

## OVERVIEW

**Current GSI Media Specifications:**  
2006 PA Stormwater BMP Manual GSI media requirements<sup>1</sup>:

- Saturated hydraulic conductivity ( $K_{sat}$ )  $\geq 0.1$  inches/hour
- Volume storage soils: no more than 10% clay content, 5-10% organic matter content

Typical GSI media requirements in various other jurisdictions<sup>2</sup>:

- Percent sand, silt, and clay (USDA sizes), topsoil, gravel, and organic matter
- USDA textural classification

**Requirements do not include the consideration of the behavior of the fine fraction of the soil, as indicated by properties such as plasticity.**

**Goals:**

- Utilize laboratory tests and field studies to compare plasticity and  $K_{sat}$  for typical GSI media
- Identify plasticity index (PI) ranges corresponding with adequate and inadequate infiltration rates in GSI
- Make recommendations for including plasticity as a screening tool in GSI specifications

## METHODS

**Mix Preparation**

- Four laboratory-prepared mixes and a contractor supplied mix with identical particle size distributions and USDA classifications (loamy sand/sandy loam, currently used by PennDOT, called "Type 1")

Table 1. Media mix compositions.

Mix Number	Clay Type	Percent Sand	Percent Clay	Percent Silt
1	Kaolin	80	10	10
2	Kaolin	80	5	15
3	Bentonite	80	10	10
4	Bentonite	80	5	15
Contractor Supplied	Unknown	88	2	10

**$K_{sat}$  Testing**

- Saturated hydraulic conductivity tests on each mix and one contractor provided mix

**Field Comparison**

- Five bioinfiltration and bioretention sites where  $K_{sat}$  and PI were measured




Figure 1. Media mix preparation.

**Soil Characterization Testing**

- Hydrometer and sieve analysis, Atterberg limit testing

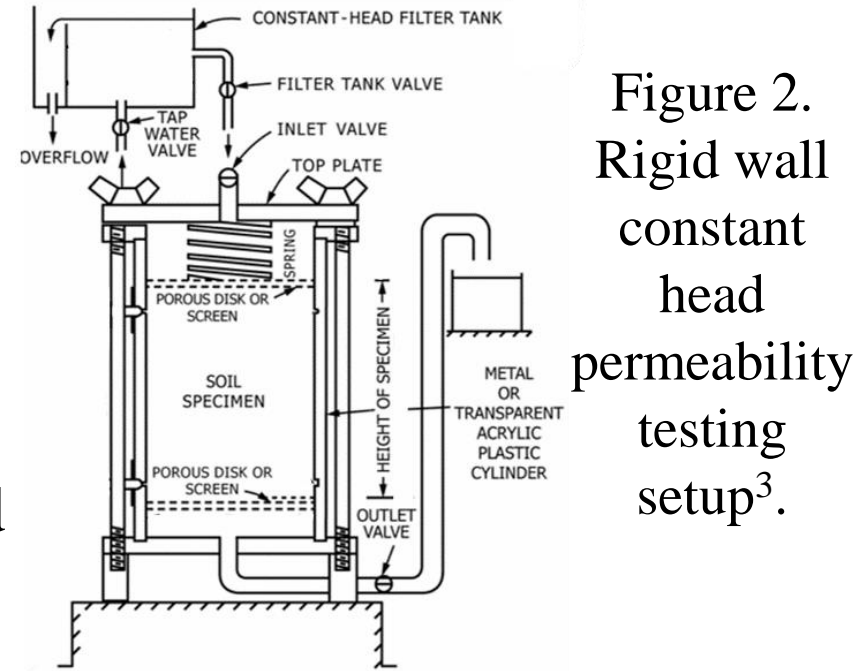


Figure 2. Rigid wall constant head permeability testing setup<sup>3</sup>.

