



THE CITY OF
CALGARY
UTILITIES & ENVIRONMENTAL PROTECTION



WorleyParsons

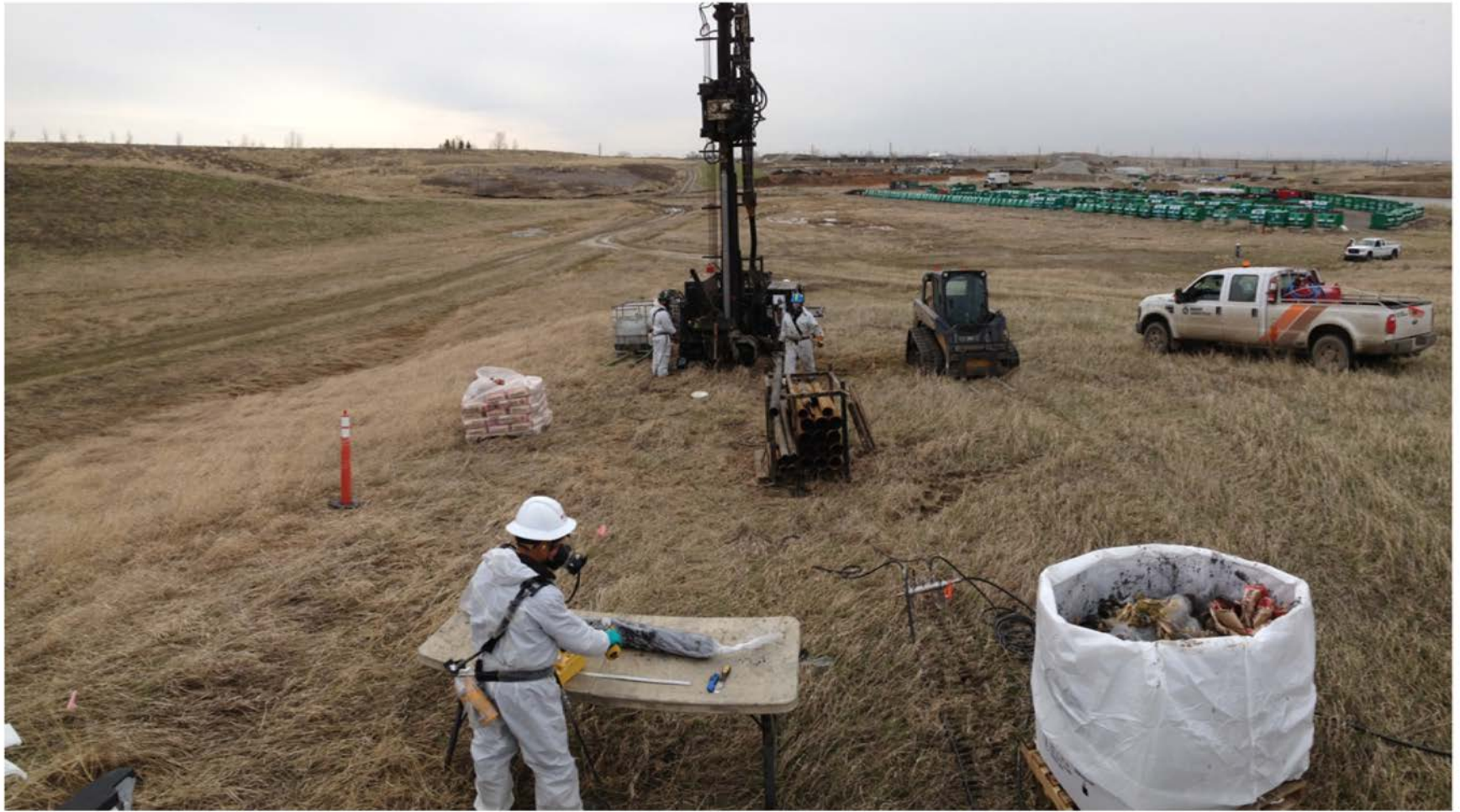
resources & energy

Integrated Characterization and 3-D Modelling of Large Industrial Sites Used to Optimize Targeted Remediation and Risk Management Programs

