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UMTRA Project Water Sampling and Analysis Plan

Falls City, Texas

February 1994

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UMTRA PROJECT WATER SAMPLING AND ANALYSIS PLAN
FALLS CITY, TEXAS

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EXECUTIVE SUMMARY

Surface remedial action will be completed at the Falls City, Texas, Uranium Mill Tailings Remedial Action Project site in the spring of 1994. Results of water sampling activity from 1989 to 1993 indicate that ground water contamination occurs primarily in the Deweesville/Conquista aquifer (the uppermost aquifer) and that the contamination migrates along four distinct contaminant plumes. Contaminated ground water from some wells in these regions has significantly elevated levels of aluminum, arsenic, cadmium, manganese, molybdenum, selenium, sulfate, and uranium. Contamination in the Dilworth aquifer was identified in monitor well 977 and in monitor well 833 at the southern edge of former tailings pile 4. There is no evidence that surface water quality in Tordilla and Scared Dog Creeks is impacted by tailings seepage.

The following water sampling activities are planned for calendar year 1994:

- Ground water sampling from 15 monitor wells to monitor the migration of the four major contaminant plumes within the Deweesville/Conquista aquifer.

- Ground water sampling from five monitor wells to monitor contaminated and background ground water quality conditions in the Dilworth aquifer. Because of disposal cell construction activities, all plume monitor wells screened in the Dilworth aquifer were abandoned.

No surface water locations are proposed for sampling.

The monitor well locations provide a representative distribution of sampling points to characterize ground water quality and ground water flow conditions in the Deweesville/Conquista aquifer downgradient of the disposal cell. The list of analytes has been modified with time to reflect constituents currently related to uranium processing activities and natural uranium mineralization. Water sampling is normally conducted biannually in late summer and midwinter.

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
ac	acre
DOE	U.S. Department of Energy
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FM	Farm-to-Market Road
ft	feet
gpm	gallons per minute
ha	hectare
km	kilometer
L/m	liters per minute
m	meter
mg/L	milligram per liter
mi	mile
QA	quality assurance
QAIP	quality assurance implementation plan
QC	quality control
SEI	Solution Engineering, Inc.
SOP	standard operating procedure
SWI	Susquehanna Western, Inc.
TAD	*Technical Approach Document*
UMTRA	Uranium Mill Tailings Remedial Action
WSAP	water sampling and analysis plan

1.0 INTRODUCTION

1.1 PURPOSE

This water sampling and analysis plan (WSAP) provides the regulatory and technical basis for ground water sampling at the Falls City, Texas, site. It identifies and justifies the sampling locations, analytical parameters, and sampling frequencies at the sites. The ground water data are used for site characterization and risk assessment.

Ground water and surface water monitoring activities are based on the U.S. Environmental Protection Agency (EPA) proposed regulations in 52 FR 36000 (1987), Uranium Mill Tailings Remedial Action (UMTRA) Project standard operating procedures (SOP) (JEG, n.d.), the *Technical Approach Document* (TAD) (DOE, 1989), and the most effective technical approach for the site.

This edition of the WSAP includes the summary and results of water sampling activities from 1989 to 1993 and the water sampling plan for calendar year 1994.

1.2 SITE LOCATION

The Falls City site is in Karnes County, Texas, approximately 8 miles (mi) (13 kilometers [km]) southwest of the town of Falls City and 46 mi (74 km) southeast of San Antonio, Texas (Figure 1.1. Before surface remedial action, the tailings site consisted of two parcels. Parcel A consisted of the mill site, one mill building, five tailings piles, and one tailings pond south of Farm-to-Market Road (FM) 1344 and west of FM 791. A sixth tailings pile north of FM 1344 and west of FM 791 was designated Parcel B (Figure 1.2).

1.2.1 Surrounding land use

The Falls City site is in rural farm country. While many residents still farm, farm income typically is supplemented by a second income.

Most land surrounding the former processing site is still used for dryland farming and cattle grazing. Crops include hay and feed products and produce from fairly substantial home gardens; most crops are raised for home consumption rather than resale.

1.2.2 Surrounding water use

Ground water from the Deweesville/Conquista and the Dilworth aquifers is not used for domestic or potable water supplies in the immediate site vicinity. Ground water from the Dilworth aquifer is used for stock watering within a 2-mi (3-km) radius of the site. Residences within the site area use deeper ground water from the Carrizo Sandstone for domestic and potable purposes and for stock watering. This water is supplied by the Three Oaks Water Cooperative.

