City of Richmond

Report to Committee

To Public Works & Transportation - Mar 22, 2006

To:	Public Works and Transportation Committee	**Date:**	February 1, 2006
From:	Robert Gonzalez, P.Eng. Director, Engineering	**File:**	10-6060-01/2005-Vol 01
Re:	**Aging Infrastructure Planning Update**		

Staff Recommendation

That the report dated February 1, 2006 from the Director, Engineering regarding the status update of the Aging Infrastructure be received for information.

Robert Gonzalez, P.Eng.
Director, Engineering
(4150)

Att. 1

FOR ORIGINATING DIVISION USE ONLY		
CONCURRENCE OF GENERAL MANAGER		
REVIEWED BY TAG	YES ☑ DW	NO ☐
REVIEWED BY CAO	YES ☑	NO ☐

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Staff Report

Origin

In July 2001, staff brought forward a report to the General Purposes Committee on the Ageing Infrastructure Replacement Costs. The Ageing Infrastructure Replacement Costs report was based primarily on our estimated inventory of assets and the expected design life of each asset. Since that time, staff completed several detailed studies on the condition and capacity of the City's infrastructure. The July 2001 report recommended that staff review Ageing Infrastructure replacement costs every three to ten years as new information becomes available.

This report is an update on the status of the Ageing Infrastructure replacement costs and one component of the Master Infrastructure Planning, five years after the initial review. This report does not address infrastructure upgrades due to growth. Upgrades due to growth will be addressed in the forthcoming DCC review and future review of the City's OCP.

Analysis

Commencing in 2001, staff began to assemble Master Infrastructure plans for the water, sewer, drainage and roads networks. Aging infrastructure consists of assets that are near the end of their useful life cycle and need to be replaced.

Water

Background - Water

Richmond's water distribution system includes over 630 km's of watermains, 13 pressure regulating chambers and over 4,000 hydrants. Approximately 60% of the water infrastructure was installed prior to 1980. The water distribution system has a replacement value of approximately $570 million.

Ageing Infrastructure Findings - Water

The ageing water infrastructure component of the Water Master Plan is largely based on an ongoing asbestos cement (AC) testing program that was started 1998, as AC pipelines represent approximately 55% of the City's watermain inventory. Pipe samples are taken on an annual basis from various locations and analyzed to determine the extent of pipe deterioration and the expected life of the pipe. In 2004, staff compiled and analyzed this information.

The testing program included the inspection of 73 AC watermain samples and predicted an average service life of 49 years for AC pipes installed prior to 1967 and an average service life of 38 years for AC pipes installed after 1967. The difference between the pipe life expectancy is due to different pipe manufacturing standards. The ageing AC watermains are of primary concern over the next 15 to 20 years as they represent a large portion of our system (approximately 378 km of AC pipe was installed between 1952 and 1985) and replacement cost will be approximately $386 million. The service life of these mains is considerably shorter than anticipated when they were installed, increasing the life cycle costs of these watermains.

This difference in average service life between the two types of AC watermain creates an overlap in the projected waterworks ageing infrastructure replacement program, which has the potential to create funding challenges for the City. Chart 1 assumes replacement of AC watermains at the end of their predicted average service life.

Since staff used an average service life for the AC water pipes, there may be a difference between the predicted end of service life and actual failure of individual watermains that could flatten the replacement curve. Regardless, the City may be required to make a $369 million contribution toward remediation of ageing infrastructure in the next 15 years.

The projected average annual water system replacement expenditure is $7.6 million including PRV stations and hydrants (see Chart 2 for the replacement value plot). The City's current annual water utility funding for existing infrastructure is approximately $6.45 million. Although the funding gap appears to be relatively small, there is a large amount of watermain replacement that should be done in the short term (Chart 2).

Sanitary Sewer

Background – Sanitary Sewer

Richmond's sanitary sewage collection system includes over 458 km's of gravity sewer mains, 150 lift stations and over 96 km of sanitary forcemains. The sanitary sewer system has a replacement value of approximately $483 million.

Ageing Infrastructure Findings - Sanitary Sewer

Staff is currently performing a condition assessment of the sanitary sewer system. The assessment program consists of conducting a visual inspection of the gravity mains and manholes, and conducting a visual and mechanical inspection of the lift stations. Long term infrastructure monitoring, remediation and replacement programs will be based on the completed condition assessment of the system. Based on the current level of funding, we expect to complete the condition assessment of the sanitary system by 2009.

Staff has performed condition assessments on 196 km's of sanitary gravity mains, approximately 46% of the system. The results of these assessments indicate that the system is in fair condition. Approximately 10% of the inspected mains require some form of high priority short term repair. A second condition assessment of the gravity sewer system should be performed in 8 year cycles and the long range replacement program reviewed at that time.

Even though the gravity mains were in fair condition, the inspection program found a significant amount of grease collecting in the gravity sewer system. Once grease has coagulated in a sanitary sewer system, it decreases the system's ability to function and is very difficult and expensive to remove. Mechanical removal of grease has the potential to damage gravity sewers during the grease removal process. Left unchecked, accumulated grease can reduce the capacity of affected sewers to the point that flooding can occur. Grease is most common in sanitary sewers that service restaurants. Restaurants are required to have functioning grease traps, however, this is not generally enforced once a restaurant is in operation. Staff will bring forward

recommendations to reduce the amount of grease entering the gravity sewer system in a subsequent report.

Inflow and infiltration (I&I) is water that enters the sanitary sewer system through leaking sewer pipes or drainage sewer system cross connections. A classic cross connection is a roof drain that is connected to the sanitary sewer system. I&I uses sewer system and sanitary treatment plant capacity that was intended to service sanitary needs. Significant I&I can contribute to surcharged sanitary sewers and local flooding. Mitigating I&I is key to deferring capacity upgrades to the Lulu Island Waste Water Treatment Plant and keeping the Sanitary Sewer utility rates as low as possible. Staff is currently monitoring sanitary pump station run times in an effort to determine which sanitary catchments may have I&I problems. To date, 79 of the City's 150 sanitary catchments have been reviewed for I&I of which 23 have I&I in excess of the GVRD guideline. Staff is currently developing a program to identify the sources of I&I in these catchments.

Staff performed a condition assessment on the thirty oldest sanitary lift stations. This review was encouraging as few structural deficiencies were discovered in this process. Public Works has done a very good job at maintaining the lift station infrastructure. The main upgrades associated with pump stations related to replacement of aging and worn pumps, and replacement of the tops of the stations including hatches also due to age.

