Implementation of Floating Weir System for Surface Skimming of Temporary Stormwater Ponds

Joel Toso, Principal Investigator
Wenck Associates, Inc.

May 2014
Research Project
Final Report 2014-18
To request this document in an alternative format call 651-366-4718 or 1-800-657-3774 (Greater Minnesota) or email your request to ADArequest.dot@state.mn.us. Please request at least one week in advance.
This study provides design information for temporary stormwater ponds with floating head skimmers. The purpose of the ponds is to remove suspended sediment and nutrient loads from stormwater runoff on active construction sites. The design information is directed at meeting the standards in the National Pollution Discharge Elimination System (NPDES) general permit which includes storing runoff from the 2-year, 24-hour rainfall event or providing the equivalent sediment control. The study results include:

- Research of currently available floating head skimmers,
- Estimation of runoff hydrology and hydraulics from active construction sites using HydroCAD,
- Estimation of water quality improvements using P8, and
- Design plans.

The study shows several available technologies for pond skimming. The pond and skimmer design manages a 2-year, 24-hour rainfall event while removing an average of 80 percent of total suspended solids (TSS) from runoff. Smaller systems do not operate equivalently without additional treatment such as adding flocculants. Plans, maintenance requirements, and special provisions are included.
Implementation of Floating Weir System for Surface Skimming of Temporary Stormwater Ponds

Final Report

Prepared by:
Joel Toso
Ian Peterson
Wenck Associates, Inc.

May 2014

Published by:
Minnesota Department of Transportation
Research Services & Library
395 John Ireland Boulevard, MS 330
St. Paul, Minnesota 55155

This report represents the results of research conducted by the authors and does not necessarily represent the views or policies of the Minnesota Department of Transportation. This report does not contain a standard or specified technique.

The Minnesota Department of Transportation does not endorse products or manufacturers. Any trade or manufacturers’ names that may appear herein do so solely because they are considered essential to this report.
ACKNOWLEDGMENTS

We would like to thank Dwayne Stenlund and Bruce Holdhusen of the Minnesota Department of Transportation for their help with this research. This research was supported with funding provided by MnDOT.
TABLE OF CONTENTS

Contents

CHAPTER 1: INTRODUCTION AND BACKGROUND ........................................................... 1
  1.1 Purpose and Scope .................................................................................................... 1
  1.2 Framework .............................................................................................................. 1
  1.3 HydroCAD Computer Model .................................................................................. 2
  1.4 P8 Computer Model ............................................................................................... 2
  1.5 Limitations and Significant Assumptions .............................................................. 2

CHAPTER 2: PROJECT TASKS .................................................................................... 3
  2.1 Task 1: Summary of Existing Technology ............................................................. 3
  2.2 Task 2: Modeling ................................................................................................... 3
  2.3 Task 3: Engineering and Stormwater Pollution Prevention Plan (SWPPP) .......... 4
  2.4 Task 4: Project Report .......................................................................................... 4
  2.5 Task 5: Meetings .................................................................................................. 4

REFERENCES .................................................................................................................. 5

APPENDIX A: Existing Technology ............................................................................... A-1
APPENDIX B: Model Outputs ....................................................................................... B-1
APPENDIX C: SWPPP and Plan Set ............................................................................ C-1
APPENDIX D: Kickoff Meeting Notes ....................................................................... D-1
EXECUTIVE SUMMARY

This study provides design information for temporary stormwater ponds with floating head skimmers. The purpose of the ponds is to remove suspended sediment and nutrient loads from stormwater runoff on active construction sites. The design information is directed at meeting the standards in the National Pollution Discharge Elimination System (NPDES) general permit which includes storing runoff from the 2-year, 24-hour rainfall event or providing the equivalent sediment control.¹ The study results include:

- Research of currently available floating head skimmers,
- Estimation of runoff hydrology and hydraulics from active constructions sites using HydroCAD,
- Estimation of water quality improvements using P8, and
- Design plans.

The study shows several available technologies for pond skimming. The pond and skimmer design manages a 2-year, 24-hour rainfall event while removing an average of 80 percent of total suspended solids (TSS) from runoff. Smaller systems do not operate equivalently without additional treatment such as adding flocculants. Plans, maintenance requirements, and special provisions are included.
CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Purpose and Scope

The purpose of this study is to provide design information for temporary stormwater ponds with floating head skimmers to remove suspended sediment and nutrient loads from stormwater runoff on active construction sites. The design information is directed at meeting the standards in the National Pollution Discharge Elimination System (NPDES) general permit which includes storing runoff from the 2-year, 24-hour rainfall event or providing equivalent sediment controls. These items are outlined in more detail in Section III.C of the Minnesota General Permit MN R100001 and apply to watersheds of 5 acres or more draining to one location that discharges to a protected water or watershed of 10 acres or more draining to the same location in all other scenarios. The study explores a defined set of basin sizes, watershed sizes, retention times, soil types, and alternate configurations. These parameters are used to investigate rate control and pollutant removal efficiency in stormwater ponds with skimmers.

The results of the investigation were used to develop a standard set of plans and a general Stormwater Pollution Prevention Plan (SWPPP) directed at meeting the requirements of the NPDES general permit and local watershed management organizations. The plan set and SWPPP will be used by the Minnesota Department of Transportation (MnDOT) for pollution control on active construction sites throughout the state.

1.2 Framework

The study includes research of currently available floating head skimmers for use by MnDOT. Each skimmer type varies greatly in application. A rating curve was created to determine the theoretical effluent rate from various skimmer sizes. The rating curve found that most skimmers provide a constant effluent rate which is restricted by outlet orifice or pipe size. Figure 1 of Appendix B is a sample rating curve used in this evaluation.

Based on the available technology and calculated rating curve, computer models were developed to evaluate the basin and skimmer hydrology and water quality improvement. The hydrology and hydraulics of runoff from active constructions sites was predicted and evaluated using HydroCAD. P8 was used to model the water quality. HydroCAD is a widely used modeling tool for the evaluation and design of stormwater systems. P8 is a useful diagnostic tool for evaluating water quality benefits of various watershed improvements. Both models require user input on watershed characteristics, infrastructure dimensions, and precipitation. HydroCAD was used to design the required pond dimensions. These were then used as input parameters to the P8 model. The modeling results estimate the water quality improvements that can be expected from the ponds.

A standard plan for a temporary stormwater pond was developed based on the results of the research and modeling. The narrative for the MnDOT SWPPP template was updated to
include this information. This standard plan includes maintenance protocols that define cleanout
frequency based on Stokes’ settling velocity.

1.3 HydroCAD Computer Model

HydroCAD is a stormwater modeling software that uses the standard Natural Resources
Conservation Service (NRCS) Curve Number (CN) method. HydroCAD is used to model
rainfall events for a specified reoccurrence interval or rainfall depth. The flow routing in
HydroCAD allows for modeling of a range of stormwater control measures. For this study, the
standard 2-year, 24-hour rainfall event (2.8 inches) for the Minneapolis/St. Paul area was used to
model the pond and skimmer system. HydroCAD includes a pond outlet device that operates like
a skimmer for constant flow after a certain water depth is achieved.

1.4 P8 Computer Model

P8 calculates runoff separately for pervious and impervious areas. Calculations for
pervious areas use the NRCS CN method. Runoff from impervious areas begins once the
cumulative storm rainfall exceeds the specified depression storage, with the runoff rate equal to
the rainfall intensity. The P8 model uses an hourly precipitation record (rain and snowfall) and
daily temperature record. Precipitation and temperature data were obtained from the
Minneapolis-St. Paul International Airport. Records from 2001 to 2010 were used for this study.
The bare soil particle file was selected to model active construction sites.

1.5 Limitations and Significant Assumptions

Five watershed sizes were used to design the temporary ponds. These watersheds were 2,
5, 10, 15, and 20 acres. Four ponds were designed for each watershed with varying dead pool
storage volumes based on the size of the watershed. 1200, 1800, 2400, and 3200 cubic feet of
dead pool storage were provided per acre of watershed. 4-foot and 2-foot dead pool storage
depths were used for the basin modeling. The NURP stormwater pond standards recommend 3
to 10 feet of dead pool storage for prevention of re-suspension of accumulated sediment.

Soil types consistent with typical Minnesota construction sites were used in the modeling
process. These soils were clay loam, sandy loam, silt loam, and loam. Clay loam is consistent
with soils from various locations in Districts 1 and 6. Sandy loam can be found in the Anoka
Sand Plain. Silt loam and loam are reflective of the Red River Valley and Mankato, respectively.
NRCS recommends a curve number of 96 for compacted soil. In order to model different soil
types, a range of curve numbers from 93 to 96 was used in the P8 model to estimate the soil
loading rate for construction sites. The soil loading rate produced by P8 was compared with the
results using the Revised Universal Soil Loss Equation for clay loam (CN:93), sandy loam
(CN:96), silt loam (CN:95), and loam (CN:94). The loading rates can be found in Table 1 of
Appendix B.
CHAPTER 2: PROJECT TASKS

2.1 Task 1: Summary of Existing Technology

The internet was researched for available passive pond skimming technologies. A technical memo describing the results is provided in Appendix A. Five designs were found and described, as well as associated basin design considerations produced by the North Carolina Department of Transportation. While the capability to improve water quality for each specific practice is not known, research suggests that devices of this type have the potential to remove upwards of 90 percent of suspended sediment. Each technology has its own specifications for discharge rate based on desired retention time.

