth in Section 1.3 of this Agreement.

16. "Principal aquifers": refers to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

17. "Representative monitoring": refers to a monitoring site within a broader network of sites that typifies one or more conditions within the Basin or an area of the Basin.

18. "Sustainability indicator": refers to any of the effects caused by groundwater conditions occurring throughout the Basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x). Sustainability indicators include 1) chronic lowering of groundwater levels, 2) reduction of groundwater storage, 3) seawater intrusion [not applicable], 4) degraded groundwater quality, 5) land subsidence, and 6) depletions of interconnected surface water.

19. "Water source type": represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, local supplies, and local imported supplies.

20. "Water use sector": refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.

21. "Water year": refers to the period from October 1 through the following September 30, inclusive, and is labeled by the ending year (e.g. the last day of Water Year 2019 is September 30, 2019).

22. "Water year type": refers to the classification provided by DWR for the San Joaquin Valley, based on unimpaired runoff. The water year type is based on a numerical index and includes five (5) classifications: Wet, Above Normal, Below Normal, Dry, and Critical.

1. INTRODUCTION

1.1. PURPOSE.

The purpose of this Agreement is to comply with SGMA's coordination agreement requirements and ensure that the multiple GSPs within the Basin are developed and implemented utilizing the same methodologies and assumptions as required under SGMA and Title 23 of the California Code of Regulations, and that the elements of the GSPs are appropriately coordinated to support sustainable management.

The Parties intend that this Agreement describe how the multiple GSPs, developed by the individual GSAs, are implemented together to satisfy the requirements of SGMA. The Parties intend this Agreement will be incorporated as part of each individual GSP developed by the Parties.

1.2. ADJUDICATION OR ALTERNATIVE PLANS IN THE BASIN. (§357.4(f).)

As of the date of this Agreement, there are no portions of the Basin that have been adjudicated or have submitted for DWR approval an alternative to a GSP pursuant to Water Code Section 10733.6.

1.3. PLAN MANAGER. (§357.4(b)(1).)

In accordance with the Title 23, California Code of Regulations Section 357.4(b)(1), the Parties hereby agree on a point of contact with DWR. The Plan Manager shall be the General Manager for the Greater Kaweah GSA. The Parties may agree to amend the appointed Plan Manager upon unanimous consent of the GSAs and written notification to DWR. The Plan Manager shall serve as the point of contact for DWR as specified in California Code of Regulations, Section 357.4, subd. (b)(1). The Plan Manager's role as the point of contact between the Management Team Committee and DWR. In this role, the Plan Manager shall, at the direction of the Management Team Committee, submit all GSPs, plan amendments, supporting information, monitoring data and other pertinent information, Annual Reports, and periodic evaluations to DWR when required. The Plan Manager may communicate other information to DWR at the request of the Management Team only. The Plan Manager has no authority to take any action or represent the Management Team Committee or a particular GSA without the specific direction and authority of the Management Team Committee or the particular GSA. The Plan Manager is obligated to disclose all communications he/she receives in his/her capacity as Plan Manager to the Management Team Committee, either in open or closed session meetings, or as otherwise appropriate.

2. BASIN SETTING

2.1. INTRODUCTION (§354.12)

The detailed basin setting for the Kaweah Subbasin, as required for GSPs prepared in accordance with Title 23, California Code of Regulations Section 354.12, is provided in Appendix 1 of this Agreement. The attached Basin Setting includes the physical setting, the Hydrogeologic Conceptual Model, groundwater conditions and water budget pursuant to Title 12, CCR Sections 354.12-354.18.

3. EXCHANGE OF DATA AND INFORMATION (§357.4(b)(2))

3.1. EXCHANGE OF INFORMATION.

In accordance with Title 23, California Code of Regulations Section 357.4(b)(2) of the GSP Regulations, the GSA Parties acknowledge and recognize that for this Coordination Agreement to be effective in the enhancement of the goals of basin-wide groundwater sustainability and compliance with the SGMA and the basin level coordinating and reporting regulations, the GSA Parties will have an affirmative obligation to exchange certain minimally necessary information among and between the other GSA Parties. Likewise, the GSA Parties acknowledge and recognize that individual GSA Parties, in providing certain information, and in particular certain raw data, may contend that limitations apply in the sharing and other dissemination of certain types of said information which may subject the individual GSA Party to certain duties regarding non-disclosure and privacy restrictions and protections.

3.2. PROCEDURE GOVERNING THE EXCHANGE OF INFORMATION.

The Parties may exchange information through collaboration and/or informal requests made at the Management Team Committee level. To the extent it is necessary to make a written request for information to another Party, each Party shall designate a representative to respond to information requests and provide the name and contact information of the designee to the Management Team Committee. Requests may be communicated in writing and transmitted in person or by mail, facsimile machine or other electronic means to the appropriate representative as named in this Agreement.

Nothing in this Agreement shall be construed to prohibit any Party from voluntarily exchanging information with any other Party by any other mechanism separate from the Management Team Committee.

3.3. NON-DISCLOSURE OF CONFIDENTIAL INFORMATION.

It is understood and agreed to that, pursuant to Section 3.1 of this Agreement, a Party to this Agreement may provide one or more of the other Parties with confidential information. To ensure the protection of such confidential information and in consideration of the agreement to exchange said information, the Parties agree as follows:

3.3.1. The confidential information to be disclosed under this Agreement ("Confidential Information") includes data, information, modeling, projections, estimates, plans, and other information that are not public and in which the Party has a reasonable expectation of confidentiality, regardless of whether such information is designated as "Confidential Information" at the time of its disclosure.

3.3.2. In addition to the above, Confidential Information shall also include, and the Parties shall have a reasonable duty to protect, other confidential and/or sensitive information which is, at the time provided (a) disclosed as such in writing and marked as confidential (or with other similar designation) at the time of disclosure; and/or (b) disclosed in any other manner and identified as confidential at the time of disclosure and is also summarized and designated as confidential in a written memorandum delivered within thirty (30) days of the disclosure.

3.3.3. The Parties shall use the Confidential Information only for the purposes set forth in this Agreement.

3.3.4. The Parties shall limit disclosure of Confidential Information within its own organization to its directors, officers, partners, attorneys, consultants, members and/or employees having a need to know and shall not disclose Confidential Information to any third party (whether an individual, corporation, or other entity) without prior written consent. A Party shall satisfy its obligations under this paragraph if it takes affirmative measures to ensure compliance with these confidentiality obligations by its employees, agents, consultants and others who are permitted access to or use of the Confidential Information.

3.3.5. This Agreement imposes no obligation upon the Parties with respect to any Confidential Information that (a) was possessed before receipt; (b) is or becomes a matter of public knowledge through no fault of the receiving Party; (c) is rightfully received from a third party not owing a duty of confidentiality; (d) is disclosed without a duty of confidentiality to a third party by, or with the authorization of, the disclosing Party; or (e) is independently developed.

3.3.6. If there is a breach or threatened breach of any provision of this section, it is agreed and understood that the non-breaching Party shall have no adequate remedy in money or other damages and accordingly shall be entitled to injunctive relief; provided however, no specification in this Agreement of any particular remedy shall be construed as a waiver or prohibition of any other remedies in the event of a breach or threatened breach of any provision of this Agreement.

3.3.7. If and to the extent the information covered by this provision is requested pursuant to the California Public Records Act (PRA), the Party subject to the PRA shall coordinate with the other Parties regarding its disclosure and obtain approval from a Party prior to disclosing information that the Party has disclosed pursuant to this provision in response to the PRA. To the extent the Party responding to the PRA is sued or otherwise challenged for withholding confidential information at the request of another Party, the Party requesting the non-disclosure shall indemnify the Party subject to the PRA for any costs and fees related to litigation or other such challenge.

4. METHODOLOGIES & ASSUMPTIONS (§357.4(b)(3))

In accordance with the Title 23, California Code of Regulations Section 357.4(b)(3) and California Water Code Section 10727.6 the Parties have entered into this Agreement to ensure that the individual GSPs in the Basin utilize the same data and methodologies for the following assumptions: 1) groundwater elevation data, 2) groundwater extraction data; 3) surface water supply; 4) total water use; 5) change in groundwater storage; 6) water budget; and 7) sustainable yield, and that such methodologies and assumptions will continue to be used in the future development and implementation of such GSPs.

The methodologies and assumptions were developed based on existing data/information, best management practices, and/or best modeled or projected data available.

Information regarding the agreed upon methodologies and assumptions, is attached as Appendix 1 to this Agreement.

5. MONITORING NETWORK (§§354.32-354.40)

5.1. The Parties developed a monitoring network and monitoring network objectives for the Basin in accordance with California Code of Regulations, Title 23, Sections 354.32 – 354.40. Each network facilitates the collection of data in order to characterize groundwater and related surface water conditions in the Basin and evaluate changing conditions that occur from implementation of the individual GSPs. The individual GSPs include monitoring objectives, protocols, and data reporting requirements as necessary under SGMA and SGMA Regulations.

5.2. The monitoring network(s) demonstrate short-term, seasonal, and long-term trends in groundwater and related surface water conditions. Each Party's GSP will include the monitoring network objectives for the Basin, including an explanation of how the network develops and implements to monitor groundwater and related surface water conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the effectiveness of GSP implementation. The monitoring network(s) accomplish the following: a) demonstrate progress toward achieving measurable objectives described in the GSPs; b) monitor impacts to the beneficial uses or users of groundwater; c) monitor changes in groundwater conditions relative to applicable measurable objectives and minimum thresholds; and d) assist with quantifying annual changes in water budget components.

5.3. The Parties hereby agree, consistent with Section 3 of this Agreement, to share information necessary to create a Basin map displaying the location and type of each monitoring site within the Basin, and a report in tabular format, including information regarding the monitoring site type, frequency of measurement, and purpose for which the monitoring site is being used.

5.4. Information regarding the agreed upon monitoring networks, which is subject to future review and modification, is attached as Appendix 2 to this Agreement.

6. COORDINATED WATER BUDGET (§357.4(b)(3)(B))

6.1 In accordance with the California Code of Regulations, Title 23, Section 357.4 (b)(3)(B), the Parties have prepared a coordinated water budget for the Basin as described herein and required by California Code of Regulations, Title 23, Section 354.18. The water budget provides an accounting and assessment of the total volume of groundwater and surface water entering and leaving the Basin, including historical, current, and projected water budget conditions, and the change in the volume of water stored. Said water budget is included as part of Appendix 1 to this Agreement.

6.2 All aspects of the coordinated water budget as described herein are addressed in the Basin Setting. In addition, the current water budget for the period 1997-2017 has been apportioned under a water accounting framework among each of the Parties as set forth in Appendix 3 to this Agreement. This water budget is preliminary and based on best available data. Further discussions among the Parties must occur after adoption of GSPs concerning mutual responsibilities in achieving the Subbasin's Sustainable Yield by 2040, or as may be otherwise extended by DWR per Water Code §10727.2 (b) (3) once further data is obtained. The Parties acknowledge that significant data gaps exist within the existing Basin Setting as further described in Section 9 below. The Parties explicitly acknowledge to use good faith efforts to obtain data necessary and to reevaluate the water budget as needed. The Parties agree to use scientifically approved methods of data collection of such data relative to the development or understanding of groundwater extractions, groundwater inflow, and groundwater storage/levels.

6.3 With improved data collection and basin understanding, the water budget will be modified to reflect the updated understanding. The Subbasin GSAs will meet at least annually to review Subbasin data relative to the water budget. Revisions to the water budget will occur no less than every two years. Attached hereto and incorporated by reference is Appendix 3, the Water Accounting Framework.

7. SUSTAINABLE YIELD AND UNDESRIABLE RESULTS (§357.4(b)(3)(C)

In accordance with Title 23, California Code of Regulations Section 357.4(b)(3)(C), the Parties hereby agree to a sustainable yield for the basin, which is supported by a description of the undesirable results for the basin, and an explanation of how the minimum thresholds and measurable objectives defined by each Plan relate to those undesirable results, based on information described in the basin setting as described in Appendix 1 attached hereto and incorporated by reference. The sustainable yield is further defined in Appendix 3. The causes and criteria to define undesirable results with respect to the local beneficial uses and users is described in Appendix 6.

8. COORDINATED DATA MANAGEMENT SYSTEM (§357.4(e))

In accordance with the Title 23, California Code of Regulations Section 357.4(e), the Parties hereby describe a coordinated data management system for the Basin. As required by SGMA and accompanying Regulations, the Parties will coordinate to maintain a data management system that is capable of storing and reporting information relevant to the development and/or implementation of the GSPs and monitoring network of the Basin.

Information regarding the agreed upon coordinated data management system, which is subject to future review and modification, shall be attached as Appendix 4 to this Agreement.

9. IDENTIFICATION OF DATA GAPS (§354.38)

The Parties will periodically evaluate the monitoring network in Appendix 2 to determine if there are data gaps that could affect the ability of the Subbasin to meet the sustainability goal of the subbasin. Current data gaps are identified in Appendix 5. At minimum, every five years, the Parties will provide an evaluation of data gaps in the five-year assessment, including steps to be taken to address data gaps before the next five-year assessment. The Parties agree to use good faith efforts to obtain data needed to fill all data gaps and to reevaluate both this Coordination Agreement and the GSPs as necessary once data gaps have been filled.

10. ADOPTION AND USE OF THE COORDINATION AGREEMENT

10.1. COOPERATIVE IMPLEMENTATION OF GSPS. (§357.4(C))

In accordance with the Title 23, California Code of Regulations Section 357.4(c), the Parties hereby explain how the Plans implemented together, satisfy the requirements of the Act and are in substantial compliance with SGMA and SGMA regulations. Each Party will ensure their GSP complies with the statutory requirements of SGMA. The Parties to this Agreement intend that their individual GSPs will be implemented together in order to satisfy the requirements of SGMA. In a coordinated manner, the collective GSPs have satisfied the requirements of Sections 10727.2 and 10727.4 of the California Water Code by providing a description of the physical setting and characteristics of the separate aquifer systems within the Basin, the methodologies and assumptions specified in Water Code Section 10727.6, both as referenced in Section 2.1 herein. They have further developed a common sustainability goal and description of the Subbasin's undesirable results, both as set forth in Appendix 6. The Parties' minimum thresholds, measurable objectives, and monitoring protocols together provide a description of how the Subbasin will be sustainably managed during the GSP implementation phase. Furthermore, the Parties have developed a coordinated water budget and monitoring network, in addition to their individual GSPs, which, when implemented together, suffice to provide the mandated data and fulfill the requirements set out in SGMA and its accompanying regulations.

The Parties have developed and calibrated a Subbasin numerical groundwater and surface water model that has been applied to simulate the operation of their combined projects and management actions and thereby demonstrate how their GSPs conform to measurable objectives and achieve sustainable yield by 2040. A description of the relevant model simulations and results are as described in Appendix 7 to this Agreement. Through the five-year GSP assessment process and continued dialogue with neighboring subbasins as to their role in influencing the changes in storage within the Kaweah Subbasin, residual storage reductions remaining from the modeling scenarios analyzed thus far will be addressed with implementation of additional projects and/or accelerated implementation of management actions designed to reduce groundwater extractions.

10.2. GSP AND COORDINATION AGREEMENT SUBMISSION (§357.4(D).)

In accordance with the Title 23, California Code of Regulations Section 357.4(d), the Parties hereby agree to the following process for submitting all Plans, Plan amendments, supporting information, all monitoring data and other pertinent information, along with annual reports and periodic evaluations. The Parties agree to submit their respective GSPs to DWR through the Management Team Committee and Plan Manager in accordance with SGMA and its accompanying regulations. The Plan Manager will be responsible for submittal of GSPs to DWR in accordance with California Water Code Section 10733.4, subdivision (b)(1)-(c). However, prior to this submittal, the Management Team Committee shall vote to approve submittal. The approval shall consist of the review of the multiple GSPs in the Subbasin by the Management Team Committee for coordination and consistency. If the Management Team Committee identifies incomplete coordination or inconsistencies that amount to a concern regarding compliance with sections of SGMA, the Management Team Committee will work with the Parties to resolve these issues prior to submittal. Parties intend that this Agreement suffice to fulfill the requirements of providing an explanation of how the GSPs implemented together satisfy Water Code Sections 10727.2, 10727.4 and 10727.6 for the entire Basin.

11. KAWEAH SUBBASIN ORGANIZATIONAL STRUCTURE AND OTHER MISCELLANEOUS PROVISIONS

11.1. GOVERNANCE. (§357.4(b)(2))

In accordance with the Title 23, California Code of Regulations Section 357.4(b)(2), the Parties hereby agree on the following responsibilities for meeting the terms of the agreement and the procedures for resolving conflicts.

11.1.1. Management Team Committee.

The Parties intend for the Management Team Committee as previously established in the Parties' MOU agreed upon until the effective date of this Coordination

Agreement. The Management Team Committee will consist of three (3) representatives appointed by each Party to this Agreement.

- Compensation. Each Management Team Committee member's compensation for service on the Management Team Committee, if any, is the responsibility of the appointing Party.

- Term. Each Management Team Committee member shall serve at the pleasure of the appointing Party and may be removed from the Management Team Committee by the appointing Party at any time.

- Meetings. The Management Team Committee will meet at least monthly, or more frequently as needed, to carry out the activities described in this Agreement. The Management Team Committee will prepare and maintain minutes of its meetings.

11.1.2. Quorum for Management Team Committee Meetings.

In order to take action at a meeting of the Management Team Committee, a majority of the Management Team Committee members must be present at the meeting, with at least one representative from each Party.

11.1.3. Compliance with Open Meetings Laws.

The Management Team Committee shall meet on a regular basis for the purposes described in this Agreement. The Management Team Committee shall comply with the Ralph M. Brown Act (Government Code Section 54950 et seq.) as applicable and shall post agendas as required.

11.1.4. Management Team Committee Officers.

The Management Team Committee may, from time to time, select from amongst its members a Chairman, who shall act as presiding officer, a Vice Chairman, to serve in the absence of the Chairman, and any other officers as determined by the Management Team Committee. There also shall be selected a Secretary, who may, but not need be, a member of the Management Team Committee. All officers shall remain in office for two years, unless removed pursuant to a majority vote of the Management Team Committee.

11.1.5. Management Team Committee Meeting Voting Provisions.

Each GSA will be entitled to one (1) vote on the Management Team Committee. The process for declaring such vote must be determined by each respective GSA. Recommendations from the Management Team Committee shall be made to the Parties' respective GSAs only upon the unanimous vote of the Management Team Committee. Should unanimity not be reached, the votes shall be reported to each GSA's Board of Directors for further direction.

11.1.6. Adoption of Management Team Committee Recommendations.

Recommendations approved by unanimous consent of the Management Team Committee shall be reported to each GSA Board, with the process and manner for GSA approval left to the discretion of each GSA. If a GSA fails to approve a recommendation of the Management Team Committee, the Management Team Committee shall reconvene and endeavor to develop an alternative recommendation that may resolve any issues which resulted in the failure to approve. If the Management Team Committee is unable to develop an alternative recommendation, or if a GSA fails to approve the Management Committee's alternative recommendation, the Parties shall evaluate whether to enter into the dispute resolution process outlined in Section 11.3 of this Agreement.

11.1.7. Failure of Management Team Committee to Reach Consensus.

The Parties acknowledge that at all times consensus may not be reached amongst the Management Team Committee. All matters in which consensus of the Management Team Committee cannot be reached shall be reported to the GSA Boards of Directors. The Management Team Committee shall reconvene after the unresolved issue has been reported to the GSA Boards of Directors. If the Management Team Committee is still unable to reach consensus, the Parties shall evaluate whether to enter into the dispute resolution process outlined in Section 11.3 of this Agreement.

11.2. RESPONSIBILITIES OF THE PARTIES.

The Parties to this Agreement agree to work collaboratively to comply with SGMA and this Agreement. Each Party to this Agreement is a GSA and acknowledges it is bound by the terms of the Agreement. This Agreement does not otherwise affect each Party's responsibility to implement the terms of their respective GSP. Rather, this Agreement is the mechanism through which the Parties will coordinate portions of the multiple GSPs to ensure such GSP coordination complies with SGMA.

11.3. DISPUTE RESOLUTION.

Any GSA may choose to initiate the following dispute resolution process by serving written notice to the remaining GSAs of the following: (1) identification of the conflict; (2) description of how the conflict may negatively impact the sustainability of the Kaweah Subbasin; and (3) a proposal for one or more resolutions. The Parties agree to designate representatives to meet and confer with each other within thirty (30) days of the date such notice is given and said representatives shall then meet within a reasonable time to address all issues identified in the notice. Should the representatives be unable to reach a resolution within ninety (90) days of the written notice, the Parties shall enter informal mediation in front of a mutually agreeable mediator.

11.4. MODIFICATION.

The Parties hereby agree that this Agreement shall be reviewed as part of each five-year assessment and may be supplemented, amended, or modified only by the mutual agreement of all the Parties. No supplement, amendment, or modification of this Agreement shall be binding unless it is in writing and signed by all Parties.

11.5. WITHDRAWAL, TERMINATION, ADDING PARTIES.

11.5.1. A Party may withdraw from this Agreement without causing or requiring termination of this Agreement effective upon six months' notice to the Management Team Committee. Any Party who withdraws shall remain obligated to pay its share of all debts, liabilities, and obligations the Party incurred, accrued, or approved pursuant to this Agreement prior to the effective date of such withdrawal.

11.5.2. A new Party may be added to this Agreement if such entity is an exclusive GSA that has developed and will implement its own separate and complete GSP.

11.5.3. This Agreement may be rescinded by unanimous written consent of all the Parties. Nothing in this Agreement shall prevent the Parties from entering into another coordination agreement.

11.6. MISCELLANEOUS.

11.6.1. <u>Severability.</u>

If any provision of this Agreement is for any reason held to be invalid, unenforceable, or contrary to any public policy, law, statute and/or ordinance, then the remainder of this Agreement shall not be affected thereby and shall remain valid and fully enforceable.

11.6.2. <u>Third Party Beneficiaries.</u>

This Agreement shall not create any right of interest in any non-Party or in any member of the public as a third-party beneficiary.

11.6.3. <u>Construction and Interpretation.</u>

This Agreement was finalized through negotiations of the Parties. Each Party has had a full and fair opportunity to review and revise the terms herein. As a result, the normal rules of construction that any ambiguities are to be interpreted against the drafting Party shall not apply in the construction or interpretation of this Agreement.

11.6.4. Good Faith.

Each Party shall use its best efforts and work in good faith for the expeditious completion of the purposes and goals of this Agreement and the satisfactory performance of its terms.

11.6.5. Execution.

This Agreement may be executed in counterparts and the signed counterparts shall constitute a single instrument. The signatories to this Agreement represent that they have the authority to sign this Agreement and to bind the Party for whom they are signing.

11.6.6. Notices.

All notices, requests, demands or other communications required or permitted under this Agreement shall be in writing unless provided otherwise in this Agreement, and shall be deemed to have been duly given and received on: (i) the date of service if personally served or served by electronic mail or facsimile transmission on the Party to whom notice is to be given at the address(es) below; (ii) on the first day after mailing, if mailed by Federal Express, U.S. Express Mail, or other similar overnight courier service; or (iii) on the third day after mailing if mailed to the Party to whom notice is to be given by first class mail, registered certified to the official addresses for each Party according to DWR.

11.6.7. No Admission or Waiver

Nothing in this Coordination Agreement is intended to modify the water rights of any Party or of any Person (as that term is defined under Section 19 of the Water Code). Nothing in this Coordination Agreement shall be construed as an admission by any Party regarding any subject matter of this Coordination Agreement, including without limitation any water right or priority of any water right that is claimed by a Party or any Person. Nor shall this Coordination Agreement in any way be construed to represent an admission by a Party with respect to the subject or sufficiency of another Party's claim to any water or water right or priority or defenses thereto, or to establish a standard for the purposes of the determining the respective liability of any Party or Person, except to the extent otherwise specified by law. Nothing in this Coordination Agreement shall be construed as a waiver by any Party of its election to at any time assert a legal claim or argument as to water, water right or any subject matter of this Coordination Agreement or defenses thereto. The Parties hereby agree that this Coordination Agreement, to the fullest extent permitted by law, preserves the water rights of each of the Parties as they may exist as of the effective date of this Coordination Agreement or at any time thereafter. Any dispute or claim arising out of or in any way related to a water right alleged by a Party may be separately resolved before the appropriate judicial, administrative or enforcement body with proper jurisdiction and is specifically excluded from the dispute resolution procedures set forth under this Coordination Agreement.

IN WITNESS WHEREOF, the Parties have entered into this Agreement as of the date executed below:

GREATER KAWEAH GROUNDWATER SUSTANABILITY AGENCY

By: ______________________

Date: 7-22-2022

MID KAWEAH GROUNDWATER SUSTAINABILITY AGENCY

By: ______________________

Date: 7/21/22

EAST KAWEAH GROUNDWATER SUSTAINABILITY AGENCY

By: ______________________

Date: 7/25/22

Appendices

Coordination Agreement

Kaweah Subbasin

Appendix 1
Basin Setting Report

Included separately due to file size

Appendix 2
Monitoring Network Summary

Appendix 2

Monitoring Network Summary

This appendix provides a summary of the monitoring networks for the management of groundwater resources within the Kaweah Subbasin in Tulare and Kings Counties. Groundwater management will be conducted by the Eastern Kaweah Groundwater Sustainability Agency (GSA), Greater Kaweah GSA, and the Mid-Kaweah GSA according to their respective groundwater sustainability plans (GSPs). Specific details of the monitoring networks can be found in the respective GSPs. This appendix will be revised periodically to reflect the expansion of the networks as data gaps are filled by ongoing management efforts.

The monitoring networks are focused on three of the six sustainability indicators, including Groundwater Levels, Water Quality, and Subsidence. Groundwater Storage will be addressed by Groundwater Levels by proxy. Seawater Intrusion is not applicable to the Kaweah Subbasin since the Pacific Ocean is located more than 80 miles to the west, beyond the Coast Mountains. Interconnected Surface Water has not been identified as applicable at this time in Mid-Kaweah and will be addressed by proxy via Groundwater Levels in the Eastern Kaweah GSA.

Groundwater Levels

Figure A-2-1 illustrates the location of monitoring wells that will be used for semi-annual measurements of groundwater levels and estimates of groundwater storage. Selected wells may be monitoring monthly within the MKGSA by the Cities of Tulare and Visalia. The three GSAs will utilize a total of 126 wells, as summarized below.

Purpose / GSA:	Greater Kaweah	Mid-Kaweah	Eastern Kaweah
Groundwater Levels	40	43	43

Groundwater Quality

Figure A-2-2 illustrates the location of wells that will be used for monitoring groundwater quality. The three GSAs will utilize a total of 285 wells, as summarized below. Most of these wells will be public supply wells which are sampled according to the requirements of the California Division of Drinking Water. Primary constituents of concern (COCs) as listed below.

Metal	Anion	Organic Compound
Arsenic	Nitrate	DBCP (1,2-dibromo-3-chloropropane)
Chromium-VI	Perchlorate	TCP (1,2,3-trichloropropane)
Sodium	Chloride	PCE (perchloroethylene/tetrachloroethylene)
Total Dissolved Solids (TDS)		

The data management system will accumulate all available data from the various sources of data but will focus on the primary COCs and their respective measurable objective and minimum threshold. Data sources include the Groundwater Ambient Monitoring and Assessment Program (GAMMA), Irrigated Lands Regulatory Program (ILRP), Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS), and other programs as the data become available.

Purpose / GSA:	Greater Kaweah	Mid-Kaweah	Eastern Kaweah
Groundwater Quality	60	110	70

Subsidence

Figure A-2-3 illustrates the location of stations that will be used for monitoring subsidence. The three GSAs will utilize a total of 32 stations, as summarized below.

Purpose / GSA:	Greater Kaweah	Mid-Kaweah	Eastern Kaweah
Subsidence	14	8	10

Figure A-2-1. Location Map for Monitoring Wells for Groundwater Levels

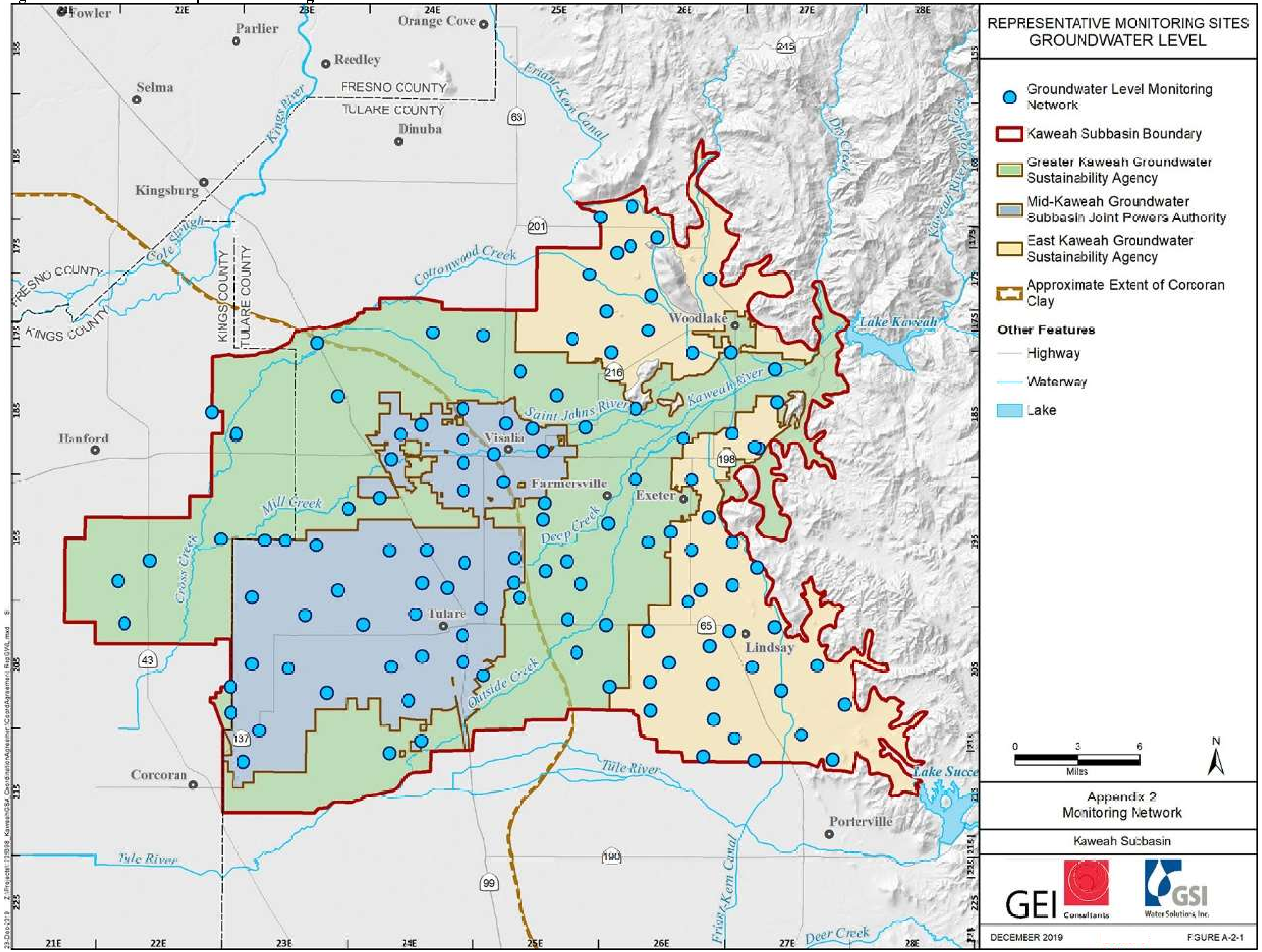


Figure A-2-2. Location Map for Supply Wells for Groundwater Quality Monitoring

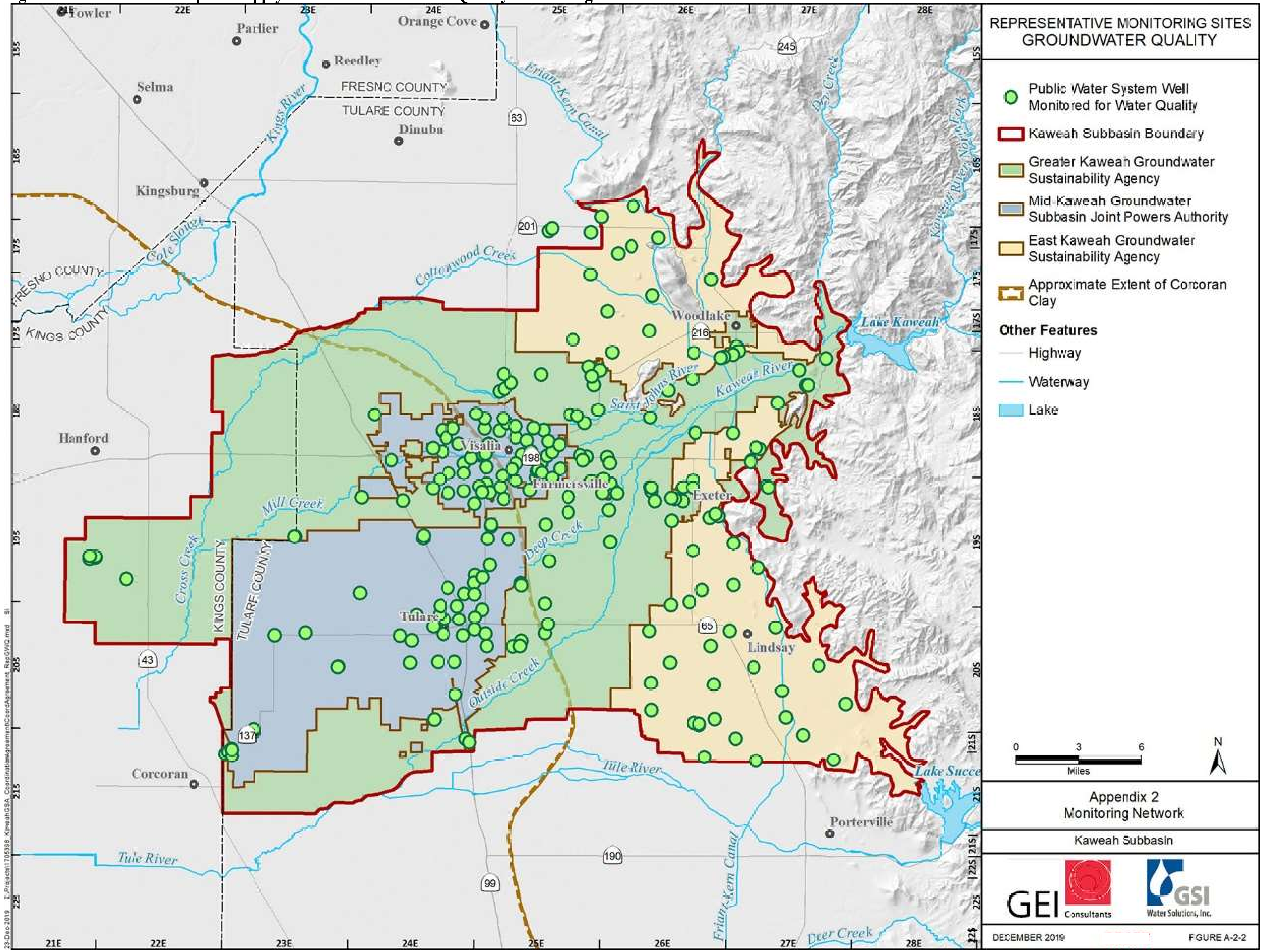
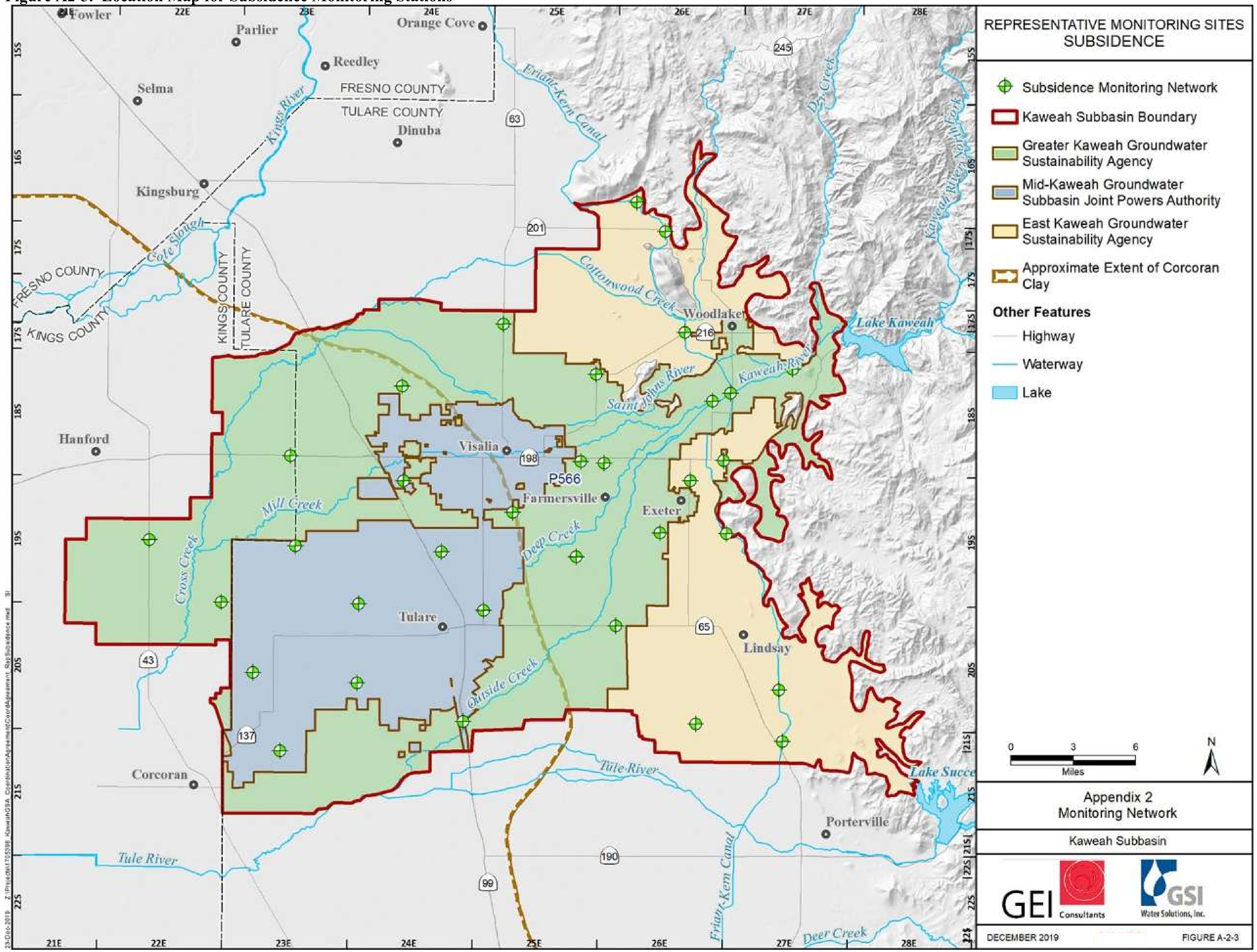


Figure A2-3. Location Map for Subsidence Monitoring Stations



Appendix 3

Water Accounting Framework Summary

Water Accounting Framework

Appendix 3 to Kaweah Subbasin Coordination Agreement

For purposes of creating a water budget pursuant to 23 Cal. Code Regs. §354.18, the GSAs in the Kaweah Subbasin have agreed that the Sustainable Yield for the Subbasin shall be divided amongst the GSAs for purposes of development of their GSPs as described in the Kaweah Subbasin water budget. The water budget is not an allocation of final determination of any water rights. This understanding is consistent with § 10720.5(b) of SGMA, which provides that nothing in SGMA or in a plan adopted under SGMA determines or alters surface or groundwater rights under common law or any provision of law that determines or grants surface water rights.

The Subbasin GSAs have discussed water budgets and have developed a means to account for various components of the water budget. These discussions accounting also included recognition of water storage and conveyance infrastructure within the Subbasin as owned/operated by various water management entities within each GSA.

These discussions culminated in an agreed-to methodology to assign groundwater inflow components to each GSA consistent with categories that recognize a native, foreign and salvaged portion of all such components. In general, this methodology defines the native portion of groundwater inflows to consist of those inflows which all well owners have access to on a pro-rata basis; the foreign portion to consist of all imported water entering the Subbasin from non-local sources under contract by local agencies or by purchase/exchange arrangements; and the salvaged portion to consist of all local surface and groundwater supplies stored, treated and otherwise managed by an appropriator/owner of the supply and associated water infrastructure systems (e.g. storm water disposal systems and waste water treatment plants).

The methodology and apportionment of groundwater inflow components is as shown in Table 3.1:

Table 3.1

Components of Groundwater Inflow

Native

- Percolation from rainfall
- Streambed percolation (natural channels) from Kaweah River watershed sources
- Agricultural land irrigation returns from pumped groundwater
- Mountain front recharge

Foreign

- Streambed percolation from imported sources
- Basin recharge from imported sources
- Ditch percolation from imported sources
- Agricultural land irrigation returns from imported sources

Salvaged

- Ditch percolation from previously appropriated Kaweah River sources
- Additional ditch/field recharge from over-irrigation
- Captured storm water returns
- Wastewater treatment plant returns
- Basin percolation from previously stored Kaweah River sources
- Agricultural land irrigation returns from Kaweah River watershed sources

*Except for mountain front recharge, sub-surface inflows in and out of the Subbasin are excluded from this accounting methodology and no ownership claims are asserted nor disavowed per this methodology.

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Applying the accounting methodology in Table 6.1 to each GSA and their member entities that hold appropriative and contract water rights and/or salvaged water infrastructure systems results in the following quantification to each GSA, shown in Table 3.2:

Table 3.2

(values in acre-feet)

	East	Greater	Mid	Total
Native Water				
	East	Greater	Mid	Total
Perc of Precip (Ag and 'Native' non-Ag land)	23,666	44,213	20,974	**88,854**
Streambed Perc from Kaweah River Sources	16,767	31,324	14,860	**62,952**
Irrigation Ret. Flow from Pumped GW	41,484	77,501	36,766	**155,752**
Mountain Front Recharge	14,976	27,978	13,273	**56,227**
Total Native	**96,894**	**181,017**	**85,874**	**363,784**
GSA % of Total Native	**27%**	**50%**	**24%**	
Foreign Water				
	East	Greater	Mid	Total
Streambed Perc from Imported Sources	0	11,730	2,523	**14,253**
Ditch Perc from Imported Sources	0	1,204	21,745	**22,949**
Basin Perc from Imported Sources	0	1,050	14,305	**15,355**
Irrigation Ret. Flow from Imported Sources	12,073	1,241	7,140	**20,453**
Total Foreign	**12,073**	**15,225**	**45,713**	**73,010**
GSA % of Total Foreign	**17%**	**21%**	**63%**	
Salvaged Water				
	East	Greater	Mid	Total
Ditch Perc from Kaw River Sources	8,835	49,771	34,880	**93,486**
Additional Recharge	226	6,892	5,697	**12,815**
Stormwater Return Flows	508	2,370	8,491	**11,368**
WWTP Return Flows	1,470	3,129	13,878	**18,477**
Basin Perc from Kaweah River Sources	0	16,005	23,479	**39,484**
Irrig. Ret. Flow from Kaweah River Sources	4,555	31,039	11,981	**47,574**
Total Salvaged	**15,593**	**109,205**	**98,406**	**223,205**
GSA % of Total Salvaged	**7%**	**49%**	**44%**	
	East	Greater	Mid	Total(*)
Grand Total	**124,560**	**305,447**	**229,992**	**659,999**
GSA % of Total	**19%**	**46%**	**35%**	

(*) Excludes net sub-surface inflow of 60 taf/yr

Note: All data is derived from the Basin Setting and is based on water budget for the period Water Year 1997 to 2017 for the Kaweah Subbasin.

As noted in Table 3.2, net sub-surface inflow is omitted from this quantification. Sub-surface inflows and outflows are discussed and quantified in the Basin Setting report (Appendix 1) and are embodied in scenarios of future groundwater conditions as simulated by application of the Subbasin computer model. As discussed in that report, the Subbasin's safe yield is estimated to be about 720,000 AF, which amount includes net sub-surface inflow. As defined in SGMA however, the Subbasin's sustainable yield may be additionally impacted when considering undesirable results for other sustainability indicators. The Parties therefore have preliminarily determined that the sustainable yield may be something less and have agreed that the total groundwater inflow of 660,000 AF identified in Table 3.2 will constitute the sustainable yield, which amount does not take into consideration net sub-surface inflow from adjacent subbasins. The estimated sustainable yield will continue to be revised pursuant to the monitoring of sustainability indicators and avoidance of undesirable results.

At this stage, inter-basin discussions concerning water budgets and associated credits for such sub-surface flows are not to the point of delineating Subbasin assignments thereof. The quantification as described serves primarily to shape future discussions among the Kaweah Subbasin GSAs concerning mutual responsibilities in achieving sustainability by 2040.

As additional data becomes available and water budget components are refined, the Subbasin water budget and estimates of sustainable yield will be periodically reevaluated, no less frequently than two years. Likewise, the individual GSA water balances will also be reviewed as this reevaluation occurs at the Subbasin level.

Appendix 4
DMS Summary

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Rancho Cordova, CA 95670
916.631.4500 fax 916.631.4501

Appendix 4 -**DMS Summary**

Memo

To: Kaweah Subbasin GSAs
Mike Hagman, East Kaweah GSA
Eric Osterling, Greater Kaweah GSA
Paul Hendrix, Mid-Kaweah GSA

From: Chris Petersen and Maria Pascoal, GEI Consultants

Date: [Status]

Re: Draft Specifications for the Kaweah Subbasin Data Management System

---

The Sustainable Groundwater Management Act (SGMA) regulations, established by the California Department of Water Resources (DWR), require that a Groundwater Sustainability Plan (GSP) must have a Data Management System (DMS) capable of securely storing and displaying information relevant to the development and implementation of the GSP. The Kaweah Subbasin will be managed by three Groundwater Sustainability Agencies (GSAs) under three GSPs. To effectively and cost-efficiently share data, the GSAs will use one DMS to store the Subbasin's SGMA data.

The DMS for the Kaweah Subbasin is currently being developed by GEI Consultants, Inc. (GEI) with data and analytical support from GSI Water Solutions (GSI). The purpose of this memorandum is to describe the specifications of the DMS. These specifications were developed based on the DMS development meeting held with the three GSAs in April 2018 and supported by Task Order KSB-05.2018 Amendment 2, Task 1 – Data Management System. This memorandum includes the following sections:

1. SGMA DMS Requirements
2. Data Structure
3. Data Contents
4. Web Interface
5. DMS Hosting
6. Summary

SGMA DMS Requirements

The Kaweah Subbasin DMS will be designed to meet the system and data requirements of SGMA.

1.1. System Requirements

The GSP Regulations (California Code of Regulations, Title 23, Division 2, Chapter 1.5, Subchapter 2) give broad requirements on data management, stating that a GSP must adhere to the following guidelines for a DMS:

> ***§ 352.6. Data Management System***
>
> *Each Agency shall develop and maintain a data management system that is capable of storing and reporting information relevant to the development or implementation of the [Groundwater Sustainability] Plan and monitoring of the basin.*
>
> *Note: Authority cited: Section 10733.2, Water Code.*
> *Reference: Sections 10727.2, 10728, 10728.2, and 10733.2, Water Code.*
>
> ***§ 352.4. Data and Reporting Standards***
>
> *(c) The following standards apply to wells:*
>
> *(3) Well information used to develop the basin setting shall be maintained in the Agency's data management system.*
>
> *Note: Authority cited: Section 10733.2, Water Code.*
> *Reference: Sections 10727.2, 10727.6, and 10733.2, Water Code.*
>
> ***§ 354.40. Reporting Monitoring Data to the Department***
>
> *Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.*
>
> *Note: Authority cited: Section 10733.2, Water Code.*
> *Reference: Sections 10728, 10728.2, 10733.2, and 10733.8, Water Code.*

1.2. Data Requirements

SGMA defines sustainable groundwater management as "the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results."[1] Furthermore, SGMA outlines six undesirable results as follows:[2]

> *One or more of the following effects caused by groundwater conditions occurring throughout the basin:*
>
> *(1) Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic*

---

[1] §10721(v)
[2] §10721(x)

lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.

(2) Significant and unreasonable reduction of groundwater storage.

(3) Significant and unreasonable seawater intrusion.

(4) Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

(5) Significant and unreasonable land subsidence that substantially interferes with surface land uses.

(6) Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

The presence or absence of the six undesirable results in a groundwater basin is determined by examining the sustainability indicator data for each. The Kaweah Subbasin DMS will store data relevant to each sustainability indicator as appropriate. There are multiple metrics by which the sustainability indicators may be observed. These metrics, as defined in the GSP Regulations and described by DWR in the Sustainable Management Criteria Best Management Practice (BMP) document,[3] are shown in **Figure 1**.

Figure 1. DWR's Sustainability Indicator Metrics

Sustainability Indicators	Lowering GW Levels	Reduction of Storage	Seawater Intrusion	Degraded Quality	Land Subsidence	Surface Water Depletion
Metric(s) Defined in GSP Regulations	• Groundwater Elevation	• Total Volume	• Chloride concentration isocontour	• Migration of Plumes • Number of supply wells • Volume • Location of isocontour	• Rate and Extent of Land Subsidence	• Volume or rate of surface water depletion

[3] https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Sustainable_Management_Criteria_2017-11-06.pdf.

The Kaweah Subbasin DMS is designed to store data for each of the six sustainability indicators. Each sustainability indicator may track one or more types of data, as shown in **Table 1**.

Table 1. DMS Data Types to Monitor the SGMA Sustainability Indicators

Sustainability Indicator	Tracking Data							
					Water Quality			
	Water Level	Extensometer	GPS	InSAR	Chloride	±10 constituents	Stream stages	Well* and/or Site Data
Subsidence	✓	✓	✓	✓				✓
Water levels	✓							✓
Groundwater storage	✓							✓
Seawater intrusion	Not applicable (per GSP development)							
Surface water/ groundwater interaction	✓						✓	✓
Water quality	✓				✓	✓		✓

*May include aquifer, construction, lithology, and/or screen data

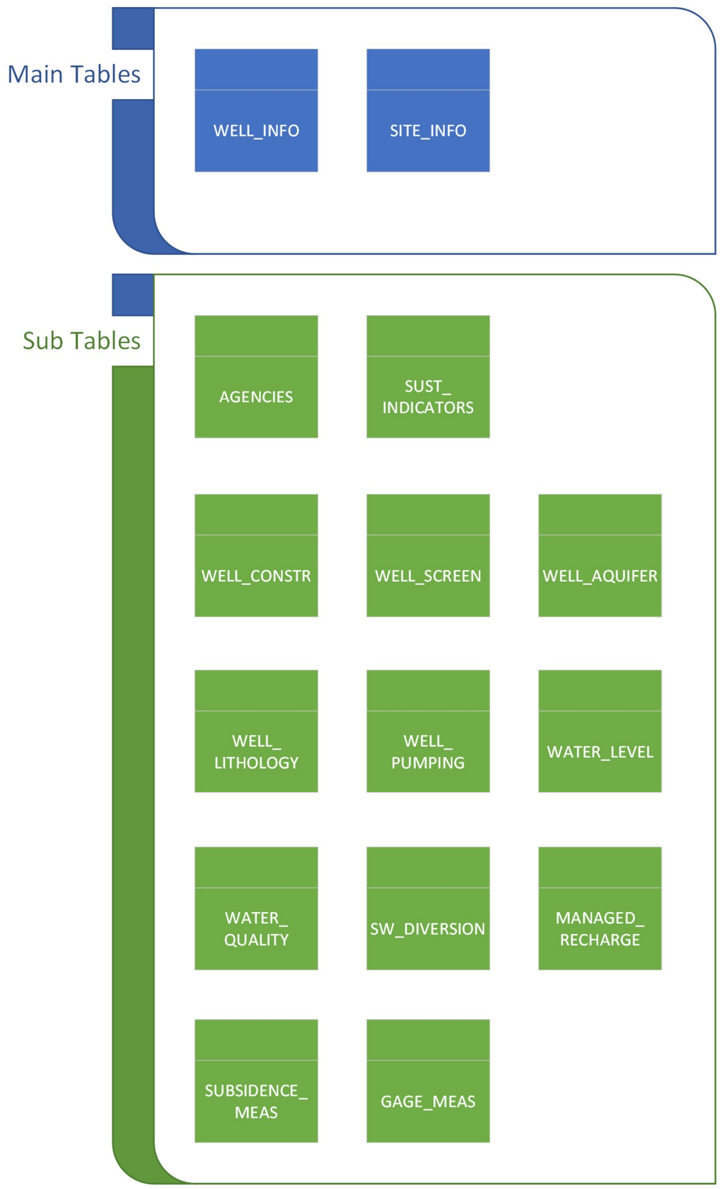
The Kaweah Subbasin DMS will accept the types of data shown in the columns of **Table 1**. However, the DMS will not necessarily be populated with historical data for each type. Data that was relied upon for 2020 GSP development is what will be uploaded in the DMS.

Data Structure

The DMS will consist of a database plus an online web viewer. Data stored in the DMS is separated by categories into tables. The tables contain columns and rows of data. Each field holds a specific type of data, such as a number, text, or date. The primary DMS data tables are shown as **Figure 2**. The figure is color-coordinated to show the relationship between tables:

- **Blue Tables** – Main tables that include point data with a unique identification and unique point location to be added to the database (e.g., Well_Info and Site_Info)
- **Green Tables** – Sub tables related to the main table that hold additional details about the well or site (e.g., correlation of a well point with water level or water quality)

Figure 2. Kaweah Subbasin DMS Tables – Main and Sub



A brief description of each main and sub table is provided in **Table 2**. There are lookup tables within each of the main and sub tables, but the lookup tables are very detailed and not outlined here. The lookup tables can be found in the upload templates described in the next section of this document.

Table 2. DMS Table Descriptions

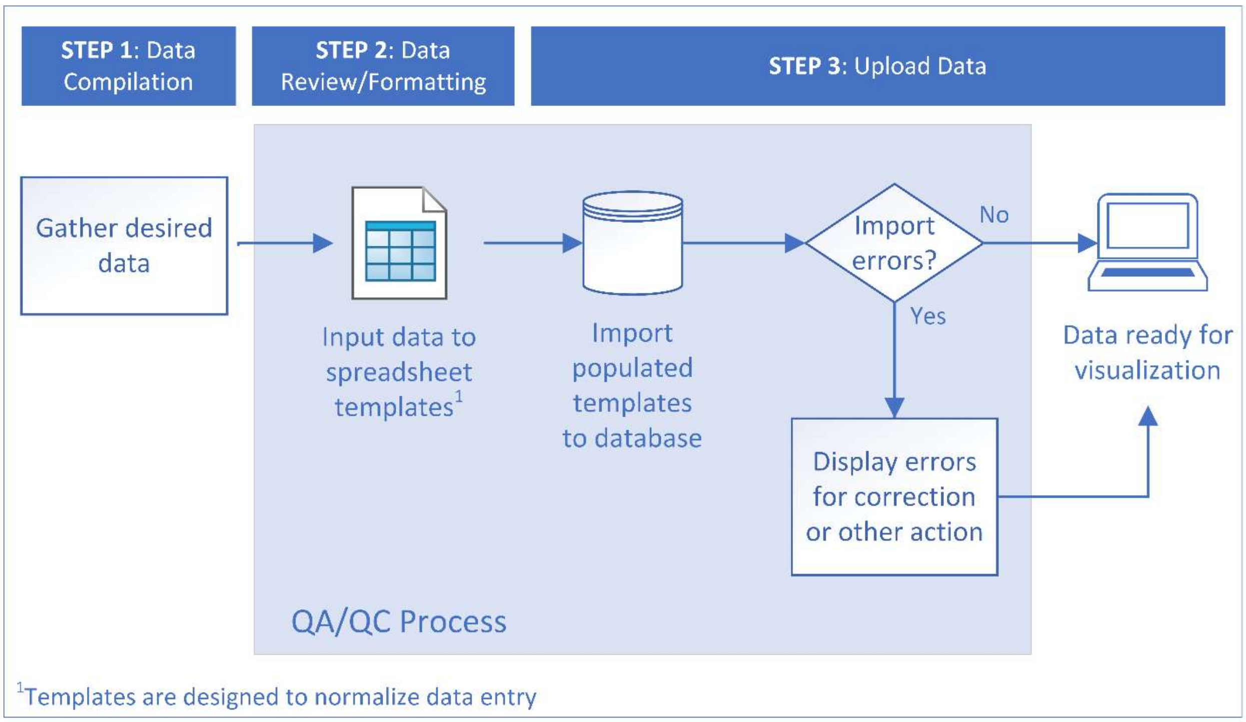
Table	Description
Main Tables	
Site Info	Information about type of station (well, recharge site, diversion, gage, extensometer, GSP) and geographic location
Well Info	General information about well, including identifiers used by various agencies
Sub Tables	
Agencies	Agency associated with the well and/or site or the collection of data at a well or site
Sustainability Indicators	Minimum Thresholds and Measurable Objectives set for monitoring network sites tracking Sustainable Management Criteria for SGMA compliance
Well Construction	Well construction information including depth, diameter, etc.
Well Construction Screen	Supplements 'Well Construction' with well screen information (one well can have many screens)
Well Geologic Aquifer	Information about the aquifer parameters of the well such as pumping test information, confinement, and transmissivity
Well Geologic Lithology	Lithologic information at a well site (each well may have many lithologies at different depths)
Water Level	Water level measurements for wells
Well Pumping	Pumping measurements for wells, annual or monthly
Managed Recharge	Recharge measurements for a recharge site, annual or monthly
SW Diversion	Diversion volume measurements for a diversion site, annual or monthly
Water Quality	Water quality data for wells or any other type of site
Subsidence Measurement	Elevation measurements from stations tracking land subsidence
Gage Measurement	Stage or discharge water level measurements from stream gages

Data Contents

Historical data will be populated into the DMS as needed to support the 2020 GSPs. State and Federal data available via online public databases will be brought directly from the data source to the DMS by the DMS development team.

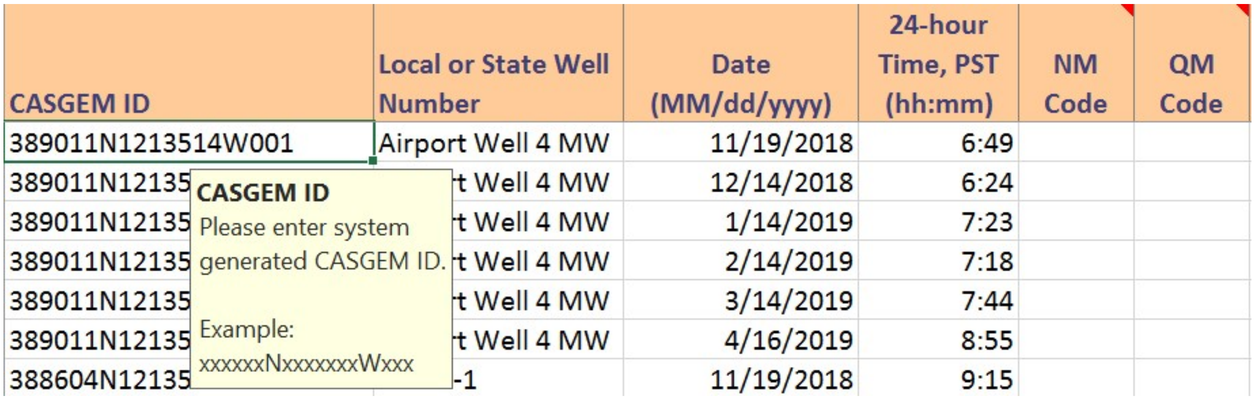
Local Kaweah Subbasin data used to support GSP development will be collected by GEI and put into spreadsheet templates designed to normalize data entry. The templates will include a set of rules restricting formatting, alphanumeric properties, and other filters. This template process is shown as **Figure 3**.

Figure 3. Template Import Process for Local Data

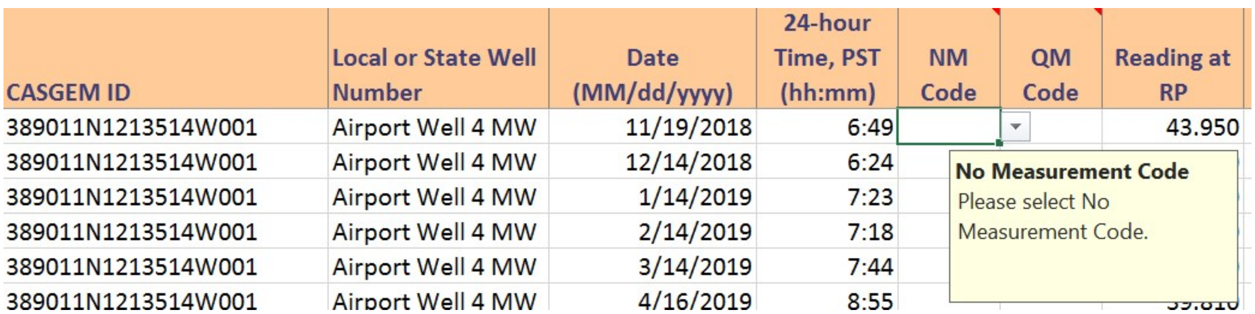


The templates include validation parameters similar to CASGEM templates. CASGEM templates are shown in **Figure 4** as an example. The templates will have pop-up windows to describe what should be filled in for each column. If a specific filter must be applied, only values that meet the criteria will appear in a drop-down list. GEI will upload data to the DMS using these templates.

Figure 4. CASGEM Template Examples



CASGEM ID	Local or State Well Number	Date (MM/dd/yyyy)	24-hour Time, PST (hh:mm)	NM Code	QM Code
389011N1213514W001	Airport Well 4 MW	11/19/2018	6:49		
389011N12135	t Well 4 MW	12/14/2018	6:24		
389011N12135	t Well 4 MW	1/14/2019	7:23		
389011N12135	t Well 4 MW	2/14/2019	7:18		
389011N12135	t Well 4 MW	3/14/2019	7:44		
389011N12135	t Well 4 MW	4/16/2019	8:55		
388604N12135	-1	11/19/2018	9:15		



CASGEM ID	Local or State Well Number	Date (MM/dd/yyyy)	24-hour Time, PST (hh:mm)	NM Code	QM Code	Reading at RP
389011N1213514W001	Airport Well 4 MW	11/19/2018	6:49			43.950
389011N1213514W001	Airport Well 4 MW	12/14/2018	6:24			
389011N1213514W001	Airport Well 4 MW	1/14/2019	7:23			
389011N1213514W001	Airport Well 4 MW	2/14/2019	7:18			
389011N1213514W001	Airport Well 4 MW	3/14/2019	7:44			
389011N1213514W001	Airport Well 4 MW	4/16/2019	8:55			[illegible]

All the Main and Sub Tables listed in **Table 2** will have a template. The compiled data will be reviewed by GEI before it is migrated into the database. The data review process will be focused and limited in scope. It will include the following checks:

- Identifying outliers that may have been introduced during the original data entry process
- Removing or flagging questionable data

Once the data has been compiled, input to the templates, and reviewed, it will be uploaded to the DMS and displayed on a visualization tool (GIS map) interface.

Moving forward, the templates will be used by the Kaweah Subbasin GSAs to prepare future data for DMS input.

Web Interface

The DMS begins with a database, stored locally or online, and is accompanied by a viewer that allows administrators to see the data in a user-friendly interface. The proposed Kaweah Subbasin DMS is a database built in Oracle plus a web application designed in JAVA.

The web application will display well and other instrument (e.g., extensometer) locations, identifying which wells or instruments are part of a representative monitoring network for the SGMA sustainability indicators.

- Clicking on a well site will display available historical water level or water quality data on a hydrograph
- Clicking on other monitoring points (e.g., extensometers) will display available historical data in tabular and chart format

The map displaying the DMS data will include additional geographic features such as GSA, local agency, and Bulletin 118 basin boundaries to provide context and facilitate interaction with the data.

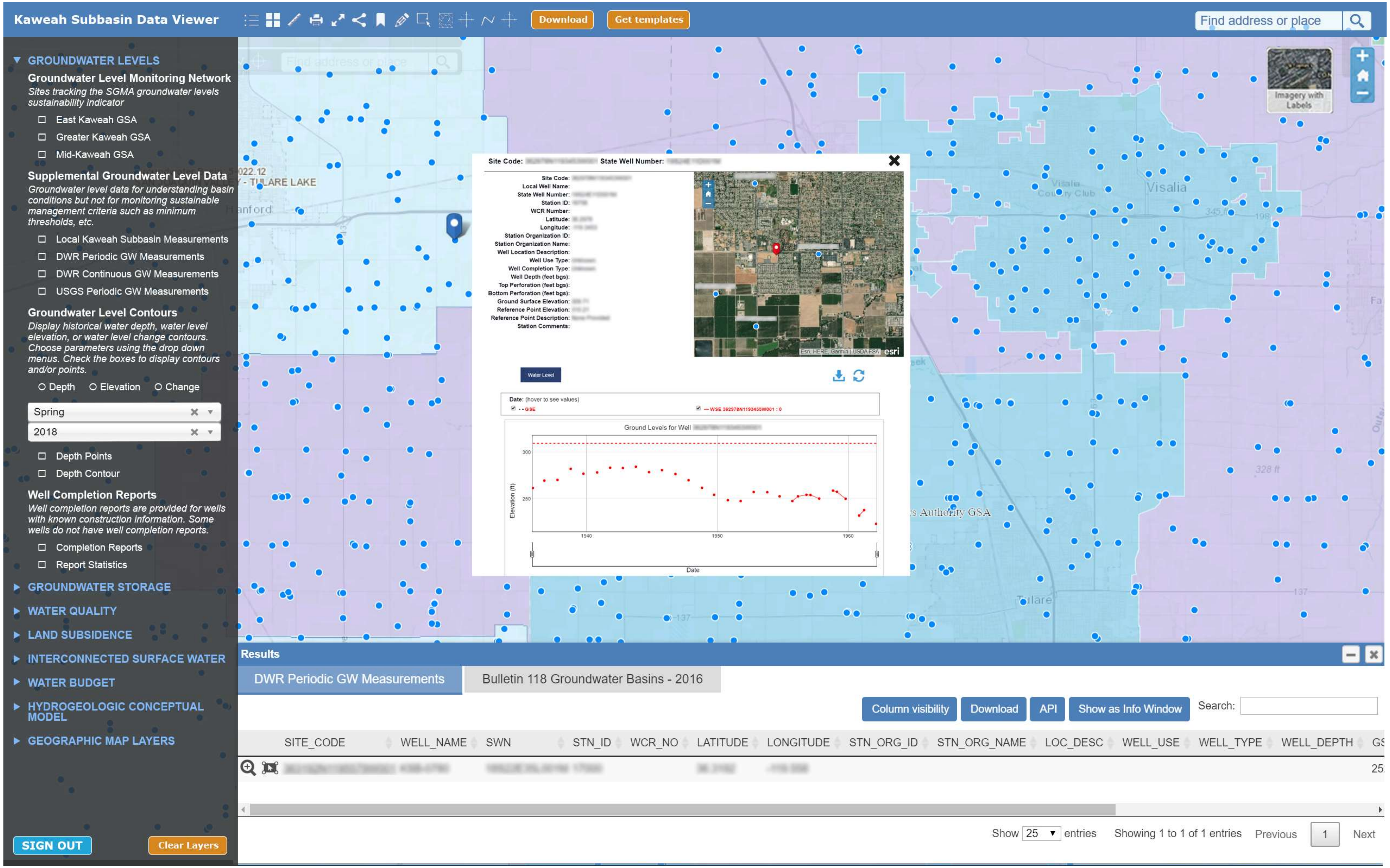
Representative monitoring network data will be made available for export to a spreadsheet format for analytical and reporting purposes. GSP Regulations Article 7 §356.2 outlines specific components to be reported annually (paraphrased):

- *General information including executive summary and location map (narrative)*
- Groundwater elevation contour maps (sourced by DWR) and hydrographs
- Groundwater extraction
- Surface water supply used or available for use, for groundwater recharge or in-lieu use
- *Total water use by water use sector and source (calculated)*
- Change in groundwater storage displayed in map and graph formats
- *Description of progress towards implementing the GSP (narrative)*

The items listed above are needed for each annual report to DWR. The Kaweah Subbasin DMS is designed to store all these items except for those shown in *italics*, which are either narratives or calculations that are done outside of the DMS.

See **Figure 5** for an example design for the Kaweah Subbasin data viewer.

Figure 5. Example Design for Kaweah Subbasin Data Viewer



DMS Hosting

GEI will host the DMS for the duration of the amended Task Order – through December 2019. After that time, hosting will be transferred to either a Kaweah Subbasin GSA or a participating agency. As of the April 2018 DMS Development Meeting, the GSAs decided to postpone choosing where the DMS would be hosted from the year 2020 forward. If needed, GEI may continue to host the DMS for a nominal fee.

Summary

The Kaweah Subbasin DMS will contain the information used to support GSP development. The data stored will be based on the requirements of SGMA and include relevant historical data collected during GSP development for each of the six sustainability indicators. The DMS will consist of an Oracle database with a web-based viewer designed using JAVA. Data will be available for export from the DMS using the web-based viewer. The DMS will be hosted on a GEI server through December 2019, after which time it will be hosted by a Kaweah Subbasin agency or stay with GEI for a fee.

Appendix 5
Data Gaps Summary

Appendix 5

Data Gaps Summary

This appendix provides a summary of the current data gaps in the Kaweah Subbasin. It represents the gaps that were identified at the time of 2020 GSP preparation by the Kaweah Subbasin GSAs: East Kaweah GSA (EKGSA), Mid-Kaweah GSA (MKGSA), and Greater Kaweah GSA (GKGSA).

The three abovementioned GSAs agreed to, at a minimum of every five years, provide an evaluation of data gaps and to make a good-faith effort to address data gaps. These commitments are documented in the Kaweah Subbasin Coordination Agreement.

In general, the Kaweah Subbasin GSPs identify a need for expanding the spatial extent and density of the monitoring networks for water levels, water quality, and subsidence. They also indicate a need for increased knowledge about the existing monitoring network including geological/hydrogeological information, well logs, and well construction information. Table A-5-1 provides a summary of the primary data gap topics.

Table 5-1. Primary data gap topics by GSP

Data Gap Topic	EKGSA GSP	MKGSA GSP	GKGSA GSP
Geological/hydrogeological information	X	X	X
Well logs	X	X	X
Well construction information	X	X	X
Stream flow monitoring	X		
Spatial extent and density of **water level** monitoring network		X	X
Spatial extent and density of **water quality** monitoring network			X
Spatial extent and density of **subsidence** monitoring network	X	X	X
Groundwater-dependent ecosystems (GDEs)	X		X
Subsurface inflows and outflows	X		
Surface water deliveries	X		
Recharge basin data collection	X		
Irrigation demand	X		
M&I demand	X		
Accurate well count, type (domestic, irrigation, etc.), and status (active, inactive, abandoned[, destroyed])		X	X
Hydraulic parameters of principal aquifers based on pumping tests		X	X
Water quality information for domestic and agricultural wells		X	X
Interconnected surface water	X		X
Pumping records		X	
Rocky Hill Fault: evaluation of flow	X		
Intermontane Valley areas	X		
Septic system contamination (Nitrate)	X		

Each of the three Kaweah Subbasin GSPs contain a list of the principal data gaps for its respective GSA area. The summary lists extracted from each GSP are provided below.

East Kaweah

From the EKGSA GSP, **Section 2.6 – Identification of Data Gaps**:

"Identification of data gaps will continue to be a work in progress. The principal data gaps are listed below, which are subject to revision during the course of completion of this GSP.

- Geological/hydrogeological information for all areas of the EKGSA.
    - The SkyTEM effort should assist in filling this data gap
    - New and/or better well logging for monitoring and production wells can also be informative in locations with little or no data
- Well construction information such as: depth of well, perforation intervals, casing diameter, and use
    - Strongly encourage the Kaweah Subbasin GSAs and Tulare County [to] initiate a well canvas of the area to develop a better data set
    - Potential Drinking Well Observation Plan can assist with gathering well data for specific drinking water wells in the region
- Stream flow monitoring on Cottonwood, Yokohl, Lewis, and Frazier Creeks
    - Gauges are proposed to be constructed, especially for the creeks potentially to be used for recharge activities
    - Specific watershed studies for these creek watersheds can be performed to better inform the estimations of creek flows and seepage
- Consistent subsidence monitoring
    - Likely remedied with more consistent InSAR data
    - Specific infrastructure to be surveyed for subsidence impacts
- Presence of GDE
    - Likely linked with the added stream flow monitoring
    - More consistent groundwater level monitoring in the intermontane valleys
- Water Budget Components
    - Further development of subsurface inflows and outflows from the mountain front and neighboring subbasins
    - Improved understanding of surface water deliveries within district boundaries
    - Retention/Recharge basin data collection and tracking as more recharge is developed
    - Improved understanding of irrigation demand and method for crop and soil types within the Subbasin and EKGSA
    - Improved tracking of M&I demands."

Greater Kaweah

From the GKGSA GSP, **Section 2. Basin Setting**:

"The following data gaps were identified for the GKGSA:

- Accurate count of wells in GKGSA area, including well type (domestic, irrigation, etc.) and status (active, inactive, abandoned, [destroyed]). A detailed reconnaissance survey is underway to verify location and operational status of wells within GKGSA's jurisdiction but was not yet complete to inform this plan).
- Construction details of wells, especially production/screen interval(s). This data gap is significant and limits a comprehensive understanding of groundwater level and groundwater quality conditions above and below the Corcoran Clay.
- Lithologic composition of aquifer, including geophysical logs at strategic locations.
- Hydraulic parameters of principal aquifers based on pumping tests.
- Water quality data for domestic and irrigation wells.
- Measurements of subsidence within the GKGSA. The historical record of measured subsidence is incomplete and provides no information to inform an understanding of subsidence with depth.
- Groundwater elevation monitoring in areas with shallower groundwater levels to confirm whether or not the potential interconnected surface water and/or GDEs are present."

Mid-Kaweah

From the MKGSA GSP, **Section 2. Basin Setting**:

"The following data gaps were identified for the MKGSA:

- Accurate count of wells in MKGSA area, including well type (domestic, irrigation, etc.) and status (active, inactive, abandoned[, destroyed])
- Construction details of wells, especially production/screen interval(s). This was a significant data gap that prevented a comprehensive understanding of groundwater level and groundwater quality conditions above and below the Corcoran Clay
- Groundwater production records from direct measurement and locally generated estimates of groundwater use in rural areas of the MKGSA. This information will improve the water budget.
- Lithologic composition of aquifer, including geophysical logs at strategic locations
- Hydraulic parameters of principal aquifers such as transmissivity, storativity and porosity based on pumping tests preferably. This information could then help with the interpretation of Aerial Electro-Magnetic (AEM) data recently collected.
- Water quality data for small rural community, domestic (rural residential home owners) and agricultural irrigation wells
- Understanding of groundwater quality trends with depth (i.e. between upper and lower principal aquifers and vertical changes within each principal aquifer). With this information, an improved understanding is possible regarding depth of base of freshwater throughout the MKGSA as well as the Kaweah subbasin as a whole.

- Measurements of subsidence within the MKGSA. The historical record of measured subsidence is incomplete and provides no information to inform an understanding of subsidence with depth. Correlation between subsidence and release of arsenic from clay mineralogy represents a data gap that needs to be filled through improved sampling and subsidence monitoring.
- Expanded monitoring of groundwater levels and groundwater quality in small rural communities and disadvantaged communities

A compilation of every reference to a data gap in any of the three Kaweah Subbasin GSPs or in the Kaweah Subbasin Basin Setting document is provided as **Table 5-2**. In general, the plan to fill a data gap is presented alongside or nearby the text where the gap is identified in the GSP or Basin Setting document.

Table 5-2. All Data Gap Reference Table

GSP	Section	Page	Data Gap
GKGSA	2.2	2-2	**Summary List** The following ***data gaps*** were identified for the GKGSA: • Accurate count of wells in GKGSA area, including well type (domestic, irrigation, etc.) and status (active, inactive, abandoned[, destroyed]). A detailed reconnaissance survey is underway to verify location and operational status of wells within GKGSA's jurisdiction but was not yet complete to inform this plan). • Construction details of wells, especially production/screen interval(s). This ***data gap*** is significant and limits a comprehensive understanding of groundwater level and groundwater quality conditions above and below the Corcoran Clay. • Lithologic composition of aquifer, including geophysical logs at strategic locations. • Hydraulic parameters of principal aquifers based on pumping tests. • Water quality data for domestic and irrigation wells. • Measurements of subsidence within the GKGSA. the historical record of measured subsidence is incomplete and provides no information to inform an understanding of subsidence with depth. • Groundwater elevation monitoring in areas with shallower groundwater levels to confirm whether or not the potential interconnected surface water and/or GDEs are present. The ***data gaps*** will be addressed as GKGSA implements the Management Actions designed to close such gaps, as described in Section 7.4 to establish a subbasin-wide Monitoring Network as described in Section 4 of this Plan.
GKGSA	4	4-1	In areas where existing monitoring does not meet the SGMA requirements, this section identifies the ***data gaps*** and proposed measures to address these ***data gaps*** during the SGMA implementation period, so the monitoring improves with time. Any such improvement will be implemented as recognized and the results will be evaluated during the 5-year updates.
GKGSA	4.10.1	4-20	**4.10.1: Data Gaps** The following section describes ***data gaps*** for groundwater elevations, groundwater quality, and land subsidence.

GSP	Section	Page	Data Gap
GKGSA	4.10.1.1	4-21	**4.10.1.1: Groundwater Elevation and Storage** As referenced in Regulation §352.4, "If an Agency relies on wells that lack casing perforations, borehole depth, or total well depth information to monitor groundwater conditions as part of a Plan, the Agency shall describe a schedule for acquiring monitoring wells with the necessary information, or demonstrate to the Department that such information is not necessary to understand and manage groundwater in the basin. Well types and construction details will need to be determined to improve the monitoring network. Downhole well surveys and desktop surveys will be utilized for existing wells to fill in the well construction details gap. New dedicated monitoring wells and converted production wells will be utilized to fill in the monitoring network spatial extent and density. Improvement will occur during the initial few years of the implementation period, prior to the first 5-year update. Currently, the Kaweah Subbasin has a total of 14 SGMA compliant, dedicated monitoring wells that may be used for groundwater level monitoring. An additional six monitoring wells are proposed through the DWR's Technical Support Services (TSS) program. Two of the proposed six wells are located within the GKGSA. While the reminder of the wells used in the interim have been identified as Key Wells in the Basin Setting, they are not dedicated SGMA compliant monitoring wells. To address this GKGSA, in coordination with EKGSA and MKGSA, plans to expand the spatial coverage of groundwater level monitoring wells by adding SGMA compliant wells at or near the locations of existing Key Wells as shown in Figure 4 3. The full development of the SGMA-compliant monitoring network is scheduled to take place over the SGMA implementation period of 2020 to 2040.
GKGSA	4.10.1.2	4-21	**4.10.1.2: Groundwater Quality** Groundwater quality data are mostly available from the reoccurring sampling requirements for public water systems, primarily the Cities of Exeter, Farmersville, and Woodlake, but also for smaller systems within the GKGSA. Additional groundwater quality data will be available from the IRLP program and the upcoming CV-SALTS program and will provide further coverage in agricultural and rural areas. DWR will construct two new nested monitoring wells for the GKGSA as part of the Technical Services Support program. In addition, inactive production wells will be converted to monitoring wells to improve the spatial extent and density of the monitoring network. Improvement will occur during the initial few years of the implementation period, prior to the first 5-year review. As described in Section 4.9, groundwater quality monitoring under existing regulatory programs for public water systems currently provide adequate coverage for the Constituents of Concern listed in the Basin Setting. For areas lacking a public water system, the IRLP and CV-SALTS programs can be used to provide groundwater quality data in the interim. Dedicated SGMA compliant monitoring wells are also eligible for use in groundwater quality sampling and can be brought in to the monitoring network as they are completed.

GSP	Section	Page	Data Gap
GKGSA	4.10.1.3	4-21	**4.10.1.3: Land Subsidence** Land subsidence has been limited by the availability of data, notwithstanding the continuous GPS data for station P566 near Farmersville since 2005 and station CRCN near Corcoran since 2010, limited and variable coverage of InSAR data for 2007 to 2010 and 2015 to 2018, and the recent 2-year period (2016-2018) of KDWCD GPS data for various locations within and around GKGSA. The continued implementation of the KDWCD Land Surface Elevation Monitoring Plan will provide additional data on future subsidence at 12 locations within GKGSA and seven locations with MKGSA plus eight locations outside the Kaweah Subbasin. The GKGSA will coordinate with adjacent subbasins, especially in the southwestern portion of the subbasin where subsidence is greatest and could be affect surface infrastructure. The KDWCD Land Surface Elevation Monitoring Network and InSAR are adequate to address the requirements of SGMA, in terms of spatial distribution. Additional refinement to KDWCD may be considered as part of interbasin coordination efforts for areas which experience higher rates of subsidence.
GKGSA	4.10.1.4	4-21	**4.10.1.4: Interconnected Surface Water** As part of addressing the ***data gap*** of spatial distribution for SGMA-compliant groundwater level monitoring, the GKGSA and other GSAs of the Kaweah Subbasin will coordinate for the installation of SGMA-compliant groundwater level monitoring to validate existing data and confirm whether or not Interconnected Surface Waters are present in the Kaweah Subbasin in proximity to the Kaweah and St. Johns Rivers. As part of addressing the data gap of spatial distribution for SGMA compliant groundwater level monitoring, the GKGSA and other GSAs of the Kaweah Subbasin will coordinate for the installation of SGMA compliant groundwater level monitoring to validate whether or not Interconnected Surface Streams are present in the Kaweah Subbasin in proximity to the Kaweah and St. Johns Rivers.
GKGSA	5.5.1	5-15	The minimum threshold for land subsidence will be a rate of annual decline in land surface elevation. Land subsidence will be measured at the representative land subsidence monitoring network, as shown on Figure 4-5. In evaluating historic groundwater elevation data with subsidence data, an acceptable correlation was not evident, so the proxy use of groundwater levels is not possible. The absence of an acceptable correlation is notable because the mechanism for subsidence is relatively low groundwater levels and the associated compaction of clay units in response to the reduction in pore pressure. We believe the inability to establish this correlation stems from a high level of uncertainty due to: • Incomplete subsidence records from existing monitoring stations. • Insufficient number of subsidence monitoring stations. • Lack of pumping records by well. • Insufficient well construction and lithologic information to correlate pumping depths with subsidence depths. • Subsidence is a more of a regional condition whereas groundwater levels are very local and can be quite variable due to local subsurface conditions. These causes represent ***data gaps*** that will be filled through management actions during Plan implementation.
GKGSA	8.1.2.1	8-3	**8.1.2.1: Groundwater Elevations in GKGSA, last paragraph:** Groundwater contour maps submitted during the first five years may reflect a composite of the principal aquifers within the subbasin due to ***data gaps*** as discussed in the Basin Setting Report (Appendix 2A) of this Plan. As additional dedicated monitoring wells are installed, and as more knowledge is gained regarding subbasin hydrogeology, groundwater conditions within each separate aquifer will be better understood. The geophysical data collection project described in Section 7 will also aid in this regard.

