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Operable Unit 3
Monk Hill Treatment System
Installation Report

National Aeronautics and Space Administration
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Pasadena, California

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ANSI	American National Standards Institute
AWWA	American Water Works Association
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CIP	cast iron pipe
DIP	ductile iron pipe
DPH	Department of Public Health
DSAL	dual swab air lift
gpm	gallons per minute
hp	horsepower
JPL	Jet Propulsion Laboratory
LF	linear feet
LGAC	liquid-phasegranular activated carbon
MCL	maximum contaminant level
MHTS	Monk Hill Treatment System
MWD	Metropolitan Water District
NASA	National Aeronautics and Space Administration
NDMA	N-Nitrosodimethyl amine
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OEAL	open end air lift
OU	Operable Unit
P&ID	piping and instrumentation diagram
ppm	parts per million
psi	pounds per square inch
PWP	Pasadena Water and Power
RD/RA	remedial design/remedial action
RTU	remote terminal unit
SARA	Superfund Amendments and Reauthorization Act
SCADA	supervisory control and data acquisition
SWV	standing well volume
TDV	total disinfectant volume

U.S. EPA	United States Environmental Protection Agency
VDC	volt direct current
VFD	variable frequency drive
VOC	volatile organic compound
WSE	Water Systems Engineering

1. INTRODUCTION

This report was prepared for the National Aeronautics and Space Administration (NASA) to document installation of the Operable Unit 3 (OU-3) Monk Hill Treatment System (MHTS) at the Jet Propulsion Laboratory (JPL). The NASA-JPL site is on the United States Environmental Protection Agency (U.S. EPA) National Priorities List (NPL) and subject to the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA).

To address chemicals in off-facility groundwater, NASA funded construction of a treatment facility, known as the MHTS, to remove target chemicals (perchlorate and volatile organic compounds [VOCs]) from the aquifer at four City of Pasadena, Water and Power Department (PWP) drinking water wells (i.e., Arroyo Well, Well 52, Windsor Well, and Ventura Well). Groundwater from Arroyo Well, Well 52 and Ventura Well is pumped to the equalization sump located at the Ventura Well site. Feed pumps are used to pump groundwater from the equalization sump to the MHTS, which is located adjacent to the Windsor Well and Windsor Reservoir. Water from Windsor Well is pumped directly to the MHTS. The MHTS consists of parallel cartridge filters to remove sediment and particulates from the groundwater, as well as four pairs of ion exchange vessels to remove perchlorate and five pairs of liquid-phase granular activated carbon (LGAC) vessels to remove VOCs. Figure 1-1 shows the location of the MHTS, and Figure 1-2 shows a picture of the MHTS taken on June 27, 2011. In this remedy, NASA directly administered the work associated with designing, permitting, and constructing the MHTS. Moving forward, PWP will be funded by NASA to lease the treatment equipment and operate the system.

The remainder of this report is divided into six sections. Section 2.0 provides information pertaining to rehabilitation of the PWP production wells. Section 3.0 describes the construction activities associated with installation of the treatment facility, and Section 4.0 describes the startup and testing and current status of MHTS activities. Section 5.0 provides a summary of surface water discharges completed during the MHTS construction and testing phases of work, and Section 6.0 includes references. The appendices for each section include documentation of the completed work. Appendices 2-1 through 2-21 contain information pertaining to the well rehabilitation activities. Appendices 3-1 through 3-9 contain documentation of the treatment system construction, including inspection reports for various activities and construction quality testing results. Appendices 4-1 through 4-3 include results from the startup and testing activities. Appendices 5-1 and 5-2 contain laboratory results from surface water discharge monitoring.

Figure 1-1. Aerial Photograph of MHTS Location

Figure 1-2. MHTS Photograph (June 27, 2011)

The municipal production wells (Arroyo, Well 52, Windsor, and Ventura) are owned by the City of Pasadena. Well rehabilitation activities completed as part of the MHTS construction project generally followed those described in the Final Remedial Design/Remedial Action (RD/RA) Work Plan for the MHTS (NASA, 2009). Specific well rehabilitation activities completed for each production well are discussed in the following subsections.

2.1 Windsor Well (No. 48)

Background

The Windsor Well (No. 48) is located in the northeast corner of the Windsor Avenue reservoir yard (Figure 1-1). The well is located approximately 325 ft due east of the Windsor Avenue north gate. The well is not enclosed in a well house; however, the electrical switchgear and supervisory control and data acquisition (SCADA) system are located in a small building approximately 92 ft southwest of the well head.

The Windsor Well was cable tool drilled, and was constructed from March 28, 1969 through July 1, 1969 by the Roscoe Moss Company. The original casing was 20-inch diameter double No. 8 gauge steel casing with 3/16 inch diameter by 2 ½ inch long mills knife perforations at: 320-344 ft, 374-384 ft, 426-450 ft, 474-485 ft, and 497-585 ft below ground surface (bgs). Table 2-1 summarizes the original well construction details. The conductor casing consists of 24-inch diameter ¼-inch gauge steel and extends from the ground surface to 50 feet bgs. A copy of the original Roscoe Moss well completion and boring log can be found in Appendix 2-1. Drinking water production from this well ceased in January 2002.

Table 2-1. Windsor Well Original Construction Details

Well ID	Completion Date	Depth (ft bgs)	Depth to Water (ft bgs) (7/21/2009)(2)	Diameter (inches)	Screened Intervals (ft bgs)	Screen Length	Well Casing	Screen Slot Size
Windsor Well(1)	1969	600.00	162.92	20.00	320-344	24	Double #8 steel gauge	Mills Knife 3/16 inch Diameter x 2 ½ inch Long
					374-384	10		
					426-450	24		
					474-485	11		
					497-585	88		
					Total Screen	**157**		

Notes:
(1) Windsor operation ceased in January 2002.
(2) Static water level measured during video log conducted July 21, 2009
bgs = below ground surface

Initial Inspection

The well pump and motor were pulled from the Windsor Well in July 2009. The pump was heavily corroded, and deemed unusable. A pre-brush video log was then completed (see Appendix 2-2 for summary video log inspection sheets), and the well was brushed with a steel bristle brush to remove

debris and incrustations before completing a post-brush video log of the well. The results of the video log indicated that the well would require a liner.

First Stage Rehabilitation

The Windsor Well was the first of the four PWP production wells to be rehabilitated and cleaned. Mobilization for the first stage of well rehabilitation and development began in February 2010. Rehabilitation efforts began with open end air lift (OEAL) pumping. This method is designed to dislodge debris from the bottom of the well and remove it. The tool consists of a vertical discharge pipe (eductor) with a smaller airline suspended down the middle of the pipe. The bottom of the eductor pipe is cut at an angle in order to prevent suction failure. Compressed air is pumped through the airline from the surface with an air compressor and is released into the eductor pipe causing a mixture of air bubbles and water. Continued injection of compressed air causes the mixture to flow up and out of the eductor pipe. The general pumping principle is based on the difference in hydrostatic pressure inside and outside of the pipe resulting from the lower specific gravity of the mixed column of water and air bubbles.

OEAL pumping was performed from a depth of 540 ft to the bottom of the well at 593 ft bgs. Approximately 53 ft of sediment was removed from the bottom of the well during the OEAL pumping.

Well rehabilitation efforts continued with dual swab air lift (DSAL) pumping to dislodge debris from the casing and remove it from the well. The tool consists of a vertical discharge pipe (eductor) with a smaller airline suspended down the middle of the pipe. A perforated section of pipe with two rubber swab flanges (i.e., rubber disks approximately the same size as the inside diameter of the well) is connected and located at the bottom of the eductor pipe. The swabs are primarily designed for cleaning (i.e., when raised and lowered during pumping) and stabilization of the assembly in the well. The airline discharge is installed above the surge blocks inside the pipe. Compressed air is pumped through the airline from the surface with an air compressor and is released into the eductor pipe causing a mixture of air bubbles and water. Continued injection of compressed air causes the mixture to flow up and out of the eductor pipe. The general pumping principle is based on the difference in hydrostatic pressure inside and outside of the pipe resulting from the lower specific gravity of the mixed column of water and air bubbles. The dual-swab tool was moved up and down along the well screen over an approximately 10 to 15 ft interval while simultaneously pumping the well.

The DSAL pumping was completed in 10 ft increments from 573 ft to 320 ft bgs. Following the DSAL pumping, groundwater samples were collected with a thief bailer and submitted to Water Systems Engineering (WSE) for inorganic and organic laboratory analyses. The WSE laboratory reports are presented in Appendix 2-3. Chemical injection and air blasting were completed following the first round of DSAL. The chemical injection consisted of a 10,700 gal blend of water, hydrochloric acid, glycolic acid, surfactant/dispersant, and an acid inhibitor which was used to dislodge and dissolve debris and biofilms from the well casing. The chemicals were mixed above ground and injected into the well in batches via a tremie pipe between dual/swabs with the rubber swab flanges set 10 ft apart. Following the chemical injection, the zone was swabbed for 10 minutes, then the injection system was lowered to the next 10 ft section of screen, and the procedure was repeated. The entire screened interval of the well was chemically cleaned following the same procedure. Air bursting was performed in the well with an air gun device (i.e., BoreBlast®) which uses pressurized nitrogen to dislodge mineral scale and scour the casing surface to further clean the well. Following the air bursting, approximately 34 ft of sediment entered the well, and was followed by OEAL pumping to remove the accumulated material from the well. Sediment samples were collected for sieve analyses, and another video log was performed due to the amount of fill that entered the well; however, the video log was of limited use due to the poor visibility. Another video log was completed six days later on March 30, 2010, and showed no apparent cause of sand production other than open perforations due to cleaning.

