



Engineer Checklist

For more detail on each bullet point see the Engineer Tip Sheet pages listed below.

Purpose of Report (page 7-8)

- Cover page with applicant details included
- Short overview (Event, Damage, Date)
- Requested funding amount clearly stated at the start of the report
- Confirm that the damage is caused by the event
- Project Scope and summary including documents reviewed for preparation of report

Analysis

- Damage Assessment for DFA (page 8)
- Level of Damage identified (Major Damage/Non-Major Damage) (page 3-4)
- High Risk Area Identified (Yes/No) (page 4)
- Appropriately mitigated pre-event identified (page 4)
- Map of area
- Detailed analysis of Damage (page 9-21)
- Confirm that all repair costs are eligible for DFA.
- Pre-Disaster Condition Evidence (may include):
 - Photos (example on page 10)
 - Maintenance records
 - Satellite images (example on page 9)
 - Diagrams

Proposed Repairs

- Proposed repair description and diagrams (page 10)
- Least-Cost Option identified and enhancements excluded
- Cost Summary (example on page 21)
- Cost Breakdown Estimate (page 5)

Appendix

- Relevant Supporting Documentation

Engineer Tip Sheet

To request DFA funding, all Local Government infrastructure cost recovery plans (ICRPs) must be accompanied by an Engineer Report. Engineer reports provide DFA with detailed plans for infrastructure repairs, cost estimates including the least-cost option to repair the infrastructure to pre-event condition, and evidence to support that all damages occurred directly from the disaster event.

Purpose of Report:

- Confirm that the project is eligible for DFA.
- Confirm that all repair costs are eligible for DFA.

Cover Page:

- Name of Event.
- Name of Local Authority.
- Project Name and Number.
- Preliminary Report - Damage Assessment, or Final Post Completion Report.

Disaster Event Elements:

- What caused the damage?
 - The report needs to directly link the damage to the DFA event.
 - If flood – dates of rainfall or river flooding.
 - If landslide – provide evidence that the slide was a direct result of the DFA event and not caused by long term on-going slope instability.

Damage Assessment

- Did major damage occur? Yes? No?
 - Major Damage is considered significant impact to the safety, structural integrity, and/or critical function of an asset or system as determined by a suitably qualified professional, where the asset or system is unable to function as intended or has a prolonged period of down time, and will require significant repairs or total reconstruction.
 - Non-major damage includes impacts to the asset or system that may result in

some down time and/or loss of function, but the critical function of the asset or system can be restored quickly with minimal disruption (e.g., superficial damage or damage to the aesthetics). Non-major damage may require cleanup and/or minor/moderate repairs but not major reconstruction.

- Did the damage occur in a high-risk area? Yes? No?
 - High-Risk areas include geographic areas designated and/or identified by municipal, provincial/territorial, Indigenous, and/or federal governments or regulatory bodies as having an enduring, elevated risk of severe consequences stemming from the impact of a specific or multiple natural hazard(s).

Flood hazards

- Where local governments, indigenous, and/or provinces have high risk designations that are, at a minimum, at the 1-in-200 year flood event level (i.e., 0.5% annual exceedance probability), this designation is used. Where designations of high risk are less than 1-in-200 (i.e., high risk set at 1-in-100), a 1-in-200 federal identified flood risk is the indication of high risk.

Other hazards

- Additional designations of high risks areas for other types of hazards may be identified at a later time.
- If the damage occurred in a high-risk area was the asset appropriately mitigated? Yes? No?
 - To be considered appropriately mitigated, an asset in an identified and/or a designated high-risk area is resilient to the identified high risk, which means it is protected in such a way that it will not experience major damage from natural hazard events that are at or lower than the identified high-risk level. Appropriate mitigation may include a combination of property-level mitigation (e.g., seismic retrofits, elevated ground floors) and community-level mitigation (e.g., dikes or adaptation measures, community FireSmart initiatives).

- What was the pre-disaster condition?

Describe the condition of damaged infrastructure immediately before the disaster.

