

Characterization and Remediation of Lac-Mégantic



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Acknowledgements ...

This project is the result of close collaboration between various stakeholders involved in clean-up and reconstruction operations. Without this invaluable collaboration in which everybody made an undeniable contribution to the work progress, the goal of securing the site before the onset of winter could never have been achieved. In particular, Golder would like to recognize the contribution of the following entities:

- City of Lac-Mégantic
- MDDEFP's "Urgence Environnement" team
- MDDEFP's regional directorate of Montérégie and other directorates involved in the project
- Ministry of Public Security (MSP)
- Ministry of Municipal Affairs, Regions and Land Occupancy (MAMROT)
- POMERLEAU
- All contractors, suppliers, and collaborators who contributed directly or indirectly to the works.



Presentation Summary

- Context and site description
- Conceptual model of site
- Site securing activities in the first few weeks
- Characterization of soil and groundwater
- Characterization of buildings
- Characterization of biological and aquatic environment of Chaudière River and Lake Mégantic
- Overview of remediation works undertaken in Lac-Mégantic in 2013
- Runoff and oily water control strategy
- Question and answer session, discussion.





Derailment

- On the night of July 6, 2013, a train operated by Montreal, Maine & Atlantic ("MMA") derailed in the heart of downtown Lac-Mégantic.
- Sixty-three (63) wagons derailed and piled one on top of the other, causing a major spillage of crude oil, a series of explosions and a fire that destroyed part of downtown.
- This catastrophic accident claimed 47 lives, destroyed some 40 buildings and infrastructure in downtown Lac-Mégantic and caused damage over 500 m from the zone of impact.





Context

- Oil spill of 6,000,000 litres on July 6, 2013:
 - Most of the oil was consumed by the fire.
 - A portion of the oil was released into Lake Mégantic and the Chaudière River.
 - A few hundred thousand litres of oil seeped into the ground and/or the municipal sewer system.

Oil transported by rail		7,679,000 litres
Oil not spilled or recovered	Oil from 9 wagons that retained all of their content	961,000 litres
	Oil contained in the other wagons that could be transloaded and recovered	740,000 litres
Oil burned or released into the environment	Oil burned or released into the environment	5,978,000 litres
	Estimate of amount of oil that reached the Chaudière River	100,000 litres
Oily water recovered	Oily water recovered in the Chaudière River	52,000 litres
	Oily water recovered in Lac-Mégantic (sewer system, lake and land)	46,678,000 litres

(Source: MDDEFP, 2014, <http://www.mddefp.gouv.qc.ca/lac-megantic/20131127-ableau-synthese-petrole.pdf>)



