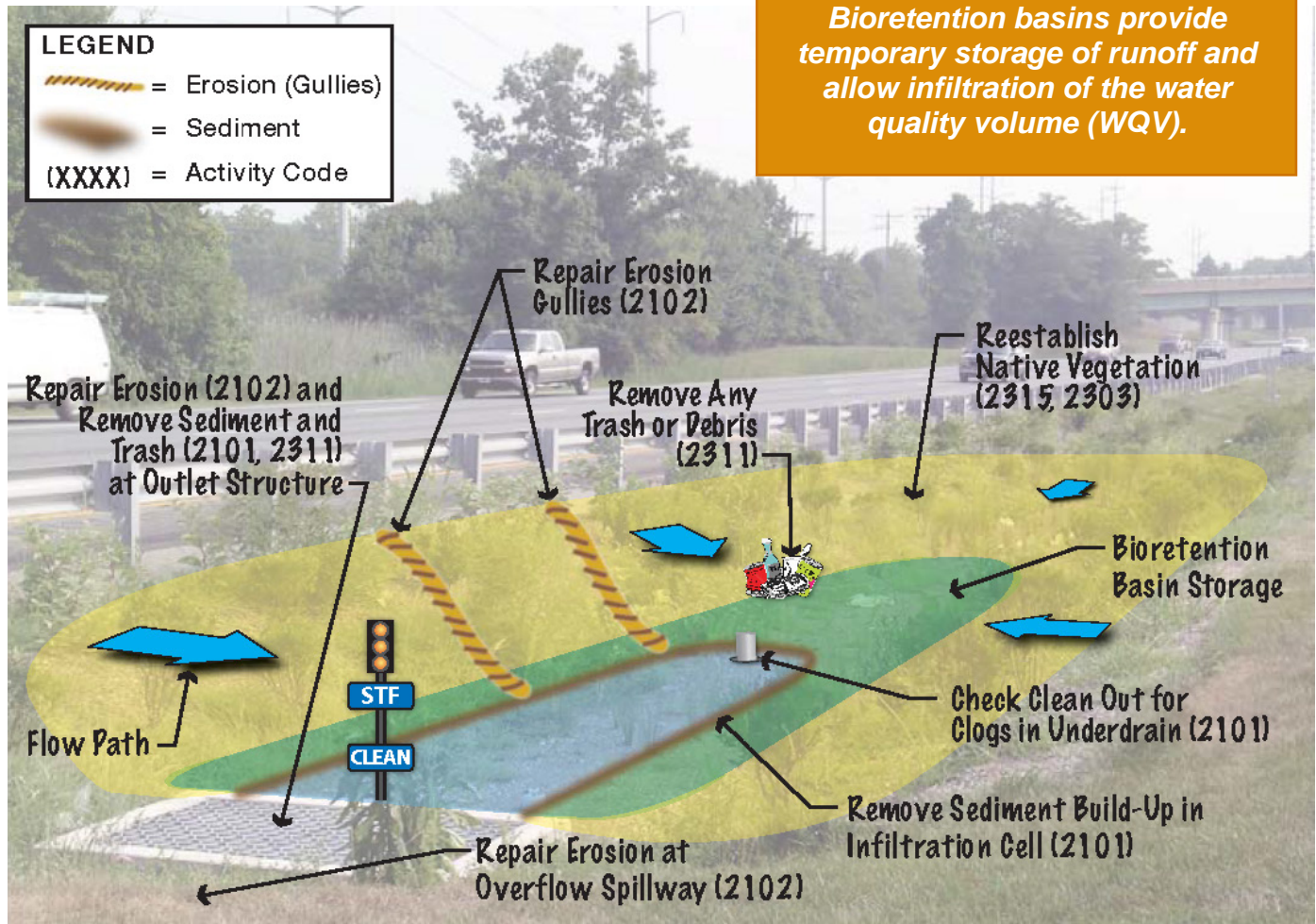


NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Bioretention

MAINTENANCE OVERVIEW



Maintenance Needs Example for Bioretention

Not to Scale

BIORETENTION BASIN QUICK FACTS

Description Bioretention basins are shallow basins in low lying areas that provides storage and treats stormwater through filtration by select plantings and infiltration within the basin and sand/compost infiltration cell (shown by light blue).

- Sediment build-up may occur due to the nature of this facility. This can clog the infiltration cell and decrease the effectiveness of the basin.
- Runoff from pipes, as well as overland sheet flow from adjacent slopes may cause erosion which will need to be filled in with amended soils and reestablished through seeding and erosion control blankets.
- **If heavy equipment must be used within the basin, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration.**

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Bioretention

Maintenance Activity	Do	Don't
Remedy any standing water (2101).	Check the outlet structure and underdrain pipe for clog; look at compacted soils and sediment build-up preventing infiltration.	Excavate infiltration cell until cause of water back-up is determined.
Remove sediment build-up (2101).	Remove sediment from the basin bottom with machinery through use of mud mats; working from the middle of basin bottom and scarifying to the edges; or using a lighter machine like a skid steer for the foreslopes and Gradall stationed outside of the basin for the bottom.	Station machinery in the bottom of the basin or use machinery with overfilled tires.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket or mulch.	Station machinery in the basin or use overfilled tires on machinery.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow	Use large machinery to mow, instead use a push or riding lawn mower.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish vegetation (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides; reference the Roadside Vegetation Establishment and Management for lists of invasive species.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, and 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* **Caution:** Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Bioretention

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: _____	Bioretention Basin	Maintenance ID: _____
Construction Completion Date: _____		Inspection Date: _____
CN: _____		

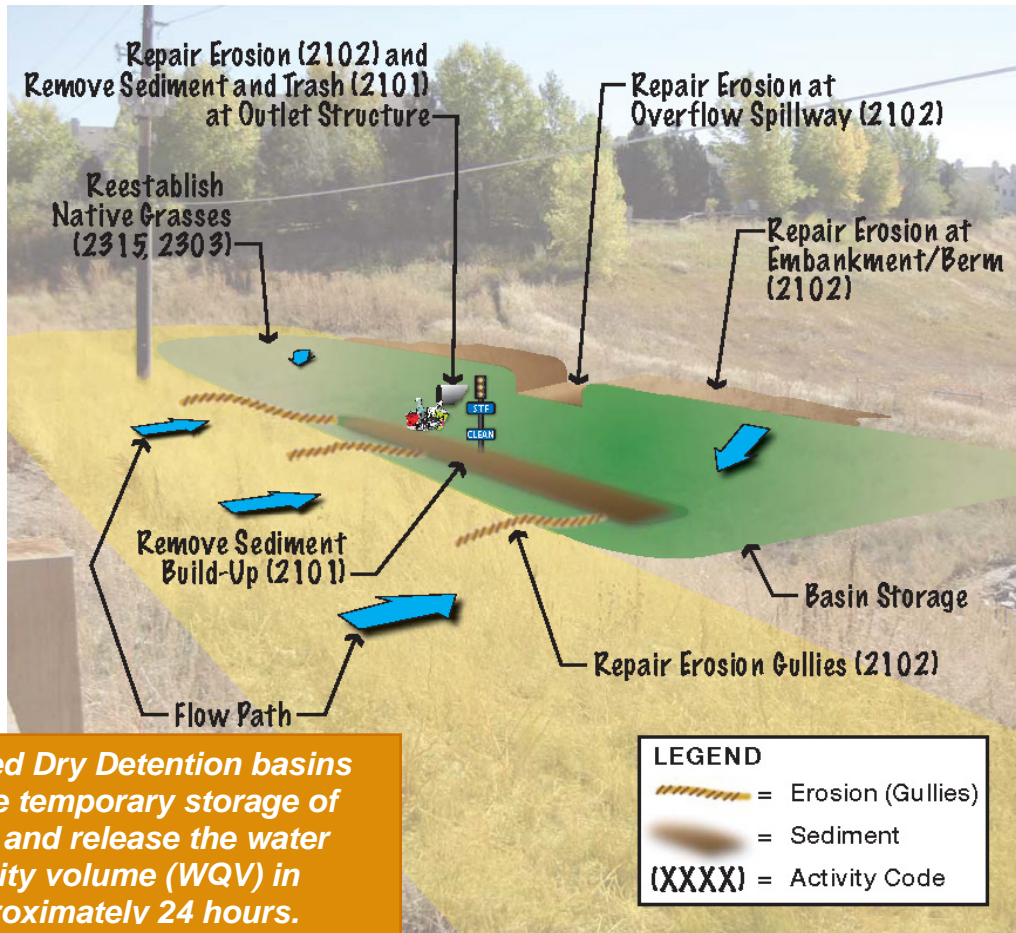
Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the basin free of surface ponding or indicators that water has ponded for an extended period of time?				2101 Drainage Maintenance	
Is the basin draining in the proper amount of time (24hrs-48 hrs)?				2101 Drainage Maintenance	
Is the basin free of erosion or any damage from equipment and vehicles?				2102 Maintain Misc. Structures	
Are the bottom of the basin, diversion structures, outlets, and forebays free of sediment buildup?				2101 Drainage Maintenance	
Are the inlets and outlets free of any trash or debris?				2311 Litter Pickup	
Is there a dense, uniform stand of the intended vegetation?				2303 Pesticides/Herbicides 2315 Seeding/Sodding	
Is the grass height between 6" and 12"?				2301 Machine Mowing 2302 Hand Mowing	
Are any pretreatment stormwater STFs in accordance with their design guides?					
Level of Service (LOS): _____					

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Extended Dry Detention

MAINTENANCE OVERVIEW



Extended Dry Detention basins provide temporary storage of runoff and release the water quality volume (WQV) in approximately 24 hours.

Maintenance Needs Example for Extended Dry Detention

Not to Scale

EXTENDED DRY DETENTION QUICK FACTS

Description Extended dry detention basins provide storage and filters the Water Quality Volume (WQV) during storm events. The volume of stormwater is released over 24 hours (72 hours maximum) and should drain down completely.

