Indian Wells Valley
Water Budget
Initial Groundwater Level

February 1, 2018

IWV-TAC Meeting

OUTLINE

Water Budget

- Groundwater Sustainability Plan Requirements
- Water Budget Elements
- Water Year Type, Hydrologic Periods
- Historical Water Budget Estimates
- Approach and Schedule for Upcoming TAC meetings
- Requested Input from TAC

Initial Groundwater Levels for Baseline Model Run

- Introduction to Baseline Model Run
- 2015 Groundwater Levels
- Approach and Schedule for Upcoming TAC meetings

GSP Requirements
DWR Best Management Practices (BMP)

CALIFORNIA CODE OF REGULATIONS

TITLE 23. WATERS

DIVISION 2. DEPARTMENT OF WATER RESOURCES

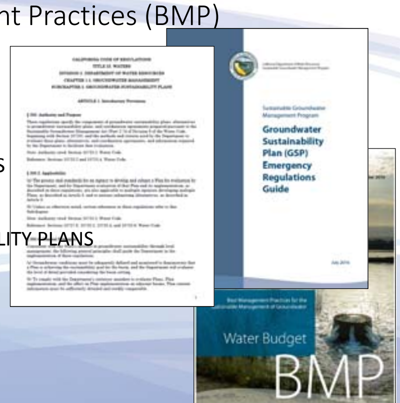
CHAPTER 1.5. GROUNDWATER MANAGEMENT

SUBCHAPTER 2. GROUNDWATER SUSTAINABILITY PLANS

ARTICLE 5. Plan Contents

SUBARTICLE 2. Basin Setting

§ 354.18 Water Budget



§ 354.18 Water Budget

(a) Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin . . . .

(b) The water budget shall quantify . . .
All Inflows, Outflows, Changes of Water in Storage, Estimate of Sustainable Yield, Water Year Type

(c) Water Budgets: Current
Historical
Projected 50 years (through 2070)
Baseline
Future Sustainability Plan

Water Budget Elements

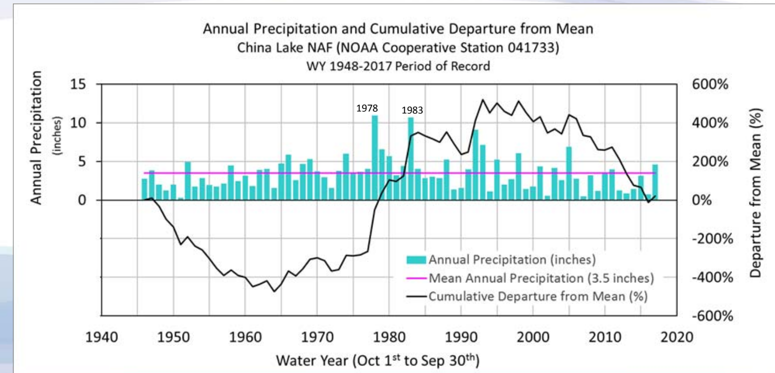
Inflow
- Subsurface Inflow
- Side Tributary Flow
- Mountain Front/Block Recharge
- Irrigation Return Flow
- Wastewater Return Flow
- [Imported Water]
- [Recycled Water]

Outflow
- Subsurface Flow to Salt Valley
- Phreatophyte Evapotranspiration
- Playa Evaporation
- Pumping
  - Domestic
  - Municipal
  - Industrial/Commercial
  - Agricultural
  - [Desalination Project]

Change of Water in Storage

2/2/2018

Water Year Type, Hydrologic Periods



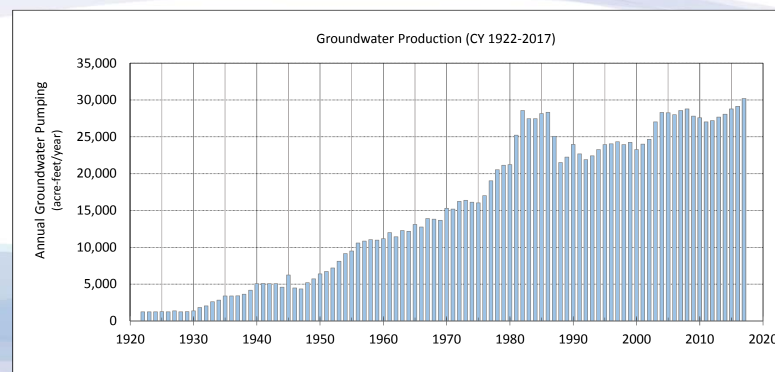
2/1/2018

Recent Estimates for Natural Recharge

Brown and Caldwell (2009)		8,521
Todd Engineers (2014)		7,700 to 11,000
Desert Research Institute (2016)		7,645
U.S. Geological Survey (2018)	(2000-2013)	6,547
	(1981-2010)	9,583

2/2/2018

Recent Pumping



2/2/2018

Approach and Schedule for Upcoming TAC meetings

Input from the TAC:

- Provide comments to Stetson by February 22, 2018 to be incorporated into a presentation at the March TAC meeting

Upcoming TAC Meetings

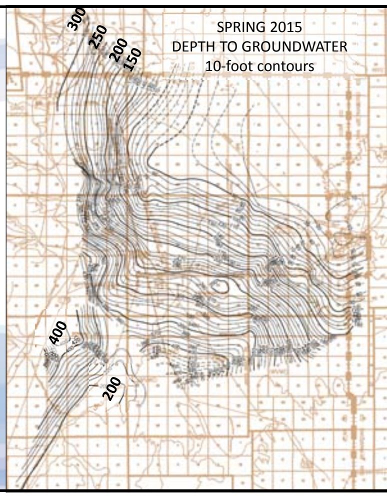
o Incorporation of Other Current Studies and Data	March 2018
o Determination of Current Water Budget	April 2018
o Review Numerical Model Results	
o Historical Calibration Water Budget	Summer 2018
o Future Baseline Water Budget	Fall 2018
o Future Sustainable Water Budgets	Oct 2018 – Feb 2019

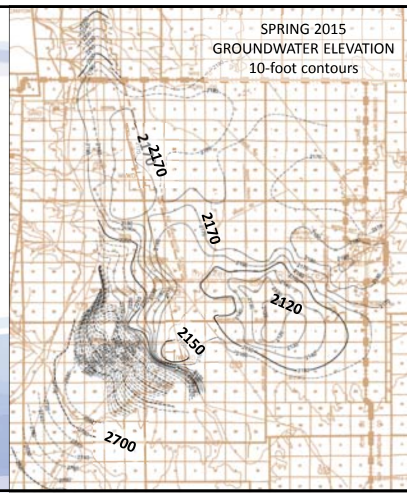
2/2/2018

Initial Groundwater Levels

- Groundwater in Storage for Future Baseline and Sustainable Management Model Runs
- Future Baseline Model
  - Used to evaluate future sustainable plan alternatives
  - 50-year historical hydrology
  - Recent land use
  - Projected water demand

2/2/2018





Approach and Schedule for Upcoming TAC meetings

Input from the TAC:

- Provide comments to Stetson by February 22, 2018 to be incorporated into a presentation at the April TAC meeting
- Provide recommendations on other Baseline Model assumptions to be discussed in April and May TAC meeting

Upcoming TAC Meetings

o Baseline Model Elements	April 2018
o Estimated Future Baseline Water Budget	May 2018
o Provide Model Assumptions for Future Baseline	end of June 2018

2/2/2018

TRANSMITTAL

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TO:	Indian Wells Valley TAC	DATE:	January 30, 2018
FROM:	Stetson Engineers Inc.	JOB NO:	2652

RE: Data Management System Comparison Matrix and Response to Comments

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The Indian Wells Valley Technical Advisory Committee (TAC) tasked Stetson Engineers on January 4, 2018 to develop a matrix comparing existing and future databases that will be used to manage geologic and hydrogeologic data within the basin. Attachment 1 compares the KCWA, Groundwater Authority DMS, and Brackish Groundwater Group's GeoGIS systems. Attachment 2 provides a comparison of the State Water Resources Control Board's (SWRCB) Groundwater Ambient Monitoring and Assessment Program (GAMA), the United States Geological Survey's (USGS) National Water Information System (NWIS), and the Department of Water Resources' (DWR) California Statewide Groundwater Elevation Monitoring Program (CASGEM).

Comments received from TAC members were also compiled in a response matrix shown in Attachment 3 (11x17). Comments pertaining to the development of the DMS under Stetson's Phase 1 task order have been addressed and reflected in the IWVGSP.COM website. Other comments pertaining to Phase 2 tasks, or refinement of Phase 1 work, are currently under development and are shown as "In Progress".

We look forward to discussing any questions the TAC might have regarding any of the three attachments provided in this transmittal.

Attachments:

Summary of Data Management Systems
Summary of Other Databases
Comment and Response Matrix

Attachment 1 - Summary of Data Management Systems

January 30, 2018

Characteristic	KCWA	IWV GSP DMS (Stetson Engineers)	Ramboll
Purpose	Store and manage groundwater levels, production, and water quality.	Subject to GSP restrictions, compile and distribute data and reports for implementation of the GSP (CA WAT§10720-10737.8).	Development of a 3D hydrogeologic conceptual model, including comprehensive hydrogeologic data and SkyTEM aeromag data.
Management	KCWA	Groundwater Authority	Brackish Group/Ramboll
Technical Database Properties			
System License Type	Proprietary - SEMS (license fee)	Open-source (no fee)	Proprietary - GeoGIS (license fee)
Database Server Type	MS SQL Server (license fee)	MySQL Server (no fee)	MS SQL Server (license fee)
Database Location	Onsite	Dedicated Offsite VPS Server	Offsite
Data Structure Flexibility	Flexible, features added as needed.	Flexible, features added as needed.	Flexible, features added as needed.
Estimated Expenses			
Customization, Setup, Digitization and Data Conversion	n/a (already completed)	Not to exceed: $102,200	$400,000 ($100,000 GeoGIS database, $300,000 additional funding)
Reoccurring Annual Cost for Update and Use	$7,000 (license and support)	$1,000 (VPS upkeep and software updates)	$2,000 (license fee for some feature set)
Data Storage			
Georeferenced Time Series Data	Groundwater levels Groundwater pumpage water quality	Groundwater levels Groundwater pumpage Water quality / chemistry Stream discharge Precipitation Evaporation SCADA System data Others as available	Groundwater levels Groundwater pumpage Water quality / chemistry Stream discharge Precipitation Evaporation SCADA System data Others as available
Document Library	No	Yes	No
Well Information	Comprehensive asset management information	Summary information	Summary information
Planned Well Data	~300 KCWA Wells	~40 GSP Wells (expandable as needed)	~1,000 wells
Digital Well Logs	Lithology eLog	lithology screening intervals	lithology well construction geophysical logs

Attachment 1 - Summary of Data Management Systems
January 30, 2018

Characteristic	KCWA	IWV GSP DMS (Stetson Engineers)	Ramboll
Scanned Documents	Yes	geophysical logs, drillers reports, soils data, pump tests	Yes
GIS Mapping	No	Yes	Yes, and model grids
Model Files	No	Yes	Yes - Grid based
Data Access and Download			
GUI Interface	Desktop Application	Web Application	Desktop Application (GeoGIS), Web Application (fee)
Public GUI Access	No	Yes	Yes (Web application)
Limit of Users	Limited to KCWA	Unlimited	Unlimited per license fee.
Data Download	No	Website	Yes
Custom Reports	Yes, SQL Application	Yes, SQL/ODBC web service	Yes, SQL/ODBC web service
Automated Management Trigger Notification	Yes, implemented for Water Quality	Planned	Planned
Automated Live Data GIS Services	No	Optional live GeoJSON layers and access to pre-rendered web map tiles	WFS/WMS services for visualization
Data Uploading			
Telemetry / Auto-Update	No	Yes, current support for USGS and DCP.	Yes, customization to read public data sources using web service or SQL connection available.
Data Entry / Uploading	KCWA uploads using the Local Application	Data is submitted to Groundwater Authority, uploads using a SQL/ODBC client.	Data is submitted to Ramboll, data uploaded using GeoGIS Desktop / Mobile Application

Attachment 2 - Summary of Other Databases

January 26, 2018

Characteristic	GeoTracker GAMA (SWRCB)	NWIS (USGS)	CASGEM (DWR)
Purpose	Compilation of water quality and water level information from State of California and Federal Agencies.	Report USGS monitoring data, for surface and ground water, including water levels and water quality.	Report current groundwater levels for state of California.
Management	SWRCB	USGS	DWR
Technical Database Prop			
System License Type	n/a	n/a	n/a
Database Server Type	n/a	n/a	n/a
Database Location	n/a	n/a	n/a
Data Structure Flexibility	n/a	n/a	n/a
Estimated Expenses			
Customization, Setup, Digitization and Data Conversion	n/a	n/a	n/a
Reoccurring Annual Cost for Update and Use	n/a	n/a	n/a
Data Storage			
Georeferenced Time Series Data	Groundwater levels Ground water quality	Groundwater levels Water quality / chemistry Stream discharge Precipitation Evaporation	Groundwater levels
Document Library	No	No, through other USSG services	No, through other DWR services
Well Information	Well location and identifier, possibly duplicate Wells	Well depth and location information	Well depth and location information
Planned Well Data	n/a	n/a	1,062 Reports
Digital Well Logs	No	No	No, 1,062 Well Completion Reports as PDFs through another DWR service

Attachment 2 - Summary of Other Databases
January 26, 2018

Characteristic	GeoTracker GAMA (SWRCB)	NWIS (USGS)	CASGEM (DWR)
Scanned Documents	n/a	n/a	n/a
GIS Mapping	Yes	Yes	Yes
Model Files	n/a	n/a	n/a
Data Access and Downlo			
GUI Interface	Web Application	Web Application	Web Application
Public GUI Access	Yes	Yes	Yes
Limit of Users	n/a	n/a	n/a
Data Download	Website	Website, REST services	Website
Custom Reports	n/a	n/a	n/a
Automated Management Trigger Notification	n/a	n/a	n/a
Automated Live Data GIS Services	n/a	n/a	n/a
Data Uploading			
Telemetry / Auto-Update	No	Yes	No
Data Entry / Uploading	n/a	n/a	Data is submitted to DWR, DWR then approves and uploads.

