



CITY OF TUCSON

MEMORANDUM

DATE: June 21, 2010

TO: Cottonwood and Ryland Landfills Files

FROM: Molly Collins, R.G.
Project Coordinator
Environmental Services

MO 6-21-10

SUBJECT: Cottonwood and Ryland Landfills
Groundwater and Soil Vapor Monitoring Results 2009

Introduction

The City of Tucson (COT) – Environmental Services (ES) prepared this report to document groundwater and soil vapor monitoring activities conducted in June 2009 at the Cottonwood and Ryland Landfills (Figure 1). This memorandum documents the 2009 water quality results and provides recommendations for changes to sample collection frequency of future groundwater and soil vapor monitoring data.

The Cottonwood Landfill waste footprint is approximately 10 acres and accepted municipal solid waste (MSW) from 1973 to 1985. The Ryland Landfill is approximately 27 acres and accepted MSW from 1960 to 1965. Both landfills meet the definition of closed solid waste facility under A.R.S. 49-701 and are exempt from the state rules covering solid waste facilities.

Groundwater and deep soil vapor at the Cottonwood and Ryland Landfills are currently monitored annually for volatile organic compounds (VOCs). Groundwater is also monitored annually for selected inorganic compounds. Shallow soil vapor outside the waste footprint at Cottonwood Landfill is monitored quarterly for landfill gas (LFG) concentrations in order to detect methane should it migrate from the waste toward nearby buildings. Methane monitoring for the Cottonwood Landfill was directed by Mayor and Council in August 1995 as part of a directive to the Solid Waste Management Department to manage and control methane gas from landfills within the City. Mayor and Council placed evaluation of methane hazards as the highest priority but also directed staff to subsequently evaluate and establish protocols for other environmental concerns, specifically the groundwater conditions at City landfills. ^{1 2}

¹ Solid Waste Management Department: Memorandum to Mayor and Council. Closed Landfill Investigation Summary, February 18, 1998

² Mayor and Council: Memorandum: Update on Landfill Methane Monitoring and Compliance, March 15, 1999

The groundwater monitoring at the Cottonwood and Ryland Landfills is part of a discretionary program conducted by COT-ES in response to the Mayor and Council directive. This discretionary program began in 1999 with an inventory of all wells near City owned landfills. Groundwater monitoring has been performed at the Cottonwood and Ryland Landfills since 2001. Semiannual groundwater and deep soil vapor sampling was conducted through 2005, and annual sampling has been conducted since 2007. There are no regulatory agencies requiring monitoring at these two sites for groundwater or deep soil vapor. Quarterly LFG monitoring of the shallow soil vapor is done to insure safety of surrounding residences, and began in response to the Mayor and Council directive discussed in the preceding paragraph.

Sampling Activities:

- Depths to groundwater were measured in monitoring wells WR-363A, SS-013A, WR-438A, and WR-442A at Ryland and WR-440A, WR-441A, and WR-437A at Cottonwood Landfill. See Table 1 for monitor well information, and Table 2 for water table elevations (WTEs). Measurements were collected to the nearest 0.01-foot with a calibrated electronic measuring device (“well sounder”).
- Groundwater samples were collected from Cottonwood Landfill monitoring wells WR-440A, WR-441A, and WR-437A on June 16, 2009.
- Groundwater samples were collected from Ryland Landfill monitoring wells WR-363A, SS-013A, WR-438A, and WR-442A on June 15, 2009.
- Tucson Water Quality Laboratory analyzed the groundwater samples for VOCs and thirty-one inorganic compounds. The full analyte list is provided in Attachment 1.
- Soil vapor samples were collected from Cottonwood soil vapor monitoring well R-100A (at sample depths 40 feet, 70 feet, 100 feet and 130 feet) and Ryland soil vapor monitoring well R-102A (at sample depths 40 feet, 70 feet, 100 feet, and 130 feet) on June 17, 2009.
- Soil vapor samples were analyzed in the field using a Landtec Gas monitor for relative concentrations of methane (CH₄), carbon dioxide (CO₂), and oxygen (O₂). Soil vapor samples were also collected in vacuum canisters and were analyzed by Columbia Analytical Services for selected VOCs by EPA Method TO-15.

Results

Hydrogeology

In June 2009, the WTEs in the seven COT groundwater monitoring wells at Cottonwood and Ryland Landfills ranged between 2,251.79 and 2,252.11 feet above mean sea level (ft. amsl). Groundwater elevations and contours are displayed on Figure 2 and Table 2. The groundwater table is generally flat with flow from each of the landfills toward the Santa Cruz River. In June 2009, groundwater elevations had increased from the previous year by an average of 2.56 feet for Cottonwood and 2.36 feet for Ryland (Figures 3 and 4). Based on the water level contours in June 2009, WR-441A is upgradient of the Cottonwood Landfill and SS-0013A is upgradient of the Ryland Landfill.

Groundwater Quality

The analytical test results indicate that no VOCs were detected above the aquifer water quality standard (AWQS) in the groundwater monitor wells at either landfill (Table 3). PCE concentrations have been below laboratory detection limits (<0.5 µg/L) for the last two years (June 2008 – 2009) in all Cottonwood and Ryland Landfill site wells. Field sampling sheets are included as Attachment 2, and the laboratory analytical reports for groundwater are included as Attachment 3. Cottonwood Landfill well WR-441A had detections of chloroform (a trihalomethane) at 0.9 micrograms per liter (µg/L) (Figure 5). There is no AWQS for chloroform, but the AWQS for total trihalomethanes is 100 µg/L. In addition, WR-441A, is located upgradient of the Cottonwood Landfill (Figure 2).

Low concentrations of PCE have been detected in only one monitoring well (WR-363A) located northeast of Ryland Landfill. The maximum PCE concentration ever observed at the well was 3.0 µg/L in July 2000, and PCE has not been detected at the well since 2008 (Figure 6).

Samples were collected in 2009 for analysis of 31 inorganic compounds listed in Attachment 1. Attachment 4 contains trend analysis of all inorganic compounds which have been detected at either landfill since 2000. Attachment 4 also contains basic data characteristic information such as number of samples, average of all samples, maximum and minimum values. Analytical data from duplicate samples collected are also compared to the values of the original analysis using relative percent difference (RPD) to assess the accuracy of the original analytical data. Industry standards for RPD values, which indicate the acceptability of duplicate results, vary depending on the media (soil or groundwater) and the method detection limit (lower detection limits produce larger apparent variability). Environmental remediation workplans which have been accepted by the U.S. Environmental Protection Agency and are available on-line specify RPD values ranging from 20% to 50%. COT-ES has used RPD values of 25% (groundwater) to 35% (soil) in the past for determining the acceptability of duplicate and split sample data.

At the Cottonwood Landfill wells, the trend graphs for all detected inorganic and organic parameters are stable or decreasing. Only nitrate has exceeded the AWQS of 10 mg/L in one well (WR-441A) at the AWQS standard of 10 mg/L. WR-441A, is located upgradient of the Cottonwood Landfill (Figure 2). Past and current detections of nitrate are consistent and stable, (Figure 7, Table 4) with nitrate at wells WR-440A and WR-441A fluctuating near the AWQS. The historic and current land practices of nearby properties (such as crop land, horse stables, and a mobile home park with septic systems), are uses commonly known to generate nitrates that can impact groundwater. Review of historic aerial photographs, indicates that Cottonwood Landfill was surrounded by crop land for many years. Today, the property to the south and southwest of the landfill is a private home with multiple horses. Therefore, nitrate is not a constituent of concern for the Cottonwood Landfill. Based on a review of data collected over the past 8 years of monitoring at the landfill, leachate from the buried waste at the Cottonwood Landfill does not appear to have impacted the aquifer.

Duplicate analytical data for the Cottonwood Landfill was compared to the original sample values using RPD (Attachment 4). RPD values calculated for the duplicate sample collected from well WR-437A at the Cottonwood Landfill were all below 20% except for total iron, which

showed an RPD value of 30%. However, the difference between the values of iron reported (0.27 mg/L and 0.2 mg/L) does not appear large enough to make the analysis invalid.

At the Ryland Landfill wells, the trend graphs for all detected inorganic and organic parameters are stable or decreasing. In the past, arsenic at well WR-363A and lead at well WR-442A have exceeded their respective AWQS (Table 4 and Attachment 4). Arsenic has been below the AWQS of 0.05 mg/L in well WR-363A since 2007, and is trending downward. Arsenic is a naturally occurring compound in the groundwater of the Tucson basin, and is not likely present in these quantities due to leachate from the buried waste. Lead was detected once above the AWQS of 0.05 mg/L in well WR-442A in 2004. The value detected in WR-442A appears anomalous in the trend graph and may have been due to sample or analytical error (Attachment 4). Based on the review of the past 8 years of monitoring data, leachate from waste buried at the Ryland Landfill has not impacted the aquifer.

Duplicate analytical data for the Ryland Landfill was compared to the sample values using RPD (Attachment 4). RPD values calculated for the duplicate sample collected for well WR-438A at the Ryland Landfill were all below 20% except for total iron, (RPD=32%), total suspended solids (TSS) (RPD = 32%) and zinc (RPD=59%). The difference between the values of iron (0.4 mg/L and 0.55 mg/L), TSS (18 mg/L and 24.9 mg/L) and zinc (0.076 mg/L and 0.14 mg/L) are significant and may indicate a natural variability in groundwater chemistry since the results of the duplicate sample are uniformly higher than the original sample for these and other metals. Therefore, the analysis is likely valid.

Soil Vapor

Landfill gas (methane, carbon dioxide and oxygen) concentrations are monitored quarterly at the Cottonwood Landfill through sixteen perimeter shallow depth probes placed between the landfill and adjoining properties with buildings that could be impacted by the migration of methane from the landfill. From March 2009 to December 2009, all methane concentrations were zero percent in the shallow perimeter probes except for at CW-14 at 10 feet where methane was detected at 0.1% (Table 5). Attachment 5 contains graphs showing methane, carbon dioxide and oxygen concentrations from March 2009 to December 2009 as well as a copy of a map showing the probe locations. Ryland Landfill does not have any shallow perimeter landfill gas probes as there are no nearby buildings that could be impacted by landfill gas. Landfill gas monitoring is performed in response to the Mayor and Council directive, and is not required by any regulatory agencies.

Deep nested soil vapor probes were installed to measure possible impacts to groundwater from vapor phase VOCs migrating from the waste. The deep nested soil-vapor wells R-100A (Cottonwood) and R-102A (Ryland) were monitored for VOCs in June of 2009. Prior to sampling, the probes in each well were purged and landfill gas concentrations were measured using the Landtec GEM 2000 Gas Analyzer and Extraction Monitor (Tables 6 and 7, and Attachment 4).