2.2 Task 2: Modeling

Using HydroCAD, temporary sedimentation basins were designed to satisfy the requirements for various watershed sizes from 2 to 20 acres. The pond design uses a rectangular configuration for modeling simplicity. The basins were designed to accommodate runoff from the 2-year, 24-hour rainfall event in the live storage area with overflow in the event of a larger rainfall event. The live storage is defined as any volume above the lowest height at which water will be discharged through the skimmer. The dead storage for these basins ranged from 1200 to 3200 cubic feet per acre.

The entire watershed was considered impervious with entirely exposed soils to most accurately reflect construction sites. Soils were modeled separately for clay loam, sandy loam, silt loam, and loam using NRCS CNs that ranged from 93 to 96. The HydroCAD model produced various basin configurations based on the size of the contributing watershed and desired retention time of 3.25 days. These basin configurations were then adapted for modeling in P8 to predict pollutant removal efficiency. Specific particle size removal efficiency was estimated using Stokes’ settling velocity for clay, silt, and very fine sand particles.

The effect of dead storage was evaluated at 4-feet and 2-feet deep. Based on these results, deadpool depth has little effect on the efficacy of the skimming basins. The results from these models can be found in Tables 2 and 3 in Appendix B. The 4-foot and 2-foot deep deadpool ponds have average TSS removal efficiencies of 79 percent and 82 percent, respectively. The deadpool does not affect treatment efficiency, because the skimmer causes discharge rates to remain constant and only the water from the pond surface is discharged. As a result, consistently clean water is discharged regardless of the size of the deadpool volume. Because the deadpool has little effect on treatment efficiency, the standard pond design uses a 1.5-foot dead pool depth (Appendix C). This reduces the cost associated with excavating larger ponds, but still provides enough depth to prevent the skimmer from becoming trapped by accumulated sediment.

A separate design was included to incorporate dead storage as low as 200 cubic feet per acre using a 2-foot dead storage depth. These smaller basin designs predict the effect of using a smaller system, such as ditch blocks, when space for properly sized systems is unavailable. The TSS removal efficiencies of these systems are shown in Table 4 of Appendix B. When the basins
are unable to retain the 2-yr rainfall event, the efficiency of the system is reduced. The addition of chemical treatment may be needed in order to maintain the removal efficiency on sites where full sized ponds are not feasible.

Stokes’ settling velocity was used to evaluate the composition of the pond effluent water. Because the skimmer removes water from the pond surface, Stokes’ equation predicts that all of the sand and silt content of the suspended sediment is captured while clay particles are largely untreated. At a 5-foot total basin depth, only 31 percent of the clay particles are retained (See Table 5, Appendix B). In watersheds with soils having high clay content, a flocculent may be added to improve removal efficiencies.

The density of various Minnesota River sediments was used to predict sediment volume accumulation in the basin. An annual rate of basin cleanout was estimated from these sediment densities and modeled sediment accumulation. According to the NPDES general permit, cleanout is needed when the pond has been filled halfway with sediment. By estimating the frequency at which this will occur, a less ambiguous standard can be maintained. Tables 6, 7, and 8 show the predicted cleanout frequencies based on basin sizes and the soil type of the contributing watershed. Estimated pond cleanout frequencies that can retain the 2-yr rainfall event range from once every three years to multiple times per year.

2.3 Task 3: Engineering and Stormwater Pollution Prevention Plan (SWPPP)

Using the modeling outputs, a standard plan was developed. This plan includes details for pond design, sizing requirements, outlet structure, SWPPP language, and maintenance protocols. In addition, special provisions for the plan set were developed. A set of plans and special provisions can be found in Appendix C. Manufacturer recommendations should be followed to ensure that the average retention time of the 2-year, 24-hr rainfall event is 3.25 days. A floating absorbent boom should be included in the design to remove oil or grease in the runoff.

2.4 Task 4: Project Report

Contents of this technical report compile the results of the study.

2.5 Task 5: Meetings

A kickoff meeting was held on January 31st, 2014 to initialize the project after the initial research had been conducted. Meeting notes are contained in Appendix D.

Other meetings were held to discuss draft results of the model and report. This report is the compilation of the result of those meetings.
REFERENCES

APPENDIX A: Existing Technology
List of Pond Skimming Devices:

1. ESC Skimmer, by Erosion Supply Company (http://www.erosionsupply.com/).
TECHNICAL MEMORANDUM

TO: Dwayne Stenlund
Minneapolis Department of Transportation

FROM: Joel Toso, PE
Ian Peterson, EIT

DATE: January 31, 2014

SUBJECT: Research of existing pond skimmer technology

Introduction:

This memo provides web research results on available passive discharge skimming technologies (i.e. floating head skimmers). Surface skimmers are intended to greatly reduce suspended sediment, oil, and grease loads in rainwater runoff when properly designed and installed.

A floating head skimmer can be defined as a raised discharge device with an inlet at or near the water’s surface where higher water quality is expected. Drawing water from the surface of the basin reduces the re-suspension of sediment due to mixing that is prevalent when draining at lower points.

Results:

Of the technologies found to be viable floating head skimmer options (see figures), the Faircloth Skimmer appears to be the most prevalently used (Figure 1). The Faircloth Skimmer is available through J.W. Faircloth and Sons Inc. located in North Carolina (http://www.fairclothskimmer.com/). A similar design is the Erosion Supply Company Skimmer (Figure 2). Erosion Supply Company is also located in North Carolina (http://www.erosionsupply.com/). Innovative Applied Solutions, LLC (http://iasllcusa.com/), again in North Carolina, provides a similar design as well (Figure 3). Thirsty Duck (http://thirsty-duck.com/), in Florida, produces a floating system that is activated by rising water levels (Figure 4). The system closes at a specific water level, as the basin fills the floating valve is opened. Fee Saver (http://swfeesaver.com/), in South Carolina, produces the Marlee Float which has an orifice in in the horizontal plane (Figure 5).
Figure 1: Typical Faircloth Skimmer shown in floating position.

Figure 2: Erosion Supply Company passive dewatering device.

Figure 3: Innovative Applied Solutions water quality skimmer detail.

Figure 4: Thirsty Duck TD series floating head pond skimmer.

Figure 5: Fee Saver Stormwater Services “The Marlee Float Skimmer.”
The use of floating head skimmers is often associated with a retrofitted basin design (Figure 6). The basin design includes pervious basin partitions that filter sediment and oil prior to reaching the skimmer device. This is done to further increase water quality and reduce the frequency of necessary maintenance on the pond skimmer. Retrofitted basin designs, depending on the type of skimmer, may also include a skimmer pit which is a shallow pit filled with riprap that prevents the skimmer from settling in accumulated sediment. This, again, improves the performance of the skimmer and reduces the need for maintenance. When oil and grease are of concern, EnviroHazmat provides a non-discharge skimmer that collects hydrocarbons. Effluent capacity and design characteristics for the skimmer devices vary greatly with the technology and are available on the websites provided. In order to achieve the desired dewatering rates, skimmer devices should be designed accordingly.

Several research endeavors have explored the effectiveness of floating head skimmers. The Faircloth skimmer has received the most attention in this research. Research conducted at North Carolina State University and Penn State University suggests that skimmers, specifically the Faircloth Skimmer, can achieve upwards of 90% total suspended solids removal. This assumes that skimmer and basin have been designed in consideration of the basin retrofits discussed above. Research conducted at the University of Minnesota, St. Anthony Falls Laboratory suggests similar results for the Thirsty Duck system. Not all of these technologies have been researched to the same extent and their compared effectiveness is therefore unknown.
Conclusion:

Available passive pond skimming technologies were researched. Five designs were found and described, as well as associated basin design considerations. While the capability to improve water quality for each specific practice is not known, research suggests that devices of this type have the potential to remove upwards of 90% of suspended sediment. Each technology has its own specifications for discharge rate based on desired retention.
APPENDIX B: Model Outputs
Figure 1: Device rating curve based on the orifice equation and pipe flow for a generic skimmer device. This graph assumes that the basin has a deadpool depth of 1.5 feet and a maximum depth of 5 feet. The pipe has a diameter of 2 inches and the pipe length is 1.4 times the pond depth per the Faircloth Skimmer recommendations.