The projected average annual replacement cost for the sewer system, including pump stations is approximately $6.3 million (see Chart 3 for the replacement value plot). The City's current annual sewer utility funding for replacement of existing infrastructure is approximately $2.5 million.

Drainage

Background - Drainage

The drainage system consists of 559 km's of pipe, 56 km's of box culvert, 174 km's of ditches, and 39 lift stations. The average age of the drainage conveyance system (pipes and box culvert) is approximately 40 years. The drainage system has a replacement value of approximately $1,160 million.

Prior to assessing the ageing infrastructure or the growth related issues of the drainage system, an accurate and easily accessible drainage inventory was required. In 2001, the drainage inventory consisted of approximately 15,000 drawings that contained drainage related information. Since that time, the drainage component of the GIS was developed which compiled all the pieces of information. In addition, a detailed topographic survey was completed for the major ditches on Lulu Island.

Ageing Infrastructure Findings - Drainage

A condition assessment program is currently being developed to address the ageing infrastructure component of the Drainage Master Plan. Staff separated the condition assessment program for underground infrastructure into three phases. Phase I is a preliminary assessment to determine the extent of the work required for budgeting purposes. Phase II will clean and inspect the

closed system (pipes and box culverts). Phase III will assess deterioration of the drainage system and develop a rehabilitation program.

Staff has an estimated completion date for Phase I of April 2006. Due to the nature of the infrastructure, staff expects to find significant amounts of debris in the closed system. Prior to performing a visual inspection, the debris will be removed to ensure that all the defects can be assessed. Staff has requested the funding to complete the condition assessment of the drainage system; however, this program was not recommended for the 2006 capital program as a majority of the 2006 funding is being used to address the problems already identified.

The condition assessment of the 39 lift stations was completed in 2003. The stations were in good repair and require some remedial work, although they are not built to seismic standards and will require upgrading as the structures near the end of their useful lives. The most significant component identified requiring replacement are the pumps themselves. Due to wear, several stations require upgrading of pumps. In addition, several of the older pumps are obsolete and can only be custom repaired, which is expensive and requires that the pump be out of service for an extended period. Retrofitting newer more efficient pumps requires reconfiguration of internal piping, adding to the overall upgrade cost.

The projected average annual replacement cost for the drainage system, including pump stations is approximately $11.9 million (see Chart 4 for the replacement value plot). The City's current annual utility funding for replacement of existing infrastructure is approximately $3.1 million.

Roads

Background - Roads

Richmond's road network consists of approximately 150 lane km's of major road network (MRN) roads, 393 lane km's of major roads, 856 lane km's of local roads, 40 lane km's of lanes, and 53 City owned parking lots. The estimated replacement cost for the road infrastructure is $325 million.

Ageing Infrastructure Findings - Roads

Staff developed a Pavement Management System (PMS) to assist in developing cost efficient rehabilitation and reconstruction programs to maximize the value of the money spent to maintain the system. The PMS combines an infrastructure database, performance-forecasting models, life-cycle cost analysis and rehabilitation and maintenance planning tools.

The PMS was completed in three phases with the last phase completed in 2004. Phase I included developing the program for major roads, Phase II for local roads, lanes and City owned parking lots, and Phase III for developing documentation and training. We are now into maintaining the PMS program to ensure that the data is kept current. The rehabilitation program is generated each year and reviewed by staff. The savings generated by rehabilitating a road at the appropriate time in its life-cycle are significant as staff are able to proactively perform relatively minor inexpensive work on the road to extend its life.

The projected average annual maintenance cost for our road network is approximately $5.0 million (see Chart 5 for the maintenance value plot).

Funding Requirements

The City's water, sewer, and drainage & dyking utilities provide funding for replacement and maintenance of our infrastructure. The recommended average annual funding amount for replacement does not include utility upgrades required to accommodate past growth and development. Road asphalt replacement funding is provided through the annual operational budget.

The following table summarizes the City's current annual funding commitment through the various utilities and operational budgets as well as an average anticipated requirement to address aging infrastructure as of 2005:

	Current Annual Funding for Replacement	**Recommended Average Annual Funding for Replacement**
Water Utility	$ 6,450,000	$ 7,602,800
Sanitary Sewer Utility	$ 2,456,400	$ 6,266,100
Drainage Utility	$ 3,089,500	$ 11,954,500
Roads	$ 2,577,500	$ 5,004,300

The attached Chart 6 presents a cumulative total of current annual funding and recommended annual funding for utility replacement.

Funding Options

The funding options available for the various utilities include:

1. Implement an immediate increase in the utility rates to provide for the required average annual funding deficit. The increase in utility rates would be approximately 27% (or $231). In addition, the increase Roads component which is funded through our City Operations programs should continue to increase by $335,000 annually as planned until the recommended funding level is reached.

   Pros:
   - The average funding level to replace the City's utilities would be met.
   - The City would be able to develop an accurate long term replacement program given that funding levels would be established.
   - This would reduce the number of expensive emergency repairs and limit disruption to residents.

- This option would allow for coordination with development because of the planned approach.
- Enables the City to address backlog of replacements required due to age.

Cons:

- Residents may not support an annual increase of $232 to their utility rates.

2. Gradually increase the utility rate over a specified period of time and increase the Roads component, which is funded through our City Operations programs by $335,000 annually as planned until the recommended funding level is reached . The risk associated with this option is that some infrastructure will require replacement due to failure rather than in a planned manner. Emergency repairs are typically five to ten times more expensive than planned proactive replacement. Funding for emergency repairs could be appropriated from reserves provided that sufficient funding is available.

   Pros:
   - Ensures City reserves are funded.
   - Eventually available funding will meet the required funding levels.

   Cons:
   - Emergency repairs are expensive and disruptive.
   - The City's long term replacement program would need to be updated depending on available funding.
   - The City has to prioritize the backlog of repairs and upcoming replacement depending on risk of failure and disruption.

3. Borrow money to fund the necessary improvements. Should the improvements exceed the available utility funds, the City can borrow funds and add the finance charges to the rates. This option in essence enables the cost of the utility to be paid by the future users who would benefit from its replacement.

   Pros:
   - The City is able to address immediate needs and repair backlog by borrowing.
   - The future residents who benefit also pay for the utility.
   - Depending on the amount borrowed, this option would reduce the number of expensive emergency repairs.

