

Peace Water Use Plan

Monitoring Program Terms of Reference

HERITAGE AND CULTURE INFORMATION PLAN

- **GMSMON-21b Peace – Erosion Monitoring of Archaeological Resources**

HERITAGE AND CULTURE INFORMATION PLAN TERMS OF REFERENCE

1.0 OVERVIEW

This document presents Terms of Reference for the monitoring programs in the Peace Heritage and Culture Information Plan (Table 1). These programs will implement archaeological overview and erosion monitoring assessments focused on the effects of normal reservoir operations on heritage sites situated within the drawdown zones of each of Williston Lake and Dinosaur Lake reservoirs and within the Peace River channel between the Peace Canyon Dam and the confluence with the Alces River.

This document provides detailed Terms of Reference for the following programs

- 1) GMSMON-21a Peace – Archaeological Overview Assessment: a 1-year archaeological overview assessment of the drawdown zones of Williston and Dinosaur reservoirs and within the Peace River channel between the Peace Canyon Dam and the confluence with the Alces River.
- 2) GMSMON-21b Peace – Erosion Monitoring of Archaeological Resources: a 9-year non-intrusive erosion monitoring of archaeological resources located in each of the drawdown zones of Williston and Dinosaur reservoirs and within the Peace River channel between the Peace Canyon Dam and the confluence with the Alces River.

**Table 1 Heritage and Culture Information Plan Monitoring Program Terms of Reference
Submission Information**

Name of Monitoring Program	Order Clause Fulfilled	Submitted with this Package	Previously Submitted To CWR	Submission Date	Leave to Commence
GMSMON-21a Peace – Archaeological Overview Assessment	Section 7.a	Yes	No	May 9, 2008	-
GMSMON-21b Peace – Erosion Monitoring of Archaeological Resources	Section 7.b	Yes	No	May 9, 2008	-

Terms of Reference for the Peace Water Use Plan Monitoring Programs Heritage and Culture Information Plan

1.0 MONITORING PROGRAM RATIONALE

During the Peace River Water Use Planning (WUP) process, the WUP Committee recognized the importance of heritage sites and locations of historic and ongoing cultural activity, to the First Nations with an interest in the area. The effects of reservoir operations on heritage sites represented by material culture and/or physical locations, such as village sites, burial places, ceremonial areas, trails, hunting and fishing locations, historic places and built heritage were a key concern raised during the WUP process. There are close to 200 documented archaeological sites within the drawdown zones of the Williston and Dinosaur reservoirs and along the shoreline of the Peace River system and it is expected that other undocumented heritage sites of significance exist within areas affected by reservoir operations. Concern for ongoing access to community resource use areas and locations used for ceremonial or spiritual activities was also raised. The WUP Committee was not able to fully evaluate the potential effects of operations on heritage and cultural sites due to incomplete information on their locations and condition

A Heritage and Culture Information Plan (HCIP) was recommended by the WUP Committee to provide a more accurate assessment of the impacts of BC Hydro operations on heritage and cultural sites. The WUP Committee recommended that a two-phase HCIP be implemented over a ten-year timeline beginning with a one-year site identification and prioritization phase followed by nine years of monitoring the effects of reservoir operations on “priority sites” identified in Phase 1.

Subsequently, the Comptroller of Water Rights (CWR) clarified that only non-intrusive heritage work could be included in an Order issued under the Water Act, thereby excluding any study that would require a permit under the Provincial Heritage Conservation Act such as: 1) inventories involving subsurface testing; 2) placement of physical structures onto an archaeological site for monitoring purposes; or 3) the collection of artifacts for analysis. As a result, terms of reference (TOR) for studies in the HCIP have been designed as non-intrusive studies to reflect this new understanding.

GMSMON-21a Peace – Archaeological Overview Assessment is a one-year study intended to address a knowledge gap regarding the number, location, elevation, condition, use, susceptibility to erosion and relative importance of heritage sites within the Williston and Dinosaur reservoirs and the Peace River that make up the Peace system. This study represents the recommended Phase 1 of the HCIP and will provide base information for GMSMON-21b.

GMSMON-21b Peace – Erosion Monitoring of Archaeological Resources will be conducted annually for nine years following the completion of GMSMON-21a. Non-intrusive monitoring techniques will be used at priority sites identified during GMSMON-21a to measure the effect of current reservoir operations on heritage

sites. This study represents the recommended Phase 2 of the HCIP and together these studies will provide information for the next Peace WUP review

The detailed approach, methods and budget for this study is presented in the attached terms of reference.

