



Columbia Projects Water Use Plan

Physical Works Terms of Reference

CLBWORKS-30A Arrow Lakes Reservoir Wildlife Enhancement Program
(Mid-Columbia River) – Engineering and Construction at Site 6a Airport
Marsh

A1.0 Addendum 4 to CLBWORKS-30A

A1.1 Background

This Terms of Reference (TOR) is submitted pursuant to the Columbia Projects Water Use Plan (WUP) Order dated January 26, 2007, under the schedule for Conditional Columbia Works and Effective Monitoring Studies, Clause 4(a).

The purpose of this works project is as follows:

- To protect and enhance areas of high value wildlife habitat identified within the Revelstoke Reach Area (WUP Order, Schedule C, Clause 5(h)); and
- To improve conditions for nesting and migratory birds and wildlife within Revelstoke Reach as identified in feasibility studies (WUP Order, Schedule C Clause 6(a)).

CWR correspondence from 2011 to 2022:

- Between 2011 and 2013, the CWR approved various requests for physical works at Airport Marsh (site 6A) on the east arm to address erosion. The west arm remained unaltered as a control comparison.
- More recently, the east arm physical works have generally been successful at minimizing erosion in the east arm as monitored under CLBMON-11B4 (WUP Order, Schedule D Clause (c)).
- On April 16, 2022, we received CWR approval for Addendum 3 for ongoing inspections and small-scale maintenance work for Site 6a for an additional 6 field seasons until 2026 or the Columbia WUP Order Review, whichever occurs first

A1.2 Rationale for Addendum

The purpose of this TOR Addendum 4 is to define the scope for physical work at Site 6a.

A1.2.1 Ongoing erosion has been observed in the west arm (control comparison)

In spring 2020 our local biologist noted that spring freshet outflows from Airport Marsh/Slough were contributing to ongoing headcut migration east toward Airport Marsh/Slough. This could result in drainage of the marsh and loss of wildlife habitat provided by this wetland.

Aerial imagery using a drone flown in 2020 (Figure 1) showed flow causing erosion of the west arm. The aerial imagery flow path was corroborated by our local biologist walking the site during freshet from local snowmelt in March 2022 when the water flow could be seen clearly. Opportunities to observe the flow paths is very limited in summer and fall. The next field observation opportunity is expected to be during the March-April 2023 freshet.

A1.2.2 Submission Scope

This submission includes scope for:

- physical works protection measures to protect the wetland values;
- periodic inspections; and
- minor regular maintenance (i.e., minor fills).

The duration of this Addendum is for a six-year period to the last field season in 2026 (which is last year of the 20-year remissions for the Columbia WUP), or until the WUP Order Review (WUPOR) is complete, whichever comes first. This scope and duration are necessary to ensure the Airport Marsh continues to function as intended.

A1.2.3 Linkages to other Columbia Project WUP Projects

This project has linkages with other Columbia WUP projects as shown in the table below

Table 1: Related WUP projects

Project	Objective of Project	Relationship to CLBWORKS-30A
CLBWORKS-29A: Arrow Lakes Feasibility Study of Wildlife Physical Works	Identification and feasibility of candidate sites for physical works enhancement	Prior steps that identified and evaluated sites 6A and 15A as sites of high value
CLBMON-11B4: Monitoring Wetland and Riparian Habitat in Revelstoke Reach in Response to Wildlife Physical Works	Monitor the wildlife utilization patterns in response to revegetation of physical work sites in Revelstoke Reach	Annual before and after biological monitoring of any impact of the Physical Works;

The biological monitoring under CLBMON-11B4 completed its last year of monitoring in 2020. Should there be major repairs undertaken Site 6a, BC Hydro will determine whether additional biological monitoring is required and will make submissions related to CLBMON-11B accordingly

A2.0 Physical Works and maintenance Proposal

A2.1 Approach

The approach to physical works protection measures and maintenance is summarized as follows:

1. Develop conceptual engineering design options, detailed design and technical specifications and summarize the findings in a final engineering detailed design report;
2. Conduct periodic inspections of the site;
3. Undertake minor, periodic maintenance if deemed necessary; and
4. Evaluate major structural repairs on a case-by-case basis; and
5. Summarize the findings in a final engineering memo to support WUP Order Review discussions

The next section provides additional information on these steps to prevent further erosion of the west arm and protect the Airport Marsh to the east.

