

HRS DOCUMENTATION RECORD COVER SHEET

Name of Site: RIVER CITY METAL FINISHING

EPA ID No. TXN000606915

Contact Persons

Site Investigation:	Adrienne Love, TCEQ Superfund Project Manager	512/239-2273
Documentation Record:	Brenda Cook, USEPA Region 6 NPL Coordinator	214/665-7436

Pathways, Components, or Threats Not Evaluated

Surface Water Migration Pathway

The Surface Water Migration Pathway was not scored because its inclusion would not significantly affect the site score (Ref. 1, Section 2.2.3).

Soil Exposure and Subsurface Intrusion Pathway

The Soil Exposure and Subsurface Intrusion Pathway was not scored because its inclusion would not significantly affect the site score (Ref. 1, Section 2.2.3; Ref 1a, Section 2.2.3).

Air Migration Pathway

The Air Migration Pathway was not scored because its inclusion would not significantly affect the site score (Ref. 1, Section 2.2.3).

HRS DOCUMENTATION RECORD

Name of Site: River City Metal Finishing

Date Prepared: January 2018

EPA Region: 6

Street Address of Site*: 12040 Potranco Road

City, County, State, Zip Code: San Antonio, Bexar County, Texas 78253

General Location in the State: South-Central Texas

Topographic Map: The following U.S. Geological Survey (USGS) 7.5 minute series topographic map was used in locating the site: Culebra Hill Quadrangle, Texas (2016) (Ref. 3, p. 1)

Latitude: 29° 25' 49.76" North

Longitude: 98° 43' 54.75" West

Ref:

*The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, disposed, or placed, or has otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under CERCLA. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

Scores

Air Pathway	Not Scored
Ground Water ¹ Pathway	100.00
Soil Exposure and Subsurface Intrusion Pathway	Not Scored
Surface Water Pathway	Not Scored

HRS SITE SCORE 50.00

¹ "Ground water" and "groundwater" are synonymous; the spelling is different due to "ground water" being codified as part of the HRS, while "groundwater" is the modern spelling.

WORKSHEET FOR COMPUTING HRS SITE SCORE

	<u>S</u>	<u>S²</u>
1. Ground Water Migration Pathway Score (S _{gw}) (from Table 3-1, line 13)	100.00	10,000
2a. Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	NS	NS
2b. Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	NS	NS
2c. Surface Water Migration Pathway Score (S _{sw}) Enter the larger of lines 2a and 2b as the pathway score.	NS	NS
3. Soil Exposure and Subsurface Intrusion Pathway Score (S _{sessi}) (from Table 5-1, line 22)	NS	NS
4. Air Migration Pathway Score (S _a) (from Table 6-1, line 12)	NS	NS
5. Total of S _{gw} ² + S _{sw} ² + S _{sessi} ² + S _a ²		10,000
6. HRS Site Score Divide the value on line 5 by 4 and take the square root	50.00	

HRS Table 3-1 –Ground Water Migration Pathway Scoresheet

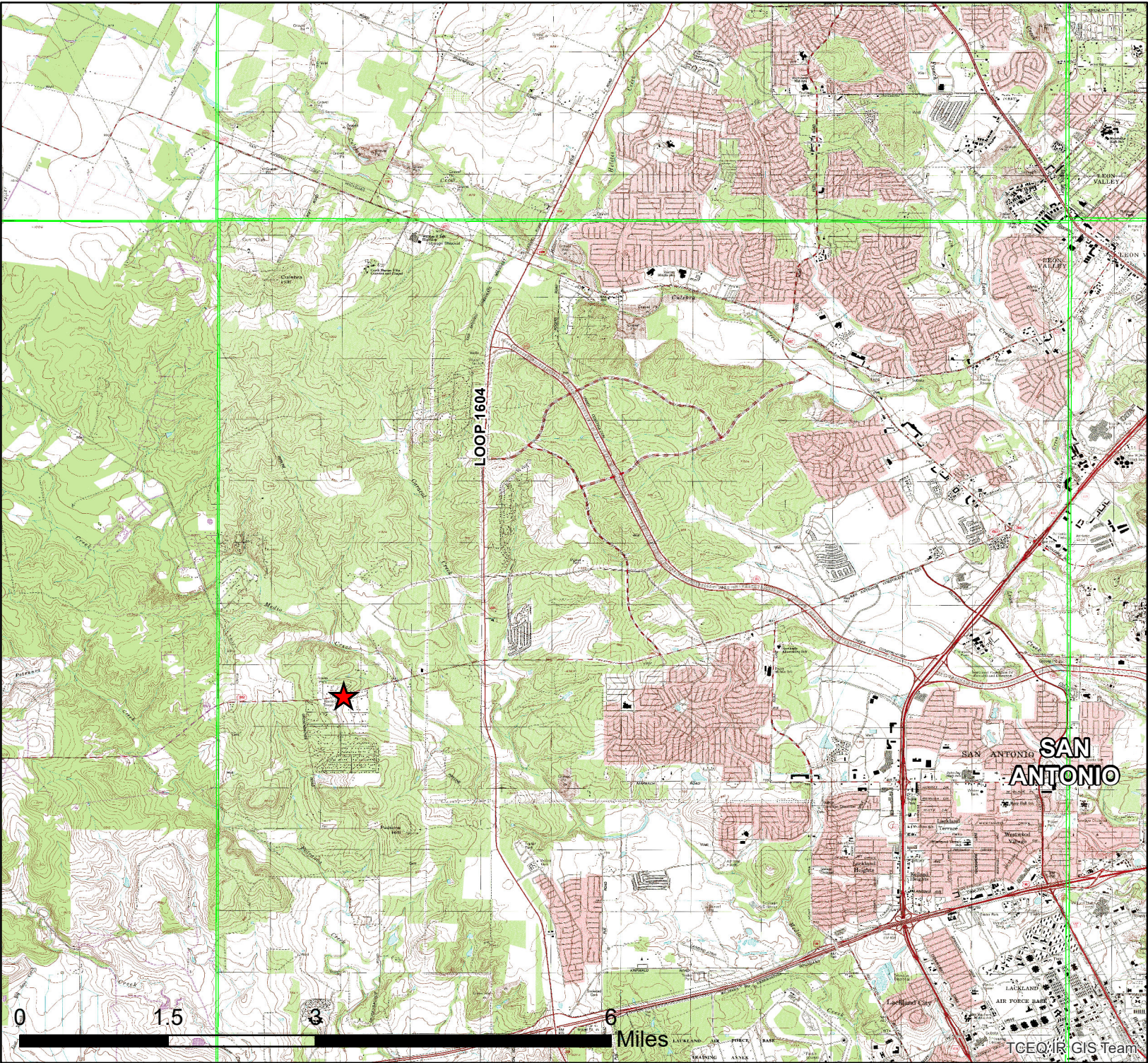
Factor Categories and Factors	Maximum Value	Value Assigned
Likelihood of Release to an Aquifer:		
1. Observed Release	550	550
2. Potential to Release:		
2a. Containment	10	0
2b. Net Precipitation	10	0
2c. Depth to Aquifer	5	0
2d. Travel Time	35	0
2e. Potential to Release [lines 2a x (2b + 2c + 2d)]	500	0
3. Likelihood of Release (higher of lines 1 and 2e)	550	550
Waste Characteristics:		
4. Toxicity/Mobility	(a)	10,000
5. Hazardous Waste Quantity	(a)	100
6. Waste Characteristics	100	32
Targets:		
7. Nearest Well	50	50
8. Population:		
8a. Level I Concentrations	(b)	9,090
8b. Level II Concentrations	(b)	0
8c. Potential Contamination	(b)	2,078
8d. Population (lines 8a + 8b + 8c)	(b)	11,168
9. Resources	5	0
10. Wellhead Protection Area	20	20
11. Targets (lines 7 + 8d + 9 + 10)	(b)	11,238
Ground Water Migration Score For An Aquifer:		
12. Aquifer Score [(lines 3 x 6 x 11)/82,500] ^c	100	100.00
Ground Water Migration Pathway Score:		
13. Pathway Score (S_{gw}), (highest value from line 12 for all aquifers evaluated) ^c	100	100.00

^aMaximum value applies to waste characteristics category.

^bMaximum value not applicable.

^cDo not round to nearest integer.

