SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY
Thursday, November 17, 2016 - 7:00 p.m.
Simpkins Family Swim Center
979 17th Avenue, Santa Cruz, California

AGENDA

1. **Call To Order**

2. **Roll Call**

3. **Oral Communications Related to Items Not on the Agenda**

4. **Approval of Minutes of the Previous Meeting**
   4.1 Accept Minutes from September 15, 2016 MGA Meeting

5. **Administrative Items**
   5.1 Appointment of Alternate Private Well Owner Representative
   5.2 Proposal to Create a Temporary Board Working Group to Work With Staff to Develop a Detailed Plan for Preparing the Groundwater Sustainability Plan
   5.3 Approve HydroMetrics WRI Scope of Work and Budget for Biennial Report

6. **Information Items**
   6.1 HydroMetrics WRI Update on Climate Change Approach & Scenarios
   6.2 Receive Notes from Technical Advisory Committee Meeting #2 for Santa Cruz Mid-County Groundwater Agency Groundwater Model
   6.3 Update on Soquel Creek Water District's Pure Water Soquel Project
   6.4 Receive Department of Water Resources Best Management Practices and Guidance Documents
   6.5 Treasurer's Report

7. **Oral Reports**
   7.1 Outreach Reports
   7.2 Status Update on Hiring of Senior Water Resource Planner
   7.3 Board Member Reports
   7.4 Staff Reports

8. **Adjournment**

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY
Draft Meeting Minutes
September 15, 2016

1. **Call to Order:** Dr. Jaffe called the meeting to order at 7:02 p.m.

2. **Roll Call**
   Board Members Present: B. Jaffe, R. Marani, C. Mathews, C. Abramson, J. Benich, Z. Friend, J. Kennedy, J. Kerr, T. LaHue, D. Lane, J. Leopold

   Staff Present: L. Strohm, R. Bracamonte, R. Duncan, J. Ricker, J. Townsend, S. Ryan, M. Schumacher, H. Luckenbach

   Absent: T. Carson, R. Menard, E. Cross, I. Rivera

   Others: There were approximately 15 members of the public in attendance.

   Presentations: "Update on Groundwater Sustainability Plan Regulations," by Derrik Williams of HydroMetrics, WRI

   The Chair rearranged the agenda as shown below by staff request.

6.2 Update on Groundwater Model

Mr. Williams provided an update on the model. There are two main components: the surface water module and groundwater module. Both components are moving forward as well as an effort to integrate the two. He explained how global climate models will be integrated into the local model.

What do you mean by results?

- This first round will result in a calibrated model that can simulate stream runoff, groundwater levels, and how they interact with each other.

Which numbers will you be using regarding climate change projections?

- HydroMetrics WRI will be using a standard number to be determined.

Which data are being used for streamflow and rainfall measurements?

- HydroMetrics WRI is using data on rainfall, soil and plant canopies, evapotranspiration, and runoff, all of which drive streamflow. Long term stream flow data are limited. USGS data are being used as well.

5.1 Approve Scope and Budget for Groundwater Model Effort by HydroMetrics WRI for FY 2016-2017

Mr. Duncan reviewed the Scope of Work which focuses on simulating future conditions, water budgets, and answering basic questions in the near term.

Will the evaluation of previous protected elevations be part of the model?

- Yes, those will be used expressly in the model without further evaluation.

What would happen if the model showed saltwater intrusion?

- That is unlikely to happen based on the structure of the model, but if it did HydroMetrics WRI would re-evaluate the model's parameters. The water levels reflect those needed to prevent intrusion in 70% of scenarios.

Dr. Jaffe noted the addition of a surface water consultant to the Technical Advisory Committee (TAC) and inquired about what he would contribute. Mr. Williams responded that the TAC requested someone with Mr. Hecht's expertise. Mr. Ricker added that the TAC is interested in surface water interactions and expressed his support. Mr. Duncan noted that Mr. Hecht was the county's hydrologist and possesses a wealth of local knowledge. The TAC is composed of consultants and agency staff including: Bruce Daniels, Andy Fisher, Brian Lockwood, and Robert Marks.

Can Private Well Owner Representatives vote on financial matters?

- They can vote on any matter. However, financial matters must be unanimously approved by agency representatives in order to pass.

Mr. Marani noted that USGS cannot have an agreement with the MGA. Ms. Schumacher suggested an amendment to the Scope of Work noting that Mr. Hecht will be paid by the MGA rather than HydroMetrics WRI.

MOTION: Dr. LaHue; Second: Mr. Leopold. To approve the Scope of Work and Budget for the Groundwater Model as amended. Motion passed unanimously.

4.1 Accept Minutes from May 19, 2016 MGA Meeting

MOTION: Mr. Friend; Second: Mr. Lane. To approve the minutes of May 19, 2016 as written. Motion passed unanimously. Abstentions: Dr. LaHue, Mr. Leopold.

6.1 Update on Quarterly Monitoring Data

Mr. Williams stated that data show short term recovery, but the goal is still to achieve long term recovery. Dr. Jaffe commented on how seasonal fluctuations can affect desired protection levels. Mr. Williams replied that the graphs do not reflect long term recovery. In the long term, water levels will fluctuate and the goal is to have the average be above protection levels. Mr.

Kennedy inquired about inferring the state of the basin from the quarterly reports. Mr. Williams shared that the state of the basin is better portrayed via annual and bi-annual reports down the road.

6.4 Update on Counties with Distressed Groundwater Basins Grant

Mr. Ricker reported that the county received a $250,000 grant to augment efforts to model inland and non-municipal pumping impacts. Work will be completed by December 2017 with streamflow measurements expected next year. The county will work with HydroMetrics WRI and the TAC to assess inland areas of the basin.

Elements of the project include:

- an inventory of wells and groundwater users for inland parts of the basin;
- groundwater measurements for private wells (inland parts of the basin);
- expanding the volunteer network to help calibrate the model;
- seasonal streamflow interactions and the impacts of inland pumping;
- looking at the potential for aquifer recharge projects in the basin;
- outreach with well owners, agricultural, and commercial well users; and
- audits with well owners to identify the potential for increased efficiency.

Mr. Kennedy asked if the county is looking for private well owner input for specific areas of the basin. Mr. Ricker welcomed input from those interested in participating. The county is available to come out and take measurements using a non-intrusive method that sends a pulse of sound down the well. Depending on how the model develops, they might also need help on the edges of the basin.

The group discussed when and how private well owner meetings have been publicized over the past two years. Mr. Duncan suggested that interested parties sign up for the MGA email list. Mr. Kerr reported that the group is contemplating additional private well owner meetings. The group acknowledged that sending notices by mail made a big difference in meeting turnout. The website nextdoor.com was suggested as another potential channel that the county is already using.

How are you identifying which streams to analyze?

- Major streams are the focus as well as anadromous samoid streams.

Do you have long term data on any of those streams?

- Some streams have spot flow measurements for the last few years.

Mr. Ricker reviewed allowable funding applications, and mentioned that funding cannot be used for implementation. Proposition 1 allows funds spent since the proposition passed in November 2014 to be used as local match.

6.5 Update on MGA's Basin Boundary Modification Request for the Santa Cruz Mid-County Groundwater Basin

Mr. Duncan provided an update on the basin boundary modification request which was submitted to DWR and officially accepted on September 21, 2016. Mr. Williams added that the request will be an information item at the next California Water Commission meeting, and will be included in Bulletin 118 which names every basin in the state. Mr. Ricker added that the boundary was accepted without any changes, and picked up some locations that were combined into the mid-county groundwater basin (e.g., Glen Canyon Road).

6.6 Update on Groundwater Sustainability Agency (GSA) Formation Status for the MGA

Mr. Williams shared that this group has become the exclusive GSA in the basin, and the only group that has the right to implement SGMA. Once Bulletin 118 is published, it will become the official GSA and will not have to reapply. Ms. Schumacher acknowledged the efforts of those who contributed to the growth of this group over the years especially the formation committee. Dr. Jaffe acknowledged that the group is a model for collaboration.

6.3 Update on Groundwater Sustainability Plan (GSP) Regulations

Mr. Williams provided an overview on the regulations, timeline, and required actions. He underscored that the legislation is a legally enforceable document along with the regulations. The Best Management Practices (BMPs) are being developed right now, two will be legally enforceable and the others will be advisory. Some BMPs will be released in December, and all six sustainability indicators must be addressed in the GSP.

Who determines whether plans are substantial enough?

- DWR. It will be in your best interest to be in touch with DWR throughout the process to give them confidence in the basin's ability to be sustainable.

Who decides which levels are acceptable?

- The GSA and the public will decide along with local jurisdictions.

Mr. Williams discussed Representative Monitoring Points (RMPs). The group will have to prove that each RMP is representative of the wells in that area. Each Undesireable Result will be defined once for the entire basin (e.g., the locally defined level for significant and unreasonable saltwater intrusion). The overall goal is for sustainability indicators to improve over time to reach measurable objectives. If levels go below the Undesireable Results, DWR can step in and manage pumping. The GSA will have to decide how large the buffer zone will be in order to mitigate the risk.

How will fluctuations be factored into the mix (e.g., over 50 years)?

- DWR appears to be more concerned with the direction of results over a 20 year trend than short term flucatuations. Having an Undesirable Result by itself is not an automatic trigger for DWR intervention. Overall, DWR needs to have conidence in the direction the basin is heading.

How do you prevent the bottom line from causing irreversible consequences?

- By defining thresholds that allow for uncertainty and mitigate risk.

Is this program granting permission to spend unlimited amounts of money? What are the financial components of this kind of undertaking?

- Money is not one of the indicators, however there is an assumption that desirable results will take the success of the local economy into account.

Undesirable Results are a function of the minimum thresholds set basin-wide and are an aggregated metric. The GSP does not have to calculate sustainable yield for the basin. Some aspects of the Plan are local and others are basin-wide. There will be one plan, one basin, and one agency for this area. The GSA will have to demonstrate that the usage of this basin does not impact neighboring basins' minimum thresholds. Ideally, neighboring GSAs will write letters to DWR acknowledging collaboration. Mr. Williams suggested that the group invite neighboring members to future meetings.

How will this group meet demand reduction goals?

- Mr. Ricker replied that the group will be interacting all adjacent basins whether or not they have a GSP. Overdrafted basins will need to provide an estimate of the demand reduction needed to mitigate overdraft.

Mr. Abramson noted that there are basins to the east and south that should also be accountable to this basin. What provision is there for that?

- This group's minimum thresholds cannot prevent neighboring basins from reaching their sustainability objectives, and vice versa.

Does DWR want check-ins during the GSP development process?

- They would like early consultation but do not have a formal program. This group has the opportunity to work with DWR from the beginning.

What is the definition of a beneficial user?

- This term is not yet defined, but could refer to environmental groups, municipalities, industrial users, and private well owners. There should be a good faith effort to reach out to everybody who may be affected by the Plan.

Mr. Kennedy commented that sustainability goes beyond avoiding negative impacts, and should encompass the nexus of social, environmental, and economic goals. He added that the GSP should consider adopting a broader definition, and requested an agenda item for next meeting item to discuss the formation of a GSP committee and charters to guide said committee.

What about environmental impacts?

- Environmental impacts are still being defined through the BMP process.

6.7 Status Update on Hiring of Senior Water Resource Planner (Oral)

Mr. Ricker reported that the recruitment process has been reopened, and the deadline for the first review is the beginning of this week. The Executive Team will reviewing the applications submitted and decide how to proceed.

6.8 Treasurer's Report

Ms. Strohm provided an example of what future reports will look like.

3. Oral Communications (Items not on the Agenda)

Ms. Steinbruner urged the group to consider putting to vote the topic of injecting sewage water and expressed her concerns about a lack of scientific analysis. Mr. Cogan echoed her comments and articulated his support for being cautious and holding a public vote. He asked the board to consider alternatives. Ms. Schumacher acknowledged the 2nd anniversary of SGMA, the leadership of this group, and becoming the official agency of the basin.

7. Oral Reports

7.1 **Outreach Reports**

Mr. Kerr provided an update on the MGA office hours held on July 12, 2016. There were 7 members of public in attendance and several board members. He suggested hosting office hours in months without MGA meetings. The next session is tentatively scheduled for October 20, 2016.

Ms. Schumacher provided an update on the monthly e-blasts. There are currently more than 450 subscribers. She asked everyone to share the website and invite others to subscribe to the newsletter.

Mr. Kerr reported that there are continuing email exchanges between the Private Well Owner Representatives and other private well owners, including requests for future meetings and opportunities to connect. Several private well owners have created a mid-county Google group. He offered to share information as appropriate.

Ms. Ryan shared the new MGA logo and latest Google analytics for the website since March including: a 30% open rate on the last e-blast, 1,150

individual users from the Santa Cruz county area, and some from Sacramento. Most people go to at least three different pages.

Dr. LaHue highlighted the importance of communicating about these meetings through a mailer or nextdoor.com or both. He also suggested that the group find a larger venue for the next board meeting.

7.2 **Board Member Reports**
None

7.3 **Staff Reports**
None

8 ADJOURNMENT

Staff indicated that they would look for a larger venue for future meetings. The meeting adjourned at 8:50 p.m. The next meeting will be held at 7:00 p.m. on Thursday, November 17th at the Simpkins Family Swim Center unless otherwise posted on the MGA website.

SUBMITTED BY:

Julia Townsend, Program Associate
Regional Water Management Foundation

APPROVED BY:

Cynthia Mathews
Board Secretary

November 17, 2016

MEMO TO THE MGA BOARD OF DIRECTORS

Subject: Agenda Item 5.1

Title: Appointment of Alternate Private Well Owner Representative

BACKGROUND

The Santa Cruz Mid-County Groundwater Agency (MGA) Joint Power Agreement (JPA) provides that the agency shall be governed by a Board of Directors comprised of 11 members, including three representatives of private well owners within the boundaries of the MGA. Section 6.4 of the JPA states: "One Alternate shall also be appointed to act as a substitute Director for any of the three Directors representing private well owners. All Alternates shall be appointed in the same manner as set forth in Section 6.3," which states that the private well representatives are to be appointed by a majority vote of the agency member directors, following a nomination process as set out in the bylaws. The three private well representatives were appointed to the Board of Directors on May 19, 2016, but an alternate private well representative was not appointed at that time.

NOMINATION PROCESS

Section 2.2 of the bylaws describes the nomination process for the private well representatives, which would include the alternate. Although the selection process was conducted prior to adoption of the bylaws on May 19, 2016, the Agency counsel advised that if the selection process followed the process described in the bylaws, it would be acceptable to appoint the private well representatives based on the outcome of that process.

A subcommittee of the Soquel-Aptos Groundwater Management Committee (SAGMC), the precursor of the MGA, was formed in 2015 to make recommendations for the private well representatives to the SAGMC. The subcommittee consisted of one representative from Central Water District (John Benich), Soquel Creek Water District (Bruce Jaffe), the City of Santa Cruz (Micah Posner), and the County of Santa Cruz (John Ricker).

The opportunity to serve as a private well representative was announced and noticed on the website, with a formal application to be completed. A total of 25 applications were submitted. The applicants' qualifications were very strong, which reflects the awareness and commitment of private well pumpers. The subcommittee met on July 27, 2015, to review applications and discuss criteria for selecting candidates to recommend for appointment.

Criteria included (not in order of importance):

- Owned or operated a well within the Mid-County Groundwater Basin
- Connections to the community
- Level of commitment

- Knowledge of the groundwater situation
- Constructive
- Open-minded
- Easy to work with

In addition, the committee sought to balance the recommendation of the three candidates considering:

- Diversity with regard to water use
- Diversity with regard to perspective
- Diversity with regard to location in the groundwater basins

The subcommittee held in-person interviews with six candidates: Curt Abramson, Jon Kennedy, Lisa Bennett, Jim Kerr, Robert Schultz, and Nicolas de Sieyes. Interviews were held on August 12th and 13th, 2015. Based on those interviews, the subcommittee recommended the appointment of Jon Kennedy, Jim Kerr, and Curt Abramson. These three representatives were formally appointed to the SAGMC Board on August 20, 2015, and were subsequently appointed to the MGA Board on May 19, 2016.

During the deliberations of the subcommittee, Robert Schultz was identified as the very strong runner-up to the three representatives that were appointed. Mr. Schultz is the President of the Trout Gulch Mutual Water Company, a private water system with 186 connections in the Aptos Hills that draws water from the Mid-County Basin. Mr. Schultz has been very interested in the groundwater management efforts and has attended most of the public workshops and MGA meetings. As a small water system operator, he provides a valuable perspective and would be well-qualified as an alternate to serve as a private well representative in the absence of one of the primary representatives.

Some concern has been expressed that the process for solicitation and nomination of private well representatives took place in 2015, prior to some people becoming aware of the process underway for improved management of the basin. There is also concern that to ensure adequate public representation the private well owners should be allowed to select their own representatives. However, the MGA is a public agency, with duly elected public agency representatives that are selected by their constituents through the formal elections process. In this case, it is appropriate to have them select the private well representatives. There is presently not a mechanism to ensure a fair election process for private well owner representatives by private well owners. Furthermore, there is ample opportunity for private well concerns to be presented and considered during MGA meetings during both oral communications and the opportunity for any member of the public to speak to individual agenda items prior to a decision by the board.

RECOMMENDATION
Recommended Board Action:

By MOTION, Appoint Robert Schultz as the Alternate Private Well Owner Representative.

By _____

John Ricker
Water Resources Division Director
County of Santa Cruz

November 17, 2016

MEMO TO THE MGA BOARD OF DIRECTORS

Subject: Agenda Item 5.2

Title: Proposal to Create a Temporary Board Working Group to Work with Staff to Develop a Detailed Plan for Preparing the Groundwater Sustainability Plan

Attachment:

1. Memo to the Soquel Aptos Groundwater Management Committee: Agenda Item 5.7 Preliminary Work Plan and Staffing Strategy for Development of the Groundwater Sustainability Plan, January 21, 2016

During the past six months, MGA staff has been working to establish the operational framework for the new agency including working on hiring the senior planner and getting the staff support arrangements with the Soquel Creek Water District and the Community Foundation of Santa Cruz County in place. During this same time frame the State Water Resources Control Board has issued and adopted emergency regulations to guide the development of required groundwater sustainability plans[1]. HydroMetrics WRI, the MGA's technical consultant, has also been making steady progress on the groundwater model which will be a key tool that will be used in developing the Groundwater Sustainability Plan (GSP).

All of this "behind the scenes" progress is definitely important and necessary but, as board members noted in their discussion at the September 15th meeting, there is a strong interest in more clearly seeing the path forward for the GSP creation.

Given this interest and recognizing the steps needed to initiate the planning work, staff is recommending that the board establish a working group as provided for in Section 5.2 of the bylaws. The working group would collaborate with staff to complete the work necessary to initiate the planning process. A possible charge and scope of work for the working group is provided below.

