Type		Material Composition	Remarks
8	Bag Mortar	Premixed concrete bags stacked on each other.	Hand placed and allowed to set in place.
9	Geotextiles	Inorganic fabrics which allow penetration of water but not soil.	Normally used under other tiles protections to prevent washing away of fines by subgrade seepage.

The following table provides a summary of condition state for each slope protection defect definition.

Table 2.5.18.2.5.6 Slope Protection Defect Definitions

Defects	Good Condition	Fair Condition	Poor Condition
Loss or deterioration of slope protection material	less than 20%	20% to 60%	more than 60%

Note: Excellent Condition – No observed material defects

2.5.19 Streams And Waterways

This section describes stream and waterway defects, followed by a summary table of defect definitions versus condition state (see Table 2.5.19.1).

For the purpose of this section, a stream is defined as a body of water over or under which a structure is built. The defects produced in the stream by the presence of structure components in or near the stream are detailed in this section. Streams are to be considered as auxiliary components.

An assessment of the stream and channel stability is important for determining the need for protective measures. A stable stream and channel is one that does not change in size, form or location over time. They have fairly constant widths, well protected banks and narrow sand bars.

An unstable stream or channel is one in which changes occur over time which are large enough to become a significant factor in the maintenance of structure components in and around the stream and channel. All alluvial channels change to some extent over time and, therefore, have some degree of instability.

There are three principal types of streams; namely, meandering, straight and braided.

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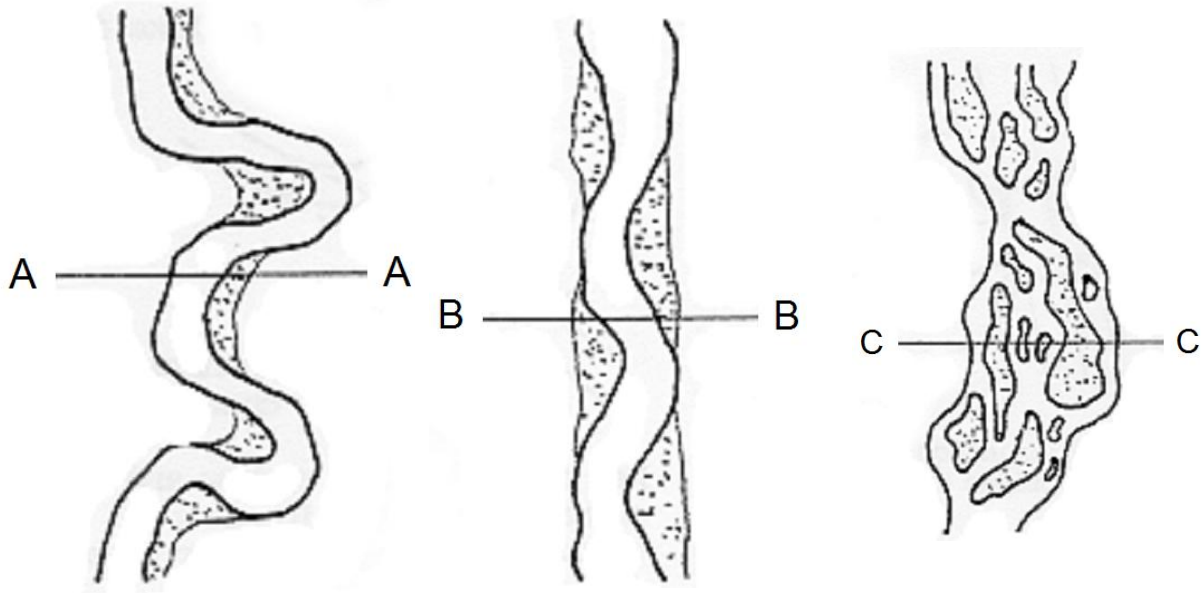
A meandering stream is characterized by alternative S-bends which migrate laterally downstream. Bank erosion occurs on the outside radius while deposition occurs on the inside radius at each bend in the stream. Meandering streams may be unstable.

A straight stream is one where the length of the stream, measured down the centreline of stream, divided by the length of the valley proper is less than 1.5. A straight stream is usually not entirely free of meandering since the main current often alternates from side to side. Straight streams are usually relatively stable.

A braided stream is identified by numerous unstable interlacing channels separated by gravel or sand bars and small islands. Braided streams are usually highly unstable.

The above three types of streams are illustrated in Figure 2.5.19.1.



Meandering (moderately stable) | Straight (stable) | Braided (unstable)

Section A-A Section B-B Section C-C

Figure 2.5.19.1 Principal Types of Streams

2.5.19.1 Material Defects of Streams and Waterways

SCOUR is the removal of material from the stream bed or bank due to the erosive action of moving water in the stream. Scour may be general or local. General scour is caused by the constriction to the natural flow created by the structure and is measured as the average depth below the original stream bed. Local scour occurs as a result of an obstruction to the flow, such as, a pier, an abutment, the toe of the embankment or accumulation of debris in the stream. Local scour is measured below the level of general scour.

DEGRADATION is the lowering of the stream bed or the widening of the stream channel due to continuous scour by the stream and usually occurring when the sediment transport capacity of the stream is enhanced by increased flow. This often results from a natural increase in the slope of the stream bed or as a result of artificial alterations. Lowering of the stream bed may also result in slumping and erosion of the stream banks, structure embankments and slope protection.

AGGRADATION is the raising of the stream bed or the narrowing of the stream channel due to deposition of material by the stream and usually results where the sediment transport capacity of the stream is decreased. This often results from a natural flattening of the stream bed gradient or as a result of artificial alterations.

ICE can cause several problems, the most common of which is ice jamming at the time of spring break-up. Ice piling against a structure may cause serious damage to the structure and ice jams may cause severe local scour by constricting the opening at the structure. Jams are frequently a result of ice flows piling up against unbroken ice at a flattening of the stream gradient. The impact of ice flows can cause bending of exposed steel piles and the breaking of timber piles.

PIPING is the subsurface removal of fines by the movement of water through the ground or embankments.

CHANGES IN ALIGNMENT may occur as the result of fluctuating water levels and changes in stream velocity.

Figure 2.5.19.2 and Figure 2.5.19.3 illustrates material defects commonly occurring in streams.