FIGURE 1: SITE LOCATION MAP



River City Metal Finishing

San Antonio, Bexar
County, Texas

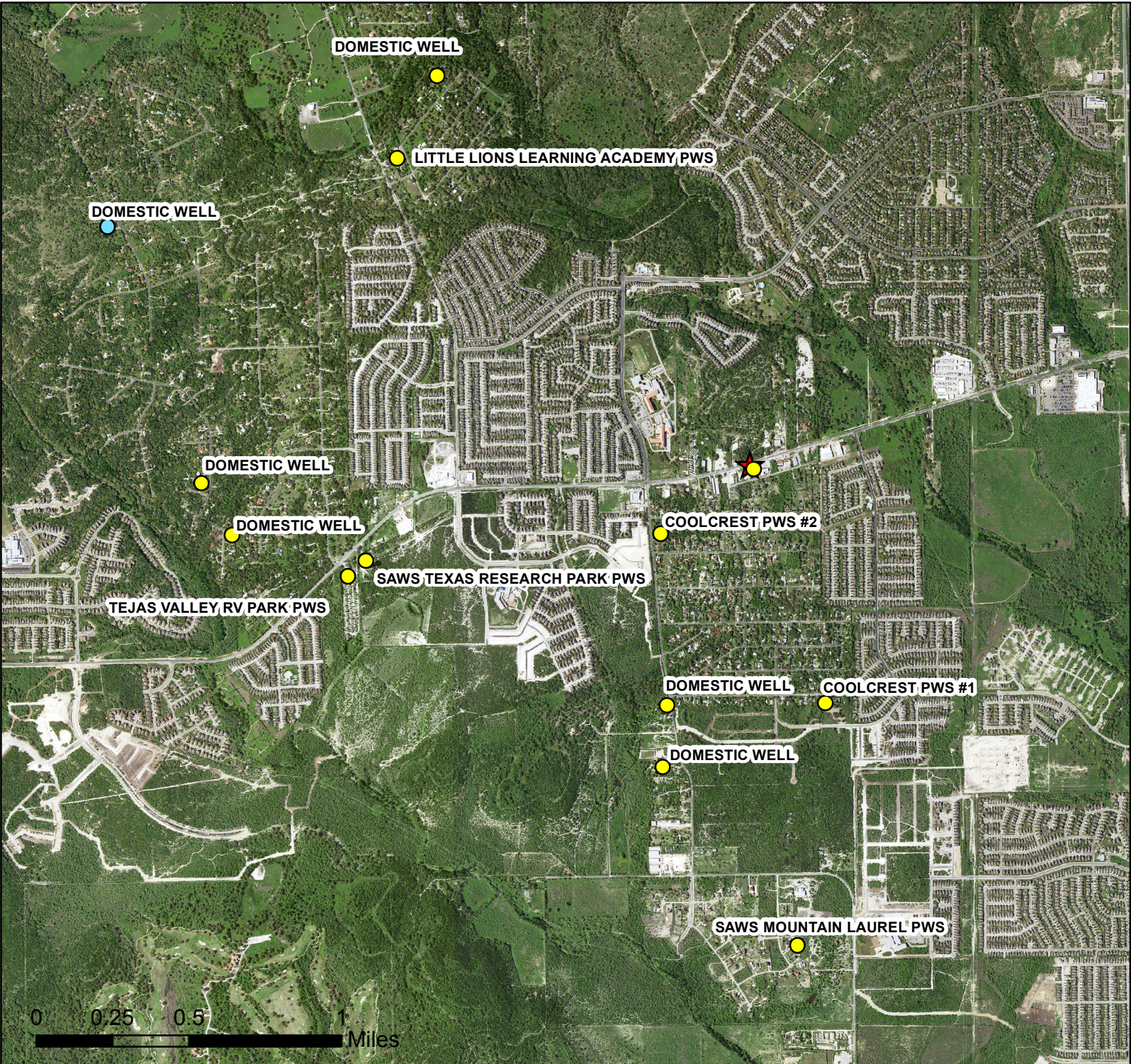
★ Site



The base map is a Statewide Digital Raster Graphic from raster mosaic dataset in the TCEQ's IR GIS Team's file geodatabase. Projection: NAD 1983, UTM Zone 14. This map was generated by the Remediation Division of the Texas Commission on Environmental Quality. This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries. For more information concerning this map, contact the Remediation Division at 800-633-9363.

TCEQ IR GIS Team

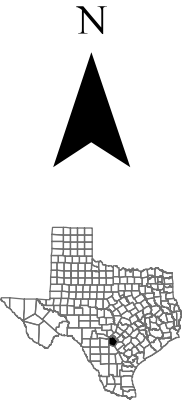
FIGURE 2: SITE FEATURES MAP



River City Metal Finishing

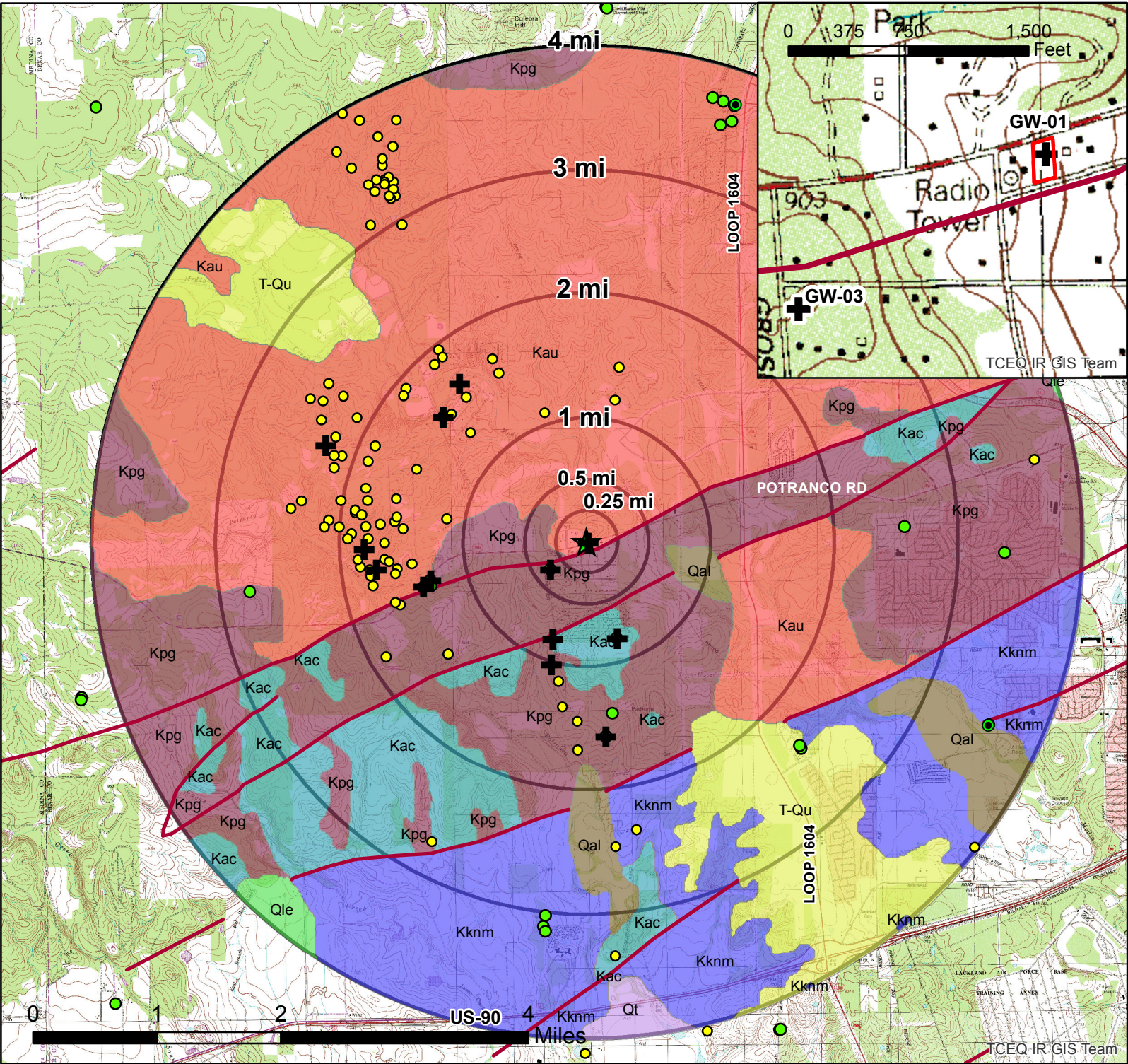
San Antonio, Bexar
County, Texas

- Background well
- Wells sampled for SI
- Site



The source of this map image is Digital Orthophoto Quarter Quad Imagery of the Culebra Hill quadrants in San Antonio, Texas, provided by the Texas Natural Resource Imagery Service. Datum: NAD 1983, UTM Zone 14. This map was generated by the Remediation Division of the Texas Commission on Environmental Quality. This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries. For more information concerning this map, contact the Remediation Division at 800-633-9363.

FIGURE 3: 4-MILE TARGET DISTANCE LIMIT MAP



River City Metal Finishing

San Antonio, Bexar
County, Texas



- Site Facility
- Site
- Wells sampled for SI
- Domestic well
- PWS well
- Capped wells/not in use
- Fault



Geologic Atlas of Texas

Rock Units

- Kac = Anacacho Limestone
- Kau = Austin Chalk
- Kknm = Navarro Group /Marlbrook Marl
- Kpg = Pecan Gap Chalk
- Qal = Quaternary Alluvium
- Qle = Leona Formation
- Qt = Fluvialite terrace deposits
- T-Qu = Uvalde Gravel

The base map is a USGS Topographic Map. The Geologic Atlas of Texas layer, including the rock units and the faults, was created by the Texas Water Development Board and the Bureau of Economic Geology. The water wells layers were obtained from the Texas Water Development Board submitted drillers online database. Projection: NAD 1983. This map was generated by the Remediation Division of the Texas Commission on Environmental Quality. This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries. For more information concerning this map, contact the Remediation Division at 800-633-9363.

FIGURE 4: SOURCE SAMPLE LOCATIONS



River City Metal Finishing

San Antonio, Bexar
County, Texas

- Facility Boundary
- SSDAP RA Soil Exceedences
- SI Soil Exceedences
- Contaminated Area = 800.59 sq ft
- berm



Digital Orthophoto Quarter Quad Imagery of the Culebra Hill quadrants in San Antonio, Texas, provided by the Texas Natural Resource Imagery Service (TNRIS). Datum: NAD 1983, UTM Zone 14. The data points for the SSDAP Removal Action (RA) Soil Exceedences and the berm are from the Removal Action Report. SI Soil Sample data points were collected during the SI field work. This map was generated by the Remediation Division of the Texas Commission on Environmental Quality. This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. It does not represent an on-the-ground survey and represents only the approximate relative location of property boundaries. For more information concerning this map, contact the Remediation Division at 800-633-9363.

FIGURE REFERENCE SHEET

Figure 1: Site Location Map

Base Map Source*: Statewide Digital Raster Graphic from raster mosaic dataset in the TCEQ's IR GIS Team's file geodatabase.

*Map annotated by TCEQ in June 2017 to depict site facility location (Ref. 3, p. 1; Ref. 13, p. 7).

Figure 2: Site Features Map

Base Map Source*: Digital Orthophoto Quarter Quad Imagery of the Culebra Hill quadrants in San Antonio, Texas, provided by the Texas Natural Resource Imagery Service (TNRIS).

*Map annotated by TCEQ in June 2017 to depict the site facility and wells sampled during the SI (Ref. 3, p. 1; Ref. 13, pp. 7; Ref. 9, 16-19, 21).

Figure 3: 4-Mile Target Distance Limit Map

Base Map Source*, Statewide DRG (Digital Raster Graphic) from raster mosaic dataset in file geodatabase from the TCEQ IR GIS Team.

Other Map Layer Sources:

USGS Geologic Atlas of Texas: This data set was jointly created by USGS, TNRIS, and the Bureau of Economic Geology. The basic unit in this system of classification is the formation. Available at: <https://www.twdb.texas.gov/mapping/data-services.asp>.

Texas Water Development Board (TWDB): This data set was downloaded from the TWDB Groundwater Database and Submitted Driller's Reports Database. This database contains information on selected water wells, springs, oil/gas tests, water levels and water quality. These databases are updated nightly. Available at: <https://www.twdb.texas.gov/mapping/gisdata.asp>

*Map annotated by TCEQ in June 2017 to depict the site facility, wells sampled during the SI, and other wells within the 4 mile target distance limit (Ref. 3, p. 1; Ref. 13, pp. 7; Ref. 9, 16-19, 21, 42).

Figure 4: Source Sample Locations Map

Base Map Source*: Digital Orthophoto Quarter Quad Imagery of the Culebra Hill quadrants in San Antonio, Texas, provided by the Texas Natural Resource Imagery Service (TNRIS).

*Map annotated by TCEQ in June 2017 to depict the site facility, property boundary, site features, and source areas determined during the SI and the SSDAP Removal Action (Ref. 3, p. 1; Ref. 13; Ref. 9, pp. 7, 18-19, 21; Ref. 6, p. 41).

