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Office of
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June 1987

EPA

Superfund Record of Decision:

HIGHLANDS ACID PIT, TX

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

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4. TITLE AND SUBTITLE SUPERFUND RECORD OF DECISION Highlands Acid Pit, TX Second Remedial Action - Final		5. REPORT DATE June 26, 1987 6. PERFORMING ORGANIZATION CODE
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15. SUPPLEMENTARY NOTES		

16. ABSTRACT

The Highlands Acid Pit site is located 16 miles east of Houston on a 6-acre peninsula in Harris County, Texas. The site is bordered on the west and south by the San Jacinto River, on the north by a wooded area, and on the east by a sand pit. The site lies within the 10-year flood plain and has subsided 2.4 feet since 1964. An unknown quantity of industrial waste sludge was disposed of at the site in the 1950s. The sludge is believed to be spent sulfuric wastes from a refinery process. The June 1984 Record of Decision, addressing the source of contamination, was inadequate to evaluate the full extent of ground water contamination. The primary contaminants of concern addressing ground water include VOCs and heavy metals.

The recommended remedial action includes a no action remedy with long-term ground water and surface water monitoring since the contaminants of concern were not detected above criteria levels. The capital cost for this monitoring program is $4,700 with annual O&M of $6,980.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Highlands Acid Pit, TX Second Remedial Action - Final Contaminated Media: gw, sw Key contaminants: VOCs, heavy metals		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)* None	21. NO. OF PAGES 37
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ABBREVIATED RECORD OF DECISION
HIGHLANDS ACID PIT
GROUNDWATER OPERABLE UNIT

Site: Highlands Acid Pit site is located 16 miles east of Houston and 1.4 miles west of Highlands, Texas.

Documents Reviewed

I have reviewed the following documents to determine the need for corrective action for the groundwater operable unit at the Highlands Acid Pit site:

- Highlands Acid Pit Site Record of Decision for the source operable unit -- dated June 25, 1984.
- Summary of Remedial Alternative Selection -- dated January 1984.
- Feasibility Study: Groundwater Management Evaluation Report for Highlands Acid Pit Site; Highlands Texas -- dated January 1986; Camp Dresser and McKee.
- Groundwater Study Report for Highlands Acid Pit -- dated April 1987; Camp Dresser and Mckee.
- Operating Plan for Remedial Action Project, Highlands Acid Pit; Highlands, Texas -- dated February 26, 1987; Chemical Waste Management, Incorporated, Volume 1, Sections 4 & 5 and Appendix E.
- Staff summaries and recommendations.
- Responsiveness Summary

The "Summary of Remedial Action Selection" is attached hereto, incorporated herein by preference, and made a part of this Record of Decision. This attached document summarizes the remedies considered and is the basis for my decision.

Description of Selected Remedial Action

- Directly upon completion of the source removal action, a long term monitoring program shall be initiated for the shallow and next lower aquifer and for the surrounding surface water bodies--water and sediment samples.
- If, after source removal, monitoring reveals that the site continues to release contamination such that the adjoining surface waters or deeper groundwater is adversely impacted, then further action will be considered. If no trend toward adverse impacts is detected, delisting will be pursued.

Declaration

Consistent with the Comprehensive Environmental Response, Compensation, and Liablity Act of 1980 as amended by Superfund Amendments and Reauthorization Act of 1986, and the National Contingency Plan, I have determined that long term monitoring of groundwater and surface waters will provide adequate protection of public health, welfare, and the environment.

The state of Texas has been consulted and agrees with the approved remedial action for the groundwater operable unit. The activities outlined in the 1984 ROD for source control operation and maintenance are incorporated into the selected remedy for the groundwater unit. In addition, Grennel Slough, Clear Lake, and the sand pits will be routinely monitored for buildup of contaminants. If an increase in contaminants from the site is detected during a monitoring period, an investigation will be initiated to determine the need for future action. For such case, a Record of Decision must be prepared for any future remedial action.

6-26-87

Date

Robert E. Layton Jr.

Robert E. Layton, Jr., P.E.
Regional Administrator, Region VI

Summary of Remedial Action Selection

Highlands Acid Pit
Groundwater Operable Unit

Highlands, Texas
April 1987

Site Location & Description

The Highlands Acid Pit site is located in a sparsely populated area of Harris County, 16 miles east of Houston and 1.4 miles west of Highlands, Texas. The location of the site is shown in Figures 1 & 2. Bordered by a wooded area to the north, Grennel Slough to the west, Clear Lake to the south, and flooded sand pits to the east, the Highlands site is situated on a 6 acre pennisula within the 10-year flood plain of the San Jacinto River. Land use in the surrounding area is 24% residential, 20% surface waters, 16.4% mixed forest, 7.6% forested wetland, and 7.6% industrial.

The average elevation of the site is approximately 5 to 10 feet above Mean Sea Level (MSL). Dense vegetation covers the site except for the bare area in the center of the site, believed to be the primary dumping area. Although drainage is primarily south into Clear Lake, there is significant drainage west into the San Jacinto River and east into the sand pits. Nearly 5 feet of subsidence has been recorded at the site between 1890 and 1973. The low relief of the surrounding area results in periodic flooding onsite. As subsidence continues, the instances of flooding are expected to increase.

Site History

The Highlands Acid Pit site was used for the disposal of an unknown quantity of industrial waste sludge, believed to be spent sulfuric acid from a refinery process, during the early 1950's. The Summary of Remedial Alternative Selection, dated January 1984, [future references: 1984 ROD Summary], outlines the site history prior to 1984. The June 24, 1984 Record of Decision (ROD) dealt with the source of contamination at the Highlands Acid Pit site. The 1984 ROD remedy included the following: 1)excavate waste and contaminated soil over a 2.41 acre area, down to the water table; 2)transport excavated material to a permitted class 1 disposal facility; 3) backfill the area with clean fill; 4)install a groundwater monitoring system; 5) perform site maintenance and groundwater monitoring for a 30 year period. The remedial design of the source control was approved December 4, 1985. Mobilization for the source control operable unit remedial action was initiated in February 1987.

The majority of information presented in the 1984 ROD Summary was adequate for identifying groundwater reclamation alternatives for the Groundwater Feasibility Study (FS) dated January 1986. However, information on the subsurface environment was inadequate to evaluate any corrective action for the shallow aquifer. The integrity of the clay aquitard separating the upper and middle aquifers and the full extent of groundwater contamination were not investigated prior to the Groundwater Study (GWS) completed in April 1987.