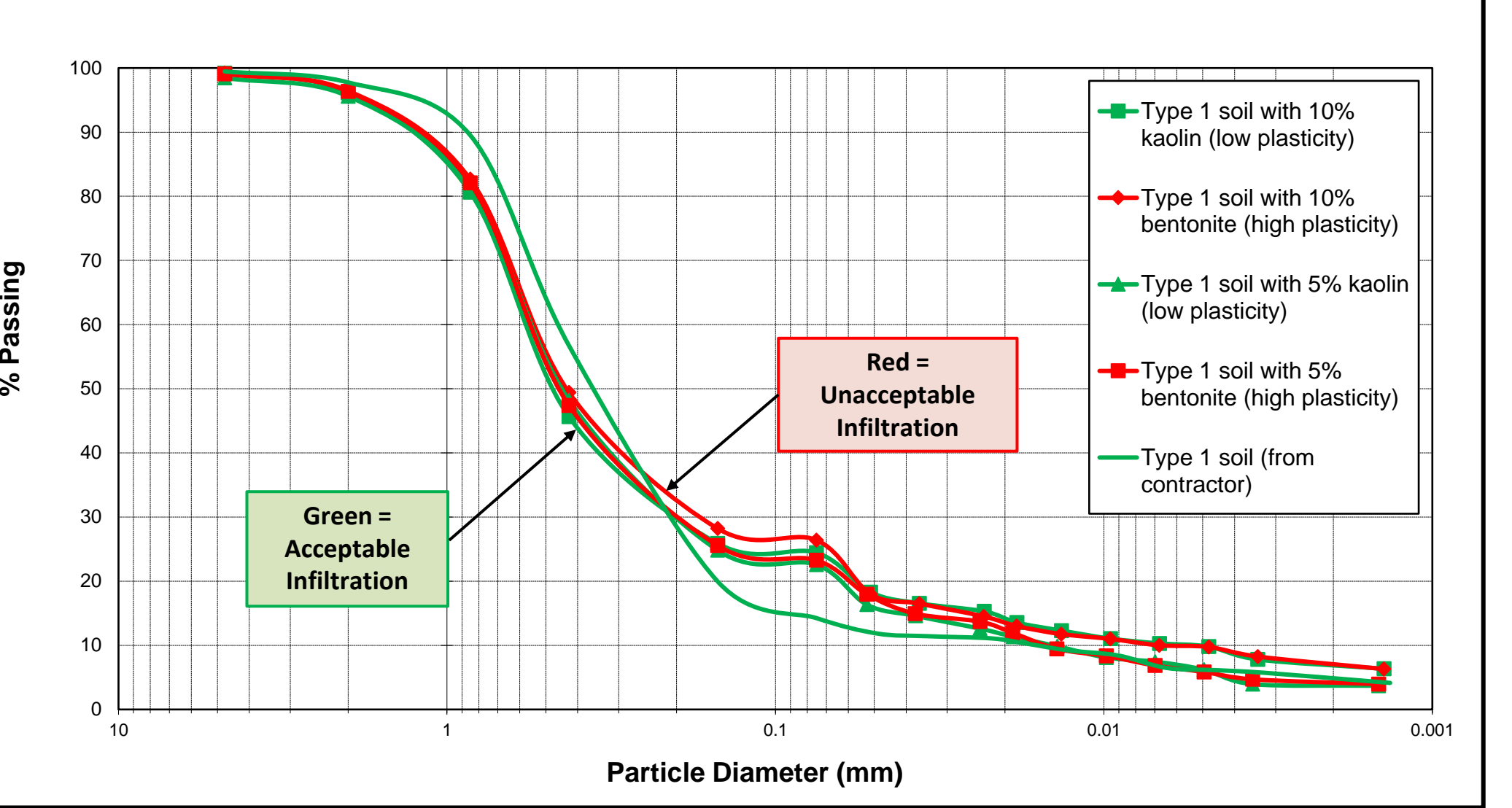


Figure 3. Particle size distributions of each media mix.