- Sediment build-up may, especially after construction. This can decrease the effectiveness of the dry detention basin and should be removed.
- Runoff from pipes, as well as overland sheet flow from adjacent slopes is collected in the basin. Both of these situations may cause erosion which will need to be filled in and vegetation should be reestablished.
- Also reference the maintenance fact sheets for Dry Forebay and Principal Spillway.
- **If heavy equipment must be used within the basin, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration.**

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Extended Dry Detention

Maintenance Activity	Do	Don't
Remove sediment build-up (2101).	Remove sediment from the basin bottom with machinery through use of mud mats; working from the middle of basin bottom to the edges; or using a lighter machine like a skid steer for the foreslopes and Gradall stationed outside of the basin for the bottom.	Station machinery in the basin or use machinery with overfilled tires.
Remedy any excess standing water (2101)	Check the outlet structure for clogging due to sediment or debris and signs of high groundwater.	Ignore the excess water.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket.	Station machinery in the basin or use overfilled tires on machinery.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow	Use large machinery to mow, instead use a push or riding lawn mower.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish native grasses through seeding (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Extended Dry Detention

Equipment/Crew/Materials

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* Caution: Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Extended Dry Detention

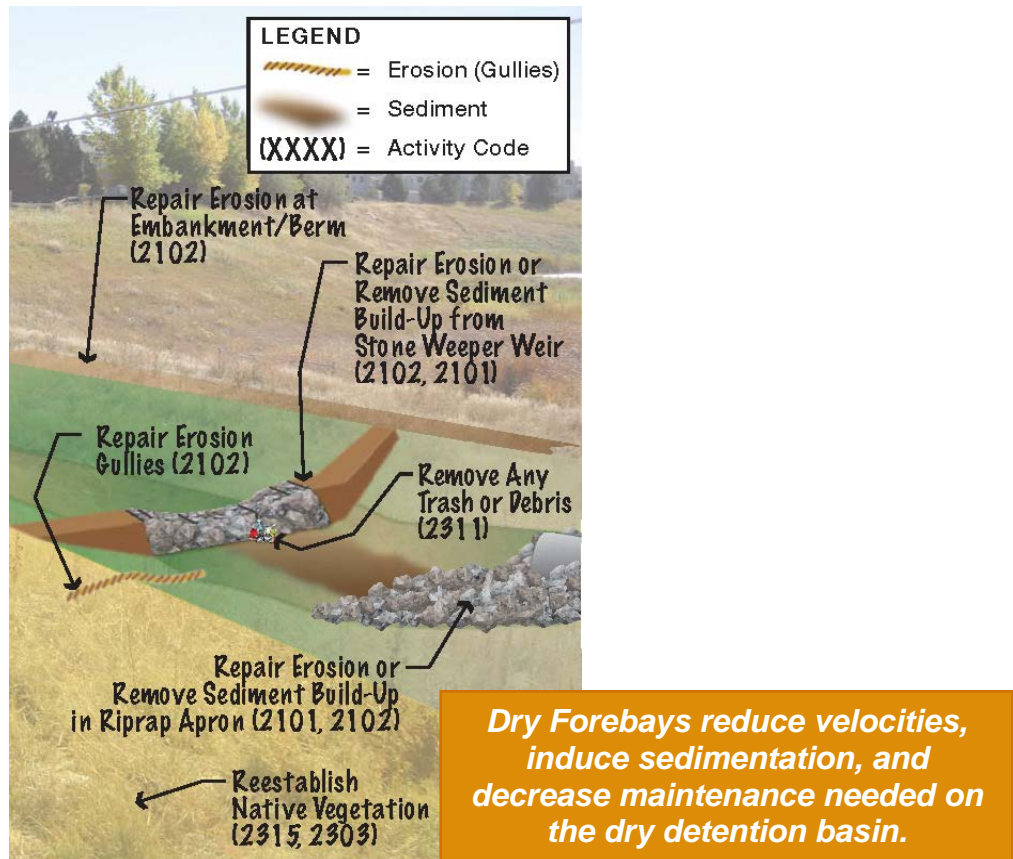
Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u>Extended Dry Detention Basin</u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the extended dry detention basin draining down in the proper amount of time (24-72 hrs)?					
Is the basin free of erosion or any damage from equipment or vehicles?				2102 Maintain Misc. Structures	
Are the bottom of the basin, diversion structures, outlets, and forebays free of sediment buildup?				2101 Drainage Maintenance	
Are the diversion structures, outlets, and forebays free of any trash or debris?				2311 Litter Pickup	
Is there a dense, uniform stand of the intended vegetation?				2303 Pesticides/Herbicides 2315 Seeding/Sodding	
Is the grass height between 6" and 12"?				2301 Machine Mowing 2302 Hand Mowing	
Are diversion structures and outlets free of structural damage?				2102 Maintain Misc. Structures	
Level of Service (LOS): _____					

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

MAINTENANCE OVERVIEW



**Maintenance Needs Example
for Forebay for Dry Detention Basin**

Not to Scale

DRY FOREBAY QUICK FACTS

Description Dry Forebays provide extra storage for a stormwater STF, but also provide energy dissipation and a location for sedimentation to occur which prevents frequent dredging of the detention facility.

- Sediment build-up in the forebay is expected. It will need to be cleaned out when 50% of the capacity is lost (remove ~2' of sediment) or it reaches the CLEAN line.
- Runoff from pipes, as well as overland sheet flow from adjacent slopes may cause erosion which will need to be filled in and reestablished.
- Also reference the maintenance factsheets for Extended Dry Detention and Principal Spillway.
- **If heavy equipment must be used within the basin, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration.**

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Dry Forebay

Maintenance Activity	Do	Don't
Remove sediment build-up (2101).	Remove 2' of sediment from the basin bottom with machinery; working from the middle of basin bottom to the edges; or using a lighter machine like a skid steer for the foreslopes and Gradall stationed outside of the basin for the bottom.	Station machinery in the basin or use machinery with overfilled tires.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket or mulch.	Station machinery in the basin or use overfilled tires on machinery.
Replace/Add riprap to berm (2102).	Repair erosion and maintain shape of weir to pass flows through.	Forget to repair the earthen section of the berm.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow	Use large machinery to mow, instead use a push or riding lawn mower.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish vegetation (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides; reference the Roadside Vegetation Establishment and Management for lists of invasive species.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* **Caution:** Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Dry Forebay

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u> Dry Forebay </u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the forebay basin free of surface ponding or indicators that water has ponded for an extended period of time?				2102 Maintain Misc. Structures	
Does the dry forebay drain in the proper amount of time (24-72 hrs)?				2102 Maintain Misc. Structures	
Is the basin free of erosion or any damage from equipment?				2102 Maintain Misc. Structures	
Is the sediment build-up below the CLEAN line?				2101 Drainage Maintenance	
Are the forebays, inlets, outlets, and stone weepers free of any trash or debris?				2311 Litter Pickup	
Is there a dense, uniform stand of the intended vegetation?				2303 Pesticides/Herbicides 2315 Seeding/Sodding	
Is the grass height between 6" and 12"?				2301 Machine Mowing 2302 Hand Mowing	
Are diversion structures and outlets free of structural damage?				2102 Maintain Misc. Structures	

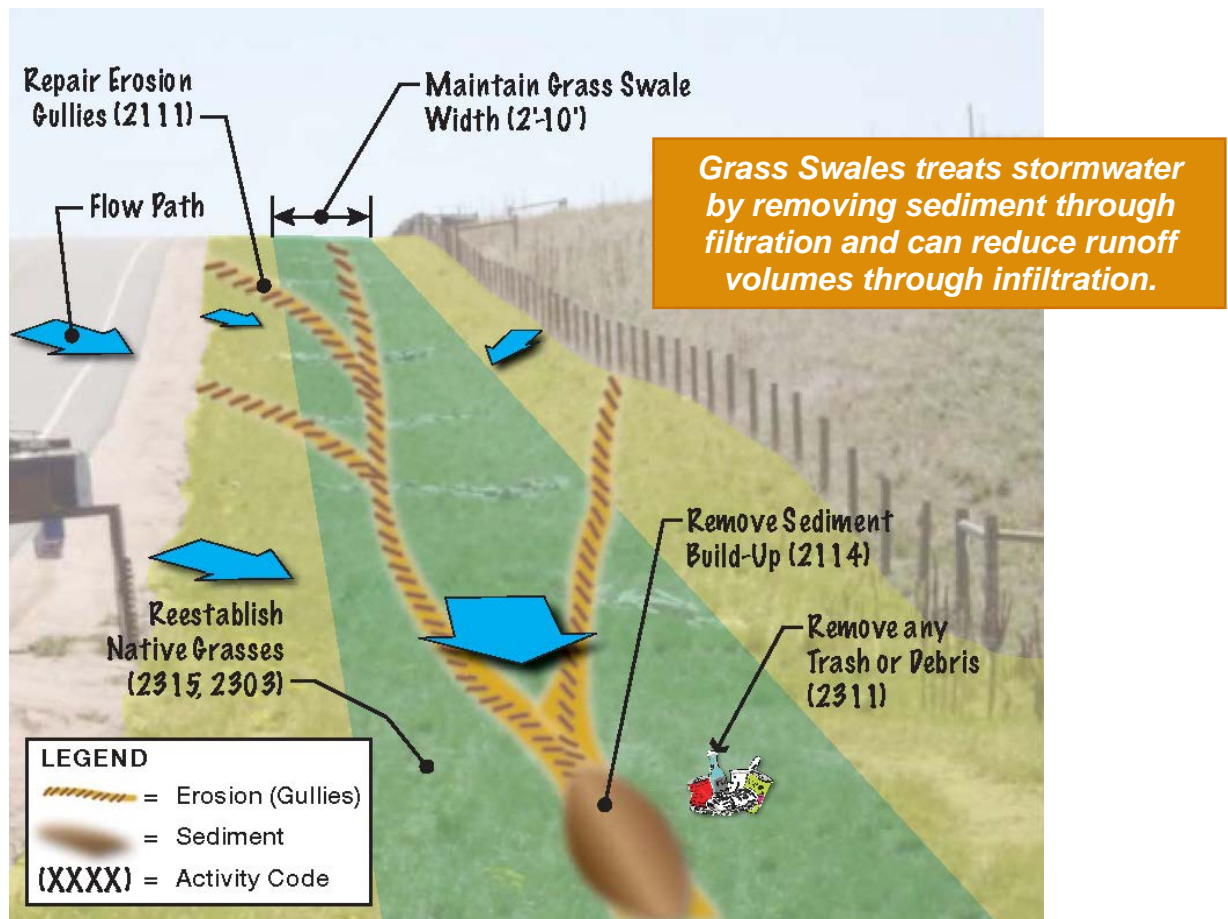
Level of Service (LOS): _____

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Grass Swale

MAINTENANCE OVERVIEW



Maintenance Needs Example for Grass Swale

Not to Scale

GRASS SWALE QUICK FACTS

Description A grass swale is a densely vegetated drainage way with a channel bottom and low pitched side slopes designed to convey runoff slowly.

