Are Certain Types of Soil Better at Reducing the Leaching of Road Salt into Waterways?

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Background

Background - Soil

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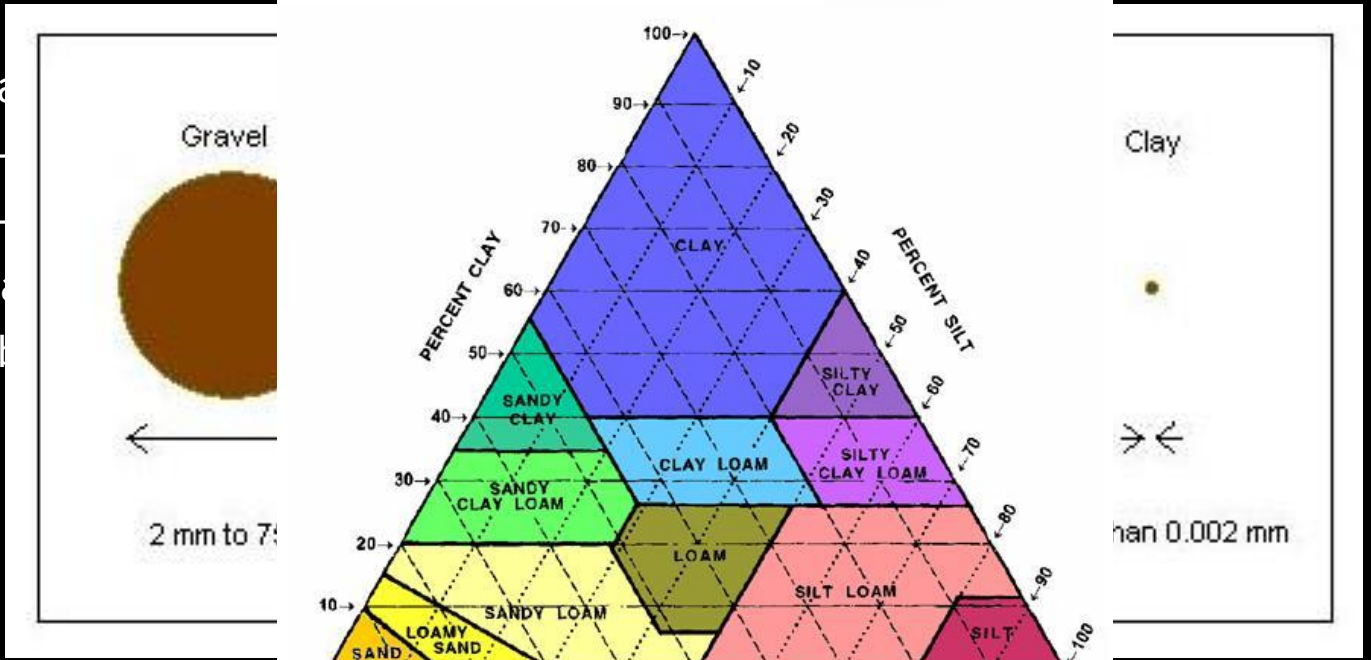

Background - Soil

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Soil texture	*CEC (cmol kg^{-1})*
Sands (low OM)	3–5
Sands (high OM)	10–20
Loams	10–15
Silt loams	15–25
Clay and clay loams	20–50
Organic soils	50–100

Background - Effects of Salt

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Table 3. Calculated chloride concentrations in six urban Burlington Vermont streams, June through November 2005. Values were calculated from continuously monitored conductivity data using linear regression.

Location	Daily Mean and total range of calculated chloride values in mg/l	Percent of daily mean chloride concentration values exceeding EPA chronic criterion
Allen Brook	78 (10-205)	0
Bartlett Brook	121 (4-244)	0.7
Centennial Brook	277 (53-754)	70
Muddy Brook Trib.	257 (14-490)	66
Sunderland Brook	103 (3-199)	0
Sunnyside Brook	261 (82-449)	79

Source: *Environmental Implications of Increasing Chloride Levels in Lake Champlain and Other Basin Waters,* Vermont Department of Environmental Conservation

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Background - Indian Brook

- Very close to high school parking lot
- Susceptible to pollution from salt on parking lots
- Flows directly into Lake Champlain

Experimentation

Experimentation - Testable Question & Hypothesis

Testable Question: Which type of soil will best mitigate the extent of salt leaching into waterways?

Hypothesis: Loam will best mitigate the extent of salt leaching into waterways due to its high cation exchange capacity

Experimentation - Methodology

- 130 g of sand, silt, and soil from school site or 25 g of loam
- 80 mL of deionized (DI) water
- 1 g salt
  - 95.8% to 99.8% of sodium chloride
- Three trials for each soil, one control trial without any salt
- When conductivity measurement of ionized solution was too high (20,000 µS/mL), dilution was required
  - 10 mL of DI water and 10 mL of ionized solution were combined
  - Conductivity of the diluted solution was doubled


