City of Roseville
Aquifer Storage and Recovery Demonstration Test Phase 2

Initial Study / Negative Declaration

Prepared for:

City of Roseville
Department of Environment Utilities

Prepared by:

MWH

June 2005

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
µS/cm	Siemens per centimeter
AF	acre-foot
AFA	acre-foot annually
ASR	aquifer storage and recovery
Basin Plan	Water Quality Control Plan
bgs	below ground surface
BMP	Best Management Practice
CDC	California Department of Conservation
CEQA	California Environmental Quality Act
CGS	California Geological Survey
City	City of Roseville
COC	compound of concern
cycle test	pilot-scale cycle test
dBA	decibels (Acoustic)
DBP	disinfection byproduct
DCMW-1	Diamond Creek Monitoring Well No. 1
DCMW-2	Diamond Creek Monitoring Well No. 2
DCMW-3	Diamond Creek Monitoring Well No. 3
DHS	California Department of Health Services
DWR	Department of Water Resources
ft	feet
ft^2	square foot
ft/day	foot per day
gpd	gallons per day
gpm	gallons per minute
HAA	haloacetic acid
hp	horsepower
IS	initial study
ISGM	North American River and Sacramento County Combined Integrated Surface Water and Groundwater Model
MCL	maximum concentration level
ml	milliliter
MND	mitigated negative declaration
MPN	most probable number
msl	mean sea level
ND	negative declaration
P/QP	public/quasi public
PCWA	Placer County Water Agency
PVC	polyvinyl chloride
RWQCB	Regional Water Quality Control Board
TDS	total dissolved solids
THM	trihalomethane
TM	technical memorandum

UBC	Uniform Building Code
WDR	waste discharge requirement
WFP	Water Forum Proposal
WTP	water treatment plant

GLOSSARY

Aquifer/Aquifer System: A water-bearing layer (formation) of rock or sediment capable of yielding sufficient, economical quantities of water to wells. Typically is unconsolidated deposits or sandstone or limestone.

Aquitard: A saturated but poorly permeable formation that does not yield water freely to a well or a spring. However, an aquitard may transmit appreciable water to or from adjacent aquifers.

Area of Influence: Area surrounding a pumping or recharging well within which the water table or potentiometric surface has been changed due to the well's pumping or recharge.

Best Management Practices (BMPs): structural, nonstructural, and managerial techniques recognized to be the most effective and practical means to reduce surface water and groundwater contamination while still allowing the productive use of resources.

Cone of Depression: A depression in the groundwater table or potentiometric surface that has the shape of an inverted cone and develops around a well from which water is being withdrawn. The slopes of the cone become increasingly steep the closer they are to the well. Its trace (perimeter) on the land surface defines the zone of influence of a well. Also called cone of drawdown.

Confined Aquifer: Aquifers that are wedged between layers of relatively impermeable materials and are consequently under pressure. Also know as an artesian aquifer.

Confining Layer: geological material through which significant quantities of water can not move; located below unconfined aquifers, above and below confined aquifers. Also known as a confining bed.

Contaminant: An undesirable substance (physical, chemical, biological, or radiological) not normally present, or an unusually high concentration of a naturally occurring substance, in water, soil, or other environmental medium.

Drawdown: The vertical distance groundwater elevation is lowered, due to the removal of groundwater. The distance between the static water level and the surface of the cone of depression.

Groundwater: Water occurring in the zone of saturation in an aquifer or soil. Water beneath the surface of the earth that saturates the pores and fractures of sand, gravel, and rock formations.

Groundwater Barrier: Rock or artificial material with a relatively low permeability that occurs (or is placed) below ground surface, where it impedes the movement of groundwater and thus may cause a pronounced difference in the heads on opposite sides of the barrier. Also called a confining layer.

Groundwater Mound: An area of elevated groundwater levels located around an injection well resulting from the injection of water into the groundwater aquifer.

Head: Height of the column of water at a given point in a groundwater system above a datum plane such as mean sea level. It is also a measure of pressure as in a confined aquifer where the elevation of the groundwater does not equal its head because it is under pressure.

Hydraulic Conductivity: A coefficient of proportionality describing the rate at which water can move through a permeable medium. It is a function of the porous medium and the fluid. The rate of flow of water in gallons per day through a cross-section of one square foot under a unit hydraulic gradient (gpd/ft^2), at the prevailing temperature. See permeability.

Impermeable: Characteristic of geologic materials that limit their ability to transmit significant quantities of water under the head differences normally found in the subsurface environment.

Mehrten Formation: A geologic unit of volcanic origin characterized by sand and gravel sized material deposited in a river environment. The Mehrten Formation is a regional groundwater producing aquifer in Sacramento County, California.

Monitoring Well: a well located some distance from a pumping well which is used to measure changes in water levels and or water quality during an applied aquifer stress. Sometime referred to as observation well or piezometer.

Permeability: Capacity of a rock or soil material to transmit a fluid.

Pliocene: Final epoch of the Tertiary period, spanning the time between 5.3 and 1.8 million years ago. It is named after the Greek words "pleion" (more) and "ceno" (new).

Potable Water: Suitable for human consumption as drinking water.

Potentiometric Surface: An imaginary surface formed by measuring the level to which water will rise in wells of a particular aquifer. For an unconfined aquifer the potentiometric surface is the water table; for a confined aquifer it is the static level of water in the wells. (Also known as the piezometric surface.)

Recharge Area: Area of land allowing water to pass through it into an aquifer by surface infiltration. This process occurs naturally when rainfall filters down through the soil or rock into an aquifer, usually in the higher gradient section overlying the aquifer.

Static Water Level: The level of water in a well that is not being pumped (the drawdown has been recharged by the surrounding groundwater).

Saturated Zone: The portion of subsurface soil and rock where every available space is filled with water. Aquifers are located in this zone.

Transmissivity: A measure of the ability of an aquifer to transmit water. The rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Transmissivity values are typically given in gallons per day through a vertical section of an aquifer one foot wide and extending the full saturated height of an aquifer under a hydraulic gradient of 1 (gpd/ft).

Unconfined Aquifer: An aquifer which the water table is its upper boundary. Because the aquifer is not under pressure the water level in a well is the same as the water table outside the well. An unconfined aquifer is near to the earth's surface causing it to be easily recharged as well as contaminated.

Unsaturated Zone: An area, usually between the land surface and the water table, where the openings or pores in the soil contain both air and water. Also called the zone of aeration.

Watershed: All the land area and water within the confines of a drainage divide in which all surface runoff will drain through one point, such as a stream or river. Determined by topographic high points.

Water Table: The water level of an unconfined aquifer, below which the pore spaces are saturated. The water table depth fluctuates with climate conditions on the land surface above and is usually gently curved and follows a subdued version of the land surface topography.

Well: An opening in the surface of the earth for the purpose of removing fresh water.

Well field: An area containing two or more wells supplying a public water supply system.

Wellhead: The physical structure, facility, or device at the land surface from or through which groundwater flows or is pumped from subsurface, water-bearing formations.

Zone of Capture: The ground water flowpaths that contribute water to an extraction well.

Zone of Influence: The area of groundwater that is affected by the pumping of a well. The faster the pumping rate the larger the area. The area of land above the cone of depression.

NEGATIVE DECLARATION

PROJECT TITLE: **Aquifer Storage and Recovery (ASR) Demonstration Test Phase 2**

PROJECT LOCATION: The project is located at 1490 Northpark Drive in the Diamond Creek subdivision, north of the intersection of Parkside Way and Northpark Drive, Roseville, CA 95747.

DATE: June 6, 2005

PROJECT APPLICANT: City of Roseville Department of Environmental Utilities

LEAD AGENCY: City of Roseville Community Development Department

CONTACT PERSON: Mark Morse, phone: (916) 774-5334

PROJECT DESCRIPTION: An ASR Demonstration Test is being proposed as a second phase of testing, following the Phase 1 Pilot Study that took place from May to September 2004 at the same location—the newly constructed Diamond Creek Well and three existing monitoring wells—Diamond Creek Monitoring Well No. 1 (DCMW-1), Diamond Creek Monitoring Well No. 2 (DCMW-2), and Diamond Creek Monitoring Well No. 3 (DCMW-3), near the vicinity of the Diamond Creek Well. A fourth monitoring well may also be added, if required by the Regional Water Quality Control Board. The demonstration test, which would take place between November 2005 and June 2007, is needed to obtain more operational and water quality information to be used for future planning of the citywide ASR project.

DECLARATION

The City of Roseville Environmental Coordinator has determined that the above project will have no significant effect on the environment and is therefore exempt from the requirement of an environmental impact report. The determination is based on the attached initial study and the following findings:

a) *The project will not degrade environmental quality, substantially reduce habitat, cause a wildlife population to drop below self-sustaining levels, reduce the number or restrict the range of special-status species, or eliminate important examples of California history or prehistory.*
b) *The project does not have the potential to achieve short-term, to the disadvantage of long-term, environmental goals.*
c) *The project will not have impacts that are individually limited, but cumulatively considerable.*
d) *The project will not have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly.*
e) *No substantial evidence exists that the project will have a negative or adverse effect on the environment.*
f) *The project incorporates all applicable mitigation measures identified in the initial study.*
g) *This negative declaration reflects the independent judgment of the lead agency.*

Written comments shall be submitted no later than 30 days from the posting date. City Council determination on this Mitigated Negative Declaration is final.

Submit comments to:
Mark Morse, Environmental Coordinator
Roseville Community Development Dept.
311 Vernon Street
Roseville, CA 95678

Posting Period: June 18, 2005 – July 18, 2005

Initial Study prepared by:

Mark Morse

Mark Morse, Environmental Coordinator
Roseville Community Development Dept.

1.0 INTRODUCTION

This Initial Study (IS) supports the Negative Declaration (ND) for the City of Roseville's Aquifer Storage and Recovery (ASR) Demonstration Test Phase 2. This project follows the Phase 1 Pilot Study, completed in August 2004, of the same location. An IS/ND for the previous study phase, as well as for the construction of the Diamond Creek Well, was approved by the Roseville City Council on May 1, 2002 and the Diamond Creek Well was built in April 2004. This IS contains five main sections:

- **Location of the Project and Name of the Proponent.**
- **Project Description.** This section contains a description of the proposed action and the mitigation measures that are incorporated into the demonstration test to avoid any potential significant, adverse impacts.
- **Initial Study Checklist.** This section provides documentation that supports the findings contained in the ND. The checklist required in the 2005 guidelines of the California Environmental Quality Act (CEQA) is presented herein with impact assessment conclusions and supporting documentation.
- **Environmental Factors Potentially Affected.** This section presents a summary of the environmental factors that may be affected and identifies whether these factors would be affected after mitigation.

The documents reviewed in preparation of this IS are presented in Section 9, Bibliography.

2.0 LOCATION OF THE PROJECT AND NAME OF THE PROPONENT

The proposed ASR Demonstration Test will primarily be conducted at the newly constructed Diamond Creek Well, which is located on Northpark Drive in the Diamond Creek subdivision, Roseville, California (as shown on **Figure 1**). The City of Roseville (City) is located on Highway 80 at the base of the western foothills of the Sierra Nevada, approximately 20 miles northeast of the City of Sacramento, California. The proponent is the City of Roseville Environmental Utilities Department.

As shown on **Figure 2**, the project location also encompasses three existing monitoring wells, referred to as Diamond Creek Monitoring Well No. 1 (DCMW-1), Diamond Creek Monitoring Well No. 2 (DCMW-2), and Diamond Creek Monitoring Well No. 3 (DCMW-3), near the vicinity of the Diamond Creek Well. A fourth monitoring well, that has not yet been located, may also be required by the Regional Water Quality Control Board. If required, the fourth monitoring well will be located in a publicly owned site or easement. The existing monitoring wells are located as follows:

- DCMW-1 and DCMW-2 are located in the park north of Pleasant Grove Creek, adjacent to the Diamond Creek Elementary School.

- DCMW-3 is located 1,400 feet southwest of the Diamond Creek Well on Opal Drive.

Although the fourth well may not be needed, it is included in this document for the purpose of impact evaluation.

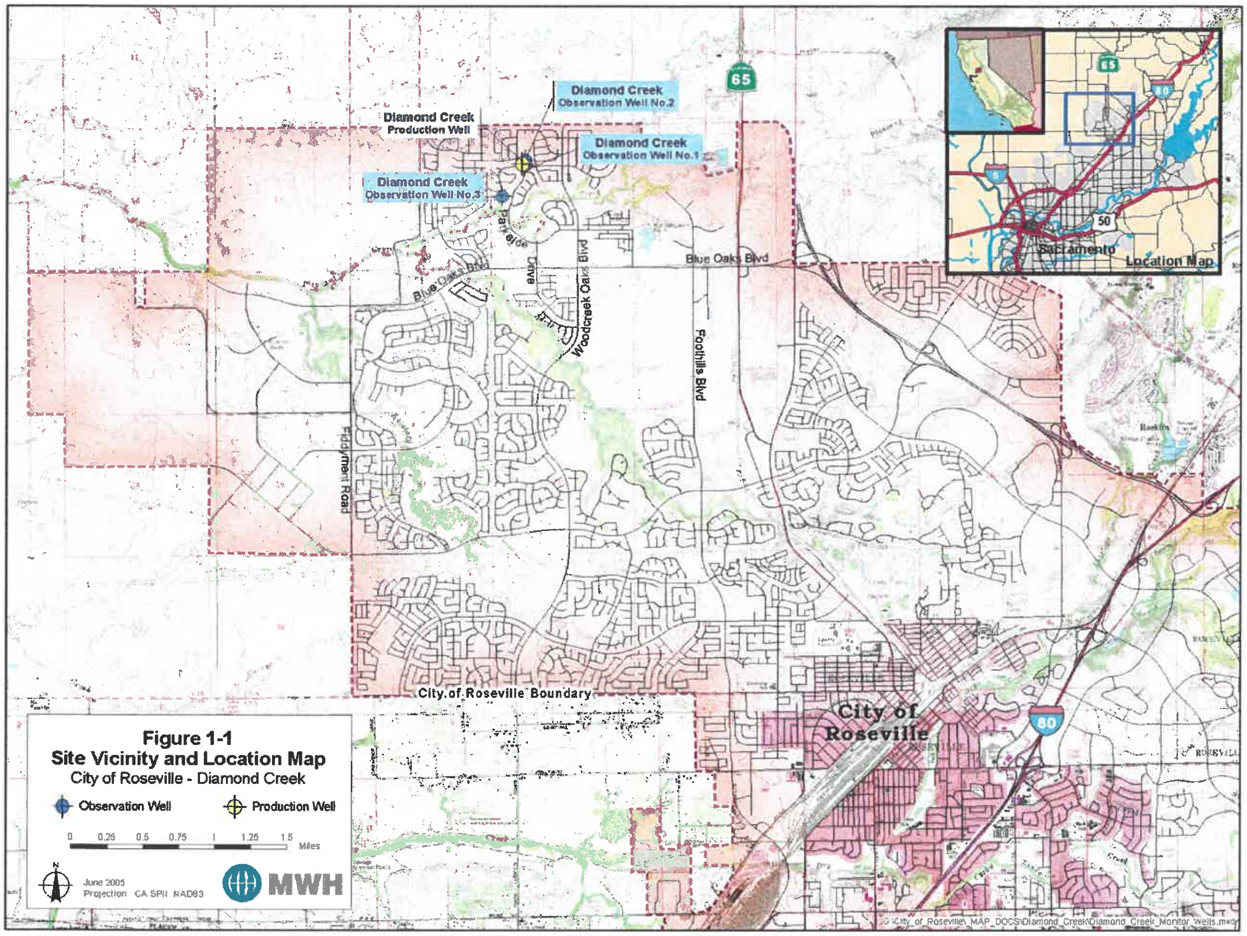

Figure 1. Site Vicinity and Location Map

Figure 2. Project Site Map

3.0 PROJECT BACKGROUND

To facilitate understanding of this IS/ND, the following section provides a brief overview of the City's water supply, the City's ASR program, and the Phase 1 Pilot Study that led up to this ASR Demonstration Test Phase 2.

3.1 CITY OF ROSEVILLE WATER SUPPLY

The City's primary water supply source is surface water from the Folsom Reservoir on the American River. In 2004, the Environmental Utilities Department supplied water to 96,000 persons within the City of Roseville. The City's water needs have been steadily rising, with deliveries increasing from 14,242 acre-feet (AF) in 1990 to 25,650 AF in 2000 (City of Roseville, 2003), and expected need projected to continue to 58,900 acre-feet annually (AFA) by build out, including water supply demands for the Foothill Business Park area and the recently annexed West Roseville Specific Plan area (City of Roseville, 2003 and 2004a). The City provides water from Folsom Reservoir through two sources: a water contract with the Central Valley Project for 32,000 AFA and purchased water rights water from Placer County Water Agency for 30,000 AFA. An additional 4,000 AF of supply was negotiated as part of the West Roseville Specific Plan annexation. This was Placer County Water Agency (PCWA) water, which was underutilized by the San Joan Water District and available in normal years (City of Roseville, 2003) Acknowledging its total entitlements of 66,000 AFA, the City has agreed to limit its surface water supply to 58,900 AFA in 2030, consistent with the Sacramento Area Water Forum (City of Sacramento, 1999) and the City's current General Plan build out demand. Groundwater has always been relied on for backup and redundancy.

