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10:30 AM – 12:00 Noon

SESSION 44: ASR and Groundwater

Recharge Master Planning in the Chino Basin, California - Mark Wildermuth, Wildermuth Environmental, Inc., Lake Forest, CA (co-authors: Ken Manning, Tom McCarthy)

The Chino Basin covers about 235 square miles and is one of the largest groundwater basins in Southern California with about 6,000,000 acre-feet of water in storage. It is the primary water supply for about 800,000 people in the Inland Empire area. The basin was adjudicated in the 1970s and is managed by a stipulated agreement, approved by the Superior Court of California in 1978. One feature of the stipulated agreement was the creation of a Watermaster to implement the physical solution it (the stipulated agreement) required. The Chino Basin Watermaster determines production and procures supplemental water for replenishment if production exceeds the safe yield. Watermaster has recently determined that future projected groundwater production in excess of the basin's safe yield will likely exceed Watermaster's ability to recharge supplemental water. Future production patterns will also cause localized drawdown challenges that cannot be overcome through groundwater replenishment at Watermaster's existing recharge facilities. This presentation focuses on the technical methods and stakeholder processes to complete the Chino Basin Recharge Master Plan. The technical work includes rainfall runoff modeling to estimate storm water recharge potential, groundwater modeling to determine optimal locations for recharge to minimize drawdown, facility conceptualization, the preparation of cost opinions, and finally alternatives analysis and ranking. The resulting trial recharge master plan will meet the groundwater replenishment requirements. Completing the Recharge Master Plan is an iterative process, ensuring that stakeholders have the opportunity to reexamine their water supply plans and recharge alternatives after the trial recharge master plan has been developed. It may be more economical for some stakeholders to reduce basin production and use other water supplies if the cost of increasing supplemental water recharge capacity exceeds the cost of producing those supplies. Conversely, some stakeholders may want to increase basin production. The stakeholders will inform the technical team and the Watermaster of their proposed revisions, and the recharge master plan will be revised to reflect these changes. The recharge master plan will be completed by July 1, 2010.

SPWSD ASR Program - Five Years of Operation - Scott Coffey, CDM, Seattle, WA (co-author: John Anderson)

In 2005, CDM assisted the Sammamish Plateau Water and Sewer District (SPWSD) in preparing and obtaining the first two aquifer storage and recovery (ASR) permits issued in the state of Washington under the recently adopted ASR rules and regulations. These permits allow the district 10 years of operational pilot testing (2005 to 2015) to evaluate the effectiveness of an ASR program within the district's service area. The ASR rules and regulations establish standards for reviewing and permitting ASR project applications. As a result, water purveyors considering ASR as a water resource management tool are subject to increased, monitoring, evaluation, and reporting efforts. SPWSD is currently in its fifth consecutive year of operational testing since the issuance of the permits and has injected more than 700 million gallons of potable water into two aquifers. During this testing period, CDM and the district have collected significant water quality and water level data and developed viable methods in evaluating storage and recovery through water quality tracing analysis. They also developed a 3D numerical groundwater model to simulate ASR operation to answer pressing environmental assessment questions during storage and recovery, including the fate of unrecovered recharge water. In the presentation, CDM will:

- Provide an overview of the district's ASR program.
- Describe the district's monitoring and operational plan to track water quality changes as a result of ASR.
- Describe how SPWSD is using the measured water quality changes and level monitoring data to evaluate storage and recovery.
- Illustrate

the district's use of the numerical groundwater model to evaluate injection and storage within the aquifer and to provide predictive simulations for targeting locations for additional injection and recovery wells. □ Describe and illustrate how the district is benefiting from recharging treated surface water into an aquifer with naturally elevated arsenic levels. □ Compare the cost-benefits of the district's program over purchasing additional water supply from a wholesale customer. □ Describe existing challenges in demonstrating aquifer storage and recovery to local agencies.

Solving the ASR Arsenic Problem: Pilot-Tested Approach Shows Promising Results – Barika Poole, CDM, Maitland, FL (co-authors: Leslie Turner, Lee Wiseman, Doug Munch, Glenn Forrest, Migdalia Hernandez)

Aquifer storage and recovery (ASR) has become a major component of water resource management initiatives worldwide. However, recent challenges regarding the implementation of ASR have discouraged utilities from developing this water management tool. Operational data for existing ASR systems and geochemical modeling have shown that injection of potable water with higher dissolved oxygen (DO) levels and higher oxidation-reduction potential (ORP) than native groundwater may cause naturally occurring minerals in the aquifer matrix, such as arsenopyrite, to be oxidized, releasing arsenic into the stored water. CDM and the St. Johns River Water Management District (SJRWMD), in cooperation with Sanford, Florida, have been investigating the use of ASR within the city. Since 2003, the project has progressed through a desktop study, an exploratory well program, regulatory permitting, and ASR system design and construction. Before initiating cycle testing with potable water, CDM designed a pretreatment system to minimize the potential for arsenic leaching. The goal of the pretreatment system is to produce a recharge water quality similar to the storage zone native groundwater through chlorine residual (Cl₂) removal and a DO reduction. The pretreatment system includes the Membrana Liqui-Cel® degasification system, which reduces injected water DO levels. The degasification system requires removal of Cl₂ to protect the membranes and also contributes to a decreased ORP—an added benefit. Implementation of the pretreatment system was initiated in two phases. Phase I began in April 2009, with Cycle Test 1, which instituted the dechlorination portion of the pretreatment system with sodium bisulfite. Data collected during the injection period shows a significant decrease in ORP in the potable water after it is pretreated, which brings it closer to native groundwater ORP levels. Cycle testing will continue in late summer with both pretreatment systems in operation. This paper/presentation will present the cycle testing results collected through the initial tests and the effects pretreatment had on arsenic leaching. The success of this project will enable the city to control future water resources through demand management, while maintaining water quality integrity by eliminating environmental challenges that occur with open reservoirs.

Underground Injection Control (UIC) Wells for Stormwater Infiltration - J. Scott Kindred, Associated Earth Sciences, Inc., Kirkland, WA (co-author: Curtis Koger)

Stormwater infiltration provides significant environmental benefits compared with traditional approaches that rely on detention and release to surface water. These environmental benefits include reduced peak flows, increased groundwater recharge, higher baseflows, and less pollutant loading to surface water. Infiltration of stormwater has been typically achieved with large infiltration ponds or covered vaults. Unfortunately, glacial till and other low permeability soils cover much of the Puget Sound basin and surface infiltration is not feasible. Deep infiltration using underground injection control (UIC) wells provides a method for bypassing low permeability surface soils and infiltrating stormwater into more permeable underlying soils. The Washington State Department of Ecology prepared a guidance document for permitting stormwater UIC wells in 2006. This document provides for a presumptive permitting approach that is suitable for low-risk situations that rely on approved treatment methods and the demonstrative approach that is suitable for more complex situations that require greater analysis and assessment. This presentation will provide examples of both using a variety of case studies. These case studies will illustrate how site-specific conditions (geology and ground water conditions) and development constraints can affect UIC design and implementation, construction methods, testing methods, and permitting approaches.