GSP	Section	Page	Data Gap
GKGSA	8.2	8-6	In accordance with § 356.4 of the Regulations, the GKGSA will conduct a periodic evaluation of its Plan no less frequently than at five-year intervals and provide a written assessment to DWR of such evaluations. The assessments will include, but not be limited to, the following... • Description of alterations to the monitoring network and its improvements to address ***data gaps***...
GKGSA	8.2.1	8-7	**8.2.1: Monitoring Network Assessment and Improvement**: The GKGSA recognizes that its initial monitoring network as described in Section 4 of this Plan includes existing monitoring sites lacking sufficient information such as well depth, screen intervals, and reliable well-log records, thereby reflecting significant ***data gaps***. Assessing these ***data gaps*** is a priority and will be conducted in accordance with § 352.2 and § 354.38 of the Regulations. Specific elements of such an assessment are to include: • Targeting areas where an insufficient number of monitoring sites exist or where sites are considered unreliable or do not meet monitoring network standards • Identifying ***data gap*** locations and reasons for their occurrence and surrounding issues that restrict monitoring and data collection • Actions to be undertaken to close identified ***data gaps***, including the addition and/or installation of new monitoring wells or surface-water measuring facilities, closure of inadequate well density areas, and needed adjustments to monitoring and measurement frequencies
MKGSA	1.4.3.1	1-12	**1.4.3.1: County of Tulare General Plan** The 2030 General Plan Update for the County of Tulare, adopted on August 28, 2018, does not have a specific update to address water usage and supply. However, the Tulare County 2012 General Plan has a Water Resources Element that requires the County to adopt ordinances and measures to:...• Encourage responsible agencies and organizations to install and monitor additional groundwater monitoring wells in areas where ***data gaps*** exist

GSP	Section	Page	Data Gap

MKGSA	2.2	2-2	**Summary List**
			The following ***data gaps*** were identified for the MKGSA:
			• Accurate count of wells in MKGSA area, including well type (domestic, irrigation, etc.) and status (active, inactive, abandoned[, destroyed])
			• Construction details of wells, especially production/screen interval(s). This was a significant ***data gap*** that prevented a comprehensive understanding of groundwater level and groundwater quality conditions above and below the Corcoran Clay
			• Groundwater production records from direct measurement and locally generated estimates of groundwater use in rural areas of the MKGSA. This information will improve the water budget.
			
			• Lithologic composition of aquifer, including geophysical logs at strategic locations
			• Hydraulic parameters of principal aquifers such as transmissivity, storativity and porosity based on pumping tests preferably. This information could then help with the interpretation of Aerial Electro-Magnetic (AEM) data recently collected.
			    • Water quality data for small rural community, domestic (rural residential home owners) and agricultural irrigation wells
			    • Understanding of groundwater quality trends with depth (i.e. between upper and lower principal aquifers and vertical changes within each principal aquifer). With this information, an improved understanding is possible regarding depth of base of freshwater throughout the MKGSA as well as the Kaweah subbasin as a whole.
			    • Measurements of subsidence within the MKGSA. The historical record of measured subsidence is incomplete and provides no information to inform an understanding of subsidence with depth. Correlation between subsidence and release of arsenic from clay mineralogy represents a data gap that needs to be filled through improved sampling and subsidence monitoring.
			    • Expanded monitoring of groundwater levels and groundwater quality in small rural communities and disadvantaged communities
			•
			The ***data gaps*** will be addressed as MKGSA implements the management actions designed to close such gaps, as described in Section 7.4.

MKGSA	4	4-1	**4. Monitoring Networks** The following chapter describes both the existing groundwater monitoring within the MKGSA area and the representative monitoring required by SGMA. In areas where existing monitoring does not meet the SGMA requirements, this chapter identifies ***data gaps*** and proposed measures to address these ***data gaps*** during the SGMA implementation period so the representative monitoring improves over time. Plan updates will reflect new information regarding improvements to representative monitoring. This Section 4 includes all information in compliance with §354.32 through §354.40 of the Regulations.
MKGSA	4.10.1	4-14	**4.10 Monitoring Network Improvement Plan/ 4.10.1 Data Gaps** The following section describes ***data gaps*** for groundwater elevations and storage, groundwater quality, and land subsidence.

GSP	Section	Page	Data Gap
MKGSA	4.10.1.1	4-15	**4.10.1.1: Groundwater Elevation and Storage Data Gaps** As referenced in Regulation §352.4, "If an Agency relies on wells that lack casing perforations, borehole depth, or total well depth information to monitor groundwater conditions as part of a Plan, the Agency shall describe a schedule for acquiring monitoring wells with the necessary information or demonstrate to the Department that such information is not necessary to understand and manage groundwater in the basin." Well types and construction details will need to be determined to improve the monitoring network. Downhole well surveys and desktop surveys will be utilized for existing wells to fill in the well construction details gap. New dedicated monitoring wells and converted production wells will be utilized to fill in the monitoring network spatial extent and density. Improvement will occur during the initial few years of the implementation period, prior to the first five-year update.
MKGSA	4.10.1.2	4-15	**4.10.1.2: Groundwater Quality Data Gaps** Groundwater quality information is currently collected for public water systems, primarily Visalia and Tulare. The groundwater quality new dedicated monitoring wells and converted production wells will be utilized to fill in the monitoring network spatial extent and density. Improvement will occur during the initial few years of the implementation period, prior to the first 5-year update. DWR will be constructing new multilevel monitoring wells at the locations shown on Figure 4-7 (at the end of this Section) as part of their Technical Support Services program. These wells will be used for both groundwater level and quality monitoring.
			4.10.1.3: Land Subsidence Data Gaps For the preparation of this initial plan, MKGSA lacked sufficient data to effectively correlate changes in groundwater levels within the MKGSA with historical land surface subsidence. This was problematic in developing accurate projections of potential future subsidence that may occur during the implementation period. Additionally, there was not sufficient data to find a good correlation between pumping and land surface subsidence. The implementation of KDWCD's Land Surface Elevation Monitoring Plan will provide additional data for future subsidence monitoring and evaluation of Sustainability Indicators. The MKGSA will explore other options for a secondary data source, especially where surface infrastructure in the southwestern portion of the subbasin could be affected.
MKGSA	4	4-22	Figure 4-7: Proposed New Multilevel Monitoring Wells to Fill ***Data gaps***
MKGSA	5.3.4.1	5-14	In evaluating historic field-measured groundwater elevation data with field-measured subsidence data, an acceptable correlation was not evident. Such a technically defensible correlation was intended for the purpose of estimating the magnitude of future subsidence if groundwater levels were ever to reach minimum thresholds throughout the Subbasin. It was notable that an acceptable correlation did not emerge, since the mechanism for subsidence is declining groundwater levels below historic lows and the associated compaction of clay units in response to the reduction in pore pressure. We believe the inability to establish this correlation stems from a high level of uncertainty due to: • Incomplete subsidence records from existing monitoring stations. • Insufficient number of subsidence monitoring stations. • Complete lack of pumping records by well. In some cases, pumping estimates were available by management area, but in most cases, there was no pumping data by well by year. • Insufficient well construction information to correlate pumping depth with observed subsidence. These causes represent significant ***data gaps*** that will be filled through management actions during Plan implementation.

GSP	Section	Page	Data Gap
MKGSA	8.1.2.1	8-2	Groundwater contour maps submitted during the first five years may reflect a composite of the principal aquifers within the subbasin due to ***data gaps*** as discussed in Section 2 of this Plan. As additional dedicated monitoring wells are installed, and as more knowledge is gained regarding subbasin hydrogeology, groundwater conditions within each separate aquifer will be better understood. The geophysical data collection project described in Section 7 will also aid in this regard.
MKGSA	8.2	8-5	**8.2 Five-Year Assessments** In accordance with §356.4 of the Regulations, the MKGSA will conduct a periodic evaluation of its Plan no less frequently than at five-year intervals and provide a written assessment to DWR of such evaluations. The assessments will include, but not be limited to, the following: • Description of alterations to the monitoring network and its improvements to address ***data gaps***…
MKGSA	8.2.1	8-5	**8.2.1 Monitoring Network Assessment and Improvement** The MKGSA recognizes that its initial monitoring network as described in Section 4 of this Plan includes existing monitoring sites lacking sufficient information such as well depth, screen intervals, and reliable well-log records, thereby reflecting significant ***data gaps***. Assessing these ***data gaps*** is a priority and will be conducted in accordance with §352.2 and §354.38 of the Regulations. Specific elements of such an assessment are to include: • Targeting GSA areas where an insufficient number of monitoring sites exist or where sites are considered unreliable or do not meet monitoring network standards • Identifying data gap locations and reasons for their occurrence and surrounding issues that restrict monitoring and data collection • Actions to be undertaken to close identified ***data gaps***, including the addition and/or installation of new monitoring wells or surface-water measuring facilities, closure of inadequate well density areas, and needed adjustments to monitoring and measurement frequencies
EKGSA	2.2.6.1	2-25	According to DWR's Bulletin 118 (2003), there are no reported groundwater barriers restricting horizontal flow in and out of the Kaweah Subbasin. There is, however, the Rocky Hill fault zone that may affect groundwater flow inside of the Subbasin and potentially cross gradient of flow along the north and south boundaries. Located in the Eastern portion of the Subbasin, the Rocky Hill fault disrupts pre-Eocene deposits and may locally penetrate older alluvial deposits. The linearity of ridges in this area defines the fault line (Refer to Figure 2-4 for the Cross Section Location Map and Figure 2-7 and Figure 2-9 for Cross Sections DD' and gg'). The Rocky Hill fault does not offset younger alluvium based on water level data (Croft, 1968); however, lithology data from boreholes suggest that older alluvium may be offset or varied in thickness at the Rocky Hill fault. In addition, Fugro West (2007), suggested that the hydrologic connection of the oxidized alluvial aquifer may be restricted near the Rocky Hill fault; this represents a ***data gap*** in groundwater flow across the Rocky Hill fault, and should be evaluated in the future, both within the Subbasin and in association with the northern and southern boundaries of the Subbasin.
EKGSA	2.3.3	2-42	**2.3.3 Existing Land Subsidence Monitoring** Past, recent and potential future monitoring of land subsidence in the Kaweah Subbasin are summarized in Table 2-5. Much of the historical data does not cover the EKGSA area. Newer data sets (2015-2017) provide more coverage. The EKGSA will strive to keep these newer data sets active to avoid ***data gaps*** in the future. While land subsidence isn't believed to be a major concern in the EKGSA, it will be monitored to avoid Undesirable Results.

GSP	Section	Page	Data Gap
EKGSA	2.3.4	2-42	**2.3.4 Existing Stream Flow Monitoring** The most useful stream flow gauges monitored within the Subbasin are located outside the EKGSA. The closest water bodies regularly monitored are the Kaweah River, St. Johns River, and Yokohl Creek. The flow gauges are located in the GKGSA Kaweah GSA. Existing stream flow monitoring represents a ***data gap*** for the EKGSA to improve moving forward. Streams of interest for the EKGSA to improve monitoring data are: Cottonwood, Lewis, and Frazier Creeks.
EKGSA	2.4.1.2	2-49	**2.4.1.2 Well Hydrographs** Hydrographs of individual wells in and around the EKGSA are presented in Appendix 2-D. Figure 2-21 is a map showing locations of these wells. These hydrographs depict the span of time between 1981 and 2017. Hydrographs outside the borders of the EKGSA were included to establish boundary conditions. It is difficult to identify wells with records that are complete for the entire base period. The wells depicted often contain ***data gaps*** but represent the most complete information available at this time. The dataset used to create these hydrographs associates water levels with a season/year format (e.g. Spr1990) rather than with a specific date. For the purposes of plotting, spring levels were considered to have been taken on March 1, while fall levels were plotted on October 1. Nevertheless, these hydrographs are a useful tool for tracking water level patterns through time across the EKGSA.
EKGSA	2.4.1.2	2-50	**Intermontane Valleys** – This classification is included to showcase wells on the Eastern border of the EKGSA with significant bedrock outcrop to their west. These wells are located in the small valleys interfingering with the mountain-front and are drilled into shallow alluvium veneering relatively shallow bedrock, with ready access to recharge coming from the mountain-front. They have consistently shallow DTW and low seasonal and hydrological deviation. Typical WSEs within these wells are consistently within 50 ft of the surface. Well 17S26E14L002M is nearly within the Valley proper and likely has deeper alluvium, less-direct recharge, and plentiful irrigation nearby. This well's hydrograph is more akin to wells in the Cottonwood Creek Interfan area as defined above, with GKGSA overall DTW and increased variation between seasons of wet and dry. Average DTW for this grouping of wells was 26.9 ft based on the years with data. There are significant temporal ***data gaps*** for this region, during which time none or only one well provided data. Between fall of 2008 and fall of 2012 no data is recorded for any of these wells.
EKGSA	2.4.1.2	2-54	**Well Depth:** Construction data for wells in the EKGSA was evaluated in a summarized format. Evaluating well logs confidently and accurately to match reports with the actual corresponding well in the field is difficult due to the current nature of the data sets available. This is a ***data gap*** that will be filled going forward. Figure 2-24, Figure 2-25, and Figure 2-26 display the average completed well depths per section for agricultural, domestic, and public wells respectively. Appendix 2-E provides more figures for these three well types, including minimum and maximum completed depths and number of wells per section.

GSP	Section	Page	Data Gap
EKGSA	2.4.3.3.4	2-62	**Nitrate**: Sources and Spatial Distribution in the EKGSA - The historical and current predominate land use in the EKGSA is for commercial irrigated agriculture with some interspersed dairy farms. While Burton et. Al (2012) reports nitrate contaminations correlates to areas of agriculture classified as orchard and vineyard land uses, USGS finds that these regions also have medium to high density septic systems. GKGSA than 50 percent of the land use in hydrogeologic zones 7, 8 and 9 are orchards or vineyards. Septic-system density GKGSA than the Subbasin median value of 5 septic systems in a 500-meter radius around each selected GAMA well occurred hydrogeologic zones 4-9, with very high density of 11.8 septic systems within 500 meters of the selected wells in zones 7, and 11.0 septic systems in zone 9. USGS data was used for this evaluation to develop a clearer understanding of potential sources of nitrate contamination. While previous reports point towards orchard and vineyard land uses, septic system density is an unquantified source of contamination. While the existence of septic systems does not necessarily mean that they are a contributing source of nitrate contamination within the aquifer. However, leaky, poorly maintained septic systems can be a serious source of localized nitrate contamination. It is currently unknown the amount of contamination associated with poorly maintained septic systems. This represents a ***data gap*** that the EKGSA and Subbasin will need to evaluate going forward. Data gathered by USGS (Report 2011-5218) was determined from housing characteristics data from the 1990 U.S. Census. The density of septic systems in each housing census block was calculated from the number of tanks and block area. To more precisely identify the nitrate sources, current data should be compiled and evaluated with proximity to domestic water wells. This effort is being made through the Disadvantaged Community Involvement Program is trying to identify septic system density and condition in the Tulare-Kern Funding Area.
EKGSA	2.4.4.3	2-67	**2.4.4.3 Recent Land Subsidence** Recent subsidence studies of the Central Valley have utilized satellite-based, remote sensing data from the Interferometric Synthetic Aperture Radar (InSAR) and aircraft-based L-band SAR or Unmanned Aerial Vehicle Synthetic Aperture Radar (UAVSAR) programs, led by NASA and Jet Propulsion Laboratory (JPL), as well as other international researchers. These datasets provide a continuous estimate of subsidence over a large portion of the Subbasin. Additionally, subsidence in the Subbasin and in the Tule Subbasin (to the south) can also be observed at point locations through continuous GPS (CGPS) stations and other land surface monitoring stations. Most of these are not located within the EKGA, representing a ***data gap***. These CGPS stations are monitored as a part of UNAVCO's Plate Boundary Observation (PBO), the California Real Time Network (CRTN) and California Spatial Reference Center (CSRC) of the Scripps Orbit and Permanent Array Center (SOPAC). Annual averages of CGPS or future extensometer data may permit a more meaningful comparison and/or calibration with InSAR data in the future. Recent and historical subsidence data is summarized in Table 2-7. The data presented includes a summary of InSAR data published in a subsidence study commissioned by the California Water Foundation (LSCE, 2014) and by JPL (Farr et al., 2015 and 2016). The InSAR data was collected from a group of satellites (Japanese PALSAR, Canadian Radarsat-2, and European Space Agency's (ESA) satellite-borne Sentinel-1A and -1B), from 2006 to 2017, however there is a ***data gap*** for the EKGSA prior to 2015 due to the limit of study and absence of satellite data collection data prior to the ESA Sentinel satellites in 2014 (Farr et. al., 2016).

GSP	Section	Page	Data Gap
EKGSA	2.4.6	2-71	**2.4.6 Groundwater Dependent Ecosystems** Where groundwater and surface water are separated by significant distances, as is the case with the majority of the EKGSA, the groundwater does not interact with the natural streams or manmade ditches, and therefore, no possibility exists for the presence of Groundwater Dependent Ecosystems (GDE). However, there are locations near the foothills of the Sierra Nevada where groundwater levels are closer to the surface. Areas where groundwater is within 30 feet of the ground surface are located along the Kaweah River (primarily in GKGSA), the Stone Corral ID area, and near Lewis Creek in the Lindsay-Strathmore ID area. Figure 2-28 represents areas where groundwater elevations as of the Spring of 2015 were within 30 feet of the ground surface. Wetlands within these areas may be considered GDE, however additional study and data are necessary. This ***data gap*** will be addressed as part of further study going forward.
EKGSA	2.5.3.2	2-82	**2.5.3.2 Inflows to the Groundwater System - Natural Channels:** The EKGSA lacks reliable, long-standing stream gauges on the four major tributaries that flow into the area from the Sierra Nevada foothills. There is a single stream flow gauge on Yokohl Creek, while the other water bodies Cottonwood, Lewis, and Frazier Creeks do not have permanent gauges. In the absence of data, streambed percolation for the EKGSA was determined by an alternate method. The percolation from these creeks was assumed to be included in the mountain-front recharge accounted for in the Subsurface Flow. This is a ***data gap*** that will be further evaluated going forward. In addition to these creeks, a portion of the St. Johns River runs along the boundary between the EKGSA and GKGSA. It is assumed percolation over this stretch enters both the EKGSA and GKGSA. Per these estimates, the average annual natural percolation into the EKGSA is 2,000 AFY as shown in Table 2-10.

GSP	Section	Page	Data Gap
EKGSA	2.6	2-92	**Summary List** **2.6 Identification of *Data gaps*:** Identification of ***data gaps*** will continue to be a work in progress. The principal ***data gaps*** are listed below, which are subject to revision during the course of completion of this GSP. • Geological/hydrogeological information for all areas of the EKGSA. o The SkyTEM effort should assist in filling this data gap o New and/or better well logging for monitoring and production wells can also be informative in locations with little or no data • Well construction information such as: depth of well, perforation intervals, casing diameter, and use o Strongly encourage the Kaweah Subbasin GSAs and Tulare County initiate a well canvas of the area to develop a better data set o Potential Drinking Well Observation Plan can assist with gathering well data for specific drinking water wells in the region • Stream flow monitoring on Cottonwood, Yokohl, Lewis, and Frazier Creeks o Gauges are proposed to be constructed, especially for the creeks potentially to be used for recharge activities o Specific watershed studies for these creek watersheds can be performed to better inform the estimations of creek flows and seepage • Consistent subsidence monitoring o Likely remedied with more consistent InSAR data o Specific infrastructure to be surveyed for subsidence impacts • Presence of GDE o Likely linked with the added stream flow monitoring o More consistent groundwater level monitoring in the intermontane valleys • Water Budget Components o Further development of subsurface inflows and outflows from the mountain front and neighboring subbasins o Improved understanding of surface water deliveries within district boundaries o Retention/Recharge basin data collection and tracking as more recharge is developed o Improved understanding of irrigation demand and method for crop and soil types within the Subbasin and EKGSA o Improved tracking of M&I demands
EKGSA	3.4.2.2.1	3-28	**Description of Minimum Thresholds:** Well monitoring data from Geotracker, and other sources, is currently not available at a granular enough level to allow for the mapping of specific contaminant plumes. Given these ***data gaps***, the current level of water quality monitoring for the identified COCs needs to be enhanced by a network to track regional trends and to serve as a warning system for changes in water quality. More details on the EKGSA's monitoring network is provided in Chapter 4.
EKGSA	4.3.1	4-4	**4.3 Groundwater Levels: 4.3.1 Monitoring Network Description** Groundwater-level monitoring has been carried out for most of the past century. Existing groundwater wells with long monitoring histories make the best targets for continued monitoring. These wells are rare, and when they exist, their usefulness is often degraded by poor data quality. Most wells have incomplete temporal histories and lack consistent measurements for consecutive years throughout their operational lives. There is no recourse for historic temporal ***data gaps***, but the temporal quality of future measurements in these wells can be ensured.

GSP	Section	Page	Data Gap
EKGSA	4.3.1	4-5	**4.3 Groundwater Levels: 4.3.1 Monitoring Network Description:** Private wells: In several parts of the EKGSA there are gaps in the current monitoring well coverage, therefore, records from private wells may be used to initially satisfy the monitoring network needs. Use of these wells would require landowners to execute agreements with the EKGSA to allow access and conduct and oversee the monitoring. This process is anticipated to be time intensive, so this option is not the most preferred method.
EKGSA	4.3.1	4-5	Figure 4-1 shows the proposed locations for the initial groundwater level monitoring network for the EGKSA, and the different types of wells to be utilized. The two wells notated with stars in the northern portion of the EKGSA are proposed dedicated monitoring wells that are anticipated to receive Technical Support Services (TSS) assistance through DWR. The seven locations notated with large circles are locations with ***data gaps***. The EKGSA will aim to obtain data from these regions (within half a mile) through agreement on private wells or through drilling dedicated monitoring wells during the first year(s) of implementation. It is understood that over the course of implementation the EKGSA will gradually convert the entire Monitoring Network to dedicated monitoring wells.
EKGSA	4.3.3	4-9	**4.3.3 Review and Evaluation of Monitoring Network:** The monitoring network will be assessed and reviewed for adherence to SGMA requirements at the end of each five-year period, with the first period beginning in 2020 and concluding in 2025. As the monitoring network currently stands there are a few ***data gaps*** that may affect the interim monitoring of the overall sustainability goal of the basin, however, these will be addressed within the first five years of monitoring.
EKGSA	4.3.3.3	4-10	**4.3 Groundwater Levels/Monitoring Network - Identification of Data Gaps:** Existing groundwater-level monitoring has provided data to prepare groundwater contour maps and identify groundwater level trends over the decades. The existing monitoring system relies heavily on the member irrigation districts, but this only provides data for a portion of the EKGSA. To better represent hydraulic gradient and flow direction within the EKGSA, about seven wells should be strategically placed for regular monitoring in the EKGSA. Figure 4-1 shows the approximate locations where additional monitoring wells are believed to be useful in accomplishing this goal and meeting the monitoring well density requirements set forth in the GSP. The EKGSA will try to fill these locations either through agreements with private landowners or by drilling new dedicated monitoring wells. Other ***data gaps*** exist in the fact that most of the proposed monitoring network wells are privately owned production wells that are used for monitoring. Specific well construction information, including depth and perforated interval, are not known for many of the wells. Also, depending on how and when the data was collected, data points in some (or all) years may be skewed. Utilizing a production well as a monitoring well runs the risk of potential influence from recent pumping that may affect the 'static' reading aimed to be captured. It is believed that much of the recorded well data within the EKGSA is credible, however the EKGSA will continue to improve this data set going forward.

GSP	Section	Page	Data Gap
EKGSA	4.3.3.4	4-10	**4.3 Groundwater Levels/Monitoring Network - 4.3.3.4 Plans to Fill Data Gaps** The EKGSA will oversee the groundwater level monitoring network, including filling areas with data gaps. This will be especially useful for the regions that are not currently monitored, such as outside irrigation district boundaries. As previously stated, Figure 4-1 depicts the wells intended to fill spatial data gaps for initial implementation. The EKGSA will need to locate accessible private wells or drill new wells in the seven locations shown. Over time the EKGSA will transition to utilizing dedicated monitoring wells in its monitoring network. To address data quality gaps related to unknown construction information, the EKGSA will utilize the following options: • **Collect well completion reports.** Accurate well Completion Reports (WCRs) can potentially provide missing well construction and completion information. These records could be collected from landowners or DWR. Due to the way that data is collected and dispersed, it is often difficult to correlate WCRs with actual wells. Locations of wells as reported on WCRs are often subjective, as they are based on the drillers' ability to convey spatial location. Multiple wells may exist within the area a well's log leads to. In some cases, wells have been destroyed or lost without documentation. Obtaining well logs directly from owners bypasses this confusion, though this is not a perfect solution. Private well owners may be unable or unwilling to provide logs for their wells. • **Perform a video inspection of each well to obtain construction information.** In the absence of verified well logs a video inspection can be performed on wells to determine the total completed depth and perforated interval(s). Each video inspection currently ranges in costs between $2,500 and as much as $15,000 if required to lift and reinstall a pump to obtain access in production wells. There would also be additional costs for administration and outreach to landowners. The EKGSA would need to enter into private agreements with individual well owners for the use of these wells; as an incentive for participation the EKGSA would cover the cost of the well video assessment. • **Abandoned Wells.** The EKGSA will assess the likelihood of monitoring former wells that have been abandoned. Use of these wells will potentially bolster the density of the monitoring network in areas with minimal coverage, likely involve less stringent access requirements, and are cheaper than drilling new wells. Additionally, since these wells are no longer in production, the monitoring of abandoned wells allows for better potential in gaining a static water level reading and better fulfill the requirements of Sub-Article 4. • **Replace monitoring point with a dedicated monitoring well.** Dedicated monitoring wells could be installed and used in place of private wells. The construction information would be known and since the EKGSA would locate these wells, access issues would not be an issue. Dedicated monitoring wells are expensive to construct, and their installation will depend on available funding. Replace monitoring point with another private well. Private wells without documented construction information may potentially be replaced with other private wells that have verified well completion information. This option may be simpler and less costly than using video inspection and would be substantially less expensive than drilling new dedicated monitoring wells. This method of network repair would side-step the expense of drilling new wells but would still be subject to availability and limitations arising from the missing historical record.
EKGSA	4.4.3.3	4-12	**Groundwater Storage/Monitoring Network - 4.4.3.3 Identification of Data Gaps** Gaps in current groundwater level monitoring networks have created corresponding inadequacies in the ability to calculate change in storage. ***Data gaps*** associated with aquifer characteristics, such as specific yield values used for storage estimates, are anticipated to be improved through the completion of different projects and studies undertaken by the Kaweah Sub-basin and the EKGSA (i.e. SkyTEM).

GSP	Section	Page	Data Gap
EKGSA	4.4.3.4	4-12	**Groundwater Storage/Monitoring Network - 4.4.3.4 Plans to Fill Data Gaps** Significant data gaps will be filled using the same methods used to address data gaps in the groundwater level network, as spatial data coverage is a critical component in the change in storage calculations. Aquifer evaluation at a Sub-basin scale was performed through a SkyTEM electromagnetic analysis. The results from this analysis were not ready in time for this initial GSP but will be available for future updates and modeling to improve the general knowledge of the aquifer characteristics moving forward.
EKGSA	4.5.2	4-15	**Water Quality/Monitoring Network - 4.5.2 Quantitative Values** Threshold values for COCs are presented in Chapter 3. These values use MCL and prevalence data to provide minimum thresholds, measurable objectives, and interim milestones for each COC. Table 4-3 repeats the monitoring network wells table, but this time shows the baseline 10-year (2008-2017) COC averages for the wells in the network with water quality data available. By comparison, only 15 of the approximately 70 wells to be monitored for water quality have data for establishing a baseline. This represents a significant ***data gap***, however the intent of the EKGSA monitoring will strive to remedy this gap over the first years of implementation. Water quality degradation will be evaluated by determining if the actions of the EKGSA degrade the beneficial use of water in the Subbasin.
EKGSA	4.5.3.3	4-16	**Water Quality/Review of Monitoring Network - 4.5.3.3 Identification of Data Gaps** The absence of groundwater level data across the entirety of the EKGSA is a ***data gap***. Future monitoring will need to address this ***data gap*** so the EKGSA can properly evaluate how groundwater management actions are impacting groundwater quality.
EKGSA	4.5.3.4	4-16	**Water Quality/Review of Monitoring Network - 4.5.3.4 Plans to Fill Data Gaps** The EKGSA's proposal to monitor COCs across the groundwater level monitoring network intends to fill some of the significant data gaps with respect to groundwater quality data. Monitoring over the first five years of implementation should provide more insight on groundwater quality (location, trends, etc.) in the EKGSA. The EKGSA will also collaborate, where appropriate and feasible, with other agencies tasked with tracking and/or improving groundwater quality for additional assistance with data gaps.
EKGSA	4.6.3.3	4-20	**Land Subsidence/Monitoring Network - 4.6.3.3 Identification of Data Gaps** Beyond the specific proposed monitoring points, no other ***data gaps*** were identified for the land subsidence monitoring network for the EKGSA. Subsidence has been an ongoing issue in portions of the Central Valley, thus monitoring systems have been put in place to evaluate the impacts. Over time these tools and data have improved and become more widespread.
EKGSA	4.6.3.3	4-20	**Land Subsidence/Monitoring Network - 4.6.3.4 Plans to Fill Data Gaps** With the addition of survey points to critical infrastructure, and utilizing the InSAR data set as a backstop, the current subsidence monitoring network is believed to sufficiently cover the EKGSA.
EKGSA	4.7.3.3	4-23	**Depletion of Interconnected Surface Water/Monitoring Network - 4.7.3.3 Identification of Data Gaps** Due to the absence of historic monitoring specifically related to groundwater-surface water connection, there are ***data gaps*** beyond that of local experience. The new proposed monitoring effort laid out in this GSP will likely shed light on the areas considered to be 'gaining' streams or connected due to perched groundwater. The new monitoring network may indicate other areas to have possible connection. In these instances, the EKGSA will adapt the monitoring to allow for further evaluation.

GSP	Section	Page	Data Gap
EKGSA	4.7.3.3	4-23	**Depletion of Interconnected Surface Water/Monitoring Network - 4.7.3.4 Plans to Fill Data Gaps** The proposed additions to the groundwater level monitoring network is expected to be a benefit to the understanding of interconnected surface water. This will be especially beneficial in the portions of the EKGSA adjacent the foothills and ephemeral streams.
EKGSA	5.2	5-3	**5.2 Projects:** Implementation through this first GSP will focus on bolstering data sets to fill ***data gaps***, and then projects fully developed based on current and projected conditions.
EKGSA	5.3.2.6	5-36	**5.3.2. Wellhead Requirements Management Actions - 5.3.2.6 Benefit Realization and Evaluation WH1 - WH-5 (Sec. 354.44.b.5)** - The expected benefits of water quality sample ports and analytical testing would fill ***data gaps*** and provide extractors with useful information.
EKGSA	5.3.3	5-41	**Groundwater Allocation Management Actions: GA-3 Groundwater Allocation "Adaptive Management" Approach** The EKGSA may adopt a policy which states an adaptive management approach, whereby the groundwater allocation may be reviewed, changed, and reestablished periodically or during extreme drought as necessary to achieve long term sustainability. It is prudent for the EKGSA to acknowledge the current level of uncertainty in the available data and existing ***data gaps*** by providing flexibility in initial groundwater allocations as more data is gathered and analyzed in the upcoming years. Adaptive management is an approach to resource management that "promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes "learning while doing" (Environmental Defense Fund et al., 2017).
EKGSA	6.1	6-1	**Plan Implementation/6.1 Estimate of GSP Implementation Costs - Plan to Fill Data Gaps (One-Time Cost)** Proper implementation of this GSP, especially as it relates to execution of projects and management actions, is contingent upon filling current ***data gaps***. This process will require determining which measures are necessary to build and maintain a comprehensive assessment of the water budget and ultimately verify groundwater sustainability. This plan to fill ***data gaps*** includes, but is not limited to, installing stream gauges, dedicated monitoring wells, and conducting a Proposition 218 vote. Costs are estimated to be approximately $1,230,000.
EKGSA	6.2	6-3	**6.2 Identify Funding Alternatives**: The EKGSA and/or its member agencies or other Kaweah Subbasin GSAs will apply for various grant funding opportunities to offset some of the capital costs associated with implementation of the GSP, whether it be a water supply project or to fill an existing **data gap**. The EKGSA will explore federal and state grant funding opportunities and low interest loans to help finance the initial steps of plan implementation.

GSP	Section	Page	Data Gap
Kaweah Subbasin Basin Setting	2.3.1.1	Q	**2.3.1.1 Key Wells:** The key wells were chosen as a subset of the entire water level monitoring database to adequately represent the Subbasin both laterally and vertically. These key wells were used along with the other monitored wells for the creation of water level contour maps and water level hydrographs. Most of the known wells in the Subbasin are either missing or have limited well construction information. Therefore, the **data gap** will be addressed with the following the steps below. 1. Further review of acquired well logs; 2. Conducting down-hole video surveys of wells; and 3. Installing additional monitoring wells as funds become available. While there are limitations associated with using water level data from wells without construction information, we have performed an initial assessment of many of the available wells with a long period of record. This process allowed for the selection of wells that were used for developing an initial understanding of groundwater level variations throughout the Subbasin. It is understood that this snapshot of groundwater conditions is limited based on the unknown completion information about the wells and may change as construction data is obtained in the future.
Kaweah Subbasin Basin Setting	2.3.4	50	**2.3.4 Existing Stream Flow Monitoring:** The records of the stream groups impacting the facilities and stockholders of the ditch companies that they manage were acquired. Although ***data gaps*** exist, these may represent relatively small quantities of contributory flows. The records of the USGS are, for the most part, supplemental to the records of the Association and local agencies. The information that is published by the USGS, however, does fill some of the ***data gaps*** that exist in the information related to the local stream groups. Figure 20 shows the locations of stream flow gauges monitored within the Subbasin.
Kaweah Subbasin Basin Setting	2.8.4	141	**2.8.4 Recent Land Subsidence:** Recent and historical subsidence data are summarized in Table 43. It includes a summary of InSAR data published in a subsidence study commissioned by the California Water Foundation (LSCE, 2014), and by JPL. The InSAR data were collected from a group of satellites (Japanese PALSAR, Canadian Radarsat-2, and ESA's satellite-borne Sentinel-1A and -1B), from 2006 to 2017, with a ***data gap*** from 2011 to 2014 because there was a gap in satellite data collection until the ESA Sentinel satellites were launched in 2014.

Appendix 6
Sustainability Goal and Undesirable Results

SUSTAINABILITY GOAL AND UNDESIRABLE RESULTS
Appendix 6 to Kaweah Subbasin Coordination Agreement

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Appendix

Appendix 6-1: Technical Approach for Developing Chronic Lowering of Groundwater Level SMC for the Kaweah Subbasin
Appendix 6-2: Potential Well Impact Analysis
Appendix 6-3: Mitigation Program Framework

6. Sustainability Goal and Undesirable Results

6.1 Introduction

This Appendix provides location-specific significant and unreasonable conditions as well as undesirable results for five of the six sustainability indicators to guide and support the Kaweah Subbasin Groundwater Sustainability Agencies (GSAs) in developing sustainable management criteria (SMC) in their individual groundwater sustainability plans (GSP). This Appendix includes the Subbasin-scale SMC guidance as required by 23 Cal. Code Regs. §§354.22-.26, i.e., the sustainability goal and a complete listing of undesirable results, including their causes, criteria and effects on beneficial uses and users. Pursuant to 23 Cal. Code Regs §354.26(d) no sustainable management criteria need to be set at this time for the undesirable results of Seawater Intrusion. Thus, pursuant to 23 Cal. Code Regs §354.26(e)[1], undesirable results associated with Seawater Intrusion will not be discussed herein.

6.2 General Approach

As described later in this Appendix, the Subbasin identified minimum thresholds, based on declining groundwater levels (hereinafter "water level" or "level") that result in significant and unreasonable results to the beneficial uses and users of groundwater within the Kaweah Subbasin. Measurable objectives are similarly based on using a trend line approach to afford the ability to provide a buffer for drought years prior to encountering minimum thresholds. The relationship of these measurable objectives and the long-term success in achieving the objectives is discussed in the context of neighboring GSAs in the Subbasin and their respective actions undertaken during GSP implementation.

The Kaweah Subbasin GSAs developed SMC within a framework of data, which currently has gaps. Every effort was made to coordinate SMC between the three GSAs. If SMCs (such as minimum thresholds and measurable objectives) vary substantially between adjacent GSAs, then the GSAs will endeavor to adjust the particular SMC as additional data becomes available so that the GSAs eliminate any substantial variance which could inhibit a GSA from implementing its GSP and achieving sustainability within its jurisdictional area.

The metrics and approaches to be employed by the Subbasin for the six sustainability indicators are shown in **Table 6-1**.

[1] 23 Cal. Code Regs §354.26(e) provides "An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

6.3 Sustainability Goal

23 Cal. Code Regs. § 354.24. *Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish and sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.*

Table 6-1: Sustainable Management Criteria by Sustainability Indicator

SMC Summary for Kaweah Subbasin		
Sustainability Indicators	**Basis for Minimum Threshold**	**Basis for Measurable Objective**
Chronic Lowering of Groundwater Levels	Protection of greater than the 90th percentile of all beneficial uses and users without allowing a greater rate of historical level decline[1]	Flexibility for at least 5 years of drought storage
Reduction in Storage	Calculated based on groundwater levels[2]	Calculated based on groundwater levels[2]
Land Surface Subsidence	Total subsidence of no more than 9 feet, and a subsidence rate of no more than 0.67 feet/year	Zero Subsidence
Water Quality	Reference to other regulators [3]	Reference to other regulators [3]
Seawater Intrusion	Not Applicable	Not Applicable
Interconnected Surface Waters	50% of channel losses in selected waterways[4]	30% of channel losses in selected waterways[4]

[1] Determined by representative monitoring sites in Analysis Zones
[2] Storage volume changes and associated SMC determined as function of water level changes
[3] e.g. SWRCB Division of Drinking Water requirements for public supply wells, RWQCB Irrigated Lands Regulatory Program
[4] This indicator applies to the East Kaweah and Greater Kaweah GSAs. The two GSAs will be implementing a Work Plan to fill data gaps and better refine understanding of location and impacts caused by groundwater pumping

The broadly stated sustainability goal for the Kaweah Subbasin is for each GSA to manage groundwater resources to preserve the viability of existing agricultural enterprises of the region, domestic wells, and the smaller communities that provide much of their job base in the Sub-basin, including the school districts serving these communities. The goal will also strive to fulfill the water needs of existing and amended county and city general plans that commit to continued economic and population growth within Tulare County and portions of Kings County.

This goal statement complies with §354.24 of the Regulations. This Goal will be achieved by:

- The implementation of the EKGSA, GKGSA and MKGSA GSPs, each designed to identify phased implementation of measures (projects and management actions) targeted to ensure that the Kaweah Subbasin is managed to avoid undesirable results and achieve measurable objectives by 2040 or as may be otherwise extended by DWR.

- Collaboration with other agencies and entities to arrest chronic groundwater-level and groundwater storage declines, reduce or minimize land subsidence where significant and unreasonable, decelerate ongoing water quality degradation where feasible, and protect the local beneficial uses and users.
- Assessments at each interim milestone of implemented projects and management actions and their achievements towards avoiding undesirable results as defined herein.
- Continuance of projects and management actions implementation by the three GSAs, as appropriate, through the planning and implementation horizon to maintain this sustainability goal.

6.4 Groundwater Levels

23 Cal. Code Regs § 354.26*(a). Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.*

The terms "significant and unreasonable" are not defined by SGMA, and are left to GSAs to define within their GSPs. The process to define "significant and unreasonable" began with stakeholder and landowner discussions. In the view of the Kaweah Subbasin GSAs and its stakeholders, the following impacts from lowering groundwater levels are viewed as "significant and unreasonable" as they would directly impact the long-term viability of beneficial uses/users (domestic, agricultural, municipal, etc.) to meet their reasonable water demands through groundwater:

- Inability of the groundwater aquifer to recover in periods of average/above average precipitation following multi-year drought periods
- Dewatering of a subset of existing wells below the bottom of the well
- Substantial increase in costs for pumping groundwater, well development, well construction, etc. that impact the economic viability of the area
- Adverse effects on health and safety
- Interfere with other sustainability indicators

6.4.1 Causes leading to Undesirable Results

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.*

The primary cause of groundwater conditions that would lead to chronic lowering of groundwater levels is groundwater pumping in excess of natural and artificial recharge over a multi-year period that includes both wetter than average and drier than average conditions. A transition to permanent crops and development of large dairies have both hardened water demand in all years. In addition to natural drought-cycles, the increase in groundwater pumping may also be the result of restricted access to imported supplies due to a variety of factors, including but not limited to, increased restrictions in the Delta, which may increase the likelihood imported supplies from Millerton Lake will be delivered outside the Kaweah Subbasin. The restriction of imported supplies may return the Kaweah Subbasin to a state it existed in prior to the development of the Friant Division of the Central Valley Project. Climate change may also affect the availability and rate upon which natural and artificial recharge is available.

6.4.2 Criteria to Define Undesirable results

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.*

The GSAs within the Kaweah Subbasin have determined that undesirable results for groundwater levels may be significant and unreasonable when a subset of existing and active wells is dewatered. This is being described this way because the Subbasin has a significant data gap related to where all active wells are, how the active wells are constructed and how much the active wells are pumping. The Subbasin GSAs have plans to obtain this information from local landowners in the future. As this data gap is addressed, the description of an Undesirable Result for the Kaweah Subbasin will be further refined based on the more complete and accurate information.

Groundwater elevations shall serve as the sustainability indicator and metric for chronic lowering of groundwater levels and, by proxy, for groundwater storage. An Undesirable Result occurs when one-third of the monitoring sites exceed the respective minimum threshold groundwater elevation.

It is the preliminary determination, after consideration of all users and uses, that the values identified herein represent a sufficient number of monitoring sites in the Subbasin such that their exceedance would represent an undesirable result for water-level declines and reduction in groundwater storage. Total completion depth data for all beneficial users (agricultural, municipal, and domestic wells), as identified in the technical Appendix 6-1 and 6-2 attached to this Appendix, has been evaluated and undesirable results are defined by the quantity of wells completely dewatered by 2040 if Minimum Thresholds are met or exceeded. However, the Kaweah Subbasin GSAs are committing to implementing a Mitigation Program to mitigate certain impacts to active wells as groundwater levels transition to a more sustainable long-term condition (see Appendix 6-3). Based on future observed groundwater levels and not less frequently than at each five-year assessment, the GSAs will evaluate whether these values need to be changed.

6.4.3 Evaluation of Multiple Minimum Thresholds

> 23 Cal. Code Regs § 354.26 *(c). The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.*

The Kaweah Subbasin GSAs will utilize multiple wells to monitor and manage the GSAs and Subbasin. A detailed description of each GSA's monitoring network are included in the Monitoring Network Section of their respective GSPs.

6.4.4 Potential Effects on Beneficial Uses and Users

Using the above-described criteria, the GSAs evaluated potential undesirable results to agricultural, domestic, industrial, and municipal beneficial uses. Overall, based on the best available data, the projects and management actions to be implemented by each GSA are predicted to decelerate and arrest chronic lowering of groundwater levels by 2040. Potential impacts to wells associated with groundwater level declines in the transition period between 2020 and 2040 were evaluated through an analysis of well completed depths (see Appendix 6-1). Potential effects of lowered groundwater levels on the various beneficial uses of groundwater in the Kaweah Subbasin are as follows:

Agricultural – Potential effects to agricultural beneficial uses and users from lowered groundwater levels include financial impacts to lower pumps, repair/replace wells, and increased pumping costs. Analysis of well depths that could be affected by lowering groundwater levels to the minimum thresholds has been completed (see Appendix 6-2).

Domestic – Some domestic uses and users of groundwater may be impacted by continued lowering of groundwater levels during the transition period from January 2020 to December 2040. Analysis of well depths that could be affected by lowering groundwater levels to the minimum thresholds has been completed (see Appendix 6-2). Lowering groundwater levels below the total depth of shallow domestic wells could lead to added costs to haul in water supplies, tie into other available supplies, consolidation with existing water service providers, or requiring other form of mitigation

Industrial & Municipal – Potential effects to industrial beneficial uses and users from lowered groundwater levels include financial impacts to lower pumps, repair/replace wells, and increased pumping costs. Analysis of well depths that could be affected by lowering groundwater levels to the minimum thresholds has been completed (see Appendix 6-2).

To address potential effects on agricultural, domestic and industrial beneficial uses and ensure access to water until the Subbasin reaches a sustainable groundwater level condition, each GSA will adopt a Mitigation Program or Programs consistent with the framework described further in the next section. Because of this mitigation, the resulting impacts as described herein during the implementation period are not considered significant and unreasonable.

6.4.5 Mitigation Program

The Subbasin is committing to developing a Mitigation Program that evaluates and protects beneficial users from lowering groundwater levels and subsidence. The core tenants of well mitigation are coordinated here; however, each GSA will develop and implement GSA-specific programs based on the localized needs of their jurisdictions. The GSAs will take appropriate action to implement the Program no later than June 30, 2023. The key factors to be included are listed below. A draft well mitigation plan template is included in Appendix 6-3.

- Identification of the priority wells to be mitigated, with approximate quantification
- An investigation and vetting process to confirm well priority and impacts
- A listing of the mitigation methods, including both short and long-term options
- Estimated costs of mitigation methods and funding mechanism(s)
- Implementation schedule

6.5 Groundwater Storage

> 23 Cal. Code Regs § 354.26*(a). Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.*

The Groundwater Storage minimum thresholds are the same as groundwater levels and groundwater elevations across the GSA and Subbasin and were used to calculate the amount of groundwater in storage below the Minimum Thresholds to the base of the aquifer. An undesirable result in groundwater storage may be significant and unreasonable if the total amount of water in storage was less than the estimated amount of groundwater in storage below the Minimum Threshold or other factors identified in section 6.4 occur.

6.5.1 Causes leading to Undesirable Results

> 23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.*

Undesirable results associated with groundwater storage are caused by the same factors as those contributing to groundwater level declines. Given assumed hydrogeologic parameters of the Subbasin, direct correlations exist between changes in water levels and estimated changes in groundwater storage.

6.5.2 Criteria to Define Undesirable results

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.*

The water-level sustainability indicator is used as the driver for calculated changes in groundwater storage. Given assumed hydrogeologic parameters of the Subbasin, direct correlations exist between changes in water levels and estimated changes in groundwater storage, and water levels are to serve as a metric for groundwater storage reductions as well. As such, when one-third of the Subbasin representative monitoring sites for water levels exceed their respective minimum thresholds, an undesirable result for storage will be deemed to occur. The current estimated volume of groundwater in storage in the Subbasin of 15 to 30 MAF is sufficient such that further depletion over the implementation period is not of a level of concern such that an undesirable result would emerge during the GSP implementation period.

6.5.3 Potential Effects on Beneficial Uses and Users

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interest, and other potential effects that may occur or are occurring from undesirable results.*

The potential effects to beneficial uses and users of reductions in groundwater storage are essentially the same as for declines in water levels. In most cases, the direct correlation is with declines in levels; however, some beneficial uses may be tied more specifically to loss of groundwater in storage.

6.6 Land Subsidence

23 Cal. Code Regs § 354.26*(a). Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.*

Land subsidence may be considered significant and unreasonable if there is a loss of a functionality of a structure or a facility to the point that, due to subsidence, the structure or facility cannot reasonably operate without either significant repair or replacement.

6.6.1 Causes leading to Undesirable Results

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.*

Geology - The geology of the Subbasin appears to have greater potential for subsidence the further west you go. Generally, it is understood that the multi-aquifer area has the greatest potential for subsidence due to the presence of the deep confined aquifer. However, even in the single aquifer area, there are disconnected clays that appear to be deposited similarly to the Corcoran Clay. These clays also have the potential to subside, but do not seem to have the high potential of other areas because the aquifer is not fully confined. This speaks to why there is still subsidence in eastern portions of the Subbasin, east of the Corcoran Clay.

Deep Aquifer - The Subbasin understands that deep pumping from pressurized aquifer zones is primarily related to subsidence. In the Kaweah Subbasin this would generally be below the Corcoran Clay. However, the specific zone below the Corcoran Clay that is subsiding is not currently known. It is also understood that some small component of subsidence is related to water level declines in the upper aquifer.

Declining Levels & Drilling Deeper - The Subbasin understands that the chronic lowering of groundwater levels is related to the triggers for subsidence. As groundwater levels decline, landowners choose to drill deeper wells to restore their access to available groundwater supplies. When new deeper wells are drilled, the geology below the previous well and above the base of the new well is subjected to new impacts from the new well. Generally, the Subbasin views the effort to stabilize groundwater levels as critical to future success in dealing with subsidence. As groundwater pumping is reduced across the Subbasin, groundwater level declines will diminish, and fewer wells will be drilled deeper which will reduce the development of subsidence across the Subbasin.

Undesirable results associated with subsidence are caused groundwater pumping from deep wells that tap pressurized zones with fine grained deposits that experience declining groundwater levels. Some GSA Management Areas experience greater adverse impacts than others. Over-pumping during drought periods, which may result in new lows in terms of groundwater elevations, is of particular concern based on current scientific understanding of subsidence trends in this region.

6.6.2 Criteria to Define Undesirable results

> 23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.*

The Kaweah Subbasin GSAs understand that impacts from subsidence have been occurring in the Kaweah Subbasin for many years. However, the rate of subsidence has seemed to increase significantly around 2007. Deep wells have collapsed with compression failures, the ground surface has slowly changed elevations over time, and some linear systems dependent on grade have experienced capacity reductions. Also, during the same period many other facilities have not experienced those negative impacts, and why some have versus others not is still very difficult to understand. Shallow wells are generally not viewed as being at risk of subsidence impacts. The

Kaweah Subbasin GSAs have attempted to consider all local infrastructure, land uses and groundwater users relative to current and potential subsidence impacts and develop a view of groundwater conditions (Minimum Threshold elevations) that would avoid Undesirable Results in the Subbasin.

The Kaweah Subbasin GSAs understand that groundwater wells are very important infrastructure for all landowners across the Subbasin. For this reason, the Kaweah Subbasin GSAs view that an Undesirable Result (UR) would occur if a significant portion of the existing deep wells in the Kaweah Subbasin became inoperable (collapsed) due to subsidence. The Kaweah Subbasin GSAs understand that the Friant-Kern Canal is a facility of statewide importance (critical infrastructure) that delivers San Joaquin River surface water to parties in the Kaweah Subbasin and beyond. For that reason, the Kaweah Subbasin GSAs also view that a UR would occur if the capacity of the Friant-Kern Canal was significantly impacted by subsidence. The Kaweah Subbasin GSAs understands that local flood control channels are very important infrastructure for all landowners across the Kaweah Subbasin. For that reason, the Kaweah Subbasin GSAs view that a UR would occur if the capacity of flood control channels in the Subbasin are significantly impacted by subsidence. And lastly, the Kaweah Subbasin GSAs understand that certain main canals are very important for landowners across the Kaweah Subbasin because their function is critical to continued use of surface water in Subbasin, which reduces demand for groundwater and provides the ability to recharge aquifers in wet years. For that reason, the Kaweah Subbasin GSAs view that a UR would occur if the capacity of certain main canals in the Subbasin are significantly impacted by subsidence.

Subsidence RMS sites will be monitored for ground surface elevation annually each fall. The primary criteria for evaluation will be the reduction in land surface elevation from the beginning of the Implementation Period (if that data is available). There will be two methods of identifying an Undesirable Result (UR) for the Subbasin. For the area outside of the Friant-Kern Canal alignment, when one-third of the Subbasin RMSs outside the Friant-Kern Canal band decline below their respective MT elevations, that will be viewed as a UR. For a one-mile band on either side of the Friant-Kern Canal, if any of the MT elevations in that band reach an MT elevation that will be viewed as a UR.

The primary criteria and metric the GSAs will monitor will be the total amount of reduction in land surface elevation and areal extent of such elevation changes.

For many of the impacts listed above, subsidence is only a problem when it is differential in nature i.e., elevation shifts across the areal extent of infrastructure deemed of high importance. For example, subsidence linearly along a major highway is manageable if gradual in its occurrence. In contrast, localized subsidence traversing across a highway, if sizable, would cause major cracking of the pavement surface and become a significant hazard to travelers. The same comparisons may be made for other infrastructure as well.

If an exceedance of a minimum threshold at a monitoring site occurs, the applicable GSA will reach out to the County, cities, water districts, and others, both public and private, and inquire as to any infrastructure that has been damaged which may require a corrective course of action if deemed necessary. A broad areal extent of land subsidence thus may not be of major concern, with the exception of the associated loss of aquifer system water storage capacity.

6.6.3 Potential Effects on Beneficial Uses and Users

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interest, and other potential effects that may occur or are occurring from undesirable results.*

The Kaweah Subbasin GSAs understand that impacts from subsidence have been occurring in the Kaweah Subbasin for many years. Some of the understood impacts are briefly discussed below:

Flood Channels - Rivers and creeks generally begin in watersheds in the foothills and mountains east of the Subbasin and flow downhill to the southwest toward the historic Tulare Lake. Part of the Kaweah Subbasin's history involves regular floods, and that is why dams were built on local rivers and streams to protect communities and farmlands from regular flood events. However, even though the dams exist, they only provide protection up to a certain magnitude flooding event. Subsidence has not been observed to diminish the capacity of local flood channels, but it theoretically could impact capacity under the right circumstances. Also, subsidence could cause a change to the amount of sediment that is moved by the system. However, there are parties responsible for the maintenance of these channels and incremental impacts are likely being addressed through maintenance.

Local Flooding - Ground surface changes can affect flood zones as well as flood control levees. Local flood control levees are maintained by agencies responsible for maintaining their effectiveness. In 2017 a local flood control levee was raised by several feet to address subsidence concerns, but that was the first such project on that levee in decades and it was completed in just a few months. The planned development of new recharge projects and the increased use of wet year surface water should more than mitigate potential modifications to existing flood zones.

Local Canals - These linear facilities are very important related to GSA Management Strategies. If their capacity is significantly impacted, it may require GSAs to shift to greater pumping reductions.

Regional Canals - These linear facilities, like the Friant-Kern Canal, usually have regional significance and have users across large sections of the Southern San Joaquin Valley. The cost of repairing subsidence impacts on these facilities are too expensive for the Kaweah Subbasin to bear. For that reason, other management strategies like pumping restrictions to stabilize groundwater levels will be imposed instead.

Shallow Wells - Shallow wells that do not have significant exposure to the confined aquifer below the Corcoran Clay do not appear to be at risk from subsidence.

Deep Wells - Wells that have significant exposure to the confined aquifer below the Corcoran Clay are at risk of collapse due to subsidence that is mostly linked to that zone. A preliminary estimate of significant and unreasonable impacts can be established by looking at well construction practices. Subsidence mainly occurs in the deeper aquifers, and therefore well collapse due to subsidence typically only affects deeper wells. Conversations with local well drillers and suppliers indicates that deeper wells are now commonly outfitted with compression sleeves (personal communication). These compression sleeves allow well casings to telescope in response to subsidence, preventing casing collapse (Turnbull, 2022). Each compression sleeve allows 6 feet of compression, and often wells are equipped with 1 or 2 sleeves (personal communication). This allows for 6 to 12 feet of subsidence without causing collapse.

Railroads - There are several railroads throughout the Subbasin that convey goods along predefined routes and the facilities also have flood control structures, like culverts, along their alignments. The observed grade changes that have occurred from subsidence do not appear to be significant for local railroads and their culverts appear to be staying stable with adjacent properties. However, steep localized subsidence can be a significant issue in terms of the cost of repairs.

Natural Gas Pipelines - Along Highway 99 there is a significant natural gas pipeline. Over the past several years this facility has been worked on at various points, but it appears the efforts related to issues other than subsidence.

Differential land subsidence may impact surface infrastructure such as building foundations, paved streets/highways, and water conveyance systems.

The Kaweah Subbasin GSAs have attempted to consider all local infrastructure, land uses and groundwater users relative to current and potential subsidence impacts and develop a view of groundwater conditions (MT elevations) that would avoid Undesirable Results in the Subbasin. Again, the Kaweah Subbasin GSAs view that stabilized groundwater levels as critical to the future success of dealing with subsidence. As groundwater pumping is reduced across the Subbasin, groundwater level declines will diminish, and fewer wells will be drilled deeper which will reduce the development of subsidence across the Subbasin.

6.6.4 Evaluation of Multiple Minimum Thresholds

23 Cal. Code Regs § 354.26 *(c). The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.*

The Kaweah Subbasin GSAs will use measurements taken at multiple subsidence benchmarks and Interferometric Synthetic Aperture Radar (InSAR) data to monitor and manage subsidence in the GSA and Subbasin. A detailed description of each GSA's monitoring networks are included in the Monitoring Networks Section of their respective GSPs.

6.6.5 Mitigation Program

The Subbasin is committing to developing a Mitigation Program that evaluates and protects beneficial users from certain land subsidence impacts. The core tenants of subsidence mitigation are coordinated in the Mitigation Program through this Coordination Agreement; however each GSA will develop and implement GSA-specific programs based on the localized needs of their jurisdictions. The GSAs will take appropriate action to implement the Program no later than June 30, 2023. The key factors to be included below. A draft well mitigation plan template is included in Appendix 6-3.

- Identification of the priority land surface infrastructure to be mitigated, with approximate quantification
- An investigation and vetting process to confirm priority and impacts
- A listing of the mitigation methods, both short and long-term options
- Estimated costs of mitigation methods and funding mechanism(s)
- Implementation schedule

6.7 Degraded Water Quality

23 Cal. Code Regs § 354.26*(a). Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.*

An undesirable result may be significant and unreasonable if groundwater quality is adversely impacted by groundwater pumping and recharge projects and these impacts result in groundwater no longer being generally suitable for agricultural irrigation and/or domestic use.

6.7.1 Causes leading to Undesirable Results

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.*

Undesirable results associated with water quality degradation can result from pumping localities and rates, as well as other induced effects by implementation of a GSP, such that known plumes and contaminant migration could threaten production well quality. Well production depths too may draw out contaminated groundwater, both from naturally occurring and man-made constituents which, if MCLs are exceeded, may engender undesirable results. Declining groundwater levels may or may not be a cause, depending on location. In areas where shallow groundwater can threaten the health of certain agricultural crops, rising water levels may be of concern as well.

6.7.2 Criteria to Define Undesirable results

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.*

Should one-third of all Subbasin designated water quality monitoring sites exhibit a minimum threshold exceedance, and those exceedances are all associated with GSA actions, an undesirable result will be deemed to occur. Groundwater quality degradation will be evaluated relative to established MCLs or other agricultural constituents of concern set by applicable regulatory agencies. The metrics for degraded water quality shall be measured by MCL compliance or by other constituent content measurements where appropriate. These metrics will include measurements for the following constituents where applicable:

- Arsenic
- Nitrate
- Chromium-6
- DBCP
- TCP
- PCE
- Sodium
- Chloride
- Perchlorate
- TDS

As explained in Section 5.3.4, in regions where agriculture represents the dominant use of groundwater, Agricultural Water Quality Objectives will serve as the metric as opposed to drinking water MCLs within public water supply jurisdictions. An exceedance of any of the MCL or Agricultural Water Quality Objectives as defined herein at any representative monitoring sites will trigger a management action within the applicable Management Area or GSA, subject to determination that the exceedance was caused by actions of the GSA. MCLs and water quality objectives are listed in each of the Kaweah Subbasin GSPs and these are subject to changes as new water quality objectives are promulgated by the State of California and the Federal EPA. The Subbasin will provide updates in our annual reports and GSP Updates throughout the implementation periods of 2020 to 2040.

6.7.3 Potential Effects on Beneficial Uses and Users

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interest, and other potential effects that may occur or are occurring from undesirable results.*

The potential effects of degraded water quality from migrating plumes or other induced effects of GSA actions include those upon municipal, small community and domestic well sites rendered unfit for potable supplies and associated uses, and/or the costs to treat groundwater supplies at the well head or point of use so that they are compliant with state and federal regulations. Potential effects also include those upon irrigated agricultural industries, as certain mineral constituents and salt build-up can impact field productivity and crop yields.

6.7.4 Evaluation of Multiple Minimum Thresholds

> 23 Cal. Code Regs § 354.26 *(c). The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.*

The Subbasin, in coordination with other GSAs in the basin will utilize multiple wells to monitor water quality and manage the GSA and basin. A detailed description of the GSA's monitoring network is included in the Monitoring Networks Section of their respective GSPs.

6.8 Interconnected Surface Waters

Interconnected surface waters within the Kaweah Subbasin are a significant data gap that needs more development through collection of additional data and further studied through the development of a technical analysis tool. The East Kaweah and Greater Kaweah GSAs are developing a work plan to collect data and analyze interconnected surface water presence and potential impacts from groundwater pumping (see Management Action Section of each respective GSP for more detail on these work plans.

6.8.1 Causes Leading to Undesirable Results

> 23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.*

Undesirable results associated with interconnected surface waters are understood to be caused by several factors. Some of these factors may include groundwater pumping, drier hydrology, and changes within the upper watershed, or some combination of those factors. Within the Kaweah Subbasin, there are currently significant data gaps related to understanding the potential locations of interconnected surface waters and their nexus to depletions caused by groundwater pumping. More information is intended to be developed and shared through a work plan being coordinated and implemented by the East and Greater Kaweah GSAs. The preliminary schedule for the work plan is in Table 6-2. Pending data gathered and/or timing of such data, there may be shifts or re-ordering of phases/tasks to better adapt and facilitate completion.

Table 6-2 Anticipated Interconnected Surface Water Work Plan Schedule

Phase	Description	Estimated Timeline
1	Additional research; data gap filling (monitoring well installation, stream gauge installation, etc.); data collection	October 2022 – June 2024
2	Analytical Tool Development – the type of tool will be determined with additional data and research	March 2023 – December 2023
3	Interconnection Analysis and Determination	January 2024 – July 2024
4	SMC Development and Incorporation into 2025 GSP	July 2024 – January 2025

6.8.2 Criteria to Define Undesirable results

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin.*

The Kaweah Subbasin (East Kaweah and Greater Kaweah GSAs specifically) are implementing a work plan that is intended to provide a clearer definition of where potentially interconnected surface waters are located and to what extent adverse impacts related to groundwater pumping are present and can be defined and quantified. At the current time (July 2022), the primary criteria and metric for defining and quantifying adverse impacts and undesirable results will be the estimated percentage of losses within potentially interconnected channels, measured as a rate or volume of depletion of surface water, until the work plan provides more information. Currently, there is not sufficient data to definitively set rate of depletions on other data. Increased channel losses reduce the amount of surface water that can be delivered throughout the Kaweah Subbasin. Delivery of surface water is a critically important part of sustainably managing the Kaweah Subbasin, thus impacts that reduce the ability to deliver surface water can become significant and unreasonable and ultimately lead to an undesirable result. The initial percentages being used for SMC are 50% losses due to groundwater pumping for the MT and 30% losses due to groundwater pumping for the MO. The East Kaweah and Greater Kaweah GSS will implement a work plan intended to fill data gaps by the 2025 GSP Update. Better definition and criteria for significant and unreasonable impacts and, ultimately, undesirable results in the locations identified as having interconnected surface waters are envisioned to be available from the proposed work plan.

6.8.3 Potential Effects on Beneficial Uses and Users

23 Cal. Code Regs § 354.26 *(b). The description of undesirable results shall include the following: (3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interest, and other potential effects that may occur or are occurring from undesirable results.*

Currently identified potential beneficial uses/users related to interconnected surface water within the East and Greater Kaweah GSA regions of the Kaweah Subbasin are surface water users, riparian and/or groundwater dependent ecosystems, and water rights holders. As more data becomes available, the Work Plan may add or subtract to these uses/users in whole or part of the reaches of the selected waterways. The potential effects of depletions to interconnected surface water, when approaching or exceeding minimum thresholds and thus becoming an undesirable result include:

- Increased losses in interconnected surface waterways used for surface water conveyance, reducing water supply reliability and volumes.
- Negatively and significantly impacting the health of riparian and/or groundwater dependent ecosystems.
- Violating laws and doctrines governing California's surface water rights.

6.8.4 Evaluation of Multiple Minimum Thresholds

23 Cal. Code Regs § 354.26 *(c). The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.*

The Kaweah Subbasin GSAs will utilize a variety of methods, to be determined based on data gained through the implementation of the work plan, to monitor and manage interconnected surface waters in the GSA and Subbasin. Further detail necessary for properly evaluating interconnected surface water and the potential relationship to groundwater pumping in the Kaweah Subbasin is anticipated to be gained through implementation of the work plan.

6.9 Seawater Intrusion

6.9.1 Undesirable results

23 Cal. Code Regs § 354.26 *(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.*

There is no potential for seawater intrusion to occur in the Kaweah Subbasin as described more thoroughly in the basin setting. Thus, no criteria need to be established.

Appendix 6-1 of the Coordination Agreement

Technical Approach for Developing Chronic Lowering of Groundwater Levels Sustainable Management Criteria in the Kaweah Subbasin

July 27, 2022

Technical Approach for Developing Chronic Lowering of Groundwater Levels Sustainable Management Criteria in the Kaweah Subbasin

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ACRONYMS & ABBREVIATIONS

DWR ....California Department of Water Resources
EKGSA ....East Kaweah Groundwater Sustainability Agency
GKGSA..........Greater Kaweah Groundwater Sustainability Agency
GSA................Groundwater Sustainability Agency
GSP ....Groundwater Sustainability Plan
MKGSA ....Mid-Kaweah Groundwater Sustainability Agency
MO ....measurable objective
MT..................minimum threshold
SGMA ....Sustainable Groundwater Management Act
SMC ....Sustainable Management Criteria
Subbasin.........Kaweah Subbasin
WCR ....Well Completion Report

1 INTRODUCTION

This technical report describes the methodology applied to a revision of the chronic lowering of groundwater level sustainable management criteria (SMC) for the San Joaquin Valley - Kaweah Subbasin (Subbasin). The revisions are in response to the California Department of Water Resources (DWR) incomplete determination of the three Groundwater Sustainability Plans (GSPs) submitted in January 2020. The three GSPs are being implemented by three Groundwater Sustainability Agencies (GSAs) covering the entirety of the Subbasin: East Kaweah GSA, Greater Kaweah GSA, and Mid-Kaweah GSA (Figure 1).

DWR provided a staff report with a statement of findings explaining the incomplete determination for the Subbasin GSPs. The staff report states, "The Plan does not define sustainable management criteria for chronic lowering of groundwater levels in the manner required by Sustainable Groundwater Management Act (SGMA) and the GSP Regulations." DWR's findings specified the following:

1. *The GSPs do not define metrics for undesirable results and minimum thresholds based on avoiding a significant and unreasonable depletion of groundwater supply, informed by, and considering, the relevant and applicable beneficial uses and users in their Subbasin.*
2. *The GSPs do not describe specific potential effects from the chronic lowering of groundwater levels and depletion of supply that would be significant and unreasonable to beneficial uses and users of groundwater, on land uses and property interests, and other potential effects and, therefore, constitute an undesirable result.*
3. *The GSPs do not consider how minimum thresholds developed for one sustainability indicator will affect other related sustainability indicators."*

The GSAs are given up to 180 days from the receipt of DWR's staff report to address the deficiencies for chronic lowering of groundwater levels SMC. This report provides the technical support to fulfill that purpose.

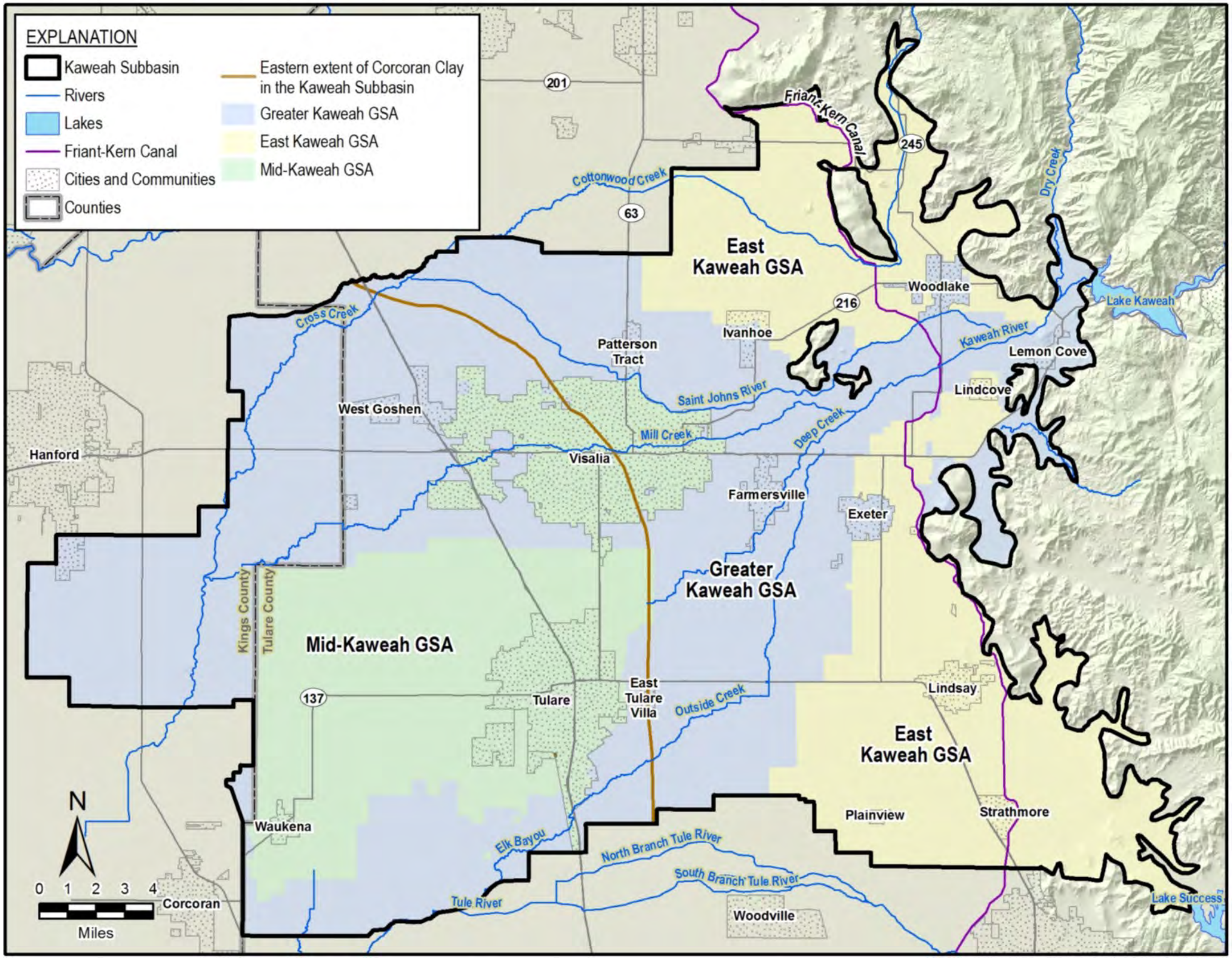


Figure 1. Groundwater Sustainability Agencies in the Kaweah Subbasin

1.1 General Approach Used to Develop Sustainable Management Criteria

Chronic lowering of groundwater levels SMC are developed to protect relevant and applicable beneficial uses and users of groundwater in the Subbasin. Beneficial users of groundwater are domestic pumpers, disadvantaged communities, small water systems (2 to 14 connections), municipal water systems (>14 connections), agricultural pumpers, California Native American Tribes, environmental users, and entities engaged in monitoring and reporting groundwater elevations. Understanding the types of users and their access to groundwater is the first step taken to inform what the GSAs and their stakeholder groups consider significant and unreasonable impacts to those users.

Since wells are how users access groundwater, the approach used to develop SMC is based on water supply well depths. The depth of wells across the Subbasin varies by depth to groundwater and beneficial user type. Because of well depth variability, the Subbasin is subdivided into analysis zones based on GSP management area boundaries, clusters of beneficial user types, aquifers, and completed well depths. Completed well depth statistics inform significant and unreasonable groundwater levels, with the SMC being based on protecting at least 90% of all water supply wells in the Subbasin.

1.2 Data Sources and Quality Control

Information used for establishing the chronic lowering of groundwater levels SMC include:

- Completed depths, screen depths, and locations of wells installed since January 1, 2002, and included in DWR's Well Completion Report (WCR) dataset (Figure 2). Only well records drilled since 2002 are used for analysis to filter out wells that may have been abandoned or no longer represent typical modern depths for active wells and current groundwater elevations. Data download date was March 1, 2022.
- Historical groundwater elevation data from DWR's California Statewide Groundwater Elevation Monitoring Program, SGMA Portal Monitoring Network Module, and individual water agencies.
- Maps of current and historical groundwater elevation contours.

The WCR dataset does not contain a complete accurate dataset, however, it is the best public source of data available. Approximately one-third of the wells drilled from 2002 on did not have well completion depths and could not be used in the analysis. For purposes of well depth analyses, we assumed the available wells with depth information are typical of depths in the Subbasin.

Well logs were reviewed for wells with completion depths less than 100 feet. This review generally found that either 1) the planned well use field was incorrectly classified as a water supply well when it was supposed to be a destroyed or remediation well, or 2) the completed well depth field was the depth of the conductor casing (often 50 feet) and not the bottom of the completed well. These inaccuracies were corrected. Furthermore, where coordinates of wells are unavailable, DWR locates the well in the middle of the Public Land Survey System section.

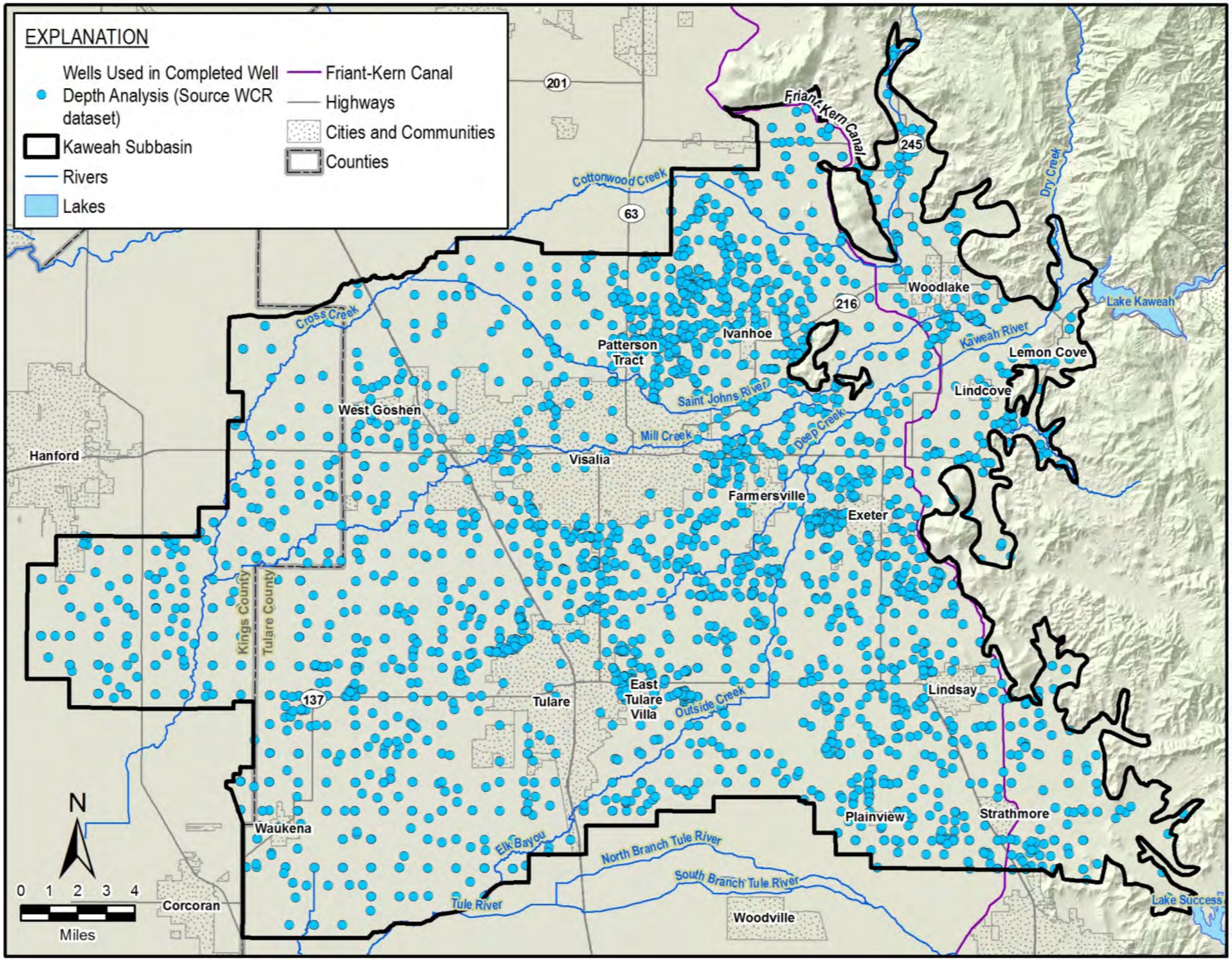


Figure 2. Location of WCR Water Supply Wells Used for Completed Well Depth Analysis

2 PROCESS USED TO ESTABLISH MINIMUM THRESHOLDS

Minimum thresholds (MTs) are derived from groundwater elevations that protect at least 90% of all water supply wells drilled since January 1, 2002, in each analysis zone, and that do not result in a greater rate of decline over water years 2020 to 2040 than experienced over a specific historical time period. Groundwater elevations representing MTs are set at representative monitoring sites identified in the Monitoring Network section of the GSPs.

The process for developing MTs is based on a comparison of three methodologies. The process is generally to:

1. Develop analysis zones based on GSP management areas, aquifer type, beneficial user types, and similar completed well depths (described in Section 2.1.1).
2. Identify water supply wells drilled since January 1, 2002, with well screen depth information or a completed well depth.
3. Designate water supply wells to either the Upper, Lower, or Single Aquifer System based on a set of assumptions (described in Section 2.1.2).
4. Designate representative monitoring sites to either the Upper, Lower, or Single Aquifer System (described in Section 2.1.2).
5. Estimate MT depths through Methodology 1 by calculating the 90th percentile well completion depth for water supply wells in each analysis zone and aquifer (described in Section 2.1.3).
6. Apply the 90th percentile protective depth corresponding to the representative monitoring sites' aquifer designation and analysis zone (described in Section 2.1.4).
7. Estimate MT depths through Methodology 2 by projecting relevant base period groundwater level trends to 2040 for each representative monitoring site (described in Section 2.1).
8. Compare elevations resultant from protective depths (Step 6) and projecting a groundwater levels trend out to 2040 (Step 7). The initial MT for the representative monitoring site is the higher elevation of the two methods (Figure 3).
9. Contour the representative monitoring site MTs obtained in Step 8 for the unconfined aquifers (Single and Upper Aquifer Systems) to determine if the MT surface is relatively smooth. If there are anomalous MTs, remove the anomalous points and interpolate the final MT elevations at these points from MT contours generated by excluding the anomalous sites. This is shown as Method 3 in Figure 3.

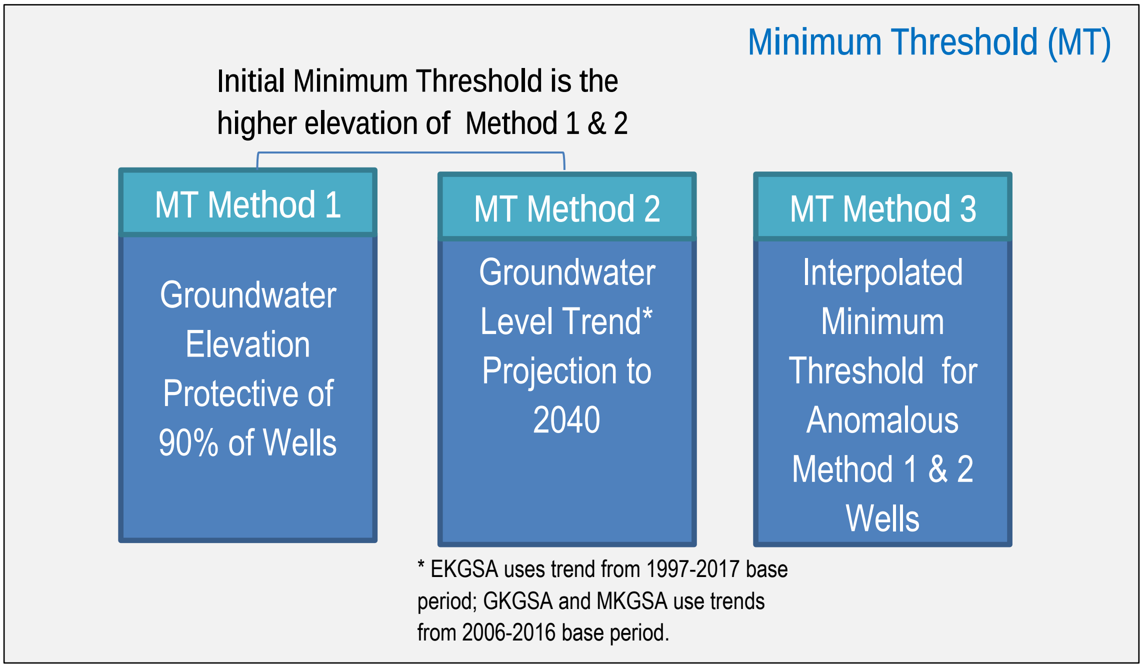


Figure 3. Minimum Threshold Methodologies

2.1 Methodology 1, Protective Elevations

The primary methodology for establishing MTs is designed to protect at least 90% of all wells in the Subbasin. This approach is protective of most beneficial uses and users of groundwater. The 90% threshold was chosen in acknowledgment that it is impractical to manage groundwater to protect the shallowest wells. More importantly, the GSAs wanted to set elevations based on well records of active wells, and not wells that may be destroyed or replaced. Because there is no active well registry to provide more accurate records, there is uncertainty regarding which wells are active. For example, the 2012-2016 drought was a period when approximately 480 wells in the Subbasin were reported dry according to the DWR's Dry Well Reporting System and a record number of wells were drilled in the Subbasin (Figure 4). Wells replaced by new deeper wells during this time are those that are presumed part of the shallowest 10% of wells in the dataset used to determine protective elevations. In consideration of the abovementioned factors, the GSA Managers selected 90% so that the dataset used to establish minimum thresholds contained well records reflective of current active wells.

