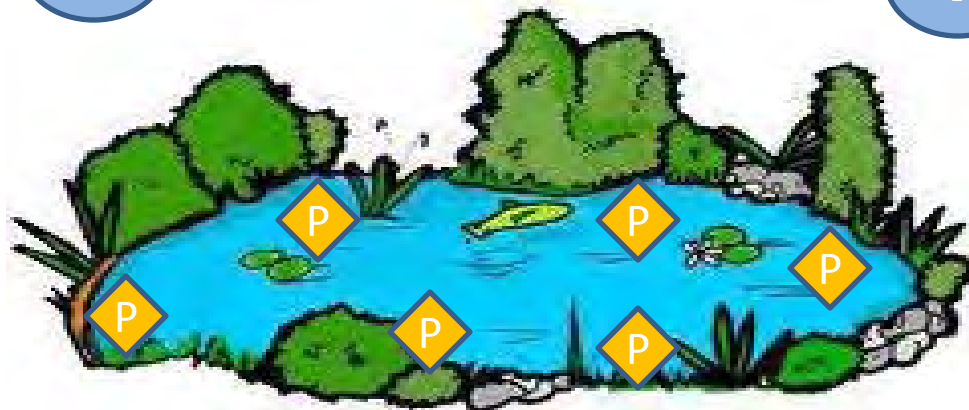
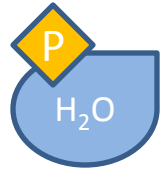
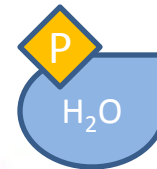
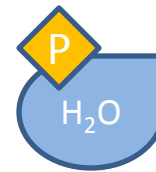
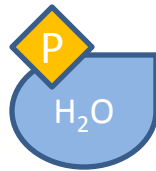
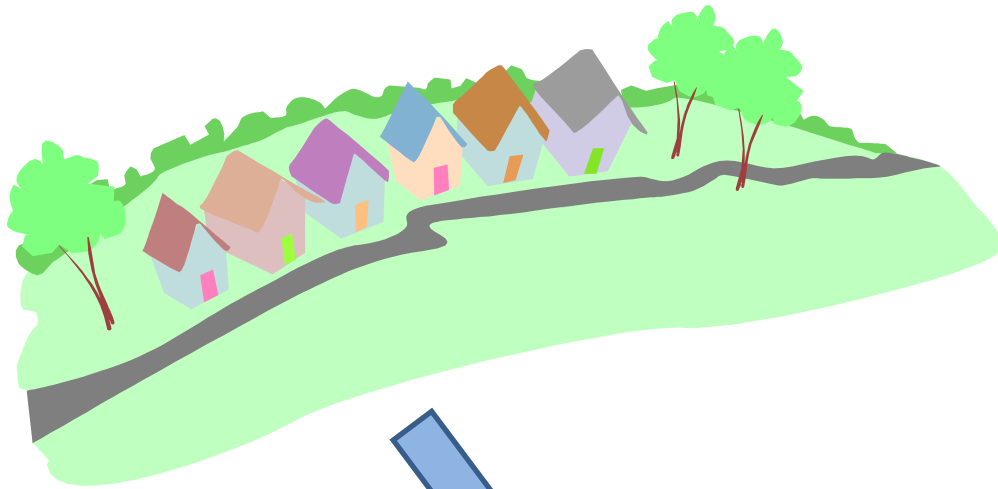


MIDS Work Group Meeting
January 21, 2011

Performance Goals Evaluation: Pollutant Loading

p-gen3-12m

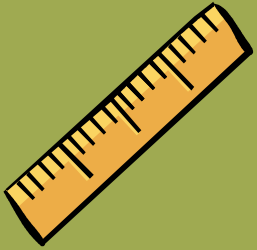
Pollutant Loading [mass/time]



Modeled 10-Acre Sites in Twin Cities Region

| Condition | Hydrologic Soils Group | |
|-----------------------------------|------------------------|---|
| | B | C |
| Developed: 20% Impervious Surface | ✗ | ✗ |
| Developed: 50% Impervious Surface | ✗ | ✗ |
| Developed: 80% Impervious Surface | ✗ | ✗ |

Developed Site Volume Control Performance Goals Modeled



1. Retain a runoff volume equal to one inch times the proposed impervious surfaces



2. Retain the post-construction runoff volume on site for the 95th percentile storm



~~3. Match the native runoff volume for the~~
~~a. 1-year 24-hour design storm~~
~~b. 2-year 24-hour design storm~~