Several studies have documented the City's need for improvements in their water supply, treatment, and distribution system to meet projected future demands (Spink Corporation, 1993; CH2M Hill, 1994). The continued growth in north and west Roseville will require additional backup water supply capacity for critical, dry years. The City has been planning a citywide ASR program to meet these water supply reliability needs.

The City's planned citywide ASR program (which is in the long-range planning stage and is not the subject of this IS/ND) would be the first implemented in the Central Valley. This program would build on the findings of 19 ASR projects of similar or greater magnitude that have been operating in Southern California and along the Pacific Coast for up to 40 years. In preparation of the materials required for the permit required from the RWQCB for the project, a literature search was prepared to cover citywide ASR programs that have been implemented elsewhere. This General Information Technical Memorandum (TM), prepared on behalf of the City, is hereby incorporated by reference and is available for review at the Roseville Corporation Yard, 2005 Hilltop Circle, Roseville, California. The General Information TM was prepared in response to "General Information Needs," described in the RWQCB, Region 5's May 3, 2005 letter to the City entitled Request for Report of Waste Discharge, City of Roseville Aquifer Storage and Recovery, Phase II Demonstration Project, Placer County. This memorandum provides an overview of a comprehensive literature review conducted to address the issues raised by the RWQCB regarding potential water quality impacts of ASR operations. The TM summarizes major findings from the literature review and general observations from the reviewed list of ASR projects in California, in other areas of the United States, and in other regions in the world with respect to the processes effecting formation and degradation of disinfection by-products.

The City has identified 11 potential well sites with aquifer storage and recovery potential for eventual use as part of a citywide ASR system, and has constructed the first of nine new wells, the Diamond Creek Well. As mentioned in Section 2, Location of Project and Name of the Proponent, the Diamond Creek Well is located north of the Parkside Way and Northpark Drive intersection, in the southwest corner of a park adjacent to the Diamond Creek Elementary School (**Figure 3**). If determined feasible, the citywide ASR program will be developed using data obtained during the Phase 1 Pilot Study, which has been completed, and the proposed Phase 2 ASR Demonstration Test, which is the subject of this IS/ND. The future citywide ASR program would receive separate project level environmental review under CEQA when the project is further developed.

Figure 3. Photo of Diamond Creek Well Pump House and DCMW-1

3.2 CITY OF ROSEVILLE AQUIFER STORAGE AND RECOVERY PROGRAM

ASR consists of three phases: potable water injection, storage, and extraction. The first phase involves injecting treated surface water through a well and storing it in a confined aquifer. During the injection phase, surface water travels away from the injection well in a radial fashion, displacing the existing groundwater and forming an irregular column of injected water around the well; the longer the injection period the wider the column of injected water. When injection has ceased and the storage phase begins, the column of injected surface water stops expanding. During the storage phase the rate and direction of groundwater movement is controlled by the natural groundwater gradient and hydraulic conductivity of the formation, and is generally very slow. During the water extraction phase, the injected column of surface water is recovered and the diameter of the column is reduced as the injected water is extracted. **Figure 4** is a schematic representation of the ASR process.

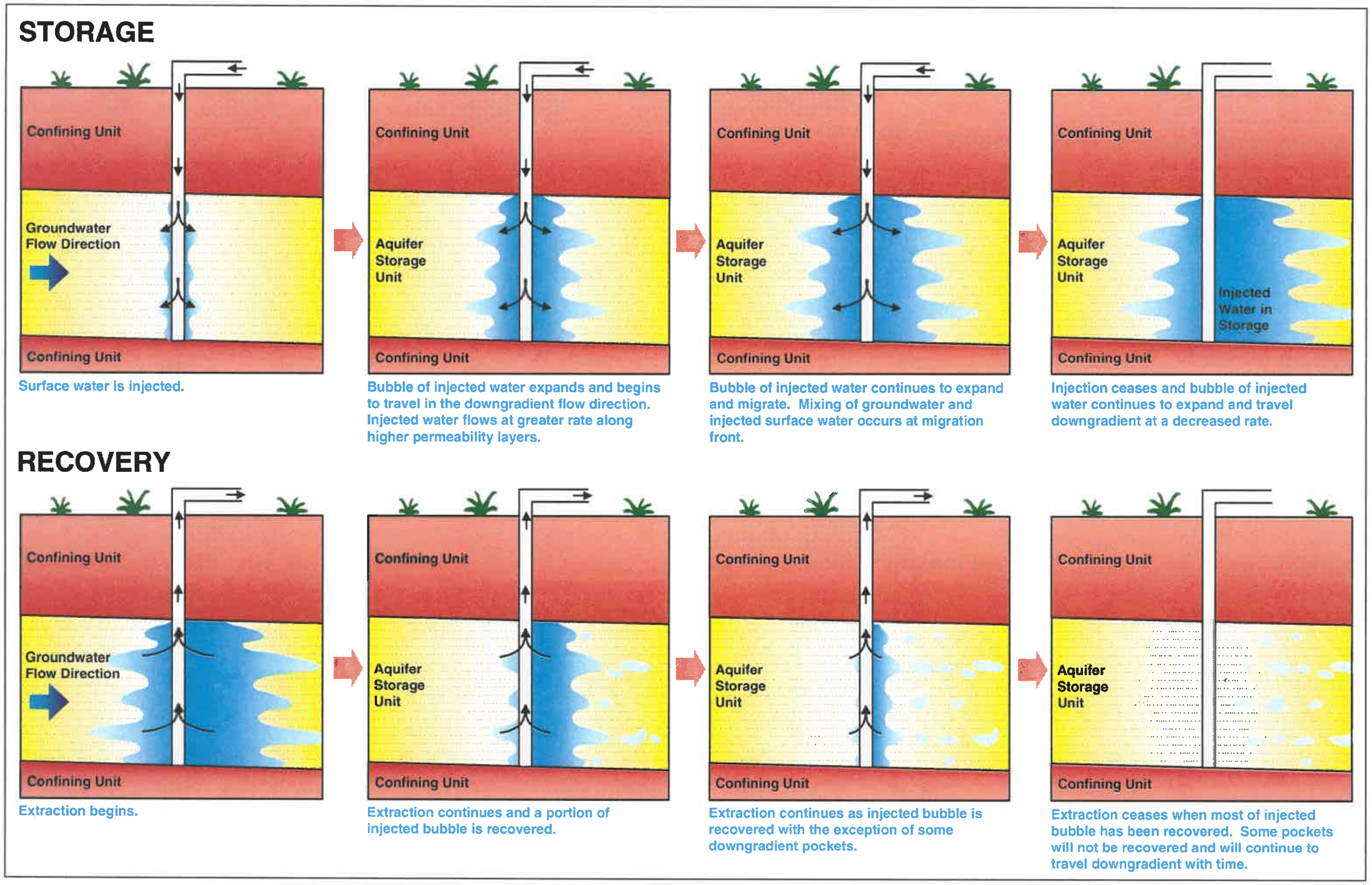

Figure 4. Schematic of Aquifer Storage and Recovery Process

Source: MWH

3.3 PHASE 1 PILOT STUDY

The ASR pilot-scale cycle test (cycle test) at the Diamond Creek Well was performed from May 5 to September 20, 2004. Cycle testing was conducted using potable water that originates in the Sierra Nevada, flows into the American River watershed, and is stored in Folsom Lake. The City conveys all of its surface water to its water treatment plant (WTP) for treatment to drinking water standards. During the cycle test, this potable (treated) water was conveyed to the Diamond Creek Well, through the City's drinking water infrastructure, and injected into the aquifer (the Mehrten formation) to evaluate the overall technical feasibility of ASR at the site.

3.3.1 Pilot Study Process

The pilot study, conducted from May to September 2004, consisted of three steps: baseline monitoring, injection, and extraction. Baseline monitoring and sampling included a series of monitoring and sampling events performed from May 5 to June 16, 2004. During this period, no water was injected at the Diamond Creek Well. The purpose of baseline monitoring and sampling was to establish the groundwater elevations and water quality in the aquifer before injecting the aquifer with treated water.

The injection portion of the cycle test consisted of 26 days of continuous surface water injection followed by two days of rest, or storage. The total volume of water injected was 158 AF (51,500,000 gallons). Injection water was transported to the Diamond Creek Well site using the City's existing drinking water distribution system. The injection portion of the cycle test included four monitoring and sampling events, performed from June 16 through July 12, 2004, to determine changes in groundwater elevations and water quality of the aquifer, at various distances from the injection well, during and following the injection period. System pressure and injection flow rate were also monitored during the injection phase of the pilot test.

There were three extraction phases during the study: July 14 through 26, August 3 through 9, and September 9 through 20, 2004. The three extraction phases were separated by storage periods lasting 8 and 31 days. The total volume of water extracted during all three phases was 439 AF (143,000,000 gallons), representing 278 percent of injected water volume. The volume extracted substantially exceeded that injected to ensure that essentially all of the injected water was removed from the aquifer. Eleven monitoring and sampling events were conducted at the Diamond Creek Well and six monitoring and sampling events were conducted at the three monitoring wells to determine changes in groundwater elevations and water quality of the aquifer, at various distances from the injection well, during and following the extraction period.

The water extracted from the aquifer was discharged into the City's stormwater system, which flows directly into nearby Pleasant Grove Creek. The extraction discharge was regulated under a waiver of waste discharge requirements (WDRs) issued by the Central Valley Regional Water Quality Control Board (RWQCB) on May 3, 2003, Resolution Order No. R5-2003-0083.

3.3.2 Pilot Study Results

Data collected during the pilot study was used to provide an understanding of local changes in groundwater elevations and quality, and to explore the feasibility of additional ASR testing and operational ASR projects in Roseville. A summary of the findings is presented in Section 7.8, Hydrology and Water Quality. The pilot study demonstrated favorable conditions with no adverse impacts to groundwater levels and no adverse water quality impact to the native groundwater in the aquifer. The *Pilot Scale Cycle Testing at Diamond Creek Well* report, completed by MWH in December 2004 and submitted to the Central Valley RWQCB, is hereby incorporated by reference and is available for review at the Roseville Corporation Yard, 2005 Hilltop Circle, Roseville, California. The conclusions of the report describe a successful ASR cycle test and recommended that a longer-term ASR demonstration test be performed at the Diamond Creek Well site to evaluate the operational characteristics of the project. The results of this cycle test indicate temporary changes in both groundwater elevations and quality. Groundwater elevations recorded during baseline monitoring at the Diamond Creek Well averaged approximately 13 feet above mean sea level (msl). The average height of mounding during the injection phase in the Diamond Creek Well was 25 feet with a maximum of 36 feet above baseline msl conditions. The average amount of drawdown in the Diamond Creek Well during the entire extraction phase was 60 feet, with a maximum of 65 feet below baseline msl conditions. Changes in groundwater quality were observed at the Diamond Creek Well during cycle testing. Based on laboratory analytical results, the source water was generally better quality than groundwater, but does include tract concentrations of disinfection by-products (DBPs) not usually found in groundwater. During the Phase 1 Pilot Study the only constituent in the extracted drinking water that posed a concern to the Central Valley RWQCB was DBPs, such as trihalomethanes (THMs) and haloacitic acids (HAAs). These constituents do not naturally occur in groundwater (see Section 7.8, Hydrology and Water Quality). Although THM concentrations in the extracted water were elevated relative to native groundwater, the concentrations during the pilot study were well below Title 22 drinking water standards and did not pose a significant health risk to consumers. The THM concentrations in the extracted water were comparable to those typically found in the City's drinking water. Based on the water quality results of the pilot study, beneficial uses of the water were not impacted.

4.0 PROJECT OBJECTIVES

The objective of the proposed project is to determine if the planned, long-term citywide ASR program is viable for the City. Following the Phase 1 Pilot Study, which determined that the Mehrten formation aquifer has the capacity to accept, store, and release water for recovery, consistent with the expectations of ASR technology, the City and the Central Valley RWQCB want to further assess the feasibility of ASR technology during a longer demonstration test in order to obtain more operational and water quality information that can be used for future planning of the citywide ASR project.

5.0 PROJECT DESCRIPTION: AQUIFER STORAGE AND RECOVERY DEMONSTRATION TEST PHASE 2

This section describes the project, including the permits and approvals that are required to perform the ASR Demonstration Test Phase 2, test facilities, activities to be undertaken during the test, and the required CEQA documentation.

5.1 REQUIRED PERMITS AND APPROVALS

Below is a description of the City approvals and RWQCB permit required for the proposed project.

5.1.1 City of Roseville

Approval of the ASR Demonstration Test Phase 2 project is a discretionary action subject to CEQA. The Roseville City Council will serve as Lead Agency for CEQA compliance and as such will adopt the ND. The City Council is also required to approve the ASR Demonstration Test Phase 2 Project.

5.1.2 Regional Water Quality Control Board

Implementation of the Demonstration Test Phase 2 requires a waiver of WDRs from the Central Valley RWQCB. This is the only permit required for the project. In issuing this discretionary permit, the RWQCB will be acting as a Responsible Agency under CEQA. As such, the RWQCB will rely on information and analysis contained in this IS/ND when issuing their waiver of WDRs.

On May 3, 2005 the City received a letter from the Central Valley RWQCB requesting the following items before the Board will consider a waiver for the test:

- Application for Waiver - Completed Form 200
- Filing Fee of $6,135
- General Information about ASR

The City provided site-specific information about the City's proposed test and the filing fee to the Central Valley RWQCB on May 16, 2005. The Central Valley RWQCB staff are currently in the process of preparing a waiver of WDRs, which will be considered by the Board at their August 4 to 5, 2005 meeting.

Information gathered during demonstration testing will be used by the RWQCB to establish permit requirements for the long-term operation of the City's ASR program.

The information provided to the RWQCB with the waiver application consists of a comprehensive literature review on ASR studies and relevant information on potential degradation of disinfection byproducts (DBPs) after injection. Table A1 in the General Information TM discussed previously in Section 3.1, City of Roseville Water Supply, tabulates the 47 leading ASR projects reviewed (excluding the City of Roseville ASR program), of which 19 are located in California, 14 located in other part of the United States, and 14 located in other countries (e.g., Australia, Greece, and England). Table A1 contains information for compounds of concern (COC) evaluated in these ASR projects, project locations, aquifer characteristics, source of injected water, and method of water treatment used in these projects. As shown, many of these projects are similar to the proposed Roseville test.

5.2 DEMONSTRATION TEST FACILITIES

The Diamond Creek Well is constructed with stainless steel material and can inject and extract water into and from the Mehrten formation, a confined aquifer located approximately 300 to 460 feet below ground surface (bgs). Three monitoring wells are constructed adjacent to and nearby the Diamond Creek Well solely for the purpose of collecting groundwater elevation and quality data. The monitoring wells (DCMW-1, DCMW-2, and DCMW-3) are constructed of polyvinyl chloride (PVC); screened within the Mehrten formation; and located 117, 196, and 1,417 feet away from the Diamond Creek Well, respectively, as shown in Figure 2. Discharge piping connects the wellhead to the existing 16-inch water line in Northpark Drive. The discharge piping is enclosed in the pump station building. The pump station building is soundproofed to meet the City's exterior noise level standards.

The piping configuration allows the system to flush, or pump, well discharge water to the storm drain for a period of time after the well pump turns on after conversion from recharge to recovery mode of operation. The flush water from the well would be routed from the pump station building to a manhole located behind the building and eventually tie into the existing storm drain facility in Northpark Drive.

The pump station building also houses a chlorination system that would add hypochlorite to the extracted water before it enters the distribution system. Hypochlorite is added to the extracted water to provide a standard level of residual disinfectant. This will entail the use of a chemical tank located within the well building and offloading capabilities for bulk chemical delivery for up to 400 gallons of a 10 to 15 percent hypochlorite solution.

