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GROUNDWATER SUSTAINABILITY PLANS

CALIFORNIA'S NEWLY-FORMED GROUNDWATER SUSTAINABILITY AGENCIES
THE REWARDS OF OPTIMIZING EFFECTIVE COORDINATION & COLLABORATION

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BACKGROUND

CALIFORNIA'S SUSTAINABLE GROUNDWATER MANAGEMENT ACT

Until 2014, when the California legislature passed the Sustainable Groundwater Management Act (SGMA), the most populous state in the union had little to no framework to regulate groundwater extraction. Attempts had been made in the past to create more structured regulation, but these had been unsuccessful. The primary form of groundwater management in the State was through prior legislation focused on groundwater planning and reporting, rather than enforceable regulation.

Extreme drought conditions beginning in 2012 led to such a large increase in groundwater use as a replacement for dwindling surface water — rising to sixty percent of the state's water supply (California Department of Water Resources (DWR), 2013) — that the legislature took decisive action. SGMA went into effect on January 1, 2015, requiring all medium- or high-priority groundwater basins in the State to establish one or more Groundwater Sustainability Agencies (GSAs) by June 30, 2017, or risk the State intervening to manage a basin's groundwater. SGMA mandates that GSAs can only be formed by one or more existing local public agencies that have water supply, water management, and/or land use authorities. For example, existing agencies like a water district, irrigation district, community service district, etc. are eligible GSAs. Likewise, cities and counties are eligible due to at a minimum, their jurisdictional land use authorities. Conversely, non-agency organizations like a Farm Bureau, a citizens' advocacy group, or similar entities are not eligible to be GSAs.

SGMA currently applies to 127 basins that are classified as high or medium priority. Each basin can have one or more GSAs. GSAs must then develop Groundwater Sustainability Plans (GSP). Basins defined by the State as "critically overdrafted" must have GSPs completed by January 31, 2020. All other medium and high priority basins must then have their GSPs completed by January 31, 2022.

GSPs must address sustainability for their entire basin. Therefore, regardless of whether there is a single or are multiple GSAs in a basin and regardless of whether a portion of a basin can be defined as "sustainable" (see below for further definition), the planning must nonetheless be done at a basin-scale. The GSA must reflect full informational and technical integration between various agencies, consultants, academics and general stakeholders. SGMA defines sustainability using six "sustainability indicators" and by virtue of how well a basin does or does not have an "undesirable result" for any of these indicators.

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Indicators

Groundwater Level Changes

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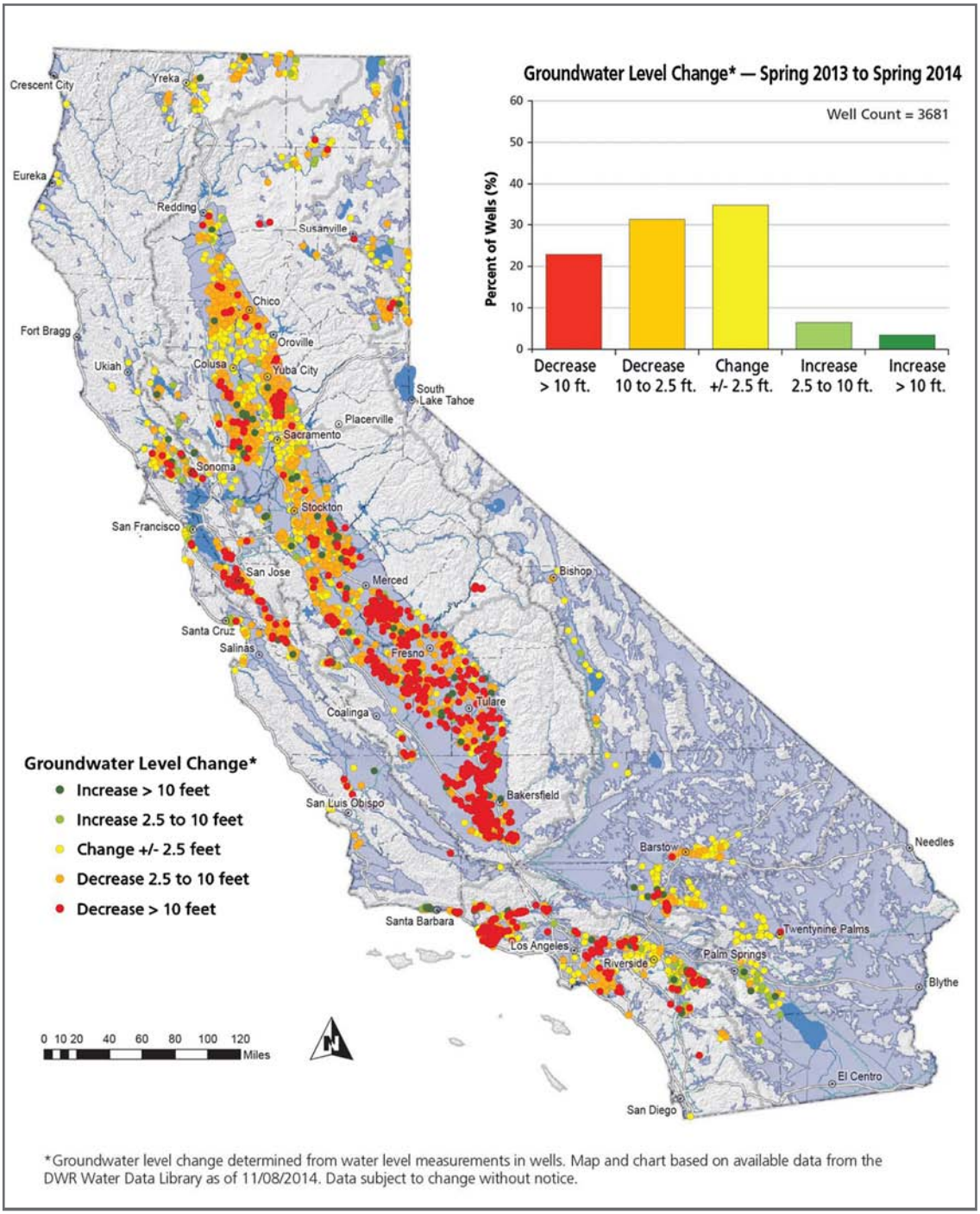
SGMA SUSTAINABILITY INDICATORS ARE:

- Chronic Lowering of Groundwater Levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
- Significant and Unreasonable Reduction of Groundwater Storage
- Significant and Unreasonable Seawater Intrusion
- Significant and Unreasonable Degraded Water Quality, including the migration of contaminant plumes that impair water supplies
- Significant and Unreasonable Land Subsidence that substantially interferes with surface land uses
- Depletions of Interconnected Surface Water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

California Water Code, section 10721(x)



*Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Water Data Library as of 11/08/2014. Data subject to change without notice.

Groundwater Cooperation

Thresholds & Objectives

Plan Complexity Factors

Collaboration & Cooperation

Collaboration Assistance

"Sunshine" Laws

To define, set, measure and achieve sustainability, GSPs must identify "minimum thresholds" and "measurable objectives" for each basin. "Minimum thresholds" refers to a numeric value for each sustainability indicator used to define undesirable results. "Measurable objectives" refer to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in a GSP to achieve the sustainability goal for the basin. GSAs are required to achieve their sustainability objectives within 20 years of a GSP's adoption.

By the time this article is published, the June 2017 deadline for agencies to inform DWR that a GSA has legally formed will have passed. While some GSAs will still be launching their new organizational structures, developing bylaws, and adding members after this milestone, the attention of many GSAs and affected stakeholders (referred to in SGMA as "beneficial users") must rapidly turn to development of their GSPs. The degree of difficulty associated with doing so will vary widely, depending on a number of factors.

Factors contributing GSP complexity include:

- Whether there is an existing groundwater management plan upon which to build
- Whether there is an existing and applicable model of hydrogeologic conditions in the basin
- The size of a gap (if one exists) between current groundwater use and what the GSA determines to be a sustainable level of use
- The availability of options to close that gap
- The number of GSAs in the basin
- Whether these GSAs are collaborating to develop a single GSP for the basin or each is developing its own GSP
- The technical and financial resources each GSA is able to assemble and deploy in the service of GSP development
- Collaboration: how well GSA members work together, as well as with other stakeholders, in developing their GSAs
- Coordination: how well GSA leaders coordinate the interplay between technical validity, political feasibility, and community values

This article addresses the last two of these variables (coordination and collaboration). More specifically, we examine how structured, collaborative problem-solving methods offer an invaluable approach for GSAs to successfully avoid or resolve conflicts, save time and financial resources, and prepare and implement a durable GSP.

The field of conflict resolution and collaborative problem-solving has flourished in the United States over the past 30 years. Widespread efforts have produced a pool of expert facilitators, academic literature, and popular books to guide GSP developers on this journey. This article draws upon that literature, as well as the insights of the authors — mediators and facilitators at California State University, Sacramento's Center for Collaborative Policy (CCP). DWR and their partner agency in SGMA compliance, the State Water Resources Control Board (SWRCB), have generously funded collaborative, facilitative and meditative assistance to basins throughout the State who applied for such support. CCP has provided these services to twenty basins throughout the State to help them establish GSAs.

GROUNDWATER SUSTAINABILITY PLANNING

TRANSPARENT PROCESS MANDATED

The GSP-development process will be a multi-year negotiation taking place in the public policy arena and quite literally in the public view. The State has two foundational "sunshine" laws that mandate the work of public agencies be carried out transparently. For local public agencies such as GSAs, an applicable law is titled the "Ralph M. Brown Act" (Brown Act) — which was first enacted by the State legislature in 1953. While amended many times since 1953, the fundamental basis for the Brown Act remains the same as when the original introduction was written:

> *The Legislature finds and declares that the public commissions, boards and councils and the other public agencies in this State exist to aid in the conduct of the people's business. It is the intent of the law that their actions be taken openly and that their deliberations be conducted openly. The people of this State do not yield their sovereignty to the agencies which serve them. The people, in delegating authority, do not give their public servants the right to decide what is good for the people to know and what is not good for them to know. The people insist on remaining informed so that they may retain control over the governing bodies they have created.*

Groundwater Cooperation

Communications Mandates

Additionally, a SGMA statutory requirement has produced stand-alone regulations (required to be prepared by DWR) describing specific components to be included in a GSP. Amongst many mandates, these regulations require that each GSP include a "communications section" in the GSP that describes:

> *…(1) An explanation of the Agency's decision-making process. (2) Identification of opportunities for public engagement and a discussion of how public input and response will be used. (3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin. (4) The method the Agency shall follow to inform the public about progress*.

California Code of Regulations, title 23, section 354.10

Higher Standard

It is worth noting that, while nuanced, this requirement exceeds almost all public engagement rules that agencies have previously been held accountable to under federal and state environmental compliance laws. The SGMA requirement to describe how public input is used to inform decisions has never been seen before in other similar laws. SGMA holds a GSA to a much higher standard: i.e., to show that it has not just sought, but also authentically considered all input. This requirement sets the stage for a GSA to earnestly build trust by showing affected beneficial groundwater users that their input has been considered. Alternatively, it also creates a dynamic through which a GSA can damage trust if their decision-making efforts prove to be insincere.

With this dynamic of transparency, GSAs will have to negotiate what, at times, will be highly sensitive and controversial decisions about groundwater use, regulation, enforcement, fee assessment, and similar issues. Collaborative approaches offer high potential to produce innovative, creative, and durable solutions to these complex groundwater management challenges. Such approaches may be time and resource-intensive. However, effective collaboration is likely to be vital to GSAs to meet SGMA deadlines to achieve sustainability. SGMA's requirements are serious and challenging: if GSAs want to avoid State intervention, they need to work together efficiently and effectively. Collaborative models offer the highest and best opportunity to achieve SGMA goals.

COLLABORATIVE NEGOTIATION

Involved Parties

As is typical in any public policy arena, groundwater policy negotiations largely involve three types of parties:

1) Those Most Immersed in the Issues and responsible for finding a solution (e.g., GSA members);
2) Those Who are Invested in the Issues, who are following the negotiation closely and want an opportunity to weigh in at strategic points along the way; and
3) Other Members of the Affected Community, who generally will rely on other parties (#1 and #2 above) to solve the problem, but expect transparency from decision-makers and want to know about opportunities to provide input in case they wish to become more involved.

Similar to many natural resource management efforts, attempts to regulate groundwater are fraught with potential conflicts. Like almost all natural resources, groundwater is finite. Its availability depends on a combination of human management and climatological variables beyond human control. Access to water has proven essential to economic and social prosperity and any attempt to limit such access is almost always met with human conflict.

Unregulated Historic Rights

Further, groundwater has previously been an essentially unregulated resource in California. Its use and availability has been guided by the principle of "overlying rights" — i.e., for most areas of the State, an overlying land owner has always been allowed to extract percolating groundwater and put it to beneficial use without approval from the SWRCB or a court. Thus groundwater user behavior and relationships have long since been established and have created hardened opinions and approaches. As this historical context adapts to the new and very different paradigm of SGMA individual GSAs, the multi-member GSAs will need to: a) cultivate trust; b) establish clear roles and procedures; c) encourage shared learning; and d) budget for coordination and conflict resolution to work most effectively together and negotiate mutually beneficial and supported outcomes. Each of these avenues to success are now discussed.

Cultivating Trust

Trust Factors

Trust is the currency of negotiations (DeSeve, 2007; Hocevar et al., 2006; Kilmann, 2011; Langridge, 2008; Stern and Coleman, 2014; Whitall, 2007). Research points to the importance of the quality of communication and interaction in collaborative forums. Key factors to determining success include "dialogue, trust building, and the development of commitment and shared understanding" (Ansell and Gash, 2008, p. 543; Bryson, Crosby, & Stone, 2015).

Decision Acceptance

Recall that a GSA can be a single agency, or a multi-member agency working with one or more other GSAs in a basin. GSAs therefore need to cultivate trust among themselves, as well as between internal members and beneficial users writ large. Trust and credibility is essential if groundwater users are going to accept the GSAs' decisions about how to achieve sustainable groundwater management (Water in the West et al., 2016). The wisdom of a GSA board's decision will only transcend a stakeholder's sense of fear, loss, and risk from such decisions if the affected stakeholders accept that such decisions, however difficult, are serving a greater good.

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Trust between individual GSAs, and between diverse members of a multi-agency GSA will range from solid, to nascent, to non-existent or antagonistic. Where trust is weak, work should focus on strengthening it. Where it is already strong, it is not to be taken it for granted. To persist, trust must be nurtured.

Whether working on trust between GSA members, or between GSAs, and/or between GSAs and beneficial users, the behaviors that help build trust are the same.

Necessary Behaviors

Trust building behaviors include:

Communication: frequent, clear, and honest

Reliability: doing what you said you would do, when you said you would do it

Accountability, Validation and Transparency: taking others' needs into consideration; affirming to others that you understand their needs; and explaining why if you cannot accommodate those needs

"Active Listening"

The practice of "active listening" is an essential skill for trust building communication. Negotiating parties often seek to be heard, more than they seek to hear. Such parties often spend a disproportionate amount of time "arguing their case." As the parties mirror each others' behavior, they commonly start talking past each other rather than with each other. In an absence of feeling heard, tensions mount. This in turn creates an atmosphere of distrust as the participants struggle in vain to have their interests be understood. In the case of SGMA, this dynamic may be acute as the governing board of a GSA deliberates, with the affected beneficial users each having a story to tell about their groundwater use and dependence. Using active listening, parties work to avoid misunderstandings and accidentally differing interpretations of what has been said. The method involves summarizing what you have heard someone say and then checking to ensure your summary is accurate before responding: "what I think I hear you saying is X….do I have that right or is there anything else I should know?" While quite effective and seemingly simple, the human drive to be right and be heard often short-circuits a participant's willingness to be this thoughtful.

In GSA negotiations, active listening must happen during an open public session. The practise holds decision-makers uniquely accountable to conduct effective inquiry about all groundwater interests, and to later be held accountable as to whether such interests were addressed.

Shuttle Diplomacy

"Shuttle diplomacy" has also proven helpful to navigate tense moments and restore positive working relationships. This is where a facilitator talks to disputants one at a time to understand their respective concerns and work out a path forward that is acceptable to all concerned. In California, an inherent challenge to both active listening and shuttle diplomacy are the limitations posed by the Brown Act. In all cases, such discussions that include the decision-makers of a GSA must happen with prior public notice and at public venues. Closed discussions with one or more GSA decision-makers are illegal and therefore require such steps to be taken by proxies such as agency staff and/or affected beneficial users — with subsequent reports being made publically to GSA decision makers.

Establishing Clear Roles and Procedures

Related to the limits created by the Brown Act and standard organizational procedures of any agency, clear roles and procedures must be in place to deliver on the above building blocks of trust. There are two levels at which this applies: 1) GSA bylaws; and 2) the arrangements put in place when the GSA establishes a subsidiary entity such as a GSP development committee, to assist the GSA in carrying out its work.

