Closure Options For Organic Soils:

Analytical Results Interpretation for Peat Material

Presented By:

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Outline

- Introduction
- Site Locations
- Peat vs Mineral soils
- Effect of moisture content on organic parameter analyses
- Silica gel clean up for hydrocarbons
- Effect of % saturation for inorganic salt analyses
- Summary and Conclusions

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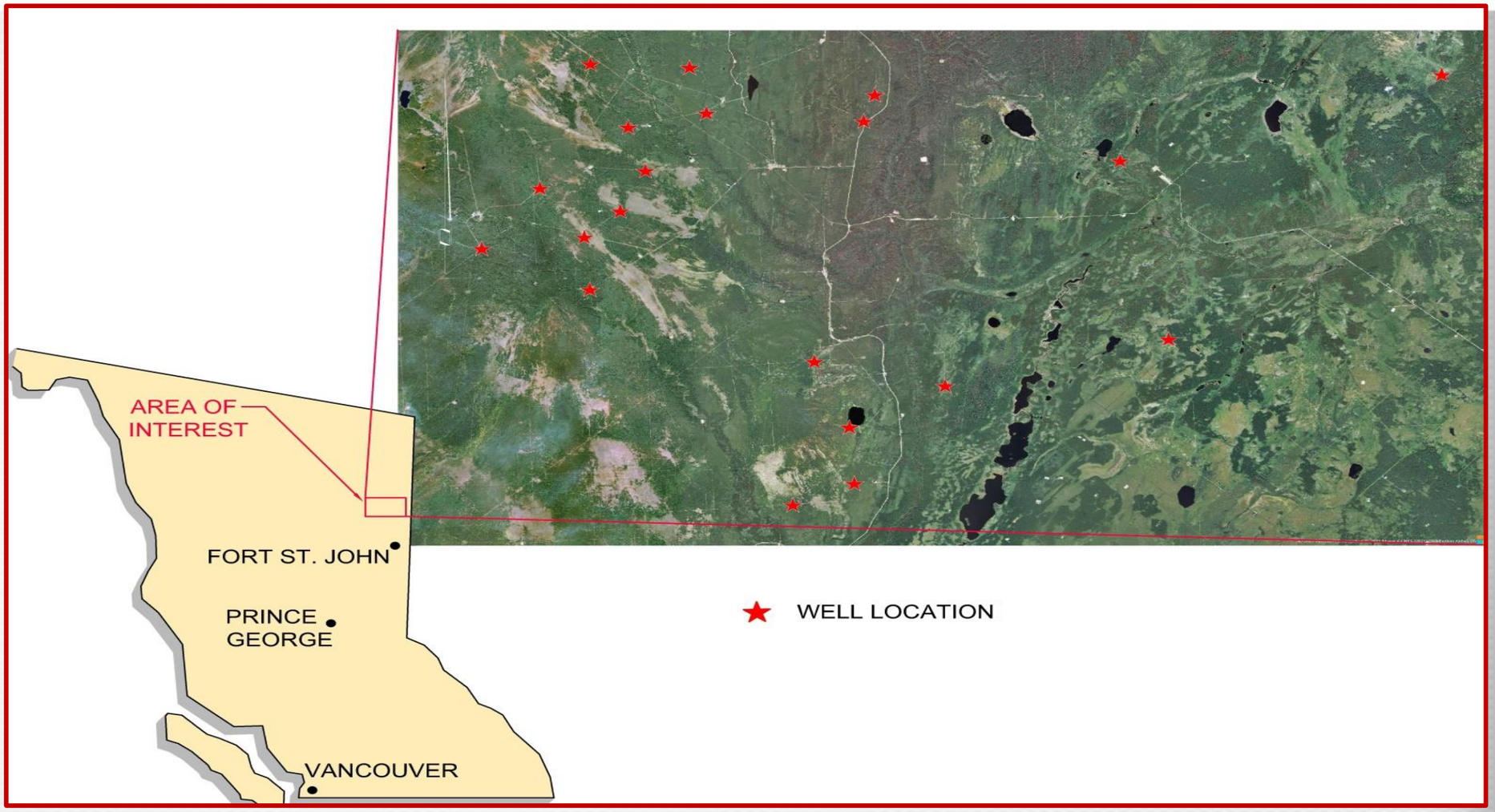
Introduction

- 20 well sites located in northeastern BC
- Located in wildland areas (Natural land use)
- Highly organic soil (thickness varied from 0.5 to 4.0 m)
- Primary contaminants of concern included PHCs, salinity and methanol



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Physical Properties of Peat

- High total organic matter and organic carbon content
- High moisture content and water holding capacity
- Very low bulk density
- Low pH

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Peat and Mineral Soil Comparison

Physical Property	Peat	Mineral Soil
Moisture Content	>70 %	~20 -30%
Organic Matter Content	> 60 %	1 to 6%
Total Organic Carbon	> 40%	< 1%
Water Holding Capacity	10 × weight	0.5 × weight
Bulk Density	0.05 to 0.3 g/cm^3	1.0 to 2.0 g/cm^3
pH	3 to 5.0	7.0

- Analytical methods and guidelines that are developed for mineral soil is used for peat !

