TEXAS

ENGINEERING TECHNICAL NOTE

Subject : *CONSERVATION PRACTICES*

No. : *210-11-TX1*

Reference : *PLANNING AND DESIGN OF DRY HYDRANTS*

Date : *JULY 1993*

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

TEXAS ENGINEERING TECHNICAL NOTE

No. 210-11-TX1

CONSERVATION PRACTICES

PLANNING AND DESIGN OF DRY HYDRANTS

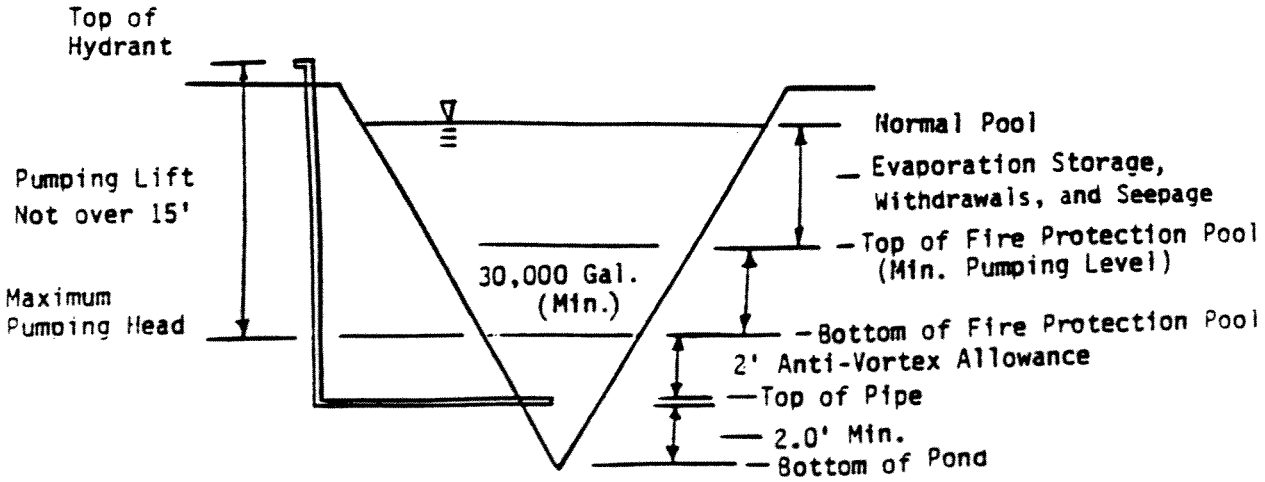
General

The planning and design of dry hydrants requires the close cooperation of the local fire department and the landowner. Items for concurrence are:

1. Location
2. Access road durability and safety
3. Type of pipe and fittings
4. Compatibility of equipment
5. Design of installation
6. Additional requirements

Water Supply

The schematic below provides an overview for water supply needs and terms. Texas Administrative Code Section 297.29 exempts dry hydrants from water use permit requirements. The Texas Key Rate Schedule, which is a fire insurance rating tool, requires that the fire protection pool level meet the 50-year drought level.



Conditions and Procedures for 50-year Drought Level

The following general procedure may be used to determine the 50-year drought level for dry hydrants in Texas.

1. The impoundment has a drainage area--storage ratio greater than the ratio shown on Figure 1.

2. The curve number for the drainage area is greater than 70.

3. Determine the average annual net lake surface evaporation (1950-56) from Figure 2. The assumption is that the drought in Texas of the 1950's is equivalent to the 50-year drought.

4. Assume that no runoff enters the impoundment.

5. Account for water withdrawals, such as livestock water use.

6. Account for seepage losses.

7. Sites known to have periodically gone dry shall not be used.

Another more detailed method for determining the 50-year drought level is to use the RESOP computer program to perform a reservoir operation study. RESOP should be used to determine the 50-year drought level for ponds not meeting the conditions of the general procedure above. The period of record 1951-65, which includes the 50's drought years, will usually be adequate to determine the 50-year drought level. References for RESOP are Technical Release 19A, "Revision of Reservoir Operation Study Computer Program (RESOP) and User Manual" and Technical Note 210-18-TX3, "Procedure for Making a Reservoir Operation Study."