GSA Bylaws

Specified Roles

Ideally, as the GSAs turn their attention to GSP development, their bylaws (or similar rules by some other name) will specify the major roles that must be filled to carry out the work of the GSA (e.g., leadership, financial management, documentation, etc.). The procedures through which those who fill these roles will execute their duties should also be well defined. Some GSAs have developed agreed-upon guiding principles, endorsed by executives of member organizations. Such principles ensure that from the outset, the GSA functions under a set of common interests which guide discussions, decisions, roles, and behavior of the GSA members. They can also serve as a helpful guide to navigate unforeseen circumstances.

Specific Procedures

To ensure shared expectations and trust between GSA stakeholders, decision-making procedures should be spelled-out explicitly in bylaws — leaving nothing open to interpretation.

Examples of procedural questions to answer include:

- Who selects the GSA's technical consultant, and how? Are others entitled to input into that decision?
- Does the GSA aspire to build consensus on some or all of its decisions?
- Among whom is consensus sought?
- Does the GSA have a back-up decision-making procedure in place in case consensus cannot be reached within a reasonable amount of time?
- How would that back-up procedure be triggered?

Modification Paths

Collaboration literature also urges GSAs to layout clear procedures to modify governance structures when and if the need arises (Conrad, Martinez, Moran, DuPraw, Ceppos, & Blomquist (2016)). It is important to recall that the GSP development and implementation schedule can take up to 24 years to achieve sustainability. Much will change in that timeframe. GSAs can expect a certain amount of conflict in the course of carrying out their responsibilities, but they can avoid unnecessary conflict by spelling out key roles and procedures in detail.

Groundwater Cooperation

Dispute Resolution

Flexibility

Collective Concerns

Interest-Based Negotiation

Data Commonality

With respect to conflict, GSAs may wish to specify "dispute resolution" procedures in their bylaws. These procedures are often structured as a set of steps, beginning with the informal and progressing to more formal and resource-intensive approaches. For example, the most informal approach might be an established norm that the disputants should have a meeting to try to work a conflict out themselves. If that doesn't work, they may ask a designated GSA leader (e.g., the agency's Executive Director) to meet with them to try to help them find a workable solution. If that doesn't work, the next step might be to discuss the issue at a full GSA meeting. If the conflict remains, the GSA might vote on whether to call in a mediator or resolve it by a majority vote of GSA members. The key thing is to recognize that conflict is inevitable and to put into place appropriate procedures that are compliant with the Brown Act and that channel conflicts in a productive direction before they arise.

GSA Subsidiary Entities

If a GSA establishes a committee to develop its GSP, this committee will need a very clear charge and explicit operating protocols. These are often spelled out in a "charter" for such a committee. The charter should be tied to, and consistent with, the GSA's bylaws — but may require an added level of specificity. For example, the operating protocols should spell out who will lead the committee (a chair, co-chairs, etc.); how committee members will be chosen; who will develop agendas for committee meetings and document progress; what resources and experts are available to support the committee who is authorized to speak to the media on behalf of the committee; and similar variables.

Numerous authors point to the importance of a flexible, adaptive approach that is responsive to new data and changing conditions (Bryson et al., 2015; Conrad et al., 2016; Innes & Booher, 1999; Pahl-Wostl, Sendzimer et al., 2007). While explicit procedures are helpful to avoid misunderstandings, the charter for a GSA committee will also need to enable participants to adapt to changed conditions and unforeseen challenges — i.e., adding, removing, and replacing members; creating and disbanding subcommittees; resolving conflicts; etc.

Encouraging Shared Learning

No single entity has all the answers to the multitude of questions that must be answered in a GSP. The people involved are embarking on a journey of shared learning. Authentic and respectful dialogue enables participants to learn together and explore ideas and options creatively (Innes & Booher, 1999, 2004).

Consensus-building processes typically rely on interest-based negotiation. A group chairperson, or at times an appointed neutral facilitator working with a group, helps the decision-making participants identify and articulate their underlying concerns and their respective criteria for a successful resolution. This facilitator then helps all involved work toward a solution that addresses the collective set of concerns and meets the collective set of criteria for a satisfying agreement. However, without training in interest-based negotiation, most parties default to the more prevalent "positional" negotiation approach — i.e., pick your favorite way of resolving a dispute and fight for that to be the winning solution (as previously alluded to under the discussion of active listening).

Interest-based negotiation can enable participants to free themselves from entrenched positions to find novel solutions (Fisher, Patton, & Ury, 2012). Interest-based negotiation requires GSA decision-makers and other participants to: commit to listen to all points of view; define objective goals in advance; and hold true to individual interests while also discussing and honoring the interests of others. This method can ultimately create decisions that deliver multiple benefits that would otherwise be non-attainable.

Interest-based negotiation is not necessarily an intuitive approach. There are pertinent skills and organizational capabilities at the level of the individual negotiator, the organization that person represents, the stakeholder group as a whole (e.g., the GSA or advisory committee), and the convening agency (DuPraw, 2014). Thus, if possible, the first form of shared learning GSAs may wish to undertake is an introductory training, for all concerned, in the use of interest-based negotiation.

During the years it will take to complete the GSP, there will be ample opportunity for all involved to learn relevant information from each other. This may occur at the organizational level or the interpersonal level. Establishing and upholding a principle of shared learning will ensure that all participants feel groundwater decisions were made thoughtfully, transparently, and equitably.

Budgeting for Coordination and Conflict Resolution.

Members of newly-formed GSAs are understandably pleased to have met the first major SGMA deadline. Those on the leading edge of this process have also already developed detailed work plans to guide the launch of their GSP development processes. They are developing their stakeholder engagement approaches. However, few have looked beyond their boundaries to fully consider the extent of coordination they need to pursue with entities outside of their own GSAs and local stakeholders. SGMA requires cross-GSA Coordination Agreements to guide GSP implementation where multiple GSAs in a single basin develop separate GSPs. These separate GSPs must ultimately be integrated.

SGMA REQUIRES THAT ALL THE GSPS IN A BASIN MUST USE THE SAME:

a) Groundwater elevation data;
b) Groundwater extraction data;
c) Surface water supply;

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d) Total water use;
e) Change in groundwater storage;
f) Water budget; and
g) Sustainable yield information and conclusions.

California Water Code, Section 10727.6

Meeting these requirements will require a significant investment of time for GSA members to deliberate among themselves, and with others (e.g. adjacent GSAs, consultants, researchers, etc.) on the "rules of engagement" — e.g., about how they manage and share data, whether formal GSA approval is necessary to do so, conditions when sharing data might be inappropriate and similar.

Watershed Coordination

Additional coordination may be needed with those outside the basin but still within the watershed (e.g., adjacent basins and entities at higher elevations than alluvial basin boundaries) in order to achieve sustainability. Related and perhaps pertinent water planning tools already implemented by the State include: Integrated Regional Water Management Plans; Agricultural Water Management Plans; Urban Water Management Plans; Salt and Nutrient Management Plans, the Irrigated Lands Regulatory Program; and Stormwater Resources Management Plans. Scholars of consensus-building and collaboration point out the challenge of effectively situating such efforts within broader institutional, political, socioeconomic, and environmental contexts (Bryson et al., 2015; Emerson, Orr, Keyes, & McKnight, 2009; Kallis, Kiparsky, & Norgaard, 2009).

Consensus Threats

Conditions that can undermine consensus-building include:

- Participating agencies that do not provide sufficient resources or support
- Political bodies or authorities that fail to support the outcomes of consensus building or lack political will for implementation
- Constituencies that feel isolated from the negotiations and agreement, even if they are represented

(Kallis et al., 2009)

Hydrological Scale

The "nestedness" of planning units within larger hydrological, regulatory, and social contexts also poses challenges. Water resources span scales from local to regional and beyond (e.g., water transfers, water export, etc.). Solutions to environmental challenges that are derived at a local scale (such as a watershed or groundwater sub-basin), may be unacceptable to stakeholders at a larger scale who also have an interest in management of the resource (such as a river basin or groundwater basin). Moreover, political boundaries rarely match hydrological boundaries, posing additional jurisdictional challenges to attaining durable agreements (Neuman, 1996; Singleton, 2002). In the SGMA context, this will come up because SGMA's "basins" are typically nested within larger watersheds.

Water Supply Planning

Lastly, GSAs will benefit from coordinating with land use planners with respect to strategies for securing adequate water supply. GSAs who face water quality constraints on their ability to manage groundwater sustainably also may find that they need to undertake a significant amount of coordination with existing water quality programs. These programs' missions, guidelines, and metrics may be inconsistent with one another and with what the GSA would otherwise want to do. GSAs cannot override them. Instead, they will need to work together to determine how to build upon one another's efforts.

THE SWEET SPOT

integrating technical validity, political feasibility, and community values

Three-Legged Agreement

A popular metaphor for a strong negotiated agreement is a three-legged stool — with one leg representing technical validity, one leg representing political feasibility, and one leg representing the values of affected parties. All three of these phenomena must be integrated into an agreement for it to garner broad support and withstand the test of time. So what should GSA leaders think about as they prepare to build a sturdy and durable agreement on how to sustainably manage groundwater in their basins? The answer includes not only "best practices" for consensus-building processes in general, but also more specific recommendations about how to integrate technical information and joint learning into the consensus-building process.

"Best Practices" for Consensus-Building Processes.

"Safe Space"

The peer-reviewed literature offers a wealth of advice about building consensus on water management plans. The importance of creating a "safe space" for collaborative dialogue that enables creativity and trust-building is stressed, as well as experimentation without alienating external parties — which could undermine the process or agreements that emerge from it (Kallis et al. (2009)).

Consensus Process

Effective consensus-building processes include:

- Process Transparency and clear, agreed-upon ground rules
- Early "Small Wins" that build the foundation for later agreements
- Broad Participation and Inclusion
- Commitment to Equalizing Existing Power Imbalances
- Shared Ownership of the process and recognition of interdependence
- Genuine Engagement in face-to-face dialogue; investment of sufficient time and resources

(Ansell & Gash, 2008; Bryson et al., 2015; Innes & Booher, 1999; Kallis et al., 2009).

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Observers of SGMA implementation in California offer advice for GSP development efforts that aligns with the above principles (Conrad et al., 2016; Dobbin, Clary, Firestone, & Christian-Smith, 2015; Kiparsky et al., 2016; Moran & Cravens, 2015; Moran & Wendell, 2015). In applied terms, SGMA sets the stage for potentially significant conflicts in the near and long-term. As previously noted, SGMA potentially re-allocates a finite resource among water users that have heretofore enjoyed the resource with relative impunity. It will require a delicate balance by decision makers to authentically incorporate public input, accommodate diverse groundwater needs, and nonetheless "do the right thing" when faced with unpopular decisions. Further, SGMA is new. There is no legal precedent for: how it should be implemented; what GSPs will ultimately look like; whether future local decisions will be deemed legal or constitutional; and etc. In short, it is untested.

Finite Resource

GSA Suggestions

Given the conditions, GSAs are well-advised to:

- Ensure they have in place a transparent, representative, and accountable governance structure
- Commit to relationships, fairness, and broad and diverse participation
- Invest sufficient time, resources, and capacity
- Follow principles of adaptive planning and governance so that both the plan and the governance approaches can respond to new information and conditions
- Coordinate with neighboring GSAs to head off conflicts that may emerge from beyond a plan's jurisdiction
- Develop an effective plan, integrating meaningful public engagement and feedback
- Seek help from professional facilitators and/or mediators (if local capacities do not exist)

Sustainability Goals

Integrating Technical Information and Joint Learning into the Consensus-Building Process

GSP development inevitably will involve a high volume of technical information. GSAs must identify sustainability goals for their respective basins. The GSPs must reflect the GSAs' decisions regarding how they will meet their sustainability goals over a 20-year period and maintain sustainable conditions over a 50-year period. To do this, the GSPs must translate sustainability goals into measurable objectives and identify minimum thresholds that help define "sustainability" and measure progress toward it (Moran, 2016). GSP regulations are part of California Water Code and, in concert with periodic additional guidance prepared by DWR and SWRCB, describe the comprehensive and potentially exhaustive scale of information must be provided in the GSP process.

Indicators Proof

Paramount in GSP development and ultimate approval by the State is the requirement that each basin must defensively prove whether they are sustainable for each of the six applicable sustainability indicators. Educated "guesses" will not suffice. Further, even for an indicator that is deemed unsustainable, the GSP must quantify what those undesirable results are and the specific actions one or more GSAs will take to reverse that condition.

Technical Content

While GSPs will be quite technical in content, they will contain sustainability solutions and strategies that must be politically feasible and, ideally, mutually acceptable to the affected beneficial users. This means that many lay people will need to understand the technical issues involved. GSAs will need to develop or tailor existing hydrogeologic models to support GSP development. In some basins, stakeholders will want to be involved in model development — i.e., helping to identify objectives for the model and acceptable levels of uncertainty (Water in the West et al., 2015). In all basins, stakeholders will want to provide input on potential solutions (Water in the West et al., 2016).

GSAs likely will want to invest particular effort to help stakeholders understand these issues. Practical understanding promotes productive discussions — whether the discussions are among GSA members, within a GSA's appointed committee, or in a public meeting.

Technical Understanding

Stakeholders of particular importance are: 1) those most impacted by groundwater management issues; and 2) those who have historically been under-represented in water management discussions (e.g., small farmers, disadvantaged groups, ethnic minorities). GSAs should work proactively to build the capacity of these two types of stakeholders to understand the technical issues, engaging them early with tangible information. If stakeholders do not understand early discussions and terminology, they will become alienated and marginalized. Key choices GSAs should consider include who provides information to stakeholders and in what format (Water in the West et al., 2016). It is often helpful to engage local "emissaries" who have already established trust in a community and who are equally affected by decisions in a GSP, to help disseminate information. Sometimes these emissaries will be appointed representatives on a GSA board but equally as often, they may have no appointed role but are nonetheless trusted and respected opinion leaders.

Making Sense

Pointing to the scientific and social complexity inherent in water management, studies highlight the importance of incorporating institutional mechanisms of learning in consensus-building efforts. Learning mechanisms enable participants to make sense of complex, uncertain, and conflicting data. They can transform data into new shared concepts and understandings that form the basis for decision-making (Kallis

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Joint Fact Finding

et al., 2009; Pahl-Wost, Craps et al., 2007; Schusler, Decker, & Pfeffer, 2003). GSP developers should decide early on how they will integrate technical experts and the stakeholder engagement process. These decisions will have cost and time implications to the process and each GSA will need to do their own "cost/benefit analysis" about when said technical engagement is essential, sufficient, or potentially too robust.

In a similar vein, literature points to "joint fact finding" as a "very integrated" learning mechanism: "In joint fact finding, stakeholders with differing viewpoints and interests work together to develop data and information, analyze facts and forecasts, develop common assumptions and informed opinion, and finally, use the information they have developed to reach decisions together." Ehrman and Stinson (1999, p. 376)

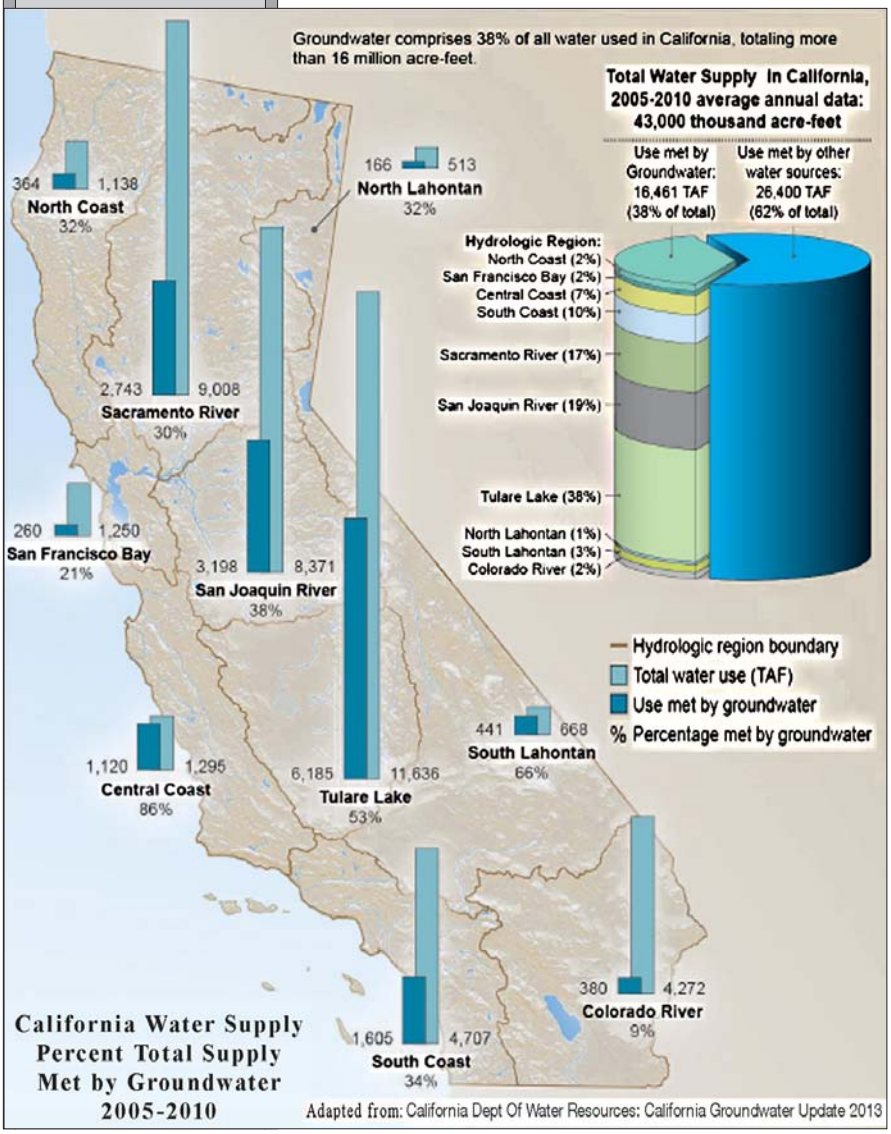
Joint fact finding can be used to:

- Create Shared Definitions and Understanding of a problem among decision-makers, stakeholders, and experts before the decision-making starts
- Integrate Scientific Knowledge with Other Pertinent Information such as the knowledge of local resource users
- Translate Technical Information Into Forms More Accessible to all stakeholders
- Identify Knowledge Gaps and areas of agreement and disagreement
- Provide a Shared and Legitimized Foundation of Knowledge to inform decision-making
- Build Trust and Relationships Among Participants that increase their capacity to productively address conflict

Ehrman & Stinson, 1999; Innes, 1998; Karl, Susskind, & Wallace, 2007; McCreary, Gammon, & Brooks, 2001.

