Municipality Of Chatham-Kent

Infrastructure and Engineering Services

To: Mayor and Members of Council

From: Infrastructure Innovation Committee

Date: January 9, 2019

Subject: Committee Recommendations - Bridges and Culverts

Recommendations

It is recommended that:

1. The Infrastructure and Engineering Services (IES) Department increase efforts to secure procurement savings utilizing methods currently in place, including,
    a. Flexible bid timing
    b. Standardized designs
    c. Bundling of larger and smaller projects
    d. Full road closures when alternative routes are available and local events are not impacted.
2. To maximize structure life and optimize funding streams, IES delay major investments when appropriate and employ load postings to structures.
3. Chatham-Kent increase efforts to petition the Provincial government and Federal government for additional infrastructure funding.
4. Chatham-Kent increase efforts to promote changes to environmental regulations to minimize costs associated with operations.
5. Chatham-Kent investigate opportunities to close roads and bridges to reduce infrastructure inventory where there is minimal impact to the public.
6. Administration bring forward a recommendation in the 2019 budget to hire one employee to manage research and development projects associated with infrastructure innovation.
7. Based on the increased frequency and magnitude of storms, IES review current design flood standards and determine if a higher standard is warranted.

Background

Council at their meeting of June 19, 2017 approved the following motion:

“That whereas infrastructure is a huge part of tax payer spending.

Whereas all new methods and new material structures be explored due to the increasing pressures to divest assets to meet the short falls.

Whereas this will only be successfully accomplished through a strategic task force made up of 4 council members, 3 members of the public with infrastructure/capital expertise, 3 members for the agricultural industry, other levels of government and Chatham-Kent staff. The task force will be led by a Council member.

Therefore, Council support the establishment of the Infrastructure, Bridge, Culverts and Roads Innovation Committee to set the framework and guidelines of its mandate and report back to Council for support and direction by October 16, 2017.”

Council considered a subsequent report at their meeting of July 17, 2018. Following consideration, Council approved the following:

“That:

2. Steve Piche, Kris Harris and Patrick Langan be appointed as members from the agricultural industry.
3. Appointments to the committee representing the members with infrastructure/ capital expertise be done at a later date.
4. Future consideration be given to representatives from other levels of government if an application is received.
5. The General Manager of Infrastructure and Engineering, the Chief Financial Officer, the Chief Legal Officer and one administrative assistant from Chatham-Kent administration support the Committee as required.”

And

“That:

1. Councillors Canniff, Fluker, Leclair and Robertson be appointed to the Committee. The four Council members appointed shall, within seven days, elect the first Chair of the Committee.”

The Council members agreed that Councillor Leclair would be the Chair.

At their meeting of January 15, 2018, Council approved the following:

1. Jim Steele, Robert Little and Dave Charron be appointed to the Infrastructure, Bridge, Culverts and Roads Innovation Committee as the three members of the public with infrastructure/capital expertise.
2. Council accept Councillor Leon Leclair's resignation from the committee and appoint a replacement.
3. Councillor Carmen McGregor be appointed to replace Councillor Leclair."

The committee has since met on seven occasions. A Terms of Reference (attached – Appendix A) was developed and approved. Various presentations were received by the committee including:

- Municipal Asset Management Plan (AMP)
    - What is the AMP - a tactical and financial plan for managing an organization's infrastructure at an agreed level of service
    - Phase I was approved January 2014
    - Phase II was approved January 2017
    - $4.5B in total assets exists in C-K; 53% of assets are funded