Site Description

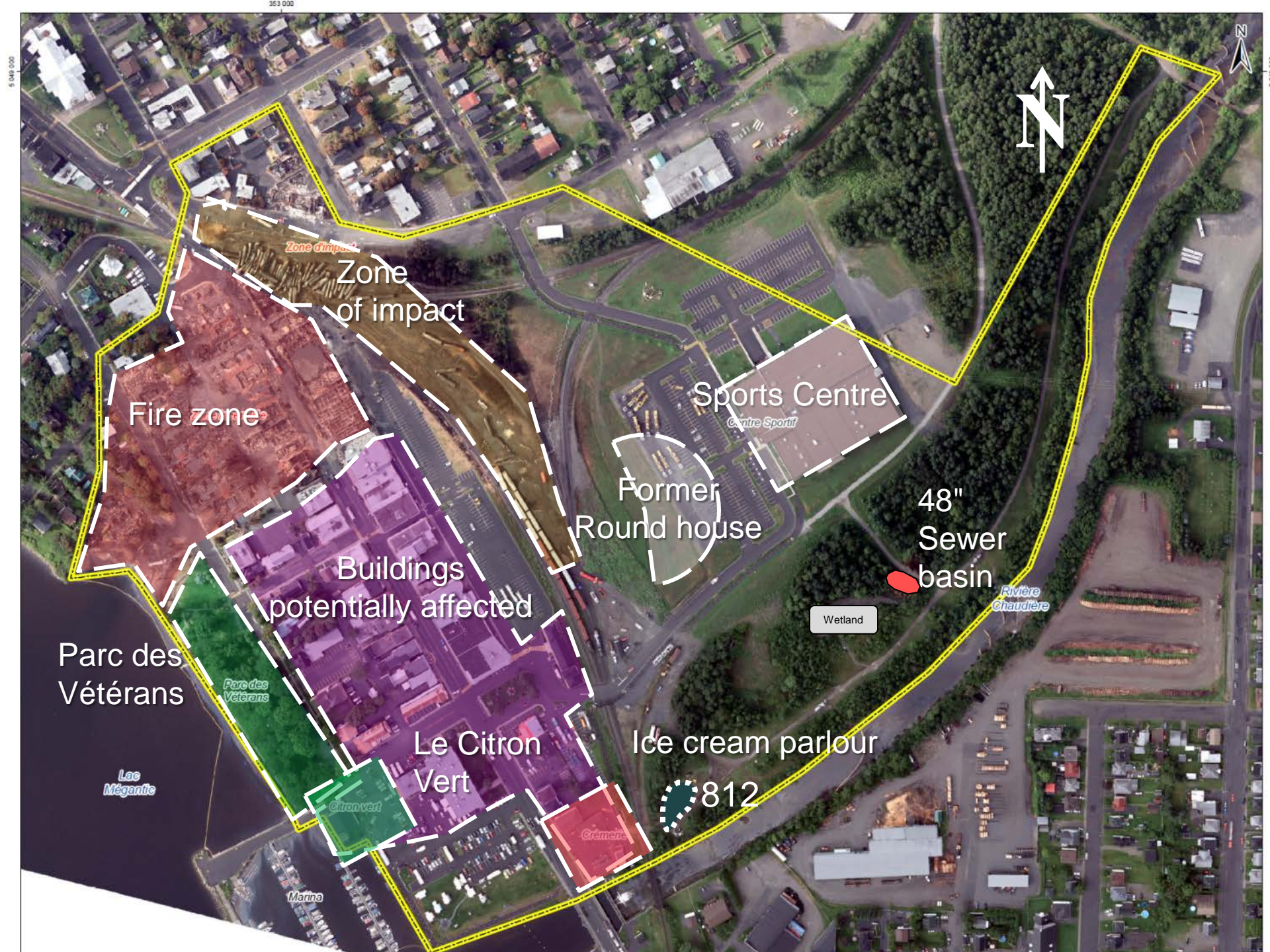
Zone
of impact

Fire
zone

Buildings
potentially
affected



Source: Pomerleau Date: July 8, 2013



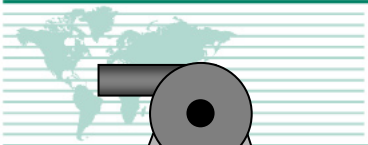


Role and Mandate of Golder Associates

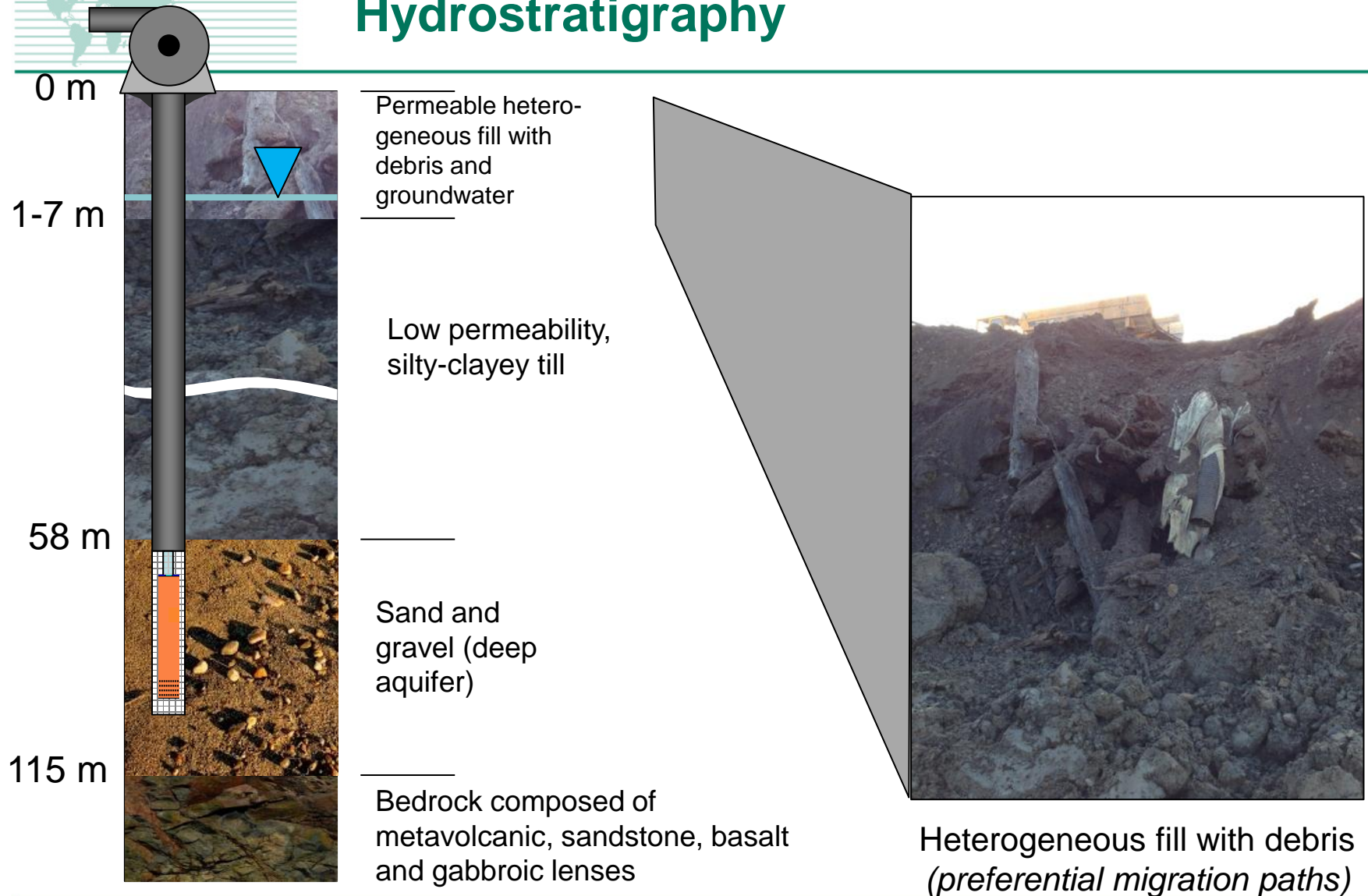
- On July 7, Golder was contracted by MMA as environmental consultant responsible for performing all remediation work in the City of Lac-Mégantic as well as supporting work on water bodies.
- Following authorization for bankruptcy protection of MMA on August 8, 2013, Golder's contract was renewed by POMERLEAU, the manager of clean-up and decontamination works on behalf of the Government of Quebec.



