City of Vernon, BC

Integrated Transportation Framework

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Integrated Transportation Framework

1.0 Executive Summary

The goal of the Integrated Transportation Framework (ITF) is to identify a functionally viable transportation network for all users including vehicles, pedestrians, and cyclists that is financially sustainable. This is the first time that a dedicated team of professionals has taken a detailed review of the City of Vernon transportation assets and network. The recommendations of the ITF represent a change in awareness of the overall costs and vision of the transportation network.

The ITF represents a collaborative effort between a number of City departments including Engineering & GIS, Operations, Bylaw, Planning and Finance. This framework has been completed in conjunction with and complementary to the 2014 Master Transportation Plan as well as the 2014 Pedestrian and Bicycle Master Plan. The commitment Vernon Council made to asset management in 2013 through the 10-year 1.9% cumulative tax increase dedicated to infrastructure renewal has already taken a positive step to raise revenues, the focus of the ITF is to contain costs to match the available funding.

The current budget including Gas Tax grants, Casino grants and 1.9% cumulative tax increase for 10 years dedicated to infrastructure renewal forecasts $7.7 million annually available for road, drainage and facility (buildings) infrastructure renewal funded from this general revenue. Roadways make up 66% of the total infrastructure that draw from the forecasted $7.7 million therefore $5.1 million is the forecasted funding available for road renewal. When the current annual road maintenance budget for overlay and crack sealing of $1.2 million is added, as well as the Transportation DCCs of $0.4 million; the total funding available for transportation renewal, improvements and maintenance is $6.7 million.

Based on the current maintenance and rehabilitation techniques the 274 km of roadway in the City of Vernon would cost approximately $376 million to replace in 2013 dollars. Using the current practices for maintenance and rehabilitation of the current roadway network, the required annual funding would be

$8.4 million per year. The required funding for transportation renewal and maintenance and available forecasted funding equate to $1.7 million annual funding shortfall. This financial reality will require the City of Vernon to modify its current maintenance and renewal practices with respect to the transportation network to contain costs.

The ITF identified practical cost control measures that the City can implement that will reduce ongoing roadway system renewal and replacement costs ensuring a financially sustainable approach to managing the City's largest class of infrastructure.

The ITF consists of a highly versatile transportation network model that can be adjusted by staff on an ongoing basis. Through the development of ITF recommendations several iterations of the model were investigated in an effort to balance costs with operational and public functionality, safety and service levels. Standard cross sections make up part of the model and these will be integrated into the City's bylaws for new road development as well as capital works programs. A number of recommendations from the ITF are as follows in order to put the City of Vernon on the path of financial sustainability:

- **Increase maintenance funding for crack sealing and overlays from $1.2M to $1.5M.**
    - Sealing road surfaces keeps water out, preserves the surface and base, increase roadway service life, and dramatically reduces life cycle costs.
- **Reduce Lane widths to 3.25 meters**.
    - Reducing lane widths to 3.25 m will save $0.3 million per year.
- **Support reclassification of the transportation network**.
    - Details of the transportation network reclassification will be brought forward as part of the Master Transportation Plan. Savings of $0.3 million per year will be realized by the City of Vernon.
- **Further investigate methods to increase service life on 27th Street**.
    - Further investigation as to the cause and implementation of solutions to lengthen shortened service life on 27 Street will save the City of Vernon millions on the busiest most expensive road in the City of Vernon.
- **Investigate and test alternative road rehabilitation and construction techniques.**
    - Test asphalt recycling and chip sealing on local roads. Initial testing of Full Depth Recycling has proven effective with the potential to savings up to 50% compared to traditional construction.
- **Adopt the roadway cross-sections into City of Vernon Bylaws.**
    - The recommended cross-sectional changes have been designed to reduce life cycle costs without reducing the function to the transportation system. It is recommended the revised cross sections form the basis for revisions to City Bylaws.

- **Replace and build new sidewalks according to the Transportation Master Plan.**
  Savings of $0.1 million annually can be realized by not replacing sidewalks in low risk areas such as low density local residential cul-de-sacs and rural local roads. The MTP also includes a net increase of new sidewalks to complete the network.
- **Develop City of Vernon policy to define the services the City of Vernon provides in boulevards**.
  - Develop City of Vernon policy that defines the road corridors that receive landscaping and associated infrastructure as well as the required maintenance.
  - Policy defining the mechanisms for new to development to build and maintain additional landscape amenities.
  - Policy defining the responsibilities of the adjacent home owners for boulevard maintenance will control and potentially reduce costs.

These recommendations will result in road renewal, improvements and maintenance costs being reduced to between $6.3 and $6.9 million annually. This annual budget is in line with the available funding described above.

The development of the ITF has led to the conclusion that while the 1.9% cumulative tax increase for 10 years is a significant step toward a financially sustainable infrastructure renewal program further steps could be taken to counter the effect of escalating unit costs which, over time, will erode the effect of increasing infrastructure funding. An additional recommendation to address escalation is also being made:

- **Report back annually on the impact of construction escalation on the City of Vernon's capacity to replace infrastructure**
  - Tracking and reporting the escalating road construction costs and making an attempt to increase budgets will result in a capacity to renew infrastructure sustainably.

The ITF will help City decision-makers to set a realistic and achievable transportation vision, integrating the ITF recommendations into current plans and bylaws. The ITF will also guide funding and implementation decisions building toward a financially sustainable roadway infrastructure, while managing public expectations for level of service.

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2.0 TERMS AND DEFINITIONS

The following commonly used terms and definitions have been described as they relate to the City of Vernon's (the City) Integrated Transportation Framework (ITF):

Arterial Road	Primary function is to deliver high volumes of traffic at higher speeds.
Associated Assets	Minor valued assets that compliment a road system such as signs, culverts, ditches, signals and streetlights.
Backlog	The accumulation of road renewal and reconstruction required by condition and age that has been deferred.
Collector Road	Primary function is to transition moderate volumes of traffic at moderate speeds between local and arterial roads.
Connectivity	The linking of sidewalks, walkways, and / or trails through neighbourhoods from homes to schools or commercial centres keeping users away from busy streets
Crack Seal	A road surface maintenance activity that provides the lowest cost remedial action to extend the life of the road surface and base. Crack sealing keeps water from seeping through the cracks in the road surface, damaging the road base, which in turn accelerates the deterioration of the road surface.
Improvement	Is an upgrade of the existing roadway segment that includes adding any additional road features during road renewal or safety upgrades such as widening lanes, adding flashing pedestrian lights or adding a sidewalk.
IRC	The Infrastructure Renewal Contribution (IRC) is the ideal annual budget amount for infrastructure renewal and is made up of two components: 1. Funding for in-year renewal projects; and 2. Funding to build up infrastructure reserves to minimize the need for borrowing to renew infrastructure.
ITF	Integrated Transportation Framework.
Local Road	Primary function is to provide access to the properties at the beginning and end of a trip, connecting to users to roads of higher volumes and speeds.

Maintenance	The planned strategy of cost-effective treatments to an existing roadway system and its associated assets that preserves the system, retards future deterioration, and maintains or improves the functional conditions of the system (without increasing structural capacity) (U.S. Federal Highway Administration, 2000).
Overlay	Is an asphalt lift or layer placed on top of the existing pavement to seal the surface, improve drainage, protect the base, and improve skid resistance.
Reconstruction	When a roadway has reached the end of its useful life and resurfacing is no-longer an option, then all lanes are excavated and the base and surface rebuilt. This can include associated assets (sidewalks, streetlights), and any utilities below the roadway.
Renewal	A non-maintenance capital repair intended to extend the life of a roadway segment.
Resurface	When a roadway cannot be overlaid due to the severity of surface defects the existing surface is milled down, minor base repairs are made, and then the road surface is re-paved. Re-paving may require one or two pavement lifts or layers.
Road Classification	Refers to the road hierarchy: arterial, collector or local.
Road Cross-Section	Refers to the transverse elements that make up a roadway, typically as seen by the user: ditches, sidewalks and pathways, boulevards, shoulders, lanes.
Road Hierarchy	Hierarchy refers the function of a road segment within the road system. Road function is captured by the classification of a road: arterial, collector or local.
Vulnerable User	Children, seniors, disabled and riders of two wheeled vehicles.

3.0 REPORT LAYOUT

This report is laid out to provide a storyline for the reader that explains the ITF report and model rationale and its findings.

- The **Terms and Definitions** section provides an explanation of some terms that are used in the document and may be new to the reader;
- The **Background** section provides the context for asset management and the undertaking of the ITF initiative;
- The **Introduction** section describes broad guiding principles that enable the ITF analysis;
- The **Vernon's Transportation Structure** section describes transportation goals, current transportation system, and the importance of sound maintenance and renewal practices;
- The **ITF Methodology** section provides information on the ITF team, analytical and communications approaches to the initiative, including interaction with Council;
- The **ITF Recommendations** section presents specific recommendations associated with the ITF analysis; and
- The **Appendix** sections A to H provide more detailed supporting information for the ITF initiative methodology, roadway cross-sections, and ITF Model use.

4.0 BACKGROUND

This ITF report presents a solution for the implementation and sustainability of the City's transportation vision, with a focus on roadway infrastructure. The importance of infrastructure to the well-being of the City is presented in the City's 2012-2014 Council's Strategic Priorities Report Card, *Action #5 - Manage our "house"*, which states:

> *"The Asset Management Investment Plan has identified replacement costs and the Asset Management Revenue Plan has identifies the revenue that is available to fund these cost pressures. The next phases of the SIIP will focus on balancing cost control and rate increases. Currently the SIIP is focusing on the City of Vernon's largest asset being our transportation network. The* ***Integrated Transportation Framework*** *will aim to create a sustainable network of roads that is both affordable and functional. All of these portions of the SIIP are scheduled for completion in 2013 and will direct the City of Vernon 2014 Capital Program."*

The City needs to manage its infrastructure in a financially sustainable manner. To do this, the City of Vernon created a Strategic Infrastructure Investment Plan (SIIP) in order to cost effectively manage its responsibilities associated with the operating and maintaining a wide variety of infrastructure, including a road system, sanitary system, stormwater system, buildings and facilities, vehicles and equipment; all of which are vital to the well-being of residents, businesses and industry of the community, and have a total replacement value of approximately $800 million (2013). The City's SIIP initiative consists of a cycle of eight (8) steps shown in Figure 1.

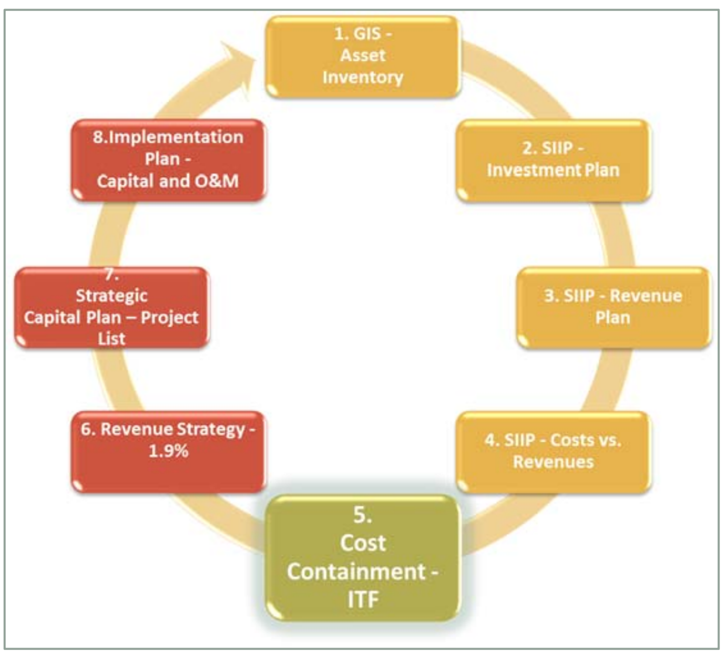


FIGURE 1: EIGHT STEP SIIP PROCESS

Steps 1 through 4 were completed during 2012 to 2013, and this ITF represents ***Step 5 - Cost Containment*** which is being completed concurrently with ***Step 6 - Revenue Strategy***.

Graphically, Steps 5 and 6 represent the iterative process of reducing costs and raising revenues to determine a financially sustainable infrastructure portfolio as shown below.

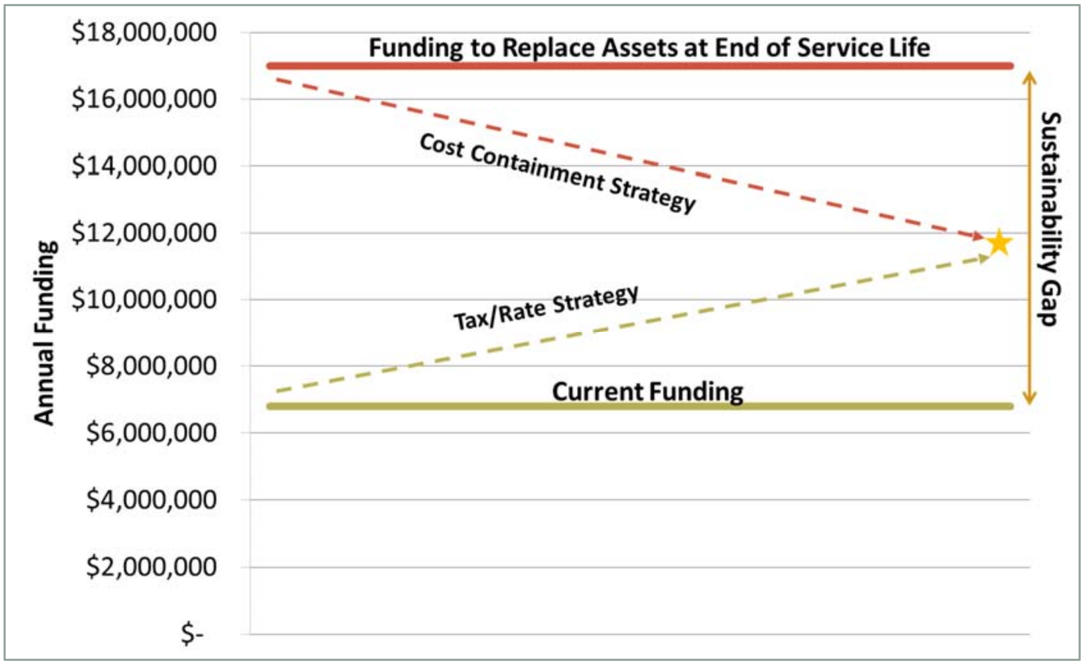


FIGURE 2: BALANCING COSTS AGAINST AVIALABLE REVENUES

The City has already increased revenue with a 1.9% tax annual increase dedicated to infrastructure renewal. The cost containment strategy needs to reduce costs to match that sustainable funding level. Reducing costs is a combination of adjusting service levels, identifying economies of scale, and adopting new technologies that require lower capital costs and extend the service life of the infrastructure.

With ongoing use and the passage of time, existing infrastructure is deteriorating; much of the City's infrastructure will be reaching the end of its expected service life over the next few decades and will require a significant investment to maintain existing levels of service. Reinvestment in the City's existing infrastructure, including renewal and replacement, is required to ensure that the asset base is preserved for future generations.

The City strives to be a sustainable and resilient community, with a diverse, affordable and sustainable infrastructure base for its residents. In the ongoing management of its infrastructure, the City must contend with a variety of challenges, including:

- Aging infrastructure;
- Changing legislation and regulations;

- Timing of growth-related improvements;
- Sustainable financing;
- Adequate reserves for future infrastructure renewal requirements; and
- High expectations from taxpayers.

With these current challenges facing the City, informed and integrated strategic investment planning is very important. Alongside many other Canadian communities, the following questions may be arising:

- What is a sustainable community?
- How do we create a sustainable community?
- How can we attract and retain people and business?
- How can we ensure residents have the services they need and prefer?
- What levels of service are affordable?
- How can we find enough money to do all of this?
- Are there cost control measures that can reduce the demand for funding?

So, how can the City reverse its growing infrastructure renewal backlog and provide the services that its residents expect? Whether done proactively or at the 11^{th} hour, the City will need to find its affordability limit for the infrastructure it currently owns and plans to build through a combination of funding increase or service level decrease; and the ideal starting point for such an exercise is the City's road system which represents 66% of all City owned assets.

5.0 INTRODUCTION

The City of Vernon is a very unique community with a very desirable mix of urban and natural rural environment, and is situated conveniently along three Provincial highways: Highway 97, Highway 97A and Highway 6. The City's commitment to long term sustainability is summed up in the City's Official Community Plan (OCP) objectives:

> *"Vernon's OCP focuses on promoting compact urban development that supports infrastructure management, encourages more housing choices and provides transportation options. This is achieved by focusing on the City Centre as the top priority for redevelopment, followed by a network of "neighbourhood centres" throughout the city, such as the Waterfront and the area around Polson Mall."*
>
> *This compact urban development pattern provides more opportunities for cycling, walking and transit and is supported by strategic investments in sidewalks, cycling routes, buses and facilities like the new transit terminus. Development on hillsides must conform to detailed*

> *design guidelines and ecologically sensitive areas are protected through the Environmental Areas Strategy."*

In 2013 City staff presented their SIIP and recommendations for 'Next Steps' to Council. With respect to the City's roadway network, Next Steps included the development of an Integrated Transportation Framework (ITF) that would assess the condition of the City's road system and provide a strategy for all costs associated with the ongoing maintenance, renewal and improvement of the roadway network components.

The ITF initiative now builds upon the SIIP by providing a highly detailed analytical framework and model with associated funding levels required to achieve the City's objectives for transportation infrastructure. By developing the ITF model rather than a single plan for all assets, the City has the ability to make adjustments based upon shifting needs and priorities.

The key to developing the ITF was building a robust Model that calculated the cost impacts of roadway network and cross-section layouts and dimensions. By using the Model to vary the strategic classification and cross-sectional elements of the roadway system it was possible to develop an unlimited supply of scenarios that calculated costs for e.g. sidewalks, parking, boulevards, lane widths, pavement thickness, street lighting and drainage. As each of the diverse team members representing Engineering, Operations, Planning, Bylaw and Finance had varying opinions on what the ideal roadway system for Vernon would entail, it was important to build all expectations into the model. Once this was done the team members could see how their collective vision was cost prohibitive, and then begin the journey of collaboratively designing a future constrained roadway system that the City could sustainably maintain, operate and reconstruct. The ITF is designed to help the City gain a reasonably accurate understanding of the ongoing funding requirements necessary to deliver the City's transportation vision.

As such key deliverables for the ITF initiative include:

- The development of roadway cross-sections for arterial, collector and local roads;
- An updateable ITF Model that generates construction costs for different roadway configurations;
- Financial funding and life cycle cost scenarios for the roadway system's maintenance, renewal and reconstruction needs and timing;
- Cost saving opportunities;
- Recommendations for changes to policy and standards,
- Recommendations for implementation of ITF findings; and
- A 4 and 20 year investment plan.

6.0 VERNON'S TRANSPORTATION STRUCTURE

6.1 TRANSPORTATION GOALS:

The City already has a number of Transportation plans and policies in place. The goal of the ITF is to integrate with these plans acting as a tool for quantifying engineering, planning and financial options that arise as the goals and values of the community change over time.

6.1.1 OFFICIAL COMMUNITY PLAN (OCP)

The City of Vernon's overall transportation goals are described in the draft (2013) Official Community Plan (OCP):

- Deliver a financially sustainable, integrated transportation network for Vernon;
- Promote community safety, health and quality of life while reducing the environmental impact of transportation;
- Increase community awareness of the benefits of using alternative transportation;
- Increase travel options through improvements to public transit and providing fully connected walking, cycling and trail networks;
- Focus on providing access to services, goods and activities to maintain a safe, efficient and cost effective network for all modes of travel over the short and long term as Vernon grows; and
- Maximize the benefits of transportation investments by integrating them with land use planning and the development of the City Centre and neighbourhood centres in a manner that promotes community safety and provides transportation choice.

In order for the transportation goals to succeed they must be considered in context of the overall management of the City's roadway network.

The importance of the City's road system goals is critical to the ITF as it is synonymous with levels of service. If levels of service were independent from the goals, there would be no strategic guidance for the development and ongoing management of the road system. The ITF therefore is designed to recommend the costs and budgets necessary to deliver the goals, with fiscal constraint in mind.

6.1.2 MASTER TRANSPORTATION PLAN (MTP)

In 2008, Vernon residents strongly expressed their demand for alternatives to the private automobile indicating the following funding priorities: Transit, Pedestrians, Cycling, High Occupancy Vehicles, Trucks / Goods Transport, and Single Occupant Vehicles. The TMP states that, "By increasing the number of trips taken by walking, cycling or using transit, known as mode share, to 20% by 2031, Vernon could grow without experiencing unacceptable congestion."

Figure 3 presents the Vernon TMP's long term objectives by focus area.

Master Transportation Plan 2013				
Pedestrian and Bike Master Plan		**Transit Strategy**	**Road Network Plan**	**Transportation Demand Management Strategy**
Pedestrians	**Bikes**			
1. Increase fully connected sidewalks 2. Implement pedestrian priority areas 3. Standardize pedestrian facilities & crossing treatments 4. Utilise paths to maximise connectivity 5. Roadside and off-road Trail Network	1. Increase fully connected bike routes 2. Implement bike route priorities 3. Standardize bike facilities & crossing treatments 4. Utilise paths and trails and bike gutters on stairs to maximise connectivity 5. Roadside and off-road Trail Network	1. Transit Future Plan 2. Custom Transit Pilot Project 3. Implement priority bus route changes 4. Bus Stop Improvement Program 5. Incentives and measures to maximize ridership	1. Integrated Transportation Framework (ITF) (Asset Management) 2. Updated Road Network Improvement Strategy 3. Implement prioritised network improvements 4. Highway 97 & 6 Corridor Plan 5. Neighbourhood Traffic Management	1. Updated Integrated Land Use Planning & Transportation Planning in OCP 2013 2. City Centre Neighbourhood Plan Parking Implementation Strategy 3. Leadership including Staff Travel Plan 4. Education & Awareness Programs 5. Private Sector & Other Agency

FIGURE 3: VERNON TRANSPORTATION MASTER PLAN OBJECTIVES

6.1.3 PEDESTRIAN & BICYCLE MASTER PLAN

The City's Pedestrian and Bicycling Plan is nearing completion and is expected to be formally released in 2014. The Pedestrian and Bicycle Master Plan would provide a detailed plan for future walking and cycling networks, with more detail as to what those facilities will look like. The plan will illustrate which cycling routes will be composed of shared streets, cycling lanes or separated pathways. Details on improving the sidewalk network will also be included.

Information on the future walking and cycling networks was used in the reconciliation of the roadway classifications and roadway cross-sectional element functionality and dimensions, with the objective to provide safe walking and cycling continuity through the City. The proposed network of pedestrian and cyclist facilities was used in the creation of the ITF model. The costs for these facilities has been included in the model.

6.2 CURRENT TRANSPORTATION SYSTEM

The City has approximately 274 km of road spread across 2,021 homogeneous road segments of varying length, classification, cross-section and functionality provided to its users:

- 63 km of Arterial classified roads;
- 41 km of Collector classified roads; and
- 170 km of Local classified roads.

The roadway system also has the following associated assets:

- 29 km of alleys;
- 16 km of off-road trails (paved and unpaved);
- 32 creek crossing structures;
- 162 km of sidewalks; and
- A wide variety of other associated assets including: signs, signals, parking meters, streetlights, ditches, curb and gutter, boulevards, trees, and irrigation.

The City's current cross-sectional elements vary in system coverage and dimensions:

- Lane widths vary between 2.2 m (Okanagan Landing Bench Rd) and 3.5m (27 St);
- Shoulder widths vary between 0.2 m (Bella Vista Rd) and 5 m (Okanagan Landing Rd); and
- Sidewalks vary between 1 m (21 Ave) and 5 m (30 Ave).

Figure 4 presents the typical road cross-section elements of a roadway, and these cross-section elements vary depending upon the road classification hierarchy and the functionality the road segment is intended to provide the users.

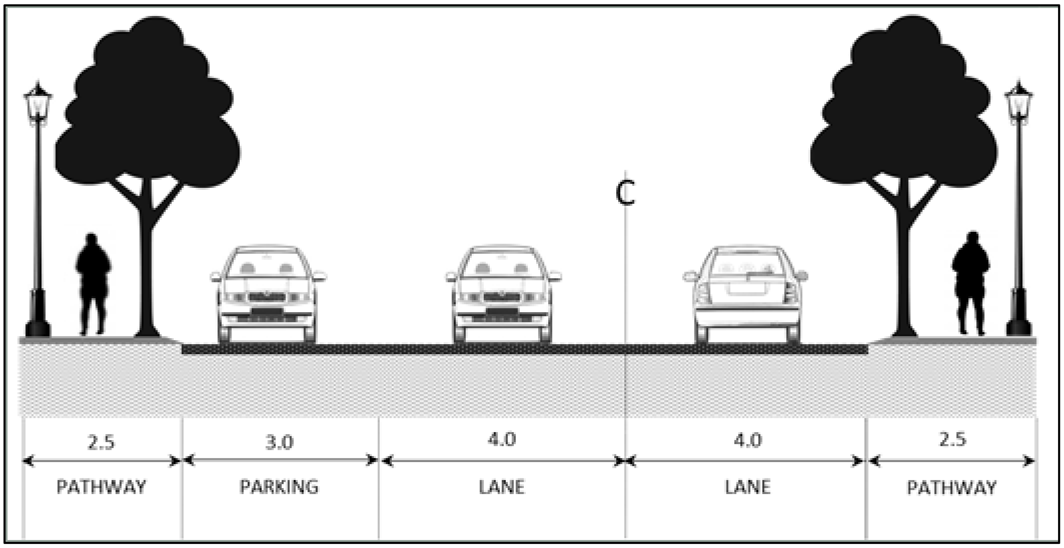


FIGURE 4: TYPICAL ROAD CROSS-SECTION

The City currently has a broad mix of roadway cross-section elements, and varying dimensions of these elements.

A broad mix of roadway cross-sections may also be a symptom of over-design. Each roadway cross-section is designed to provide a specific function, e.g. high mobility, pedestrian use, cyclist use, parking, access to property. Over-design can result in redundant functionality and/or over-sized dimensions which increase original construction costs, as well as future renewal and ongoing maintenance and operating costs. Finding the right cross-section and cross-sectional element dimensions is critical to identifying the City's road system affordability limits.

6.3 Road Maintenance and Renewal

The City's road system has a total replacement value of approximately $376 million (2013). It has an expected remaining life of 47%, meaning that the roads are past half of their expected lives, and have a growing backlog of maintenance and renewal of $41 million.

The effective financial management of roadway renewal backlog is crucial as roadway renewal backlog has a significant adverse effect on road surface and base life, as well as the magnitude of renewal costs associated with each. As seen in Figure 5, the extent and timing of roadway renewal is directly linked to the service life achieved, and the cost to optimize the service life, for example:

- When little or no crack sealing is done to prevent water penetration which is subject to freeze/thaw cycles the road service life follows Curve A. This requires expensive reconstruction after only 12 to 15 years;

- Crack sealing has a limited life of 5 to 7 years and cannot be done indefinitely, at some point the road surface should be overlaid with a new lift of asphalt. When crack seal is done, but overlays not done or not done in a timely manner then the service life of the road follows Curve B. This results in premature reconstruction of the road; and
- When both crack sealing and overlays are done in a timely manner it is possible to get two overlays on top of the original pavement, and the service life of the road follows Curve C. The exact timing of the cycles and the cost of reconstruct or overlay will depend on the classification of the road.
- The volume of traffic also has a direct impact on the deterioration of the road; thus arterial and collector roads will require more maintenance and shorter reconstruct periods.