- Bridges 101 Introduction
    - Inventory
        - 859 Bridges > 3.0 m span
        - 19,000 Culverts < 3.0 m span
    - Every bridge > 3.0 m is fully inspected at least once every two years; Ontario Structural Inspection Manual (OSIM) report is generated
    - Typical Design Services
        - In-house personnel for spans < 5.5 m
        - Consultants for spans > 5.5 m
    - Typical Life:
        - Bridge = 75 years assuming at least one rehabilitation at 37 years
        - Culvert = 50 years with regular maintenance
    - Bridge / Culvert fundamentals defined
    - In a high investment, long life type of business, innovation must occur in a logical, comprehensive manner
        - Risks/costs may appear several years after implementation
        - C-K is moving forward with many non-traditional approaches
    - Designs must consider all variables (over 40) to determine the best use of technology and the most cost effective design
        - Safety is the #1 priority
        - Future community use, traffic patterns and environment are considered
        - Total costs over the life of the structure guides the recommended solution
    - List of Innovation, Continuous Improvement Projects provided

- Bridge Project Planning
    - 20 year bridge project overview was presented

- Bridge Sourcing process
    - Process flow
    - Environmental Assessment (EA) process
    - Bridge types
    - Bridge / Culvert Management Fundamentals
    - Bridge / Culvert Key Design Variables
    - Tendering versus Design Build
    - Best Practices for Competitive Bidding

- Bridge and Culvert Funding Shortfall Discussion Summary
    - Committee member Bob Little presented the bridge and culvert discussion summary to the committee. The presentation comprised a summation of all discussions and suggestions that occurred to date at the committee level.
    - From this list, the committee ranked all ideas generated and agreed to focus on key initiatives

Comments

The key initiatives agreed to by the Committee included the following:

IES currently employ various strategies to minimize the costs associated with the construction of projects. These include flexible bid timing, the use of standardized designs, the bundling of larger and smaller projects, and full road closures when alternative routes are available and local events are not impacted. These strategies enable contractors to better manage their workload and resources, resulting in lower bids. The offset of these strategies is that completion dates of projects may be extended and the public may experience a greater level of inconvenience. It is recommended that IES continue these initiatives and where possible, increase usage.

IES regularly examine opportunities to extend the life of a structure via a minor investment as opposed to a major replacement or rehabilitation. This will often result in a load posting rating but ensures the structure has fully reached its maximum life. Delaying major investments when appropriate can also assist with year over year funding challenges and resource constraints. It is recommended that IES continue this practice.

Both the Provincial and Federal government provide infrastructure funding through various programs. It is recommended that C-K increase efforts to petition upper levels of government for additional funding.

It has been estimated that environmental legislation adds 10% to 20% to the total project cost resulting from mitigation requirements. Often work can move forward with very minor impact to the environment, but legislation dictates otherwise. As a result, contractors must make allowances for delays and mitigation requirements, resulting in

increased costs. It is recommended that C-K promote changes to environmental acts to improve the efficiency of construction projects while still respecting the local habitat.

In 2018, the Municipality funded 53% of the average annual funds required by the infrastructure lifecycle plan. This level of funding is insufficient for C-K to maintain the $4.5B in total assets that currently exist within the municipality. Along with continuing to increase funding, it is recommended that administration review opportunities to reduce the inventory of assets. This includes the closure of current bridges and roads. Public consultation will take place on any initiatives associated with closures.

Resources within the IES team are fully tasked and proper resource management is essential for optimal performance. Currently there is very little capacity available for research on newer technologies that exist in the market. Due to the long life of the assets in question, significant study and research is required to ensure the technology will deliver on promises over the long term. The Committee recommendations in this area are twofold. First, a new position be created to specifically focus on research and development. A request will be submitted for Council's consideration during the 2019 budget deliberations. Second, it is recommended that Council consult with IES prior to bringing forth motions related to engineering projects or initiatives. This practice will ensure the use of best practices, adherence to regulations and result in minimal implementation issues.

Finally, related to climate change, C-K is experiencing higher intensity storms at a greater frequency level than in years past. Based on this trend, it is recommended that C-K review current infrastructure design standards and consider increasing such standards where flooding could affect populated areas. Appendix B depicts the "Design Flood Criteria" used by C-K Engineering. Although this initiative will effectively increase the cost of structures, long term the community will be in a better position to mitigate the impacts of flooding.

