A White Paper: Issues and Options for Groundwater Management in the Indian Wells Valley under the Sustainable Groundwater Management Act

Introduction

The Indian Wells Valley (IWV) faces water resources challenges which have been growing for over 50 years. However, with the implementation of the 2014 Sustainable Groundwater Management Act (SGMA) a plan to address these challenges must now be completed in the next two years. This white paper presents an approach to address the challenges in a way that provides for the following in IWV:

- Sustainable groundwater management and compliance with SGMA
- Long-term water security
- A means to fund the needed water projects
- Long-term viability of the Naval Air Weapons Station (NAWS), with respect to water
- Economic stability and continued growth

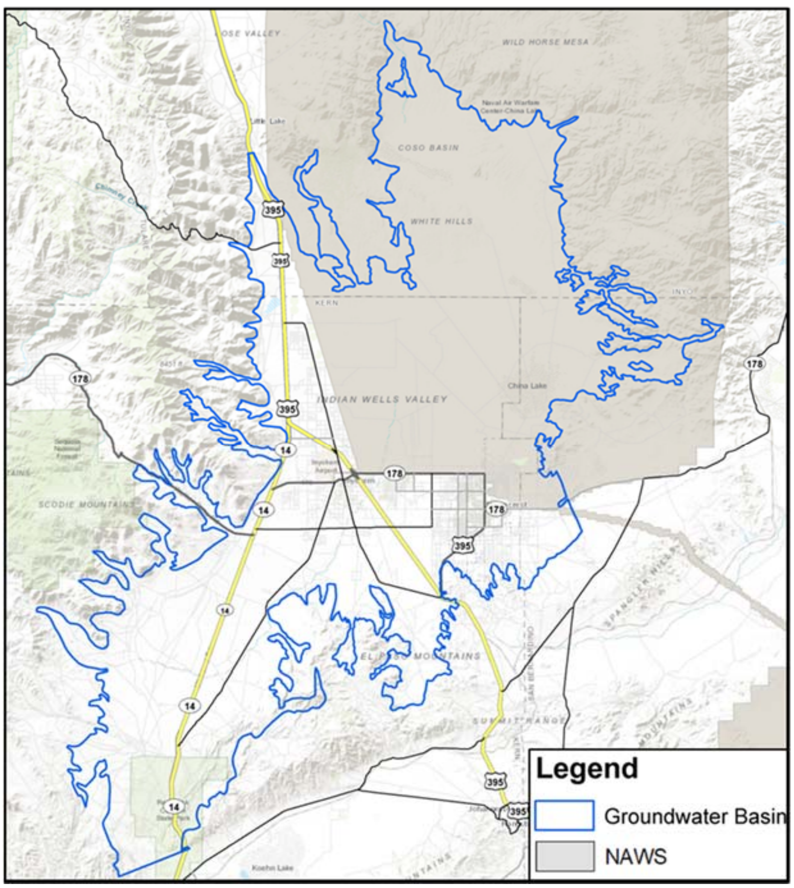

Figure 1: Indian Wells Valley Groundwater Basin

The proposed strategy consists of the following five key elements:

1. Given the volume of groundwater in storage in the IWV Groundwater Basin (the Basin) (see **Figure 1**), allowing current pumping to continue for a period of time while alternate water supplies are developed
2. Charging a pumping assessment (in three forms of groundwater extraction fees) to pay for groundwater management, studies, and engineering design/permitting for alternate water supplies
3. Developing alternate water supplies (e.g. brackish water, imported water) to offset future pumping reductions
4. Implementing a market-driven groundwater pumping reduction program, with the ability to trade pumping allocations
5. Developing a contingency plan for shallower domestic wells that face water supply problems prior to the Basin reaching sustainability
6. Develop water conservation plans that incentivize all water users in IWV to use less water

Groundwater Sustainability

The IWV Basin (Basin ID 6-54) has been listed by the California Department of Water Resources (DWR) as a medium priority basin subject to critical overdraft. This requires that a Groundwater Sustainability Plan (GSP) be developed by the Indian Wells Valley Groundwater Authority (IWVGA), which is the Groundwater Sustainability Agency (GSA) for the Basin, by January 2020. Under SGMA, the Basin must be managed consistent with the Basin's "sustainable yield" by 2040; however, DWR may grant a ten year extension from 2040 to 2050. SGMA defines sustainable yield as "*the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result*." The following are the potential undesirable results, as defined by SGMA:

1. chronic lowering of groundwater levels
2. significant and unreasonable reduction of groundwater storage
3. significant and unreasonable seawater intrusion
4. significant and unreasonable degraded water quality
5. significant and unreasonable land subsidence
6. depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

The GSA, in this case, the IWVGA member agencies with input from the water resources manager (WRM), the advisory committees and the community, defines the basin sustainability criteria and associated undesirable results.

Sustainable yield is NOT safe yield. Safe yield is a technical and legal term that defines the amount of water that can be withdrawn from the Basin without resulting in long-term loss of groundwater in storage. Thus, over a period of years, safe yield must equal the amount of water entering the Basin (i.e. recharge) minus basin outflows. Under SGMA, sustainable yield could be higher than safe yield, if a small annual loss of groundwater in storage is not considered significant and unreasonable by the GSA or by DWR.