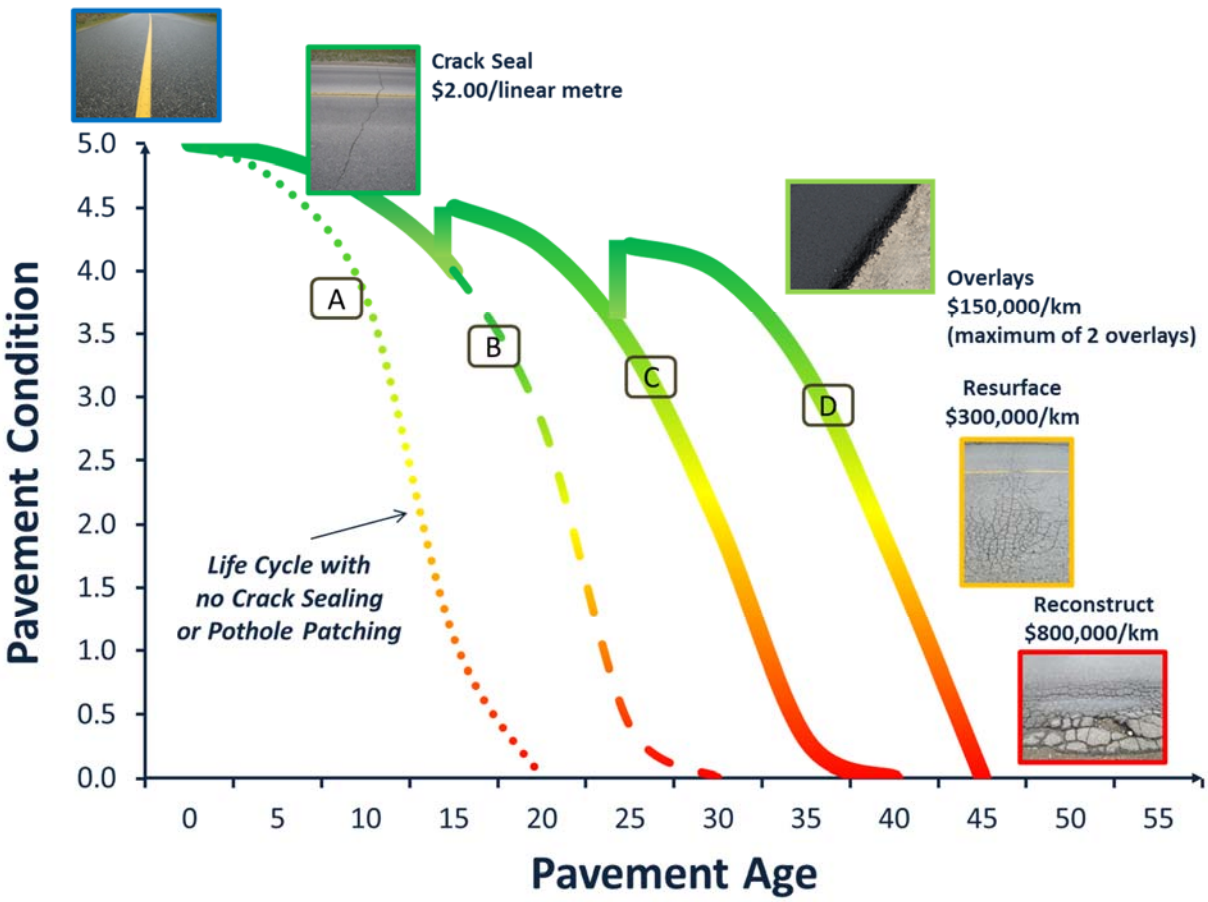


FIGURE 5: PAVEMENT DETERIOARATION CURVE (NOTE: THE COSTS ARE BASED ON AVERAGES FROM THE ITF MODEL)

Figure 5 also presents how pavement surface life deteriorates over time and how renewal costs increase significantly as deterioration increases. A typical pavement surface will lose 40% over the first 75% of its life, and then rapidly loses another 40% of its life over only 12% of its life.

The key to sound pavement management practice is to plan long-term and fund regular maintenance by sealing cracked surfaces. As can be seen from the different pavement deterioration curves in Figure 5:

> Crack Seal: *Is a major road surface maintenance activity that provides the lowest cost remedial action to extend the life of the road surface and base? Crack sealing keeps water from damaging the road base, which in turn accelerates the deterioration of the road surface.*
>
> Overlay: *Is an asphalt lift placed on top of the existing pavement to seal the surface, improvement drainage, protect the base and improve skid resistance.*
>
> Resurface: *When a roadway cannot be overlaid due to the severity of surface defects the existing surface is milled down, minor base repairs are made, and then the road surface is re-paved. Re-paving may require one or two pavement lifts or layers.*
>
> Reconstruction: *When a roadway has reached the end of its useful life and resurfacing is no-longer an option, then all lanes are excavated and the base and surface rebuilt. This typically requires replacement of sidewalks, and any utilities below the roadway.*
>
> NOTE: The City of Vernon uses a combination of resurfacing and overlay techniques on road sections with variable road condition issues.

- ***Curve A***: Not sealing road surfaces or providing good drainage will reduce the life of a road. Crack seal is relatively inexpensive @ $2.00/linear metre.
- ***Curve B***: Not overlaying a road in a timing fashion will reduce the life cycle of a road. Overlays extend the life of a road and are relatively inexpensive @ $150,000/km, as compared to resurfacing @ $300,000/km and reconstruction @ $800,000/km. The exact timing of the cycles and the cost of reconstruct or overlay will depend on the classification of the road.
- ***Curve C***: Overlaying a road surface in a timely manner can virtually triple its life. Overlays are not effective once surface defects have become prevalent.
- ***Curve D***: Shows the final overlay required to reach the 45 year service life of a typical Vernon arterial road.

The common practice for roadway surface overlay is that it can only be done twice to be cost effective. Unfortunately many of the City's roadway surfaces have already been overlaid twice, and will need to be either re-surfaced or reconstructed. The City is strategically planning its road overlay and reconstruction with required replacement

The City's current road maintenance and replacement program is based upon available budget which allows for limited rehabilitation and reconstruction every year, therefore the backlog of work increases and overall condition of the road and transportation network decrease. The road renewal and maintenance funding that is available has recently been focussed on arterial and collector roads in the worst condition since these are the roads that service the largest number of residents.

The City of Vernon should avoid the often adopted focus on roads that are in the worst condition first. The practice of "worst first" (continually addressing only those roads in the poorest condition) is a failing strategy as reconstruction and rehabilitation are the most expensive ways to restore roadways. An alternative and more sustainable pavement management strategy would be to base roadway renewal upon financial consequences. The elements of a financial consequences pavement management (FCPM) strategy have been assumed in the ITF investment plan and recommendations, and include:

- Gaining Council and community support and funding;
- Developing an inventory of the entire road system;
- Segmenting roadways into a classification hierarchy of arterials, collectors and locals roads;

- Adopting a sound pavement maintenance program;
- Establishing pavement condition thresholds for renewal investments;
- Assessing the pavement condition of each roadway segment;
- Prioritizing projects based on rate of deterioration and the cost escalation of delaying renewal;
- Selecting the most cost effective pavement maintenance treatment for each road segment; and
- Monitoring pavement condition over time and make FCPM process improvements as necessary.

6.3.1 MAINTENANCE REQUIREMENTS

The goal of roadway maintenance is to provide cost-effective treatments to existing roadway systems that preserve the system, deter future deterioration and maintain or improve the condition of the system. Roadway maintenance provides outcomes related to preservation, safety, user comfort and aesthetics, and benefit or loss of benefit of these outcomes is generally the result of funding levels in these seven (7) areas.

1. Surface Maintenance:
    - Pothole filling, crack sealing, road patching
    - Grading, sweeping, shoulder drop off
    - Debris and animal removal
2. Water Drainage:
    - Ditch cleaning, culvert cleaning, catch basin cleaning
    - Shoulder washout
3. Roadside Maintenance:
    - Mowing, vegetation removal, tree and branch control
    - Sidewalk repair, graffiti removal
4. Traffic Maintenance:
    - Sign cleaning, sign re-setting
    - Line painting, signal repairs
5. Structure Maintenance
6. Emergency Maintenance:
    - Incident management, evacuation support
    - Flood control, spill clean-up
7. Winter Maintenance:
    - Plowing, sanding

Roadway infrastructure assets require regular maintenance and care in day to day operations to achieve or even surpass their designed service lives. Maintenance repairs are relatively low dollar fixes as compared to major capital renewal and replacement, and enable a community to get the most out of their roadway infrastructure, and keep associated taxes down.

Conversely, the deferral of roadway maintenance can cause safety problems and result in a more rapid loss of service life of both road surface and road base. The loss of road base service life, in turn, reduces the maximum service life of future road surface overlays.

Water is the most destructive element to pavements; when water penetrates through cracks and potholes the pavement and subsurface service life decreases resulting in expensive resurfacing or reconstruction. Global transportation knowledge practice identifies the following conditions associated with funding roadway maintenance:

- Postponing road maintenance results in high direct and indirect costs;
- If defects are neglected, an entire road section may fail completely, requiring full reconstruction at three times or more the cost; and
- Timely maintenance sustains the quality and safety of the road, and minimizes costs.

The City currently funds pavement maintenance as follows:

- Crack sealing @ $200,000 per year; and
- Overlays @ $1,000,000 per year.

The crack sealing budget was increased in 2014 by $100,000 and the $200,000 annual funding now allows for a 5 year cycle of crack sealing every road in the City, which is recommended practice.

The overlay budget is not sufficient and will lead to shortened life cycles for road base. Preferred funding for overlays are discussed in the recommendations section of this report.

6.4 Road Reconstruction and Improvements

The best value for money goal in managing road surface and base is a three pronged approach which accentuates the adage, “Good Roads Cost Less”:

- Preservation with sound road maintenance practices, e.g. sealing cracks and ensuring good drainage;
- Rehabilitation (overlays) to seal aging pavements and protect the base from water penetration and freeze/thaws; and
- Reconstruction when both the surface and base have failed to the point where maintenance and rehabilitation interventions are no longer functionally or financially effective.

The reconstruction of a roadway involves the replacement of the entire existing pavement structure (surface and base) by the placement of the equivalent or increased pavement structure. Roadway reconstruction is necessary when a pavement (surface and base) has structurally failed and can no longer support the traffic demand. Current roadway reconstruction techniques are the most expensive option for pavement renewal at approximately $3.5 million/km for an arterial road (paved width 19.25m), $2.0

million for a collector road (paved width 11.9m), and $1.4 million/km for a local road (paved width 8.9m). Unfortunately, many roads in Vernon have deteriorated to the point that there is no other option available but reconstruction.

Fortunately there are other less expensive techniques for reconstruction being introduced in the industry such as 'rototilling' (pulverization and reuse of material). Rototilling involves the grinding of the surface and rototilling of the top layer of the base, typically up to a depth of 25cm, then recycling the rototilled material, compaction of the recycled material, and overlaying it with one or two asphalt lifts. This process can save approximately 50% off of the traditional cost for the road base. This rototilling option has been included in the ITF Model, and is being tested by the City on local roads, and should be tested selectively on collector and arterial roads, but not on urban arterial roads due to traffic volumes and loads.

To accommodate all roadway users the ITF cross-sections took into consideration the interaction between vehicle and vulnerable user (cyclist and pedestrian) traffic. In each case traffic interaction was offset by some degree of user separation; however it was not economically feasible to provide fully separated pathways and/or sidewalks on the both side of every road in the City. More focused and detailed discussion was undertaken in both the Pedestrian and Cycling Master Plan and the Master Transportation Plan. Figure 6 demonstrates the theory used by the ITF in accommodating all roadway users.

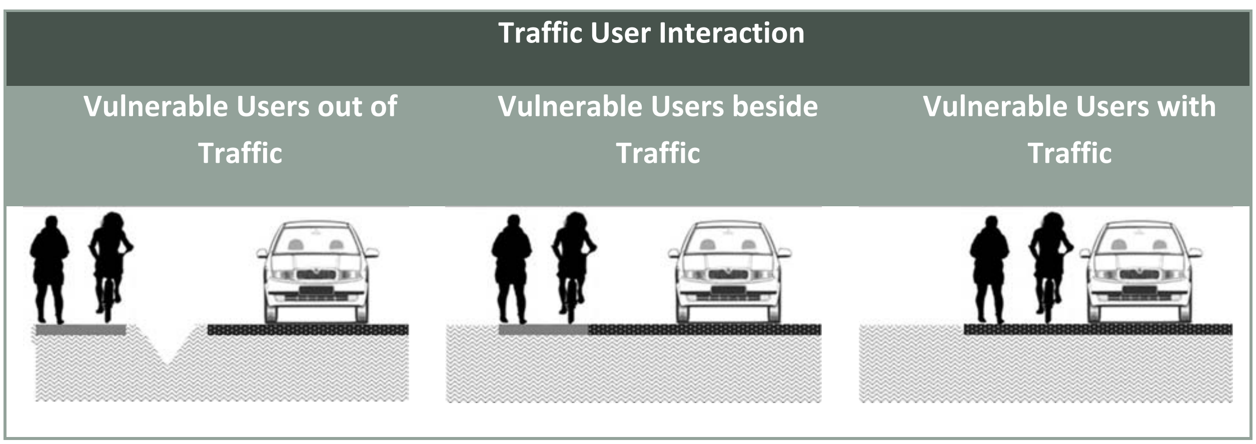


FIGURE 6: TRAFFIC USER INTERACTION

7.0 ITF Methodology

An effective roadway transportation system is developed strategically, not by default or through ad hoc annual adjustments and additions. Much of the strategic direction for the City of Vernon's transportation system is defined in the Master Transportation Plan. The role of the ITF is to work in conjunction with this plan (and others) to help define the financially sustainability and find trade-offs where necessary to make sure the goals of the each plan are achievable.

The details associated with the ITF process and tasks are shown in Appendix F – ITF Detailed Methodology.

Selecting the right balance of diversity and experience in the City's ITF Working Group was as important as the ITF analysis itself. The ITF Working Group needed representatives involved in any aspect of roadway strategic goal setting, funding, planning, asset management, design, operations, maintenance and by-law.

While the ITF was refined with feedback from the City's Senior Management Team, the core ITF Working Group was made up of the following staff:

- Chris Thompson, Project Manager:
  - GIS, asset management, funding;
- Mark Dowhaniuk, Infrastructure Engineer:
  - Asset management, scope, capital;
- Amanda Watson, Transportation Engineer:
  - Transportation planning, cycling, pedestrians, modeling, road cross-sections
- James Rice, Manager Public Works:
  - Operations, maintenance, capital;
- Ed Stranks, Manager Engineering Development Services;
  - By-law, development, road cross-sections;
- Rob Miles, Manager Long Range Planning and Sustainability:
  - Land use, road cross-sections;
- Kevin Bertles, Finance Director;
  - Road system funding, infrastructure investment increases.

The Working Group met regularly through the development of the ITF to discuss and build consensus on the following:

- the road hierarchy and cross-sections needed to accommodate roadway users;
- level of service and investment reasonable for roadway maintenance, renewal and improvements;
- evaluation criteria were needed to determine investment priorities; and
- how best to inform the public about the ITF rationale and recommendations.

The ITF developed a set of six (6) basic roadway cross-sections, with variants of each, for the City to provide a level of design consistency at affordable levels. In general, each cross-section provides a decreasing level of function and therefore a decreasing unit cost. From this list the City can choose the cross-section that best fits the budget and functionality required.

7.1 Transportation Funding

Balancing renewal, improvement and maintenance costs to determine Vernon's infrastructure affordability limits is critical to the City's asset management program. When costs continue to exceed available funding on an annual basis infrastructure backlog builds and reduces the service life of assets. Therefore it is very important to have a clear understanding of the roadway infrastructure funding available, and manage to it by adjusting roadway cross-sectional elements, testing and implementing different and more cost effective maintenance and renewal techniques.

The City has seven (7) sources of revenue to fund infrastructure renewal and improvements through the capital program:

- Gas Tax grants;
- Casino gaming grants;
- Infrastructure reserves;
- General Revenue (taxation);
- Development Cost Charges (DCC)
- Build Canada grants; and
- Sewer rates.

Of these revenue sources, four (4) sources were used in the calculation of funding for the roadway system: Transportation DCC's, Casino gaming grants, Gas Tax grants and General Revenue.

In calculating infrastructure funding, Casino gaming grants and Gas Tax grants were held constant over the analysis period, but allocated at 80% to account for a level of uncertainty over future grant sustainability Contributions from General Revenue, however, were increased by 1.9% over a ten year term starting in 2013 as per Council's resolution to dedicate an increase in funding of 1.9% of general taxation to infrastructure renewal.

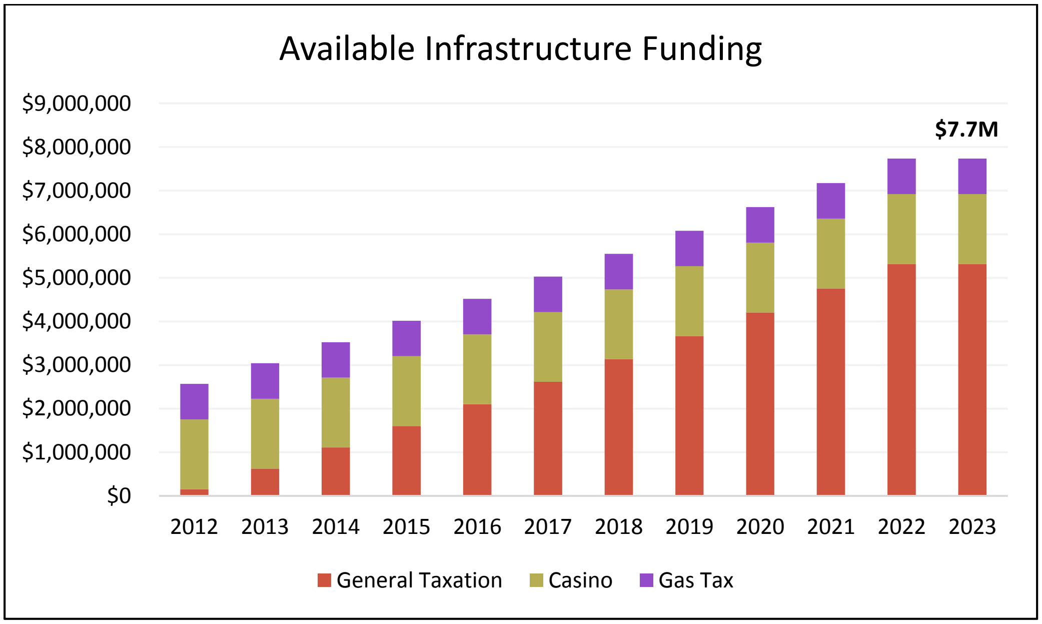


FIGURE 7 - INFRASTRUCTURE FUNDING GROWTH BREAKDOWN

At the end of the ten year period $7.7 million will be allocated towards infrastructure renewal consisting of General Revenue, Casino gaming grants and Gas Tax grants. It important to note the $7.7 million must fund additional infrastructure renewal including building facilities, the airport, storm infrastructure as well as transportation infrastructure. Figure 8, from the Sustainable Infrastructure Investment Plan, shows the transportation infrastructure is 66% of the value of the assets funded by General Revenue, Casino gaming grants and Gas Tax grants; therefore 66% or $5.1 million of the $7.7 million should be applied to transportation infrastructure renewal.

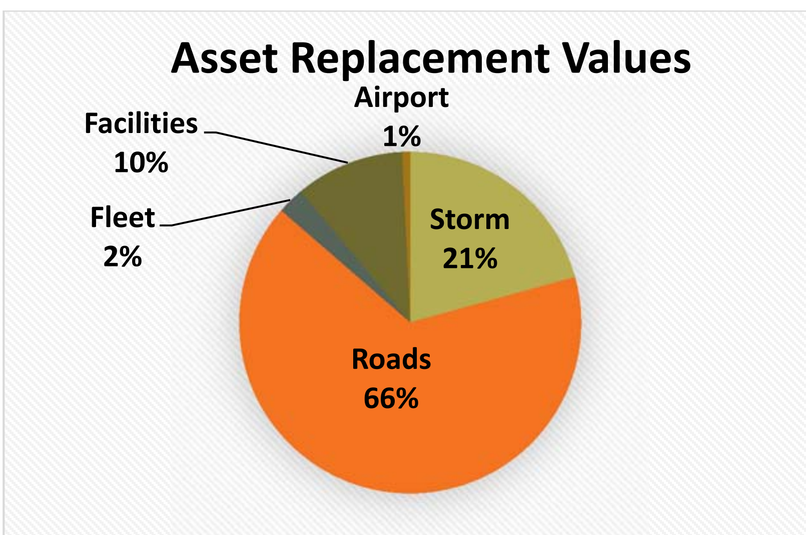


FIGURE 8 - GENERAL REVENUE FUNDED ASSET REPLACEMENT VALUES

Transportation DCC funding was also included in the ITF funding sources because DCC improvements were included in the replacement value of transportation infrastructure. The ITF model included DCC improvements to existing roads that were consistent with the Master Transportation Plan. New roads that largely benefit future development areas were not included in the model since they are typically funded 99% by the development. A couple of examples to illustrate this are the 29/30 Street improvements were included in the model but the Eastside Road Extension was not. Transportation DCC's were thus included in the available revenue as they are an important funding source for transportation improvements. Transportation DCC's were estimated based on an average of the contributions to the program over the most recent 4 year period since the new DCC Bylaw was endorsed. The DCC revenue included as revenue for improvement equated to $0.4 million per year. This is a conservative number as this period of time saw a decrease in development over this period compared to the average of the last 17 years is $0.7 million per year contribution to Transportation DCCs.

The available funding for transportation renewal, improvements and maintenance is as follows:

Current annual funding for roadway maintenance at $1.2 million includes overlay and crack sealing;

- Average annual Transportation DCC funding at $0.4M.
- Estimated annual Gas tax funding at $0.5M;
- Estimated Casino funding at $1.0M;
- General Taxation funding at $3.6M after 10 years of 1.9% increases; and

Summing all the available funding together the City of Vernon has $6.7 million available annually to fund transportation renewal, improvements and maintenance.

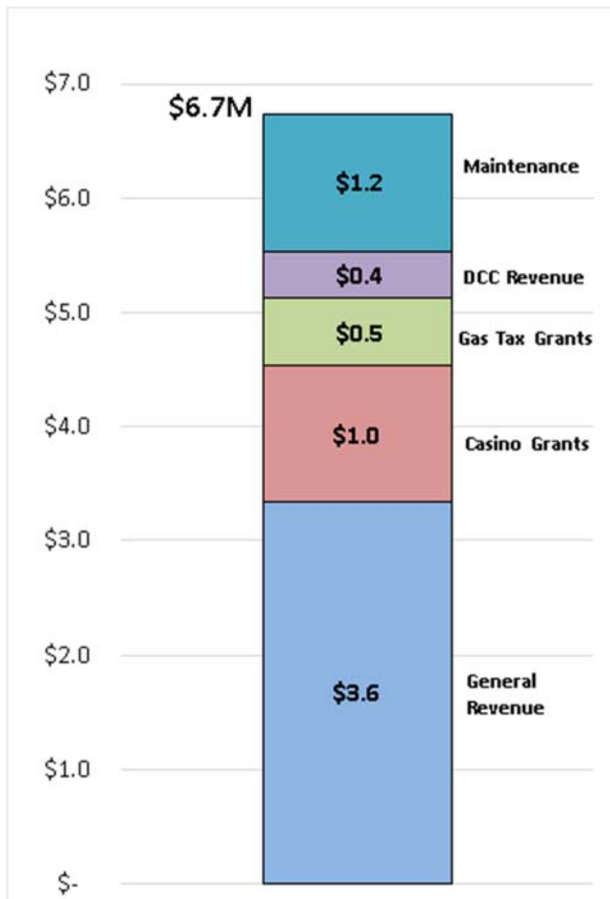


FIGURE 9 - ROADWAY FUNDING CALCULATION SUMMARY

7.2 REDEFINE THE ROADWAY SYSTEM FUNCTIONAL HIERARCHY

Prior to developing the roadway cross-section the current City road classification scheme was re-assessed to ensure that there was no redundancy between the arterial, collector and local roads. Classifying a roadway higher than it needs to be typically results in excessive functionality and higher costs to operate, maintain and renew.

The re-classification process took approximately one (1) month to complete as neighbourhood area impacts, activity centre connectivity and cross-City mobility routes were debated and tested within the Working Group. The result of this re-classification exercise is shown in terms of road lengths in Figure 10 and **Error! Reference source not found.**

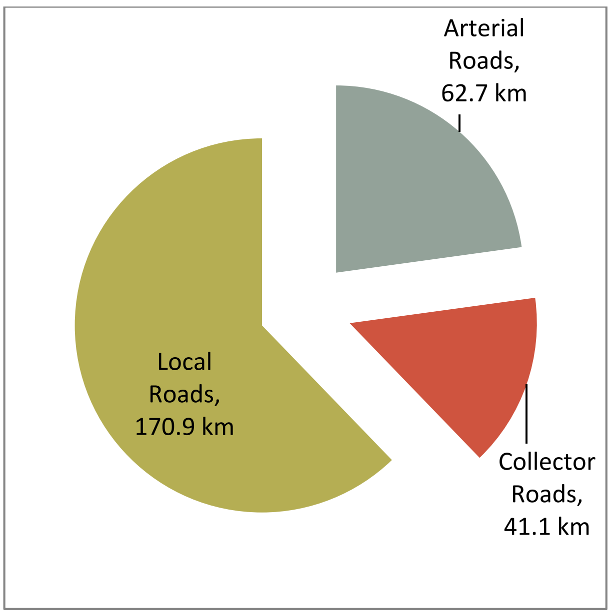


FIGURE 10: CURRENT ROAD CLASSIFICATION (KMS)

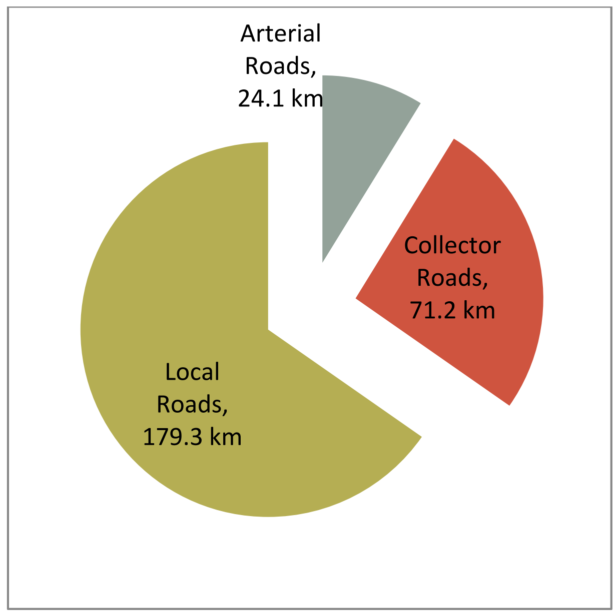


FIGURE 11: PREFERRED ROAD CLASSIFICATION (KMS)

Figure 12 and Figure 13 provide a high level assessment of the change in roadway system costs based upon the average cost per km for the City's arterial, collector and local roads.