- Include supporting evidence – photos, reports, maintenance records, as built drawings etc.
 - Include infrastructure measurements or quantities of materials damaged by disaster.
- What is the least cost option to restore the damaged infrastructure to pre-event

condition?

- Cost breakdown estimate (choose 1 of the 3 options):

1. Build back to pre-event condition:

The repairs represent only the minimum amount needed to return the works to pre- disaster condition. In this case the engineer's report needs to clearly state that the costs represent only the costs with measurements or quantities of materials of returning to pre- disaster condition.

2. Build with enhancements (build back better):

Additional work is undertaken beyond restoring to pre-disaster condition. In this case the engineer's report needs to identify the minimum cost with measurements or quantities of materials to return the works to pre-disaster condition or functionality, and then separately identify the costs associated with any enhancements. Any costs associated with enhancements will **not** be DFA eligible unless supported with documentation to confirm they are required to meet mandatory standard, regulation, or code/bylaw.

3. Different repairs required:

An alternative solution is undertaken. The engineer's report needs to identify the minimum cost to return the works to pre-disaster condition, and then separately identify and cost any alternate solutions. DFA eligible costs will be lesser than the cost to return to pre-disaster condition or the alternate solution.

- What are the DFA eligible costs?
 - Refer to DFA legislation link - https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/124_95
 - If the work is NOT started – the engineers report will be preliminary and will provide estimated Class D costs (or a combination of actual and estimated costs if work has started).
 - If the work has been completed the report will be a final or post repair report and provide actual costs (these costs will match the invoices and claim summary being submitted to EMCR).

- What resources were used to prepare the engineer report?
- Any reports or documents that were used to support conclusions for DFA eligibility must be appended to the report, such as:
 - Geotech reports.
 - MFLRNORD and DFO requirements/approval letter.
 - Archaeologic Study, Hydraulic Study, and other engineer's reports required for approval process.
- Who prepared the Report?
 - Report must be signed by engineer with the engineering company name.

See next page for Sample Report.

City of Riverbend



**City of
Riverbend Cost
Recovery Plan
Engineer
Assessment**

DFA Sample Report

Name of Local Authority: City of Riverbend

Date: August 24, 2020

Project Title: Recovery Repair Works

File Number: 2021-05

Name of Event: Spring Freshet Flood 2020

Date of Damage: May 31 – June 1, 2020

Funding Request: **\$143,943.00**

Documents included:

- Map of effected area.
- MFLNRORD Conditional Approval Letter (if required).
- Photos of damage – pre and post event.
- Cost Estimate.



August 27, 2020

City of Riverbend
Disaster Financial Assistance

The following is a summary of our engineering review of damage that occurred to the City of Riverbend from the Spring Freshet 2020 at Carpenter Creek and Dike.

Applicant Information:

The City of Riverbend. Contact Kate Fern CFO and George Smith, Public Works.

Scope:

Chris Arbutus of Cedar Engineering has reviewed flood damage sustained by the City of Riverbend during the May 31/June 1, 2020, flood event. Cedar Engineering was asked to review the Disaster Financial Assistance (DFA) application and provide an opinion as to whether the site damage was consistent with DFA eligibility criteria, and to estimate the cost for repairs.

A field review was completed by Chris Arbutus and the undersigned on August 25, 2020, in the company of Kate Fern (CAO) and George Smith (Public Works) of the City of Riverbend. All sites identified were in reasonable working order before the event occurred.

Damage Assessment for DFA:

The location of where the damage occurred in the City of Riverbend was identified as a high-risk Area. The trails were in good condition prior to the event and appropriately mitigated. The event that occurred was a once in 200-year flood event. Non-major damage has occurred during the event, and the area will require some repairs and clean up.



City of Riverbend Damage Assessment 2020



Figure 1: Overview of City of Riverbend- Site Location Map Damaged Sites by flood

The following provides a description of the losses at each site. The City has identified 4 sites. Following the field inspection Cedar Engineering added the additional Site 3 to make a total of 5 Sites.