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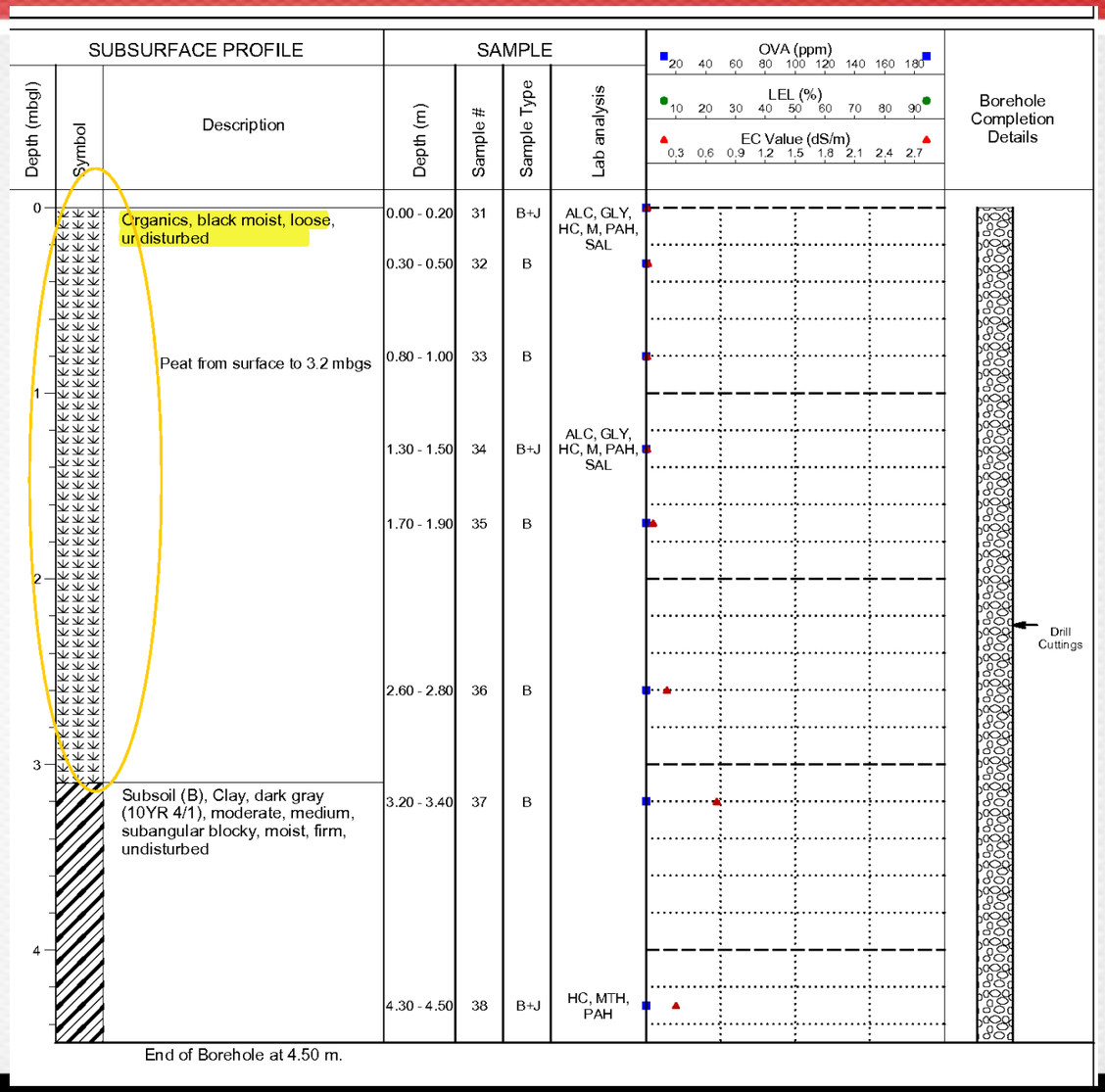
Typical Borehole Log

