Technical Memorandum

Hillsboro Aquifer Storage and Recovery Pilot Project

Cycle 2 Summary

March 2011

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Purpose

The purpose of this technical memorandum is to provide a summary of the results of Cycle #2 at the Comprehensive Everglades Restoration Plan (CERP) Hillsboro Aquifer Storage and Recovery (ASR) pilot project. This report is also being submitted to the Florida Department of Environmental Protection (FDEP) in fulfillment of Specific Condition Nos. 18 and 27 of the project CERPRA permit and Specific Condition No. 7 of the project Administrative Order, and Specific Condition 7(f) of the UIC permit. A project location map is presented on **Figure 1**. This document augments a similar memorandum regarding Cycle #1 that was submitted in August 2010. The results of this testing provide a basis for continued operation, testing and monitoring of the system. This report also includes recommendations for adjustments in the monitoring requirements and cycle testing program as a result of the data that have been collected and analyzed.

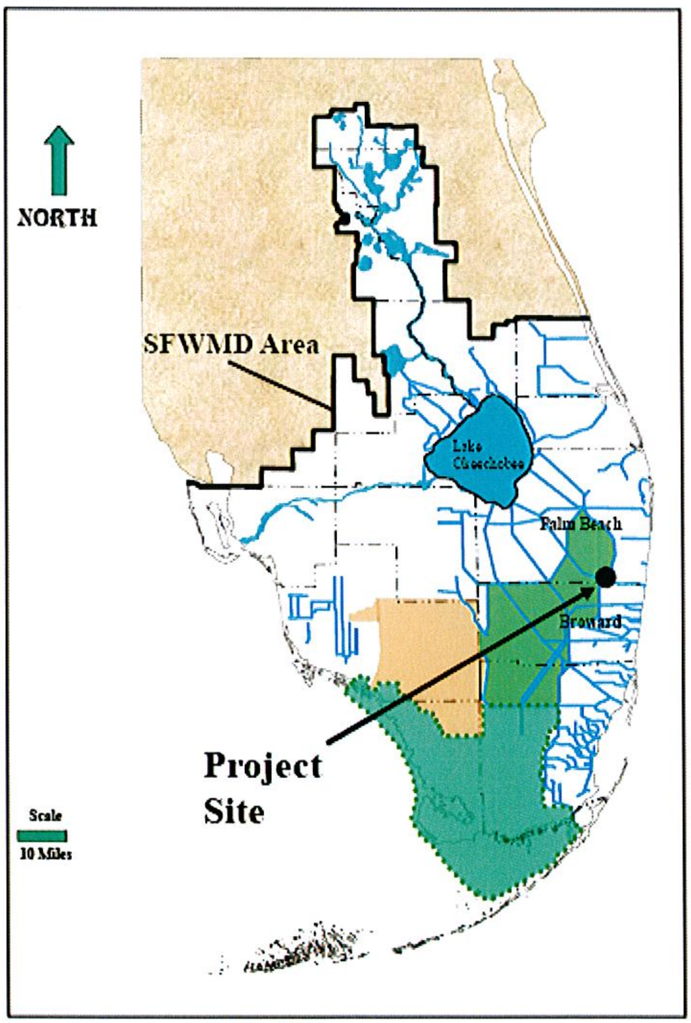


Figure 1. Project Location Map

Essential Findings

- Cycle #2 at the Hillsboro ASR pilot project was successfully conducted from April through August of 2010. The cycle consisted of 92 total days of recharge (with occasional interruptions), resulting in storage of approximately 1,135 acre feet of water within the Floridan Aquifer.
- The recharge period was followed by 21 days of recovery. Recharge and recovery rates averaged 3,300 gallons per minute (gpm), which is equivalent to 4.5 milliion gallons of water per day (mgd).
- Recovery was terminated when the recovered water exhibited a specific conductance of 1,225 micromhos per centimeter (umhos/cm). Using that criterion, the recovery efficiency for Cycle 2 was approximately 22 percent, which is similar to that from Cycle #1. Further improvement in the recovery efficiency is anticipated during subsequent cycles, as a target storage volume is developed.
- A net volume of 300,000,000 gallons of water (equivalent to 920 acre feet) remained in the aquifer after the recovery period, which will locally recharge the aquifer and serve as an initial "target storage" volume of water for Cycle 3.
- Equipment testing and monitoring indicates that the facility is operating as designed – although there were occasions when the electrical system shut down and brief periods of non-compliance during recharge.
- The system was monitored remotely, with occasional site visits for monitoring and routine operation and maintenance by staff.
- During recharge, the ASR wellhead pressure increased from approximately 50 psi to over 70 psi for a brief period of time. In an effort to decrease wellhead pressures, a schedule of weekly backflushing was implemented.
- Water quality data from the storage-zone monitoring wells indicated that canal recharge water mixed and diffused with groundwater at distances of 330 and 1,000 feet away from the ASR well. Wells completed above and below the storage zone indicated little if any impacts from water emplaced within the storage zone.
- Water recovered from the system displayed no toxic effects and generated no elevated levels of mercury.
- During Cycle #2, the arsenic concentration in the recovered water and all of the site monitoring wells did not exceed 10 ppb during the entire recovery period.
- Continued testing of the system should proceed with Cycle #3, consisting of a 90 day recharge period, followed by a 60-day storage duration, followed by recovery until the 1,275 umhos/cm water quality standard is reached. A reduced level of monitoring is also recommended.

Background

Construction of the Hillsboro aquifer storage and recovery (ASR) pilot project was completed in July 2009. The ASR system was built to recharge, store and recover water from the Hillsboro Canal, to demonstrate the effectiveness of this technology as part of the CERP. The system is located adjacent to the western terminus of

Loxahatchee Road, along the Hillsboro Canal, in western Boca Raton, near the future location of the CERP Fran Reich Preserve, as shown in **Figure 2.**

The ASR system consists of an ASR well with connections to the Hillsboro Canal via an intake/discharge structure, injection pump, a mechanical screen filter, and ultraviolet (UV) disinfection system. The ASR well has 24-inch diameter casing cemented to a depth of 1,015 feet below land surface (fbls) and an open borehole completed below the casing, to a depth of 1,225 fbls. Recovery is accomplished via a vertical turbine pump mounted on the ASR wellhead, which routes water from the ASR well back through the surface piping to the intake/discharge structure.

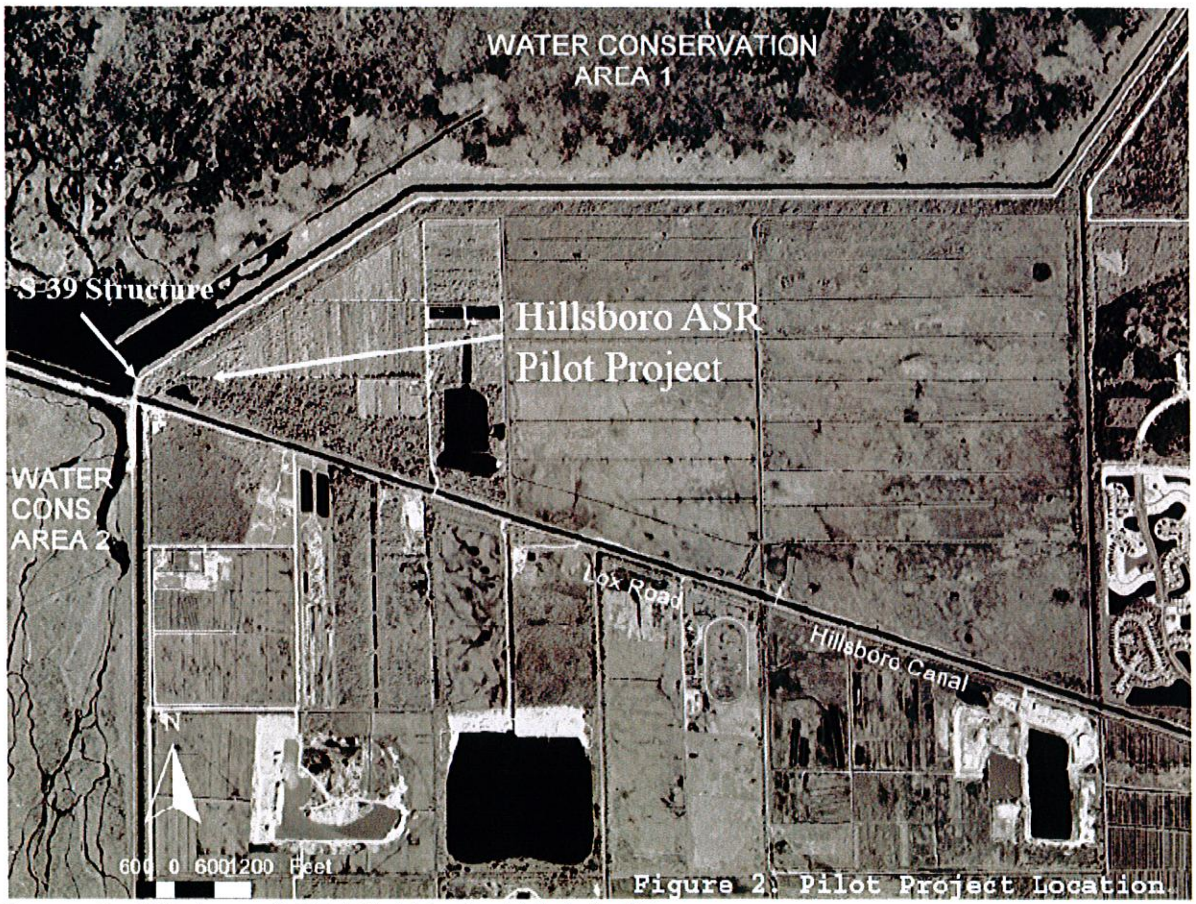


Figure 2. Hillsboro ASR Pilot Project Vicinity Map

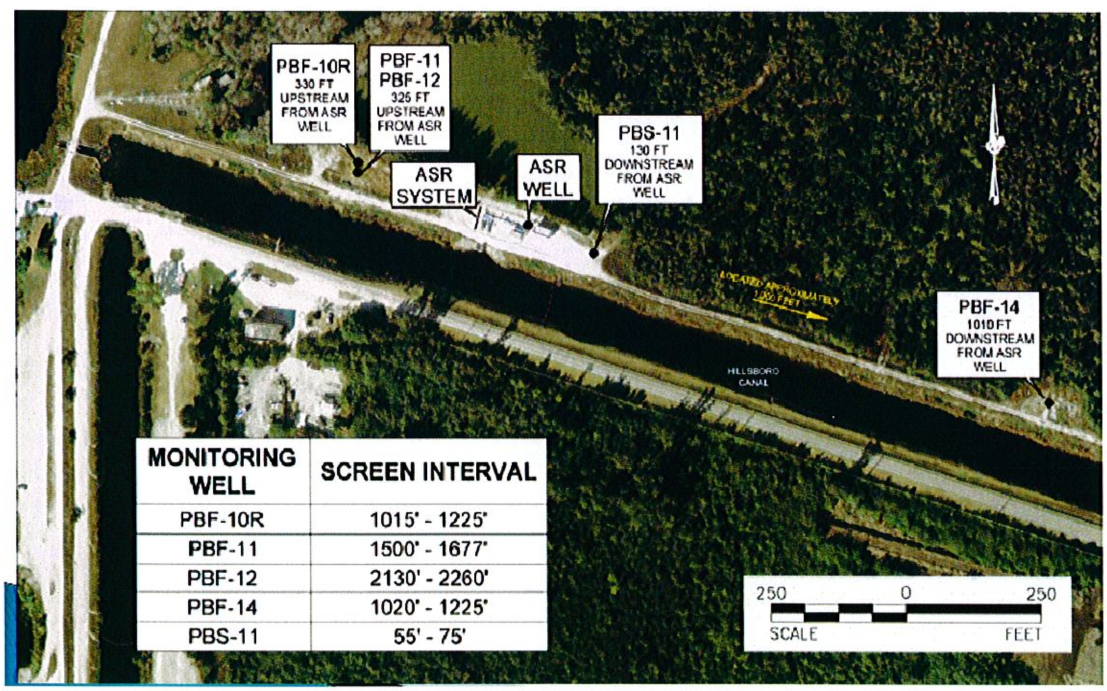
The project was built and is operating under the following permits and authorizations:

- UIC Permit 153872-002-UC
- CERPRA Permit: 01543872-003-GL
- NPDES Permit: FL0484890
- Water Quality Criteria Exemption: 06-0718
- Administrative Order: 153872-005-UC

The associated monitoring well network consists of the following wells, as shown aerially on Figure 3.

- PBF-10R: Storage-zone (Upper Floridan Aquifer) monitor well 330 feet from the ASR well, consisting of a monitoring interval from 1,015 and 1,225 feet below land surface (fbls);
- PBF-11: Intermediate-depth monitor well 326 feet from the ASR well with an intermediate monitoring interval from 1,515 to 1,670 fbls;
- PBF-12: Deep (Lower Floridan Aquifer) monitor well 326 feet from the ASR well, with a monitoring interval from 2,135 to 2,260 fbls;
- PBF-14: Storage-zone monitor well 1,010 feet from the ASR well, single zone design with an open borehole from approximately 1,015 to 1,225 fbls, and;
- PBS-11: Surficial Aquifer System monitor well about 130 feet from the ASR well with a screened interval from approximately 155 to 175 fbls.

The vertical relationships between the wells and the stratigraphy at the site are presented on Figure 4.



MONITORING WELL	SCREEN INTERVAL
PBF-10R	1015' - 1225'
PBF-11	1500' - 1677'
PBF-12	2130' - 2260'
PBF-14	1020' - 1225'
PBS-11	55' - 75'

Figure 3. Hillsboro ASR Pilot Project Monitor Well Location Map

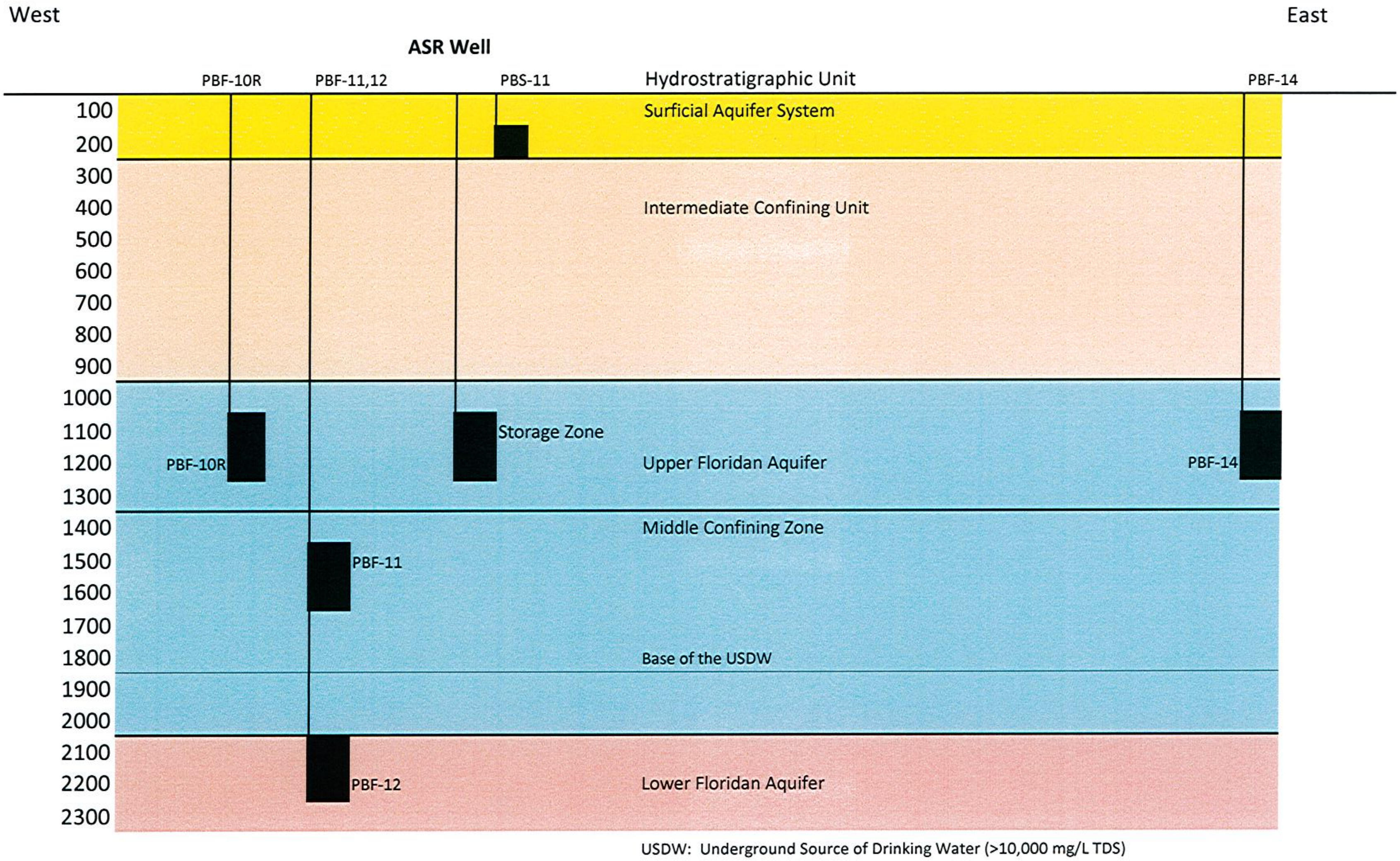


Figure 4.
Hillsboro ASR Pilot Project
Well Completion Cross Section

Cycle Testing Overview

The Cycle 1-was previously conducted from January 2010 through March 2010, the results of which were summarized in an earlier technical memorandum. Cycle 2 was initiated on April 26, 2010 and continued through August 17, 2010. During the recharge period, an average injection rate into the ASR well of approximately 3,400 gallons per minute (gpm) was maintained. A total of 81 days of recharge took place over a period of 92 consecutive days, resulting in emplacement of 370,000,000 gallons (1,135 acre feet) of water stored in the upper Floridan aquifer. There was no storage period included during this cycle. Cycle 2 recovery began on July 27, 2010 and ended on August 17, 2010 for a total of 21 days. A total of 82 million gallons of water were recovered from the system before the cycle was terminated in compliance with the NPDES permit. Figure 5 presents a graphic view of the total quantity of water recharged, stored and recovered from the ASR system during Cycles 1 and 2.

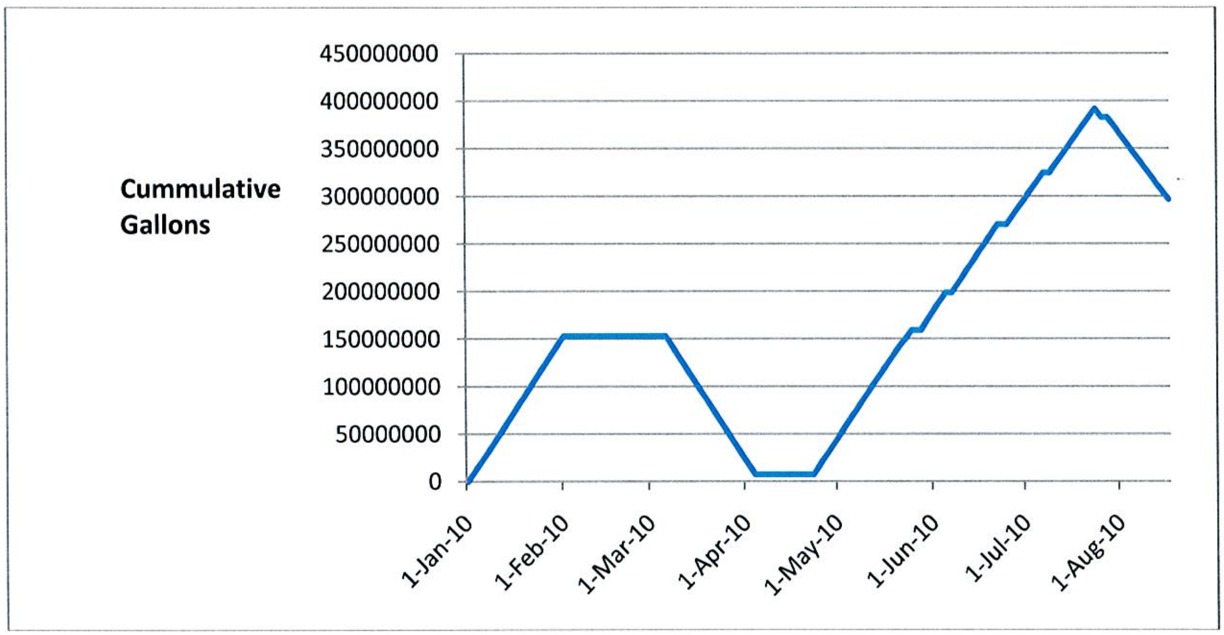


Figure 5. Hillsboro ASR Pilot Project Cumulative Recharge, Storage and Recovery Volumes (gallons).