To manage the Basin consistent with the sustainable yield, while still meeting current water demands, Basin water users must:

1. reduce the volume of native groundwater pumping
2. develop new sources of water to offset pumping reductions and meet water demands

With respect to the former, reductions in groundwater pumping in the Basin should be addressed in a manner that follows the SGMA mandate for the IWVGA to "*consider the interests of all beneficial uses and users of groundwater*." This means setting up a pumping reduction plan that is fair and equitable, takes economic and social factors into account, and does so to achieve SGMA mandates in a reasonable time period, while minimizing the risk of litigation and additional costs for the community to bear. With respect to the latter, development of new sources of water will require funding through the collection of fees. The IWVGA should develop a water pricing and funding mechanism through the public process of the GSP preparation where all water users in the Basin pay an equitable price for their water.

Pumping in IWV

According to records maintained by the IWVWD, between 1975 and 2015 an estimated 1,057,000 AF of groundwater has been removed from the Basin (IWVWD, 2017). These pumping volumes are based on information provided to the IWV Cooperative Groundwater Management Group (CGMG) or estimated by IWVWD, in the absence of such information. The estimated total volume pumped equates to an average annual pumping volume of approximately 25,800 AFY over this period (see **Figure 2**). With the maturing of pistachio orchards in the IWV over time and termination of state-mandated conservation measures, it is estimated that pumping will reach 28,600 AFY by 2020 (based on pre-drought urban water use, and acreage of pistachio trees in IWV and average annual demand for mature trees).

Overdraft

Overdraft occurs when the amount of pumping over an extended time period exceeds the amount of recharge to the basin over that same time period, and groundwater is removed from storage; that is, pumping exceeds the safe yield. Groundwater in storage can be viewed as our "water savings account"; whereas, recharge is our income and discharge (pumping) is our expenses. As in life, we may need to dip into our savings when times are tough (e.g. drought), and restore our savings when times are good (e.g. wet years). In addition, we may need to withdraw from savings to invest in something with good long-term returns (e.g. an alternate water supply). In many groundwater basins in California, overdraft has been productively managed to generate economic growth and invest in long-term water solutions (e.g.

Orange County Water District [OCWD]). Thus, overdraft may be acceptable to the extent that it results in economic growth that can be used to pay for long-term water solutions that eventually allow the groundwater basin to achieve sustainability.

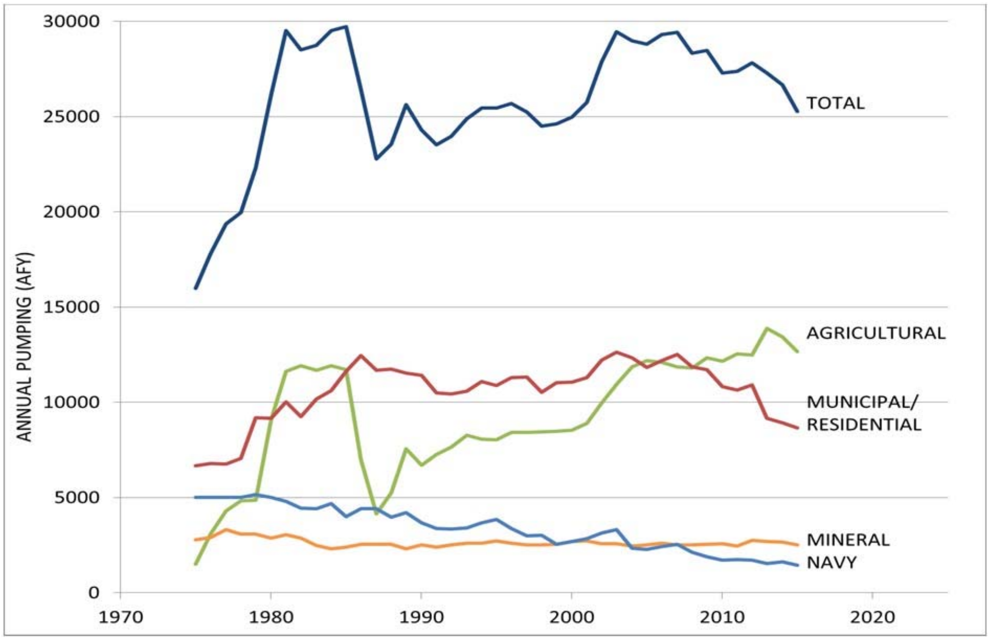

Figure 2: Historical Pumping (AFY) for Various Uses in IWV (1975-2015), IWVWD (2017)

Groundwater Levels

According to data collected and maintained by the Kern County Water Agency (KCWA) (KCWA, 2016), between approximately 1960 and 2015, groundwater levels in IWV have declined up to 45 feet (0.7 feet/year) in some areas with heavy pumping. In other parts of the Basin, where there has been little or no groundwater pumping, groundwater level declines appear to have been far less. For example, at the US Bureau of Reclamation (USBR) well #1 (T27S/R38E-23F) in the southwest area of the Basin, groundwater levels showed no decline between 1994 and 2013 (KCWA, 2016). With continued pumping at a rate of 28,600 AFY (the estimated pumping for 2020), groundwater levels would continue to decline at 1.2 ft/year on average in areas with significant pumping (see **Figure 3**), and water levels would be approximately 40 feet lower by 2050, based on that rate of decline.

