Characterizing Soil Based on Chemical and Physical Properties

Intern: **Ranulfo Morales**

Major: **Mechanical Engineer-UCSB**

Mentor: **Kristin Clark**

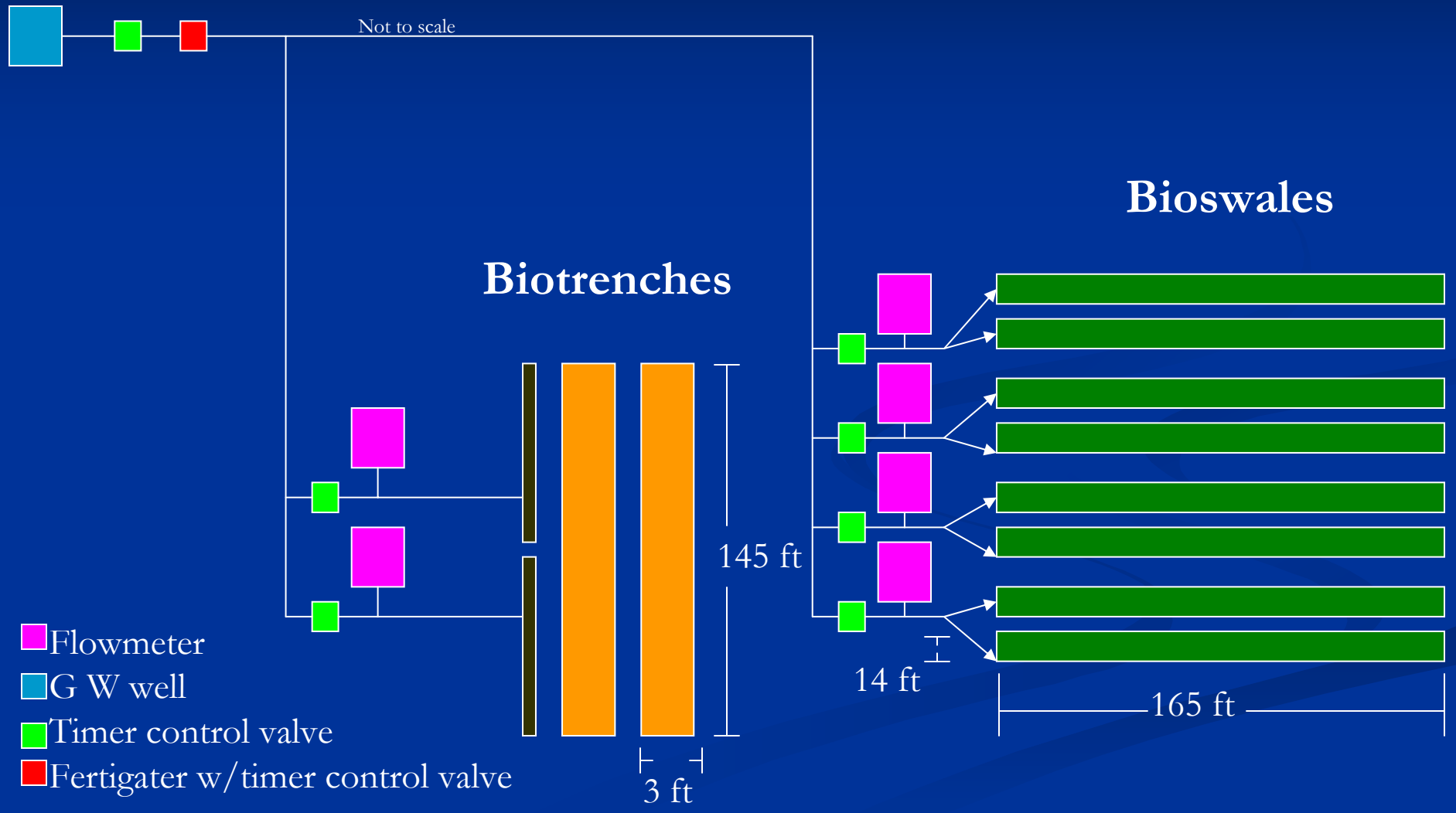
Faculty Advisor: **Dr. Arturo Keller**

Project Funded By: L.A Regional Water Quality Board and Friends of the Santa Clara River

Background

- Water quality improvement in the Santa Clara River.
- Decrease pesticides and nutrients daily loads from agriculture runoff into the Santa Clara River.
- Use bioswales and bioactive trenches to decontaminate water as a low cost alternative.