- When channel is reshaped, make sure it is put back to the design width (2 ft-10 ft typical).
- Runoff from pipes, as well as overland sheet flow from adjacent slopes and roadsides is concentrated in this STF. This runoff may cause erosion or can drop out sediment and cause build-up.
- **If heavy equipment must be used within the swale, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration. Compaction runs the risk of preventing infiltration and decreasing the efficiency of the swale.**

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Grass Swale

Maintenance Activity	Do	Don't
Reshape the ditch (2111); repair erosion and eliminate gullies.	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket.	Station machinery in the swale or use overfilled tires on machinery.
Remove sediment build-up (2114).	Remove sediment from the swale with machinery through use of mud mats; working downstream to upstream and scarifying; or using a Gradall stationed outside of the swale.	Station machinery in the swale or use machinery with overfilled tires.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish native grasses through seeding (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller or other means to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Equipment/Crew/Materials

Activity Code	Description	Materials	Equipment	Crew Size
2111	Reshaping Ditches and Filling Washouts	Riprap, Fill Soil	1 Skid Steer, 1 Tandem Truck	4
2114	Channel Cleaning and Reshaping	As Required	1 Skid Steer, 1 Tandem Truck, 1 Pickup	3
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* Caution: Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Grass Swale

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u>Grass Swale</u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is there a dense, uniform stand of the intended vegetation?	<input type="checkbox"/>	<input type="checkbox"/>		2303 Pesticides/Herbicides 2315 Seeding/Sodding	
Is the swale free from erosion and any damage from equipment or vehicles?	<input type="checkbox"/>	<input type="checkbox"/>		2111 Reshape Ditch	
Is the swale free of trash and debris?	<input type="checkbox"/>	<input type="checkbox"/>		2311 Litter Pickup 2114 Clear Channel	
Is the swale free of sediment buildup, and other obstructions?	<input type="checkbox"/>	<input type="checkbox"/>		2114 Clear Channel	
Level of Service (LOS): _____					

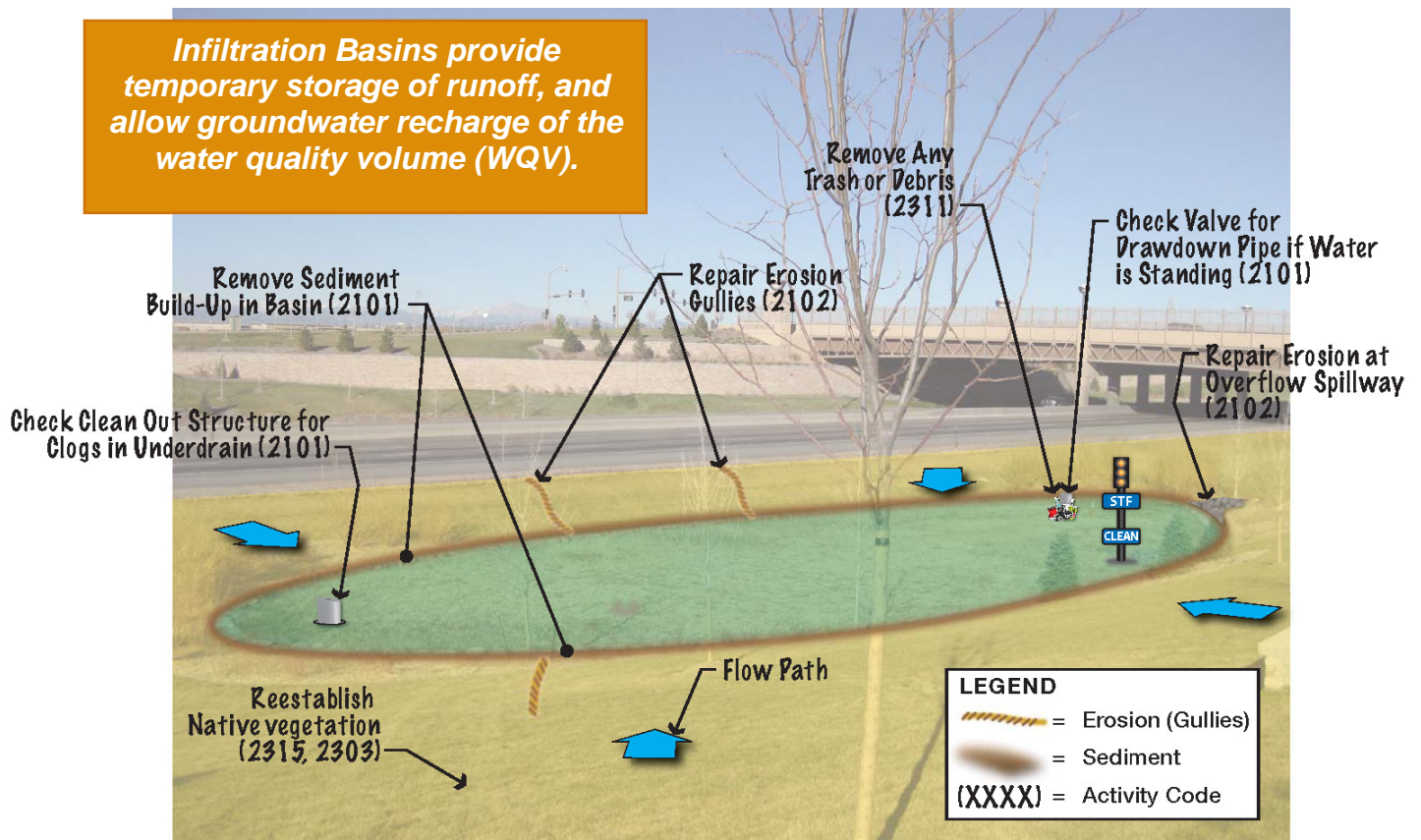
LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Infiltration Basin

MAINTENANCE OVERVIEW

Infiltration Basins provide temporary storage of runoff, and allow groundwater recharge of the water quality volume (WQV).



Maintenance Needs Example for Infiltration Basin

Not to Scale

INFILTRATION BASIN QUICK FACTS

Description It is a low lying area that provides storage and filters stormwater while also allowing groundwater recharge soil.

- Sediment build-up may occur due to the nature of this facility. This can clog infiltrating soil and decrease the effectiveness of the basin.
- Runoff from pipes, as well as overland sheet flow from adjacent slopes, may cause erosion which will need to be filled in and reestablished through seeding and erosion control blankets.
- **If heavy equipment must be used within the basin, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration.**

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Infiltration Basin

Maintenance Activity	Do	Don't
Remedy any standing water (2101).	Check the underdrain pipe for clog; look at compacted soil and sediment build-up preventing infiltration. Retest underlying soil for infiltration rate.	Excavate basin until cause of water back-up is determined.
Remove sediment build-up (2101).	Remove sediment from the basin bottom with machinery through use of mud mats; working from the middle of basin bottom and scarifying to the edges; or using a lighter machine like a skid steer for the foreslopes and Gradall stationed outside of the basin for the bottom.	Station machinery in the basin or use machinery with overfilled tires.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket or mulch.	Station machinery in the basin or use overfilled tires on machinery.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow	Use large machinery to mow, instead use a push or riding lawn mower.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish vegetation (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides; reference the Roadside Vegetation Establishment and Management for lists of invasive species.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Equipment/Crew/Materials

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* **Caution:** Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Infiltration Basin

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u> Infiltration Basin </u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the basin free of surface ponding or indicators that water has ponded for an extended period of time?				2101 Drainage Maintenance	
Is the basin draining in the proper amount of time (24-48 hrs)?				2101 Drainage Maintenance	
Is the basin free of erosion or any damage from equipment and vehicles?				2102 Maintain Misc. Structures	
Are the bottom of the basin, diversion structures, outlets, and forebays free of sediment buildup?				2101 Drainage Maintenance	
Are the diversion structures, outlets, and forebays free of any trash or debris?				2311 Litter Pickup	
Is there a dense, uniform stand of the intended vegetation?				2303 Pesticides/Herbicides 2315 Seeding/Sodding	
Is the grass height between 6" and 12"?				2301 Machine Mowing 2302 Hand Mowing	
Are any pretreatment stormwater STFs in accordance with their design guides?					