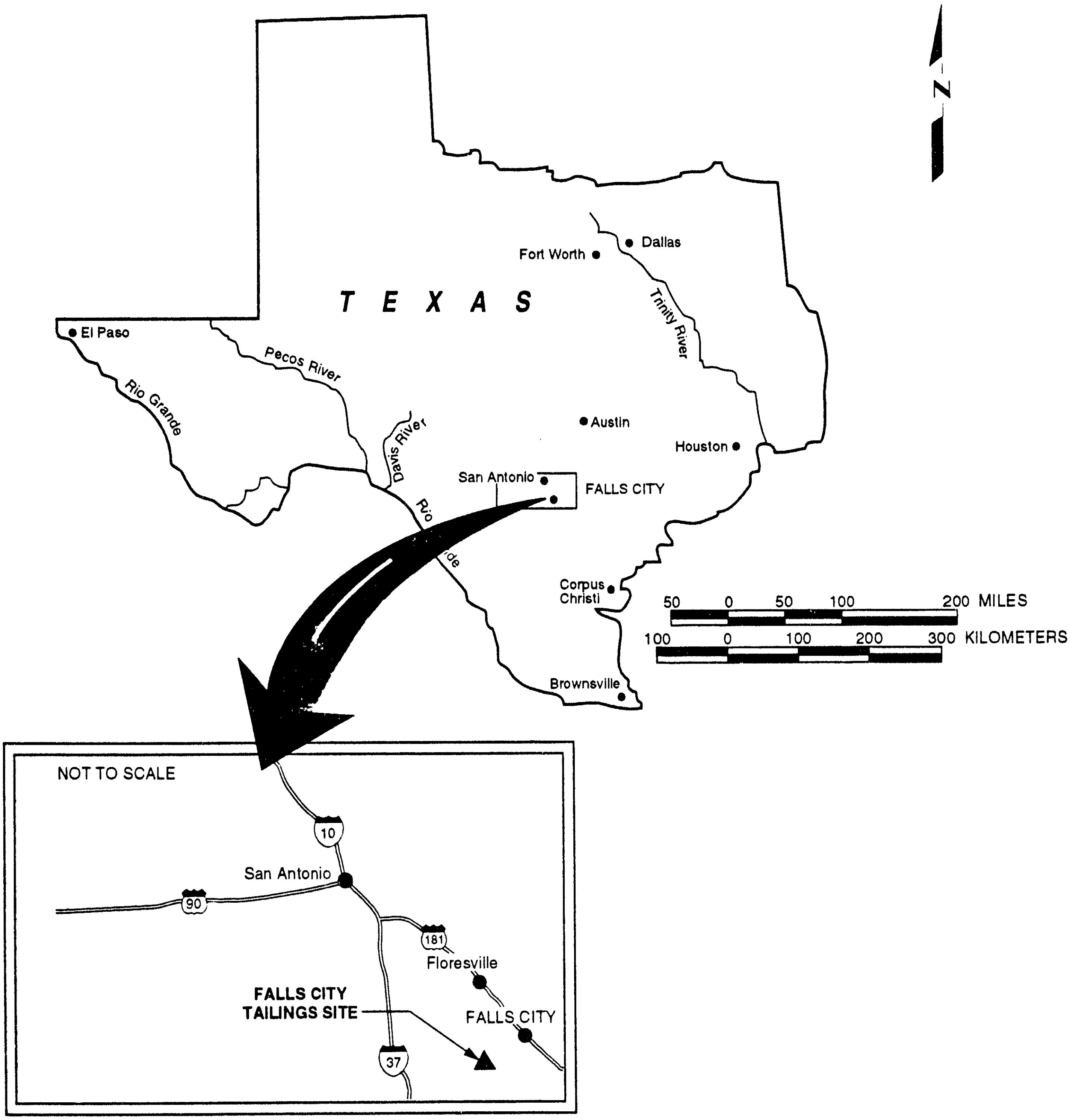

FIGURE 1 .1
LOCATION OF THE FALLS CITY, TEXAS, SITE

MAC: SITE/FCT/WSAP/LOCMAP

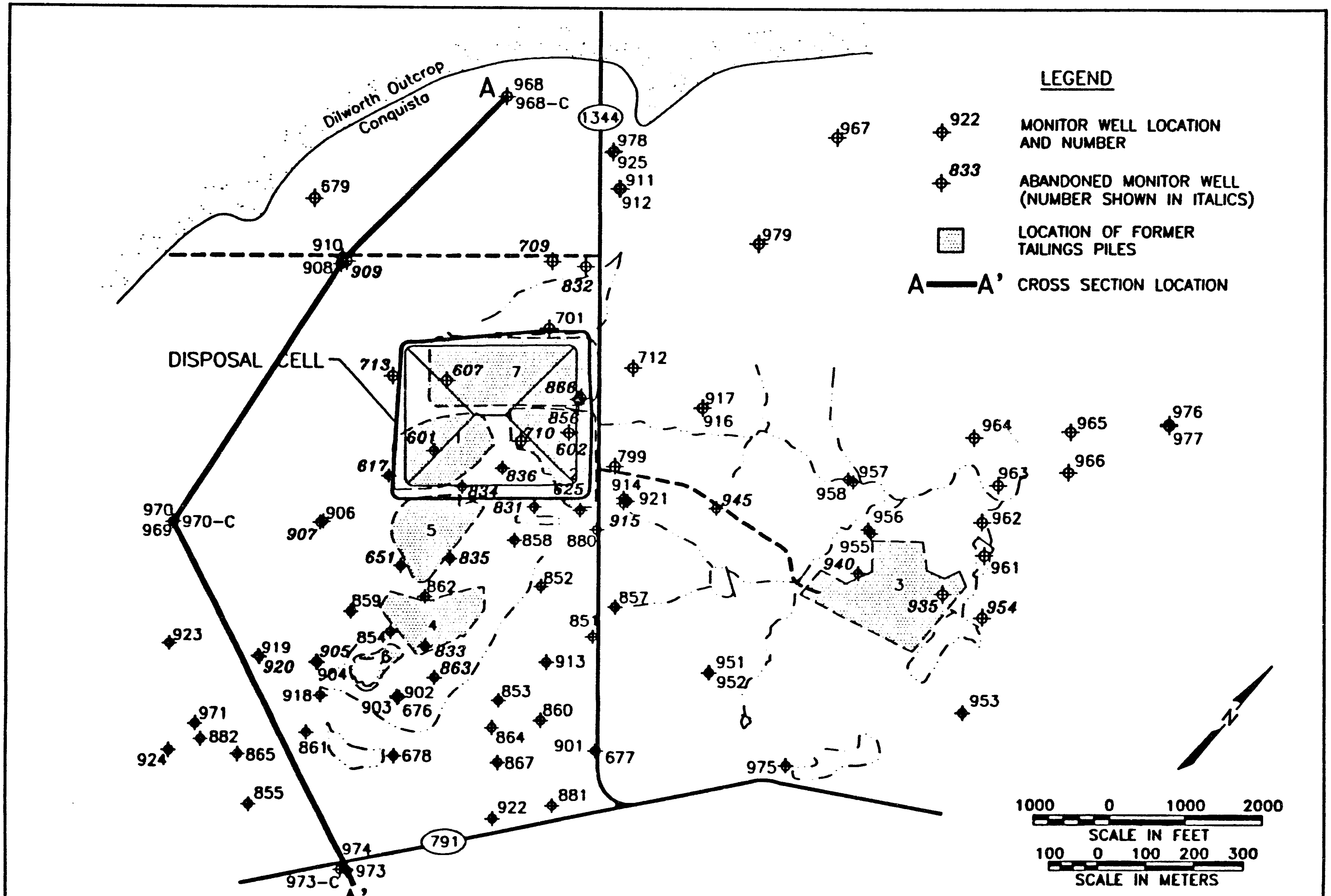

FIGURE 1.2
LOCATIONS OF MONITOR WELLS, FORMER TAILING PILES, AND DISPOSAL CELL, FALLS CITY, TEXAS, SITE

1.3 SITE HISTORY

Shallow uranium ore deposits were discovered in western Karnes County, Texas, in 1954. In this same area, Susquehanna Western, Inc. (SWI) built and operated a uranium mill at the Falls City site from April 1961 to August 1973. The mill used a sulfuric acid leach-countercurrent decantation-solvent extraction process to treat approximately 2.5 million tons (2.3 million metric tons) of ore averaging 0.16 percent uranium oxide (U_3O_8). More than 700 tons (600 metric tons) of U_3O_8 concentrate ("yellow cake") were sold to the Atomic Energy Commission while the mill was in operation.

Waste tailings and processing solutions from the SWI milling operation were impounded in seven separate ponds, four of which were open-pit mines excavated into the ore-bearing sandstone. The tailings ponds were 30 to 35 feet (ft) (9 to 11 meters [m]) deep and unlined, except for natural clay foundation soils and sediments.

In 1975, SWI sold the mill site and residual tailings piles to Solution Engineering, Inc. (SEI) and its partner, Basic Resources, Inc. From late 1978 to early 1982, SEI conducted secondary solution uranium mining from four of the piles. This operation included a system of shallow injection/recovery wells and an ion exchange bed to recover uranium and molybdenum from solution. The uranium leaching agent was acid water from tailings pond 7. Residual process waters were pumped back to this pond. All ponds were evaporated except pond 6, which is thought to be recharged by natural seepage.

