Pilot project on RDX treatability in a tributary of Small Pines river, 2 CDSB Valcartier (Quebec)

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National Workshop on Federal Contaminated sites
April 2014
Overview

1) Introduction: Valcartier and general overview of RDX;
2) Searching for solutions;
3) Construction;
4) Problems encountered and required changes;
5) Monitoring and follow-up actions;
6) Questions?
Valcartier Support Base

- 30 km up in the Northwest part of Quebec city;
- Area of 220 km$^2$;
- Use of the Range and Training Areas;
- Pines river/St-Joseph Lake;
Energetic materials (RDX)

- Used in training and in combat;
- Often found in compounds. Here are some examples:

<table>
<thead>
<tr>
<th>Military Names (Compounds)</th>
<th>Uses</th>
<th>Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp B</td>
<td>Artillery, mortar, grenade</td>
<td>60% RDX 40% TNT</td>
</tr>
<tr>
<td>C-4</td>
<td>Demolition</td>
<td>91% RDX (+ 9% wax)</td>
</tr>
<tr>
<td>Octol</td>
<td>Anti-tank shells</td>
<td>70 % HMX (10% RDX) 30% TNT</td>
</tr>
</tbody>
</table>

- RDX (Hexahydro-1,3,5-trinitro- 1,3,5-triazine): mostly used for shells and high explosive rounds (synonyms: cyclonite, hexogen, ...);

- Main sources of contaminant;

- Physical, chemical and toxicological properties of RDX:
  - Moderately soluble;
  - Possibly carcinogenic (US EPA);
  - Low natural biodegradation.
General overview of RDX

Sampling work

• Sampling of source zones, within DND’s territory and downstream, at receptors.
  - RDX analysis (low limit): detection limit at 0.03g/L;
  - Sampling at different periods during the year (spring, lowest water level, heavy rain episode, fall).

Managing criteria

• MDDEFP’s Quality criteria for surface water:
  (Contamination prevention - water and aquatic life): 0.3 µg/L;

  → Target considered to allow protection of the drinking water resource.

Other reference values

<table>
<thead>
<tr>
<th></th>
<th>MDDEFP</th>
<th>DRSP (Qbc)</th>
<th>Health Canada</th>
<th>US EPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic life</td>
<td>42 µg/L</td>
<td>3 µg/L</td>
<td>9 µg/L</td>
<td>2 µg/L</td>
</tr>
</tbody>
</table>
Monitoring RDX (general observations)

- Surface water problematic;
- Most significant [ ] have been measured in spring;
- Liri impact area: significant source;
- Risk of impact on receptors.

<0.03 µg/L to 0.835 µg/L

0.48 µg/L to 2.48 µg/L

Lac St-Joseph

Drinking water intake

Monitoring RDX (general observations)

- Surface water problematic;
- Most significant [ ] have been measured in spring;
- Liri impact area: significant source;
- Risk of impact on receptors.
Liri impact area

- Area of 8.4 km$^2$
- Topography;
- Geology;
- Hydrography;
- Usage.
Searching for solutions

- **Design and implementation of a solution to RDX**: 
  - **Considerations:**
    - Restricted access (security and site usage);
    - No electricity;
    - Simple and fast to build;
    - Low installation and repair costs (demolition risk);
    - Treatment efficiency.

- **Preliminary steps:**
  - Implementing contracts (Biogénie SRDC inc, Englobe corp. division);
  - Concept study: Filter basin on peatbog, filter marsh and filtration on tributaries (chosen concept);
  - Laboratory study: Filtration tests with carbon in columns;
  - Selecting a definitive site (RP-20);
  - Drawing and specifications.
Selected location

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- Tributary of Small Pines river (low flow rate);
- [ ] and ↑ load;
- Accessible by vehicles;
- Site configuration (ex. landscape, vegetation, etc.)

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- Geographic location (in the middle of the impact area);
- Limited access → training;
- Unexploded explosive ordnances (UXO);
- Risk of damage.
Design

Design description:
Three (3) main components:

1) Sediment pool (total of 3);
2) Screening devices;
3) Filtering dam.

Design criterias...Here are some examples:

1) Flow rate: maximal annual flow of 0.12 m^3/s;
2) [ ] and RDX load: maximal theoretical [ ] of 10 µg/L;
3) Carbon filtering capacity;
4) Efficiency vs hydraulic conductivity: mix of 2 carbon types.
5) Etc...
Design details
Design details (continued)
Construction

Preliminary work:
• Environmental assessment (EA);
• DFO approval;
• Coordination with RTAs;
• Implementing contracts (construction/Biogénie ; UXOs/GEMTECH);
• DCC technical support with UXOs;
• Land surveying;
• Vegetation removal;
• Bypass channel.

Construction (august/september 2013):
• 21 days of access window - 14 days required;
• Use of “low tech” materials (ex. geomembrane, riprap, etc.)

Commissioning – september 4th 2013
Run-in period

- **Initial performance (September 2013)**
  - *64% Efficiency*: 5.4 µg/L upstream and 2.0 µg/L downstream.

- **Fall 2013**
  - ↑ of upstream water level caused by a loss of hydraulic conductivity (fine sediments);
  - Design allows an overflow above the filter, when the maximum operating flows are exceeded or in case of clogging.
Modifications required

Problem analysis and investigation:

• Management of sediments:
  - Carbon sampling (% saturation) → RDX removal rate of 96%.

• Solution: Installation of a 2 inches PVC screen wall:
  - Allows the diversion or the sedimentation of fine sediments without restricting the flow.

Modifications (November 2013):

• Implementation of a contract (Biogénie);
• Coordination with RTAs authorities;
• EOD work on an access road by the 5 CER;
• Modifications with a very short window of access.
Modifications required
Modifications required (continued)
Monitoring –post modifications

• Sampling post-modifications (november 25th 2013):
  - Efficiency of 75% : 5,7µg/L upstream and 1,4 µg/L downstream.

• No intervention or visit possible before spring 2014! SECURITY!!!

• Spring 2014 (to be continued...):
  - Monitoring of the RDX concentration levels;
  - Follow-up on the work condition and efficiency during spring melt;
  - Maintenance, modifications and repairs (if needed).
Next actions

• The mass balance indicates that higher reduction in RDX mass throughout Valcartier is required to ensure the receptors protection.

• R&D is ongoing, but no solution to reduce RDX “at the source” is actually available.

• Following the first system performance analysis:
  - Design and construction of a second filtration device in 2014;
  - Support from an Engineering military unit (5 CER) for construction;
  - Monitoring the other contributor, and potentially contributor sites...
Questions????