Memorandum

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From: *Dominic Giaudrone, Jennifer Smith, and Kevin Lee, CDM*

Date: *August 22, 2011*

Subject: *South Tacoma Channel Well 12A Groundwater Extraction and Treatment System (GETS) Inspection*

This memorandum summarizes an inspection of the Groundwater Extraction and Treatment System (GETS) at the South Tacoma Well 12A Superfund Site conducted by CDM Federal Programs Corporation (CDM). The inspection included the following activities:

- Observed the granular activated carbon (GAC) media change out on July 18, 2011, post-change out startup activities on July 19, 2011, and replacement of the pump and discharge pipe at EW-3 on July 20, 2011.
- Inspected the extraction wells and treatment system to determine the current conditions of system instrumentation and controls, operations, and overall performance.
- Conducted an extraction well performance evaluation to determine whether improvements could be made to increase the capture zone compared to historical data.

System Inspection

CDM inspected the system to assess the general condition of the groundwater extraction wells and the treatment system. The valves, sample ports, pressure gauges, air release valves, flow meters, totalizers, and the low level alarm at extraction well (EW) 1 were inspected to determine if they were in functioning condition. The naming convention used for identification of valves and pressure gauges followed those outlined in the *O&M Manual Groundwater Extraction and Treatment System* (URS 2004). Valves and sample ports were tested by opening and closing them. The pressure gauges were tested to determine if they read a value of 0 pounds per square inch gauge (psig) when vented to the atmosphere and whether a pressure was indicated when pressurized. However, the readings on functioning pressure gauges were not verified by comparing to a calibrated gauge, so the accuracy of the pressure values were not verified. The air release valves, flow meters, and totalizers were visually inspected. Photos of the inspection are presented in Figures 1 to 10.

An inventory of supplies at the GETS trailer was collected for equipment and parts including water level indicators, filters, pressure gauges, gaskets, and other spare parts. There was a general need for improvement of housekeeping in the trailer, in particular disposal of non-functioning equipment such as pressure gauges and broken parts.

The pump and down-hole discharge pipe for EW-3 was replaced on July 20, 2011. The old pump and piping were replaced because flow rates had decreased from approximately 9 gallons per minute (gpm) to 3 gpm. The old pump and HDPE pipe were pulled and found to be impacted with what appeared to be a soft iron precipitate. Significant fouling was identified in the piping - when connected to a fire hydrant at full capacity, there was a small steady flow exiting the pipe. This fouling was the primary cause for reduced flow capacity at EW-3. The original pump was kept on site as a spare since it appeared to be functioning, and the primary cause of the reduction in flow rate was determined to be an obstruction in the down-hole discharge piping.

System Inspection Findings

Several pressure gauges are not functioning properly on both the extraction wells and the treatment system, and require replacement (Table 1). The pressure transducers at EW-2, EW-3, EW-4 and EW-5 were either not functioning or not present. These transducers were intended to control the pump speed and maintain the desired drawdown in each well. Since the pressure transducers were not functioning, the pump flow rate was being controlled manually by adjusting the motor speed. Thus, the system was not being operated to optimize flow. For the wells to operate as designed, the pressure transducers require replacement. Based on discussion with the current operators, it is our understanding that the transducers have been unreliable; however, it is not known whether they were properly maintained (e.g., regular desiccate replacement to prevent moisture in the vent tubing). Either the transducers need to be replaced, or high and low level switches should be installed in the wells to control pump operation to achieve the desired drawdown in each well.

The level switch at EW-1 was inadvertently tested during the extraction well performance testing when the depth to water dropped below the low level alarm set point. The alarm was not triggered during this time and the well ran dry. The low level sensor should be replaced to protect the pump from a potential dry-running condition.

A hoist on the top of the GAC vessels has been used in the past for moving heavy equipment and opening the large manways on top of the vessels. The condition of the hoist is unknown; however, it is unprotected from the elements and no preventative maintenance has been performed in at least 6 years, possibly longer. Significant rusting was observed on the chain and the hoist housing. It is recommended that the hoist be inspected by a qualified person to determine if it is safe to use and any required maintenance should be performed prior to operation of the hoist. In the interim, lock out/tag out procedures should be followed to prevent operation of the hoist as it may no longer be safe to operate up to its rated capacity.