Source: Pomerleau Date: July 8, 2013

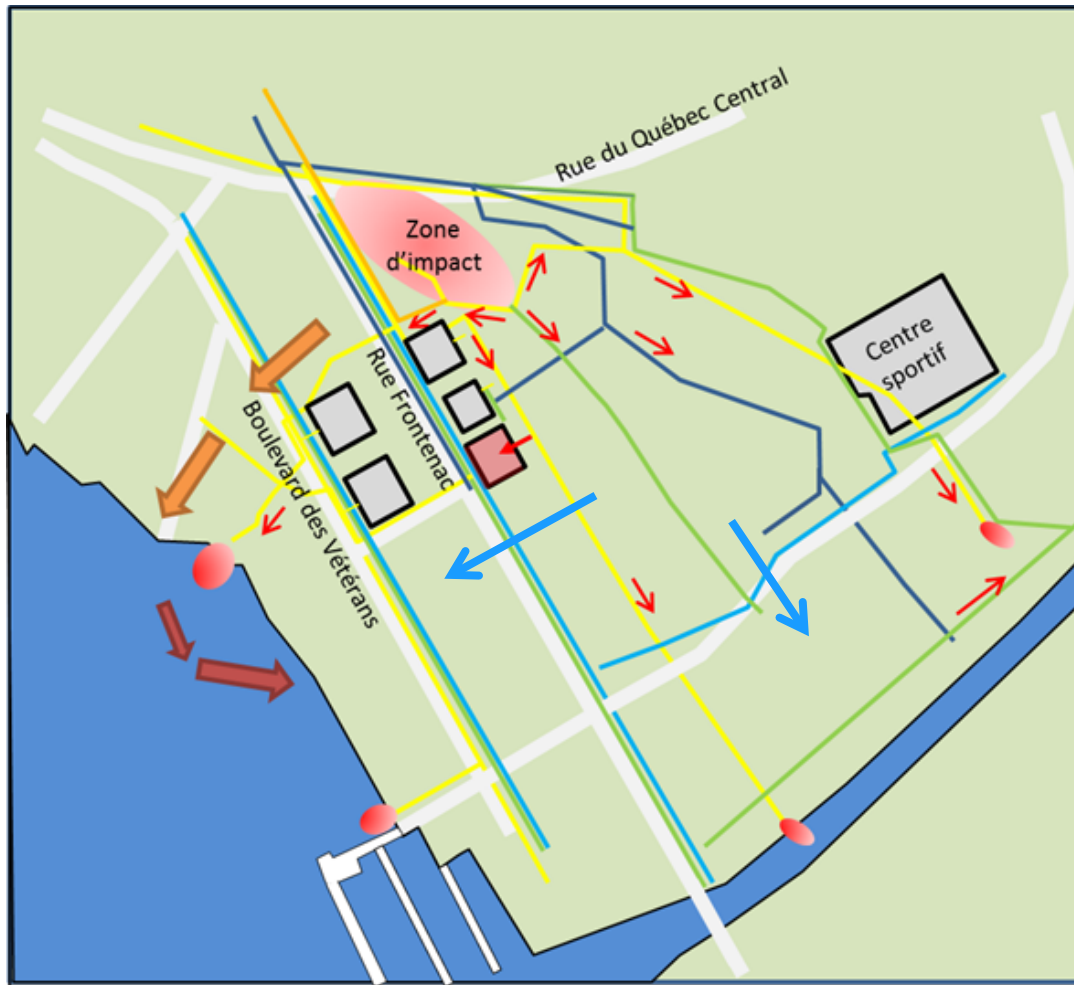


Hydrostratigraphy





Conceptual Model of On-site Contamination Dispersion



- Surface flow of inflamed oil
- Inflamed oil pushed by wind along the riprapped shore
- Hot oil flowing in the sewers or along their granular envelope
- Spill of oil on water bodies via the sewers and other conduits
- Stormwater sewer
- Sanitary sewer
- Aqueduc
- Abandoned underground pipe
- Direction of groundwater flow



Conceptual Model of On-site Contamination Dispersion

1 to 2 m in the zone of impact



Fill

Low permeability silt

Accumulation of water and free oil

Migration of oil through pipes and their granular envelope





Conceptual Model of On-site Contamination Dispersion



Contamination of fill under buildings and their immediate vicinity





Site Securing Activities in *First Few Weeks*

OBJECTIVE: Prevent the spread of contamination via preferential paths into watercourses

