PIPE BUOYANCY

PVC Profile Gravity Sewer Pipe floated after installation due to groundwater conditions.

Pipe buoyancy should be considered anytime there is a possibility that pipe flotation could occur.

Some of those conditions are:

- Pipelines in an area with high watertable.
- Flooding to consolidate backfill.
- Pipelines in areas, which will be inundated, such as a flood plain or under a future man-made lake.
- Subaqueous pipelines.

The buoyancy of a buried pipeline depends upon the weight of the pipe material, the weight of the volume of water displaced by the pipe, the weight of the liquid load carried by the pipe, and the weight of the backfill material.

Whenever the watertable level is above the invert of the pipe, the potential for flotation exists. The resistance to flotation is directly related to the specific gravity of the pipe material and the volume of water displaced.

Table 1

Specific gravity weight per cubic foot of various pipe materials.

	Specific Gravity	Weight Per Cubic Foot
HDPE	0.95	59
PVC	1.38	86
ABS	1.06	66
Fiberglass	2.00	125
Aluminum	2.65	165
Steel	7.85	490
Ductile Iron	7.10	443
Concrete	2.40	150
Fresh Water	1.00	62.4

Table 2

Pipe Weights Per Foot of Length Per Diameter

		12"	15"	18"	21"	24"	27"	30"	36"	42"	48"
ADS N-12	PE	3	3	7	--	14	--	18	22	--	--
Hancor Hi-Q	PE	3	5	7	--	12	--	16	22	--	--
Permacore	PE	--	--	14	17	22	27	31	41	55	65
Spirolite 40	PE	--	--	8	9	11	14	16	23	35	65
63	PE	--	--	8	9	11	14	16	23	35	40
100	PE	--	--	10	13	17	23	25	40	48	40
160	PE	--	--	13	18	20	27	34	45	56	59
Perma Loc 46	PVC	--	--	12	15	19	--	--	--	--	--
Ultra Rib	PVC	5	8	12	15	19	--	--	--	--	--
Vylon HC	PVC	--	--	--	--	27	30	35	54	--	100
Hobas SN 46	FibG	11	--	21	--	35	--	54	77	104	134
CSP - 16 ga.	*	10	12	14	17	19	23	26	29	33	38
CAP - 16 ga.	**	3	4	5	6	6	--	--	--	--	--
CAP - 16 ga.	***	--	--	--	--	--	8	9	11	13	15
Ductile Iron CL	50	47	--	80	--	113	--	151	--	262	329
RCP	****	**120**	**155**	**175**	**225**	**290**	**350**	**410**	**563**	**745**	**920**

* 2-2/3" x 1/2" *** 3" x 1"

** 2-2/3" x 1/2" **** Bell & spigot "O" ring gasket - B wall

Note that in Table 2 all plastic and corrugated metal pipes are very lightweight compared to concrete pipe. As an example: **an empty 36" polyethylene pipe weighs 22 pounds per foot and displaces 607 pounds of water, which means that there is an uplift force of 585 pounds per foot, whereas, concrete pipe will have an uplift force of only 97 pounds.**

BUOYANCY OF PIPE

As a conservative practice, the pipeline should be considered empty. The weight of any future water is then an additional safety factor. At some point in time, the pipeline may be dewatered, thus subjecting the pipeline to a greater potential for flotation.

DISPLACED WATER WEIGHT

When water is displaced, a buoyant or upward force exists. The magnitude of the upward force is equal to the weight of water displaced. If the buoyant force is greater than the weight of the object displacing the water, flotation will occur. The weight of fresh water displaced per linear foot of a fully submerged circular pipe can be calculated by the equation:

$$Ww = \pi(OD)^2 62.4/4$$

or

$$Ww = 49.01 \times OD^2$$

Where: Ww = weight of displaced water, pounds per linear foot.

CONCLUSIONS

1. When high watertable conditions are present (or may be in the future), consideration should be made as to the potential for flotation. The decision as to what type of pipe to use may be based solely on flotation.
2. The weight of fluid inside the pipe should not be considered because all pipelines may be dewatered at some time.
3. Concrete pipe should be the pipe of choice whenever the possibility of flotation exists.