Biotrenches and Bioswales



My Contribution

- Understand a way to study the transport of nutrients and pesticides in the swales and trenches.
- Transport processes:
  - Adsorption
  - Advection-dispersion
- Characterize the physical properties of soils:
  - Bulk density
  - Moisture content
  - Specific gravity
  - Particle size

Overview

Preliminary Analysis

- Collect soil samples
- Process using ASTM methods

Methods

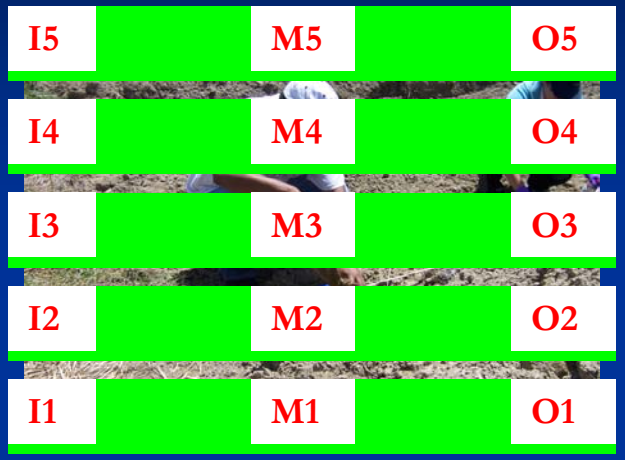
- Measure Specific Gravity, Soil Moisture, Hygroscopic Moisture, Bulk density, % soil suspension

Analysis

- Calculate particle size and texture

Process

1



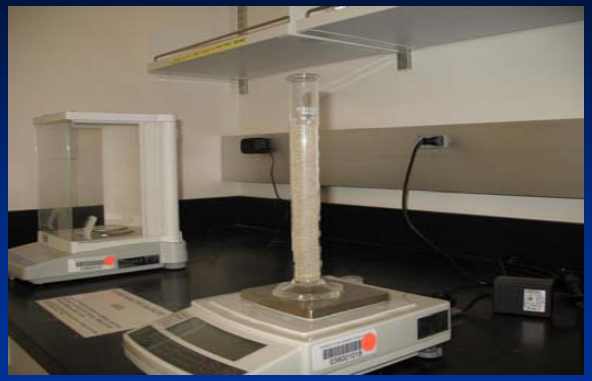
1. Take soil samples from Bioswales
2. Label and separate samples in plate for air drying.
3. Sieve in 2mm pan
4. Put other half of samples in Al. pan to oven dry