## RESULTS & DISCUSSION

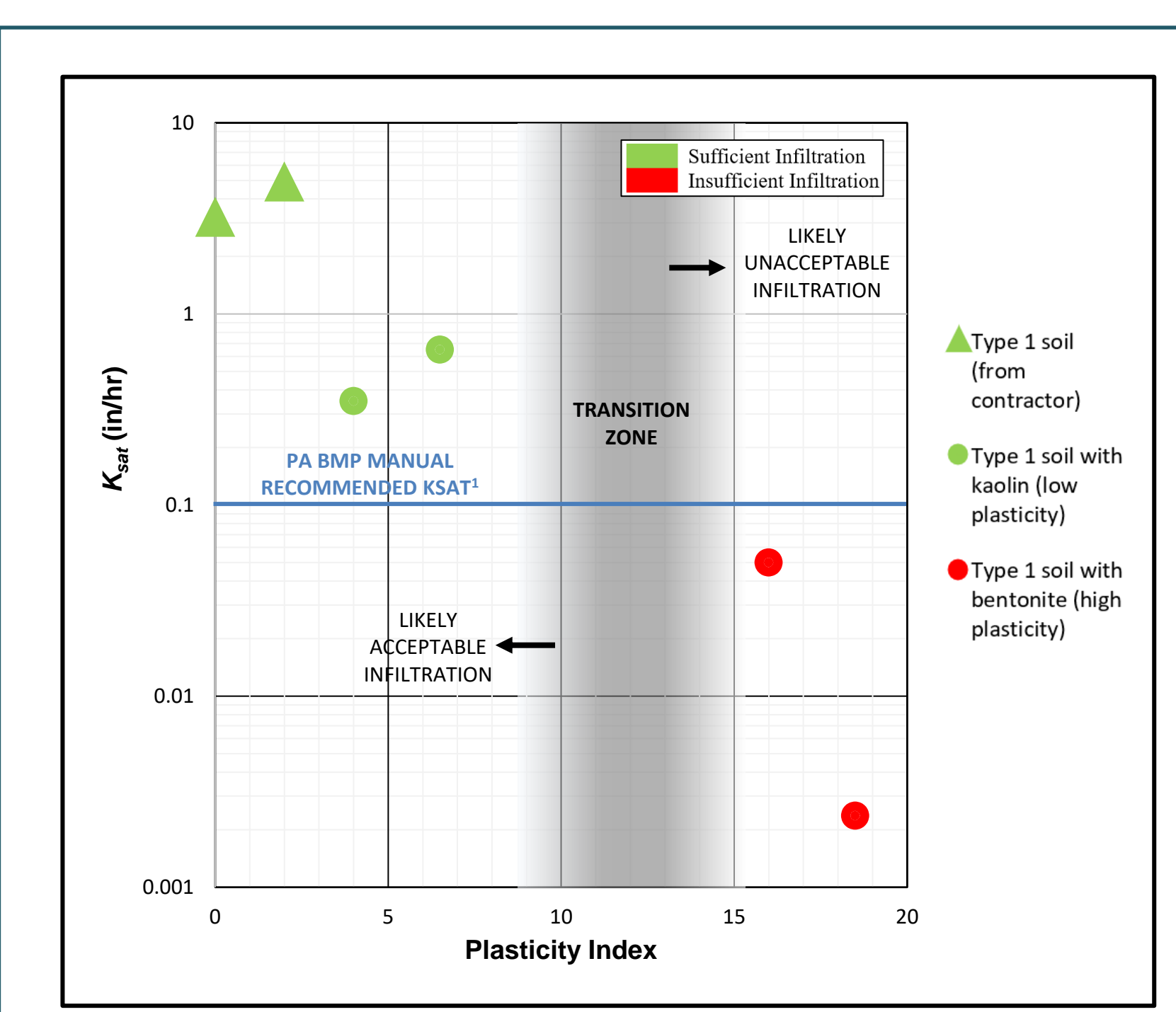


Figure 4. Resulting  $K_{sat}$  and PI values for each sandy loam/loamy sand mix.

