SIMPLE STREAM CROSSINGS

GUIDELINES FOR BCTS COORDINATING REGISTERED PROFESSIONALS

Ministry of Forests, Lands and Natural Resource Operations

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INTRODUCTION

Purpose

This document is intended to provide guidance around project scope and personal qualifications to those BCTS managers who may wish to utilize in-house forest professionals for the design and construction of simple stream crossings, to those forest professionals who would undertake the role of coordinating registered professional (CRP), and to ministry bridge engineers who may be requested to carry out a professional review for a CRP. Accordingly, this document addresses specific issues and items for which a BCTS forest professional acting as the CRP must be equipped to carry out the necessary project work, providing continuity of professional responsibility through oversight and direct supervision, and making decisions related to:

1. selection of structure type and size;
2. project components/ roles and responsibilities tied to expected outcomes;
3. minimum/sample documentation of layout, design and construction details; and
4. baseline competencies/skill sets for CRPs.

BCTS Rationale

A local BCTS manager may determine that it is desirable for a forest professional in that office to undertake professional responsibility for simple bridges by becoming the CRP for those bridges. While there may be additional reasons for that decision, the following must all apply:

- there should be benefits to the program in the continuity of project planning from inception to completion;
- there will be a cost reduction to the program in project design and oversight; and
- the individual forest professional who is expected to become the CRP on the project must have the necessary skills to fully carry out this function (the CRP for BCTS bridges would retain outside professional expertise only for superstructure design).

Background

The initial consideration of using non-professional engineers to design and construct certain bridge crossings on forest roads led to inclusion of such and associated criteria in the Forest Road Regulation under the *Forest Practices Code Act* in 2000. The impetus for this amendment to the regulation was to allow simple bridges to be designed by a forest professional employed by the owner/builder of the structure, so that there were situations where it was not mandatory to retain a consulting engineer who generally was located some distance from the crossing site. Accordingly, there was and is no intention to create a class of consultants who would carry out the services under contract.

Simple crossings are currently defined in the *Guidelines for Professional Services in the Forest Sector - Crossings* (the Guideline). While the Guideline provides specific details and exceptions, these crossings generally involve single span, non-composite structures that are on stable streams, and that are restricted in length, height and foundation conditions. The Guideline provides a broad coverage of the role of a CRP with respect to

all aspects of stream crossings on forest roads. Within that discussion, the Guideline also deals with constraints and conditions under which a forest professional might take professional responsibility for certain crossings. Perhaps the single most critical element of the Guideline that should convince a manager or a practitioner to stop and consider his or her options with respect to professional responsibility for a simple bridge crossing is:

> ***"The Coordinating Registered Professional can only accept and take responsibility for those projects for which they are equipped with the necessary skills and knowledge."***

Review and Acceptance of Individuals as CRPs

Normally, before forest professionals are hired by a local office, their professional certifications and personal skills have been scrutinized by the local management as being acceptable for the work to be assigned to the position. However, acting as in-house CRP for simple bridges is an add-on to the normal workload of the individual, and the expertise for such work has not previously been evaluated by either the professional organization that licenses the individual or the managers/supervisors of the staff professional. It is therefore imperative that a process be available to evaluate the abilities of the proposed CRP: prior to undertaking a simple BCTS bridge project as a CRP for the first time (or before the next project for those individuals who have been carrying out such work already), an individual forest professional must submit his or her work for evaluation by a ministry bridge engineer (in a region or at branch). This evaluation will take the form of a professional evaluation review, to inform the CRP candidate and the applicable BCTS manager that suitable design, evaluation and documentation practices are being applied to these simple bridge projects. The review may also determine any shortfalls in knowledge and abilities that are apparent, while providing some recommendations for upgrading those skills. Additionally, practicing CRPs should liaise with the bridge engineer(s) from time to time to fine tune their processes and outputs as they work on projects with differing component parts. Again, this liaison process can be formalized occasionally as a professional evaluation review.

APPLICATION

A key objective of any such structure constructed by or for BCTS is to limit the exposure to risk as applied to:

- users of the bridge;
- workers constructing the bridge;
- utilities, properties and residents adjacent to the bridge;
- the environment, fish, water quality and other impacted resources;
- the forest professional acting as the CRP; and
- the ministry as the employer and owner, including short and long-term financial considerations.