2

3

4

Methods

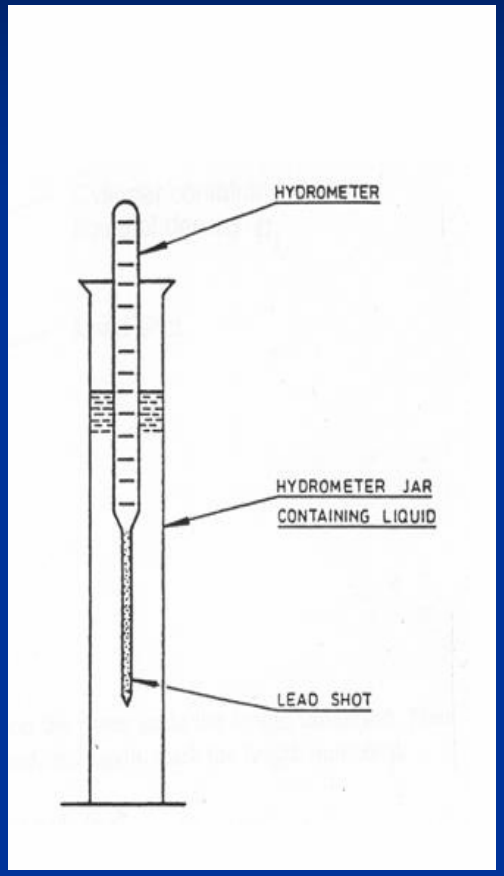


Measure Bulk Density

Measure moisture content using the oven dried method

Measure specific gravity of the soil relative to water

Methods and Apparatus

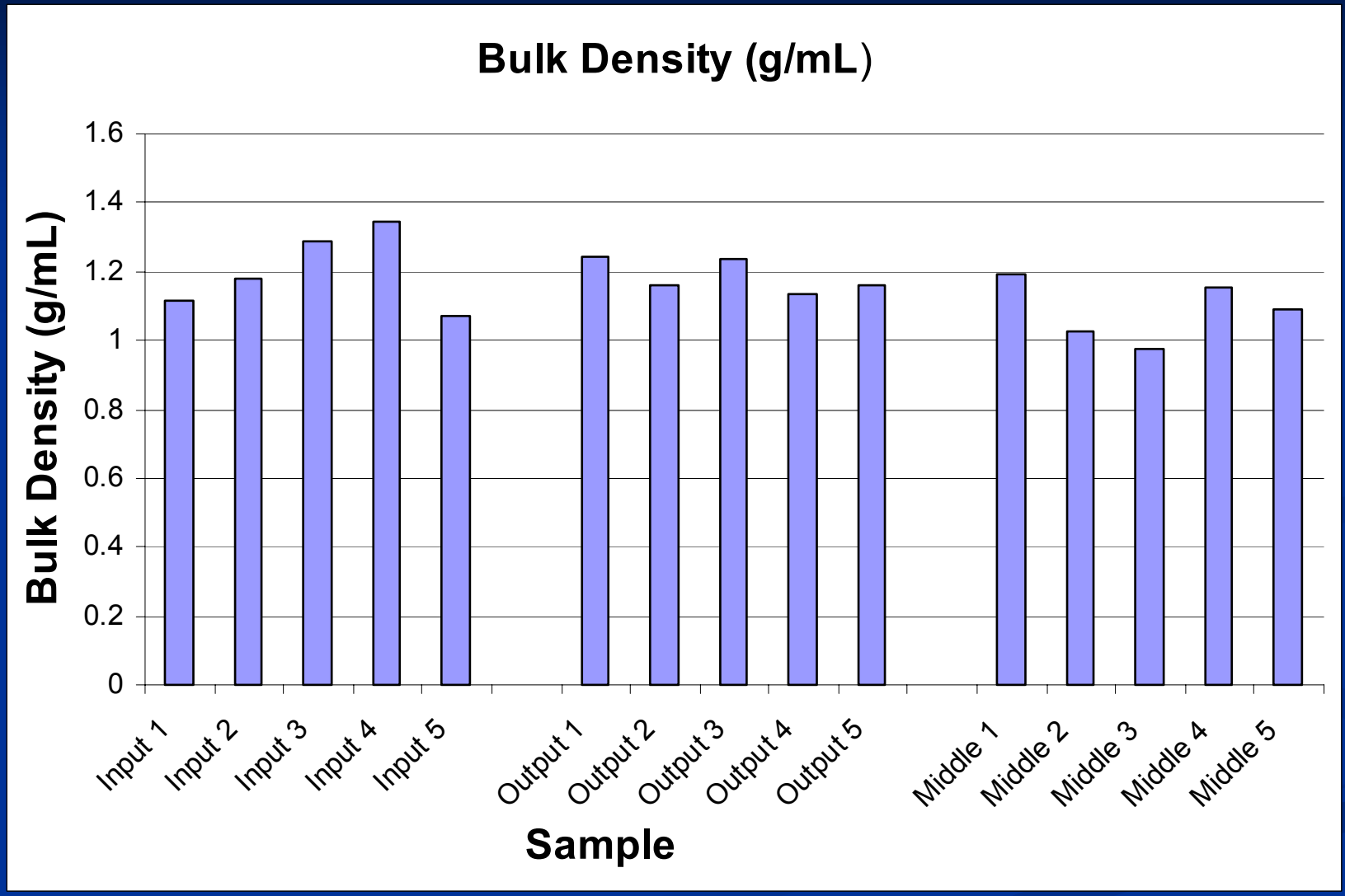


