GW - 101

D.P. apps

GENERAL CORRESPONDENCE

YEAR(S):

1990

GW-101

DISCHARGE PLAN

I. TYPE OF OPERATION

This site is a staging yard for Smith Energy Services, an oil field fracturing and acidizing company. There are three categories of activities at this facility.

1. Administrative office
2. Heavy equipment maintenance
3. Chemicals storage

II. NAME OF OPERATOR AND LOCAL REPRESENTATIVE

Smith Energy Services, a division of Allied Prod. Corp.
2198 East Bloomfield Highway
Farmington, NM
Brake Stevenson, District Manager
505-325-2732

III. LOCATION OF DISCHARGE

SE/4, SW/4, Section 14, Township 29N, Range 13W
Farmington, San Juan County, New Mexico

enclosure: Facility site plan
City map

IV. LANDOWNERS

CLM Properties, Inc.
Michael T. Green, President
P.O. Box 1766
Farmington, NM

V. FACILITY DESCRIPTION

Land:
Approximately 565.000 sq. ft. (12.98 acres). The property is located in the city of Farmington, New Mexico, San Juan County. The property is generally long and rectangular in shape. It has 350 ft. of highway frontage on U.S. Highway 64 on the North side. It has Molta Street on the West side and land on the East, (presently owned by Meridian Oil & Gas). Customer parking is South of the main office and employee parking is West of the main office.

Building:
The facility is comprised of three buildings totaling 21,140 sq. ft. The buildings are steel frame, concrete block structure. The main office is 5,220 sq. ft. The shop is 8,640 sq. ft. and consists of six bays for maintenance in heavy equipment with 2 overhead 7-ton cranes. Also in the shop space is an 80' long wash bay for the washing of equipment. It also has a locker room in a portion of the second story for employee storage, and showers. The warehouse has two sections, one for storage of flammable chemicals and one section for general storage.

Office	5,220
Shop	8,640
Warehouse	7,280

General:
The property is served by utility gas, electricity, and city water and sewer. There are 4 sand storage bins in the Northwest part of the yard and an acid tank on the East end of the warehouse.

Building Equipment:
The office and warehouse are lighted with fluorescent lights. The shop has mercury vapor and fluorescent lights. The shop and office have forced air heaters and air conditioners. The warehouse has heaters.

PART VI DISCHARGE PLAN APPLICATION

MATERIALS STORED OR USED AT THE FACILITY

	NAME	GENRAL MAKE-UP OR SPECIFIC BRAND NAME	SOLID OR LIQUID	TYPE CONTAINER	ESTIMATE VOLUME STORED	LOCATION
1.	DRILLING FLUID	N/A TO SES				
2.	BRINES:					
	A: potasium chloride		SOLID	BAGGED	100 LBS.	WAREHOUSE
	B: rock salt		SOLID	BAGGED	1600 LBS.	WAREHOUSE
3.	ACIDS/CAUSTICS					
*	A. hydrochloric acid		LIQUID	TANK	5000 GAL.	ACID DOCK
*	B. CA-1 citric acid (dry)		SOLID	BAGGED	1000 LBS.	WAREHOUSE
*	C. CA-4 citric acid (50%) liq.		LIQUID	DRUM	80 GAL.	WAREHOUSE
*	D. boric acid		SOLID	BAGGED	600 LBS.	WAREHOUSE
*	E. BW 4 sulfamic acid		SOLID	BAGGED	1600 LBS.	WAREHOUSE
4.	DETERGENTS AND SOAPS					
	A. steam cleaner soap	IMTECH	LIQUID	DRUM	55 GAL.	SHOP
5.	SOLVENTS AND DEGREASERS					
*	A. AGD-2 tributy phosphate		LIQUID	DRUM	55 GAL.	WAREHOUSE
	B. saety kleen 105/140 solvent		LIQUID	DRUM	30 GAL.	SHOP
	C. cal pac carburetor cleaner		LIQUID	CAN	5 GAL.	SHOP
6.	PARRAFIN TREATMENT/EMULSION BREAKERS/SURFACTANTS					
*	A. AMS03 checker sol p-tekstim		LIQUID	DRUM	110 GAL.	WAREHOUSE
*	B. EPS04 PB-8723 (corexit 8547)		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	C. EPS09 ASP 322		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	D. SAA02 nonylphenol ethoxylate isopropyl alchohol		LIQUID	DRUM	130 GAL.	WAREHOUSE
*	E. SAA03 PB 8724 (corexit 9629)		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	F. SSS02 PB-8591		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	G. AR-02 ASP 313		LIQUID	DRUM	20 GAL.	WAREHOUSE
*	H. CCC-3 aquet 812		LIQUID	DRUM	100 GAL.	WAREHOUSE
*	I. FAA-2 chembetaine c		LIQUID	DRUM	350 GAL.	WAREHOUSE
*	J. MCFRS PB9049		LIQUID	DRUM	300 GAL.	WAREHOUSE
*	K. CCC05W arquad DMCB-SE-1		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	L. PDC-1 clear 7815		LIQUID	DRUM	145 GAL.	WAREHOUSE
7.	BIOCIDES					
*	A. BCS-4 dryocide		SOLID	BAGGED	50 LBS.	WAREHOUSE
*	B. BCS-7 xcide 600		SOLID	BAGGED	300 LBS.	WAREHOUSE

*	C. PFL-1 adomite 539D	LIQUID	DRUM	8 GAL.	WAREHOUSE
8.	OTHERS				
	A. ACID INHIBITORS				
*	1. CIA-1 corexit PB 8728	LIQUID	DRUM	110 GAL.	WAREHOUSE
*	2. CIA-2 corexit PB 8580	LIQUID	DRUM	110 GAL.	WAREHOUSE
*	3. CIA-3 AK-7	LIQUID	DRUM	55 GAL.	WAREHOUSE
	B. GELLING AGENTS/FRICTION REDUCERS FOR WATER				
	1. WGA-02 hydroxypropyl guar	SOLID	BAGGED	3000 LBS.	WAREHOUSE
	2. WGA-06 guar gum (refined)	SOLID	BAGGED	1900 LBS.	WAREHOUSE
	3. CMG-1 galacto-manna blend	SOLID	BULK BAG	9100 LBS.	WAREHOUSE
	4. CMG-2 galacto-manna blend	SOLID	BULK BAG	7900 LBS.	WAREHOUSE
	5. WFR-02 ASP 820	LIQUID	DRUM	165 GAL.	WAREHOUSE
	C. GELLING AGENTS/FRICTION REDUCERS FOR OIL				
*	1. OGA-02 ASP 200	LIQUID	DRUM	55 GAL.	WAREHOUSE
*	2. OGA-05 AOG-1	LIQUID	DRUM	55 GAL.	WAREHOUSE
*	3. OFR-01 TR0322=CP-565	LIQUID	DRUM	55 GAL.	WAREHOUSE
	D. GELLING AGENTS/FRICTION REDUCERS FOR ACID				
*	1. AGA-2 DSGA	LIQUID	DRUM	55 GAL.	WAREHOUSE
	E. CROSS LINKER-ADDITIVE FOR GEL				
*	1. CX-1 blend ipa/titanium	LIQUID	DRUM	200 GAL.	WAREHOUSE
*	2. CX-6 blend ipa/titianium	LIQUID	DRUM	275 GAL.	WAREHOUSE
*	3. CX-13 liquid sodium borate	LIQUID	DRUM	400 GAL.	WAREHOUSE
*	4. CX-14 blend ipa/zirconium	LIQUID	DRUM	100 GAL.	WAREHOUSE
*	5. CX-15 blend ipa/ triethanolmine/zirconium	LIQUID	DRUM	25 GAL.	WAREHOUSE
*	6. CX-91 blend ipa/titanium	LIQUID	DRUM	240 GAL.	WAREHOUSE
*	7. CDA-1 blend ipa/ acetyl acetone	LIQUID	DRUM	40 GAL.	WAREHOUSE
	F. BUFFERS				
	1. BW-3 sodium carbonate	SOLID	BAGGED	50 LBS.	WAREHOUSE
	2. potassium carbonate	SOLID	BAGGED	1200 LBS.	WAREHOUSE
	G. BREAKERS				
	1. WCB-LT blend triethanolamine	LIQUID	DRUM	200 GAL.	WAREHOUSE
	2. MCB ACT hampene copper 7.5%	LIQUID	DRUM	55 GAL.	WAREHOUSE
	3. WCB-1 ammonium persulfate	SOLID	BAGGED	3000 LBS.	WAREHOUSE
	4. sodium percarbonate	SOLID	BAGGED	700 LBS.	WAREHOUSE
	5. WEB-2 gelbrake el	SOLID	BAGGED	110 LBS.	WAREHOUSE
	6. DWB-1 tekstim 3507	SOLID	BAGGED	3000 LBS.	WAREHOUSE
	7. EWB-1 encapsulated breaker	SOLID	BAGGED	200 LBS.	WAREHOUSE

H. FRAC PROPPANT				
1. sand	SOLID	BULK	840 TONS	SAND SILO
2. resin coated sand	SOLID	BULK/BAG	2 TONS	WAREHOUSE
I. LUBRICANTS				
1. conoco ep rock drill oil 100	LIQUID	TANK	500 GAL.	SHOP
2. universal anti-freeze and coolant	LIQUID	TANK	300 GAL.	SHOP
3. power tran III fluid	LIQUID	TANK	300 GAL.	SHOP
4. fleet heavy duty motor oil	LIQUID	TANK	300 GAL.	SHOP
5. mobil synthetic, mobilube	LIQUID	DRUM	110 GAL.	SHOP
J. WELDING/CUTTING				
1. oxygen	GAS	CYLINDER	1 EA.	SHOP
2. acetylene	GAS	CYLINDER	1 EA.	SHOP

*MSDS APPENDIX B

PART VII: Sources and Quantities of Effluent and Waste Solids Generated at the Facility

Waste Type/General Composition and Source	Volume per Month	Major Additives
1. Truck Wastes:		
a. Diluted acid reinstate, this is Hydrochloric acid residue left in cargo tank and back flushed with water.	100 gallons	Hydrochloric acid/ ClA-1, CA-4, SAA-2, EPS-9
2. Truck, Tank, and Drum Washing:		
a. Truck washing operations	n/a	n/a to SES
b. Drum or cargo washing	n/a	n/a to SES
3. Steam Cleaning of Parts, Equipment, and Tanks		
a. Parts - These parts are cleaned with detergents.	100 gallons	Water
b. Tanks	n/a	n/a to SES
4. Solvents and De-greaser Use	30 gallons	Safety-Kleen
5. Spent Acids, Caustics, or Completion Fluids	see truck wastes	
6. Waste Slop Oil	n/a	Oily rags/floor dry
7. Waste Lubrication and Motor Oil	600 gallons	Oil
8. Oil Filters	40 filters	n/a
9. Solids and Sludges from Tanks (none generated)	n/a	n/a to SES
10. Painting Waste (none generated)	n/a	n/a to SES
11. Sewage - This is water and sewage which is disposed of through the city of Farmington, NM sewage.	28,000 gallons	Farmington City Water

12.	Other Waste Liquids		
	a. Laboratory waste - This consists of essentially all chemicals in the facility.	10 gallons	Produced water, oil, and various chemicals
	b. Chemical warehouse (photo)	n/a	n/a to SES
13.	Other Waste Solids		
	a. Used drums - This consists of used chemical drums	n/a	n/a to SES
	b. Chemical warehouse (photo)	n/a	n/a to SES
	c. Batteries	10	n/a

VIII. DESCRIPTION OF CURRENT LIQUID AND SOLID WASTE COLLECTION/STORAGE/DISPOSAL PROCEDURES

B. Collection and Storage

1. Truck Waste:

See attached information for above ground Hydrochloric Acid (22° Be) tank, recycle process for diluted Hydrochloric Acid and accidental spillage at facility (Information is on diagram 1).

2. Truck, Tank, and Drum Washing:

Truck - All of SES equipment is washed at a locally owned establishment.

Bubble City
3125 Bloomfield Hwy.
Farmington, NM 87401

Drums or Cargo - This is not done by SES or anywhere at the facility.

3. Steam Cleaning of Parts, Equipment, and Tanks:

Engine Parts - These parts are cleaned with water in a wash bay which is equipped with a drain area. This system will run into a separator, which separates any oil from the water. The water is then disposed of through the Farmington Waste Water Treatment. The oil in the separation procedure is stored in an underground sump which has a holding capacity of 470 gallons. This oil in the sump is disposed of one to two times a year or as needed (see diagram 3).

Tanks - This is not done by SES or anywhere at the facility.

4. Solvents and De-greaser Use:

This is supplied by Safety-Kleen and is periodically taken for recycling and replenished with new solvent.

Safety-Kleen
777 Big Timber Road
Elgin, IL 60123

5. Spent Acids, Caustics, or Completion Fluids:

Diluted Hydrochloric Acids with various inhibitors and surfactants are recycled through the unit located on the north-east corner of the warehouse (see diagram 2). The system and its capacities are shown on diagram 1.

There are not any caustics or completion fluids disposed of on the SES facility.

6. Waste Slop Oil:

There is not any waste slop oil generated on the SES facility.

7. Waste Lubrication and Motor Oil:

All of the waste motor oil/lubrication is stored in a 4' X 8' vertical container which is transferred to above ground storage tanks. The tanks are vertical tanks and are emptied periodically by a local vendor for recycling. The last date of pick up was 5/29/90 and consisted of 946 gallons.

Mesa Oil, Inc.
4701 Broadway, S.E.
Albuquerque, NM 87105

8. Oil Filters:

All of the oil filters are stored in a 4' X 8' vertical container in the maintenance shop where they are allowed to drain. They are then disposed of through the local trash service.

9. Solid Waste Sludge From Tanks:

There is not any solid waste sludge generated by SES at this facility.

10. Painting Wastes:

There is not any painting waste generated by SES at this facility.

11. Sewage Waste:

The sewage waste is disposed of through the Farmington waster water treatment system. There is no disposal of any SES chemicals/acids through this system. There is an average of 28,000 gallons of sewage per month at this facility.

City of Farmington
P.O. Box 4100
Farmington, NM 87499

12. Other Waste Liquid:

Laboratory waste - This waste is stored in designated 55 gallon drums, located in the wet chemical side of the warehouse. Disposal will be handled by:

Van Waters & Rogers, Inc.
ChemCare
P.O. Box 5287
Denver, CO 80217-5287

Chemical warehouse (wet chemical side) - Chemicals are mixed in this area with minimal amount of spillage. Any spillage flows to the outdoor concrete basin located on the north-east side of the warehouse (see diagram 1 for the recycle process).

13. Other Waste Solids:

Used drums - These are stored on a truck at the facility and are periodically transported to West Texas Drum in Midland, Texas for reuse by the facility.

Chemical warehouse (dry chemical side) - Chemicals are stored here and are mixed in the field. There is no mixing of chemicals on this side of the chemical warehouse. Chemicals from broken containers or bags are swept up, and as much as possible of the material is placed back into inventory and used. Contaminated residue and bags containing residue of hazardous materials are to be placed in an over pack container and held for disposal through the following company:

Van Waters & Rogers, Inc.
ChemCare
P.O. Box 5287
Denver, CO 80217-5287

All other chemicals listed as stored at the facility are added in the field at specific well sites. All remaining unused chemicals are brought back to the facility and returned to inventory. No wastes are generated from chemical usage other than minor spillage/drainage to the underground vault/tank for recycling.

Batteries - These are stored in the mechanics shop and are periodically picked up for recycling by a local vendor.

San Juan Steel and Salvage
5418 U.S. Hwy 64
Farmington, NM 87401

The entire SES facility is paved. It has a berm extending along the west side of the facility which is approximately 3 feet in height. This prevents any commingle of water from the SES facility to the surrounding area. Refer to diagram 1 for the specific details on the above ground Hydrochloric Acid storage tanks and the lined underground recycling system.

All drums are sealed and stored on a truck for transportation to a disposal site as stated above. The surface is paved and no spillage occurs in this area.

The SES facility was built in 1979 so no need for integrity of buried piping is necessary.

B. Existing Effluent and Solid Disposal

A. On Site Facilities

a. There is one area (wash bay) where oily waste is disposed of by the use of a sump. The wash bay is used to wash/clean mechanical parts for repair of SES equipment.

1. Berm - There is a berm which extends along the west side of the facility excluding the offices and office parking. The berm is approximately 3 feet high. Its purpose is to prevent water runoff to the surrounding area. This berm was installed in March of 1992.

2. Oil Separator/Floor Drain/Oil Waste Storage Tank - This consists of a floor drain which connects to an oil separator. The oil is stored in an underground storage tank and the water is disposed of in the Farmington waste water treatment system. This system is only used for the purpose os cleaning SES equipment parts which are to be repaired. There is approximately 200 gallons per month which is separated and stored. The underground storage tank is 9 feet deep and has a storage volume of 470 gallons and is made of concrete. The oily waste storage tank is emptied by Mesa Oil, Inc. periodically or as needed. This system was installed when the facility was built (see diagram 3).

3. Leach Fields - This does not apply to the SES facility. There are not any leach fields on the SES facility.

4. Injection Wells - This does not apply to the SES facility. There are not any injection wells on the SES facility.

5. Drying Beds or Other Pits - This does not apply to the SES facility. There are not any drying beds or pits on the SES facility.

6. Solid Disposal -

   a. Oil Filters - There are approximately 40 filters per month disposed of through the local land fill.

   b. Laboratory Waste - This consists of various hydrocarbons/produced water/chemical additives which are tested in the laboratory. These are stored in 55 gallon drums and disposed of through Van Waters & Rogers ChemCare program.

   c. Used Drums - Used drums are stored on a semi trailer (see facility diagram) which is on pavement. The drums are sealed and no spillage occurs in this area. Approximately 240 drums per year are returned for reuse.

      West Texas Drum Company
      4130 W. Industrial
      Midland, TX 79703

7. SES does not have any leach fields or pits and therefore is not applicable to this section.

   a. See attached diagram #1 for the Hydrochloric acid in storage and recycling system.

   b. See attached diagram #1 for the location of the sampling system for the underground vault/storage tank for Hydrochloric acid.

   c. NOT APPLICABLE TO SES - This facility has no plans to cease operations in the near future.

B. Off Site Disposal

The off site disposal information is listed above with address, location, and method of shipping.

IX. PROPOSED MODIFICATIONS

Not applicable to this application.

X. INSPECTION, MAINTENANCE, AND REPORTING

A. The acid sump and vault monitoring system will be checked monthly and a log maintained of the date, time, and name of the individual completing the check. When leaks are detected, the acid reclaim system will be immediately shut down and repairs begin. If it is found that contamination has penetrated beyond the liner system, O.C.D. will be immediately notified.

B. Ground water monitoring not applicable to current operators.

C. In June of 1992 an earthen berm was installed along the west boundary of the facility, excluding the office and employees parking lot area. This berm is designed to contain storm water run off and keep it on the facility.

XI. SPILL LEAK PREVENTION AND REPORTING PROCEDURES
Note: See appendix D for Smith Emergency spill guidelines.

1. Above Ground Acid Storage Tank and Containment Area:

This is a 24,000 gallon capacity hydrochloric acid tank that is rubber lined. The containment area consists of concrete floor and walls (see diagram #4) covered with acid resistant epoxy spray. The containment area will hold more than one and one third times the volume of the tank should a spill occur.

The hydrochloric acid tank is visually inspected for leaks each time acid is loaded and unloaded from the tank. The containment area and epoxy lining is to be visually inspected annually.

In the event of a major spill into the containment area, immediate steps would begin to neutralize the hydrochloric acid (table 1) and vacuum tracks utilized to haul the material to an approved disposal site.

In the event a small leak was detected in the storage tank the contents of the tank would be immediately transferred into authorized cargo vessels and the leaking tank would be taken out of service until replaced or repaired.

2. Acid Recovery System (sump, piping, vault, and tank)

This system is designed to catch spills and allow for drain up of equipment and is detailed on diagram #1. To prevent contamination of the soil the vault and sump are equipped with a 30 mill. high density liner, piping is four inch pvc inside six inch pvc. These liners are designed to contain contamination and protect the ground water.

Monitoring pipes have been installed between the concrete and the liners and will be monitored monthly for fluid. If leaks are detected, the system will be shut down and immediate repairs or replacement started.

If it is found that contamination penetrated beyond the liner, the state O.C.D. will be notified.

3. Warehouse Area

a. Dry Chemical Room - this is an enclosed area with concrete floors. Minor spills are to be swept up and materials returned to inventory for later use. Small amounts of chemicals that are too contaminated for use will be placed into over pack drums for later disposal, depending on the nature of the hazard. No leak detection is necessary for this area.

b. Wet Chemical Room - this is an enclosed area with concrete floors and a floor drain for wash down purposes. Liquid chemicals are stored in 55 gallon drums or five gallon buckets.

The floor drain runs through a two inch pvc pipe for a distance of approximately six feet to the acid tank containment area where it is plumed into a 55 gallon container. The chemicals and fluids that enter this drum are currently being recycled into acid loads as these chemicals are acid additives.

Other piping in the wet chemicals room consists of a water pipe and a Venturi system used to load water and chemicals for acid. All pipes are exposed and require no special monitoring other than visual inspection for leaks, which is accomplished on a day to day basis when the system is used.

Small spills are washed down the floor drain and into the container. Then recycled into acid loads. A large spill would not be anticipated in this area.

*** Notification of Spills ***

Product	Hazardous Ingredient	Reportable Quantity
AGA-2		NR
AGD-2		NR
AMS-3	Methanol/Ethylene Glycol	7,267 lbs.
AR-2		NR
BCS-4	Ethelene Thiourea	50 lbs.
BCS-7		NR
BW-4	Sulphuric Acid	28,571 lbs.
CA-4		NR
CCC-3	Ethylene Glycol	10,000 lbs.
CCC-5-W		23,000 lbs.
CDA-1		NR
CIA-1	Methyl & Propargyl Alcohols	8,862 lbs.
CIA-2	Propargyl Alcohol	25,592 lbs.
CIA-3	Thiourea	70 lbs.
CX-1		NR
CX-6		NR
CX-13		NR
CX-14		NR
CX-15		NR
CX-91		NR
EPS-4	Methyl Alcohol	13,193 lbs.
EPS-9	Napthalene	1,000 lbs.
FAA-2		NR
HCL-0	Hydrochloric Acid	5,000 lbs.
MC-FRS		NR
OFR-1	Ethylene Glycol (4%)	25,000 lbs.
OGA-2	Sodium Aluminate	27,000 lbs.
OGA-5	Methanol	37,037 lbs.
PDC-1	Napthalene	1,266 lbs.

Notification of Spills cont'd

Product	Hazardous Ingredient	Reportable Quantity
PFL-1	Ammonium Bisulfite	19,000 lbs.
RM-18		NR
SAA-2		NR
SAA-3		NR
SSS-2	Methyl Alcohol & Xylene	14,286 lbs.

XII. SITE CHARACTERISTICS

1. Water Resources Information:

Based on a preliminary review of available records from the New Mexico State Engineers Office, there appears to be eight water supply wells within a half mile radius of the Smith Energy site. They are listed at the end of this section.

All wells appear to be located over 1000 feet from the site. The wells in Section 14 appear to be located up and cross gradient based on preliminary monitor well water level measurements. The remaining six wells in Sections 22 and 23 appear to be located down and cross gradient from the site.

The San Juan River is south of the site, approximately three-quarters of a mile down-gradient. The Animas River is north of the site, approximately one mile up-gradient. Both rivers flow to the west and south, and year around water flow. The Willett Ditch provides irrigation water to farms in the general proximity of the site. The Willett Ditch is fed on the south side of the Animas River, upstream of the site approximately 3/4 miles. Based on discussions with the New Mexico State Engineers Office, this ditch appears to be used primarily for irrigation and industrial use and is not a public drinking water source.

WATER WELL INFORMATION
SMITH INTERNATIONAL, INC.
2198 EAST BLOOMFIELD HIGHWAY
FARMINGTON, SAN JUAN COUNTY, NEW MEXICO
SEPTEMBER, 1992

Location (T.R.SEC.QUAD)	Name	Well No.	Use	Water Depth (ft.)	Aquifer
29.13.14.313	Valley Drive In	SJ-00176	dom,stk	35	Qal
29.13.14.443	Dowell, Inc.	N/A	N/A	15	Kk,Qal
29.13.22.22	Dennis Burke	SJ-01673	dom	14	Qal
29.13.23.1	Tom Kannard	SJ-01562	dom	6	Qal
29.13.23.11	N/A	SJ-01719	N/A	N/A	N/A
29.13.23.123	N/A	SJ-00187	N/A	40	Qal
29.13.23.22	Mary Barkley	SJ-00352	dom	30	Qal
29.13.23.22	Tom Pratt	SJ-01376	dom	15	Qal

Notes:
N/A - Information not available
dom - domestic water source
stk - water source for livestock
Kk - Kirtland Shale
Qal - Quaternary alluvium

Based on available information from the State of New Mexico Engineers Office.

2. Site Groundwater Information:

Three previously installed groundwater monitor well were used to estimate the site groundwater gradient. The wells had been installed by ENERLOG/TIS for Smith International during an environmental audit of the property in August 1990. The wells were drilled with an air drill rig, and completed with four inch PVC casing. The monitor well information and groundwater level measurements (taken 2-7-92) are summarized at the end of this section.

Based on the water level measurements from the three wells, the groundwater ranges from 28 to 30 feet below the existing ground surface. The groundwater gradient and subsequent flow direction is to the west and south and averages approximately 0.002 feet/foot. The shallow alluvial groundwater appears to represent an unconfined aquifer. The groundwater level and gradient may vary, considering the sites relative proximity to both the San Juan River and Animas River and site soil conditions.

During the course of the excavation and abatement of the U.S.T. and pit, the groundwater at the bottom of the excavation was observed to fluctuate in depth. Fluctuations appeared to be on the order of one to three feet, corresponding to a water level of 27 to 30 feet bsg. This fluctuation was not unusual, considering the site soil condition, and proximity of the site to the San Juan and Animas Rivers.