The 50-year drought level for spring-fed impoundments can be determined by experience in the area. Interviewing knowledgeable local inhabitants often gives a good indication of drought levels for spring-fed ponds.

Where streams are used for the water source, stream gage data may be analyzed to determine water source reliability. In the absence of gage data, local experience will again be the most important factor in determining water source reliability and 50-year drought levels.

Example - General Procedure for 50-year Drought Level

A proposed dry hydrant site is located at a damless pond in Bell County, Texas. The average water surface area during the drought is 0.5 acre. The pond's sides and bottom are located in good clay materials. The pond's drainage area to storage ratio is 15 and the curve number for the drainage area is 80. Twenty

animal units of cattle use the pond for drinking. The 50-year drought level is found as follows:

a. From Figure 2, the net surface evaporation is 46 in. or 3.8 ft.

b. Account for livestock water use:
20 AU x 15 gpd/AU x 365 d = 109,500 gal = 0.34 ac ft
0.34 ac ft ÷ 0.5 ac (pond surface) = 0.7 ft

c. Account for seepage: The seepage rate is about 10^{-7} cm/sec (1.24 in./yr) which is negligible.

d. The 50-year drought level is 4.5 ft (3.8 ft + 0.7 ft) below the normal pool. The normal pool is the elevation of the emergency spillway or the crest elevation of the pipe spillway when present.

Hydrant Site Location

Generally, the hydrant will be located near the embankment to take advantage of deeper water and be less likely to have problems due to siltation and algae growth. The site should have good surface drainage and be located away from swales and low places.

Also, locations within a drainage area with an expected high silt load, such as cultivated fields without terraces or adequate soil cover, shall be avoided. In some cases, conservation practices, such as filter strips, may be applied to reduce sediment delivered to the pond. Dry hydrants shall be installed at locations assuring 20 or more years of service life.

Table 1. Intake Strainer Details

Pipe Size Inches Diameter	Number of Holes Needed for 4 Times Area of Pipe Hole Size, Inches 0.25 1/4	0.3125 3/16	0.375 3/8	Minimum Length Feet *	Top Width Solid Inches **
6	2303	1475	1024	3.4	4
8	4096	2621	1820	4.6	6
10	6400	4096	2844	5.6	7
12	9216	5898	4096	6.6	8

* Based on hole spacing = 2 hole diameters minimum
** No holes in top portion of pipe for distance shown to counter anti-vortex forces.

Intake Strainer Details

To avoid a vortex or whirlpool during pumping, at least 2.0' should be allowed unless a special design is prepared to eliminate the vortex. A vortex allows air to enter the pump which decreases pump capacity and may cause the pump to loose prime. Special designs may include a baffle or anti-swirl plates or the top of the pipe may be left solid (without holes). See Table 1 to determine the top width in inches to leave solid. Table 1 also shows the number of holes by diameter needed to give four times the pipe's flow area. Also, it shows the minimum perforated pipe length needed, i.e., for 6" diameter pipe - 1024 holes @ 3/8" diameter are needed for 3.4' length of pipe with the top 4" left solid.

Strainers should have the holes deburred and smoothed so that flow through the hole (orifice) is not impeded. Where silt or other minute particles are a concern, commercial well screens should be recommended.

It is recommended that the intake strainer end cap also be perforated to improve intake flow and back-flushing characteristics. Also, a pinned or snap-in cap is preferred to a hinged cap.

Pump Lift

To prevent an air-lock, which will not allow the fire truck pump to prime, the centerline of the pump intake on the truck shall be no lower than the centerline of the dry hydrant outlet. The dry hydrant outlet should be approximately 24 inches above ground level and near enough to the road so that one 10-foot length of flexible hard rubber suction hose can be used to the truck. Pumping lift (elevation head) shall not exceed 15 feet.

The total pumping head shall not exceed 20 feet when line, elbow, fitting losses, and elevation head are added. Pumping head shall be figured for each site to include head loss from screen, elbows, line friction, elevation (static head) and hard rubber suction hose to the fire truck. Head loss for fittings (intake screen if applicable, elbows, and hydrant connection) are computed by using equivalent pipe length from Table 2 and adding to total length of pipe required. Tables 3 and 4 give the head loss for plastic pipe and hard rubber suction hose.

