ESSO EXPLORATION & PRODUCTION CHAD INC.

CHAD DEVELOPMENT PROJECT

GENERAL PROJECT SPECIFICATION FOR SEPTIC TANK AND EFFLUENT DISPOSAL INTO DRAINAGE FIELD (TEMPORARY) GPS-018

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1.0 SCOPE

This specification covers mandatory requirements for the design, installation and materials for septic tanks, leach fields and curtain drains for domestic sewage treatment and disposal.

2.0 SUMMARY OF ADDITIONAL REQUIREMENTS

2.1 Table 1 lists the specifications, codes and standards which shall be used with this specification.

TABLE 1. CODES AND STANDARDS

American Society of Testing and Materials (ASTM) Standards	
A 53	Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
C 890	Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
C 1227	Precast Concrete Septic Tanks
D 2321	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D 2729	Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
F 405	Corrugated Polyethylene (PE) Tubing and Fittings
F 412	Terminology Relating to Plastic Piping Systems
F 449	Subsurface Installation of Corrugated Thermoplastic Tubing for Agricultural Drainage or Water Table Control
F 758	Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport and Similar Drainage
F 789	Type PS-46 Poly(Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings

2.2 The local approving authority (local health departments, etc.) shall be contacted regarding septic tank specific requirements for leach field design materials and their installations.

2.3 The septic tank and drainage field shall be designed to handle the load capacity of 360 liters (95 gallons) per capita per day.

3.0 SEPTIC TANK SYSTEMS

3.1 Septic tanks shall be buried, watertight receptacles designed to receive wastewater (discharge from toilets, kitchens, baths, showers, laundry facilities and sinks) from camp facilities. The septic tank separates solids from liquids, provides limited digestion of organic matter, stores solids and allows the clarified liquid to discharge for further treatment and disposal.

3.2 Septic tanks may be cylindrical or rectangular in shape. Septic tank design criteria shall be the following:

a. Adequate sludge storage shall be provided to prevent settleable solids from flowing into the outlet pipe.

b. Air scum volume above the liquid shall be at least 12.5% of the liquid volume but not less than 230 mm (9 in.) high for the entire surface above the liquid.

c. Inlet baffle/inlet tee shall direct the flow downwards to prevent the scum layer from plugging the inlet. The inlet baffle/inlet tee shall extend at least 450 mm (18 in.) below the water line but not more than 40% of the water depth. The inlet baffle/inlet tee shall be at least 150 mm (6 in.) above the water line. The top of the tee shall be a minimum of 50 mm (2 in.) below the underside of the tank cover.

d. Outlet baffle/outlet tee shall retain the floating scum layer and prevent scum from entering the outlet pipe. The outlet baffle/outlet tee shall extend at least 450 mm (18 in.) below the water line but not more than 40% of the water depth. The outlet baffle/outlet tee shall extend 150 mm (6 in.) above water level.

e. Retention period shall be not less than 48 hours at maximum sludge depth and scum accumulation.

f. Surface area to depth ratio for all chambers shall be maximized. The ratio shall be greater than 2.0.

g. Vents shall be provided to allow the escape of methane and hydrogen sulphide gas.

h. Access to the tank interior shall be provided for inspection and cleaning.

i. Septic tank capacity shall have a safety factor of two to three times the daily design flow.

j. Grease traps shall be installed upstream of septic tanks to remove grease before wastewater enters the tanks. Grease retention capacity in kilograms shall be at least equal to 25% of the flow capacity in l/min (grease retention capacity in pounds shall be at least equal to twice the flow capacity in gallons per minute).

k. Invert of the outlet pipe from the septic tank shall be a minimum of 100 mm (4 in.) above the invert of any distribution pipe in the leach field.

l. The diameter of both the inlet and outlet lines should be the same, and should be a minimum of 100 mm (4 in).