1. Review the state's recently adopted emergency regulations for GSPs and develop a draft scope of work, strategy, and schedule for preparing the GSP. Elements of this task would include:
    a. Identifying the portions of plan development that would be completed by staff and those that would be the focus of the proposed GSP Development Committee. (See earlier discussion of this topic in the attached agenda

[1] See http://www.water.ca.gov/groundwater/sgm/pdfs/GSP_Emergency_Regulations.pdf

item from the January 21, 2016 Soquel Aptos Groundwater Management Committee, which would provide a place to begin this task.);

b. Conduct a needs assessment and identify the resources necessary to support development of the plan, for example additional services to support technical, policy, facilitation, or outreach work needed during the planning process; and create and recommend to the board a proposed approach to provide the resources, for example through contracts, or shared services;
c. Create and recommend to the MGA Board any RFPs for additional consulting resources and evaluate and recommend to the board any contracts for resources needed to support plan development.

2. Develop the GSP scope of work, schedule and budget for work expected to be done during FY 2017-2018 GSP development work

3. Prepare for the board's consideration a draft charge for the GSP Development Committee as well as a recommendation for the GSP Development Committee's membership;

4. Develop and recommend to the board any additional working groups or other efforts focused on "getting ready" topics, for example, water use data or community outreach and engagement efforts.

If the board chooses to pursue this proposal it would need to appoint members of the working group. To meet the criteria for an informal working group, membership cannot include more than 4 members of the board, because working groups are not intended to exceed the board's quorum requirement[2].

In addition, if the board chooses to pursue establishing a working group, the following timeline for the group's efforts is suggested:

1. Convene the working group before Christmas;
2. Complete work in no more than 6 months;
3. Report progress/recommendations to the MGA Board at its January, March and May 2017 meetings, with a goal of completing all work by May 2017 and initiating the GSP planning process no later than July 2017; and

[2] See Section 9.1 of the Santa Cruz Mid-County Groundwater Agency Joint Powers Authority

4. Ensure that the working group includes in its March 2017 report its recommendations to the board on the FY 2017-2018 budget for the GSP development work.

Possible Board Actions:

1. By MOTION, to appoint a temporary board working group as defined in the bylaws to develop a detailed plan for preparing the GSP.

By: _____

Rosemary Menard
Water Director
City of Santa Cruz

Prepared on behalf of Executive Team Members: John Ricker, Ralph Bracamonte, Ron Duncan, and Rosemary Menard

January 21, 2016

MEMO TO THE SOQUEL APTOS GROUNDWATER MANAGEMENT COMMITTEE

Subject: Agenda Item 5.7 — Preliminary Work Plan and Staffing Strategy for Development of the Groundwater Sustainability Plan

Attachment 1: Table on GSP Requirements with reference to existing sections of the 2007 AB 3030 Plan or other existing or ongoing work covering that topic

Background

The purpose of this item is to provide information to the SAGMC and ask for feedback so that additional work can proceed based on the SAGMC's feedback.

After the formation of the Groundwater Sustainability Agency (GSA) through the pending Joint Powers Agreement, the next major piece of work the GSA will need to undertake is the development of a Groundwater Sustainability Plan (GSP).

A collaborative multi-agency Staff Working Group (SWG) has been meeting over the last few months to begin the development of a work plan for the GSP and to talk about how the GSP would be financially, administratively and technically supported and to develop identify the budget and other resources needed for plan development. Some of the details of the SWG's proposal and work plan on this topic are presented in Agenda Item 5.7.

Discussion

The SWG's discussions on the development of the GSP have included a thorough review of what the requirements for the GSP are, an initial assessment of an approach to developing the plan, and some discussion about the kinds of resources needed to support plan development. Each of these topics is discussed below.

<u>What does the GSP Need to include?</u>

As staff and elected officials from the Soquel Creek and Central water districts know very well from their many years of working together on the Basin Implementation Group (BIG), a considerable amount of the work required to create a GSP has been done over time. In particular the BIG created a groundwater management plan for the Soquel-Aptos basin in the 1990s and most recently revised it in 2007 (see http://www.soquelcreekwater.org/our-water-groundwater/groundwater-management-plan).

The 2007 AB 3030 Soquel-Aptos Groundwater Management Plan, and the information developed from the implementation of that plan over time, provides a strong foundation on which to develop the GSP for the Santa Cruz Mid-County Groundwater Basin. Staff's assessment is that much of the effort to create a GSP would really be focused on updating the 2007 Plan rather than starting with a blank sheet of paper.

Attachment 1 lists the required elements of the Groundwater Sustainability Plan and shows, in the column on right, the links to the existing sections of the AB 3030 plan covering that topic or to other work that is being done, such as the updates of various agency Urban Water Management Plans.

It is interesting to note that the list of required elements for the GSP does not explicitly include one of the key issues that the SAGMC has been discussing, which is the assessment of impact on the basin by various pumpers. Presumably the work that needs to be done to assess impacts and link assessed impacts to any future assessment program to support implementation of basin recovery strategies would be covered in the two elements on measurable objectives and implementation strategies needed to achieve sustainability.

Initial Assessment of Approach to Developing the GSP

In looking at the required components of the GSP as well as at the 2007 Groundwater Management Plan, it is clear that some aspects of a GSP are more likely to be of specific interest to the community, while other elements are less likely to hold the same level of interest. Examples of the latter include monitoring programs and protocols. Examples of the former include impact assessments, mitigation and management strategies, and potential funding approaches and allocations.

In creating a draft work plan for the development of the GSP, one of the goals the SWG discussed was involved identifying ways to make sure the planning process achieves what it needs to and does so in a manner that is cost-effective and efficient for everyone. Given this goal, the SWG's assessment is that it would make sense to begin the process by focusing the work and differentiating roles and responsibilities for work elements between staff and technical resources and the GSA and any GSA subcommittee.

Table 1 below describes an example of how roles might be differentiated between responsibilities for GSP elements to be developed by the Staff and reviewed as draft products by any GSA subcommittee created to work on the GSP, and those work products to be developed as work products of the GSA GSP subcommittee. The GSP would ultimately need to be signed off on by the full GSA.

Table 1

Possible Roles of Staff and GSP subcommittee for GSP Plan Elements

Potential Examples of Staff Generated Work Products	**Potential Examples of Subcommittee Generated Work Products**
Groundwater levels, groundwater quality, subsidence and groundwater-surface water interactions	Measurable objectives, as well as interim milestones in increments of five years, to achieve the sustainability goal in the basin within 20 years of implementation of the plan
Historical and projected water demands and supplies	A description of how the plan helps meet each objective and how each objective in intended to achieve the sustainability goal for the basin for long-term beneficial uses of groundwater
Basin boundary map	Analysis and development of recommendation on major policy issues for example: • requirements for metering and reporting of use; • programs for the assessment of fees and charges • etc.
Existing and potential recharge area map	
The monitoring and management of groundwater levels within the basin	
The monitoring and management of groundwater quality, groundwater quality degradation, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin	

An approach such as the one described would focus staff and technical resources on developing data sets, translating data into information to be used by policy makers and many of the more descriptive and foundational pieces of the needed work. It would also allow the work to be done by the GSA and any subcommittee it creates to focus on policy and policy analysis issues associated with the more narrowly focused but more critical issues that the GSP will need to tackle.

<u>What resources might be required to support the development of the GSP?</u>

Resource requirements to complete the GSP will likely fall into three likely categories:

1. Technical consultants
2. Facilitation
3. Staffing

The SWG's preliminary assessment of the needs in each of these areas is described below:

1. Technical consultants:
   As the SAGMC is aware, considerable resources are already being invested in technical analyses and the development of modeling tools. The current consultant involved in this work is Hydrometrics WRI, and the expectation is that this consultant team would continue to play a role in many of the detailed analyses and modeling work that will be done as part of the GSP development.

   As the plan development process gets underway, additional technical topics are likely to be identified that will require technical support. One area that has already been identified is associated with the anticipated impact assessment work, and is likely to focus on three issues:
   a. Data collection and verification. The goal here would be to make sure that the data set to be used in any impact analysis is viewed by all the interests as being complete, accurate, and a fair representation of reality;
   b. Analysis of data to assess and potential impacts. This analysis would likely include use application of the groundwater model. Due to the importance of the analysis, the SWG recommends that we plan to spend some time during this phase getting people comfortable with the model in order to build confidence in the modeling results.
   c. Translation of impacts from a percentage or numeric value of some kind to the basis for some kind of ongoing funding program to support actions needed to put the basin on a path to sustainability. The consultant support needed for this work might require skills in public policy and financial analysis rather than or perhaps in addition to engineering, hydrogeologic, or other technical and planning skill sets.

2. Facilitation
   The SAGMC has talked about creating a subcommittee of the GSA to be involved in the development of the GSP. The discussion to date has been to include a broader representation of community interests in this subcommittee and to provide high quality opportunities for community engagement in the creation of the GSP. As discussed earlier, the SWG is suggesting that the focus for this group be on policy

issues and alternatives, with a goal of creating a high level of community agreement about these elements of the GSP.

The SWG's assessment is that the subcommittee will be more likely to achieve its goal if it is professionally facilitated. A goal of the establishing a subcommittee is to provide a forum for developing community buy-in for the plan and any assessments that might be levied on private well owners. A professional facilitator maximizes the potential for achieving this goal because a professional facilitator job is to support the group in reaching agreement on the work it is doing.

3. Staffing
   A preliminary assessment is that 1.5 FTE of additional staffing resources will be needed to support the GSA during the coming couple of years. The half FTE would be for administrative support for the GSA and for any subcommittee created by the GSA to work on the GSP.

   The addition of a full time position would be to focus on work required to update and revise the 2007 plan to meet the requirements of the GSP. To meet this need, the SWG has been discussing a range of possible options including the following:
   a. Hire the work out to a engineering/technical firm that has the capacity to take the significant quantities of available data and work through the document section by section updating it – key skill sets needed probably include writing experience as much or more than technical skills, which would continue to be available through existing consultant contracts.
   b. Hire a staff person to be housed at one of the agencies (or possibly through the Regional Water Management Foundation) to support the GSP development process and provide routine staffing to the GSP Development Subcommittee The new person would likely need to bring a planning, project manager or engineering type skill set, and would not substitute for the ongoing active involvement of GSA Member Agency executive level staff. Under this option, this new position would do much of the work updating the plan and would provide additional staff support to the GSA subcommittee working on the plan.
   c. Absorbing the work by making assignments to staff in the various GSA agencies. Given available resources and existing commitments, the SWG has concluded that this approach doesn't seem practical nor is it likely to result in timely performance, much less effective support for the Subcommittee.

The SWG is seeking feedback from the SAGMC on the proposed approach to developing the plan, the initial staffing assessment, the resource requirement, and potential strategies for providing the resources needed to get the job done.

POSSIBLE ACTIONS

1. Provide feedback to Member Agency staff to be used in further developing the work plan for the development of the GSP and resource support strategy for further consideration at a future SAGMC/GSA meeting; or
2. No action.

By Rosemary Menard
on behalf of the staff executive team of
John Ricker, Ralph Bracamonte, Ron Duncan and Rosemary Menard

	California Water Code - Part 2.74 - Sustainable Groundwater Management		
	Focus	**Groundwater Sustainability Plan (GSP) Required and Related Components**	**Information Sources and other Notes**
Plan Components	Land Use Planning - Growth Projections	A groundwater sustainability plan **shall take into account the most recent planning assumptions** stated in local general plans of jurisdictions overlying the basin.	Use content from work being done to update 2015 Urban Water Management Plans as the source documents for this.
	Physical Description	A description of the physical setting and characteristics of the aquifer system underlying the basin that **includes historical data to the extend available**	General sources for this information are the 2007 AB 3030 Groundwater Management Plan, and annual updates (available for Water Years 2011 and 2012), additional BIG products, plus documents such as the boundary revision report
	Groundwater Conditions	Groundwater levels, groundwater quality, subsidence, and groundwater-surface water interaction.	Use historical quartly monitering plus anything relevant from the recent peer review related to safe groundwater levels
	Historical Supply and Demand	A general discussion of historical and projected water demands and supplies.	Information of historical usage and customer demands is available for the areas served by the public water systems. Might make sense to think about how to convey the historical trends of private well development and/or small system development over time.
	Basin Boundary Map	A map that details the area of the basin and the boundaries of the groundwater sustainability agencies that overlie the basin that have or are developing groundwater	November 2015 Basin Boundary Change Report
	Recharge Area Map	A map identifying existing and potential recharge areas for the basin. The map or maps shall identify the existing recharge areas that substantially contribute to the replenishment of the groundwater basin. The map or maps shall be provided to the appropriate local planning agencies after adoption of the groundwater sustainability plan.	For a starting point, see Figure 5-2 (page 101) of the 2007 Update of the Groundwater Management Plan, with data to be revised based on any additional work done since the preparation of the 2007 plan update plus any relevant work of Andy Fisher's Recharge Initiative (see: http://es.ucsc.edu/~afisher/RechargeInitiative/index.htm)
Objectives and Implementation	Measurable Objectives	Measurable objectives, as well as interim milestones in increments of five years, to achieve the sustainability goal in the basin within 20 years of the implementation of the plan.	As a starting point, see Section 4 of the 2007 Update of the Groundwater Management Plan plus the more recent discussions in the 2011 and 2012 annual update documents prepared to provide progress reports on the status of work on implementing the plan. I think this information is a strong foundation upon which to build a revised/updated plan.
	How to meet objectives and obtain sustainability	A description of how the plan helps meet each objective and how each objective is intended to achieve the sustainability goal for the basin for long-term beneficial uses of groundwater.	As a starting point, see Section 4 of the 2007 Update of the Groundwater Management Plan plus the more recent discussions in the 2011 and 2012 annual update documents prepared to provide progress reports on the status of work on implementing the plan. I think this information is a strong foundation upon which to build a revised/updated plan.
		***The plan may, but is not required to** , address undesirable results that occurred before, and have not been corrected by, January 1, 2015. Notwithstanding paragraphs (1) to (3), inclusive, a groundwater sustainability agency has discretion as to whether to set measurable objectives and the timeframes for achieving any objectives for undesirable results that occurred before, and have not been corrected by, January 1, 2015.*	I believe we have pretty much determined that this needs to happen for this basin. The compelling reason is that the threat of seawater intrusion to this basin requires that we restore basin conditions to a sustainable level rather than just maintain the current conditions.
	Planning/Implementation Horizon	A planning and implementation horizon.	Presumably the plan would cover the 20 year window that would be the maximum available time to bring the basin to a point of being sustainable.
		Components relating to the following, as applicable to the basin:	
Plan Components	Groundwater Level Monitoring	The monitoring and management of groundwater levels within the basin.	Section 3.4 of the 2007 Groundwater Management Plan described current conditions for groundwater levels and extractions. Section 5, Element 1 of the 2007 Groundwater Management Plan focus's on Groundwater Monitoring. This information, along with the updated information in the 2011 and 2012 annual update reports and the quarterly monitoring data that has been developed and presented to the BIG and SAGMC over the years is a strong foundation for building this element of the plan. Finally Section 5 Element 8 describes approaches to Managing Pumping.
	Groundwater Quality Monitoring	The monitoring and management of groundwater quality, groundwater quality degradation, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin.	Section 3.5 of the 2007 Groundwater Management Plan provides baseline information on Natural Groundwater Quality. In addition, Section 5, Element 1 of the 2007 Groundwater Management Plan focus's on Groundwater Monitoring, including monitoring water quality parameters. This information, along with the updated information in the 2011 and 2012 annual update reports and the quarterly monitoring data that has been developed and presented to the BIG and SAGMC over the years is a strong foundation for building this element of the plan.
	Mitigation	Mitigation of overdraft.	Elements 4, 5, 6, 7, 8, 9, 10, and 13 of the 2007 Plan and the additional information provided in the 2011 and 2102 annual status reports provide information on strategies being pursued to mitigate overdrafts.
	Recharge Possibilities	How recharge areas identified in the plan substantially contribute to the replenishment of the basin.	Elements 7, of the 2007 Plan and the additional information provided in the 2011 and 2102 annual status reports provide information on the role of recharge and efforts to protect and enhance basin recharge. There is also a reference in the 2012 update to a study to evaluate the relationship between precipitation levels and recharge, but I didn't see specific information on results of this work.
	Surface Supply Available for Recharge/In-Lieu	A description of surface water supply used or available for use for groundwater recharge or in-lieu use.	Probably the most relevant work here is from the analysis the City did of opportunities for in lieu and ASR, which built on work done by Kennedy Jenks on the water exchanges and water transfer study
	Monitoring Site Descriptions	A summary of the type of monitoring sites, type of measurements, and the frequency of monitoring for each location monitoring groundwater levels, groundwater quality, subsidence, streamflow, precipitation, evaporation, and tidal influence. The plan shall include a summary of monitoring information such as well depth, screened intervals, and aquifer zones monitored, and a summary of the type of well relied on for the information, including public, irrigation, domestic, industrial, and monitoring wells.	Monitoring information is available in Section 5 Element 1 of the 2007 Groundwater Management Plan plus in the regular quarterly monitoring reports that are developed and routinely provided to the SAGMC (and to its predecessor, BIG).
	Monitoring Protocols	Monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem, and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin. The monitoring protocols shall be designed to generate information that promotes efficient and effective groundwater management.	
	Potential Effects of GSP on Local Water Resources-Related Land Use Planning Documents	A description of the consideration given to the applicable county and city general plans and a description of the various adopted water resources-related plans and programs within the basin and an assessment of how the groundwater sustainability plan may affect those plans.	
		In addition to the requirements of Section 10727.2, a groundwater sustainability plan **shall include**, where appropriate and in collaboration with the appropriate local agencies, **all of the following**:	Quite a bit of the remaining items are covered inSections 4, 5, and 6 in the 2007 plan and the 2011 and 2012 annual updates. This work is a solid foundation on which to build the plan elements that have to be developed for the GSP.
	Seawater Intrusion	Control of saline water intrusion.	
	Wellhead Protection	Wellhead protection areas and recharge areas.	
	Migration of Contaminated Water	Migration of contaminated groundwater.	
	Well Abandonment	A well abandonment and well destruction program.	
	Groundwater Replenishment	Replenishment of groundwater extractions.	
	Conjunctive Use Activities and Opportunities	Activities implementing, opportunities for, and removing impediments to, conjunctive use or underground storage.	
	Well Construction	Well construction policies.	
	?	Measures addressing groundwater contamination cleanup, recharge, diversions to storage, conservation, water recycling, conveyance, and extraction projects.	
	Conservation	Efficient water management practices, as defined in Section 10902, for the delivery of water and water conservation methods to improve the efficiency of water use.	
		Efforts to develop relationships with state and federal regulatory agencies.	
	Land Use Planning Agency Coordination	Processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity.	
	Environmental Impacts	Impacts on groundwater dependent ecosystems.	

November 17, 2016

MEMO TO THE MGA BOARD OF DIRECTORS

Subject: Agenda Item 5.3

Title: Approve HydroMetrics WRI Scope of Work and Budget for Biennial Report

Attachment:
1. Scope for 2015-2016 Biennial Review & Report from HydroMetrics, Dated November 3, 2016

Purpose
This item requests approval of the HydroMetrics WRI Scope of Work and associated budget for the biennial report regarding the state of the groundwater basin.

Introduction
The Soquel-Aptos Groundwater Management Committee decided it was more appropriate and cost effective to have a biennial report (versus an annual report) on the state of the groundwater basin. The quarterly monitoring updates still provide a mechanism to be informed on any basin changes that might occur between biennial reports.

