Funding Water Infrastructure for the Long Term

Regional District of Central Kootenay

Lister

April 11, 2018

econics

Table of Contents	Page #

The preparation of this project was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

1.0 Executive Summary

The Lister water system owned and operated by the Regional District of Central Kootenay (RDCK) is located in Electoral Area B southeast of Creston. The system comprises a well, a steel reservoir, a chlorination system and about 21km of distribution pipes. The system serves about 195 parcels fully built out with residential homes.

This report summarizes the infrastructure of the Lister water system. The report identifies the Annual Cost of Sustainable Ownership (ACSO) for the water system, and presents a funding scenario for long term sustainable renewal of the system.

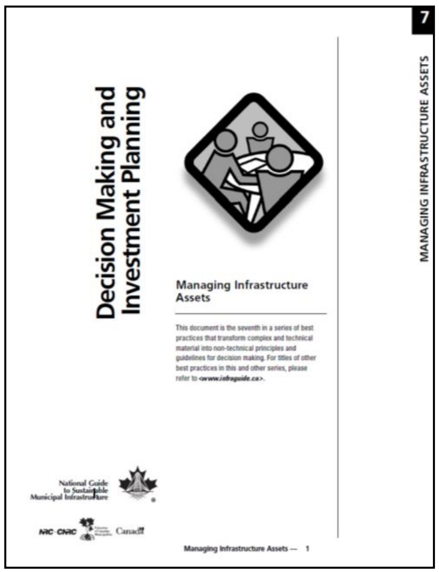
The analysis is based on assumptions current as of January 2018. Infrastructure management is a work-in-progress and should be reviewed from time to time as assumptions and other influencing factors change over time.

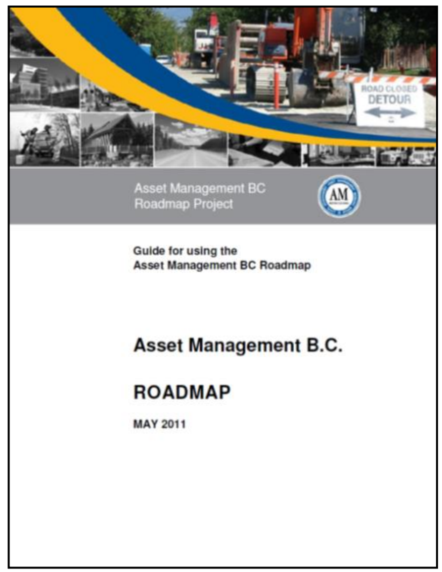
Four recommendations follow from this analysis as follows:

1. Review regularly the unit costs for pipe replacement and other pricing assumptions.
2. Prioritize work using a risk-based approach by considering condition and impact of failure of assets.
3. Bolster annual contributions for asset renewal from rates and fees and build up reserves to required target levels.
4. Update the asset schedule on ongoing basis.

2.0 Best Practices

The information in this report is developed using an adaptation of best practices, methods and frameworks from several sources. See section 8.0 References for details.





Best practices encourage elected representatives to ensure there are adequate provisions in local government budgets to renew infrastructure when it is required. Sufficient funds should be raised for that purpose and whenever appropriate an infrastructure reserve fund can be used to accumulate funds until they are needed.

3.0 Tangible Capital Asset Reporting

With the introduction in 2009 of new reporting requirements as per section 3150 of the Public Sector Accounting Board (PSAB) Handbook, local governments are required to report tangible capital assets[1] as assets (versus expenses) in the financial statements as shown below in Table 1.

Table 1: Tangible Capital Asset Value Reported in Financial Statements (2015-2017)

	Dec 31, 2015	Dec 31, 2016	Dec 31, 2017
Historic Cost	$1,410,513	$1,351,753	
Accumulated Depreciation	416,413	$443,408	
Net Value	994,100	908,345	
Annual Asset Depreciation	26,995	26,995	

Source: RDCK Finance Department

3.1 Annual Asset Depreciation

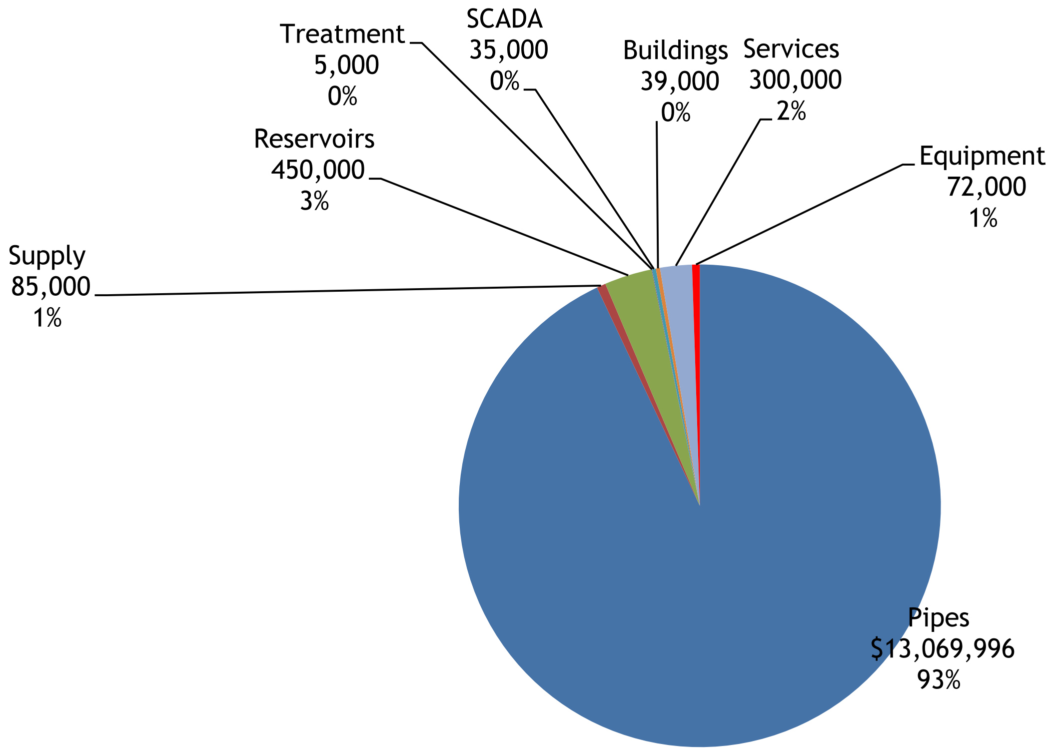
Annual asset depreciation[2] is an accounting term that represents how much an asset's book value reduces every year. It is normally calculated by dividing an asset's historic cost by its estimated service life. Depreciation can be used as an indicator of how much funds should be put aside each year for the eventual future replacement of the asset. However, because asset depreciation does not reflect the effects of inflation, technological advancements or changing standards, relying on depreciation can result in under funded reserves.