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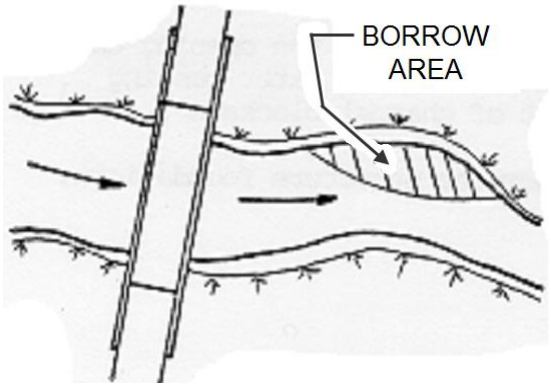
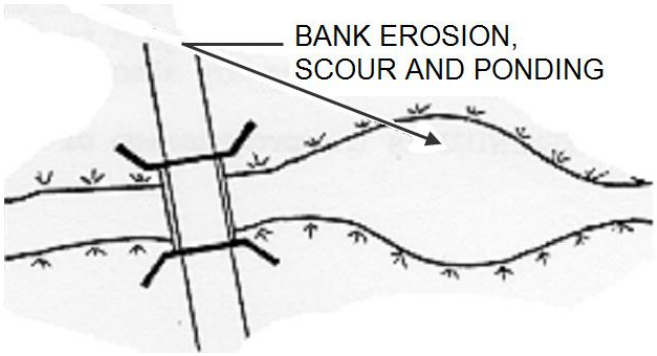
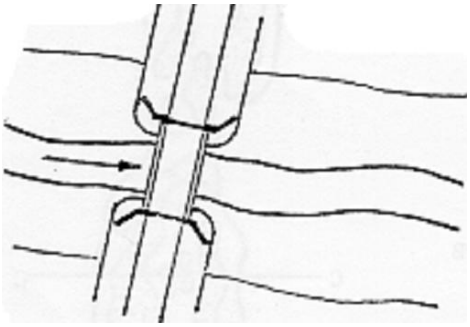


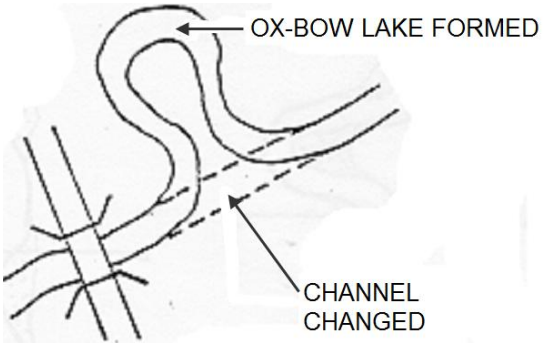
Removing large quantities of gravel from channel bottom causes degradation upstream



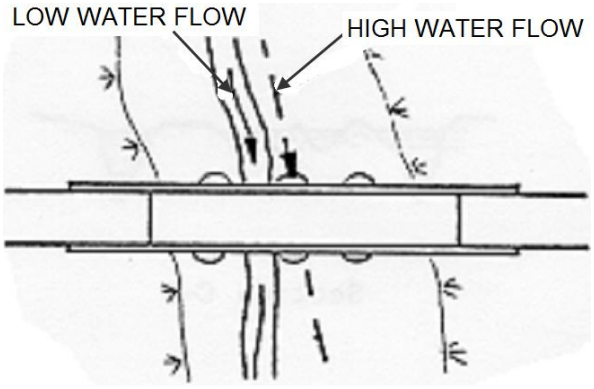
A firm channel bottom or constriction causes scour, bank erosion and ponding downstream



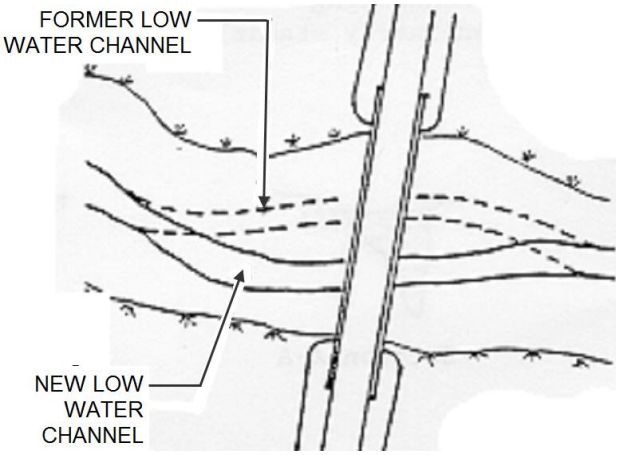
Channel constriction produces scour around the bridge during flood



New channel cuts off ox-bow and steepens channel profile with increase in flow velocity and degradation upstream



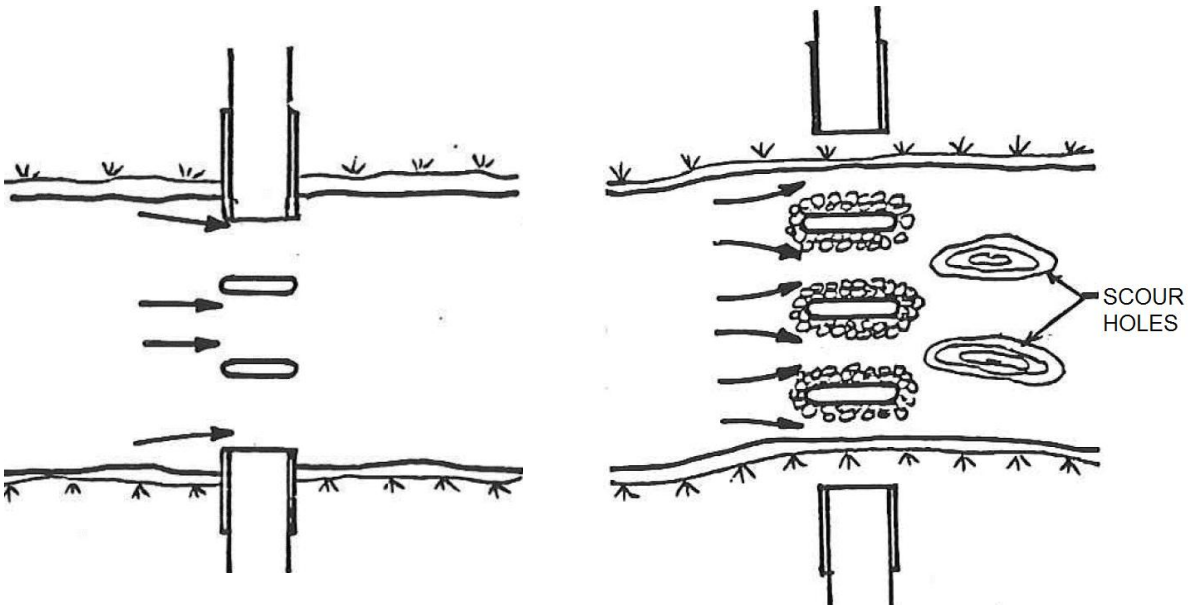
Scour around piers is influenced by location of pier to flow. Note change of flow at high