Hydrometer

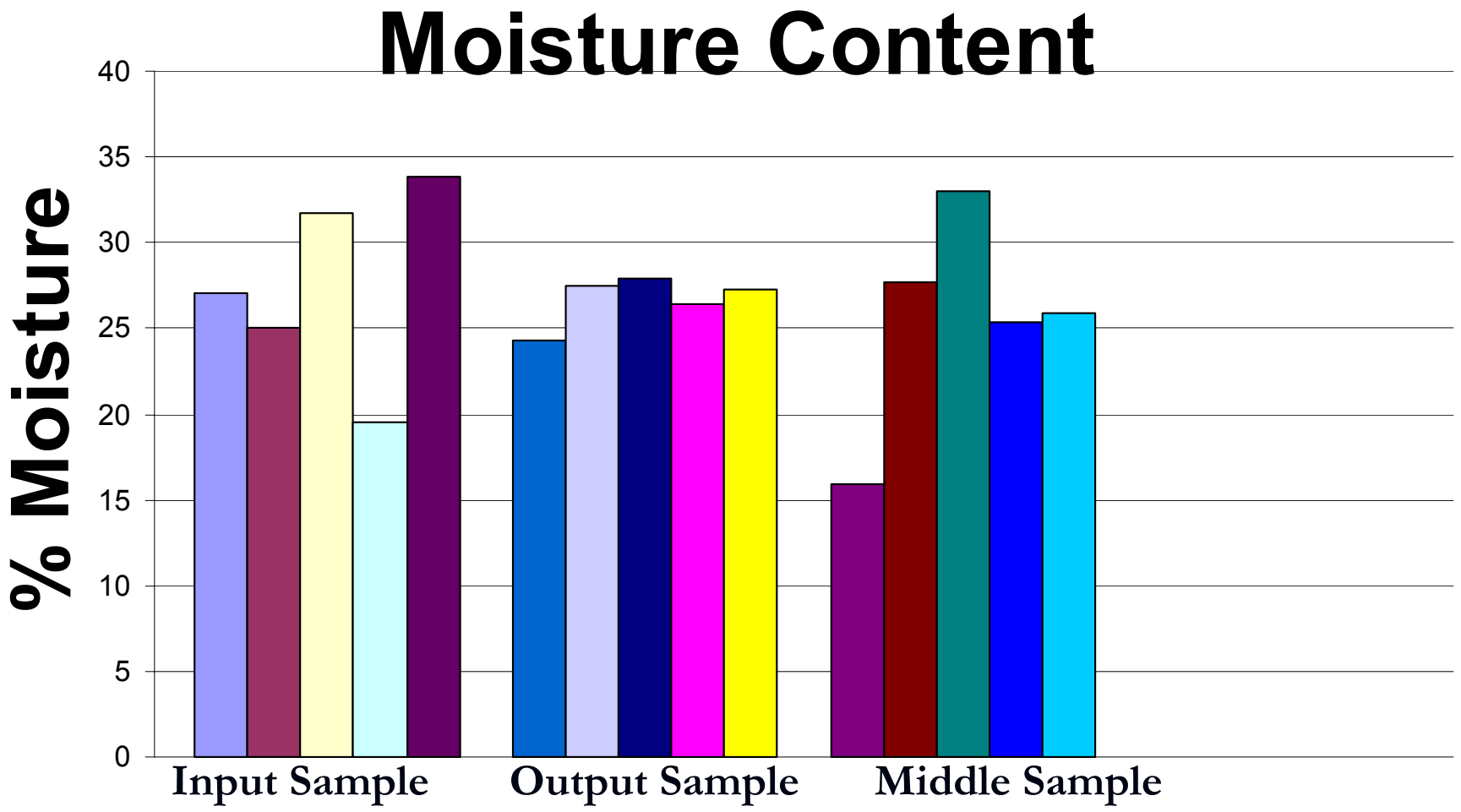
Soil Samples

Data Book

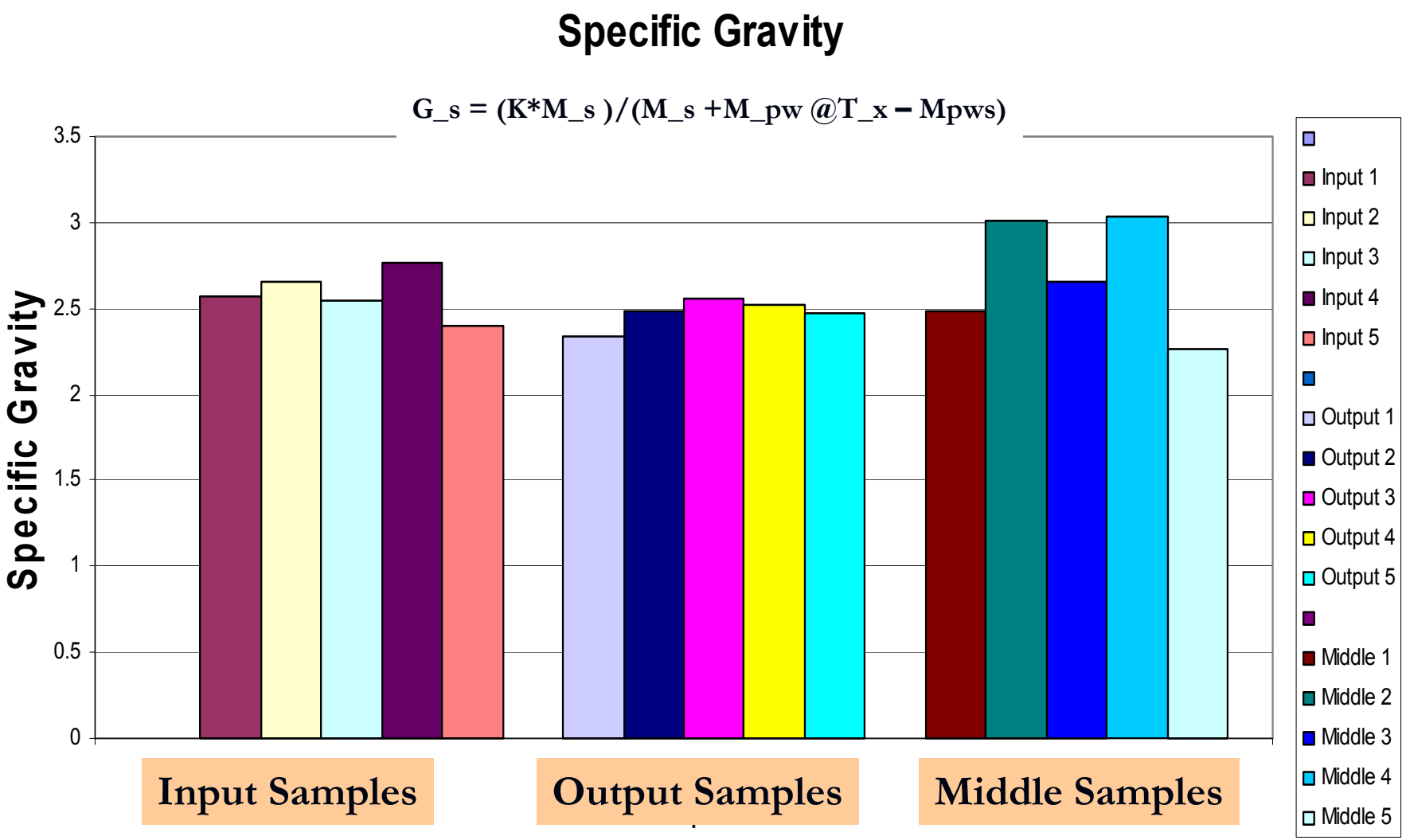
Data


Bulk Density (g/mL)
Bulk Density (g/mL)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Input 1
Input 2
Input 3
Input 4
Input 5
Output 1
Output 2
Output 3
Output 4
Output 5
Middle 1
Middle 2
Middle 3
Middle 4
Middle 5
Sample

Data


Moisture Content
% Moisture
40
35
30
25
20
15
10
5
0
Input Sample
Output Sample
Middle Sample

