



Office of the Auditor General / Bureau du vérificateur général

FOLLOW-UP TO THE 2009 AUDIT OF THE BRIDGE MAINTENANCE

PROCESS FOR A SPECIFIC BRIDGE

2011

SUIVI DE LA VÉRIFICATION DU PROCESSES D'ENTRETIEN DES

PONTS DANS UN CAS PRÉCIS DE 2009

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EXECUTIVE SUMMARY

Introduction

The Follow-up to the 2009 Audit of the Bridge Maintenance Process for a Specific Bridge was included in the Auditor General’s Audit Plan.

The key findings of the original 2009 audit included:

- The City spent more than \$97,000 in 2007 to correct deficiencies in the design and construction of the Conley Bridge.
- The design and construction of the 2004 deck replacement of the structure had several deficiencies that were directly responsible for the failure of the deck in 2005. The City should consider action against the design consultant and the contractor involved to recover the costs of these repairs.
- The same engineering firm that performed the original design was engaged by the City to correct their deficiencies.

Summary of the Level of Completion

The table below outlines our assessment of the level of completion of each recommendation as of January 31, 2011. Management’s response was in agreement with that assessment.

CATEGORY	% COMPLETE	RECOMMENDATIONS	NUMBER OF RECOMMENDATIONS	PERCENTAGE OF TOTAL RECOMMENDATIONS
LITTLE OR NO ACTION	0 – 24	-	-	-
ACTION INITIATED	25 – 49	-	-	-
PARTIALLY COMPLETE	50 – 74	-	-	-
SUBSTANTIALLY COMPLETE	75 – 99	3	1	25%
COMPLETE	100	1, 2, 4	3	75%
TOTAL			4	100%

Conclusion

The City addressed the recommendations of the audit and has essentially completed their implementation.

Acknowledgement

We wish to express our appreciation for the cooperation and assistance afforded the audit team by management.

RÉSUMÉ

Introduction

Le Suivi de la vérification du processus d'entretien des ponts dans un cas précis de 2009 était prévu dans le Plan de vérification du vérificateur général.

Les principales constatations de la vérification de 2009 sont les suivantes :

- La Ville a dépensé plus de 97 000 \$ en 2007 afin de remédier à des défaillances dans la conception et la construction du pont Conley.
- La conception et la construction du remplacement du tablier du pont Conley en 2004 comportaient de nombreuses déficiences directement responsables du bris du tablier en 2005. La Ville devrait envisager des poursuites contre le consultant et l'entrepreneur en cause lors des travaux relativement à la gestion de la conception et de la construction pour recouvrer les coûts de ces réparations.
- La même société d'ingénieurs-conseils qui a réalisé la conception originale a été engagée par la Ville pour corriger les irrégularités.

Sommaire du degré d'achèvement

Le tableau ci-dessous présente notre évaluation du degré d'achèvement de chaque recommandation le 31 janvier 2011. Par la suite, la réponse de la direction concordait avec cette évaluation.

CATÉGORIE	POURCENTAGE COMPLÉTÉ	RECOMMANDATIONS	NOMBRE DE RECOMMANDATIONS	POURCENTAGE DU TOTAL DES RECOMMANDATIONS
PEU OU PAS DE MESURES PRISES	0 – 24	-	-	-
ACTION AMORCÉE	25 – 49	-	-	-
COMPLÉTÉE EN PARTIE	50 – 74	-	-	-
PRATIQUEMENT COMPLÉTÉE	75 – 99	3	1	25 %
COMPLÉTÉE	100	1, 2, 4	3	75 %
TOTAL			4	100 %

Conclusion

La Ville a examiné les recommandations de la vérification et les a, en grande partie, mises en œuvre.

Remerciements

Nous tenons à remercier la direction pour la coopération et l'assistance accordées à l'équipe de vérification.

1 INTRODUCTION

The Follow-up to the 2009 Audit of the Bridge Maintenance Process for a Specific Bridge was included in the Auditor General's Audit Plan.

The key findings of the original 2009 audit included:

- The City spent more than \$97,000 in 2007 to correct deficiencies in the design and construction of the Conley Bridge.
- The design and construction of the 2004 deck replacement of the structure had several deficiencies that were directly responsible for the failure of the deck in 2005. The City should consider action against the design consultant and the contractor involved to recover the costs of these repairs.
- The same engineering firm that performed the original design was engaged by the City to correct their deficiencies.

