



U.S. ARMY

GAM - GREEN ASSET MANAGEMENT INSPECTION

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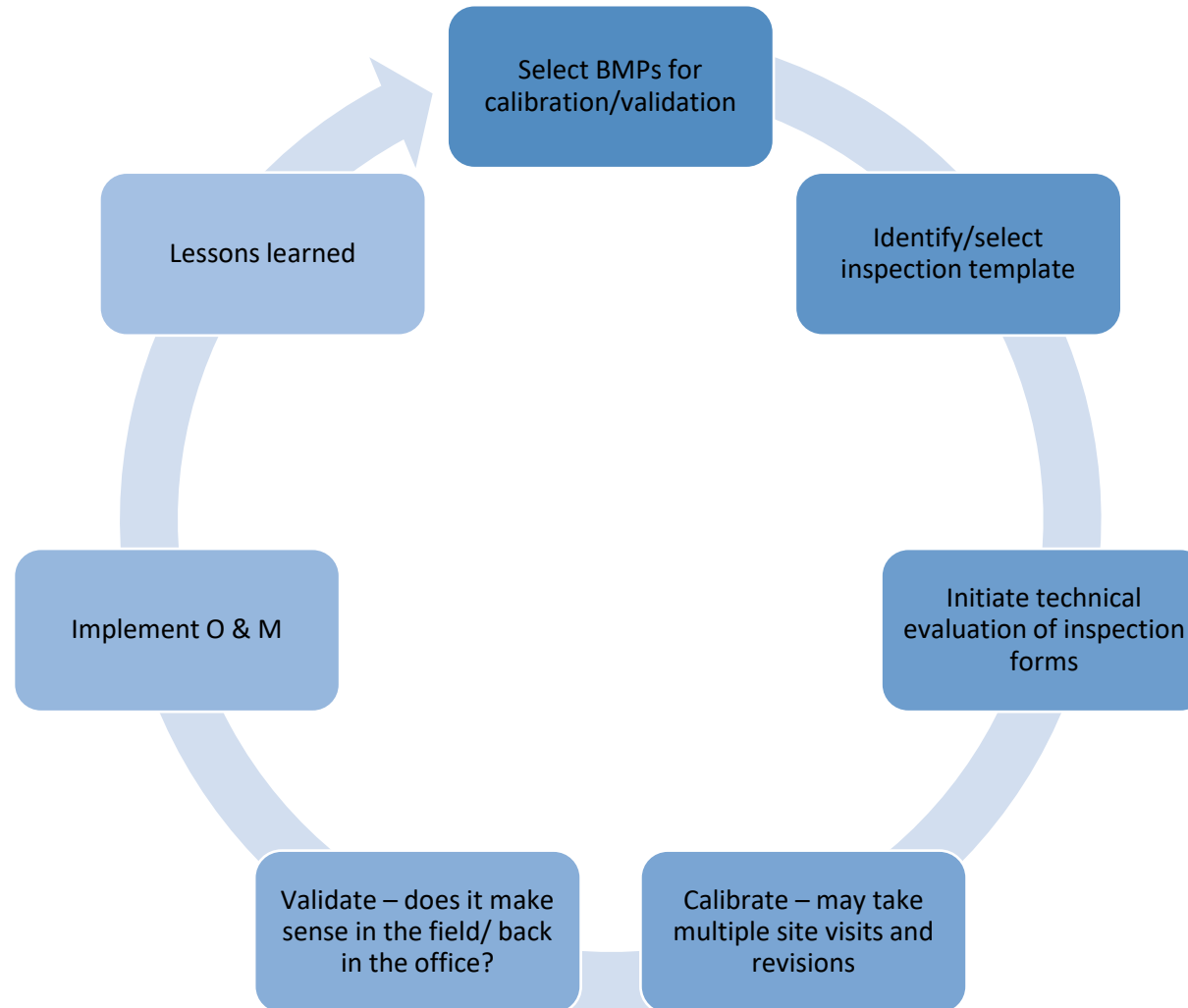
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BMP Inspection Form Development Process