**The source of this map image is Esri, used by the EPA with Esri's permission.

REFERENCES

Ref.

No. Description of the Reference

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SITE SUMMARY

Site Description:

The site includes the release of hazardous substances from the River City Metal Finishing (RCMF) facility and the migration of that release to the Edwards Aquifer. RCMF is a former metal plating shop that operated from 1994 until approximately 2002 (Ref. 4, p. 1). The former RCMF facility is located at 12040 Potranco Road, approximately one mile west of Loop 1604, in San Antonio, Texas (Figure 1).

The RCMF facility consisted of a main building and external operation areas, including two storage sheds, a paint booth, paint stripping area, a location for drums and recycling, and a septic tank area. The main building had five rooms: an office, a main plating room, a polish room, a brass room, and a paint stripping room. Three covered areas were also attached to the main building: a wastewater evaporator area, an acid and rinse tank area, and a lacquer application booth. Facility operations were all conducted within the main building. At RCMF, decorative items would be dismantled, plated, colored if necessary, polished, and reassembled. The electroplating process involved pretreatment of items with caustic or acidic solutions, followed by immersion in either a chrome, nickel, copper, brass, silver, gold, or aluminum solution, and finishing in a rinse water solution. The items would then be polished using either buffer wheels or lathes. Over time the resulting sludge from the plating process was removed and disposed of. Polishing materials and metal shavings were generated as waste; metal shavings were collected into drums and stored for recycling (Ref. 5, pp. 2-3).

The facility also occasionally performed painting and lacquering, using a painting booth that was located outside the west side of the building adjacent to the polishing room. Paint stripping was reportedly performed in a large tank of sodium gluconate and sodium hydroxide, which was located with a stagnant rinse tank inside the southwest corner of the building (Ref. 4, p. 4; Ref. 5, pp. 2-3).

There are no known facility permits or permitted release levels.

The Texas Commission on Environmental Quality (TCEQ) confirmed chromium contamination exceeding the Maximum Contaminant Level (MCL) in the shallow groundwater through a sample obtained from the onsite monitoring well in 2010 by the Corrective Action Section (Figure 2; Ref. 4, pp. 1, 25). The TCEQ Superfund Site Discovery and Assessment Program (SSDAP) conducted additional investigations in 2013-2014, including a removal of onsite structures and their contents and sampling of the onsite soil, onsite monitoring well, and nearby public water supply (PWS) and domestic wells (Ref. 6, pp. 8, 9, 32). The TCEQ PA/SI Program conducted a Site Inspection (SI) in May 2016 which confirmed that soil contamination had migrated through RCMF facility soils to the shallow groundwater (Ref. 7, pp. 10-12, 165, 151; Ref. 8, pp. 1-23; Ref. 9, p. 16). In the sample collected during the SI, metals and cyanide associated with facility operations were detected in the monitoring well (GW-01), including hexavalent chromium above the MCL (Ref. 7, pp. 10-12, 151, 165; Ref. 8, p. 1).

The target aquifer (aquifer of concern) is the Edwards Aquifer system. The Edwards Aquifer system is the sole source of water for the San Antonio area, where it provides domestic, public supply, industrial, and agricultural water (Ref. 10, pp. 50, 51). There are 20 PWS wells located within the 4-mile target distance limit (TDL) of the site that are being scored in this HRS evaluation (Figure 3). The faulting of the Balcones Fault Zone (BFZ) and fractured limestone conditions associated with the geologic formations of the Edwards Aquifer system establish effective porosity that provide efficient pathways for contamination to migrate through fractures and enter the aquifer (Figure 3; Ref. 6, p. 33; Ref. 11, pp. 5-7). Literature suggests that there is evidence for hydraulic communication between the Austin Chalk and the Edwards Aquifer through faults, which have placed the groundwater bearing units at the same altitudes, thus allowing water to flow freely between the two strata (Ref. 12, p. 24). Furthermore, the two public drinking water wells closest to the site facility have observed releases of

hexavalent chromium above the HRS cancer risk value and cyanide above background levels (Ref. 2, p. 3; Ref. 7, pp. 20, 21, 24, 25, 71, 151, 155; Ref. 8, pp. 2-3). Therefore, the site has been scored based on actual contamination of hexavalent chromium and cyanide in the Edwards Aquifer.

2.2 SOURCE CHARACTERIZATION

2.2.1 SOURCE IDENTIFICATION

Name of source: Contaminated Soil

Number of source: 1

Source Type: Contaminated Soil

The source is onsite soil contaminated by facility processes. Sampling during the 2013-2014 TCEQ SSDAP-directed Removal Action confirmed chromium detections in the onsite soil (Ref. 6, p. 43). These concentrations did not exceed the Texas Risk Reduction Program (TRRP) Commercial/Industrial Protective Concentration Level, so onsite soils were not removed (Ref. 6, pp. 38, 43). However, concentrations of five samples exceed the background concentrations for chromium, copper, nickel, selenium, and cyanide determined in the 2016 SI event (Tables 1 and 2; Ref. 6, p. 133; Ref. 7, pp. 64-65, 154, 175; Ref. 8, p. 13). The TCEQ removed drums, onsite structures, and the former building foundation, and completed the installation of a run-off prevention berm in January 2014 to prevent further off-site migration (Figure 4; Ref. 6, pp. 9, 30-31). A Restrictive Covenant was filed on March 4, 2015, to limit the use of the property to commercial/industrial under TRRP (Ref. 13, p. 1).

All seven source characterization samples, including one duplicate, collected from the surface soil at the site during the SI, contained antimony, cadmium, chromium, copper, lead, nickel, selenium, silver, and zinc at varying concentrations (Table 2; Ref. 9, pp. 26-27; Ref. 7, pp. 26-39, 151-152; Ref. 8, pp. 5-11). Concentrations for chromium in source soil samples ranged from 38.3-682 mg/Kg (Ref. 7, pp. 26, 28, 30, 32, 34, 36, 38, 151-152; Ref. 8, pp. 5-11).

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

River City Metal Finishing operated as an electroplater from 1994 to approximately 2002 (Ref. 4, p. 4). The electroplating process involved pretreatment of items with caustic or acidic solutions, followed by immersion in either a chrome, nickel, copper, brass, silver, gold, or aluminum solution, and finishing in a rinse water solution. The items would then be polished using either buffer wheels or lathes. Over time the resulting sludge from the plating process was removed and disposed of. Polishing materials and metal shavings were generated as waste; metal shavings were collected into drums and stored for recycling. RCMF also occasionally performed painting and lacquering (Ref. 5, pp. 2-3).

Previous investigations of the facility by the TCEQ and its predecessor agencies found several instances of improper hazardous waste storage and labeling practices, ultimately leading to the issuance of multiple violations and three Agreed Orders (Ref. 5, p. 2; Ref. 14, pp. 1-6; Ref. 15, pp. 1-4; Ref. 16, pp. 3-5). Elevated concentrations of chromium, copper, nickel, zinc, and cyanide were detected in three soil samples collected adjacent to the former facility building by Texas Natural Resource Conservation Commission (TNRCC, the predecessor agency to the TCEQ) inspectors in 1999. The inspectors attributed this contamination to ongoing air deposition from the onsite evaporation system, which was observed operating without emissions control, or from storm water run-off, which had been allowed to accumulate in the evaporator area (Ref. 16, pp. 1-3, 5).

Based on contents of drums removed during the SSDAP Removal Action, the TCEQ identified the site COCs to include antimony, cadmium, copper, lead, nickel, selenium, silver, zinc, cyanide, total chromium, and hexavalent chromium (Ref. 6, pp. 23-24, 37). Subsurface soil to 10 feet was sampled for these COCs in the SSDAP and SI sampling events. All samples were compared to a background sample obtained during the SI event. This background sample was collected from a similar soil type approximately one mile south-southwest of the RCMF property to establish relative concentrations for site soils (Ref. 9, pp. 18, 25, 41, 64; Ref. 17, p. 1). This sample was collected from the 0-6 inch depth interval and analyzed using method ILM05.3-ICP/MS for metals and EPA 335.4 for cyanide (Ref. 7, pp. 66, 175, 191). Summarized below in Table 1 are the background soil sample results.

Table 1 – 2016 Site Inspection Background Soil Sample Results			
Hazardous Substance	SS-01		
	Concentration (mg/kg)	RL (mg/kg)¹	Reference
Antimony	UJ ²	0.5	Ref. 7, pp. 1-3, 65, 66, 154; Ref. 8, p. 13
Cadmium	U ³	1.5	Ref. 7, pp. 1-3, 64, 154; Ref. 8, p. 13
Chromium	8.9	2.9	Ref. 7, pp. 1-3, 64, 154; Ref. 8, p. 13
Copper	U ³	5.8	Ref. 7, pp. 1-3, 64, 154; Ref. 8, p. 13
Cyanide	<0.04 ⁴	0.04 ⁴	Ref. 7, p. 174, 175, 180, 190, 191, Ref. 8, p. 13
Lead	8.2	0.5	Ref. 7, pp. 1-3, 65, 154; Ref. 8, p. 13
Nickel	U ³	5.8	Ref. 7, pp. 1-3, 64, 154; Ref. 8, p. 13
Selenium	U ³	1.0	Ref. 7, pp. 1, 65, 154; Ref. 8, p. 13
Silver	U ³	2.9	Ref. 7, pp. 1-3, 64, 154; Ref. 8, p. 13
Zinc	14.6	5.8	Ref. 7, pp. 1-3, 64, 154; Ref. 8, p. 13

¹ The Reporting Limits are the equivalent of the HRS-defined term Sample Quantitation Limit, defined as the lowest concentration at which an analyte can be reliably measured and reported without qualification, and are adjusted for sample size, dilution, and matrix interference (HRS Section 1.1, Definitions; Ref. 7, p. 3).

²UJ = The analyte was not detected at or above the reported value. The reported value is an estimate (Ref. 7, p. 149).

³U = Not detected (Ref. 7, p. 150).

⁴Concentrations below the Reporting Limit are reported as non-detects or <RL (Ref. 7, pp. 171, 190, 191).

Soil sampling design during the SSDAP removal and sampling event consisted of an initial comprehensive assessment utilizing X-ray fluorescence (XRF), followed by laboratory analysis of seven samples obtained from an area which indicated the greatest concentration of contaminants (Ref. 6, pp. 37-43, 129-131, 133; Ref. 36, pp. 11, 17, 23). Site COCs were detected at elevated concentrations in six of the seven samples (Ref. 6, p. 133). Six locations were chosen within this area for soil analysis during the SI; sample results similarly found elevated concentrations of a variety of site COCs in all samples using ILM05.3-ICP analysis for metals (Ref. 7, pp. 26-39, 151-152).

