A Study of Onsite Sewage Containment Vessel Replacements in Loudoun County, Virginia 5/1/2000 to 2/1/2016

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Introduction

Replacement of tanks serving onsite sewage systems is an unpleasant and unexpected expense to homeowners, especially with relatively new homes. Tank failures are expensive, damaging to landscape, degrading to groundwater and cause increased stress on treatment systems. Collapse can be dangerous to humans and pets. It is often difficult to identify causes of failure and responsible parties involve designers, manufacturers, installers, and owners.

In Loudoun County, 66 out of 1,046 tanks or pump chambers in alternative systems inspected prior to November 2009 pursuant to Loudoun County Ordinance 1067 were found to have visible groundwater infiltration or inflow. Additionally, a series of high profile tank collapses focused attention on the issue. On December 15, 2009, the Loudoun County Board of Supervisors attempted to address this concern by amending County Ordinance 1066 to include language creating more strict requirements for design, manufacture, installation, and testing of sewage containment vessels. This revision went into effect on April 1, 2010 and included such new requirements as maximum cover over a tank of 48 inches, testing for structural soundness and water tightness, and having a precast riser terminating no more than six inches below grade. Specifically, this ordinance established minimum structural standards of 300 pounds (lbs.) per square foot with 2500 lbs. concentrated wheel loading at the tank center. For each one foot increase in tank burial depth, 150 lbs. per sq. foot of load bearing strength was required up to a maximum four foot burial. Boots and cast in risers were also required in an attempt to make tanks more watertight. Drains to remove water from around tanks were mandated if water table indicators were observed over seams or penetrations.

This study is an attempt to quantify the scope of replacements, identify potential causes, and determine the effectiveness of the revised ordinance in reducing tank deficiencies.

Methods

The Loudoun County Health Department (LCHD) reviewed minor repair (MR) and septic abandonment (SAB) permits through Loudoun County's Land Management Information System (LMIS) database to determine the number of septic and pump tanks that were installed after May 1, 2000, which experienced structural integrity issues and were permitted for replacement prior to February 22, 2016. Structural integrity issues included tank collapses, cracks, leaking and deformations, with each resulting in replacement. Each permit was researched individually to determine tank size, installer, manufacturer and reason for replacement.

Records were not available to determine how many of each type of tank were installed in Loudoun. Therefore, the percentage of failures for each tank type in relation to the number installed could not be determined. Anecdotally, ME Concrete (ME) distributed many tanks in Loudoun until the time of the local ordinance. Winchester Building Supply (WBS) and Hanover Concrete tanks have been and continue to be common tanks installed in Loudoun County both prior to and subsequent to the ordinance revision. Roth and Infiltrator Water Technologies tanks have become more common since the ordinance's enactment.

Results

An estimated 6,116 tanks in 3,660 onsite systems were installed between May 1, 2000 and February 1, 2016. Of these, an estimated 1,561 tanks in 867 onsite systems were installed on or after April 1, 2010, when the new tank requirements went into effect.

Upon review of each minor repair permit that resulted in the replacement of a septic or pump tank, a total of 74 tanks were identified as replaced; this included 68 (1.5%) of an estimated 4,555 tanks installed between May 1, 2000 and March 31, 2010 and 6 (0.4%) of the 1,561 tanks installed between April 1, 2010 and February 22, 2016. File review determined that 38 of the 74 (51%) were replaced due to tank collapses. The remaining tanks were replaced due to deformation, leaking or cracks that were observed in various locations of the tank, such as cracks in the sidewall, bottom and top of tanks. These cracks resulted in tanks that were not water tight and therefore leaking effluent.

Table 1: Summary of Tank Failures Since 2000

	Installed Before New Tank Requirements (May 2000-March 2010)				**Installed Since New Tank Requirements (April 2010-Feb. 2016)**			
Description of Failure	**Concrete**	**Plastic***	**Total**	**% Total**	**Concrete**	**Plastic***	**Total**	**% Total**
Collapse	**23**	**15**	**38**	**56%**	0	0	0	**0%**
Cracks in sidewalls	**14**	**0**	**14**	**21%**	0	**3**	**3**	**50%**
Leaking	**2**	**6**	**8**	**12%**	0	**2**	**2**	**33%**
Bottom Cracked	**2**	**1**	**3**	**4%**	0	**1**	**1**	**17%**
Deformed	0	**2**	**2**	**3%**	0	0	0	**0%**
Top Cracked	**2**	0	**2**	**3%**	0	0	0	**0%**
Poor concrete strength	**1**	0	**1**	**1%**	0	0	0	**0%**
Total	**44**	**24**	**68**	**----**	0	**6**	**6**	**----**
Percent of Total	**65%**	**35%**	**----**	**----**	0%	**100%**	**----**	**----**