3.3 The following shall be provided for the top slab:

a. Access openings in chamber to permit inspection, pump-out and sludge removal.

b. Covers with plastic or epoxy-coated steel bar handles shall be provided for the openings. Covers must be prevented from moving laterally if sitting on top of the slab.

c. Locks for covers that are flush with or above the ground to prevent unauthorized access to the septic tank.

d. If the tank slab is below grade it shall have a minimum soil cover of 300 mm (12 in.) and manhole risers shall be provided to raise access openings 150 mm (6 in.) above finish grade elevation.

e. Where access opening or an inspection opening has a dimension greater than 200 mm (8 in.) a label of non-corrosive material shall be placed in a prominent place to warn everyone, in French and English, that "Entrance into the Tank could be Fatal."

3.4 Minimum setbacks for septic tank systems are shown in Table 2.

TABLE 2. SEPTIC SYSTEM SETBACKS

Features	Distance Septic Tank (meters)	Distance To Leach Field (meters)
Building (Outside Wall Face)	3.0	10.0
Property Boundary	3.0	3.0
Surface Water	15.0	15.0
Cut or Embankment	8.0	60.0
Nearest Dug Well or Other Source of Domestic Water Supply	60.0	100.0
Water Service Pipes	3.0	8.0
Walks and Drives	2.0	2.0
Large Trees	3.0	3.0

3.5 Septic tanks shall be designed for loads in accordance with ASTM C890. If the septic tank is located in an area where there is access to traffic then the septic tank shall be designed for an AASHTO HS-20 Load.

4.0 LEACH FIELD DRAINAGE SYSTEM

4.1 The leach field drainage system shall be sited and designed to provide the physical, chemical and biological environment necessary for the wastewater renovation through the soil. Major factors which shall be considered in the design of leach fields include the following:

a. Local soil conditions; soil characteristics including texture, structure, stratification, bulk density, grain size distribution and coefficient of permeability.

b. Depth of bedrock and presence of bedrock fissures or fractures.

c. Saturated soil and high groundwater table; the groundwater table must be a minimum 1 m (3 ft.) below the bottom of the leach field trench.

d. Surface slope.

e. Presence of ponding and/or flood conditions.

f. Per capita sewage flows.

g. Design life of the system.

4.2 The design of the leach field system shall consider that soil bacteria break down soluble organic pollutants and that physical filtering action of the soil removes suspended particles, including sewage borne bacteria and viruses. This action causes the production of slimy films of bacteria on the soil particles in the leach fields. In naturally well drained soils such as sand, sandy loam and loamy textures, the crust (slimy film) impedes the flow of water into the soil horizons and will be unsaturated and aerobic. This results in an increase of the contact time with the soil and ultimately of the treatment efficiency. Clay soil, on the other hand, would be nearly saturated and anaerobic and hence would require greater trench length to achieve a satisfactory treatment.

4.3 Percolation Test

4.3.1 The percolation characteristics of the soil shall be used to determine the ability of the soil to perform as a leach field. A minimum of four separate tests shall be carried out in four holes spaced uniformly over the proposed leach field. If the test results are not consistent within ±30%, additional tests in different locations may be required by ESSO.

4.3.2 Leach fields shall consist of conventional trenches and beds, or disposal mounds or a combination thereof based on the geotechnical conditions and field survey information. Table 3 provides a guide for the selection of disposal methods under various site constraints.

TABLE 3. LEACH METHOD APPLICABILITY

Method	Site Constraints											
	Soil Permeability			Depth to Bedrock			Depth to Water Table		Slope			Small Lot Size
	Very Rapid	Rapid - Moderate	Slow - Very Slow	Shallow and Porous	Shallow and Nonporous	Deep	Shallow	Deep	0-5%	5-15%	15%	
Trenches		X	X[1]			X		X	X	X	X	X[2]
Beds		X				X		X	X			X
Mounds	X	X	X	X	X	X	X	X	X	X	X	

"X" means system can function effectively with that constraint.