Relevant to potential conditions under SGMA, joint fact finding may be a particularly crucial step in situations where the science is highly disputed and prone to becoming a contest of "dueling experts" (Ehrman & Stinson, 1999).

Fact Finding Principles



Planning efforts can apply the principles of joint fact finding in a variety of ways. While each process requires its own unique design, successful efforts tend to share common elements (Baldwin, Tan, White, Hoverman, & Burry, 2012; Gleason et al., 2010; Karl et al., 2007; McCreary et al., 2001; Schusler et al., 2003).

Successful joint fact finding principles include:

- A transparent process and structure
- Clear roles, responsibilities, goals, and objectives
- Sufficient funding, time, and resources
- Inclusive and diverse participation across affected interests, stakeholders, and experts
- Extended engagement and face-to-face dialog
- Consideration of both expert and non-expert knowledge
- A neutral facilitator or mediator who assists in convening and managing the process (if local capacity doesn't exist)
- Creation of a shared synthesis document
- Use of shared tools for viewing, analyzing, and interpreting data

Other methods and tools that can support shared learning in water planning include data visualization such as: spatial data and maps; participatory or collaborative modeling; jointly produced risk assessments or other analyses; and shared databases (Baldwin et al., 2012; Bartlett, 2011; Ehrmann & Stinson, 1999; Jackson, Tan, & Nolan, 2012; Pahl-Wostl, Craps, et al., 2007; Voinov & Bousquet, 2010). Working together with such tools enables specialists, and lay persons to transform their disparate knowledge into a shared form that can provide a foundation for consensus building and decision-making (Kallis et al., 2009).

Groundwater Cooperation

Neutral Advisor

Shared Ownership

Hard Choices

Reductions

Collaboration Benefits

Recent SGMA observers offer additional advice in the context of joint fact finding methods for how GSP development processes may address scientific uncertainty and complexity. Moran & Cravens (2015) encourage GSP developers to use collaborative modelling and decision-support tools to head off the "dueling experts" dynamic and to build broad-based trust in the data and model outcomes. Dobbin et al. (2015) make similar suggestions and also suggest the use of web-based information and communication tools, such as mapping applications, document libraries, and newsletters. Web-based tools are particularly helpful in the SGMA context because all parties involved are learning as they go. Web-based communication strategies enable widespread learning to a large audience quickly, enabling relatively rapid integration of newly-emerging "best practices."

The examples above present "very integrated" ways to translate technical information among stakeholders. A "moderately integrated" approach may opt to employ a neutral technical advisory committee, panel of experts, academic institution, or consulting firm to provide objective input to the stakeholder engagement process on scientific or technical matters. In general, this approach provides less opportunity for broad participant engagement with the data and science than undertaking a joint fact-finding process. If undertaking this approach, the group should consider how they will select experts and design the questions and process so that stakeholders feel their interests are represented and the conclusions are perceived with legitimacy (Ehrmann & Stinson, 1999).

At the "least integrated" end of options, GSA leaders might opt to receive direct input from both technical experts and stakeholders, but not to foster dialogue between technical experts and stakeholders. This could appear to give GSA leaders more control over shaping conclusions and keeping discussions on track. However, this approach is an impediment to developing shared ownership in the outcome, and that shared ownership is invaluable to build trust in general and ownership of specific GSP outcomes.

CONCLUSION

GSAs are faced with many hard choices as they develop their GSPs. Every piece that goes into the plan will have a cost. Whether they are funding a fact-finding study, siting a project that may affect land use and use of other resources, monitoring groundwater use, developing or strengthening regulations, or assessing fees, there will be a price tag — financial, political, or otherwise.

GSAs will need to determine the right configuration of strategies to achieve sustainability, how to implement them in a manner that keeps costs manageable, how to share these costs and where to find the necessary funds. As actual (not just theoretical) projects come online, there will be interest from additional stakeholders — who will need to be listened to and folded into the process. Perceived stakes will deepen as GSAs that cannot sufficiently augment supply or reduce demand will need to consider imposing reductions in groundwater usage and determine how to allocate such reductions.

Establishing GSAs was an important first step to create a legal structure through which agencies can work together and jointly use the powers that SGMA gives them — but that is only the beginning. Being legally compliant as an agency doesn't mean a GSA is prepared yet to govern and engage the public. Having a decision-making structure in place does not mean that decision-making will be easy. GSA leaders can make GSP development more manageable, successful, and durable by pursuing collaborative methods that authentically engage all concerned.

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Groundwater Mitigation

GROUNDWATER MITIGATION

PILOTING GROUNDWATER MITIGATION IN ARIZONA'S VERDE VALLEY

by Amanda E. Cronin, M.S., AMP Insights; Jocelyn Gibbon, J.D., Freshwater Policy Consulting; and Davíd Pilz, J.D., AMP Insights (Seattle, WA)

Introduction

Groundwater Scarcity

Throughout the western United States — and beyond — management of groundwater resources is a significant and growing challenge. Once considered by many to be a near-limitless resource, groundwater scarcity has become increasingly apparent and widespread. Growing levels of pumping have lead to declining groundwater tables, decreased aquifer storage, and diminished well productivity. The challenge is heightened in the many areas where significant surface water features — rivers, streams, and springs — are connected to and fed by groundwater. In these watersheds, declining groundwater tables are frequently paired with decreasing streamflow, along with attendant impairments to ecological function and water supply security. These conditions sometimes result in an existential threat to the continued flow of the affected river or stream.

Limited Management

In Arizona, groundwater makes up about 40% of the state's overall water supply (ADWR, "Supply and Demand"). Yet, as discussed below, groundwater use is comprehensively tracked and managed only in the most populated areas of the state. In the rest of the state, tools for managing groundwater resources are limited. This is true in Arizona's Verde Valley and the majority of the greater Verde River watershed in north-central Arizona, where the lack of good management tools poses a long-term threat to the health and flow of the Verde River. The Verde is one of Arizona's last healthy, perennially flowing rivers. It is a critical resource to the communities it flows through and serves.

Voluntary Mitigation

The Verde River Exchange Water Offset Program (the Exchange) is a new, locally developed, voluntary "groundwater mitigation" program. It is designed to provide local groundwater users with a way to reduce their individual "water footprint" and the cumulative impact of groundwater pumping on the Verde River. The Exchange is implemented by the local conservation group Friends of Verde River Greenway (Friends) in partnership with other local and regional partners. Designed with existing, regulatory groundwater mitigation programs in mind — but with careful attention to local context and values — the program is in its second year and has completed several small pilot projects. To the authors' knowledge, it is the first voluntary groundwater mitigation program in operation in the US.

The first section of the article offers background about the Verde River Valley, introduces the concept of groundwater mitigation and briefly discusses two groundwater mitigation case studies from the Pacific Northwest. The next section discusses the major hurdles that required consideration prior to the development of the Verde River Exchange, followed by the third section which focuses on implementation of the Exchange. The last two sections of the article present the initial pilot projects and look forward to initial steps over the next few years of program implementation.

The Verde River and Verde Valley

Drinking Water & Irrigation

The Verde Valley is located in central Arizona, north of Phoenix and south of Flagstaff. It makes up the central portion of the Verde River watershed, which extends from the heights of northern Arizona's Colorado Plateau forests and grasslands, through the red-rock canyons of its geologic "transition zone," and into the lower-elevation Basin-and-Range province, where the river is impounded by two successive reservoirs before it meets the Salt River east of Phoenix. The river is a significant source of drinking water for the Phoenix metropolitan area. Irrigation water in the Verde Valley is also supplied by the Verde River. The connected groundwater system is the sole potable water source for numerous Verde Valley communities (Clarkdale, Cottonwood, Camp Verde, Jerome, Sedona) and many residents in the upstream Prescott-area. Native American communities also rely on the river, including the Yavapai Prescott Indian Tribe, the Yavapai-Apache Nation, the Fort McDowell Yavapai Nation, and the Salt River Pima-Maricopa Indian Community (see Figure 1).

River Attributes

Significant stretches of rivers in Arizona — according to one study, 35% of the state's formerly perennial river miles — have already been altered or lost due to dams or escalating uses that have depleted or dried up river flows (Turner and List 2007; The Nature Conservancy Center for Science and Policy). As noted above, the Verde is one of the last remaining healthy, perennially flowing rivers in the state.

The Verde River and its tributaries feature over 400 miles of interconnected riparian habitat along a flowing river, supporting 92 species of mammals and 76 native amphibian and reptile species (Haney *et al*. 2008). Forty miles of the mainstem have been designated as a Wild and Scenic River, one of only two Wild and Scenic Rivers in Arizona (with the second being Fossil Creek, a Verde tributary) (Arizona NEMO 2005). The Verde's shores house treasured Cottonwood/Willow Gallery Forests, a forest type endemic to

Groundwater Mitigation

Hydrological Connection

Needed Tools

"Mitigation"

the Southwestern United States, and one of the rarest riparian habitat types in North America (Stromberg 1993 and USGS, Digital Representations of Tree Species Range Maps). Further, the desert river is at the heart of recreational opportunities, local culture and identity, and a critical tourism economy in the area.

The base flow of the Verde River is derived from hydrologically connected groundwater. Consequently, as the area grows and groundwater use increases, river levels decline (Garner *et al*. 2013). The Verde is also a fast-growing area: population of the Verde Basin more than doubled from 1980 to 2000 (ADWR 2009). By one estimate, the number of wells in the Verde Valley area of the watershed increased from approximately 200 to over 6,000 between 1950 and 2011 (VRBP 2015). The issue of groundwater pumping depleting surface flow is not unique to the Verde Valley, nor even to the state, but is especially prevalent in the arid Southwest. In Arizona, one study documented that without efforts to conserve or otherwise alter course, municipal groundwater pumping alone (projected through 2050) could dry up seven significant river stretches in the state while significantly degrading others, including portions of the Verde River (Marshall *et al*. 2010).

Given the importance of the Verde to the communities that surround and depend on it, the paucity of available management tools, and long-standing challenges with finding comprehensive solutions in a contested and unadjudicated system (described further below), many stakeholders have an interest in finding tangible, practical, and locally appropriate steps that can be taken to protect river flows and groundwater supplies — or at least to build some of the tools needed to ultimately achieve those goals. The Verde River Exchange was born out of studying successful groundwater management programs elsewhere in the West, and adapting one particularly promising mechanism — groundwater mitigation — to the Verde's local context.

Figure 1: Verde River Watershed

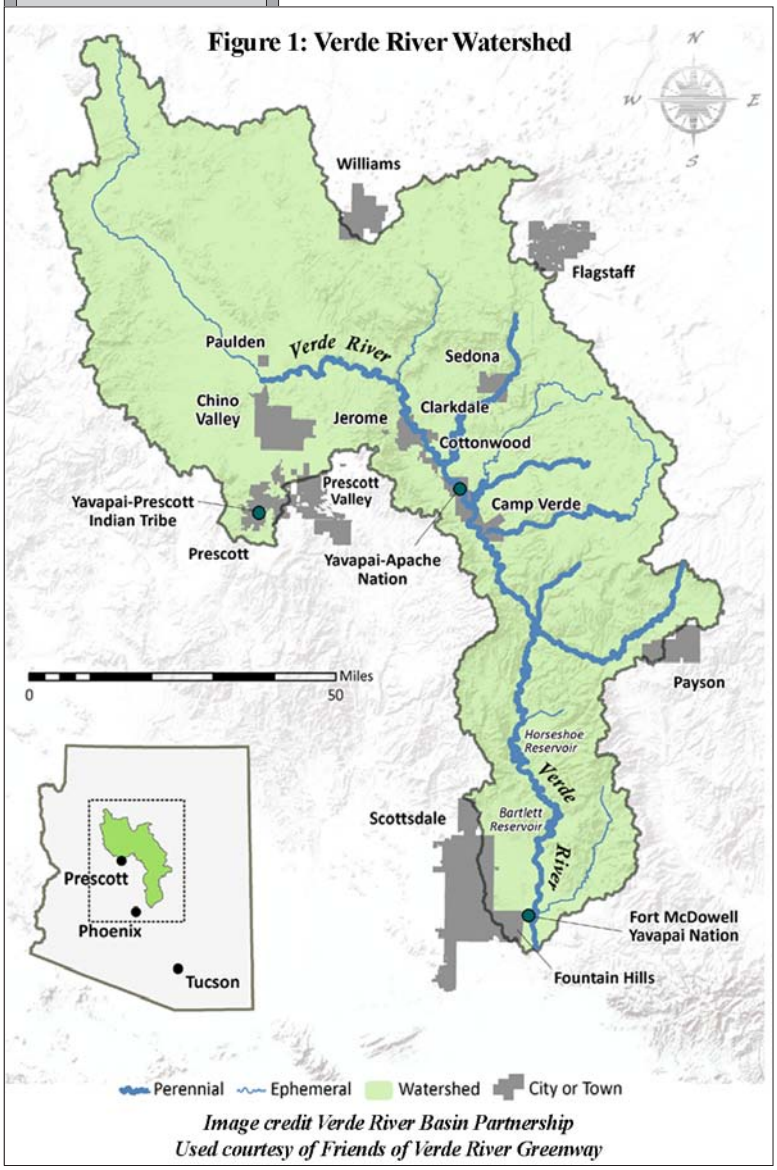

Image credit Verde River Basin Partnership
Used courtesy of Friends of Verde River Greenway

Groundwater Mitigation

The term "mitigation" is defined by Merriam-Webster's online dictionary as "[making] (something) less severe, harmful, or painful." Taken literally, groundwater mitigation refers to actions that reduce the severity of impacts from groundwater pumping. In the context of a groundwater mitigation program, the definition has come to mean something even more specific. In this context, groundwater mitigation refers to reducing or fully offsetting the impacts of new or existing groundwater pumping on connected aquifers or surface water sources or both.

Groundwater mitigation is a policy mechanism used in basins across the West to manage groundwater, especially in instances where groundwater and surface water systems are connected — though historically often treated as separate resources in law and policy. In these physically connected systems, mitigation allows management of groundwater in a way that considers impacts to surface water, but does not require permits or rights to groundwater and surface water to be merged into a single system. It also facilitates development of new and changed water uses while accounting for impacts. It is thus a tool to accommodate growth and development while preserving critical resources. The concept has increasingly been incorporated in areas where pumping threatens to deplete surface flows.

In general, mitigation programs function by requiring that new groundwater users mitigate the impact(s) of their pumping. There is no monolithic approach to groundwater mitigation and its implementation varies depending on site-specific hydrology and other factors. It is possible, however, to look at existing programs and glean a set of issues and options to be considered in program and policy design. For example, it is critical to identify specifically which impacts are to be mitigated and what actions can provide this mitigation — sometimes referred to as mitigation "demand" and "supply." There are also choices to be made about how and to what degree mitigation should match relevant impacts in terms of quantity, location, timing, and duration.

Groundwater Mitigation

The next two sections briefly describe two groundwater mitigation programs that helped to inspire work on the Exchange in the Verde Valley and offer examples of how the mechanism can work. In addition to these two examples, groundwater mitigation programs, or programs that function much like groundwater mitigation under a different name ("augmentation plans" in Colorado, for example), also exist or are in development across the West in Oregon, Washington, Montana, Idaho, Nebraska, and New Mexico.

The Dungeness Water Exchange (Washington)

Despite being in rainy western Washington, the Dungeness Watershed nonetheless faces water management challenges. Sitting in the rain shadow of the Olympic Mountains, the Dungeness Valley receives only 16 inches of rain each year, very little of which falls in the late summer and early fall. The fertile Dungeness Valley has historically been a farming area and relies on irrigation from the Dungeness River. As one of the sunniest and driest places in western Washington, the Dungeness Valley has also attracted considerable population growth over the last twenty years. Much of this new growth relies on groundwater wells that are in hydraulic connectivity with surface water flows. The Dungeness River also supports four endangered species of salmon and steelhead.