New water channel may be formed after a flood

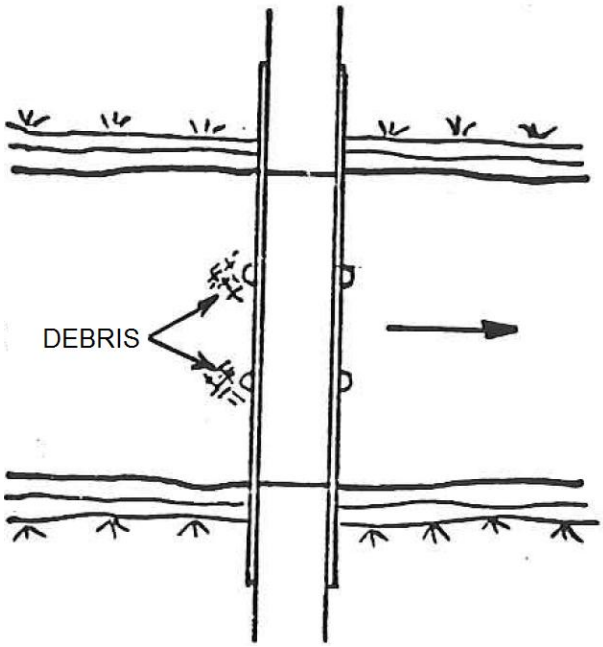
water

Figure 2.5.19.2 Typical Material Defects in Streams

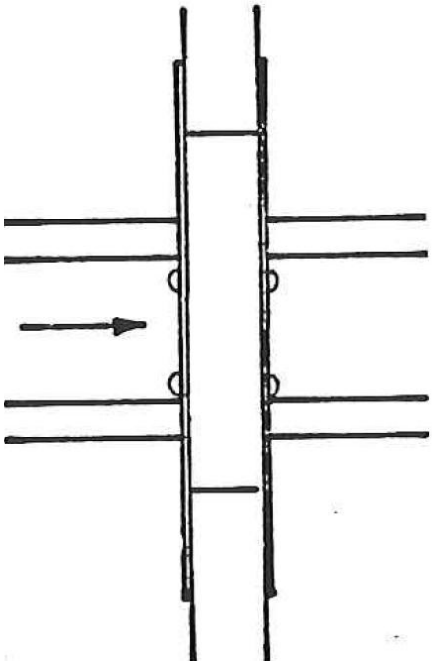


Protruding abutment produces local scour at upstream

Rip-rap around piers may cause local score downstream



Debris around pier reduces opening causing increased scour



Lined banks reduce scour, but if channel is constricted it may increase general scour at bridge

Figure 2.5.19.3 Typical Material Defects in Steams (cont.)

2.5.19.2 Performance Defects in Streams and Waterways

Performance defects in streams and waterways are based upon the ability of the structure opening to accommodate the stream flow; the frequency of flooding at the structure; and material defects of streams that adversely affect other components of the structure.

BLOCKAGE of the stream channel may occur as a result of accumulations of debris due to natural causes, beavers dams, or due to aggradation of the stream bed or banks. Large quantities of debris are carried down by relatively fast-flowing streams having erodible banks.

FLOODING over the structure and adjacent roadways occurs if the opening under the structure was not designed to accommodate the volume of water passing through it. Flooding may also occur as a result of channel blockage.

UNDERMINING is the progression of the scour under the structure foundations.

2.5.19.3 Defect Table

Table 2.5.19.1 Streams and Waterways Defect Definitions

Defects	Good Condition	Fair Condition	Poor Condition
Scour or degradation of the stream bed or stream banks	A few locations but not exposing the foundations	Numerous locations at the top of the previously covered foundations	Any locations att the bottom of previously covered foundations
Scour at inlet or outlet of culverts and soil-steel structures	Slight	Moderate	Extensive and with loss of embankment fill
Stream alignment shifted	but not encroaching against components not previously subject to stream flow	and encroaching close to components not previously subject to stream flow	with stream flow directly against most of components not previously subject to stream flow
Aggradation	A few locations	Medium	Extensive
affecting the stream flow at the structure	no	significant	severely

Note: Excellent Condition – No observed material defects

2.5.20 Accessories (Attachments And Signs)

The following table provides a summary of condition state for each accessory defect definition.

Defects	Good Condition	Fair Condition	Poor Condition
Sign conditions	Not standard	Not located according to standards	Illegible, missing or provides misleading, wrong or inaccurate information
Material defects	Light	Medium	Severe and very severe
Components on attachment		Loose, damaged or bent	Broken or missing

Note: *Excellent Condition – No observed material defects.*

2.5.21 References

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2.6 SUSPECTED PERFORMANCE DEFICIENCIES

A Performance deficiency should be recorded if an element's ability to perform its intended function is in question, and one or more performance defects exist. Performance defects for the various elements of a structure are described in Part 2, Section 2.5. Often, an inspector "suspects" a performance deficiency, but is unsure of the extent of this deficiency until some follow-up action is taken. A list of common performance deficiencies is shown in Section 2.6.12.6.1. These deficiencies are often applicable to several elements, however, in some cases, the deficiencies listed are applicable to only one type of element. An example of a suspected performance deficiency is "Load Carrying Capacity". The typical follow-up action for this deficiency would be to carry out a strength evaluation of the structure (or element). Section 2.6.12.6.1 also describes typical deficiencies for various elements and lists possible follow-up actions. The follow-up action could take the form of either an additional investigation or a maintenance operation.

In most cases, performance defects in an element are closely related to or attributable to material defects. In some cases, performance defects exist due to defects in design or construction and may not be directly related to material defects. Also, performance defects in a component may be the result of unexpected behaviour of the structure or due to performance defects in other components of the structure.

It should be noted that the list of suspected performance deficiencies should be considered during the inspection of each element.

For Retaining walls:

All retaining walls must be maintained in a stable condition. Any portion showing signs of deterioration, deflection or settlement should be monitored, repaired, reinforced or replaced. Any wall showing signs of tilting, settling or other movement should be monitored to determine whether the process is ongoing.

Since RSS/MSE technology is well established, the need for monitoring programs should be limited to:

- cases in which new features or materials have been incorporated in the design
- substantial post construction settlements are anticipated and/or construction rates require control and,
- where degradation/corrosion rates of reinforcements require monitoring because of the use of marginal fills or anticipated changes in the in-situ regime.

A comprehensive program may involve:

- **Deflection monitoring** to establish gross structure performance and as an indicator of the location and magnitude of potential local distress to be more fully investigated.

- **Structural performance monitoring** to primarily establish tensile stress levels in the reinforcement and or connections. A second type of structural performance monitoring would measure or establish degradation rates of the reinforcements.
- **Pullout resistance** proof testing to establish the level of pullout resistance within a reinforced mass as a function of depth and elongation.