Table 1 Proposed schedule and estimated annual expenditure for the implementation of monitoring programs associated with the Peace Heritage and Culture Information Plan

Reference	Monitoring Program	Total Cost
GMSMON21a	Peace Archaeological Overview Assessment	\$95,517
GMSMON21b	Peace Erosion Monitoring of Archaeological Resources	\$574,221
Total		\$669,738

Monitoring Program No. GMSMON-21b Peace – Erosion Monitoring of Archaeological Resources

1.0 Introduction

During the Peace River Water Use Planning (WUP) process, the WUP Committee recognized the importance of heritage sites and locations of historic and ongoing cultural activity, to the First Nations with an interest in the area. The WUP Committee was not able to fully evaluate the effects of reservoir operations on heritage sites due to gaps in existing documented information. As part of a program for additional information the WUP Committee report recommended a study to monitor the effects of wind and wave erosion on a selection of heritage sites located in areas that are directly affected by reservoir operations in the Peace region. The overarching goal of this study is to provide information that could be used to design appropriate management of wind and wave effects either through the development of suitable operating regimes or through non-operating alternatives such as site protection measures.

Subsequent to the completion of the WUP Committee recommendations, the Comptroller of Water Rights clarified that only non-intrusive heritage work could be included in an Order issued under the Water Act, thereby excluding any study that would require a permit under the Provincial Heritage Conservation Act (e.g., the placement of a physical works structure within an archaeological site for the purpose of measuring erosion). As a result, the Order stipulates non-intrusive erosion monitoring of archaeological resources located in Williston and Dinosaur reservoirs and along the banks of the Peace River from the Peace Canyon Dam to the confluence of the Alces River near the B.C./Alberta border. This document provides detailed Terms of Reference for a 9-year non-intrusive erosion monitoring study of archaeological resources that are within the study area as described in the Order.

A separate Reservoir Archaeology Program aimed at achieving compliance with the Heritage Conservation Act is in development with the Archaeology Branch and is expected to address aspects of long-term archaeological management that are not included in these Terms of Reference. The Reservoir Archaeology Program will incorporate the results of this erosion monitoring study in the development of a comprehensive archaeological management plan for the Williston and Dinosaur reservoirs.

In consideration of the shared geographical and cultural areas of a variety of heritage and archaeological studies proposed for the Peace, efforts will be made to communicate findings and build upon the results of the studies conducted as part of the Peace Heritage and Culture Information Plan as they relate to work being done either simultaneously or sequentially under other BC Hydro programs such as the Reservoir Archaeology Program or archaeological impact assessments for physical works programs such as dust control or debris management. Similarly, efforts will be made to coordinate the work so as not to negatively impact the scheduling of any proposed BC Hydro heritage studies and programs.

1.1 Definitions

Some terms carry multiple meanings and the following definitions are provided for the purpose of these terms of reference:

“archaeology site” refers to heritage sites (see below) that are protected under the Heritage Conservation Act.

“community resource use activities” refers to historic and ongoing sustenance practices such as hunting, fishing, trapping, gathering, and guiding, as examples.

“heritage site” refers to locations represented by material culture and/or physical place, such as village sites, burial places, ceremonial areas, trails, hunting and fishing locations, historic places and built heritage.

2.0 STUDY RATIONALE

2.1 Background

The Williston Reservoir was impounded in 1967 with the construction of the W.A.C. Bennett dam and Gordon M. Shrum generating station and the Dinosaur Reservoir was created with the construction of the Peace Canyon Project which began in 1974. In accordance with Provincial heritage law of that time a number of archaeological inventory studies were carried out along the banks of the Peace, Parsnip and Finlay Rivers in advance of the construction of these projects (Borden 1962, McGhee 1963, Mitchell 1964).

