Project Work Plan

Cape Broyle Forebay Spillway Replacement

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Newfoundland Power
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January 27, 2012

Subject: Cape Broyle Forebay Spillway Replacement Project Work Plan

Dear Mr. Ball & Mr. Humby;

Please find the enclosed Project Work Plan for the engineering design and construction of the Cape Broyle Forebay Spillway Replacement. The work plan is a requirement of ENGI 8700 and has been prepared to facilitate the completion of course requirements within the prescribed deadlines.

The enclosed work plan outlines the tasks require for completion of the project and associated deadlines. Information on expected deliverables and risks associated with the project are also included.

Should you have any questions regarding this work plan, RAMP Consulting would be pleased to discuss them with you.

Regards,

Scott MacIsaac
Project Manager
RAMP Consulting

Attached: Cape Broyle Forebay Spillway Replacement Project Work Plan
CC: Dr. S. Bruneau

Table of Contents

1.0 Project Description

The Cape Broyle/Horse Chops Hydroelectric Development is located in the southeast region of the Avalon Peninsula. The system was developed by Newfoundland Power Inc. in 1953, and has a watershed area of 192 square kilometers. Two hydroelectric plants operate in series: the upstream Horse Chops plant has a maximum capacity of 8.3 MW and the downstream Cape Broyle plant with a capacity of 6.3 MW (Newfoundland Power, 2009).

It has been determined by Newfoundland Power (NP) that the existing spillway at the Cape Broyle Forebay does not meet current Canadian Dam Association Guidelines and is deteriorated to the extent that it requires replacement (Mitchelmore Engineering, 2003). As shown in *Figure 1* below, the current spillway is controlled using wooden stoplogs, which must be removed to release water from the reservoir during times of flood. The operation of the spillway in its present configuration is quite labour intensive, requires detailed reservoir monitoring and leads to reduced hydroelectric plant output decreasing revenue through unwarranted operating costs and reduced production. Removing stop logs is a very labor intensive and is a potentially hazardous activity, requiring two employees to manually lift logs from the crest to the spillway walkway above during flood events. Flow predictions are required prior to a flood event to ensure a sufficient number of logs are removed to accommodate additional flood flow. Possible dam safety issues are created if an insufficient number of logs are removed. The removal of stoplogs is therefore typically completed conservatively, leading to water wastage as too many logs are often removed. Replacing stop logs during spill conditions is difficult and dangerous, causing more water to be wasted

