Treatability Studies to Support On-Site Beneficial Reuse of Tidal Flat Sediments at a CERCLA Site

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Focused Feasibility Study Treatability Studies

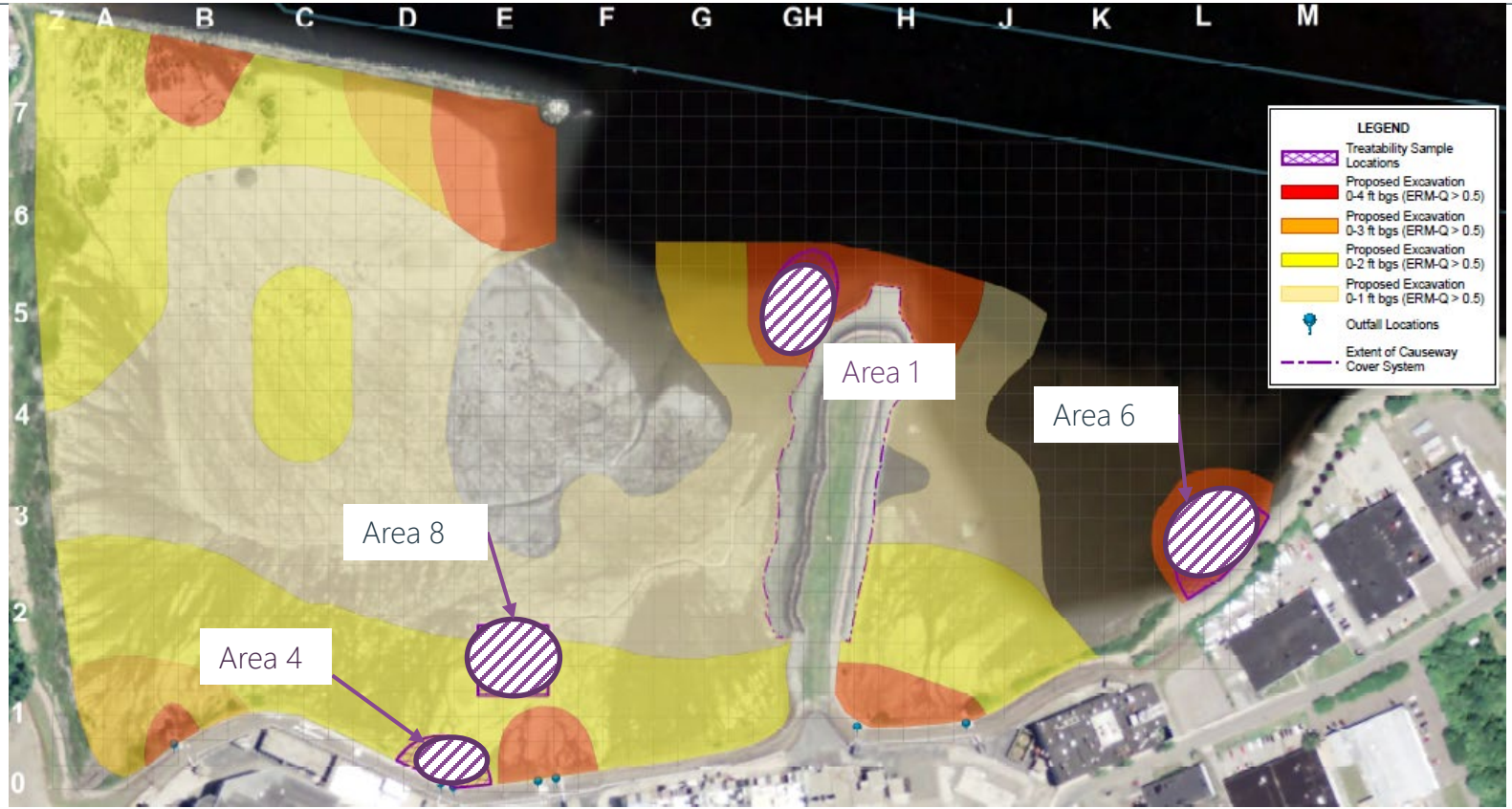
- Site history and background
- Project scope
- Sampling approach and objectives
- **Results (beneficial re-use focused)**
  - SPLP (leaching)
  - Residential direct contact
  - Solidification (strength)
- Conclusions