Summarized in the following table is analytical evidence of contamination found during the SSDAP soil sampling for the Removal Action and SI source sampling associated with Source 1. Note that only those samples containing elevated concentrations have been listed. Sample locations are shown in Figure 4 of this HRS documentation record.

Table 2 – Source Samples					
Sample ID	Sample Depth	Hazardous Substance	Concentration (mg/kg)	RL (mg/kg)¹	Reference
C3-10-SW	10 feet bgs	Nickel	14.3	2.04	Ref. 6, pp. 85, 94-95, 133, 160; Ref. 36, pp. 2-3, 79, 109
C3-10-W	Surface	Chromium	68.3	2.1	Ref. 6, pp. 85, 95, 133, 161; Ref. 36, pp. 2-3, 80, 110
		Copper	20.6	2.1	Ref. 6, pp. 85, 95, 133, 161; Ref. 36, pp. 2-3, 80, 110
		Nickel	26.5	2.1	Ref. 6, pp. 85, 95, 133, 161; Ref. 36, pp. 2-3, 80, 110
		Selenium	2.7 JI-DL ⁴ (1.13 with correction factor ⁵)	0.524	Ref. 6, pp. 85, 95, 133, 161; Ref. 36, pp. 2-3, 11, 17, 80, 110
E3-10-NW	Surface	Nickel	8.38	2.1	Ref. 6, pp. 90, 95, 133, 158; Ref. 36, pp. 2-3, 77, 109
C2-20-NES	Surface	Chromium	105	2.12	Ref. 6, pp. 82-83, 95, 133, 159; Ref. 36, pp. 2-3, 78, 109
		Copper	8.47	2.12	Ref. 6, pp. 82-83, 95, 133, 159; Ref. 36, pp. 2-3, 78, 109

Table 2 – Source Samples					
Sample ID	Sample Depth	Hazardous Substance	Concentration (mg/kg)	RL (mg/kg) ¹	Reference
		Cyanide	0.258 J ⁶	0.542	Ref. 6, pp. 82-83, 95, Ref. 36, pp. 9, 11, 17, 23
		Nickel	9.04	2.12	Ref. 6, pp. 82-83, 95, 133, 159; Ref. 36, pp. 2-3, 78, 109
D3-10-NW	Surface	Copper	9.01	2.13	Ref. 6, pp. 91, 95, 133, 156; Ref. 36, pp. 2-3, 75, 108
		Nickel	28.6	2.13	Ref. 6, pp. 91, 95, 133, 156; Ref. 36, pp. 2-3, 75, 108
D3-10-NW	5 feet bgs	Chromium	35.2	2.28	Ref. 6, pp. 91, 95, 133, 157; Ref. 36, pp. 2-3, 76, 108
		Nickel	16.5	2.28	Ref. 6, pp. 91, 95, 133, 157; Ref. 36, pp. 2-3, 76, 109
SS-02	0-6"	Chromium	97.9 J ²	1	Ref. 7, pp. 1-3, 26, 151; Ref. 8, p. 9
		Copper	61.2 J ²	2.1	Ref. 7, pp. 1-3, 26, 151; Ref. 8, p. 9
		Nickel	62.1 J ²	2.1	Ref. 7, pp. 1-3, 26, 151; Ref. 8, p. 9
		Selenium	1	1	Ref. 7, pp. 1-3, 27, 151; Ref. 8, p. 9
		Silver	4.3 J ²	1	Ref. 7, pp. 1-3, 26, 151; Ref. 8, p. 9
		Zinc	190 J ² (126.66 with correction factor ³)	2.1	Ref. 7, pp. 1-3, 26, 151; Ref. 8, p. 9
SS-03 (field duplicate of SS-02)	0-6"	Chromium	78.2	1.1	Ref. 7, pp. 1-3, 28, 151-152; Ref. 8, p. 9
		Copper	53.7	2.1	Ref. 7, pp. 1-3, 28, 151-152; Ref. 8, p. 9
		Nickel	59.2	2.1	Ref. 7, pp. 1-3, 28, 151-152; Ref.

Table 2 – Source Samples					
Sample ID	Sample Depth	Hazardous Substance	Concentration (mg/kg)	RL (mg/kg) ¹	Reference
					8, p. 9
		Selenium	1.3	1.1	Ref. 7, pp.1-3, 29, 151-152; Ref. 8, p. 9
		Silver	4.2	1.1	Ref. 7, pp.1-3, 28, 151-152; Ref. 8, p. 9
		Zinc	149	2.1	Ref. 7, pp. 1-3, 28, 151-152; Ref. 8, p. 9
SS-04	0-6"	Antimony	3	0.5	Ref. 7, pp. 1-3, 31, 152; Ref. 8, p. 10
		Cadmium	2.3	0.5	Ref. 7, pp. 1-3, 30, 152; Ref. 8, p. 10
		Chromium	682	1	Ref. 7, pp. 1-3, 30, 152; Ref. 8, p. 10
		Copper	650	2	Ref. 7, pp. 1-3, 30, 152; Ref. 8, p. 10
		Nickel	3200	2	Ref. 7, pp. 1-3, 30, 152; Ref. 8, p. 10
		Selenium	3.6	1	Ref. 7, p. 1-3, 31, 152; Ref. 8, p. 10
		Silver	31.7	1	Ref. 7, pp. 1-3, 30, 152; Ref. 8, p. 10
		Zinc	530	2	Ref. 7, pp. 1-3, 30, 152; Ref. 8, p. 10
SS-05	0-6"	Antimony	0.6	0.5	Ref. 7, p. 1-3, 33, 152; Ref. 8, p. 11
		Chromium	209	1	Ref. 7, pp. 1-3, 32, 152; Ref. 8, p. 11
		Copper	192	2	Ref. 7, pp. 1-3, 32, 152; Ref. 8, p. 11
		Nickel	261	2	Ref. 7, pp. 1-3, 32, 152; Ref. 8, p. 11

Table 2 – Source Samples					
Sample ID	Sample Depth	Hazardous Substance	Concentration (mg/kg)	RL (mg/kg) ¹	Reference
		Selenium	2.2	1	Ref. 7, pp. 1-3, 33, 152; Ref. 8, p. 11
		Silver	19.3	1	Ref. 7, pp. 1-3, 32, 152; Ref. 8, p. 11
		Zinc	698	2	Ref. 7, pp. 1-3, 32, 152; Ref. 8, p. 11
SS-06	0-6"	Chromium	38.3	1	Ref. 7, pp. 1-3, 34, 152; Ref. 8, p. 5
		Copper	21.8	2.1	Ref. 7, pp. 1-3, 34, 152; Ref. 8, p. 5
SS-07	0-6"	Antimony	0.6	0.5	Ref. 7, pp. 1-3, 37, 152; Ref. 8, p. 6
		Chromium	76.5	1.1	Ref. 7, pp. 1-3 36, 152; Ref. 8, p. 6
		Copper	102	2.1	Ref. 7, p. 1-3, 36, 152; Ref. 8, p. 6
		Selenium	1.3	1.1	Ref. 7, p. 1-3, 37, 152; Ref. 8, p. 6
		Silver	4.5	1.1	Ref. 7, p. 1-3, 36, 152; Ref. 8, p. 6
		Zinc	431	2.1	Ref. 7, p. 1-3, 36, 152; Ref. 8, p. 6
SS-08	0-6"	Antimony	2	0.5	Ref. 7, p. 1-3, 39, 152; Ref. 8, p. 7
		Chromium	305	1.1	Ref. 7, p. 1-3, 38, 152; Ref. 8, p. 7
		Copper	201	2.2	Ref. 7, p. 1-3, 38, 152; Ref. 8, p. 7
		Lead	40.2	0.5	Ref. 7, p. 1-3, 39, 152; Ref. 8, p. 7
		Nickel	294	2.2	Ref. 7, p. 1-3, 38, 152; Ref. 8, p. 7
		Selenium	2.7	1.1	Ref. 7, p. 1-3, 39, 152; Ref. 8, p. 7
		Silver	12	1.1	Ref. 7, p. 1-3, 38, 152; Ref. 8, p. 7
		Zinc	206	2.2	Ref. 7, p. 1-3, 38, 152; Ref. 8, p. 7

¹The Reporting Limits are the equivalent of the HRS-defined term Sample Quantitation Limit, defined as the lowest concentration at which an analyte can be reliably measured and reported without qualification, and are adjusted for sample size, dilution, and matrix interference (HRS Section 1.1, Definitions; Ref. 7, p. 3).

²J = the reported value is an estimate, but presence of the analyte in the result is confirmed (Ref. 7, p. 149).

³The correction factor was applied to SS-02 result for zinc. Although not required by the HRS or the EPA Fact Sheet (Ref. 35, pp. 8, 18), qualified data are adjusted to demonstrate the relative increase in contamination over background.

⁴JL-DL= Estimated due to high relative percent difference in serial dilution (Ref. 36, pp. 2-3, 11, 17, 80, 108-110).

⁵ The correction factor was applied to C3-10-W result for selenium. Although not required by the HRS or the EPA Fact Sheet (Ref. 35, pp. 8, 18), qualified data are adjusted to demonstrate the relative increase in contamination over background.

⁶J = Analyte detected between the sample detection limit and the reporting limit (Ref. 36, p. 17, 23). The reported value is an estimate, but presence of the analyte in the result is confirmed.

2.2.3 HAZARDOUS SUBSTANCES AVAILABLE TO A PATHWAY

Source Containment

A berm comprised of a line of hay bales was installed along the east and southeast portions of the site during the 2013-2014 Removal Action to prevent downgradient migration of contaminants in the soil (Ref. 6, p. 30). No site-wide liner was installed to prevent infiltration to the groundwater. There were no containment features pertaining to contaminated soils documented in inspections of the site prior to the installation of the berm. However, a liner was observed in a trench behind the former facility building during a 2013 visit prior to the Removal Action (Ref. 5, pp. 3-4; Ref. 6, pp. 15-16).

Containment Description	Containment Factor Value	References
Gas release to air: NS	NS	NS
Particulate release to air: NS	NS	NS
Release to groundwater: Evidence of hazardous substance migration from source area, i.e., a release of total chromium and hexavalent chromium to the shallow groundwater bearing unit at 25 feet below ground surface (ft bgs) in the onsite monitoring well and in the Edwards aquifer at 520 ft bgs in two public supply wells.	10	(Ref. 4, p. 24; Ref. 7, pp. 10-12, 165, 21, 25, 151; Ref. 8, pp. 1-3)
Release via overland migration and/or flood: NS	NS	NS

NS= Not Scored

2.4.2 HAZARDOUS WASTE QUANTITY

2.4.2.1.1. Hazardous Constituent Quantity (Tier A)

Description

The Hazardous Constituent Quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the total mass of all Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) hazardous substances in the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, Section 2.4.2.1.1]. There are insufficient historical and current data (manifests, potentially responsible party (PRP) records, State records, permits, waste concentration data, etc.) available to adequately calculate the total or partial mass, of all CERCLA hazardous substances in the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous constituent quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier B, Hazardous Wastestream Quantity (Ref. 1, Section 2.4.2.1.1).