Hydraulic Connectivity

These factors led the Washington State Department of Ecology to adopt a new water management rule in 2013 requiring mitigation for all new groundwater wells (WAC 173-518). This regulatory requirement precipitated the launch of the Dungeness Water Exchange, a groundwater mitigation program operated by the nonprofit, Washington Water Trust. This program generates mitigation credits by purchasing existing senior irrigation water rights and transferring them to instream flows and also by working with watershed partners to operate shallow aquifer recharge sites. The program sells mitigation certificates for a one-time fee to new water users, most of which are new homebuilders. Clallam County requires that mitigation be purchased prior to the issuance of a building permit. To date the Dungeness Water Exchange has issued mitigation certificates to over 200 new homes.

Mitigation Credits

Building Permits

For additional information about mitigation activities in the Dungeness basin, *see* Cronin, *TWR* #139 and Cronin & Fowler, *TWR* #102.

The Deschutes Groundwater Mitigation Program (Oregon)

The Deschutes River in Central Oregon rises from groundwater springs at the foot of the Cascade Mountains and flows approximately 250 miles north to the Columbia River. Due to the potential for groundwater pumping to interfere with state-designated Scenic Waterway flows in the Deschutes River, the State of Oregon stopped issuing new groundwater permit approvals in 1995 and created the Deschutes Groundwater Mitigation Program in 2002. The goal of the program is to offset the impacts of new groundwater withdrawals on flows within specific geographic areas in the basin (zones of impact) while accommodating new groundwater development. New groundwater permits are not granted by the state until the required mitigation is provided.

Scenic Waterway Flows

Mitigation obligations can be met by either temporary or permanent mitigation credits. These credits are developed by leasing and temporarily fallowing, or permanently purchasing and retiring, consumptive use irrigation and municipal water rights. If developers propose to use temporary mitigation, they are required to purchase two credits (each credit represents one acre-foot of water) for each acre-foot of mitigation need. According to the latest five-year review of the program in 2009, modeled streamflow for the Deschutes River below the city of Bend has improved by as much as 27 cubic feet per second due to mitigation actions. To date, 66 new groundwater permits have been issued under the program.

Temporary or Permanent Credits

For additional information about mitigation activities in the Deschutes basin, *see* Cronin & Fowler, *TWR* #102.

Charting a Course for the Verde River Exchange

In the Verde Valley, a small group of interested stakeholders considered whether groundwater mitigation might provide the framework for a *voluntary* system for reducing the impacts of groundwater pumping, despite the adaptations that would be required to adjust to the local context. The first step was to determine whether any "fatal flaws" might prevent success. A scoping study completed in 2013, with support from Environmental Defense Fund and the Walton Family Foundation, concluded that developing a groundwater mitigation program in the Verde Valley would be challenging, but that none of the challenges were fatal flaws. The primary hurdles identified by the scoping study were: (1) the lack of a regulatory framework to require new groundwater pumpers to purchase mitigation, meaning that (unlike prior similar systems) the program would rely on people and entities voluntarily purchasing mitigation to offset their impact to the Verde River — an issue of mitigation "demand"; and (2) the lack of adjudicated water rights in the area, making development of reliable mitigation "supply" projects potentially difficult. Each of these hurdles is discussed in some detail below.

Voluntary System

Hurdles

Groundwater Mitigation

Regulatory Structure

Reasonable Use

Demand for Mitigation in the Verde Valley: Developing A Voluntary Approach

The first major challenge identified in early feasibility analysis of the Exchange was the lack of a regulatory structure that requires or incentivizes mitigation for new groundwater pumping. Arizona is often heralded as having an innovative approach to managing groundwater — but this is true only for specified populated areas of the state. Arizona's Groundwater Management Act (GMA, 1980) created specific zones of the state around large population centers, called Active Management Areas (AMAs), where groundwater pumping is restricted and managed.

By contrast, outside of Arizona's AMAs, groundwater use is generally subject only to the doctrine of *reasonable use*: under Arizona statute, a landowner may withdraw and use groundwater for any "reasonable and beneficial use" (Ariz. Rev. Statutes § 45-453). The reasonable use doctrine in practice enables groundwater users to withdraw water even if the use interferes with a neighbor's pumping, or if it may eventually interfere with surface water rights. In Arizona, there is no priority or water rights system for groundwater outside of AMAs and there are no provisions that require pumping to be limited to the amount that can be reliably used in the long-term or that disallow pumping because of anticipated future reductions in streamflow. There is a legal category of water, called "subflow," that, while pumped from underground, is closely enough connected to the stream that it requires a surface water right (*see* decision in "*Southwest Cotton*"— cite below). But "subflow" has not yet been identified through Arizona's stream adjudications (discussed below) — so at present, this issue complicates rather than improves the situation. Without a statutory provision requiring or incentivizing groundwater mitigation, the Exchange must rely on generating voluntary demand for mitigation.

Non-Regulatory Incentives

Why anyone would voluntarily spend money on groundwater mitigation is a question the Exchange has faced from the start. Broad categories of non-regulatory incentives were identified by the scoping study and expanded on over time by Friends and the Exchange planning group.

Identified non-regulatory incentives include:

- Avoiding harm to others and/or the environment
- Using mitigation to increase future water security
- Obtaining a marketing benefit by advertising a water-dependent product as "water neutral" or otherwise using mitigation in marketing and promotion
- Ensuring water availability for future economic development

Sustainability & Marketing

Among these voluntary drivers of demand, the most promising prospect during planning phases was the potential for water-dependent businesses in the Verde Valley to purchase mitigation to demonstrate their commitment to sustainability and potentially obtain a marketing benefit. For example, the Verde Valley has a burgeoning vineyard and wine-making industry. Some vineyards irrigate with groundwater and these businesses seemed like natural first-movers in the groundwater mitigation market. Other businesses identified as possible early adopters for mitigation sales included small, locally owned hotels and other hospitality related businesses that use significant amounts of water. Many hotels already seek to advertise themselves as sustainable and so purchasing mitigation seemed like a natural fit for some of these businesses. In addition to vineyards and the hospitality industry, initial analyses also identified individual homeowners and small housing developments as potential targets for outreach. Because the Verde River is such an important feature of the local landscape and a place where many locals and tourists alike recreate, a desire to contribute to sustaining the river could motivate demand for mitigation from homeowners and developers.

Demand Drivers

While identifying several possible drivers of voluntary demand, early discussions about the Exchange also focused on whether and how to expand demand over time through other types of incentives. Therefore, in addition to the initial drivers described above, the question remains whether there may be potential for additional mechanisms to drive demand. For example, local jurisdictions such as counties and cities have authority over land use and other issues that intersect with water use, which these jurisdictions might be able to leverage to incentivize participation in a mitigation program. Similarly, local jurisdictions could potentially develop inter-jurisdictional infrastructure or other projects and offer access to the benefits of the projects on condition that users participate in the mitigation program. The extent to which local jurisdictions might be willing to explore these types of incentives and how they might be used alongside the more altruistic and community-based incentives relied on by the Exchange is a focus of current analysis and remains an open question. It is also a difficult question, and one that the Exchange and local jurisdictions need to approach thoughtfully, taking into account local needs, conditions, and potential risks.

One of the most critical determinants of success for both voluntary and quasi-regulatory incentives is the Exchange's ability to develop mitigation supply projects that fit both of the different demand models. The next section discusses mitigation supply in the Verde Valley with a focus on the difficulty of creating mitigation supply given the lack of adjudicated water rights in Arizona.

Groundwater Mitigation

Supply/Demand

Adjudicated Rights

Priority System

"Claimed" Rights

Uncertainty

"Sever and Transfer"

Aquifer Recharge & Reuse

Mitigation Supply in the Verde Valley: Working in an Unadjudicated System

Matching supply with demand is at the core of operations for any mitigation program. Supply meets demand by providing mitigation appropriately matched in quantity, location, timing, and duration. Generally, mitigation programs, including the Exchange, rely on reducing consumptive uses of water to generate mitigation supply. The logic is that reducing consumptive water use for mitigation can result in a net zero impact of a new consumptive use if the two are properly matched. Retiring or reducing an existing consumptive use through a water transaction is the most straightforward way to create mitigation credits.

However, water transactions are made difficult in Arizona due to a lack of *adjudicated water rights*. Water rights adjudication is the process of judicially settling all claims to the right to use water on an interconnected surface or groundwater system (or connected surface and groundwater system in states with "conjunctive management" of these resources). The result of an adjudication is that the quantity, location, type of use, location of points of diversion, and priority relationship of all water rights in a water source are fully "*decreed*" — i.e., finalized and certified by a court with governing jurisdiction. Water rights in the Verde Valley are not adjudicated, meaning that water right quantity, location, priority, etc. are subject to change when an adjudication is eventually finalized for the region.

Along the Verde River, as in most of Arizona, surface water rights are governed by the Prior Appropriation Doctrine. Before the passage of Arizona's Public Water Code, enacted in 1919, a surface water right could be established by putting water to a beneficial purpose, in combination with meeting various evolving requirements for providing notice. The Arizona Public Water Code required that a new surface water user apply for and obtain a permit from the state prior to diverting surface water (ADWR, "Surface Water"). Under current law, applications to divert surface water must be made with the Arizona Department of Water Resources (ADWR). ADWR will then issue a certificate of a water right after proof of the beneficial use is presented (Ariz. Rev. Statutes § 45-151 et seq.).

While it is possible to know how "claimed" water rights are being used currently and how they have been used in the past, only a final adjudication will permanently settle water rights on the Verde. In other words, water rights that are being relied upon today could eventually be found in an adjudication to not be valid or to be significantly different (perhaps allowing less water or a smaller place of use) than what is being claimed today.

The Verde River is part of the larger Gila River Adjudication, which includes over 38,000 parties and embraces vastly complex legal and hydrologic issues (ADWR, "Adjudications"). The adjudication proceedings have been ongoing for over forty years, and due to the complexity and size, it is unlikely that there will be significant resolution anytime soon. This uncertainty around water rights limits water management options and has resulted in little enforcement of surface water rights throughout the state.

The lack of adjudicated water rights means that — for the purposes of developing mitigation supply water transactions — water right quantity, validity, and relative priority can only be estimated. This circumstance vastly complicates these transactions. Groundwater mitigation programs in fully adjudicated water rights contexts often rely on changes of use of water rights to create mitigation supply. For example, in the Dungeness and Deschutes examples described above, temporary and permanent changes of use of irrigation water rights to instream water rights are two of the primary vehicles for developing mitigation supply. Arizona does have laws on the books that allow for these types of changes to water rights, at least on a permanent basis (called a *sever and transfer* under Arizona law [Ariz. Rev. Statutes § 45-172]). Yet, the lack of adjudication and resulting uncertainty is likely one reason that no sever and transfer applications for instream flow purposes have been approved in the state.

The Exchange and its partners, therefore, needed to identify transactional forms combined with water rights due diligence procedures (described below) that can be effective even within the uncertainties of an unadjudicated system. Initial scoping identified three broad categories of transactions that could generate supply for the Exchange. These categories include transactions involving: 1) surface water; 2) groundwater; and 3) reclaimed water — meaning that the Exchange can engage current surface, ground or reclaimed water users to alter their current water use so that a consumptive use benefit to stream flow results.

Given the physical (if not legal) interconnectivity between surface water and groundwater in the Verde Valley, temporary or permanent retirement, or forbearance of a surface water use or a groundwater use, could generate mitigation credits to offset groundwater use. Aquifer recharge is another possibility for generating mitigation credits. With careful use of existing groundwater science and by using water supplies that are currently being consumed, areas in the watershed could be identified where recharge would enhance stream flow in the Verde River or tributaries, and mitigation credits could be generated. Finally, reclaimed water from cities in the Verde Valley that is currently evaporated or consumed could also potentially be used — most likely as supply for aquifer recharge — to increase stream flows in the Verde.

The most promising transaction types identified for initially generating mitigation supply in the

Groundwater Mitigation

Forbearance

Verde Valley are temporary forbearance agreements or other water use agreements with irrigators. A forbearance agreement is a contract with a water rights holder to abstain from the use of all or portion of their water right for a given period. Forbearance agreements do not require state approval and thus lack any state regulatory backing for enforcement. Compliance with a forbearance agreement is measured by the performance of the water right holder (i.e., by temporarily ceasing irrigation on a specific number of acres). Forbearance agreements are often short-term and offer several key benefits to the landowner, including that any landowner can voluntarily enter an agreement with a private organization without going through an official administrative review. Another possible water user agreement option would be reducing consumptive irrigation use by switching to less water-intensive crops or "deficit irrigating" existing crops.

Group Forbearance

Forbearance agreements can also facilitate agreements among a group of water users to rotate the forbearance responsibility among several landowners to maintain the viability of agricultural operations. In some areas, including the middle Verde River, seasonally-timed short-term forbearance agreements or longer-term arrangements among a small group of water users can provide long-term benefits to streams, aquifers, or riparian habitat by supplying water during the hottest and driest time of the year.

As the Exchange has moved into pilot transactions, it has worked closely with the local chapter of The Nature Conservancy in developing supply. Prior to assisting the Exchange, the Conservancy has been working with farmers and others in the watershed to develop a robust and successful flow restoration program. This past success has been a major boon to the Exchange as the Conservancy has been able to assist the Exchange with developing mitigation supply for pilot projects.

Implementing and Managing the Verde River Exchange

Advisory Council

Early in the process of considering a groundwater mitigation program, a planning group was formed to consider first, the feasibility of forming a groundwater mitigation program and then later the design and strategy for the program. The planning group played a substantial role in determining the institutional design of the program as well as guiding initial outreach efforts. The planning group was eventually formalized as the Exchange Advisory Council (Advisory Council), with representatives from local and state conservation groups, local irrigators, local elected officials and municipal staff, and other community members and water experts. The Advisory Council provides overall strategic direction to the Exchange, weighs in on policy decisions, and guides and participates in outreach activities for the program. It is also responsible for reviewing mitigation supply projects before mitigation credits are created. Given the voluntary nature of the Exchange, the local and outside technical expertise gathered on both the initial planning group and the Advisory Council are critical to building a robust groundwater mitigation program with community buy-in.

Goals

The planning group identified one primary goal and two secondary goals for the Exchange. The primary long-term goal for the Exchange is to reduce the impact of groundwater pumping in the Verde Valley on the Verde River and its springs and tributaries. Secondary goals for the Exchange include indirect stream flow augmentation as well as piloting a new conjunctive water management strategy. The five-year vision statement for the Exchange is to develop "*[A] new model of locally driven groundwater management [that]sustains a vibrant regional economy and secures a healthy Verde River*."

Vision Statement

Values

Values of the exchange include:

- implementing actionable local solutions that work in the larger Arizona water rights and water politics picture
- respecting local economic, environmental, and social values
- preserving property rights and local water users' autonomy
- ensuring collaboration and shared stewardship among water users and community members from different sectors
- focusing on a positive, voluntary, and proactive approach
- addressing long-term challenges

Exchange policies and criteria also aim at:

- ensuring no net loss in hydrologic function
- entering into water use agreements only with willing participants
- avoiding impairment to senior water rights
- creating mitigation credits from water that has been beneficially used
- respecting ditch company rules
- operating consistently with land use requirements

In addition to broad strategic guidance, the Advisory Council has also helped develop and adopt specific policies for the pilot phase of the Exchange. These policies are meant to address the challenges and goals presented above, and to define how mitigation and impacts will be matched under the program. The next two sections briefly discuss key policies related to mitigation supply and mitigation buyers.

Groundwater Mitigation

Supply Projects Criteria

Criteria for Mitigation Supply Projects

As described above, mitigation supply projects involve making changes to existing surface or groundwater uses in order to reduce consumptive use and generate mitigation credits. Because there are currently not adjudicated water rights in the Verde Valley — and no water rights at all associated with groundwater use — evaluation of potential supply projects centers around the relevant water use, along with information related to any water rights claim.

There are three minimum criteria for mitigation supply projects in the pilot phase of the Verde River Exchange:

(1) the water use must be tied to a historic surface water use with a water rights filing and evidence of use prior to the Public Water Code of 1919 (though some groundwater users can be eligible);
(2) the water use must have demonstrable proof of beneficial use in three out of the last five years; and
(3) the use must be located in a "zone of impact" that matches mitigation demand.

If all these minimum requirements are met then the subject water right or groundwater use is eligible for further consideration in light of preferred and more detailed criteria.

Zone of Impact

To match the location of groundwater pumping with the location of mitigation, three zones of impact were established for the pilot phase of the Exchange (depicted in Figure 2 below). A buyer's pumping impact can be offset only by mitigation supply created in the same or an upstream zone of impact. So, for example, in Figure 2 below, an impact in Zone 3 can be offset by a project in either Zone 1 or 2, but the options for offsetting impacts in Zones 1 and 2 are more limited.

Due Diligence

First, an interested participant in a supply project is contacted and the surface water or groundwater use is identified as the basis of a potential and desirable pilot mitigation project. Then, due diligence on the water use and water right claim is conducted to verify the validity of the water use or water right claim. Due diligence related to the water use draws on available sources of information including legal parcel records, aerial photography, state water rights filings, and well registry records as well as landowner interviews and site visits.