Water quality changes were observed during due to mixing of fresh water from the Hillsboro Canal with the native water of the Floridan Aquifer. Table 1 below provides a comparison of the "source" water from the Hillsboro Canal to the native groundwater from the Floridan Aquifer prior to the initiation of cycle testing at the site. During the initial stages of recovery, the water produced from the ASR well was nearly 100% source (canal) water; however, as recovery progressed, the percentage of native groundwater increased as the percentage of source water decreased. All of the water that had previously been recharged during Cycle 1 was removed from the aquifer during the corresponding recovery mode of that cycle.

Table 1. Hillsboro ASR Pilot Project Initial Water Quality Comparison

Parameter	Hillsboro Canal	Floridan Aquifer (ASR Well)
Total Dissolved Solids (mg/L)	370	4,064
Chloride (mg/L)	70	1,800
Sodium (mg/L)	37	1,020
Sulfate (mg/L)	11	560
Specific Conductance (umhos/cm)	650	6,590
Color (units)	60	10

Operational Data

Intake/Discharge Structure and Recharge Pump

A concrete intake/discharge structure for the system is located along the bank of the Hillsboro Canal. A site schematic showing the location of the surface facilities of the system is presented on **Figure 6**. During the recharge mode, water from the canal is pumped via a recharge pump mounted on the structure, through filters and disinfection units, and into the ASR well. As the water flows from the canal and into the structure, it passes through a slotted intake screen mounted below the water surface in the canal. The canal intake screen contains an air burst system that is used to prevent clogging of the screen. During Cycle 2, the air burst system was activated periodically (at least once a week), as needed, to keep the screen slots open and free from accumulated debris.

Unplanned Outages

During the recharge period, the well system was turned off automatically during four discrete events as a result of power surges and nearby lightning strikes. The well system operated as designed during these unplanned outages, wherein the well valves automatically closed off, effectively sealing the well from the surface system. The well pumps, filtration, and disinfection systems were not damaged during these events, and the well was able to be put back into operation through the normal start-up routine. The unplanned outages resulted in a cessation of recharge for a total of 11 days during the recharge period and two days during the recovery period.

Wellhead Pressures During Recharge

During the recharge mode of Cycle 2, the pressures observed at the ASR wellhead were increased from less than 50 psi to 78 psi during the first 30 days of recharge. During the same period, the flow rate into the ASR well declined from 5 mgd to approximately 4 mgd as a result of the higher wellhead pressures, as shown on **Figure 7**.

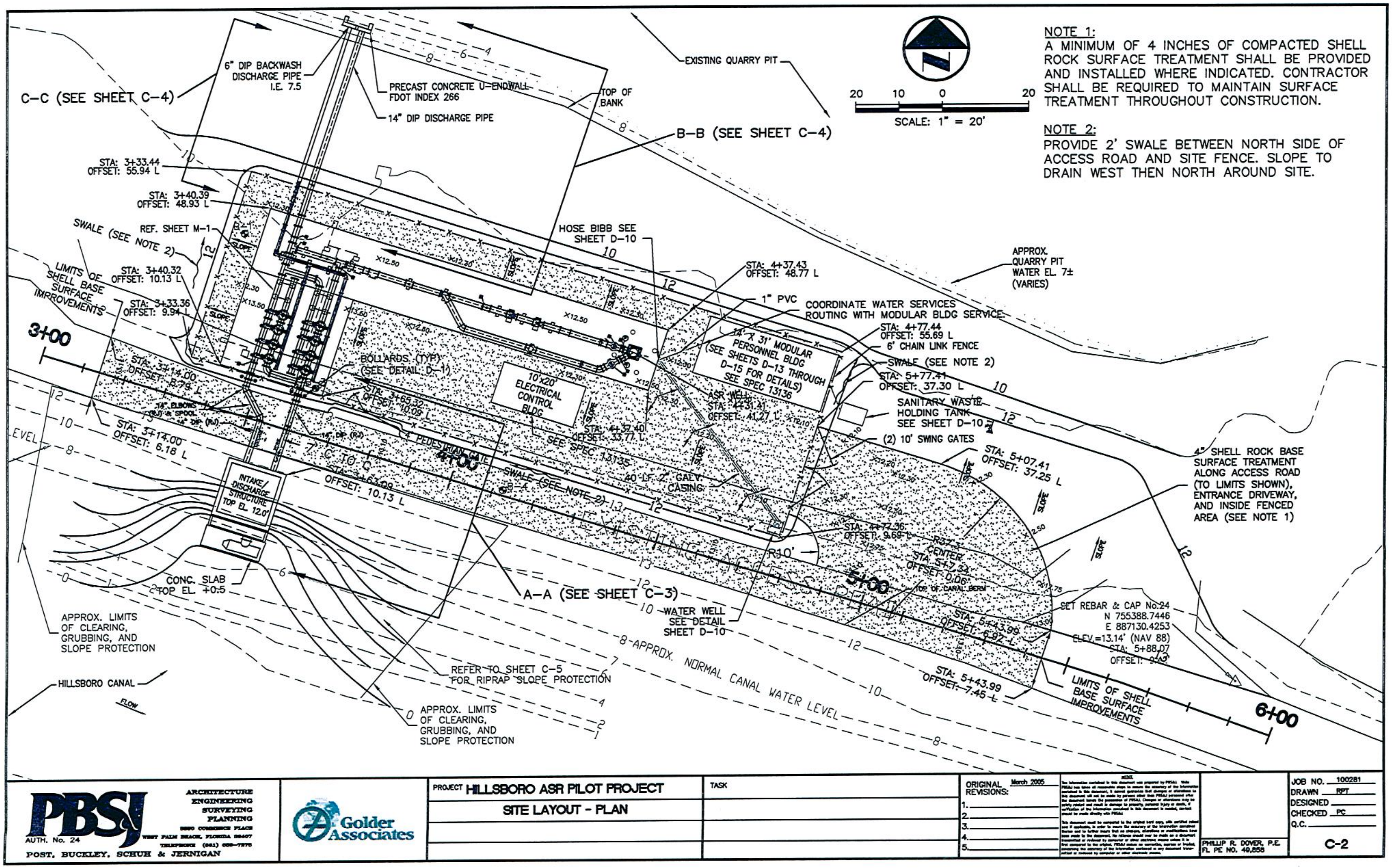


Figure 6. Hillsboro ASR Pilot Project. Site schematic.

Well Head Pressure and ASR Flow

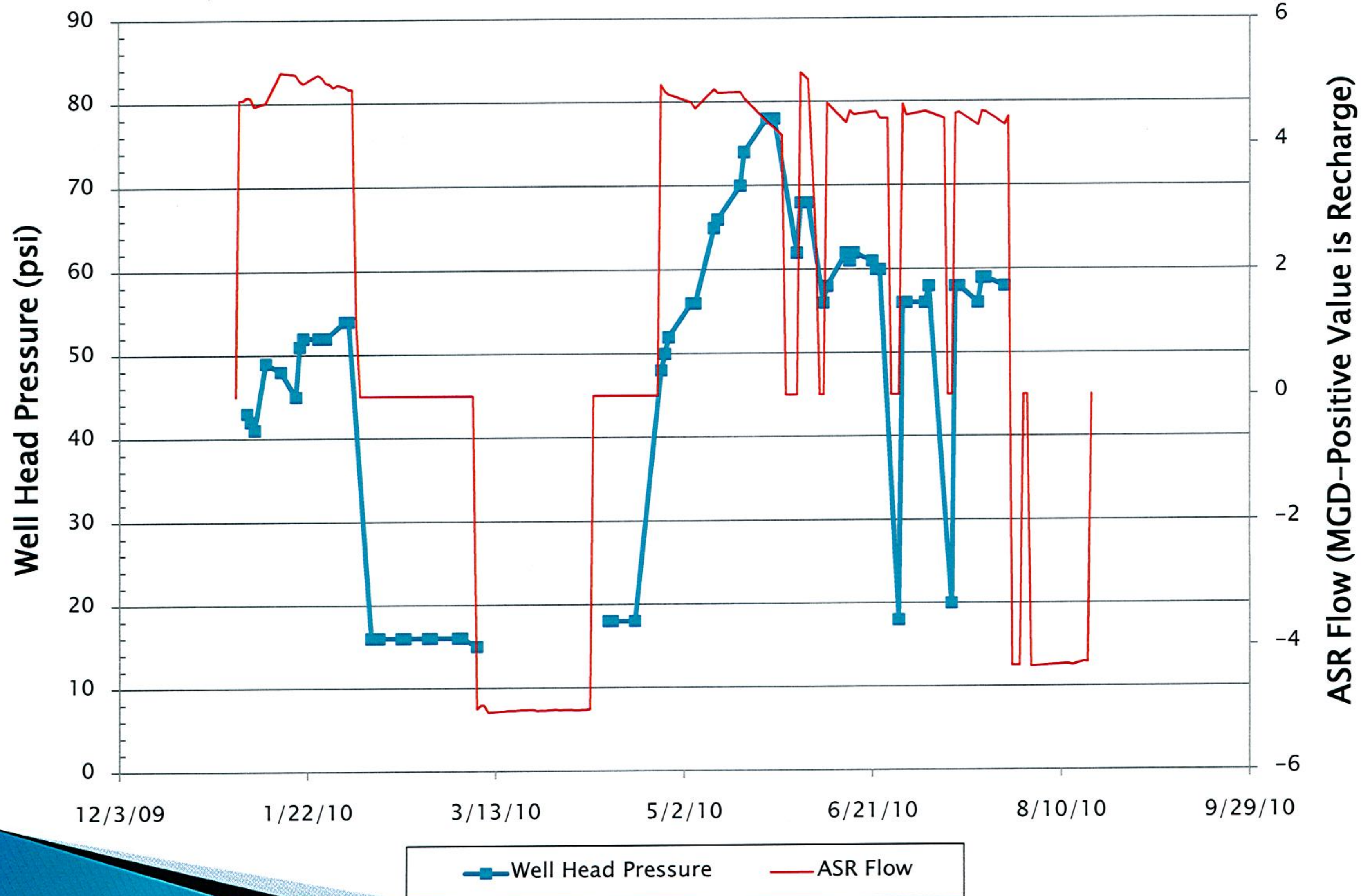


Figure 7. Hillsboro ASR Pilot Project. Wellhead pressures during cycle testing.

The cause of the increase in wellhead recharge pressure was suspected to be a buildup of solids in the well casing and formation in the near vicinity of the ASR well. In order to decrease wellhead pressures, the ASR well was taken offline and a brief period of recovery "backflushing" took place, to pump the solids out of the well. The initial backflushing event lasted about 5 hours, during which the recovered water was routed to the on-site quarry pit. During the backflushing event, water was recovered from the ASR well at a rate of about 3,500 gpm. The backflushing event was successful at removing a large quantity of solids from the ASR well and reducing the recharge pressures. A second, similar backflushing event was undertaken two days later, which was successful at further reducing wellhead pressures. A weekly routine of backflushing was then undertaken, wherein the well was taken offline and backflushed for a period of approximately two hours. During the backflushing, the recovered water turbidity was monitored. Figure 8 presents a time series of turbidity during a typical backflushing event. The weekly backflushing routine was successful at maintaining wellhead recharge pressures to approximately 60 psi for the remainder of the recharge period.

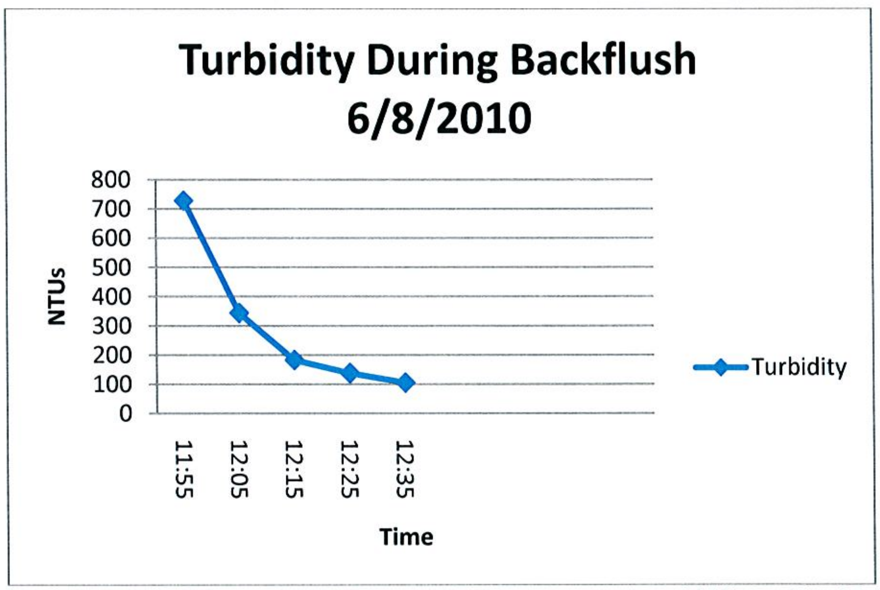


Figure 8. Hillsboro ASR Pilot Project Recovered Water Turbidity During Backflushing.

During recovery, water pumped from the ASR well passes through the intake/discharge structure back into the canal, and is aerated using an eductor mounted within the structure. Dissolved oxygen (DO) readings during Cycle 2 ranged from 7.8 mg/l to 10.5 mg/l, indicating that the educator system successfully operated as designed to raise DO levels to a minimum of 5 mg/L, as required in the system NPDES permit.

Filtration System Performance

The filtration system is designed to mechanically remove suspended solids before the water is disinfected and pumped into the ASR well during recharge. The system is comprised of eight self-cleaning individual filter units manufactured by Amiad Filtration Systems. The filter units work in parallel, meaning the total flow during recharge is split into eight streams as it passes through the system, before being re-combined as it exits the system.

Each filter unit uses mechanical filtration to separate the solids from the water. The filter unit media is comprised of a woven screen with a designed opening size. A screen slot size of 80 microns was used throughout Cycle 2. During Cycle 2, the filter backflush interval ranged from 30 to 65 minutes. Backwash water from the filters drains to the onsite quarry pit. Although this system was effective in removing some particulate solids from entering the ASR well, it was not completely effective in removing biological organisms which ultimately contributed to the buildup of slime and encrusting material in the well that led to the increase in ASR recharge pressures mentioned previously. ***Future consideration should be given to reducing the aperature size of the filters, to increase the effectiveness of the filtration process.***

Recharge Disinfection System

The disinfection system consists of two, in-line ultraviolet (UV) light units. Within each of the UV units are a series of twelve high-intensity UV lamps. The UV units are placed in-series following the filtration units (described above) and before the water flows into the ASR well. Water is disinfected only during the recharge mode. In other words, water does not flow through the UV units during the recovery mode.

During Cycle 1, the units were maintained on the manual "high" intensity setting to assure that adequate disinfection occurred during the entirety of the recharge mode. This was successful at maintaining total coliforms at less than 4 units/100mL during Cycle 1. However, during Cycle 2, the disinfection system appeared to have been somewhat less effective – particularly during events in early June, and late July, as shown graphically on **Figure 9**. These brief events appear to correlate with periods of poor water quality in the source water, as exhibited by elevated concentrations of total organic carbon (TOC), iron and color, which may have been the result of rain events during the summer months. ***Future consideration should be given to increasing the size or number of UV units, so as to increase the disinfection effectiveness of the system, if that is desired.***

ASR Well Recovery Pump

Inside of the 24-inch diameter ASR well casing resides the recovery pump and a pressure transducer. The recovery pump is used to withdraw water from the ASR well during the recovery mode. The recovery pump intake is located about 140 feet below land surface, within the ASR well. During Cycle 2, the recovery pump operated successfully, and recovered water at a rate of approximately 3,300 gpm, equivalent to a daily rate of 4.5 mgd.

Electrical Consumption

The site's electrical consumption was monitored throughout Cycle 2. The electrical consumption is an important factor when considering the future operational costs associated with such facilities. Given the relatively large pumps and electric-intensive UV disinfection units, the electrical consumption could be significant.

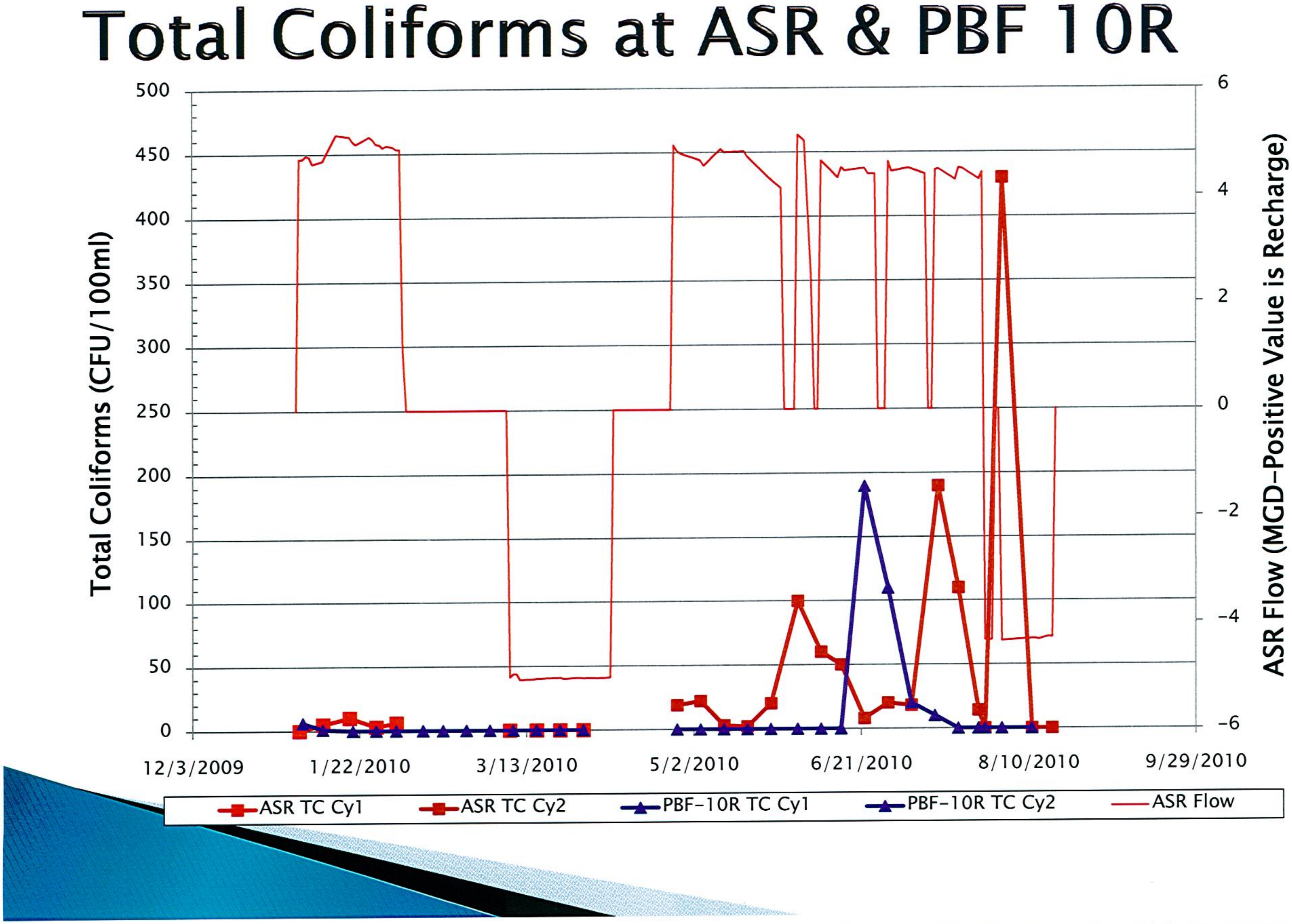


Figure 9. Hillsboro ASR Pilot Project. Coliform concentrations.

