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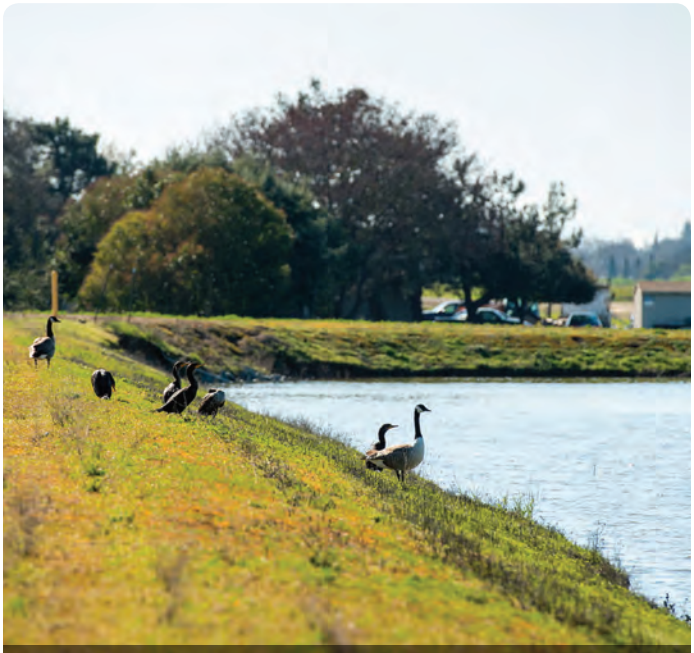
Research Brief

AquaCharge: A Design Tool for Balancing Groundwater Management Trade-Offs

Overview

Many arid regions face groundwater security and reliability challenges, such as overdraft and climate change-driven precipitation shifts. Increasingly, water managers are considering recharging aquifers using stormwater and recycled water–Managed Aquifer Recharge (MAR). These projects are hindered by a lack of tools to evaluate system design costs and trade-offs. Stanford researchers have developed AquaCharge, a planning tool that can optimize system costs and performance to help water managers make more informed decisions about how MAR can fit into water management strategies.



Waterfowl gather at groundwater recharge ponds located on the grounds of the Stockton East Water District.

Key Points for Policymakers

- The AquaCharge model allows for more comprehensive and precise analyses of cost, water volume and energy trade-offs among different design scenarios. It can improve water planners' understanding of these trade-offs and the best strategies for fitting them into water management plans;
- AquaCharge can efficiently and accurately inform decisions about groundwater recharge pond policies and development of new water supplies;
- AquaCharge can improve design of multi-supply recharge ponds, including how to best manage issues of locating and scaling infrastructure. In case studies, AquaCharge was able to identify designs that were up to 20% more cost-effective;
- AquaCharge is able to identify system designs that optimize infrastructure lifecycle cost and total groundwater recharge while satisfying regulatory or other policy constraints. This allows water planners to adapt the model to accommodate site-specific geographic, policy and technological contexts.

Background

Increasing groundwater recharge capability is a critical component to ensuring water security for regions across the U.S. where scarcity is an ongoing issue. In California, for example, it is imperative for urban water utilities to determine cost-effective opportunities to safely diversify water supplies and efficiently recharge aquifers. To successfully plan for sustainable freshwater systems, innovative water sources, such as recycled water and stormwater, must be viewed as potential recharge assets when compiling a water manager's portfolio.

In urban districts, the two main strategies for increasing water supplies–collecting stormwater runoff and recycling treated wastewater–are usually separate processes that necessitate the construction of costly and under-utilized infrastructure. Applying the AquaCharge model can inform water planning and quantify trade-offs among different groundwater recharge pond designs. The model considers factors such as the availability of recharge ponds and stormwater supplies, the potential to produce recycled water and options for installing recycled water pipelines. More specifically, AquaCharge helps to clarify how augmented groundwater recharge ponds can accommodate both stormwater and recycled water with improved cost-effectiveness.

Groundwater recharge pond.

Adding advanced treated recycled water into a recharge pond can also create more consistent, higher-quality groundwater recharge. Case studies in Los Angeles have shown that dynamic management of recycled water deliveries could result in 68% more recharge capacity when compared to more conservative strategies. Increased water recycling facility utilization may also serve as a politically important performance metric that water utility boards and rate payers perceive favorably. Leveraging the capabilities of AquaCharge to demonstrate lower overall operating costs makes it more likely for water planners to pursue these types of multi-supply projects without having to seek funds from external partners.

In addition to being a useful tool for water managers, AquaCharge may help lower the barrier for planning future multi-supply groundwater recharge pond projects to enhance urban water supplies and improve water supply resiliency.

About the Authors

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