Scope of Work
Attachment 1 contains a Scope of Work from HydroMetrics for the biennial report for water years 2015 and 2016. The biennial report uses the context of the Groundwater Management Plan to update the MGA on basin conditions and activities over the last two years with the goal of supporting Sustainable Groundwater Management Act (SGMA) implementation. The MGA Fiscal Year 2016/17 budget for this effort is $50,000. The proposed Scope of Work is estimated at $49,640.

Waiver of Purchasing Policy
The MGA purchasing policy states that services over $45,000 will be selected based on a Request for Qualification process. However, in this situation it seems prudent to contract directly with HydroMetrics. Thus, staff recommends that the Board waive the standard RFQ process and award the contract to HydroMetrics for a cost not-to-exceed $49,640.

Possible Board Actions:

1. By MOTION, waive the MGA's standard purchasing policy requirements.

2. By MOTION, approve the Scope of Work as presented by HydroMetrics WRI and authorize the authorized staff representatives to sign a purchase order in the amount not to exceed $49,640.

By _____

Ron Duncan
General Manager
Soquel Creek Water District

519 17th Street, Suite 500
Oakland, CA 94612

Mr. Ron Duncan
General Manager
Soquel Creek Water District
On behalf of Santa Cruz Mid-County Groundwater Agency Executive Staff
P.O. Box 1550
Capitola, CA 95010

November 3, 2016

Subject: Scope for 2015-2016 Biennial Review and Report

Dear Mr. Duncan:

Annual Review and Reports (ARR) of the Soquel-Aptos Groundwater Management Plan (GMP) were prepared for Water Years 2009-2014 using an approach based on updating a living document. The approach aims to meet the following goals:

- Control the annual cost of reporting;
- Better summarize the overall condition of the production aquifers;
- Provide a reference for assessing changes from year to year; and
- Review the status of the GMP implementation.

The Soquel-Aptos Groundwater Management Committee, decided not to prepare an ARR for Water Year 2015 as it focused on first steps for implementation of the Sustainable Groundwater Management Act (SGMA). The Santa Cruz Mid-County Groundwater Agency (MGA) was formed and is the Groundwater Sustainability Agency (GSA) for the Santa Cruz Mid-County Groundwater Basin. This year, the MGA budgeted preparation of a Biennial Review and Report (BRR) that will update the living document based on conditions for Water Years 2015-2016.

As the Biennial Review and Report will be prepared for the MGA, it will include a couple of changes to support SGMA implementation:

- It will cover the Santa Cruz Mid-County Groundwater Basin that has been approved by California Department of Water Resources (DWR) based on the MGA's basin boundary modification request. Previously the ARRs covered a slightly different area called the Soquel-Aptos Groundwater Management Area.
- It will include components for Annual Reports in DWR's regulations for Groundwater Sustainability Plans (GSP), provided information to prepare those components are readily available.

The BRR should not be considered a renewal of the GMP, which is not allowed under SGMA, nor will it fully meet GSP requirements. Instead, the purpose of the BRR is to use the context of the GMP to update the MGA on basin conditions and activities over the last two years with the goal of supporting SGMA implementation. HydroMetrics WRI is pleased to submit this scope of work to prepare the BRR to meet this purpose.

Biennial Report Update

Starting with the Water Year 2009 ARR, we have created a living document that is updated with new information on basin conditions each year. The Soquel-Aptos Basin Implementation Group (BIG) and Soquel-Aptos Groundwater Management Committee approved the six reports for Water Years 2009 through 2014, and expressed satisfaction with the revised format. For the Water Years 2015-16 update of the living document, we will add and replace report sections as described in the document's Section 1.2. In general, summaries and maps of previous water years will remain in the binder as similar summaries and maps for Water Years 2015-2016 are added. Section 6 reviewing the status of GMP implementation will be updated through Water Year 2016. Graphs showing multi-year conditions, such as graphs of pumping, precipitation, water levels, and water quality, will be replaced with graphs updated through Water Year 2016. Table 1-1 from the report is reproduced as Table 1 below to summarize the items included in the report.

The BRR update will not include new recommendations section for section. It may be more appropriate that this type of basinwide planning be part of the GSP development process.

Table 1: Summary of Items to Add or Replace for Each Annual Report

Report Item	Add or Replace in Report
Executive Summary	Add
Section 1 - Background and Scope	Replace
Section 2 - Basinwide Conditions	
Text	Add
Precipitation and pumping charts	Replace
Pumping tables	Replace
Maps	Replace
Section 3 - 5 - Aquifer Conditions	
Text	Add
Summary tables	Add
Pumping charts	Replace
Contour maps	Add
Hydrographs	Replace
Chemographs	Replace
Section 6 - GMP Implementation Status	Replace
Section 7 - Recommendations	*No Update*

Additional Components Based on GSP Regulations

The ARRs already include most of the Annual Report components listed in the GSP regulations (Section 356.2). There are a few aspects of these components that will be expanded upon in this BRR update to more completely meet the requirements in the regulations:

1. Contour maps for spring and fall will be added including groundwater levels for the Purisima DEF aquifer unit as the regulations require contour maps for each principal aquifer in the basin.
2. Groundwater extraction will be updated to include estimates for non-municipal water use that have been developed for the groundwater model.

There are two Annual Report components in the regulations that have not been included in the ARRs. These components will be added because this information is readily available.

1. Surface water supply available for groundwater recharge or in-lieu use. We will provide this information from the recent County and City of Santa Cruz studies.
2. Information on total water use in addition to groundwater extraction. Although most of water use is from groundwater extraction, which has been provided in previous ARRs, we will provide information on total water use based on data and estimates compiled for the groundwater model.

The component of reporting groundwater in storage that is required in the regulations will not be included in this BRR update because the best tool to estimate this will be the groundwater model, which is still under development.

Use of New Database

Although we have set up calculations, mapping, and plotting of groundwater data for previous ARRs, there will be additional work this year to rework the setups to use data extracted from Soquel Creek Water District's (SqCWD) recently implemented WISKI database. The WISKI database allows for more use of data recorded by automatic loggers and those data will be included in this BRR update.

Report Review

In accordance with the procedures outlined in the GMP, the administrative draft of the updates for the 2015-2016 BRR will first be presented for review and comment to the Basin Advisory Group (BAG), comprising technically qualified staff from SqCWD, Central Water District, City of Santa Cruz, County of Santa Cruz, and Pajaro Valley Water Management Agency (PVWMA). This is now essentially the staff from the MGA member agencies, plus Brian Lockwood of PVWMA. After comments from the BAG have been addressed and incorporated into the updates, a draft of the updates will then be provided to the MGA Board. The final updates for compilation into the living document will be prepared using comments received from the MGA Board. A final electronic version of the current living document will be created in PDF format for distribution by the MGA.

Meetings

Two meetings will be required for the 2015-2016 BRR:

Meeting 1 - Discussion of administrative draft updates to the BRR to the Basin Advisory Group (BAG).

Meeting 2 - Presentation of final draft updates to the BRR to the MGA Board

The cost estimate for meetings assumes a comprehensive presentation will not be prepared for the BAG meeting, but a short summary presentation will be prepared for the MGA Board meeting. It is assumed that only one HydroMetrics WRI representative will attend the meetings.

Cost

The estimated cost breakdown for BRR is attached. Billing rates are based on rates contracted with Soquel Creek Water District for 2016-2017. The estimated cost to prepare the 2015-2016 BRR is $49,640.

Schedule

The schedule for the BRR is based on meeting the following milestones:

Early December 2016:	HydroMetrics WRI receives required data.
End January 2017:	Administrative draft (electronic) provided to BAG for review
Mid February 2017:	BAG meeting
Early March 2017:	Draft updates provided (PDF version) for distribution in MGA Board packet
March 16, 2017:	MGA Board meeting
Early April 2017:	Final updates incorporated into PDF of living document for ARRs covering Water Years 2009-2016

Please contact me if you have any questions.

Sincerely,

Cameron Tana, Vice President
HydroMetrics Water Resources Inc.

Cc: Ralph Bracamonte, Central Water District
Rosemary Menard, City of Santa Cruz
John Ricker, County of Santa Cruz

Attachment: Cost Estimate

Tasks	HydroMetrics WRI Labor						Other Direct Costs	TOTALS
	Derrik Williams	Cameron Tana	Georgina King	Staff	Labor Total			
	President	Vice President	Principal Hydrogeologist	Hydrologist				
Rates	$210	$195	$185	$120	Hours	($)	($)	($)
Biennial Report and Review								
GIS maps of locations and areas (executive summary and Section 2)	0	2	4	16	22	$ 3,050		$ 3,050
Add water use and surface water availability estimates (Section 2)	0	4	16	4	24	$ 4,220		$ 4,220
Update pumping and rainfall tables and plots (Sections 2-5)	0	2	8	8	18	$ 2,830		$ 2,830
Set up and update hydrographs and chemographs with WISKI (Sections 3-5)	0	8	4	48	60	$ 8,060		$ 8,060
GIS maps of contour maps including DEF groundwater levels (Sections 3-5)	2	8	16	72	98	$ 13,580		$ 13,580
Describe basin conditions and update tables with WISKI data (Sections 3-5)	1	24	8	16	49	$ 8,290		$ 8,290
Update basin management sections (Section 6)	1	8	0	8	17	$ 2,730		$ 2,730
BAG and MGA Meetings	0	24	4	4	32	$ 5,900	$ 200	$ 6,100
Finalize Report	0	4	0	0	4	$ 780		$ 780
TOTAL	***4***	***84***	***60***	***176***	***324***	***$ 49,440***	***$ 200***	***$ 49,640***

November 17, 2016

MEMO TO THE MGA BOARD OF DIRECTORS

Subject: Agenda Item 6.1

Title: HydroMetrics WRI Update on Climate Change Approach & Scenarios

Attachments:

1. Draft Technical Memorandum from HydroMetrics WRI titled "Concepts for Model Simulations (Task 5), dated November 4, 2016

2. Draft Technical Memorandum from HydroMetrics WRI titled "Santa Cruz Mid-County Basin Groundwater Flow Model: Future Climate for Model Simulations (Task 5)", dated November 4, 2016

Purpose

This memo provides the draft technical memorandums associated with the groundwater modeling simulations and the climate change approaches being considered for the Santa Cruz Mid-County Groundwater Agency (MGA). The Technical Advisory Committee (TAC) and agency staff will provide recommendations for final input selection. However, this memo also provides MGA Board members the opportunity to review the simulations and climate scenarios being considered and provide input if desired.

Summary of Attachments

Attachment 1 describes the three basic groundwater management strategies proposed to be evaluated for the MGA groundwater modeling and they include: (a) in-lieu recharge, (b) injection of highly purified water, and (c) aquifer storage and recovery (ASR) of treated surface water. Attachment 2 provides two climate scenarios: (a) temperature weighted and (b) temperature weighted with adjustments for participation. One of the two climate scenarios presented in this memo will be selected to run simulations using the groundwater model.

Possible Board Action:

1. Informational, no motion necessary but direction may be provided.

By _____

Ron Duncan
General Manager
Soquel Creek Water District

1814 Franklin St, Suite 501
Oakland, CA 94612

DRAFT TECHNICAL MEMORANDUM

To: Mid-County Groundwater Agency Executive Staff

From: Cameron Tana

Date: November 4, 2016

Subject: Concepts for Model Simulations (Task 5)

1. Introduction

This technical memorandum documents concepts for simulations of future groundwater management alternatives using the GSFLOW model of the Santa Cruz Mid-County Groundwater Basin (Basin) currently under development. The goal of the simulations is to evaluate strategies to recover the Basin to achieve sustainability by 2040 and maintain sustainability beyond that.

2. Groundwater Management Strategies and Plans

The simulations will evaluate three basic groundwater management strategies that have been proposed in the basin: in-lieu recharge, injection of highly purified water, and aquifer storage and recovery (ASR) of treated surface water.

These strategies can be achieved with various supplemental supplies, some of which are already being evaluated by member agencies of the Santa Cruz Mid-County Groundwater Agency..

1. In-lieu recharge is essentially a reduction in pumping. This can be achieved by conservation, transfer of surface water supply, desalination, and direct potable reuse.
2. Injection of highly purified water involves dedicated injection wells that support pumping at other wells. This is the strategy behind the Pure Water Soquel project that is currently undergoing environmental review by Soquel Creek Water District (SqCWD). The City of Santa Cruz (City) also is undergoing a Recycled Water Facilities Planning Study (RWFPS) that includes evaluation of this strategy.

3. Aquifer storage and recovery is being evaluated by the City of Santa Cruz that would store excess surface water treated to drinking water standards and extraction from the same wells as water supply during drought years.

Although the simulations of these strategies for the MGA will be based on projects being planned or evaluated by SqCWD and City, they will not be exactly the same in order to focus the simulations on evaluating individual strategies to sustainability for the whole basin. SqCWD and the City's specific projects have additional goals besides basin sustainability but the MGA simulations can help guide those evaluations. Additional runs are already planned for those projects separate from the MGA scope.

In addition, these initial MGA simulations will evaluate the three strategies individually, even though the strategies could be implemented in combination. Based on results of these simulations, the MGA can scope additional runs to evaluate different variations or combinations of strategies.

3. Simulation Assumptions

3.1. Pumping and Injection

The assumed pumping and injection for the simulations are based on demand history and projections as well as plans that have been developed by SqCWD and the City with modifications to focus on sustainability for the whole basin.

The no-project simulation that will be used for Pure Water Soquel EIR will also be used for basis of comparison for the three management scenarios. Pumping will be based on demand from before the most recent drought, demand projections, or specified pumping plans.

The in-lieu recharge simulation will be based on pumping amounts or estimates achieved by conservation during the most recent drought and a potential transfer of City winter surface water supply to SqCWD based on current infrastructure limits.

The injection of highly purified water simulation is based on an expansion of the Pure Water Soquel project that uses full injection capacity of all potential injection well sites that SqCWD has identified because the Pure Water Soquel project is not planned to inject enough water to achieve basinwide recovery and sustainability. Although total pumping will be the same as no-project simulation, the simulation will include redistribution of pumping to pump more in aquifers receiving injection in order to reduce pumping in aquifers not receiving injection.

The ASR simulation is based on Building Block 2 of the City's Water Supply Advisory Committee Building Block memo (WSAC, 2015) with injection based on available surface water supply, and recovery for City supply based on its demand shortfall. In order to ensure there is always net progress for basin recovery and sustainability, the City's cumulative recovery will be limited to a percentage of what is cumulatively injected. Although pumping beyond ASR recovery will be the same as no-project simulation, the simulation will include redistribution of pumping to pump more in aquifers receiving injection in order to reduce pumping in aquifers not receiving injection.

The total amounts of supplemental supply are different for each of these simulations as they are based on preliminary documentation of what is reasonably feasible. The simulations are not based on previous estimates for basinwide pumping goals for recovery and long-term sustainability based on water balance evaluations (HydroMetrics WRI, 2015). The different strategies may be able to achieve recovery and sustainability at different yield values so it is our recommendation to evaluate strategies based on what is currently considered feasible rather than targeting a generalized basinwide estimate.

3.2. Climate Data Sets

Each simulation will initially be run on two climate data sets:

1. The historical climate of Water Years 1985-2015 that is the calibration period. It is important to simulate for calibrated climate conditions when comparing simulation results.
2. An initial climate change scenario based on a catalog of historical climate as documented in a separate memo. This simulation will also include adjustment of offshore boundary condition for sea level rise.

4. Model Results Evaluation

The primary evaluation of model results will be of simulated groundwater levels, specifically in comparison with protective elevations that are estimated to protect the Basin's production aquifers from seawater intrusion. Pending development of measurable objectives for the MGA's Groundwater Sustainability Plan, achieving protective elevations at all coastal monitoring wells will define basin recovery and maintaining groundwater levels at those elevations will define long-term sustainability.

Even though there are plans to implement the Seawater Interface (SWI2) package in the GSFLOW model, it still makes sense to compare groundwater level results to protective elevations that represent the range of possible offshore aquifer properties that cannot be calibrated due to the lack of groundwater level data in offshore aquifers. However, simulated seawater interface results may lead to the need to re-evaluate protective elevations.

The other main model output that will be evaluated will be water budget components, most notably effects on streamflows.

5. References

HydroMetrics WRI, 2015, Estimated Effects on Sustainable Yield and Pumping Goals of Climate Change and Updated Basin Consumptive Use Using Water Balance Approach, technical memorandum to Ron Duncan, Soquel Creek Water District, October 27.

WSAC Technical Team, 2015, Updated Information on Portfolio Building Blocks, prepared for City of Santa Cruz Water Supply Advisory Committee, July 1.

HydroMetrics WRI
1814 Franklin St, Suite 501
Oakland, CA 94612

DRAFT TECHNICAL MEMORANDUM

To: Mid-County Groundwater Agency Executive Staff

From: Georgina King and Cameron Tana

Date: November 4, 2016

Subject: Santa Cruz Mid-County Basin Groundwater Flow Model: Future Climate for Model Simulations (Task 5)

Contents

1.0 INTRODUCTION

This technical memorandum documents our approach for developing an initial future climate scenario to be implemented with simulations using the GSFLOW model of the Santa Cruz Mid-County Groundwater Basin currently under development, and presents two proposed climate scenarios. Climate data used in GSFLOW includes minimum and maximum temperature, and precipitation at the Santa Cruz Co-op and Watsonville Waterworks stations.

The objective of this subtask is to develop a reasonable climate scenario that adequately represents the warmer temperatures that are being predicted due to global climate change. At the August 24, 2016 TAC meeting, Prof. Andrew Fisher suggested using a catalog of historical annual climate instead of one of the multitude of General Circulation Models (GCM) available for future climate scenarios. The premise of this approach is that we use actual historical climate data representing the warmest years on record and not modeled climate data such as GCM. This approach is appropriate because to retain integrity of the climate data, the future climate scenario must have temperature data that corresponds to precipitation data, which is ensured by using historical data. A similar approach using historical data instead of using future climate predictions is used by Metropolitan Water District of Southern California to evaluate its region's future water supply reliability (MWD, 2016).

As discussed in our revised scope of work for fiscal year 2016-2017 approved by the MGA Board, downscaling one or more GCM scenarios to develop additional climate change scenarios has been re-prioritized for implementation in 2017. This is still recommended because the GCMs predict temperatures warmer than even the warmest years on record.

2.0 CLIMATE DATASETS

2.1 SANTA CRUZ CO-OP STATION

The Santa Cruz Co-op station has climate data available from January 1893 through present. Figure 1 shows the average annual temperature ranges and overall average for Water Years 1894 through 2016. It is visually evident that minimum temperatures have been higher since 1977. Maximum temperatures do not show the same trend, perhaps because of the moderating influence of the ocean. Expectedly, average annual temperatures also show an increase, but of a lower magnitude than the minimum temperature increase due to more stable maximum temperatures. Water Years 2013 through 2016 have four of the five hottest average annual temperatures in the record. Table 1 illustrates that post-1977, average annual temperatures at the Santa Cruz Co-op

station are 1.3° F warmer than before 1977. The 1985-2015 average for the model calibration period is also shown.