Site 1 - Walkway: A large volume of bed load was deposited and was shifting in the main channel of Carpenter Creek during the event resulting in an avulsion at the downstream right bank and subsequent flooding and erosion of a 55 m long section of 1-meter-wide gravel walkway as shown in Figure 2. The City does not have pre-event photos. The trail was in good working order before the spring flooding occurred.

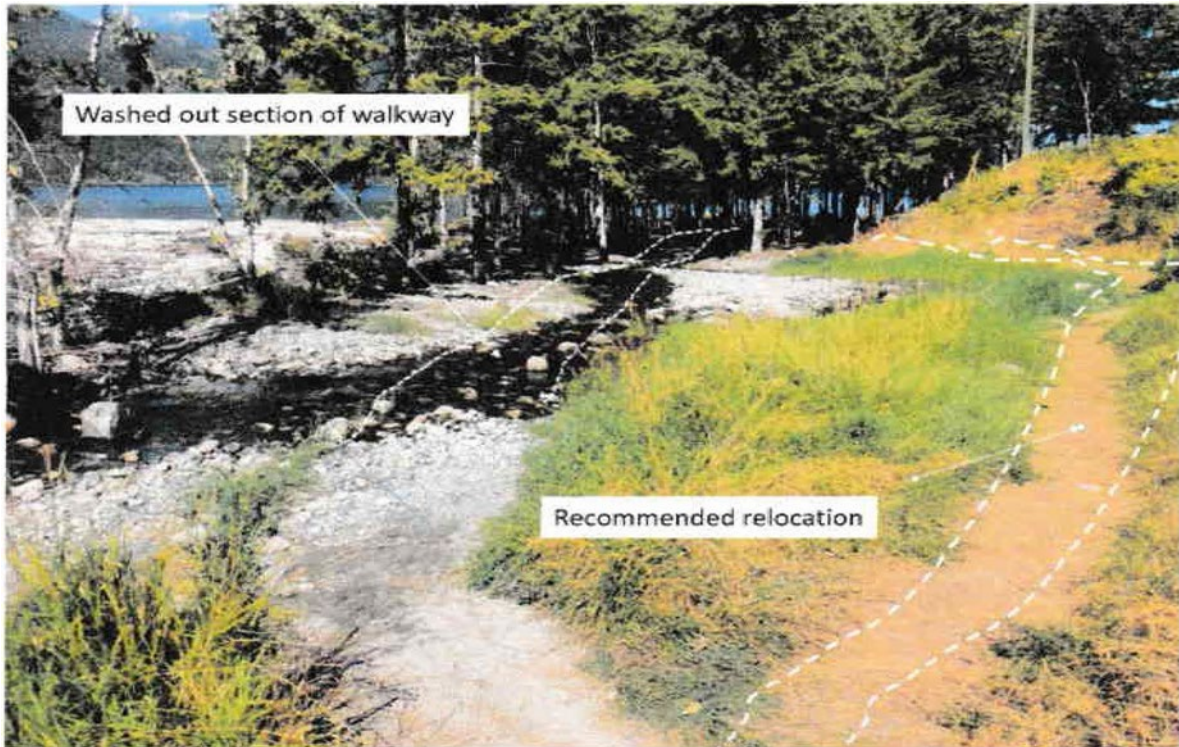


Figure 2: Site I - Walkway Flooding and Erosion August 25, 2020

The estimated cost to reconstruct the walkway is summarized in Table 1. The estimate is based on the relocation of the section of walkway approximately as shown in Figure 2. It is deemed impractical to reconstruct the washed-out section of walkway in the location it existed prior to the flood.

Firstly, it would require the excavation of the substrate of the main channel of Carpenter Creek to divert the water from the worksite. This work in and about a stream would require authorization from MFLNRORD increasing the project duration and cost substantially. It is questionable whether the ministry would authorize this work.

Secondly, because of the elevated main creek bed adjacent to the entrance to the new channel that eroded the walkway and the continued deposition and shifting of gravel and

accumulation of log jams there is a high probability that the area would flood again next freshet.