Laboratory analysis of soil vapor samples detected concentrations of VOCs as follows: PCE, trichlorofluoromethane, benzene, toluene, and vinyl chloride (Figure 5, Tables 8 and 9, and

Attachment 5). During the 2009 monitoring, the highest concentration of PCE (0.045 µg/L) was detected in R-100A at 40-feet bgs (below ground surface) (Figure 8). Trend graphs of PCE concentrations at well R-102A are depicted in Figure 9. The highest vinyl chloride detection was in R-100A at 130 feet bgs with a concentration of 0.013 µg/L. Vinyl chloride was also observed in Ryland's three shallowest depth probes with a concentration range of 0.0075 - 0.012 µg/L (Figure 5).

Although VOCs have been detected in the vadose zone, these concentrations are low in comparison to the estimated Groundwater Protection Levels (GPLs) for the Cottonwood Landfill as established in 2008 by Hargis & Associates³. The table below compares maximum detected values in 2009 to the Cottonwood Landfill GPLs. There are no GPLs established specifically for the Ryland Landfill since waste and groundwater conditions are very similar to those at the Cottonwood Landfill. The current PCE and vinyl chloride soil vapor concentrations are significantly below the estimated GPLs, therefore, there is a low probability of soil vapor VOC impacts to groundwater above AWQSS. Since VOC concentrations in soil gas have remained relatively stable, and VOCs were not detected in groundwater (with exception of total trihalomethanes), it is reasonable to infer that VOCs in the vadose zone at Cottonwood and Ryland Landfills are not likely to cause impacts to groundwater quality at this time.

Compound	Cottonwood/Ryland 2009 Maximum Detected Concentrations (µg/L)	Cottonwood Landfill GPLs (µg/L)
PCE	0.045	22
TCE	ND (<0.0095)	9
Vinyl chloride	0.013	264
Cis-1,2 dichloroethene	ND (<0.0095)	100

ND = not detected

Proposed Changes to Monitoring

Currently, groundwater at the Ryland and Cottonwood Landfills is monitored and sampled annually for VOCs and 31 inorganic parameters listed in Attachment 1. Shallow soil vapor is monitored for LFG quarterly. Deep soil vapor is monitored and sampled annually for VOCs. As described in the preceding sections, there are no water quality issues due to the impact of leachate or the migration of soil vapor VOCs from the waste. Based on a review of the trends for the previous 8 years for inorganic and VOC data, the probability of impacts to the groundwater from waste buried at these landfills is low. Therefore, COT-ES will no longer monitor groundwater or deep soil vapor at these two landfills as long as they remain undisturbed (i.e. the soil cover remains intact and there are no plans for redevelopment). COT-ES will reevaluate

³ EEC and Hargis + Associates, Inc, April 10, 2008, Soil Vapor Assessment at Los Reales, Prudence, Vincent Mullins, Irvington, Cottonwood, and Ryan Landfills

conditions at the landfills annually to determine if groundwater or deep soil vapor monitoring is necessary.

COT-ES will initiate a program to inspect and maintain the landfills quarterly to correct problems such as wildcat dumping, erosion of soil cover, and vandalism of the wells. All groundwater and deep vapor monitoring wells at the two landfills will be inspected and repaired as needed to insure they are secure and in proper working order.

Shallow soil vapor in the perimeter wells at the Cottonwood Landfill will continue to be monitored for LFG quarterly in order to be protective of nearby buildings. The results will be reported annually. The quarterly monitoring program and the maintenance program described in the preceding paragraph will be detailed in a separate document.

Conclusions and Recommendations

- Since 2001, as part of the City-wide landfill assessment, the COT has monitored groundwater at Cottonwood and Ryland Landfills. There have been no VOCs detected above regulatory standards during that time.
- A trend analysis of all VOCs and inorganic data collected to date indicates that there are no impacts to the groundwater due to leachate or soil vapor migration from the waste.
- Exceedences of the AWQS nitrate standard are not likely due to landfill activities, and are attributed to nearby land use.
- Methane has been detected at 0.1% at one probe on the perimeter of the Cottonwood Landfill during the past 4 quarters of shallow probe monitoring. Methane is not monitored at the Ryland Landfill as there are no nearby structures.
- COT-ES will discontinue groundwater and deep soil vapor monitoring at these two landfills as long as conditions at the landfills remain unchanged. COT-ES will reevaluate the landfill conditions annually to determine if soil vapor and groundwater monitoring is necessary.
- COT-ES will continue quarterly LFG monitoring at the Cottonwood Landfill in order to be protective of nearby structures. LFG monitoring results will be detailed in an annual report.
- COT-ES will initiate a program to inspect and maintain these landfills to correct problems such as wildcat dumping, erosion of soil cover, and vandalism of the wells. All groundwater and deep vapor monitoring wells at the two landfills will be inspected and repaired as needed to insure they are secure and in proper working order. Details of this program will be outlined in a separate letter.

If you have any questions concerning this memorandum, please contact me at (520) 837-3703.

NP/MC/mv

Enclosures

Figures

- 1: Cottonwood and Ryland Landfills – Location Map
- 2: Cottonwood and Ryland Landfills – Groundwater Elevation Map
- 3: Cottonwood Landfill Groundwater Monitor Wells Hydrographs
- 4: Ryland Landfill Groundwater Monitor Wells Hydrographs
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- 6: PCE Concentrations for Groundwater Monitor Wells
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- 9: PCE Concentrations for Soil-Vapor Monitor Wells at Ryland Landfill

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- 5: Landfill Gas Concentrations at Cottonwood Landfill
- 6: Soil-Vapor Monitor Well, R-100A, Landfill Gas Measurements
- 7: Soil-Vapor Monitor Well, R-102A, Landfill Gas Measurements
- 8: Soil-Vapor Monitor Well, R-100A, Analytical Test Results for Selected VOCs
- 9: Soil-Vapor Monitor Well, R-102A, Analytical Test Results for Selected VOCs

Attachments

- 1: Groundwater Analyte List
- 2: Field Data Collection Sheets for Groundwater Sampling
- 3: Laboratory Analytical Test Results for Groundwater Samples
- 4: Groundwater Inorganic Parameter Trend Analysis and Data Characteristics
- 5: Graphs showing Methane, Carbon Dioxide and Oxygen Percentages, Cottonwood Landfill 2009
- 6: Field Data Collection Sheets for Soil-Vapor Sampling
- 7: Laboratory Analytical Test Results for Soil-Vapor Samples

cc: (Full Report Email Link)
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File: Cottonwood and Ryland Landfill