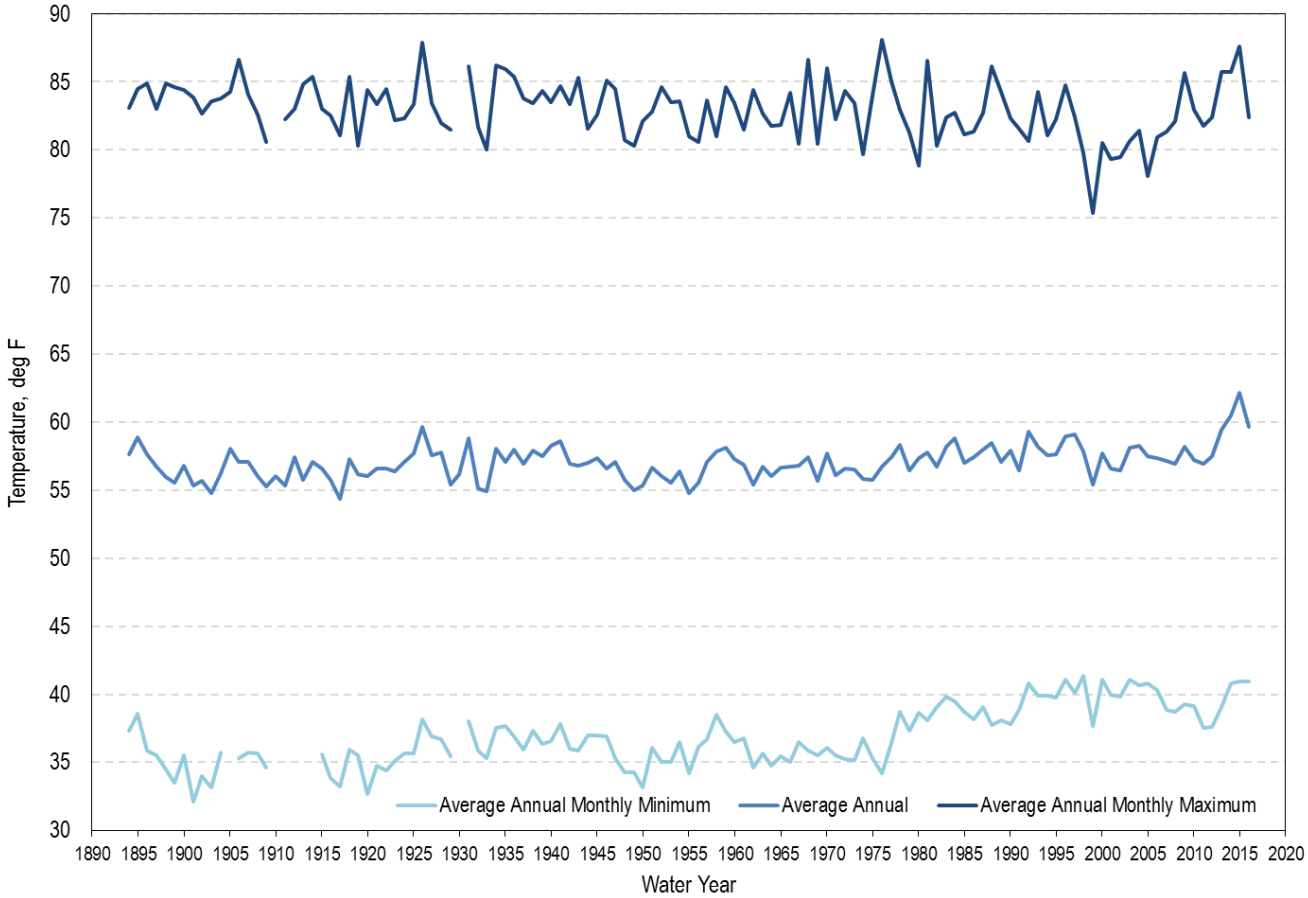


Figure 1: Measured Minimum, Maximum, and Average Annual Temperatures at the Santa Cruz Co-op Station

Table 1: Santa Cruz Co-op Station Average Annual Temperatures for Selected Periods

Annual Temperature, °F	
1985-2015 Average	57.9
1977-2016 Average	57.9
Pre-1977 Average	56.6
1894-2016 Average	57.0

Figure 2 presents the annual precipitation recorded at the Santa Cruz Co-op station. The average annual precipitation for various periods of interest are provided in Table 2. Although the chart on Figure 2 does not show any discernible trends, the averages in Table 2 indicate that pre-1977 precipitation was very slightly lower than that experienced

from 1977 onwards. In general however, the data do not show a trend that is visually evident like temperature.

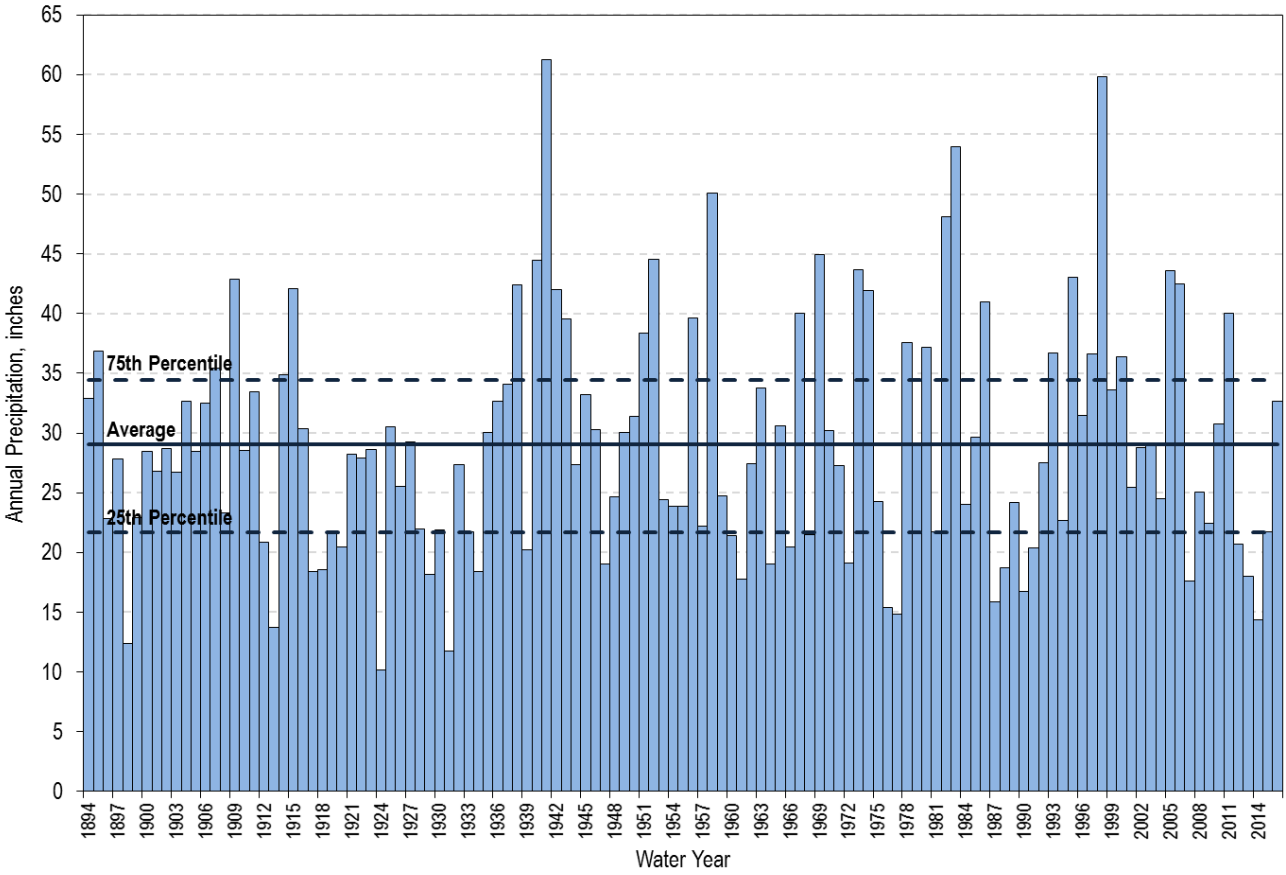


Figure 2: Annual Precipitation at the Santa Cruz Co-op Station

Table 2: Santa Cruz Co-op Station Average Precipitation for Selected Periods

Annual Precipitation, inches	
1985-2015 Average	29.0
1977-2016 Average	30.0
Pre-1977 Average	28.7
1894-2016 Average	29.1

2.2 WATSONVILLE WATERWORKS STATION

The Watsonville Waterworks station has climate data available from January 1908 through present. Figure 3 shows average annual temperature ranges and overall average for Water Years 1909 through 2016; note there were a number of missing records in the monthly data used to generate the annual averages; therefore those years are not included on the chart. The line showing minimum temperatures has a clear increasing trend over the period of record, with a slight jump in temperatures from 1977 onwards where

minimum temperatures mostly remain consistently above pre-1977 temperatures. At this station, maximum temperatures also show an increasing trend like minimum temperatures but they are more muted. The Watsonville Waterworks station is 4.5 miles from the ocean compared to the Santa Cruz Co-op station which is two miles from the ocean, and has less effects from the ocean. Average annual temperatures also show a noticeable increase after 1977. Table 4 illustrates that post-1977, average annual temperatures at the Watsonville Waterworks station are 1.7 °F warmer than before 1977.

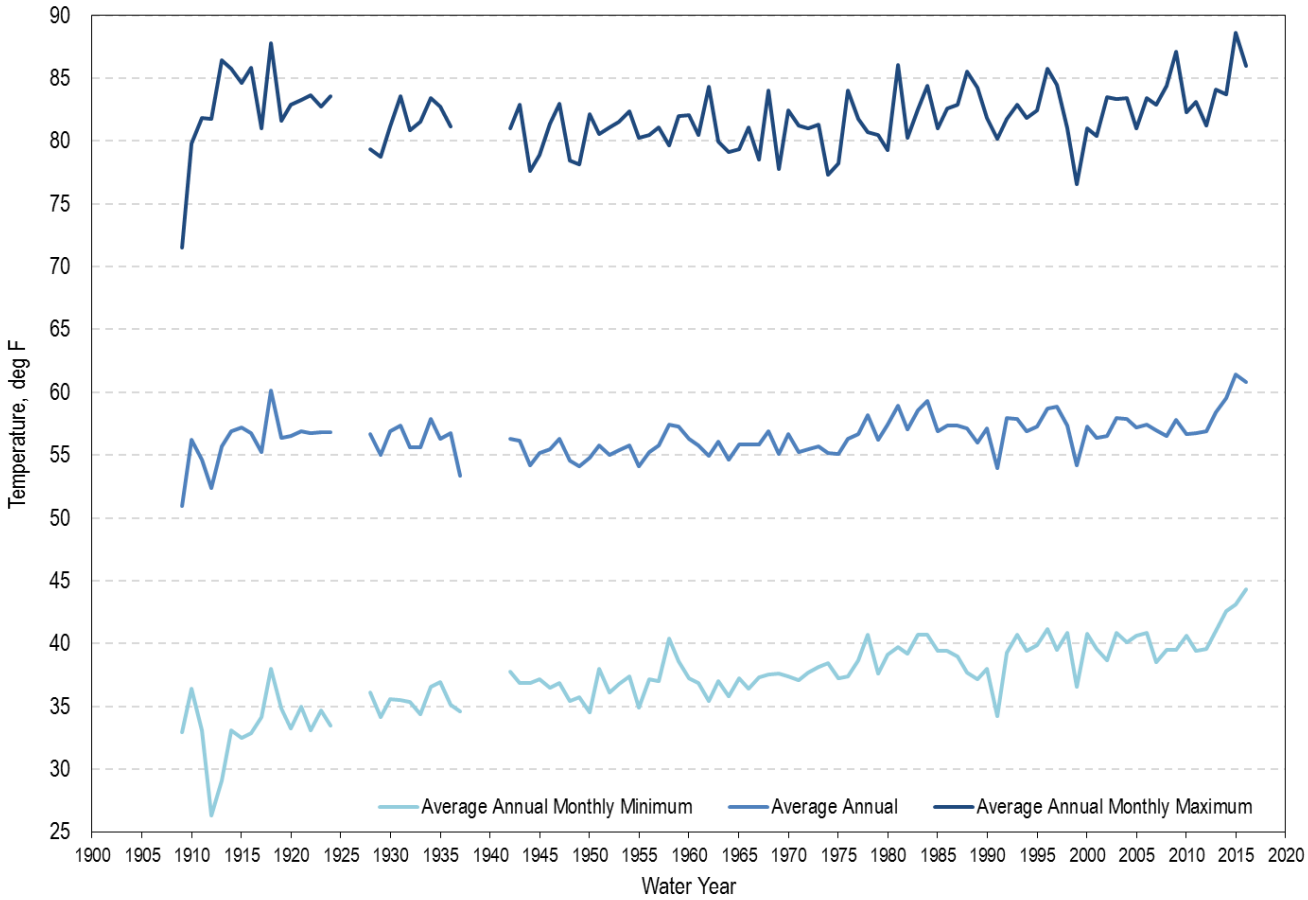


Figure 3: Measured Minimum, Maximum, and Average Annual Temperatures at the Watsonville Waterworks Station

Table 3: Watsonville Waterworks Station Average Annual Temperatures for Selected Periods

Annual Temperature, °F	
1985-2015 Average	57.3
1977-2016 Average	57.5
Pre-1977 Average	55.8
1894-2016 Average	56.5

Figure 4 presents the annual precipitation recorded at the Watsonville Waterworks station. The average annual precipitation for various periods of interest are provided in Table 4. The data suggest that since the 1980s, there has been an increase in the amount of precipitation at this station. This is confirmed in Table 4 where post-1977 precipitation is 2.8 inches more than before 1977.

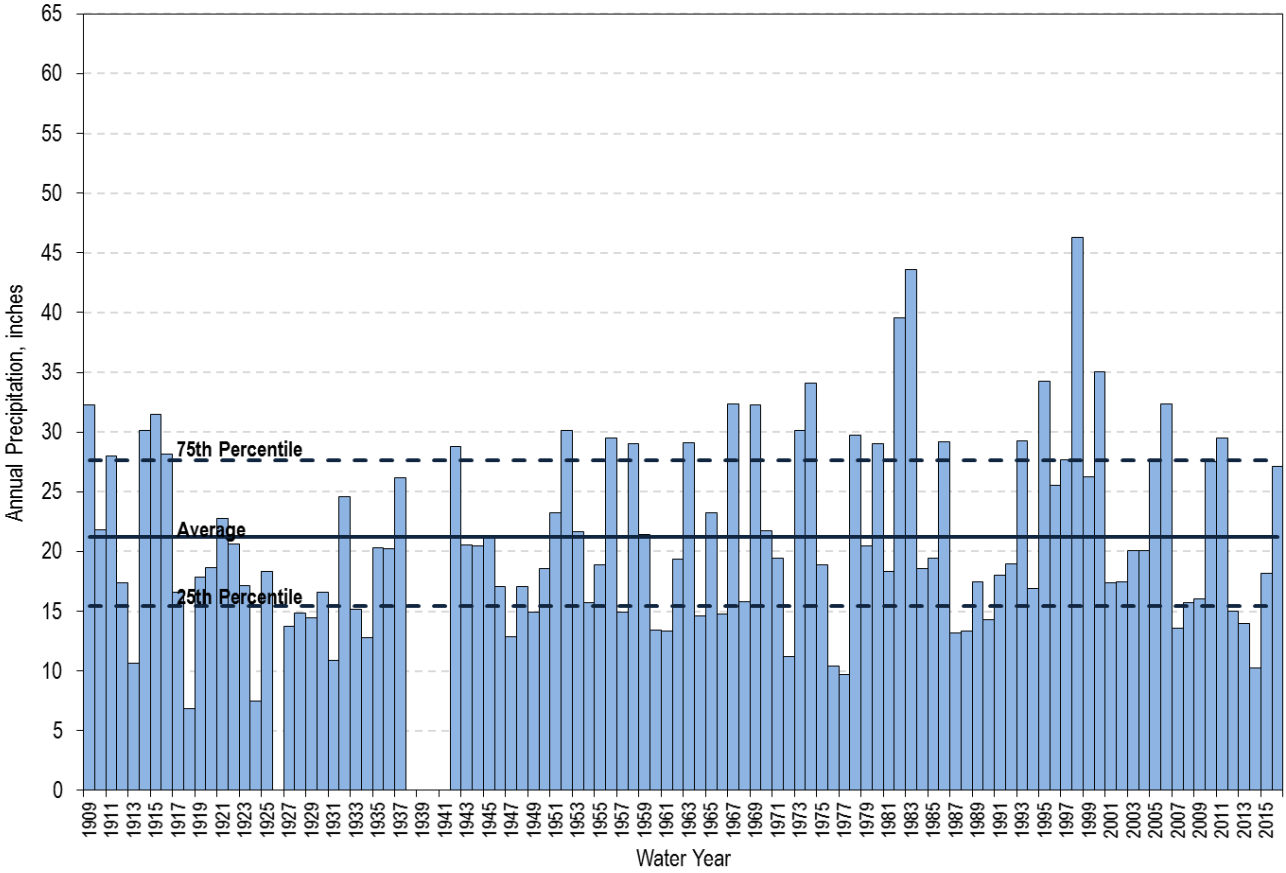


Figure 4: Annual Precipitation at the Watsonville Waterworks Station

Table 4: Watsonville Waterworks Station Average Precipitation for Selected Periods

Annual Precipitation, inches	
1985-2015 Average	21.9
1977-2015 Average	22.9
Pre-1977 Average	20.1
1909-2015 Average	21.2

3.0 APPROACH

3.1 CLIMATE CATALOG

Using the general method for creating a catalog of each historical year suggested by Prof. Andrew Fisher (Young, 2016), exceedance probabilities (p) for both temperature and precipitation are calculated using the following equation for the full dataset on record for the climate station:

$$p = \frac{m}{n+1}$$

where m is the rank based on total precipitation or temperature (from largest to smallest), and n is the total number of years in the dataset. A chart of exceedance probabilities for temperature and precipitation at the Santa Cruz Co-op station is provided on Figure 5. The catalog is based on the Santa Cruz Co-op station because the majority of model cells are assigned to it for rainfall distribution in PRMS, the watershed component of the GSFLOW model.