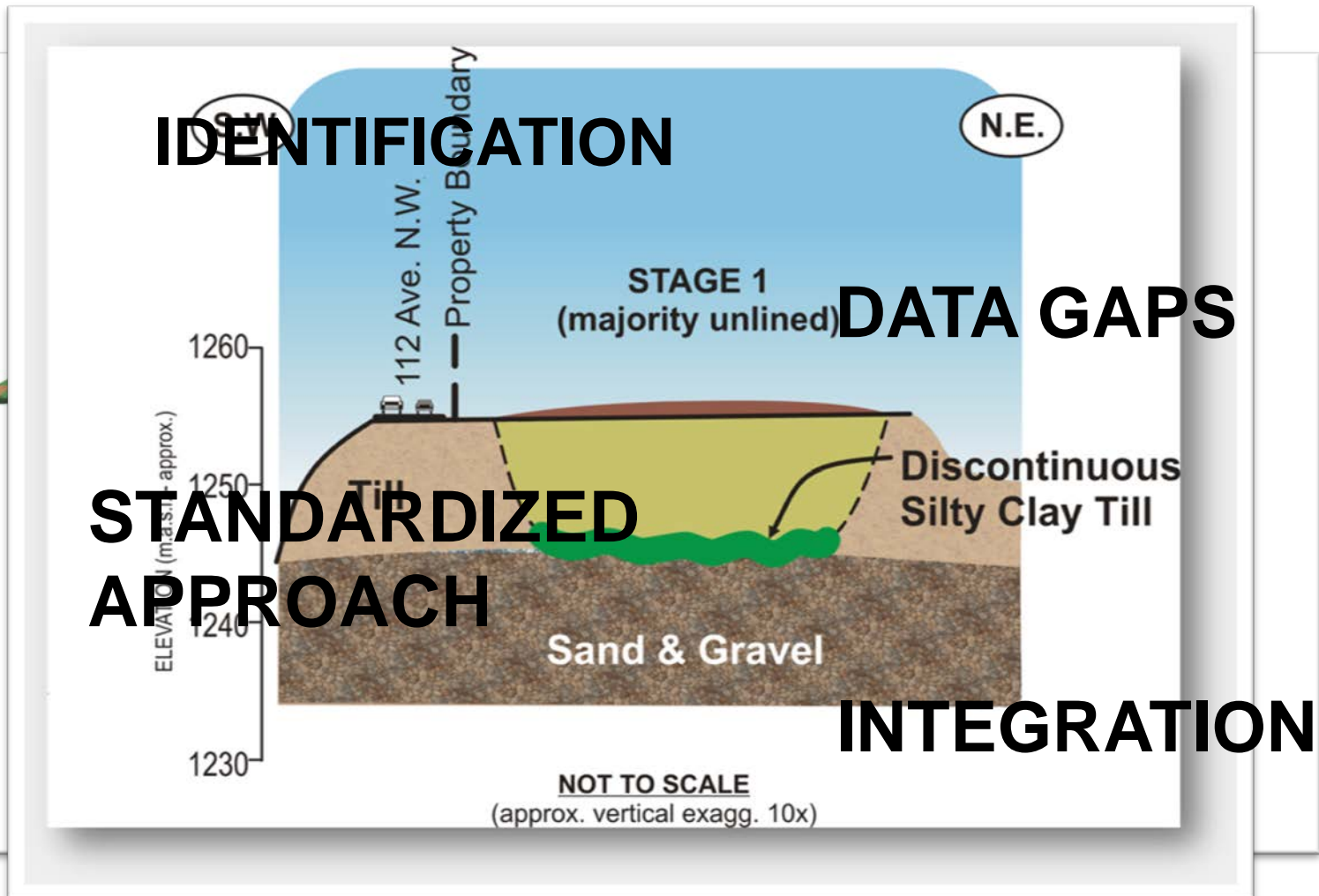
October 2014



Introduction



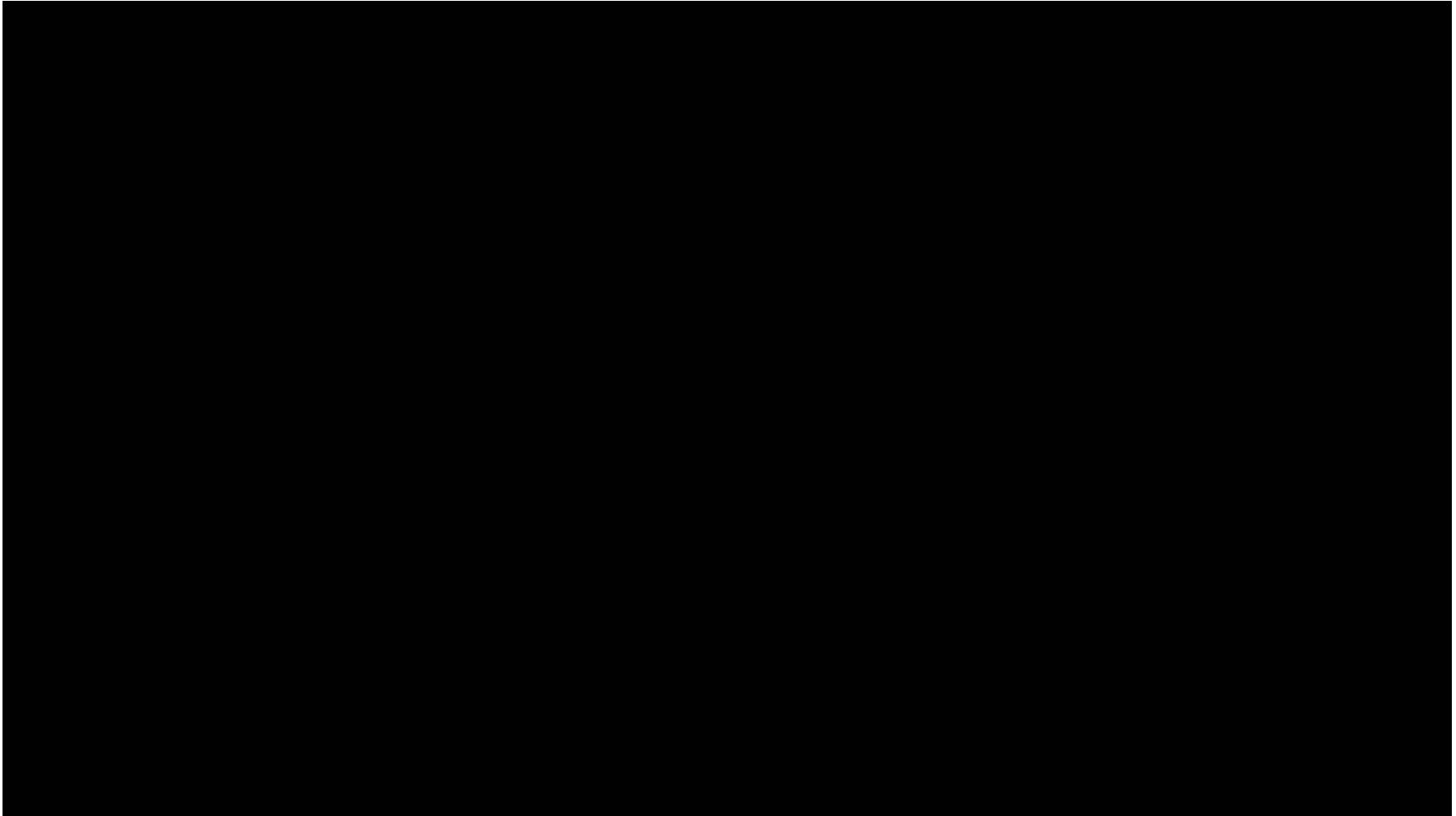
Process



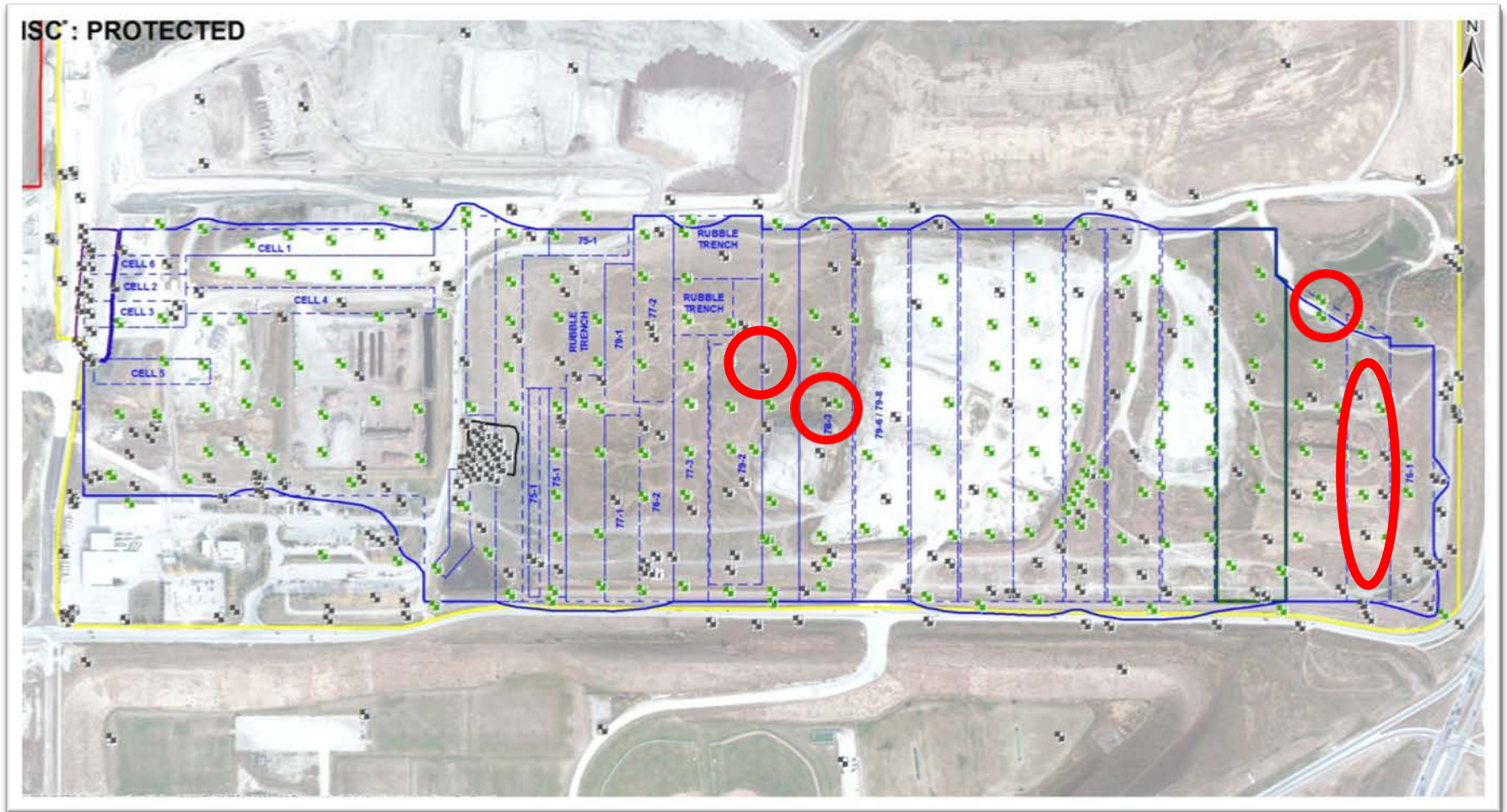
Data Density

Parameter	Stage 1 Spyhill WMF	Areas 1, 2 & 9 East Calgary WMF
Date Opened	1968	1968
Area (ha)	~61	~52
Existing Boreholes	192	192
New Boreholes	203	222
Number of Historical Intrusive Investigations	19	19
Number of Historical Consultants	4	5