During Cycle 2, the electrical consumption varied based on the operational phase. During the recharge phase, the electrical power consumption cost averaged about $130 per day. This cost reflects the operation of the recharge pump, filtration and disinfection units, and the monitoring devices. The consumption during the storage phase was predictably less, averaging about $5 per day. The consumption during the recovery phase averaged $110 per day, reflecting the operation of the recovery pump and monitoring devices (no disinfection or filtration is employed during recovery). ***Power consumption costs could be reduced in the future by removal of the recovery pump, and allowing the well to recover by utilizing the natural artesian head that is available from the Floridan Aquifer at the site. Consideration of this recovery method should be evaluated in future designs of the CERP ASR systems.***

Operational Oversight

It is important part of the pilot project to monitor the level of staffing required to keep the system operational and in compliance. The recorded manpower during cycle testing will be used to estimate costs for subsequent cycles and for ASR systems in the future. During Cycle 2, staff time was spent on performing the required testing (recording data, sampling, system operation and maintenance). Site visits typically consisted of two people, although some visits were by one person. The transitions from one testing mode to another were generally attended by several people. The system is designed to not require daily attention during normal operational modes (recharge, storage or recovery). The data show that, on average, the site was visited two or three times per week. Site visits typically involve multiple tasks including data recording, sampling, and maintenance. Daily site visits averaged a cost of $680 per day. ***It is expected that staffing requirements will decrease during subsequent cycles as monitoring becomes less frequent and system operation becomes more reliable. Further reductions in site visits could be facilitated by enabling remote monitoring of the facility through installation and operation of telemetry devices.***

Hydraulic Data

ASR Well

Prior to the initiation of cycle testing at the site, the ASR wellhead gauge indicated 16 psi, which translates to 37 feet of "static" artesian head above land surface. Land surface at this location is approximately 13 feet above sea level (NGVD29). This pressure is representative of the water levels exhibited in the upper Floridan aquifer at this location. As discussed in a previous section, wellhead pressures increased during the recharge period resulting from slime buildup and biological plugging of the well casing and formation during recharge. During this period of increased ASR wellhead pressures, the recharge flow rate into the well decreased. Recharge flow rates were subsequently restored through initiation of a weekly backflushing program.

Monitor Wells

PBF-10R –This well is completed in the same depth as the storage zone of the ASR well, at a distance of about 330 feet from the ASR well. Prior to the initiation of recharge, the static pressure at this wellhead was approximately 14.7 psi, equating to an elevation of about +52 feet above NGVD29, as shown on **Figure 10**. During Cycle 2 recharge, the water level in this well rose to +65 feet NGVD29, then declined to +60 feet NGVD as flow rates to the ASR well declined. During this same time period, in early June, water produced from this monitor well exhibited a drastic increase in turbidity and TSS. It was suspected that this was attributed to a partial collapse of the open borehole of this monitor well. This was subsequently confirmed during a video survey performed on the monitor well during January 2011. Further discussion of the water quality produced form this well will be discussed in the "Water Quality" section of this report. During the subsequent months of recharge and backflushing, the water level in this well remained near +65 feet NGVD at recharge rates of 4.4 mgd were maintained at the ASR well. Upon the cessation of recharge and the initiation of recovery from the ASR well, the monitor wellhead pressure declined to +37 feet NGVD29. This water level was five feet higher than the elevation recorded from this well during recovery from Cycle 1, and is attributed to the added head in the aquifer resulting from the emplacement of buoyant fresh water into the formation.

PBF-14- This monitor well is completed at the same depth as the ASR well, at a distance of approximately 1,000 feet away from the ASR well. Prior to the initiation of recharge, the static water level at this well was +52 feet NGVD29. During recharge, the water level at this well rose to +65 feet NGVD29 and fluctuated between +65 and +67 feet NGVD29 during the remainder of the recharge period. It is interesting to note that the observed water level at this well "converged" with the water level observed at well PBF-10R, indicating that both wells were within the influence of the plume of recharged water within the aquifer.

Observations at PBF-14 are particularly important because they indicate that approximately 13 feet of increased head will be induced in the upper Floridan aquifer at a distance of 1,000 from ASR well, during times when the ASR wells are used for either recharge or recovery. This information should be useful when evaluating the cumulative interference effects that multiple ASR wells will have on each other at this location in the future.

During recovery, the water level at this location declined to +43 feet NGVD29. Interestingly, this water level was five feet higher than the elevation recorded from this well during recovery from Cycle 1, and is attributed to the added head in the aquifer resulting from the emplacement of a substantial volume of fresh water into the formation.

PBF-11- This well is completed in an interval just below the storage zone, at a distance of 330 feet from the ASR well. Prior to recharge, the water level at this location was approximately +53 feet NGVD29. During recharge, the water level rose slightly, to approximately +55 feet NGVD29, indicating a subtle head buildup in this well during

Floridan Water Levels and ASR Flow

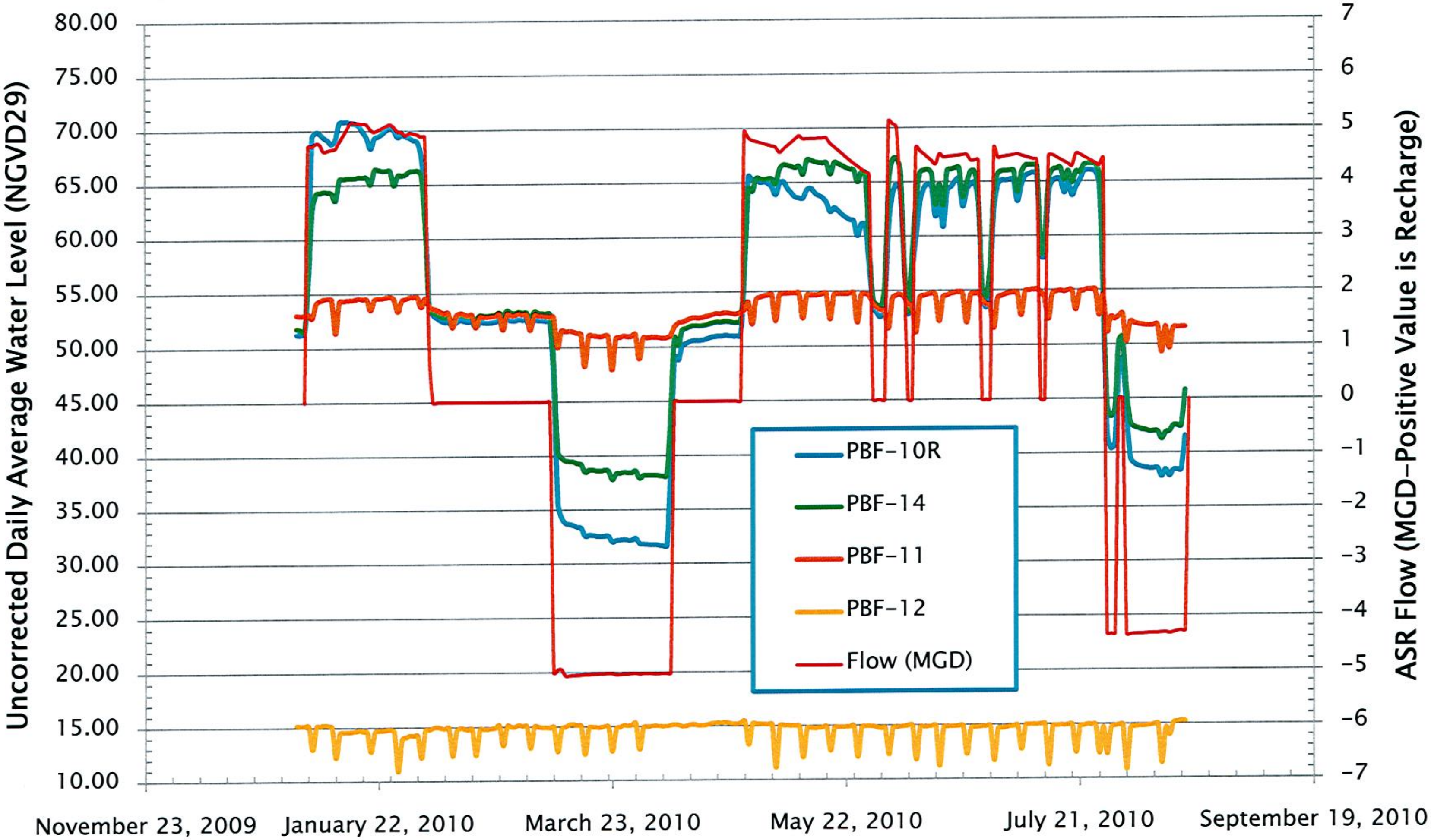


Figure 10. Hillsboro ASR Pilot Project. Water levels during cycle testing.

recharge. Upon the initiation of recovery at the ASR well, the water level at this well declined to approximately +53 feet NGVD29, again indicating a subtle effect from withdrawal at the ASR. These observations are interesting in that there appears to be evidence of some leakance between the storage zone and the portion of the aquifer beneath it.

PBF-12 – This well is completed in a deeper, lower portionof the Floridan aquifer, below the USDW, at a location about 330 feet from the ASR well. As during Cycle 1, the water level at this location was approximately +15 feet NGVD29. During both Cycles 1 and 2 – from recharge, storage and recovery - the water level at this location varied minimally, and did not show any direct responses to pumping at the ASR well. ***It is recommended that this well be removed from further sampling and water quality monitoring during future cycle testing at the facility.***

PBS-11 – This well is completed in the Surficial Aquifer System at a location about 130 feet from the ASR well. Prior to the cycle test, the water level elevation was approximately +10 feet NGVD29, and during both cycles, water level at this location varied minimally and did not show any direct responses to pumping at the ASR well. ***It is recommended that this well be removed from further sampling and water quality monitoring during future cycle testing at the facility.***

Water Quality

Source Water (Hillsboro Canal)
During the recharge period, the chloride concentration in the canal water averaged about 65 mg/L, TDS averaged about 320 mg/L and the conductivity in the water ranged primarily between about 500 and 700 umhos/cm. The color of the water was approximately 70 units. The dissolved oxygen concentration averaged about 6.5 mg/L and the ORP was mildly negative, averaging -10. The sulfate concentration averaged approximately 20 mg/L and the iron concentration averaged 40 mg/L. The arsenic concentration in the recharge water averaged about 1.2 ppb.

General Constituents – Conductivity, Chloride, TDS, and Turbidity
Water quality data from both Cycles 1 and 2 are tabulated on **Table 2**. The trends of specific conductivity data from the cycles can be viewed graphically on **Figure 11,** which presents specific conductivity data from the ASR well and monitor wells PBF-10R and PBF-14. During Cycles 1 and 2, canal water was pumped into the ASR well exhibiting a conductivity of approximately 500 to 700 mhos/cm. During the 30-day recovery period of Cycle 1, the conductivity of the recovered water increased from 620 mhos/cm to almost 4,000 umhos/cm. During recovery period of Cycle 2, the conductivity of the recovered water from the ASR well slowly increased from 580 umhos/cm to 1,225 umhos/cm, when recovery was terminated.

Observations at the storage zone monitoring wells reveal some interesting trends in water conductivity. Water from monitor well PBF-14 (located about 1,000 feet from the

Table 1. Chemical Characteristics at ASR Well and Associated Monitoring Network During Cycles 1 & 2.
Permit # 153872-002-UC to operationally (cycle) test Hillsboro Aquifer Storage and Recovery (ASR) Project (HASR-ASR-1)

Facility name: Hillsboro ASR
Permit Nº. 153872-002-UC

Operator's name: Bruce Weaver
Sampler: Bruce Weaver / Lianne Ramos
PM: Gregory Powell/Jonathan Shaw

Location and total depth	Event: Phase		Date	Time	Chloride (mg/L)	TDS (mg/L)	Arsenic (µg/L)	Gross Alpha (pCi/L)	T Coliforms (CFU/100mL)	F Coliforms (CFU/100mL)	TOC	Total Mercury (ug/L)	Methyl Mercury (ug/L)	Total Phosphorus (mg/L)	Sulfate (mg/L)	TSS (mg/L)	color (PCU)	Iron (ug/L)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	Turbidity (NTU)	ORP	Temperature
ASR Well	Recharge	B	1/4/2010	15:10	68.7	361	1.1	2.54U ± 1.12 (2.54)	U	U		0.000574	0.000049		20.6	5U	50		585	10.55	7.63	1.22	NC	NC
		1W	1/11/2010	11:23	102	387	1.1	1.41 ± 0.603 (0.735)	5	U		0.000639	0.000065		22.4	5U	60		679	8.94	8.08	1.31	NC	9.71
		2W	1/19/2010	10:27	82.4	383	1.3	2.35U ± 0.943 (2.35)	10	52***		0.000684	0.00009		15.4	5U	60		674	8.11	7.64	1.40	103.60	16.47
		A	1/19/2010	10:27	Under different spreadsheet														674	8.11	7.64	1.40	103.60	16.47
		3W	1/27/2010	11:52	70.3	352	1.0	1.82U ± 0.779 (1.82)	3	U		0.0007	0.000175		15.9	5U	50		631	6.83	7.98	1.30	-59.00	18.91
		4W/M/E	2/2/2010	14:32	82.8	379	1.8	1.62U ± 1.06 (1.62)	6	U		0.00137	0.000181		22.2	5U	60		678	7.83	7.64	1.62	24.70	21.83
	Storage	1W	2/10/2010																					
		2W	2/16/2010																					
		3W/M	2/23/2010																					
		4W	3/2/2010																					
	Recovery	1W	3/8/2010	14:30	81.2	343	102.0	3.05 ± 1.43 (2.00)	U	U		0.00124	0.000158		25.7	32.5	40		621	8.34	7.44	17.00	-77.70	21.21
		2W	3/16/2010	12:32	233.0	714	34.4	2.71± 1.74 (2.66)	U	U		ND	0.000032		75	5U	15		1388	8.12	7.06	0.31	-60.50	20.63
		A	3/22/2010	14:56	Under different spreadsheet														2075	7.23	7.55	0.26	-83.40	20.60
		3W	3/23/2010	13:00	456.0	1050	31.8	6.93 ±1.97 (1.64)	U	U		0.000246 I	0.000091		138	5U	20		2249	7.98	7.37	0.31	-119.10	20.67
		4W/M	3/30/2009	11:26	763.0	1750	15.3	8.01 ± 2.43 (2.53)	U	U		0.000252	0.000106		217	5U	10		3088	7.74	7.39	0.24	-146.30	21.03
	End of Cycle 1		4/7/2010	9:56	NC	NC	6.7	8.41 ± 2.29 (1.82)	NC	NC						5U	NC		3988	6.76	7.50	0.22	-133.20	21.66
	Recharge	W1	4/27/2010	11:03	46.9	323	1.60	1.96 ± 0.707 (0.789)	19	U	9.9	0.002490	NC	0.027	23.9	5.5	35.0	85.7	509	7.71	8.07	6.22	-2.60	25.02
		W2	5/4/2010	12:25	45.8	262	1.10	2.91U ± 1.45 (2.91)	22	U	14.3	0.000894	0.175	0.024	12.7	5.0U	70.0	44.3	427	7.87	7.75	1.88	12.30	28.98
		W3	5/11/2010	11:40	45.5	239	1.20	0.906U±0.541 (0.906)	3	U	13.4	0.000767	0.142	0.026	14.8	5.0U	40.0	78.3	429	8.33	7.76	3.38	21.10	28.66
		W4	5/18/2010	12:15	67.0	353	1.60	1.44U ± 0.798 (1.44)	2	U	14.4	0.000630	0.176	0.021	21.4	5.0U	40.0	31.7 I	616	7.28	7.67	1.70	12.10	27.95
		W5	5/25/2010	12:27	62.6	340	0.95 I	2.94U ± 1.69 (2.94)	20	8	15.6	0.000513	0.166	0.190	17.5	5.0U	70.0	45.4	542	4.69	7.38	1.81	8.70	29.69
		W6	6/2/2010	11:20	64.7	329	1.10	2.31U ± 1.30 (2.31)	100	10	90.2	0.000597	0.181	0.017	17.4	5.0U	60.0	45.4	541	6.71	7.99	1.76	-14.00	30.25
		W7	6/9/2010	12:10	72.5	335	1.80	1.41U ± 0.740 (1.41)	60	U	16.8	0.001670	0.088	0.058	20.3	10	70.0	80.6	543	6.81	7.86	4.15	-13.20	30.32
		W8	6/15/2010	11:55	55.9	250	0.92 I	2.34U ± 0.861 (2.34)	50	U	43	0.001000	0.291	0.032	11.0	5.0U	100.0	76.6	384	6.02	7.45	1.69	-8.50	31.00
		W9	6/22/2010	11:30	63.4	346	1.30	1.63U ± 0.931 (1.63)	8	U	12.7	0.000605	0.077	0.350	25.7	5.0U	60.0	31.6 I	478	6.73	7.93	2.34	-17.10	30.78
		W10	6/29/2010	11:45	67.4	320	0.91 I	1.60U ± 0.975 (1.60)	20	U	20.2	0.000900	0.164	0.021	18.2	9	50.0	58.6	482	6.29	7.68	1.52	-10.40	31.77
		W11	7/6/2010	10:50	79.3	358	1.40	1.2U ± 0.8	18	4	49.1	0.001240	0.062	0.029	30.2	5.0U	90.0	31.2 I	532	6.65	8.21	2.07	-25.90	28.61
		W12	7/14/2010	9:00	79.1	316	1.20	ND ± 2.11	190	4	25.1	0.000800	0.073	0.025	23.6	5.0U	100.0	36.6 I	490	6.90	7.51	1.34	7.70	30.94
		W13	7/20/2010	10:30	73.1	356	1.30	2.26U ± 0.723 (2.26)	110	38	18.4	0.000882	0.073	0.040	27.8	5.0U	70.0	25.2 I	538	7.76	8.16	2.16	-14.50	30.55
		W14	7/26/2010	11:10	69.1	339	1.30	1.69U ± 1.06 (1.69)	14	10	18.6	NC	0.091	0.190	23.9	5.0U	80.0	27.8 I	538	7.47	7.96	2.48	-5.80	31.02
	Recovery	W1	7/28/2010	13:10	82.6	352	2.70	1.11U ± 0.704 (1.11)	U	U	14.4	0.000804	0.345 H	0.029	30.8	5.0U	50.0	376.0	579	1.96	7.64	0.82	-104.30	31.50
		W2	8/2/2010	10:40	94.9	402	0.90 I	2.86U ± 1.64 (2.86)	430	30	14.5	0.000798	0.300	0.069	33.0	5.0U	50.0	20.0U	625	1.79	7.81	3.18	-113.30	30.78
		W3	8/11/2010	12:40	196.0	602	1.20	5.25 ± 2.59 (2.90)	U	U	37.7	0.000257 I	0.067	0.008	58.2	5.0U	30.0	152.0	979	2.03	7.72	0.33	-96.20	29.63
		W4	8/17/2010	14:15	259.0	750	0.96 I	1.55U ± 0.946 (1.55)	U	U	35.4	0.000317 I	0.041 B	0.0055	78.8	5.0U	25.0	139.0	1225	5.89	7.62	0.35	-9.80	29.02
FAMW-1 (PBF-10R) 1225 ft	Recharge	B	1/5/2010	8:32	1920.0	5170	NC	NC	6	U		NC	NC		NC	NC	5U		8611	1.36	7.12	7.13	NC	21.40
		1W	1/11/2010	9:12	2010.0	5470	NC	NC	1	U		NC	NC		NC	NC	5U		8240	1.98	7.75	7.70	NC	21.04
		2W	1/20/2010	11:40	1880.0	4230	NC	NC	U	U		NC	NC		NC	NC	5U		7661	0.68	7.80	6.39	-169.40	23.26
		3W	1/27/2010	9:25	1610.0	4260	NC	NC	U	U		NC	NC		NC	NC	5U		7171	3.06	7.56	2.25	-132.30	22.73
		4W/M	2/2/2010	10:47	1850.0	4250	NC	NC	U	U		NC	NC		537	NC	5U		7269	0.17	7.65	5.41	-264.20	24.27
	Storage	1W	2/10/2010	9:34	1800.0	3320	0.53 I	9.94U ± 5.81 (9.94)	U	U		0.000209 I	0.000020 U		535	NC	5U		6525	0.55	7.50	1.25	-242.20	22.82
		2W	2/16/2010	9:28	1850.0	3270	0.90 I	7.74U ± 3.89 (7.74)	U	U		ND	0.000020 U		563	NC	5U		6178	1.13	7.64	0.26	-249.50	23.13
		3W/M	2/23/2010	9:36	1630.0	3350	0.86 I	2.24U ± 1.46 (2.24)	U	U		ND	0.000020 UH		518	NC	5U		5878	0.95	7.50	0.15	-228.00	23.24
		4W	3/2/2010	9:23	1470.0	2910	0.85 I	8.32U ± 5.08 (8.32)	U	U		0.000177 I	0.000020 U		487	NC	5U		5908	0.95	7.51	0.45	-235.90	23.41
	Recovery	1W	3/9/2010	8:53	1600.0	2940	0.61 I	3.94 ± 1.55 (1.88)	U	U		NC	NC		NC	NC	5U		6015	0.23	7.46	0.91	-265.10	23.21
		2W	3/16/2010	9:34	1950.0	3430	0.82 I	2.02 ± 0.925 (1.23)	U	U		NC	NC		NC	NC	5U		7244	0.38	7.57	0.17	-260.10	23.25
		3W	3/23/2010	10:01	2050.0	4490	0.98 I	2.92 ± 1.68 (2.49)	U	U		NC	NC		NC	NC	30		7777	0.16	7.64	0.16	-252.20	23.41
		4W/M	3/30/2010	9:08	2170.0	5400	0.52 I	6.47 ± 1.91 (1.79)	U	U		NC	NC		671	NC	5U		7948	0.38	7.66	0.11	-267.80	22.78
	End of Cycle 1		4/7/2010	NC																				
	Recharge	W1	4/27/2010	12:16	2260.0	6020	0.55 I	7.83±2.27 (2.08)	U	U	2.1	0.000187	0.020U	0.011	701.0	5.0U	5.0U	20.4 I	8199	0.32	7.42	2.83	-246.40	23.96
		W2	5/4/2010	11:00	2000.0	6380	0.62 I	3.69 ± 1.78 (2.49)	U	U	2.0	0.001500	0.021U	NC	738.0	13.5	5.0U	134	7410	0.22	7.50	15.90	-262.40	23.82
		W3	5/11/2010	8:58	1920.0	4160	0.61 I	11.2 ± 3.69 (2.90)	U	U	1.8	0.001130	0.020	NC	633.0	13	5.0	79.4	6868	0.14	7.63	9.89	-268.70	23.79
		W4	5/18/2010	9:30	1790.0	3950	0.64 I	8.01 ± 2.23 (1.87)	U	U	1.6	0.001080	0.020	NC	550.0	53	5.0	114	6611	0.15	7.66	13.20	-266.40	24.22
		W5	5/25/2010	9:37	1920.0	5230	0.50 U	4.29 ± 1.85 (2.39)	U	U	1.6	0.004030	0.020U	NC	516.0	42	5.0U	120	6255	0.18	7.61	31.60	-256.30	23.84
		W6	6/2/2010	10:00	1700.0	3760	5.10	9.85 ± 2.97 (2.84)	U	U	1.8	0.127000	0.019U	NC	462.0	994	5.0U	3630	5934	0.15	7.53	28.00	-269.20	24.02
		W7	6/9/2010	9:50	1740.0	3590	18.80	15.8 ± 3.71 (2.40)	U	U	2.3	0.284000	0.186	NC	471.0	2860	5.0	12600	5751	0.09	7.68	1000.00	-249.10	23.92
		W8	6/15/2010	9:30	1530.0	3350	19.00	15.4 ± 3.75 (2.44)	U	U	2.1	0.456000	0.020U	NC	413.0	3170	250.0	11100.0	5533	0.12	7.59	1000.00	-252.30	23.91
		W9	6/22/2010	9:35	90.8*	4130	2.20	4.61 ± 1.79 (2.20)	190	120	2	0.038600	0.020U	NC	24.5*	267	5.0U	1080.0	6003	0.15	7.63	157.00	-223.50	23.86
		W10	6/29/2010	9:40	1810.0	4040	11.40	7.68 ± 2.26 (1.98)	110	U	2.3	0.093700	0.038	NC	498.0	502	5.0	6280.0	6059	0.26	7.62	1000.00	-249.10	24.25
		W11	7/6/2010	9:00	1610.0	3940	7.20	10.2 ± 6.0	20	10	2.8	0.093200	0.040 B	NC	577.0	826	10.0	5210.0	6310	0.27	7.62	184.00	-277.60	23.65