Bioretention systems

Regular Inspection and Maintenance Guidance for Bioretention Systems	
<p>Maintenance of bioretention systems and tree filters can typically be performed as part of standard landscaping. Regular inspection and maintenance is critical to the effective operation of bioretention systems to insure they remain clear of leaves and debris and allow free draining. This page provides guidance on maintenance activities that are typically required for these systems, along with the suggested frequency for each activity. Individual systems may have more, or less, frequent maintenance needs, depending on a variety of factors including the occurrence of large storm events, overly wet or dry conditions (I.E., drought), regional hydrologic conditions, and the upstream land use.</p>	
<p>Score, description</p> <p>0, Continue routine maintenance/NA 1, Minor issues observed, needs attention 2, Major Issues observed, requires immediate attention 3, Failure</p>	
<p>Inspection Activities: common maintenance activity is the removal of leaves from the system and bypass structure. Visual inspections are routine for system maintenance. This includes looking for standing water, accumulated leaves, holes in the soil, mulch layers of plant distress, and debris and sediment accumulation in the system. Mulch and/or vegetation coverage is integral to the performance of the system, including infiltration rate and nutrient uptake. Vegetation care is important to system productivity and health.</p>	
<p>ACTIVITY</p> <p>Check to ensure the filter surface remains well draining after storm events. Remedy: If filter bed is clogged, draining poorly, or standing water covers more than 15% of the surface, then remove top few inches of discolored material. Till or rake remaining material as needed. A record should be kept of the time to drain for the system completely after a storm event. The system should drain completely within 72 hours.</p>	<p>FREQUENCY</p> <p>After every major storm in the first few months, then annually.</p>
<p>Check inlets and outlets for leaves and debris. Remedy: Rake in and around the system to clear it of debris. Also, clear the inlet and overflow if obstructed.</p>	
<p>Inspect inlets and outlets to ensure good condition and no evidence of deterioration. Check to see if high-flow bypass is functioning. Remedy: Repair or replace any damaged structural parts, inlets, outlets, or sidewalls.</p>	
<p>Check for animal burrows and short circuiting in the system. Remedy: Soil erosion from short circuiting or animal burrows should be repaired when they occur. The holes should be filled and lightly compacted</p>	<p>Quarterly initially, then annually.</p>
<p>Check to insure the filter bed does not contain more than 2 inches accumulated material Remedy: Remove sediment as necessary. If 2 inches or more of filter bed has been removed, replace media with either mulch or a (50% sand, 20% woodchips, 20% compost, 10% soil) mixture.</p>	
<p>During extended periods without rainfall, inspect plants for signs of distress. Remedy: Plants should be watered until established (typical only for first few months) or as needed thereafter.</p>	
<p>Check for robust vegetation coverage throughout the system. Remedy: If at least 50% vegetation coverage is not established after 2 years, supplemental planting should be performed.</p>	<p>Annually</p>
<p>Check for dead or dying plants, and general long term plant health. Remedy: This vegetation should be cut and removed from the system. If woody vegetation is present, care should be taken to remove dead or decaying plant material. Separation of herbaceous vegetation rootstock should occur when over-crowding is observed (greater than 80%).</p>	<p>Annually</p>

CHECKLIST FOR INSPECTION OF BIORETENTION SYSTEM				
Location:	Time:	Inspector:		
Date:	Date last rain event:	Site Conditions:		
Rain > 0.10" last 24 hours Y / N		Vegetation:		
GRADE: 0%		Final Score: 0		
		Total points possible: 66		
Score, description				
0, Continue routine maintenance/NA				
1, Minor issues observed, needs attention				
2, Major Issues observed, requires immediate attention				
3, Failure				
Inspection Items	Weight	Score 0 - 3, circle score or select drop down menu	Comments/Corrective Action	
1. Standing Water (Annually)				
A) No evidence of standing water after 72 hours.	3	0 1 2 3	Score = 0	
2. Short Circuiting & Erosion (Annually)				
A) No evidence of animal burrows or other holes?		0 1 2 3	Score = 0	
B) No evidence of erosion?		0 1 2 3	Score = 0	
C) Evidence of sediment accumulation on surface? Attach picture.		0 1 2 3	Score = 0	
3. Overflow Bypass / Inlet Inspection (Annually)				
A) Surface is at design level, typically 4" below overflow	2	0 1 2 3	Score = 0	
B) Overflow bypass / inlet (if available) is functional?	3	0 1 2 3	Score = 0	
C) Overflow bypass / outlet (if available) is functional?	3	0 1 2 3	Score = 0	
D) No evidence of blockage or accumulated leaves/sediment?	3	0 1 2 3	Score = 0	
4. Debris Cleanup (Annually)				
A) Free from litter, leaves, and dead vegetation?		0 1 2 3	Score = 0	
5. Mulch Depth (if applicable)				
A) Mulch at original design depth? If applicable.		0 1 2 3	Score = 0	
6. Vegetation Coverage (Annual)				
A) Plants are stable, roots not exposed?		0 1 2 3	Score = 0	
B) Robust coverage?		0 1 2 3	Score = 0	
C) Invasive plants present (> 5%) (attach picture)?		0 1 2 3	Score = 0	
D) Dead or decaying plants removed from the system?		0 1 2 3	Score = 0	
E) Prune perennial vegetation?		0 1 2 3	Score = 0	
F) Prune dead, diseased, or crossing tree branches		0 1 2 3	Score = 0	
7. Drought Conditions (As needed)				
A) Water plants as needed, if applicable.		0 1 2 3	Score = 0	
B) Dead or dying desirable, if applicable.		0 1 2 3	Score = 0	
TOTAL Score 0				
Notes				
<p>Corrective Action Criteria:</p> <p>90 - 100%, Pass, continue routine maintenance 45 - 90%, Needs attention/maintenance < 45%, Needs urgent repair/replacement</p>				
Corrective Action Needed				Due Date
1.				
2.				
3.				

