CH2MHILL®

Incorporating Sustainability into Site Closure – A Field Example

Leanne Murdie Austrins

Outline

- Defining Sustainability and Sustainability Goals
- Phased Remediation Planning Model
- Sustainable Soil Management
  - *Insitu*
  - *Exsitu*
- Sustainable Water Management
  - Surface Water Management
  - Groundwater Management
- Results against Goals
- Final Site Condition

Sustainability Goals



- A remedy or a combination of remedies whose net benefit on human health and the environment is maximized through the judicious use of limited resources

Key elements for Remediation:

- Energy Intensity Reduction
- Community Acceptance;
- Environmental Protection

Site Overview



- Chemical production plant in operation for over 70 years was closed
- Site complicated by age of contamination, native glacial clay till with fractures, and permeable utility corridors
- 322 acres of property prepared for property transfer through a combination of *insitu* and *exsitu* remediation and legal negotiations
- Volatile Organics Compounds present in the subsurface for over 60 years in some locations.

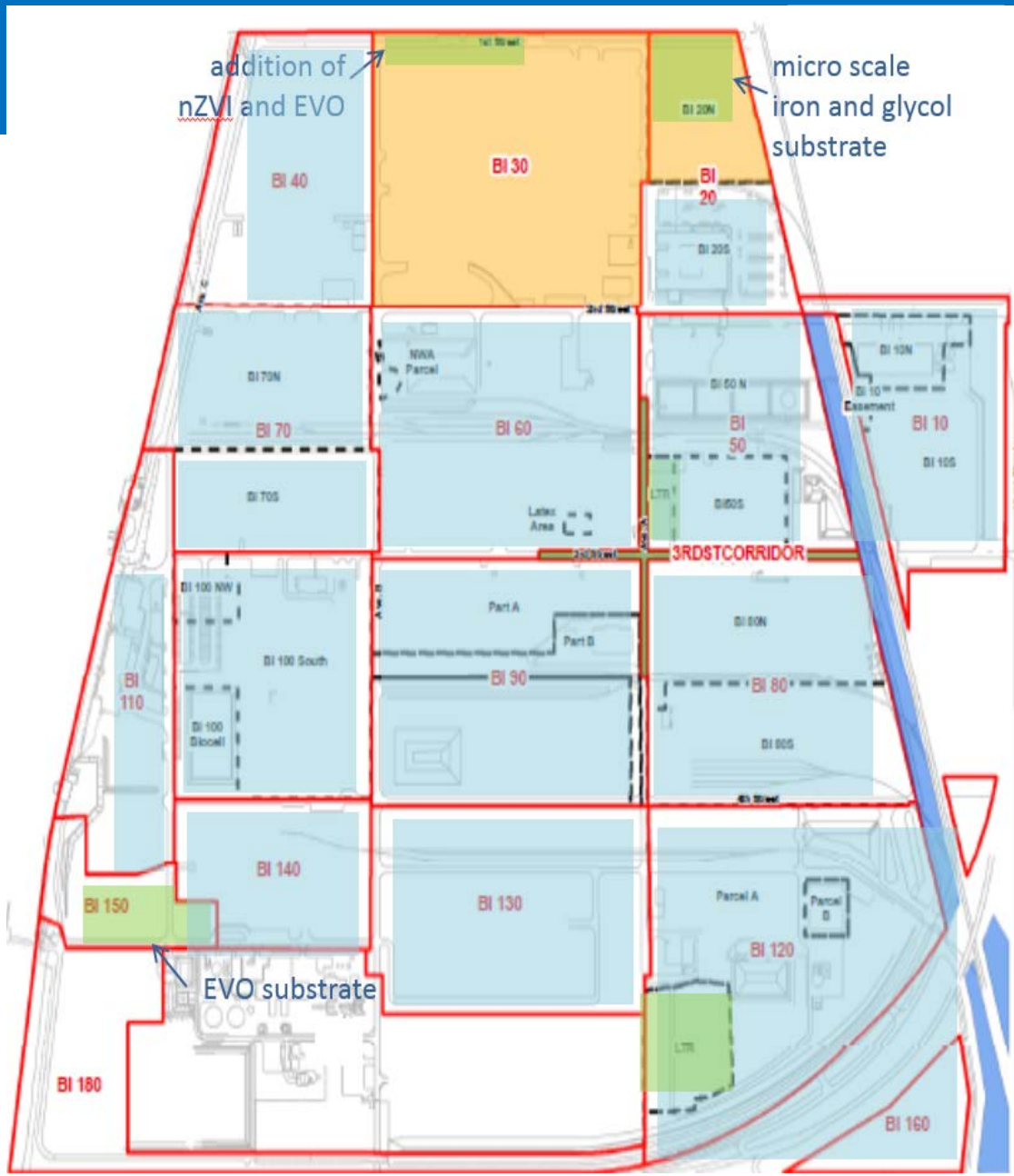
Remedy Selection Process



- Flow Chart Developed for Decision Making
  - CVOC Contaminated Soil to be Remediated:
    - DNAPL, >TCLP criteria, or posing risk to surface water
  - Treat in Soil Treatment Area (STA)
    - CVOCs > TCLP
  - Treat In Situ with Fracture and Injection
    - Volume too large to treat in STA (>10,000 cys)
    - Soil cannot be excavated (below building, below piping)
    - Longer timeframe available

Sustainable Soil Management

Where *Insitu* and *Exsitu* Remediation were Applied



Design of *ExSitu* Remedial Strategy



- Premise - SOIL IS NOT A WASTE
- Reach target concentrations in 5 – 7 years
- Must be cost effective based on volume of soil to be treated (60,000 cubic yards)
- Selected amendment must be able to treat near saturation CVOC soil concentrations to <TCLP criteria
  - ex 1,2 DCA from 20 mg/kg to 500 mg/kg (0.5 mg/l TCLP, 20x rule = 10 mg/kg)
- Anaerobic Reductive Dechlorination in Soil Treatment Area (STA)
- Mix Ratio: 3 Soil/ 0.5 manure/ 0.5 wood chips
- Mixing machinery must be able to adequately mix low permeability clay soils and the treatment amendments