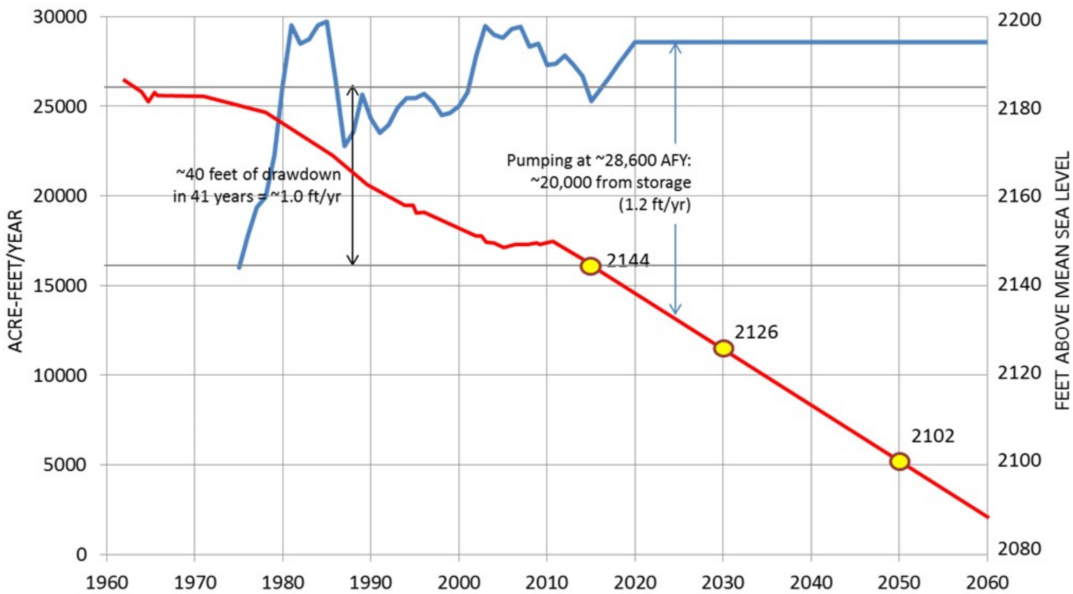

Figure 3: Projected Groundwater Levels (to 2060) in Pumping Areas in IWV with Estimated 2020 Pumping Rates Maintained (1975-2015 data for the Bucket Well – T27S/R40E, Sect. 15, Well D01 [KCWA, 2016]). The Bucket Well is considered representative of groundwater levels in areas with significant pumping.

The Big Questions

Given the proposed strategy, the following questions must be addressed for the Basin:

1. Can the estimated 2020 rate of pumping in the Basin be maintained for a modest period without causing long-term, "significant and unreasonable undesirable results", as defined in SGMA?
2. How should future pumping reductions be implemented over several decades, as allowed under SGMA, in a fair and equitable manner that best fosters cooperation rather than conflict?
3. What alternate sources of water supply can be developed and how much will they offset pumping reductions?
4. How should future groundwater management, studies, and new water projects be funded?
5. What happens if shallow domestic wells start to run dry?

Much additional study and data is needed to definitively answer these questions, and the WRM, TAC, and groundwater pumpers in the IWV are already developing plans for such studies. However, this paper presents a preliminary conceptual approach to answer these questions and outlines a set of governing principles for managing groundwater in the Basin.

How Long Can Estimated 2020 Pumping Be Maintained?

This question will be more definitively addressed through future proposed field investigations, notably borehole and aerial geophysical mapping and monitoring well installation, ongoing groundwater modeling, and the US Geological Survey (USGS) study to estimate natural recharge to the basin. While the exact volume of groundwater in storage is not currently known, studies by the USGS and Bureau of Land Management (BLM) have identified fresh groundwater in borings to depths >1,400 feet [BLM, 1993]. Recent geophysical studies by Stanford University have identified a transition to deeper, connate brackish water at depths between approximately 850 and >1600 feet (Stanford, 2016). Therefore, even with groundwater levels in areas of pumping currently at 400 feet bgs, these figures suggest that at least 1,000 feet of fresh groundwater exists within the Basin.

SGMA, together with concerns about undesirable results associated with long-term declining groundwater levels (e.g., subsidence, upwelling of deeper, connate brackish waters, and higher pump lifts), compels a management plan that results in groundwater levels that stabilize within a reasonable timeframe. However, because the Basin has significant fresh groundwater in storage, the Basin can likely afford continued pumping for a modest period without causing long-term, significant and unreasonable undesirable results. This will allow pumpers time to adjust their operations to the future pumping reductions, allow for the development of alternate water supplies for the IWV, and minimize socio-economic impacts.