2.6.1 Suspected Performance Deficiency Types

2.6.1.1 Load Carrying Capacity (#1)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Girder Deck Top Railing System etc. (Note – deficiencies in most elements can trigger a strength evaluation)	• Material defects leading to loss of strength, or which are indicative of inadequate strength of the component (e.g., 20% section loss at mid-span of girder) • Detrimental modifications made subsequent to construction; • Strong evidence of under design for current loads.	• Strength evaluation • Monitoring of deformations (displacements or rotations) or cracks.

Retaining Walls Examples: Slipping or tilting of wall)	• Bulging upward of grade in front of wall. This indicates that a large movement has occurred and failure is imminent. • If ground in front of wall is disturbed, the wall may have lost passive resistance for sliding stability • Material defects leading to loss of strength • Possible bearing capacity failure. • Detrimental modifications made subsequent to construction • Differential out-of-plumb orientation of wall along its length • Ground pressure under toe of wall is excessive thus forward tilting of wall may result. • Old walls are often deficient in toe thickness and this might result in fractures at the toe. This condition does not necessarily signify danger, but if discovered wall should be kept under observation • Sloped vegetation on top of wall • Differential settlement or low spot in wall • Overall wall leaning beyond vertical alignment tolerance • Panel contact, resulting in spalling/cracking • Foundation (subgrade) material is too soft or wet for proper bearing. • Fill material of poor quality or not properly compacted	• Excavate an exploratory hole behind the retaining wall in order to prove its thickness and • construction (i.e. are there counterforts built in the wall?) • A wall which is overturning can be strengthened by building counterforts behind or in front of the wall • Strength evaluation • Drill the wall in a number of selected places measuring the thickness and observing the type and condition of the material penetrated. • Seal these cracks and monitor • Situation should be evaluated by qualified geotechnical specialist

2.6.1.2 Excessive Deformations (#2)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action

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Railing System, Deck Top, Truss Chord, Abutment Wall, Bearings, etc	• Severely bent members • Overloading, either single or repetitive occurrence, resulting in permanent deformations of the deck or deck components. • Permanent deformations, especially in compression components • Unanticipated or excessive vibration or deflection of components, connections or joints under live loads • Unexpected noise from components or connections due to vehicles moving across the structure. • Mis-alignment, lateral deformation, warping, etc. of components; • Inability of the abutment to withstand lateral earth pressures, as indicated by long, medium horizontal cracks in abutments; • Deformation of the roof slab, floor slab or walls of culverts. • Deformation of soil-steel structures such as flattening or peaking of the soffit or buckling of the shoulders or haunches; • Up-lift at ends of soil-steel structures • Movements causing distress in a bearing or it's components, or in other structure components;	• Strength evaluation • Monitoring of deformations (displacements or rotations)

Retaining walls Examples: Deflection or rotations, Wall out of vertical alignment tolerance (plumbness), ie leaning in or out, Wall out of horizontal alignment tolerance, or bulging Large variations in movement of adjacent panels.	• Backward Tilting of Wall • A deep rotational slip is occurring dislodging the retaining wall • Panel not battered sufficiently. • Oversized backfill and/or compaction equipment working within 1 m (3 ft) zone of back of wall facing panels. • Backfill material placed wet of optimum moisture content. Backfill contains excessive fine materials (beyond the specifications for percent of materials passing a No. 200 sieve) • Backfill material pushed against back of facing panel before, being compacted above reinforcing elements. • Excessive or vibratory compaction of uniform, medium-fine sand (more than 60 % passing No. 40 sieve). • Backfill material dumped close to free end of reinforcing elements, then spread toward back of wall, causing displacement of reinforcements and pushing panel out. • Shoulder wedges not seated securely. • Shoulder clamps not tight. • Slack in reinforcement to facing connections. • Inconsistent tensioning of geosynthetic reinforcement to MBW unit. • Localized over-compaction adjacent to MBW unit. • Excessive batter set in panels for select granular backfill material being used • Inadequate compaction of backfill. • MBW unit manufactured out of vertical tolerance. • Backfill saturated by heavy rain or improper grading of backfill after each day's operations. • Backfill material not uniform. • Backfill compaction. • Inconsistent setting of facing panels.	• Removal of reinforced fill and reinforcing elements, followed by the resetting of the panel

2.6.1.3 Continuing Settlement (#3)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action

Foundations	• Loss of strength or support for applied loads due to material defects; • Loss of material supporting foundations due to scour or erosion • Consolidation or failure of underlying soil resulting in cracking or movement of foundations, abutments or piers • Loss of contact between piles and pile cap or pier cap; • Changes in the inclination of piles. • Rotational movement of pile caps and loss of full contact with piles.	• Regular Monitoring of settlement, pier and abutment elevations and crack widths • Strength evaluation • Geotechnical investigation • Underwater investigation
Retaining walls	• Sunken grade behind the wall or the top of wall alignment has dropped • Differential settlement between walls and abutment	

2.6.1.4 Continuing Movements (#4)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Abutment Wall, Pier, Deck Top, Bearings, Retaining walls etc.	• Out of plumb of abutment walls, piles, piers or other components supported on them; • Tilting or bulging of Retained Soil System (RSS) walls • Unusual or unexpected substructure movements occurring during the passage of heavy vehicles over the bridge; • Tapering or misalignment of cracks and joints in foundations, abutments, piers or other components supported on them; • Sudden drops or kinks in the structure profile over piers or abutment walls when sighting along railings or beam lines; • Abnormally large or small openings or misalignment of deck expansion joints at abutments and piers; • Abnormal displacements or inclinations of bearings; • Abnormally large or small clearance between ballast wall and superstructure; • Cracks in abutment wall and ballast wall • Shift in alignment from original position;	• Regular monitoring and measurement of movements, inclinations, crack widths, etc. • Underwater investigation • Geotechnical investigation For retaining wall: • Drive sheet piling in front of the toe to cut through the slip plane and thus prevent further movement. • As a temporary measure, excavate soil from the top of the wall and dump it over the wall • Place concrete under and in front of the wall toe in short lengths for length required.