Exsitu Remediation – STA

Exsitu Remediation – STA

Exsitu Remediation

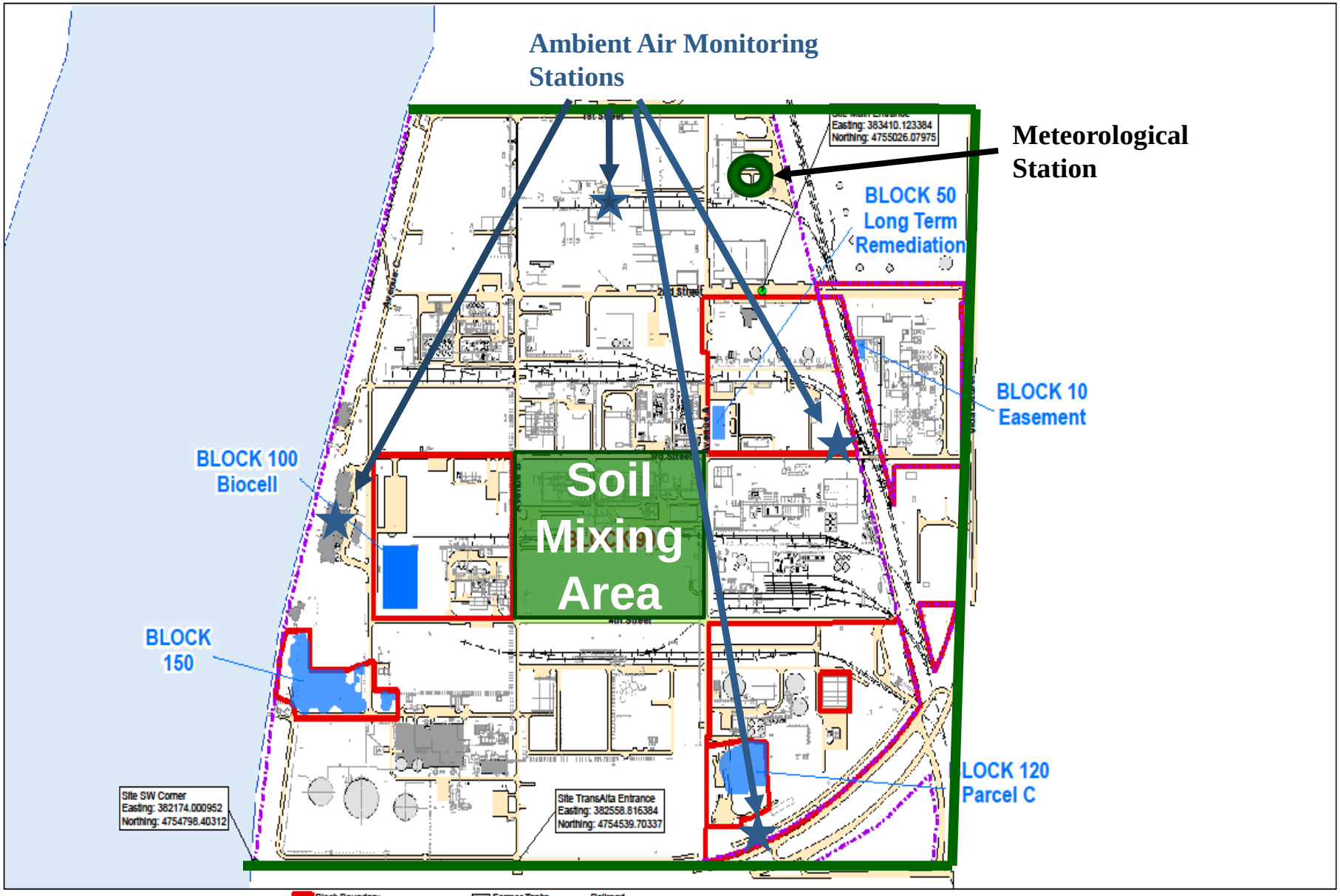


- Total treated: 60,000m3
- Treatment area footprint: 4.7 ac
- Operating time period: 145 days
- Daily production average: 410 yards per day
- $350/yard treatment cost if disposed as hazardous waste