Client Comment Log

Client: *Indian Wells ValleyGroundwater Authority*

Project: *Phase 1 - Software Engineering and Development of the Indian Wells Valley Data Management System*

Project Number: 2652-001:04

Comments

Comment Number	Reviewer (1st initial-Last name)	Association	Review Date (##/##/##)	Reference General Area	Reference Detail	Review Comments / Questions	*Responder (1st initial-Last name)*	Proposed Actions	*Resolution / Response*	*Resolution Date (##/##/##)*
1	W. Major	TAC	12/15/17	Library		I don't know if it is capable of wildcard searching, or other Boolean operations such as those outlined below in the Google Guide, but once the Library starts to amass thousands of documents, having some additional search flexibility will quickly help users hone in on a small number of results from a larger set.	M. McCammon	Fix/improve the search document documentation to explain SQL wildcard support.	Completed	1/29/2018
2	W. Major	TAC	12/15/17	Library		Another option to consider for search filtering is the use of cascading filters on keywords. Some find this easier to use and more intuitive than having to construct elaborate wildcard or Boolean arguments.	M. McCammon	Need an example to work from. No action.	No Action.	1/3/2018
3	W. Major	TAC	12/15/17	Dataset Viewers	GW Production	[W]ithin the Ground Water Production Data tab is a header reference to Camp Pendleton…	M. McCammon	Remove references	Refrences to Camp Pendleton Removed	12/15/2017
4	W. Major	TAC	12/15/17	Map Interface Page		Within the Map Interface tab, there is the Legend on the right-hand-side of the page. Within that legend for the KCSWA wells are a series of icons showing a bold color, a muted pastel color and a muted pastel color with a diagonal slash through them. I haven't found these defined anywhere on the site, but I'm assuming they mean active, inactive, and abandoned/destroyed?	M. McCammon	Legend will be added and updated. Additionally, the website has hover text/tooltips.	In progress - Phase II.	
5	W. Major	TAC	12/15/17	Map Interface Page		Also on the Map Interface tab, one additional feature that I would find very useful would be a marquee tool (either rectangular, circular, or free form) to select a group of wells in a particular area and then export particular data fields for those wells (such as TDS, total depths, etc.) to an Excel sheet.	M. McCammon	Implement simple selection tool, probably rectangular, that would work with the one layer at a time i.e. well, or USGS, or surface water sites only.	In progress.	
6	W. Major	TAC	12/15/17	Map Interface Page		I would encourage you to get water quality data input as soon as possible, particularly TDS as we would make great use of it on the Brackish Water Feasibility Study.	M. McCammon	Add water quality data in Phase II.	In progress - Phase II.	
7	A. Bingham	TAC	12/20/17	Login		I had some trouble setting up a password and I am not sure if it has accepted the password I was forced to change and I am not sure why.	M. McCammon	Review login settings.	Corrected	1/8/2018
8	A. Bingham	TAC	12/20/17	User Page		Plus the number of *'s are not the sum as the password.	M. McCammon	Number of * shown is a placeholder as passwords or password length is not stored. Change placeholder to "[password]".	Feature added.	12/22/2017

Comments										
Reviewer								Proposed Actions		
Comment Number	**Reviewer** (1st initial-Last name)	**Association**	**Review Date** (##/##/##)	**Reference** General Area	**Reference** Detail	**Review Comments / Questions**	***Responder*** *(1st initial-Last name)*	**Proposed Actions**	***Resolution / Response***	***Resolution Date*** *(##/##/##)*
9	A. Bingham	TAC	12/20/17	Data	USGS	So first off, I cannot understand what the dataset USGS sites are that are listed and my other question is why any information regarding Searles Valley even presented? There is nothing that is part of the IWV basin groundwater GSP etc. If I can understand some of the sites listed for stream water, groundwater, atmospheric site etc, they are confusing. I cannot access or bring up any history data and the vast majority is for brine wells and perhaps some brackish wells but I have only checked a few of them and there is only TDS location info. All of this data on Searles Valley does not affect and is not related to or part of the IWV basin.	M. McCammon	Final data will be populated in Phase II. Data for example only, automatically populated from USGS.	In progress - Phase II.	
10	A. Bingham	TAC	12/20/17	Data	USGS	For example, one well was listed as having data from 1967 to 1985 but only had 6. There was no other info. So with all that said, lol, is that because it is very old USGS information that is on their own website for history purposes?	M. McCammon	Final data will be populated in Phase II. Data for example only, automatically populated from USGS.	In progress - Phase II.	
11	A. Bingham	TAC	12/20/17	GSP Reports		I shifted over to the 2nd water data title and selected water level reports. The next page was a bit confusing without any title links so I selected the copy database well information link in one of the bullet sentences.	M. McCammon	Current page shown is placeholder for a future TBD feature.	In progress.	
12	A. Bingham	TAC	12/20/17	Wells	Basin Info	When mousing over the wells and the info tags pop up, it is difficult to shift to things above cuz you can't see them, lol.	M. McCammon	Edit well info display.	In progress.	
13	A. Bingham	TAC	12/20/17	Holistic Graphs		I was a bit confused of the select part on the bottom and how to add something to the graph. The star '*' button might be better if positioned on the right side of the magnify identifier. I didn't know that was an enter button on the left side.	M. McCammon	Create an additional 'Enter' button on the right side that appears when data can be added to graph.	Improvements applied in Phase II.	
14	A. Bingham	TAC	12/20/17	Data	Production	Also I tried to add agriculture data but I don't know what other buttons to select and it wouldn't change anything or give me some information as to why it won't work, has no data, cannot add....etc.	M. McCammon	Final data will be populated in Phase II. Data not provided yet other than the "demonstration".	In progress - Phase II.	
15	A. Bingham	TAC	12/20/17	Holistic Graphs		Is there a play button that move the graph? I did click on the pause but no change. I could select the arrow and drag it back and forth. Just my thoughts!	M. McCammon	Unclear what is asked. Range shown can be modified by the bar on top of the graphs or by selecting a period with the mouse. No Action.	No Action.	1/3/2018
16	A. Bingham	TAC	12/20/17	Wells	Well Info	Ok, then I went back into the Wells By Basin/Subbasin DEMO. I clicked on one of the wells and it listed LS Elevation. Is that Land Surface Elevation? I am so used to ground surface or just surface elevation, lol.	M. McCammon	Add on hover (tooltip) text to clarify.	In progress.	
17	D. Decker	TAC	12/28/17	About Page		There needs to be a short paragraph on the Home Page that summarizes the purpose of the page (likely above the buttons). It will be important to have another home page paragraph that ties the sub elements (buttons) to the common purpose of the page.	S. Reich / M. McCammon	Develop and improve the "About sub-page", make the about page appear at a more reasonable location.	In progress - Phase II.	
18	D. Decker	TAC	12/28/17	Layout		There is a mistake in the sub element listing in the present draft- there are two "Water Data" buttons present.	M. McCammon	Correct the "Water Data" Button to "GSP Reports"	Fixed	1/29/2018
19	D. Decker	TAC	12/28/17	General Info		"State sustainability requirements […] are not obviously present yet."	M. McCammon	Add State Sustainability requirements to the "General Info" section of the website.	In progress - Phase II.	
20	D. Decker	TAC	12/28/17	Water Quality		"only a water quality element under "Water Data" and no connection with the same to State sustainability requirements"	M. McCammon	Add State sustainability requirements to the Water Quality portal. Time depends on how the State sustainability requirements are specified.	In progress - Phase II.	

Comments										
Reviewer								Proposed Actions		
Comment Number	Reviewer (1st initial-Last name)	Association	Review Date (##/##/##)	Reference General Area	Reference Detail	Review Comments / Questions	*Responder (1st initial-Last name)*	Proposed Actions	*Resolution / Response*	*Resolution Date (##/##/##)*
21	D. Decker	TAC	12/28/17	Home Page		There will need to be a GSP button with a summary of the Plan and then specific buttons for sub elements that can be for example be connected to the findings under "Water Data". As the site is developed it will be a presentation of the progress on the GSP and its ultimate implementation.	M. McCammon	**Clarification needed:** Relationship between this and existing placeholder "GSP Reports"?	No Action.	1/3/2018
22	D. Decker	TAC	12/28/17	Library		The library is at present incomplete as you are certainly aware. What is present is a strong beginning. It will be useful to place the papers in subcategories within the library. Those subcategories should be accessible.	M. McCammon	**Clarification needed:** Currently there is a 'keywords' classification which has been implemented. Need additional clarification on how the 'subcategories' would behave differently.	No Action.	1/3/2018
23	D. Decker	TAC	12/28/17	Search		There is no search button present except for the library. I submit there should be a site- wide search function on the home page for full utilization of the site contents.	M. McCammon	Several portal pages exist which have this functionality. Functionality will be improved with time as data is added.	No Action.	1/3/2018
24	D. Decker	TAC	12/28/17	Search		…"it would be very valuable to enable OCR for all of the documents posted (library, well data, State documents, GSP, etc) so that a search can include the contents of all of the pertinent papers."	M. McCammon	Currently policy is to OCR all PDF documents before uploading. PDF viewers, such as Adobe Acrobat, can conduct a text search within a document with OCR text.	No Action.	1/3/2018
25	D. Decker	TAC	12/28/17	Search		In regard to the search function, it would be very valuable to enable OCR for all of the documents posted (library, well data, State documents, GSP, etc) so that a search can include the contents of all of the pertinent papers. I realize it may be harder to implement search when there are differing levels of site content availability. I suspect however that the majority of material on the site will be unrestricted.	M. McCammon	The current search uses a small set of selected metadata. A search function for PDF document contents would require an additional budget.	No Action.	1/3/2018

DRAFT

Indian Wells Valley Groundwater Authority
Technical Advisory Committee (TAC) Potential Action Schedule
February 1, 2018

TAC Meeting	Tentative Topic [1]	POAM Line Number [2]	Description
December 2017	Evaluation of Groundwater Model and Data Management System	8, 27	Discussion/Review
	Salt and Nutrient Management Plan	112	Review Draft Report
January 2018	Well Database Groundwater Truthing Study	108	Discussion
	Data Management System	8	Discussion
February 2018	Water Budget Elements / Initial Groundwater Levels	--	Initial Discussion
	Data Management System	8	Discussion
March 2018	Water Budget Elements	--	Discussion
	Recycled Water Feasibility	77	Initial Discussion
	Imported Water Opportunities/Constraints	68	Initial Discussion
April 2018	Water Budget Elements	--	Discussion
	Baseline Model Assumptions	29	Initial Discussion
	Data Gaps and Prioritization	39	Initial Discussion
	USGS Recharge Study	104	Review Draft Report
	Imported Water Opportunities/Constraints	68	Discussion
	Monitoring Wells - Location Siting	42	Initial Discussion
May 2018	Baseline Model Assumptions	29	Discussion
	Conceptual Hydrogeologic Model and Water Balance	24	Discussion
	Imported Water Opportunities/Constraints	68	Discussion
	Recycled Water Feasibility	77	Discussion