Hazardous Wastestream Quantity: Not Evaluated

Are the data complete for hazardous constituent quantity for this source? No

2.4.2.1.2. Hazardous Wastestream Quantity (Tier B)

Description

The Hazardous Wastestream Quantity for Source No. 1 could not be adequately determined according to the HRS requirements; that is, the total mass, or a partial estimate, of all hazardous wastestreams and CERCLA pollutants and contaminants for the source and releases from the source is not known and cannot be estimated with reasonable confidence [Ref. 1, Section 2.4.2.1.2]. There are insufficient historical and current data (manifests, PRP records, State records, permits, waste concentration data, annual reports, etc.) available to adequately calculate the total mass, or a partial estimate, of all hazardous wastestreams and CERCLA pollutants and contaminants for the source and the associated releases from the source. Therefore, there is insufficient information to evaluate the associated releases from the source to calculate the hazardous wastestream quantity for Source No. 1 with reasonable confidence. Scoring proceeds to the evaluation of Tier C, Volume (Ref. 1, Section 2.4.2.1.2).

Hazardous Wastestream Quantity Value: Not Evaluated

Are the data complete for hazardous wastestream for this source? No

2.4.2.1.3. Volume (Tier C)

Description

The information available on the depth of Source No. 1 is not sufficiently specific to support an exact volume of the contaminated soil with reasonable confidence. The depth of contaminated soil throughout the area is not known; therefore, it is not possible to assign a volume (Tier C) for Source No. 1 (Ref. 1, Section 2.4.2.1.3).

Source No: 1

Source No. 1 has been assigned a value of 0 for the volume measure (Ref. 1, Section 2.4.2.1.3). As a result, the evaluation of hazardous waste quantity proceeds to the evaluation of Tier D, area (Ref. 1, Section 2.4.2.1.3).

Volume Assigned Value: 0

2.4.2.1.4. Area (Tier D)

Description

The area of Source 1 was determined by measurements obtained by using Geographic Information System (GIS) software, based on the size of the polygon formed by the contaminated soil samples collected from the former facility property. The area of Source 1 was calculated to total 800.59 square feet (ft²) (Figure 4 of this HRS documentation record). The Tier D equation for assigning a value for area source type “Contaminated Soil” is $A/34,000$ [(Ref. 1, Table 2-5, Section 2.4.2.1.4)]. Calculations for Source 1 are as follows:

Area of Source 1 (square feet): 800.59

Area Assigned Value: $800.59/34,000$

Area Assigned Value: 0.0235

2.4.2.1.5. Source Hazardous Waste Quantity Value

Per the HRS, the highest of the values assigned to the source for hazardous constituent quantity (Tier A), hazardous wastestream quantity (Tier B), volume (Tier C), and area (Tier D) should be assigned as the source hazardous waste quantity value [(Ref. 1, p. Section 2.4.2.1.5)].

Highest value assigned from Ref. 1, Table 2-5: 0.0235

SUMMARY OF SOURCE DESCRIPTIONS

Source No.	Source Haz. Waste Quantity Value	Source Hazardous Constituent Quantity Complete? (Y/N)	Containment Factor Value by Pathway				
			Ground Water (GW) (Ref. 1, Table 3-2)	Surface Water (SW)		Air	
				Overland/flood (Ref. 1, Table 4-2)	GW to SW (Ref. 1, Table 3-2)	Gas (Ref. 1, Table 6-3)	Particulate (Ref. 1, Table 6-9)
1	0.0235	N	10	NE	NE	NE	NE

NE= Not Evaluated

Description of Other Possible Sources:

Other possible sources of contamination include the waste evaporation area described in the Investigation Report, rinse and processing tanks, a “chromium contaminated area,” and various drums (some of which were in poor condition) that were mostly unlabeled. No containment features have been described in previous investigation reports, however, mismanagement of wastes was described in the 2008 investigation report. Additionally, the Removal Action Report documents a break in the foundation of the facility building near the vat room where spills were likely (Ref. 5, pp. 2-4; Ref. 6, pp. 13, 16).

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 GENERAL CONSIDERATIONS

Ground Water Migration Pathway Description

The Edwards Aquifer system (referred to in literature as the Edwards Aquifer) contains at least two individual karst aquifers, the Kainer and Person Formations of the Edwards Group, and is one of the most productive carbonate aquifer systems in the United States. This dissolution-modified, faulted limestone aquifer system is the sole source of public-water supply for San Antonio and is the major source of water for Bexar County (see Table 3 for the typical stratigraphic correlations of the Edwards Aquifer system in the region) (Ref. 11, p. 5). The overlying stratigraphic units- the Austin Group (also referred to as the Austin Chalk) and Quaternary Alluvium- yield groundwater, and are a source of recharge to the Edwards Aquifer system through fractures and stream flow, respectively (Ref. 11, pp. 5, 8; Ref. 12, pp. 7, 14; Ref. 18, p. 53).

The Austin Chalk is divided into three parts: the lowermost component, which consists of a hard, thin-bedded limestone; the middle component, which is composed of soft, massive chalky limestone; and the uppermost component, which consists of chalky limestone, some of which is argillaceous (Ref. 12, p. 23). In San Antonio, the Austin Chalk is approximately 200-350 feet thick. Locally, the Austin Chalk is a minor aquifer interconnected with the Edwards via faults (Ref. 18, p. 20).

The Person Formation is divided into three geologic members: undivided cyclic and marine members, undivided leached and collapsed members, and the regional dense member. The undivided cyclic and marine members are composed of mudstone to packstone, miliolid grainstone, and chert, and range in thickness from 80-90 feet. The undivided leached and collapsed members range from 70 to 90 feet thick and are composed of crystalline limestone to grainstone, chert, and collapsed breccias. (Ref. 11, p. 8). Extensive lateral cavern development and large rooms are associated with this member (Ref. 11, p. 8). The regional dense member is a dense, argillaceous mudstone that ranges in thickness from 20-24 feet.

The Kainer Formation is divided into four geologic members: the grainstone member, an aquifer; the Kirschberg evaporite member, an aquifer; the dolomitic member, an aquifer; and the basal nodular member (Ref. 11, p. 8). The Kirschberg evaporite member is one of the most permeable, with likely extensive cavern development (Ref. 11, p. 8). The Kirschberg evaporite member appears to be the most porous and permeable subdivision with pore structure and secondary neospar and travertine deposits (Ref. 11, p. 11). The dolomitic member is composed of mudstone to grainstone; crystalline limestone; and chert, and thickness ranges from 110 to 130 feet (Ref. 11, p. 8). Some beds in this member are relatively permeable and porous as a result of burrowing and dissolution causing a honeycombed framework (Ref. 11, p. 11). The basal nodular member is composed of shaly, nodular limestone, mudstone, and miliolid grainstone and is 50 to 60 feet thick (Ref. 11, p. 8).

The Edwards Aquifer system has relatively high permeability and effective porosity, as a result of the lithology, stratigraphy, diagenesis, and selective dissolution (i.e., karstification) (Ref. 11, p. 10). The karst and fractured limestone conditions associated with the geologic formations establish effective porosity that provides efficient pathways for contamination to enter the aquifer (Ref. 11, pp. 5, 7; Ref. 18, p. 22).

The Person and Kainer Formations are considered one hydrologic unit consistent with the historic regional approach (Ref. 12, p. 30; Ref. 11, p. 9). Water well reports and drilling logs of wells within the investigation area do not indicate individual formations within the Edwards (Ref. 19, pp. 3, 6, 11, 16, 17, 19, 27, 30, 33, 36, 54, 51,

55, 57, 66, 70, 72, 74). Some well logs within the four mile TDL identify karst features (such as honeycomb texture, caves, and voids) and/or fractured limestone conditions which promote hydraulic communication within the Edwards Aquifer system (Ref. 19, pp. 13, 14, 22, 24, 50-51; Ref. 12, p. 20; Ref. 11, pp. 5, 7).

Regional Hydrogeology/Aquifer Description:

Table 3 – Regional Geology within the San Marcos Platform						
Series	Group, Formation, or Member			Thickness	Hydrogeologic Properties	
Quaternary	Alluvium			0-45	aquifer	
	Terrace deposits			30	not saturated	
Tertiary	Uvalde Gravel			30	not known to yield water	
Upper Cretaceous	Navarro Group		Marlbrook Marl	500	confining	
	Taylor Group		Pecan Gap	300-500	confining	
			Anacacho Limestone			
	Austin Group		Austin Chalk	200-350	aquifer	
			Eagle Ford Shale	30-50	confining	
			Buda Limestone	40-50	confining	
			Del Rio Clay	40-50	confining	
Lower Cretaceous	Edwards Aquifer		Georgetown Limestone		2-20	confining
		Edwards Group	Person Formation	Cyclic and marine members, undivided	80-90	aquifer
				Leached and collapsed members, undivided	70-90	aquifer
				Regional dense member	20-24	confining
			Kainer Formation	Grainstone member	50-60	aquifer
				Kirschberg evaporite member	50-60	aquifer
				Dolomitic member	110-130	aquifer
				Basal nodular member	50-60	aquifer
		Trinity	Upper Glen Rose		300-400	confining

(Ref. 11, p. 8; Ref. 12, pp. 14-15; Ref. 18, pp. 20, 35; Ref. 20, p. 18)

Two aquifers of concern being evaluated for the HRS are within the Edwards Aquifer system of Lower Cretaceous age (Ref. 11, p. 8). The site overlies the artesian zone of the Edwards Aquifer system, in that the strata forming the aquifer system are confined (Ref. 21, p. 1; Ref. 18, p. 30, 33). The site area is situated over the San Marcos platform depositional province in the Balcones Fault Zone (BFZ) of the Edwards Aquifer (Ref. 18, p. 22).

The San Marcos platform was deposited during the Lower Cretaceous simultaneously with two other provinces that occupy the present day area of San Antonio: the Devils River Trend and the Maverick Basin (Ref. 20, p. 18). During the formation of the San Marcos platform, the depositional environment varied from open marine to arid, hot, supratidal flats. The San Marcos platform is defined as a complex, highly variable carbonate platform environment disrupted by erratic sea level changes (Ref. 20, p. 19). The depositional sequence stratigraphy for the Edwards Group is generally represented as a detached, rimmed carbonate platform with layer-cake lithologies and periodic karst development. Episodes of subaerial exposure and incipient karst development occurred first in the middle part of the Kainer Formation and later in the middle to upper parts of the Person Formation (Ref. 22, pp. 8-9). The karstification of the rocks of the San Marcos platform enhanced permeability, creating the most transmissive part of the Edwards Aquifer system (Ref. 18, p. 4). Following this period, the Edwards Group was buried by Late Cretaceous sediments characteristic of marine transgression. Late [Upper] Cretaceous and Early Tertiary continental uplift caused erosion in the present-day recharge area of the San Marcos Platform, exposing the Edwards Group at the surface. In the confined zone of the aquifer, the Late Cretaceous strata remain (Table 3; Ref. 18, p. 23).

