Synthesis of Water Quality BMP Studies

Nonpoint Source Best Management Practices Database - a searchable database on the effectiveness of BMPs.
 † *NPS-BMP-DB-Part1: Fecal Indicator Bacteria*
 † *NPS-BMP-DB-Part2: Nutrients and Sediments*

https://ag-bmp.twri.tamu.edu/

1) BMP EFFECTIVENES

2) LIT. REVIEW, META-ANALYSIS

3) DATABASE, DISCUSSION

4) APPLICATION

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make every drop count

BMP Effectiveness
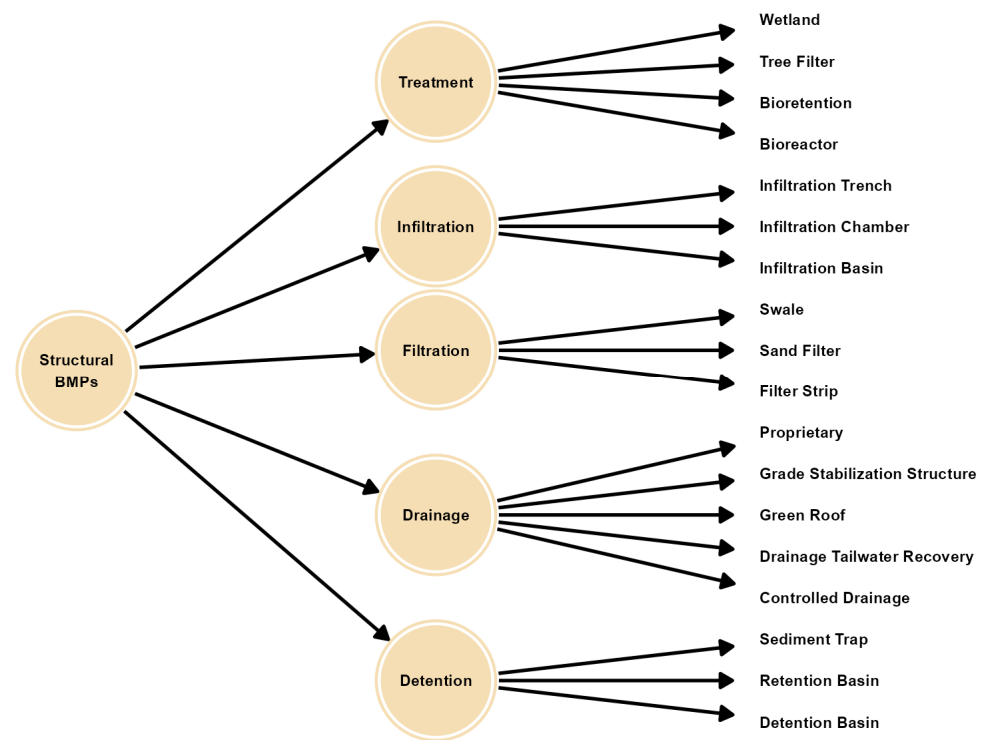
† Watershed Planning & BMPs = Bread & Butter
† Control the delivery of pollutants to water bodies by <u>source reduction</u>, <u>transport retardation,</u> & <u>remediation</u>.

† Several practices (type e.g., structural, process – e.g., treatment, scale – e.g., field)

† Resources – EPA National Menu of BMPs, NRCS FOTG, Others e.g., ISBMPD, Harris Cty BMPbase

Field Office Technical Guide (FOTG)

† Primary scientific references for NRCS.
† Sec.4 - Practice Standards and Supporting Documents
† Sect.5 - Conservation Effects. Has indicators of the impacts CPs

National Menu of Best Management Practices

† NPDES Stormwater Program fact sheets
† Designs, evaluation, good practices

Structural BMPs

- Treatment
  - Wetland
  - Tree Filter
  - Bioretention
  - Bioreactor
- Infiltration
  - Infiltration Trench
  - Infiltration Chamber
  - Infiltration Basin
- Filtration
  - Swale
  - Sand Filter
  - Filter Strip
- Drainage
  - Proprietary
  - Grade Stabilization Structure
  - Green Roof
  - Drainage Tailwater Recovery
  - Controlled Drainage
- Detention
  - Sediment Trap
  - Retention Basin
  - Detention Basin