- Plug and re-route sewer lines
- Implement air quality monitoring
- Construct vents on manholes
- Construct temporary ponds at sewer outlets
- Construct numerous trenches to intercept oil having infiltrated the water table and pump out oily water





Site Securing Activities in *First Few Weeks* (*cont'd.*)



Redundant pond for sewage water
Source: MDDEFP



Vapour monitoring of sewer lines
Source: MDDEFP



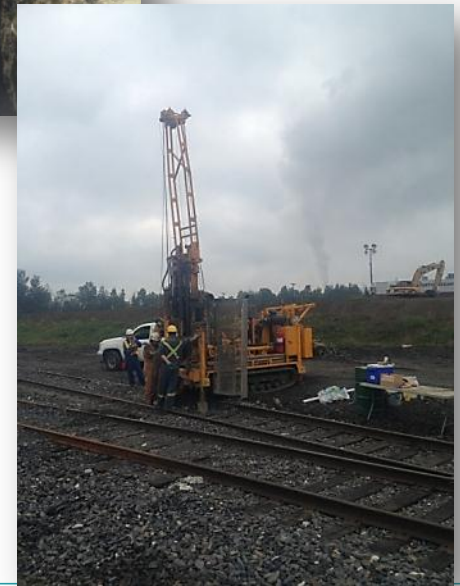
Booms on water bodies
Source: MDDEFP

- Installation of bentonite or clay plugs at strategic locations along underground infrastructures
- Installation of recovery wells in sewer fill (hydrovacs)
- Interventions on Lake Mégantic and the Chaudière River.



Summary of Characterization Work

- Environmental characterization work performed between July 10 and October 28, 2013:
 - Soil: 320 trenches and 116 boreholes
 - Groundwater: 84 monitoring wells
 - Surface water: watercourses and temporary basins
 - Over 1,200 soil samples and 125 groundwater samples sent to lab for chemical analysis
 - Daily monitoring of water and material levels at control points
 - Chemical characterization of spilled material
 - Characterization of buildings
 - Characterization of biological and aquatic environment.



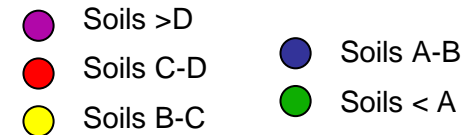


Presumed Enclaves of Impacted Soil (as of October 28, 2013)

Zone of impact

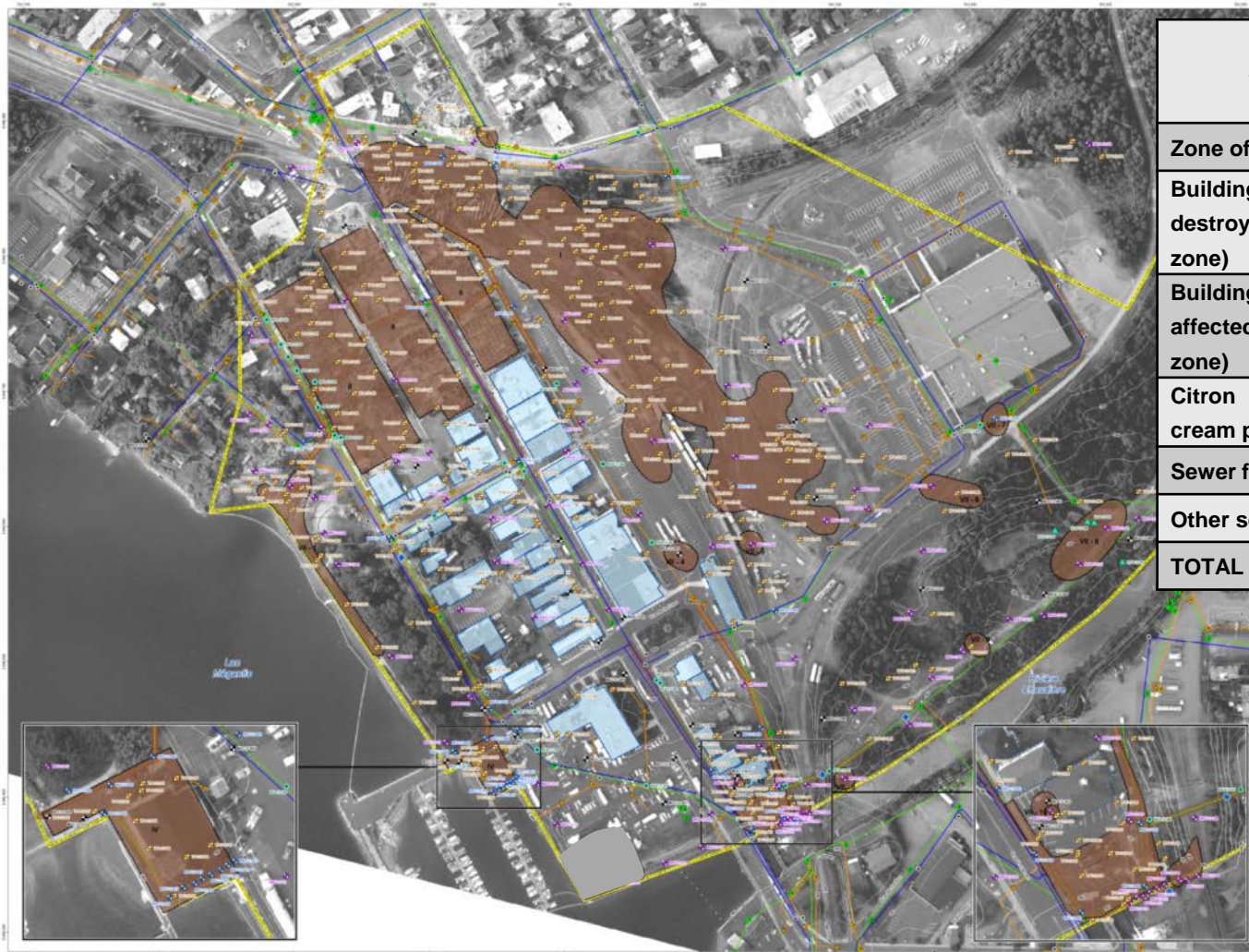
The majority of contaminated soil was found in fill material.