Table 1: This table shows the annual TSS load (tons/ac/yr) produced by the P8 models. These are then compared to values calculated using the Revised Universal Soil Loss Equation. The P8 loadings were used in combination with the listed soil densities to predict needed pond cleanout frequency. The soil densities are based on soil samples taken from the bed of the Minnesota River (James, 2009).

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Annual TSS Load P8 (tons/ac/yr)</th>
<th>Annual TSS Load RUSLE (tons/ac/yr)</th>
<th>Soil Density (lb/ft³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay Loam</td>
<td>14.70</td>
<td>13.88</td>
<td>44.9</td>
</tr>
<tr>
<td>Sandy Loam</td>
<td>23.91</td>
<td>22.67</td>
<td>69.6</td>
</tr>
<tr>
<td>Silt Loam</td>
<td>20.25</td>
<td>22.67</td>
<td>51.0</td>
</tr>
<tr>
<td>Loam</td>
<td>17.22</td>
<td>17.92</td>
<td>61.7</td>
</tr>
</tbody>
</table>
Table 2: This table shows the annual TSS removal efficiency predicted in P8 of a basin and skimmer designed to match the parameters presented for the associated basin having 4 foot deep dead storage. The average removal efficiency for these systems is 79%. The curve number for Clay Loam, Sandy Loam, Silt Loam, and Loam were 93, 96, 95, and 94 respectively.

<table>
<thead>
<tr>
<th>Dead pool</th>
<th>Clay Loam</th>
<th>Sandy Loam</th>
<th>Silt Loam</th>
<th>Loam</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,200 cf/ac</td>
<td>80%</td>
<td>79%</td>
<td>79%</td>
<td>79%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>82%</td>
<td>81%</td>
<td>81%</td>
<td>81%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>83%</td>
<td>82%</td>
<td>82%</td>
<td>83%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>85%</td>
<td>84%</td>
<td>85%</td>
<td>85%</td>
</tr>
<tr>
<td>1,200 cf/ac</td>
<td>77%</td>
<td>76%</td>
<td>77%</td>
<td>77%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>79%</td>
<td>78%</td>
<td>79%</td>
<td>79%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>81%</td>
<td>80%</td>
<td>81%</td>
<td>81%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>84%</td>
<td>83%</td>
<td>83%</td>
<td>84%</td>
</tr>
<tr>
<td>1,200 cf/ac</td>
<td>75%</td>
<td>73%</td>
<td>74%</td>
<td>75%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>78%</td>
<td>77%</td>
<td>77%</td>
<td>78%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>80%</td>
<td>79%</td>
<td>79%</td>
<td>80%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>83%</td>
<td>82%</td>
<td>82%</td>
<td>83%</td>
</tr>
<tr>
<td>1,200 cf/ac</td>
<td>74%</td>
<td>71%</td>
<td>72%</td>
<td>73%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>77%</td>
<td>76%</td>
<td>77%</td>
<td>77%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>80%</td>
<td>78%</td>
<td>79%</td>
<td>79%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>83%</td>
<td>81%</td>
<td>82%</td>
<td>82%</td>
</tr>
<tr>
<td>1,200 cf/ac</td>
<td>73%</td>
<td>70%</td>
<td>71%</td>
<td>72%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>77%</td>
<td>75%</td>
<td>76%</td>
<td>77%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>79%</td>
<td>78%</td>
<td>78%</td>
<td>79%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>83%</td>
<td>81%</td>
<td>82%</td>
<td>82%</td>
</tr>
</tbody>
</table>
Table 3: This table shows the annual TSS removal efficiency predicted in P8 of a basin and skimmer designed to match the parameters presented for the associated basin having 2 foot deep dead storage. The average removal efficiency for these systems is 82%. The curve number for Clay Loam, Sandy Loam, Silt Loam, and Loam were 93, 96, 95, and 94 respectively.

<table>
<thead>
<tr>
<th>Dead pool</th>
<th>Clay Loam</th>
<th>Sandy Loam</th>
<th>Silt Loam</th>
<th>Loam</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,200 cf/ac</td>
<td>81%</td>
<td>80%</td>
<td>81%</td>
<td>81%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>83%</td>
<td>82%</td>
<td>83%</td>
<td>83%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>85%</td>
<td>84%</td>
<td>84%</td>
<td>84%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>87%</td>
<td>86%</td>
<td>87%</td>
<td>87%</td>
</tr>
<tr>
<td>5 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,200 cf/ac</td>
<td>80%</td>
<td>79%</td>
<td>79%</td>
<td>79%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>82%</td>
<td>81%</td>
<td>81%</td>
<td>82%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>84%</td>
<td>83%</td>
<td>83%</td>
<td>83%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>86%</td>
<td>86%</td>
<td>86%</td>
<td>86%</td>
</tr>
<tr>
<td>10 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,200 cf/ac</td>
<td>79%</td>
<td>78%</td>
<td>78%</td>
<td>78%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>81%</td>
<td>80%</td>
<td>81%</td>
<td>81%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>83%</td>
<td>82%</td>
<td>83%</td>
<td>83%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>86%</td>
<td>85%</td>
<td>85%</td>
<td>86%</td>
</tr>
<tr>
<td>15 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,200 cf/ac</td>
<td>78%</td>
<td>77%</td>
<td>77%</td>
<td>78%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>81%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>83%</td>
<td>82%</td>
<td>82%</td>
<td>83%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>86%</td>
<td>85%</td>
<td>85%</td>
<td>86%</td>
</tr>
<tr>
<td>20 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,200 cf/ac</td>
<td>78%</td>
<td>77%</td>
<td>77%</td>
<td>77%</td>
</tr>
<tr>
<td>1,800 cf/ac</td>
<td>81%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>2,400 cf/ac</td>
<td>83%</td>
<td>82%</td>
<td>82%</td>
<td>82%</td>
</tr>
<tr>
<td>3,600 cf/ac</td>
<td>86%</td>
<td>85%</td>
<td>85%</td>
<td>85%</td>
</tr>
</tbody>
</table>
Table 4: This table shows the annual TSS removal efficiency predicted in P8 of a basin and skimmer designed to match the parameters presented for the associated basin having 2 foot deep dead storage on a project that does not have enough space to accommodate a larger basin. The average removal efficiency for these systems is 67%. The curve number for Clay Loam, Sandy Loam, Silt Loam, and Loam were 93, 96, 95, and 94 respectively.

<table>
<thead>
<tr>
<th>Dead pool</th>
<th>Clay Loam</th>
<th>Sandy Loam</th>
<th>Silt Loam</th>
<th>Loam</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 cf/ac</td>
<td>60%</td>
<td>57%</td>
<td>58%</td>
<td>59%</td>
</tr>
<tr>
<td>400 cf/ac</td>
<td>69%</td>
<td>66%</td>
<td>67%</td>
<td>68%</td>
</tr>
<tr>
<td>600 cf/ac</td>
<td>73%</td>
<td>71%</td>
<td>72%</td>
<td>73%</td>
</tr>
<tr>
<td>800 cf/ac</td>
<td>75%</td>
<td>74%</td>
<td>74%</td>
<td>75%</td>
</tr>
</tbody>
</table>

Table 5: The top half of the table shows the percent by mass of clay (Cl), silt (MS), and very fine sand (VFS) for each design soil type. The bottom portion of the table shows basin removal efficiency based on soil type and Stokes’ settling velocity. This assumes that the live storage depth is 5 feet deep and the settling velocity for CL, MS, and VFS is 62.5, 12.5, and 0.02 ft/hr, respectively.
Table 6: The left portion of the table shows the sizing, footprint, volume, and peak depth of the design basin based on the watershed size. These basins are designed to accommodate a 2-yr, 24-hr rainfall event and have a design dead storage depth of 4 feet. The basins are sized not to exceed 10 feet in total depth. Where the peak depth indicated “Overflow,” this design depth maximum has been exceeded in a 2-year, 24-hour rainfall event. The left portion of the table shows the predicted annual pond cleanout frequency based on watershed size, sediment accumulation, basin removal efficiency, soil type, soil density, and a cleanout depth of 2 feet.