Such simple bridge projects are considered within the framework of BCTS/government projects, and the components generally include:

- project planning and oversight;

- collection and analysis of site information and conditions;
- selection of bridge components;
- design of component parts, including the selection and utilization of design aids prepared by Professional Engineers; and
- field reviews during construction for acceptance of the structure.

For simple bridge projects to address the objectives of BCTS around the use of in-house CRPs, those applicable forest professionals must personally carry out ***all*** such work detailed above, either directly or by supervising the sub-professional work of others.

PROJECT COMPONENTS/ ROLES AND RESPONSIBILITIES

A simple bridge crossing is normally composed of the following elements that require proficiency by the CRP:

- determination of bridge location, considering alignment of bridge to road and stream, constraints on stream channel works, and soils and topography;
- collection and application of site data;
- field layout;
- analyses of flood hydrology and stream hydraulics;
- determination of bridge span and clearance above high water;
- overall composition and general arrangement of the bridge and all connections and components, reflecting the site data and analysis, as well as the expected life span of the structure;
- superstructure design, including specified uses of professional design aids, complexities around material types and structural considerations, and relative costs of various options;
- substructure considerations, including connections to the superstructure, as well as foundations limitations;
- construction of the crossing; and
- use and maintenance of the completed structure.

STRUCTURE TYPE AND SIZE

The Guideline provides some specific limitations to the size and nature of simple bridges, including:

- channel stability;
- foundation conditions;
- dimensions of sills and cribs;
- vertical and horizontal alignment of span and approaches;
- superstructure types (single span, non-composite); and
- simple bridges would not include: girder field splicing, welding and grouting.

Further, to limit the bridge's exposure to debris, ice and stream flow issues, simple bridges should be restricted to those located outside the wetted perimeter at design high water. This direction was contained in earlier Regulations under the *Forest Practices Code Act*.

The Guideline provides a limitation on foundation pressures to no more than 200 kPa. For most crossings, this will restrict the span of the simple bridge to one where the combined live and dead loading on the span will result in a bearing pressure of less than 200 kPa. Individuals assuming the responsibility as a CRP for a structure should have a working understanding of bridge bearing pressure determination and limitations and where the CRP is directly conducting this work must be competent in the determination of design bearing pressure and capacity.

The following table provides illustrative span limitations for various bridge superstructures and some simple typical foundation types. This table is must not be construed as a comprehensive listing or a design aid. The table is only intended for sample and illustrative purposes and is not a design aid.

Maximum Bridge Spans (metres) for Maximum 200 KPa Foundation Bearing Pressure

Bridge Type	Abutment Configuration	Maximum Span for Specified Design Vehicle Configuration (metres) Factor of Safety = 1.2 (DL+LL)		
		Highway	Off-Highway	
		BCL-625	L100	L165
All Steel Portable	Single row lock-blocks	20	14	*>200KPa*
	Two rows high lock-blocks	20	12	*>200KPa*
	400 Wide Timber/Log Sill	*>200KPa*	*>200KPa*	*>200KPa*
	600 Wide Timber/Log Sill	14	*>200KPa*	*>200KPa*
	800 Wide Timber/Log Sill	20	12	*>200KPa*
Timber Deck on Steel Girders	Single row lock-blocks	28	15	*>200KPa*
	Two rows high lock-blocks	23	13	*>200KPa*
	400 Wide Timber/Log Sill	*>200KPa*	*>200KPa*	*>200KPa*
	600 Wide Timber/Log Sill	14	*>200KPa*	*>200KPa*
	800 Wide Timber/Log Sill	23.5	12.5	*>200KPa*
Concrete Deck on Steel Girders	Single row lock-blocks	19.5	12.5	*>200KPa*
	Two rows high lock-blocks	16	11	*>200KPa*
	400 Wide Timber/Log Sill	*>200KPa*	*>200KPa*	*>200KPa*
	600 Wide Timber/Log Sill	11.5	*>200KPa*	*>200KPa*
	800 Wide Timber/Log Sill	16.5	10.5	*>200KPa*
Concrete Slabs	Single Row lock-blocks	13.5	9	*>200KPa*
	Two rows high lock-blocks	11.5	*>200KPa*	*>200KPa*
	400 Wide Timber/Log Sill	*>200KPa*	*>200KPa*	*>200KPa*
	600 Wide Timber/Log Sill	*>200KPa*	*>200KPa*	*>200KPa*
	800 Wide Timber/Log Sill	11.5	*>200KPa*	*>200KPa*