Level of Service (LOS): _____

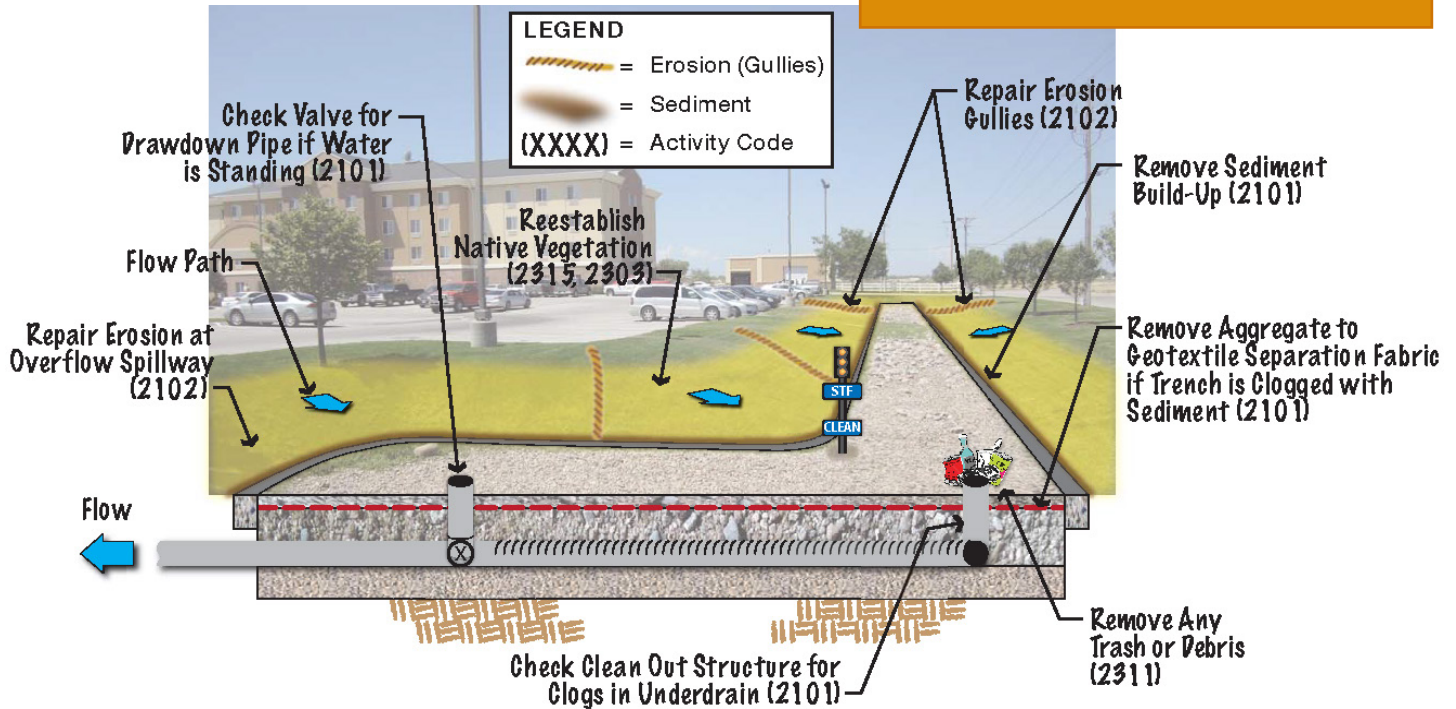
LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Infiltration Trench

MAINTENANCE OVERVIEW

Infiltration Trench provides temporary storage of runoff and allows for groundwater recharge all within the right-of-way.



Maintenance Needs Example for Infiltration Trench

Not to Scale

INFILTRATION TRENCH QUICK FACTS

Description An infiltration trench is a trench filled with drainage aggregate that is located in a flat, low lying area within medians or elsewhere in the ROW. The infiltration trench filters stormwater and provides temporary storage in the void spaces of the aggregate while also allowing groundwater recharge.

- Sediment build-up may occur near the edges of the infiltration trench. This can clog the infiltration trench and decrease the effectiveness of the basin.
- Runoff from pipes, as well as overland sheet flow from adjacent slopes, may cause erosion which will need to be filled in and reestablished through seeding and erosion control blankets.
- **If heavy equipment must be used within the trench, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration.**

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Infiltration Trench

Maintenance Activity	Do	Don't
Remedy any standing water (2101).	Check the underdrain pipe for clogs; look at sediment build-up preventing flows.	Excavate infiltration cell until cause of water back-up is determined.
Remove sediment build-up (2101).	Remove sediment build-up adjacent to aggregate filled trench. Remove upper layer of aggregate and the separation fabric and replace.	Allow sediment to get into the lower layer of aggregate.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket or mulch.	Station machinery in the basin or use overfilled tires on machinery.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow	Use large machinery to mow, instead use a push or riding lawn mower.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish vegetation (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides; reference the Roadside Vegetation Establishment and Management for lists of invasive species.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Equipment/Crew/Materials

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* **Caution:** Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Infiltration Trench

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u> Infiltration Trench </u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

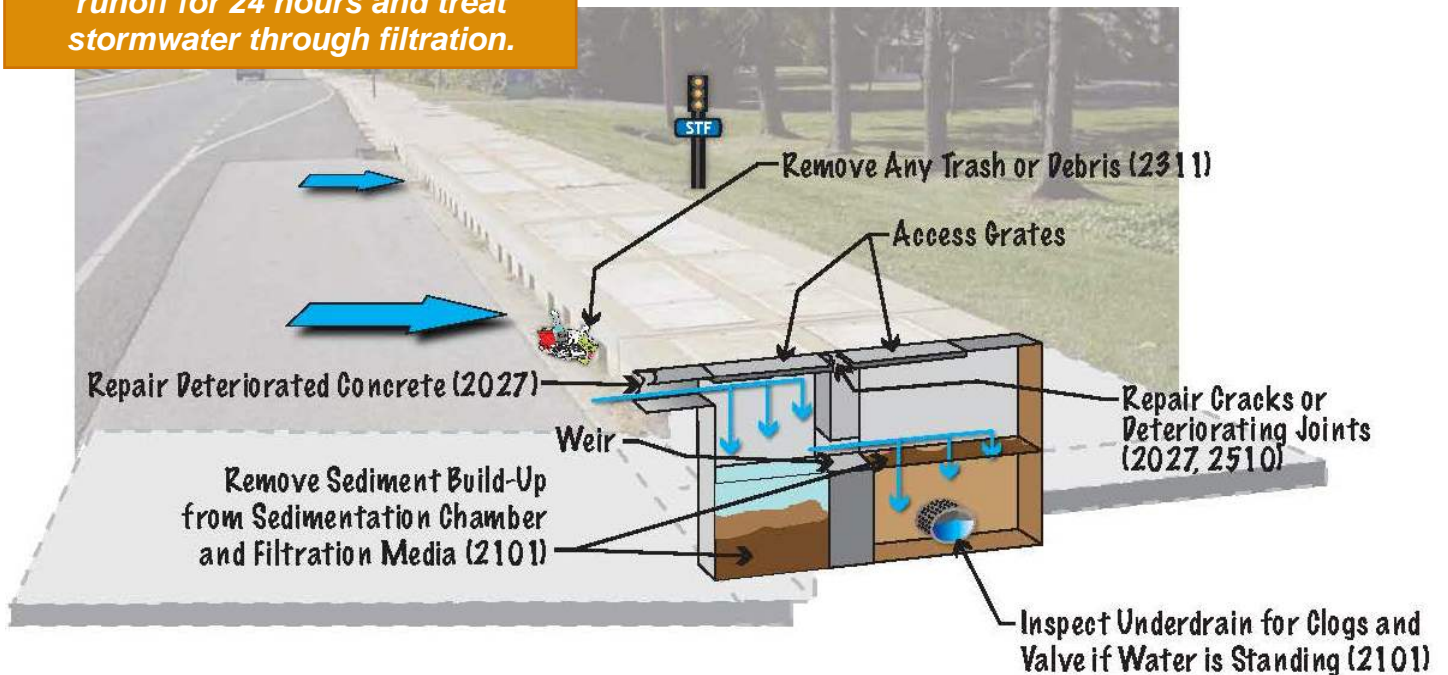
Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the trench free of surface ponding or indicators that water has ponded for an extended period of time?					
Do the associated observation wells show the trench is draining in the proper amount of time (48-72 hrs)?					
Is the trench free of erosion or any damage from equipment?				2102 Maintain Misc. Structures	
Are the trench surface, diversion structures, outlets, and forebays free of sediment buildup?				2101 Drainage Maintenance	
Are the trench, diversion structures, inlets, and outlets free of any trash or debris?				2311 Litter Pickup	
Are any pretreatment stormwater STFs in accordance with their design guides?					

Level of Service (LOS): _____

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

MAINTENANCE OVERVIEW

Media Filters provide storage of runoff for 24 hours and treat stormwater through filtration.



Maintenance Needs Example for Media Filter

Not to Scale

MEDIA FILTER QUICK FACTS

Description Media Filters treat stormwater through a filter bed of sand after sediment drops out within the sedimentation chamber.

- Sediment build-up may occur due to the nature of this facility. The sedimentation chamber is only designed for a quarter of the WQV and will need to be cleaned out periodically. The filter bed may also require occasional clean out.
- The structure may leak due to construction or deteriorating concrete. Inspect for leaks and remedy when problems arise.
- **The media filter should be maintained through the access grates. Aggregates used in the facility may need to be replaced at times.**

NDOT Stormwater Treatment Facility

MAINTENANCE GUIDE

Media Filter

Maintenance Activity	Do	Don't
Patch any deteriorated concrete (2027).	Patch deteriorated or leaking concrete, while placing construction materials a reasonable distance from the treatment facility. Construction materials washed into the facility may adversely affect the facility.	Ignore deteriorated concrete. If it is not remedied then the facility may develop more significant issues.
Remedy any standing water (2101).	Check the control valve opening and underdrain pipe for clog; look at sediment build-up preventing infiltration.	Assume it is a one-time thing and vacuum out water.
Remove sediment build-up (2101).	Remove sediment from sedimentation chamber and filter bed with vacuum trucks when depth exceeds 6 inches. Remove and replace upper 2 to 3 inches of filtration media and aggregate around drawdown pipes at the same time.	Stockpile removed sediment in a location that will flow back into the STF.
Repair erosion and eliminate gullies in the contributing basin (2102).	Fill in erosion with soil mix and lightly compact. Cover with erosion control blanket or mulch.	Disturb more soil with the maintenance equipment.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Repair any cracks or deteriorating joints (2510).	Repair deteriorated joints or any cracks, while placing construction materials a reasonable distance from the treatment facility. Construction materials washed into the facility may adversely affect the facility.	Ignore concrete cracks, this deterioration may lead to more significant issues.