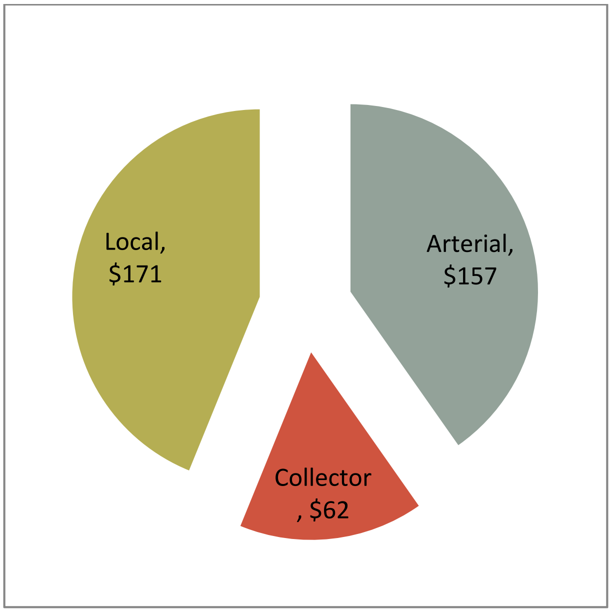


FIGURE 12: COST OF CURRENT ROADWAY CLASSIFICATION

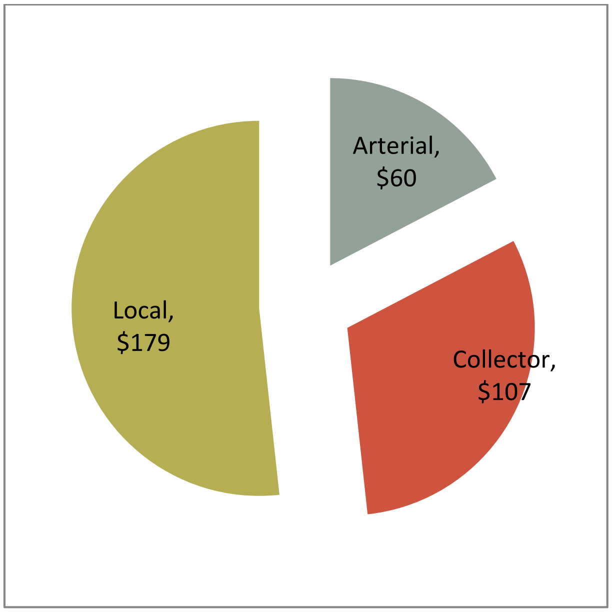


FIGURE 13: COST OF PREFERRED ROADWAY CLASSIFICATION

Figure 12 and Figure 13 show a $44 million savings over the life cycle of the roadway acquired through road classification reconciliation which will save the City approximately $0.3 million per year (based on averages for the entire roadway system) once the new classification takes effect.

7.3 Develop & Assign Physical and Functional Roadway Targets

There were six (6) basic roadway cross-sections, with variants of each, developed under the ITF that span all arterial, collector and local roads. The cross-section logic begins with the ideal high use arterial roadway based upon current City need, and all other cross-sections decrease in hierarchy, function and cost down to the basic two lane rural local road (see Figure 144).

Each roadway cross-section in the ITF was tailored to the City's rural functional requirements and its active transportation preferences. The ITF roadway cross-sections represent the range of roadway infrastructure that is affordable for the City, without compromising roadway function. ITF cross-sections are not intended to compromise or restrict roadway design for new development; however they do demonstrate a practical level of service that is currently within the City's affordability range.

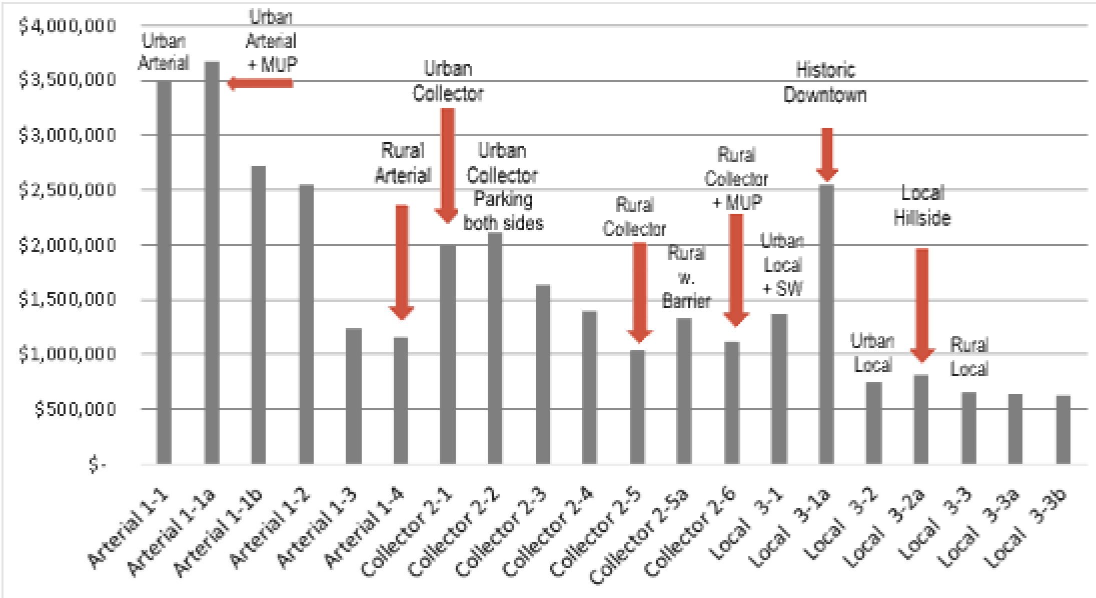


FIGURE 14: ITF ROADWAY CROSS-SECTION LIST VS COST/KM

These cross-sections are not intended to restrict the layout of roadway elements, but are intended to demonstrate how increasing roadway function comes at a cost. Where a roadway cross-section shows the need for an off-road bike path and sidewalk on opposite sides of the road, the City may decide to combine the bike path and sidewalk into a wider multi-use path on one side of the road. This approach maintains the desired function within the preferred cost parameters.

Graphic and cost representations of the roadway elements, dimensions and intended functionality for each of the ITF's proposed roadway cross-sections can be found in Appendix A – Cross-Section Dimensions, and Function. These roadway cross-section changes can be made as each road segment comes up for renewal. This approach would provide the most cost effective approach.

7.4 Develop Reconstruction, Renewal and Maintenance Program

7.4.1 Capital Cost Estimates

The cost estimates in this ITF report comprise of both hard (construction) and soft capital (non-construction) costs to ensure that investment analyses and recommendations are realistic with no hidden costs. Capital costs are segmented and based upon individual roadway cross-sectional elements to increase the accuracy of each cost estimate and to provide flexibility to the City in adjusting the cross-sectional elements and their dimensions as required with shifting priorities and unforeseen economic conditions.

Hard capital unit costs are updated on an annual basis based on City of Vernon construction pricing and include:

- Road surface and base;
- Curb & gutter, sidewalks and pathways;
- Boulevard and streetlights;
- Ditching;
- Lanes and alleys;
- Trails and stairways;
- Crossings; and
- Other associated assets (e.g. traffic control, culverts).

Soft capital costs are also updated regularly and include:

- Contingency @ 20%;
- Engineering planning & design @ 15%; and
- Construction administration @ 8%.

Soft capital costs can be adjusted in the model as conditions change, and contingencies can be monitored and re-directed to other un-funded priorities, where not spent on specific projects. Cross-section costs were based upon the unit costs shown in Figure 155. These unit costs may be updated in the ITF model as City bid costs change or to develop 'what-if' scenarios for investment and budgeting purposes.

Item	Unit Cost	Unit	Additional Information	
Asphalt	$150.00	per tonne	2.5	tonnes/m3 (includes $35/t removal)
Base	$36.00	per tonne	2.2	tonnes/m3 (includes $18/t removal)
Chip Seal	$5.00	m^2		Over existing surface
Curb and Gutter	$65.00	per linear metre		
Asphalt Curb	$5.63	per linear metre		100mm high, 150mm wide
Sidewalk	$100.00	per square metre		10mm thick concrete on 150mm thick base
Boulevard	$13,000.00	per km		trees @ $600/tree @ 20m
Boulevard	$17,000.00	per km		irrigation
Boulevard	$10.00	per square metre		grass
Lighting	$6,500.00	each	40	metre spacing
Ditch	$10.00	per linear metre		

FIGURE 15: UNIT COSTS

As mentioned earlier in the report, roadway cross-sections are hierarchical and decrease in function provided (level of service) and in per kilometre cost from an arterial road section 1-1 at $3.5 million down to a local road section 3-3b at $0.6 million.

This flexibility allows the City to select the right and affordable cross-section for the right purpose. This cross-section schema does not mean that developers could not build to a higher function; rather it implies that, at roadway renewal time, the City will only fund renewal to the level shown in the City's new cross-section, and any incremental functionality would need to be provided by the neighbourhood. This approach is affordable to the City over the long term and is an equitable arrangement for residents in all neighbourhoods, e.g. affluent neighbourhoods are not renewed to a higher level than less affluent neighbourhoods.

Based upon the unit costs above, Figure 166 shows the 20-year annual re-investment calculated by the ITF Model.

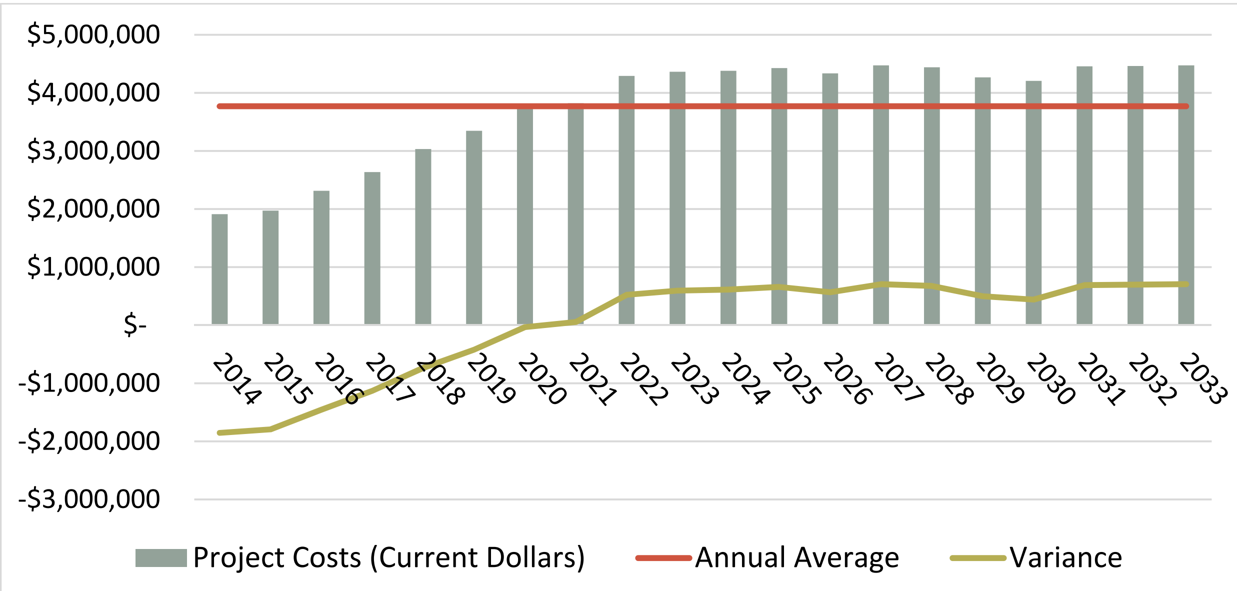


FIGURE 16: 20 YEAR CAPITAL COST SUMMARY

The current City of Vernon Subdivision and Development Servicing Bylaw (SADS) specifies that the roadway pavement structures shall be designed for a 15-year design life throughout the City. Clearly, many road surfaces are lasting longer that that period, and due to financial realities most roads cannot be resurfaced or receive overlay treatment on a cycle of that frequency. The ITF Model was used extensively to model the optimal road service lives based on available long-term funding and acceptable levels of service. The recommended road service lives are outline below:

Road Class	Surface Life	Base Life
Arterial Road	15 Years	45 Years
Collector Road	30 Years	60 Years
Local Road	60 Years	60 Years

FIGURE 17 - RECOMMENDED ROAD SERVICE LIVES

Figure 18 shows the relative costs and treatment timing for a full life cycle for all roads based on actual figures from the ITF model. Note that these treatment periods are averages for each road class. For example, 27 St, the most heavily used Arterial road in the City, will likely undergo overlay treatments on a much shorter cycle than other Arterial roads with lower traffic volumes that will last longer than the average.

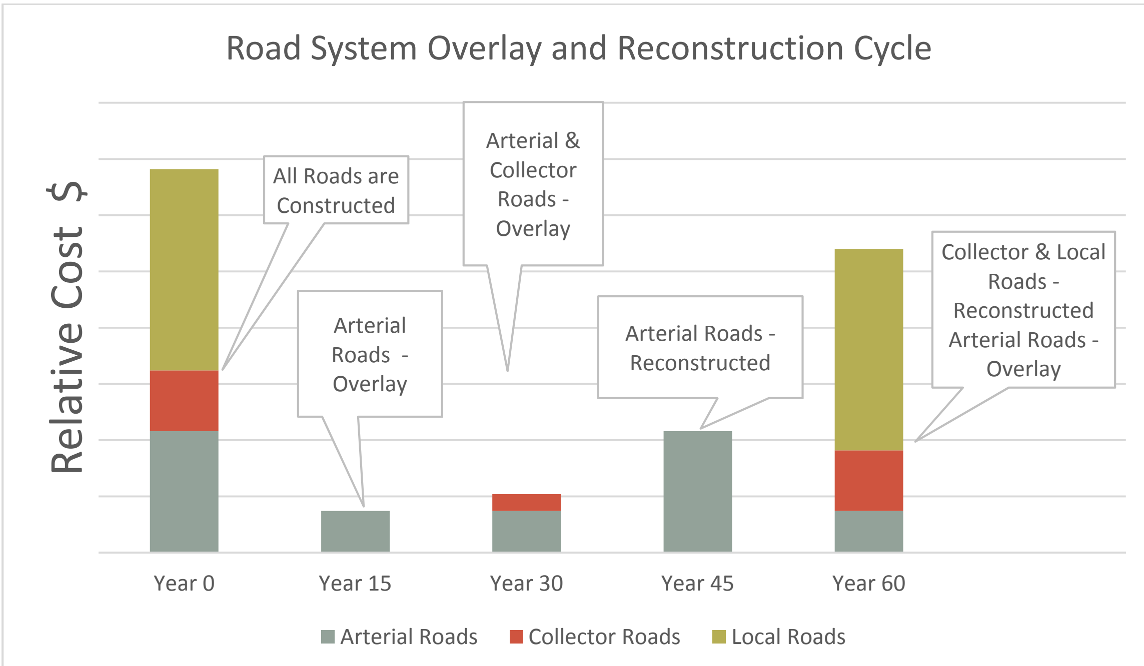


FIGURE 18: ROADWAY CAPITAL AND MAINTENANCE PROGRAM

Road Class	Year 0	Year 15	Year 30	Year 45	Year 60
Arterial	Construction	Overlay	Overlay	Re-Construction	Overlay
Collector	Construction		Overlay		Re-Construction
Local	Construction				Re-Construction

7.4.2 CALCULATING ANNUAL COSTS

There are a number of ways to look at the long-term costs for maintaining and rebuilding our roadway system. Figures in this model show up to a 20 year projection for costs, a reasonable amount of time to envision, however Vernon's roads are expected to have a service life of between 45 to 60 years. An average annual cost to maintain and reconstruct roads is needed compare against funding available in annual budgets for the road system. Keeping expected service life in mind, the ITF model was used to project road maintenance and renewal costs for a 180-year period which represents 4 life cycles for arterial roads and 3 life cycles for collector and local roads. The table below demonstrates the calculation including maintenance and reconstruction costs in the model over the 180 year period. Note that all roads would be reconstructed at the same time in year 180, representing the beginning of the next 180-year cycle.

Class	Year 0	Year 15	Year 30	Year 45	Year 60	Year 75	Year 90	Year 105	Year 120	Year 135	Year 150	Year 165	Year 180	Total	Annual Crack Sealing	**Avg**
Arterial	$55	$18	$18	$55	$18	$18	$55	$18	$18	$55	$18	$18		$364	$.02	$2.04
Collector	$104		$30		$104		$30		$104		$30			$402	$.05	$2.28
Local	$133				$133				$133					$399	$.13	$2.35
																$6.67 / year

Costs in this table are for calculation purposes only, and only represent a theoretical road system where all roads in the City would start their life cycle from year 0.

7.4.3 Maintenance Cost Estimates

Roadway maintenance costs are based upon the City's current Road Maintenance practices (Figure 19). These costs should be reconfirmed and updated annually in accordance with needs and cost escalation.

Service	Unit	Current Budget	Unit Cost
Base Failures	lane / km	$ 88,000	$ 160.00
Boulevard Landscape areas	m2	$ 230,000	$ 4.04
Boulevard Trees	Each	$ 224,000	$ 44.80
Concrete Sidewalks/linear trails	km	$ 138,000	$ 1,210.53
Crack Sealing	lane / km	$ 202,000	$ 1,854.55
Ditching	km	$ 20,000	$ 4,000.00
Downtown Beautification	m	$ 43,200	$ 44.08
Flushing	lane / km	$ 36,000	$ 65.45
Line Painting	lane / km	$ 165,000	$ 300.00
Litter Control	lane / km	$ 4,200	$ 7.64
Pot Hole Patching	lane / km	$ 139,000	$ 252.73
Road Rehabilitation (overlays)	lane / km	$ 985,000	$ 70,357.14
Roadside Mowing	lane / km	$ 38,000	$ 380.00
Shoulder Grading	km	$ 13,600	$ 1,360.00
Snow and Ice (anti/icing)	lane / km	$ 88,000	$ 440.00
Snow and Ice (plowing)	lane / km	$ 367,000	$ 667.27

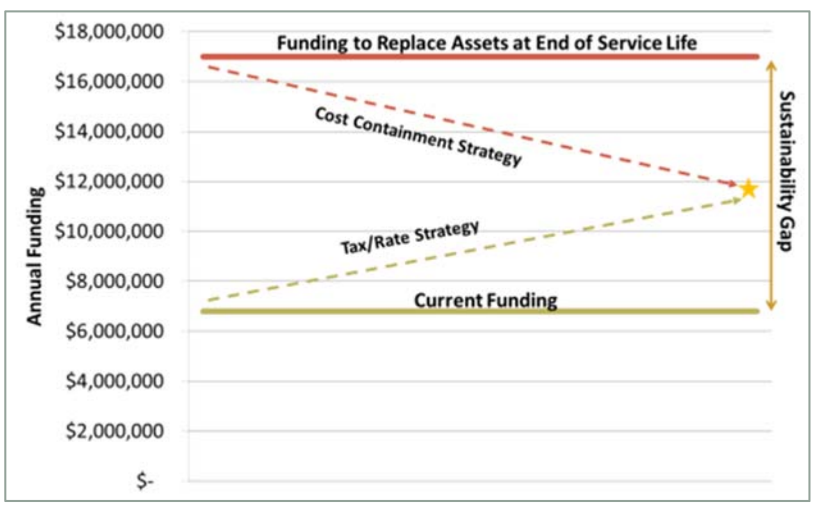
Service	Unit	Current Budget	Unit Cost
Snow and Ice (removal)	lane / km	$ 88,000	$ 4,400.00
Spray Patching	lane / km	$ 75,000	$ 5,000.00
Street Lighting	Each	$ 510,000	$ 345.29
Street Sweeping (spring cleanup)	lane / km	$ 180,000	$ 327.27
Street Sweeping (summer and fall)	lane / km	$ 180,000	$ 327.27
Traffic Signals	each	$ 247,000	$ 7,484.85
Traffic Signs	Each	$ 144,000	$ 30.64
Vandalism/Emergency Repairs	lane / km	$ 20,000	$ 36.36
Weed Control	lane / km	$ 45,000	$ 128.57
Totals		$ 4,270,000	

FIGURE 19: ROADWAY MAINTENANCE COSTS

The two areas where roadway maintenance needs to be increased are in crack sealing and overlays. The current funding for these programs is approximately $1.2M, and the ITF model calculations recommend transferring $0.33M from the capital program to the maintenance program after the 10 years of infrastructure funding is complete to build a base for the capital program. Both of these road repair methods are relatively inexpensive as compared to reconstruction and are necessary, in a timely fashion, to maximize and stretch out the service life of a roadway. Crack sealing and overlaying after surfaces have been allowed to develop and mature with several cycles of water penetration, in concert with freezing and thawing, will not regain the lost service life of a roadway surface or base.

7.5 Balancing Costs and Funding

The ITF is a major phase in the SIIP's *Cost Containment* component designed to reduce the roadway sustainability gap.



As shown previously in the report, the balancing of costs and revenues is the process of increasing roadway funding through a reasonable and publically acceptable Tax/Rate Strategy; and decreasing roadway costs through the reconciliation of roadway classification and cross-sectional elements to accommodate the necessary user functionality, without compromising system integrity.

The Working Group used the ITF model to development numerous scenarios designed to reduce costs down to the City's affordability limit. The ITF model provides the City with the ongoing ability to adjust and readjust roadway requirements as priorities, economics and technologies change. The ITF model can be queried to modify costs by altering cross-section dimensions.

Based upon the SIIP roadway required annual funding of $8.4 million and the available road budget of $6.7 million after ten years of 1.9% tax increases as shown in the Section 7.1 Determine Transportation Funding, there is still a $1.7 million annual budget shortfall or sustainability gap. To reduce this sustainability gap the Working Team used the ITF Model as a tool to develop numerous scenarios. Various parameters that were modelled are described in the following section.

The key to balancing and reducing costs within the transportation network is to limit the amenities provided to the minimum while still providing the required function of the road to all users. In most instances this was a case of reducing the asphalt width and maximizing road service life through preventative maintenance.

7.5.1 Road Reclassification

A number of segments of Arterial and Collector roads were 'de-classified' down to Collector and Local roads, in coordination with the Master Transportation Plan, with an overall cost savings of $0.3M / year expected. The reclassification was done in parallel with Master Transportation Plan and is supported by traffic volumes and intended use to provide a functional transportation network. As roads are re-classified to a lower classification road cross-sectional components (lanes, sidewalks, walkways) as well as transverse components (thickness of asphalt, depth of road base) were reduced resulting in a corresponding reduction in reconstruction costs. An illustration in the reduction can be seen in Figure 20, below.

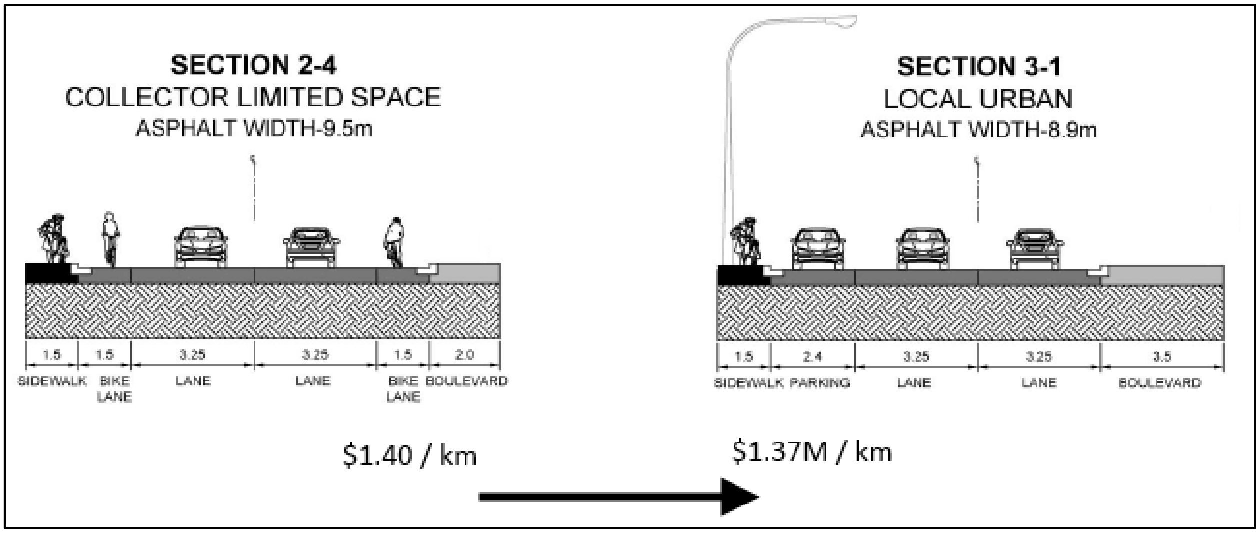


FIGURE 20: COST SAVINGS THROUGH RECLASSIFYING ROADS

Figure 20 shows a reduction in asphalt width from 9.5 m to 8.9 m. This reduced width in combination with a 25mm reduction in asphalt thickness and a 75mm reduction in base thickness results in a cross section that is less expensive per kilometer.

7.5.2 Reduction in Lane Width

Using the ITF Model, all lane widths in our transportation model were reduced from 3.5m to 3.25m in an effort to reduce overall pavement width. Applied over the 563 km of lanes in the City of Vernon the reduction resulted in a cost savings of $0.3M / year. Figure 21 shows an example of what a lane width reduction might look like, noting that the lane width refers to the width of a travel lane. In some cases, current lane widths are greater than 3.5m, and upon reconstruction the lane or lanes for that particular road will be built to a width of 3.25m.

39 Ave at 23 St **29 St @ 43 Ave**

FIGURE 21 - REDUCTION IN LANE WIDTHS

7.5.3 Fewer Sidewalk Replacements

Sidewalk widths vary from 1.5m to 2.0m wide in the ITF Model, however other widths can be designed, and the cost subsequently modelled. The estimated cost for a sidewalk on one side of the road varies from $210,000 / km to $280,000 for 1.5m wide and 2.0m wide sidewalks respectively. Note these costs do not include curb and gutter.

Pedestrian and Bicycle Master Plan investigated routes that would provide for the best connectivity for pedestrians. Areas were identified through community consultation where sidewalks were not considered a priority, and in these areas when road reconstruction or rehabilitation is planned, sidewalks will be reviewed for condition and may be left in place after road reconstruction, partially repaired or completely removed depending on the condition. Figure 22 suggests a situation that a sidewalk replacement would not be included in the infrastructure renewal. Although it is recommended that some sidewalks not be replaced, there will be a net gain of sidewalks in the model to provide a completely connected pedestrian network as per the Master Transportation Plan. The projected cost savings by following the Pedestrian and Bicycle Master Plan recommendations and not replacing some sidewalks where they currently exist, while improving connections is estimated at $0.1M / year.

4300 blk of 9 St **2700 blk of 11 St**

FIGURE 22 FEWER SIDEWALK REPLACEMENTS

7.5.4 Alternative Maintenance and Construction Techniques

There are a number of cost-saving opportunities for Vernon to explore for with respect to road maintenance and construction. Currently crack sealing and asphalt overlay are the methods used for preventative maintenance to preserve and slow the rate of deterioration. In the future, other preventative maintenance treatments will be investigate for appropriateness including spray patching (manual chip seal), chip sealing, seal coating and hot in-place recycling. It is necessary to apply the right treatment to the right pavement at the right time. The objective is to identify the sections that would benefit most from preventive maintenance, perform this identification in a timely manner, and select the most beneficial treatment.

Traditional methods of road reconstruction and rehabilitation involve removing the existing road asphalt surface, granular road base and disposing of the material off-site. In recent years alternative methods of road reconstruction and rehabilitation have been used throughout North America involving reusing and recycling road materials including Asphalt Recycling or Full Depth Reclamation. Asphalt recycling can involve a number of different techniques all of which recycle the existing asphalt sometimes with the addition new materials and repaved to create a new road surface. Full Depth Reclamation can also involve a number of different techniques involving the pulverization and mixing of the full thickness of the asphalt pavement and a predetermined portion of the underlying base material to provide a homogeneous base material (ARRA, 2001). Full Depth Reclamation can be compared to roto-tilling an asphalt into the existing road base. Reused or recycled road materials tend to be less costly than natural aggregates, particularly when the cost of processing is offset against the substantially greater cost of disposal. When properly processed and incorporated into appropriate road construction materials applications, the performance of the recycled product can be equivalent to that for conventional natural aggregate products (InfraGuide, 2005). The City has used Asphalt Recycling as a form of road surface renewal (road overlay program) and recent use of Full Depth Reclamation has shown a cost savings of approximately 50% compared to traditional road reconstruction.