1. Tangible Capital Assets (TCA) are defined by the Public Sector Accounting Board as a physical asset used in the delivery of service and having a useful life of more than 1 year.
2. Is sometimes termed annual asset amortisation.

4.0 Asset Inventory

Lister water infrastructure is summarized here. The total value of the infrastructure and the value of each asset category is shown here in 2017 dollars.

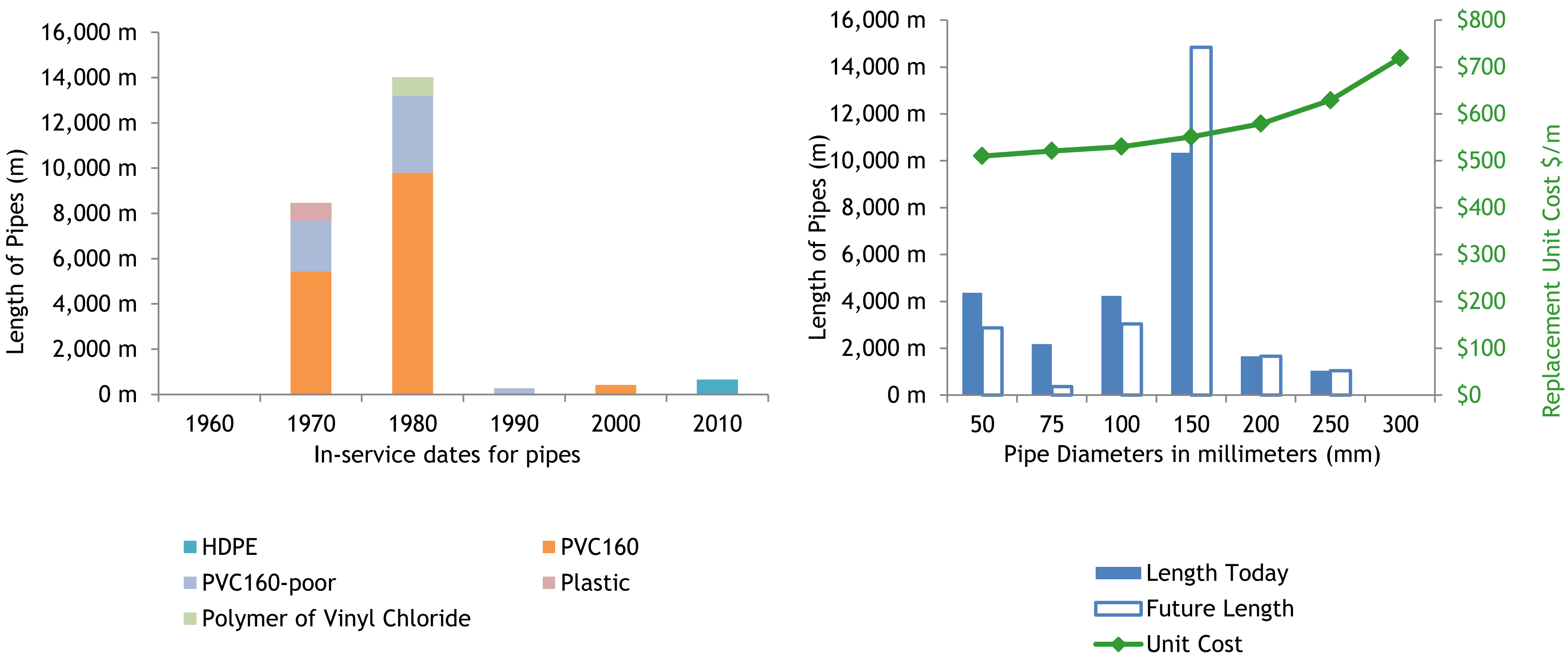
Figure 1: Lister 2017 WATER Assets Replacement Value: $14,055,996



4.1 Water Transmission and Distribution Network

Approximately 23.8 Kms of pipes was installed in Lister since the 1970s.

Figure 2: Lister Pipe Distribution Network (Length, Material, Diameter)



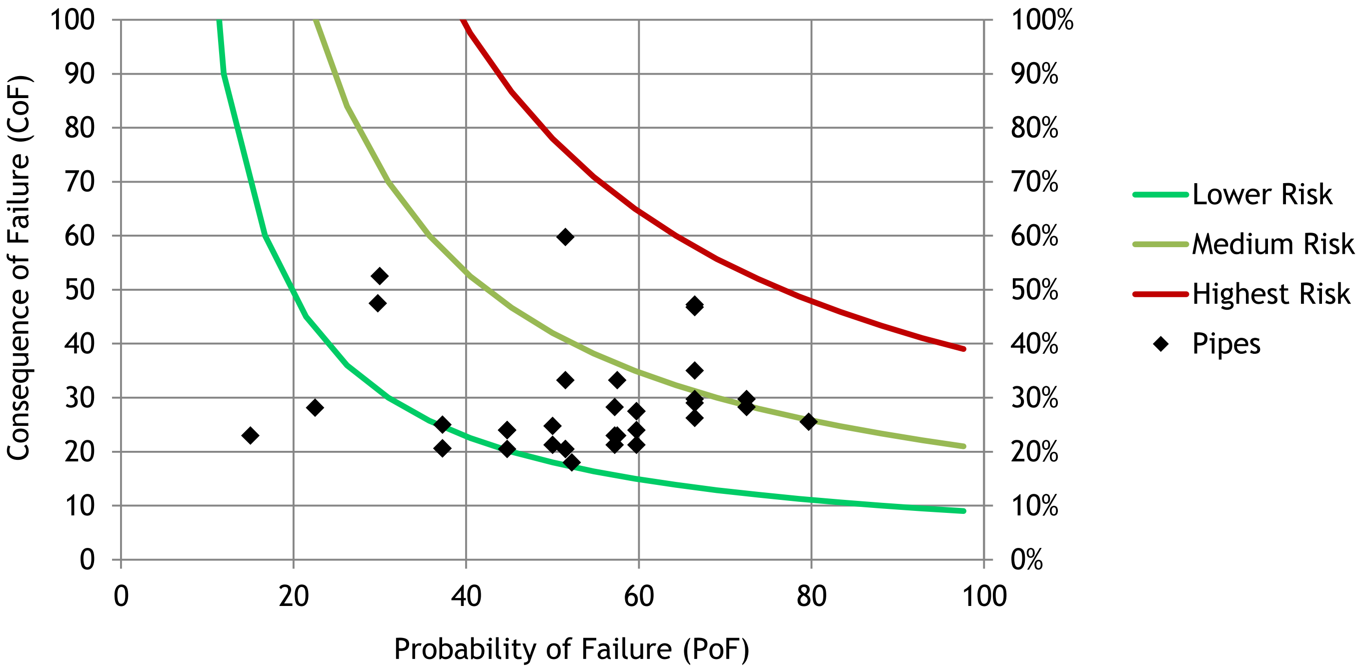
Note: due to minimal availability of records, some in-service dates may be estimated by decade from old maps.