FIGURES

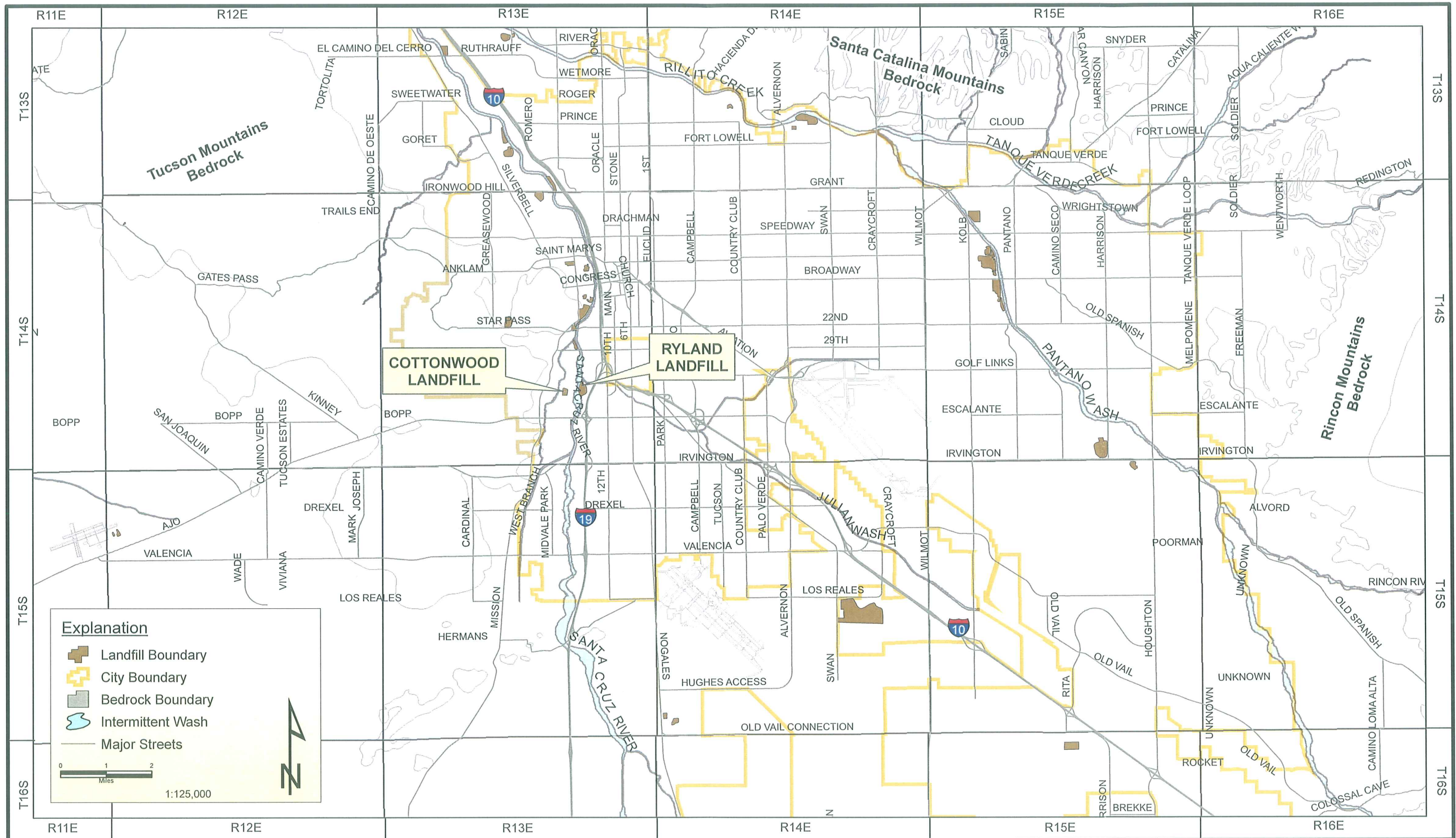


Figure 1
 Location Map
 Cottonwood and Ryland Landfills

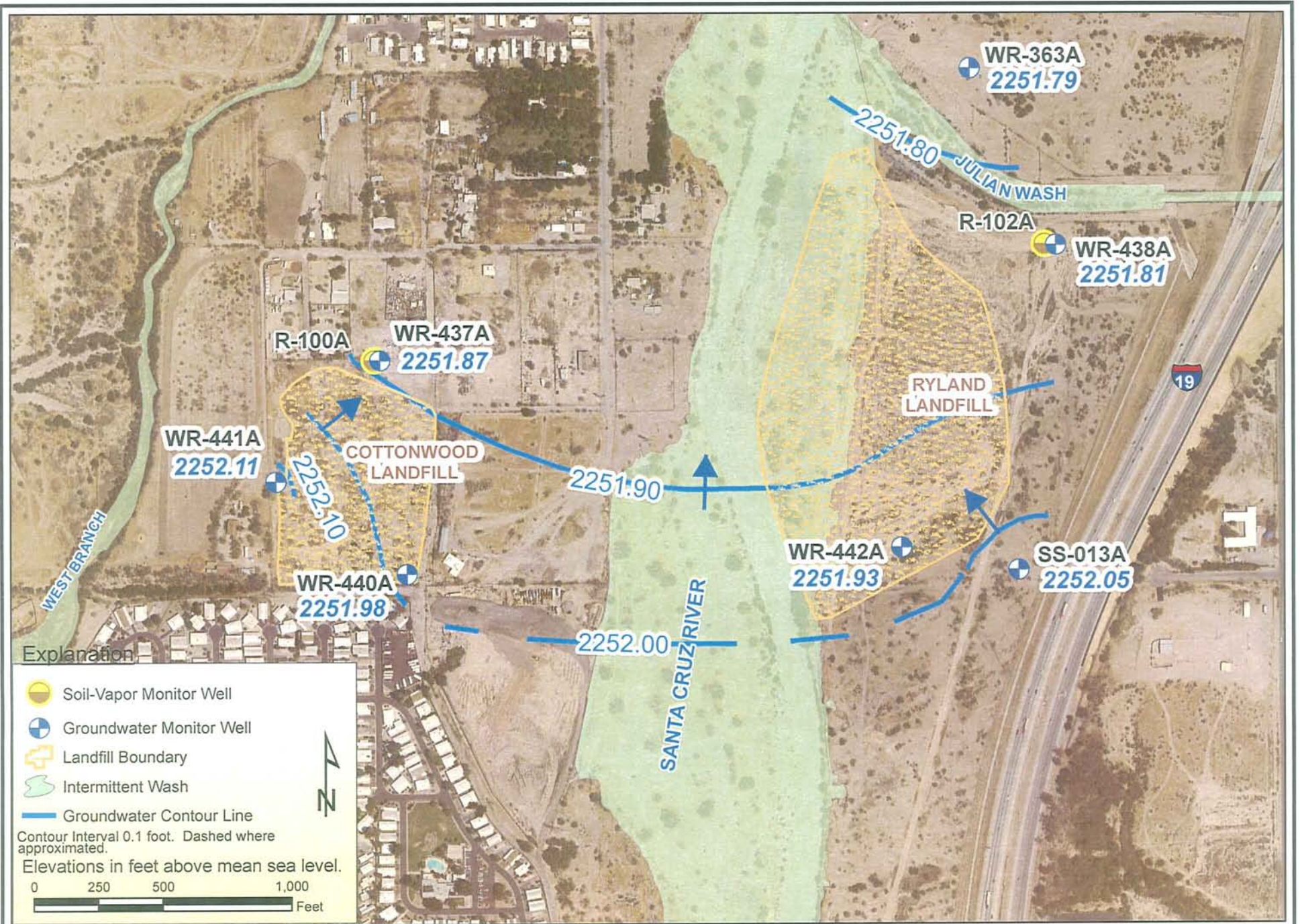


FIGURE 2
Groundwater Table Elevation Map June 2009
Cottonwood and Ryland Landfills

Figure 3
Cottonwood Landfill Groundwater Monitor Wells Hydrographs
Cottonwood and Ryland Landfills - Monitoring Report

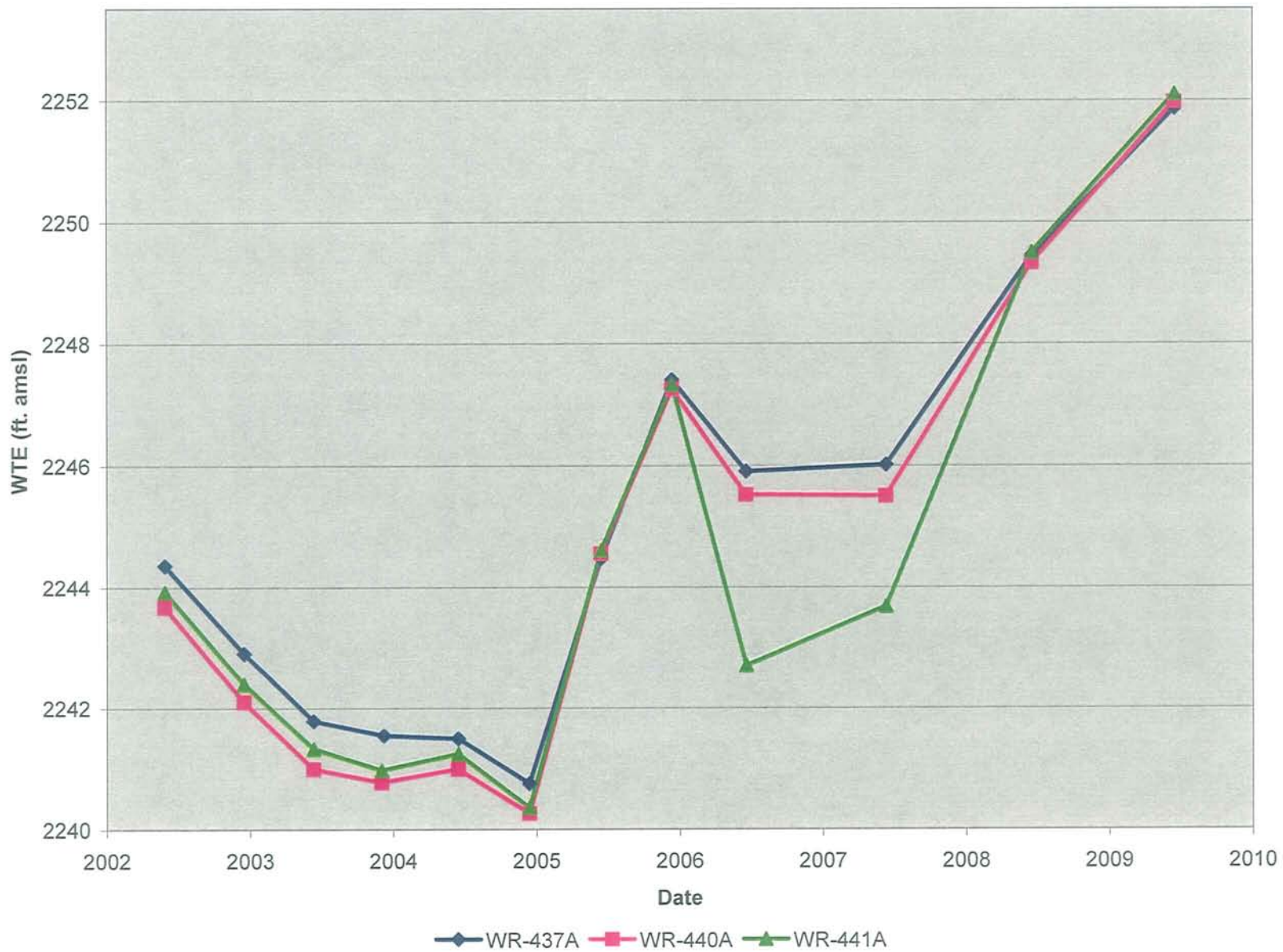
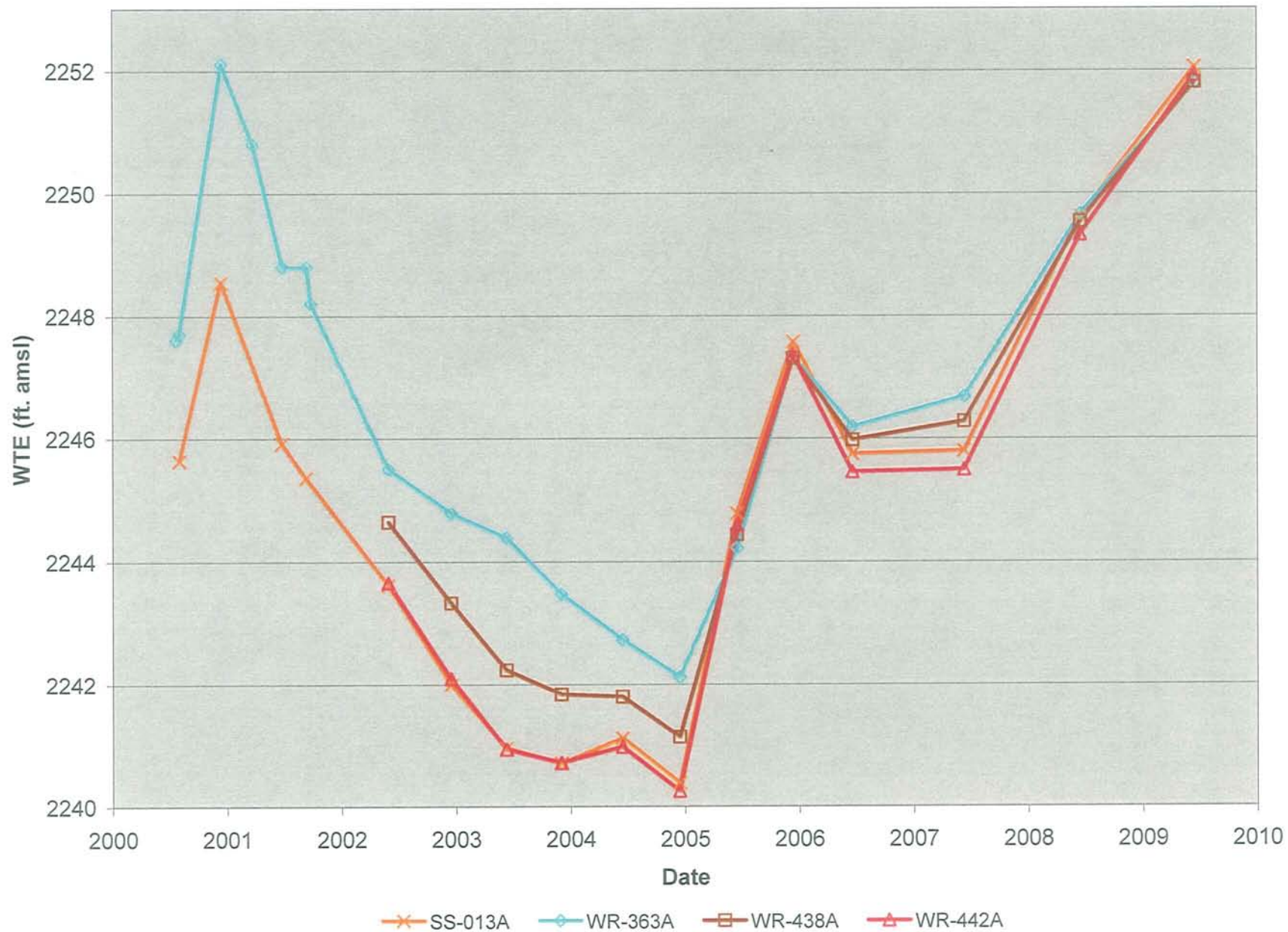
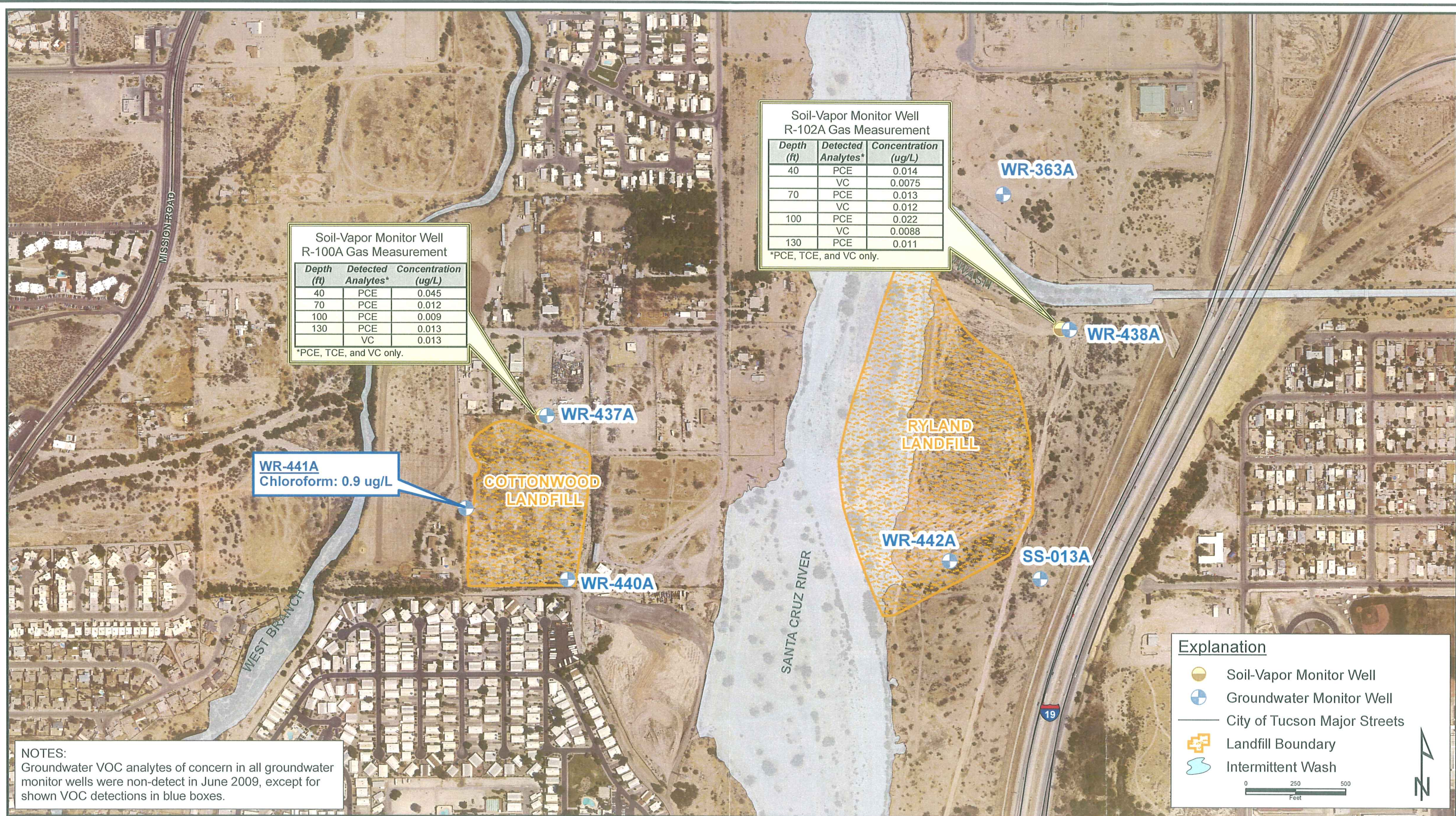