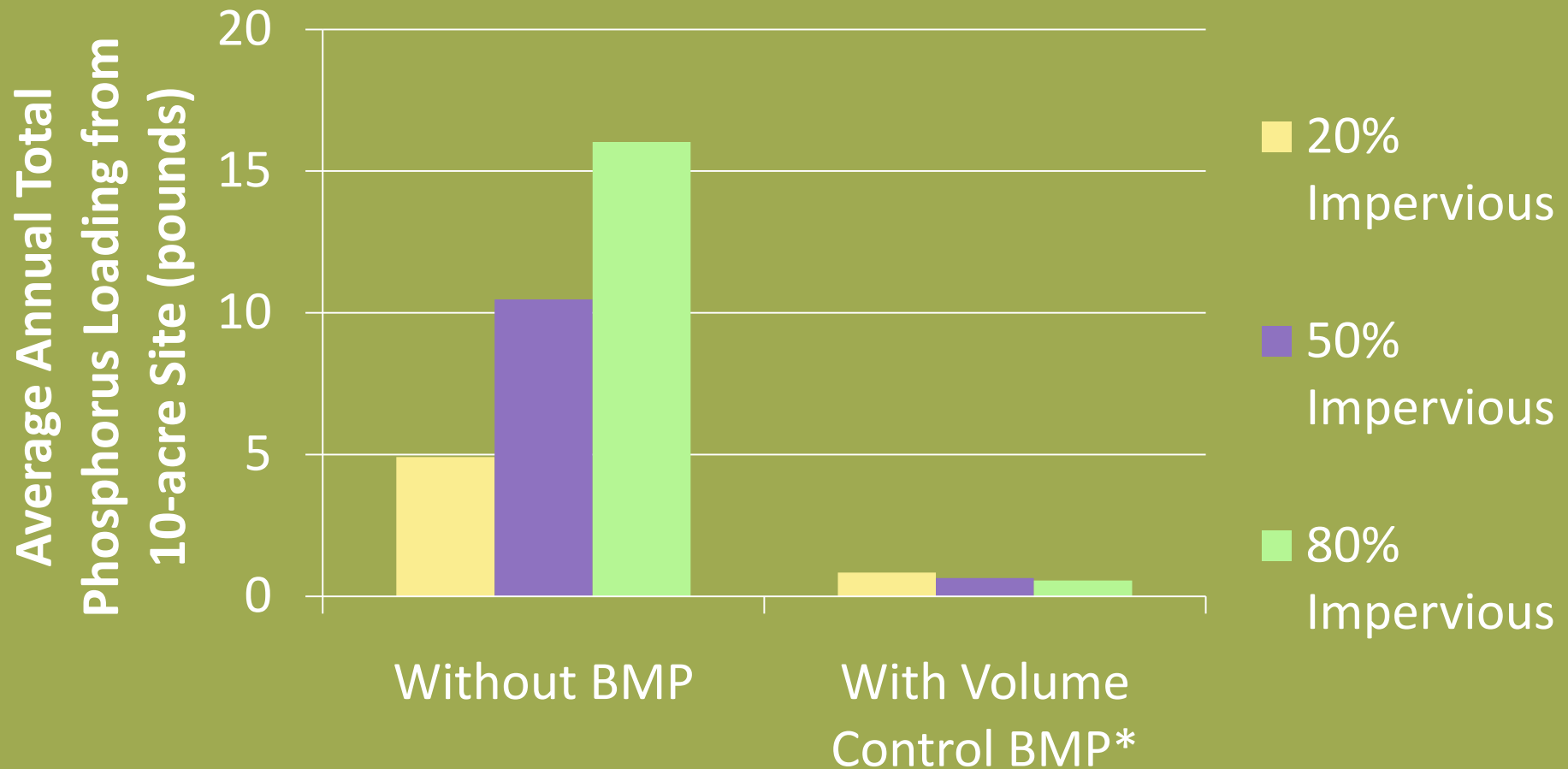
Questions to address today:

How well do volume control BMPs reduce phosphorus loading?

How does the phosphorus removal compare amongst the four performance goals?

Why is there so little difference in removal between the performance goals?

Phosphorus Loading Reduction from Volume Control BMPs



* Based on average loading from the four performance goal scenarios

Questions to address today:

How well do volume control BMPs reduce phosphorus loading?

Very well.

Phosphorus removals range from 72% - 97%.