Since construction of the dams, a number of heritage studies have been conducted within and adjacent to the reservoirs in relation to various developments, including mining, forestry and oil and gas. In 2003, at the request of the Tsay Keh Dene, BC Hydro commissioned an archaeological survey of the Williston reservoir draw down zone within Finlay Reach to assess the effects of reservoir operations and relic-collecting on archaeological sites in that area (Arcas 2004). Most recently, an archaeological impact assessment of proposed dust management areas in the Williston Lake drawdown, again primarily in the Finlay Reach, is underway in 2007. Nearly 200 archaeological sites have been documented within the study area to date (Arcas 2006). Several documented sites appear to contain materials that are considered scientifically significant from an archaeological perspective as well as being of importance to local First Nation communities. In consideration of the extent of land within the study area that has never been surveyed for archaeology sites it is expected that additional undocumented heritage sites may exist in unexamined areas.

In 2006 BC Hydro's Generation Engineering Services conducted a map review to determine the area potentially subjected to reservoir induced erosion, flooding, landslides and groundwater impacts along the shoreline of the Williston and Dinosaur reservoirs above the maximum normal reservoir level (MNRL). This review provides information on the geology, geomorphology and configuration of the shoreline that can be used to understand these factors within the draw down zones.

The condition of a documented archaeological site is typically assessed only once, at the time of recording, and few sites are formally re-assessed. Since erosion in a reservoir takes place in a complex environment involving landform, aspect, de-vegetation, surface debris, surficial geology, weather, and human or animal intervention in addition to reservoir operations, the cumulative effect can be difficult to interpret. In order to develop an understanding of taphonomic process (post-depositional effects on archaeological materials) related to reservoir operations, repeated visits to a site over time are required. An important feature of erosion monitoring is the application of quantitative measures on a scale and frequency appropriate to the effects.

To date, evaluations of the erosion effects related to ongoing reservoir operations (i.e. the raising and lowering of water levels) on heritage sites have been both sporadic and anecdotal. Consequently, erosion effects related to reservoir operations are not well understood in terms of their magnitude, severity, rate of change or duration.

This erosion monitoring study will provide a long-term opportunity to observe and measure the effects of reservoir operations on selected heritage sites.

2.2 Heritage Monitoring Purpose

The primary purpose of this erosion monitoring study is to provide information that can be used in future WUP processes. Two key management questions were raised during the WUP consultative process regarding archaeology. The first focused on collecting information regarding the nature of the heritage resources that are present within the reservoir through inventory work. The second was aimed at understanding the effect reservoir operations may be having on these archaeological resources. This erosion monitoring study is primarily concerned with the latter although new information on archaeological sites is also expected to be gained as a result of this work.

During the Peace WUP, performance measures were used to evaluate proposed operational regimes. For heritage sites the performance measures were based on two competing hypotheses:

- 1) that it is preferable to keep heritage sites inundated to prevent erosion and exposure to unauthorized artifact collection, and
- 2) that it is preferable to keep heritage sites exposed to allow access for traditional and/or community resource use or archaeological study.

Faced with these conflicting hypotheses, the WUP Committee chose to work with Hypothesis 1 and evaluated proposed operating alternatives that would inundate heritage sites a greater number of days per year as preferable. Quantitative information regarding the effects of reservoir operations on heritage sites will help to identify meaningful performance measures in the next Peace WUP review.

3.0 ARCHAEOLOGICAL EROSION MONITORING PROPOSAL

3.1 Objective and Scope

The objective of the planned erosion monitoring study is to collect quantitative measures of the magnitude, severity, rate of change and estimated duration of erosion effects caused by reservoir operations on selected heritage sites situated within the draw down zones of the Williston and Dinosaur reservoirs and the Peace River from the Peace Canyon Dam to the confluence of the Alces River near the B.C./Alberta. The typical draw down elevation of Williston reservoir is between 671 and 657.4 m and for Dinosaur; between 502.7 and 501.6. These draw down areas and the banks of the Peace River as described above constitute the geographical scope of the study area.

3.2 Approach

This project will involve research and analysis, as a well as an in-field component for establishing monitoring stations and subsequent data collection. Erosion monitoring stations will be established at a minimum of six locations within the study area divided between the Williston reservoir draw down (min 3 sites), the Dinosaur reservoir draw down (min 1 site) and along the banks of the Peace River (min 2 sites) and re-visited annually. Archaeological sites identified through the Peace - Archaeological Overview Assessment will be selected for monitoring according to their suitability for long-term monitoring due to their location in areas affected by reservoir operations, the presence of cultural materials on the surface, accessibility and community preference.

In accordance with the Order, this erosion monitoring study will be conducted using non-intrusive methods.