Alternative reconstruction techniques on local roads are varied and their use will depend on an evaluation of the current road surface and road base condition for the suitability for the candidate process. Based on information available, estimates of $0.7M to $1.3M per year can be achieved thru the use of alternative reconstruction techniques on local roads.

Silver Star Road Rehabilitation (2012)

FIGURE 23 – ALTERNATIVE CONSTRUCTION TECHNIQUES

7.5.5 Reducing the paved surface on local roads

The ITF has developed new road cross-section standards that will be adhered to for local roads undergoing new construction and capital works projects. These standards may prescribe a reduced level of service from what currently exists while still meeting the functional requirements for the particular segment of road. Figure 24 illustrates local roads built to different standards that are meeting the same functionality. The road with the wider asphalt width will be built to the new standard with an 8.9m asphalt width.

FIGURE 24 CHANGING ROAD STANDARDS

Reducing the paved surface on local roads, essentially reconstructing these roads to a standard width is projected to save $0.1M per year in road reconstruction costs.

7.5.6 THE COST OF PARKING

Due to previous public and council feedback the project team completed some detailed analysis regarding the cost of parking. Several scenarios were considered with varying levels of on-street parking. Scenarios were analysed with reduced on-street parking on local roads to maintaining the current level of parking on local roads throughout the City.

Based on an asphalt and road base width of 2.4m for parking, the estimated cost to construct a parking lane per km varies by road class between $202,000 / km to for a local road to $254,000 / km for a collector road to $285,000 / km for an arterial road. Note that there are additional annual costs to maintain this asphalt including (but not limited to) pavement crack sealing, overlay, snow removal, street sweeping, and pot hole patching. When added together, the total replacement cost for that portion of the roadway dedicated to parking throughout the City of Vernon road network is $39M, which includes only those roadways with dedicated parking as part of the cross-section.

The project team was aware that the desired level of service for most residents includes some form of on-street parking (on one side), so parking was maintained on most local roads in a number of the model scenarios that focused on the cost of parking. In nearly all of the ITF model scenarios the loss of parking was limited, and in the most aggressive reduced parking scenario the cost of reducing parking, essentially reducing the asphalt width by a parking lane on one or both sides, was approximately $0.06M / year over the life cycle of the entire road network. Understanding the value that residents place on parking and the inevitable difficulty in justifying reducing road width to remove parking, parking on local roads was maintained at the current levels in the recommended ITF model scenario.

Parking on arterial and collector roads was also analyzed in the same reduced parking scenarios, which resulted in small cost savings due to the limited number of arterial and collector road cross-sections that include parking. Removing parking from arterial and collector roads often involved changing the cross-section to a form that proved unsuitable for the traffic conditions or neighbourhood environment as a further detriment to a reduced parking scenario. As a result parking on arterial and collector roads was maintained at the current levels in the recommended ITF model scenario.

7.5.7 The Cost of On-Street Bike Lanes

In the current roadway network on-street bicycle lanes have a dual functionality of providing a dedicated travel lane for cyclists while being used for snow storage in the winter months. The network for on-street bike lanes used in the ITF model was based on the Master Transportation Plan. In the modelling that was done in the ITF, standard 1.5m bike lanes were included in the road cross-section design and costing.

As with parking, the cost of the roadway width for bike lanes can be isolated and reconstruction costs can be determined based on the road classification. The estimated cost to construct a bike lanes (on both sides of the road) per km varies by road class between $253,000 / km to for a local road to $317,000 / km for a collector road to $357,000 / km for an arterial road. There are 26 km of existing bike lanes / snow storage areas in the City of Vernon with a replacement value of $8.8 million. Note that there are additional annual costs to maintain this asphalt including (but not limited to) pavement crack sealing, overlay, street sweeping, and pot hole patching). The Pedestrian and Bicycle Master Plan provides details for the planned expansion of on-street bike lanes as well and other bicycle facilities.

7.5.8 The Cost of Landscaping and Boulevards

Through the ITF the project team aimed to provide recommendations to where and what type of landscaping amenities as well as what maintenance services will be provided in boulevard areas throughout the City of Vernon. Boulevards are defined in the ITF model as the space between the road and property line.

Through the Good Neighbor Bylaw adjacent property owners are responsible for landscaping maintenance between the road and property line. Some notable exceptions to this Bylaw were noted during the ITF and include the following:

- Boulevards adjacent to several multi-use paths are currently maintained by the City of Vernon (area between the road and multi-use path). The best examples of these streets are 29 Street, 20 Street and 25 Avenue;
- Trees, landscaping and irrigation in boulevards within the Historic Downtown area of the City Centre Neighborhood Plan (CCNP) are maintained by the City of Vernon.

Both the capital construction cost and the ongoing maintenance were included in the ITF model to attach costs to these additional amenities.

Costs for landscaping adjacent to multi-use paths (MUP) was included in the ITF model for the following corridors:

- 25 Ave within the DNP and west to 27 Avenue;
- 29 / 30 Street Transportation Upgrade Highway 6 to 48 Avenue;
- 20 Street from 43 to 46 Avenue
- Kalamalka Lake Road from Highway 6 to 11 Avenue

The project team all agreed that these corridors should receive some additional landscaping treatment but outside of these areas, additional landscaping should be limited. There are several other MUPs that currently exist or are planned that fall outside these corridors. For construction of MUP outside of the areas listed above it is recommended that the City provide minimal landscaping and boulevard maintenance to control cost.

Costs for boulevard landscaping and irrigation were also included for Historic Downtown Area of the CCNP and a map of the areas can be viewed in in Appendix B. Generally these streets include the following:

- 29 Avenue
- 30 Avenue
- 31 Avenue
- 32 Avenue
- 34 Street

The costs included in these section added capital construction and maintenance costs for the installation of street trees and irrigation as well as decorative streetlights. Note that decorative items such as colored concrete, street furniture, banner arms on streetlights and twinkle lights were not included in any of the costs as these items have all been paid for by adjacent property owners through the Local Area Service process.

It is important to note that the City of Vernon's landscaping and maintenance services do not include additional services at the entrances to some of the newer subdivisions and neighborhood centers. The ITF model does not consider the increased services to communities such as Turtle Mountain, The Rise, Foothills, Adventure Bay and Predator Ridge.

There is a covenant registered on the title of each property at Predator Ridge and the Rise which requires the owner to pay a monthly fee to a private utility company in each subdivision.

In the case of the Rise it is Bella Vista Utilities which provides snow clearing of public sidewalks, private property yard maintenance, maintenance of boulevard areas, clean-up of private vacant lots, etc. In essence, all private property owners are paying a monthly fee to have their properties and boulevard areas be maintained by a private utility firm which the owners have a say in how the utility is operated, what they budget for and any capital works being planned and undertaken. Eventually the monthly fee is going to pay for the operation and maintenance of the recreation facility. The developer would pay the capital costs to build the facility on the developer`s property (which would then be transferred to the ownership of the utility).

In the case of Predator Ridge, there is a private utility carrying on similar works. There currently is a recreation centre, tennis court and children`s play area in place which the private property owners (and their guests) can use for free, as they are paying the operation and maintenance costs.

The Rise has a residents association in place which has a voluntary membership policy and which has organized a Neighborhood Crime Watch program, spring clean-up program, residents BBQ, fund raising events for donation to a certain items such as the hospital foundation and other such social oriented events and projects. We are not aware if Predator Ridge has yet formalized a residents or neighborhood association.

The project team recommends that the City of Vernon form policy to define the services the City of Vernon provides in boulevards. The policy should define the road corridors that receive landscaping and associated infrastructure as well as the required maintenance and be consistent with the ITF. The ITF has included capital and maintenance costs for specific corridors and any additional services are recommended to be modelled prior to the City committing the services. The policy will also define the responsibilities of the adjacent home owners for boulevard maintenance thus controlling and potentially reducing costs. The policy will also provide the mechanism for future development to construct and maintain additional services either by way of a Local Area Service or Private Utilities.

7.5.9 The Cost of Lanes and Alleys

The City of Vernon has 29 km of alleys with a replacement value of about $2.3 million. The alleys have a mix of paved and unpaved surfaces. Where alleys exist in the downtown core and other commercial areas, the surface is mainly paved asphalt. In residential areas, most alleys have an unpaved chip sealed surfaces.

Chip sealing an alley is a process that applies an oil-based tar binding material over a layer of gravel. As it dries, and vehicles drive over the surface, the tar binds with the gravel forming a solid surface. The benefits of chip sealing over a gravel surface are reduced dust and a smoother driving surface for neighbourhood vehicles, as well as garbage and recycling trucks. The City of Vernon has a chip sealing program that is currently funded at $35,000 per year. This funding has provided for a maintenance program where alleys will see resurfacing every 9 years, thus defining the City of Vernon's unpaved alley level of service.

The service life of chip sealed alley surface is between 5-10 years, depending on traffic volume and type, while paving an alley with asphalt over an appropriate alley road base is expected to have a 60 year surface life. Although the initial cost of paving an alley with asphalt is considerably higher than chip sealing, the maintenance costs of repeated sealing are eliminated. Paved alleys are periodically repaired with pothole patching based on public requests and are also resurfaced if utilities are replaced below the surface of the lane.

Alley North of 30 Ave, facing East from 30 St

FIGURE 25 - PAVED ALLEY IN POOR CONDITION

A number of alleys, such as the one in Figure 25, despite being paved, were not constructed with the proper base materials cannot be re-paved with an overlay treatment. Reconstruction of the base and surface materials will be required for this lane to reach its expected service life. Costs for reconstruction were based on using the same base recycling that is being proposed for local roads.

The ITF model took into account a number of factors with respect to developing a suitable program for alley maintenance and reconstruction; including alley condition, typical use and traffic volume, and projected utility replacement needs. The ITF recommends the most financially sustainable model for alleys is to limit paved alleys to just downtown and higher traffic commercial areas, with all residential alleys being chip sealed. The current 9-year chip sealing cycle is recommended, however a $10,000 increase in chip sealing funding from the $35,000/yr to $45,000/yr is recommended to accommodate the larger number of residential alleys that will become part of the chip sealing program. A reconstruction program for paved lanes should also be considered. To limit the costs of reconstruction in paved lanes alternative construction techniques such as asphalt recycling should be used for paved alleys where practicable. A new paved lane reconstruction program should be considered with $40,000 per year in funding. This allows for reconstruction of paved lanes every 60 years.

7.5.10 The Cost of Streetlights

There are approximately 2,200 streetlights located in road right of ways that the City of Vernon is responsible for maintaining and replacing. In addition, there is an approximately equal number of streetlights mounted on hydro poles throughout relatively older subdivisions that the City is only responsible for power consumed through an agreement with BC Hydro. The replacement value of these streetlights is $20.6 million based on the ITF model. This is a significant cost to the road network and control over the type and spacing of streetlights represents a significant opportunity to control costs.

In areas serviced by streetlights on hydro poles, there is little likelihood City-maintained streetlights will be installed due to the cost of removing and installing underground power infrastructure. Every effort has been made to accurately model roadway cross-sections with the streetlight infrastructure that currently exists.

It should be noted that there are different types of City-maintained streetlights installed throughout the City, however in terms of cost they can be broken down to 2 different categories: ornamental or standard. Standard streetlights are the typical galvanized pole with a cobra head, while ornamental streetlights take different forms, but as the name suggests are more decorative than the standard streetlight.

Standard Streetlight **24 Ave, East Hill** | **Ornamental Streetlight with planters 30 Ave** | **Ornamental Streetlight 18 St, East Hill** | **Ornamental Streetlight Turtle Mountain Blvd**

FIGURE 26 STREETLIGHT TYPES

Throughout the ITF Model cross-sections where streetlights are found, the average spacing is 40m. In an effort to manage costs, standard streetlights are used in nearly all cross-sections. Cross-sections in Vernon's historic downtown are the one exception where ornamental streetlights are used, at a variable spacing resulting in a higher cost per kilometer.

Standardization of the type, spacing and location for both ornamental and standard streetlights should be a component of future revisions to road standards. Any increase in the use of ornamental lights should be modelled in the ITF to review the cost implications.

7.5.11 The Cost of Shortened Service Life

From operational history some roads in the City of Vernon are seeing a reduced service life than expected. The most publicly visible; is 27 Street. Historically each section of 27 street has required an overlay every 7 years rather than the expected 15 years for an arterial road. The shortened life could be attributed to any one or a combination of following:

- The highest traffic volume of any road the City of Vernon maintains;
- Highest truck traffic and with the perception that some trucks may be overloaded; and
- Inadequate or failed base gravels below the asphalt surface.

This report will recommend the City of Vernon conduct further analysis to confirm the likely causes and recommended solutions. The table below shows the long-term cost of the maintenance and replacement program for 1 km of arterial road with a cross-section that models 27 St with both a 7.5-year and a 15-year surface life. Red text indicates maintenance (overlay) while black text indicates reconstruction. As can be seen the average cost over several cycles is double that for the arterial road with a 7-year surface life.

Year	Arterial - Typical	Arterial - 27 St
1	$3.5	$3.5
7.5		$1.0
15	$1.0	$1.0
22.5		$1.0
30	$1.0	$1.0
37.5		$1.0
45	$3.5	$3.5
Total	**$9.0**	**$12.0**

FIGURE 27: ARTERIAL MAINTENANCE AND REPLACEMENT COSTS OF 27 ST

7.5.12 Escalation

The forecasted escalation of construction and maintenance costs is a highly debatable value. The impacts to the City of Vernon's ability to renew and maintain infrastructure are seen clearly from the figure below as amount of construction work that the City of Vernon is able to complete decreases over time as construction costs increase.

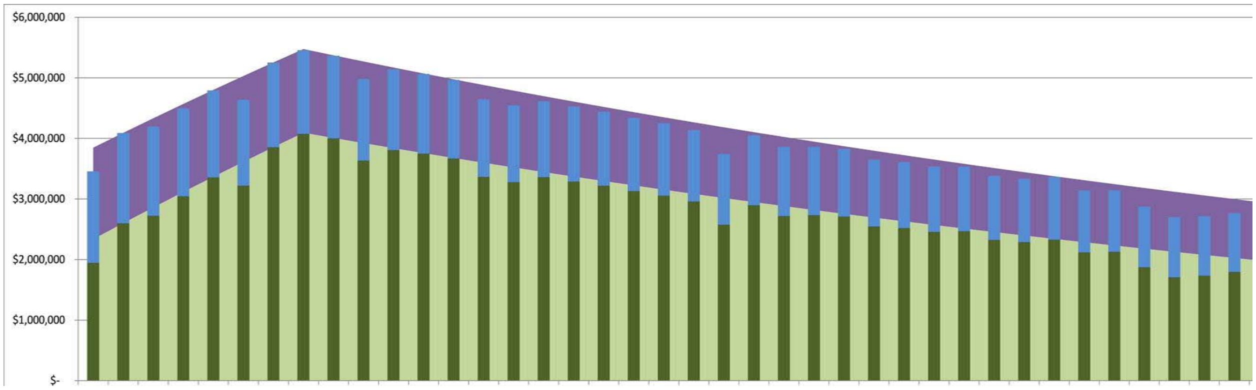


FIGURE 28 - IMPACTS OF ESCALATION ON AVAILABLE CONSTRUCTION BUDGETS

To counteract the impact of escalation the project team recommends an annual review of the impacts of escalation to capital renewal and maintenance capacity, followed by a funding recommendation to address the change in costs. As an example, a review of pricing could include a scenario that reveals a 4.5% increase in road capital construction and road maintenance costs from the previous year. Based on the current roadway funding calculations, the resulting increases would be $140,000 and $54,000 for the capital construction budget and overlay / crack sealing budget, respectively. The sum of the increases for the road renewal and maintenance increases ($194,000) would be put forward to be added to the City budget as an increase for the coming year of less than 1% (approximately 0.7%) to accommodate the rising costs of construction for the current year. It should be noted that reduced construction costs are possible, and in years when a reduction occurs the opportunity to accelerate capital renewal could be achieved.

It is important to mention that the current direction of council to dedicate a 1.9% annual tax increase for 10 years to infrastructure renewal capacity building is an important step towards building a sustainable capital renewal program, however the changing costs of construction and maintenance need to be tracked and accommodated in order to ensure the efforts to building capacity for capital renewal are not eroded by escalation.

7.5.13 Summary of Cost Savings

Category	Minimum (millions)	Maximum (millions)
SIIP IRC	**$8.4**	**$8.4**
Road Reclassification	$0.3	$0.3
Reduce Lane Widths	$0.3	$0.3
Fewer Sidewalk Replacements	$0.1	$0.1
Alternative Construction Techniques	$0.7	$1.3
Reduce paved surface on local roads	$0.1	$0.1
Subtotal	**$1.5**	**$2.1**
Revised Annual Rebuild & Maintenance Costs	**$6.9**	**$6.3**

7.6 Public Outreach

In developing the ITF outreach program the goal was to help the public in preparing their feedback by providing context around:

- What the ITF initiative is?
- Why it is important to the community, e.g. cost versus roadway function, affordability versus performance, and the long term impact of costs on the decisions made today?
- What this means to them personally? and
- How ITF decision will affect their lives?

7.6.1 What We Did

The ITF public outreach program aimed to capture feedback from residents and businesses within the City of Vernon. Communications were designed to provide full disclosure to all in order to encourage feedback. The following outreach methods were used and summaries of these can be found in Appendix D:

- Presentation at UDI meeting
- Newspaper;
- Open House; and
- Media Release.

7.6.2 UDI Presentation

The project team endeavored to present the City of Vernon's Asset Management and ITF work to the Greater Vernon Chamber of Commerce action committee called the Business Improvement Group for Real Estate Development (BIG RED) as well as the Urban Development Institute (UDI). BIG RED declined the presentation on the ITF but the ITF methodology and a summary of the City of Vernon's Asset Management work was presented to UDI on November 6, 2013.

The general comments from UDI was an understanding of the need to control infrastructure costs, the need for continued investment in infrastructure and a desire to be consulted if and when road cross sections are changed in City of Vernon bylaws. The presentation to UDI is included in Appendix D.

7.6.3 Public Open House

A public open house was held at Greater Vernon Recreation Centre Auditorium on Wednesday, November 27, 2013 from 5pm – 7pm. The open house presentation material, the advertisement in the Vernon Morning Star as well as the media release are included in Appendix C.

The goal of presentation materials was to show the City of Vernon's Asset Management work to date and present how the ITF was aiming to control costs related to the City of Vernon's largest asset; our transportation network.

The Open house was attended by 11 members of the public. Below is a summary of the comments received:

1. The City of Vernon should invest more into road replacement to make up for previous lack of investment.
2. Local business owner with over 50 employees felt it was important to invest in infrastructure and connecting the pedestrian and cycle network in order keep and attract new families.
3. Several attendees felt the current pedestrian and cycle network was segmented and a hindrance to promoting walking and cycling in Vernon.
4. Several attendees felt more trail connections were a needed investment to make a more walkable community.
5. Several attendees expressed that they would be willing to pay more to have improvements to the transportation network.

7.7 Workshop with Council

On April 7, 2014 the City ITF Working Group conducted a workshop with Council to present the ITF process and findings, and capture Council feedback. The following Council concerns were noted and have been incorporated into the ITF Model and the recommendations in this report:

- The extent that DCCs and grants could offset pressures on General revenue funding of roadways. *The project team have included Transportation DCCs in available revenues*;
- How the new roadway cross-sections will impact DCCs. *Both the recommendations in ITF and the proposed Master Transportation Plan network will impact the transportation DCC projects. An update to the DCC program is scheduled for 2015* ;
- Ensure that lowering roadway classifications will still accommodate traffic volumes. *All proposed changes in the ITF have been coordinated with the Master Transportation Plan to preserve and improve the transportation network*;
- Concern regarding stormwater pipe versus a ditch and the function of these pieces of infrastructure. *The project team was not suggesting removal of stormwater piping in established neighborhoods with ditched drainage systems. The road network and cross sections were created with the intent that existing ditches in rural areas would remain ditches and future low density development in rural areas would utilize ditches and swales in favor of a piped system. It should be noted that a ditched drainage system has added benefits of providing both drainage service in minor and major storms with the added benefit of reducing downstream flows through infiltration. Typical piped systems are only designed for the minor storm (5 or 10 year return storms) and any storm larger is designed to surcharge to the road surface and flow overland.*
- Need to contrast roadway and shoulder widths against pedestrian safety, cyclist safety, and vehicle speeds*. The Master Transportation Plan was the basis for the network modelled in the ITF. More detailed discussion on safety is provided in that report;*
- Need to present final approved recommendations to the public to help them understand why changes are being made. *Additional public communication regarding the ITF recommendations will be forthcoming following endorsement of the recommendations*; and
- Need to make sure that the ITF remains a decision-making framework that can be adjusted and modified based upon changing priorities and economics. *The true value of the work completed in the ITF is the tool that was created that can be updated and provide recommendations to changing costs, priorities and requests from the public.*

8.0 ITF RECOMMENDATIONS

The ITF model that accompanies this report shows that there are several actions that can be adopted by the City that will effectively reduce the City's roadway backlog and deliver the needed roadway improvements to accommodate all roadway users. These actions include:

- **Increase maintenance funding for crack sealing and overlays from $1.2M to $1.5M.**
  - Sealing road surfaces keeps water out, preserves the surface and base, increase roadway service life, and dramatically reduces life cycle costs.
- **Reduce Lane widths to 3.25 meters**.

  - Reducing lane widths to 3.25 m will save $0.3 million per year.
- **Support reclassification of the transportation network**.
  - Details of the transportation network reclassification will be brought forward as part of the Master Transportation Plan. Savings of $0.3 million per year will be realized by the City of Vernon.
- **Further investigate methods to increase service life on 27th Street**.
  - Further investigation as to the cause and implementation of solutions to lengthen shortened service life on 27 Street will save the City of Vernon millions on the busiest most expensive road in the City of Vernon.
- **Investigate and test alternative road rehabilitation and construction techniques.**
  - Test asphalt recycling and chip sealing on local roads. Initial testing of Full Depth Recycling has proven effective with the potential to save up to 50% compared to traditional construction.
- **Adopt the roadway cross-sections into City of Vernon Bylaws.**
  - The recommended cross-sectional changes have been designed to reduce life cycle costs without reducing the function to the transportation system. It is recommended the revised cross sections form the basis for revisions to City Bylaws.
- **Replace and build new sidewalks according to the Transportation Master Plan.**
  Savings of $0.1 million annually can be realized by not replacing sidewalks in low risk areas such as low density local residential cul-de-sacs and rural local roads. The MTP also includes a net increase of new sidewalks to complete the network.
- **Develop City of Vernon policy to define the services the City of Vernon provides in boulevards**.
  - Develop City of Vernon policy that defines the road corridors that receive landscaping and associated infrastructure as well as the required maintenance.
  - Policy defining the mechanisms for new to development to build and maintain additional landscape amenities.
  - Policy defining the responsibilities of the adjacent home owners for boulevard maintenance will control and potentially reduce costs.

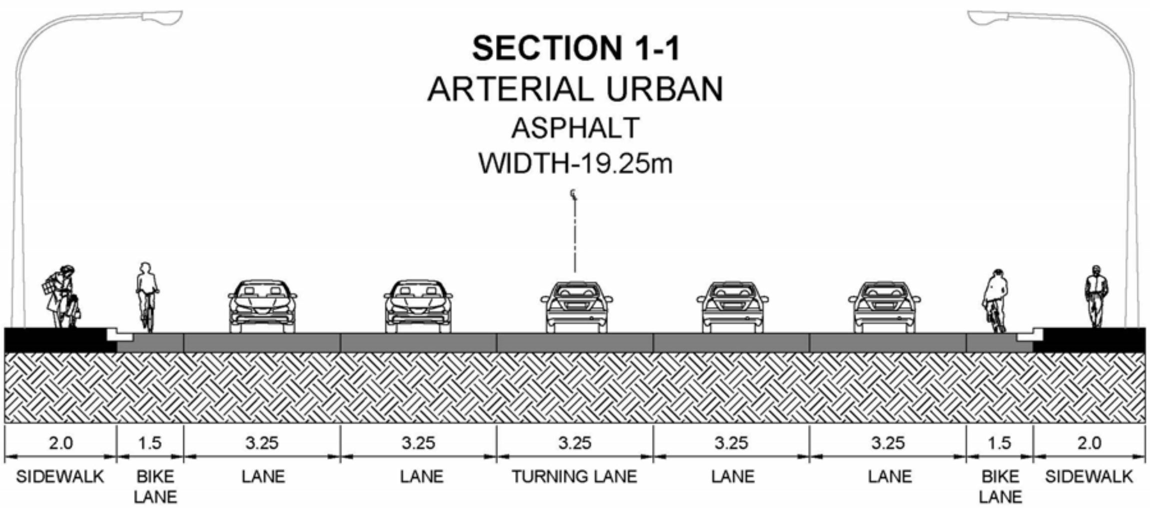
These recommendation will resulted in a road renewal, improvements and maintenance being reduced to between $6.3 and $6.9 million annually. This annual budget is in line with the available funding described above.

The development of the ITF has led to the conclusion that while the 1.9% cumulative tax increase for 10 years is a significant step toward a financially sustainable infrastructure renewal program further steps could be taken to counter the effect of escalating unit costs which, over time will erode the effect of increasing infrastructure funding. An additional recommendation to address escalation is also recommended:

- **Report back annually on the impact of construction escalation on the City of Vernon's capacity to replace infrastructure**
    - Tracking and reporting the escalating road construction costs and making an attempt to increase budgets will result in a capacity to renew infrastructure sustainably.

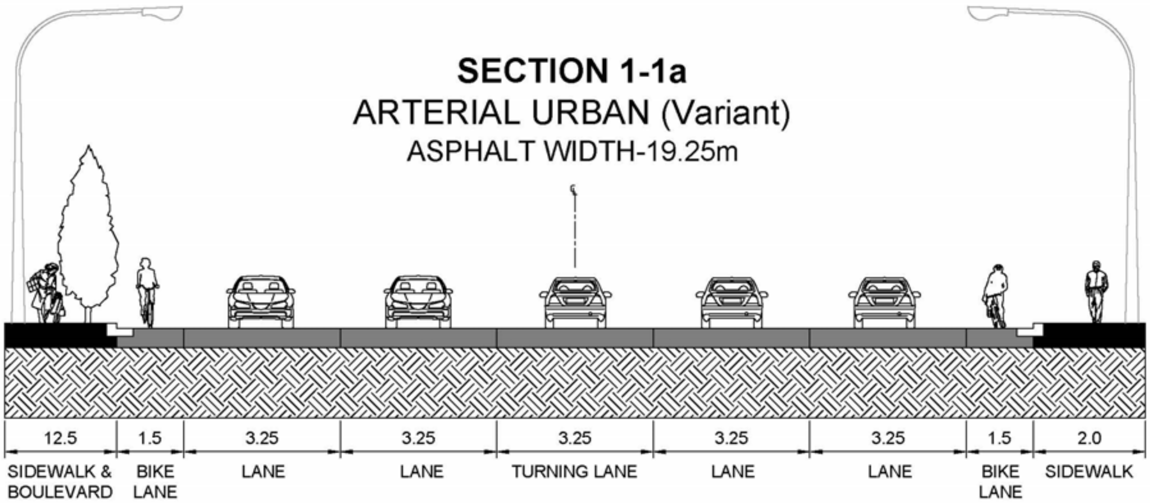
The ITF will help City decision-makers to set a realistic and achievable transportation vision, integrating the ITF recommendations into current plans and bylaws. The ITF will also guide funding and implementation decisions building toward a financially sustainable roadway infrastructure, while managing public expectations for level of service.