Spyhill WMF



Evaluate Existing Data



Standardized Data Entry

Spyhill Delineation Program



Project # 307074-01449
Borehole #: 12-22U
Piezometer #: N/A

Date Logged: 05-Sep-2012
Logged By: MAGH
Helper: DOUS
Drill (1 or 2): 1

Drilling Method: Sonic
Coord. Collect: SURVEY
Casing Diameter (m): 4.5

Survey Date: 17-Sep-2012
Northing: 5668899.601
Easting: -12051.851

Elevation (mASL): 1260.587
Weather Cond: Overcast
Leachate Level (ft):

Lithology			Grain Size Distribution					Observations						Sample			Meter Readings						Notes	
Start Depth	End Depth	material	Grav&Cob	Snd	Silt	Clay	Org	Moist	Color	Plast	Hard	Stain	Odor	Oxidized	Type	Start Depth	End Depth	OVA (ppm or %LEL)		PID (ppm or %LEL)		Meth. (ppm, %LEL, %Vol)		
ft	ft		%	%	%	%	%								ft	ft	value	unit	value	unit	value	unit		
0	2	C	10	30	40	20		M	Br									50	P	3	P	120	P	Rootlets
2	5	C	5	10	35	50		M	Br	S	F													Sub-rounded gravel, rootlets, re-worked clay
5	8	C	10	10	20	50	10	M	Br	S	F							50	P	3	P	<5	P	Mixed with organics, re-worked
8	10	WD						D																Grass cuttings, plastic, fabric
10	15	WB						D										2	L	273	P	5	L	Wood, paper, plastic, cardboard
15	20	WD						D										2	L	260	P	5	L	Cardboard, insulation, wood, paper
20	21	WB	10	10	30	50		M	G	S	F							1	L	370	P	3	L	Re-worked clay
21	25	WD						D																Leaves, grass, paper, plastic, glass, wood
25	30	WD						D										2	L	291	P	250	P	Wood, paper, organic debris, newspaper (1982)
30	31	WB						M	G		H							45	P	490	P	4	L	Re-worked clay
31	35	WD						D																Wood, plastic, cardboard
35	40	WD						D										1	L	174	P	4	L	Wood, cardboard, fabric, leaves, loose soil
40	42	WD						D										2	L	734	P	4	L	Wood, paper, unidentified organics
42	45	WB	5	10	35	50		M																Re-worked clay
45	50	WD						D										2	P	382	P	11	L	Plastic, paper, cardboard, fabric
50	53	WD						D										40	P	172	P	130	P	Paper, grass clippings
53	55	T	5	5	40	50		M																Gravel sub-angular, <2cm diameter
55	60	T	10	5	30	55		M										45	P	5	P	880	P	Gravel <5cm diameter, coal fragments

Notes: Backfilled with grout, then bentonite. Soil bag "CC".