2 KEY FINDINGS OF THE ORIGINAL 2009 AUDIT OF THE BRIDGE MAINTENANCE PROCESS FOR A SPECIFIC BRIDGE

The 2004 design assignment was deficient as follows:

1. In 2004, the consultant did not investigate the reasons why the deck failed, although the Infrastructure Management Senior Engineer noted in an email dated August 17, 2004 that the deck drainage was inadequate, as evidenced by staining indicating ponding on the deck. The Senior Engineer noted that: "The breaks have all occurred on the driver side eastbound lane. Staining on the underside of the deck indicates that water may be ponding along the centreline of the bridge and weakening the decking under the driver's side wheels, i.e., closest to the centreline". The consultant did not consider lack of drainage and the effect of moisture on the timber as a potential cause of the deck failure.
2. The 2004 design was carried out without an adequate field survey of the structure, which would have disclosed that the stringers were not at the same level.
3. The 2004 consultant did not take into account in the design that the timber deck placed in 1994 had been levelled with steel plates (shims). As a result, the contract documents did not make provision for the shims and they were included as an extra to the contract. Consequently, the City had to pay the contractor a higher cost for the supply and installation of the shims than if the shims had been included in the contract documents. If the shims were indeed required, the contract documents should have included the shims, including specifications and details.

4. The site instruction issued by the consultant recommending that shims be used to level the deck did not provide specifications or details for the shims. Management advise that the shims were restrained on the interior stringers by nailing plates that extended from the wood deck to the stringers on both sides of the shims, and they consider that there was no need to make a physical connection of the shims. The consultant should have provided a detail requiring that the shims be affixed to the bridge beams to prevent the shims from moving. In fact, the 2007 deck replacement drawings provide several details for the connection of the shims to the deck and the steel stringers.
5. The design of the deck in 2004 did not provide cross-fall to provide drainage of the deck. Poor drainage results in ponding of water on the deck, which contributes to the premature failure of the timber deck. Moisture is a significant factor in deterioration of wood structures, and efficient removal of water is essential to prevent premature damage to wood. The fact that the November 2005 inspection of the timber deck showed rotting of some of the timber in the deck indicates that the moisture problem was severe. The consultant should have made provisions for moisture control in 2004. In fact, in the 2007 design, the same consultant recommended adding waterproofing and a wearing surface to the timber deck to reduce moisture in the deck.
6. The additional stringers recommended by the consultant were added as a precaution against heavy axle loads, but their need was not fully justified by the consultant during the design work. The stringers were not required because the structure was posted as “No Trucks” after the 2004 contract.

Construction of the 2004 contract was deficient as follows:

1. The shims used to level the timber decking were not attached to the top flanges of the stringers. Lacking a detail provided by the consultant, the carpenter used nailing plates that extended from the wood deck to the steel stringers on each side of the shims. This method of restraint was not adequate, as evidenced by the subsequent vibrations, excessive noise and excessive displacements of the timber deck. In fact, the 2007 deck replacement drawings show details to connect the timber deck, the shims, and the steel stringers together.
2. The shims were constructed of plain steel, which rusted very quickly. As a minimum, the shims should have been galvanized. It is noted that the consultant site instruction specifies galvanized shims and the Inspector’s notes also indicate the shims were galvanized. This discrepancy would indicate that the Inspector did not notice that the shims were not, in fact, galvanized.
3. The contractor had the carpenter provide and install the steel shims, although a carpenter is not qualified for structural steel work. The shims should have been provided and installed by the structural steel sub-contractor.

4. The actual cost of construction was \$90,225, which is \$31,742 higher than the original contract due to the addition of stringers, changes required to the nailing pattern and the stringer connectors, and the steel shims. Management have indicated that the additional cost resulted from additional temporary signs and the shimming. The cost of the stringers is not justified by the eventual posting of the bridge for NO TRUCKS.