<u>Proposed Pumping Strategy</u>

Given the above analysis and modeled drawdown, continued pumping at estimated 2020 rates in areas where most of the current pumping occurs (e.g. Ridgecrest and the Brown Road agricultural area), and with corresponding estimated rates of groundwater level decline, could be sustained for many decades if not centuries. However, this would not be acceptable under SGMA, as the groundwater level declines would be chronic and DWR would view a long-term loss of storage as significant and unreasonable. Therefore, it is proposed that pumping in these areas at estimated 2020 rates be maintained through 2030 (see **Figure 4**). Between 2030 and 2040 (possibly extended to 2050), groundwater pumping in these areas would be reduced to reach the native safe yield (assumed herein to be between 7,700 [DRI, 2016] and 11,000 AFY [ECORP, 2012]; however, further study is required to confirm the native safe yield for the Basin).

This proposed "soft landing" strategy presents the following advantages:

- It meets the demand for water in the Basin through 2030 from local groundwater resources
- It allows alternate water supply projects (e.g. brackish water) to be developed and brought on-line by 2030
- It allows for the imposition of a pumping assessment on a sustained pumping volume (i.e. 28,600 AFY) to fund ongoing groundwater management in the Basin, groundwater studies, and capital projects (e.g. brackish water development)
- It would reduce the risk of possible conflict over near-term reductions and allocations and potential resulting litigation by lessening the economic impact on pumpers that have made significant investments in the basin

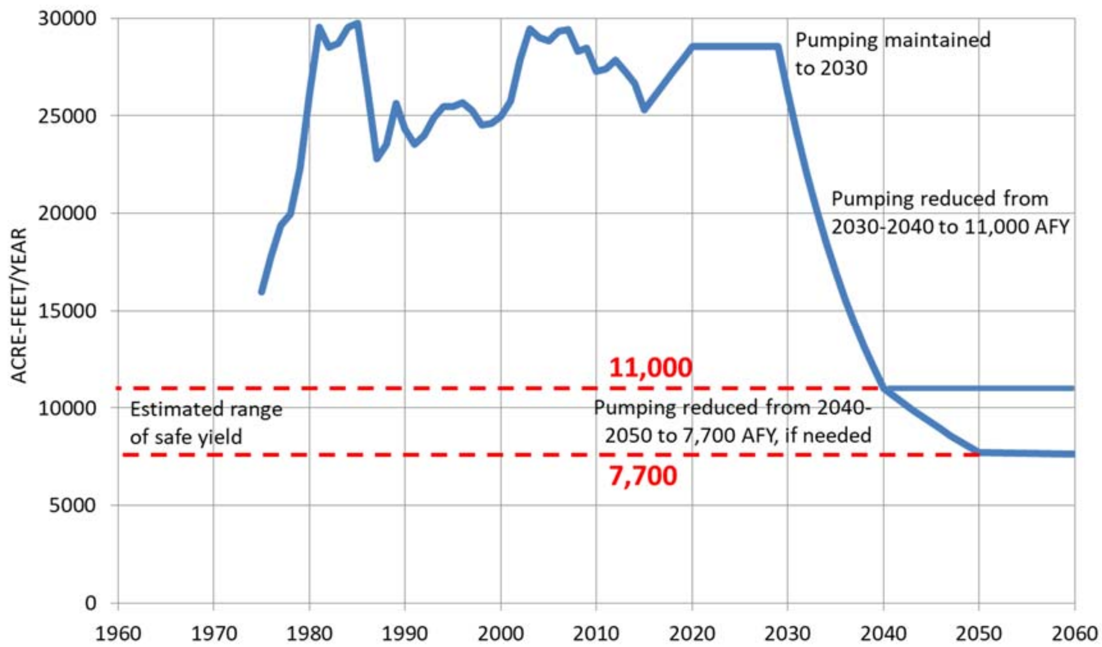

Figure 4: Historical (1975-2016) and Proposed (2017-2060) Groundwater Pumping in the Basin

The proposed pumping strategy would result in an estimated additional 18 feet (1.2 ft/year over 13 years) of groundwater level decline by 2030 in areas of pumping (**Figure 5**) and an additional 10 feet of groundwater level declines between 2030 and 2050. However, after 2050, groundwater levels would stabilize with pumping at the safe yield.

As noted above, the proposed pumping strategy would result in an estimated additional 28-foot decline in groundwater levels in the vicinity of the Bucket Well (see **Figure 5**). However, declines may be slightly higher in some areas, and considerably less in many areas. Therefore, to ensure that significantly higher declines do not occur in some areas, it is proposed that a threshold groundwater elevation be set at 40 feet below 2015 levels (the last year for which we have groundwater level data across the Basin). That is, groundwater levels at key monitoring wells located throughout the IWV Basin cannot decline more than 40 feet below 2015 levels. Even prior to the proposed pumping reduction schedule between 2030 and 2040 (possibly extended to 2050), immediate reductions would be implemented based greater than anticipated groundwater level declines. For example:

- If groundwater levels decline to 25 feet below 2015 levels in a monitoring well, then pumping rates would be reduced to achieve 67% of 2015 levels in the vicinity of that monitoring well
- If groundwater levels decline to 35 feet below 2015 levels), then pumping would be reduced to rates that achieve 33% of 2015 levels
- If groundwater levels continue to decline to 40 feet below 2015 levels, then pumping would be reduced to the assigned “free pumping allocations” (see later discussion)