   Cons:
   - The cost of borrowing would be added to the utility rates.
   - Since borrowing addresses only short term needs, the City's long term replacement program would need to be updated depending on available funding.

4. A combination of the above options.

The City's current approach is similar to Option 2, which has included gradual increases to utility rates. Staff recommends that a planned funding strategy be developed in conjunction with the review of the 2007 utility rates. A planned funding strategy over a specified period of time will enable staff to develop a long term reliable replacement program and coordinate with development to enable smart sequencing and realize cost savings by working together where utility replacement and upsizing utilities for development overlap.

In addition, Staff reviews the foregoing options on a regular basis and has considered the option of borrowing to fast track infrastructure replacement. To date, the option of borrowing has not been favourable from a financial perspective. To supplement utility funds, the City has also successfully secured infrastructure grants through various partnership programs.

Financial Impact

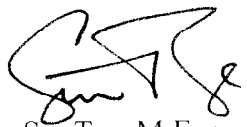
None at this time.

Conclusion

The Master Plans have all advanced considerably since the Ageing Infrastructure Replacement Costs report was brought forward in 2001. Staff anticipate that the Water and Roads Master Plans will be completed in 2006, and the Drainage and Sanitary Master Plans will be complete by 2009. The work done to date has enabled the City to direct funds strategically to areas receiving greatest benefit to maximize the life of our infrastructure.

There are various options available to address the utility funding deficits. The City's approach has been to gradually increase rates. This approach carries some risk in that the City has to respond to emergency repairs as certain infrastructure fails. Staff recommends that a planned funding strategy be developed in conjunction with the review of the 2007 utility rates as noted above.

Because this report addresses long-term infrastructure replacement plans, it is important that it be reviewed every three to ten years. The recent increase in construction costs have been reflected in this report and therefore it is possible that if construction costs decrease in the future the total required funding will need further review. In addition, as the Master Plans develop, there will be additional information available that will impact the City's infrastructure replacement plans and funding requirements.



Siu Tse, M.Eng., P.Eng.
Manager, Engineering Planning
(4075)

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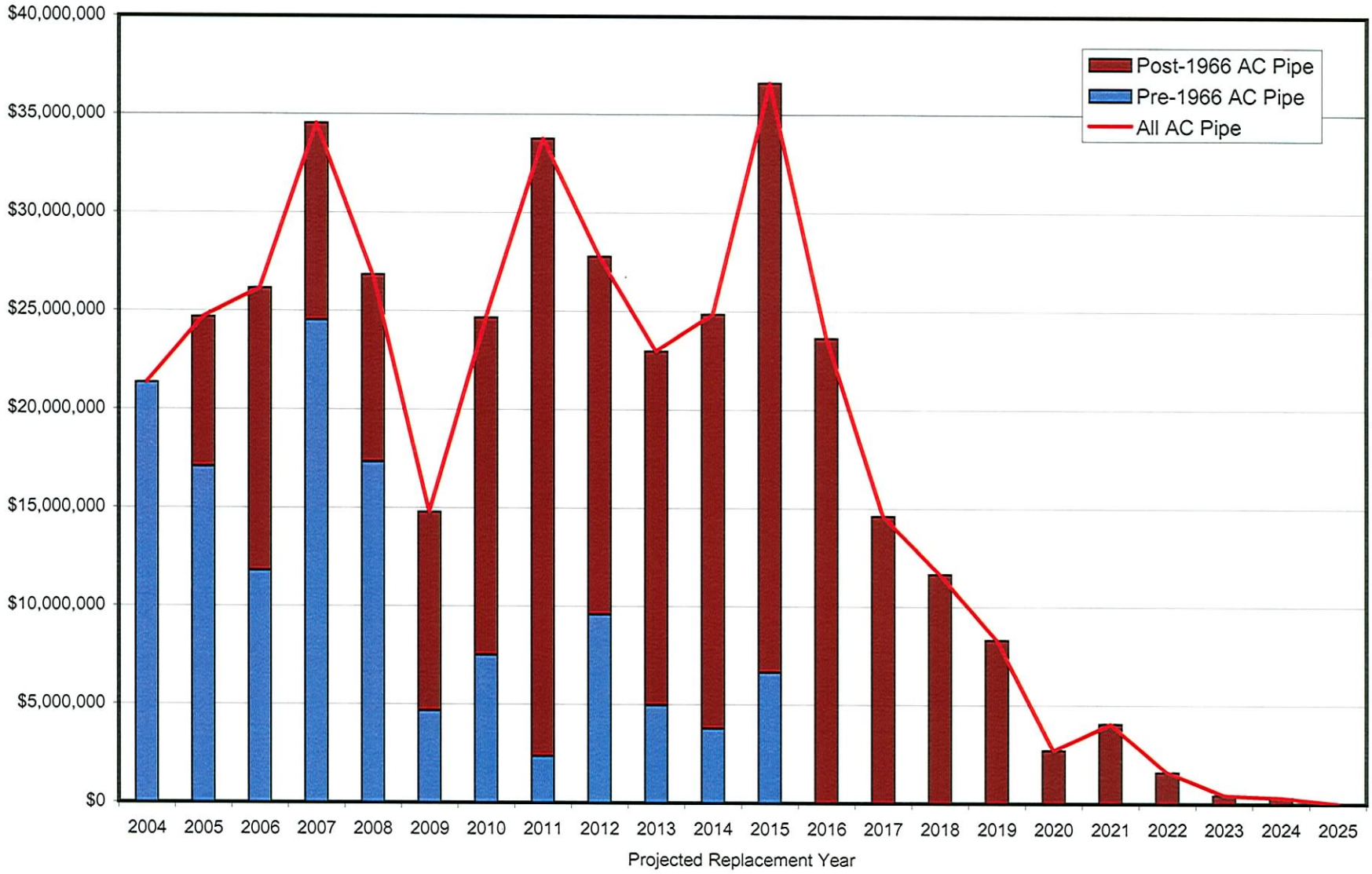
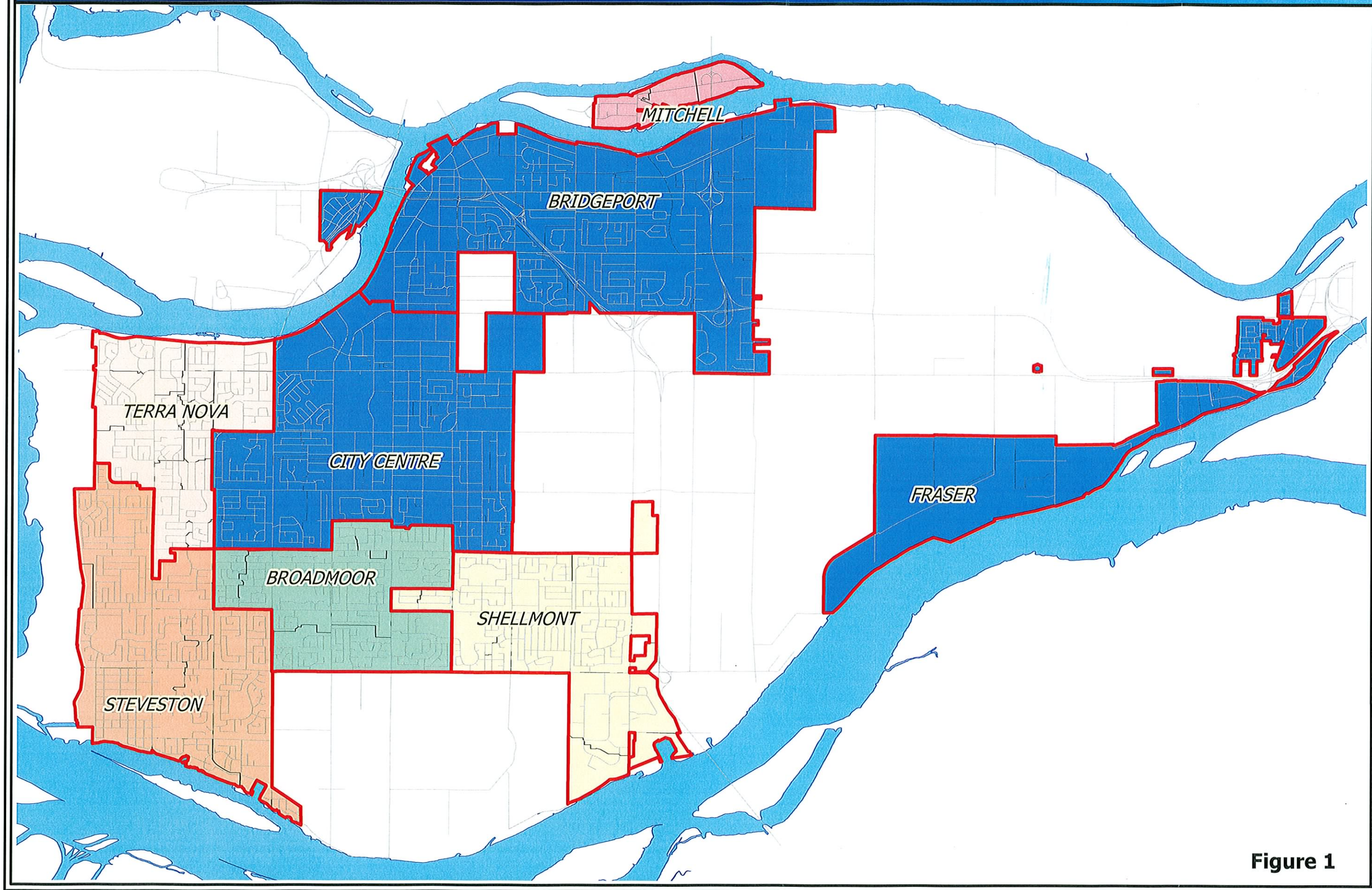
Appendix I – Charts