Equipment/Crew/Materials

Activity Code	Description	Materials	Equipment	Crew Size
2027	Concrete Patching	Gravel, sand, ready mixed concrete, Portland cement, concrete cure	1 Concrete Saw, 1 Concrete Breaker, 1 Skid Steer, 1 Vibrator, 1 Tandem Truck, 1 Pickup	6
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe, 1 Vacuum Truck	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe, 1 Motor Grader	4
2311	Litter Pickup	N/A	1 Pickup	2
2510	Joint and Crack Filling	Rubber asphalt joint seal	1 Pickup, 1 Tandem truck, 1 Air Compressor, 1 Router, 1 Asphalt Heater	6

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Media Filter

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u>Media Filter</u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

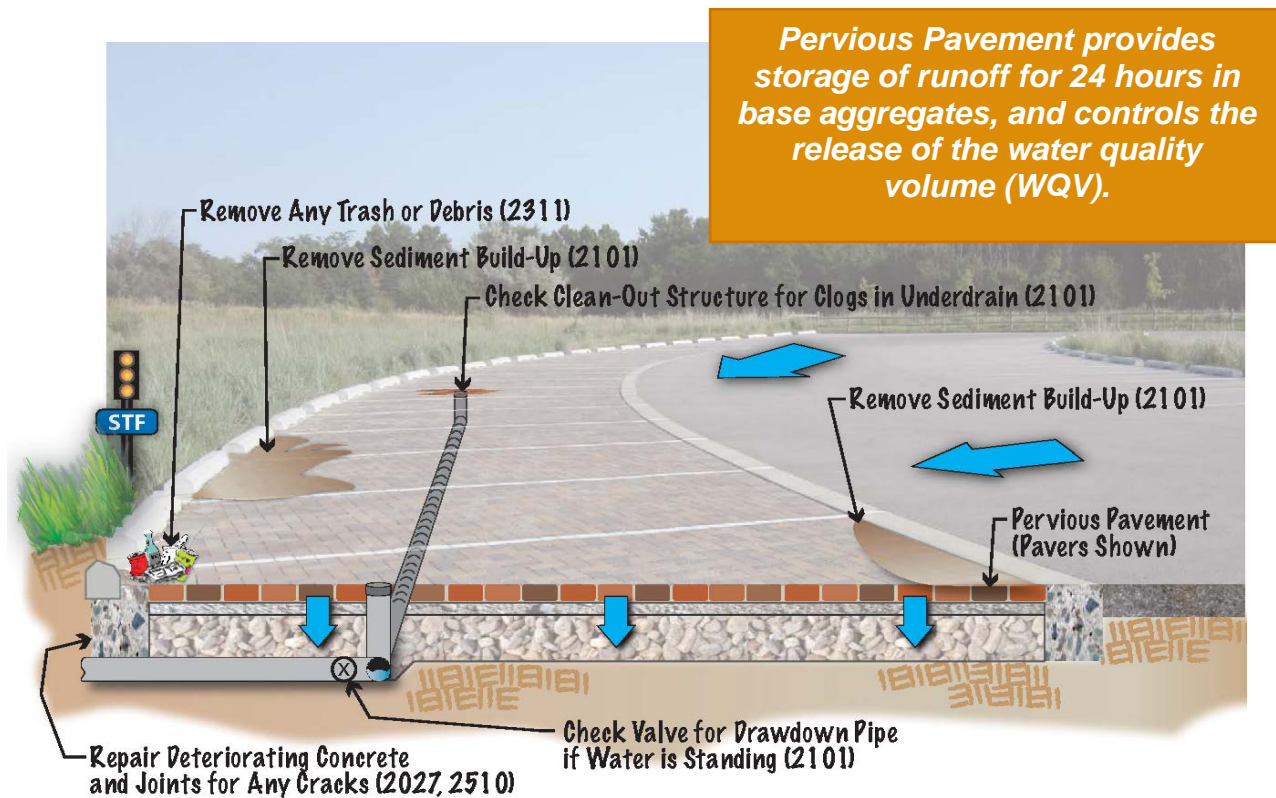
Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the filter free of surface ponding or visible backups?					
Do the associated sedimentation and filter chambers show evidence of ponding outside the proper drawdown time (24-48 hrs)?				2101 Drainage Maintenance	
Is the contributing area free of erosion?				2102 Maintain Misc. Structures	
Is there 6 or more inches of sediment build up in the sedimentation chamber/forebay?				2101 Drainage Maintenance	
Is filter bed surface free of sediment buildup?				2101 Drainage Maintenance	
Are the diversion structures, outlets, inlets, and forebays free of any trash or debris?				2311 Litter Pickup	
Is the sedimentation chamber's permanent pool free of leaks?				2102 Maintain Misc. Structures	
Is the media filter free of any noticeable odors?					
Is the concrete free of any damage, cracking, or deterioration?				2027 Concrete Patching 2510 Joint and Crack Filling	
Level of Service (LOS): _____					

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Pervious Pavement

MAINTENANCE OVERVIEW



Maintenance Needs Example for Pervious Pavement

Not to Scale

PERVIOUS PAVEMENT QUICK FACTS

Description Pervious concrete or asphalt, or pavers may comprise the pervious pavement STF. The facility treats stormwater through filtration and temporary storage of the water quality volume (WQV).

- Sediment build-up may occur due to the nature of this facility. This can clog the base course aggregate and decrease the effectiveness of the facility.
- If the pervious surface becomes clogged, then there may be standing water. A vacuum truck should be able to remove clogs and get the facility back in working order.
- **If heavy equipment is needed to repair pervious pavement and base course materials, do not station equipment on the pavement. Pervious pavement is generally designed for lighter loading and can easily be disturbed by turning movement of heavy equipment.**

NDOT Stormwater Treatment Facility

MAINTENANCE GUIDE

Pervious Pavement

Maintenance Activity	Do	Don't
Remedy any standing water (2101).	Check the underdrain pipe for clog; look at sediment build-up preventing flows.	Pull up pavers until cause of water back-up is determined.
Remove sediment build-up (2101).	Remove sediment and debris from pavement with vacuum trucks.	Use power washers/hoses or brooms to clean out sediment. It tends to be pushed further into STF.
Repair structural damage to outlets, diversion structures, pavers (2102).	Repair structures while maintaining proper erosion control procedures to protect the treatment facility.	Allow damaged structures to remain. This may adversely affect the treatment facility.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.

Equipment/Crew/Materials

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe, 1 Vacuum Truck	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2311	Litter Pickup	N/A	1 Pickup	2

* Caution: Twisting the tires of Heavy Equipment on pervious pavers can shift pavers and reduce void space, ultimately reducing the effectiveness of the STF.

NDOT Stormwater Treatment Facility

MAINTENANCE GUIDE

Pervious Pavement

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u> Pervious Pavement </u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the pavement surface free of surface ponding or indicators that water has ponded for an extended period of time?					
Does the observation well show the pavers are draining in the proper amount of time (24-48 hrs)?					
Are the pavement surface and outlets free of sediment buildup?				2101 Drainage Maintenance	
Are the trench, diversion structures, outlets, and forebays free of any trash or debris?				2311 Litter Pickup	
Are the trench, diversion structures, outlets, and forebays free of any structural damage?				2102 Maintain Misc. Structures	

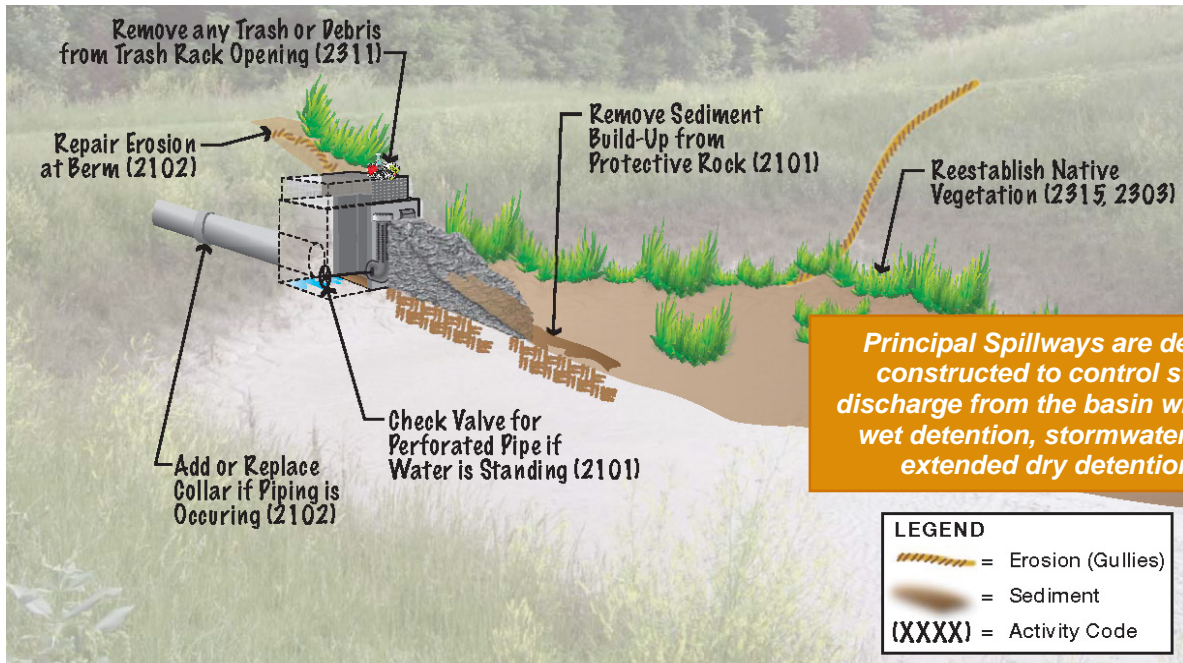
Level of Service (LOS): _____

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Principal Spillway

MAINTENANCE OVERVIEW



Principal Spillways are designed and constructed to control storage and discharge from the basin which may be a wet detention, stormwater wetland, or extended dry detention facility.

Maintenance Needs Example for Principal Spillway
Not to Scale

PRINCIPAL SPILLWAY QUICK FACTS

Description Principal Spillways provide the control for storage and discharge for detention and stormwater wetland facilities.