TAC Meeting	Tentative Topic [1]	POAM Line Number [2]	Description
	Aerial Electro-Magnetic Geophysics Survey (SkyTEM)	107	Review Draft Report
	Monitoring Wells - Location Siting	42	Discussion
June 2018	Recycled Water Feasibility	77	Review Draft Technical Memorandum
	Numerical Groundwater Model Updates / Baseline Model Run	29	Recommendation to Board
	Imported Water Options	68	Discussion
	Conceptual Hydrogeologic Model and Water Balance	24	Review Draft Technical Memorandum
	Sustainable Management Criteria	32	Initial Discussion
	Projects and Management Activities (Scenarios)	79	Initial Discussion
	Aquifer Test - Work Plan	62	Discussion
	Weather Stations - Location Siting	55	Discussion
July 2018	Recycled Water Feasibility	77	Review Draft Technical Memorandum
	(GSP) Introduction Chapter	19	Review Draft GSP Chapter
	Brackish Groundwater Resources Feasibility Study	105	Review Draft Report
	Sustainable Management Criteria	32	Discussion
	Projects and Management Activities (Scenarios)	79	Discussion
	Monitoring Protocols	11	Discussion
	Weather Stations - Location Siting	55	Discussion
	Aquifer Test - Work Plan	62	Discussion
	Stream Gages - Location Siting	52	Discussion
	Sustainable Management Criteria	32	Discussion
	Projects and Management Activities (Scenarios)	79	Recommendation to Board

TAC Meeting	Tentative Topic [1]	POAM Line Number [2]	Description
August 2018	Stream Gages - Location Siting	52	Discussion
	Aquifer Test - Testing/Results	63	Discussion
	Transducers/Telemetry	13	Discussion
September 2018	Water Quality Sampling	59	Discussion
October 2018	Imported Water Options	68	Review Draft Technical Memorandum
November 2018	Imported Water Options	68	Review Draft Technical Memorandum
	Monitoring Wells - Installation	45	Discussion
December 2018	Transducers/Telemetry	13	Discussion
January 2019	(GSP) Plan Area and Basin Setting Chapter	30	Review Draft GSP Chapter
February 2019	Groundwater Modeling Results	82	Initial Discussion
	(GSP) Plan Area and Basin Setting Chapter	30	Review Draft GSP Chapter
	Sustainability Goals and Sustainability Management Criteria	32	Discussion
March 2019	Groundwater Modeling Results	82	Discussion
	Sustainable Management Criteria	32	Discussion
	Geochemical Reaction / Transport Analysis Results	60	Discussion
April 2019	Groundwater Modeling Results/Plan Implementation	82	Discussion
	Sustainable Management Criteria	32	Recommendation to Board
	Transducers/Telemetry	13	Discussion
	Geochemical Reaction/Transport Analysis	60	Discussion
May 2019	Plan Implementation	86	Discussion

TAC Meeting	Tentative Topic [1]	POAM Line Number [2]	Description
June 2019	Transport Modeling and Alternative Effects of Land Subsidence	84	Discussion
	Plan Implementation	86	Discussion
July 2019	(GSP) Sustainable Management Criteria Chapter	34	Review Draft GSP Chapter
	(GSP) Projects and Management Actions to Achieve Sustainability Goal Chapter	85	Review Draft GSP Chapter
	Plan Implementation	86	Recommendation to Board
August 2019	Monitoring Wells - Installation	46	Discussion
	(GSP) Plan Implementation Chapter	86	Review Draft GSP Chapter
August - September 2019	(GSP) Draft Report	91	Review Draft GSP Report

Notes:

[1] The tentative POAM topics for each TAC meeting will be reviewed and updated periodically.

[2] POAM line numbers reference the draft POAM dated November 2017. A revised draft POAM will be presented to the Board at the February 2018 IWVGA Board Meeting, after which the TAC PAS will be updated to show the revised POAM line references.

INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

MARCH 1, 2018 TAC MEETING

AGENDA ITEM 5b: WATER BUDGET ELEMENTS

HISTORICAL PUMPING ESTIMATES

Enclosures:

- Excerpt from Todd, 2014 Report
- Excerpt from DRI, 2016 Model Report

3. Water Use

Overdraft in Indian Wells Valley groundwater basin is not a result of decreased recharge. Natural recharge today is nearly the same as it was prior to development a century ago. Overdraft is caused by the large amount of groundwater extracted and used in the valley. Accordingly, it is worth characterizing the types and amounts of water use in some detail. The purpose of this water use inventory is not to find culprits but rather to begin identifying opportunities for management. All of the pumpers contribute to overdraft, and all of the current water uses would be considered "reasonable and beneficial" under the California Constitution.

The description of water use presented below is in chronological order, from historical to future. The intent is not to suggest that water use return to some particular date in the past, but rather to illustrate how various categories of water use can and do change over time. Estimates of current water use are documented in detail so that assumptions and uncertainty are clear. Future water use is unknown and will likely be affected by this report and the associated stakeholder planning process. However, land use zoning and population projections reveal the potential for water demand to increase in the future.

3.1 Historical Water Use

Annual groundwater pumping during 1920-2012 reported by previous investigators is shown in **Figure 9** broken down by user category. The values for 1920-1974 were estimated by the U.S. Geological Survey (Berenbrock and Martin, 1991), and the subsequent years were estimated by IWVWD. Several patterns are notable in the figure. Total groundwater production began increasing rapidly when NAWS was established in the early 1940s and has increased nearly continuously since then. Current total groundwater production is about 25 times greater than it was prior to 1940. Private domestic production is relatively small and has increased at a slow, steady rate. Production for export to the community of Trona and mining operations in Searles Valley (presently operated by Searles Valley Minerals) increased fairly quickly until the late 1970s and has remained steady at that level since then. Municipal production has fluctuated with changes in population, which are driven primarily by employment at NAWS. Growth was rapid during 1970-1990 and has been more gradual since then. Much of the increase in municipal pumping resulted from a shift in personnel and residential water use from NAWS to Ridgecrest. NAWS pumping has decreased rapidly and steadily over the past four decades and is presently less than one-fourth of its peak use in 1970. The decrease resulted from substantial reduction in irrigated landscape area on the base, in addition to the population exodus. Agricultural water use has fluctuated substantially due to changes in cropping patterns and irrigation practices. For example, one major alfalfa grower decreased per-acre water applications by one-third from the 1960s to 1990s but increased irrigated acreage about eight-fold (Mead, 2013).

The uncertainty in estimating non-metered pumping (such as by agricultural and private domestic wells) is revealed by discrepancies between the historical data sets during periods where they overlap. The U.S. Geological Survey and IWVWD data sets overlapped during 1975-1985, and the two estimates differed substantially in some years. The municipal and private domestic pumping estimates differed by up to 23 percent, NAWS pumping estimates differed by up to 34 percent, and agricultural pumping estimates differed by as much as a factor of two. Similarly, estimates of private domestic and agricultural pumping developed in this report for 2010-2012 differ from the estimates in IWVWD's database. Rather than attempt to explain the cause of historical discrepancies, this report focuses on thoroughly documenting its own methods used to estimate current water use in each category, so that the assumptions and calculations are clear and the results can be evaluated accordingly.

3.2 Current Water Use

Water use as of 2013 is estimated in this section for six categories: military (China Lake NAWS), municipal, Searles Valley Minerals, private domestic, agricultural and environmental. **Figure 10** compares current water use for the first five of those categories, which are the ones supplied by groundwater. Environmental uses are presently supplied by recycled water. The estimates shown in the figure represent average annual use under current population, land use and water use factors. However, all water uses fluctuate somewhat from year to year due to weather patterns and other transient factors.

Municipal and agricultural uses are the two largest uses and are similar in magnitude (36-40 percent of total groundwater pumping). However, current agricultural land use will require increasing amounts of water over the next 10-12 years as recently-planted pistachio orchards grow to maturity. That latent demand will increase agricultural groundwater demand by about 70 percent, as indicated by the dashed box on the agricultural water use bar in the figure. The approximate range of uncertainty is indicated by error bars in the figure. Details regarding data, assumptions and uncertainty for each category of water use are presented below.

Table 1 lists estimated groundwater demand by user category for 2010, 2013 and 2025. These three dates were selected to reveal the effects of recent agricultural expansion on water demand over that 15-year period. Agricultural water demand is broken down by crop type and growth stage: alfalfa, young pistachios and mature pistachios. The sources of the acreage tabulations and water use factors are explained below.

The location of groundwater pumping is important to understanding water level patterns, water quality trends, potential conflicts among users, and overdraft. The map in **Figure 11** shows the current locations of groundwater pumping in Indian Wells Valley. The points labeled as private domestic wells are actually the locations of residences mapped from aerial photographs and that are presumed to have on-site domestic wells. Similarly, one agricultural well is shown at the center of each alfalfa field and pistachio orchard on the assumption that each field and orchard is served by a local well. The area of each circle is proportional to the annual pumping volume (except for private domestic wells, which would be too small to see easily if they were displayed proportionally). Groundwater pumping is distributed fairly uniformly along the south and west sides of NAWS. Agricultural pumping dominates on the west side of NAWS, and municipal, NAWS and SVM pumping dominate on the south side. A comparison with Figure 7 shows that pumping is concentrated in areas of relatively good water quality, although the southern area has generally lower TDS than the western area.

China Lake NAWS

NAWS produces water from six wells located on the base to supply on-base water needs. These needs are essentially municipal in character, and include two schools, office and laboratory buildings, some residences, and a small amount of landscape irrigation. The golf course is irrigated with recycled water, not groundwater. All of the wells are metered, and average annual production during 2008-2012 was 1,800 AFY.

Table 1. Indian Wells Valley Groundwater Demand in 2010, 2013 ~~and 2025~~

	2010 Conditions[2]			2013 Conditions			Estimated 2025 Conditions		
User	Acres	Applied Water ft/yr	Water Use AFY[1]	Acres	Applied Water ft/yr	Water Use AFY[1]	Acres	Applied Water ft/yr	Water Use AFY[1]
Private Domestic			1,000			1,000			1,100
IWVWD + Inyokern CSD			8,000			8,000			8,200
NAWS			1,800			1,800			1,800
SVM			2,600			2,600			2,600
Ridgcrest park irrigation			350			350			350
Alfalfa	870	8.0	7,000	990	8.0	7,900	990	8.0	7,900
Pistachios									
Young trees	0	0.25	0	2,200	0.25	550	0.0	0.25	0
Mature trees	300	5.0	1,500	300	5.0	1,500	2,500	5.0	12,500
Subtotal of current uses			22,300			23,700			34,500
Potential increase in irrigated cropland[3]							25,530	5.0	130,000
Potential total									165,000

only historical pumping reviewed for March 2018 IWV-TAC meeting

Notes:

[1] All water use entries rounded to two significant digits.

[2] Water use except for new alfalfa fields and pistachio orchards was approximately the same in 2010 as in 2013.

[3] Potential future agricultural water demand assumes additional cropland consists of mature pistachios.

IWVWD = Indian Wells Valley Water District CSD = Community Services District NAWS = Naval Air Weapons Station China Lake SVM = Searles Valley Minerals AFY = acre-feet per year

Municipal

IWVWD provides the municipal water supply for the City of Ridgecrest and China Lake Acres. Eleven wells were active during 2008-2012, most of which are within the IWVWD service area but a few of which are in outlying areas southwest of Ridgecrest. Production from the wells is metered, and total production averaged 8,000 AFY during 2008-2012. The City of Ridgecrest operates five wells to irrigate a total of 41 acres of turf (measured from Google Earth imagery) at City Hall, Pearson Park, Jackson Park, and the Kerr-McGee Sports Facility. Using an estimated annual irrigation rate of 7.8 ft/yr (Provost and Pritchard, 2011) total irrigation use is 320 AFY. The IWVWD database shows an average of 370 AFY for 2008-2012, but the basis for the estimate is not documented. Given the relatively small magnitude of this use, an intermediate value of 350 AFY was used for this analysis. Inyokern CSD supplies municipal uses in Inyokern from a single well. Average annual production during 2008-2012 was 120 AFY. The sum of these three municipal uses was 8,350 AFY.

Characteristics of municipal water use that help guide management programs include per-capita water use and the proportions of indoor and outdoor use. Per-capita water use within the IWVWD service area decreased from 269 gallons per person per day (gpcd) in 1990 to 219 gpcd in 2010 (IWVWD, 2011; Morquecho, 2013). This 19 percent decrease was the result of local water conservation efforts. The proportions of indoor and outdoor water use were estimated by comparing monthly groundwater production with WWTP inflows, as shown in **Figure 12**. The lower line in the plot is inflow to the WWTP, which represents indoor use and has remained fairly constant seasonally and from year to year. The upper line shows municipal groundwater production, which has large seasonal fluctuations due to irrigation in summer. The difference between the upper and lower curves represents outdoor use. Beginning around 2008, outdoor use decreased by 16 percent relative to prior years. Outdoor use during 2009-2012 accounted for 67 percent of total IWVWD water use.[2]

Searles Valley Minerals

Searles Valley Minerals (SVM) pumps groundwater from wells in the eastern part of Ridgecrest and exports the water to Searles Valley for municipal and industrial uses. Production is metered and routinely compiled by IWVWD. Annual groundwater pumping averaged 2,570 AFY during 2008-2012 and has varied by only +/- 9 percent since 1985.