Tidal flats conditions

High tide

Low tide

Remedial Footprint



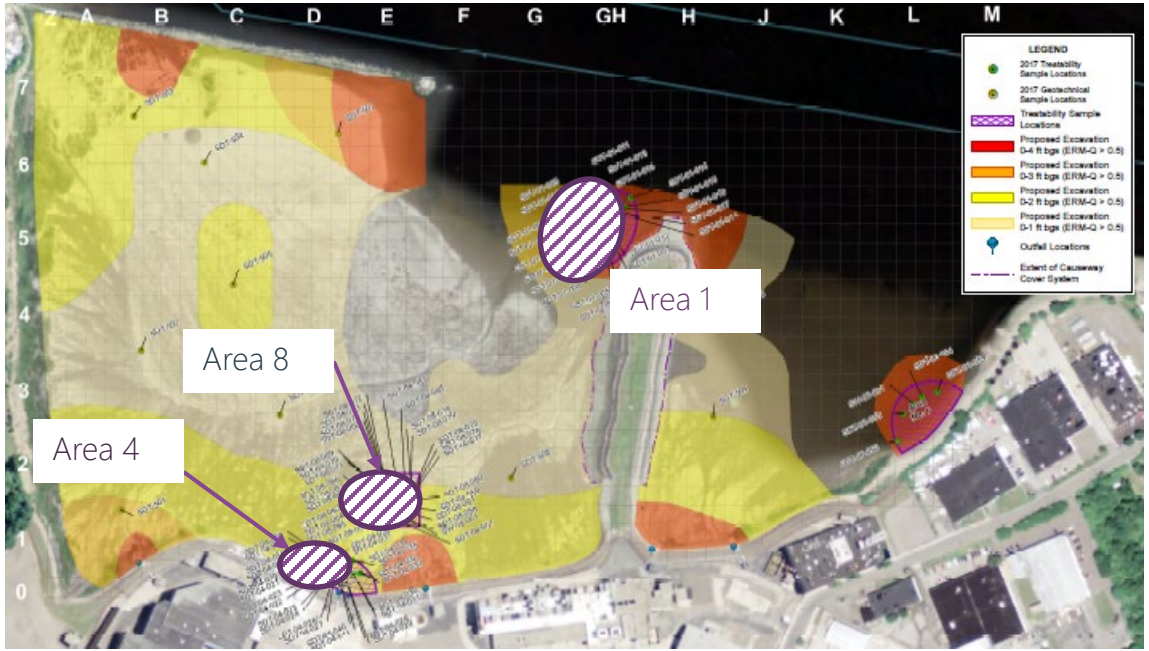
Tidal flats – proposed remedial footprint volume (0-4ft)

Removal Depth (ft)	Non-TSCA Volume (cy) (Beneficial Reuse)	Volume (cy) 1 ppm ≤ PCB < 50 ppm (RCRA D Disposal)	Volume (cy) 50 ppm ≤ PCB (TSCA Disposal)	Total Volume (cy)
0-1	68,000	4,000	240	72,200
1-2	42,000	300	120	42,400
2-3	10,000	4,100	0	14,100
3-4	10,000	100	0	10,100
Total	130,000	8,500	360	138,900

Note: Most volume is non-TSCA (<1 ppm PCBs) and can potentially re-used on site.

August to October 2017 Treatability Sampling

- 40 gal sediment
- 55 gal water
- geotechnical
- Testing completed 8/17 to 2/18
- Biased to high PCBs, high Hg, high ERM-Q



Objectives

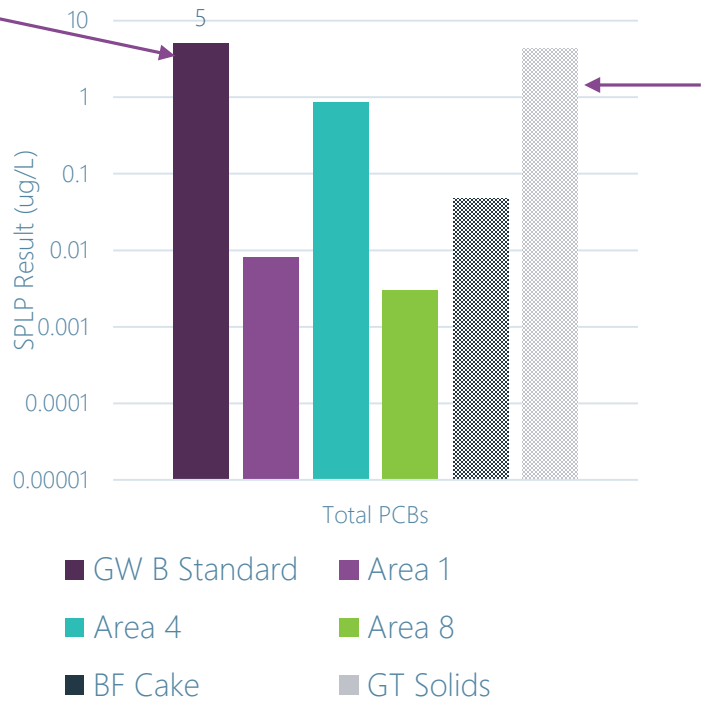
Test	Objective
Modified elutriate	Identify water quality concerns resulting from dewatering activities, compare to SB chronic standards
Organic carbon	Confirm TOC levels, verify sediment is representative, determine if potentially a concern with solidification
Geotechnical testing	Establish physical properties of sediment, verify consistent with past results for cost estimating purposes
SPLP raw and processed	verify material can be placed on site in accordance with State leaching to groundwater standards
Waste characterization	Ensure suitability for placement on-site or as RCRA D material off-site, State residential direct contact
Flocculant test	Identify appropriate flocculant for use in treatability testing, encourages settling the best
Dewatering	Support dredge evaluation, evaluate dewatering methods, comparison of %solids achieved, passing paint filter
Solidification: SPLP/TCLP	Determine if solidified sediments can be placed on site (compliance with state leaching to groundwater standards), pass TCLP
Solidification: UCS	Determine achievable strength of solidified sediments consistent with likely end use of the site (40 to 80 psi)