Chart 1: AC Watermain Replacement at End of Service Life Funding Requirements (2003 Dollars)



RICHMOND
Island City, by Nature

Modelled Sanitary Sewer Study Areas



Legend

Modelled Areas

February, 2006

Note:

The information shown on this map is compiled from various sources and the City makes no warranties, expressed or implied, as to the accuracy or completeness of the information.

Users are reminded that lot sizes and legal description must be confirmed at the Land Title office in New Westminster.

This map IS NOT a legal document, and is published for information and convenience purposes only.

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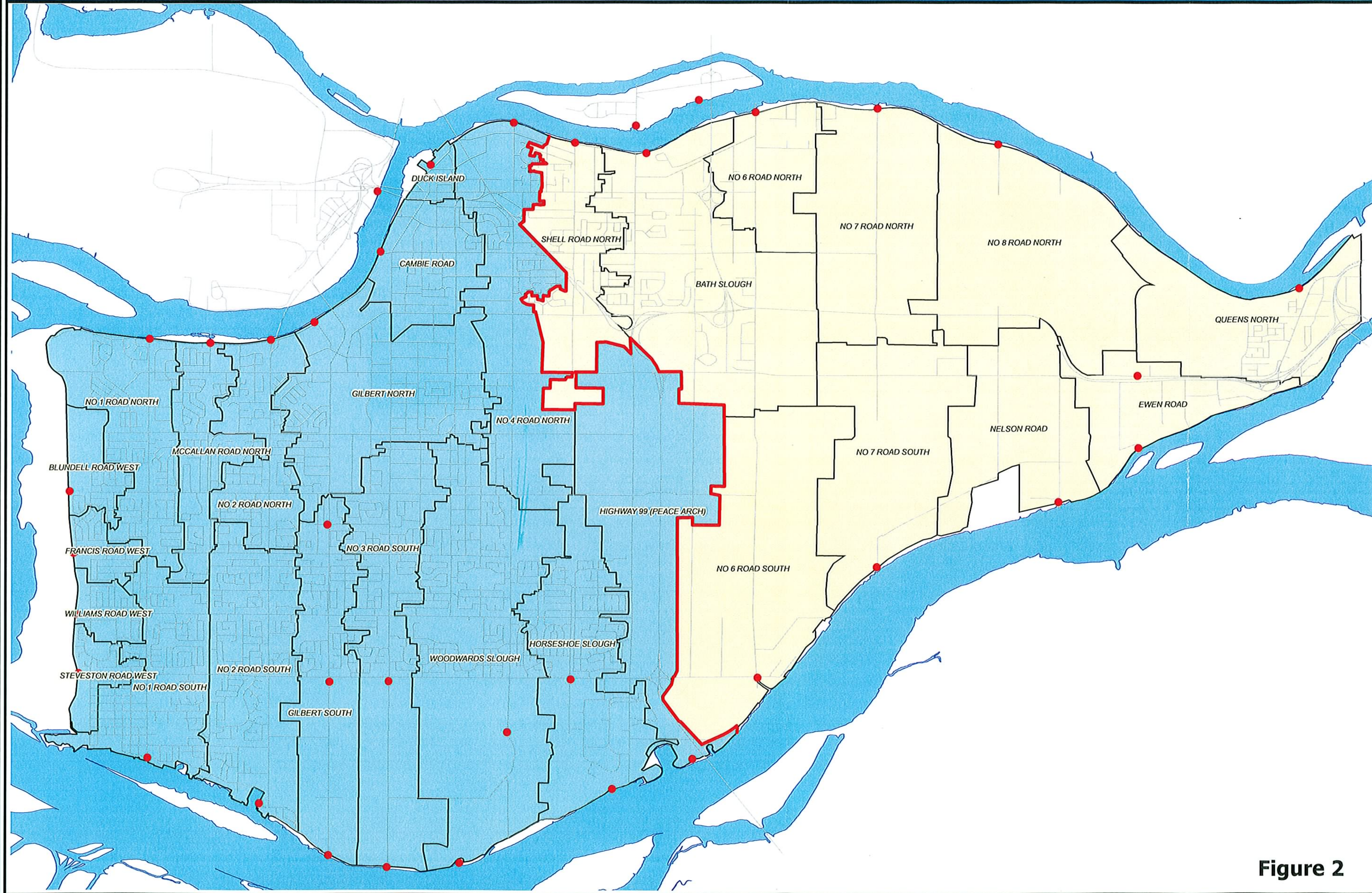
Figure 1