Monitoring stations will be situated in a variety of landscape contexts with reference to the landscape model of archaeological potential developed in the Peace – Archaeological Overview Assessment (GMSMON 21a). Each monitoring station should measure no less than 0.04 ha (e.g. 20 m x 20 m) and no greater than 0.25 ha (e.g. 50 m x 50 m) in area. Configuring the monitoring stations to capture a maximum amount of archaeological information in addition to a landform setting that exhibits the effects of erosion related to reservoir operations will be critical to the success of the study.

Locations exhibiting archaeological materials and/or features on the surface will be selected to ensure that effects specific to archaeological resources can be measured. Locations with either documented or previously undocumented archaeological sites may be suitable. The limits of the monitoring station will be clearly defined and recorded. No intrusive materials will be placed within the station and no materials or equipment brought in for the purpose of the study will be left on site. As this study is not being carried out under a Provincial Heritage Inspection Permit, no artifacts or other cultural materials will be collected from the monitoring stations and no subsurface testing will be conducted.

The project will take a collaborative multi-disciplinary team approach directed by a professional archaeologist and including a survey engineer, a quaternary geologist

and technical assistants throughout the project. The technician will support the work of the archaeologist in the field primarily for surveying for archaeological materials but may also provide support to the geologist or survey engineer as directed. An in-office technician will provide support for data processing and/or GIS related work. These roles are designed to provide entry positions for local First Nations to directly participate in the study. The archaeologist will be responsible for monitoring station selection and for identification, recording, mapping and interpretation of cultural materials and features present on the ground surface within the limits of the station. The archaeologist will be responsible for collating all collected data and project reporting.

Using terrestrial-based LIDAR, the survey engineer will collect a complete scanned dataset of the selected monitoring station. This dataset will be geospatially tied to the UTM grid (NAD 83). The resulting point cloud will be converted into a detailed topographic map (DTM) at a suitable scale (e.g., 1:500). The DTM will include a related (thematic) layer of information regarding the archaeological features, artifacts and other materials observed on the ground surface. In addition, a physical datum will be established offsite for elevation control and as a reference point to aid in re-location.

Despite its additional cost when compared to more traditional means (intrusive physical structures combined with GPS or photogrammetry) there are several advantages in using LIDAR for measuring erosion effects. Laser scanning technology is a highly accurate method for collecting geospatial information at a fine scale. The resulting point cloud can be similar to the pixels in a digital photographic image but in the case of LIDAR, each point is geo-referenced to a chosen grid, in this case UTM. Unlike GPS where geo-reference points are collected individually by the GPS operator while moving over an area, LIDAR can be positioned off-site and can collect millions of individual data points as close as 5 cm apart with one scan. Topographical undulations require that the scanner position be re-positioned for collecting multiple overlapping scans, which are stitched together to create a combined point cloud from which 3-dimensional surface representations can be generated. Subsequent data analysis is required to create a DTM and related sections or other products. Features, such as vegetation, can create interference during the scans and this should be considered and addressed to minimize "shadows" in the scans during the data collection.