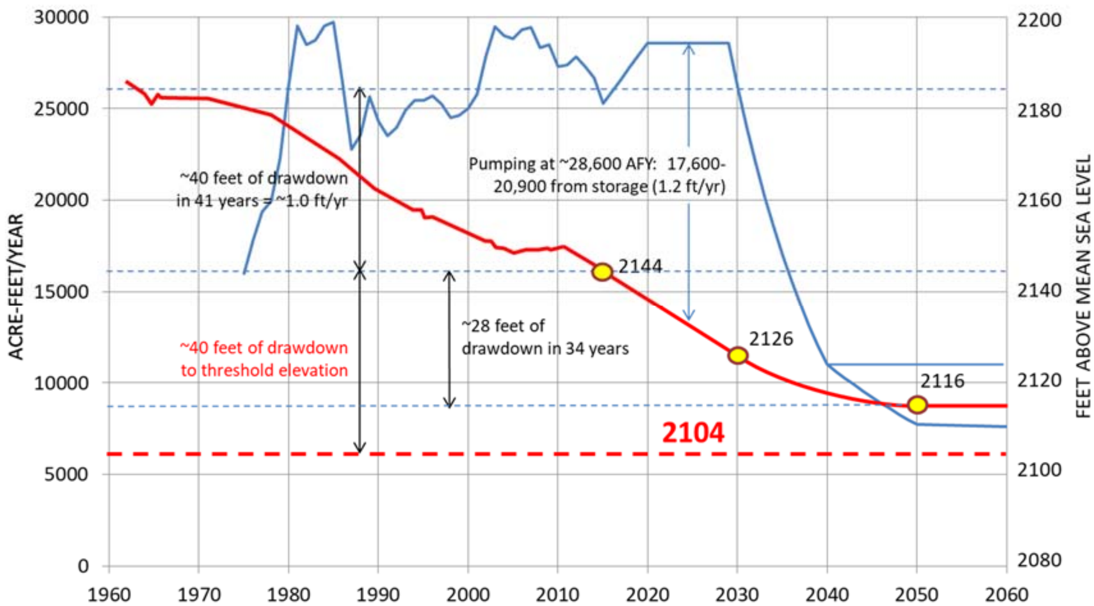

Figure 5: Historical (1960-2016) and Future (2017-2060) Groundwater Levels with the Proposed Pumping Strategy (1975-2015 data for the Bucket Well – T27S/R40E, Sect. 15, Well D01)

How Should Pumping Reductions Be Implemented?

As noted in the above proposed pumping strategy, between 2030 and 2040 (possibly extended to 2050), total native fresh groundwater pumping would be reduced from projected 2020 demands of 28,600 AFY to the native safe yield, which for purposes of this white paper is estimated to be between 7,700 and 11,000 AFY.

To develop a better estimate of pumping volumes, the exact number of *de minimis* pumpers in IWV (defined in SGMA as using 2 AFY or less for domestic purposes), the condition of their wells, and their water use must be established. However, the metering of all *de minimis* pumpers may not be practical or necessary to achieve groundwater sustainability in the Basin. In addition, most private well owners do not have access to alternate supplies. Therefore, it has been conservatively assumed that the total volume of groundwater pumped by *de minimis* pumpers, estimated at 1,100 AFY (IWVWD, 2017), would not change. *De minimis* pumpers would be required to adopt water conservation measures, and would be encouraged to connect to local public or domestic mutual water companies to the extent feasible (see later discussion). In addition to the *de minimus* pumpers, it has been assumed that pumping at NAWS would be sustained at current levels (i.e. 1,500 AFY), given the need to maintain operations at NAWS, their Federal water rights, and past conservation measures undertaken at NAWS.

With the conservative assumption that volumes extracted by *de minimis* pumpers and NAWS may not change, reductions would be borne by all non-*de minimis* pumpers: IWVWD, Mojave, Meadowbrook, SVM, Simmonds Ranch, Quist Farms, the community of Inyokern, other smaller farmers, and the City of

Ridgecrest. Without potential reductions by *de minimis* pumpers and NAWS (e.g. from conservation measures), these non-*de minimus* pumpers would need to reduce their combined pumping of native fresh groundwater supplies from about 26,000 AFY to between 5,100 and 8,400 AFY (between 68 and 80% or 5.5 to 7.8% per year from 2030 to 2040 or possibly 2050). The loss of pumping would be offset by the development of alternate water supplies made available to these pumpers (see later discussion).

To achieve the necessary reduction in native groundwater pumping, each of the non-*de minimis* pumpers would be assigned two forms of allocations, which would be keyed to three different extraction fees discussed further below. Each pumper would obtain an annual "baseline pumping allocation" which, cumulatively, together with the domestic well users, would total the 2020-2030 baseline of 28,600 AFY - referred to herein as the "operating yield". The baseline pumping allocations would be ramped down proportionally from 2030 to 2050 until the operating yield equaled the native safe yield (estimated for purposes of this white paper to be between 7,700 and 11,000 AFY).[1]

Each pumper would also be assigned a share of the basin's native safe yield as a sub-set of their baseline allocation - referred to herein as a "free pumping allocation". At any time after 2020, a pumper may pump up to their free pumping allocation and only pay a small, per AF, basin management fee and no capital projects fee (sometimes referred to as a replenishment fee) or overdraft fee (see later discussion). The pumping allocation assigned to each pumper would only include native groundwater supplies and would not include any water they receive from alternate sources, such as treated brackish water.

