
Groundwater Visibility: The Missing Link

by William M. Alley¹, Lisa Beutler², Michael E. Campana³, Sharon B. Megdal⁴, and John C. Tracy⁵

¹Corresponding author: National Ground Water Association, 4731 Winona Ave., San Diego, CA 92115; 619-922-2544; walley@ngwa.org

²MWH Americas, 3301 C Street, Suite 1900, Sacramento, CA 95816.

³Technical Director, American Water Resources Association, P.O. Box 1626, Middleburg, VA 20118.

⁴University of Arizona Water Resources Research Center, 350 N. Campbell Ave., Tucson, AZ 85719.

⁵Texas Water Resources Institute, 1500 Research Parkway, Suite 150, College Station, TX 77843.

For most of the public, groundwater is out of sight and out of mind. Our inability to readily see groundwater and limited measurements of this resource contribute to its lack of visibility in discussions of water policy, governance, and management—at least when compared to surface water. This visibility challenge is far from new. In 1861, an Ohio court famously concluded that groundwater was so “secret, occult, and concealed” that any attempt to regulate it “would be involved in hopeless uncertainty, and would be, therefore, practically impossible” (Frazier v. Brown 1861). While the science and water law have advanced, groundwater remains largely undervalued and narrowly perceived (Campana 2014), not only by the general public but also by many professionals in the water, energy, environmental, and agricultural sectors.

This is not to say that progress has not been made. In recent years, awareness of the importance of groundwater has resulted from articles and news reports on the increased use of groundwater due to drought conditions in the western United States, particularly California; news stories of groundwater depletion and contamination coming out of India, China, the Middle East, and elsewhere around the world; as well as the results from the GRACE satellites (Famiglietti 2014; Alley and Alley 2017). Groundwater depletion and contamination are increasingly seen as both local and

global issues threatening food security, drinking water, and the environment.

Groundwater has also attracted the attention of the business world. Consider this statement about groundwater depletion in a recent report by the Earth Security Group (2016): “The rapid depletion of aquifers is a systemic risk to one billion people in the world’s growing economies. Aquifers are shared across national borders and have the potential to spark conflict. Companies must act beyond their site operations and help improve groundwater governance if they are to ensure their sustainable growth.”

Groundwater Governance

Almost invariably, groundwater is more locally managed than surface water and has a larger number of individuals involved. These characteristics present significant challenges in its management and highlight the importance of a widely shared understanding of groundwater systems. Recent years have seen considerable interest in promoting responsible collective action by the many actors involved in groundwater, including well owners, public agencies, the private sector, and water consumers. These ideas fall under the general rubric of “groundwater governance.”

Achieving a state of “good” groundwater governance is a relatively complex concept, and there is considerable variation among its definitions. The UN Food and Agriculture Organization (FAO), UNESCO International Hydrological Programme, the International Association of Hydrogeologists, and the World Bank recently concluded a 4-year program supported by the Global Environment Facility, entitled “Groundwater Governance, A Framework for Action” (Global Environment Facility, World Bank, UNESCO-IHP, FAO, and IAH 2016). Their consensus definition of groundwater governance, which was adapted from that of Foster and Garduño (2013), is as follows: “Groundwater governance comprises the enabling framework and guiding principles for responsible collective action to ensure control, protection and socially sustainable utilization of groundwater resources for the benefit of humankind and dependent ecosystems” (Global Environment Facility, World Bank, UNESCO-IHP, FAO, and IAH 2016). In comparison, groundwater management is what the actors do within the governance framework to implement the policies and plans that have been established to develop and protect groundwater. Unfortunately,

Table 1
Factors Contributing to Good Groundwater Governance

- Recognizing surface water and groundwater as a single resource
- Active engagement of local stakeholders in the decision-making process
- Pressure from external bodies to achieve suitable and workable solutions
- Public education on groundwater and its importance
- An emphasis on public guardianship and collective responsibility
- Consideration of groundwater within other policy areas, such as agriculture, energy, and land use
- Adequate laws and enforcement
- Fully funded and properly staffed groundwater management agencies
- Characterization of major aquifer systems
- Effective and independent monitoring of groundwater status and trends
- Recognizing the long-term response of groundwater systems
- Accounting for interactions between groundwater and climate
- Community leadership

Source: Alley and Alley (2017).

by almost any definition, groundwater governance is inadequate in most, if not all, countries (Varady et al. 2012; Foster and Garduño 2013; Megdal et al. 2015).

A review of factors contributing to groundwater governance (Table 1) reveals the central importance of increasing the “visibility” of groundwater in a number of respects: its connection to surface water; the relevance of groundwater to agricultural, land use, and other policies; the inherent slow response time of many groundwater systems; the importance of monitoring groundwater status and trends; and understanding the feedbacks between groundwater and climate. Another key aspect of “visibility” is the transparency of groundwater information and management.