A fourth monitoring well, if needed, would be built in a public right-of-way (i.e., in a street or a park) or where the City has a public easement. The well would be located in a down gradient direction from the Diamond Creek Well (i.e., toward the west-southwest) and would be installed only if required to obtain additional data. The well would be constructed in accordance with standard well construction procedures and would consist of a 4-inch diameter well constructed of PVC installed to a depth of approximately 500 feet. The well would be constructed and developed in the same manner as DCMW-1, DCMW-2, and DCMW-3. Construction of a fourth monitoring well would take place during daylight hours over a period of three to five days and the location would be selected, or traffic management measures employed, so as not to affect any nearby residential access. The finished visible part of the well would be a 12-inch diameter metal plate secured to and flush with the ground surface (see **Figure 3** for photo of

DCMW-1). A diagram showing the engineering of the Diamond Creek Well and the monitoring wells is presented in **Figure 5.**

5.3 AQUIFER STORAGE AND RECHARGE DEMONSTRATION TEST PHASE 2 ACTIVITIES

The ASR Demonstration Test (Phase 2) will build on the results of the Pilot Study (Phase 1), testing operations, groundwater elevations, and water quality conditions for a longer period of time. The main ASR Demonstration Test activities will be injecting and

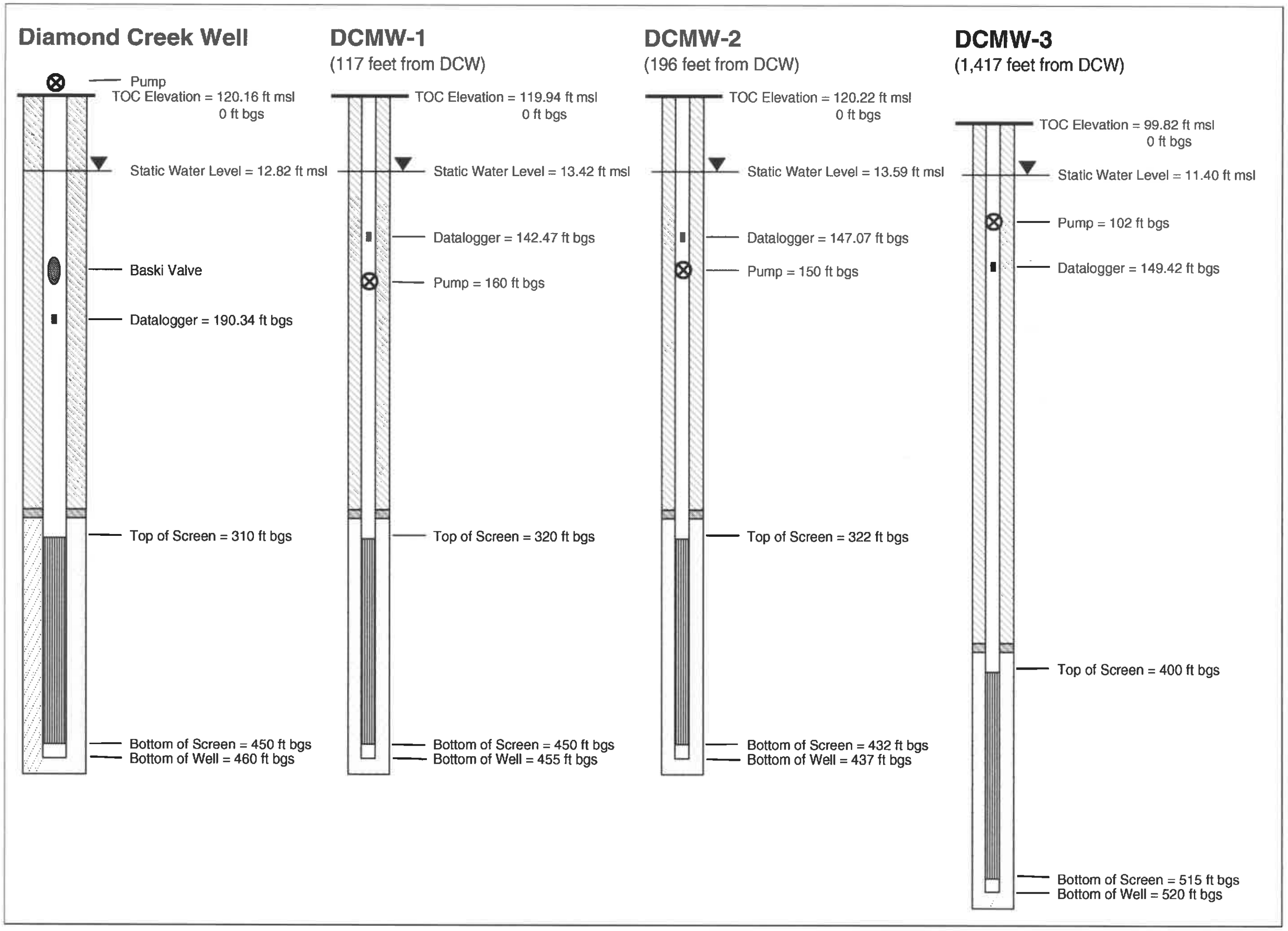

Figure 5. Engineering Diagram of Diamond Creek Well and Monitoring Wells

Source: MWH

extracting drinking water into and out of the Mehrten formation, using the Diamond Creek Well, and monitoring the effects of these processes at the Diamond Creek Well, three existing monitoring wells, and a potential fourth monitoring well. The first section below provides the water injection and extraction schedule, followed by sections describing the entire demonstration test, to include the water source, transmission of the water to the well, injection of the water into the aquifer, aquifer storage, extraction from the aquifer, water sampling, and final distribution. A contingency plan, to mitigate any impacts found during the test, is also described.

5.3.1 Demonstration Test Schedule

The proposed demonstration test involves six months of injection, four months of storage, and 10 months of extraction. **Table 1** presents the test schedule for the proposed Phase 2 ASR Demonstration Test.

Table 1. Proposed Phase 2 Aquifer Storage and Recovery Demonstration Test Schedule

ASR Phase	Phase Start	Phase End	Duration (months)
Injection	November 2005	April 2006	6
Storage	May 2006	August 2006	4
Extraction	September 2006	June 2007	10

5.3.2 Water Source

The demonstration test will be conducted using potable drinking water originating from Folsom Reservoir, the same source that was used during the Phase 1 Pilot Study. As previously discussed, the water drains from the Sierra Nevada, flows into the American River, and is stored in Folsom Reservoir. The volume of water diverted is within the City's existing surface water rights and no change in water rights is required for the demonstration test.

5.3.3 Transmission of Water from Source to Diamond Creek Well

The City will convey water from Folsom Reservoir to its Barton Road water treatment plant for treatment to California Department of Health Services drinking water standards. The City will then convey the water, for a distance of approximately 13.2 miles, to the Diamond Creek Well through its existing water distribution system. Water treatment at the City's treatment plant includes flocculation, sedimentation, filtration, disinfection, fluoridation, and pH adjustment for corrosion control. **Figure 6** provides a schematic of the pipeline route from the water treatment plant to the Diamond Creek Well.

5.3.4 Injection of Water at the Diamond Creek Well

Surface water injection into the Mehrten formation aquifer will only occur at the Diamond Creek Well. The average water injection rate, as shown in **Table 2**, will be similar to the Phase 1 Pilot Study (1,300 to 2,000 gallons per minute [gpm]).

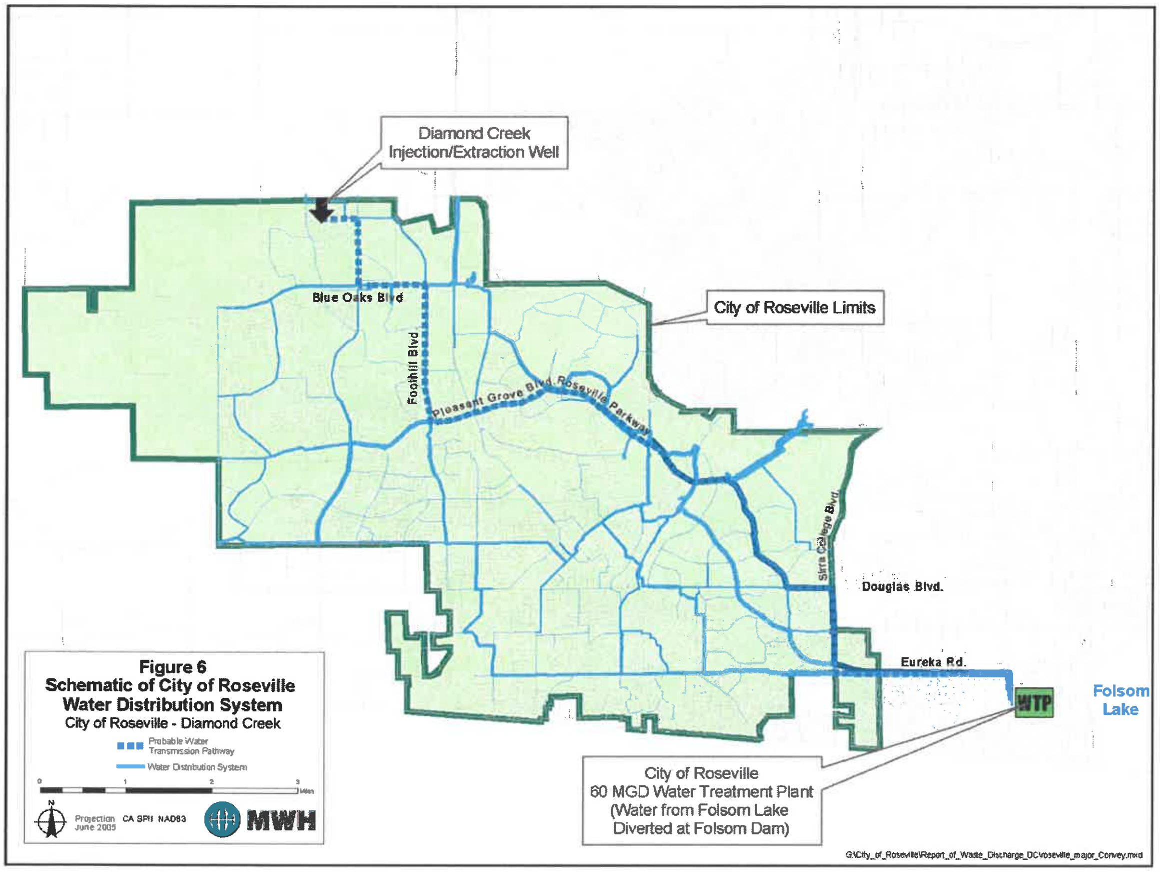

Figure 6. Schematic of City of Roseville Water Distribution System

Table 2. Anticipated Volume of Injected and Extracted Drinking Water, Aquifer Storage and Recovery Demonstration Test Phase 2

	Injection Phase	Extraction Phase
Phase Duration	6 months / 180 days	10 months / 300 days
Average Flow Rate (gpm)	1,375	2,500
Average Flow Rate (AF/day)	6.08	11.05
Total Volume (gallons)	3.56×10^8	1.08×10^9
Total Volume (AF)	1,094	3,314
Volume Extracted (minus) Volume Injected (AF)		2,220
Volume Extracted versus Volume Injected		303%

Key
AF acre-foot
gpm gallons per minute

5.3.5 Water Storage

Water will be stored in the aquifer and no pumping will occur for four months. During this period the City will regularly monitor changes in groundwater quality to quantify the rate and better understand the mechanism(s) for changes in DBP concentrations.

5.3.6 Water Extraction

Extraction will take place from September 2006 to June 2007. The extraction rate planned for the demonstration test (2,500 gpm) is approximately 1,000 gpm less than the average extraction rate during the Phase 1 Pilot Study (3,440 gpm). A lower extraction rate is expected for Phase 2 because the extracted water will be discharged into the City's drinking water distribution system under system pressure. During the pilot study, water was discharged directly into a storm drain with no backpressure, resulting in a higher extraction rate

When initiating the demonstration test extraction phase, the Diamond Creek Well will be purged for approximately 10 minutes to remove any suspended solids from the water system. Suspended solids are commonly found in extracted water during pump initiation, caused by water turbulence within the well casing and filter pack.

5.3.7 Sampling

City staff will collect water quality samples and measure water table elevations at the Diamond Creek Well and each of the monitoring wells. Sampling will be conducted approximately once per week throughout the duration of the demonstation test. All well sampling can be completed within approximately eight hours and will be completed during daylight hours. Sampling activities will include

- Collecting depth-to-water measurements, at the Diamond Creek Well and each of the three (or four) monitoriong wells, using an electronic water indicator. These wells are also equipped with data loggers for automatic collection of water level data. This manual collection of depth-to-water data serves as a quality control check.

- Purging (pumping) a calculated volume of groundwater from each of the three monitoring wells. Purging will be performed using a portable generator, transported to the well locations to power dedicated pumps located within the well casings. Purged water, generally in the range of 500 gallons per well, will be disposed of directly into a stormwater drain, consistent with the City's stormwater discharge permit. Well purging is necessary to remove stagnant water from the well to assure that representative groundwater is collected and sampled.
- Collecting water quality samples at each well, for laboratory analysis, according to the Proposed Monitoring Program (**Appendix A**).

The sampling schedule will encompass baseline, injection, storage, and extraction phases of the demonstration test. Baseline sampling is designed to determine elevations and water quality of the goundwater in the aquifer before beginning treated water injections, while the sampling during the other phases is designed to monitor changes in groundwater elevation and quality during the injection, storage, and extraction phases of the test.

5.3.8 Water Distribution

The City has authorization, from the California Department of Health Services (DHS), to return the extracted water to the drinking water distribution system during this demonstration test. Authorization was provided by DHS based on the sucessful operation of the Phase 1 Pilot Study and the high quality of the water extracted during Phase 1, which met all Title 22 drinking water standards. The Phase 1 Pilot Study discharged the extracted water from the Diamond Creek Well into the stormwater drain for a period of approximately 29 days at an average rate of 3,440 gpm. Water quality analyses of the discharged water performed during Phase I confirmed that the water would not adversely affect the condition of Pleasant Grove Creek.

During the first 10 minutes of extraction during Phase 2, the extracted water will be routed into the facility's stormwater drain, which flows into a tributary of Pleasant Grove Creek. Discharge of treated water into the stormwater drainage system is a common practice and is allowed under the City's existing permit for stormwater discharge.

5.3.9 Contingency and Mitigation Plan

As noted above, during the Phase 1 Pilot Study the only constituent in the extracted drinking water that posed any type of concern to the Central Valley RWQCB was the presence of THMs and other DBPs, which do not naturally occur in groundwater (see Section 6.8, Hydrology and Water Quality). Although DBP concentrations in the extracted water during the Phase 1 Pilot Study were elevated relative to native groundwater, the concentrations were well below DHS drinking water standards and did not pose a significant health risk to consumers.

The demonstration test project proposes a duration and volume of pumping that is expected to remove all THMs and other DBPs from the aquifer. However, if concentrations of these chemicals were found in the aquifer at levels above Central Valley RWQCB's water quality objectives at the end of the proposed extraction period, the City would implement its contingency and mitigation plan, which calls for continued pumping at the Diamond Creek Well until monitoring data confirm that essentially all DBPs have been removed.

During the Phase 1 Pilot Study, 2.8 times more water was extracted than injected in order to remove all DBPs. The pilot study did not include a storage period between the injection and extraction phases. Information from many other ASR projects indicates that concentrations of DBPs decrease rapidly during storage periods. The ASR Demonstration Test Phase 2 includes a four-month storage period and it is expected that concentrations of DBPs would decrease significantly during this phase of the test. For this reason, the proposed 10 months of extraction may be an overestimate of actual time and volume (three times the volume of water injected) required to remove the DBPs. However, the City is committed to continue pumping, as needed, to remove all DBPs or other constituents of concern from the aquifer following the Phase 2 test.

5.4 CALIFORNIA ENVIRONMENTAL QUALITY ACT DOCUMENTATION

Construction of the Diamond Creek Well and execution of the Phase 1 Pilot Study were covered by an IS/MND (City of Roseville, 2002), approved by the Roseville City Council on May 1, 2002. The Phase 2 ASR Demonstration Test is covered in this environmental document, which includes an evaluation of the potential impacts of the project and recommends mitigation measures, or preparation of an Environmental Impact Report, according to the CEQA 2005 Guidelines. The future citywide ASR program will be covered by a separate environmental document that will be prepared when that program is developed and proposed. Thus, this document covers only the Demonstration Test Phase 2 for the specified duration and no long-range permanent activities are included.

6.0 CITY OF ROSEVILLE MITIGATING ORDINANCES, GUIDELINES, AND STANDARDS

CEQA allows the use of uniformly applied, previously adopted development policies or standards as mitigation for the environmental effects of future projects when those standards have been adopted by the City, with findings based on substantial evidence that the policies or standards will substantially mitigate environmental effects (CEQA Guidelines §15183(f)). The City's Noise Ordinance, Flood Damage Prevention Ordinance, Construction Standards, Improvement Standards, Tree Ordinance, Subdivision Ordinance, and Community and Specific Plan Design Guidelines include standards and policies that are uniformly applied to development projects throughout the City. In March 2003, the City of Roseville adopted Findings of Fact confirming that certain environmental impacts for the following issue areas are mitigated by the uniform application of the above ordinances, guidelines, and standards (Resolution 03-169):

- Noise
- Flooding
- Urban Form/Aesthetics
- Tree Impacts
- Cultural Resources Impacts
- Hazards/Hazardous Materials
- Water Quality
- Drainage
- Traffic

The City's mitigating ordinances, guidelines, and standards are referenced, where applicable, in this Initial Study Checklist. Because the City has adopted CEQA Findings that these Mitigating Policies and Standards substantially mitigate environmental impacts, no additional project-specific mitigation is required for the specified impact areas.