- $95/yard total treatment cost in STA
- Treated soils can be used as backfill material onsite

SOIL WAS NOT A WASTE

Then and Now





Notes:
1. Base drawing provided by Dow Sarnia, February 2010.

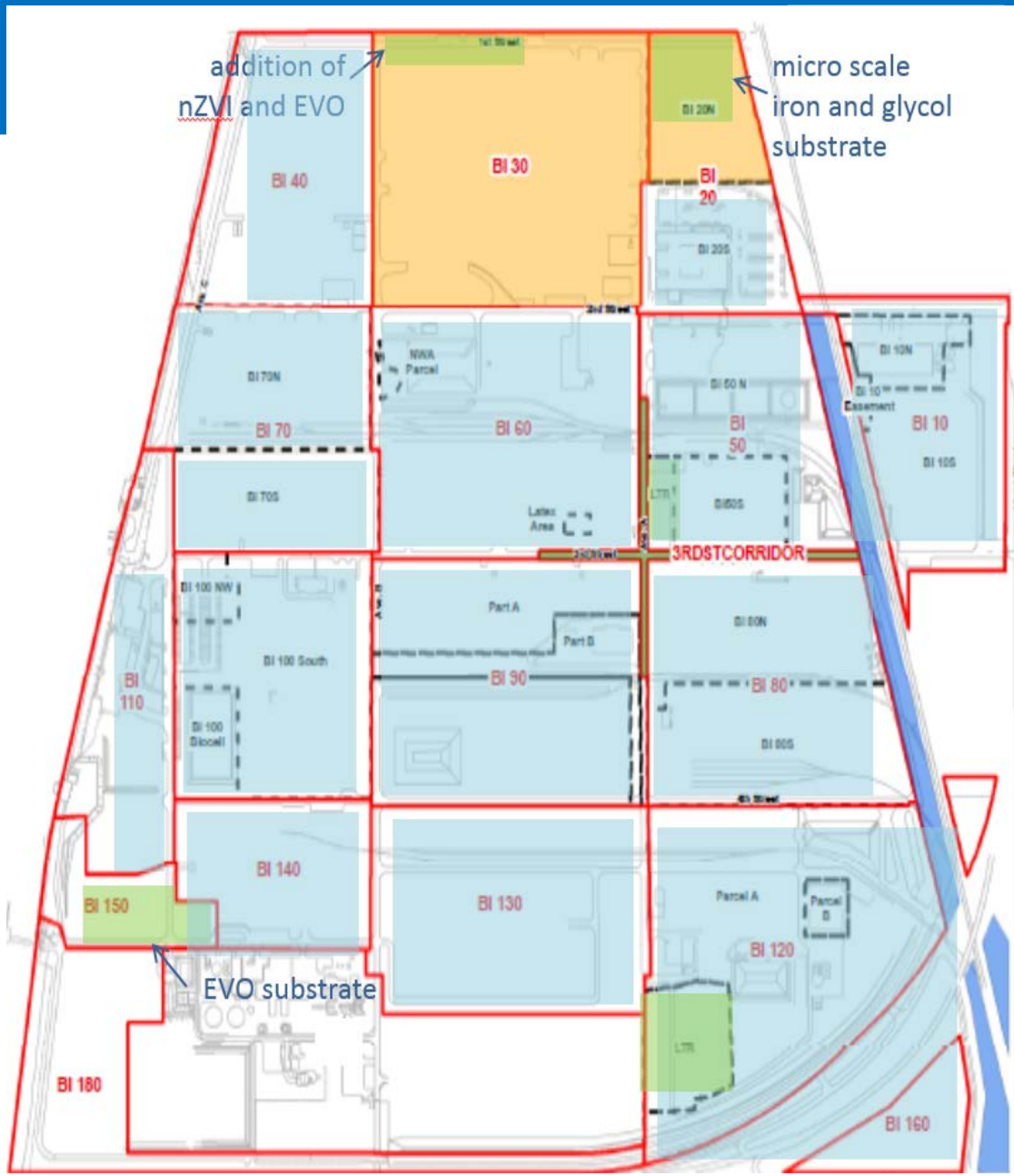
Figure 2
Site Plan
Dow Chemical Canada ULC
Sarnia, Ontario