RICHMOND
Island City, by Nature

Modelled Drainage Catchments



Legend

- Modelled Areas
- Pumpstations

February, 2006

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Figure 2

Chart 2: Ageing Infrastructure Report - Watermain Replacement Value

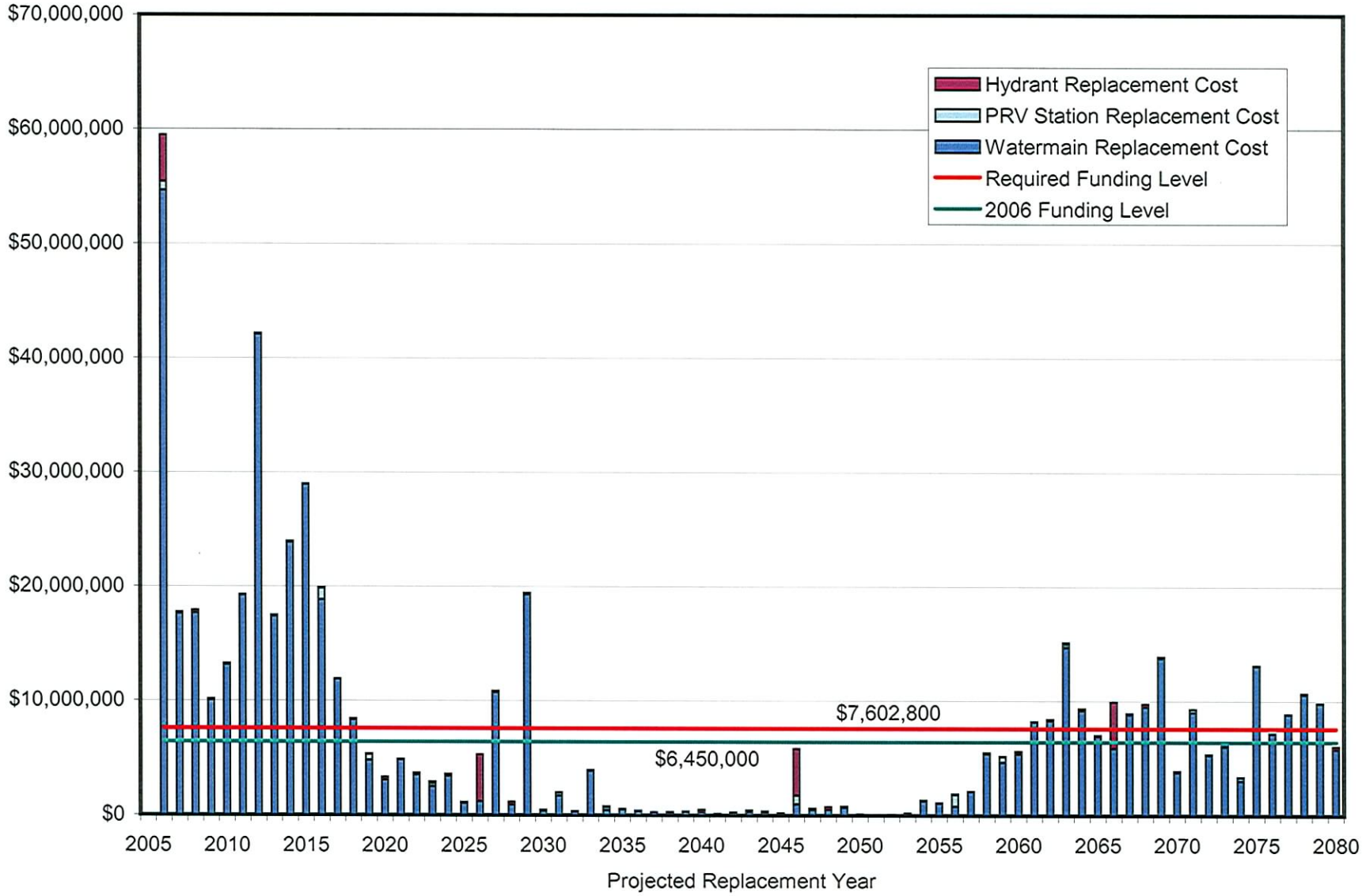


Chart 3: Ageing Infrastructure Report - Sanitary Replacement Value