Notes:

1. Construct only during dry conditions. Use trench configuration only.
2. Flow reduction suggested.

4.4 Trenches and Beds

4.4.1 Trenches shall be 300 mm to 900 mm (1 ft. to 3 ft.) wide and up to 30 m (100 ft.) or more long. Only one distribution pipe shall be installed per trench at the designed slope with the primary infiltration surfaces on the bottom and side walls of the excavation. The distribution pipe shall be laid with a minimum 150 mm (6 in.) thick bed of washed, graded, crushed rock or gravel, 20 mm to 50 mm (3/4 in. to 2 in.) in size. This material shall be placed in the trench bottom and levelled true to grade prior to laying the pipe. Aggregate shall be placed around the pipe until only the top center is still visible.

4.4.2 A final check of grade and alignment shall be made to confirm that the designed slope has been met. Then additional aggregate shall be placed in the trench so that the lines are covered with a minimum depth of 50 mm (2 in.) above the pipe. The trench shall be backfilled further to grade level with suitable material.

4.4.3 The sizing of trenches and beds is a function of the characteristics of the infiltrative surface. Table 4 shows several soil types, soil percolation rates and trench and bed loading rates. However, design rates shall be based on percolation test results.

TABLE 4. TRENCH AND BED DESIGN CRITERIA

Soil Type	Percolation Rate (minutes/cm)	Trench Bed Bottom Area Application Rate [1][2] (cm/day)	Additional Criteria
Gravel, coarse sand	0.4	Not suitable [3]	Trenches shall not be used in highly permeable soils.
Coarse to medium sand	0.4-2	5	
Fine sand, loamy sand	2-6	3	
Sandy loam, loam	6-12	2.5	
Loam, porous silt loam	12-14	2	
Silty clay loam, clay loam [4]	24-48	1 [5]	Use of trenches shall be limited to exceptional circumstances if percolation rates are lower than 24 min/cm. Trenches shall never be used where percolation rate is less than 48 min/cm.

Notes:

1. May be suitable estimates for sidewall infiltration rates.
2. Rates based on septic tank effluent from a domestic waste source. A factor of safety may be desirable for wastes of significantly different character.
3. Soils with percolation rates < 0.25 min/cm (1 min./in.) can be used if the soil is replaced with a suitably thick (> 600 mm (2 ft.) layer of loamy sand or sand.
4. Soils without expandable clays.
5. These soils may be easily damaged during construction.

4.4.4 As a design guide, Table 5 shows the suggested dimensions of trenches.

TABLE 5. TRENCH DIMENSIONS

Width (mm)	Length (m)	Depth Below Grade (mm)	Cover Thickness (mm)	Spacing Between Trenches (m)
300 to 900	30	450 to 600 (1)	150 min.	1.8 minimum (2)

Notes:

1. May be deeper if more suitable horizon exists and groundwater table is low.
2. Measured from side wall to side wall; depends on design and on percolation characteristics of the soil.

4.5 Disposal Mounds

4.5.1 Mounds shall be used in relatively impermeable soils or in areas with shallow water tables or porous bedrock. Disposal mounds shall consist of trenches or beds constructed of suitable fill material placed above the existing grade. Effluent from septic tanks shall be siphoned or pumped into the mounds (usually medium to coarse sand) through distribution networks.

4.5.2 Mounds shall extend beyond the field a minimum of 3 m (10 ft) and enough to prevent seapage out of the sidesand.

5.0 DISTRIBUTION NETWORK

To achieve uniform application of effluent over the entire infiltrative surface area depending upon suitability and terrain, either of the two methods described herein shall be adopted.