Areas of Strategic Focus and Critical Success Factors

The recommendations in this report support the following areas of strategic focus:

☐ Economic Prosperity:

Chatham-Kent is an innovative and thriving community with a diversified economy

☒ A Healthy and Safe Community:

Chatham-Kent is a healthy and safe community with sustainable population growth

☐ People and Culture:

Chatham-Kent is recognized as a culturally vibrant, dynamic, and creative community

☐ Environmental Sustainability:

Chatham-Kent is a community that is environmentally sustainable and promotes stewardship of our natural resources

The recommendations in this report support the following critical success factors:

☒ Financial Sustainability:

The Corporation of the Municipality of Chatham-Kent is financially sustainable

☒ Open, Transparent and Effective Governance:

The Corporation of the Municipality of Chatham-Kent is open, transparent and effectively governed with efficient and bold, visionary leadership

☐ Has the potential to support all areas of strategic focus & critical success factors

☐ Neutral issues (does not support negatively or positively)

Consultation

The Infrastructure of Bridges, Roads and Culverts Innovation Committee reviewed this report and concur with the recommendations.

Financial Implications

The proposed position for Infrastructure Research and Development be deferred to budget.

Prepared by:

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Carmen McGregor
Chair, Infrastructure, Bridges, Culverts and
Roads Innovation Committee

Reviewed by:

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Thomas Kelly, P.Eng., MBA
General Manager
Infrastructure and Engineering Services

Attachment – Appendix A - Terms of Reference
Appendix B - Design Flood Criteria

REF: P:\RTC\Infrastructure and Engineering\I & ES\2019\4061 - Committee Recommendations - Bridges and Culverts.docx

Appendix A

Infrastructure of Bridges, Culverts, and Roads Innovation Committee

Terms of Reference

Approved April 3, 2018

1. Mandate

The purpose of this Committee will be to consider how the Municipality of Chatham-Kent can innovate and optimize investments related to the infrastructure of bridges, culverts and roads. The Committee will review the processes related to:

1. Establishing asset priorities
2. Procurement:
    a. "Tendering" versus "Design Build"
    b. Sourcing Criteria - Evaluation of projects based on initial investment, projected life, risk and the annual lifecycle costs required to maintain the infrastructure
    c. Tendering timelines
    d. Types of projects - standardization
3. Financing
4. Inventory reduction and/or repurposing of assets
5. Service level changes
6. Consideration of new infrastructure
7. Utilization of traditional products versus new technology and the relationship to product life and risks
8. Legal liability and risk management considerations
    a. Requirements for Professional Engineering approval and adherence to all codes

2. Composition of Committee

Voting:

(a) Four (4) members of Council

– Carmen McGregor, Bryon Fluker, Derek Robertson, and Darrin Canniff

(b) Three (3) Agriculture representatives

– Steve Piche, Patrick Langan, Kris Harris

(c) Three (3) Infrastructure Experts

– Jim Steele, Robert Little, Dave Charron

Non-Voting Support / Resource Members

(a) Staff support

– Thomas Kelly (GM, Infrastructure and Engineering Services), Mike Turner (CFO), John Norton (GM, Community Development), Nancy vandenBoorn (Executive Assistant), others as deemed necessary by the committee.

(b) Other Government representation – currently vacant.

3. Term of Membership

The length of term is the balance of this term of Council plus one full term of Council. Replacements (if necessary) shall be appointed in accordance with the Committee of Council policy.

Members shall serve without remuneration; however, expenses such as mileage will be reimbursed in accordance with municipal policy.

4. Role Committee Members and Meeting Procedure

The committee shall select a Chair.

Meetings will be held at 5:00 p.m. on the first Tuesday of the month or at the call of the Chair.

Meeting protocol will follow the Municipal Council procedural by-law.

Meetings are open to the public and notice needs to be given within 48 hours as to where and when the meetings will be held and topics to be discussed.

This is an advisory committee of Council. Council has final decision-making authority.