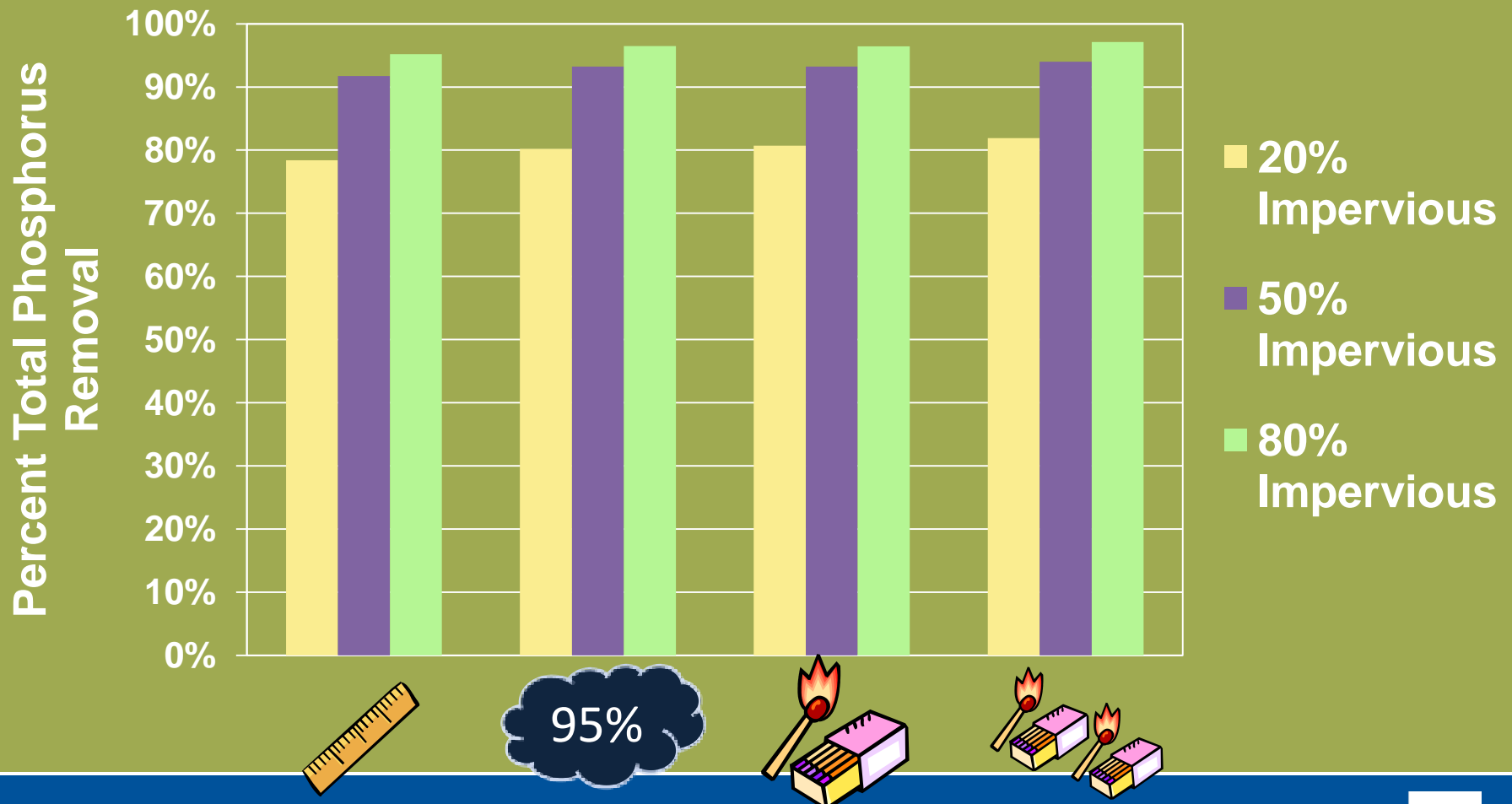
Questions to address today:

- How does the phosphorus removal compare amongst the four performance goals?