- Guidance
 - Scoring system
 - Activity
 - Frequency
- Checklist
 - Inspection items
 - Weight
 - Score
 - Comments/corrective action
 - Total Score

Porous Pavements











Regular Inspection and Maintenance Guidance for Porous Pavements	
Regular inspection and maintenance is critical to the effective operation of porous pavement. It is the responsibility of the owner to maintain the pavement in accordance with the minimum design standards. This page provides guidance on maintenance activities that are typically required for these systems, along with the suggested frequency for each activity. Individual systems may have more, or less, frequent maintenance needs, depending on a variety of factors including the occurrence of large storm events, seasonal changes, and traffic conditions.	
Score, description 0, Continue routine maintenance/NA 1, Minor Issues observed, needs attention 2, Major Issues observed, requires immediate attention 3, Failure	
Inspection Activities: Visual inspections are an integral part of system maintenance. This includes monitoring pavement to ensure water drainage, debris accumulation, and surface deterioration.	
ACTIVITY	FREQUENCY
Check for standing water on the surface of the pavement after a precipitation event, no standing water should remain within 30 minutes after rainfall had ended. Remedy: Cleaning of porous pavement is recommended.	1 to 2 times per year, more frequently for high use sites or sites with higher potential for run-on
Inspect for sediment and organic debris on the pavement surface or within forebays. Remedy: Vacuum sweeper shall be used regularly to remove sediment and organic debris on the pavement surface. The sweeper may be fitted with water jets. For loose debris, a power/leaf blower or gutter broom can be used to remove leaves and trash.	
Inspect for accumulation of debris and dead leaves. Remedy: Pavement vacuuming should occur during spring and fall cleanup to remove accumulated debris and dead leaves, at minimum.	
Inspect for blockage or clogging of open spaces. Remedy: Power washing can be an effective tool for cleaning clogged areas. This should occur at mid pressure typically less than 500 psi and at an angle of 30 degrees	
Check for damage to porous pavements from non-design loads. Remedy: Damaged areas may be repaired by use of infrared heating and rerolling of pavement. Typical costs may be 2,000/ day for approximately 500 ft of trench.	
Maintenance Activities	
Routine preventative cleaning is more effective than corrective cleaning.	
ACTIVITY	FREQUENCY
Controlling run-on and debris tracking is key to extending the life of porous surfaces. Erosion and sedimentation control of adjacent areas is crucial. Forebay areas should remain clear. Vacuuming adjacent non porous asphalt can be effective at minimizing run-on.	Whenever vacuuming adjacent porous pavements
Do not store materials such as sand/salt, mulch, soil, yard waste, and other stock piles on porous surfaces.	
Damage can occur to porous pavement from non-design loads. Precautions such as clearance bars, signage, tight turning radius, high curbs, and video surveillance may be required where there is a risk off non-design loads. Posting of signage is recommended (i.e. passenger vehicles only, light truck traffic, etc. as per pavement durability rating.)	As needed