Any party with a demand that exceeds its free pumping allocation would have the option of paying the capital projects fee or purchasing/leasing free pumping allocation from another pumper with surplus (see later discussion). Of course, in lieu of paying the capital projects fee or acquiring additional free pumping allocation, a pumper could also substitute the to-be-developed alternative supplies to avoid pumping of native groundwater in excess of their free pumping allocation.

As discussed later, commencing in 2030, as the operating yield is gradually reduced annually, a pumper pumping in excess of its annual baseline allocation (its share of the operating yield) would also pay an "overdraft fee," which would be added to the funds obtained from the capital projects fee to fund projects to develop alternative water supplies.

[1] This is similar to the approach and terminology used in the judgment entered in the Seaside Basin Adjudication, which defines an "operating safe yield" and individual shares thereof as well as a considerably lower "native safe yield" with individual shares thereof. The shares of the operating yield are reduced triennially by 10% until the operating yield is equivalent to the native safe yield. Pumping in excess of the native safe yield share incurs a replenishment assessment and pumping in excess of the shares of the operating safe yield incurs an additional and higher per AF replenishment assessment (or overdraft fee).

What Alternate Sources Can Be Developed?

To meet the future water demands within IWV, given the proposed reduction in native fresh groundwater pumping, alternate water supplies will need to be developed. The following alternate water supplies have been identified as having some potential to meet water demands within IWV:

1. The development of brackish groundwater within the Basin, and construction of pipelines to supply non-*de minimus* groundwater pumpers
2. The relocation of some pumping to the far southwest of the Basin (i.e. El Paso area), and construction of a pipeline to the central area of the Basin
3. The development of supplies in areas adjacent to the Basin with surplus water, and construction of a pipeline to the central area of the Basin
4. The development of a groundwater banking program with the Los Angeles Department of Water and Power (DWP), where a portion of the banked water is retained to supplement natural recharge to the basin
5. The development of water supplies far from the Basin, and exchange of that water with DWP either directly or indirectly, and the equivalent off-take of water from the Los Angeles Aqueduct (i.e. a water swap)
6. Reuse and/or recycling of waste water from IWV users (estimated at 2,000 AFY)

It should be noted that pumping brackish groundwater (option 1) and fresh groundwater in the far southwest (option 2) would still be removing groundwater from storage and result in groundwater level declines in these pumping areas. For these reasons, these strategies should only be viewed as interim projects (i.e. 20-50 years), and not permanent, long-term strategies. Brackish groundwater beneath the north and east areas of the Basin would likely have no reasonable beneficial use and, to the extent that is true, it could be managed differently under SGMA from areas underlain by fresh groundwater. This would allow pumping of brackish groundwater so long as there were no significant and unreasonable undesirable results in areas of fresh groundwater. In addition, the migration of poorer quality, brackish groundwater would lead to water quality degradation in areas of the Basin with fresh groundwater. The pumping of brackish groundwater would control this migration and mitigate this undesirable result. Pumping in the far southwest area of the Basin, south of the IWV Fault Zone), would still be removing fresh groundwater (with beneficial uses) from storage. However, by moving pumping away from the central area with chronic groundwater level declines (~1 ft/year) it would serve as an interim measure to reduce the rate of decline. A separate management area would potentially need to be established for the southwest area to allow short-term pumping within the sustainable yield of this defined area.

Depending on the Basin's native safe yield and the amount of pumping, alternative supplies will need to offset between 17,600 AFY (28,600 minus 11,000 AFY) and 20,900 (28,600 minus 7,700 AFY) of reductions. It is not likely that one alternate supply can deliver that much water to the IWV. Therefore, two or more (and perhaps all) of the above alternate supplies will likely be needed. Brackish groundwater (alternative #1) likely represents a significant potential interim source of alternate water in the near term, has a high likelihood of success, can deliver water before 2030, and is local. A brackish groundwater feasibility study is already underway. In addition, grant funding from DWR is available for additional brackish water studies and a treatment demonstration plant. Feasibility evaluations for other alternate supplies (#2 through #6) will need to be developed in the coming months and years.

How to Fund Ongoing Groundwater Management And New Water Projects?

In general, groundwater management activities fall into the following three categories:

- Ongoing management activities (e.g. data collection, collation and analysis – monitoring groundwater pumping rates, groundwater levels, water quality, etc.)
- Groundwater studies (e.g. southwest area pumping feasibility analysis)
- Capital projects (e.g. new water supply wells, water treatment facilities, transmission pipelines)

Funding for these activities can come from one or more of the following sources:

1. Grant funds available from the State and Federal government
2. Low-interest government loans (e.g. State Revolving Loan [SRF] funds)
3. Voluntary contributions from pumpers
4. Taxes (e.g. property taxes, sales taxes, special taxes)
5. Groundwater extraction fees
6. Private investment, either as a privately owned project or public-private partnership

Wherever grant funds are available, the IWVGA or a group of pumpers should pursue these aggressively (e.g. Proposition 1 GSP development grants, brackish water grants, geophysics grants, water treatment grants). In addition, low-interest government loans should be secured for major capital projects. Where a study or capital project provides a benefit to a select group of pumpers, then those parties should be encouraged to voluntarily fund a portion of such studies or projects (e.g. the current brackish water study).