The San Marcos platform facies associated with the Edwards Group are the Person Formation and the Kainer Formation (Ref. 20, p. 19). The Late Cretaceous period of deposition includes the Del Rio Clay, Buda Limestone, Eagle Ford Group, and the Austin Chalk, together considered the upper confining unit of the Edwards Aquifer system (Ref. 20, p. 18). Within the San Marcos platform, the Person Formation and the Kainer Formation make up seven of the eight hydrostratigraphic units of the Edwards Aquifer (Table 3) (Ref. 11, p. 8). All the units together act as one hydrogeologic unit, often referred to as 'the Edwards and associated limestones' (Ref. 12, p. 30).

The Edwards Aquifer system within the BFZ is one of the most permeable and productive aquifers in the United States, and is the sole source of water for the San Antonio area, where it supplies domestic, public supply, industrial, and agricultural wells (Ref. 10, p. 50-51; Ref. 11, p. 5). The BFZ is defined by a series of high angle normal faults that disrupt strata from the Lower Cretaceous through the Paleocene. The vertical displacement of the Lower Cretaceous strata initiated the hydrogeologic conditions ultimately responsible for the creation of the Edwards Aquifer within in the BFZ (Ref. 10, pp. 19, 35). Generally, groundwater flows downdip or southward from the Edwards outcrop (Ref. 10, p. 52). Although not always the case, hydraulic conductivity of the carbonates associated with the Edwards in the BFZ has typically increased over time as a result of faulting and fracturing that connected previously isolated voids, and subsequent dissolution. This dissolution along fractures and bedding planes formed joint cavities and solution channels that eventually became the primary conduits of regional groundwater flow (Ref. 10, pp. 38, 47).

The Edwards is recharged by precipitation on permeable areas of the outcrop, seepage of Hill Country streams that cross permeable areas of the outcrop of the Edwards Group and the Devils River Formation, subsurface inflow across the updip margin of the BFZ where the Trinity Aquifer is laterally adjacent to the downfaulted Edwards, and diffuse upward leakage from the underlying Trinity Aquifer (Ref. 10, p. 52). Openings along faults has allowed for communication between the Austin Chalk and the Edwards Aquifer (Ref. 18, p. 20). Leakage has also been documented between the Edwards Aquifer and the Austin Chalk along faults (Ref. 23, p. 14).

The Edwards Aquifer system, and the water-bearing units that underlie the RCMF site and recharge the Edwards Aquifer system, in order of depth, are discussed below.

- Aquifer/Stratum 1 (uppermost): Quaternary Alluvium

Description

The Quaternary alluvium exists within the TDL of the site, but is not mapped at the site itself, and is not named in any of the site well logs (Figure 3; Ref. 19, pp. 2-22). Quaternary alluvium strata are generally stream terraces which are composed of gravel, sand, and silt, and yield water of good quality (Ref. 12, p. 28). The Alluvium ranges in thickness from 0 to 45 feet (Ref. 12, p. 28). Within the San Marcos platform in the Balcones Fault Zone, the Quaternary Alluvium is in hydraulic connection with streams (Ref. 18, p. 20). These stream losses account for 60 to 80 percent of the recharge to the Edwards Aquifer system in the San Antonio area, and the rest of the recharge is derived from direct infiltration in the inter-stream areas (Ref. 18, p. 13).

- Aquifer/Stratum 2: Austin Chalk

Description

The Austin Group (also known as the Austin Chalk) supplies water for domestic or stock use where yields of 500 gpm or more were reported from several wells. Such yields may result when wells have been drilled into subsurface caverns. Some of the large yields from the Austin Chalk are believed to be obtained where the formation is in hydraulic communication (e.g., faults, secondary porosity) with the Edwards Aquifer system (Ref. 12, p. 24). In the Coolcrest #2 well log, the Austin Chalk is recorded at 155-360 feet bgs (Ref. 19, p. 3). In the next nearest well to the site, the Austin Chalk exists between 150-320 feet bgs (Ref. 19, p. 6). The uppermost component of the Austin Chalk is comprised of chalky limestone, some of which is argillaceous (Ref. 12, p. 23). The well at the site is reportedly drilled into the Austin Chalk at a total depth of 25 ft bgs. The well log indicates silty clays, which may correspond with the argillaceous upper unit of the Austin Chalk (Ref. 19, pp. 77-78).

Much of the outcrop boundary of the Austin Chalk consists of faults (Ref. 12, p. 23). The fault that transects the site area shown on Figure 3 of this HRS documentation record may account for the discrepancy between the site well and the Coolcrest #2 well regarding the differing depths of the Austin Chalk, as the BFZ is characterized by high-angle, normal faults (Figure 3; Ref. 10, p. 35; Ref. 19, pp. 3, 78).

There are several confining units that separate the Austin Chalk and the Edwards Aquifer, including the Eagle Ford Shale, Buda Limestone, Del Rio Clay, and Georgetown Limestone (Table 3). The Eagle Ford Shale is considered a barrier to vertical cross-formational flow. The Buda Limestone is considered to be fractured in the San Antonio area, and locally yields water in small quantities (Ref. 18, p. 20). The Del Rio is said to have negligible permeability, and is the true confining unit between the Edwards and the Austin Chalk; however, in a well located 1.2 mi north of the site facility, the water level is 168 feet bgs in the Del Rio Clay (150-210 feet bgs) (Ref. 18, p. 20; Ref. 19, p. 81). The Georgetown Limestone is also relatively impermeable, but may be water-bearing in Bexar County, and is considered part of the Edwards hydrologic unit (Ref. 12, p. 30). Despite the lithologically confining characteristics of these strata, large volumes of water from the Edwards limestones move upward via fault planes through the confining units (Ref. 24, p. 14).

- Aquifer/Stratum 3 (deepest): Edwards Aquifer System

Description

The seven members of the Person Formation and the Kainer Formation comprise seven of the eight hydrogeological subdivisions of the Edwards Aquifer system (Ref. 11, p. 8). Hydrogeologic subdivision VI (the Kirschberg evaporite member) appears to be the most porous and permeable subdivision in the Kainer Formation (Ref. 11, p. 5). Hydrogeologic subdivision III (Leached and Collapsed members, undivided) is the most permeable subdivision in the Person Formation (Ref. 11, p. 5). Hydrogeologic subdivision II (cyclic and marine members, undivided) is moderately permeable, with fabric- and not-fabric-selective porosity (Ref. 11, p. 11). Very permeable zones are distributed throughout units II and VII. The most permeable zones occur in honeycombed rocks formed by large rudist molds and irregular openings developed in burrowed tidal wackestone deposits (Ref. 18, pp. 4, 22). Honeycomb texture is mentioned in the well log associated with SAWS Texas Research Park within 2 miles of the site (Figure 2; Ref. 19, pp. 12-14). Well logs within the 4 mile TDL do not name individual formations within the Edwards system except for (occasionally) the Georgetown Limestone (Ref. 19, pp. 3, 6, 11, 16, 17, 19, 27, 30, 33, 36, 54, 51, 55, 57, 66, 70, 72, 74).

Site-specific Hydrogeology:

Based on the review of selected drillers logs located in the investigation area (within 2 miles of the soil source), the depth to the water level in the Edwards in site wells ranges from 517-522 feet bgs (Ref. 19, pp. 3, 14). Water level is often reported at shallower depths in the site wells, either in the Austin Chalk or other unnamed limestones (105-220 feet bgs), but the wells are generally cased off in the shallower zone, and screened or open hole for the Edwards Aquifer system to the total depth of the well (Ref. 19, pp. 2, 3, 4, 6, 10, 12-14, 16, 19). Of the observed release wells, Coolcrest #2 is open hole from 512-606 feet bgs, and the log for Coolcrest #1 only mentions casing from 0-506 feet bgs, with a total well depth of 606 ft bgs (Ref. 19, pp. 2-4). Of the potentially contaminated wells that were sampled, which all draw from the Edwards: the log for the Grosenbacher well (GW-16) does not specify construction below 515 ft, but the total depth of the well is 545 ft; the SAWS Mountain Laurel well is open hole from 440-690 ft bgs; the SAWS Texas Research Park well is open hole from 400-850 ft bgs; the Tejas Valley RV park PWS well is open hole from 556-664 ft bgs; and for the well located at 13415 Rolling Brook (GW-14), straight wall casing is indicated with a total depth of 600 ft bgs (Ref. 9, pp. 18, 40; Ref. 19, pp. 6, 9, 12, 15, 19).

- Aquifer Interconnections/Distance from Source

Description

The aquifers within the Edwards Aquifer system being evaluated for HRS purposes, the Person and Kainer Formations, are interconnected within the Balcones Fault Zone (Ref. 22, pp. 4, 5, 8; Ref. 11, pp. 4, 5). Although there is heterogeneity in the Edwards Aquifer system due to the lithologic characteristics of the different hydrogeologic subdivisions, hydraulic communication within the aquifers is fostered by movement of groundwater along vertical or steeply inclined, open fractures that act as passageways through which water can enter permeable strata (Ref. 11, pp. 8-10; Ref. 18, pp. 13, 22). Water moves from fractures into collapsed breccias, burrowed wackestones, and rudist grainstones that have significant intrinsic permeability (Ref. 18, pp. 4, 22). Water well reports and drilling logs within two miles of the site identify karst features and/or fractured limestone conditions which promote hydraulic communication within the Edwards Aquifer system (Ref. 19, pp. 15, 22, 24; Ref. 11, pp. 5, 7).

Regionally, there is a confining unit that separates the Person Formation from the Kainer Formation, the Regional

Dense member, which is the bottom of the Person. However, literature suggests that it does not impede cross-flow between the two Formations in vertical fractures (Ref. 11, p. 7).

Groundwater in the Austin Chalk Formation is locally interconnected with the Edwards Aquifer by openings along faults in the San Antonio area (Ref. 18, p. 20). Literature indicates that faults have relieved the artesian pressure in San Antonio, as indicated by local springs, similar chemical qualities of water, and simultaneous water level rises and falls from wells in the Austin Chalk and wells in the Edwards Aquifer. (Ref. 24, p. 13).