At the beginning of April 2010, an AquaFreed® injection was completed to further scour the casing and surrounding gravel pack. This was followed by DSAL pumping throughout the screened zone. Copies of daily field notes/logsheets are provided in Appendix 2-4.

At the completion of the cleaning activities described above, a new liner was installed into the Windsor Well from April 12–April 16, 2010. The liner was manufactured by Roscoe Moss, and consisted of 322.50 ft of 14.50-inch outside diameter, ¼ inch thick blank, high-strength, low alloy casing (including a 5-ft long dielectric coupler for connecting dissimilar metals), and 270.50 ft of 14.50-inch 304L stainless steel wire-wrapped screen (0.080-inch slot size). Table 2-2 provides a summary of well liner construction details. Silica Resources Incorporated engineered gravel pack was gravity fed into the annular space between the original casing and the new liner. The liner was not cemented in place as was stated in the RD/RA work plan. The well screen was swabbed to ensure consolidation of the gravel pack. The Windsor well liner diagram is presented in Appendix 2-6.

Table 2-2. Windsor Well Liner Construction Details

Well ID	Completion Date	Depth (ft bgs)	Depth to Water (ft bgs) (8/9/2010)	Diameter (inches)	Well Casing	Liner Blank (ft bgs)	Liner Screen* (ft bgs)	Screen Slot Size
Windsor Well	2010	592.00	139.65	14.50	High strength low alloy	0.00 – 322.50	322.50 - 592.00	0.080

* 304L Stainless Steel Wire-wrapped Screen

Following the liner installation, the well was pumped via DSAL. The well rehabilitation was then completed with a third round of DSAL pumping from 320 ft to 593 ft to further consolidate the liner gravel pack. A total of 353,300 gallons was extracted from the Windsor Well during the first stage of well rehabilitation, which occurred between February 22, 2010 and April 28, 2010. All water was containerized at the Windsor Well site, trucked to JPL and treated using the OU-1 treatment system.

Second Stage of Rehabilitation

Beginning June 9, 2010, a diesel-powered vertical turbine test pump was installed into the well over a three-day period. Following the pump installation, sound panels were constructed around the pumping equipment due to the close proximity of nearby residents. In early July 2010, a filtration and containment system was installed and connected to the Windsor Well's discharge piping. This system would be used to pre-filter development purge water before reaching the MHTS influent cartridge filters. It consisted of two separate skids with four sand media filters on each skid connected with influent and effluent piping, check valves, flow meter/totalizer, and backwash hoses leading to a weir tank. Figure 2-1 shows the diesel-powered test pump, sound panels, discharge piping, and sand filtration units. Well discharge water flowed from the well's discharge piping directly through the sand filters, and to the MHTS via system pipelines (i.e., pre-existing 12-inch and newly installed 24-inch buried pipelines). Sand filter backwash water produced during filter operation was sent to a weir tank to settle. Figure 2-2 shows the sand filter units, truck mounted diesel motor, and backwash containment tank.

Figure 2-1. Windsor Well Filtration and Sound Walls Test Pumping August 3, 2010

Figure 2-2. Windsor Well Filtration and Containment During Test Pumping August 3, 2010

The second stage of well rehabilitation consisted of six days of development pumping which was completed from July 29 through August 5, 2010. A total of 2,121,293 gallons was pumped during this time. An 8-hour step drawdown test was then completed on August 5, 2010, with a total of 603,803 gallons being pumped. After the step test, the diesel-powered motor was swapped with an electric motor due to noise concerns during the 24-hour test. Finally, a 24-hour continuous rate test was performed on August 9 and August 10, 2010 at a flowrate of 1,400 gallons per minute (gpm). Drawdown was measured at 122.30 ft, and the specific capacity was calculated to be 11.44 gpm/ft. A total of 2,331,793 gallons was pumped during the continuous rate test. The sand filtration system was bypassed during the step and continuous rate tests. Daily field logsheets are presented in Appendix 2-4. After completion of the well development and pumping tests, a second round of groundwater samples were collected and submitted to

WSE for inorganic and organic analyses. The laboratory results are provided in Appendix 2-3. Following the groundwater sampling, a dynamic spinner log was performed. Results of the spinner log are presented in Appendix 2-5. An additional 583,600 gallons was pumped from the Windsor Well during the spinner log test. Table 2-3 provides a summary of first stage and second stage rehabilitation dates and total volumes extracted from the Windsor Well.

Table 2-3. Windsor Well Rehabilitation

Well ID	First Stage Rehabilitation	First Stage Rehab. Volume Extracted (gallons)	Second Stage Rehabilitation	Second Stage Rehab. Volume Extracted (gallons)
Windsor Well	2/22/10 – 4/28/10	353,300	7/29/10 – 8/11/10	5,036,685

Data collected during the pump testing was used to design the Windsor Well pump. The pump submittal is provided in Appendix 2-6. On December 9, 2010, well disinfection was performed utilizing a procedure that exceeded American National Standards Institute/American Water Works Association (ANSI/AWWA) standard C654. The method was chosen since the well had been sitting idle since August 2010. It consisted of calculating the borehole volume (or standing well volume [SWV]), multiplying SWV by four to determine the total disinfectant volume (TDV), and TDV was multiplied by the concentration of chlorine desired (this case 500 mg/L), divided by the percent of active hypochlorite solution (12.5% sodium hypochlorite). This volume was added and swabbed into the well for disinfection of the well and gravel pack. This was followed by the new pump installation, which was completed on December 11, 2010. All pump equipment was disinfected prior to installation into the well. The new pump consisted of a Goulds® nine-stage 1,400 gpm flow rated pump with cast iron, glass-lined bowls and silica bronze impellers. Following the disinfection and pump installation, extracted groundwater from Windsor Well was de-chlorinated and blended with water from the Gould reservoir pipeline prior to being discharged to the spreading basins. Once the well discharge water reached chlorine residual, PWP staff collected samples for bacteriological laboratory analyses. Upon passing the bacteriological tests, water extracted from the Windsor Well was sent to MHTS virgin media to be processed. Treated water was discharged to spreading basin #5, and the well was in operation until December 27, 2010 when the pump automatically shutdown. An electrical and pump investigation determined that the pump was producing gravel pack from the well, and the pump was removed from the well on December 31, 2010. A video log performed on January 14, 2011 determined that there was a circular hole in the blank casing, and a patch was installed the following day. The well was disinfected on January 19, 2011, and the pump was reinstalled into the well. The well was purged, de-chlorinated, and the extracted water was discharged to spreading basin #5 and blended with potable water from PWP's Calaveras pipeline. The well was disinfected again on January 26, 2011 due to a failed bacteriological test, and the well was pumped, de-chlorinated, blended with Calaveras potable water, and discharged to spreading basin #5. On January 30, 2011, after passing the bacteriological tests, Windsor Well purge water was sent directly to MHTS for order #4 system performance testing; the treated water was discharged directly to spreading basin #5. Gravel pack production was observed during the system performance testing, but eventually stopped. At the time it was assumed that there was residual gravel pack in the pipelines that was flushed out during the system performance testing.

In early February 2011, a new US Motors (Emerson) 250 hp premium efficiency vertical hollow shaft electric motor with 120 volt space heater and thermostat was installed. Table 2-4 summarizes the

Windsor well pump details. After the installation, PWP performed transformer testing on February 7, 2011 that included multiple startups of the Windsor Well. The following day, the pump seized, and it was pulled from the well. A video log performed on February 12, 2011 determined that there was a hole in the patch installed one month earlier. Table 2-5 summarizes monthly pumping from the Windsor Well.

Table 2-4. Windsor Well Pump

Well ID	Pump Setting	Motor Horsepower	Flowrate
Windsor Well	389.50	250	1,400

In mid-August 2011, the well contractor is removing the liner from the well and the cause of the liner hole will be investigated. Results of the investigation and modifications to the existing well will be presented in an addendum to this document at a later date.

Table 2-5. Windsor Well Monthly Pumping Volumes

Month and Year	Volume (gallons)
February 2010	79,500
March 2010	109,000
April 2010	164,800
May - June 2010	0
July 2010	245,203
August 2010	4,791,482
September 2010 – November 2010	0
December 2010	22,901,560
January 2011	15,943,000
February 2011	700,300
March 2011 – June 2011	0
Total:	**44,934,845**

2.2 Well 52

Background

Well 52 is located on the east side of Karl Johnson Parkway (the City of Pasadena maintenance access road located east of the spreading grounds, which extend from the JPL east parking lot access road [to the north] all the way to the Devil's Gate dam). The well is located 462 ft due south of the intersection of Karl Johnson Parkway and the east parking lot (Figure 1-1). The well site consists of two attached buildings constructed of brick and cinder blocks. The actual wellhead is located outside, and the associated electrical equipment, switchgear and SCADA system are located inside the northern building. The well site is surrounded by a chain-link fence (north side: 71-ft; south side: 51-ft; east side: 106-ft; west side: 113-ft; height: 8 ft) with three gates located on the north, west, and south sides.

Well 52 was cable tool drilled, and was constructed from September 30, 1977 to November 24, 1977 by Roscoe Moss. The original casing was constructed of 20-inch diameter double No. 8 gauge steel casing with hydraulic louver cut perforation that are 3/16 inch wide by 2 ½ inch long and at the following intervals: 250 – 360 ft, 360 – 367 ft, 372 – 556 ft, and 556 – 630 ft bgs. The conductor casing consists of three-ply No. 8 gauge steel and extends from the ground surface to 50 ft bgs. Characteristics of Well 52 are summarized in Table 2-6 and a copy of the original Roscoe Moss construction and boring log is presented in Appendix 2-7.