Recommendations forwarded to Council must be of the majority view of the committee.

5. Agenda Outline:

1. Call to Order
2. Adoption of Agenda
3. Declaration of Pecuniary/Conflict of Interest
4. Deputations regarding items on the committee agenda
5. Motion for Approval of previous meeting minutes
6. Business arising from the minutes
7. New Business
8. Next Meeting
9. Adjournment

6. Reports to Council

Minutes, after committee approval, will be forwarded to Council. Reports to Council will be submitted on an as needed basis.

WC-1 Design Flows (Bridges and Culverts)

SCOPE

This standard identifies the minimum Design Flows for the sizing of bridges and culverts for flow conveyance on Regulated and non-Regulated Watercourses. It also identifies the requirement for accommodating the Regulatory Flow on Regulated Watercourses, and for determining the maximum allowable increase in flood elevations upstream of a bridge or culvert. This standard provides the hydrologic basis for all water crossing standards, WC-1 to WC-13.

DESIGN REFERENCES

Canadian Highway Bridge Design Code (CHBDC, 2000).
Exceptions to the Canadian Highway Bridge Design Code, CAN/CSA-S6-00 For Ontario, June 2002

1. HYDROLOGY

This standard addresses the Design Flow requirements for standard road classifications and low volume roads.

1.1 Standard Road Classifications

1.1.1 As a minimum, bridges and culverts of Provincial Highways shall be designed to the criteria shown in the following table, except as outlined in Section 1.1.2 to Section 1.1.4 of this standard:

Design Flow Return Period for Bridges and Culverts - Standard Road Classifications

Functional Road Classification	Return Period of Design Flows (Years) [1,2,3]		Check Flow for Scour
	Total Span less than or equal to 6.0 m	Total Span greater than 6.0 m	
Freeway, Urban Arterial	50	100	130% of 100 year
Rural Arterial, Collector Road	25	50	115% of 100 year
Local Road	10	25	100% of 100 year

Note:
1. The listed design flows apply to roads under the jurisdiction of the Ministry of Transportation.
2. The Fish Passage Design Flow for culverts is defined in Standard WC-12 Fish Passage Requirements Through Culverts
3. Sometimes referred to as Normal Design Flow

1.1.2 On Regulated Watercourses the Regulatory Flow shall be calculated in all cases where Floodline Mapping is available, where there is a potential risk to public safety, or where there is potential damage to adjacent properties, as applied in Section 2.3 of this standard.

1.1.3 The criteria may be modified in exceptional cases, such as for unusually large structures, or for vital routes which must remain useable during Regulatory Flow conditions. Use of Regulatory Flow criteria in the latter case shall be justified by a cost-benefit analysis.

1.1.4 If the road classification is likely to be upgraded or downgraded within 5 years of construction, the Return Period shall be based on the future classification.

1.2 Low Volume Roads

Design Flow Return Periods for Bridges on Low Volume Roads were developed to achieve economies without compromising safety. These requirements apply only to bridges. Culverts shall be designed in accordance with Section 1.1 of this standard.

1.2.1 As a minimum, bridges shall be designed to accommodate the Design Flow without damage to the structure or approaches. Relief Flow over the road shall be in accordance with Standard WC-13 Relief Flow (Bridges and Culverts). Drainage facilities for Low Volume Roads shall be designed to the criteria shown in the following table, except as provided in Section 1.2.2 to 1.2.5 of this standard:

Design Flow Return Period for Bridges on Low Volume Roads

		Return Period of Design Flow (Years)[1,2]	
Road Function	**Vulnerability**	**Total Span less than or equal to 6.0 m**	**Total Span greater than 6.0 m**
Collector and Arterial	High	25	50
	Low	25	50
Local	High	10	25
	Low	10	25
Resource Access	High	5	10
	Low	5	10
Recreation	High	5	10
	Low	2	2

Notes:
[1] The listed design storms apply to roads under the jurisdiction of the Ministry of Transportation.
[2] Sometimes referred to as Normal Design Flow

1.2.2 The Check Flow need not be considered.

1.2.3 On Regulated Watercourses the Regulatory Flow shall be calculated in all cases where Floodline Mapping is available, where there is a potential risk to public safety, or where there is potential damage to adjacent properties, as applied in Section 2.3 of this standard.