A large fault- part of the regionally extant BFZ- strikes northeast, crossing within ~200 feet south of the site, and other faults present within the investigation area (within 2 miles from the center of the contaminant plume), contribute to the hydraulic communication between the Austin Chalk and the Edwards Aquifer system (Figure 3; Ref. 11, p. 5; Ref. 12, pp. 24, 44; Ref. 19, p. 83). This fault lies between the site well and both Coolcrest wells, which are located south of the fault, providing a hydraulic conduit between the site and these two PWS wells (Figure 3; Ref. 12, p. 44; Ref. 19, p. 83).

Finally, a further indication of the hydraulic communication between these formations in the site area is the actual contamination of hexavalent chromium and cyanide detected in the on-site monitor well and in the Coolcrest wells (GW-03 and GW-04) that are completed in the Edwards Aquifer (Ref. 7, pp. 20-21, 24-25, 151; Ref. 8, pp. 2-3; Ref. 19, pp. 2-4). Therefore, the Austin Chalk, Person Formation, and Kainer Formation, are considered one aquifer for HRS purposes; they will be referred to as the Austin Chalk/Edwards Aquifer for the remainder of this HRS documentation record.

- Aquifer Discontinuities within Target Distance Limit

There are no discontinuities that transect the aquifer within the 4-mile TDL. Regional faulting within the Edwards Aquifer has displaced strata causing heterogeneity throughout the aquifer system (Ref. 18, p. 36).

3.1 LIKELIHOOD OF RELEASE

3.1.1 OBSERVED RELEASE

Aquifer Being Evaluated:

The Austin Chalk/Edwards Aquifer system is being evaluated for this HRS, based on the interconnectivity of the shallower Austin Chalk with the Edwards Aquifer system. (Section 3.0.1)

Chemical Analysis

Background Concentrations:

The sample collected for background of total metals and cyanide analyses in the deeper groundwater was collected at a private well located at 605 Oak Village in a well with open hole completion in the Edwards at 387 ft bgs to a total depth of 440 feet bgs (Ref. 8, p. 23; Ref. 19, p. 27; Ref. 27, p. 1). The Edwards aquifer wells in this area that were sampled during the SI are screened or open hole between 400-850 ft bgs (Ref. 19, pp. 2-4, 6, 9, 12, 15, 19). Coolcrest well #2 is open hole from 512-606 feet bgs, and the log for Coolcrest #1 only mentions casing from 0-506 feet bgs, with a total well depth of 606 ft bgs (Ref. 19, pp. 2-4). The ground surface elevation of the well used for background conditions is 940 ft above sea level (asl) (Ref. 3, p. 2; Ref. 9, pp. 18, 40; Figure 2). The elevations of Coolcrest 2 and Coolcrest #1 are 922 ft and 918 ft asl, respectively (Ref. 3, p. 1; Figure 2; Ref. 19 pp. 2, 4). These wells are similar in elevation, depth, and all draw from the Edwards. Samples were analyzed with ILM05.3-ICP for metals and ISM02.3 for Total Cyanide (Ref. 7, pp. 69-71). Although total chromium is naturally occurring, hexavalent chromium is more likely to occur in the environment as a result of industrial processes including the production of metal alloys for chrome plating, as a constituent in dyes and pigments for paints, the fabrication of refractory bricks for furnaces, tanning leather, and wood preserving; therefore a background value of '0' is assumed. Hexavalent chromium can move from the soil to underlying groundwater, and exists in oxidizing conditions (Ref. 25, p. 1).

Table 4 – Background Sample				
Sample ID	Depth to Water/Total Well Depth (feet bgs)	Date	References	
GW-13	258/440	5/11/2016	Ref. 8, p. 23; Ref. 19, p. 27	
Sample ID	Hazardous Substance	Concentration	Sample Quantitation Limit	References
GW-13	Cyanide	U	0.01 mg/L	Ref. 7, p. 1-3, 71, 155; Ref. 8, p. 23

The Reporting Limits are the equivalent of the HRS-defined term Sample Quantitation Limit, defined as the lowest concentration at which an analyte can be reliably measured and reported without qualification, and are adjusted for sample size, dilution, and matrix interference (HRS Section 1.1, Definitions; Ref. 7, p. 3).

U = Not detected (Ref. 7, p. 150).

Contaminated Samples:

The groundwater samples identified in the table below were sampled during the SI on May 9, 2016, and analyzed using modified EPA method 218.7 for hexavalent chromium, ILM05.3-ICP/MS for metals, and ISM02.3 for Total Cyanide. Groundwater samples GW-03 and GW-04 were collected by the TCEQ from the two nearby Coolcrest PWS wells (Figure 2; Ref. 7, pp. 18-25, 151; Ref. 8, pp. 3-4; Ref. 9, pp. 16-17).

Table 5 – Contaminated Samples				
Sample ID	Depth to Water/Total Well Depth (feet bgs)	Date Collected	References	
GW-03/Coolcrest Well #2	522/606	5/9/2016	Ref. 7, pp. 3-21, 151; Ref. 19, p. 3; Ref. 8, p. 3	
GW-04/Coolcrest Well #1	251/606	5/9/2016	Ref. 7, pp. 22-25, 151; Ref. 19, p. 4; Ref. 8, p. 4	
Sample ID	Hazardous Substance	Concentration (µg/L)	Sample Quantitation Limit (µg/L)	References
GW-03	Hexavalent Chromium	0.232	0.06	Ref. 7, p. 1-3, 21, 151; Ref. 8, p. 3
GW-03	Cyanide	0.061 (mg/L)	0.01 (mg/L)	Ref. 7, p. 1-3, 20, 151; Ref. 8, p. 3
GW-04	Hexavalent Chromium	0.194	0.06	Ref. 7, p. 1-3, 25, 151; Ref. 8, p. 4
GW-04	Cyanide	0.0566 (mg/L)	0.01 (mg/L)	Ref. 7, p. 1-3, 24, 151; Ref. 8, p. 4

The Reporting Limits are the equivalent of the HRS-defined term Sample Quantitation Limit, defined as the lowest concentration at which an analyte can be reliably measured and reported without qualification, and are adjusted for sample size, dilution, and matrix interference (HRS Section 1.1, Definitions; Ref. 7, p. 3).

Attribution:

The River City Metal Finishing facility conducted electroplating operations from 1994 to approximately 2002 (Ref. 4, p. 4). Electroplating services provided by the facility included chrome, nickel, copper, brass, silver, gold, and aluminum etching (Ref. 5, pp. 2-3). Chromium was detected in site soils at concentrations ranging from 38.3-682 mg/Kg (Ref. 7, pp. 26, 28, 30, 32, 34, 36, 38, 151-152; Ref. 8, pp. 5-11). Onsite soil sampled during the 2016 SI was non-detect for cyanide, and was not analyzed for hexavalent chromium (Ref. 7, pp. 174-175, 178-180; Ref. 8, pp. 1-23). However, cyanide was detected in drums that had been stored onsite prior to the Removal Action, and detected in soils screened by X-Ray Fluorescence (Ref. 6, p. 17, 23-24, 201-208). It was also detected in soils near the facility building above its background concentration in a June 2, 1999, investigation. Laboratory results are not available from this investigation (Ref. 5, p. 6; Ref. 14, p. 4). Cyanide was also detected in soil samples collected in January 2014 (Ref. 36, pp. 23-26, 28, 29).

Although onsite soil has not been tested for hexavalent chromium, it is highly unlikely to occur naturally in groundwater (Ref. 25, p. 1). Hexavalent chromium was detected in the shallow groundwater monitoring well at 9,280 µg/L at the facility (Ref. 7, pp. 165, 151; Ref. 8, p. 1). Chromium, manganese, selenium, and cyanide were also detected in the sample obtained from the onsite shallow groundwater monitoring well, thus establishing a link between site operations and groundwater contamination (Ref. 7, pp. 10-12, 14-16, 151, 175; Ref. 8, p. 1). Previous investigations also documented elevated levels of chromium in this well. A sample collected when the well was installed in 2010 contained chromium at 17.1 mg/L (Ref. 4, p. 24). Another sample collected during the SSDAP Removal Action contained chromium at 5.22 mg/L (Ref. 6, pp. 36, 105). Results for the sample (GW-01) collected from the shallow groundwater monitoring well at the River City Metal Finishing facility on May 9th, 2016, during the SI are provided in the table below.

Table 6 – Facility Monitoring Well Sample				
Sample ID	Depth to Water/Total Well Depth (feet bgs)	Date Collected	References	
GW-01	14.57/27.33	5/9/2016	Ref. 7, pp. 10-12, 151, 165; Ref. 26, p. 3; Ref. 8, p. 1; Ref. 19, p. 78	
Sample ID	Hazardous Substance	Concentration (µg/L)	Sample Quantitation Limit (µg/L)	References
GW-01	Hexavalent Chromium	9,280 HTS, J	600	Ref. 7, p. 1-3, 151, 165; Ref. 26, p. 4; Ref. 8, p. 1
GW-01	Chromium	9,310	10	Ref. 7, p. 1-3, 10, 151; Ref. 26, p. 4; Ref. 8, p. 1
GW-01	Cyanide	0.0119 (mg/L)	0.01 (mg/L)	Ref. 7, p. 1-3, 12, 151; Ref. 26, p. 4; Ref. 8, p. 1
GW-01	Manganese	15.2	5.0	Ref. 7, p. 1-3, 10, 151; Ref. 26, p. 4; Ref. 8, p. 1
GW-01	Selenium	27.6	4.0	Ref. 7, p. 1-3, 10, 11, 151; Ref. 26, p. 4; Ref. 8, p. 1

The Reporting Limits are the equivalent of the HRS-defined term Sample Quantitation Limit, defined as the lowest concentration at which an analyte can be reliably measured and reported without qualification, and are adjusted for sample size, dilution, and matrix interference (HRS Section 1.1, Definitions; Ref. 7, p. 3).

J= Estimated. HTS = Holding time lapsed prior to analysis. (Ref. 7, pp. 149, 160, 165, 176).

The samples collected from the two nearby Coolcrest PWS wells drawing from the Edwards Aquifer (GW-03 and GW-04) contained hexavalent chromium above the HRS cancer risk value at 0.232 and 0.194 µg/L, respectively. Cyanide was also detected in these wells at significant concentrations above background, which was non-detect (Ref. 7, pp. 21-22, 24-25, 71, 151, 153; Ref. 19, pp. 2-4; Ref. 8, pp. 2-3). A search for other possible sources of

plating chemicals in the site vicinity identified one facility that used chromium compounds, located approximately 2.8 mi northeast of the site. The search did not identify any other sources of cyanide (Ref. 28, pp. 1-7). Therefore, contamination associated with RCMF facility past operations has been transmitted through site soils to the Edwards Aquifer (Ref. 29, p. 1). The releases of hexavalent chromium and cyanide to the aquifer are attributable at least in part to the site.