A2.1.1 Conceptual Engineering Design Options

Further physical works protection measures are required including the development of conceptual engineering design options, followed by detailed design and technical specifications. Given the erodible substrate and subtle undulating topography in the area, we are continuing to evaluate the options for managing water entering the west arm commencing with field inspection by an engineer in spring 2023. We will investigate options to direct surface water flows toward the armoured east arm and away from the west arm and consider any contributions from subsurface water flow to the channel erosion in the west arm.

Conceptual engineering design will consider options including:

- Blocking flow in the most southerly of two existing flow paths (water conveyance B:C-2) through the old rail bed (Figure 1).
- The placement of low berms/check dams to prevent runoff from entering the west arm (Figure 2 – C:D). Low berms can be constructed of local material and coir cloth to allow grass to grow through the material to slow or divert water flow (Figure 2 – water conveyance C:D).
- Taking the same approach in placing rip rap for the west arm as was done for the east arm is considered a fallback option if other options developed in the conceptual engineering design phase are not deemed effective with annual monitoring. Rip rap placement in the west arm is not included in this request.

Figure 1: Site 6a - Aerial View of overland flow paths to east arm

Water conveyance points B:C-1 and B:C-2

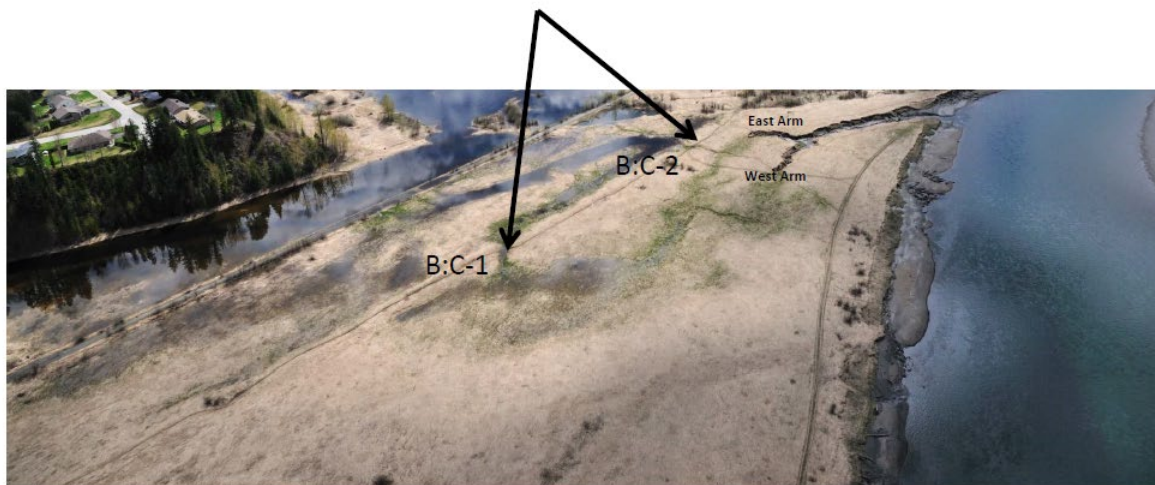
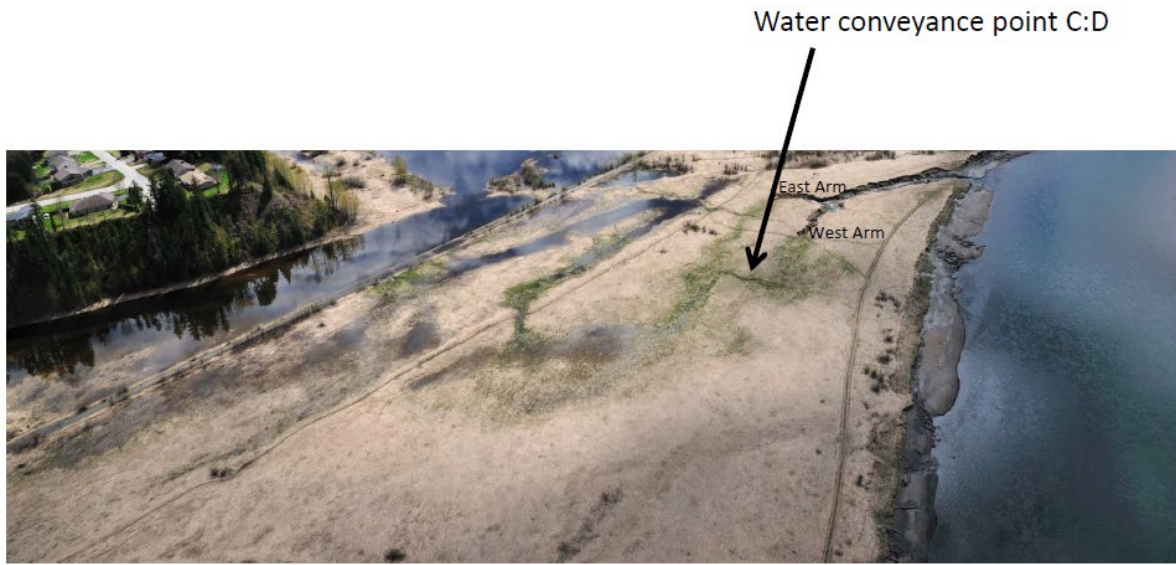


