Little Pony Creek
Watershed Improvement Review Board Project

Project Background

Little Pony Creek watershed is a 2,875 acre watershed located on the southeastern edge of Council Bluffs, Iowa and is within the two mile jurisdictional area targeted for urban/suburban and industrial/commercial growth. (See Appendix One:Maps.) At the time of the grant application the land use was 46% agricultural with the remaining area in various stages of urban / suburban development, including a 230 acre subdivision, expansion of the Council Bluffs Airport and construction of a new expressway. The last 15 years have resulted in a 15% increase of total acres developed on land that was formerly used for agricultural production. Projected development in the watershed could eliminate agricultural land use entirely.

Little Pony Creek Watershed lies within the Loess Hills Region of western Iowa. The Loess Hills are Iowa's most fragile landform region in terms of susceptibility to erosion. It is likely that as further urban development occurs, soil erosion will increase at levels higher than that seen in other urbanizing parts of Iowa outside of the Loess Hills region.

Little Pony Creek drains into Mosquito Creek which the Iowa Department of Natural Resources uses to replenish the water levels at Lake Manawa when the water quality is acceptable. Lake Manawa State Park is a major recreational facility for the Council Bluffs / Omaha Metro and surrounding communities. The 772 acre lake encompasses most of the1, 529 acre park, with private lands along several of the shore lines. Swimming, waterskiing, fishing, boating and camping are just a few of the activities available at Lake Manawa. Both Mosquito Creek and Lake Manawa are on the Iowa 2004 EPA Section 303d List of Impaired Waters for the State of Iowa. Mosquito Creek has an aquatic life impairment and Lake Manawa a primary contact impairment caused by turbidity and algae. Addressing stormwater issues and improving water quality within the Little Pony Creek Watershed is one step in the process to remove both Mosquito Creek and Lake Manawa from the 303d list.

As development continues throughout the watershed it brings great opportunities and great challenges. The challenges include dealing with large amounts of soil erosion occurring on development sites as large amounts of topsoil are "stripped". Removing the topsoil has increased the amount of sediment that enters into Little Pony Creek; it also becomes very difficult to establish any type of protective cover. The hydrology of the watershed will dramatically change from an area that infiltrates rainfall to an area that sheds rainfall. If not addressed with "Urban Best Management Practices" (BMP's) the city and county will continue facing the two fold problem of water quality and water quantity. Those problems arise from an increase in the quantity of storm water runoff and an increase in the quantity of sediment and urban pollutants in that runoff, resulting in decreased water quality, increased potential for flooding, and increased maintenance costs for cleanup of storm sewer systems whose capacity is reduced by sediment accumulation.

Through this grant we had the opportunity to show how "best management practices" (BMP's) reduce storm water runoff and improve water quality. By bringing awareness to

stormwater concerns throughout the watershed the project's success can be measured in many ways. The demonstration of the environmental and financial benefits of the BMP's and the Information and Education provided has brought about a change in mindset of developers, engineers and others in the business of urban development and a conscious effort on their part to implement change. The increase of BMP's engineered into development plans has created opportunities for economic growth. Businesses in Conservation Landscaping and BMP Installation have increased, creating jobs in the area and further promoting the conservation BMP's. The project has helped to form new partnerships with other conservation agencies, the Pottawattamie County Board of Supervisors and the City of Council Bluffs and their departments of Engineering, Public Works and Planning and Zoning. These municipalities are looking at developing ordinances and policy changes to address stormwater runoff using Low Impact Development. All of these successes are in addition to the environmental benefits made by the installation of the BMP's. (See Appendix Five: Financials)

The partners

A diverse group of partners was brought together to ensure the success of the project and continue to work in the arena of storm water issues. These included:

West Pottawattamie County Soil & Water Conservation District
City of Council Bluffs (Engineer)
Pottawattamie County Board of Supervisors and County Engineer
Iowa School for the Deaf
Lewis Central Community Schools
US Fish and Wildlife Service
Iowa State Extension Service
Duggan Home Inc.
Natural Resources Conservation Service
Iowa Division of Agricultural and Land Stewardship
Hungry Canyons Alliance
Loess Hills Economic Development Committee
Golden Hills Resource Conservation & Development

Reduce storm water runoff and sedimentation to improve the quality of water leaving Little Pony Creek Watershed.