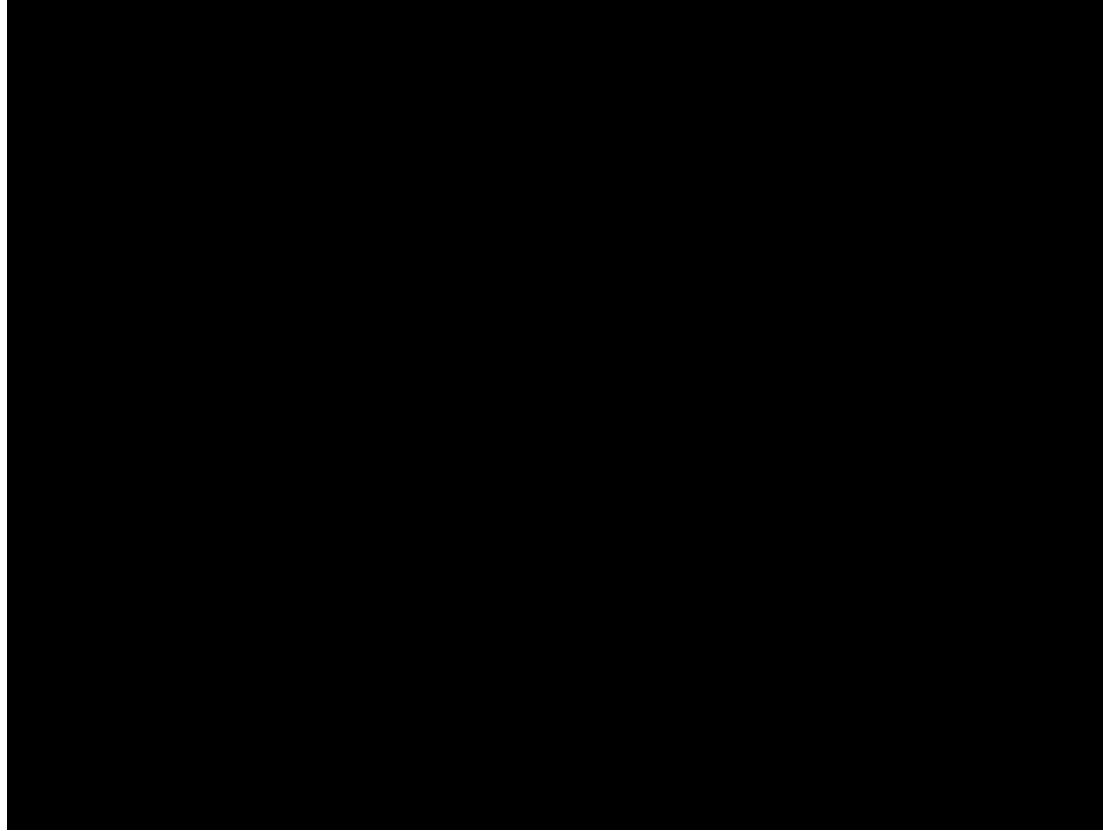
Multiple Data Platforms



Intrusive Investigation

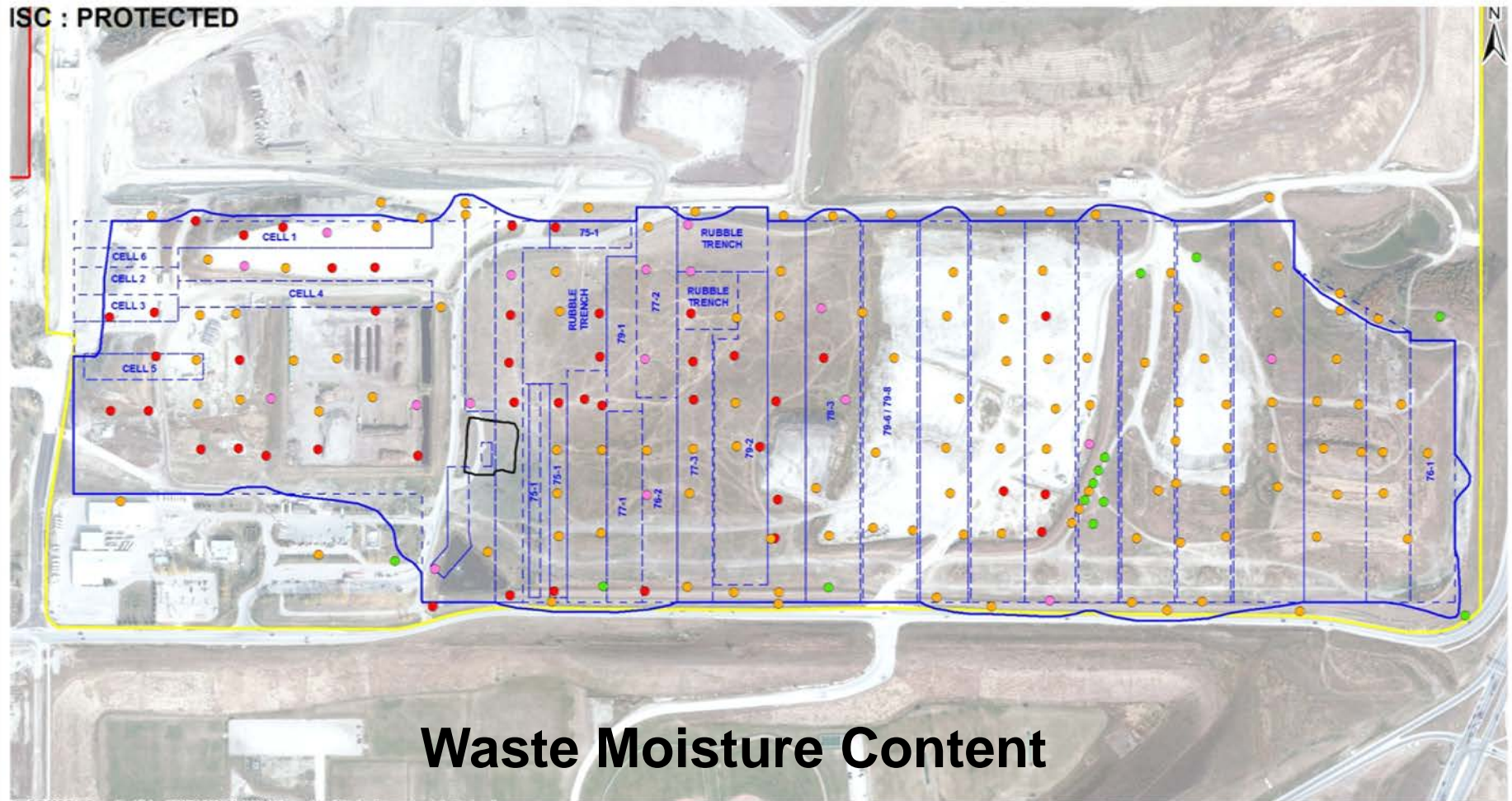


Preliminary Data Evaluation for Targeted Installations



