Peace Project Water Use Plan

Physical Works Terms of Reference

- GMSWORKS#21 WLL Dust Control Trials

Addendum 3
A3 Addendum to GMSWORKS#21 WLL Dust Control Trials

A3.1 Addendum Rationale

The terms of reference (ToR) for GMSWORKS#21 WLL Dust Control Trials (Dust Trials), dated April 2, 2008 (with Addenda 1 and 2 dated March 26, 2009 and March 15, 2010, respectively), described a timeline of three years for the dust mitigation trials. The Dust Trials completed its third year in 2010, having conducted assessments of several different dust mitigation methodologies:

1. Tillage techniques, including analysis of appropriate tools (e.g., chisel, lister) and methods (e.g., spacing experiment),
2. Irrigation, including pumped and gravity-fed distribution, and artificial pondage,
3. Native vegetation, including grasses and Equisetum sp. with and without soil enhancement, and
4. Vegetation protection using protective debris berms.

The results of those trials indicate:

1. Tillage is an effective short-term dust control method where soil, beach access, archaeological site density, and topography are suitable. Given these limitations, tillage is not suitable at many locations in the Finlay Arm.
2. Irrigation is impractical because of logistical requirements and soil conditions.
3. Native vegetation shows potential for effective and efficient dust control in suitable areas. However, more extensive longer term studies are needed to identify the best species, planting technique, maintenance requirements, and survivability. Soil enhancement is required in most areas. Soil enhancement using debris to create compost is promising but longer term studies in conjunction with the native vegetation trial described above are needed.
4. Due to low reservoir levels in 2009 and 2010, vegetation protection techniques remain untested.
5. Adequate dust control in the region will likely not be achieved using only tillage and vegetation so additional dust control methods require identification and testing.

To address these knowledge gaps, BC Hydro and Tsay Keh Dene jointly propose to conduct further work as described in this ToR Addendum.

This Addendum describes a three-year work scope and a 1-year budget for:

(i) a Vegetation Enhancement trial combining native vegetation trials and soil enhancement trials;
(ii) a continued Vegetation Protection trial; and
(iii) a feasibility assessment of soil binders as an alternative or complementary mitigation tool.

We propose to refine the work scope and submit a budget annually due to the experimental nature of these trials.

A3.2 Revised Work Plan for GMSWORKS#21 WLL Dust Control Trials

A3.2.1 Management Questions
Based on the results of the previous years' trials, the management questions are identified as:

1. Can vegetation be established on the beaches of the Finlay Arm of Williston Reservoir at a sufficient density and over a sufficient area to be an effective and efficient dust mitigation technique?

2. Are debris berms an effective mitigation technique for protecting vegetation on the beaches of the Finlay Arm of Williston Reservoir?

3. Can a soil binding agent be an effective and efficient dust mitigation technique on the beaches of the Finlay Arm of Williston Reservoir and be acceptable from regulatory, environmental, archaeological, and human health perspectives?

These management questions will be addressed through three sub-projects:

1. Vegetation Enhancement
2. Vegetation Protection
3. Soil Binder Feasibility Assessment

**A3.2.2 Revised Objectives**

The objectives of these trials are to address the management questions by collecting the data necessary to draw inferences and to test the appropriate hypotheses.

All trials should take an adaptive management approach emphasizing both effectiveness at dust control and efficiency in terms of costs, logistics, personnel, and timing. This may require alterations to scope, schedule, or budget of the project over time as lessons learned suggest or require alterations to the approach.

Design and implementation of the project should also anticipate the need to acquire sufficient data within three years to, at minimum, provide as sound a scientific analysis as possible to allow a determination of the value of continuing, cancelling, expanding, or operationalizing the use of vegetation for dust control on Williston at the end of that 3-year period.

**A3.2.2.1 Vegetation Enhancement**

The objectives of the Vegetation Enhancement trial and Vegetation Protection trial build upon the results-to-date and include:

1. Determine if vegetation can be established using seeds, seedlings, or other form of transplant and determine the most effective and efficient means of doing so.

2. Identify under what conditions (e.g., elevation, soil conditions, species, soil amendments, etc.) vegetation would be expected to survive and establish a self-sustaining (or semi-self-sustaining) population.

3. Determine if Williston Reservoir debris-wood-fibre-based compost is an effective soil amendment/conditioner to assist in establishing self-sustaining (or semi-self-sustaining) populations of plant species, and, if the answer is yes, develop a plan for efficient composting.

**A3.2.2.2 Vegetation Protection**

The objective of this trial is to evaluate the use of woody debris berms to protect existing vegetation on the Finlay Arm of Williston Reservoir.