† BMP efficiencies reported in studies vary.
† WPPs, I-plans include targets for quantity & BMPs types needed to achieve standards.
† BMP selection can be biased based on the studies selected or information available.
† **Reviewed literature, inventories & synthesized data on BMP effectiveness – Make info generalizable and applicable**

2

Methods

Systematic Literature Review. To identify, appraise and provide a summary of current literature relevant to a research question

HIERARCHY OF SCIENTIFIC EVIDENCE

STRONGEST

- SYSTEMATIC REVIES & MA
- CONTROLLED TRIALS
- COHORT STUDIES
- CASE CONTROL STUDIES
- CASE REPORTS
- EDITORIALS, OPINION PAPER

Search Criteria		
	Key words	**Source**
FIB	"fecal indicator bacteria" or "*E. coli*", or "*Escherichia coli*", or "enterococci" or "enterococcus" and "best management practices", or "BMPs", and "effectiveness", or "performance".	Web of Science, Google Scholar, PubMed, TAMU library catalogue, references
Nutrients, Sediments	"nutrient", or "nitrogen", or "phosphorus" or "sediment" or "TSS" and "best management practices", or "BMPs", and "effectiveness", or "performance"	

Selection Criteria		
Attributes	**Inclusion criteria**	**Exclusion criteria**
e.g., Study type	Journal articles, book chapters, conference papers	Review studies, modeling studies, estimations based on other studies e.g., TMDLs.
Others: Location, Timeframe, Reported results		

Data Extraction	
Grouping	Extracting data and cross validating each other
Meta data	ValueID, StudyID, Pub_Year, Parameter, Source, SourceType, BMP, BMP_SubCat, BMP_Category, Scale, Location, State, Area, n, Pre, Post, Unit, % Reduction, e.t.c.

Meta-regression. Statistical combination of results from separate studies.
Advantages - improvement in precision, settle controversies from conflicting claims.

Results

https://ag-bmp.twri.tamu.edu/

† NPS-BMP-DB-Part1: *Fecal Indicator Bacteria*
† NPS-BMP-DB-Part2: *Nutrients and Sediments*

Part1 n=137

Non-Point Source Best Management Practices Database (NPS-BMP-DB). Part 1: Fecal Indicator Bacteria

version: 1.04

Introduction

For the purpose of improving the understating of the effectiveness of BMPs, this database catalogues information on BMP effectiveness extracted from peer reviewed scientific literature between 2000 to 2022 conducted in the United States (USA). The database also consists of statistical analysis of pooled efficacy values and evaluates the relative effectiveness of different practices in reducing pollutant loads. The database provides a source of reference for water quality planning and implementation studies or projects. The synthesized values can also be used to test the accuracy of computer model predictions on the effectiveness of BMPs.

Contents

Links	Description
Data Dictionary	Description of codes/columns in the List of Studies and FIB_Database sheets
List of Studies	Catalogue of peer reviewed scientific literature on BMP effectiveness spanning 2000 to 2022
FIB_Database	Summary of data on BMP effectiveness and other related information.
Analysis	Statistical analysis of the pooled BMP data.
Regression Data	Data worksheets used to produce regression results.
Equations	Equations and tables for predicting percent reductions based on input concentrations.
Version History	Details on database changes.

How to cite this database

Kikoyo, D., Jain, S., Wright, J., Schramm M. (2023) Non-Point Source Best Management Practices Database (NPS-BMP-DB) - a searchable database on the effectiveness of BMPs - Part 1: Fecal Indicator Bacteria
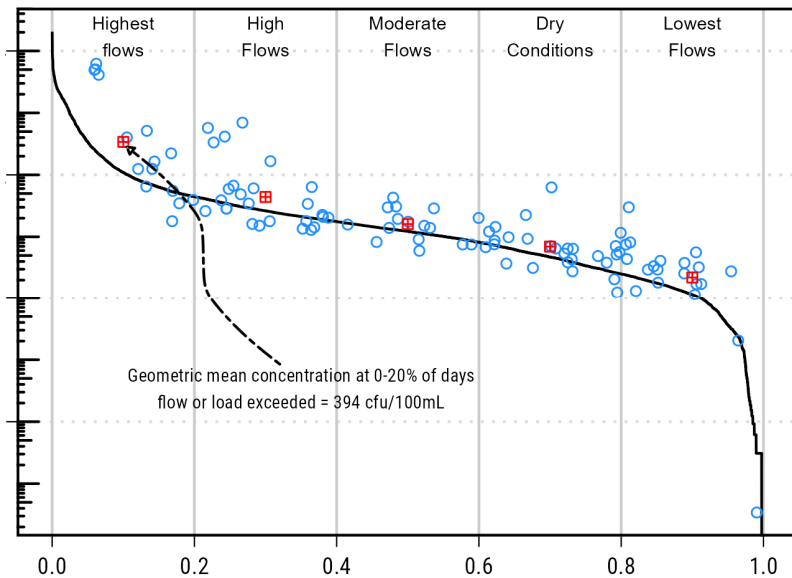
Funding Statement