MONITOR WELL DATA SUMMARY
SMITH INTERNATIONAL, INC.
2198 EAST BLOOMFIELD HIGHWAY
FARMINGTON, SAN JUAN COUNTY, NEW MEXICO
SEPTEMBER, 1992

DRILLING & COMPLETION INFORMATION
SEPTEMBER, 1992

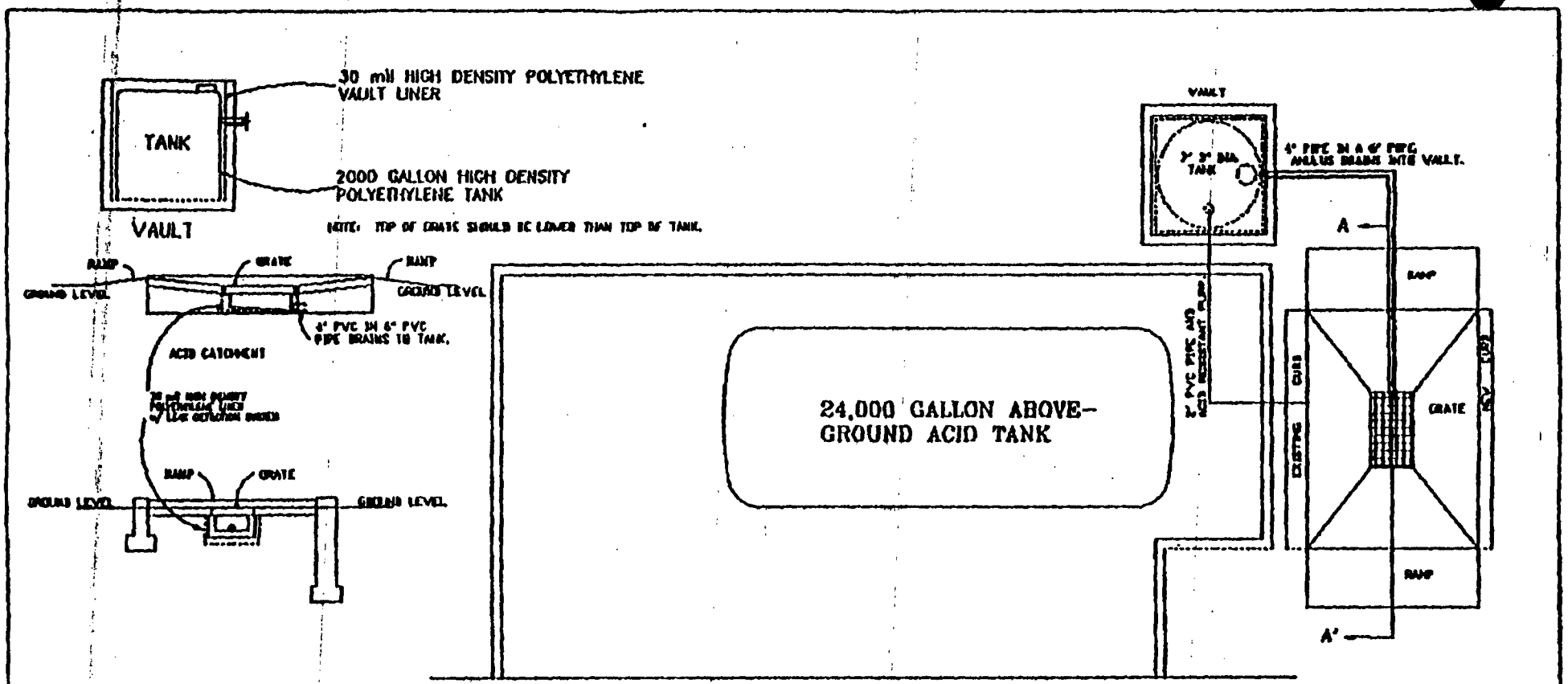
MONITOR WELL	TOTAL DEPTH	WATER LEVEL	TOP OF SCREEN
1	34	25	15
2	40	30	18
3	40	28	20

SURVEY & WATER LEVEL INFORMATION
FEBRUARY 7, 1992

LOCATION	ELEV.	COORDINATE X	COORDINATE Y	WATER LEVEL(bgs)	WATER ELEV.
SW WAREHOUSE COR. (benchmark)	100.00	0.00	0.00		
MW1	99.78	346.41	195.63	28.54	71.24
MW2	99.85	85.11	-289.32	29.98	69.87
MW3	99.77	67.82	-199.59	29.74	70.03

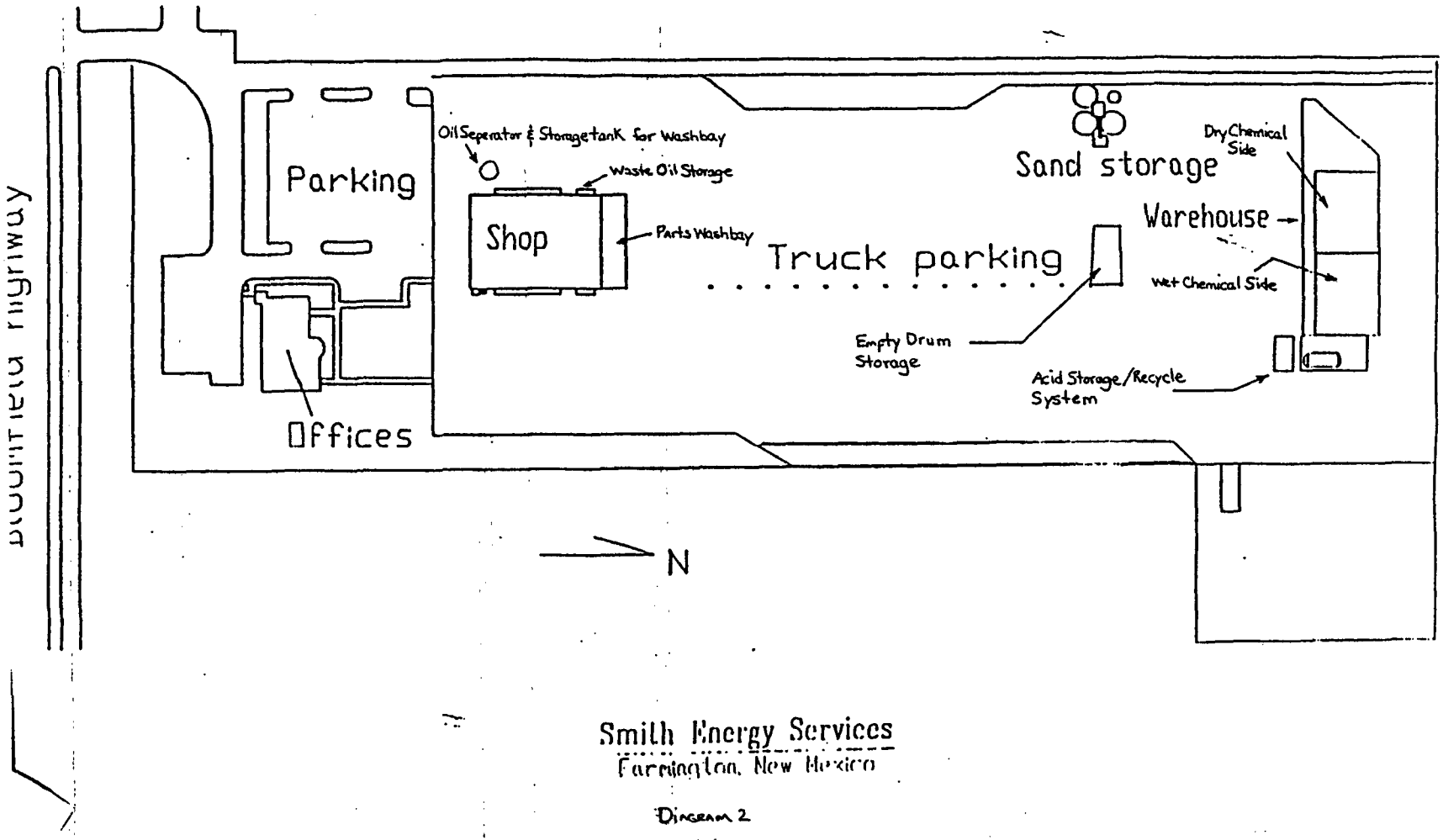
San Juan testing laboratories completed a Soils Engineering Report in May of 1979, a copy of which is enclosed as appendix C.

The majority of the facility is paved to minimize the potential for surface liquid penetration of the subsurface soil. With continued monitoring of sumps, piping, and vault areas, little danger exists of contaminating subsurface soil and aquafers.



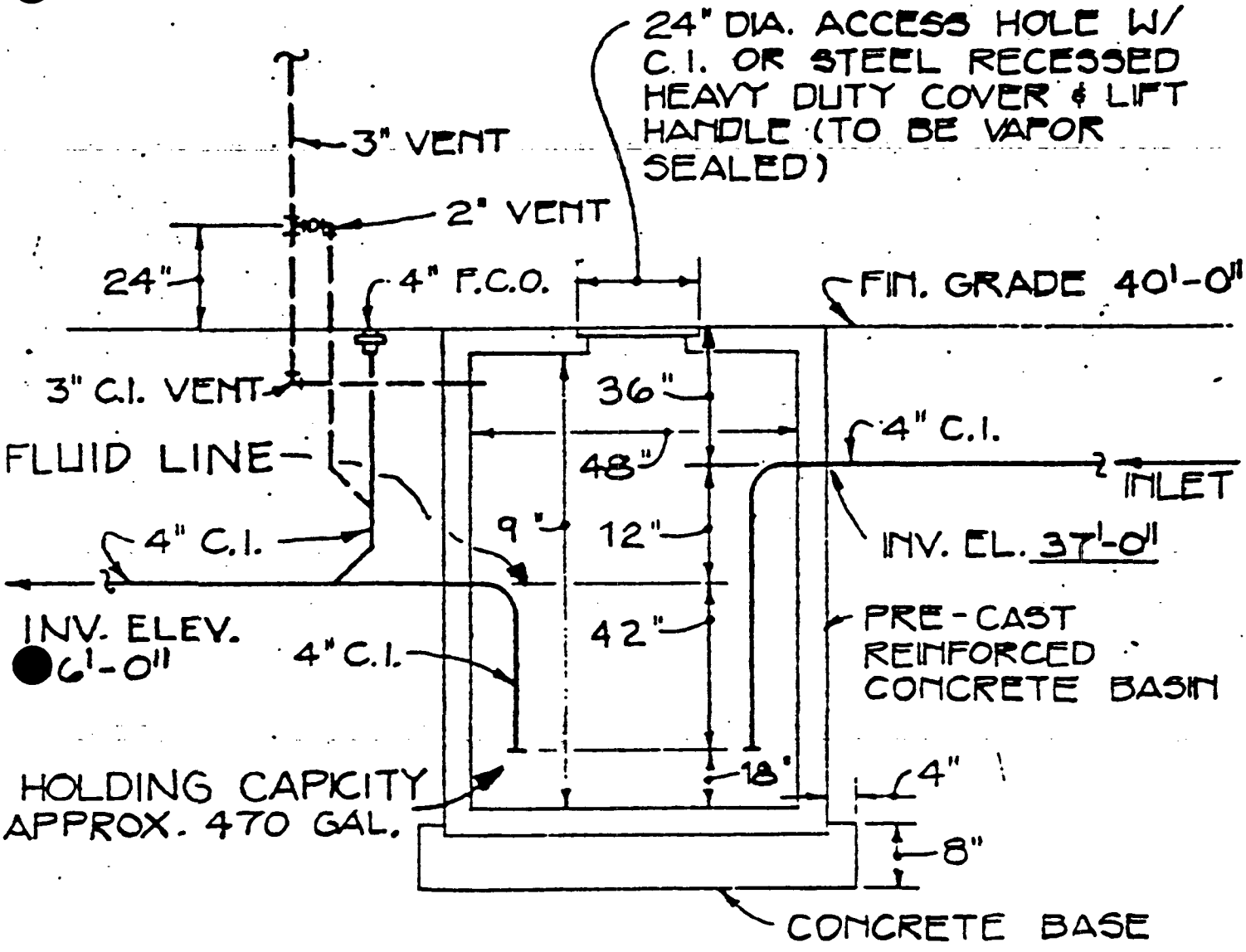
SMITH INTERNATIONAL INC. 2198 EAST BLOOMFIELD HWY FARMINGTON, NEW MEXICO ACID UST AND LOADING SYSTEM CLOSURE PROJECT NO: 91410	ENVIROTECH INC. ENVIRONMENTAL SCIENTISTS & ENGINEERS 5796 U.S. HIGHWAY 64-3014 FARMINGTON, NEW MEXICO 87401 PHONE: (505) 632-0615	ACID STORAGE AND LOADING AREA REPLACEMENT ACID CATCHMENT SCHEMATIC SHEET: 4 DRAWN: 5-5-92 DRWN BY: JDD PRJ MGR: MKL

Diagram 1



Smith Energy Services
Farmington, New Mexico

Diagram 2

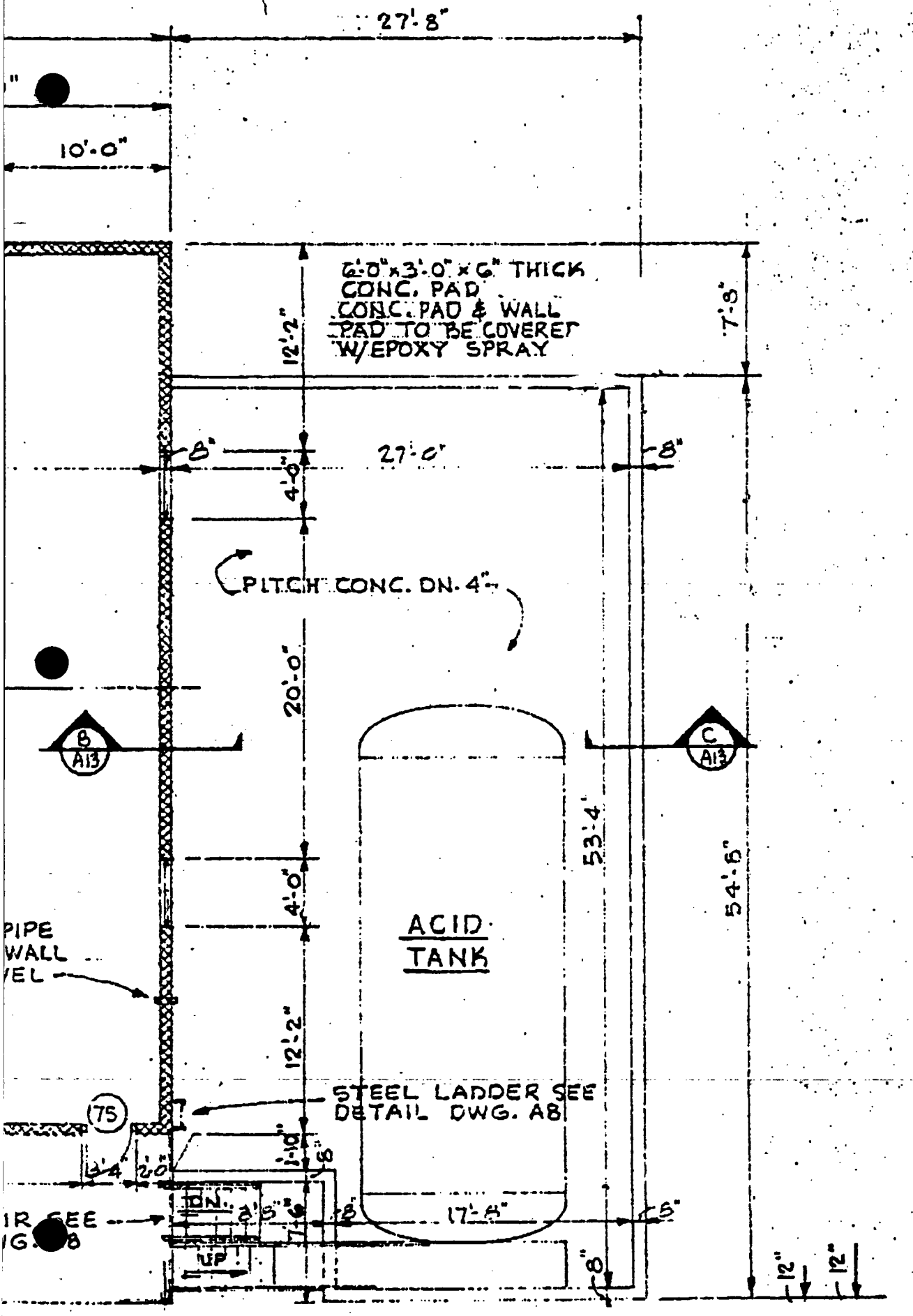


NOTE:
WATERPROOF SEAL ALL PENETRATIONS THRU SIDE WALLS OF BASIN.

GAS & OIL INTERCEPTOR DETAIL

SCALE: NONE

DIAGRAM 3



SIDNEY J. HOOK, ENGINEER
2701 ALCOTT ST.
DENVER, COLORADO

JUCTION CO., INC.
ACID CIRCUIT
COLORADO

Table 1
Quantities of Various Alkalies Required to Neutralize
100 Gallons of Hydrochloric Acid

Hydrochloric (Muriatic) Acid			Neutralizing Chemicals				
Acid Concentration At. % HCl	Specific Gravity of Solution	Acutal Pounds of Acid per 100 Gals.	CaO Quicklime Lbs.	$Ca(OH)_2$ Lime Lbs.	Na_2CO_3 Anhydrous Soda Ash Lbs.	50% NaOH Liquid Caustic Soda Lbs.	NaOh Bead/Flake Caustic Soda Lbs.
0.1	Use 1.000	.837	.644	.852	1.27	1.836	.918
0.2	Use 1.000	1.674	1.28	1.70	2.54	3.672	1.836
0.3	Use 1.000	2.511	1.93	2.52	3.81	5.50	2.75
0.4	Use 1.000	3.35	2.58	3.41	5.08	7.34	3.67
0.5	Use 1.0015	4.19	3.19	4.22	6.35	9.18	4.59
0.6	Use 1.0015	5.02	3.86	5.11	7.62	11.02	5.51
0.7	Use 1.0015	5.86	4.51	5.93	8.89	12.86	6.43
0.8	Use 1.0015	6.70	5.15	6.82	10.16	14.68	7.34
0.9	Use 1.0015	7.53	5.79	7.63	11.43	16.52	8.26
1.	1.0032	8.37	6.44	8.52	12.7	18.36	9.18
2.	1.0082	16.83	12.94	17.12	24.6	36.96	18.48
3.	1.0131	25.41	19.54	25.79	37.0	55.70	27.85
4.	1.0181	33.99	26.14	34.53	49.3	74.4	37.2
5.	1.023	42.73	32.86	43.42	62.0	93.6	46.8
6.	1.0279	51.47	39.56	52.31	74.6	112.8	56.4
10.	1.0474	87.41	67.22	88.92	126.8	191.4	95.7
20.	1.0980	183.3	141	186	267	402	201
25.	1.1261	234.8	179	237	339	512	256
30.	1,1526	288.4	221	293	419	632	316
35.	1.1778	343.8	264	348	498	752	376

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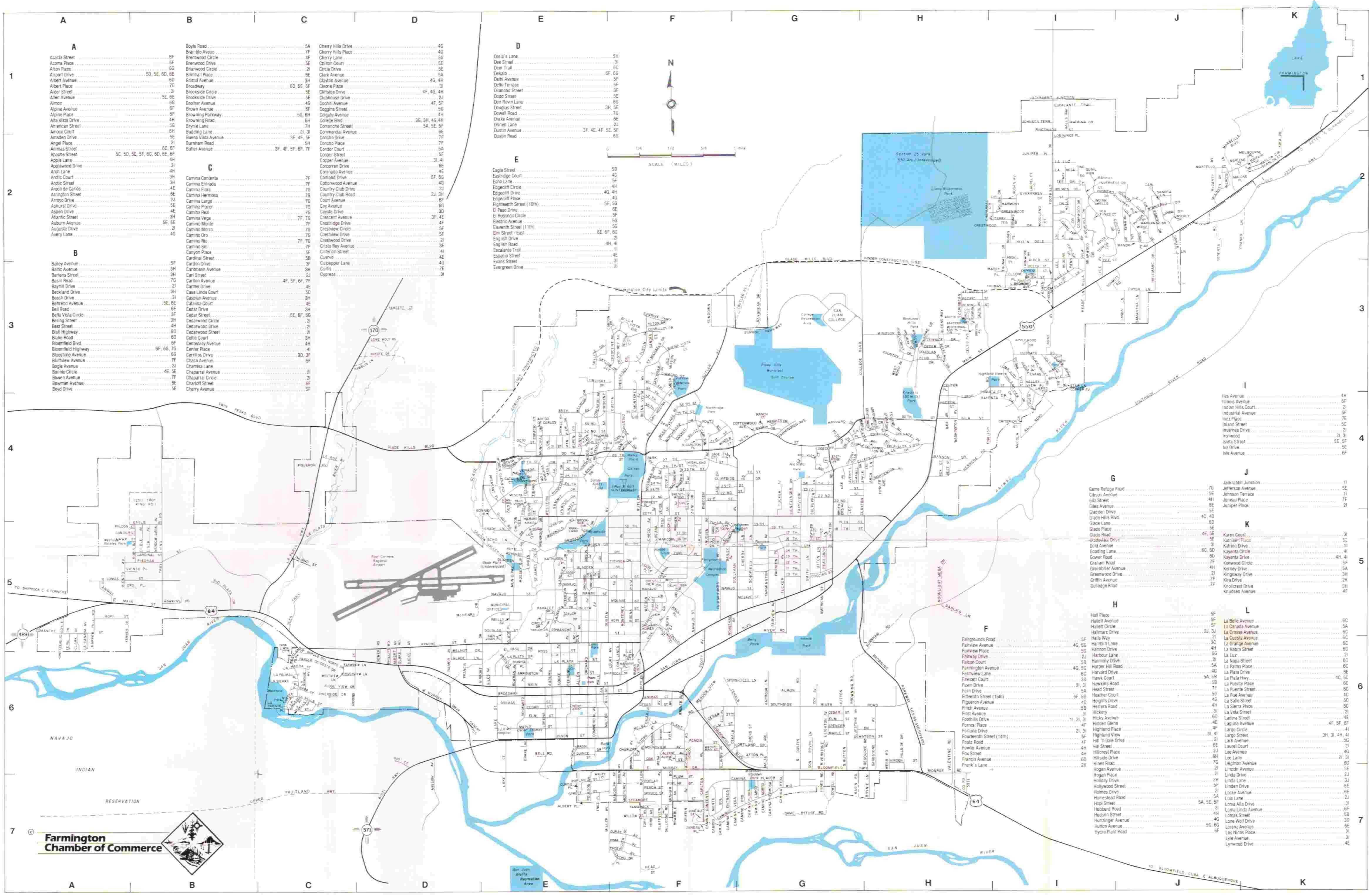
SEDONA, AZ.



A

Acacia Street 6F
Acoma Place 5F
Afton Place 6G
Airport Drive 5D, 5E, 6D, 6E
Albert Avenue 6D
Albert Place 7E
Alder Street 3I
Allen Avenue 5E, 6E
Almon 6G
Alpine Avenue 6F
Alpine Place 6F
Alta Vista Drive 4H
American Street 5G
Amoco Court 6H
Amsden Drive 5E
Angel Place 2I
Animas Street 6E, 6F
Apache Street 5C, 5D, 5E, 5F, 6C, 6D, 6E, 6F
Apple Lane 4H
Applewood Drive 3I
Arch Lane 4H
Arctic Court 3H
Arctic Street 3H
Aredo de Carlos 4E
Arrington Street 6E
Arroyo Drive 2J
Ashurst Drive 5E
Aspen Drive 4E
Atlantic Street 3H
Auburn Avenue 5E, 6E
Augusta Drive 2I
Avery Lane 4G

B

Bailey Avenue 5F
Baltic Avenue 3H
Bartens Street 3H
Basin Road 7G
Bayhill Drive 2I
Beckland Drive 3H
Beech Drive 3I
Behrend Avenue 5E, 6E
Bell Road 6E
Bella Vista Circle 3F
Bering Street 3H
Best Street 4H
Bisti Highway 6D
Blake Road 6D
Bloomfield Blvd. 6F
Bloomfield Highway 6F, 6G, 7G
Bluestone Avenue 6G
Bluffview Avenue 7F
Bogie Avenue 2J
Bonnie Circle 4E, 5E
Bowen Avenue 7F
Bowman Avenue 5E
Boyd Drive 5E
Boyle Road 5A
Bramble Aveue 7F
Brentwood Circle 4F
Brenwood Drive 5E
Briarwood Circle 2I
Brimhall Place 6E
Bristol Avenue 3H
Broadway 6D, 6E, 6F
Brookside Circle 5E
Brookside Drive 5E
Brother Avenue 4G
Brown Avenue 6F
Browning Parkway 5G, 6H
Browning Road 6H
Brynie Lane 7H
Budding Lane 2I, 3I
Buena Vista Avenue 3F, 4F, 5F
Burnham Road 5H
Butler Avenue 3F, 4F, 5F, 6F, 7F

C

Camina Contenta 7F
Camina Entrada 7F
Camina Flora 7G
Camina Hermosa 7G
Camina Largo 7G
Camina Placer 7G
Camina Real 7G
Camina Vega 7F, 7G
Camino Monte 7F
Camino Morro 7G
Camino Oro 7G
Camino Rio 7F, 7G
Camino Sol 7F
Canyon Place 5F
Cardinal Street 5B
Cardon Drive 3F
Caribbean Avenue 3H
Carl Street 2J
Carlton Avenue 4F, 5F, 6F, 7F
Carmel Drive 4E
Casa Linda Court 5C
Caspian Avenue 3H
Catalina Court 4E
Cedar Drive 3H
Cedar Street 6E, 6F, 6G
Cedarwood Circle 2I
Cedarwood Drive 2I
Cedarwood Street 2I
Celtic Court 3H
Centenary Avenue 4H
Center Place 4I
Cerrillos Drive 3D, 3F
Chaco Avenue 5F
Chamisa Lane
Chaparral Avenue 2I
Chaparral Circle 2I
Charlott Street 6F
Cherry Avenue 5F
Cherry Hills Drive 4G
Cherry Hills Place 4G
Cherry Lane 5G
Chilton Court 5E
Circle Drive 5E
Clark Avenue 5A
Clayton Avenue 4G, 4H
Cleone Place 3I
Cliffside Drive 4F, 4G, 4H
Clubhouse Drive 2J
Cochiti Avenue 4F, 5F
Coggins Street 5G
Colgate Avenue 4H
College Blvd 3G, 3H, 4G, 4H
Comanche Streett 5A, 5E, 5F
Commercial Avenue 6E
Concho Drive 7F
Concho Place 7F
Condor Court 5A
Cooper Street 5F
Copper Avenue 3I, 4I
Corcorran Drive 6E
Coronado Avenue 4E
Cortland Drive 6F, 6G
Cottonwood Avenue 4G
Country Club Drive 2J
Country Club Road 2J, 3H
Court Avenue 6F
Coy Avenue 6G
Coyote Drive 3D
Crescent Avenue 3F, 4E
Crestridge Drive 4F
Crestview Circle 5F
Crestview Drive 5F
Crestwood Drive 2I
Cristo Rey Avenue 3F
Criterion Street 4I
Cuervo 4E
Culpepper Lane 4G
Curtis 7E
Cypress 3I

D

Darla's Lane 5H
Dee Street 3I
Deer Trail 5C
Dekalb 6F, 6G
Delhi Avenue 5F
Delhi Terrace 5F
Diamond Street 3F
Dodd Street 5E
Don Rovin Lane 6G
Douglas Street 3H, 5E
Dowell Road 7G
Drake Avenue 6E
Drinen Lane 2J
Dustin Avenue 3F, 4E, 4F, 5E, 5F
Dustin Road 6G

E

Eagle Street 5B
Eastridge Court 4G
Echo Lane 5E
Edgecliff Circle 4H
Edgecliff Drive 4G, 4H
Edgecliff Place 4G
Eighteenth Street (18th) 5F, 5G
El Paso Drive 6E
El Redondo Circle 5F
Electric Avenue 5G
Eleventh Street (11th) 5G
Elm Street - East 6E, 6F, 6G
English Drive 2I
English Road 4H, 4I
Escalante Trail 1I
Espacio Street 4E
Evans Street 3I
Evergreen Drive 2I

F

Fairgrounds Road 5F
Fairview Avenue 4G, 5G
Fairview Place 5G
Fairway Drive 2J
Falcon Court 5B
Farmington Avenue 4G, 5G
Farmview Lane 6C
Fawcett Court 3D
Fawn Drive 2I, 3I
Fern Drive 5A
Fifteenth Street (15th) 5F, 5G
Figueroh Avenue 4C
Finch Avenue 5B
First Avenue 3I
Foothills Drive 1I, 2I, 3I
Forrest Place 4F
Fortuna Drive 2I, 3I
Fourteenth Street (14th) 5F
Foutz Road 4F
Fowler Avenue 4H
Fox Street 4H
Francis Avenue 6D
Frank's Lane 2K

G

Game Refuge Road 7G
Gibson Avenue 5E
Gila Street 4H
Giles Avenue 6E
Gladden Drive 5E
Glade Hills Blvd. 4C, 4D
Glade Lane 6D
Glade Place 5E
Glade Road 4E, 5E
Gladeview Drive 5F
Gold Avenue 3I
Gooding Lane 6C, 6D
Gower Road 6D
Graham Road 7F
Greenbrier Avenue 4H
Greenwood Drive 2I
Griffin Avenue 7F
Gulledge Road 7F