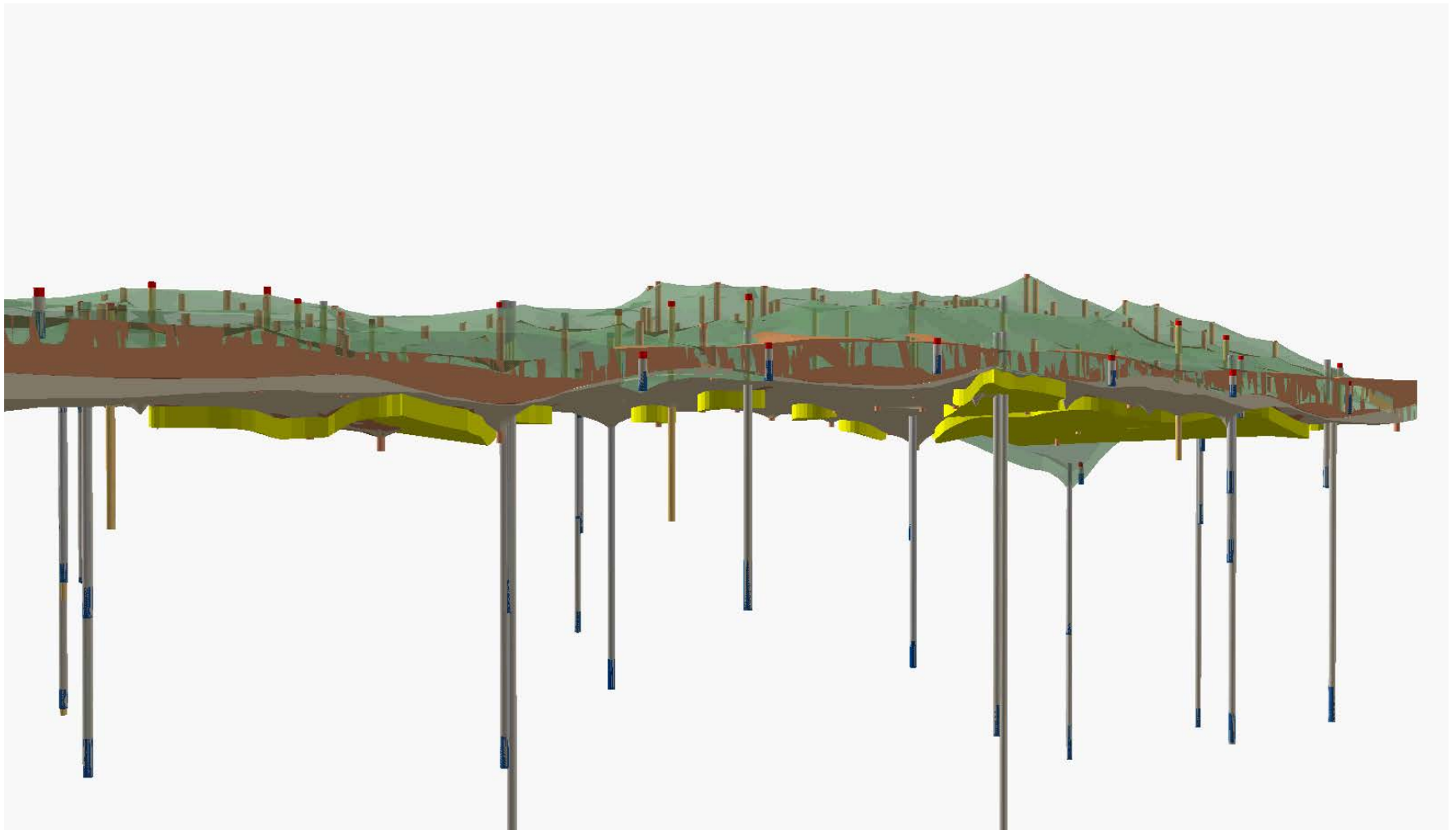
CSM Refinement

ISC : PROTECTED

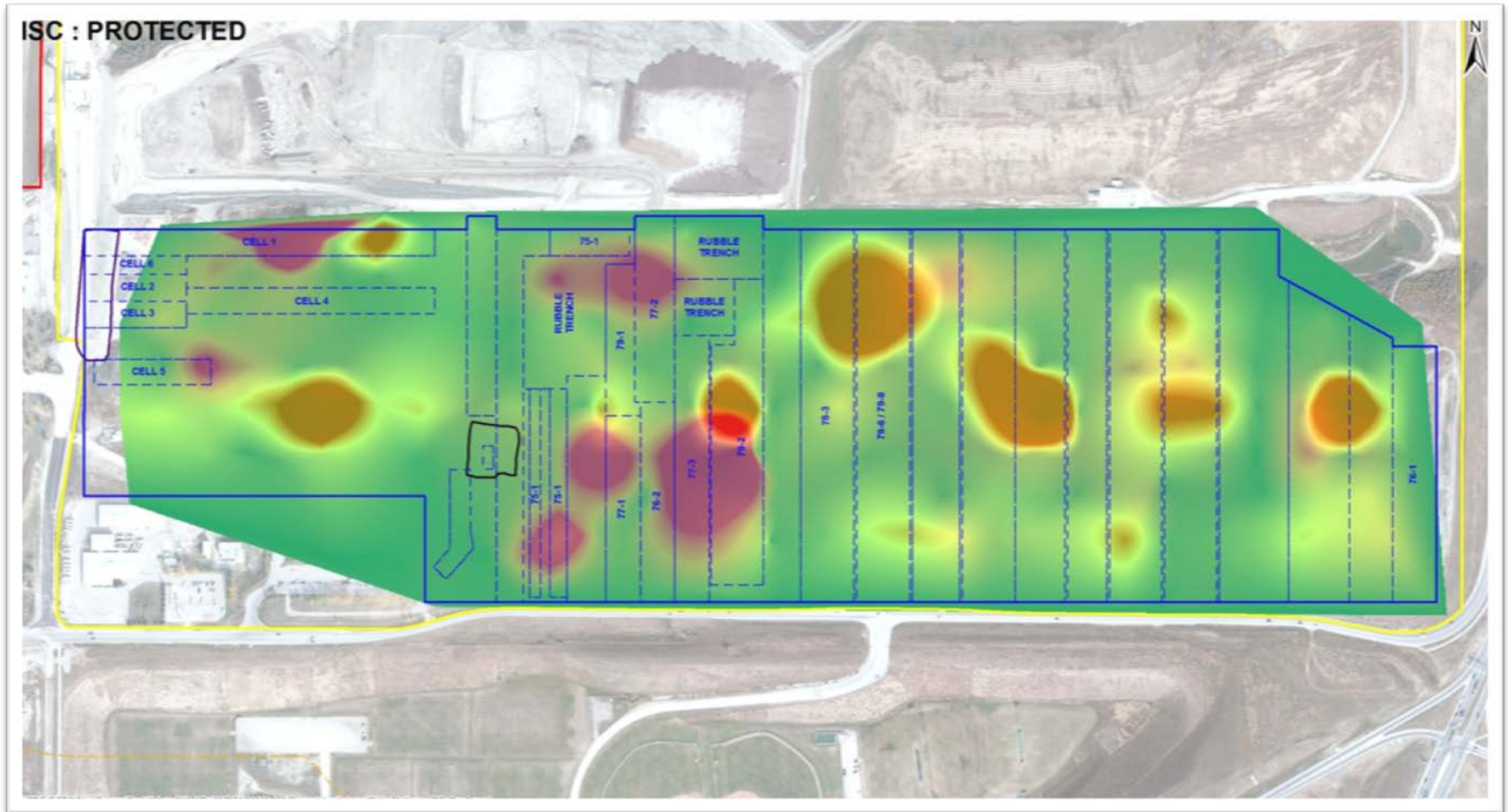


Waste Moisture Content

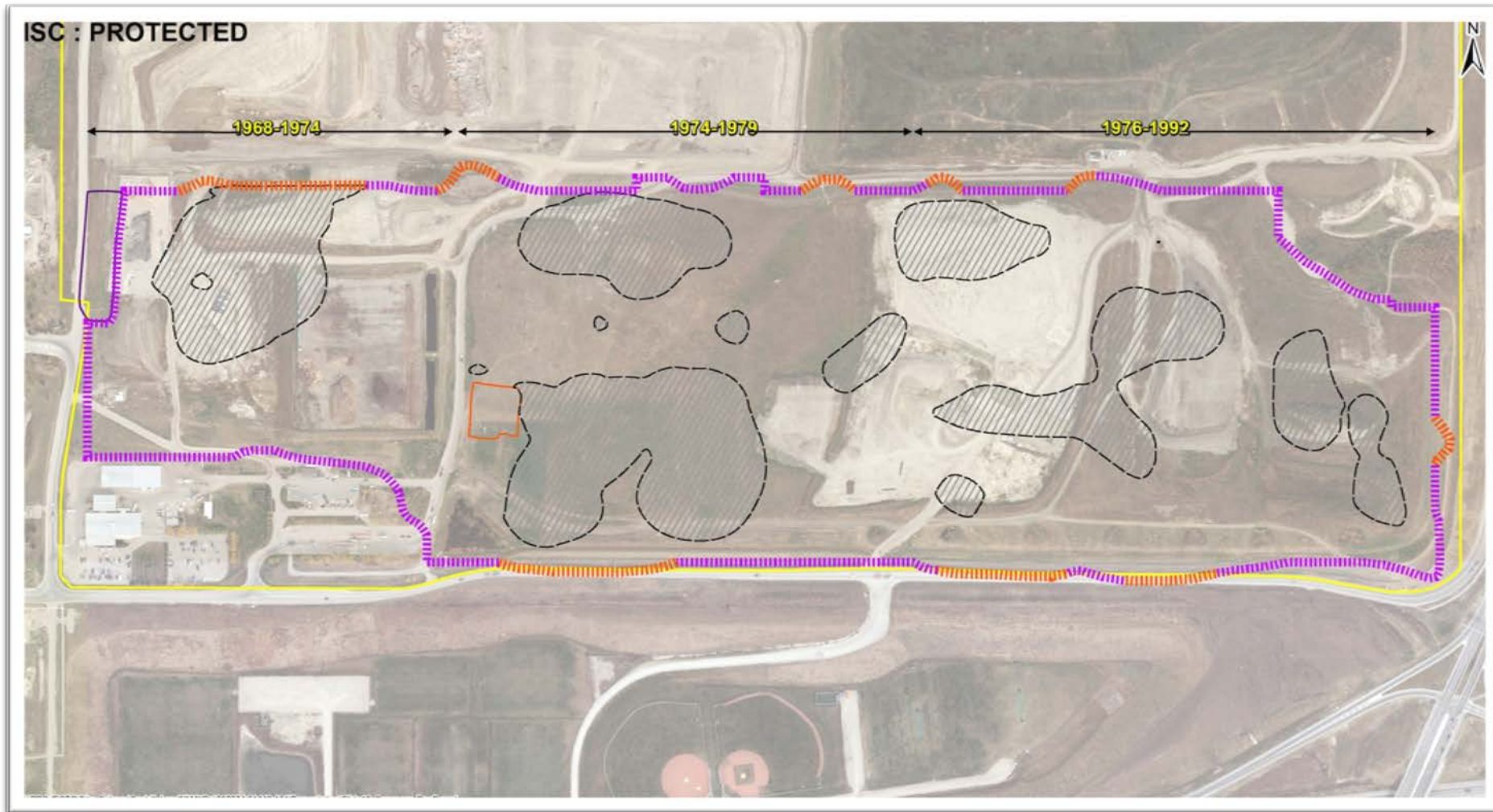
3-D Model



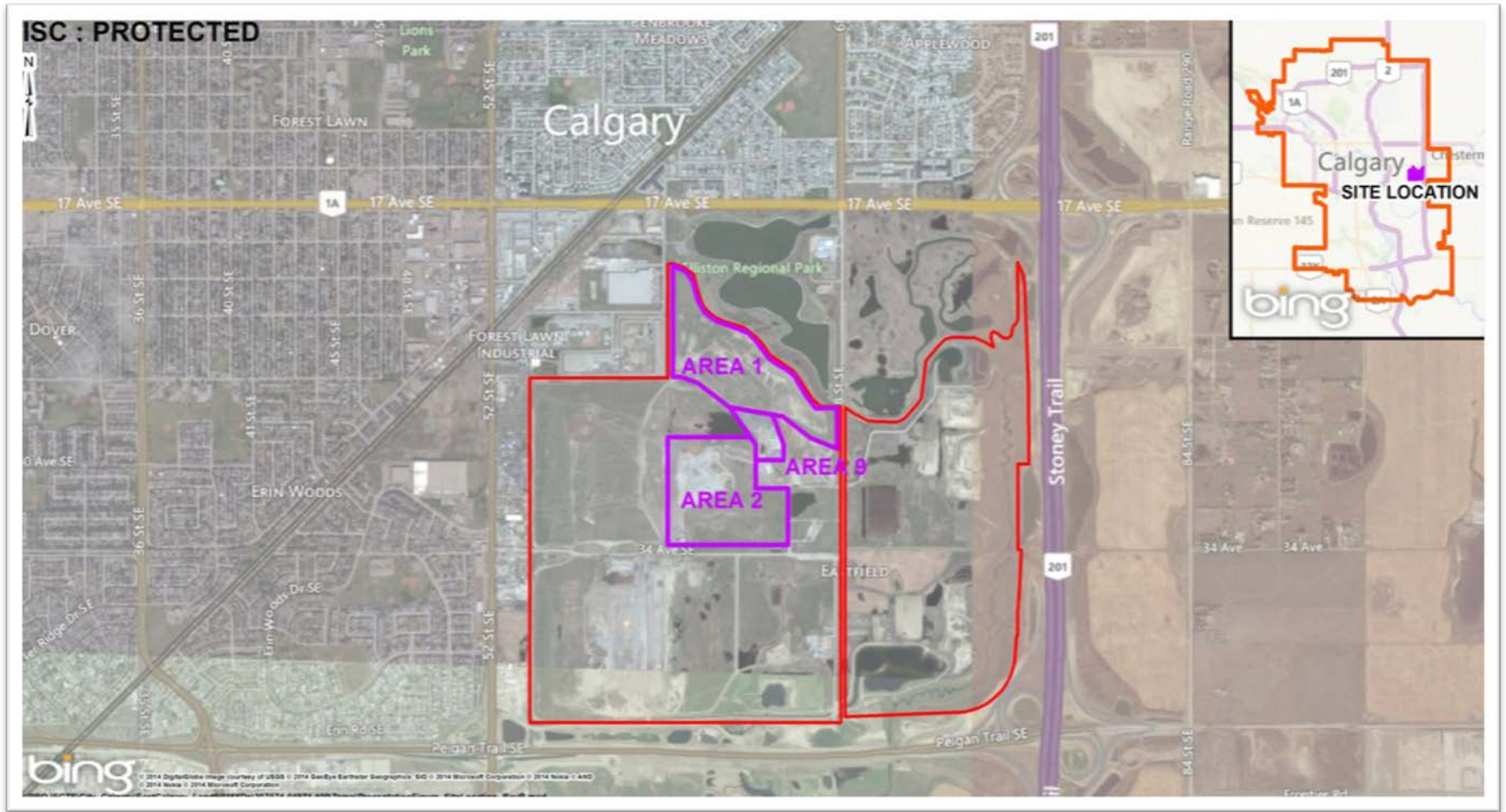