Items such as broken pressure gauges, damaged system components, and other unnecessary equipment and supplies should be removed from within and beneath the GETS trailer. Buckets of GAC stored beneath the trailer should be disposed of during the next GAC change out. Pipe insulation is in poor condition. Over the years, several sections of pipe insulation have been removed to access the piping and in those areas the piping is no longer protected from the elements. However, the insulation is in a similar condition to when the City of Tacoma assumed responsibility for system O&M. Much of the piping is also heat traced (Figure 6). The heat tracing is activated by a thermostat and given the ambient temperature was significantly above freezing during the inspection, it was not possible to test the heat tracing to verify that is functioning properly. Where possible, the heat tracing was inspected visually. The heat tracing between the sump pump and the effluent storage tank is disorganized and not installed in accordance with manufacturer recommendations and should be reinstalled. Additionally, several sections of wiring associated with heat tracing on the east side of the site are damaged and may be an electrical hazard (Figure 8). The damaged wiring should be repaired or replaced.

The eye wash did not work upon initial inspection. The valve to the City of Tacoma water line was closed to prevent water from freezing in the pipes during colder temperatures. The valve was opened during the inspection and the eye wash functioned properly. The valve to the City of Tacoma water line was left open so the eye wash could be used if needed.

After the lag vessel was changed out with fresh GAC, the water used for media transfer was drained from the trailer into secondary containment sump. . The sump storage capacity was quickly exceeded, and water flowed into the secondary containment area. There is a sump pump used to transfer water from the sump to the effluent storage tank, but the flow rate is low. The City of Tacoma used a 3.5 horsepower (hp) trash pump to increase the flow rate and decrease the transfer time . The trash pump is owned by the City of Tacoma; another pump may need to be acquired when responsibility of O&M tasks is transferred to CDM. Alternatively, the sump pump could be replaced with a higher head model to achieve the desired performance.

Extraction Well Performance Evaluation

CDM inspected each of the GETS extraction wells to assess performance of the wells, pumps, and associated system components. To use the GETS to evaluate mass discharge, it will be necessary to adjust extraction rates to achieve the desired target capture zone. The size and spatial extent of the capture zone may need to be altered to support mass flux and mass discharge measurements. However, it was unknown whether current operating conditions were similar to those in the *Draft Field Investigation and Capture Zone Analysis Report* (URS 2005). Historical flow rate data for each of the extraction wells show reduced flows since 1998 (Figure 11). The performance evaluation was conducted to determine whether there was potential for enhancement of the capture zone size.

Formal pump tests were not conducted; however, flow rates were adjusted and depth-to-water (DTW) measurements were recorded to determine the approximate sustainable yield of each well and identify the limiting factor(s) for each well. Results were compared with the pump curves, historical pump test data from 1988 and 1995, and system performance data collected during the 2004/2005 Capture Zone Evaluation. This information is summarized in Table 2. Pump intakes for the extraction wells range from 63 to 67 feet below ground surface (bgs) and the wells are generally operated to maintain at least 5 feet of water above the pump intake to prevent the pumps from running dry and to minimize cycling. Typical target water levels for extraction wells range from 55 to 60 feet bgs depending on the exact pump intake depth in each extraction well. Finding for each well are presented below.

EW-1

EW-1 was the first extraction well installed and has always been the best producing well of the GETS extraction wells. In 1988, shortly after installation and development, a step drawdown test was performed on EW-1 and the well was able to sustain 303 gpm with a DTW of about 52.5 feet bgs (Robinson and Noble 1988). During the inspection, on July 19, 2011, EW-1 was operating at approximately 43 gpm with a DTW of about 60 feet bgs (approximately 7 feet above the pump intake). We increased the flow by approximately 10 gpm and the well ran dry indicating that the current sustainable yield is approximately 43 gpm. The extraction rate is currently limited by the well and a rehabilitation program is recommended if additional production is desired. Because this well initially pump tested at over 300 gpm, it is believed that production could be improved significantly by rehabilitation. The low level alarm in EW-1 was also found to be faulty. It should have shut down the pump prior to running dry, but did not. Findings are summarized below:

- The well efficiency has declined significantly since the initial pump test, but has not changed significantly since 2004.
- Production is limited by the well, not the pump or discharge pipe.
- The low level sensor is not functioning and will not protect the pump from running dry.
- Rehabilitation is recommended if additional production is desired from this well.