H

Hall Place 5F
Hallett Avenue 5F
Hallett Circle 5F
Hallmarc Drive 2J, 3J
Halls Way 2I
Hamblin Lane 3C
Hannon Drive 4H
Harbour Lane 6G
Harmony Drive 2I
Harper Hill Road 5A
Harvard Drive 4G
Hawk Court 5A, 5B
Hawkins Road 5B
Head Street 7F
Heather Court 5G
Heights Drive 4G
Herrera Road 4H
Hickory 3I
Hicks Avenue 6D
Hidden Glenn 4E
Highland Place 4F
Highland View 3I, 4I
Hill 'n Dale Drive 2I
Hill Street 6E
Hillcrest Place 2J
Hillside Drive 6H
Hines Road 7G
Hogan Avenue 2I
Hogan Place 2I
Holiday Drive 2H
Hollywood Street 5F
Holmes Drive 2I
Homestead Road 5A
Hopi Street 5A, 5E, 5F
Hubbard Road 3I
Hudson Street 4H
Hunzinger Avenue 4G
Hutton Avenue 5G, 6G
Hydro Plant Road 6F

I

Iles Avenue 4H
Illinois Avenue 6F
Indian Hills Court 2I
Industrial Avenue 5F
Inez Place 7E
Inland Street 5C
Invernes Drive 2I
Ironwood 2I, 3I
Isleta Street 5E, 5F
Iva Drive 5E
Ivie Avenue 6F

J

Jackrabbit Junction 1I
Jefferson Avenue 5E
Johnson Terrace 1I
Juneau Place 7F
Juniper Place 2I

K

Karen Court 3I
Kathleen Place 5E
Katrina Drive 1I
Kayenta Circle 4I
Kayenta Drive 4H, 4I
Kenwood Circle 5F
Kerney Drive 5A
Kingsway Drive 3H
Kira Drive 2K
Knollcrest Drive 3H
Knudsen Avenue 4F

L

La Belle Avenue 6C
La Canada Avenue 5A
La Crosse Avenue 6C
La Cuesta Avenue 6C
La Grange Avenue 6C
La Habra Street 6D
La Luz 2I
La Napa Street 6C
La Palma Place 6C
La Plata Drive 6E
La Plata Hwy 4C, 5C
La Puente Place 6C
La Puente Street 6C
La Rue Avenue 4C
La Salle Street 6C
La Sierra Place 6C
La Veta Street 2I
Ladera Street 4E
Laguna Avenue 4F, 5F, 6F
Largo Circle 4I
Largo Street 3H, 3I, 4H, 4I
Lark Avenue 5G
Laurel Court 2I
Lee Avenue 4G
Lee Lane 2I, 3I
Leighton Avenue 6G
Lincoln Avenue 5E
Linda Drive 2J
Linda Lane 3J
Linden Drive 5E
Locke Avenue 6E
Lola Lane 2J
Loma Alta Drive 3I
Loma Linda Avenue 6F
Lomas Street 5B
Lone Wolf Drive 3D
Lorena Avenue 6E
Los Ninos Place 2I
Lyle Avenue 3I
Lynwood Drive 4E

M

Mabel Drive 4G
Main Street 1K, 2J, 2K, 3H, 3I, 3J, 4H, 5A, 5B, 5C, 5F, 5G, 5H, 6C, 6D, 6E, 6F
Malone Place 2J, 2K
Malta Avenue 6G
Manana Place 6F
Mancos Lane 2J
Manor Street 2J
Maple Street 6E, 6G
Marcy Place 3I
Maricopa Place 5F
Marilyn Drive 2J
Marlene Court 2J
Marlow Circle 2K
Marquette Avenue 4G, 4H
Marseille Blvd. 2J
Martello Street 2J
Mauzy Circle 7E
Mayfair Drive 3K
McCarty Avenue 2J
McColm Drive 4I
McCormick School Road 6F
McDonald Road 5E
McHenry Drive 6D
McKinsey Avenue 2J
Meade Lane 3I
Meadow Lark Avenue 5B
Meadow View 6F
Mediterranean Place 3H
Melba Lane 6F
Melbourne Place 2K
Melrose Drive 4E
Merino Kraal 5E
Mesa Drive 4E
Mesa Verde Avenue 4F, 5F, 6F
Meseta 4E
Mickey Drive 2J
Miller Avenue 6E, 7E, 7F
Mission Avenue 6D, 7D
Mojave Street 5E, 5F, 5G
Monroe Road 6H
Monterey Avenue 4H, 5H, 7F
Monterey Circle 4F
Moonlight Mesa Drive 5H
Mortensen Road 4H
Mossey Cup Drive 5E
Mossman Drive 4F
Mount View Street 6F
Mountain View Drive 4E
Municipal Drive 4E, 5E
Murray Drive - East 6F
Murray Drive - West 6D, 6E

N

Nambe Street 5E
Nathan Avenue 4F
Navajo Street 5D, 5E, 5F, 5G
Nineteenth Street (19th) 5G
Northridge Drive 4F
Northwood Circle 4E
Northwood Drive 4E

O

Oak Street 6F
Ocio Place 4E
Ocio Street 4E
Ojo Court 6D
Old Aztec Hwy 2J, 2K
Old Bloomfield Hwy. 6F, 6G
Old Mission Road 3F
Orchard Avenue 5E, 6E
Orchard Drive 5E
Orchard Homes Drive 5F
Oriole Avenue 5B
Oro Place 5A, 5B
Ouray Avenue 7F

P

Pacific Street 3H
Padilla Drive 6E
Palmer Avenue 6D
Palo Verde Street 4E
Palomas Circle 4E
Paralee Drive 5E
Park Place 4F
Parkland Circle 5E
Parque De Oeste Drive 6C
Parque Del Norte Drive 6C
Peace Valley Road 3I
Peach Street 7F
Pear Grove Lane 5G
Penney Lane
Pheasant Place 4E
Phillips Road 6D
Piedra Vista Drive 3I, 4I
Piedras Street 5B
Pima Avenue 7F
Pine Hurst Drive 2I
Pine Street 3I
Pinon Street 6E
Plaza Drive 3I
Plum Street 7F
Pontiac Drive 4E
Poplar Street 7E, 7F
Poquita Street 4I
Poulson Avenue 7E
Princeton ASvenue 4H
Pryor Lane 3J
Putter Place 2J

Q

Quail Run 2I
Queensway 3H
Quince Street 6E

R

Rail Road 4I
Railroad Drive 3I
Ranch Court 4G
Ranch Drive 4G
Randolph Avenue 7F
Ravella Drive 3I
Redwood Avenue 3I
Reilly Avenue 5E
Resource Avenue 6H
Ridge Lea Court 5E
Ridge View Drive 6C
Ridgecrest Drive 4E
Rinconada Street 1I, 2I
Rio Animas Avenue 5A
Rio Vista Court 4G
Rio Vista Way 4G
River Road 5G
Riverside Drive 6C
Riverstone Road 6G
Riverview Lane 6C
Roberts Road 2J
Robin Avenue 5B
Rosa Street 4E
Ross Avenue 6E
Rowe Avenue 3I

S

Sage Court 4F
Sage Drive 4F, 5F
Sagebrush 3I
Saint Andrews Drive 2I
Saint James Place 5E
Saint Michaels Drive 3F
Samantha Lane 3J
San Juan Blvd 5G, 6F
San Juan Place 5E
San Medina Avenue 4F
San Paula Avenue 3F, 4F
Sandia Court 3F
Sandra Lane 2J
Sandstone Avenue 6H
Santa Barbara Drive 4E
Santa Teresa Court 2I
Santiago Avenue 4F, 5F
Scanlon Street 2K
Schmitt Road 3I, 3J
Schofield Avenue 4G, 5G
Schwartz Avenue 6E
Scott Avenue 5F, 6F
Sea Pines Court 2I
Sedona Court 3F
Self Lane - See Alta Vista 4H
Service Street 5G
Seventeenth Street (17th) 5F, 5G
Shadow Valley Lane 5E
Shady Lane 5E
Shiprock Street 6F
Sierra Vista Drive 3I, 4I
Silver Avenue 3I
Silver Street 7F
Sixteenth Street (16th) 5F, 5G
Skyline Court 3E
Skyline Drive 3E, 3F
Smith Lane 5G
Southside River Road 1 3J, 3K, 4I, 4J, 5H, 5I, 5F, 6G, 6H
Spencer Drive 6G
Springfield Lane 6F
Spruce Street 7E, 7F
Staghorn Place 4E
Stanford Avenue 4H
Star Lane 3I
Sullivan Avenue 4G, 5G
Summit Drive 4E
Sundown 3F
Sunrise Parkway 3F
Sunset Avenue 4E
Sunset Place 4E
Suntuoso Court 4F
Sycamore Street 7F

T

Tamarack Street 7F
Taos Avenue 7F
Tarry Terrace 2I
Taylor Drive 5E
Tee Court 2I
Tee Drive 2I
Tenth Street (10th) 5G
Terrace Drive 3H
Tesoro 4E
Teton Drive 3F
Thirteenth Street (13th) 5G
Thirtieth Circle (30th) 4H
Thirtieth Place (30th) 4G
Thirtieth Street (30th) 4E, 4F, 4G, 4H
Thirty Eighth Street (38th) 4E, 4F
Thirty Fifth Street E (35th) 4E, 4F
Thirty First Street E (31st) 4E, 4F
Thirty Fourth Street (34th) 4F
Thirty Ninth Street (39th) 3F, 4F
Thirty Second Street (32nd) 4E
Thirty Seventh Street (37th) 4F
Thirty Sixth Street (36th) 4F
Thirty Third Street E (33rd) 4E, 4F
Thomas Avenue 2I
Thomas Drive 2I, 3I
Tierra 4E
Tory Avenue 7F
Troy King Road 4B, 5B
Tucker Avenue 4G, 5G
Tulane Avenue 4H
Twelfth Street (12th) 5G
Twentieth Street (20th) 4E, 4F, 4G, 4H
Twenty Eight Street (28th) 4F
Twenty Fifth Street (25th) 4E, 4F, 4G
Twenty First Street (21st) 4F
Twenty Fourth Street (24th) 4E, 4F, 4G
Twenty Second Street (22nd) 4F, 4G
Twenty Seventh Street E (27th) 4E, 4F
Twenty Sixth Street E (26th) 4E, 4F
Twenty Third Street (23rd) 4F, 4G
Twilight Drive 3E
Twin Peaks Blvd. 4A, 4B, 4C
Tycksen Drive 5E, 5F

U

Upper Fruitland Hwy.
Ute Street 5E, 5F
Utton Lane 5G

V

Valentine Road 7H
Valley View 4E
Venada 4E
Ventana Circle 5A
Viento Avenue 5A, 5B
Viento Place 2I, 3I
Villa View Drive 7H
Vine Avenue 5F, 6F
Virden Street 6H
Vista Circle 4E

W

Wagner Avenue 4F, 5F, 6F
Walker Road 6E, 7E
Wall Avenue 5E, 6E
Walnut Drive 6D
Washington Avenue 4H
Waterman Street 6F
Watson Avenue 5F
Watson Street 6G, 6H
Webb Road 6H
Wedge Place 2J
Western Avenue 4E, 5E
Westland Park Drive 6C
Westview Lane 6C
Westwood Avenue 3H
Williams Drive
Willow Street 7F
Wilshire Drive 3H
Windsor Drive 3H
Winnifred Drive 2J
Winter Court 4F
Woodland Court 2I

Y

Yale Drive 4G, 4H
York Avenue 7F
Yucca Avenue 5F

Z

Zia Court 4F
Zuni Drive 4F, 5F
Zuni Place 5F

San Juan Testing Laboratory, Inc.

907 W. APACHE P.O. BOX 2079 FARMINGTON, NEW MEXICO 87401 (505) 327-4966

Craftsman Construction Co., Inc.
5660 S. Syracuse Circle
Englewood, Colorado 80111

8 May 1979

Attention: Mr. Kas Berget

Project: Smith Energy Services
Office & Warehouse Facilities
Bloomfield Highway
Farmington, New Mexico

Job No. S-150

In accordance with your Purchase Order 94033, this firm has conducted soil engineering services for the proposed office and warehouse to be located on the north side of Bloomfield Highway, Farmington, New Mexico. The purpose of this soils engineering report is to provide recommendations for use in the design of foundation elements, to provide procedures for use in site and subfloor preparation, to present surface drainage recommendations and to present pavement sections. It is understood that the proposed development will consist of office, shop and warehouse buildings together with sand silo, auto and truck parking lots and driveways. Maximum structural loads are estimated to range to approximately 2 to 3 kips per lineal foot and 40 kips for wall and column footings, respectively. Sand silos will stand approximately 45 feet in height. Site topography would indicate that relatively minor zones of fill will be required below slabs-on-grade to attain finished floor elevations.

At the time of this exploration, the site was undeveloped agricultural property. Existing ground surface is relatively level with surface drainage generally developing from south to north. Agricultural crops have been grown within the last year in the vicinity of test pits 5, 6 and 7, but it has probably been several years since crop growing was active in the remaining area. Vegetative ground cover consists of a growth of weeds and crop remnants. An existing ditch traverses the site as shown on the site plan.

Smith Energy Services
Job No. S-150

Seven test pits were excavated with an Allis Chalmers backhoe at locations shown on the accompanying site plan. Subsoil stratification across the site is relatively uniform as presented in the following tabulation.

Pit No.	Sandy Clay (CL) (Organics) (Firm)	Sandy Clay (CH) (Organics) (Stiff)	Clayey Sand and Gravel (Medium Dense)	Silty Sand, Cobbles and Boulders (Dense)
1	0-1'	--	1-3'	3-11.8'
2	0-1'	--	1-2.8'	2.8-10.8'
3	0-1.2'	--	1.2-3'	3-11.7'
4	0-0.8'	--	0.8-3'	3-9.6'
5	--	0-1'	1-2.8'	2.8-8.8'
6	--	0-1'	1-2.5'	2.5-10.5'
7	--	0-1'	1-4'	4-9.2'

Soil moisture contents were described as being at to below the respective plastic limits for the fine-grained soils and as damp to slightly damp for granular soils. No free groundwater was encountered in any of the borings; however, information from other boring logs indicate that groundwater levels exist at depths of 15 to 20 feet and may fluctuate several feet during irrigation season or periods of high rainfall on the watersheds.

Consolidation tests conducted on undisturbed clay and/or sand samples indicated that subsoils at shallow foundation levels (0 to 3 feet) exhibit moderate compressibility potentials at in-situ soil moisture contents and tendencies to undergo expansion under high moisture conditions. Near surface native soils which have been disturbed by plowing exhibit relatively low densities and will require recompaction for uniform support of fill zones. These soils would also exhibit expansive potentials after remolding and saturation and should, therefore, not be used as sources of fill materials.

Smith Energy Services
Job No. S-150

Foundations: Due to the minor extent of fills anticipated to attain finished grades at proposed building locations, recommendations for foundation systems bearing upon undisturbed native subsoils are presented. Additional recommendations for conditions not covered herein will be supplied upon request.

Unit bearing capacities as presented herein should be considered as allowable maximums for dead plus design live load conditions. A one-third increase is permissible when considering total loads including wind or seismic forces. Two (2.0) feet and 1.33 feet are recommended as minimum widths of column and wall footings, respectively. Finished grade references should be considered as lowest adjacent grade for perimeter footings and as floor level for interior footings.

Because of the tendency toward differential foundation movement, it is suggested that all continuous footings and any masonry walls be reinforced and constructed using frequent grouting, horizontal and vertical reinforcement, etc. to better distribute stresses in the event of a significant moisture buildup. Frequent use of control joints is recommended in masonry walls to minimize unsightly cracking.

Structure	Footing Depth Below* Existing Grade	Finished Grade	Allowable Soil Bearing Pressure	Estimated Settlement
Office	3.0 ft. (min.)	2.5 ft. (min.)	3000 psf	1/4 inch
Shop	3.0 ft. (min.)	2.5 ft. (min.)	3000 psf	3/8 inch
Warehouse	3.0 ft. (min.)	2.5 ft. (min.)	3000 psf	1/4 inch
Sand Silo	3-4 ft.** (min.)	3.0 ft. (min.)	4000 psf	1/2-3/4 inch

*Greater depth requirement to govern. Depth below finished grade would be appropriate where cuts are required.

**Variable depth to ensure bearing upon the underlying dense silty sand and cobbles.

Due to the likelihood that exposed footing excavations will consist of sandy cobbles which will result in uneven bearing surfaces, it is recommended that a "leveling course" consisting of well graded sand or sand and gravel with a maximum size of 1½ inches and not more than 25% passing the No. 200 sieve be used. The leveling course should be compacted to at least 95% of ASTM: D1557 dry density.

Interior non-load bearing walls or partitions could be placed on a thickened slab provided that control joints are provided where these partitions contact structural components.

Site and Subfloor Preparation: The following procedure is recommended for preparation of the site and fill placement for support of slabs-on-grade on native or compacted soils.

1. Strip and remove all vegetation, fill piles, debris and upper one foot of native clay soils, etc. within the building areas for a lateral distance of 5 feet beyond exterior building lines. If sandy clay materials are remaining after removal of upper one foot, it is recommended that an additional depth of one foot of this material be removed. Clean and widen all ditches, etc. to accommodate compaction equipment. If disturbed or loose subsoils are encountered, depth of removal should be increased to completely remove all such loose or disturbed zones.

2. Scarify, moisten or dry as required, and compact exposed soils to a minimum depth of 8 inches. Depressions or over-excavated areas should be widened as required to accommodate compaction equipment.

3. Place and compact required fill in horizontal lifts at thicknesses consistent with compaction equipment used to

achieve uniform densities throughout lift thickness. Due to the expansive characteristics exhibited by the on-site soils, it would be desirable to restrict their use to fills exterior to the building lines. It is recommended that fill below slabs-on-grade should be imported granular soils with a low expansive potential.

4. The final four inches underlying floor slabs should be a well graded sand and/or gravel base course containing less than 5% passing Number 200 sieve.

5. All subgrade preparation and fill placement should be accomplished under observation and testing directed by a soils engineer so that compliance to project specifications is attained.

Imported fill should exhibit 100% passing the 6 inch sieve and have an expansion potential of 1.0% or less when exposed to saturation of remolded fill sample compacted to 90% of the ASTM: D1557 density at a moisture content approximately 2% below optimum and under a surcharge load of 100 psf.

The compaction of all fill materials should be performed to the specified percent of maximum density as determined in accordance with ASTM: D1557. Moisture content between optimum plus or minus 3 percent shall be obtained for imported soils with a plasticity index of 6 or greater. Native near surface soils shall be compacted at a moisture content between optimum and plus 4 percent.

	Minimum Percent Compaction
Native sand-silty sand soils:	
Below slabs-on-grade	90
Below foundation elements	95
Native clay soils	85
Subbase fill (imported):	
Below slabs-on-grade	90
Below foundation elements	95

	Minimum Percent Compaction
Base course	95
Miscellaneous backfill	90

Recommendations made herein regarding slabs-on-grade based upon compacted fill are dependent upon satisfactory site preparation, compaction of surface and placement and compaction of fill. Therefore, earthwork relative to structural support should be accomplished under observation and testing directed by a soils engineer. Adequate inspection should be provided during site grading, compaction of backfill, floor fill and base course so that complaince with recommended specifications is achieved.

Drainage: It is considered essential that positive drainage be provided during construction and be maintained throughout the life of the facilities.

Exterior site grading must insure rapid runoff at surface waters. Down spouts, parking lot drainage and other concentrations of surface runoff must be avoided on the north sides of structures and should be extended away from all structures in suitably sized culverts, lined or paved drainage ditches. Areas proposed for grass or other planting requiring extensive irrigation should be avoided adjacent to any proposed structure. Site grading adjacent to each structure should be 5% for the first 10 feet and no less than 2% to suitably sized drainage structures, to eliminate the possibility of impounding surface water with subsequent saturation and settlement of subgrade soils. Backfill against footings, exterior walls, and in utility line trenches should be well compacted and be free of construction debris to reduce the possibility of moisture infiltration through loose soils.

Pavement: Based upon the results of CBR testing, the native clay subgrade is a very poor material for support of pavement

sections. Therefore, the following procedure is presented to develop an adequate subgrade, subbase and base course system to support pavement surfaces.

1. Excavate and remove the upper one foot of native clay soils. Remove any soft or loose soil zones where proof-rolling with a 50 ton roller for a minimum of 4 passes indicates instability. Clean and widen ditches.

2. Place and compact a minimum thickness of 12 inches of well graded non-plastic granular subbase material exhibiting 100% passing 4 inch sieve and no more than 20% passing No. 200 sieve. Compaction should be accomplished in 6 inch lifts to at least 95% of AASHTO T-180 maximum dry density. Increased thickness is appropriate where additional fills are required to achieve design grades.

3. Place and compact a minimum of 8 inch compacted thickness of dense graded aggregate base course to at least 95% of AASHTO T-180.

4. A bituminous prime coat should be placed over the compacted base course at a rate not to exceed 0.15 gallons per square yard.

5. A dense graded plant mixed asphaltic paving should then be placed to a minimum thickness of 3 inches.

The adequacy and performance of pavement structures is dependent upon surface drainage on and adjacent to the structure. Therefore, positive surface drainage is imperative and ponding or flow of water adjacent to pavement edges should not be allowed.

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Where moisture content increases in subsoils, pavement deterioration is accelerated and requires maintenance on a more frequent basis.

Corrosion: Type II air entrained cement will provide protection for all concrete structures above groundwater table and subjected to local freeze-thaw conditions.

Please do not hesitate to contact the undersigned if you have any questions regarding the contents of this report or if we can be of further service.

Respectfully submitted,
ENGINEERS TESTING LABORATORIES, INC.
Geotechnical Services

By: Glen K. Copeland, P.E. 5-8-79 Reviewed by: James G. Bennitt, P.E.

/jm

Job No. S-150

Boring No.	Depth, ft.	Soil Class.	Particle Size Distribution, %				Atterberg Limits			Moisture - Density Rel.			Specific Gravity	Permeability		'R' Value		
			Cobbles 3" to 12"	Gravel 3" to #4	Sand #4 to 200	Fines - 200	PL	LL	PI	Dry Density pcf	Optimum Moisture %	Meth.		Dry Density pcf	K Ft./Yr.	Corrected 'R'	Expansion Pressure psf	
Group 1		CH			29	71	23	51	28									
Group 2		CL		1	36	63	17	29	12									
Group 3		SM-SC		32	35	44	13	23	10									
Group 4		SM-SC		15	40	45	15	21	6									
Group 5		SM-GM		36	30	34	18	19	1									
Group 6		SM-GM		37	50	13	Non-Plastic											

Boring No.	Depth, ft.	Remarks
Group 1		Composite of #5 (0-0.8'); #6 (0-1'); #7 (0-1')
Group 2		Composite of #1 (0-0.8'); #2 (0-1'); #3 (0-1.2'); #4 (0-0.8')
Group 3		Composite of #1 (0.8-3'); #2 (0.8-2.8'); #4 (0.8-3.1')
Group 4		Composite of #5 (0.8-2.8'); #6(1-4.7'); #7(1-2.3')
Group 5		Composite of #3 (1.2-3.4'); #4 (3.1-4.6'); #5 (2.8-4.4'); #7 (2.3-3.9')
Group 6		Composite of #1 (3-4.8'); #2 (2.8-4.6'); #3 (3.9-6.2'); #4 (4.6-9.6'); #5 (4.4-8.4'); #6 (4.7-10.5'); #7 (3.9-9.2')

LEGEND

Moisture Density Relationship
1. Tested D-1556/AASHTO T-217
2. Tested ASTMD-2922/D-3017
3. Tested ASTMD-2922/AASHTO T-217
4. Rock correction applied to maximum dry density. AASHTO T-224
5. Other_____

Specific Gravity
6. Minus # 4
7. Plus # 4

Classification/Particle Size
8. Visual
9. Laboratory Tested

SOIL PROPERTIES

Job No. S-150

Pit No.	Depth, ft.	Soil Class.	Expansion/Compression: Initial Dry Density pcf	Initial Moisture Content, %	Surcharge KSF	+ Expan. - Comp. %	Max. Swell Pressure KSF	Water Soluble Matter, %: Salts	Sulfates	Shear Strength: Test Method	Initial Moisture Content, %	Dry Density pcf	C KSF	∅ Deg.	Consolidation: Initial Void Ratio	Surcharge KSF	Consol. %
4	2.7'	SM-SC		8.5	0.26	-1.36											
"	"	"	"	"	0.52	-3.49											
"	"	"	"	"	1.03	-7.90											
6	2.0'	CH		19.0	0.26	-1.33											
"	"	"	"	"	0.52	-1.50											
"	"	"	"	"	1.03	-2.21											
"	"	"	"	"	1.03(5)	-1.80											

Boring No.	Depth, ft.	Remarks

LEGEND

Shear Strength Test Method
- DS Direct Shear
- DS Direct Shear (saturated)
- UC Unconfined Compression
- UU Unconsolidated Undrained
- CU Consolidated Undrained w/pore press
- CU Consolidated Undrained
- CD Consolidated Drained
- CR Cyclic Consolidated Undrained w/pore press

REMARKS

1. In-situ density.
2. Compacted density (Approx. 95% of ASTM:D698 max. density at moisture content slightly below optimum).
3. Compacted density (Approx. 95% of ASTM:D1557 max. density at moisture content slightly below optimum).
4. In-situ moisture.
5. Submerged to approximate saturation.
6. Consolidation % upon saturation.
7.

SOIL PROPERTIES

SAN JUAN TESTING LAB., INC.
PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

KEY TO SYMBOLS

symbol	Unified class.	AASHTO Equivalent	typical names
	GW	A-1-a	well graded gravels and gravel-sand mixtures
	GP	A-1-a	poorly graded gravels and gravel-sand mixtures
	GM	A-1-b	silty gravels and gravel-sand mixtures
	GC	A-1-b	clayey gravels and gravel-sand mixtures
	SW	A-2-4	well graded sands and gravelly sands
	SP	A-3	poorly graded sands and gravelly sands
	SM	A-2-4 A-2-5	silty sands and sandsilt mixtures
	SC	A-2-6 A-2-7	clayey sands and sand-clay mixtures
	ML	A-4 A-5	inorganic silts, very fine sands and fine silty sands
	CL	A-6 A-7-6	inorganic clays of low to medium plasticity
	OL	A-4 A-5	organic silts and silty clays of low plasticity
	MH	A-5 A-7-5	inorganic silts
	CH	A-7-6	inorganic clays of high plasticity
	OH	A-5 A-7-5	organic clays of high plasticity
	PT		highly organic soils, peat and muck

Water Level

indicates location of water table at time of boring

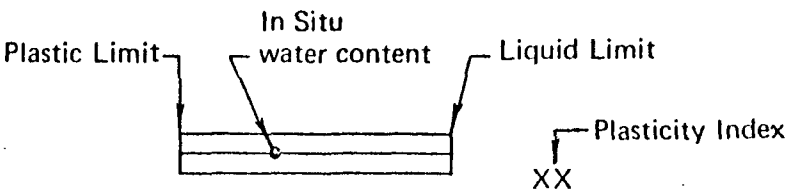
Sample Type

A - augered
C - cored
D/A - drilled with air
D/W - drilled with water
H - hand sampled
S - standard penetration spoon
U - undisturbed

Physical Tests

C - consolidation
D - direct shear
P - Permeability
T - triaxial
U - unconfined compression
S - soil sulfate potential

$$\text{Water Content} = \frac{\text{weight of water}}{\text{weight of solids}} \times 100$$



Standard Penetration

Standard penetration resistance data is obtained at the intervals indicated on the boring log, utilizing a 2" O.D. split spoon sampler driven by a 140-pound, "pin-guided" weight with a 30" drop. The penetration resistance recorded on the log represents the number of blows required to drive the 2" O.D. sampler one foot into the undisturbed strata, and thus is a measure of the strength of the soil.

Shear Strength

Shear strength represents the maximum undrained shear resistance as measured with a field shear vane device.

san juan testing laboratory, inc.

