WATERLOO
ENGINEERING

Consulting Engineering
Competition Problem

Spring 2014
Waterloo Engineering Competition
July 4-5, 2014

General Rules & Guidelines

1. All communication devices must be turned off.
2. Competitors will be allowed to use:
    a. Computers, USB keys, CDs, pre-existing files etc.
    b. Internet
    c. Reference books

    All other tools must be cleared with the competition coordinator before use. Cell phones, online communication (e.g. MSN, GoogleChat, Skype) or other communication devices are prohibited. **Violation of these rules may result in disqualification.**
3. Visitors are not allowed throughout the development and build stage.
4. You have five (5) hours to create your proposal and accompanying presentation.
5. All deliverables must be submitted to the submission desk prior to the end of the report and research phase. It is the team's responsibility to bring its deliverables from the design area to the submission desk. Teams will receive a penalty for late submissions. If a team is three (3) or more minutes late, the team will be disqualified.
6. Keep work stations clean. Tidy up at the end.
7. If teams are unsure about rules or require further clarification, please ask one of the organisers. Volunteers may be able to assist, but in the event of discrepancies between volunteers and organizers, the organisers' opinion will be followed.

Schedule

Friday, July 4	5:15 p.m. – 5:30 p.m.	Competitor Check-In	E2 1303
	5:30 p.m. – 6:00 p.m.	Welcome/Briefing	E2 1303
	6:00 p.m. – 11:00p.m.	Report and Research Phase	Various assigned classrooms
	11:00p.m. – 11:30p.m.	Submissions/Debriefing	E2 1303
Saturday, July 5	7:30 a.m. – 8:00 a.m.	Competitor Check-In	RCH 3rd-floor lobby
	8:00 a.m. – 10:30 a.m.	Presentations	RCH 306
	10:30 a.m. – 11:00 a.m.*	Announcement of Winners	RCH 306

*Times are approximate and will be confirmed come competition day.

Please arrive promptly according to the schedule.

Volunteers will bring food and drinks around to teams between 9:00 and 10:00 p.m. Each competitor will be given one (1) can of drink. Competitors are encouraged to bring water bottles as bottled water will not be provided. There will be water fountains nearby for refills.
Please remind the competition coordinators and volunteers of your dietary restrictions and/or allergies.

There will be a question period after the problem is presented during the briefing session. No questions will be answered during the development and build stage to ensure fairness in the competition.

BACKGROUND INFORMATION

Tar sands are heavy oil, combined with clay, sand, and water that cannot be pumped out of the ground like conventional oil. Instead, it is extracted using open pit mines or heated and pumped out using in situ technology.

With **surface mining**, the area is first cleared of trees, then the muskeg is drained of water and removed and then the underlying clay, silt and gravel is removed to expose the tar sands deposit. Large shovels excavate the tar sands and load it in giant trucks that transport it to an extraction plant where heat and water separate the bitumen from the sand.

In situ extraction is performed by drilling several wells into the deposit, using steam to heat and separate the bitumen, and then pumping the bitumen to the surface. Most in situ tar sands deposits are 350 to 600 metres below the surface. The two main types of in situ technology are steam assisted gravity drainage (SAGD) and cyclic steam stimulation (CSS).

Keystone XL - TransCanada's proposed Keystone XL would nearly double U.S. imports of tar sands, locking it into a dependence on hard-to-extract oil and generating a massive expansion of the destructive tar sands oil operations in Canada. The proposed pipeline threatens to contaminate freshwater supplies in America's agricultural heartland and increase refinery emissions in already-polluted communities of the U.S. Gulf Coast. Building the pipeline would be the same as building 7 new coal-fired power plants and running them continuously for 50 years. Following widespread opposition to the pipeline in the U.S., the Obama administration announced it would conduct another environmental review of the pipeline expected to be completed in 2013.

Enbridge Northern Gateway - The Enbridge Northern Gateway Pipelines would carry 525,000 barrels of oil per day from the Alberta tar sands to the port of Kitimat on the North Coast of British Columbia. Oil tankers 8 times the size of the Exxon Valdez would carry oil to markets in China and the US. This pipeline and the super tankers would put the salmon streams, forests, whales, bears, coastal ecosystem, and more at risk from oil spills. This pipeline is opposed by over 100 First Nations, many of whom have used ancestral laws to ban oil tanker and tar sands pipelines from their traditional territories. Over 4000 people have signed up to speak at the public hearings in 2012 and 80% of British Columbians would like to see a permanent ban on oil tankers.

Kinder Morgan - Kinder Morgan already has the Trans Mountain pipeline that carries 350,000 barrels per day from the tar sands to Vancouver where it is shipped to US markets. Kinder Morgan is now applying to expand the pipeline to 700,000 barrels per day and to increase oil tankers from 2 to 10 per week. Kinder Morgan is proposing to dredge the waters approaching the terminal in Vancouver to allow larger Suezmax tankers access to the terminal.

Enbridge Trailbreaker - Enbridge wants to reverse the flow of an existing pipeline, Line 9, to carry more tar sands oil into Ontario. This is part of a larger project, originally called Trailbreaker, which would bring tar sands oil into Quebec for the first time. From there, the oil would travel to Portland, Maine and then to the Gulf Coast refineries via oil super-tankers.

As outlined above, it is no surprise that tar sands have emerged as Canada's fastest-growing source of greenhouse gas (GHG) pollution and are also poisoning the water, polluting the air, and destroying the land. Oil companies are aggressively developing the tar sands and are striving to increase production by 150 percent between 2010 and 2035. Some major impacts due to these proposed expansion projects are outlined here.