2.6.1.5 Seized Bearings (#5)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Bearings	Binding or jamming of expansion or rotational components due to corrosion, lack of lubrication or damage to sliding surfaces;	• Strength evaluation to account for change in articulation • Lubricate Bearings (Maintenance Operation)

2.6.1.6 Bearing not Uniformly Loaded / Unstable (#6)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Elastomeric Bearing, Rocker Bearing, etc.	• Non-uniform contact of bearing surfaces with each other or with bearing seat • Excessive inclinations of bearings	Regular monitoring of bearing movements

2.6.1.7 Jammed Expansion Joint (#7)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Armouring/ retaining devices, Retaining walls	• Inadequate joint gap to accommodate anticipated further movement; • Surfacing materials have jammed in the joints during resurfacing of deck; • Design or construction problems not allowing proper movement of multi-seal joints.	• Regular monitoring of deck movements • Clean out gap (Maintenance operation)

2.6.1.8 Pedestrian / Vehicular Hazard (#8)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action

Armouring/ retaining devices, Sidewalk, Retaining walls	• Vertical or horizontal misalignment across the joint; • Severe material defects (e.g. Spalling) • Horizontal, vertical or rotational displacements in curbs and sidewalks as they are hazardous to pedestrian and vehicular safety, and present obstructions to snow plows. • Inadequate curb height, or loss of curb height for sidewalks due to the placement of an additional layer of wearing surface or deck overlay	• Remove obstruction (Maintenance operation) • Review Code requirements for curb height

2.6.1.9 Rough Riding Surface (#9)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Wearing Surface, Deck Top (exposed), Approach slabs	• Rough approaches, settlement or consolidation of approach embankments, or deterioration of the approach slabs or ramps, resulting in vehicles "bouncing" onto the bridge. In addition to applying excessive dynamic loading to the bridge, this may also result in difficulty in maintaining vehicle control • Rough surface on bridge. • Depressions and cracks in the roadway pavement above culverts and soil-steel structures;	• Smooth out asphalt at approach (Maintenance operation) • Patching bridge deck (Maintenance operation) • Strength evaluation

2.6.1.10 Surface Ponding (#10)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Sidewalk, Wearing surface	• Water ponding on sidewalks/wearing surface, as it presents a safety hazard, especially if allowed to freeze;	• Fill in depression with asphalt (Maintenance Operation)

2.6.1.11 Deck / Wall Drainage (#11)

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Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Drainage System	• Deck drains not provided where necessary, or have inadequate size of opening; • Deck drains and drainage systems improperly constructed with inadequate slopes or sharp directional changes; • Drainage system plugged or partially plugged and not allowing for free and unobstructed flow of water; • Drainage outlets discharging directly onto structure components or roadways below the deck; • Drainage outlets discharging directly onto embankment without proper provision for collecting, channelling and controlling of discharge with splashpads, spillways or gutters; • Inadequate provision for drainage at the structure approaches. For retaining walls: • Add water pressure behind wall Percolate down through the expansion joints and softening the soil under the toe of the wall. Lateral creep of the wall can occur	• Review deck drainage requirements For retaining walls: • Clean wall drains

2.6.1.12Slippery Surfaces (#12)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Deck Top	• Loss in riding comfort and potential loss of vehicle control due to defects in the component material; • Loss of protection to underlying surfaces due to defects in the wearing surface materials;	• Resurface problem area (Maintenance Operation)

2.6.1.13Flooding / Channel Blockage (#13)

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Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Streams & Waterways, Retaining walls	• **The inspector should look for the following evidence of high water levels, inadequate opening at the structure and adverse affects on other components of the structure:** • Bending or buckling of the lower chord of steel trusses in the downstream direction by ice or heavy debris; • Ice scars and damage to substructures; • Coarse debris, such as branches and small trees, caught or wedged under the superstructure; • Fine debris, such as grass and twigs, on fences, trees, embankments, structures, etc.; • Wash lines on bare soil slopes; • Mud or silt deposited on embankments; • Marks and stains on structures.	• Determine historical frequency of flooding and recorded water levels and compare to current high water elevation • Monitor water elevations throughout year • Perform hydrology study For retaining walls: • Seal the ground behind the wall • Seal these cracks and monitor

2.6.1.14 Undermining of Foundation (#14)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action
Streams & Waterways, Foundations, Retaining walls	• Loss of material supporting foundations due to scour or erosion.	• Underwater Investigation • Strength elevation

2.6.1.15 Unstable Embankments (#15)

Element Group/Name (Examples)	Description of Deficiency	Possible Follow-up Action

Embankments	• Settlement of embankment, slope protections or approach roadway; • Sliding failure of the toe or slopes of the embankment; • Surface or deep seated slips; • Loss of embankment material from under foundations.	• Geotechnical investigation
Retaining walls	• Slope has started to move and allowing water in the cracks thus increasing the pressure behind the wall	• Seal the ground behind wall

2.6.2 References

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2.7 MAINTENANCE NEEDS

Maintenance work is defined as any type of work that does not require the issuing of a capital construction project. It includes routine maintenance items as well as targeted structural repairs to a specific element.

Routine Maintenance – preventative maintenance and minor repair work to an element that can be performed without engineering direction. Routine maintenance is an important part of prolonging bridge life. It includes regular work such as cleaning or debris removal, as well as some urgent safety items that are not structural issues. It is usually carried out by bridge crews or road maintenance personnel (typically Area Maintenance Contractors (AMC) or Management Outsourced Contractors (MO)).

Structural Maintenance Work – is work to improve the structural capacity of a select element, and not part of a larger construction project to improve the entire bridge. It generally requires engineering design drawings to complete the work, but the work must be done in a timeframe that precludes a conventional capital construction contract from being used. Structural Maintenance Work includes emergency repairs to restore structural capacity as well as holding strategy repairs to select elements to maintain the structure in a safe condition until a capital

construction contract is carried out. This work is typically directed by the regional structural offices and delivered through the Operations Services Office via AMC or MO.

The bridge inspector should note the need for maintenance work when performing a detailed visual inspection, and also the timeframe required.

The following timeframes can be used:

- **"Urgent"** applies to structure, motorist and pedestrian safety items that should be completed as soon as possible. Work in this category typically includes; routine maintenance items such as protruding expansion joint armouring, missing electrical covers, very severe pothole repairs and scaling loose concrete or flaking patina. It also includes emergency structural maintenance items such as repairing fatigue cracks in girders, addition of temporary supports to severely corroded beam ends and repairs to severely damaged piles.
- **"1 year"** timeframe generally applies to serviceability items that should be done within about a 1 year timeframe. Work in this category typically includes; routine maintenance items that do not affect safety such as many types of bridge and deck drain cleaning, debris removal from waterway, worn timber wearing boards and sidewalk surface repairs.
- **"2 year"** timeframe applies to durability items that can be done in 2 years or more. These items must be low enough in urgency that they will not become a serious concern before the next biennial inspection, should they not be completed. At that time the urgency can be revised if it is approaching a more critical state. Work in this category typically includes: cosmetic patching of concrete, repair of signs, painting, concrete sealing, rout and seal cracks and expansion joint seal replacement.

Minor defects that will most likely never be repaired, need not be identified as a Maintenance Need.