<table>
<thead>
<tr>
<th>Dead pool</th>
<th>Top Footprint (sq-ft)</th>
<th>Bottom Footprint (sq-ft)</th>
<th>Dead pool Volume (ft³)</th>
<th>2 yr storm peak depth (ft)</th>
<th>Cleanout Frequency (year⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Clay Loam</td>
</tr>
<tr>
<td>2 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,200 cf/acre</td>
</tr>
<tr>
<td>1,200 cf/acre</td>
<td>5114</td>
<td>131</td>
<td>2396</td>
<td>8.85</td>
<td>1.1</td>
</tr>
<tr>
<td>1,800 cf/acre</td>
<td>6007</td>
<td>305</td>
<td>3659</td>
<td>8.21</td>
<td>0.7</td>
</tr>
<tr>
<td>2,400 cf/acre</td>
<td>6721</td>
<td>484</td>
<td>4792</td>
<td>7.78</td>
<td>0.5</td>
</tr>
<tr>
<td>3,600 cf/acre</td>
<td>8102</td>
<td>902</td>
<td>7231</td>
<td>7.13</td>
<td>0.4</td>
</tr>
<tr>
<td>5 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,200 cf/acre</td>
</tr>
<tr>
<td>1,200 cf/acre</td>
<td>7492</td>
<td>697</td>
<td>6142</td>
<td>9.92</td>
<td>1.1</td>
</tr>
<tr>
<td>1,800 cf/acre</td>
<td>9017</td>
<td>1220</td>
<td>9017</td>
<td>9.40</td>
<td>0.7</td>
</tr>
<tr>
<td>2,400 cf/acre</td>
<td>10629</td>
<td>1830</td>
<td>12284</td>
<td>8.69</td>
<td>0.5</td>
</tr>
<tr>
<td>3,600 cf/acre</td>
<td>13242</td>
<td>3023</td>
<td>18165</td>
<td>7.82</td>
<td>0.4</td>
</tr>
<tr>
<td>10 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,200 cf/acre</td>
</tr>
<tr>
<td>1,200 cf/acre</td>
<td>10629</td>
<td>1830</td>
<td>12284</td>
<td>Overflow</td>
<td>1.1</td>
</tr>
<tr>
<td>1,800 cf/acre</td>
<td>13242</td>
<td>3006</td>
<td>18165</td>
<td>9.96</td>
<td>0.7</td>
</tr>
<tr>
<td>2,400 cf/acre</td>
<td>15856</td>
<td>4356</td>
<td>24524</td>
<td>9.63</td>
<td>0.5</td>
</tr>
<tr>
<td>3,600 cf/acre</td>
<td>20430</td>
<td>6882</td>
<td>36285</td>
<td>8.49</td>
<td>0.4</td>
</tr>
<tr>
<td>15 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,200 cf/acre</td>
</tr>
<tr>
<td>1,200 cf/acre</td>
<td>13242</td>
<td>3006</td>
<td>18165</td>
<td>Overflow</td>
<td>1.1</td>
</tr>
<tr>
<td>1,800 cf/acre</td>
<td>16901</td>
<td>4879</td>
<td>27094</td>
<td>Overflow</td>
<td>0.7</td>
</tr>
<tr>
<td>2,400 cf/acre</td>
<td>20430</td>
<td>6882</td>
<td>36285</td>
<td>9.93</td>
<td>0.5</td>
</tr>
<tr>
<td>3,600 cf/acre</td>
<td>26877</td>
<td>10803</td>
<td>54014</td>
<td>8.77</td>
<td>0.4</td>
</tr>
<tr>
<td>20 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,200 cf/acre</td>
</tr>
<tr>
<td>1,200 cf/acre</td>
<td>15856</td>
<td>4356</td>
<td>24524</td>
<td>Overflow</td>
<td>1.1</td>
</tr>
<tr>
<td>1,800 cf/acre</td>
<td>20430</td>
<td>6882</td>
<td>36285</td>
<td>Overflow</td>
<td>0.7</td>
</tr>
<tr>
<td>2,400 cf/acre</td>
<td>24980</td>
<td>9583</td>
<td>48813</td>
<td>9.97</td>
<td>0.5</td>
</tr>
<tr>
<td>3,600 cf/acre</td>
<td>33498</td>
<td>15115</td>
<td>73094</td>
<td>8.85</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Table 7: The left portion of the table shows the sizing, footprint, volume, and peak depth of the design basin based on the watershed size. These basins are designed to accommodate a 2-yr, 24-hr rainfall event and have a design dead storage depth of 2 feet. The basins are sized not to exceed 10 feet in total depth. The left portion of the table shows the predicted annual pond cleanout frequency based on watershed size, sediment accumulation, basin removal efficiency, soil type, soil density, and a cleanout depth of 1 foot.

<table>
<thead>
<tr>
<th>Dead pool (cf/acre)</th>
<th>Top Footprint (sq-ft)</th>
<th>Bottom Footprint (sq-ft)</th>
<th>Dead pool Volume (ft³)</th>
<th>2 yr storm peak depth (ft)</th>
<th>Cleanout Frequency (year⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clay Loam</td>
<td>Sandy Loam</td>
<td>Silt Loam</td>
<td>Loam</td>
<td></td>
</tr>
</tbody>
</table>
| 2 Acre Watershed  
1,200 cf/acre | 7832 | 812 | 2396 | 6.33 | 1.1 | 1.1 | 1.3 | 0.9 |
| 1,800 cf/acre | 9216 | 1296 | 3572 | 5.63 | 0.7 | 0.8 | 0.9 | 0.6 |
| 2,400 cf/acre | 10609 | 1849 | 4835 | 5.08 | 0.5 | 0.6 | 0.7 | 0.5 |
| 3,600 cf/acre | 12996 | 2916 | 7231 | 4.40 | 0.4 | 0.4 | 0.4 | 0.3 |
| 5 Acre Watershed  
1,200 cf/acre | 11772 | 2352 | 5968 | 7.31 | 1.1 | 1.2 | 1.3 | 0.9 |
| 1,800 cf/acre | 14641 | 3721 | 9017 | 6.27 | 0.7 | 0.8 | 0.9 | 0.6 |
| 2,400 cf/acre | 17292 | 5112 | 12023 | 5.57 | 0.5 | 0.6 | 0.7 | 0.5 |
| 3,600 cf/acre | 22201 | 7921 | 18077 | 4.70 | 0.4 | 0.4 | 0.4 | 0.3 |
| 10 Acre Watershed  
1,200 cf/acre | 17292 | 5112 | 12023 | 8.06 | 1.1 | 1.1 | 1.3 | 0.9 |
| 1,800 cf/acre | 22201 | 7921 | 18077 | 6.78 | 0.7 | 0.8 | 0.9 | 0.6 |
| 2,400 cf/acre | 26732 | 10712 | 24002 | 5.95 | 0.5 | 0.6 | 0.7 | 0.5 |
| 3,600 cf/acre | 35344 | 16384 | 35937 | 4.94 | 0.4 | 0.4 | 0.4 | 0.3 |
| 15 Acre Watershed  
1,200 cf/acre | 22201 | 7921 | 18077 | 8.49 | 1.1 | 1.1 | 1.3 | 0.9 |
| 1,800 cf/acre | 28900 | 12100 | 26920 | 7.07 | 0.7 | 0.8 | 0.9 | 0.6 |
| 2,400 cf/acre | 35344 | 16384 | 35937 | 6.14 | 0.5 | 0.6 | 0.7 | 0.5 |
| 3,600 cf/acre | 47524 | 24964 | 53797 | 5.04 | 0.4 | 0.4 | 0.4 | 0.3 |
| 20 Acre Watershed  
1,200 cf/acre | 26732 | 10712 | 24002 | 8.80 | 1.1 | 1.1 | 1.3 | 0.9 |
| 1,800 cf/acre | 35344 | 16384 | 35937 | 7.24 | 0.7 | 0.8 | 0.9 | 0.6 |
| 2,400 cf/acre | 43681 | 22201 | 48090 | 6.25 | 0.5 | 0.6 | 0.7 | 0.5 |
| 3,600 cf/acre | 59536 | 33856 | 72222 | 5.09 | 0.4 | 0.4 | 0.4 | 0.3 |
Table 8: The left portion of the table shows the sizing, footprint, volume, and peak depth of the design basin based on the watershed size. These basins are designed assuming that the project does not have enough space to accommodate a larger basin and have a design dead storage depth of 2 feet. Where the peak depth indicated “Overflow,” this design depth maximum has been exceeded in a 2-yr, 24-hr rainfall event. The left portion of the table shows the predicted annual cleanout frequency based on watershed size, sediment accumulation, basin removal efficiency, soil type, soil density, and a cleanout depth of 1 foot.