Private Domestic

A new estimate of private domestic groundwater use was developed for this analysis because prior estimates were not sufficiently documented to evaluate their accuracy. Google Earth air photo imagery and a digital parcel map obtained from Kern County were used in GIS (Geographic Information Systems) to locate all parcels outside the IWVWD, NSWS and Inyokern CSD service areas that contained at least one structure that appeared to be a residence. A total of 1,235 developed residential parcels were identified (locations shown on Figure 10). All of these were assumed to be served by on-site domestic wells. In addition, numerous homes in the western part of Ridgecrest and China Lake Acres reportedly have wells that pre-dated annexation to the IWVWD service area and that are still in use, at least for irrigation. The maximum number of such residences was estimated by counting all existing residences on parcels greater than 2.25 acres in size located west of Mahan Road. There were 353 parcels that fit this description, bringing the total number of residences supplied by on-site wells to as much as 1,588.

Based on field reconnaissance and inspection of aerial imagery, average per-residence water use on parcels with private domestic wells is probably similar to average water use per single-family home in Ridgecrest, which was 0.528 AFY (IWVWD, 2011). Swimming pools and lawns are both noticeably more common in town than in outlying areas. However, IWVWD customers pay more for each additional unit of water than well owners, and they are the focus of IWVWD's water conservation program. In contrast, rural residential parcels appear to have more tree canopy area per house on average than homes in town. About 50 homes in the area between Mahan Road and Jacks Ranch Road have exceptionally large amounts of vegetation, but those are offset by numerous rural residences that have almost none. Also, the trees and shrubs at rural residences are almost always drought-tolerant varieties such as mesquite, eucalyptus, pine and oleander. In light of these counterbalancing considerations, an assumption of equal water use by urban and rural single-family homes appears reasonable.

Multiplying the per-residence water use factor by the number of parcels with domestic wells obtains an estimated 838 AFY of private domestic groundwater use. A small water system and possibly some small parcels in China Lake Acres also reportedly use wells, which could push the estimate closer to 900 AFY. On the other hand, many of the large-lot residences within the IWVWD service area might not have wells, and some might use wells only for irrigation, which would shift the estimate of private domestic pumping down toward 800 AFY.

The estimate of private well pumping in the IWVWD database is much larger: 2,800 AFY. However, that number includes some agricultural pumping. A groundwater study in 2003 determined that only 1,730 AFY of the total was rural residential use (Tetra Tech EM, Inc., 2003). The estimate of private well

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[2] These calculations exclude park irrigation by City of Ridgecrest wells. The indoor/outdoor proportions were calculated at the customer's point of use by adjusting well production for estimated water pipe leaks and adjusting WWTP inflow for estimated sewer pipe leaks.

pumping was reportedly developed by spectral analysis of color-infrared aerial photography that measured the area of irrigated vegetation. The photos were taken in the late 1980s, and the number of residences was not reported. All irrigated areas were assigned a water use factor equivalent to that of alfalfa, including rural residential landscaping. That methodology produced an estimate that was probably too high by about one-third (Decker, 2013). A reasonable adjustment of the previous estimate might thus be more like 1,150 AFY.

Even with downward adjustments, the IWVWD estimate and the one developed for this study still differ, but the difference is quite small in the context of the overall basin water balance. Accordingly, averaging the two estimates to 1,000 AFY is reasonable for the purposes of this study.

Agricultural

Agricultural water use has been changing rapidly in the past two years, and independent estimates of current and future agricultural water use were developed for this study so that planning can be based on a clear and consistent set of data, assumptions and methods. The amount of irrigation water applied to a crop equals the crop area (in acres) multiplied by its annual irrigation demand (in feet per year). Net agricultural water use is the amount of applied water minus deep percolation beneath the root zone, which in most locations returns to the principal aquifer and which was assumed to be a fixed percentage of applied water. Each of these factors is explored in detail below.

A map of irrigated cropland as of 2013 was compiled through a combination of air photo inspection (Google Earth imagery dated May 2013) and on-the-ground site inspections. This resulted in the map of currently irrigated cropland shown in **Figure 13**. The only two crops grown commercially in the valley are alfalfa and pistachios. Cropland under cultivation prior to 2011 is indicated with different colors, to emphasize the large increase that has occurred since then. Since 2010, alfalfa acreage has increased from 870 to 990 acres, and pistachio plantings have increased from 300 to 2,500 acres. All of the new alfalfa and most of the new pistachio plantings have been in the Brown Road area north of Highway 395 and Inyokern. Crop area was measured in GIS and corresponds to the actual planted area, not the gross parcel area.

Alfalfa fields are irrigated by center-pivot overhead sprinkler systems. When alfalfa farming commenced in the 1960s, 10-11 feet of water were customarily applied per year. That amount was gradually reduced to about 7 ft/yr by the early 2000s by switching sprinkler heads and pressures and by managing irrigation more carefully (Mead, 2013). The reduced amount was reportedly sufficient to prevent salt buildup in the soil and therefore must have included a leaching fraction (deep percolation beneath the root zone). The amount of water use reported by the two current alfalfa growers was about 10,800 AFY in 2011 and 2012, which corresponds to 10.9 ft/yr of applied water on the current alfalfa acreage. A study of alfalfa irrigation requirements in other arid California locations (Shafter and Brawley) found that average annual crop ET was about 7 ft/yr (Hansen and others, 2008). Allowing for an irrigation inefficiency of 20 percent (10 percent spray evaporation and 10 percent deep percolation), the irrigation requirement would be 8.8 ft/yr. Thus, estimates of applied water range from 7 to 11 feet. A value of 8 feet is used for the water balance and overdraft calculations in this report, recognizing that it might be slightly low. Application of this irrigation rate to the alfalfa acreage in 2013 provides an estimated use of 7,900 AFY of groundwater for alfalfa irrigation.

Recycled water from the City of Ridgecrest wastewater treatment plant is used to irrigate approximately 30 acres of alfalfa at a former WWTP site in eastern Ridgecrest. An average of 220 AFY is used for that purpose. Because the source of water is recycled water, this use is not included in the tabulation of groundwater demand.

Pistachio trees take about 12 years to reach maturity, and the per-acre irrigation requirement parallels the growth of the trees. Water is delivered by drip irrigation, initially with one emitter per seedling and with additional lines and emitters introduced as the trees grow. According to one grower new to the area, annual irrigation starts at around 0.25 ft/yr (averaged over the full area of the orchard) and is expected to reach 4 ft/yr when the trees reach full size (Stiefvater, 2013). A University of California study of pistachio irrigation under drought conditions measured 4.4 ft/yr of crop ET during the mid-April to mid-November growing season, after adjusting by the ratio of reference ET in Barstow to reference ET in the San Joaquin Valley study area (Goldhamer, 2005). Assuming a minimum 10 percent leaching requirement, the crop ET estimate translates to 4.9 ft/yr of applied water. Irrigation requirements in the Brown Road area could be higher than this due to the reportedly windy conditions, which would increase reference ET above the amount measured in Barstow (Mead, 2013; Decker 2013). In addition, the trees may need some winter irrigation to prevent root desiccation in the desert environment. Another local grower who has farmed pistachios for many years reported a use of 750 AFY on a 125-acre orchard of mature trees, which equals an annual application rate of 6 ft/yr (Quist, 2012). The three estimates of irrigation rate for mature pistachios range from 4 to 6 ft/yr. An average value of 5 ft/yr is used in this study for quantifying overdraft and the basin water balance. Multiplying the 5 ft/yr and 0.25 ft/yr irrigation rates by the areas of mature and young trees, respectively, obtains an estimated 2,050 AFY of groundwater used for pistachio irrigation in 2013 (Table 1).

Environmental

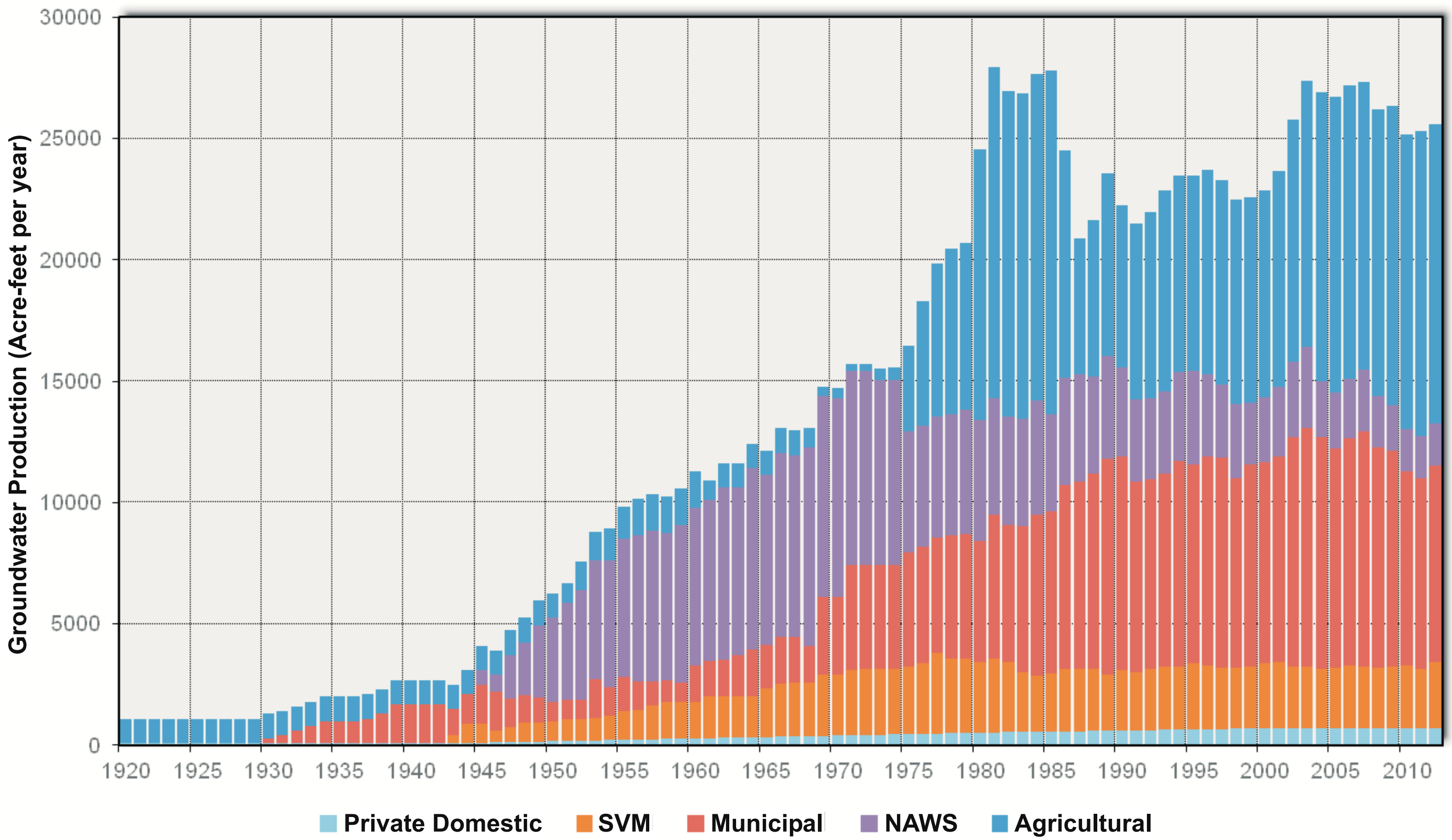
The most well-known environmental water use in Indian Wells Valley—for the tui chub—does not draw directly on groundwater from the principal aquifer and accordingly is not shown as a groundwater demand (Table 1). The environmental use is supported entirely by WWTP pond percolation and irrigation return flow on NAWS. Those sources of recharge flow a short distance through the shallow aquifer and emerge at the land surface to create Lark Seep, which discharges into a series of channels and wetlands in the direction of China Lake playa. Lark Seep and a short channel that feeds into it support a healthy population of tui chub, an endangered fish species. The tui chub, an endangered species, currently is dependent on wastewater disposal from the City of Ridgecrest and NAWS, and thus depends indirectly on groundwater pumping.

Annual evapotranspiration from open water and cattail marsh at Lark Seep has been estimated to equal 390 AFY (Bilhorn and Feldmeth, 1991). An additional 420 AFY evaporates from downstream areas, but those areas support few fish. These two evaporative losses combined approximately equal the amount of WWTP pond percolation (estimated to equal 630 AFY in 2010) and irrigation deep percolation at the golf course (75 AFY). This suggests that the local sources of percolation do not support phreatophytic plants farther north toward the China Lake playa.

China Lake playa was historically ringed by various types of phreatophytic vegetation supported by shallow groundwater near the playa discharge area. Kunkel and Chase (1969) measured over 12,000 acres of sparse saltgrass and pickleweed growth around the perimeter of China Lake playa on aerial photographs taken in 1953. The vegetated area presumably decreased since then as groundwater pumping has intercepted increasing amounts of groundwater that otherwise would have discharged at the playa.