EW-2

In 1995, shortly after installation and development, a step drawdown test was performed on EW-2 and the well was able to sustain 24 gpm with a drawdown of 19.39 feet (approximately 54.4 feet bgs) (ICF Technology Inc. 1995). During the inspection, on July 20, 2011, EW-2 was operating at approximately 11.6 gpm with a DTW of about 55.5 feet bgs (approximately 10 feet above the pump intake). The extraction rate currently appears to be limited by the well as the pump has additional capacity, but the DTW is near the desired maximum drawdown. A rehabilitation program is recommended if additional production is desired from this well.

Findings are summarized below:

- The well efficiency has declined significantly since the initial pump test and since 2004.
- Production currently appears to be limited by the well, not the pump or discharge pipe.
- Rehabilitation is recommended if additional production is desired from this well.
- If rehabilitation is performed, a larger pump will likely be required to maximize production from EW-2.

EW-3

In 1995, shortly after installation and development, a step drawdown test was performed on EW-3 and the well was able to sustain 12.5 gpm with a drawdown of 18.48 feet (approximately 54.4 feet bgs) (ICF Technology Inc. 1995). During the inspection, on July 20, 2011, EW-3 was operating at approximately 11.6 gpm with a DTW of about 57 feet bgs (approximately 6.5 feet above the pump intake). The extraction rate currently appears to be limited by the well as the pump has additional capacity, but the DTW is near the desired maximum drawdown. The well may still benefit from rehabilitation; however, performance has not degraded significantly since the original pump test. Findings are summarized below:

- The well efficiency has declined slightly since the initial pump test.
- Production is currently limited by the well, not the pump or discharge pipe.
- Rehabilitation is unlikely to significantly improve performance of this well.

EW-4

In 1995, shortly after installation and development, a step drawdown test was performed on EW-4 and the well was able to sustain 11.5 gpm with a drawdown of 13.3 feet (approximately 47.5 feet bgs) (ICF Technology Inc. 1995). The flow was increased to 17 gpm, but the pump test was interrupted before the water level stabilized so it is not known how much more flow the well could sustain. It did run dry at the next step of 40 gpm. During the inspection, on July 20, 2011, EW-4 was operating at approximately 9 gpm with a DTW of about 46 feet bgs (approximately 17 feet above the pump intake). The extraction rate currently appears to be limited by the discharge pipe as the pump was operating at the maximum revolutions per minute (rpm) and limited pressure was observed on the upstream pressure gauge at the wellhead. Findings are summarized below:

- Production currently appears to be limited by the discharge pipe, not the well. The down-hole discharge pipe should be inspected and cleaned or replaced.

- Rehabilitation is not recommended. During previous attempts to redevelop the well, large amounts of sand pack were pulled into the well during surging. It is suspected that the well may be damaged or improperly constructed. If additional information is desired, a down-hole video inspection is recommended.

EW-5

In 1995, shortly after installation and development, a step drawdown test was performed on EW-5 and the well was able to sustain 7.5 gpm with a drawdown of 15.3 feet (approximately 49 feet bgs) (ICF Technology Inc. 1995). The flow was increased to 10 gpm and the well ran dry. During the inspection, on July 20, 2011, EW-5 was operating at approximately 8 gpm with a DTW of about 54.5 feet bgs (approximately 10 feet above the pump intake). The extraction rate currently appears to be limited by both the well and the discharge pipe. Findings are summarized below:

- Production currently appears to be partially limited by the discharge pipe. While it may not result in an increase in the yield from the well, the down-hole discharge pipe should be inspected and cleaned or replaced in order to improve the efficiency of the pump.

- Given that the well could not sustain 10 gpm in the original pump test, it is unlikely that performance would be significantly improved, above the current 8 gpm, by rehabilitation. Well performance should be reassessed once the pressure gauges and down-hole discharge pipe are replaced.

Recommendations

The primary recommendations from the GETS system inspection and extraction well performance evaluation include:

System Inspection

- Several pressure gauges were broken and warrant replacement (Table 1). Since the time of this inspection, the City of Tacoma has reportedly replaced several of these gauges. After gauges are replaced at the extraction wells, pressure readings should be collected and compared to the pump curves to verify the pumps are operating within the manufacturer's specifications.