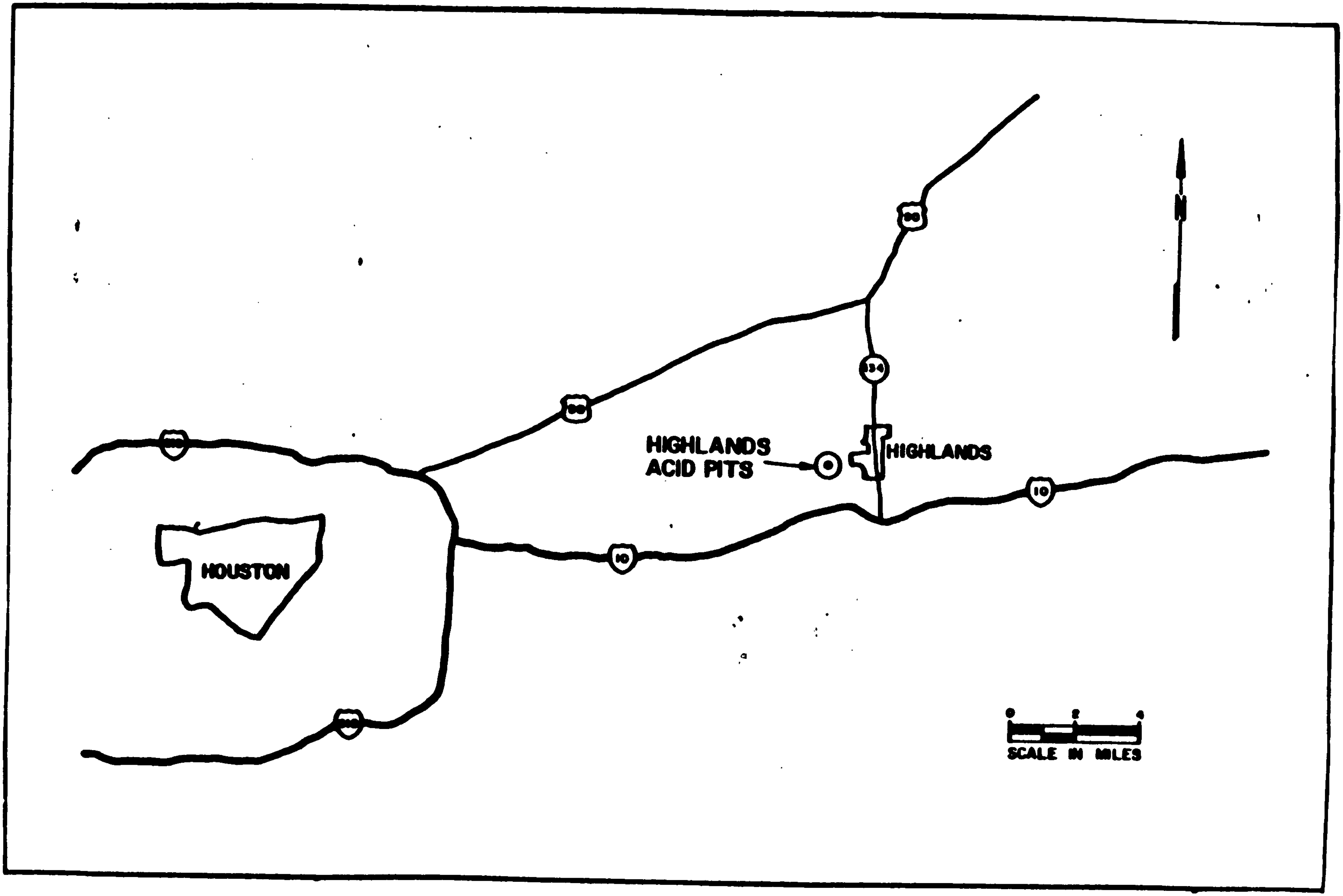
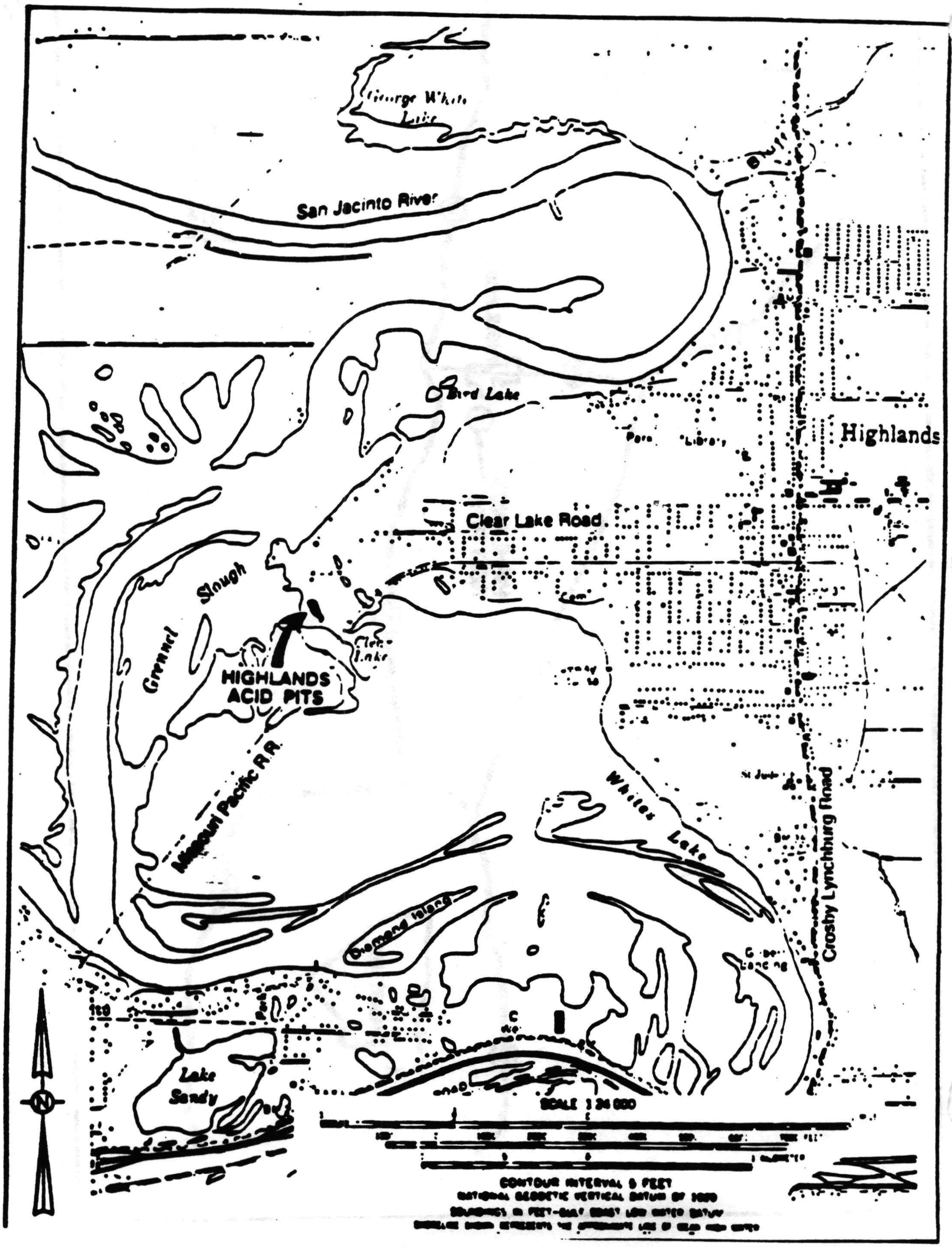


FIGURE 1: SITE LOCATION HIGLANDS ACID PITS

FIGURE 2: LOCATION MAP OF HIGHLANDS ACID PIT



CURRENT SITE STATUS

The 1984 ROD Summary presents the findings of the Highlands site Remedial Investigation (RI)/Feasibility Study (FS) in reference to surface water levels, alluvium deposits, aquifer formations, water well inventory, nature and distribution of wastes at the site, and impact assessments for exposure of wastes to the hydrologic system. Information relevent to the groundwater operable unit is summarized in the following subparts. Although reported in the Groundwater Study, this information originated in previous investigations.

Geology

The local near-surface geology at the Highlands site is comprised of three sand intervals separated by two clay strata, Figure 3. The upper sand layer, recent meanderbelt alluvial sediments, varies in thickness from 18.5 to 26.0 feet. The Beaumont Clay Formation, underlying the upper sand, forms alternating layers of clay and sand. The clay aquitard directly beneath the upper sand is 30 feet thick across the entire site area. This clay interval grades from a slightly silty clay at the alluvial contact to a silty sandy clay at -45 feet MSL. A 23 to 26 foot sand layer, the middle sand, underlies the clay aquitard. A second clay aquitard, 25 feet thick, separates the middle sand from a lower sand interval, 14 to 18 feet thick.

Hydrogeology

The permeability of the upper alluvial sand ranges from 4.0 to 8.0 ft/day. Groundwater elevations in the upper sand are strongly correlated with the level of the San Jacinto River, indicating that the river and the alluvium are hydraulically connected. Due to this connection, groundwater flow varies with the level of the river. At high tide, the primary flow directions are east toward the sand pits and south toward Clear Lake. The groundwater flow to the west, toward the San Jacinto River, is small. At low tide, similar flow patterns are evident. However, the groundwater elevations and gradients are lower and there is some inland flow to the southern portion of the site. Groundwater elevations for wells completed in the upper sand range from 1.64 to 2.25 MSL.

Limited information is available for the middle and lower sands. Only one well was completed in the middle sand. The groundwater elevation in this well is -1.53 feet MSL. Two wells completed in the lower sand show groundwater elevations ranging from -57.02 to -64.25 feet MSL.