3.3 Future Water Demand

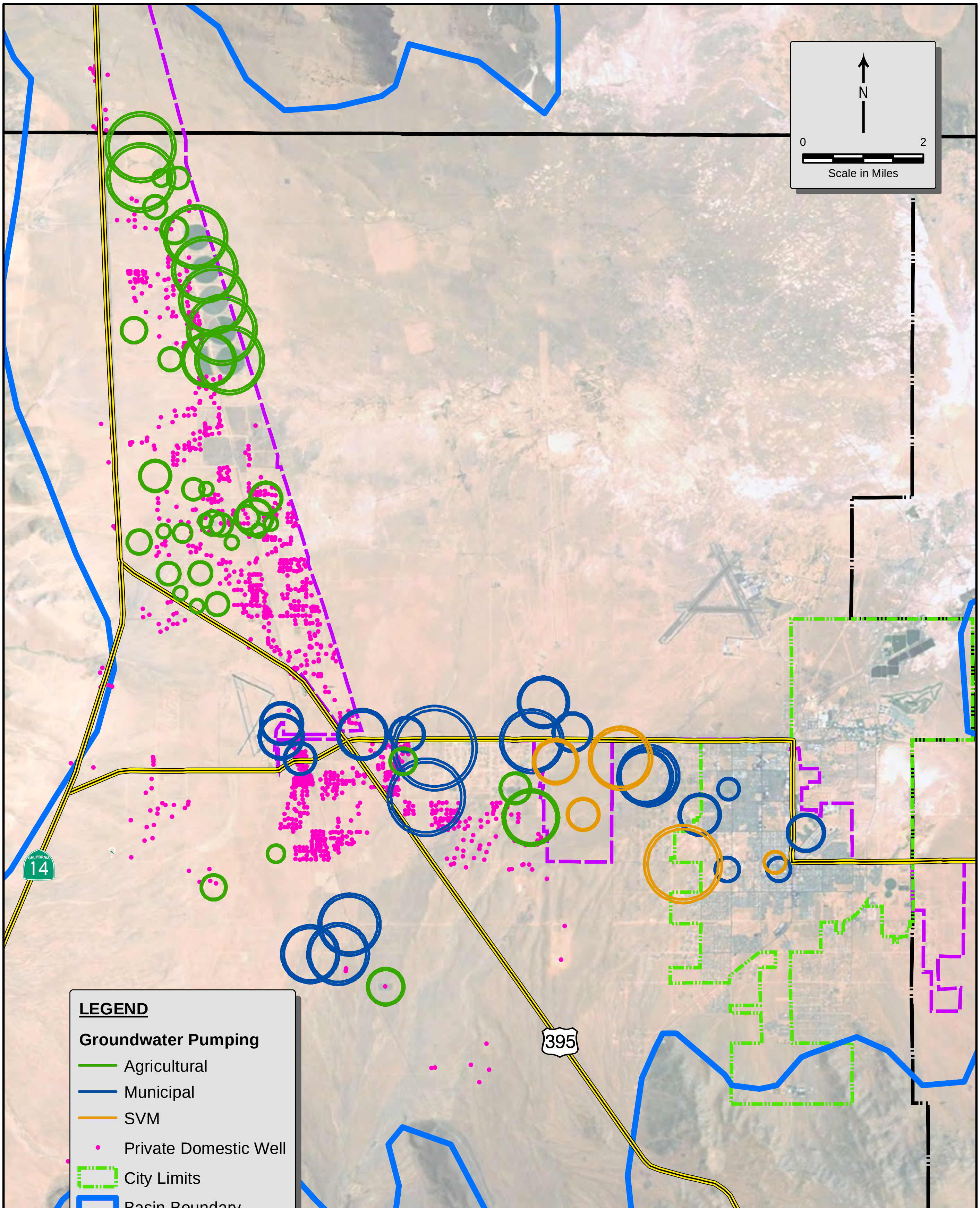
All sectors of water use in Indian Wells Valley are difficult to forecast because they hinge on uncertain economic factors, including defense research spending, agricultural and mineral commodity prices, and potential new industries such as solar energy. The only water demand certain to increase over the next



Data sources:
1920-1974: Berenbrock and Martin (1991)
1975-2012: IWVWD

SVM = Searles Valley Minerals
NAWS = Naval Air Weapons Station China Lake

January 2014	**Figure 9**
TODD ENGINEERS Alameda, California	**Groundwater Production 1920 - 2012**



January 2014

TODD ENGINEERS
Alameda, California

Figure 11
Pumping Locations and Amounts in 2013

Notes:
Circle area is proportional to annual production.

Valley, and Coso/Argus Ranges, respectively. The addition of 50 afy from the El Paso Mountains is added from estimates presented by Brown and Caldwell (2009) and Todd Engineers (2014). The total volume of mountain block recharge is 7,700 afy.

According to Todd Engineers (2014), wastewater from the treatment plant evaporates and then percolates into the shallow groundwater system. Because thick clay layers separate the shallow aquifer from the principal aquifer between the wastewater treatment plant and China Lake playa, essentially none of the percolated water contributes to the yield of the principal aquifer (Todd Engineers, 2014). Additional groundwater recharge in the amount of 80 afy can be attributed to leakage from the Indian Wells Valley Water District distribution system. Other sources—such as the reinfiltration of water pumped for agricultural and municipal use—can be handled by assuming net groundwater pumping, and therefore do not need to be directly considered in the groundwater recharge budget.

3.5.2 Groundwater Pumping

The steady-state groundwater model was calibrated to water levels measured in 1920. Although a small amount of domestic groundwater pumping may have occurred prior to 1920 (<1,000 afy), the steady-state model assumes no significant groundwater pumping.

3.5.2.1 Groundwater Pumping Database 1920 to 2025

As part of project objectives, a groundwater pumping database was developed to represent historical (1920 through 2013) pumping and future pumping projections (2014 through 2025). Each historical pumping well was evaluated and assigned to a category: private domestic, Searles Valley Minerals, municipal, NAWS, or agricultural. Individual wells were then verified using existing databases from Brown and Caldwell (2009) and aerial photographs. Historical pumping totals for each category were digitized from Todd Engineers (2014, Figure 9) based on the United States Geologic Survey (USGS) estimates of historical pumping from 1920 to 1974 and the Indian Wells Valley Water District rates from 1975 to 2013. Water use for 2013 is estimated to be approximately 23,700 afy (Todd Engineers, 2014), with the Indian Wells Valley Water District, Inyokern CSD, and alfalfa using approximately 67 percent of this total. Within each category, historical data for individual wells are used if available. If historical data for individual wells are not available, then nonagricultural pumping totals are divided evenly among the appropriate wells.

Agricultural wells are assigned rates according to the well's corresponding agricultural use (alfalfa or pistachios) and the rates for each agricultural type reported by Todd Engineers (2014). Agricultural use is calculated based on cropland identified in a Geographic Information System maintained by NAWS and it is current as of 2014. A total of 989 acres is assigned as alfalfa and 3,283 acres as pistachios (including acreage identified as under development). These acreages differ somewhat from the 2013 estimates of Todd Engineers (990 for alfalfa and 2,500 for pistachios) and also from those in the Kern County planning EIR report (1,467 for alfalfa and 3,322 for pistachios, which also include acreage under development).

Agricultural groundwater pumping rates are based on plant consumptive needs, improved technology, and irrigation inefficiency (e.g., spray evaporation and deep percolation). Applied water to alfalfa ranges between 7 and 11 ft/yr (i.e., afy/acre = ft/yr) and the value of 8 ft/yr is used for groundwater pumping. In the first year, pistachio seedlings use 0.25 ft/yr. After 12 years, they reach maturity and consume approximately 5 ft/yr. It is assumed that the increase is linear from year 1 to year 12, and then maintains at 5 ft/yr. The estimated potential groundwater pumping by 2025 is 35,000 afy, which is consistent with the estimates by Todd Engineers (2014).

INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

MARCH 1, 2018 TAC MEETING

AGENDA ITEM 5c: RECYCLED WATER OPPORTUNITIES

Recycled Water Opportunities

Enclosures:

- Presentation

Recycled Water Opportunities and Constraints Evaluation

Indian Wells Valley Groundwater Authority

Technical Advisory Committee Meeting

March 1, 2018

Stetson Engineers Inc.

Outline

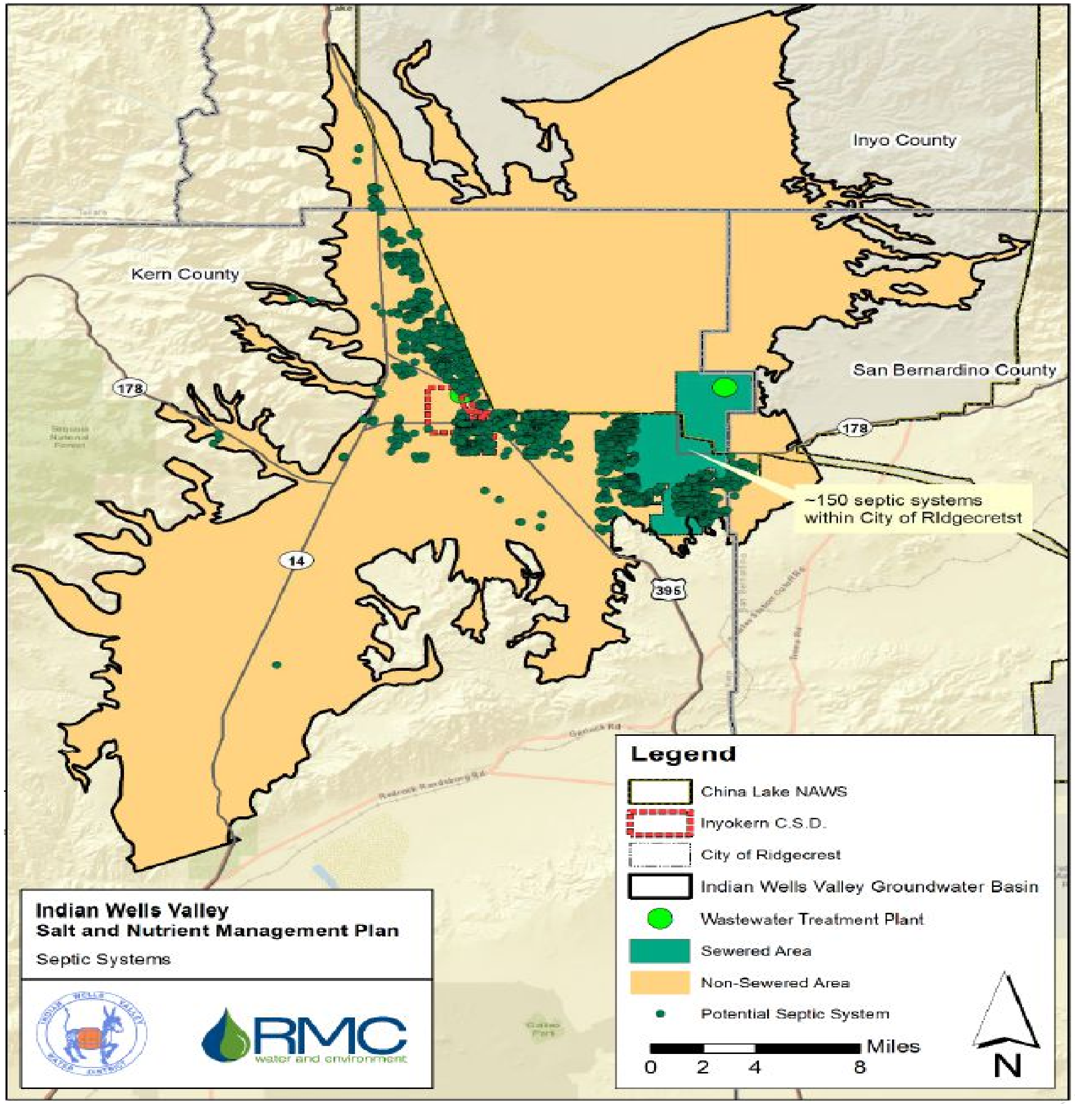
- Purpose and Background
- Current Sources of Wastewater and Recycled Water
- Existing Recycled Water Uses
- Opportunities
  - Non-Potable Reuse
  - Indirect Potable Reuse
  - Direct Potable Reuse
- Next Steps