7.0 INITIAL STUDY CHECKLIST

The Initial Study Checklist is presented in accordance with the CEQA Environmental Checklist Form. The Environmental Checklist Form requires the Lead Agency to answer a series of questions regarding the effects of the project on the environment, as follows.

7.1 AESTHETICS

Would the project:

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☐	☒
d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?	☐	☐	☐	☒

Questions a. through d.

The demonstration test will take place within the existing Diamond Creek Well and up to four monitoring wells, three of which exist (see Figure 3), therefore none of these questions apply to the project.

Conclusion: Any Urban Form/Aesthetics impacts are mitigated by the uniform application of the City of Roseville Resolution 03-169 described above in Section 6, City of Roseville Mitigating Ordinances, Guidelines, and Standards. As no impact is foreseen as a result of the project, no mitigation measures are required.

7.2 AGRICULTURE RESOURCES

In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997), prepared by the California Department of Conservation (CDC), for use in assessing impacts on agriculture and farmland. Would the project:

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Involve other changes in the existing environment that, due to their location or nature, could result in conversion of Farmland to non-agricultural use?	☐	☐	☐	☒

Questions a., b., and c.

The proposed demonstration test will take place in an existing facility using three existing monitoring wells and a possible fourth well to be built in an urban area within City limits. Therefore, these questions do not apply.

Conclusion: As no impact is foreseen as a result of the project, no mitigation measures are required.

7.3 AIR QUALITY

Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:

a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment zone under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for				

ozone precursors)?	☐	☐	☐	☒
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒

Questions a. through d.

Air emissions from vehicles used by demonstration test personnel (two vehicle trips—one round trip—per day) are too small to calculate and are therefore considered to be less than significant.

Question e.

The chlorination activities of the demonstration test will produce minor chemical odors that will be limited to one room within the pump station building. The pump station building is not accessible to the public. Therefore, no impacts from odors will result from the project.

Conclusion: Project impacts to air quality will be less than significant.

7.4 BIOLOGICAL RESOURCES

Would the project:

a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive, natural community identified in local or regional plans, policies, or regulations, or by California Department of Fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands, as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.), through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) Interfere substantially with the movement of any				

native resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	☒
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

Questions a. through f.

The proposed project will take place within an existing building, three existing monitoring wells, and a potential fourth well that will be constructed on a developed urban site; therefore these questions do not apply to the project.

Conclusion: As no impact is foreseen as a result of the project, no mitigation measures are required.

7.5 CULTURAL RESOURCES

Would the project:

a) Cause a substantial adverse change in the significance of an historical resource, as defined in Section 15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource, pursuant to Section 15064.5?	☐	☐	☐	☒
c) Directly or indirectly destroy a unique paleontological resource or site, or unique geologic feature?	☐		☒	☐
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐		☒	☐

Questions a. through d.

The project would be implemented using existing water distribution infrastructure and facilities. Therefore, it is not expected that the project would create the potential for impacts to historic, archaeological, or paleontological resources. The only possible exception would be if the RWQCB requires installation of a fourth monitoring well. If required, the new monitoring well would be installed within a public right-of-way or where the City has a public easement. Since these areas have been previously disturbed, it is considered unlikely that monitoring well installation would cause impacts to cultural resources. Further, the City of Roseville Mitigating Policies and Standards include requirements intended to prevent impacts to cultural resources. Consequently, related impacts are considered less than significant.

Conclusion: The City of Roseville's adopted Findings for Mitigating Policies and Standards determine that in the event that previously unidentified cultural resources are present on a project site, impacts to those resources would be prevented by the requirements of the City's Construction Standards. Specifically, the City of Roseville Construction Standards (Resolution 01-208) requires that the contractor stop construction if signs of an archeological site are discovered during construction of the project. Work shall be halted and the Community Development Department notified. A qualified archeologist shall be notified and additional mitigation may be required. Based on the City's findings, potential impacts to cultural resources would be mitigated to less than significant.

7.6 GEOLOGY AND SOILS

Would the project:

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area, or based on other substantial evidence of a known fault (CDC,1997a).	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in an on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☒	☐

d) Be located on expansive soil, as defined in Table 18- 1-B of the Uniform Building Code (1994), creating substantial risks to life or property? ☐ ☐ ☐ ☒

e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water? ☐ ☐ ☐ ☒

7.6.1 Geologic Setting

Regional Geology

The Department of Water Resources (DWR) Bulletin 118-3 identifies and describes various geologic formations that constitute water-bearing deposits underlying the North American Subbasin, where the project site is located (DWR, 1974). These formations include an upper, unconfined aquifer system consisting of the Riverbank (formerly known as Victor) and Turlock Lake/Laguna (formerly known as Fair Oaks-Laguna) formations, and a lower, semi-confined aquifer system consisting primarily of the Mehrten formation. These formations are typically composed of lenses of inter-bedded sand, silt, and clay interlaced with coarse-grained stream channel deposits.

Groundwater occurs in unconfined to semiconfined states throughout the North American Subbasin. Semiconfined conditions occur in localized areas; the degree of confinement typically increases with depth below the ground surface. Groundwater in the Victor, Fair Oaks, and Laguna formations (the "upper aquifer") is typically unconfined. However, because of the heterogeneous nature of the alluvial depositional system, semiconfined conditions can be encountered at shallow depths in the aquifer. The deeper Mehrten formation (the "lower aquifer") typically exhibits semiconfined conditions. An additional discussion of the regional geology is included in the *Diamond Creek Well Completion Report* (MWH, 2003), which is available for review at 2005 Hilltop Circle, Roseville California.

Local Hydrogeology

The Mehrten formation is the target aquifer for the City's ASR program. The Mehrten formation is Pliocene in age and is divided into two units: (1) volcanic sands, gravels, and clays (sedimentary) and (2) zones of tuff-breccia. The sedimentary unit is composed of black andesitic sands, reported by well drillers as "black sands" and interbedded blue to brown clays. The black andesitic sands are well sorted and often associated with beds of gravel containing cobbles and boulders. The other unit of the Mehrten formation is a hard and very dense, gray tuff-breccia, reported by well drillers as "lava," which typically overlies the sedimentary unit. This tuff-breccia consists of angular blocks of black, gray, and red fine-grained to porphyritic andesite. The Mehrten units range in thickness from 200 to 1,200 feet (ft) and form a semiconfined aquifer that dips toward the west at approximately 1 to 2 degrees.

A summary of subsurface lithologic data recorded at the Diamond Creek Well and the three monitoring well sites is shown in **Figure 7**. Lithology at the Diamond Creek Well consists almost solely of clay and silt from the ground surface (approximately 120 ft above msl) to approximately 300 ft bgs. From 300 to 460 ft bgs, the predominate soil material encountered consists of sands and gravels, consistent with descriptions of the Mehrten formation. Soils returned to silts and clays from approximately 460 ft bgs to the total depth of the borehole, 502 ft bgs. This 160-foot-thick aquifer was designated as part of the Mehrten formation based on the volcanic and "black sand" lithologic characteristics observed. Similar lithologic conditions were observed in DCMW-1 and DCMW-2, with approximate Mehrten formation top depths at 310 and 305 ft bgs, respectively. The bottom of the Mehrten formation was not identified at these locations.

The lithology encountered at DCMW-3 was similar in composition to the lithology at the Diamond Creek Well, but significant water-bearing deposits consistent with the Mehrten formation were located at much greater depths. At DCMW-3, the top of the Mehrten formation was identified at 380 ft bgs, approximately 90 ft lower in elevation than at the Diamond Creek Well. The ground surface elevation at DCMW-3 is approximately 100 ft above msl. **Figure 8** provides a cross-section of the local site geology, based on observed subsurface lithology.

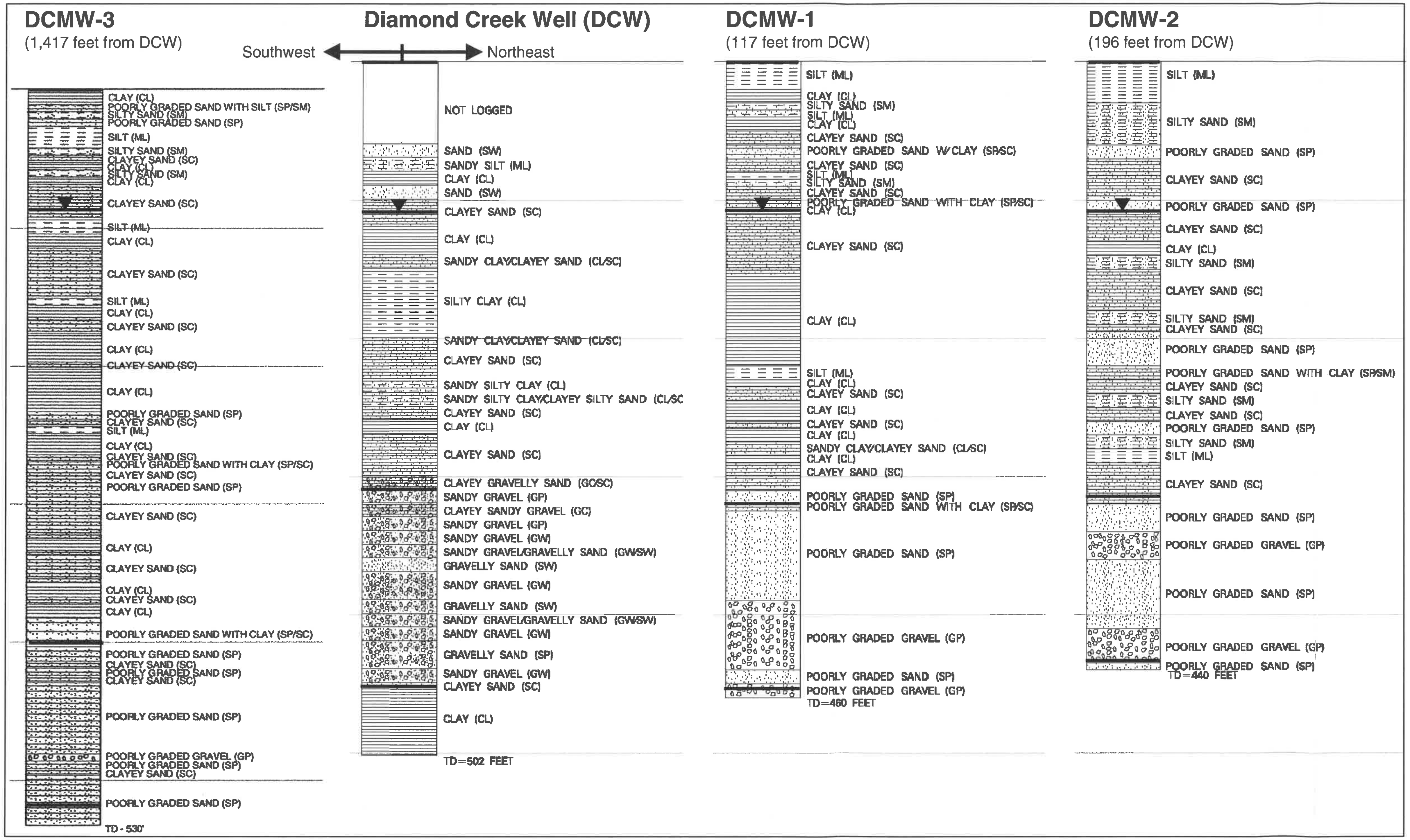

Figure 7. Subsurface Lithology at the Diamond Creek Well and Monitoring Wells

Source: MWH

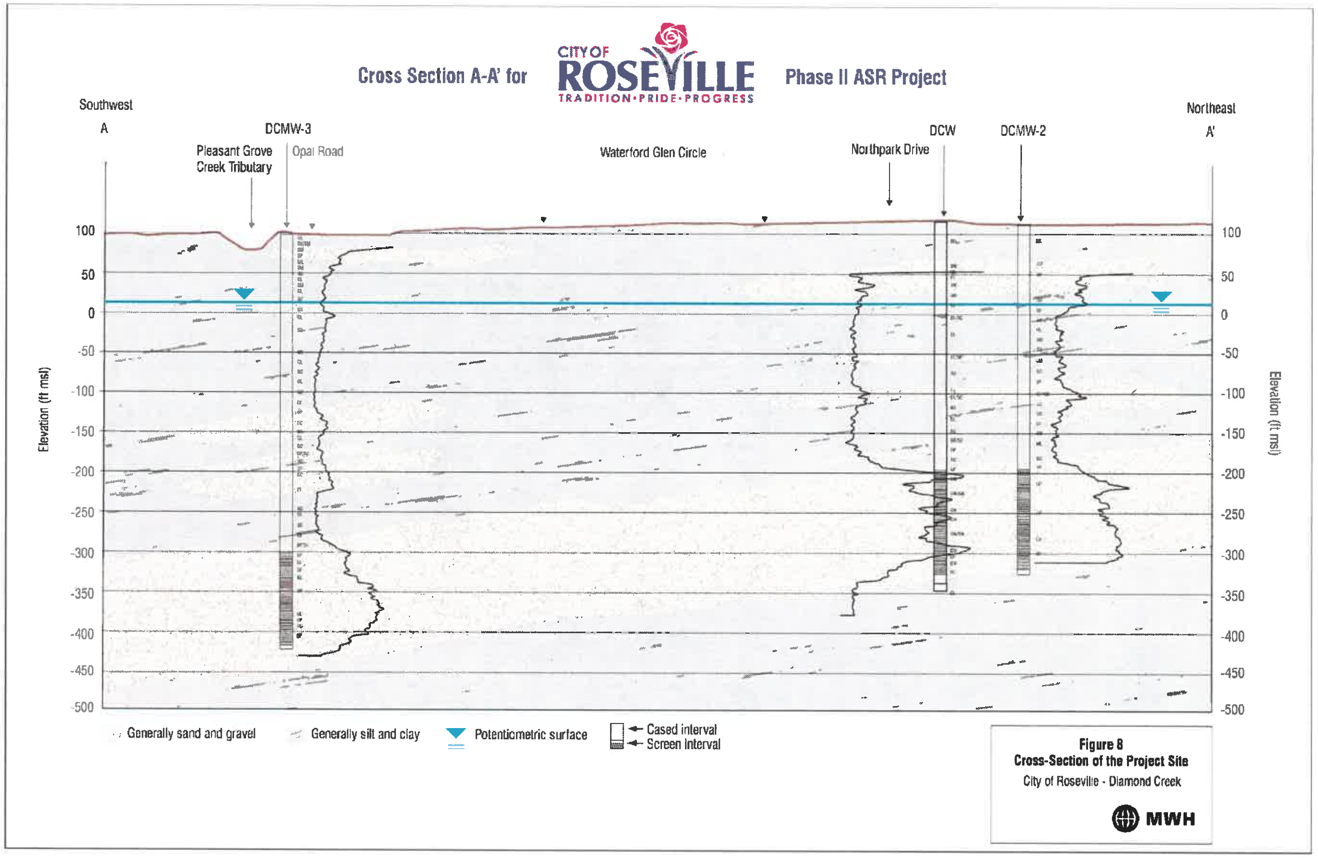

Figure 8. Cross-Section of the Project Site

Question a. i, ii, iii, iv

7.6.2 FAULTING AND SEISMICITY

Regional and Local Faults

The potential for seismic activity from faults, referred to in Question a.i., to affect the geology of the project site is low. A fault is defined as a fracture or zone of closely associated fractures along which rocks on one side have been displaced, with respect to those on the other side. A fault zone is a zone of related faults that are braided and subparallel, but may be branching or divergent. An active fault is defined as one that has had surface displacement within Holocene time (about the last 11,000 years). A potentially active fault is one that has showed evidence of displacement during Quaternary time (last 1.6 million years). An "inactive" fault is considered one that has not shown any evidence of displacement within Quaternary time (CDC, 1997a).

The Alquist-Priolo Special Studies Zone Act of 1972 is directed at areas, as identified by the State Geologist, likely to experience earthquakes. The Act focuses on surface fault rupture and not shaking. The project site is not located within an Alquist-Priolo Earthquake Fault Zone (City of Roseville, 2004a) and, therefore, would not be subject to the permitting requirements of the Alquist-Priolo Earthquake Fault Zoning Act.[1] No Alquist-Priolo Fault Zones are located within Placer County or adjacent Sacramento, Sutter, Yuba, Nevada, or El Dorado counties (CDC, 1999).