- The pressure transducers at EW-2, EW-3, EW-4, and EW-5 are either missing or non-functional. The transducers either need to be replaced, or high and low level switches should be installed to control operation to achieve the desired drawdown in each well.

- The low-level switch on EW-1 needs to be replaced because it did not trigger a system alarm when the well was run dry.

- Lockout/tag out procedures should be applied to the hoist on the top of the GAC vessels as an interim measure until it is properly inspected.

- Broken parts and non-functioning equipment in and beneath the GETS trailer that should be disposed of.
- Damaged electrical wiring should be repaired and heat tracing should be reapplied in accordance with the manufacturer recommendations.
- A new pump will be needed for transfer of water from the sump to the effluent storage tank during media change out activities.

Extraction Well Performance

- If additional production is desired from EW-1 and EW-2, well rehabilitation is recommended.
- Groundwater samples should be collected and analyzed by a specialty analytical laboratory to develop an effective site-specific rehabilitation program.
- Down-hole discharge piping should be cleaned or replaced at EW-4 and EW-5. Well performance should be reassessed after this is conducted.
- Depending on the success of rehabilitation in EW-2, a larger pump may be required to maximize production from this well once it is rehabilitated.
- EW-4: If additional information is desired, a down-hole video inspection is recommended.

References

ICF Technology Inc. 1995. Pumping Test Report, Groundwater Extraction and Treatment System, Commencement Bay South Tacoma Channel Well 12-A Site, Tacoma, Washington. July 1995.

Robinson and Noble. 1988. Construction and Testing of EPA Extraction Well/Well12A. June 1988.

URS. 2004. Operation and Maintenance Manual, Groundwater Extraction and Treatment System, South Tacoma Channel/Well 12A Superfund site. December 2004.

URS. 2005. Draft Field Investigation and Capture Zone Analysis Report, Commencement Bay, South Tacoma Channel/Well12A Superfund Site, Tacoma, Washington. September 2005.

Tables and Figures

Table 1. Summary of GETS inspection.

ID	Condition		Notes
	Functioning	Needs Replacement	
Dual Bag Filter 1 (East)	x		
Dual Bag Filter 2 (West)	x		
Dual Bag Filter 1 (East) Pressure Gauge 1		x	see note 1
Dual Bag Filter 1 (East) Pressure Gauge 2		x	see note 1
Drain valve on Bag Filter 1 (East)	x		
Dual Bag Filter 2 (West) Pressure Gauge 1		x	see note 1
Dual Bag Filter 2 (West) Pressure Gauge 2	x		
Drain valve on Bag Filter 2 (West)	x		
East Vessel	x		
Pressure Relief Valve East Vessel	x		
Air Release Valve East Vessel	x		
West Vessel	x		
Pressure Relief Valve West Vessel	x		
Air Release Valve West Vessel	x		
Off-line Cartridge Filter	x		
Effluent Storage Tank	x		
Effluent Storage Tank Level Switch Low	x		
Effluent Storage Tank Level Switch High	x		
Transfer Pump	x		
Back flush Pump	x		
Sump Pump	x		
Sump Pump Filter	x		
Sump Low Level Indicator	x		
Sump High Level Indicator	x		
Sight Glass	x		
Flow Controller	x		
Effluent Flow Meter	x		

ID	Condition		Notes
	Functioning	Needs Replacement	
Eye wash shower	x		
PI-20	x		
PI-21	x		
PI-22	x		
PI-23	x		
PI-24	--	--	unknown, under insulation
PI-25		x	see note 1
PI-26	x		
PI-27	x		
PI-28	x		
PI-29		x	valve to gauge is leaking
PI-30		x	see note 1
PI-31		x	see note 1
SP-1 Pressure Gauge		x	see note 1
SP-2 Pressure Gauge		x	see note 1
SP-3 Pressure Gauge		x	see note 1
V-1	x		
V-2	x		
V-3	x		
V-4	x		
V-5	x		
V-6	x		
V-7	x		
V-8	x		
V-9	x		
V-10	x		
V-11	x		
V-14	x		
V-15	x		
V-16	x		
V-17	x		
V-18	--	--	not tested
V-19	x		
V-22	--	--	not tested
V-23	--	--	not tested
V-24	x		
V-25	--	--	not tested
V-26	--	--	not tested
V-27	--	--	not tested
V-28	x		
V-29	x		