Given approximately 10% of wells are shallower than the protected elevations, the GSAs in the Subbasin are in the process of establishing a Well Mitigation Program to assist impacted well owners.

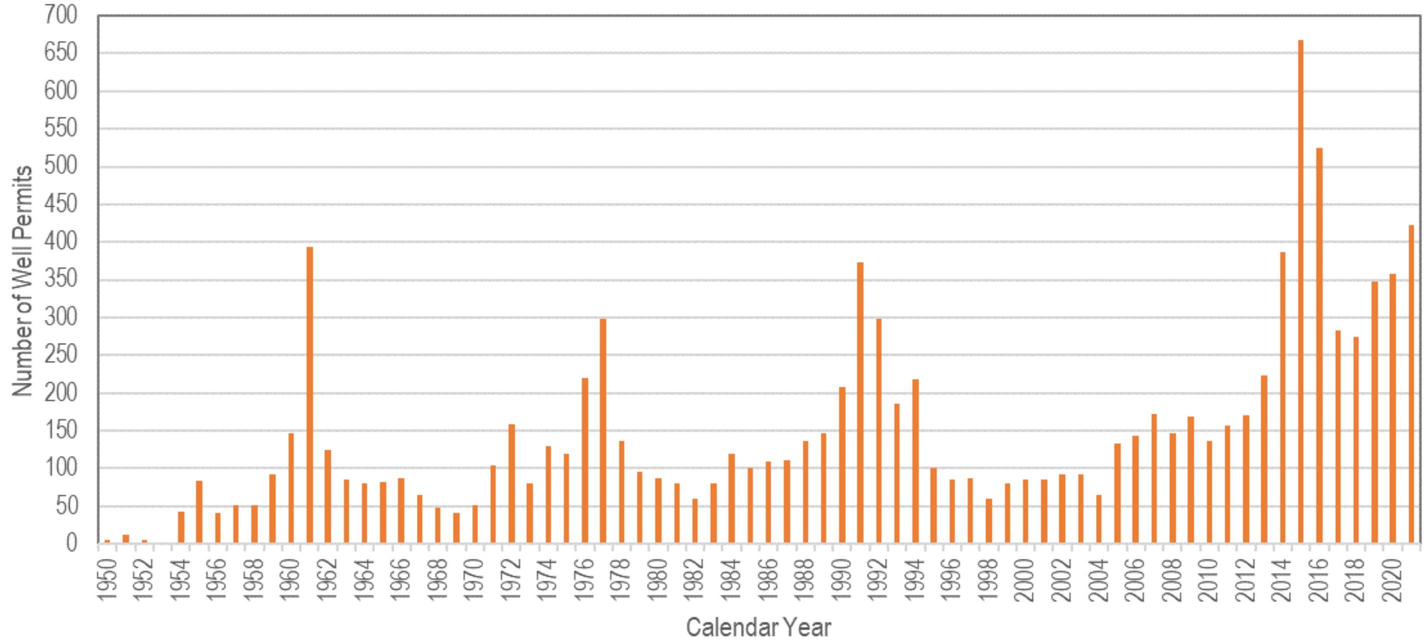


Figure 4. Annual Number of Water Supply Wells Drilled in the Kaweah Subbasin from 1950 to 2021

A total of 3,353 water supply well records from the WCR dataset are used for identifying significant and unreasonable groundwater elevations for beneficial groundwater users and uses. Criteria used to select well records from the WCR dataset include:

- The wells are drilled after January 1, 2002
- The wells are water supply wells with a planned purpose of domestic supply (includes DACs and private domestic wells), agricultural use, industrial use, or public supply (includes small water systems and municipal wells), and
- The wells have completed well depth data.

2.1.1 Analysis Zones

Because well depths vary with location, unique protective elevations are set for analysis zones that divide the Subbasin. The analysis zones are intended to group wells that would experience similar impacts by accounting for GSP management areas, groundwater elevations, base of aquifer, aquifer type, beneficial user type, land use, and similar completed well depths. A total of 39 spatial analysis zones are delineated (Figure 5). Twenty-three zones (analysis zones 1-23) cover the Single Aquifer System east of the limit of the Corcoran Clay shown on Figure 5. Sixteen zones (analysis zones 24-39) underlain by Corcoran Clay are split into an Upper and Lower Aquifer System based on the depth of the Corcoran Clay (described in Section 2.1.2). The Corcoran Clay is delineated vertically and spatially from recent airborne electromagnetic data acquired in the Subbasin by Stanford University (Kang *et al*., 2022).

2.1.2 Aquifer Designations

Aquifer designations are assigned to wells in the WCR dataset and the GSAs' representative monitoring sites based on available construction information and Corcoran Clay extent, depth, and thickness. As shown on Figure 6, the Corcoran Clay is a prominent confining geologic unit that underlies the western portion of the Subbasin and pinches out below the eastern portion of the Subbasin. The clay surface dips slightly with shallower occurrence to the east than the west. The Corcoran Clay is between 290 and 490 feet deep and up to 80 feet thick in the Subbasin.

All wells located east of the Corcoran Clay extent are designated as in the Single Aquifer System (Figure 6). Where the Corcoran Clay is present, wells are designated as Upper Aquifer System if the bottom of the well is above the bottom of the Corcoran Clay, and Likely Upper if the bottom of the well is within 50 feet of the bottom of the Corcoran Clay. Wells are designated as Lower Aquifer System if the top of its screen is within or below the Corcoran Clay. Wells are designated as Likely Lower if the total depth of the well with unknown screen depth is more than

50 feet below the bottom of the Corcoran Clay, or it is screened from less than 50 feet below the Corcoran Clay to more than 50 feet below the Corcoran Clay.

For wells without construction information that are underlain by the Corcoran Clay, groundwater level hydrographs are compared with hydrographs of other wells with construction information in the same analysis zone to determine in which aquifer the well is likely screened. Wells are designated as assumed Upper or assumed Lower Aquifer System based on similarities in seasonal and long-term groundwater level trends. Groundwater level hydrographs for representative monitoring sites are grouped by analysis zone and aquifer in Appendix A.

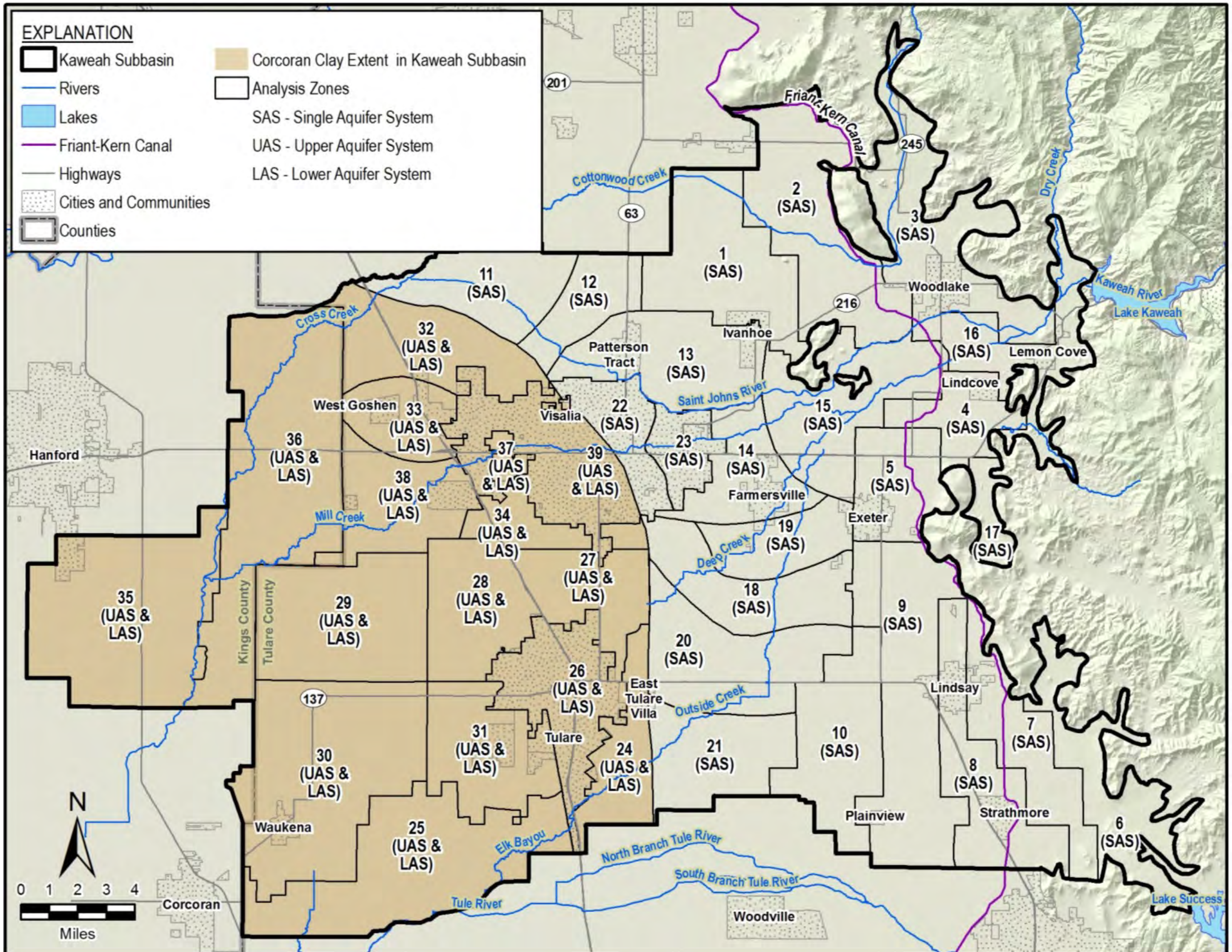


Figure 5. Kaweah Subbasin Analysis Zones

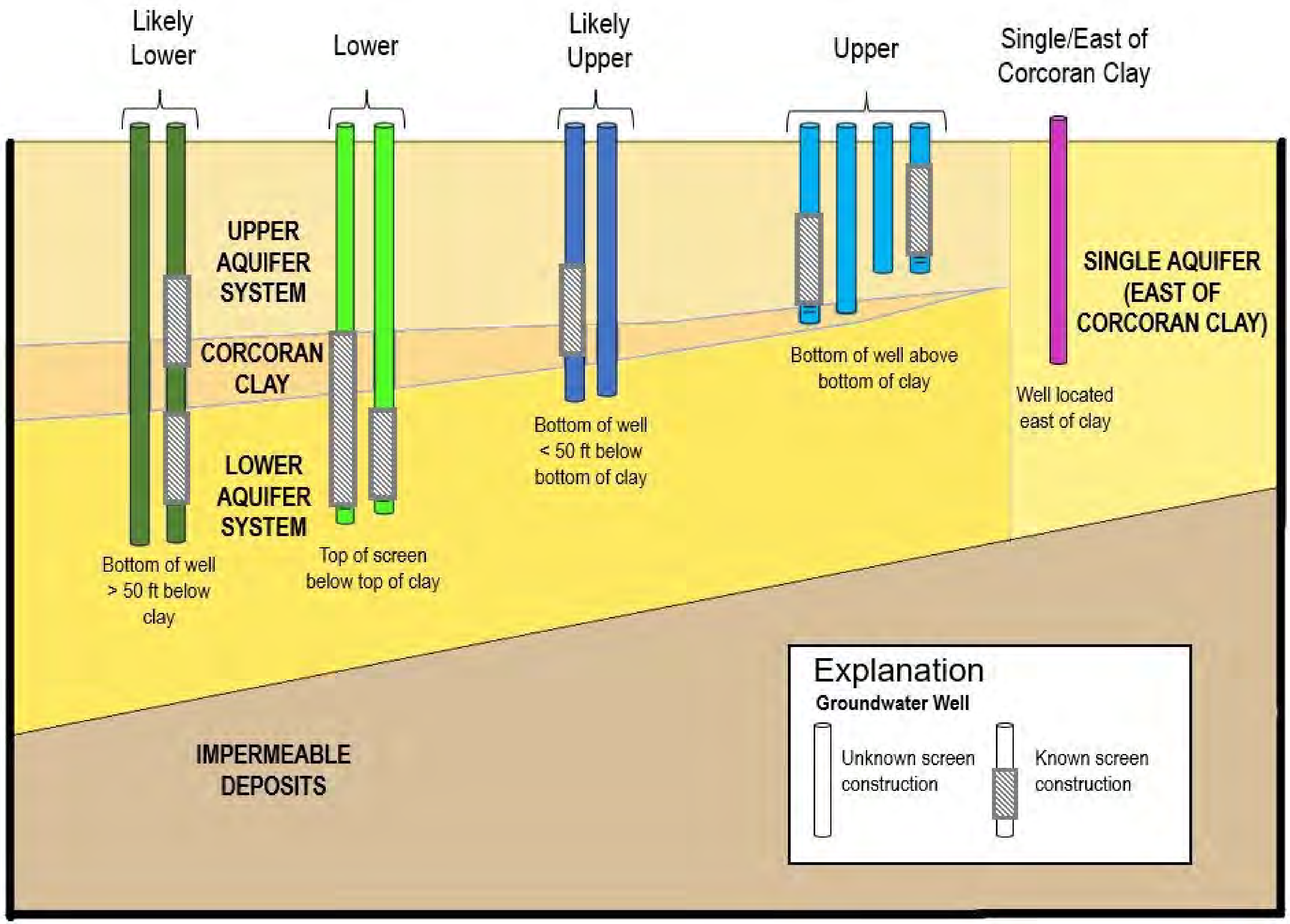


Figure 6. Kaweah Subbasin Aquifer Designation Assumptions

2.1.3 Completed Well Depth Analysis

Completed well depth is analyzed rather than total depth or depth of screens for the following reasons.

- Total depth drilled is typically deeper than the completed depth. Sometimes the difference can be quite large if the bottom portion of the well is not considered water bearing enough by the driller and is backfilled up to where the well is to be screened.
- More wells in the WCR dataset have completed depth information than well screen information. Of the wells with completed well depth information, 80% of those wells have screen depths. Since it is typical that wells are screened near the bottom of the completed well, more wells could be used in the analysis if completed well depth is used rather than screen depth.

Completed well depths vary by well use type, depth to groundwater, and aquifer. Figure 7 though Figure 13 depict the distribution of well use type and completed well depths across the Subbasin. Figure 7 shows a histogram of completed well depths across the entire Subbasin. Wells used in analysis are designated an aquifer system according to the assumptions outlined in Section 2.1.2.

Most wells in the Subbasin are completed to depths between 100 and 700 feet. The most common completed well depth is 350 to 400 feet, with about 700 total wells drilled to this depth. Well depth by type and aquifer is reviewed to assess which beneficial users would be impacted by lower groundwater levels. Figure 8 through Figure 10 are aquifer-specific histograms of completed well depth by well use type. Most supply wells in the Subbasin are either used for agricultural or domestic water supply. Agricultural wells are more numerous than other types of water supply wells and also cover the widest range of depths, including the deepest depths of all wells. Overall, the shallowest wells tend to be domestic supply wells with few domestic wells installed deeper than 450 feet. There are relatively fewer public supply wells, with the majority less than 450 feet deep, although there are some that are deeper than 800 feet.

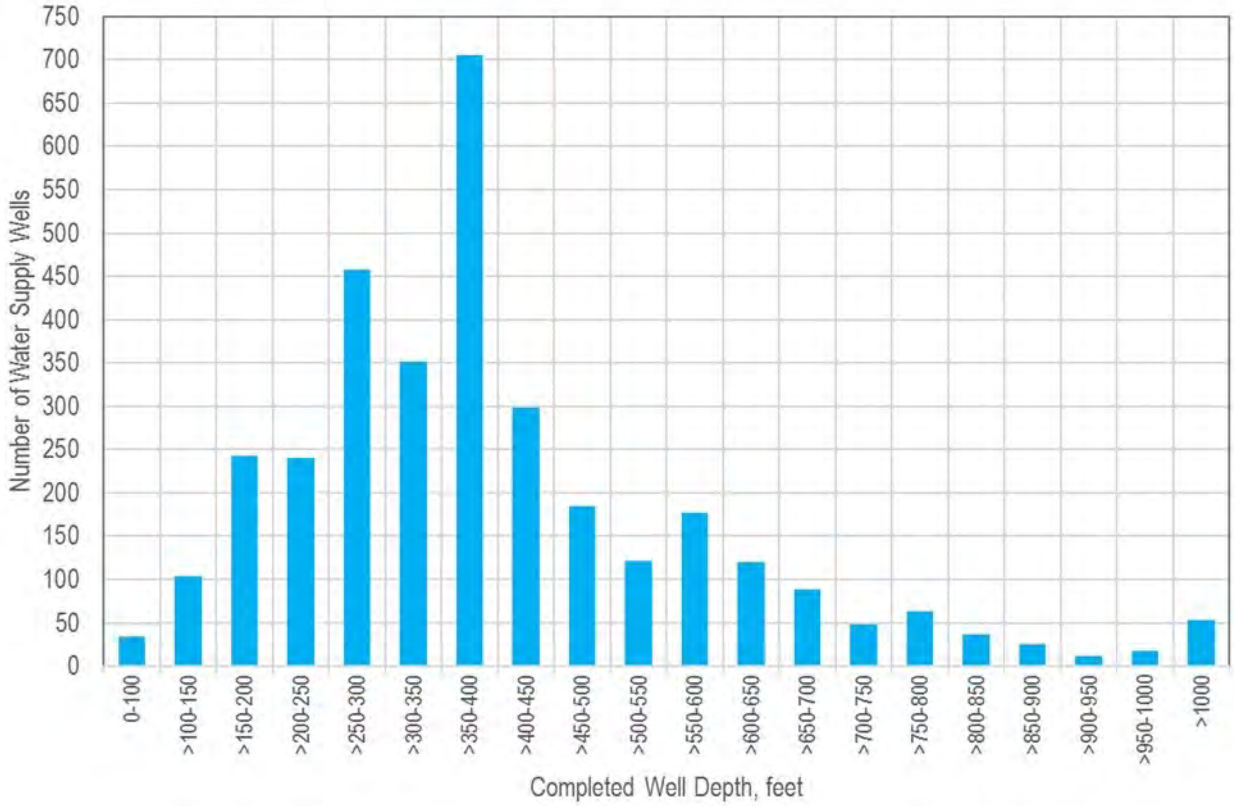


Figure 7. Histogram of Completed Wells Depths for Water Supply Wells in the Kaweah Subabsin

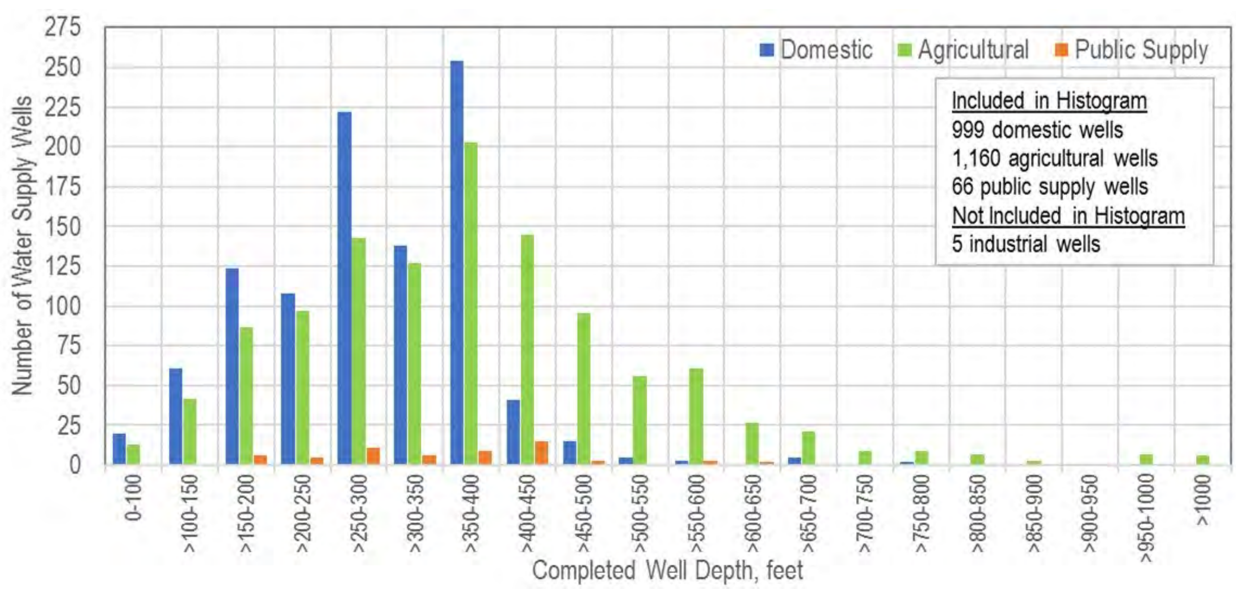


Figure 8. Histogram of Completed Well Depths for Single Aquifer System Water Supply Wells

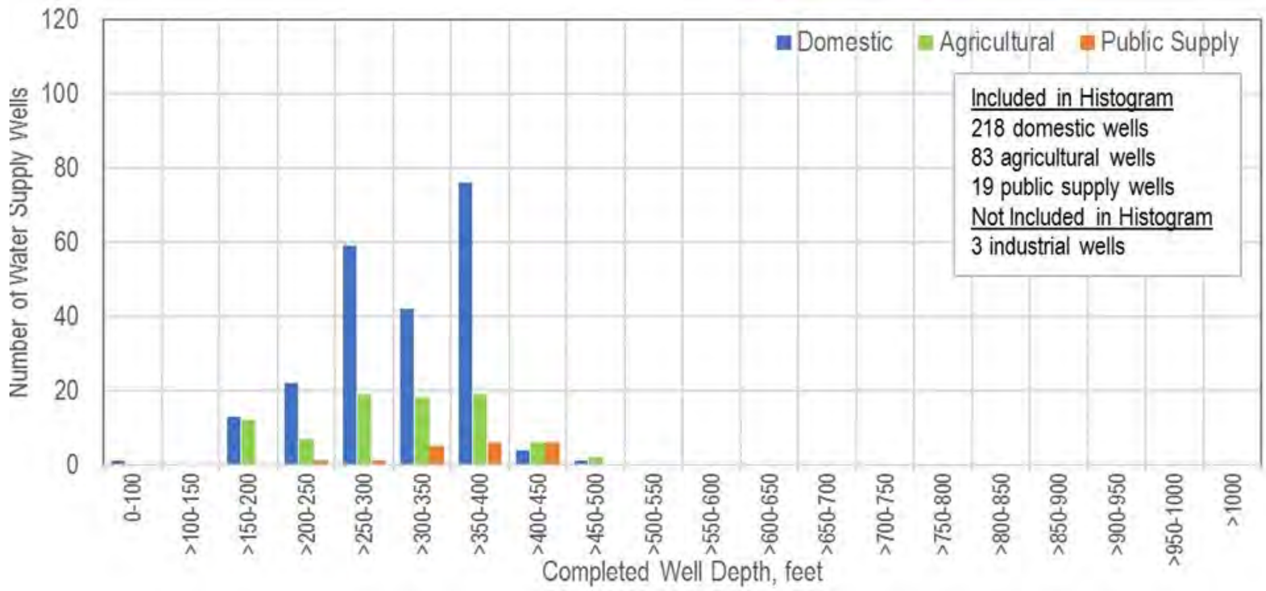


Figure 9. Histogram of Completed Well Depths for Upper Aquifer System Water Supply Wells

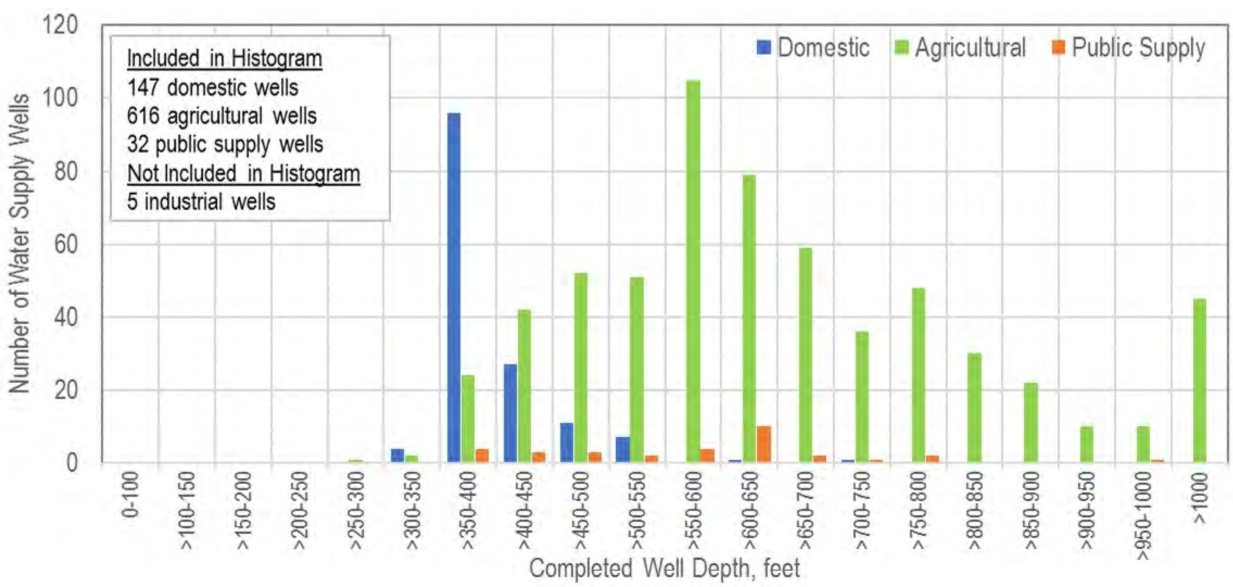


Figure 10. Histogram of Completed Well Depths for Lower Aquifer System Water Supply Wells

The number, depth, and type of water supply wells completed in each of the three aquifer systems are summarized below:

- The Single Aquifer System contains the most wells (2,232) and greatest well density (6.1 wells per square mile) of the three aquifer systems. It also has some of the shallowest wells in the Subbasin, with depths less than 100 feet (Figure 8). It has similar numbers of domestic (999) and agricultural wells (1,160), though overall domestic wells are shallower. About 60% of wells shallower than 200 feet in the Single Aquifer System are domestic wells and about 40% are agricultural wells.
- The Upper Aquifer System has the fewest total wells of the three aquifers (323) and has a well density of about 1 well per square mile. About 2.5 times as many domestic wells (218) as agriculture supply wells (83) are completed in the Upper Aquifer System, as shown on Figure 9. The shallowest wells in the Upper Aquifer System are between 150 and 200 feet, which is slightly deeper than the Single Aquifer System. This is because groundwater levels are deeper in the western portion of the Subbasin underlain by the Corcoran Clay. About 60% of wells in the top 100 feet of the saturated Upper Aquifer System (from 150 to 250 feet) are domestic wells and 40% are agricultural wells.
- The Lower Aquifer System wells are screened mostly below the Corcoran Clay and are generally deeper than 300 feet (Figure 10). The dataset analyzed has 803 wells and a well density of about 2.5 wells per square mile. About 77% of wells screened in the Upper Aquifer System are agricultural wells (616). However, since most domestic wells are installed shallower than 450 feet and most agricultural wells are installed deeper than 450 feet, there are more domestic wells than agricultural wells in the shallower portions of the Lower Aquifer System. In total, about 65% of wells that are less than 450 feet deep are domestic wells and 35% are agricultural wells.

Completion well depths are evaluated by analysis zone because their depths vary spatially due to different groundwater depths across the Subbasin. Appendix B contains histograms of completed well depth by water use type and analysis zone. Figure 11 through Figure 13 show the proportions of well use types distributed across the Subbasin by analysis zone. By grouping wells in analysis zones, the predominant well use depths in the zone influence statistics used to determine protective groundwater elevations. For example, analysis zone 19 on Figure 11 has more domestic wells than other well use types which means the completed depth statistics derived from wells in the zone are influenced more by domestic wells than other use types.

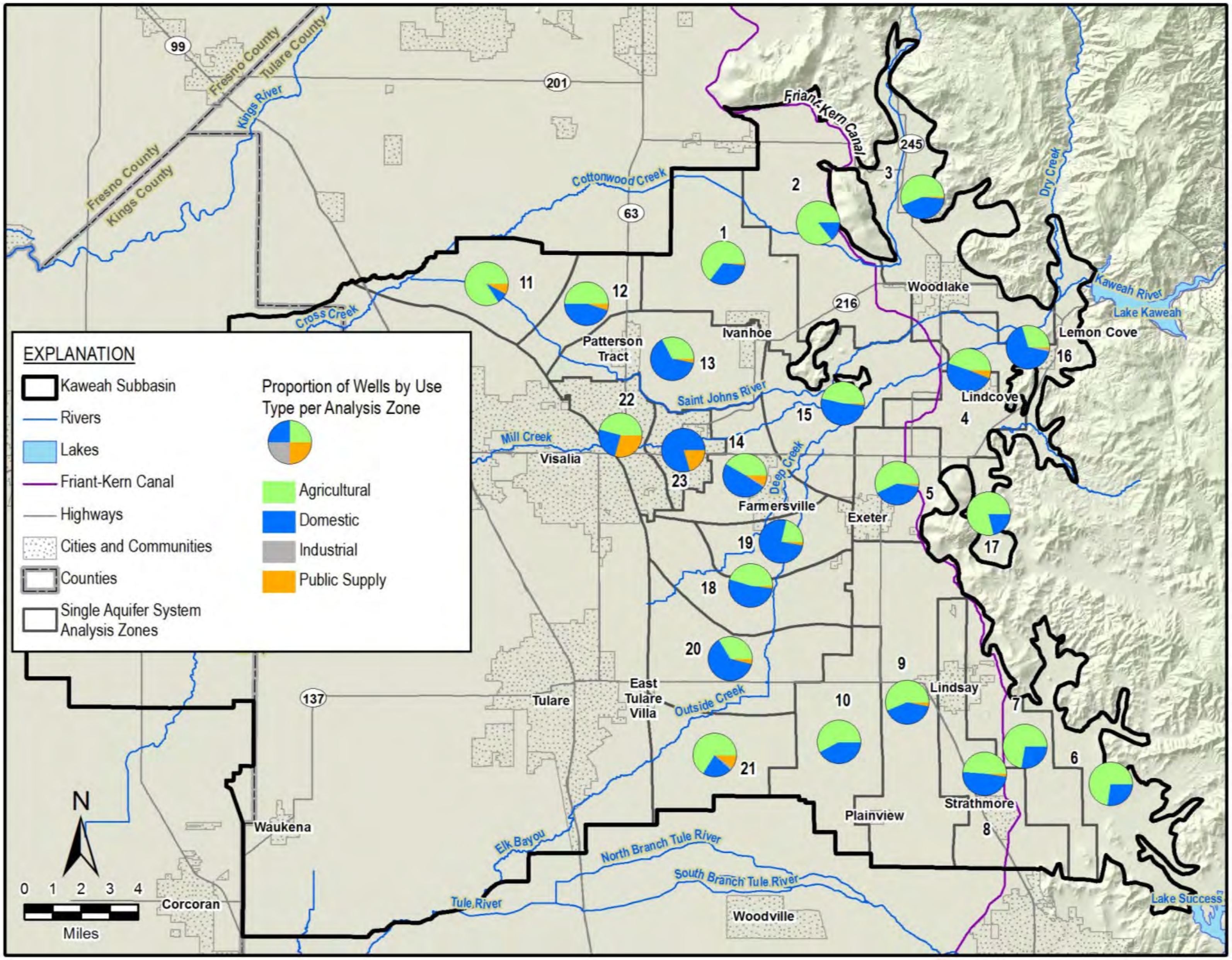


Figure 11. Single Aquifer System Well Use Types by Analysis Zone

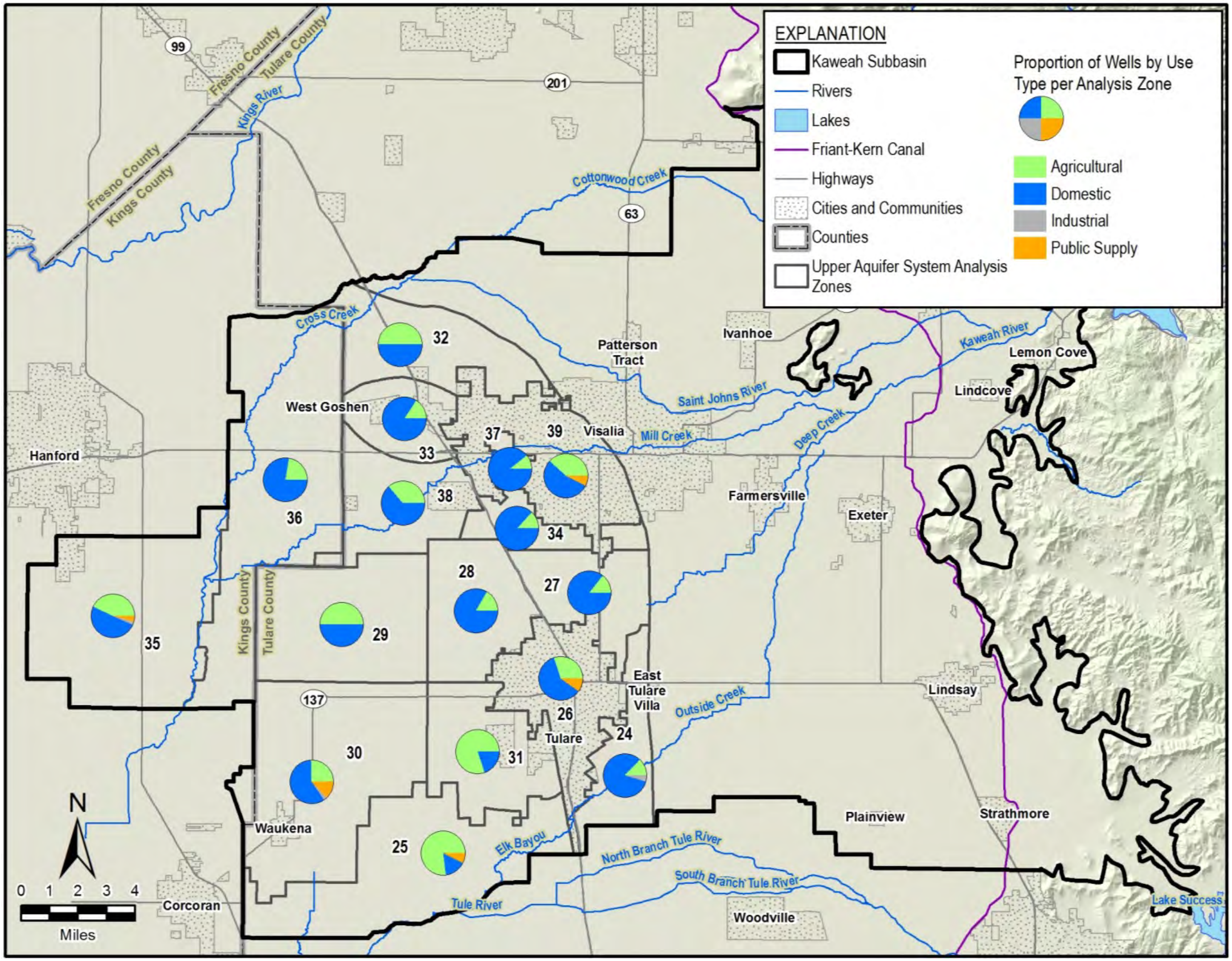


Figure 12. Upper Aquifer System Well Use Types by Analysis Zone

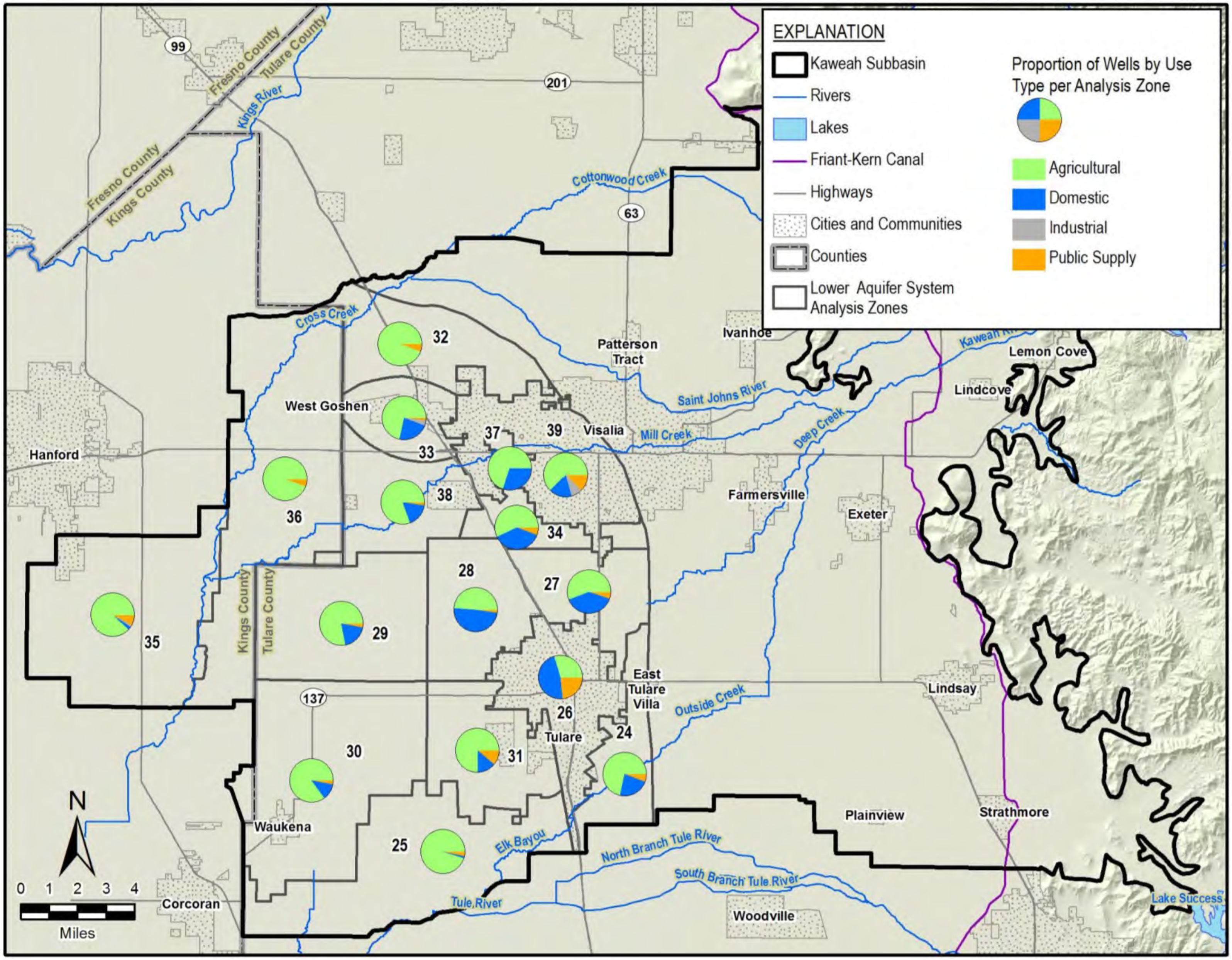


Figure 13. Lower Aquifer System Well Use Types by Analysis Zone

Well type spatial variability within the various aquifer systems is described below:

- The Single Aquifer System wells are relatively evenly split between domestic and agricultural use as shown on Figure 11. Wells around the margins of the Subbasin, including analysis zones 1, 2, 3, 11, and 17 are predominantly used for agriculture, while wells near the Kaweah River distributaries in the middle of the Subbasin such as zones 16, 19, 20, and 23 are predominantly used for domestic purposes. Visalia is the only area with greater than 20% public supply wells (analysis zones 22 and 23).

- The Upper Aquifer System is predominantly pumped by domestic wells as shown on Figure 12. However, there are parts of the Subbasin that are not heavily populated and nearly all wells are used for agriculture (analysis zones 25 and 31). Other areas with a relatively even number of domestic and agricultural supply wells include analysis zones 29 and 35 to the west and 32 to the north. Public supply wells make up less than 20% of all wells in each analysis zone, with the most concentrated distribution near Waukena (analysis zone 30).
- The Lower Aquifer System is primarily pumped by agricultural wells but there are a few areas near Tulare and Visalia where domestic wells make up between 25% to 50% of all wells (Zones 26, 27, 28, 34, and 37). Areas with the greatest number of public supply or industrial wells are in Tulare (analysis zone 26) and Visalia (analysis zone 39).

2.1.4 Protective Elevations

To calculate a groundwater elevation minimum threshold based on protection of active water supply wells, a statistical approach using percentiles was taken to develop a realistic view of active wells given well status uncertainties. A percentile well depth, or percentage of wells that would be deeper than a particular depth, was calculated for each analysis zone and aquifer. For example, the 90th percentile well depth (for wells ranked from deepest to shallowest), is the depth that 90% of wells are deeper than or equal to. This means 10% of wells are shallower than the 90th percentile depth. The 10% shallowest completed well depth are not used in the analysis as it is likely they are no longer active.

Selecting the 90th percentile recognizes the uncertainty in the accuracy and completeness of the DWR WCR dataset and accounts for destroyed or replaced shallower wells. The impracticability of managing the Subbasin to the shallowest wells is an additional factor leading to consensus amongst the three GSAs to, at a minimum, protect 90% of all water supply wells.

The 90th percentile completed well depths are calculated for each of the analysis zones by aquifers using the data described in Section 1.2. The analysis was not performed on a particular well use type but for all water supply wells within each analysis zone. Figure 14 shows the protective elevation depths for the three aquifer systems by analysis zone.

Protective well depths follow similar trends as the well completion statistics. The protective well depths are generally shallowest for the Single Aquifer System (Table 1), followed by the Upper Aquifer System, with the deepest protective depths in the Lower Aquifer System. The median protective well depth is 200 feet for the Single Aquifer System, 241 feet for the Upper Aquifer System, and 400 feet for the Lower Aquifer System. The range of protective depths are 100 to 378 feet for the Single Aquifer System, 168 to 300 feet for the Upper Aquifer System, and 380 to 606 feet for the Lower Aquifer System.

Table 1. Summary of Protective Elevations Statistics by Aquifer

Aquifer	90th Percentile Protective Depth (feet below ground surface)		
	Minimum	Median	Maximum
Single Aquifer System	100	200	378
Upper Aquifer System	168	241	300
Lower Aquifer System	380	400	606

The number of well records in the WCR dataset with construction information, above or below the protective elevation are summarized in Table 2. As mentioned previously, some of these shallow wells are likely destroyed and replaced with deeper wells, Domestic well depths tend to be shallower than wells used for other purposes, so a slightly higher number and percentage of domestic wells are potentially impacted by groundwater declines compared to other wells. Of the 297 wells shallower than the 90th percentile well depth, 58% are domestic wells, 39% are agricultural wells, and 3% are public supply wells. However, in total, 90% of all well types installed since January 2002 are deeper than protective well depths, including 88% of domestic wells, 94% of agricultural wells, and 92% of public supply wells. Although the full set of WCR wells lacks construction information for many wells, if it is assumed the percentages of well use type and depth are the same for the full set of WCR wells as the subset of wells with construction information, the subset percentages may be used to scale up the number of potentially impacted wells to the full set of WCR wells.

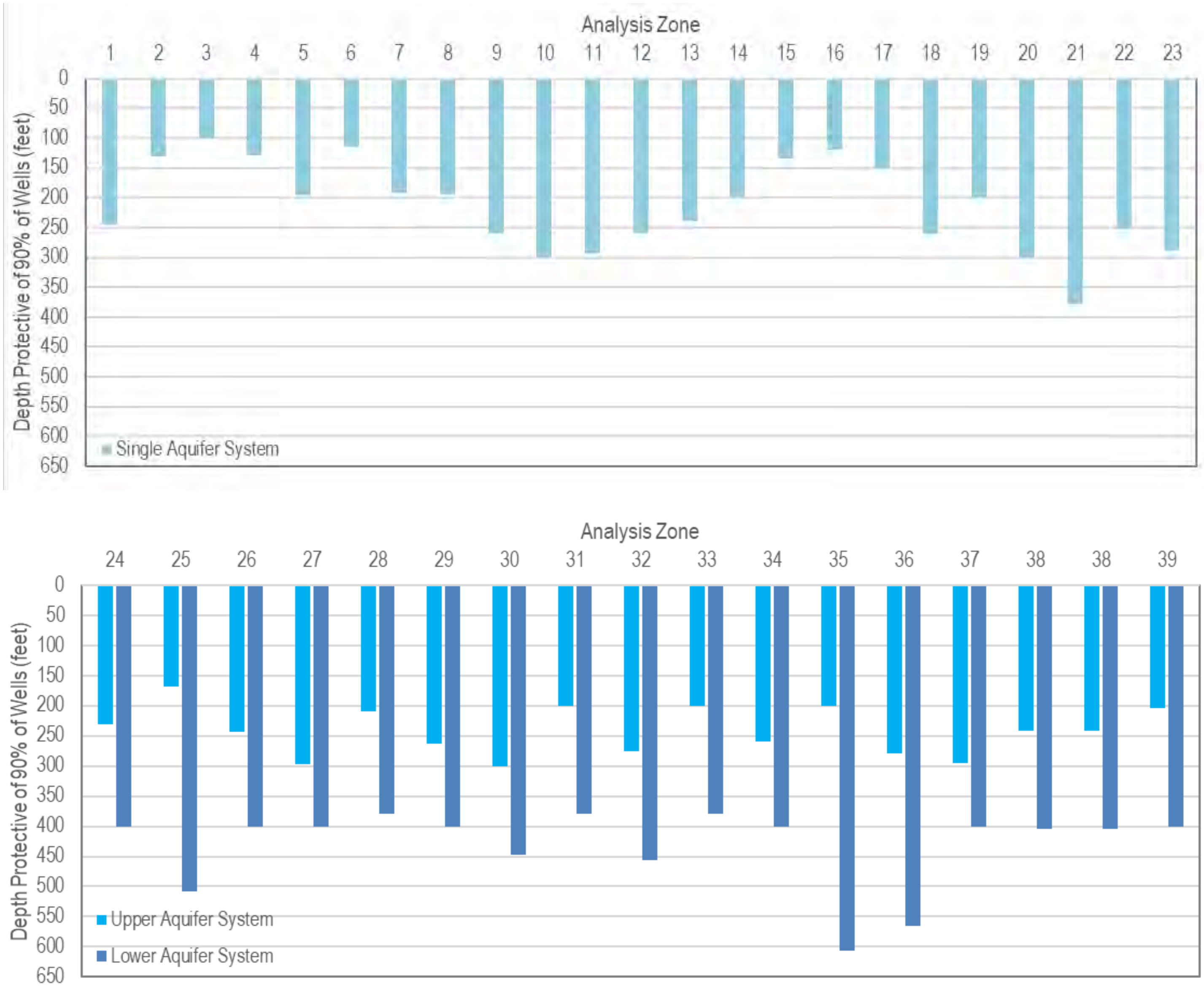


Figure 14. Analysis Zone Depths Protective of 90% of Water Supply Wells in the Kaweah Subbasin

Table 2. Summary of Basinwide Potential Well Impacts of Groundwater Levels at 90% Protective Depths Using WCR Well Records with Construction Information

Well Use Type	Deeper than 90% Protective Depth		Shallower than 90% Protective Depth		Total Number
	Number of Wells Deeper than the Protective Depth	Well Use Type Percentage	Number of Potentially Impacted Wells	Well Use Type Percentage	
Domestic	1,193	39%	171	58%	1,364
Agricultural	1,742	57%	117	39%	1,859
Public Supply	108	4%	9	3%	117
Industrial	13	0%	0	0%	13
Total	3,056		297		3,353

The number of well records in the WCR dataset of wells with construction information, potentially impacted at the 90% protective depth for each of the three aquifer systems are summarized in Table 4. Domestic wells in the Single Aquifer System will be the most impacted if groundwater levels fall to the protective elevation, followed by agricultural wells. Lower Aquifer System agricultural wells will be impacted more than domestic wells because of the greater number of agricultural wells in the Lower Aquifer System (Figure 10). The Upper Aquifer System has the least potentially impacted wells, with more domestic wells than agricultural wells potentially impacted.

Table 3. Summary of Potential Well Impacts of Groundwater Levels at 90% Protective Depths by Aquifer Using WCR Well Records with Construction Information

Well Use Type	Single Aquifer System		Upper Aquifer System		Lower Aquifer System		Total
	Number of Potentially Impacted Wells	Well Use Type Percentage	Number of Potentially Impacted Wells	Well Use Type Percentage	Number of Potentially Impacted Wells	Well Use Type Percentage	
Domestic	135	63%	19	68%	17	30%	171
Agricultural	74	35%	9	32%	34	61%	117
Public Supply	4	2%	0	0%	5	9%	9
Industrial	0	0%	0	0%	0	0%	0
Total	213		28		56		297

The East Kaweah Groundwater Sustainability Agency (EKGSA) and Greater Kaweah Groundwater Sustainability Agency (GKGSA) areas are those with the greatest number of wells shallower than the 90% protective depth (Table 4). This is because the Single Aquifer System underlies all of the EKGSA and a portion of the GKGSA, and it is the aquifer with the largest number of potentially impacted wells above the 90% protective depth. The GKGSA has the greatest total number of potentially impacted wells and the Mid-Kaweah Groundwater Sustainability Agency (MKGSA) has the fewest. The GSA areas are shown on Figure 1. Table 4 also summarizes the density of potentially unprotected wells within each GSA area. The EKGSA has the greatest overall density at 0.63 wells per square mile, GKGSA has 0.42 wells per square mile, and MKGSA the lowest density at 0.22 wells per square mile.

The protective elevation for each representative monitoring site is calculated by subtracting the analysis zone-specific 90th percentile protective depth from the representative monitoring site's surface elevation. Appendix C lists the 90% protective elevations for all the representative monitoring sites.

Table 4. Summary of Potential Well Impacts with Groundwater Levels at 90% Protective Depths by GSA Using WCR Well Records with Construction Information

Well Use Type	East Kaweah GSA			Greater Kaweah GSA			Mid-Kaweah GSA			Total
	Potentially Impacted Wells		Well Use Type Percentage in GSA	Potentially Impacted Wells		Well Use Type Percentage in GSA	Potentially Impacted Wells		Well Use Type Percentage in GSA	
	Number	Wells per Square Mile		Number	Wells per Square Mile		Number	Wells per Square Mile		
Domestic	58	0.32	52%	93	0.27	64%	17	0.10	49%	171
Agricultural	50	0.27	45%	47	0.14	32%	18	0.11	51%	117
Public Supply	3	0.02	3%	6	0.02	4%	0	0	0%	9
Industrial	0	0	0%	0	0	0%	0	0	0%	0
Total	111	0.61		151	0.43		35	0.22		297

2.2 Methodology 2, Groundwater Level Trend

This method extrapolates groundwater level trends for individual representative monitoring sites over a selected base period out to 2040. In all cases the trend is a decline with a rate that varies across the Subbasin. The EKGSA used a different base period than the GKGSA and MKGSA base period as described below. If the MT is derived from this method, it means groundwater levels are set to protect more than 90% of wells in the analysis zone while not allowing groundwater levels to decline at a greater rate than the base period.

In the EKGSA, groundwater level trends over a historical 21-year base period (1997-2017) are projected to 2040. EKGSA critically analyzed the projected 2040 groundwater levels and determined the magnitude of potential impacts likely to occur due to the current pumping and recharge regime. In cases where projected groundwater levels mirror the condition of the basin before the 1950s, when Central Valley Project brought in surface water supplies, or were not sufficiently protective of aquifer storage capacity it was determined that returning groundwater conditions similar to pre-1950 is undesirable. In EKGSA's eastern analysis zones (also called threshold regions), some initial MT elevations were increased due to the shallow depth to the bottom of the aquifer. Groundwater level MTs are established for each of the EKGSA's 10 analysis zones based on available groundwater level trend data for wells within each analysis zone. EKGSA representative monitoring sites within an analysis zone are therefore assigned the same MT groundwater elevations.

For representative monitoring sites in the GKGSA and MKGSA, the groundwater level trend base period projected to 2040 is the 11-year period from 2006 to 2016. The 2006-2016 base period represents a more recent period that reflects recent pumping patterns and includes the effects of the 2012-2016 drought. Unlike EKGSA which assigns a single MT to all representative monitoring sites within an analysis zone, GKGSA and MKGSA representative monitoring sites all have unique MTs based upon the 11-year groundwater level trend.

2.3 Methodology 3, Interpolated Minimum Threshold

After estimating MTs using methodologies 1 and 2, some GKGSA and MKGSA representative monitoring site MTs were determined to be anomalously low compared to neighboring monitoring sites because the wells' 2006-2016 groundwater level trend are much steeper than adjacent representative monitoring sites. There are four sites in the Single Aquifer System and three sites in the Upper Aquifer System where this occurs.

For representative monitoring sites with anomalously low MTs derived from the higher of Methodology 1 and 2 elevations, MTs were raised to an elevation determined by interpolating from MT contours. The contours are generated from the representative monitoring site MTs without the seven sites as control points. Figure 15 identifies the resultant MT contours and identifies the seven sites with pre-adjusted and adjusted MTs labeled. The result of using Methodology 3 is that MTs were interpolated into a smooth surface of MTs without any significant level change (“cliffs”) between representative monitoring sites.

2.4 Selection of Method to Use for Minimum Threshold

For each representative monitoring site, the elevations based on the 90% protective depth (Method 1) and groundwater levels trend (Method 2) are compared. The higher of the two elevations is selected as the MT. If the groundwater level trend elevation is higher than the protective elevation, more than 90% of wells in the analysis zone are protected. Appendix C includes the elevations for both methods and highlights the elevation of the method used for MTs.

Even though multiple methods are used by the GSAs to establish MTs, contours of MTs for the Single and Upper Aquifer Systems (unconfined) and the Lower Aquifer System (confined) onFigure 15 and Figure 16, respectively, demonstrate MTs across the Subbasin do not show abnormal differences between RMS and MTs decrease in elevation from east to west similar to groundwater elevations.

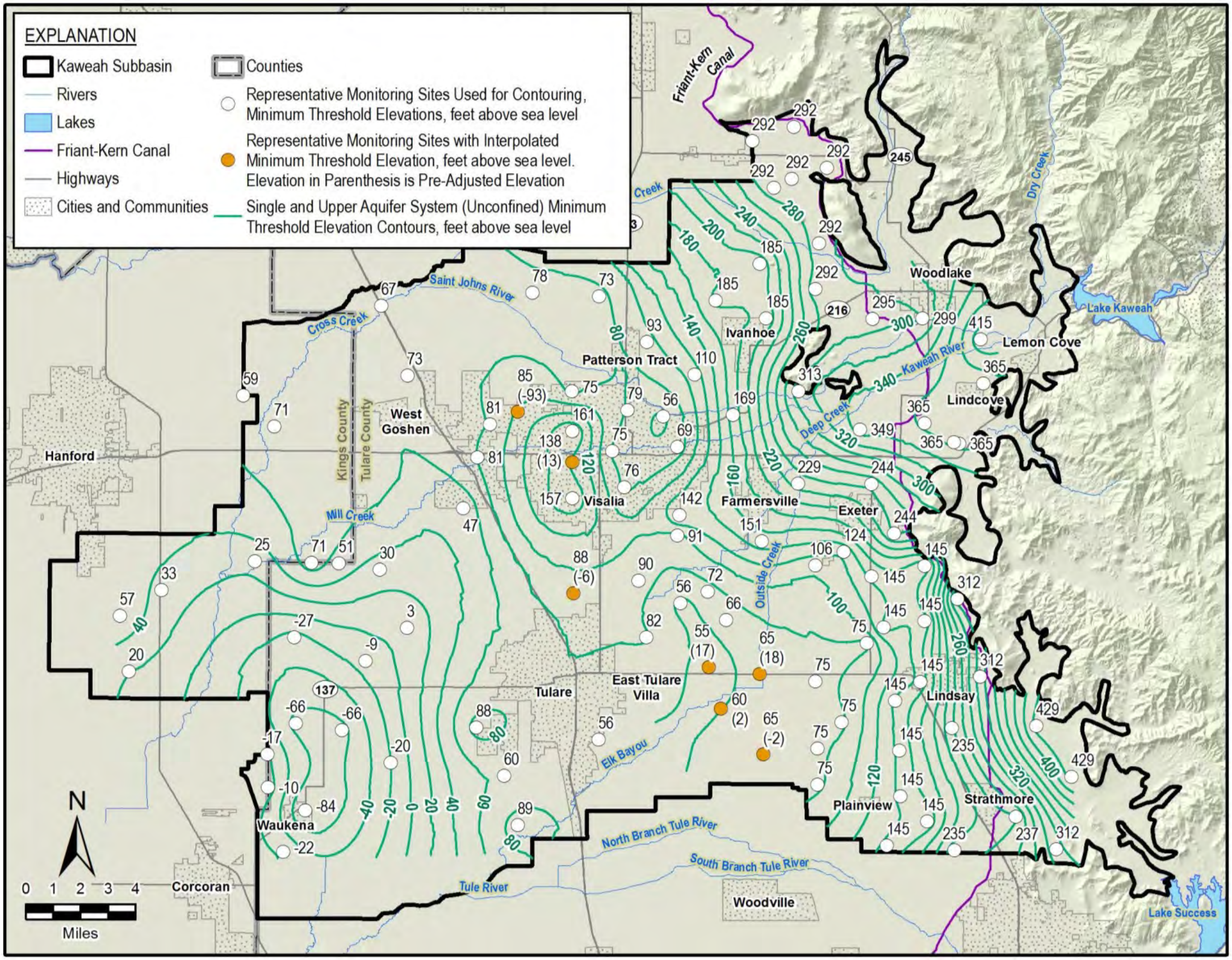


Figure 15. Single and Upper (Unconfined) Aquifer System Minimum Threshold Contours Across the Kaweah Subbasin

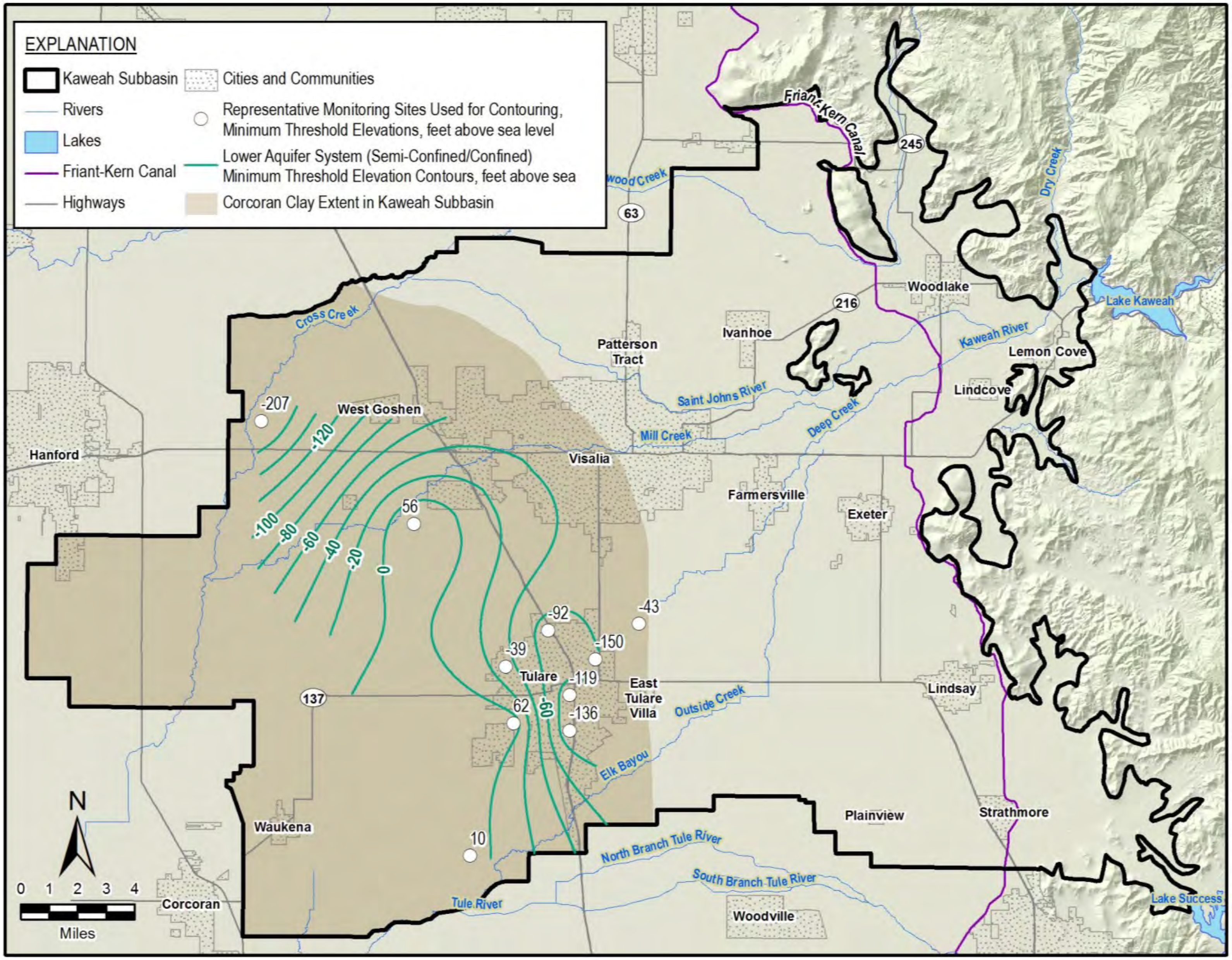


Figure 16. Lower Aquifer (Semi-Confined/Confined) System Minimum Threshold Contours Across the Kaweah Subbasin

3 PROCESS USED TO ESTABLISH MEASURABLE OBJECTIVES AND INTERIM MILESTONES

3.1 Measurable Objective Methodologies

Measurable objectives (MOs) are established at groundwater elevations higher than MTs to provide operational flexibility and reflect the GSAs' desired groundwater conditions in 2040. The margin of operational flexibility accounts for droughts, climate change, conjunctive use operations, other groundwater management activities, and data uncertainty. The GSAs in the Kaweah Subbasin are managing their groundwater sustainability to meet the MO in 2040.

The EKGSA MOs are based on Spring 2017 groundwater levels. Spring 2017 was a wet year that followed the 2012-2016 drought. This approach applies to wells where the MT is based on the 1997-2017 groundwater level trend projection described in Section 1.1 and shown on Figure 17.

The GKGSA and MKGSA MOs are based on one of two methods, depending on which methodology was used to set MTs. Figure 17 graphically shows the relationship between the different MT and MO methodologies.

MO Method 1, Groundwater Level Trend Projection to 2030:

- For GKGSA and MKGSA representative monitoring sites with MTs derived from the groundwater level trend projection, the MO is the 2006-2016 groundwater elevation projected to 2030 (Figure 18).
- For representative monitoring sites where the MT is set using the protective elevation, and the difference between the MT and groundwater elevation trend projected to 2030 is 20 feet or more, the MO is the 2006-2016 groundwater elevation projected to 2030 (Figure 18).

MO Method 2: 5-Year Drought Storage Based on 2006-2016 Trend

- For representative monitoring sites where the MT is set using the protective elevation, and the difference between the MT and groundwater elevation trend projected to 2030 is less than 20 feet, the MO is set at an elevation that provides for 5 years of drought storage above the MT. Five years of drought storage is determined as the groundwater level change occurring over 5 years using the 2006-2016 groundwater level trend (Figure 19). The groundwater level change is added to the MT elevation to establish the MO elevation (Figure 19).

- For representative monitoring sites where anomalously low MTs are adjusted by interpolating from MT contours, the MO is set at an elevation that provides for 5 years of drought storage above the adjusted MT.

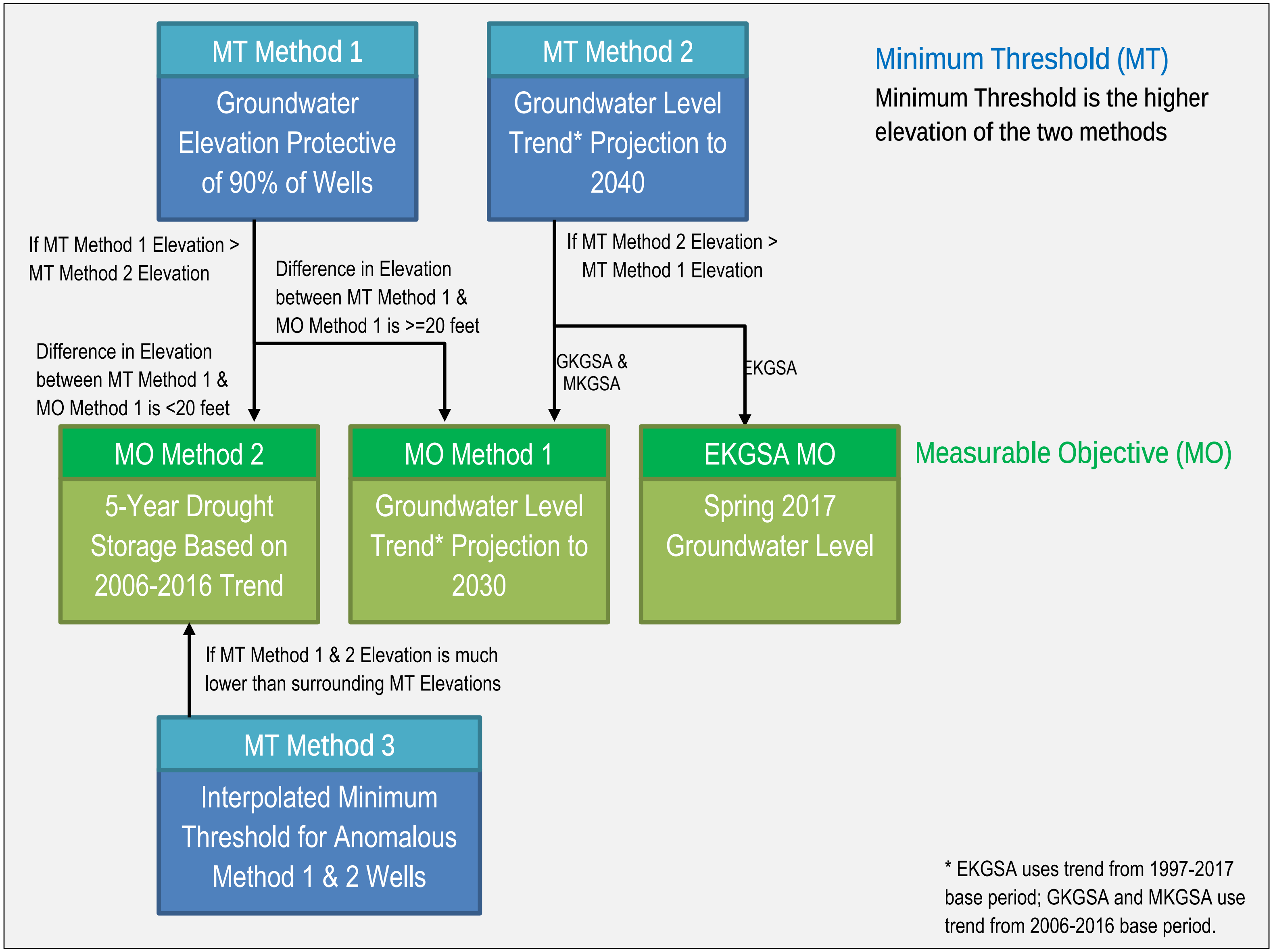


Figure 17. Relationship Between Minimum Threshold and Measurable Objective Methodologies

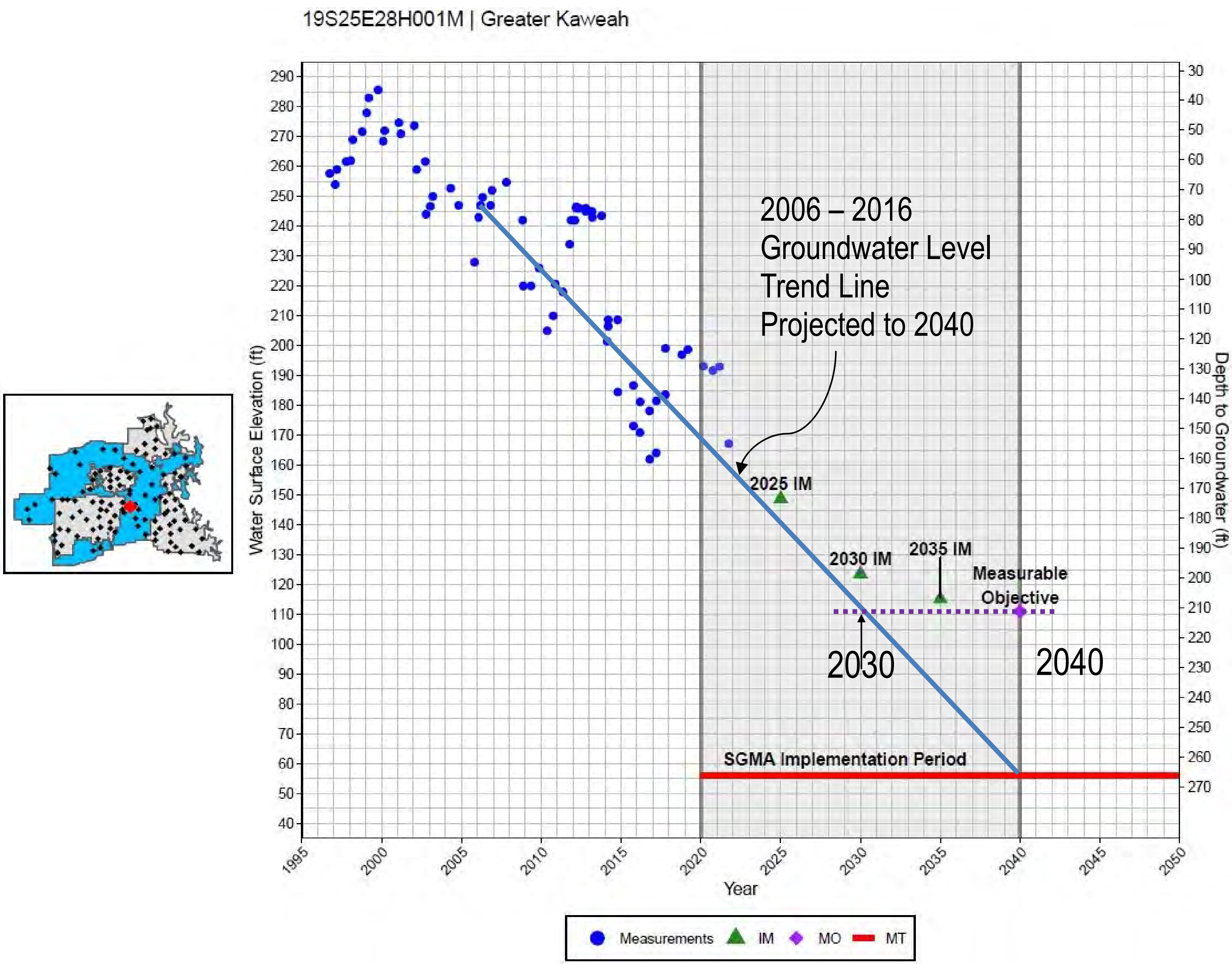


Figure 18. Example Hydrograph Showing Projection of 2006 – 2016 Trend Line

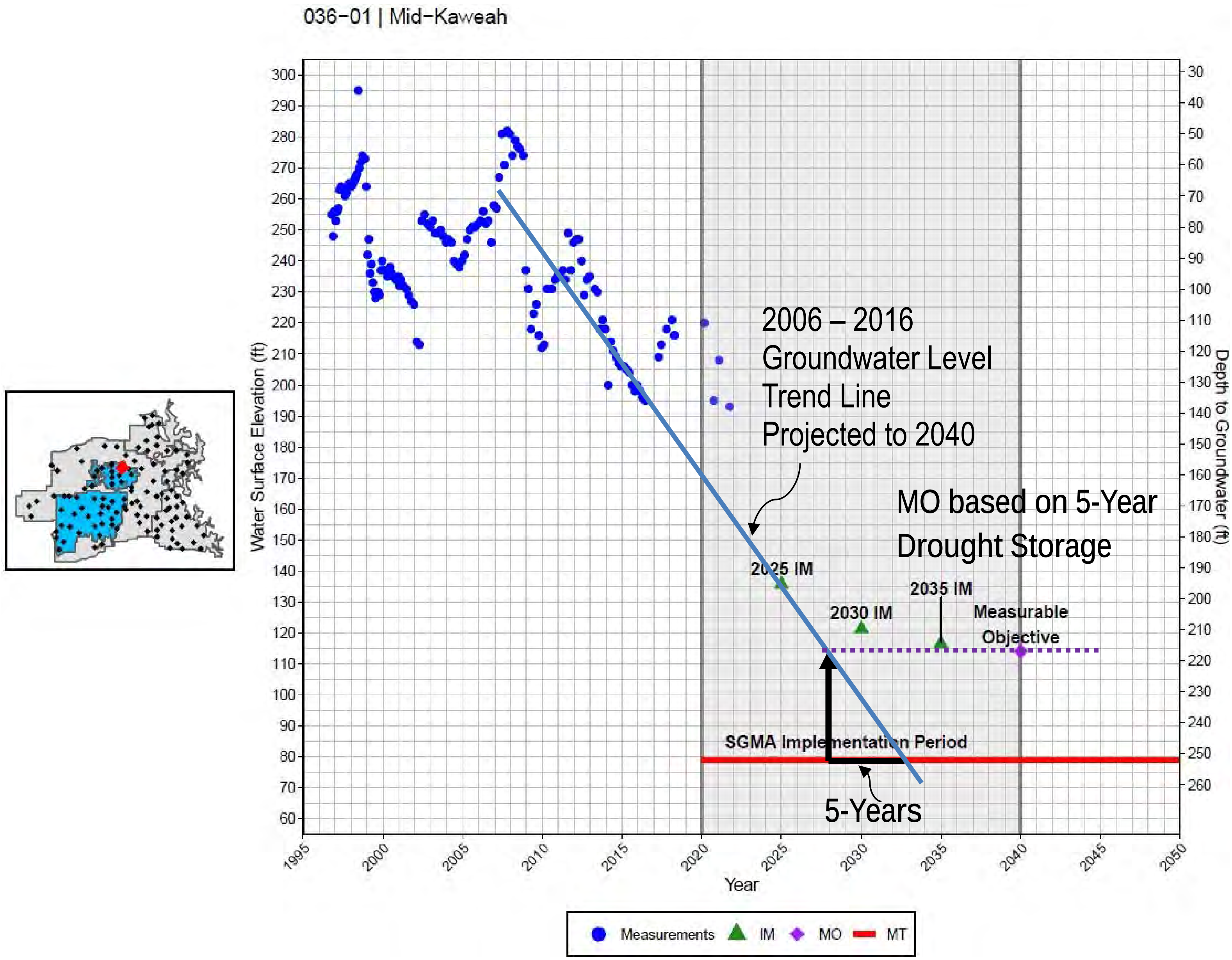


Figure 19. Example Hydrograph Showing Measurable Objective Based on 5-Year Drought Storage

3.2 Interim Milestone Methodology

Interim milestones for all representative monitoring sites take the form of a curve that flattens out toward 2040 when the MO is reached. The curve shape is determined based on implementation of projects and management actions over the next 18 years.

For the EKGSA, interim milestones are proportional to percent of overdraft to be corrected in 5-year intervals through implementation period. The interim milestones leading to groundwater level stabilization are unique to each analysis zone but follow the same incremental mitigation rate for correction of 5%, 25%, 55%, and 100% by 2025, 2030, 2035, and 2040, respectively.

Interim milestones for GKGSA and MKGSA representative monitoring sites are based on incrementally decreasing groundwater level change over time based on the following:

- 2025 interim milestone– extend the 2006-2016 groundwater level trend to 2025
- 2030 interim milestone –elevation at two-thirds of the elevation difference between the 2025 interim milestone and the MO
- 2035 interim milestone - elevation at two-thirds of the elevation difference between the 2030 interim milestone and the MO

The method for setting GKGSA and MKGSA interim milestones is illustrated on Figure 20.