<table>
<thead>
<tr>
<th>Dead pool</th>
<th>Top Footprint (sq-ft)</th>
<th>Bottom Footprint (sq-ft)</th>
<th>Dead pool Volume (ft³)</th>
<th>2 yr storm peak depth (ft)</th>
<th>Cleanout Frequency (year⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Clay Loam</td>
</tr>
<tr>
<td>15 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Clay Loam</td>
</tr>
<tr>
<td>200 cf/ac</td>
<td>8538</td>
<td>1045</td>
<td>3006</td>
<td>Overflow</td>
<td>6.5</td>
</tr>
<tr>
<td>400 cf/ac</td>
<td>11761</td>
<td>2352</td>
<td>5988</td>
<td>Overflow</td>
<td>3.3</td>
</tr>
<tr>
<td>600 cf/ac</td>
<td>14636</td>
<td>3703</td>
<td>9017</td>
<td>Overflow</td>
<td>2.2</td>
</tr>
<tr>
<td>800 cf/ac</td>
<td>17293</td>
<td>5097</td>
<td>11631</td>
<td>9.92</td>
<td>1.7</td>
</tr>
<tr>
<td>20 Acre Watershed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Clay Loam</td>
</tr>
<tr>
<td>200 cf/ac</td>
<td>9714</td>
<td>1481</td>
<td>3485</td>
<td>Overflow</td>
<td>7.5</td>
</tr>
<tr>
<td>400 cf/ac</td>
<td>13678</td>
<td>3267</td>
<td>7971</td>
<td>Overflow</td>
<td>3.3</td>
</tr>
<tr>
<td>600 cf/ac</td>
<td>17293</td>
<td>5097</td>
<td>12023</td>
<td>Overflow</td>
<td>2.2</td>
</tr>
<tr>
<td>800 cf/ac</td>
<td>19863</td>
<td>6578</td>
<td>15159</td>
<td>Overflow</td>
<td>1.7</td>
</tr>
</tbody>
</table>
APPENDIX C: SWPPP and Plan Set
STORM WATER POLLUTION PREVENTION PLAN (SWPPP) NARRATIVE

PROJECT DESCRIPTION/LOCATION
SP INJECTION IS LOCATED ON 1/2 (SEE PAGE 2 TO 10) IN THE CITY OF SAN ANTONIO, COUNTY.

THE PLANNED SCOPE OF THE PROJECT INCLUDES:

- Auxtilla Watershed
- Private River Area
- Ground Water

SPECIAL AND IMPAIRED WATERS

THE SOURCES OF SPECIAL AND IMPAIRED WATERS ARE LOCATED WITHIN ONE MILE OF THE PROJECT LIMITS AND RECEIVED RUNOFF FROM THE PROJECT SITE, DUE TO THE PROXIMITY OF THESE SPECIAL AND IMPAIRED WATERS, THE DMRs DEPICTED IN APPENDIX 2 OF THE DMR PERMIT WILL APPLY TO ALL AREAS OF THE SITE.

WATERWAY (ENVIRONMENTAL): NOT INFLUENT WATERS

- GRASSY WATERSHED
- INFLUENT WATERS (AQUIFER MANAGEMENT DISTRICT)

AREAS OF ENVIRONMENTAL SENSITIVITY (AES) AND INFESTED WATERS

IN ADDITION TO THE LIST OF SPECIAL AND IMPAIRED WATERS THE CONTRACTOR SHALL BE AWARE THAT THERE ARE WETLANDS AND EXISTING STORMWATER FACILITIES AROUND AND WITHIN THE PROJEC CT BOX. THERE IS A MAP OF OPEN NATURAL RESOURCES ON THE LAST PAGE OF THE SWPPP.

THE FOLLOWING WATERSHEDS HAVE BEEN IDENTIFIED BY THE DMR AS BEING INFESTED BY INFECTED SPECIES LISTED WATERSHEDS WEST.

SOIL TYPE:

- SOIL TYPES TYPICALLY FOUND ON THIS PROJECT ARE XXXXX.

LONG-TERM MAINTENANCE AND OPERATION

PROCEDURE:

- THE CONTRACTOR IS RESPONSIBLE FOR THE INSTALLATION, INSPECTION, AND MAINTENANCE OF THE PERMANENT STORMWATER TREATMENT SYSTEM.
- THE CONTRACTOR WILL INSTALL A MAINTENANCE ROUTINE TO ENSURE THE CONTINUITY OF THE SYSTEM.
- THE CONTRACTOR WILL INSTALL A MAINTENANCE ROUTINE TO ENSURE THE CONTINUITY OF THE SYSTEM.
- THE CONTRACTOR WILL INSTALL A MAINTENANCE ROUTINE TO ENSURE THE CONTINUITY OF THE SYSTEM.
- THE CONTRACTOR WILL INSTALL A MAINTENANCE ROUTINE TO ENSURE THE CONTINUITY OF THE SYSTEM.

SITE INSPECTION AND MAINTENANCE

- THE CONTRACTOR SHALL PERFORM A VISUAL INSPECTION OF THE PROJECT SITE AT LEAST ONCE EVERY SEVEN DAYS DURING CONSTRUCTION AND WITHIN 24 HOURS OF A RAINFALL OF 0.25 INCHES IN 24 HOURS, INSPECT AND REPORT ANY TEMPORARY AND PERMANENT WATER QUALITY MANAGERS, ENSURE EROSION CONTROL AND CONSTRUCTION PRACTICES UNTIL THE PERMITS ARE ISSUED. THE CONTRACTOR SHALL SUBMIT A FINAL INSPECTION REPORT FOR EACH PERIOD.
- THE CONTRACTOR SHALL SUBMIT A FINAL INSPECTION REPORT FOR EACH PERIOD.
- THE CONTRACTOR SHALL SUBMIT A FINAL INSPECTION REPORT FOR EACH PERIOD.
- THE CONTRACTOR SHALL SUBMIT A FINAL INSPECTION REPORT FOR EACH PERIOD.
- THE CONTRACTOR SHALL SUBMIT A FINAL INSPECTION REPORT FOR EACH PERIOD.

LOCATION OF SWPPP REQUIREMENTS

- THE REQUIRED SWPPP REQUIREMENTS FOR THE PROJECT ARE LOCATED IN THE APPENDIX OF THE SWPPP.
- THE REQUIRED SWPPP REQUIREMENTS FOR THE PROJECT ARE LOCATED IN THE APPENDIX OF THE SWPPP.
- THE REQUIRED SWPPP REQUIREMENTS FOR THE PROJECT ARE LOCATED IN THE APPENDIX OF THE SWPPP.
- THE REQUIRED SWPPP REQUIREMENTS FOR THE PROJECT ARE LOCATED IN THE APPENDIX OF THE SWPPP.
- THE REQUIRED SWPPP REQUIREMENTS FOR THE PROJECT ARE LOCATED IN THE APPENDIX OF THE SWPPP.
STORM WATER POLLUTION PREVENTION PLAN (SWPPP) NARRATIVE (CONTINUED)

STABILIZATION TIME FRAME

<table>
<thead>
<tr>
<th>AREA</th>
<th>TIME FRAME</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAND-LEVEL FEET OF DRAINAGE DITCH ON SMALL</td>
<td>APPROXIMATE TIME OF COMPLETION OF CONSTRUCTION ACTIVITIES</td>
<td>1/1</td>
</tr>
<tr>
<td>WATER-LEVEL FEET OF DRAINAGE DITCH ON SMALL</td>
<td></td>
<td>1/2</td>
</tr>
<tr>
<td>DRAINAGE DITCHES ON SMALL</td>
<td></td>
<td>1/3</td>
</tr>
</tbody>
</table>

STABILIZED PERIOD OF DRAIN DUE TO WHERE THE DRAIN GETS MIST. | 1/4 |

GENERAL RULES ON UTILIZATION OF TERRESTRIAL AND POLYETHYLENE PIPE ARE NOT ACCEPTABLE STABILIZATION METHODS IN THESE AREAS. | 1/5 |

EQUIPMENT: MUST BE STABILIZED IN ORDER TO BE CONSIDERED PERMIT CONTROL DIPS. USE RAPID STABILIZATION METHOD. | 1/6 |

A. STABLE ETION CONSTRUCTION BETWEEN MAY 1 - AUGUST 1, SEED WITH SEED MIXTURE 11/111 | 1/7 |

B. STABLE ETION CONSTRUCTION BETWEEN AUGUST 1 - OCTOBER 15, SEED WITH SEED MIXTURE 11/111 | 1/8 |

C. MULTIPLE YEAR CONSTRUCTION | 1/9 |

6. KEEP DITCHES AND EXPOSED SLOPES IN AN EVEN ROOM GRADED CONDITION IN ORDER TO BE ABLE TO APPLY EROSION CONTROL MEASURES, WROUGHT IRON, AND SURFACES. | 1/10 |

GENERAL SWPPP NOTES FOR CONSTRUCTION ACTIVITY: | 1/11 |

1. ANNOY THE SWPPP AND DOCUMENT ANY AND ALL CHANGES TO THE SWPPP AND ASSOCIATED PLANS SHEETS IN A TIMELY MANNER. STORE THE SWPPP AND ALL AMENDMENTS ON SITE AT ALL TIMES. | 1/12 |

2. PREPARE AND SUBMIT A SITE MANAGEMENT PLAN FOR THE ENGINEER'S ACCOMPLISHMENT OF CONSTRUCTION, CONCRETE, GRASS, APPLICATION AREAS, WROUGHT IRON, AND OTHER AREAS OF CONSTRUCTION OR DESTRUCTION. | 1/13 |

3. INSPECT ALL AREAS OF CONSTRUCTION OR DESTRUCTION FOR DAMAGE TO THE SITE MANAGEMENT PLAN, AND REPORT ANY ISSUES TO THE ENGINEER. | 1/14 |