Climate: The emissions from the development of the tar sands are 2-4 times more greenhouse gas intensive than conventional oil and are the fastest growing source of GHG pollution in Canada. In the last two decades, tar sands emissions have more than doubled and they are predicted to double again by 2020. There are no federal regulations to limit the amount of GHGs from the tar sands, permitting the oil companies to continue to expand production. In fact, the amount of GHGs from the tar sands is growing faster than in any other sector.

Land: The tar sands deposits cover approximately 140,000 square kilometres of Alberta, an area about the size of Florida. The oil is extracted using open pit mines and in situ, or drilling, operations. The mining region covers an area bigger than Greater Vancouver. Tar sands reserves that cannot be accessed through open pit mines are extracted using In situ methods. This technology uses steam, injected into the ground, to thin the oil and it is then pumped out. The open pit mines have removed 686 square kilometers of boreal forest and the in situ sites are threatening wild caribou herd.

Water Contamination: Tailings are the toxic sludge created by the process of mining tar sands. The tailings are kept in large "lakes" created to store the waste indefinitely. Every eight days, the amount of tailings added to the lakes is enough to fill the Toronto Skydome or fill the Washington Monument 320 times. The tailings lakes seep into natural water ways and contaminate the fish and other wildlife, however, the amount of seepage is not public.

Water Use: Mining operations in the tars sands are licensed to use 652 million cubic metres of water each year. This is about 7 times as much as the annual water needs of the Edmonton area. Almost none of that water is returned, threatening ecosystems such as the Athabasca River, which flows into one of the world's largest freshwater deltas. The cumulative impacts of tar sands development on water are largely unknown due to inadequate monitoring.

Air: In addition to greenhouse gases, tar sands operations release large volumes of sulphur dioxide and nitrogen oxides into the environment. In fact, these chemicals are major contributors to acid rain. The Alberta emissions regulations are less stringent then the international standards and even so, they are often exceeded.

PROBLEM STATEMENT

Due to its sheer scale, all Canadians are affected by the tar sands, no matter where they live. The tar sands are the fastest growing source of global warming pollution in Canada. Yet, there is no solid plan for curbing emissions, even though industry has big plans to expand the production of tar sands over the coming decade.

Global warming isn't the only environmental problem made worse by the break-neck expansion of the tar sands. Massive toxic wastelakes, toxic air and water pollution, habitat and species destruction are all legacies of the enormous operations in northern Alberta. Preventing the expansion of the tar sands, and eventually phasing this dirty source of energy out of use, is the only way to reduce our reliance on yesterday's fossil fuel economy and build a responsible and sustainable clean energy future.

For this competition, you will be assuming the roles of consultants hired by Environment Canada to propose a plan to combat the industrial growth of oil sands and provide any alternative strategy or product that is environmentally friendly and economically viable.

Some questions and points to keep in mind while coming up with the solution are outlined below as guidelines. You may incorporate some or all of the points in your solution.

- The extent and strategy behind your solution – can it replace existing processes and industry practices entirely, or does it target specific segments and areas of the problem statement?
- International impact – Is your solution targeted for implementation locally, or is there scope for extending it to other countries with similar issues as well? Does it involve international cooperation in the industry, or can it be isolated and addressed indigenously?
- Feasibility and effectiveness – How hard is it to implement your solution, how long will it take for positive effects to be seen, what are potential side effects, is it a temporary fix or a permanent alternative, has it already been tried before but didn't work out etc.
- Economic viability – Cost of implementation and factors to consider for large scale use, technology and knowledge needed, effect on the local communities etc.

DELIVERABLES

At the end of the report and research phase, each team is required to submit the following items:

1. A PowerPoint or PDF presentation
2. A proposal detailing the designed solution

PRESENTATIONS

Teams will create and present a 15-20 minute presentation for a panel of judges. Order of the presentation and the rooms in which teams present will be determined randomly, and will be announced 30 minutes prior to the presentation start time. Teams will be permitted 5 minutes following the presentation in which judges and the general audience may ask questions. Parts of the presentation should be shared equally between the team members to score full points.

The first place team will represent the University of Waterloo 'B' at the next Ontario Engineering Competition. In the event that the first place team is unable to attend, the second place team shall take their place.

REFERENCES

- http://www.pembina.org/oil-sands
- http://environmentaldefence.ca/issues/tar-sands
- http://mapleleafweb.com/features/alberta-s-oil-sands-key-issues-and-impacts
- http://desmog.ca/2014/03/25/bill-4-passes-b-c-parks-now-officially-open-pipelines-and-drilling
- http://www.canadiangeographic.ca/magazine/jun08/feature_tar_sands.asp
- http://www.theglobeandmail.com/news/national/environmental-health-risks-of-alberta-oilsands-probably-underestimated-study/article16667569/

MARKING SCHEME

The marking scheme is divided in to three parts. The first deals with the overall quality and feasibility of the solution, and the second and third parts deal with the quality of the report and presentation.

Solution	**50%**
Environmental, Social and Economic Analysis (Short & Long Term)	20%
Structured Engineering Approach & Methodology	10%
Economic & Environmental Impact	10%
Feasibility & Originality of Proposal	10%
Report	**25%**
Comprehensiveness	10%
Stating Assumptions	5%
References/Sources	5%
Presentation/Format	5%
Presentation	**25%**
Presentation Quality	10%
Speaker Quality	5%
Complements the Report	5%
Responses to Questions	5%
Penalty: underuse of time	*-5%*
Penalty: overuse of time	*-5%*