Total head loss = head loss x (line length + equivalent length of pipe) + elevation change or static head + length of hard rubber hose x head loss of rubber hose.

The usual design pumping rate is 1000 gpm. Even if the present fire truck pumping rate is less, the higher design rate will allow for future upgrading of equipment.

Table No. 2 Equivalent Pipe Lengths for Various Fittings
(250 to 1250 GPM Pumping Rate)

Pipe Fitting	Pipe Diameter in Inches			
	6	8	10	12
Intake Screen	5	7	8	9
90 degree Elbow (Standard)	16	22	27	32
90 degree Elbow (Long Sweep)	11	14	18	20
45 degree Elbow	7.5	10	13	15
Hydrant Connection (6" x 4-1/2")	2.5	2.5	2.5	2.5

Table No. 3 Head Loss in Feet per 100 Feet of Pipe Length
(PVC PIP SDR-26)

Pumping Rate, GPM	Pipe Diameter, Inches			
	6	8	10	12
250	0.58	0.15	0.05	0.02
500	2.08	0.52	0.17	0.07
750	4.42	1.11	0.37	0.15
1000	7.54	1.88	0.64	0.26
1250	11.4	2.85	0.97	0.39

Table No. 4. Head Loss in Feet per 100 Feet of Hard Rubber Suction Hose

GPM	Inside Diameter of Hose in Inches				
	2.5	4.0	4.5	5.0	6.0
250	38.2	3.9	2.2	1.3	0.5
500	138.0	14.0	7.9	4.7	1.9
750		29.8	16.8	10.0	4.2
1000		50.6	28.5	17.1	7.0
1250		76.7	43.2	25.9	10.7

Dry Hydrant - Other Considerations

A pipe support for the intake screen should provide 2.0 feet of clearance from the pond bottom.

Dry hydrants made of PVC material must be painted with a high grade epoxy paint where components are exposed to ultraviolet light rays.

Specific guidance for the access road is provided in the Dry Hydrant Manual.

PONDS AND RESERVOIRS: Guide for Estimating Approximate Acres of Drainage Area Required Per Acre-Foot of Storage in a Farm Pond