There are many groundwater basins in California that are actively managed by a special district (e.g. OCWD) and many basins where a Watermaster has been appointed after an adjudication proceeding. In nearly all of these basins, a groundwater extraction fee or replenishment assessment is imposed on the pumpers to pay for ongoing basin management activities, fund studies, and provide complete or partial funding for capital projects.

A conceptual groundwater extraction fee structure for the IWV could include three types of fees: (1) a basin management fee, (2) a capital projects fee, and (3) an overdraft fee. The fees would be levied on every pumper in the basin on an annual per AF basis with the exception that *de-minimis* users would be just charged a flat annual fee. The actual amount of each type of pumping fee would be set each year based on the projected budget for groundwater management activities and planned studies in the coming fiscal year and the five-year basin plan that includes planned capital projects. Thus, depending upon the budgets and plans, in some years the capital projects fee may be higher than the basin management fee, and visa-versa.

For all pumpers (except *de-minimis* users), the small "basin management fee" would be assessed on every AF pumped to pay for general management activities (e.g., administrative costs, monitoring, basin research).

The "capital projects fee" would be assessed only on pumping that exceeds a pumper's assigned free pumping allocation to pay for feasibility studies, engineering design and permitting (i.e., the soft construction costs) of capital facilities to develop alternative water supplies for the IWV. The hard construction costs for capital facilities, along with ongoing operation and maintenance (O&M) costs and periodic replacement costs, would be built into the per AF delivered cost of the alternate water supplies. That is, alternate supplies would mostly be funded by the ultimate users of that water. It is anticipated that the capital projects fee would decline between 2030 and 2050, as most of the alternate water supply projects would be constructed between 2030 and 2050.

An "overdraft fee" would also be assessed for any pumping in excess of the baseline allocation. The overdraft fee would be designed (priced) to: (1) discourage individual pumping above the increasingly reduced baseline allocations (and cumulative pumping above the overall operating yield); (2) incentivize a market for exchange of allocations; and (3) fund the purchase of alternate water by the basin manager to be used to recharge the basin and offset the overdraft pumping. To achieve these goals, the overdraft fee would be set at a value slightly higher than the cost of alternate supplies. This would encourage the development and use of these alternate supplies, and create a common pricing for water throughout the Basin, whether it is local native groundwater or alternate supplies.

Figure 6 illustrates when the various pumping fees might be assessed against an individual pumper between 2020 and 2050 and beyond.

As noted, the imposition of fees can also provide a market for the transfer of pumping allocations. For example, a pumper may lease or permanently sell its free pumping allocation to another pumper or lease any part or all of their baseline allocation to another pumper that needs additional water supplies that year. This transaction is between two independent pumpers, but subject to approval by the basin manager. In practice, the value of this transferred water is capped by the overdraft fee. That is, if it is cheaper to pay the overdraft fee, then why purchase another party's pumping allocation? Clearly, a series of rules and procedures would need to be developed to establish and manage such a water-trading market.

One important takeaway is that allowing more pumping generates more fees, and while allowing current pumping to continue removes more groundwater from storage it also generates even more fees. By imposing a capital projects fee on pumping in excess of the free pumping allocation and an additional overdraft fee on pumping in excess of the baseline allocation, it allows the pumping that created the problem to pay for the solution.

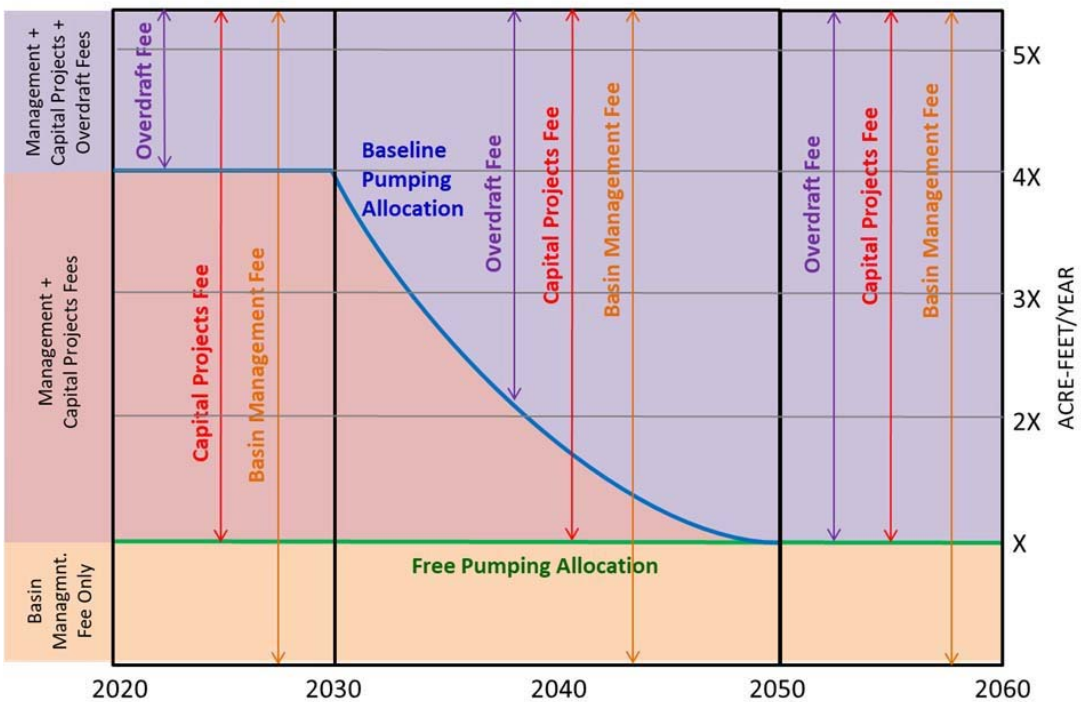

Figure 6: Assessment of Fees Relative to Free Pumping Allocation and Baseline Pumping Allocation