4.2 Risk and Criticality Assessment of Distribution Network

Each length of pipe was plotted on this risk matrix based on its probability and consequence of failure. These were determined by applying a risk and criticality scoring method based on specific data for each pipe including: critical land use affected, water pressure, available fire flows, stream proximity, break history, install quality, install depth and number of connections. Explanation for the application of this method is beyond the scope of this report.

The results shown below in Figure 3 provide a way for RDCK management to alter the expected replacement dates and prioritize work based on highest risk/ highest needs.

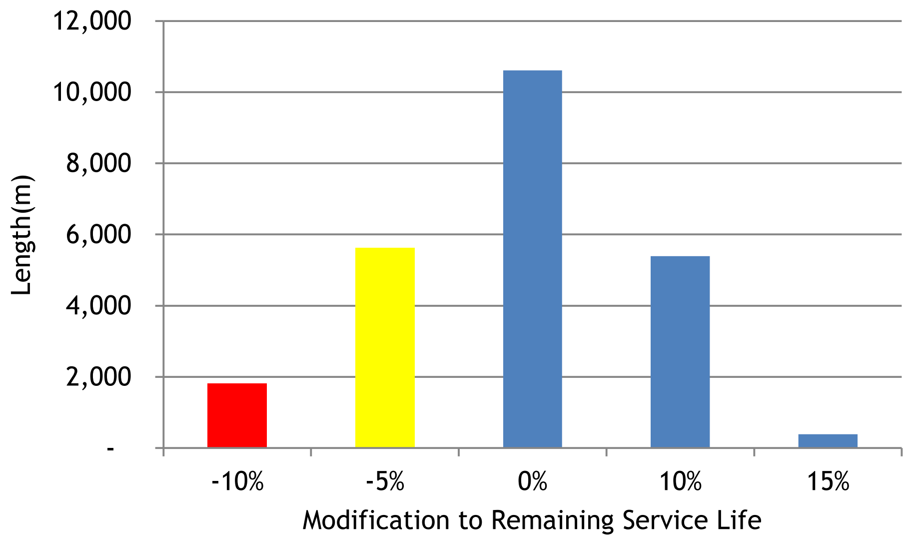
Figure 3: Consequence and Probability of Failure for Distribution Network



4.2 Risk and Criticality Assessment of Distribution Network

Depending on its position on the risk matrix in figure 3, each pipe's estimated service life will be modified. Low risk pipes (those with a low probability and/or low consequence of failure) will have their service life extended. High risk pipes will have their service life decreased and therefore become a higher priority. Figure 4 below summarizes the application of this service life modifier to the total length of pipes in the system.

Figure 4: Pipe Remaining Service Life Modifications Resulting from Risk Factor



4.2 Risk and Criticality Assessment of Distribution Network

Table 2 below lists the pipes with the highest risk scores based on probability of failure (PoF) and consequence of failure (CoF).

Table 2: Pipes with Highest Risk Factors

Item ID	Description	Qty	Type	Diameter Today	In Service Year	PoF	CoF	RiskF	Base ESL	RBSL	Next Replacement Year	Model Replacement Value
PN36		1817.5	PVC160	100	1970	52	60	-10%	50	45	2015	963,275.00
PN11		512.0	PVC160	50	1970	67	47	-5%	50	47.5	2018	261,120.00
PN14		927.5	PVC160	150	1970	67	47	-5%	50	47.5	2018	511,058.67
PN15		273.5	HDPE	50	2015	30	53	-5%	80	76	2091	139,494.90
PN18		367.2	PVC160	75	1970	52	33	-5%	50	47.5	2018	191,290.41
PN24		805.6	PVC160-poor	75	1970	73	28	-5%	30	28.5	1999	443,902.48
PN25		615.3	PVC160-poor	50	1970	73	30	-5%	30	28.5	1999	339,030.95
PN32		1193.6	PVC160-poor	100	1982	80	26	-5%	30	28.5	2011	657,692.68
PN34		110.5	PVC160	250	1970	67	35	-5%	50	47.5	2018	69,504.50
PN37		818.5	PVC	50	1982	58	33	-5%	80	76	2058	417,435.00
PN02		401.4	PVC160	100	1982	52	18	0%	50	50	2032	212,731.53
PN03		233.1	PVC160	50	2000	50	21	0%	50	50	2050	118,890.23
PN05		186.8	PVC160	50	2000	50	25	0%	50	50	2050	95,256.82
PN09		79.9	PVC160	50	1970	67	26	0%	50	50	2020	40,738.23
PN10		403.0	PVC160	150	1970	52	21	0%	50	50	2020	222,035.99
PN12		399.4	PVC160	150	1970	52	21	0%	50	50	2020	220,055.99
PN13		772.4	PLASTIC	50	1970	67	30	0%	50	50	2020	393,926.86
PN16		821.2	PVC160	100	1970	67	29	0%	50	50	2020	435,227.79
PN21		2000.1	PVC160	150	1982	60	28	0%	50	50	2032	1,102,046.96
PN22		789.9	PVC160	150	1982	60	24	0%	50	50	2032	435,235.12

4.2 Risk and Criticality Assessment of Distribution Network

Table 3 below lists the pipes with the highest probability of failure (PoF).