Contaminated volumes > B (limit for residential use) estimated at 69,000 m³.





Summary of Volumes of Impacted Soils > B as of October 28, 2013



Sector	Approximate contaminated volume (as of October 28, 2013)
Zone of impact	69,000 m ³
Building foundations destroyed (within fire zone)	12,000 m ³ to 22,000 m ³
Building foundations affected (outside fire zone)	2,900 m ³
Citron Vert and ice cream parlour zone	4,500 m ³ to 6,100 m ³
Sewer fill	4,300 m ³
Other sectors	10,400 m ³ to 22,000 m ³
TOTAL	103,100 m³ to 126,300 m³



Characterization of Buildings

- Objective: evaluate the environmental condition of soils under the slab and around 39 buildings in the zone affected by the derailment.
- Work performed:
 - Outside trenches around drains or foundation walls of each building
 - Perforations and test drilling under the slab (gas measurements and soil samples).



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Characterization of Buildings

- Assessments were also carried out to evaluate:
 - Structural conditions
 - Management options for contaminated soil under buildings (excavation with shoring, demolition or temporary relocation, on-site treatment)
 - Market value and replacement cost of buildings.

Overall results: some buildings affected by the spill





Biological Characterization of Aquatic Environment of Chaudière R. and Lake Mégantic

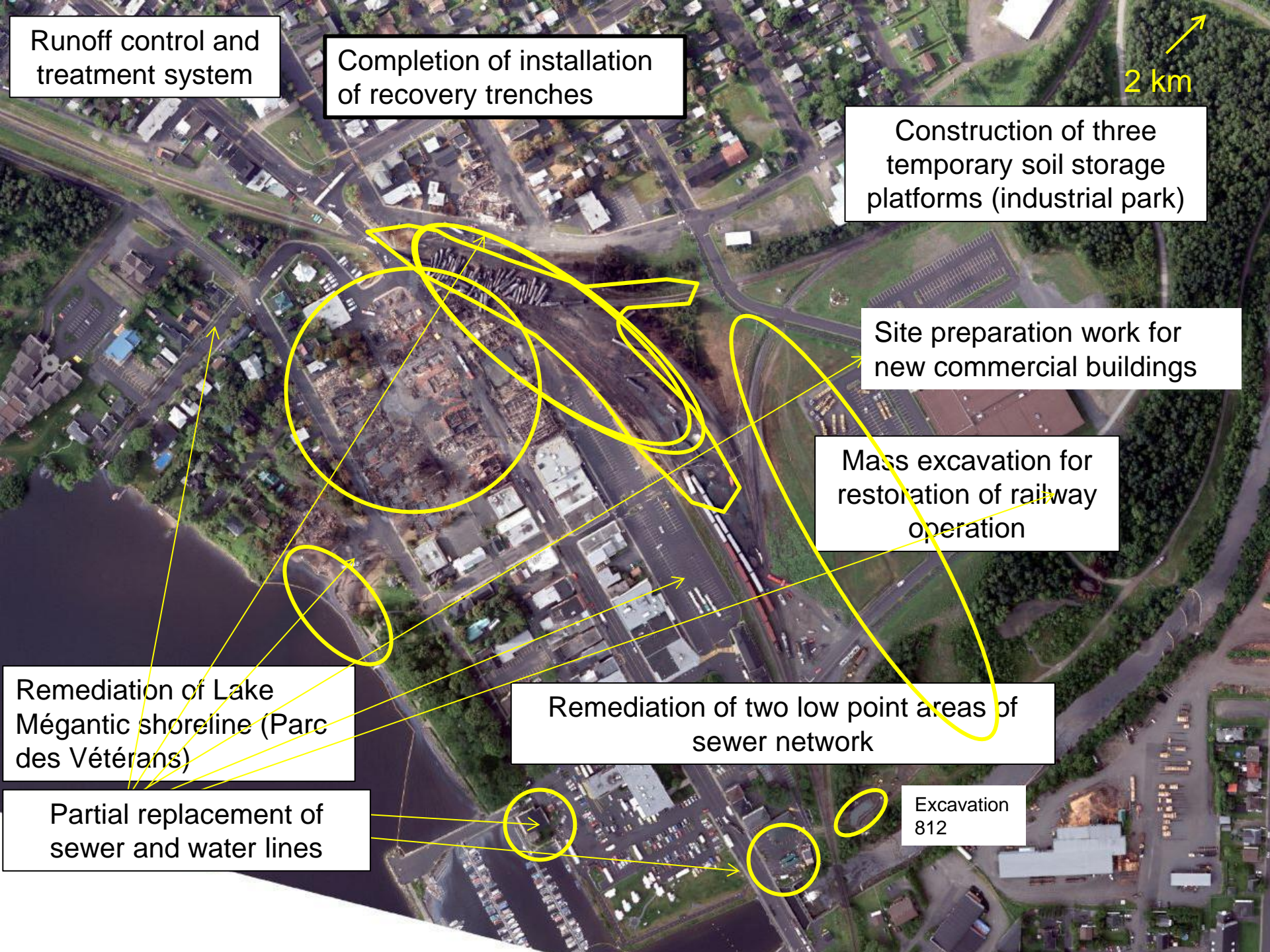
- Surface water quality:
 - 5 sampling stations on the river, 2 on the lake
 - Each station visited 25-30 times
 - 185 samples taken and analyzed
- Sediment quality:
 - Visual inspections (3 per km for first 40 km and 3 every 2 km thereafter)
 - 92 sampling stations on the river (1 per km), 2 on the lake
 - 94 samples analyzed
- Health of fish communities
 - Electro-, gillnet and fyke net fishing (July)
 - Observation of individuals with visual signs of impact and collection of flesh and liver samples
- Fish and bird mortality
 - Observation and collection of dead fish in the booms
 - Collection of affected/dead birds in the first days following the spill