Figure 1 Cape Broyle Forebay Spillway

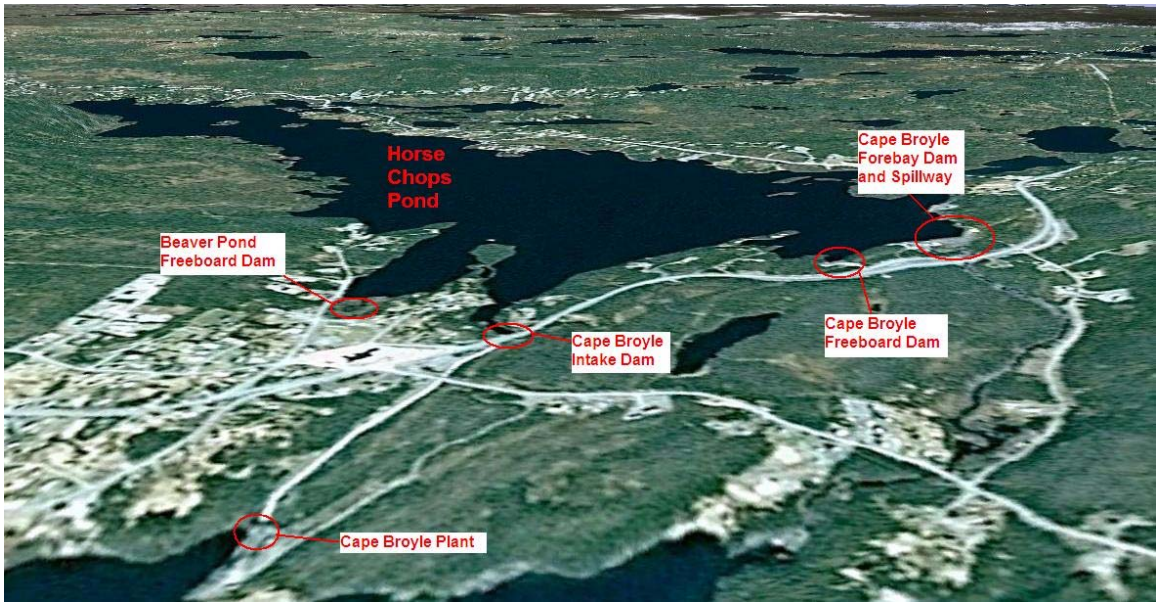


Figure 2 Horse Chops Pond and associated hydraulic structures

2.0 Project Requirements

RAMP Consulting (RAMP) is responsible for the evaluation of a replacement overflow spillway for the Cape Broyle Forebay site. RAMP will complete a detailed literature review to explore alternative spillway concepts. Upon completion of the literature review, concept design and evaluation will be undertaken. Alternatives will be evaluated based on Canadian Dam Associations Guidelines, the hydrological impacts on associated waterways, feasibility and constructability. Finally a detailed cost estimate, as well as construction sequence for the demolition of the existing structure and construction of replacement structure will be completed. The cost estimate will include all capital and operating costs associated with the recommended alternative.

Specific Project Requirements:

- Literature Review
- Concept Design
    - Hydrological Design
    - CDA Guidelines
    - Feasibility
    - Constructability
- Final Concept Evaluation
    - Cost Estimate
    - Operating Characteristics
    - Demolition/Construction Sequence
    - Structure Details
- Final Report

3.0 Methodology

NP has asked RAMP to provide a concept evaluation for the replacement of the Cape Broyle Forebay spillway. RAMP is responsible for the review of potential concepts to be utilized, assessment of feasibility and constructability, and finally concept design.

During initial stages of the project it is important to have a clear understanding of project goals and expectations set out by NP. Weekly meetings and frequent email correspondence have been used to ensure all project requirements are clear to both NP and RAMP. RAMP has accumulated several sources of information to begin a literature review of possible concepts. A detailed schedule has been composed to keep all work on track. Once sufficient information has been gathered and the review process started, team members will begin concept design and evaluation.

The following sections will further describe the organizational structure of RAMP consulting, and the main tasks which will be undertaken for this project.

Organization

The complexity of this project requires that all members of the RAMP team work together, building towards the successful completion of the project. To ensure this project is executed in the most complete and thoughtful manner, the majority of the work performed will be a collaboration of all team members. By submersing the entire team in all technical aspects of the work, approaching the problem from four differing perspectives, we generate the greatest value for the client through the culmination of thoughts and opinions of four individuals.

To direct the RAMP team and achieve optimal results, a leader with specific expertise and final responsibility has been chosen in each of the subfields described below:

Hydrotechnical Design: Dam safety guidelines require that the new spillway must meet the design flood as anticipated through years of hydrological data compilation. Hydrotechnical analysis to determine flood parameters such as capacity and flood elevation is paramount in ensuring the safety of the spillway and surrounding dams. A strong background in hydraulics is required to perform these tasks. Brad Prior is the Hydrotechnical Design Lead.

Design Feasibility and Constructability: Although there are numerous types of spillway design alternatives, there will only be a small number that are feasible for this site and meet the client's requirements. Taking into account all factors, such as hydrological requirements, spatial and environmental constraints, construction time, methodology, and cost, the final design will be selected. Knowledge of common

construction practices and construction management experience would be an asset. Justin Ropson is the Design Feasibility and Constructability Lead.

Drafting and Estimation: The primary deliverables of this project will include concept drawings and cost estimates in addition to the client report. Compilation of these documents will be an ongoing process requiring an articulate individual at the lead. Experience using cost estimation software and AutoCAD are paramount. Jamie Anstey is the Drafting and Estimating Lead.

Project Manager: As main point of contact between the consulting group and the client, the project manager will be responsible for arranging meetings, preparing agenda's and minutes as necessary. Overall coordination of all responsibilities required to present the final deliverables in a timely and cost efficient manner. Strong interpersonal and communication skills are invaluable for the Project Manager. Scott MacIsaac is the Project Manager.