Table 3: Pipes with Highest Probability of Failure

Item ID	Description	Qty	Type	Diameter Today	In Service Year	PoF	CoF	RiskF	Base ESL	RBSL	Next Replacement Year	Model Replacement Value
PN32		1193.6	PVC160-poor	100	1982	80	26	-5%	30	28.5	2011	657,692.68
PN24		805.6	PVC160-poor	75	1970	73	28	-5%	30	28.5	1999	443,902.48
PN25		615.3	PVC160-poor	50	1970	73	30	-5%	30	28.5	1999	339,030.95
PN11		512.0	PVC160	50	1970	67	47	-5%	50	47.5	2018	261,120.00
PN14		927.5	PVC160	150	1970	67	47	-5%	50	47.5	2018	511,058.67
PN34		110.5	PVC160	250	1970	67	35	-5%	50	47.5	2018	69,504.50
PN09		79.9	PVC160	50	1970	67	26	0%	50	50	2020	40,738.23
PN13		772.4	PLASTIC	50	1970	67	30	0%	50	50	2020	393,926.86
PN16		821.2	PVC160	100	1970	67	29	0%	50	50	2020	435,227.79
PN21		2000.1	PVC160	150	1982	60	28	0%	50	50	2032	1,102,046.96
PN22		789.9	PVC160	150	1982	60	24	0%	50	50	2032	435,235.12
PN23		1199.1	PVC160	150	1982	60	28	0%	50	50	2032	660,728.63
PN27		272.7	PVC160-poor	50	1994	60	21	0%	30	30	2024	150,237.15
PN37		818.5	PVC	50	1982	58	33	-5%	80	76	2058	417,435.00
PN28		830.3	PVC160-poor	150	1970	58	23	0%	30	30	2000	457,513.74
PN26		1011.8	PVC160-poor	75	1982	57	28	0%	30	30	2012	557,482.03
PN30		608.4	PVC160-poor	150	1982	57	23	0%	30	30	2012	335,220.59
PN31		601.6	PVC160-poor	50	1982	57	21	0%	30	30	2012	331,468.09
PN02		401.4	PVC160	100	1982	52	18	0%	50	50	2032	212,731.53
PN36		1817.5	PVC160	100	1970	52	60	-10%	50	45	2015	963,275.00

4.2 Risk and Criticality Assessment of Distribution Network

Table 4 below lists the pipes with the highest consequence of failure (CoF).

Table 4: Pipes with Highest Consequence of Failure

Item ID	Description	Qty	Type	Diameter Today	In Service Year	PoF	CoF	RiskF	Base ESL	RBSL	Next Replacement Year	Model Replacement Value
PN36		1817.5	PVC160	100	1970	52	60	-10%	50	45	2015	963,275.00
PN15		273.5	HDPE	50	2015	30	53	-5%	80	76	2091	139,494.90
PN01		939.6	PVC160	250	1982	30	48	10%	50	55	2037	591,021.55
PN11		512.0	PVC160	50	1970	67	47	-5%	50	47.5	2018	261,120.00
PN14		927.5	PVC160	150	1970	67	47	-5%	50	47.5	2018	511,058.67
PN34		110.5	PVC160	250	1970	67	35	-5%	50	47.5	2018	69,504.50
PN37		818.5	PVC	50	1982	58	33	-5%	80	76	2058	417,435.00
PN18		367.2	PVC160	75	1970	52	33	-5%	50	47.5	2018	191,290.41
PN25		615.3	PVC160-poor	50	1970	73	30	-5%	30	28.5	1999	339,030.95
PN13		772.4	PLASTIC	50	1970	67	30	0%	50	50	2020	393,926.86
PN16		821.2	PVC160	100	1970	67	29	0%	50	50	2020	435,227.79
PN24		805.6	PVC160-poor	75	1970	73	28	-5%	30	28.5	1999	443,902.48
PN26		1011.8	PVC160-poor	75	1982	57	28	0%	30	30	2012	557,482.03
PN35	Reservoir outlet pipe	196.9	HDPE	200	2012	23	28	15%	80	92	2104	114,005.10
PN21		2000.1	PVC160	150	1982	60	28	0%	50	50	2032	1,102,046.96
PN23		1199.1	PVC160	150	1982	60	28	0%	50	50	2032	660,728.63
PN09		79.9	PVC160	50	1970	67	26	0%	50	50	2020	40,738.23
PN32		1193.6	PVC160-poor	100	1982	80	26	-5%	30	28.5	2011	657,692.68
PN20		774.2	PVC160	150	1982	37	25	10%	50	55	2037	426,565.13
PN05		186.8	PVC160	50	2000	50	25	0%	50	50	2050	95,256.82

4.2 Risk and Criticality Assessment of Distribution Network

Table 5 below lists the pipes in order of soonest planned for replacement.

Table 5: Next Pipes Due for Replacement

Item ID	Description	Qty	Type	Diameter Today	In Service Year	PoF	CoF	RiskF	Base ESL	RBSL	Next Replacement Year	Model Replacement Value
PN25		615.3	PVC160-poor	50	1970	73	30	-5%	30	28.5	1999	339,030.95
PN24		805.6	PVC160-poor	75	1970	73	28	-5%	30	28.5	1999	443,902.48
PN28		830.3	PVC160-poor	150	1970	58	23	0%	30	30	2000	457,513.74
PN32		1193.6	PVC160-poor	100	1982	80	26	-5%	30	28.5	2011	657,692.68
PN26		1011.8	PVC160-poor	75	1982	57	28	0%	30	30	2012	557,482.03
PN30		608.4	PVC160-poor	150	1982	57	23	0%	30	30	2012	335,220.59
PN31		601.6	PVC160-poor	50	1982	57	21	0%	30	30	2012	331,468.09
PN36		1817.5	PVC160	100	1970	52	60	-10%	50	45	2015	963,275.00
PN11		512.0	PVC160	50	1970	67	47	-5%	50	47.5	2018	261,120.00
PN14		927.5	PVC160	150	1970	67	47	-5%	50	47.5	2018	511,058.67
PN34		110.5	PVC160	250	1970	67	35	-5%	50	47.5	2018	69,504.50
PN18		367.2	PVC160	75	1970	52	33	-5%	50	47.5	2018	191,290.41
PN13		772.4	PLASTIC	50	1970	67	30	0%	50	50	2020	393,926.86
PN16		821.2	PVC160	100	1970	67	29	0%	50	50	2020	435,227.79
PN09		79.9	PVC160	50	1970	67	26	0%	50	50	2020	40,738.23
PN10		403.0	PVC160	150	1970	52	21	0%	50	50	2020	222,035.99
PN12		399.4	PVC160	150	1970	52	21	0%	50	50	2020	220,055.99
PN27		272.7	PVC160-poor	50	1994	60	21	0%	30	30	2024	150,237.15
PN21		2000.1	PVC160	150	1982	60	28	0%	50	50	2032	1,102,046.96
PN23		1199.1	PVC160	150	1982	60	28	0%	50	50	2032	660,728.63

5.0 Annual Cost of Sustainable Ownership (ACSO)

Because things wear out over time and with constant use, including water infrastructure, it makes sense that eventually they will need to be replaced. Replacing infrastructure is often very expensive so it is typically desirable to put funds aside during the life of the infrastructure so that funds are available when needed. So a question that infrastructure-based organizations should ask is: *how much should be contributed annually to keep up with the asset wear*?