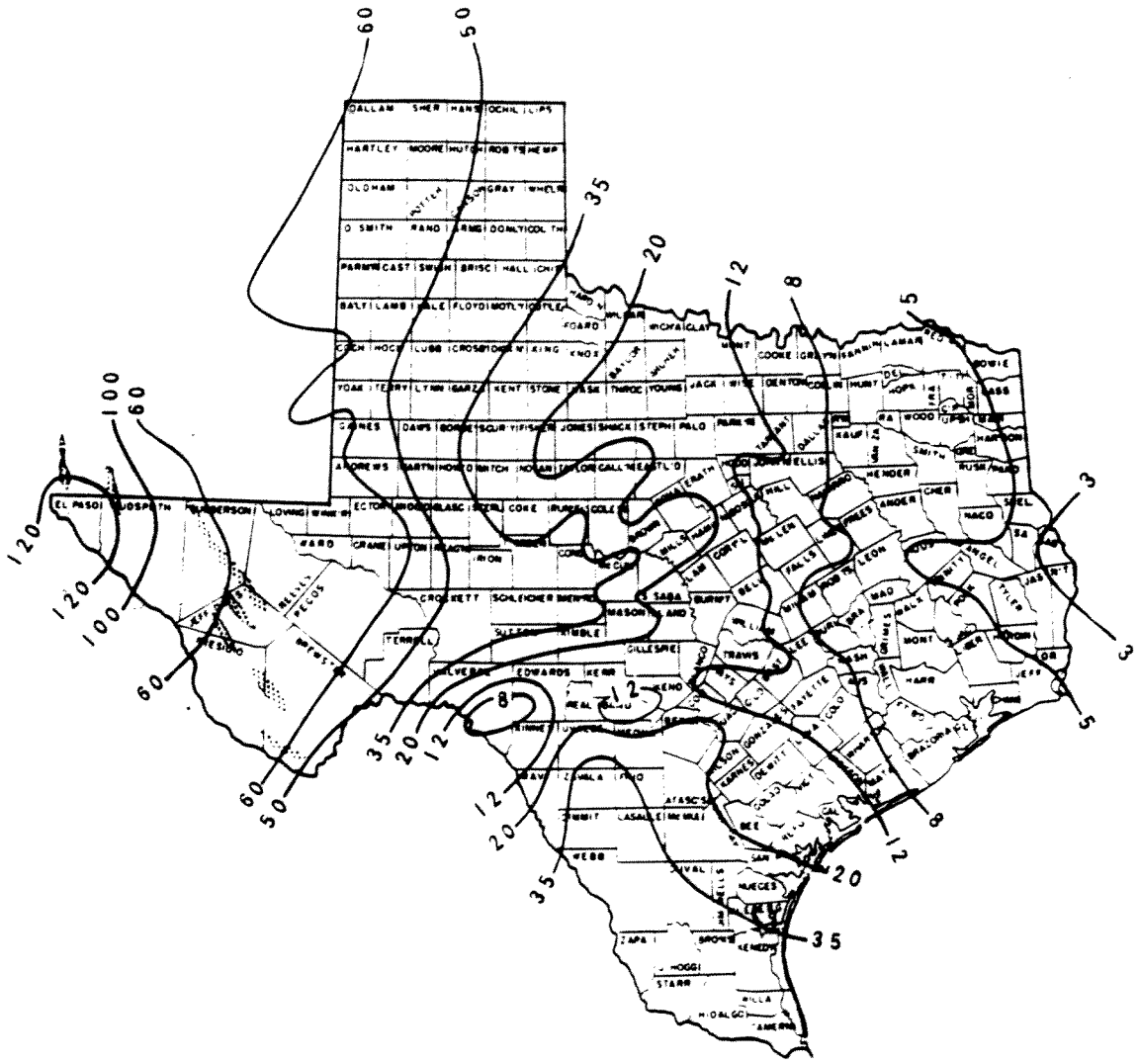


Figure 1

Note: These drainage area-storage ratios do not apply when ponds are used for irrigation.

REFERENCE	U.S. DEPARTMENT OF AGRICULTURE	Drawing No.
Chapter 11, Part I, Engineering Field Manual for Conservation Practices	SOIL CONSERVATION SERVICE Temple, Texas	4-L-29475 SHEET 1 OF 1 DATE 6/70