Purpose

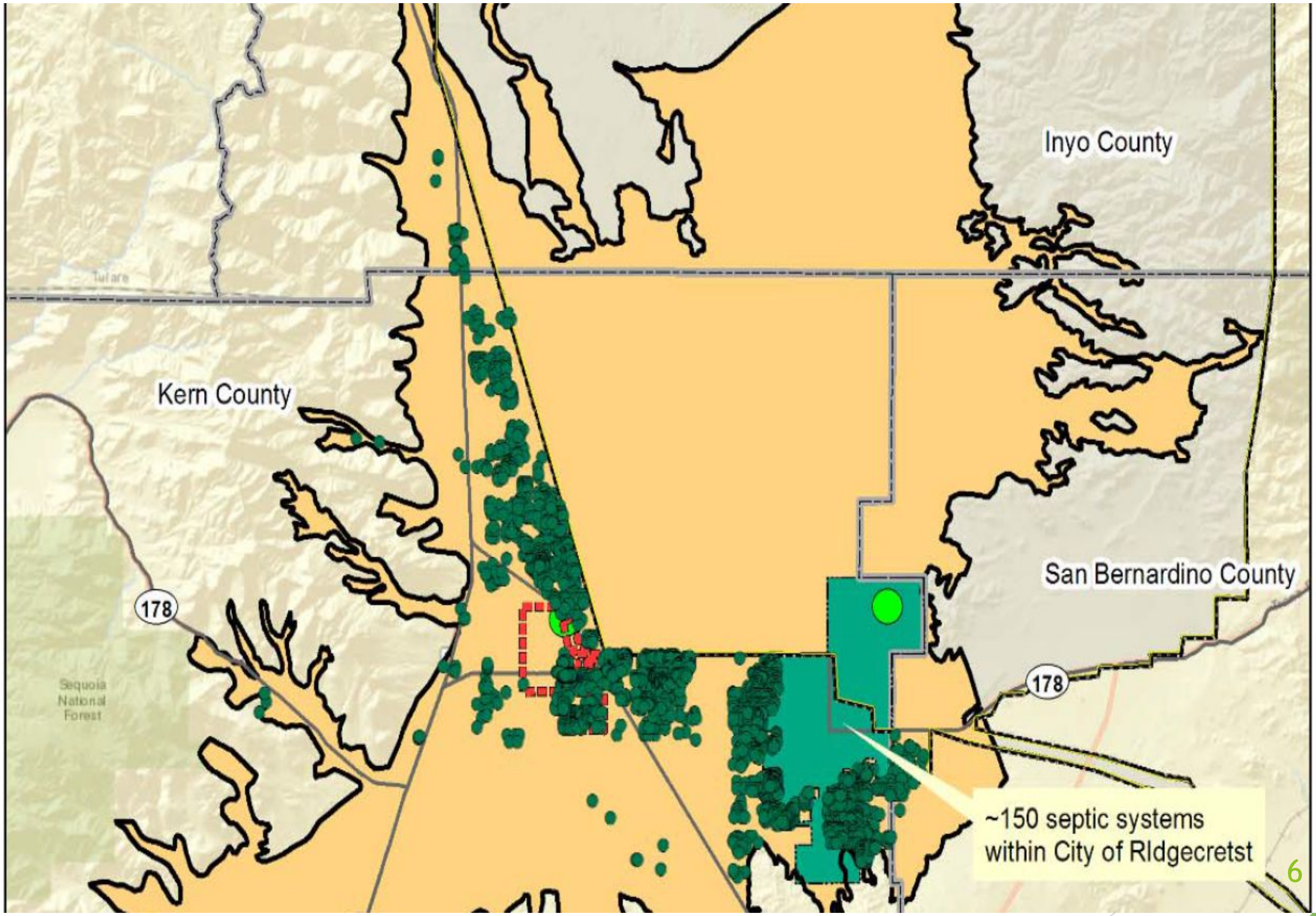
- Determine the uses, quantities, and cost of recycled water that may be used to enhance the water supply in the Indian Wells Valley groundwater basin

Current Sources of Wastewater and Recycled Water

- City of Ridgecrest collection system
  - City wastewater treatment plant (WWTP)
- Inyokern Community Services District (CSD) collection system
  - Inyokern CSD WWTP
- Septic systems



Indian Wells Valley Water District, Salt and Nutrient Management Plan, January 2018.



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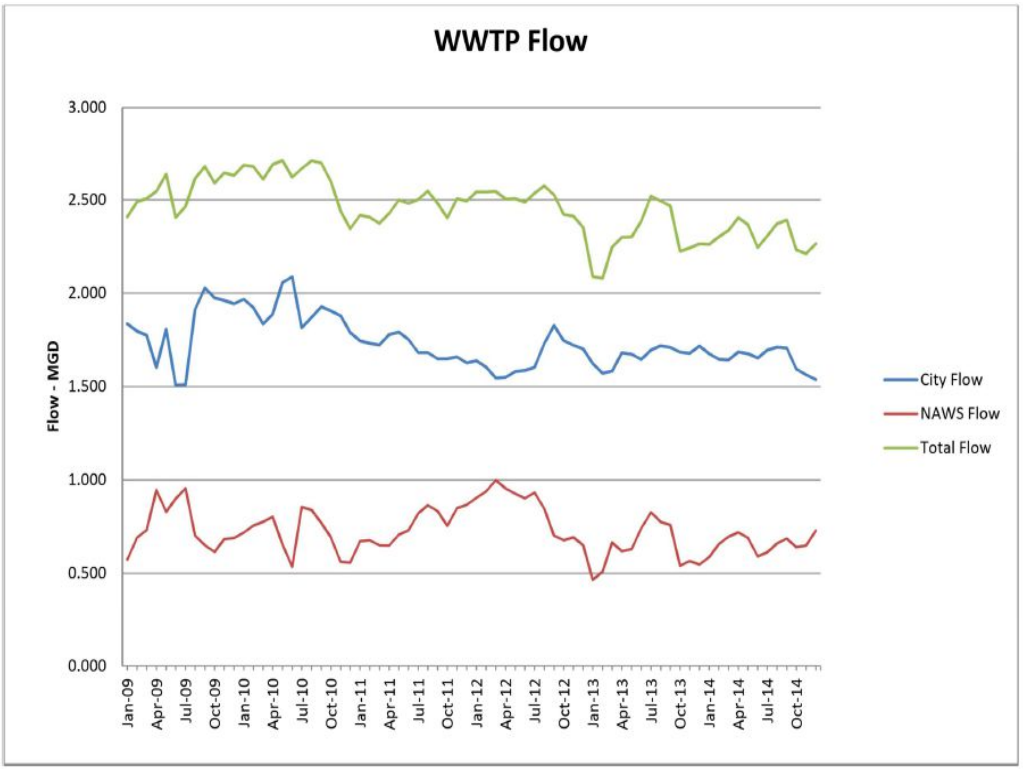
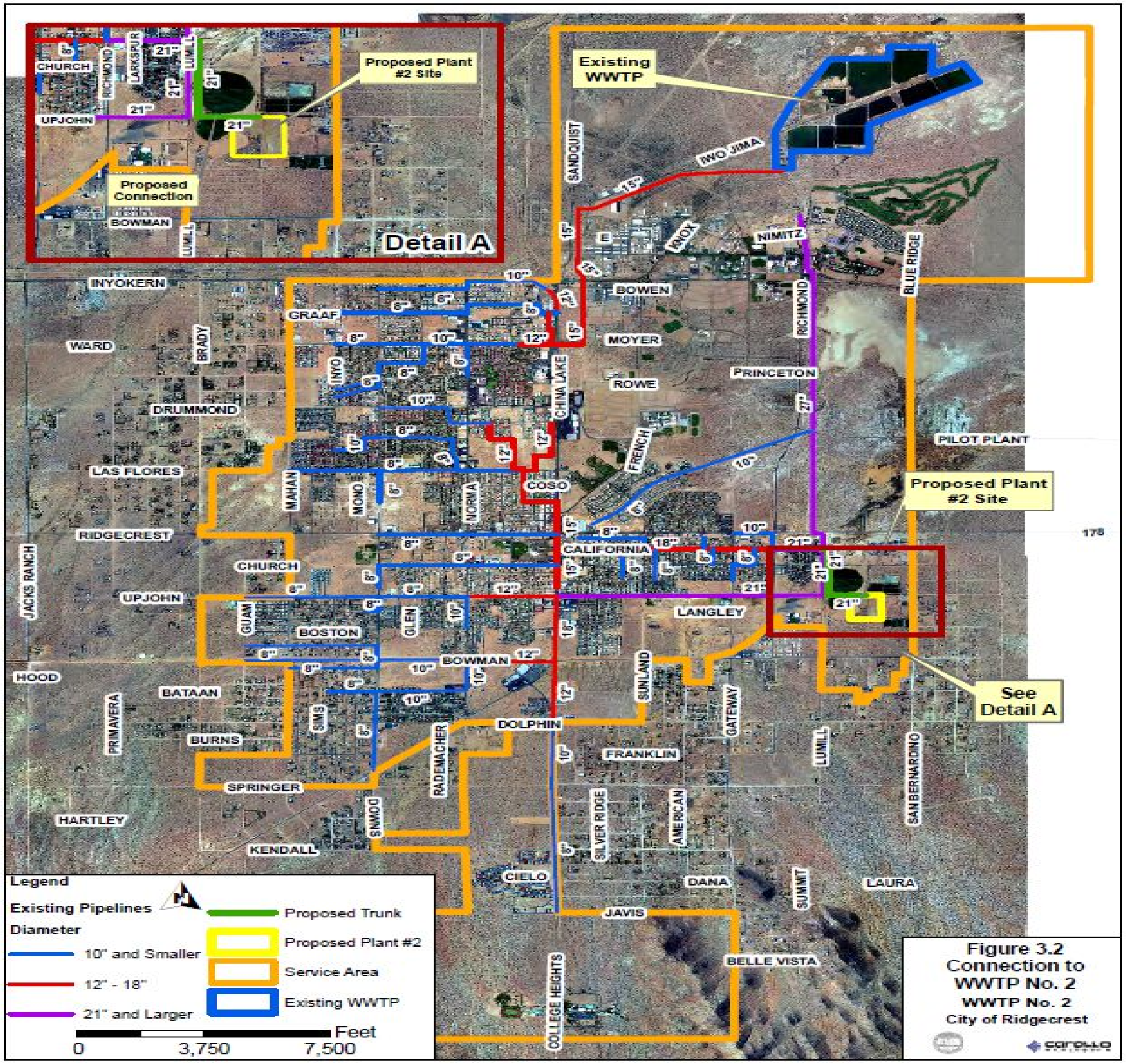
Indian Wells Valley Water District, Salt and Nutrient Management Plan, January 2018.

City of Ridgecrest – Existing Plant



Provost & Pritchard, Wastewater Treatment Plant Facility Plan, October 2015.

- Produces **undisinfected secondary** recycled water, as defined per CDPH Title 22 *Regulations Related to Recycled Water*, 2014
- Capacity of 3.6 million gallons per day (MGD)
  - Annual average daily flow of 2.31 MGD in 2014
    - 2,588 acre-feet per year (AFY)
- 11 facultative ponds – 239 acres
  - 9 active ponds – 186 acres
    - Evaporation; minimal percolation to principal aquifer
    - Two ponds provide seepage flow to Lark Seep



Carollo Engineers, City of Ridgecrest Wastewater Treatment Plant Final Project Report, September 2008.

Upgrade and/or Relocation of City WWTP

- City of Ridgecrest is currently under negotiations to upgrade and/or relocate the existing WWTP.
- Completed items as of April 5, 2017 City Council meeting:
  - Facility planning of two site alternatives (NAWS site / City site)
  - Financial studies and new adopted sewer rates
  - 30% plan design
  - Environmental Impact Report (EIR)
  - Preliminary application for Clean Water State Revolving Fund (CWSRF) loan
  - New easement maps and legal descriptions with draft operating agreement (Navy)

Next Steps for the City

- File notices of determination for EIR
- Finalize easement/use negotiations with the Navy
- Site selection for WWTP
- Authorize final design services
- Submit technical, environmental, and financial security packages to State Water Resources Control Board (SWRCB) for CWSRF loan application
- Apply for waste discharge permits to SWRCB

Inyokern CSD - WWTP

- A portion of the Inyokern CSD service area has a sewer collection system flowing to the Inyokern CSD WWTP.
  - Other areas assumed to have septic systems
- 0.035 MGD capacity
- Effluent disposal in settling ponds
  - Evaporation

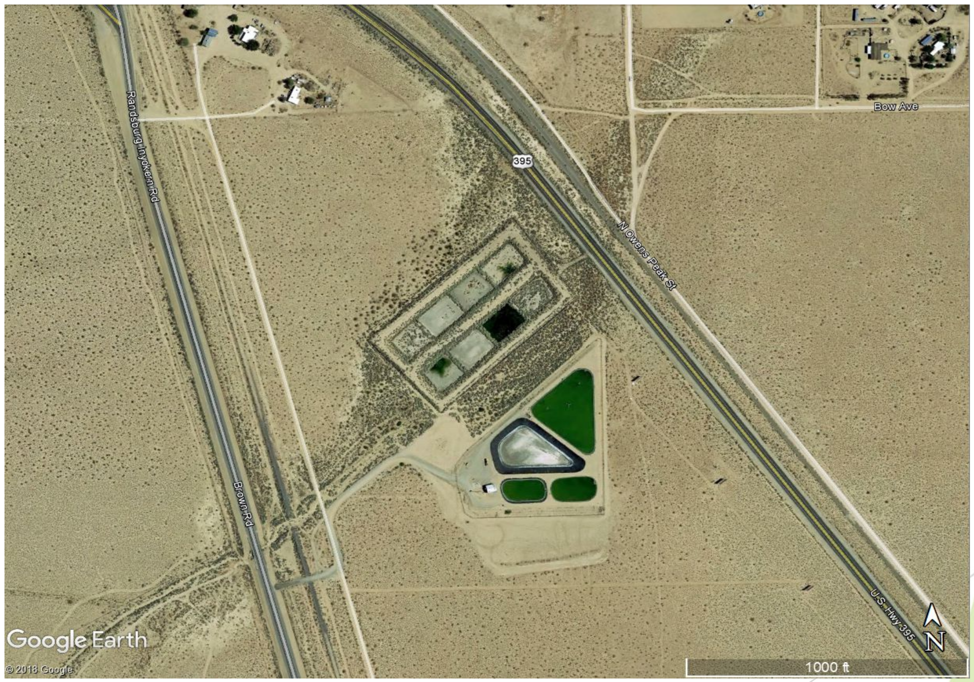


Image from Google Earth.