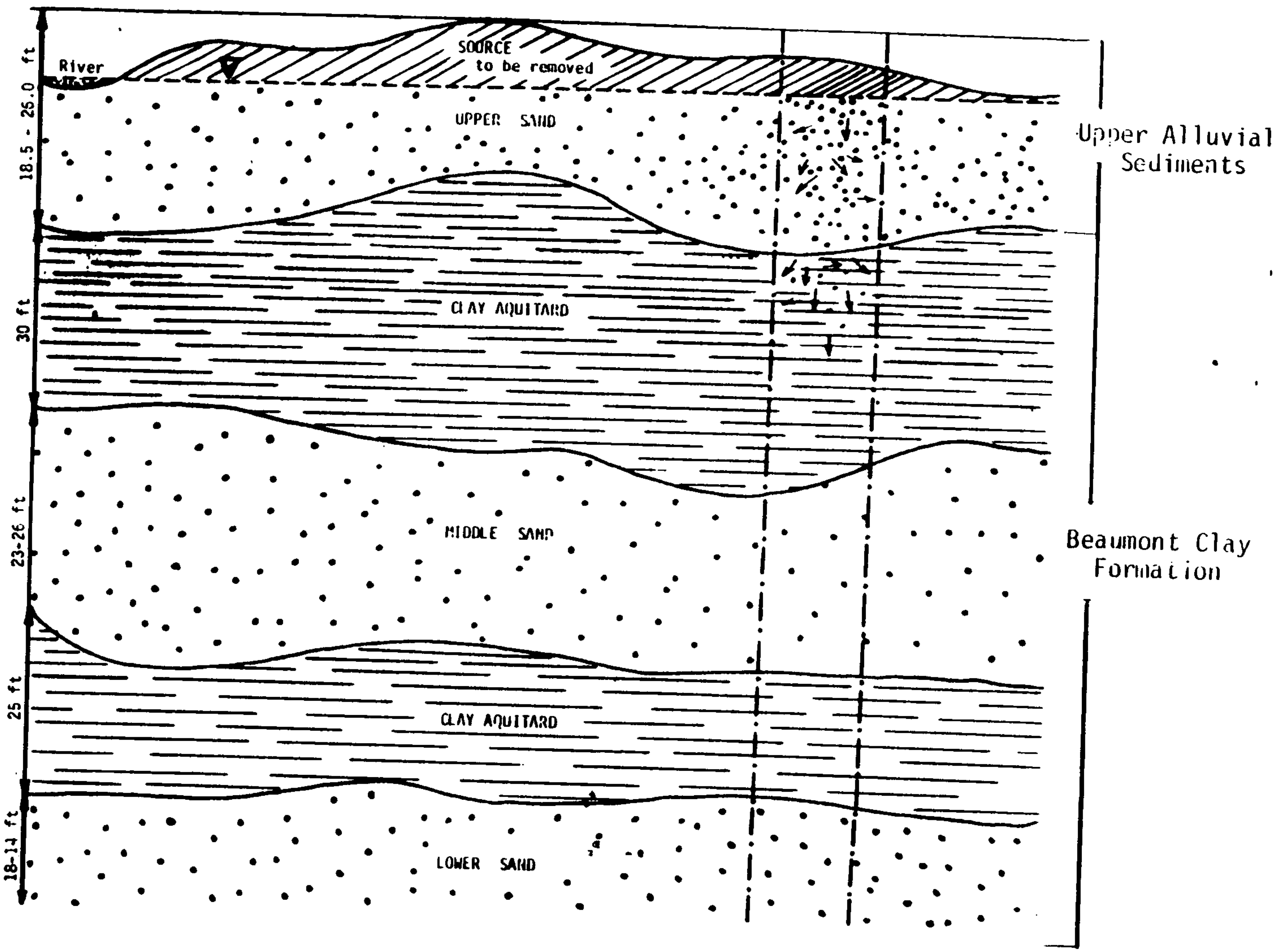


FIGURE 3: HIGHLANDS ACID PIT SITE NEAR-SURFACE GEOLOGY

Groundwater Study Investigation (GWS)

In March 1985, a groundwater study was initiated to evaluate the potential for migration of shallow groundwater contaminants once the source of contamination is removed. In November 1985, fieldwork at the site included redevelopment and repair of existing monitoring wells. New monitoring wells were also installed in the upper aquifer. To establish the extent of contaminant migration, a second phase of sampling was completed in July 1986. Additional surface water and sediment samples were taken, as well as samples from the upper and middle aquifer and the clay aquitard. Figure 4 shows onsite sampling locations referenced in the GWS. The legend for this figure cross-references the well labels used in previous investigations.

The nearest private well, screened in the middle aquifer 1/2 mile north of the site, was also sampled. This well is not used for drinking water and, based on the limited middle aquifer information available, is located up gradient from the site. Figure 5 is a location map of private wells within a 2 mile radius of the site. Well 7 is the only middle aquifer well. All other wells are screened in the deeper aquifer. From the well survey of this area, the shallow aquifer is not considered a source of potable water.

Extent & Magnitude of Contamination: Sampling results show high concentration levels of volatile organics and heavy metals within the upper sand saturated zone (shallow aquifer). Chosen on the basis of toxicity, concentration, and persistence, the contaminants of major concern include benzene, pyridine, arsenic, cadmium, chromium, and lead. Table 1 includes the range of concentrations for each of these contaminants as sampled over the 9 shallow aquifer wells onsite. Standards used to assess health and environmental risks are also listed. Water Quality Criteria (WQC) are used for surface water impacts and Maximum Contaminant Levels (MCL) are used for drinking water aquifer determinations. With the exception of pyridine, all high concentrations were detected in well UA5 (Figure 4), located in the most contaminated area onsite. The high concentration of pyridine was detected in well UA1 (Figure 4).

Although organics & heavy metals have saturated the transition region between the upper sand and the underlying clay aquitard, contaminants of concern were not detected in the middle aquifer. The contaminant concentrations detected at various depths within the clay aquitard are for two referenced boring locations AS1 and AS2, Tables 2 and 3 respectively. Benzene was found in decreasing concentrations up to a depth of 8 feet in the clay aquitard while pyridine was not detected beyond a 3 foot depth. Maximum concentrations of both benzene and pyridine reach only 3 feet in each of the boring samples. Inorganics of concern were found at background levels within the clay aquitard.

With the exception of chromium, contaminants of concern were not detected in the San Jacinto River, Grennel Slough, Clear Lake, or the sand pits. Total chromium was detected at 0.005 mg/l in Grennel Slough, well below the WQC of 0.05 mg/l for Cr^{+6} and 170 mg/l for Cr^{+3}. Sediments sampled at the same surface water locations do not demonstrate levels of concern when compared to background concentrations.

LEGEND for FIGURE 4

Description	Sampling Number: Groundwater Study	Sampling Number: Previous Investigations	Comments
Upper Aquifer	UAI	MW-1B	
	UA2	NW-2B	
	UA3	MW-3B	
	UA4	MW-4	
	UA5	MW-1	TDWR well
	UA6	MW-5	TDWR well
		MW-6	TDWR well
	UA8		New well
	UA9		New well
	UA10		New well
Middle Aquifer	MA2	MW-2A	
Deep Aquifer	DA1	MW-1A	
	DA2	MW-3A	
Surface Water Sampling	SW1	A-3	
	SW2	A-4	
	SW3	A-10	
	SW4	A-6	
Sediment Sampling	SD1	A-3	
	SD2	A-4 (EHA) S-2 (TDWR)	
	SD3	A-10(EHA) S-1 (TDWR)	
	SL4	A-6	
Aquitard Sampling	AS1	B-7	
	AS2	B-3	