1.4 SITE STATUS

All tailings and contaminated materials have been consolidated and will be stabilized in a disposal cell in the present location of piles 1, 2, and 7. Tailings and contaminated materials from pond 6, the windblown areas, and piles 3, 4, and 5 were consolidated in the disposal cell. After completion, the disposal cell will cover approximately 130 acres (ac) (50 hectares [ha]).

The final restricted area will cover approximately 290 ac (120 ha) and may be enclosed by a perimeter fence. The remainder of the designated site eventually will be released for any use consistent with existing land use controls, after remedial action is complete. Figure 1.2 shows the locations of the monitor wells, the former tailings piles, and the disposal cell.

1.5 SAMPLING PLAN

The current water sampling plan for the Falls City disposal site is to collect ground water samples from selected U.S. Department of Energy (DOE) monitor well locations. The monitor wells locations provide a representative distribution of sampling points to characterize ground water quality and ground water flow conditions in the site vicinity. The list of analytes has been modified with time;

it currently reflects constituents related to uranium processing activities and natural uranium mineralization. Water sampling normally is conducted biannually in late summer and winter.

The last water quality sampling round was completed in January 1994. The next water quality sampling round is scheduled in September 1994 and will include 20 monitor wells.

2.0 SITE CHARACTERISTICS

2.1 PHYSIOGRAPHIC SETTING

The Falls City site is in the low, rolling hills of south-central Texas, within the West Gulf section of the inner Coastal Plain province. Floodplains flanked by several levels of fluvial terraces and cuestas formed from the differential erosion of the gulfward dipping sequences of resistant and incompetent strata are the prominent landforms in the region.

2.2 GEOLOGY

The Falls City site is underlain by sedimentary rock that dips gently southeastward toward the Gulf of Mexico. These strata are composed locally of sand, silt, and clay deposits of the Whitsett and Manning Clay Formations. The site is directly underlain by the Dubose Clay, Deweesville Sandstone, Conquista Clay, and Dilworth Sandstone Members of the Whitsett Formation. The Dilworth Sandstone, the basal member of the Whitsett Formation, overlies the Manning Clay Formation, the oldest geologic unit encountered during the site drilling program (Figure 2.1).

2.3 HYDROLOGY

2.3.1 Surface water

The Falls City site is situated on the drainage divide (Figure 2.2) between the San Antonio River to the northeast and the Atascosa River to the southwest. Surface drainage from the vicinity of piles 2 and 3 and the northern portion of pile 7 travels approximately 4 mi (6 km) northeast via Scared Dog Creek to the San Antonio River. Surface drainage from former tailings ponds 1, 4, 5, and 6 and portions of piles 2 and 7 travels southwest via Tordilla Creek into Borrego Creek 17 mi (27 km) to the Atascosa River. These creeks flow only for short periods immediately after large rainstorms.

2.3.2 Ground water

Two low-yield aquifers (Deweesville/Conquista and Dilworth aquifers) are within the upper 100 to 200 ft of the Whitsett Formation sediments underlying the site. Although the Deweesville/Conquista and Dilworth units are referred to as aquifers in this report, these units were never developed as a source for drinking water supply because of their low yields (generally less than 1 gallon per minute [gpm] (4 liters per minute [L/m]) and poor water quality. These two aquifers are underlain by the carbonaceous clays and lignite seams of the Manning Clay Formation, which effectively form a 300-ft (90-m)-thick aquitard.