Hazardous Substances Released

Hexavalent chromium at concentrations above the HRS cancer risk value and cyanide concentrations above the site-specific background concentration meet the criteria for an observed release to the Edwards Aquifer (Ref. 2, p. 3; Ref. 7, pp. 21, 25, 71, 151, 155; Ref. 8, pp. 2, 3, 23).

Ground Water Observed Release Factor Value: 550

3.1.2 POTENTIAL TO RELEASE

As specified in the HRS, since an observed release was established to the Edwards Aquifer, the potential to release was not evaluated (Ref. 1, Section 3.1.1).

3.2 WASTE CHARACTERISTICS

3.2.1 TOXICITY/MOBILITY

The following toxicity, mobility, and combined toxicity/mobility factor values are associated with the hazardous substances found at Source 1 or are observed releases to the Austin Chalk/Edwards Aquifer. The hazardous substances that are not associated with an observed release are non-liquid metals, and only a portion of the geologic strata from the source to the aquifer of concern is karst, so the mobility factor value for those substances were evaluated as non-karst.

Table 7 – Toxicity/Mobility Values					
Hazardous Substance	Association	Toxicity Factor Value	Mobility Factor Value	Toxicity/Mobility (Ref. 1, Table 3-9)	References
Antimony	Source 1	10,000	0.01	100	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 13
Cadmium	Source 1	10,000	0.01	100	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 53
Copper	Source 1	100	0.01	1	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 18
Hexavalent Chromium	Observed Release	10,000	1	10,000	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 3
Total Chromium	Source 1	10,000	0.01	100	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 8
Cyanide	Source 1, Observed Release	1,000	1	1,000	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 48
Lead	Source 1	10,000	0.01	100	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 2, p. 23
Nickel	Source 1	10,000	0.01	100	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 28

Table 7 – Toxicity/Mobility Values					
Hazardous Substance	Association	Toxicity Factor Value	Mobility Factor Value	Toxicity/Mobility (Ref. 1, Table 3-9)	References
Selenium	Source 1	100	1.0	100	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 33
Silver	Source 1	100	1.0	100	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 38
Zinc	Source 1	100	0.01	0	Ref. 1, Sections 2.4.1.2, 3.2.1; Ref. 1a, Section 2.4.1.1; Ref. 2, p. 43

Toxicity/Mobility Factor Value: 10,000
(Ref. 1, Table 3-9)

3.2.2 HAZARDOUS WASTE QUANTITY

Source No.	Source Type	Source Hazardous Waste Quantity	Source Hazardous Constituent Quantity Complete?
1	Contaminated Soil	1.72	No
Sum of Values: 0.0235, rounded to 1 (HRS Section 2.4.2.2, Table 2-6)			

There are 909 targets for the Ground Water Migration Pathway subject to Level I and Level II concentrations (Ref. 7, pp. 20, 21, 24, 25, 151; Sections 3.3.2.2 and 3.3.2.3 of this HRS documentation record). Therefore, according to HRS Section 2.4.2.2, if the hazardous constituent quantity is not adequately determined and targets are subject to Level I or Level II concentrations, a pathway Hazardous Waste Quantity factor value of 100 was assigned, since it was greater than the value obtained from HRS Table 2-6 based on the hazardous waste quantity value of Source 1 (Ref. 1, Section 2.4.2.2).

Hazardous Waste Quantity Factor Value: 100
(Ref. 1, Table 2-6)

3.2.3 WASTE CHARACTERISTICS FACTOR CATEGORY VALUE

Toxicity/Mobility Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 100

Toxicity/Mobility Factor Value x Hazardous Waste Quantity Factor Value: 1×10^6

Waste Characteristics Factor Category Value: 32
(Ref. 1, Table 2-7)

3.3 TARGETS

3.3.1 NEAREST WELL

The public drinking water wells Coolcrest TX150046A (Coolcrest #1) and Coolcrest TX150046B (Coolcrest #2) (See Figures 2 and 3 of this HRS documentation record) are subject to Level I concentrations (Ref. 1, Section 3.3.1; Ref. 7, pp. 21, 25, 151; Ref. 8, pp. 2-3). Therefore, a value of 50 is assigned.

Well IDs: GW-03 (Coolcrest #2) and GW-04 (Coolcrest #1)

Level of Contamination (I, II, or potential): I

Nearest Well Factor Value: 50
(Ref. 1, Section 3.3.1)

3.3.2 POPULATION

3.3.2.1 Level of Contamination

3.3.2.2 Level I Concentrations

Level I concentrations are those concentrations detected in groundwater which are at or above the lowest eligible HRS benchmark for a given substance (HRS Sections 2.5.2, 3.3.2.1, 3.3.2.2). Hexavalent chromium concentrations are above the cancer risk screening concentration in groundwater samples GW-03 and GW-04 collected from Coolcrest wells #2 and #1, respectively.

Table 8 – Level I Concentrations					
Well	Sample	Substance	Conc. (µg/L)	Cancer Risk Screening Concentration Benchmark (µg/L)	Reference(s)
Coolcrest PWS #2	GW-03	Hexavalent Chromium	0.232	0.05 ¹	Ref. 2, p. 3; Section 3.1.1 of this HRS documentation record; Ref. 19, p. 2
Coolcrest PWS #1	GW-04	Hexavalent Chromium	0.194	0.05 ¹	Ref. 2, p. 3; Section 3.1.1 of this HRS documentation record; Ref. 19, p. 4

¹ = 5E-05 mg/L or 0.05 µg/L

Level I Population Targets

The Coolcrest PWS wells are subject to Level I concentrations of hexavalent chromium (Ref. 7, pp. 21, 25, 151). These wells serve a population of 909 individuals (Ref. 30, p.1). 909 individuals x 10 = 9,090 target points assigned.

Level I Concentrations Factor Value: 9,090

3.3.2.3 Level II Concentrations

Level II Population Targets

Cyanide concentrations in the Coolcrest wells are Level II concentrations, above background concentrations but below HRS benchmark values, at 0.0610 mg/L in GW-03 and 0.0566 mg/L in GW-04 (Ref. 2, p. 48; Ref. 7, pp. 20, 24, 151). The populations associated with these wells were counted under Level I Population Targets; therefore, the Level II Concentrations Factor Value is 0.

Level II Concentrations Factor Value: 0

3.3.2.4 Potential Contamination

Potential Population Targets

(Note that domestic wells were not considered for the scoring of potential population since they do not alter the listing decision.)

0 to 0.25 mile

No active PWS wells were identified between 0 and 0.25 mile from the site (Figure 3).

0.25 to 0.5 mile

Coolcrest well #2 at 12304 Poinciana (G0150046B) serves half of the Coolcrest community of 909 individuals (Ref. 19, p. 2; Ref. 30, p. 1) (Figures 2 and 3). This well has been counted under the Level I contamination category.

0.5 to 1 mile

Coolcrest well #1 at 11926 Madrona (G0150046A) serves half of the Coolcrest community of 909 individuals (Ref. 19, p. 4; Ref. 30, p. 1) (Figures 2 and 3). This well has been counted under the Level I contamination category.

1 to 2 miles

The SAWS Mountain Laurel (TX0150545) well serves 141 individuals (Ref. 30, p. 6). The SAWS Texas Research Park well located on Talley Road, along with one other well in the following distance category, serve 8,124 individuals. Each well serves half the population: 4,062 individuals (Ref. 30, p. 18; Ref. 31, p. 1). The Tejas Valley RV park well (TX0150495) serves 354 individuals (Ref. 30, p. 13). The Little Lions Learning Academy well (TX0150560) serves approximately 100 individuals (Ref. 30, p. 27). In total, these wells serve 4,657 individuals.

2 to 3 miles

The SAWS Texas Research Park well located on Stevens Ranch Road, along with the Talley Road well in the previous distance category, serve 8,124 individuals. Each well serves half the population: 4,062 individuals (Ref.

30, p. 18; Ref. 31, p. 1). Three additional wells belong to the SAWS public water supply. Two are located at 11401 Marbach Lane (G0150018GL and G0150018GK), and one is located at 10371 Tippecanoe (G0150018GJ). These wells serve SAWS Pressure Zone 5, which, with 13 other wells, serve a total population of 224,979 individuals (Ref. 32, p. 2). Each well in Pressure Zone 5 contributes less than 40 % of the water supply; therefore the population can be divided equally between the wells, resulting in each well serving approximately 14,061 individuals ($224,979/16$ total wells = 14,061) (Ref. 32, pp. 1, 2). The total population served by these four wells equals 46,245 total individuals.

3 to 4 miles

An additional well associated with SAWS Pressure Zone 5 was identified (G0150018GH/Bear Creek well). This well serves approximately 14,061 individuals ($224,979$ individuals/ 16 total wells = 14,061) (Ref. 32, pp. 1-3). The cluster of wells located north of the site within this distance category (Figure 3) is the SAWS Anderson wells, associated with Pressure Zone 7, which, with a total of 10 wells, serve approximately 406,602 individuals. The wells in use are 1, 2, 4, and 5. These four wells serve approximately 162,640 individuals ($(406,602/10 = 40,660) \times 4 = 162,640$) (Ref. 31, p. 1). There are also the three Air Force Village II PWS wells, which serve 655 people (Ref. 30, p. 32). In total, all wells in this distance category serve 177,356 individuals.

Table 9 - Potential Population Target Values			
Distance Category	Population	Distance-Weighted Population Value (Ref. 1, Table 3-12)	References
0 to 1/4 mile	0	0	n/a
>1/4 to 1/2 mile	0	0	Ref. 30, p. 1
>1/2 to 1 mile	0	0	Ref. 30, p. 1
>1 to 2 miles	4,657	939	Ref. 30, pp. 7, 14, 19, 28; Ref. 31, p. 1
>2 to 3 miles	46,245	6,778	Ref. 30, p. 19; Ref. 32, p. 1
>3 to 4 miles	177,356	13,060	Ref. 30, p. 33; Ref. 31, p. 1; Ref. 32, p. 1

Sum of Distance-Weighted Population Values: 20,777

Sum of Distance-Weighted Population Values/10: 2,077.7

A potential contamination factor value of 2,077.7 is calculated and rounded to 2,078 according to the directions of HRS Section 3.3.2.4.

Potential Contamination Factor Value: 2,078

3.3.3 RESOURCES

Resources have not been evaluated at this time, since drinking water wells score the site and evaluating them would not affect the overall score.

Resources Factor Value: 0

3.3.4 WELLHEAD PROTECTION AREA

The designated wellhead protection areas of the SAWS PWS wells contain observed contamination attributable to the sources at the site. Therefore, a value of 20 has been assigned (Ref. 33, pp. 2, 6-7; Ref. 34, pp. 41-43).

Wellhead Protection Area Factor Value: 20