Table 2-6. Well 52 Original Construction Details

Well ID	Completion Date	Depth (ft bgs)	Depth to Water (ft bgs) (7/15/2009) (2)	Diameter (inches)	Screened Intervals (ft bgs)	Screen Length (ft)	Well Casing	Screen Slot Size
Well 52(1)	1977	647.00	79.10	20	250-360	110	Double #8 gauge steel	Hydraulic Louver 3/16 inch Wide x 2½ inch Long
					360-367	7		
					372-556	184		
					556-630	74		
					Total Screen	**375**		

Notes:
(1): Well 52 operation ceased in January 2002; median monthly production of 1,600 gpm (pumping water level: 170 ft bgs); General Pump removed equipment in September 2003.
(2): Water level measured during video log July 15, 2009.

Operation of Well 52 ceased in January 2002. In the two years prior to system shutdown, the median monthly groundwater production rate from Well 52 was 1,300 gpm, with an associated depth to water of approximately 170 ft bgs. The pump and associated equipment were removed from the well in September 2003 by General Pump Company, and video and geophysical logging of the well was completed by Pacific Surveys.

First Stage Rehabilitation

A pre-brush video log was completed on July 15, 2009 (see Appendix 2-8 for summary video log inspection sheets), and the well was brushed with a steel bristle brush to remove debris and incrustations

before completing a post-brush video log of the well. Mobilization for the first stage of well rehabilitation and development began in April 2010.

Rehabilitation efforts began with OEAL pumping from a depth of 610 ft to 634 ft followed by bailing from 634 ft to the bottom of the well at 642 ft bgs. Approximately 36 ft of sediment was removed from the bottom of the well during the OEAL pumping and bailing. Well rehabilitation efforts continued with DSAL pumping to dislodge debris from the casing and remove it from the well. The DSAL pumping was completed in 10 ft increments from 250 ft to 630 ft. Following the DSAL pumping, groundwater samples were collected with a thief bailer and submitted to WSE for inorganic and organic analyses. The WSE laboratory reports are presented in Appendix 2-9. A chemical injection and air blasting were completed following the first round of DSAL. The chemical injection consisted of a 27,600 gallon blend of water, hydrochloric acid, glycolic acid, surfactant/dispersant, and an acid inhibitor which was used to dislodge and dissolve debris and biofilms from the well casing. The chemical cleaning process followed the same procedure outlined in section 2.1 above. Air bursting was performed in the well with an air gun device (i.e., BoreBlast®), which uses pressurized nitrogen to dislodge mineral scale and scour the casing surface to further clean the well. Following the air bursting, approximately 11 ft of sediment entered the well, and was followed by OEAL pumping to remove the accumulated material from the well. Sediment samples were collected for sieve analyses. Following OEAL pumping, an AquaFreed® carbon dioxide injection was completed to further scour the casing and surrounding gravel pack. This was followed by DSAL pumping in 10 ft increments throughout the entire screened zone which was completed by May 27, 2010. A total of 296,800 gallons was extracted from Well 52 during the first stage of well rehabilitation, which occurred from April 28, 2010 through May 28, 2010. All water was containerized at the Well 52 site, trucked to JPL and treated using the OU-1 treatment system.

During the months of June, July, and most of August 2010, no well work was completed due to the loading of sacrificial media into the MHTS vessels (June 21, 2010 – June 28, 2010), media backwashing (July 15, 2010 – August 20, 2010), and the installation of a containment and filtration system located at the Ventura well site (August 16, 2010 – August 24, 2010) that was first used for Well 52 discharge water. The filtration system is described below.

Ventura Well Site Containment and Filtration

In mid August 2010, a filtration and containment system was installed at the Ventura well site. This system would be used to pre-filter development purge water before entering the Ventura sump, boosters, and the MHTS influent cartridge filters. It was used in conjunction with sacrificial media loaded in the MHTS. Conceptually, this system was very similar to the small system previously located at the Windsor Well, but it was designed to handle higher flowrates (i.e., 400 to 2,200 gpm). Two influent pipelines are located east of the Ventura booster building (Figure 2-3). One influent pipeline carries water from Well 52 and Arroyo, and the other is from the Ventura Well. Temporary piping was connected to the two pipe risers, and was linked to two 21,000 gallon containment tanks to remove sediment (Figure 2-4). Next, water was pumped from the two tanks with high flow pumps (i.e., 2,200 gpm max flow) to four banks of skid-mounted sand filters capable of 1,000 gpm each (Figure 2-5). Water processed by the sand filters then flows into the MHTS booster station sump where it was boosted by one of three 250 hp pumps to the system for processing. Backwash water generated by the sand filters was sent to a weir tank located adjacent to the containment tanks to allow sediment to settle. Water from the weir was pumped through a four-unit bag filter unit and into the 21,000 gallon tanks for processing. In addition to equipment listed above, there were multiple pipelines, hoses, check valves, and flow meter/totalizers. This system was first used during air production testing that was completed in late August and early September 2010 followed by pump development at Ventura, Arroyo and Well 52. The system was dismantled in November 2010 at the completion of Well 52 pump development and testing.

Figure 2-3. Discharge Pipeline Connection to Containment and Filtration Units

Figure 2-4. Containment Tanks and Bag Filter Unit

Figure 2-5. Sand Filtration Units near the Ventura Well

From August 31, 2010 to September 2, 2010, air production testing was performed for a three-day period using a pump situated between two inflatable packers set at various depths to determine air production from the perforated interval of the well. Limited air production was observed during the testing. It was determined that it would not cause pump damage, as air would dissipate in the Ventura sump. Approximately 1,076,613 gallons of water was extracted from the well during the air production testing. Discharge water was processed by the MHTS loaded with sacrificial media and discharged to spreading basin number #5. Daily development logsheets are provided in Appendix 2-10.

On September 15, 2010, a video log was performed to determine the well's condition and the need for a liner installation. At this time, a possible crack in the original casing was identified at 222 to 225 ft, and a liner was recommended for installation into the well for structural integrity and prevention of sand pumping. On September 23, 2010, a second round of air bursting was performed in the well, and sediment samples were collected for a second sieve analysis used for gravel pack and liner screen design.

A new liner was installed into the Well 52 from October 5, 2010 to October 11, 2010. The liner was manufactured by Roscoe Moss, and consisted of 255 ft of 16 5/8 inch outer diameter 5/16 inch thick blank high-strength low alloy casing (including a 5-ft long dielectric coupler), and 360 ft of 16 5/8-inch 304L stainless steel wire-wrapped screen (0.070-inch slot size). Table 2-7 summarizes Well 52 liner construction details. Silica resources engineered gravel pack was gravity fed into the annular space between the original well casing and the new liner. The liner was not cemented in place as was stated in the RD/RA work plan. The screened zone was swabbed to ensure consolidation of the gravel pack. The Well 52 liner diagram is presented in Appendix 2-12.

Table 2-7. Well 52 Liner Construction Details

Well ID	Completion Date	Depth (ft bgs)	Depth to Water (ft bgs) (11/1/2010)	Diameter (inches)	Well Casing	Liner Blank (ft bgs)	Liner Screen* (ft bgs)	Screen Slot Size
Well 52	2010	615.00	57.64	16.63	High strength low alloy	0.00 – 255.00	255.00 - 615.00	0.070

* 304L stainless steel wire-wrapped screen

Following the liner installation, the well was pumped via DSAL in the screen zone to further consolidate the liner gravel pack. A total of 64,844 gallons of water was extracted from Well 52 during the gravel pack consolidation, which was completed on October 15, 2010. Water was containerized at Well 52 site, trucked to Ventura's containment and filtration system, and treated using the MHTS.

Second Stage of Rehabilitation

Following the DSAL pumping, a diesel-powered vertical turbine test pump was installed into the well. The second stage of well rehabilitation was resumed and consisted of three days of development pumping, which was completed from October 23, 2010 to October 27, 2010. A total of 1,383,565 gallons was pumped during this time. An 8-hour step-down test was then completed on October 28, 2010, with a total of 838,269 gallons being pumped. After the step test, the diesel-powered motor was swapped with an electric motor due to noise concerns during the 24-hour test. Finally, a 24-hour continuous rate test was performed on November 1, 2010 and November 2, 2010 at a flowrate of 1,853 gpm. Drawdown was measured at 105.16 ft, and the specific capacity was calculated to be 17.62 gpm/ft. A total of 3,018,753 gallons was pumped during the continuous rate test. Daily field logsheets are presented in Appendix 2-10. After completion of the well development and pumping tests, a second round of groundwater samples were collected and submitted to WSE for inorganic and organic analyses. The laboratory results are presented in Appendix 2-9. Following the groundwater sampling, a dynamic spinner log was performed. Results of the dynamic spinner logging are presented in Appendix 2-11. An additional 226,467 gallons was pumped from the Well 52 during the spinner log test and discrete depth groundwater sampling. Table 2-8 provides a summary of first stage and second stage rehabilitation dates and total volumes extracted from Well 52.

Table 2-8. Well 52 Rehabilitation

Well ID	First Stage Rehabilitation	First Stage Rehab. Volume Extracted (gallons)	Second Stage Rehabilitation	Second Stage Rehab. Volume Extracted (gallons)*
Well 52	4/28/10 – 5/28/10	296,800	8/18/10 – 11/3/10	6,400,438

* = Includes air production testing.

Data collected during the pump testing were used to design the well pump for Well 52, which consists of a Goulds® four-stage 1,800 gpm flow-rated pump with cast iron, glass-lined bowls and silica bronze impellers. Table 2-9 summarizes Well 52 pump details. On December 29, 2010 and December 30, 2010,

well disinfection was completed prior to the installation of the new well pump. The installation of a new well pump and new US Motors (Emerson) 200 hp premium efficiency vertical hollow shaft electric motor with 120 volt space heater and thermostat was completed on January 14, 2011.