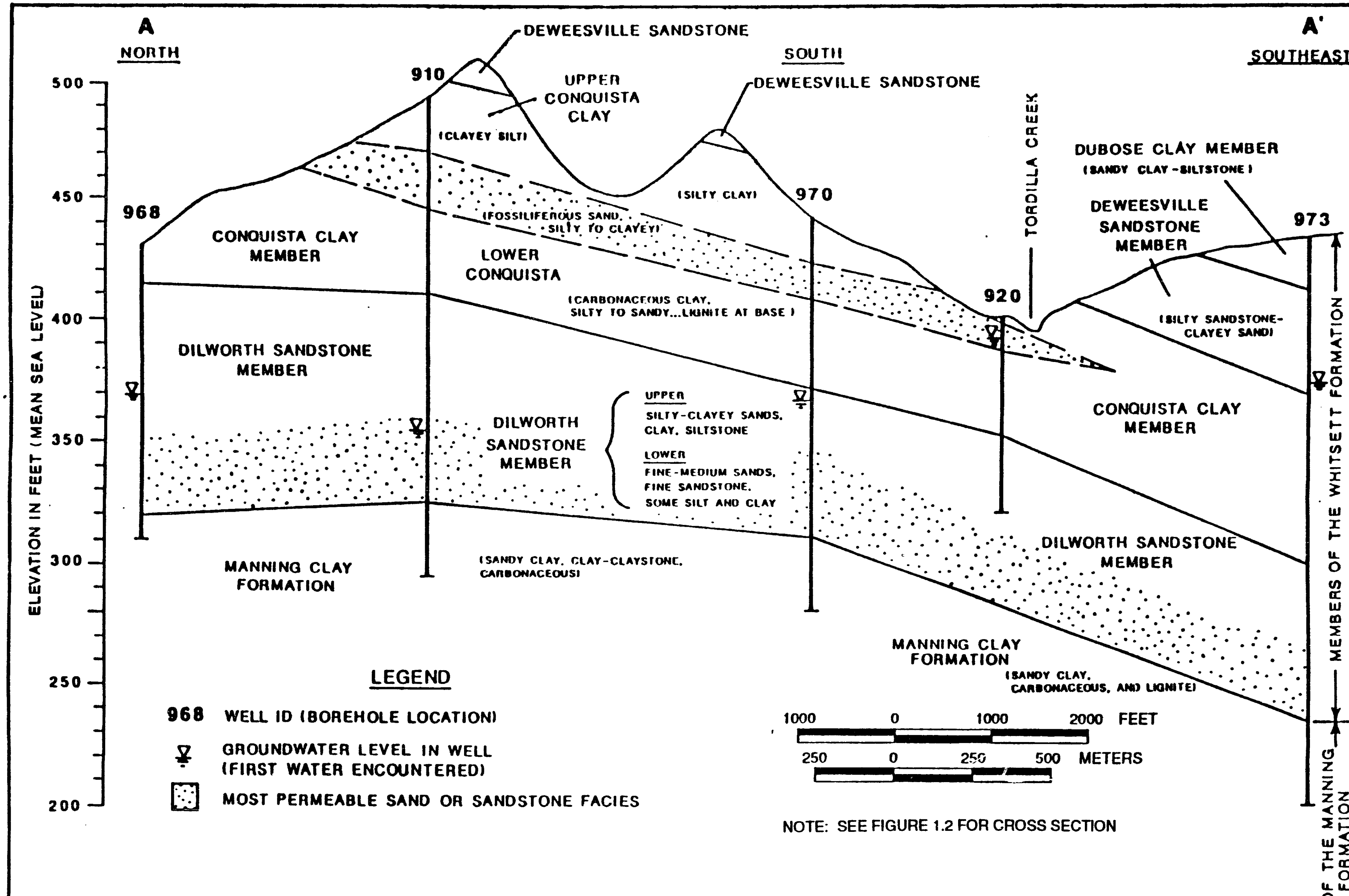

FIGURE 2.1
GEOLOGIC CROSS SECTION A - A'
FALLS CITY, TEXAS, SITE

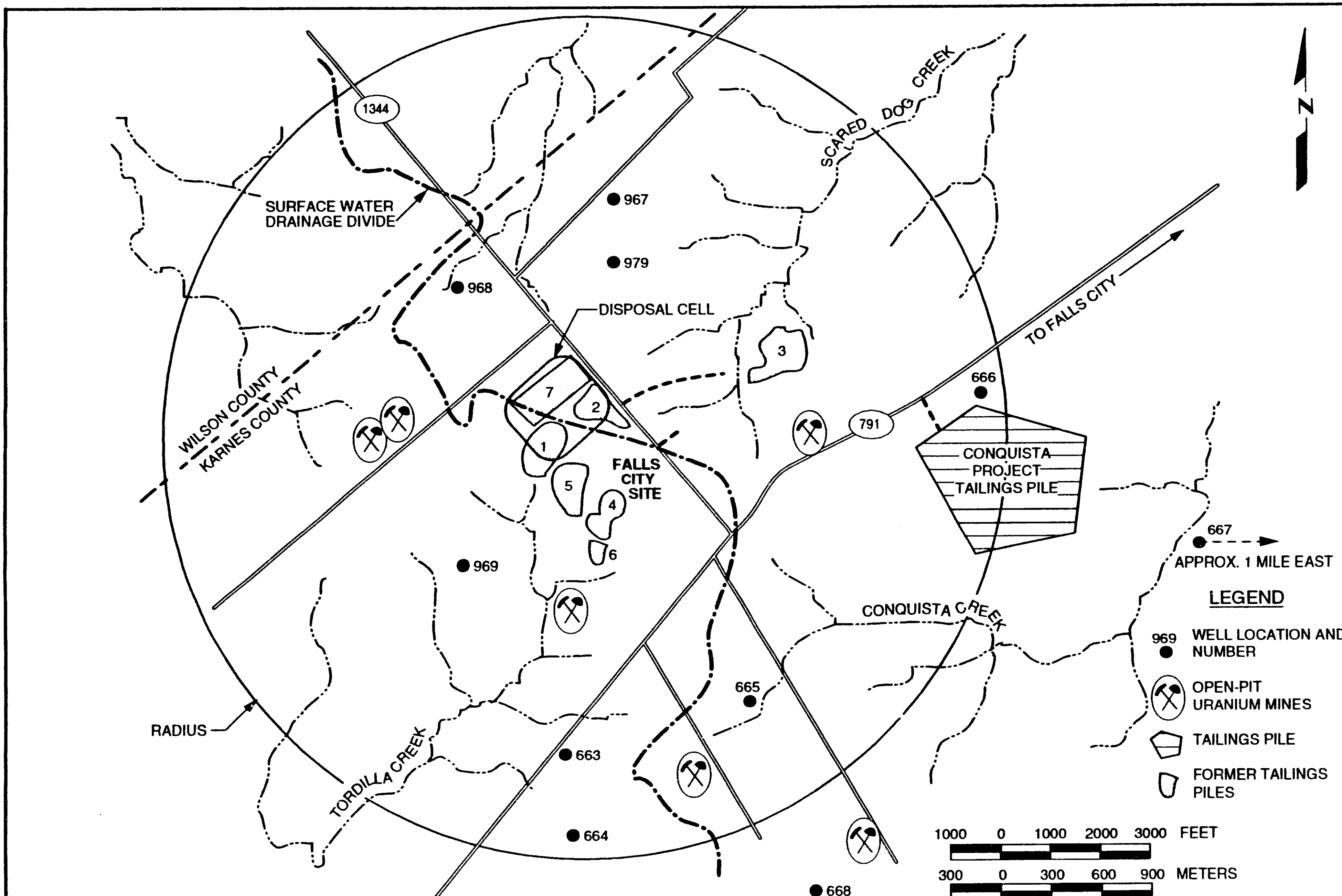

FIGURE 2.2
LOCATIONS OF THE DILWORTH BACKGROUND WELLS AND THE DEWEESVILLE/CONQUISTA CONOCO 600 SERIES WELLS
FALLS CITY, TEXAS, SITE

MAC: SITE/FCT/WSAP/LOCBACKWELLS

Deweesville/Conquista aquifer

The Deweesville/Conquista aquifer includes the fine-grained sands and sandy clays of the Deweesville Sandstone, the upper Conquista Clay Member, and the middle Conquista Clay fossiliferous sandstone unit (predominantly fine clayey sand). In the site vicinity, the Deweesville/Conquista aquifer extends approximately 60 to 70 ft (18 to 21 m) below land surface.

Shallow ground water is found in the aquifer at depths of 5 to 30 ft (1.5 to 9 m) below land surface. Ground water occurs under unconfined conditions in the northern and western portions of the site vicinity and along creek beds but is confined by the Dubose Clay downdip to the southeast. In areas where the Deweesville/Conquista aquifer is unconfined, the potentiometric surface is generally a subdued replica of the surface topography. Generally, ground water south of the drainage divide flows south and southwest toward Tordilla Creek. Shallow ground water north of the drainage divide flows northeast along Scared Dog Creek. South of the site, however, the aquifer is confined (or at least semiconfined) and ground water in this region flows downdip to the southeast. The potentiometric surface of the Deweesville/Conquista aquifer is shown in Figure 2.3.

Ground water within the Deweesville/Conquista aquifer recharges by infiltrating precipitation in the Deweesville/Conquista outcrop areas, seepage of tailings fluids, and interformation leakage (from overlying sediments) in downdip areas. Ground water yield from the Deweesville/Conquista aquifer is generally less than 1 gpm (4 L/m), but yields of up to 5 gpm (20 L/m) were obtained from a monitor well screened in the fossiliferous interval of the Conquista Sandstone.

Dilworth aquifer

The Dilworth aquifer, the basal sandstone member of the Whitsett Formation, is separated from the Deweesville/Conquista aquifer by 30 to 50 ft (9 to 15 m) of carbonaceous clay of the lower Conquista Clay Member, which acts as an aquitard to downward seepage. The semiconfined Dilworth aquifer extends 100 to 190 ft (30 to 60 m) below the mill site area. The potentiometric surface in the Dilworth aquifer unit shows ground water flows generally southeast (downdip) and east beneath the site from the Dilworth outcrop (recharge) band northwest of the site (Figure 2.4).