5.1 Distribution Box Network (Figure 1)

5.1.1 The system shall use either of two different types of pipes:

a. 100 mm (4 in.) diameter PVC pipes having two rows of holes near the invert 450 mm (18 in.) off vertical center. The holes shall be 10 mm to 20 mm (1/2 in. to 3/4 in.) in

diameter and spaced 75 mm (3 in.) apart. PVC solid pipes 100 mm (4 in.) in diameter shall be used from the distribution box to the perforated pipes.

b. 100 mm (4 in.) diameter PVC drain tiles with 6 mm to 12 mm (1/4 in. to 1/2 in.) joint openings.

5.1.2 The basic system design shall be as follows:

a. The perforated pipes shall be laid approximately level and the solid pipes shall be sloped depending upon the terrain.

b. Effluent flows by gravity from the distribution box through the solid pipes to the perforated pipes or drain tiles.

c. The number of pipes used and the distance between them is a function of the characteristics of the soil, percolation rate and the bottom area application rate.

d. The 100 mm (4 in.) PVC perforated pipes or drain tiles shall be interconnected by a solid common header of 100 mm (4 in.) PVC pipe and distribution box.

e. Outlet inverts from the distribution box shall all be at the same elevation and the inlet invert shall be 25 mm (in.) above the outlet inverts.

5.2 Serial Distribution Method/Relief Line Distribution Network (Figure 2)

5.2.1 This system uses overflow or relief lines between trenches in place of distribution boxes. Similar to the distribution box network in paragraphs 5.1.1 and 5.1.2, this method also uses a combination of solid 100 mm (4 in.) PVC pipe and perforated 100 mm (4 in.) PVC pipe or open jointed drain tiles.

5.2.2 The basic system design shall be as follows:

a. The invert of the overflow section shall be located near the top of the porous media in order to use the maximum capacity of the trench.

b. For the gravity system, the invert of the overflow from the first absorption trench shall be at least 100 mm (4 in.) lower than the invert of the septic tank outlet.

c. Relief lines shall be separated far enough apart to prevent short circuiting (1.8 m to 3 m (6 ft. to 10 ft.)).

d. Pipe fittings for relief lines shall be selected to suit the slope.

e. A minimum of 1.8 m (6 ft.) (horizontal) of undisturbed earth is recommended between absorption trenches.

f. Distribution pipe in absorption trenches shall extend an equal distance (approximately) in both directions from the solid interconnection and relief pipes. Distribution pipes and trenches shall be level and normally follow slope contours.

6.0 PERFORMANCE TESTS FOR SEPTIC TANKS

6.1 Hydrotesting shall be used to demonstrate the strength of the tank to resist anticipated external and internal loads.

6.2 Testing for leaks to determine leakage below the ground water level shall be performed using or water pressure testing. Water pressure testing shall be performed by sealing the tank, filling with water and let stand for 24 hours; refill the tank; the tank shall be approved if water level is held for one hour.

7.0 MATERIALS FOR CONSTRUCTION OF SEPTIC TANK AND LEACH FIELD PIPING

7.1 Septic Tanks

7.1.1 Septic tanks shall be one of the following:

a. Precast or cast-in-place reinforced concrete, watertight, structurally sound and resistant to excessive corrosion and decay. Inlet and outlet pipes shall be sealed with a compound that bonds both the concrete and pipe materials.

b. Steel, epoxy or bitumen coated.

c. Fibreglass; floatation collars may be required if the groundwater table is high.

7.2 Piping Materials for Leach Field

7.2.1 Pipes shall be perforated and solid PVC, 100 mm (4 in.) in diameter, (including fittings) in accordance with ASTM D 2729.

7.2.2 As an alternate to perforated pipes, 100 mm (4 in.) diameter PVC drain tile with 6 mm to 12 mm (1/4 in. to 1/2 in.) joint openings may be used.