Quantification

The Exchange policy also defines how mitigation credits (referred to as "Water Offset Credits") are quantified. Following the due diligence review, a consumptive use assessment based on a standardized estimate of crop irrigation requirements and irrigated acreage is completed to determine the annual volume of the credit. Estimates of consumptive use and impacts of groundwater pumping on local hydrology are necessarily inexact, even when studied thoroughly with the best science. To account for these uncertainties the Exchange uses a trading ratio of 1.25:1 for all mitigation projects. A trading ratio is simply the ratio of the mitigation required relative to the pumping being offset. Uncertainty or risk is addressed through using the trading ratio to provide insurance that the mitigation will be sufficient to the task.

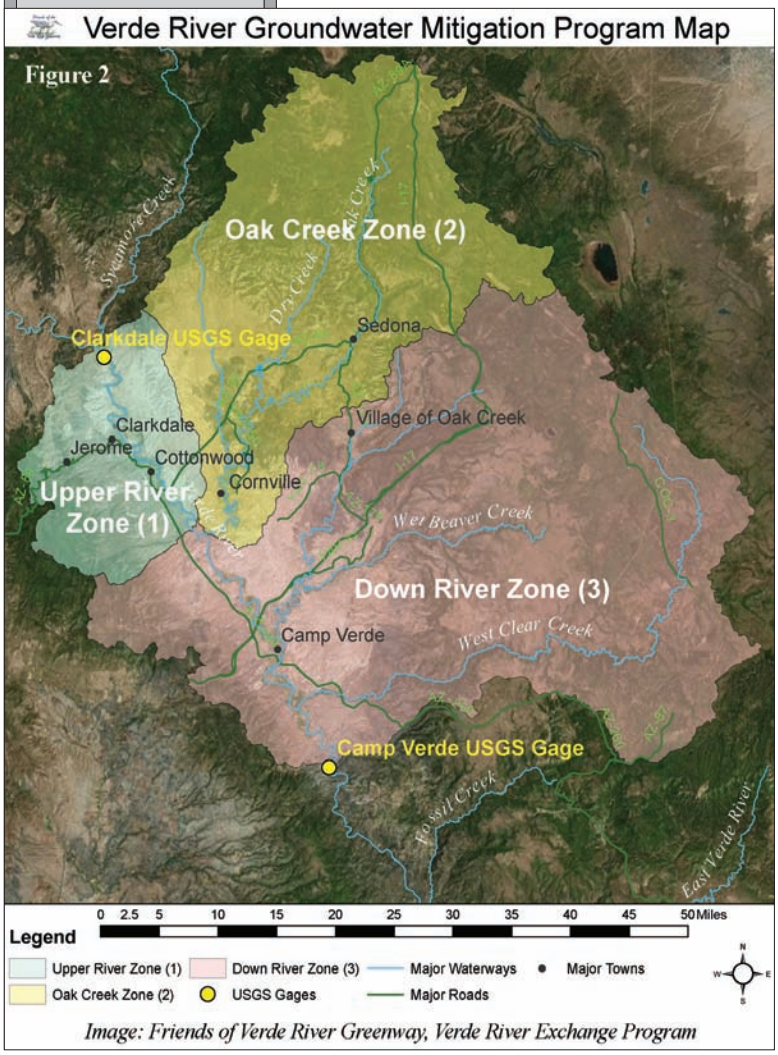

Image: Friends of Verde River Greenway, Verde River Exchange Program

Criteria for Mitigation Buyers

As discussed above, attracting buyers to a voluntary mitigation program was one of the biggest challenges identified in designing the Exchange. Exchange policy allows for irrigation, domestic, commercial, municipal, and new and existing groundwater users to participate in the program by purchasing credits (with only a few exceptions). The program is focused on groundwater users as buyers because surface water users are generally using water under a senior water right, whereas the impacts of (typically more recent) groundwater pumping are not regulated or managed.

The general requirement for buyers is that they have a groundwater use within the project area (the Verde Valley as depicted in Figure 2). If it is a new groundwater use it must be outside of the Holocene alluvium zone as mapped by the Arizona Geological Survey. This is a geologic zone physically close to the river and generally known to be in direct hydraulic connectivity with the Verde River — and which may in the future help to define the legal "subflow zone" in the watershed (*see* decision in *Gila IV— cite below*). Thus far, the Exchange has worked only with existing, rather than new, groundwater users.

Mitigation buyers purchase "Water Offset Credits" that represent an offset of water use for the calendar year

Groundwater Mitigation

in which the certificate is issued and may be renewed annually, contingent on available supply. The Exchange's Mitigation Policy provides guidelines for estimating the annual consumptive use of different types of likely mitigation buyers, in order to match the quantity of the groundwater use with the quantity of mitigation provided on an annual basis. (Mitigation buyers, however, may also choose to offset a portion of their water use.)

"Packages" Approach

In the future, the Exchange plans to offer alternative mitigation packages available only to individual domestic users and small businesses with minimal reliance on water as part of their operations or services. "Packages" are based on estimating an average amount of water use for a broad set of users. As mitigation sales increase, the package approach to selling mitigation to individual homeowners and an identified set of particularly low-water-use businesses is expected to make marketing, tracking, and administrative processing more straightforward than if, for example, each home purchased a distinct amount of mitigation.

Verde River Exchange Outreach

Attracting participants to the Exchange and generally raising awareness of the impact of groundwater pumping on surface water resources are both critical to the success of the Exchange. As the first program of its kind in Arizona, the Exchange focuses on broadly communicating its benefits to ensure that the program is well received in the community as a whole. Considerable effort has been put into general outreach including presentations at local group meetings and events, creation of paper marketing materials, a website, news releases, and organized events. For example, the Exchange held an end-of-year celebration in 2016 and showcased the first two mitigation buyers. Exchange press releases have led to coverage of the program in at least fourteen media outlets at the local, state, and national level. Generally, press coverage has been very positive, emphasizing the cooperative and voluntary nature of the program and its role in preserving a flowing Verde River. The Exchange also gained a statewide audience of water managers and experts when it was recognized as one of five finalists in the 2016 Arizona "Water Innovation Challenge" sponsored by the Arizona Community Foundation, Republic Media, and Arizona State University's Morrison Institute for Public Policy.

Pilot Projects

Vineyard Pilot Projects

The Exchange was formally launched in 2016 with the implementation and announcement of two small pilot projects. Two prominent vineyards in the Verde Valley agreed to purchase newly created Water Offset Credits to help mitigate the impact of their groundwater use on the Verde River. Both businesses use groundwater to grow grapes in their vineyards close to the banks of Oak Creek, a major tributary to the Verde. Both vineyard owners are interested in the long-term sustainability of their operations and the region, and in demonstrating that the Verde Valley's burgeoning wine industry can be compatible with, and supportive of, that sustainability. Each enterprize also derives value from visitors who are attracted to the Verde Valley in part because of the beauty and feel of its desert river and streams. Each vineyard owner is a community business leader interested in helping advance innovative and collaborative solutions to long-term challenges. The two vineyards thus agreed to be "first adopters" to help pave the way for the Exchange by participating in the new program.

Water Offset Credits

Each of the two initial Exchange pilot projects involved the purchase of Water Offset Credits to mitigate the impacts of groundwater use associated with about 4.5 acres of vineyard during the calendar year in 2016. Credits were created when a nearby family agreed to temporarily fallow pasture acreage that had recently and historically been irrigated with water from Oak Creek, thus reducing the "draw" on the system. Based on its program criteria and procedures, the Exchange estimated the reduced consumptive use of irrigation water associated with the forbearance agreement and recorded this volume of water as Water Offset Credits, which were then purchased by the vineyards. A neutral third-party, Bonneville Environmental Foundation (BEF), provided third-party review of the supply project to ensure consistency with program criteria, and the credits were tracked via an internal Exchange registry. BEF is a leader in the field of voluntary water offset actions and provided critical support to the Exchange through their advice and review. The Nature Conservancy monitored the supply project to ensure compliance with the temporary fallowing agreement.

Fallowing

Next Steps

Expanding Program

Upon completion of the initial pilot projects, the Exchange completed a strategic planning process to guide next steps in refining the program and expanding its reach and impact. The strategic plan contemplates expanding participation in the program on the part of both buyers and those who partner with the program to create supply. As of this writing (July 2017), the Exchange is finalizing and preparing to announce additional pilot projects representing purchase of 2017 Water Offset Credits by a more diverse set of Verde Valley businesses, and in a wider range of locations within the project area. The Exchange is also diversifying the methods for generating Water Offset Credits, looking into options for supply projects ranging from crop conversion to recharge projects. Eventually the Exchange would like to pursue mitigation projects that last longer than a year, and that put a larger volume of water back into the system. At the same time, the team is exploring options for small, standardized "packages" for purchase by residential and other small water users, and working with BEF and other partners to investigate the possibility of registering credits on a national registry.

Groundwater Mitigation

Awareness

Incentives

Expanding the reach of the program includes exploring technical, legal, and political aspects of possible new mechanisms, but it also includes expanding understanding of the program and its benefits within the community. To this end, the Exchange is reaching out to businesses, residents, elected leaders, and others within the Verde Valley to broaden the dialogue about both the offset mechanism and the long-term challenges it is meant to help address.

Finally, the advisory council is embarking on its investigation of new incentives that could help encourage and facilitate broad participation in a mitigation program. This investigation includes initiating a dialogue with local jurisdictions about how offset mechanisms might be further incorporated into local planning and development processes. Ultimately, it is hoped that the Exchange will be able to continue to work with Verde Valley water users of all sectors to put real water back into the Verde River system. The Exchange intends to raise the profile and understanding of the long-term issues facing this watershed and others like it, and is beginning to craft pieces of a locally grown solution that could both sustain the river and allow the area to grow, develop, and thrive. As the program grows, it is expected that local stakeholders will continue to contribute resources and creative energy to advancing innovations and collaboration in the watershed. The Exchange has been built with careful attention to innovations that have been tested elsewhere — and at the same time is offered as a new tool to be considered in ongoing discussions of the fate of the Verde River, the communities that depend on it, and that of other similarly situated watersheds.

To follow the progress of the Verde River Exchange, visit the program website at www.verderiverexchange.org.

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Water Project Integration

High Value Resource

Range of Uses

Demand Timing

Conflicts

INTEGRATED WATER PROJECT DEVELOPMENT

DIVERSE GROUPS SET ASIDE DIFFERENCES TO IMPROVE CONDITIONS IN THE ICICLE CREEK BASIN

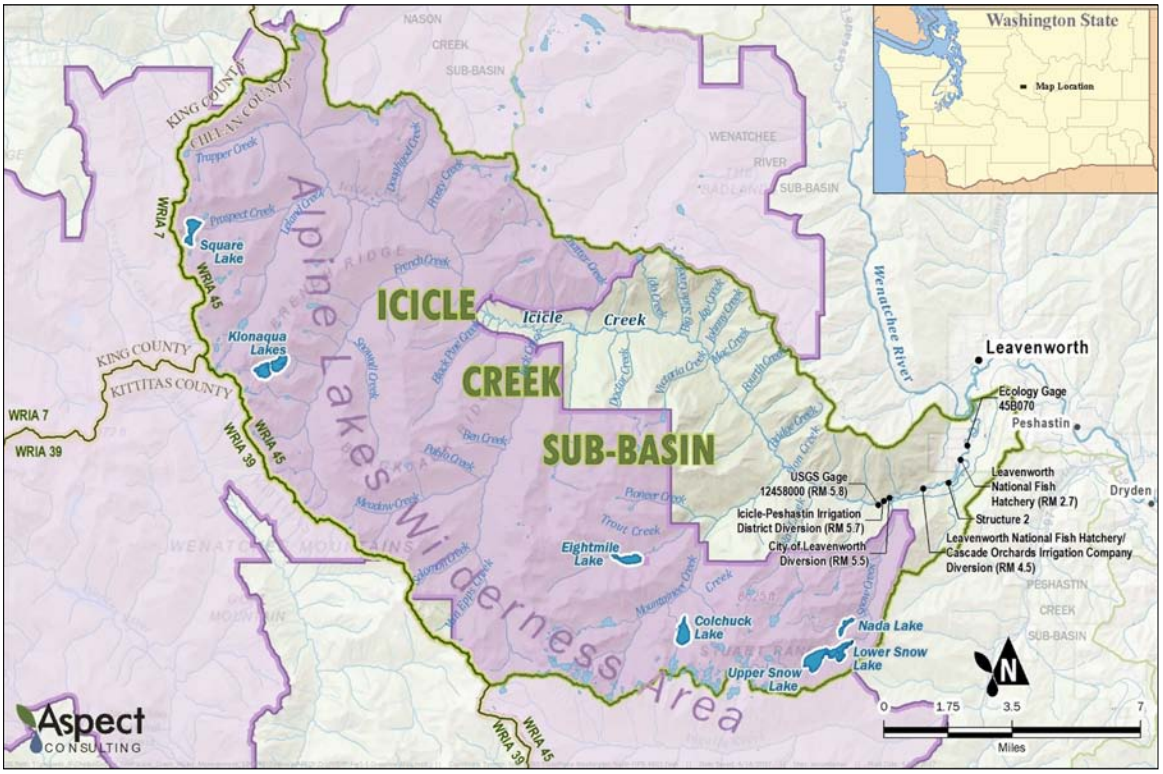
by Mike Kaputa, Director, Chelan County Natural Resources Department (Wenatchee, WA)

Introduction

The Icicle Creek basin encompasses an area approximately 212 square miles northwest of the City of Leavenworth in central Washington State. This makes it the largest sub-watershed in Water Resource Inventory Area 45 (WRIA 45), contributing 20% of the Wenatchee River's annual flow. The area has high aesthetic, recreational, and environmental value because much of the land coverage resides on undeveloped land in the Alpine Lakes Wilderness and the Wenatchee National Forest. The Icicle Creek basin brings life to the local economies by providing the primary water source to the City of Leavenworth, which is a nationally renowned tourist destination, and to the Icicle-Peshastin Irrigation District (IPID), which supplies water to the agricultural base along the Wenatchee River Valley from Leavenworth to the City of Wenatchee. The Icicle Creek basin also sustains life for aquatic resources — namely anadromous fish species such as Chinook, Coho, and Steelhead — which utilize instream flows for rearing and spawning habitat. These fish are an important cultural resource for the regional First Nations of the Colville Confederated Tribes and Yakama Nation.

Because flows from Icicle Creek support a broad range of local and regional demands — from domestic water supply to agricultural irrigation to habitat for anadromous fish species — a diverse set of stakeholders is affected by the relative health of this watershed. Like many watersheds in central and eastern Washington, balancing available supplies with demands is not necessarily a matter of overall quantity. Rather, it is a matter of the timing of supplies relative to the timing of demands. Significant excess supplies exist for a relatively short window in the spring and early summer months during the freshet period. However, a significant deficit of supplies develops later in the year during late summer / early fall — just when returning salmon are looking to spawn. This imbalance, specifically with the late summer instream supply shortage, has resulted in significant conflict between stakeholders. Resolutions are needed.

An unusual challenge with the Icicle Creek basin is related to the types of conflicts. While instream vs. out-of-stream conflicts exist in many basins, the Icicle Creek basin also has conflicts related to different fish proponents (e.g. native fish vs. hatchery fish), and diverging environmental interests (e.g. instream flow interest vs. wilderness interest). This makes arriving at solutions even more difficult in that not all costs are viewed as monetary and not all stakeholders place the same value on the same benefits — whether the benefits be instream or out-of-stream.



Water Project Integration

Historic Development

Hatchery v. Wild Fish

Municipal Rights

Late Summer Competition

Instream Flows

Long-Standing Conflicts Over Water

The conflicts between Icicle Creek basin stakeholders are very real and long-standing. Early economic development in this region depended on agriculture. As a result, major water resources infrastructure were built in Icicle Creek and high in the Alpine Lakes region decades before the area was designated as wilderness by the federal government in 1976. National economic factors led to the construction of Grand Coulee Dam, which blocked salmon migration along the uppermost reaches of the Columbia River. This fisheries impact was addressed by the construction and operation of the Leavenworth National Fish Hatchery (LNFH) in the late 1930s. LNFH now produces 1.2 million smolts annually. A small fraction of these smolts later return as adult chinook salmon to repeat the species' lifecycle. Not everyone agrees that this practice is best, because hatchery-raised fish compete for limited instream resources with native-born populations of fish. The hatchery site is also a historical Tribal fishing ground, where each year the Yakama Nation and Colville Confederated Tribes catch fish as they have done since time immemorial. This makes the returning hatchery fish critical for Tribal sustenance. The disagreement between hatchery and wild fish is so deep that it is the subject of both prior and ongoing litigation, such as *Wild Fish Conservancy v. Salazar et al.*, 628 F.3d 513 (9th Cir. 2010), *Wild Fish Conservancy v. Irving et al*., 221 F. Supp. 3d 1224 (E.D. Wash. 2016), *Wild Fish Conservancy v. Washington State Department of Ecology*, No. P10-019 (Wash. Pollution Control Hearings Bd., July 11, 2016), and *Center for Environmental Law and Policy v. United States Fish and Wildlife Service*, No. 2:15-CV-0264-SMJ, 2017 WL 1731706 (E.D. Wash. May 3, 2017).