Assets wear out over time and eventually need to be replaced.

This question can be answered in different ways. Some look to the financial statements to find the annual asset depreciation amount. Although conveniently available in any financial statement, this figure likely does not accurately answer the question. Asset depreciation is useful for determining the net value of assets on the books. Because depreciation is based on historic cost, it doesn't reflect present day costs and therefore under represents actual wear and tear.

Another approach in determining *annual asset wear* is to determine the present day replacement value of the assets and take a percentage, say 1% or 2% of that value. Establishing 1% as the average annual wear and tear cost implies that the entire asset base is replaced, on average, every 100 years (every 50 years at 2%). This is easy to calculate if you have present day valuations for the assets. However this method makes a broad assumption about estimated service life (ESL) of assets. In fact, different asset types have different ESLs.

In a more refined approach, instead of aggregating ESL, an asset replacement schedule is developed itemizing each asset along with their specific ESLs. In this way, the replacement time frames for each asset can be accounted for separately. This approach enables a risk-based approach to determining replacement time frames. For example, assets of the same class that are in good condition may have delayed replacement despite reaching their ESL.

See Appendix A for a more detailed discussion on Annual Cost of Sustainable Ownership.

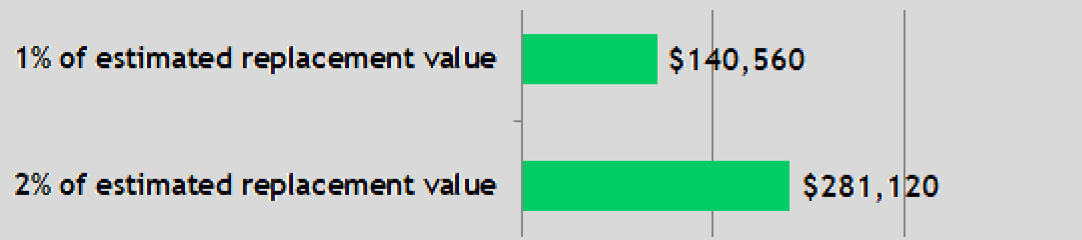
5.0 Annual Cost of Sustainable Ownership (continued)

Recall the annual asset depreciation which was discussed earlier in section 3.0. This figure is an indication of annual wear and tear but is based on historic cost and does not reflect replacement cost in present day terms.

Annual depreciation, also known as annual amortisation, from financial statements is shown here for comparison purposes but not recommended as ACSO.

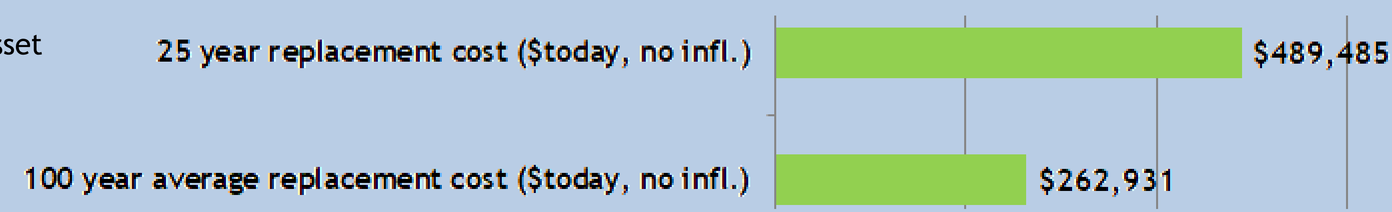
Another approach to determine annual cost of sustainable ownership is to use a figure between 1% and 2% of the total system replacement value. This implies the aggregate estimated service life of the system is between 50 and 100 years.

Calculation based on percentage of present day replacement value.



To get a more refined figure, instead of taking an aggregate approach, an asset replacement schedule is developed and each asset's estimated service life is taken into account separately. See Appendix A for a more detailed discussion on Annual Cost of Sustainable Ownership.