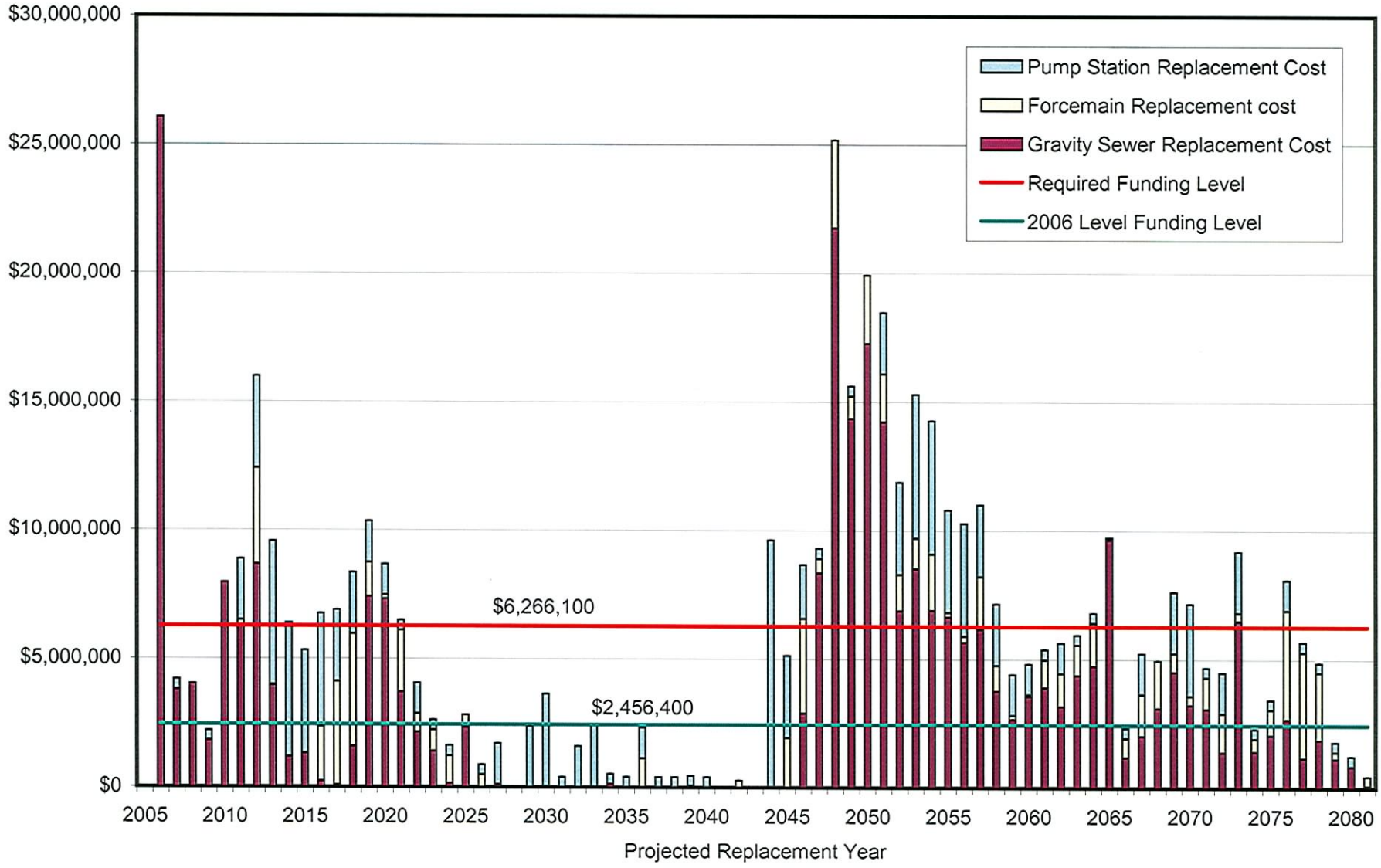


Chart 4: Ageing Infrastructure Report - Drainage Replacement Value

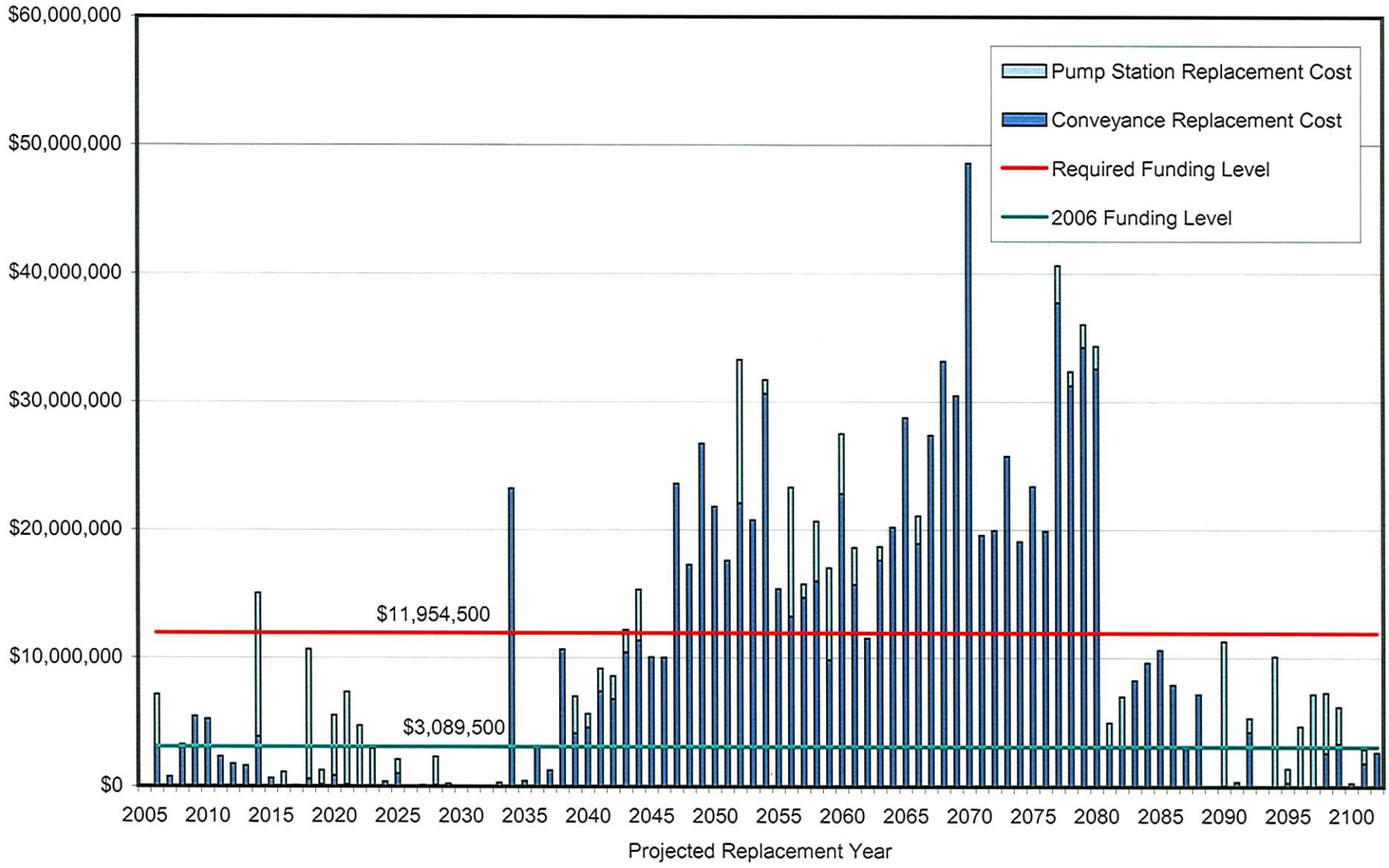
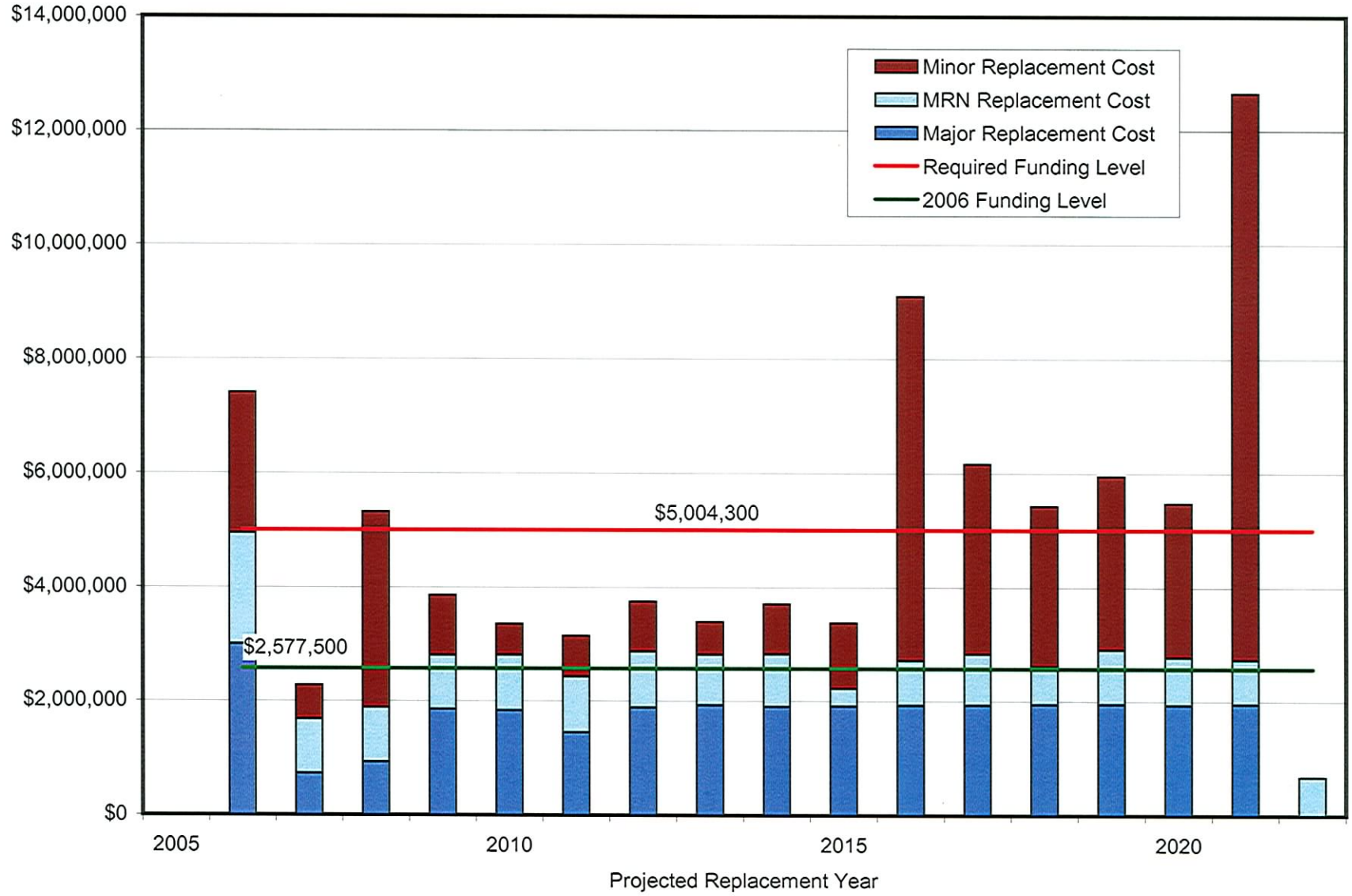


Chart 5: Ageing Infrastructure Report - Road Maintenance Value



CITYHALL-#1409450-v1-Ageing_Infrastructure_Report_-_Road_Maintenance_Value_-_March_2006.XLS - Plot