The greatest shortcoming of groundwater governance has been called “its failure to grasp the central importance of the human dimension . . . and the consequent neglect of stakeholders in governance and management” (Global Environment Facility, World Bank, UNESCO-IHP, FAO, and IAH 2016). Raising awareness is essential to get political and stakeholder participation, and to achieve a greater sense of urgency to address current problems and long-term risks. Several decades ago, Elinor Ostrom, Nobel Laureate for Economics in 2009, noted that an effective information and communication system is also the key to accountability for governance of “common-pool resources” such as groundwater (Ostrom 1990).

Groundwater Visibility Initiative

Recognizing a critical need to elevate groundwater discussions and raise awareness of the resource, the National Ground Water Association (NGWA) and American Water Resources Association (AWRA) recently launched a Groundwater Visibility Initiative.

In April 2016, NGWA and AWRA convened 25 water experts from across the United States and Canada in a day-long Groundwater Visibility Initiative workshop (Alley et al. 2016). This seminal event sought to discuss the best ways to elevate groundwater’s status in the international discourse on water policy, governance, and management by crafting recommendations for action.

The attendees tackled an agenda consisting of provocative talks by recognized experts, panel discussions, and breakout sessions. They articulated ways to better integrate groundwater into water resources management and incorporate it into policies for agriculture, energy, environment, land-use planning, and urban development.

The following is a summary of the workshop findings and recommendations:

1. Managing groundwater requires working with people

Achieving groundwater sustainability requires societal decisions that involve tradeoffs and should be made through informed, transparent public participation. Many of the current ideas for addressing groundwater sustainability fall within the broad concept of groundwater governance. Governance is an important part of sustainable aquifer management.

Multidisciplinary teams and alliances among multiple stakeholder and governance/management associations can provide greater expertise to solve these problems. Communications programs are required to help overcome misperceptions about groundwater and surface water interactions and demonstrate their connectivity. Examples of good management and governance should be provided to decision makers and other stakeholders.

2. Data and information are keys

Better data on aquifer systems, including water withdrawals and consumptive use are needed for both groundwater and surface water management. Different aquifers behave differently because of different geology, extent, and hydroclimatic settings. Monitoring and ongoing evaluation at appropriate spatiotemporal scales for individual systems are necessary to understand trends in both quality and quantity. Data should be readily accessible to all stakeholders.

3. Some “secrets” remain

Groundwater and climate are inextricably linked through both recharge rates and water demands. Improved scientific understanding is needed of climate impacts on supply (quantity and quality) and demand for groundwater and its interaction with surface water.

Long lag times for groundwater impacts and system responses must be understood and addressed in groundwater planning and management.

4. We need to take care of what we have

Ensure that planning and investment incorporate infrastructure rehabilitation and maintenance.

5. Effective groundwater management is critical to an integrated water management portfolio that is adaptive and resilient to drought and climate change

A diverse water management portfolio that includes groundwater, surface water, conservation, recycling, and so on, will contribute to greater water security and less risk. Groundwater supports instream flows, surface water bodies, ecosystems, and sustainable supply for water users. Groundwater also contributes to the quality of surface water and mediates its temperature.

Managed aquifer recharge is a potentially critical element of drought mitigation planning. Groundwater systems should be analyzed for their resilience and vulnerability to climate perturbations. Projects should be reviewed from a long-term resilience perspective rather than a short-term one. In this context, groundwater management is especially important as a tool to buffer extremes.

Models need to be reviewed and adaptive. Collaborative modeling can be an effective tool to foster buy-in of management options by stakeholders.

In a fully integrated system, repurposing dams and flood control operations for recharge is another opportunity.

6. To be robust, agriculture, energy, environmental, land-use planning, and urban development policies must incorporate groundwater considerations

Groundwater problems typically do not have a single solution. Return flows from different sectors have significant intersection with groundwater management issues. Planning and management need to be integrated across all of the sectors. This includes matching quality, quantity and use.

Land-use planning can be used to protect or enhance base flow of streams, floodplain management, and groundwater recharge. Agricultural and open space districts can be an opportunity for a win-win; for example, by overlaying zones for scenic protection and agricultural preservation to enhance recharge.

Water managers should consider innovative ways of education and outreach to the agricultural sector, including: (1) the key role of agricultural extension agents; (2) subsidy-based conservation programs; (3) self-regulation with performance-based criteria; (4) “grow-off challenges” through crop yield competitions with guarantees; (5) early adapter programs; and (6) professionally facilitated communication.

Take-Away

The Denver workshop is intended as only a first step in efforts by NGWA, AWRA, and the workshop participants to increase groundwater’s visibility in scientific, management, and policy dialogues. A complementary effort to inform, engage, and educate stakeholders on the critical need for addressing our shrinking groundwater resources came out of the recent International Symposium on Managed Aquifer Recharge (ISMAR9) held June 2016 in Mexico City, Mexico (Villareal et al. 2016).

Now is the time to overcome society’s “out of sight and out of mind” and “secret and occult” perspectives on groundwater. In order to increase groundwater awareness, scientists should join together with water managers and policy makers to become creative and socially involved team players working within the broad array of water-using sectors. The hard work of making groundwater visible has just begun.

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