Calculation based on Asset Replacement Schedule

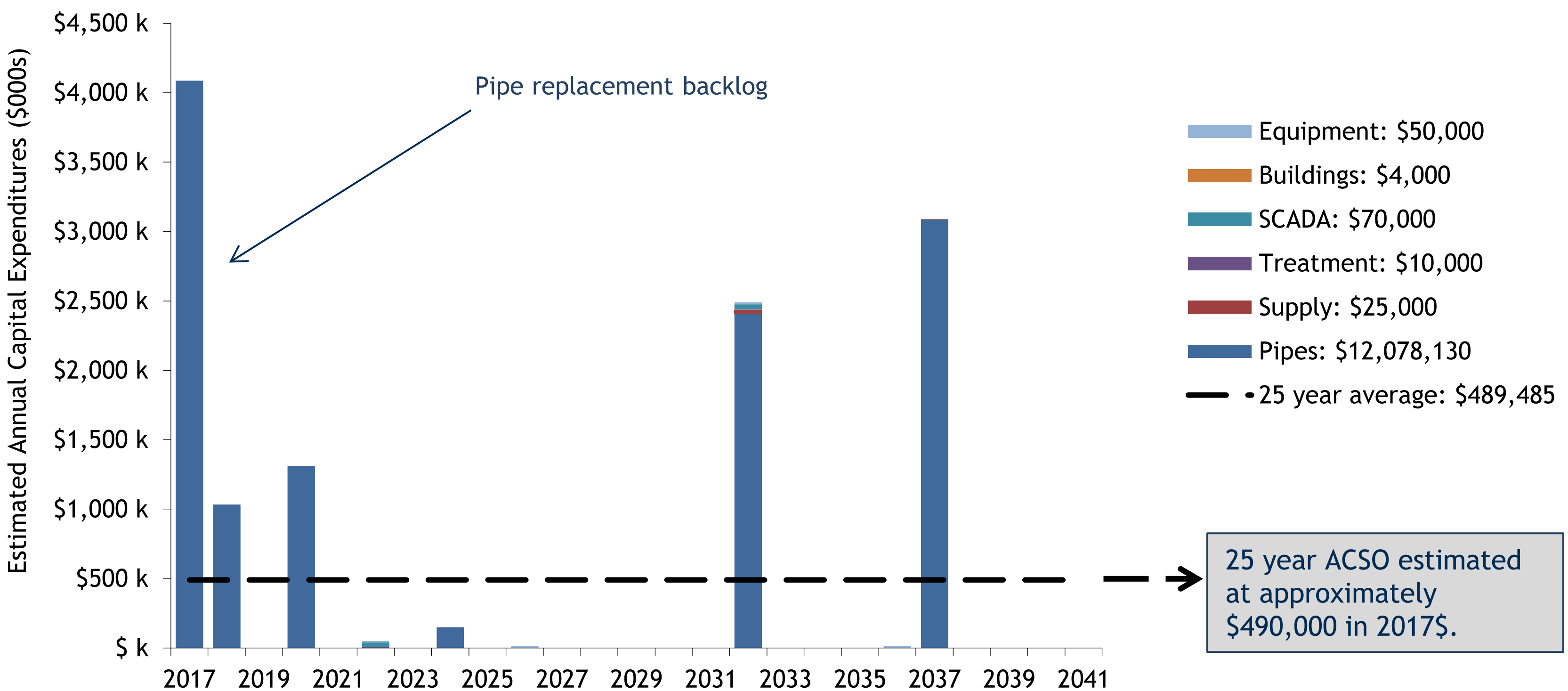


5.0 Annual Cost of Sustainable Ownership (continued)

5.1 Asset Replacement Schedule

This chart summarizes the Asset Replacement Schedule (ARS) 25 year period projection of asset replacement. The average cost over the 25 year period, also termed the Annual Cost of Sustainable Ownership (ACSO) is shown by the dash line.

Figure 5: Lister 25 Year Asset Replacement Schedule



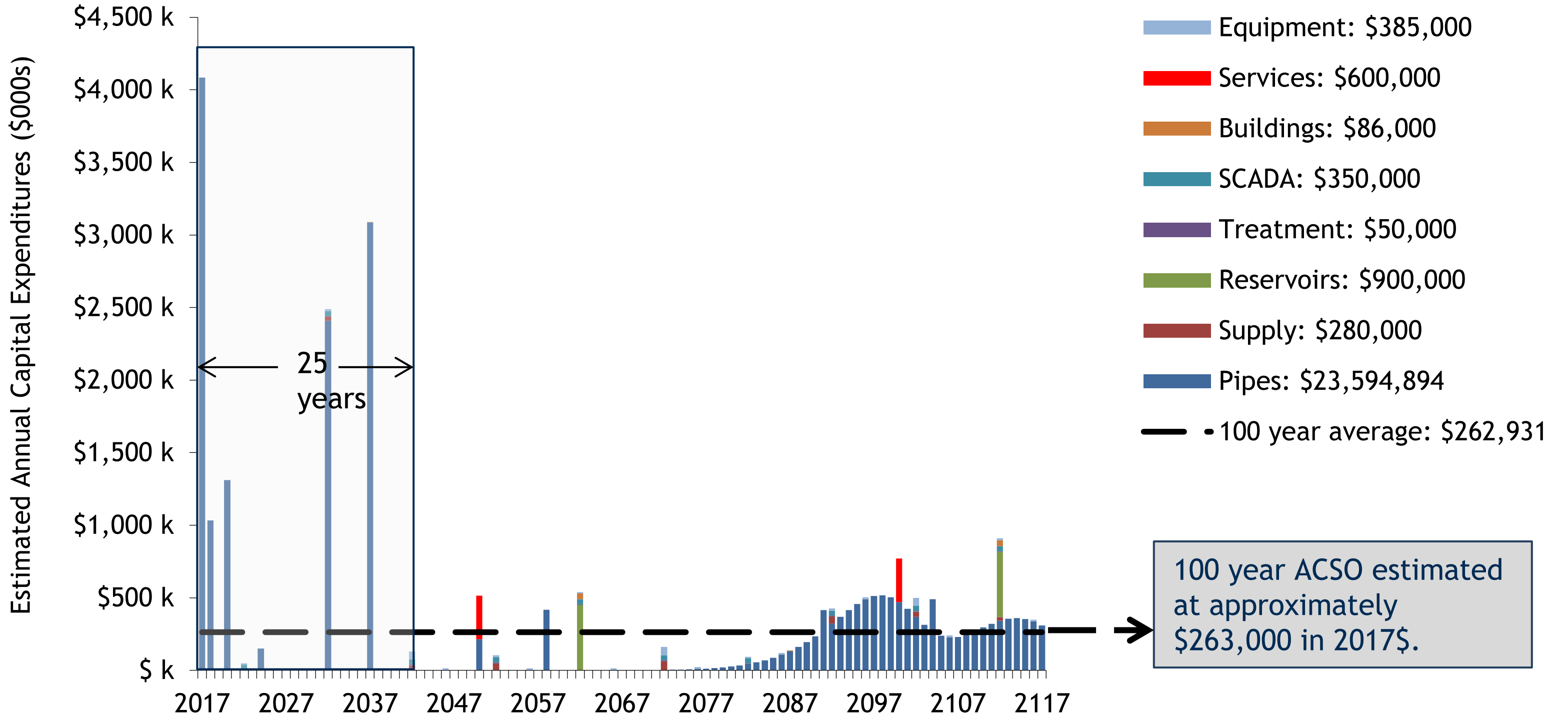
Figures are in 2017$ and not adjusted for inflation.

5.0 Annual Cost of Sustainable Ownership (continued)

5.1 Asset Replacement Schedule (continued)

This chart summarizes the Asset Replacement Schedule (ARS) 100 year period projection of asset replacement. The average cost over the 100 year period, also termed the Annual Cost of Sustainable Ownership (ACSO) is shown by the dash line.

Figure 6: Lister 100 Year Asset Replacement Schedule



Figures are in 2017$ and not adjusted for inflation.