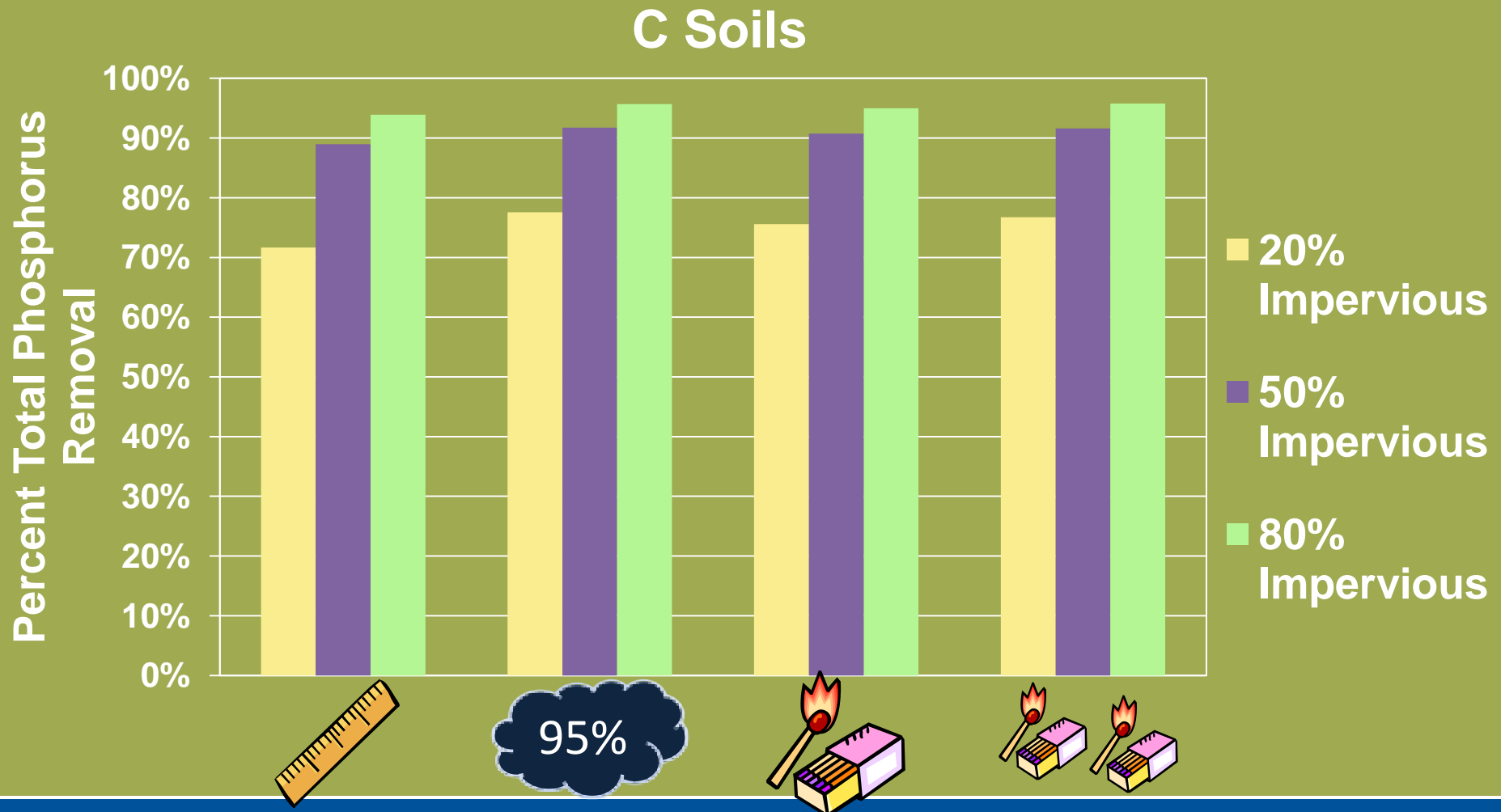


Results of Pollutant Removal Analysis

B Soils



Results of Pollutant Removal Analysis



Questions to address today:

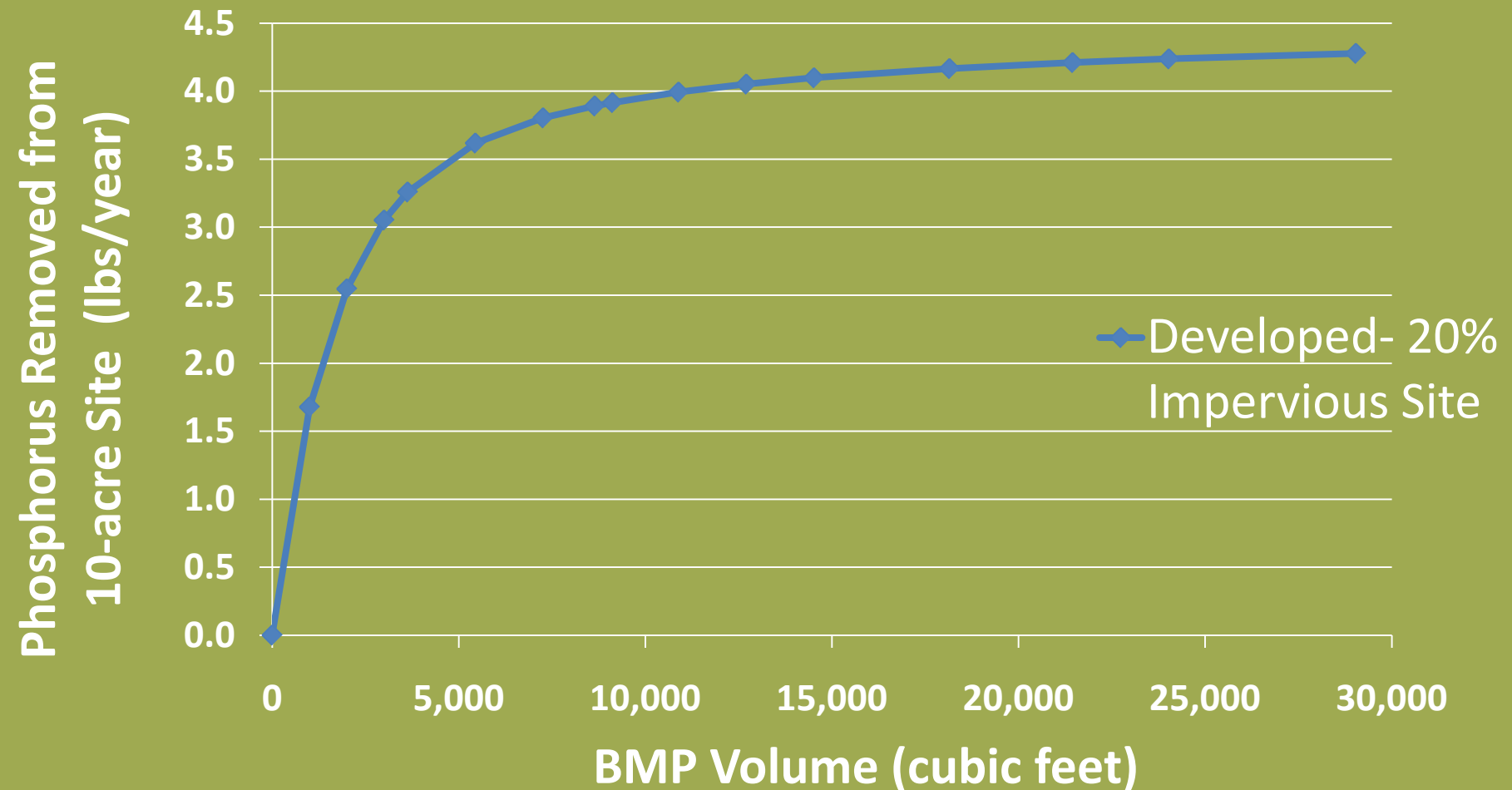
How does the phosphorus removal compare amongst the four performance goals? **For all practical purposes, they're the same.**