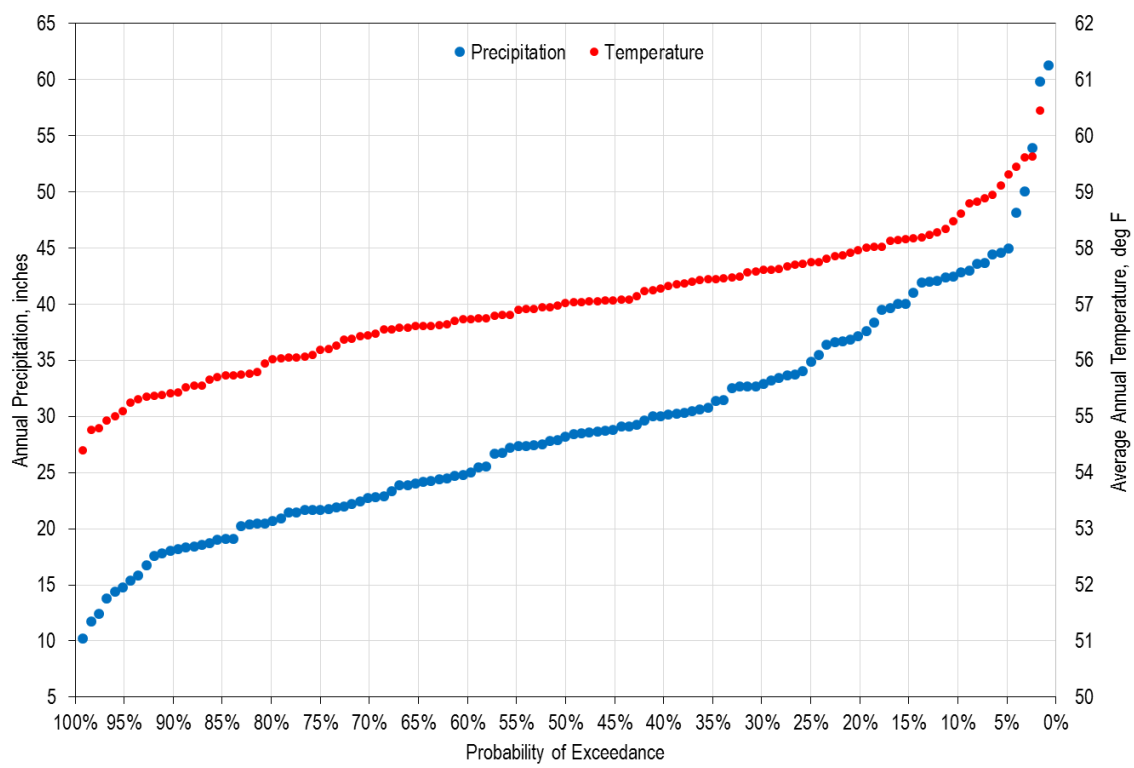


Figure 5: Probability of Exceedance for Annual Precipitation and Average Annual Temperature, Santa Cruz Co-op Station

Figure 6 and Figure 7 graphically show consecutive water years' probabilities of exceedance for temperature and precipitation at the Santa Cruz Co-op Station, respectively. Figure 6, similar to Figure 1, shows that since 1977, there has been an increased number of years that have less than a 50% probability of exceedance, i.e., warmer than the rest of the record. Figure 7 shows no visual trend towards either decreasing or increasing precipitation over time like temperature does.

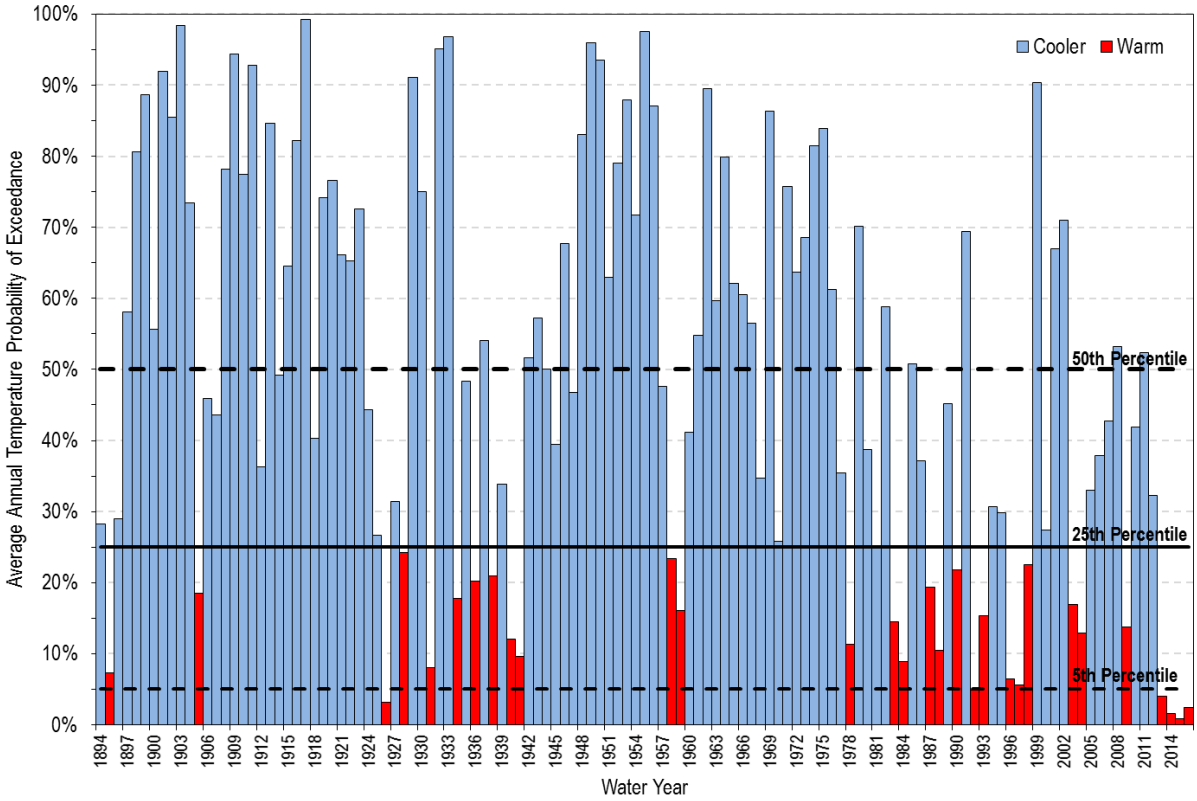


Figure 6: Average Annual Temperature Probability of Exceedance for the Santa Cruz Co-op Station

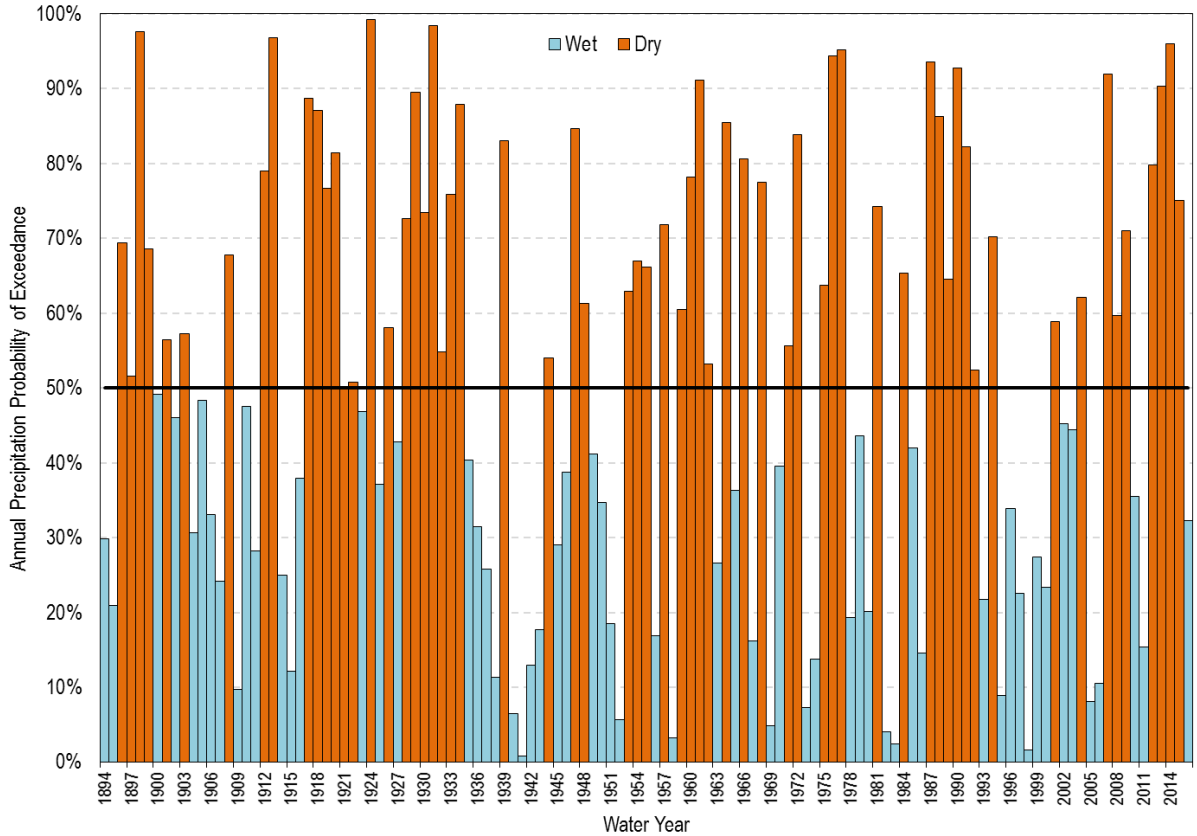


Figure 7: Annual Precipitation Probability of Exceedance for the Santa Cruz Co-op Station

Another way to visualize the climate data based on probabilities of exceedance is to classify each water year according to a combination of temperature and precipitation probabilities shown in Table 5. Appendix A provides the probabilities for all water years on record for the Santa Cruz Co-op Station, and Figure 8 presents the historical data color-coded by classification plotted against precipitation.

Table 5: Classification of Probabilities

Probability of Exceedance		Category
Precipitation	Average Temperature	
>= 50%	< 25%	Warm and Dry
< 50%	< 25%	Warm and Wet
< 50%	>= 25%	Cooler and Wet
>= 50%	>= 25%	Cooler and Dry

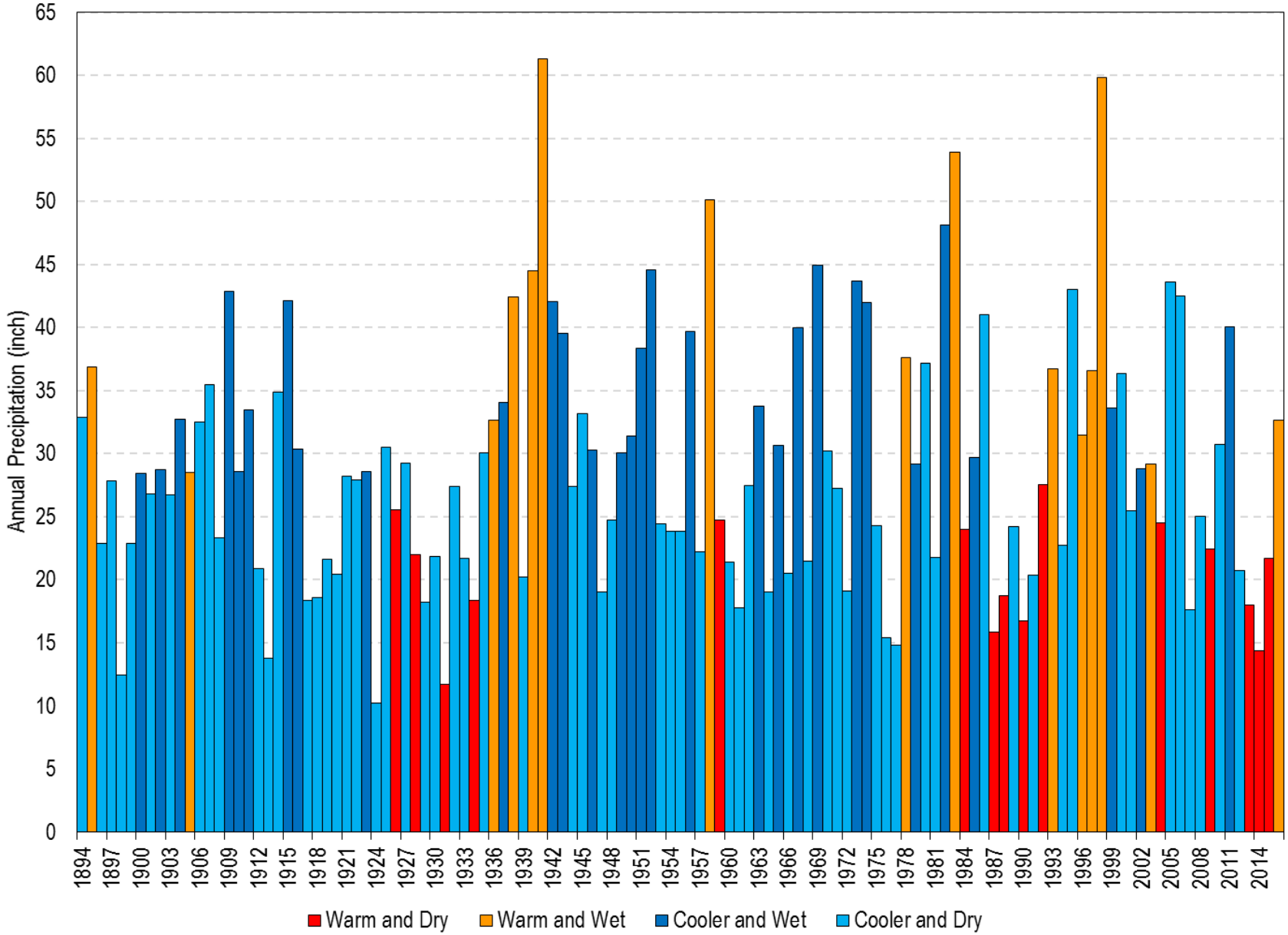


Figure 8: Santa Cruz Co-op Station Classification of Historical Water Years

3.2 FUTURE CLIMATE SCENARIO GENERATION

The future climate scenario will cover Water Years 2016-2069. This time span is selected to meet the requirement in California Department of Water Resources regulations for Groundwater Sustainability Plans (GSP) to evaluate sustainability for future climate over fifty years. Fifty years after the 2020 GSP deadline for the critically overdrafted Santa Cruz Mid-County Groundwater Basin goes through Water Year 2069. Water Year 2016 will be simulated based on recorded climate data using initial conditions from the end of the calibrated model run of Water Years 1985-2015. The 53 water years 2017-2069 will be simulated using the approach described below.

As temperature shows a much more evident trend than precipitation, the catalog of annual average temperature at the Santa Cruz Co-op station is used to generate one future climate scenario. First, a subset of historic climate is selected to form a catalog from which to generate the future climate scenario. The catalog of years selected are all the years from 1977 to 2016 representing the most recent period where warming has been observed, plus six additional years from 1909[1] to 1977 that have a temperature probability of exceedance of 25% or less, i.e., the warmest years and that don't have entire months of missing temperature data in the Watsonville Waterworks station record. See bold records in Appendix A for those years included in the catalog.

The catalog is then randomly ordered using the Random Number Generator in Excel to generate the scenario. The Random Number Generator uses weights applied to each water year to ensure a distribution of annual temperatures that is hotter than the historical record but still includes variability. Weights are assigned by categories of exceedance probabilities for temperature shown in Table 6. For example, the warmest category (<5% exceedance probability) is given a 50% weight and includes Water Years 1992, and 2013-2016. Warmer years are given greater weights than cooler years to ensure an overall warmer scenario is generated, while still including cooler years to include variability.

[1] Water Year 1909 was selected because this is the first water year for the Watsonville Waterworks station climate records. If we used prior years, there would be no climate data for the Watsonville Waterworks station for the future climate scenario for those years.

Table 6: Weights Assigned to Catalog of Water Years Based on Temperature Exceedance Probabilities

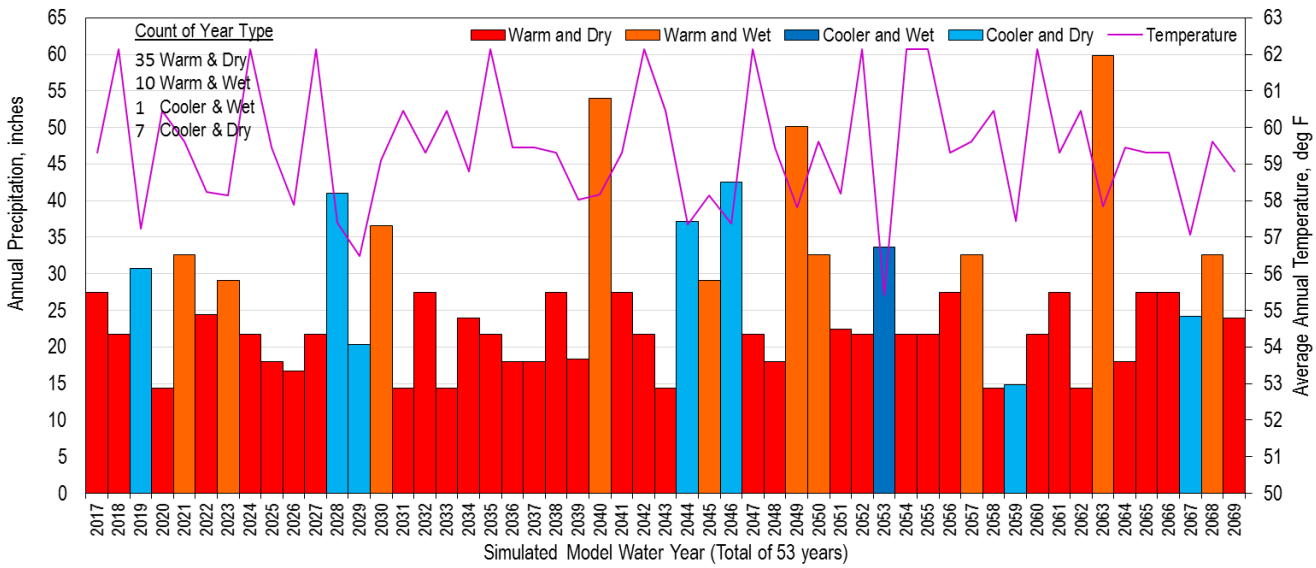
Exceedance Probability Category	Weight
< 5%	0.5
5 – 25%	0.3
>=25 – 50%	0.1
> = 50%	0.1

After the water year sequence is selected based on the Santa Cruz Co-op temperature data, climate data for the future climate scenario for the Watsonville Waterworks station is selected based on the same water year sequence. Climate data for both the Santa Cruz Co-op and Watsonville Waterworks stations are input into the GSFLOW model.

4.0 Proposed Climate Scenarios

4.1 Temperature Weighted

The first scenario is generated using the temperature weights shown in Table 6 and the Random Number Generator to arrive at a sequence of 53 water years with an average temperature that is as high as we could get without manually selecting the warmest years. Figure 9 shows the color-coded distribution of water years for the Santa Cruz Co-op station representing a potential future climate scenario that is on average 2.4 °F warmer than the long-term average and 1.6 °F warmer than the average annual temperature from 1977-2016. The scenario also has 3.1 inches less precipitation per year than the long-term historical average as 4 of the 5 hottest years used for 50% of the scenario are dry years. Appendix B provides a list of the randomly selected historic years generated for this scenario.