**A3.2.2.3 Soil Binder Feasibility Assessment**
The objectives of the Soil Binder Feasibility Assessment will include:

1. Identify potential soil binders suitable from regulatory, environmental, archaeological, and human health perspectives to be tested as a dust suppressant on the beaches of the Finlay Arm of Williston Reservoir and the conditions necessary for the application in test plots of such binders.

2. Given that an environmentally acceptable soil binding agent is available, assess the overall suitability for use in the Finlay Arm of Williston Reservoir given the remote location, archaeological interests, limited road access, and people living along the Finlay Arm. This assessment will consider but is not limited to dispersal options, health effects, environmental impact, archaeological impact, product life, and time and cost efficiency.

3. Determine the effectiveness of candidate soil binders in suppressing dust in the Finlay Arm of Williston Reservoir by appropriate scientific trials, the exact nature of which is to be determined.

Project coordination between these trials is necessary as well as with other projects involved in the Williston Dust Mitigation Program and other BCH projects; therefore design and implementation should be flexible.

A3.2.3 Methodology

A3.2.3.1 Vegetation Enhancement

Vegetation Enhancement Trials Methodology:

**Woody Debris Composting:** The trial will test on-site composting of woody debris in the Finlay Arm of the reservoir. The compost produced from this trial will supply the vegetation trials with a soil enhancer. Composting will occur in the Finlay Arm near trial sites. Composting will entail:

- Creating feedstock by chipping/grinding the wood
- Amending feedstock using developed recipes
- Composting feedstock

Once ready, compost will be transported to beach trial sites as needed.

**Effects of Different Re-vegetation Systems, Nutrient Regimes, and Elevation on Vegetation Establishment:** The trial will test the effects of different nutrient enhancement strategies, elevation, species, and propagation alternatives on plant survival. Trials are intended to facilitate rapid learning and high-capacity treatment screening with both demonstrable results and statistical validity. The trials will follow an adaptive management approach where information garnered each year will assist in refining trial efforts in the following year.

The ability for plants to persist under inundated conditions is a fundamental question. The study area layout will reflect the importance of answering this question. One suggested design is to layout treatments in a series of long strip plots (~600-1300 m) running from the low water line all the way up to full pool. Strip plots will begin at an elevation where flooding will not exceed two metres depth as areas flooded by more than two metres are unlikely to sustain vegetation. Plots will be marked and georeferenced to ensure they can be relocated in following years. A tentative selection of treatments includes:
### No Plants Sown or Planted

Double Control -- no fert, no seeding/planting  
Control -- broadcast NPK, but no seeding/planting  
(optional, if room) Compost Control -- incorporated compost, no seeding/planting

### Sowing Treatments

<table>
<thead>
<tr>
<th>Sowing Treatment</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Seed Mix, drill-seeded, no fert.</td>
<td></td>
</tr>
<tr>
<td>Native Seed Mix, drill seeded, with broadcast or side-delivered NPK @ 300kg/ha</td>
<td></td>
</tr>
<tr>
<td>Native Seed Mix, drill seeded, with incorporated compost @ 120 t/ha</td>
<td></td>
</tr>
<tr>
<td>Native Seed Mix, broadcast or hydroseeded with NPK @300kg/ha or compost @120 t/ha</td>
<td></td>
</tr>
<tr>
<td>Seed Mix 1, with NPK or compost</td>
<td></td>
</tr>
<tr>
<td>Reed canarygrass (flood resistant perennial native sp), with NPK or compost</td>
<td></td>
</tr>
<tr>
<td>Reclamation seed mix (e.g., Pickseed wet-site/riparian), drilled or broadcast</td>
<td></td>
</tr>
</tbody>
</table>

A tentative selection of proposed sites includes:

1. Davis Beach  
2. Omineca Beach  
3. Colins Bay Beach

Trials occurring in the autumn will coincide with high water elevations thereby restricting sowing/planting to high beach locations only.

The planting/sowing trials will be monitored to assess if plant mortality is due to inundation or drought. Formal density count surveys of surviving and dead plants in permanently marked plots (e.g., 1X2 m plots) will take place in the fall and the following spring (late April/early May) to assess which species survived and to what elevation they survived inundation. Formal survey data will be expressed as percentages (of seeds emerged, or transplants surviving), arc-sine transformed to improve normality, and tested for significant differences among treatments and 1-m elevation bands using two-way analysis of variance (ANOVA), or if the data are too skewed, using Kruskal-Wallis tests. Significant differences will serve to guide the narrowing of treatment options to be pursued in future years. Any significant survival of a plant species will indicate its potential use, at some elevation, in future years. In general, results will be used to guide revegetation operations in year 2 and 3.

Native seeds will be collected in the autumn to be used in future revegetation efforts. Seedlings will be acquired from a local greenhouse operation for the vegetation trial. Should the trial prove to be successful, then it would be cost effective to build a greenhouse in Tsay Keh in the future for the production of seeds, cuttings and plugs to be used in a long-term re-vegetation program.