Table 2. Hillsboro ASR Pilot Project.
Constituents of interest.

		W12	7/13/2010	10:35	1830.0	9690*	1.80	ND ± 2.11	10	u	2.7	0.018700	0.020U	NC	628.0	99	5.0	699.0	6464	0.32	7.67	73.50	-227.90	24.04
		W13	7/20/2010	9:35	1820.0	4060	9.60	4.95 ± 1.99 (2.61)	U	U	2.9	0.049700	0.020U	NC	525.0	626	50.0	4850.0	6088	0.41	7.93	746.00	-231.40	23.92
		W14	7/26/2010	10:00	1880.0	4060	1.90	20.5 ± 9.09 (20.5)	U	U	2.9	0.012000	0.020U	NC	532.0	108	10.0	744.0	6505	0.44	7.62	86.90	-220.50	24.41
	Recovery	W1	7/28/2010	11:26	1930.0	4480	0.90 I	16.3 ± 8.50 (16.3)	U	U	2.9	0.003310	0.020U H	NC	591.0	NC	5.0	137.0	6669	0.13	7.73	21.40	-217.30	24.55
		W2	8/2/2010	9:40	2050.0	4690	0.65 I	5.57 ± 2.21 (2.94)	U	U	3.1	0.000773	0.020U	NC	655.0	NC	5.0	44.1	7075	0.18	7.83	7.69	-174.00	24.01
		W3	8/11/2010	11:20	2670.0	4790	0.50U	15.5u ± 9.28 (15.5)	U	U	21.9	0.000302 I	0.020U	NC	678.0	5.0U	5.0	20.00U	7478	0.12	7.71	0.67	-166.60	24.02
		22M	8/13/2010	10:52	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	651.0	NC	NC	NC	7198	0.14	7.58	2.32	-124.60	24.09
FAMW-2 upper (PBF-11) 1677 ft	Recharge	B	1/5/2010	9:10	998.0	2350	0.97 I	2.96 ± 1.19 (1.41)	U	U		NC	NC		NC	NC	5U		4293	0.83	8.47	0.30	NC	21.92
		1W	1/11/2010	11:44	1030.0	2480	0.5U	18.3 ± 4.14 (2.39)	U	U		NC	NC		NC	NC	5U		4428	1.00	7.98	0.06	NC	21.62
		2W	1/20/2010	11:59	1160.0	2440	0.60 I	5.27 ± 1.85 (1.45)	U	U		NC	NC		NC	NC	10U		4490	0.72	8.43	0.43	-158.60	23.21
		3W	1/27/2010	10:00	1020.0	2570	1.2	6.48 ± 4.04 (6.48)	U	U		NC	NC		NC	NC	5U		4685	1.18	8.38	0.29	-159.30	22.84
		4W/M	2/2/2010	10:39	970.0	2540	1.1	6.16 ± 2.10 (2.53)	U	U		NC	NC		284	NC	10		4560	0.21	8.07	0.21	-248.60	23.87
	Storage	1W	2/10/2010	10:12	1150.0	2360	NC	NC	U	U		NC	NC		NC	NC	5U		4527	0.40	8.14	0.28	-262.00	23.52
		2W	2/16/2010	11:18	1030.0	2510	NC	NC	U	U		NC	NC		NC	NC	5U		4573	0.71	8.18	1.08	-267.60	23.02
		3W/M	2/23/2010	10:53	1160.0	2510	0.86 I	3.56 ± 1.57 (2.11)	U	U		NC	NC		NC	NC	10		4535	0.45	7.85	0.30	-285.40	23.44
		4W	3/2/2010	10:21	973.0	2420	NC	NC	U	NA		NC	NC		NC	NC	15		4510	0.27	7.92	0.39	-261.70	23.10
	Recovery	1W	3/9/2010	10:22	881.0	2290	0.55 I	6.97 ± 1.99 (1.77)	U	U		NC	NC		NC	NC	35		4469	0.28	7.95	0.04	-293.30	22.97
		2W	3/16/2010	10:42	1190.0	2350	0.80 I	5.47 ± 1.48 (1.33)	U	U		NC	NC		NC	NC	15		4465	0.36	7.90	0.16	-281.90	22.73
		3W	3/23/2010	11:11	1010.0	2180	1.0	7.79 ± 2.08 (1.61)	U	U		NC	NC		NC	NC	5U		4410	0.27	7.86	0.39	-292.10	22.86
		4W/M	3/30/2010	9:44	1010.0	2420	0.53I	7.84 ± 2.11 (1.67)	U	U		NC	NC		283	NC	5U		4322	0.16	7.95	0.20	-282.60	22.48
	End of Cycle 1		4/7/2010	NC																				
	Recharge	W1	4/27/2010	14:14	1150.0	2600	0.50U	5.93 ± 2.04 (2.39)	U	U	NC	NC	NC	NC	NC	NC	30.0	NC	4211	0.17	7.82	0.73	-323.60	23.51
		W2	5/4/2010	10:40	1160.0	2640	0.50U	5.45 ± 2.17 (2.83)	U	U	NC	NC	NC	NC	NC	NC	10.0	NC	4222	0.32	7.70	0.22	-260.60	23.82
		W3	5/11/2010	9:05	1120.0	2770	0.50U	8.16 ± 2.06 (1.34)	U	U	NC	NC	NC	NC	NC	NC	15.0	NC	4293	0.12	7.81	0.53	-292.30	23.18
		W4	5/18/2010	9:50	1200.0	2590	0.50U	7.87 ± 1.75 (2.01)	U	U	NC	NC	NC	NC	NC	NC	5.0U	NC	4424	0.18	7.92	1.37	-268.90	23.35
		W5	5/25/2010	9:39	1250.0	2820	0.50U	6.59 ± 1.91 (1.69)	U	U	1.3	NC	NC	NC	NC	NC	5.0U	NC	4340	0.13	7.78	0.31	-276.50	23.18
		W6	6/2/2010	10:25	1220.0	2660	0.67 I	6.46 ± 2.15 (1.95)	U	U	NC	NC	NC	NC	NC	NC	10.0	NC	4484	0.11	7.90	1.46	-275.20	23.40
		W7	6/9/2010	10:05	1180.0	3050	0.50U	10.6 ± 2.82 (2.01)	U	U	NC	NC	NC	NC	NC	NC	5.0U	NC	4366	0.09	7.86	0.56	-255.50	23.58
		W8	6/15/2010	10:05	1170.0	3050	0.63 I	5.51 ± 2.62 (3.79)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	4309	0.07	7.77	0.14	-273.30	23.44
		W9	6/22/2010	10:00	1030.0	2790	0.50U	6.67 ± 1.97 (1.60)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	4305	0.11	7.83	0.54	-244.10	23.58
		W10	6/29/2010	9:50	1320.0	2630	1.10	14.2 ± 3.47 (2.32)	U	U	1.4	NC	NC	NC	NC	NC	5.0	NC	4323	0.13	7.83	0.85	-265.10	23.54
		W11	7/6/2010	9:10	1100.0	2660	0.73 I	10.8U ± 6.6	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	4342	0.08	7.94	2.01	-294.60	23.34
		W12	7/13/2010	10:40	1330.0	2700	0.50U	8.08 ± 3.81	U	U	NC	NC	NC	NC	321.0	NC	5.0	NC	4399	0.15	7.90	0.88	-240.60	23.32
		W13	7/20/2010	9:48	1110.0	2640	0.50U	7.38 ± 2.19 (1.74)	U	U	NC	NC	NC	NC	NC	NC	10.0	NC	4321	0.21	8.17	0.59	-247.10	23.82
		W14	7/26/2010	10:05	1080.0	2700	0.50U	2.15U ± 0.814 (2.15)	U	U	2.1	NC	NC	NC	371.0	NC	20.0	NC	4375	0.23	7.88	0.73	-229.50	24.08
	Recovery	W1	7/28/2010	11:45	1090.0	2640	0.50U	8.71U ± 4.72 (8.71)	U	U	NC	NC	NC	NC	NC	NC	10.0	NC	4317	0.44	7.96	0.76	-241.00	24.34
		W2	8/2/2010	9:30	1070.0	2750	0.50U	4.81 ± 2.10 (2.97)	U	U	NC	NC	NC	NC	NC	NC	10.0	NC	4285	0.17	8.05	0.80	-194.70	23.21
		W3	8/11/2010	10:40	1060.0	2660	0.50U	10.2u ± 6.01 (10.2)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	4305	0.21	8.08	0.92	-195.20	23.19
		22M	8/13/2010	11:06	NC	NC	NC	NC	NC	NC	25.1	NC	NC	NC	329.0	NC	NC	NC	4192	0.57	7.87	0.24	-175.00	22.86
FAMW-2 lower (PBF-12) 2260 ft	Recharge	B	1/5/2010	9:41	17800.0	28900	6.7 I	15.3 ± 3.46 (1.89)	U	U		NC	NC		NC	NC	5U		45138	0.65	7.44	0.43	NC	20.96
		1W	1/11/2010	10:43	16600.0	25400	5.6 I	7.16 ± 2.11 (2.02)	U	U		NC	NC		NC	NC	5U		44222	1.46	7.52	0.84	NC	19.95
		2W	1/20/2010	12:06	16500.0	29400	2.7	57.9 ± 12.4 (2.97)	U	U		NC	NC		NC	NC	5U		45986	0.51	7.49	0.21	-129.70	22.79
		3W	1/27/2010	10:26	16500.0	31400	4.61 I	134U ± 77.8 (134)	U	U		NC	NC		NC	NC	5U		46583	0.70	7.53	0.11	-121.30	23.13
		4W/M	2/2/2010	11:19	16300.0	29100	4.3J	26.9 ± 5.58 (2.30)	U	U		NC	NC		1550	NC	5U		45486	0.18	7.28	0.47	-237.00	23.33
	Storage	1W	2/10/2010	10:39	19500.0	27200	NC	NC	U	U		NC	NC		NC	NC	5U		44860	0.27	7.35	0.27	-214.40	22.10
		2W	2/16/2010	9:54	16100.0	28900	NC	NC	U	U		NC	NC		NC	NC	5U		45240	0.62	7.30	0.18	-207.20	22.17
		3W/M	2/23/2010	10:00	16400.0	26500	4.9 I	1.84 ± 0.400 (0.194)	U	U		NC	NC		NC	NC	5U		44610	0.56	7.21	0.16	-192.10	22.89
		4W	3/2/2010	9:49	16800.0	24500	NC	NC	U	U		NC	NC		NC	NC	5U		44505	0.55	7.22	0.16	-204.30	22.22
	Recovery	1W	3/9/2010	9:37	18500.0	25200	2.9 I	16.1 ± 3.61 (1.83)	U	U		NC	NC		NC	NC	5U		44271	0.27	7.36	0.18	-212.30	22.86
		2W	3/16/2010	10:06	17600.0	24000	1.7	9.18 ± 3.00 (3.63)	U	U		NC	NC		NC	NC	5U		45479	0.38	7.34	0.52	-206.30	22.24
		3W	3/23/2010	10:18	18500.0	23900	4.8 I	14.4 ± 3.41 (2.39)	U	U		NC	NC		NC	NC	5U		45672	0.16	7.33	0.12	-205.80	22.21
		4W/M	3/30/2010	9:30	17700.0	29000	0.63 I	24.9 ± 5.27 (2.20)	U	U		NC	NC		NC	NC	5		45031	0.25	7.30	0.21	-219.30	22.12
	End of Cycle 1		4/7/2010	NC																				
	Recharge	W1	4/27/2010	11:36	17800.0	35600	5.0U	22.4 ± 4.83 (1.97)	U	U	NC	NC	NC	NC	NC	NC	5.0U	NC	43865	0.48	7.33	0.99	-183.90	24.52
		W2	5/4/2010	10:50	17500.0	42100	2.5U	18.6 ± 4.01 (1.58)	U	U	NC	NC	NC	NC	NC	NC	5.0U	NC	43659	0.24	7.24	0.41	-214.10	23.86
		W3	5/11/2010	9:40	17400.0	29400	5.0U	24.7 ± 5.41 (2.46)	U	U	NC	NC	NC	NC	NC	NC	5.0U	NC	43177	0.38	7.30	0.29	-199.30	23.35
		W4	5/18/2010	9:45	16900.0	33100	1.50	13.7 ± 3.35 (2.42)	1	U	NC	NC	NC	NC	NC	NC	5.0U	NC	43415	0.15	7.22	2.29	-209.00	23.58
		W5	5/25/2010	10:00	15300.0	33100	1.30	17.5 ± 4.09 (2.02)	U	U	NC	NC	NC	NC	NC	NC	5.0U	NC	42918	0.21	7.21	0.14	-213.80	23.31
		W6	6/2/2010	10:15	17100.0	34900	3.9 I	23.4 ± 5.39 (2.99)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	42941	0.12	7.19	9.41	-221.20	23.44
		W7	6/9/2010	10:00	19500.0	41000	1.50	36.4 ± 7.62 (2.61)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	43102	0.12	7.33	0.99	-206.60	23.84
		W8	6/15/2010	10:10	17700.0	31400	4.10	33.3 ± 6.75 (2.51)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	42086	0.19	7.26	0.25	-217.30	24.10
		W9	6/22/2010	10:10	16000.0	30500	5.0U	20.3 ± 4.54 (2.44)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	42445	0.14	7.31	0.26	-184.00	24.21
		W10	6/29/2010	9:45	18300.0	31300	14.00	28.4 ± 5.92 (1.53)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	42582	0.15	7.26	0.48	-198.60	23.87
		W11	7/6/2010	9:05	21900.0	31400	9.7 I	8.1 ±2.5	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	42883	0.11	7.36	0.84	-224.00	23.21
		W12	7/13/2010	10:45	20400.0	119*	5.0U	ND ± 44.9	U	U	NC	NC	NC	NC	1830	NC	10.0	NC	43351	0.16	7.31	1.65	-187.70	23.92
		W13	7/20/2010	9:40	17600.0	32500	5.0U	15.7 ± 3.62 (1.69)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	42663	0.24	7.57	1.19	-170.00	23.86
		W14	7/26/2010	10:20	18700.0	33000	1.50	228U ± 131 (228)	U	U	NC	NC	NC	NC	1790.0	NC	10.0	NC	43214	0.38	7.36	0.73	-166.00	23.94

Table 2 cont.