ID	Condition		Notes
	Functioning	Needs Replacement	
V-30	--	--	not tested
Sump Pump Pressure Gauge		x	see note 1
EW-1	x		
EW-1 Pressure Gauge 1		x	see note 1
EW-1 Pressure Gauge 2		x	see note 1
EW-1 Totalizer	x		
EW-1 Level Switch Low		x	alarm was not triggered when well ran dry
EW-1 Level Switch High	--	--	unable to test
EW-2	x		
Transducer EW-2		x	broken
Heat Tracing EW-2	--	--	present, visually inspected
EW-2 Pressure Gauge 1		x	see note 1
EW-2 Pressure Gauge 2		x	see note 1
EW-2 Totalizer	x		
EW-2 Vault High Level Alarm	--	--	not tested
EW-3	x		
Transducer EW-3		x	broken
Heat Tracing EW-3	--	--	present, visually inspected
EW-3 Pressure Gauge 1		x	see note 1
EW-3 Pressure Gauge 2		x	see note 1
EW-3 Totalizer	x		
EW-3 Vault High Level Alarm	--	--	not tested
EW-4	x		
Transducer EW-4		x	not present
Heat Tracing EW-4	--	--	present, visually inspected
EW-4 Pressure Gauge 1		x	see note 1
EW-4 Pressure Gauge 2		x	see note 1
EW-4 Totalizer	x		not tested
EW-4 Vault High Level Alarm	--	--	not tested
EW-5	x		
Transducer EW-5		x	broken
Heat Tracing EW-5	--	--	present, visually inspected
EW-5 Pressure Gauge 1		x	see note 1
EW-5 Pressure Gauge 2		x	see note 1
EW-5 Totalizer	x		not tested
EW-5 Vault High Level Alarm	--	--	not tested

Notes:

1. Pressure gauges were considered not functional if the gauge did not zero upon venting to the atmosphere, if parts were visually broken (e.g. needle broken), and/or the pressure reading was not consistent with expected system pressures.

Table 2. Summary of historical extraction well pump performance data.

Extraction Well	Date	Sustainable Flow Rate (gpm)	Depth to Water (feet bgs)
EW-1	June 1988[a]	303	52.5
	February 2005[b]	33.0	59.6
	July 2011[c]	43.0	60.0
EW-2	July 1995[d]	24	54.4
	February 2005[b]	17.2	48.0
	July 2011[c]	11.6	55.5
EW-3	July 1995[d]	12.5	52.5
	February 2005[b]	9.1	44.6
	July 2011[c]	11.6	57.0
EW-4	July 1995[d]	11.5[e]	47.5
	February 2005[b]	9.2	44.4
	July 2011[c]	9.0	46.0
EW-5	July 1995[d]	7.5	48.9
	February 2005[b]	8.0	55.1
	July 2011[c]	8.0	54.5

Notes:

a. Robinson and Noble. 1988. Construction and Testing of EPA Extraction Well/Well12A. June 1988.
b. Weekly inspection and maintenance field notes from February 21, 2005, when GETS was optimized for capture zone analysis.
c. July 2011 GETS Inspection.
d. ICF Technology Inc. 1995. Pumping Test Report, Groundwater Extraction and Treatment System, Commencement Bay South Tacoma Channel Well 12-A Site, Tacoma, Washington. July 1995.
e. Measurement error at 20 gpm test point; no data were collected. The well ran dry at 40 gpm.

gpm - gallons per minute
bgs – below ground surface

Figure 1. GETS treatment vessels facing west.

Figure 2. GETS treatment vessels facing east.

Figure 3. Extraction well 1 (EW-1).

Figure 4. Header for water from extraction wells to treatment system. Dual bag filters in background.