5.0 Annual Cost of Sustainable Ownership (continued)

5.2 Asset Maintenance

Certain infrastructure components undergo maintenance on a regular basis to maximize operating conditions and extend the life of the infrastructure as much as possible before replacement is required. Maintenance activities are covered under the operations and maintenance budget rather than the capital budget. The following table outlines maintenance activities specific to the Lister water system.

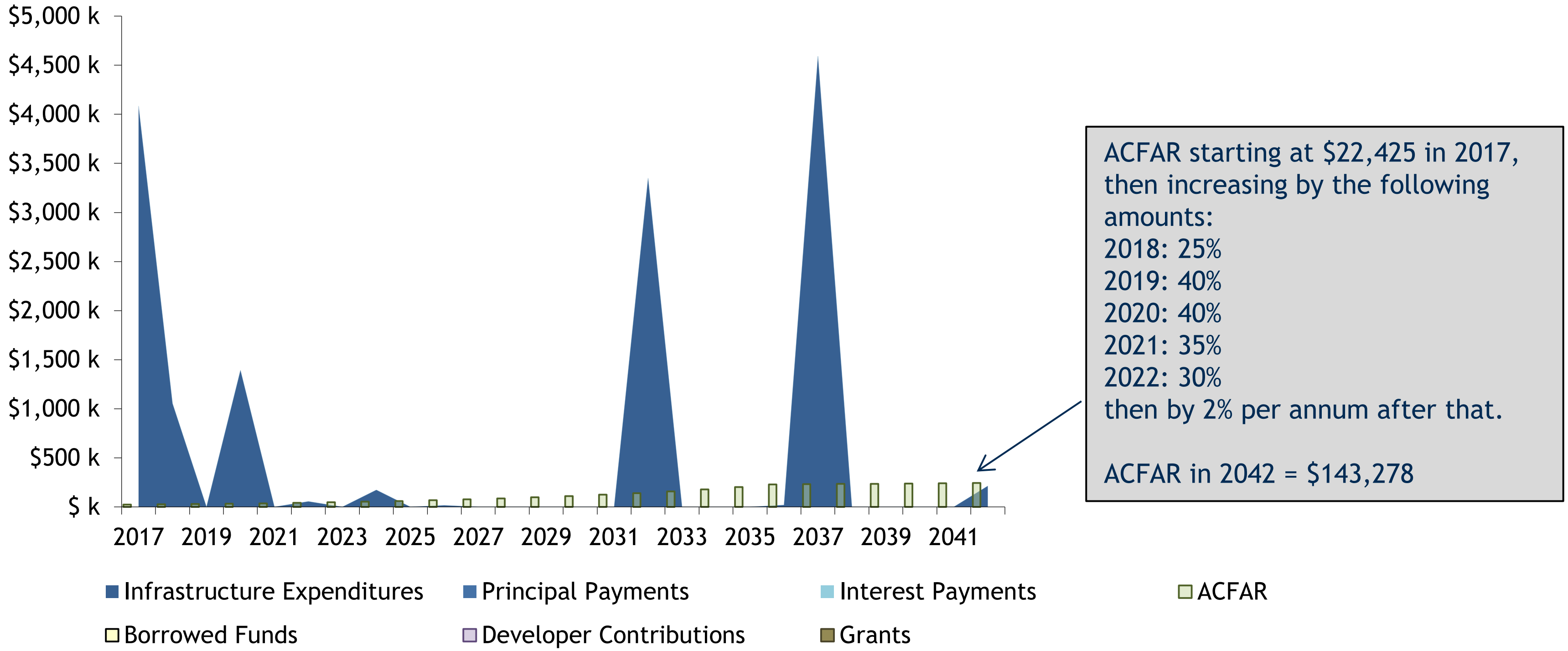
- Distribution system flushing (with flush valves and flushing hydrants) – annually
- Reservoir check and cleaning if necessary – annually
- Well pump - check for operation and record flow totalizer and instantaneous flow, well water level and reservoir water level – biweekly
- Chlorine injection equipment – check for operation and day tank level, record chlorine residual - biweekly

6.0 Funding Scenarios

The Annual Contributions for Asset Replacement (ACFAR) refers to the amount of funds allocated annually from operating revenues towards asset replacement. ACSO, described earlier is the theoretical amount to be achieved. ACFAR is the actual amount generated from operations. Ideally ACFAR = ACSO. The funds are used in different ways: some funds are spent annually on asset renewal projects for the year, some portions may be put away into reserve, or some used to service debt associated with past projects.

RDCK policy is to cover ACFAR through parcel taxes. For modeling purposes this scenario assumes that grant funding available today will also be available in the future, however this is not guaranteed.