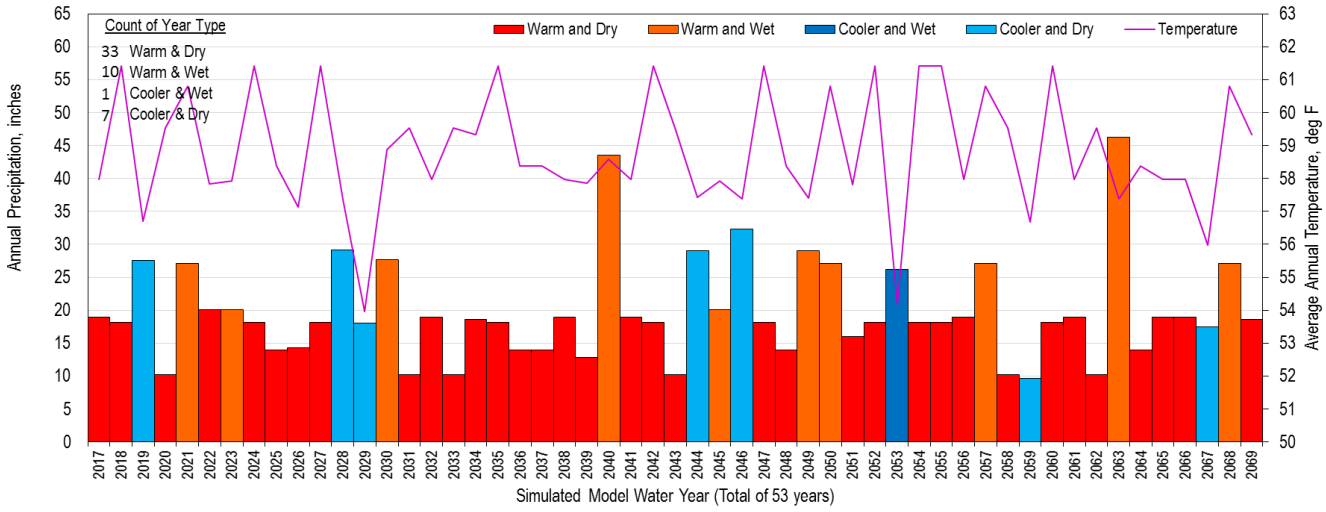
Annual Temperature, deg F	
Scenario Average	59.4
1985-2015 Average	57.9
1977-2016 Average	57.8
Pre-1977 Average	56.6
1894-2016 Average	57.0

Annual Precipitation, inches	
Scenario Average	26.0
1985-2015 Average	29.0
1977-2016 Average	29.9
Pre-1977 Average	28.7
1894-2016 Average	29.1

Figure 9: Temperature Weighted Climate Scenario for Santa Cruz Co-op Station

Using the same sequence of 53 water years used for the Santa Cruz Co-op station temperature weighted climate scenario, Figure 10 shows a potential future climate scenario for the Watsonville Waterworks station that is on average 2.4 °F warmer than the long-term average and 1.4°F warmer than the average annual temperature from 1977-

2016. The scenario also has 1.3 inches less precipitation per year than the long-term historical average.



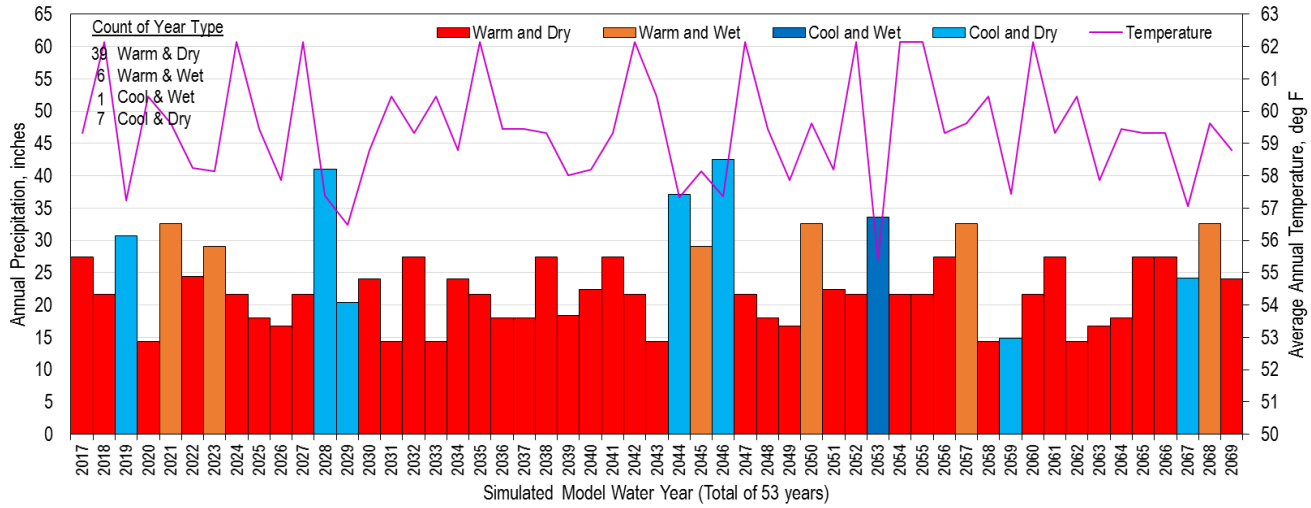
Annual Temperature, deg F	
Scenario Average	58.8
1985-2015 Average	57.3
1977-2016 Average	57.4
Pre-1977 Average	55.8
1894-2016 Average	56.4

Annual Precipitation, inches	
Scenario Average	19.8
1985-2015 Average	21.9
1977-2016 Average	22.8
Pre-1977 Average	20.1
1894-2016 Average	21.1

Figure 10: Temperature Weighted Climate Scenario for Watsonville Waterworks Station

4.2 Temperature Weighted and Precipitation Adjusted

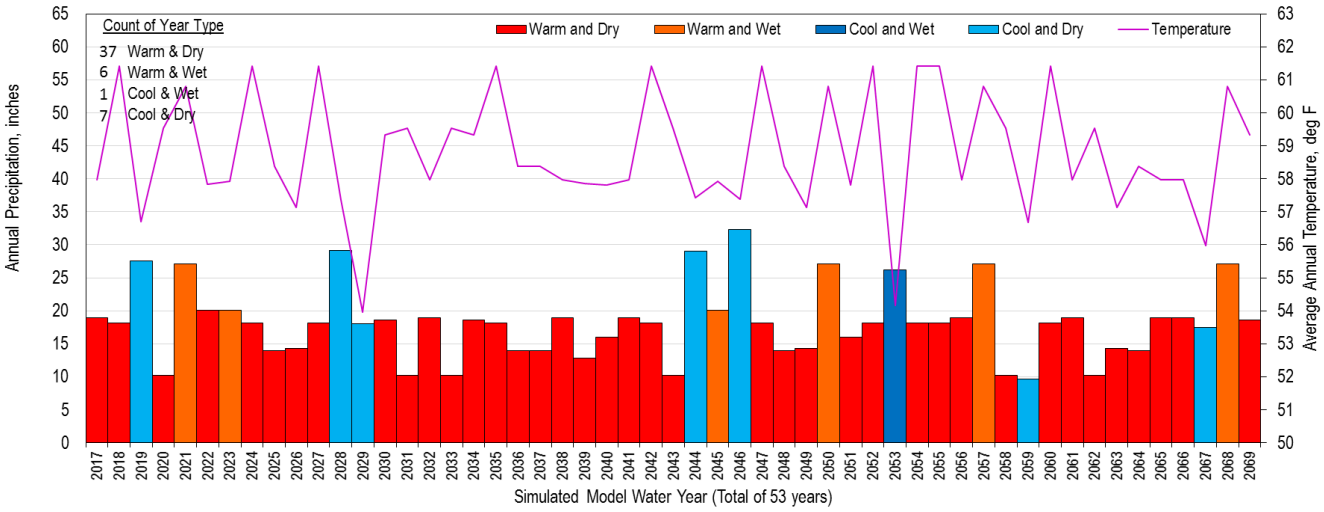
Although there is no trend of decreased precipitation in the Santa Cruz area, a drier scenario than that generated by weighting temperature only is also generated for consideration. We avoided randomly generating a new dataset based on both temperature and precipitation weights as we want a scenario that we can compare with the temperature weighted climate scenario. To arrive at this scenario, we start with the temperature weighted scenario and then adjust the four wettest "Warm and Wet" years to "Warm and Dry" by substituting the "Warm and Wet" years with "Warm and Dry" years with similar temperatures but less precipitation. Figure 11 shows the color-coded distribution of water years for the Santa Cruz Co-op station representing a potential future climate scenario that has the same average temperature as the temperature weighted scenario but has 5.4 inches less precipitation per year than the long-term average. Appendix B provides a list of the randomly selected historic years generated for this scenario. Figure 12 shows this potential future climate scenario applied to the Watsonville Waterworks station that results in the same average temperature as the temperature weighted scenario but has 2.9 inches less precipitation per year than the long-term average.



Annual Temperature, deg F	
Scenario Average	59.4
1985-2015 Average	57.9
1977-2016 Average	57.8
Pre-1977 Average	56.6
1894-2016 Average	57.0

Annual Precipitation, inches	
Scenario Average	23.7
1985-2015 Average	29.0
1977-2016 Average	29.9
Pre-1977 Average	28.7
1894-2016 Average	29.1

Figure 11: Temperature Weighted Climate Scenario for Santa Cruz Co-op Station with Decreased Precipitation Adjustment



Annual Temperature, deg F	
Scenario Average	58.8
1985-2015 Average	57.3
1977-2016 Average	57.4
Pre-1977 Average	55.8
1894-2016 Average	56.4

Annual Precipitation, inches	
Scenario Average	18.2
1985-2015 Average	21.9
1977-2016 Average	22.8
Pre-1977 Average	20.1
1894-2016 Average	21.1

Figure 12: Temperature Weighted Climate Scenario for Watsonville Waterworks Discussion and Limitations

5.0 Discussion and Limitations

One of the two scenarios presented in this memo will be selected to run simulations using the GSFLOW model. The selection will be made based on input from MGA member agency staff, the model Technical Advisory Committee, and possibly the MGA Board.

This approach of using historical climate allows us to generate climate scenarios that are warmer than the past 40 years but it does not increase temperatures to the degree that some of the GCMs predict global warming. For example, GCMs (Flint and Flint, 2014) have been downscaled to the San Lorenzo-Soquel Basin, which includes the Santa Cruz Mid-County Groundwater Basin. The downscaled predictions include warming of up to 4.1 °F (GFDL A2, a moderately warmer, drier future) and 6.2°F (MIROC-esm RCP 8.5, the warmest, driest future) over our simulated model period (54 years from Water Year 2016 – 2069). It is important to note that these GCM predicted temperatures are for minimum temperatures which, as shown above, tend to have a greater increase than average temperatures. We used average temperature in our analysis. Additionally, the GCM downscaled predictions are for the entire San Lorenzo-Soquel Basin which extends much farther inland than the Santa Cruz Co-op and Watsonville Waterworks stations.

Assigning lower weights to the "Cooler and dry" and "Cooler and wet" classifications will raise the scenario's average temperature slightly but still not as high as those in the GCMs described above because the hottest years in the historical record are not as hot as what is projected by the GCMs.

Simulating GCM projections will require downscaling GCM results to the Santa Cruz Co-op and Watsonville Waterworks stations for distribution to the model grid by the PRMS watershed component of GSFLOW. The USGS has recommended that the Jensen-Haise formulation for potential evapotranspiration used in the model be changed to Priestly-Taylor or Penman-Monteith when using hotter GCM projections. The Priestly-Taylor and Penman-Monteith evapotranspiration formulations have only recently been added to PRMS so it will take additional work to implement with the likelihood of issues implementing new capabilities. Therefore, we will use one of the scenarios described in this memo to represent future climate to perform the initial evaluation of groundwater management alternatives. Implementation of downscaled GCM projections has been re-prioritized to 2017.

This approach also does not project trends for temporal precipitation patterns as previously evaluated by Daniels (2014)[2]. Daniels identified long-term trends in storm

[2] Dr. Bruce Daniels is Board President of Soquel Creek Water District, a member agency of the Santa Cruz Mid-County Agency that is funding development of this GSFLOW model. Dr. Daniels also serves on the Technical Advisory Committee for this model.

intensity, duration, and pauses between storms and assessed effects on groundwater recharge and streamflow of those trends projected into the future. Since those projections are not part of the historical record, they are not part of the climate scenario described in this memo. However, 83% of historical years randomly selected for the future climate scenario in this memo are from 1990-2016, so the historical trends for these patterns are reflected in the scenario.

6.0 REFERENCES

Daniels, B.K. 2014. *Hydrologic response to climate change in California: observational and modeling studies.* Ph.D. dissertation, University of California, Santa Cruz. December.

Flint L.E. and A.L. Flint. 2014. *California basin characterization model: a dataset of historical and future hydrologic response to climate change*, U.S. Geological Survey Data Release, doi:10.5066/F76T0JPB

Metropolitan Water District of Southern California (MWD). 2016. *Integrated water resources plan, 2015 update*. Report No. 1518. January.

Young, K. 2016. *A high-resolution, regional-scale analysis of stormwater runoff in the San Lorenzo river basin for managed aquifer recharge decision making*. Masters of Science Thesis, University of California, Santa Cruz. June.

Appendix A

Santa Cruz Co-op Station Exceedance Probabilities with Year Type Classification

Water Year	Temperature			Precipitation			Classification
	Average (°F)	Rank	Probability of Exceedance	Total (inches)	Rank	Probability of Exceedance	1 = Warm & dry 2 = Warm & wet 3 = Cooler & dry 4 = Cooler & wet
1894	57.6	35	28.2%	32.9	37	29.8%	4
1895	58.9	9	7.3%	36.8	26	21.0%	2
1896	57.6	36	29.0%	22.9	86	69.4%	4
1897	56.8	72	58.1%	27.8	64	51.6%	4
1898	55.9	100	80.6%	12.4	121	97.6%	4
1899	55.5	110	88.7%	22.9	85	68.5%	4
1900	56.8	69	55.6%	28.4	61	49.2%	3
1901	55.4	114	91.9%	26.8	70	56.5%	4
1902	55.7	106	85.5%	28.7	57	46.0%	3
1903	54.8	122	98.4%	26.7	71	57.3%	4
1904	56.3	91	73.4%	32.7	38	30.6%	3
1905	58.0	23	18.5%	28.5	60	48.4%	2
1906	57.1	57	46.0%	32.5	41	33.1%	4
1907	57.1	54	43.5%	35.5	30	24.2%	4
1908	56.0	97	78.2%	23.3	84	67.7%	4
1909	55.2	117	94.4%	42.9	12	9.7%	3
1910	56.1	96	77.4%	28.6	59	47.6%	3
1911	55.3	115	92.7%	33.5	35	28.2%	3
1912	57.4	45	36.3%	20.9	98	79.0%	4
1913	55.7	105	84.7%	13.8	120	96.8%	4
1914	57.0	61	49.2%	34.9	31	25.0%	4
1915	56.6	80	64.5%	42.1	15	12.1%	3
1916	55.8	102	82.3%	30.4	47	37.9%	3
1917	54.4	123	99.2%	18.4	110	88.7%	4
1918	57.3	50	40.3%	18.6	108	87.1%	4
1919	56.2	92	74.2%	21.7	95	76.6%	4
1920	56.1	95	76.6%	20.5	101	81.5%	4
1921	56.6	82	66.1%	28.2	62	50.0%	4
1922	56.6	81	65.3%	27.9	63	50.8%	4
1923	56.4	90	72.6%	28.6	58	46.8%	3
1924	57.1	55	44.4%	10.2	123	99.2%	4
1925	57.7	33	26.6%	30.5	46	37.1%	4
1926	59.6	4	3.2%	25.6	72	58.1%	1
1927	57.6	39	31.5%	29.3	53	42.7%	4

Water Year	Temperature			Precipitation			Classification
	Average (°F)	Rank	Probability of Exceedance	Total (inches)	Rank	Probability of Exceedance	1 = Warm & dry 2 = Warm & wet 3 = Cooler & dry 4 = Cooler & wet
1928	**57.8**	**30**	**24.2%**	**22.0**	**90**	**72.6%**	**1**
1929	55.4	113	91.1%	18.2	111	89.5%	4
1930	56.2	93	75.0%	21.9	91	73.4%	4
1931	**58.8**	**10**	**8.1%**	**11.7**	**122**	**98.4%**	**1**
1932	55.1	118	95.2%	27.4	68	54.8%	4
1933	54.9	120	96.8%	21.7	94	75.8%	4
1934	**58.0**	**22**	**17.7%**	**18.4**	**109**	**87.9%**	**1**
1935	57.0	60	48.4%	30.1	50	40.3%	4
1936	**58.0**	**25**	**20.2%**	**32.7**	**39**	**31.5%**	**2**
1937	56.9	67	54.0%	34.1	32	25.8%	3
1938	57.9	26	21.0%	42.4	14	11.3%	2
1939	57.5	42	33.9%	20.2	103	83.1%	4
1940	58.3	15	12.1%	44.5	8	6.5%	2
1941	58.6	12	9.7%	61.3	1	0.8%	2
1942	57.0	64	51.6%	42.0	16	12.9%	3
1943	56.8	71	57.3%	39.5	22	17.7%	3
1944	57.0	62	50.0%	27.4	67	54.0%	4
1945	57.3	49	39.5%	33.2	36	29.0%	4
1946	56.6	84	67.7%	30.3	48	38.7%	3
1947	57.1	58	46.8%	19.1	105	84.7%	4
1948	55.7	103	83.1%	24.7	76	61.3%	4
1949	55.0	119	96.0%	30.0	51	41.1%	3
1950	55.3	116	93.5%	31.4	43	34.7%	3
1951	56.6	78	62.9%	38.4	23	18.5%	3
1952	56.0	98	79.0%	44.6	7	5.6%	3
1953	55.6	109	87.9%	24.4	78	62.9%	4
1954	56.4	89	71.8%	23.8	83	66.9%	4
1955	54.8	121	97.6%	23.9	82	66.1%	4
1956	55.6	108	87.1%	39.7	21	16.9%	3
1957	57.0	59	47.6%	22.2	89	71.8%	4
1958	**57.8**	**29**	**23.4%**	**50.1**	**4**	**3.2%**	**2**
1959	**58.1**	**20**	**16.1%**	**24.8**	**75**	**60.5%**	**1**
1960	57.3	51	41.1%	21.4	97	78.2%	4
1961	56.9	68	54.8%	17.8	113	91.1%	4
1962	55.4	111	89.5%	27.5	66	53.2%	4
1963	56.7	74	59.7%	33.7	33	26.6%	3
1964	56.0	99	79.8%	19.0	106	85.5%	4
1965	56.6	77	62.1%	30.6	45	36.3%	3
1966	56.7	75	60.5%	20.5	100	80.6%	4
1967	56.8	70	56.5%	40.0	20	16.1%	3