909 WEST APACHE · P. O. BOX 2079 · FARMINGTON, NEW MEXICO

PHONE:
327-9944

Date 5-8-79

Report to Smith Energy Services

Requested by Smith Energy Services Sampled by Lab Technician

Project Smith Energy Services Location Farmington, New Mexico

Source of Material 40 ft. east of Hole #5 and 40 ft. south of Hole #5 also 150 ft. south of Hole #5

Lab No. Recap of CBR Data

TEST RESULTS

RECAP OF CBR DATA

Lab No.					
Lime (%) pH	-				
Surcharge (psf)	100				
Blows	12				
Density (pcf)	109.9				
Proctor (%)	89.3				
Initial Moisture (%)	13.8				
Absorption (%)					
Swell (%)	0				
Unified Classification	CH				
Liquid Limit	51				
Plastic Index	28				
CBR (%)	1				

AASHTO T180 Method A

Maximum Dry Density 123.1 pcf

Optimum Moisture 13.6 %

San Juan Testing Laboratory, Inc.

907 W. APACHE P.O. BOX 2079 FARMINGTON, NEW MEXICO 87401 (505) 327-4966

SOIL SULFATE POTENTIAL

Date 4-27-79

Project Smith Energy Services Sampled by Lab Technician

Client Craftsmen Construction Co. Tested by C. Cochran

Location Farmington, New Mexico Supervised by

Source of Material Subsurface Investigation

TEST RESULTS

Lab. No.	Hole No.	Sample No.	Depth	Soil Description	Percent Sulfate	Recommended Cement Type
	3	2	0.8-3.1'	Silty & Sandy Clay	0.13	II
	4	3	2.8-4.6'	"	0.13	II
	5	2	0.8-2.8'	"	0.13	II
	6	2	1.0-2.4'	"	0.13	II
	7	2	1.0-2.2'	"	0.13	II

ATTACK ON CONCRETE BY SOILS CONTAINING VARIOUS SULFATE CONCENTRATIONS *

Relative Degree of Sulfate Attack	% Water-Soluble Sulfate (as SO_4) in Soil Samples	Cement
Negligible	0-0.10	
Positive	0.10-0.20	Use Type II Cement
Severe	0.20-2.0	Use Type V Cement
Very Severe	Over 2.0	Use Type V Cement

*SOURCE: USBR Concrete Manual, 1975 Edition

TEST NO. _____

san juan repro Form 360-31

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER	Test Pit #1			PROJECT	Smith Energy Services
COLLAR ELEVATION	96.8	LOGGED BY	RH	CLIENT	Craftsmen Construction Co.
DATE DRILLED	4-10-79	TESTED BY	RH	LOCATION	Farmington, New Mexico
DATE REPORTED		SUPERVISED BY	LEC	LAB NUMBER	

DEPTH (FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)	STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)	PHYSICAL TESTS*
0	Sandy Clay & Organics	CL			1	H	99	91	63	12		
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	78	69	44	6		
	Silty Sand & Cobbles	GM			3	H				NP		
5	Boulders to 18" size below 5 ft.				4	H				NP		
10												
	Stopped @ 11.8' Limit of Backhoe No Groundwater											
15												
20												

WATER CONTENT (PERCENT): 5 10 15 20 25 30 35

STANDARD PENETRATION BLOWS/FT. (LOG SCALE): 5 10 20 30 40 50 100 160

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* ... SHEET FOR EXPLANATION

San Juan Repro Form 360-33

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE

FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER	Test Pit #2			PROJECT	Smith Energy Services
COLLAR ELEVATION	97.0	LOGGED BY	RH	CLIENT	Craftsmen Construction Co.
DATE DRILLED	4-10-79	TESTED BY	RH	LOCATION	Farmington, New Mexico
DATE REPORTED		SUPERVISED BY	LEC	LAB NUMBER	

DEPTH (FEET)	SOIL PROFILE: DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLES: SAMPLE NUMBER	TYPE*	LABORATORY TESTS: GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)	STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)	PHYSICAL TESTS*
0	Sandy Clay & Organics	CL			1	H	99	91	63	12		
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H				6		
	Silty Sand & Cobbles	GM			3	H				NP		
5	Boulders up to 24" size below 4.5 ft.				4	H				NP		
10	Stopped @ 10.8' Caving Excavation No Groundwater											
15												
20												

WATER CONTENT* (PERCENT): 5 10 15 20 25 30 35

STANDARD PENETRATION* BLOWS/FT. (LOG SCALE): 5 10 20 30 40 50 100 160

* - CITE ONLY FOR EXPLANATION

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE

FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #3
COLLAR ELEVATION: 97.0
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH-(FEET)	SOIL PROFILE: DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLES: SAMPLE NUMBER	SAMPLES: TYPE*	LABORATORY TESTS: GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)	STANDARD PENETRATION* BLOWS/FT.(LOG SCALE)	PHYSICAL TESTS*
0	Sandy Clay & Organics	CL			1	H	99	91	63	12		
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	64	51	34	1		
5	Silty Sand & Cobbles	GM			#	H				NP		
	Boulders up to 18" size below 6.3'				4	H				NP		
10												
15	Stopped @ 11.3' Limit of Backhoe No Groundwater											
20												

WATER CONTENT* (PERCENT): 5 10 15 20 25 30 35

STANDARD PENETRATION* BLOWS/FT.(LOG SCALE): 5 10 20 30 40 50 100 160

* SEE KEY FOR EXPLANATION

san juan repro Form 350 33

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE

FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #4
COLLAR ELEVATION: 95.8
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH (FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200
0	Sandy Clay & Organics	CL			1	H	99	91	63
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	78	69	44
	Silty Sand & Cobbles	GM			3	H			
5					4	H			
	Boulders up to 18" size below 9.5'								
10	Stopped @ 9.6' Caving No Groundwater								
	Note: Secured undisturbed push sample at depth interval 2.7'								
15									
20									

WATER CONTENT* (PERCENT): 5 10 15 20 25 30 35

STANDARD PENETRATION* BLOWS/FT. (LOG SCALE): 5 10 20 30 40 50 100 160

PHYSICAL TESTS*

12
6
1

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FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #5
COLLAR ELEVATION: 93.2
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH (FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)	STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)	PHYSICAL TESTS*
0	Silty Clay w/Organics	CH			1	H	99	92	71			
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	85	74	45			
	Silty Sand & Cobbles	GM			3	H						
5					4	H						
	Boulders up to 16" size below 6'				5	H						
10	Stopped @ 8.8' Caving No Groundwater											
15												
20												

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PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #6
COLLAR ELEVATION: 93.9
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH-(FEET)	SOIL PROFILE: DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLES: SAMPLE NUMBER	SAMPLES: TYPE*	LABORATORY TESTS: GRAIN SIZE % PASSING #4	#40	#200	LABORATORY TESTS: WATER CONTENT* (PERCENT)	STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)	PHYSICAL TESTS*
0	Silty Clay w/Organics	CH			1	H	99	92	71		28	
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	85	74	45		6	
	Cobbles below 2.5'				3	H					6	
5	Silty Sand & Cobbles	GM			4	H				NP		
10	Stopped @ 10.5' Limit of Backhoe No Groundwater											
15	Note: Secured undisturbed push sample from depth interval 2.0 feet.											
20												

WATER CONTENT* (PERCENT): 5 10 15 20 25 30 35
STANDARD PENETRATION* BLOWS/FT. (LOG SCALE): 20 30 40 50 100 160 | 40 45 50 55

19

* [illegible] SOILS [illegible] EXPLANATION

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE

FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

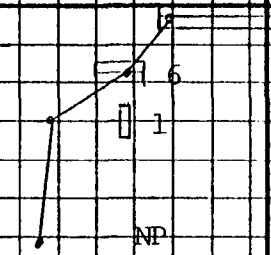
HOLE NUMBER	Test Pit #7			PROJECT	Smith Energy Services
COLLAR ELEVATION	95.1	LOGGED BY	RH	CLIENT	Craftsmen Construction Co.
DATE DRILLED	4-10-79	TESTED BY	RH	LOCATION	Farmington, New Mexico
DATE REPORTED		SUPERVISED BY	LEC	LAB NUMBER	

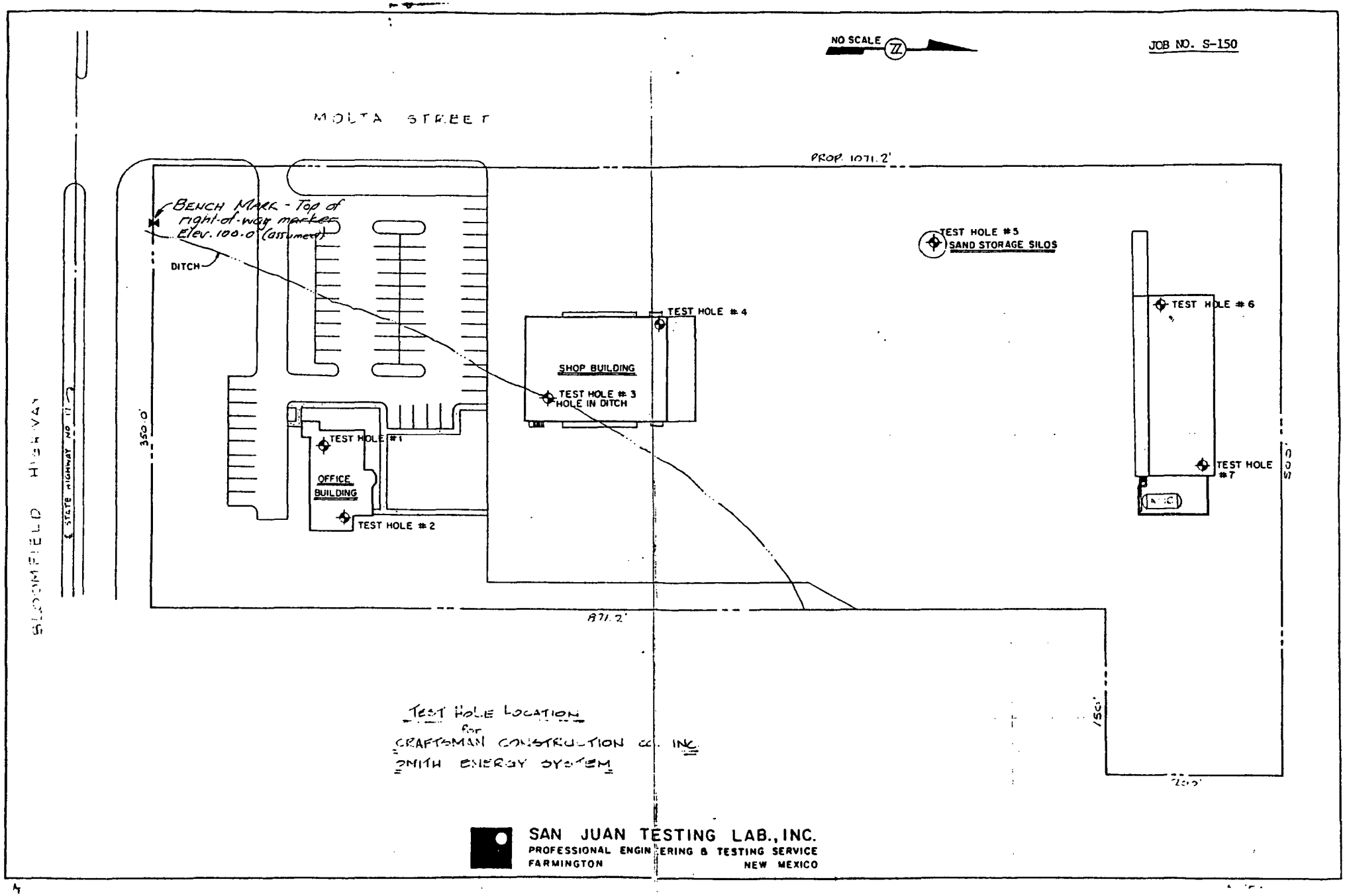
DEPTH-(FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200
0	Silty Clay w/Organics	CH			1	H	99	92	71
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	85	74	45
	Silty Sand & Cobbles	GM			3	H			
5	Cobbles up to 12" size below 4'				4	H			
10	Stopped @ 9.2' No Groundwater								
15									
20									

WATER CONTENT * (PERCENT): 5 10 15 20 25 30 35

STANDARD PENETRATION* BLOWS/FT.(LOG SCALE): 40 45 50 55 20 30 40 50 100 160

PHYSICAL TESTS*




NO SCALE
JOB NO. S-150
MOLTA STREET
PROP. 1071.2'
BENCH MARK - Top of right-of-way marker Elev. 100.0' (assumed)
DITCH
TEST HOLE #5
SAND STORAGE SILOS
TEST HOLE #4
SHOP BUILDING
TEST HOLE #3
HOLE IN DITCH
TEST HOLE #6
TEST HOLE #1
OFFICE BUILDING
TEST HOLE #2
TEST HOLE #7
350.0'
500.0'
871.2'
150'
200'
BLOOMFIELD HIGHWAY
STATE HIGHWAY NO. 17
TEST HOLE LOCATION
for
CRAFTSMAN CONSTRUCTION CO. INC.
SMITH ENERGY SYSTEM
SAN JUAN TESTING LAB., INC.
PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON
NEW MEXICO

SMITH ENERGY SERVICES
A DIVISION OF ALLIED PRODUCTS CORPORATION

SMITH ENERGY SERVICES SPILL GUIDELINES

DEFINITIONS

"Hazardous Material Spill' means a chemical, substance or material which has been determined by federal or state regulations, and identified by labels, placards, or markings to pose an unreasonable risk to the health, safety and environment when spilled or otherwise released into the environment.

GUIDELINES

1. The on-site supervisor shall consider people first. When an incident happens, be sure that no personnel will be harmed by the spilled material.

   A. Evacuate people from the spill area and render aid as necessary. Secure area from entry by spectators or any unauthorized personnel.

   B. Refer to shipping papers, material safety data sheets or response guide for emergency data concerning the spilled material.

   C. Utilize the required personal equipment: mask, gloves, goggles, etc. as is necessary to protect personnel.

   D. Notify emergency response services: police, fire department, etc. if spilled materials are hazard to human health or a serious threat to the environment.

   E. Be prepared to inform emergency response services personnel of all steps taken to protect human health and the environment. Show shipping papers to the police and/or fire response people. Your shipping papers will give police and health professional all the important data needed to handle the emergency. The proper shipping name, the hazard classification and the UN or NA numbers are normally enough during the emergency phase. UN (United Nations) or NA (North American numbers are found in the DOT Hazardous Materials Tables, Sec. 172.101 and the optional Hazardous Materials Tables, Sec. 172.102 (CFR, Title 49, Parts 100-199).

2. Containment of Released Materials

Contain materials in as small an area as is possible. This will prevent any widespread contamination of the environment.

A. Build dams or dikes with dirt or other available materials.

B. Divert flow to a safe area with series of dirt dikes or ditches.

C. Make every effort to prevent spilled materials from entering any waterways, storm drains, etc.

D. Call for heavy equipment if necessary to contain the spill area, provided the material is not potentially hazardous to equipment operators.

3. Protect Smith energy Services' equipment of you can do so safely.

4. Report the incident to the district manager immediately after steps 1 and 2 above have been accomplished or while step 2 is being accomplished.

5. Begin clean-up procedures. Take whatever action is necessary to remove all contaminated soil from the spill area. Coordinate disposal of contaminated spills, etc. with proper company and compliance officers. If the spill is small, the operator may be able to collect the contaminated soil and end the incident. If the spill is massive, the station manager will direct the clean-up. Risk areas where spill incidents may occur:

A. On the yard while loading or transferring acids or chemicals.

B. On the highway, accidents or leaks which develop during transportation.

C. On location while product is being pumped or mixed.

6. Reporting Hazardous Material Incidents

Any of the following transportation conditions involving DOT hazardous materials and in which the condition is a direct result of hazardous materials must be reported to DOT:

A. A person is killed.

B. A person receives injuries requiring hospitalization.

C. Estimated damages to Smith Energy Services' equipment or other property damage exceeds $50,000.

D. Fire, breakage or spillage of radioactive materials,

E. Fire, breakage, spillage or suspected contamination by etiological agents.

F. The spilled material is a hazardous material that is equal to or exceeds the reportable quantity as listed on the manifest or shipping document.

G. A condition exists which the responsible Smith Energy Services' representative believes that reporting is necessary even though steps A - F above do not exist.

Note: When required to file a telephone report of a hazardous transportation material incident, the person making the report must use the following checklist in order to expedite the reporting procedure:

1) Name of person making report.
2) Name and address of carrier represented by person making the report.
3) Telephone number where person can be reached.
4) Date, time and location of hazardous materials incident.
5) Extent of injuries is known.
6) Classification, proper shipping name and quantity of hazardous materials involved.
7) Type of incident and nature of hazardous materials involved.
8) Whether or not a continuing danger to life exists.

Note: A hazardous materials transportation spill requires filing Form #F5800.1 within fifteen days.

7. Reporting Requirements for Environmental Protection Agency or State Environmental Offices

Any spill or discharge of any material onto the ground results in the generation of waste. The waste may or may not be hazardous. In either case, the waste requires special handling and disposal. There is also a concern that the spill may damage the environment. When deciding whether a report is necessary, both factors must be considered.

To simplify the decision concerning agency reporting, incidents have been classified by size, the prospect of involving property owned or controlled by others, and the possibility of damage to the environment.

A. Class S incident. A spill which stays in the immediate vicinity of the source and is either confined or soaks into the ground, generally less than 1 barrel, and can be cleaned up in a few minutes.

Actions to be taken with Class S incident:

1) Steps 1 through 5 above as needed.
2) Document the incident, report the name of the material spilled, time, date, amount spilled, what clean-up actions were taken, and disposition of contaminated material.
3) Send copy of documentation to Loss Control Department, Golden.

B. Class M incident. Any incident where released materials runs away from source and may enter drains, sewers, streams, waterways and/or property owned or controlled by others. this included spills that could be washed away by rainfall into storm drains or waterways not under SES control. Class M incidents will require more than one hour to clean up.

Actions to be taken with Class M incident:

1) Steps 2 through 5 above as needed.
2) Attempt to confine release so as to prevent it from leaving immediate area and to keep it from entering any sewer, watercourse or property of others.
3) Under no condition allow local response teams to wash residue into sewers, etc.

4) Notify district manager who will:

   a) Get help to confine the spill as needed.
   b) Notify emergency response agencies if needed.
   c) Notify Smith Energy Services, Golden for direction concerning agency notification.

   Note: If local emergency response services have been notified, they will contact state and federal agencies without waiting for SES to make notification. It is still a requirement of the law that SES notify the state and federal agencies.

C. Class L incident. These incidents involve significant releases which flow uncontrolled into areas where confinement is impossible, such as a river, or occurs so rapidly that confinement is beyond the capabilities of the on-site SES personnel.

Actions to be taken with Class L incident:

1) Steps 1 and 2 above.
2) District manager request outside help to scene;SES will rely on the local emergency response planning.
3) Notify SES region and division office.
4) Notify the required state of federal agencies.

D. Class R spill, radioactive materials. For spills of radioactive materials, refer to SES Radioactive Materials Operating and Emergency Procedures Manual.

8. Dealing with the Media: Emergency Response Radio Channels are monitored by the media. If local emergency services are notified, anticipate media coverage. Smith Energy Services' personnel will not discuss the incident with anyone except those with the need to know, such as fire fighters or police personnel. Advise statements will be made by proper authority.

9. Training

All Smith Energy personnel involved in the day-today handling of hazardous materials shall receive formal instruction to the procedures outlined herein. This training shall be conducted annually and each new hire will receive this training during his orientation phase with SES.

Table 1
Quantities of Various Alkalies Required to Neutralize
100 Gallons of Hydrochloric Acid

Hydrochloric (Muriatic) Acid			Neutralizing Chemicals				
Acid Concentration At.%HCI	Specific Gravity of Solution	Acutal Pounds of Acid per 100Gals.	CaO Quicklime Lbs.	Ca(OH)2 Lime Lbs.	Na,CO3 Anhydrous Soda Ash Lbs.	50% NaOH Liquid Caustic Soda lbs.	NaOh Bead/Flake Caustic Soc Lbs.
0.1	Use 1.000	.837	.644	.852	1.27	1.836	.918
0.2	Use 1.000	1.674	1.28	1.70	2.54	3.672	1.836
0.3	Use 1.000	2.511	1.93	2.52	3.81	5.50	2.75
0.4	Use 1.000	3.35	2.58	3.41	5.08	7.34	3.67
0.5	Use 1.0015	4.19	3.19	4.22	6.35	9.18	4.59
0.6	Use 1.0015	5.02	3.86	5.11	7.62	11.02	5.51
0.7	Use 1.0015	5.86	4.51	5.93	8.89	12.86	6.43
0.8	Use 1.0015	6.70	5.15	6.82	10.16	14.68	7.34
0.9	Use 1.0015	7.53	5.79	7.63	11.43	16.52	8.26
1.	1.0032	8.37	6.44	8.52	12.7	18.36	9.18
2.	1.0082	16.83	12.94	17.12	24.6	36.96	18.48
3.	1.0131	25.41	19.54	25.79	37.0	55.70	27.85
4.	1.0181	33.99	26.14	34.53	49.3	74.4	37.2
5.	1.023	42.73	32.86	43.42	62.0	93.6	46.8
6.	1.0279	51.47	39.56	52.31	74.6	112.8	56.4
10.	1.0474	87.41	67.22	88.92	126.8	191.4	95.7
20.	1.0980	183.3	141	186	267	402	201
25.	1.1261	234.8	179	237	339	512	256
30.	1.1526	288.4	221	293	419	632	316
35.	1.1778	343.8	264	348	498	752	376

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0.7	Use 1.0015	5.86	4.51	5.93	8.89	12.86	6.43
0.8	Use 1.0015	6.70	5.15	6.82	10.16	14.68	7.34
0.9	Use 1.0015	7.53	5.79	7.63	11.43	16.52	8.26
1.	1.0032	8.37	6.44	8.52	12.7	18.36	9.18
2.	1.0082	16.83	12.94	17.12	24.6	36.96	18.48
3.	1.0131	25.41	19.54	25.79	37.0	55.70	27.85
4.	1.0181	33.99	26.14	34.53	49.3	74.4	37.2
5.	1.023	42.73	32.86	43.42	62.0	93.6	46.8
6.	1.0279	51.47	39.56	52.31	74.6	112.8	56.4
10.	1.0474	87.41	67.22	88.92	126.8	191.4	95.7
20.	1.0980	183.3	141	186	267	402	201
25.	1.1261	234.8	179	237	339	512	256
30.	1,1526	288.4	221	293	419	632	316
35.	1.1778	343.8	264	348	498	752	376

To determine the volume of water necessary to dilute acid to a definite volume of lesser strength, use the following formula:

Volume of water necessary =

$$(\text{Vol desired}) - \frac{(\text{Vol desired})\,(\text{desired \%})\,(\text{Sp Gr desired})}{(\text{Orig acid \%})\,(\text{Sp Gr orig acid})}$$

INCREASING CONCENTRATION OF ACID

To determine the volume of strong acid necessary to increase the concentration of acid to a definite volume of acid of higher concentration, use the following formula:

Volume of strong acid necessary =

$$(\text{Vol desired}) \cdot \frac{(\text{desired \%})\,(\text{Sp Gr desired}) - (\text{Orig \%})\,(\text{Sp Gr orig})}{(\text{strong \%})\,(\text{Sp Gr strong}) - (\text{Orig \%})\,(\text{Sp Gr orig})}$$

HYDROCHLORIC ACID AT 60°F.

Barrels Strong Acid Required to Make 24 Barrels of					Sp. Gr.	Be°
15%	10%	7½%	5%	3%	60°F.	60°F.
					1.0069	1.00
					1.0140	2.00
				24.0	1.0149	2.13
				16.8	1.0211	3.00
			24.0	14.3	1.0249	3.52
			21.0	12.5	1.0284	4.00
			16.6	9.9	1.0357	5.00
		24.0	15.8	9.4	1.0374	5.24
		23.9	15.8	9.4	1.0375	5.25
		22.8	15.0	8.9	1.0394	5.50
		21.7	14.3	8.5	1.0413	5.75
		20.7	13.6	8.1	1.0432	6.00
		19.8	13.0	7.8	1.0450	6.25
		19.0	12.5	7.4	1.0469	6.50
		18.2	12.0	7.1	1.0488	6.75
	24.0	17.8	11.7	7.0	1.0499	6.89
	23.6	17.5	11.5	6.8	1.0507	7.00
	22.7	16.8	11.1	6.6	1.0526	7.25
	21.8	16.2	10.7	6.3	1.0545	7.50
	21.1	15.6	10.3	6.1	1.0564	7.75
	20.3	15.1	9.9	5.9	1.0584	8.00
	19.7	14.6	9.6	5.7	1.0603	8.25
	19.0	14.1	9.3	5.5	1.0623	8.50
	18.4	13.6	9.0	5.3	1.0642	8.75
	17.8	13.2	8.7	5.2	1.0662	9.00
	17.3	12.8	8.4	5.0	1.0681	9.25
	16.8	12.4	8.2	4.9	1.0701	9.50
	16.3	12.1	7.9	4.7	1.0721	9.75
	15.8	11.7	7.7	4.6	1.0741	10.00
24.0	15.6	11.6	7.6	4.5	1.0750	10.12

HYDROCHLORIC ACID AT 60°F.