Data Comparisons



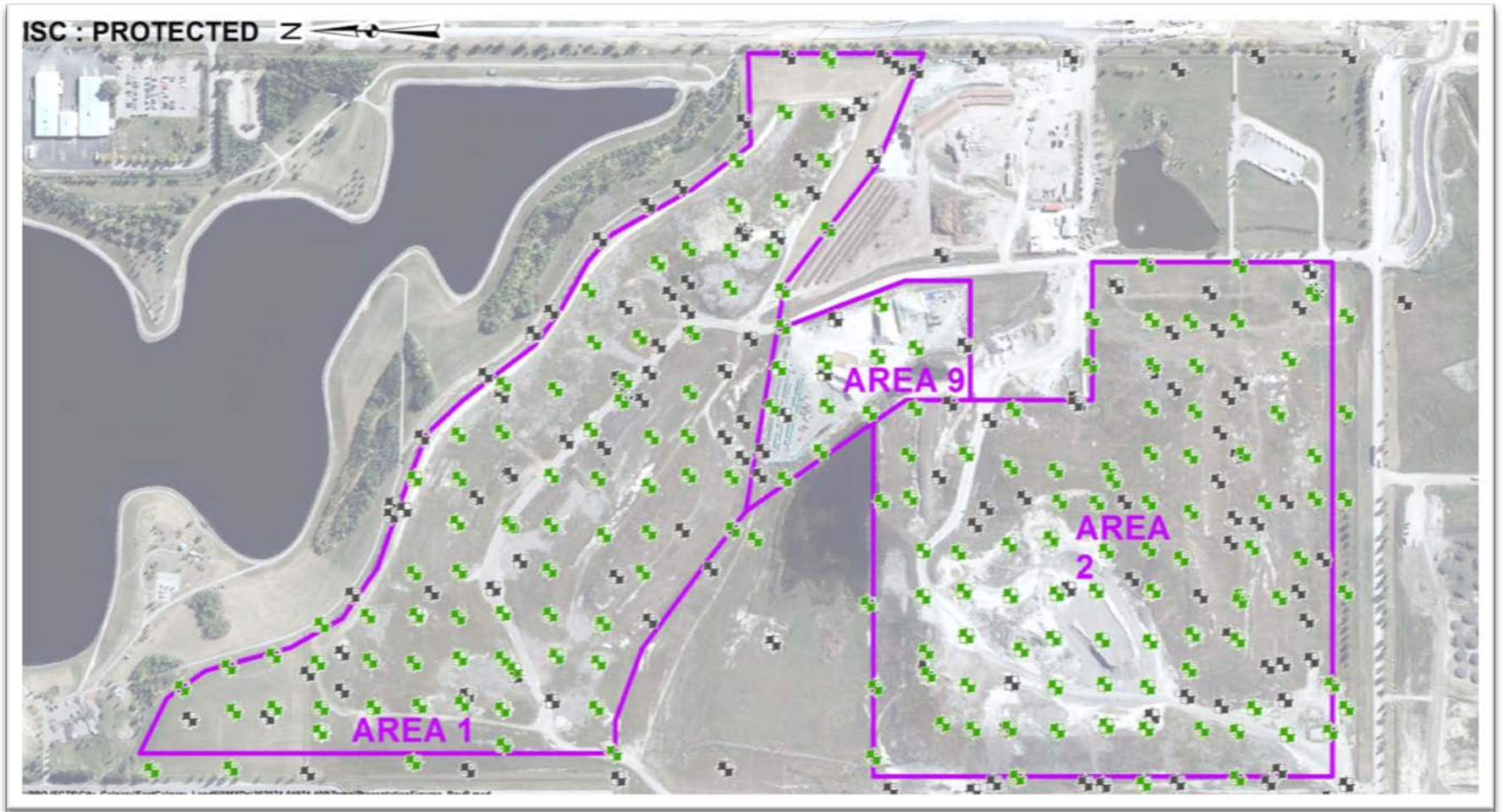
Risk Management



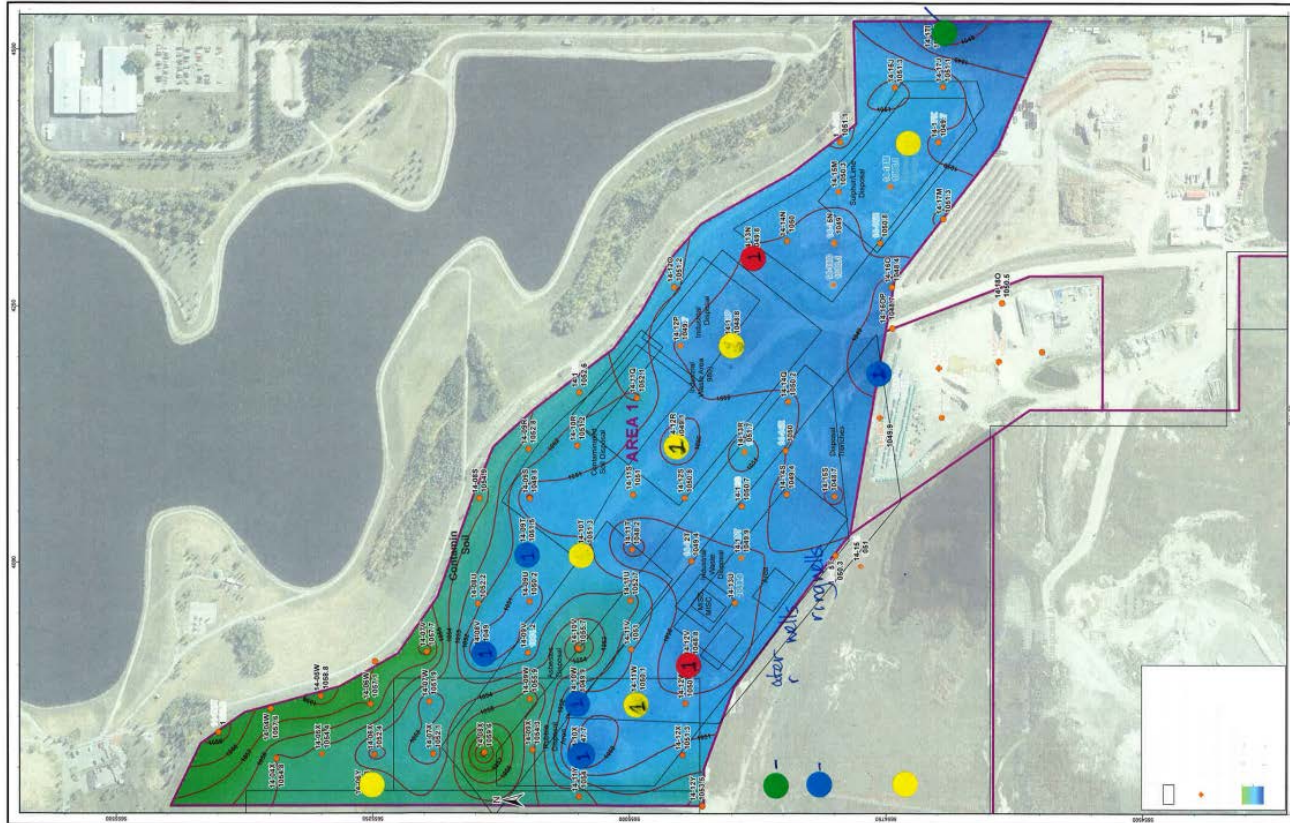
East Calgary WMF



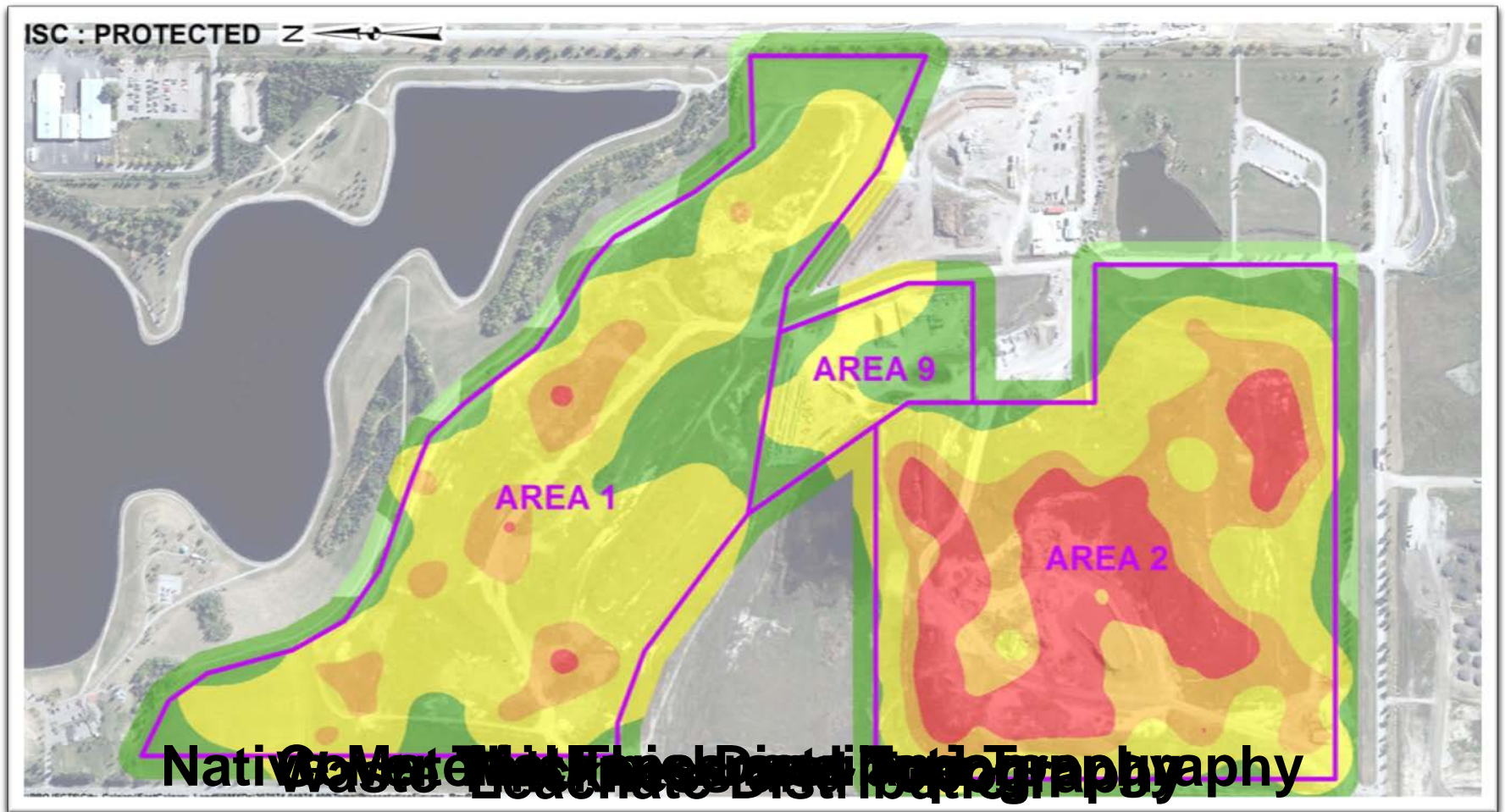
Data Evaluation