Infiltrating precipitation recharges the ground water in the Dilworth aquifer in the Dilworth outcrop areas. Ground water yields from monitor wells screened in the Dilworth aquifer are generally less than 1 gpm (4 L/m). The Manning Clay Formation underlies the Dilworth aquifer and functions as an aquitard (a sandy carbonaceous clay).

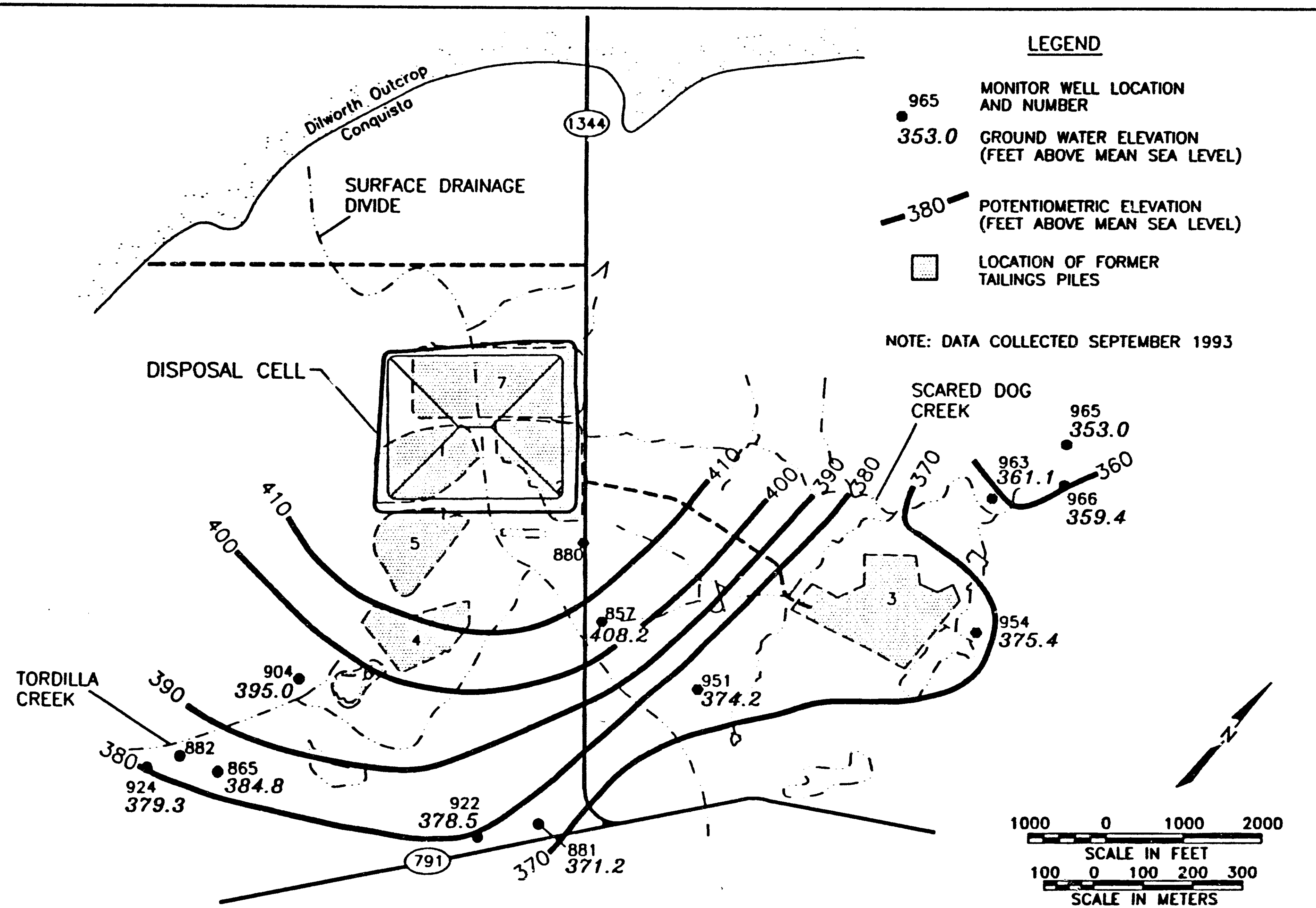

FIGURE 2.3
POTENTIOMETRIC SURFACE OF THE DEWEESVILLE/CONQUISTA AQUIFER
FALLS CITY, TEXAS SITE

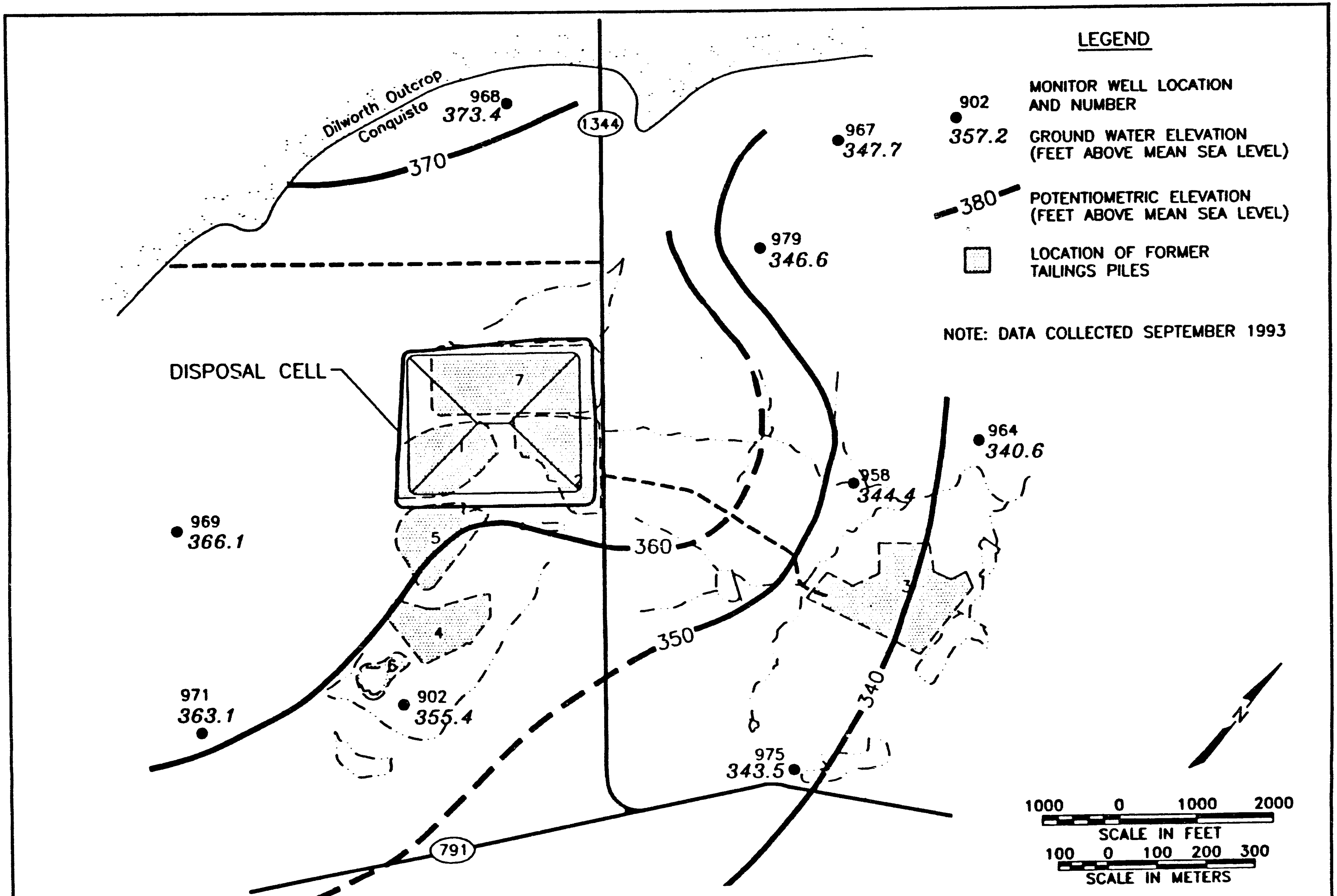

FIGURE 2.4
POTENTIOMETRIC SURFACE OF THE DILWORTH AQUIFER
FALLS CITY, TEXAS, SITE

2.4 WATER QUALITY

2.4.1 Background ground water quality

Background ground water quality for the Deweesville/Conquista and Dilworth aquifers is defined as the quality of ground water at the Falls City UMTRA site that would be present if uranium mining and processing activities had not occurred.

There is no single background ground water quality for each of these aquifers, however, and the natural ground water quality varies within these aquifers as a function of residence time and aquifer matrix composition. The Deweesville/Conquista and Dilworth aquifers can each be separated into three general regions or zones with different mineralogical and compositional characteristics. These zones are defined as the oxidized, transitional, and reduced zones. Although these zones overlap, the ground water in each zone typically is distinct in composition from the ground water in the other zones. Table 2.1 summarizes background ground water quality at the site.

Deweesville/Conquista

The oxidized zone is defined as the outcrop area and shallow subsurface of this aquifer. At the Falls City UMTRA site, this zone of the Deweesville/Conquista was largely unsaturated before mining and milling. It later became saturated by the influx of large volumes of tailings leachate. Significant amounts of ground water in this zone at the mill site do not result from natural processes and the ground water itself is a contaminant. Therefore, a "background ground water quality" for this zone in the Deweesville/Conquista does not exist.

The transitional zone begins at the downdip edge of the Deweesville/Conquista outcrop (where the sediments are dominantly oxidized) and ends before the downgradient limit of the DOE monitor well array (e.g., 922 and 881, where the sediments are dominantly reduced). The premining ground water quality in this uranium mineralized zone may have ranged from that present today in monitor well 951 to the much poorer quality water found in monitor wells 922 and 881. The interaction of oxidizing water from the recharge area with the pyrite- and ore-bearing sediments causes high variability in the background ground water in this zone.