- PennDOT Type 1** average  $K_{sat} = 3.8$  in/hr
- Kaolin** mix average  $K_{sat} = 0.5$  in/hr
- Bentonite** mix average  $K_{sat} = 0.05$  in/hr
- Water flows through the kaolin mix nearly 10 times faster than it does through the bentonite mix.**

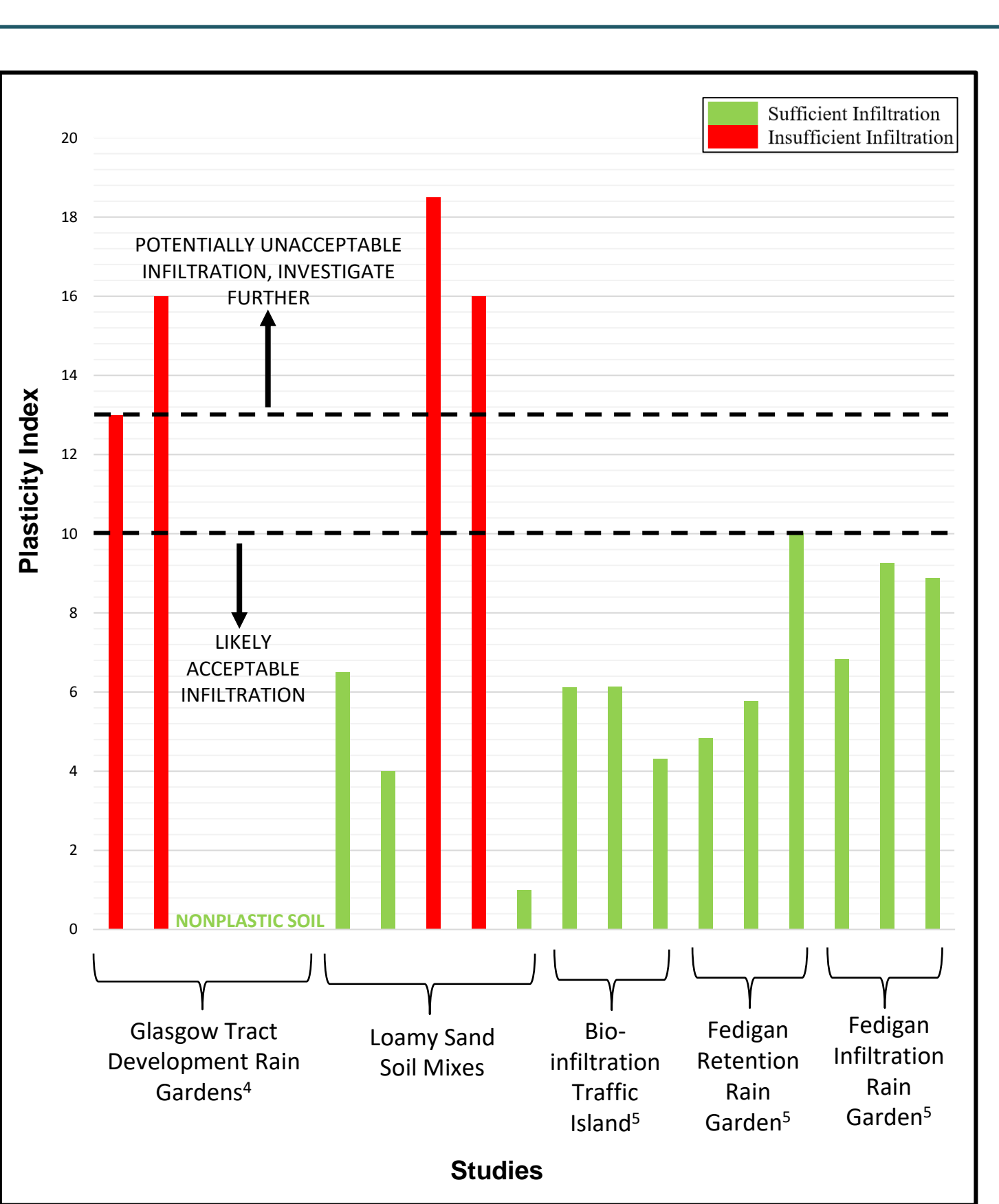


Figure 5. PIs of various field and laboratory studies.