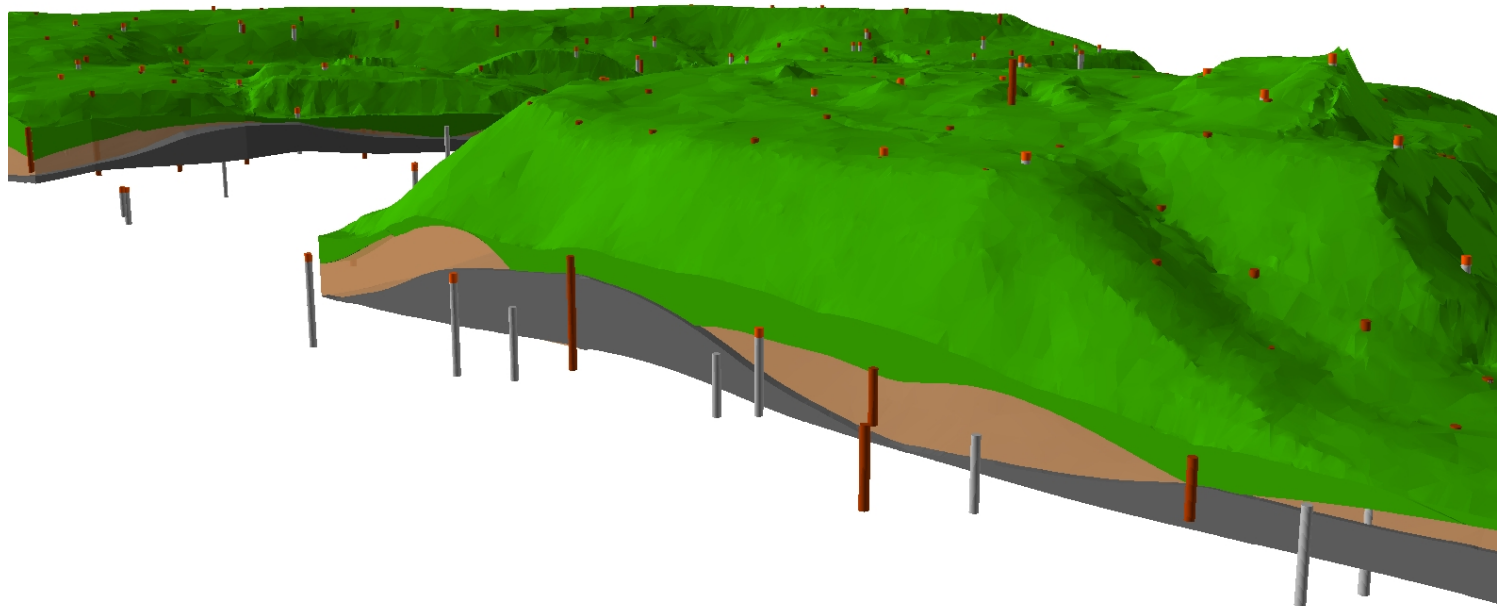
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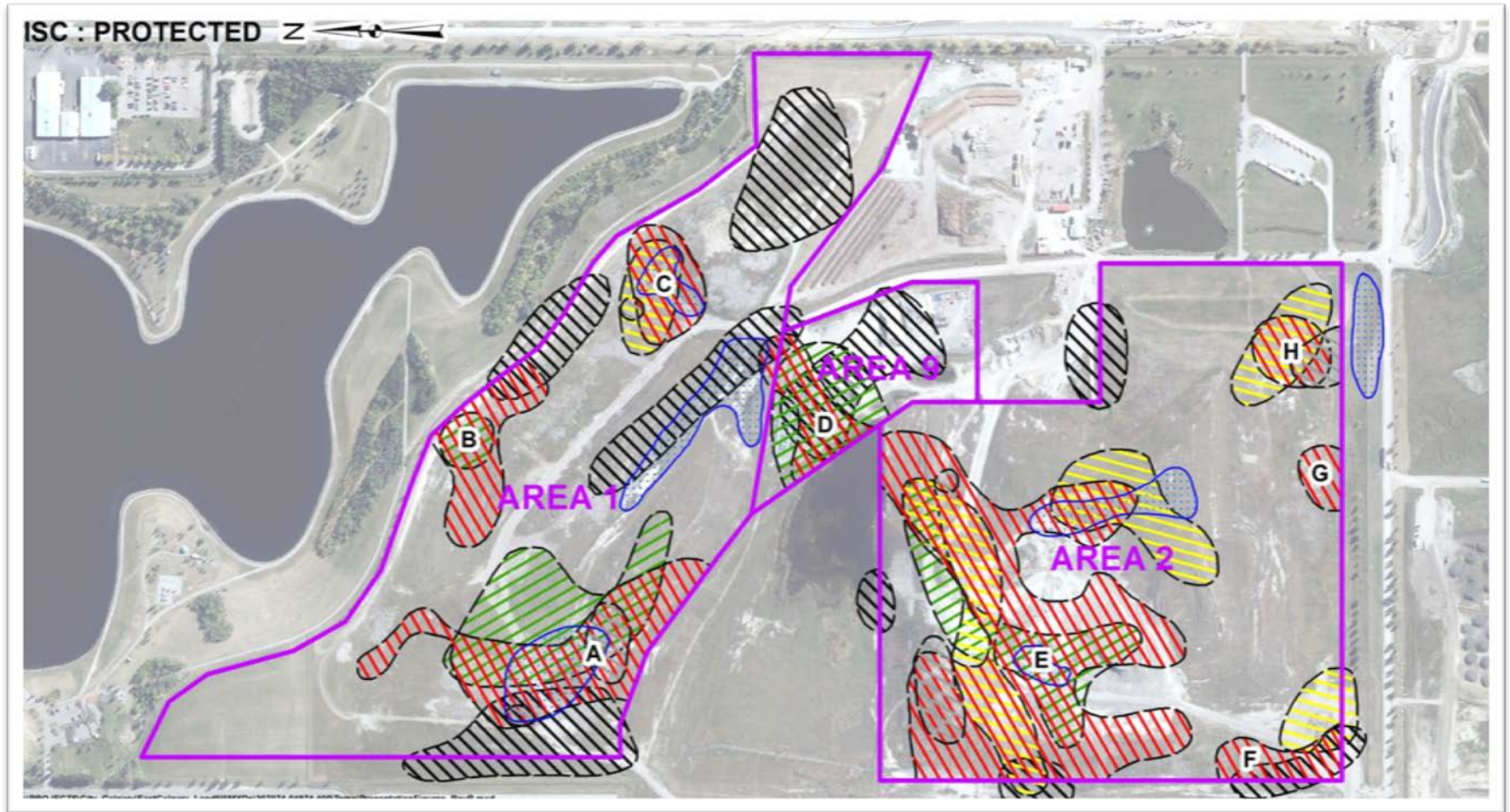
CSM Refinement



3-D Model



Risk Management



Lessons Learned



Summary



Thank You

- ▶ Co-authors
 - Marc Bowles (WorleyParsons)
 - Tom Anthony (The City of Calgary)
- ▶ The City of Calgary
- ▶ Dedicated Field Staff
 - Conor Boyd
 - Sarah Dougherty
 - Cody Couture
- ▶ GIS Analyst
 - Tom Graham