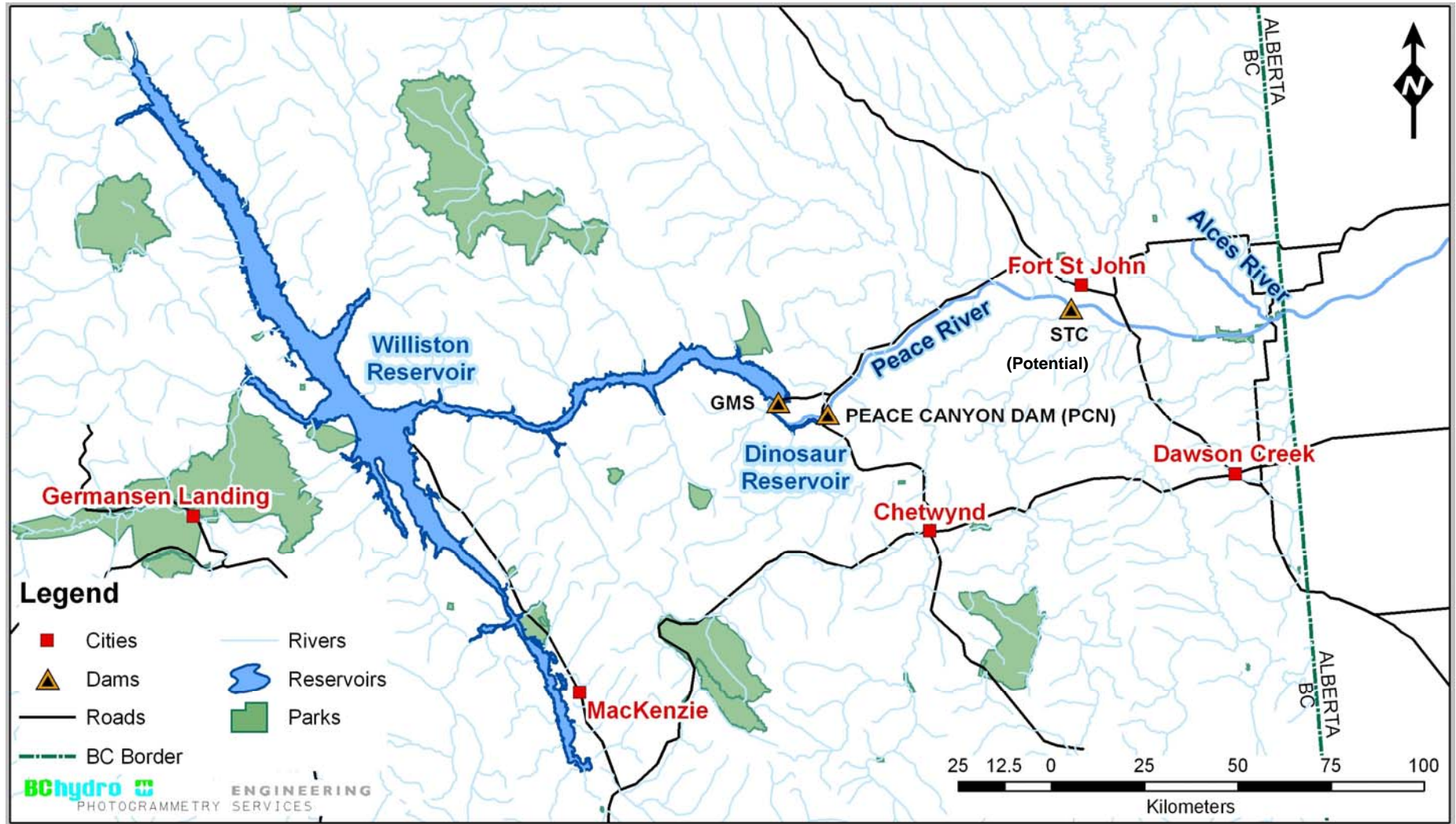


Figure 3-1: Location of Peace Erosion Monitoring of Archaeological Resources study area.

LIDAR is a particularly appropriate technology for this erosion monitoring study because;

- 1) it is non-intrusive,
- 2) it has suitable resolution for recording spatial areas in fine detail,
- 3) DTMs can be created from the data, lessening time required for field mapping, and
- 4) changes in volume (i.e. erosion or accretion) between comparable scans over time can be readily calculated.

In Year 1, the quaternary geologist will assist in the selection of monitoring stations and develop a geological (stratigraphic) model, including an assessment of erosion susceptibility, for each station. The geological models would be based on visual inspections of exposed soil layers with no excavation. The potential for extrapolation of the geological models to the rest of the reservoir draw down zone outside the study areas should be considered in the model development. In Years 5 and 9, the geologist will re-visit each monitoring station, inspect the changes to the exposed sections, review the collected geo-spatial (LIDAR) data and provide a report that compares the observed and measured effects with those predicted from the Year 1 model.

All final annual reports will be shared with local First Nations.

The project team will conduct accurate surveys in accordance with BC Hydro's *General and Technical Standards for Reservoir Archaeological Work*, meeting all relevant requirements.

3.3 Methods

The erosion monitoring will involve five basic tasks outlined below:

3.3.1 Task 1: Project Management

Project management will involve the general administrative and technical oversight of the project. This task will include, but not be limited to:

- 1) budget management,
- 2) study team management,
- 3) logistic coordination,
- 4) technical oversight of field and analysis components, and
- 5) facilitation of data transfer among other investigators, as required.