Figure 4
Ryland Landfill Groundwater Monitor Wells Hydrographs
Cottonwood and Ryland Landfills - Monitoring Report





Soil-Vapor Monitor Well R-100A Gas Measurement

Depth (ft)	Detected Analytes*	Concentration (ug/L)
40	PCE	0.045
70	PCE	0.012
100	PCE	0.009
130	PCE	0.013
	VC	0.013

*PCE, TCE, and VC only.

Soil-Vapor Monitor Well R-102A Gas Measurement

Depth (ft)	Detected Analytes*	Concentration (ug/L)
40	PCE	0.014
	VC	0.0075
70	PCE	0.013
	VC	0.012
100	PCE	0.022
	VC	0.0088
130	PCE	0.011

*PCE, TCE, and VC only.

WR-441A
Chloroform: 0.9 ug/L

NOTES:
Groundwater VOC analytes of concern in all groundwater monitor wells were non-detect in June 2009, except for shown VOC detections in blue boxes.

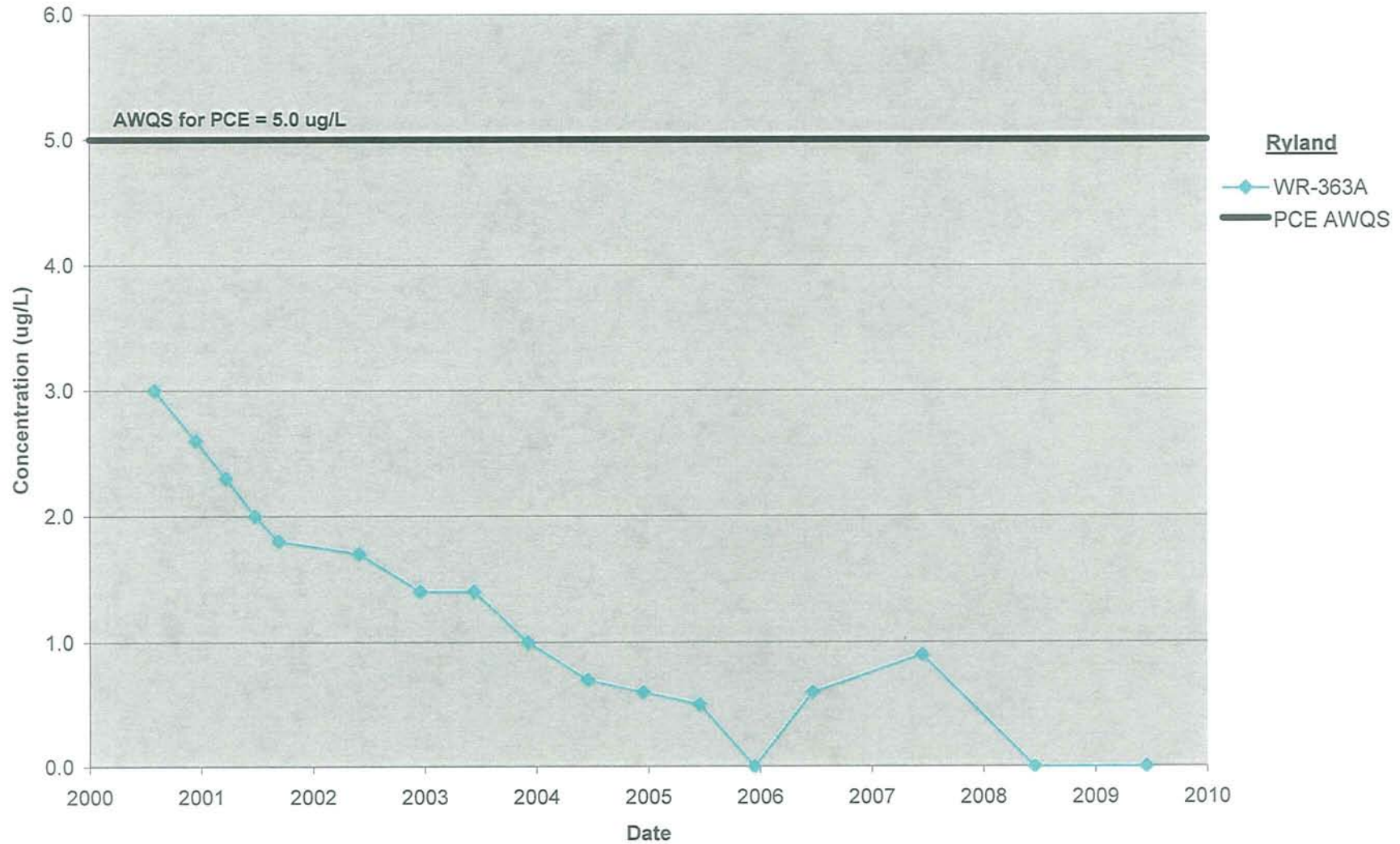
Explanation

- Soil-Vapor Monitor Well
- Groundwater Monitor Well
- City of Tucson Major Streets
- Landfill Boundary
- Intermittent Wash

0 250 500
Feet

FIGURE 5
Groundwater and Soil Vapor Concentration
Cottonwood and Ryland Landfills

Figure 6
PCE Concentrations in Groundwater Monitor Wells*
Cottonwood and Ryland Landfills - Monitoring Report



*All other groundwater monitor wells at Cottonwood and Ryland Landfills have been non-detect for PCE Concentrations which are below the reporting limit (< 0.5 ug/L) plots as a zero value.