USDA-SCS FORT WORTH TEX. 1970

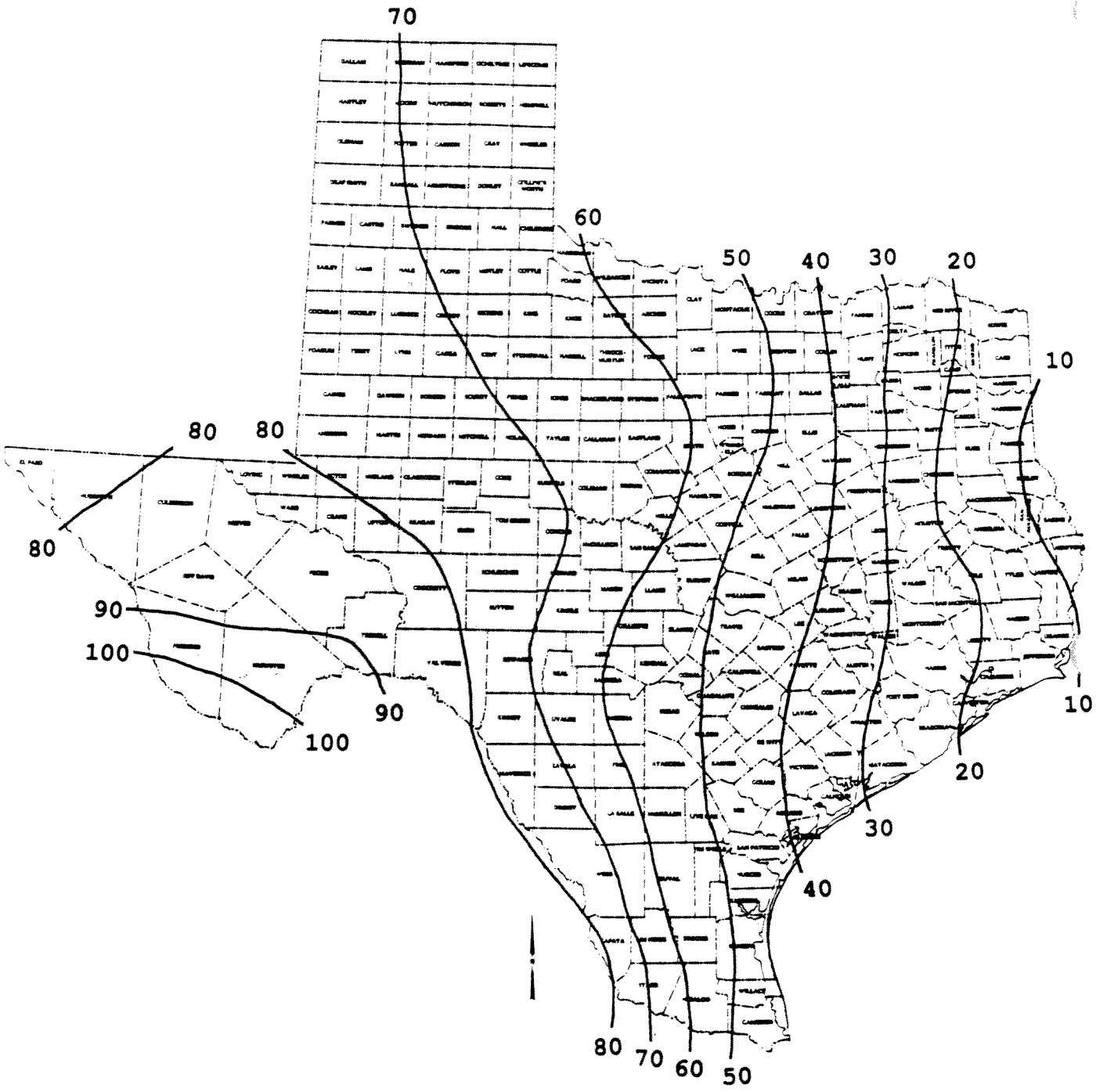


Figure 2

Average Annual Net Lake Surface Evaporation

in Inches 1950-56

TEXAS

APPROXIMATE SCALE MILES

BASE COMPILED FROM USGS NATIONAL ATLAS 1970 EDITION

From Texas Water Development Board, Report 64, Monthly Reservoir Evaporation Rates for Texas 1940 Through 1965

DRY HYDRANT DESIGN

Water Supply

1.	DA/Storage Ratio (Figure 1) min. 12	actual	15
2.	Curve Number		80
3.	Net Evaporation (Figure 2)		3.8 Ft
4.	Withdrawals 0.34 Ac Ft ÷ 0.5 Ac		0.7 Ft
5.	Seepage		— Ft
6.	50-yr Drought Level (3+4+5)		4.5 Ft
7.	Elev.(Ft) Normal Pool		100.0
8.	Elev.(Ft) 50-yr Drought Level (7-6)		95.5

Hydraulic Design

Minimum Pumping Capacity 1000 **GPM. Pipe Diameter** 6 **In.**

Equivalent Pipe Length (Table 2)

Intake Screen	5 **Ft.**
90° Elbow 2 **@** 16 **Ft/each**	32 **Ft**
45° Elbow ____ **@** ____ **Ft/each**	____ **Ft.**
Hydrant Connection	2.5 **Ft.**
Total Equivalent Pipe Length =	39.5 **Ft.**

Pipe Length = Horizontal Pipe + Vertical Pipe = 73 **Ft.**

Pipe Length + Equivalent Pipe Length = 112.5 **Ft.**

(1) **Head Loss for Pipe and Fittings =** 112.5 **Ft x** 7.54 **Ft/100 L.F.**
= 8.5 **Ft.** **(Table 3)**

(2) **Hard Suction Hose Loss =** 10 **Ft x** 7.0 **Ft/100 L.F. (Table 4)**
= 0.7 **Ft.**