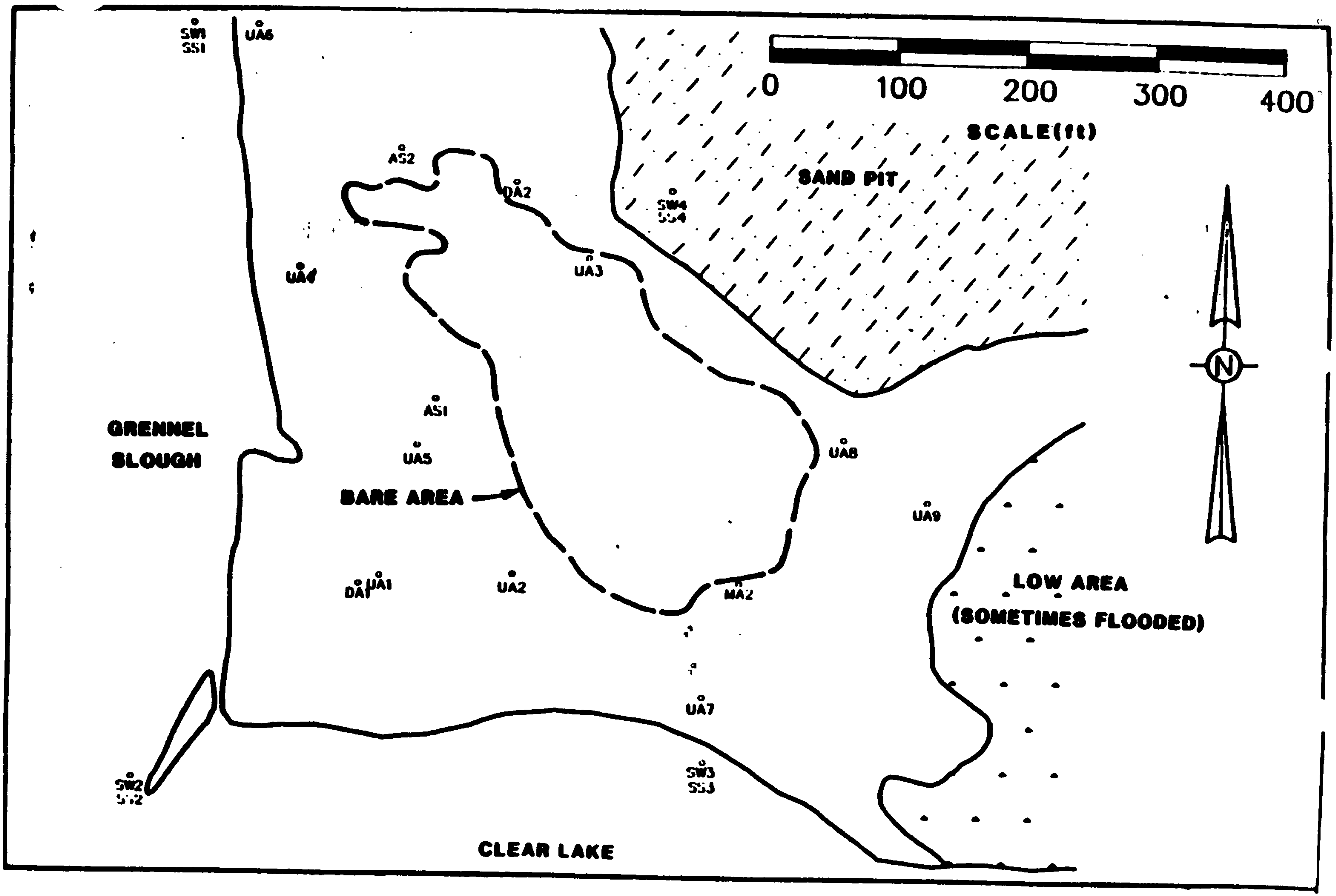


FIGURE 4: SAMPLE LOCATIONS

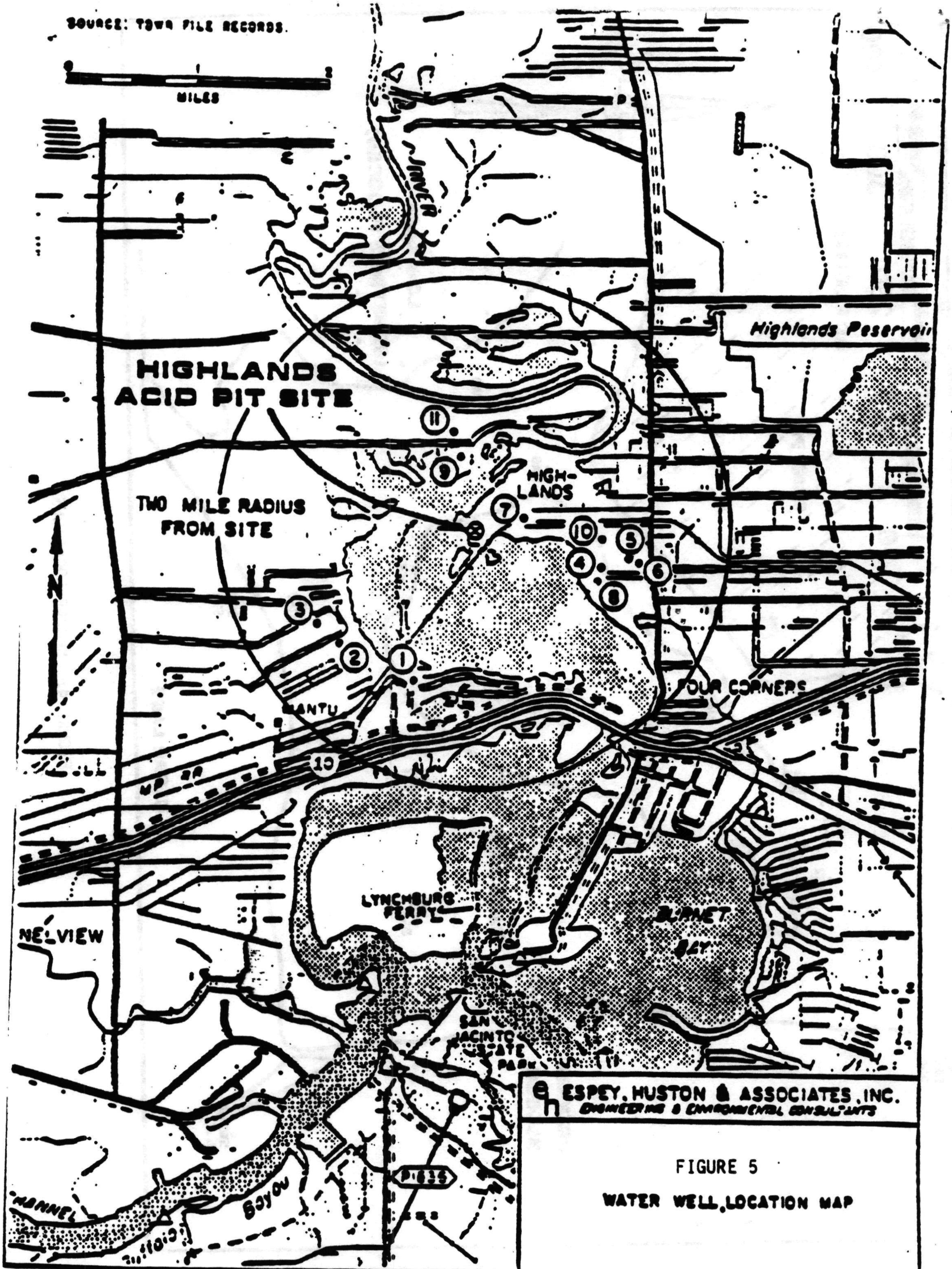


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FIGURE 5

WATER WELL LOCATION MAP

TABLE 1: CONTAMINANTS OF CONCERN IN THE SHALLOW AQUIFER (sampling events from 11-85 through 6-86)

CONTAMINANTS OF CONCERN	RANGE OVER 9 WELLS ONSITE	CLEAN WATER ACT Water Quality Criteria	SAFE DRINKING WATER ACT Maximum Contaminant Levels
Benzene	ND - 210.0	[0.66]	0.005
Pyridine	ND - 3.2	None Established	None Established
Arsenic	ND - 1.2	2.2 ng/l	0.05
Cadmium	ND - 0.019*	0.01	0.01
Chromium, total	0.018 - 2.699	---	---
Chromium, Cr^{+6}	---	0.05	0.05
Chromium, Cr^{+3}	---	170.0	None Established
Lead	0.005 - 0.118	0.05	0.05

NOTES: All concentrations in mg/l unless stated otherwise.