A large part of the grant funds were used as financial incentives for the installation of BMP's throughout the watershed. During the three-year grant period a total of 10 rain gardens, 12 bioswales, 1 sediment and water control basin, 1 pervious concrete demonstration area and 6.5 acres of compost seeding were installed throughout the watershed. In addition to the WIRB projects the momentum spurred other urban projects including a county wide rain garden initiative that resulted in the installation of 44 additional rain gardens, porous paving sites and additional compost seeding.

Project Accountability

	Unit	Total per WIRB Grant agreement	Accomplished WIRB Funds	Percent completed	BMP's Installed Outside LPCWS (No WIRB $)
Stormwater Plan	No. Ac.	1 developed plan for the Lt Pony Creek Watershed 2,875	BMP Manual & Model Ordinance Guide 640,000	200%	
I&E					
Tours	No.	6	7	116%	
Information Booth	No.		5		
Presentations	No.		6		21
Workshops Seminars	No.	6	6	100%	
Practices					
Bio-swales	No	3	12	400%	
Sed & Water Basins	No.	10	1	10%	
Rain Gardens	No. Sq.Ft	7	10 2360	142%	44
Compost Seeding	Ac.	1.5 Ac.	6.5Acres	433%	3 - ¼ Acre Lots
Pervious Concrete	No. Sq.Ft	1 200	1 200	100%	1

Rain gardens

The 10 rain gardens installed in the Little Pony Creek Watershed total 2,360 square feet and will capture and infiltrate 17,700 gallons of water with every 1 inch rain. Throughout the county a total of 13,660 square feet of rain gardens have been installed to capture and infiltrate 2.4 million gallons in the same storm event.

The rain gardens installed in the watershed consists of both residential rain gardens and larger rain gardens installed at a school campus and a retirement community. The gardens are all unique in design and site specific.

The Risen Son site is unique as it has a 500 square foot rain garden that was designed to function as part of a "treatment train" or a combination of practices working together to handle large volumes of storm water run off. The design was created using input from a group of residents and maintenance staff and includes a pervious concrete patio, a rain garden, two bioswales and a picnic and exercise area. The site is frequented by staff and residents as a place to enjoy a walk, bird watch or just enjoy the outdoors. The site has also been included in several watershed tours and as part of an educators Low Impact Development tour sponsored by the University of Nebraska Douglas/Sarpy County Extension.

Risen Son Rain Garden taken July 2009. Photos were taken 24 hours apart following a 1.8 inch rain event.

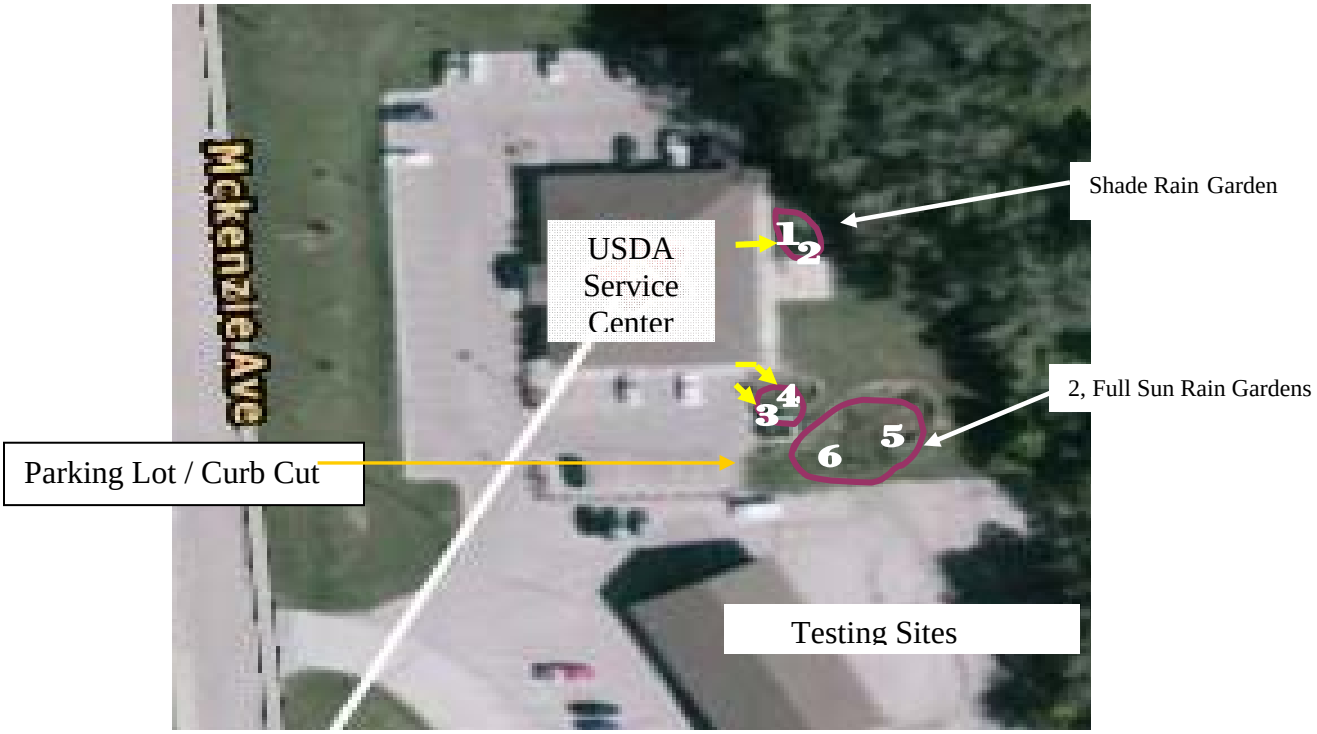
At Iowa School for the deaf students helped to choose the plants and then helped raise some of them in their greenhouse classroom. The garden was constructed by professional landscapers and staff, students and volunteers did the planting and do garden maintenance. The ISD rain garden is used as an outdoor classroom where students get hands-on experience as they learn about conservation, horticulture, and the environment. It includes a handicap accessible raised bed on the outer edge and a stepping stone path to allow all students to use the garden. The garden is also a registered Monarch Waystation where students tag and identify migrating monarchs each fall as part of Kansas State University's Monarch Watch Program and is a favorite stop on our watershed tours.