Figure 2: Site 6a - Aerial View of overland flow paths to west arm



A2.1.1 Develop Detailed Design and Technical Specifications and summarize the findings in an engineering detailed design report

Prior to construction, a final engineering detailed design report will be prepared. The final report may include (but is not limited to) the following:

- Survey data
- Issued for Construction (IFC) drawings.
- Detailed design, technical specifications; and
- Construction drawings;

A2.1.2 Conduct periodic inspections of the sites

The sites should be inspected periodically to confirm that the structures are performing as intended. There are two types of inspections planned:

- Periodic visual site inspections: These will be completed for 6A, with photos taken, and if necessary, any change in condition will be documented.

A2.1.3 Undertake minor, periodic maintenance if deemed necessary

Following inspection, it may be necessary to undertake periodic maintenance particularly in cases where the overall objectives of the project could be compromised. For example, small amounts of substrate or gravel may be replaced if there is concern about the rate of erosion.

This type of maintenance will occur opportunistically. It may require consultation with biologists and/or engineers to determine whether the issue would be compromising the wetland. Records will be kept of all maintenance undertaken and included in the final report.

A2.1.4 Evaluate major structural repairs on a case-by-case basis

At this time, BC Hydro is requesting a provision for physical works to the scoped in conceptual design phase for the Airport Marsh site (site 6A).

The key steps for undertaking a major structural repair are the same as the implementation steps described in the CLBWORKS-30A TOR Addendum 2, dated September 2015 (see section 3.1 Key-Tasks Implementation), and will be scaled down appropriately for the size of the structural repair. That is, we will seek an engineered solution, appropriate regulatory approvals and permits and ensure appropriate environmental and archeological planning prior to and during construction of the repairs.

A2.1.5 Summarize the findings in an engineering memo

Following the final inspections, and incorporating information from any maintenance undertaken, a final engineering condition assessment project report will be prepared. The final report may include (but is not limited to) the following:

- Survey data
- Summary of the changes and findings over the period and since construction;
- Overall condition assessment of the works;
- Photos supporting the assessment;
- Lessons learned, if appropriate; and
- If relevant, include design recommendations as appropriate that could inform any future similar physical works.

A2.2 Schedule

A schedule for illustration purposes is shown in Table 2 below. The minor repairs include place holders should repairs be necessary at the site 6A location.

Table 2: Proposed Monitoring and Repairs Schedule

Task	2023	2024	2025	2026
Inspections & eng memo		x	x	x
Minor repairs				x
Known Major Repairs (Site 6A)				
Design, specifications, drawings and reporting	x			
Construction (Supply/Install)		x		
Summary memo			x	
			Earliest of WUPOR or 2026	

A2.3 Budget

The implementation budget for this TOR Addendum 4 is shown in Table 3 below. It requires additional implementation budget of \$296,369, for a revised total implementation budget for CLBWORKS-30A of \$2,010,501.

The budget assumptions are provided below:

- Inflation per annum: 6% in 2023, 5% in 2024, 4% in 2025 and 3.3% in 2026
- \$10,000 in 2026 has been added for minor repairs at Site 6A if needed. Updates to the Annual Report would be provided for any work of this nature.
- As we are awaiting additional site visit in spring 2023 to confirm an engineering approach for the Site 6A major repair and ongoing uncertainty in supply chains for construction, we have applied a 20% contingency to our estimate for 2023-2026.

Table 3: Budget associated with TOR Addendum 4

The total revised budget for the project is \$919,229