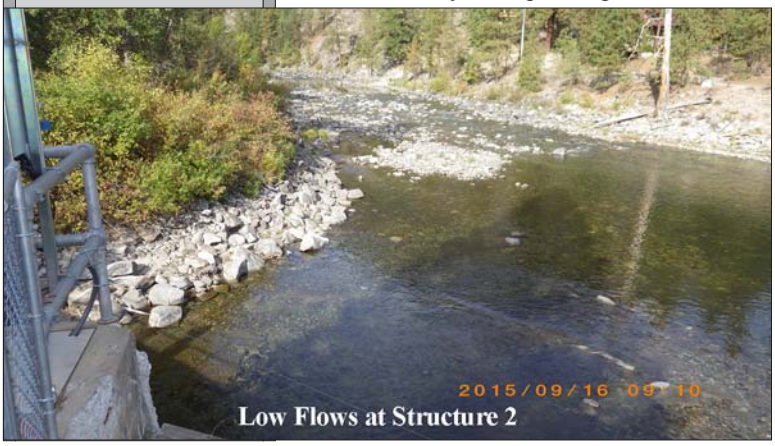
Current conflicts are not limited to fish. Over the years, the City of Leavenworth has transitioned from a rail town to a bustling top tourist destination with close to two million visitors each year. While domestic supplies for the City represent a tiny fraction of overall water demand, that use is none-the-less contentious. The magnitude of the City's diversionary right from Icicle Creek has also been the subject of litigation. In 2012, the Chelan County Superior Court ruled in favor of the Washington State Department of Ecology (defendant) against the City of Leavenworth (plaintiff), in *City of Leavenworth vs. Department of Ecology*, No. 09-2-00748-3 (Chelan Cnty. Super. Ct. Dec. 19, 2011), limiting the determination of the City's annual quantity to 275acre-feet per year. The City contends that their annual quantity should be much higher (1,085 acre feet per year) based on year-round continuous diversion. The City has appealed this decision. Currently, this case is on hold in hopes that a coordinated effort between stakeholders may arrive at better solutions.

Demands on the System and Current Challenges

Notwithstanding legal disagreements for water supplies, various water appropriations (water rights) place significant stress on the system because all users compete for water at the same time. Irrigators, fish, domestic users, and hatchery fish targets all need precious late summer water. Climate change has the potential to create additional shortages for all of these users. The following subsections discuss some of the specific challenges in the Icicle Creek basin.

Instream Flows

Instream flows are an important component of the Icicle Creek basin's water budget. Adequate instream flows contribute to healthy aquatic and riparian ecosystems, protection of federal Endangered Species Act (ESA) listed fish species, water quality, aesthetics, and recreation. Instream flow protection has been promoted through instream flow rules and watershed planning initiatives, with high importance assigned to improving habitat for salmonids. However, instream flows in late summer often drop below those set in Washington Administrative Code (WAC) 173-545-040. That rule sets minimum flows in the lower reaches of Icicle Creek at 275 **c**ubic **f**eet per **s**econd (cfs), but in drought years flow can be as low as 20 cfs in the historical channel near the LNFH. These low stream flows affect water quality and limit habitat diversity for aquatic species, and have contributed to exceedances of state and federal standards for temperature. Icicle Creek supports three ESA-listed species: Upper Columbia spring Chinook salmon, Steelhead, and bull trout. The picture below shows the low flow of 35.7 cfs during the 2015 drought at LNFH Structure 2, which is the start of the natural channel reach of Icicle Creek adjacent to the Hatchery.



Low Flows at Structure 2

Leavenworth National Fish Hatchery

The US Bureau of Reclamation (Reclamation) funds the operation and maintenance of LNFH as mitigation for fish losses resulting from the construction of Grand Coulee Dam and creation of the Columbia Basin Project. LNFH is operated by the US Fish and Wildlife Service (USFWS) on behalf of Reclamation. Water supply to the hatchery is from a combination of Icicle Creek surface water flows and

Water Project Integration

Hatchery Production

groundwater, with reservoir storage (Snow Lakes and Nada Lake) located in the Alpine Lakes Wilderness Area. To ensure production goals of 1.2 million fish are met, LNFH needs a reliable supply of cool, pathogen-free water year-round. Such supply is not always possible. Nor is meeting fish production targets. The situation is also getting worse because of climate change. In the 2015 drought, LNFH had to euthanize fish and move others to offsite acclimation facilities due to warm temperatures and water-borne disease that threatened to critically disrupt hatchery operations.

Tribal and Non-Tribal Harvest

The Yakama Nation and Colville Confederated Tribes have harvest rights in lower Icicle Creek, as stated in the Yakama Treaty of 1855, Article 10.

Adult spring-run Chinook salmon return to LNFH between mid-April and mid-July each year. A Tribal fishery is permitted during this time if run size is large enough to both meet the hatchery broodstock goal of ~1,200 spawners and provide fish in excess of hatchery needs. The broodstock goal is a function of the hatchery's obligation under *U.S. v. Oregon*, 302 F. Supp. 899 (D. Or. 1969) to produce 1.2 million juvenile spring Chinook salmon.

Tribal Fishing

The success of the Tribal fishery is dependent on the concentration of returning adult salmon in the pool at the base of the fish ladder. This is the location where the majority of Tribal fishing currently occurs with Tribal members using traditional dipnets, or modern rod-and-reel, from scaffolds erected along the streambank. Tribal fish harvest has declined considerably since 2001. Based on data provided by Yakama Nation Fisheries (Table 1 below is from Steven Parker from Yakama Nation Fisheries, sent November 28, 2016), Tribal spring Chinook harvest between 2001 and 2014 has decreased by 90%, going from 5,075 fish harvested to 547. This decline has been consistent over this period.

Domestic Uses and Municipal Supply

Growth Outpaces Rights

Icicle Creek and groundwater in the Icicle Creek basin are important water sources for municipal and domestic uses. According to the 2010 US Census, the City of Leavenworth has a population of ~2,000, but it is also an internationally renowned tourist destination that attracts nearly two million visitors each year. The City has water rights to withdraw 1.5 cfs from Icicle Creek and 2.2 cfs from groundwater for municipal use. However, these water rights are not sufficient to support population projections out to 2050. Based on growth rates set by the City of Leavenworth Water System Plan and the Wenatchee Watershed Assessment, it is predicted that by 2050 there will be 199 new homes outside the Urban Growth Boundary in the Icicle Creek basin, and 2,546 more **e**quivalent **r**esidential **u**nits (ERUs) within the Urban Growth Boundary. Because this area is so heavy with recreation and tourism, the projected demand was based on ERUs rather than population.

Icicle Creek Spring Chinook Fishery

Return Year	Trapped @ Hatchery	Sport Harvest	YN Harvest	CCT Harvest	Percent Tribal Harvest	Remaining in River	Total Run
1999	2,103	108	175		7.2	45	2,431
2000	4,457	1,606	3,238		34.2	163	9,464
2001	6,259	2,260	5,075		33.6	1,488	15,082
2002	6,459	1,201	3,796		30.9	828	12,284
2003	4,825	935	1,852		22.7	549	8,161
2004	2,308	347	863		23.1	214	3,732
2005	2,560	103	1,063		28.0	67	3,793
2006	1,957	529	588		18.7	73	3,147
2007	1,708	115	751		28.6	48	2,622
2008	3,229	347	1,036		21.2	283	4,895
2009	3,232	640	617	210	13.2	195	4,684
2010	11,307	993	683	310	5.2	237	13,220
2011	4,970	873	233	365	3.8	77	6,153
2012	3,749	971	287	123	5.6	131	5,138
2013	2,094	323	42		1.6	134	2,593
2014	4,375	TBD	547		10.4	357	5,279

Note – all fish are of hatchery origin
YN = Yakama Nation; CCT = Colville Confederated Tribes
Blank boxes represent absence of data

Agricultural Reliability

Agriculture is a crucial component of the Chelan County economy. In 2012, over 75,000 acres were in agricultural production, generating $206,000,000 in market value for the County. The waters of the Icicle Creek basin play an important role in this agricultural production by providing water to IPID and Cascade Orchard Irrigation Company (COIC), which supply water to nearly 9,000 acres. In total, 129 cfs of irrigation diversions are authorized from Icicle Creek.

IPID manages five lakes — Square, Klonaqua, Colchuck, Eightmile and Snow — in the Icicle Creek basin to supplement water supplies during drought years. These lakes include manmade infrastructure that was built in the 1920s through the 1950s to allow for additional storage and release of water within the Icicle Creek basin to offset their diversions from the creek itself. In drought years, storage from all the lakes is used to provide water to IPID. In non-drought years, the district drains one lake rotationally for maintenance activities.

Despite the importance of agriculture and irrigation, there is not enough water to supply all of the irrigation demand. In the Icicle Creek basin and Wenatchee River Watershed, there are approximately 38 water rights that can be curtailed based on low streamflow. On average, these water users face curtailment in at least 7 out of every 10 years.

Water Project Integration

Salmonid Habitat

Habitat

The Upper Columbia Revised Biological Strategy (Biological Strategy) identifies the following factors affecting habitat conditions for ESA-listed salmonids in Icicle Creek:

- Land development downstream of LNFH has affected stream channel migration, recruitment of large wood, and off-channel habitat.
- There is a barrier to migration in the boulder field.
- Water withdrawals in Icicle Creek (primarily between Rat Creek and LNFH) likely contribute to low flows and high temperatures.
- The Icicle Road upstream of Chatter Creek may confine the stream channel and affect floodplain function in certain places.

Additional passage barriers exist at the hatchery, which are used for operation, including water management, broodstock collection, and Tribal fishery maintenance. Biological Strategy: *See* RTT (Regional Technical Team). 2014. *A Biological Strategy to Protect and Restore Salmonid Habitat in the Upper Columbia Region. A Draft Report to the Upper Columbia Salmon Recovery Board*.

Integrated Strategy

Working for Solutions: The Icicle Work Group

These problems have created a critical need to improve conditions in the Icicle Creek basin and ensure that reliable water resources for fish, agriculture, and domestic water users are available. Over the last five years, it has become clear that an integrated strategy is needed to address ecological and usage issues while considering the potential climate impacts, and ensuring all actions comply with state and federal law. Fortunately, a group is currently working to do just that.

Work Group Formation

Finding common ground among conflicting parties and agreeing on a strategy is what Chelan County and over a dozen stakeholders in the Icicle Creek basin set out to do in 2012 with the formation of the Icicle Work Group. Co-led by the Washington State Department of Ecology's (Ecology's) Office of Columbia River (OCR) and Chelan County, and funded largely by Washington state funding sources, the IWG represents local, state, and federal agencies, Tribes, irrigation and agricultural interests, and environmental organizations. All these parties convened to develop solutions to chronic water supply problems affecting families, farms, and fish in the Icicle Creek basin. Each stakeholder has had a voice in the formation of the guiding principles, which if followed, will ensure that individual stakeholder needs will be met.

Members

Icicle Creek Work Group Members:

Cascade Orchard Irrigation Company
Chelan County
City of Leavenworth
City of Cashmere
Confederated Tribes of the Colville Reservation
Confederated Tribes of the Yakama Indian Nation
Icicle and Peshastin Irrigation District
Icicle Creek Watershed Council
National Oceanic and Atmospheric Administration Fisheries
Trout Unlimited – Washington Water Project
US Bureau of Reclamation
US Fish and Wildlife Service – Leavenworth National Fish Hatchery
US Forest Service
Washington State Department of Ecology
Washington State Department of Fish and Wildlife
Washington Water Trust

Diverse Interests

Historically, it is rare to get diverse fish proponents in the same room with hatchery managers to brainstorm common solutions. One would also not expect to see the City of Leavenworth on the same side of the table as Ecology on water matters, since the two have been at odds over the extent of the City's diversionary right from the Icicle Creek. Building trust between senior irrigators and instream flow advocates is challenging. What unites these strange bedfellows is the simple need for more water for everyone — particularly during the driest times of the year when streamflows are at their lowest, crop demand is at their highest, and anadromous species are preparing to spawn. There is a shared realization that they can accomplish more by working together than by litigating separately.

Compromise Benefits

This is no small task, and it requires everyone to give a little to get a little. For example, IPID holds senior diversionary rights, whose demands at times may seem to dwarf the remaining flows left instream for other demands. IPID's presence alone is so significant that improvements to their infrastructure may yield the most benefit to instream flows. In exchange for improvements that reduce their long-term cost and improve reliably, they have expressed a willingness to reduce their diversions or re-organize their storage facilities' operations. Similarly, LNFH has experienced temperature and pathogen problems, which they can resolve by transitioning to greater reliance on groundwater and installing additional conservation and reuse practices, which will leave more water instream. At the end of the day, compromising to find ways to increase supply, reduce diversions, and better utilize diverted water is the name of the game. The IWG members are putting aside their differences, knowing that the sum here is greater than its parts.

Water Project Integration

Icicle Strategy

Guiding Principles

The IWG's Guiding Principles

This diverse group developed a common set of goals to work towards for Icicle Creek basin's overall benefit. Their cooperative efforts, known as the Icicle Strategy, resulted in formal Guiding Principles to best outline and address the area's most chronic and dire water supply needs. These principles (see table below) include: setting specific targets for increased flows in sensitive reaches; clearly defining the need for coexistence between native and hatchery fish populations through improved habitat and sustainable hatchery function; and identifying obligations to Tribal treaty rights and local, state, and federal laws.

Guiding Principle	Metric	
Improve Instream Flows	Icicle Creek Historic Channel: • 60 cfs minimum flows (drought years) • 100 cfs minimum flows (non-drought years), short-term goal • 250 cfs minimum flows (non-drought years), long-term goal • 2,600 cfs maximum flow to preserve habitat function	Flow improvement needed (in projects) to meet total minimum flows: 40 cfs[1]
Improve sustainability of LNFH	• Meet *U.S. v. Oregon* and other agreements specifying fish production requirements • 57 cfs supply protected long-term (at least 20 cfs conservation goal) • Diverse source availability (temperature, pathogen-free) to maximize fish health • Structures minimize unintended fish passage impediments	
Protect Tribal and Non-Tribal harvest	• Catch per unit of effort (CPUE) improved • Maintain multi-species harvest opportunities • Tribal Impacts Assessment and Adaptive Management Plan being implemented, addressing attraction flows, sediment transport, fish migration/straying, site access and amenities	
Improve Domestic Supply	• 1,750 acre-feet of reliable year-round supply (2.5 cfs average, 5 cfs peak)	
Improve Agricultural Reliability	• Automate / Optimize Alpine Lakes Reservoirs for improved reliability (plus instream flow benefit) • Restore/repair Eightmile Lake Reservoir up to 2,500 acre-feet (1,125 ac-ft additional instream flow/domestic benefit) • Current interruptible agricultural users have firm supply in average water years / agriculture water bank (2 to 4 cfs)	
Enhance Icicle Creek Habitat	• Improve passage in Icicle Creek including to Upper Icicle Creek • Make investments in physical habitat improvement with consideration for high flow habitat and low flow refuge, minimize fish passage impediments, and improve limiting factor spawning/rearing • Offset project-related terrestrial impacts with land acquisition/easements	
Comply with State and Federal Law, and Wilderness Acts	• Identify and engage regulators in the process • Environmental review completed (project check) • All projects appropriately permittable (project check) • All diversions (LNFH, IPID, COIC) appropriately screened (project check)	

[1]Based on a review of historic stream gage records, the existing average low flow in historic channel in non-drought years is 65 cfs (16 of the most recent 20 years) and average drought low flows is 20 cfs (2001, 2003, 2005, 2015). To meet Guiding Principle flow targets, approximately 40 cfs in project flow benefit is needed.

Potential Solutions

Prior the formation of the Icicle Work Group (IWG) and its associated Icicle Strategy, each stakeholder had been developing projects that only met their own individual needs. This created problems getting projects completed because each lacked broad local support, faced funding challenges, and often were up against opposition from other local stakeholders because individual goals conflicted.

Project List

One of the IWG's first exercises was to assemble a master project list based on:

- Conceptual ideas by its members
- Projects identified in the Wenatchee Watershed Plan (a larger watershed scale plan approved in 2006)
- Projects already waiting in various funding program queues
- Projects in active appraisal or feasibility studies.

In the first few months of the IWG (e.g., early 2013), over 60 potential projects had been identified that could assist in meeting the Guiding Principles.

Screening Evaluation

Following identification of potential projects, and concurrent with their efforts to put numeric standards to the qualitative Guiding Principles, the IWG developed a screening evaluation for the projects. This method included considering factors such as project benefits and costs and water right pedigree (which includes a right's reliability, priority date, and federal or state origination). Then the IWG went through several iterative exercises where projects were aggregated to meet the Guiding Principles and provided a range of options based on the above listed factors. Only then were they advanced for consideration.

PEIS

Since the formation of the IWG, a suite of projects has survived and have progressed to varying degrees (conceptual, appraisal, and feasibility). These projects were then offered to the public during environmental scoping of a Programmatic Environmental Impact Statement (PEIS). The PEIS process began in early 2016, and as of the date of this article, is the subject of a public comment period on the draft PEIS. Description of some of the projects being considered in the draft PEIS are now presented.