The upgradient limit of the reduced zone for the Deweesville/Conquista is defined as the downgradient edge of the DOE monitor well array (beginning at FM 791). Available ground water quality data from Conoco monitor wells 667 and 668 suggest that the ground water quality of the Deweesville/Conquista in parts of this zone is lower in sulfate, chloride, and many other constituents than water from the transitional zone. The locations of the Conoco monitor wells and Dilworth background monitor wells are shown in Figure 2.2. Because numerous mined ore bodies occur in the oxidizing, transitional, and reducing

Table 2.1 Summary of background ground water quality for Deweesville/Conquista and Dilworth aquifers, Falls City, Texas, site

Constituent	Concentration at each location (mg/L - except for pH)						
	951[a]	667[b]	668[b,c]	967[d]	968[d]	969[a]	979[d]
Alkalinity[e]	307	252	250	116	226	291	193
Calcium	364	335	405	278	90	495	258
Chloride	708	785	944	793	338	779	672
Iron	0.03	0.45	0.19	<0.03	<0.03	0.87	<0.03
Magnesium	29	31.8	45.1	30.5	8.1	61	28.3
Manganese	0.21	0.21	0.78	0.02	<0.01	2.94	0.07
Nitrate	4	4.9	3.5	10.2	12.4	1.3	4.4
pH	6.75	6.65	6.63	5.98	6.58	6.70	6.08
Potassium	45	43	29	30	18	43	36
Sodium	652	678	583	675	121	550	531
Sulfate	856	1043	930	817	156	1290	569
TDS	2291	3120	3310	2750	624	3650	2210

[a]Monitor well is located in the transitional zone.
[b]Monitor well is located in the reducing zone.
[c]*Water quality data from June 1991 to July 1991.*
[d]Monitor well is located in the oxidized zone.
[e]mg/L $CaCO_3$.

zones of the regional sediments (including the Deweesville/Conquista) (Figure 2.2), the concentrations of hazardous trace constituents vary considerably from locale to locale in this aquifer.

Dilworth

Of the four DOE Dilworth background wells at the UMTRA site (967, 968, and 979), three are completed in the oxidized zone and one (969) in the transitional zone of this aquifer. The ground water quality of monitor well 969 is more representative of the remaining DOE Dilworth wells at the site. The three upgradient wells in the oxidized zone of the Dilworth produce ground water of better quality than is typical of the Dilworth. A comparison of Dilworth ground water from the transitional zone of this aquifer (where most DOE Dilworth wells are screened) to these three oxidized zone wells suggests that contamination of the Dilworth is far more pervasive than it actually is.

2.4.2 Magnitude of site-related ground water contamination

The Falls City water quality data have been reviewed for 1989 through 1993. A statistical, geochemical, and hydrological analysis of these data indicates widespread tailings-related contamination in the Deweesville/Conquista aquifer and significantly less contamination in the Dilworth aquifer.

Deweesville/Conquista

Contamination in the Deweesville/Conquista aquifer generally travels along four distinct contaminant plumes (Figure 2.5). Contaminated ground water from some wells in all these regions has significantly elevated levels of aluminum, arsenic, cadmium, manganese, molybdenum, selenium, sulfate, and uranium.

Although the four contaminated regions at the Falls City site have many chemical similarities, each region or plume has important chemical differences that give it a distinct geochemical signature. These four contaminated regions are described below.