ISD Rain Garden/Outdoor Classroom

USDA Field Office Rain Gardens.

Three rain gardens were installed at the Council Bluffs USDA Service Center June 2006 totaling over 1300 square feet and capturing run off from the building and parking lot. The demonstration gardens have over 30 native species marked with plant ID signs and a large interpretive sign details the garden and thanks donors. In the spring of 2008 repair work to the sidewalk allowed 3 downspouts to be extended using underground tubing to convey runoff directly into the 2 smaller rain gardens.

The gardens are visited regularly by those interested in the practice and have been used as part of several tours and training sessions. The Service Center rain gardens are also a registered Monarch Waystation site.



Gardens were tested annually for compaction and penetrability using a penetrometer.

Service Center- Rain Garden Compaction Readings						
10/30/06 NP= No Penetration						
Depth	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
0-3"	30	10	40	30	40	10
3-12"	NP	10	NP	40	NP	10
12-24"	NP	30	NP	NP	NP	40
10/30/07						
Depth	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
0-3"	5	10	40	5	10	10
3-12"	5	10	60	5	70	10
12-24"	20	10	60	30	70	30
10/29/2008						
Depth	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
0-3"	5	10	50	5	10	5
3-12"	5	10	70	5	30	5
12-24"	15	10	70	30	70	20

Bioswales

Throughout the watershed there were 12 bioswales installed over the three-year period. The bioswales include a large bioswale designed on the ISD Campus to direct stormwater from the parking lot and Lied Center into the rehabilitated wetlands, 8 smaller bioswales along the parkway in the Hills of Cedar Creek housing development, a large bioswale at the Council Bluffs Airport directs stormwater from parking lots and buildings into a sediment and water control basin and two smaller bioswales were installed at Risen Son. The bioswales vary in design but all function as part of a "treatment train" or a combination of BMP's designed to work together. The Council Bluffs Airport bioswale was designed using erosion control products called scour stop along with coconut and straw matting to convey water from a 10 acre drainage area. Soil loss was 38 tons/acre/year before and reduced to 2 tons/acre/year after installation. (See Appendix Four: pictures)

Water & Sediment Control Basins (638's)

Although several priority sites were chosen for the installation of water and sediment control basins, "selling" the idea to urban landowners was not easy. Throughout the grant period a lot of time was spent educating landowners of the benefits and financial incentives of installing basins. However, due to the high cost of installation and long term maintenance agreements landowners were hesitant to commit in an urban growth area.