Why is there so little difference in TP removals between the performance goals?

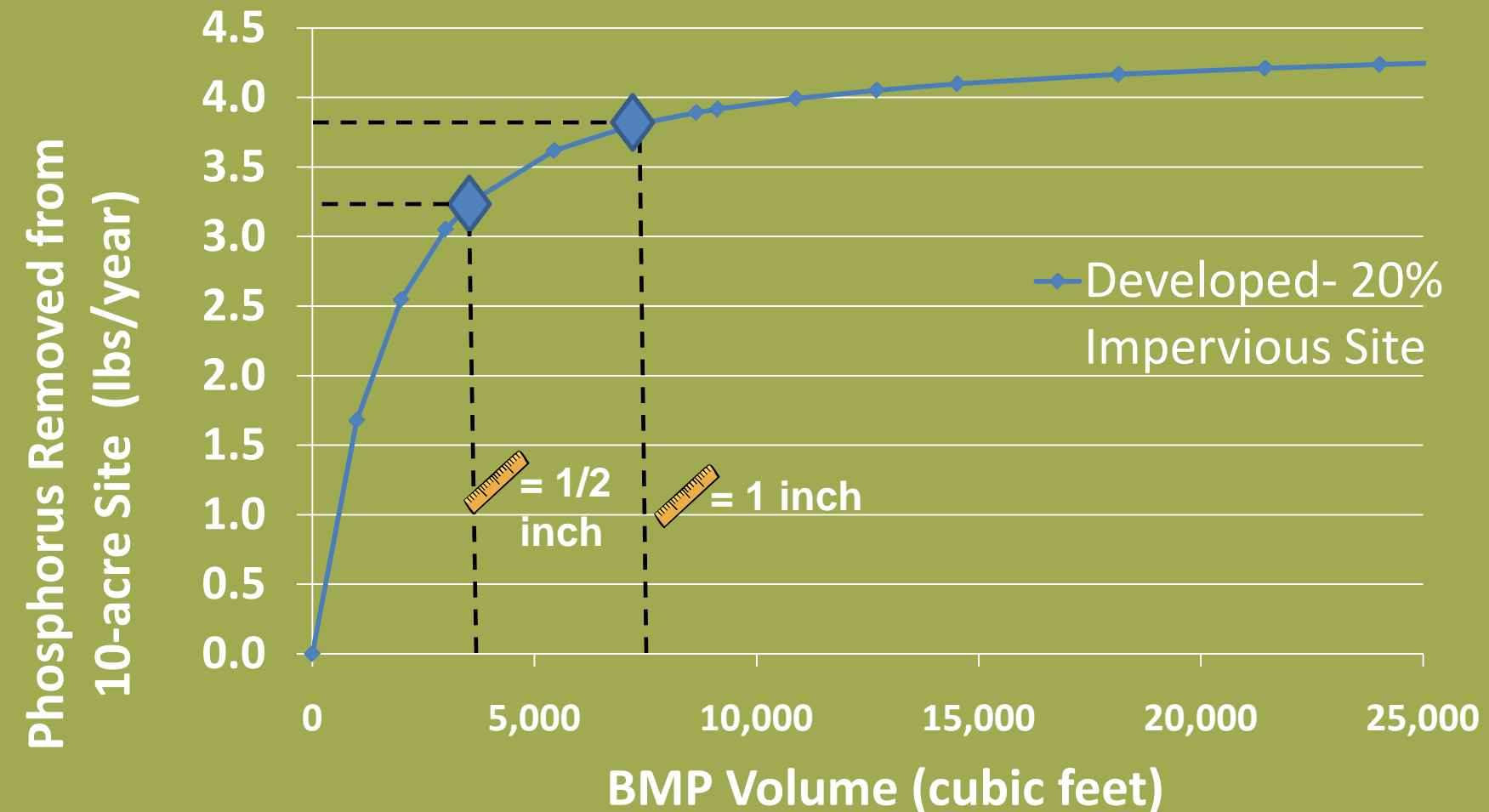
Law of Diminishing Returns

- **Law of diminishing returns** means that the first unit of consumption of a good or service