Eastern plume region

The eastern plume region originates from tailings pile 3. A major lobe of contamination extends approximately 3000 ft (900 m) north-northeast in ground water beneath Scared Dog Creek (Figure 2.5). The pH of contaminated ground water encountered by several monitor wells along Scared Dog creek (e.g., 962, 963, 965, and 966) commonly ranges between 3 and 5; however, in some areas this plume is not acidic (e.g., monitor wells 955 and 961)(DOE, 1992). Monitor well 953 approximately 1200 ft (3600 m) east-southeast of pile 3 (Figure 1.2) also shows evidence of tailings-related contamination such as elevated uranium and low pH (DOE, 1992). The lack of monitor wells in this region south of tailings pile 3 precludes a more precise delineation of a possible southeastern lobe of the eastern plume region.

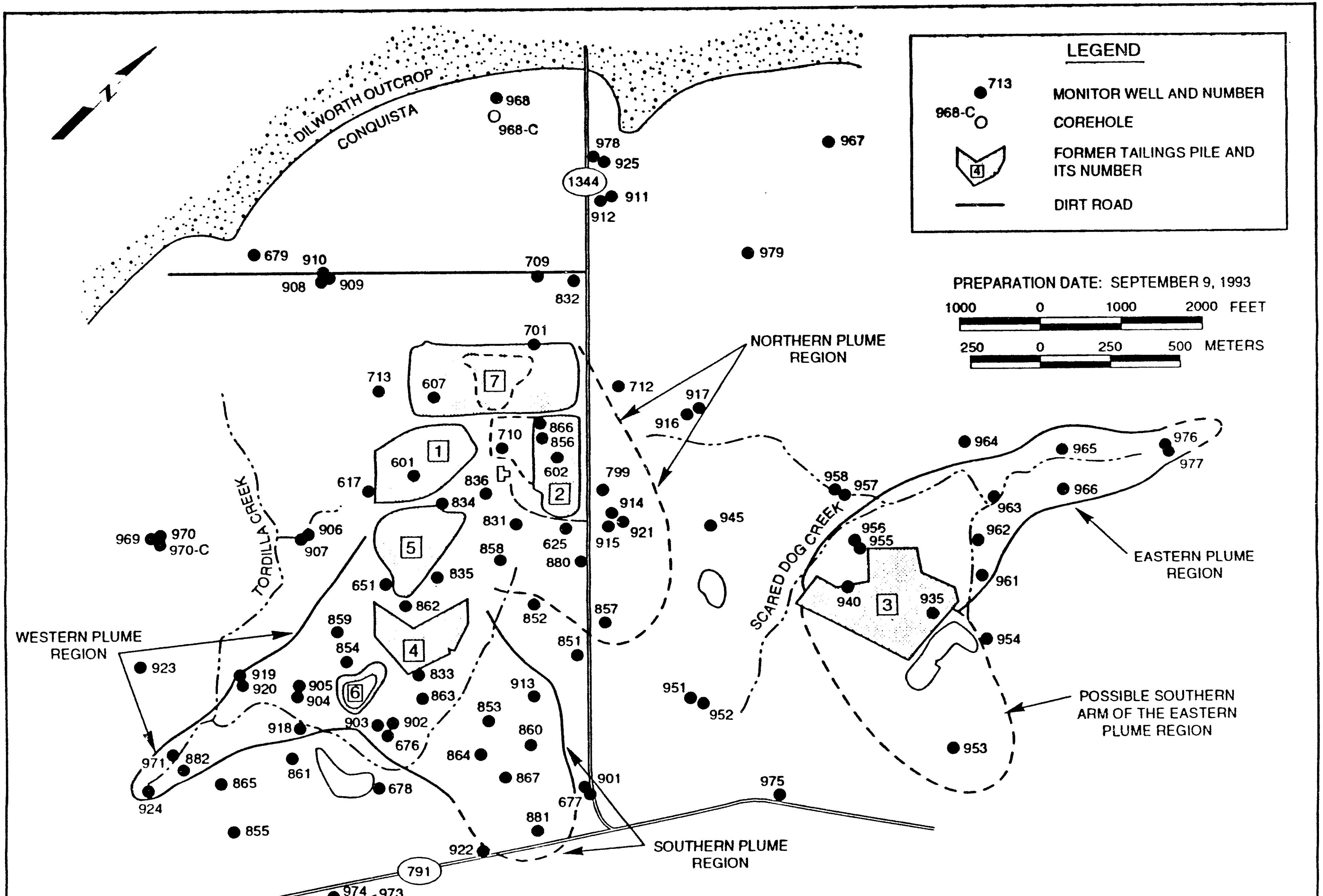

FIGURE 2.5
APPROXIMATE DISTRIBUTION OF TAILINGS-CONTAMINATED GROUND WATER
FALLS CITY, TEXAS, SITE

MAC: SITE/FCT/WSAP/DEEREFWELL

Northern plume region

The northern plume region is associated primarily with former piles 1, 2, and 7. The pH of the ground water in this region varies from about 3 in monitor well 625 to almost 7 in well 921. Locally in this region, very high levels of sulfate contamination (approximately 11,000 milligrams per liter [mg/L] in monitor well 625) are present. The extremely high sulfate concentrations in this part of the Deweesville/Conquista aquifer were generated by a tailings pond that existed in the southern end of pile 2.

Southern plume region

The primary source areas of the southern plume region appear to be tailings piles 4 and 5 and pond 6. The southern plume region may extend as far as FM 791, approximately 2500 ft (760 m) to the southeast. This plume is generally acidic, with a pH range from 3 to 4 and significantly higher chloride concentrations than the other plume regions. The high chloride associated with this plume appears to originate primarily from the pond in tailings pile 6. Analysis of this pond water indicates chloride levels greater than 16,000 mg/L (DOE, 1992).

Western plume region

Much of this plume region is also acidic (e.g., monitor wells 854, 882, and 904). Ground water from monitor wells 918 and 924, however, is not acidic or is only slightly acidic (pH ranges from 5 to 7) (DOE, 1992). The southwest plume region appears to originate from piles 4 and 5 and to a lesser extent pond 6. This contaminated region extends over 3000 ft (900 m) to the southwest in ground water beneath Tordilla Creek from pile 4 and pond 6.

The area between piles 4 and 5 contains a 1- to 3-ft (0.3- to 1-m)-thick zone of acidic, sulfate- and possibly metals-rich ground water that is perched on top of a thin but laterally extensive silicified layer in the Deweesville/Conquista. This shallow perched saturated zone was probably generated by horizontal flow along this silicified layer when tailings leachate was injected into piles 4 and 5 during *in situ* mining operations (DOE, 1992).

Dilworth

Contamination in the Dilworth aquifer was identified in monitor well 977 and in monitor well 833 at the southern edge of pile 4.

Ground water sampled from monitor well 977 (sampled June 1991) is acidic (pH 4.23) and contains moderately elevated levels of aluminum (1.02 mg/L), iron (1.4 mg/L), sulfate (1580 mg/L), and uranium (0.054 mg/L) (DOE, 1992).

Only two sampling rounds (February 1986 and December 1991) were conducted from monitor well 833, before it was abandoned during construction of the disposal cell. The decrease in alkalinity and pH and the significant increase in concentrations of ammonium, iron, manganese, sulfate, and uranium in the ground water from this well over time (DOE, 1992) suggests the Dilworth is being contaminated in this area.