9.0 APPENDIX A – CROSS-SECTION DIMENSIONS, AND FUNCTION



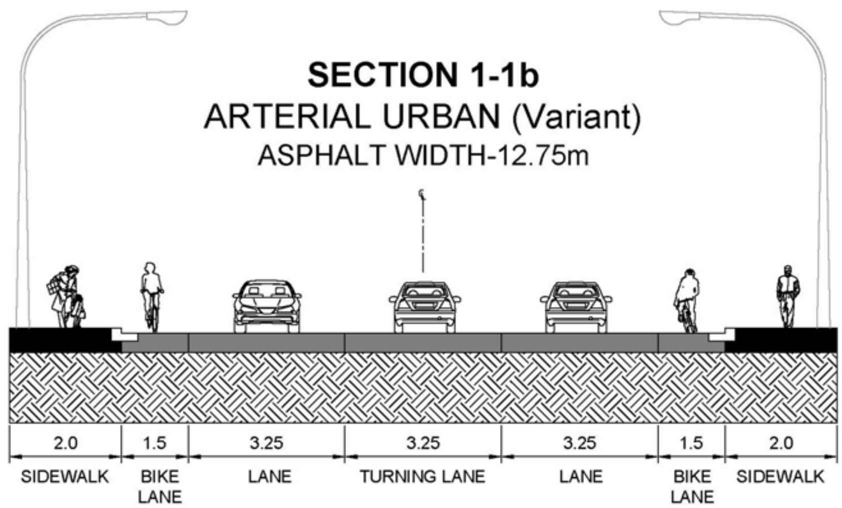
Functionality	Physical Description
• High Mobility • High Multi-Use / Vulnerable User Separation • Low User Conflicts	1-1 Arterial Road - Urban • Two lanes, 3.25m wide in both directions • Central turning lane, 3.25m wide • Bicycle lane adjacent to sidewalk on both sides to tie into bicycle master plan • 2.0m sidewalk on both sides to accommodate higher pedestrian movements and utility strip • Concrete curb and gutter is provided on both sides of the road • No on street parking/ loading provided • This is suitable for high volumes roads with sufficient ROW • Lane widths will vary based on available ROW and other road corridor conditions • Lights on power poles optional (one or both sides)

FIGURE 29: CROSS-SECTION 1-1



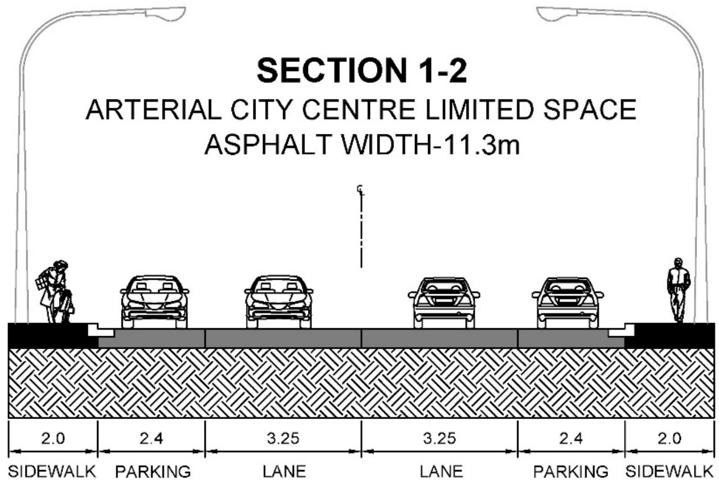
Functionality	Physical Description
• High Mobility • High Multi-Use / Vulnerable User Separation • Low User Conflicts • Wide Boulevard	1-1a Arterial Road - Urban (Variant) • Two lanes, 3.25m wide in both directions • Central turning lane, 3.25m wide • Bicycle lane adjacent to sidewalk on both sides to tie into bicycle master plan • 2.0m sidewalk on one side to accommodate higher pedestrian movements and utility strip • Concrete curb and gutter is provided on both sides of the road • Sidewalk/Wide Boulevard on one side only • No on street parking/ loading provided • This is suitable for high volumes roads with sufficient ROW • This currently applies to sections of 25th Avenue • Lights on power poles optional (one or both sides)

FIGURE 30: CROSS-SECTION 1-1A



Functionality	Physical Description
• High Mobility • High Multi-Use / Vulnerable User Separation • Low User Conflicts	1-1b Arterial Road - Urban (Variant) • One lane, 3.25m wide in each direction • Central turning lane, 3.25m wide • Bicycle lane adjacent to sidewalk on both sides to tie into bicycle master plan • 2.0m sidewalk on both sides to accommodate higher pedestrian movements and utility strip • Concrete curb and gutter is provided on both sides of the road • No on street parking/ loading provided • This is suitable for high volume urban roads with high demand for left turn movements, but with restricted ROW. • Lights on power poles optional (on one or both sides)

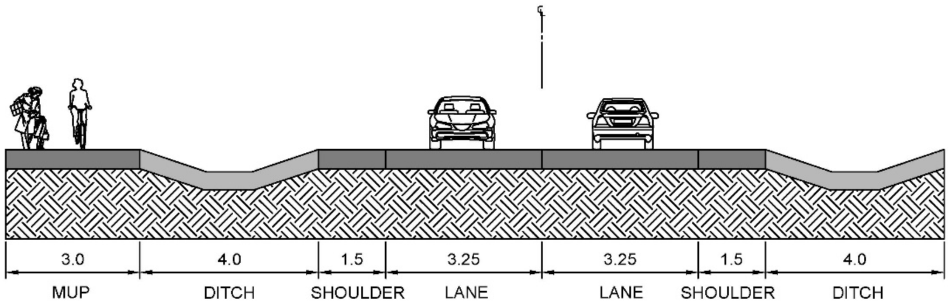
FIGURE 31: CROSS-SECTION 1-1B



Functionality	Physical Description
• High Mobility • Moderate to High Multi-Use / Vulnerable User Separation • Moderate User Conflicts • Parking Two Sides	1-2 Arterial Road - City Centre Limited Space • 2.0m sidewalk on both sides • This is suitable for high volume roads with tighter ROW provision, within the existing city centre.

FIGURE 32: CROSS-SECTION 1-2

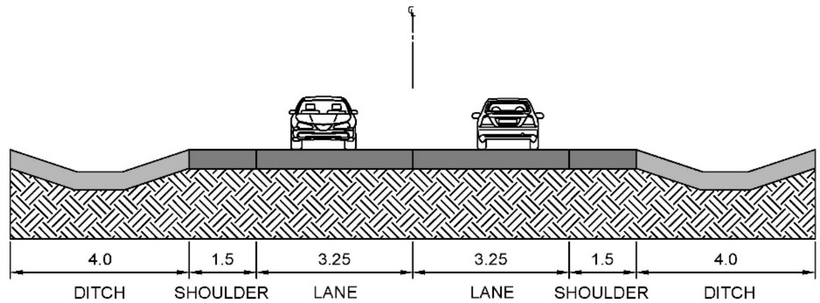
SECTION 1-3
ARTERIAL RURAL MUP
ASPHALT WIDTH-9.5m (MINIMUM)



Functionality	Physical Description
• High Mobility • Moderate Multi-Use / Vulnerable User Separation • Low User Conflicts	1-3 Arterial Road - Rural with Multi-Use Pathway • One lane, 3.25m wide in each direction • 1.5m shoulders on each side of the road • No on street parking/ loading provided • A separate 3.0m wide multi-use path is included to accommodate pedestrians and cyclists • Ditches are incorporated for the drainage requirements • Suitable for rural areas with high vehicle, pedestrian and cyclist volumes • 1.5m shoulder and ditch provides snow storage in winter

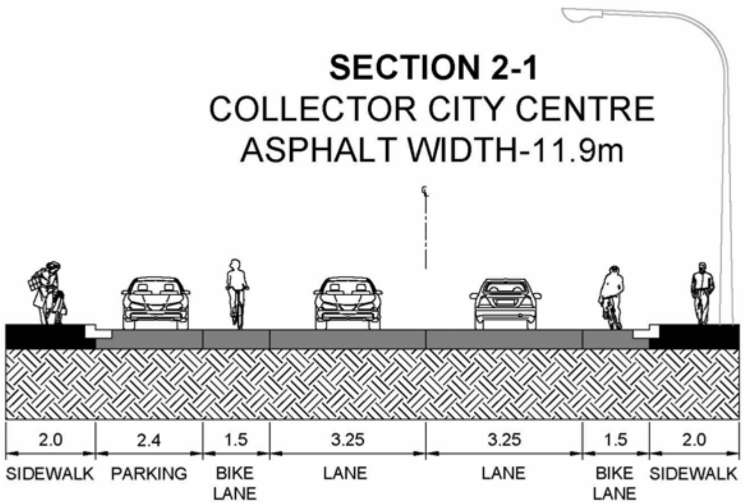
FIGURE 33: CROSS-SECTION 1-3

SECTION 1-4
ARTERIAL RURAL
ASPHALT WIDTH-9.5m (MINIMUM)



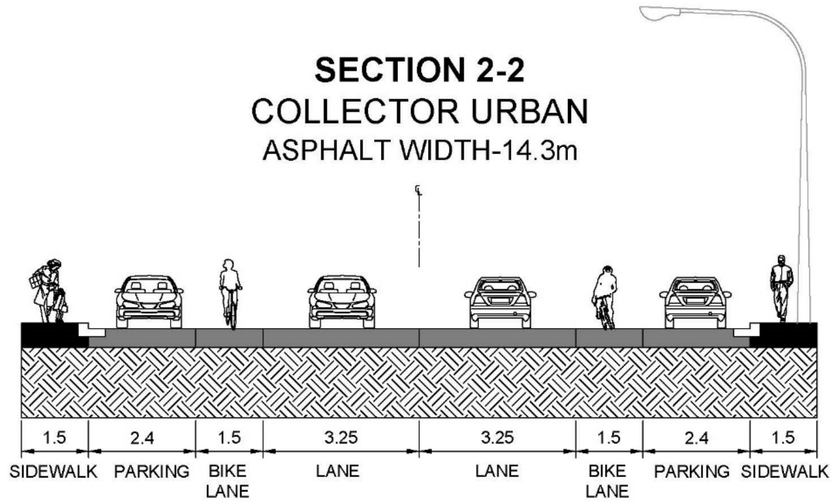
Functionality	Physical Description
• High Mobility • Moderate Multi-Use / Vulnerable User Separation • Moderate User Conflicts	1-4 Arterial Road - Rural • Same as Rural MUP (1-3) except the Multi-Use Path is not provided • Suitable for rural areas with only high vehicle volumes • 1.5m shoulders both on each side of the road • 1.5m shoulder and ditch provides snow storage in winter

FIGURE 34: CROSS-SECTION 1-4



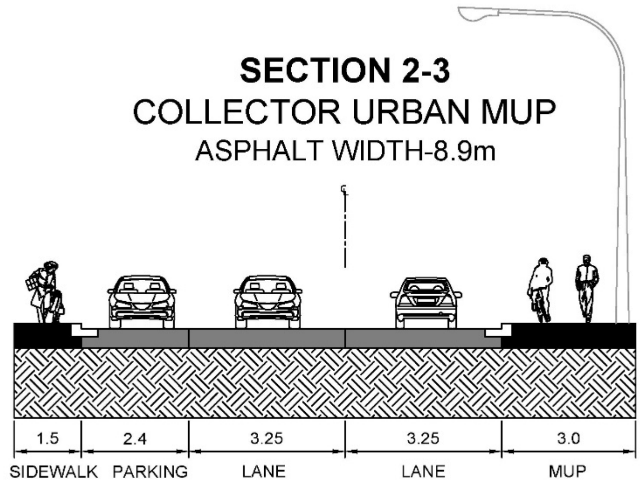
Functionality	Physical Description
• High Mobility • High Multi-Use / Vulnerable User Separation • Moderate User Conflicts • Parking one-side	2-1 Collector - City Centre • One lane, 3.25m wide in each direction • Parking provided on one side of the road • 2.0m Sidewalk on both sides to accommodate higher pedestrian movements and street furniture • Bicycle lane on travel lane side of parking on one side to tie into bicycle master plan • Concrete curb and gutter is provided on both sides of the road • This is suitable for roads with medium volume, low speed of vehicles, pedestrians and cyclists with tighter ROW provision, i.e. within the existing town centre. • Parking can be substituted for bicycle lanes • Light on power pole optional

FIGURE 35: CROSS-SECTION 2-1



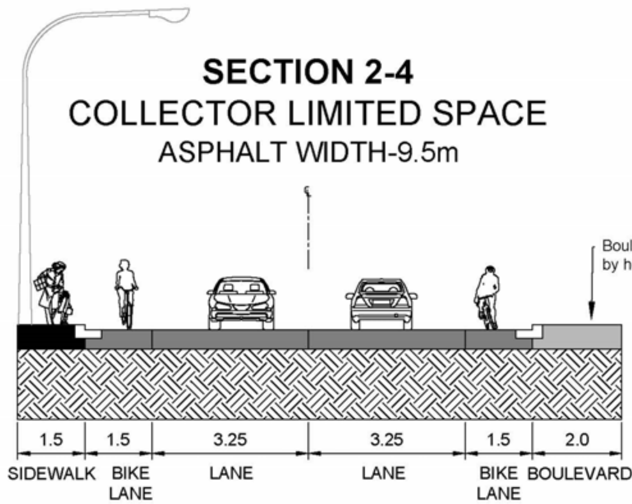
Functionality	Physical Description
• Moderate to High Mobility • Moderate Multi-Use / Vulnerable User Separation • Moderate User Conflicts • Parking two sides	2-2 Collector - Urban • Similar to the City Centre (2-1) cross section except parking both sides • This is suitable for roads with medium, low speed vehicle volumes and medium pedestrian volumes • Light on power pole optional

FIGURE 36: CROSS-SECTION 2-2



Functionality	Physical Description
• Moderate to High Mobility • High Multi-Use / Vulnerable User Separation • Low User Conflicts • Parking one-side	2-3 Collector - Urban with Multi-Use Pathway • One lane, 3.25m wide in each direction • Parking provided on one side of the road only • This cross section includes a separate 3.0m wide multi-use pathway rather than a bicycle lane beside a traffic lane • This is suitable for roads with higher cyclist and pedestrian volumes and ties in with the bicycle master plan. This is suitable where the cyclists are less confident and feel safer with the separation from the traffic lanes • The parking lane and the sidewalk should be provided on the same side of the road • No winter snow storage unless there is a parking ban, one side only

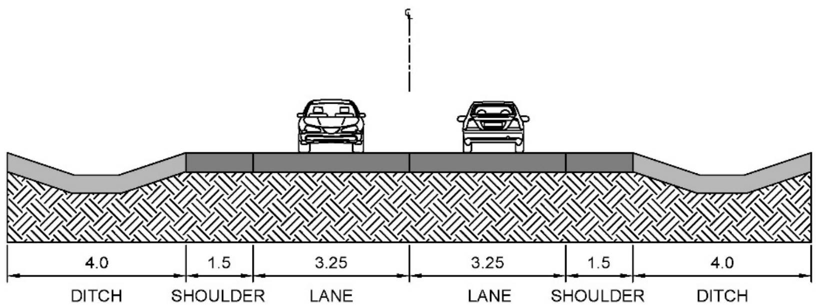
FIGURE 37: CROSS-SECTION 2-3



Functionality	Physical Description
• Moderate to High Mobility • High Multi-Use / Vulnerable User Separation • Low User Conflicts	2-4 Collector - Limited Space • One lane, 3.25m wide in each direction • One 1.5m sidewalk • Concrete curb and gutter is provided on both sides of the road • No on street parking/ loading provided • Separate bicycle path facility is provided • This cross section is suitable for roads with medium traffic, and pedestrians, but high cyclist volumes. Constrained ROW • No winter snow storage, snow storage will reduce functional lane widths in winter • Light on power pole optional

FIGURE 38: CROSS-SECTION 2-4

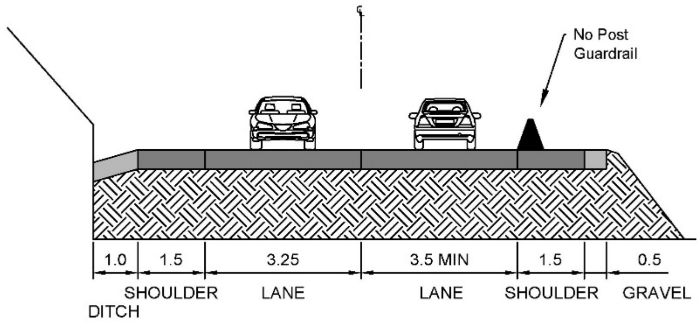
SECTION 2-5
COLLECTOR RURAL
APSHALT WIDTH-9.5m (MINIMUM)



Functionality	Physical Description
• High Mobility • Moderate Multi-Use / Vulnerable User Separation • Moderate User Conflicts	2-5 Collector - Rural • One lane, 3.25m wide in each direction • 1.5m shoulders on each side of the road • No on street parking/ loading provided • No separate bicycle facility is provided, but cyclists are able to use the shoulder. • Ditches are incorporated for the drainage requirements • Suitable for rural areas with medium vehicle volume and low to medium cyclist volumes • 1.5m shoulder and ditch provides snow storage in winter

FIGURE 39: CROSS-SECTION 2-5

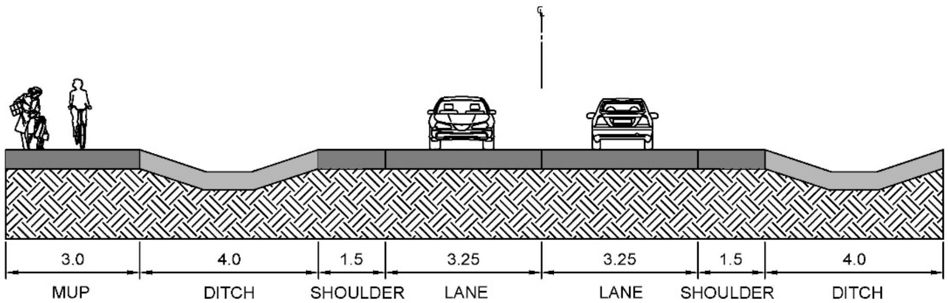
SECTION 2-5a
COLLECTOR RURAL (Variant)
APSHALT WIDTH-9.75m (MINIMUM)



Functionality	Physical Description
• High Mobility • Moderate Multi-Use / Vulnerable User Separation • Moderate User Conflicts	2-5a Collector - Rural (Variant) • One lane 3.5m wide, other lane 3.25m wide • 1.5m shoulders on each side of the road • 0.5m gravel or 1.0m ditch before hillside • No-Post guardrail on one side • No on street parking/ loading provided • No separate bicycle facility is provided, but cyclists are able to use the shoulder. • Ditches are incorporated for the drainage requirements • Suitable for rural areas with medium vehicle volume and low to medium cyclist volumes • 1.5m shoulder, 0.5m gravel, and ditch provides snow storage in winter

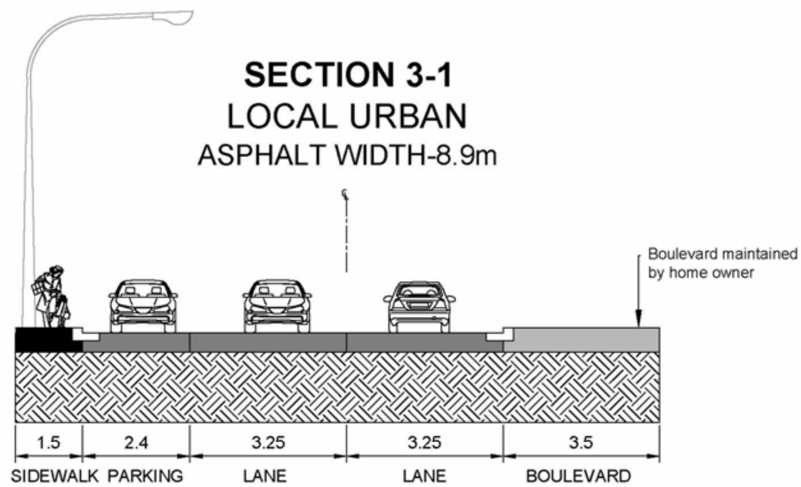
FIGURE 40: CROSS-SECTION 2-5A

SECTION 2-6
COLLECTOR RURAL MUP
ASPHALT WIDTH-9.5m (MINIMUM)



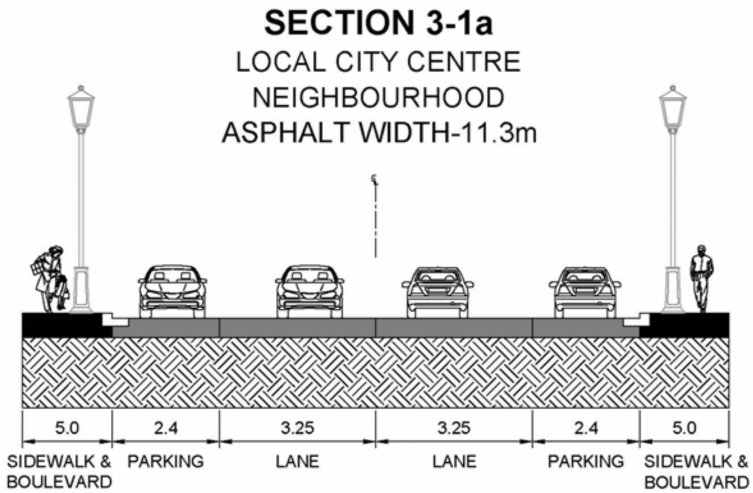
Functionality	Physical Description
• High Mobility • Moderate Multi-Use / Vulnerable User Separation • Low User Conflicts	2-6 Collector Road - Rural with Multi-Use Pathway • One lane, 3.25m wide in each direction • 1.5m shoulders on each side of the road • No on street parking/ loading provided • A separate 3.0m wide multi-use path is included to accommodate pedestrians and cyclists • Ditches are incorporated for the drainage requirements • Suitable for rural areas with high vehicle, pedestrian and cyclist volumes • 1.5m shoulder and ditch provides snow storage in winter

FIGURE 41: CROSS-SECTION 2-6



Functionality	Physical Description
• High Property Access • Moderate Multi-Use / Pedestrian Separation • Moderate User Conflicts • Parking One Side	3-1 Local - Urban • 3.25m wide traffic lane in each direction as the volumes and speeds will be lower • This cross section provides one parking lane and one 1.5m sidewalk. The parking lane and the sidewalk should be provided on the same side of the road • Separate bicycle path facility is not provided in this cross section, cyclists travel beside vehicle traffic • Concrete curb and gutter is provided on both sides of the road (Asphalt curb may be substituted) • This is suitable for residential areas where there are low volumes and low speeds • Light on power pole optional

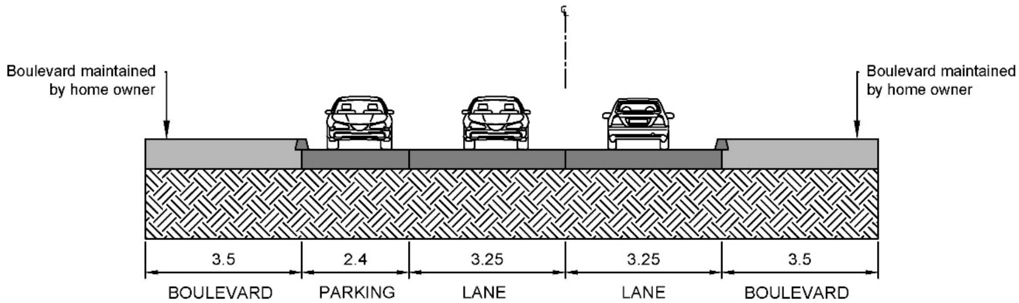
FIGURE 42: CROSS-SECTION 3-1



Functionality	Physical Description
• High Property Access • High Multi-Use / Pedestrian Separation • Moderate User Conflicts • Parking Two Sides	3-1a Local - City Centre Neighbourhood • This is a special cross section to allow for uniqueness of the historic down town roads • Ornamental streetlights at 28m spacing (both sides) • Lanes at 3.25m in each direction • Includes a 5.0m sidewalk / boulevard on both sides • Includes equivalent of a 2.0m boulevard strip with landscaping on both sides as part of the 5.0m sidewalk / boulevard. • Concrete curb and gutter is provided on both sides of the road • Bicycle path facility is not provided in this cross section

FIGURE 43: CROSS-SECTION 3-1A

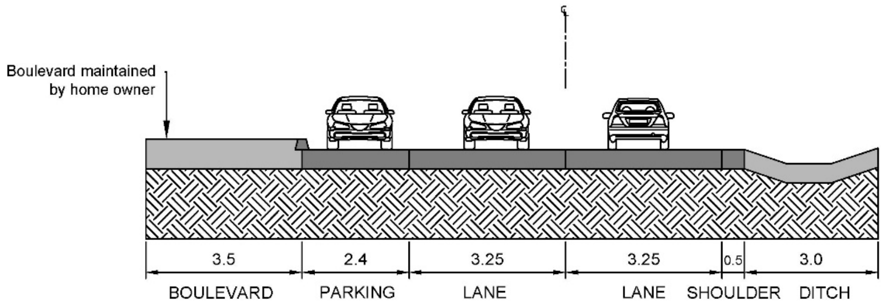
SECTION 3-2
LOCAL NO SIDEWALK
ASPHALT WIDTH-8.9m



Functionality	Physical Description
• High Property Access • Moderate to High Multi-Use / Vulnerable User Separation • Moderate User Conflicts • Parking One Side	3-2 Local - No Sidewalk • One, 3.25m traffic lane in each direction • Asphalt curb is provided on both sides of the road • This cross section is suitable where this is constrained ROW provision and very low pedestrian volumes • Pedestrians and cyclists travel beside traffic • In winter, parking ban will provide some space for snow storage. • Light on power pole optional

FIGURE 44: CROSS-SECTION 3-2

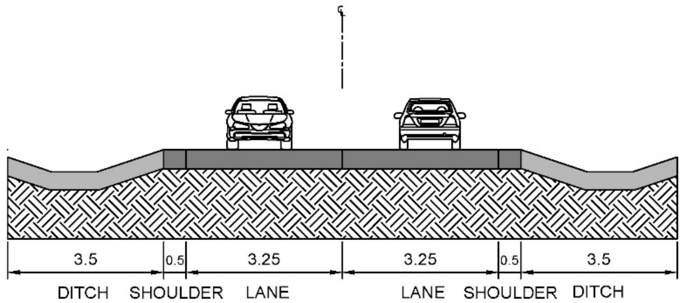
SECTION 3-2a
LOCAL RESIDENTIAL (Variant)
ASPHALT WIDTH-9.4m



Functionality	Physical Description
• High Property Access • Moderate to High Multi-Use / Vulnerable User Separation • Moderate User Conflicts • Parking One Side	3-2a Local - Residential (Variant) • One lane, 3.25m traffic lane in each direction • Asphalt curb is provided on one side of the road • 0.5m paved shoulder one side • This cross section is suitable where there is a constrained ROW provision and very low pedestrian volumes • Pedestrians and cyclists travel beside traffic • In winter, parking ban and ditch will provide some space for snow storage. • Light on power pole optional

FIGURE 45: CROSS-SECTION 3-2A

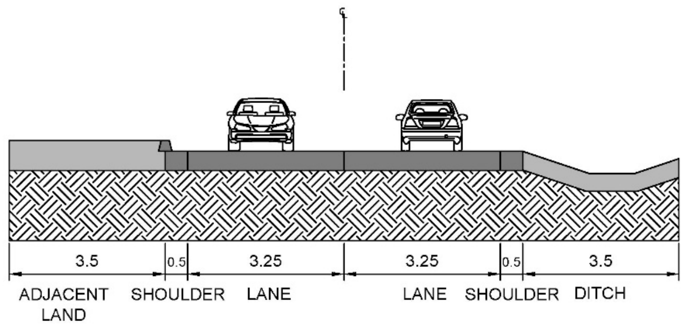
SECTION 3-3
LOCAL RURAL
ASPHALT WIDTH-7.5m