yields more utility than the second and subsequent units.
- Each additional unit of consumption (e.g., BMP volume) yields less and less utility

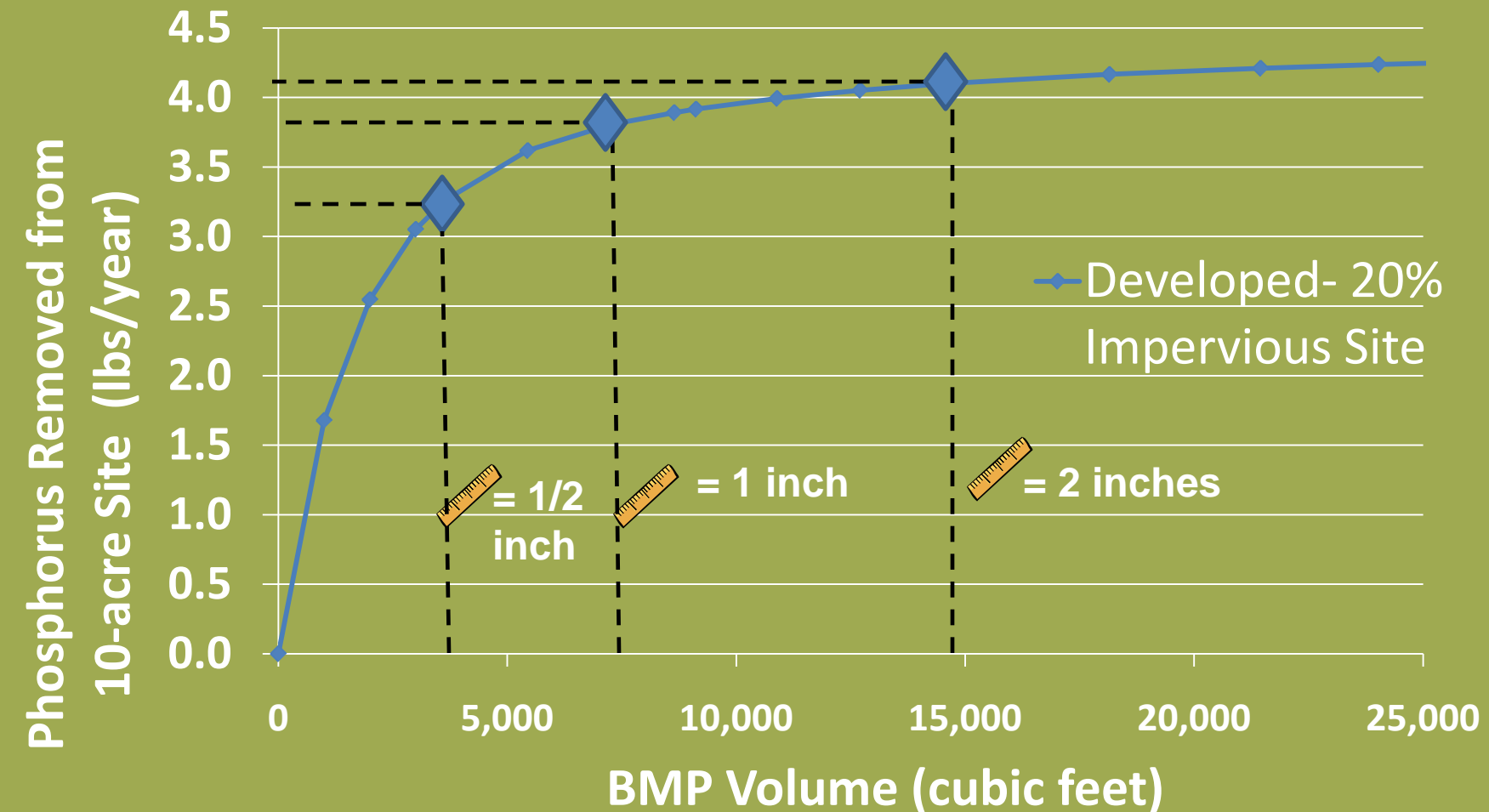
Relationship of Annual Phosphorus Removal and BMP Volume