A maintenance list is then forwarded to maintenance crews for action – either to complete the routine maintenance work or to initiate a structural maintenance contract for those items requiring more complex procedures or engineering design. At the completion of the maintenance work, the maintenance crew should inform the engineer responsible for the detailed inspection so that it can be confirmed that all safety related maintenance was performed satisfactorily. A standard list of maintenance needs, and a description of each, is shown in Table 2.7.1 Maintenance Needs.

Table 2.7.1 Maintenance Needs

	Maintenance Need	Description
1	Railing System Repair	Repair and/or replacement of metal handrails, railing systems and posts, as well as securing the railings.
2	Bridge Deck Joint	The repair of expansion joint armouring due to safety issues for

	Maintenance Need	Description
	Repair	the traveling public or pedestrians.
3	Structural Steel Repair	The repair of loose or missing bolts and fasteners.
4	Timber Repair	The repair of loose or missing bolts and fasteners.
5	Works for Modular Bridges	The works include installation, removal, repair, and maintenance that is unique to modular bridges, but not including work defined by structural maintenance operations.
6	Animal/Pest Control	The installation and maintenance of animal/pest control devices under bridge structures, such as beaver dam removal.
7	Erosion and Vegetation Control at Bridges	Operations performed to prevent or repair damage due to erosion, such as scour at abutments and around piers, and washouts on slopes. Includes removal of obstructions to water flow, clearing of vegetation growth, etc. that has a safety concern.
8	Scaling (Loose Concrete or ACR Steel)	The removal of loose delaminated concrete or delaminated patina of ACR steel girders that pose a risk as a falling hazard.
9	Missing Electrical Covers	The repair of missing electrical box covers.

2.8 INSPECTION FORMS

This section describes the required information to be included in MTO inspection reports. It is the Owner's discretion on what information they want recorded in their reports. A partial sample of an MTO report is included in Section 2.8.9 for reference purposes of this section. The MTO report typically consists of four parts which include the following content:

Part 1: General location information, including Site Number and map reference (usually page 1, after the title page)

Part 2: General structure tombstone information and history (usually page 2)

Part 3: General information pertaining to the structural inspection (usually page 3)

Part 4: Individual element information and condition data record for the inspection (usually page 4 onwards)

A brief description of parts 2 to 4, and some key definitions of the various data entry fields associated with the different parts, are found in the following sub-sections.

A description of each section of the report and the definitions of the various data entry fields are contained below.

2.8.1 Structure Information (Page 2 Of Example Report)

This section provides a summary of general inventory tombstone data including the structure's year built, superstructure replacement history, the overall structure's type, dimensions and material. This section is a useful reference in the field and should be reviewed by the inspector to ensure that the data is accurate and populated, as much as possible.

2.8.2 Capital Work History (Page 2 Of Example Report)

It is important that the inspector has all the capital work history of a structure to ensure that they understand how the structure may have changed since it's original construction and how it could impact the structure's behavior (e.g., Semi-integral conversions, Deck Replacement, Patch Waterproof and Pave, Joint Replacement, etc.). Additionally, this information is necessary for the proper transitioning of element quantities through the different condition states (See Section 2.5.3). This section of the report should include the contract number, contract year, structure completion year, work category, and the scope of work for each capital project completed on the structure. The regional staff need to populate this information as soon after contract award or as the contract has been completed as possible.

2.8.3 Special Inspection Notes (Page 2 Of Example Report)

This section of the report provides inspectors with a field to write special notes about the structure that are inspection specific. This can include particular safety concerns that were observed, such as traffic control requirements, noxious plants at site, fast flowing river, etc. The inspector should also include information about specific details of the structure that need close attention in following inspections such as fatigue prone details, out of plane bending, deformations, settlements, suspected DEF, etc.

2.8.4 Additional Investigation History (Page 2 Of Example Report)

This section provides the inspector with information on any additional investigations that were completed on this structure. The section should include the date and type of any historical additional investigations as well as any important comments regarding the results of the investigation and it's timing. The selection of an additional investigation in the current inspection will also be shown in this location.

These investigations are described in Part 3 of this manual. The required data and priority (urgency) of the inspection is described below:

Priority – None: Indicates that the investigation is not required.
Priority – Normal: Indicates that the investigation should be completed before the time of the next inspection (usually within two years).

Priority – Urgent: Indicates that the investigation should be completed as soon as possible.

2.8.5 Inspection History (Page 2 Of The Example Report)

This section of the report records the structures inspection history and will help the inspector and owner ensure that the required structural inspections are being completed in a timely manner and according to legislation. The inspection history should include the inspection type, the date of the inspection and any comments that were written in the General Notes portion of the report as described in Section 2.8.6.

2.8.6 Field Inspection Information (Page 3 of the Example Report)

This section will be collecting information associated specifically with the OSIM inspection being reported. It will include the following data:

- **Inspection Type:** Regular OSIM, Enhanced OSIM, etc.
- **Lead Inspector, Supervising Engineer, and Others in Party:** These fields should be populated with the names of the people associated with the inspection.
- **Firm:** The Firm responsible for conducting the inspection (Ex. MTO or name of consulting firm)
- **Inspection Year:** The year the inspection took place.
- **Inspection Duration, hr:** The amount of time spent completing the inspection.
- **Next Inspection Date:** Indicate the date when the next OSIM inspection is required.
- **Inspection BCI:** This is the structures Bridge Condition Index result for the inspection which indicates the current bridges condition. Bridge Condition Index is defined in other MTO documents and is specific for MTO.
- **BCI Justification:** This is a description of the primary reasons for large increases or decreases in the BCI. Required if BMS increases by more than 5 points or decreases more than 3 points.
- **Equipment Used:** This is a description of the tools used to complete the inspection. Examples include: Bridge Master, cherry picker, barge, hand tools, drone, ladder, etc.
- **General Comments:** This section is intended to include the inspector's overall assessment of the structure's condition as well as a general overview of elements that are in poor condition. Additionally, reasons for any large changes in the structure's condition or reasons for an incomplete inspection should also be included. Any urgent repair needs should not be recorded in this area or this report. **Urgent repair needs must be brought to the attention of the owner immediately.**

2.8.7 Job Activities (Page 3 of the Example Report)

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This section of the report provides details of the inspection's general activities. It describes the date the inspection was completed, the time that the inspection started and ended, the weather and temperature, who was in the inspection party, and any general comments about how the weather and field conditions might impact the results or observations made in the inspection (Ex. 'Heavy rains earlier in the morning left the structure wet.')

2.8.8 Structure Element and Condition Data (Page 4 Of The Example Report)

The data for each bridge element shall be shown on one table. The tables can be duplicated for as many elements as exist for each bridge.