Figure 7: Lister 25 Year Expenditures and Funding

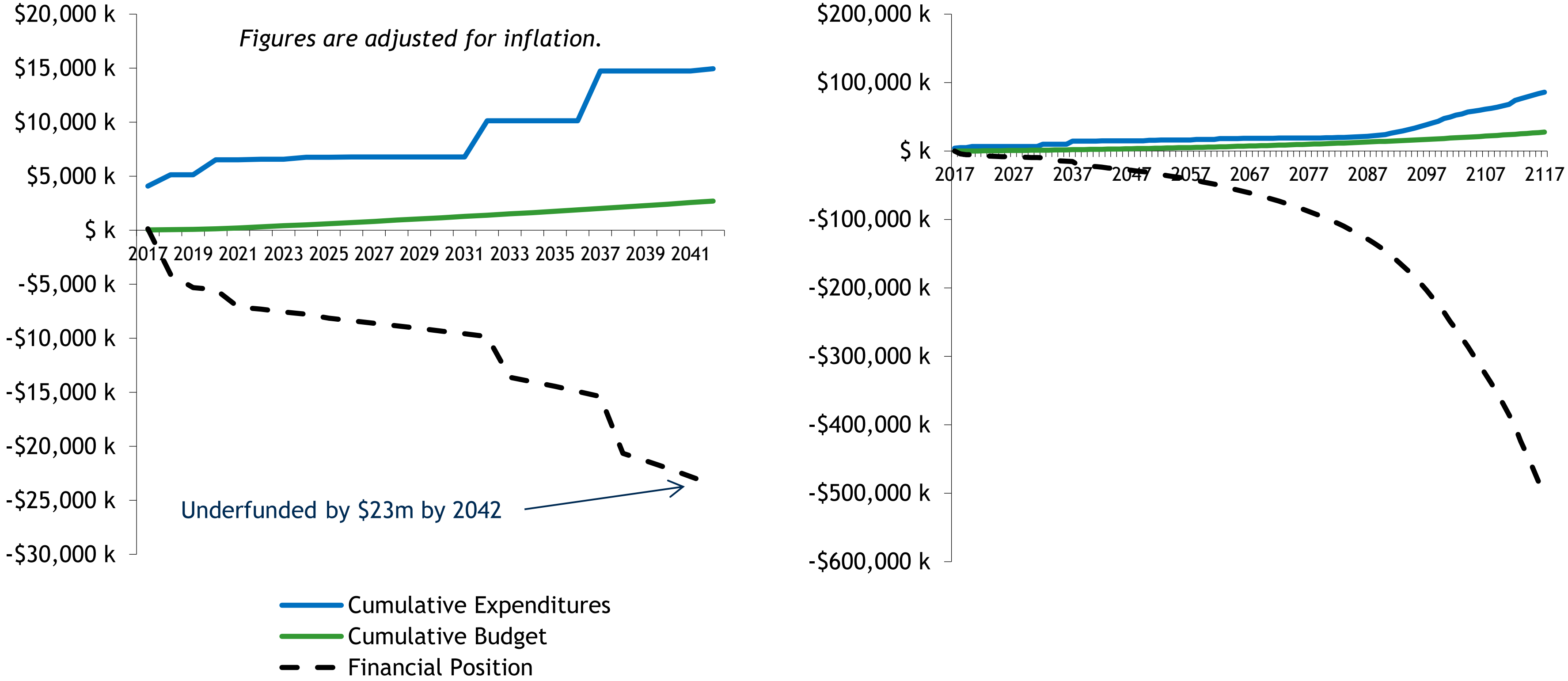


6.0 Funding Scenarios (continued)

This chart compares the expenditures and allocated funds from figure 7. The blue line shows the cumulative expenditures, inflation adjusted, projected over the next 25 years in the asset schedule. The green line shows the cumulative funds allocated towards these projects.

The dash line is the difference between what is projected to be spent and available funds. When this line is above 0, it represents a surplus of funds typically held in an asset reserve fund; when below zero, the dash line represents a shortfall and implies the need for additional funding, or the works need to be delayed or canceled.

Figure 8: Lister 25 Year and 100 Year Financial Position



7.0 Recommendations

The following recommendations follow from the analysis in this report.

1. Unit costs for pipe replacements can vary significantly between the average default unit costs provided in the model and a real unit cost determined from a carefully costed project budget. To ensure the accuracy of the long term revenue requirements and avoid over-stating funding requirements, unit costs for pipe replacement and other pricing assumptions of the other assets should be reviewed regularly;
2. To ensure accuracy of the model, remaining service life of assets should be reviewed and updated regularly. Detailed condition assessments should be conducted on the oldest assets, those assets nearing or beyond the 2/3rd or later stage in their estimated service life. Also, assessing the impact of failure and consequence of failure for each asset will help to prioritize on a risk and criticality basis;
3. Make necessary adjustments to rates and fees to bolster the annual contribution for asset replacement (ACFAR) with an aim to have ACFAR meet ACSO and to build up a reserve fund in advance of large future expenditures. The financial position on page 20 can be a guide in determining reserve fund target level; and,
4. Update the asset schedule tool on a regular basis to reflect changes brought about from items 1, 2 and 3 above, and other external factors that change the financial picture.

8.0 Related Reading

Opus (2011). Guide for Using the Asset Management BC Roadmap. Opus International Consultants (Canada) Limited 2011

Infraguide (2005). Decision Making and Investment Planning: Managing Infrastructure Assets. Federation of Canadian Municipalities and National Research Council, Ottawa, ON, October 2005.

Econics (2013). Funding Infrastructure Replacement for the Long Term: Developing an Asset Replacement Schedule (ARS) and Establishing an Annual Contribution for Asset Renewal (ACFAR). November 2013. See Appendix A.

9.0 Glossary of Terms

Annual Asset Depreciation (Annual Amortisation) - The amount the net value of an asset decreases each year; normally calculated by dividing the historic cost by the estimated service life. Does not factor inflation.

Annual Contribution for Asset Replacement (ACFAR) – ACFAR refers to the amount of funds allocated annually from operating revenues towards asset replacement: spent on projects that year, put away into reserve; or used to service debt associated with past asset replacement projects. Increasingly, ACFAR is becoming a budgeted line item rather than based on unplanned revenue surpluses.

Annual Cost of Sustainable Ownership (ACSO) – ACSO is the average annual cost of replacing infrastructure over a long time period, say 25 or 100 years. ACSO is given in today's dollars and therefore does not consider inflation. ACSO therefore increases over time and should be recalculated periodically.

Asset Liability – Assets currently overdue for replacement based on theoretical estimated service life.

Asset Replacement Schedule (ARS) - A forward looking method that considers in-service year, estimated service life and current replacement value of assets to estimate extent of future anticipated capital expenditures.

Asset wear and tear - A concept that is meant to imply that assets wear down every year and it is therefore logical that the beneficiaries of the assets repay the dollar value of that *wearing down*.

9.0 Glossary of Terms

Consequence of Failure (CoF) – refers to a relative assessment in terms of a score from 0 to 100 of how significant the impact of failure would have on the community and considers economic, operating, social and environmental consequences.

Estimate Service Life (ESL) – refers to the number of years an asset or group of assets is expected to remain in service before being replaced. This value may change over time from its original estimate to reflect assets that are wearing out more quickly than anticipated, or lasting longer than originally expected.

Financial Position - The term *financial position* is used in this report to mean the relationship between the long-term expenditures and long-term funding available to support expenditures. The financial position is calculated by subtracting the cumulative expenditures from the cumulative available funding. If the financial position is positive, then there are surplus funds available in reserve. A negative financial position implies borrowing.

Infrastructure Deficit – An infrastructure deficit exists if the average annual contributions towards asset replacement are not sufficient to meet the annual average cost of sustainable ownership.

Probability of Failure (CoF) – refers to a relative assessment in terms of a score from 0 to 100 of the likeliness that a failure would occur based on the condition of the pipe as measured through several proxies including: age, water pressure, break history, install quality and install depth.

Tangible Capital Assets (TCA) - Defined by the Public Sector Accounting Board as a physical asset used in the delivery of service and having a useful life of more than 1 year.