CHECKLIST FOR INSPECTION OF POROUS PAVEMENTS				
Location:		Inspector:		
Date:	Time:	Site Conditions:		
Rain > 0.10" last 24 hours Y / N		Date of last rain event:		
GRADE: 0%		Final Score		0
		Total points possible		33
Score, description				
0, Continue routine maintenance/NA				
1, Minor Issues observed, needs attention				
2, Major Issues observed, requires immediate attention				
3, Failure				
Inspection Items	Weight	Score 0 - 3, circle score or select drop down menu		Comments/ Corrective Action
1. Debris Cleanup (Annually)				
B) Estimated percent of blocked open spaces?	5	0	1 2 3	Score = 0
0, none 1, 1-25% 2, 26-50% 3, >50%				
C) Adjacent non porous pavement clear of debris?		0	1 2 3	Score = 0
D) Catch basins (if applicable)?		0	1 2 3	Score = 0
2. Controlling Run-On (Annually)				
A) Adjacent vegetated areas show no signs of erosion and run-on to porous pavement? If applicable.		0	1 2 3	Score = 0
3. Outlet / Catch Basin Inspection (If available) (Annually)				
A) No evidence of blockage?		0	1 2 3	Score = 0
B) Good condition, no need for cleaning/repair?		0	1 2 3	Score = 0
4. Pavement/Material Condition (Annually)				
A) No evidence of deterioration?		0	1 2 3	Score = 0
B) No cuts from utilities visible?		0	1 2 3	Score = 0
C) No evidence of improper design load applied?		0	1 2 3	Score = 0
5. Signage / Stockpiling (If applicable)				
A) Proper signage posted indicating usage for traffic		0	1 2 3	Score = 0
B) No stockpiling of materials and no seal coating?		0	1 2 3	Score = 0
6. Weed control (As Needed)				
A) No evidence of vegetation in pavement?		0	1 2 3	Score = 0
B) Litter present?		0	1 2 3	Score = 0
		TOTAL Score 0		
Notes				
Corrective Action Criteria: 90 - 100%, Pass, continue routine maintenance 46 - 90%, Needs attention/maintenance < 45%, Needs urgent repair/replacement				
Corrective Action Needed				Due Date
2.				
3.				

- Inspection Item Example
 - Estimated % of blocked open spaces
 - Scored 1 – 3
 - 0 = none
 - 1 = 1 - 25%,
 - 2 = 25 - 50%,
 - 3 = >50%,
- Corrective Action Criteria
 - 90 – 100% Pass
 - 46 – 90% Needs attention
 - < 45% Needs urgent repair or replacement

Supplemental documents for inspections

NATIVE VERSUS INVASIVE LOOK ALIKE PLANTS IN NORTH TEXAS

<p>BASTARD CABBAGE (I) VS TANSY MUSTARD (N)</p>	<p>Bastard cabbage has yellow flowers with small bulbs down the stem. Tansy mustard also has yellow blooms, but the stems have small pin like leaves.</p>	<p>INVASIVE</p>  <p>Photo by Lynn Adelson - Texas A&M Extension Service, Bastard Cabbage - A Widespread Invasive Cool-Season Annual Weed</p>	<p>NATIVE</p>  <p>Photo by: Chinese University of Agriculture, Forestry and Life Science</p>
<p>ALLIGATORWEED (I) VS AMERICAN WATERWILLOW (N)</p>	<p>The difference between these two aquatic plants is highlighted in the blooms, they are different, but the stems look almost identical. Globular white flowers indicate alligatorweed and white with purple center waterwillow.</p>	<p>INVASIVE</p>  <p>Photo by: Brian Wilfridson-Alligatorweed & Pond plant of the World, Editor: USDA, APHIS, FWS</p>	<p>NATIVE</p>  <p>Photo by: David D. Theobald, USDA Forest Service, Plant of the World - American Waterwillow</p>
<p>CHINABERRY TREE (I) VS WESTERN SOAPBERRY (N)</p>	<p>Chinaberry fruit is opaque with bi-pinnately compound leaves. Soapberry fruit is more translucent with pinnately compound leaves.</p>	<p>INVASIVE</p>  <p>Photo by: Nator Hamrick, Penn State, Editor: New York Times, Photo: Wally Goodrich - Chinaberry</p>	<p>NATIVE</p>  <p>Photo by: Oklahoma State University - William Scobey</p>
<p>CHINESE TALLOW (I) VS EASTERN REDBUD (N)</p>	<p>Chinese tallow and eastern redbud both have tear drop shaped leaves with seed pods(kernels) that drape down. The Chinese tallow have uncovered flowers while redbuds have enclosed seeds which bloom into flowers.</p>	<p>INVASIVE</p>  <p>Photo by: Joseph LaForest, Posted by: US EAS for a site on Chinese Tallow</p>	<p>NATIVE</p>  <p>Downloaded by Paul Nelson for Pittsburg Department of Conservation on Eastern Redbud</p>
<p>BERMUDAGRASS (I) VS BUFFALO GRASS (N)</p>	<p>Bermuda Grass seed heads narrow and dark compared with Buffalo grass's seed heads which produce white seeds.</p>	<p>INVASIVE</p>  <p>Photo by: Aaron L. Patten, Posted by: Purdue University in article called: Common Bermudagrass.</p>	<p>NATIVE</p>  <p>Photo by: Texas Native Seed Program, Sound in Grass, Weed and Wildflower guide by Texas department of Transportation</p>