*Includes both plastic and fiberglass tanks

<u>Failures by Size and Manufacturer</u>

Larger tanks comprised the majority of failures. The ME 1875 gallon concrete tank had the highest number of replacements. Among plastic tanks, the Snyder tanks had the highest number. Winchester Building supply tank replacements were also more often found among larger volume tanks. The total number of each type of tank in the ground is not known, so the rate of failure of each type and size tank cannot be determined.

Table 2: Number of Failures by Tank Size

Size	Tank Type	Installed Before New Tank Requirements (May 2000-March 2010)	Installed Since New Tank Requirements (April 2010-Feb. 2016)
Large	ME 1875	22	Not in use
Large	Snyder 1500	10	Not in use
Large	WBS 1500	6	0
Large	ME 1500	5	Not in use
Large	Fralo 1500	1	2
Large	Infiltrator IM-1530	Not in use	1
Medium	Snyder 1250	7	Not in use
Medium	WBS 1250	5	0
Medium	ME 1250 (one FX)	4	Not in use
Medium	Infiltrator 1250	0	3
Small	Snyder 1050	3	Not in use
Small	Delta(df60)	2	0
Small	Tapp/ME 1125	1	Not in use
Small	WBS 1000	1	0
Small	Orenco 1000	1	0

Table 3: Number of Failures by Tank Type

Tank Type	Installed Before New Tank Requirements (May 2000-March 2010)				Installed Since New Tank Requirements (April 2010-Feb. 2016)			
	Concrete	Plastic*	Total	% Total	Concrete	Plastic*	Total	% Total
ME (mid-seam)	**25**	0	**25**	**37%**	0	0	0	0%
Snyder (one-piece)	0	**20**	**20**	**29%**	0	0	0	0%
WBS (mid-seam)	**8**	0	**8**	**12%**	0	0	0	0%
Infiltrator	0	**0**	**0**	**0%**	0	**4**	**4**	**67%**
ME (top seam)	**4**	0	**4**	**6%**	0	0	0	0%
WBS (top-seam)	**3**	0	**3**	**4%**	0	0	0	0%
Delta (DF60)	0	**2**	**2**	**3%**	0	0	0	0%
ME	**2**	0	**2**	**3%**	0	0	0	0%
Roth/Fralo	0	**1**	**1**	**1%**	0	**2**	**2**	**33%**
Orenco (one-piece)	0	**1**	**1**	**1%**	0	0	0	0%
Tapp (mid-seam)	**1**	0	**1**	**1%**	0	0	0	0%
WBS	**1**	0	**1**	**1%**	0	0	0	0%
Hanover concrete all models	0	0	0	**0%**	0	0	0	0%
Grand Total	**44**	**24**	**68**	**----**	**0**	**6**	**6**	**----**

*Includes both plastic and fiberglass tanks

Time from Installation to Replacement

Time from installation to tank replacement inspection ranged from 1 month to 172 months.

Table 4: Average Months from Installation to Replacement of Failed Tanks

Tank Type	Before New Tank Requirements (May 2000-March 2010)	Since New Tank Requirements (April 2010-Feb. 2016)
ME 1500 unknown	5 (2)	Not in use
Snyder 1050	17 (3)	Not in Use
Infiltrator 1250	Not in use	18 (3)
Snyder 1500	35 (9)	Not in use
WBS 1500 mid	56 (3)	0
ME 1250 mid	58 (2)	Not in use
ME 1250 top	65 (3)	Not in use
WBS 1250 mid	67 (4)	0
Snyder 1250	83 (8)	Not in use
ME 1875 mid	84 (21)	Not in use
WBS 1500 top	91 (3)	0
Roth/Fralo 1500	115(1)	62 (2)
Delta DF60	115(2)	0
Infiltrator IM-1530	Not in use	9 (1)

The number of failures for each tank type is included in parentheses after the average. The remaining systems with one failure each included Orenco 1000 (59 months), WBS 1500 unknown (64 months), ME 1500 mid (84 months), WBS 1250 top (88 months), and WBS 1000 mid (98 months), and Tapp 1125 (172 months).