Figure 7
Nitrate Concentrations in Groundwater Monitoring Wells
Cottonwood and Ryland Landfills - Monitoring Report

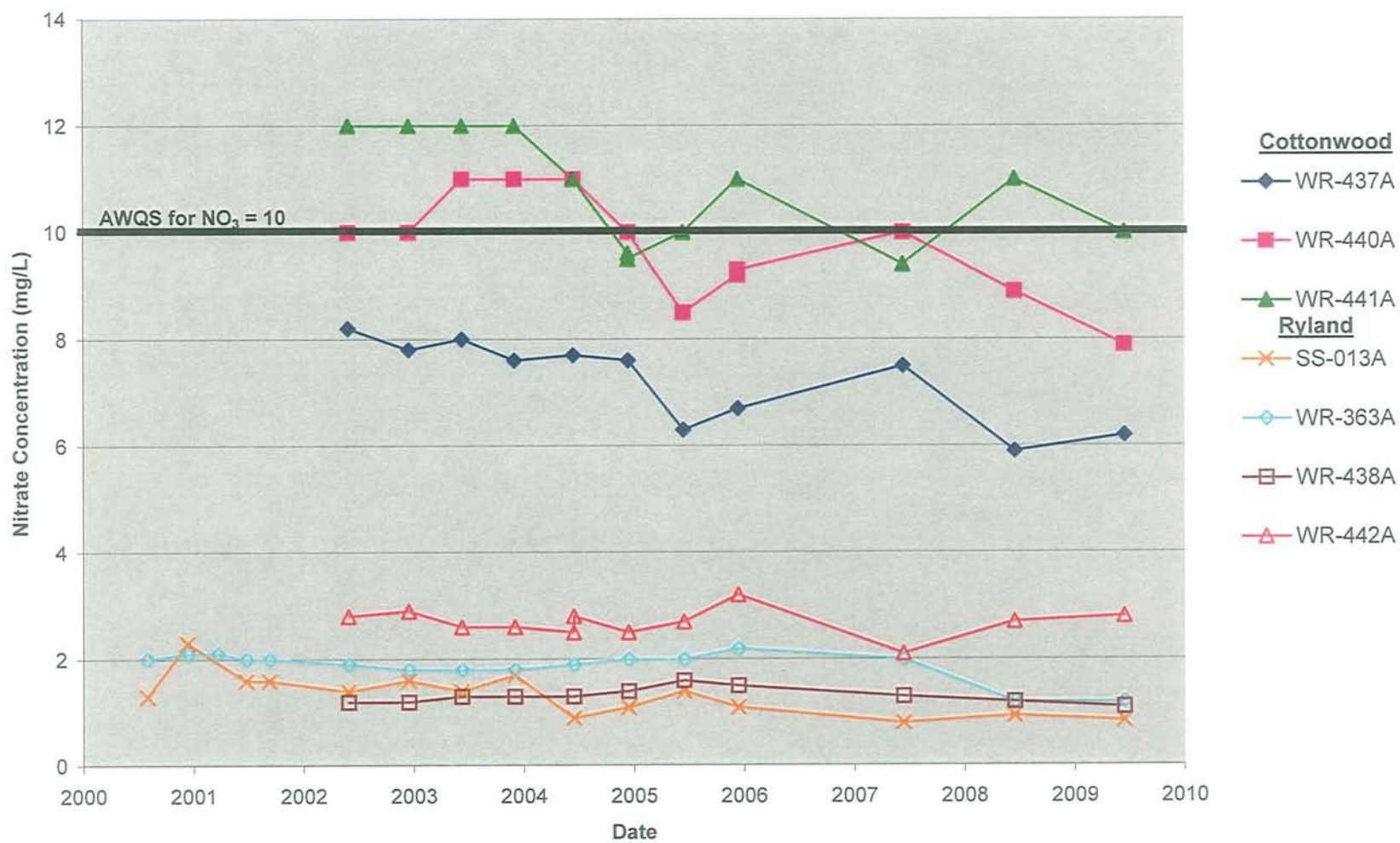
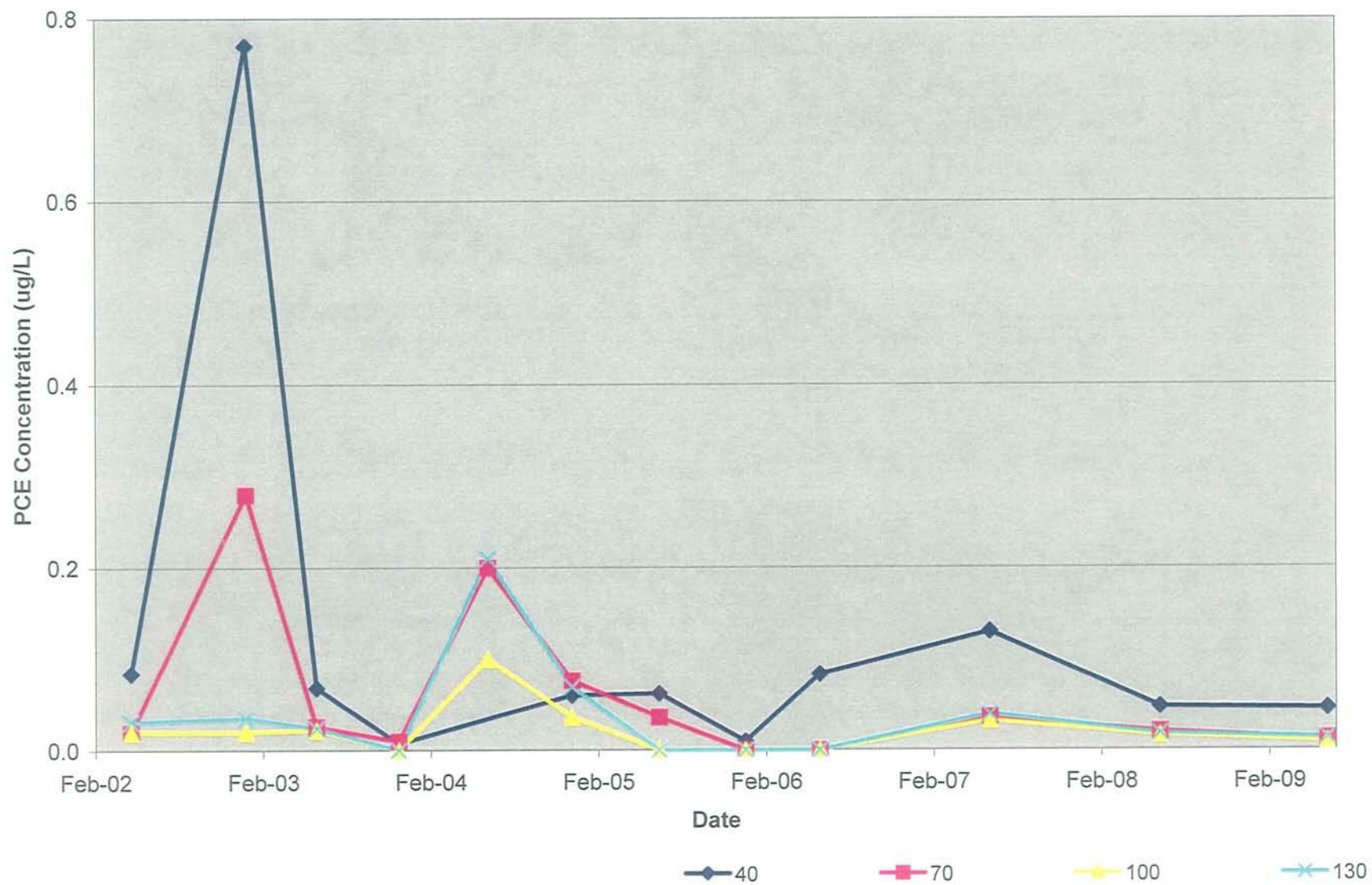
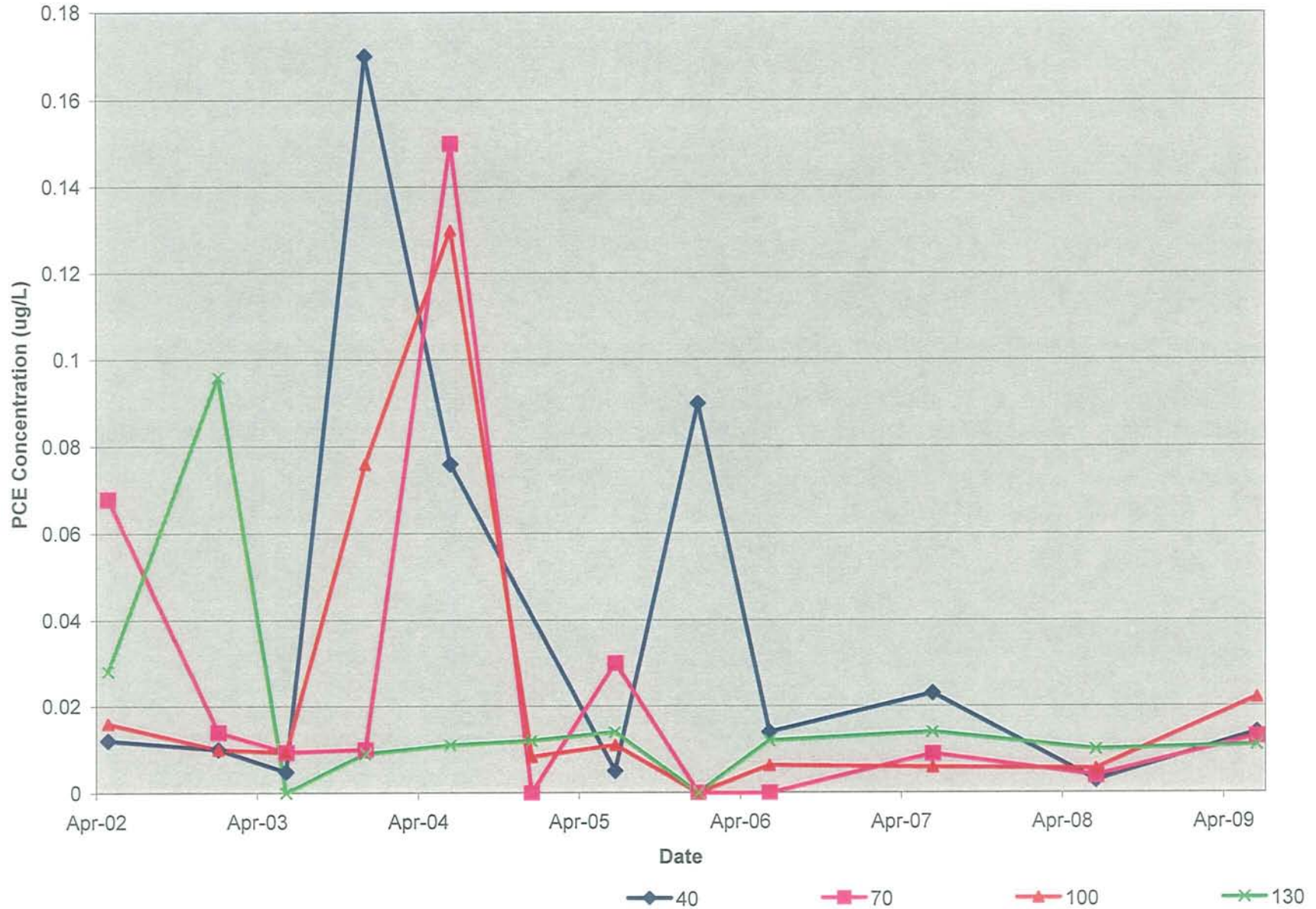


Figure 8
PCE Concentrations for Soil-Vapor Monitor Well R-100 at Cottonwood Landfill
Cottonwood and Ryland Landfills - Monitoring Report



*There are no standards for soil-vapor concentrations

Figure 9
PCE Concentrations for Soil-Vapor Monitor Well R-102A at Ryland Landfill
Cottonwood and Ryland Landfills - Monitoring Report



*There are no standards for soil -vapor concentrations.