Septic Systems

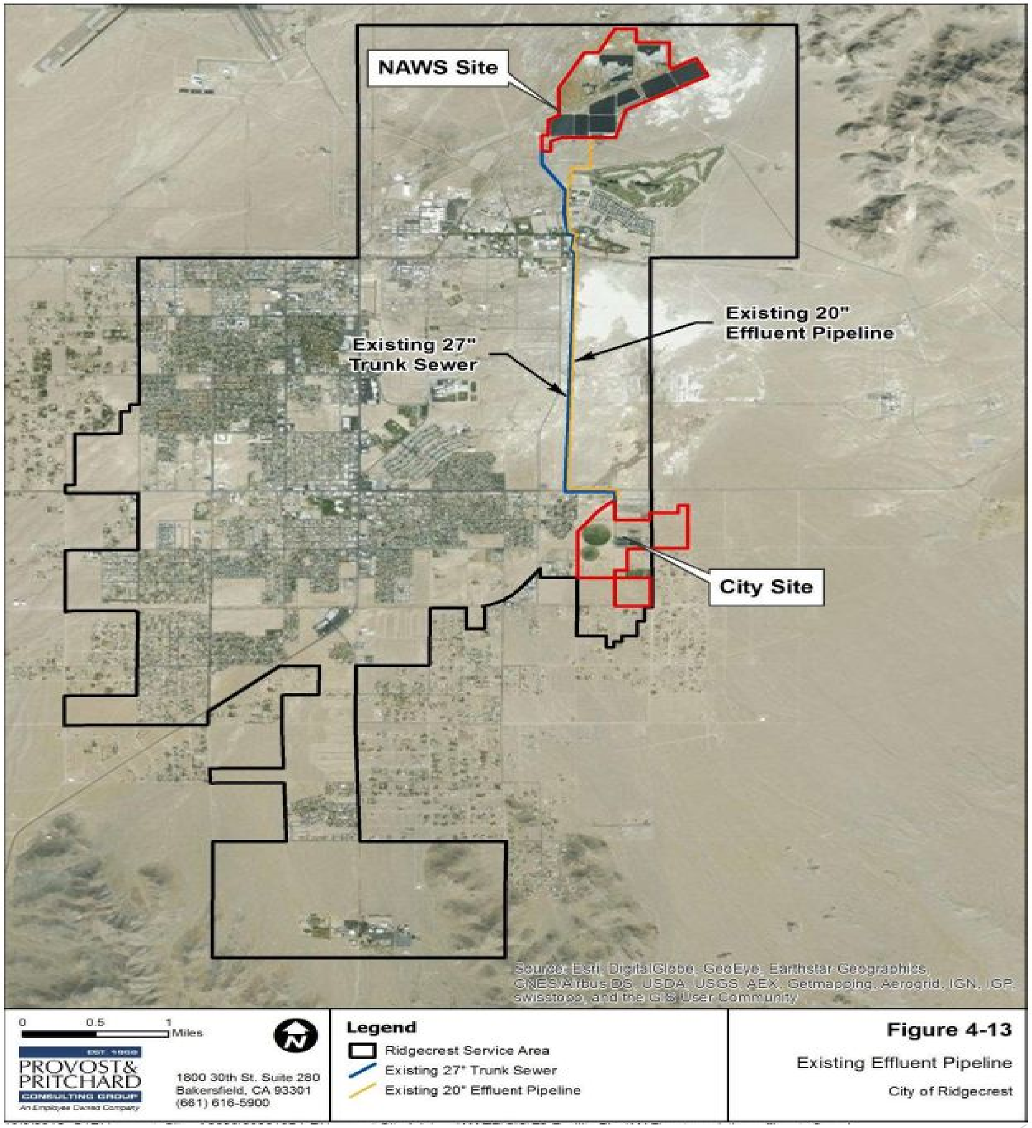
- Information on septic tank flows and design is rather limited.
- **Assumptions** per the IWV Water District's Salt and Nutrient Management Plan (2018):
  - 150 parcels within City boundaries use septic systems
  - Parcels outside the City boundaries use septic systems
  - Each parcel with a septic system produces 263 gallons per day (gpd) of wastewater
  - Septic tank outflow water quality:
    - Total dissolved solids (TDS): 670 milligrams per Liter (mg/L)
    - Nitrate (N): 30 mg/L

Existing Recycled Water Uses from the City WWTP

- Navy
  - City must provide up to 750 acre-feet per year (AFY) to the Navy for uses including golf course irrigation
    - Golf course typically requires only 500 AFY
- City
  - Some alfalfa irrigation is managed by the City
  - Average of 220 AFY for approximately 30 acres of alfalfa
- Disposal at Facultative Ponds
  - Percolation
  - Evaporation
  - Seepage for Lark Seep habitat

Lark Seep: Mojave Tui Chub Habitat

- U.S. Fish and Wildlife Service and California Department of Fish and Game first introduced 400 tui chub to Lark Seep in 1971
- 1993 MOU between the Navy and the City:
  - Allows the City to use the 20” effluent pipeline from Navy site facultative ponds to the City site for irrigation of alfalfa
  - Allows the Navy to ensure that treated effluent of appropriate quality and quantity is available—through pond seepage—to the tui chub habitat north of the ponds
- “China Lake Revisits Strategies to Protect Endangered Fish”
  - Published in *Currents*, The Navy’s Energy and Environment Magazine, fall 2015
  - Discusses plans to implement sustainable and efficient management strategies and monitoring plans for the tui chub population
  - Current status and impacts on recycled water



Provost & Pritchard, Wastewater Treatment Plant Facility Plan, October 2015.

Summary: Current Recycled Water Status

- Total generated recycled water at City plant: **2,588 AFY**
  - Annual average daily flow of 2.31 MGD (2,588 AFY) in 2014
- Navy recycled water use: **500 AFY**
- City alfalfa irrigation: **220 AFY**
- Total current available recycled water for beneficial use: **1,868 AFY**
  - Assumptions:
    - Facultative ponds contribute 0 AFY to primary aquifer through percolation
  - Considerations:
    - Tui chub habitat water supplied from the ponds will require quantification
    - Additional generated wastewater will be available from the Inyokern CSD WWTP and septic tanks
      - Additional wastewater collection system(s) will be necessary

2,588 AFY
-500 AFY
-220 AFY
1,868 AFY

Opportunities

- Non-Potable Reuse
  - Landscaping
  - Industrial uses
  - Agricultural irrigation
- Indirect Potable Reuse
  - Basin recharge
    - Surface or subsurface applications
- Direct Potable Reuse

Non-Potable Reuse

- Landscape Irrigation
  - 1,868 AFY of recycled water available from City WWTP
  - Landscape irrigation may use approximately 7.2 feet of recycled water per year
    - 77 acres of irrigable land identified by Provost & Pritchard, 2015 → 555 AFY
    - Additional land (22 acres) identified within City boundaries → 159 AFY
    - Additional land (12 acres) identified within Navy boundaries → 87 AFY
- Searles Valley Minerals
  - Industrial and operational uses
- Agricultural Irrigation
  - Relocating alfalfa farms closer to the City WWTP
- Septic Tanks
  - Greywater systems for outdoor irrigation (plants, yards, etc.)

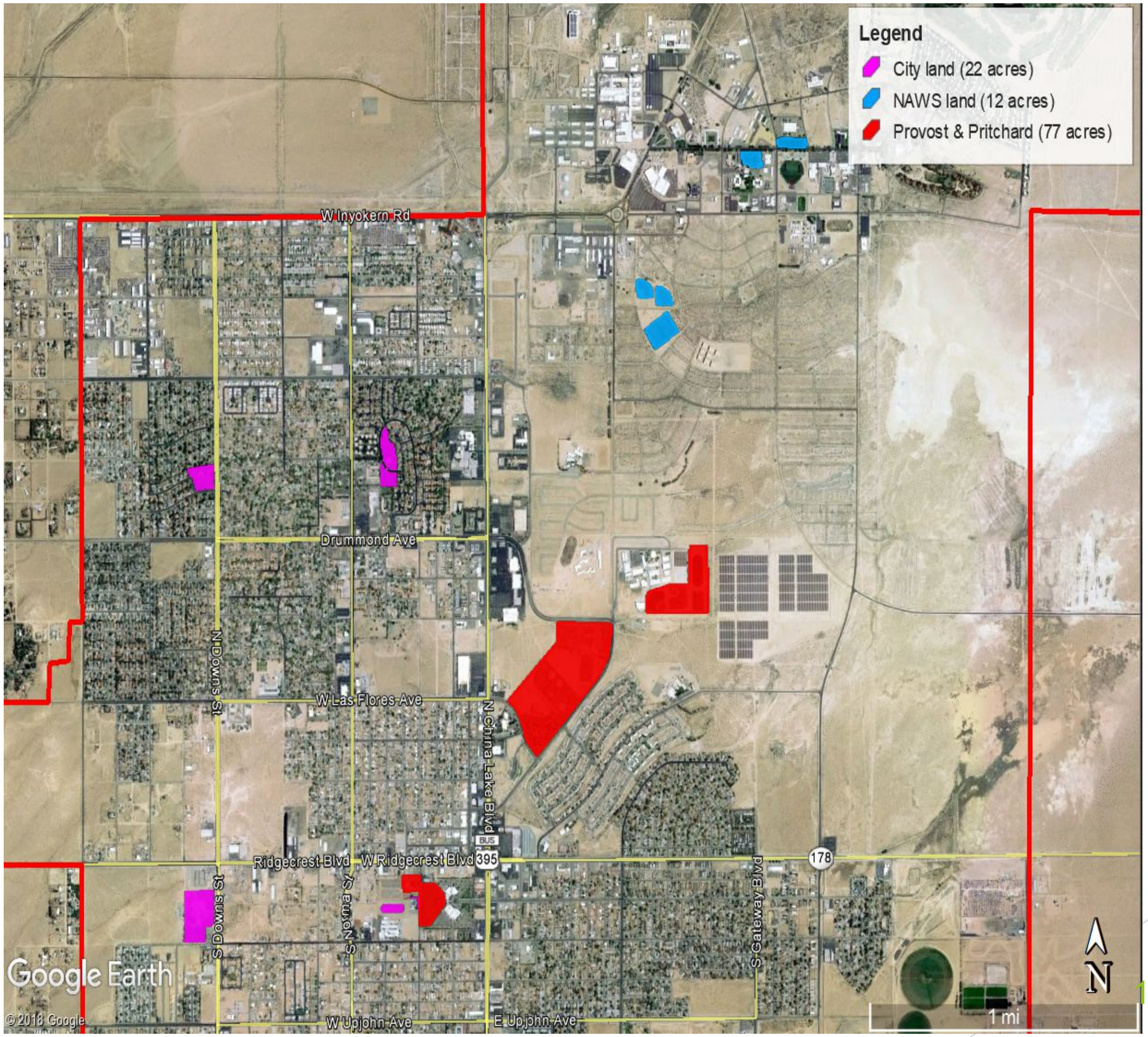


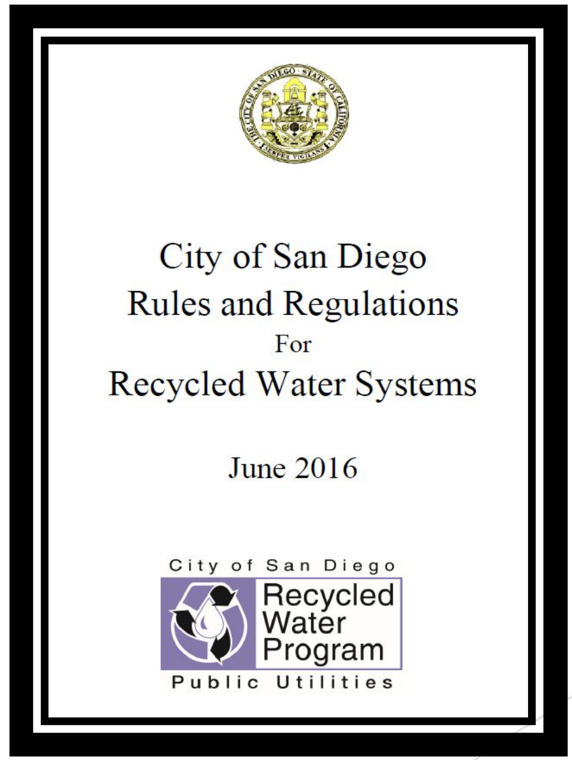
Image from Google Earth.