The City's project management of the 2004 and 2007 rehabilitation work was deficient as follows:

1. No one questioned the design of the deck without shims, although the IM Senior Engineer had mentioned it in his email, noted above.
2. The reasons for failure of the deck were not fully investigated, even though the IM Senior Engineer noted evidence of water ponding on the deck and suggested that they could have weakened the deck along the failure area. The visual observations should have been followed up by the consultant.
3. The additional stringers proposed by the consultant were accepted without requiring further justification from the consultant. The cost of the additional stringers was unnecessary because the bridge was posted for No Trucks.
4. Management have indicated that one of the reasons for not investigating the deck failure in 2004 was that the deck had been in service for 10 years and therefore it had reached its life expectancy; consequently, Management have indicated that the deck failure was not unexpected. If this was the case [which we do not accept as accurate], the City should have been ready to replace the deck in 2004 or earlier. Therefore, justification for design shortcomings on the basis of "lack of time".
5. Once the 2004 deck failed in 2005, no one questioned the consultant's design or suggested that failure could be due to design deficiencies. During the design work done in 2006 and 2007 there was no documentation or communications that address why the 2004 design did not work properly and why the deck had to be replaced after only two years of service.
6. Management have indicated that they do not consider that the 2004 deck failed, although they replaced the deck as a result of noise complaints due to noise resulting from the deck moving against the steel stringers, due to the shims not being totally effective. However, they exonerate the consultant from any fault, justifying the problems with the 2004 design on the basis of complications due to the variable depth shims required and that installation of variable depth shims would have been very time consuming and that a short time was available before winter. It should be noted that in our opinion, the deck did fail in serviceability.

7. Management have indicated that placement of the shims was complicated by variable sag and twisting of the stringers. There is no documentation in the file to indicate that the consultant addressed the reasons for sagging and twisting of the stringers, notwithstanding that such deformations could be indicative of serious structural deficiencies of the stringers. The City's Project Manager should have addressed this issue when replacing the timber deck.
8. The City agreed to classify the deck design as a "pilot project", essentially removing all responsibility from the consultant and assuming all potential exposure to liability itself. Given that this was the second failure of the deck, this decision protects the consultant and not the City. This is particularly concerning when one considers that the design of timber decks is well established.
9. Once the deck failed one year after construction, the City should have requested a third party to review the design and construction, in order to determine who was at fault regarding the failure. Alternatively, the City should have reviewed the cause of the failure.
10. The cost of the engineering design for the 2007 deck replacement was \$12,600, plus GST, and the corresponding cost of construction was \$84,970, plus GST. The total additional cost was \$97,570 plus GST.
11. Part-time inspection may have been a factor in the failure of the 2004 deck, as evidenced by the fact that the contractor appears to have used plain steel shims instead of galvanized steel shims, but the Inspector did not correct this deficiency. In the 2007 contract, the Inspector was absent from the site for some of the days when the contractor was placing the connectors between the deck, the shims and the steel stringers.

3 STATUS OF IMPLEMENTATION OF 2009 AUDIT RECOMMENDATIONS

2009 Recommendation 1

That the City refer this file to Legal Services to determine the feasibility of obtaining compensation from the consultant and the 2004 contractor for the costs of design and construction of the 2007 deck repair.

2009 Management Response

Management agrees with the recommendation. Files will be referred to Legal Services for review in Q4 2009.

Management Representation of the Status of Implementation of Recommendation 1 as of January 31, 2011

The file was referred to Legal Services in Q4 of 2009. In January and February 2010, the City Clerk and Solicitor Department, in cooperation with Infrastructure Services, reviewed the possibility of obtaining compensation from the consultant and the 2004 contractor for the costs of design and construction of the 2007 deck repair.

Given the audit's finding that the bridge failure was apparent in 2005, and the coming into force of the Limitations Act, 2002 on January 1, 2004, the legal or economic feasibility of obtaining compensation is minimal. In short, the potential Defendants would have defences open to them based on the two year limitation period which, based on the balance of probabilities, would likely succeed. In addition, the City would likely be required to engage expert witnesses which could add significantly to the costs of pursuing such a claim. Further to this, the general risks inherent to litigation add to the unlikelihood of a significant recovery of costs.

Management: % complete *100%*

OAG's Follow-up Audit Findings regarding Recommendation 1

The City provided an opinion prepared by Legal Services indicating that they had reviewed the matter and on that basis, they considered that there is a low likelihood of being able to recover from the contractor or the consultant.