Functionality	Physical Description
• Mobility and Property Access • Low Multi-Use • Low User Conflicts	3-3 Local - Rural • One lane, 3.25m traffic lane in each direction • 0.5m paved shoulders on each side of the road • Ditches are incorporated for the drainage requirements • This cross section is suitable for low volume roads in a rural setting, i.e. agricultural land uses or low density residential • 0.5m shoulder and ditch provides snow storage in winter

FIGURE 46: CROSS-SECTION 3-3

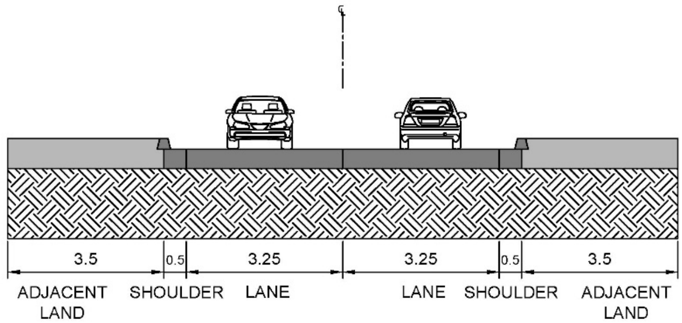
SECTION 3-3a
LOCAL RURAL CURB ONE SIDE NO PARKING
ASPHALT WIDTH-7.5m



Functionality	Physical Description
• Mobility and Property Access • Low Multi-Use • Low User Conflicts	3-3a Local - Rural (Curb one side, no parking) • One lane, 3.25m traffic lane in each direction • 0.5m paved shoulders on each side of the road • Asphalt curb on one side of the road • Ditch is incorporated for the drainage requirements • This cross section is suitable for low volume roads in a rural setting, i.e. agricultural land uses or low density residential • 0.5m shoulder and ditch provides snow storage in winter

FIGURE 47: CROSS-SECTION 3-3A

SECTION 3-3b
LOCAL RURAL CURB BOTH SIDES NO PARKING
ASPHALT WIDTH-7.5m

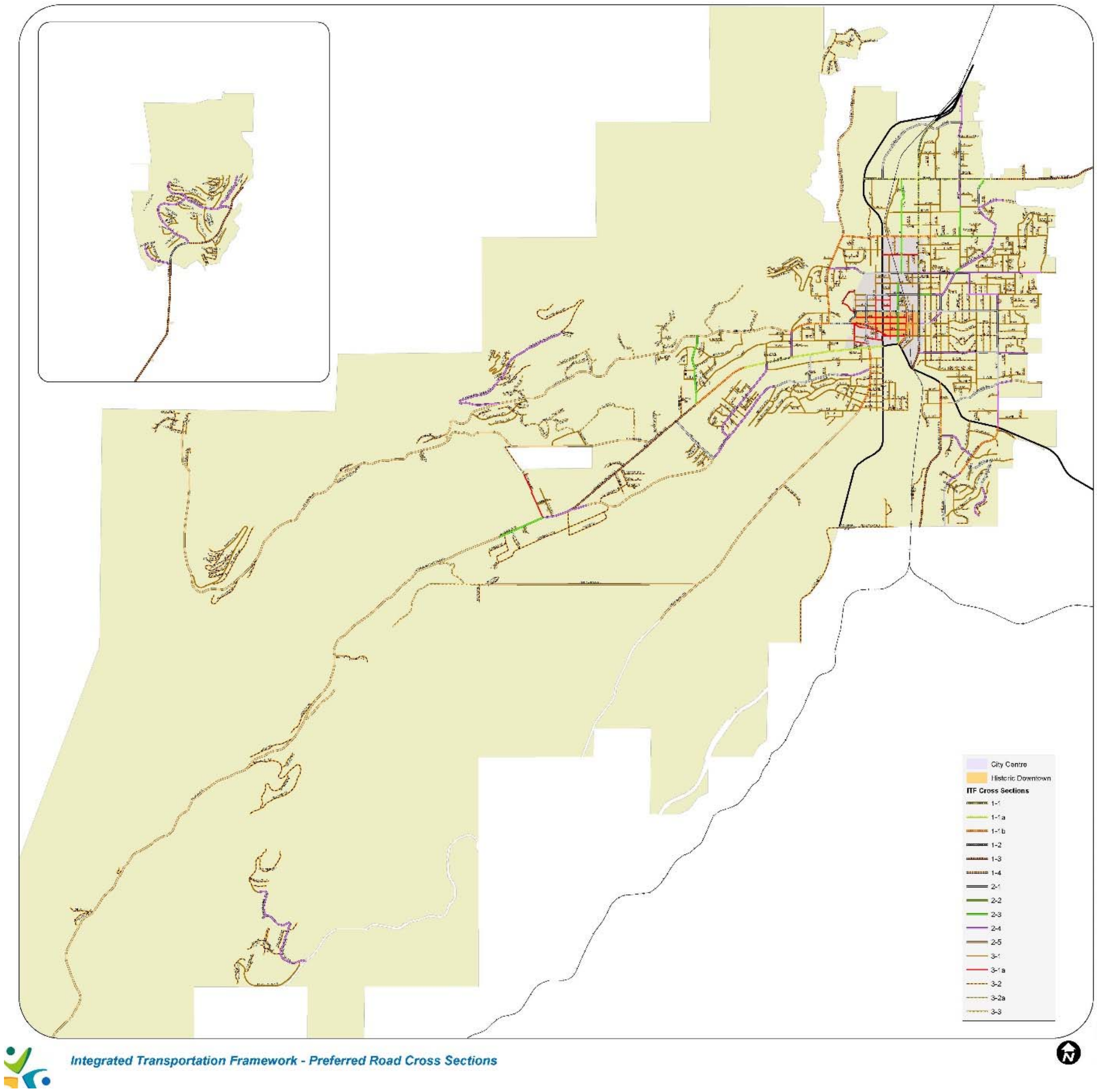


Functionality	Physical Description
• Mobility and Property Access • Low Multi-Use • Low User Conflicts	3-3b Local - Rural (Curb both sides, no parking) • One lane, 3.25m traffic lane in each direction • 0.5m paved shoulders on each side of the road • Asphalt curb on each side of the road • This cross section is suitable for low volume roads in a rural setting, i.e. agricultural land uses or low density residential

FIGURE 48: CROSS-SECTION 3-3B

10.0 APPENDIX B – MAP OF CITY ROADS AND CROSS-SECTIONS

Large format attached map (36” x 36”), available as separate document



11.0 APPENDIX C – PUBLIC OUTREACH

INTEGRATED TRANSPORTATION FRAMEWORK

CITY OF Vernon

The City of Vernon is developing an Integrated Transportation Framework that will establish a consistent and affordable roadway system for different types of users now and into the future.

Staff will be available to answer questions and explain some of the ideas the City of working towards in developing the framework and invite you to attend an open house

OPEN HOUSE

Wednesday, November 27
Vernon Rec Centre Auditorium, 3310 37 Ave
5:00 p.m. - 7:00 p.m.

INTEGRATED TRANSPORTATION FRAMEWORK EXPLAINED

The ITF Explained

Much of the Vernon's public infrastructure were constructed in the 1950s & 1960s

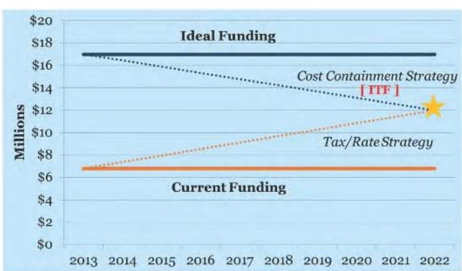
$1 today was valued at 10 ¢ at that time:

- Gallon of gas was $0.31 ($0.08 litre)
- New car was $2,500
- New home was $15,000

Infrastrucutre funding has not, and probably could not keep up with rising prices.

It is very likely, with today's cost of living, that communities such as the Vernon would look very different than they do today.

The Integrated Transporation Framework is developing strategies that the City of Vernon can use to reduce the cost of roadway replacement, rehabilitation and maintenance

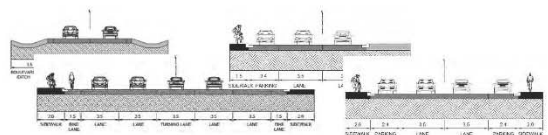


ITF Strategies

Understand the detailed costs of each type of roadway function

- Arterial Roads - $$$
- Collector Roads - $$
- Local Roads - $

Develop various road corridor designs

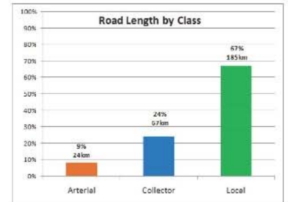


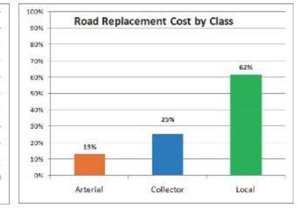
Identify cost saving opportunities

Do you know:

- Typical sidewalk installation (one side) costs $274,000 per kilometre
- Planting trees along both sides of a road costs $62,000 per kilometre
- Adding a parking lane to a local road costs $206,000 per kilometre

- Projected revenue insufficient to cover planned expenses
- Increasing taxes is not going to solve the problem (there is a limit)
- A cost containment strategy (the ITF) is required to solve the problem





ITF Goals

Develop a long-term financially sustainable strategy for the maintenance and replacement of our roadways

- A plan of future preferred roadway classifications
- A plan of future preferred roadway function

Use the results of the ITF to develop a long-term roadway renewal plan

Preferred Road Classifications

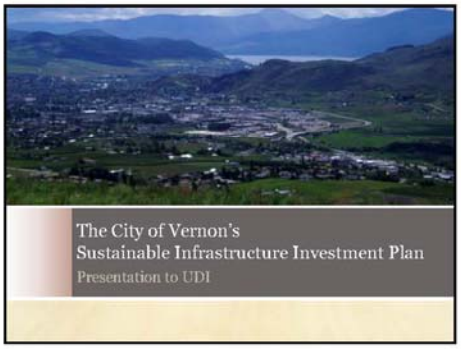
CITY OF Vernon

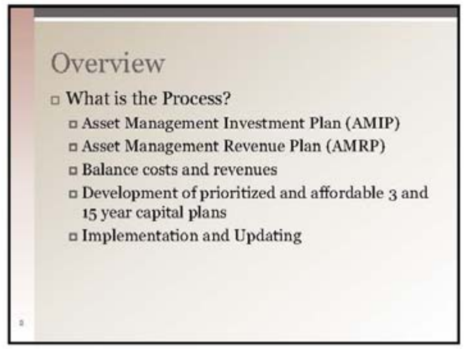
CONTACT

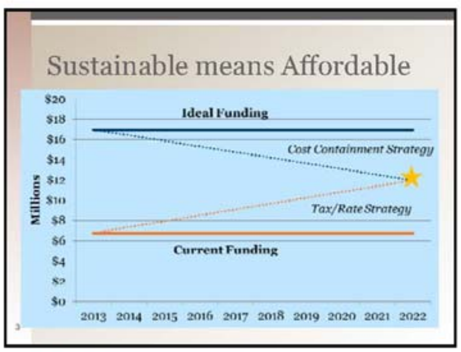
Phone: 250.550.3622 Fax: 250.545.5309
E-mail: cthompson@vernon.ca | www.vernon.ca

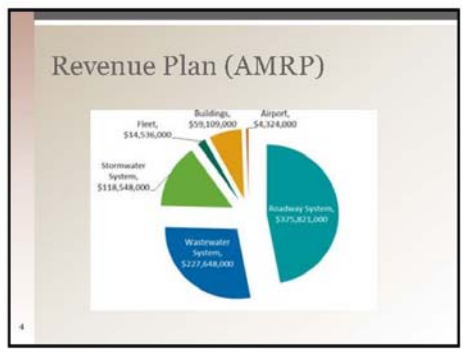
12.0 APPENDIX D – UDI PRESENTATION

8/27/2014

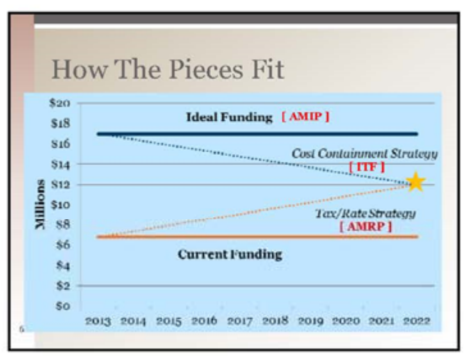

The City of Vernon's
Sustainable Infrastructure Investment Plan
Presentation to UDI


Overview
What is the Process?
Asset Management Investment Plan (AMIP)
Asset Management Revenue Plan (AMRP)
Balance costs and revenues
Development of prioritized and affordable 3 and 15 year capital plans
Implementation and Updating


Sustainable means Affordable
Ideal Funding
Cost Containment Strategy
Tax/Rate Strategy
Current Funding
Millions
$20
$18
$16
$14
$12
$10
$8
$6
$4
$2
$0
2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Revenue Plan (AMRP)
Fleet, $14,536,000
Buildings, $59,109,000
Airport, $4,324,000
Stormwater System, $118,548,000
Roadway System, $375,821,000
Wastewater System, $227,648,000


Revenue Plan (AMRP)
Weighted Life of Infrastructure: 47 years
Average Remaining Life: 51%
Infrastructure Renewal Contribution: $17 M


How The Pieces Fit
Ideal Funding [AMIP]
Cost Containment Strategy
[ITF]
Tax/Rate Strategy
[AMRP]
Current Funding
Millions
$20
$18
$16
$14
$12
$10
$8
$6
$4
$2
$0
2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

1

8/27/2014

AMRP

- 20 year 'funding cash flow' analysis
- Calculates revenues
  - Rates, taxes, fees, DCCs, grants
  - Uses population growth scenario
- Uses all infrastructure related costs
  - Future improvement costs
  - AMIP renewal costs
  - Operations & maintenance costs

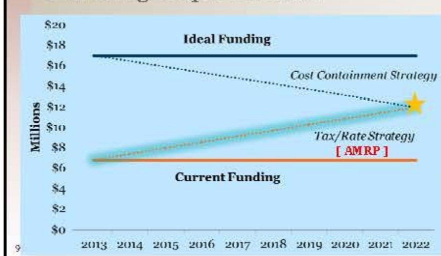
7

Sustainability Gap

- Projected revenue insufficient to cover planned expenses
- Major challenges include the infrastructure renewal contribution and current backlog
- Cash flow challenges over next 10 years even without addressing the infrastructure renewal contribution and current backlog
- Losing ground, not sustainable

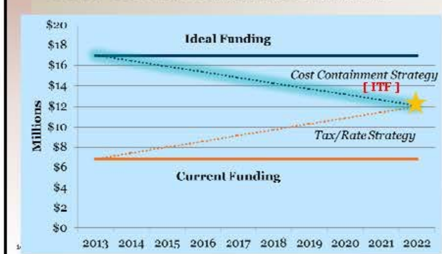
8

Funding Gap Solutions



9

Cost Containment Solutions



ITF Rationale

- Key recommendation from the City's Strategic Infrastructure Investment Plan (SIIP)
  - Roadway system value is $376 million
  - Average remaining life is 48%
  - Work backlog is $41 million
  - Need to balance costs against funding

11

ITF Scope

- Reconcile and streamline roadway system classification hierarchy
  - Arterial, collector and local roads
- Identify consistent and affordable roadway cross-sections for each road classification
  - Lanes, parking, bike lanes, sidewalks, pathways
  - Lighting, landscaping, snow storage
- Identify related maintenance, renewal and improvement costs

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2

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Guiding Principles

- Build on OCP vision
- Road system must accommodate all users
  - Vehicles
  - Bicycles
  - Pedestrians
- Recommendations must be affordable, implementable and sustainable
- Recommendations to be a collaborative effort between City departments

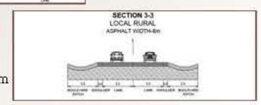
13

Cost versus Function

- ITF uses 17 cross-sections
  - In general, decrease in level of function and cost

From @ $3.45million/km

To @ $0.72million/km



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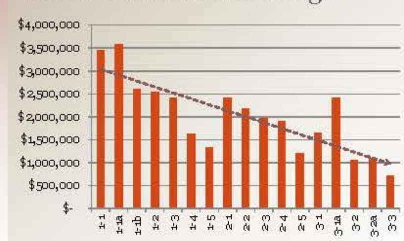
Cross-Section Descriptions

Cross-Section Code	Cross-Section Classification	Cross-Section Description
1-1	Arterial	Urban
1-1a	Arterial	Urban (variant)
1-1b	Arterial	Urban (variant)
1-2	Arterial	City Centre
1-3	Arterial	City Centre Limited Space
1-4	Arterial	Rural MUP
1-5	Arterial	Rural
2-1	Collector	City Centre
2-2	Collector	Suburban
2-3	Collector	Urban MUP
2-4	Collector	Limited Space
2-5	Collector	Rural
3-1	Local	Urban
3-1a	Local	Historic Downtown
3-2	Local	Hillside
3-2a	Local	Hillside (variant)
3-3	Local	Rural

15

Cross-Section Cost Range



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Cross-Section Cost Impact

- What is all Local Roads were section 3-3?
  - ITF value drops from $429M to $305M
  - Average weighted life of local road = 70 years
  - City savings = $1.8 M/year

Classification	Current Length (km)	Current Value (millions)	ITF Length (km)	ITF Value (millions)	If All Locals 3-3 (millions)
Arterial	63	$103	23	$56	$56
Collector	41	$53	67	$109	$109
Local	171	$173	185	$264	$140
Totals	**275**	**$329**	**275**	**$429**	**$305**

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ITF Model Capability

- Detailed valuation of current roadway system by roadway element
- Forecast future maintenance and capital costs for system improvements
  - Parking, bike lanes, sidewalks, pathways, landscaping, pathways, boulevards, etc.
- Can adjust roadway element dimensions to test for affordability
- Can produce a 20 year capital plan

18

3

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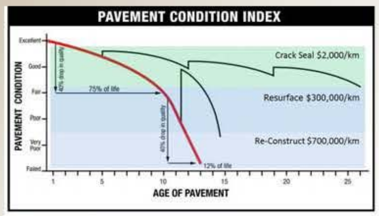
Improvements versus Renewal



19

ITF Priority Setting

- ITF Model sensitive to staff and Council priority preferences
  - Road class, condition and deterioration
  - Active transportation and use
  - School zones
  - Trucking and transit routes
  - Land use

20

Process Next Steps

- Balance costs against forecast funding in ITF Model
- Identify potential cost saving measures
- Identify optimum funding range
- Present ITF rationale to select stakeholders
- Present ITF rationale at Open House
- Workshop ITF recommendations and public feedback with Council
- Finalize ITF in December 2013

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Balancing Next Steps

- Revenue Generation
  - Grants (lobby FCM/UBCM), Financing, Rate/Tax Adjustments (Newly endorsed 1.9% tax Policy), Economic Development
- Cost Containment
  - Improve maintenance management, adjust levels of service, increase risk (project deferral), refine system capacity, protect reserves, economies of scale
- Triple Bottom Line Approach to Capital Planning

22

Discussion and Feedback

23

4

13.0 APPENDIX E - LITERATURE CITED

ARRA, 2001. Basic Asphalt Recycling Manual, Asphalt Recycling and Reclaiming Association, Maryland, U.S.A.

Reuse and Recycling of Road Construction and Maintenance Materials, 2005. National Guide to Sustainable Municipal Infrastructure (InfraGuide)

14.0 APPENDIX F – ITF DETAILED METHODOLOGY

The ITF consists of a 10 Step process that starts with the City's road way vision (see Figure 49). This Phase 2 consisted of Steps 1 to 3 and 5 to 10, as Step 4 was completed during Phase 1. It is important to note that the methodology starts and ends with the strategic vision, by either confirming the vision's affordability, or modifying the vision to be affordable.

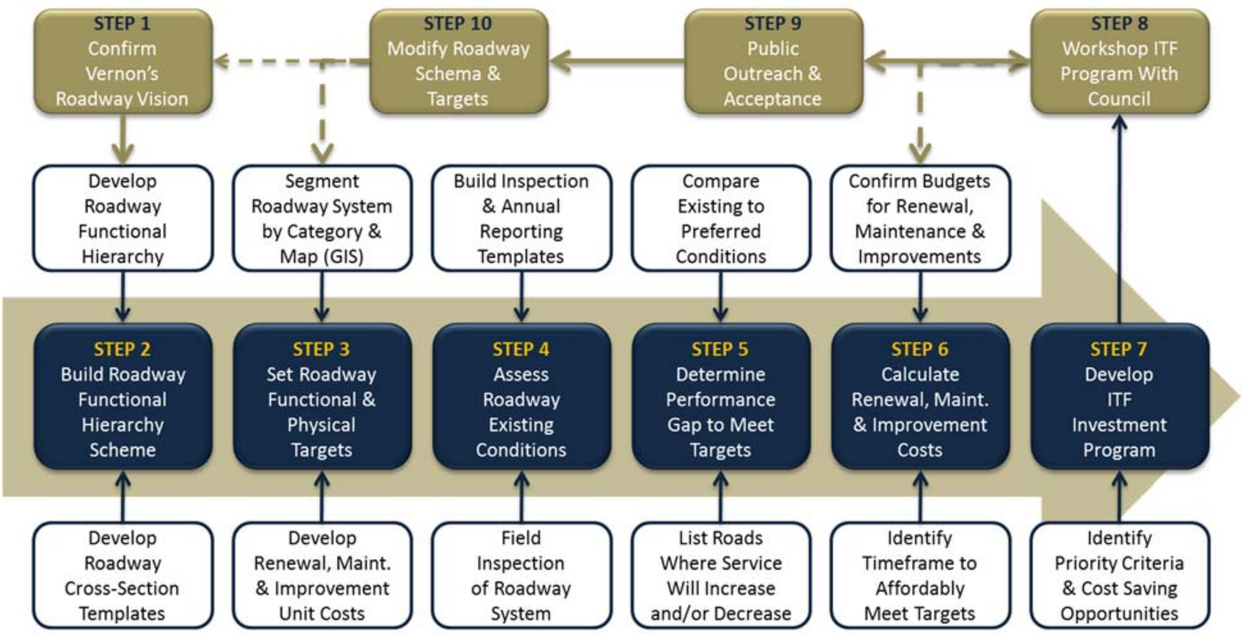


FIGURE 49: ITF METHODOLOGY

Confirm/Adjust Roadway Vision (Step 1)

A roadway vision is very important to both the design and implementation of the ITF findings by providing staff the guidance they need to develop the details in the initial ITF iteration, and to protect staff while implementing the ITF findings.

The vision is the starting point in the development of the roadway hierarchy and preferred cross-section templates. After Step 10 it may be necessary to adjust the transportation vision, which will enable the final and affordable iteration through the ITF Steps to produce the final ITF that is to be implemented.

Confirm/Adjust Roadway Hierarchy and Functionality (Steps 2 & 3)

Developing Road Hierarchy & Functionality Criteria

Having a roadway hierarchy with sub-classifications is very important to developing an ITF as they present a sub-hierarchy with a decreasing function and therefore costs. This enables the design roadway cross-sections for each of these sub-classifications. For example:

- Arterial 1 with top functionality (sidewalks, lights, paths, lane widths, etc.): Unit Cost = $A;
- Arterial 2 with less functionality than 1.1: Unit Cost <$A;
- Arterial 3 with less functionality than 1.2: Unit Cost <<$A;
- Collector 1 with top functionality (sidewalks, paths, lane widths, etc.): Unit Cost = $B < $A;
- Collector 2 with less functionality than 2.1: Unit Cost <$B;
- Collector 3 with less functionality than 2.2: Unit Cost <<$B;
- Local 1 with top functionality (sidewalks, paths, lane widths, etc.): Unit Cost = $C < $B;
- Local 2 with less functionality than 3.1: Unit Cost <$C; and
- Local 3 with less functionality than 3.1: Unit Cost <<$C.

The number of levels in each classification depends upon the make-up of the City's current road system, and anticipating what will be required for the future ITF system. As part of this exercise the service life for road surface and base is set upon the sub-classification hierarchy. This means that higher classified roadways get the greatest renewal attention, while the lowest classified roadways are expected to deteriorate a bit more prior to renewal.

Using Hierarchy Criteria to Set Roadway Cross-Sections

With the roadway sub-classifications complete, roadway cross-sections for each classification are developed using the described functionality. Costs for the cross-sectional elements rather than the entire cross-section are developed; this is useful when renewing a roadway segment that is also to be upgraded; only the incremental cost of the upgrade would be included in the ITF investment plan in Step 7, unless the road improvement is a stand-alone project. This approach provides for the most cost-effective and accurate ITF investment plan. Figure 50 presents an example of component costing for the cross-section examples shown in Figure 51 and Figure 52.

Cross-Section 1-0			Cross-Section 3-0		
Item	Material	Cost/km	Item	Material	Cost/km
Road Surface	Asphalt	$ 518,000	Road Surface	Asphalt	$ 192,000
Road Base	Gravel	$ 728,000	Road Base	Gravel	$ 332,800
Curb & Gutter	Concrete	$ 165,000	Shoulder	Gravel	$ 15,000
Sidewalk	Concrete	$ -	Sidewalk	Concrete	$ -
Pathway	Brick	$ 575,000	Pathway	Brick	$ -
Lighting @ 50m	TBD	$ 260,000	Lighting @ 50m	TBD	$ -
Ditching	Earth	$ -	Ditching	Earth	$ 20,000
Total		**$2,246,000**	**Total**		**$ 559,800**

FIGURE 50: COMPONENT COSTING OF IMPROVEMENTS EXAMPLE

Cross-section detail is kept to a minimum, e.g. focus on the basics, so as not to overwhelm the public with extraneous design detail at this time. These details can be put into the cross-sections when a recommended improvement option becomes a project and goes to design.

Two examples of cross-sections are shown in Figure 51 and Figure 52.

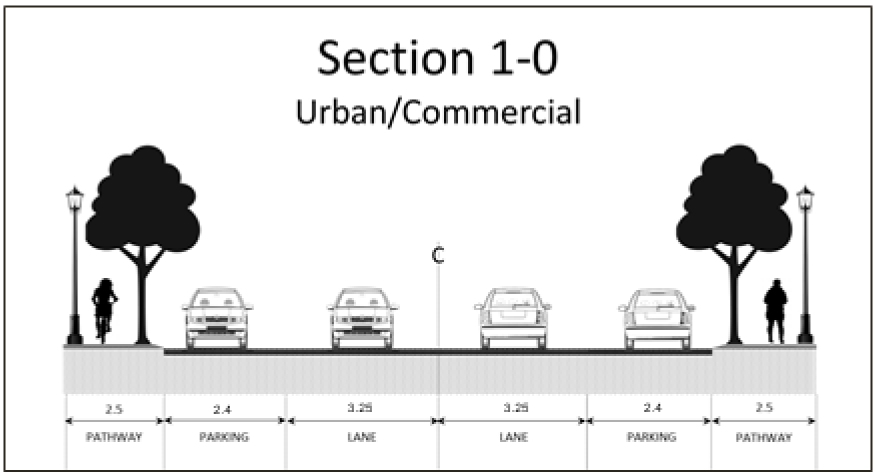


FIGURE 51: HIGH-END CROSS-SECTION EXAMPLE

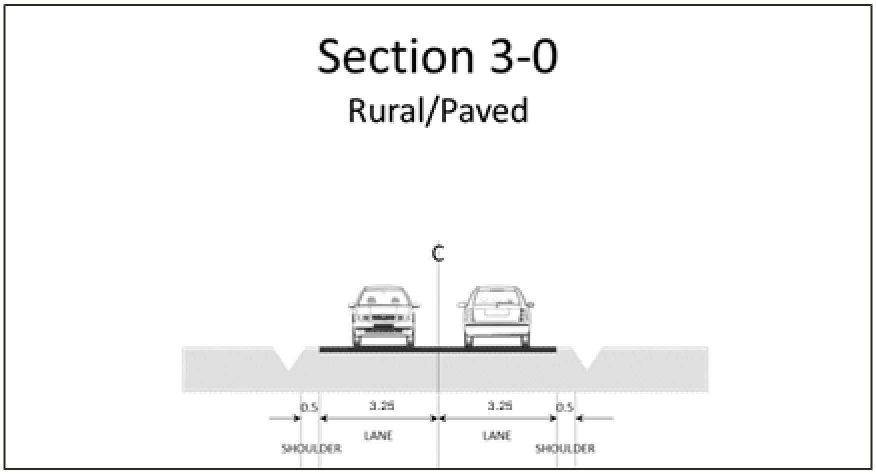


FIGURE 52: LOW-END CROSS-SECTION EXAMPLE

Assessing Roadway Existing Conditions (Step 4)

Assessing roadway conditions was completed during ITF. City roadways were divided into 2,028 segments and assessed using an inspection form similar to the example to the right.