3.0 DATA COLLECTION OBJECTIVES

3.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQO) define the way in which samples are collected, handled, and analyzed. This includes defining analytical support levels; following standard procedures for water sampling, preservation, transport, and various other field procedures; performing DQOs in accordance with quality assurance (QA) and quality control (QC) protocols; and providing analytical data validation. DQOs that will be followed during data collection and evaluation activities are defined in the guidance document (DOE, 1993a), UMTRA Project documents such as the QA implementation plan (QAIP) (DOE, 1993b) and applicable SOPs (JEG, n.d.), and other DOE and EPA documents.

3.2 REGULATORY REQUIREMENTS

The regulatory requirements for ground water sampling at the Falls City site are specified in EPA proposed groundwater protection standards (52 FR 36000 [1987]) and in state (Texas) regulations.

3.3 COMPLIANCE MONITORING

Ground water in the Deweesville/Conquista and Dilworth aquifers is Class III (limited use) because it meets one of the criteria for supplemental standards. For this supplemental standard application, concentration limits and a point of compliance are not specified. However, the DOE will continue to monitor ground water quality at the site at selected locations after surface remedial action is completed in the spring of 1994. At that time, a long-term surveillance plan will be developed to address the monitoring needs of the disposal cell. The data collected will be used to evaluate the disposal cell performance.

3.4 SITE CHARACTERIZATION

Characterization of contaminant migration will be an ongoing site characterization activity. Monitor wells within and just beyond the fringes of the contaminant plumes will be monitored.

3.5 RISK ASSESSMENT

Water samples for a baseline risk assessment were taken from monitor wells downgradient of the disposal cell. The sampling results will be used to determine contaminant plume locations, constituent concentrations, and water quality and quantity at potential receptor points. A list of potential contaminants of concern will be compiled to assess risks to human health or the environment at the Falls City site. At this time, no additional data collection needs are required for risk assessment purposes. When the final risk assessment is conducted, sampling locations and analytical parameters will be determined.

4.0 WATER SAMPLING PLAN

4.1 SAMPLING LOCATIONS

The ground water monitoring network consists of 15 wells screened in the Deweesville/Conquista aquifer and 5 wells screened in the Dilworth aquifer. The Deweesville/Conquista aquifer monitor wells that will be sampled are within or just beyond the fringes of the four contaminant plumes. Because of disposal cell construction activities, all monitor wells screened in the plume in the Dilworth aquifer beneath pile 4 were decommissioned and no longer exist. Ground water sampling in the Dilworth aquifer will consist of sampling five wells to primarily monitor background and downgradient ground water quality conditions. The network of monitor wells for the Deweesville/Conquista and Dilworth aquifers is shown in Table 4.1.

Surface water samples will not be collected from Scared Dog and Tordilla Creeks because they are ephemeral, with base flows that are either nonexistent or too sporadic to sample on a periodic basis. These creeks flow only for short periods immediately after large rainstorms. Surface water samples collected and analyzed in 1992 do not indicate that surface water quality in Tordilla and Scared Dog Creeks is affected by tailings seepage.

4.2 CONSTITUENT SELECTION

The ground water monitoring program includes collecting and analyzing ground water samples from the monitor wells listed in Table 4.1. Ground water samples were initially evaluated for hazardous constituents generally expected to be in or derived from the residual radioactive materials related to the uranium processing activities. The list of constituents was modified during subsequent sampling events to focus on hazardous constituents related to uranium processing activities at this site. Based on existing ground water quality data, all ground water samples collected at the site will be analyzed in the laboratory for the following constituents: aluminum, ammonium, bromide, calcium, chloride, iron, magnesium, manganese, mercury, molybdenum, nitrate, potassium, sodium, sulfate, and uranium. Water samples from monitor wells are normally filtered at the site before they are shipped to the laboratory for analysis.

Alkalinity, pH, specific conductance, temperature, dissolved oxygen, and oxidation/reduction potential will be measured in the field. Alkalinity, pH, specific conductance, temperature, and redox potential are easily measured and provide early indications of changes in ground water quality.

4.3 SAMPLING FREQUENCY

Ground and surface water have been monitored at the Falls City site since 1986. Ground water sampling will be conducted biannually for fiscal year

Table 4.1 Ground water monitoring network, Falls City, Texas, site

Well number	Formation screened	Screened interval (depth below surface) (ft)	Screened interval (depth below surface) (m)
677	Deweesville	49 - 80	15 - 24
851	Deweesville	27 - 37	8 - 11
857	Conquista	44 - 54	13 - 16
862	Dilworth	41 - 51	12 - 16
865	Conquista	35 - 45	11 - 14
867	Deweesville	53 - 63	16 - 19
880	Deweesville	35 - 45	11 - 14
881	Conquista	90 - 100	27 - 30
882	Conquista	31 - 41	9 - 12
919	Conquista	9 - 19	3 - 6
921	Conquista	45 - 55	14 - 17
922	Deweesville	68 - 78	21 - 24
924	Conquista	19 - 29	6 - 9
953	Deweesville	21 - 41	6 - 12
958	Dilworth	60 - 80	18 - 24
963	Conquista	9 - 19	3 - 6
965	Conquista	18 - 28	5 - 9
969	Dilworth	88 - 108	27 - 33
977	Dilworth	30 - 40	9 - 12
979	Dilworth	69 - 79	21 - 24

1994. This sampling frequency will allow evaluation of trends in ground water flow conditions and ground water quality, and also will provide additional information and continuity of the data base. This additional information will be useful during the ground water remediation phase.

4.4 DATA INTERPRETATION

Water sampling data collected during 1994 will be analyzed and evaluated according to prescribed UMTRA Project procedures and compared with the existing data base. Trends will be analyzed to detect any variations in ground water flow conditions and ground water quality. Variations will be evaluated and modifications to the sampling plan will be noted, justified, and implemented as appropriate.

4.5 ANOMALOUS DATA EVALUATION

If results from the water sampling are beyond the range of expected values, the suspect data will be evaluated to determine the cause of the deviation. If the deviation cannot be related to an error in sample collection or analysis, or to processes reasonably expected to occur in the hydrogeologic environment, the location will be resampled during the next scheduled sampling round, or sooner if dictated by an urgent need related to potential impact to human health and the environment. Detailed procedures for evaluating anomalous data are included in the WSAP guidance document (DOE, 1993a).

5.0 LIST OF CONTRIBUTORS

The following individuals contributed to the preparation of this document.

Name	Contribution
E. Storms	Overall document responsibility; authorship; hydrology
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B. Harvey	Graphic design
J. Torline	Technical editing, document production coordination

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FEDERAL REGISTER

52 FR 36000, "Standards for Remedial Actions at Inactive Uranium Processing Sites; Proposed Rule," September 24, 1987.

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