8.0 CURTAIN DRAINS

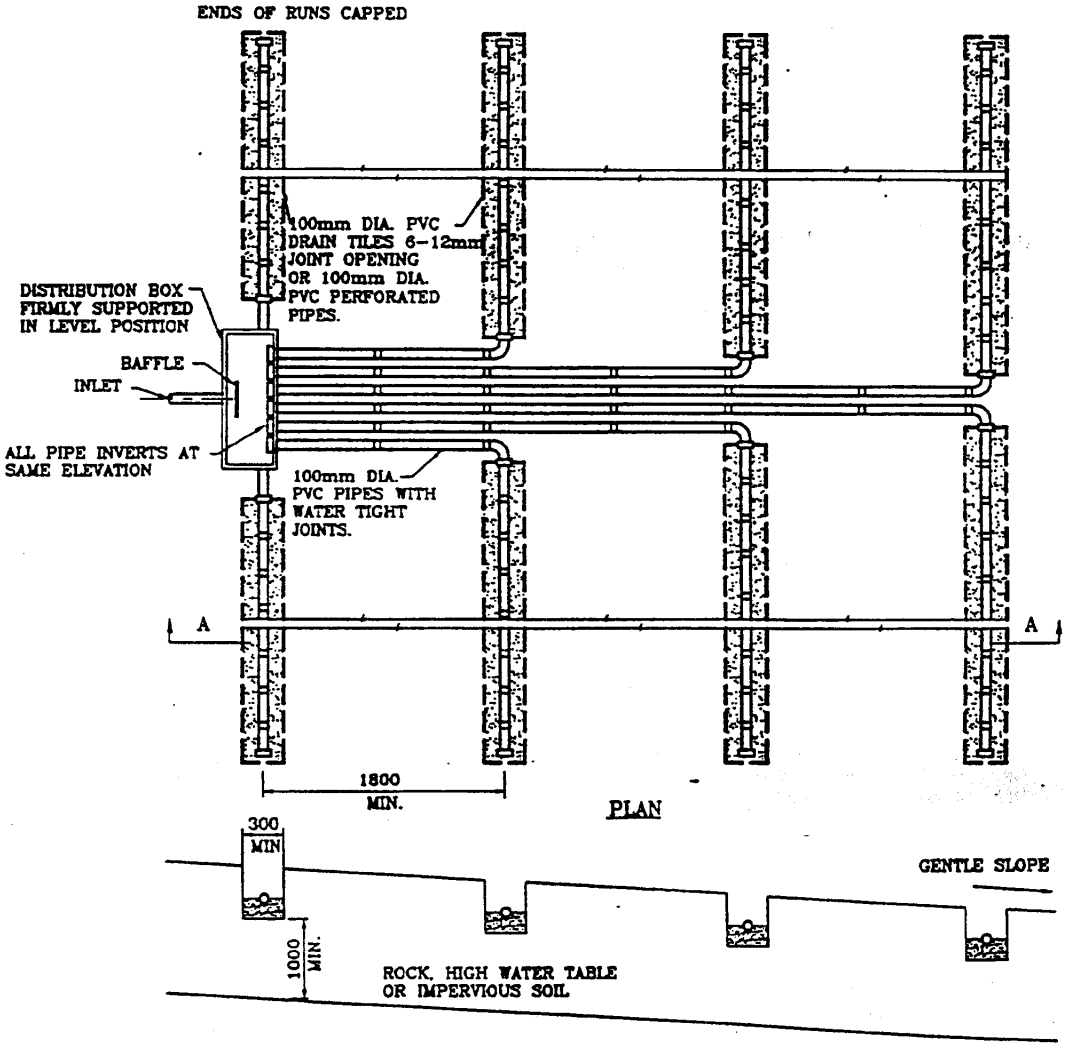
If required, curtain drains shall be installed to prevent natural (ground) water seepage into a leach field. The drains shall be installed in accordance with ASTM D 2321 or F 449 and be at least 300 mm (1 ft.) deeper than the leach lines, and 2.4 m to 3.0 m (8 ft. to 10 ft.) from the leach line. The curtain drain shall be directed to a free outlet.