Part2 n=492
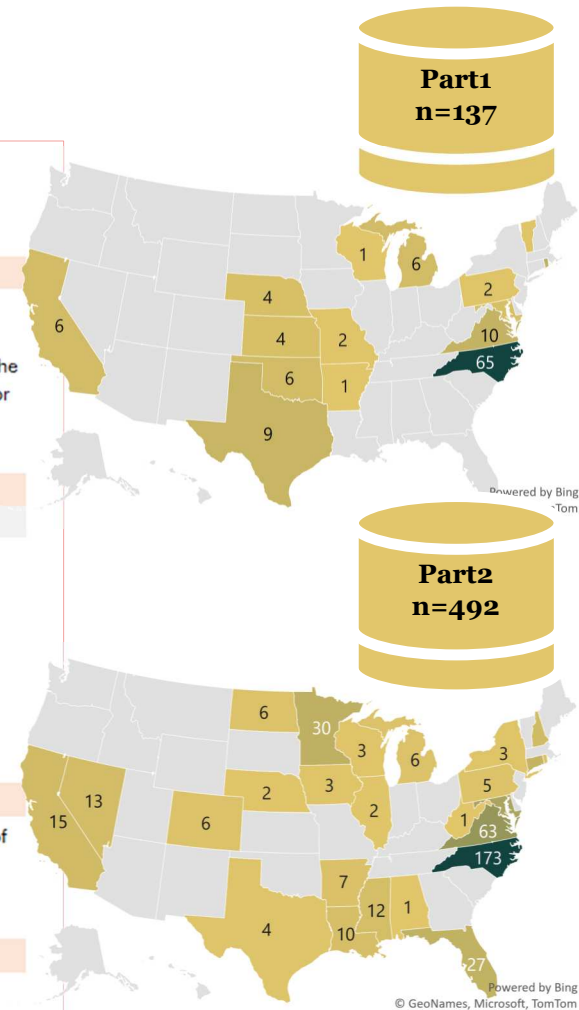
Application

Category	Equation	Pre-Treatment Concentration	Predicted Percent Reduction (r)	Pre-Treatment Concentration	Predicted Percent Reduction
Agriculture	y = (x - exp(1.115+0.795*log(x))/x	500	14.49	5000	46.61
Urban	y = (x - exp(0.054+0.866*log(x))/x	500	53.95	5000	66.13
Filtration	y = (x - exp(-0.767+0.978*log(x))/x	500	59.52	5000	61.52
Detention	y = (x - exp(1.523+0.734*log(x))/x	500	12.26	5000	52.45
Treatment	y = (x - exp(0.285+0.836*log(x))/x	500	51.97	5000	67.06
Livestock	y = (x - exp(1.317+0.769*log(x))/x	500	11.05	5000	47.71

Geometric mean concentration at 0-20% of days flow or load exceeded = 394 cfu/100mL

† M1

$$LR = \frac{AU}{plan} \times \frac{FC}{AU} \times \frac{cfu}{fc} \times Pract_e \times Prox_f$$

$$= 8.16 \times 8.55 \times 10^9 \times \frac{126}{200} \times 0.58 \times 0.15$$

$$= 3.824 \times 10^{10}$$

† M2

$$r\% = \frac{394 - e^{1.115 + 0.795 \times log(394)}}{394} \times 100 = 10.43\%$$

$$LR = \frac{AU}{plan} \times \frac{FC}{AU} \times \frac{cfu}{fc} \times r$$

$$= 8.16 \times 8.55 \times 10^9 \times \frac{126}{200} \times 0.1043$$

$$= 4.58 \times 10^{10}$$