4. PROVIDE LABOR AND MATERIALS TO THE ENGINEER TO COMPLETE THE SITE MANAGEMENT PLAN. | 1/15 |

5. IT IS THE DESIGNER'S INTENT THAT THE CONTRACTOR BUILD AND INSTALL EROSION CONTROL DIPS PRIOR TO INITIATING ANY ACTIVITY THAT MAY CAUSE EROSION TO THE SITE MANAGEMENT PLAN. | 1/16 |

4. BEFORE ANY MAJOR ALTERATION TO THE PROJECT ENVIRONMENT OFFICIAL SWPPP, 1/17 |

9. PROVIDE A SWPPP PLAN AT EACH WORK AREA ON SITE. | 1/18 |

10. STORE ALL BSTRING MATERIALS THAT HAVE THE POTENTIAL TO LEAK OILS,ousticides, Pesticides, Herbicides, POLYETHYLENE, TREATMENT CHEMICALS, AND LANDSCAPE MATERIALS UNDER COVER AND IN A SECURE LOCATION. | 1/19 |

11. PROVIDE A SECURE STORAGE AREA WITH RESTRICTED ACCESS FOR ALL MATERIALS SUCH AS TOXIC WASTE, RETURN WASTE, AND GROUNDED MATERIALS. WASTE TO THE DESIGNATED STORAGE AREA AT THE END OF THE BUSINESS DAY. | 1/20 |

12. STORE ALL HAZARDOUS MATERIALS AND TOXIC WASTE EXCLUDING POTABLE WATER CONTAINERS. | 1/21 |

13. STORE ALL HAZARDOUS MATERIALS AND TOXIC WASTE EXCLUDING POTABLE WATER CONTAINERS. | 1/22 |

14. STORE, CLEAN, AND DISPOSE OF ALL SOLID WASTE. | 1/23 |

15. POSITION ALL PORTABLE TOILETS SO THAT THEY ARE SECURE AND CANNOT BE TIPPED OR ENDED OVER. PROPERLY DISPOSE OF ALL WASTE. | 1/24 |

16. FUEL AND MAINTAIN VEHICLES IN A DESIGNATED CONTAINER AREA WHERE FEASIBLE. USE DUMP TRUCKS OR APPROPRIATE VEHICLES TO TRANSPORT MATERIALS TO THE SITE. | 1/25 |

17. LIMIT VEHICLE AND EQUIPMENT RAWING TO A DESIGNATED AREA OF THE SITE. CONTAIN THROUGH THE RAINING DRAINAGE SYSTEMS OR OTHER EFFECTIVE MEANS. PROPER DISPOSE OF ALL WASTE GENERATED BY VEHICLES AND EQUIPMENT RAWING. | 1/26 |

18. PROVIDE EFFECTIVE CLOSED CONTAINMENT FOR ALL LIQUID AND SOLID WASTE GENERATED. | 1/27 |

19. CREATORS AND FOLLOW A WRITTEN OPERATIONAL PLAN FOR ALL WASTE MATERIALS. | 1/28 |

20. USE METHODS AND OPERATIONAL PROCEDURES THAT PREVENT免費 DISPOSAL OR DISPOSAL OF FREE MATERIALS, CUTTINGS, SEEDS, AND OTHER SUBSTANCES FROM AREAS OF EXTENSIVE OR FUTURE VEGETATION. | 1/29 |

21. USE METHODS AND OPERATIONAL PROCEDURES THAT PREVENT FREE DISPOSAL OR DISPOSAL OF FREE MATERIALS, CUTTINGS, SEEDS, AND OTHER SUBSTANCES FROM AREAS OF EXTENSIVE OR FUTURE VEGETATION. | 1/30 |

C.2

STORM WATER POLLUTION PREVENTION PLAN NARRATIVE
STORM WATER POLLUTION PREVENTION PLAN (SWPPP) NARRATIVE (CONTINUED)

WATER RESOURCES NOTES

THESE NOTES ARE ISSUED WITH THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) NARRATIVE IS INTENDED TO PROVIDE INFORMATION ON CRITICAL DRAINAGE FEATURES, NATURAL RESOURCES, AND CONTINUOUS OPERATIONS THAT MAY IMPACT DRAINAGE AND NATURAL RESOURCES.

1. THE SIZE AND ELEVATION OF DRAINS, STORM SEWER PIPES, CATCH BASINS, PONDS, INFILTRATION/INFILTRATION BASINS, PERIMETER DRAINAGE, AND OTHER DEVICES MAY VARY SPECIFICALLY DESIGNED TO COMPLY WITH METRO WATER RESOURCES REQUIREMENTS. THE DESIGN DRAWINGS ARE ON FILE WITH METRO WATER RESOURCES, CHANGING THESE ITEMS OR THE DIRECTION OF FLOW FROM WHAT IS SHOWN ON THE PLANS MAY CAUSE PROBLEMS OFF THE PROJECT AND INCREASE THE PROJECT COSTS. UNLESS APPROVED BY THE ENGINEER, SUCH CHANGES ARE NOT PERMITTED.

2. SUBSIDED ALL DRAINAGE OPEN SPACES AS SHOWN IN THE SITE PLAN.

3. INSTALLATION OF DRAINAGE TILES DAMAGED DURING CONSTRUCTION SHALL BE REPLACED, REPLACED OR REPAIRED, AND CONNECTED TO THE EXISTING DRAINAGE SYSTEM TO ENSURE THAT EXISTING DRAINAGE SYSTEM IS INTEGRATED. THIS SHOULD BE DONE IN THE APPROVAL OF THE AS-BUILT DRAWINGS.

5. THE FOLLOWING WATER RELATED PERMITS APPLY TO THIS PROJECT:

- Zoning Permit
- Erosion Control Permit
- Storm Water Permit
- Storm Water Management Permit

REVIEW ALL PERMITS FOR ANY SPECIAL CONDITIONS THAT WILL IMPACT CONSTRUCTION OF THE PROJECT.

TEMPORARY DRAINAGE ACTIVITIES MAY BE REQUIRED FOR RAINWATER DRAINAGE AND UTILITY WORK. THEREFORE, IT IS RECOMMENDED THAT PERMITS BE OBTAINED FROM THE COUNTY OR LOCAL GOVERNMENT TO MEET THESE REQUIREMENTS. PERMITS WILL BE REQUIRED FOR THIS PROJECT. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING PERMITS PRIOR TO COMMENCING DRAINAGE ACTIVITIES. ANY TEMPORARY DRAINAGE MAY BE DETERMINED BY THE CONTRACTOR UPON APPROVAL OF THE CONSTRUCTION PERMIT.

POND CONSTRUCTION NOTES

1. DO NOT SPECIFY MATERIALS OR POND EQUIPMENT OR VEHICLES IN A CONSTRUCTED POND.

2. DRAIN PONDS TO MEET THE DESIGN CAPACITIES AND ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MIGHT BE REQUIRED WHERE THE POND IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO POND BOTTOMS MUST BE REINFORCED BEFORE 24 HOURS.

3. THE CONTRACTOR MAY NOT SPECIFY MATERIALS OR POND EQUIPMENT OR VEHICLES IN A CONSTRUCTED POND.

INFILTRATION CONSTRUCTION NOTES

1. DO NOT SPECIFY MATERIALS OR POND EQUIPMENT OR VEHICLES IN A CONSTRUCTED INFILTRATION AREA.

2. INSTALL INFILTRATION DRAINAGE UNLESS ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MAY BE REQUIRED WHERE THE INFILTRATION AREA IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO INFILTRATION AREAS MUST BE COMPLETE PRIOR TO COMMENCING DRAINAGE ACTIVITIES.

3. INSTALL INFILTRATION DRAINAGE UNLESS ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MAY BE REQUIRED WHERE THE INFILTRATION AREA IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO INFILTRATION AREAS MUST BE COMPLETE PRIOR TO COMMENCEMENT OF DRAINAGE ACTIVITIES.

4. INSTALL INFILTRATION DRAINAGE UNLESS ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MAY BE REQUIRED WHERE THE INFILTRATION AREA IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO INFILTRATION AREAS MUST BE COMPLETE PRIOR TO COMMENCEMENT OF DRAINAGE ACTIVITIES.

5. INSTALL INFILTRATION DRAINAGE UNLESS ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MAY BE REQUIRED WHERE THE INFILTRATION AREA IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO INFILTRATION AREAS MUST BE COMPLETE PRIOR TO COMMENCEMENT OF DRAINAGE ACTIVITIES.

6. INSTALL INFILTRATION DRAINAGE UNLESS ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MAY BE REQUIRED WHERE THE INFILTRATION AREA IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO INFILTRATION AREAS MUST BE COMPLETE PRIOR TO COMMENCEMENT OF DRAINAGE ACTIVITIES.