Untreated sediment testing

- SPLP (aqueous, compare to State groundwater – Industrial)
  - No exceedances of metals or PCBs of the state GW standards (industrial)- untreated sediment meets state leachability standards
  - Highest PCB result of 2.3 ug/L (<5 ug/L std) from locations biased towards highest PCB locations on site
  - Mercury in only one sample was at the limit of 20 µg/L
- Solid waste (total constituent compare against residential direct contact standards)
  - can exceed for PCBs, As, Cu (possibly), relatively small volume, must go off-site
  - Sampling/characterization program to identify PCBs exceeding 1 ppm, and other metals exceeding direct contact (residential) criteria

Example data chart – PCBs SPLP

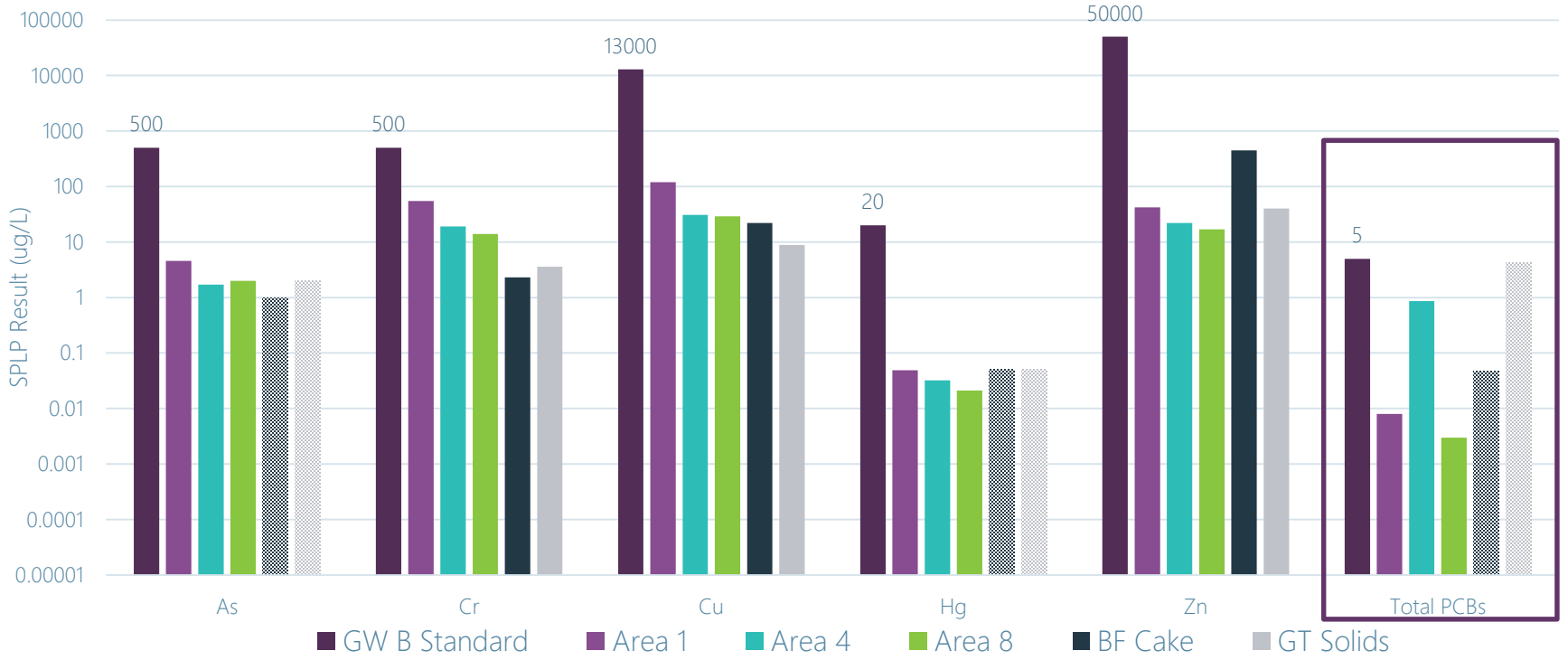
- Standard, SPLP based



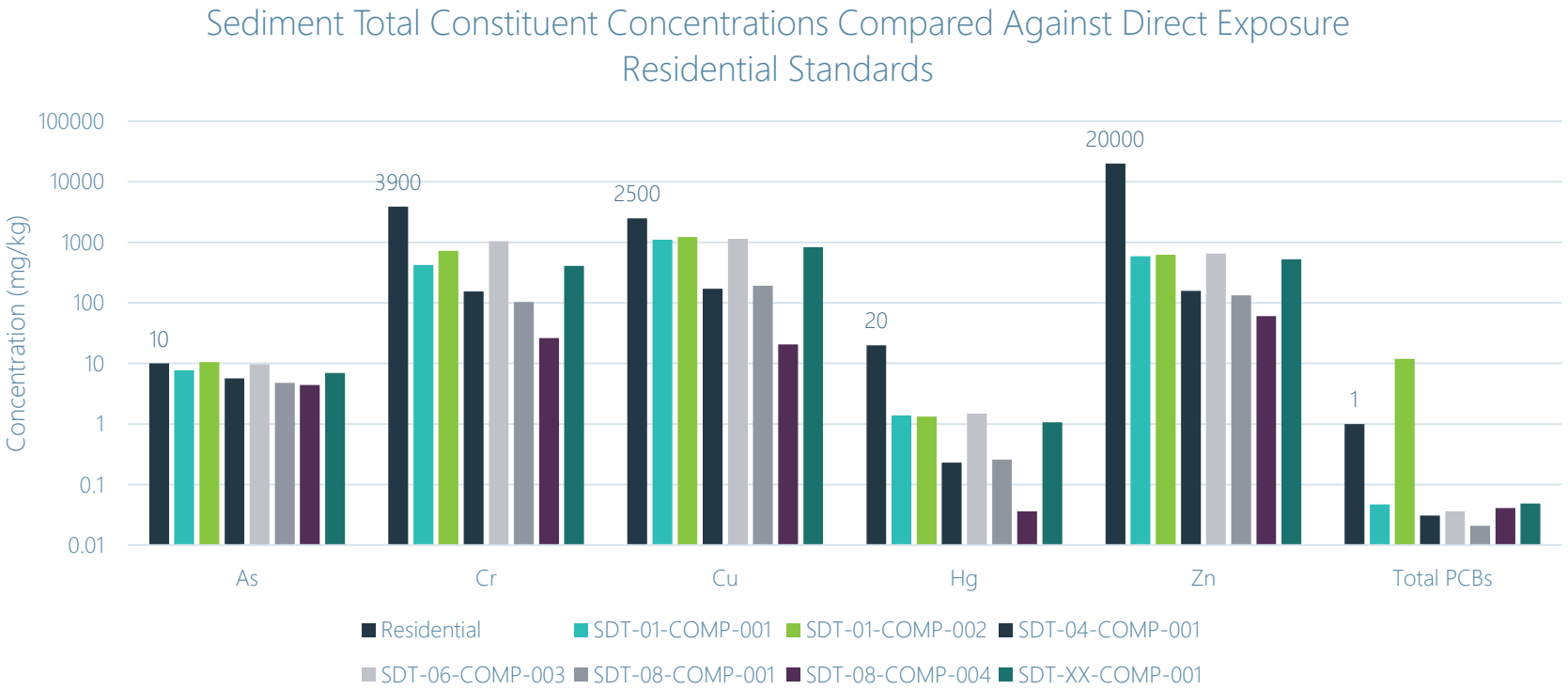
- Greyed out bars are non-detect

- Results from 3 areas, unprocessed
- Results for belt-filter processed sediments
- Results of geotube processed sediments
- Log-base scale

Raw and dewatered sediment SPLP Results



Total concentrations against State Direct Exposure Criteria



Study 1 - Bench-scale treatability tests

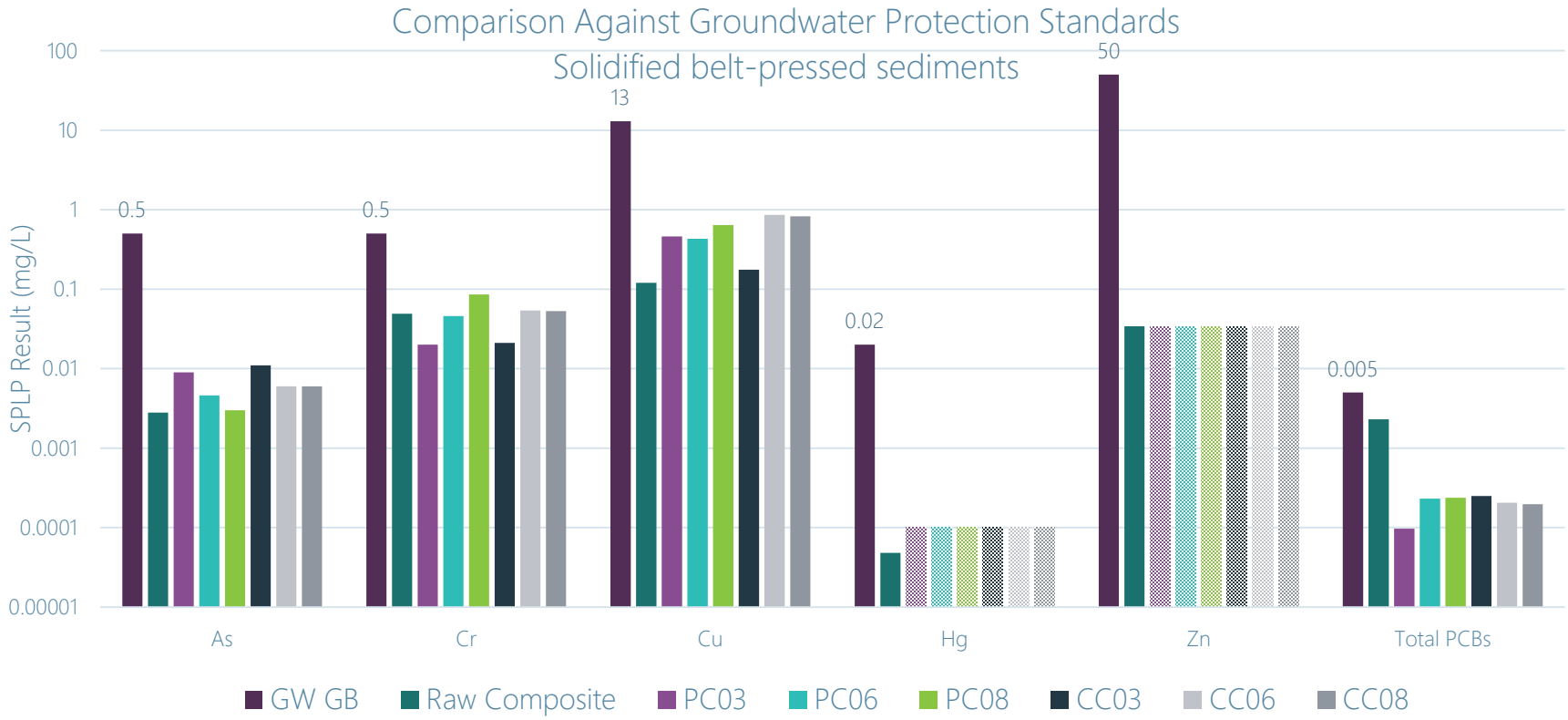
The following tests were conducted:

- Dewatering
  - Flocculant
  - Mechanical
  - Geotube
  - Gravity
- Water treatment
  - Carbon adsorption
  - Filtration
- Solidification

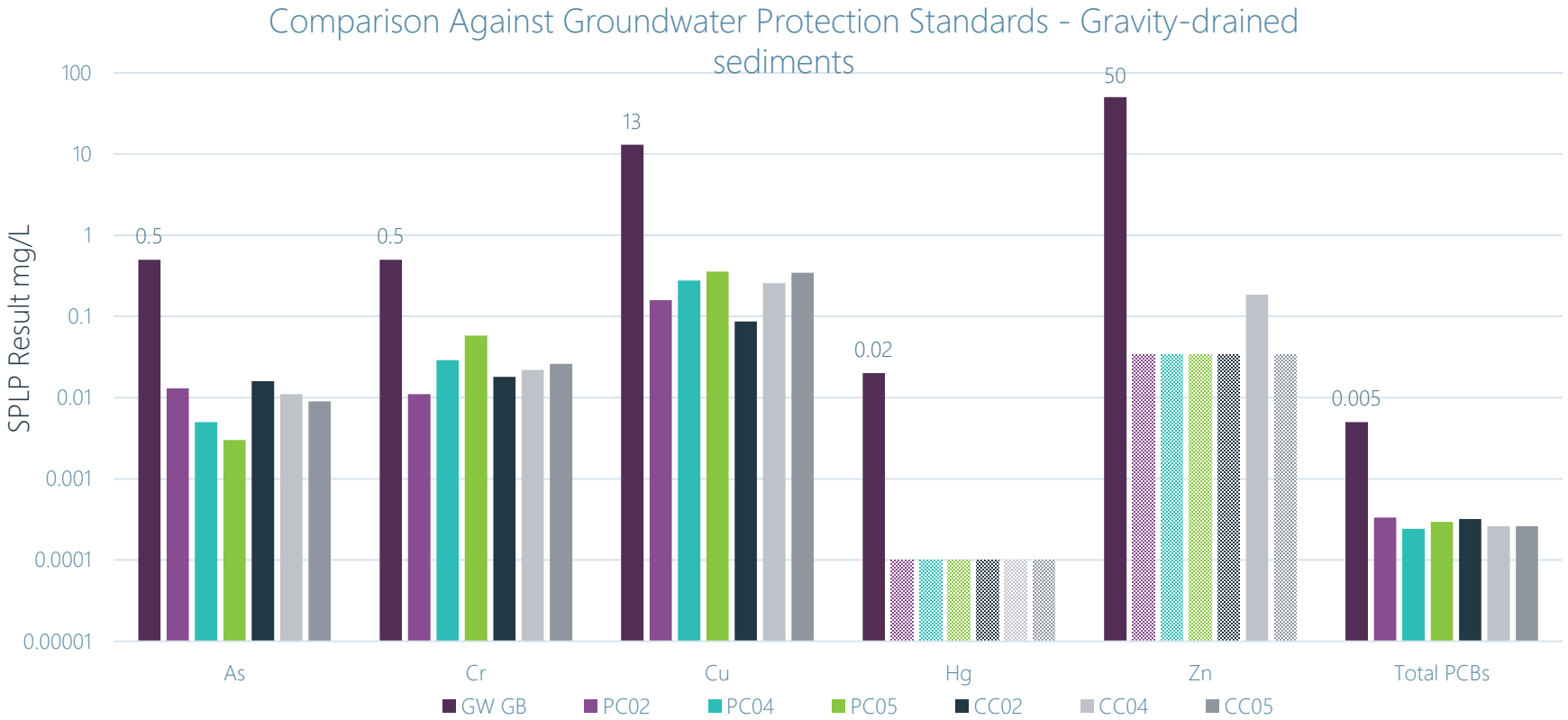
Study 1 - Treatability testing - solidification