- **Peat layers of 0.5 m to 4.0 m thickness followed by clay/silty clay**



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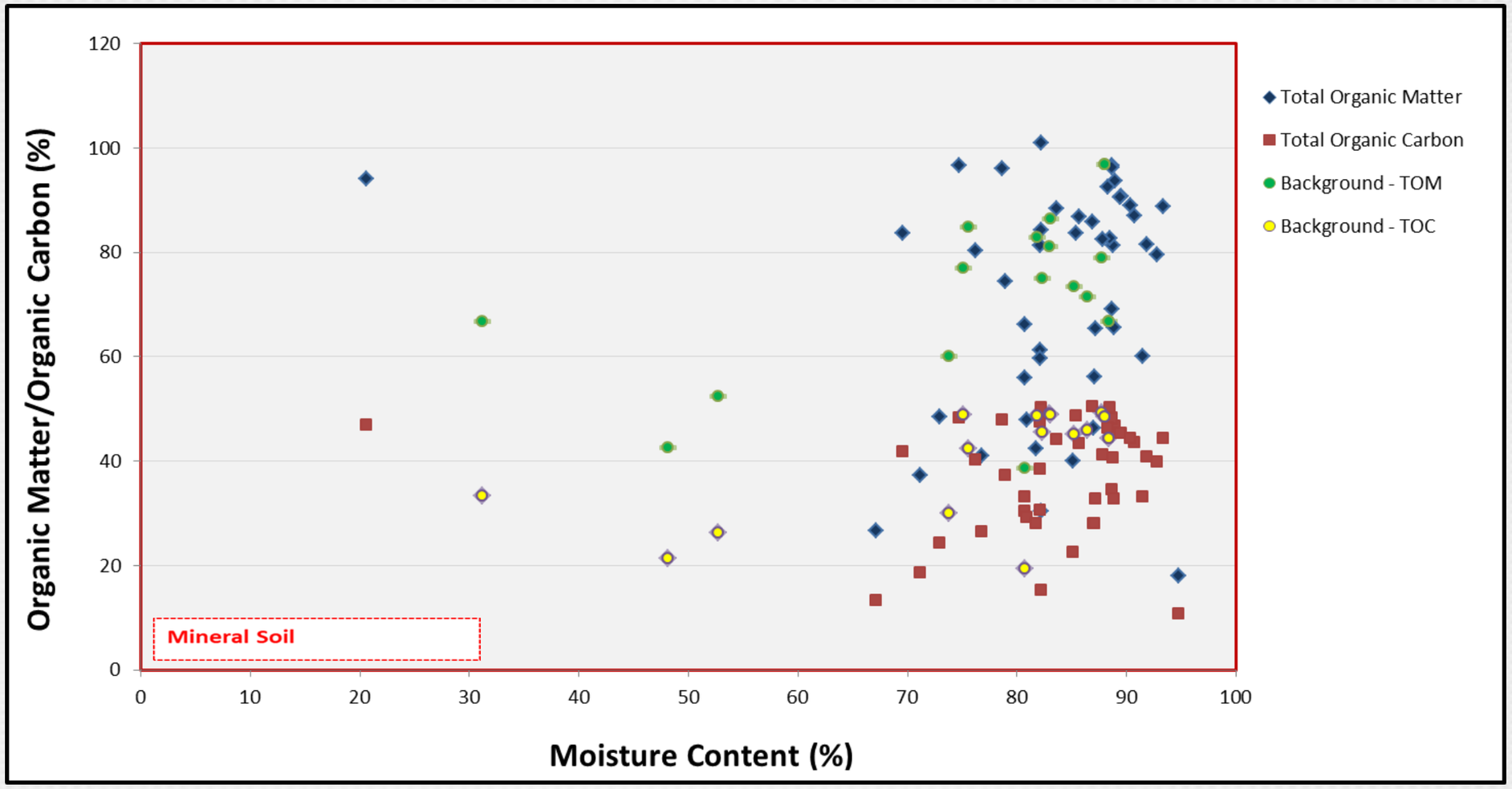
Total Organic Matter and Organic Carbon Distribution in Peat



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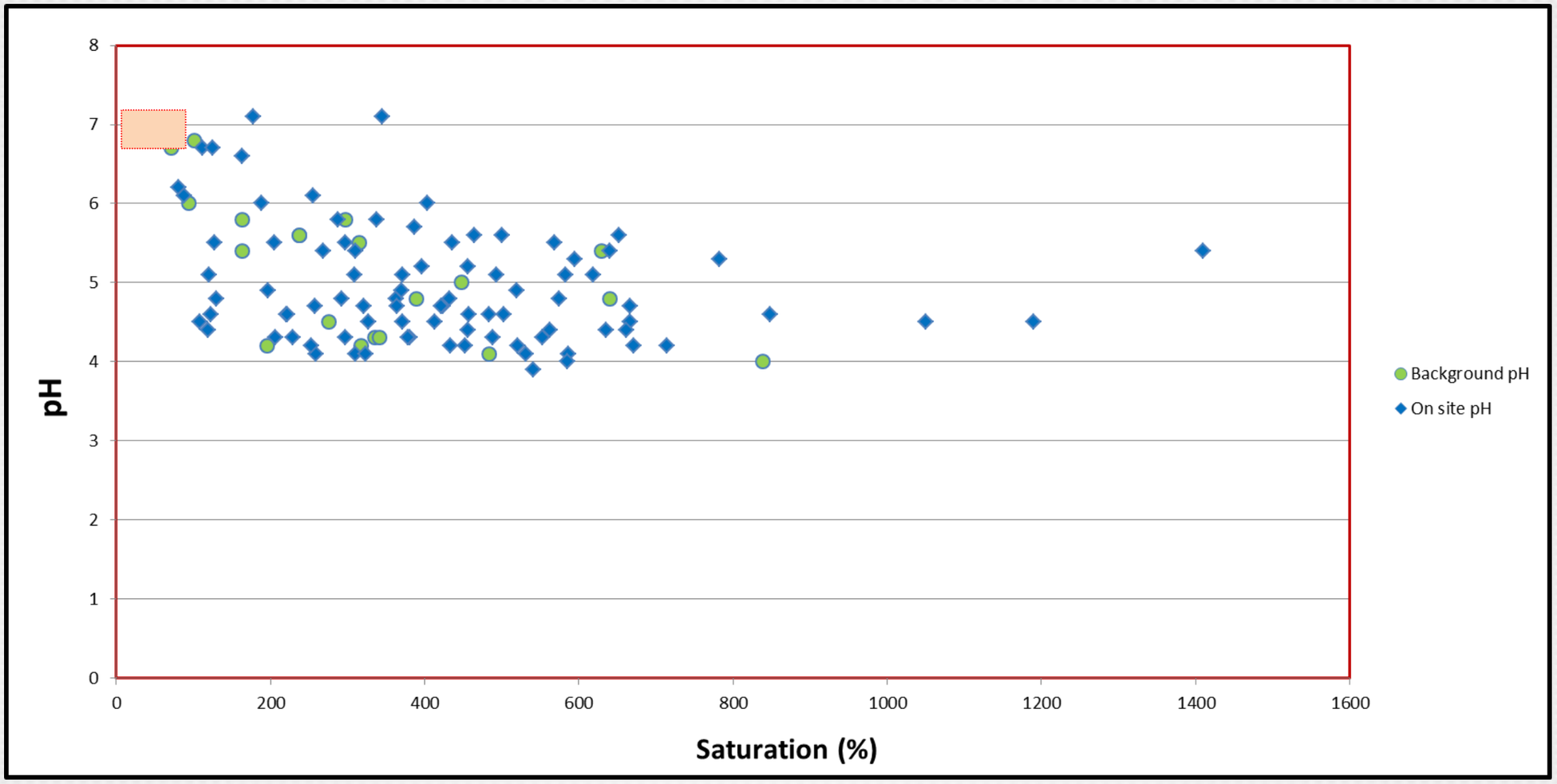
Variation of pH with % Saturation in Peat



