Remediation Scenarios for Proposed West Village Development Area, Calgary, Alberta

Calgary Municipal Land Corporation

Tom Jacklin, Advisian; Aaron Jambrosic, AECOM; Martha Watson, Watson Consulting and Julie Sullivan, Barr Engineering Co.

www.**advisian**.com

Advisian

WorleyParsons Group

Outline

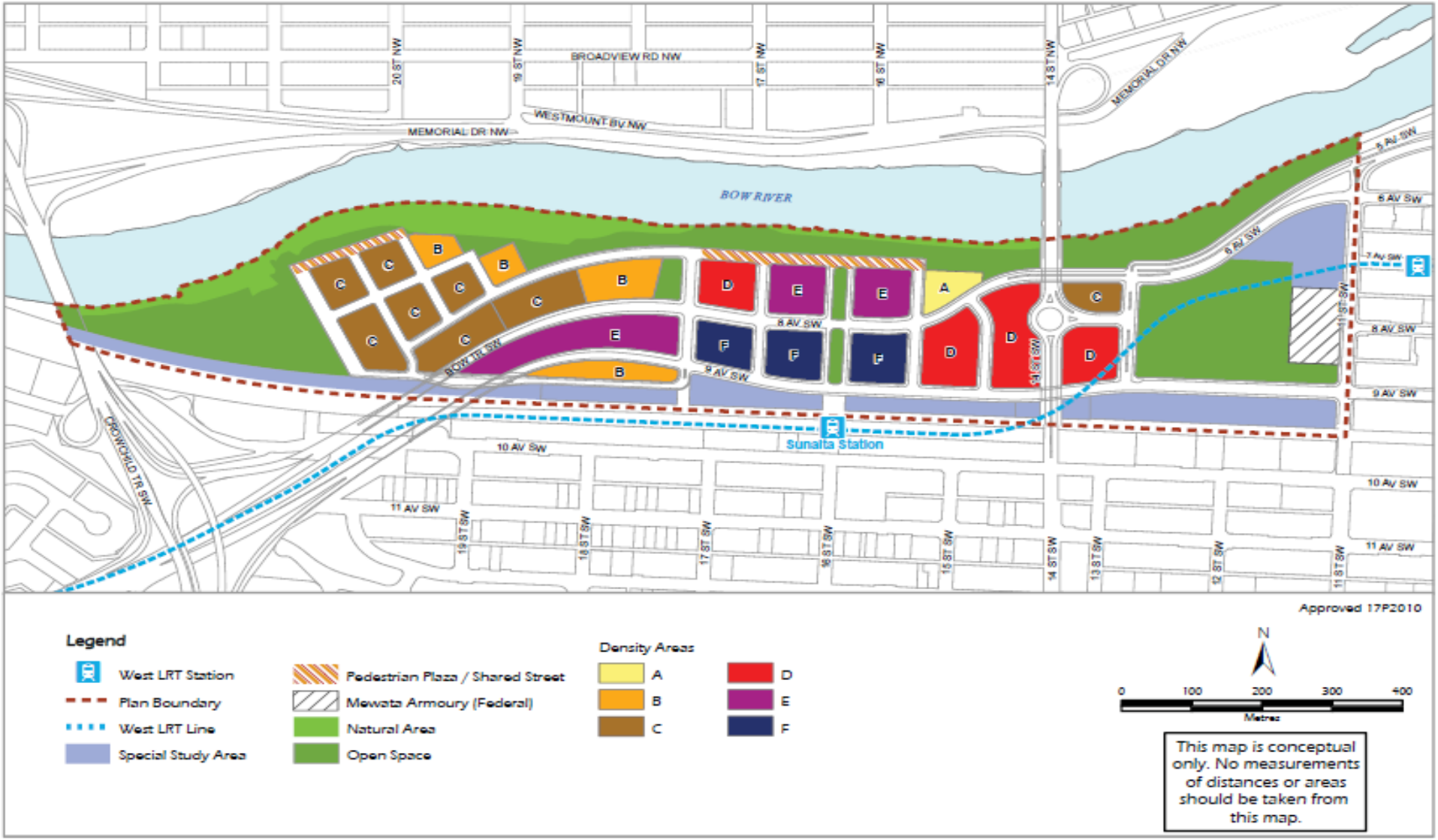
1. West Village Environmental Analysis Part III
2. Development Considerations for Remediation
3. Approaches to Remediation
    - Remediation Overview
    - Alignment with Development
    - Identification and Screening of Remediation Strategies
    - Cost Estimate
    - Class of Cost Estimate and Risk
4. Summary
5. Questions