ND = No Detection at HSL Detection Limit

[] = Detection Limit Value

* Well directly beneath site was sole detection--all others showed ND.

TABLE 2: BORING AS-1 SAMPLING SUMMARY

(Concentrations in ug/kg)

Samples for 11/85 Depth (feet)	0.0-5.0	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5
Benzene	430	570	13	3,J	1800
Pyridine	16000,B	7000	ND	3400	13000

Samples for 6/86 Depth (feet)	2.5-4.5	4.5-6.5	6.5-8.5	8.5-10.5	10.5-12.5	12.5-14.5	14.5-16.5	16.5-18.5	18.5-20.5	20.5-22.5
Benzene	98	ND	ND	ND	ND	11	4,J,B	2,J,B	ND	ND
Pyridine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	3100	12000	ND	ND	6100	4500	3000	5400	2200	3100
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	37000	37000	40000	44000	35000	27000	28000	26000	31000	30000
Lead	13000	15000	22000	22000	16000	14000	17000	27000	13000	8900

TABLE 3: BORING AS-2 SAMPLING SUMMARY

(Concentrations in ug/kg)

Samples for 11/85

Depth (feet)	0.0-5.0	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5
Benzene	44	52	ND	ND	230
Pyridine	2700	970	ND	ND	4700

Samples 6/86

Depth (feet)	2.5-4.5	4.5-6.5	6.5-8.5	8.5-10.5	10.5-12.5	12.5-14.5	14.5-16.5	16.5-18.5	18.5-20.5	20.5-22.5	22.5-24.5
Benzene	580	350	72	ND	ND	ND	ND	ND	ND	ND	ND
Pyridine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	ND	10600	ND	4100	8400	4900	ND	ND	ND	8400	ND
Cadmium	ND	2900	ND	2600	2000	[1400]	1200	ND	1300	2900	1900
Chromium	22000	16000	27000	26000	20000	17000	8200	18000	20000	25000	25000
Lead	28500	21800	10100	13100	21400	20500	16300	10100	15900	18400	7800

Transport & Impact of Contamination: Upon completion of the source removal action, surface water contamination from runoff will be eliminated. The source of the contaminant loading to the upper aquifer will also be removed. Migration pathways will then include vertical movement of shallow groundwater through the underlying clay aquitard to deeper groundwaters and lateral movement of shallow groundwater to surface water bodies.

The natural flow of groundwater cleanses the pore spaces within the shallow aquifer over time. Attenuation of contaminants down to nondetectible levels within the upper aquifer should take about 350 years. This time estimate is based upon the retardation factor of benzene and the properties of the aquifer itself. Organics should attenuate throughout the clay aquitard horizontally and vertically while inorganics are caught in sediments of the top portion of the clay aquitard. If organics reach the middle aquifer, contaminants could be detected before levels of concern are reached.

Groundwater flow to surface water bodies will continue to carry some contaminants to the surface environment. However, the heavy metals are not mobile at the pH of the transition region for groundwater flow to surface water bodies and the organics are volatile upon contact with the atmosphere. In view of the dynamics of the river and the properties of the contaminants, the San Jacinto River should not be affected.

ENFORCEMENT

Only one potentially responsible party, the landowner, has been identified. The identified party does not have the financial assets to pay for any remedial action pertaining to the groundwater at the site. Attempts to identify the generator(s) of the waste have been unsuccessful. Therefore, the Environmental Protection Agency, Region VI office, recommends that the Fund be used for the groundwater operable unit remedial action at the Highlands Acid Pit site.

ALTERNATIVES EVALUATION

The exposure to risks associated with contaminants present in the shallow groundwater, upon completion of the source removal, form the basis for the following objectives of the Groundwater Operable Unit:

- Characterize contaminant migration to surface waters, area environment, and deeper groundwaters.
- Determine potential impacts to potential receptors.
- Evaluate the need for groundwater corrective action at the Highlands site.

The groundwater FS identified four remedial alternatives for groundwater reclamation prior to fulfilling the above objectives. Although these remedial alternatives were developed to eliminate or reduce the risks of future exposure to shallow aquifer contaminants, these risks were not entirely established due to the lack of data. The GWS was initiated to meet the above objectives by providing the information required to effectively evaluate those remedial alternatives generated in the groundwater FS. Furthermore, such information would ensure a reliable evaluation of the need for groundwater corrective action. The GWS results indicate that the no action alternative should be considered in the final screening process.

All remedial alternatives are to be screened based upon the results of the GWS in conjunction with the criteria outlined in the Superfund Amendments and Reauthorization Act (SARA) and the National Contingency Plan (NCP):

- Effectiveness
- Implementability
- Cost

Effectiveness is evaluated on a basis of protectiveness, reliability, and reduction in toxicity, mobility, or volume. Applicable, Relevant, and Appropriate Requirements (ARARS) of other Federal and more stringent State laws are also used to determine the effectiveness of a remedy. Implementability involves technical feasibility, availability of required resources, and administrative feasibility (time frame of implementation and level of operator skill/attention). Total cost includes capital, replacement, and operation and maintenance.

Table 4 is a summary of the initial screening of available alternative options as determined in the groundwater FS. Table 5 outlines the costs associated with each alternative developed after the initial screening. The no action alternative was not included in the FS--an additional groundwater study was recommended instead. The following discussion will focus on the final evaluation of each alternative, including the no action alternative, in consideration of relevant GWS information as well as the short and long term effects of SARA criteria and the requirements of the NCP. Table 6, found prior to the Recommended Alternative section, is a summary of the environmental, technical, and public health considerations for each alternative.

TABLE 4: INITIAL SCREENING OF TECHNOLOGIES

TREATMENT	STATUS PRIOR TO GWS	REASONS FOR REJECTION
ISOLATION		
Encapsulate the shallow aquifer with a surface cap/liner, clay bottom and		
o grout curtain sides	Rejected	Ineffective as continuous low permeability barrier.
o sheet pile sides	Rejected	Steel is most economical, but corrodes with acidity.
o slurry wall sides	Acceptable	
IN-SITU		
Chemical or Biological Agents degrade, remove, or immobilize contaminants.	Unacceptable	Treatment agent must be contaminant specific to avoid new toxic products.
GROUNDWATER RECOVERY		
Remove at least 5 volumes of shallow aquiter groundwater.		
o No treatment with Deep Well Injection.	Acceptable	
o Biological Treatment System* with Discharge and Deep Well Injection.	Acceptable*	
o Carbon Adsorption System** with Discnarge and Deep Well Injection.	Acceptable*	

*This system comprised of (1) chemical precipitation, (2) activated sludge, (3) partial discharge/disposal.

**Comprised of (1) multi-media filtration, (2) carbon adsorption, (3) reverse osmosis, (4) partial discharge [illegible]posal.

TABLE 5: GROUNDWATER FS ALTERNATIVES COST SUMMARY

REMEDIAL ALTERNATIVES	COSTS CAPITAL	ANNUAL O&M	PRESENT WORTH*
Slurry Wall Containment System	$786,750	$82,500	$1,550,000
Recovery/Offsite Disposal	$388,125	$3,886,250	$15,120,000
Recovery/Onsite Biological Treatment Partial Discharge and Offsite Disposal	$775,625	$284,250	$1,860,000
Recovery/Onsite Carbon Treatment Partial Discharge and Offsite Disposal	$413,125	$1,123,750	$4,675,000

*BASIS: 0% inflation rate; 10% discount rate; 5 year life cycle, except for slurry wall alternative -- 30 year life cycle used.

ALTERNATIVE 1

Isolation of the Upper Aquifer: A slurry wall with a 2000 foot circumference, a 3 foot width, and a 23 foot depth (5 feet into the clay aquitard, 18 feet within the upper sand) was assumed adequate to contain the contaminant plume. The clay aquitard was assumed to be impermeable. A cap 6 acres in size, consisting of a 2 foot clay layer with a synthetic liner, was also required.