Figure 3: Site 2 Log Jam August 25, 2020

Site 2 - Log jam: The high creek flows resulted in the development of several new log jams in the creek channel throughout the City. The City is concerned that the log jam shown in Figure 3 will increase the risk of erosion of the adjacent riprapped bank. The removal of the jam would reduce the likelihood of a bigger jam forming in subsequent freshet flows and would reduce the risk of damage to the adjacent riprap bank protection. However, there was no evidence of loss of riprap from the bank resulting from this event. The removal of the jam would require prior authorization from MFLNRORD. One alternative is to cut up and spread the logs in channel to reduce the likelihood of creek redirection.

Site 2 Log Jam is not eligible for DFA funding: removal of tree debris is considered mitigative as no infrastructure is impacted.

City of Riverbend Damage Assessment 2020

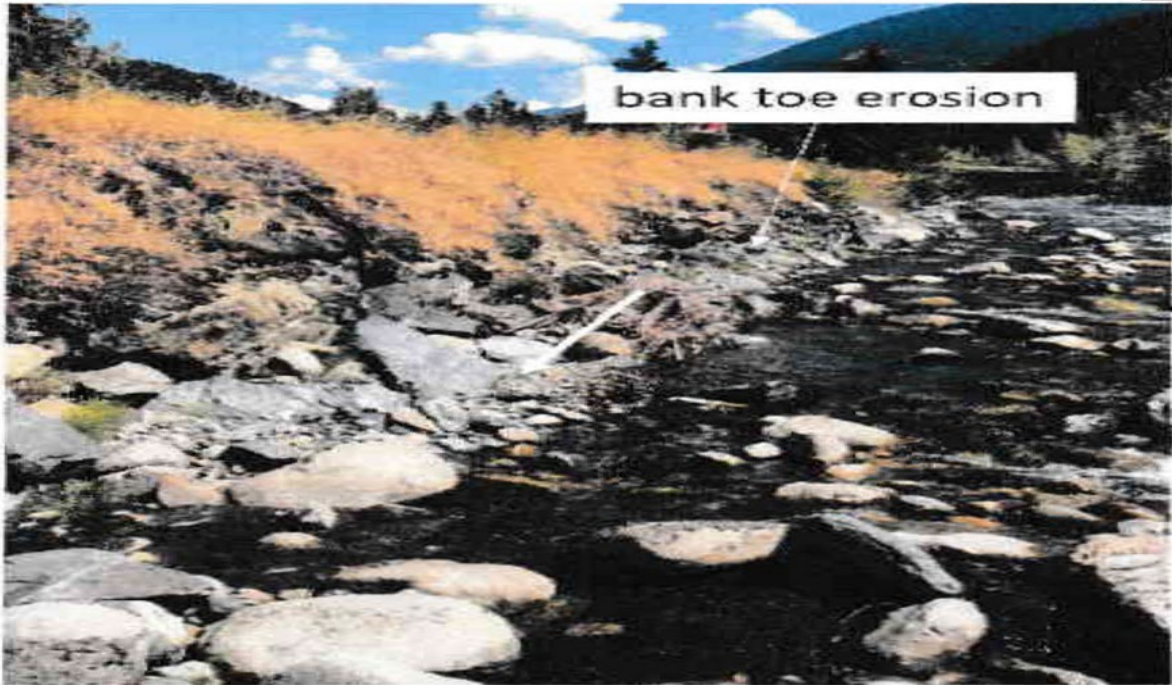


Figure 4: Site 3 Riprap Toe Erosion August 25, 2020

Site 3 Right Bank Erosion: A 15 m length of riprap bank protection, approximately 190 m downstream from the Highway 6 bridge (see Figure I) was damaged as shown in Figure 4. Costs (Table 1) for riprap repairs to this site and Sites 4 and 5 are considered eligible.



City of Riverbend Damage Assessment 2020



Figure 5: Site 4 Riprap Lost August 25, 2020

Site 4 -Riprap Replacement: Approximately 67 m of bank protection was damaged as shown in Figure 5.