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Organic Parameter Analyses in Peat

- Laboratory analyses are performed on **Wet Weight Basis (As Received).**
- The results are reported in **Dry Weight Basis.**
- To convert the result from the Wet Weight to Dry Weight basis:

$$Dry\ Weight\ Concentration = \frac{Wet\ Weight\ Concentration}{(1 - Moisture\ Content)}$$

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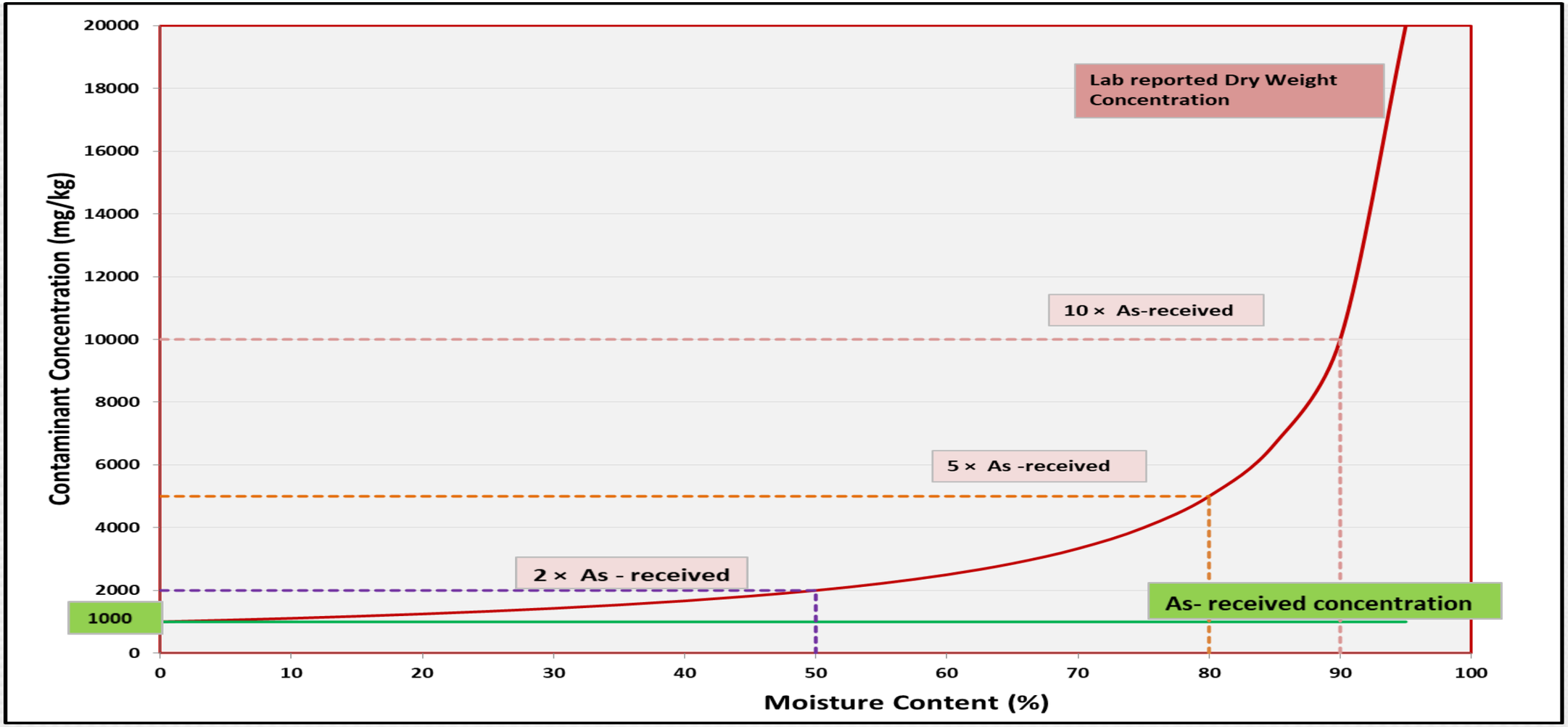
Variation of Contaminant Concentration with Moisture Content