Using project objectives provided by the client and instructor, RAMP has identified key tasks that are required for completion of the project. While maintaining a team approach to the project as a whole, individual expectations are as follows:

- Maintain an engineering log book
- Frequently check company email
- Participation in weekly client meetings
- Participation in weekly status meetings

Client Interaction

The client is to provide the information and relevant documents to ensure the group understands the structure, operations and goal of the project and company. Once the initial planning stages of the assigned project begin, the client will be responsible to provide direction and mentorship, as well as final approval of the project report. The Client and Project Manager will use email as primary correspondence, and meetings will be held when necessary.

Deliverables

The deliverables expected throughout the project can be found below. For scheduling details, see section

Deliverable	Date	Status
Engineering Log	January 9 – April 3, 2012	Ongoing
Statement of Qualifications	January 11, 2012	Complete
Project Binder	January 9 – April 3, 2012	Ongoing
Weekly Status Reports	January 30 – April 2, 2012	-
Meeting Agenda/Minutes	January 9 – April 3, 2012	Ongoing
Project Work Plan	January 27, 2012	Complete
Final Project Report	April 3, 2012	-
Final Project Presentation	April 3, 2012	-

Desired Outcomes

The principle goal for this project is to identify a feasible alternative to the current stop log spillway located at the Cape Broyle Forebay site. By completing a through literature review and evaluating several viable options, a recommendation will be made to NP with a reasonably accurate cost estimate including capital and operating costs, as well as a construction sequence to be used.

4.0 Tasks

Literature Review

A literature review will be conducted in order to determine possible alternatives to be used at the Cape Broyle Forebay site. Several sources of information will be used during this review, including internal NP studies and texts identified by the client, as well as external state-of-technology research completed by RAMP. The purpose of the literature review is to identify existing or new spillway alternatives that are feasible for the Cape Broyle Forebay Spillway. This stage of the project will involve some conceptual design and preliminary calculations. It is imperative to consider: hydrological requirements, environmental and client imposed constraints, as well as construction quantities and costs. Below are several sources that have been reviewed to identify types of spillways and the required calculations;

- "Newfoundland Power – Rattling Brook Hydroelectric Development, Main Spillway Replacement Assessment" prepared by Hatch (2007)
- "Newfoundland Power Inc. Cape Broyle / Horse Chops Hydro System, Flood and Dam Break Study" prepared by AMEC E&C Services Limited (2002)
- "Design of Small Dams" by the US Department of the Interior, Bureau of Reclamation (1987)

- "Hydraulic Design of Labyrinth Weirs" by Henry T. Falvey (2003)

Concept Design and Evaluation

Upon completion of the literature review, the most feasible options will be explored in the conceptual evaluation stage. Further analysis of feasibility, operational characteristics and constructability will be carried out. NP has identified that the spillway should be capable of handling significant flood flows without requiring on site personnel. This operational characteristic will be significant in determining concepts to proceed with, as any automated designs will require remote operation.

Because the structural conceptual design is interdependent with hydraulic parameters and outcomes, these calculations will be completed iteratively. A flow of 125 m^3/s will be used as the 1/10,000 year design flood (AMEC, 2002). The spillway structure will be required to pass this flood flow while maintain adequate freeboard on all dams on Horse Chops Pond. If required, an increase to freeboard on adjacent dams will be evaluated, and appropriate suggestions will be made to the client. Other design considerations will include ice loading, hydrostatic forces, uplift, erosion and sedimentation. Flow at the toe of the spillway will be assessed to ensure no undercutting of the dam. If required, any energy dissipation mechanisms will be designed.