Element Group:
The main category of element (e.g. ABUTMENTS, ACCESSORIES (ATTACHMENTS AND SIGNS), APPROACHES, BARRIERS, BEAMS/MAJOR LONGITUDINAL ELEMENT (MLEs), etc - See Table 2.2.1)

Element Name:
The individual element name (Abutment Walls, Ballast Walls, Bearings, Wingwalls, Bridge Mounted Sign Supports, Electrical, Noise Barrier, etc and sub-element name (if applicable) (Interior/Exterior, End, Intermediate, Middle) - See Table 2.2.1

Material:

The material the element is made of:

Aluminum	Corrugated steel	Mass concrete	Steel
Asphalt	Gravel	Plastic	Weathering steel
Cast Iron	Hybrid	Precast concrete	Wood
Cast-in-place concrete	Masonry	Retained soil system	Other

Element Type:
The specific type of element (e.g., Safety Shape without Railing, elastomeric bearing, etc.)

Location:
A description of where the element is on the structure (e.g., East pier, portal bracing, etc.) or in the event of a separate Element Table for similar elements a descriptor to distinguish the element (e.g., Pier 1, Pier 2, Pier 3, etc)

Environment:
The degree to which the element is exposed to salt spray (Benign – no exposure to Harsh – full exposure) . Below is a list of the elements and their associated environment:

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Table 2.8.1: Elements and Their Associated Environment

Element Group	Element Name	Environment Category
Abutments (Below Expansion Joints)	All Elements	Moderate
Abutments (Within 5 m of a travelled lane)	Abutment Walls	Harsh
	Ballast Walls	Moderate
	Bearings	Harsh
	Wingwalls	Harsh
Abutments (No Joints Above)	All Elements	Benign
Accessories (Attachments and Signs)	All Elements	Moderate
Approaches	Approach Slabs	Moderate
	Barriers (Interior)	Harsh
	Barriers (Exterior)	Moderate
	All Other Elements	Harsh
Barriers	Barrier / Parapet Walls (interior)	Harsh
	Barrier / Parapet Walls (Exterior)	Moderate
	Hand Railings	Harsh
	Posts	Harsh
	Railing Systems	Harsh
Beams/Main Longitudinal Elements (Ends - uncoated and below expansion joints)*	All Elements	Moderate
Beams/Main Longitudinal Elements (Middle)	All Elements	Benign
Bracing	Bracing	Benign
Coatings	Railing Systems / Hand Railings	Harsh
	Structural Steel (Ends)	Moderate
	Structural Steel (Intermediates)	Benign
Culverts	All Elements	Benign
Decks	Deck Top	Moderate
	Drainage Systems	Harsh
	Soffit – Inside Boxes	Benign
	Soffit – End	Moderate
	Soffit – Exterior	Moderate
	Soffit – Interior	Benign
	Wearing Surface	Harsh
Embankments & Streams	All Elements	Benign

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Element Group	Element Name	Environment Category
Foundation	Foundation (below ground level)	Benign
Joints	All Elements	Harsh
Piers (Uncoated - Within 5 m of traveled lane)	Bearings	Harsh
	Caps	Harsh
	Shafts / Columns / Pile Bents	Harsh
Piers (Coated - Within 5 m of traveled lane)	All Elements	Moderate
Piers (Beyond 5 m of traveled lane)	All Elements	Benign
Retaining Walls (Beyond 5 m of traveled lane)	All Elements	Benign
Retaining Walls (Within 5 m of traveled lane)	All Elements	Harsh
Sidewalks / Curbs	All Elements	Harsh
Trusses / Arches (Above the Deck with no coating; If coating is effective)**	All Elements	Harsh
Trusses / Arches (Below the Deck, at Ends, and Below Joints with no coating)	All Elements	Harsh
Trusses / Arches (Below the Deck, at Ends with no joints, and middle with no coating)	All Elements	Moderate

* For Beams/MLE elements that are coated, at the girder ends and below a joint, the environment will be Benign.

**For Truss and Arch elements that are above the deck and coated the environment will be Moderate.

Protection System:
The type of protection system for that element (e.g., Deck overlay type – latex, cathodic protection, rebar type - coated, stainless, galvanizing, etc.). Generally, protecting the element from exposure or chloride attack.

Dimensions (Length, Width, Height):
The dimensions used to calculate the total quantity of the element, as described in Section 2.4.1.

Count:
The number of occurrences of the element under consideration (e.g., 6 girders, 12 bearings, etc)

Total Quantity:
The count times the quantity for one element (Units are defined in Table 2.2.1).

PART 2 – DETAILED VISUAL INSPECTION

Condition Data:
This portion of the table is used to record the "severity and extent (quantity)" of the material defects of the various bridge components as described in Section 2.5. A detailed visual inspection is required for all elements. Appropriate special equipment (BridgeMaster, bucket truck, ladders, etc.) should be used to facilitate this assessment for an Enhanced Inspection**.**

When recording the "extent" (quantity) that an element is in a particular condition state, the following guidelines should be followed:

- Select the appropriate inspection quantity units from Table 2.2.1 (m^2, m., Each, All)
- For Elements with units of m^2 or m:
  The actual inspection quantity units should always be used for the part of the element in the Poor Condition State (e.g., 15 m^2). Percent should not be used unless the quantity in poor exceeds 33%.
- Enter the quantity in the 3 Condition States (Good, Fair, Poor) in most cases starting with the POOR quantities. See the appropriate Condition State Table in the Section 2.5.
- Quantity in Excellent = Total Quantity - Quantities in other states (Good, Fair and Poor)
- Elements with "each" as unit - give number of occurrences of the element in each State
- Elements with "all" as unit - place entire quantity in one state
- If an element is not completely visible, or the view is obstructed, quantities should be estimated, and the "Limited Inspection" box should be checked on the form. (e.g., Foundations, ballast walls, etc)

Comments:
Comments shall provide information on the location and general size (large/small) of each poor and fair defect to help future inspectors account for the recorded quantities. How the quantity was estimated should also be recorded. Comments shall also be used to provide general information on the element.

Maintenance Needs:
Maintenance Needs should be selected from the pick list shown in Section 2.7 along with the timeframe (Urgent, 1-year, 2-years). Written comments should also be made about maintenance needs. For additional information, refer to Section 2.7.

Suspected Performance Deficiencies (Performance Deficiencies):
Suspected Performance Deficiencies, as described in Section 2.6, should be recorded if a potential deficiency exists, or if a follow-up action is required. (e.g., strength evaluation, specialized inspection, monitoring, etc.). Select deficiencies from the pick list on page 3 of the form and enter the appropriate Code number.

Photo Reference:
Used to reference photo numbers and descriptions from inspection.