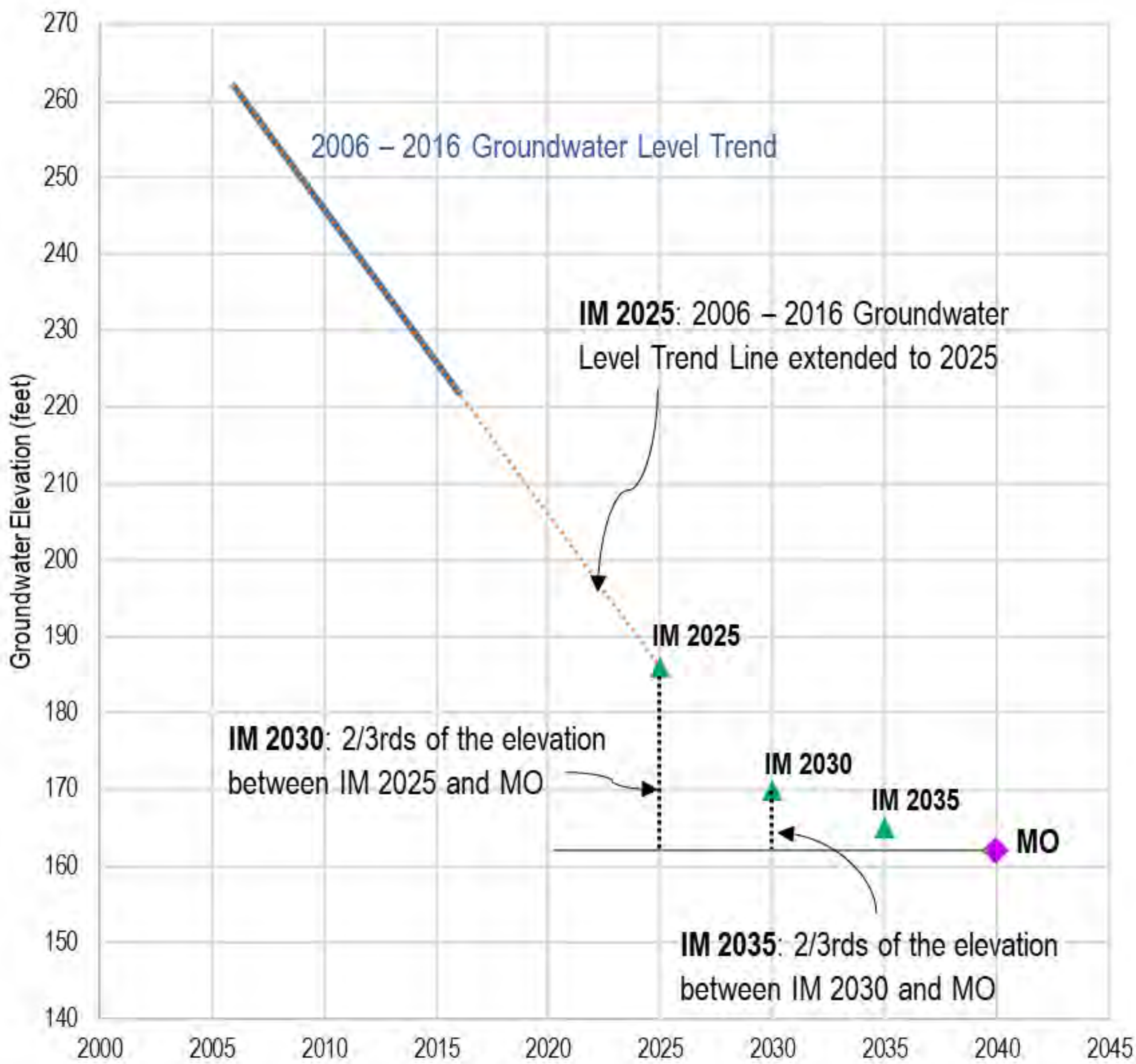


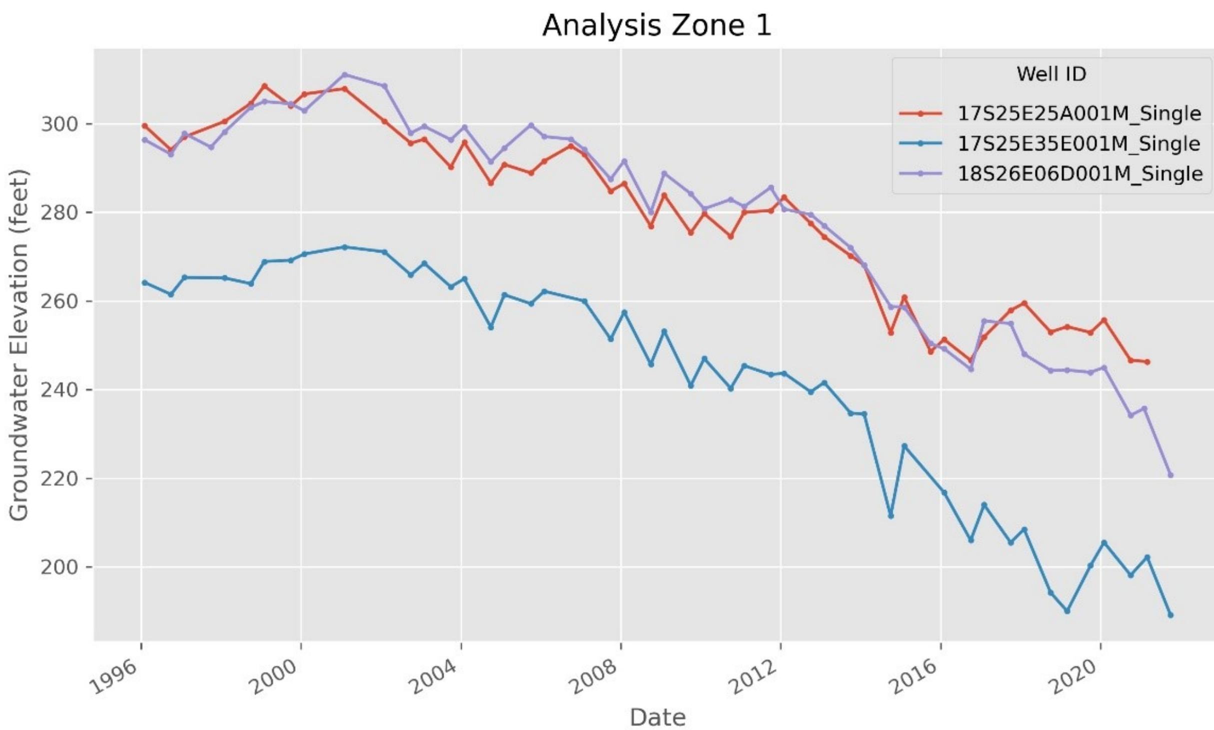
Figure 20. Example of Interim Milestone Method for GKGSA and MKGSA Represenative Monitoring Sites

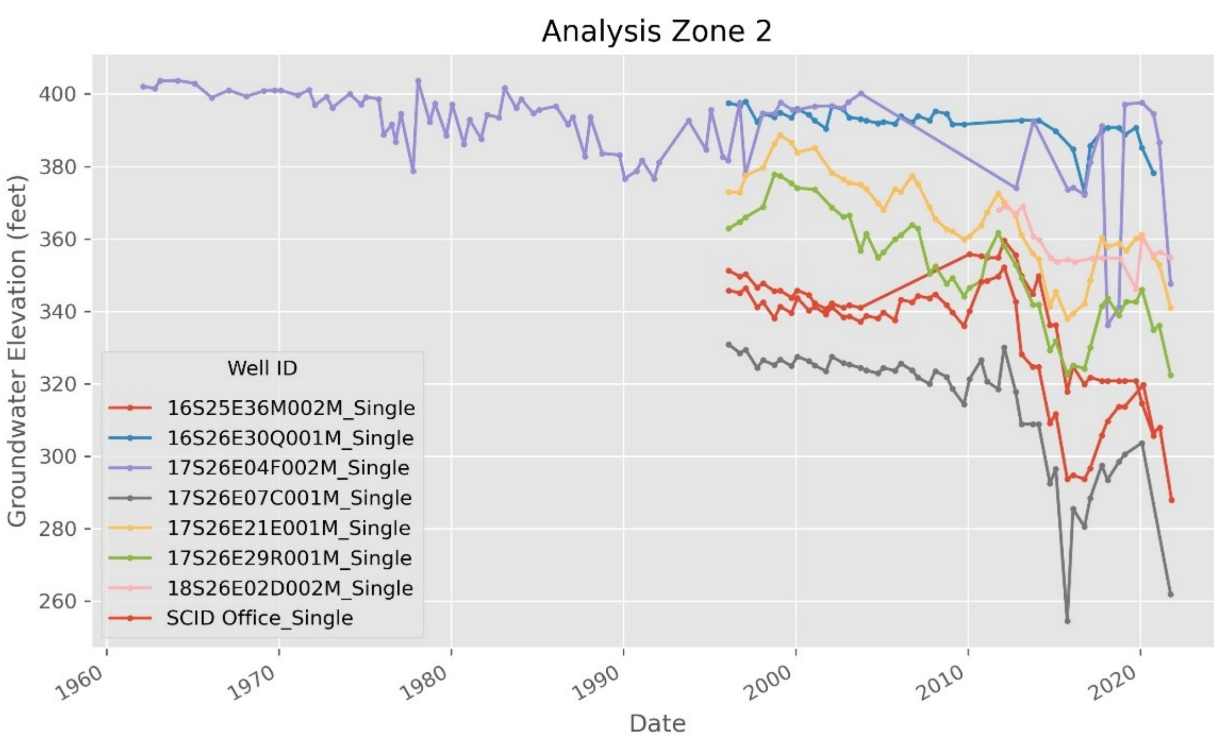
4 REFERENCES

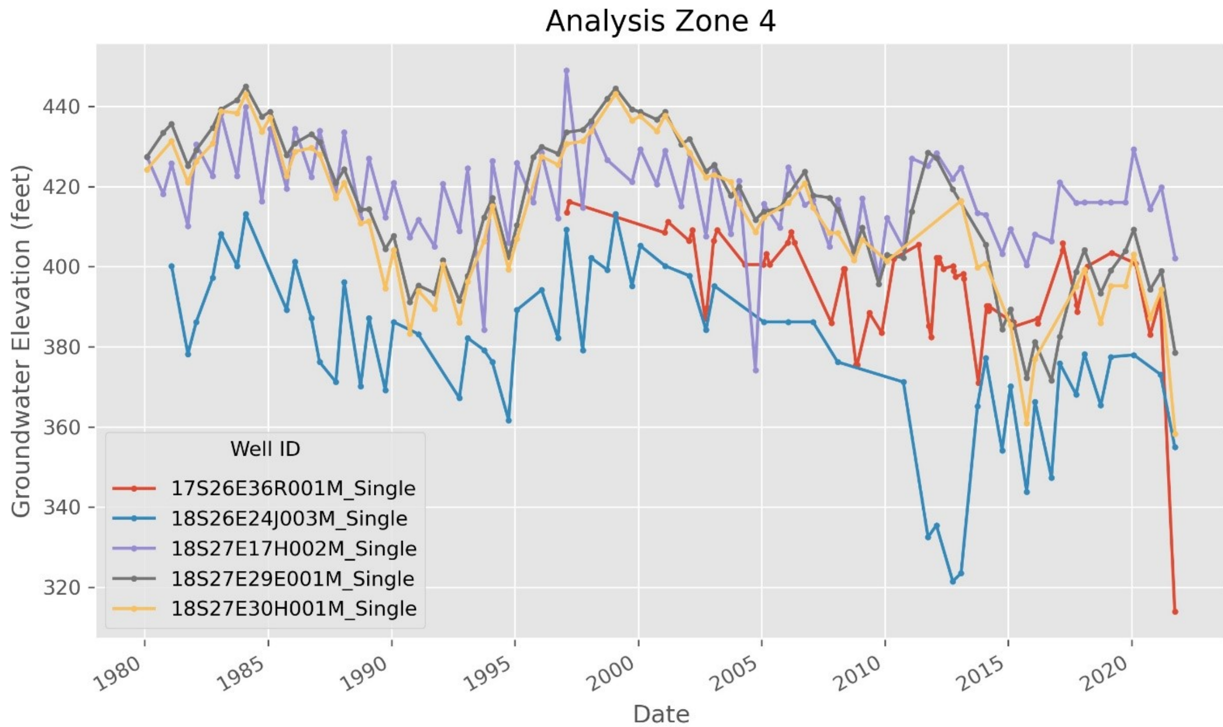
Kang, S., Knight, R., & Goebel, M. (2022). Improved imaging of the large-scale structure of a groundwater system with airborne electromagnetic data. *Water Resources Research*, 58, e2021WR031439. https://doi.org/10.1029/2021WR031439

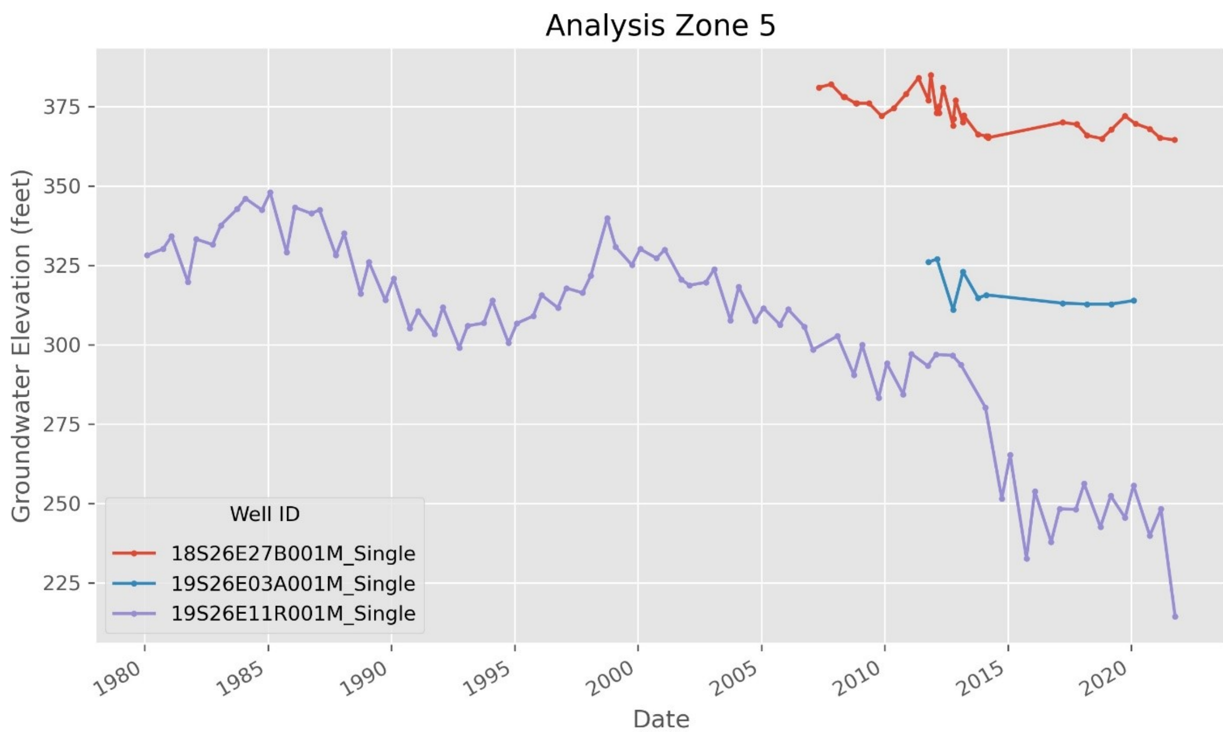
Appendix A

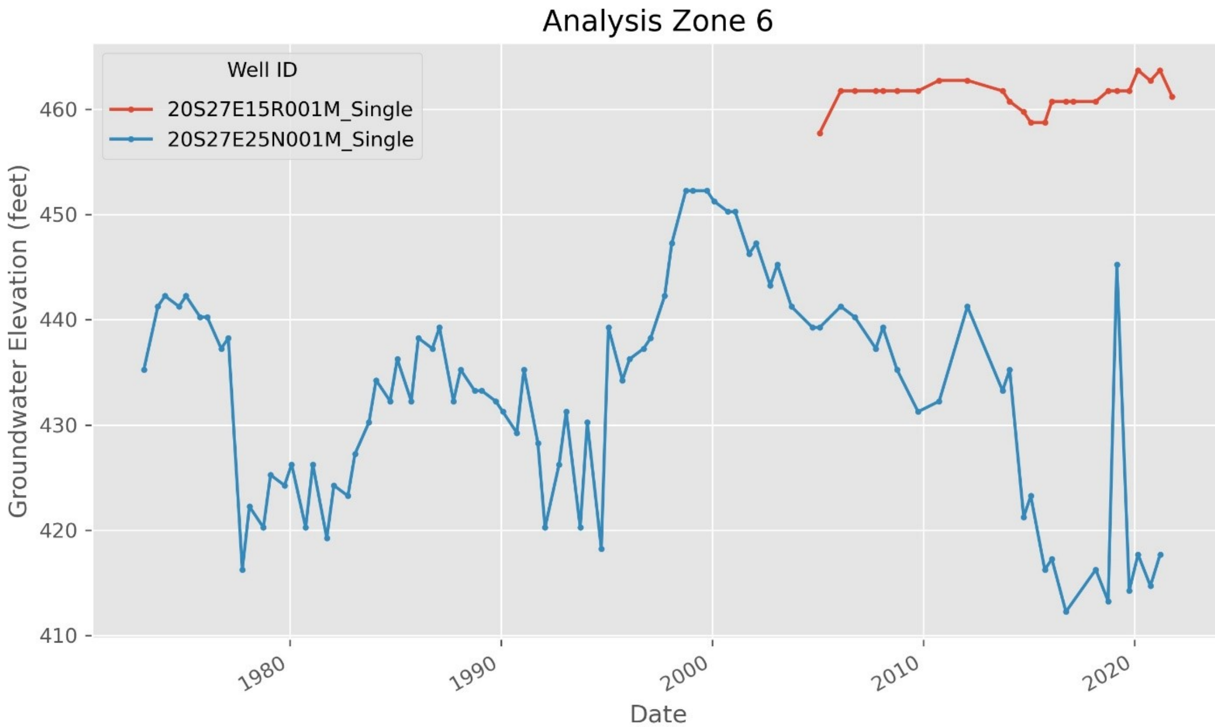
Representative Monitoring Site Hydrographs by Aquifer and Analysis Zone

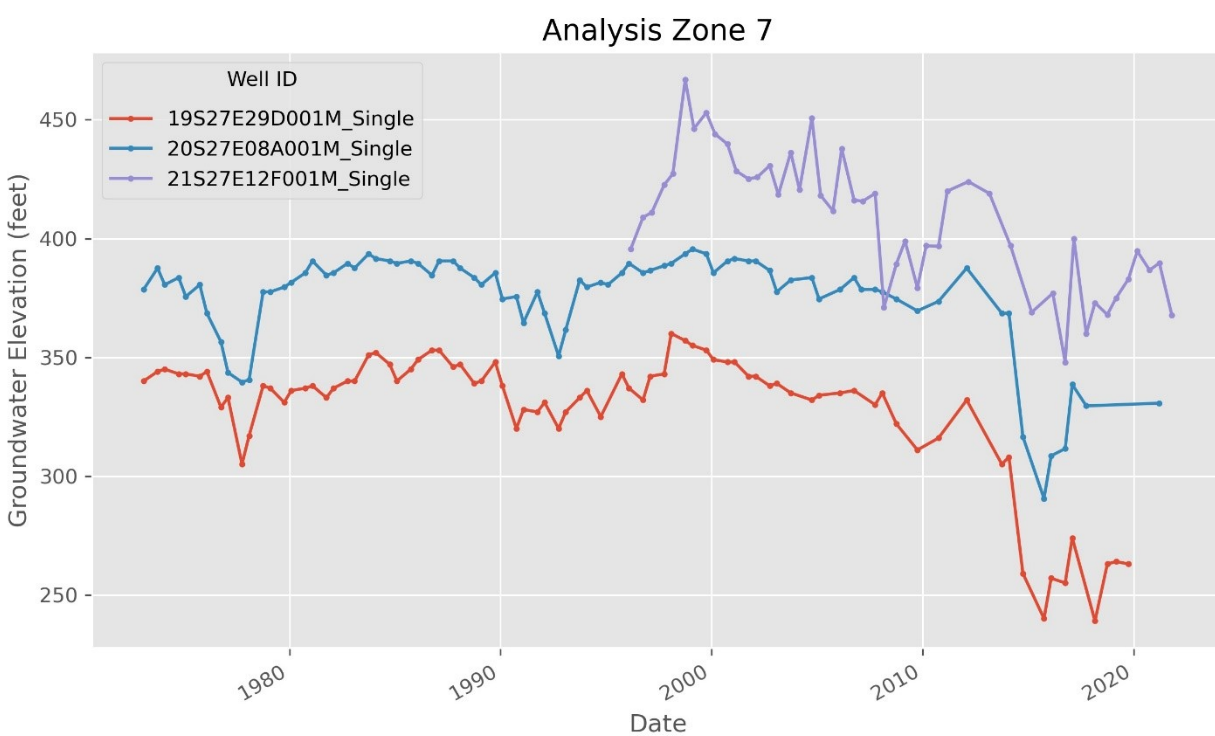

Analysis Zone 1
Well ID
17S25E25A001M_Single
17S25E35E001M_Single
18S26E06D001M_Single
Groundwater Elevation (feet)
300
280
260
240
220
200
1996
2000
2004
2008
2012
2016
2020
Date

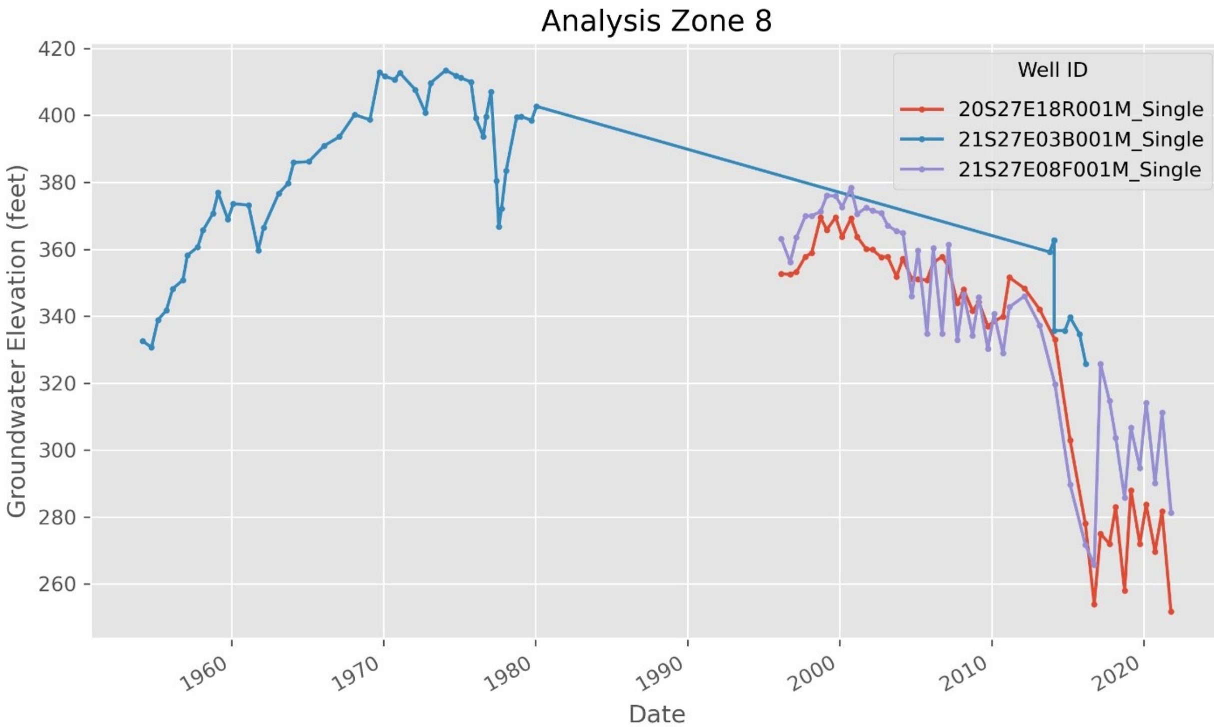

Analysis Zone 2
Well ID
16S25E36M002M_Single
16S26E30Q001M_Single
17S26E04F002M_Single
17S26E07C001M_Single
17S26E21E001M_Single
17S26E29R001M_Single
18S26E02D002M_Single
SCID Office_Single
Groundwater Elevation (feet)
400
380
360
340
320
300
280
260
1960
1970
1980
1990
2000
2010
2020
Date

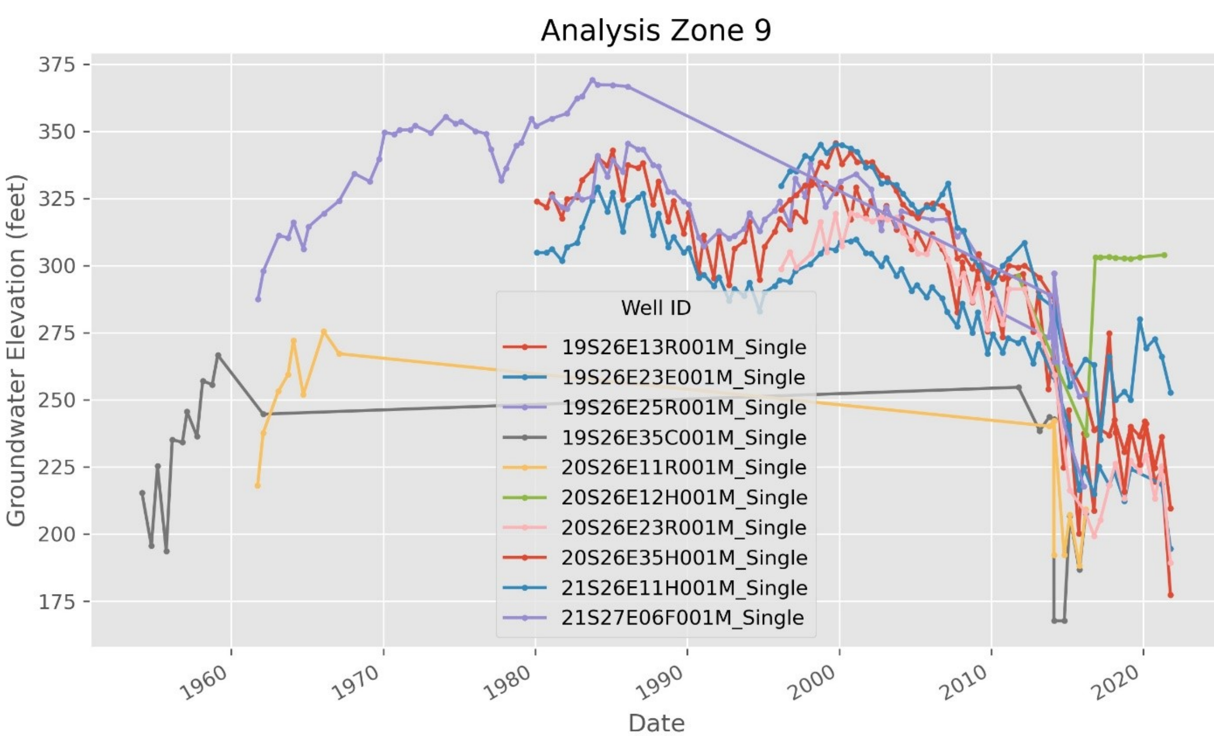

Analysis Zone 4
Groundwater Elevation (feet)
440
420
400
380
360
340
320
Well ID
17S26E36R001M_Single
18S26E24J003M_Single
18S27E17H002M_Single
18S27E29E001M_Single
18S27E30H001M_Single
1980
1985
1990
1995
2000
2005
2010
2015
2020
Date

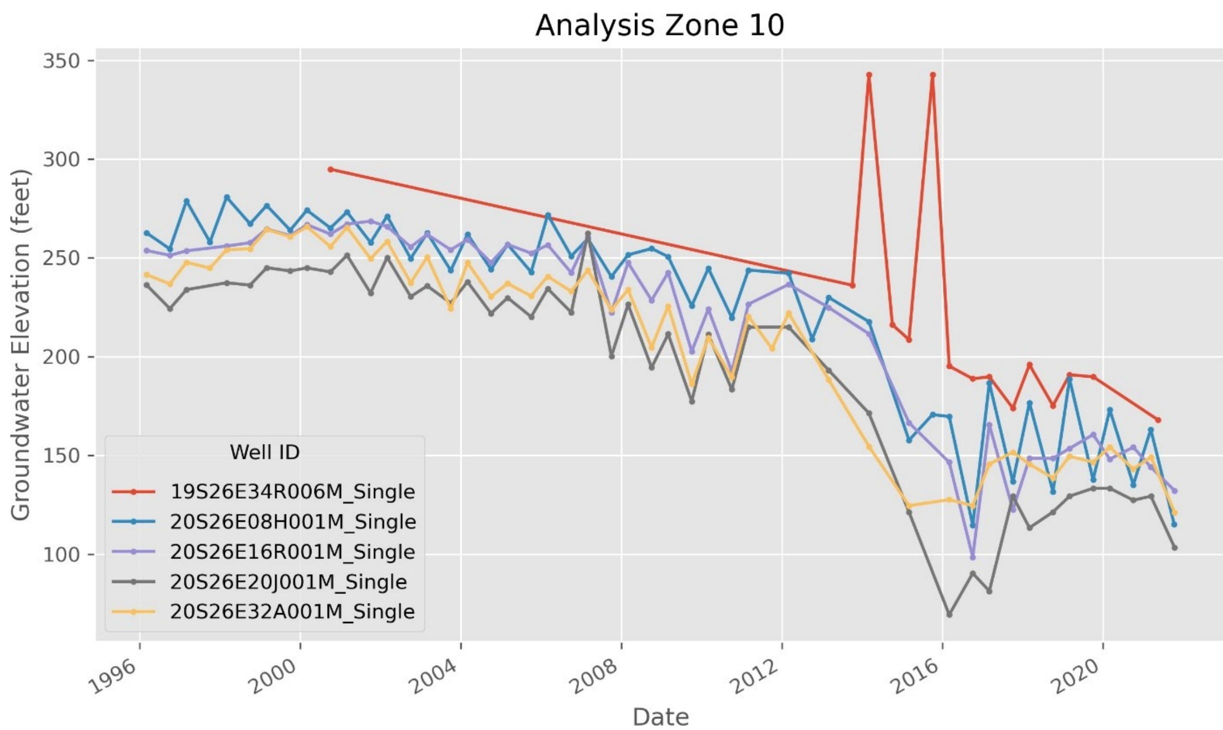

Analysis Zone 5
Groundwater Elevation (feet)
375
350
325
300
275
250
225
Well ID
18S26E27B001M_Single
19S26E03A001M_Single
19S26E11R001M_Single
1980
1985
1990
1995
2000
2005
2010
2015
2020
Date

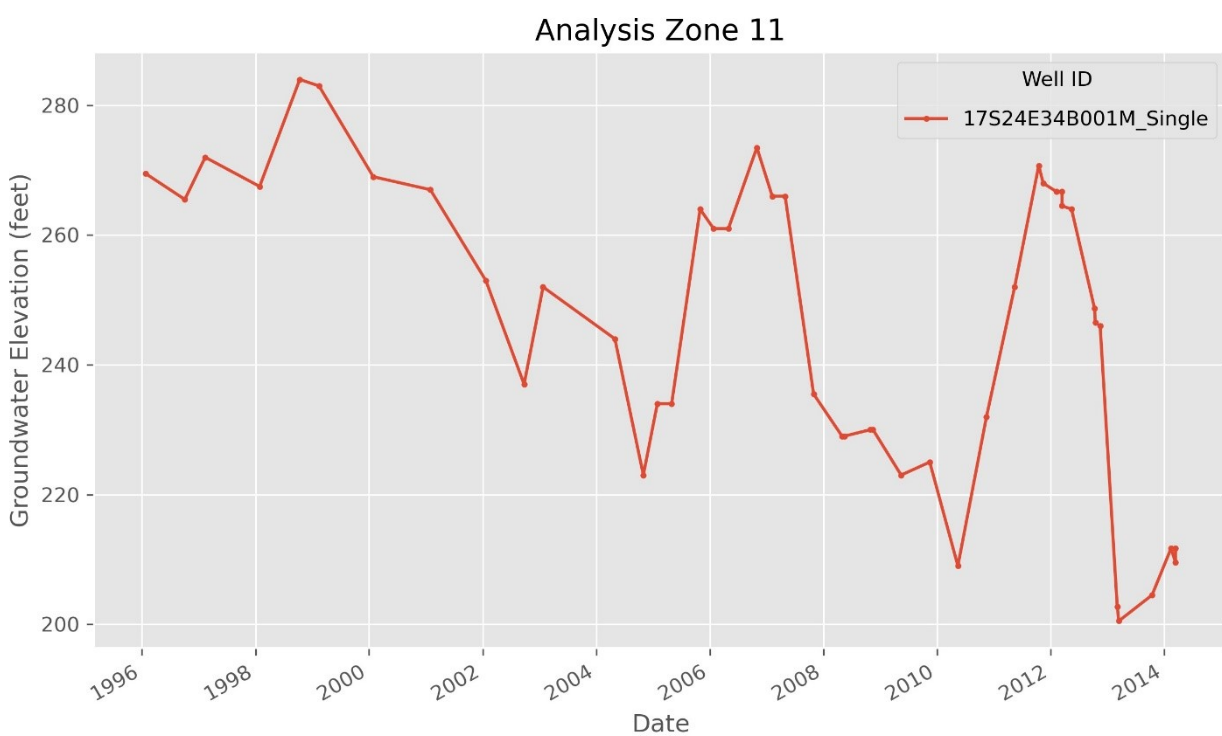

Analysis Zone 6
Well ID
20S27E15R001M_Single
20S27E25N001M_Single
Groundwater Elevation (feet)
410
420
430
440
450
460
1980
1990
2000
2010
2020
Date

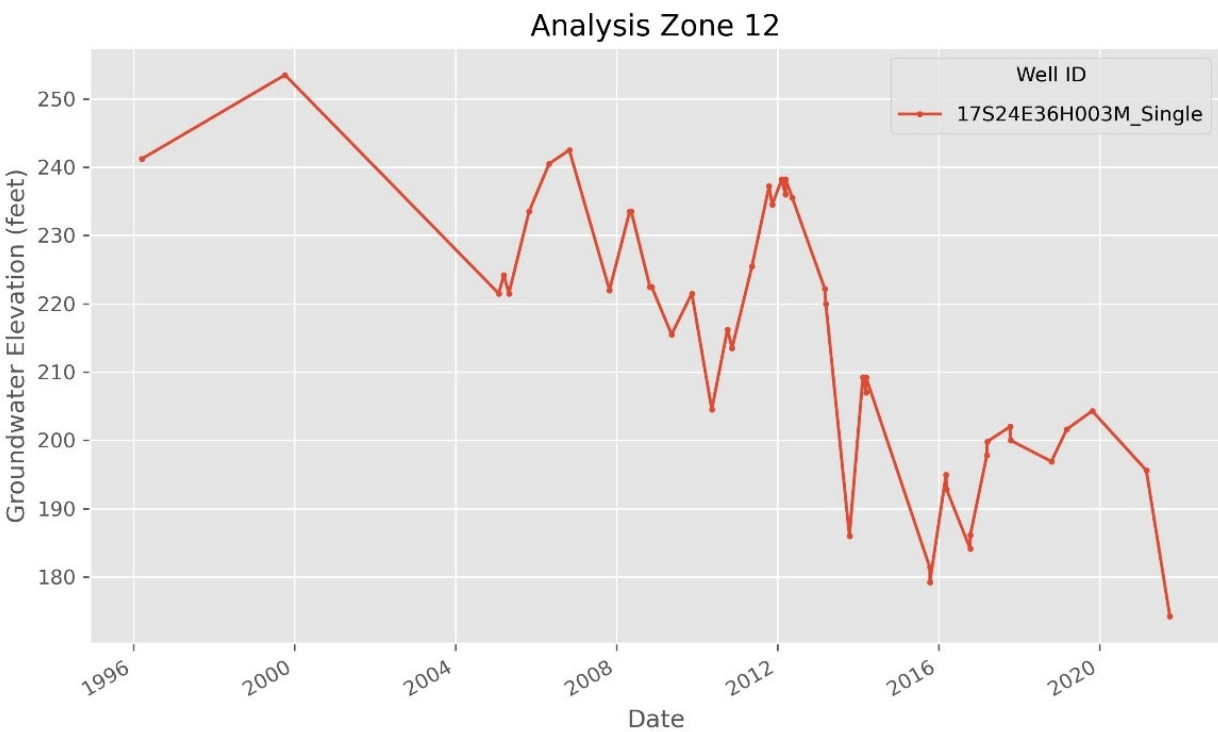

Analysis Zone 7
Well ID
19S27E29D001M_Single
20S27E08A001M_Single
21S27E12F001M_Single
Groundwater Elevation (feet)
250
300
350
400
450
1980
1990
2000
2010
2020
Date

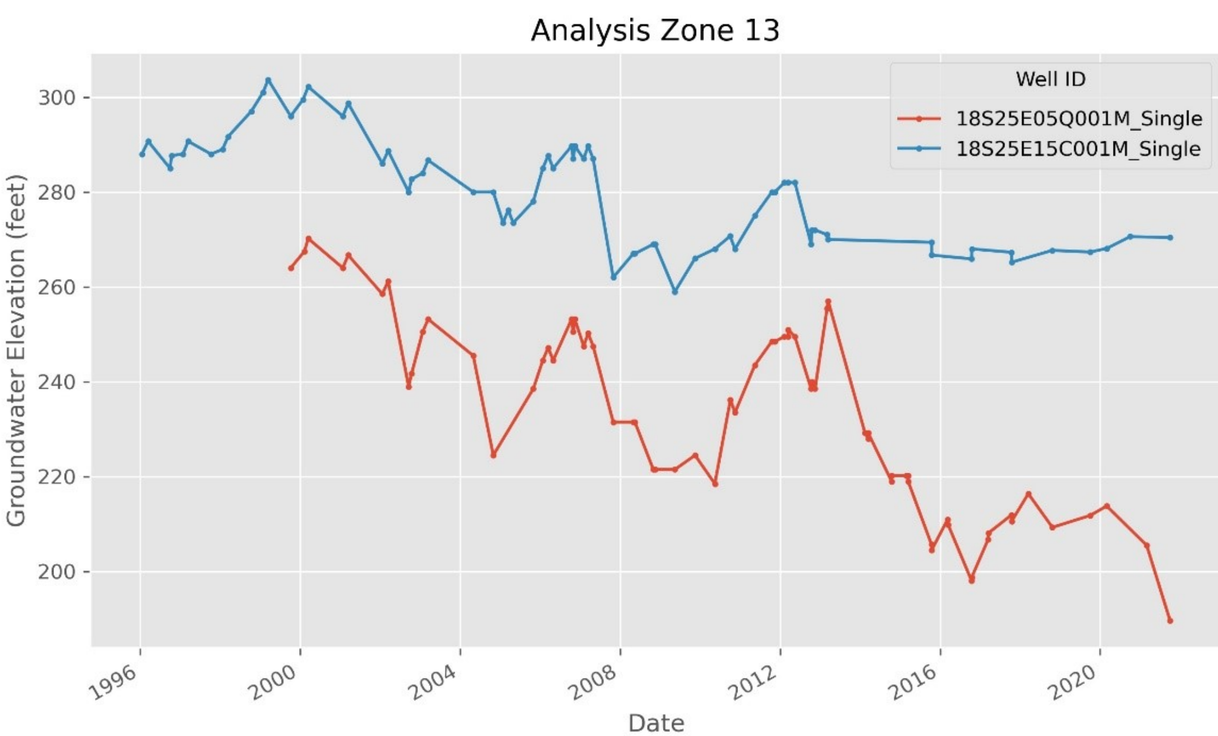

Analysis Zone 8
Groundwater Elevation (feet)
420
400
380
360
340
320
300
280
260
1960
1970
1980
1990
2000
2010
2020
Date
Well ID
20S27E18R001M_Single
21S27E03B001M_Single
21S27E08F001M_Single

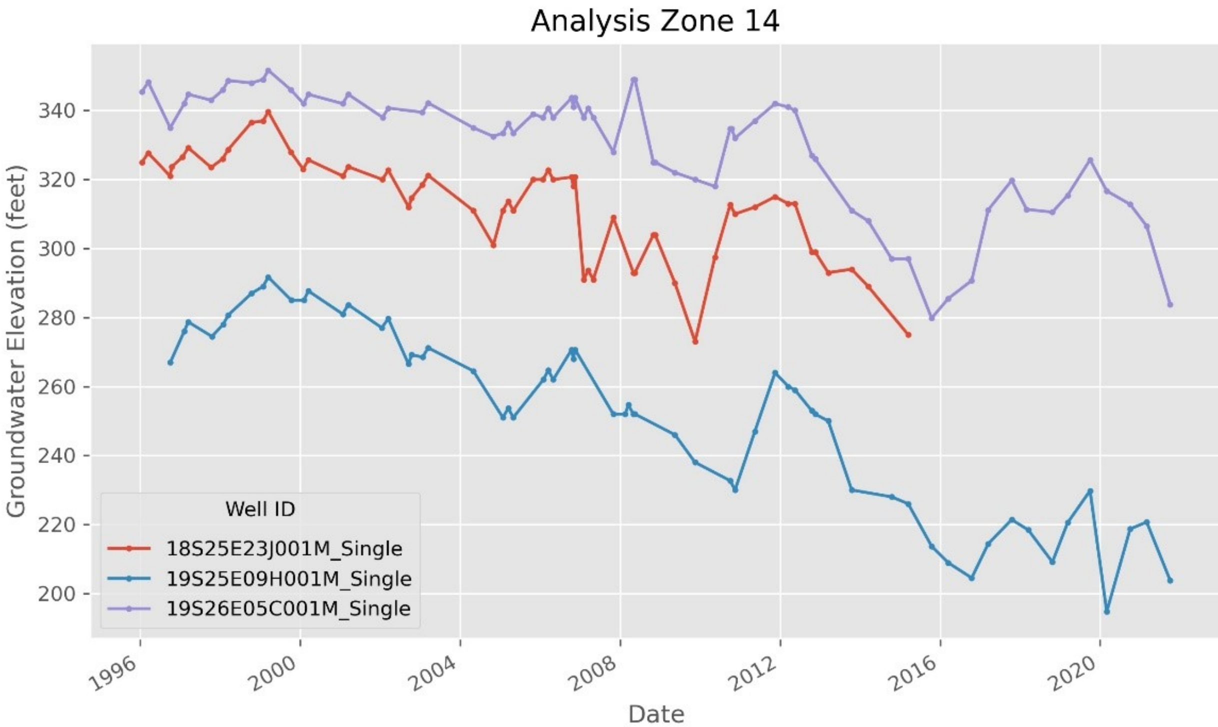

Analysis Zone 9
Groundwater Elevation (feet)
375
350
325
300
275
250
225
200
175
1960
1970
1980
1990
2000
2010
2020
Date
Well ID
19S26E13R001M_Single
19S26E23E001M_Single
19S26E25R001M_Single
19S26E35C001M_Single
20S26E11R001M_Single
20S26E12H001M_Single
20S26E23R001M_Single
20S26E35H001M_Single
21S26E11H001M_Single
21S27E06F001M_Single

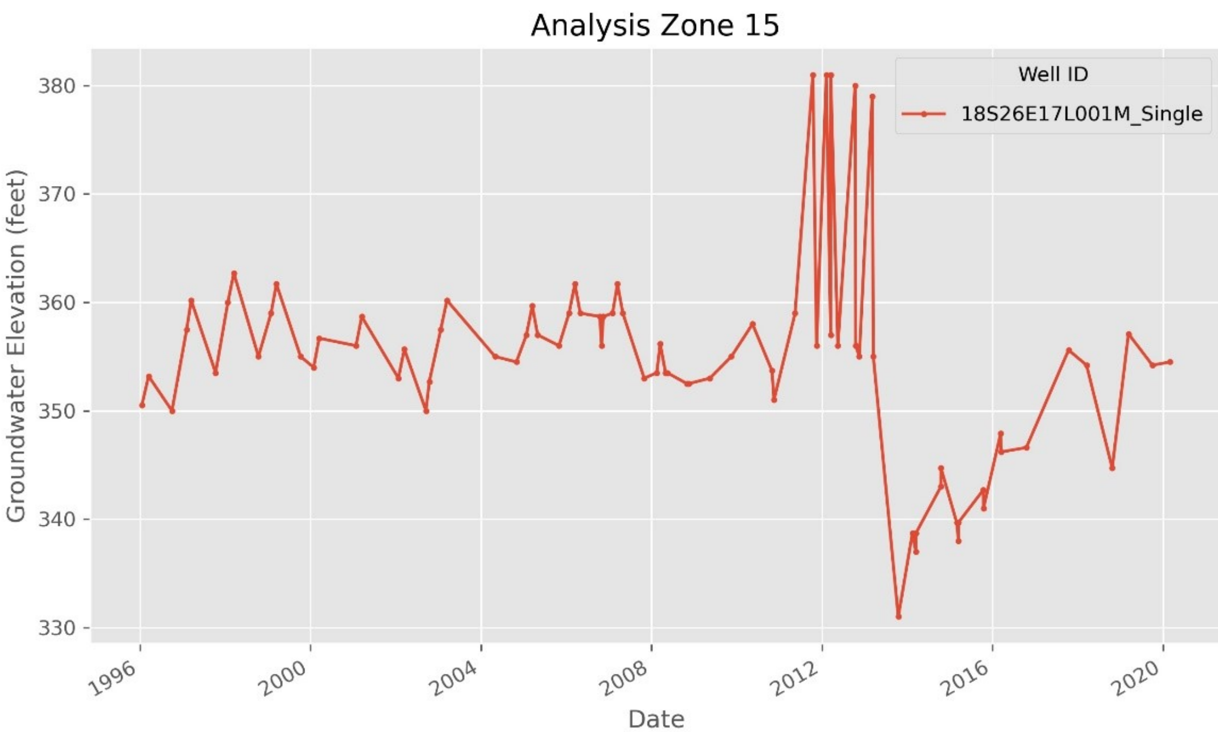

Analysis Zone 10
Groundwater Elevation (feet)
350
300
250
200
150
100
Well ID
19S26E34R006M_Single
20S26E08H001M_Single
20S26E16R001M_Single
20S26E20J001M_Single
20S26E32A001M_Single
1996
2000
2004
2008
2012
2016
2020
Date

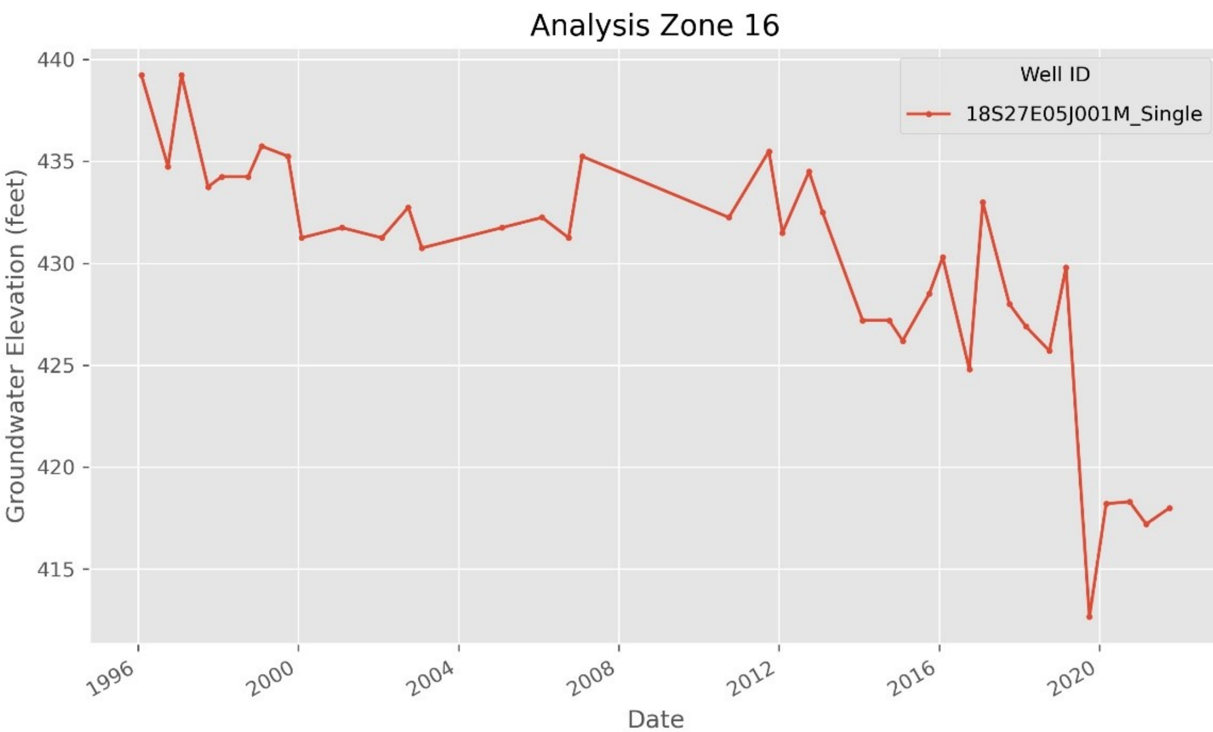

Analysis Zone 11
Groundwater Elevation (feet)
280
260
240
220
200
Well ID
17S24E34B001M_Single
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
Date

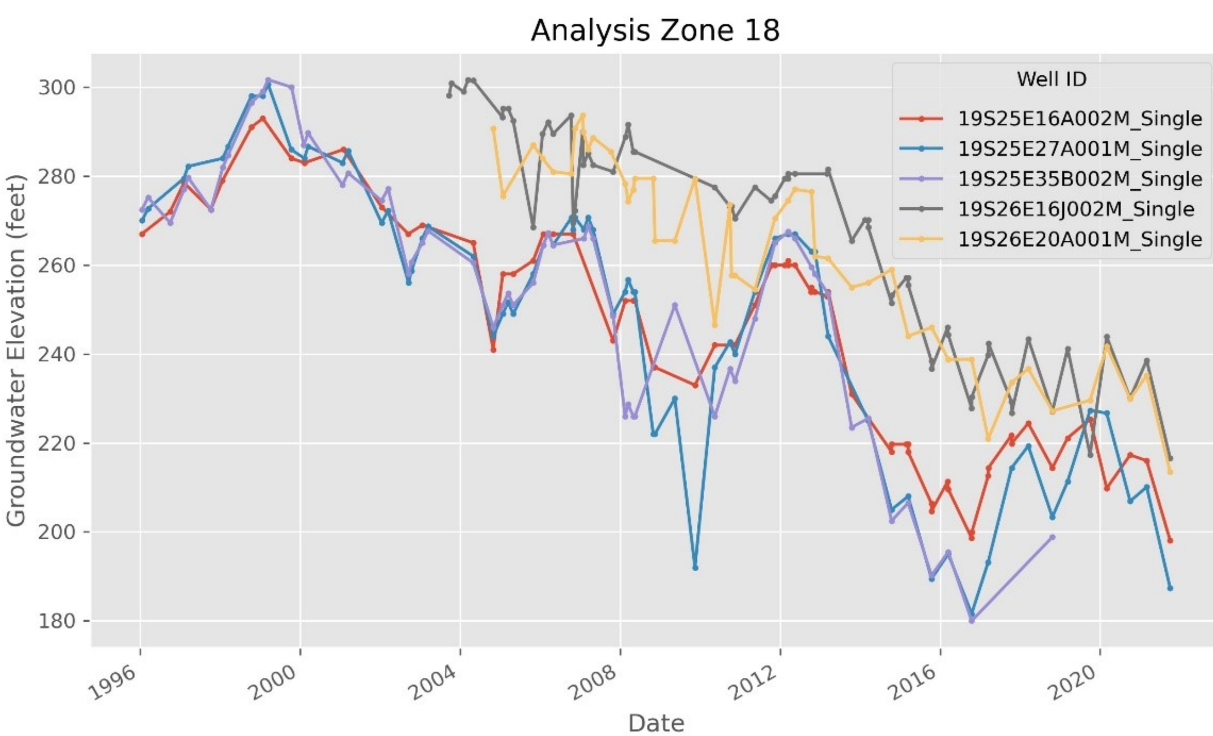

Analysis Zone 12
Well ID
17S24E36H003M_Single
Groundwater Elevation (feet)
250
240
230
220
210
200
190
180
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 13
Well ID
18S25E05Q001M_Single
18S25E15C001M_Single
Groundwater Elevation (feet)
300
280
260
240
220
200
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 14
Groundwater Elevation (feet)
340
320
300
280
260
240
220
200
Well ID
18S25E23J001M_Single
19S25E09H001M_Single
19S26E05C001M_Single
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 15
Groundwater Elevation (feet)
380
370
360
350
340
330
Well ID
18S26E17L001M_Single
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 16
Well ID
18S27E05J001M_Single
Groundwater Elevation (feet)
440
435
430
425
420
415
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 18
Well ID
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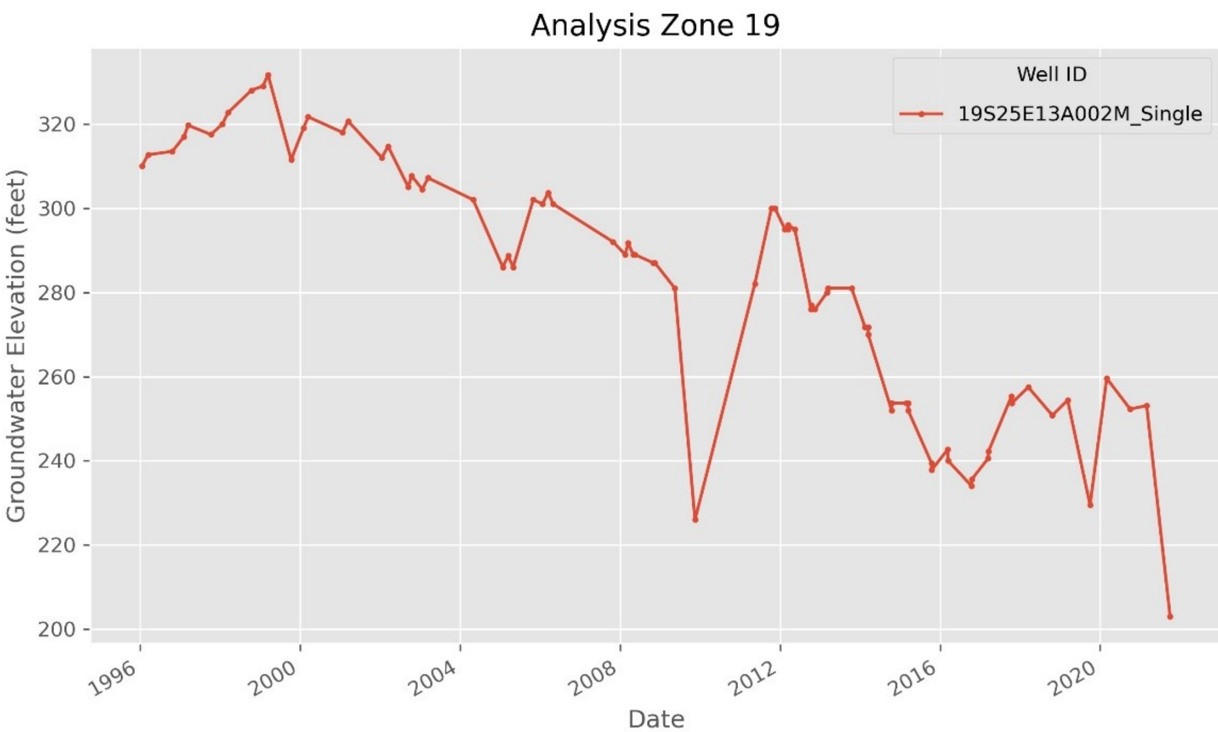
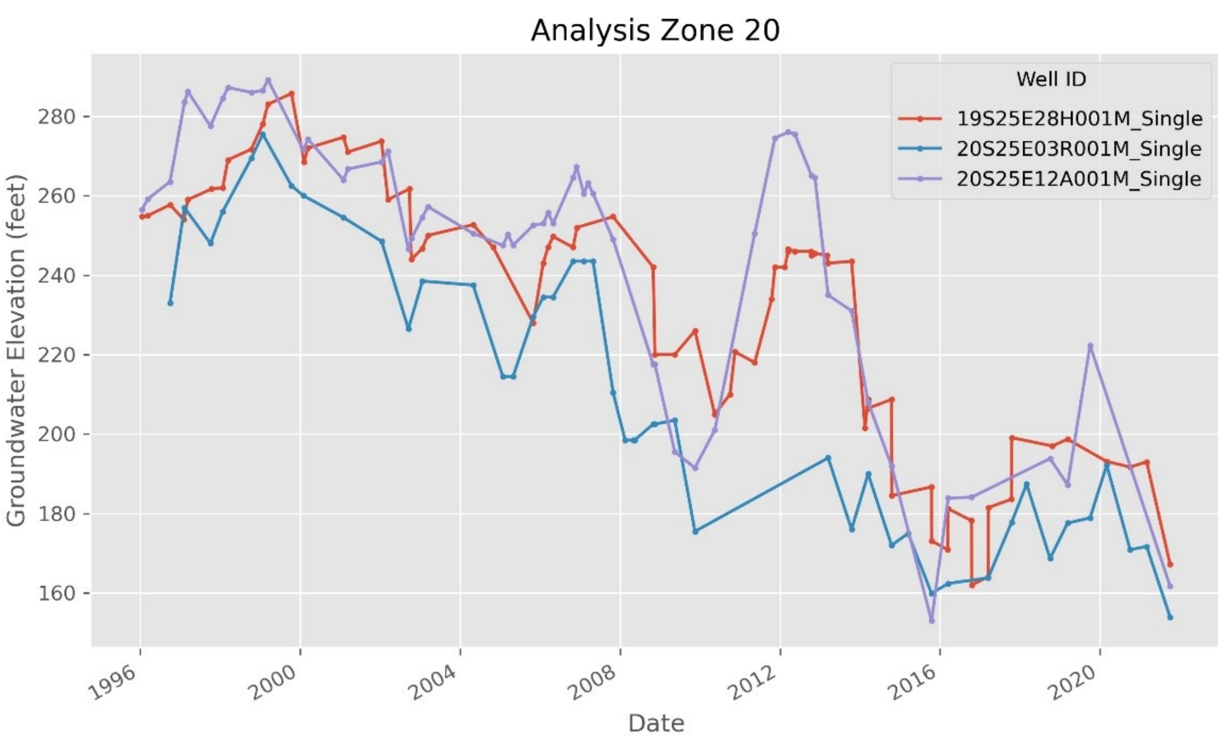
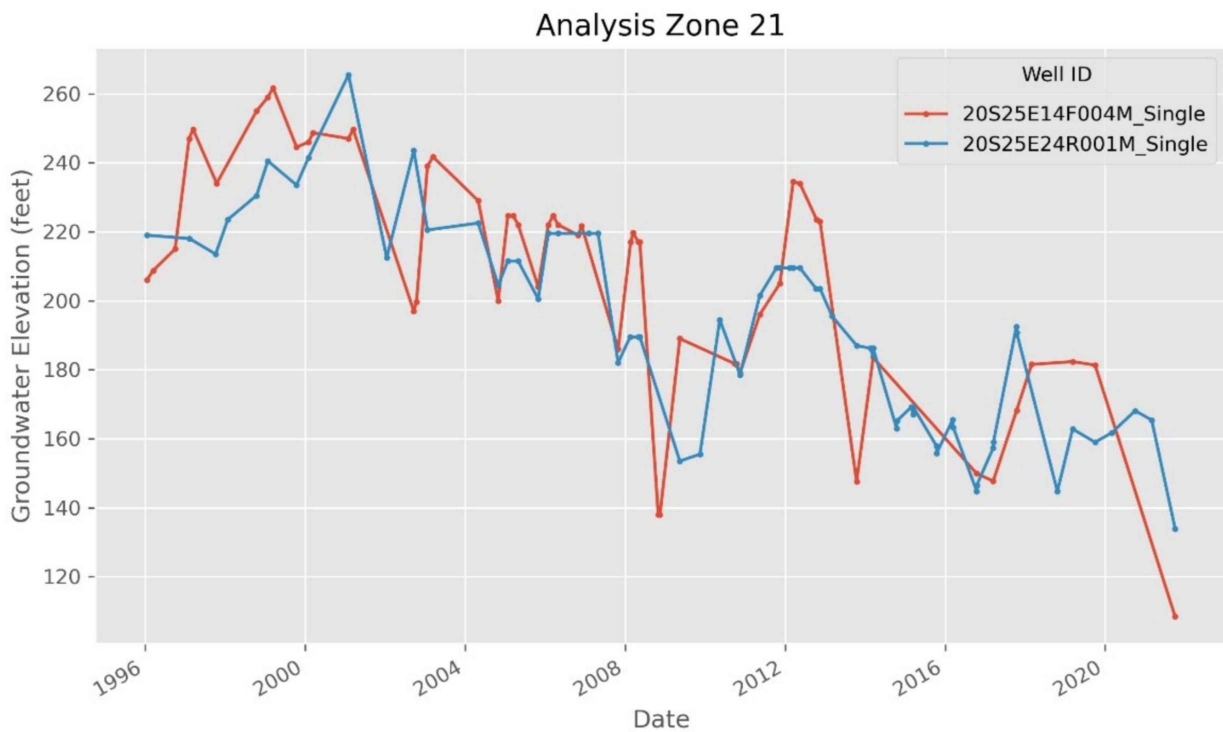
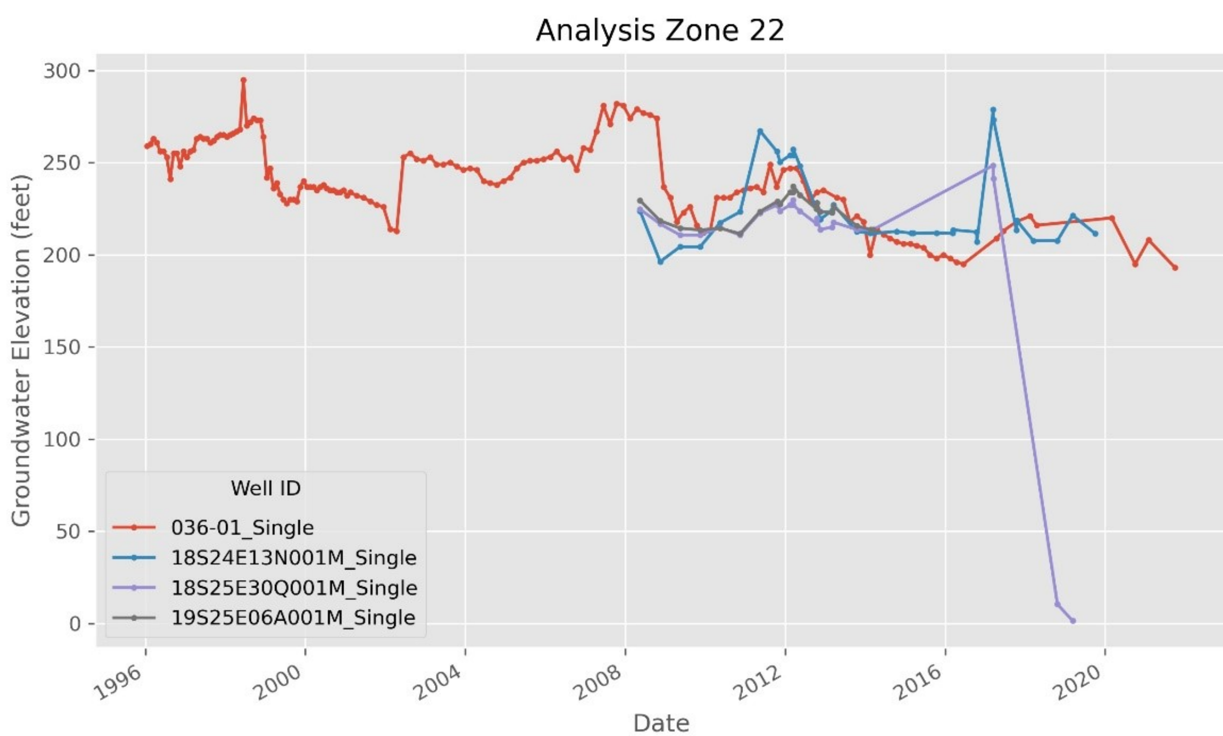
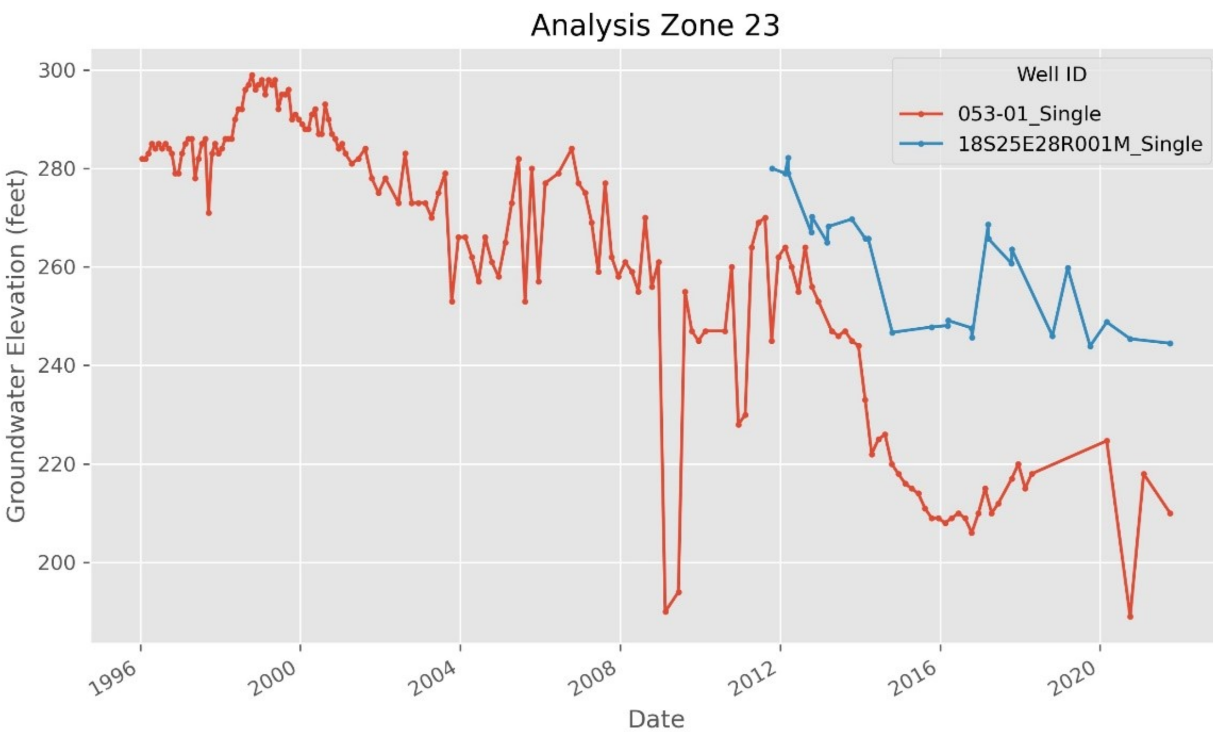
19S25E27A001M_Single
19S25E35B002M_Single
19S26E16J002M_Single
19S26E20A001M_Single
Groundwater Elevation (feet)
300
280
260
240
220
200
180
1996
2000
2004
2008
2012
2016
2020
Date

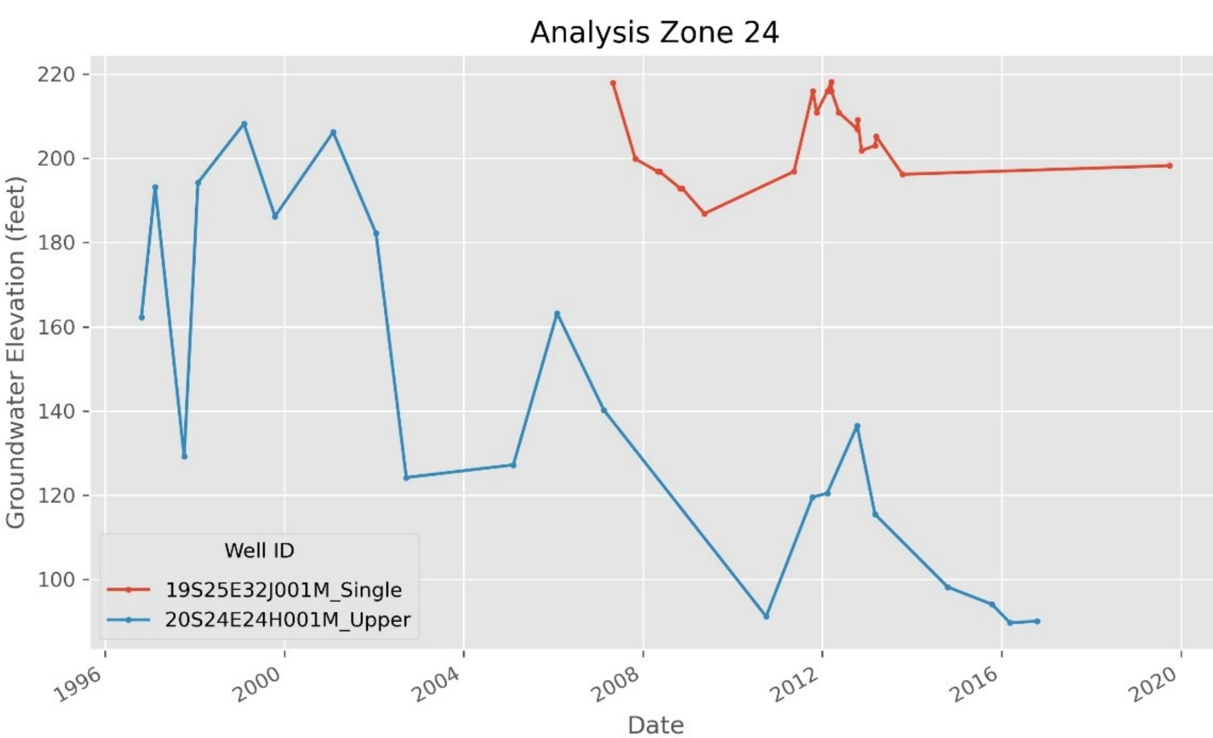

Analysis Zone 19
Well ID
19S25E13A002M_Single
Groundwater Elevation (feet)
320
300
280
260
240
220
200
1996
2000
2004
2008
2012
2016
2020
Date

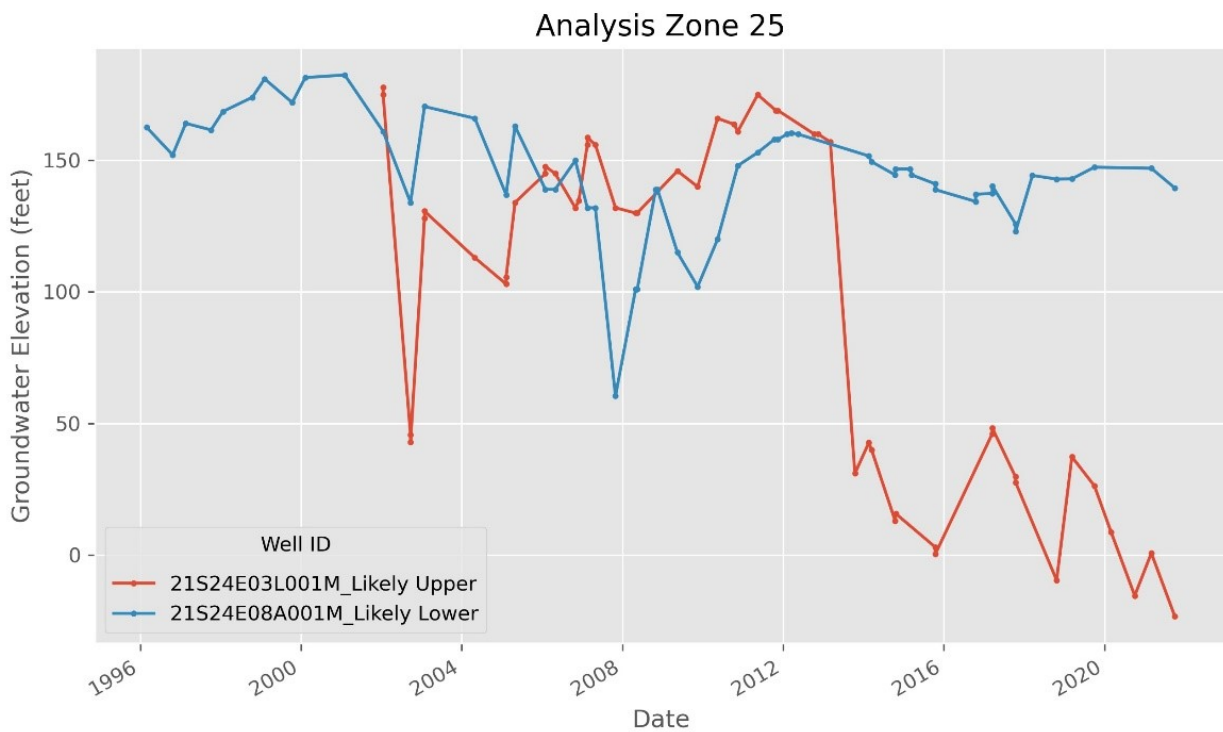

Analysis Zone 20
Well ID
19S25E28H001M_Single
20S25E03R001M_Single
20S25E12A001M_Single
Groundwater Elevation (feet)
280
260
240
220
200
180
160
1996
2000
2004
2008
2012
2016
2020
Date

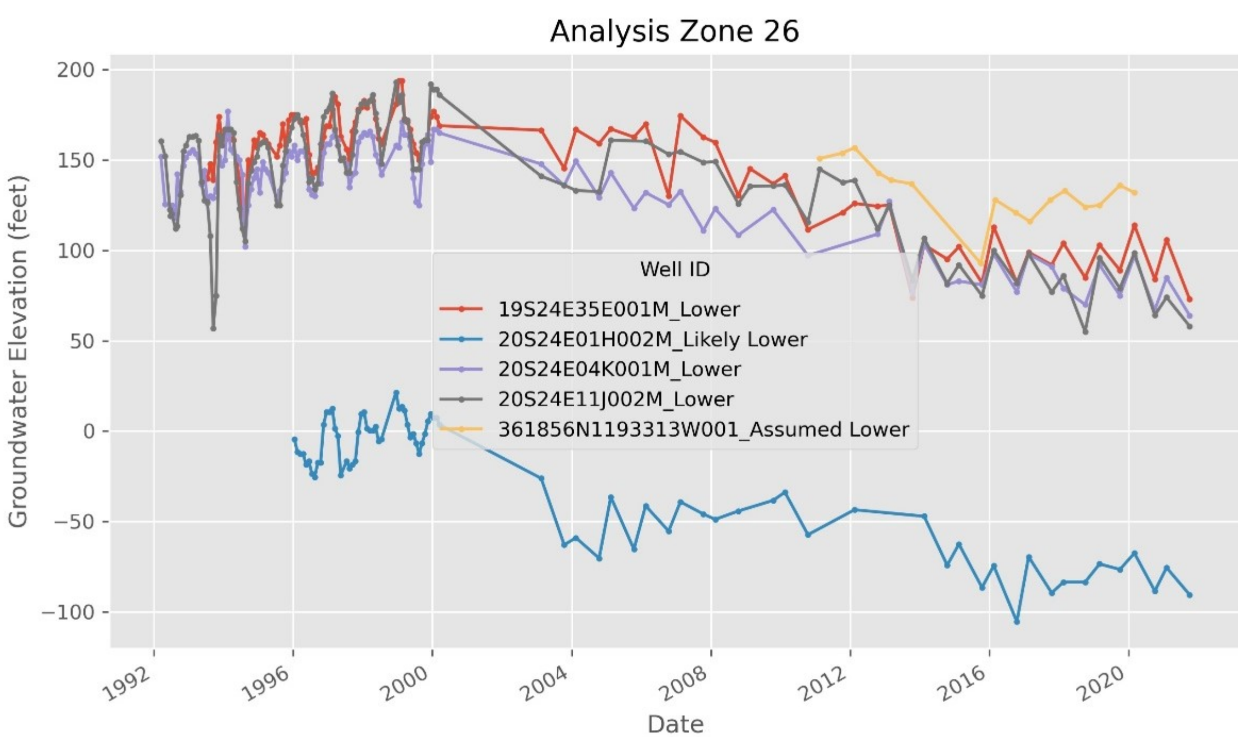

Analysis Zone 21
Well ID
20S25E14F004M_Single
20S25E24R001M_Single
Groundwater Elevation (feet)
260
240
220
200
180
160
140
120
1996
2000
2004
2008
2012
2016
2020
Date

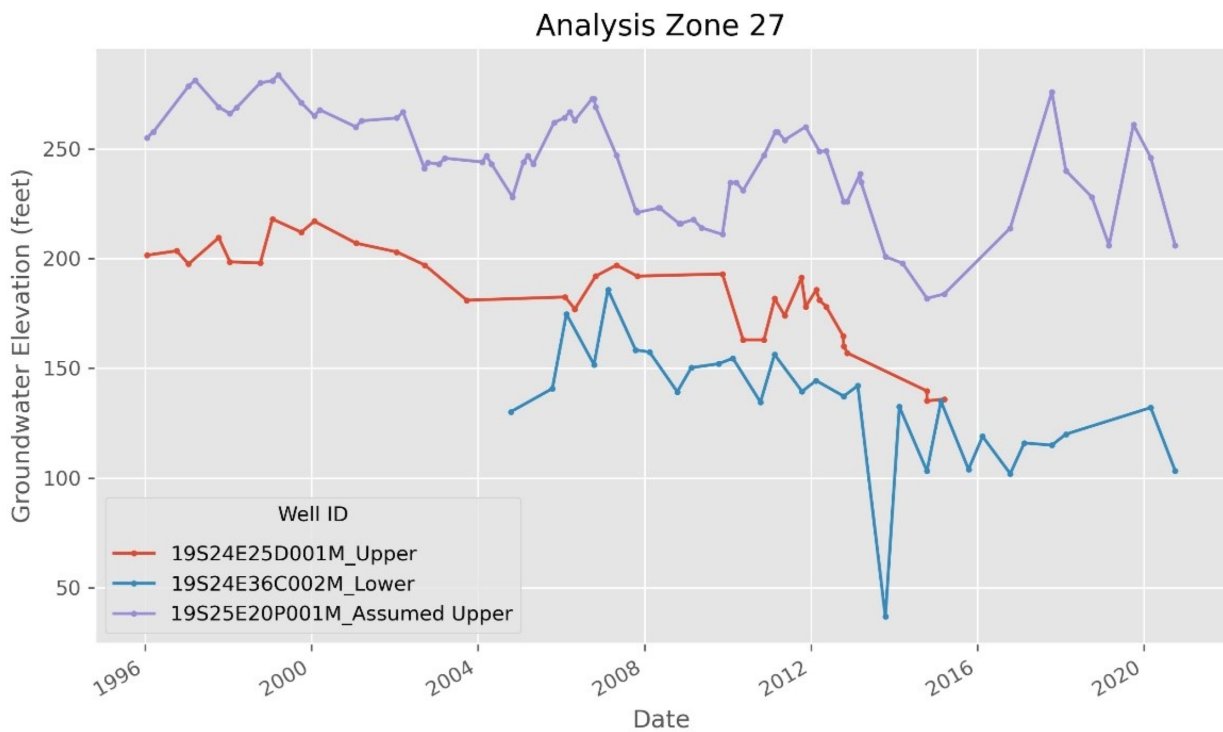

Analysis Zone 22
Well ID
036-01_Single
18S24E13N001M_Single
18S25E30Q001M_Single
19S25E06A001M_Single
Groundwater Elevation (feet)
300
250
200
150
100
50
0
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 23
Groundwater Elevation (feet)
300
280
260
240
220
200
Well ID
053-01_Single
18S25E28R001M_Single
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 24
Groundwater Elevation (feet)
220
200
180
160
140
120
100
Well ID
19S25E32J001M_Single
20S24E24H001M_Upper
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 25
Groundwater Elevation (feet)
150
100
50
0
Well ID
21S24E03L001M_Likely Upper
21S24E08A001M_Likely Lower
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 26
Groundwater Elevation (feet)
200
150
100
50
0
−50
−100
Well ID
19S24E35E001M_Lower
20S24E01H002M_Likely Lower
20S24E04K001M_Lower
20S24E11J002M_Lower
361856N1193313W001_Assumed Lower
1992
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 27
Groundwater Elevation (feet)
Date
Well ID
19S24E25D001M_Upper
19S24E36C002M_Lower
19S25E20P001M_Assumed Upper
250
200
150
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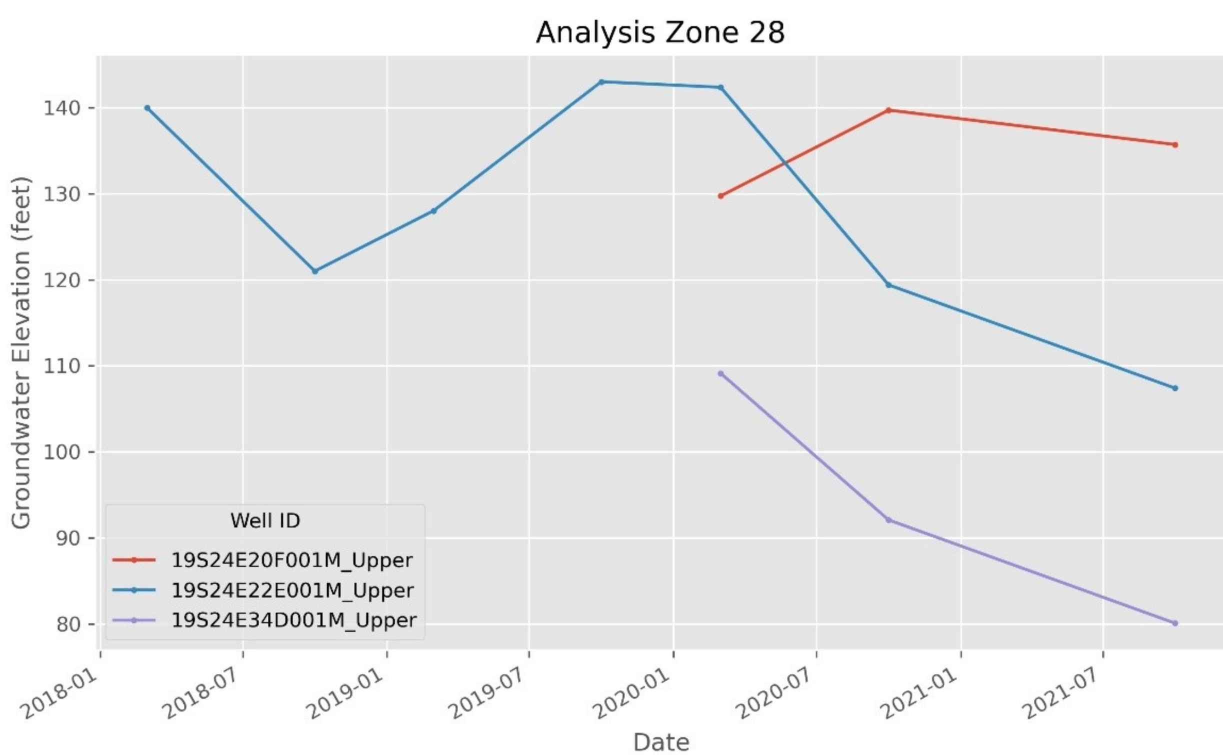
50
1996
2000
2004
2008
2012
2016
2020