KWO \\WATERLOO\PROJ\DOWCHEMICALCANADA\LIBRARY\GIS\DOWSARNIA\REPORTS\473404_BLK100_BIOCELL\GIS\MAPFILES\SITE_PLAN.MXD NDYER 7/12/2013 13:29:28

CH2MHILL

Soil Mixing Process

On Site Areas where *Insitu* and *Exsitu* Remediation were Applied



Design of *InSitu* Remedial Strategy

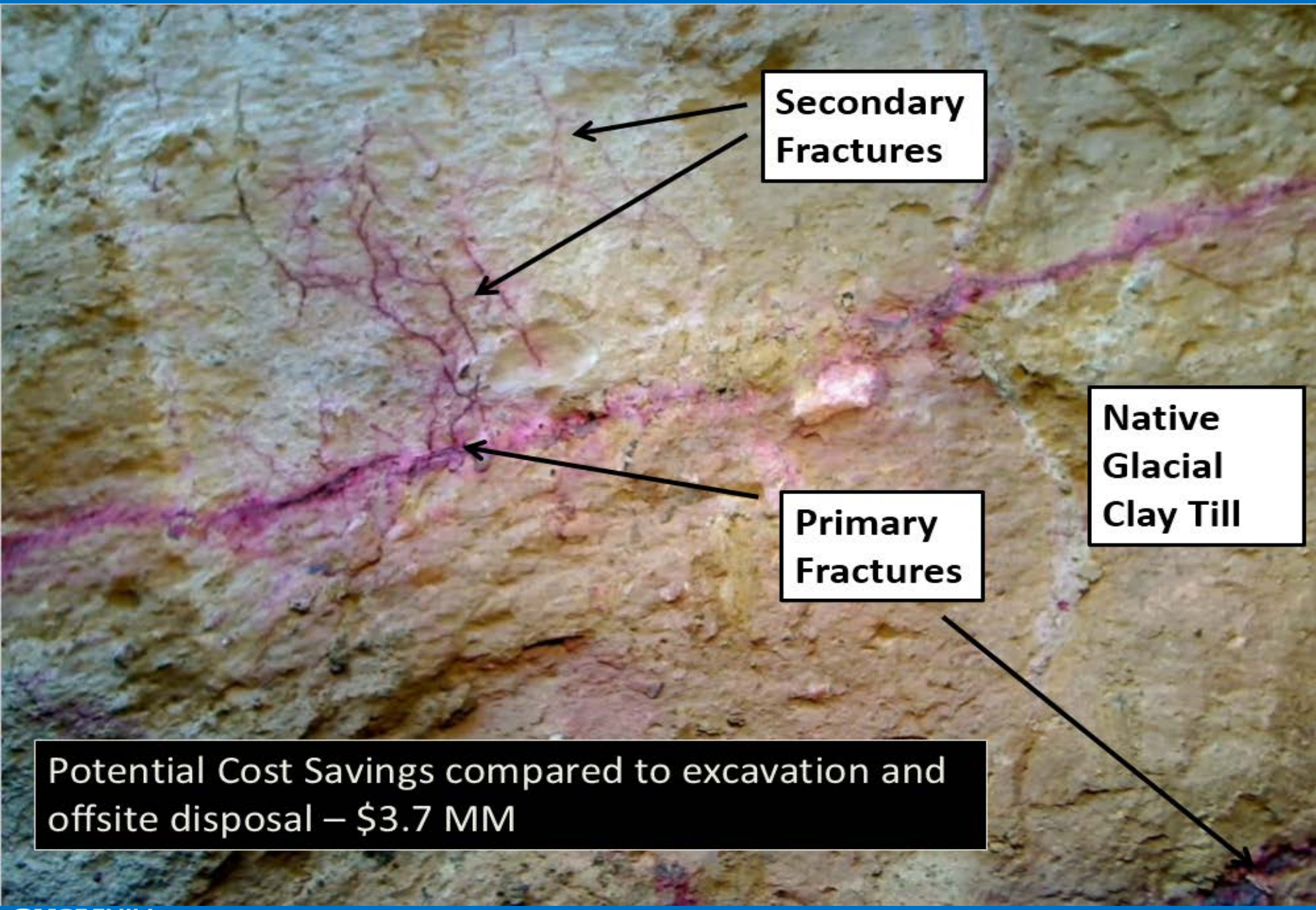


- Premise - SOIL IS NOT A WASTE
- Reach target concentrations in 5 – 7 years
- Must be cost effective based on volume of soil to be treated (in excess of 110,000 m3)
- Selected amendment must be able to treat near saturation CVOC soil concentrations to <TCLP criteria
  - ex 1,2 DCA from 20 mg/kg to 500 mg/kg (0.5 mg/l TCLP, 20x rule = 10 mg/kg)

Hydraulic Fracture & Injection



- Iron and organic carbon successfully added to the subsurface.
- Amendment detected throughout a 20 to 30 foot radius from the injection point and secondary fractures visible up to 12 inches vertically from the primary fractures.
- Long term success throughout the vertical treatment zone is still in question.



Insitu Remediation



- Total treated: 20,000m3
- Application Period: 14 days
- $350/yard treatment cost if disposed as hazardous waste
- $45/yard total treatment cost for *insitu*
- Success of treatment – may be seeing rebounding after 6 years post application, clay matrix diffusion extremely slow