2.8.9 Example Inspection Report

PART 2 – DETAILED VISUAL INSPECTION

Ontario

STRUCTURE INSPECTION REPORT

Site Number: 33X-0101/B0 – [Inspection Type]

[Type here]

LOCATION	
Main Highway:	Latitude:
Region	Longitude:
Area:	Owner/Custodian:
Township:	Inspected By:
Current County:	Admin System:
Regional Representative:	

PART 2 – DETAILED VISUAL INSPECTION

Ontario

STRUCTURE INSPECTION REPORT

Site Number: 33X-0101/B0 – [Inspection Type] [Type here]

STRUCTURE INFORMATION	
Year Built:	Year Superstructure Built:
Structure Category:	Structure Material 1:
Structure Type 1:	Structure Material 2:
Structure Type 2:	Overall struct. Width, m:
Total deck length, m:	Direction of structure:
Overall deck area, sq.m:	Skew angle, degree:
Roadway width, m:	Fill on structure, m:
Min. vert. clearance, m:	Load Limit, tonnes:
Heritage Designation:	Span length, m
No. of Span:	Fatigue Index:
Reg. OSIM Freq, yrs:	Enh. OSIM Freq, yrs:
Critical Elements: Top Chord, Bottom Chord	

CAPITAL WORK HISTORY				
Contract No.	Contract Year	Structure Completion Year	Work Category	Scope of Works

SPECIAL INSPECTION NOTES	
Date	Special Notes

ADDITIONAL INVESTIGATION HISTORY				
Date Requested	Date Completed	Additional Investigation	Priority	Comments

INSPECTION HISTORY				
Type	Date	BCI	General Comments	BCI Justification

PART 2 – DETAILED VISUAL INSPECTION

Ontario

STRUCTURE INSPECTION REPORT

Site Number: 33X-0101/B0 – [Inspection Type] [Type here]

FIELD INSPECTION INFORMATION			
Inspection type:		Inspection year:	
Lead Inspector:		Inspection duration, hr:	
Supervising Engineer:		Next Inspection date:	
Others in party:			
Firm:		Inspection BCI:	
BCI Justification:			
Equipment Used:			
General Comments:			

JOB ACTIVITIES						
Date	Start Time	End Time	Weather	Temp.	Comments	Inspector Party

PART 2 – DETAILED VISUAL INSPECTION

Ontario

STRUCTURE INSPECTION REPORT

Site Number: 33X-0101/B0 – [Inspection Type] [Type here]

STRUCTURE ELEMENT AND CONDITION DATA						
Element Groups:	**Barriers**		**Dimensions**		**Condition Data**	
Element Name	**Barrier/Parapet Walls>Interior**		**Units:**	**m**	**Units:**	**Sq.m**
Material:	Cast-in-place Concrete		**Length:**	17.4	**Excellent**	0
Element Type:	Safety Shape without railing		**Width:**	8.5	**Good**	148
Location:			**Height:**		**Fair**	0
Environment:	Harsh		**Count:**		**Poor**	0
Protection System:			**Inspected**	Yes	**Total Quantity**	148
Comments:						
Maintenance Needs:						
	Timing:	Urgent	1 Year	2 Years		
Performance Deficiencies:						
Photo Reference						

STRUCTURE ELEMENT AND CONDITION DATA						
Element Groups:	**Beams/MLE's**		**Dimensions**		**Condition Data**	
Element Name	**Girders > End (over abutment)**		**Units:**	**m**	**Units:**	**Sq.m**
Material:	Precast Concrete		**Length:**	52.7	**Excellent**	0
Element Type:	I Type		**Width:**	0.38	**Good**	1042
Location:			**Height:**	0.9	**Fair**	2
Environment:	Moderate		**Count:**	9	**Poor**	0
Protection System:			**Inspected**	Yes	**Total Quantity**	1044
Comments:						
Maintenance Needs:						
	Timing:	Urgent	1 Year	2 Years		
Performance Deficiencies:						
Photo Reference						

APPENDIX A – EXAMPLES OF MATERIAL DEFECTS, PERFORMANCE DEFICIENCIES, AND MAINTENANCE

The following pages depict examples of various material defects and performance deficiencies. The photographs are listed in order of Element Group first and then by Element. For each photograph, the Condition State is identified for the portion on the element with the worst material defects. During an actual inspection, the quantity of the element in each condition state would be recorded.

A.1 ABUTMENTS

Figure A.1 (a) Concrete Wingwall.

Condition State: Fair/Poor	**Performance Deficiency: None**
Numerous medium cracks and several wide cracks with penetration of water through wall and efflorescence.	

PART 2 – DETAILED VISUAL INSPECTION

Figure A.1 (b) Wood Lagging – Abutment Wall

Condition State: Good	**Performance Deficiency: Settlement concern.**
Light weathering of wood.	Movement of \ lagging has opened gaps between timbers. Although movement appears to have stabilized, deck drainage occurs through gaps in deck timbers, providing a direct source of water for continued removal of fill materials. Continued loss of fill will result in approach settlement, causing possible damage to vehicles and an increase in maintenance activities. No significant effect on other components

PART 2 – DETAILED VISUAL INSPECTION

Figure A.1 (c) Wood Post and Lagging Abutment Wall

Condition State: Poor	**Performance Deficiency: Load Carrying Capacity, Continuing Movements**
Displacement of lagging member. Pile cap not bearing fully on piles. Severe rotation of piles.	Continuing rotation causing eccentric loading to abutment. Separation between horizontal lagging members and medium deformation.

PART 2 – DETAILED VISUAL INSPECTION

Figure A.1 (d)Masonry Abutment Wall

Condition State: Fair	Performance Deficiency: None
Medium loss of Mortar	Wall is satisfactorily supporting superstructure loads

Figure A.1 (e) Concrete Abutment Wall

PART 2 – DETAILED VISUAL INSPECTION

Condition State: Poor	Performance Deficiency: Bearing Not Uniformly Loaded/Unstable
Severe spall with exposed rebar undermining bearing seat.	Bearing seat area reduced. Undermining should be monitored especially if it is occurring under multiple girders. Future evaluation may need to be considered.

Figure A.1 (g) Abutment Wall

Condition Statement: Poor	Performance Deficiency:

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	None
Spall with exposed rebar.	

FigureA.1 (h)Abutment Bearing: Looking up at deck soffit and elastomeric bearing

Condition State: Good	Performance Deficiency: None
No material defects observed	The black stains on the soffit indicate that the elastomeric bearing is walking. The inspector should monitor and make notes in the report to ensure that the bearing remains uniformly loaded.

PART 2 – DETAILED VISUAL INSPECTION

FigureA.1 (i) Elastomeric Bearing

Condition State: Fair	**Performance Deficiency: Continuing Movement**
Elastomer overloaded due to lack of contact surface.	Bearing walking out from under girders, providing inadequate support. Concrete-concrete contact imminent.

Figure A.1 (j) Laminated Elastomeric Bearing

Condition State: Good	**Performance Deficiency: None**