Analysis Zone 28
Groundwater Elevation (feet)
Date
Well ID
19S24E20F001M_Upper
19S24E22E001M_Upper
19S24E34D001M_Upper
140
130
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2018-01
2018-07
2019-01
2019-07
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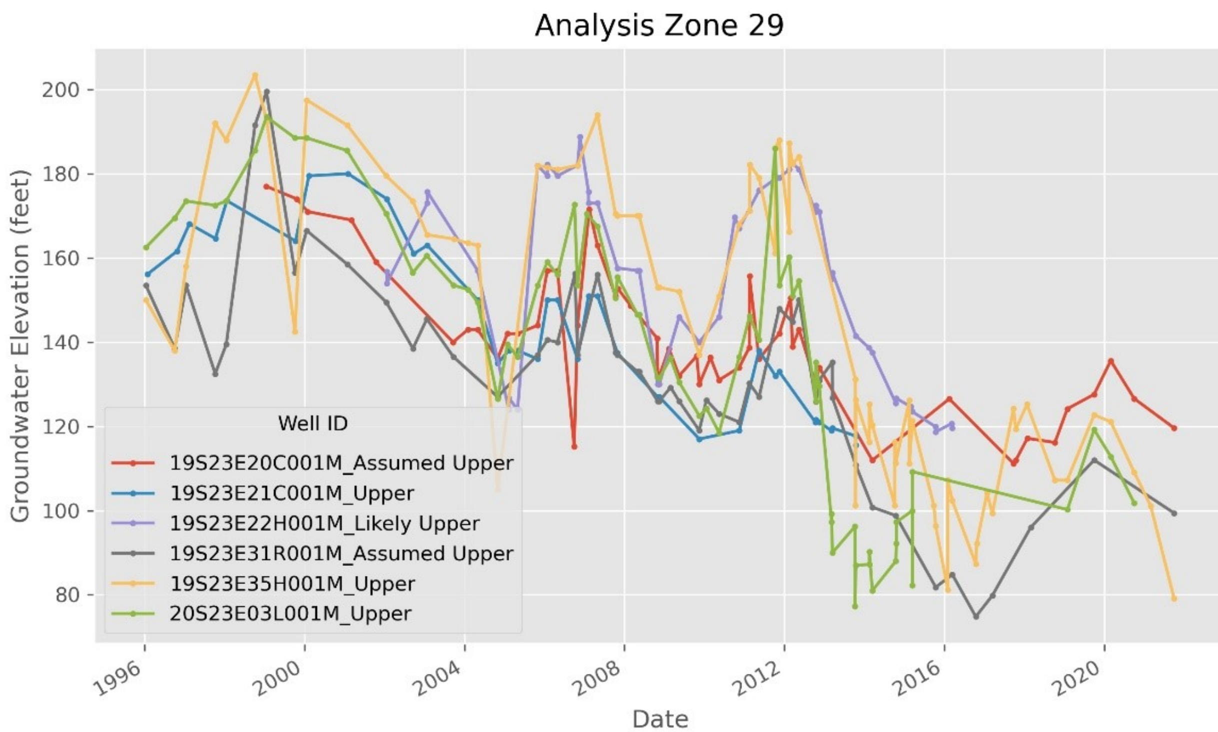
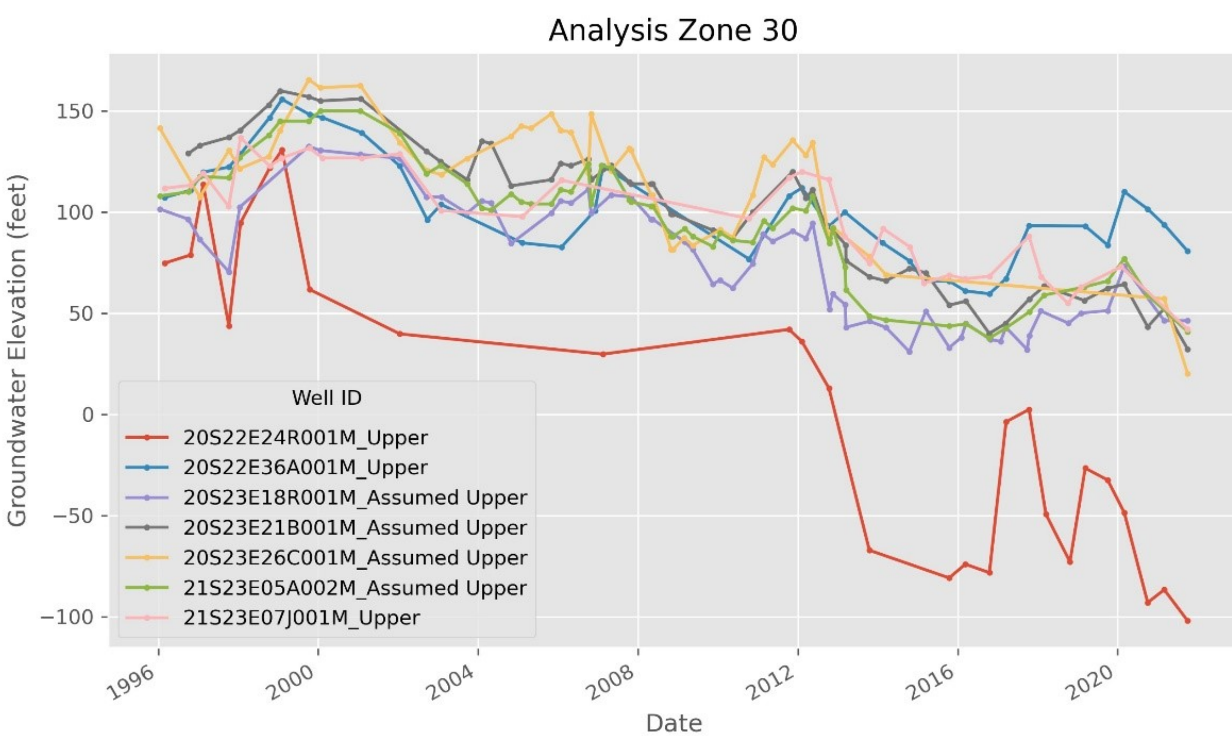
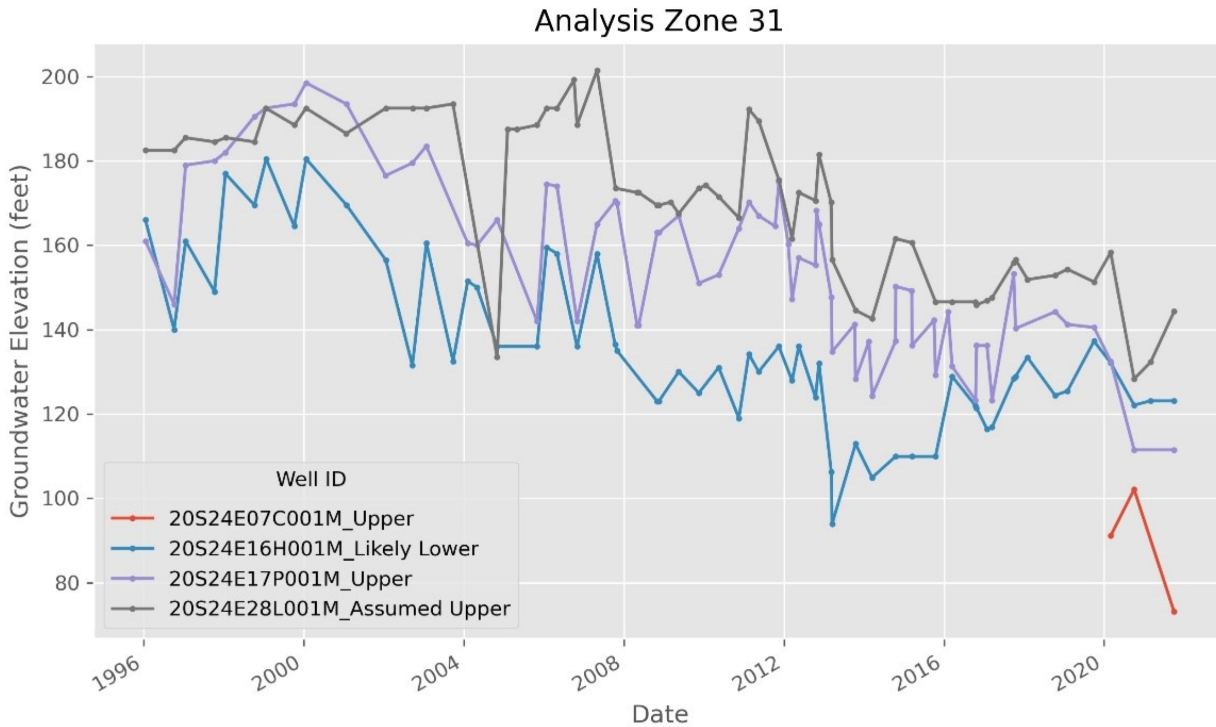
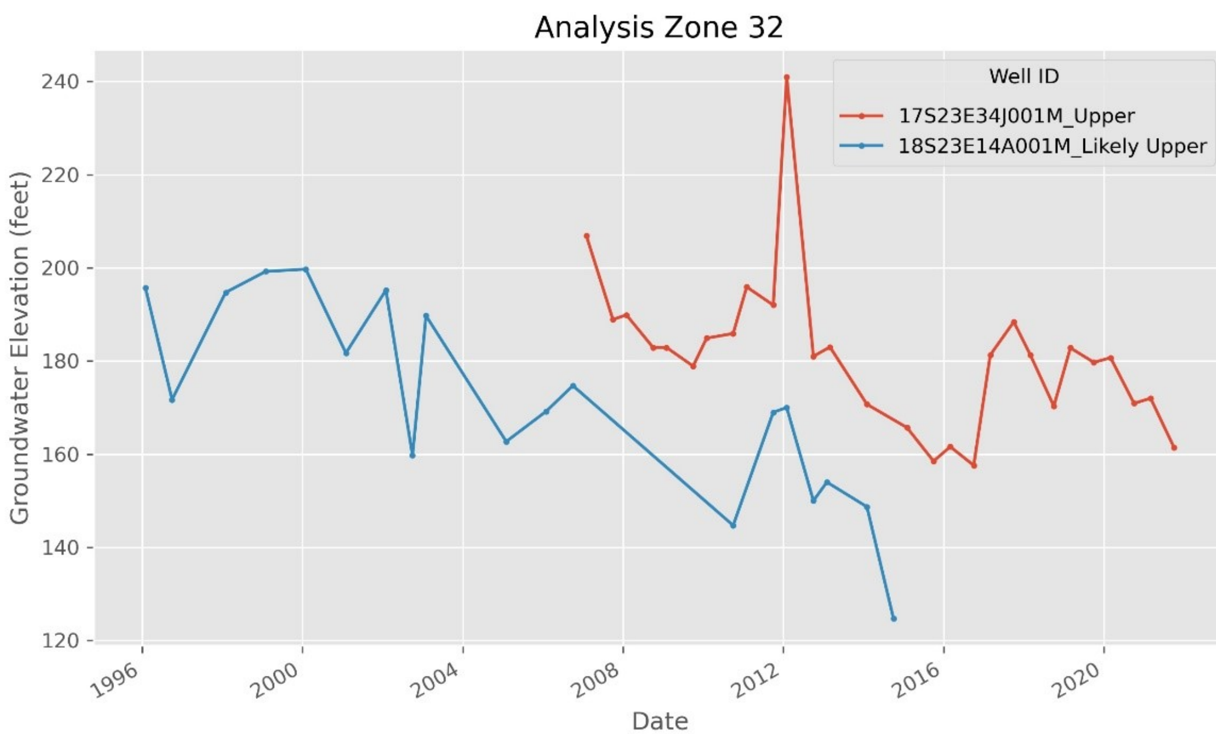
2020-07
2021-01
2021-07

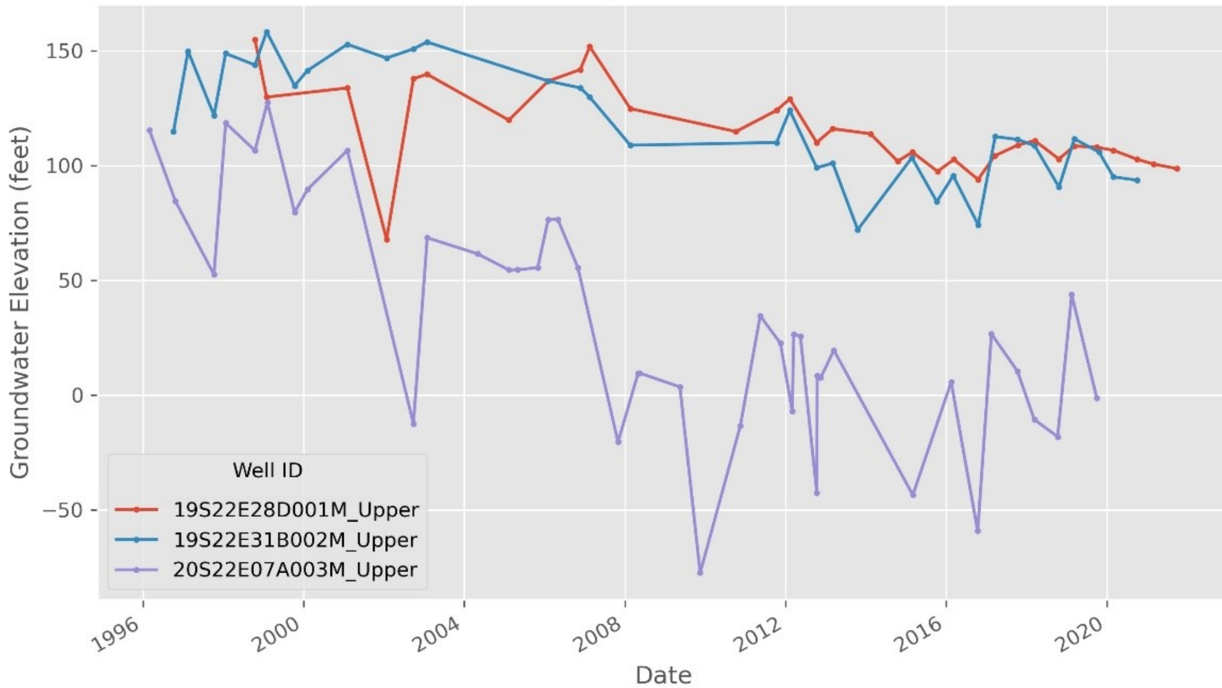

Analysis Zone 29
Groundwater Elevation (feet)
200
180
160
140
120
100
80
Well ID
19S23E20C001M_Assumed Upper
19S23E21C001M_Upper
19S23E22H001M_Likely Upper
19S23E31R001M_Assumed Upper
19S23E35H001M_Upper
20S23E03L001M_Upper
1996
2000
2004
2008
2012
2016
2020
Date


Analysis Zone 30
Groundwater Elevation (feet)
150
100
50
0
−50
−100
Well ID
20S22E24R001M_Upper
20S22E36A001M_Upper
20S23E18R001M_Assumed Upper
20S23E21B001M_Assumed Upper
20S23E26C001M_Assumed Upper
21S23E05A002M_Assumed Upper
21S23E07J001M_Upper
1996
2000
2004
2008
2012
2016
2020
Date

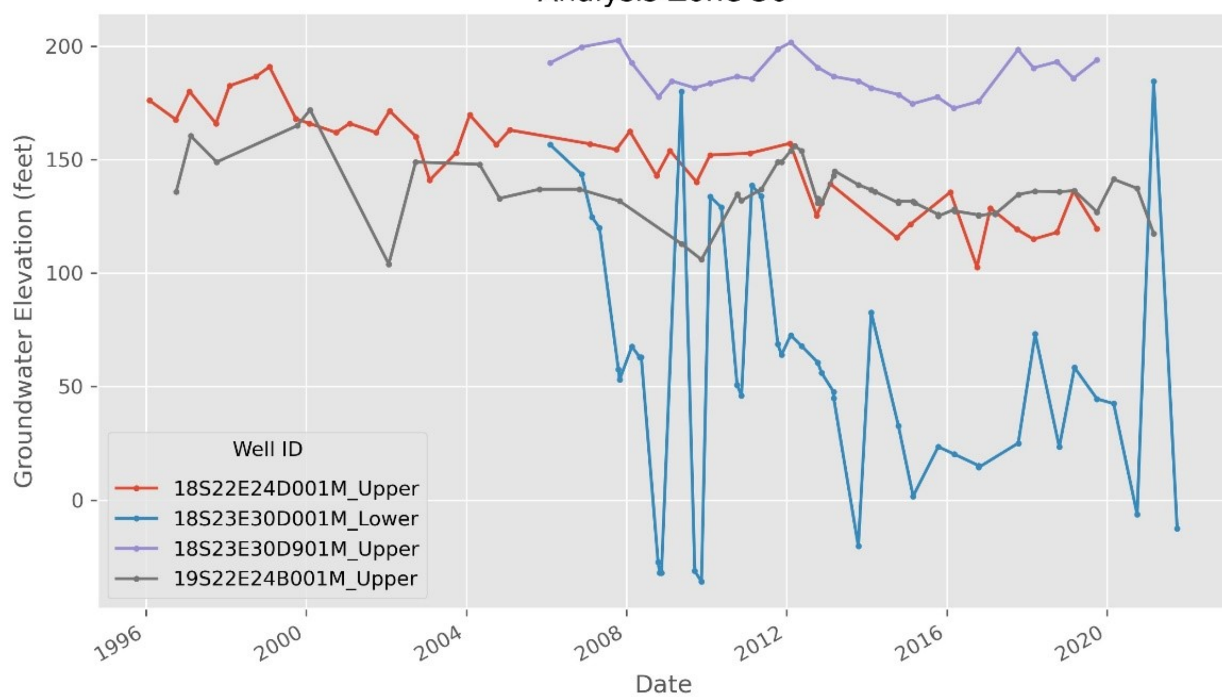

Analysis Zone 31
Groundwater Elevation (feet)
Date
Well ID
20S24E07C001M_Upper
20S24E16H001M_Likely Lower
20S24E17P001M_Upper
20S24E28L001M_Assumed Upper
200
180
160
140
120
100
80
1996
2000
2004
2008
2012
2016
2020

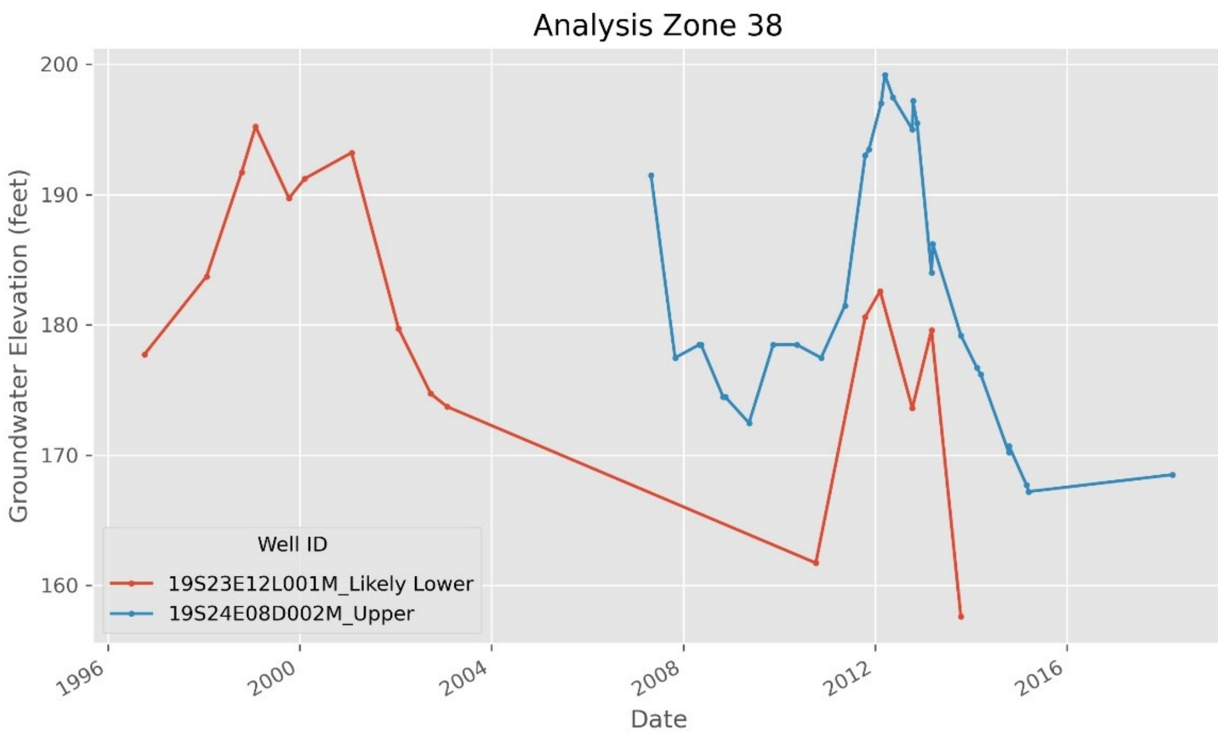

Analysis Zone 32
Groundwater Elevation (feet)
Date
Well ID
17S23E34J001M_Upper
18S23E14A001M_Likely Upper
240
220
200
180
160
140
120
1996
2000
2004
2008
2012
2016
2020

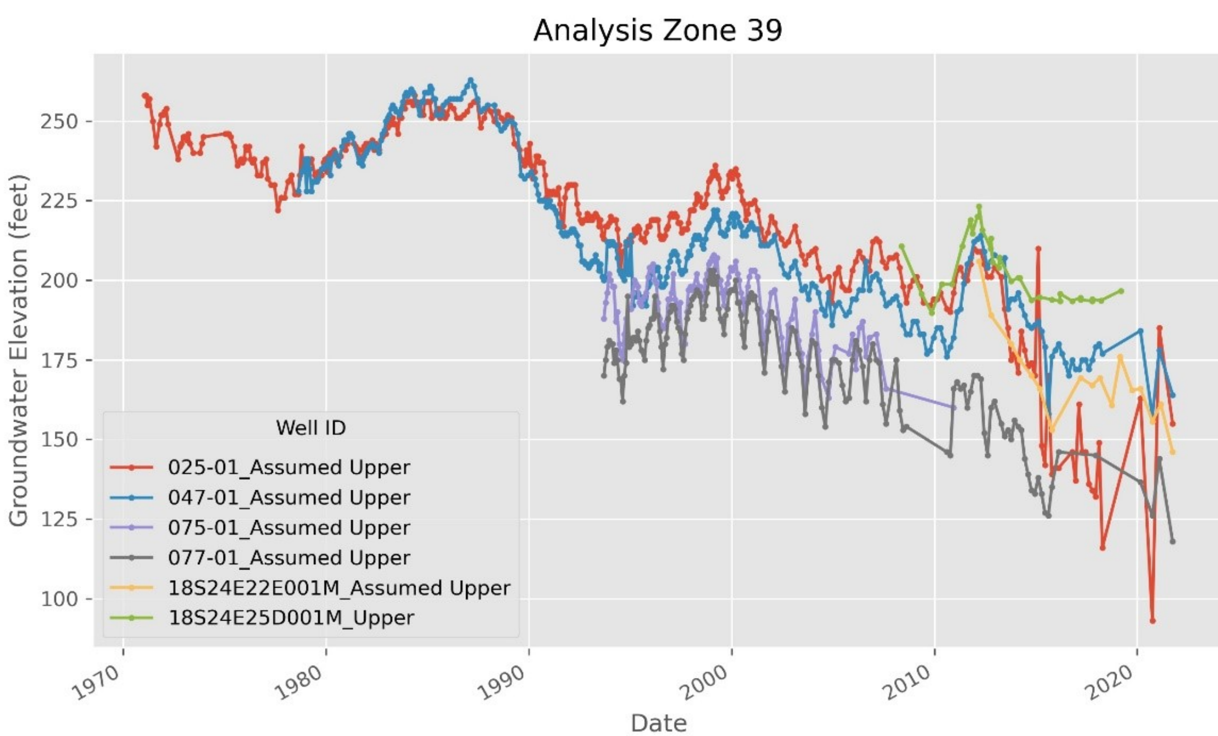
Analysis Zone 35



Analysis Zone 36



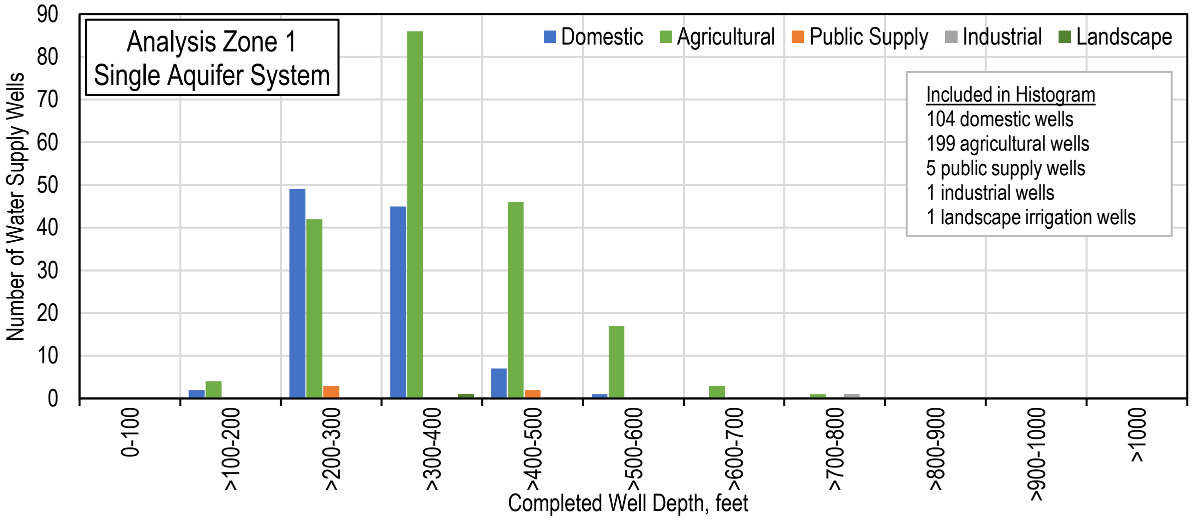

Analysis Zone 38
Groundwater Elevation (feet)
200
190
180
170
160
1996
2000
2004
2008
2012
2016
Date
Well ID
19S23E12L001M_Likely Lower
19S24E08D002M_Upper

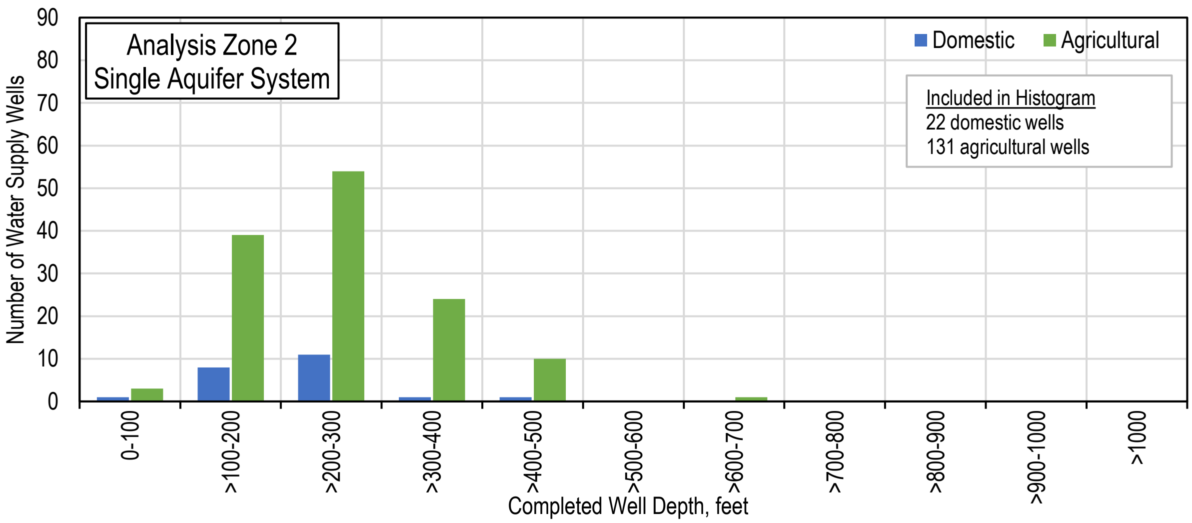

Analysis Zone 39
Groundwater Elevation (feet)
250
225
200
175
150
125
100
1970
1980
1990
2000
2010
2020
Date
Well ID
025-01_Assumed Upper
047-01_Assumed Upper
075-01_Assumed Upper
077-01_Assumed Upper
18S24E22E001M_Assumed Upper
18S24E25D001M_Upper

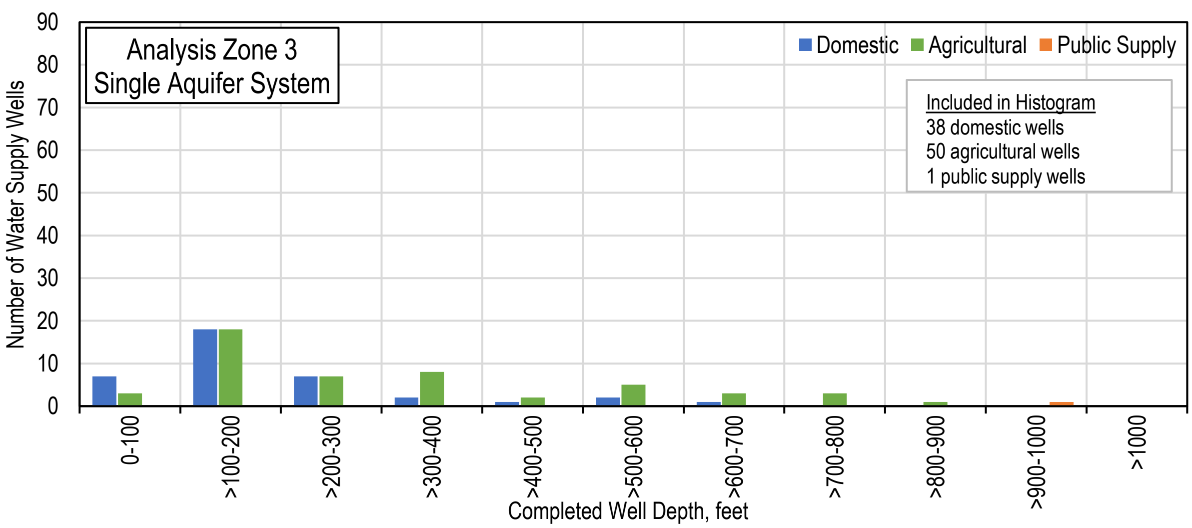
MONTGOMERY & ASSOCIATES

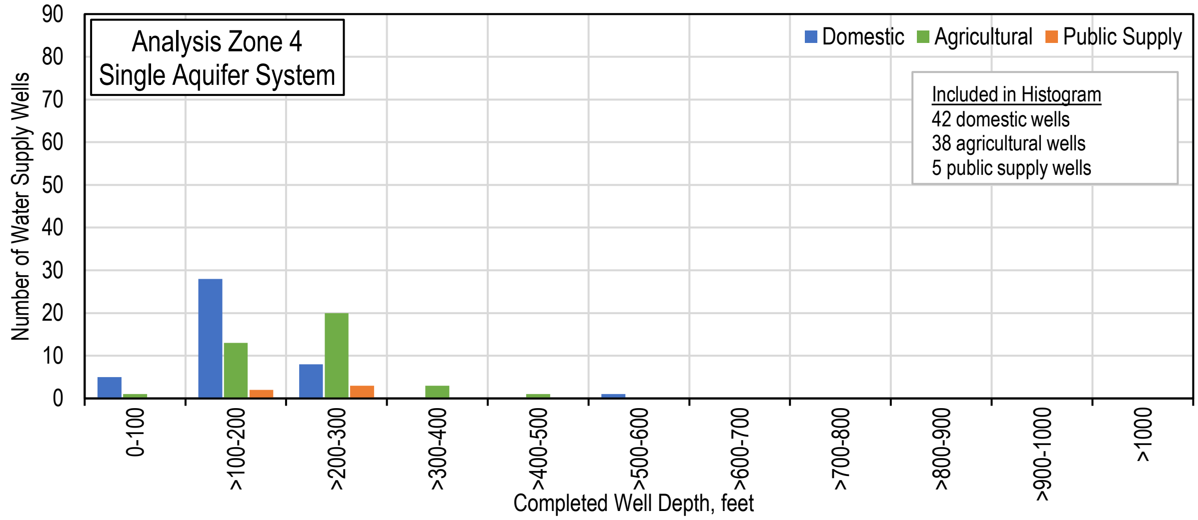
Appendix B

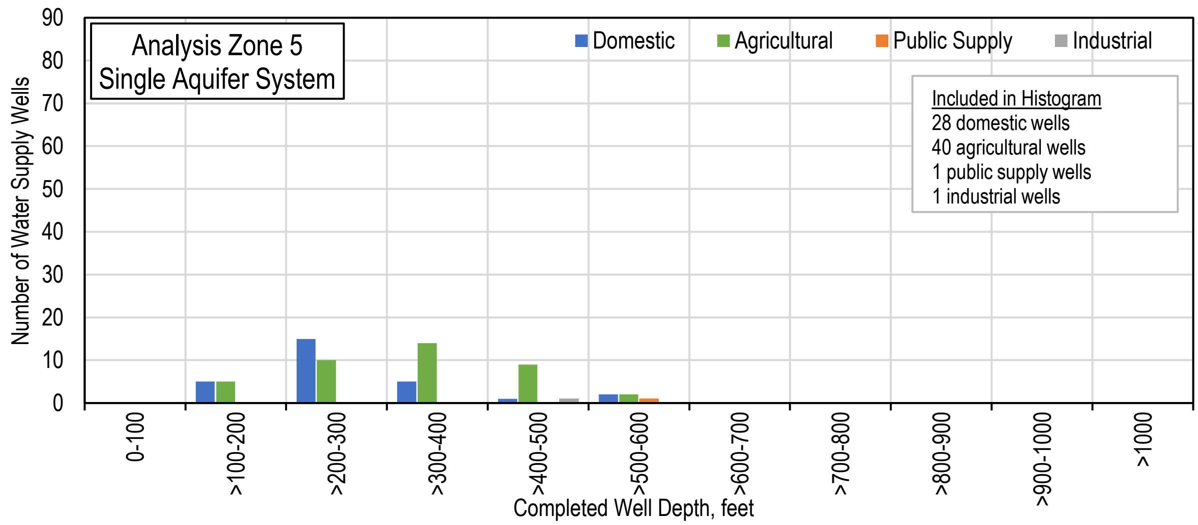
Completed Well Depth Histograms by Analysis Zone

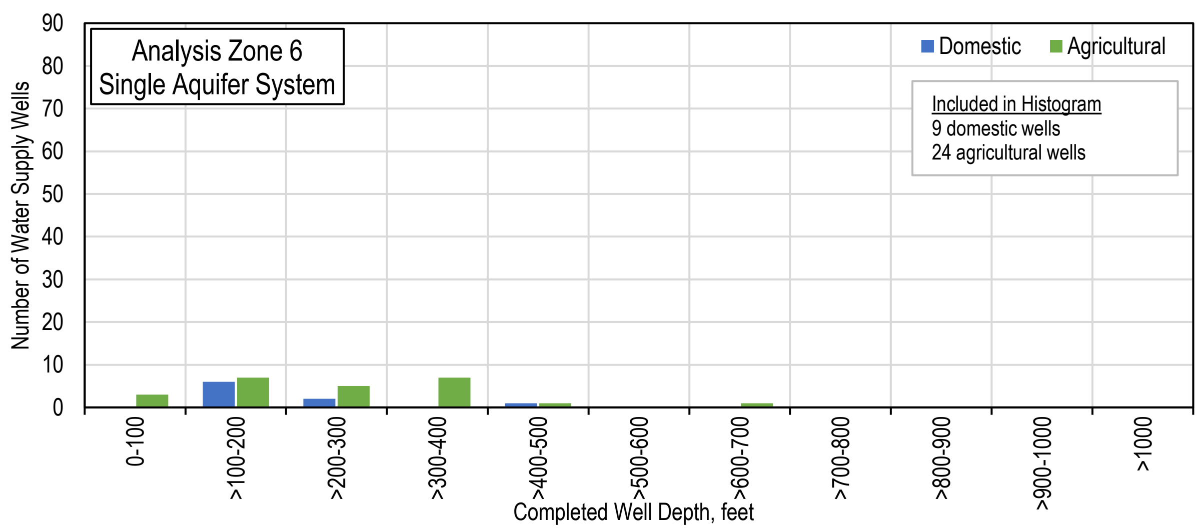

Analysis Zone 1
Single Aquifer System
Domestic
Agricultural
Public Supply
Industrial
Landscape
Included in Histogram
104 domestic wells
199 agricultural wells
5 public supply wells
1 industrial wells
1 landscape irrigation wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

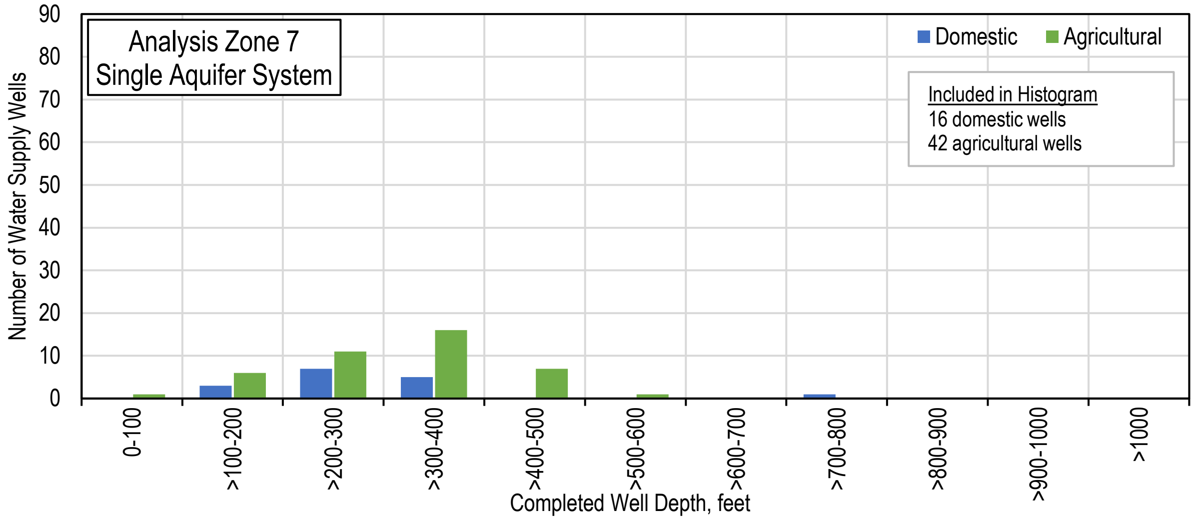

Analysis Zone 2
Single Aquifer System
Domestic
Agricultural
Included in Histogram
22 domestic wells
131 agricultural wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

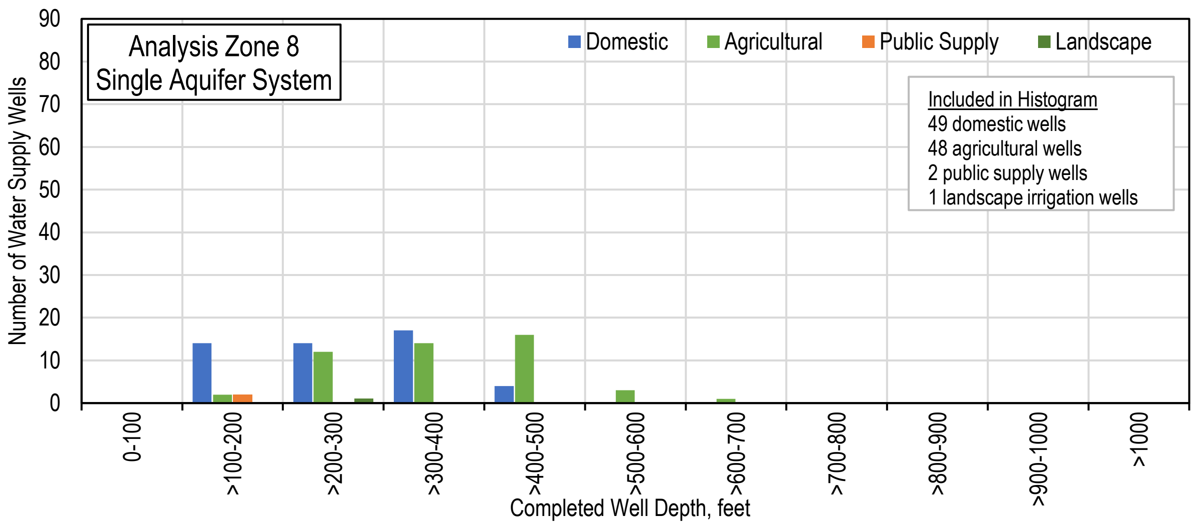

Analysis Zone 3
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
38 domestic wells
50 agricultural wells
1 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

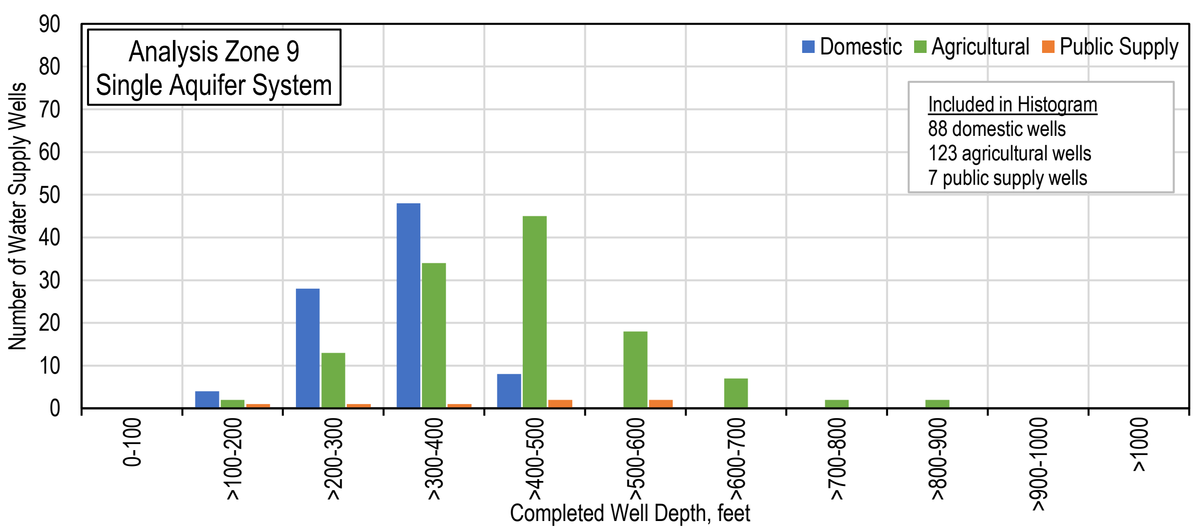

Analysis Zone 4
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
42 domestic wells
38 agricultural wells
5 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

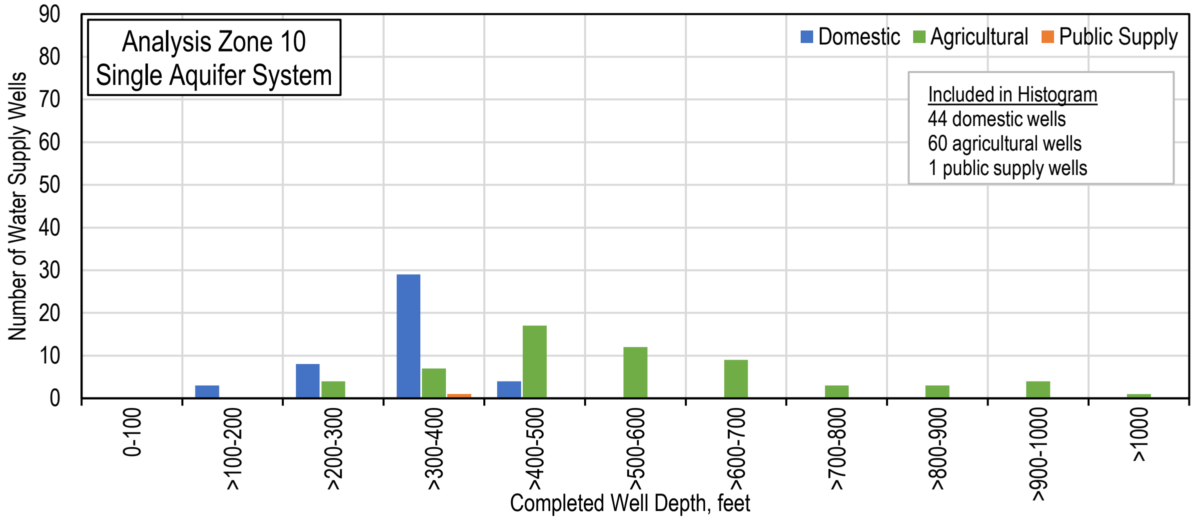

Analysis Zone 5
Single Aquifer System
Domestic
Agricultural
Public Supply
Industrial
Included in Histogram
28 domestic wells
40 agricultural wells
1 public supply wells
1 industrial wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

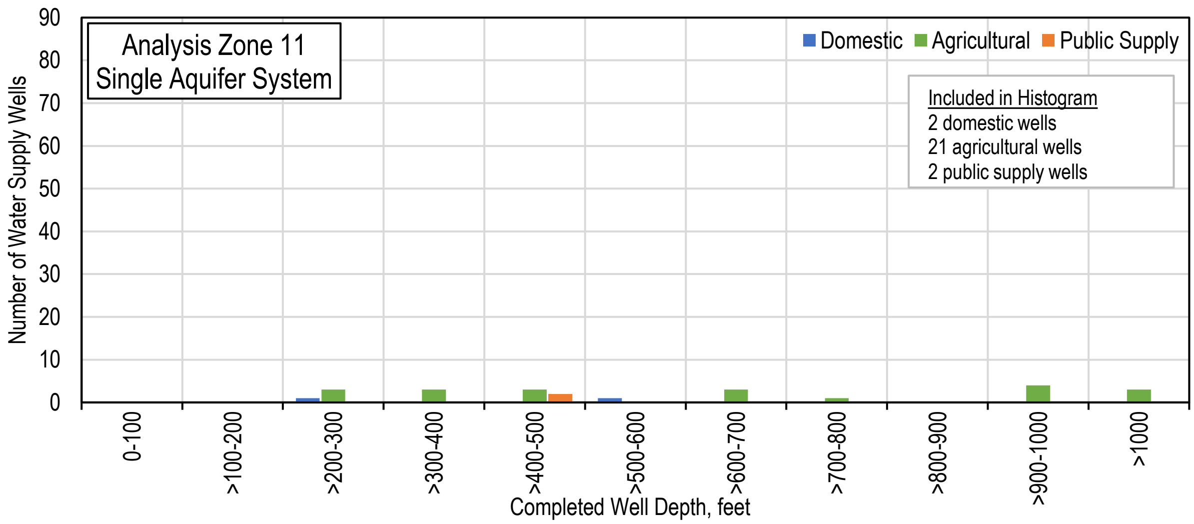

Analysis Zone 6
Single Aquifer System
Domestic
Agricultural
Included in Histogram
9 domestic wells
24 agricultural wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

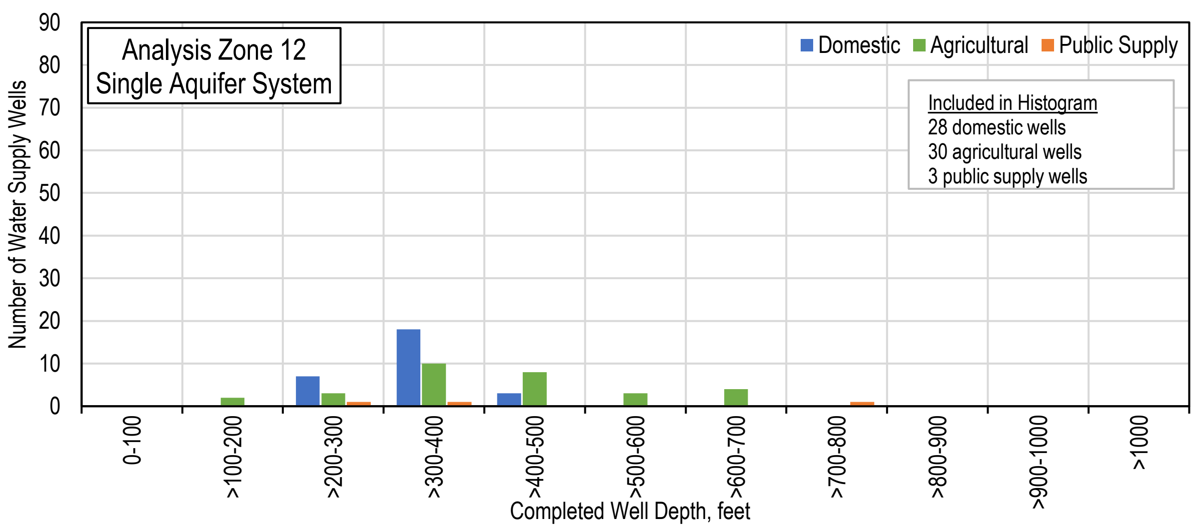

Analysis Zone 7
Single Aquifer System
Domestic
Agricultural
Included in Histogram
16 domestic wells
42 agricultural wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

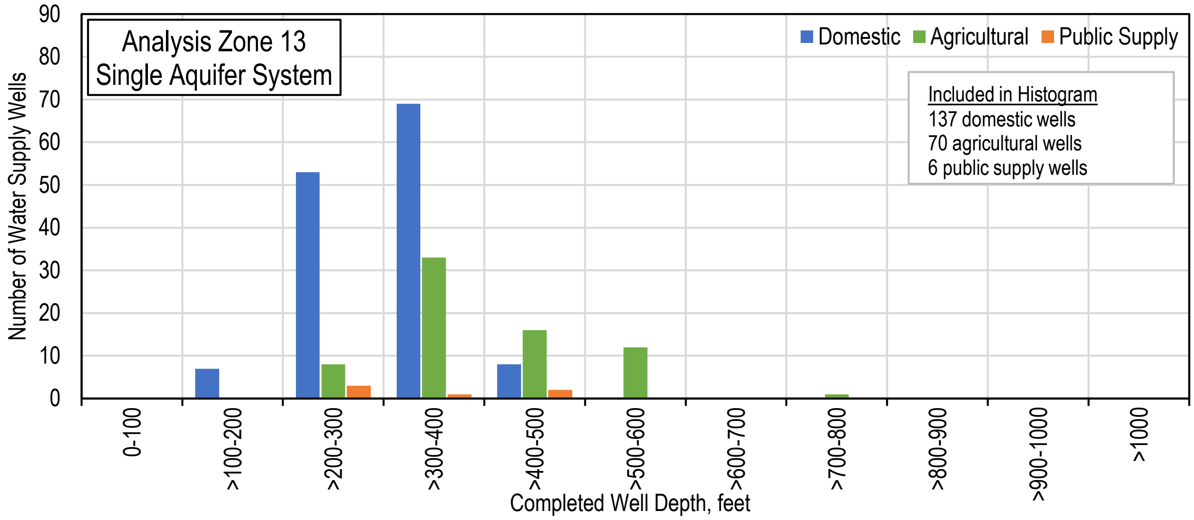

Analysis Zone 8
Single Aquifer System
Domestic
Agricultural
Public Supply
Landscape
Included in Histogram
49 domestic wells
48 agricultural wells
2 public supply wells
1 landscape irrigation wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

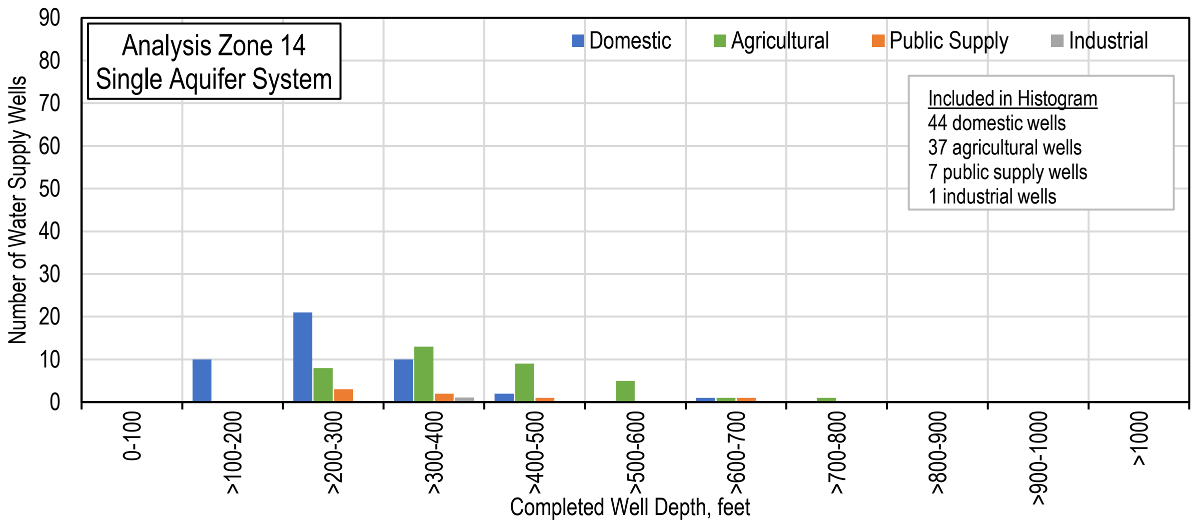

Analysis Zone 9
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
88 domestic wells
123 agricultural wells
7 public supply wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

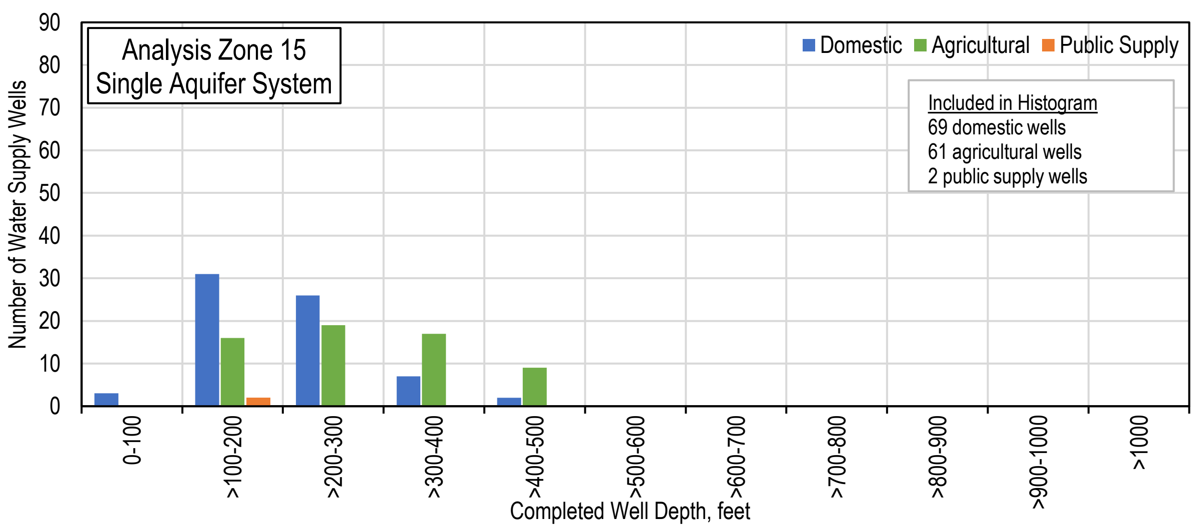

Analysis Zone 10
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
44 domestic wells
60 agricultural wells
1 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

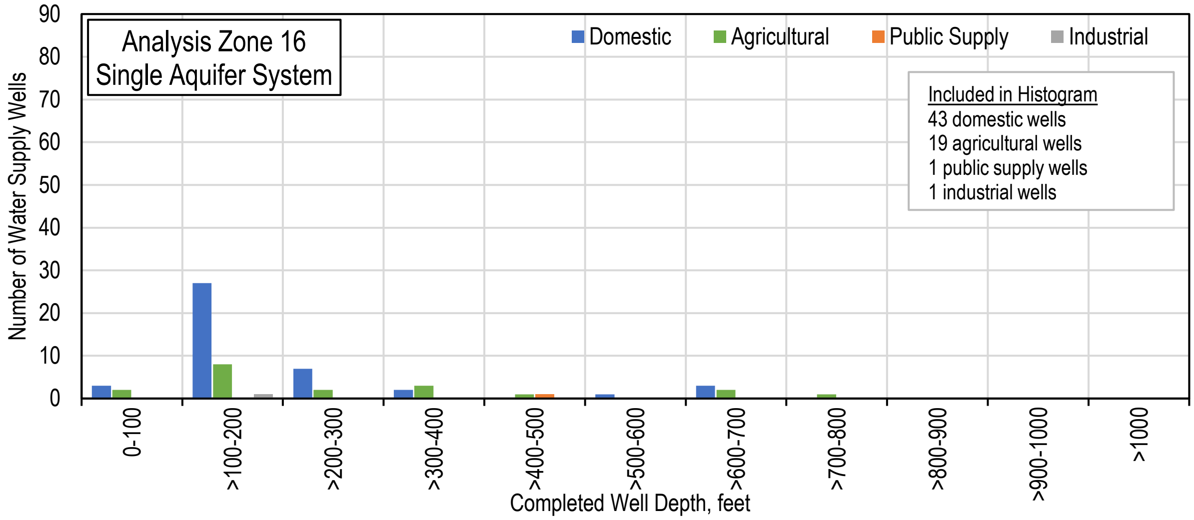

Analysis Zone 11
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
2 domestic wells
21 agricultural wells
2 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet

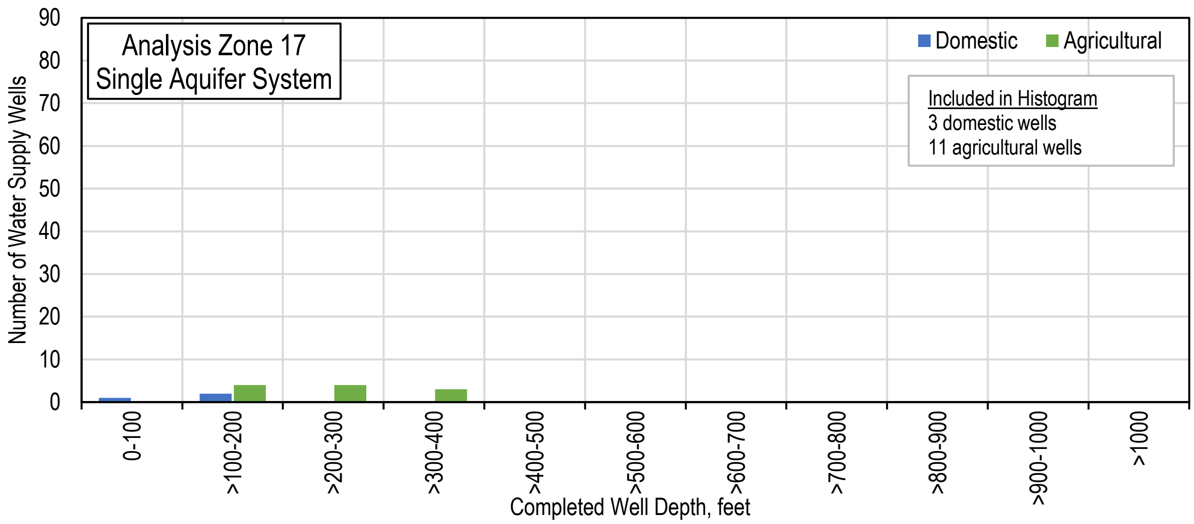

Analysis Zone 12
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
28 domestic wells
30 agricultural wells
3 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet

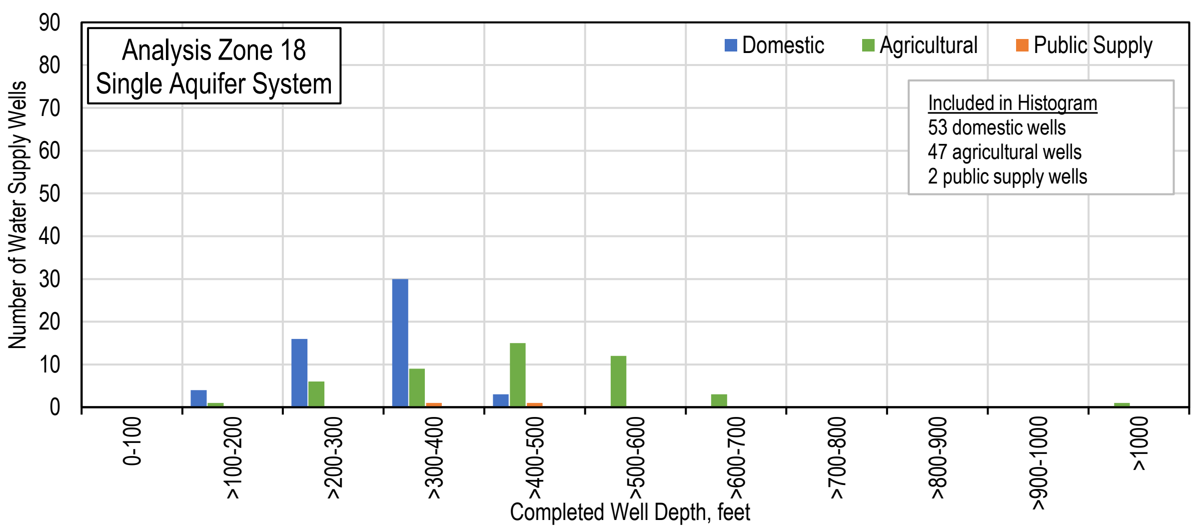

Analysis Zone 13
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
137 domestic wells
70 agricultural wells
6 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

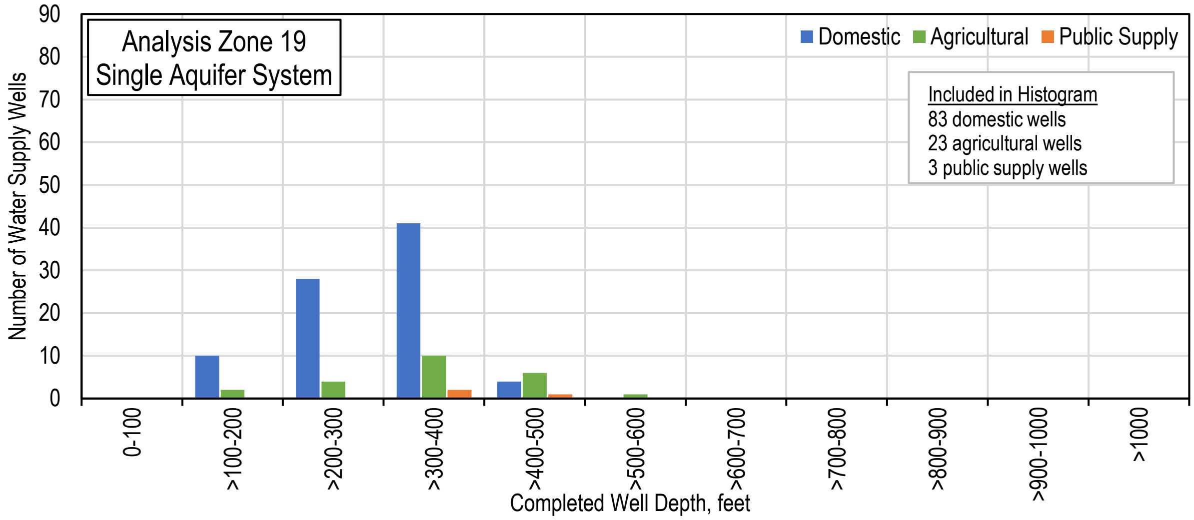

Analysis Zone 14
Single Aquifer System
Domestic
Agricultural
Public Supply
Industrial
Included in Histogram
44 domestic wells
37 agricultural wells
7 public supply wells
1 industrial wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

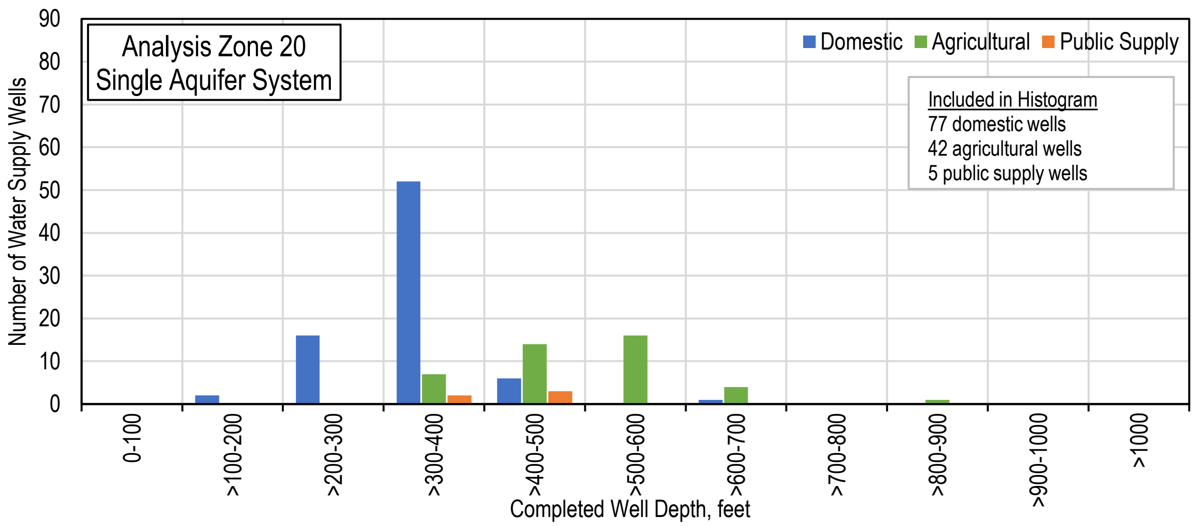

Analysis Zone 15
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
69 domestic wells
61 agricultural wells
2 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

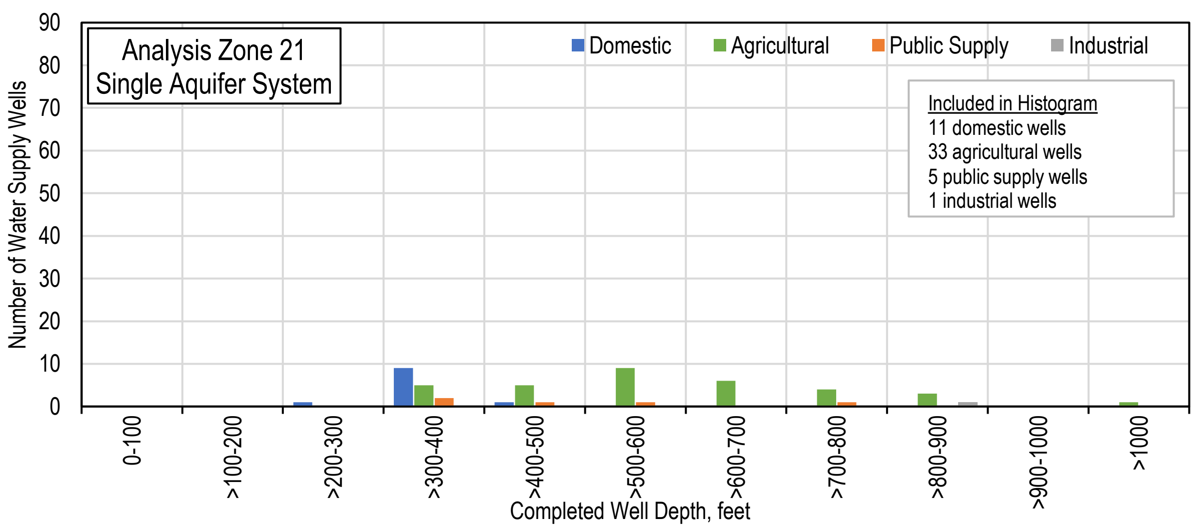

Analysis Zone 16
Single Aquifer System
Domestic
Agricultural
Public Supply
Industrial
Included in Histogram
43 domestic wells
19 agricultural wells
1 public supply wells
1 industrial wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

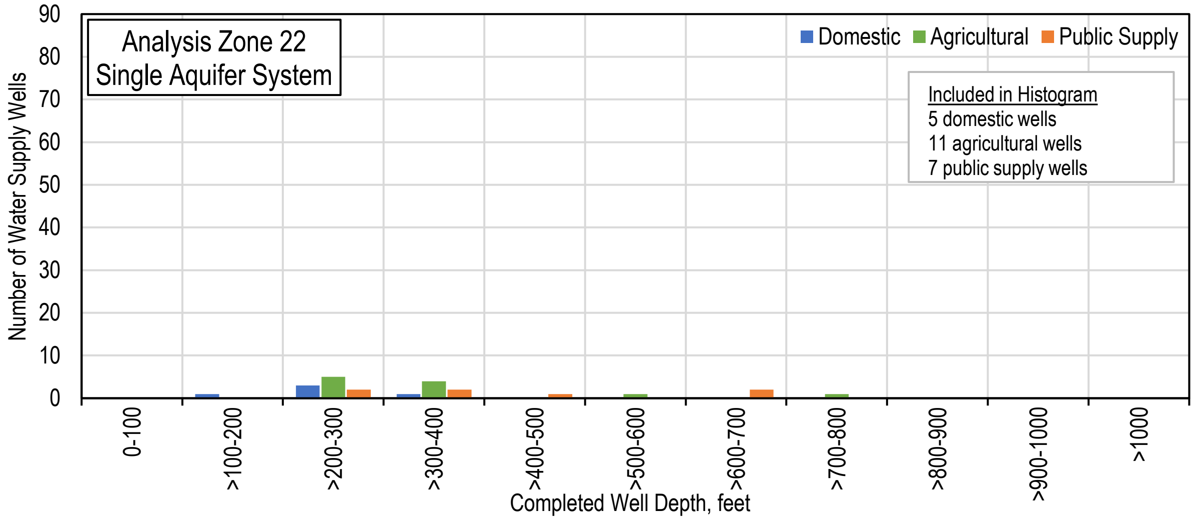

Analysis Zone 17
Single Aquifer System
Domestic
Agricultural
Included in Histogram
3 domestic wells
11 agricultural wells
Number of Water Supply Wells
Completed Well Depth, feet

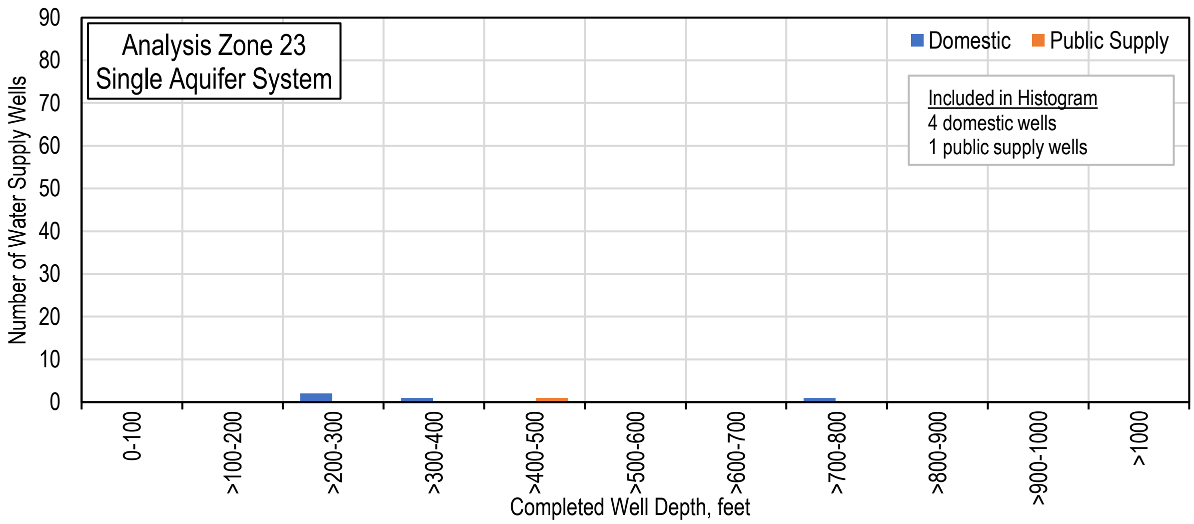

Analysis Zone 18
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
53 domestic wells
47 agricultural wells
2 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet

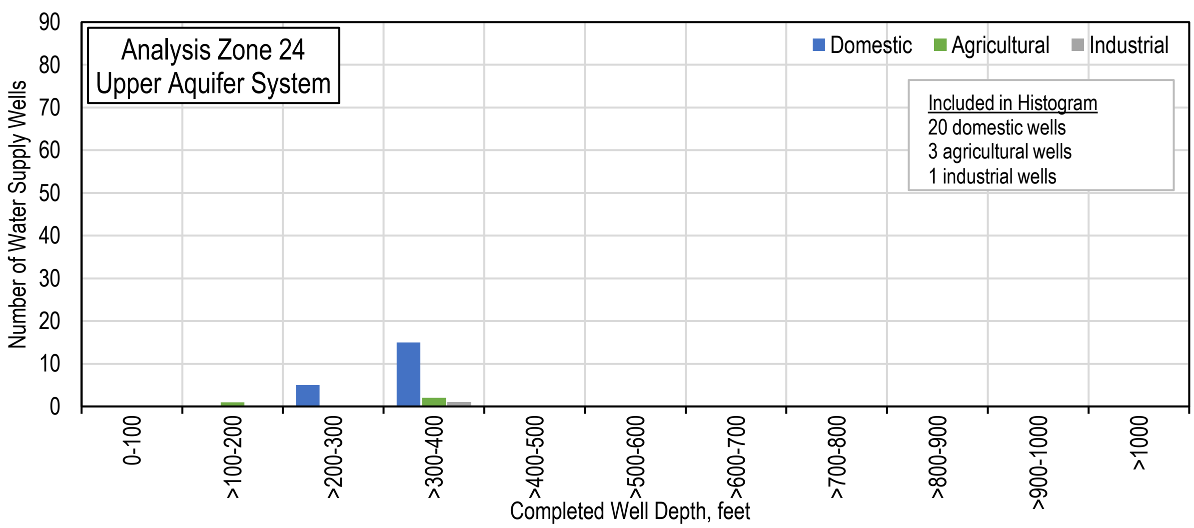

Analysis Zone 19
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
83 domestic wells
23 agricultural wells
3 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

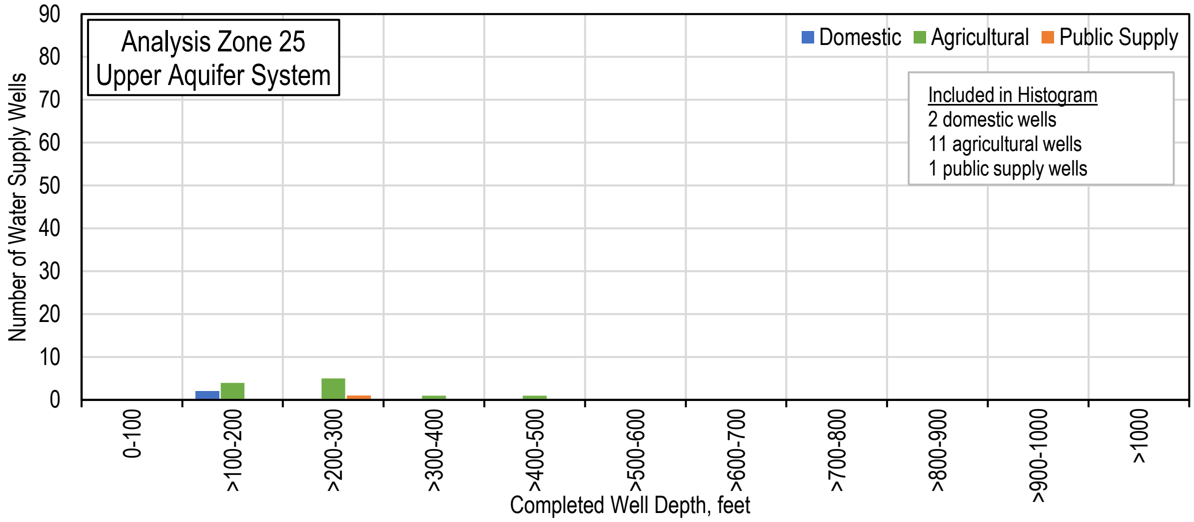

Analysis Zone 20
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
77 domestic wells
42 agricultural wells
5 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

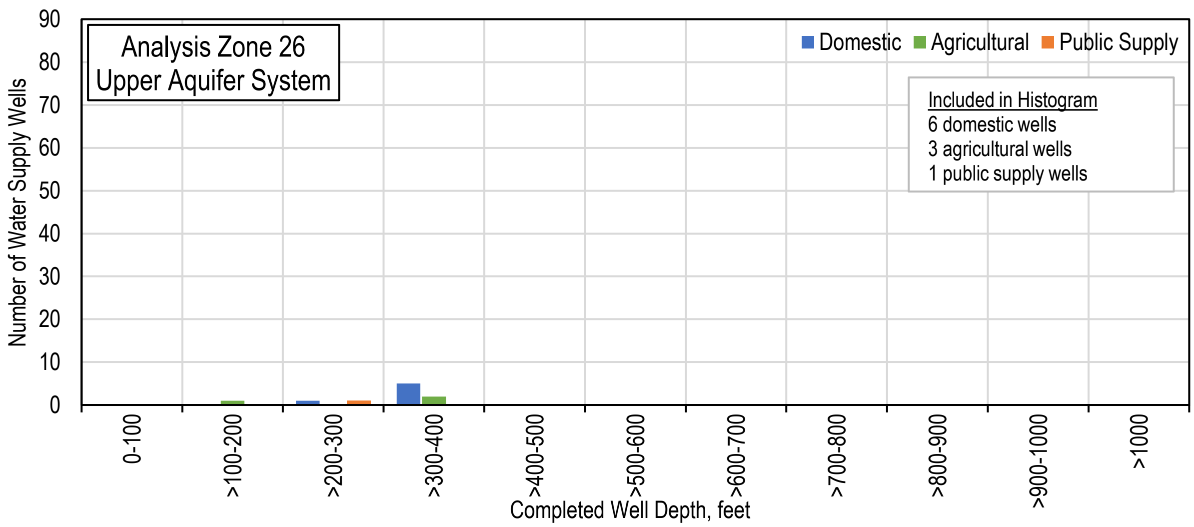

Analysis Zone 21
Single Aquifer System
Domestic
Agricultural
Public Supply
Industrial
Included in Histogram
11 domestic wells
33 agricultural wells
5 public supply wells
1 industrial wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

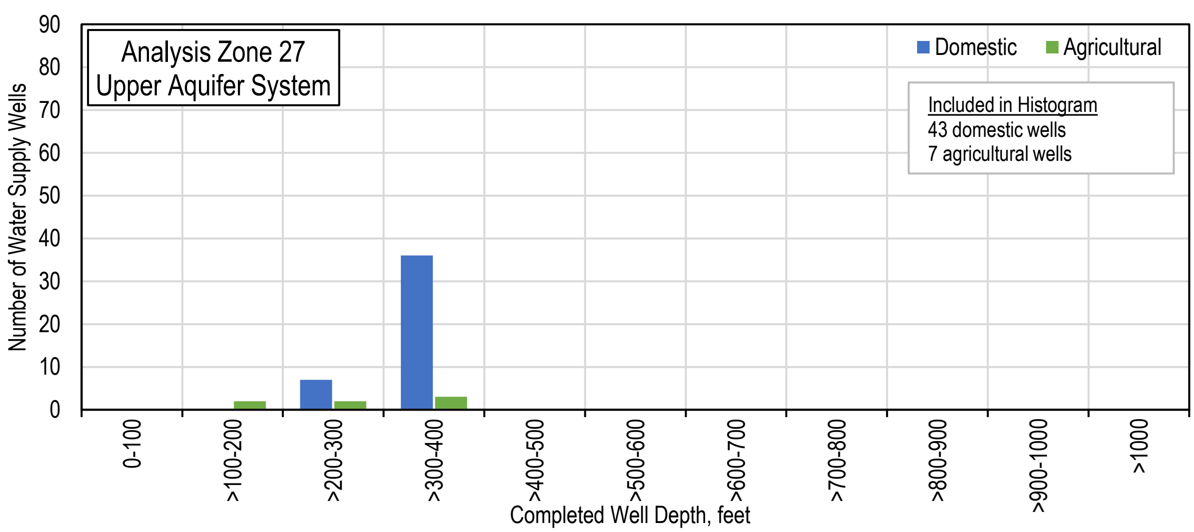

Analysis Zone 22
Single Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
5 domestic wells
11 agricultural wells
7 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

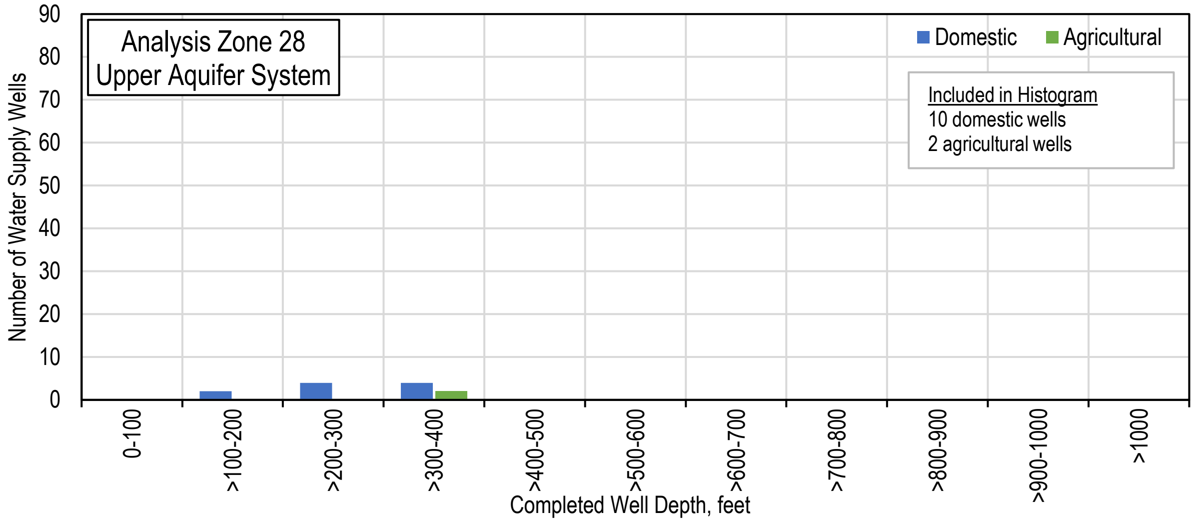

Analysis Zone 23
Single Aquifer System
Domestic
Public Supply
Included in Histogram
4 domestic wells
1 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

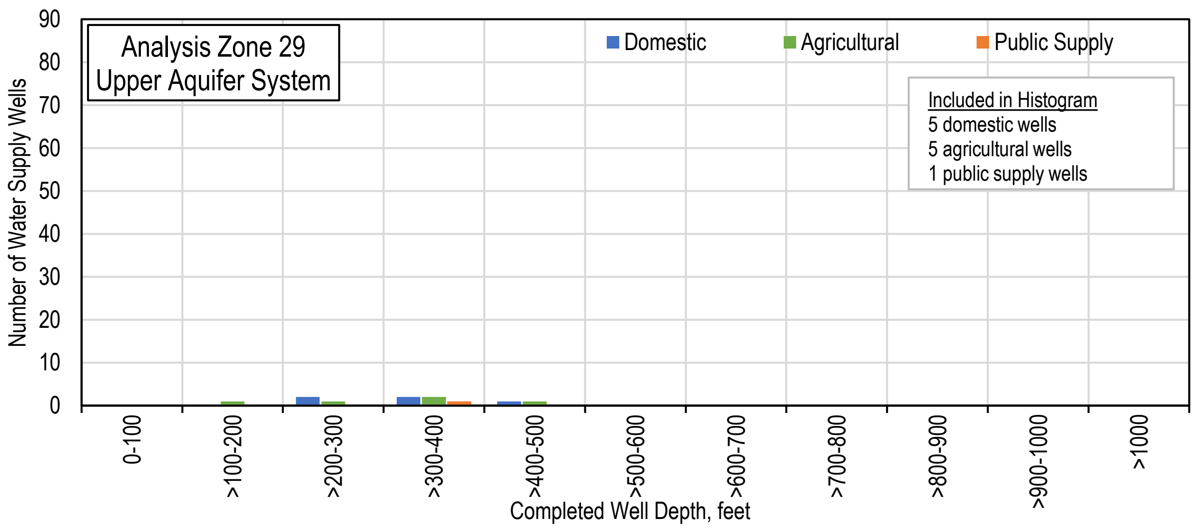

Analysis Zone 24
Upper Aquifer System
Domestic
Agricultural
Industrial
Included in Histogram
20 domestic wells
3 agricultural wells
1 industrial wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

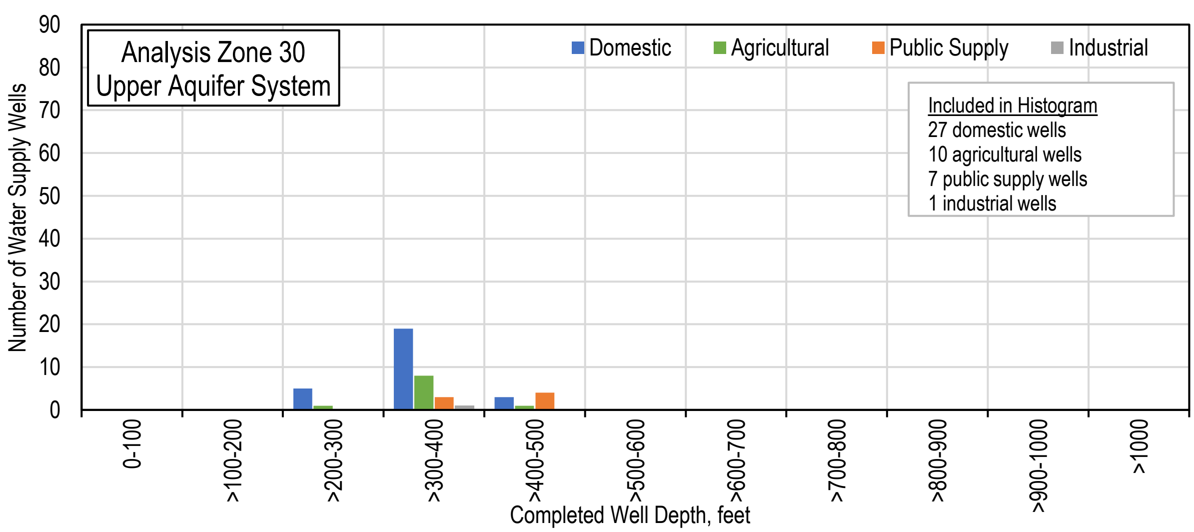

Analysis Zone 25
Upper Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
2 domestic wells
11 agricultural wells
1 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

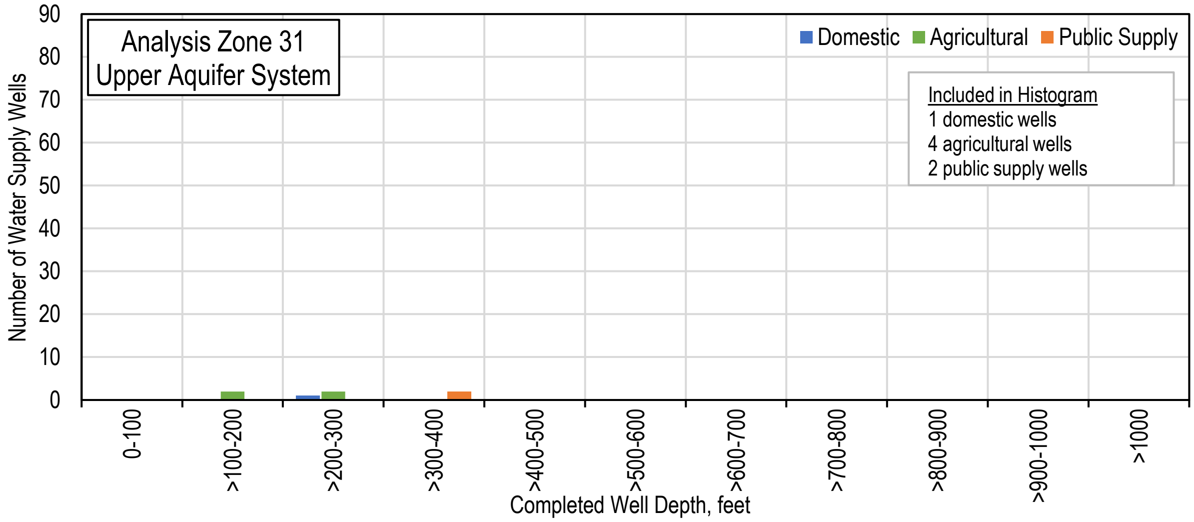

Analysis Zone 26
Upper Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
6 domestic wells
3 agricultural wells
1 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