Water Year	Temperature			Precipitation			Classification
	Average (°F)	Rank	Probability of Exceedance	Total (inches)	Rank	Probability of Exceedance	1 = Warm & dry 2 = Warm & wet 3 = Cooler & dry 4 = Cooler & wet
1968	57.4	43	34.7%	21.5	96	77.4%	4
1969	55.7	107	86.3%	44.9	6	4.8%	3
1970	57.7	32	25.8%	30.2	49	39.5%	4
1971	56.1	94	75.8%	27.2	69	55.6%	4
1972	56.6	79	63.7%	19.1	104	83.9%	4
1973	56.5	85	68.5%	43.7	9	7.3%	3
1974	55.8	101	81.5%	42.0	17	13.7%	3
1975	55.7	104	83.9%	24.3	79	63.7%	4
1976	56.7	76	61.3%	15.4	117	94.4%	4
1977	**57.4**	**44**	**35.5%**	**14.8**	**118**	**95.2%**	**4**
1978	**58.3**	**14**	**11.3%**	**37.6**	**24**	**19.4%**	**2**
1979	**56.5**	**87**	**70.2%**	**29.2**	**54**	**43.5%**	**3**
1980	**57.4**	**48**	**38.7%**	**37.1**	**25**	**20.2%**	**4**
1981	**57.7**	**31**	**25.0%**	**21.7**	**92**	**74.2%**	**4**
1982	**56.7**	**73**	**58.9%**	**48.1**	**5**	**4.0%**	**3**
1983	**58.2**	**18**	**14.5%**	**53.9**	**3**	**2.4%**	**2**
1984	**58.8**	**11**	**8.9%**	**24.0**	**81**	**65.3%**	**1**
1985	**57.0**	**63**	**50.8%**	**29.7**	**52**	**41.9%**	**3**
1986	**57.4**	**46**	**37.1%**	**41.0**	**18**	**14.5%**	**4**
1987	**58.0**	**24**	**19.4%**	**15.9**	**116**	**93.5%**	**1**
1988	**58.5**	**13**	**10.5%**	**18.7**	**107**	**86.3%**	**1**
1989	**57.1**	**56**	**45.2%**	**24.2**	**80**	**64.5%**	**4**
1990	**57.9**	**27**	**21.8%**	**16.8**	**115**	**92.7%**	**1**
1991	**56.5**	**86**	**69.4%**	**20.4**	**102**	**82.3%**	**4**
1992	**59.3**	**6**	**4.8%**	**27.5**	**65**	**52.4%**	**1**
1993	**58.2**	**19**	**15.3%**	**36.7**	**27**	**21.8%**	**2**
1994	**57.6**	**38**	**30.6%**	**22.7**	**87**	**70.2%**	**4**
1995	**57.6**	**37**	**29.8%**	**43.0**	**11**	**8.9%**	**4**
1996	**59.0**	**8**	**6.5%**	**31.5**	**42**	**33.9%**	**2**
1997	**59.1**	**7**	**5.6%**	**36.6**	**28**	**22.6%**	**2**
1998	**57.9**	**28**	**22.6%**	**59.8**	**2**	**1.6%**	**2**
1999	**55.4**	**112**	**90.3%**	**33.7**	**34**	**27.4%**	**3**
2000	**57.7**	**34**	**27.4%**	**36.4**	**29**	**23.4%**	**4**
2001	**56.6**	**83**	**66.9%**	**25.5**	**73**	**58.9%**	**4**
2002	**56.4**	**88**	**71.0%**	**28.8**	**56**	**45.2%**	**3**
2003	**58.1**	**21**	**16.9%**	**29.1**	**55**	**44.4%**	**2**
2004	**58.2**	**16**	**12.9%**	**24.5**	**77**	**62.1%**	**1**
2005	**57.5**	**41**	**33.1%**	**43.6**	**10**	**8.1%**	**4**
2006	**57.4**	**47**	**37.9%**	**42.5**	**13**	**10.5%**	**4**
2007	**57.1**	**53**	**42.7%**	**17.6**	**114**	**91.9%**	**4**

Water Year	Temperature			Precipitation			Classification 1 = Warm & dry 2 = Warm & wet 3 = Cooler & dry 4 = Cooler & wet
	Average (°F)	Rank	Probability of Exceedance	Total (inches)	Rank	Probability of Exceedance	
2008	**56.9**	**66**	**53.2%**	**25.0**	**74**	**59.7%**	**4**
2009	**58.2**	**17**	**13.7%**	**22.4**	**88**	**71.0%**	**1**
2010	**57.2**	**52**	**41.9%**	**30.8**	**44**	**35.5%**	**4**
2011	**57.0**	**65**	**52.4%**	**40.1**	**19**	**15.3%**	**3**
2012	**57.5**	**40**	**32.3%**	**20.7**	**99**	**79.8%**	**4**
2013	**59.4**	**5**	**4.0%**	**18.0**	**112**	**90.3%**	**1**
2014	**60.5**	**2**	**1.6%**	**14.4**	**119**	**96.0%**	**1**
2015	**62.2**	**1**	**0.8%**	**21.7**	**93**	**75.0%**	**1**
2016	**59.6**	**3**	**2.4%**	**32.6**	**40**	**32.3%**	**2**

Bold records denote water years included in the catalog for future climate scenario generation

Appendix B

Proposed Climate Scenarios

The Weighted Temperature Scenario with Precipitation Adjustment columns only show those water years where records are manually adjusted to be drier. For the remaining years, data from the Weighted Temperature Scenario apply.

	Weighted Temperature Scenario					Weighted Temperature Scenario with Precipitation Adjustment (Drier)				
		Temperature		Precipitation			Temperature		Precipitation	
Model Water Year	Historic Water Year	Average (°F)	Probability of Exceedance	Average (inches)	Probability of Exceedance	Historic Year if changed	Average (°F)	Probability of Exceedance	Average (inches)	Probability of Exceedance
2016	2016	59.6	2.4%	32.6	32.3%					
2017	1992	59.3	4.8%	27.5	52.4%					
2018	2015	62.2	0.8%	21.7	75.0%					
2019	2010	57.2	41.9%	30.8	35.5%					
2020	2014	60.5	1.6%	14.4	96.0%					
2021	2016	59.6	2.4%	32.6	32.3%					
2022	2004	58.2	12.9%	24.5	62.1%					
2023	2003	58.1	16.9%	29.1	44.4%					
2024	2015	62.2	0.8%	21.7	75.0%					
2025	2013	59.4	4.0%	18.0	90.3%					
2026	1990	57.9	21.8%	16.8	92.7%					
2027	2015	62.2	0.8%	21.7	75.0%					
2028	1986	57.4	37.1%	41.0	14.5%					
2029	1991	56.5	69.4%	20.4	82.3%					
2030	1997	59.1	5.6%	36.6	22.6%	1984	58.8	8.9%	24.0	65.3%
2031	2014	60.5	1.6%	14.4	96.0%					
2032	1992	59.3	4.8%	27.5	52.4%					
2033	2014	60.5	1.6%	14.4	96.0%					
2034	1984	58.8	8.9%	24.0	65.3%					
2035	2015	62.2	0.8%	21.7	75.0%					
2036	2013	59.4	4.0%	18.0	90.3%					
2037	2013	59.4	4.0%	18.0	90.3%					
2038	1992	59.3	4.8%	27.5	52.4%					
2039	1934	58.0	17.7%	18.4	87.9%					
2040	1983	58.2	14.5%	53.9	2.4%	2009	58.2	13.7%	22.4	71.0%
2041	1992	59.3	4.8%	27.5	52.4%					
2042	2015	62.2	0.8%	21.7	75.0%					
2043	2014	60.5	1.6%	14.4	96.0%					

Model Water Year	Weighted Temperature Scenario					Weighted Temperature Scenario with Precipitation Adjustment (Drier)				
	Historic Water Year	Temperature		Precipitation		Historic Year if changed	Temperature		Precipitation	
		Average (°F)	Probability of Exceedance	Average (inches)	Probability of Exceedance		Average (°F)	Probability of Exceedance	Average (inches)	Probability of Exceedance
2044	1980	57.4	38.7%	37.1	20.2%					
2045	2003	58.1	16.9%	29.1	44.4%					
2046	2006	57.4	37.9%	42.5	10.5%					
2047	2015	62.2	0.8%	21.7	75.0%					
2048	2013	59.4	4.0%	18.0	90.3%					
2049	1958	57.8	23.4%	50.1	3.2%	1990	57.9	21.8%	16.8	92.7%
2050	2016	59.6	2.4%	32.6	32.3%					
2051	2009	58.2	13.7%	22.4	71.0%					
2052	2015	62.2	0.8%	21.7	75.0%					
2053	1999	55.4	90.3%	33.7	27.4%					
2054	2015	62.2	0.8%	21.7	75.0%					
2055	2015	62.2	0.8%	21.7	75.0%					
2056	1992	59.3	4.8%	27.5	52.4%					
2057	2016	59.6	2.4%	32.6	32.3%					
2058	2014	60.5	1.6%	14.4	96.0%					
2059	1977	57.4	35.5%	14.8	95.2%					
2060	2015	62.2	0.8%	21.7	75.0%					
2061	1992	59.3	4.8%	27.5	52.4%					
2062	2014	60.5	1.6%	14.4	96.0%					
2063	1998	57.9	22.6%	59.8	1.6%	1990	57.9	21.8%	16.8	92.7%
2064	2013	59.4	4.0%	18.0	90.3%					
2065	1992	59.3	4.8%	27.5	52.4%					
2066	1992	59.3	4.8%	27.5	52.4%					
2067	1989	57.1	45.2%	24.2	64.5%					
2068	2016	59.6	2.4%	32.6	32.3%					
2069	1984	58.8	8.9%	24.0	65.3%					

November 17, 2016

MEMO TO THE MGA BOARD OF DIRECTORS

Subject: Agenda Item 6.2

Title: Receive Notes from Technical Advisory Committee Meeting #2 for Santa Cruz Mid-County Groundwater Agency Groundwater Model

Attachment:
1. Notes from August 24, 2016 Technical Advisory Committee Meeting

Background
The groundwater model being prepared by HydroMetrics WRI for the Santa Cruz Mid-County Groundwater Agency is currently underway. As part of the process, a Technical Advisory Committee (TAC) has been established to provide guidance and input on the model's development.

Discussion
The TAC met for the second time on August 24, 2016. HydroMetrics WRI provided a presentation on the progress of the model and discussed developments on subsurface boundary conditions, the Precipitation Runoff Modeling System (PRMS) watershed model setup, climate change scenarios, and model simulations.

A copy of the notes from the August 24th TAC meeting is attached.

Possible Board Action:

1. Informational, no motion necessary.

By _____
Melanie Mow Schumacher
Special Projects-Associate Manager
Soquel Creek Water District

By _____
Ron Duncan
General Manager
Soquel Creek Water District

1814 Franklin St, Suite 501
Oakland, CA 94612

DRAFT TECHNICAL MEMORANDUM

To: Ron Duncan

From: Cameron Tana, Georgina King and Sean Culkin

Date: November 4, 2016

Subject: Notes from Technical Advisory Committee Meeting #2 - August 24, 2016
Santa Cruz Mid-County Groundwater Agency Groundwater Model

ATTENDEES:

Technical Advisory Committee
Bruce Daniels, Soquel Creek Water District (SqCWD) Board President
Andy Fisher, UC Santa Cruz (UCSC)
Barry Hecht, Balance Hydrologics
Brian Lockwood, Pajaro Valley Water Management Agency (PVWMA)
Robert Marks, Pueblo Water Resources, consultant to City of Santa Cruz

Model Team
Cameron Tana, HydroMetrics WRI
Sean Culkin, HydroMetrics WRI
Georgina King, HydroMetrics WRI
Justin Huntington, Huntington Hydrologic (by web meeting)
Linda Woolfenden, U.S. Geological Survey (USGS, by web meeting)

Member Agency Staff
Ralph Bracamonte, Central Water District
Heidi Luckenbach, City of Santa Cruz (by web meeting)
John Ricker, County of Santa Cruz
Sierra Ryan, County of Santa Cruz
Ron Duncan, Soquel Creek Water District
Melanie Schumacher, Soquel Creek Water District
Brice Dahlmeier, Soquel Creek Water District

Mid-County Groundwater Agency Board Member
Jon Kennedy, Private Well Representative

Members of Public
Nick de Sieyes, Private Well Owner

The following discussion points were brought up during HydroMetrics WRI's presentation on the groundwater model progress. We have included responses and/or follow up action where applicable.

1. Subsurface Boundary Condition Update

- Robert Marks (Pueblo) commented that layers representing the Purisima aquifers should outcrop to the undersea Soquel Canyon. He indicated that there are maps available that show these offshore outcrops. HydroMetrics commented that the offshore bathymetry was represented in the layer elevations of the model but the geometry of the outcrops to the canyon weren't a part of building the hydrostratigraphy. HydroMetrics subsequently exchanged emails with Robert about this comment, which is related to his comment from the first TAC meeting that extending the model domain only 1 mile offshore will not be sufficient to simulate the City of Santa Cruz's plans to store water in basin for drought years. The email exchange is provided as an attachment, but HydroMetrics' main responses are as follows:
    - The offshore outcrops of the Purisima Formation are directly offshore and much closer than Soquel Canyon and therefore much more likely to serve as the heads boundary condition and be the source of seawater intrusion than the canyon.
    - The choice of extending the model domain only 1 mile offshore was based on previous cross-sectional modeling work.
    - If seawater interface simulations show we need to extend the model to better evaluate offshore storage, this can be done after the model is calibrated with the current domain. There shouldn't be much additional calibration needed because all calibration target data are onshore. Additional funding would be needed for this work.

- Andy Fisher (UCSC) commented that independent of the basin modification work carried out by HydroMetrics, he had arrived at the same conclusion regarding the watershed area of the shared Mid-County and Santa Margarita Basin boundary as shown in the presentation.
- Brian Lockwood (PVWMA) pointed out that the "bulls eye" shown on the slide discussing the eastern boundary conditions is no longer mapped as such. Brian Lockwood will provide updated groundwater contours.
    - HydroMetrics has received updated groundwater contours from PVWMA through Fall 2014, and has used these data, in addition to observation of the initial MODFLOW model runs to revise the boundary condition in this area.

2. PRMS Watershed Model Setup

- With regards to spatial distribution of precipitation, Brian Lockwood (PVWMA) remarked that the long-term average in the Pajaro area is about 22 inches/year, but could be as low as 13 inches/year in a dry year.
    - HydroMetrics will add the Watsonville WWTP rainfall station to the model and assign model cells in the Pajaro area to calculate rainfall based on the Watsonville WWTP station.
- Barry Hecht (Balance) recommended that HydroMetrics not correlate Santa Cruz precipitation "too far to the east." He cited USGS work by Ned Andrews, and mentioned that storms making landfall could cause precipitation in a relatively constrained area such that there was a distinction in rainfall to the Soquel and Corralitos watersheds with little correlation between Santa Cruz and Watsonville stations. Bruce Daniels (SqCWD) corroborated this and mentioned "atmospheric rivers" that occur along a narrow front.
    - HydroMetrics will use the Andrews study to help assign either the Watsonville WWTP or Santa Cruz COOP station to each model cell. Barry has provided this paper.
- Justin Huntington (Huntington Hydrologic) explained the reasoning for not applying climate parameters to each HRU grid cell in the model – it requires adding time series data for precipitation per cell per day which is numerically

intensive and slow. Linda Wolfenden (USGS) mentioned that the USGS had used this method in previous models and had file management issues.

  - HydroMetrics is using the precip_1sta module for rainfall distribution, where a combination of spatial and temporal data is used. The spatial data is based on PRISM mean monthly precipitation distributions. The temporal data will be based on daily precipitation measurements from the Santa Cruz COOP station and Watsonville WWTP station.

- Andy Fisher (UCSC) made comments about calibrating PRMS. He recommends not calibrating to daily data and de-emphasizing attempts to match each peak flow at stream gauge observation points. Instead he recommends calibrating to baseflow since that is more important to the groundwater component of the model.
  - HydroMetrics will calibrate the model to monthly streamflow values.
- Barry Hecht followed Andy Fisher's comments by saying the model shouldn't be used to make decisions on land use changes effects on flood risk, since that requires accurate daily flow simulations.
  - The model should not be used to evaluate flood risk. The purpose of the model is to evaluate groundwater management.
- Per the conversation about return flow, Andy Fisher suggested adding return flow to the recharge package in MODFLOW instead of using new PRMS water use module.
  - HydroMetrics will add all return flow components as infiltration in the unsaturated zone flow (UZF) package required for use in GSFLOW. The USGS has added this capability to GSFLOW. Future development of the model may use the new PRMS water use module.

3. Climate Change Scenarios

- Andy Fisher suggested that we develop our own catalog of past climate instead of using an external climate model, and to pick a wet/dry/warm/hot period from the catalog of past conditions, for instance, picking a 5-year period or 5 analog years as a worst case.

  - HydroMetrics was receptive to this methodology and included the methodology as approach for priority climate scenario in scope approved by the MGA Board September 15, 2016. Andy has subsequently shared with HydroMetrics a student's dissertation where this methodology is documented. HydroMetrics will provide a memo on development of a climate change scenario to the TAC in November.

- Bruce Daniels supported Andy Fisher's method of generating a catalog of past climate, and suggested picking an actual climate period from the past 15 years to use as a proxy for inputs to the climate change scenarios.
  - HydroMetrics has developed a climate change scenario based on Andy Fisher's suggestion that provides greater weight to the most recent years based on the warming trend over the last 40 years.
- Robert Marks pointed out the City of Santa Cruz will be asking for model runs based on downscaling of GFDL-A2 global climate model to be consistent with climate change modeling of the City's surface water supply.
  - Model runs based on downscaling of global climate models are now scheduled for 2017.
- Ron Duncan (SqCWD) reiterated that the District needs to be prepared for a "worst case" so they can be sure they will have adequate supply.
  - Using a catalog of historical years as suggested by Andy Fisher will not be worst case compared to global climate model projections because projections show a warmer climate than experienced in the available historical record. Therefore, downscaling global climate models for GSFLOW model runs is still worthwhile.

4. Model Simulations

- Bruce Daniels commented that for the selected supplemental supply project, much of the initial injected water may be lost from the aquifer as discharge to streams. Therefore it may be necessary to inject more than initially predicted to maintain both outflow to the streams and recharge to the aquifer, and that when injection ceases, recharged water may leave the system quickly as stream discharge.

  - Part of the modeling for Advanced Purified Water Groundwater Replenishment EIR will track injected water and calculate how much flows to wells, offshore, and to streams. Model mass balance results will also show changes to total flows as well.

- Robert Marks commented that the "cumulative" scenario for the EIR that includes City of Santa Cruz projects will be a combination of in-lieu recharge and ASR by the City.
  - This is the plan for the cumulative scenario for the EIR and the scenario will be developed based on input from the City.
- John Ricker (Santa Cruz County) commented that the County wants the model to evaluate effects on baseflow in addition to effects of private well pumping.
  - The GSFLOW model has the capability to evaluate effects on baseflow.

Attachment. Email exchange between HydroMetrics WRI and Robert Marks on modeled offshore extent

Cameron Tana

From: Robert Marks <rmarks@pueblo-water.com>
Sent: Tuesday, September 27, 2016 4:02 PM
To: Cameron Tana
Cc: Derrik Williams; Sean Culkin
Subject: RE: offshore canyon outcrops of Purisima

Hi Cameron,

Thank you for carefully considering my concerns and your thoughtful reply, I really appreciate it. I think your response and overall approach to the boundary condition are both reasonable. Let's get the model constructed and calibrated as planned and start running some ASR simulations, and see what happens. Depending on the initial results, we can go from there.