Water Project Integration

Irrigation Upgrade

Conservation Projects - Irrigation System: Saving water can have as meaningful an impact as generating new supplies, and irrigators are continually working on ways to limit losses from their seepage. Projects explored as part of the Icicle Strategy include piping and lining of IPID and COIC canals. On-farm efficiency upgrades such as soil-moisture sensors and micro-spray emitters are also being explored, along with reductions in operational spill through the use of re-regulation reservoirs. These improvements will conserve water while benefiting fish by increasing streamflow.

Supply Efficiency

Conservation Projects - Domestic Systems: These projects focus on technical assistance to conserve domestic water supply for the City of Leavenworth and Chelan County. These efforts implement municipal and rural water efficiency projects such as replacing aging pipes, leak detection and repair, meter installation, and water use conservation to improve domestic supply. The goal, in concert with the other projects, is to create enough water to sustain the City and County through 2050.

Hatchery Improvements

Leavenworth National Fish Hatchery Conservation & Water Quality Improvements: The IWG has proposed several projects to improve LNFH water supply and reliability and to enhance Tribal and recreational fish harvest:

Hatchery Conservation — Install recirculating tanks, which use about half as much water as conventional raceways and thereby benefit instream flows. Engage projects to offset some of the surface water use by improving access to groundwater.

Groundwater Augmentation — Restore diminished groundwater supply through new well construction to meet temperature and pathogen standards.

Effluent Pumpback — Hatchery effluent water to augment groundwater supply and instream flows.

Automated Controls

Alpine Lakes Reservoirs Optimization, Modernization, and Automation: One effort with large instream flow benefits is the Alpine Lakes Release Optimization Project. This project involves releasing more water for fish from the Alpine Lakes reservoirs operated by IPID instead of holding it in reserve for long-term irrigation drought relief. The project aims to upgrade existing irrigation infrastructure operated by IPID and USFWS in the Alpine Lakes Wilderness area by modernizing and automating up to seven existing lakes that are operated as reservoirs. To do this, engineers are working to design automated controls that can remotely adjust release from the lakes in response to low flow levels in Icicle Creek. This contrasts with the current operation, which releases water manually and only when irrigators need it during drought years. All water supplied by the project benefits instream flow. Meanwhile, IPID improves its ability to remotely manage a large number of sites that are difficult to access,while preserving the water for their orchardists during critical drought years.

Wilderness Concerns

The challenge with this project is the concern over impacts to the Alpine Lakes Wilderness Area where the reservoirs are located. At the time of its creation in 1976, IPID and Reclamation retained property or easements to the reservoirs, which allows for their perpetual use and operation. Proponents of the Wilderness Area would rather not see these improvements be made and in the long-term want to see the reservoir infrastructure removed in its entirety. Beyond the short-term construction impacts (e.g. solar panels, telemetry to remotely operate gates), re-operation of the lakes means visitors will experience something different — namely lower lake levels in the late summer when water that used to be left in the lake to hedge against irrigator drought risk will now be released for fish.

Water Bank

Eightmile Lake Restoration Project: This project aims to restore Eightmile Lake Reservoir to its historic high water mark. Damage at the dam has limited its full capacity for many years. The project would improve instream flow and agricultural reliability, and provide domestic supply benefits. To do this, the Eightmile Lake Dam would be rebuilt and 900 acre-feet of the restored supply would be used to form a water bank that could be debited to offset population growth through 2050 for the City of Leavenworth and surrounding rural areas in Chelan County. As another project located in the Wilderness Area and as a reservoir (as opposed to conservation), this project has also received significant scrutiny as to its merits and potential impacts.

Source Exchange

Source Exchange: Two major source exchange projects are being considered in the PEIS which will reduce or eliminate major diversions from Icicle Creek. COIC is looking at ways to divert their water further downstream on the Wenatchee River through pumps rather than draw from Icicle Creek. Under this model, Icicle Creek is used to convey water downstream to a new surface water pump station. The PEIS also considers a partial pumpback scenario for IPID, which would divert a portion of their Icicle and Peshastin Creek diversions from the Wenatchee River instead. The drawback of these projects is the added pumping cost required to lift the water back to the original canal. Since these projects would be dedicated for fish only (no new irrigated acres), it is challenging to find adequate long-term funding for pumping, operation, and maintenance costs.

Agricultural Reliability

Water Markets: Under this project, the IWG would create a voluntary Icicle Water Market to improve reliability for agriculture use in the Icicle Creek basin and Wenatchee River Watershed during shortages. The water market would be seeded with an initial 1,000 acre-feet of senior water rights.

Restoration

Habitat Protection and Enhancement: Restoring, improving, and protecting habitat throughout the Icicle Creek basin for fish and wildlife is key to the IWG's work. To help achieve this, they have identified stream restoration and protection projects such as riparian plantings, engineered log jams, and conservation easements to improve stream habitat and ecosystem health.

Water Project Integration

Tribal Fishery

Fish Passage: The IWG has proposed several projects to improve fish passage in Icicle Creek by assessing and removing barriers so fish have better access to healthy habitats. These include improved operation at LNFH's Structure 2 and modification of channel morphology at the Boulder Field.

Protect Tribal Fishery: This project ensures other proposed IWG projects do not have negative effects on Tribal fisheries and federally protected harvest rights. To accomplish this, IWG will develop an adaptive plan that includes an assessment of flow and channel morphology at current fishing locations. This plan will develop alternatives for attraction and retention of fish in Tribal fishing areas during the harvest periods that are coordinated with changing operations at LNFH and increased flow. Additionally, the plan will include monitoring fishery effectiveness as a key project component.

Fish Screen Upgrades

Fish Screen Compliance: The LNFH, City of Leavenworth, and IPID each have a large diversion on Icicle Creek with screens that do not meet current requirements. The IWG is proposing to upgrade these screens to comply with Washington State and federal laws (see Revised Code of Washington (RCW) 77.57.070 and WAC 220-660) and help LNFH meet screening requirements set in the Biological Opinion. These screening projects will help decrease fish mortality in Icicle Creek.

Instream Reservation

Instream Flow Rule Amendment: Within the Wenatchee River Instream Flow Rule (WAC 173-545), a reservation of water was established for future domestic use in the Icicle Creek basin. Currently, the reserve is set at 0.1 cfs, but the rule allowed an increase to 0.5 cfs in the Icicle Creek basin if low flows in Icicle Creek were addressed. This will help meet domestic water needs for Chelan County through 2050. Coupling this rule amendment with the flow improvement and habitat projects would fulfill the expanded reservation provision requirements.

Increased Storage

Enhanced Storage in Alpine Lakes: Another alternative in the PEIS evaluates the opportunity to increase storage at existing lakes (e.g. raise Eightmile Lake and Upper Snow Lake to higher water levels) and create new storage at Upper Klonaqua Lake (current storage is only in Lower Klonaqua Lake). The majority of this water would be used for further instream flow benefits, with some additional supplies for domestic use longevity. Since this would create the most construction-related impacts in the Wilderness Area, these alternatives have been highly scrutinized and criticized by wilderness supporters.

Alternatives

Many Ways to Achieve the Goal

The IWG understood that there is no one project that will fix all of Icicle Creek basin's issues and that there is not just one way to achieve the goals set forth in their Guiding Principles. As the projects came together, the IWG mixed and matched potential solutions into various combinations that could create the most benefit for the lowest cost. The result is five Alternatives, each with its own package of projects from the options discussed above — all of which, if fully implemented, are able to meet all of the Guiding Principles.

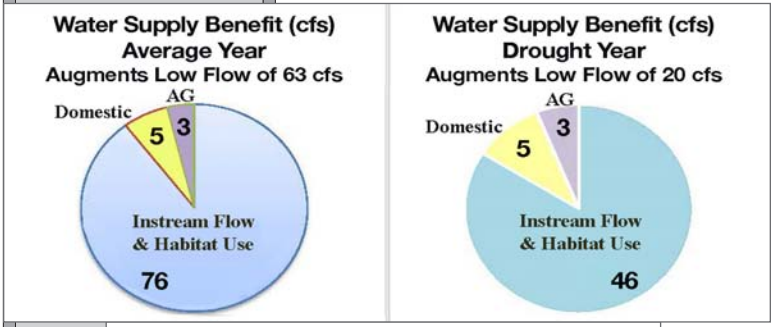
Common Sense Solutions

A common theme throughout the alternatives (with the exception of the "do nothing" alternative) is a set of common-sense solutions, which consist of conservation, water market development, habitat projects, Tribal fisheries protections, and amendments to instream flow rules. These solutions are found throughout all the alternatives and have nearly-uniform support based on the comments received on the PEIS to-date. The other alternatives are distinguished by the degree to which other major other projects are incorporated. Each alternative is listed and described briefly in the table below.

Icicle Work Group Alternatives under Consideration

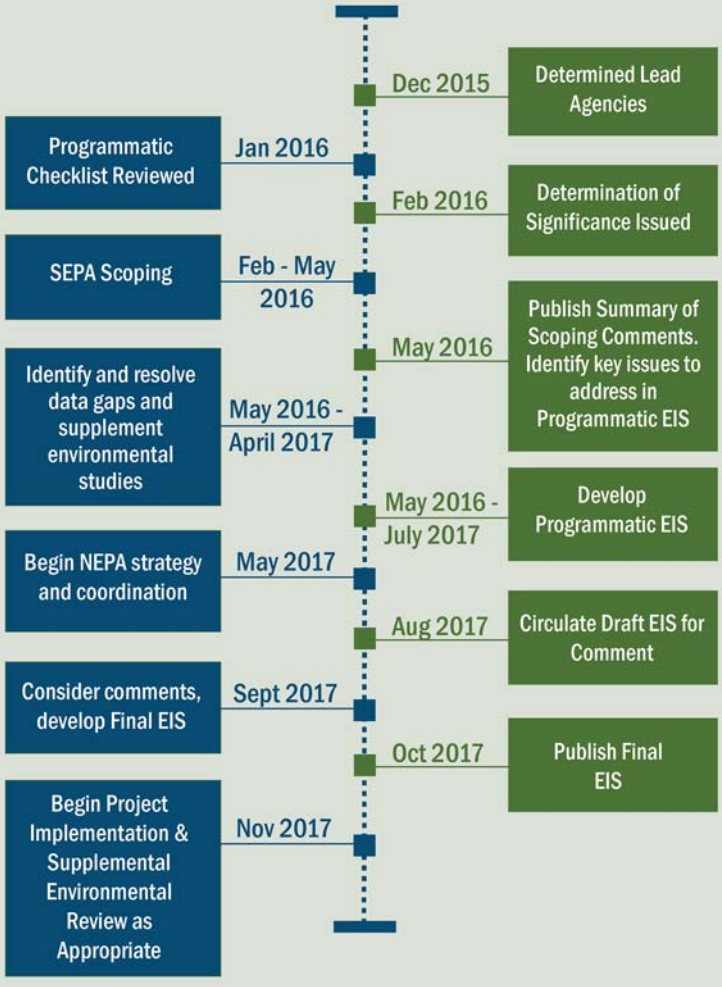
Alternative Being Considered	Projects
No Action Alternative	No Action
Alternative 1 Construction Cost= $81.7M Flow Improvement = 85 cfs	• Alpine Lakes Reservoirs Optimization, Modernization and Automation • Eightmile Lake Restoration • All other conservation, habitat, fish passage, water market, fish screen, and Tribal fishery protection projects.
Alternative 2 Construction Cost= $91.6M Flow Improvement =80 cfs	• Eightmile Lake Restoration • Peshastin Irrigation District Pump Exchange • All other conservation, habitat, fish passage, water market, fish screen, and Tribal fishery protection projects.
Alternative 3 Construction Cost= $89.0M Flow Improvement =67 cfs	• Peshastin Irrigation District Pump Exchange • Legislative fix for instream flow impacts associated with out-of-time mitigation of conservation projects • All other conservation, habitat, fish passage, water market, fish screen, and Tribal fishery protection projects.
Alternative 4 Construction Cost= $96.4M Flow Improvement =153 cfs	• Alpine Lakes Reservoirs Optimization, Modernization and Automation • Eightmile Lake Enhancement • Upper Klonaqua Storage Enhancement • Upper Snow Storage Enhancement • All other conservation, habitat, fish passage, water market, fish screen, and Tribal fishery protection projects.

Water Project Integration



These pie charts show the additional water supply developed from Alternative 1. Alternatives 2, 3, and 4 provide similar benefits. Numbers represent the increase in cfs.

What is the Timeline for Environmental Review?



Substantial Benefits

All of the Alternatives being considered in the PEIS would have a transformative effect on the Icicle Creek basin. For example, the pie charts summarize instream benefits in both an average year and drought year, as well as improvement in agricultural reliability and extending domestic supplies through 2050. In each of the Alternatives — because the flow achievement goal is the most ambitious Guiding Principle — approximately 90% of the water supply development benefits instream flow and habitat. With this level of improvement, it is the IWG's hope that it will signal an end to decades of litigation over water supplies in the basin.

Public Outreach and Next Steps

The IWG's work has included a robust public process. While not everyone agrees with every solution proposed, the IWG has made a good faith effort to ensure that everyone's voice has been heard and have undertaken a significant outreach effort in the last five years. In addition to quarterly public meetings, IWG members have given numerous presentations to local community groups and the public. The PEIS process launched in early 2016 contained a thorough public process, including the current public comment period, as outlined in the following figure.

At the culmination of the PEIS process, the Icicle Work Group anticipates that it will provide a recommendation to the co-leads (Ecology and Chelan County) on a Preferred Alternative to implement, likely in the fall of 2017. After a Final PEIS is adopted, several actions are likely. Those projects that have a National Environmental Policy Act (NEPA) nexus, or those projects that do not have sufficient information in the PEIS to fully evaluate environmental impacts, will require supplemental environmental review. Those projects without a NEPA nexus that have a sufficient evaluation in the PEIS would proceed to implementation, presuming that permitting occurs and funding is available.

The Cost of Doing Nothing is High

Real solutions to conflicts in the Icicle Creek basin have never been closer than they are now. Much more work, however, is needed. Without the coordinated approach of the IWG, projects may continue to progress individually and may lead to improved conditions. But, without the participation of IWG members and projects developed as part of the Icicle Strategy, any enhancements developed by one entity may not be as effective as if they were implemented and managed along with multiple projects and stakeholder input. Simply put, project implementation may take much longer in the best case or not at all in the worst case. A No-Action Alternative has the potential to further complicate the following issues or leave them unresolved:

Resumption of *City of Leavenworth vs. Department of Ecology*, No. 09-2-00748-3 (Chelan Cnty. Super. Ct. Dec. 19, 2011): This case is currently on hold while the City of Leavenworth and Ecology try to resolve the issues through the IWG. The Guiding Principles address the City of Leavenworth and surrounding area's domestic supply concerns and calls for 1,750 acre-feet of reliable year-round supply. Without the projects that would increase domestic supply, the City's diversion amount will remain in contention and litigation would resume.

Water Project Integration

Mike Kaputa, AICP, is Director of the Chelan County Natural Resources Department, an appointed position working for the Chelan County Commissioners. He has been with the County since 1996, starting as an environmental and senior planner. The department works with local citizens and numerous agency, Tribal, and non-profit partners to advance water resource, salmon recovery, land use, and recreation projects and programs. His department also oversees capital construction projects, leads regulatory updates, manages collaborative policy initiatives, and performs research and monitoring. Mr. Kaputa earned his B.A. in Environmental Science and dual Master's degrees in Educational Studies and Urban and Environmental Planning from the University of Virginia.

Losing benefit from IPID participation: IPID currently manages its Alpine Lake reservoirs solely for irrigation needs. As the biggest senior water right holder in the basin, losing them as a participant would significantly undercut the instream flow objectives of the basin. None of the Alternatives being considered in the PEIS expand irrigation in IPID. The only benefit they would derive is infrastructure improvements that will benefit fish and instream flows.

LNFH risks losing State partnership: The LNFH is actively collaborating with Ecology and Washington Department of Fish and Wildlife as part of the Icicle Strategy to assess hatchery operations and look for ways to improve and enhance the infrastructure to make it more sustainable, while increasing water quality and benefiting fish health and habitat. Synergy will be lost in this process if the collaboration ends and projects are not addressed under the Icicle Strategy.

Restricted long-term growth in the City of Leavenworth and Icicle Creek basin: One of the IWG's priorities is to meet current and future domestic water supplies for the City of Leavenworth and surrounding basin through 2050. Without a sustainable plan for addressing growth in the City of Leavenworth and rural Chelan County, there is no guaranteed plan for the water supply to keep up with demand as the population rises. Past water planning efforts only planned for growth through 2020.

No improved agricultural reliability: Several of the projects proposed by the IWG have an added benefit of improving agricultural water reliability. If no-action occurs under the Icicle Strategy, it is unlikely the Water Markets project will be implemented. The interruptible water users in the basin will continue to face hardship when low streamflows prevent them from irrigating. IPID and COIC would not enjoy improved delivery systems from new infrastructure that can serve their members better.

Possible fish screening process delays: The Icicle Strategy includes upgrading fish screens at major diversions along Icicle Creek to comply with current fish passage requirements. The City of Leavenworth, IPID, and the LNFH/COIC have diversions in need of fish screen upgrades. Without an integrated process, each entity would have to seek funding and go through the fish screen design and implementation process independently, likely resulting in delayed implementation.

