STORMWATER PIPE CALCULATIONS

This memo provides support documentation for storm pipe investment values included on the Reclaim60 website. Methodology and example calculations for cost estimating are outlined in this document.

Current population, length of existing storm pipe, and average age of stormwater conveyance system were collected from municipalities and service districts via a survey. Municipalities and service districts were contacted by email during September and October 2019. District managers, city engineers and public works directors provided information.

1.1 POPULATION

If population information was not obtained directly from cities or municipalities, 2012 Baseline Projections from the Utah Governor's Office of Management and Budget (GOMB) were used to estimate 2020 and 2060 populations for individual municipalities. This was used instead of the Kem C. Gardner Policy Institute projections from 2015 because the Gardner study does not provide detail below the county level. Population by municipality was essential to be able to calculate storm pipe needs by municipality.

In any case where population supplied by a municipality disagreed significantly with that of the GOMB estimate, the estimate from the municipality was used for analysis.

In some counties, notably Davis and Salt Lake Counties, service districts covered portions of several different municipalities. In this case, populations supplied by the districts were compared to values from the GOMB estimate to ensure that population was not double counted. The population growth was also projected according to county growth rates calculated from the GOMB projections.

1.2 EXISTING LENGTH OF STORM PIPE

In the cases where the length of existing sewer pipe was not obtained directly from the municipality, a method for estimating length of existing storm pipe was developed. Data from reporting municipalities was used to develop a per capita length of storm water conveyance pipe. This was done by dividing the length of storm pipe provided in the surveys by the serviced population, which resulted in 7ft/capita storm pipe. This value was used to estimate the number of miles of storm pipe in a town. An example calculation is below:

City: Anytown
Type: Urban
2020 Population (GOMB): 62,154
Per Capita Storm Pipe: 7 ft/cap

$$(62{,}154\ capita) * \frac{7\ ft}{capita} * \frac{1\ mile}{5280\ ft} = \ 118\ miles\ of\ collection\ pipe$$

In rural municipalities, due to the wider geographic spread of population, 10 ft/capita was used to estimate length of storm pipe.

Most municipalities have curb and gutter on the streets to manage surface flows. However, many rural communities in Utah do not have stormwater conveyance systems. This study assumed that 2.6 million of the current 3.1 million people in the state, about 84% of the population, likely are served by storm pipe. Using this metric, a breakpoint population of 9000 was selected. For the calculations, if the population of a municipality was less than 9000, the town did not have storm pipe. Additionally, the balance of the population in a county (not included in towns and cities) was assumed to not have storm pipe, with the exception of Salt Lake and Utah Counties.

1.3 REPLACEMENT NEEDS

The average age of the storm pipe system was used to determine how much of the system would need to be replaced by 2060. The lifespan of a typical concrete storm pipe is theoretically indefinite in Utah. Unlike sewer and water pipes, storm pipes are rarely wetted and are seldom exposed to harsh chemicals. However, many storm pipes are currently made of corrugated iron pipe, which is subject to corrosion. The storm pipe lifespan was assumed to be 70 years for this study. If the average age of a system is 30 years, 50% of the system will reach 70 years old by 2060 and will need to be replaced. Using this relationship, the percentage of pipe that would need replacement was determined as illustrated in Table 1. Ages of the systems were rounded to the nearest increment of 5 years for simplicity.

Table 1. Age Based Replacement Schedule

Age (years)	Replaced (%)
0	0%
5	8%
10	17%
15	25%
20	33%
25	42%
30	50%
35	58%
40	67%
45	75%
50	83%
55	92%
60	100%
65	100%

70	100%
75	100%
80	100%

In cases where the age of the system was unknown, an average age of 30 years was assumed. An example calculation is as follows:

City: Anytown
Type: Urban
Length of Storm Pipe: 83 miles
Average Age of Storm Pipe: 30 years

$$(83\ miles) * 50\%\ R\&R = \ 42\ miles\ R\&R$$

Thus, by 2060, the municipality will need to replace about 42 miles of existing storm pipe.