TABLES

**Table 1
Monitor Well Information
Cottonwood and Ryland Landfill - Monitoring Reports**

Well Name	ADWR Registration Number	Date Constructed	Well Type	Well Diameter (in.)	Screen Interval (ft bgs)	Material of Constuction	Total Depth (ft)	Easting	Northing	Benchmark Elev. (ft AMSL)
Cottonwood										
R-100A	55-590010	10/21/2002	Deep Nested Vapor Probes	0.5	35-40, 65-70, 95-100, 125-130	SCH 80 PVC	135	985,658.06	433,156.87	--
WR-437A	55-590011	2/21/2002	Groundwater Monitor	5	135-225	SCH 80 PVC	226	985,679.23	433,157.09	2394.39
WR-440A	55-590874	3/19/2002	Groundwater Monitor	5	135.5-225.5	SCH 80 PVC	228	985,784.24	432,332.91	2397.98
WR-441A	55-590876	3/13/2002	Groundwater Monitor	5	135-210	SCH 80 PVC	215	985,275.02	432,690.58	2395.02
Ryland										
R-102A	55-590007	3/22/2002	Deep Nested Vapor Probes	0.5	35-40, 65-70, 95-100, 125-130	SCH 80 PVC	135	988,257.01	433,604.32	--
SS-013A	55-619920	6/17/1930	Groundwater Monitor	16	34-202*	Steel	282	988,156.57	432,345.11	2399.57
WR-363A	55-580371	5/24/2000	Groundwater Monitor	5	109-209.5	SCH 80 PVC	215	987,966.49	434,281.90	2388.60
WR-438A	55-590005	3/29/2002	Groundwater Monitor	5	135-225	SCH 80 PVC	228	988,300.18	433,600.95	2392.45
WR-442A	55-590875	4/9/2002	Groundwater Monitor	5	135-225	SCH 80 PVC	230	987,701.99	432,433.27	2396.16

Notes:

*Open hole from 202-266.

in. = inches

ft bgs = feet below ground surface

ft AMSL = feet Above Mean Sea Level, NAVD 88.

Geographic coordinate system is Arizona Central State Plane NAD 83.

Benchmark elevation is chiseled x on concrete pad.

Survey data provide by Tetra Tech on 6/26/02.

R-102A x,y data obtained from 2005 ortho image.

Table 2
Water Table Elevations
Cottonwood and Ryland - Monitoring Reports

Well Name	Date	Time	DTW (ft)	Correction Factor (ft)	Corrected DTW (ft)	Benchmark Elv. (ft. a.m.s.l.)	WTE (ft)
Cottonwood Landfill							
WR-437A	6/16/2009	816	143.04	-0.52	142.52	2394.39	2251.87
WR-440A	6/16/2009	954	146.93	-0.93	146.00	2397.98	2251.98
WR-441A	6/16/2009	914	143.88	-0.97	142.91	2395.02	2252.11
Ryland Landfill							
SS-013A	6/15/2009	1012	149.19	-1.67	147.52	2399.57	2252.05
WR-363A	6/15/2009	1146	137.43	-0.62	136.81	2388.60	2251.79
WR-438A	6/15/2009	846	141.19	-0.55	140.64	2392.45	2251.81
WR-442A	6/15/2009	933	144.99	-0.76	144.23	2396.16	2251.93

Notes:

DTW = depth to water, feet below measuring point.

ft = feet

Correction factor is the measured difference between the measuring point and the benchmark elevation.

Benchmark Elevation is a chiselled x on the concrete pad. In NAVD 88, feet above mean sea level.

WTE = water table elevation.

Table 3
Groundwater Selected VOCs Concentration (ug/L)
Cottonwood and Ryland Landfills - Monitoring Report

Well Name	Date	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	Chloroform	Dichlorodifluoromethane	Trichlorofluoromethane	
Cottonwood Landfill									
WR-437A	5/29/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/16/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/11/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/1/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/14/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/13/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/14/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/12/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/19/2006	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/12/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/17/2008	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/16/2009	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	D	6/16/2009	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
WR-440A	5/29/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/16/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/11/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/1/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/14/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/13/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/14/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/12/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	D	12/12/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
		6/19/2006	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	D	6/19/2006	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
		6/12/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
		6/17/2008	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	6/16/2009	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	

Table 3
Groundwater Selected VOCs Concentration (ug/L)
Cottonwood and Ryland Landfills - Monitoring Report

Well Name	Date	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	Chloroform	Dichlorodifluoromethane	Trichlorofluoromethane	
WR-441A	5/29/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/16/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/11/2003	<0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	
	12/1/2003	<0.5	<0.5	<0.5	<0.5	0.9	<0.5	<0.5	
	6/14/2004	<0.5	<0.5	<0.5	<0.5	1.0	<0.5	<0.5	
	12/13/2004	<0.5	<0.5	<0.5	<0.5	1.0	<0.5	<0.5	
	D	12/13/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
		6/14/2005	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5
		12/12/2005	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	<0.5
		6/19/2006	<0.5	<0.5	<0.5	<0.5	1.3	<0.5	<0.5
6/12/2007		<0.5	<0.5	<0.5	<0.5	0.9	<0.5	<0.5	
6/17/2008		<0.5	<0.5	<0.5	<0.5	1.1	<0.5	<0.5	
6/16/2009		<0.5	<0.5	<0.5	<0.5	0.9	<0.5	<0.5	
Ryland Landfill									
SS-013A	8/2/2000	<0.5	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5	
	12/13/2000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/25/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	9/10/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	5/30/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/16/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/10/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/2/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/15/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/14/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/16/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/13/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/20/2006	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/13/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/16/2008	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
6/15/2009	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		

Table 3
Groundwater Selected VOCs Concentration (ug/L)
Cottonwood and Ryland Landfills - Monitoring Report

Well Name	Date	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	Chloroform	Dichlorodifluoromethane	Trichlorofluoromethane	
WR-363A	7/31/2000	3.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/13/2000	2.6	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	
	3/22/2001	2.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/25/2001	2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	9/10/2001	1.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	5/30/2002	1.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/16/2002	1.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/10/2003	1.4	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/2/2003	1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/15/2004	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/14/2004	0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/16/2005	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/13/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	D	12/13/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
6/20/2006		0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
6/13/2007		0.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
6/16/2008		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
6/15/2009		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
WR-438A	5/30/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/16/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/10/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/2/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	D	12/2/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
		6/15/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/14/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/16/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	12/13/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/20/2006	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
6/13/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		
6/16/2008	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		
D	6/16/2008	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
	6/15/2009	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
D	6/15/2009	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	

Table 3
Groundwater Selected VOCs Concentration (ug/L)
Cottonwood and Ryland Landfills - Monitoring Report

Well Name	Date	PCE	TCE	cis-1,2-DCE	Vinyl Chloride	Chloroform	Dichlorodifluoromethane	Trichlorofluoromethane
WR-442A	5/30/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/16/2002	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	6/10/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/2/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	6/15/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
D	6/15/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/14/2004	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	6/16/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
D	6/16/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/14/2005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	6/20/2006	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
D	6/20/2006	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	6/13/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
D	6/13/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	6/16/2008	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	6/15/2009	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
AWQS		0.5	0.5	7	0.2			

^D = Duplicate Sample

Table 4
Groundwater Selected Inorganics Concentrations (mg/L)
Cottonwood and Ryland Landfills - Monitoring Report

Well Name	Date	Ca	Na	Mg	K	NO ₃	NO ₂	HCO ₃ (Biocarb. Alkalinity)	F	SO ₄	Br	TPO ₄	CaCO ₃ (hardness)	TDS	TSS	TOC	Al	Cr	Fe	As	Pb	
Cottonwood Landfill																						
WR-437A	05/29/02	166	115	34	4.6	8.2	<0.1	267	0.44	415	0.7	<0.01	554	1010	<1	0.65	<0.1	<0.02	<0.02	0.0028	0.0037	
	12/16/02	162	111	32	4.4	7.8	<0.1	261	0.42	386	0.63	0.021	537	1010	<1	0.49	<0.1	<0.02	<0.02	0.0033	0.0046	
	06/11/03	156	NA	31	NA	8	<0.1	258	0.33	370	0.66	<0.01	518	1010	<1	0.6	NA	NA	NA	NA	NA	
	12/01/03	149	NA	30	NA	7.6	<0.1	260	0.45	370	0.62	0.064	496	987	<1	0.56	NA	NA	NA	NA	NA	
	06/14/04	151	110	30	4.2	7.7	<0.1	267	0.47	354	0.63	0.1	503	980	<1	0.76	<0.1	<0.02	0.12	0.0031	<0.002	
	12/13/04	156	113	32	4.6	7.6	<0.1	258	0.51	356	0.66	0.12	521	963	<1	0.47	NA	NA	NA	NA	NA	
	06/14/05	141	104	28	4.0	6.3	<0.1	274	0.45	295	0.51	0.045	469	897	1	0.35	<0.1	<0.02	0.079	0.0047	<0.002	
	12/12/05	145	105	29	4.2	6.7	<0.1	247	0.48	326	0.56	0.036	481	889	2.1	0.54	NA	NA	NA	NA	NA	
	06/12/07	NA	NA	NA	NA	7.5	<0.1	NA	0.48	357	0.65	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.0041	NA
	06/17/08	NA	NA	NA	NA	5.9	<0.1	NA	0.52	308	0.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.004	NA
	^D 06/17/08	NA	NA	NA	NA	5.9	<0.1	NA	0.53	308	0.52	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.004	NA
	^D 06/16/09	141	109	29	4.3	6.2	<0.1	247	0.49	313	0.53	0.031	473	893	3.7	0.43	<0.1	<0.02	0.27	0.0037	<0.002	
	^D 06/16/09	141	108	29	4.3	6.2	<0.1	248	0.48	326	0.53	0.027	473	888	3.6	0.42	<0.1	<0.02	0.2	0.0037	<0.002	
WR-440A	05/29/02	185	109	37	4.7	10	<0.1	258	0.46	415	0.95	<0.1	613	1060	<1	0.54	<0.1	<0.02	<0.02	0.0028	0.0032	
	12/16/02	195	110	38	4.7	10	<0.1	256	0.41	416	0.95	0.014	643	1130	<1	0.53	<0.1	<0.02	<0.02	0.0034	0.005	
	06/11/03	190	NA	37	NA	11	<0.1	258	0.31	418	1	<0.1	628	1150	<1	0.66	NA	NA	NA	NA	NA	
	12/01/03	198	NA	38	NA	11	<0.1	265	0.42	424	0.98	0.041	652	1150	<1	0.54	NA	NA	NA	NA	NA	
	06/14/04	190	112	37	4.5	11	<0.1	278	0.43	399	0.96	0.057	628	1140	<1	0.57	<0.1	<0.02	0.029	0.0027	<0.002	
	12/13/04	191	114	38	4.8	10	<0.1	267	0.48	391	1	0.097	634	1120	<1	0.5	NA	NA	NA	NA	NA	
	06/14/05	172	107	34	4.3	8.5	<0.1	275	0.42	368	0.77	0.039	568	1020	<1	0.38	<0.1	<0.02	0.26	0.0042	0.0027	
	12/12/05	177	109	35	4.5	9.2	<0.1	251	0.45	359	0.84	0.027	586	1040	<1	0.43	NA	NA	NA	NA	NA	
	^D 12/12/05	177	108	35	4.5	9.3	<0.1	248	0.45	359	0.84	0.022	585	1030	<1	0.46	NA	NA	NA	NA	NA	
	06/12/07	NA	NA	NA	NA	10	<0.1	NA	0.45	376	0.91	NA	NA	NA	NA	NA	NA	NA	NA	0.0038	NA	
	06/17/08	NA	NA	NA	NA	8.9	<0.1	NA	0.49	333	0.77	NA	NA	NA	NA	NA	NA	NA	NA	0.0029	NA	
	06/16/09	155	105	31	4.2	7.9	<0.1	278	0.45	338	0.67	0.045	516	988	<1	0.44	<0.1	<0.02	0.16	0.0031	<0.002	
	WR-441A	05/29/02	192	140	37	4.7	12	<0.1	312	0.47	411	1	<0.01	632	1180	<1	0.78	<0.1	<0.02	<0.02	0.0027	0.0064
12/16/02		175	133	33	4.4	12	<0.1	302	0.46	359	0.86	0.016	574	1110	<1	0.62	<0.1	<0.02	<0.02	0.0033	0.0072	
06/11/03		155	NA	31	NA	12	<0.1	318	0.37	299	0.8	0.012	513	1030	<1	0.79	NA	NA	NA	NA	NA	
12/01/03		156	NA	30	NA	12	<0.1	312	0.50	300	0.75	0.055	514	NA	<1	0.76	NA	NA	NA	NA	NA	
06/14/04		157	128	31	4.3	11	<0.1	346	0.49	285	0.74	0.051	520	1030	<1	0.9	<0.1	<0.02	0.026	0.0036	<0.002	
12/13/04		164	136	32	4.4	9.6	<0.1	349	0.53	272	0.81	0.063	542	1070	1	0.86	NA	NA	NA	NA	NA	
^D 12/13/04		165	135	33	4.4	9.5	<0.1	332	0.53	270	0.8	0.075	546	1070	1.3	0.72	NA	NA	NA	NA	NA	
06/14/05		161	132	32	4.4	10	<0.1	330	0.45	294	0.7	0.036	534	1010	<1	0.6	<0.1	<0.02	1.5	0.0048	0.0022	
12/12/05		163	133	32	4.6	11	<0.1	342	0.48	296	0.73	0.062	538	1030	<1	0.69	NA	NA	NA	NA	NA	
06/12/07		NA	NA	NA	NA	9.4	<0.1	NA	0.44	346	0.94	NA	NA	NA	NA	NA	NA	NA	NA	0.0043	NA	
06/17/08	NA	NA	NA	NA	11	<0.1	NA	0.49	289	0.77	NA	NA	NA	NA	NA	NA	NA	NA	0.0036	NA		
06/16/09	148	130	30	4.2	10	<0.1	348	0.48	269	0.71	0.041	493	1020	<1	0.74	<0.1	<0.02	0.34	0.0043	<0.002		