WHY IS IT IMPORTANT TO CONTROL THE GROWTH OF INVASIVE SPECIES?

Many invasive plants undermine native ones and disturb soil and growth patterns which is why it is crucial to maintain controlling and stopping the spread of these invaders.

YELLOW BLUESTEM (I) VS LITTLE BLUESTEM (N)

Yellow bluestem have V-shaped seed heads that pop out of the top of the grasses. Little bluestem doesn't have V-shaped seed heads - these bluestems seeds are leathery.

INVASIVE




Photo by: Elly Williams- Forestry for USDA, Yellow and Coarsetop (yellow)

NATIVE






Photo by: Rob Rowland - Missouri Department of Conservation

HOW CAN YOU HELP THE SPREAD OF INVASIVE PLANTS?

Knowing the difference between invasive and common native species helps identify what should be weeded and what shouldn't in impacted areas.

INVASIVE SPECIES PG. 2

<p>JOHNSONGRASS (I) VS SWITCHGRASS (N)</p>	<p>Yellowish brown bunches of seeds for both plants. Johnsongrass seed heads are darker than switchgrass.</p>	<p>INVASIVE</p>  <p>Picture by Michigan State University for Johnsongrass seeds</p>	<p>NATIVE</p>  <p>Picture found on Governor's Canal Conservation website</p>
<p>CHINESE PRIVET (I) VS FLOWERING DOGWOOD (N)</p>	<p>The leaves are make these easier to identify, dogwoods have predominant veins through-out the entire leaf while privets do not.</p>	<p>INVASIVE</p>  <p>School of Renewable Nature Resources LSU, LaCenter, LA State, LaSalle</p>	<p>NATIVE</p>  <p>Picture by: Jim Robbins, Picture on NC State Gordon College Plant Technology</p>
<p>GIANT RAGWEED (I) VS GOLDENROD (N)</p>	<p>Ragweed has lobed leaves and yellow flowers while goldenrod also has yellow flowers and elongated leaves</p>	<p>INVASIVE</p>  <p>Picture from University of Arkansas Forest Diseases on Ragweed</p>	<p>NATIVE</p>  <p>Photo by: Peter M. Cook, Posted by: Minnesota Wildflower website</p>
<p>NODDING THISTLE (I) VS TEXAS THISTLE (N)</p>	<p>Both thistles have spiked stems but noddling thistle blooms are rounded while Texas thistles are more coned shaped.</p>	<p>INVASIVE</p>  <p>Picture from the Missouri Department of Conservation.</p>	<p>NATIVE</p>  <p>Photo by: Casey Reynolds, PhD</p>

CRABGRASS (I) VS BAHIA GRASS (N)

Crabgrass starts more centrally then spreads out and creates v shaped seed bunches, while Bahia grass is less coarse but has those v shaped seed pouches.

INVASIVE



Crabgrass picture above was posted by Michigan State University in an article called: Large Crabgrass - Digitaria sanguinalis