Be° 60°F.	Per Cent HCl	Gallons Strong Acid Required to Make 1000 Gallons of 15%	10%	7½%	5%	3%
10.25	15.22	985	641	475	313	186
10.50	15.67	958	623	462	304	181
10.75	16.01	932	607	450	296	176
11.00	16.41	908	591	438	289	171
11.25	16.81	885	576	427	281	167
11.50	17.21	863	562	416	274	163
11.75	17.61	842	548	406	267	159
12.00	18.01	821	535	396	261	155
12.25	18.41	802	522	387	255	151
12.50	18.82	783	510	378	249	148
12.75	19.22	765	498	369	243	144
13.00	19.63	748	487	361	238	141
13.23	20.00	733	477	354	233	138
13.25	20.04	731	476	353	232	138
13.50	20.45	715	466	345	227	135
13.75	20.86	700	456	338	222	132
14.00	21.27	685	446	330	218	129
14.25	21.68	671	437	324	213	127
14.50	22.09	657	428	317	209	124
14.75	22.50	644	419	311	205	122
15.00	22.92	631	411	304	200	119
15.25	23.33	618	403	298	197	117
15.50	23.75	606	395	293	193	114
15.75	24.16	595	387	287	189	112
16.00	24.57	584	380	282	186	110
16.10	24.73	580	377	280	184	109
16.20	24.90	575	375	278	183	109
16.30	25.06	571	372	276	182	108
16.40	25.23	567	369	274	180	107
16.50	25.39	563	366	272	179	106
16.60	25.56	559	364	270	178	105
16.70	25.72	555	361	268	176	105
16.80	25.89	551	359	266	175	104
16.90	26.05	547	356	264	174	103
17.00	26.22	543	353	262	173	103
17.10	26.39	539	351	260	171	102
17.20	26.56	535	348	258	170	101
17.30	26.73	531	346	256	169	100
17.40	26.90	528	343	255	168	100
17.50	27.07	524	341	253	166	99
17.60	27.24	520	339	251	165	98
17.70	27.41	516	336	249	164	98
17.80	27.58	513	334	247	163	97
17.90	27.75	509	332	246	162	96
18.00	27.92	506	329	244	161	96
18.10	28.09	502	327	242	160	95
18.20	28.26	499	325	241	159	94
18.30	28.44	495	323	239	157	94
18.40	28.61	492	320	237	156	93
18.50	28.78	489	318	236	155	92
18.60	28.95	486	316	234	154	92
18.70	29.13	482	314	233	153	91
18.80	29.30	479	312	231	152	90
18.90	29.48	476	310	230	151	90
19.00	29.65	473	308	228	150	89
19.10	29.83	469	306	226	149	89
19.20	30.00	466	304	225	148	88

Barrels Strong Acid Required to Make 24 Barrels of 15%	10%	7½%	5%	3%	Sp Gr 60°F.	Be° 60°F
23.6	15.4	11.4	7.5	4.5	1.0761	10.25
23.0	15.0	11.1	7.3	4.3	1.0781	10.50
22.4	14.6	10.8	7.1	4.2	1.0801	10.75
21.8	14.2	10.5	6.9	4.1	1.0821	11.00
21.2	13.8	10.2	6.7	4.0	1.0841	11.25
20.7	13.5	10.0	6.6	3.9	1.0861	11.50
20.2	13.2	9.7	6.4	3.8	1.0881	11.75
19.7	12.8	9.5	6.3	3.7	1.0902	12.00
19.2	12.5	9.3	6.1	3.6	1.0923	12.25
18.8	12.2	9.1	6.0	3.5	1.0943	12.50
18.4	12.0	8.9	5.8	3.5	1.0964	12.75
17.9	11.7	8.7	5.7	3.4	1.0985	13.00
17.6	11.4	8.5	5.6	3.3	1.1004	13.23
17.5	11.4	8.5	5.6	3.3	1.1006	13.25
17.2	11.2	8.3	5.5	3.2	1.1027	13.50
16.8	10.9	8.1	5.3	3.2	1.1048	13.75
16.4	10.7	7.9	5.2	3.1	1.1069	14.00
16.1	10.5	7.8	5.1	3.0	1.1090	14.25
15.8	10.3	7.6	5.0	3.0	1.1111	14.50
15.5	10.1	7.5	4.9	2.9	1.1132	14.75
15.1	9.9	7.3	4.8	2.9	1.1154	15.00
14.8	9.7	7.2	4.7	2.8	1.1176	15.25
14.6	9.5	7.0	4.6	2.7	1.1197	15.50
14.3	9.3	6.9	4.5	2.7	1.1219	15.75
14.0	9.1	6.8	4.5	2.6	1.1240	16.00
13.9	9.1	6.7	4.4	2.6	1.1248	16.10
13.8	9.0	6.7	4.4	2.6	1.1256	16.20
13.7	8.9	6.6	4.4	2.6	1.1265	16.30
13.6	8.9	6.6	4.3	2.6	1.1274	16.40
13.5	8.8	6.5	4.3	2.6	1.1283	16.50
13.4	8.7	6.5	4.3	2.5	1.1292	16.60
13.3	8.7	6.4	4.2	2.5	1.1301	16.70
13.2	8.6	6.4	4.2	2.5	1.1310	16.80
13.1	8.5	6.3	4.2	2.5	1.1319	16.90
13.0	8.5	6.3	4.1	2.5	1.1328	17.00
12.9	8.4	6.2	4.1	2.4	1.1336	17.10
12.8	8.4	6.2	4.1	2.4	1.1345	17.20
12.8	8.3	6.2	4.1	2.4	1.1354	17.30
12.7	8.2	6.1	4.0	2.4	1.1363	17.40
12.6	8.2	6.1	4.0	2.4	1.1372	17.50
12.5	8.1	6.0	4.0	2.4	1.1381	17.60
12.4	8.1	6.0	3.9	2.3	1.1390	17.70
12.3	8.0	5.9	3.9	2.3	1.1399	17.80
12.2	8.0	5.9	3.9	2.3	1.1408	17.90
12.1	7.9	5.9	3.9	2.3	1.1417	18.00
12.1	7.9	5.8	3.8	2.3	1.1426	18.10
12.0	7.8	5.8	3.8	2.3	1.1435	18.20
11.9	7.7	5.7	3.8	2.2	1.1444	18.30
11.8	7.7	5.7	3.8	2.2	1.1453	18.40
11.7	7.6	5.7	3.7	2.2	1.1462	18.50
11.7	7.6	5.6	3.7	2.2	1.1471	18.60
11.6	7.5	5.6	3.7	2.2	1.1480	18.70
11.5	7.5	5.5	3.7	2.2	1.1489	18.80
11.4	7.4	5.5	3.6	2.2	1.1498	18.90
11.3	7.4	5.5	3.6	2.1	1.1508	19.00
11.3	7.3	5.4	3.6	2.1	1.1517	19.10
11.2	7.3	5.4	3.6	2.1	1.1526	19.20

HYDROCHLORIC ACID AT 60° F.

Be° 60°F	Per Cent HCl	Gallons Strong Acid Required to Make 1000 Gallons of 15%	10%	7½%	5%	3%
19 30	30 18	463	307	231	157	87
19 40	30 35	460	300	227	146	87
19 50	30 53	457	298	221	145	86
19 60	30 71	454	296	219	144	86
19 70	30 90	451	294	218	143	85
19 80	31 08	448	292	216	142	85
19 90	31 27	445	290	215	141	84
20 00	31 45	442	288	213	140	83
20 10	31 64	439	286	212	140	83
20 20	31 82	436	284	210	139	82
20 30	32 01	433	282	209	138	82
20 40	32 19	430	280	208	137	81
20 50	32 38	428	278	206	136	81
20 60	32 56	425	277	205	135	80
20 70	32 75	422	275	204	134	80
20 80	32 93	419	273	202	133	79
20 90	33 12	417	271	201	132	79
21 00	33 31	414	270	200	132	78
21 10	33 50	411	268	198	131	78
21 20	33 69	409	266	197	130	77
21 30	33 88	406	264	196	129	77
21 40	34 07	403	263	195	128	76
21 50	34 26	401	261	193	127	76
21 60	34 45	398	259	192	127	75
21 70	34 64	396	258	191	126	75
21 80	34 83	393	256	190	125	74
21 90	35 02	391	255	189	124	74
22 00	35 21	388	253	187	123	73
22 10	35 40	386	251	186	123	73
22 20	35 59	384	250	185	122	72
22 30	35 78	381	248	184	121	72
22 40	35 97	379	247	183	120	72
22 50	36 16	377	245	182	120	71
22 60	36 35	374	244	181	119	71
22 70	36 54	372	242	180	118	70
22 80	36 73	370	241	179	118	70
22 90	36 93	368	239	177	117	69
23 00	37 14	365	238	176	116	69
23 10	37 36	363	236	175	115	69
23 20	37 58	360	235	174	115	68
23 30	37 80	358	233	173	114	68
23 40	38 03	356	232	172	113	67
23 50	38 26	353	230	170	112	67
23 60	38 49	351	228	169	111	66
23 70	38 72	348	227	168	111	66
23 80	38 95	346	225	167	110	65
23 90	39 18	344	224	166	109	65
24 00	39 41	341	222	165	109	64
24 10	39 64	339	221	164	108	64
24 20	39 86	337	219	163	107	64
24 30	40 09	335	218	162	106	63
24 40	40 32	333	217	160	106	63
24 50	40 55	330	215	159	105	62
24 60	40 78	328	214	158	104	62
24 70	41 01	326	212	157	104	62
24 80	41 24	324	211	156	103	61
24 90	41 48	322	210	155	102	61
25 00	41 72	320	208	154	102	60

Barrels Strong Acid Required to Make 24 Barrels of 15%	10%	7½%	5%	3%	Sp. Gr. 60°F.	Be° 60°F.
11 1	7 7	5 4	3 5	2 1	1.1535	19 30
11 0	7 2	5 3	3 5	2 1	1.1544	19 40
11 0	7 1	5 3	3 5	2 1	1.1554	19 50
10 9	7 1	5 3	3 5	2 1	1.1563	19 60
10 8	7 0	5 2	3 4	2 0	1.1574	19 70
10 8	7 0	5 2	3 4	2 0	1.1584	19 80
10 7	7 0	5 2	3 4	2 0	1.1590	19 90
10 6	6 9	5 1	3 4	2 0	1.1600	20 00
10 5	6 9	5 1	3 3	2 0	1.1609	20 10
10 5	6 8	5 1	3 3	2 0	1.1619	20 20
10 4	6 8	5 0	3 3	2 0	1.1628	20 30
10 3	6 7	5 0	3 3	2 0	1.1637	20 40
10 3	6 7	5 0	3 3	1 9	1.1647	20 50
10 2	6 6	4 9	3 2	1 9	1.1656	20 60
10 1	6 6	4 9	3 2	1 9	1.1666	20 70
10 1	6 6	4 9	3 2	1 9	1.1675	20 80
10 0	6 5	4 8	3 2	1 9	1.1684	20 90
9 9	6 5	4 8	3 2	1 9	1.1694	21 00
9 9	6 4	4 8	3 1	1 9	1.1703	21 10
9 8	6 4	4 7	3 1	1 9	1.1713	21 20
9 7	6 3	4 7	3 1	1 8	1.1722	21 30
9 7	6 3	4 7	3 1	1 8	1.1732	21 40
9 6	6 3	4 6	3 1	1 8	1.1741	21 50
9 6	6 2	4 6	3 0	1 8	1.1751	21 60
9 5	6 2	4 6	3 0	1 8	1.1760	21 70
9 4	6 1	4 6	3 0	1 8	1.1770	21 80
9 4	6 1	4 5	3 0	1 8	1.1779	21 90
9 3	6 1	4 5	3 0	1 8	1.1789	22 00
9 3	6 0	4 5	2 9	1 7	1.1798	22 10
9 2	6 0	4 4	2 9	1 7	1.1808	22 20
9 2	6 0	4 4	2 9	1 7	1.1817	22 30
9 1	5 9	4 4	2 9	1 7	1.1827	22 40
9 0	5 9	4 4	2 9	1 7	1.1836	22 50
9 0	5 9	4 3	2 9	1 7	1.1846	22 60
8 9	5 8	4 3	2 8	1 7	1.1856	22 70
8 9	5 8	4 3	2 8	1 7	1.1866	22 80
8 8	5 7	4 3	2 8	1 7	1.1875	22 90
8 8	5 7	4 2	2 8	1 7	1.1885	23 00
8 7	5 7	4 2	2 8	1 6	1.1895	23 10
8 7	5 6	4 2	2 7	1 6	1.1904	23 20
8 6	5 6	4 1	2 7	1 6	1.1914	23 30
8 5	5 6	4 1	2 7	1 6	1.1924	23 40
8 5	5 5	4 1	2 7	1 6	1.1935	23 50
8 4	5 5	4 1	2 7	1 6	1.1944	23 60
8 4	5 4	4 0	2 7	1 6	1.1953	23 70
8 3	5 4	4 0	2 6	1 6	1.1963	23 80
8 2	5 4	4 0	2 6	1 6	1.1973	23 90
8 2	5 3	4 0	2 6	1 5	1.1983	24 00
8 1	5 3	3 9	2 6	1 5	1.1993	24 10
8 1	5 3	3 9	2 6	1 5	1.2003	24 20
8 0	5 2	3 9	2 6	1 5	1.2013	24 30
8 0	5 2	3 9	2 5	1 5	1.2023	24 40
7 9	5 2	3 8	2 5	1 5	1.2033	24 50
7 9	5 1	3 8	2 5	1 5	1.2043	24 60
7 8	5 1	3 8	2 5	1 5	1.2053	24 70
7 8	5 1	3 8	2 5	1 5	1.2063	24 80
7 7	5 0	3 7	2 5	1 5	1.2073	24 90
7 7	5 0	3 7	2 4	1 4	1.2083	25 00

GW-101

DISCHARGE PLAN

I. TYPE OF OPERATION

This site is a staging yard for Smith Energy Services, an oil field fracturing and acidizing company. There are three categories of activities at this facility.

1. Administrative office
2. Heavy equipment maintenance
3. Chemicals storage

II. NAME OF OPERATOR AND LOCAL REPRESENTATIVE

Smith Energy Services, a division of Allied Prod. Corp.
2198 East Bloomfield Highway
Farmington, NM
Brake Stevenson, District Manager
505-325-2732

III. LOCATION OF DISCHARGE

SE/4, SW/4, Section 14, Township 29N, Range 13W
Farmington, San Juan County, New Mexico

enclosure: Facility site plan (diagram #2)
City map (appendix A)

IV. LANDOWNERS

CLM Properties, Inc.
Michael T. Green, President
P.O. Box 1766
Farmington, NM

V. FACILITY DESCRIPTION

Land:
Approximately 565.000 sq. ft. (12.98 acres). The property is located in the city of Farmington, New Mexico, San Juan County. The property is generally long and rectangular in shape. It has 350 ft. of highway frontage on U.S. Highway 64 on the North side. It has Molta Street on the West side and land on the East, (presently owned by Meridian Oil & Gas). Customer parking is South of the main office and employee parking is West of the main office.

Building:
The facility is comprised of three buildings totaling 21,140 sq. ft. The buildings are steel frame, concrete block structure. The main office is 5,220 sq. ft. The shop is 8,640 sq. ft. and consists of six bays for maintenance in heavy equipment with 2 overhead 7-ton cranes. Also in the shop space is an 80' long wash bay for the washing of equipment. It also has a locker room in a portion of the second story for employee storage, and showers. The warehouse has two sections, one for storage of flammable chemicals and one section for general storage.

Office	5,220
Shop	8,640
Warehouse	7,280

General:
The property is served by utility gas, electricity, and city water and sewer. There are 4 sand storage bins in the Northwest part of the yard and an acid tank on the East end of the warehouse.

Building Equipment:
The office and warehouse are lighted with fluorescent lights. The shop has mercury vapor and fluorescent lights. The shop and office have forced air heaters and air conditioners. The warehouse has heaters.

PART VI DISCHARGE PLAN APPLICATION

MATERIALS STORED OR USED AT THE FACILITY

	NAME	GENRAL MAKE-UP OR SPECIFIC BRAND NAME	SOLID OR LIQUID	TYPE CONTAINER	ESTIMATE VOLUME STORED	LOCATION
1.	DRILLING FLUID	N/A TO SES				
2.	BRINES:					
	A: potasium chloride		SOLID	BAGGED	100 LBS.	WAREHOUSE
	B: rock salt		SOLID	BAGGED	1600 LBS.	WAREHOUSE
3.	ACIDS/CAUSTICS					
*	A. hydrochloric acid		LIQUID	TANK	5000 GAL.	ACID DOCK
*	B. CA-1 citric acid (dry)		SOLID	BAGGED	1000 LBS.	WAREHOUSE
*	C. CA-4 citric acid (50%) liq.		LIQUID	DRUM	80 GAL.	WAREHOUSE
*	D. boric acid		SOLID	BAGGED	600 LBS.	WAREHOUSE
*	E. BW 4 sulfamic acid		SOLID	BAGGED	1600 LBS.	WAREHOUSE
4.	DETERGENTS AND SOAPS					
	A. steam cleaner soap	IMTECH	LIQUID	DRUM	55 GAL.	SHOP
5.	SOLVENTS AND DEGREASERS					
*	A. AGD-2 tributy phosphate		LIQUID	DRUM	55 GAL.	WAREHOUSE
	B. saety kleen 105/140 solvent		LIQUID	DRUM	30 GAL.	SHOP
	C. cal pac carburetor cleaner		LIQUID	CAN	5 GAL.	SHOP
6.	PARRAFIN TREATMENT/EMULSION BREAKERS/SURFACTANTS					
*	A. AMS03 checker sol p-tekstim		LIQUID	DRUM	110 GAL.	WAREHOUSE
*	B. EPS04 PB-8723 (corexit 8547)		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	C. EPS09 ASP 322		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	D. SAA02 nonylphenol ethoxylate isopropyl alchohol		LIQUID	DRUM	130 GAL.	WAREHOUSE
*	E. SAA03 PB 8724 (corexit 9629)		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	F. SSS02 PB-8591		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	G. AR-02 ASP 313		LIQUID	DRUM	20 GAL.	WAREHOUSE
*	H. CCC-3 aquet 812		LIQUID	DRUM	100 GAL.	WAREHOUSE
*	I. FAA-2 chembetaine c		LIQUID	DRUM	350 GAL.	WAREHOUSE
*	J. MCFRS PB9049		LIQUID	DRUM	300 GAL.	WAREHOUSE
*	K. CCC05W arquad DMCB-SE-1		LIQUID	DRUM	55 GAL.	WAREHOUSE
*	L. PDC-1 clear 7815		LIQUID	DRUM	145 GAL.	WAREHOUSE
7.	BIOCIDES					
*	A. BCS-4 dryocide		SOLID	BAGGED	50 LBS.	WAREHOUSE
*	B. BCS-7 xcide 600		SOLID	BAGGED	300 LBS.	WAREHOUSE

*	C. PFL-1 adomite 539D	LIQUID	DRUM	8 GAL.	WAREHOUSE
8.	OTHERS				
	A. ACID INHIBITORS				
*	1. CIA-1 corexit PB 8728	LIQUID	DRUM	110 GAL.	WAREHOUSE
*	2. CIA-2 corexit PB 8580	LIQUID	DRUM	110 GAL.	WAREHOUSE
*	3. CIA-3 AK-7	LIQUID	DRUM	55 GAL.	WAREHOUSE
	B. GELLING AGENTS/FRICTION REDUCERS FOR WATER				
	1. WGA-02 hydroxypropyl guar	SOLID	BAGGED	3000 LBS.	WAREHOUSE
	2. WGA-06 guar gum (refined)	SOLID	BAGGED	1900 LBS.	WAREHOUSE
	3. CMG-1 galacto-manna blend	SOLID	BULK BAG	9100 LBS.	WAREHOUSE
	4. CMG-2 galacto-manna blend	SOLID	BULK BAG	7900 LBS.	WAREHOUSE
	5. WFR-02 ASP 820	LIQUID	DRUM	165 GAL.	WAREHOUSE
	C. GELLING AGENTS/FRICTION REDUCERS FOR OIL				
*	1. OGA-02 ASP 200	LIQUID	DRUM	55 GAL.	WAREHOUSE
*	2. OGA-05 AOG-1	LIQUID	DRUM	55 GAL.	WAREHOUSE
*	3. OFR-01 TRO322=CP-565	LIQUID	DRUM	55 GAL.	WAREHOUSE
	D. GELLING AGENTS/FRICTION REDUCERS FOR ACID				
*	1. AGA-2 DSGA	LIQUID	DRUM	55 GAL.	WAREHOUSE
	E. CROSS LINKER-ADDITIVE FOR GEL				
*	1. CX-1 blend ipa/titanium	LIQUID	DRUM	200 GAL.	WAREHOUSE
*	2. CX-6 blend ipa/titianium	LIQUID	DRUM	275 GAL.	WAREHOUSE
*	3. CX-13 liquid sodium borate	LIQUID	DRUM	400 GAL.	WAREHOUSE
*	4. CX-14 blend ipa/zirconium	LIQUID	DRUM	100 GAL.	WAREHOUSE
*	5. CX-15 blend ipa/ triethanolmine/zirconium	LIQUID	DRUM	25 GAL.	WAREHOUSE
*	6. CX-91 blend ipa/titanium	LIQUID	DRUM	240 GAL.	WAREHOUSE
*	7. CDA-1 blend ipa/ acetyl acetone	LIQUID	DRUM	40 GAL.	WAREHOUSE
	F. BUFFERS				
	1. BW-3 sodium carbonate	SOLID	BAGGED	50 LBS.	WAREHOUSE
	2. potassium carbonate	SOLID	BAGGED	1200 LBS.	WAREHOUSE
	G. BREAKERS				
	1. WCB-LT blend triethanolamine	LIQUID	DRUM	200 GAL.	WAREHOUSE
	2. MCB ACT hampene copper 7.5%	LIQUID	DRUM	55 GAL.	WAREHOUSE
	3. WCB-1 ammonium persulfate	SOLID	BAGGED	3000 LBS.	WAREHOUSE
	4. sodium percarbonate	SOLID	BAGGED	700 LBS.	WAREHOUSE
	5. WEB-2 gelbrake el	SOLID	BAGGED	110 LBS.	WAREHOUSE
	6. DWB-1 tekstim 3507	SOLID	BAGGED	3000 LBS.	WAREHOUSE
	7. EWB-1 encapsulated breaker	SOLID	BAGGED	200 LBS.	WAREHOUSE

H. FRAC PROPPANT				
1. sand	SOLID	BULK	840 TONS	SAND SILO
2. resin coated sand	SOLID	BULK/BAG	2 TONS	WAREHOUSE
I. LUBRICANTS				
1. conoco ep rock drill oil 100	LIQUID	TANK	500 GAL.	SHOP
2. universal anti-freeze and coolant	LIQUID	TANK	300 GAL.	SHOP
3. power tran III fluid	LIQUID	TANK	300 GAL.	SHOP
4. fleet heavy duty motor oil	LIQUID	TANK	300 GAL.	SHOP
5. mobil synthetic, mobilube	LIQUID	DRUM	110 GAL.	SHOP
J. WELDING/CUTTING				
1. oxygen	GAS	CYLINDER	1 EA.	SHOP
2. acetylene	GAS	CYLINDER	1 EA.	SHOP

*MSDS APPENDIX B

PART VII: Sources and Quantities of Effluent and Waste Solids Generated at the Facility

Waste Type/General Composition and Source	Volume per Month	Major Additives
1. Truck Wastes:		
a. Diluted acid reinstate, this is Hydrochloric acid residue left in cargo tank and back flushed with water.	100 gallons	Hydrochloric acid/ CIA-1, CA-4, SAA-2, EPS-9
2. Truck, Tank, and Drum Washing:		
a. Truck washing operations	n/a	n/a to SES
b. Drum or cargo washing	n/a	n/a to SES
3. Steam Cleaning of Parts, Equipment, and Tanks		
a. Parts - These parts are cleaned with detergents.	100 gallons	Water
b. Tanks	n/a	n/a to SES
4. Solvents and De-greaser Use	30 gallons	Safety-Kleen
5. Spent Acids, Caustics, or Completion Fluids	see truck wastes	
6. Waste Slop Oil	n/a	Oily rags/floor dry
7. Waste Lubrication and Motor Oil	600 gallons	Oil
8. Oil Filters	40 filters	n/a
9. Solids and Sludges from Tanks (none generated)	n/a	n/a to SES
10. Painting Waste (none generated)	n/a	n/a to SES
11. Sewage - This is water and sewage which is disposed of through the city of Farmington, NM sewage.	8,000 gallons	Farmington City Water

12.	Other Waste Liquids		
	a. Laboratory waste - This consists of essentially all chemicals in the facility.	10 gallons	Produced water, oil, and various chemicals
	b. Chemical warehouse (photo)	n/a	n/a to SES
13.	Other Waste Solids		
	a. Used drums - This consists of used chemical drums	n/a	n/a to SES
	b. Chemical warehouse (photo)	n/a	n/a to SES
	c. Batteries	10	n/a

VIII. DESCRIPTION OF CURRENT LIQUID AND SOLID WASTE COLLECTION/STORAGE/DISPOSAL PROCEDURES

B. Collection and Storage

1. Truck Waste:

See attached information for above ground Hydrochloric Acid (22° Be) tank, recycle process for diluted Hydrochloric Acid and accidental spillage at facility (Information is on diagram 1).

2. Truck, Tank, and Drum Washing:

Truck - All of SES equipment is washed at a locally owned establishment.

Bubble City
3125 Bloomfield Hwy.
Farmington, NM 87401

Drums or Cargo - This is not done by SES or anywhere at the facility.

3. Steam Cleaning of Parts, Equipment, and Tanks:

Engine Parts - These parts are cleaned with water in a wash bay which is equipped with a drain area. This system will run into a separator, which separates any oil from the water. The water is then disposed of through the Farmington Waste Water Treatment. The oil in the separation procedure is stored in an underground sump which has a holding capacity of 470 gallons. This oil in the sump is disposed of one to two times a year or as needed (see diagram 3).

Tanks - This is not done by SES or anywhere at the facility.

4. Solvents and De-greaser Use:

This is supplied by Safety-Kleen and is periodically taken for recycling and replenished with new solvent.

Safety-Kleen
777 Big Timber Road
Elgin, IL 60123

5. Spent Acids, Caustics, or Completion Fluids:

Diluted Hydrochloric Acids with various inhibitors and surfactants are recycled through the unit located on the north-east corner of the warehouse (see diagram 2). The system and its capacities are shown on diagram 1.

There are not any caustics or completion fluids disposed of on the SES facility.

6. Waste Slop Oil:

There is not any waste slop oil generated on the SES facility.

7. Waste Lubrication and Motor Oil:

All of the waste motor oil/lubrication is stored in a 4' X 8' vertical container which is transferred to above ground storage tanks. The tanks are vertical tanks and are emptied periodically by a local vendor for recycling. The last date of pick up was 5/29/90 and consisted of 946 gallons.

Mesa Oil, Inc.
4701 Broadway, S.E.
Albuquerque, NM 87105

8. Oil Filters:

All of the oil filters are stored in a 4' X 8' vertical container in the maintenance shop where they are allowed to drain. They are then disposed of through the local trash service.

9. Solid Waste Sludge From Tanks:

There is not any solid waste sludge generated by SES at this facility.

10. Painting Wastes:

There is not any painting waste generated by SES at this facility.

11. Sewage Waste:

The sewage waste is disposed of through the Farmington waster water treatment system. There is no disposal of any SES chemicals/acids through this system. There is an average of 28,000 gallons of sewage per month at this facility.

City of Farmington
P.O. Box 4100
Farmington, NM 87499

12. Other Waste Liquid:

Laboratory waste - This waste is stored in designated 55 gallon drums, located in the wet chemical side of the warehouse. Disposal will be handled by:

Van Waters & Rogers, Inc.
ChemCare
P.O. Box 5287
Denver, CO 80217-5287

Chemical warehouse (wet chemical side) - Chemicals are mixed in this area with minimal amount of spillage. Any spillage flows to the outdoor concrete basin located on the north-east side of the warehouse (see diagram 1 for the recycle process).

13. Other Waste Solids:

Used drums - These are stored on a truck at the facility and are periodically transported to West Texas Drum in Midland, Texas for reuse by the facility.

Chemical warehouse (dry chemical side) - Chemicals are stored here and are mixed in the field. There is no mixing of chemicals on this side of the chemical warehouse. Chemicals from broken containers or bags are swept up, and as much as possible of the material is placed back into inventory and used. Contaminated residue and bags containing residue of hazardous materials are to be placed in an over pack container and held for disposal through the following company:

Van Waters & Rogers, Inc.
ChemCare
P.O. Box 5287
Denver, CO 80217-5287

All other chemicals listed as stored at the facility are added in the field at specific well sites. All remaining unused chemicals are brought back to the facility and returned to inventory. No wastes are generated from chemical usage other than minor spillage/drainage to the underground vault/tank for recycling.

Batteries - These are stored in the mechanics shop and are periodically picked up for recycling by a local vendor.

San Juan Steel and Salvage
5418 U.S. Hwy 64
Farmington, NM 87401

The entire SES facility is paved. It has a berm extending along the west side of the facility which is approximately 3 feet in height. This prevents any commingle of water from the SES facility to the surrounding area. Refer to diagram 1 for the specific details on the above ground Hydrochloric Acid storage tanks and the lined underground recycling system.

All drums are sealed and stored on a truck for transportation to a disposal site as stated above. The surface is paved and no spillage occurs in this area.

The SES facility was built in 1979 so no need for integrity of buried piping is necessary.

B. Existing Effluent and Solid Disposal

A. On Site Facilities

a. There is one area (wash bay) where oily waste is disposed of by the use of a sump. The wash bay is used to wash/clean mechanical parts for repair of SES equipment.

1. Berm - There is a berm which extends along the west side of the facility excluding the offices and office parking. The berm is approximately 3 feet high. Its purpose is to prevent water runoff to the surrounding area. This berm was installed in March of 1992.

2. Oil Separator/Floor Drain/Oil Waste Storage Tank - This consists of a floor drain which connects to an oil separator. The oil is stored in an underground storage tank and the water is disposed of in the Farmington waste water treatment system. This system is only used for the purpose os cleaning SES equipment parts which are to be repaired. There is approximately 200 gallons per month which is separated and stored. The underground storage tank is 9 feet deep and has a storage volume of 470 gallons and is made of concrete. The oily waste storage tank is emptied by Mesa Oil, Inc. periodically or as needed. This system was installed when the facility was built (see diagram 3).