7. INSTALL INFILTRATION DRAINAGE UNLESS ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MAY BE REQUIRED WHERE THE INFILTRATION AREA IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO INFILTRATION AREAS MUST BE COMPLETE PRIOR TO COMMENCEMENT OF DRAINAGE ACTIVITIES.

8. INSTALL INFILTRATION DRAINAGE UNLESS ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MAY BE REQUIRED WHERE THE INFILTRATION AREA IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO INFILTRATION AREAS MUST BE COMPLETE PRIOR TO COMMENCEMENT OF DRAINAGE ACTIVITIES.

9. INSTALL INFILTRATION DRAINAGE UNLESS ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MAY BE REQUIRED WHERE THE INFILTRATION AREA IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO INFILTRATION AREAS MUST BE COMPLETE PRIOR TO COMMENCEMENT OF DRAINAGE ACTIVITIES.

10. INSTALL INFILTRATION DRAINAGE UNLESS ALL UPLAND DRAINAGE ACTIVITIES ARE COMPLETED. PERMITS MAY BE REQUIRED WHERE THE INFILTRATION AREA IS LOCATED SUCH THAT IT COULD CREATE DRAINAGE ISSUES TO INFILTRATION AREAS MUST BE COMPLETE PRIOR TO COMMENCEMENT OF DRAINAGE ACTIVITIES.

LANDSCAPE NOTES

1. FILTER LESSONS SHALL BE PLACED, AS NEEDED, TO TRAP SEDIMENT ON THE LOWER END OF DRAIN CHUTES. FILTER LESSONS WILL BE PLACED, AS NEEDED, TO TRAP SEDIMENT ON THE LOWER END OF DRAIN CHUTES.

2. TILLING FOR SEEDS OR SEEDLINGS MUST BE PLANTED AND MAINTAINED WITH MOW CHIPS.

3. MOW CHIPS MAY BE USED FOR TILLING AND SEEDING UNTIL PLANTING OPERATIONS CAN BE COMPLETED.

4. ANY POND CORNERS OR POND CORNERS MUST BE PLANTED AND MAINTAINED WITH MOW CHIPS.

5. MOW CHIPS MUST BE PLANTED AND MAINTAINED UNTIL PLANTING OPERATIONS CAN BE COMPLETED.

C-3

WATER RESOURCES NOTES AND STORM WATER POLLUTION PLAN NARRATIVE

DRAWN BY: XXXX CHECKED BY: XXXX CERTIFIED BY: XXXX

STATE NO. OF SHEETS

SHEET 3 OF 4
STORM WATER POLLUTION PREVENTION PLAN (SWPPP) NARRATIVE (CONTINUED)

MAPS
A - This project does/does not have more than 10 acres draining to a common location and therefore a temporary sediment basin is/is not required. Temporary sediment basins shall provide treatment to runoff before it leaves the construction site or enters surface waters. The CONTRACTOR shall comply with the following requirements:

1. Sedimentation basins must provide live storage of runoff resulting from the 2-yr 24-hr rainfall event from each acre drained to the basin with a minimum of 1,800 cf/acre live storage volume. (Where no calculation has been performed, each basin shall provide at least 3,600 CF/acre of live storage.) Sedimentation basins must include a stabilized emergency overflow to prevent basin integrity failure.

2. Discharge from temporary sedimentation basins will be withdrawn from the surface in order to minimize the discharge of pollutants.

B - Discharge from basin draining shall not adversely affect the receiving water or downstream properties. CONTRACTOR will visually check to ensure adequate treatment has been obtained and that nuisance conditions will not result from the discharge.

C - Any discharge observed to be occurring during the inspection shall be recorded, described, and photographed.
1. Pond width (W) shall be approximately half the length (L).
2. Pond inflow must be concreted to prevent erosion.
3. Install three pond fiber baffles in the pond from the inflow to the
   skimmer device with a spacing of one third of the basin length (L).
   Two pond fiber baffles may be installed in ponds less than
   20-feet in length with a spacing of one third the basin length. See
   Pond Baffle Detail.

- 8 gauge wire, high
- tensile wire strand
- shall be secured
- with 1-inch diameter
- landscape staples

- Heavy Duty
- Steel "T" Post
- (1.25 lb/in)

- POND FIBER BATTLE DETAIL

- Silt Baffle
- Material over Wire
- (Strand) and Secure
- with Plastic ties at
- Posts and on wire
- every 12"
**Method 1**

- Stabilization lines
- Aluminum angle brackets (bolted to m1 wall or molded)
- Flexible seal
- Pond outlet
- Stakes lines to pond bank

**Method 2**

- Sedimentation pond
- *Stainless steel cable length adjusted to support skimmer at desired elevation*
- Normal pond level
- To outlet
- Expansion seal

**Plan View of Installation**

- **Sandbag Installation**
- **Plate Installation**
- **CMP Installation**

**Notes:**

<table>
<thead>
<tr>
<th>Size (Dia)</th>
<th>Max Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>INCHES</td>
<td>CFS</td>
</tr>
<tr>
<td>2</td>
<td>0.04</td>
</tr>
<tr>
<td>2.5</td>
<td>0.06</td>
</tr>
<tr>
<td>3</td>
<td>0.10</td>
</tr>
<tr>
<td>4</td>
<td>0.21</td>
</tr>
<tr>
<td>5</td>
<td>0.38</td>
</tr>
<tr>
<td>6</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**Emergency Overflow Level**

- 4" Typ
- Plywood plugs
- Bolt and spacer (4 typical)
- Skimmer connection - 6" PVC

**End View**

- Plastic or metal endplate
- Attachment points

**Floating Head Skimmer**

C-8
INDEX

<table>
<thead>
<tr>
<th>SP2005#</th>
<th>ITEM#</th>
<th>DATA</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>(2573) STORM WATER MANAGEMENT</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>S-2</td>
<td>(3875) WATER TREATMENT</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

PROJECT PLANS
The Plans for this Project, consisting of the sheets tabulated below, were approved by the State Design Engineer.

<table>
<thead>
<tr>
<th>PROJECT NO.</th>
<th>TYPE OF WORK</th>
<th>TOTAL SHEETS</th>
<th>SHEET NO.</th>
<th>DATE OF APPROVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.P. ##</td>
<td>xxx</td>
<td>##</td>
<td>##</td>
<td></td>
</tr>
</tbody>
</table>

New or revised sheets were approved as listed below:

<table>
<thead>
<tr>
<th>PROJECT NO.</th>
<th>SHEET NO.</th>
<th>DATE OF APPROVAL</th>
</tr>
</thead>
</table>
DIVISION S

S-1  (2573) STORM WATER MANAGEMENT

The provisions of Mn/DOT 2573 are supplemented and/or modified with the following:

S-1.1 The first paragraph of Mn/DOT 2573.3 A.1 Erosion Control Supervisor, is revised to read as follows:

The Erosion Control Supervisor shall be a responsible employee of the prime Contractor and/or duly authorized by the prime Contractor to represent the prime Contractor on all matters pertaining to the NPDES construction stormwater permit compliance. The Erosion Control Supervisor shall have authority over all Contractor operations which influence NPDES permit compliance including grading, excavation, bridge construction, culvert installation, utility work, clearing/grubbing, and any other operation that increases the erosion potential on the Project. In addition, the Erosion Control Supervisor shall implement the Contractor’s quality control program and other provisions in accordance with 1717.2 and be available to be on the Project within 24 hours at all times from initial disturbance to final stabilization as well as perform the following duties:

S-1.2 The first paragraph of Mn/DOT 2573.3 A.4 Construction of Temporary Sediment Basins and Traps, is revised to read as follows:

Construct temporary sediment basins per plan for Construction Storm Water Pond concurrently with the start of soil disturbing activities. Direct storm water run off from localized watershed to the basins. Mulch, seed, or both, the exposed side slopes of the basins meeting the requirements of the NPDES permit or within 14 calendar days.

S-1.3 Mn/DOT 2573.3 G replace (Blank) with Pond Fiber Baffle Installation and add the following:

Install the pond fiber baffle per plan. Use Mn/DOT 3885, Category 5 material.

S-1.4 The first paragraph of Mn/DOT 2573.3 P.4 Sediment Basins and Traps, is revised to read as follows:

Inspect the basin after each rainfall event greater than 0.5 inches. Once basin has drained, remove the accumulated sediment if the depth of sediment collected in the basin reaches the top of the rock pad for the pond skimmer. Complete drainage and removal within 72 h of discovery or as soon as field conditions allow access. Remove sediment to the original designed or excavated grade or as necessary to restore the function of the device.

S-1.5 Mn/DOT 2573.4 I replace (Blank) with Pond Fiber Baffle and add the following:

The Engineer will measure the pond fiber baffle by the length installed.

S-1.6 Mn/DOT 2573.4 Add new section O Floating Head Skimmer with the following new paragraph:

The Engineer will measure the float head skimmer by each skimmer provided.