City of Riverbend Damage Assessment 2020



Figure 6: Site 5 Bank Erosion August 25, 2020

Site 5 Riprap Replacement: Riprap erosion protection on a 26 m section of dike upstream of the Highway 6 bridge was eroded as shown in Figures 6 to 8. A large gravel bar and trees in the channel upstream of the bridge and adjacent to this site constricted the channel, caused log jams, and resulted in water being forced to impinge directly into the dike as shown in Figures 7 through 9.

City of Riverbend Damage Assessment 2020



Figure 7: Site 5 Dike Erosion August 24, 2020



City of Riverbend Damage Assessment 2020

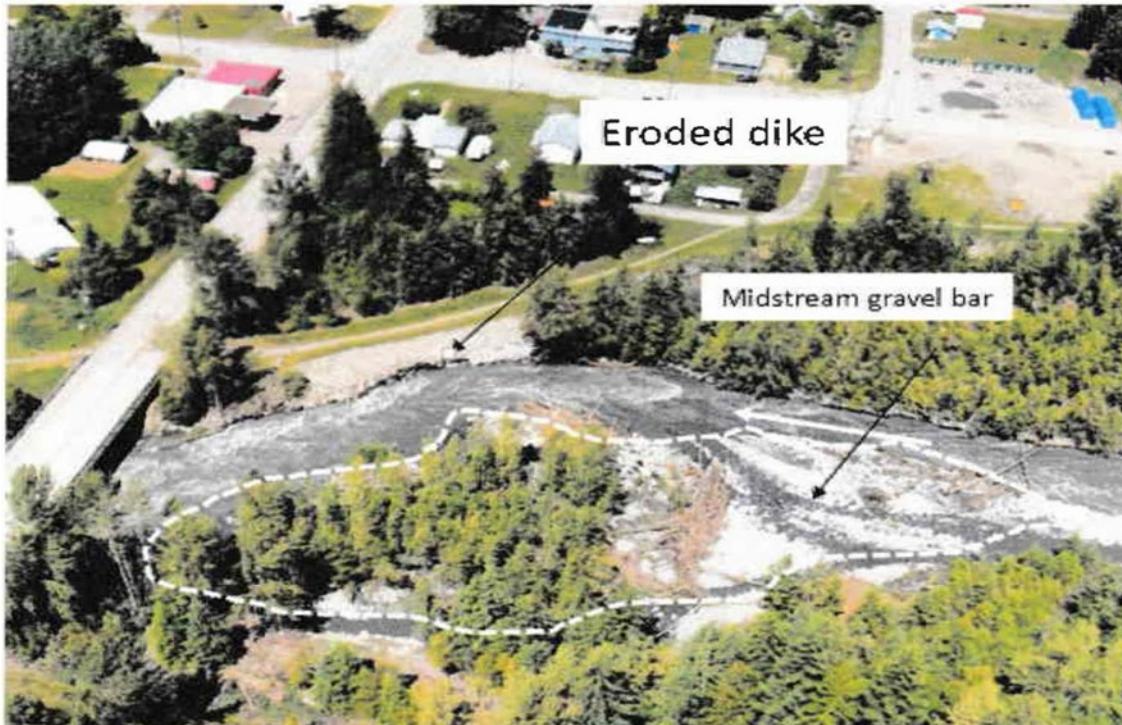


Figure 8a: Site 5 Gravel bar and trees mid-stream upstream of Highway 6 bridge June 3, 2020



City of Riverbend Damage Assessment 2020



Figure 8b: Site 5 View of mid-channel gravel bar and trees upstream of bridge, June 3, 2020



City of Riverbend Damage Assessment 2020



Figure 9: Site 5 View of gravel bar and log jam forcing flood waters to impinge on dike May 31, 2020 (courtesy City of Riverbend)

The dike was initially constructed in the 1970's and upgraded in the 1990's. During the 2013 freshet the dike was damaged at this same location with loss of erosion protection and some of the dike prism as shown in Figure 10. The photo in Figure 10 was taken from CGT Engineering report to the City dated September 11, 2013. In 2014 the dike slope was reconstructed and armored with riprap, as shown in Figure I, taken from CGT report to the City dated September 8, 2014. It is understood the repairs were funded partially by the Province.