- Evaluate sediment additives to meet on-site re-use requirements
- Portland Cement and Calciment for gravity dewatered and belt pressed dewatered sediments:
  - 3%, 6%, 8% for belt pressed sediments
  - 2%, 4%, and 5% for gravity drained sediments
- Physical properties after treatment
- Leaching tests – all pass
  - SPLP – Site COCs (PCBs, 8 metals, Hg)
  - TCLP – RCRA 8 metals

Study 1 - SPLP results – Belt press



Study 1 - SPLP results – Gravity Drained



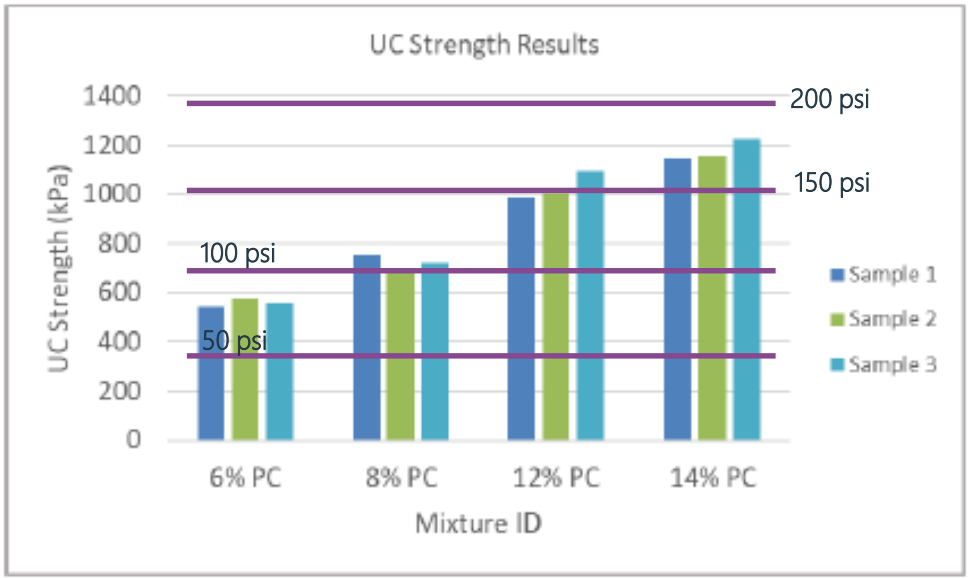
Study 1 - Solidification results – UCS values

Untreated Material Type	Reagent Type	Reagent Addition % by Wet Soil wt.	UCS (psi)
DEW-SED-PT-Belt Press	Type I Portland Cement	3.0	8.8
		6.0	108.3
		8.0	91.3
	Mintek Calciment	3.0	F
		6.0	31.5
		8.0	33.8
DEW-SED-Gravity Drain	Type I Portland Cement	2.0	5.5
		4.0	61.0
		5.0	90.0
	Mintek Calciment	2.0	F
		4.0	11.5
		5.0	18.5

Study 2 -Treatability testing – solidification via PFTM

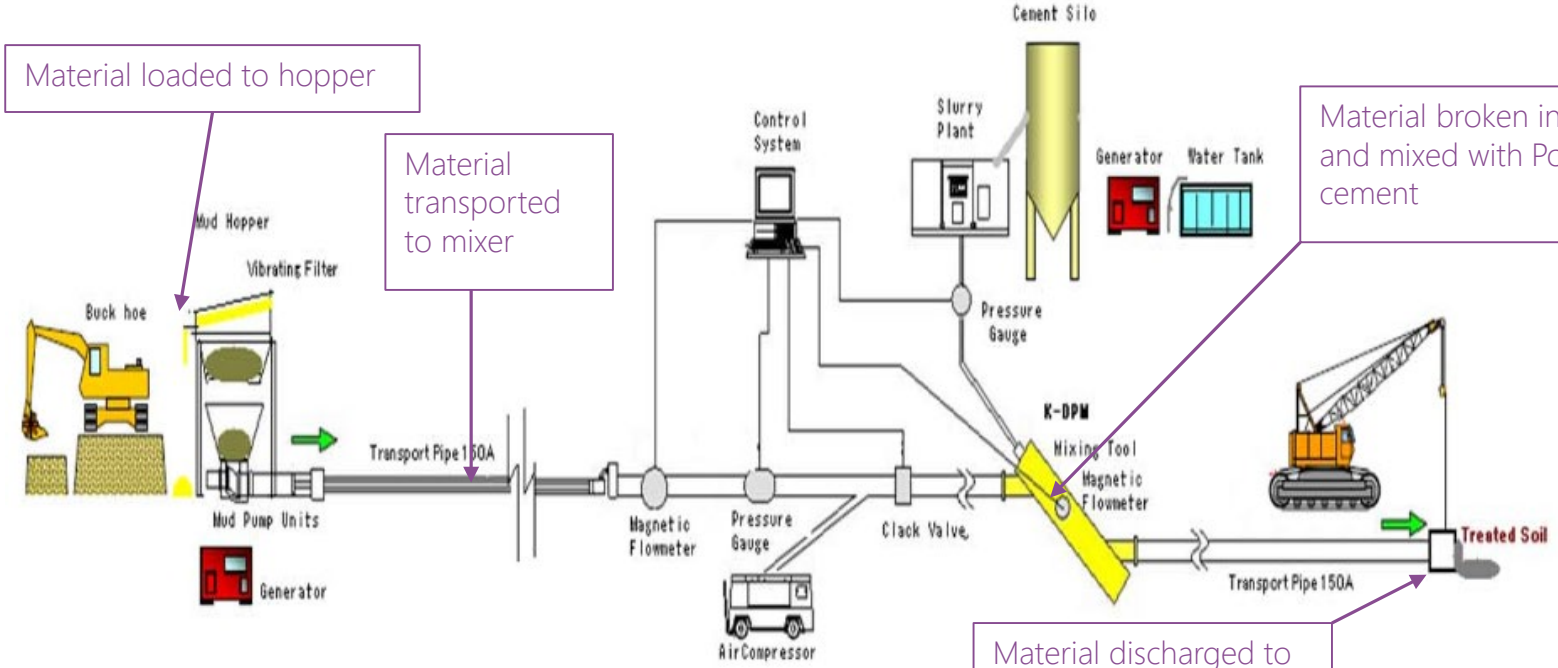
- Bench-scale testing completed using process that simulates mixing in PFTM process
- Tested addition rates of Portland cement of 6%, 8%, 12% and 14%
- Mixed using a 1:1 w:c slurry
- Results show excellent strength development, from 80 to 170 psi (UCS)