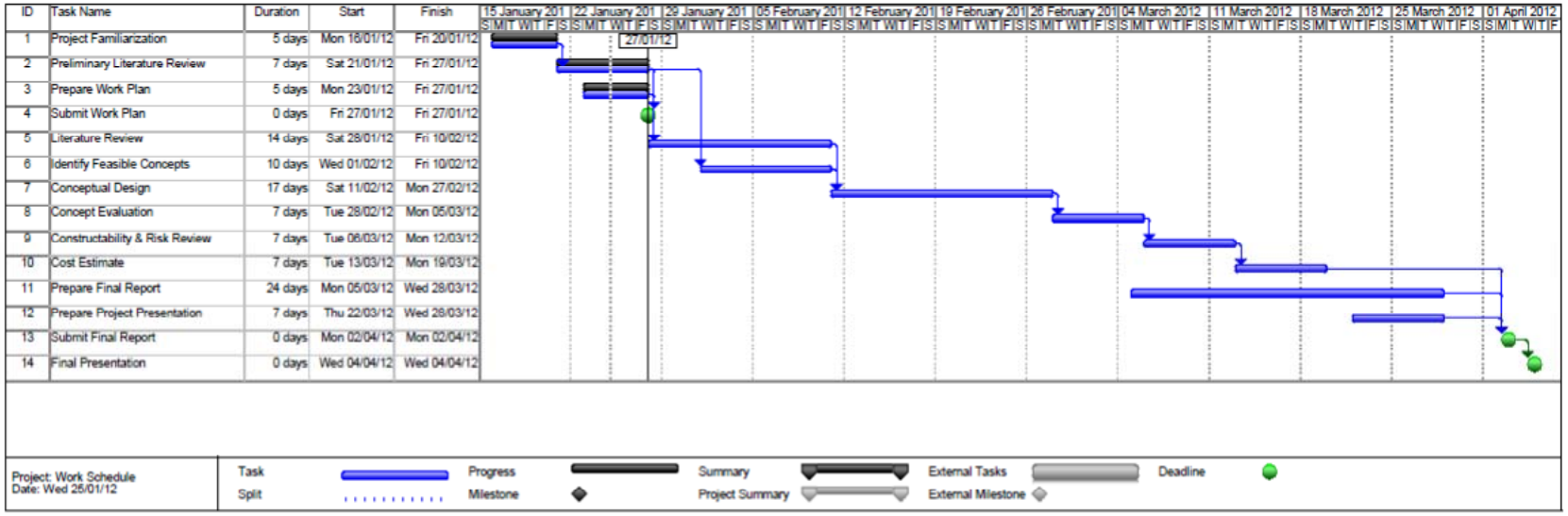
Cost Estimate

RAMP will perform a detailed cost analysis and feasibility of the redesign of the Cape Broyle spillway. NP will provide unit prices for major items such as riprap, mobilization and demobilization. RS Means CostWorks will be used for any items not provided by NP. NP recognizes that quantity takeoffs are only preliminary due to lack of survey information. It is expected that the cost estimate will be within +/- 25%

3.0 Project Schedule

A schedule of major tasks and milestones has been developed for the Cape Broyle Forebay Spillway Replacement. A baseline schedule captured on January 16, 2012 and will be used throughout the duration of the project. Prior to each weekly progress meeting, the schedule will be updated to reflect current progress and revised deadlines. Project execution will be tracked using MS Project. The project manager is responsible to update the schedule and ensure deadlines are achieved.

The schedules finish date is fixed. Modifications to task durations will be confined by the finish milestones.



ID	Task Name	Duration	Start	Finish
1	Project Familiarization	5 days	Mon 16/01/12	Fri 20/01/12
2	Preliminary Literature Review	7 days	Sat 21/01/12	Fri 27/01/12
3	Prepare Work Plan	5 days	Mon 23/01/12	Fri 27/01/12
4	Submit Work Plan	0 days	Fri 27/01/12	Fri 27/01/12
5	Literature Review	14 days	Sat 28/01/12	Fri 10/02/12
6	Identify Feasible Concepts	10 days	Wed 01/02/12	Fri 10/02/12
7	Conceptual Design	17 days	Sat 11/02/12	Mon 27/02/12
8	Concept Evaluation	7 days	Tue 28/02/12	Mon 05/03/12
9	Constructability & Risk Review	7 days	Tue 06/03/12	Mon 12/03/12
10	Cost Estimate	7 days	Tue 13/03/12	Mon 19/03/12
11	Prepare Final Report	24 days	Mon 05/03/12	Wed 28/03/12
12	Prepare Project Presentation	7 days	Thu 22/03/12	Wed 28/03/12
13	Submit Final Report	0 days	Mon 02/04/12	Mon 02/04/12
14	Final Presentation	0 days	Wed 04/04/12	Wed 04/04/12

4.0 Project Financials

Costs associated with ENGI 8700 are small. A budget has been allocated to cover printing and general office expenses and travel costs associated with site visits. Should further expenses be incurred, a meeting will be held to reallocate funds.