Table 2-9. Well 52 Pump

Well ID	Pump Setting	Motor Horsepower	Flowrate
Well 52	357.4	200	1,800

The well pump was operated beginning January 14, 2011 and the extracted groundwater was de-chlorinated and discharged to spreading basin #5 while blending with MHTS treated water or potable water from PWP's potable Calaveras pipeline. After passing the bacteriological tests, water extracted from Well 52 was processed through MHTS loaded with virgin media on January 19, 2011. Well 52 was operated on a daily basis during the business week (i.e., Monday through Friday) through March 16, 2011. Extracted water was processed through MHTS and discharged to spreading basin #5. Beginning on March 17, 2011, Well 52 was operated continuously through the MHTS and discharging to spreading basin #5 with the exception of March 21, 2011–March 23, 2011 and March 26, 2011–March 29, 2011 when Well 52 water was processed and disinfected for drinking water during the Metropolitan Water District (MWD) Maintenance Shutdown. Following the MWD shutdown, the well was operated on a daily basis, and extracted water was processed through MHTS and discharged to spreading basin #5 from March 30, 2011 through May 20, 2011. Monthly production volumes are provided in Table 2-10

Table 2-10. Well 52 Monthly Pumping Volumes

Month and Year	Volume (gallons)
April 2010	49,800
May 2010	247,000
June - July 2010	0
August 2010	200,059
September 2010	876,540
October 2010	2,278,679
November 2010	3,245,219
December 2010	0
January 2011	23,925,827
February 2011	8,800,024
March 2011	32,607,100
April 2011	14,096,800
May 2011	8,353,200
June 2011	15,000
Total:	**94,695,249**

In late May 2011, the well subcontractor measured the liner's gravel pack and determined that a large volume was missing. The pump was pulled from the well on May 26 and May 27, 2011 and a video log was completed in early June 2011; the log showed multiple holes in the screened zone and one in the blank casing. In mid-August 2011, the well contractor will remove the liner from the well and the cause of the liner hole will be investigated. Results of the investigation and modifications to the existing well will be presented in an addendum to this document at a later date.

2.3 Ventura Well

Background

The Ventura Well is located on the east side of Karl Johnson Parkway; approximately 1,350 ft due south of the intersection of Karl Johnson Parkway and the JPL east parking lot access road. The well site consists of two attached buildings constructed of brick and cinder blocks with a removable roof. The attached buildings house the production well, SCADA system, pump motor electrical switchgear, and booster pump variable frequency drives (VFDs). The wellhead is housed in the building immediately north of the switchgear. The entrance to the buildings is located within a fenced lot that is roughly 172 ft

× 40 ft in size. The fenced lot includes a pre-fabricated building that was constructed during OU-3 construction effort which houses three 250 hp booster pumps. The booster pumps feed water from the two concrete-lined sumps (the MHTS equalization sumps) that are located below the building floor to the MHTS. The equalization sumps have a combined volume of 32,800 gallons. The remainder of the fenced lot is empty.

The Ventura Well was constructed by the Roscoe Moss Company from June 7, 1924 to August 6, 1924 and consists of 26-inch diameter double No. 8 gauge steel casing. The conductor casing consists of double ¼-inch gauge steel and extends from the ground surface to 30 ft bgs. The original well construction details are summarized in Table 2-11.

Table 2-11. Ventura Well Original Construction Details

Well ID	Completion Date	Depth (ft bgs)	Depth to Water (ft bgs) (7/21/2009) (c)	Diameter (inches)	Screened Intervals (ft bgs)	Screen Length	Well Casing	Screen Slot Size
Ventura Well[a]	1924	473.00	76.17	20[b]	102-141	39	#8 steel gauge	Mills Knife ¾ inch Diameter x 5-5 ½ inch Long
					164-218	54		
					242-244	2		
					260-312	52		
					410-468	58		
					Total Screen	**205**		

(a) Ventura Well operation ceased in January 2002.
(b) Well originally constructed of 26-inch diameter casing – modified in 1988 with a 20-inch diameter liner.
(c) Static water level measured during video log conducted July 21, 2009

The well was relined in 1988 by PWP's subcontractor General Pump with 220 ft of 20-inch diameter blank casing, and 240 ft of 20-inch 316 stainless steel wire-wrapped 0.060-inch slot screen. Table 2-12 summarizes the Ventura Well liner construction details, and details can be found in Appendix 2-13. A copy of the original Roscoe Moss construction and boring log is presented in Appendix 2-14. Operation was previously discontinued in January 2002.

Table 2-12. Ventura Well Liner Construction Details (Installed 1988)

Well ID	Completion Date	Depth (ft bgs)	Depth to Water (ft bgs) (9/21/2010)	Diameter (inches)	Well Casing	Liner Blank (ft bgs)	Liner Screen* (ft bgs)	Screen Slot Size
Ventura Well	1988	460.00	59.30'	20.00	Stainless	0.00 – 220.00'	220.00 - 460.00	0.060

First Stage Rehabilitation

The well pump and motor were pulled from Ventura Well in July 2009 (Figure 2-6). The pump was inspected and it was determined that it needed to be replaced due to heavy corrosion (Figure 2-7). A pre-brush video log was then completed (see Appendix 2-16 for summary video log inspection sheets), and the well was brushed with a nylon brush (i.e., due to wire-wrapped screen) to remove debris and incrustations before completing a post-brush video log of the well. The results of the video log indicated that blank and screen sections of the liner installed in 1988 were in good condition. Mobilization for the first stage of well rehabilitation and development began in May 2010.

Figure 2-6. Ventura Pump Before Rehabilitation

Figure 2-7. Ventura Pump Removed July 2009

Rehabilitation efforts began with OEAL pumping from a depth of 460 ft to the bottom. Sediment and gravel were removed during OEAL pumping, so a video log was performed again to check the screen condition. The video log confirmed that the well liner was in good condition and didn't appear to be the

cause for gravel production. Well rehabilitation efforts continued with DSAL pumping to dislodge debris from the casing and remove it from the well. The DSAL pumping was completed in 10 ft increments from 218 ft to 448 ft. A chemical injection, air blasting, and AquaFreed® injection were completed following the first round of DSAL. The chemical injection consisted of a blend of 17,000 gallons of water, hydrochloric acid, glycolic acid, surfactant/dispersant, and an acid inhibitor which was used to dislodge and dissolve debris and biofilms from the well casing. The chemical cleaning process followed the same procedure outlined in section 2.1 above. Air bursting was performed in the well with an air gun device (i.e., BoreBlast®), which uses pressurized nitrogen to dislodge mineral scale and scour the casing surface to further clean the well. Finally, AquaFreed® carbon dioxide injection was completed to further scour the casing and surrounding gravel pack. The first stage of well rehabilitation was then completed with a second round of DSAL pumping from 218 ft to 448 ft. A total of 178,400 gallons was extracted from the Ventura Well during the first stage of well rehabilitation, which occurred from May 17, 2010 to June 9, 2010. Copies of the daily logsheets are provided in Appendix 2-17. All water was containerized at the Ventura Well site, trucked to JPL and treated using the OU-1 treatment system.

Second Stage of Rehabilitation

Following the well rehabilitation activities, a diesel-powered vertical turbine test pump was installed and well development activities were completed. Development water was processed through the containment and filtration system that was located at the Ventura Well site. Two days of development pumping were completed on September 13 and 14, 2010. A total of 914,100 gallons was pumped during this time. An 8-hour step-down test was then completed on September 15, 2010, with a total of 711,600 gallons being pumped. After the step test, the diesel-powered motor was swapped with an electric motor due to noise concerns during the 24-hour test. Finally, a 24-hour continuous rate test was performed on September 21, 2010 and September 22, 2010 at a flowrate of 1,830 gpm. Drawdown was measured at 91.10 ft, and the specific capacity was calculated to be 20.08 gpm/ft. A total of 2,787,700 gallons was pumped during the continuous rate test. Daily pumping logsheets are provided in Appendix 2-17. After completion of the well development and pumping tests, groundwater samples were collected and submitted to WSE for inorganic and organic laboratory analyses, and results are presented in Appendix 2-15. Following the groundwater sampling, a dynamic spinner log was performed. An additional 1,066,000 gallons was pumped from the Ventura Well during the dynamic spinner log test. Results of the dynamic spinner log are provided in Appendix 2-18. Table 2-13 provides a summary of first stage and second stage rehabilitation dates and total volumes extracted from the Ventura Well.

Table 2-13. Ventura Well Rehabilitation

Well ID	First Stage Rehabilitation	First Stage Rehab. Volume Extracted (gallons)	Second Stage Rehabilitation	Second Stage Rehab. Volume Extracted (gallons)
Ventura Well	5/17/10 – 6/9/10	178,400	9/7/10 – 10/4/10	5,479,400

Data collected during the pump testing was used to design the well pump for Ventura, which consists of a Goulds® four-stage 1,600 gpm flow-rated pump with cast iron, glass-lined bowls and silica bronze impellers. A copy of the pump submittal is provided in Appendix 2-19. A US Motors (Emerson) 150 hp premium efficiency vertical hollow shaft electric motor with 120 volt space heater and thermostat was

installed. Installation of the new well pump and motor was completed on December 23, 2010. Table 2-14 summarizes the Ventura well pump details.

Table 2-14. Ventura Well Pump

Well ID	Pump Setting	Motor Horsepower	Flowrate
Ventura Well	405.10	150	1,600

Two rounds of well disinfection were completed prior to passing the bacteriological tests, and sending extracted groundwater from Ventura Well to the MHTS. Following the disinfection, extracted groundwater from Ventura was de-chlorinated and blended with either treated water from the MHTS or water from PWP's potable Calaveras pipeline prior to being discharged to the spreading basins. The Ventura Well was operated and processed by MHTS on a daily basis except during system maintenance and during the MWD shutdown between January and the end of June 2011. Extracted purge water was processed through MHTS to keep water flowing through the media and vessels to prevent biological growth, and discharged to spreading basin #5. Table 2-15 summarizes the volume of water pumped each month from Ventura Well.