The project site is situated between the Coast Range and San Francisco Bay region, a seismically active zone, and the Sierra Nevada, an historically active seismic zone. According to the California Geological Survey (CGS), no active faults or mapped faults are known to exist within Roseville in the vicinity of the project site (CDC, 2005). The closest faults identified by the CGS, on its Probabilistic Seismic Hazard Assessment Maps, are located approximately 25 miles east of the project site in the Foothills Fault System, which is a series of inactive faults located along the western slope of the Sierra Nevada. The Foothills Fault System extends approximately 225 miles (360 kilometers [km]), from Tehama County in the north to Mariposa County in the south. The faults located to the west of the project site include those within the San Francisco Bay region. According to the CGS, the faults closest to the project site in the San Francisco Bay region are the Great Valley thrust faults, which generally occur along the western portions of Colusa, Yolo, Solano, and Contra Costa counties, approximately 60 miles or more from the project site. The historically active Hayward Fault is located approximately 80 miles from the project site and the historically active San Andreas Fault is located approximately 90 miles from the project site.

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[1] The Alquist-Priolo Special Studies Zones Act of 1972 was changed to the Alquist-Priolo Earthquake Fault Zoning Act as a result of a July 25, 1993 amendment.

Although no active faults are located within Placer County, three inactive faults lie within the immediate Roseville vicinity. These inactive faults include: 1) the Volcano Hill fault, located east of the City limits; 2) the Linda Creek fault, which extends along Linda Creek through Roseville and a portion of Sacramento County; and 3) an unnamed fault alignment extending east to west between Folsom Lake and the City of Rocklin (City of Roseville, 2004a).

Seismicity and Hazards Associated with Ground Shaking

Roseville and the Sacramento Region have a low probability of experiencing significant ground shaking (City of Roseville, 2004a). The CGS, with cooperation of the U.S. Geological Survey, evaluates the potential for areas within California to incur strong seismic ground shaking and seismic-related ground failure. While any community within California is subject to potential seismic activity, the Roseville area is classified as a low-severity earthquake zone (CDC, 1996).

Liquefaction

Because liquefaction generally occurs in near-surface, unconsolidated, saturated materials that are post-Holocene in age (none of which describe the project site), and because the potential for seismic activity at the project site is low, liquefaction is not considered a significant hazard at the project site (City of Roseville, 2004). The IS prepared for construction of the Diamond Creek Well facilities acknowledged the (low) potential for liquefaction at the project site. All project components constructed at the site in anticipation of the City's ASR Pilot Test were designed for Seismic Zone 3, in accordance with the provisions of the Uniform Building Code (UBC) and consistent with the development standards of the Roseville General Plan. The proposed project does not involve the construction of any new structures or wells and would not affect the determination made in the previous IS. A description of liquefaction is provided below that supports the less-than-significant determination for liquefaction to occur at the project site.

Liquefaction is a physical process that occurs during some earthquakes and may lead to ground failure. Liquefaction takes place when seismic shear waves pass through a saturated granular soil layer, distort its granular structure, and cause some of its pore spaces to collapse, causing the materials to act as viscous fluids rather than solids. The collapse of the granular structure increases pore space water pressure and decreases the soil's shear strength.

The vast majority of liquefaction hazards are associated with sandy soils and silty soils of low plasticity. Cohesive soils are generally not considered susceptible to soil liquefaction. In addition to sandy and silty soils, some gravelly soils are potentially vulnerable to liquefaction. Most gravelly soils drain relatively well; however, when their voids are filled with finer particles or they are surrounded by less pervious soils, drainage can be impeded and they may be vulnerable to cyclic pore pressure generation and liquefaction (CDC, 1997b). Moreover, gravelly geologic units tend to be deposited in a more turbulent depositional environment than sands or silts, tend to be fairly dense, and generally resist liquefaction. Accordingly, conservative "preliminary" methods may often suffice for evaluation of liquefaction potential. For example, based on the *Guidelines for Evaluating and Mitigating Seismic Hazards in California (CDC,*1996, gravelly deposits that can be shown to be pre-Holocene, such as those found in the Mehrten formation, are generally not considered susceptible to liquefaction.

In addition, in order to be susceptible to liquefaction, potentially liquefiable soils must be saturated or nearly saturated and are generally located in low-lying areas. According to the CGS, in general, liquefaction hazards are most severe in the upper 50 feet of the surface. If it can be demonstrated that any potentially liquefiable materials present at a site are currently unsaturated (e.g., are above the water table), have not previously been saturated (e.g., are above the historic-high water table), and are highly unlikely to become saturated (given foreseeable changes in the hydrologic regime), then such soils generally do not constitute a liquefaction hazard that would require mitigation. No changes to the upper 50 ft of the project site would occur as a result of the proposed project.

The geologic materials encountered at the project site generally include 300 ft of sands, clayey sand, and silty clay before encountering the Mehrten formation aquifer, which consists of approximately 160 ft of volcanic sandy gravel and gravelly sand deposited during the Pliocene. The Mehrten formation is considered a confined to semiconfined aquifer and is believed to be completely saturated. In addition, saturated sediment is also present above the Mehrten formation in the clay and sand layers. The clay layer serves as an aquitard separating the Mehrten formation aquifer from an upper unconfined aquifer. During construction of the 502-foot Diamond Creek Well in November 2002, the static water level was encountered approximately 106 ft bgs (MWH, 2003). Unsaturated sediments were generally encountered from the ground surface to this measured level and are graphically represented on the project site's cross-section (**Figure 8**).

Landslides

Landslide hazards are not associated with the proposed project, as no changes to the land surface will occur. The topographic relief at the project site is generally flat. The ground surface at the Diamond Creek Well and monitoring wells DCMW-1 and DCMW-2 is approximately 120 ft above msl. At DCMW-3 the ground surface is approximately 100 ft above msl, which corresponds to a gradient of approximately 0.014 between the two areas. The location of the potential fourth well will be selected with the same characteristics.

Question b.

The proposed project does not involve the discharge of water onto land surface, which could result in soil erosion or loss of topsoil. Therefore, no impact would occur.

Question c.

The proposed project, other than the Diamond Creek Well pump house, which was constructed in accordance with construction standards stated in the UBC for Seismic Zone 3, is not located directly "on" a geologic unit, but instead exercises a confined aquifer using a water production well that is drilled "through" multiple geologic units. The project site is located within an existing residential community and the geologic units were shown, prior to construction of the community, to be extremely stable and developable. Because the proposed project only involves the injection, storage, and extraction of water in an extremely transmissive aquifer located from 300 to 460 ft bgs, and no impacts to local geology or soils would be experienced during the duration of the proposed project, no impact would occur. Although no impact would occur, and this issue is considered less than significant because of this site's characteristics, a discussion of some issues associated with unstable soils and groundwater extraction is provided for the reader's information.

Subsidence

Based on known information of the aquifer system(s) underlying the Diamond Creek Well, ground subsidence is not believed to be a concern during injection and extraction of water from the Mehrten formation during the ASR Demonstration Test Phase 2.

Land subsidence is a gradual settling or sudden sinking of the Earth's surface due to subsurface movement of earth materials. The principle causes of subsidence are aquifer compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost. In the case of the proposed project, which involves injecting, storing, and extracting groundwater from the Mehrten formation, groundwater withdrawal would be the most likely mechanism for ground subsidence at the project site. But, as discussed below, subsidence is not a concern associated with the proposed project. The objective of the proposed project is to perform a pumping test within the Mehrten formation aquifer to demonstrate the feasibility of ASR technology. The purpose of an operational ASR system is to stabilize groundwater levels and maintain the volume of water within the aquifer, effectively reducing the potential for subsidence associated with groundwater pumping. A discussion of subsidence follows.

In aquifer systems that include semiconsolidated silt and clay layers (aquitards), long-term groundwater level declines can result in a vast, one-time release of water from the pore space of the clay minerals. This decrease in pore pressure causes a flattening and compression of the platy clay framework, which manifests itself as land subsidence. Accompanying this release of water is a largely non-recoverable reduction in the pore volume of the compacted aquitards, which results in a reduction of the total storage capacity of the aquifer system. Allowing water levels to recover to their pre-development status cannot reinstate the loss of aquifer pore space (U.S. Department of the Interior, 2000).

The proposed project is the demonstration phase of ASR, which involves adding surface water to an aquifer, effectively increasing the pressure head of the system for the duration of the injection cycle; storing water in the aquifer, which allows the pressure head to normalize; then extracting water from the aquifer, effectively reducing the pressure head and creating a localized, but temporary, "cone of depression" in the potentiometric surface. The Diamond Creek Well is the only conduit that injects and extracts water from the Mehrten formation, which is believed to be a semiconfined to confined aquifer in the vicinity of the project site. In Figure 8, which displays the subsurface lithology observed in the project wells, multiple distinct and thick clay layers are located above the Mehrten formation; these layers constitute an aquitard(s) separating the Mehrten formation from an upper unconfined to semiconfined aquifer, and from upper unsaturated (or saturated) and unconsolidated material. Multiple lenses of sand, silts, and clays characterize this area.

During the pilot study, head elevations in the monitoring wells were observed to fluctuate as expected, based on the relative distance from the Diamond Creek Well. Head elevations increased during injection, recovered during storage, and decreased during extraction. Because of the extremely transmissive nature of the Mehrten formation, which was determined by analyzing the changes in head elevations in the monitoring wells over time, head elevations changed almost immediately when the Diamond Creek Well was turned on and off and when flow rates fluctuated. This trend was observed to replicate itself during each of the three extraction cycles of the pilot study and calculations used to determine the hydraulic properties of the aquifer were consistent with the performance of a confined aquifer. Hydraulic conductivity is the hydraulic variable that describes the rate at which water can flow through a permeable medium, in this case the Mehrten formation. Analysis of the data generated during the Phase 1 Pilot Study indicated that the hydraulic conductivity of the Mehrten formation was approximately 200 ft per day (ft/day) (MWH, 2004). Conversely, clay, which is the geologic material located above and below the Mehrten formation, has published hydraulic conductivity values that range from 0.028 ft/day to 0.00028 ft/day (Fetter, 2001). Therefore, during injection and extraction cycles of the proposed project, most, if not all, of the water is moving through and coming from the Mehrten formation. The wells installed at the project site are only screened within the highly transmissive Mehrten formation to ensure that water only moves through that interval.

In a saturated aquifer system, water generally flows in a path of "least resistance" and is released much more easily from a permeable sand and gravel medium, like the Mehrten formation, than from an impermeable clay medium, which has an internal structure that "holds" onto water. Water from the overlying clay layer, the aquitard, would have a natural tendency to release water from pore space if groundwater levels in the underlying Mehrten formation were lowered below historical low values, over a broad area, for an extended period of time (on the order of years). Because this test will not result in a regional reduction in groundwater levels below historical low values, subsidence is not considered a concern.

Although no monitoring of land subsidence was performed during the Phase 1 Pilot Study, and is not a component of the proposed project, should the City decide to proceed with an operational ASR program at the Diamond Creek Well, or at other sites within the City, ground subsidence monitoring equipment may be considered at that time.

Question d.

No project components would be placed on soils that are expansive or would result in landslides; therefore, no impact would occur.

Question e.

This question is not applicable to the proposed project; therefore, no impact would occur.

Conclusion: No mitigation is proposed as it relates to Geology and Soils.

7.7 HAZARDS AND HAZARDOUS MATERIALS

a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☒	☐
d) Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan, or where such a plan has not been adopted within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒

h) Expose people or structures to a significant risk of loss injury or death involving wild land fires, including where wild lands are adjacent to urbanized areas or where residences are intermixed with wild lands? ☐ ☐ ☐ ☒

Questions a. through h.

Chlorination at the project will be accomplished by bulk delivery or manual mixing of a solution of hypochlorite in a 400 gallon storage tank using tap water and dry chemicals to produce the desired 10-15 percent solution strength. The solution storage tank material is composed of high-density polyethylene, suitable for the intended use of the solution stored and located within the existing well building. The solution will be conveyed automatically via chemical metering pumps and related piping and appurtenances; no special containment or handling procedures are required. Therefore, no hazards or hazardous conditions will be created by the proposed project.

Conclusion: Any Hazards and Hazardous Materials impacts are mitigated by the uniform application of the City of Roseville Resolution 03-169, described above in Section 6, City of Roseville Mitigating Ordinances, Guidelines, and Standards. As no impact from hazards and hazardous materials is foreseen as a result of the project, no mitigation measures are required.

7.8 HYDROLOGY AND WATER QUALITY

Would the project:

a) Violate any water quality standards or waste discharge requirements? ☐ ☐ ☒ ☐

b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge, such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)? ☐ ☐ ☒ ☐

c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on- or off-site? ☐ ☐ ☐ ☒

d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially

increase the rate or amount of surface runoff in a manner, which would result in flooding on-or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems, or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality?	☐	☐	☒	☐
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary, or Flood Insurance Rate Map, or other flood hazard delineation map?	☐	☐	☐	☒
h) Place structures, within a 100-year flood hazard area, that would impede or redirect flood flows?	☐	☐	☐	☒
i) Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of failure of a levee or dam?	☐	☐	☐	☒
j) Inundate the project site by seiche, tsunami, or mudflow?	☐	☐	☐	☒

Question a.

7.8.1 GROUNDWATER

Regulatory Background

The project area lies within the purview of the Central Valley RWQCB's Water Quality Control Plan (Basin Plan). The Basin Plan defines the beneficial uses of surface and groundwater in the Central Valley and establishes water quality objectives to satisfy those beneficial uses (RWQCB, 1998). Unless otherwise designated by the Central Valley RWQCB, the beneficial uses of all ground waters in the Central Valley include municipal and domestic water supply, agricultural supply, industrial service supply, and industrial process supply (RWQCB, 1998).

The Central Valley RWQCB recognizes that ASR projects present some unique issues with respect to regulating water quality. In a recent staff report, the Central Valley RWQCB (2005), while recognizing the potential value of ASR projects, identified two general issues of concern with regard to regulating ASR projects: potential aquifer water quality degradation, in general, and contamination from chlorine disinfection byproducts, in particular (RWQCB, 2005). The Central Valley RWQCB addressed the issue of regulating general water quality degradation by citing the State Water Resources Control Board's Antidegradation Policy (Resolution No. 68-16). ASR projects generally use treated drinking water for aquifer injection, so this water must meet Basin Plan drinking water standards, which are based on Title 22 Maximum Concentration Levels (MCLs). However, even if the water satisfies the MCLs it may have poorer water quality than that of the water in the aquifer. If so, injecting the water into the aquifer may risk degrading the quality of the ground water, which could violate the Antidegradation Policy. Under this policy, the quality of any water that meets or exceeds levels needed to protect existing and probable future beneficial uses must be maintained until or unless it has been demonstrated that any change in water quality will be consistent with the maximum benefit to the people of the state, will not unreasonably affect beneficial uses of such water, and will not result in the violation of any water quality objectives (RWQCB, 2003 and 2005). In short, if the injection of water into an aquifer results in reduced water quality in the aquifer, the Central Valley RWQCB could treat such injection as a harmful discharge of waste even if no water quality objectives were violated.

The Central Valley RWQCB (2005), in its staff report, discussed the issue of regulating contamination of an aquifer from DBPs both with respect to the Antidegradation Policy and specific water quality objectives. Many municipalities treat their water supplies with chlorine to eliminate pathogens and thereby make the water safe to drink. The chlorinated water often contains significant concentrations of DBPs, including THMs and HAAs, which present health risks at certain concentrations. The native groundwater of an aquifer generally has none of these DBPs, so injection of treated water would degrade the aquifer with respect to these chemicals, potentially violating the Antidegradation Policy. In addition, the Central Valley RWQCB (2005) posited that injection of treated water into the aquifer could result in a violation of the toxicity water quality objectives for these chemicals. The Central Valley RWQCB (2003 and 2005) does not consider the drinking water standards (MCLs) for the DBPs to be adequately protective of groundwater. These standards were derived by balancing the health benefit provided by chlorination with the potential toxicity of DBPs, in consideration also of the high costs of alternative water treatment processes. However, because the effects of chlorination are not germane with respect to the native groundwater, which may be free of pathogens and serve other beneficial uses than drinking water, the Central Valley RWQCB (2003) requires the toxicity objectives for DBPs in groundwater be based on much lower levels of health risk than those used for the MCLs.

The Central Valley RWQCB (2005) recognizes that burdensome regulation of ASR projects would risk inhibiting their development and that this would be undesirable given the high potential value and need of such projects. Therefore, the staff report recommends that demonstration projects, such as that proposed in this IS/ND, be regulated under a conditional waiver of WDRs. As stated in the report, "In general, the waiver would allow groundwater pollution for a short-term, controlled project, contingent upon (a) adequate monitoring to determine the nature and extent of water quality impacts from the short-term testing and to predict long-term impacts from full implementation of the ASR project, (b) submittal and implementation of contingency plans to clean up or abate unintended impacts on groundwater quality should the demonstration project result in violation of water quality objectives beyond the predicted injection front or violation of water quality objectives after the injected water has been extracted." The City's Phase 1 Pilot Study received a conditional waiver of WDRs from the Central Valley RWQCB. The results of the pilot study, described below, show that the demonstration test can be expected to have transient, largely beneficial effects on aquifer water quality with a less-than-significant impact on native groundwater.