SOIL WAS NOT A WASTE however, treatment is not complete

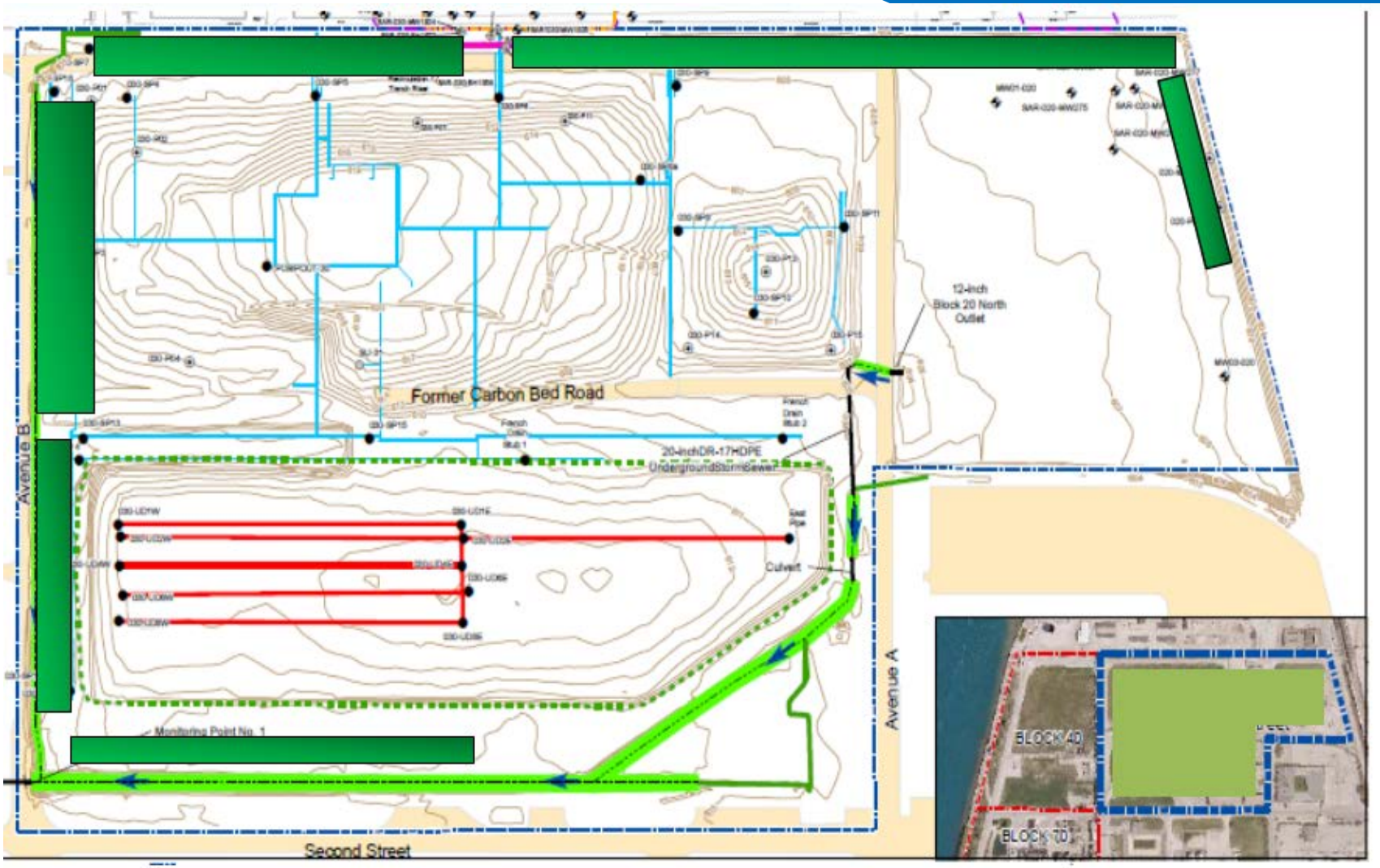


Sustainable Water Management

Groundwater Management – Design of Passive Hydraulic Control

- Premise- no operational features remaining.
- Need to control water levels in a French Drain system that was previously controlled by pumping and onsite carbon treatment.
- Reduce flow from 20 gpm to 1 gpm.
- Infiltration reduction necessary.

Tree Plantation Design



Challenges/Lessons Learned



- Trees require 5 years or more to reach maturity
- Tree mortality
- Finding all infiltration sources
- Precipitation during dormancy periods
- Aeration tubes allowed infiltration
- Interim water management

Surface Water Management



- Site contoured to promote surface runoff to a single discharge point.
- Site vegetated to utilize surface water and reduce TSS.
- Negotiated regulatory discharge to provincial water body after sampling to confirm clean surface water.

July 15, 2010
TSS = 1,400 mg/L

October 19, 2011
TSS = 75 mg/L

October 19, 2012
TSS = 25 mg/L

Water Management

- Regulatory permission granted for direct discharge to the provincial water body.
- Management of dormancy periods being controlled by further reduction of infiltration and installation of passive permeable reactive beds in areas of seeps.
- Goal to allow water table to be at static with no additional pumping.

Sustainability - How Did We Do?



Energy Intensity Reduction;

- Achieved – massive reduction in carbon footprint due to negotiations and remedial strategy.
- Negotiated extended timeframes for insitu remediation.
- Exsitu remediation occurred onsite, reducing transportation costs.
- No mechanized treatment remains onsite.
- Trees provide passive pumping to control groundwater gradient.
- Reduced GAC usage - formerly 70,000 to 80,000 lbs of carbon per year and costs for transportation to regeneration facility.

Sustainability - How Did We Do?



Community Acceptance;

- Achieved – aggressive community education and community support
- Development of recreational property

Sustainability - How Did We Do?

Environmental Protection;

- Achieved – land is fully available for industrial reuse

- No offsite migration potential remains

Field Site



Before

After

Acknowledgements

CH2M HILL Team:
Phil Smith
Catherine Creber
Krista Aitchison
Chris Peace
Steve Scandlen
Rich Block
Jeremy Meyer

Dow Chemical Canada Inc. Team:
Joanne West
Dave Wandor

Questions/ Comments?