From information presented in the GWS, contaminants have penetrated the clay aquitard both vertically and horizontally. If a slurry wall were constructed, lateral dispersion within the aquitard would be limited while vertical migration could be intensified. Contaminants would have a higher potential for reaching the middle aquifer. A synthetic liner between the upper sand and clay aquitard is technically infeasible. Therefore, the slurry wall remedial alternative has been rejected due to unreliable effectiveness.

ALTERNATIVE 2

Groundwater Recovery & Offsite Disposal: The shallow aquifer holds 11.5 million gallons of groundwater beneath the site. In consideration of aquifer characteristics and the affinity for adsorption of contaminants of concern, approximately 5 times this amount would need to be removed in order to cleanse the pore spaces of contaminants present. A configuration of 35 shallow wells on 60-foot centers could withdraw groundwater at 50,400 gallons/day (gpd). These wells would then discharge through a polypropylene piping system to a centrally located holding tank. After pH adjustment, the liquid waste could be transported to a local deep well injection field for disposal.

About 300 days were estimated to remove 11.5 million gallons, assuming service time for each well at varying times. Therefore, any recovery process was assumed to take a minimum of 5 years. During this time, any offsite disposal alternative would create a potential exposure route. Access roads to and from the site pass directly through a residential neighborhood.

The GWS uses a slightly more conservative estimate for the number of times the pore spaces should be flushed in order to remove contaminants of concern from the shallow aquifer--at least 6 volumes are necessary. Even this amount of time might prove inadequate to remove the contaminants lying in the lower sediments of the upper sand saturated zone. Possibly a 7- to 9-year period would be required for groundwater reclamation through this alternative.

Since 100% of the contamination is merely moved to a different location, the effectiveness of this non-treatment remedy falls below that of similar treatment alternatives which could permanently and significantly reduce the toxicity, mobility, or volume of contaminants. Furthermore, this alternative would not comply with the 1986 Land Disposal Restrictions which require treatment of contaminated water down to specified levels prior to deep well injection (Land Disposal Restrictions effective for Superfund sites November 8,1988).

ALTERNATIVE 3

Groundwater Recovery, Onsite Biological Treatment, & Discharge/Offsite Disposal: The groundwater recovery system is the same as that discussed under alternative 2.

The Biological System would utilize chemical precipitation followed by a conventional activated sludge unit. The sludge generated by both these steps would total 3% of the contaminated groundwater feed stream. The sludge was assumed to be withdrawn at a sufficient flow rate to keep the solids content below the upper limit allowable at deep well disposal sites. Final filtration was assumed unnecessary and was not included in the FS cost analysis. The remaining 97% could be discharged as adequately treated water. Although the entire process must be continuous (24 hour operation/day), the pumping limit of the shallow aquifer remains about 50,000 gpd. Therefore, the cleanup would last the same number of years required for groundwater recovery.

The 1986 Land Disposal Restrictions would apply to deep well injection disposal. In addition, any discharged water would be required to meet the limits imposed by the National Pollutant Discharge Elimination System.

In any groundwater recovery alternative, the length of time required for final aquifer cleanup is of major consequence. An onsite groundwater treatment alternative would transport less volume offsite than the 100% disposal option, but such an alternative would present potential hazards for area residents and for the surface environment. Shallow groundwater pumped to the surface would create a potential direct exposure risk to contaminants over an extended time period of 7 to 9 years, perhaps longer. The floodplain area, with the continued subsidence, offers little stability for a long term onsite treatment remedy.

ALTERNATIVE 4

Groundwater Recovery, Onsite Cabon Adsorption Treatment, & Discharge/Offsite Disposal: The groundwater recovery system is the same as that discussed under alternative 2.

The Carbon System would utilize multi-media filtration followed by carbon adsorption treatment and reverse osmosis. About 80% of the waste stream could be discharged as adequately treated water while the remaining 20% would require deep well injection. The system would operate on an 8 hour day cycle for the same number of years required for groundwater recovery.

The 1986 Land Disposal Restrictions would apply to deep well injection disposal and to the disposal of spent carbon. Any discharged water would be required to meet the limits imposed by the National Pollutant Discharge Elimination System.

Concern over a potential direct exposure from onsite treatment also applies to the carbon adsorption remedy, as discussed above under alternative 3. During flooding, the batch system might pose less hazards than the biological system continuous operation. However, the difference is insignificant when comparing effectiveness and technical implementability.

ALTERNATIVE 5

No Action with Groundwater/Surface Environment Monitoring: Table 7 is a summary of specifications for groundwater and surface water monitoring. The shallow aquifer monitoring is necessary to track the attenuation process. As a protective measure, the middle aquifer should also be monitored. If contamination does break through the clay aquitard, corrective action can be initiated before levels of concern are reached. Similarly, sediment and surface water samples are recommended for the sand pits, Grennel Slough, and Clear Lake to ensure that contaminants do not impact the surrounding surface area. Monitoring should begin immediately upon completion of the source removal. Table 8 is a detailed breakdown of monitoring costs for this alternative.

If combined with a long term monitoring program, a no action remedy would not pose technical, environmental, or health considerations (Table 6) given the current available site data. Any future risk of exposure for the surrounding area residents and the surface environment is anticipated to be less than that risk associated with groundwater recovery alternatives due to site-specific characteristics.

Applicable, Relevent, and Appropriate Requirements for the Selected Remedy

SARA emphasizes the importance of ARARS in selection of the remedial action. Site-specific conditions were considered when reviewing groundwater and surface environment standards to determine the need for corrective action. Water Quality Criteria were used to evaluate the effect of upper aquifer contaminants in the surface waters at Highlands due to the hydrologic connection with the upper aquifer. Maximum Contaminant Level concentrations were used for the deeper groundwaters beneath the upper sand at Highlands. Standards have not been established for contaminants of concern within sediments of the surface water bodies or within sediments of underlying strata. Therefore, those concentrations of contaminants detected were compared to background levels specific to the Highlands area. Since contaminants of concern were not detected above corresponding criteria in any of the surface water bodies or deeper aquifers, a no action remedy with long term monitoring is feasible for the Highlands site.

SARA criteria for remedial alternatives emphasizes the requirement for permanent and significant reduction of toxicity, mobility, or volume of contaminants. However, this criteria must also be balanced with the short and long term effects of the remedy. The groundwater recovery alternatives would present potential exposure pathways for area residents and the surrounding environment over a seven to nine year period. The non-treatment/offsite disposal alternative can not be considered due to noncompliance with the 1986 Land Disposal Restrictions for deep well injection. The treatment systems with discharge/offsite disposal would accomplish the same end result as the no action remedy with long term monitoring.

TABLE 6: FINAL ALTERNATIVES SUMMARY

ALTERNATIVE DESCRIPTIONS	ENVIRONMENTAL & PUBLIC HEALTH CONSIDERATIONS	TECHNICAL CONSIDERATIONS
Encapsulate the shallow aquifer with slurry wall sides.	Excavation will present short-term exposure to surrounding environment and residents.	Clay bottom is unaceptable upon review of GWS data.
GW recovery with offsite deep well injection.	Transportation offsite would pose a new potential exposure route. Access roads to and from the site pass through a residential neighborhood.	Any GW recovery involves at least 6 years of groundwater pumping. Disposal of untreated sludge by deep well injection does not comply with the 1986 Land Disposal Restrictions.
GW recovery with biological treatment and discharge & offsite deep well injection.	Same as for deep well injection. Treatment systems at this site could pose hazards due to the floodplain location.	Same as for deep well injection. Operation must take into account hazardous conditions during flooding. Discharged water must meet water quality criteria.
GW recovery with carbon absorption treatment and discharge & offsite deep well injection.	Same as for biological system.	Same as for biological system. "Spent Carbon" must be disposed of if not regenerated. Disposal of spent carbon must meet the requirements of the 1986 Land Disposal Restrictions.
No action with monitoring in middle and shallow aquifer, and sand pits.	None.	None.