3. Leach Fields - This does not apply to the SES facility. There are not any leach fields on the SES facility.

4. Injection Wells - This does not apply to the SES facility. There are not any injection wells on the SES facility.

5. Drying Beds or Other Pits - This does not apply to the SES facility. There are not any drying beds or pits on the SES facility.

6. Solid Disposal -

   a. Oil Filters - There are approximately 40 filters per month disposed of through the local land fill.

   b. Laboratory Waste - This consists of various hydrocarbons/produced water/chemical additives which are tested in the laboratory. These are stored in 55 gallon drums and disposed of through Van Waters & Rogers ChemCare program.

   c. Used Drums - Used drums are stored on a semi trailer (see facility diagram) which is on pavement. The drums are sealed and no spillage occurs in this area. Approximately 240 drums per year are returned for reuse.

      West Texas Drum Company
      4130 W. Industrial
      Midland, TX 79703

7. SES does not have any leach fields or pits and therefore is not applicable to this section.

a. See attached diagram #1 for the Hydrochloric acid in storage and recycling system.

b. See attached diagram #1 for the location of the sampling system for the underground vault/storage tank for Hydrochloric acid.

c. NOT APPLICABLE TO SES - This facility has no plans to cease operations in the near future.

B. Off Site Disposal

The off site disposal information is listed above with address, location, and method of shipping.

IX. PROPOSED MODIFICATIONS

Not applicable to this application.

X. INSPECTION, MAINTENANCE, AND REPORTING

A. The acid sump and vault monitoring system will be checked monthly and a log maintained of the date, time, and name of the individual completing the check. When leaks are detected, the acid reclaim system will be immediately shut down and repairs begin. If it is found that contamination has penetrated beyond the liner system, O.C.D. will be immediately notified.

B. Ground water monitoring not applicable to current operators.

C. In June of 1992 an earthen berm was installed along the west boundary of the facility, excluding the office and employees parking lot area. This berm is designed to contain storm water run off and keep it on the facility.

XI. SPILL LEAK PREVENTION AND REPORTING PROCEDURES
Note: See appendix D for Smith Emergency spill guidelines.

1. Above Ground Acid Storage Tank and Containment Area:

This is a 24,000 gallon capacity hydrochloric acid tank that is rubber lined. The containment area consists of concrete floor and walls (see diagram #4) covered with acid resistant epoxy spray. The containment area will hold more than one and one third times the volume of the tank should a spill occur.

The hydrochloric acid tank is visually inspected for leaks each time acid is loaded and unloaded from the tank. The containment area and epoxy lining is to be visually inspected annually.

In the event of a major spill into the containment area, immediate steps would begin to neutralize the hydrochloric acid (table 1) and vacuum tracks utilized to haul the material to an approved disposal site.

In the event a small leak was detected in the storage tank the contents of the tank would be immediately transferred into authorized cargo vessels and the leaking tank would be taken out of service until replaced or repaired.

2. Acid Recovery System (sump, piping, vault, and tank)

This system is designed to catch spills and allow for drain up of equipment and is detailed on diagram #1. To prevent contamination of the soil the vault and sump are equipped with a 30 mill. high density liner, piping is four inch pvc inside six inch pvc. These liners are designed to contain contamination and protect the ground water.

Monitoring pipes have been installed between the concrete and the liners and will be monitored monthly for fluid. If leaks are detected, the system will be shut down and immediate repairs or replacement started.

If it is found that contamination penetrated beyond the liner, the state O.C.D. will be notified.

3. Warehouse Area

a. Dry Chemical Room - this is an enclosed area with concrete floors. Minor spills are to be swept up and materials returned to inventory for later use. Small amounts of chemicals that are too contaminated for use will be placed into over pack drums for later disposal, depending on the nature of the hazard. No leak detection is necessary for this area.

b. Wet Chemical Room - this is an enclosed area with concrete floors and a floor drain for wash down purposes. Liquid chemicals are stored in 55 gallon drums or five gallon buckets.

The floor drain runs through a two inch pvc pipe for a distance of approximately six feet to the acid tank containment area where it is plumed into a 55 gallon container. The chemicals and fluids that enter this drum are currently being recycled into acid loads as these chemicals are acid additives.

Other piping in the wet chemicals room consists of a water pipe and a Venturi system used to load water and chemicals for acid. All pipes are exposed and require no special monitoring other than visual inspection for leaks, which is accomplished on a day to day basis when the system is used.

Small spills are washed down the floor drain and into the container. Then recycled into acid loads. A large spill would not be anticipated in this area.

*** Notification of Spills ***

Product	Hazardous Ingredient	Reportable Quantity
AGA-2		NR
AGD-2		NR
AMS-3	Methanol/Ethylene Glycol	7,267 lbs.
AR-2		NR
BCS-4	Ethelene Thiourea	50 lbs.
BCS-7		NR
BW-4	Sulphuric Acid	28,571 lbs.
CA-4		NR
CCC-3	Ethylene Glycol	10,000 lbs.
CCC-5-W		23,000 lbs.
CDA-1		NR
CIA-1	Methyl & Propargyl Alcohols	8,862 lbs.
CIA-2	Propargyl Alcohol	25,592 lbs.
CIA-3	Thiourea	70 lbs.
CX-1		NR
CX-6		NR
CX-13		NR
CX-14		NR
CX-15		NR
CX-91		NR
EPS-4	Methyl Alcohol	13,193 lbs.
EPS-9	Napthalene	1,000 lbs.
FAA-2		NR
HCL-0	Hydrochloric Acid	5,000 lbs.
MC-FRS		NR
OFR-1	Ethylene Glycol (4%)	25,000 lbs.
OGA-2	Sodium Aluminate	27,000 lbs.
OGA-5	Methanol	37,037 lbs.
PDC-1	Napthalene	1,266 lbs.

Notification of Spills cont'd

Product	Hazardous Ingredient	Reportable Quantity
PFL-1	Ammonium Bisulfite	19,000 lbs.
RM-18		NR
SAA-2		NR
SAA-3		NR
SSS-2	Methyl Alcohol & Xylene	14,286 lbs.

XII. SITE CHARACTERISTICS

1. Water Resources Information:

Based on a preliminary review of available records from the New Mexico State Engineers Office, there appears to be eight water supply wells within a half mile radius of the Smith Energy site. They are listed at the end of this section.

All wells appear to be located over 1000 feet from the site. The wells in Section 14 appear to be located up and cross gradient based on preliminary monitor well water level measurements. The remaining six wells in Sections 22 and 23 appear to be located down and cross gradient from the site.

The San Juan River is south of the site, approximately three-quarters of a mile down-gradient. The Animas River is north of the site, approximately one mile up-gradient. Both rivers flow to the west and south, and year around water flow. The Willett Ditch provides irrigation water to farms in the general proximity of the site. The Willett Ditch is fed on the south side of the Animas River, upstream of the site approximately 3/4 miles. Based on discussions with the New Mexico State Engineers Office, this ditch appears to be used primarily for irrigation and industrial use and is not a public drinking water source.

WATER WELL INFORMATION
SMITH INTERNATIONAL, INC.
2198 EAST BLOOMFIELD HIGHWAY
FARMINGTON, SAN JUAN COUNTY, NEW MEXICO
SEPTEMBER, 1992

Location (T.R.SEC.QUAD)	Name	Well No.	Use	Water Depth (ft.)	Aquifer
29.13.14.313	Valley Drive In	SJ-00176	dom,stk	35	Qal
29.13.14.443	Dowell, Inc.	N/A	N/A	15	Kk,Qal
29.13.22.22	Dennis Burke	SJ-01673	dom	14	Qal
29.13.23.1	Tom Kannard	SJ-01562	dom	6	Qal
29.13.23.11	N/A	SJ-01719	N/A	N/A	N/A
29.13.23.123	N/A	SJ-00187	N/A	40	Qal
29.13.23.22	Mary Barkley	SJ-00352	dom	30	Qal
29.13.23.22	Tom Pratt	SJ-01376	dom	15	Qal

Notes:
N/A - Information not available
dom - domestic water source
stk - water source for livestock
Kk - Kirtland Shale
Qal - Quaternary alluvium

Based on available information from the State of New Mexico Engineers Office.

2. Site Groundwater Information:

Three previously installed groundwater monitor well were used to estimate the site groundwater gradient. The wells had been installed by ENERLOG/TIS for Smith International during an environmental audit of the property in August 1990. The wells were drilled with an air drill rig, and completed with four inch PVC casing. The monitor well information and groundwater level measurements (taken 2-7-92) are summarized at the end of this section.

Based on the water level measurements from the three wells, the groundwater ranges from 28 to 30 feet below the existing ground surface. The groundwater gradient and subsequent flow direction is to the west and south and averages approximately 0.002 feet/foot. The shallow alluvial groundwater appears to represent an unconfined aquifer. The groundwater level and gradient may vary, considering the sites relative proximity to both the San Juan River and Animas River and site soil conditions.

During the course of the excavation and abatement of the U.S.T. and pit, the groundwater at the bottom of the excavation was observed to fluctuate in depth. Fluctuations appeared to be on the order of one to three feet, corresponding to a water level of 27 to 30 feet bsg. This fluctuation was not unusual, considering the site soil condition, and proximity of the site to the San Juan and Animas Rivers.

MONITOR WELL DATA SUMMARY
SMITH INTERNATIONAL, INC.
2198 EAST BLOOMFIELD HIGHWAY
FARMINGTON, SAN JUAN COUNTY, NEW MEXICO
SEPTEMBER, 1992

DRILLING & COMPLETION INFORMATION
SEPTEMBER, 1992

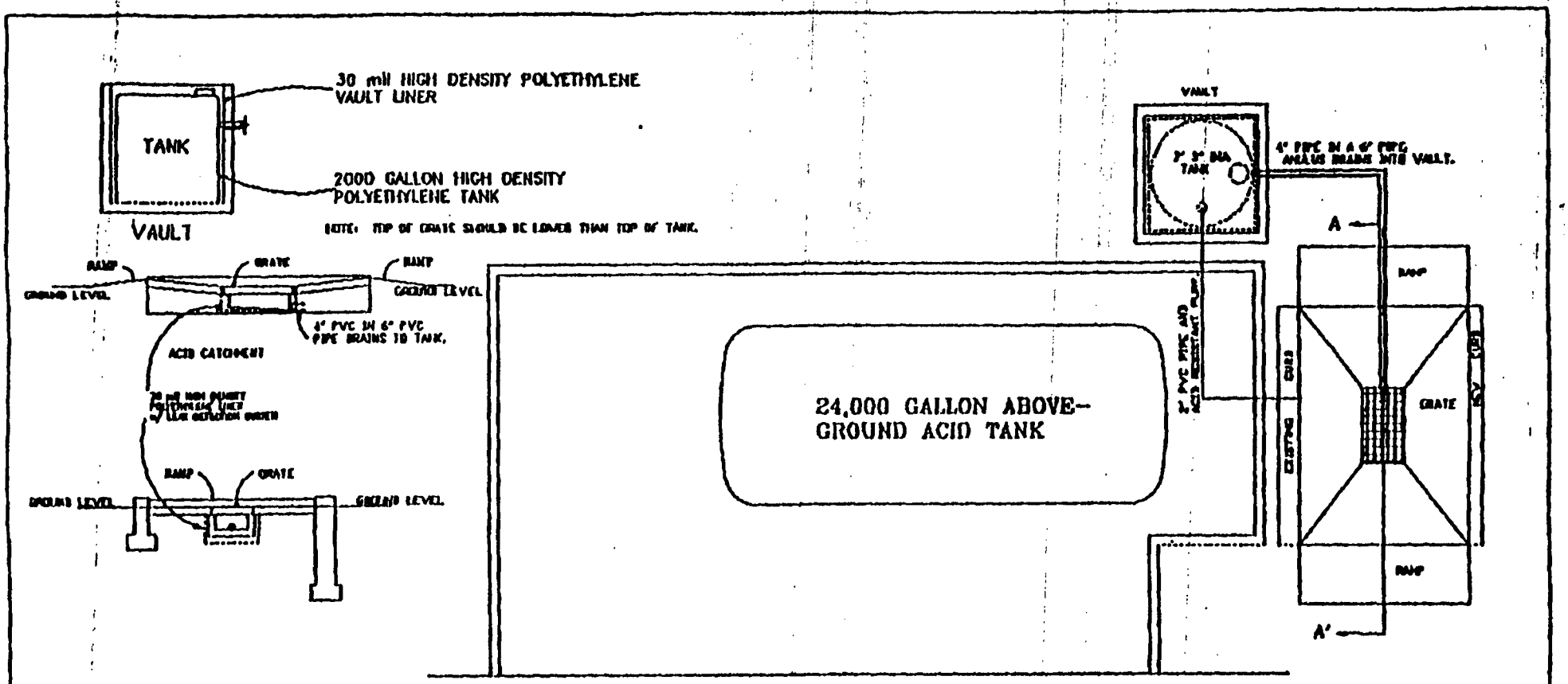
MONITOR WELL	TOTAL DEPTH	WATER LEVEL	TOP OF SCREEN
1	34	25	15
2	40	30	18
3	40	28	20

SURVEY & WATER LEVEL INFORMATION
FEBRUARY 7, 1992

LOCATION	ELEV.	COORDINATE X	COORDINATE Y	WATER LEVEL(bgs)	WATER ELEV.
SW WAREHOUSE COR. (benchmark)	100.00	0.00	0.00		
MW1	99.78	346.41	195.63	28.54	71.24
MW2	99.85	85.11	-289.32	29.98	69.87
MW3	99.77	67.82	-199.59	29.74	70.03

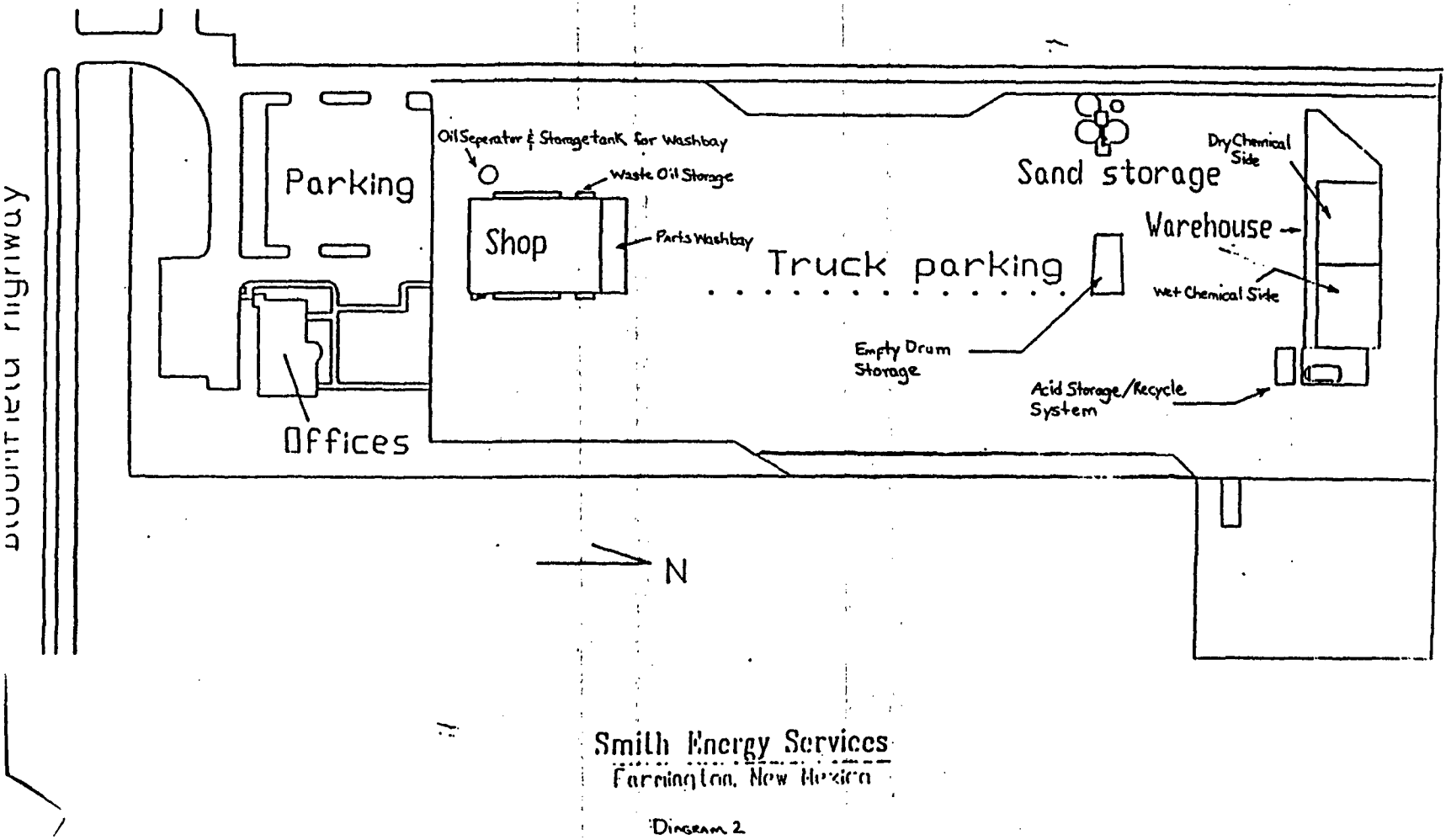
San Juan testing laboratories completed a Soils Engineering Report in May of 1979, a copy of which is enclosed as appendix C.

The majority of the facility is paved to minimize the potential for surface liquid penetration of the subsurface soil. With continued monitoring of sumps, piping, and vault areas, little danger exists of contaminating subsurface soil and aquafers.



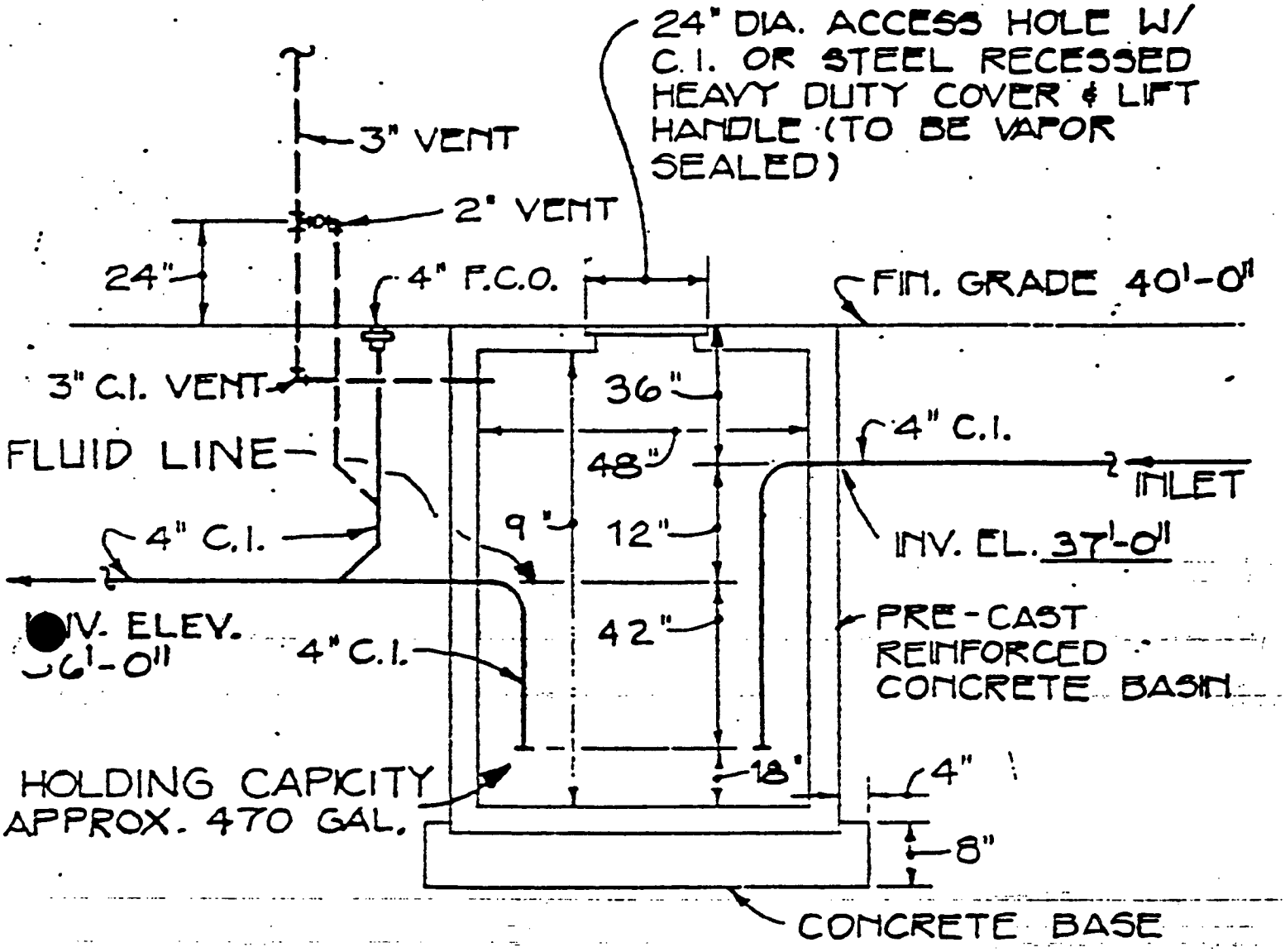
SMITH INTERNATIONAL INC. 2198 EAST BLOOMFIELD HWY FARMINGTON, NEW MEXICO ACID UST AND LOADING SYSTEM CLOSURE — PROJECT NO: 91410	ENVIROTECH INC. ENVIRONMENTAL SCIENTISTS & ENGINEERS 5796 U.S. HIGHWAY 64-3014 FARMINGTON, NEW MEXICO 87401 PHONE: (505) 632-0615	ACID STORAGE AND LOADING AREA REPLACEMENT ACID CATCHMENT SCHEMATIC SHEET: 4 — DRAWN: 5-5-92 DRWN BY: JDD — PRJ MGR: MKL

Diagram 1



Smith Energy Services
Farmington, New Mexico

Diagram 2

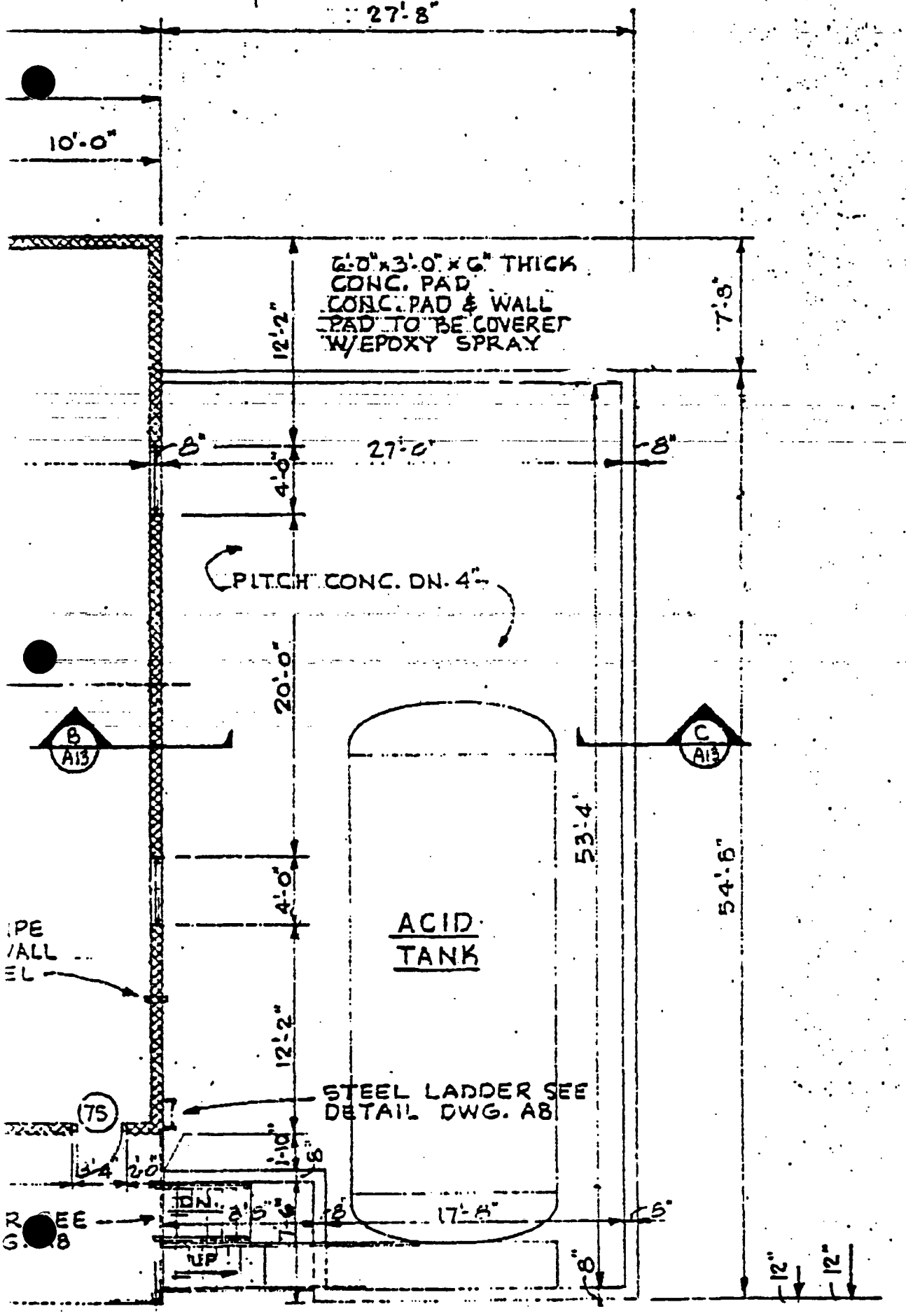


NOTE:
WATERPROOF SEAL ALL PENETRATIONS THRU SIDE WALLS OF BASIN.

GAS & OIL INTERCEPTOR DETAIL

SCALE: NONE

DIAGRAM 3



SIDNEY J. FLOOK, ENGINEER
2701 ALCOTT ST.
DENVER, COLORADO

LUCTION CO., INC.
ACHT CIRCLE
ELLWOOD

Table 1
Quantities of Various Alkalies Required to Neutralize
100 Gallons of Hydrochloric Acid

Hydrochloric (Muriatic) Acid			Neutralizing Chemicals				
Acid Concentration At. % HCl	Specific Gravity of Solution	Acutal Pounds of Acid per 100 Gals.	CaO Quicklime Lbs.	$Ca(OH)_2$ Lime Lbs.	Na_2CO_3 Anhydrous Soda Ash Lbs.	50% NaOH Liquid Caustic Soda Lbs.	NaOh Bead/Flake Caustic Soda Lbs.
0.1	Use 1.000	.837	.644	.852	1.27	1.836	.918
0.2	Use 1.000	1.674	1.28	1.70	2.54	3.672	1.836
0.3	Use 1.000	2.511	1.93	2.52	3.81	5.50	2.75
0.4	Use 1.000	3.35	2.58	3.41	5.08	7.34	3.67
0.5	Use 1.0015	4.19	3.19	4.22	6.35	9.18	4.59
0.6	Use 1.0015	5.02	3.86	5.11	7.62	11.02	5.51
0.7	Use 1.0015	5.86	4.51	5.93	8.89	12.86	6.43
0.8	Use 1.0015	6.70	5.15	6.82	10.16	14.68	7.34
0.9	Use 1.0015	7.53	5.79	7.63	11.43	16.52	8.26
1.	1.0032	8.37	6.44	8.52	12.7	18.36	9.18
2.	1.0082	16.83	12.94	17.12	24.6	36.96	18.48
3.	1.0131	25.41	19.54	25.79	37.0	55.70	27.85
4.	1.0181	33.99	26.14	34.53	49.3	74.4	37.2
5.	1.023	42.73	32.86	43.42	62.0	93.6	46.8
6.	1.0279	51.47	39.56	52.31	74.6	112.8	56.4
10.	1.0474	87.41	67.22	88.92	126.8	191.4	95.7
20.	1.0980	183.3	141	186	267	402	201
25.	1.1261	234.8	179	237	339	512	256
30.	1.1526	288.4	221	293	419	632	316
35.	1.1778	343.8	264	348	498	752	376

San Juan Testing Laboratory, Inc.