Assumptions:

- Allowable bearing Capacity of Soil = 200kPa
- Timber/Log Sill Brg area:
  1) 400 x 4500 = 1.8 m^2
  2) 600 x 4500 = 2.7 m^2
  3) 800 x 4500 = 3.6 m^2
- Lock Block Abutment Brg Area = 750 x 6000 = 4.5m^2

DOCUMENTATION

Contents

The quality and quantity of documentation of layout, design and construction details for a simple crossing project must be sufficient to provide all of the following:

- planning options (including project timing, location alternatives, and lifespan of the structure) that can be reviewed and approved by other agencies and ministry programs;
- topographic and geometric information for field crews to properly lay out the crossing on the ground;
- dimensions and specifications to direct the constructor to select suitable bridge materials;
- dimensions, details, notes and specifications to allow the constructor to erect the structure accurately, safely and in a structurally sound manner;
- design and drawing information that would be sufficient for an independent peer review of the design of the crossing;
- evidence of professional responsibilities tied to a specific portion or phase of the work, without overlap or gaps in such responsibilities.

To realize the foregoing outcomes, suitable documentation must be completed in a clear and legible manner so that others may review the information, and placed on the project file. Such documentation includes:

- a project checklist (see Appendix A), indicating project components plus items requiring consideration by the CRP, and situations requiring the CRP to sign and seal the outputs;
- field notes to record site data, including topography, controls, stream characteristics and measurements of flow,
- site plan appropriate for the nature of the proposed bridge. The site plan typically includes:
    - locations of stream flow measurements;
    - plan and profile of the approaches and crossing;
    - adjacent constraints/controls or items that may be impacted by the structure;
    - description of crossing foundation and stream bank material types;
- design notes, including a record of the reviews of alternative configurations and spans, based on:
    - stream flow calculations;
    - design high water elevation;
    - stability of the stream banks;
    - impacts on adjacent resources;
    - projected life span of the crossing structure; and
    - comparisons of alternatives and their relative costs;
- general arrangement drawings, including details of professional design aids; note that a general arrangement drawing used for soliciting alternative superstructures or prices must be signed and sealed by the CRP (any structural concepts

incorporated in the drawing must be reviewed and signed off by a P.Eng before the CRP signs and seals the drawing);

- design/construction drawings, including shop drawings and construction notes where applicable;
- for re-used portable spans, a record by a qualified inspector that he/she has inspected the span at the new site, and has not found any damage or deterioration that would preclude its re-use at this location (should there be any such damage or deterioration, a P.Eng. would be retained to examine the span, and design and oversee any remedial work to repair the structure);
- records of field inspection(s) of the construction;
- as-built records, incorporating assurance of the construction's general conformance with the approved design, approved changes to the original design and data entry into the bridge register following construction; and
- use of professional seals on the final drawings.

Required Drawings

Bridge Type	General Arrangement Drawing	Superstructure Drawing
Permanent bridge span (including first-use portable spans)	**Required**	**Required**
Log stringer bridges	**Required**	
Re-used portable spans	**Required** (see also Superstructure Drawings)	**Optional** (to be included where there may be insufficient space on the General Arrangement Drawing to provide a schematic of the portable span incorporating sufficient details to: • identify the types and dimensions of components of the re-used superstructure, including girders or stringers and deck; • confirm the identity of the re-used structure; and • list any transportation requirements that may need to be followed

a) General Arrangement Drawing details:

- standard title block with:
  - site and structure number noted;
  - CRP's name and seal, taking professional responsibility for the overall layout and design of the bridge;
  - name of the stream, road, and station (km) and adequate information to detail the location of the structure;
  - drawing scale;