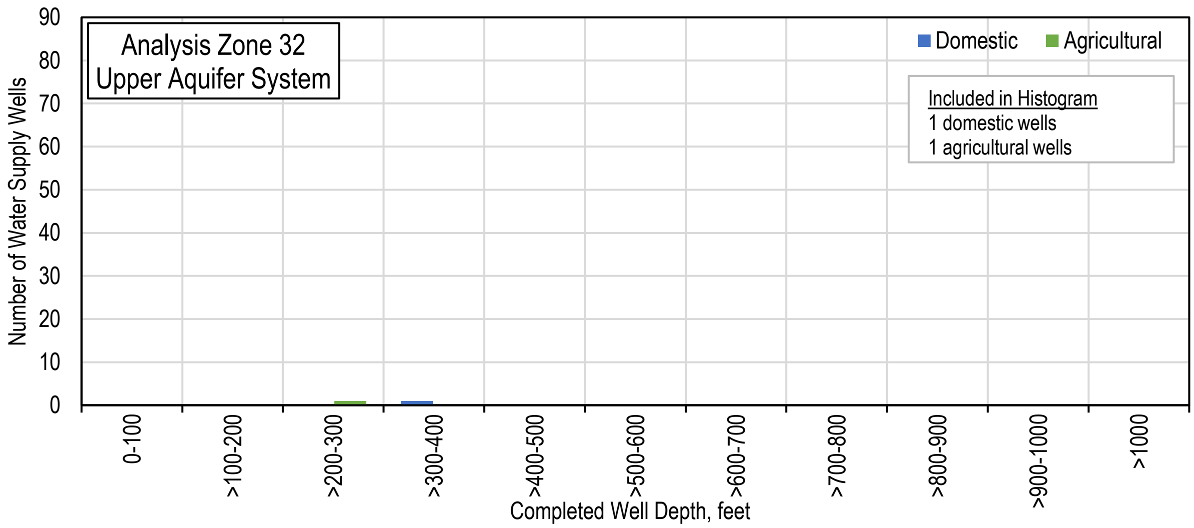

Analysis Zone 27
Upper Aquifer System
Domestic
Agricultural
Included in Histogram
43 domestic wells
7 agricultural wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

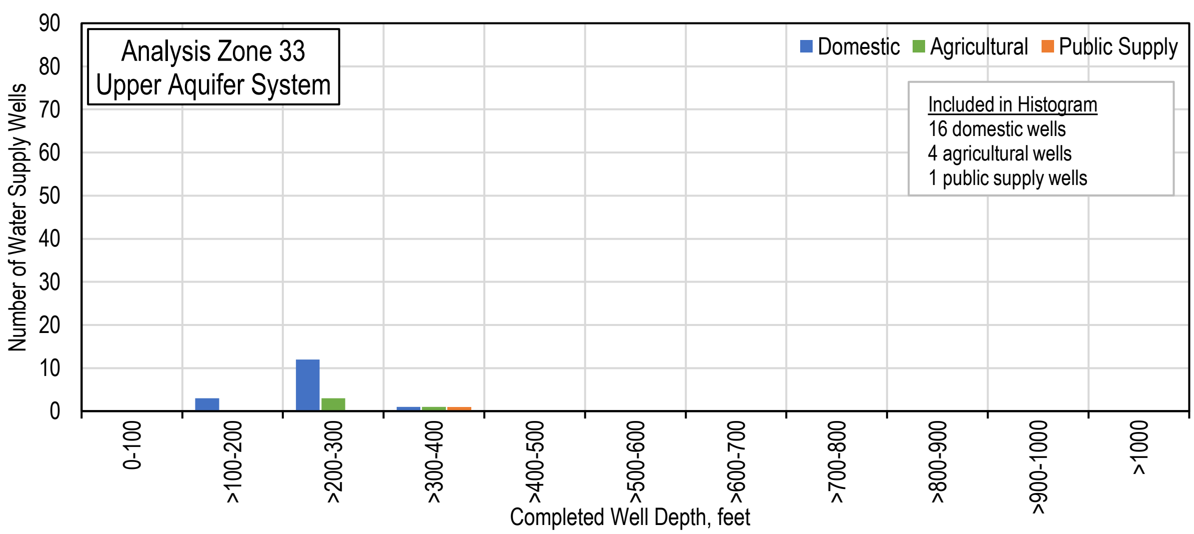

Analysis Zone 28
Upper Aquifer System
Domestic
Agricultural
Included in Histogram
10 domestic wells
2 agricultural wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

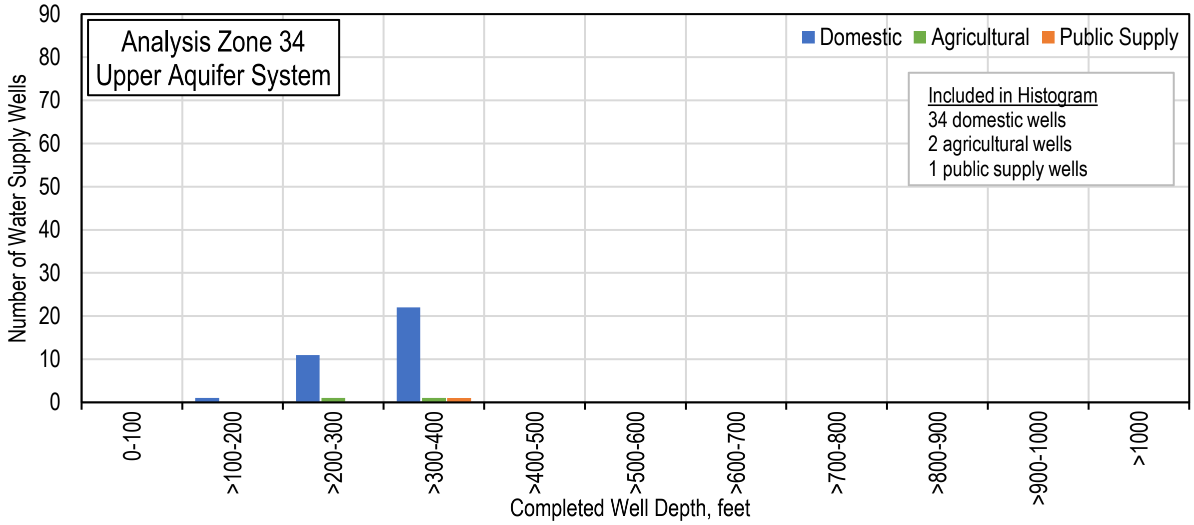

Analysis Zone 29
Upper Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
5 domestic wells
5 agricultural wells
1 public supply wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

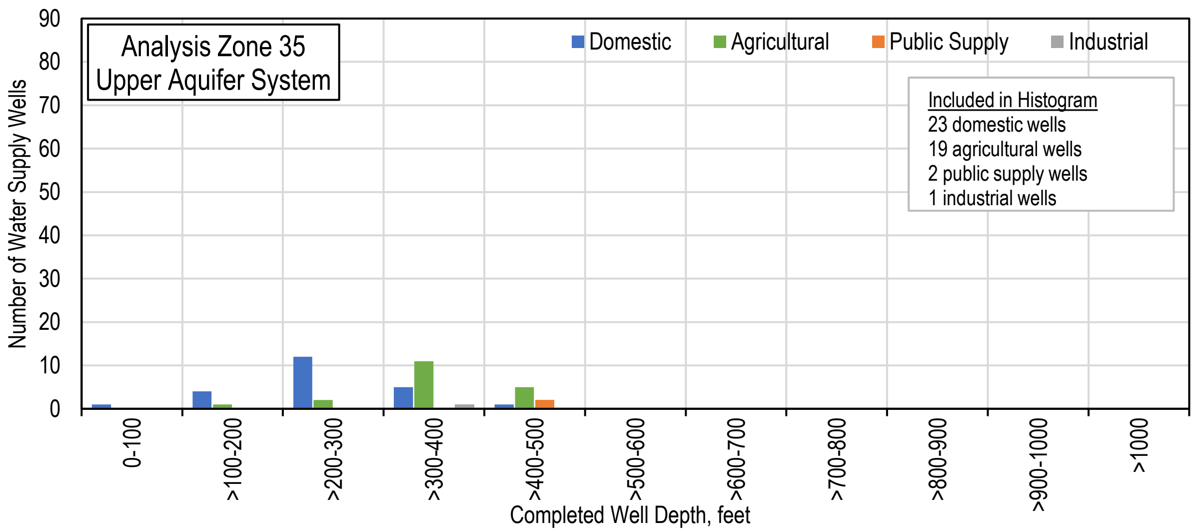

Analysis Zone 30
Upper Aquifer System
Domestic
Agricultural
Public Supply
Industrial
Included in Histogram
27 domestic wells
10 agricultural wells
7 public supply wells
1 industrial wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

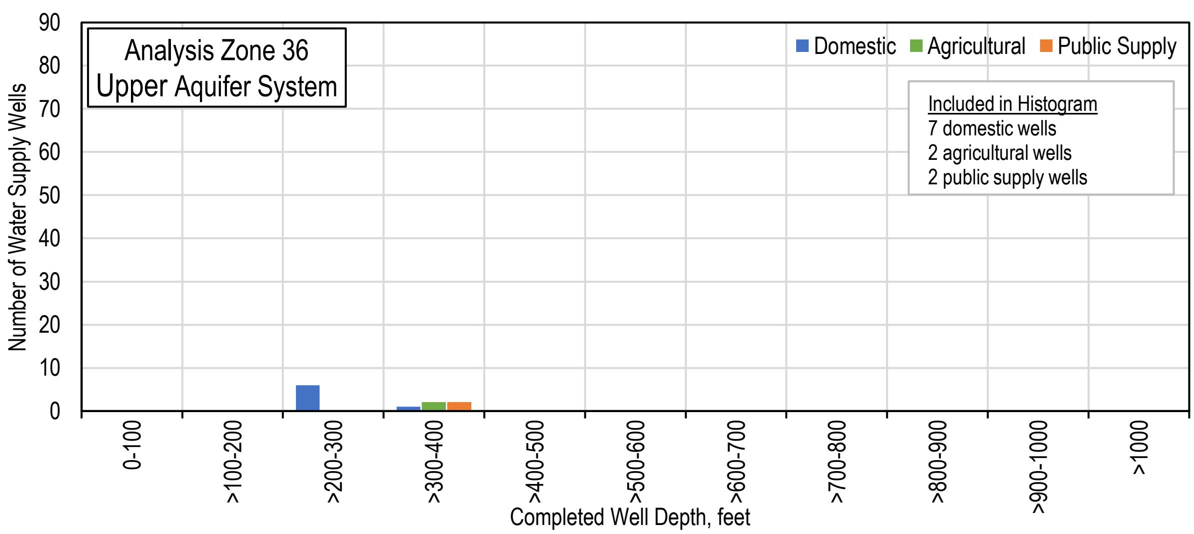

Analysis Zone 31
Upper Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
1 domestic wells
4 agricultural wells
2 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

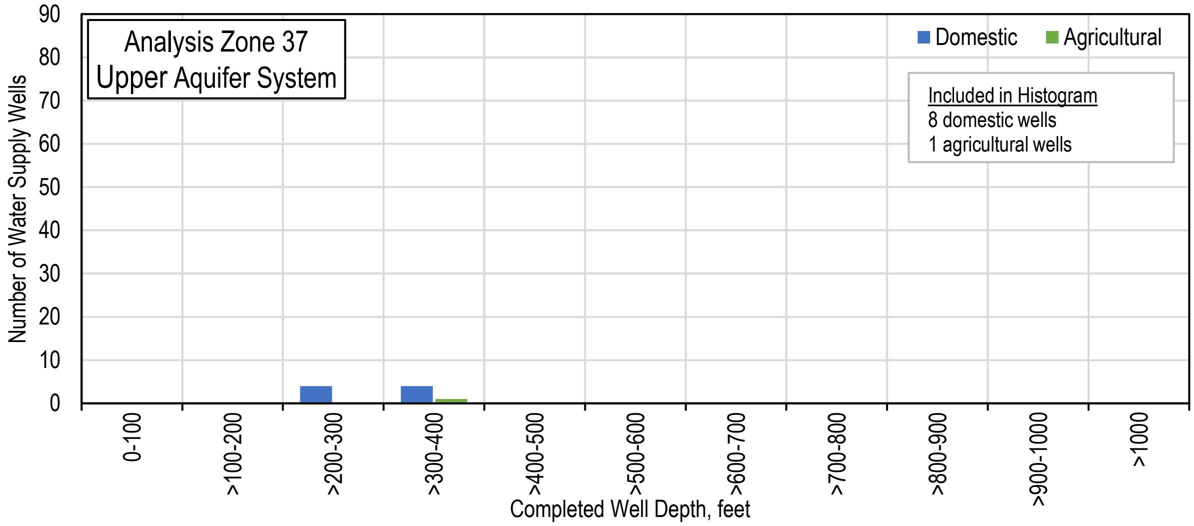

Analysis Zone 32
Upper Aquifer System
Domestic
Agricultural
Included in Histogram
1 domestic wells
1 agricultural wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

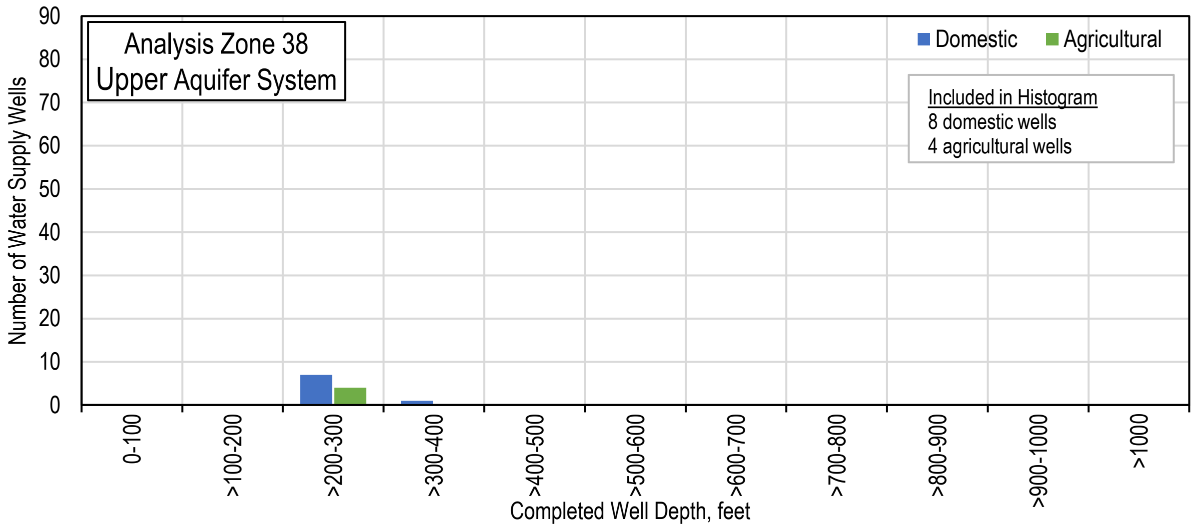

Analysis Zone 33
Upper Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
16 domestic wells
4 agricultural wells
1 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

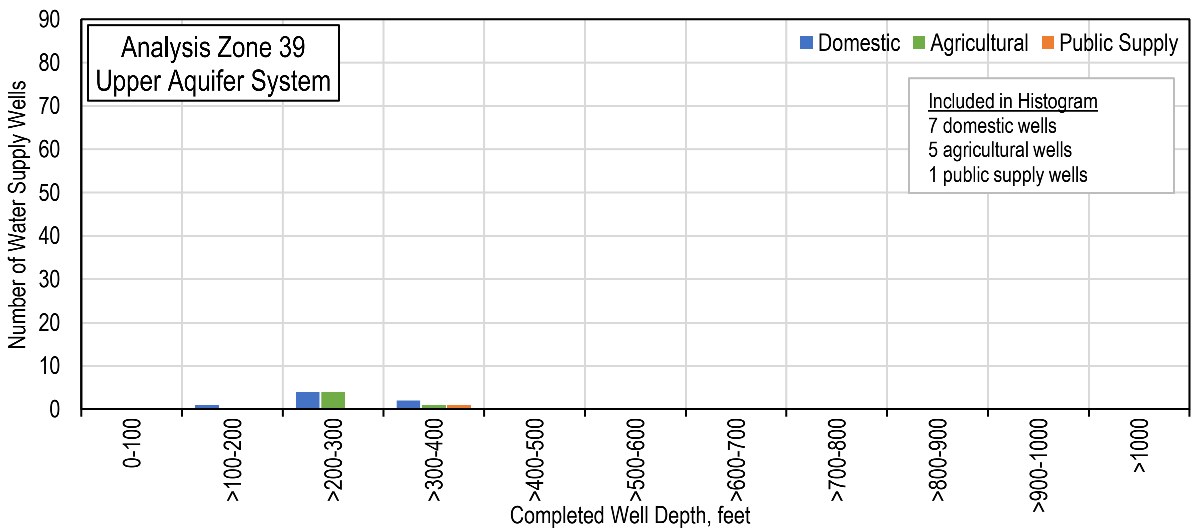

Analysis Zone 34
Upper Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
34 domestic wells
2 agricultural wells
1 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

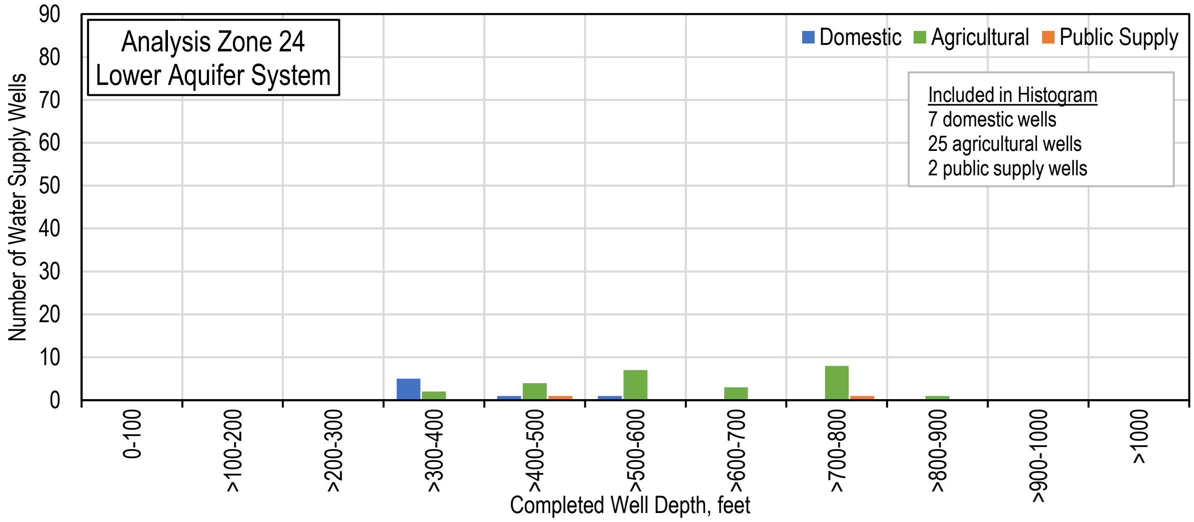

Analysis Zone 35
Upper Aquifer System
Domestic
Agricultural
Public Supply
Industrial
Included in Histogram
23 domestic wells
19 agricultural wells
2 public supply wells
1 industrial wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

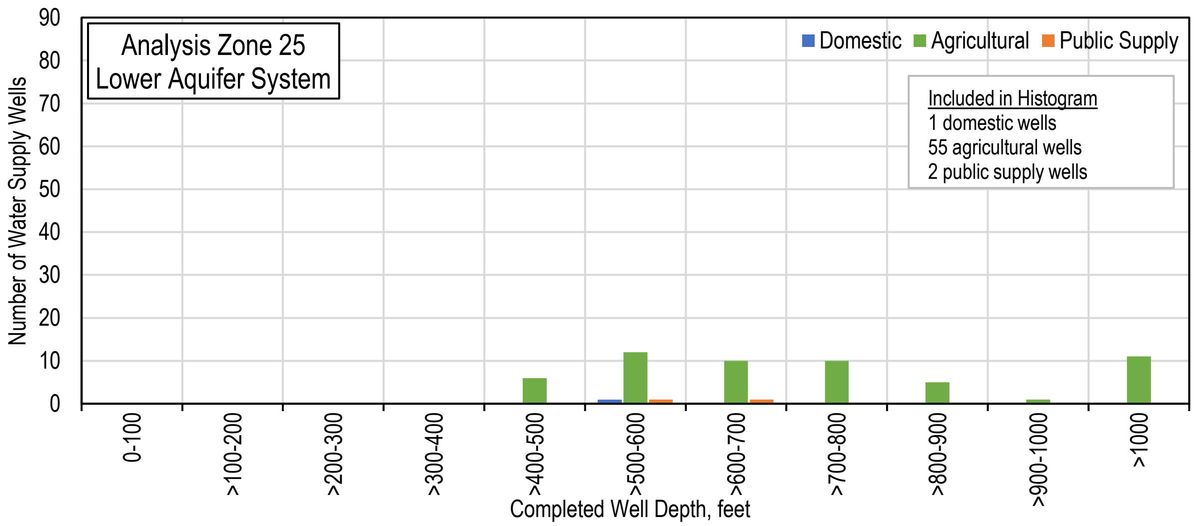

Analysis Zone 36
Upper Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
7 domestic wells
2 agricultural wells
2 public supply wells
Number of Water Supply Wells
0
10
20
30
40
50
60
70
80
90
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

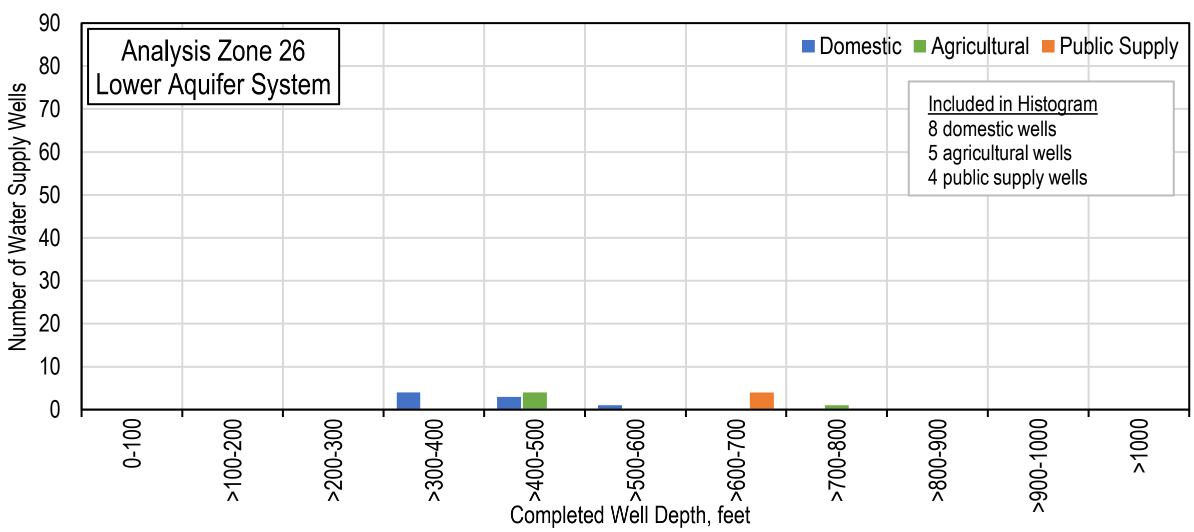

Analysis Zone 37
Upper Aquifer System
Domestic
Agricultural
Included in Histogram
8 domestic wells
1 agricultural wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

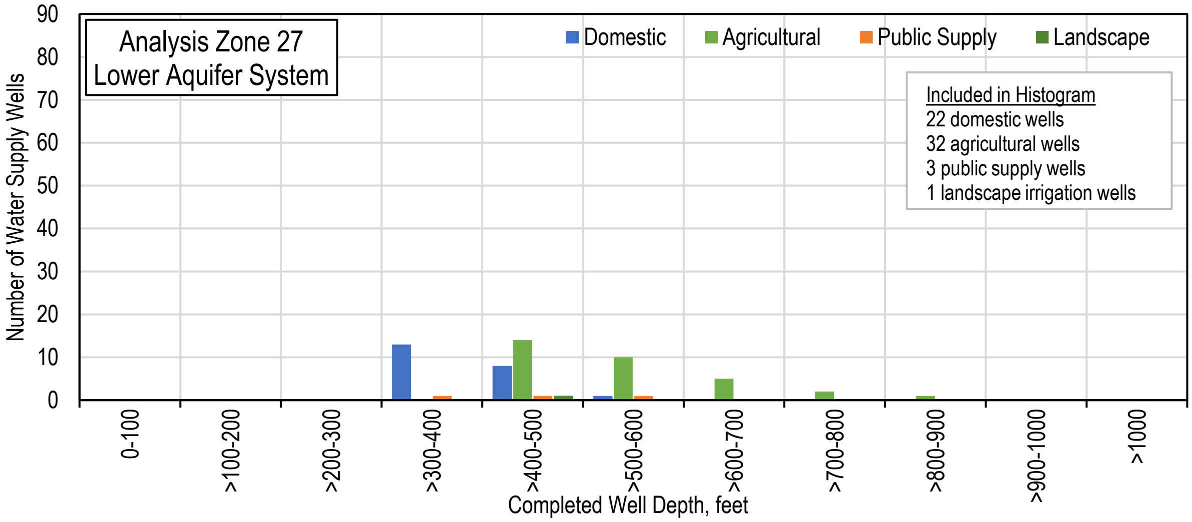

Analysis Zone 38
Upper Aquifer System
Domestic
Agricultural
Included in Histogram
8 domestic wells
4 agricultural wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

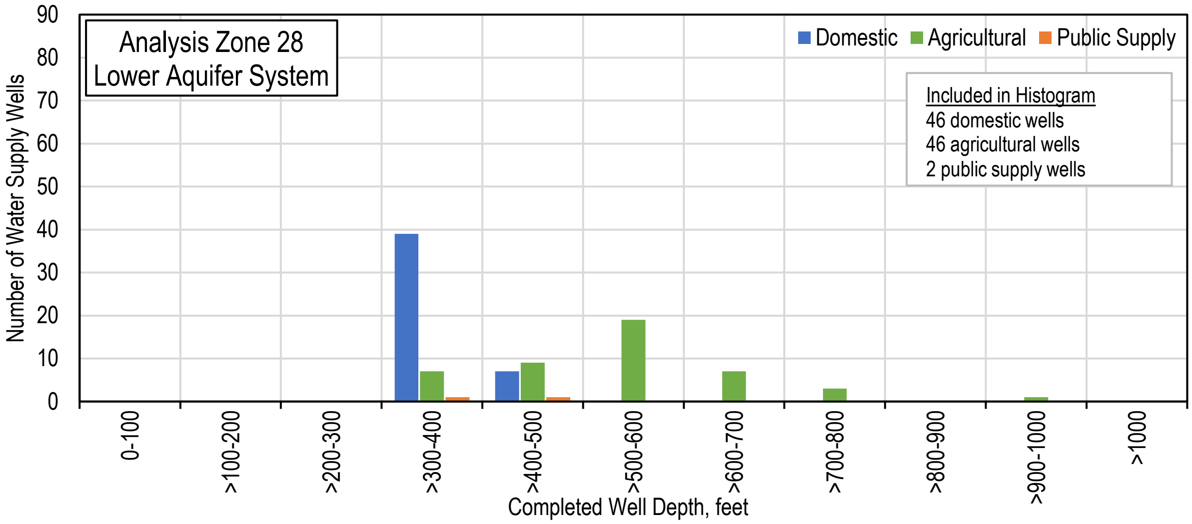

Analysis Zone 39
Upper Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
7 domestic wells
5 agricultural wells
1 public supply wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

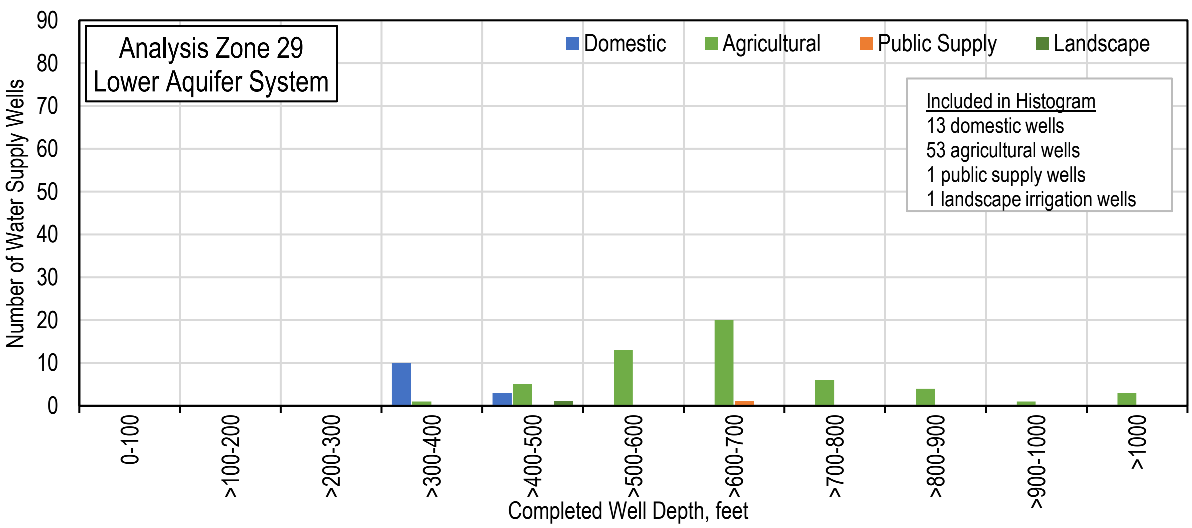

Analysis Zone 24
Lower Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
7 domestic wells
25 agricultural wells
2 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

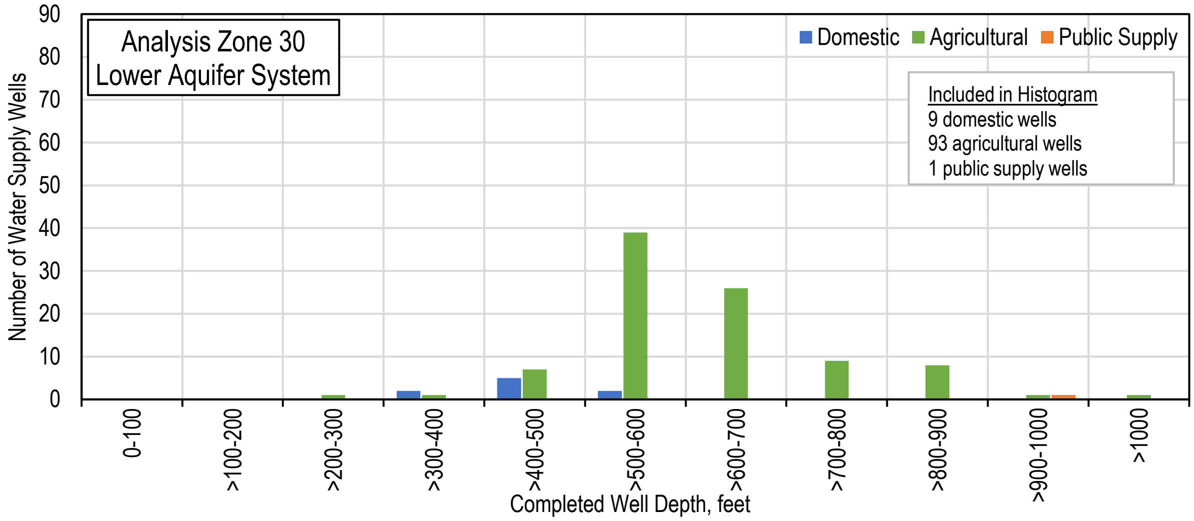

Analysis Zone 25
Lower Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
1 domestic wells
55 agricultural wells
2 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

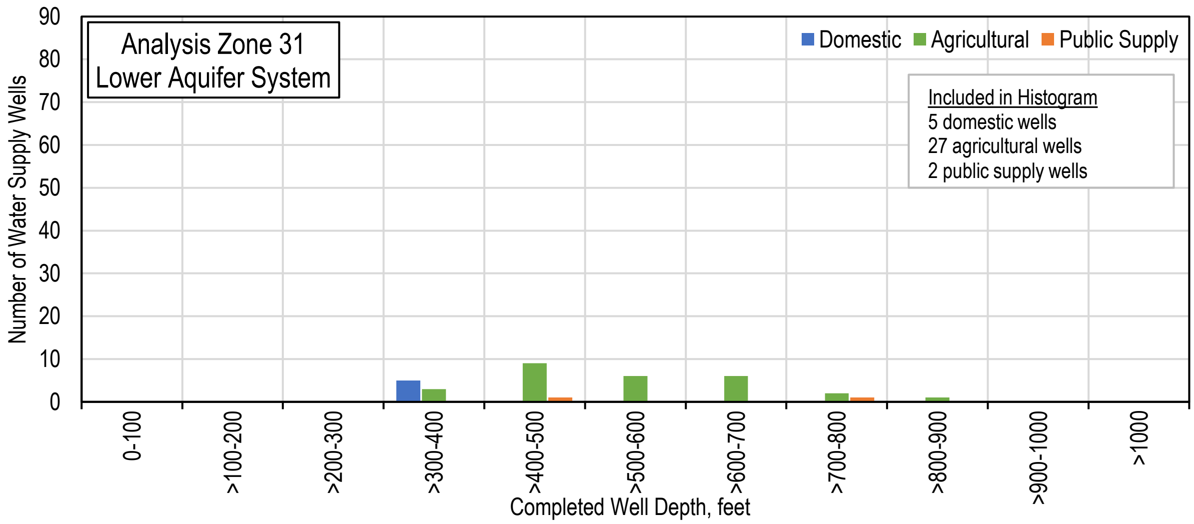

Analysis Zone 26
Lower Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
8 domestic wells
5 agricultural wells
4 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

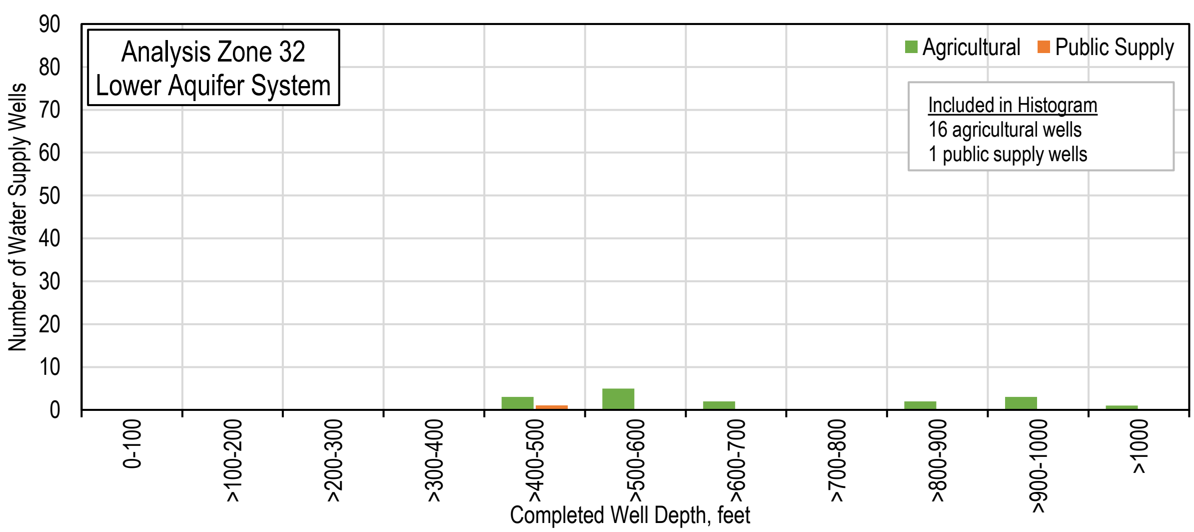

Analysis Zone 27
Lower Aquifer System
Domestic
Agricultural
Public Supply
Landscape
Included in Histogram
22 domestic wells
32 agricultural wells
3 public supply wells
1 landscape irrigation wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

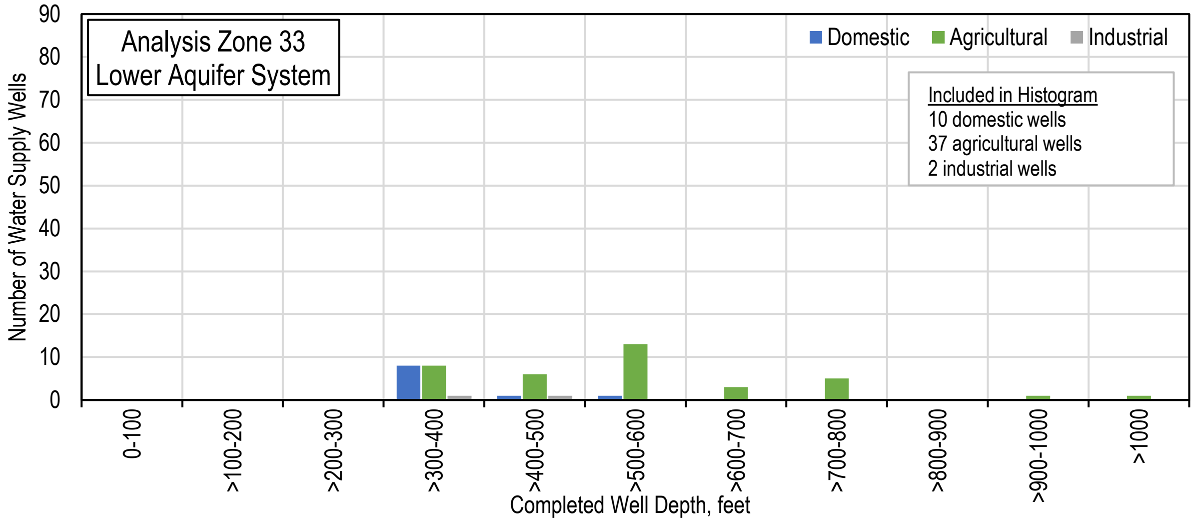

Analysis Zone 28
Lower Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
46 domestic wells
46 agricultural wells
2 public supply wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

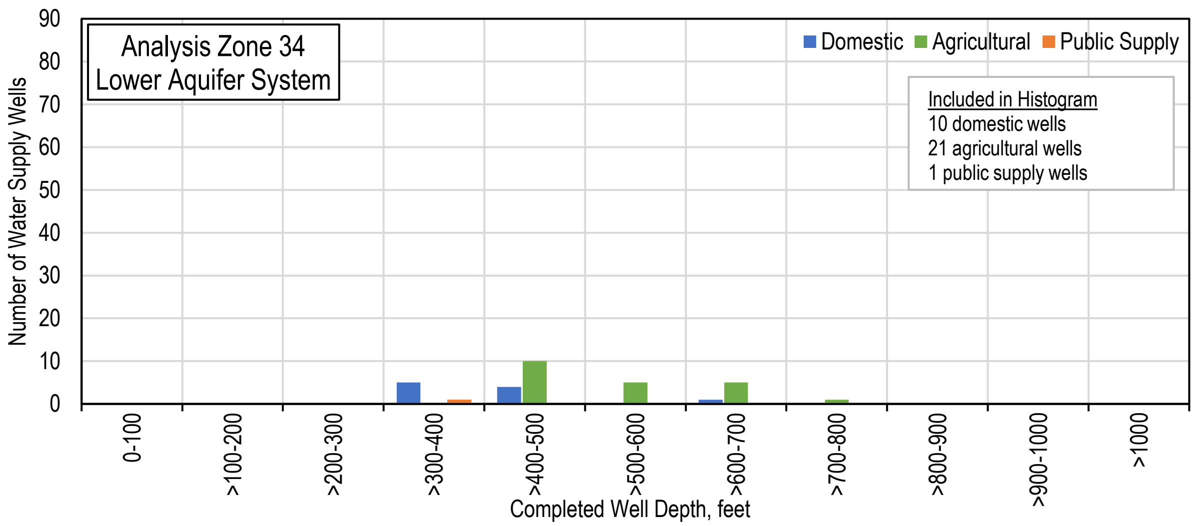

Analysis Zone 29
Lower Aquifer System
Domestic
Agricultural
Public Supply
Landscape
Included in Histogram
13 domestic wells
53 agricultural wells
1 public supply wells
1 landscape irrigation wells
Number of Water Supply Wells
Completed Well Depth, feet
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000

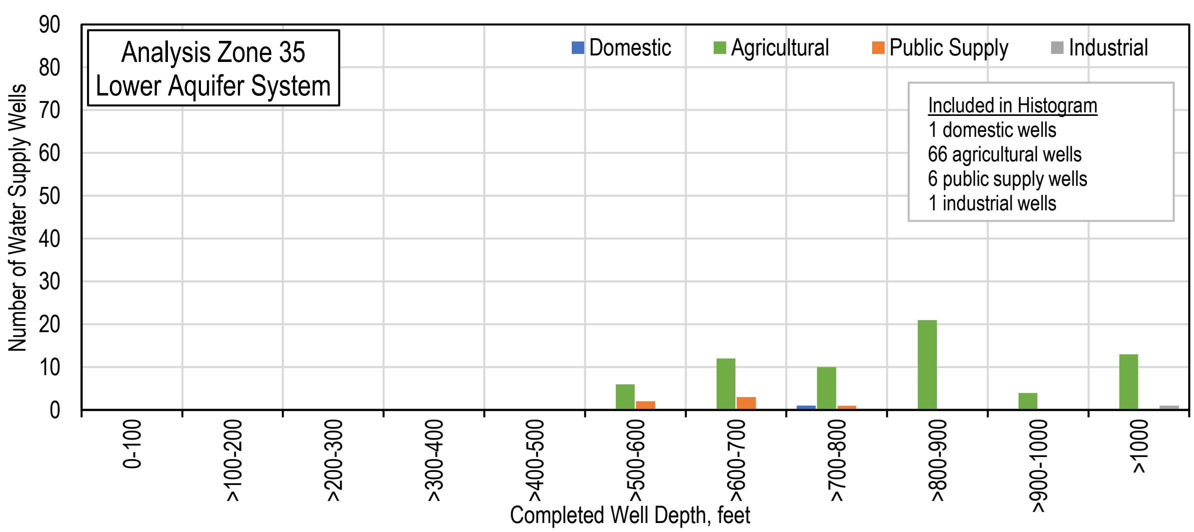

Analysis Zone 30
Lower Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
9 domestic wells
93 agricultural wells
1 public supply wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

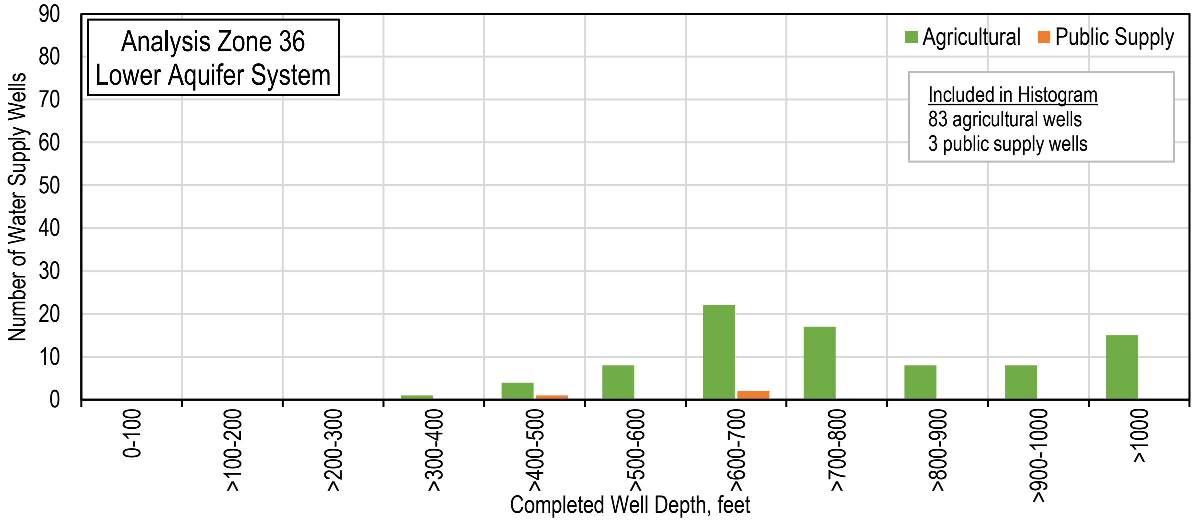

Analysis Zone 31
Lower Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
5 domestic wells
27 agricultural wells
2 public supply wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

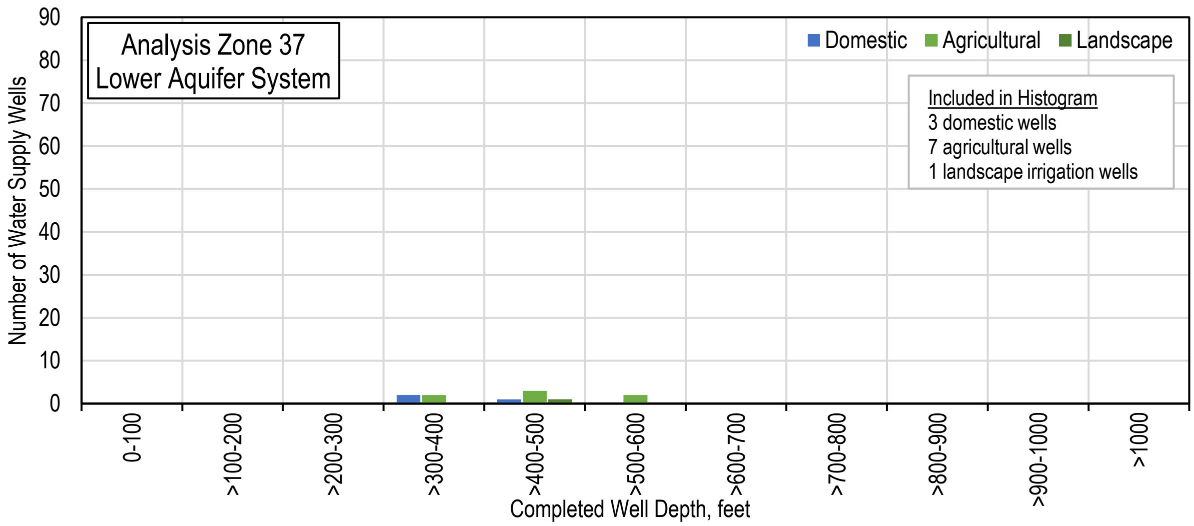

Analysis Zone 32
Lower Aquifer System
Agricultural
Public Supply
Included in Histogram
16 agricultural wells
1 public supply wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

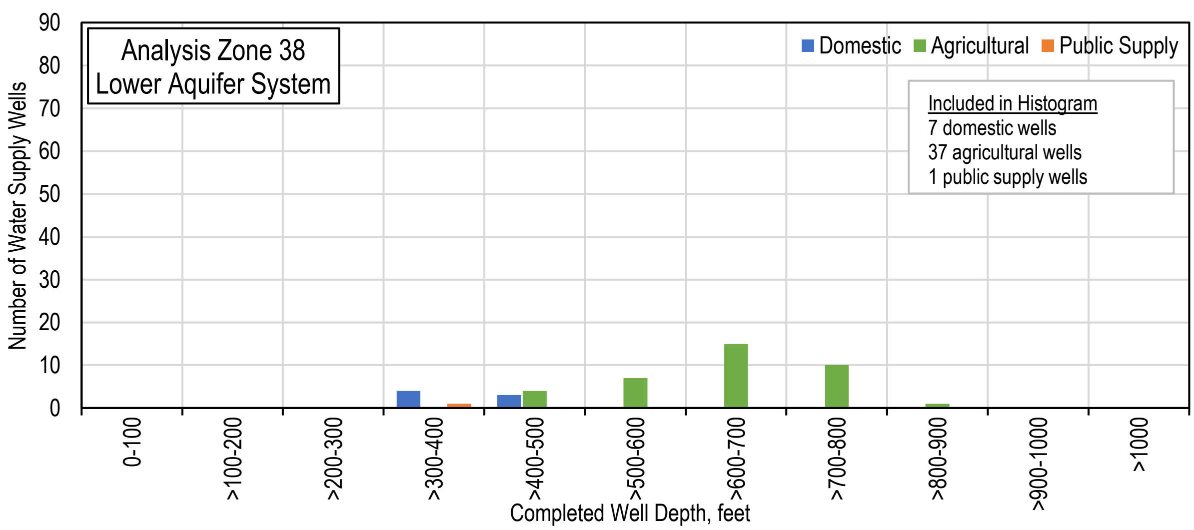

Analysis Zone 33
Lower Aquifer System
Domestic
Agricultural
Industrial
Included in Histogram
10 domestic wells
37 agricultural wells
2 industrial wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

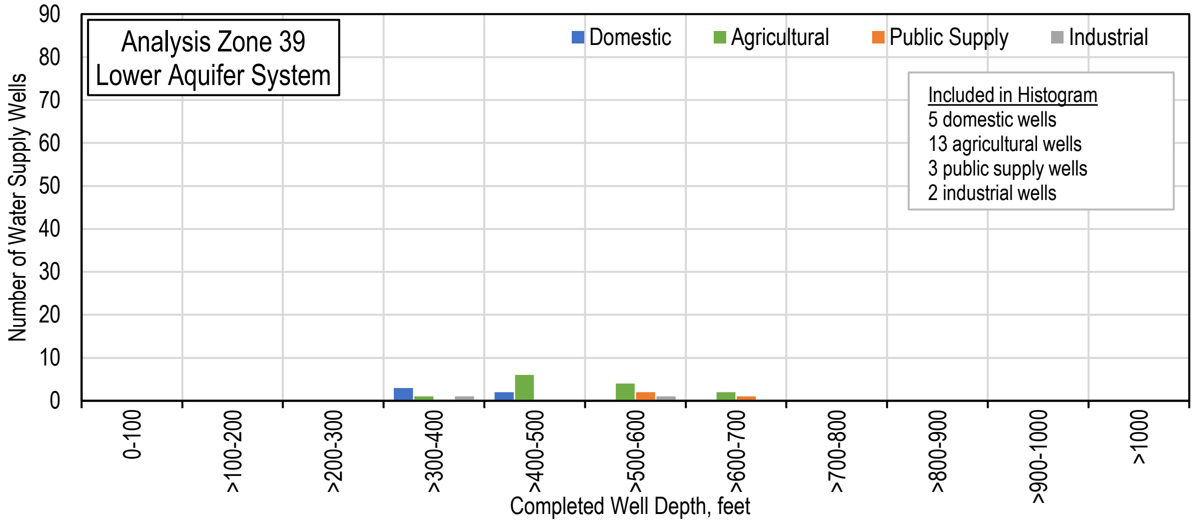

Analysis Zone 34
Lower Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
10 domestic wells
21 agricultural wells
1 public supply wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet


Analysis Zone 35
Lower Aquifer System
Domestic
Agricultural
Public Supply
Industrial
Included in Histogram
1 domestic wells
66 agricultural wells
6 public supply wells
1 industrial wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet


Analysis Zone 36
Lower Aquifer System
Agricultural
Public Supply
Included in Histogram
83 agricultural wells
3 public supply wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet


Analysis Zone 37
Lower Aquifer System
Domestic
Agricultural
Landscape
Included in Histogram
3 domestic wells
7 agricultural wells
1 landscape irrigation wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet


Analysis Zone 38
Lower Aquifer System
Domestic
Agricultural
Public Supply
Included in Histogram
7 domestic wells
37 agricultural wells
1 public supply wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet


Analysis Zone 39
Lower Aquifer System
Domestic
Agricultural
Public Supply
Industrial
Included in Histogram
5 domestic wells
13 agricultural wells
3 public supply wells
2 industrial wells
Number of Water Supply Wells
90
80
70
60
50
40
30
20
10
0
0-100
>100-200
>200-300
>300-400
>400-500
>500-600
>600-700
>700-800
>800-900
>900-1000
>1000
Completed Well Depth, feet

MONTGOMERY
& ASSOCIATES

Appendix C

90% Protective Elevations (Methodology 1), Groundwater Level Trend Elevations (Methodology 2), and Interpolated Minimum Threshold (Methodology 3) for Representative Monitoring Site Minimum Thresholds

90% Protective, Groundwater Level Trend, and Interpolated Minimum Threshold Elevations for Kaweah Subbasin Representative Monitoring Sites

Unique Well ID	Local Well ID	GSA	Aquifer System	Analysis Zone	Methodology 1 90% Protective Elevation (feet)	Methodology 2 Groundwater Level Trend Projection Elevation (feet)	Methodology 3 Interpolated Minimum Threshold (feet)
16S25E36M002M	16S25E36M002M	East Kaweah	Single	2	260	292	-
16S26E30Q001M	16S26E30Q001M	East Kaweah	Single	2	285	292	-
17S25E25A001M	17S25E25A001M	East Kaweah	Single	1	124	185	-
17S25E35E001M	KSB-2107	East Kaweah	Single	1	110	185	-
17S26E04F002M	KSB-2369	East Kaweah	Single	2	276	292	-
17S26E07C001M	17S26E07C001M	East Kaweah	Single	2	233	292	-
17S26E21E001M	KSB-2354	East Kaweah	Single	2	266	292	-
17S26E29R001M	17S26E29R001M	East Kaweah	Single	2	269	292	-
18S26E02D002M	18S26E02D002M	East Kaweah	Single	2	295	292	-
18S26E06D001M	18S26E06D001M	East Kaweah	Single	1	130	185	-
18S26E24J003M	18S26E24J003M	East Kaweah	Single	4	306	365	-
18S27E17H002M	18S27E17H002M	East Kaweah	Single	4	327	365	-
18S27E29E001M	18S27E29E001M	East Kaweah	Single	4	330	365	-
18S27E30H001M	18S27E30H001M	East Kaweah	Single	4	327	365	-
19S26E03A001M	19S26E03A001M	East Kaweah	Single	5	207	244	-
19S26E11R001M	19S26E11R001M	East Kaweah	Single	5	198	244	-
19S26E13R001M	19S26E13R001M	East Kaweah	Single	9	123	145	-
19S26E23E001M	Lindsay Well 15	East Kaweah	Single	9	103	145	-
19S26E25R001M	19S26E25R001M	East Kaweah	Single	9	98	145	-
19S26E34R006M	Lindsay Well 14	East Kaweah	Single	10	43	75	-
19S26E35C001M	19S26E35C001M	East Kaweah	Single	9	88	145	-
19S27E29D001M	19S27E29D001M	East Kaweah	Single	7	197	312	-
20S26E08H001M	KSB-2333	East Kaweah	Single	10	30	75	-
20S26E11R001M	20S26E11R001M	East Kaweah	Single	9	100	145	-
20S26E12H001M	Lindsay Well 11	East Kaweah	Single	9	112	145	-
20S26E16R001M	20S26E16R001M	East Kaweah	Single	10	39	75	-
20S26E20J001M	20S26E20J001M	East Kaweah	Single	10	32	75	-
20S26E23R001M	20S26E23R001M	East Kaweah	Single	9	98	145	-
20S26E32A001M	KSB-2344	East Kaweah	Single	10	35	75	-
20S26E35H001M	20S26E35H001M	East Kaweah	Single	9	104	145	-
20S27E08A001M	20S27E08A001M	East Kaweah	Single	7	211	312	-
20S27E15R001M	20S27E15R001M	East Kaweah	Single	6	354	429	-
20S27E18R001M	20S27E18R001M	East Kaweah	Single	8	194	235	-
20S27E25N001M	20S27E25N001M	East Kaweah	Single	6	363	429	-
21S26E11H001M	21S26E11H001M	East Kaweah	Single	9	110	145	-
21S27E03B001M	21S27E03B001M	East Kaweah	Single	8	237	235	-
21S27E06F001M	21S27E06F001M	East Kaweah	Single	9	119	145	-
21S27E08F001M	21S27E08F001M	East Kaweah	Single	8	199	235	-
21S27E12F001M	21S27E12F001M	East Kaweah	Single	7	287	312	-
SCID Office	SCID Office	East Kaweah	Single	2	243	292	-

Unique Well ID	Local Well ID	GSA	Aquifer System	Analysis Zone	Methodology 1 90% Protective Elevation (feet)	Methodology 2 Groundwater Level Trend Projection Elevation (feet)	Methodology 3 Interpolated Minimum Threshold (feet)
17S23E34J001M	KSB-1161	Greater Kaweah	Upper	32	-5	67	-
17S24E34B001M	KSB-1580	Greater Kaweah	Single	11	5	78	-
17S24E36H003M	KSB-1775	Greater Kaweah	Single	12	55	73	-
17S26E36R001M	KSB-2690	Greater Kaweah	Single	4	299	288	-
18S22E24D001M	KSB-0818	Greater Kaweah	Upper	37	-38	59	-
18S23E14A001M	KSB-1222	Greater Kaweah	Upper	32	5	73	-
18S23E30D001M	KSB-0905	Greater Kaweah	Lower	36	-311	-207	-
18S23E30D901M	KSB-0903	Greater Kaweah	Upper	36	-26	71	-
18S25E05Q001M	KSB-1936	Greater Kaweah	Single	13	93	81	-
18S25E15C001M	KSB-2058	Greater Kaweah	Single	13	109	110	-
18S25E23J001M	KSB-2147	Greater Kaweah	Single	14	164	169	-
18S26E17L001M	KSB-2297	Greater Kaweah	Single	15	250	313	-
18S26E27B001M	KSB-2466	Greater Kaweah	Single	5	199	349	-
18S27E05J001M	KSB-2822	Greater Kaweah	Single	16	328	415	-
19S22E24B001M	KSB-0856	Greater Kaweah	Upper	36	-36	25	-
19S22E28D001M	KSB-0616	Greater Kaweah	Upper	35	33	19	-
19S22E31B002M	KSB-0531	Greater Kaweah	Upper	35	27	57	-
19S23E12L001M	KSB-1259	Greater Kaweah	Lower	38	-129	56	-
19S23E21C001M	KSB-1055	Greater Kaweah	Upper	29	-9	51	-
19S25E09H001M	KSB-2017	Greater Kaweah	Single	14	142	92	-
19S25E13A002M	KSB-2200	Greater Kaweah	Single	19	151	114	-
19S25E16A002M	KSB-2015	Greater Kaweah	Single	18	75	91	-
19S25E27A001M	KSB-2089	Greater Kaweah	Single	18	72	57	-
19S25E28H001M	KSB-2021	Greater Kaweah	Single	20	23	56	-
19S25E32J001M	KSB-1937	Greater Kaweah	Upper	24	82	49	-
19S25E35B002M	KSB-2139	Greater Kaweah	Single	18	66	47	-
19S26E05C001M	KSB-2291	Greater Kaweah	Single	14	171	229	-
19S26E16J002M	KSB-2411	Greater Kaweah	Single	18	106	124	-
19S26E20A001M	KSB-2322	Greater Kaweah	Single	18	92	106	-
20S22E07A003M	KSB-0550	Greater Kaweah	Upper	35	20	-28	-
20S22E24R001M	KSB-0889	Greater Kaweah	Upper	30	-73	-17	-
20S22E36A001M	KSB-0890	Greater Kaweah	Upper	30	-79	-10	-
20S24E24H001M	KSB-1783	Greater Kaweah	Upper	24	51	56	-
20S25E03R001M	KSB-2095	Greater Kaweah	Single	20	8	17	55
20S25E12A001M	KSB-2197	Greater Kaweah	Single	20	17	18	65
20S25E14F004M	KSB-2114	Greater Kaweah	Single	21	-72	2	60
20S25E24R001M	KSB-2203	Greater Kaweah	Single	21	-63	-2	65
21S24E03L001M	KSB-1535	Greater Kaweah	Upper	25	89	-24	**
21S24E08A001M	KSB-1425	Greater Kaweah	Lower	25	-262	10	-

Unique Well ID	Local Well ID	GSA	Aquifer System	Analysis Zone	Methodology 1 90% Protective Elevation (feet)	Methodology 2 Groundwater Level Trend Projection Elevation (feet)	Methodology 3 Interpolated Minimum Threshold (feet)
025-01	KSB-1696	Mid-Kaweah	Upper	39	112	13	138
036-01	KSB-1884	Mid-Kaweah	Single	22	79	27	-
047-01	KSB-1699	Mid-Kaweah	Upper	39	107	157	-
053-01	KSB-1977	Mid-Kaweah	Single	23	52	56	-
075-01	KSB-1447	Mid-Kaweah	Upper	39	81	60	-
077-01	KSB-1427	Mid-Kaweah	Upper	39	81	33	-
18S24E13N001M	KSB-1689	Mid-Kaweah	Single	22	69	75	-
18S24E22E001M	KSB-1526	Mid-Kaweah	Upper	39	103	-139	85
18S24E25D001M	KSB-1690	Mid-Kaweah	Upper	39	114	161	-
18S25E28R001M	KSB-2014	Mid-Kaweah	Single	23	54	69	-
18S25E30Q001M	KSB-1819	Mid-Kaweah	Single	22	75	34	-
19S23E20C001M	KSB-0994	Mid-Kaweah	Lower	29	-12	71	-
19S23E22H001M	KSB-1168	Mid-Kaweah	Upper	29	3	30	-
19S23E31R001M	KSB-0946	Mid-Kaweah	Upper	29	-27	-72	-
19S23E35H001M	KSB-1226	Mid-Kaweah	Upper	29	3	-101	-
19S24E08D002M	KSB-1384	Mid-Kaweah	Upper	38	47	38	-
19S24E20F001M	KSB-1408	Mid-Kaweah	Upper	28	75	Drilled after 2016	-
19S24E22E001M	KSB-1545	Mid-Kaweah	Upper	28	86	Drilled after 2016	-
19S24E25D001M	KSB-1709	Mid-Kaweah	Upper	27	2	-6	88
19S24E34D001M	KSB-1536	Mid-Kaweah	Upper	28	77	Drilled after 2016	-
19S24E35E001M	KSB-1628	Mid-Kaweah	Lower	26	-109	-92	-
19S24E36C002M	KSB-1903	Mid-Kaweah	Lower	27	-98	-43	-
19S25E06A001M	KSB-1862	Mid-Kaweah	Single	22	76	35	-
19S25E20P001M	KSB-1905	Mid-Kaweah	Upper	27	24	90	-
20S23E03L001M	KSB-1129	Mid-Kaweah	Upper	29	-9	-81	-
20S23E18R001M	KSB-0948	Mid-Kaweah	Upper	30	-66	-173	-
20S23E21B001M	KSB-1071	Mid-Kaweah	Upper	30	-66	-126	-
20S23E26C001M	KSB-1206	Mid-Kaweah	Upper	30	-64	-20	-
20S24E01H002M	KSB-1770	Mid-Kaweah	Lower	26	-289	-150	-
20S24E04K001M	KSB-1506	Mid-Kaweah	Lower	26	-123	-39	-
20S24E07C001M	KSB-1320	Mid-Kaweah	Upper	31	58	Drilled after 2016	-
20S24E11J002M	KSB-1695	Mid-Kaweah	Lower	26	-119	-121	-
20S24E16H001M	KSB-1538	Mid-Kaweah	Lower	31	-115	62	-
20S24E17P001M	KSB-1431	Mid-Kaweah	Upper	31	58	88	-
20S24E28L001M	KSB-1477	Mid-Kaweah	Upper	31	58	60	-
21S23E05A002M	KSB-0976	Mid-Kaweah	Upper	30	-84	-141	-
21S23E07J001M	KSB-0922	Mid-Kaweah	Upper	30	-36	-22	-
361856N1193313W001	KSB-1706	Mid-Kaweah	Lower	26	-136	-287	-

Note. bolded elevation indicates the minimum threshold assigned to the representative monitoring site

Appendix 6-2 of the Coordination Agreement

Well Impact Analysis Hydrographs

1 SUMMARY PURPOSE

This summary describes all water supply well completion data available for the San Joaquin Valley - Kaweah Subbasin (Subbasin) since January 1, 2002. The purpose of this summary is estimate for the number of wells that may be impacted by groundwater levels declining to elevations protective of 90% of wells in the Subbasin (described in Appendix 5A). These estimates can be used by the Groundwater Sustainability Agencies (GSAs) to develop well mitigation plans for their respective Groundwater Sustainability Plans (GSPs).

The majority of minimum thresholds described in Appendix 5A are at higher elevations than elevations protective of 90% of wells. The estimates of potentially impacted wells therefore overestimate the number of wells. However, since these estimates are to be used for determining the magnitude of wells to be addressed by mitigation plans, they can be considered worst-case estimates.

2 WELL RECORDS IN THE KAWEAH SUBBASIN

A majority of water supply wells installed in the Subbasin since 2002 have well construction information available from Department of Water Resources (DWR) Well Completion Reports submitted by well drillers. These well records are used to develop chronic lowering of groundwater level sustainable management criteria (SMC), as described in Appendix 5A. This summary supplements potential well impacts described in Appendix 5A by including wells without completed well depth information.

2.1 Data Sources and Quality Control

Well completion information compiled in this appendix is from the DWR Well Completion Report (WCR) dataset, downloaded on March 1, 2022. The WCR dataset does not contain a complete accurate dataset, however, it is the best public source of data available. For example, some wells in the dataset are likely dry or have been destroyed. To filter out wells that may have been abandoned or no longer represent typical modern well depths and current groundwater elevations, only well records drilled since 2002 are used for analysis. Furthermore, well completion reports are not always accurately located. Where coordinates of wells are unavailable, DWR locates the well in the middle of the Public Land Survey System section. The location given by DWR in the WCR dataset is used in this analysis.

2.2 Total Well Records

The majority of water supply well records used in the analysis have known well depths, and the well use type for wells without well depth data are generally proportional to those with depth information. The number of wells installed in the Subbasin both with and without known well depths are included in Table 1. Approximately 3,758 supply wells have been installed in the Subbasin since 2002. Of these, 3,353, or about 89%, have well completion data in the WCR dataset and are used in the SMC analysis described in Appendix A. The proportion of wells used for various purposes is nearly identical for the full WCR dataset compared to the subset of wells with known depths; almost all supply wells are either used for agricultural use (55%) or domestic use (41%). Comparatively small numbers of wells are used for public supply (3%), and industrial (1%) purposes. Since the subset of wells with known depths includes a majority of well records in the dataset and closely approximates well types installed in the Subbasin, it is an appropriate dataset to use to develop mitigation plans.

Table 1. Water Supply Well Records by Use Type

Well Use	All Water Supply Well Records from Jan 1, 2002		Well Records with Depth Information	
	Number of Wells	Percentage	Number of Wells	Percentage
Agricultural	2,061	55%	1,859	55%
Domestic	1,546	41%	1,364	41%
Public Supply	129	3%	117	3%
Industrial	22	1%	13	<1%
TOTAL	3,758	-	3,353	-

2.3 Well Records by GSA

Table 2 summarizes the number of well records by well use type for each GSA. There are approximately 1,276 well records in East Kaweah, 1,814 in Greater Kaweah, and 668 in Mid-Kaweah.

Table 2. Summary of Wells by GSA

Well Use Type	East Kaweah		Greater Kaweah		Mid-Kaweah		Total
	Number of Wells	Percentage	Number of Wells	Percentage	Number of Wells	Percentage	
Domestic	463	36%	814	45%	269	40%	1,546
Agricultural	793	62%	914	50%	354	53%	2,061
Public Supply	17	1%	71	4%	41	6%	129
Industrial	3	<1%	15	1%	4	1%	22
Total	1,276	-	1,814	-	668	-	3,758

2.4 Well Records by Analysis Zone

Well records from each analysis zone may be used by GSAs for well mitigation plans. The total number of well records in each aquifer zone is summarized in Table 3. Figure 1 shows the location of the analysis zones.

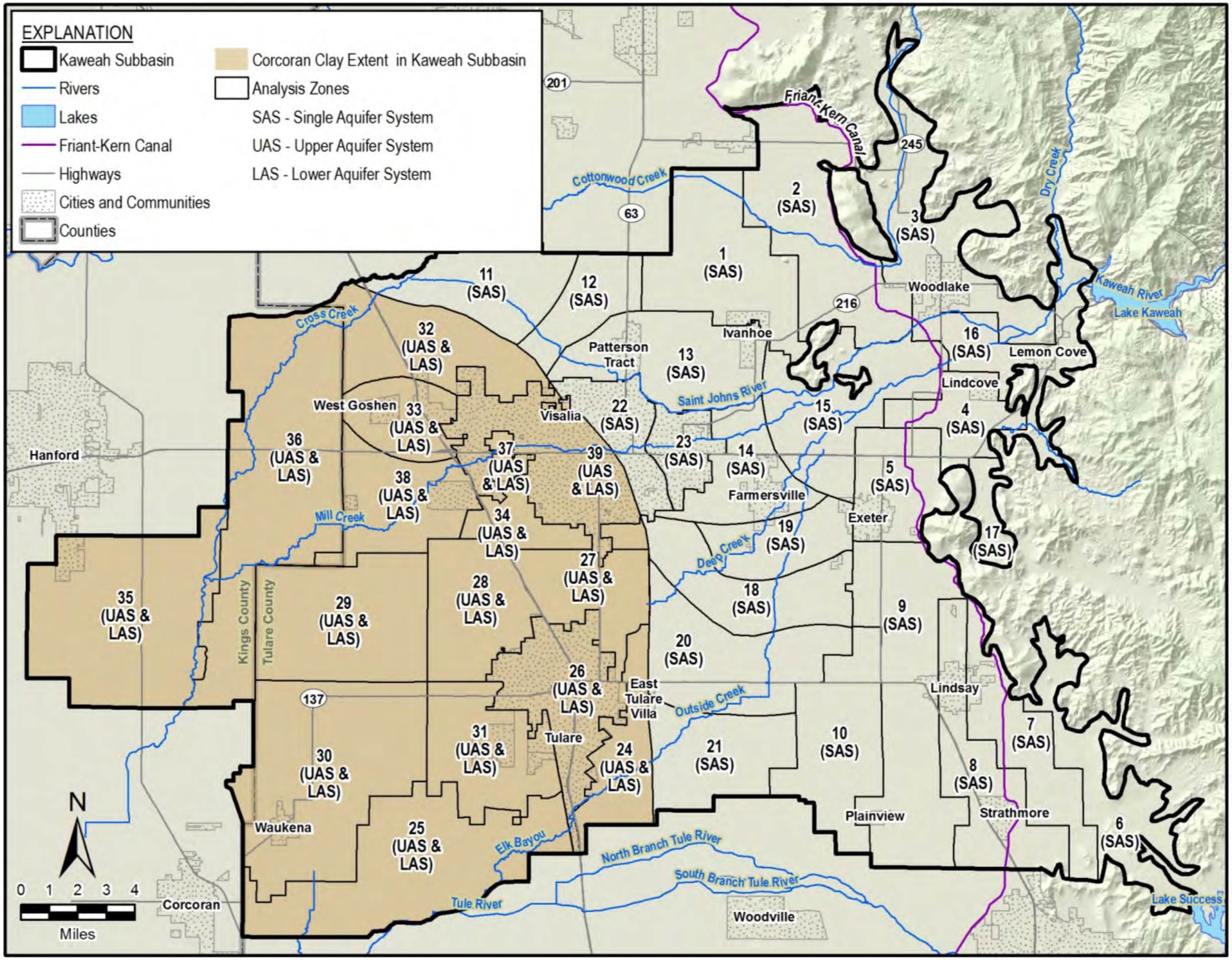


Figure 1. Kaweah Subbasin Analysis Zones

Table 3. Total Well Records by Analysis Zone

Analysis Zone	Agricultural Well Records	Domestic Well Records	Public Well Records	Industrial Well Records	Total Well Records
1	211	118	1	5	335
2	149	23	1	0	173
3	52	39	0	1	92
4	46	42	0	6	94
5	43	29	1	1	74
6	25	9	0	0	34
7	46	18	0	0	64
8	51	56	0	2	109
9	137	99	0	7	243
10	69	52	0	1	122
11	24	2	0	2	28
12	33	30	0	3	66
13	85	146	0	7	238
14	42	52	1	7	102
15	65	73	0	2	140
16	19	46	1	1	67
17	11	3	0	0	14
18	56	62	0	3	121
19	25	87	0	3	115
20	55	88	0	5	148
21	38	12	1	5	56
22	16	6	0	7	29
23	3	7	0	1	11
24	33	33	1	2	69
25	70	3	0	4	77
26	14	18	0	7	39
27	49	75	0	4	128
28	50	69	0	2	121
29	61	19	0	2	82
30	108	52	1	10	171
31	33	8	0	4	45
32	18	1	3	1	23
33	44	32	3	1	80
34	25	52	1	2	80
35	89	29	4	9	131
36	87	8	0	6	101
37	9	15	0	0	24
38	43	16	0	2	61
39	27	17	3	4	51
Total	2,061	1,546	22	129	3,758

3 POTENTIALLY IMPACTED WELLS

3.1 Well Records Shallower than Protective Well Depth by GSA

Wells shallower than protective well depths described in Appendix 5A may be impacted should groundwater elevations approach or exceed minimum thresholds during GSP implementation. The total number of well records shallower than protective well depths in each GSA is estimated using the percentage of wells shallower than the 90th percentile well depth by well use type. Selection of the 90th percentile well depth accounts for uncertainty in the data, especially regarding the likelihood the shallowest wells have been destroyed and replaced during ongoing dry conditions and declining groundwater levels. The analysis is completed using only wells with known well depths. The majority of minimum thresholds described in Appendix 5A are at higher elevations than elevations protective of 90% of wells. The tables that follow therefore overestimate the number of potentially impacted wells. However, since these estimates are to be used for determining the magnitude of wells to be addressed by mitigation plans, they can be considered worst-case estimates.

Table 4 through Table 6 show the approximate number of impacted wells in each GSA, including wells with unknown well depths.

- East Kaweah GSA – approximately 122 wells may be impacted, including 64 domestic wells, 55 agricultural wells, and 3 public supply wells (Table 4).
- Greater Kaweah GSA – approximately 167 wells may be impacted, including 105 domestic wells, 55 agricultural wells, and 7 public supply wells (Table 5).
- Mid-Kaweah GSA – approximately 43 wells may be impacted, including 22 domestic wells and 21 agricultural wells (Table 6).

Table 4. East Kaweah GSA Potentially Impacted Wells

Well Use Type	Well Records with Known Depth			All Well Records		
	Number of Wells	Number of Potentially Impacted Wells	Percentage Potentially Impacted Wells	Number of Wells	Number of Potentially Impacted Wells	Density of Impacted Wells (wells per square mile)
Domestic	418	58	14%	463	64	0.35
Agricultural	721	50	7%	793	55	0.30
Public Supply	16	3	19%	17	3	0.02
Industrial	2	0	0%	3	0	0
Total	1,157	111		1,276	122	0.67

Table 5. Greater Kaweah GSA Potentially Impacted Wells

Well Use Type	Well Records with Known Depth			All Well Records		
	Number of Wells	Number of Potentially Impacted Wells	Percentage Potentially Impacted Wells	Number of Wells	Number of Potentially Impacted Wells	Density of Impacted Wells (wells / square mile)
Domestic	732	96	13%	814	105	0.30
Agricultural	829	49	6%	914	55	0.16
Public Supply	64	6	10%	71	7	0.02
Industrial	8	0	0%	15	0	0
Total	1,633	151		1,814	167	0.48

Table 6. Mid-Kaweah GSA Potentially Impacted Wells

Well Use Type	Well Records with Known Depth			All Well Records		
	Number of Wells	Number of Potentially Impacted Wells	Percentage Potentially Impacted Wells	Number of Wells	Number of Potentially Impacted Wells	Density of Impacted Wells (wells / square mile)
Domestic	214	17	8%	269	22	0.13
Agricultural	309	18	6%	354	21	0.13
Public Supply	37	0	0%	41	0	0
Industrial	3	0	0%	4	0	0
Total	563	35		668	43	0.26

3.2 Well Records Shallower than Protective Well Depth by Analysis Zone

The total number of well records within each analysis zone may be used by the GSAs to estimate potential impacts to be addressed by Well Mitigation Programs. The approximate number of well records that are shallower than the protective well depth in each aquifer zone are summarized in Table 7. Figure 1 shows the location of the analysis zones.

Table 8. East Kaweah GSA Potentially Impacted Wells Summarized by Analysis ZoneTable 8 through Table 10 summarize estimated GSA-specific potential well impacts by well use type.

Table 7. Basinwide Potentially Impacted Wells Summarized by Analysis Zone

Analysis Zone	Agricultural Well Records	Domestic Well Records	Public Well Records	Industrial Well Records	Total Well Records
1	15	19	0	0	34
2	15	3	0	0	18
3	2	2	0	0	4
4	2	7	0	0	9
5	3	4	0	0	7
6	3	1	0	0	4
7	6	1	0	0	7
8	1	9	0	1	11
9	7	14	0	2	23
10	3	7	0	0	10
11	2	1	0	0	3
12	3	3	0	0	6
13	1	16	0	1	18
14	0	10	0	0	10
15	5	10	0	0	15
16	2	4	0	0	6
17	1	1	0	0	2
18	2	11	0	0	13
19	2	6	0	0	8
20	0	14	0	0	14
21	3	2	0	0	5
22	3	1	0	0	4
23	0	2	0	0	2
24	2	4	0	0	6
25	8	1	0	0	9
26	2	0	0	0	2
27	2	4	0	0	6
28	1	3	0	0	4
29	2	2	0	0	4
30	7	8	0	0	15
31	2	1	0	0	3
32	4	0	0	0	4
33	3	4	0	0	7
34	0	6	0	1	7
35	7	1	0	2	10
36	8	1	0	1	10
37	0	1	0	0	1
38	0	6	0	2	8
39	2	1	0	0	3
Total	131	191	0	10	332

Table 8. East Kaweah GSA Potentially Impacted Wells Summarized by Analysis Zone

Analysis Zone	Agricultural Well Records	Domestic Well Records	Public Well Records	Industrial Well Records	Total Well Records
1	15	19	0	0	34
2	15	3	0	0	18
3	2	2	0	0	4
4	1	5	0	0	6
5	2	3	0	0	5
6	3	1	0	0	4
7	6	1	0	0	7
8	1	9	0	1	11
9	7	14	0	2	23
10	3	7	0	0	10
Total	55	64	0	3	122

Table 9. Greater Kaweah GSA Potentially Impacted Wells Summarized by Analysis Zone

Analysis Zone	Agricultural Well Records	Domestic Well Records	Public Well Records	Industrial Well Records	Total Well Records
3	0	0	0	0	0
4	1	2	0	0	3
5	1	1	0	0	2
11	2	1	0	0	3
12	3	3	0	0	6
13	1	16	0	1	18
14	0	10	0	0	10
15	5	10	0	0	15
16	2	4	0	0	6
17	1	1	0	0	2
18	2	11	0	0	13
19	2	6	0	0	8
20	0	14	0	0	14
21	3	2	0	0	5
22	0	0	0	0	0
23	0	0	0	0	0
24	2	4	0	0	6
25	8	1	0	0	9
30	0	0	0	0	0
32	4	0	0	0	4
33	3	4	0	0	7
34	0	6	0	1	7
35	7	1	0	2	10
36	8	1	0	1	10
37	0	1	0	0	1
38	0	6	0	2	8
Total	55	105	0	7	167

Table 10. Mid-Kaweah GSA Potentially Impacted Wells Summarized by Analysis Zone

Analysis Zone	Agricultural Well Records	Domestic Well Records	Public Well Records	Industrial Well Records	Total Well Records
22	3	1	0	0	4
23	0	2	0	0	2
24	0	0	0	0	0
26	2	0	0	0	2
27	2	4	0	0	6
28	1	3	0	0	4
29	2	2	0	0	4
30	7	8	0	0	15
31	2	1	0	0	3
39	2	1	0	0	3
Total	21	22	0	0	43

Appendix 6-3:

Kaweah Subbasin Mitigation Program Framework

MITIGATION PROGRAM FRAMEWORK
KAWEAH COORDINATION AGREEMENT APPENDIX 6
Groundwater Levels and Land Subsidence

Introduction

Sustainable Management Criteria identified in each of the Kaweah Subbasin GSAs have been developed to avoid significant and unreasonable impacts to domestic, municipal, agricultural, and industrial beneficial uses and users of groundwater. However, analysis based on available data suggests that numerous wells may be impacted during the implementation period between 2020 and 2040 as a result of continued lowering of groundwater levels.[1] Wells, land use, property and infrastructure may also be impacted from land subsidence during this period.

As a result of the foregoing, the Kaweah Subbasin GSAs agree to each individually implement a Mitigation Program (Mitigation Program) subject to the following minimum requirements and subject to the schedule provided herein. The purpose of the Mitigation Program is to mitigate for continued overdraft pumping for groundwater levels and land subsidence. Each Kaweah Subbasin GSA will adopt and implement a Mitigation Program to identify impacts caused by pumping within the GSA's boundaries that may require mitigation. Each Mitigation Program will separately identify the impacts to beneficial uses that the Mitigation Program is intended to address. Each Mitigation Program will include a claim process to address impacts to: (i) domestic and municipal wells; (ii) agricultural wells; and (iii) critical infrastructure. Because the Mitigation Program will resolve impacts from groundwater management, significant and unreasonable results to wells and land uses that may occur prior to reaching Minimum Thresholds will be avoided.

Mitigation Program Framework

Each GSA shall include a Mitigation Program as a project or management action identified in that GSA's GSP, describing the following elements:

Identification of Need for Mitigation

The Mitigation Program will begin with a plan to establish the process for identification of wells or land uses in need for mitigation. The process may include: 1) an application process by the landowner or well user; or 2) data collection by the GSA and outreach to the affected user. The GSPs in the Subbasin set Measurable Objectives and Minimum Thresholds based on 2015 groundwater levels and land elevation. Impacts from that point further will be evaluated as potentially affected due to the allowance of some level of continued overdraft.

[1] See Technical Appendix 5A, Technical Approach for Developing Chronic Lower of Groundwater Levels Sustainable Management Criteria in the Kaweah Subbasin for a detailed description of the establishment of MT; Technical Appendix 5C, Potential Well Impact Summary.

Evaluation

Once a potential well or land use has been identified as possibly impacted, an evaluation will occur by the GSA to determine whether the well has been adversely impacted by declining groundwater levels or by land subsidence which have been identified as occurring because of allowable continued overdraft conditions.

Qualifications

GSAs may qualify mitigation based on a user's compliance with the GSA's GSP, Rules & Regulations, and other laws or regulations. For example, a user who has caused or contributed to overdraft may not qualify for the Mitigation Program.