Remediation Activities Undertaken in 2013





Runoff control and treatment system

Completion of installation of recovery trenches

Construction of three temporary soil storage platforms (industrial park)

Site preparation work for new commercial buildings

Mass excavation for restoration of railway operation

Remediation of two low point areas of sewer network

Excavation 812

2 km

Remediation of Lake Mégantic shoreline (Parc des Vétérans)

Partial replacement of sewer and water lines



Completion of Installation of Recovery Trenches

- Over 1,100 linear metres of recovery trenches dug





Sewer and Water System Replacement Plan

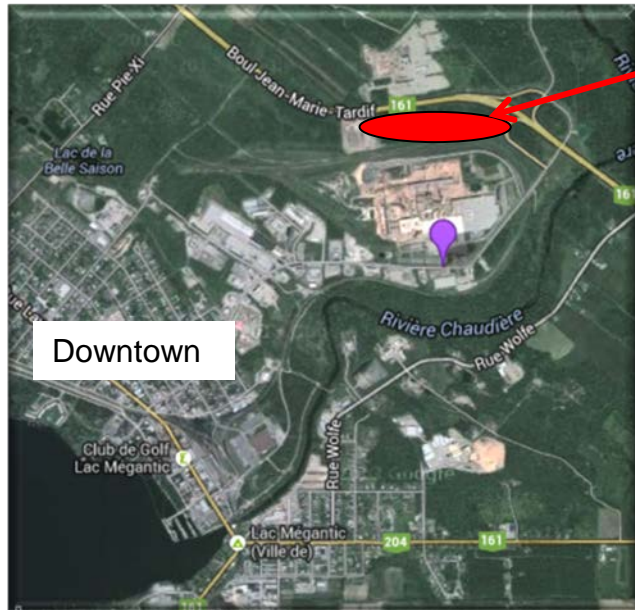
- Assessment of sewer network conditions via video inspections
- Sewer management plan
- Replacement of sewer and water infrastructure deemed priority / contaminated
- Other sewers temporarily isolated to avoid contamination



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Construction of Three Temporary Storage Platforms for Soil Treatment



3 platforms 2 km from downtown, each with an approximate capacity of 30,000 m³



All three platforms are now filled.



Mass Excavation for Railway Track Reconstruction

- Mass excavation of contaminated soil along railways scheduled to be returned to service in December 2013.
- Most significant volume of contaminated soils excavated.





Mass Excavation for Railway Track Reconstruction

A logistic challenge!

- Up to 48 Golder employees on site at a time
- 24 field technicians sampling excavations, boreholes, and other control points
- Team of 6 to 8 professionals present daily on site for data management (GIS, CADD and EQuIS)
- Samples analyzed every night and results ready at 6 a.m. the following morning to determine game plan for that day
- Secure collaboration workspace for sharing of data in real time throughout the works





Mass Excavation for Railway Track Reconstruction

Significant debris to manage





Remediation of Lac-Mégantic Shoreline at Parc des Vétérans and along the Fire Zone

- During the fire, part of the oil floating on Lake Mégantic was pushed by strong winds toward the eastern shore of the lake.