- Sediment build-up may occur near the spillway. This will decrease the amount of available storage and can cause overtopping. The bottom of the basin should be cleaned out when it reaches the CLEAN line (generally up to 6" of sedimentation allowed).
- Permanent Pool Elevation Marker (PPEL) will show the design permanent pool. Levels consistently below the marker may indicate excessive seepage or a leak within the outlet structure. Levels consistently above the marker may indicate a plugged drawdown pipe.
- Extended Dry Detention basins (no PPEL marker) should not have standing water longer than 72 hours, if there is water present, there may be a clog within the principal spillway components.
- Trash can clog the outlet pipes and will collect in the trash rack; it should be cleaned out as necessary.
- Also reference the maintenance factsheets for Extended Dry Detention, Wet Detention, or Stormwater Wetland and Forebay.
- **Heavy equipment used to repair the principal spillway should access it from the nearby berm (width at least 8 ft) so as to not compact soils within the basin.**

NDOT Stormwater Treatment Facility

MAINTENANCE GUIDE

Principal Spillway

Maintenance Activity	Do	Don't
Remove sediment build-up (2101).	Remove sediment from the basin bottom with machinery (ie: Gradall) stationed on edge of basin.	Station machinery in the basin or use machinery with overfilled tires.
Return basin to design permanent pool elevation when water surface is below PPEL marker (2101).	Check the outlet structure and drawdown valve for leaks; check with designer to see if groundwater is the source and if nearby monitoring wells show groundwater depletion.	Leave alone, assuming all the water evaporated.
Remedy and excess standing water (2101).	Check the outlet structure for clogging due to sedimentation or debris and signs of high groundwater.	Ignore the excess water.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket or mulch.	Station machinery in the basin or use overfilled tires on machinery.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow	Use large machinery to mow, instead use a push or riding lawn mower.
Reestablish vegetation (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides; reference the Roadside Vegetation Establishment and Management for lists of invasive species.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Equipment/Crew/Materials

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* **Caution:** Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Principal Spillway

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u>Principal Spillway</u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

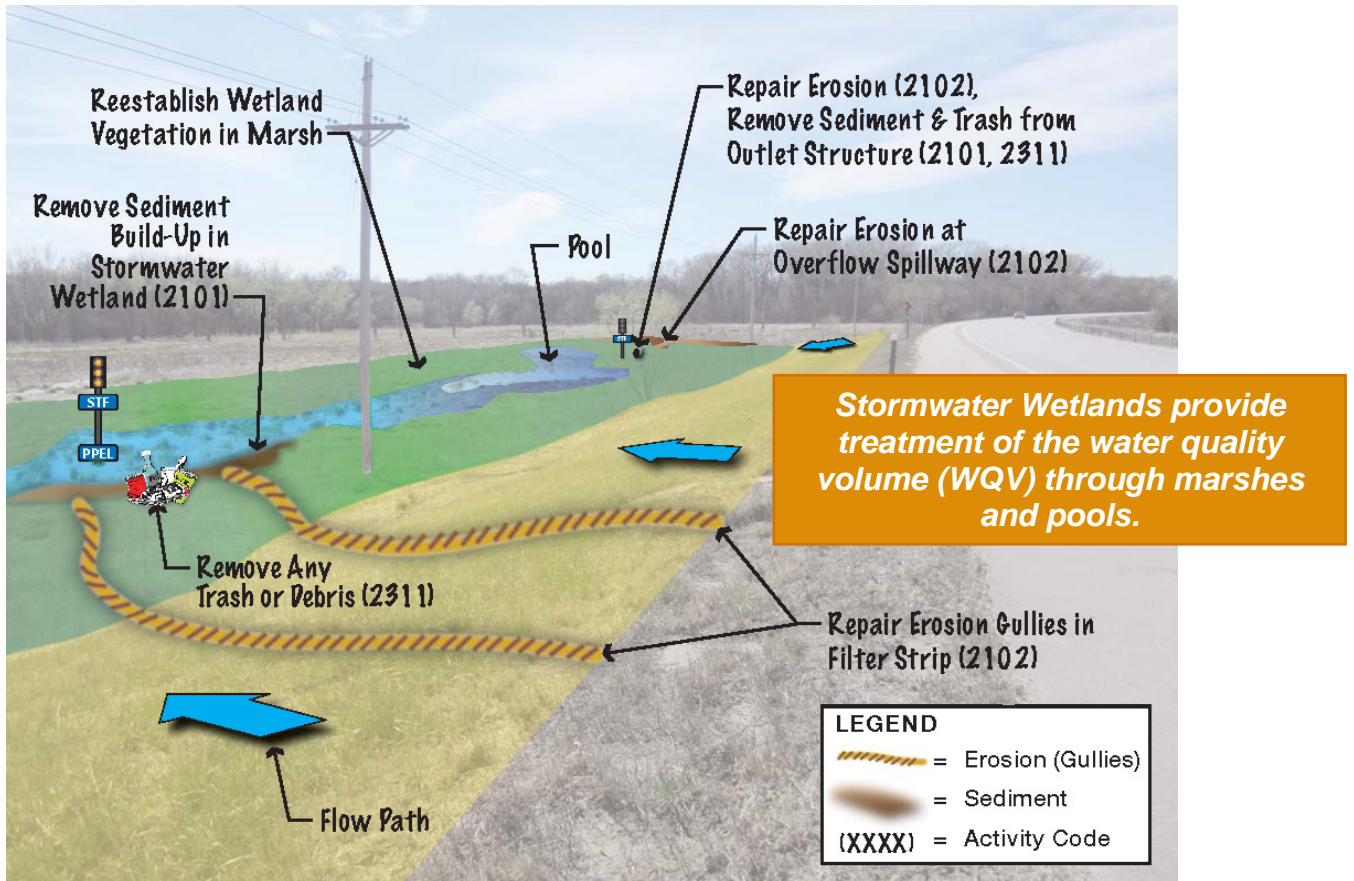
Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Does the wet detention basin drain only to permanent pool elevation? Does the extended dry detention basin drain completely?					
Does the wet detention basin drain down to the permanent pool elevation in the proper amount of time (24-72 hrs)?					
If the above questions are no, Check control valve for debris and sediment - open more if there appears to be a clog and clean it out, close some if pond drains too quickly. Does valve change affect the water level?					
Is the protective rock filled with sediment, preventing the basin to drain down to the PPEL marker or bottom of Extended Dry Detention Basin in time?					
If the backup is not caused by the control valve, then look at aggregate encasing underdrain/ perforated riser for sediment buildup.					
Are the inlets, outlets, and downstream side of outlets free of erosion or any damage from equipment or vehicles?				2102 Maintain Misc. Structures	
Is the protective rock free of debris and sediment build-up?				2101 Drainage Maintenance	
Are the diversion structures, forebays, and outlets free of any trash or debris?				2311 Litter Pickup	
Level of Service (LOS): _____					

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Stormwater Wetland

MAINTENANCE OVERVIEW



Maintenance Needs Example for Stormwater Wetland

Not to Scale

STORMWATER WETLAND QUICK FACTS

Description Stormwater Wetlands are basins that capture stormwater runoff and pass it through a series of marshes and pools of varying depths, supporting wetland and aquatic vegetation.

- Sediment build-up may occur, especially after construction. This can decrease the effectiveness of the wetland and should be removed.
- Runoff from pipes, as well as overland sheet flow from adjacent slopes, may cause erosion which will need to be filled in and vegetation reestablished.
- Permanent Pool Elevation Marker (PPEL) will show the design permanent pool. Levels consistently below the marker may indicate excessive seepage or a leak within the outlet structure. Levels consistently above the marker may indicate a plugged drawdown pipe.
- Also reference the maintenance factsheets for Wet Forebay for Principle Spillway.
- **If heavy equipment must be used within the basin, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration.**

NDOT Stormwater Treatment Facility

MAINTENANCE GUIDE

Stormwater Wetland

Maintenance Activity	Do	Don't
Remove sediment build-up (2101).	Remove sediment from the wetland bottom with machinery through use of mud mats; working from the middle of wetland to the edges; or using a lighter machine like a skid steer for the foreslopes and Gradall stationed outside of the wetland for the bottom.	Station machinery in the basin or use machinery with overfilled tires.
Remedy any high water or low water conditions as noted by PPEL marker (2101).	Check the outlet structure for clogs or leaks; look at sediment build-up preventing flows.	Ignore the excess water or water shortage, as it is likely a larger problem.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket or mulch.	Station machinery in the basin or use machinery with overfilled tires.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow around the facility.	Use large machinery to mow, instead use a push or riding lawn mower.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish wetland vegetation (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides; reference the Roadside Vegetation Establishment and Management for lists of invasive species.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Equipment/Crew/Materials

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* **Caution:** Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Stormwater Wetland

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF:	Stormwater Wetland	Maintenance ID:	
Construction Completion Date:		Inspection Date:	
CN:			

Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the stormwater wetland water surface below the permanent pool elevation (>6")?				2101 Drainage Maintenance	
Does the stormwater wetland drain down to the permanent pool elevation in the proper amount of time (24-72 hrs)?				2101 Drainage Maintenance	
Is the stormwater wetland free of erosion or any damage from equipment or vehicles?				2102 Maintain Misc. Structures	
Are the bottom of the stormwater wetland, diversion structures, outlets, and forebays free of sediment buildup?				2101 Drainage Maintenance	
Are the diversion structures, outlets, and forebays free of any trash or debris?				2311 Litter Pickup	
Is there a dense, uniform stand of the intended vegetation?				2303 Pesticides/Herbicides 2315 Seeding/Sodding	
Is the grass height between 6" and 12"?				2301 Machine Mowing 2302 Hand Mowing	
Are diversion structures and outlets free of structural damage?				2102 Maintain Misc. Structures	