Mitigation

Once a well has been identified as adversely impacted due to declining groundwater levels or land subsidence, the proper mitigation to alleviate impacts must be determined. This could be any of the following:

For groundwater level impacts, this could include any of the following:

1) Repairing the well;
2) Deepening the well;
3) Constructing a new well;
4) Modifying pump equipment;
5) Provide temporary or permanent replacement water;
6) Coordinate consolidation with existing water systems; or
7) With the consent of the affected user, providing other acceptable means of mitigation.

For land use impacts, this could include any of the following:

1) Increased restrictions in groundwater extractions for certain regional areas;
2) Repair to canals, turnouts, stream channels, water delivery pipelines, and basins;
3) Repair to damaged wells;
4) Addressing flood control;
5) Repair to other damaged infrastructure including highways, roads, bridges, utilities, and buildings; or
6) With the consent of the affected user, providing other acceptable means of mitigation.

Various factors may reflect the proper mitigation methods for the specific well or land use at issue. For example, age, location, the financial impact to the beneficial user as a result of mitigation, and the beneficial user of the well may reflect which mitigation measures are optimal.

Outreach

Public outreach and education will be provided during development of the Mitigation Program and prior to implementation by each GSA. Prior to implementation, extensive outreach will be geared toward notifying landowners of the Mitigation Program requirements, facilitate how to qualify for the Mitigation Program, and how to apply for assistance. Outreach will be offered in multiple languages as appropriate for the GSA. Outreach methods could include workshops, mailings, flyers, website postings, Board meeting announcements, etc.

Common elements developed at the Kaweah Subbasin level shall be shared with the public through coordinated workshops and public meetings. As material and data become available, the Kaweah Subbasin GSAs will coordinate workshops for the public to attend. While special workshops can be utilized, the Kaweah Subbasin GSAs will utilize the quarterly Kaweah Subbasin Management Committee (Management Committee) meetings as a resource to share Workplan updates. The Management Committee is a coordinated meeting between representatives from each GSA, and the public is invited to attend and participate in the meetings. Meetings shall be noticed on GSA websites and shall be sent to interested parties. Interested parties are collected on an ongoing basis in the Kaweah Subbasin. Individual outreach plans specific to each GSA Mitigation Program shall be developed and shared with the public via individual outreach efforts at each.

Mitigation Program Adoption Schedule

Each GSA will formulate and implement a mitigation claims process for domestic and municipal use impacts within the first quarter of 2023, and complete all other aspects of the Mitigation Program by June 30, 2023. The initial claims process shall include reference to local programs and resources from the County, State, non-profit organizations, and the Kaweah Basin Water Foundation.

As the Kaweah Subbasin GSAs anticipate that the individual Mitigation Programs will require time to be developed and established in a public and transparent fashion, in the interim, the Kaweah Subbasin GSAs will coordinate the development of an Interim Domestic Well Mitigation Program at a yet to be determined funding level and emergency criteria to make the limited funding available for drinking water well mitigation.

Mitigation Program Funding Source

Each GSA will develop a funding mechanism for the Mitigation Program, which is dependent on the specific GSA needs for specific expected impacted wells, critical infrastructure, and land uses within each GSA. Funding is anticipated to be available for each GSA's Mitigation Program through implementation of assessments, fees, charges, and penalties. In addition, the GSAs will explore grant funding. The State has many existing grant programs for community water systems and well construction funding. County, state, and federal assistance will be needed to successfully implement the respective Mitigation Programs. Each GSA may, separately or in coordination with other GSAs, also work with local NGOs that may be able to provide assistance or seek grant monies to help fund the Mitigation Program. GSAs may act individually or collectively to address and fund mitigation measures.

Below is a list of funding being sought within the Kaweah Subbasin:

- The Safe and Affordable Funding for Equity and Resilience (SAFER) Program through the California State Water Resources Control Board
- Household Water Well Program through the United State Department of Food and Agriculture
- Household Water Well System Grant Program through the United State Department of Food and Agriculture

Annual Reporting and Mitigation Evaluations

The Kaweah Subbasin GSAs intend to utilize the Annual Report submitted to DWR to report on and update progress on the Mitigation Program(s).

With the information presented, the Kaweah Subbasin GSAs anticipate pursuing locating and refining the potential number of wells impacted by lowering of groundwater levels to the MTs in the Kaweah Subbasin. The Kaweah Subbasin GSAs intend to leverage new tools developed by the California Department of Water Resources such as the Dry Domestic Well Susceptibility Tool and well surveys to establish a refined estimate of drinking water well impacts. The Kaweah Subbasin GSAs will continue to evaluate impacts to beneficial uses and users of Land Subsidence.

Appendix 7

Groundwater Modeling Technical Memorandum

KAWEAH SUBBASIN
GROUNDWATER MODELING REPORT

Final 12/31/19

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Introduction

This memorandum describes the application of the Kaweah Subbasin Hydrologic Model (KSHM) to analysis of future conditions in the Kaweah Subbasin during the GSP implementation period from 2020 to 2040. The model is applied to estimate future water deficit and water levels under base no-action scenarios. It is also applied to assess the impacts of projects and management actions proposed by the Subbasin GSAs. The modeling results helped inform the GSAs in finalizing their sustainable management criteria including articulation of a basin wide sustainability goal statement and verifying the reasonableness of the measurable objectives, minimum thresholds, and interim milestones set at each groundwater level representative monitoring well for the 20-year GSP implementation period. The results are also intended to inform collaboration with other agencies and entities to arrest chronic water-level and groundwater storage declines, reduce or minimize land subsidence where significant and unreasonable, decelerate ongoing water quality degradation where feasible, and protect beneficial uses. The modeling approach and results of verification runs have been previously described in an earlier report which is provided in Appendix 1 of this report.

Model Scenarios

The first modeling task initiated includes extending the duration of the model from the modeled period of water years 1999 to 2017 through the SGMA compliance period of water years 2020 to 2040. All modeling runs, from the no-action "Base Case" scenario through the projects and management action scenarios, incorporate climate change in accordance with DWR's climate change direction. The base case was used to identify measurable objectives and to facilitate planning for projects and management actions. The set of model runs to be performed was determined through iterative discussions and summarized in a presentation to the Kaweah Subbasin management team on April 17, 2019. The model runs implemented consisted of the following:

- Case 1, Base No-Action Scenario: Base Case Run with averaged water year repeated and adjusted to account for long term trend due to climate projections
- Case 2, Variable Base No-Action Scenario: Base case with historical sequence of wet and dry years
- Case 3, Reversed Variability Base No-Action Scenario: Base case with reversed historical sequence of wet and dry years
- Case 4, Future Management Actions Only: Built on the Base No-Action Scenario but with Pumping Reductions
- Case 5, Future Projects and Management Actions: Built on the Base No-Action Scenario but with Pumping Reductions and Projects

Preparing Projected Hydrology

Projected climate conditions for the implementation period are important inputs for the determination of measurable objectives and ultimately the sustainability of the basin. The GSP Emergency Regulation which was issued by DWR to guide development of GSPs includes guidance for preparation of Project Hydrology for 2020 to 2040 implementation period. Section 354.18(c)(2)(B) of the GSP Emergency Regulation outlines the relevant requirements for preparing historical and projected water budgets.

For historical water budget, the regulation requires a quantitative assessment based on a minimum of 10 years of data including with the most recently available information. The 20-year current period (1997 to 2017) used for the Kaweah basin historical water budget meets and exceeds this requirement. For projected hydrology, the regulation requires future hydrology to be established using 50 years of historical precipitation, evapotranspiration, and streamflow information as a baseline. The regulation also requires projected hydrology information to be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.

To support the development of a projected hydrology that meets the requirements of the regulation, DWR has provided a gridded, statewide dataset that contains over 89 years of detrended hydrologic time series (1922 to 2011) to capture variability. DWR has also computed the climate states at 1995, 2030 and 2070 using a combination of global climate models, and the climate states have been applied to the detrended time series to generate three future hydrologic time series. For estimation of imported water supplies such as those from the Friant-Kern system, DWR has simulated 82 years of future hydrologic time series using the CalSim model. Three climate time series, each 50 or more years long, were extracted from the DWR data and used to characterize projected hydrology in the Kaweah Basin under 1995, 2030 and 2070 conditions.

Case 1: Base Case of Future with Averaged Conditions and No Projects

To meet the GSP Emergency Regulation requirements, a base case of projected hydrology covering the 20-year period for 2020 to 2040 is developed based on historical monthly averages. The average monthly hydrologic conditions experienced between 1997 through 2017 (the "current period") are assumed for each year of the compliance period, and annual change factors are applied to account for the long-term trend due to climate change. Future water supply projections (including Class I, II and other water deliveries) from the Friant Water Authority are included in the base case. Detailed steps for generating the projected hydrology time series are described in the following steps:

- First Year (2020): Projected hydrology for the first year (2020) are computed as the monthly averages of the current hydrology (1997 to 2017). An implied change factor of 1 is used for the first year of projected hydrology.

- Early Years (2021 to 2030): Projected hydrology for subsequent years from 2021 to 2030 are computed by applying a set of change factors to account for climate change. Twelve climate change factors are computed using the percent change of the mean monthly values between two DWR-provided climate projection datasets centered around years 1995 and 2030, respectively. The linear trend is used to incremental apply the monthly change factors to each year between 2021 and 2030, and the change factors are applied to the monthly averages of the current (2020) hydrology to generate the projected hydrology.

- Later Years (2031 to 2040): Projected hydrology for the later years from 2031 to 2040 are computed by similarly applying factors to account for climate change. The climate change factors for later years is computed using the rate of change of the mean monthly values between DWR-provided climate projection datasets centered around years 2030 and 2070, respectively. The trend is applied incremental to the monthly values beginning with 2030 hydrology to generate projected hydrology for each year between 2031 and 2040.

Table 1 shows the monthly change factors computed for use in projecting future precipitation, evapotranspiration and water supply in the Kaweah Subbasin. Separate change factor values are provided for use in 2030 and 2040. Since a value of 100% is assumed for the first year 2020, change factors are easily interpolated for all intermediate years between 2020 and 2040 using a linear trend. Different change factors are computed in each of the three GSAs, and different change factors are also applied for water supplies from Kaweah Lake, Kings and the Friant Kern system.

Table 1: Monthly Hydrologic Change Factors Derived from DWR-Provided Climate Change Projections.

	Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Precipitation (Percent of 2020 Values)													
East Kaweah	2030	92	102	98	108	104	109	103	85	88	101	109	105
East Kaweah	2040	89	97	97	111	104	109	99	80	87	104	112	111
Greater Kaweah	2030	92	101	97	108	105	108	103	87	88	101	112	105
Greater Kaweah	2040	90	96	97	110	105	108	100	83	87	101	113	110
Mid-Kaweah	2030	92	101	96	108	105	108	103	87	88	100	109	105
Mid-Kaweah	2040	90	96	95	110	105	108	100	83	87	100	110	110
Evapotranspiration (Percent of 2020 Values)													
East Kaweah	2030	104	103	103	105	103	103	102	104	104	103	103	103
East Kaweah	2040	105	105	106	106	105	104	103	105	105	104	104	104
Greater Kaweah	2030	104	103	104	105	103	103	102	104	104	103	103	103
Greater Kaweah	2040	105	105	106	106	104	103	103	105	105	104	104	104
Mid-Kaweah	2030	104	103	104	105	103	102	102	104	104	103	103	103
Mid-Kaweah	2040	105	105	106	107	104	103	103	105	105	104	104	104
Water Supply (Percent of 2020 Values)													
Kaweah Lake	2030	102	106	110	125	121	119	105	82	58	64	91	99
Kaweah Lake	2040	99	101	111	131	128	124	104	75	51	61	90	102
Kings	2030	100	111	118	135	131	127	115	96	64	58	84	96
Kings	2040	97	107	122	144	142	137	119	92	57	53	81	99
Friant-Kern	2030	85	97	146	152	116	110	101	97	85	90	85	85
Friant-Kern	2040	83	94	144	157	118	112	102	93	82	87	81	83

To generate the projected hydrology, the monthly change factors are applied to the fluxes from the calibrated model for the current period. The precipitation, evapotranspiration and water supply change factors are applied to different fluxes as follows:

- Mountain Front Runoff (precipitation change factors)
- Agricultural Pumping (evapotranspiration change factors)
- Agricultural Irrigation Return Flow (evapotranspiration change factors)
- Ditch Percolation (future estimated surface water allocations)
- Precipitation Percolation (precipitation change factors)
- River Recharge (water supply change factors)

Case 2: Future with Interannual Variability and No Projects

The second modeling case is used to evaluate the impacts of interannual variability including extreme conditions such as wet and dry years and multi-year droughts which could impact water quality or induce subsidence. The projected hydrology is based on the historical hydrologic time series (1997 to 2017) with a climate adjustment applied to reflect climate conditions centered at 2030. This model run includes over 10 years of current hydrology and 50 years of projected hydrology as required by the GSP regulations. However, the results cannot be used for setting intermediate 5-year targets between 2020 and 2040 since the historical sequence of wet and dry years cannot be assumed to recur in the future. The results of this model run are used primarily to estimate the magnitude of uncertainty in future projections of performance targets.

Case 3: Future with Interannual Variability Reversed and No Projects

The third modeling case also uses the historical time series used in Case 2 to evaluate the impacts of interannual variability and extreme wet and dry years. However, the sequence of historical time series is reversed such the model run begins with the most recent historical years of data while the oldest year of data enters the model last. The time series reversal changes the sequencing of hydrologic years but preserves the seasonal patterns that occurred within each year. To account for the impacts of climate change, a set of 12 monthly change factors is computed from the DWR climate projections centered at 2030 and applied to each year of the reversed time series.

The results of Case 3 run are useful for assessing the sensitivity of projected hydrology and sustainability indicators to the sequence of future annual droughts and wet years. However, the results cannot be used for setting intermediate 5-year targets between 2020 and 2040 since the sequence of years cannot be assumed to recur in the future. The results of this model run are also used to assess the magnitude of uncertainty in future projections of performance targets.

Case 4: Altered Future with Management Actions

The fourth modeling case reflects a future scenario where only management actions would be employed to achieve sustainability. Management actions are to be implemented with the goal of reducing pumping and mitigating further decline in aquifer water levels. They include conservation and monitoring programs aimed at limiting extraction and reducing water use. They also include market-based mechanisms and external assistance programs to reduce the economic impact of reduced water use. Table 2 shows the list of near-term management actions to be implemented in the Kaweah Subbasin in Case 4 which does not include implementation of any projects, with the exception of relatively new and operating water exchanges within Mid-Kaweah GSA.

Table 2: List of Management Actions included in Case 4

Region	Management Actions
East Kaweah GSA	• 5% Demand Reduction • 2025 Demand Reduction Programs/Policies • 2030 Demand Reduction Programs/Polices • 2035 Demand Reduction Programs/Polices
Greater Kaweah GSA	• Modified Surface Water Deliveries • Fallowing Program
Mid-Kaweah GSA	• Extraction Measurement Program • Groundwater Extraction Allocation Implementation

Case 5: Altered Future with Management Actions and Projects

The fifth modeling case reflects a future scenario where projects and management actions would be employed to achieve sustainability. While management actions are aimed at reducing pumping, projects are proposed with the primary goal of increasing recharge. Table 3 shows the list of initial projects and management actions included in Case 5. Case 5 is expected to generate the smallest water deficit since it reflects the combined impacts of recharge projects and pumping reduction from all the management actions previously listed in Case 4. Not all of the projects and management actions listed in table three

Table 3: List of Projects and Management Actions included in Case 5

Region	Management Actions	Projects
East Kaweah GSA	• 5% Demand Reduction • 2025 Demand Reduction Programs/Policies • 2030 Demand Reduction Programs/Policies • 2035 Demand Reduction Programs/Policies	• Lewis Creek Delivery • Cottonwood Creek Delivery • Yokohl Creek Delivery • Micro-Basins • Lindsay Recharge Basin • Wutchumna Ditch Delivery • Rancho de Kaweah
Greater Kaweah GSA	• Modified Surface Water Deliveries • Fallowing Program	• Cross Creek Layoff Basin • Improved LIWD Basins • New LIWD Basins • New Delta View Canal • Deliveries to Delta View Landowners thru Lakeland • On-Farm Recharge • Kings River Floodwater Arrangement • Buying Surplus Water in Wet Years • Paregien Basin • Basin No. 4 • Hannah Ranch • Lewis Creek Water Conservation • Ketchum Flood Control & Recharge • St Johns River Water Conservation • Peoples Recharge Expansion
Mid-Kaweah GSA	• Extraction Measurement Program • Groundwater Extraction Allocation Implementation	• Cordeniz Recharge Basin • Okieville Recharge Basin • Tulare Irrigation District / GSA Recharge Basin • On-Farm Recharge Programs • McKay Point Reservoir • Kaweah Subbasin Recharge Facility • City of Visalia / Tulare Irrigation District Exchange Program • Sun World International / Tulare Irrigation District Exchange Program • City of Tulare / Tulare Irrigation District Catron Basin • Packwood Creek Water Conservation Project • Visalia Eastside Regional Park & Groundwater Recharge

Boundary Conditions

The Kaweah Subbasin numerical groundwater model is intended to be used as a valuable planning tool to guide groundwater managers in planning projects and management actions to achieve sustainability within the implementation period. To achieve this goal, particular attention is paid to how the head boundary conditions are specified in the model. Within the groundwater model, the General Head Boundary (GHB) surrounds the Kaweah Subbasin model at a distance of approximately 3 miles beyond the KSB boundary, located within the neighboring subbasins to the north, west and south. The area between the GHB and the Kaweah Subbasin is considered a “buffer zone,” the purpose of which is to evaluate subsurface inflow and outflow (underflow) between the adjacent subbasins. Figure 1 shows the model extent with the General Head Boundary represented by the line marking the edge of the model extent.

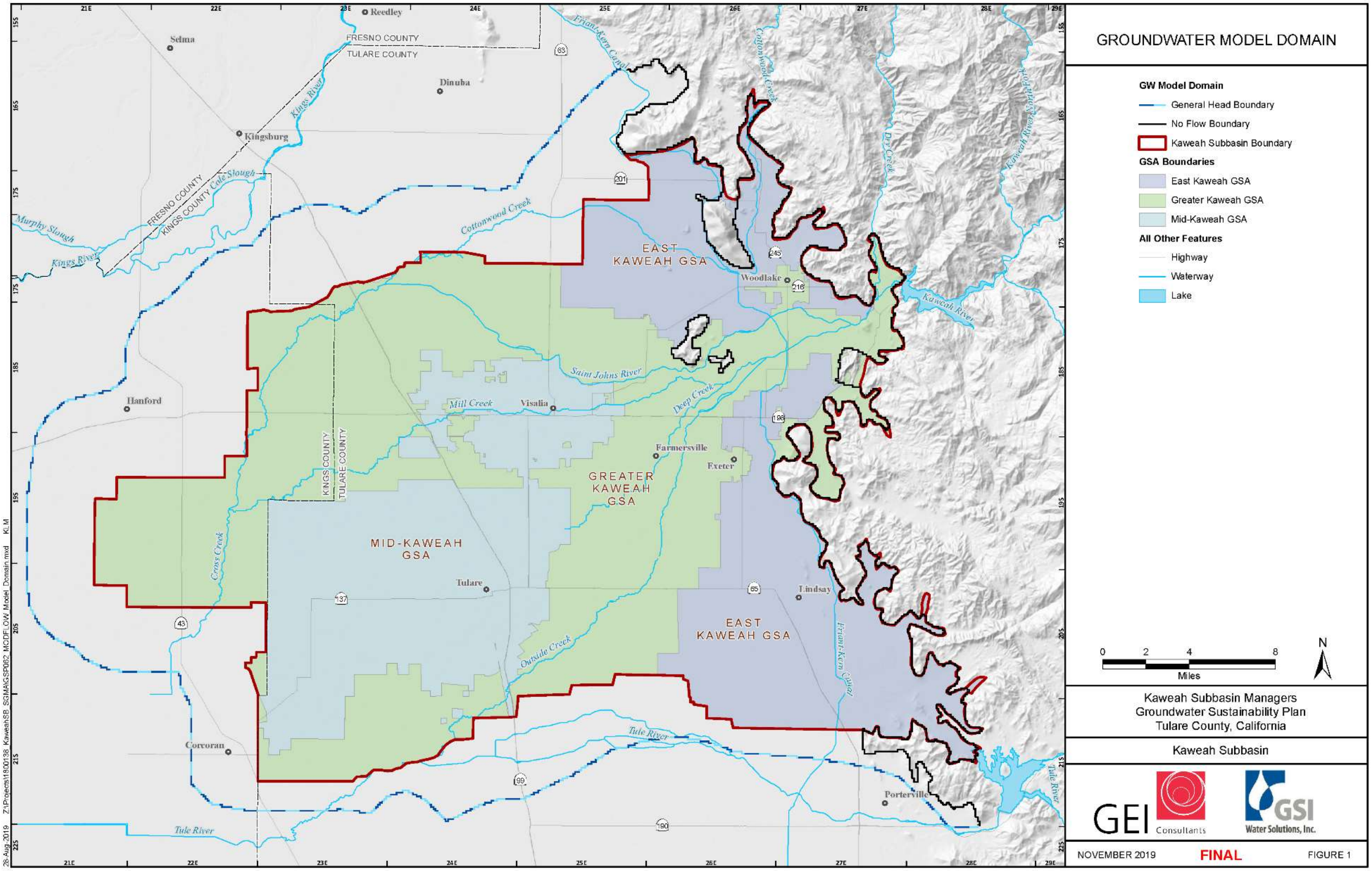


Figure 1: Kaweah Subbasin Model Domain

Head boundary conditions play an important role in modeling because, along with aquifer properties, they determine the magnitude of flows in and out of the subbasin. Boundary water levels for a modeling run must be specified for each month in the simulation period prior to each model run. They are difficult to specify accurately since they are based on water levels that respond to the change in fluxes due to actions in neighboring subbasins. However, they must be specified accurately enough to reflect changing fluxes entering and leaving the subbasin through the boundary.

In the Kaweah model, future water levels at the general head boundary are prescribed based on observed water elevations and simulated current hydrology (1997-2017) from the calibrated model. Future boundary water elevations from 2020 to 2040 were set by repeating the 12 average monthly values of the period from 1997 through 2017. This approach preserves the seasonal water level changes at boundary. It also ensures that the magnitude of underflow fluxes entering and leaving the basin for the base case are of the same order of magnitude as underflow fluxes for current hydrology. As projects and management actions are implemented within Kaweah and surrounding subbasins, the head boundary conditions and underflow will also change but these changes cannot be predicted without full knowledge of all projects and management actions in the region. The surrounding subbasins have the same modeling issues which can only be resolved in future by setting boundary conditions with modeled water levels from surrounding subbasins.

Figure 2 shows contours of the potentiometric surface for initial water levels at the start of the planning period in 2020. The elevation of the water table generally decreases from east to west. The highest water level elevations of between 300 and 400 ft occur in East Kaweah GSA at the transition from the Sierras to the valley floor. The lowest water levels of 40 ft or less occur along Cross Creak at the western edge of Greater Kaweah and Mid-Kaweah GSAs.

Figure 3 shows contours of the projected potentiometric surface changes between 2020 and 2040 under the base, no-project scenario. Contour values are generally negative indicating water levels in the Kaweah Subbasin would continue to decline without action to reduce extraction or increase supply. The largest declines would occur in the middle of the subbasin with declines exceeding 80 ft around Visalia. The region of decline is shaped like a cone centered around Visalia and extending over the entire subbasin.

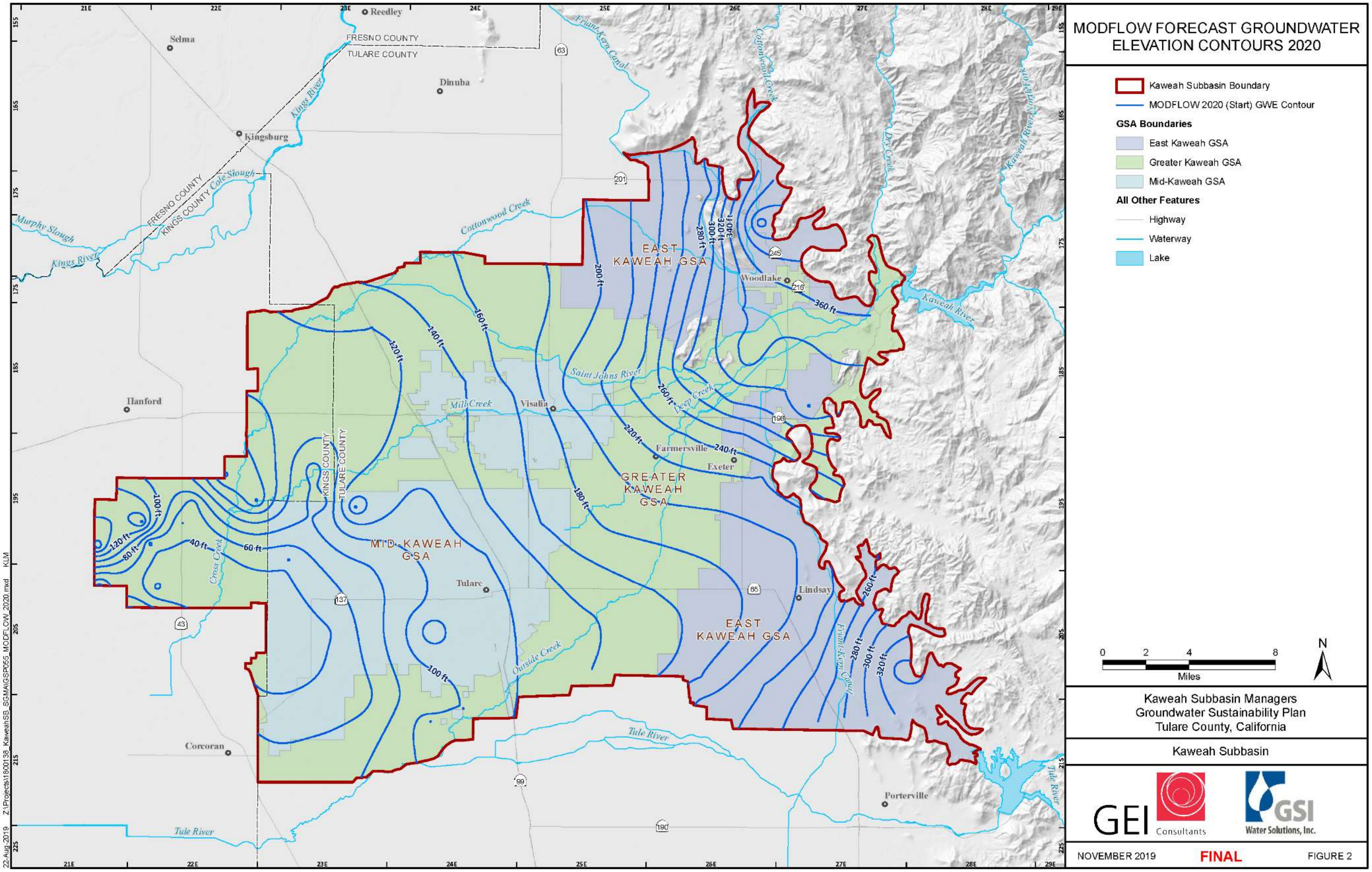


Figure 2: Potentiometric Surface Map showing Water Levels at the Beginning of the Simulation Period in 2020.

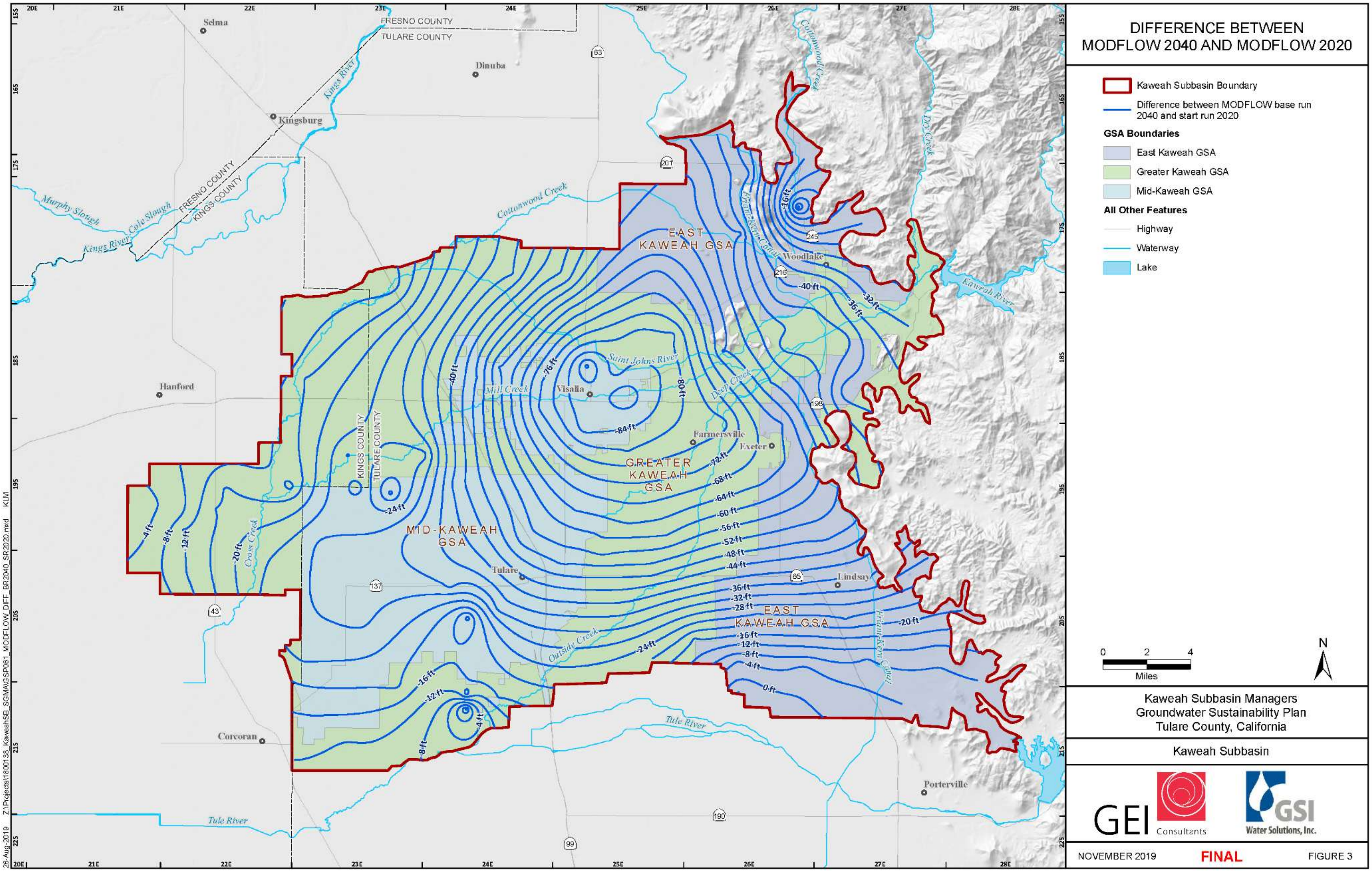


Figure 3: Map of Potentiometric Surface Changes from 2020 to 2040 under the Base Case with No Projects.

Recharge and Pumping Projections

As shown in the Basin Setting chapter of the GSP for the Kaweah Subbasin, climate change is projected to increase temperatures and evapotranspiration, leading to an equivalent increase in crop demands and groundwater pumpage. Percolation also increases with increases in the volume of applied irrigation water. The increase in evapotranspiration coupled with shifts in the seasonal patterns of precipitation could also affect changes to the quantity and timing of deep percolation and groundwater storage. With projected demands anticipated to increase by approximately 10 percent by 2040 (Table 34 of the Kaweah Basin Setting Report), a combination of demand management and recharge programs are required to close the deficit in the Projected Water Budget.

Surface water availability changes are incorporated as presented in the Projected Water Budget section of the Basin Setting document. This availability affects surface water delivery to crops and, by extension, groundwater pumpage to satisfy crop requirements. Surface water availability also impacts recharge along streams, ditches and recharge basins. Additional recharge (on-farm recharge) and recharge basins are included as future projects in the basin. In the interest of maximizing the surface water supply during wet periods, the future projects evaluated in modeling case 5 include on-farm recharge or other large-scale recharge projects.

Municipal pumping within each city and overall agricultural pumping within each GSA are adjusted as percentages of the base case scenario. Municipal pumpage is modeled as documented in the Basin Setting, in accordance with anticipated pumpage documented in urban water management plans. For the base period, irrigated agriculture demand averaged 1,055,700 AF/WY, which was satisfied by a combination of surface water and groundwater. Recent crop survey data indicate that this demand is from a variety of crops including almonds, alfalfa, citrus, cotton, grapes, olives, truck crops, walnuts, wheat and several others (Davids Engineering, 2018). Crop ET was derived for each of these crops for each year during the recent period of 1999 to 2017, based upon trends in water use for each crop. During the period, total water demand related to the growing of almonds has increased by 14 percent, while total water demand to satisfy miscellaneous field crops has declined by 18 percent. By considering all of the trends for a total of 16 crop categories on a net basis, the average change in crop water ET demand has been relatively unchanged, increasing modestly each year between 1999 and 2018. Future projection of crop demand to 2040 and 2070 indicates that agricultural demand will increase to 1,138,200 AF/WY in 2030 and 1,239,500 AF/WY in 2070, which includes projected climate change effects.

Changes in agriculture water use are implemented through cropping changes, land fallowing or other land-use conversion alternatives. Cropping changes are included in the no-action model runs (Case 1, 2 and 3) as presented in the Projected Water Budget section of the Basin Setting document. Land retirement is included as a management action in the fourth and fifth scenarios.

Each GSA is able to model separate reduced pumpage "ramp downs" and specific projects and management actions in increments of 5 years or less. The results of the numerical modeling are summarized at a GSA-level along with water level changes, hydrographs, and water budget components in 5-year increments from 2020 through 2040. The 5-year summaries allow the GSAs to determine the anticipated effectiveness of projects and management actions.

Agricultural pumping reductions are incorporated into the groundwater model relative to the baseline run for many of the predictive scenarios. Reductions in pumpage are specified in areas smaller than the GSA such as the scale of an entitlement holder or a water district. Pumpage reductions are also allowed to vary temporally. To accommodate these spatial and temporal variations within the model, a shapefile is developed of the areas where pumpage reductions are proposed and used to assign a proportional reduction in pumpage for modeling areas. Likewise, reductions of pumpage are assigned evenly throughout the agricultural pumpage at the GSA scale. Temporally, these reductions are assigned in approximately 5-year periods (such as 2021 - 2025 or 2026 - 2030) to allow sufficient time for planning operational changes. A relative adjustment is also applied to irrigation return flows to maintain consistency with the prescribed agricultural pumping reductions.

Change in water levels from the baseline can readily be summarized over specified pumpage areas at the end of each 5-year period. However, the groundwater zone budget determining underflow, change in storage, other groundwater model fluxes, and objectives are only computed at the GSA level.

Water from Management Actions and Projects

The impacts of Management Actions and Projects on reducing average annual water deficits in the Kaweah Subbasin over the implementation period 2020 to 2040 are shown in
Table 4. The water deficit reductions are provided in thousands of acre-feet per year. Separate values are shown for the Management Actions (Case 4) and the combined impact of Projects and Management Actions (Case 5) for East Kaweah GSA, Greater Kaweah GSA and Mid-Kaweah GSA. Summary results for the full Kaweah Subbasin are also provided. For Mid-Kaweah GSA, the proposed Management Actions are included in Case 4 while Case 5 includes only proposed Projects without Management Actions. This is because Management Actions in Mid-Kaweah GSA include reoperation of existing projects such as capturing and storing local or regional flood flows that would otherwise leave the subbasin and operating existing Packwood Creek recharge facilities.

Table 4: Water Deficit Reduction from Projects and Management Actions in Thousands of Acre-Feet per Year

	Water Deficit Reduction (1000 Acre-Feet/Year)							
	East Kaweah GSA		Greater Kaweah GSA		Mid-Kaweah GSA		Kaweah Subbasin	
Water Year	Case 4: Management Actions	Case 5: Total	Case 4: Management Actions	Case 5: Total	Case 4: Management Actions and Existing Projects	Case 5: Projects without Management Actions	Case 4: Management Actions	Case 5: Total
2020	0	1.8	3.3	12.7	5	5	8.3	19.5
2021	1.5	5.1	4.5	14.2	5	5	11	24.3
2022	1.5	8.3	4	13.7	5	5	10.5	26.9
2023	1.5	8.3	8	77.4	5	5	14.5	90.6
2024	1.5	11	4	14.2	5	5	10.5	30.2
2025	7.5	14.5	4.5	14.7	5.6	10	17.6	39.2
2026	7.5	23.5	16.3	26.4	6.3	10	30	59.9
2027	7.5	23.5	16.3	99.3	6.9	10	30.6	132.8
2028	7.5	23.5	16.3	26.6	7.5	10	31.3	60
2029	7.5	23.5	16.3	26.6	8.1	10	31.9	60
2030	16.5	27	16.3	26.6	8.8	15	41.5	68.5
2031	16.5	27	36	130.1	9.4	15	61.9	172.1
2032	16.5	27	36	46.5	10	15	62.5	88.4
2033	16.5	27	36	46.5	10.6	15	63.1	88.4
2034	16.5	27	36	46.5	11.3	15	63.8	88.4

2035	30	30.5	36	140	11.9	15	77.9	185.5
2036	30	30.5	65	75.6	12.5	15	107.5	121.1
2037	30	30.5	65	75.6	13.1	15	108.1	121.1
2038	30	30.5	65	75.6	13.8	15	108.8	121.1
2039	30	30.5	65	172.6	14.4	15	109.4	218
2040	30	30.5	65	75.6	15	15	110	121.1
Min	**0**	**1.8**	**3.3**	**12.7**	**5**	**5**	**8.3**	**19.5**
Max	**30**	**30.5**	**65**	**172.6**	**15**	**15**	**110**	**218**
Mean	**14.6**	**21.9**	**29.3**	**58.9**	**9**	**11.4**	**52.9**	**92.2**

The results show that proposed management actions (case 4) in the Kaweah Subbasin could yield approximately 52,900 acre-feet per year of reductions in water deficit. Case 5 results in a total water deficit reduction of 92,200 acre-feet annually on average and in the last five years the deficit reduction is 121,000 acre-feet which implies that the projects alone would yield 39,300 acre-feet per year. The Kaweah Subbasin Basin Setting Report estimates the basin Safe Yield at 720,000 acre-feet per year and the average annual groundwater pumping in the basin during the current water budget period is 798,000 acre-feet. Therefore, a reduction in deficit of 121,000 through the implementation of projects and management actions will ensure that we are operating within the safe yield of the basin. The Greater Kaweah GSA contributes to 64% of deficit reduction while East Kaweah and Mid-Kaweah contribute 24% and 12%, respectively. Implementation of most management actions increases gradually in each GSA over the 20-year planning horizon but with some stepped increases occurring approximate every five years. Projects in East Kaweah and Mid-Kaweah steadily reduce water deficits within their respective GSAs over the planning horizon. However, in Greater Kaweah, the projects yield gradually increasing volumes of water punctuated by large recharge volumes during wet years which are assumed to recur every four years.

Figure 4 shows contours of difference in 2040 water levels between the base no-action scenario and the scenario in which management actions are implemented but with no projects. The introduction of Management Actions would result in an overall rise in 2040 water levels relative to the no-action scenario. The largest improvements occur in the area between Cottonwood Creek and Saint Johns River with water levels rising up to 28 ft. Rises of over 20 ft are seen in other across the middle of the subbasin, stretching from areas along Mill Creek near Visalia to the Friant-Kern Canal near Lindsay.

Figure 5 shows contours of difference in 2040 water levels between the base no-action scenario and the scenario with full implementation of proposed projects and management actions. Under this scenario, the largest improvements in water levels of over 52 ft occur along Saint Johns River and Deep Creek, just west of Mckays Point. Improvements of over 40 ft are also seen between Mill Creek and Cross Creek near Remnoy.

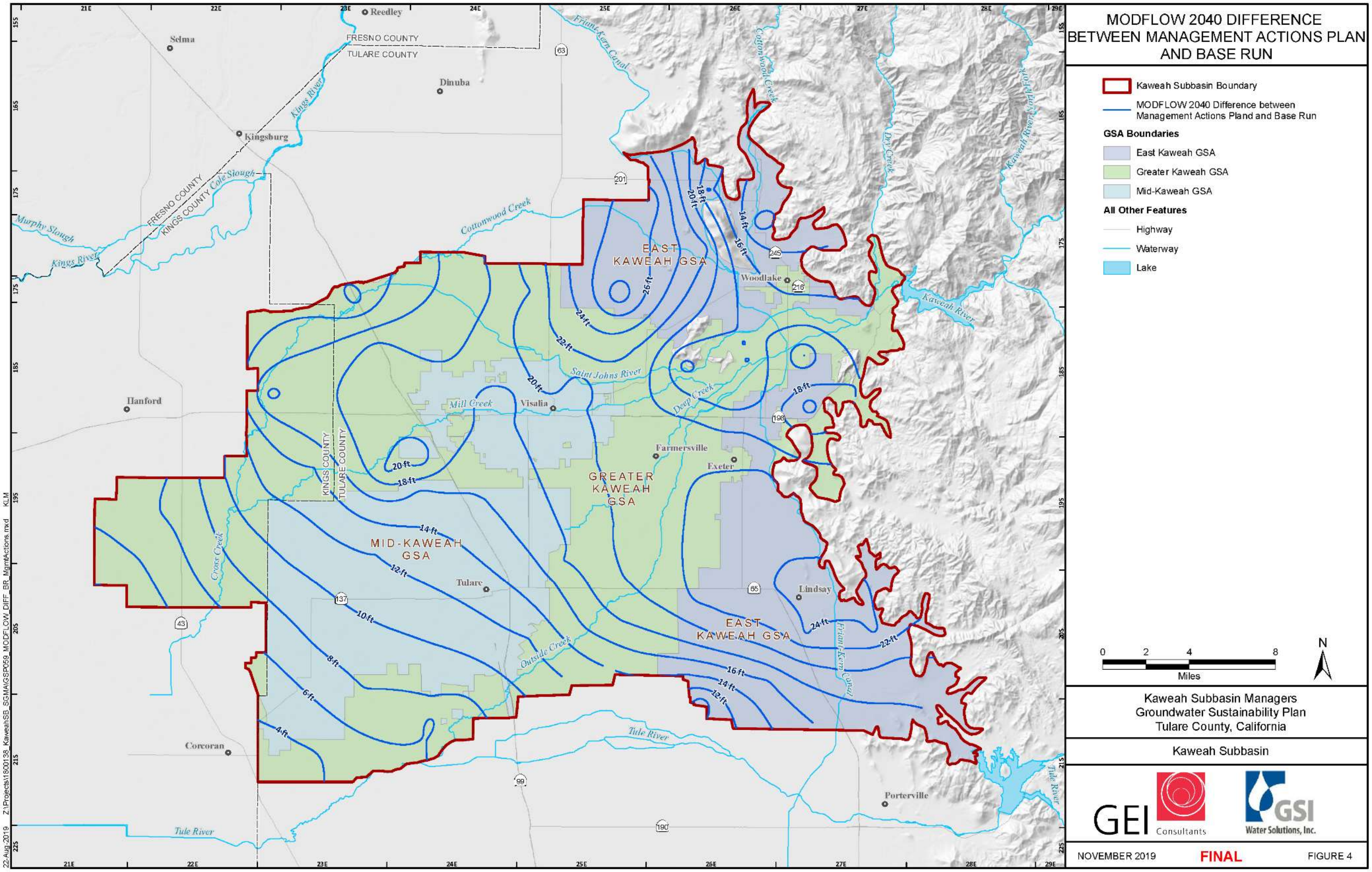


Figure 4: Map of Differences in Potentiometric Surfaces between Base Case 1 with No Projects and Case 4 with Management Actions Only in 2040.

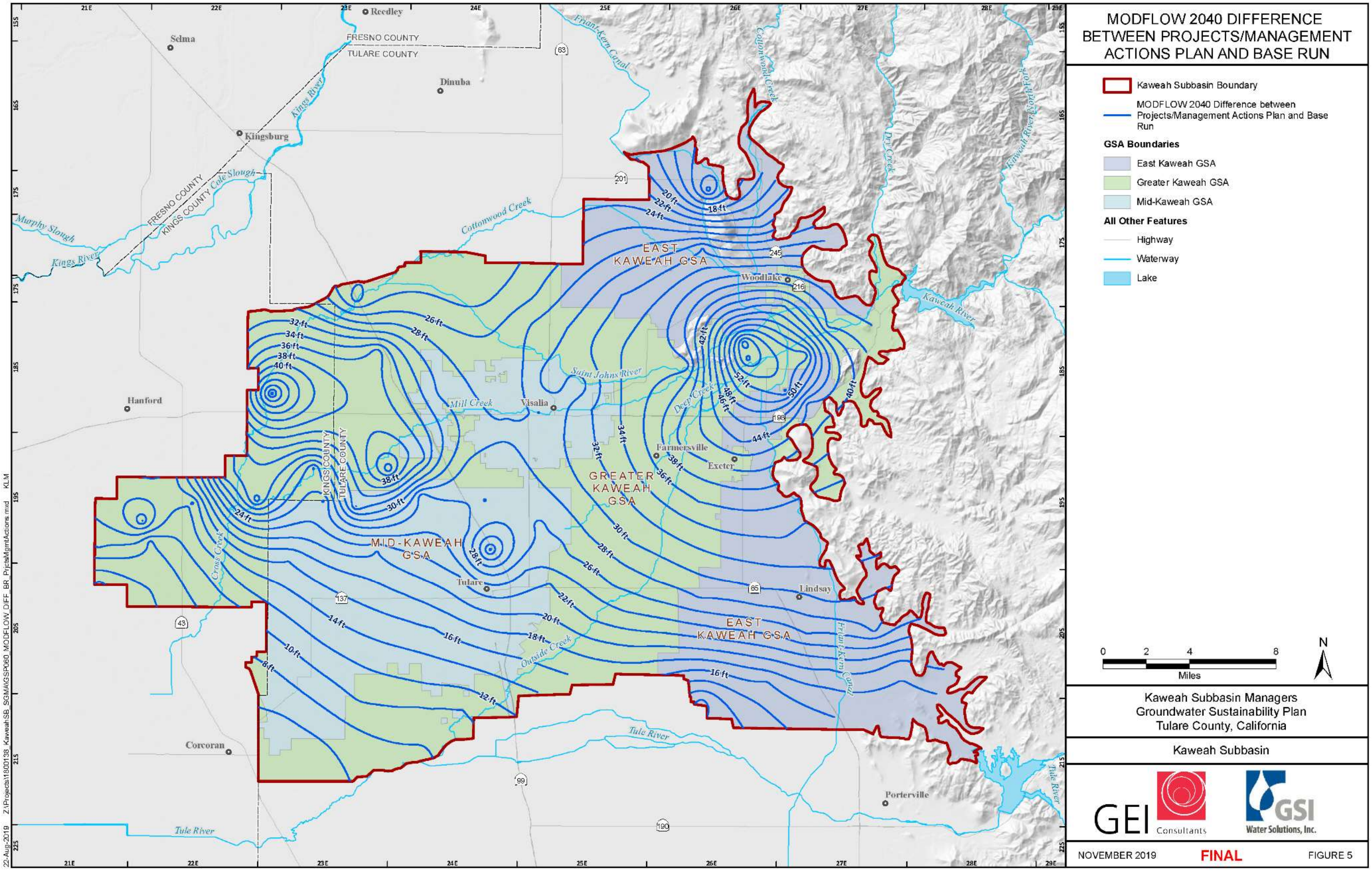


Figure 5: Map of Differences in Potentiometric Surfaces between the Base Case 1 with No Projects and Case 5 with Management Actions and Projects in 2040.

Summary Results for Kaweah Subbasin

The impacts of the management actions and projects on groundwater fluxes and storage in the basin for the five modeling cases analyzed are summarized in Table 5. For each run, fluxes are presented for the initial water year (2020) followed by average fluxes for the next 5-year period. Inflow fluxes presented include recharge, underflow entering the Kaweah Subbasin from surrounding buffer zone, and total inflow fluxes. Outflow fluxes presented include pumping from agricultural wells, aquifer discharge to streams, pumping from non-agricultural wells, underflow discharged from the Kaweah Subbasin to the surrounding buffer zone, and total outflow. Annual rates of change in storage and cumulative storage changes at the end of each period are also presented.

The results show that for Base Case 1, water deficits would continue to increase steadily through the planning horizon, reaching a cumulative storage decline of 1.5 million acre-feet by 2040. The deficits increase during the period because total inflows increase by 7.7% while total outflows increase by 14.7%. While their total recharge fluxes are identical, simulations for the variable Case 2 and reversed variability Case 3 result in values of cumulative storage declines that are over 1.2 million acre-feet apart by 2040. The difference is mostly due to a difference in underflow into the Kaweah Subbasin of over 1 million acre-feet between the two cases. The reversal of fluxes also changes the water balance dynamics and results in intermediate storage deficits that are more severe in Case 3 than in Case 2. While future sequences of wet and dry water years cannot be predicted, the results suggest that Kaweah GSAs could benefit from contingency planning for interim deficits resulting from unfavorable water year sequences.

The results for Case 4 show that implementation of Management Actions could yield a 6% reduction in pumping from agricultural wells, resulting in a 4.4% reduction in total outflow relative to Case 1. Over the 20-year planning horizon, this translates to a 46% reduction in cumulative storage decline. The combination of Projects and Management Actions in Case 5 yields an 8.3% increase in recharge and a 2.8% reduction in total outflow. The net impact of the changes from Case 5 is a 79.9% reduction of the average annual storage decline from 71,500 acre-feet/year (or 1,501,901 acre-feet in 21 years) to 15,100 acre-feet/year (or 316,370 acre-feet in 21 years) from January 2020 to December 2040.

Table 5: Impacts of Projects and Management Actions on Groundwater Fluxes and Storage in the Kaweah Subbasin.

Period in Water Years	Inflow (Acre-Feet/Year)			Outflow (Acre-Feet/Year)					Change in Storage (Acre-Feet/Year)	Cumulative Change in Storage (Acre-Feet)
	Recharge	Underflow Buffer to KSB	Total Inflow	Ag Pumping	Aquifer Discharge to Stream	Non-Ag Pumping	Underflow KSB to Buffer	Total Outflow		
Case 1: Base Case of Future with Averaged Conditions and No Projects										
2020	676,105	185,429	861,534	726,105	0	101,360	60,420	887,886	-26,352	-26,352
2021 - 2025	674,117	206,914	881,031	747,316	0	108,481	62,235	918,032	-37,001	-211,359
2026 - 2030	674,117	218,869	892,987	783,289	0	120,729	64,877	968,895	-75,908	-590,899
2031 - 2035	674,106	236,257	910,364	803,716	0	132,728	64,898	1,001,341	-90,977	-1,045,786
2036 - 2040	674,566	253,312	927,878	813,133	0	141,028	64,940	1,019,101	-91,223	-1,501,901
Case 2: Future with Interannual Variability and No Projects										
2020	927,137	157,959	1,085,096	503,909	0	94,915	68,183	667,008	418,089	418,089
2021 - 2025	709,912	206,077	915,990	680,497	521	99,663	57,998	838,678	77,311	804,646
2026 - 2030	653,687	203,723	857,410	765,822	229	123,965	71,984	962,000	-104,590	281,694
2031 - 2035	666,604	225,936	892,540	810,017	213	143,603	88,081	1,041,913	-149,373	-465,173
2036 - 2040	618,801	274,083	892,883	945,506	55	135,831	81,597	1,162,989	-270,106	-1,815,704

Case 3: Future with Interannual Variability Reversed and No Projects										
2020	1,191,324	173,864	1,365,188	507,156	43	143,667	103,103	753,969	611,219	611,219
2021 - 2025	479,819	243,678	723,498	1,040,180	239	143,185	85,176	1,268,779	-545,282	-2,115,190
2026 - 2030	659,066	281,360	940,425	821,914	179	137,714	68,758	1,028,566	-88,140	-2,555,892
2031 - 2035	671,770	308,325	980,094	719,378	72	113,587	50,052	883,089	97,005	-2,070,868
2036 - 2040	780,164	276,155	1,056,320	606,836	520	94,432	58,089	759,876	296,443	-588,650
Case 4: Altered Future with Management Actions										
2020	681,104	184,922	866,026	722,860	0	101,360	60,625	884,845	-18,819	-18,819
2021 - 2025	679,116	204,412	883,529	739,493	0	108,481	63,114	911,088	-27,560	-156,619
2026 - 2030	679,116	210,690	889,805	755,265	0	120,729	67,164	943,158	-53,353	-423,384
2031 - 2035	679,116	217,985	897,100	743,447	0	132,870	69,283	945,600	-48,500	-665,881
2036 - 2040	679,611	220,124	899,735	712,386	0	144,094	72,166	928,646	-28,911	-810,436
Case 5: Altered Future with Management Actions and Projects										
2020	693,019	184,909	877,928	722,860	0	102,029	60,664	885,553	-7,625	-7,625
2021 - 2025	709,227	199,605	908,833	740,079	0	108,555	64,540	913,174	-4,342	-29,332
2026 - 2030	728,472	199,572	928,043	760,614	0	120,771	70,815	952,199	-24,156	-150,112
2031 - 2035	753,547	201,107	954,655	756,950	0	133,173	77,059	967,182	-12,526	-212,744
2036 - 2040	738,199	201,171	939,369	734,500	0	144,715	80,879	960,094	-20,725	-316,370

Summary Results by GSA

Summary Results for East Kaweah GSA

Table 6 is a summary of predictive modeling results for East Kaweah over the 20-year planning horizon. Case 4 and Case 5 result in the lowest annual water deficit (noted as “Change in Storage” in Table 6 and subsequent tables). The results indicated that implementation of Management Actions in Case 4 could reduce well pumping by 13,900 acre-feet/year and reduce the annual water deficit from 16,200 acre-feet/year to 6,600 acre-feet/year. The combination of Management Actions and Projects in Case 5 increases total inflow by 8,900 acre-feet/year, and the annual water deficit falls to 3,000 acre-feet/year.

Table 6: Summary of Predictive Modeling Results for East Kaweah in Acre-Feet per Year

Summary Results for East Kaweah GSA	Base Case 1	Variable Base Case 2	Reversed Variable Case 3	Management Actions Case 4	Management & Projects Case 5
Recharge	118,096	118,064	117,445	118,107	126,632
Inflow from Buffer Zone	48,298	42,370	50,735	45,408	44,830
Inflow from Greater Kaweah	34,417	36,925	33,253	34,643	38,227
Total Inflow	200,811	197,360	201,434	198,159	209,689
Pumping from Ag Wells	166,025	166,324	164,666	152,120	159,167
Aquifer Discharge to Streams		0	0		
Pumping from Non-Ag Wells	2,842	2,669	2,652	2,842	2,796
Outflow to Buffer Zone	6,267	6,048	5,661	6,563	6,574
Outflow to Greater Kaweah GSA	41,843	44,553	42,017	43,278	44,121
Total Outflow	216,977	219,595	214,996	204,803	212,658
Annual Change in Storage	-16,166	-22,235	-13,563	-6,644	-2,969

Summary Results for Greater Kaweah GSA

Table 7 shows a summary of predictive modeling results for Greater Kaweah over the 20-year planning horizon. In Greater Kaweah, the Reversed Variable Case 3 achieves better reduction in water storage decline than the Management Actions Case 4. However, the results of Case 3 are unreliable for planning as the reductions occur due to significant increases in uncontrolled inflow from the buffer region relative to Case 2. The results for Case 4 indicate that implementation of Management Actions could reduce well pumping by 29,100 acre-feet/year relative to Case 1 and reduce the annual water deficit from 37,300 acre-feet/year to 20,800 acre-feet/year. The combination of Management Actions and Projects in Case 5 increases total inflow by 15,500 acre-feet/year relative to Case 1, and the annual water deficit falls to 5,400 acre-feet/year.

Table 7: Summary of Predictive Modeling Results for Greater Kaweah in Acre-Feet per Year

Summary Results for Greater Kaweah GSA	Base Case 1	Variable Base Case 2	Reversed Variable Case 3	Management Actions Case 4	Management & Projects Case 5
Recharge	375,882	376,172	375,755	375,946	412,038
Inflow from Buffer Zone	177,354	180,487	219,638	165,516	153,823
Inflow from East Kaweah	41,843	44,553	42,017	43,278	44,121
Inflow from Mid-Kaweah	78,872	95,441	77,646	80,407	79,441
Total Inflow	673,950	696,653	715,056	665,148	689,424
Pumping from Ag Wells	469,694	470,276	468,868	440,620	440,625
Aquifer Discharge to Streams	-	242	242	-	-
Pumping from Non-Ag Wells	41,251	40,544	41,703	41,573	41,676
Outflow to Buffer Zone	48,322	58,435	53,653	51,085	55,910
Outflow to East Kaweah GSA	34,417	36,925	33,253	34,643	38,227
Outflow to Mid-Kaweah GSA	117,527	133,587	131,464	117,982	118,389
Total Outflow	711,211	740,010	729,182	685,903	694,826
Annual Change in Storage	-37,261	-43,357	-14,126	-20,755	-5,402

Summary Results for Mid-Kaweah GSA

Table 8 shows a summary of predictive modeling results for Mid-Kaweah over the 20-year planning horizon. In Mid- Kaweah, the Reversed Variable Case 3 achieves better reduction in water storage decline than Case 4 and Case 5. However, the results of Case 3 are unreliable for planning as the reductions occur due to significant reductions in uncontrolled outflows to Greater Kaweah. The results for Case 4 indicate that implementation of Management Actions could reduce well pumping by 4,000 acre-feet/year relative to Case 1 and reduce the annual water deficit from 18,100 acre-feet/year to 11,100 acre-feet/year. The combination of Management Actions and Projects in Case 5 increases total inflow by 5,300 acre-feet/year relative to Case 1, and the annual water deficit falls to 6,700 acre-feet/year.

Table 8: Summary of Predictive Modeling Results for Mid-Kaweah in Acre-Feet per Year

Summary Results for East Kaweah GSA	Base Case 1	Variable Base Case 2	Reversed Variable Case 3	Management Actions Case 4	Management & Projects Case 5
Recharge	180,338	180,627	180,391	185,275	191,817

Inflow from Buffer Zone	1,120	1,288	2,077	1,027	975
Inflow from Greater Kaweah	117,527	133,587	131,464	117,982	118,389
Total Inflow	298,985	315,503	313,932	304,284	311,181
Pumping from Ag Wells	148,251	149,738	149,738	144,204	147,046
Aquifer Discharge to Streams	-	-	-	-	-
Pumping from Non-Ag Wells	80,488	81,083	78,895	80,930	81,152
Outflow to Buffer Zone	9,466	10,111	7,995	9,936	10,236
Outflow to Greater Kaweah GSA	78,872	95,441	77,646	80,407	79,441
Total Outflow	317,077	336,373	314,274	315,477	317,875
Change in Storage	-18,092	-20,870	-342	-11,193	-6,694

Conclusions and Recommendations

The Kaweah Subbasin Basin Setting Report estimates the basin Safe Yield at 720,000 acre-feet per year and the average annual groundwater pumping in the basin during the current water budget period is 798,000 acre-feet. Therefore, a reduction in deficit of 121,000 acre-feet through the implementation of projects and management actions will ensure that we are operating within the safe yield of the basin.

Through the five-year GSP assessment process and continued dialogue with neighboring subbasins as to their role in influencing the changes in storage within the Kaweah Subbasin, we expect to have improvements in our understanding of boundary conditions. Future updates to the groundwater model are expected to show stabilized groundwater levels through the implementation of the projects and management action considered in the GW modeling study. If residual storage reductions remain from these future modeling scenarios analyzed at the five year update, the GSAs will take further action to stabilize groundwater levels and reductions in storage with the implementation of additional projects and/or accelerated implementation of management actions designed to reduce groundwater extractions.

Under some modeling scenarios (such as the Reversed Variable Case 3), water levels within the buffer region can become misaligned with changing water levels within the subbasin. The misaligned water levels can significantly alter the amount of inflow or outflow moving across the buffer region or between neighboring GSAs, altering the patterns of water storage declines. Such transboundary flows are not sustainable over the long term and should not be relied upon to achieve sustainability targets. Future groundwater modeling efforts should identify approaches to account for transboundary flows to ensure reduction in water storage decline are achieved through sustainable approaches.

The Kaweah Subbasin groundwater model produced a fit between measured and model-generated data with a relative error of 3% in layer 1 and 10.7% in layer 3 during model calibration. This was determined to be an adequate fit for the planning model for GSP development. As the Kaweah Subbasin GSAs move from plan development to implementation, it is recommended that further resources be dedicated to the calibration of the model to enhance its accuracy and reliability as a decision-making tool.

Appendix 1: Model Approach and Verification

Introduction: Kaweah Groundwater Modeling

The purpose of this update is to communicate the current progress of the groundwater modeling efforts for Kaweah Subbasin. It was compiled from materials originally published on the Kaweah Subbasin website in March 2017 under the heading “Review of Existing Kaweah Subbasin GW Models and Approach for Model Development to Support GSP”.

Early in 2017, the GEI Consultants, Inc. (GEI) and GSI Water Solutions, Inc. (GSI) teams prepared a Technical Memorandum (TM) to evaluate the groundwater models available for use in development of the Groundwater Sustainability Plans (GSP) for the three Groundwater Sustainability Agencies (GSA) in the Kaweah Sub- Basin (Subbasin). That TM, dated March 8, 2017, presented the significant comparative details of three numerical groundwater flow models that cover the Sub- Basin, including:

- Kaweah Delta Water Conservation District (KDWCD) Groundwater Model,
- Central Valley Hydrologic Model (CVHM), and
- California Central Valley Groundwater-Surface Water Simulation Model (C2VSim) coarse grid and fine grid variants.

The March 2017 TM identified the water budget from the most recent update of the KDWCD Water Resources Investigation (WRI) as an accounting "model", but it is essentially a water accounting analysis that uses water consumption and soil moisture models. It is not a three-dimensional, numerical groundwater flow model, but is a valuable analysis that will be used as primary inputs to the groundwater model. The March 2017 TM recommended use of the KDWCD Groundwater Model as the preferred tool for Sustainable Groundwater Management Act (SGMA) applications based upon its relative ability to address the potential model needs cited in SGMA regulations. Model selection criteria used in the TM included: model availability; cost of development and implementation; regulatory acceptance; suitability for GSP-specific analyses; and relative abilities to assess Subbasin water budget components, future undesirable results, and impacts of future management actions and projects.

More recently, the Kaweah Management Team, consisting of the East Kaweah, Greater Kaweah, and Mid-Kaweah Groundwater Sustainability Agencies (EKGSA, GKGSA, and MKGSA) approved a scope of work to develop a Subbasin wide numerical groundwater model to support GSP development and implementation. Efforts related to groundwater model development and use of the calibrated tool were generally defined within three tasks, as follows:

- Task 1 — Perform a technical assessment of existing groundwater models that cover the Kaweah Subbasin, with emphasis on the KDWCD Model, and develop an approach to update and revise the selected source model as required to support the objectives of the GSP.
- Task 2 — Perform model revisions and updates for the selected groundwater model as documented in Task 1, with a focus on supporting GSP objectives.
- Task 3 — Apply the updated model predictively for each GSA and cumulatively for the entire Subbasin to simulate future conditions, with and without potential management actions and projects proposed to support GSP implementation.

This TM documents the results of Task 1. GEI and GSI (the Modeling Team), as part of supporting Subbasin SGMA compliance, have evaluated the existing KDWCD Groundwater Model for update to simulate the entire Subbasin and relevant adjacent areas. The following presents technical details and performance aspects of the KDWCD Model and proposes a general approach for utilizing the model to support development of the GSP. Specifics of this approach may change over the course of model development as dictated by data constraints and improved conceptualization provided by the updated Subbasin Basin Setting developed through the Management Team. This TM and associated analyses satisfy Task 1 requirements, including:

- Perform a detailed evaluation of the existing KDWCD groundwater model inputs and outputs, including test runs and simulations, comparisons with water budget data, and a general comparison with regional C2VSim and CVHM models.
- Develop a plan to move forward with the model update, including assessment of status of required hydrogeologic data, updates to model area, parameters, fluxes, spatial framework, stress periods, validation periods, and calibration periods and general approach for the model domain.
- Prepare a TM summarizing the path forward for modeling support of the GSP, including technical coordination with adjacent basin GSA representatives regarding groundwater modeling methods and assumptions.

Additionally, the Modeling Team will present the key findings of this TM in a workshop for representatives of the Subbasin GSAs. This working session will allow GSA representatives to better understand the model design and capabilities as well as provide a forum for discussion of current, future, and outstanding data as well as planning needs for model development and predictive simulations.

After submittal of this proposed modeling approach and path forward, the Modeling Team will execute the recommended actions described in this document. Once updated, the Modeling Team is recommending adoption of the name Kaweah Sub- Basin Hydrologic Model (KSHM) for this new SGMA tool to differentiate it from the previous modeling efforts and to reflect the fact that it includes complex hydrologic analyses in addition to groundwater flow.

The Modeling Team previously performed a cursory review of pertinent aspects affecting the efficient use of the three major groundwater modeling tools that cover the Subbasin. This TM is built upon that analysis and includes a more in-depth assessment of the newly released beta version of the C2VSim model provided by the California Department of Water Resources (DWR). Although the results of the March 2017 analysis were reinforced with findings from this review, the Modeling Team also looked at the datasets contained within these valuable, regional modeling tools to see if they may be of use in the development of the KSHM.

CVHM is an 11-layer model that covers the entire Central Valley. It has a spatial resolution of one square mile and includes both a coupled lithologic model and Farm Process module (model) that are used to estimate hydraulic parameters and agricultural groundwater demand and recharge, respectively. The CVHM was previously deemed not to be a viable modeling alternative for the Subbasin analyses by the Modeling Team due to several factors. Most significant of these is the fact that the model data is only current to 2009, well before the SGMA-specified accountability date of 2015. The model resolution is also not suitable to reflect all water budget components at the precision required to assess past and current groundwater responses to water management within each GSA. The CVHM is also not suitably calibrated nor reflective of the hydrostratigraphy in the Subbasin and does not match the higher resolution and more accurate crop and related groundwater pumping estimates produced by Davids Engineering, Inc. (Davids Engineering) time-series analysis of evaporation and applied water estimates for the KDWCD; soon to be provided for the entire Subbasin through water year 2017.

Lastly, the use of the Farm Process is cost prohibitive, given the fact that it would have to be rigorously calibrated to the evapotranspiration and deep percolation estimates already provided by the Davids Engineering analysis.

The DWR-supported C2VSim Fine Mesh Beta Version was assessed in greater detail as part of the development of this modeling approach. Like CVHM, the C2VSim fine mesh does not include the high resolution of crop demands and surface water deliveries that are in the existing KDWCD model and can be easily updated with the KSHM. It also does not have the element resolution, flexibility to change fluxes, cost savings, and GSA-level accuracy of a sub-regional model designed to incorporate the highest resolution and locally accurate consumptive use and recharge information available. The Modeling Team assessed model layering, significant water budget components, storage change, and groundwater level elevation changes used in C2VSim relative to KDWCD monitoring well locations. The previous KDWCD model produced a better match for the data and estimates from the WRI, and at a significantly higher resolution. Simulated storage change within the Sub- Basin was greater than that estimated by C2VSim by over 20,000 acre-feet per year (AFY); without documentation of how the quantification of water budget components was performed. Calibration of regional flow directions and gradients were reasonable but not as accurate nor locally refined as that observed with the KDWCD modeling efforts.

The beta version of the C2VSim model is not currently considered to be calibrated in a quantitative sense, and no documentation is publicly available to assess the resolution or accuracy of the model inputs for the Subbasin. Because of our analysis and comparison of the C2VSim Fine Mesh Beta Model with the water budget and groundwater conditions from the WRI and the draft Basin Setting; the C2VSim was deemed to be a viable source of regional information to supplement development of the KSHM. However, relative to a modeling approach using the KSHM, the C2VSIM model would not provide a more accurate or cost-efficient option for satisfying SGMA regulations.

The KDWCD Groundwater Model was originally developed by Fugro Consultants, Inc. (Fugro) under the direction and sponsorship by KDWCD. Model development was documented in the report "Numerical Groundwater Flow Model for the Kaweah Delta Water Conservation District, Final Report" (April 2005). The objective of the model was to simulate the water budget estimates as refined under the WRI in 2003 and evaluate calibrated groundwater elevations, and modeled fluxes to and from adjacent subbasins.

In May 2012, the KDWCD model was expanded to the east and southeast by Fugro to include the service areas of the Cities of Lindsay and Exeter, and adjacent irrigation districts, including: the Lewis Creek Water District; some unincorporated land and significant portions of Exeter Irrigation District, Lindmore Irrigation District, and Lindsay-Strathmore Irrigation District. The purpose of this effort was to update only the geographic extent, and it did not include updates to the simulation period or the calibration. The model was intended to be updated, refined, and improved in the coming years to provide a rigorously calibrated model over this larger extent, but this proposed work was not performed prior to initiation of SGMA and GSP development efforts.

Modeling Code and Packages

The KDWCD model was developed using MODFLOW 2000. MODFLOW, developed and maintained by the United States Geological Survey (USGS), is one of the most commonly used groundwater modeling codes in the world and is considered an industry standard. The pre- and post-processing of groundwater model data was performed using Groundwater Vistas, a third-party graphical user interface (GUI) that is among the most commonly used software in the groundwater industry to facilitate the use of MODFLOW.
The previous two KDWCD model variants used the following MODFLOW modules, or "packages":

- Well Package (WELL) Recharge
- Package (RCH)
- General Head Boundary (GHB) Package

MODFLOW utilizes large text files of numerical values as input files that provide the model with the values of various physical parameters and fluxes; all incorporated into the three-dimensional (3D) model structure. Much of the pre-processing and spatial organization of the data used to develop the MODFLOW input files was accomplished by Fugro using customized FORTRAN routines, as well as a geographic information system (GIS). Because of more recently available evapotranspiration and applied water estimates from Davids Engineering, the use of these FORTRAN routines is no longer necessary; providing a significant cost and time savings.

A summary of the construction and implementation of various water budget components into these model packages is discussed in following sections.

Model Extent and Discretization

The spatial extent of the KDWCD model is presented in Figure 1. The figure displays the original model extent as well as the expanded extent to the east from the 2012 update. The model extends approximately twelve miles from east to west and 7.5 miles from north to south. It is composed of uniform 1,000 foot by 1,000- foot model cells for each layer.
There are some areas of the Subbasin that are not currently within the model domain (Figure 1), including much of what is now the EKGSA area. To evaluate the entire Subbasin area, in support of SGMA, it will be necessary to expand the model area to include all of the areas within the Subbasin. The updated model must also have shared boundaries and shared buffer zones with all adjacent groundwater sub- basins, as well as an evaluation of subsurface inflow and outflow (underflow) between the subbasins. Figure 2 shows the proposed, expanded model grid for the new KSHM extent.

Model Layers

The KDWCD model is vertically discretized into three layers as shown on hydrogeologic cross sections shown on Figures 3, 4, and 5. These hydrogeologic cross sections show the principal aquifers, aquitard, and associated geologic units located throughout the Subbasin. Layer 1 represents the unconfined, basin sediments from the ground surface down to the Corcoran Clay in the western portion of the model domain or deeper; also including some older Quaternary alluvial deposits in the eastern portion of the domain. Layer 2 represents the Corcoran Clay, which is the primary aquitard in the Subbasin, where it is present in the western portion of the domain. In the eastern portion of the model area, where the Corcoran Clay pinches out, Layer 2 is simply represented with a minimal thickness and hydraulic parameters comparable to those of Layer 1. Layer 3 represents the largely confined basin sediments below the Corcoran Clay, where it is present, and deeper unconsolidated sediments to the east of the occurrence of this regional confining unit.

Although some of the regional models covering large areas of the Central Valley (i.e., CVHM and C2VSim) have a more highly discretized vertical layering, the Modeling Team believes that the three-layer conceptual model represented in the KDWCD model is justified given the available data and therefore suitable for the primary modeling objectives that support GSP development.

Model Simulation Time Periods

The KDWCD model was originally set up with 38 6-month stress periods to simulate the 19-year (calendar) calibration period of 1981 through 1999. Water budget components as documented in the 2003 WRI were used as input into the model and spatially distributed to the degree feasible given the spatial resolution and precision of the data sources and model grid.

It is likely that, after any recommended changes to the KDWCD model are implemented into the KSHM, the Modeling Team will calibrate the model through water year 2017 and perform validation simulations to confirm that the previous calibration developed with the historic WRI information is a suitable starting point the new simulation period. After validation, additional model refinements and updates can proceed to further improve the predictive capabilities of the KSHM using the aforementioned recent, high-resolution datasets as well as updated Basin Setting information.

Model Parameters

- **Hydraulic Conductivity/Transmissivity.** Hydraulic conductivity values are documented in the 2005 Model Report as well as in previous iterations of the WRI and conform with industry-standard literature values for the types of aquifer materials encountered at these depth intervals. Calibrated, horizontal hydraulic conductivities for Layer 1 (upper, unconfined aquifer) range from 50 feet/day (ft/d) to 235 ft/d, with the highest values in the southwest portion of the model area. Horizontal hydraulic conductivities for the portion of Layer 2 representing the Corcoran Clay were set at 0.024 ft/d. In the eastern area of Layer 2, where the Corcoran Clay pinches out, hydraulic conductivity values range from 50 to 150 ft/d and are essentially equal to the values assigned to the same area in Layer 1. Horizontal hydraulic conductivities for Layer 3 range from 25 ft/d to 125 ft/d. This distribution of hydraulic conductivity is consistent with previously published estimates from both the WRI and industry-standard literature estimates for the lithologies encountered.
- **Vertical Hydraulic Conductivity.** Vertical hydraulic conductivity in the model is set to a ratio of the estimated horizontal hydraulic conductivity, or an anisotropy ratio of 1:1. This means that the vertical hydraulic conductivity of the Corcoran Clay was assumed to be equal to its horizontal conductivity and was apparently based upon the extensive perforation of the Corcoran Clay and other aquifer units by fully penetrating wells. This perforation of the regional aquitard allows for greater hydraulic connection between the upper and lower aquifer units. The Modeling Team will assess the validity of this anisotropy ratio during the validation simulation and adjust where merited.
- **Storage Parameters.** Specific yields in the unconfined aquifer (Layer 1) range from approximately 8% to 14%. Storage coefficients for the confined areas were set at an order of magnitude of approximately 1 x 10-4. The storage coefficients used for the unconfined and the confined portions of the model are typical of those found in the basin and documented in the WRI as well as other commonly referenced literature for large basin fill valleys.

Model Boundary Packages and WRI Water Budget Components

As mentioned previously, the KDWCD model uses three MODFLOW packages: WELL, RCH, and GHBs. A discussion of how those packages are used follows below.

- **Well Package (WELL).** As currently constructed, the KCWCD model represents the following WRI water budget components; which were calculated outside of the model Groundwater Vistas graphical user interface (GUI) using GIS and a FORTRAN routine that are unavailable to the Modeling Team. The flux values specified in the WELL package input files are essentially "lumped" fluxes representing the sum of the following water budget components:
    - Well pumpage (outflow)
    - Rainfall-based recharge (inflow)
    - Irrigation return flows (inflow)
    - Ditch loss (inflow)
    - Recharge basins (inflow)

The compilation of multiple water budget components into a single MODFLOW package makes tracking and assessment of the individual water budget components from model simulations difficult. Additionally, this model flux accounting approach and design makes evaluation of possible changes in the water budget because of management actions, changes in water demand or availability, and groundwater projects problematic. Because of this lumping of separate water budget components, every cell in Layer 1 is represented in the WELL Package. This makes the exact validation of the test runs and verification of the calibration with the WRI challenging. Without access to the spatial and temporal distributions of all water budget components utilized by Fugro, it is not possible to recreate the exact WELL package input file. However, the gross water budget inflow, outflow and storage values from the earlier WRI's match those simulated by the model and were reproduced by the Modeling Team.

- Recharge Package (RCH). The natural stream channels of the St. John's and the Lower Kaweah Rivers are represented in the model using the MODFLOW RCH Package. The RCH package applies a flux (ft/yr) in the surficial (shallowest) cells at the location where applied. The natural seepage flux values (or groundwater recharge) applied to the model correspond to the values of stream infiltration spatially estimated for these rivers and documented in the WRI.
- General Head Boundaries (GHB). The KDWCD model has GHBs assigned to all cells on the exterior perimeter of the model, as seen on Figure 1. GHBs are commonly used to represent the edges of a model domain within a larger aquifer extent. Reference heads (groundwater elevations) and "conductance" terms for adjacent aquifers just outside the model domain are used by this package to calculate fluxes in and out across the boundary. The Modeling Team generally agrees with the use of GHBs in the north, south, and west portions of the Subbasin. However, we propose the removal of the GHBs along the eastern portion of the subbasin at the Sierra Nevada mountain front. Conceptually, the eastern model boundary, especially with the expansion and inclusion of the EKGSA area, is not a head-dependent boundary, but a flux-dependent one based on mountain front recharge and seepage from natural drainages and streams adjacent to relatively impermeable material. Thus, this boundary is better represented using a no-flow condition coupled with a recharge or prescribed underflow component.

Previous WRIs have included estimates of inflow and outflow across the study boundaries, and comparisons between modeled and calculated values vary significantly both spatially and by magnitude. However, there are several variables that directly impact estimated underflow values that have not been sufficiently constrained, due to the focus of previous work being on the interior of the KDWCD area. Recently updated basin conditions, improved understanding of appropriate regional groundwater conditions adjacent to the Subbasin and use of an expanded model area will significantly improve the certainty of these underflow estimates.

- Model Calibration. Calibration of the KDWCD model for the historic simulation period of 1981-1999 is discussed in the April 2005 model report. These include charts of observed versus modeled water levels for three different time periods and transient hydrographs for 30 target well locations. The density of calibration targets was deemed adequate by the Modeling Team for a model of this area and with the resolution of the model input datasets. Detailed calibration statistics are not documented in the report, but qualitative inspection of the hydrographs indicates that the calibration is adequate for future use in predictive simulations. Additionally, an open-source and industry-standard parameter estimation and optimization algorithm and code (PEST) was used to enhance model calibration. This is a common and robust industry practice that typically improves model calibration statistics.

Adequacy of the KDWCD Groundwater Model for GSP Development

Layering Scheme. The 3-layer model layering scheme incorporated into the KDWCD model was deemed adequate by the Modeling Team for use in GSP analyses, and likely does not need significant revision prior to use. This decision was based upon the agreement of the model layers with the hydrogeologic conceptual model for the Subbasin as well as the ability of the previous model to simulate historic fluctuations in groundwater elevations over an extensive spatial extent and temporal period. However, should the refinement of the lithologic and stratigraphic understanding of the basin and identification of specific pumping intervals require additional vertical resolution, both Layer 1 and Layer 2 can be split into two layers to improve the model's ability to match and describe key vertical gradients and changes in groundwater level elevations and pressures near prominent pumping centers. At present, this vertical refinement is not required nor supported by data.

Model Area. The model area will need to be expanded so that the entire Subbasin is included in the model. In addition, at the request of and in coordination with the technical groups for both Kaweah and adjacent subbasins, a buffer zone will be included outside the defined Subbasin boundaries so that adjacent models will overlap and share model input and monitoring data. This overlap will assist in reconciling differences between the direction and magnitude of groundwater gradients along subbasin boundaries. The preliminary extent of this buffer zone is proposed to be approximately 3 miles; however, this value will be revised in areas based on of the estimated locations of pervasive groundwater divides or apparent hydrologic boundaries.

Cell Size. The 1,000 feet square cell size appears to be adequate for the data density for most model inputs. However, due to improvements in computing speed and power, the Modeling Team recommends initially using a smaller cell size of 500 feet square to 1) accommodate improvements in assigning real world boundaries to the model grid, and 2) leverage the improved resolution of crop demand and evapotranspiration data available for this effort.

Parameters. Hydraulic conductivity and storage parameters will remain unchanged at the start of model revisions and calibration scenarios. These will be adjusted if the Modeling Team determines it is necessary during the model validation run or if model calibration standards require parameter refinements.

Stress Periods. The previous temporal discretization of the model incorporated 6- month stress periods. To appropriately characterize seasonal rainfall, surface water delivery and pumping patterns; one-month stress periods should be adopted for predictive simulations. This decision will be finalized after review and conditioning of the input groundwater demand and recharge datasets.

With these revisions to the model framework and geometry of the KDWCD model to support the development of the KSHM will be adequate for use to support GSP analyses. The following section summarizes additional, recommended revisions to the organization of the model inputs, parameters, boundary conditions, and MODFLOW packages.

Proposed Revisions to KDWCD Groundwater Model and Model Approach

The Modeling Team concludes that the KDWCD model is suitable to support GSP development if the following revisions and refinements to the model are performed to develop the KSHM. As mentioned above, once updated, the Modeling Team is recommending adoption of the name Kaweah Subbasin Hydrologic Model for this new SGMA tool. This nomenclature is based upon that fact that this model incorporates more than simply a groundwater model in the final analysis. It also incorporates crop demand/evapotranspiration (with precipitation modeling) and applied water models.

The Modeling Team recommends that the relationships between the water budget components, as defined in the WRI (December 2003, revised July 2007), and the MODFLOW modeling packages currently available, be re-organized such that lumping of different water budget components within single MODFLOW packages is minimized. Some degree of aggregation may be unavoidable, but efforts will be made to apply unique water budget components from the updated WRIs and associated water budget components to more appropriate and recent MODFLOW packages.

Additionally, we will utilize features of MODFLOW and Groundwater Vistas that allow for tracking of unique components within a single model package when possible. The current and proposed revised conceptual assignments of water budget components to MODFLOW packages are summarized below.

A major change and advantage of this effort relative to previous modeling work involves the availability and use of time-series evapotranspiration and applied water estimates from 1999 through water year 2017, provided by Davids Engineering. This data set uses remote sensing imagery from Landsat satellites to estimate agricultural water demand throughout the Subbasin at a very high resolution (approximately 30 meters). This information was not available for previous model builds, and its use will not only improve the understanding and accuracy of agricultural water requirements relative to the previous land use and soil moisture balance calculations that have been used, but also enhance the spatial calibration and predictive capability of the updated and expanded KSHM. The Davids Engineering dataset also includes estimates of deep percolation of applied water and precipitation. During the review of the KDWCD model and development of this modeling approach, the Modeling Team performed testing of the use of this dataset and was able to readily develop crop requirements and associated pumping estimates at a resolution even finer than the proposed model resolution.