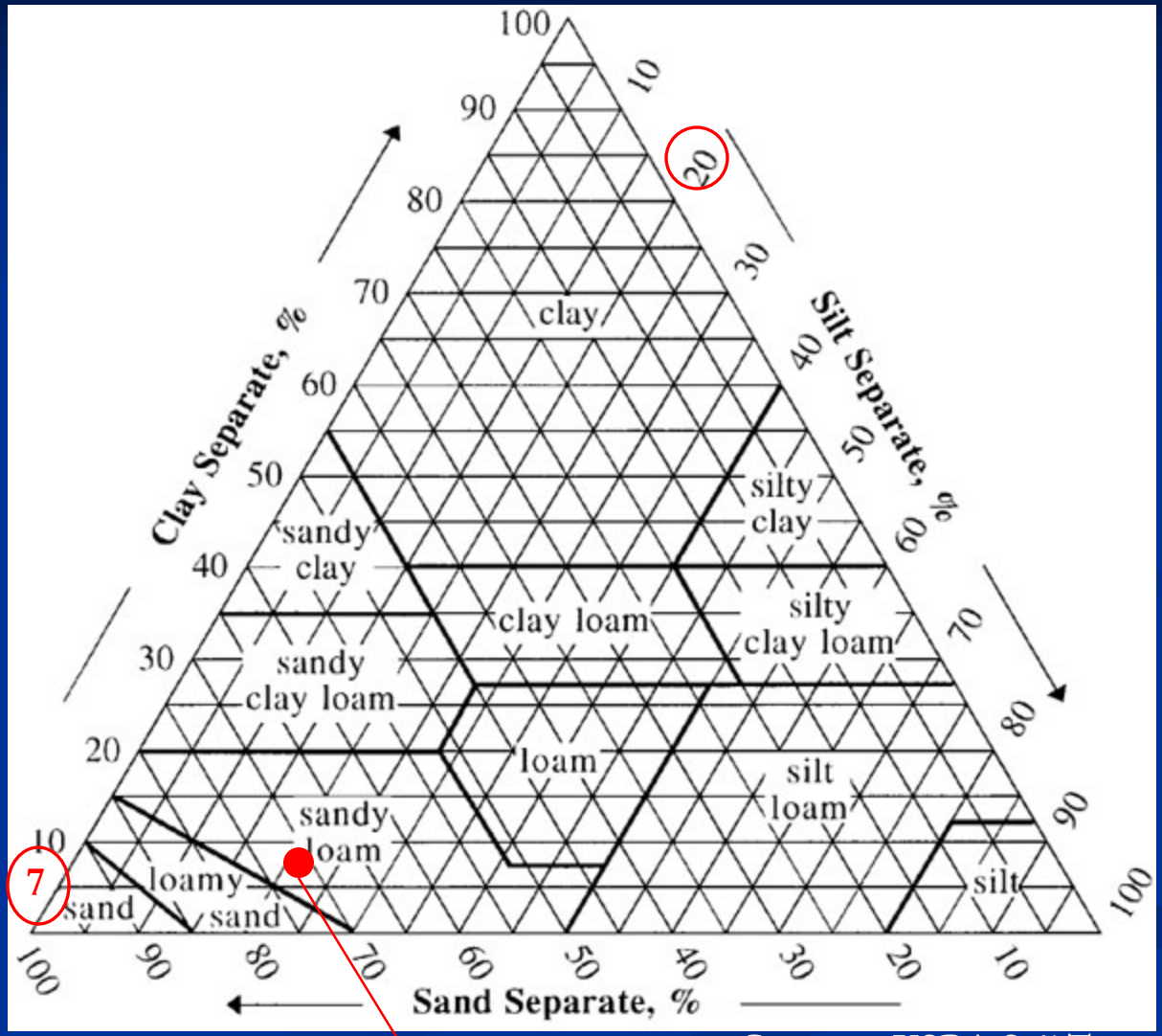
Data


Specific Gravity
G_s = (K*M_s)/(M_s +M_pw @T_x – Mpws)
Specific Gravity
3.5
3
2.5
2
1.5
1
0.5
0
Input Samples
Output Samples
Middle Samples
Input 1
Input 2
Input 3
Input 4
Input 5
Output 1
Output 2
Output 3
Output 4
Output 5
Middle 1
Middle 2
Middle 3
Middle 4
Middle 5

Results

Output 3 Sample (g)

% Suspension	time
27.82	2 min
17.51	
15.45	
13.39	
9.27	
7.21	4 hrs
3.09	



Courtesy: USDA-Soil Texture

What We Learned

* How to use the Hydrometer

* Classify soil texture using USDA Soil Texture Triangle

* Analyze the particle size of the different samples

Future Work

* Characterize chemical properties:
  - Soil organic matter (SOM)
  - Dissolved organic matter (DOM)
  - Cation-exchange capacity (CEC)
  - Residual pesticides