Well	Phase	Event	Date	Time	Cl	TDS	As	GA	T Col.	F Col.	TOC	M	MM	TP	Sulfate	TSS	Color	Iron	SC	DO	pH	Turb.	ORP	Temp
	Recovery	W1	7/28/2010	11:35	19000.0	33600	5.0U	177U ± 93.7 (177)	U	U	NC	NC	NC	NC	NC	NC	10.0	NC	42637	0.15	7.35	1.07	-167.40	24.53
		W2	8/2/2010	9:50	16400.0	31000	1.40	12.3 ± 3.81 (2.87)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	42669	0.17	7.48	0.42	-118.80	23.76
		W3	8/11/2010	10:30	15800.0	29500	1.10	126 ± 76.3 (111)	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	43625	0.22	7.40	3.58	-189.30	23.93
		22M	8/13/2010	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	RN	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
FAMW-3 (PBF-14) 1225 ft	Recharge	B	1/5/2010	11:13	1490.0	3380	NC	NC	U	U		NC	NC		NC	NC	5U		6024	1.03	7.63	11.90	NC	22.24
		1W	1/11/2010	15:34	1560.0	3150	NC	NC	U	U		NC	NC		NC	NC	5U		6197	0.57	7.83	16.20	NC	21.29
		2W	1/20/2010	10:11	1330.0	2840	NC	NC	U	U		NC	NC		NC	NC	5U		5000	1.00	7.83	19.90	-178.40	23.05
		3W	1/26/2010	10:17	1070.0	2860	NC	NC	U	U		NC	NC		NC	NC	5U		5122	2.24	7.80	8.26	-145.70	22.35
		4W/M	2/2/2010	13:27	1040.0	2320	NC	NC	U	U		NC	NC		288	NC	5U		4317	0.30	7.60	14.30	-268.40	24.47
	Storage	1W	2/10/2010	12:41	966.0	2140	0.66 I	5.71U ± 3.12 (5.71)	U	U		0.000154 I	0.000020 U		285	NC	5U		3648	0.57	7.61	2.24	-208.60	23.15
		2W	2/16/2010	12:03	837.0	1860	1.1	4.70U ± 2.94 (4.70)	U	U		ND	0.000020 U		262	NC	5U		3243	0.33	7.65	1.32	-230.70	23.12
		3W/M	2/23/2010	12:51	691.0	1790	1.0	3.46 ± 1.40 (1.74)	U	U		ND	0.000020 U		232	NC	5U		3015	0.32	7.56	1.86	-185.10	24.71
		4W	3/2/2010	14:14	681.0	1590	1.0	5.06U ± 3.12 (5.06)	U	U		0.000209 I	0.000020 U		262	NC	5U		2981	0.40	7.52	1.38	-218.10	23.81
	Recovery	1W	3/9/2010	12:17	713.0	1630	0.75 I	4.07 ± 1.30 (1.38)	U	U		NC	NC		NC	NC	5U		3045	0.21	7.64	0.81	-220.90	23.42
		2W	3/16/2010	14:03	865.0	2040	1.2	3.49 ± 1.19 (1.33)	U	U		NC	NC		NC	NC	5U		4125	0.27	7.56	0.38	-229.30	23.52
		3W	3/23/2010	14:21	1040.0	2200	1.3	5.25 ± 1.88 (2.16)	U	U		NC	NC		NC	NC	5U		4626	0.16	7.57	0.38	-240.00	23.88
		4W/M	3/30/2010	13:06	1190.0	2810	0.52 I	6.40 ± 1.85 (1.70)	U	U		NC	NC		336	NC	5U		4859	0.26	7.58	0.19	-233.60	24.04
	End of Cycle 1		4/7/2010	NC																				
	Recharge	W1	4/27/2010	14:50	1280.0	3130	0.67 I	6.59 ± 1.93 (1.62)	U	U	1.9	0.00012U	0.020U	0.008	393.0	5.0U	5.0	25.8 I	4657	0.15	7.57	14.30	-274.50	23.99
		W2	5/4/2010	13:50	1120.0	2580	0.96 I	3.53 ± 1.91 (2.80)	U	U	2.3	0.000163 I	0.020U	NC	300.0	10.5	5.0U	63	4208	0.95	7.40	11.70	-188.70	24.96
		W3	5/11/2010	13:15	871.0	2310	1.00	4.37 ± 1.38 (1.40)	U	U	2.7	0.000123 I	0.020U	NC	257.0	19.5	5.0U	128	3410	0.11	7.45	30.40	-200.70	25.91
		W4	5/18/2010	13:18	683.0	1560	1.30	3.22 ± 1.85 (2.74)	U	U	3.1	0.000132I	0.020U	NC	219.0	30.5	5.0U	217	2846	0.18	7.42	28.60	-189.20	24.72
		W5	5/25/2010	13:45	613.0	1640	1.30	3.49 ± 1.31 (1.64)	U	U	3.4	ND	0.020U	NC	206.0	19	5.0U	86.7	2488	0.16	7.20	18.70	-174.10	24.78
		W6	6/2/2010	13:00	507.0	1490	1.00	3.38 ± 1.35 (1.78)	U	U	3.5	0.00012U	0.020U	NC	213.0	16.5	5.0	64.4	2402	0.08	7.35	16.90	-208.00	24.78
		W7	6/9/2010	14:05	663.0	1380	1.60	2.69 ± 0.965 (1.15)	U	U	3.6	ND	0.020U	NC	202.0	5.5	5.0	27.6 I	2297	0.15	7.28	11.00	-136.60	24.49
		W8	6/15/2010	12:45	487.0	1250	1.10	3.62U ± 2.31 (3.62)	U	U	3.8	0.00012U	0.020U	NC	175.0	12	5.0	22.1 I	2082	0.10	7.21	15.40	-147.10	24.94
		W9	6/22/2010	12:35	495.0	1160	1.10	2.40 ± 1.26 (1.85)	U	U	4.3	0.00012U	0.020U	NC	166.0	5	5.0	36.0 I	1926	0.15	7.22	7.90	-148.60	24.61
		W10	6/29/2010	12:20	328.0	1120	1.20	4.67 ± 2.64 (3.86)	U	U	4.3	0.000122 I	0.020U	NC	132 I	22	5.0	64.5	1927	0.29	7.43	14.30	-154.10	25.22
		W11	7/6/2010	11:40	452.0	1060	0.79 I	5.4U ± 3.3	U	U	4.9	0.000175 I	0.019U	NC	148.0	8.5	10.0	34.9 I	1835	0.14	7.33	9.75	-154.80	24.95
		W12	7/13/2010	13:40	435.0	1040	0.98I	ND ± 2.45	U	U	5.8	0.00013U	0.020U	NC	141.0	6	10.0	43.7	1823	0.18	7.07	7.59	-129.30	25.72
		W13	7/20/2010	12:10	415.0	1030	1.00	3.37U ± 1.99 (3.37)	U	U	6.3	0.00013U	0.020U	NC	139.0	22	10.0	35.0 I	1730	0.17	7.52	11.60	-150.90	25.67
		W14	7/26/2010	13:30	388.0	1000	0.97 I	6.87U ± 3.24 (6.87)	U	U	6.4	0.00013U	0.020U	NC	130.0	5.0U	5.0	20.0U	1710	0.20	7.19	5.23	-133.90	25.92
	Recovery	W1	7/28/2010	12:42	337.0	848	1.00	4.29 ± 2.36 (3.38)	U	U	6.6	0.000158 I	0.020U H	NC	119.0	NC	5.0	20.0U	1430	0.14	7.11	1.22	-125.00	25.64
		W2	8/2/2010	11:40	327.0	934	1.80	4.22U ± 2.33 (4.22)	U	U	6.2	0.00013U	0.020U	NC	118.0	NC	5.0	290.0	1481	0.15	7.43	1.98	-86.30	25.59
		W3	8/11/2010	14:10	396.0	1030	0.66 I	4.53 ± 2.20 (2.85)	NC	NC	26.7	0.00013U	0.023 B	NC	140.0	5.0U	5.0	20.0U	1728	0.42	7.41	0.30	-74.50	25.24
		22M	8/13/2010	13:03	NC	NC	NC	NC	U	U	NC	NC	NC	NC	146.0	NC	NC	NC	1756	0.23	7.35	2.91	-56.40	25.06
SASMW-1 (PBS-11) 206 ft	Recharge	B	1/5/2010	10:30	1170.0	2660	NC	NC	U	U		NC	NC		NC	NC	10		4640	1.40	6.95	8.44	NC	22.44
		1W	1/11/2010	13:10	1000.0	2590	NC	NC	U	U		NC	NC		NC	NC	5		4604	0.83	7.18	10.80	NC	22.22
		2W	1/20/2010	9:16	1060.0	2630	NC	NC	U	U		NC	NC		NC	NC	15		4651	3.10	6.91	0.23	-126.00	22.70
		3W	1/26/2010	11:31	1070.0	2540	NC	NC	U	U		NC	NC		NC	NC	15		4767	2.09	7.21	0.39	-143.30	23.40
		4W/M	2/2/2010	12:19	1020.0	2330	1.4	NC	U	U		NC	NC		169	NC	15		4681	0.66	7.09	0.43	-259.90	24.49
	Storage	1W	2/10/2010	11:40	1060.0	2560	NC	NC	U	U		NC	NC		NC	NC	15		4602	3.44	7.07	0.18	-234.80	23.38
		2W	2/16/2010	11:18	971.0	2530	NC	NC	U	U		NC	NC		NC	NC	15		4550	1.88	7.08	0.38	-245.60	24.08
		3W/M	2/23/2010	12:13	1090.0	2620	1.4	3.56 ± 1.57 (2.11)	U	U		NC	NC		NC	NC	20		4607	2.12	6.97	0.26	-219.70	24.64
		4W	3/2/2010	11:00	1010.0	2560	NC	NC	U	NA		NC	NC		NC	NC	20		4582	1.79	7.05	0.22	-243.70	23.61
	Recovery	1W	3/9/2010	11:33	1040.0	2390	0.82 I	3.80 ± 1.49 (1.83)	U	U		NC	NC		NC	NC	5U		4541	1.71	7.47	0.66	-239.30	23.80
		2W	3/16/2010	11:48	1020.0	2290	1.3	3.62 ± 1.43 (1.85)	U	U		NC	NC		NC	NC	10		4615	1.19	6.99	0.50	-237.60	24.17
		3W	3/23/2010	12:24	1020.0	2380	1.4	8.10 ±4.64 (6.63)	U	U		NC	NC		NC	NC	20		4659	0.52	6.96	0.39	-214.20	24.05
		4W/M	3/30/2010	10:56	1020.0	2600	0.50U	6.60 ± 1.84 (1.30)	U	U		NC	NC		NC	NC	10		4601	0.65	6.95	0.37	-238.00	23.93
	End of Cycle 1		4/7/2010	NC																				
	Recharge	W1	4/27/2010	12:49	1100.0	3120	NC	NC	U	U	NC	NC	NC	NC	NC	NC	15.0	NC	4499	0.27	7.00	0.19	-237.90	24.87
		W2	5/4/2010	11:50	1150.0	2990	NC	NC	U	U	NC	NC	NC	NC	NC	NC	15.0	NC	4464	0.38	6.83	0.77	-214.10	25.36
		W3	5/11/2010	10:45	1130.0	2560	NC	NC	U	U	NC	NC	NC	NC	NC	NC	10.0	NC	4443	0.26	6.90	0.28	-218.90	24.78
		W4	5/18/2010	11:10	1170.0	2580	NC	NC	U	U	NC	NC	NC	NC	219.0	NC	15.0	NC	4442	0.19	6.83	1.01	-217.70	25.36
		W5	5/25/2010	11:25	1160.0	2730	NC	NC	U	U	NC	NC	NC	NC	NC	NC	20.0	NC	4386	0.27	6.89	0.35	-216.40	25.15
		W6	6/2/2010	11:50	952.0	3120	NC	NC	U	U	NC	NC	NC	NC	NC	NC	15.0	NC	4414	0.25	6.97	6.64	-242.40	24.94
		W7	6/9/2010	11:20	1000.0	2690	NC	NC	U	U	NC	NC	NC	NC	NC	NC	5.0	NC	4395	0.23	6.91	2.71	-182.00	24.93
		W8	6/15/2010	11:05	867 I	10500*	NC	NC	U	U	NC	NC	NC	NC	NC	NC	15.0	NC	4347	0.20	6.93	1.86	-205.00	26.05
		W9	6/22/2010	11:00	894.0	2720	NC	NC	U	U	NC	NC	NC	NC	NC	NC	20.0	NC	4215	0.28	6.97	4.84	-195.10	25.39
		W10	6/29/2010	11:00	1180.0	2660	0.68 I	4.93 ± 1.93 (2.45)	U	U	NC	NC	NC	NC	NC	NC	15.0	NC	4324	0.18	6.74	4.75	-169.00	25.36
		W11	7/6/2010	10:15	954.0	1070*	NC	NC	1	U	NC	NC	NC	NC	NC	NC	20.0	NC	4320	1.05	7.06	1.40	-211.80	25.15
		W12	7/13/2010	12:10	1200.0	2590	NC	NC	U	U	NC	NC	NC	NC	NC	NC	35.0	NC	4364	0.65	6.86	0.79	-177.30	26.05
		W13	7/20/2010	11:00	998.0	2660	NC	NC	U	U	NC	NC	NC	NC	NC	NC	15.0	NC	4287	0.83	7.14	0.35	-196.60	25.57
		W14	7/26/2010	11:45	951.0	2700	0.77 I	16.6U ± 9.62 (16.6)	U	U	NC	NC	NC	NC	208 I	NC	25.0	NC	4344	0.51	6.95	0.23	-183.30	25.65
	Recovery	W1	7/28/2010	9:10	945.0	2710	NC	NC	U	U	NC	NC	NC	NC	NC	NC	15.0	NC	4256	0.40	6.95	0.62	-184.80	24.85
		W2	8/2/2010	11:00	904.0	2780	NC	NC	U	U	NC	NC	NC	NC	NC	NC	20.0	NC	4276	0.28	7.21	1.45	-142.80	25.36
		W3	8/11/2010	13:23	907.0	2730	NC	NC	U	U	NC	NC	NC	NC	250U	NC	15.0	NC	4346	1.29	6.93	0.52	-110.80	25.28

Table 2 cont.

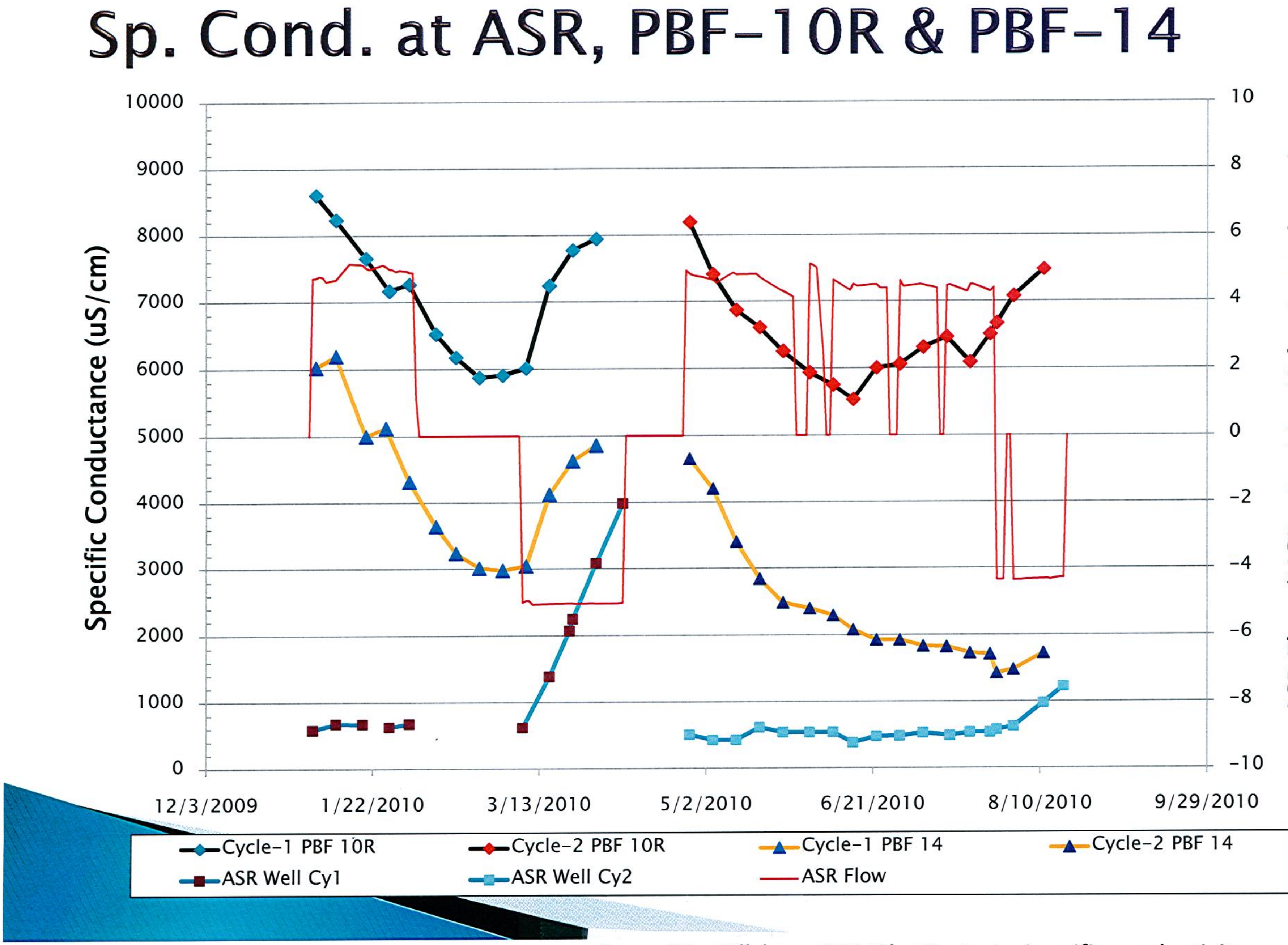


Figure 11. Hillsboro ASR Pilot Project. Specific conductivity concentrations.

ASR well) exhibited a net decline from 6,000 umhos/cm to 5,000 umhos/cm during Cycle 1 and continued a subtle decline towards 1,700 umhos/cm during Cycle 2. This trend is indicative of steady growth of a "bubble" of stored water within the aquifer. With continued cycle testing, it is anticipated that the quality of water produced from this well would begin to closely approximate the canal water recharged into the ASR well.

The quality of water produced from monitor well PBF-10R shows a more complex pattern, as a result of the partial collapse of the open borehole midway through the recharge period of Cycle 2. The water exhibited a decline from 8,600 umhos/cm to 6,000 umhos/cm during recharge of Cycle 1, then increased to 8,000 umhos/cm during storage and subsequent recovery periods. During Cycle 2, the conductivity of water recovered from this monitor well decreased to approximately 5,500 umhos/cm, then began to increase during the same time period at when the monitor well began to experience high turbidity associated with collapse of the open borehole.

Further insight into the behavior of the monitor wells is also gleaned from detailed review of the turbidity data from these wells, graphically presented on **Figure 12**. During the recharge mode of Cycles 1 and 2, the turbidity of the canal water varied between 1 and 8 NTUs. During both recovery events, the first flush water produced from the ASR well exhibited high turbidity, then declined to less than 1NTU for the remainder of the recovery periods. During Cycle 1, the turbidity of water produced from PBF-14 declined progressively from 10 NTUs to less than 1 NTU. The same pattern repeated in the same well during Cycle 2. Water produced from monitor well PBF-10R during Cycle 1 exhibited a progressive decline in turbidity from 8 NTUs to less than 1 NTU during Cycle 1, however, during the recharge mode of Cycle 2, the water from the well produced a progressive increase in turbidity, associated with the probable collapse of the open borehole. During the subsequent recovery period, water produced form the well exhibited a progressive decrease in turbidity – to less than 1 NTU – near the end of the recovery period, indicating that the well was being developed, and fine-grained solids were being removed from the open borehole. Further analyses of additional constituents of interest in the recharged and recovered water, as well as the storage-zone monitor wells (PBF-10R and PBF-14) are presented in the following sections.

Table 3 presents an expanded set of constituents of interest from these wells, including haloacetic acids, metals, chlorinated organics, anions, cations, nutrients and radionuclide species. Because the other monitor wells at the site exhibited muted or non-detectable water quality responses during this cycle, they are not included in the discussion, however, the water quality observed in those wells (PBF-11, PBF-12 and PBS-11) may be viewed on Table 2.

Dissolved Oxygen and Oxidation-Reduction Potential
The dissolved oxygen (DO) concentration in the recharge water averaged about 7 mg/L. The water subsequently recovered from the ASR well exhibited a DO concentration of approximately 2 mg/L (prior to being aerated by the educator system). DO concentrations in wells PBF-10R and PBF-14 remained primarily below 0.4 during the entire recharge and recovery periods.