Item	Budget	Current	%
Printing	$60.00	$15.00	25
Office Expenses	$20.00	$0.00	0
Travel	$20.00	$0.00	0

5.0 Risk Identification and Control

The Cape Broyle Forebay Spillway Replacement Project presents very little risk to RAMP Consulting or the Client. The main risks identified are communication, literature availability, design assumptions and construction.

Communication

Open communication with the client will ensure any issues are resolved immediately. The Project manager will act as the main point of contact and will maintain communication on a regular basis. When required, meetings will be scheduled to facilitate open discussion and thorough analysis over the course of the project.

Literature Availability

A large portion of the requirements sent out by the Client involves an analysis of current literature on hydraulic structures to be considered for the Cape Broyle Spillway Replacement. Ensuring sufficient literature is available and accessible is critical to the success of the project.

Design Assumptions

The site information available at this phase of the project is limited: topographical and structural surveys have not yet been carried out as the project is still in a very preliminary stage. As such, the design and feasibility assessment of each concept will depend heavily on these assumptions. Incorrect or inaccurate assumptions may slant the assessment of the concepts, and would not affect each concept evenly as its highly dependent upon the extent of construction or demolition required.

6.0 References

AMEC E&C Services Limited . "Newfoundland Power Inc. Cape Broyle / Horse Chops Hydro System, Flood and Dam Break Study" (2002).

Google Earth Image. "Cape Broyle / Horse Chops Pond Area" (2012).

Mitchelmore Engineering Company Ltd. "Dam Safety Review Cape Broyle / Horse Chops Development" (2003).

Newfoundland Power. "Potential Projects to Increase Energy Production" (2009).

Appendix A – Statement of Qualifications

Statement of Qualifications

Engineering
above expectations

Design

Drafting

Project Estimating

Project Management

RAMP CONSULTING

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Our mission...

At RAMP Consulting we strive to exceed our client's expectations by providing innovative solutions to meet their civil and structural needs.

Who we are...

We are a team of senior civil engineering students from Memorial University with a history of successful group cooperation and academic excellence.

What we do...

- Structural Design / Analysis
- Civil & Earthworks Design
- Project Estimating
- Project Management
- Finite Element Analysis
- Drafting

Outer Cove Bridge Replacement Project

Previous project experience

- Outer Cove Bridge Replacement Project (Outer Cove, NL)
- ScotiaBank (Clarenville, NL)
- Avalon Mall Power Center (St. John's, NL)
- Metrobus Terminal (St. John's, NL)
- Gibraltar Condominiums –Freshwater Road (St. John's, NL)
- Memorial University Parking Structure (St. John's, NL)
- RNC Headquarters Redevelopment (St. John's, NL)
- Irving Oil Refinery (Saint John, NB)
- North Bay Regional Health Centre (North Bay, ON)
- Airport Trail Tunnel (Calgary, AB)
- Mount Royal University Expansions (Calgary, AB)

ScotiaBank (Clarenville, NL)

Bringing innovation to the next level...

...that's the power of RAMP

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JUSTIN ROPSON

JAMIE ANSTEY

SCOTT MacISAAC

BRADLEY PRIOR

A TEAM THAT WORKS...

Justin has experience in a number of industries: with the most significant being in estimating and structural design for oil processing and storage facilities, as well as research and development related to the integrity of electrical transmission systems. His industrial design and field experience, diligent work ethic and team-building attitude make him an asset to any project. Notable past experience includes:

- Preliminary quantity estimating, as well as detailed structural design for an above ground crude oil pipeline.
- Research & development of probabilistic and statistical models to forecast asset deterioration.

Jamie has a range of experience throughout engineering in structural design, estimating , project management, field engineer and drafting. His professional attitude, work experience and technical knowledge provide many benefits to the company and to the client. Notable past experience includes:

- Preliminary design of ScotiaBank in Clarenville, NL, and the Avalon Mall Power Center as well as other structural elements.
- Structural modeling and analysis using S-frame and other design software.
- Field engineer at Outer Cove Bridge Replacement Project.
- Drafting and 3D modeling in AutoCAD.