TABLE 7: RECOMMENDED ALTERNATIVE---NO ACTION WITH MONITORING

TYPE OF RECOMMENDED MONITORING	MINIMUM NUMBER OF LOCATIONS	FREQUENCY MONITORED PER YEAR	TYPE OF ANALYSIS FOR EACH LOCATIONS
Upper Aquifer Wells	3	First Year: 4 Thereafter: 1	Full HSL Scan plus pyridine
Middle Aquifer Wells	4	1	GW Quality plus Inorganics/Organics
Grennel Slough, Clear Lake, and the Sand Pits:	1 (for each)	1	For each type of of sample:
(1) Surface Water Samples			(1) Inorganics Only
(2) Sediment Samples			(2) Benzene, Pyridine, and Inorganics

TABLE 8: DETAILED COST BREAKDOWN FOR
THE NO ACTION REMEDY WITH MONITORING

ACTIVITY	ANNUAL COSTS ($)	
GW Monitoring*	1st Year Only	Years 2-30
Collection of Samples	560	200
Sample Analysis	6,380	3,080
Administrative	800	320
Subtotal for Groundwater Monitoring	7,740	3,600
SW Monitoring		Years 1-30
Surface Water Analysis		525
Sediment Analysis		2,550
Collection & Administration (10% of Analysis total)		300
Subtotal for Surface Monitoring		3,375

Total Cost of Monitoring for the first year = $11,120
Total Annual Cost for the remaining 29 years = $ 6,980

Present Worth Value** for Total Cost = $69,730

*Groundwater monitoring costs are estimated by the same equations outlined in the current Operating Plan for the Highlands source operable unit. Four wells in the upper aquifer are used for simplification of cost analysis instead of the minimum requirement of three.

**This value does not account for those funds already allocated within the Operating Plan referenced above. Basis: 0% inflation rate; 10 % discount rate; 30 year period.

RECOMMENDED ALTERNATIVE

Long Term Monitoring Program: A No Action Remedy with monitoring of the surface environment and groundwater is recommended for the Highlands site. After about 30 years of existence at the Acid Pit location, organics and inorganics have impacted the shallow aquifer beneath the site (unused water zone), but have not affected the San Jacinto River, Grennel Slough, Clear Lake, or deeper groundwaters. The sand pits have been in existence for 15 years. Contaminants of concern have not been detected in recent sampling events.

Once the source removal is complete, the contaminant migration to the shallow aquifer will be significantly reduced. The natural flow of groundwater in this aquifer will disperse those contaminants already present and will allow attenuation of contaminants within the clay aquitard. The middle aquifer should not be affected by contaminants already present in the shallow aquifer and the clay aquitard.

The groundwater monitoring wells are currently in place due to the 1984 ROD requirements. The current Operating Plan for Highlands Remedial Action Project (dated February 13, 1987) estimates $6,420 per year for groundwater monitoring costs. This estimate is based upon semi-annual monitoring of 8 wells. Over a 30 year period with a 10% discount rate, the present worth value for total monitoring costs is $60,502. This money is already funded under the source control ROD of 1984 for the Highlands site.

Additional costs for the surface water and sediment sampling, plus the changes due to groundwater monitoring frequencies, totals $4,700 for the first year and $560 per year for the remaining 29 years. For the purpose of comparative cost analysis, four monitor wells for the upper aquifer were used instead of the minimum requirement of three. The present worth value for total additional costs of monitoring over the entire 30 year period is estimated at $10,000.

OPERATION & MAINTENANCE

Implementation of the long term monitoring program for the groundwater operable unit will be part of the operation and maintenance plan for the source operable unit. Refer to the 1984 ROD for other post-closure activities on site.

ATTACHMENT I

Health Assessment for Highland Acid Pit Groundwater Operable Unit

by

Agency for Toxic Substances
and Disease Registry

March 5, 1987

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

March 5, 1987

MEMORANDUM

SUBJECT: Groundwater Study, Highlands Acid Pits Site
Highlands, Texas SI-87-136

FROM: Senior Public Health Advisor
Regional Office for Health Response
ATSDR/EPA-6

TO: Cynthia J. Aduddell
Texas Remedial Section (6H-ST)

The Agency for Toxic Substances and Disease Registry (ATSDR) has been requested to review and evaluate the document "Final Report for Highlands Acid Pit, Highlands, Texas - Groundwater Contamination Evaluation, February 1987." Based on the document the United States Environmental Protection Agency (USEPA), Region VI is recommending that the middle aquifer at the site and nearby sand pits be monitored for organics on a yearly basis after completion of the proposed remedial action.

The conclusions and recommendations presented have been developed with the assistance and concurrence of ATSDR, Health Assessments Branch.

BACKGROUND

The Highlands Acid Pit Site is located approximately 1.4 miles west of Highlands, Texas on a peninsula bordered by wooded areas to the north, Grennel Slough to the west, Clearlake to the south, and ponds and flooded sand pits to the east. Dumping is felt to have started at the site in 1951 and consist primarily of refinery sludges.

As part of the USEPA Record of Decision for the site, contaminated soil and sediment above the water table will be removed and replaced with clean fill. This will reduce contaminated surface runoff to the surrounding surface waters and downward migration into groundwater sources. Beneath the site are three sand intervals forming shallow, middle and deep aquifers separated by two clay aquitards. Organic and inorganic contaminants have been found in the shallow aquifer and organic contaminants have migrated into the aquitard separating the shallow and middle aquifers. Contaminants of concern have been identified as-organics: benzene and pyridine; inorganics: cadmium, chromium and lead.

The San Jacinto River and the upper sand aquifer are hydraulically connected. Groundwater in the Houston region is furnished by the Chicot and Evangeline Aquifers. The middle and lower sand aquifers are in the Chicot Aquifer.

ENVIRONMENTAL PATHWAYS

Groundwater migration of contaminants to the surrounding surface waters and downward migration toward the middle aquifer are the primary pathways of conern. Should contamination of surrounding surface waters occur, then concern would also exist over the possibility of aquatic contamination.

HUMAN PATHWAYS

Of principle concern would be the potential for ingestion/contact with contaminated potable water, potential contact with contaminated surface water through recreation activities (i.e., swimming), and consumption of potentially contaminated fish from the surrounding surface waters.

DISCUSSION

1. Groundwater

Seven monitoring wells in the shallow aquifer (5-25 feet) identified low pHs, high total dissolved solids and high benzene levels. There appears to be differences in the concentrations reported in Exhibit 4-3 and Exhibit 5-1 for shallow aquifer monitoring. This may reflect differing sampling periods, however, Exhibit 5-1 does not indicate when sampling occurred. Likewise, p.5-4, para. 5-2, indicates the highest concentration for benzene as being 148 mg/l while Exhibit 5-1 indicates the high as 52 mg/l and Exhibit 4-3 as 210 mg/l. Several metal concentrations in the shallow aquifer also exceeded acceptable levels. It was reported that no public wells are drawing water from the shallow aquifer.

Three monitoring wells in the deep aquifers (greater than 60 feet deep) were reported as having acceptable pHs and benzene levels, but elevated levels of manganese and lead. Eleven water wells were identified as being located within a two mile radius of the site and in the Chicot Aquifer (some confusion exists in the reporting, p.2.3., para. 2.4, reports the wells within 2 miles while p.6.8, para 6.3, reports them within one mile). The nearest residential well was one-half mile north of the site and located in the middle aquifer. Site contaminants were not evident in samples from this well. Based on the information provided, it does not appear that the middle or lower aquifers have been affected by contaminants from the site.

2. Aquitard

Borings have identified benzene migration downward into the aquitard separating the shallow and middle aquifers to a depth of eight feet.

Migration has greatly exceeded that predicted by theoretical calculations and likely is related to slickensides. Inorganic migration does not appear to represent a problem.

3. Surface Waters

Benzene has not been detected in surface water samples taken in Gennel Slough, Clear Lake or the sand pits. Other organics and inorganics were within acceptable ranges. Concentrations of organics and inorganics in sediment samples taken in the same locations were not exceptional and for inorganics, within normal background ranges.