West Village Development Considerations that affect Remediation

- *Land Ownership*
- *Land use Planning*
- *Infrastructure Road and Utilities*
- *Site Assessment Key Findings*
- *Schedule*

Land Ownership

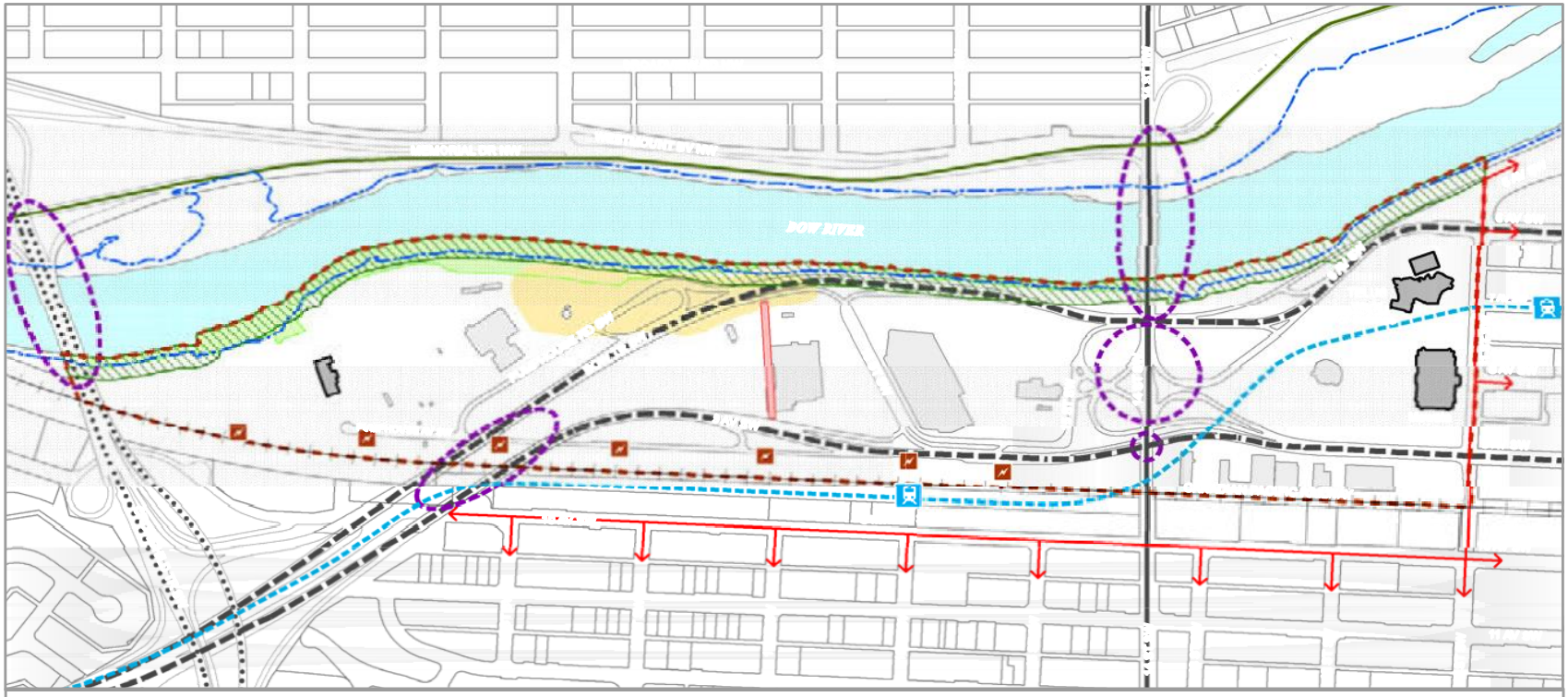
Land Use Planning - ARP



Land Use Planning – CalgaryNext

CalgaryNEXT as Proposed by CSEC

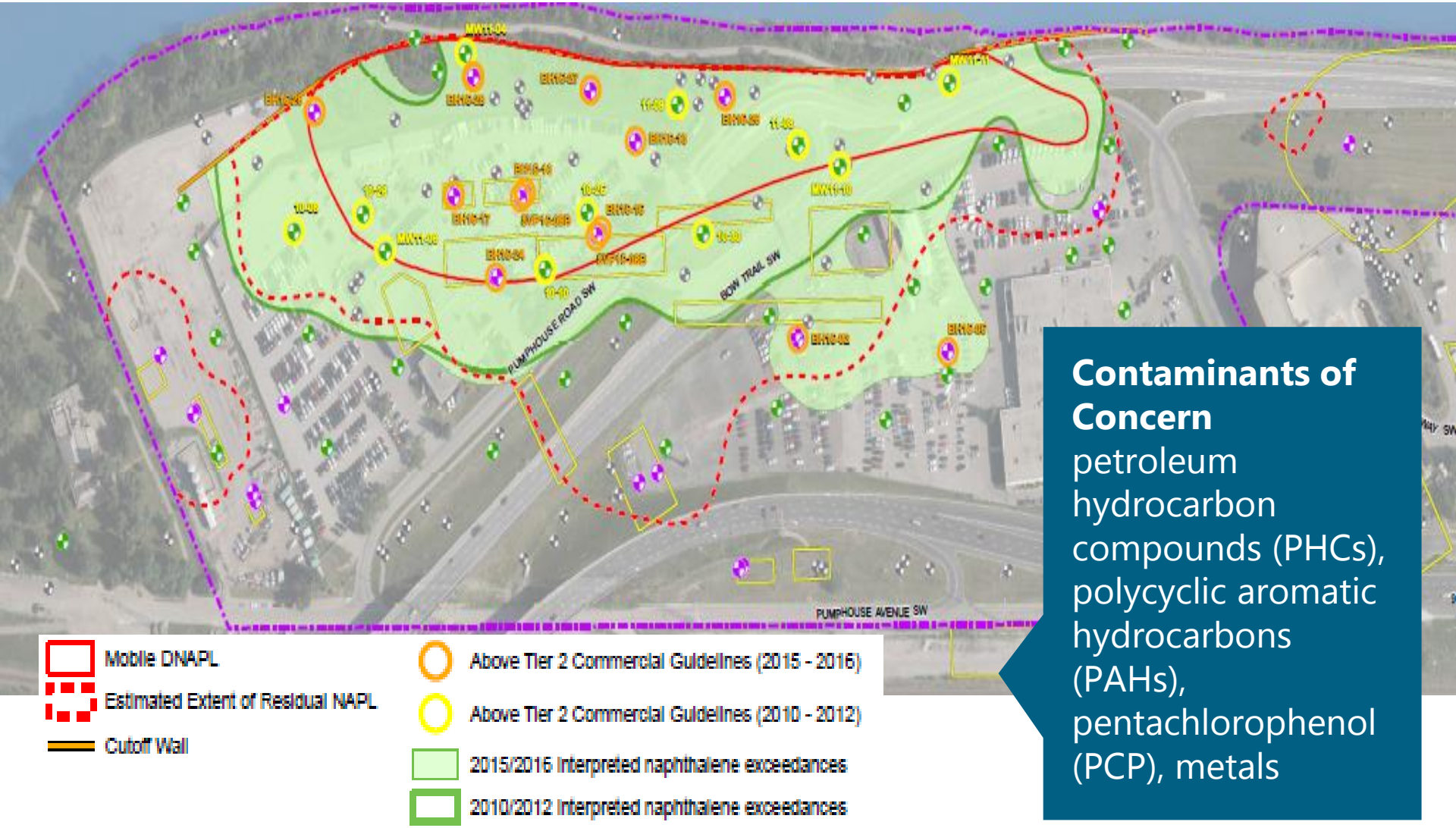
Infrastructure - Transportation and Road



Infrastructure - Utility

- Storm water management
- Master drainage plan
- Floodplain and final grade
- Sanitary sewers
- Potable water systems distribution and trunk
- Interim or temporary utilities
- Shallow utilities
- Waste and materials (efficient resources utilization)

Site Assessment Key Findings



Contaminants of Concern
petroleum hydrocarbon compounds (PHCs), polycyclic aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), metals

Approaches to Remediation

Remediation Overview

Best practices applied to clean up wood treating sites show that, in general, six technologies or strategies can be used, usually in combination.