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Decontamination of Low Points: Ice Cream Parlour and Le Citron Vert





Le Citron Vert: Pumping of Free Product (pre-excavation)





Remediation around Le Citron Vert Restaurant



View from Le Citron Vert restaurant



Installation of sheet piling



Demolition of Le Citron Vert





Remediation of Ice Cream Parlour Sector



Major challenge of this remediation: work area besides a bridge and a major dam controlling the outflow of Lake Mégantic and the Chaudière River.





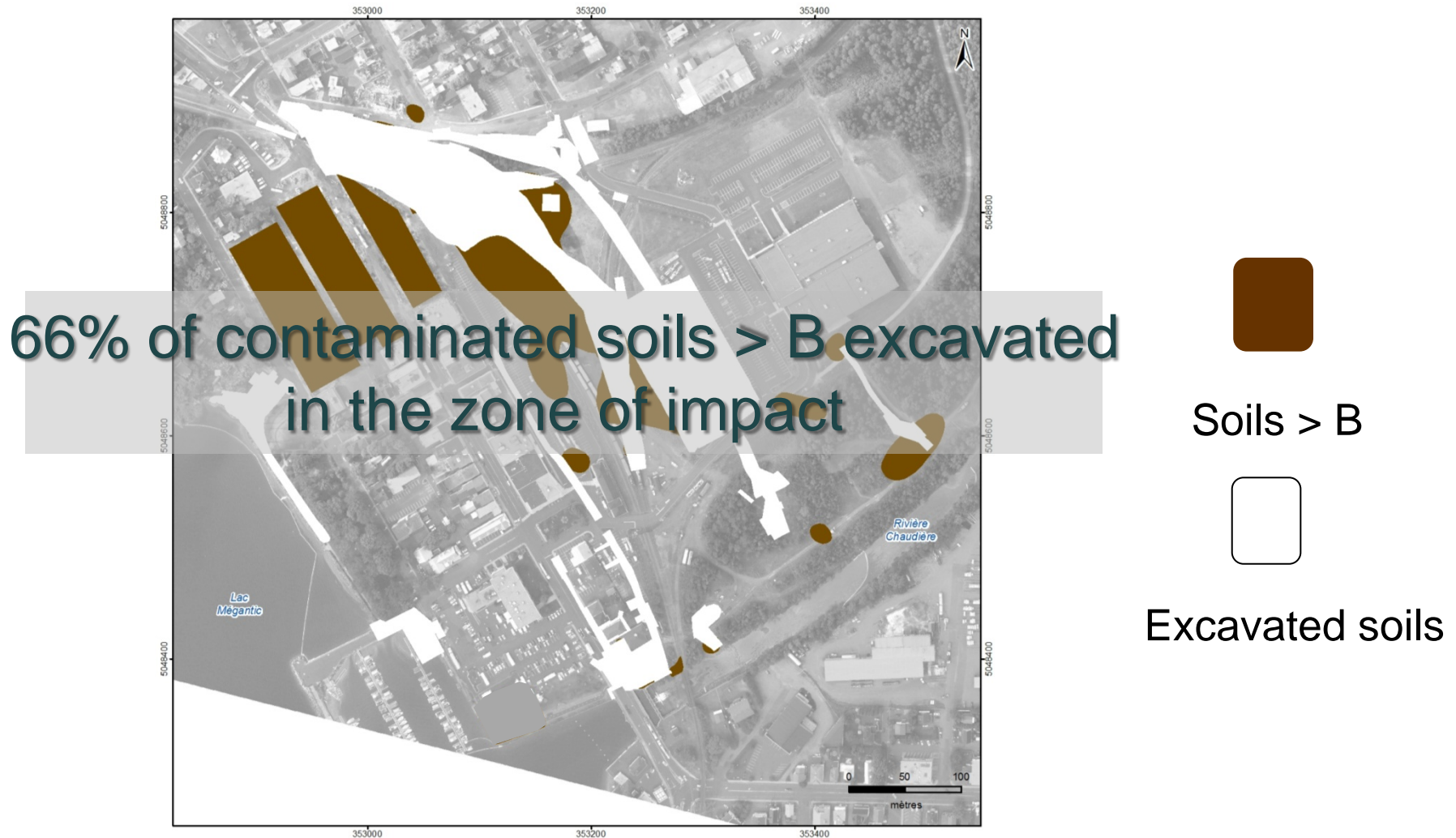
Data Management

- All boreholes, trenches, excavations, etc. were georeferenced by systematic surveying
- EQulS database
 - Results received from the lab immediately entered into EQulS database
 - Production of results in tabular format using EQulS
- Connection to EQulS database to extract analytical data and map the results
- Mapping using geographic information systems (GIS)





Summary of Enclaves of Contaminated and Excavated Soil (remediation work)





Estimated Volume of Soils on Site > B Excavated as per December 19, 2013

Sector	Estimated volume of soils on site >B [m ³]	Volume > B excavated as per December 19, 2013 [m ³]*	Percentage of soils > B excavated
Zone of impact	69,000	45,800	66%
Other sectors within area of intervention	34,100 to 57,300	13,300	23% to 39%
TOTAL estimated	103,100 to 126,300	59,100	47% to 57%
New buildings and new Papineau Street	0	5800 m ³	N/A

* Equivalent volume on site (bulked volume / 1.2)