Relationship of Annual Phosphorus Removal and BMP Volume



Relationship of Annual Phosphorus Removal and BMP Volume



Summary of diminishing returns

10-acre site with 20% impervious on B soils

| Performance Goal: “X” off impervious surfaces | Increase in BMP Volume | Pounds Phosphorus Removed | % Phosphorus Removal | Pounds removed per cubic foot of BMP volume |
|---|------------------------|---------------------------|----------------------|---|
| 0.5 inch | x 1 | 3.3 | 67% | 9×10^{-4} |
| 1 inch | x 2 | 3.8 | 78% | 1.4×10^{-4} |
| 2 inch | x 4 | 4.1 | 84% | 0.4×10^{-4} |

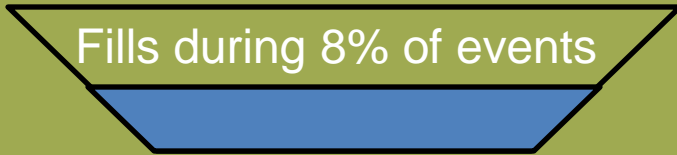
Another way of showing diminishing returns of volume control BMPs

Fills during 23% of runoff-producing events



BMP Sized for ½-inch off impervious surface

Fills during 8% of events



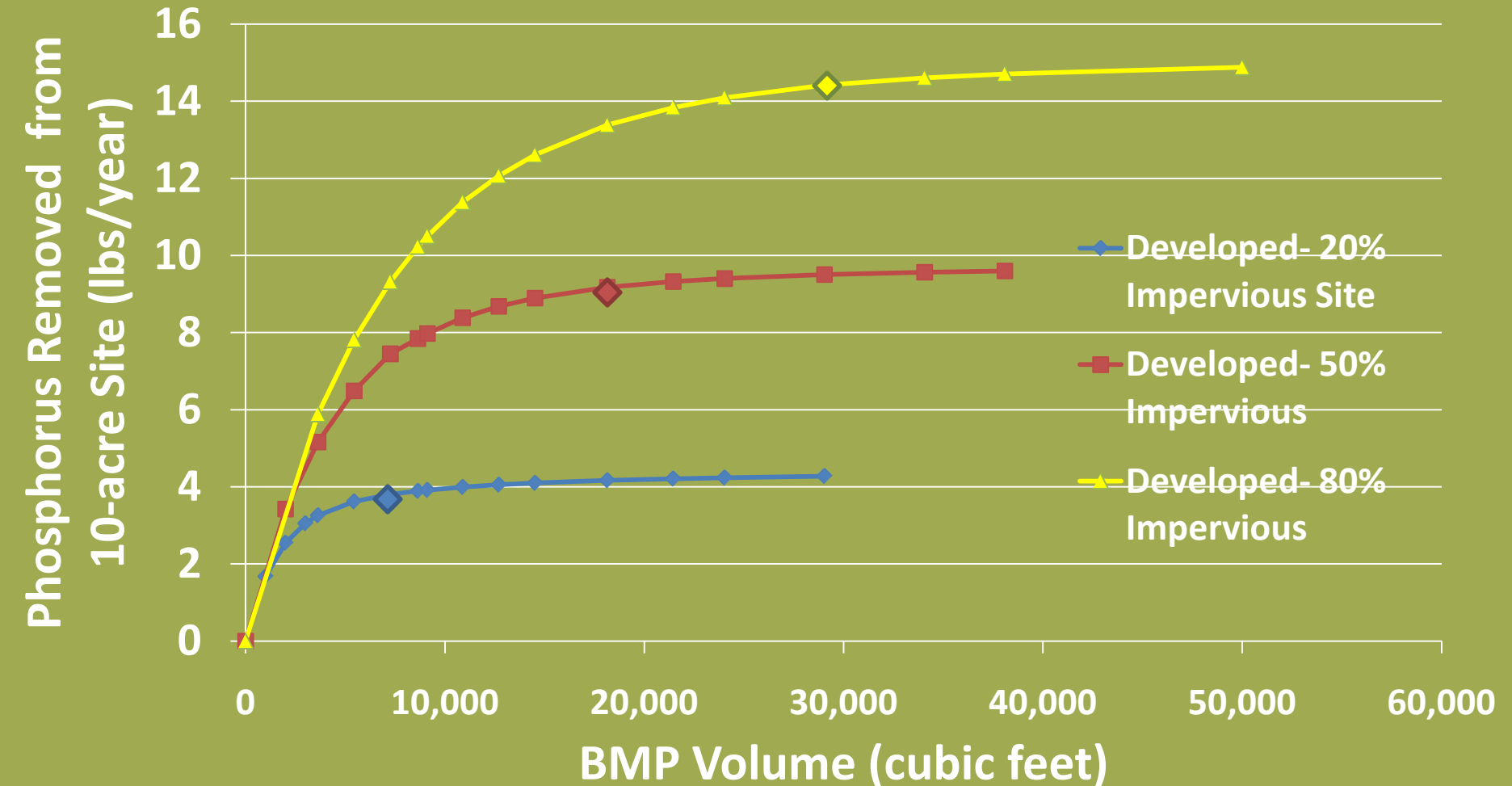
BMP Sized for 1-inch off impervious surface