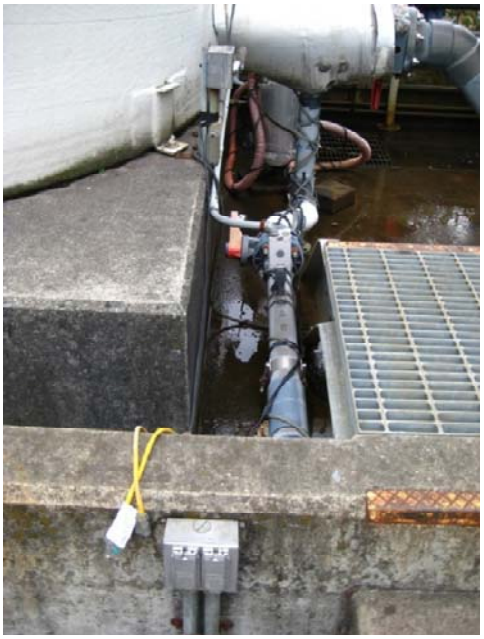

Figure 5. Heat tracing (black) placed throughout lines near effluent storage tank.

Figure 6. Effluent storage tank and piping. Several stretches of piping without insulation.

Figure 7. Frayed wiring present in several locations at the GETS.

Figure 8. EW-3 during pump pull. Piping was dismantled to remove the pump.

Figure 9. EW-3 during pump pull. Black HDPE tubing was replaced due to fouling.

Figure 10. EW-3 pump showing iron precipitate that accumulated on pump intake.

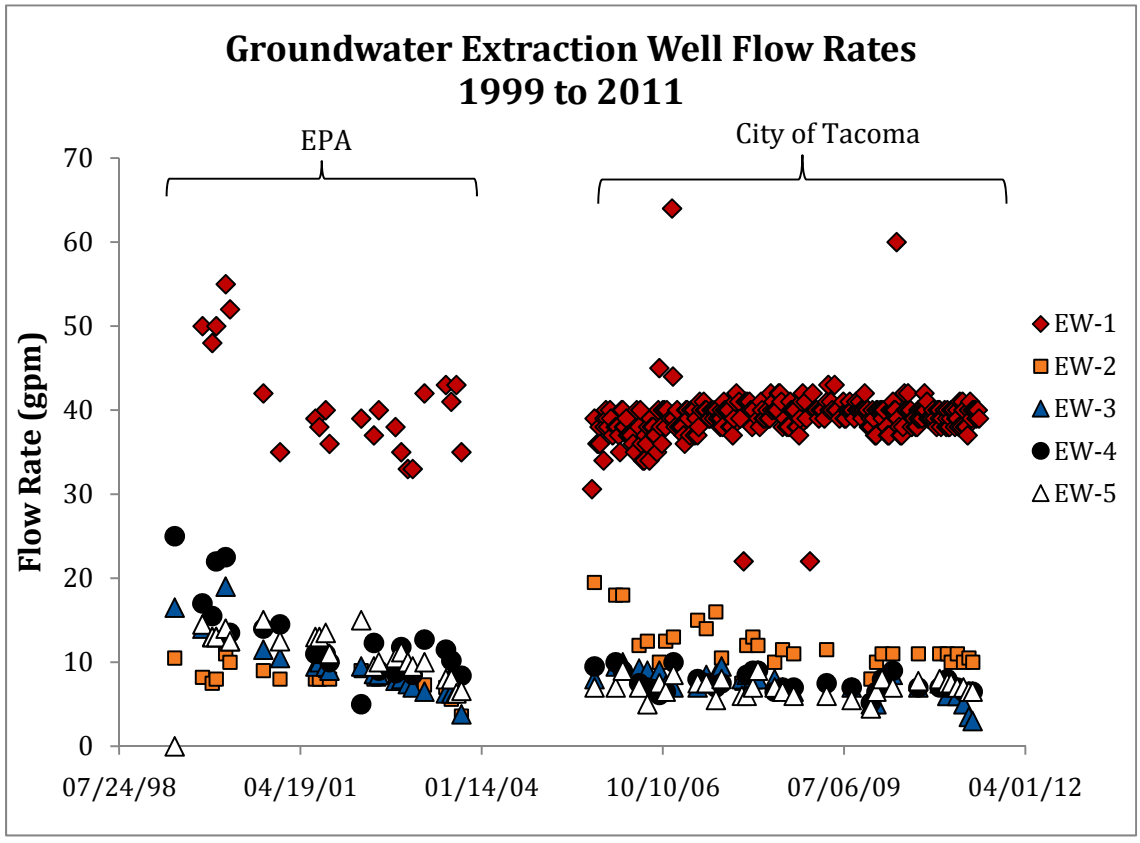

Figure 11. Groundwater Historical Flow Rates 1999 to 2011.