9.0 CLOSURE OF SEPTIC TANK AND DRAINAGE FIELD SITE

Before closure of a septic tank and drainage field site can be considered complete, the following items shall be completed:

- The septic tank shall be pumped empty. The sludge shall be disposed in a location and manner acceptable to ESSO.
- The septic tank shall be removed from the ground, repaired if necessary and reused. The hole shall be replaced with suitable fill. The topsoil and vegetation shall be replaced and suitable soil erosion mitigation measures shall be employed.
- The ends of all underground pipes shall be properly plugged.

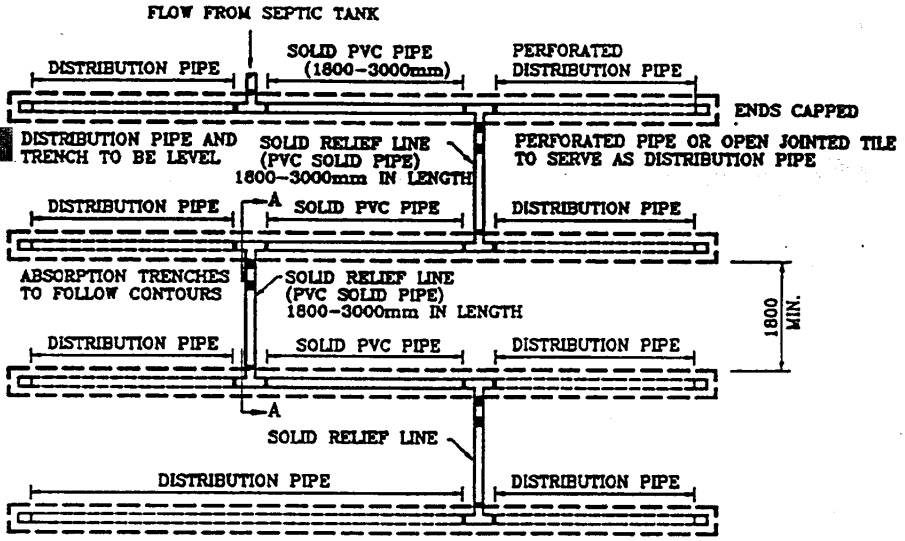
FIGURE 1 - DISTRIBUTION BOX LEACH FIELD FOR LEVEL/GENTLE SLOPING SITES



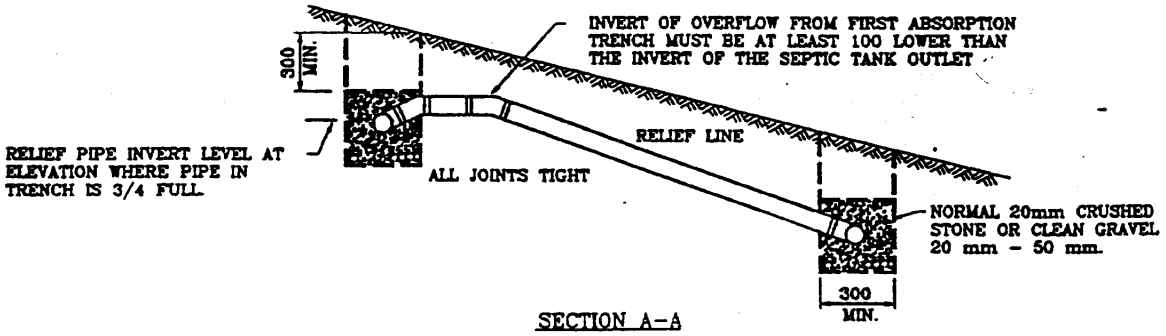
NOTES:

1: ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED NOT TO SCALE.

FIGURE 2 - SERIAL DISTRIBUTION LEACH FIELD FOR SLOPING SITES



PLAN



SECTION A–A

NB: ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE NOTED
NOT TO SCALE.