Each roadway cross-section element was measured and its construction materials recorded:

- Lanes;
- Parking;
- Shoulders;
- Boulevards;
- Sidewalks;
- Drainage structure; and
- Streetlights.

Asphalt surfaces were also assessed for defect and defect severity:

- Cracking;
- Settlement and heaving;
- Potholes;
- Patch condition; and
- Rutting.

Distresses were then entered into the ITF database.

[redacted] DATE: EVALUATOR:

STREET: Pollard Road

FROM: Highway 97 TO: Cul-de-sac

ITEM	LEFT S/W	LEFT SURFACE DRAINAGE	LEFT SHOULDER	ROAD	RIGHT SHOULDER	RIGHT SURFACE DRAINAGE	RIGHT S/W
CONDITION RATING	YES NO CONCRETE ASPHALT GRAVEL 1 2 3	CURB CONC. DITCH ASPHALT NONE 1 2 3	PAVED GRAVEL ANGLE* PARALLEL* RT ANGLE* N/A*	PAVED GRAVEL SEAL COAT 1 2 3	PAVED GRAVEL ANGLE* PARALLEL* RT ANGLE* N/A*	CURB CONC. DITCH ASPHALT NONE 1 2 3	YES NO CONCRETE ASPHALT GRAVEL 1 2 3

*PARKING 15

LANE WIDTH S/W BOULEVARD PARKING OR SHOULDER ROAD CROWNED CROSSFALLED PARKING OR SHOULDER BOULEVARD S/W

SECTION A-A

DITCH WIDTH (METRES) LEFT STREETLIGHTS ON POWER POLE SEPARATE POLE RIGHT STREETLIGHTS ON POWER POLE SEPARATE POLE

PAVEMENT SURFACE		PREVIOUS CONDITION ASSESSMENT
CONDITION	RATING	BY: CTQ DATE: 13/05/2009
ALLIGATOR	1 2 3	INVENTORY:
MAP	1 2 3	ROAD ID: 1510
TRAVERSE	1 2 3	ROAD: POLLARD RD
LONGITUDINAL	1 2 3	SURFACE: SOUND
RUTTING	1 2 3	FROM: MAIN
RAVELING	1 2 3	TO: POLLARD CLASS: LOC
FROST HEAVE	1 2 3	KM FROM: 0 LENGTH: 200
SETTLING	1 2 3	KM TO: 0.2 WIDTH: 15
PATCHING	1 2 3	

SURFACE COMMENTS:

ASSESSMENT:
SURROUNDING: URBAN
DRAINAGE: WELL DRAINING
SURFACE: SOUND
TERRAIN: LOWLANDS/VALLEY
EMBANKMENT FILL: 50
EMBANKMENT CUT: 50

OPERATIONAL ISSUES:

SHEET GRID: 626
100530-04ROAD95-00140

SHOULDERS VARY FROM PAVED SHOULDER RT SIDE FOR PARKING FOR CLINIC.

Setting Initial Targets and Identifying the Gaps (Step 5)

Identifying Improvement Gaps

An initial pass at identifying the roadway improvement gaps is done by comparing the preferred roadway hierarchy with the existing sub-classification for each roadway segment. By making this comparison it is possible to determine what roadway segments need to increase or decrease in sub-classification.

Confirming/Adjusting Renewal Requirements

Using the City's Asset Management model and road inspection assessments as a base, the new sub-classification service lives previously developed can be incorporated and the optimum renewal dates and roadway renewal backlog re-calculated. Knowing the optimum dates for renewal will assist in selecting the corresponding improvement date, as road improvements will likely be delivered during renewal to save money.

Identifying Maintenance Gaps

Using the City's new roadway maintenance contract it is possible to determine what is spending on winter and non-winter maintenance by road segment. These costs are then compared to the maintenance costs from other municipalities and best practices to establish any maintenance funding gaps associated with the following maintenance services:

1. Surface Maintenance;
2. Water Drainage;
3. Roadside Maintenance;
4. Traffic Maintenance;
5. Structure Maintenance;
6. Emergency Maintenance; and
7. Winter Maintenance.

Each of these 7 maintenance service categories is then sub-divided into its baseline services (Figure 53), and the benefit of each is calculated in terms of: safety, road preservation, user comfort and aesthetics.

FIGURE 53: ROAD SURFACE MAINTENANCE BENEFITS

This enables the calculation of the dollar value of each maintenance service and benefit which assists budget deliberations, and will help with maintenance program presentations to the public.

Estimating Needs Costs (Step 6)

Improvement Costs

Using the unit costs developed in Step 3 roadway improvement costs can be determine as: 1) a set with all improvements at full cost as stand-alone projects; and 2) a set with improvements at only incremental cost being delivered with roadway renewal.

Renewal Costs

The data for road renewal costs is based upon the field work conducted during the ITF Phase 1 (Roadway Condition Assessments), and enhanced through the ability to provide more detailed estimates of the individual elements of each roadway cross-section. These costs are also adjusted based upon terrain, e.g. hard or easy construction.

Maintenance Costs

In the City’s case, roadway maintenance costs were highly detailed due to the recent tendering of several components of its road maintenance services. These costs are then compared to those of other eastern and western Canadian communities for reasonableness.

Integration of Costs by Road Segment

Once the program costs for roadway improvements, renewal and maintenance have been calculated, the costs can be combined to show the actual long term cost of each road segment in the system.

Balancing Costs and Funding to Develop ITF Investment Plan (Step 7)

Identification of Non-Level of Service Cost Savings

Prior to conducting a trade-off assessment to balance the ITF costs and against available funding, other sources of costs saving measures are identified, including but not limited to:

- Re-assessing design standards to increase asset service life;
- Optimizing maintenance to maximize asset service life;
- Identify minor capital treatments that can extend asset service life;
- Integrate road, water, sewer and drainage projects;
- Manage project contingencies outside of the project; this can result with an increase in projects;
- Updating bylaws to reflect the new roadway cross-sections; and
- Develop a road maintenance policy that ensures that roadways are kept in a good state of repair to postpone expensive renewal and reconstruction.

Identification of Level of Service Cost Savings

This is the essence of the ITF, strategically adjusting levels of service to meet the City's affordability limit without compromising system integrity.

For this exercise the most probable funding scenario is used to develop a long term program of ITF investments which will be a combination of roadway improvement and renewal projects based upon a sound roadway maintenance program.

To make the level of service adjustments trade-off criteria are developed to establish road segment improvement and renewal priorities. Typical trade-off criteria include safety, renewal timing, traffic volumes, active transportation, and connectivity.

From this information it is possible to build a long term 20-year ITF Investment Plan, and explain how the ITF Investment Plan should be used to advance projects through the City's capital planning process.

Council Workshop (Step 8)

Based upon the balanced ITF Investment Plan, with its trade-offs and risks, a presentation can be made to Council on the ITF findings, and decisions on next steps.

Public Outreach (Step 9)

A public outreach program would typically consist of the following:

- **Conducting a Readiness Assessment**: to determine the local public climate, e.g. target audiences, interests, concerns, possible roadblocks. This will help shape the key messages to be used throughout the delivery of the public outreach program;
- **Developing Three (3) key messages**: on the City's ITF to provide the overarching rationale for the importance of an affordable road system that serves all users. The messages should be broad and positive, and each key message will be broken down into a series of speaking points. The key messages and speaking points are critical to outreach success by ensuring that Mayor, Council and staff are consistent when responding to questions;
- **Prepare and Issue a News Release**: to prepare residents for the information they will see at the open house, and help place the information in a positive context; and
- **Conduct an Open House**: in a workshop-style format with a morning and evening session in an effort to capture the feedback from all City residents.

ITF Adjustments (Step 10)

Based upon the feedback from Council and the public adjustments may be made to the City's road transportation vision, the roadway hierarchy, roadway cross-sections, priorities, re-balance the ITF Investment Plan and associated risks.

15.0 APPENDIX G - ITF VERSUS SIIP CONSISTENCY

Both the Investment Plan component of the SIIP and the ITF model calculated replacement costs for the roadway system using methodologies of differing complexity. An early task for the ITF was to confirm the SIIP roadway investment analysis numbers, the results from this assessment are shown in Figure 54 and are demonstrated to be very comparable with a total variance of only $4.75 million or 1.2%.

A minor variance between the SIIP Investment Plan and ITF was expected as the SIIP, being a strategic document, looked at the unit costs of different classifications and widths of the City's roadways as a whole, whereas the ITF breaks roadway cross-sectional elements into separate categories and materials, allowing for a more accurate cost calculation. The 1.2% variance in roadway costs between the SIIP and ITF actually demonstrates the accuracy of the SIIP analysis.

Category	ITF	SIIP	Variance
Roadways	$339,658,908	$328,977,861	-$10,681,047
Alleys	$14,840,907	$12,952,295	-$1,888,611
Creek Crossings	$17,462,970	$15,890,762	-$1,572,208
Parking Meters	$1,161,283	$844,585	-$316,699
Associated Assets	$14,283,514	$23,995,670	$9,712,156
Totals	**$387,407,582**	**$382,661,173**	**-4,746,409**

FIGURE 54: ITF VERSUS SIIP

Some of the SIIP/ITF variance in associated assets is partially due to streetlights not being included as associated assets in the SIIP roadway numbers. As records on associated assets are rarely accurate e.g. quantity of signs, posts and small culverts it is not surprising to find a variance in this asset category.

16.0 APPENDIX H – ITF MODEL USER GUIDE

The application is built to be reasonably straightforward. This guide is meant as a quick overview, and highlights some of the less obvious features.

16.1 Data Viewers

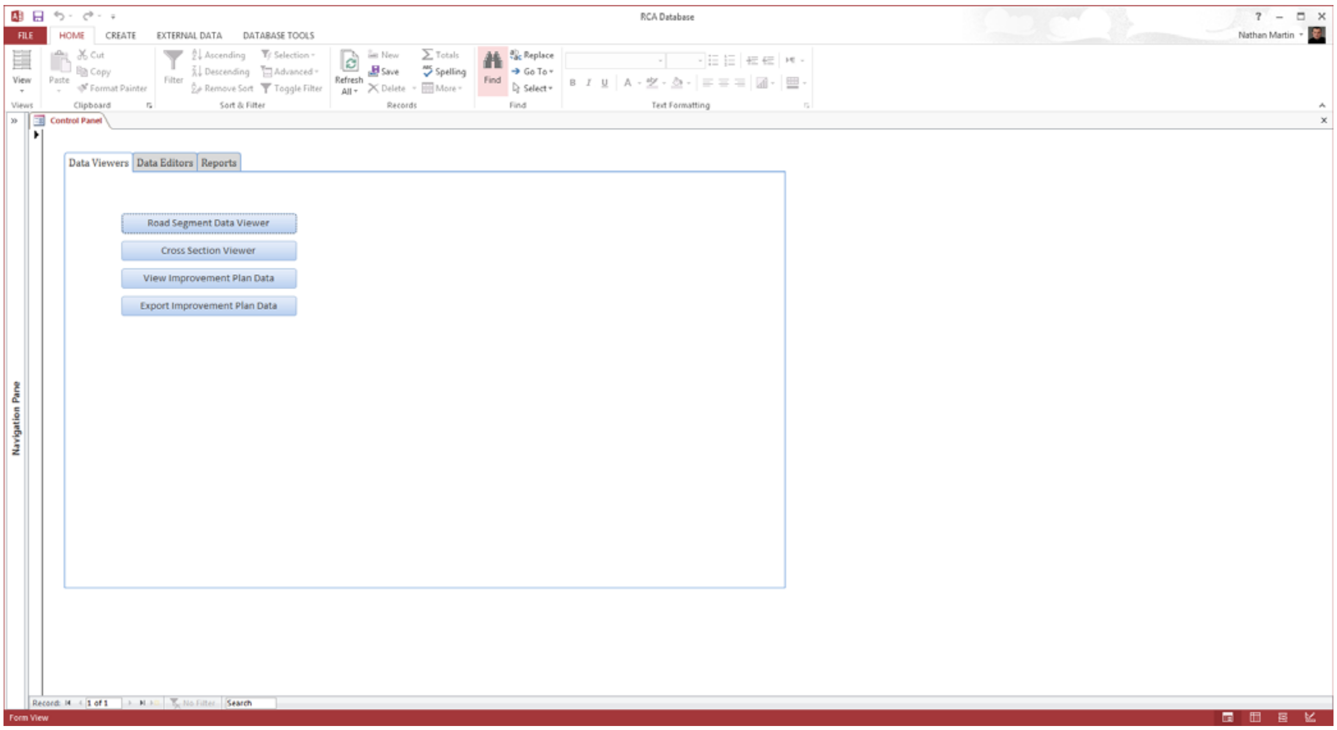


FIGURE 55: THE DATA VIEWER MENU

There are four data viewers present. These show various sets of data in a usable format.

16.2 Road Segment Data Viewer

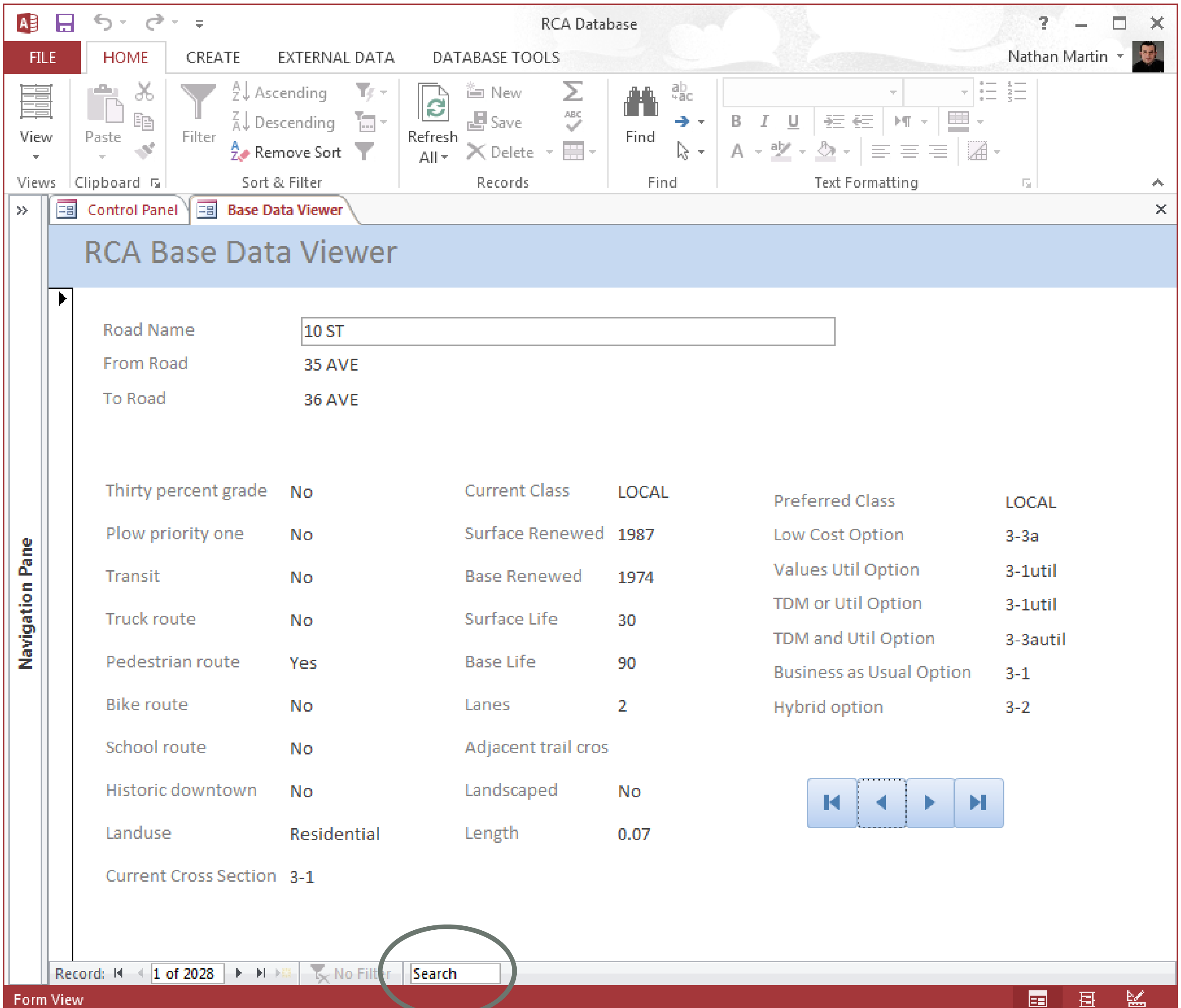


FIGURE 56: ROAD SEGMENT DATA VIEWER

To search for a particular road, use the search window at the bottom of the form

The road segment data viewer is used to view individual records for a particular road section. Navigation arrows allow the user to move from one record to the next or the previous, or to the first or last records. Access's built-in search filter is usable, and can quickly guide the user to specific records of interest.

16.3 Cross Section Viewer

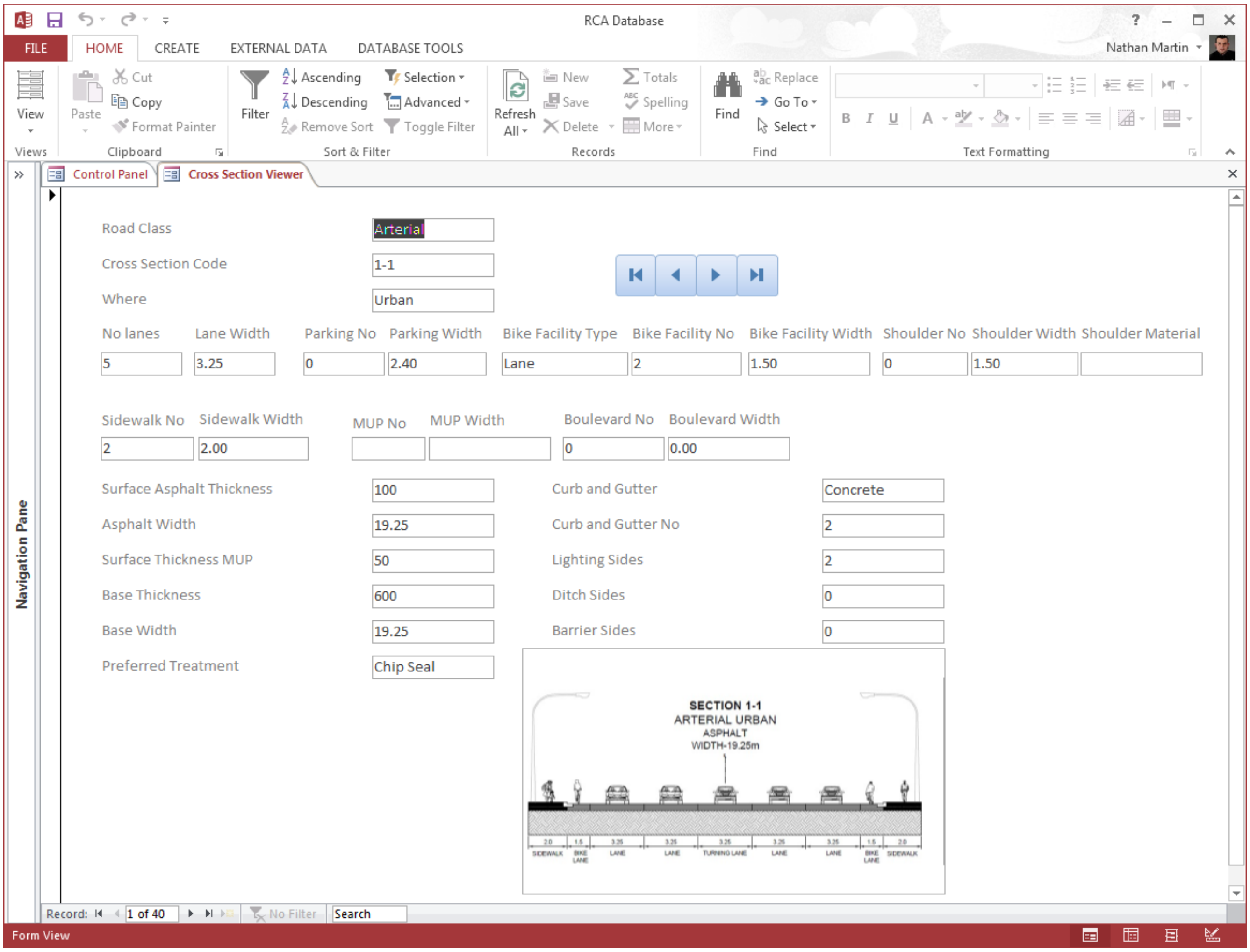


FIGURE 57: CROSS SECTION DATA VIEWER

The cross section viewer allows users to view the cross section definitions used by the model.

16.4 View/Export Improvement Plan Data

The Improvement plan data is configured to replace the data in the RCA spreadsheet. The viewer opens in datasheet mode, so that the values can be selected and directly copy/pasted into the spreadsheet's Invest Priority tab at cell E6, replacing the formulas present in those cells with the values calculated in Access. The export feature creates a spreadsheet file which can be copy/pasted into the RCA spreadsheet.

16.5 Data Editors

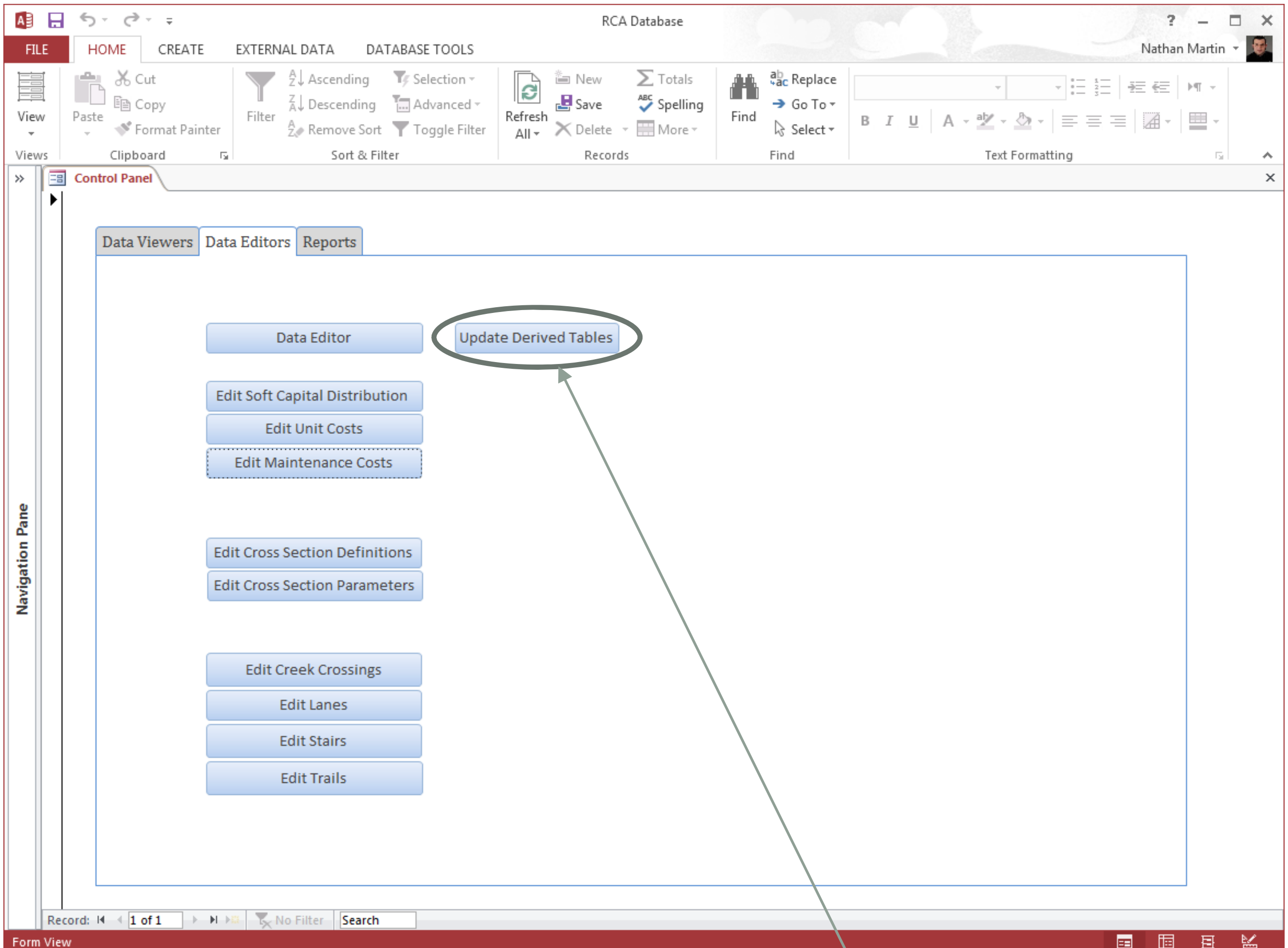


FIGURE 58: THE DATA EDITORS MENU

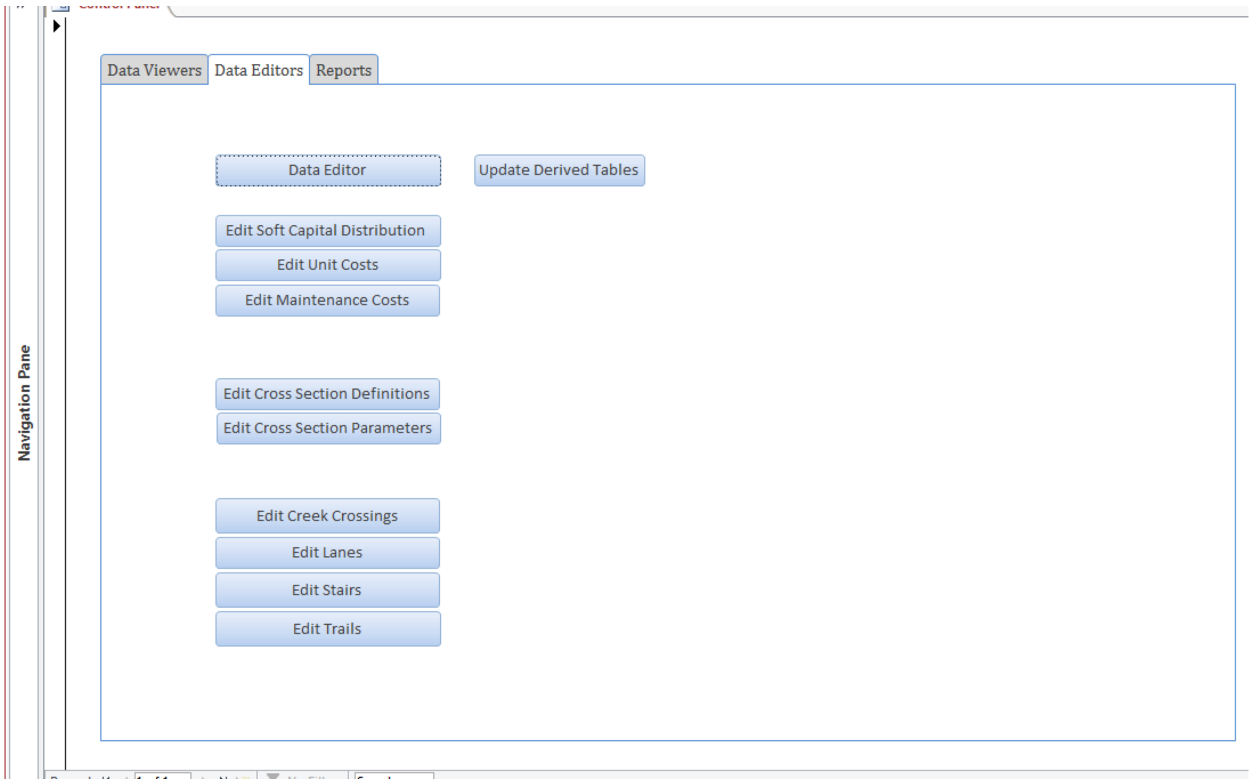
Update Derived Tables button

Various data editors are available, which can be used to update the source data and to test various scenarios.