Figure 2. Unconfined Compressive Strength Results



Note: 100 Kilopascal (kPa) = 14.5 psi

Study 2 - Pneumatic flow tube mixing



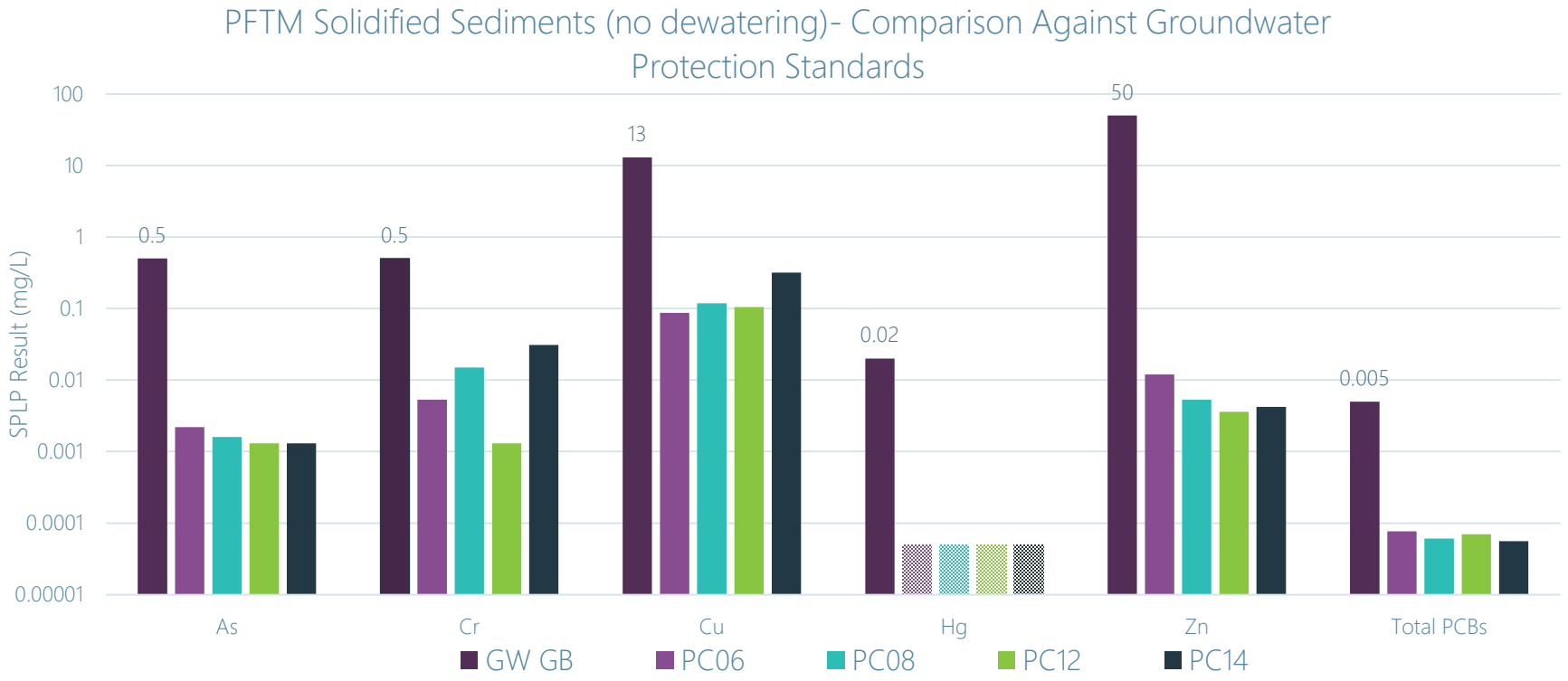
Pneumatic flow tube mixing

Material Consistency Immediately After Discharge

Material Consistency ~24-hours After Discharge

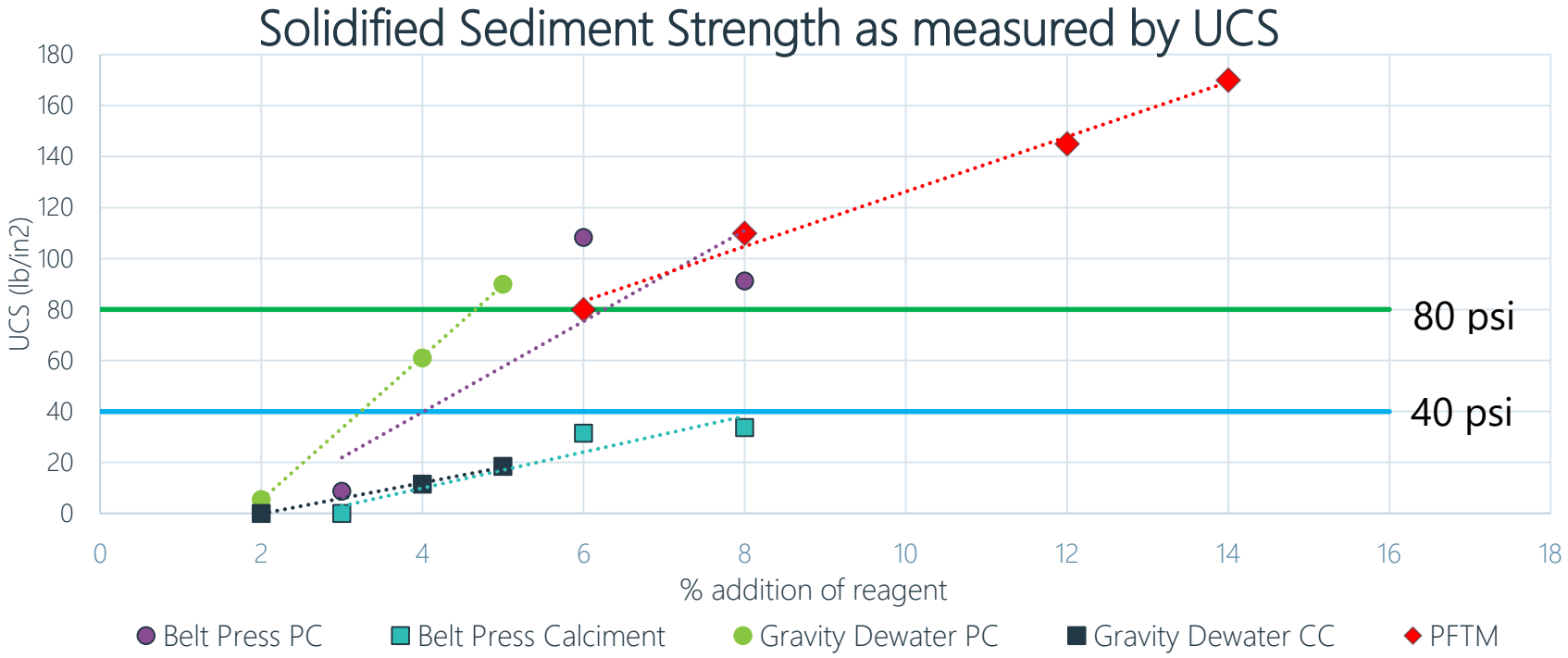
Courtesy of TPRG

Study 2 - SPLP results for PFTM solidified sediments



Sediment Before and After

Study 1 and Study 2 Comparison



PC= Portland cement; CC=Calciment; PFTM= pneumatic flow tube mixing; UCS= unconfined compressive strength (ASTM D1633); psi = pounds per square inch

Treatability testing conclusions

- Leaching to groundwater (State GW Standards)
  - Study 1 and Study 2 solidified samples pass SPLP tests, meeting leaching to GW standards
- RCRA – All samples pass TCLP and hazardous waste characteristics
- Total waste direct contact residential standards (State standards)
  - PCBs and copper can exceed total waste residential criteria
  - An ongoing sampling program will be needed
  - Volume is small relative to re-use volume

Treatability testing conclusions (cont'd)

- Study 1 - Gravity
  - >=4% PC develops significant strength
  - Calciment pass paint filter, little strength
- Study 1 - Belt press
  - >=6% PC developed significant strength
  - Calciment ~35 psi @ 8%
- Study 2 - PFTM
  - UCS of 80 to 170 psi (6 to 14% PC)
- Final Conclusions
  - Gravity drained, belt pressed dewatered, and PFTM all develop sufficient strength
  - Sediments suitable for reuse based on leaching to GW, direct contact, and strength requirements
  - Processed sediments from various dredging methods can meet on-site reuse requirements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