City of Riverbend Damage Assessment 2020

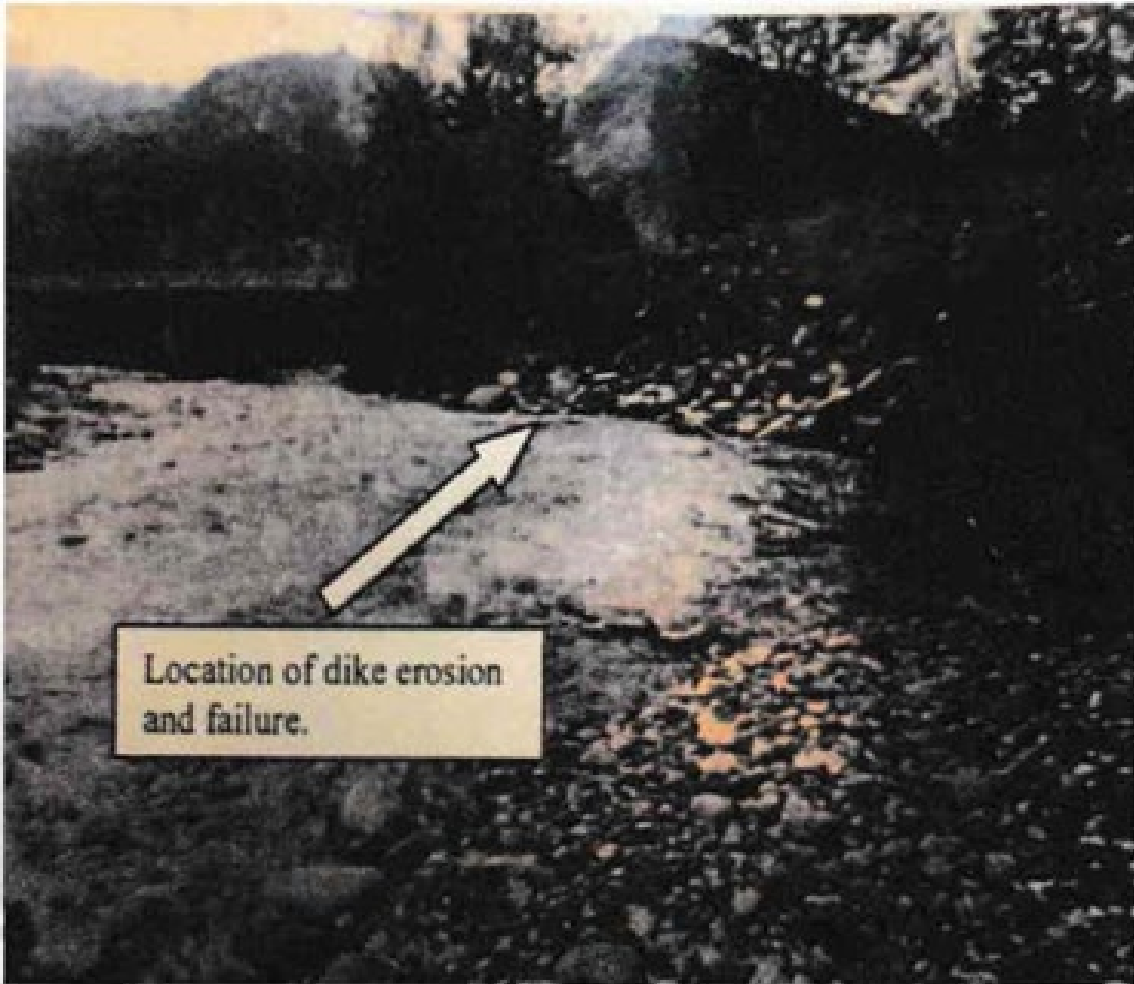


Figure 10: Site 5 View of Erosion Resulting from June 2013 Flood (CGT 2013)



City of Riverbend Damage Assessment 2020



Figure 11: Site 5 View of repaired dike photo from September 2014 (CGT 2014)

The estimated volume of riprap lost during the May 31/June event is 143 m³. Simply reconstructing to the pre-event configuration is not recommended as there would be a high likelihood of a repeat failure. Conceptual review indicates that the maximum riprap slope angle should be 1.5H: 1V (which is consistent with the 2013 riprap design) and should include a toe trench (also part of the 2013 design).