Results of the Phase 1 Pilot Study

The Phase 1 Pilot Study tested water quality of the treated water injected into the aquifer as well as water quality of the groundwater before and during the injection and extraction phases of the study (a summary of the pilot study implementation schedule is provided in Section 5, Project Description). As described in the project description, the City's drinking water, which originates in the American River watershed, is obtained from Folsom Reservoir, while the groundwater is obtained from the Merhten formation, a deep confined or semiconfined aquifer. Treated water from the City's WTP was sampled at the injection/extraction well (Diamond Creek Well) twice during a 42-day baseline period, before beginning injections of the treated water, and four times during the 26-day water injection period. Groundwater was sampled at three monitoring wells (DCMW-1, DCMW-2, and DCMW-3) three times during the baseline period, four times during the injection phase of the study, and six times during three extraction phases. Groundwater was also sampled at the Diamond Creek Well during the baseline and extraction phases, but was not sampled during the injection phase when the treated water, which was sampled at the well, was being injected at this site. Water quality constituents analyzed for the pilot study were selected based on requests by Central Valley RWQCB and suggestions from MWH.

Table 3 gives the results of the analyses of the City's WTP treated water, for the Central Valley RWQCB-requested water quality parameters, and shows the most stringent drinking water standard (MCL) for each of the parameters. All the parameters satisfied the MCLs. The MCL for total coliform is not given because the sampling schedule was not appropriate for testing drinking water for total coliform. Coliform concentrations are expressed as the most probable number (MPN) per 100 milliliter (ml). The June 23, 2004 treated water sample had a total coliform concentration of 8.7 MPN/100 ml, which exceeds the Basin Plan objective for total coliform in groundwater (2.2 MPN/100 ml). It should also be noted that although the MCL for total THMs was not exceeded, the most restrictive (non-drinking water) toxicity objectives for THMs in groundwater, as discussed in the previous section, are much lower than the drinking water MCLs. Chloroform was the principal THM in all the treated water samples. The most restrictive toxicity objective for chloroform is 1.1 micrograms per liter (μg/L) (RWQCB, 2003), which is well below any of the total THM concentrations reported in **Table 3**.

Tables 4 and 5 provide the laboratory analysis results for the Central Valley RWQCB-requested parameters in the groundwater at the Diamond Creek Well (**Table 4**) and at the three monitoring wells (Table 5). As indicated in the project description, DCMW-1 and DCMW-2 are within 200 ft of the Diamond Creek Well, while DCMW-3 is 1,417 ft down gradient. No MCLs were exceeded in the Diamond Creek Well groundwater samples (Table 4), but the MCL for total dissolved solids was slightly exceeded at the DCMW-1 and DCMW-2 wells during the baseline period, early in the injection period, and late in the extraction period (**Table 5**). In addition, the MCL for boron was equaled or slightly exceeded in baseline, early injection, and late extraction groundwater samples from DCMW-2. A number of samples from all three monitoring wells exceeded the Basin Plan objective for total coliform in groundwater. These exceedences occurred during all three project test phases. A few of the values were very high, which could have resulted from contamination of the samples. As was true for the treated water (Table 3), total THM concentrations in the groundwater did not exceed the MCL for total THM, but far exceeded the most restrictive non-drinking water toxicity objectives in many samples from all the wells except DCMW-3. Note that the highest total THM and total HAA concentrations occurred in samples from the injection and early extraction phases of the test. These patterns of DBP concentrations are discussed in the next section.

Table 3. Water Quality Results for Central Valley Regional Water Quality Control Board-Requested Parameters from Pilot Study of Treated Water

WTP									
CONSTITUENT	**UNITS**	**MCL[1]**	**DETECT LIMIT**	**Sample Date**					
				Baseline		Injection			
				5/5/2004[3]	**5/19/2004[3]**	**6/16/04**	**6/23/04**	**6/30/04**	**7/7/04**
WTP									
Chlorine Residual	mg/L	4	0.05	0.9	0.6	0.49	0.4	0.34	0.44
Dissolved Ammonia	mg/L (N)	1.5[2]	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dissolved Boron	mg/L	1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dissolved Fluoride	mg/L	2	0.1	0.3	0.7	0.7	0.6	0.8	0.8
Dissolved Iron	mg/L	0.3	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Nitrate	mg/L	10	0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1
Dissolved Sulfate	mg/L	250	1	6	6	5	5	5	5
pH**	pH Units	N/A	0.1	9	8.9	8.5	8.7	8.6	**8.6**
Total Coliform	MPN/100ml	N/A	1.1	ND	ND	ND	**8.7**	ND	ND
Total Dissolved Solids	mg/L	500	1	55	61	48	43	52	49
Total HAA	µg/L	60	N/A	20.9	23.7	16.8	18.6	18.8	13.3
Total Kjeldahl Nitrogen	mg/L (N)	1	0.1	<0.1	<0.1	<0.1	--	<0.1	<0.1
Total THM	µg/L	80	N/A	43.1	43.7	35.1	36.1	37.3	35.6

[1] California Department of Health Services Primary MCL

[2] Taste & Odor Threshold

Key

µg/L	micrograms per liter
HAA	haloacetic acid
MCL	maximum concentration level
mg/L	milligrams per liter
ml	milliliter
MPN	most probable number
ND	not detected
THM	trihalomethane
WTP	water treatment plant

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Table 4. Results for Central Valley Regional Water Quality Control Board-Requested Constituents in Groundwater from Pilot Study at Diamond Creek Well

CONSTITUENT	UNITS	MCL[1]	DETECT LIMIT	Sample Date													
				Baseline			Extraction / Storage										
				5/5/04	5/12/04	5/19/04	7/14/04	7/16/04	7/19/04	7/21/04	7/23/04	7/26/04	8/2/04	8/5/04	8/9/04	9/9/04	9/20/04
DCW																	
Dissolved Ammonia	mg/L (N)	1.5[2]	0.01	<0.01	- -	<0.01/<0.01	<0.01	- -	- -	<0.01	- -	<0.01	<0.01	- -	- -	- -	- -
Dissolved Boron	mg/L	1	0.1	0.7	- -	0.7/0.7	<0.1	- -	- -	0.4	- -	0.6	0.6	- -	- -	0.7	- -
Dissolved Chloride	mg/L	250	1	166	162	170/170	4	14	43	69	92/92	125	129	139	154	154	- -
Dissolved Fluoride	mg/L	2	0.1	<0.1	- -	0.2/0.2	0.8	- -	- -	0.4	- -	0.3	0.3	- -	- -	0.3	0.2
Dissolved Iron	mg/L	0.3	0.005	0.005	- -	<0.005/<0.005	<0.005	- -	- -	<0.005	- -	<0.005	<0.005	- -	- -	- -	- -
Dissolved Manganese	mg/L	0.05	0.005	<0.005	- -	<0.005/<0.005	<0.005	- -	- -	<0.005	- -	<0.005	<0.005	- -	- -	- -	- -
Dissolved Molybdenum	mg/L	0.01[3]	0.005	<0.005	- -	<0.005/<0.005	<0.005	- -	- -	<0.005	- -	<0.005	<0.005	- -	- -	- -	- -
Dissolved Sulfate	mg/L	250	1	25	- -	27/27	5	- -	- -	15	- -	22	23	- -	- -	24	- -
Total Coliform	MPN/100ml	N/A	1.1	ND	- -	ND/ND	ND	ND	- -	ND	- -	ND	ND	- -	- -	- -	- -
Total Dissolved Solids	mg/L	500	1	447	470	463/463	58	90	178	236	287/292	387	397	402	424	437	- -
Total HAA	µg/L	60	N/A	0.0	- -	0.0/0.0	14	- -	- -	9.5	- -	1.6	0.0	- -	- -	- -	- -
Total THM	µg/L	80	N/A	0.52	5.4	0.5/0.6	46.7	39.9	33.5	27.2	21.9/21.9	13.1	12.1	9	5.2	5.4	1.5

[1] California Department of Health Services Primary MCL

[2] Taste & Odor Threshold

[3] Agricultural Water Quality Limit

2.5/2.6 - Primary and duplicate sample

- - = Not sampled

Key

µg/L	micrograms per liter	ml	milliliter
DCW	Diamond Creek Well	MPN	most probable number
HAA	haloacetic acid	ND	not detected
MCL	maximum concentration level	THM	trihalomethane
mg/L	milligrams per liter		

Table 5. Results for Central Valley Regional Water Quality Control Board-Requested Constituents in Groundwater from Pilot Study at Diamond Creek Monitoring Wells

CONSTITUENT	UNITS	MCL[1]	DETECT LIMIT	Sample Date													
				Baseline				Injection				Extraction / Storage					
				5/5/04	5/12/04	5/19/04	6/8/04	6/16/04	6/23/04	6/30/04	7/7/04	7/14/04	7/21/04	7/26/04	8/2/04	9/9/04	9/20/04
DCMW-1																	
Dissolved Ammonia	mg/L (N)	1.5[2]	0.01	<0.01/<0.01	- -	NS	- -	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	- -	- -
Dissolved Boron	mg/L	1	0.1	0.9/0.8	- -	NS	- -	0.8	0.2	0.1	<0.1	<0.1	0.6	0.9	**0.8**	**1**	- -
Dissolved Chloride	mg/L	250	1	185/185	187	NS	- -	188	37	14	8	6	84	159	158	189	- -
Dissolved Fluoride	mg/L	2	0.1	<0.1/<0.1	- -	NS	- -	0.2	0.6	0.7	0.8	0.8	0.3	0.2	0.2	0.3	- -
Dissolved Iron	mg/L	0.3	0.005	0.005/<0.005	- -	NS	- -	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	- -	- -
Dissolved Manganese	mg/L	0.05	0.005	<0.005/<0.005	- -	NS	- -	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	- -	- -
Dissolved Molybdenum	mg/L	0.01[3]	0.005	<0.005/<0.005	- -	NS	- -	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	- -	- -
Dissolved Sulfate	mg/L	250	1	29/29	- -	NS	- -	29	10	6	6	6	17	27	28	29	- -
Total Coliform	MPN/100ml	N/A	1.1	ND/ND	- -	NS	ND	ND	**170**	ND	ND	ND	ND	ND	**6.4**	- -	- -
Total Dissolved Solids	mg/L	500	1	**529/540**	**512**	NS	- -	**539**	168	116	80	71	282	484	446	**515**	- -
Total HAA	μg/L	60	N/A	0/0	- -	NS	- -	0	15.6	18.6	18.3	14.3	4.4	0.0	0.0	- -	- -
Total THM	μg/L	80	N/A	0.7/0.89	0.0	NS	- -	0	31.2	38.4	43.1	44.5	24.7	9.9	9	2.4	0.83
DCMW-2																	
Dissolved Ammonia	mg/L (N)	1.5[2]	0.01	<0.01	- -	<0.01	- -	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01/<0.01	- -	- -
Dissolved Boron	mg/L	1	0.1	**1**	- -	**1**	- -	**1**	0.5	0.2	0.1	0.1	0.9	**1**	**1/1**	**1.1**	- -
Dissolved Chloride	mg/L	250	1	204	208	205	- -	207	81	24	9	13	148	180	182/180	203	- -
Dissolved Fluoride	mg/L	2	0.1	<0.1	- -	0.2	- -	0.2	0.4	0.6	0.7	0.7	0.2	0.2	0.2/0.2	0.4	- -
Dissolved Iron	mg/L	0.3	0.005	0.005	- -	<0.005	- -	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005/<0.005	- -	- -
Dissolved Manganese	mg/L	0.05	0.005	<0.005	- -	<0.005	- -	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005/<0.005	- -	- -
Dissolved Molybdenum	mg/L	0.01[3]	0.005	<0.005	- -	<0.005	- -	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005/<0.005	- -	- -
Dissolved Sulfate	mg/L	250	1	32	- -	33	- -	33	16	8	6	7	26	31	32/32	31	- -
Total Coliform	MPN/100ml	N/A	1.1	ND	- -	**41**	- -	ND	ND	ND	ND	ND	ND	ND	ND/**5.3**	- -	- -
Total Dissolved Solids	mg/L	500	1	**544**	**547**	**572**	- -	**546**	266	151	85	93	415	**528**	**528/502**	**512**	- -
Total HAA	μg/L	60	N/A	0.0	- -	0.0	- -	0.0	13.3	19.6	15.2	6.1	0	0	0.0/0.0	- -	- -
Total THM	μg/L	80	N/A	0.0	0.0	0.0	- -	0.0	24.5	36.8	43.3	42.0	10.9	5.1	5.2/5.0	2	0.76
DCMW-3																	
Dissolved Ammonia	mg/L (N)	1.5[2]	0.01	<0.01	- -	<0.01	- -	<0.01	<0.01/<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	- -	- -
Dissolved Boron	mg/L	1	0.1	0.6	- -	0.6	- -	0.6	0.6/0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	- -
Dissolved Chloride	mg/L	250	1	147	150	148	- -	148	149/149	150	142	144	142	141	141	146	- -
Dissolved Fluoride	mg/L	2	0.1	0.1	- -	0.2	- -	0.2	0.2/0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	- -
Dissolved Iron	mg/L	0.3	0.005	<0.005	- -	<0.005	- -	<0.005	<0.005/<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	- -	- -
Dissolved Manganese	mg/L	0.05	0.005	<0.005	- -	<0.005	- -	<0.005	<0.005/<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	- -	- -
Dissolved Molybdenum	mg/L	0.01[3]	0.005	<0.005	- -	<0.005	- -	<0.005	<0.005/<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	- -	- -
Dissolved Sulfate	mg/L	250	1	23	- -	24	- -	24	24/24	24	25	25	24	24	24	23	- -
Total Coliform	MPN/100ml	N/A	1.1	ND	- -	ND	- -	**200**	**15**/ND	**9.9**	ND	**DET**[4]	**27.1**	ND	**9.9**	- -	- -
Total Dissolved Solids	mg/L	500	1	425	432	422	- -	464	428/400	433	440	452	412	418	439	418	- -
Total HAA	μg/L	60	N/A	0.0	- -	0.0	- -	0.0	0.0/0.0	0.0	0.0	0.0	0.0	0.0	0.0	- -	- -
Total THM	μg/L	80	N/A	0.9	1.1	0.0	- -	0.0	0.0/0.0	0.0	0.0	39.9	0.0	0.0	0.0	0	0

[1] California Department of Health Services Primary MCL
[2] Taste & Odor Threshold
[3] Agricultural Water Quality Limit
[4] DET = Detected in presence/absence test

2.5/2.6 = Primary and duplicate sample
- - = Not sampled

Key

μg/L	micrograms per liter	HAA	haloacetic acid	MCL	maximum concentration level	mg/L	milligrams per liter
ml	milliliter	MPN	most probable number	ND	not detected	THM	trihalomethane

Potential Effects of the Demonstration Test Phase 2

Three questions need to be answered to assess the likely effects of the demonstration test on water quality.

1. How does the water quality of the treated water injected into the aquifer compare to the aquifer's native groundwater in the project area?
2. What will be the geographical extent of changes to the aquifer water quality produced by injecting treated water?
3. How close to its original water quality conditions will the aquifer's native groundwater be in the project area when the test is completed?

These questions can largely be answered by analyzing the findings of the Phase 1 Pilot Study. The design of the pilot study and demonstration test are very similar, with the principal differences being the duration of the tests and the volumes of water involved. The volumes of water will be greater and the injection and extraction phases will be longer (in the range of several months) for the demonstration test than they were for the pilot study (see Section 5, Project Description). In addition, the demonstration test will include a four-month aquifer storage phase between injection and extraction periods. With these differences in mind, the results of the pilot study can be reasonably extrapolated to assess the effects of the demonstration project on water quality.

The first question posed above, concerning differences between the water quality of the treated water injected into the aquifer and the aquifer's native groundwater in the project area, can be answered by directly comparing the chemistry of the treated water samples and the baseline groundwater samples from the pilot study. To facilitate this comparison, mean values were computed for all the parameters analyzed. Means for treated water were computed from the two baseline and six injection phase sampling dates at the Diamond Creek Well, whereas means for the native groundwater were computed from the three baseline sampling dates at the four wells (Diamond Creek Well, DCMW-1, DCMW-2, and DCMW-3). The means are provided in **Table 6**.

The treated water exhibited better water quality than the native groundwater with respect to many, but not all, water quality constituents. Mean concentrations of most inorganic constituents were lower in the treated water than in the groundwater (Table 6). The mean total dissolved solids (TDS) level, which estimates the mineral content of the water, is almost ten-fold lower in the treated water than the groundwater. A low mineral content is generally considered favorable for domestic water supplies. On the other hand, the DBPs were, as expected, much higher in the treated water than in the native groundwater (Table 6). Mean concentrations of total THMs and total HAAs were low or undetected in the groundwater and were relatively high in the treated water, although still below the MCLs. Total coliform was found in both the treated water and the groundwater samples, but as indicated previously, these detections likely resulted from sample contamination.