Table 2-15. Ventura Well Monthly Pumping Volumes

Month and Year	Volume (gallons)
May 2010	99,000
June 2010	79,400
July 2010 – August 2010	0
September 2010	5,479,400
October 2010 – November 2010	0
December 2010	742,800
January 2011	21,769,842
February 2011	5,239,124
March 2011	16,258,016
April 2011	8,925,700
May 2011	8,552,500
June 2011	9,633,900

Table 2-15. Ventura Well Monthly Pumping Volumes (Continued)

Month and Year	Volume (gallons)
Total:	**76,779,682**

Figure 2-8. Ventura Well August 18, 2011

2.4 Arroyo Well (No. 25)

Background

The Arroyo Well is located on the eastern side of the JPL east parking lot access road (see Figure 1-1). The well is located 126 ft south of the JPL east parking lot fence, and approximately 1,350 ft north of the intersection of Windsor Avenue, Ventura Street, and the JPL east parking lot access road. The property consists of a small well house (approximate dimensions: 18 ft × 23 ft) that houses the well, associated ancillary piping, electrical equipment, and two booster pumps, and is surrounded by a chain-link fence (61 ft × 32 ft). Two access gates are located on the eastern and southern perimeter.

The Arroyo Well was cable tool drilled and constructed from June 10, 1930 until August 22, 1930 by Roscoe Moss. The original well was drilled to a depth of 668 ft, and constructed with 26-inch diameter No. 8 gauge steel casing with mills knife perforations that are 5/8-inch diameter by 5-inches long and at the following intervals: 127 – 302 ft, 306 – 331 ft, 367 – 372 ft, 398 – 404 ft, 457 – 489 ft, 498 – 506 ft, 508 – 524 ft, 538 – 554 ft, 568 – 594 ft, 598 – 627 ft bgs. According to PWP records, the starter casing consists of four-ply No. 8 gauge steel and extends from the ground surface to 30 ft bgs. The casing was extended by approximately 5 ft and the shaft was filled with gravel in 1967. In October 1977, a 20-inch diameter steel hanging liner was installed into the well. It was 324 ft long and the bottom 100 ft was perforated (i.e., 0 to 224 ft blank casing and 224 to 324 ft perforated casing). The total depth of the well is 668 ft bgs; the well was sounded on November 30, 1971 and recorded a total depth of only 643 ft bgs

due to a buildup of fines in the base of the borehole. Characteristics of the Arroyo Well are summarized in Table 2-16 and a copy of the Roscoe Moss construction and boring log is presented in Appendix 2-20.

Table 2-16. Arroyo Well Original Construction Details

Well ID	Completion Date	Depth (ft bgs)	Depth to Water (ft bgs) (7/15/2009) (2)	Diameter (inches)	Screened Intervals (ft bgs)	Screen Length (ft)	Well Casing	Screen Slot Size
Arroyo Well(1)	1930	668	96.00	26(a)	127-302	175	#8 steel gauge	Mills Knife 5/8 inch Diameter x 5 inch Long
					306-331	25		
					367-372	5		
					398-404	6		
					457-489	32		
					498-506	8		
					508-524	16		
					538-554	16		
					568-594	26		
					598-627	29		
					Total Screen	**338**		

Notes:
(1): Arroyo operation ceased in 1997
(2): Static water level measured during video log conducted July 15, 2009
(a): Well originally constructed of 26-inch diameter casing – modified in 1975 with a 20-inch diameter hanging liner from 0 to 324 ft (perforated: 224-324 ft; welded at surface).

Operation of the Arroyo Well ceased in 1997. In the two years prior to system shutdown, the median monthly groundwater production rate from the Arroyo Well was 2,400 gpm, with an associated depth to water of approximately 145 ft bgs. The pump and associated equipment were removed from the well in September 2003 by General Pump Company, and video and geophysical logging of the well was completed by Pacific Surveys.

First Stage Rehabilitation

A pre-brush video log was completed on July 15, 2009 (see Appendix 2-21 for summary video log inspection reports). Nearly a year later, mobilization for the first stage of well rehabilitation and development began on June 14, 2010. Over the next two days, the well contractor removed the hanging liner from the well, which was followed by a video log of the well. Next, the well was brushed with a steel bristle brush to remove debris and incrustations. OEAL pumping was used from a depth of 619 ft to 660 ft to remove material that accumulated in the bottom of the well during brushing. A post-brushing and OEAL pumping video log was performed on June 24, 2010.

Well rehabilitation efforts continued with DSAL pumping to dislodge debris from the casing and remove it from the well. The DSAL pumping was completed in 10 ft increments from 129 ft to 627 ft. Following the DSAL pumping, groundwater samples were collected with a thief bailer and submitted to WSE for inorganic and organic laboratory analyses. The laboratory reports are presented in Appendix 2-22. A chemical injection and air blasting were completed following the first round of DSAL. The chemical

injection consisted of a blend of 19,700 gallons of water, hydrochloric acid, glycolic acid, surfactant/dispersant, and an acid inhibitor which was used to dislodge and dissolve debris and biofilms from the well casing. The chemical cleaning process followed the same procedure outlined in section 2.1 above. Air bursting was performed in the well with an air gun device (i.e., BoreBlast®), which uses pressurized nitrogen to dislodge mineral scale and scour the casing surface to further clean the well. Following the air bursting, OEAL pumping was used to remove fill that accumulated on the bottom of the well. Sediment samples were collected for sieve analyses for use in the design of the liner's gravel pack and screen. Beginning July 15, 2010 a second round of DSAL pumping was completed in 10 ft increments from 129 ft to the total depth of the well. Daily pumping logsheets are provided in Appendix 2-23. Next a 20-inch diameter dummy or mandrel was lowered into the well to ensure that a liner could fit inside of the original casing.

A new liner was installed into the Arroyo Well from August 9, 2010 through August 18, 2010. The liner was manufactured by Roscoe Moss, and consisted of 273 ft of 18 5/8 inch outside diameter, 5/16 inch thick blank high-strength low alloy casing (including a 5-ft long dielectric coupler), and 370 ft of 18 5/8-inch 304L stainless steel wire-wrapped screen (0.060-inch slot size). Table 2-17 summarizes the Arroyo Well liner construction details. Silica resources engineered gravel pack was installed in the annular space between the original well casing and the new liner. The screened zone was swabbed to ensure consolidation of the gravel pack. The Arroyo well liner diagram is presented in Appendix 2-25.

Table 2-17. Arroyo Well Liner Construction Details

Well ID	Completion Date	Depth (ft bgs)	Depth to Water (ft bgs) (10/18/2010)	Diameter (inches)	Well Casing	Liner Blank (ft bgs)	Liner Screen* (ft bgs)	Screen Slot Size
Arroyo Well	2010	643.00	73.80	18.63	High strength low alloy	0.00 - 273.00	273.00 - 643.00	0.060

* 304L Stainless Steel Wire-wrapped Screen

Following the liner installation, an AquaFreed® carbon dioxide injection was completed to further scour the casing and surrounding gravel pack. This was followed by a third round of DSAL pumping in 10-ft increments throughout the entire screened zone which was completed by August 27, 2010. On September 14 and 15, 2010, OEAL pumping was completed to clean out the bottom of the well. A total of 355,400 gallons was extracted from the Arroyo Well during the first stage of well rehabilitation which occurred from June 14, 2010 through September 15, 2010. All first stage rehabilitation purge water was pumped from the Arroyo site to the Well 52 site via temporary pipeline, where it was contained and filtered, and trucked to JPL and treated using the OU-1 treatment system.

Second Stage of Rehabilitation

Following the OEAL pumping, a diesel-powered vertical turbine test pump was installed into the well, and the second stage of well rehabilitation began on October 4, 2010. After two days of pumping the well contractor encountered pump problems and had to pull the pump. The pump was re-installed and pump development resumed on October 9, 2010 with three additional days of test pumping. A total of 2,488,000 gallons was pumped during the five days of pump development. An 8-hour step-down test was then completed on October 13, 2010, with a total of 974,000 gallons being pumped. After the step test

the diesel-powered motor was swapped with an electric motor due to noise concerns during the 24-hour test. Finally, a 24-hour continuous rate test was performed on October 18, 2010 and October 19, 2010 at a flowrate of 2,220 gpm. Drawdown was measured at 167.30 ft, and the specific capacity was calculated to be 13.26 gpm/ft. A total of 3,211,000 gallons was pumped during the continuous rate test. Daily field logsheets are presented in Appendix 2-23. After completion of the well development and pumping tests, a dynamic spinner log was performed. Results of the dynamic spinner log test are presented in Appendix 2-24. An additional 749,000 gallons were pumped from the Arroyo well during the spinner log test. Table 2-18 summarizes first and second stage rehabilitation dates and volumes removed during each rehabilitation stage.

Table 2-18. Arroyo Well Rehabilitation

Well ID	First Stage Rehabilitation	First Stage Rehab. Volume Extracted (Gallons)	Second Stage Rehabilitation	Second Stage Rehab. Volume Extracted (Gallons)*
Arroyo Well	6/14/10 – 9/15/10	355,400	9/27/10 – 10/26/10	7,422,000

Data collected during the pump testing were used to design the well pump for the Arroyo Well, which consists of a Goulds® five-stage 2,200 gpm flow-rated pump with cast iron, glass-lined bowls and silica bronze impellers. The pump submittal is provided in Appendix 2-25. On November 30, 2010, approximately six weeks before the pump installation, a final video log was performed. On January 13, 2011, well disinfection was completed prior to the installation of the new well pump. The installation of the new well pump and new US Motors (Emerson) 250 hp premium efficiency vertical hollow shaft electric motor with 120 volt space heater and thermostat was completed on January 16, 2011. Table 2-19 summarizes the Arroyo well pump details.