Fills during 2% of events

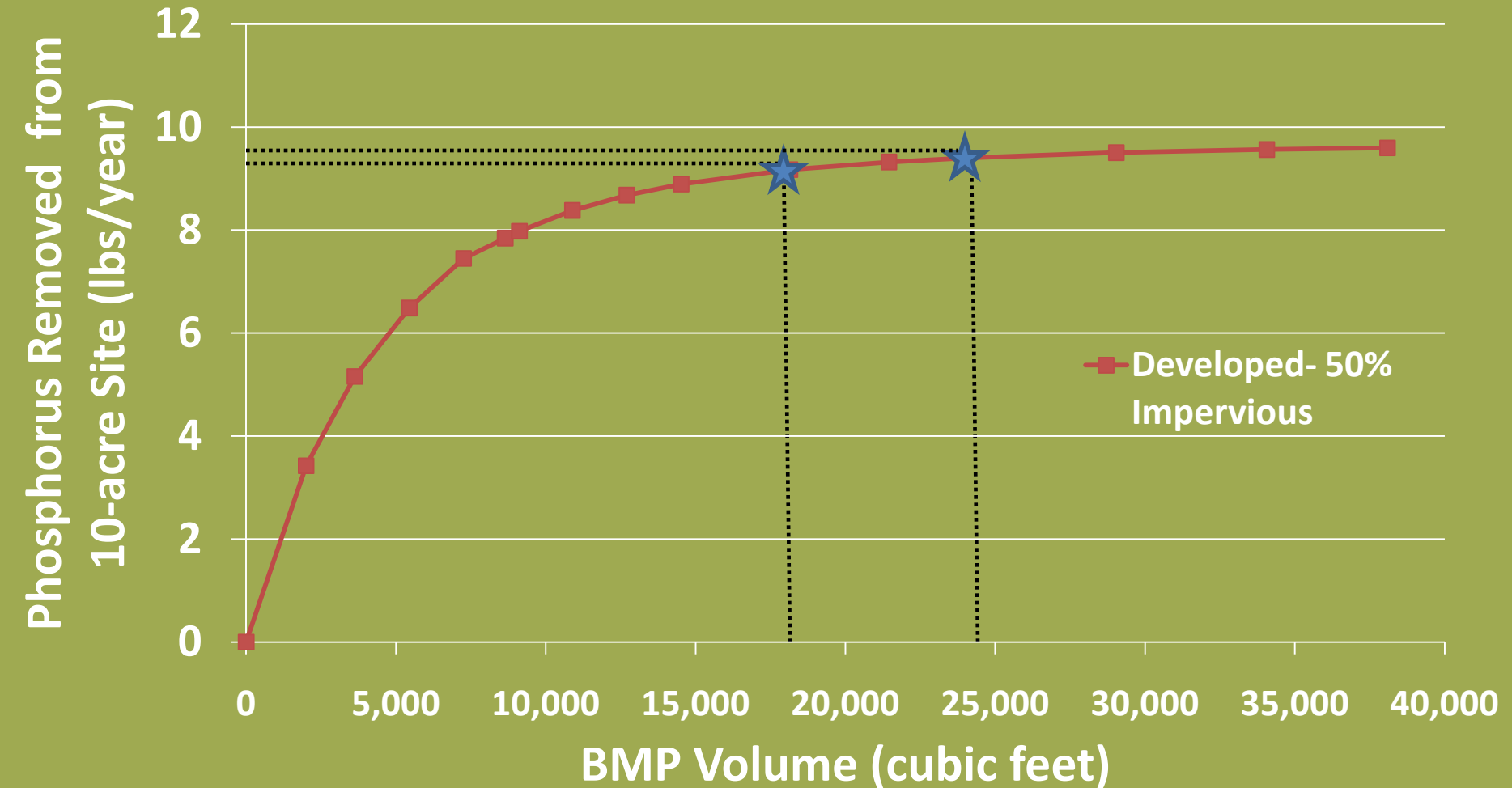


BMP Sized for 2-inches off impervious surface

Relationship of Annual Phosphorus Removal and BMP Volume



Relationship of Annual Phosphorus Removal and BMP Volume



Conclusions

How well do volume control BMPs reduce phosphorus loading? **Very well.**

How does the phosphorus removal compare amongst the four performance goals? **For all practical purposes, they're the same.**

Why is there so little difference in TP removals between the performance goals? **The Law of Diminishing Returns.**

Questions, Discussion, Feedback???

- Any performance goal method could be adjusted to require a larger BMP and provide more water quality treatment.
- How much water quality treatment is enough?
 - MIDS Legislation
 - TMDLs
 - Anti-degradation