On p.6-4 and 6-5 it is speculated that inorganic migration has occurred, and probably for some time, to the surrounding surface waters and that the lack of elevated concentrations in surface waters and sediments would indicate that inorganic contaminants pose no threat through this pathway. However, this is based on the calculated velocity of the groundwater, without the constraints of retardation of the contaminants, and limited sampling results. Information provided does not support the assumption that the maximum concentration of inorganic contaminants has reached the surrounding surface waters and represent no potential hazard.

On p. 6-7 it is indicated that the benzene travel time to the sand pits area is 23 years. This would indicate it should have already reached this area regardless of the fact that the pits have only existed 15 years.

4. Contaminated Waste

The total estimated volume of waste at the site is 77,428 yd^3 (p.2-4). Of this 18,703 yd^3 lie above the water table and will be removed. However, this leaves 58,725 yd^3 of untreated waste. While the relative distribution of contaminants (i.e., benzene) in the areas above and below the water table has not been identified, the potential exists that the proposed remedial action will remove only approximately 25% of the problem. The remaining 75% could continue to impact through the shallow aquifer on the surrounding surface waters and the aquitard.

CONCLUSION

Organic and inorganic contamination exists in the shallow aquifer; however, since it is not used as a potable water source, it only presents a problem to the extent it contaminates lower aquifers and surrounding surface waters. The lower aquifers appear uncontaminated at this time. Benzene migration through the aquitard, because of the uncertainty associated with its migration rate, represents some potential for future contamination of the middle aquifer. This potential should be followed. Contamination of surrounding surface waters above acceptable concentrations was not identified through the sampling conducted. However, the assumption that contaminants have reached these areas and been effectively diluted was not adequately supported. Monitoring should be continued to support this assumption.

RECOMMENDATIONS

1. Monitoring of the middle aquifer should be continued on a periodic basis.

2. Monitoring of the three surrounding surface waters and associated sediments should be continued on a periodic basis.

Carl R. Hickam, R.S.

ATTACHMENT II

Responsiveness Summary for
Highlands Acid Pit
Groundwater Operable Unit

by

Environmental Protection Agency
Region VI

May 27, 1987

RESPONSIVENESS SUMMARY
Highlands Acid Pit
Groundwater Operable Unit

This Community Relations Responsiveness Summary is divided into the following sections:

I. Concerns raised prior to the Groundwater Study Public Comment Period.

II. Concerns raised during the Groundwater Study Public Comment Period.

III. Response to Community Concerns.

VI. Remaining Concerns.

I. Concerns raised prior to the Groundwater Study Public Comment Period.

The Highlands Acid Pit site was broken into two operable units for remedial activities. The source control remedy was determined in the 1984 Record of Decision (ROD) to include: (1) excavation of waste and contaminated soil over a 2.41 acre area down to the water table, (2) transportation of excavated materials to a permitted class 1 disposal facility, (3) clean fill for the excavated area, (4) installation of a groundwater monitoring system, (5) site maintenance and groundwater monitoring for a 30 year period. Those issues raised during the source operable unit public comment period can be found in the 1984 ROD Summary, Attachment I, Community Relations.

II. Concerns raised during the Groundwater Study Public Comment Period.

Copies of the Feasibiltiy Study Report (FS) and copies of the Groundwater Study Report (GWS) were sent to repositories prior to the press release of the proposed remedial action, May 6, 1987, for the groundwater operable unit. A copy of the fact sheet is also on file. The public meeting was held in Highlands, Texas on May 12, 1987. The Texas Water Commision gave a brief presentation on the current status of the source removal action onsite. The Environmental Protection Agency (EPA) presented GWS results, identified remedial alternatives considered from the FS, and discussed the details of the proposed remedial action -- no action with long term monitoring. Comments expressing satisfaction with the remedy were made during and after the public meeting. Questions were answered in relation to the following topics:

- Once the current source control remedy is completed, what effect will the site have on property values for area residents?
- Is a lawsuit pending againist the Highlands site?
- Could an infant's illness be caused by the site?
- Were the original wastes assumed to be industrial in nature, or were they tracked down to origin?
- If residents use the city's water, do they need to worry? What is the source of this water?

II. (continued)

About 20 people were present at the public meeting. No written comments were received during the public comment period, May 6 through May 27, 1987. However, some concern over the lack of sampling in the southeast area of the site (Clear Lake area) was expressed by Brad Christensen of Highlands, Texas. Mr. Christensen grew up in the area and had valid reasons for this concern. See section IV for follow-up actions.

III. Response to Community Concerns

The specific responses to the above listed topics can be found in the public transcript on file in the EPA Region VI office. The following synopsis is representative of this transcript.

- Once the current source control is completed, the EPA cannot say that property values would increase. The agency has no influence over property values near Superfund sites.

- No lawsuit is currently pending against Highlands. If a viable potentially responsible party had been found, the EPA would follow up for cost recovery, even after the remedial action is completed.

- The infant's illness can not be attributed to the Highlands site unless the infant had been onsite. No contaminants have been detected offsite. Adequate fencing and site security is an important aspect of the remedial action. The agency has strived for the maximum protection possible.

- The original source of the waste sludge is unknown. However, the contaminants are characteristic of industrial waste resulting from refinery processes.

- The Highlands city water should not be affected by the Highlands site. The EPA has established the area of influence in relation to the site, and as previously noted, the documented wells in that area draw water from the lower aquifer. Only one well is screened in the middle aquifer and that well is in the opposite direction of contaminated groundwater flow.

The last topic, in reference to the source of the city's drinking water supply, is addressed more fully by information received from the Harris County Health Department (correspondence dated May 14, 1987):

> There are two water supplies for the Highlands area: Harris County Water Control & Improvement District #1 which has about 2,000 connections serving most of the Highlands area and Harris County Fresh Water Supply District #1B which serves the remaining 200 connections southeast of Highlands along Jones Road. Both water districts use a combination of well water and surface water. Surface water is obtained from the Baytown Area Water Authority plant on Thompson Road, which treats Trinity River Water. Fresh Water

III. (continued)

Supply Distcict #1B has one water well located at 1721 Jones Road which is 480 feet deep. Water Control and Improvement District #1 has three (3) 500 feet deep wells to augment their surface water supplies.

Chemical analysis for both surface water and well water were also submitted to the EPA. The water quality is adequate for drinking water and domestic purposes. No contamination was detected in any of the water samples.

IV. Remaining Concerns

The southeast portion of the site, beyond the excavation area, has experienced excessive erosion & subsequent runoff to Clear Lake. Flow patterns as described by Mr. Christensen were previously documented by a Texas Department of Water Resources interoffice memorandum, on file at the EPA Region VI office, correspondece dated May 8, 1984.

To determine if contamination was carried with flooded sediments into Clear Lake, EPA Region VI plans to sample the southeast portion of Clear Lake. Previous sampling of this area was not completed since the southern portion of the site did not show contamination.

TEXAS WATER COMMISSION

Paul Hopkins, Chairman
Ralph Roming, Commissioner
John O. Houchins, Commissioner

C. Martin Wilson III, General Couns
James K. Rourke, Jr., Chief Examiner
Mary Ann Hefner, Chief Clerk

Larry R. Soward, Executive Director

June 26, 1987

Mr. Robert E. Layton, Jr., P.E.
Regional Administrator
U. S. Environmental Protection Agency
Region VI
1445 Ross Avenue
Dallas, Texas 75202-2733

Re: Draft Abbreviated Record of Decision
Highlands Acid Pit Groundwater Operable Unit

Dear Mr. Layton:

We have reviewed the proposed Draft Abbreviated Record of Decision (ROD) and responsiveness summary for the Highlands Acid Pit - Groundwater operable unit.

We have no objection to the issuance of a ROD by the Environmental Protection Agency (EPA). Before the State of Texas can concur by providing its 10% share of the cost for the selected remedial alternative, the fiscal impact of this action must be evaluated and subsequently coordinated with state's budgetary process.

On a related matter, we would like to comment on the obligation of State monies for a period of 30 years after the remedial construction activities are complete. Such a commitment by the State of Texas may be a violation of Article VIII, Section 6 of the Texas Constitution which addresses the appropriation of money beyond a two year period.

Sincerely,

Larry R. Soward

Larry R. Soward
Executive Director