907 W. APACHE P.O. BOX 2079 FARMINGTON, NEW MEXICO 87401 (505) 327-4966

Craftsman Construction Co., Inc.
5660 S. Syracuse Circle
Englewood, Colorado 80111

8 May 1979

Attention: Mr. Kas Berget

Project: Smith Energy Services
Office & Warehouse Facilities
Bloomfield Highway
Farmington, New Mexico

Job No. S-150

In accordance with your Purchase Order 94033, this firm has conducted soil engineering services for the proposed office and warehouse to be located on the north side of Blocmfield Highway, Farmington, New Mexico. The purpose of this soils engineering report is to provide recommendations for use in the design of foundation elements, to provide procedures for use in site and subfloor preparation, to present surface drainage recommendations and to present pavement sections. It is understood that the proposed development will consist of office, shop and warehouse buildings together with sand silo, auto and truck parking lots and driveways. Maximum structural loads are estimated to range to approximately 2 to 3 kips per lineal foot and 40 kips for wall and column footings, respectively. Sand silos will stand approximately 45 feet in height. Site topography would indicate that relatively minor zones of fill will be required below slabs-on-grade to attain finished floor elevations.

At the time of this exploration, the site was undeveloped agricultural property. Existing ground surface is relatively level with surface drainage generally developing from south to north. Agricultural crops have been grown within the last year in the vicinity of test pits 5, 6 and 7, but it has probably been several years since crop growing was active in the remaining area. Vegetative ground cover consists of a growth of weeds and crop remnants. An existing ditch traverses the site as shown on the site plan.

Smith Energy Services
Job No. S-150

Seven test pits were excavated with an Allis Chalmers backhoe at locations shown on the accompanying site plan. Subsoil stratification across the site is relatively uniform as presented in the following tabulation.

Pit No.	Sandy Clay (CL) (Organics) (Firm)	Sandy Clay (CH) (Organics) (Stiff)	Clayey Sand and Gravel (Medium Dense)	Silty Sand, Cobbles and Boulders (Dense)
1	0-1'	—	1-3'	3-11.8'
2	0-1'	—	1-2.8'	2.8-10.8'
3	0-1.2'	—	1.2-3'	3-11.7'
4	0-0.8'	—	0.8-3'	3-9.6'
5	—	0-1'	1-2.8'	2.8-8.8'
6	—	0-1'	1-2.5'	2.5-10.5'
7	—	0-1'	1-4'	4-9.2'

Soil moisture contents were described as being at to below the respective plastic limits for the fine-grained soils and as damp to slightly damp for granular soils. No free groundwater was encountered in any of the borings; however, information from other boring logs indicate that groundwater levels exist at depths of 15 to 20 feet and may fluctuate several feet during irrigation season or periods of high rainfall on the watersheds.

Consolidation tests conducted on undisturbed clay and/or sand samples indicated that subsoils at shallow foundation levels (0 to 3 feet) exhibit moderate compressibility potentials at in-situ soil moisture contents and tendencies to undergo expansion under high moisture conditions. Near surface native soils which have been disturbed by plowing exhibit relatively low densities and will require recompaction for uniform support of fill zones. These soils would also exhibit expansive potentials after remolding and saturation and should, therefore, not be used as sources of fill materials.

Foundations: Due to the minor extent of fills anticipated to attain finished grades at proposed building locations, recommendations for foundation systems bearing upon undisturbed native subsoils are presented. Additional recommendations for conditions not covered herein will be supplied upon request.

Unit bearing capacities as presented herein should be considered as allowable maximums for dead plus design live load conditions. A one-third increase is permissible when considering total loads including wind or seismic forces. Two (2.0) feet and 1.33 feet are recommended as minimum widths of column and wall footings, respectively. Finished grade references should be considered as lowest adjacent grade for perimeter footings and as floor level for interior footings.

Because of the tendency toward differential foundation movement, it is suggested that all continuous footings and any masonry walls be reinforced and constructed using frequent grouting, horizontal and vertical reinforcement, etc. to better distribute stresses in the event of a significant moisture buildup. Frequent use of control joints is recommended in masonry walls to minimize unsightly cracking.

Structure	Footing Depth Below* Existing Grade	Finished Grade	Allowable Soil Bearing Pressure	Estimated Settlement
Office	3.0 ft. (min.)	2.5 ft. (min.)	3000 psf	1/4 inch
Shop	3.0 ft. (min.)	2.5 ft. (min.)	3000 psf	3/8 inch
Warehouse	3.0 ft. (min.)	2.5 ft. (min.)	3000 psf	1/4 inch
Sand Silo	3-4 ft.** (min.)	3.0 ft. (min.)	4000 psf	1/2-3/4 inch

*Greater depth requirement to govern. Depth below finished grade would be appropriate where cuts are required.

**Variable depth to ensure bearing upon the underlying dense silty sand and cobbles.

Due to the likelihood that exposed footing excavations will consist of sandy cobbles which will result in uneven bearing surfaces, it is recommended that a "leveling course" consisting of well graded sand or sand and gravel with a maximum size of 1½ inches and not more than 25% passing the No. 200 sieve be used. The leveling course should be compacted to at least 95% of ASTM: D1557 dry density.

Interior non-load bearing walls or partitions could be placed on a thickened slab provided that control joints are provided where these partitions contact structural components.

Site and Subfloor Preparation: The following procedure is recommended for preparation of the site and fill placement for support of slabs-on-grade on native or compacted soils.

1. Strip and remove all vegetation, fill piles, debris and upper one foot of native clay soils, etc. within the building areas for a lateral distance of 5 feet beyond exterior building lines. If sandy clay materials are remaining after removal of upper one foot, it is recommended that an additional depth of one foot of this material be removed. Clean and widen all ditches, etc. to accommodate compaction equipment. If disturbed or loose subsoils are encountered, depth of removal should be increased to completely remove all such loose or disturbed zones.

2. Scarify, moisten or dry as required, and compact exposed soils to a minimum depth of 8 inches. Depressions or over-excavated areas should be widened as required to accommodate compaction equipment.

3. Place and compact required fill in horizontal lifts at thicknesses consistent with compaction equipment used to

achieve uniform densities throughout lift thickness. Due to the expansive characteristics exhibited by the on-site soils, it would be desirable to restrict their use to fills exterior to the building lines. It is recommended that fill below slabs-on-grade should be imported granular soils with a low expansive potential.

4. The final four inches underlying floor slabs should be a well graded sand and/or gravel base course containing less than 5% passing Number 200 sieve.

5. All subgrade preparation and fill placement should be accomplished under observation and testing directed by a soils engineer so that compliance to project specifications is attained.

Imported fill should exhibit 100% passing the 6 inch sieve and have an expansion potential of 1.0% or less when exposed to saturation of remolded fill sample compacted to 90% of the ASTM: D1557 density at a moisture content approximately 2% below optimum and under a surcharge load of 100 psf.

The compaction of all fill materials should be performed to the specified percent of maximum density as determined in accordance with ASTM: D1557. Moisture content between optimum plus or minus 3 percent shall be obtained for imported soils with a plasticity index of 6 or greater. Native near surface soils shall be compacted at a moisture content between optimum and plus 4 percent.

	Minimum Percent Compaction
Native sand-silty sand soils:	
Below slabs-on-grade	90
Below foundation elements	95
Native clay soils	85
Subbase fill (imported):	
Below slabs-on-grade	90
Below foundation elements	95

	Minimum Percent Compaction
Base course	95
Miscellaneous backfill	90

Recommendations made herein regarding slabs-on-grade based upon compacted fill are dependent upon satisfactory site preparation, compaction of surface and placement and compaction of fill. Therefore, earthwork relative to structural support should be accomplished under observation and testing directed by a soils engineer. Adequate inspection should be provided during site grading, compaction of backfill, floor fill and base course so that complaince with recommended specifications is achieved.

Drainage: It is considered essential that positive drainage be provided during construction and be maintained throughout the life of the facilities.

Exterior site grading must insure rapid runoff at surface waters. Down spouts, parking lot drainage and other concentrations of surface runoff must be avoided on the north sides of structures and should be extended away from all structures in suitably sized culverts, lined or paved drainage ditches. Areas proposed for grass or other planting requiring extensive irrigation should be avoided adjacent to any proposed structure. Site grading adjacent to each structure should be 5% for the first 10 feet and no less than 2% to suitably sized drainage structures, to eliminate the possibility of impounding surface water with subsequent saturation and settlement of subgrade soils. Backfill against footings, exterior walls, and in utility line trenches should be well compacted and be free of construction debris to reduce the possibility of moisture infiltration through loose soils.

Pavement: Based upon the results of CBR testing, the native clay subgrade is a very poor material for support of pavement

sections. Therefore, the following procedure is presented to develop an adequate subgrade, subbase and base course system to support pavement surfaces.

1. Excavate and remove the upper one foot of native clay soils. Remove any soft or loose soil zones where proof-rolling with a 50 ton roller for a minimum of 4 passes indicates instability. Clean and widen ditches.

2. Place and compact a minimum thickness of 12 inches of well graded non-plastic granular subbase material exhibiting 100% passing 4 inch sieve and no more than 20% passing No. 200 sieve. Compaction should be accomplished in 6 inch lifts to at least 95% of AASHTO T-180 maximum dry density. Increased thickness is appropriate where additional fills are required to achieve design grades.

3. Place and compact a minimum of 8 inch compacted thickness of dense graded aggregate base course to at least 95% of AASHTO T-180.

4. A bituminous prime coat should be placed over the compacted base course at a rate not to exceed 0.15 gallons per square yard.

5. A dense graded plant mixed asphaltic paving should then be placed to a minimum thickness of 3 inches.

The adequacy and performance of pavement structures is dependent upon surface drainage on and adjacent to the structure. Therefore, positive surface drainage is imperative and ponding or flow of water adjacent to pavement edges should not be allowed.

Smith Energy Services
Job No. S-150

Where moisture content increases in subsoils, pavement deterioration is accelerated and requires maintenance on a more frequent basis.

Corrosion: Type II air entrained cement will provide protection for all concrete structures above groundwater table and subjected to local freeze-thaw conditions.

Please do not hesitate to contact the undersigned if you have any questions regarding the contents of this report or if we can be of further service.

Respectfully submitted,
ENGINEERS TESTING LABORATORIES, INC.
Geotechnical Services

By: Glen K. Copeland, P.E. 5-8-77 Reviewed by: James G. Bennitt, P.E.

/jm

10-37

Job No. S-150

Boring No.	Depth, ft.	Soil Class.	Particle Size Distribution, %				Atterberg Limits			Moisture - Density Rel.			Specific Gravity	Permeability		'R' Value		
			Cobbles 3" to 12"	Gravel 3" to #4	Sand #4 to 200	Fines - 200	PL	LL	PI	Dry Density pcf	Optimum Moisture %	Meth.		Dry Density pcf	K Ft./Yr.	Corrected 'R'	Expansion Pressure psf	
Group 1		CH			29	71	23	51	28									
Group 2		CL		1	36	63	17	29	12									
Group 3		SM-SC		32	35	44	13	23	10									
Group 4		SM-SC		15	40	45	15	21	6									
Group 5		SM-GM		36	30	34	18	19	1									
Group 6		SM-GM		37	50	13	Non-Plastic											

Boring No.	Depth, ft.	Remarks
Group 1		Composite of #5 (0-0.8');#6 (0-1'); #7 (0-1')
Group 2		Composite of #1 (0-0.8'); #2 (0-1'); #3 (0-1.2'); #4 (0-0.8')
Group 3		Composite of #1 (0.8-3'); #2 (0.8-2.8'); #4 (0.8-3.1')
Group 4		Composite of #5 (0.8-2.8'); #6(1-4.7'); #7(1-2.3')
Group 5		Composite of #3 (1.2-3.4'); #4 (3.1-4.6'); #5 (2.8-4.4'); #7 (2.3-3.9')
Group 6		Composite of #1 (3-4.8'); #2 (2.8-4.6'); #3 (3.9-6.2'); #4 (4.6-9.6'); #5 (4.4-8.4'); #6 (4.7-10.5'); #7 (3.9-9.2')

LEGEND

Moisture Density Relationship
1. Tested D-1556/AASHTO T-217
2. Tested ASTMD-2922/D-3017
3. Tested ASTMD-2922/AASHTO T-217
4. Rock correction applied to maximum dry density. AASHTO T-224
5. Other_____

Specific Gravity
6. Minus # 4
7. Plus # 4

Classification/Particle Size
8. Visual
9. Laboratory Tested

SOIL PROPERTIES

Job No. S-150

Pit Boring No.	Depth, ft.	Soil Class.	Expansion/Compression: Initial Dry Density pcf	Initial Moisture Content, %	Surcharge KSF	+ Expan. - Comp. %	Max. Swell Pressure KSF	Water Soluble Matter, %: Salts	Sulfates	Shear Strength: Test Method	Initial Moisture Content, %	Dry Density pcf	C KSF	∅ Deg.	Consolidation: Initial Void Ratio	Surcharge KSF	Consol. %
4	2.7'	SM-SC		8.5	0.26	-1.36											
"	"	"	"	"	0.52	-3.49											
"	"	"	"	"	1.03	-7.90											
6	2.0'	CH		19.0	0.26	-1.33											
"	"	"	"	"	0.52	-1.50											
"	"	"	"	"	1.03	-2.21											
"	"	"	"	"	1.03(5)	-1.80											

Boring No.	Depth, ft.	Remarks

LEGEND

Shear Strength Test Method
- DS Direct Shear
- DS Direct Shear (saturated)
- UC Unconfined Compression
- UU Unconsolidated Undrained
- CU Consolidated Undrained w/pore press
- CU Consolidated Undrained
- CD Consolidated Drained
- CR Cyclic Consolidated Undrained w/pore press

REMARKS

1. In-situ density.
2. Compacted density (Approx. 95% of ASTM:D698 max. density at moisture content slightly below optimum).
3. Compacted density (Approx. 95% of ASTM:D1557 max. density at moisture content slightly below optimum).
4. In-situ moisture.
5. Submerged to approximate saturation.
6. Consolidation % upon saturation.
7.

SOIL PROPERTIES

SAN JUAN TESTING LAB., INC.
PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

KEY TO SYMBOLS

symbol	Unified class.	AASHTO Equivalent	typical names
	GW	A-1-a	well graded gravels and gravel-sand mixtures
	GP	A-1-a	poorly graded gravels and gravel-sand mixtures
	GM	A-1-b	silty gravels and gravel-sand mixtures
	GC	A-1-b	clayey gravels and gravel-sand mixtures
	SW	A-2-4	well graded sands and gravelly sands
	SP	A-3	poorly graded sands and gravelly sands
	SM	A-2-4 A-2-5	silty sands and sandsilt mixtures
	SC	A-2-6 A-2-7	clayey sands and sand-clay mixtures
	ML	A-4 A-5	inorganic silts, very fine sands and fine silty sands
	CL	A-6 A-7-6	inorganic clays of low to medium plasticity
	OL	A-4 A-5	organic silts and silty clays of low plasticity
	MH	A-5 A-7-5	inorganic silts
	CH	A-7-6	inorganic clays of high plasticity
	OH	A-5 A-7-5	organic clays of high plasticity
	PT		highly organic soils, peat and muck

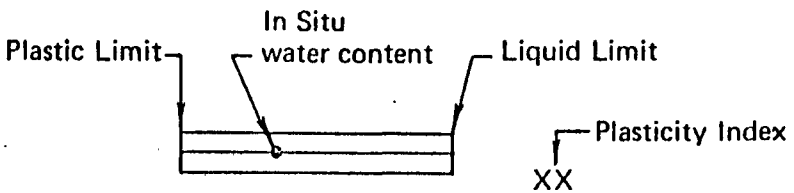
Water Level

indicates location of water table at time of boring

Sample Type
A - augered
C - cored
D/A - drilled with air
D/W - drilled with water
H - hand sampled
S - standard penetration spoon
U - undisturbed

Physical Tests
C - consolidation
D - direct shear
P - Permeability
T - triaxial
U - unconfined compression
S - soil sulfate potential

$$\text{Water Content} = \frac{\text{weight of water}}{\text{weight of solids}} \times 100$$



Standard Penetration

Standard penetration resistance data is obtained at the intervals indicated on the boring log, utilizing a 2" O.D. split spoon sampler driven by a 140-pound, "pin-guided" weight with a 30" drop. The penetration resistance recorded on the log represents the number of blows required to drive the 2" O.D. sampler one foot into the undisturbed strata, and thus is a measure of the strength of the soil.

Shear Strength

Shear strength represents the maximum undrained shear resistance as measured with a field shear vane device.

san juan testing laboratory, inc.

909 WEST APACHE • P. O. BOX 2079 • FARMINGTON, NEW MEXICO

PHONE:
327-9944

Date 5-8-79

Report to Smith Energy Services

Requested by Smith Energy Services Sampled by Lab Technician

Project Smith Energy Services Location Farmington, New Mexico

Source of Material 40 ft. east of Hole #5 and 40 ft. south of Hole #5 also 150 ft. south of Hole #5

Lab No. Recap of CBR Data

TEST RESULTS

RECAP OF CBR DATA

Lab No.					
Lime (%) pH	-				
Surcharge (psf)	100				
Blows	12				
Density (pcf)	109.9				
Proctor (%)	89.3				
Initial Moisture (%)	13.8				
Absorption (%)					
Swell (%)	0				
Unified Classification	CH				
Liquid Limit	51				
Plastic Index	28				
CBR (%)	1				

AASHTO T180 Method A

Maximum Dry Density 123.1 pcf

Optimum Moisture 13.6 %

San Juan Testing Laboratory, Inc.
907 W. APACHE P.O. BOX 2079 FARMINGTON, NEW MEXICO 87401 (505) 327-4966

SOIL SULFATE POTENTIAL

Date 4-27-79

Project Smith Energy Services Sampled by Lab Technician

Client Craftsmen Construction Co. Tested by C. Cochran

Location Farmington, New Mexico Supervised by

Source of Material Subsurface Investigation

TEST RESULTS

Lab. No.	Hole No.	Sample No.	Depth	Soil Description	Percent Sulfate	Recommended Cement Type
	3	2	0.8-3.1'	Silty & Sandy Clay	0.13	II
	4	3	2.8-4.6'	"	0.13	II
	5	2	0.8-2.8'	"	0.13	II
	6	2	1.0-2.4'	"	0.13	II
	7	2	1.0-2.2'	"	0.13	II

ATTACK ON CONCRETE BY SOILS CONTAINING VARIOUS SULFATE CONCENTRATIONS *

Relative Degree of Sulfate Attack	% Water-Soluble Sulfate (as SO_4) in Soil Samples	Cement
Negligible	0-0.10	
Positive	0.10-0.20	Use Type II Cement
Severe	0.20-2.0	Use Type V Cement
Very Severe	Over 2.0	Use Type V Cement

*SOURCE: USBR Concrete Manual, 1975 Edition

TEST NO. _____

san juan repro Form 360-31

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER	Test Pit #1			PROJECT	Smith Energy Services
COLLAR ELEVATION	96.8	LOGGED BY	RH	CLIENT	Craftsmen Construction Co.
DATE DRILLED	4-10-79	TESTED BY	RH	LOCATION	Farmington, New Mexico
DATE REPORTED		SUPERVISED BY	LEC	LAB NUMBER	

DEPTH (FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)
0	Sandy Clay & Organics	CL			1	H	99	91	63	12
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	78	69	44	6
	Silty Sand & Cobbles	GM			3	H				NP
5	Boulders to 18" size below 5 ft.				4	H				NP
10										
	Stopped @ 11.8' Limit of Backhoe No Groundwater									
15										
20										

STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)

PHYSICAL TESTS*

* SEE SOIL KEY FOR EXPLANATION

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #2
COLLAR ELEVATION: 97.0
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH (FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)	PHYSICAL TESTS*
0	Sandy Clay & Organics	CL			1	H	99	91	63	12	
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H				6	
	Silty Sand & Cobbles	GM			3	H				NP	
5	Boulders up to 24" size below 4.5 ft.				4	H				NP	
10	Stopped @ 10.8' Caving Excavation No Groundwater										
15											
20											

STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)

5 10 20 30 40 50 100 160

WATER CONTENT* (PERCENT): 5 10 15 20 25 30 35

* SEE SHEET ... KEY FOR EXPLANATION

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE

FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #3
COLLAR ELEVATION: 97.0
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH (FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)	STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)	PHYSICAL TESTS*
0	Sandy Clay & Organics	CL			1	H	99	91	63	12		
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	64	51	34	1		
5	Silty Sand & Cobbles	GM			#	H				NP		
	Boulders up to 18" size below 6.3'				4	H				NP		
10												
	Stopped @ 11.3' Limit of Backhoe No Groundwater											
15												
20												

WATER CONTENT (PERCENT): 5 10 15 20 25 30 35

STANDARD PENETRATION BLOWS/FT. (LOG SCALE): 5 10 20 30 40 50 100 160

* SEE SOIL KEY FOR EXPLANATION

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #4
COLLAR ELEVATION: 95.8
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH (FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)
0	Sandy Clay & Organics	CL			1	H	99	91	63	12
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	78	69	44	6
	Silty Sand & Cobbles	GM			3	H				1
5	Boulders up to 18" size below 9.5'				4	H				NP
10	Stopped @ 9.6' Caving No Groundwater									
	Note: Secured undisturbed push sample at depth interval 2.7'									
15										
20										

STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)

PHYSICAL TESTS*

* SEE SHEET FOR EXPLANATION

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE

FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #5
COLLAR ELEVATION: 93.2
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH (FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)
0	Silty Clay w/Organics	CH			1	H	99	92	71	28
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	85	74	45	6
	Silty Sand & Cobbles	GM			3	H				1
5					4	H				NP
	Boulders up to 16" size below 6'				5	H				NP
10	Stopped @ 8.8' Caving No Groundwater									
15										
20										

STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)

PHYSICAL TESTS*

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #6
COLLAR ELEVATION: 93.9
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH-(FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)	PHYSICAL TESTS*
0	Silty Clay w/Organics	CH			1	H	99	92	71		
	Clayey Sand & Gravel Some Cobbles Cobbles below 2.5'	SM-SC			2	H	85	74	45		
					3	H					
5	Silty Sand & Cobbles	GM			4	H					
10	Stopped @ 10.5' Limit of Backhoe No Groundwater										
15	Note: Secured undisturbed push sample from depth interval 2.0 feet.										
20											

STANDARD PENETRATION* BLOWS/FT.(LOG SCALE)

* ... SOIL CLASSIFICATION

SAN JUAN TESTING LAB., INC.

PROFESSIONAL ENGINEERING & TESTING SERVICE

FARMINGTON NEW MEXICO

SUBSURFACE INVESTIGATION LOG

HOLE NUMBER: Test Pit #7
COLLAR ELEVATION: 95.1
DATE DRILLED: 4-10-79
DATE REPORTED:

LOGGED BY: RH
TESTED BY: RH
SUPERVISED BY: LEC

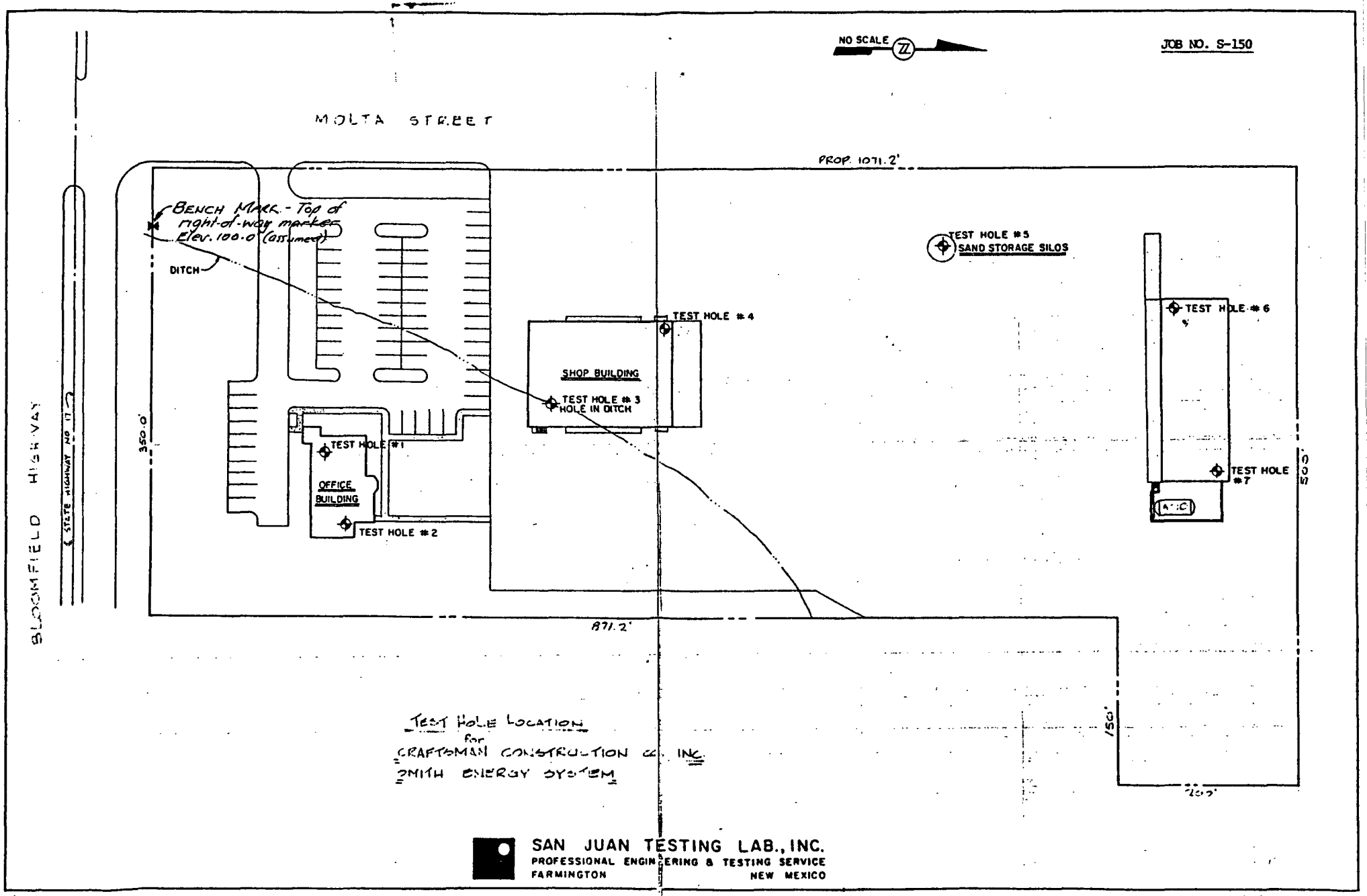
PROJECT: Smith Energy Services
CLIENT: Craftsmen Construction Co.
LOCATION: Farmington, New Mexico
LAB NUMBER:

DEPTH (FEET)	DESCRIPTION	UNIFIED CLASS.*	SYMBOL*	WATER LEVEL*	SAMPLE NUMBER	TYPE*	GRAIN SIZE % PASSING #4	#40	#200	WATER CONTENT* (PERCENT)
0	Silty Clay w/Organics	CH			1	H	99	92	71	
	Clayey Sand & Gravel Some Cobbles	SM-SC			2	H	85	74	45	
	Silty Sand & Cobbles	GM			3	H				
5	Cobbles up to 12" size below 4'				4	H				
10	Stopped @ 9.2' No Groundwater									
15										
20										

STANDARD PENETRATION* BLOWS/FT. (LOG SCALE)

PHYSICAL TESTS*

* . C I T I . . . FOR EXPLANATION


NO SCALE
JOB NO. S-150
MOLTA STREET
PROP. 1071.2'
BENCH MARK - Top of right-of-way marker Elev. 100.0 (assumed)
DITCH
TEST HOLE #5
SAND STORAGE SILOS
TEST HOLE #4
SHOP BUILDING
TEST HOLE #3
HOLE IN DITCH
TEST HOLE #6
TEST HOLE #1
OFFICE BUILDING
TEST HOLE #2
TEST HOLE #7
ATTIC
350.0'
871.2'
505'
150'
200'
BLOOMFIELD HIGHWAY
STATE HIGHWAY NO 17
TEST HOLE LOCATION
for
CRAFTSMAN CONSTRUCTION CO., INC.
SMITH ENERGY SYSTEM
SAN JUAN TESTING LAB., INC.
PROFESSIONAL ENGINEERING & TESTING SERVICE
FARMINGTON
NEW MEXICO

SMITH ENERGY SERVICES
A DIVISION OF ALLIED PRODUCTS CORPORATION

SMITH ENERGY SERVICES SPILL GUIDELINES

DEFINITIONS

"Hazardous Material Spill' means a chemical, substance or material which has been determined by federal or state regulations, and identified by labels, placards, or markings to pose an unreasonable risk to the health, safety and environment when spilled or otherwise released into the environment.