- site location key map;
- design vehicle configuration for load and alignment;
- design code references (the most recent version of the *CAN/CSA S6-00 – Canadian Highway Bridge Design Code* and the *Canadian Foundation Engineering Manual*);
- design high-water elevation;
- clearance between the design high-water level and soffit (low point of underside of superstructure) of the bridge;
- road approaches and grades, including width requirements (e.g., allowance for vehicle side tracking) and side slopes, to a sufficient distance back from the bridge to show potential problems, or to the end of the first cut or fill;
- dimensioning and labelling of component parts;
- standard arrangement of log stringers, curbs, needle beams, decking and cribs or sills, and connection details to each other;
- where applicable, standard arrangement of portable superstructure and connection details to substructure;
- relevant site data that might be required to finalize a location or design:
    - the riparian class for streams or lake classification;
    - the apparent high-water elevation of the stream, based on visible evidence of recent flooding;
    - a description of stream stability and stream bank materials, including any evidence of bedrock at the crossing location;
    - cross-sections and a profile of the stream: one cross-section should be along the proposed road centreline and extend beyond the stream channel width, normally to at least 50 m on each side;
    - horizontal and vertical location of reference points established during the site survey, which can be used to establish (and re-establish) the structure location during construction; and
    - the date of the survey and name of the surveyor.

    If a fish stream is involved, the *Fish-stream Crossing Guidebook* Chapter 3 should be consulted for additional site information requirements.

- location (vertical and horizontal) of proposed structure relative to field reference points;
- for bridges on a grade, deck elevations at bridge ends relative to field reference points;
- approach barriers, if required;
- abutment elements, configuration, and connections;
- dimensions and sizes of components;
- field fabrication details, where applicable;
- scour protection: dimensions, composition, extent of placement, design slope and other considerations;

- foundation requirements, material types and depth, and compaction level limit of construction for contract purposes;
- specifications for foundation/fill materials and those bridge materials not specified on other drawings, where applicable;
- special instructions relating to material erection, installation standards, requirements, or methods as deemed necessary;
- references to those professional design aids that are used and in the public domain; professional design aids that are proprietary are to be attached to the design notes; and
- references to other drawings, where applicable.

b) Superstructure Drawing details:

- standard title block with:
  - site and structure number noted;
  - P.Eng's name and seal, taking professional responsibility for the design and drawing of the superstructure elements;
  - name of the stream, road, and station (km) and adequate information to detail the location of the structure;
  - drawing scale;
- component details, including dimensions, sizes and connections (including connections to substructure);
- materials specifications and CSA references, including but not limited to:
  - steel grades, impact category, finish;
  - timber species, grades, preservative treatment;
  - concrete strength, slump, and air entrainment, related to both precast and cast in place items;
  - girder to sill bearings;
  - superstructure elements, configuration, and connections;
  - girder or stringer arrangements and connections;
  - curb configuration, connections, and component elements;
  - field fabrication details, where applicable.

Field Reviews during Construction

The CRP, or designate under his or her "direct supervision", must carry out field reviews that the CRP in his or her professional discretion considers necessary to ascertain whether the bridge construction work substantially complies in all material respects with the approved construction documents (e.g., design drawings, specifications, and supporting documents) prepared for the work.

This enables the CRP in a timely manner to direct and approve any necessary amendments to the design (and hence the construction) due to unforeseen site conditions. Prior to commencement of construction, the CRP would complete the form FS 137 Assurance of Field Reviews, to record the proposed number and timing of field reviews. During construction, the CRP and any designates would maintain suitable field notes to record any problems that might occur, together with the resulting remedial works.

Record (As-built) Drawings and Documents

Upon completion of bridge construction, the CRP would prepare record (as-built) drawings and documents as a record to document what was constructed or implemented at the crossing. The types of documented information would vary, but can include measurements, elevations, sizes or notes marked on the approved construction documents, including any significant amendments or modifications to the bridge design. The CRP would sign and seal the record drawings and documents once completed. Following construction of the bridge, the CRP ensures that the record drawings and documents are placed on the appropriate ministry file.

The types of changes showing on record drawings and documents normally include:

- actual log stringer, curb, needle beam and crib log dimensions (span lengths and diameters);
- any changes to fabricated materials;
- actual footing base elevation, deck elevation, and alignment location; and
- confirmation of scour protection requirements.

Additional record documentation might include:

- fabrication plant inspection reports, including mill test certificates and concrete test results; and
- any other pertinent fabrication, field, and construction data.