Runoff Control Strategy

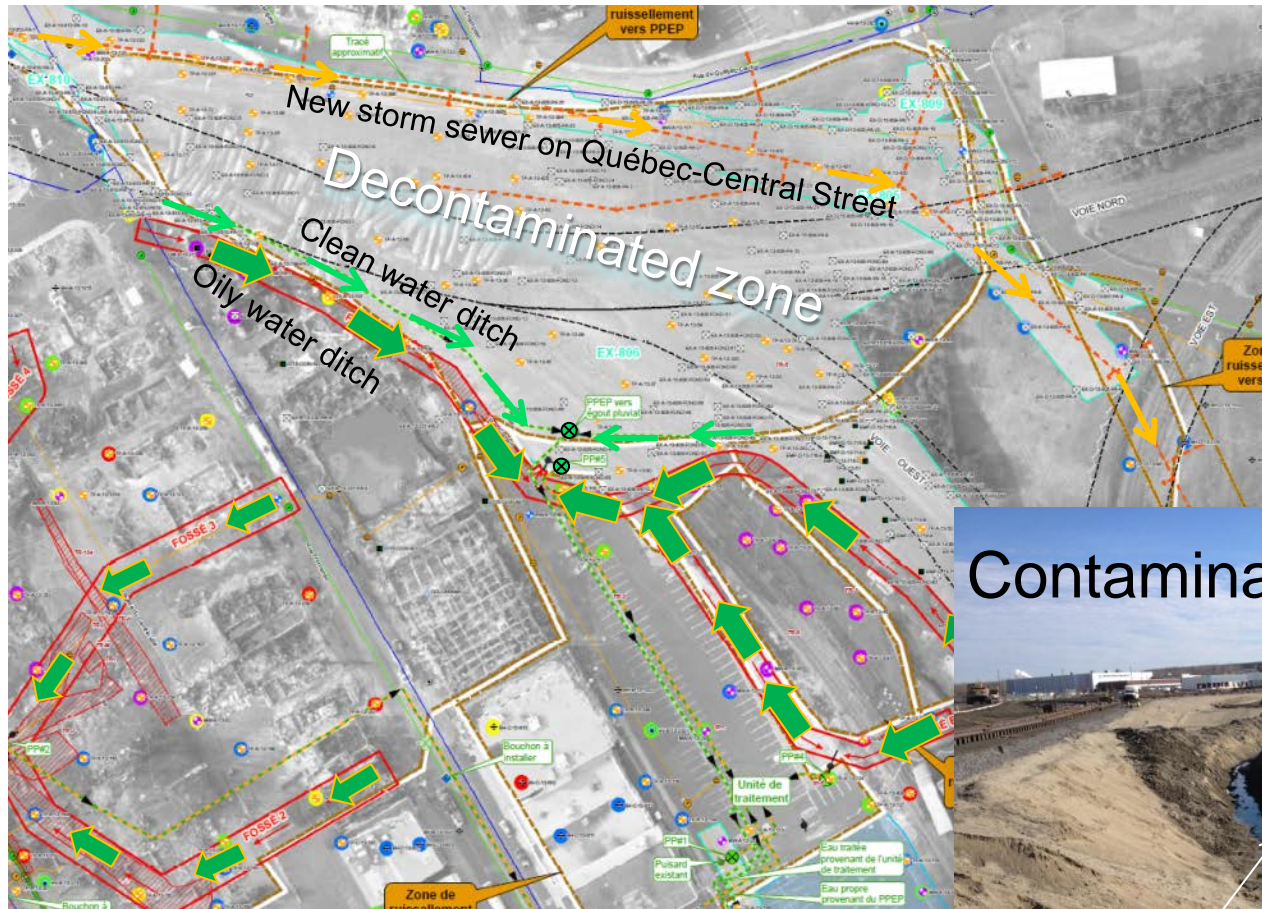
■ Objectives:

- 1) Control the migration of surface runoff and groundwater downstream of contaminated soil to avoid recontaminating the newly installed sewer lines and the fill around them;
- 2) Avoid recontaminating clean fill;
- 3) Collect oily water in trenches for treatment.





Runoff and Oily Water Control Strategy – Decontaminated Zone





Runoff and Oily Water Control Strategy



Installation of oil water collector pipes at foundation level of certain buildings.



Construction of a 3,400 m³ retention pond with treatment facility.

Aerial photo: Robert Mercier



Overview of Activities Involving Golder in 2013

- City of Lac-Mégantic sector secured
- Sector of intervention and buildings characterized
- Runoff management plan implemented and operational
- Railways reconstructed
- Significant quantity of contaminated soil excavated and loaded onto treatment platforms
- Residues transferred to MDDEFP-authorized disposal sites
- Land prepared for new Papineau Street, sewer lines, and commercial buildings
- Base of access to new bridge on Papineau Street initiated
- Certain sewer lines replaced (the most urgent)
- Contribution to river characterization work



Golder Associés Ltée has been recognized by the Association des ingénieurs-conseils du Québec (association of consulting engineers of Québec) during their Grands Prix du génie-conseil québécois and declared the winner in the Environment category for this project with a special mention for its collaborative and inclusive approach.





Thank you - Questions?