GUIDELINES

1. The on-site supervisor shall consider people first. When an incident happens, be sure that no personnel will be harmed by the spilled material.

   A. Evacuate people from the spill area and render aid as necessary. Secure area from entry by spectators or any unauthorized personnel.

   B. Refer to shipping papers, material safety data sheets or response guide for emergency data concerning the spilled material.

   C. Utilize the required personal equipment: mask, gloves, goggles, etc. as is necessary to protect personnel.

   D. Notify emergency response services: police, fire department, etc. if spilled materials are hazard to human health or a serious threat to the environment.

   E. Be prepared to inform emergency response services personnel of all steps taken to protect human health and the environment. Show shipping papers to the police and/or fire response people. Your shipping papers will give police and health professional all the important data needed to handle the emergency. The proper shipping name, the hazard classification and the UN or NA numbers are normally enough during the emergency phase. UN (United Nations) or NA (North American numbers are found in the DOT Hazardous Materials Tables, Sec. 172.101 and the optional Hazardous Materials Tables, Sec. 172.102 (CFR, Title 49, Parts 100-199).

2. Containment of Released Materials

Contain materials in as small an area as is possible. This will prevent any widespread contamination of the environment.

A. Build dams or dikes with dirt or other available materials.

B. Divert flow to a safe area with series of dirt dikes or ditches.

C. Make every effort to prevent spilled materials from entering any waterways, storm drains, etc.

D. Call for heavy equipment if necessary to contain the spill area, provided the material is not potentially hazardous to equipment operators.

3. Protect Smith energy Services' equipment of you can do so safely.

4. Report the incident to the district manager immediately after steps 1 and 2 above have been accomplished or while step 2 is being accomplished.

5. Begin clean-up procedures. Take whatever action is necessary to remove all contaminated soil from the spill area. Coordinate disposal of contaminated spills, etc. with proper company and compliance officers. If the spill is small, the operator may be able to collect the contaminated soil and end the incident. If the spill is massive, the station manager will direct the clean-up. Risk areas where spill incidents may occur:

A. On the yard while loading or transferring acids or chemicals.

B. On the highway, accidents or leaks which develop during transportation.

C. On location while product is being pumped or mixed.

6. Reporting Hazardous Material Incidents

Any of the following transportation conditions involving DOT hazardous materials and in which the condition is a direct result of hazardous materials must be reported to DOT:

A. A person is killed.

B. A person receives injuries requiring hospitalization.

C. Estimated damages to Smith Energy Services' equipment or other property damage exceeds $50,000.

D. Fire, breakage or spillage of radioactive materials,

E. Fire, breakage, spillage or suspected contamination by etiological agents.

F. The spilled material is a hazardous material that is equal to or exceeds the reportable quantity as listed on the manifest or shipping document.

G. A condition exists which the responsible Smith Energy Services' representative believes that reporting is necessary even though steps A - F above do not exist.

Note: When required to file a telephone report of a hazardous transportation material incident, the person making the report must use the following checklist in order to expedite the reporting procedure:

1) Name of person making report.
2) Name and address of carrier represented by person making the report.
3) Telephone number where person can be reached.
4) Date, time and location of hazardous materials incident.
5) Extent of injuries is known.
6) Classification, proper shipping name and quantity of hazardous materials involved.
7) Type of incident and nature of hazardous materials involved.
8) Whether or not a continuing danger to life exists.

Note: A hazardous materials transportation spill requires filing Form #F5800.1 within fifteen days.

7. Reporting Requirements for Environmental Protection Agency or State Environmental Offices

Any spill or discharge of any material onto the ground results in the generation of waste. The waste may or may not be hazardous. In either case, the waste requires special handling and disposal. There is also a concern that the spill may damage the environment. When deciding whether a report is necessary, both factors must be considered.

To simplify the decision concerning agency reporting, incidents have been classified by size, the prospect of involving property owned or controlled by others, and the possibility of damage to the environment.

A. Class S incident. A spill which stays in the immediate vicinity of the source and is either confined or soaks into the ground, generally less than 1 barrel, and can be cleaned up in a few minutes.

Actions to be taken with Class S incident:

1) Steps 1 through 5 above as needed.
2) Document the incident, report the name of the material spilled, time, date, amount spilled, what clean-up actions were taken, and disposition of contaminated material.
3) Send copy of documentation to Loss Control Department, Golden.

B. Class M incident. Any incident where released materials runs away from source and may enter drains, sewers, streams, waterways and/or property owned or controlled by others. this included spills that could be washed away by rainfall into storm drains or waterways not under SES control. Class M incidents will require more than one hour to clean up.

Actions to be taken with Class M incident:

1) Steps 2 through 5 above as needed.
2) Attempt to confine release so as to prevent it from leaving immediate area and to keep it from entering any sewer, watercourse or property of others.
3) Under no condition allow local response teams to wash residue into sewers, etc.

4) Notify district manager who will:

   a) Get help to confine the spill as needed.
   b) Notify emergency response agencies if needed.
   c) Notify Smith Energy Services, Golden for direction concerning agency notification.

   Note: If local emergency response services have been notified, they will contact state and federal agencies without waiting for SES to make notification. It is still a requirement of the law that SES notify the state and federal agencies.

C. Class L incident. These incidents involve significant releases which flow uncontrolled into areas where confinement is impossible, such as a river, or occurs so rapidly that confinement is beyond the capabilities of the on-site SES personnel.

Actions to be taken with Class L incident:

1) Steps 1 and 2 above.
2) District manager request outside help to scene;SES will rely on the local emergency response planning.
3) Notify SES region and division office.
4) Notify the required state of federal agencies.

D. Class R spill, radioactive materials. For spills of radioactive materials, refer to SES Radioactive Materials Operating and Emergency Procedures Manual.

8. Dealing with the Media: Emergency Response Radio Channels are monitored by the media. If local emergency services are notified, anticipate media coverage. Smith Energy Services' personnel will not discuss the incident with anyone except those with the need to know, such as fire fighters or police personnel. Advise statements will be made by proper authority.

9. Training

All Smith Energy personnel involved in the day-today handling of hazardous materials shall receive formal instruction to the procedures outlined herein. This training shall be conducted annually and each new hire will receive this training during his orientation phase with SES.

Guidelines (continued)

Table 1
Quantities of Various Alkalies Required to Neutralize
100 Gallons of Hydrochloric Acid

Hydrochloric (Muriatic) Acid			Neutralizing Chemicals				
Acid Concentration At.%HCI	Specific Gravity of Solution	Acutal Pounds of Acid per 100Gals.	CaO Quicklime Lbs.	Ca(OH)2 Lime Lbs.	Na,CO3 Anhydrous Soda Ash Lbs.	50% NaOH Liquid Caustic Soda lbs.	NaOh Bead/Flake Caustic Soc Lbs.
0.1	Use 1.000	.837	.644	.852	1.27	1.836	.918
0.2	Use 1.000	1.674	1.28	1.70	2.54	3.672	1.836
0.3	Use 1.000	2.511	1.93	2.52	3.81	5.50	2.75
0.4	Use 1.000	3.35	2.58	3.41	5.08	7.34	3.67
0.5	Use 1.0015	4.19	3.19	4.22	6.35	9.18	4.59
0.6	Use 1.0015	5.02	3.86	5.11	7.62	11.02	5.51
0.7	Use 1.0015	5.86	4.51	5.93	8.89	12.86	6.43
0.8	Use 1.0015	6.70	5.15	6.82	10.16	14.68	7.34
0.9	Use 1.0015	7.53	5.79	7.63	11.43	16.52	8.26
1.	1.0032	8.37	6.44	8.52	12.7	18.36	9.18
2.	1.0082	16.83	12.94	17.12	24.6	36.96	18.48
3.	1.0131	25.41	19.54	25.79	37.0	55.70	27.85
4.	1.0181	33.99	26.14	34.53	49.3	74.4	37.2
5.	1.023	42.73	32.86	43.42	62.0	93.6	46.8
6.	1.0279	51.47	39.56	52.31	74.6	112.8	56.4
10.	1.0474	87.41	67.22	88.92	126.8	191.4	95.7
20.	1.0980	183.3	141	186	267	402	201
25.	1.1261	234.8	179	237	339	512	256
30.	1.1526	288.4	221	293	419	632	316
35.	1.1778	343.8	264	348	498	752	376

Table 1
Quantities of Various Alkalies Required to Neutralize
100 Gallons of Hydrochloric Acid

Hydrochloric (Muriatic) Acid			Neutralizing Chemicals				
Acid Concentration At. % HCl	Specific Gravity of Solution	Acutal Pounds of Acid per 100 Gals.	CaO Quicklime Lbs.	$Ca(OH)_2$ Lime Lbs.	Na_2CO_3 Anhydrous Soda Ash Lbs.	50% NaOH Liquid Caustic Soda Lbs.	NaOh Bead/Flake Caustic Soda Lbs.
0.1	Use 1.000	.837	.644	.852	1.27	1.836	.918
0.2	Use 1.000	1.674	1.28	1.70	2.54	3.672	1.836
0.3	Use 1.000	2.511	1.93	2.52	3.81	5.50	2.75
0.4	Use 1.000	3.35	2.58	3.41	5.08	7.34	3.67
0.5	Use 1.0015	4.19	3.19	4.22	6.35	9.18	4.59
0.6	Use 1.0015	5.02	3.86	5.11	7.62	11.02	5.51
0.7	Use 1.0015	5.86	4.51	5.93	8.89	12.86	6.43
0.8	Use 1.0015	6.70	5.15	6.82	10.16	14.68	7.34
0.9	Use 1.0015	7.53	5.79	7.63	11.43	16.52	8.26
1.	1.0032	8.37	6.44	8.52	12.7	18.36	9.18
2.	1.0082	16.83	12.94	17.12	24.6	36.96	18.48
3.	1.0131	25.41	19.54	25.79	37.0	55.70	27.85
4.	1.0181	33.99	26.14	34.53	49.3	74.4	37.2
5.	1.023	42.73	32.86	43.42	62.0	93.6	46.8
6.	1.0279	51.47	39.56	52.31	74.6	112.8	56.4
10.	1.0474	87.41	67.22	88.92	126.8	191.4	95.7
20.	1.0980	183.3	141	186	267	402	201
25.	1.1261	234.8	179	237	339	512	256
30.	1.1526	288.4	221	293	419	632	316
35.	1.1778	343.8	264	348	498	752	376

To determine the volume of water necessary to dilute acid to a definite volume of lesser strength, use the following formula:

Volume of water necessary =

$$\text{(Vol desired)} \quad \frac{\text{(Vol desired) (desired \%) (Sp Gr desired)}}{\text{(Orig acid \%) (Sp Gr orig acid)}}$$

INCREASING CONCENTRATION OF ACID

To determine the volume of strong acid necessary to increase the concentration of acid to a definite volume of acid of higher concentration, use the following formula:

Volume of strong acid necessary =

$$\text{(Vol desired)} \quad \frac{\text{(desired \%) (Sp Gr desired) (Orig \%) (Sp Gr orig)}}{\text{(strong \%) (Sp Gr strong) (Orig \%) (Sp Gr orig)}}$$

HYDROCHLORIC ACID AT 60°F.

Barrels Strong Acid Required to Make 24 Barrels of					Sp. Gr.	Be°
15%	10%	7½%	5%	3%	60°F.	60°F.
					1.0069	1.00
					1.0140	2.00
				24.0	1.0149	2.13
				16.8	1.0211	3.00
			24.0	14.3	1.0249	3.52
			21.0	12.5	1.0284	4.00
			16.6	9.9	1.0357	5.00
		24.0	15.8	9.4	1.0374	5.24
		23.9	15.8	9.4	1.0375	5.25
		22.8	15.0	8.9	1.0394	5.50
		21.7	14.3	8.5	1.0413	5.75
		20.7	13.6	8.1	1.0432	6.00
		19.8	13.0	7.8	1.0450	6.25
		19.0	12.5	7.4	1.0469	6.50
		18.2	12.0	7.1	1.0488	6.75
	24.0	17.8	11.7	7.0	1.0499	6.89
	23.6	17.5	11.5	6.8	1.0507	7.00
	22.7	16.8	11.1	6.6	1.0526	7.25
	21.8	16.2	10.7	6.3	1.0545	7.50
	21.1	15.6	10.3	6.1	1.0564	7.75
	20.3	15.1	9.9	5.9	1.0584	8.00
	19.7	14.6	9.6	5.7	1.0603	8.25
	19.0	14.1	9.3	5.5	1.0623	8.50
	18.4	13.6	9.0	5.3	1.0642	8.75
	17.8	13.2	8.7	5.2	1.0662	9.00
	17.3	12.8	8.4	5.0	1.0681	9.25
	16.8	12.4	8.2	4.9	1.0701	9.50
	16.3	12.1	7.9	4.7	1.0721	9.75
	15.8	11.7	7.7	4.6	1.0741	10.00
24.0	15.6	11.6	7.6	4.5	1.0750	10.12

HYDROCHLORIC ACID AT 60°F.

Be° 60°F.	Per Cent HCl	Gallons Strong Acid Required to Make 1000 Gallons of 15%	10%	7½%	5%	3%
10 25	15 22	985	641	475	313	186
10 50	15 62	958	623	462	304	181
10 75	16 01	932	607	450	296	176
11 00	16 41	908	591	438	289	171
11 25	16 81	885	576	427	281	167
11 50	17 21	863	562	416	274	163
11 75	17 61	842	548	406	267	159
12 00	18 01	821	535	396	261	155
12 25	18 41	802	522	387	255	151
12 50	18 82	783	510	378	249	148
12 75	19 22	765	498	369	243	144
13 00	19 63	748	487	361	238	141
13 23	20 00	733	477	354	233	138
13 25	20 04	731	476	353	232	138
13 50	20 45	715	466	345	227	135
13 75	20 86	700	456	338	222	132
14 00	21 27	685	446	330	218	129
14 25	21 68	671	437	324	213	127
14 50	22 09	657	428	317	209	124
14 75	22 50	644	419	311	205	122
15 00	22 92	631	411	304	200	119
15 25	23 33	618	403	298	197	117
15 50	23 75	606	395	293	193	114
15 75	24 16	595	387	287	189	112
16 00	24 57	584	380	282	186	110
16 10	24 73	580	377	280	184	109
16 20	24 90	575	375	278	183	109
16 30	25 06	571	372	276	182	108
16 40	25 23	567	369	274	180	107
16 50	25 39	563	366	272	179	106
16 60	25 56	559	364	270	178	105
16 70	25 72	555	361	268	176	105
16 80	25 89	551	359	266	175	104
16 90	26 05	547	356	264	174	103
17 00	26 22	543	353	262	173	103
17 10	26 39	539	351	260	171	102
17 20	26 56	535	348	258	170	101
17 30	26 73	531	346	256	169	100
17 40	26 90	528	343	255	168	100
17 50	27 07	524	341	253	166	99
17 60	27 24	520	339	251	165	98
17 70	27 41	516	336	249	164	98
17 80	27 58	513	334	247	163	97
17 90	27 75	509	332	246	162	96
18 00	27 92	506	329	244	161	96
18 10	28 09	502	327	242	160	95
18 20	28 26	499	325	241	159	94
18 30	28 44	495	323	239	157	94
18 40	28 61	492	320	237	156	93
18 50	28 78	489	318	236	155	92
18 60	28 95	486	316	234	154	92
18 70	29 13	482	314	233	153	91
18 80	29 30	479	312	231	152	90
18 90	29 48	476	310	230	151	90
19 00	29 65	473	308	228	150	89
19 10	29 83	469	306	226	149	89
19 20	30 00	466	304	225	148	88

Barrels Strong Acid Required to Make 24 Barrels of					Sp. Gr	Be°
15%	10%	7½%	5%	3%	60°F.	60°F.
23 6	15 4	11 4	7 5	4 5	1 0761	10 25
23 0	15 0	11 1	7 3	4 3	1 0781	10 50
22 4	14 6	10 8	7 1	4 2	1 0801	10 75
21 8	14 2	10 5	6 9	4 1	1 0821	11 00
21 2	13 8	10 2	6 7	4 0	1 0841	11 25
20 7	13 5	10 0	6 6	3 9	1 0861	11 50
20 2	13 2	9 7	6 4	3 8	1 0881	11 75
19 7	12 8	9 5	6 3	3 7	1 0902	12 00
19 2	12 5	9 3	6 1	3 6	1 0923	12 25
18 8	12 2	9 1	6 0	3 5	1 0943	12 50
18 4	12 0	8 9	5 8	3 5	1 0964	12 75
17 9	11 7	8 7	5 7	3 4	1 0985	13 00
17 6	11 4	8 5	5 6	3 3	1 1004	13 23
17 5	11 4	8 5	5 6	3 3	1 1006	13 25
17 2	11 2	8 3	5 5	3 2	1 1027	13 50
16 8	10 9	8 1	5 3	3 2	1 1048	13 75
16 4	10 7	7 9	5 2	3 1	1 1069	14 00
16 1	10 5	7 8	5 1	3 0	1 1090	14 25
15 8	10 3	7 6	5 0	3 0	1 1111	14 50
15 5	10 1	7 5	4 9	2 9	1 1132	14 75
15 1	9 9	7 3	4 8	2 9	1 1154	15 00
14 8	9 7	7 2	4 7	2 8	1 1176	15 25
14 6	9 5	7 0	4 6	2 7	1 1197	15 50
14 3	9 3	6 9	4 5	2 7	1 1219	15 75
14 0	9 1	6 8	4 5	2 6	1 1240	16 00
13 9	9 1	6 7	4 4	2 6	1 1248	16 10
13 8	9 0	6 7	4 4	2 6	1 1256	16 20
13 7	8 9	6 6	4 4	2 6	1 1265	16 30
13 6	8 9	6 6	4 3	2 6	1 1274	16 40
13 5	8 8	6 5	4 3	2 6	1 1283	16 50
13 4	8 7	6 5	4 3	2 5	1 1292	16 60
13 3	8 7	6 4	4 2	2 5	1 1301	16 70
13 2	8 6	6 4	4 2	2 5	1 1310	16 80
13 1	8 5	6 3	4 2	2 5	1 1319	16 90
13 0	8 5	6 3	4 1	2 5	1 1328	17 00
12 9	8 4	6 2	4 1	2 4	1 1336	17 10
12 8	8 4	6 2	4 1	2 4	1 1345	17 20
12 8	8 3	6 2	4 1	2 4	1 1354	17 30
12 7	8 2	6 1	4 0	2 4	1 1363	17 40
12 6	8 2	6 1	4 0	2 4	1 1372	17 50
12 5	8 1	6 0	4 0	2 4	1 1381	17 60
12 4	8 1	6 0	3 9	2 3	1 1390	17 70
12 3	8 0	5 9	3 9	2 3	1 1399	17 80
12 2	8 0	5 9	3 9	2 3	1 1408	17 90
12 1	7 9	5 9	3 9	2 3	1 1417	18 00
12 1	7 9	5 8	3 8	2 3	1 1426	18 10
12 0	7 8	5 8	3 8	2 3	1 1435	18 20
11 9	7 7	5 7	3 8	2 2	1 1444	18 30
11 8	7 7	5 7	3 8	2 2	1 1453	18 40
11 7	7 6	5 7	3 7	2 2	1 1462	18 50
11 7	7 6	5 6	3 7	2 2	1 1471	18 60
11 6	7 5	5 6	3 7	2 2	1 1480	18 70
11 5	7 5	5 5	3 7	2 2	1 1489	18 80
11 4	7 4	5 5	3 6	2 2	1 1498	18 90
11 3	7 4	5 5	3 6	2 1	1 1508	19 00
11 3	7 3	5 4	3 6	2 1	1 1517	19 10
11 2	7 3	5 4	3 6	2 1	1 1526	19 20

HYDROCHLORIC ACID AT 60° F.

Be° 60°F.	Per Cent HCl	Gallons Strong Acid Required to Make 1000 Gallons of 15%	10%	7½%	5%	3%
19 30	30 18	463	307	229	147	87
19 40	30 35	460	306	227	146	87
19 50	30 53	457	298	221	145	86
19 60	30 71	454	296	219	144	86
19 70	30 90	451	294	218	143	85
19 80	31 08	448	292	216	142	85
19 90	31 27	445	290	215	141	84
20 00	31 45	442	288	213	140	83
20 10	31 64	439	286	212	140	83
20 20	31 82	436	284	210	139	82
20 30	32 01	433	282	209	138	82
20 40	32 19	430	280	208	137	81
20 50	32 38	428	278	206	136	81
20 60	32 56	425	277	205	135	80
20 70	32 75	422	275	204	134	80
20 80	32 93	419	273	202	133	79
20 90	33 12	417	271	201	132	79
21 00	33 31	414	270	200	132	78
21 10	33 50	411	268	198	131	78
21 20	33 69	409	266	197	130	77
21 30	33 88	406	264	196	129	77
21 40	34 07	403	263	195	128	76
21 50	34 26	401	261	193	127	76
21 60	34 45	398	259	192	127	75
21 70	34 64	396	258	191	126	75
21 80	34 83	393	256	190	125	74
21 90	35 02	391	255	189	124	74
22 00	35 21	388	253	187	123	73
22 10	35 40	386	251	186	123	73
22 20	35 59	384	250	185	122	72
22 30	35 78	381	248	184	121	72
22 40	35 97	379	247	183	120	72
22 50	36 16	377	245	182	120	71
22 60	36 35	374	244	181	119	71
22 70	36 54	372	242	180	118	70
22 80	36 73	370	241	179	118	70
22 90	36 93	368	239	177	117	69
23 00	37 14	365	238	176	116	69
23 10	37 38	363	236	175	115	69
23 20	37 58	360	235	174	115	68
23 30	37 80	358	233	173	114	68
23 40	38 03	356	232	172	113	67
23 50	38 26	353	230	170	112	67
23 60	38 49	351	228	169	111	66
23 70	38 72	348	227	168	111	66
23 80	38 95	346	225	167	110	65
23 90	39 18	344	224	166	109	65
24 00	39 41	341	222	165	109	64
24 10	39 64	339	221	164	108	64
24 20	39 86	337	219	163	107	64
24 30	40 09	335	218	162	106	63
24 40	40 32	333	217	160	106	63
24 50	40 55	330	215	159	105	62
24 60	40 78	328	214	158	104	62
24 70	41 01	326	212	157	104	62
24 80	41 24	324	211	156	103	61
24 90	41 48	322	210	155	102	61
25 00	41 72	320	208	154	102	60

Barrels Strong Acid Required to Make 1000 Barrels of 15%	10%	7½%	5%	3%	Sp. Gr. 60°F.	Be° 60°F.
11 1	7 2	5 4	3 5	2 1	1 1535	19 30
11 0	7 2	5 3	3 5	2 1	1 1544	19 40
11 0	7 1	5 3	3 5	2 1	1 1554	19 50
10 9	7 1	5 3	3 5	2 1	1 1563	19 60
10 8	7 0	5 2	3 4	2 0	1 1574	19 70
10 8	7 0	5 2	3 4	2 0	1 1581	19 80
10 7	7 0	5 2	3 4	2 0	1 1590	19 90
10 6	6 9	5 1	3 4	2 0	1.1600	20 00
10 5	6 9	5 1	3 3	2 0	1.1609	20 10
10 5	6 8	5 1	3 3	2 0	1 1619	20 20
10 4	6 8	5 0	3 3	2 0	1.1628	20 30
10 3	6 7	5 0	3 3	2 0	1.1637	20 40
10 3	6 7	5 0	3 3	1 9	1 1647	20 50
10 2	6 6	4 9	3 2	1 9	1 1656	20 60
10 1	6 6	4 9	3 2	1 9	1 1666	20 70
10 1	6 6	4 9	3 2	1 9	1.1675	20 80
10 0	6 5	4 8	3 2	1 9	1 1684	20 90
9 9	6 5	4 8	3 2	1 9	1 1694	21 00
9 9	6 4	4 8	3 1	1 9	1 1703	21 10
9 8	6 4	4 7	3 1	1 9	1.1713	21 20
9 7	6 3	4 7	3 1	1 8	1 1722	21 30
9 7	6 3	4 7	3 1	1 8	1 1732	21 40
9 6	6 3	4 6	3 1	1 8	1 1741	21 50
9 6	6 2	4 6	3 0	1 8	1 1751	21 60
9 5	6 2	4 6	3 0	1 8	1 1760	21 70
9 4	6 1	4 6	3 0	1 8	1 1770	21 80
9 4	6 1	4 5	3 0	1 8	1 1779	21 90
9 3	6 1	4 5	3 0	1 8	1 1789	22 00
9 3	6 0	4 5	2 9	1 7	1 1798	22 10
9 2	6 0	4 4	2 9	1 7	1 1808	22 20
9 2	6 0	4 4	2 9	1 7	1 1817	22 30
9 1	5 9	4 4	2 9	1 7	1 1827	22 40
9 0	5 9	4 4	2 9	1 7	1 1836	22 50
9 0	5 9	4 3	2 9	1 7	1 1846	22 60
8 9	5 8	4 3	2 8	1 7	1 1856	22 70
8 9	5 8	4 3	2 8	1 7	1 1866	22 80
8 8	5 7	4 3	2 8	1 7	1.1875	22 90
8 8	5 7	4 2	2 8	1 7	1 1885	23 00
8 7	5 7	4 2	2 8	1 6	1 1895	23 10
8 7	5 6	4 2	2 7	1 6	1.1904	23 20
8 6	5 6	4 1	2 7	1 6	1.1914	23.30
8 5	5 6	4 1	2 7	1 6	1.1924	23 40
8 5	5 5	4 1	2 7	1 6	1.1935	23 50
8 4	5 5	4 1	2 7	1 6	1.1944	23 60
8 4	5 4	4 0	2 7	1 6	1.1953	23 70
8 3	5 4	4 0	2 6	1 6	1.1963	23 80
8 2	5 4	4 0	2 6	1 6	1.1973	23 90
8 2	5 3	4 0	2 6	1 5	1.1983	24 00
8 1	5 3	3 9	2 6	1 5	1 1993	24.10
8 1	5 3	3 9	2 6	1 5	1.2003	24 20
8 0	5 2	3 9	2 6	1 5	1.2013	24.30
8 0	5 2	3 9	2 5	1 5	1 2023	24.40
7 9	5 2	3 8	2 5	1 5	1 2033	24 50
7 9	5 1	3 8	2 5	1 5	1.2043	24 60
7 8	5 1	3 8	2 5	1 5	1.2053	24 70
7 8	5 1	3 8	2 5	1 5	1 2063	24 80
7 7	5 0	3 7	2 5	1 5	1.2073	24 90
7 7	5 0	3 7	2 4	1 4	1.2083	25 00