OAG: % complete *100%*

2009 Recommendation 2

That the City undertake the work themselves or request proposals from a different consultant in cases where recently constructed works fail prematurely, to ensure that the original design is subject to adequate peer review.

2009 Management Response

Management agrees with the recommendation.

Effective immediately, Infrastructure Services will ensure that in cases where work is to be done as a result of construction works that have failed prematurely, requests for proposal will be sought from a different consultant or the work will be undertaken by the City.

Management Representation of the Status of Implementation of Recommendation 2 as of January 31, 2011

Infrastructure Services has agreed that in cases where work is to be done as a result of construction works that have failed prematurely, requests for proposal will be sought from a different consultant or the work will be undertaken by the City.

Management: % complete *100%*

OAG's Follow-up Audit Findings regarding Recommendation 2

We concur with management's representation.

OAG: % complete **100%**

2009 Recommendation 3

Given that in the 2004 contract the Inspector did not notice that the shims were not galvanized, and in the 2007 contract the Inspector was not on site at all times when the deck was being placed, that the City ensure that projects in which part-time construction inspection will be provided be arranged such that the Inspector has detailed instructions and sufficient decision latitude to allow the Inspector to ensure that critical construction steps are inspected.

2009 Management Response

Management agrees with the recommendation.

The reference to provisions for part-time inspections is consistent with the Infrastructure Services department's Inspection Manual for City Construction Contracts.

Management Representation of the Status of Implementation of Recommendation 3 as of January 31, 2011

The Infrastructure Services Department's Inspection Manual for City Construction Contracts outlines inspection requirements that Construction Inspectors must follow.

Management: % complete **100%**

OAG's Follow-up Audit Findings regarding Recommendation 3

Part A - Inspection Manual for City Construction Contracts has specific requirements for the provision of inspection during construction. Installation of a timber deck is not specifically listed in the Structural Tasks, and given the potential for failure of this type of deck, it may be prudent to add a specific inspection task to the Inspection Manual.

OAG: % complete **90%**

Management Representation of Status of Implementation of Recommendation 3 as of November 16, 2011

Management agrees with the OAG's follow-up audit finding.

The City has only four wood deck bridges. Two of them are for regular traffic and two are on unmaintained right of ways (ROW). The requirement to add a specific inspection task to the Inspection Manual will be included in the next update. Since a date has not been set for the next update, in the interim, a reference has been

included in SIMS to highlight this requirement so that it can be flagged for the next deck renewal.

Management: % complete *90%*

2009 Recommendation 4

Given the information provided by management regarding sagging and twisting of the steel stringers, that the City arrange for a different consultant to inspect the bridge, with particular regard to the existing sagging and twisting of the steel stringers.

2009 Management Response

Management agrees with the recommendation. This inspection will be completed by Q2 2010.

Management Representation of the Status of Implementation of Recommendation 4 as of January 31, 2011

This structure (SN 753090) was inspected in 2008 and 2010 by City Structural Inspectors, under the direction of the Senior Structural Engineer. The concerned steel stringers were inspected and compared to previous inspections. No visual evidence of deterioration has been noted. This structure is now on a yearly inspection schedule and is included in the 2011 OSIM inspection to be carried out by a consultant. A different consultant will be used.

Management: % complete *100%*

OAG's Follow-up Audit Findings regarding Recommendation 4

The City provided the results of the 2008 and 2010 inspections carried out by City Structural Inspectors, and confirmation that the structure was included in the planned 2011 OSIM inspections.

OAG: % complete *100%*

4 SUMMARY OF THE LEVEL OF COMPLETION

The table below outlines our assessment of the level of completion of each recommendation as of January 31, 2011. Management’s response was in agreement with that assessment.

CATEGORY	% COMPLETE	RECOMMENDATIONS	NUMBER OF RECOMMENDATIONS	PERCENTAGE OF TOTAL RECOMMENDATIONS
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COMPLETE	100	1, 2, 4	3	75%
TOTAL			4	

5 CONCLUSION

The City addressed the recommendations of the audit and has essentially completed their implementation.

6 ACKNOWLEDGEMENT

We wish to express appreciation to the staff and management for their cooperation and assistance throughout the audit process.