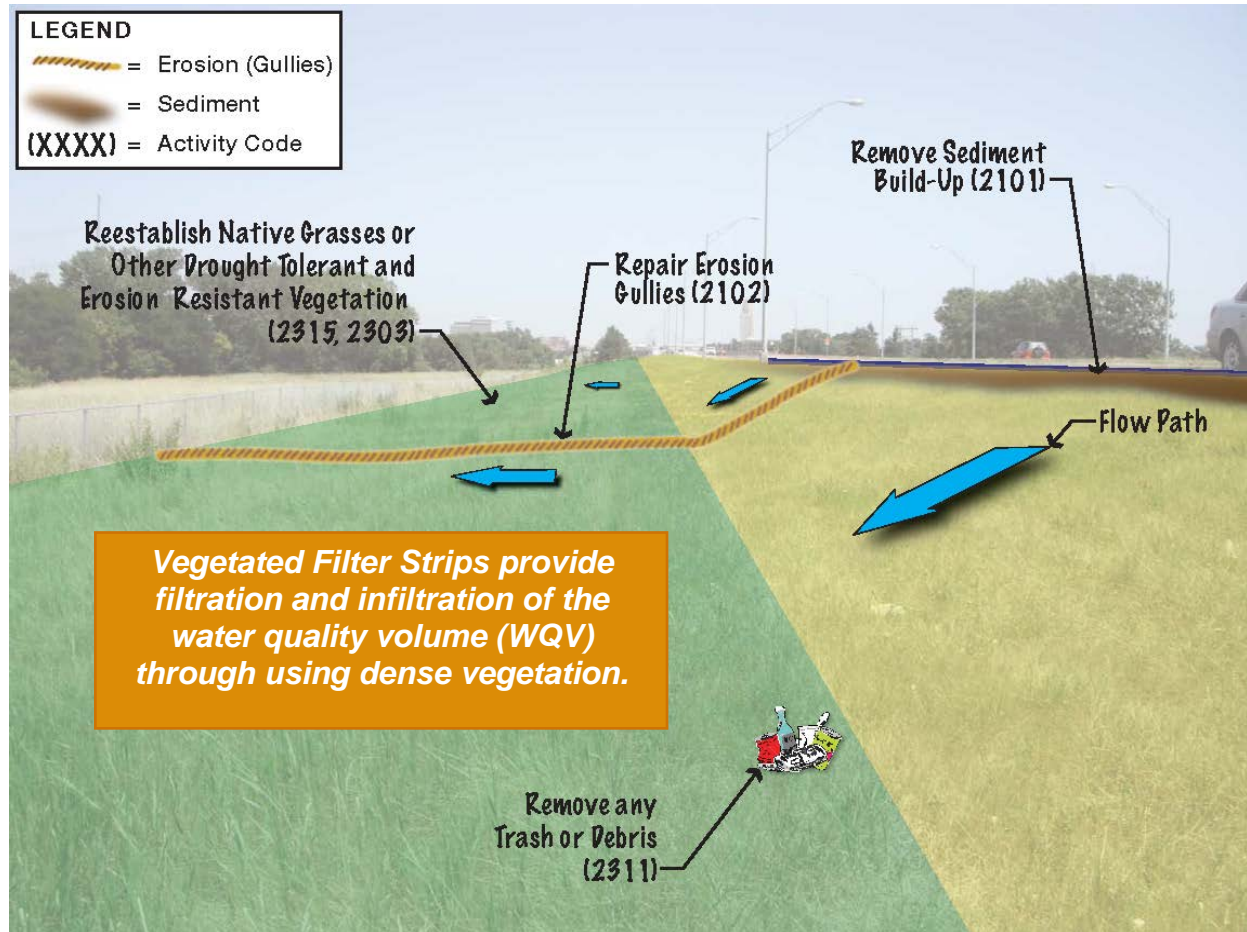
Level of Service (LOS):

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Vegetated Filter Strip

MAINTENANCE OVERVIEW



Maintenance Needs Example for Vegetated Filter Strip

Not to Scale

VEGETATED FILTER STRIP QUICK FACTS

Description Vegetated Filter Strips are sections of dense grass typically adjacent to roadways that treat stormwater by filtering and infiltrating the water quality volume (WQV).

- Sediment build-up may occur along the pavement edge preventing runoff from reaching the filter strip.
- Runoff from overland sheet flow from adjacent slopes can cause erosion on the filter strip which will need to be filled in and reestablished.
- All obstructions from trash and debris prevent sheet flow from occurring which decreases the filter strip function; trash and debris should be picked up and disposed.
- **If heavy equipment must be used within the filter strip, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration.**

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Vegetated Filter Strip

Maintenance Activity	Do	Don't
Remove sediment build-up (2101).	Remove sediment from the filter strip with machinery through use of mud mats, or using a lighter machine like a skid steer for the foreslopes. Replace aggregate in any level spreaders to the extents of any clogging.	Station machinery in the filter strip or use machinery with overfilled tires.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket or mulch.	Station machinery in the filter strip or use machinery with overfilled tires.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow	Use large machinery to mow, instead use a push or riding lawn mower.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish vegetation (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides; reference the Roadside Vegetation Establishment and Management for lists of invasive species.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Equipment/Crew/Materials

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* **Caution:** Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Vegetated Filter Strip

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u>Vegetated Filter Strip</u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

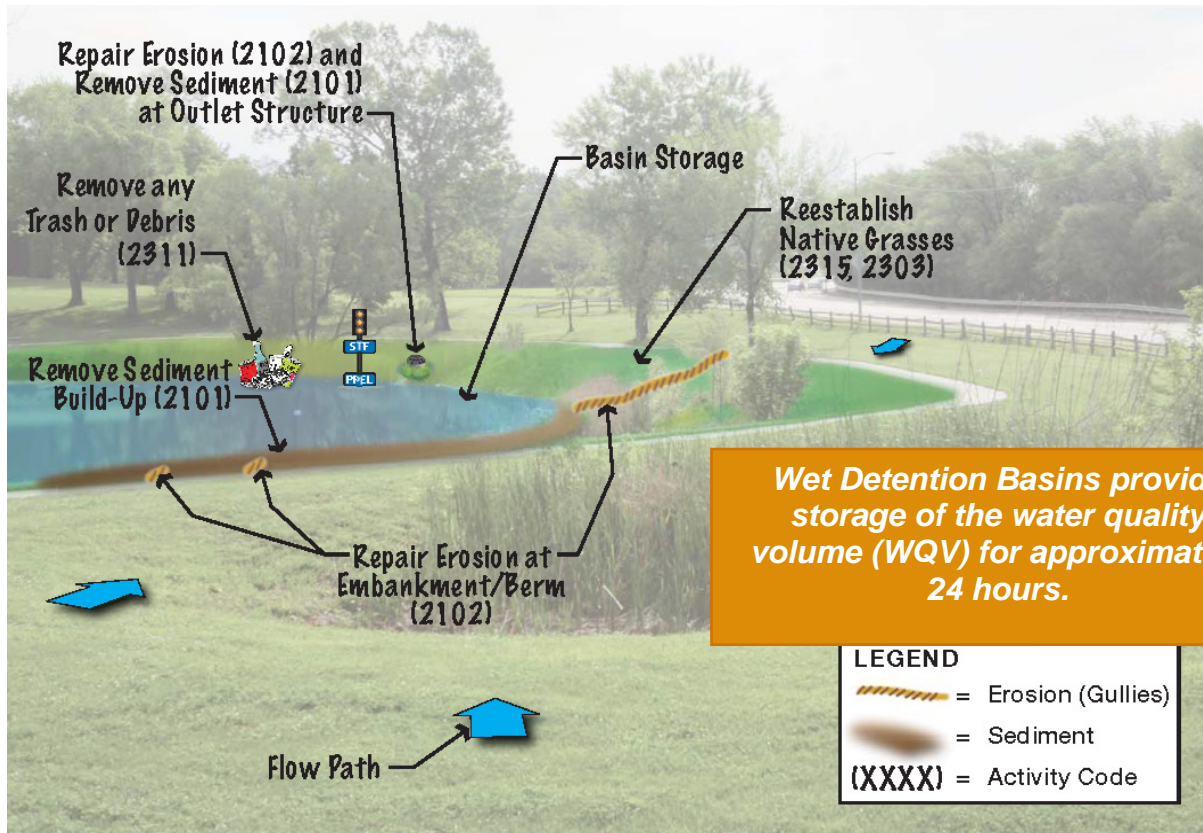
Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is there a dense, uniform stand of the intended vegetation?				2303 Pesticides/Herbicides 2315 Seeding/Sodding	
Is the filter strip free of erosion and any damage from equipment?				2102 Maintain Misc. Structures	
Is the filter strip free of trash and debris?				2311 Litter Pickup	
Is the filter strip free of sediment buildup, ponding, and other obstructions?				2101 Drainage Maintenance	
Is any associated level spreader free of sediment buildup or other clogs?				2101 Drainage Maintenance	
Is the grass height between 6" and 12"?				2301 Machine Mowing 2302 Hand Mowing	
Level of Service (LOS): _____					

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Wet Detention

MAINTENANCE OVERVIEW



Wet Detention Basins provide storage of the water quality volume (WQV) for approximately 24 hours.

Maintenance Needs Example for Wet Detention

Not to Scale

WET DETENTION BASIN QUICK FACTS

Description Wet Detention Basins provide temporary storage for stormwater runoff above the permanent pool of water. The excess volume is typically released over 24 hours (72 hours maximum).