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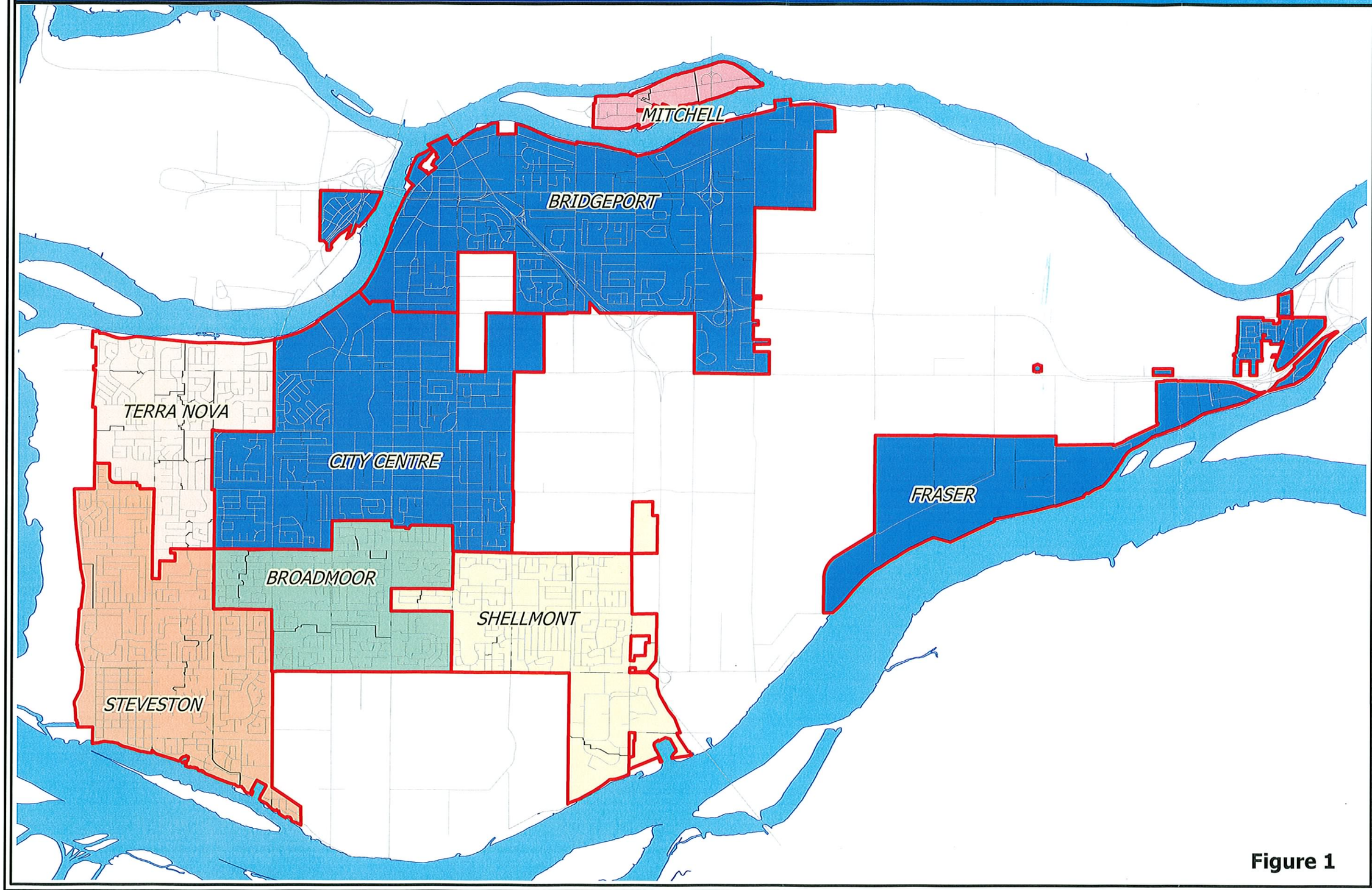
Island City, by Nature

Modelled Sanitary Sewer Study Areas



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Modelled Areas

February, 2006

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Figure 1

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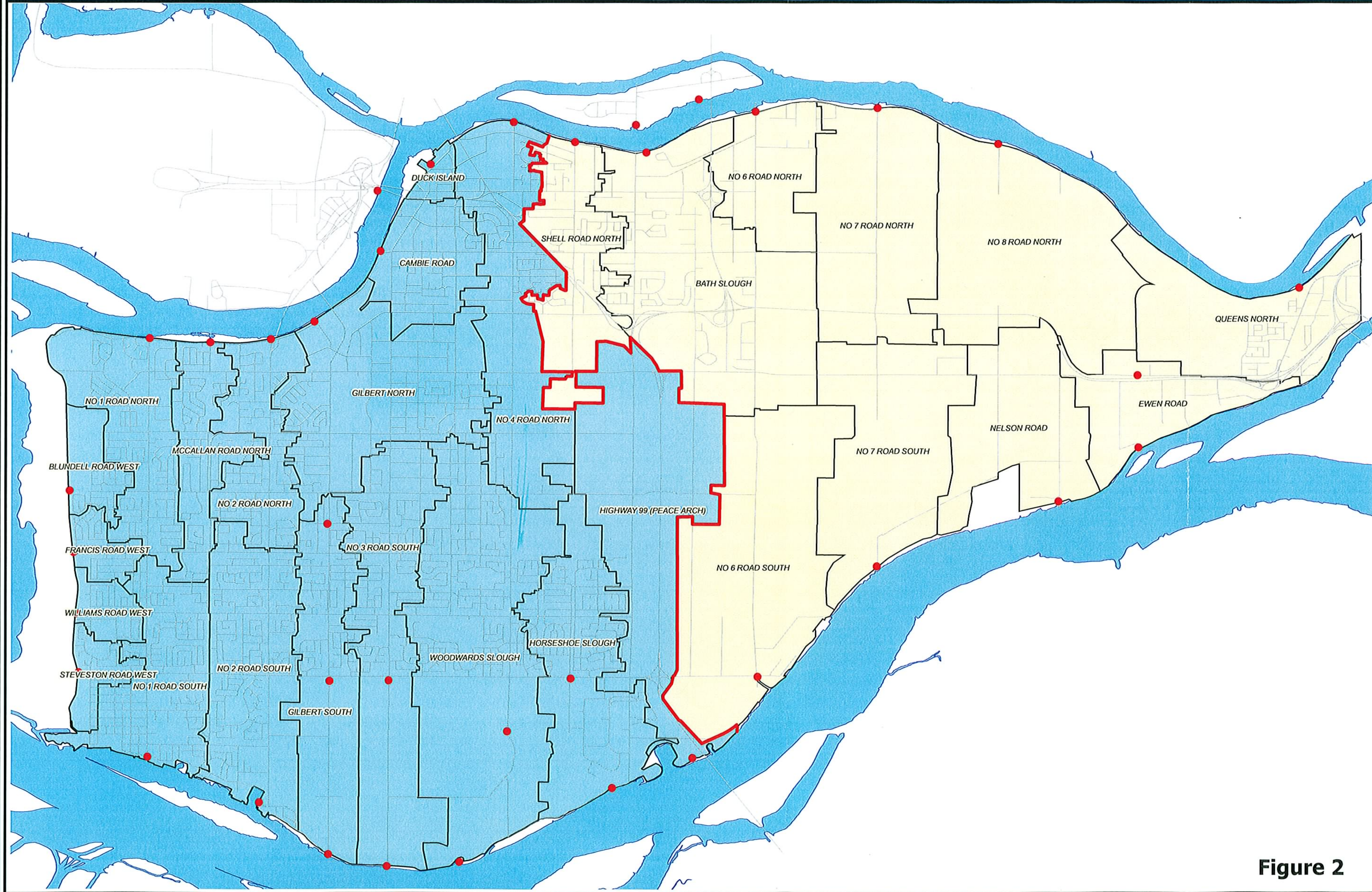
Island City, by Nature

Modelled Drainage Catchments



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Modelled Areas

Pumpstations

February, 2006

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Figure 2