Table 2-19. Arroyo Well Pump

Well ID	Pump Setting	Motor Horsepower	Flowrate
Arroyo Well	418.40	250	2,200s

The well pump was operated beginning January 22, 2011 and the extracted groundwater was de-chlorinated and discharged to spreading basin #5 while blending with MHTS treated water from Ventura and Well 52. After passing the bacteriological tests, water extracted from the Arroyo Well was processed through MHTS loaded with virgin media on January 24, 2011. The Arroyo Well was operated on a daily basis during the business week (i.e., Monday through Friday) through March 16, 2011, and extracted water was processed through MHTS and treated water was discharged to spreading basin #5. Beginning on March 17, 2011, the Arroyo Well was operated continuously through the MHTS and discharging to spreading basin #5 with the exception of March 21, 2011–March 23, 2011 and March 26, 2011–March 29, 2011, when Arroyo well water was processed by MHTS and disinfected for drinking water during the MWD maintenance shutdown. Following the MWD shutdown, the well was operated on a daily basis, and extracted water was processed through MHTS and discharged to spreading basin # 5 from March 30, 2011 through June 29, 2011. Monthly production volumes are provided in Table 2-20 Beginning on July

5, 2011, PWP began continuous operation of the Arroyo Well. Discharge water is being processed by MHTS, disinfected, and distributed to the drinking water system.

Table 2-20. Arroyo Well Monthly Pumping Volumes

Month and Year	Volume (gallons)
June 2010	127,500
July 2010	148,400
August 2010	69,500
September 2010	10,000
October 2010	7,422,000
November 2010 – December 2010	0
January 2011	8,822,200
February 2011	5,960,050
March 2011	31,862,952
April 2011	4,697,383
May 2011	7,755,200
June 2011	16,002,000
Total:	**82,877,185**

Figure 2-9. Arroyo Well August 18, 2011

3.1 Site Grading and Drainage

Site grading was completed per the grading plan provided in the RD/RA Work Plan (NASA, 2009). Sheets C-110 and C-111 of the as-built drawings show the final site grading elevations and rip-rap swale along the north and east side of the treatment pad area (Appendix 3-1). All grading was compacted a minimum of 90%, per the design plans. Appendix 3-2 includes inspection reports from Moore Twining Associates, Inc., documenting that the minimum compaction requirements were achieved.

A minor modification to the drainage around the treatment pad area was made during construction to improve drainage of storm water near the treatment pad area. This drainage modification included the removal of 6 inches of soil from between the southern end of the treatment pad and the access driveway, and installation of a 12-inch wide trench to the native subgrade, roughly 3 ft deep, running west to east parallel to the concrete pad. A geotextile mat was placed in the trench and surrounding area where soil was removed, and the mat was topped with ¾-inch gravel to grade.

During site grading and other earth moving activities, Durasoil® dust suppressant was applied for dust control. This product is PM10 and PM2.5 compliant, environmentally safe, and lasts between 9 and 16 months. Durasoil® was selected as the method for dust control to minimize the need for repeated water applications during the often hot and dry conditions encountered during construction activities.

3.2 Underground Pipeline Construction

Underground piping associated with the MHTS includes several existing underground pipelines which were inspected and tested, and several new pipelines to convey extracted groundwater to the treatment system and treated water to the Windsor Reservoir or Arroyo Seco Spreading Basins, as appropriate. Discharge of treated water to the spreading basins is necessary during periods of startup and testing or other routine maintenance activities, when the water cannot be sent to the Windsor Reservoir. A summary of the previous pipeline investigation and testing, and a discussion of the pipeline installation and upgrade activities completed as part of the treatment system construction is provided in the following subsections. Daily inspection logs were completed by Civiltec Engineering, Inc. and are provided in Appendix 3-3.

3.2.1 Summary of Previous Pipeline Investigation and Testing

As discussed in the RD/RA Work Plan (NASA, 2009), the condition of all pre-existing pipelines was assessed through closed circuit television inspections. Overall, the pipes were found to be in good condition; however, additional pressure testing was performed on two of the pipes to further evaluate their integrity. The pressure testing was performed on 1,100 ft of the 16-inch steel pipeline (from Ventura Well to the proposed influent connection point at the Windsor Site) and 255 ft of the 12-inch ductile iron pipeline (from Windsor Well to a location just east of the north driveway at the Windsor Site) in accordance with the intent of AWWA M11 and AWWA C600, respectively. Both pipelines passed the pressure tests.

3.2.2 Pipeline Installation and Upgrades

The installation of new underground pipeline and upgrades/modifications to existing underground pipelines were completed as described in the RD/RA Work Plan (NASA, 2009). Table 3-1 summarizes the new pipeline installation and pipeline upgrade/modification activities. The layout and configuration of the underground pipelines is shown on C-101 through C-109 and associated sheets of the as-built drawings (Appendix 3-1). All transmission pipelines and pressure distribution mains were pressure and leak tested in accordance with Section 15042, Hydrostatic Testing of Pressure Pipelines, of the PWP Technical Specifications for the Construction of MHTS. All pipelines passed the pressure and leak test.

Table 3-1. Summary of Pipeline Installation and Upgrade Activities

	Diameter and Material	Length	Description
Combined MHTS Influent	24 inch DIP	255 LF	Installed from MHTS pad to point of connection with Windsor Well and equalization sump influent pipelines
Influent from Windsor Well	12 inch DIP	65 LF	Installed from Windsor Well to point of connection with 24 inch MHTS influent pipeline
Influent from Equalization Sump	16 inch DIP	--	Connected 16 inch pipeline from equalization sump to 24 inch MHTS influent line at Windsor Site
MHTS Effluent	24 inch DIP	322 LF	Installed from MHTS pad to Windsor Reservoir and sand box
Surface Water Discharge	30 inch RCP	30 LF	Demolished and reconnected 30LF of existing 30 inch RCP line at Windsor Site
Surface Water Discharge	30 inch RCP	129 LF	Installed new portion of pipeline connecting the existing 30 inch RCP near the Windsor Ave extension to Arroyo Seco Spreading Basin #5
Arroyo Well Discharge	12 inch DIP	20 LF	Replaced a portion of the existing Arroyo Well discharge pipeline
Equalization Sump Influent	12 inch/16 inch steel	15 LF	Replaced/modified connection of existing Arroyo Well and Well 52 combined influent pipeline with the equalization sump
Equalization Sump Overflow	8 inch DIP	36 LF	Installed from equalization sump to Arroyo Seco Spreading Basin
Backwash Supply	10 inch DIP	272 LF	Installed from City of Pasadena potable water connection to MHTS pad
Backwash Discharge	10 inch DIP	347 LF	Installed from MHTS pad to sand box

CIP – cast iron pipe
DIP – ductile iron pipe
LF – linear feet
RCP – reinforced concrete pipe

Installation of the 30-inch RCP line extending from the Windsor Ave extension to the Arroyo Seco Spreading Basin #5 for surface water discharge was also accompanied by improvements to the outfall at this location. Construction changes to the drainage outfall from the final design plans included installation of two gravity retaining walls, reconstruction of the scoured slope area, and installation of a wire mesh screen for vermin control. The final outfall construction is shown on sheets C-103 and C-109 of the as-built drawings (Appendix 3-1).

3.3 MHTS Concrete Pad Installation

The concrete pad was constructed in the south central portion of the Windsor site with dimensions of approximately 100-ft by 150-ft, per the design plans provide in the RD/RA Work Plan (NASA, 2009). Preparation for the concrete pad construction included 2 ft of overexcavation and compaction of native material at 95% relative density below the foundation and extending at least 2 ft horizontally beyond the foundation perimeter per the design plans. Compaction testing results for the concrete pad foundation area is included in Appendix 3-2. Placement of the rebar for the concrete pad reinforcement was inspected on a daily basis, and the daily inspection logs are included in Appendix 3-3. Concrete testing was also performed per the specifications provided in the RD/RA Work Plan (NASA, 2009). Results of the concrete testing, including slump tests, concrete temperatures, air temperatures, and compression tests (at 7 and 28 days) are provided in Appendix 3-4 with the sampling field logs. Details of the final concrete pad construction are shown on sheets TPS-101 and TPS-102 of the as-built drawings (Appendix 3-1).

3.4 Treatment System Construction

The MHTS was designed with a maximum capacity of 7,000 gpm, and consists of the following components:

- equalization sump and three booster pumps at the Ventura booster station (Figure 3-1),
- three parallel influent cartridge filters (Figure 3-2),
- four parallel pairs of ion exchange vessels (each pair configured in series, Figure 3-2),
- five pairs of LGAC vessels (each pair configured in series, Figure 3-3), and
- a bag filter for processing backwash water.

Figure 3-1. Photograph of the Ventura Booster Station

Figure 3-2. Photograph of the Cartridge Filters and Ion Exchange Vessels

Figure 3-3. Photograph of the LGAC Vessels

Equipment sizing and placement were completed per the design plans provided in the RD/RA Work Plan (NASA, 2009). One minor piping modification to the treatment system design was completed, which included the installation of a recirculation line on the last pair of LGAC vessels to accommodate treatment of backwash water. Details of the Ventura booster station, including the equalization sumps, booster pumps, and associated piping are shown in the as-building drawings on sheets VWA-101 through VWA-105, VWM-101 and VWM-102, and VWS-101 and VWS-102 (Appendix 3-1). Details of the treatment system construction, including vessels and the associated aboveground piping and valves, are shown on sheets TPM-101 through TPM 105 of the as-built drawings (Appendix 3-1).