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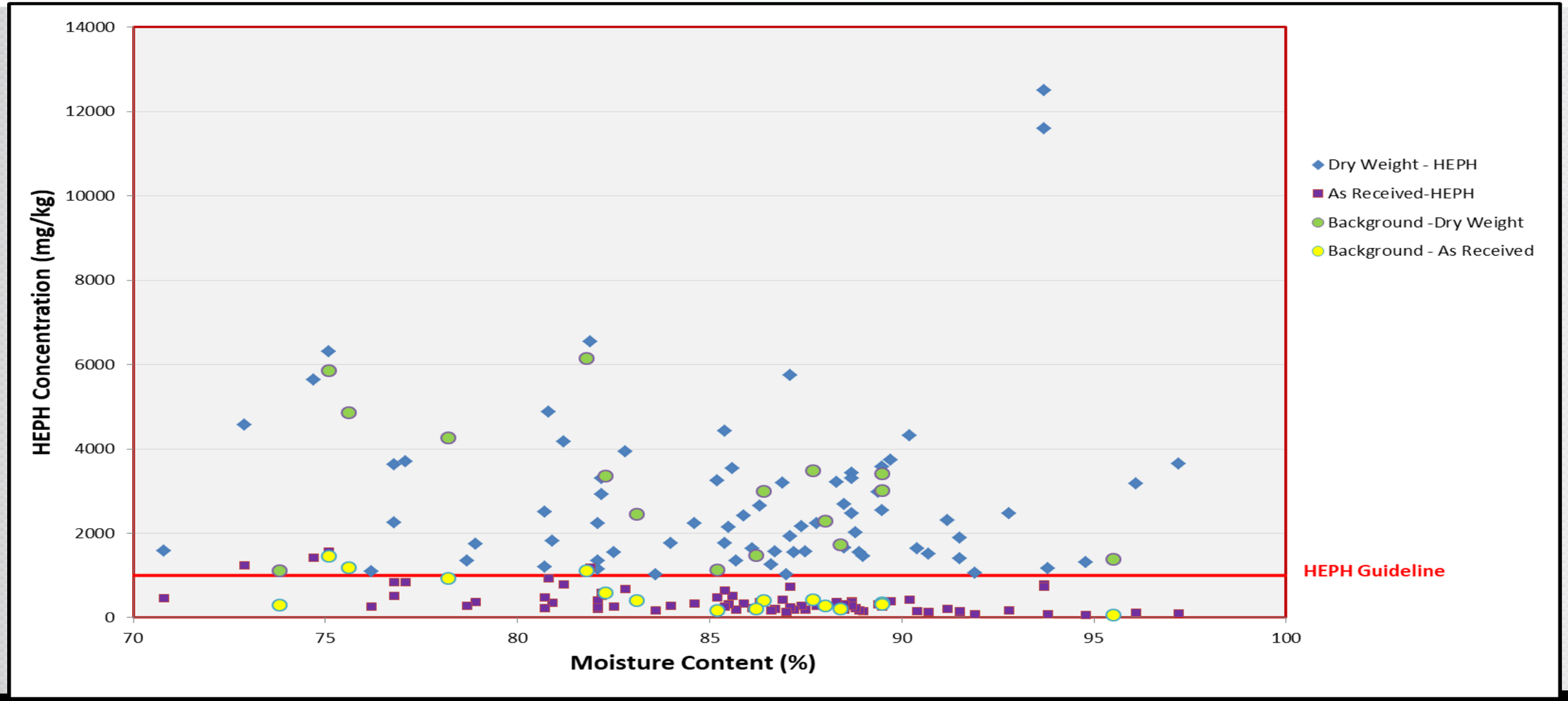
Comparison of Dry weight with As Received – HEPH (C19-C32)



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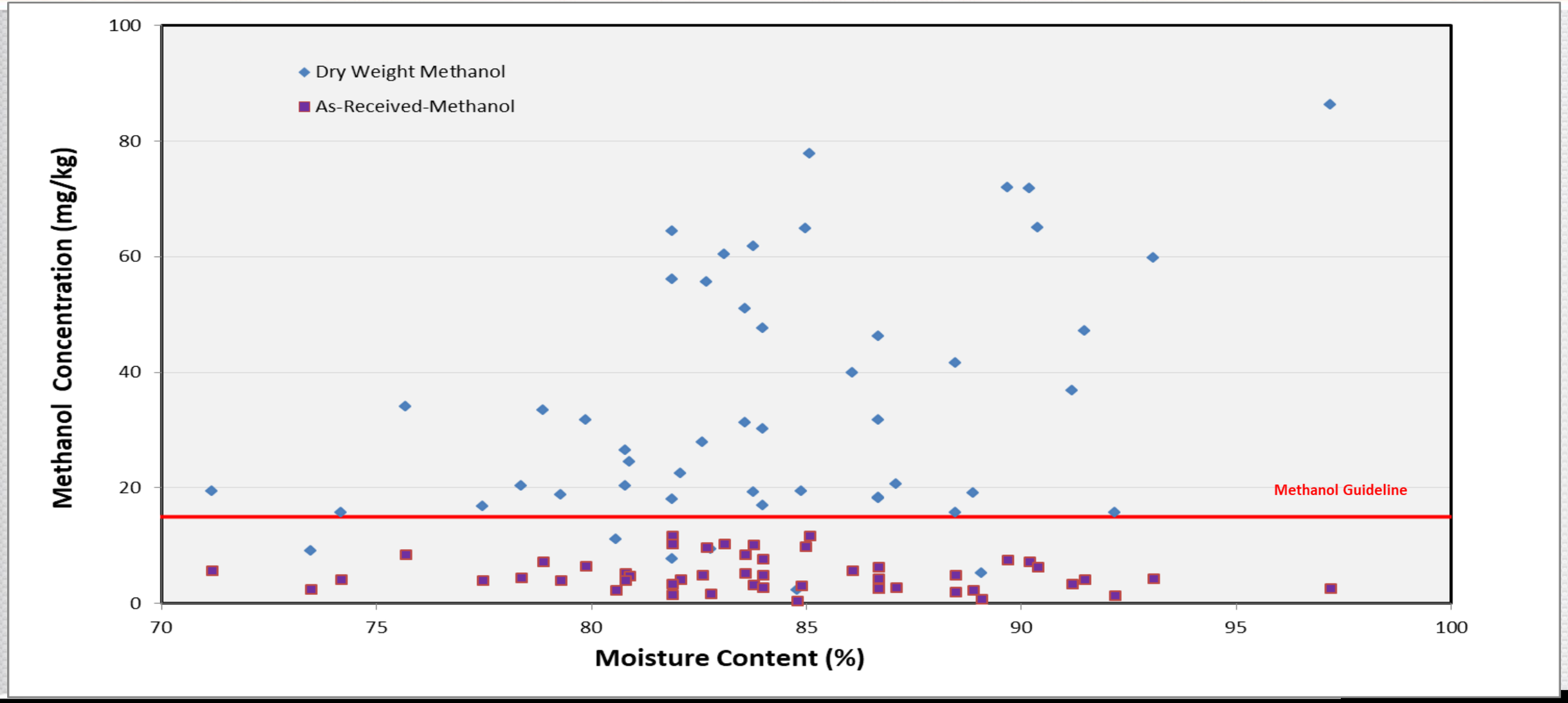
Comparison of Dry weight with As- Received (Wet Weight) - Methanol