Crossing Construction Assurance for Simple Crossings

After construction of a simple crossing, the CRP ***must*** sign and seal a statement (**FS 1414 form**) indicating that the entire structure is in general conformance with the approved construction documents. The **FS 1414** form, ***CRP Crossing Assurance Statement,*** is required for all simple crossing works and is the only form required when the CRP carries out all of the professional services – coordination, planning/design, record drawings, and crossing construction conformance. The **FS 138** form, ***Statement of Construction Conformance,*** is required and shall supplement the FS 1414 when another professional engineer or forester is responsible for conducting construction field reviews for a simple crossing, who is not the CRP. In order for the CRP to sign the FS 1414 in such a case, the CRP would need to satisfy himself or herself that the other professional who conducts the field reviews is qualified to do so and has conducted appropriate field reviews and provided suitable documentation to demonstrate adequate due diligence.

FS 1414 - CRP Crossing Assurance Statement

The **FS 1414** form, ***CRP Crossing Assurance Statement***, replaces the former "*CRP Statement of Bridge Construction Conformance*" form formerly provided in chapter 4 of the *Engineering Manual*. The new FS 1414 is for construction of simple crossings. This form is consistent with the generic crossing assurance statement form provided in the APEGBC and ABCFP Joint Practices Board professional practice guidelines titled, "*Guidelines for Professional Services in the Forest Sector – Crossings*."

The FS 1414:

- is required for all bridge and major culvert crossings and is to be signed by a PEng or RPF acting in the role of the CRP;
- its use by RFPs is limited to "simple" structures;
- is consistent with the generic *Crossing Assurance Statement* form provided in the "*Guidelines for Professional Services in the Forest Sector – Crossings*";
- shall be supplemented with an FS 138 where the CRP has delegated the construction field services to another professional engineer or forester;
- is more encompassing than the FS 138 because it is designed to be used by the CRP who is responsible for all professional services for the crossing project including coordination, planning/design, record drawings, and crossing assurance statement.

FS 138 - Statement of Construction Conformance (Construction of Bridges, Major Culverts, and Other Structures)

The **FS 138** form, ***Statement of Construction Conformance***, has been updated. This form is for use for construction conformance of bridges, major culverts and other ministry structures. The form has been revised to utilize the term "professional of record" and to provide for RPF sign-off (as applicable).

The FS 138:

- is to be signed by a PEng or RPF who provides construction field services only, where bridge or major culvert project planning and engineering design was likely carried out by others;
- its use by RPFs is limited to "simple" structures;

- is not a crossing assurance statement [i.e., it is not intended to address the Coordinating Registered Professional (CRP) role];
- may be used for a bridge, major culvert, retaining structure or other engineered structure.

Use and Maintenance of the simple crossing

In addition to record drawings and documents, the CRP places on the same file/register any apparent or known future inspection and maintenance issues, together with a recommendation for the frequency of future routine maintenance inspections. The intent is to ensure that any particular aspects that the CRP may have considered in producing the design or identified during construction, which require inspection attention, is clearly identified.

BASELINE COMPETENCIES/SKILL SETS

Competency

Professional competence in a subject area typically arises from:

- formal study such as university courses; or equivalent knowledge gained from a combination of short courses, workshops and self study;
- understanding of and familiarity with the professional and technical component parts of the project;
- office and field experience related to such project work experience, usually with mentoring by a senior professional; and
- continuing professional development – keeping abreast of emerging literature, research and studies.

Some proficiency is required in all facets of a simple crossing project, including:

- layout;
- site data collection;
- site plan;
- hydrology/hydraulics;
- determining span length; and
- selecting substructure type.

Education and Education Equivalent

For simple bridge crossings, a CRP must have appropriate training in subjects such as:

- crossing structure design;
- forest road design;
- terrain analysis;
- soil strength and other soil properties;
- stream flood hydrology and hydraulics; and

- route and site surveying.

For CRPs having limited university/technical school level academic equivalents for the above subjects, but having successfully completed applicable courses and seminars, ensure that the Understanding and Familiarity applies, and that the Experience is particularly applicable and complete.

Understanding of and Familiarity with Subject Matter/Topics

A CRP needs to be generally familiar with the following items:

- guidebooks and professional guidelines applicable to:
    - fish stream identification;
    - fish stream crossings;
    - forest road engineering;
    - terrain stability management and assessment;
    - riparian management; and
    - other relevant manuals.

A CRP also needs to be familiar with the following items on a region or area-specific basis:

- methods of bridge construction;
- common road construction practices;
- factors affecting workability/stability/performance of fills and cut slopes;
- relevant regulatory requirements for bridge design and construction;
- assessing environmental impacts; and
- worker and bridge user safety.