Prior to delivery to the site, the vessel lining and coating were inspected by the vendor, Calgon Carbon Corporation, and an independent inspector, Schiff Associates. The vessel linings and coatings were approved as having been completed per the specifications. The vessel inspection reports are provided in Appendix 3-5.

Upon completion of the equipment and piping installation, the system was pressure tested for 8 hours at 110 pounds per square inch (psi). A problem was identified in which the flanges were not seating properly with the gaskets. The flange faces were cleaned to ensure the machined finish of the flange seated properly with the gasket and gaskets were replaced to ensure tight seals. After fixing several flange/gasket leaks, the pressure test passed. Daily inspection logs documenting installation and pressure testing of the MHTS equipment are provided in Appendix 3-3.

3.5 Treatment System Disinfection

The water mains, treatment system vessels, and associated piping were disinfected in accordance with AWWA C651-92. The residual chlorine levels were measured to be approximately 70 to 80 parts per million (ppm) after 24 hours, and the system was flushed to dechlorinate the equipment. Water samples were then collected for coliform and plate count testing on the disinfected equipment. Disinfection logs are provided in Appendix 3-6, and results of the disinfection sampling are provided in Appendix 3-7. Table 3-2 summarizes the volume of disinfection water utilized for equipment and pipeline disinfection.

Table 3-2. Summary of Disinfection Volumes

Description	Linear Feet	ft^3	Volume (gal)
Influent Pipelines			
12 inch Below Ground Pipeline (Arroyo - Well 52)	565	444	3,322
16 inch Below Ground Pipeline (Well 52 - Ventura)	825	1,146	8,573
16 inch Below Ground Pipeline (Ventura Sump - MHTS Wye)	960	1,334	9,980
12 inch Below Ground Pipeline (Windsor - MHTS Wye)	70	54	404
24 inch Below Ground Influent Pipeline (MHTS Wye - Influent)	280	880	6,583
Effluent Pipeline			
24 inch Below Ground Effluent Pipeline (MHTS)	300	954	7,070
Backwash Pipelines and Filters			
10 inch Below Ground Potable BW Influent (MHTS)	300	163	1,220
10 inch Below Ground BW Effluent Pipeline (MHTS)	270	147	1,010
F-401 (Ion Exchange Backwash Filter)	-	60	449
F-402 (LGAC Backwash Filter)	-	115	860
Monk Hill Treatment System Pipeline and Vessels			
24 inch Above Ground Pipeline (MHTS)	484	1,520	11,370
Cartridge Filters (ea) x 3	--	26	195
10 inch Above Ground Pipeline (MHTS)	484	264	1,975
10 inch valve tree to header line (11')(4 per tree)(9 valve trees)	--	216	1,616
Ion Exchange Vessels (8 total; 1000 ft^3 each)	--	8,000	59,844
LGAC Vessels (10 total 2000 ft^3 each)	--	20,000	149,610
Wells and Discharge Piping			
Arroyo Discharge Piping	110	86	643
Well 52 Discharge Piping	115	90	673
Ventura Discharge Piping	50	27	202
Windsor Discharge Piping	235	128	958
Ventura Sump and Booster Station			
Ventura Sump	--	4,385	32,800
Ventura Booster Pumps and Piping	85	118	883
Totals:	**5,133**	**40,157**	**300,240**

3.6 Instrumentation and Controls

Final piping and instrumentation diagrams (P&IDs) are provided on sheets PID-101 through PID-108 of the as-built drawings (Appendix 3-1). These P&IDs show the piping, valves and instrumentation for the installed system. Instrumentation associated with the MHTS equipment primarily includes flow meters, differential pressure gauges, and rupture disk alarms. All instrumentation devices on the treatment system are monitoring devices only; no devices are configured with return control signals. In general, the instrumentation was installed per the plans presented in the RD/RA Work Plan (NASA, 2009); however,

some modifications were made per the direction of the City of Pasadena based on their requirements for long-term system monitoring and operation.

A SCADA junction box was installed to receive all signals from the monitoring instrumentation and includes a 24 volt direct current (VDC) power supply for the system instrumentation. The existing remote terminal units (RTUs) were used to connect the new SCADA system to the City's existing SCADA.

3.7 Windsor Site Access and Windsor Avenue Road Improvements

Paved driveways were built to provide truck access to the Windsor site and treatment pad. The main access road running between the north and south entrance gates and along the west side of the treatment pad was constructed as 20-ft wide, per the design plans (NASA, 2009). The center of the pad is also accessible to vehicles from this main access road. A secondary 15-ft wide access road was built around the north, south, and east sides of the treatment pad. All grading, compaction, and asphalt placement was completed per the design plans; documentation of these activities is provided in Appendices 3-2 and 3-3. As-built drawings of the Windsor Site access driveways are provided on sheets C-110 and C-111 (Appendix 3-11).

Additional street improvements were also completed on Windsor Avenue, adjacent to the western Windsor site boundary. The area along Windsor Avenue located just below the south gate was widened to provide easy access for delivery trucks. In addition, a curb, gutter, street lighting, and sidewalk were installed along Windsor Avenue. The as-built street improvement plans are provided on sheets 1 through 8 of the Windsor Avenue Improvement drawings in Appendix 3-1.

3.8 Waste removal

All waste materials generated on site during MHTS construction activities were recycled through proper recycling centers, and all weights were calculated based on recycling center scales. The total weight of recycled waste from this construction project was 4,080.08 tons. Appendix 3-8 includes the final construction and demolition waste management report. This final report includes all MHTS construction activities from April 20, 2009 through May 31, 2011. Table 3-3 includes a summary of waste material from the construction activities.

Table 3-3. Summary of Waste Material from MHTS Construction Activities

Material Type	Recycled (tons)	Landfilled (tons)	Hauler(s)	Destination Facility(ties)
Concrete	48	0	RC Foster Corp.	Ramco
Metal	7.06	0	SA Recycling	SA Recycling
Rock	744	0	RC Foster Corp.	Ramco
Soil	3144	0	RC Foster Corp.	Vulcan
Asphalt	132	0	RC Foster Corp.	Vulcan/Ramco
Mixed Debris	5.02	0	Athens	Arakelian Enterprises Inc.

3.9 Environmental Impact Monitoring

In accordance with the Environmental Policy Guidelines of the City of Pasadena, an initial study was prepared to determine whether the MHTS construction project would have a significant effect on the environment. Several mitigation measures were identified and included as part of the project design to minimize potential significant effects on the environment (NASA, 2009). These mitigation measures were approved by the City of Pasadena under Conditional Use Permit #5057 and implemented as planned during construction activities.

3.9.1 Aesthetics

To screen the view of the MHTS from Windsor Avenue, a row of trees and shrubs was planted on the western perimeter of the site. In addition, a green screen was installed on the south entrance gate and fence along Windsor Avenue. Shrubs were also planted along the northern and southern site boundaries to screen the view of the MHTS from neighboring properties in those directions. To further help the MHTS equipment blend in with the existing view and natural environment, a light color green was used to paint the tanks, piping, and equipment. A photograph of the MHTS site from Windsor Avenue is shown in Figure 3-4.

Figure 3-4. Photograph of Landscaping Improvements along Windsor Avenue

3.9.2 Biological Impacts

In accordance with the approved mitigation measures, impact to the vegetated area south of the Arroyo discharge pipeline extension was avoided and no clearing, grubbing, or vegetation removal within or adjacent to the Arroyo Seco Master Plan Area was conducted during nesting bird season (April 15 to August 1).

3.9.3 Cultural Resources

No archaeological resources were encountered during construction activities.

3.9.4 Drainage Capacity

In accordance with the Windsor Site Drainage Analysis provided in the RD/RA Work Plan (NASA, 2009), no site drainage upgrades were necessary to accommodate storm flows from the improved site. However, as discussed in Section 3.1, a minor modification was made to the drainage around the treatment pad area to improve drainage of storm water near the pad. This entailed the removal of 6 inches of soil from between the southern end of the treatment pad and the access driveway, installation of a 12-inch wide trench to the native subgrade, placement of a geotextile mat over the area, and backfill with ¾-inch gravel to grade.

3.9.5 Noise Exposure

Per the planned mitigation measures, a sound enclosure was installed around the feed pumps at the Ventura booster station to ensure that the noise generated by the pumps was reduced to levels less than 5 decibels above ambient levels at the nearest property line. In addition, potential vibrations associated with the pumps are attenuated with shock absorbers and proper alignment.

Noise impacts from general construction activities were minimized by conducting site activities during specified time periods of the day (8 am to 5 pm), and using sound enclosures when necessary. During certain loud construction activities (impact wrench, soil vibration, etc.) located near or around surrounding neighbors restricted times of 10 am to 3 pm were used. Daily sound measurements were recorded to document that the above measures were effective. Appendix 3-9 includes the daily sound logs completed during the construction activities.

3.9.6 Traffic Capacity

In accordance with the planned mitigation measures, mobilization of construction equipment to the Windsor Reservoir site for the MHTS project did not occur while roofing materials were delivered for the Windsor Reservoir Seismic Retrofit project. In addition, pedestrian, equestrian, and bicycle access along Karl Johnson Parkway was maintained during construction activities at the Ventura Well and Well 52 sites.

4. MHTS STARTUP TESTING AND CURRENT OPERATING STATUS

4.1 MHTS Startup Testing

The MHTS startup was conducted in accordance with the approved California Department of Public Health (DPH) System Performance Test and Startup Procedure included as Appendix 4-1. Startup testing began in December 2010 and was completed in late January 2011. Table 4-1 summarizes the startup testing procedures and the initial perchlorate sample results. The complete system performance test results submitted by the City of Pasadena to the DPH can be found in Appendix 4-2.