**Nutrient and Tillage Convergence:** The trial will take place on a high dust production beach such as Davis and will incorporate all the lessons learned to-date from the tillage and vegetation experiments over the last three years. The study will have five treatments:

1. Unseeded (Control)  
2. Seeded, no nutrient amendment  
3. Seeding with the addition of compost at 5% tilled into the top 15 cm.
4. Seeding with the addition of synthetic N:P:K fertilizer
5. Seeding with the addition of 5% compost and N:P:K fertilizer

Formal density count surveys of surviving and dead plants in permanently marked plots (e.g., 1X2 m plots) will take place will occur in the fall and the following spring (late April/early May) to assess which species survived and to what elevation they survived inundation. Formal survey data will be expressed as percentages (of seeds emerged, or transplants surviving), arc-sine transformed to improve normality, and tested for significant differences among treatments using appropriate statistical test. Significant differences will serve to guide the narrowing of treatment options to be pursued in years 2 and 3.

**Enhancement and Establishment of Permanent Vegetation Cover on a High Impact Beach:** This is a demonstration site located on Tsay Keh Beach that will test several strategies for vegetation dust control. The site design and strategies will be determined by Tsay Keh Dene with advice of a soil and vegetation expert. A suggested approach is:

1. Nutrient enrichment on existing native vegetation in the northeast part of the beach.
2. Hydro seeding of a seed mix on the central part of the beach along with ploughing in areas currently ploughed and the north and west bank of the beach
3. Planting of strips of *Phalaris arundinacea* (Reed canary grass) plugs on the exposed “island” in the south west.
4. Planting of willow cuttings on all natural sandy berms on the beach

**A3.3.3.2 Vegetation Protection**

**Vegetation Protection Trials Methodology:**

In 2009, a debris bundle protection trial was established to test its effectiveness in protecting a beach area from debris scour. This structure will be assessed in 2011, or as soon as water levels permit, to determine its effectiveness. Should it prove effective, additional trial sites may be established.

**Vegetation Protection Trials Effectiveness Monitoring:**

The amount of debris trapped on both sides of the vegetation protection system will be evaluated. Debris volume will be assessed at the site before water rises this year and then again in spring 2011 after water levels have dropped to assess the effectiveness of the protection structures.

**A3.2.2 Soil Binder Feasibility Assessment**

**Soil Binder Feasibility Assessment Methodology:**

1. Assess feasibility of soil binder application to Williston Reservoir based on available literature, consultation with manufacturers and existing users of the
product, consultation with government bodies in regards to environmental/health regulations, and consultation with BCH WDMP project managers.

2. Develop and implement a pilot study to test the effectiveness of the candidate soil binders on Williston Reservoir beaches

A3.3 Revised Deliverables for GMSWORKS#21 WLL Dust Control Trials

This project includes the following deliverables:

- Any permits required to implement these trials.
- A comprehensive annual report that collates all of the data and includes:
  (a) An executive summary of the project;
  (b) The objectives and scope of the monitor;
  (c) Methods of data collection (including map of sites and photodocumentation), assumptions, and analysis;
  (d) A description of the compiled data set and results of all analyses, and
  (e) A discussion of the consequences of these results as they pertain to the management questions.

A report will be provided in hard-copy and electronically in Microsoft Word and Adobe Acrobat (*.pdf) format. The required maps and figures will be included as embedded objects in the report. All maps and figures will also be provided in their native format as separate files. Raw data will be submitted in an appropriate format (e.g., Microsoft Access database, Microsoft Excel). All photos will be submitted electronically.

- A final report submitted at the end of the trial period that collates the data from the entire trial period. It will include conclusions and recommendations for future dust mitigation measures in addition to the requirements described above for an annual report.
- Annual presentations to the First Nations communities and Chief and Council of results-to-date.

A3.4 Revised schedule for GMSWORKS#21 WLL Dust Control Trials

Vegetation Enhancement and Vegetation Protection trials:
Fieldwork - April or May 2011/2012/2013.
Draft report(s) - November 2011/2012/2013.
Final report(s) - January 2012/2012/2013.

Soil Binder Feasibility Assessment:
Feasibility assessment and pilot study development - April 2011
Draft report - November 2011
Final report(s) - January 2012
Implement Pilot Study April/May 2012
Draft report(s) - November 2012
Final report(s) - January 2013.
A3.5 Revised budget for GMSWORKS#21 WLL Dust Control Trials

The total cost for the Revised GMSWORKS#21 WLL Dust Control Trials is $2,905,285. The budget does not include archaeological survey and environmental monitoring costs that may be required to complete the work.