Some of the calculations are complex, and intermediate steps need to be stored in order for the reports to run correctly. Storing the results of these calculations is accomplished by clicking on the “Update Derived Tables” button.

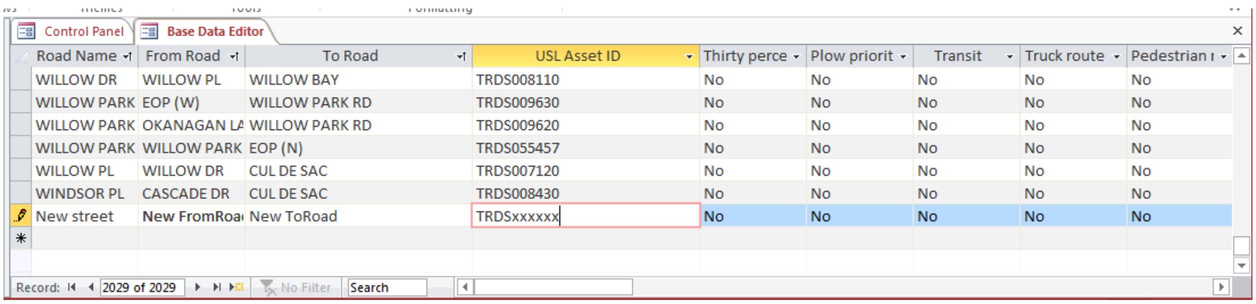
16.6 ADDING A NEW ROAD SEGMENT

16.6.1 STEP 1: OPEN THE DATA EDITOR

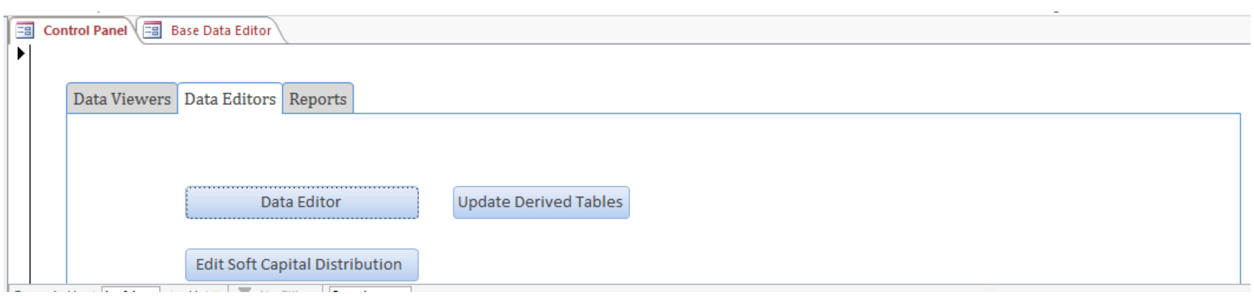


16.6.2 STEP 2: GO TO THE LAST LINE OF THE DATASET

16.6.3 Step 3: Enter the new segment's data



16.6.4 Step 4: Update the Derived Tables



16.7 Reports

The Reports screen allows the user to run reports and to specify a limited number of filters. The "Upgrade Option" filter applies to all reports, and selects the set of preferred cross-sections to be used.

The Road and Road Class filters are applied to the Segment Summary Report.

Note: Once a report has been run, if new filters are selected, the report will need to be run a second time before it updates

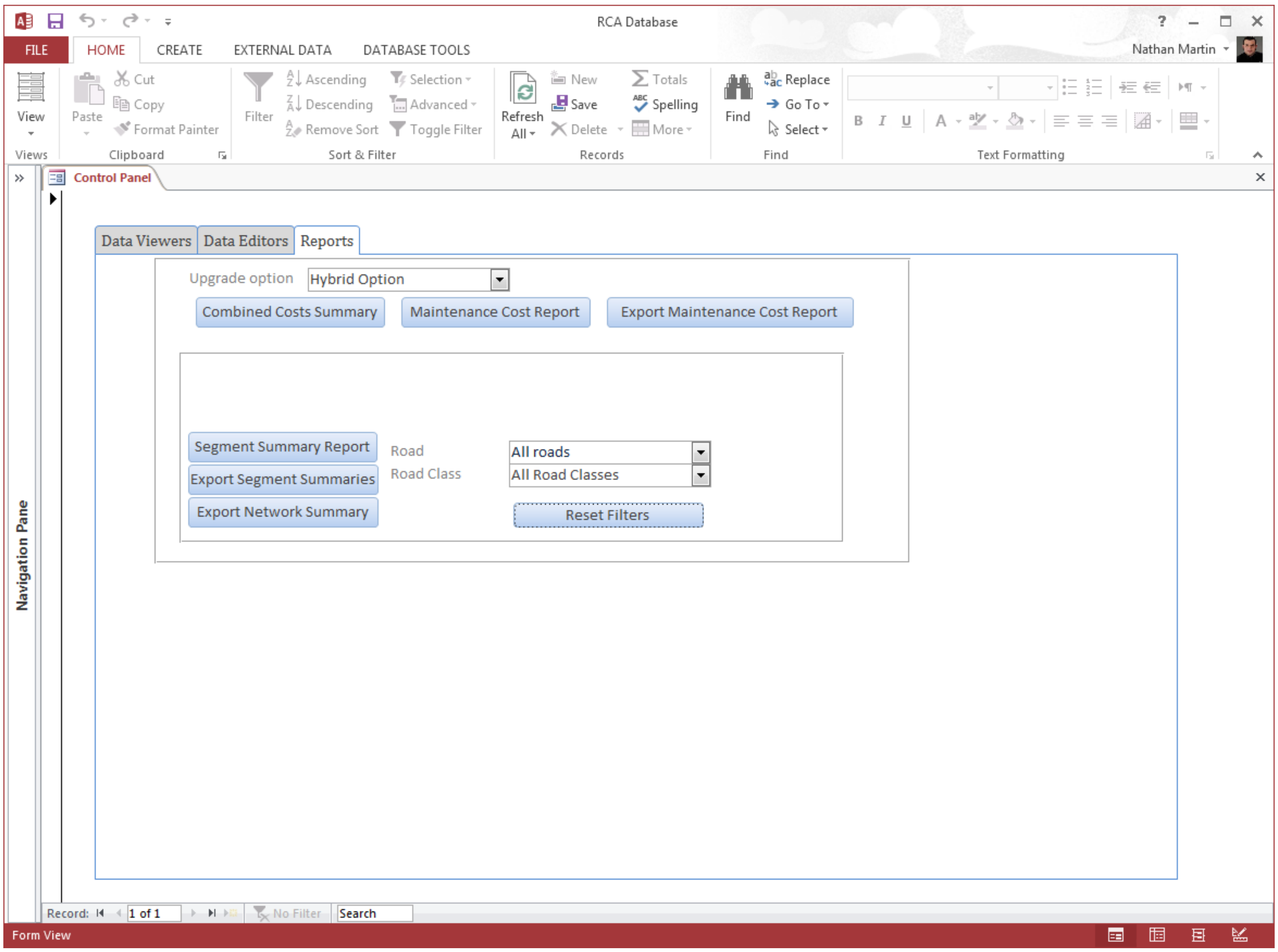


FIGURE 59: THE REPORTS MENU

All of the reports include Access's filtering functionality. Most data fields can be filtered using the right-click menu.

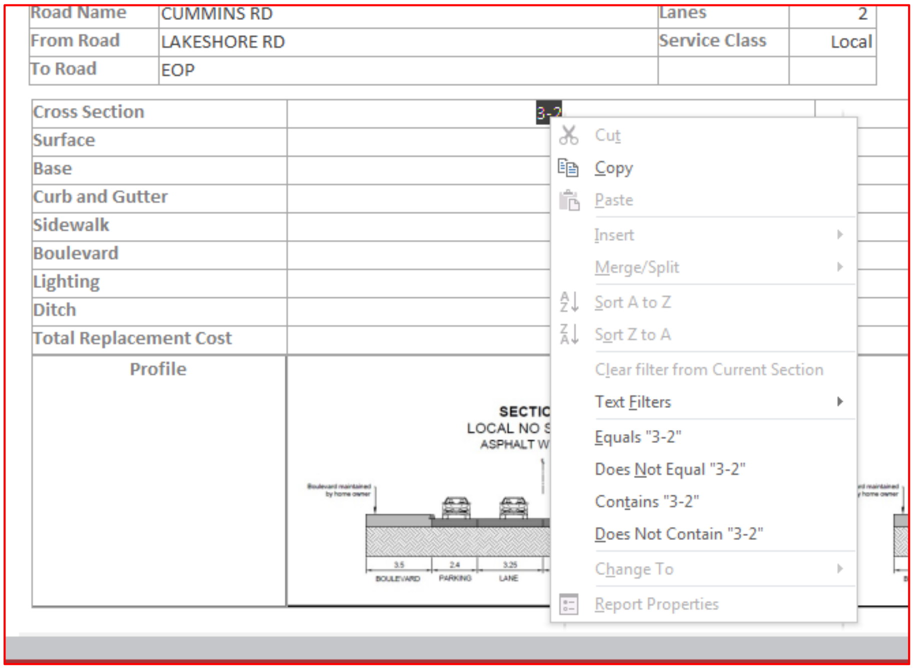
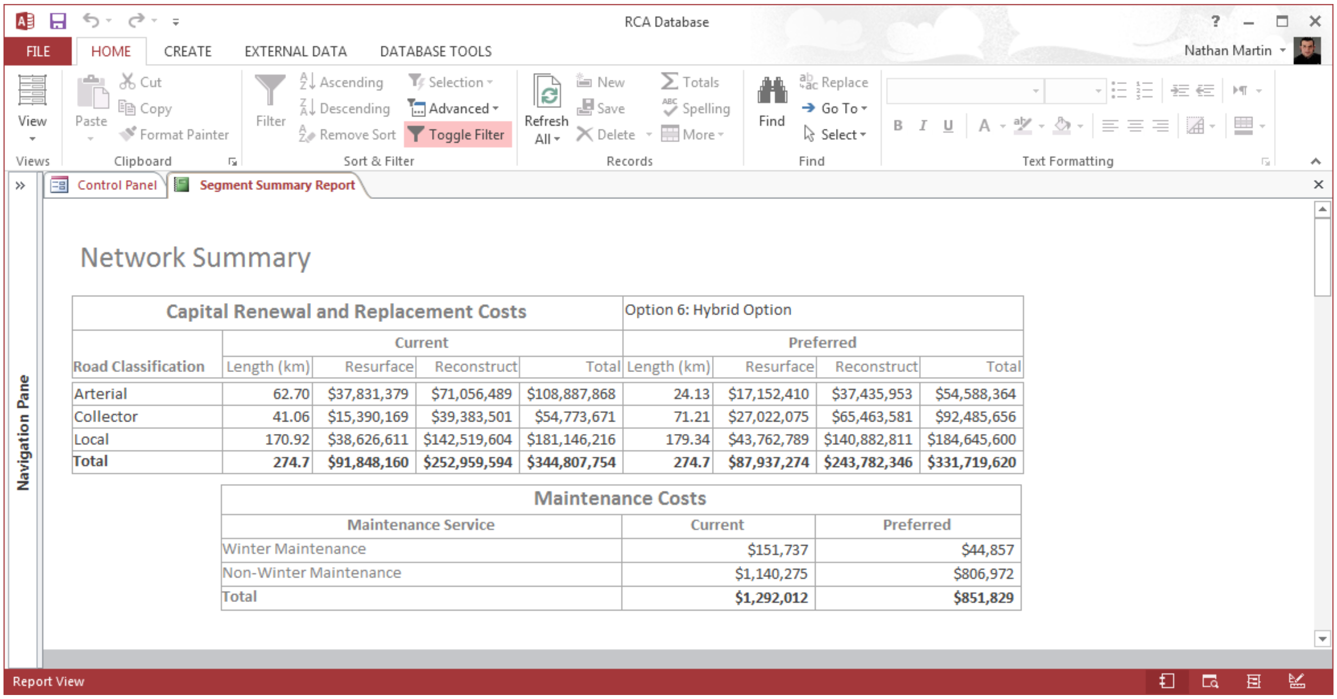


FIGURE 60: THE FILTERING DROP-DOWN MENU

16.8 Segment Summary Report

The Segment Summary report is a network summary followed by a segment-by-segment detail. This report can take some time to run.

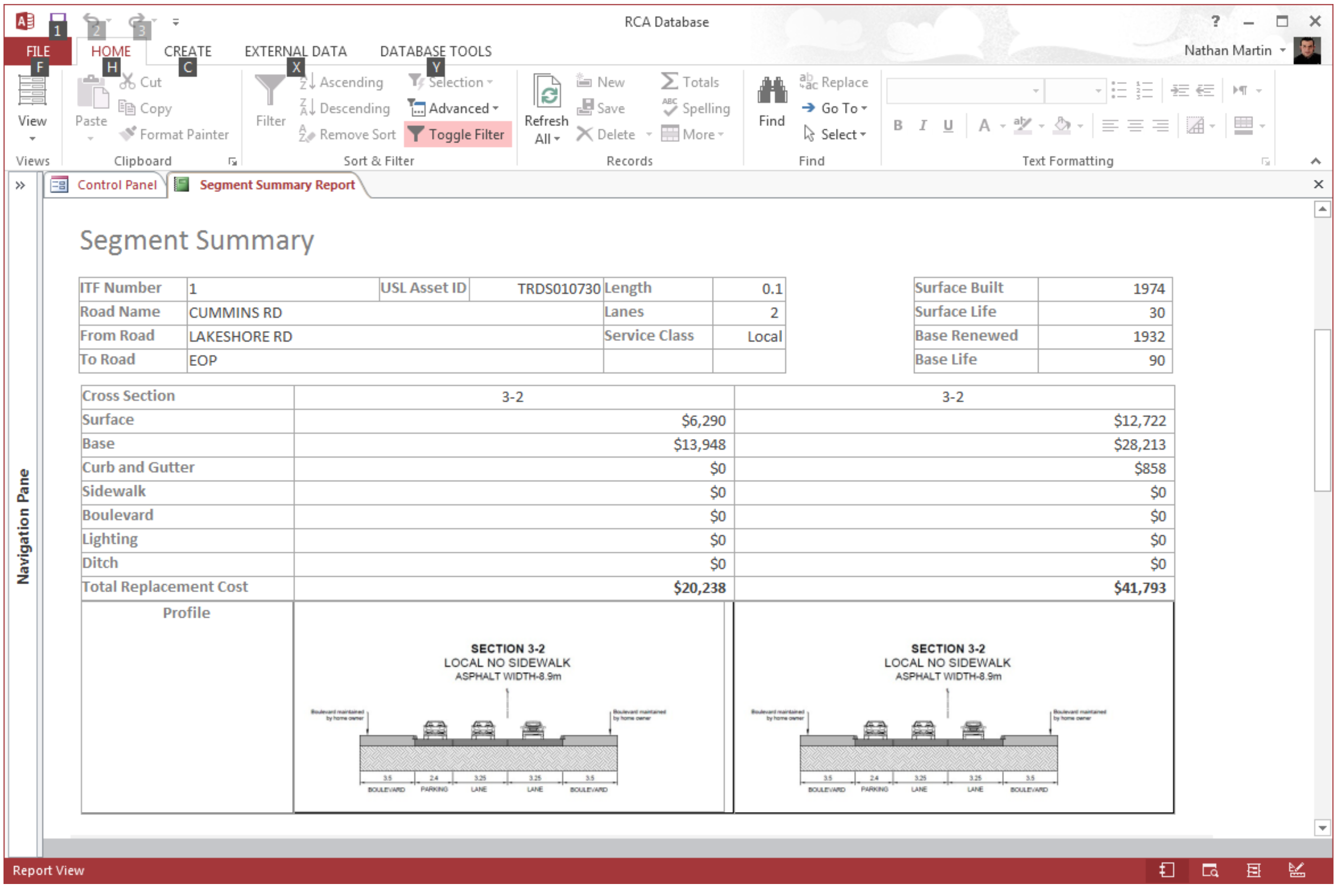


Network Summary

Capital Renewal and Replacement Costs					Option 6: Hybrid Option			
	Current				Preferred			
Road Classification	Length (km)	Resurface	Reconstruct	Total	Length (km)	Resurface	Reconstruct	Total
Arterial	62.70	$37,831,379	$71,056,489	$108,887,868	24.13	$17,152,410	$37,435,953	$54,588,364
Collector	41.06	$15,390,169	$39,383,501	$54,773,671	71.21	$27,022,075	$65,463,581	$92,485,656
Local	170.92	$38,626,611	$142,519,604	$181,146,216	179.34	$43,762,789	$140,882,811	$184,645,600
Total	**274.7**	**$91,848,160**	**$252,959,594**	**$344,807,754**	**274.7**	**$87,937,274**	**$243,782,346**	**$331,719,620**

Maintenance Costs		
Maintenance Service	Current	Preferred
Winter Maintenance	$151,737	$44,857
Non-Winter Maintenance	$1,140,275	$806,972
Total	**$1,292,012**	**$851,829**

FIGURE 61: THE NETWORK SUMMARY SECTION OF THE SEGMENT SUMMARY REPORT



Segment Summary

ITF Number	1	USL Asset ID	TRDS010730	Length	0.1
Road Name	CUMMINS RD			Lanes	2
From Road	LAKESHORE RD			Service Class	Local
To Road	EOP				

Surface Built	1974
Surface Life	30
Base Renewed	1932
Base Life	90

Cross Section	3-2	3-2
Surface	$6,290	$12,722
Base	$13,948	$28,213
Curb and Gutter	$0	$858
Sidewalk	$0	$0
Boulevard	$0	$0
Lighting	$0	$0
Ditch	$0	$0
Total Replacement Cost	$20,238	$41,793
Profile	SECTION 3-2 LOCAL NO SIDEWALK ASPHALT WIDTH-8.9m	SECTION 3-2 LOCAL NO SIDEWALK ASPHALT WIDTH-8.9m

FIGURE 62: THE SEGMENT SUMMARY SECTION OF THE SEGMENT SUMMARY REPORT

16.9 MAINTENANCE COST REPORT

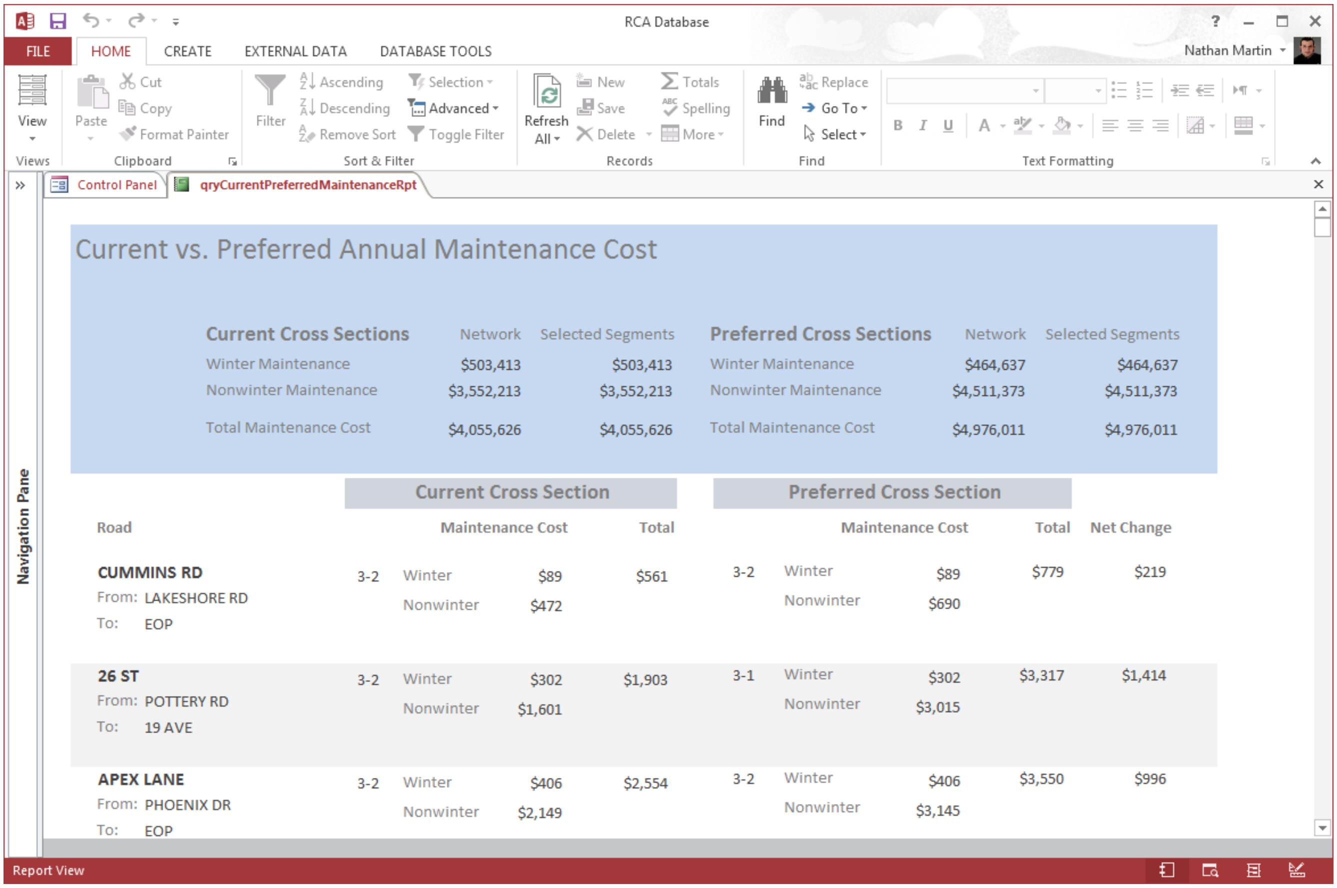
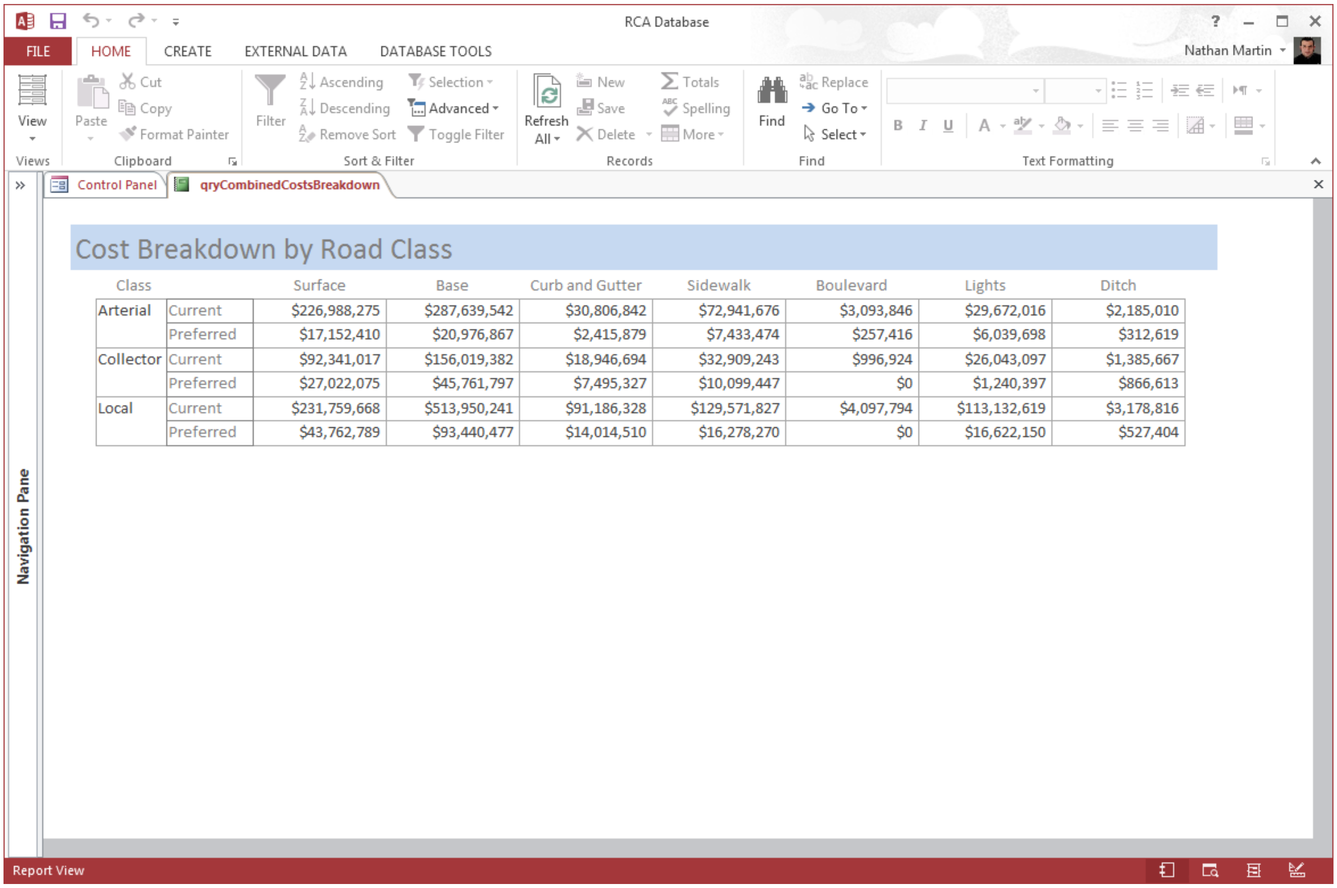


FIGURE 63: THE MAINTENANCE COST REPORT

16.10 Combined Costs Summary



Cost Breakdown by Road Class

Class		Surface	Base	Curb and Gutter	Sidewalk	Boulevard	Lights	Ditch
Arterial	Current	$226,988,275	$287,639,542	$30,806,842	$72,941,676	$3,093,846	$29,672,016	$2,185,010
	Preferred	$17,152,410	$20,976,867	$2,415,879	$7,433,474	$257,416	$6,039,698	$312,619
Collector	Current	$92,341,017	$156,019,382	$18,946,694	$32,909,243	$996,924	$26,043,097	$1,385,667
	Preferred	$27,022,075	$45,761,797	$7,495,327	$10,099,447	$0	$1,240,397	$866,613
Local	Current	$231,759,668	$513,950,241	$91,186,328	$129,571,827	$4,097,794	$113,132,619	$3,178,816
	Preferred	$43,762,789	$93,440,477	$14,014,510	$16,278,270	$0	$16,622,150	$527,404

FIGURE 64: COMBINED COST SUMMARY

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City of Vernon
Infrastructure Engineer