Table 4-1. Summary of Startup Testing Procedures

Order	Name (Scenario)	Flow rate (gpm)	ClO_4^- (ppb)	Date Completed
1.	Ventura	1,600	5.8	01/15/2011
2.	Windsor	1,400	5.3	12/21/2010
3.	Well 52	1,800	9.5	01/20/2011
4.	Combined	7,000	29.6	01/31/2011
5.	Arroyo + Well 52	4,000	31.6	01/25/2011
6.	Arroyo	2,200	37.6	01/24/2011

4.2 DPH Permit

A signed Engineering Report approving the proposed amendment to the City of Pasadena Water Supply Permit 1910124PA-003 was received from the DPH on March 17, 2011. A copy of the signed Engineering Report can be found in Appendix 4-3.

4.3 Current MHTS Operations

As of March 21, 2011, PWP began intermittent operation of the treatment system for drinking water production. As mentioned previously, PWP is being funded by NASA to lease the treatment equipment and operate the system. To date, approximately 327,765,000 gallons have been extracted and successfully treated by the MHTS, of the 327,765,000 gallons; 107,038,000 gallons have been disinfected and supplied to City of Pasadena consumers.

The MHTS system is currently running at a reduced capacity of 2,200 gpm because of the additional well repairs that are ongoing at Windsor Well and Well 52. The reduced operations result in only six of eight ion exchange vessels being in operation and all 10 LGAC vessels being in operation; the vessels that are not being used require maintenance flushing in order to minimize bacteriological growth.

During well rehabilitation and initial startup, an estimated 35 pounds of perchlorate and 5 pounds of VOCs were removed by the MHTS through July 31, 2011.

5. SURFACE WATER DISCHARGE MONITORING

5.1 Surface Discharge Summary

Since July 27, 2010, surface water discharges to City of Pasadena Spreading Basin #5 have occurred as part of the MHTS construction and startup. These discharges have followed the substantive requirements of General National Pollutant Discharge Elimination System (NPDES) Permit No. CAG914001 in accordance with CERCLA Section 121(e) (1) and the approved Discharge Protocol (NASA, 2010). All water discharged was stored in City of Pasadena spreading basins and allowed to percolate back into the aquifer from which it originated and was not allowed to flow into receiving water ways.

A total of approximately 300 million gallons were discharged to Spreading Basin #5 during the course of construction and system startup. All sample logs, results and flow meter totalizer readings are tabulated in Appendix 5-1; copies of the laboratory reports are available in Appendix 5-2.

Fifty-one (51) separate surface water discharge sampling events were performed during the MHTS construction and start-up period. Samples collected during each event were analyzed for 61 individual compounds in accordance with the Discharge Protocol (NASA, 2010). Of these 3,111 analytes, only 18 did not meet the discharge limits. Eleven (11) of the 18 analytes that did not meet the discharge limits were associated with disinfection using chlorine, which is required for potable water and for disinfecting drinking water wells. All of the disinfection byproducts concentrations and residual chlorine levels in the discharge water were below drinking water maximum contaminant levels (MCLs) for total trihalomethanes and residual chlorine, and below the California Response Level for N-Nitrosodimethylamine (NDMA). The remaining analytes detected in excess of the discharge limits were anomalies, or resulted from unexpected conditions. Table 5-1 summarizes each analyte that did not meet the discharge limit, and provides an explanation and corrective action (if appropriate).

5.2 Future Discharge Events

The future surface discharges will remain consistent with the regulations and operations outlined within the Discharge Protocol (NASA, 2010). As the City of Pasadena becomes more familiar with day-to-day operations and requirements of the treatment system over the next year, the discharge operations will be reviewed and optimized for the next annual reporting period.

Table 5-1. Summary of Samples Exceeding the Discharge Limits

Date	Parameter(s)	Discharge Limit	Result	Activity (Volume Represented by Discharge)	Explanation and Corrective Action
07/27/2011	Chlorodibromomethane	0.401 µg/L	1.4 µg/L	Virgin Carbon Backwash Using Potable Water (306,300 gallons)	These three parameters are associated with disinfection using chlorine. In this case, all three compounds originated from the potable water supply used to backwash the virgin carbon. Note, that the chlorodibromomethane and dichlorobromomethane results are below the California maximum contaminant level (MCL) for total trihalomethanes of 80 µg/L and the NDMA result isbelow the California Response Level of 0.3 µg/L.
	Dichlorobromomethane	0.56 µg/L	1.7 µg/L		
	N-Nitrosodimethyl amine (NDMA)	0.00069 µg/L	0.009 µg/L		
	Acute Toxicity (Fish Bio)	>90%	15%		This result is believed to be an anomaly. A sample collected from the potable water supply immediately following this result yielded 100% survival. All subsequent samples met the discharge limit.
08/05/2011	Chloride	150 mg/L	160 mg/L	Windsor Well Step Test (5,036,685 gallons)	Initial Windsor Well sampling resulted in a slightly elevated chloride level. After the pumping and development of Windsor Well, chloride levels dropped and did not exceed the discharge limit again. Note, this result is below the Federal secondary MCL for drinking water of 250 mg/L.
12/13/2011	Dichlorobromomethane	0.56 µg/L	1.8 µg/L	Well Disinfection and Blending (5,773,870 gallons)	These parameters are associated with disinfection using chlorine. Note, the dichlorobromotethane result is below the California maximum contaminant level (MCL) for total trihalomethanes of 80 µg/L and the NDMA result isbelow the California Response Level of 0.3 µg/L.
	NDMA	0.00069 µg/L	0.0027 µg/L		

Table 5-1. Summary of Samples Exceeding the Discharge Limits, cont.

Date	Parameter(s)	Discharge Limit	Result	Activity (volume extracted)	Explanation and Corrective Action
12/13/2011	Chromium III, Total Recoverable	16 µg/L	24 µg/L	Well Disinfection and Blending (5,773,870 gallons)	This result appears to be an anomaly because it has not been observed in any other sample collected from the MHTS. This parameter will continue to monitored in the upcoming events.
12/21/2011	NDMA	0.00069µg/L	0.0037 µg/L	Well Disinfection and Blending (19,729,780 gallons)	NDMA is associated with disinfection using chlorine. As required by the DPH, each well must achieve disinfection based on the AWWA standards. Normal operation of the wells will not require the levels of chlorination/disinfection required during these initial events, so levels are not expected to be as high. These results are below the California Response Level of 0.3 µg/L
12/29/2011	Residual Chlorine	0.10 mg/L	0.12 mg/L	Carbon Backwash and Windsor Well Pumping (344,650 gallons)	The residual chlorine was a result of using potable water for the carbon backwash. A chemical feed pump is used to add sodium thiosulfate to remove the residual chlorine. In this instance the thiosulfate feed was not sufficient, so levels are expected to be lower during future disinfection events. These results are below the Federal MCL for drinking water of 4.0 mg/L
	NDMA	0.00069µg/L	0.021 µg/L		NDMA is associated with disinfection using chlorine. As required by the DPH, each well must achieve disinfection based on the AWWA standards. Normal operation of the wells will not require the levels of chlorination/disinfection required during these initial events, so levels are expected to be lower during future disinfection events. These results are below the California Response Level of 0.3 µg/L
01/06/2011	pH	6.5-8.5 S.U.	9.1	Virgin Carbon Backwash (6,860,870 gallons)	Virgin carbon will increase the pH in the backwash water. To address this, pre-conditioned carbon is used to keep pH levels within an acceptable range. This sample represented the only occurrence of pH that was greater than the discharge limit. Pre-conditioned carbon will continue to be purchased to address pH levels during carbon backwashing

Table 5-1. Summary of Samples Exceeding the Discharge Limits, cont.

Date	Parameter(s)	Discharge Limit	Result	Activity (volume extracted)	Explanation and Corrective Action
01/10/2011	Dichlorobromomethane Chlorodibromethane	0.56 µg/L 0.40 µg/L	4.4 µg/L 3.8 µg/L	Ventura Well Blending with Potable Water (4,159,600 gallons)	These two compounds are associated with disinfection using chlorine. These results are below the California MCL for total trihalomethanes of 80 µg/L.
	Residual Chlorine	0.10 mg/L	0.42 mg/L		The residual chlorine was a result of using potable water for blending. A chemical feed pump is used to add sodium thiosulfate to remove the residual chlorine. In this instance, the pump prime was lost for a portion of the discharge. Monitoring of the chemical feed pump and concentrations is now required during the de-chlorination process. The result is below the Federal MCL for residual chlorine of 4.0 mg/L.
01/19/2011	Perchlorate	4.0 µg/L	4.6 µg/L	Well 52 Blended with MHTS water (7,590,859 gallons)	During well pumping, Well 52 was blended with treated MHTS water. Unexpectedly, perchlorate concentrations increased in the raw water from Well 52. A more conservative blending approach will be applied in the future. Note, the result was below the California MCL for perchlorate of 6 µg/L.
07/21/2011	Perchlorate	4.0 µg/L	15.6 µg/L	Ion Exchange Vessel Backflushing (10,000 gallons)	Ion exchange vessel 301B was sitting idle and required backflushing to keep biological growth to a minimum. The result was unexpected since the ion exchange vessel is used to remove perchlorate. In the future, backflush water will require blending to ensure compliance with the substantive requirements for perchlorate.
07/27/2011			6.64 µg/L		

6. REFERENCES

National Aeronautics and Space Administration (NASA). 2009. *Final Remedial Design/Remedial Action (RD/RA) Work Plan for the Monk Hill Treatment System (MHTS).* June.

National Aeronautics and Space Administration (NASA). 2010. *Monk Hill Treatment System Protocol for Discharge to Arroyo Seco* April.