- Sediment build-up may occur due to the nature of this facility. This will decrease the amount of available storage and can cause overtopping. The bottom of the basin should be cleaned out (remove 6" of sediment) when it reaches the CLEAN line.
- Permanent Pool Elevation Marker (PPEL) will show the design elevation for the permanent pool. Levels consistently below the marker may indicate excessive seepage or a leak within the outlet structure. Levels consistently above the marker may indicate a plugged drawdown pipe.
- Runoff from pipes, as well as overland sheet flow from adjacent slopes may cause erosion which will need to be filled in and reestablished.
- Also reference maintenance factsheets for Wet Forebay and Principal Spillway.
- **If heavy equipment must be used within the basin, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration.**

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Wet Detention

Maintenance Activity	Do	Don't
Remove sediment build-up (2101).	Remove sediment from the basin bottom with machinery through use of mud mats; working from the middle of basin bottom to the edges; or using a lighter machine like a skid steer for the foreslopes and Gradall stationed outside of the basin for the bottom.	Station machinery in the basin or use machinery with overfilled tires.
Remedy any high water or low water conditions as noted by PPEL marker (2101).	Check the outlet structure for clogs or leaks; look at sediment build-up preventing flows.	Ignore the excess water or water shortage, as it is likely a larger problem.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket or mulch.	Station machinery in the basin or use overfilled tires on machinery.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow around the facility	Use large machinery to mow, instead use a push or riding lawn mower.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish vegetation (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides; reference the Roadside Vegetation Establishment and Management for lists of invasive species.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* **Caution:** Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Wet Detention

Stormwater Treatment Facility Maintenance Inspection Form

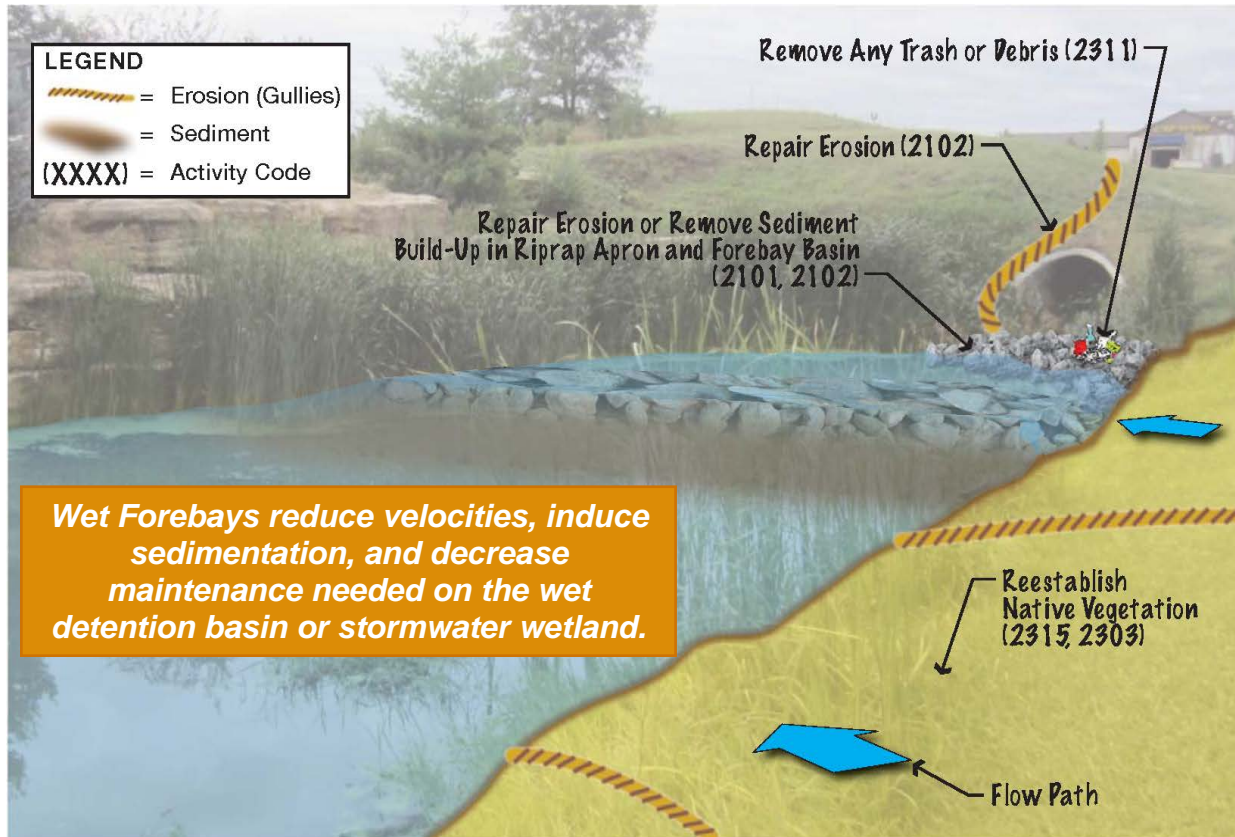
Type of STF: <u>Wet Detention Basin</u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the wet detention basin water surface below the permanent pool elevation (>6")?				2101 Drainage Maintenance	
Does the wet detention basin drain down to the permanent pool elevation in the proper amount of time (24-72 hrs)?				2101 Drainage Maintenance	
Is the basin free of erosion or any damage from equipment or vehicles?				2102 Maintain Misc. Structures	
Are the bottom of the basin, diversion structures, outlets, and forebays free of sediment buildup?				2101 Drainage Maintenance	
Are the diversion structures, outlets, and forebays free of any trash or debris?				2311 Litter Pickup	
Is there a dense, uniform stand of the intended vegetation?				2303 Pesticides/Herbicides 2315 Seeding/Sodding	
Is the grass height between 6" and 12"?				2301 Machine Mowing 2302 Hand Mowing	
Are diversion structures and outlets free of structural damage?				2102 Maintain Misc. Structures	

Level of Service (LOS): _____

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F

MAINTENANCE OVERVIEW



Maintenance Needs Example for Forebay for Wet Detention Basin

Not to Scale

WET FOREBAY QUICK FACTS

Description Wet Forebays provide energy dissipation and a location for sedimentation to occur to reduce the need to dredge the detention facility or stormwater wetland.

- Sediment build-up in the forebay is expected. It will need to be cleaned out when 50% of the capacity is lost (remove ~2' of sediment) or it reaches the CLEAN line.
- Runoff from pipes, as well as overland sheet flow from adjacent slopes may cause erosion which will need to be filled in and reestablished.
- Also reference the maintenance factsheets for Wet Detention or Stormwater Wetland, and Principal Spillway.
- **If heavy equipment must be used within the basin, make sure it has tracks or low pressure tires; when replacing soils it should be lightly compacted to allow infiltration.**

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Wet Forebay

Maintenance Activity	Do	Don't
Remove sediment build-up (2101).	Remove 2' of sediment from the basin bottom with machinery; working from the middle of basin bottom to the edges; or using a lighter machine like a skid steer for the foreslopes and Gradall stationed outside of the basin for the bottom.	Station machinery in the basin or use machinery with overfilled tires.
Repair erosion and eliminate gullies (2102).	Fill in erosion with soil mix (contact RSU for details) and lightly compact. Cover with erosion control blanket or mulch.	Station machinery in the basin or use overfilled tires on machinery.
Replace/Add riprap to seepage berm (2102).	Repair erosion and maintain riprap elevation approximately 3" below the Permanent Pool Elevation (PPEL).	Expect the berm to hold the weight of heavy machinery.
Maintain vegetation between 6" and 12" (2301, 2302)	Hand mow or machine mow	Use large machinery to mow, instead use a push or riding lawn mower.
Remove trash and debris (2311).	Use handwork to pick up the trash and debris.	Use equipment to remove debris.
Reestablish vegetation (2315) and occasionally maintain through pesticides and herbicides (2303).	Use hand application of pesticides and herbicides; reference the Roadside Vegetation Establishment and Management for lists of invasive species.	Use pesticides or herbicides unless explicitly stated in inspection report.
Repair tire ruts (2350).	Use a tiller to decompact the soil in and around the rut, fill voids with soil mix (contact RSU for details) and regrade, lightly compact, and cover with erosion blanket or mulch.	Fill the rut in with soil and recompact.

Activity Code	Description	Materials	Equipment	Crew Size
2101	Drainage Structure Maintenance	Pipes, outlet structures, fill soil	1 Skid Steer, 1 Tandem Truck, 1 Pickup, 1 Gradall or Backhoe	3
2102	Maintaining Miscellaneous Structures	Riprap, etc.	1 Skid Steer, 1 Pickup, 2 Tandem Trucks, 1 Gradall or Backhoe*, 1 Motor Grader*	4
2301	Machine Mowing	N/A	1 Tractor/Mower, 1 Pickup	1
2302	Hand Mowing	N/A	1 Pickup, 1 Mower	2
2303	Chemical Control of Insects and Roadside Trees and Shrubs	N/A	1 Tandem Truck, 1 Weed Sprayer, 1 Pickup, 1 Tractor	2
2311	Litter Pickup	N/A	1 Pickup	2
2315	Seeding and Sodding	Seed Mixtures, Erosion Control Mat	1 Pickup, 1 Tandem Truck, and as required: 1 Tractor, 1 Seed Drill	3
2350	Other Roadside Maintenance	Fill soil, Erosion Control Mat	1 Garden Tiller, 1 Skid Steer, 1 Pickup, 1 Tandem Trucks, 1 Motor Grader*	2

* **Caution:** Heavy Equipment can compact soils and reduce effectiveness of STF.

NDOT Stormwater Treatment Facility MAINTENANCE GUIDE

Wet Forebay

Stormwater Treatment Facility Maintenance Inspection Form

Type of STF: <u>Wet Forebay</u>	Maintenance ID: _____
Construction Completion Date: _____	Inspection Date: _____
CN: _____	

Inspection Activity:	No	Yes	Comments:	Maintenance Activity Codes	Due Date for Maintenance
Is the rock surface just below the permanent pool elevation?				2102 Maintain Misc. Structures	
Is the basin free of erosion or any damage from equipment?				2102 Maintain Misc. Structures	
Is the sediment build-up below the CLEAN line?				2101 Drainage Maintenance	
Are the forebay basin, inlets, and riprap seepage berm free of any trash or debris?				2311 Litter Pickup	
Is there a dense, uniform stand of the intended vegetation around the facility?				2303 Pesticides/Herbicides 2315 Seeding/Sodding	
Is the grass height between 6" and 12"?				2301 Machine Mowing 2302 Hand Mowing	
Are diversion structures and outlets free of structural damage?				2102 Maintain Misc. Structures	
Level of Service (LOS): _____					

LOS Description	LOS Ranking
Treatment facility is functioning properly; wear has occurred but there is no structural damage and no maintenance is required.	A
Treatment facility is functioning; there is minor deterioration of the facility and some maintenance may be required.	B
Treatment facility's function has not been significantly altered; there is moderate deterioration of the structure and maintenance is required.	C
Treatment facility does not function properly; there is major deterioration of the facility and major maintenance is required.	D
Treatment facility is no longer functional; there is a complete failure of the facility.	F