Table 6. Mean Concentrations of Constituents in Treated Water and Native Groundwater from the Phase 1 Pilot Study

CONSTITUENT	UNITS	MCL LIMIT[1]	DETECT LIMIT	Treated Water[2]	Ground-water[2]
Inorganic Analyses					
Dissolved Aluminum	mg/L	0.05-.2	0.01	0.03	< .01
Dissolved Ammonia	mg/L (N)		0.01	0.01	< .01
Dissolved Barium	mg/L	2	0.05	< .05	0.1
Dissolved Boron	mg/L	1	0.1	< .01	0.8
Dissolved Bromide	mg/L		0.01	0.01	0.2
Dissolved Calcium	mg/L		1	9.3	34.6
Dissolved Chloride	mg/L	250	1	3.3	176.5
Dissolved Fluoride	mg/L	2	0.1	0.7	0.2
Dissolved Hardness	mg/L (CaCO3)		1	32.0	156.1
Dissolved Iron	mg/L	0.3	0.005	< .005	0.005
Dissolved Magnesium	mg/L		1	2.0	17.1
Dissolved Manganese	mg/L	0.05	0.005	< .005	< .005
Dissolved Molybdenum	mg/L		0.005	< .005	< .005
Dissolved Nitrate	mg/L	10	0.1	0.1	5.9
Dissolved Organic Carbon	mg/L (C)		0.1	1.8	0.3
Dissolved Potassium	mg/L		0.5	0.6	2.3
Dissolved Silica (SiO2)	mg/L		0.1	9.8	74.2
Dissolved Sodium	mg/L		1	3.7	80.1
Dissolved Sulfate	mg/L	250	1	5.3	27.8
Total Dissolved Solids	mg/L	500	1	51.3	491.0
Conductance (EC)	µS/cm		1	84.7	745.3
pH	pH Units		0.1	8.9	8.0
Total Alkalinity	mg/L (CaCO3)		1	28.7	61.6
Total Kjeldahl Nitrogen	mg/L (N)	1	0.1	<.1	<.1
Organic Analyses					
Fluorobenzene	µg/L		0.5	10.2	8.7
2,3-Dibromopropionic Acid	µg/L		1	46.5	50.6
Trihalomethanes (THMs)					
Bromodichloromethane	µg/L	80	0.5	2.4	< .5
Bromoform	µg/L	80	0.5	< .5	0.5
Chloroform	µg/L	80	0.5	36.1	1.0
Dibromochloromethane	µg/L	100	0.5	< .5	< .5
Total THM	µg/L	80		38.5	1.0
Haloacetic acids (HAAs)					
Bromochloroacetic Acid (BCAA)	µg/L		1	< 1.	< 1.
Dibromoacetic Acid (DBAA)	µg/L	-	1	< 1.	< 1.
Dichloroacetic Acid (DCAA)	µg/L		1	6.1	< 1.
Monobromoacetic Acid (MBAA)	µg/L		1	< 1.	< 1.
Monochloroacetic Acid (MCAA)	µg/L	-	1	< 1.	< 1.
Trichloroacetic Acid (TCAA)	µg/L	300	1	12.6	< 1.
Total HAA	µg/L	60		18.7	< 1.
Miscellaneous Analyses					
Chlorine Residual	mg/L	4	0.05	0.5	0.2095**
Total Coliform	MPN/100ml		1.1	2.4	6.1

[1] California Department of Health Services Primary MCL

[2] Concentrations reported below detection limit were averaged at the detection limit value

Key

µg/L	micrograms per liter	MCL	maximum concentration level	ml	milliliter
µS/cm	Siemens per centimeter	mg/L	milligrams per liter	MPN	most probable number

The results shown in **Table 6** indicate that injecting treated water into the aquifer during the demonstration test would largely improve the aquifer's water quality, but the elevation of the DBPs is an adverse impact. The environmental significance of the elevated DBPs depends on its geographical extent and its duration.

The expected geographical extent of the elevated DBPs in the aquifer resulting from the demonstration test was determined by means of groundwater modeling runs using expected injection rates and volumes of water, and information collected during the pilot study on the hydraulic properties of the aquifer. Particle tracking analysis, conducted as part of the modeling, indicated that the injected water is expected to travel approximately 550 ft upgradient and 829 ft down gradient from the Diamond Creek Well. Therefore, the impact of elevated DBPs is expected to be limited to a relatively small area near the Diamond Creek Well. As will be shown, the water injected during the pilot study reached DCMW-1 and DCMW-2, which are less than 200 ft from the Diamond Creek Well, but did not reach DCMW-3, which is 1,417 ft down gradient of the Diamond Creek Well. This is consistent with the expectation that the impact of elevated DBPs would be limited to a relatively small area near the Diamond Creek Well.

The demonstration test will not affect water quality for other users of groundwater. Within the area around the Diamond Creek Well that the injected water will occupy during the demonstration test, the City is the only user reasonably expected to extract water. No other users of the Merhten formation aquifer are within or anywhere near the affected area. Private domestic wells in most of western Placer County use a shallow, unconfined aquifer overlying the Mehrten formation. They use this shallow aquifer because of lower drilling and pumping costs and because the water quality is good. Geophysical analyses conducted by the City indicate that aquitards isolate this aquifer from the Mehrten formation.

The duration of elevated DBPs in the aquifer will depend on the duration of the injection, storage, and extraction phases of the demonstration test and, most especially, the degree of removal of the injected water by the extraction process. To ensure recovery of almost all injected water during the pilot study, the volume of water extracted was 278 percent of that injected. As shown in **Figures 9 and 10**, the pilot study was successful in removing essentially all constituents of the injected treated water by the end of the project. The injected water was high in total THMs and low in TDS, relative to the native groundwater. Therefore, at DCMW-1, which is only 117 ft from the Diamond Creek Well, TDS levels fell and THM rose sharply at the start of the injection process. After extraction of the water began, the TDS rose and THM dropped quickly. TDS levels appeared to reach pre-injection levels more quickly than the THM levels, but by the end of the project both parameters were close to the levels of the native groundwater. At DCMW-3, which was too distant from the Diamond Creek Well for the treated water to reach it, there was no significant change in levels of TDS or THM over the course of the pilot study. The single high THM sample recorded on July 14 was believed a result of sampling error.

Groundwater modeling runs were used to estimate the volume of water that will need to be extracted during the demonstration test to ensure complete recovery of the injected water constituents. As currently planned, water will be extracted over a period of 10 months and the volume of water extracted is expected to be about 300 percent of that injected. Groundwater modeling estimated the size of the capture zone, or the portion of the aquifer hydraulically affected by the extraction process. According to the modeling, the capture zone will be substantially larger than the maximum volume of injected water occupying the aquifer. In fact, the simulated capture zone extends 2,600 ft beyond DCMW-3. Therefore, extraction pumping is expected to successfully remove almost all of the injected water and its chemical constituents. It should be noted that during the injection and extraction portions of the demonstration test flow may cease or reverse, for short periods of time, during sample collection or to provide routine maintenance of pumps and equipment. A Groundwater Modeling TM was prepared, by MWH for the City, to describe the three-dimensional numerical groundwater model that was developed to help design the demonstration scale ASR test at the DCW. The memorandum, hereby incorporated by reference and available for review at the Roseville Corporation Yard, 2005 Hilltop Circle, Roseville, California, describes the methodology for data collection and manipulation and provides technical detail on the model construction. The memorandum also provides a detailed discussion of the model results, including the impacts of ASR operations on water levels in the vicinity of the ASR project site, anticipated zone of influence, and zone of capture. Recommendations were included as part of the memorandum to improve future understanding of the subsurface hydrogeology and flow conditions in the vicinity of the ASR project site in the City.

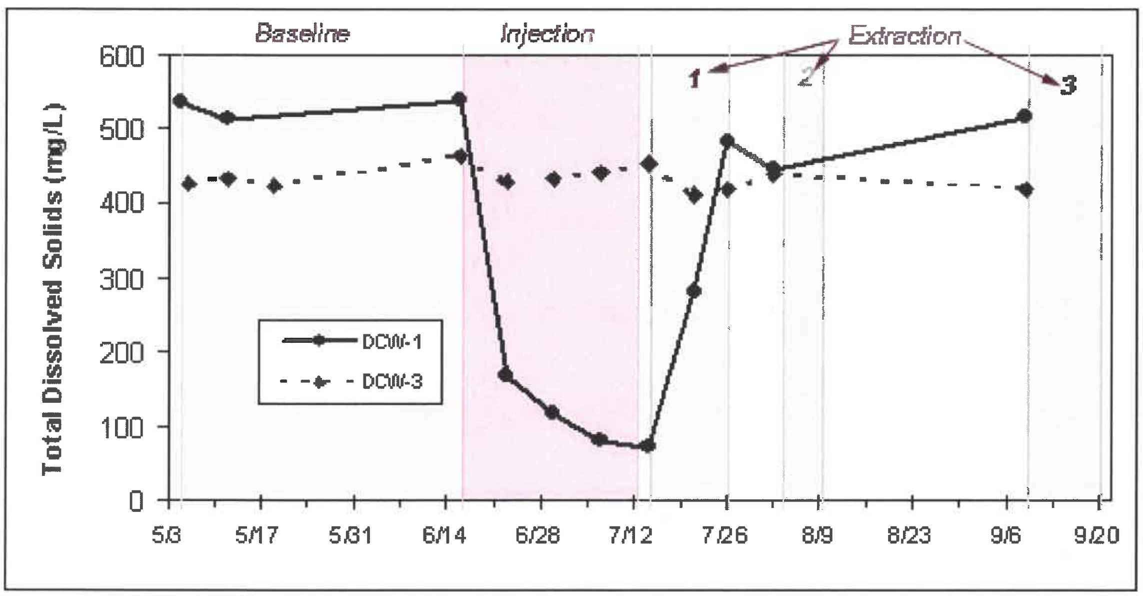

Figure 9. Variations in Total Dissolved Solids Concentrations at DCMW-1 and DCMW-3

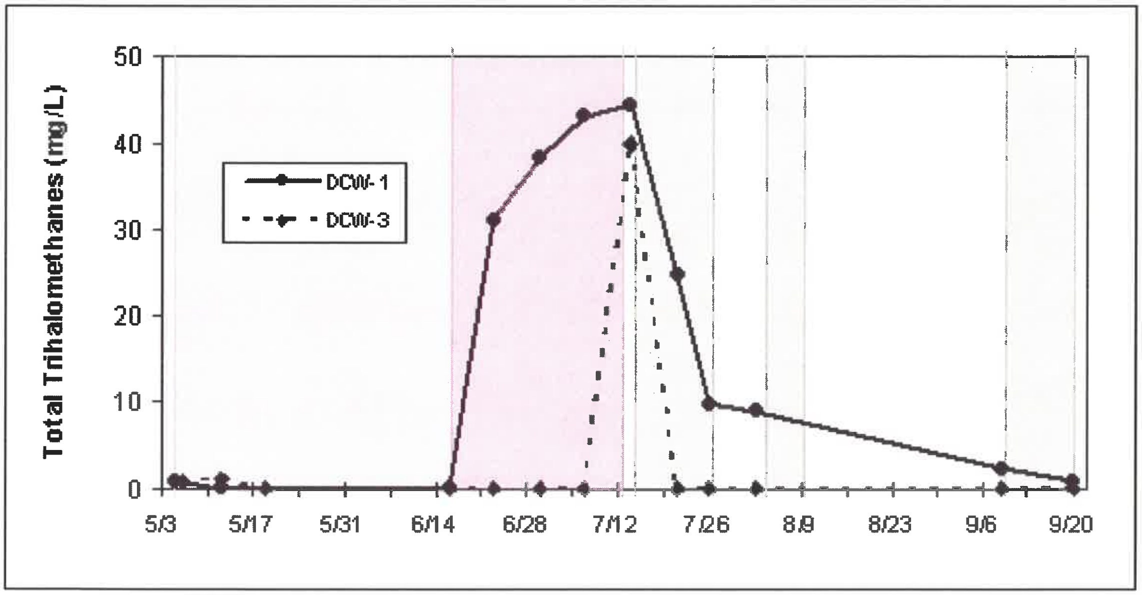

Figure 10. Variations in Trihalomethane Concentrations at DCMW-1 and DCMW-3

It is possible that natural reduction of THMs and other DBPs may occur in the aquifer during the demonstration test, which may mitigate the impacts of these chemicals. There is evidence that THMs and HAAs are biologically degraded, or chemically adsorbed, in groundwater aquifers, which reduces their concentrations (RWQCB, 2005). Because the demonstration test will last substantially longer than the pilot study and will include a four-month storage phase, there will be more opportunity for such a reduction of the THMs and HAAs to occur. A reduction in these chemicals would be detectable by groundwater monitoring. If such a reduction occurred, the time needed for the extraction phase of the test could be reduced.

The only water quality constituents identified in the treated drinking water that have a potential to adversely affect the water quality of the aquifer are DBPs. However, as discussed above, it is expected that these chemicals will affect a relatively small volume of the aquifer during the Demonstration Test Phase 2 and will be largely removed during the extraction phase of the project. Therefore, the project is anticipated to have a less than significant impact on the quality of the groundwater. In the event that unanticipated impacts to water quality are encountered during the demonstration test, a contingency plan, which is described in Section 5, Project Description, will be implemented.

According to the contingency plan, if, at the end of the scheduled demonstration test extraction period, groundwater monitoring detects concentrations of THMs, HAAs, or other DBPs that exceed the Central Valleys RWQCB's water quality objective, the City would continue pumping at the Diamond Creek Well until monitoring data indicate that the concentrations have been reduced below the water quality objectives

7.8.2 SURFACE WATER

The Demonstration Test Phase 2 project has little or no effect on surface waters and there is only one potential issue concerning surface water quality. During the first 10 minutes of extraction, the extracted water will be routed into the facility's stormwater drain, which flows into a tributary of Pleasant Grove Creek. This tributary is commonly dry and water discharged in the channel may not reach the creek. The water extracted at the start of the extraction phase is likely to be pure treated drinking water, undiluted with groundwater. Chlorine used to treat drinking water is potentially harmful to aquatic organsisms, but it often dissipates rapidly after being dissolved in the water. No chlorine residual was detected in water samples at any stage of the extraction phase of the Pilot Study Phase 1. Discharge of treated water into the stormwater drainage system is a common practice and is allowed under the City's existing permit for stormwater discharge. Phase 1 testing indicated that residual chlorine present in the drinking water quickly dissipated in the groundwater aquifer or was consumed by the organic carbon also present in the drinking water. For this reason we do not expect the presence of residual chlorine to pose a risk to surface water during short discharges to the stormwater system.

Question b.

The Demonstration Test Phase 2 is expected to have a less than significant impact on groundwater supplies or recharge. The amount of water extracted would be small, compared to annual recharge for the groundwater basin. The Diamond Creek Well uses a deep, confined aquifer, the Merhten formation, rather than the shallow, unconfined aquifer that is typically used by private wells. The Merthten formation is preferred for high production municipal and industrial wells since this has the least potential to affect private, domestic water wells. Most private, domestic wells in Placer County are completed in the upper, unconfined aquifer because of cost and because the water quality is good.

The expected duration of the demonstration test project would be short-term as compared to most groundwater extraction projects. The project would be implemented to further the objectives of the Groundwater Management Element of the Water Forum Proposal (WFP). If successful, the testing will provide information necessary to later implement the conjunctive use objectives of the WFP, which would eventually contribute to enhanced water supplies and the maintenance of adequate groundwater levels.

The potential for the Diamond Creek Well to affect existing water wells was evaluated in some detail using both regional and site specific groundwater models. Regional impacts were considered using the North American River and Sacramento County Combined Integrated Groundwater and Surface Water Model (IGSM). The IGSM is a finite element, quasi three-dimensional, multi-layered model that integrates surface water and groundwater on a monthly time step. Site-specific impacts were analyzed using a Visual MODFLOW, also a three-dimensional, multi-layered numerical groundwater model.

Both models consider formation of a concentrated localized groundwater mound during injection and a cone of depression around the well when pumping occurs from an aquifer.

The shape and depth of the localized groundwater mound or cone of depression depends on many factors, including: pumping rates, nearby streams or wells, the amount of water stored in the aquifer, ease of water movement within the aquifer, and whether the aquifer is confined or unconfined. Modeling for the Diamond Creek Well used an extraction rate of 2,500 gpm (the assumed production rate) and considered a period of six months (March to August) during a two-year drought period (1976 to1977). This was considered a reasonable, worst-case scenario.