Indirect Potable Reuse

- Basin Recharge
  - Surface Application: spreading grounds
    - Shallow aquifer contains high TDS concentrations
    - Minimal percolation to principal aquifer
      - Shallow aquifer comprised of fine sand, silt, and clay—low permeability
      - Confining clay layer separating shallow and principal aquifers
    - Required effluent quality: disinfected tertiary (Title 22 Regulations Related to Recycled Water)
  - Subsurface Application: injection wells
    - Required additional treatment: Reverse osmosis and advanced oxidation
    - Proximity to other pumping wells

Direct Potable Reuse

- City of San Diego
- Integration with existing water distribution systems
  - Indian Wells Valley Water District
  - City of Ridgecrest
  - Smaller water agencies
- Recycled water supplies have seasonal variance
  - Need for recycled water reservoirs and other storage options



City of San Diego
Rules and Regulations
For
Recycled Water Systems

June 2016

City of San Diego
Recycled Water Program
Public Utilities

Next Steps

- Regulatory Analysis (water quality, level of treatment, and permitting)
  - SWRCB
  - Division of Drinking Water
  - Regional Water Quality Control Board (Lahontan)
- Facilities
  - Level of treatment
  - Conveyance/configuration of required infrastructure
- 20-Year Economic Feasibility: treatment plant, infrastructure, retrofits, etc.
  - Capital (construction) costs
  - Operations and Maintenance (O&M) costs

INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

MARCH 1, 2018 TAC MEETING

AGENDA ITEM 5D: IMPORTED WATER OPPORTUNITIES

Imported Water Opportunities

Enclosures:

- Presentation
- Map

Alternative Opportunities and Constraints to Enhance Water Supplies

INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

Technical Advisory Committee Meeting

March 1, 2018

Stetson Engineers Inc.

Contents

- Scope of Investigation
- Evaluation Process
- Alternative Water Supply Sources/Uses
  - Imported Water Supply Sources
  - Stormwater
- Demand Management Measures
- Constraints
  - Institutional Issues
  - Costs
- TAC Discussion

Scope of Investigation

- Imported Water Opportunities/Constraints
- Local water replenishment (Stormwater) Optimization Opportunities/Constraints
- Demand Management Measures (Conservation) Opportunities/Constraints
- Institutional Issues/Constraints
- (Recycled Water Opportunities studied separately)

Evaluation Process

- Identify potential water source
- Quantify available supply
- Identify institutional constraints
- Identify existing infrastructure
- Identify required infrastructure
- Estimate costs
- Identify potential environmental impacts

Alternative Water Supply Sources / Uses

- Imported Water
  - Replenishment
    - Spreading grounds
    - Injection
  - Direct Use
    - Untreated water for non-potable use
    - Construct surface water treatment plant
- Stormwater
  - Replenishment
    - Spreading grounds
- Demand Management Measures
  - Conservation

Potential Imported Water Sources

- Owens Valley
- Adjacent Groundwater Basins
- State Water Project (SWP)
- Water Banking
- Central Valley Project (CVP)
- Cadiz Water Project
- Ocean Desalination
- Other Local Water Sources (i.e. Nickels Water)

Potential Imported Water Sources (cont.)

- Owens Valley Water
  - Concept
    - City of Los Angeles could provide water from Owens Valley via the Los Angeles Aqueduct.
  - Opportunities
    - Obtain Owens Valley Water Directly
      - Negotiate with City of Los Angeles to make Owens Valley Water available
      - Reinstate historical arrangement for NAWS China Lake to receive Owens Valley Water
    - Exchange Another Source for Owens Valley Water
      - Exchange SWP Water
      - Exchange Non-SWP Water
      - Exchange CVP Water
      - Exchange Camp Pendleton MWD Allocation
      - Exchange Edwards AFB Federal Reserve Rights Allocation in Antelope Valley

Potential Imported Water Sources (cont.)

- Adjacent Groundwater Basins
  - Concept
    - IWVGA could import water directly from adjacent groundwater basins or exchange water with City of Los Angeles.
  - Opportunities
    - Butterworth Ranch (Owens Valley Basin)
      - Proposed by Todd Groundwater (2014)
      - Discontinue farming and pump water into Los Angeles Aqueduct
    - Fremont Valley
      - Fremont Valley Recovery Project (Presentation at Jan 2017 IWVGA Board Meeting)
        - Import water directly from Fremont Valley Basin
        - Or: exchange water with City of Los Angeles to make Owens Valley Water available to IWVGB

Potential Imported Water Sources (cont.)

- State Water Project
  - Concept A
    - IWVGA could negotiate with State Water Project contractors to import water via a pipeline extension to the IWVGB.
  - Opportunities
    - Antelope Valley East Kern Water Agency
    - Mojave Water Agency
  - Concept B
    - Wheel non-SWP water in SWP facilities
  - Opportunities
    - Lake Isabella
    - Kern River Rights

Potential Imported Water Sources (cont.)

- Water Banking
  - Concept
    - IWVGA could purchase SWP or non-SWP banked water.
    - IWVGA could store water in water banks.
  - Opportunities
    - Willow Springs Water Bank
      - IWVGA could become a project sponsor and provide a Hazards Mitigation Plan in exchange for 30,000 AF bank allocation
    - Negotiate with SWP contractor to bank water in Antelope Valley for City of Los Angeles; Owens Valley Water exchanged to IWVGB
    - Negotiate with City of Los Angeles to bank water in IWVGB
      - Percentage of banked water to remain in IWVGB

Potential Imported Water Sources (cont.)

- Central Valley Project
  - Concept
    - IWVGA could obtain Central Valley Project water.
  - Opportunities
    - Negotiate with CVP contractors to import water via a pipeline extension to the IWVGB

Potential Imported Water Sources (cont.)

- Cadiz Water Project
  - Concept
    - Private and public groundwater conservation and recovery project to export groundwater to project participants.
  - Opportunities
    - Negotiate/partner with Cadiz Inc. to exchange water with MWD and/or City of Los Angeles

Potential Imported Water Sources (cont.)

- Ocean Desalination
  - Concept
    - Provide funding for a portion of the yield of a desalination project.
  - Opportunities
    - Example: West Basin Municipal Water District
    - Yield made available to MWD or City of Los Angeles
    - Owens Valley Water made available to IWVGB

Potential Imported Water Sources (cont.)

- Other Local Water Sources
  - Nickels Water
    - Description
      - Kern River water rights owned by the Nickel Family LLC.
    - Opportunities
      - Purchase Nickel allocation if available.

Stormwater Capture Optimization

- Description
  - Stormwater capture and replenishment.
- Opportunities
  - Evaluate feasibility of mountain front recharge (Todd Groundwater (2014))

Demand Management Measures

- Description
  - Conservation activities and projects to reduce potable water demand.
- Opportunities
  - Urban Water Conservation
  - Agricultural Water Conservation
  - Industrial Water Conservation

Demand Management Measures (cont.)

- Urban Water Conservation
  - Indian Wells Valley Water District Urban Water Management Plan (Current Programs)
    - Best Management Practices defined by the California Urban Water Conservation Council
    - Verify and evaluate current conservation programs
  - Incorporate findings from Prop 1 Conservation Projects
    - Water Conservation and Rebate Program
    - Water Audit, Leak Detection, and Leak Repair Program

Demand Management Measures (cont.)

- Urban Water Conservation
  - Potential Programs
    - Residential Rebate Program
    - Retrofit/Water Saving Incentives
      - Turf Removal
      - High Efficiency Appliances
      - Sprinkler Nozzles
      - Irrigation Controls
      - Commercial Equipment
      - Other

Demand Management Measures (cont.)

- Agriculture Water Conservation
  - Proposed by Todd Groundwater (2014)
    - Minimize sprinkler losses
    - Meter well pumping
    - Convert alfalfa fields to pistachio orchards
  - Verify and evaluate opportunities

Demand Management Measures (cont.)

- Industrial Water Conservation
  - Searles Valley Minerals
    - Identify water use process
    - Determine potential recycling/reuse opportunities

Institutional Issues/Constraints

- State Water Project
  - State Water Project Wheeling Policy
    - California Water Code Section 1810: "…neither the state, nor any regional or local public agency may deny a bona fide transferor of water the use of a water conveyance facility which has unused capacity, for the period of time for which the capacity is available, if fair compensation is paid for that use, subject to the following:"
      - Long-term water service contracts and rights have priority to unused capacity
      - Beneficial uses or quality of the water in the facility may not diminish (except that additional treatment is provided)
      - During emergencies, long-term water service contracts and rights have priority to unused capacity (even if unused capacity was transferred under Section 1810)
      - The use of facilities cannot injure any legal user of water and cannot unreasonably affect fish, wildlife, or other instream beneficial uses

Institutional Issues/Constraints (cont.)

- Other Considerations
  - Export Restrictions
    - Water Export Ordinances (i.e. Inyo County, Kern County)
    - Groundwater Judgments (i.e. Antelope Valley)
  - Federal Reserve Rights
    - Non-transferable?

Water Costs

- Sample Costs
  - Permanent SWP Table A Transfers: $5,000/AF to $6,000/AF (as of 2018 data)
    - Costs dependent on hydrologic conditions and do not include the annual cost of water (capital repayment and delivery).
  - Water Banking
    - Kern County Example: One time fee of $1,470/AF to $1,690/AF plus annual fees, recharge fees, and recovery fees. Does not include cost of water.
    - Willow Springs Water Bank: One time fee of $1,662/share to $2,078/share plus annual fees, recharge fees, and recovery fees. Does not include the cost of water.
  - Cadiz Water Project: $775/AF annually (as of 2016)

Water Costs (cont.)

- Sample Costs (cont.)
  - Nickel Water: leased for $1,000/AF annually (as of 2018)
  - Desalination
    - Carlsbad Desalination Plant: $2,131/AF annually to $2,367/AF annually (as of 2016)
  - Other Water Supplies (single year and multi-year transfers): $250/AF to $700/AF annually (as of 2018)
    - Costs dependent on hydrologic conditions.
- Price Reference
  - MWD 2018 Tier 1 Full Service Treated Rate: $1,015/AF

Discussion with TAC

- Request input on other sources of water supply to consider and evaluate
- Request input on other known constraints
- Request information regarding historical pipeline alignment to NAWS China Lake

Thank You

POTENTIAL ALTERNATIVE WATER OPPORTUNITES

INDIAN WELLS VALLEY GROUNDWATER AUTHORITY

MARCH 1, 2018 TAC MEETING

AGENDA ITEM 5f: REPORTING ON PRODUCTION

TAC INPUT TO WRM ON REPORTING OF PRODUCTION

1. Provide a list of potential well production situations (single family home, mutual wells, municipal, industrial, etc.)
2. Provide advice on establishing contact/responsible persons for each well production situation.
3. For all meters, provide meter options and details. Provide periodic certification and responsibility. (GSA cannot require meters until GSP is complete.)
4. Provide guidelines for estimating and submitting electrical power use for well production.
5. Provide guidelines for estimating Ag water use (references).
6. Provide advice on methods to report well production, reporting periods, verification, and GSA administration support.

Heather Steele

Subject: FW: GW Pumping Alternatives

From: James A. Worth [mailto:jim@mcmurtreyhartsock.com]
Sent: Monday, February 19, 2018 9:38 AM
To: Adam Bingham <bingham@svminerals.com>
Cc: Steve Johnson <stevej@stetsonengineers.com>
Subject: GW Pumping Alternatives

Adam

This email follows the IWVGA Board's decision to task the TAC with reviewing and providing comments on the alternatives available to measure groundwater pumping when a meter has not been installed. Below is the draft language on potential options that was prepared by Staff:

<u>Groundwater Pumping Measurement:</u>

For those wells that have meters, groundwater pumping could be measured based on meter readings. [We understand the water district and SVM already have meters installed. We are unsure how many other pumpers have meters.] Although the IWVGA has the authority to impose groundwater extraction fees, it will not acquire the authority to require metering of groundwater wells until the GSP is adopted. In light of this, the IWVGA should develop criteria and a procedure for measuring extractions by those non-metered wells. Options include, but are not limited to, the following:

- Request that impacted pumpers install approved meters on their wells; or
- Use existing studies that estimate agricultural use based on crop type as well as average household use for those supplying Municipal & Industrial water; or
- Use electrical usage, pump type and depth to groundwater to determine pumping for electric powered pumps. A comparable method could be developed for fuel powered pumps.
- Extractions reported by pumpers under penalty of perjury.

We look forward to any comments, suggestions or additional alternatives that the TAC may have with respect to this issue. If you have any questions or need additional information, feel free to contact Steve Johnson or me if I may be of assistance. Thanks.

Jim

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