City of Riverbend Damage Assessment 2020

The riprap placed on the lower slope in 2013 had a lower slope angle of 1H:1V compensated by larger riprap sizing. In addition, it is recommended that the gravel bar, log jam, and trees shown in Figures 7 and 8 be removed from the channel to realign flow under the highway bridge and reduce pressure on the dike. Once the channel is cleared the accumulation of gravel and log jams should be monitored and actions taken to prevent the re-establishment of the channel constriction. This can be facilitated with coordination between the City, MFLNRORD (Dike Inspection and habitat concerns), DFO and MOTI by updating the Vegetation Management Plan. During the May 31/June event the highway bridge sustained damage in the form of lost riprap that provides pile cap protection (piles now exposed).

The cost of repairs summary (Table 1) for Site 5 is based on the plan to reconstruct the bank with a flatter slope angle and scour protection described above. The construction will involve instream work. Consequently, authorization will be required from MFLNRORD. Most likely MFLNRORD will require an environmental assessment and oversight during construction. This cost is included in Table 1.

As noted above, Cedar Engineering recommends the removal and subsequent monitoring of the gravel bar build-up to reduce the risk of future damage to the dike and the highway bridge. This would include obtaining authorization from MFLNRORD and DFO to complete the initial gravel and tree removal and re-grading, revising, and updating the Vegetation Management Plan. As this work may not be eligible for DFA (to be confirmed) it is not included in Table 1.



City of Riverbend Damage Assessment 2020

Cost Summary: As stated, Table I provides a conceptual cost estimate to complete the works at the least cost option (not including channel works and debris removal upstream of the bridge-which may be eligible for DFA as it will assist in protecting the replacement riprap and highway bridge). The work at all sites will require authorization for work in and about a stream (Water Sustainability Act (WSA)). It is assumed that the work will be completed under one WSA authorization and that an RPBio report and site inspections will be required.

Table 1: Cost repair summary (conceptual design stage)

Site No.	Item	Unit Cost	Cost	Comment
1.	20 m ³ of Sand and gravel haul to site.	\$50	\$5,000	
1.a	10 hrs Machine Time Strip, level, load, spread	\$77.15	\$771.50	Class 3 mini
2.	60 hrs Buck debris in channel	\$50/hr	\$3,000	Cost not DFA eligible
3.	10m ³ Riprap	\$220	\$2,200.	Buy, haul, placement
4.	192 m ³ Riprap	\$220	\$2,200	Buy, haul, placement



City of Riverbend Damage Assessment 2020

Table 1: Cost repair summary, con't.

Site No.	Item	Unit Cost	Cost	Comment
5.	192m ³ Riprap	\$220	\$2,200	Buy, haul, placement
5a	30 hrs Excavator (30 tonne) instream work to dewater toe	\$171.05	\$5,131.50	Reconfigure slope and
9b	Site Survey		\$2,000	
9c	Geotextile		\$2,000	

All Sites

Engineer Design, drawings, design, and specs \$15,000

Prepare drawings, Dike Act and WSA approvals, construction oversight and project completion report.

Hydrotechnical Report \$1,600

Hydrologic and hydraulic analysis to establish design parameters.

Riprap Site Inspections during construction – general conformance.

RPBio Report and Section 11 Application \$4,000

On site monitoring and project completion report.

Total Costs **\$143,943** (Less \$3,000, costs associated with log jam).

Any questions, please call.

Sincerely,

Chris Arbutus

Chris Arbutus, Cedar Engineering