Conclusion

The IWG's plan represents the best chance for the Icicle Creek basin. Its efforts are the result of years of collaboration and compromise between a diverse group invested in finding the best options for fish, farmers, residents, and recreationists. The PEIS that is out for public review and comment shows the impact of each alternative and benefits they can potentially bring to the basin. With public input over the next several months, Ecology and Chelan County look forward to selecting a package of projects to implement real change in the Icicle Creek basin.

For Additional Information:
Mike Kaputa, Chelan County Natural Resources, 509/ 670-6935 or Mike.Kaputa@co.chelan.wa.us

Meet the Author: *Author Mike Kaputa will be presenting on the Icicle Creek Basin water project collaboration at the American Water Resources Association Annual Conference*
Portland, Oregon, November 5-9 — Info at: www.awra.org

WATER BRIEFS

RIVER PROTECTION FIRST ANTI-DEGRADATION STANDARD OR

The Oregon Environmental Quality Commission voted unanimously July 13 to designate the North Fork Smith River and its tributaries in southern Oregon as the first Outstanding Resource Water (ORW) in Oregon. The designation stems from a petition filed February 2016 from a group of conservation and fishing organizations. Outstanding Resource Waters are high quality waters that constitute an outstanding state resource due to their extraordinary water quality or ecological values, or where special protection is needed to maintain critical habitat areas. *See* Oregon's ORW policy at OAR 340-041-0004(8). The North Fork Smith River is a federally-designated Wild and Scenic River. It is a 28-mile tributary of the Smith River that flows south into California on its way to the Ocean. The decision adds protections under Oregon's water quality standards to ensure that there is no degradation of water quality. The policies would prohibit new permitted point source discharges to the waters and would prohibit other activities that could degrade the current high water quality, exceptional ecological characteristics, and values of the waters.

This is Oregon's first designation of an ORW, and the first in the Pacific Northwest. The waters of the North Fork Smith River are valuable habitat for endangered populations of Coho salmon, several rare plant species and other fish and wildlife.

Oregon Department of Environmental Quality (ODEQ) took public comment on the petition and issued a detailed report supporting the special designation (*see* website below). The designation deals a potentially fatal blow to an international corporation's efforts to mine nickel and other minerals from the North Fork's watershed. "The Outstanding Resource Waters designation would likely preclude any surface mining in the watershed. There are unvalidated claims for nickel mining owned by the Red Flat Mining Corporation. Red Flat had proposed exploratory drilling to begin the process of validating these claims." ORW Rulemaking Report (Item P), page 5.

For info: Jennifer Wigal, ODEQ, 503/ 229-5323 or wigal.jennifer@deq.state.or.us; Final Rules/Staff Report at website: www.oregon.gov/deq/wq/Pages/WQ-Standards-ORWO.aspx

WATER BRIEFS

OGALLALA AQUIFER WEST
LONG-TERM DECLINE

USGS released a report on June 16 detailing changes of groundwater levels in the Ogallala, or High Plains, Aquifer, showing that long-term aquifer decline continues. The report presents water-level change data in the aquifer for two separate periods: from 1950 (prior to significant groundwater irrigation development) to 2015, and from 2013 to 2015. Water-level declines began soon after the beginning of substantial irrigation with groundwater (about 1950). *See* USGS Scientific Investigations Report 2017–5040, https://doi.org/10.3133/sir20175040.

Change in storage for the 2013 to 2015 comparison period was a decline of 10.7 million acre-feet, which is about 30% of the change in recoverable water in storage calculated for the 2011 to 2013 comparison period. A smaller decline for the 2013 to 2015 comparison period is likely related to reduced groundwater pumping. In 2015, total recoverable water in storage in the aquifer was about 2.91 billion acre-feet, which is an overall decline of about 273.2 million acre-feet, or 9%, since predevelopment. Average area-weighted water-level change in the aquifer was a decline of 15.8 feet from predevelopment to 2015 and a decline of 0.6 feet from 2013 to 2015. The USGS study used water-level measurements from 3,164 wells for the predevelopment to 2015 study period and 7,524 wells for the 2013-2015 study period. The Ogallala underlies about 112 million acres in parts of eight states: Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas and Wyoming.

For info: USGS Report at: https://pubs.er.usgs.gov/publication/sir20175040

GROUNDWATER USE KS
SURFACE WATER IMPACTS

Groundwater declines in the Great Plains is leading to reductions in stream flows, resulting in impacts on streams' fish communities. New research maps the loss of stream habitat for many small fish in the Great Plains region and attributes it to declining groundwater sources. This research is one of the first examples that links groundwater depletion to changes in the biotic communities of the river. More than 350 miles of stream has been lost the last 65 years because of a reduction in the groundwater, and researchers expect another 180 miles of lost stream by 2060. The reduction of the region's streams is transforming the fish community as several species of fish that were once plentiful in the Great Plains and serve an important role in the food web are no longer found in the area. All species of at-risk fish prefer larger, fast-flowing waters and reproduce by spawning above the riverbed so the eggs float downstream. The 2011 and 2012 droughts combined with decreasing groundwater that feeds the streams and many dams have changed the fish habitat and prevent fish from swimming back upstream to start the reproductive cycle over.

The report used groundwater well data from the 1950s to 2010 to track the rate of change in the water table of the High Plains Aquifer.

See Proceedings of the National Academy of Sciences, 2017; 114 (28): 7373 DOI: 10.1073/pnas.1618936114. Available at: http://www.pnas.org/content/114/28/7373.full.

For info: Keith Gido, 785/ 532-5088 or kgido@k-state.edu

ASPEN WATER STORAGE CO
MANAGEMENT STRATEGIES

On July 19, Aspen, Colorado announced that it is in contract to buy two adjoining parcels of land in Woody Creek for $2.65 million to potentially use for water storage in the future. The parcels are 1.805 acres and 61 acres downstream of Aspen. The impetus for the purchase is to seek a way to transfer decreed storage rights to locations other than the decreed locations on Castle Creek and Maroon Creek. Since 1965, the City has held decreed water storage rights at sites in Maroon and Castle Creek Valleys but the nature of these pristine locations has made it a priority for the City to first seek other ways to address water shortages and seek alternate locations for water storage. The City is completing its due diligence on the Woody Creek parcels, including conducting research on the environmental, hydrologic, and geologic nature of the sites. Should the City elect to complete the land purchase, it will begin the lengthy process to engineer the property for an excavated reservoir and/or below ground in-situ water storage. With less than a day's storage for the municipal water supply, it has long been a goal of the City to mitigate the risks of running out of potable water and untreated irrigation water, and drawing down the instream flows on Maroon and Castle Creeks.

For info: Steve Barwick, Aspen City Manager, 970/ 920-5205 or steve.barwick@cityofaspen.com; Aspen website: www.aspenpitkin.com/Departments/Utilities/Water/

CLIMATE CHANGE IMPACT US
IRRIGATED CROP YIELDS

Researchers at the Massachusetts Institute of Technology (MIT) on July 11 released a report, "*Is Current Irrigation Sustainable in the United States? An Integrated Assessment of Climate Change Impact on Water Resources and Irrigated Crop Yields*." The new study finds that certain hotspots in the US will experience severe reductions in crop yields by 2050, due to climate change impacts on irrigation. Most adversely affected will be the Southwest. Less rainfall will mean reduced runoff into water basins that feed irrigated fields. Similarly, maize grown in Utah, now yielding 40% of the optimal expected yield, will decrease to 10%. In the Northwest, water shortages to the Great Basin region will lead to large reductions in irrigated forage. In contrast, the researchers predict a decrease in water stress in the southern Plains, leading to greater yields of sorghum and soybeans. By 2050, the team projects that, under a business-as-usual scenario, a number of water basins in the US will start experiencing water shortages. Several basins, particularly in the Southwest, will see existing water shortages "severely accentuated," according to the study.

For info: Report available at: http://onlinelibrary.wiley.com/doi/10.1002/2016EF000473/full

URANIUM MINE CLEANUP NM
EPA CONTRACT AWARDED

EPA has awarded a Navajo-owned company a $3.85 million contract to clean up portions of the Quivira Mines. The site is located on the Navajo Nation in McKinley County, New Mexico. Funding comes from a $1 billion settlement reached in 2015 for the cleanup of 50 abandoned uranium mines for which Kerr McGee Corporation and its successor, Tronox, have responsibility. During the Cold War, 30 million tons of uranium ore were mined on or adjacent to the Navajo Nation, leaving more than 500 abandoned mines. Since 2008, EPA has conducted preliminary investigations at all of the mines, remediated 49 contaminated structures, provided safe drinking water to 3,013 families in partnership with the Indian Health Service, and performed cleanup or stabilization work at nine mines. In total, EPA has reached settlements valued at $1.7 billion to clean up more than 40 of the highest priority mines.

For info: www.epa.gov/navajo-nation-uranium-cleanup

WATER BRIEFS

NEW WATER SOURCES US

COAL PRODUCTION DECLINES

The US has seen several coal power plant closures in recent years with more on the way in the next ten years. Coal power generation demands a large amount of water compared to natural gas plants and renewable energy sources such as wind and PV solar. The closure or conversion of many coal plants in the western US means that a new source of water could be on the market, as energy companies reduce their need for water. These changes in coal plants are estimated to result in about 84,000 acre-feet per year of reduced water demand in the western US with a market value of roughly $300 million. In the current *Water Market Insider*, WestWater Research discusses the impact on water demands as coal production decreases.

For info: Report at: www.waterexchange.com/q2-2017-water-market-insider-new-water-from-old-power/

CALENDAR

August 15 CA & WEB
California State Water Resources Control Board Meeting - SGMA Implementation, Sacramento. CalEPA Headquarters Bldg., 1001 I Street. For info: www.waterboards.ca.gov

August 15-19 WA
The Council of State Governments West Annual Meeting: Innovation is Our Nature, Tacoma. Hotel Murano, 1320 Broadway. For info: http://www.csgwest.org/annualmeeting/default.aspx

August 16-17 Myanmar
2nd Global Water Conference 2017: Towards Sustainable Water Security in Southeast Asea, Yangon. Sule Shangri-la. For info: http://www.globalwaterconference.com/

August 18 WEB
Water Finance Clearinghouse Webinar, WEB. 2-3 p.m. Eastern. Presented by EPA's Water Infrastructure and Resiliency Finance Center. For info: www.epa.gov/waterfinancecenter/water-finance-clearinghouse

August 21-24 OR
Oregon Association of Water Utilities 23rd Annual Summer Classic Conference, Seaside. Seaside Convention Center. For info: https://oawu.net/wp-content/uploads/Seaside2017Final.pdf

August 22 TX & WEB
Legislative Update 2017: Water Law, WEB. Sponsored by Texas Bar CLE. For info: http://www.texasbarcle.com/CLE/AABuy0.asp?sProductType=EV&lID=16185

August 22 WEB
Enforcement & Compliance History Online Quarterly Webinar: Water Facility Search Tools (Water Facility Search, Effluent Charts & Pollutant Loading Tool), WEB. 1:30 p.m. Presented by EPA's' ECHO. For info: https://echo.epa.gov/help/training

August 22-24 OH
14th Annual EPA Drinking Water Workshop: Small Systems Challenges & Solutions, Cincinnati. Hilton Cincinnati Netherland Plaza. For info: www.epa.gov/water-research (>> "Outreach & Other Resources")

August 24 WEB
Water Finance Clearinghouse Webinar, WEB. 2-3 p.m. Eastern. Presented by EPA's Water Infrastructure and Resiliency Finance Center. For info: www.epa.gov/waterfinancecenter/water-finance-clearinghouse

August 24-25 AZ
Arizona Water Law Conference: Balancing the Rights & Interests of All Arizonians, Scottsdale. Hilton Scottsdale. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

August 31 WEB
Water Finance Clearinghouse Webinar, WEB. 2-3 p.m. Eastern. Presented by EPA's Water Infrastructure and Resiliency Finance Center. For info: www.epa.gov/waterfinancecenter/water-finance-clearinghouse

September 10-11 Israel
Cutting-Edge Solutions to Wicked Water Problems Conference, Tel Aviv. Tel Aviv University. Sponsored by American Water Resources Assoc. & Water Research Center at Tel Aviv University. For info: http://www.awra.org/meetings/Israel2017/

September 10-13 AZ
32nd Annual WateReuse Symposium: What's Next in Water Reuse Policy, Operations, Technology and Public Perception, Phoenix. Phoenix Hilton. For info: https://watereuse.org/news-events/conferences

September 11 VA
Hydropower 101 Conference, Alexandria. Embassy Suites by Hilton Alexandria Old Town. For info: www.euci.com/event

September 11-12 NM
25th Anniversary SuperConference - New Mexico Water Law: The History & Future of Our Water Resources, Santa Fe. La Fonda Hotel on the Plaza. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

September 11-12 CA
Climate Change and Energy in California, San Francisco. Marriott Marquis Hotel. For info: Law Seminars Int'l, 206/ 567-4490 or www.lawseminars.com

September 11-13 WY
The Environmental Council of States Fall Meeting, Jackson. Snow King Resort. For info: www.ecos.org/event/2017-ecos-fall-meeting/

September 12 VA
Introduction to FERC Hydropower Conference, Alexandria. Embassy Suites by Hilton Alexandria Old Town. For info: www.euci.com/event

September 13 WA
Emerging Issues in Water Quality Regulations Seminar, Seattle. Hilton Garden Inn Downtown. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

September 13 VA
FERC Hydropower Licensing Conference, Alexandria. Embassy Suites by Hilton Alexandria Old Town. For info: www.euci.com/event

September 13-14 Canada
Canadian Shale Water Management 2017: Reducing the Cost of Water Recycling & Reuse Conference, Calgary. Met Conference Centre. For info: http://www.canada.shale-water-management.com/access/program

September 15 CA
California Environmental Quality Act (CEQA) Seminar, Santa Monica. DoubleTree Guest Suites Santa Monica Hotel. For info: Law Seminars Int'l, 206/ 567-4490 or www.lawseminars.com

September 17 WA
Washington Environmental Cleanup: CERCLA & MTCA, Seattle. Washington State Convention Ctr. For info: Environmental Law Education Center, www.elecenter.com/

September 17-21 TX
EPA Region 6 Stormwater Conference and LID Competition, San Antonio. Hilton Palacio. Organized by EPA Region 6, in partnership with San Antonio, Texas, Texas A&M University Kingsville, Municipal Separate Storm Sewer Systems (MS4s), and States in Region 6.. For info: Nelly Smith, EPA, smith.nelly@epa.gov

September 18 WA
Environmental Contamination & Cleanup Conference: CERCLA + MTCA + Sediments, Seattle. Washington State Convention Ctr. For info: Environmental Law Education Center, www.elecenter.com/

September 18-19 CA
California Coastal Law Conference: Legal, Policy & Commission Updates, Los Angeles. Los Angeles Athletic Club. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

September 18-20 AUST
10th International Riversymposium and Environmental Flows Conference: Sustainable River Basin Management, Brisbane, Australia. Presented by International River Foundation. For info: http://riversymposium.com/

September 18-20 NV
WaterPro Conference - Annual Conference of the National Rural Water Assoc., Reno. Grand Sierra Resort. For info: http://waterproconference.org/

The Water Report
Water Rights, Water Quality & Water Solutions in the West
260 N. Polk Street • Eugene, OR 97402

CALENDAR

(continued from previous page)

September 20 TX

Pollution Prevention Waste Management Workshop, Austin. J.J. Pickle Research Campus, University of Texas at Austin. Presented by Texas Commission on Environmental Quality. For info: www.tceq.texas.gov/p2/events

September 25-26 CA

Endangered Species Act Conference, San Francisco. BASF Conference Center. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

September 25-27 CA

CASQA in the Capital: Building Bridges for Water: California Stormwater Quality Association (CASQA) Annual Conference, Sacramento. Sacramento Convention Center. For info: www.casqa.org/events/annual-conference/hotel-and-travel

September 26-27 CO

Indian Law & Natural Resources: The Basics & Beyond Institute, Westminster. Marriott Hotel. For info: Rocky Mt. Mineral Law Foundation, 303/ 321-8100, info@rmmlf.org or www.rmmlf.org

September 28-29 MT & WEB

Montana Water Law - 17th Annual Seminar, Helena. Great Northern Hotel. For info: The Seminar Group, 800/ 574-4852, info@theseminargroup.net or www.theseminargroup.net

September 30-Oct. 4 IL

WEFTEC 2017: The Water Quality Event & Exhibition, Chicago. McCormick Place North & South. Presented by Water Education Foundation. For info: www.weftec.org/future-weftec-schedule/

October 3 WA

2017 AWRA Washington State Conference: "The 100 Year Anniversary of the Washington Water Code: Where We Came From & Where We're Going", Seattle. Mountaineers Seattle Program Center, 7700 Sand Point Way NE. Presented by Washington Section of the American Water Resources Assoc. For info: http://waawra.org/event-2504575

October 3 NV

Alliance for Water Efficiency Annual Meeting & Reception, Las Vegas. South Point Hotel & Conference. Sonoma C Room. Includes AWE Groundhog Days Music Night. For info: http://www.allianceforwaterefficiency.org/AMM2017.aspx

October 3 TX

Texas Water Law Conference: A Look at Today & Planning for Tomorrow, San Antonio. Witte Museum. For info: CLE Int'l, 800/ 873-7130 or www.cle.com