Well Pumping. Groundwater pumpage will be the dominant water budget component represented in the WELL package. Other, more limited fluxes may also be used to represent mountain front fluxes or other unforeseen fluxes that are specified but do not have a specific package that is appropriate. All pumpage will be coded within the WELL package input files to identify the pumping by source, use, or entity. Municipal wells will be specifically located and simulated when well permits and required data reports are accessible and provide data specific to each well. Agricultural well pumpage will likely be spatially averaged, or "spread across", irrigated areas because of the uncertainty associated with irrigation well location, construction, and monthly or seasonal pumping rates.

Precipitation-based recharge. The Modeling Team proposes to represent this water budget component using the Recharge package.

Natural channel infiltration. Infiltration of surface water in the natural stream channels of the St. John's and the Lower Kaweah Rivers is currently assigned to the Recharge Package. The Modeling Team proposes to maintain this data in the recharge package along the spatial location of the courses of the rivers. If deemed appropriate and more beneficial the latest version of the Stream Package (SFR2) may be used for localized reaches of continuously flowing water, where gages do not adequately monitor seepage that can be applied directly as recharge. The Stream package calculates infiltration (inflow) to the aquifer based on defined parameters regarding bed geometry and vertical conductivity, and this will likely involve some iterative re-definition of STREAM package components to accurately portray the calculated water budget component flux. Native evapotranspiration (ET), where relevant, will be subtracted from either the precipitation or natural channel infiltration modules. The inclusion of natural, riparian ET will be addressed specifically upon finalization of the water budget for the Subbasin.

Man-made channel recharge. (i.e., ditch and canal loss). This is currently incorporated with four other water budget components as a single summed value in the Well Package. The Modeling Team proposes to represent this water budget component using either the Recharge package or another Type 3 boundary condition type, such as a prescribed stage above land surface. Should another more advanced MODFLOW module prove to more effective in simulating this flux, it will be utilized, and the reasoning documented in the model development log.

Irrigation Return Flows. Irrigation return flows are the component of the water budget that infiltrates into the subsurface due to over-watering of crops. This is currently incorporated with four other water budget components as a single summed value in the Well Package. The Modeling Team proposes to represent this water budget component using the Recharge package, but to differentiate it from precipitation-based recharge within Groundwater Vistas by assigning zone identifiers that are different from the rainfall-based recharge.

Artificial Recharge Basins. This is currently incorporated with four other water budget components as a single summed value in the Well Package. Recharge basins are likely to be a common management strategy to help achieve sustainability in the Subbasin. As such, the model should be able to individually represent each recharge basin. These could be represented in the Recharge Package or other more sophisticated module if specifically merited.

Lateral Model Boundaries. These are currently simulated using the GHB Package. We will maintain this concept, but the locations of the GHBs will be moved to locations beyond the edge of the Subbasin up to the extent of the expanded model area. Assigned reference heads for the GHB cells will be based on observed groundwater elevations from historic groundwater elevation maps. GHB head assignments for predictive runs may be lowered over time if current trends indicate declining water levels over the next 20-40 years. These head assignments were finalized in consultation and coordination with adjacent subbasin technical groups as well as any regional modeling or State-derived predictive information.

Mountain Front Recharge. Currently, a GHB is assigned to the eastern edge of the Subbasin, along the front of the Sierra Nevada foothills. The modeling team will remove this GHB and represent mountain front recharge using the Recharge Package. Conceptually, mountain front recharge is not a head-dependent boundary, but a specified flux-dependent boundary.

Calibration Period and Validation Period. As discussed previously, the original model was calibrated to a 19-year calibration period using 6-month stress periods. The Modeling Team suggests that upon completion of the KSHM model, a validation run simulating the time period of 1999-2017 be made to assess that the model is still adequately calibrated. Upon assessment of the validation simulation, the KSHM will undergo the calibration process using both qualitative and quantitative measures, such as parameter estimation software (PEST), to produce the final calibrated simulation modeling tool to be used to refine the Subbasin water budget and be used for predictive simulations. Moving forward, the updated groundwater model for the Kaweah Subbasin will begin in 1999 and continue to be updated as new GSP updates are required and deemed necessary by the GSAs. This new start date is due to the substantially increased accuracy and spatial resolution of water budget features, primarily crop demand and surface water deliveries that result in agricultural pumping estimates, beginning with the first year that high quality satellite imagery and associated evapotranspiration/soil moisture balance models were provided by Davids Engineering. This modeling effort can be updated in the future with newer and more accurate local and regional data from neighboring GSAs to benefit required SGMA reporting, refinements, and optimization of the GSPs within the Subbasin.

Predictive Simulations. Predictive simulations through the SGMA timeframe of 2040 and beyond are performed using the same monthly stress period interval and are developed using the projected climate dataset provided by DWR. Correlations between this climatic projection and previously quantified groundwater demands and surface water deliveries are developed to produce a suitable baseline predictive simulation that will serve as a starting point for assessing the impacts of various adaptive management actions and groundwater projects.

Simulations are performed for individual GSAs, but also the cumulative effects of future groundwater management in the Subbasin are assessed relative to the baseline predictive simulation.

Collaboration with Neighboring Subbasins

The Modeling Team collaborated with neighboring subbasin technical representatives during the update and application of the KSHM, with permission from the Kaweah Subbasin GSAs. The purpose for this coordination is to accomplish the following objectives:

- Receive input from GSAs' representatives on modeling tools and approaches in adjacent basins.
- Exchange data and information for consistency between tools.
- Agree on boundary conditions including both gradients and heads located at and outside of the boundaries of the Subbasin.
- Ensure that the KSHM integrates well, to the extent possible, with adjacent tools that our approaches for Kaweah Subbasin will not result in conflicting boundary conditions or water budgets.

The Modeling Team recommends that inter-basin model coordination meetings begin in August of 2018 and continue until the simulations required for use in developing the draft GSP is are completed. We anticipate the need for four (4) focused meetings on this approximate schedule:

1. KSHM Approach Meeting — Mid September 2018
2. KSHM Update Meeting — Late October 2018
3. KSHM Model Baseline Run and Boundary Flux Meeting — Late November 2018
4. KSHM Model Simulation Results Meeting — January 2019

The Modeling Team attended one meeting with the Tulare Lake Subbasin modeling group on June 15th, 2018 to facilitate data transfer between the two modeling efforts and improve agreement and conceptual consistency between the Sub- Basins. Upon request from the Kaweah Subbasin managers and committees, the Modeling Team will continue to collaborate and improve consensus with adjacent modeling groups to improve model agreement and sub-regional consistency between calibrated and predictive simulations. The Modeling Team is also prepared to develop and share baseline predictive simulation results with neighboring basins and accept in-kind data sharing to further improve predictive accuracy and understanding on adaptive management and project options and collaboration. These activities are approved by GSA representatives prior to the Modeling Team sharing any information or data.

Conclusions and Recommendations Regarding Model Updates

In general, the Modeling Team believes that the KDWCD model provides an adequate precursor model that is suitable for use in GSP development if the following revisions and updates are incorporated.

Groundwater Vistas Version 7 will be the processing software package utilized. We will maintain MODFLOW as the basic code and will update to MODFLOW-USG or MODFLOW-NWT to take advantage of advances in numerical solution techniques that are available in these updated MODFLOW revisions.

1. Extent. The model will need to be expanded to fill the area between the general head boundary of the current model and the Subbasin boundary shown in Figure 1 to include the entire area of the Kaweah Subbasin.
2. Layers. The model layering scheme depicting two water-bearing layers above and below the Corcoran Clay is suitable for the objective of supporting the GSP development.
3. Historical Simulations. The KDWCD model has been calibrated to the 1981- 1999 hydrologic period. Based on inspection of the hydrographs presented in the 2005 modeling report and the 2012 Model update report, observed water levels are adequately simulated to consider this model effectively calibrated. The objective is to have a model suitable to simulate projected management actions through the entire Subbasin. No changes will be made to the inputs to the 1981-1999 run. Therefore, it is already calibrated to that period. We are just re-organizing the assignment of water budget components to different MODFLOW packages from 1999-2017, and beyond. Monthly stress periods will be used.

4. **Assignment of water budget components to MODFLOW Packages.** The Modeling Team proposes to revise the conventions used in the KDWCD model. This will be the most involved part of the model revision. The updated water budget values that have been generated by the GSA will continue to be the primary input as far as flux values go. However, we propose to organize them into more readily identifiable currently available MODFLOW packages to help with the analyses of potential water budget changes that may correspond to management actions in the future.
5. **Recharge Components.** Spatial distribution of such water budget components as percolation of precipitation, irrigation return flow, recharge basins, etc., will be updated based on the most currently available data.
6. **Model Parameters.** Hydraulic conductivity (horizontal and vertical) and storage coefficient will initially stay unchanged during the validation period simulation. If the calibration target hydrographs for the validation period indicate that a suitable match is retained between observed and modeled water levels, the existing parameters will be retained.
7. **Flow Boundaries.** In areas where the existing GHB boundaries are within the Kaweah Subbasin, they will be expanded approximately 1-2 miles, or at locations of any likely groundwater divides from the Subbasin boundary on the north, south, and west sides of the Subbasin. The assigned heads for these GHBs for the 1999-2017 verification run will be based on published groundwater elevations in the vicinity as depicted in contour maps published by DWR. Seasonal variability in assigned GHB heads can be incorporated.
8. **No-Flow Boundaries.** The eastern GHB along the base of the Sierra foothills will be removed. Instead, the flux in the Recharge Package will be increased along this boundary to represent mountain front recharge. The flux volume from the GHB will be evaluated, and this flux volume will be approximated using the Recharge Package.

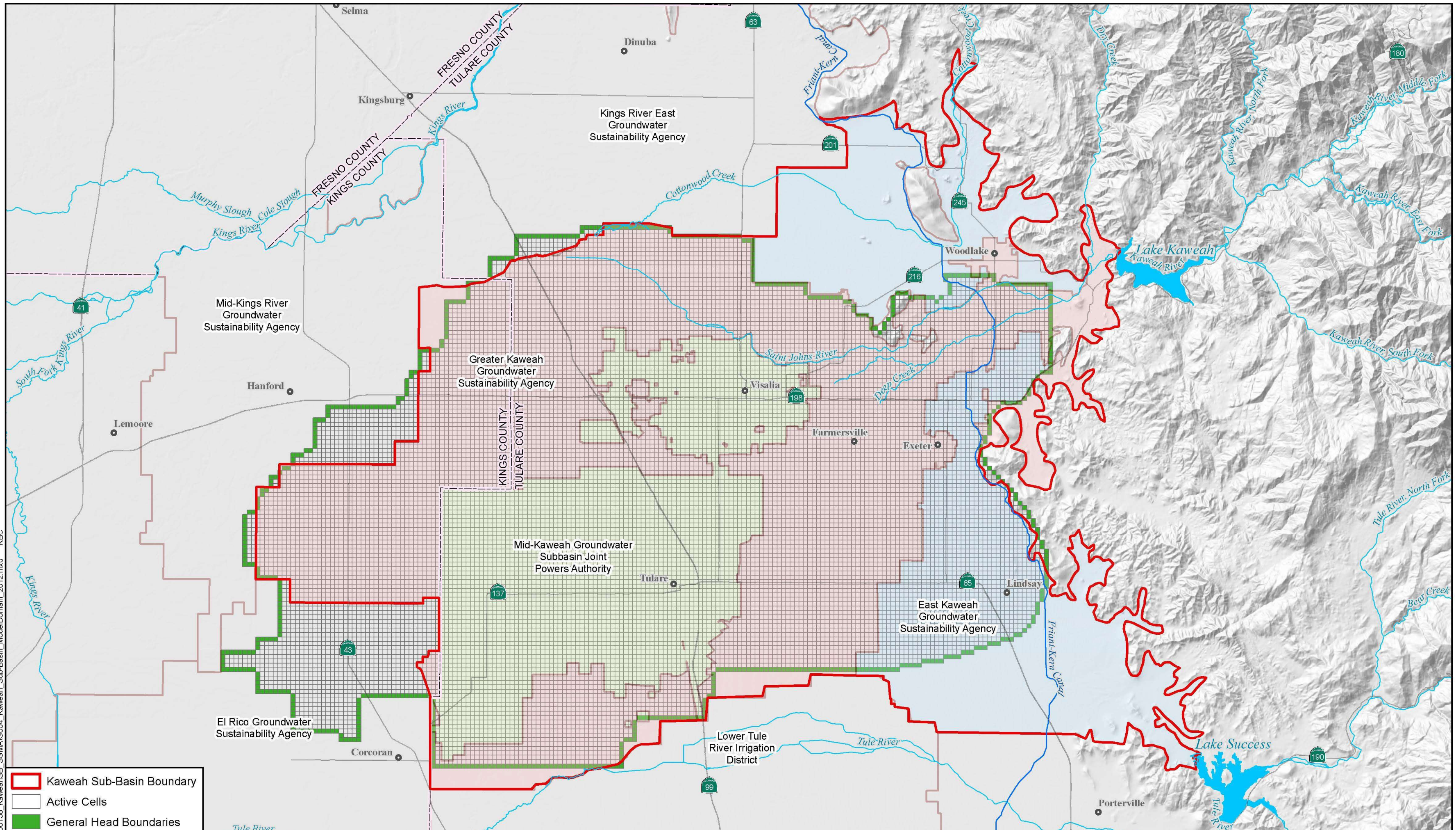
Estimated Schedule of Model Update Activities

The Modeling Team proposes the following schedule for the major groundwater model update activities. Estimated timeframes for key inter-basin model coordination meetings and updates are also included in the following table to provide a more comprehensive schedule and to facilitate meeting planning. Specific model development and simulation tasks may shift to earlier or later timeframes, but it is the intention of the Modeling Team to comply with the overall schedule and satisfy deadlines for the final deliverable of the calibrated modeling tool and associated predictive scenarios. Should information not be available to the Modeling Team in time to use them in development of the calibrated model simulation or predictive simulations, the data will either not be included, or the schedule may be adjusted to accommodate their inclusion, per guidance from Sub- Basin GSA leadership.

Updates and presentations on the status of the groundwater modeling efforts will occur at regular intervals during Coordinated Subbasin and individual GSA meetings, per the scope of work for the groundwater modeling task order.

Modeling Activity	Estimated Completion
Refinement and expansion of model domain and boundary conditions	Early September 2018
Update water budget with David's Engineering and EKGSA data	Early September 2018
Development of calibration targets	Mid-September 2018
Parameterization of model layers	Mid-September 2018
Refinement of groundwater fluxes	Mid-September 2018
Inter-basin KSHM Approach Meeting (inter-basin)	Mid-September 2018

Adjust boundary conditions, fluxes, and parameters using any new adjacent basin data	Late September 2018
Initiate Formal Calibration Process	Early October 2018
Inter-basin KSHM Update Meeting	Late October 2018
Complete initial calibration process	Early November 2018
Calibration and model refinements and preparation for predictive simulations	Late November 2018
Inter-basin KSHM Calibrated Model and Boundary Flux Meeting	Late November 2018
Develop predictive baseline scenario — Subbasin level	Early December 2018
Develop GSA specific predictive simulations	Mid December 2018
Cumulative Subbasin simulations	Early January 2019



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6 3 0 6
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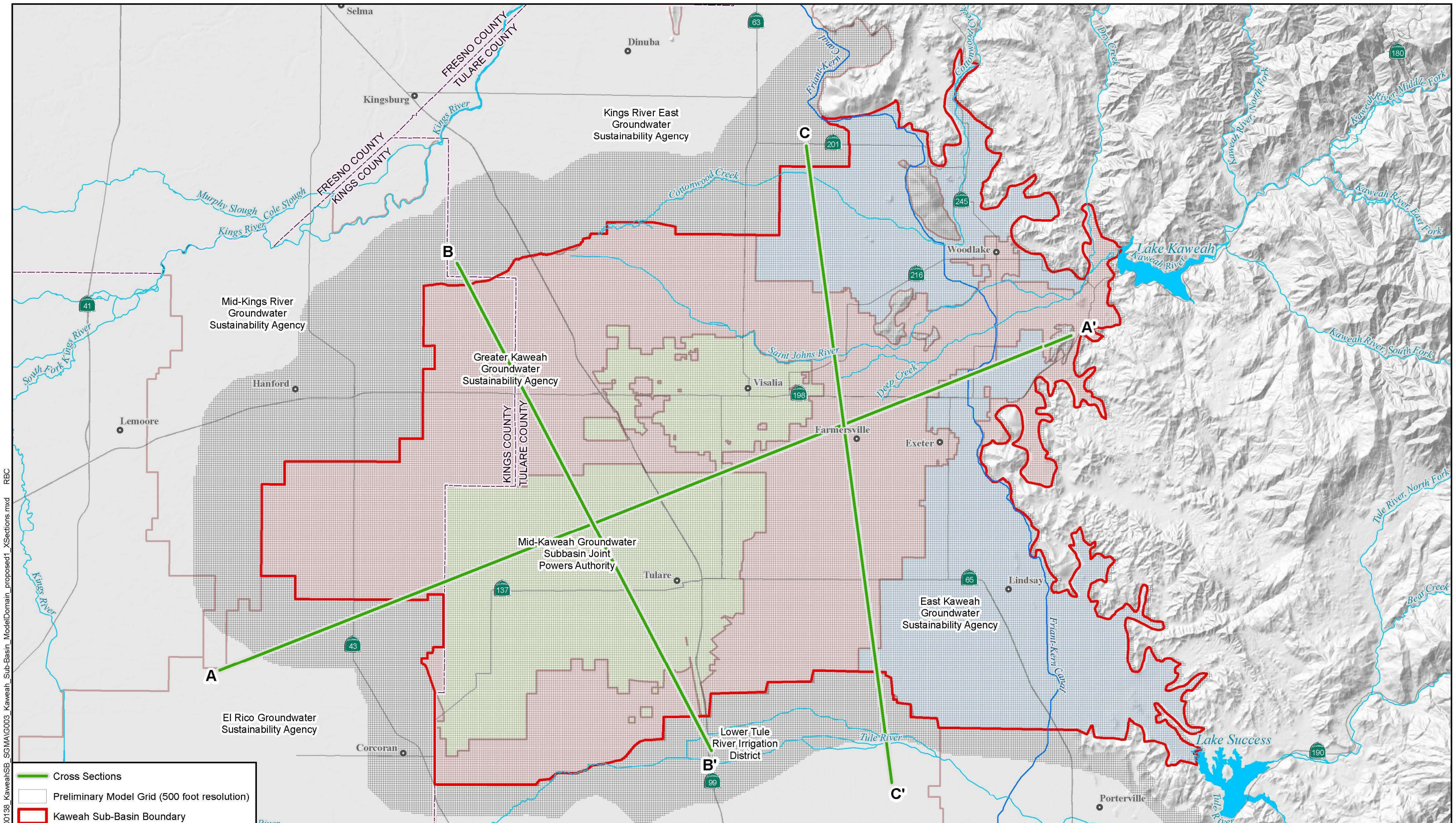
Kaweah Sub-Basin
Groundwater Modeling Task 1
Tulare County, California

Kaweah Sub-Basin

GSI Water Solutions, Inc.
GEI Consultants

2012 KDWCD EXPANDED MODEL DOMAIN
WITH GENERAL HEAD BOUNDARIES

AUGUST 2018 DRAFT FIGURE 1



Kaweah Sub-Basin
Groundwater Modeling Task 1
Tulare County, California

Kaweah Sub-Basin

GSI Water Solutions, Inc.

GEI Consultants

PRELIMINARY KSHM GRID EXTENT AND RESOLUTION INCLUDING BUFFER ZONES AND CROSS SECTION LOCATIONS

AUGUST 2018 DRAFT FIGURE 2

Groundwater Model Modifications

Modifications were made to the Kaweah Subbasin Hydrologic Model (KSHM) by the groundwater modeling team during the period of July through September 2018. The modifications which were reported first reported in Progress Report Number 1- November 2018 include the following.

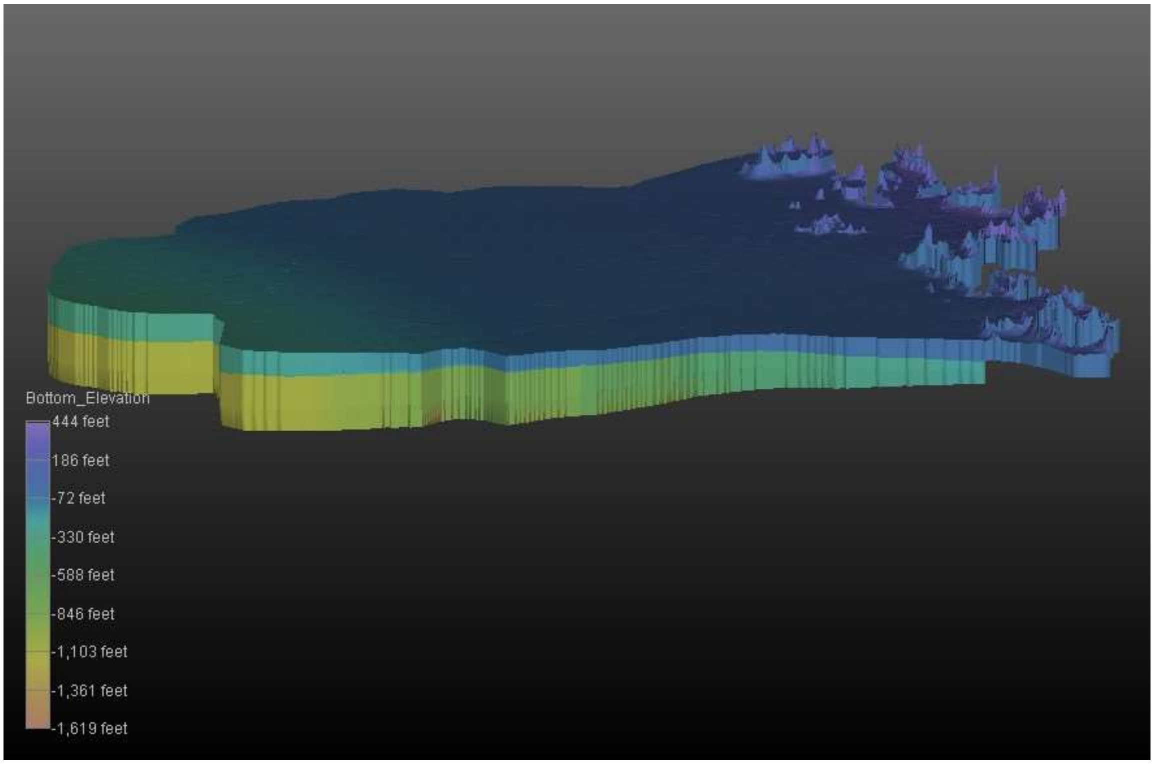
1. Added the general head boundaries
   a. What is a general head boundary? Water levels are fixed, and fluxes change

      - The General-Head Boundary package is used to simulate head-dependent flux boundaries. In the General-Head Boundary package the flux is always proportional to the difference in head.

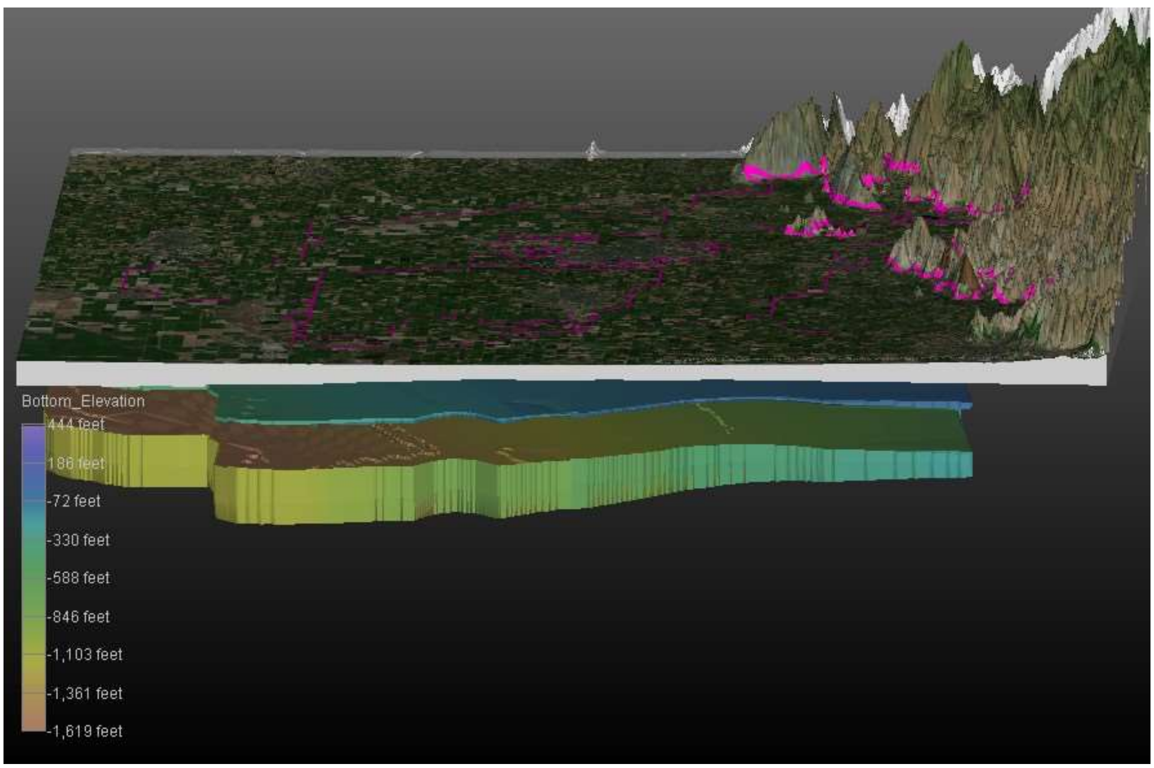
   b. The general head boundary condition is set on the north, west and south boundaries of the model and in model layers 1, 2, and 3.
2. Set the agricultural pumping based on Davids Engineering crop demand analysis for the period 1999 to 2017.
3. Distributed surface water delivery information spatially.
4. Refined the model grid from 1000 to 500-foot grids.
5. Refined stress periods from 6-month to 1-month step stress periods.
6. Expanded model layers into East Kaweah GSA area and up to the Eastern edge of the Kaweah Subbasin. Total model thickness in the east determined by the evaluation of the wells penetrating into the bedrock.
7. Added mountain front recharge and distributed recharge volumes proportionally based on upstream watershed size.
8. Increased the thickness of model layer three by lowering the base to near the bottom of the Tulare Formation.

Exploded View of Groundwater Model Layers

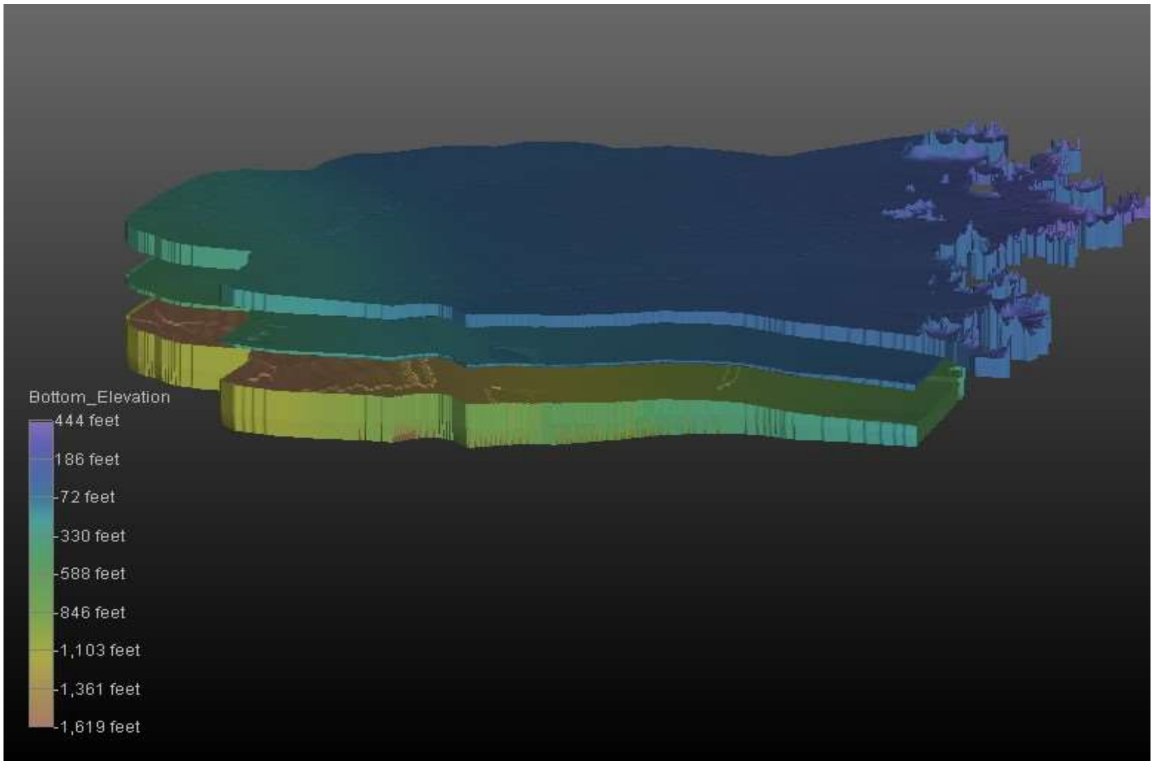
3-Dimensional Oblique Elevation of Entire Model Domain



3-Dimensional Oblique Elevation w/Aerial Photo and GSA Boundary Outlined

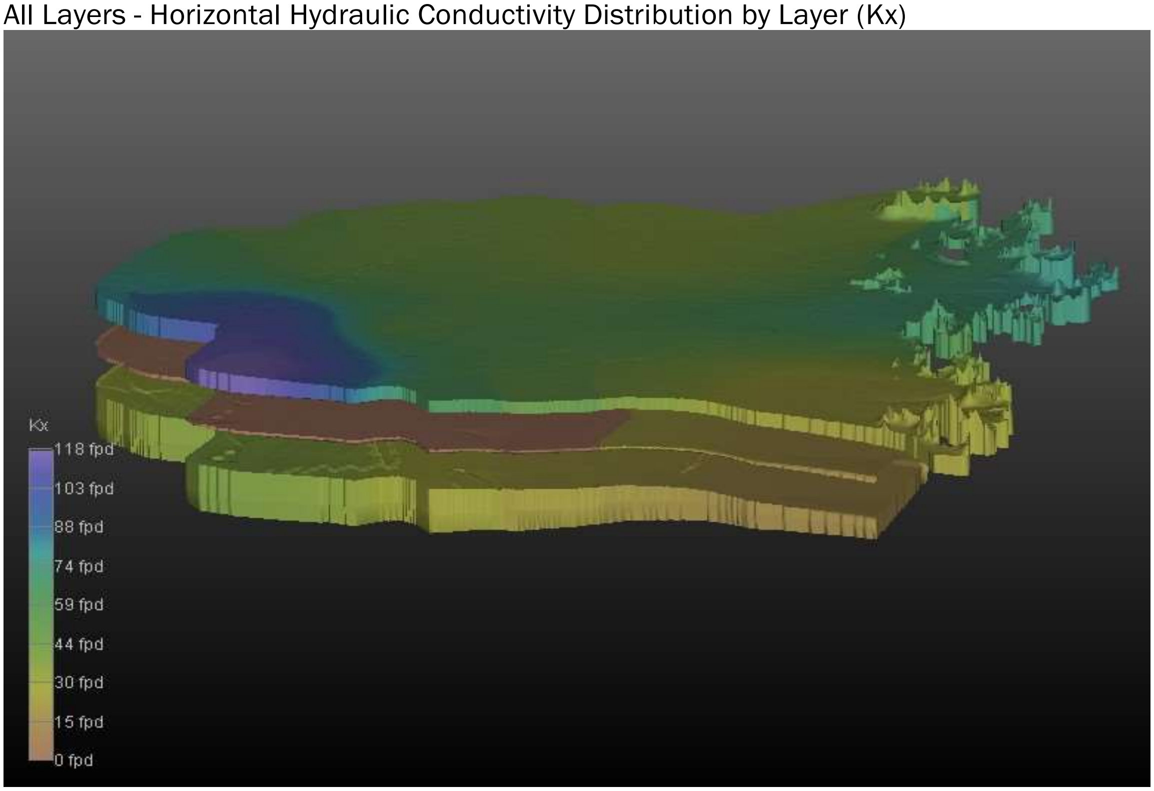


Exploded View of Groundwater Model Layers

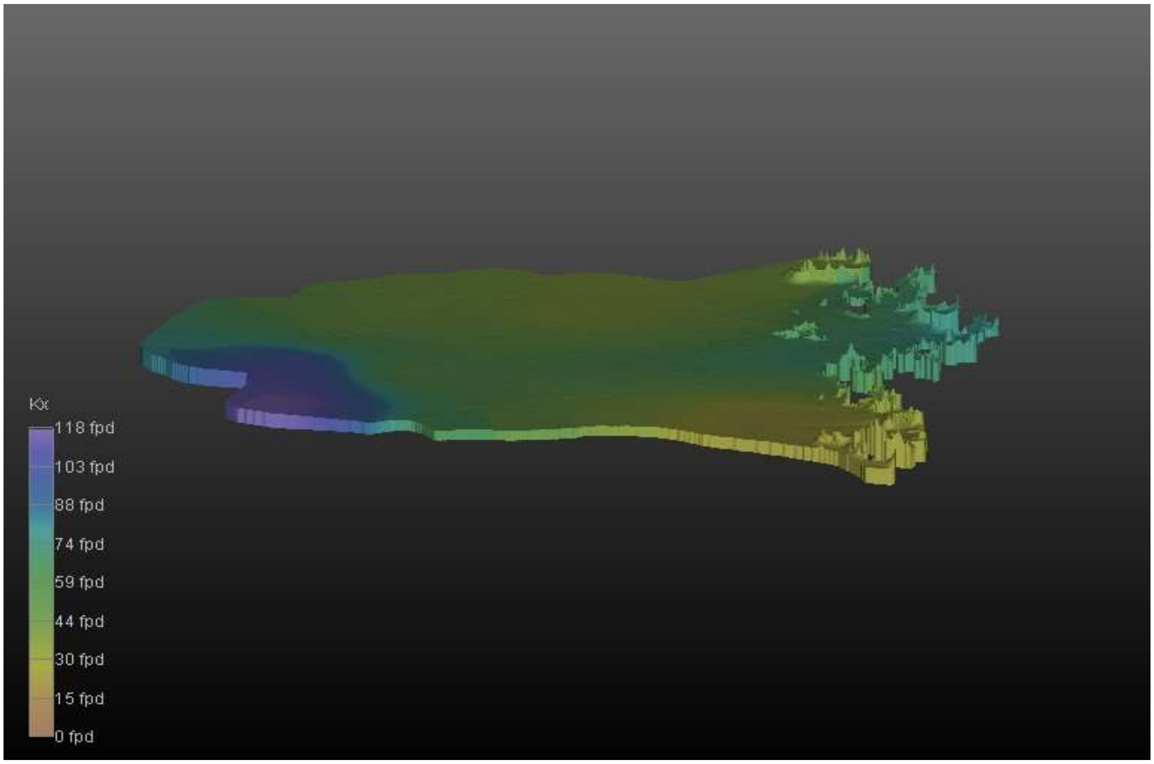


Horizontal Hydraulic Conductivity Distribution by Layer (Kx)

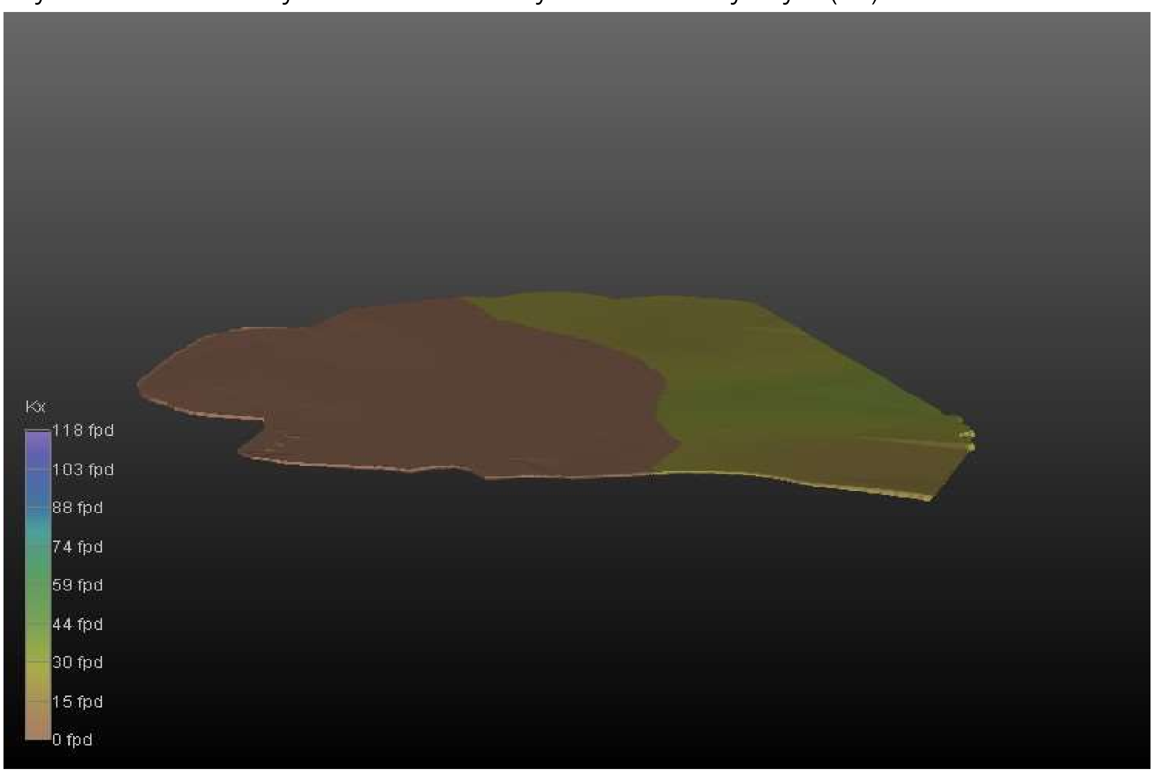
All Layers - Horizontal Hydraulic Conductivity Distribution by Layer (Kx)



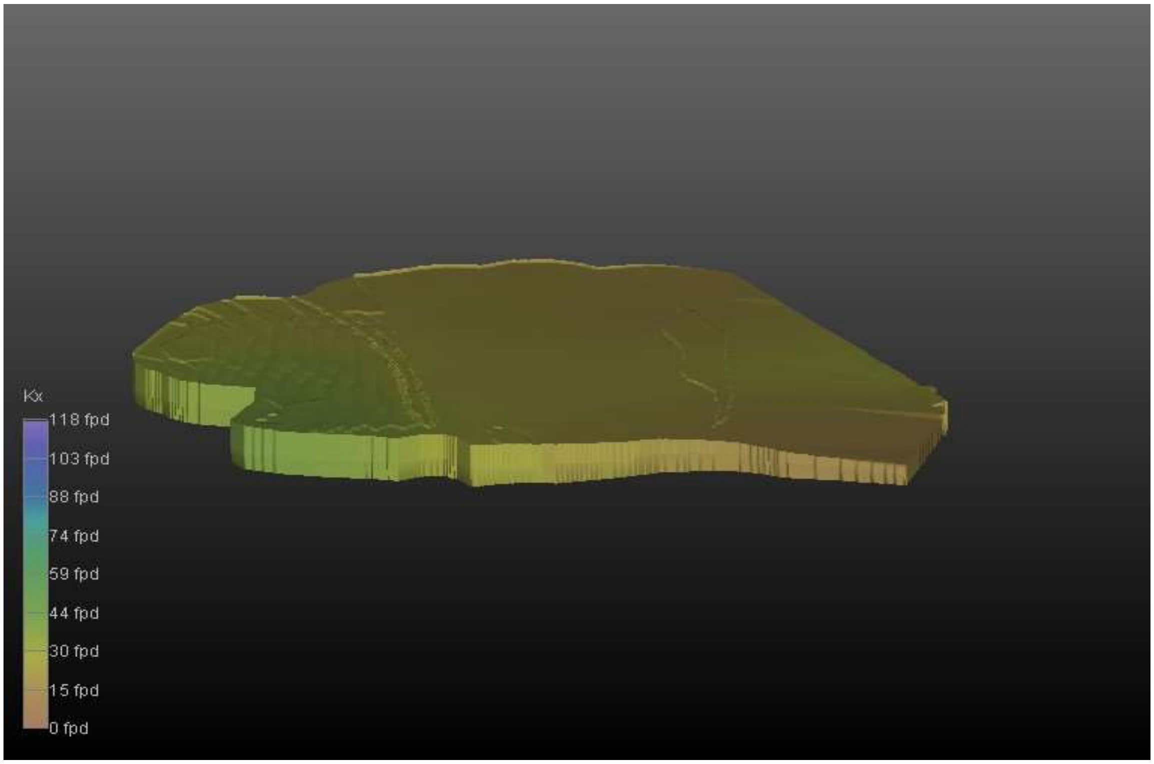
Layer 1 - Horizontal Hydraulic Conductivity Distribution by Layer (Kx)



Layer 2 - Horizontal Hydraulic Conductivity Distribution by Layer (Kx)

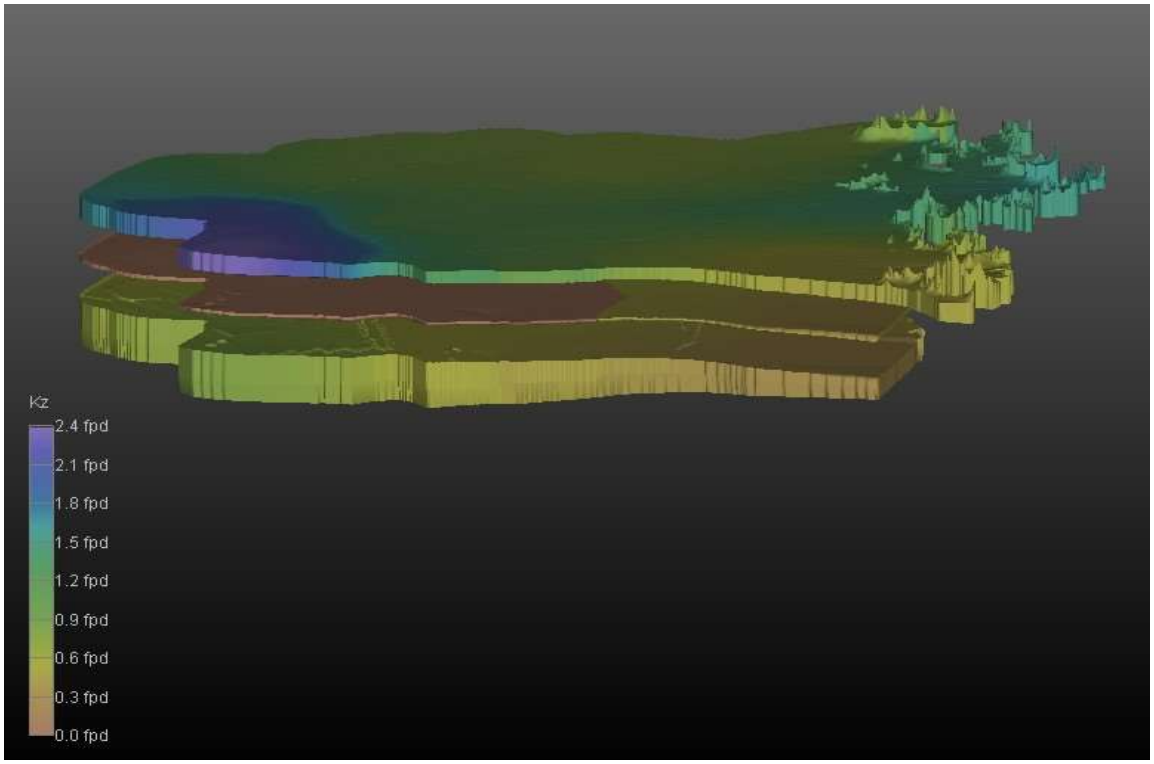


Layer 3 - Horizontal Hydraulic Conductivity Distribution by Layer (Kx)

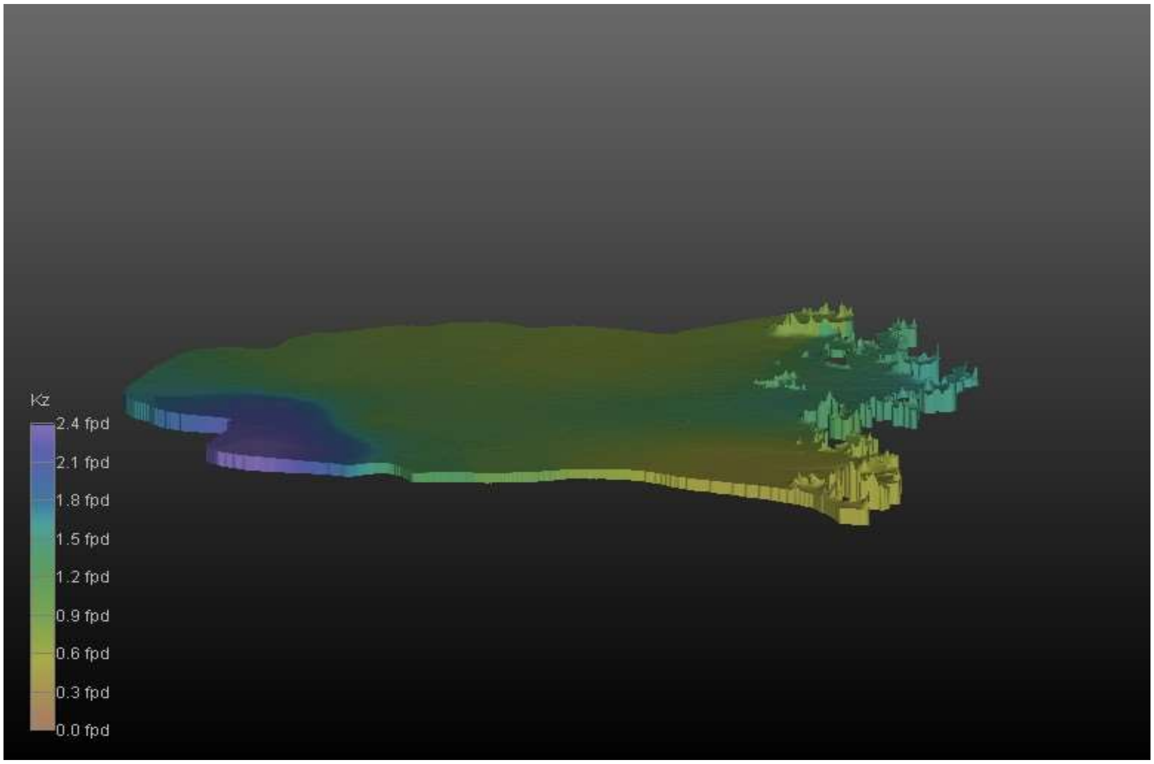


Vertical Hydraulic Conductivity Distribution by Layer (Kz)

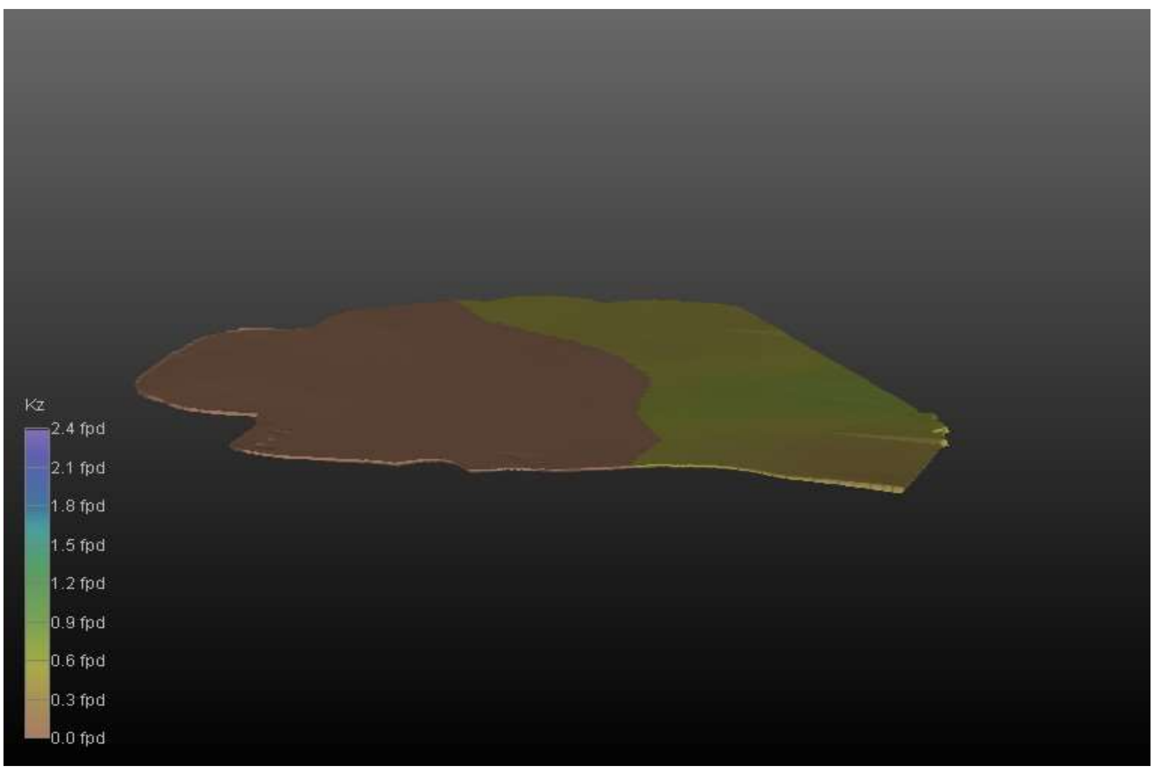
All Layers - Vertical Hydraulic Conductivity Distribution by Layer (Kz)



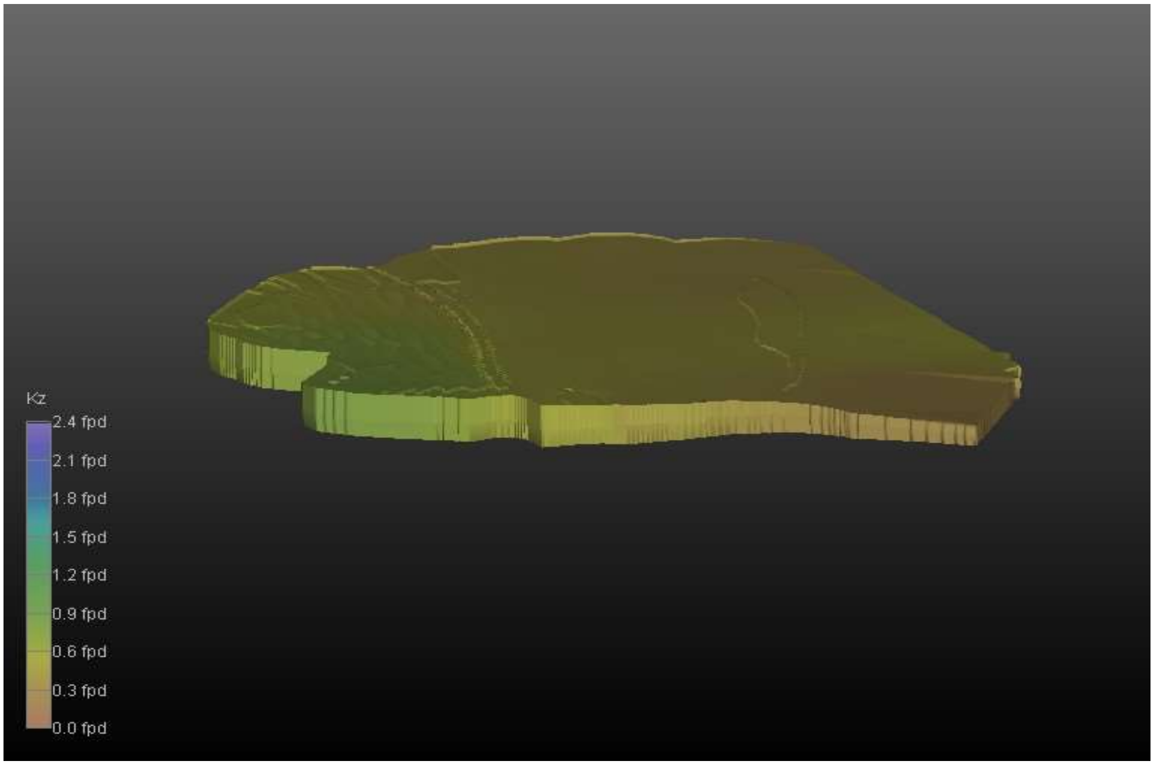
Layer 1 - Vertical Hydraulic Conductivity Distribution by Layer (Kz)



Layer 2 - Vertical Hydraulic Conductivity Distribution by Layer (Kz)



Layer 3 - Vertical Hydraulic Conductivity Distribution by Layer (Kz)



Process of Model Verification

1. The groundwater modeling team performed verifications model runs from 1999 to 2017. The purpose of these simulations was to verify the accuracy of the model to match the new water budget and observed groundwater elevations throughout expanded grid area.
2. The modeling team adjusted the vertical hydraulic conductivity in all three layers to improve the match.
3. Storage values from the previous model were unchanged.

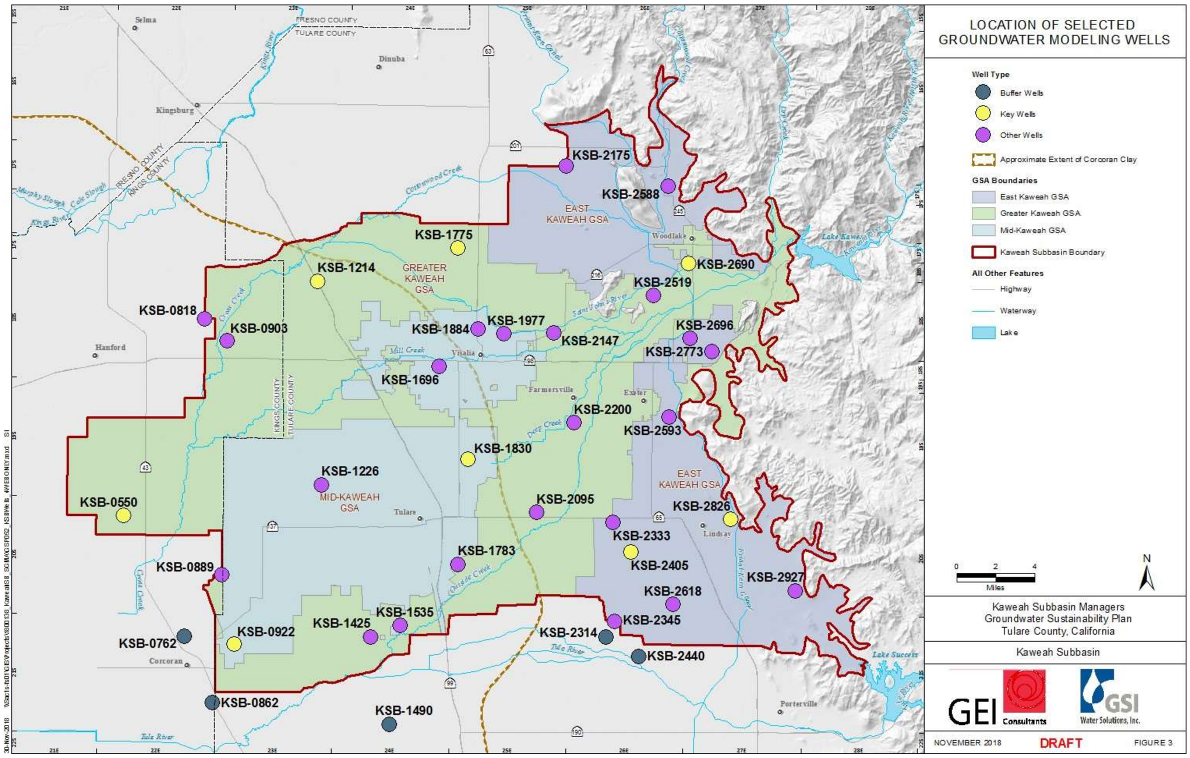
Results of Verification

The groundwater modeling team increased the number of calibrated targets from 30 in the 2012 update to over 900 in the KSHM. All 900 of these targets have been included in the calibration statistics that follow the presentation of key well hydrographs.

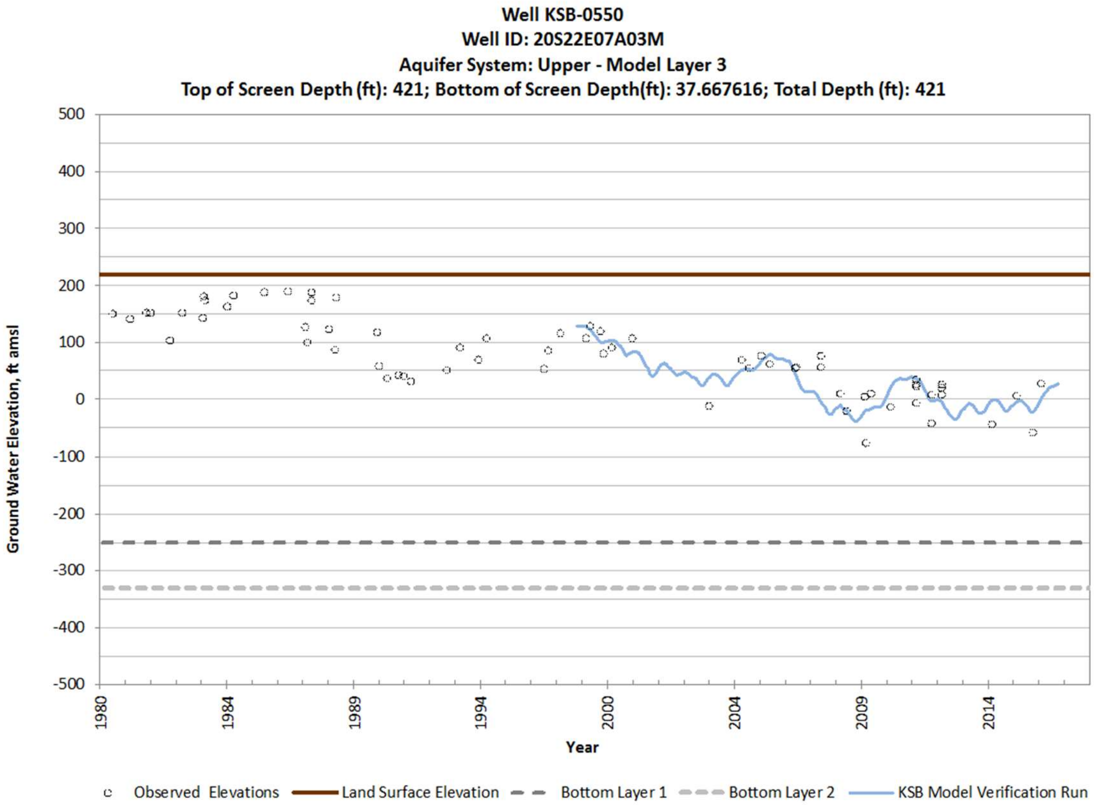
Included below is a map showing the locations of a group of key wells throughout the basin showing the match between observed and model simulated groundwater levels.

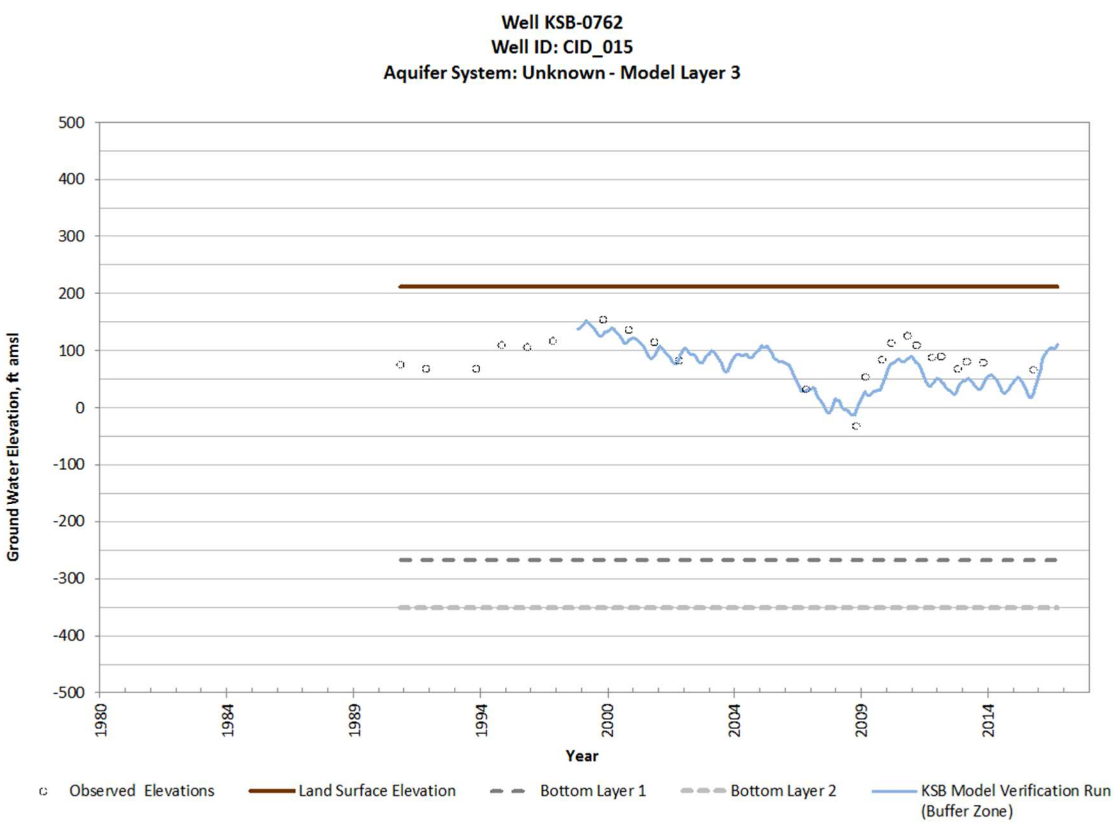
Hydrograph Wells

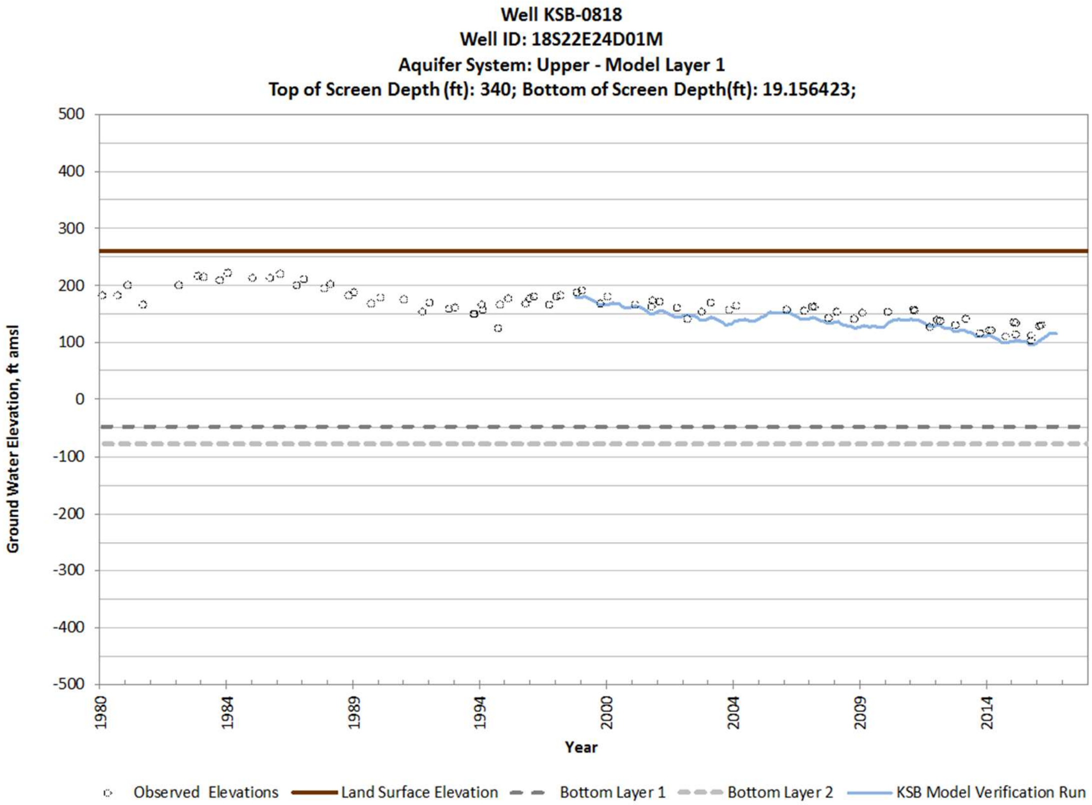
WELL LOCATIONS

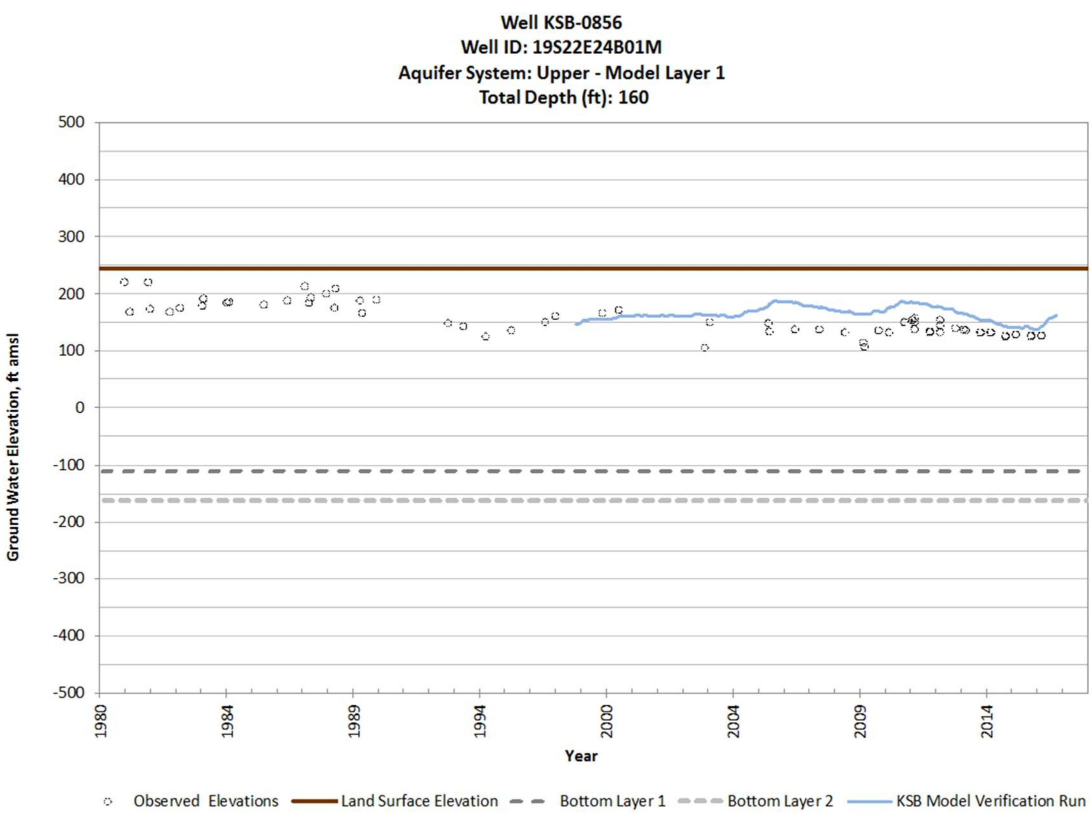


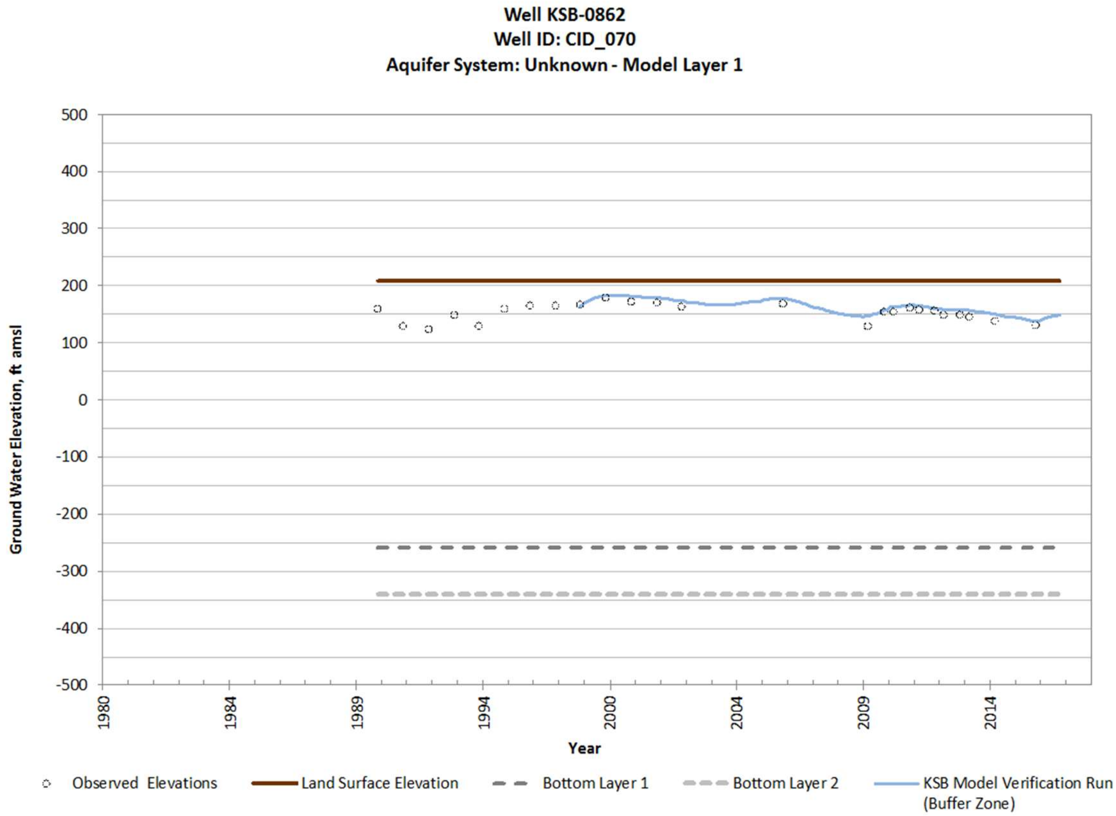
Hydrographs showing the match between observed and modeled groundwater elevations are presented for 37 key wells in the Kaweah Subbasin. Similar hydrographs have also been computed for over 900 wells within the subbasin and 200 wells within the model domain outside the subbasin. These additional hydrographs are available on demand but have been excluded from the report for brevity.


Well KSB-0550
Well ID: 20S22E07A03M
Aquifer System: Upper - Model Layer 3
Top of Screen Depth (ft): 421; Bottom of Screen Depth(ft): 37.667616; Total Depth (ft): 421
Ground Water Elevation, ft amsl
Year
Observed Elevations
Land Surface Elevation
Bottom Layer 1
Bottom Layer 2
KSB Model Verification Run

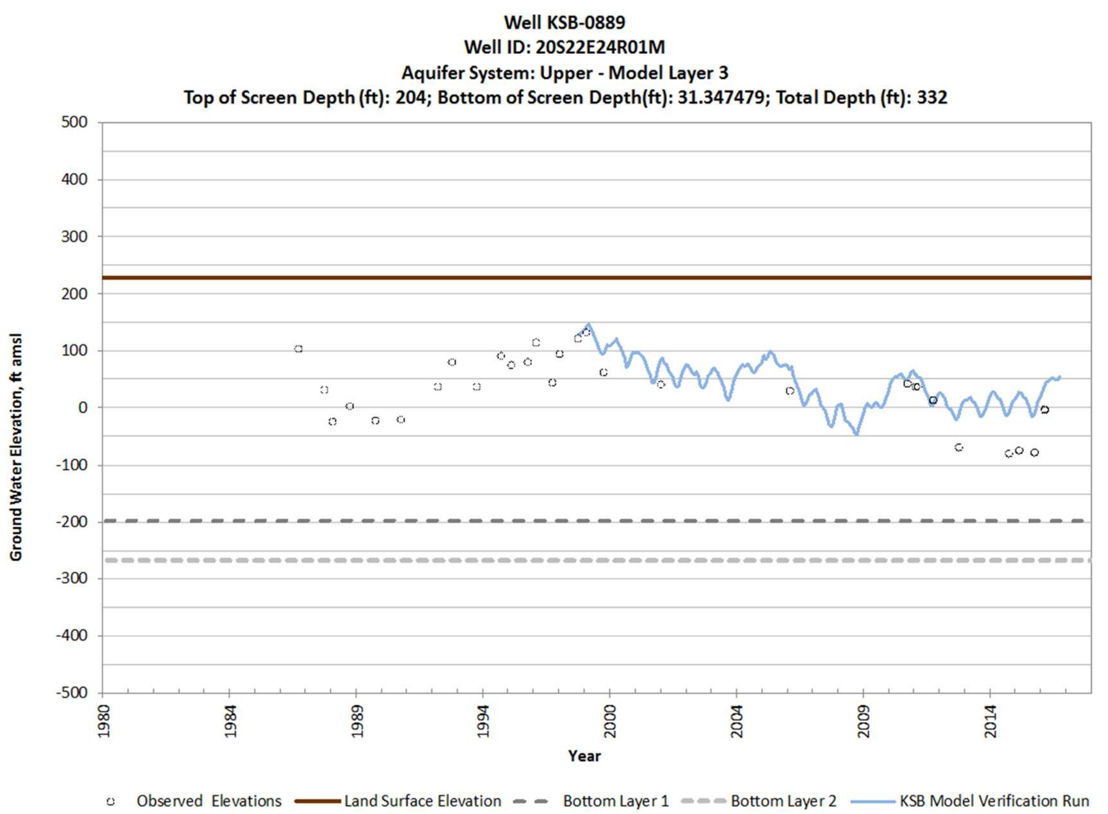

Well KSB-0762
Well ID: CID_015
Aquifer System: Unknown - Model Layer 3
Ground Water Elevation, ft amsl
Year
Observed Elevations
Land Surface Elevation
Bottom Layer 1
Bottom Layer 2
KSB Model Verification Run (Buffer Zone)


Well KSB-0818
Well ID: 18S22E24D01M
Aquifer System: Upper - Model Layer 1
Top of Screen Depth (ft): 340; Bottom of Screen Depth(ft): 19.156423;
Ground Water Elevation, ft amsl
500
400
300
200
100
0
-100
-200
-300
-400
-500
1980
1984
1989
1994
2000
2004
2009
2014
Year
Observed Elevations
Land Surface Elevation
Bottom Layer 1
Bottom Layer 2
KSB Model Verification Run

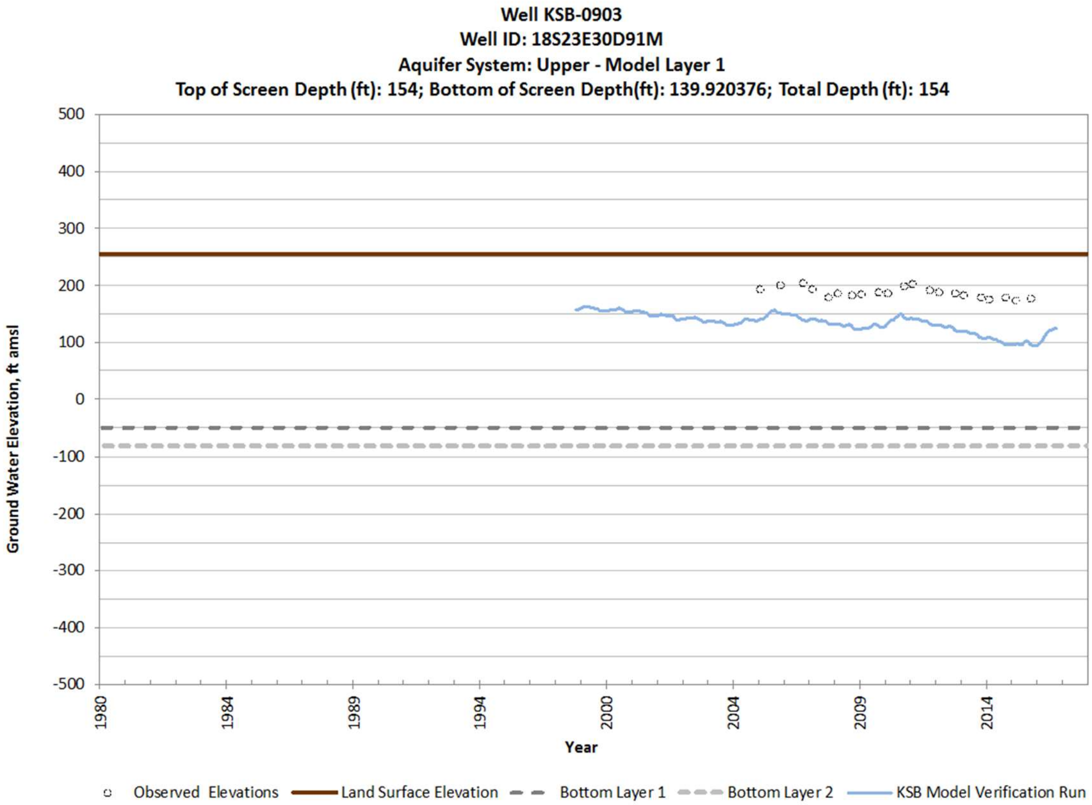

Well KSB-0856
Well ID: 19S22E24B01M
Aquifer System: Upper - Model Layer 1
Total Depth (ft): 160
Ground Water Elevation, ft amsl
500
400
300
200
100
0
-100
-200
-300
-400
-500
1980
1984
1989
1994
2000
2004
2009
2014
Year
Observed Elevations
Land Surface Elevation
Bottom Layer 1
Bottom Layer 2
KSB Model Verification Run

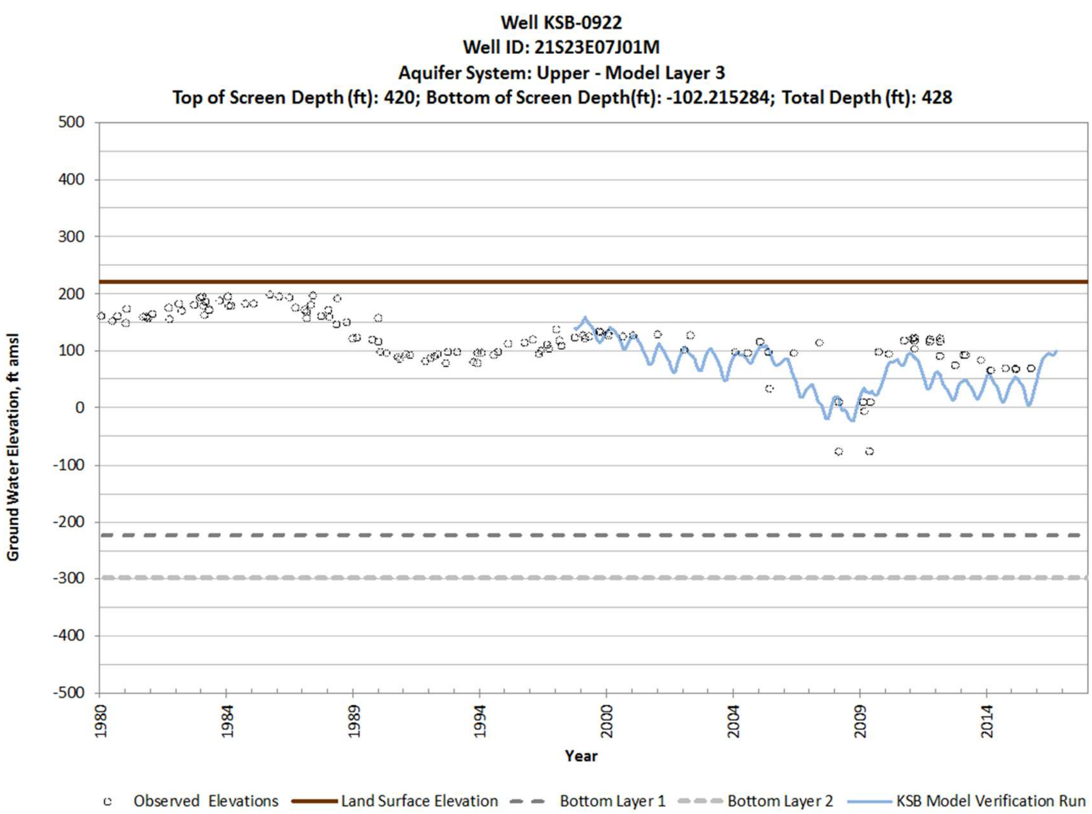


Well KSB-0862
Well ID: CID_070
Aquifer System: Unknown - Model Layer 1
Ground Water Elevation, ft amsl
500
400
300
200
100
0
-100
-200
-300
-400
-500
1980
1984
1989
1994
2000
2004
2009
2014
Year
Observed Elevations
Land Surface Elevation
Bottom Layer 1
Bottom Layer 2
KSB Model Verification Run (Buffer Zone)



Well KSB-0889
Well ID: 20S22E24R01M
Aquifer System: Upper - Model Layer 3
Top of Screen Depth (ft): 204; Bottom of Screen Depth(ft): 31.347479; Total Depth (ft): 332
Ground Water Elevation, ft amsl
500
400
300
200
100
0
-100
-200
-300
-400
-500
1980
1984
1989
1994
2000
2004
2009
2014
Year
Observed Elevations
Land Surface Elevation
Bottom Layer 1
Bottom Layer 2
KSB Model Verification Run


Well KSB-0903
Well ID: 18S23E30D91M
Aquifer System: Upper - Model Layer 1
Top of Screen Depth (ft): 154; Bottom of Screen Depth(ft): 139.920376; Total Depth (ft): 154
Ground Water Elevation, ft amsl
500
400
300
200
100
0
-100
-200
-300
-400
-500
1980
1984
1989
1994
2000
2004
2009
2014
Year
Observed Elevations
Land Surface Elevation
Bottom Layer 1
Bottom Layer 2
KSB Model Verification Run


Well KSB-0922
Well ID: 21S23E07J01M
Aquifer System: Upper - Model Layer 3
Top of Screen Depth (ft): 420; Bottom of Screen Depth(ft): -102.215284; Total Depth (ft): 428
Ground Water Elevation, ft amsl
500
400
300
200
100
0
-100
-200
-300
-400
-500
1980
1984
1989
1994
2000
2004
2009
2014
Year
Observed Elevations
Land Surface Elevation
Bottom Layer 1
Bottom Layer 2
KSB Model Verification Run