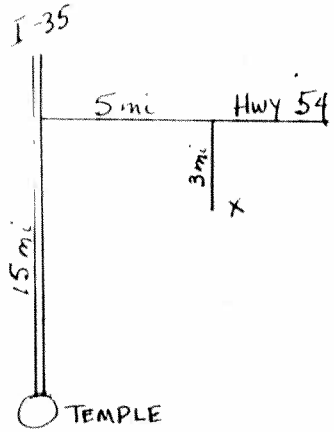
(3) **Static Lift =** 9.7 **Ft.** 105 − 95.3

Total Suction Lift = (1) 8.5 **+ (2)** 0.7 **+ (3)** 9.7 **=** 18.9 **Ft.** **(20 Feet Maximum).**

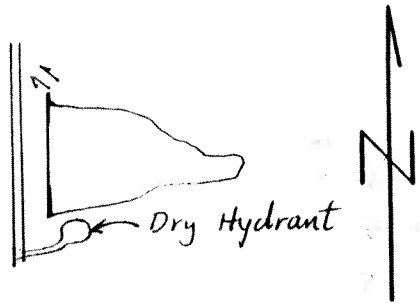
DRY HYDRANT INSTALLATION

A Dry Fire Hydrant will be installed at the location shown and in accordance with the drawing on the reverse side. All arrangements for volume of the water, permission for access to the site, and compatability with the local Fire Department equipment have been made.
(Sign below or attach documentation of permissions granted)

Coy Citizen	Ima Firefighter, 3N1 F.D.
Landowner	**Local Fire Department**
7/1/93	7/1/93
Date	**Date**



