

Effectiveness of BMP Controls Study

FINAL REPORT

SUBMITTED TO:

Lake Wallenpaupack Watershed Management District

SUBMITTED BY:

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FY1999 EPA Grant Task 2

Introduction

The purpose of this report is to summarize the results achieved from the work performed as part of the Lake Wallenpaupack Watershed Management District (LWWMD) FY 1999 EPA grant project, Task 2 – Efficiency of BMP Controls Study. The goal of this project was to determine the effectiveness of two Best Management Practices (BMPs) that were installed as part of the FY1998 EPA Grant Project. The two BMPs are the Bakker Marine project and the Krautter Agricultural BMP project.

Bakker Marine Project

Bakker Marine is located in Paupack Township, Wayne County, PA. The marina has a large paved parking lot and covered boat storage area. Stormwater from these impervious areas was running off the site and causing erosion and flooding along roadsides in the Walt's Landing development, as shown in the photos below. A detention basin existed on the site but was not functioning properly, leading to excessive sheet flow across area fields and right into lake. Many area homes had flooded basements and property damage during heavy rains.



Poorly-functioning Detention Basin Adjacent To Bakker Marine Before BMPs Installed



Roadside and Flooding during rain event before BMP installed

For the project, the existing detention basin was converted to a constructed stormwater wetland system to receive and treat the site runoff. The project was constructed in 2000. The wetland consists of six sediment forebays and a large basin. The outlet of the wetland is directed into a rock channel along the roadside. The goal of the BMP is to not only slow the stormwater velocity, but also to retain some stormwater for nutrient and sediment removal and peak flow reduction. The photos below show the constructed wetland post-construction and after wetland plant establishment.

It should be noted that it took several years for the wetland plantings to become well established, but they are thriving now.



Sediment Forebay at Constructed Wetland Inlet



Wetland Plantings Help Filter Stormwater and Trap Sediment

The water quality monitoring at Bakker Marine began soon after construction. Samples were collected at the inlet and the outlet of the wetland system during three separate storm events. However, the data from the first set of samples were not used since the vegetation was slow to establish and no nutrient reduction was achieved. The sampling re-commenced once the vegetation was established with much better results. The data were then evaluated to determine the efficiency of the system.

The results are shown in the table below. As shown in the table, good nutrient reduction was achieved for both total phosphorus, nitrate+nitrite nitrogen, and total suspended solids.

Parameters	Bakker Marina		Percent Reduction
	Inlet	Outlet	
Total Phosphorus (mg/L)	0.366	0.199	46
Ammonia Nitrogen (mg/L)	0.1	0.1	0
Nitrate+Nitrite Nitrogen (mg/L)	0.185	0.09	51
Total Nitrogen (mg/L)	0.82	0.66	20
Total Suspended Solids (mg/L)	18	11.1	38

Krautter Farm Project

The Carroll Krautter farm is located in Greene Township, Pike County, PA. The farm primarily raises livestock. The farm had lots of open manure piles and loose soils, as shown below.



Manure Pile in Uncovered Storage Area Before BMP Construction

Krautter farm is located near a pond and a tributary to Wallenpaupack Creek. As part of this project, an agricultural waste facility with a roof was constructed, as shown in the photo below. In addition, water diversion and heavy use area protection was installed on the property.



Inside of Agricultural Waste Facility Post-Construction

At the Krautter Farm project, both pre-construction and post-construction stormwater samples were collected at the outlet of the agricultural waste facility. The data were analyzed to determine the efficiency of the BMP. As shown in the table below, good nutrient reduction was achieved for total phosphorus and total suspended solids, and exceptionally good reduction was achieved for each of the nitrogen compounds.

Parameters	Krautter Farm		Percent Reduction
	Pre-Construction	Post-Construction	
Total Phosphorus (mg/L)	9.95	4.09	59
Ammonia Nitrogen (mg/L)	10.95	0.38	97
Nitrate+Nitrite Nitrogen (mg/L)	18.48	0.91	95
Total Nitrogen (mg/L)	78.98	9.91	87
Total Suspended Solids (mg/L)	832.5	357	57

The water quality monitoring data for both projects are provided in Appendix A.

Appendix A

Water Quality Monitoring Data

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Krautter Farm

Sample	Date	Location	BOD (mg/L)	F Coliform (#/100 mL)	Total P (mg/L)	DRP (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO2/3 (mg/L)	TN (mg/L)	TSS (mg/L)
Pre-construction	7/22/2003	Outlet	207	> 157000	14	6.5	64	4	36	100	1300
Pre-construction	9/24/2003	Outlet	158	> 500000	5.9	2.6	57	17.9	0.96	57.96	365
Average			182.5	328500	9.95	4.55	60.5	10.95	18.48	78.98	832.5
Post-construction	11/8/2006	Outlet	174	TNTC	4.09	2.51		0.38	0.91	9.91	357

BOD= Biological Oxygen Demand
 F Coliform= Fecal Coliform Bacteria
 Total P=Total Phosphorus
 DRP=Dissolved Reactive Phosphorus
 TKN=Total Kjeldahl Nitrogen
 NH3=Ammonia Nitrogen
 NO2/3=Nitrate+Nitrite Nitrogen
 TN=Total Nitrogen
 TSS=Total Suspended Solids

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Bakker Marina

Sample	Date	Location	BOD (mg/L)	F Coliform (#/100 mL)	Total P (mg/L)	DRP (mg/L)	TKN (mg/L)	NH3 (mg/L)	NO2/3 (mg/L)	TN (mg/L)	TSS (mg/L)
Pre-establishment	10/27/2003	Inlet	4.5	140	0.153	0.063	0.5	< 0.1	0.16	0.66	18
Pre-establishment	10/27/2003	Outlet	9.8	200	0.29	0.065	0.66	< 0.1	0.08	0.74	69
Post-construction	9/7/2006	Inlet			0.494			< 0.1	0.22	0.9	21
Post-construction	11/8/2006	Inlet	5.8	460	0.238	0.08		< 0.1	0.15	0.74	15
Average					0.366			0.1	0.185	0.82	18
Post-construction	9/7/2006	Outlet			0.192			< 0.1	0.04	0.73	7.2
Post-construction	11/8/2006	Outlet	8.4	200	0.206	0.08		< 0.1	0.14	0.59	15
Average					0.199			0.1	0.09	0.66	11.1

BOD= Biological Oxygen Demand
 F Coliform= Fecal Coliform Bacteria
 Total P=Total Phosphorus
 DRP=Dissolved Reactive Phosphorus
 TKN=Total Kjeldahl Nitrogen
 NH3=Ammonia Nitrogen
 NO2/3=Nitrate+Nitrite Nitrogen
 TN=Total Nitrogen
 TSS=Total Suspended Solids