Modeling results showed minor changes in groundwater levels in existing wells in the area. A 3-foot reduction in the groundwater level was shown within the nearest existing well, the Fiddyment Ranch Well. This well is located on Fiddyment Road in the southwest quarter of Section 18 (approximately 1 mile southwest of the Diamond Creek Well site). Other existing wells are 2 miles or greater away from the Diamond Creek Well. The modeling shows a 1-foot reduction in groundwater levels 2 miles from the proposed well. Existing wells' yield, or energy consumption, would not be altered with a 3- or 1-foot reduction in groundwater levels and therefore this amount of reduction is generally not considered significant according to engineering Best Management Practice (BMP) in the basin. A groundwater modeling TM was prepared to describe the three-dimensional numerical groundwater model developed to help design the demonstration scale ASR test at the Diamond Creek Well. The memorandum describes the methodology for data collection and manipulation and technical detail on the model construction. The memorandum also provides a detailed discussion of the model results including the impacts of ASR operations on water levels in the vicinity of the ASR project site, anticipated zone of influence, and zone of capture. Recommendations were included as part of the memorandum to improve future understanding of the subsurface hydrogeology and flow conditions in the vicinity of the ASR project site in the City. The groundwater TM is hereby incorporated in full by reference and is available for review at the Roseville corporation Yard, 2005 Hilltop Circle, Roseville, California

Questions c. and d.

The Demonstration Test Phase 2 will take place within a residential development, Diamond Creek Subdivision, which includes engineered stormwater drainage.

Question e.

The stormwater drainage system on Northpark Drive was designed to accommodate runoff from the site of the proposed Diamond Creek Well and pump station.

Question f.

The demonstration test project is not expected to substantially degrade water quality. The expected effects of the project on water quality are addressed above in the response to Question a.

Question g.

The site of the proposed demonstration test is not within a flood hazard area and does not include the construction of housing.

Question h.

The proposed demonstration test does not include actions or facilities that could cause flooding, or could affect levees or dams.

Question i.

The low topographic relief at the site of the proposed demonstration test and the lack of any large water body preclude the potential for inundation by seiche, tsunami, or mudflow.

Question j.

The site's location is inland and precludes the occurrence of these impacts.

Conclusion: Any flood, drainage, and water quality impacts are mitigated by the uniform application of the City of Roseville Resolution 03-169**.** As no impact is foreseen as a result of the project, no mitigation measures are required.

7.9 LAND USE AND PLANNING

Would the project:

a)	Physically divide an established community?	☐	☐	☐	☒
b)	Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c)	Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

Questions a. and c.

The proposed project will take place within the recently constructed Diamond Creek Well building, three existing monitoring wells, and a potential fourth monitoring well located within a public right-of-way, so there would be no division of an established community. There are no applicable habitat conservation plans or natural community conservation plans.

Question b.

The proposed project will be located within the Diamond Creek Subdivision on property designated Public/Quasi Public (P/QP) in the North Roseville Specific Plan (City of Roseville, 1997) and P/QP School/Park/Fire Station in the City of Roseville Zoning Ordinance. These designations allow and provide for the well and pumping station use. The demonstration test is a compatible use within this land use designation.

Conclusion: As no impact is foreseen as a result of the project, no mitigation measures are required.

7.10 MINERAL RESOURCES

Would the project:

a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

Question a.

The proposed project site does not contain known mineral resources.

Question b.

The proposed project site is not located in the vicinity of locally important mineral recovery site.

Conclusion: As no impact to mineral resources is foreseen as a result of the project, no mitigation measures are required.

7.11 NOISE

Would the project result in:

a) Exposure of persons to, or generation of, noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☐	☒
b) Exposure of persons to, or generation of, excessive Ground borne vibration or ground borne noise levels?	☐	☐	☐	☒

c) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☒
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

Questions a. and c.

The residential uses west of the Diamond Creek Well are approximately 50 feet away from the well and the pumping station. Noise levels at 50 feet away from the Diamond Creek Well are estimated at 55 to 65 decibels (Acoustic) (dBA). The building has been soundproofed to meet the City's exterior noise level standards, as specified in the City of Roseville Noise Ordinance.

During sampling of the monitoring wells a small generator will run to provide power to the dedicated, submersible pumps in each monitoring well. The generator is powered by a three to five horsepower (hp) internal combustion engine and will sit on the back of a pick-up truck; the noise level will be equivalent to a power lawn mower. The duration of noise will be no more than one to two hours per week, during daytime hours, at each well location at the beginning of each test phase and once a month toward the end of each test phase.

If a fourth monitoring well is required, well installation would be conducted during daytime hours and would be consistent with the City's noise ordinance.

Therefore, it is not foreseen that any residential uses will be affected by noise from activities at the monitoring wells.

Question b.

The demonstration test activities do not generate substantial ground borne vibration or noise.

Questions d., e., and f.

The project site is not located within an airport land use plan and is not within 2 miles from an airport or active private airstrip.

Conclusion: Based on the analysis above, project noise impacts will be less than significant and no mitigation measures are required. Any noise impacts are mitigated by the uniform application of City of Roseville Resolution 03-169, described in Section 6, City of Roseville Mitigating Ordinances, Guidelines, and Standards.

7.12 POPULATION AND HOUSING

Would the project:

a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Questions a. and c.

The demonstration test will not change existing water supplies, demands, or uses and therefore will not affect population growth either directly or indirectly. The demonstration test will gather information necessary for future planning for a citywide ASR program. The potential effects on population growth of the future ASR program will be evaluated separately by the City in a future environmental document.

Question b.

The proposed demonstration test will take place within the premises of the recently built Diamond Creek Well and will not displace existing housing.

Conclusion: As no impacts to population and housing are foreseen from the project, no mitigation measures are required.

7.13 PUBLIC SERVICES

a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, or the need for new or physically altered governmental

facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the following public services:				
i) Fire protection?	☐	☐	☐	☒
ii) Police protection?	☐	☐	☐	☒
iii) Schools?	☐	☐	☐	☒
iv) Parks?	☐	☐	☐	☒
v) Other public facilities?	☐	☐	☐	☒

Questions a through v

The demonstration test will not be labor intensive and, therefore, it will not result in a demand for increase in City staff that operates and maintains the City's water supply and treatment system. No increases are expected in the demand for the kinds of public services that would support new residents, such as schools, utilities, parks, fire, or police protection. Furthermore, the demonstration test will take place in a secure location within the Diamond Creek Well building and at the monitoring well locations, and will not substantially increase the demand for police or fire protection.

Conclusion: As no impacts to public services are foreseen from the project, no mitigation measures are required.

7.14 RECREATION

a) Would the project increase the use of existing neighborhood and regional parks, or other recreational facilities, such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities, which might have an adverse physical effect on the environment?	☐	☐	☐	☒

Question a.

There will not be water supply effects that will result in deterioration of existing park and recreational facilities.

Question b.

The proposed project does not include recreational facilities or require construction or expansion of recreational facilities.

Conclusion: As no impacts to recreation are foreseen from the project, no mitigation measures are required.

7.15 TRANSPORTATION/TRAFFIC

Would the project:

a) Cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, volume to capacity ratio on roads, or congestion at intersections)?	☐	☐	☐	☒
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location, that results in substantial safety risks?	☐	☐	☐	☒
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒

Questions a., b., and e.

The proposed demonstration test involves a limited number of vehicle trips and equipment use within a developed residential neighborhood. The number of project related trips for the duration is estimated, on average, at one round trip every day for two people in one pick-up truck. The vehicle would use Route 65, Blue Oaks Boulevard, and Woodcreek Oaks Boulevard for access. The demonstration test will not be labor intensive, will not require infrequent visits by City staff, and will not require the delivery of water treatment chemicals or other materials. Therefore, the project will not cause increases in traffic, contribute to congestion, reduce the level of service standards, or increased safety risks.

Question c.

This question does not apply to the proposed project.

Question d.

The well and pump station facilities are housed in a small building along Northpark Drive, in the southwest corner of the park located south of Diamond Creek Elementary School. There will be limited visits to the facility by City staff and infrequent use of maintenance equipment.

Question f.

The existing Diamond Creek Well site has sufficient parking for maintenance staff and there will be infrequent need for City staff to visit the facilities.

Question g.

The proposed project will not conflict with adopted policies, plans, or programs supporting alternative transportation.

Conclusion: Any traffic impacts are mitigated by uniform application of the City of Roseville Resolution 03-169 described in Section 6, City of Roseville Mitigating Ordinances, Guidelines, and Standards. As no impacts to transportation/traffic are foreseen from the project, no mitigation measures are required.

7.16 UTILITIES AND SERVICE SYSTEMS

Would the project:

a) Exceed wastewater treatment requirements of the applicable RWQCB?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c) Require or result in the construction of new storm-water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒

d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination by the wastewater treatment provider, which serves or may serve the project, that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

Question a.

When initiating the demonstration test extraction phase, the Diamond Creek Well will be purged for approximately 10 minutes to remove any suspended solids from the water system. Suspended solids are commonly found in extracted water during pump initiation, caused simply by water turbulence within the well casing. The water will be discharged into the stormwater system on Northpark Drive (adjacent to the pump station). This discharge at start-up will comply with the RWQCB standards for release into the stormwater drain, just as it did during the Phase 1 Pilot Study.

Following the "pump to waste" period of approximately 10 minutes, the water will be directed into the drinking water service for the remainder of the extraction portion of the demonstration test.

This amount of water and its quality (see Section 7.8, Hydrology and Water Quality) will not exceed the RWQCB's requirements.

Questions b. and c.

The small amount of water to be discharged into the stormwater system at the start of the extraction phase will not have significant effect on the need for new stormwater drainage or wastewater treatment facilities in Roseville.

Question d.

No new or expanded entitlements will be needed to implement the proposed project.

Question e.

The proposed project facilities will not increase the demand for wastewater treatment because the water extracted from the well as part of the demonstration test will be placed into the water supply distribution system. The only exception will be the approximately

10 minute period at the beginning of extraction, as described in the answer to question a. This amount of extracted water will not have an impact on the wastewater treatment system.

Questions f. and g.

The proposed project will not generate substantial solid waste and therefore will have a minimal effect on landfill capacity. The project execution plan will comply with all federal, state, and local statutes and regulations related to solid waste.

Conclusion: As no impacts to utilities and service systems are foreseen from the porposed project, no mitigation measures are required.

7.17 MANDATORY FINDINGS OF SIGNIFICANCE

a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
b) Does the project have impacts that are individually limited, but cumulative considerable (e.g., the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☐	☐	☒
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

Question a.

The proposed project does not have the potential to degrade the quality of the environment, substantially reduce fish or wildlife species' habitat, cause fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory.

Question b.

When proposed project impacts are considered along with, or in combination with other impacts, the project-related impacts are less than significant. The proposed project will not add substantially to any cumulative effects.

Question c.

The project does not have environmental effects that could cause substantial adverse effects on human beings, either directly or indirectly

8.0 ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED AND ENVIRONMENTAL DETERMINATION

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact," as indicated by the following checklist.

☐ Aesthetics	☐ Agriculture Resources	☐ Air Quality
☐ Biological Resources	☐ Cultural Resources	☒ Geology/Soils
☐ Hazards & Hazardous Materials	☒ Hydrology/Water Quality	☐ Land Use/Planning
☐ Mineral Resources	☐ Noise	☐ Population/Housing
☐ Public Services	☐ Recreation	☐ Transportation/Traffic
☐ Utilities/Service Systems	☐ Mandatory Findings of Significance	

Yes ✔ I find that the proposed project **COULD NOT** have a significant effect on the environment and a **NEGATIVE DECLARATION** will be prepared.

No I find that although the proposed project **COULD** have a significant effect on the environment, there **WILL NOT** be a significant effect in this case because the mitigation measures described in this initial study have been added to the project. A **MITIGATED NEGATIVE DECLARATION** will be prepared.

No I find that the proposed project **MAY** have a significant effect on the environment and an **ENVIRONMENTAL IMPACT REPORT** is required.

No I find that the proposed project **MAY** have a significant effect(s) on the environment, but at least one effect: has been adequately analyzed in an earlier document pursuant to applicable legal standards, and has been addressed by mitigation measures based on the earlier analysis as described on attached sheets, if the effect is a "potentially significant impact" or is "potentially significant unless mitigated." An **ENVIRONMENTAL IMPACT REPORT** is required, but it must analyze only the effects that remain to be addressed.

No I find that although the proposed project could have a significant effect on the environment, there **WILL NOT** be a significant effect in this case because all potentially significant effects: have been analyzed adequately in an earlier EIR pursuant to applicable standards and have been avoided or mitigated pursuant to an earlier EIR or Negative Declaration, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature	[signature]	Date	6.14.05
	Mark Morse		Environmental Coordinator
Printed Name	Mark Morse	Title	

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Appendix A

Proposed Monitoring Program

Proposed Monitoring Program

The proposed monitoring program includes a discussion on the monitoring program objectives and methodology.

Monitoring Program Objectives

The objectives of the monitoring program during project testing at the DCW are to further addressed the following questions.

- How effective is ASR at recovering a "bubble" of injected water after a storage period of 4 months?
- What are the fate and transport of constituents of concern?
- What are the spatial and temporal trends associated with the degradation of disinfection by-products?
- What are the chemical processes that contribute to the natural degradation of disinfection by-products?

Monitoring Program Methodology

Appendix G summarizes the schedule of water level and water quality analysis during baseline, injection, storage, extraction, and post-test periods of demonstration testing. Data collected during this test will include manual readings, collection of electronic data, and samples for constituent analysis.

Groundwater Level Monitoring

During project testing, manual measurements of groundwater levels will be monitored at the DCW and three monitoring wells. Measurements will be collected according to the schedule presented in **Appendix G**. All wells will be equipped with a pressure transducer/data logger prior to initiation of cycle testing. The probes will be pre-programmed to take water column height readings during and after completion of cycle testing. Measurement frequency will be at short intervals during the beginning and end of injection and extraction. This frequency will be set at longer intervals as steady state water levels are achieved in the aquifer. Data will be downloaded from the units according to the schedule in **Appendix G**.

Water Quality Sampling

Water quality samples will be collected weekly, bi-monthly, or monthly at the WTP, DCW, and three monitoring wells between October 4, 2005 and July 10, 2007. Samples collected for constituent analysis will either be analyzed in the field with the use of portable water testing meters or will be sent for analysis by a California Certified analytical laboratory. The three monitoring wells will be equipped with dedicated pumps and purged at a minimum of three well volumes prior to each sample collection. Water quality samples from the DCW and WTP will be collected at a sampling port located directly inside the pump house.

Twenty-six full sampling suites will be conducted during demonstration testing to include all constituents listed on the RWQCB May 3, 2005 letter enclosure "Analytes to Be Monitored for the City of Roseville Injection Water Quality Characterization Report." 126 partial sampling events will be conducted for constituents selected to best characterize the chemical processes effecting the natural degradation of disinfection by-products. **Table 7** summarizes water quality sampling activity for project testing. A detailed sampling schedule including sampling dates, constituents, analytical methods, and reporting units is included in **Appendix G**.

Presentation of Data

A report summarizing demonstration testing at the DCW will be provided to the RWQCB. This will follow similar structure and formatting as the "Pilot Scale Testing at

Diamond Creek Well" report presented to the RWQCB in December 2004 (General Information Technical Memorandum, Appendix D, Tab 36).

Table 7

Demonstration Testing Sampling Summary

Schedule of Demonstration Testing Activities	Date	Sampling Frequency	WTP[1]		DCW[2]		DCMW-1[3]		DCMW-2[4]		DCMW-3[5]	
			Partial[6]	Full[7]	Partial[6]	Full[7]	Partial[6]	Full[7]	Partial[6]	Full[7]	Partial[6]	Full[7]
CVRWQB Required List	May, 2005	weekly		2		2						
Testing Start	4-Oct-05											
Baseline	4-Oct-05	weekly	1	1	3	1	1	1	1	1	1	1
1 month												
Injection	1-Nov-05	weekly	2				2		2			
6 months		bi-monthly	1				1		1		3	
		monthly	5				5		5		5	
Storage	18-Apr-06	weekly			5		5		5		5	
4 months		bi-monthly			3	2	3	2	3	2	3	2
Extraction	8-Aug-06	weekly			4		4		4		4	
10 months		monthly			8	1	8	1	8	1	8	1
Post-Test	15-May-07	weekly	1	1	3	1	1	1	1	1	1	1
2 months												
Testing End	10-Jul-07											
Total Samples to be Collected:			**10**	**4**	**26**	**7**	**30**	**5**	**30**	**5**	**30**	**5**

Partial Suites = 126 sampling events
Full Suites = 26 sampling events

(1) Water Treatment Plant - "treated water proposed for aquifer injection"
(2) Diamond Creek Well - "groundwater smaples from the ASR well"
(3) Diamond Creek Monitoring Well 1
(4) Diamond Creek Monitoring Well 2
(5) Diamond Creek Monitoring Well 3
(6) Partial sampling suites will include a select group of constituents chosen to best characterize the chemical processes effecting the natural degradation of disinfection by-products. Constituents included in the partial list are depicted in **Appendix G**. Final selection of the partial list will be made following receipt of sampling results taken May, 2005.
(7) Full sampling suites will include all constituents listed on the CRWQCB May 3, 2005 letter enclosure "Analytes to Be Monitored for the City of Roseville Injection Water Quality Characterization Report"