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Organic Analyses – Silica Gel Treatment

- Biogenic organic compounds (polar molecules) in peat samples can be extracted during the analyses process and show artificially elevated organic parameter concentrations.
- Silica gel treatment can be used to remove polar molecules and address this issue.
- Applicable only for PHC C10 - C34 range (i.e. LEPH (C10- C16) and HEPH (C19-C32) in BC or F2 (C12-16) and F3 (C16-34) in AB).
- Silica gel treatment allows one time use of 0.5 g of silica gel to remove polar molecules.

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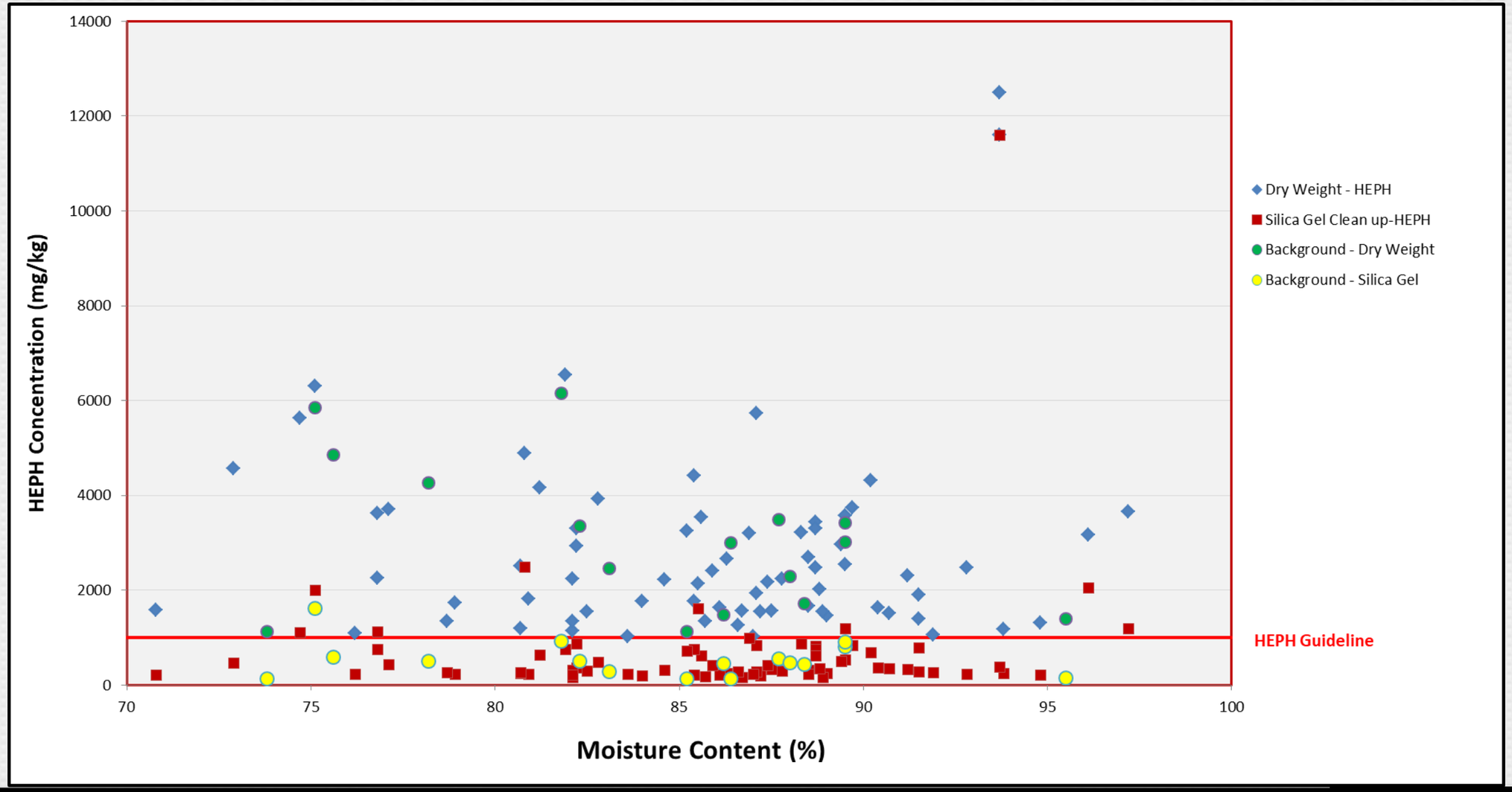
Organic Analyses –Silica Gel Clean Up



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Silica Gel Clean Up Limitations

- Silica gel treatment process was developed on mineral soil with < 5% total organic matter content.
- Silica gel can also remove petrogenic compounds (such as diesel and motor oil); therefore, the use is restricted to one time 0.5 g.
- In highly organic soils, silica gel treatment can be ineffective if oversaturated by high organic matter content in peat and overestimate the final result.