Location and total depth	Event: Phase		Event: Date	Event: Time	1631 E Mercury: Low Level HG (ug/L)	5522 Haloacetic Acids: Dibromoacetic Acid (ug/L)	Dichloroacetic Acid (ug/L)	Haloacetic Acids (total) (ug/L)	Monobromoacetic Acid (ug/L)	Monochloroacetic Acid (ug/L)	Trichloroacetic Acid (ug/L)	2,3-Dibromopropanoic Acid (S) (ug/L)	200.7 MET ICP: Lithium (ug/L)	Boron (ug/L)	Calcium (ug/L)	Iron (ug/L)	Magnesium (ug/L)	Potassium (ug/L)	Sodium (ug/L)	Strontium (ug/L)
ASR Well	Recharge	W1	4/27/2010	11:03	0.002490	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	136%	25.0U	50.1	68300	85.7	4950	4670	29500	1070
		W2	5/4/2010	12:25	0.000894	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	124%	25.0U	49.8 I	50400	44.3	6760	3890	29900	832
		W3	5/11/2010	11:40	0.000767	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	124%	25.0U	48.6 I	53700	78.3	6240	3870	29100	867
		W4	5/18/2010	12:15	0.000630	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	125%	3.7 I	61.8	73700	31.7 I	9530	5400	41200	1270
		W5	5/25/2010	12:27	0.000513	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	89%	25.0U	62.3U	61900	45.4	9150	4820	39900	1140
		W6	6/2/2010	11:20	0.000597	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	94%	25.0U	67.4	57200	45.4	9310	4420	42900	1140
		W7	6/9/2010	12:10	0.001670	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	118%	ND	71	54000	80.6	7700	4200	46900	945
		W8	6/15/2010	11:55	0.001000	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	93%	2.8 I	63.1	31700	76.6	6900	2700	36700	560
		W9	6/22/2010	11:30	0.000605	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	124%	25.0U	60.1	68600	31.6 I	7100	4600	39900	1220
		W10	6/29/2010	11:45	0.000900	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	121%	3.8 I	70.3	48400	58.6	9300	3800	44600	900
		W11	7/6/2010	10:50	0.001240	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	173%	25.0U	94.5	37500	31.2 I	13100	4500	56700	955
		W12	7/14/2010	9:00	0.000800	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	114%	4.37	87	36400	36.6 I	10300	3660	49100	697
		W13	7/20/2010	10:30	0.000882	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	95%	25.0U	72.2	53900	25.2 I	8480	4380	49500	1040
		W14	7/26/2010	11:10	NC	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	106%	25.0U	73.9	51500	27.8 I	8540	4330	47500	1040
	Recovery	W1	7/28/2010	13:10	0.000804	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	123%	25.0U	88.2	55900	376.0	9780	4320	49100	1150
		W2	8/2/2010	10:40	0.000798	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	124%	6.8 I	222	53900	20.0U	39900	11200	189000	4940
		W3	8/11/2010	12:40	0.000257 I	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	118%	25.0U	153	56900	152.0	16700	6300	108000	1700
		W4	8/17/2010	14:15	0.000317 I	0.61U R	0.61U R	0.61U R	0.61U R	0.61U R	0.61U R	119%	NC	186	64400	139.0	22900	8100	155000	2050
FAMW-1 (PBF-10R) 1225 ft	Recharge	W1	4/27/2010	12:16	0.000187 I	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	119%	60.8	1560	151000	20.4 I	181000	56500	1360000	7600
		W2	5/4/2010	11:00	0.001500	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	120%	55.7	1360	142000	134	164000	52000	1520000	7320
		W3	5/11/2010	8:58	0.001130	0.61U	0.61U	1.7	0.61U	1.7	0.61U	116%	52.4	1140	136000	79.4	153000	52500	1130000	7490
		W4	5/18/2010	9:30	0.001080	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	123%	44.1 I	1070	131000	114	149000	50500	1060000	7550
		W5	5/25/2010	9:37	0.004030	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	102%	47.3 I	1010	132000	120	142000	45600	1010000	7680
		W6	6/2/2010	10:00	0.127000	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	104%	47.0 I	885	322000	3630	130000	40000	945000	7310
		W7	6/9/2010	9:50	0.284000	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	118%	ND	995	700000	12600	162000	40000	945000	9800
		W8	6/15/2010	9:30	0.456000	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	87%	80.4	854	700000	11100.0	158000	40200	890000	7700
		W9	6/22/2010	9:35	0.038600	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	127%	47.2 I	963	177000	1080.0	137000	41400	1000000	7330
		W10	6/29/2010	9:40	0.093700	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	101%	46.4 I	1010	302000	6280.0	146000	43400	1060000	7340
		W11	7/6/2010	9:00	0.093200	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	144%	49.1 I	916	252000	5210.0	146000	45400	1020000	7630
		W12	7/13/2010	10:35	0.018700	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	94%	36.5	1050	145000	699.0	145000	43400	960000	7340
		W13	7/20/2010	9:35	0.049700	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	95%	51	985	253000	4850.0	142000	40900	930000	7400
		W14	7/26/2010	10:00	0.012000	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	109%	50.2	1000	137000	744.0	140000	40800	960000	7350
	Recovery	W1	7/28/2010	11:26	0.003310	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	120%	54.1	1110	127000	137.0	147000	45400	1160000	7360
		W2	8/2/2010	9:40	0.000773	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	130%	54.8	1210	128000	44.1	156000	51000	1200000	7640
		W3	8/11/2010	11:20	0.000302 I	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	104%	58.4	1310	130000	20.0U	160000	49000	1240000	7570
FAMW-3 (PBF-14) 1225 ft	Recharge	W1	4/27/2010	14:50	0.00012U	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	85%	28.4 I	584	97000	25.8 I	106000	33200	695000	8120
		W2	5/4/2010	13:50	0.000163 I	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	123%	26.01 I	562	98600	63	102000	31800	630000	7700
		W3	5/11/2010	13:15	0.000123 I	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	149%	25.0U	435	87900	128	81600	26600	461000	6780
		W4	5/18/2010	13:18	0.000132I	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	130%	20.2 I	382	83300	217	71300	24800	411000	6260
		W5	5/25/2010	13:45	ND	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	95%	25.0U	336	72900	86.7	63700	21100	346000	6030
		W6	6/2/2010	13:00	0.00012U	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	112%	25.0U	323	66800	64.4	60400	19300	333000	5950
		W7	6/9/2010	14:05	ND	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	121%	ND	313	64500	27.6 I	58100	17700	311000	6020
		W8	6/15/2010	12:45	0.00012U	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	93%	15.01 I	276	62800	22.1 I	54100	15700	276000	5550
		W9	6/22/2010	12:35	0.00012U	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	122%	25.0U	259	60400	36.0 I	50500	14600	254000	5410
		W10	6/29/2010	12:20	0.000122 I	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	133%	13.2 I	253	63600	64.5	51000	14100	253000	5410
		W11	7/6/2010	11:40	0.000175 I	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	138%	25.0U	235	56700	34.9 I	48100	13500	250000	5270
		W12	7/13/2010	13:40	0.00013U	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	94%	11.1	240	58600	43.7	46400	13100	234000	5160
		W13	7/20/2010	12:10	0.00013U	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	94%	25.0U	235	55200	35.0 I	44400	12500	233000	5050
		W14	7/26/2010	13:30	0.00013U	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	101%	25.0U	235	54000	20.0	44100	12200	231000	5010
	Recovery	W1	7/28/2010	12:42	0.000158 I	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	125%	25.0U	208	53600	20.0U	38800	10900	185000	4820
		W2	8/2/2010	11:40	0.00013U	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	124%	13.5 I	105	55400	290.0	11200	4490	57100	1290
		W3	8/11/2010	14:10	0.00013U	0.61U	0.61U	0.61U	0.61U	0.61U	0.61U	114%	25.0U	243	54700	20.0U	43600	12500	221000	5060

Location and total depth	Phase		Date	200.8 MET ICPMS: Aluminum (ug/L)	Arsenic (ug/L)	Barium (ug/L)	Cadmium (ug/L)	Chromium (ug/L)	Cobalt (ug/L)	Copper (ug/L)	Lead (ug/L)	Manganese (ug/L)	Nickel (ug/L)	Selenium (ug/L)	Zinc (ug/L)	524.2 THM: Bromodichloromethane (ug/L)	Bromoform (ug/L)	Chloroform (ug/L)	Dibromochloromethane (ug/L)	Total Trihalomethanes (Calc.) (ug/L)	4-Bromofluorobenzene (S)
ASR Well	Recharge	W1	4/27/2010	77.1	1.60	18.9	0.050U	0.50U	0.50U	2.1	0.50U	4.5	0.80 I	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	92.00%
		W2	5/4/2010	17.4	1.10	15.6	0.050U	0.50U	0.50U	1.1	0.50U	11.6	0.64 I	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	100%
		W3	5/11/2010	35.6	1.20	16.9	0.050U	0.50U	0.50U	1.3	0.50U	4.9	1.1	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	88%
		W4	5/18/2010	5.3U	1.50	21.5	0.050U	0.50U	0.50U	0.93U	0.50U	7.7	1.1	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W5	5/25/2010	12.6	0.95 I	16.4	0.050U	0.50U	0.50U	0.93U	0.50U	4.7	0.81 I	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W6	6/2/2010	10.2	1.10	16.8	0.050U	0.50U	0.50U	0.94 I	0.50U	3.6	2.1	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	104%
		W7	6/9/2010	43.6	1.80	22.9	0.050U	0.50U	0.50U	2	0.50U	4.9	1.3	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	99%
		W8	6/15/2010	10.3	0.92 I	15.7	0.050U	0.50U	0.50U	0.93U	0.50U	18	0.62U	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	96%
		W9	6/22/2010	13	1.30	17	0.050U	0.50U	0.50U	0.93U	0.50U	3.5	0.62U	0.50U	2.7 I	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W10	6/29/2010	16.9	0.91 I	16.5	0.050U	0.50U	0.50U	0.93U	0.50U	7.5	0.62U	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	92%
		W11	7/6/2010	14.7	0.97 I	36.8	0.050U	0.50U	0.50U	0.93U	0.50U	3	1.8	0.50U	2.8U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W12	7/14/2010	18.3	1.20	24.2	0.050U	0.50U	0.50U	1	0.50U	6.7	1.3	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W13	7/20/2010	15.4	1.30	18.2	0.050U	0.50U	0.50U	1.5	0.50U	3.8	1.4	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	98%
		W14	7/26/2010	11.1	1.30	16.8	0.050U	0.50U	0.50U	1.6	0.50U	6.1	2.4	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	93%
	Recovery	W1	7/28/2010	5.3U	2.70	18.8	0.050U	0.50U	0.50U	10	0.50U	7.6	1.9	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W2	8/2/2010	5.8 I	0.90 I	19.2	0.050U	2.5U	0.50U	0.93U	0.50U	0.69U	1.7	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	95%
		W3	8/11/2010	5.3U	1.20	17.2	0.050U	0.50U	0.50U	1.8	0.50U	2.3	1.7	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	93%
		W4	8/17/2010	7.9 I	0.96 I	17.2	0.058 I	0.50U	0.50U	0.96 I	0.50U	2.5	0.95 I	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	107%
FAMW-1 (PBF-10R) 1225 ft	Recharge	W1	4/27/2010	14.1	0.55 I	86.4	0.050U	0.50U	0.50U	1.3	0.50U	1	2.4	0.50U	3.2 I	0.25U	0.25U	0.25U	0.25U	0.25U	96%
		W2	5/4/2010	91.6	0.62 I	2650	0.050U	0.86 I	0.50U	1.8	0.82 I	2.2	3.1	0.50U	13.4	0.25U	0.25U	0.25U	0.25U	0.25U	102%
		W3	5/11/2010	58.8	0.61 I	1570	0.050U	0.51 I	0.57 I	2.6	0.78 I	1.6	3.9	0.50U	7	0.25U	0.25U	0.25U	0.25U	0.25U	89%
		W4	5/18/2010	84.8	0.64 I	2890	0.050U	0.90 I	0.50U	2.1	1.7	2.4	3.4	0.50U	3.2 I	0.25U	0.25U	0.25U	0.25U	0.25U	92%
		W5	5/25/2010	174	0.50 U	2760	0.050U	0.82 I	0.70 I	2.3	1.5	3.8	2.8	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	93%
		W6	6/2/2010	3700	5.10	3150	0.84	27.5	2	17	39.9	84.2	12	0.55 I	42.3	0.25U	0.25U	0.25U	0.25U	0.25U	104%
		W7	6/9/2010	9970	18.80	882	2.5	89.2	4.6	47.3	163	266	23.6	5.0U	90.1	0.25U	0.25U	0.25U	0.25U	0.25U	95%
		W8	6/15/2010	13100	19.00	1100	2.8	99.4	6.1 I	57.1	151	310	33	5.0U	115	0.25U	0.25U	0.25U	0.25U	0.25U	98%
		W9	6/22/2010	1190	2.20	3530	0.28	9	1.2	4.8	13.7	27.5	5.1	0.50U	10.9	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W10	6/29/2010	7120	11.40	1010	1.3	36.2	2.5	37.5	70.7	88	12.7	1.3	46.5	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W11	7/6/2010	7770	7.20	29.6	1.1	32.8	2.4	19.7	63.1	74.2	13.4	0.80 I	34.1	0.25U	0.25U	0.25U	0.25U	0.25U	97%
		W12	7/13/2010	735	1.80	8100	0.090 I	4.9	1	6.2	8.2	13.4	7	0.50I	8	0.25U	0.25U	0.25U	0.25U	0.25U	103%
		W13	7/20/2010	6070	9.60	20900	1.1	33.6	2.3	19.2	57.2	72.5	24	1	38.3	0.25U	0.25U	0.25U	0.25U	0.25U	99%
		W14	7/26/2010	808	1.90	37800	0.19	5.2	0.97 I	4.7	7.8	13.8	4	0.50U	7.2	0.25U	0.25U	0.25U	0.25U	0.25U	95%
	Recovery	W1	7/28/2010	108	0.90 I	3140	0.084 I	0.63 I	0.86 I	2.1	1.8	5.2	3.7	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	97%
		W2	8/2/2010	31.2 I	0.65 I	1130	0.050U	2.5U	1	2.5	0.50U	3.8	5	0.50U	2.5	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W3	8/11/2010	5.3U	0.50U	137	0.050U	0.50U	0.92 I	1.8	0.50U	2.3	5.1	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
FAMW-3 (PBF-14) 1225 ft	Recharge	W1	4/27/2010	21	0.67 I	18.9	0.050U	0.50U	0.50U	0.93U	0.50U	1.4	1.4	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W2	5/4/2010	77.8	0.96 I	34.1	0.050U	0.50U	0.50U	0.99 I	0.50U	1.5	1.7	0.50U	2.6 I	0.25U	0.25U	0.25U	0.25U	0.25U	100%
		W3	5/11/2010	100	1.00	43.9	0.050U	0.64 I	0.50U	1.7	0.50U	1.5	2.5	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	91%
		W4	5/18/2010	171	1.30	86.4	0.050U	0.68 I	0.50U	1	0.50U	1.8	2.3	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	95%
		W5	5/25/2010	100	1.30	32.5	0.089 I	0.50U	0.50U	0.93U	0.50U	1.5	1.7	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W6	6/2/2010	60.2	1.20	28.3	0.50U	5.0U	0.50U	0.97 I	0.50U	1	2.9	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	104%
		W7	6/9/2010	26.4	1.60	21.6	0.050U	0.50U	0.50U	0.93U	0.50U	1	1.6	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	98%
		W8	6/15/2010	27.2	1.10	17.5	0.050 I	0.50U	0.50U	0.93U	0.50U	0.69U	0.79 I	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	98%
		W9	6/22/2010	23.3	1.10	22.1	0.051 I	0.50U	0.50U	0.93U	0.50U	0.69U	0.62U	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W10	6/29/2010	53.2	1.20	30.1	0.051 I	0.50U	0.50U	0.93U	0.50U	0.81 I	0.66 I	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W11	7/6/2010	38.7	0.79 I	25.8	0.050U	0.50U	0.50U	1.2	0.50U	0.69U	1.4	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	93%
		W12	7/13/2010	35.5	0.98I	25.2	0.050U	0.87 I	0.50U	1.3	0.50U	1.1	2.8	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	103%
		W13	7/20/2010	29.7	1.00	23.2	0.059 I	0.50U	0.50U	0.93U	0.50U	0.69U	1.5	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	99%
		W14	7/26/2010	13	0.97 I	19.1	0.065 I	0.50U	0.50U	0.93U	0.50U	0.69U	0.62U	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	96%
	Recovery	W1	7/28/2010	5.3U	1.00	18.1	0.050U	5.0U	0.50U	0.93U	0.50U	0.69U	0.89 I	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	94%
		W2	8/2/2010	21.1	1.80	23	0.050U	2.5U	0.50U	35.8	0.50U	4.1	2.1	0.50U	2.5U	0.25U	0.25U	0.25U	0.25U	0.25U	97%
		W3	8/11/2010	5.3U	0.66 I	17.2	0.063 I	0.50U	0.50U	0.93U	0.50U	0.76 I	1.5	0.50U	2.5	0.25U	0.25U	0.25U	0.25U	0.25U	95%

R: Data qualified as Rejected
U: Below Detection Limit
NC: not collected
ND: non-detected
I: The reported value is between the laboratory metlhod deletction limit and the laboratiry practical quantitation limit.

Table 3. Hillsboro ASR Pilot Project.

Cycle #2 expanded constituent list.