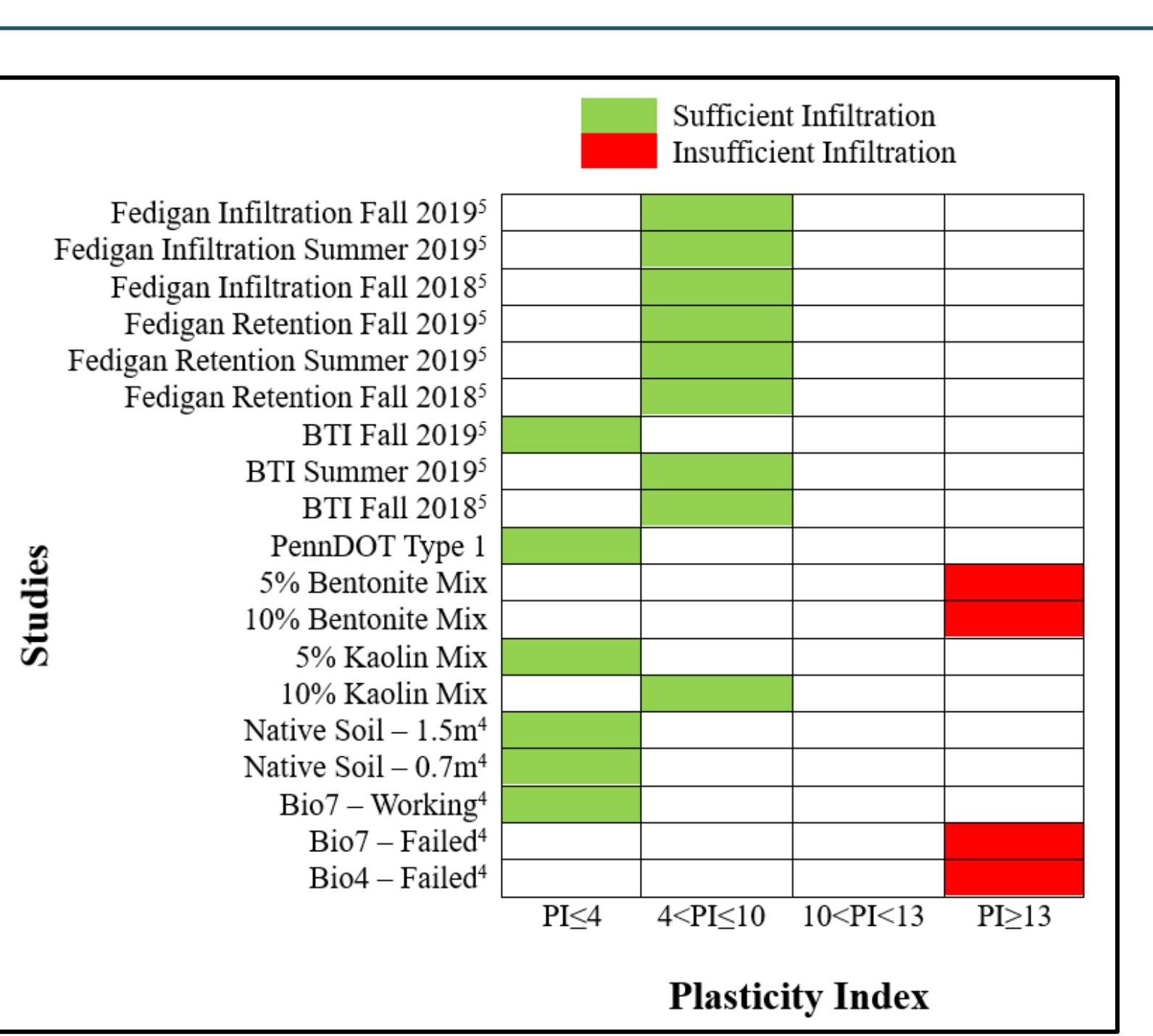


Figure 6. Individual field and laboratory results, including PI ranges and their infiltration efficiency for GSI.

- Field sites with **insufficient** infiltration had **PIs of 13 or greater**
- Field sites with **sufficient** infiltration had **PIs of 10 or less**

## SUMMARY & FUTURE WORK

- Findings:** Soil plasticity is a useful indicator of potentially inadequate  $K_{sat}$  → Soils with a PI < 10 typically provide sufficient infiltration, while soils with a PI > 13 typically had  $K_{sat} < 0.1$  in/hr
- Limitations:** Conclusions are limited to these case studies
- Future Work:** Collect data for soils with PIs falling between 10 and 13 to refine the estimated transition zone

## REFERENCES

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