Other technologies are also available, but have less available performance data.

There is a range of means for addressing cleanup problems at CCS and the balance of West Village.

Remediation Strategy Identification & Screening

Approaches to treating creosote and pentachlorophenol:

- Excavation and disposal in authorized landfills;
- Excavation and thermal treatment (incineration);
- Excavation and bio-stabilization;
- In-place treatment using solidification and stabilization;
- In-place treatment using thermal desorption; and
- Containment (this was the chosen remedy at the CCS site implemented by the Province in 1995).

Alignment with Development

Ideally, remediation efforts would be coordinated with redevelopment efforts. Synergies for shared infrastructure excavation and soil handling.

At this early stage assumptions were made regarding the placement of future buildings, infrastructure, roadways and the configuration of the CalgaryNEXT complex at two different locations.

Assembly of Remediation Combinations

Technology Grouping	Technology Type	Process Option	Location
Ex-situ	Excavation	Off-site Disposal	NAPL Source Area (bedrock and overburden) Fringe Saturated or Unsaturated zone
	Excavation	Thermal treatment and reuse	
	Excavation	Bio-stabilization and reuse	
In-Situ	Solidify Soils	Inject and mix bentonite	
	Thermal	Electric Resistivity Heating	
	Enhanced Containment	Slurry wall, groundwater recovery and treatment	

Schedule - Soil Volumes

Site Area	Estimated Soil Volume (cubic metres)
NAPL impacted soils	171,000
The unsaturated fringe zone (contamination in soil above groundwater outside of the NAPL zone)	47,000
The saturated fringe zone (contamination in soil below groundwater outside of the NAPL zone)	39,000
Hot spot excavations	12,000
Total	269,000

Schedule

Strategy	Investigation, Design, and Permitting (Approx. years)	Remediation Phase (Approx. years)	Total Duration (Approx. years)
Excavate and Dispose	2	3	5
Excavate, Treat Thermally and Reuse	3	4	7
Excavate, Biostabilize and Reuse	2.5	5.5	8
In-Situ Solidification	2.5	5	7.5
In-Situ Thermal	3	7	10
Enhanced Containment	1	0.5	1.5

Costing Model

For each remedial combination developed a detailed costing model including:

- Costing Assumptions
- Remedial Approach
- Construction Costs
- General Costs (CM, PM, Owners costs, design contingencies)

Cost Estimate

Remedy Combination	1	2	3	4	5	6
Criteria \ Value	Excavate and Dispose	Excavate Treat Thermally and Reuse	Excavate Biostabilize and Reuse	In-Situ Solidification	In-Situ Thermal	Enhanced Containment
Construction Cost Estimate ($M)	$69	$57	$42	$51	$48	$1.8
CM, PM, Design Estimate ($M)	$41	$31	$23	$28	$26	$1.1
Total ($M)	$110	$88	$65	$79	$74	$2.9

Land Remediation Summary

Estimated Costing of Remedial Approaches	Expedited Approach	Measured Approach
Canada Creosote Site	$110,000,000	$65,000,000
Balance of West Village	$30,000,000	$20,000,000
Estimated Total	$140,000,000	$85,000,000
Estimated Timeline for Canada Creosote Site Work		
Additional Investigation, Regulatory Approvals and Permitting (approximate time)	3-5 years	3-5 years
Remediation (approximate time)	3 years	5 years
TOTAL	**6-8 years**	**8-10 years**

Questions?

West Village Environmental Report
http://www.calgarymlc.ca/s/CMLC-Enviro-Background-Rpt-04-18-16-V16.pdf