1.4 NEW INSTALLATION

Population growth necessitates installation of new storm pipe to protect public and private property. New development increases impervious area, and therefore increases the amount of runoff generated during storm events. Many methods can be used to manage the increased runoff, but this study only considered the cost of installing new stormwater conveyance. The projection for future storm pipe length was calculated by taking the difference between 2060 and 2020 population. The difference was then multiplied by the 7 or 10 ft of storm pipe per capita factor for urban or rural municipalities, respectively. An example calculation is shown below:

City: Anytown
Type: Urban
2020 Population: 62,154
2060 Population: 133,800
Per Capita Storm Pipe: 7 ft/cap

$$(133{,}800 - 62{,}154\ capita) * \frac{7\ ft}{capita} * \frac{1\ mile}{5280\ ft} = \ 95\ miles\ additional\ pipe\ by\ 2060$$

Many small towns may need stormwater conveyance systems in the future. The breakpoint population, 9000, was used to project which towns would likely adopt stormwater conveyance by 2060. If the population of a town exceeded 9000 by 2060, the entire population was assumed to adopt stormwater conveyance. An example calculation is shown below:

Town: Anytown
Type: Rural
2020 Population: 6,039
2020 Length of Storm Pipe: 0 miles

2060 Population: 18,481
Per Capita Storm Pipe: 10 ft/cap

$$(18{,}481\ capita) * \frac{10\ ft}{capita} * \frac{1\ mile}{5280\ ft} = \ 36\ miles\ of\ collection\ pipe\ in\ 2060$$

If the population of a town did not exceed 9000 by 2060, it was assumed that no new stormwater conveyance would be installed.

1.5 COST ESTIMATING

The cost of installing new infrastructure is shared by municipalities and developers. In most cases, developers carry the bulk of the cost. To calculate the portion paid by municipalities, a ratio of 25/75 was assumed, with municipalities covering the cost of 25% of newly installed pipe. To replace existing pipe, however, the municipalities cover 100% of the cost.

Two unit costs were developed to estimate the price of replacing existing and installing new storm pipe. A concrete pipe size of 24 inches in a 4-foot deep, 5300-foot long trench governed the cost for both scenarios. For replacement of existing pipe, cutting and replacing roadways and sidewalks was included, and existing manholes were assumed to remain in place. Attachment A in the Appendix summarizes values used to obtain the unit cost, $70/foot, for replacing existing storm pipe.

An example calculation for the cost of replacing existing storm pipe is as follows:

City: Anytown
Storm Pipe Needing Replacement: 42 miles
Unit Cost: $70/ft
Portion of Cost Paid: 100%

$$(42\ miles\ pipe) * \frac{\$70}{ft} * \frac{5280\ ft}{mile} * 100\% = \$15.5\ million$$

Replacing existing storm pipe in this municipality will cost $15.5 million.

For new installation, it was assumed that the pipes would be installed before laying asphalt or concrete for roads and sidewalks. New manholes were also included in the cost, which is $74/foot. Attachment B in the Appendix summarizes values used to obtain the unit cost for installing new storm pipe.

City: Anytown
New Pipe to Meet Future Demand: 95 miles
Unit Cost: $74/ft
Portion of Cost Paid: 25%

$$(95\ miles\ pipe) * \frac{\$74}{ft} * \frac{5280\ ft}{mile} * 25\% = \$9.3\ million$$