COMMUNITY LOCATION MAP



DETAILED HYDRANT LOCATION

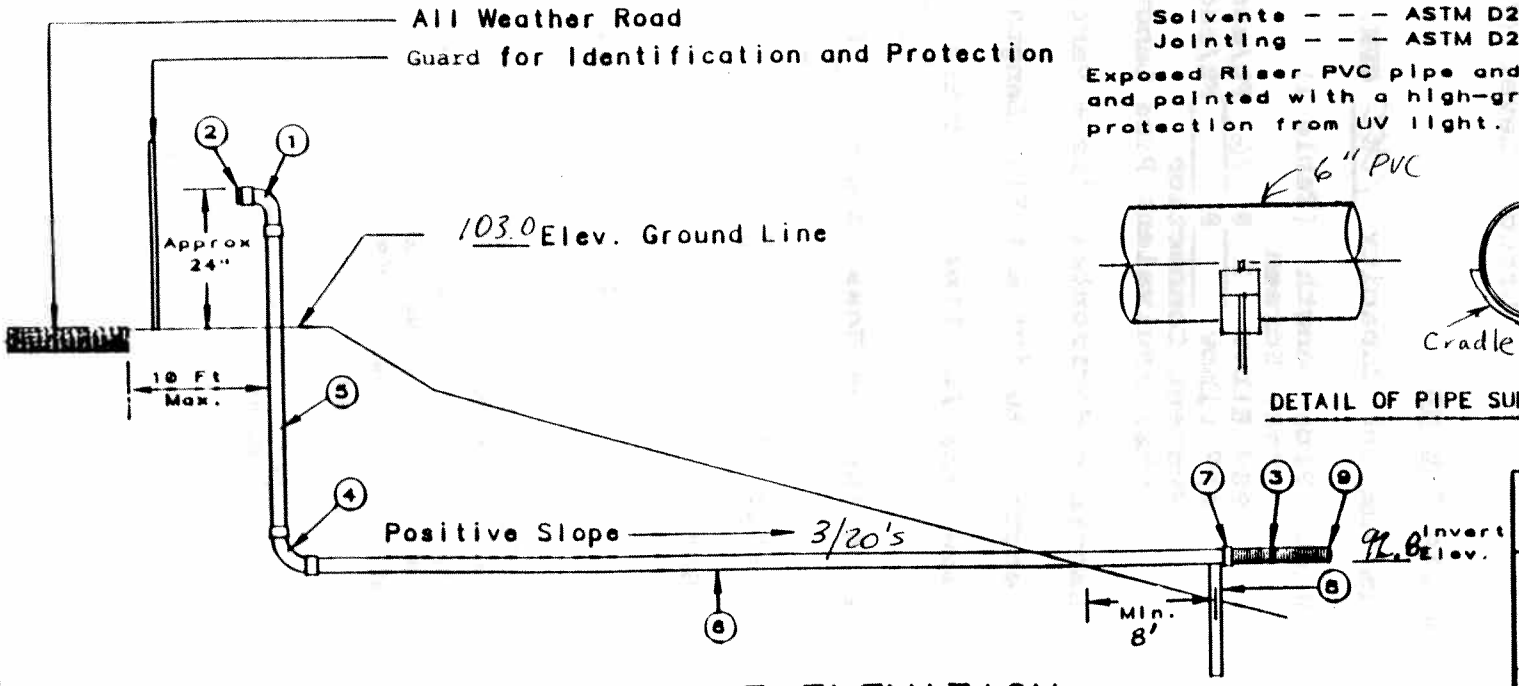
BILL OF MATERIALS

Item	Mark	Quan	Unit
6" to 6" Hydrant Assembly – 90° Bend	1	1	Each
Hydrant Cap – 6 "	2	1	Each
6" x 40" PVC Strainer (1024 ¾" diameter holes)	3	1	Each
6" SCH 40 PVC 90° Bend	4	1	Each
6" SCH 40 PVC Pipe – Riser	5	13	Lin. Ft
6" SCH 40 PVC Pipe	6	60	Lin. Ft
6" SCH 40 PVC Couplings	7	3	Each
Underwater Support	8	1	Each
Strainer Cap – Removable	9	1	Each
Primer Cleaner		1	Can
PVC Glue		1	Can
High Grade Epoxy Paint		1	Can

Note: PVC materials shall be Schedule 40 (ASTM D1785) SDR 26 (ASTM D2241), or stronger.

Fittings – – – ASTM D2466
Bell Joints — ASTM D2672
Solvents – – – ASTM D2564
Jointing – – – ASTM D2855

Exposed Riser PVC pipe and fittings shall be primed and painted with a high-grade of epoxy paint for protection from UV light.



DRY HYDRANT ELEVATION

DETAIL OF PIPE SUPPORT

POND – DRY HYDRANT

CON CITIZEN

BELL COUNTY

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	Jr. Free	7/1/93
Checked	Ralph Sims	7/1/93
Approved	Ralph Sims	7/1/93
Sheet	1 of 1	

This Practice Meets Specifications Jr. Free 7/15/93
Sig Date

TX (T-93)

BILL OF MATERIALS

Item	Mark	Quan	Unit
6" to " Hydrant Assembly – 90° Bend	1	1	Each
Hydrant Cap – "	2	1	Each
6"x " PVC Strainer (1024 ⅜" diameter holes)	3	1	Each
6" PVC 90° Bend	4	1	Each
6" PVC Pipe – Riser	5		Lin.Ft
6" PVC Pipe	6		Lin.Ft
6" PVC Couplings	7		Each
Underwater Support	8	1	Each
Strainer Cap – Removable	9	1	Each
Primer Cleaner			Can
PVC Glue			Can
High Grade Epoxy Paint			Can

COMMUNITY LOCATION MAP

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Note: PVC materials shall be Schedule 40 (ASTM D1785) SDR 26 (ASTM D2241), or stronger.