This gradual "soft-landing" approach, coupled with a fee structure for pumping in excess of the native safe yield and allowance of pumper-to-pumper exchanges of allocation, has been implemented in several prior groundwater management/ overdraft curtailment programs. Examples include the Mojave Basin and Seaside Basin. The approach affords the following advantages:

- It allows time for pumpers to adjust to the necessary ramp-downs in their baseline allocation of the operating yield to the native safe yield, helping minimize economic impacts on pumpers and reducing the risk of potential costly litigation
- It builds capital to fund the initial development of alternative supplies and affords time to bring the new projects online without water supply disruption
- It fosters a market for exchanges of allocations among pumpers, which in turn, incentivizes conservation and reallocation of groundwater supplies from lower- to higher-valued uses

What Happens If Domestic Wells Start To Dry-up?

As noted in the pumping strategy section, it is proposed that current pumping levels be maintained through 2030. Pumping would then be reduced to the sustainable yield between 2030 and 2040 (and possibly extended to 2050). However, as noted, this pumping will result in continued declines in groundwater levels through at least 2040. An additional groundwater level decline threshold would be set at 40 feet beyond 2015 levels (see prior discussion). The larger groundwater pumping wells operated by IWVWD, SVM, and larger agricultural interests are deep enough to accommodate an additional 40-feet of groundwater level decline without any serious adverse consequences for the well. However, with this additional drawdown, there is a possibility that shallower, domestic wells could face problems; in fact, some wells may become inoperable. A contingency plan is needed to address these situations.

The following are potential solutions to these problems:

1. For isolated properties, subsidize the drilling of a new, deeper domestic well for the impacted party
2. Connect the party to the municipal supply (i.e. IWVWD), if they are proximate to the municipal distribution network
3. Connect the party to an alternate supply (e.g. treated brackish water), if they are close to the treated water delivery pipeline
4. Connect the impacted party to a neighbor's well, if that well has not been impacted and the neighbor is willing to allow such a connection
5. Establish a domestic mutual water company in an impacted area, drill a new, deeper well to service this area, and connect the impacted parties to the mutual water company distribution system

Where a party is located far from the IWVWD distribution network, but in an area with many domestic well owners, option 5 will likely be preferable.

Conclusion

IWV can continue to pump fresh groundwater at rates in the near term in excess of native safe yield, so long as such pumping does not cause significant and unreasonable undesirable results, as defined in SGMA and established by the IWVGA. However, this pumping will eventually have to be reduced to meet sustainability goals for the Basin. It is proposed that fresh groundwater pumping continue at current rates through 2030, and then be reduced to the sustainable yield between 2030 and 2040 (possibly extending to 2050).

A contingency plan should be developed to ensure that *de minimis* domestic well owners have access to a water supply in the event their wells run dry. This plan could include the creation of domestic mutual water companies.

A pumping fee assessment comprising a basin management fee on every AF of groundwater extracted and a capital projects fee on every AF above an assigned "free pumping allocation" should be imposed. In addition, an overdraft assessment should be charged for any pumping above a party's "annual baseline allocation" of the operating yield. These assessments should be used to pay for ongoing basin management, groundwater studies, and a portion of capital projects. Imposing these assessments also creates a market for the transfer of pumping allocations between parties.

In summary, IWV can dip into their groundwater savings to yield long-term economic growth and invest in projects with a long-term return of water. This strategy lets the pumping that created the overdraft problem pay for the long-term solution.

REFERENCES

BLM, 1993. IWV Groundwater Project Technical Report (http://iwvgroundwater.org/wp-content/uploads/2013/03/174_Bureau_of_Rec_IWV_vol_II_Dec_1993_Part1.pdf)

DRI, 2017. Groundwater Resource Sustainability: Modeling Evaluation for the Naval Air Weapons Station, China Lake, California. Desert Research Institute, September 2016

ECORP, 2012. Final Environmental Impact Report, Water Supply Improvement Project for Indian Wells Valley Water District. ECORP Consulting, February 2012

IWVWD, 2016. Annual Groundwater Production Data for the IWV Basin (http://iwvgroundwater.org/iwv-production-data/)

KCWA, 2016. Hydrographs for Selected Monitoring Wells in the IWV Basin (http://iwvgroundwater.org/hydrographs/)

Stanford, 2016. Field Applications of TEM and NMR in IWV (http://iwvgroundwater.org/wp-content/uploads/2013/06/Stanford-Jesse-Crews-Presentation-081816.pdf)