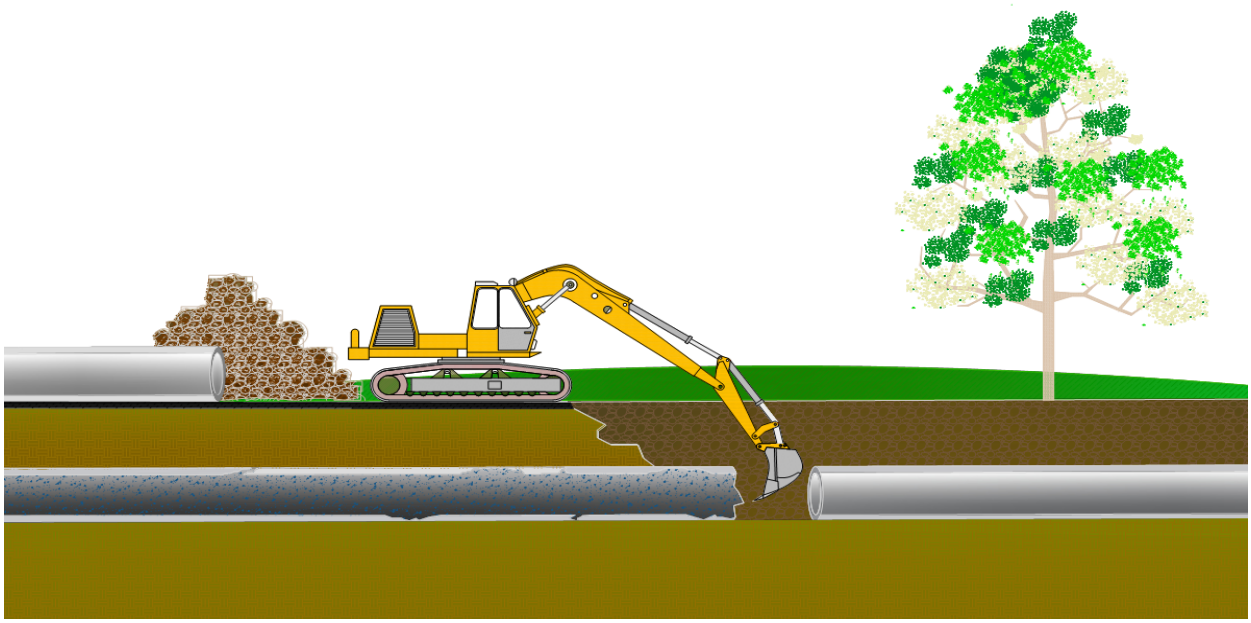
Meeting future demand for storm pipe in this municipality will cost about $9.3 million. The total cost for replacing and installing new storm pipe in this municipality is expected to be about $24.8 million. This same methodology was applied to all municipalities in the state and resulted in an overall cost of $1.3 billion. The projected cost by county for storm pipe is summarized in Attachment C in the Appendix.

APPENDIX

ATTACHMENT A: STORM PIPE REPLACEMENT

Opinion of Probable Costs
Statewide Storm Pipe Cost Survey
Replace Storm Drain Pipe (24" at 4' Deep, 5300' Long Trench)

Item	Description	Unit	Quantity	Unit Cost	Total Cost
1	Excavation	CY	5,496	$7.00	$38,474
2	Removal/Disposal of Existing Pipe	LF	5,300	$2.00	$10,600
3	Disposal of Excavated Materials	LF	5,496	$3.00	$16,489
4	Pipe Material (24" Corrugated HDPE)	LF	5,300	$20.00	$106,000
5	Pipe Installation	LF	5,300	$5.00	$26,500
6	Pipe Bedding Material (Placed)	CY	3,141	$7.00	$21,985
7	Trench Backfill Material (Placed)	CY	2,356	$9.00	$21,200
8	Asphalt Patch	SF	21,200	$2.00	$42,400
9	Manholes (assume reuse existing)	EA	0	$4,000.00	$0
10					
	Subtotal				**$283,648**
11	Contingency			30%	$85,094
	Total Cost				**$368,743**
12				LF	$5,300
	Unit Cost			LF	**$70**



ATTACHMENT B: NEW STORM PIPE INSTALLATION COST

Opinion of Probable Costs
Statewide Storm Pipe Cost Survey
New Storm Drain Pipe (24" at 4' Deep, 5300' Long Trench)

Item	Description	Unit	Quantity	Unit Cost	Total Cost
1	Excavation	CY	5,496	$7.00	$38,474
2	Disposal of Excavated Materials	LF	5,496	$3.00	$16,489
3	Pipe Material (24" Corrugated HDPE)	LF	5,300	$20.00	$106,000
4	Pipe Installation	LF	5,300	$5.00	$26,500
5	Pipe Bedding Material (Placed)	CY	3,141	$7.00	$21,985
6	Trench Backfill Material (Placed)	CY	2,356	$9.00	$21,200
7	Asphalt	SF	21,200	$2.00	$42,400
8	Manholes (800 FT spacing)	EA	7	$4,000.00	$28,000
9					
	Subtotal				**$301,048**
10	Contingency			30%	$90,314
	Total Cost				**$391,363**
11				LF	$5,300
	Unit Cost				**$74**