Table 5
Landfill Gas Concentrations at Cottonwood Landfill
Cottonwood and Ryland Landfills - Monitoring Report

LANDFILL	PROBE NAME	DEPTH (feet)	DATE	CH4 (%)	CO2 (%)	O2 (%)
Cottonwood	CW-01	5	9/5/08	0	9.5	11.3
			12/5/08	0	2.2	18.8
			3/6/09	0	2.2	19.3
			6/5/09	0	2.9	16.7
Cottonwood	CW-01	12	9/5/08	0	5.1	15.6
			12/5/08	0	2.3	18.8
			3/6/09	0	7.1	14.3
			6/5/09	0	6.3	13.6
Cottonwood	CW-02	5	9/5/08	0	3.5	16.6
			12/5/08	0	2.0	19.1
			3/6/09	0	2.0	18.9
			6/5/09	0	0.2	20.5
Cottonwood	CW-02	12	9/5/08	0	7.1	13.1
			12/5/08	0	6.8	14.4
			3/6/09	0	5.8	15.2
			6/5/09	0	5.9	13.9
Cottonwood	CW-06	5	9/5/08	0	1.2	19.3
			12/5/08	0	1.2	19.6
			3/6/09	0	0.3	20.7
			6/5/09	0	1.1	19.3
Cottonwood	CW-06	12	9/5/08	0	3.2	17.7
			12/5/08	0	3.6	17.7
			3/6/09	0	3.3	17.7
			6/5/09	0	2.1	18.0
Cottonwood	CW-07	5	9/5/08	0	0.4	20.4
			12/5/08	0	0.3	20.5
			3/6/09	0	1.4	19.6
			6/5/09	0	1.3	19.4
Cottonwood	CW-07	12	9/5/08	0	2.2	18.6
			12/5/08	0	1.6	19.4
			3/6/09	0	3.3	17.7
			6/5/09	0	2.9	17.6
Cottonwood	CW-11	10	9/5/08	0	4.4	16.7
			12/5/08	0	4.2	16.8
			3/6/09	0	3.7	17.6
			6/5/09	0	1.4	18.5
Cottonwood	CW-11	25	9/5/08	0	3.6	16.7
			12/5/08	0	8.9	12.7
			3/6/09	0	7.1	14.3
			6/5/09	0	3.8	16.7
Cottonwood	CW-12	10	9/5/08	0	3.1	16.9
			12/5/08	0	0.2	20.8
			3/6/09	0	0.0	21.1
			6/5/09	0	1.4	18.4
Cottonwood	CW-12	25	9/5/08	0	1.5	18.9
			12/5/08	0	3.4	14.1
			3/6/09	0	5.4	15.8
			6/5/09	0	1.4	18.4
Cottonwood	CW-13	10	9/5/08	0	5.4	14.8
			12/5/08	0	2.9	18.3
			3/6/09	0	1.6	19.0
			6/5/09	0	6.9	14.4

Table 5
Landfill Gas Concentrations at Cottonwood Landfill
Cottonwood and Ryland Landfills - Monitoring Report

LANDFILL	PROBE NAME	DEPTH (feet)	DATE	CH4 (%)	CO2 (%)	O2 (%)
Cottonwood	CW-13	25	9/5/08	0	3.4	17.1
			12/5/08	0	5.3	16.0
			3/6/09	0	0.3	20.7
			6/5/09	0	10.8	9.7
Cottonwood	CW-14	10	9/5/08	0	3.0	16.2
			12/5/08	0	2.0	18.3
			3/6/09	0	5.5	15.6
			6/5/09	0	4.6	15.7
Cottonwood	CW-14	25	9/5/08	0	0.3	20.5
			12/5/08	0	2.1	17.4
			3/6/09	0	9.5	11.8
			6/5/09	0	8.0	12.4
Cottonwood	CW-15	10	9/5/08	0	7.9	12.2
			12/5/08	0	5.4	15.6
			3/6/09	0	9.5	11.8
			6/5/09	0	3.4	16.0
Cottonwood	CW-15	25	9/5/08	0	16.0	4.3
			12/5/08	0	4.3	16.6
			3/6/09	0	5.5	15.5
			6/5/09	0	6.2	12.4
Cottonwood	CW-16	10	9/5/08	0	6.4	12.4
			12/5/08	0	5.4	15.3
			3/6/09	0	7.9	13.0
			6/5/09	0	6.4	13.7
Cottonwood	CW-16	25	9/5/08	0	11.1	5.0
			12/5/08	0	16.3	4.7
			3/6/09	0	15.7	5.8
			6/5/09	0	9.4	10.8
Cottonwood	CW-18	10	9/5/08	0	3.3	15.5
			12/5/08	0	5.4	15.5
			3/6/09	0	6.2	14.3
			6/5/09	0	2.6	17.1
Cottonwood	CW-18	25	9/5/08	0	10.4	10.1
			12/5/08	0	2.3	17.9
			3/6/09	0	10.7	10.3
			6/5/09	0	2.0	18.0
Cottonwood	CW-19	10	9/5/08	0	3.4	17.3
			12/5/08	0	3.3	17.8
			3/6/09	0	4.3	14.8
			6/5/09	0	3.5	17.1
Cottonwood	CW-19	25	9/5/08	0	2.3	18.2
			12/5/08	0	4.2	17.1
			3/6/09	0	6.0	11.4
			6/5/09	0	2.7	18.1
Cottonwood	CW-21	10	9/5/08	0	2.2	18.2
			12/5/08	0	3.3	17.8
			3/6/09	0	3.2	17.9
			6/5/09	0	1.3	19.6
Cottonwood	CW-21	25	9/5/08	0	2.9	17.1
			12/5/08	0	5.5	15.9
			3/6/09	0	0.0	20.9
			6/5/09	0	1.7	19.0

**Table 5
Landfill Gas Concentrations at Cottonwood Landfill
Cottonwood and Ryland Landfills - Monitoring Report**

LANDFILL	PROBE NAME	DEPTH (feet)	DATE	CH4 (%)	CO2 (%)	O2 (%)
Cottonwood	CW-23	10	9/5/08	0	3.4	15.7
			12/5/08	0	5.8	15.2
			3/6/09	0	2.3	18.7
			6/5/09	0	2.6	17.8
Cottonwood	CW-23	25	9/5/08	0	5.4	12.4
			12/5/08	0	10.0	11.1
			3/6/09	0	3.5	17.7
			6/5/09	0	2.3	17.8
Cottonwood	CW-24	10	9/5/08	0	1.4	18.6
			12/5/08	0	1.5	19.0
			3/6/09	0	1.7	19.0
			6/5/09	0	0.9	19.4
Cottonwood	CW-24	25	9/5/08	0	2.0	17.6
			12/5/08	0	1.4	17.7
			3/6/09	0	4.8	15.2
			6/5/09	0	0.0	20.6
Cottonwood	CW-25	10	9/5/08	0	5.8	11.9
			12/5/08	0	0.5	20.4
			3/6/09	0	0.3	20.8
			6/5/09	0	3.6	16.7
Cottonwood	CW-25	25	9/5/08	0	1.4	18.7
			12/5/08	0	8.7	12.7
			3/6/09	0	4.0	14.9
			6/5/09	0	6.8	13.7

Table 6
Cottonwood Landfill Soil-Vapor Monitor Well - R-100A
Landfill Gas Measurements
Cottonwood and Ryland Landfills - Monitoring Report