Thanks again,
RM

Robert C. Marks, P.G., C.Hg.
Principal Hydrogeologist

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rmarks@pueblo-water.com

From: Cameron Tana [mailto:cameron@hydrometricswri.com]
Sent: Monday, September 26, 2016 12:31 PM
To: Robert Marks
Cc: Derrik Williams ; Sean Culkin
Subject: RE: offshore canyon outcrops of Purisima

Hi Robert,

Thank you for the detailed explanation of your concern; it has helped us with our thinking on the model. Sorry for the delayed response; I wanted to make sure the three of us here had a chance to discuss it. We will flesh out your comment with the concerns you write below in our summary of the TAC meeting but this is how we plan to respond:

- The offshore outcrops of the Purisima are directly offshore. Though these outcrops are to the west of where the Purisima aquifers are pumped, they are much closer than Soquel Canyon and therefore much more likely to serve as the heads boundary condition and drive seawater intrusion than the canyon. Based on Figure 1 of our latest cross-sectional model report and Figure 15 of the model hydrostratigraphy memo, you can see how the A unit outcrops to the west and how the AA unit does not outcrop offshore. Please let us know if you need copies of these memos.

- We tested seawater intrusion with cross-sectional models to western Purisima outcrop from Moran Lake and SC-9. When comparing SC-9 model to outcrop and SC-9 model directly offshore where saltwater would have to come

through overlying aquifer and aquitard units, we concluded that larger seawater intrusion risk was from directly offshore as opposed to the nearest outcrop.

- All of our cross-sectional models were less than 3,500 feet in length. These models were originally designed to evaluate protective elevations and higher levels to achieve storage. The models were long enough to make sure interface did not intersect the end of model. This is the basis for choosing 1 mile offshore extent for the basin model.

- Given unknown location of seawater interface in Purisima, we think it makes sense to assume interface location conservatively and also consistent with relatively close location of nearest outcrop and potential for intrusion through overlying layers: something close to the protective location and within 1 mile of the coast.

- Although Essaid mapped muds and Purisima outcrop below bay, we don't think it makes sense to rely on the muds or mapping of muds to prevent seawater intrusion. However, the conductances for GHBs representing offshore outcrops within the model grid will represent additional resistance to flow between ocean and aquifers and we'll see how sensitive onshore calibration is to it.

- Extending model will increase run times for calibration to cover area without calibration data. Our plan is to calibrate without extending.

- If seawater interface simulations show we need extended model to better evaluate offshore storage, we can do so at that time. There shouldn't be much additional calibration needed because all calibration data is onshore. We would have to request funding for this additional work.

- Our sense is that the extent of the A unit outcrop that is modeled should be large enough to calculate amount of groundwater storage that can be achieved to the west. The current interface is likely onshore as Soquel Point Medium is intruded and Moran Lake Medium has had intrusion historically. It seems unlikely that injection could push the interface more than a mile offshore to the west in an area where the A unit is outcropping directly offshore.

- There actually may be more of an issue with artificially limiting of storage volume to the east of Soquel Point. This is an area where seawater intrusion has not been detected onshore in the Purisima as the grid turns north with the coast to New Brighton Beach. However, as mentioned above, there is also a pathway for seawater intrusion through the shallower units and we would likely assume a starting interface closer to the shore.

- Any necessary future extension of the grid should only involve activating currently inactive cells instead of changing the model origin. We would have to assign layer elevations, assign newly active cells as ocean HRUs in PRMS, and redo boundary conditions. This is still substantial work, another reason we want to make sure it is necessary before undertaking it.

Please let us know if you would like to discuss before we send out our draft TAC summary. Would it be ok to include your email as attachment to the summary? We'd like to summarize your concern but don't want to miss anything. Thank you.

Best, Cameron

From: Robert Marks [mailto:rmarks@pueblo-water.com]
Sent: Monday, September 19, 2016 2:42 PM

To: Sean Culkin <sean@hydrometricswri.com>; Cameron Tana <cameron@hydrometricswri.com>
Cc: Derrik Williams <derrik@hydrometricswri.com>
Subject: RE: offshore canyon outcrops of Purisima

Sean,

Yes, the canyon (and arguably the natural offshore boundary of the Tp) is about 5 – 6 mi offshore. As I mentioned in the 1st TAC meeting, limiting the model domain to 1 mi offshore is of significant concern to me. My concerns can be summarized as follows:

1. The main thing the City wants to evaluate with the model is aquifer storage projects. One of the main questions we want to evaluate with the model is how much supplemental water can be placed into storage, and what are the hydraulic losses before they recover it, which affects project yields and costs (and ultimately, feasibility). Similarly, when the water is recovered, what is the potential to induce unacceptable landward movement of the seawater interface (these aren't the only concerns, but are some of the main ones).

2. In a confined aquifer, storage of recharge is achieved through compression of water (negligible) and expansion of the aquifer matrix (more significant). As such, head changes induced by hydraulic stresses can propagate very large distances offshore as a pressure response.

3. Making the domain of the model only extend 1-mi offshore may mean a couple of things (at least):

    a. There is a lot of actual potential storage (aquifer expansion) space in the Tp offshore that is not accounted for in the model domain. This could lead to an underestimation of how much recharge the aquifer system can accept and overestimation of the hydraulic losses.

    b. The position of the seawater interface will never be more than 1-mi offshore at the start of in any simulation, even when there is evidence that it may actually be 2 – 3 mi offshore at the start of the base period (i.e. Essaid's simulations). This can lead to an overestimation of the potential for seawater intrusion during recovery phases.

We don't know whether placing the boundary 1 mi instead of 5 -6 mi offshore will have a significant effect on the above questions or not. In the absence of extending the model domain to coincide with the physical boundary of the Tp, examining the stress dependency of this boundary will be very important in order to ensure it is a valid representation of the real system.

Depending on the results of the stress dependency testing, question that will likely come up include:

1. Why was 1-mi selected? Why not 2, 3 or 5?

2. What would it take to add rows to the model domain and extend it out to the physical boundary at the canyon?

3. Is it unreasonable to do so?

The City is going to be making $150M+ project decisions based in no small part on the results of the GW modeling. My overall objective with this line of questioning is to avoid as many uncertainties in the model and, hence, the evaluation of aquifer storage projects, as possible. As you all know, the results of any groundwater model are going to be questioned, no matter what. To the extent that model assumptions can be justified in a simple straight forward manner, the better. If we get into a situation where we have to start talking about manipulating conductance factors at the boundary to explain model predicted head and mass balance change results to non-hydrogeologists (i.e., the decision makers), that worries me a bit.

Sorry for the lengthy reply.

Let me know your thoughts.

Thx,
RM

Robert C. Marks, P.G., C.Hg.
Principal Hydrogeologist

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rmarks@pueblo-water.com

From: Sean Culkin [mailto:sean@hydrometricswri.com]
Sent: Monday, September 19, 2016 6:51 AM
To: Robert Marks <rmarks@pueblo-water.com>; Cameron Tana <cameron@hydrometricswri.com>
Cc: Derrik Williams <derrik@hydrometricswri.com>
Subject: Re: offshore canyon outcrops of Purisima

At a glance, it looks like the canyon is farther than one mile offshore which puts it out of the model domain. In that case can we just revise our response accordingly?

From: Robert Marks <rmarks@pueblo-water.com>
Sent: Friday, September 16, 2016 5:26 PM
To: Cameron Tana
Cc: Sean Culkin; Derrik Williams
Subject: RE: offshore canyon outcrops of Purisima

Hi Cameron,

Yes and No. I was referring to Eittriem 2000, but I believe the Figs in Johnson 2004 that you refer to are truncated and don't extend out to the canyon.

Attached is a Fig we presented in our ASR Recon-Study for the City showing Ettriem's mapping out to the canyon. As you can see, Tp is mapped on the canyon walls ("Soquel Canyon"). I have it as a shapefile if you need it too.

Related to this issue, I've also attached a paper by Essaid (1992). This is interesting for a variety of reasons, but for the matter at hand it shows a simple conceptualization of the Tp extending offshore out to the canyon and simulates the position of the seawater / freshwater interface.

Let me know your thoughts.

Have a nice weekend.

Thx,
RM

Robert C. Marks, P.G., C.Hg.
Principal Hydrogeologist

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From: Cameron Tana [mailto:cameron@hydrometricswri.com]
Sent: Friday, September 16, 2016 4:42 PM
To: Robert Marks <rmarks@pueblo-water.com>
Cc: Sean Culkin <sean@hydrometricswri.com>; Derrik Williams <derrik@hydrometricswri.com>
Subject: offshore canyon outcrops of Purisima

Hi Robert,

We have prepared a summary of MGA model TAC meeting minutes and have the following item:

- Robert Marks (Pueblo) commented that layers representing the Purisima aquifers should outcrop to the undersea canyon. He indicated that there are maps available that show these offshore outcrops. HydroMetrics commented that the offshore bathymetry was represented in the layer elevations of the model but the geometry of the outcrops to the canyon weren't a part of building the hydrostratigraphy.

We want to check if the maps you reference are different than the ones in Johnson et al 2004: Fig 2-5a and 2-5b both called "Seafloor Exposure of Purisima Formation" based on Ettraim et al 2000 and side-scan sonar, respectively. If so, could you pass along or point us to them? Thanks.

Have a great weekend.

-Cameron

November 17, 2016

MEMO TO THE MGA BOARD OF DIRECTORS

Subject: Agenda Item 6.3

Title: Update on Soquel Creek Water District's Pure Water Soquel Project

Background

Melanie Schumacher from the Soquel Creek Water District (District) will provide a 20 minute informational presentation on the District's Community Water Plan and Pure Water Soquel Project.

To address the challenges of a critically overdrafted groundwater basin with seawater intrusion occurring at the coastline, the District developed its Community Water Plan in 2015. Based on community input, the Community Water Plan serves as the District's roadmap to meet its goal of long-term sustainability by 2040. Key components of the plan include water conservation, groundwater management, and securing new water supplies. The District is currently evaluating three supply options with its preferred option being Pure Water Soquel, a groundwater replenishment project using purified water. This proposed project involves taking municipal wastewater from the County Sanitation District or treated effluent from the City of Santa Cruz's wastewater treatment facility and using advanced water treatment methods to produce high-quality purified water. The purified water would then be injected into the ground to replenish the groundwater basin and provide a barrier against seawater intrusion. The project also has a potential benefit of reducing the amount of treated wastewater that goes out to the Pacific Ocean.

Discussion

Environmental review is currently underway on the Pure Water Soquel Project and the District has requested the opportunity to share information and present to the MGA Board.

Possible Board Action:

1. Informational, no motion necessary.

By _____

Melanie Mow Schumacher
Special Projects-Associate Manager
Soquel Creek Water District

By _____

Ron Duncan
General Manager
Soquel Creek Water District

November 17, 2016

MEMO TO THE MGA BOARD OF DIRECTORS

Subject: Agenda Item 6.4

Title: Receive Department of Water Resources Best Management Practices and Guidance Documents

Attachment

1. Department of Water Resources Flyer for Best Management Practices – Public Meetings and How to Comment

Background

Chapter 7 of the Sustainable Groundwater Management Act (SGMA), in Water Code Section 10729(d), states that, "By January 1, 2017, the department shall publish on its internet Web site best management practices for the sustainable management of groundwater."

The Groundwater Sustainability Plan Emergency Regulations (GSP Regulations), which were adopted in May 2016, address best management practices (BMPs) on Monitoring Protocols and Data and Reporting Standards. Other than BMPs addressing these two topics, SGMA and the GSP Regulations provide no direction or limitation with respect to what type of BMPs should be developed to assist groundwater sustainability agencies (GSAs) with making sustainable groundwater management decisions. The California Department of Water Resources (DWR) has elected to publish two categories of information that can assist GSAs with developing GSPs: BMPs and Guidance Documents. This information is in DRAFT form, is subject to revision, and does not serve as a substitute for the GSP Regulations or the statutory provisions of SGMA.

Best Management Practices

BMPs are intended to provide clarification, guidance, and examples to help GSAs develop the essential elements of a GSP. DWR was required to develop BMPs through a public process, and the GSP Regulations may be updated to incorporate BMPs, if desired. The BMP categories are:

- Draft BMP 1: Monitoring Protocols, Standards, and Sites
- Draft BMP 2: Monitoring Networks and Identification of Data Gaps
- Draft BMP 3: Hydrogeologic Conceptual Model
- Draft BMP 4: Water Budget
- Draft BMP 5: Modeling

All five draft BMP documents can be accessed and downloaded online: http://www.water.ca.gov/groundwater/sgm/pdfs/BMPs_5_Combined_Draft_2016-10-28.pdf

Draft Guidance Documents

Guidance Documents were prepared for topic areas unique to SGMA, for topics where no established practices in the water management industry exist, and which may not have been specifically identified in the GSP Regulations. The Guidance Documents include:

- Draft: Preparation Checklist for GSP Submittal
- Draft: GSP Annotated Outline

These documents can be accessed and downloaded online: http://www.water.ca.gov/groundwater/sgm/pdfs/GD_GSP_Checklist_Draft_2016-10-28.pdf, and http://www.water.ca.gov/groundwater/sgm/pdfs/GD_GSP_Outline_Draft_2016-10-28.pdf

DWR is developing three additional guidance documents for Establishing Sustainable Management Criteria, Engagement with Tribal Governments, and Stakeholder Engagement and Communications. These have not been released yet.

Required BMP Public Meetings

DWR is required to develop the BMPs through a public process and four meetings have been scheduled at various locations in CA (see Attachment 1). The meeting on November 15th in Sacramento will be live-streamed.

BMP Public Comments

DWR will accept public comments through **November 28, 2016** and instructions on how to submit comments are included in Attachment 1.

Discussion

DWR released and posted the draft BMPs and Guidance Documents for public comment on October 28, 2016. MGA staff members John Ricker and Melanie Mow Schumacher, and Cameron Tana with HydroMetrics WRI have participated on advisory group meetings with DWR representatives and have provided the draft documents to the Executive Team for each agency's review.

There was limited time to review the BMPs prior to the preparation of the board packet, so MGA staff will discuss this topic orally at the November 17 MGA board meeting.

Possible Board Actions:

1. Informational, no motion necessary.

By _____

Melanie Mow Schumacher
Special Projects-Associate Manager
Soquel Creek Water District

By _____

Ron Duncan
General Manager
Soquel Creek Water District

Hosted by the DWR Sustainable Groundwater Management Program

The Sustainable Groundwater Management Act (SGMA) directs the Department of Water Resources (DWR) to identify Best Management Practices (BMPs) for the sustainable management of groundwater basins. The DWR Sustainable Groundwater Management Program is hosting a series of required public meetings (listed below) to solicit input regarding the planned BMP topics, as well as other potential GSP guidance information. The meetings are an opportunity to discuss BMPs and GSP guidance information and to provide feedback to DWR. The draft BMPs will be posted on DWR's website prior to the public meetings at the following link: http://water.ca.gov/groundwater/sgm/bmps.cfm

Monday, November 14, 2016
2:00 P.M.
Willows City Hall, City Council Chambers
201 North Lassen Street
Willows, CA 95988

Tuesday, November 15, 2016
9:30 A.M.
Resources Building, Auditorium
(California Water Commission Meeting)
1416 Ninth Street
Sacramento, CA 95814
Live Streaming Video Will be Available at **http://cwc.videossc.com/**

Wednesday, November 16, 2016
4:00 P.M.
Clovis Veterans Memorial Building, Veteran's Room
808 4th Street
Clovis, CA 93612

Thursday, November 17, 2016
1:00 P.M.
Delhi Community Center, Ballroom
505 E. Central Avenue
Santa Ana, CA 92707

HOW TO COMMENT

At a Public Meeting:
Via Comment Card

Email to:
SGMPS@water.ca.gov

Mail to:
California Department of Water Resources
Attn: Lauren Bisnett, Public Affairs
P.O. Box 942836
Sacramento, CA 94236

November 17, 2016

MEMO TO THE MGA BOARD OF DIRECTORS

Subject: Agenda Item 6.5

Title: Treasurer's Report

Attachment

1. Treasurer's Report for the Period Ending October 31, 2016

Attached is the Treasurer's Report for September and October 2016. The report contains three sections:

- Statement of Changes in Revenues, Expenses and Net Position
  - This interim financial statement provides information on the revenue that has been invoiced to the member agencies and the expenses that have been recorded as of October 31, 2016.
- Statement of Net Position
  - This interim financial statement details the cash balance at Wells Fargo Bank, the depository institution for the Santa Cruz Mid-County Groundwater Agency (MGA), the membership revenue still owed through accounts receivable, and the resulting net income as reported on the Statement of Changes in Revenues, Expenses and Net Position from the preceding page.
- Warrants
  - The list of warrants reflects all payments made by the MGA, either by check or electronic means, for the period covered by the Treasurer's Report.

The Treasurer's Report will be provided on a monthly basis according to statutory requirement and to promote transparency of the agency's financial transactions.

Possible Board Action:

1. Informational, no motion necessary.

By _____

Leslie Strohm
Treasurer
Santa Cruz Mid-County Groundwater Agency

Treasurer's Report

Santa Cruz Mid-County Groundwater Agency
For the period ended October 31,2016

Prepared by
Leslie Strohm

Prepared on
November 1, 2016

Statement of Revenues, Expenses and Changes in Net Position

September - October, 2016

	Total
INCOME	
Total Income	
GROSS PROFIT	**0.00**
EXPENSES	
5100 Groundwater Management Services	4,984.87
5110 Grndwtr Mgmt - Groundwater Monitoring	3,162.50
5120 Grndwtr Mgmt - Groundwater Model	76,779.24
5317 Office Services - Bank Charges	29.49
5415 Outreach Services	1,100.00
Total Expenses	**86,056.10**
NET OPERATING INCOME	**-86,056.10**
NET INCOME	**$ -86,056.10**

Statement of Net Position

As of October 31, 2016

	Total
ASSETS	
Current Assets	
Bank Accounts	
1100 Wells Fargo Business Checking	929,736.80
Total Bank Accounts	929,736.80
Accounts Receivable	
1200 Accounts Receivable - Membership Revenue	115,250.00
Total Accounts Receivable	115,250.00
Total Current Assets	1,044,986.80
TOTAL ASSETS	$1,044,986.80
LIABILITIES AND EQUITY	
Liabilities	
Total Liabilities	
Equity	
Retained Earnings	
Net Income	1,044,986.80
Total Equity	1,044,986.80
TOTAL LIABILITIES AND EQUITY	$1,044,986.80

Warrants

September - October, 2016

Date	Transaction Type	Num	Name	Memo/Description	Clr	Amount
Check						
10/11/2016	Check	SVCCHRG		Service Charge	R	-8.94
						8.94
09/12/2016	Check	SVCCHRG		Service Charge	R	-20.55
						20.55
Bill Payment (Check)						
10/14/2016	Bill Payment (Check)	10007	Hydrometrics Water Resources, Inc.		R	-43,344.87
						-43,344.87
09/28/2016	Bill Payment (Check)		Duncan Design	Voided		0.00
						0.00
09/28/2016	Bill Payment (Check)	10004	Hydrometrics Water Resources, Inc.	Voided		0.00
						0.00
09/28/2016	Bill Payment (Check)	10005	Duncan Design		R	-1,100.00
						-1,100.00
09/28/2016	Bill Payment (Check)	10006	Hydrometrics Water Resources, Inc.		R	-41,581.74
						-41,581.74
09/02/2016	Bill Payment (Check)	10002	Regional Water Management Foundation		R	-4,036.59
						-4,036.59