Scott's strong work ethic, professionalism, integrity and a high standard of excellence have formed the basis for excelling in dynamic environments to accomplish broad and comprehensive goals. Scott has completed work terms in design, project management and construction coordination. Through his work experience, combined with a strong academic background and willingness to learn, Scott would be an asset to any project team. Notable past experience includes:

- Structural design and remediation at the Irving Oil Refinery, Saint John, New Brunswick.
- Project Coordinator for concrete form/place/finish contract at the Airport Trail Tunnel, Calgary, Alberta.

Brad is a senior civil engineering student at Memorial University. Brad boasts nearly two years of project management experience as an owner's representative on major government infrastructure projects such as the RNC Headquarters Redevelopment and Memorial University's Parking Structure. As a former owner's representative, Brad is familiar with managing both design and construction while balancing the project budget and time constraints.

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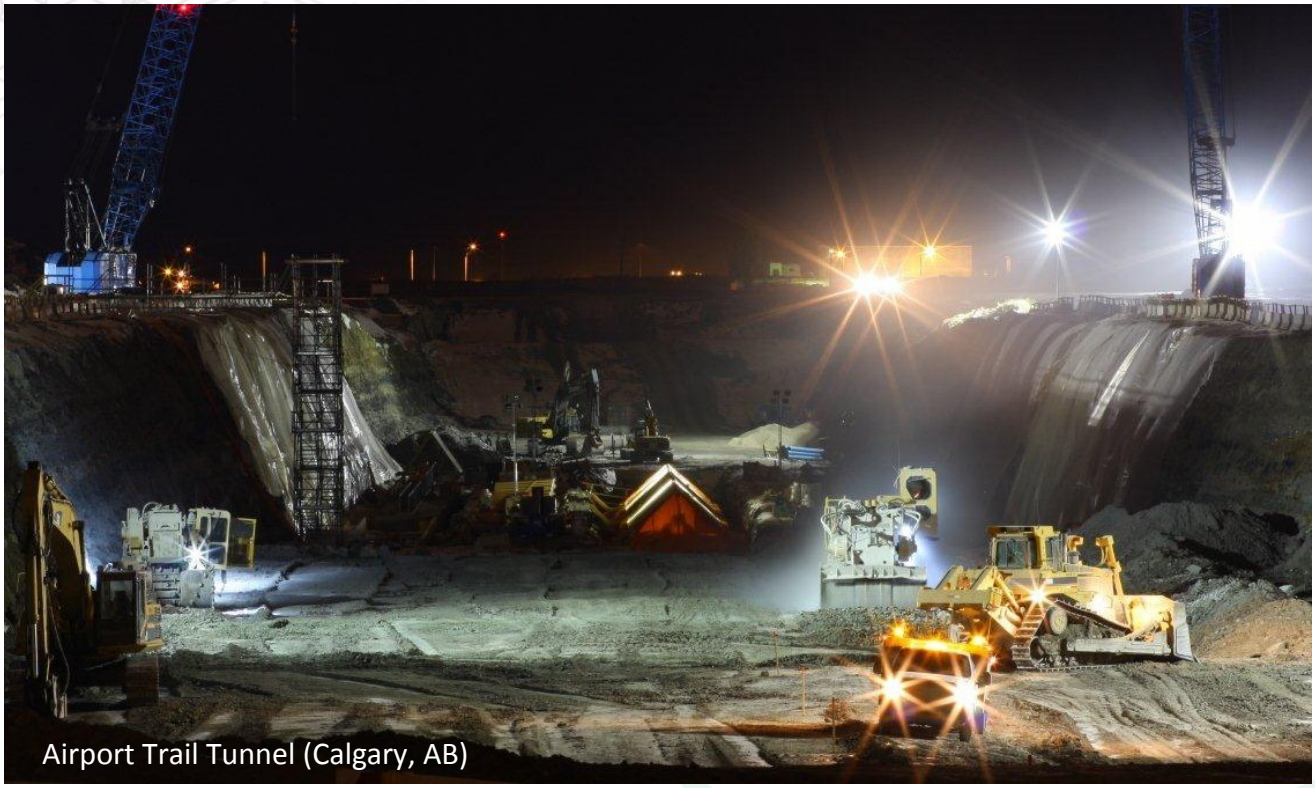

Airport Trail Tunnel (Calgary, AB)

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