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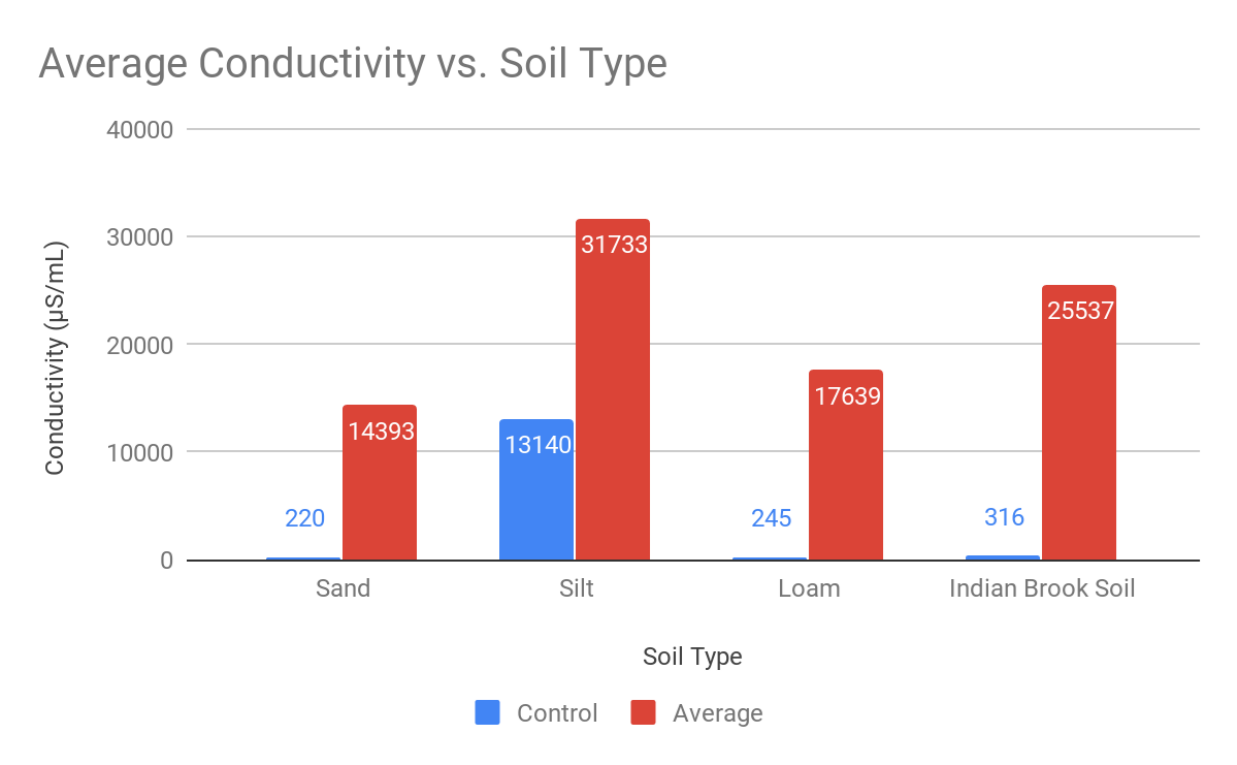
Experimentation - Data



Experimentation - Data

		Conductivity (µS/mL)				
		Control	Average	Trial 1	Trial 2	Trial 3
Soil Type	Sand	220	14393	15270	12540	15370
	Silt	13140	31733	35460	34280	25460
	Loam	245	17639	4616	7300	41000
	Indian Brook Soil	316	25537	28860	33500	14250

Conclusions

- The data collected did not support the hypothesis that loam would be best at mitigating the extent of salt leaching into waterways
- A conclusion is unable to be made due to lack of consistent data
- Sources of error

Further Research

- More trials
  - Other sources of soil
  - Clay
- By volume instead of mass?
- Measure the chloride and sodium ions separately?
  - Lack of equipment
- Impact on riparian vegetation
- Can riparian vegetation be used to reduce salt runoff?
- What would best assist Indian Brook’s soil to help prevent salt leaching into Indian Brook?
  - Addition of a type of soil

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References

Brown, Katharine, and Jeremy Lemon. “Cations and Cation Exchange Capacity.” Cations and Cation Exchange Capacity | Fact Sheets, 2019, soilquality.org.au/factsheets/cation-exchange-capacity.

Elgin, Erick, and Michigan State University. “Salt Runoff Can Impair Lakes.” *MSU Extension*, 19 Nov. 2018, www.canr.msu.edu/news/salt_runoff_can_impair_lakes.

Goldy, Ron. “Anions and Cations in Plants, Oh My! But Why Do We Care?” *MSU Extension*, 20 Sept. 2018, www.canr.msu.edu/news/anions_and_cations_in_plants_oh_my_but_why_do_we_care.

Goldy, Ron. “What Is Your Soil Cation Exchange Capacity?” *MSU Extension*, 2 Oct. 2018, www.canr.msu.edu/news/what_is_your_soil_cation_exchange_capacity.

Upper Valley Trails Alliance. “Indian Brook Park.” *Indian Brook Park - Trail Finder*, www.trailfinder.info/trails/trail/indian-brook-park.

Michigan Technological University - Michigan Environmental Education Curriculum. *Soil Particle Size*, techalive.mtu.edu/meec/module06/SoilClassification.htm.

Pearson, Krista E. “Basics of Salinity and Sodicity Effects on Soil Physical Properties.” *Basics of Salinity and Sodicity Effects on Soil Physical Properties - MSU Extension Water Quality | Montana State University*, waterquality.montana.edu/energy/cbm/background/soil-prop.html.

Rastogi, Nina Shen. “Does Road Salt Harm the Environment?” *Slate Magazine*, Slate, 16 Feb. 2010, slate.com/technology/2010/02/does-road-salt-harm-the-environment.html.

Shambaugh, Angela. “Environmental Implications of Increasing Chloride Levels in Lake Champlain and Other Basin Waters.” Vermont Department of Environmental Conservation , Feb. 2008.