1.2.4 Low water crossings, which accommodate the Design Flow but overtop during more severe flooding, may be considered as an alternative, but not for Collector or Arterial Roads.

1.2.5 The Return Period should be determined by the owner in order to establish the acceptable length of time the structure is impassable. Where required, approval shall be sought from other agencies having jurisdiction.

1.2.6 The hydrology criteria may be modified in exceptional cases, such as for unusually large structures or for vital routes which must remain useable during more severe storm conditions. Use of a more severe design storm in the latter case shall be justified by a cost-benefit analysis.

1.3 Channel Realignment or Diversion

Channel realignment or channel restoration upstream or downstream of a water crossing that will alter the storage or discharge characteristics upstream of the crossing, shall be designed to meet the design standards of the crossing. As a minimum the combined capacity of the watercourse and floodplain shall convey the 25-year Design Flow. The main channel is to be designed to a lower Design Flow such that a stable channel is maintained.

2. HYDRAULICS

2.1 Design Flow and Upstream Water Surface Elevations

The existing and proposed upstream water surface elevations shall be calculated for Design Flow identified in Sections 1.1.1 and 1.2.1 of this standard and shall be used for the design of the Water Crossing.

2.2 Range of Flows and Upstream Water Surface Elevations

The existing and proposed upstream water surface elevations shall be calculated for Design Flows with Return Periods ranging from 5 years to 100 years, where the estimated water surface elevations will be used for assessing impacts on Rating Curves upstream of the water crossing.

2.3 Regulatory Flow and Upstream Water Surface Elevations

The existing and proposed upstream water surface elevations shall also be calculated for Regulated Watercourses where the Regulatory Flow estimate is required.

2.4 Check Flow

The Return Period for the Check Flow is identified in Section 1.1.1 of this standard. The Check Flow shall be used for scour analysis to assess structural integrity where required.

2.5 Winter Flow Condition

The Winter Flow Depth shall be used to evaluate icing conditions where required.

3. PHYSICAL CHARACTERISTICS

There are no physical characteristic standards applicable to Design Flows (Bridges and Culverts).

4. COMMENTARY

- The decision whether there would be any risk to public safety or potential damage to adjacent properties as a result of change in flood elevations shall be determined in consultation with the Municipality, Conservation Authority or the Ministry of the Natural Resources given their responsibilities under the Conservation Authorities Act and Lakes and Rivers Improvement Act.
- In the case where a drainage system that is not subject to regulations for conveyance or flood protection (e.g. municipal drain) is being conveyed under the highway, the design approach shall be followed for the protection of the highway.

- Where, through consultation with the Conservation Authority and/or MNR, there is an increase in flood elevation on private land that will adversely impact the landowners, an agreement will be made with the affected landowners.
- Design Flows for water crossings shall normally be based on existing runoff conditions, but, at the request of the municipality concerned, and subject to the Ministry's cost sharing policies, may be based on runoff conditions anticipated 20 years from the time of design.
- Upstream water surface elevations are calculated for all design storms in recognition that any increase in flood elevation may represent an increase in flood risk.
- Assessment of the Check Flow is not normally required if the structure is designed to the larger Regulatory Flow criteria.
- Performance of culverts on fish migration routes shall be checked with the Standard WC-12, Fish Passage through Culverts.
- The calculation of upstream elevations for a range of Design Flows under existing and proposed conditions is to be used to evaluate the impact of the structure on the upstream Rating Curve. If there is a negative impact, based upon the effect on private property or drainage systems, it may be necessary to change the proposed opening size to mitigate potential impacts.