A safety plan must be developed and submitted to the BC Hydro study implementation lead for all aspects of the study involving field work, in accordance

with BC Hydro's procedures and guidelines. This safety plan must be submitted and accepted by BC Hydro prior to any fieldwork being undertaken. Specific safety training may be required.

3.3.2 Task 2: Documentary Research

This task includes, but is not limited to:

- 1) a review of published and unpublished reports, particularly Phase 1 of the HCIP; the Peace – Archaeological Overview Assessment;
- 2) a review of all documented archaeological sites within the study area as described in Section 3.1. ; and
- 3) a review of available air photos, orthophotos and digital elevation models of the drawdown zone.

Preliminary selection of appropriate monitoring station locations will be made as a result of the documentary research with particular attention to the results of Phase 1 the Peace - Archaeological Overview Assessment.

3.3.3 Task 3: Monitoring Station Site Selection and Erosion Susceptibility Model Development

Final monitoring station selection will take place in the field to ensure that both archaeological and landform aspects are well represented and that each station is configured to capture appropriate data. The selection and establishment of monitoring stations in the field will be combined with the collection of baseline data during a single field trip in Year 1. An individual offsite datum will be established for each monitoring station.

Year 1 will also include the development of an erosion susceptibility model for each established monitoring station by a quaternary geologist.

3.3.4 Task 4: Data Collection

Both archaeological and geospatial data collection will take place in each of the nine years of this study. Baseline LIDAR scans will be established in Year 1, with successive LIDAR scans (epochs) in each of Years 2-9, inclusive.

Within each monitoring station, the position, type and morphological characteristics of all surface artifacts, cultural features and exposed sediments will be recorded by the professional archaeologist and technical support staff. Digital photographs with a minimum 300 dpi will be taken of the monitoring station and of all archaeological features and artifacts observed within. Information required for submitting or updating B.C. Archaeological Site Inventory Forms will be recorded.

Geospatial data collection will include LIDAR scans of the entire monitoring station. Multiple overlapping scans may be required to account for all topographic undulations and to maximize the completeness of scanned ground. The position of each scan will be recorded using GPS and linked to UTM (NAD 83). A set of colour

digital photographs will be collected from the same position as each LIDAR scan to capture the area covered in each scan.

3.3.5 Task 5: Analysis and Reporting

A draft interim report that summarizes the methods employed and study findings will be prepared shortly after the conclusion of the data collection each year. A final report for the study will include:

- an executive summary;
- a description of the monitoring station set up and data collection methods;
- a detailed summary of the archaeological data collection findings for each monitoring station;
- a detailed summary of the geomorphologic data collection findings for each monitoring station;
- a detailed analysis of the observed measured erosion at each monitoring station as compared to the erosion susceptibility model(s);
- hard copy and digital maps, in an acceptable format, showing the monitoring station locations and the position of all surface archaeological features and artifacts per year;
- detailed scans (maps and sections) showing the recorded changes between successive epochs; and
- a detailed quantitative analysis of the collected data regarding the effects of the reservoir on archaeological resources expressed in terms of magnitude (volumetric and dimensional changes), severity, rate of change and duration.

Reports will follow the standard format that is being developed for WUP monitoring programs. All reports will be provided in hard-copy and as Microsoft Word and Adobe Acrobat (*.pdf) format, and all maps and figures will be provided as embedded objects in the Word file and as separate GIS files.

The preparation and submission of B.C. Archaeological Site Inventory Forms for all newly identified sites or updates to previously documented site data records is also required.

3.4 Schedule

The study will take place over nine years with Year 1 expected to take place in spring of 2009. The exact timing will depend on site conditions, but it is expected that the greatest extent of the Williston reservoir drawdown zone will be exposed in the spring; typically between April and June when the area is free from snow and ice but is not yet inundated from rising reservoir levels. Low water levels and minimal snow cover on the ground are needed for effective mapping. The field component of the project within Williston reservoir should take place before the end of June when reservoir levels start to rise. The shoreline of Dinosaur reservoir and the banks of the Peace River should be available for a longer, but less predictable, period.

3.5 Budget

The annual budget for this study is estimated at \$64,000 (in 2004 dollars).

Annual budget estimates assumes a 2% rate of inflation and a 5% contingency for the duration of the program.

Assumed Inflation Rate	2%	\$546,877
Contingency	5%	\$574,221

3.6 References

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