ATTACHMENT C: SUMMARY OF STORM SYSTEMS AND COST BY COUNTY

Opinion of Probable Costs

Statewide Storm Pipe Cost Survey

County	2020 Population	2060 Population Projection[4]	Existing Storm Sewer Pipe (miles)	Average Age of Existing Storm Sewer Pipe[6]	Storm Sewer Pipe to be Replaced (miles)[3]	New Storm Pipe to be Installed by City (miles)[1,2,5]	Cost to Replace	Cost to Install New	Total Cost
Beaver	7,767	13,502	0	30	0	0	$ -	$ -	$ -
Box Elder	54,571	77,029	26	30	13	12	$ 4,804,800	$ 4,786,320	$ 9,591,120
Cache	139,228	292,829	416	30	275	54	$ 101,640,000	$ 21,098,880	$ 122,738,880
Carbon	21,602	24,384	0	30	0	4	$ -	$ 1,367,520	$ 1,367,520
Daggett	1,444	1,678	0	30	0	0	$ -	$ -	$ -
Davis	355,137	503,985	556	27	260	52	$ 96,096,000	$ 20,415,120	$ 116,511,120
Duchesne	23,258	29,275	0	30	0	5	$ -	$ 1,855,920	$ 1,855,920
Emery	11,230	12,141	0	30	0	0	$ -	$ -	$ -
Garfield	6,063	8,963	0	30	0	0	$ -	$ -	$ -
Grand	10,300	14,301	0	30	0	0	$ -	$ -	$ -
Iron	57,055	127,795	48	30	24	23	$ 8,870,400	$ 8,791,200	$ 17,661,600
Juab	13,750	27,502	0	30	0	7	$ -	$ 2,735,040	$ 2,735,040
Kane	8,357	18,583	0	30	0	6	$ -	$ 2,148,960	$ 2,148,960
Millard	12,787	16,311	0	30	0	0	$ -	$ -	$ -
Morgan	11,945	24,234	0	30	0	6	$ -	$ 2,246,640	$ 2,246,640
Piute	1,635	2,436	0	30	0	0	$ -	$ -	$ -
Rich	2,532	3,909	0	30	0	0	$ -	$ -	$ -
Salt Lake	1,180,859	1,812,891	1,502	33	818	210	$ 302,332,800	$ 81,855,840	$ 384,188,640
San Juan	17,737	19,387	0	30	0	0	$ -	$ -	$ -
Sanpete	31,637	45,495	0	30	0	5	$ -	$ 1,855,920	$ 1,855,920
Sevier	30,504	42,729	0	30	0	11	$ -	$ 4,297,920	$ 4,297,920
Summit	45,491	5,482	105	13	18	0	$ 6,652,800	$ -	$ 6,652,800
Tooele	83,677	203,377	99	30	50	39	$ 18,480,000	$ 15,140,400	$ 33,620,400
Uintah	38,983	50,174	15	30	8	1	$ 2,956,800	$ 488,400	$ 3,445,200
Utah	650,594	1,398,075	1,300	27	624	295	$ 230,630,400	$ 115,262,400	$ 345,892,800
Wasatch	32,741	96,696	78	30	39	14	$ 14,414,400	$ 5,470,080	$ 19,884,480
Washington	196,762	581,731	246	30	124	146	$ 45,830,400	$ 56,849,760	$ 102,680,160
Wayne	2,845	6,425	0	30	0	0	$ -	$ -	$ -
Weber	255,152	449,055	282	30	142	69	$ 52,483,200	$ 26,862,000	$ 79,345,200
Total	**3,305,643**	**5,910,374**	**4,673**	**29**	**2,395**	**956**	**$885,192,000**	**$373,528,320**	**$1,258,720,320**
Rounded Cost[7]							**$900,000,000**	**$400,000,000**	**$1,300,000,000**

[1]Assumed municipalities pay for 25% and contractors pay for 75% of length of storm sewer pipe installation in new development.

[2]Assumed installation of storm pipe if 2060 population for a municipality exceeds 9000.

[3]Assumed all storm pipe needing rehabilitation is replaced.

[4]Population estimates based on numbers collected from service districts or municipalities. When not available, population estimates based on "Municipal Population Projections: 2012 Baseline Projections - Utah Governors Office of Management and Budget."

[5]In urban communities, 8ft/capita (calculated using data collected from cities and improvement districts) for new sewer installation was used to estimate length of new pipe installation. In rural communities 12ft/capita accounts for larger distances between homes.

[6]Age of storm pipe based on survey information. If community was not contacted, the assumed average system age was 30 years.

[7]Costs were rounded up to the nearest $100 million. The total cost is the sum of the rounded values.