Location and total depth	Event							SM 2320B				2120B	2540C	2540D	4500S2E	4500S2F	4500 SiO2D	300.0 IC Anions			300.0 IC Anions 28 days				365.3	5310B	EPA 900.0m	EPA 903.1	EPA 904.0	EPA 908.0
	Phase		Date	Time	Dibromofluoromethane (S)	Toluene-d8 (S)	1,2-Dichloroethane-d4 (S)	Alkalinity, Carbonate (CaCO3) (mg/L)	Alkalinity, Bicarbonate (CaCO3) (mg/L)	Alkalinity, Hydroxide (mg/L)	Alkalinity, Total as CaCO3 (mg/L)	Color (cu)	TDS (mg/L)	TSS (mg/L)	Sulfide (mg/L)	Hydrogen Sulfide (mg/L)	Dissolved Silica (mg/L)	Nitrate as N (mg/L)	Nitrite as N (mg/L)	Orthophosphate as P (mg/L)	Bromide (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	Total Phosphorus (mg/L)	TOC (mg/L)	Gross Alpha (pCi/L)	Radium 226 (pCi/L)	Radium 228 (pCi/L)	Uranium (pCi/L)
ASR Well	Recharge	W1	4/27/2010	11:03	100%	98%	101%	31.00	743.00	5.0U	774.00	35.0	323	5.5	1.0U	1.0U	5.30	0.09	0.025U	0.050U	0.14	46.9	0.27	23.9	0.027	9.9	1.96 ± 0.707 (0.789)	0.798 ± 0.542 (0.240)	1.23U ± 0.587 (1.23)	0.989 ± 0.391 (0.408)
	Recharge	W2	5/4/2010	12:25	105%	93%	100%	5.0U	124.00	5.0U	124.00	70.0	262	5.0U	1.0U	1.0U	7.1	0.09	0.025U	0.050U	0.14	45.8	0.22	12.7	0.024	14.3	2.91U ± 1.45 (2.91)	0.893 ± 0.570 (0.548)	0.867U ± 0.427 (0.867)	0.536U ± 0.322 (0.536)
	Recharge	W3	5/11/2010	11:40	99%	100%	109%	5.0U	125.00	5.0U	125.00	40.0	239	5.0U	1.0U	1.0U	5.8	0.025U	0.025U	0.050U	0.014	45.5	0.24	14.8	0.026	13.4	0.906U±0.541 (0.906)	0.579U ± 0.310 (0.579)	0.894U ± 0.399 (0.894)	0.827 ± 0.504 (0.715)
	Recharge	W4	5/18/2010	12:15	99%	98%	99%	5.0U	198.00	5.0U	198.00	40.0	353	5.0U	1.0U	1.0U	10.4	0.025U	0.025U	0.050U	0.27	67.0	0.36	21.4	0.021	14.4	1.44U ± 0.798 (1.44)	0.784U ± 0.613 (0.784)	0.860U ± 0.412 (0.860)	0.839U ± 0.516 (0.839)
	Recharge	W5	5/25/2010	12:27	103%	93%	104%	5.0U	163.00	5.0U	163.00	70.0	340	5.0U	1.0U	1.0U	9	0.094	0.025U	0.050U	0.22	62.6	0.31	17.5	0.190	15.6	2.94U ± 1.69 (2.94)	0.824U ± 0.463 (0.824)	0.977U ± 0.459 (0.977)	0.671U ± 0.308 (0.671)
	Recharge	W6	6/2/2010	11:20	106%	94%	101%	5.0U	163.00	5.0U	163.00	60.0	329	5.0U	1.0U	1.0U	8	0.025U	0.025U	0.050U	0.21	64.7	0.32	17.4	0.017	90.2	2.31U ± 1.30 (2.31)	0.843U ± 0.540 (0.843)	0.914U ± 0.495 (0.914)	0.736 ± 0.433 (0.680)
	Recharge	W7	6/9/2010	12:10	98%	103%	94%	5.0U	140.00	5.0U	140.00	70.0	335	10	1.0U	1.0U	5	0.091	0.025U	0.050U	0.26	72.5	0.3	20.3	0.058	16.8	1.41U ± 0.740 (1.41)	0.859 ± 0.584 (0.259)	0.809U ± 0.405 (0.809)	0.518 ± 0.240 (0.339)
	Recharge	W8	6/15/2010	11:55	97%	103%	91%	5.0U	85.70	5.0U	85.70	100.0	250	5.0U	1.0U	1.0U	7	0.025U	0.025U	0.050U	0.27	55.9	0.22	11.0	0.032	43	2.34U ± 0.861 (2.34)	1.14U ± 1.18 (1.14)	1.58U ± 0.669 (1.58)	0.442U ± 0.265 (0.442)
	Recharge	W9	6/22/2010	11:30	106%	96%	109%	5.0U	161.00	5.0U	161.00	60.0	346	5.0U	1.0U	1.0U	6	0.025U	0.025U	0.050U	0.3	63.4	0.33	25.7	0.350	12.7	1.63U ± 0.931 (1.63)	0.935U ± 0.700 (0.935)	0.954 ± 0.494 (0.865)	0.773 ± 0.450 (0.609)
	Recharge	W10	6/29/2010	11:45	106%	95%	107%	5.0U	131	5.0U	131.00	50.0	320	9	1.0U	1.0U	9	0.11	0.025U	0.050U	0.26	67.4	0.32	18.2	0.021	20.2	1.60U ± 0.975 (1.60)	0.849U ± 0.477 (0.849)	1.03U ± 0.499 (1.03)	0.493U ± 0.303 (0.493)
	Recharge	W11	7/6/2010	10:50	104%	96%	104%	5.0U	113.00	5.0U	113.00	90.0	358	5.0U	1.0U	1.0U	13.5	0.11	0.025U	0.050U	0.29	79.3	0.3	30.2	0.029	49.1	1.2U ± 0.8	0.4 ± 0.2	0.7U ± 0.4	0.50U
	Recharge	W12	7/14/2010	9:00	102%	91%	104%	5.0U	106.00	5.0U	106.00	100.0	316	5.0U	1.0U	1.0U	28	0.14	0.025U	0.05	0.31	79.1	0.28	23.6	0.025	25.1	ND ± 2.11	ND ± 0.416	1.99 ± 1.19	0.50U
	Recharge	W13	7/20/2010	10:30	105%	99%	112%	5.0U	140.00	5.0U	140.00	70.0	356	5.0U	1.0U	1.0U	24	0.12	0.025U	0.050U	0.34	73.1	0.36	27.8	0.040	18.4	2.26U ± 0.723 (2.26)	0.562U ± 0.169 (0.562)	1.39 ± 0.609 (1.03)	0.65 I
	Recharge	W14	7/26/2010	11:10	106%	104%	115%	5.0U	137.00	5.0U	137.00	80.0	339	5.0U	1.0U	1.0U	8.9	0.12U	0.12U	0.25U	0.43	69.1	0.33	23.9	0.190	18.6	1.69U ± 1.06 (1.69)	0.409U ± 0.293 (0.409)	0.898U ± 0.485 (0.898)	0.60 I
	Recovery	W1	7/28/2010	13:10	112%	105%	112%	5.0U	144.00	5.0U	144.00	50.0	352	5.0U	1.0U R	1.0U R	9.9	0.025U	0.025U R	0.050U	0.5	82.6	0.4	30.8	0.029	14.4	1.11U ± 0.704 (1.11)	0.642U ± 0.480 (0.642)	0.931 ± 0.439 (0.742)	0.50U
	Recovery	W2	8/2/2010	10:40	110%	110%	125%	5.0U	139.00	5.0U	139.00	50.0	402	5.0U	1.0U R	1.0U R	10	0.025U	0.025U	0.050U	0.52	94.9	0.41	33.0	0.069	14.5	2.86U ± 1.64 (2.86)	0.984 ± 0.490 (0.148)	1.28 ± 0.486 (0.738)	0.50U
	Recovery	W3	8/11/2010	12:40	106%	89%	105%	5.0U	138.00	5.0U	138.00	30.0	602	5.0U	1.0U	1.0U	10	0.050U	0.050U	0.10U	1.1	196.0	0.71	58.2	0.008	37.7	5.25 ± 2.59 (2.90)	0.732U ± 0.535 (0.732)	1.19 ± 0.532 (0.893)	0.50U
	Recovery	W4	8/17/2010	14:15	101%	96%	102%	5.0U	138.00	5.0U	138.00	25.0	750	5.0U	1.8	1.0U R	9.4	0.12U	0.12U	0.25U	2.1	259.0	1.3	78.8	0.0055	35.4	1.55U ± 0.946 (1.55)	1.25 ± 0.668 (0.713)	1.22 ± 0.599 (1.04)	0.899U ± 0.464 (0.899)
FAMW-1 (PBF-10R) 1225 ft	Recharge	W1	4/27/2010	12:16	99%	99%	99%	5.0U	129.00	5.0U	129.00	5.0U	6020	5.0U	3.7	1.0U	10.5	0.050U	0.050U	0.10U	6.8	2260.0	0.81	701.0	0.011	2.1	7.83 ± 2.27 (2.08)	3.50 ± 1.30 (0.661)	0.901U ± 0.463 (901)	0.415U ± 0.260 (0.415)
	Recharge	W2	5/4/2010	11:00	108%	93%	99%	5.0U	124.00	5.0U	124.00	5.0U	6380	13.5	3.5	1.0U	11.5	0.25U	0.25U	0.50U	6.9	2000.0	1.7	738.0	NC	2.0	3.69 ± 1.78 (2.49)	2.81 ± 1.12 (0.627)	0.307U ± 0.416 (0.807)	0.650U ± 0.312 (0.650)
	Recharge	W3	5/11/2010	8:58	99%	100%	107%	5.0U	125.00	5.0U	125.00	5.0	4160	13	3.9	1.0U	11.2	0.25U	0.25U	0.50U	6.5	1920.0	1.9	633.0	NC	1.8	11.2 ± 3.69 (2.90)	1.87 ± 0.870 (0.774)	0.819U 0.361 (0.819)	1.11U ± 0.325 (1.11)
	Recharge	W4	5/18/2010	9:30	102%	97%	99%	5.0U	126.00	5.0U	126.00	5.0	3950	53	3.7	1.0U	13.5	0.50U	0.50U	1.0U	6.7	1790.0	3.1	550.0	NC	1.6	8.01 ± 2.23 (1.87)	2.53 ± 1.14 (1.05)	0.746U ± 0.416 (0.746)	1.09U± 0.418 (1.09)
	Recharge	W5	5/25/2010	9:37	103%	91%	106%	5.0U	131.00	5.0U	131.00	5.0U	5230	42	3.5	1.0U	12	0.050U	0.050U	0.10U	5.3	1920.0	1.8	516.0	NC	1.6	4.29 ± 1.85 (2.39)	1.94 ± 0.883 (0.594)	0.849U ± 0.389 (0.594)	0.652U ± 0.304 (0.652)
	Recharge	W6	6/2/2010	10:00	103%	98%	99%	5.0U	458.00	5.0U	458.00	5.0U	3760	994	4.3	1.0U	12	0.50U	0.50U	1.0U	6.2	1700.0	2.8	462.0	NC	1.8	9.85 ± 2.97 (2.84)	5.96 ± 1.85 (0.944)	1.73U ± 0.762 (1.73)	1.87 ± 0.644 (0.625)
	Recharge	W7	6/9/2010	9:50	93%	119%	97%	5.0U	953.00	5.0U	953.00	5.0	3590	2860	2.3	1.0U	10.5	0.50U	0.50U	1.0U	6.2	1740.0	3	471.0	NC	2.3	15.8 ± 3.71 (2.40)	9.29 ± 4.74 (1.48)	1.81 ± 0.789 (1.28)	2.28 ± 0.737 (0.572)
	Recharge	W8	6/15/2010	9:30	99%	101%	92%	5.0U	1150.00	5.0U	1150.00	250.0	3350	3170	4.6	1.0U	9	0.12U	0.12U	0.25U	6.9	1530.0	3	413.0	NC	2.1	15.4 ± 3.75 (2.44)	28.6 ± 9.99 (1.76)	1.35U ± 0.729 (1.35)	6.12 ± 2.17 (2.23)
	Recharge	W9	6/22/2010	9:35	105%	96%	107%	5.0U	167.00	5.0U	167.00	5.0U	4130	267	3.7	1.0U	12.5	0.025U	0.025U	0.050U	0.39	90.8	0.15	24.5	NC	2	4.61 ± 1.79 (2.20)	3.18 ± 1.24 (0.821)	1.24 ± 0.650 (1.15)	2.13 ± 0.711 (0.574)
	Recharge	W10	6/29/2010	9:40	109%	98%	107%	5.0U	253.00	5.0U	253.00	5.0	4040	502	3.4	1.0U	10.5	0.25U	0.25U	0.50U	5.6	1810.0	2	498.0	NC	2.3	7.68 ± 2.26 (1.98)	7.65 ± 2.64 (1.76)	2.56 ± 1.11 (2.56)	2.34 ± 0.699 (0.425)
	Recharge	W11	7/6/2010	9:00	105%	96%	107%	5.0U	392.00	5.0U	392.00	10.0	3940	826	3.5	1.0U	8.5	0.25U	0.25U	0.50U	6.5	1610.0	2	577.0	NC	2.8	10.2 ± 6.0	1.7 ± 0.4	0.7U ± 0.4	5.8
	Recharge	W12	7/13/2010	10:35	104%	99%	95%	5.0U	146.00	5.0U	146.00	5.0	9690	99	2.6	1.6	25	0.25U	0.25U	0.50U	7.2	1830.0	2.1	628.0	NC	2.7	ND ± 2.88	2.19 ± 0.649	ND ± 1.51	0.74 I
	Recharge	W13	7/20/2010	9:35	101%	101%	106%	5.0U	285.00	5.0U	285.00	50.0	4060	626	3.3	1.0U	29	0.50U	0.50U	1.0U	7.7	1820.0	3.2	525.0	NC	2.9	4.95 ± 1.99 (2.61)	3.33 ± 1.38 (1.09)	1.21U ± 0.618 (1.21)	0.50U
	Recharge	W14	7/26/2010	10:00	104%	110%	117%	5.0U	140.00	5.0U	140.00	10.0	4060	108	3.6	1.0U	10.4	0.50U	0.50U	1.0U	10.8	1880.0	4.5	532.0	NC	2.9	20.5 ± 9.09 (20.5)	3.62 ± 1.18 (0.590)	0.876U ± 0.467 (0.876)	0.81 I
	Recovery	W1	7/28/2010	11:26	103%	110%	112%	5.0U	129.00	5.0U	129.00	5.0	4480	NC	3.8	1.0U R	11.2	0.50U	0.50U R	1.0U	18.9	1930.0	9.7	591.0	NC	2.9	16.3 ± 8.50 (16.3)	2.11 ± 0.867 (0.611)	1.13 ± 0.511 (0.859)	0.50U
	Recovery	W2	8/2/2010	9:40	101%	109%	113%	5.0U	126.00	5.0U	126.00	5.0	4690	NC	3.5	1.0U R	11.4	0.50U	0.50U	1.0U	11.2	2050.0	4.2	655.0	NC	3.1	5.57 ± 2.21 (2.94)	1.75 ± 0.724 (0.430)	1.24 ± 0.493 (0.778)	0.50U
	Recovery	W3	8/11/2010	11:20	106%	89%	105%	5.0U	121.00	5.0U	121.00	5.0	4790	5.0U	4.3	1.0U	10.7	0.50U	0.50U	1.0U	10.9	2670.0	4.5	678.0	NC	21.9	15.5U ± 9.28 (15.5)	2.20 ± 0.880 (0.713)	0.958 ± 0.467 (0.805)	0.50U
FAMW-3 (PBF-14) 1225 ft	Recharge	W1	4/27/2010	14:50	101%	98%	101%	5.0U	130.00	5.0U	130.00	5.0	3130	5.0U	1.0U	1.0U	12.7	0.12U	0.12U	0.25U	3.8	1280.0	1.3	393.0	0.008	1.9	6.59 ± 1.93 (1.62)	3.46 ± 1.31 (0.268)	0.961U ± 0.493 (0.961)	0.456U ± 0.228 (0.456)
	Recharge	W2	5/4/2010	13:50	105%	92%	98%	5.0U	133.00	5.0U	133.00	5.0U	2580	10.5	2.2	1.0U	11	0.050U	0.050U	0.10U	3.3	1120.0	1.1	300.0	NC	2.3	3.53 ± 1.91 (2.80)	3.95 ± 1.43 (0.692)	0.555U ± 0.479 (0.955)	0.502U ± 0.229 (0.502)
	Recharge	W3	5/11/2010	13:15	100%	102%	106%	5.0U	141.00	5.0U	141.00	5.0U	2310	19.5	2.6	1.0U	10.4	0.050U	0.050U	0.10U	2.8	871.0	1.2	257.0	NC	2.7	4.37 ± 1.38 (1.40)	1.16 ± 0.671 (0.673)	0.917U ± 0.434 (0.917)	0.705U ± 0.352 (0.705)
	Recharge	W4	5/18/2010	13:18	100%	100%	100%	5.0U	146.00	5.0U	146.00	5.0U	1560	30.5	1.6	1.0U	9.8	0.25U	0.25U	0.50U	2.7	683.0	1.8	219.0	NC	3.1	3.22 ± 1.85 (2.74)	2.15 ± 0.917 (0.566)	0.835U ± 0.419 (0.835)	1.05 ± 0.577 (0.804)
	Recharge	W5	5/25/2010	13:45	104%	92%	105%	5.0U	155.00	5.0U	155.00	5.0U	1640	19	1	1.0U	11	0.050U	0.050U	0.10U	1.9	613.0	1.1	206.0	NC	3.4	3.49 ± 1.31 (1.64)	1.67 ± 0.868 (0.681)	0.868U ± 0.465 (0.868)	0.764U ± 0.279 (0.764)
	Recharge	W6	6/2/2010	13:00	108%	96%	103%	5.0U	157.00	5.0U	157.00	5.0	1490	16.5	1	1.0U	10	0.12U	0.12U	0.25U	2.1	507.0	1.4	213.0	NC	3.5	3.38 ± 1.35 (1.78)	1.70 ± 0.806 (0.568)	1.21 ± 0.594 (1.06)	0.446u ± 0.252 (0.446)
	Recharge	W7	6/9/2010	14:05	95%	123%	96%	5.0U	151.00	5.0U	151.00	5.0	1380	5.5	1	1.0U	9.5	0.12U	0.12U	0.25U	2	663.0	1.4	202.0	NC	3.6	2.69 ± 0.965 (1.15)	1.95 ± 0.889 (0.598)	0.788U ± 0.381 (0.788)	0.519U ± 0.269 (0.519)
	Recharge	W8	6/15/2010	12:45	96%	104%	88%	5.0U	153.00	5.0U	153.00	5.0	1250	12	2	1.0U	9.5	0.025U	0.025U	0.050U	2.1	487.0	1.4	175.0	NC	3.8	3.62U ± 2.31 (3.62)	1.56 ± 0.741 (0.522)	0.828U ± 0.346 (0.828)	0.488U ± 0.212 (0.488)
	Recharge	W9	6/22/2010	12:35	107%	95%	106%	5.0U	146.00	5.0U	146.00	5.0	1160	5	1.5	1.0U	8.5	0.12U	0.12U	0.25U	2	495.0	1.4	166.0	NC	4.3	2.40 ± 1.26 (1.85)	2.57 ± 1.09 (0.795)	0.891U ± 0.444 (0.891)	0.674U ± 0.372 (0.674)
	Recharge	W10	6/29/2010	12:20	104%	99%	106%	5.0U	151.00	5.0U	151.00	5.0	1120	22	1.6	1.0U	8	0.025U	0.025U	0.050U	1.4	328.0	1.3	132 I	NC	4.3	4.67 ± 2.64 (3.86)	1.29 ± 0.670 (0.633)	0.752U ± 0.378 (0.752)	0.545U ± 0.282 (0.545)
	Recharge	W11	7/6/2010	11:40	104%	96%	104%	5.0U	148.00	5.0U	148.00	10.0	1060	8.5	1.2	1.0U	9	0.12U	0.12U	0.25U	1.8	452.0	1.5	148.0	NC	4.9	5.4U ± 3.3	1.4 ± 0.3	0.7U ± 0.4	0.50U
	Recharge	W12	7/13/2010	13:40	103%	97%	96%	5.0U	138.00	5.0U	138.00	10.0	1040	6	1.4	1.0U	21	0.12U	0.12U	0.25U	1.8	435.0	1.4	141.0	NC	5.8	ND ± 2.45	1.48 ± 0.504	3.84 ± 1.34	0.50U
	Recharge	W13	7/20/2010	12:10	108%	102%	112%	5.0U	140.00	5.0U	140.00	10.0	1030	22	1.1	1.0U	6.0 I	0.12U	0.12U	0.25U	1.9	415.0	1.6	139.0	NC	6.3	3.37U ± 1.99 (3.37)	1.49 ± 0.823 (0.898)	0.909 ± 0.454 (0.793)	0.50U
	Recharge	W14	7/26/2010	13:30	103%	109%	109%	5.0U	140.00	5.0U	140.00	5.0	1000	5.0U	1.2	1.0U	9.5	1.2	0.12U	0.25U	2.4	388.0	1.7	130.0	NC	6.4	6.87U ± 3.24 (6.87)	1.08 ± 0.537 (0.162)	0.889U ± 0.425 (0.889)	0.50U
	Recovery	W1	7/28/2010	12:42	104%	109%	114%	5.0U	134.00	5.0U	134.00	5.0	848	NC	1.0U	1.0U R	10.1	0.12U	0.12U R	0.25U	2.2	337.0	1.5	119.0	NC	6.6	4.29 ± 2.36 (3.38)	4.78 ± 1.48 (0.542)	0.788U ± 0.414 (0.788)	0.50U
	Recovery	W2	8/2/2010	11:40	105%	103%	121%	5.0U	138.00	5.0U	138.00	5.0	934	NC	1.0U R	1.0U R	10.3	0.12U	0.12U	0.25U	2.2	327.0	1.5	118.0	NC	6.2	4.22U ± 2.33 (4.22)	1.37 ± 0.602 (0.154)	0.630U ± 0.313 (0.630)	0.50U
	Recovery	W3	8/11/2010	14:10	106%	90%	104%	5%	139.00	5.0U	139.00	5.0	1030	5.0U	1.1	1.0U	9.7	0.12U	0.12U	0.25U	2.3	396.0	1.7	140.0	NC	26.7	4.53 ± 2.20 (2.85)	2.01 ± 0.830	0.659 ± 0.450 (0.788)	0.50U

R: Data qualified as Rejected
U: Below Detection Limit
NC: not collected
ND: non-detected
I: The reported value is between the laboratory practical quantitation limit.