Tank Use

Failures were more common in tanks that were often less than full. Pump chambers represented the majority of tank failures, though septic tanks represent the majority of tanks in the ground.

Table 5: Tank Failures by Use

Tank use	Installed Before New Tank Requirements (May 2000-March 2010)		Installed Since New Tank Requirements (April 2010-Feb. 2016)	
	Total	% Total	Total	% Total
Pump Chamber	42	62%	3	50%
Septic Tank	22	32%	3	50%
ATU	2	3%	0	----
Pump and Haul	2	3%	0	----
Total	68	----	6	----

Installers

The three highest volume installers in the study area also had the highest number of replacements. Installers absent from this list have not had tank replacements on systems they installed.

Table 6: Tank Replacements by Installer

Installer	Installed Before New Tank Requirements (May 2000-March 2010)	Installed Since New Tank Requirements (April 2010-Feb. 2016)
Settle construction group	22	0
McKim Construction	19	2
Triple R Construction	17	0
Legacy/Schooley Construction	2	0
Plummer Brothers Construction Company	2	0
Bob Settle	2	0
SES Mid Atlantic LLC	0	2
Thomas Athey General Contracting	1	0
R. A. Case Co. Inc	1	0
Great Falls Septic	0	1
Homeowner	0	1
Sechrist Construction	1	0
TJT Corporation	1	0

Failures of Tanks Installed Post Ordinance

Six tanks installed after the ordinance have been replaced. All six of these tanks were plastic, including four that were infiltrator plastic tanks. One of these was buried at 48 inches and another was a pump chamber on the same site buried at 3 feet. Another infiltrator tank requiring replacement was an installation that was suspended during construction. The other two tanks were Roth/Fralo pump chambers serving the same system in a wet landscape position. Company representatives are currently investigating the cause of these failures.

Cost

The present cost in Loudoun and outside Loudoun of select septic tanks post ordinance are shown in the table below. Plastic tank costs are assumed to be the same in Loudoun as outside. The additional cost of boots and risers are cited as the reason for increased cost for Loudoun tanks from Winchester Building Supply (WBS).

Table 7: Tank Costs

Type of Tank	Outside Loudoun County	Loudoun County
Hanover top seam 1250 gal.	$986	$1600
WBS top seam 1250 gal	$1530	$1750
Infiltrator IM-1530	n/a	$1495.49
Roth RMT-1250	n/a	$1737.70

Source: Telephone quotes from concrete manufacturers and a local vendor of plastic tanks 2/2016.

Conclusions and Limitations

Leaking tanks bypass the treatment system and discharge effluent directly to the ground, or they take in groundwater, increasing stress on the treatment/absorption system; both are threats to groundwater.

While tanks installed post ordinance are newer installations and the number of installations have dropped post 2008, the ordinance appears to be reducing the number of concrete tank replacements. Of the 74 tank replacements that have occurred, 68 occurred on tanks installed prior to the ordinance and 6 have occurred in systems installed afterward. Tanks with the highest number of replacements, ME and Snyder, chose not to pursue approval under the local ordinance. It is a matter of concern that plastic tanks are still showing high rates of replacement.

Tanks that are largely empty, such as pump chambers, ATU's and pump and haul tanks, represented a larger proportion of failures. This is more striking in that the number of septic tanks likely exceeds the number of pump chambers, ATU's and pump and haul tanks. It is presumed that the lack of interior liquid to resist outside pressure causes more stress on tank structure.

Post ordinance tanks have been constructed to more rigorous standards, and this along with less age has likely been the reason for fewer replacements of tanks installed post ordinance.

The numbers of tanks of each type installed were not available for the study period, so rates of failure could not be determined; this data is currently being collected for new systems. Additionally, this study only looked at known failures and undoubtedly more tanks in need of replacement are still in service awaiting discovery. It should also be kept in mind that the tanks installed post ordinance are newer and have not been subject to environmental factors for as long of a time period.

Going forward, the Health Department will continue to gather improved information on the types of systems in the ground and the likelihood that these systems are functioning as designed. Tanks will be examined as existing systems are routinely inspected as part of Loudoun County's 2011 requirement for periodic pumping. Data collected will clarify effectiveness of the ordinance as the tanks installed under the new County standards begin to age. Future evaluations will be needed to better establish differential rates of failure.