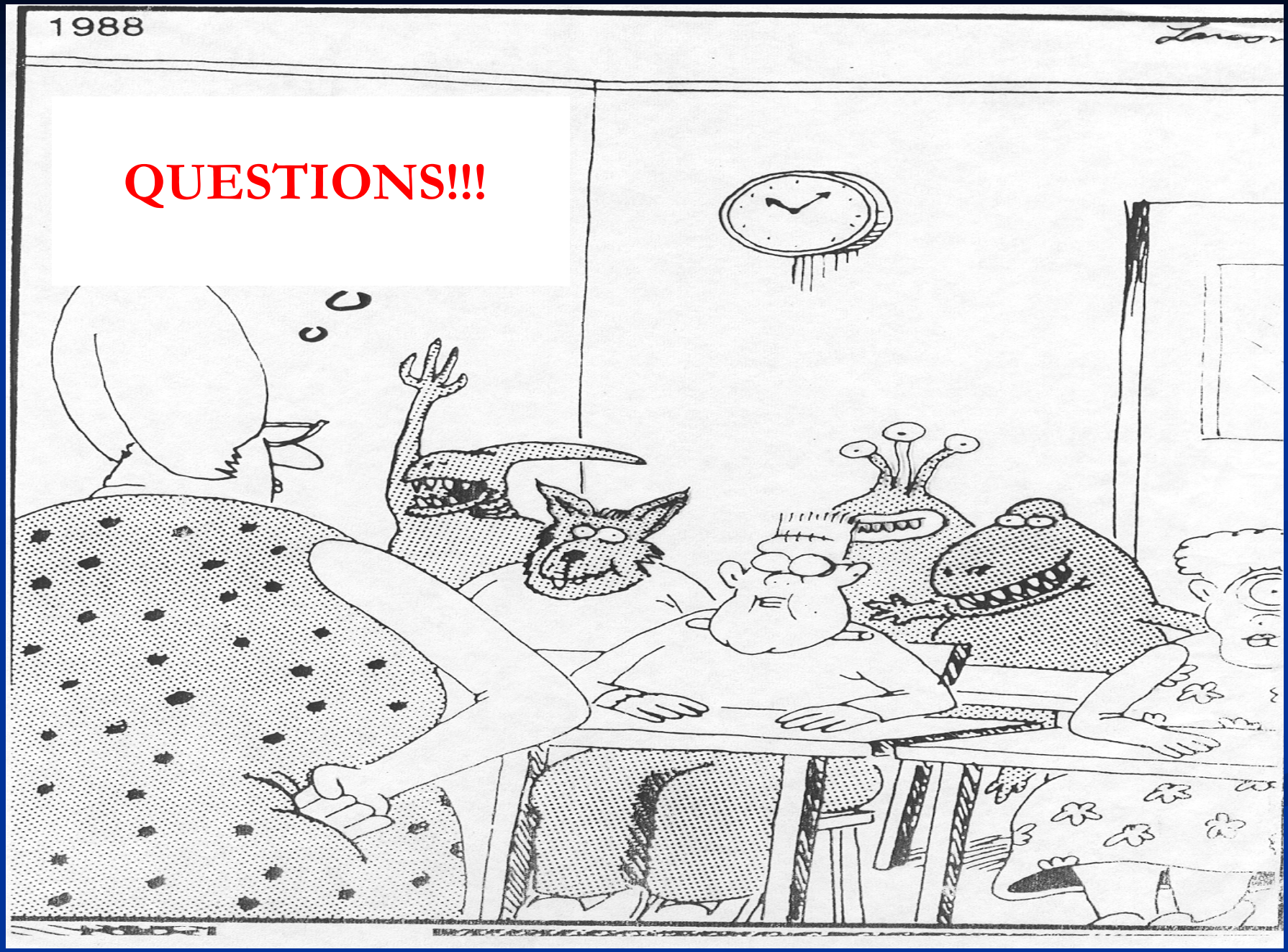
* Model lateral and vertical transport of ground water

Acknowledgments

Kristin Clark
Dr. Arturo Keller
Peng Wang

Samantha Freeman
Dr. Nick Arnold
Liu-Yen Kramer
Luke Bawazer
Dr. Evelyn Hu

Group B



http://maxweber.hunter.cuny.edu/pub/eres/EDSPC715_MCINTYRE/MonstersCartoon

Biotrenches and Bioswales