NATIVE




Photo by: Casey Reynolds, PhD

STOP THE SPREAD OF INVASIVE SPECIES

Lessons Learned

- Keep it simple
- Know your team



CHECKLIST FOR INSPECTION OF BIORETENTION SYSTEM / TREE FILTERS		
Location: <i>PCWRP Bioretention</i>	Inspector:	
Date: <i>7/5/22</i>	Time:	
Date Since Last Rain Event: <i>7</i>	Site Conditions: <i>cloudy day</i>	
Inspection Items	Satisfactory (S) or Unsatisfactory (U)	Comments/Corrective Action
1. Initial Inspection After Planting and Mulching		
Plants are stable, roots not exposed	S U	
Surface is at design level, typically 4" below overflow	S U	<i>undercut the road</i>
Overflow bypass / inlet (if available) is functional	S U	<i>fix</i>
2. Debris Cleanup (2 times a year minimum, Spring & Fall)		
Litter, leaves, and dead vegetation removed from the system	S U	
Prune perennial vegetation	S U	
3. Standing Water (1 time a year, After large storm events)		
No evidence of standing water after 72 hours	S U	
4. Short Circuiting & Erosion (1 times a year, After large storm events)		
No evidence of animal burrows or other holes	S U	<i>@ outfall channel</i>
No evidence of erosion	S U	
5. Drought Conditions (As needed)		
Water plants as needed	S U	
Dead or dying plants	S U	
6. Overflow Bypass / Inlet Inspection (1 times a year, After large storm events)		
No evidence of blockage or accumulated leaves	S U	<i>sediment</i>
Good condition, no need for repair	S U	
7. Vegetation Coverage (once a year)		
50% coverage established throughout system by first year	S U	<i>note present</i>
Robust coverage by year 2 or later	S U	
8. Mulch Depth (if applicable) (once every 2 years)		
Mulch at original design depth after tilling or replacement	S U	
9. Vegetation Health (once every 3 years)		
Dead or decaying plants removed from the system	S U	
10. Tree Pruning (once every 3 years)		
Prune dead, diseased, or crossing branches	S U	
Corrective Action Needed		Due Date
1. <i>inlet blocked and bypass cutting</i>		
2.		
3.		

if present go invasive

CHECKLIST FOR INSPECTION OF BIORETENTION SYSTEM			
Location: <i>Rain Garden</i>	Inspector:		
Date:	Time:	Site Conditions:	
Rain > 0.10" last 24 hours	Y/N	Vegetation:	
		Final Score:	<i>0</i>
		Total points:	<i>69</i>
Score, description			
0. Continue routine maintenance-NA			
1. Minor issues observed, needs attention			
2. Major issues observed, requires immediate attention			
3. Failure			
Inspection Items	Weight	Score 0-3, circle score or select drop down menu	Comments/Corrective Action
1. Standing Water (Annually)			
A) No evidence of standing water after 72 hours	3	0 1 2 3	Score = 0
2. Short Circuiting & Erosion (Annually)			
A) No evidence of animal burrows or other holes?		0 1 2 3	Score = 0
B) No evidence of erosion?		0 1 2 3	Score = 0
C) Evidence of sediment accumulation on surface? Attach picture		0 1 2 3	Score = 0
3. Overflow Bypass / Inlet Inspection (Annually)			
A) Surface is at design level, typically 4" below overflow	2	0 1 2 3	Score = 0
B) Overflow bypass / inlet (if available) is functional?	3	0 1 2 3	Score = 0
C) Overflow bypass / outlet (if available) is functional?	3	0 1 2 3	Score = 0
D) No evidence of blockage or accumulated leaves/sediment?	3	0 1 2 3	Score = 0
4. Debris Cleanup (Annually)			
A) Free from litter, leaves, and dead vegetation?		0 1 2 3	Score = 0
5. Mulch Depth (if applicable)			
A) Mulch at original design depth? If applicable		0 1 2 3	Score = 0
6. Vegetation Coverage (Annually)			
A) Plants are stable, roots not exposed?		0 1 2 3	Score = 0
B) Robust coverage?		0 1 2 3	Score = 0
C) Invasive plants present (> 5%) (attach picture)?		0 1 2 3	Score = 0
D) Dead or decaying plants removed from the system?		0 1 2 3	Score = 0
E) Prune perennial vegetation?		0 1 2 3	Score = 0
F) Prune dead, diseased, or crossing tree branches		0 1 2 3	Score = 0
7. Drought Conditions (As needed)			
A) Water plants as needed	N/A	0 1 2 3	Score = 0
B) Dead or dying desirable, if applicable	N/A	0 1 2 3	Score = 0
TOTAL Score 0			
Notes			
Corrective Action Criteria:			
0-21. Pass, continue routine maintenance			
21-46. Needs attention/maintenance			
47-69. Needs urgent attention/replacement			
Corrective Action Needed		Due Date	
1.			
2.			
3.			

decomposer needs to be allowed if the rain event - till to note for after

No overflows - will causing some erosion

water out

could usage made if needed based on the rains

4. 0-10

2. 10-21

4. 45-69

change to 1.

would not check infiltration every year. Could replace A. - possible hole per hour - double ring infiltrometer