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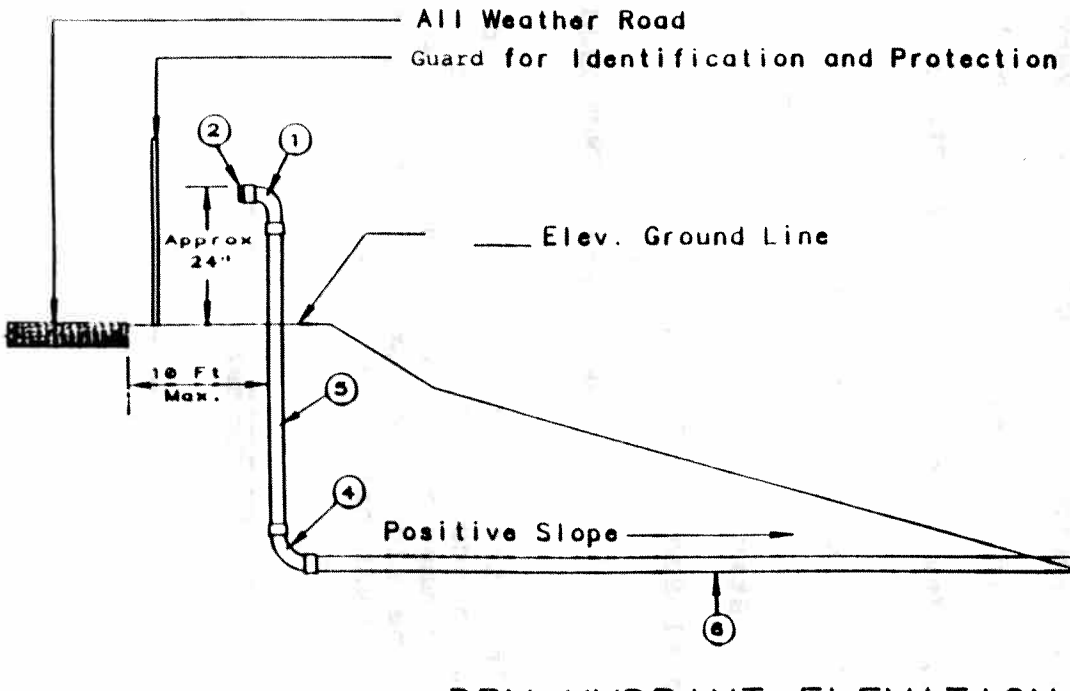
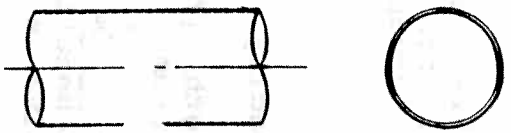


DRY HYDRANT ELEVATION



DETAIL OF PIPE SUPPORT

This Practice Meets Specifications _____ Signed _____ Date

POND – DRY HYDRANT

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed _____ Date _____
Checked _____ _____
Approved _____ _____
Sheet ____ of ____

TX (7-93)

DRY HYDRANT DESIGN

Water Supply

1. DA/Storage Ratio (Figure 1) min._____ actual_____
2. Curve Number _____
3. Net Evaporation (Figure 2) _____Ft
4. Withdrawals _____Ft
5. Seepage _____Ft
6. 50-yr Drought Level (3+4+5) _____Ft
7. Elev.(Ft) Normal Pool _____
8. Elev.(Ft) 50-yr Drought Level (7-6) _____

Hydraulic Design

Minimum Pumping Capacity _____ GPM. Pipe Diameter ____ In.

Equivalent Pipe Length (Table 2)

Intake Screen	_____ **Ft.**
90° Elbow ____**@** ____**Ft/each**	_____ **Ft**
45° Elbow ____**@** ____**Ft/each**	_____ **Ft.**
Hydrant Connection	2.5 **Ft.**
Total Equivalent Pipe Length =	_____**Ft.**

Pipe Length = Horizontal Pipe + Vertical Pipe = _____Ft.

Pipe Length + Equivalent Pipe Length = _____Ft.

(1) **Head Loss for Pipe and Fittings =** ____Ft x ____Ft/100 L.F. (Table 3)
= _____ **Ft.**

(2) **Hard Suction Hose Loss =** ____Ft x ____Ft/100 L.F. (Table 4)
= ____**Ft.**

(3) **Static Lift =** _____ **Ft.**

Total Suction Lift = (1) + (2) + (3) =_____ **Ft.** (20 Feet Maximum).

DRY HYDRANT INSTALLATION

A Dry Fire Hydrant will be installed at the location shown and in accordance with the drawing on the reverse side. All arrangements for volume of the water, permission for access to the site, and compatability with the local Fire Department equipment have been made.
(Sign below or attach documentation of permissions granted)

_____ _____
Landowner **Local Fire Department**

_____ _____
Date **Date**