Table 3 cont.

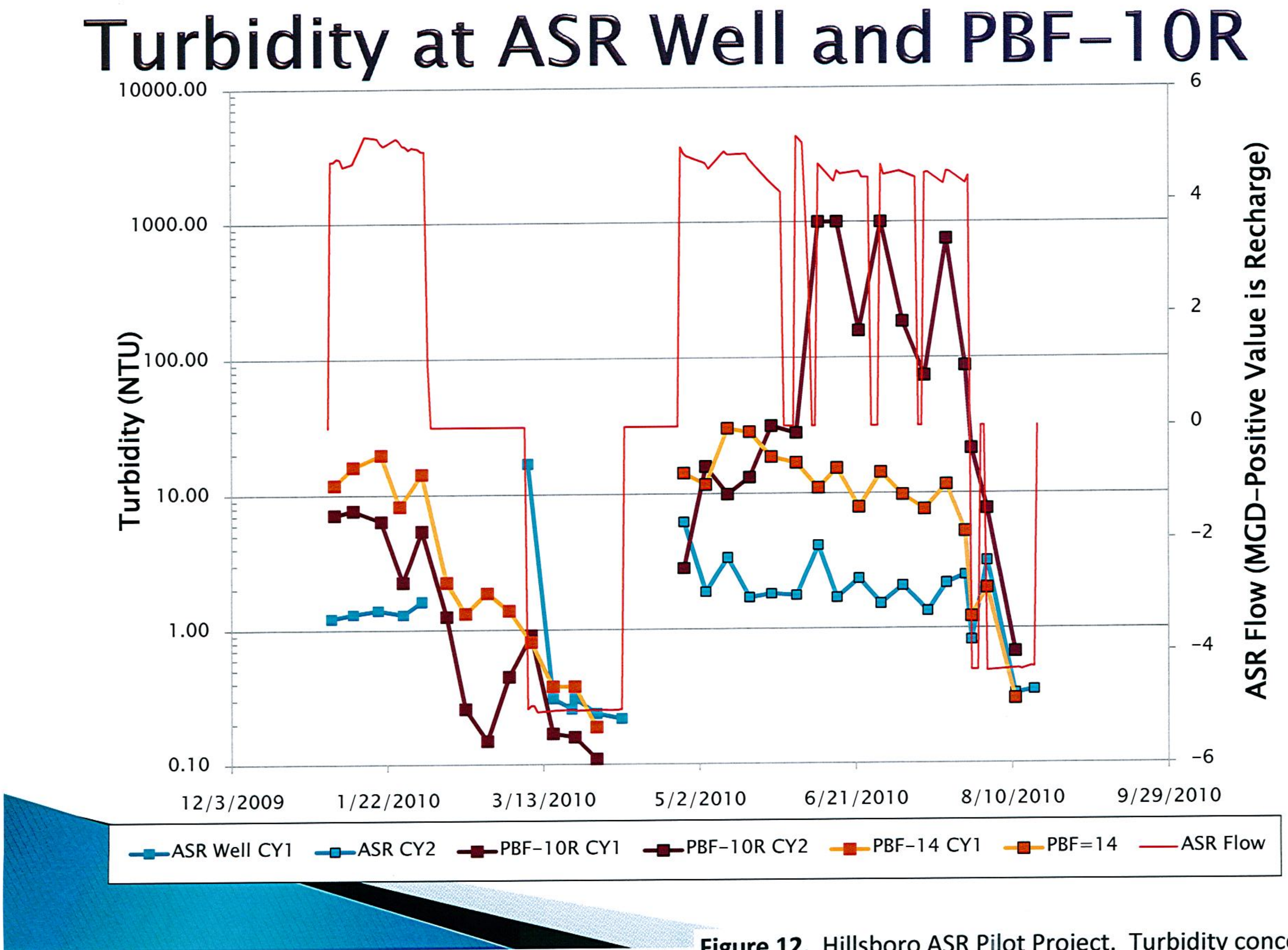


Figure 12. Hillsboro ASR Pilot Project. Turbidity concentrations.

The oxidation-reduction potential (ORP) of recharge water ranged between -26 and +21 throughout the recharge period. The ORP of the recovered water was initially -104 and gradually increased to -9.8 during the 3-week recovery period. The ORP of water collected from well PBF-10R ranged between -132 and -276 through the entire recharge and recovery periods. The ORP of water from well PBF-14 increased from -274 at the start of recharge to -133 by the end of the recharge period. During recovery, the ORP in water collected from this well continued to increase, from -125 at the initiation of recovery, to -56 by the termination of recovery.

Metals – Iron and Arsenic
During recharge period, arsenic concentrations in the recharge water averaged about 1.2 ppb. The arsenic and iron concentrations observed at well PBF-10R remained less than 1 ppb until early June, when the borehole instability occurred. After that event, arsenic concentrations increase to approximately 10 ppb for the remainder of the recharge period, as shown on **Figure 13**. However, during recovery arsenic concentrations in PBF-10R remained below 10 ppb. Arsenic concentration at well PBF-14 averaged approximately 1 ppb throughout the entire cycle. Iron concentration at well PBF-14 closely approximated the concentration the range of concentrations of the recharge water throughout the entire cycle, as shown on **Figure 14**.

Nutrients – Phosphorus and Total Organic Carbon
During recharge period, total phosphorus (TP) concentrations in the recharge water averaged about 75 ppb. During recovery, the TP in the recovered water was initially 29 ppb, but declined to 5 ppb by the end of the 3-week recovery period. TP concentrations were not monitored in the monitor wells during this cycle.

Total organic carbon (TOC) concentrations in the recharge water averaged about 25 mg/L during the recharge. TOC concentrations in the recovered water were initially 14.5 mg/L and increased to approximately 35 mg/L by the end of the recovery period. TOC concentrations in well PBF-10R were not monitored, however, in well PBF-14, TOC concentrations increased subtly throughout the recharge and recovery period, from 2 ,?I to 26.7 at the end of the cycle.

Microbiota – Total Coliforms
Total coliforms ranged between 2 to 190 CFU/100ml throughout the recharge period. Only one weekly sample collected from the ASR well exhibited a total coliform concentration that was above detection levels. In well PBF-10R, total coliforms were below detection level until mid-June, when they became present for a 3 week interval. Total coliforms were below detection levels at well PBF-14 throughout the entire recharge and recovery period.

Mercury Species

Arsenic at PBF 10R & PBF 14

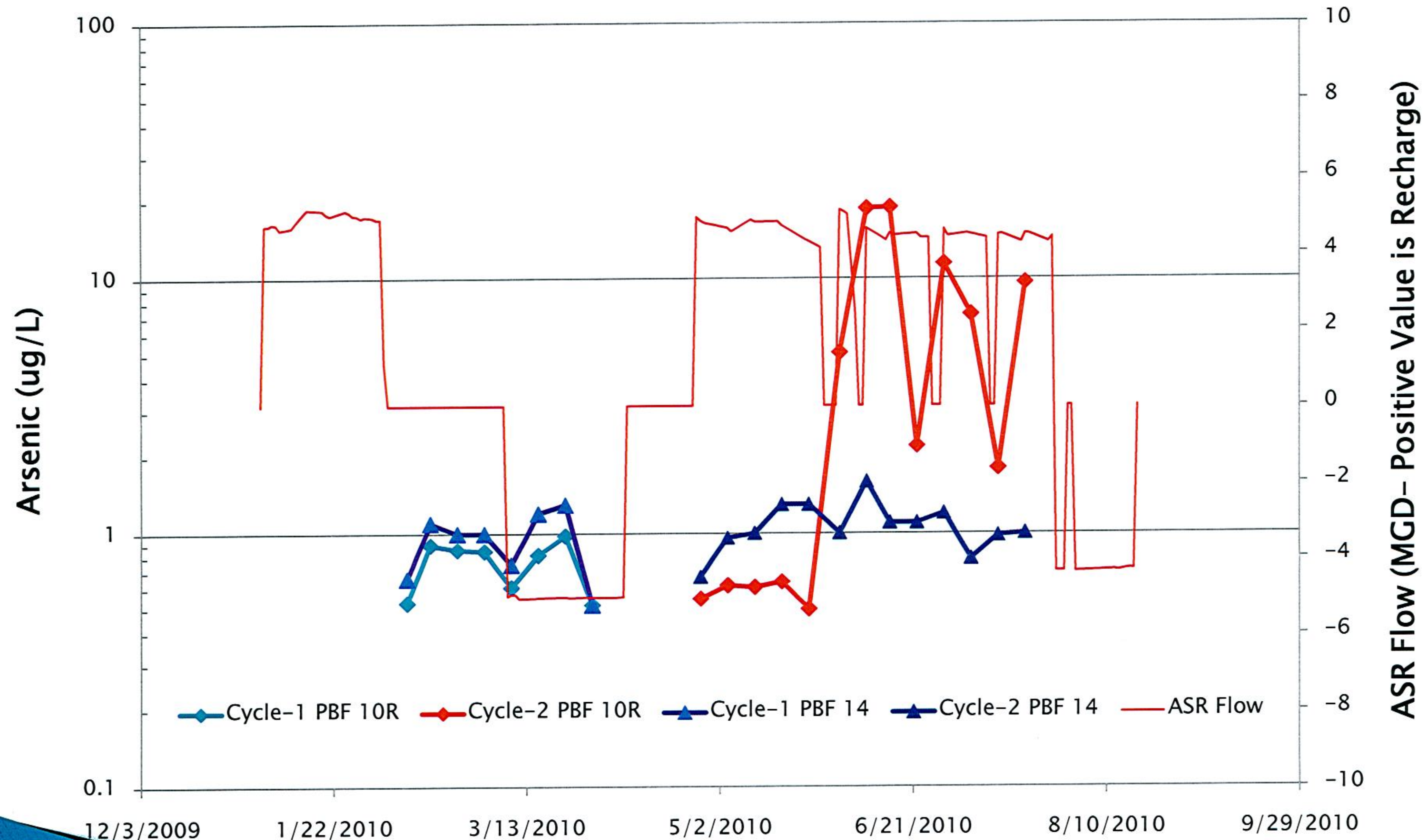


Figure 13. Hillsboro ASR Pilot Project. Arsenic at site monitoring wells.

Iron at ASR, PBF-10R & PBF-14

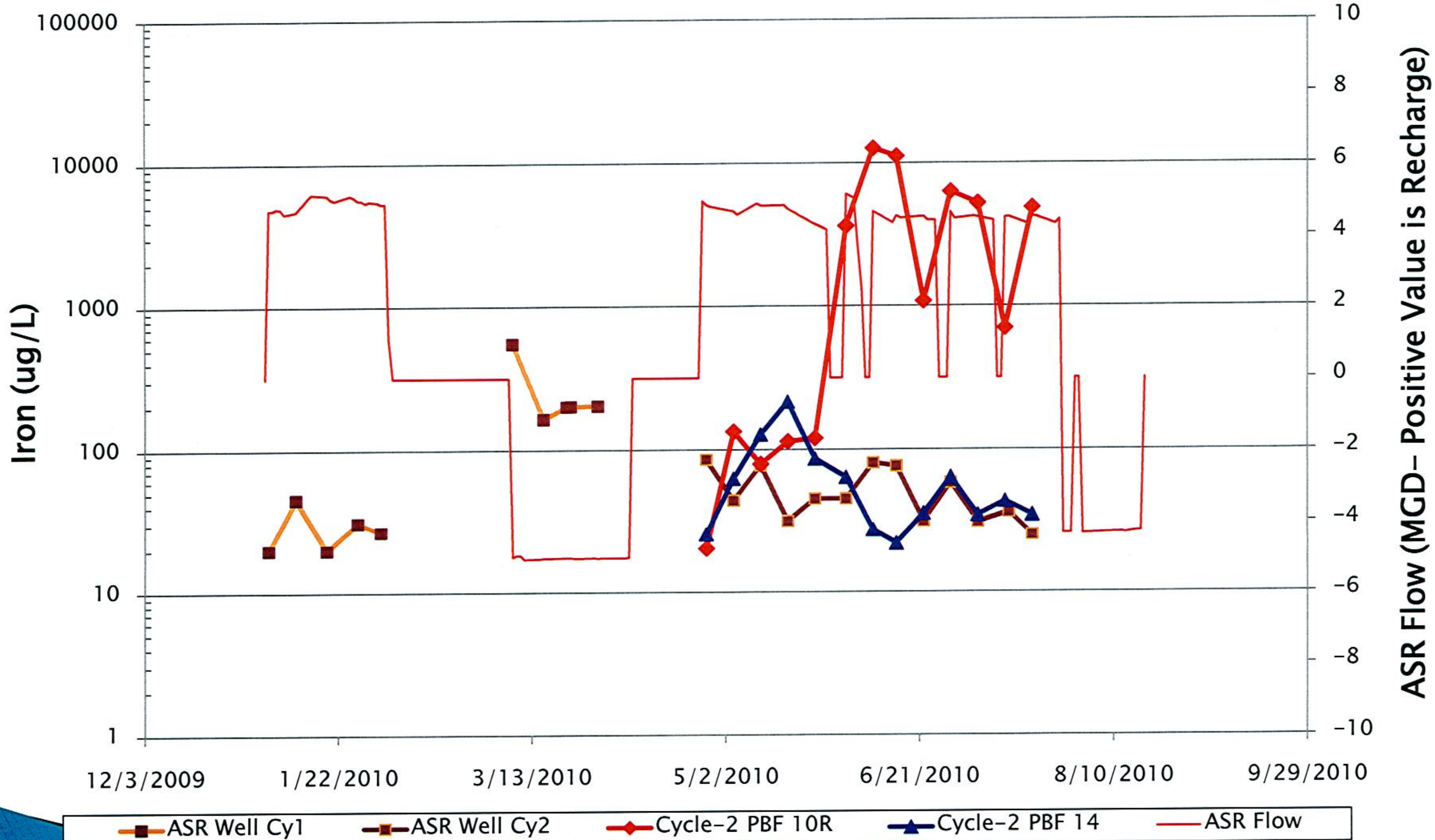


Figure 14. Hillsboro ASR Pilot Project. Iron at site monitoring wells.

Total mercury concentrations in water recharged into the ASR well averaged approximately 0.001 ppb throughout the recharge period. Water recovered from the ASR well exhibited total mercury concentrations of approximately 5 ppb. These concentrations are substantially below the Florida Class III water quality standard of 12 ppb for total mercury.

End of Recovery "Snapshot"

Recovery from the ASR well was terminated when the specific conductivity of the recovered water reached 1,225 umhos/cm, within compliance specified in the project NPDES permit. When this permit-driven limit was achieved, approximately 22 percent of the recharged water had been recovered. **Table 4** presents the concentrations of various constituents of interest on the date that recovery was terminated, shown in comparison to the average concentration of the same constituents that were pumped into the ASR well during the recharge period.

Table 4. Hillsboro ASR Pilot Project End of Recovery Water Quality Snapshot

Constituent	**Average recharge water concentration**	**End of recovery water concentration**
Conductivity (umhos/cm)	500	1,225
Chloride (mg/L)	60	259
TDS (mg/L)	310	750
pH	7.5	7.6
Turbidity (NTU)	1.6	0.35
Sodium (mg/L	1,100	1,240
Sulfate (mg/L)	22	79
Iron (ug/L)	40	139
Color (PCU)	70	25
Arsenic (ppb)	1.2	0.96
Phosphorus (ppb)	75	5

Comparison with PBCWUD Hillsboro ASR Well System Performance

The Palm Beach County Water Utilities Department (PBCWUD) operates a similar ASR system along the Hillsboro Canal, about 5 miles east of this project location. Beginning in 2004, a series of test cycles were conducted on the PBCWUD ASR well. The initial cycle for the PBCWUD ASR system consisted of 97 day recharge period (at 5 mgd), followed by 13 days of storage. Recovery was terminated after 10 days, when the chloride concentration reached 252 mg/L. As a result, the recovery efficiency of the first cycle was roughly 10 percent. A second, similar cycle was subsequently conducted, at similar rates and durations, which resulted in an increase in the recovery efficiency to 38 percent. A third cycle was later conducted, utilizing a recharge period of 64 days, followed by 63 days of storage and 18 days of recovery resulting in a recovery efficiency increase to 51 percent. This improvement in operational performance at the PBCWUD ASR site is particularly encouraging, in light of the results from the CERP Hillsboro ASR system, which exhibited an initial recovery efficiency of 22 percent from cycle 2, which was conducted using similar in duration and rates. ***This comparison indicates that it***

is reasonable to expect continued improvement in recovery efficiency with continued cycle testing.

Ecological Data

In order to evaluate the potential toxicity of the water recovered from the system during Cycle 2, the recovered water was tested according to the NPDES and CERPRA permit requirements. Four weekly samples were collected. The permit requires acute toxicity tests using the waterflea (*C. dubia*) and the bannerfin shiner (*C. leedsi*). The tests (routine toxicity tests) were conducted using grab samples of recovered water collected on the following schedule (as required by the ASR permit):

Recovered water samples were collected every four to six days until the end of the recovery period. The recovered water was blended with varying percentages of control water, in the concentrations as follows: 0% (recovered water), 6.25%, 12.5%, 25%, 50%, and 100%. Sampling dates, conductivity and test results are presented in **Table 5**. All recovered water samples showed no quantifiable acute toxicity and met the permit requirements. ***Since these results are essentially identical to those from Cycle 1, it is recommended that toxicity test be eliminated from further cycle testing at the project.***

Table 5. Hillsboro ASR Pilot Project Cycle #2 Toxicity Test Results.

Test	**Collection date**	**Recovered water Concentration**	**% Survival**	
			Ceriodaphnia dubia	***Cyprinella leedsi***
1	7/29/2010	0% (control water)	100	100
		6.25	100	100
		12.5	100	100
		25	100	100
		50	95	100
		100 (recovered water)	100	100
		LC50	**>100%**	**>100%**
2	8/9/2010	0% (control water)	INVALID	100
		6.25	-	100
		12.5	-	100
		25	-	100
		50	-	100
		100 (recovered water)	-	100
		LC50	-	**>100%**
3	8/13/2010	0% (control water)	100	100
		6.25	100	100
		12.5	95	100
		25	100	100
		50	100	100
		100 (recovered water)	100	100
		LC50	**>100%**	**>100%**

Test	Collection date	Recovered water Concentration	% Survival	
			Ceriodaphnia dubia	*Cyprinella leedsi*
4	8/18/2010	0% (control water)	100	100
		6.25	100	100
		12.5	100	100
		25	100	100
		50	100	100
		100 (recovered water)	95	100
		LC50	**>100%**	**>100%**

Conclusions and Recommendations

- Equipment testing during Cycle 2 at the Hillsboro ASR pilot project indicates that the facility is operating as designed, although there were occasional periods of non-compliance of the disinfection system and elevated wellhead pressures as a result of biological clogging.
- The system operated successfully with occasional visits for monitoring and routine maintenance.
- Water quality data from the storage-zone monitoring wells indicated that canal water mixed and diffused with groundwater at distances of 330 and 1,000 feet away from the ASR well. Wells completed above and below the storage zone indicated little if any impacts from water emplaced within the storage zone.
- The recovery efficiency for Cycle 2 was approximately 22 percent. Further improvement in the recovery efficiency is anticipated during subsequent cycles, as a target storage volume is developed.
- Water recovered from the system displayed no toxic effects and did not generate elevated levels of mercury.
- Water recovered from the ASR well and all of the monitoring wells exhibited an arsenic concentration of less than 10 parts per billion (ppb) below 10 ppb throughout the entirety of Cycle 2.

Based on these findings, the following recommendations are made:

- Continue testing the system with Cycle 3, which will consist of 90 days of recharge followed by 60 days of storage, followed by recovery until the pre-set conductivity of 1,275 umhos/cm is reached.
- In order to decrease operating wellhead pressures, an acidization should be performed on the well, to remove particulate matter near the wellbore.
- A reduced level of water quality monitoring is justified for Cycle 3, particularly at the monitoring wells that showed little if any hydraulic or water quality effects of operation of the ASR well, which would include PBF-11, PBF-12 and PBS-11.