Experience

A CRP should have sufficient bridge project experience, derived from several projects a year spread over a period of at least 3 years, such that the experience would include:

- working under the supervision or mentorship of a Professional Engineer seasoned in this area of practice;
- a range of ground conditions and design complexity; and
- time spent with bridge foremen and machine operators carrying out bridge construction and maintenance.

The CRP's work experience and responsibilities during that period should be a combination of ***all*** of the following:

- planning;
- field layout of bridges;
- bridge site data collection and site plan preparation;
- general bridge design, and coordination of specialist design components;

- bridge construction; and
- bridge use and maintenance.

As a result of the above knowledge and skills, the CRP should be able to generate the outcomes as detailed in Appendix B for each of the simple bridge crossing activities.

Appendix A:

CRP Project Tracking Checklist

CRP to use this checklist to complete a record of key decisions made by the CRP and any other professionals undertaking specific responsibility during the project.

Structure ID	**Road Name**	**Location**
BCTS Business Area:	**Crossing Name**	**Project No.**

Element Being Tracked For CRP Responsibility -- check off each completed item to confirm that each has been properly carried out and the results recorded	**CRP Sign-off and Seal Carried Out**	**If CRP sign-off is required but not carried out, provide rationale:**
PLANNING:		
☐ consultation to determine project timing, location alternatives, and lifespan of the structure		
LAYOUT:		
☐ determine bridge location		
☐ collect and apply site data		
☐ determine bridge span and clearance above high water		
☐ decide on overall bridge composition, general arrangement and connections		
DESIGN:		
☐ analyze flood hydrology and stream hydraulics		
☐ apply professional design aids (ensure that proprietary aids are attached to the design notes)		
☐ design substructure elements, including connections to the superstructure		
☐ ensure that required number of field inspections during construction are specified in the design notes		
☐ prepare the general arrangement drawing	☐	
☐ oversee any P.Eng. design of permanent or portable spans, including his/her preparation, and signing and sealing of		

the superstructure drawing		

CONSTRUCTION:

☐ carry out field inspections	Date: _____ Element: _____ Date: _____ Element: _____ Date: _____ Element: _____	
☐ provide assurance of general conformance (FS1414 and FS138 as appropriate)	☐	

USE AND MAINTENANCE:

☐ enter bridge data into bridge register		
☐ provide any information in the bridge register around future inspections and specific elements at risk		

Name of CRP:	**CRP Signature**	**Date:**

Seal:

Appendix B:

Summary of CRP Activities and Outcomes

ACTIVITY	OUTCOMES
Planning (note that the CRP is responsible for carrying out any consultations with other groups and agencies)	• determining the general location and proposed lifespan of a bridge;
Field layout (note that the CRP is responsible for confirming the general location of the crossing relative to the road layout)	• incorporating an effective, efficient stream crossing into the road layout, by establishing in the field a centerline for the structure and road approaches that can be surveyed and designed;
Site data and plan (note that the CRP is deemed to be responsible for carrying out this phase of the work, such that the CRP oversees and directs the work of survey staff collecting the data and preparing the site plan)	• collecting data for and preparing a plan that extends far enough up and down stream and along the road centre line to adequately describe the crossing project and its impact on adjacent areas;
Design (note that the CRP is responsible for the overall bridge design, including incorporating the output of specialist design work)	• selecting the optimum length and height of the crossing structure; • designing the substructure for the bridge; and • designing the bridge superstructure through the use of professional design aids or, where applicable, coordinating and incorporating the superstructure design, if any, of a P.Eng carrying out the superstructure design;
General arrangement drawing (note that the CRP is responsible for preparing this drawing)	• preparing, signing and sealing a site specific drawing that incorporates: o the approved bridge structure and its approaches; o applicable site data and specifications; and o a key map;
Construction of the crossing (Note that the CRP is responsible for professional oversight of the bridge construction)	• reviewing and being accountable for construction work, including: o changed conditions, and the need for any resulting amendments to the design/construction; and o signing and sealing general conformance to the approved design;
Future crossing use (Note that the CRP is responsible for communicating any future maintenance requirements)	• identifying any specific future maintenance issues that must be monitored; and • recommending the frequency of future routine maintenance inspections.