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Inorganic Parameter Analyses - Metals

- **BC Strong Acid Leachable Method is effective and appropriate for metal ion analyses in peat.**
  - **Due to low pH and nutrient rich composition, peat is likely to have naturally elevated high metal concentrations.**
  - **The BC background metal database is developed for mineral soil.**
  - **Created a regional background metal database for comparison.**

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Inorganic Parameter Analyses – Salinity Parameters

- **Saturated paste extraction involves the addition of water to a dried sample until reaches the point of saturation.**
- **Once the soil is fully saturated, the mixture will be left to allow the salts to reach equilibrium.**
- **The water phase is extracted and the filtrate is analyzed for salts.**

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Saturated Paste – Salt Analyses

- **Concentrations in the filtrate are measured in mg/L and converted into mg/kg using the saturation %.**

$$Dry\ Weight\ Concentration = Measured\ Concentration \times (\%\ Saturation)$$

Saturation % = mass of water that is absorbed / mass of the soil

- **High water absorption capacity or the water holding capacity (Saturation %) of peat will cause significant increase in reported concentrations.**

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Saturated Paste – Salt Analyses

Soil Type	% Saturation
Sand	15
Clay	65
Swelling Clay	100
Peat	100 to 3,000

% saturation of 1000 ⟹ 10 g of peat can hold 100 g of water.

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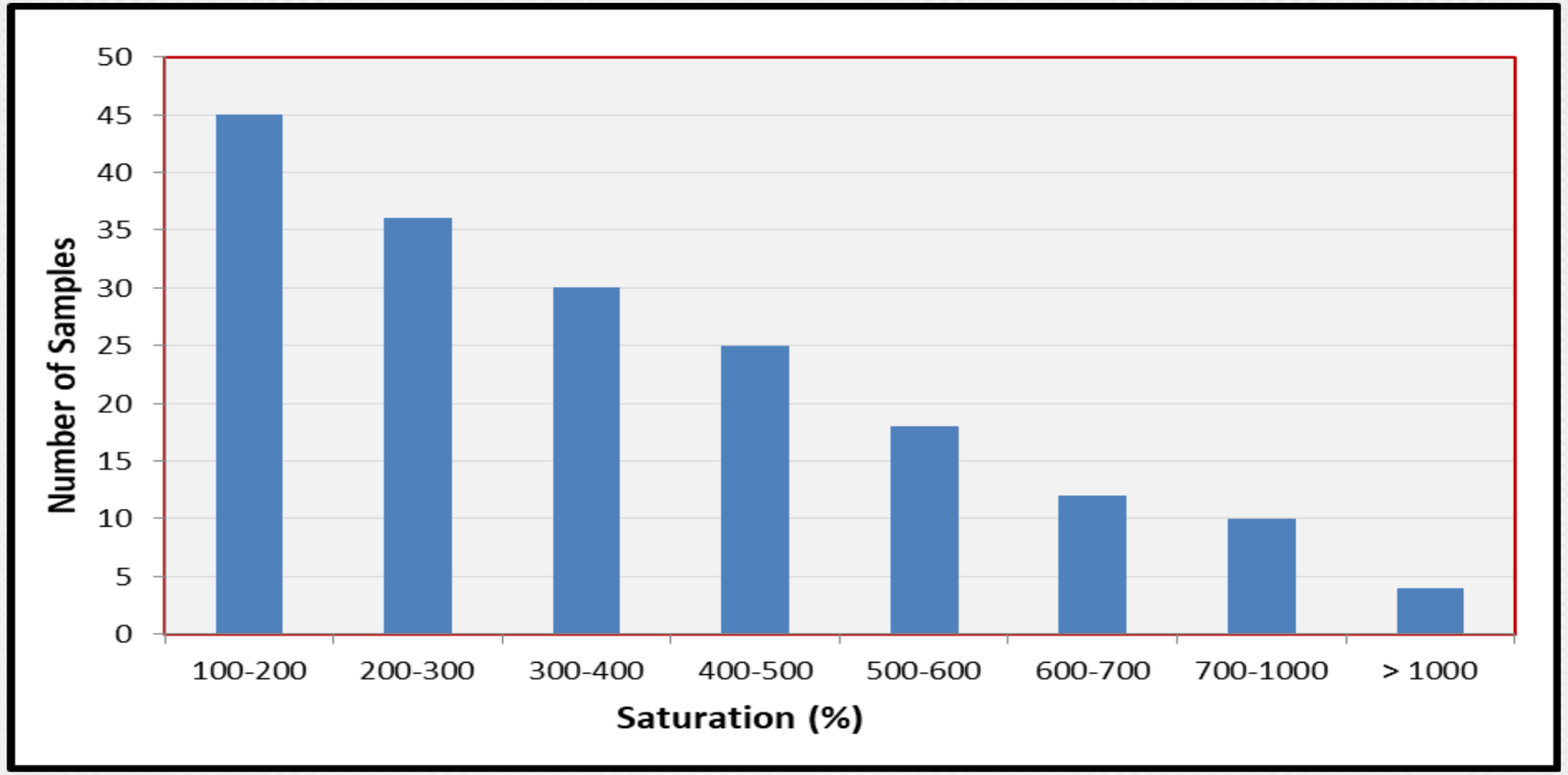
Measured % Saturation