S-1.7 Mn/DOT 2573.5 E, Sediment Traps, is revised to read as follows:
The Engineer will measure sediment traps (construction storm water ponds) quantities by volume for basin excavation and construction. Items required to install the construction storm water pond per plan not specifically listed here, such as outlet structures and oil boom, are considered incidental to the cost of installing the construction storm water pond. The Engineer will measure excavation by volume of the material in its original position. The Engineer will measure overflow devices separately.

S-1.8

Mn/DOT 2573.5 I, Pay Items, is revised to adding the following items:

Item No.: 2573.503; Item: Pond Fiber Baffle; Unit: linear foot (meter).
Item No.: 2573.511; Item: Floating Head Skimmer; Unit: each.

S-2 (3875) WATER TREATMENT

The provisions of Mn/DOT 3875.2 are supplemented and/or modified with the following:

S-2.1 Mn/DOT 3875.2 A.4 Floating Head Skimmer, is revised to read as follows:

Provide a schedule 40 PVC pipe at least 1.5 in [38 mm] diameter for the floating head skimmer. Use the following skimmers or approved equal: ESC Skimmer, by Erosion Supply Company (http://www.erosionsupply.com/), Faircloth Skimmer, by J.W. Faircloth and Sons Inc. (http://www.fairclothskimmer.com/), IAS Skimmer, by Innovative Applied Solutions, LLC (http://iasllcusa.com/), Marlee Float, by Fee Saver (http://swfeesaver.com/), or Thirsty Duck Buoyant Flow Control Device, by Thirsty Duck (http://thirsty-duck.com/). Use a flocculant with a floating head skimmer in accordance with 3898, “Flocculants,” to provide additional treatment if shown on the plans.
## INDEX

<table>
<thead>
<tr>
<th>SP2005#</th>
<th>ITEM#</th>
<th>DATA</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>(2573)</td>
<td>STORM WATER MANAGEMENT</td>
<td>13</td>
</tr>
<tr>
<td>S-2</td>
<td>(3875)</td>
<td>WATER TREATMENT</td>
<td>14</td>
</tr>
</tbody>
</table>

## PROJECT PLANS

The Plans for this Project, consisting of the sheets tabulated below, were approved by the State Design Engineer.

<table>
<thead>
<tr>
<th>PROJECT NO.</th>
<th>TYPE OF WORK</th>
<th>TOTAL SHEETS</th>
<th>SHEET NO.</th>
<th>DATE OF APPROVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.P. ##</td>
<td>xxx</td>
<td>##</td>
<td>##</td>
<td></td>
</tr>
</tbody>
</table>

New or revised sheets were approved as listed below:

<table>
<thead>
<tr>
<th>PROJECT NO.</th>
<th>SHEET NO.</th>
<th>DATE OF APPROVAL</th>
</tr>
</thead>
</table>
DIVISION S

S-1 (2573) STORM WATER MANAGEMENT

The provisions of Mn/DOT 2573 are supplemented and/or modified with the following:

S-1.1 The first paragraph of Mn/DOT 2573.3 A.1 Erosion Control Supervisor, is revised to read as follows:

The Erosion Control Supervisor shall be a responsible employee of the prime Contractor and/or duly authorized by the prime Contractor to represent the prime Contractor on all matters pertaining to the NPDES construction stormwater permit compliance. The Erosion Control Supervisor shall have authority over all Contractor operations which influence NPDES permit compliance including grading, excavation, bridge construction, culvert installation, utility work, clearing/grubbing, and any other operation that increases the erosion potential on the Project. In addition, the Erosion Control Supervisor shall implement the Contractor’s quality control program and other provisions in accordance with 1717.2 and be available to be on the Project within 24 hours at all times from initial disturbance to final stabilization as well as perform the following duties:

S-1.2 The first paragraph of Mn/DOT 2573.3 A.4 Construction of Temporary Sediment Basins and Traps, is revised to read as follows:

Construct temporary sediment basins per plan for Construction Storm Water Pond concurrently with the start of soil disturbing activities. Direct storm water run off from localized watershed to the basins. Mulch, seed, or both, the exposed side slopes of the basins meeting the requirements of the NPDES permit or within 14 calendar days.

S-1.3 Mn/DOT 2573.3 G replace (Blank) with Pond Fiber Baffle Installation and add the following:

Install the pond fiber baffle per plan. Use Mn/DOT 3885, Category 5 material.

S-1.4 The first paragraph of Mn/DOT 2573.3 P.4 Sediment Basins and Traps, is revised to read as follows:

Inspect the basin after each rainfall event greater than 0.5 inches. Once basin has drained, remove the accumulated sediment if the depth of sediment collected in the basin reaches the top of the rock pad for the pond skimmer. Complete drainage and removal within 72 h of discovery or as soon as field conditions allow access. Remove sediment to the original designed or excavated grade or as necessary to restore the function of the device.

S-1.5 Mn/DOT 2573.4 I replace (Blank) with Pond Fiber Baffle and add the following:

The Engineer will measure the pond fiber baffle by the length installed.

S-1.6 Mn/DOT 2573.4 Add new section O Floating Head Skimmer with the following new paragraph:

The Engineer will measure the float head skimmer by each skimmer provided.

S-1.7 Mn/DOT 2573.5 E, Sediment Traps, is revised to read as follows:
The Engineer will measure sediment traps (construction storm water ponds) quantities by volume for basin excavation and construction. Items required to install the construction storm water pond per plan not specifically listed here, such as outlet structures and oil boom, are considered incidental to the cost of installing the construction storm water pond. The Engineer will measure excavation by volume of the material in its original position. The Engineer will measure overflow devices separately.

S-1.8 Mn/DOT 2573.5 I, Pay Items, is revised to adding the following items:

Item No.: 2573.503; Item: Pond Fiber Baffle; Unit: linear foot (meter).
Item No.: 2573.511; Item: Floating Head Skimmer; Unit: each.

S-2  (3875) WATER TREATMENT

The provisions of Mn/DOT 3875.2 are supplemented and/or modified with the following:

S-2.1 Mn/DOT 3875.2 A.4 Floating Head Skimmer, is revised to read as follows:

Provide a schedule 40 PVC pipe at least 1.5 in [38 mm] diameter for the floating head skimmer. Use the following skimmers or approved equal: ESC Skimmer, by Erosion Supply Company (http://www.erosionsupply.com/), Faircloth Skimmer, by J.W. Faircloth and Sons Inc. (http://www.fairclothskimmer.com/), IAS Skimmer, by Innovative Applied Solutions, LLC (http://iasllcusa.com/), Marlee Float, by Fee Saver (http://swfeesaver.com/), or Thirsty Duck Buoyant Flow Control Device, by Thirsty Duck (http://thirsty-duck.com/). Use a flocculant with a floating head skimmer in accordance with 3898, “Flocculants,” to provide additional treatment if shown on the plans.
APPENDIX D: Kickoff Meeting Notes
MEETING MINUTES

SUBJECT: Pond Skimming Kickoff Meeting

CLIENT: Dwayne Stenlund
         Bruce Holdhusen
         Minnesota Department of Transportation

PROJECT: Implementation of Floating Weir System for Surface Skimming of Temporary Stormwater Ponds

DATE: January 31st, 2014, 8:00 A.M.

MEETING LOCATION: MnDOT, 395 John Ireland Blvd, St. Paul, MN 55155

MEETING PARTICIPANTS:

<table>
<thead>
<tr>
<th>Dwayne Stenlund, MnDOT</th>
<th>Joel Toso, Wenck Associates Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bruce Holdhusen, MnDOT</td>
<td>Ian Peterson, Wenck Associates Inc.</td>
</tr>
</tbody>
</table>

- Review results of pond skimmer technology research.
  - Carolinas house the major proprietors of this technology.
  - Faircloth is the first to enter the market.
  - MnDOT cannot show preference to one technology so the designs must be applicable to any device.
- Discussion of MPCA NPDES general permit.
  - Systems must have equivalent sediment treatment when ponds are not feasible.
  - Stepped ditch system may provide a system to meet that requirement.
  - Potential addition of chemical treatment to improve sediment removal when needed.
  - Need to quantify surface skimming technology removal efficiency in order to determine what equivalent treatment is.
- Modeling task.
  - Will be using HydroCAD and P8 to model the effect of pond skimming technology.
  - Test the reliability of proprietor effluent rate information.
  - Check the effect of orifice flow, pipe flow, and weir flow.
  - Use various configurations and explore configurations that are not available in the marketplace.
  - Identify the effect of soil type on TSS removal for various regions in Minnesota.
  - Use a retention time of 3.25 days to have adequate time for sediment deposition.
- Determine what happens when you have a large watershed and only the space for a small pond.
  - Some construction sites do not have the space to put in a conventional BMP but still need to comply with the general permit.
  - Stepped ditch system with and without skimmers.
  - Rock checks for ponding.
  - May need a flocculent.