Date	Depth (ft)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)
5/1/2002	40	0.0	16.6	4.5
	70	0.0	18.6	2.3
	100	0.1	18.1	1.0
	130	0.8	18.5	0.1
1/6/2003	40	0.0	14.4	6.1
	70	0.0	20.3	1.5
	100	0.0	18.6	1.8
	130	2.6	20.7	0.5
6/9/2003	40	0.0	10.8	10.2
	70	0.0	17.3	3.5
	100	0.3	19.4	1.6
	130	3.1	20.1	0.6
12/5/2003	40	0.0	14.3	7.7
	70	0.0	15.6	3.1
	100	0.0	2.9	17.4
	130	3.2	21.2	0.3
6/16/2004	40	0.1	14.0	7.4
	70	0.1	19.0	2.5
	100	0.8	19.0	1.6
	130	3.5	21.0	0.0
12/16/2004	40	0.0	11.4	10.3
	70	0.0	18.9	2.3
	100	0.3	21.0	0.0
	130	3.1	21.4	0.0
6/24/2005	40	0.0	13.1	8.1
	70	0.0	18.2	3.0
	100	0.6	20.4	0.8
	130	3.2	21.1	0.2
12/29/2005	40	0.0	15.1	6.9
	70	0.0	3.7	17.6
	100	0.0	3.3	18.0
	130	3.2	21.2	21.2
6/9/2006	40	0.0	12.7	8.9
	70	0.0	18.5	3.3
	100	0.4	20.6	1.2
	130	2.6	21.8	0.0
6/14/2007	40	0.0	13.4	7.5
	70	0.0	19.3	2.3
	100	0.9	21.2	0.2
	130	2.9	22.0	0.2
6/18/2008	40	0.0	12.4	7.8
	70	0.0	18.8	2.1
	100	0.0	20.7	0.2
	130	2.7	21.4	0.1
6/17/2009	40	0.0	11.8	5.7
	70	0.0	18.7	1.7
	100	0.0	21.1	0.3
	130	2.6	20.9	0.7

Table 7
Ryland Landfill Soil-Vapor Monitor Well - R-102A
Landfill Gas Measurements
Cottonwood and Ryland Landfills - Monitoring Report

Date	Depth (ft)	CH ₄ (%)	CO ₂ (%)	O ₂ (%)
5/1/2002	40	0.0	2.6	18.0
	70	0.0	4.0	15.1
	100	0.0	5.7	10.0
	130	0.0	2.7	9.3
1/6/2003	40	0.0	2.4	17.2
	70	0.0	5.7	12.4
	100	0.0	5.8	8.8
	130	0.0	2.1	8.8
6/9/2003	40	0.0	1.7	18.7
	70	0.0	5.7	13.6
	100	0.0	6.0	9.7
	130	0.0	2.4	9.0
12/5/2003	40	0.0	2.0	18.6
	70	0.0	6.2	13.5
	100	0.0	6.3	9.3
	130	0.0	3.4	8.4
6/16/2004	40	0.0	1.9	18.7
	70	0.1	6.0	12.6
	100	0.1	5.9	8.6
	130	0.1	3.2	7.6
12/16/2004	40	0.1	2.2	18.8
	70	0.0	6.1	13.0
	100	0.0	6.3	9.3
	130	0.0	3.6	8.3
6/24/2005	40	0.0	1.9	18.7
	70	0.0	6.0	12.8
	100	0.0	5.9	8.9
	130	0.0	3.2	7.9
12/29/2005	40	0	2.7	18.2
	70	0	6	13.1
	100	0	5.6	9.4
	130	0	3.3	8.5
6/9/2006	40	0	1.9	19.1
	70	0	6.1	13.1
	100	0	5.9	9.1
	130	0	3.3	8.3
6/14/2007	40	0	2.5	18.5
	70	0	6.1	13.1
	100	0	6.1	9.2
	130	0	3.7	8.2
6/18/2008	40	0	2.2	18
	70	0	0.1	12.7
	100	0	6.4	9
	130	0	4	8
6/17/2009	40	0	3.3	17.6
	70	0	0.6	10.1
	100	0	6.6	7.8
	130	0	5.1	9.1

Table 8
Cottonwood Landfill R-100A Vapor Probe Results - Selected VOCs
Cottonwood and Ryland Landfills - Monitoring Report

Date	Depth (ft)	PCE	TCE	cis 1,2-DCE	VC	TCFM
5/1/2002	40'	0.084	ND	ND	ND	0.33
1/6/2003	40'	0.77	0.0018	ND	ND	0.55
6/9/2003	40'	0.068	ND	ND	ND	0.37
12/5/2003	40'	0.0076	ND	ND	ND	0.12
12/16/2004	40'	0.060	ND	ND	ND	ND
6/24/2005	40'	0.062	ND	ND	ND	0.41
12/29/2005	40'	0.0097	ND	ND	ND	ND
6/9/2006	40'	0.083	ND	ND	ND	0.46
6/14/2007	40'	0.13	ND	ND	ND	0.47
6/18/2008	40'	0.047	ND	ND	ND	0.38
6/17/2009	40'	0.045	ND	ND	ND	0.23
5/1/2002	70'	0.02	ND	ND	ND	0.25
1/6/2003	70'	0.28	0.0017	ND	ND	0.47
6/9/2003	70'	0.026	ND	ND	ND	0.28
12/5/2003	70'	0.010	ND	ND	ND	0.14
6/16/2004	70'	0.2	0.061	ND	ND	0.45
12/16/2004	70'	0.076	ND	ND	ND	0.48
6/24/2005	70'	0.036	ND	ND	ND	0.31
12/29/2005	70'	ND	0.036	ND	ND	ND
6/9/2006	70'	ND	ND	ND	ND	0.31
6/14/2007	70'	0.036	ND	ND	ND	0.4
6/18/2008	70'	0.02	ND	ND	ND	0.28
6/17/2009	70'	0.012	ND	ND	ND	0.096
5/1/2002	100'	0.02	0.017	ND	ND	0.12
1/6/2003	100'	0.02	0.0017	ND	ND	0.19
6/9/2003	100'	0.022	ND	ND	ND	0.18
12/5/2003	100'	ND	ND	ND	ND	0.086
6/16/2004	100'	0.1	ND	ND	ND	0.25
12/16/2004	100'	0.036	ND	ND	ND	0.19
6/24/2005	100'	ND	ND	ND	ND	0.21
12/29/2005	100'	ND	ND	ND	ND	ND
6/9/2006	100'	ND	ND	ND	ND	0.25
6/14/2007	100'	0.032	0.0034	ND	ND	0.15
6/18/2008	100'	0.016	ND	ND	ND	0.15
6/17/2009	100'	0.009	ND	ND	ND	0.087
5/1/2002	130'	0.031	0.0091	ND	ND	0.11
1/6/2003	130'	0.035	0.0026	ND	ND	0.089
6/9/2003	130'	0.024	0.0067	ND	0.0032	0.081
12/5/2003	130'	ND	ND	ND	ND	0.057
6/16/2004	130'	0.21	ND	ND	ND	0.14
12/16/2004	130'	0.069	ND	ND	ND	0.11
6/24/2005	130'	ND	ND	ND	ND	0.097
12/29/2005	130'	ND	ND	ND	0.026	ND
6/9/2006	130'	ND	0.077	ND	ND	0.097
6/14/2007	130'	0.039	ND	ND	ND	0.11
6/18/2008	130'	0.018	0.0043	ND	0.0027	0.071
6/17/2009	130'	0.013	ND	ND	0.013	0.13

ND = non-detect
PCE = tetrachloroethene
TCE = trichloroethene
cis-1,2-DCE = cis-1,2-dichloroethene
TCFM = trichlorofluoromethane
VC = Vinyl Chloride
All concentrations are reported in ug/L

Table 9
Ryland Landfill R-102A Vapor Probe Results - Selected VOCs
Cottonwood and Ryland Landfills - Monitoring Report

Date	Depth(ft)	PCE	TCE	cis 1,2-DCE	VC	TCFM
5/1/2002	40	0.012	ND	ND	ND	0.0019
1/6/2003	40	0.01	ND	ND	ND	0.0027
6/9/2003	40	0.0048	ND	ND	ND	0.0015
12/5/2003	40	0.17	0.0046	0.0024	ND	ND
6/16/2004	40	0.076	ND	ND	ND	ND
6/24/2005	40	0.005	ND	ND	ND	ND
12/29/2005	40	0.09	ND	ND	ND	1.1
6/9/2006	40	0.014	ND	ND	ND	ND
6/14/2007	40	0.023	0.11	0.0026	ND	ND
6/18/2008	40	0.0029	ND	ND	ND	ND
6/17/2009	40	0.014	ND	ND	0.0075	ND
5/1/2002	70	0.068	ND	ND	ND	0.0014
1/6/2003	70	0.014	ND	ND	ND	0.0019
6/9/2003	70	0.0094	ND	ND	ND	0.0018
12/5/2003	70	0.01	ND	ND	ND	ND
6/16/2004	70	0.15	ND	ND	ND	ND
12/16/2004	70	ND	ND	ND	ND	ND
6/24/2005	70	0.03	ND	ND	ND	ND
12/29/2005	70	ND	ND	ND	ND	ND
6/9/2006	70	ND	ND	ND	ND	ND
6/14/2007	70	0.009	ND	ND	ND	ND
6/18/2008	70	0.004	ND	ND	ND	ND
6/17/2009	70	0.013	ND	ND	0.012	ND
5/1/2002	100	0.016	ND	ND	ND	ND
1/6/2003	100	0.01	ND	ND	ND	ND
6/9/2003	100	0.0093	ND	ND	ND	ND
12/5/2003	100	0.076	ND	ND	ND	ND
6/16/2004	100	0.13	0.0077	ND	ND	ND
12/16/2004	100	0.0083	ND	ND	ND	ND
6/24/2005	100	0.011	ND	ND	ND	ND
12/29/2005	100	ND	ND	ND	ND	0.19
6/9/2006	100	0.0063	ND	ND	ND	ND
6/14/2007	100	0.0059	ND	ND	ND	0.0031
6/18/2008	100	0.0056	ND	ND	ND	ND
6/17/2009	100	0.022	ND	ND	0.0088	ND
5/1/2002	130	0.028	ND	ND	ND	ND
1/6/2003	130	0.096	ND	ND	ND	ND
6/9/2003	130	ND	ND	ND	0.053	ND
12/5/2003	130	0.009	ND	ND	ND	ND
6/16/2004	130	0.011	ND	ND	ND	ND
12/16/2004	130	0.012	ND	ND	ND	ND
6/24/2005	130	0.014	ND	ND	ND	ND
12/29/2005	130	ND	ND	ND	ND	0.23
6/9/2006	130	0.012	ND	ND	ND	ND
6/14/2007	130	0.014	ND	ND	ND	ND
6/18/2008	130	0.01	ND	ND	ND	0.0033
6/17/2009	130	0.011	ND	ND	ND	0.18

ND = non-detect
PCE = tetrachloroethene
TCE = trichloroethene
cis-1,2-DCE = cis-1,2-dichloroethene
VC = Vinyl Chloride
TCFM = trichlorofluoromethane
all concentrations are reported in ug/L