- % saturation ranged from 100 to 1,410 %
- Inorganic salt concentrations in mg/kg were 1 - 14 times higher than mg/L

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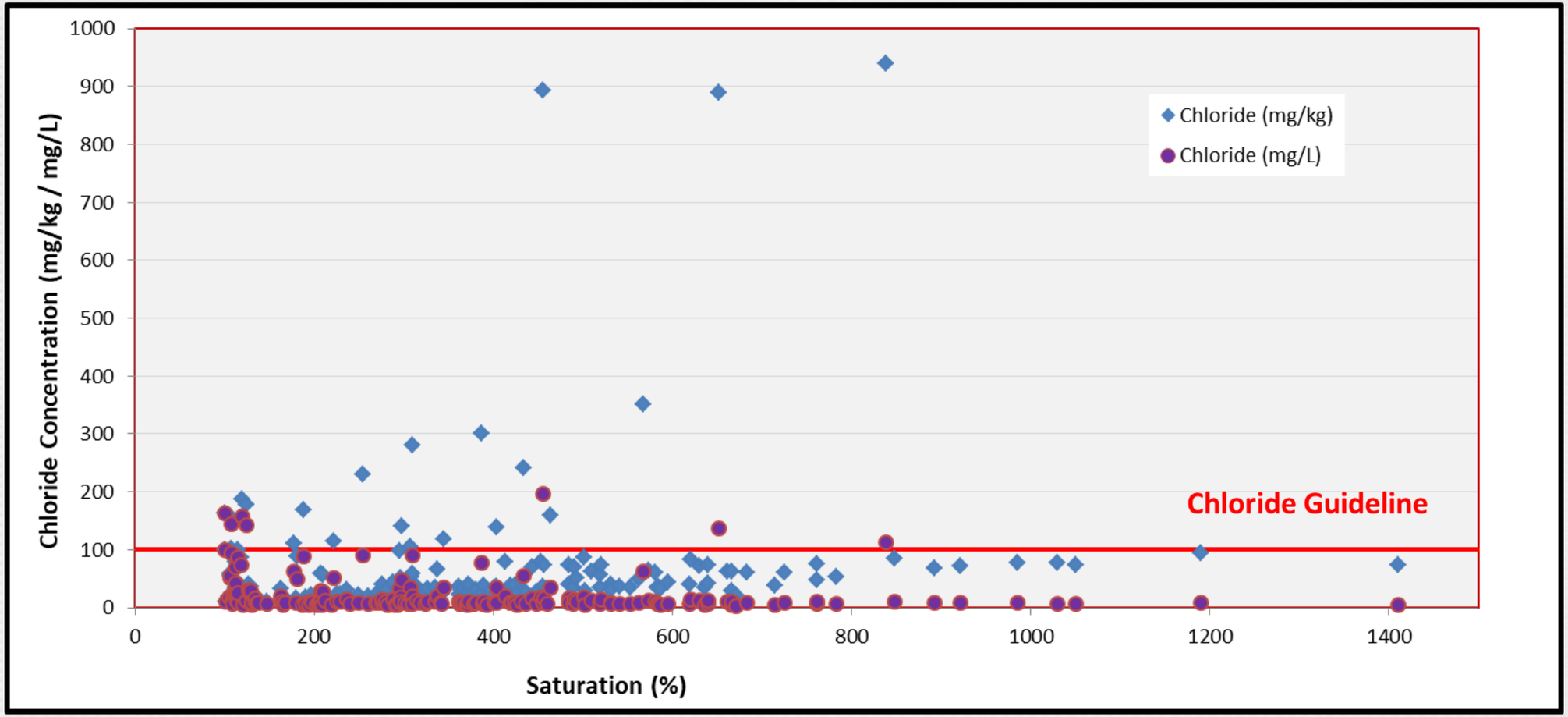
Variation of Chloride Concentrations with % Saturation



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Summary and Conclusions

- Analytical methods developed for mineral soil is used for peat.
- Use borehole logs, moisture content, % saturation, organic matter and organic carbon content to confirm the presence of peat.
- High moisture content in peat can create false elevated organic parameter concentrations (PHCs) due to the moisture conversion factor.

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Summary and Conclusions

- **Use Silica-Gel treatment to remove biogenic influences.**
- **Elevated % saturation can cause small concentrations of inorganic salt to appear very large.**

Use a combination of methods to evaluate/justify the results to ensure natural, uncontaminated sites are NOT unnecessarily remediated.

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Summary and Conclusions

- **Other justifications that can be used:**
  - **BC Groundwater model with site specific fraction of organic carbon (foc) content (maximum allowable is 0.05, which is equivalent to 5 % TOC) for selected organic parameters (BTEX, methanol).**
  - **Chromatogram interpretations.**
  - **Biogenic Interference Calculation (BIC) Scale (In Alberta).**

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QUESTIONS?

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