One basin was installed at the Council Bluffs Airport which is at the top of the watershed. The basin was designed to capture a large volume of water from a 14 acre drainage area of both agricultural and impervious land use. The soil loss was 10 tons/acre/year before and reduced to 5 tons/acre/year. (See Appendix Four: pictures)

Compost Seeding

From the grant agreement our goal was to compost seed 6 lots each a quarter of an acre. Actually installed was a total of 6.5 acres of compost seeding in the watershed which includes a side by side comparison of compost seeding and sod installation. The compost seeded lot was installed in the fall of 2008 next to the recently installed sod lot of the side by side town home. The compost seeded lot was quick to come up and had excellent coverage in a short time using minimal watering. No underground sprinklers were installed but above ground hoses and sprinklers were used several times a week to give the lawn a good soaking. The compost amended soil quickly absorbed and held the moisture, providing nutrients for strong root growth and lush green turf. Once established, watering of the compost lot was limited to once a week and only if less than one inch of natural rainfall occurred. It quickly grew into a lush green lawn. (See Appendix Four: pictures)

The sod was green when installed and stayed green with the use of a sprinkler system on a regular basis. Sprinklers were set to run 30 minutes every third day regardless of natural rain fall amounts. It was common to see water running out from under the sod and over the curb during the frequent watering and when checked the sod was easily pulled back due to very little root growth.

In the early spring of 2009 the lots were checked regularly and the compost lot was the first in the neighborhood to green up, later as the sod began to break dormancy the compost lot was already covered with a lush green carpet of grass.

The financial savings were impossible to quantify because the sod lot sprinklers are connected to a large grid of underground sprinklers. The sprinkler system includes several townhomes and green spaces maintained as part of the homeowners association benefits. The compost lot townhome was used as a model home and recently sold to a homeowner that appreciated the “green yard” of their new home that also includes 2 rain gardens installed by the developer.

The biggest benefit to this comparison project was the developer’s decision to change his policies. He has changed the covenants for the next phase of the development to allow compost seeding for lawns instead of the previous sod requirement and plans to use compost seeding on all of the developments common use green spaces.

Outside of the watershed 3, half-acre lots were compost seeded as part of the Habitat for Humanity Project.

Monitor storm water quantity and quality.

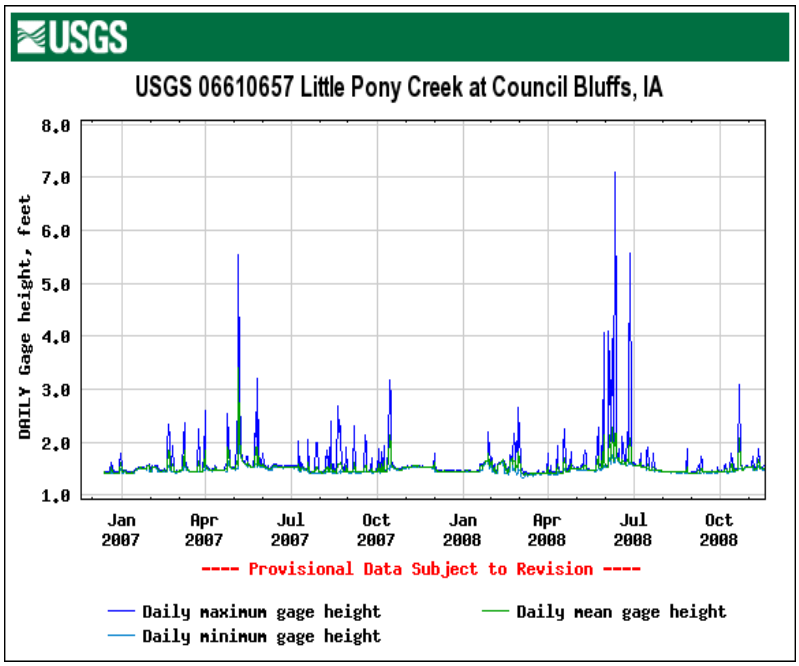
NRCS and IDALS watershed projects generally use the sediment calculator as a tool to show quantitative values of the conservation practices. Due to the urban aspect of this project area, volume of water or gallons captured is the best way to show quantity. To fully understand the benefits and effectiveness of the best management practices consider the following. In Western Iowa we receive an average of 32” of rain fall per year, which equals 868,750 gallons falling onto an acre of land per year. A 1,500 square foot house on a small lot can produce over 5,000 gallons of runoff from a one inch rain as water flows from the house roof, driveway, patios and even compacted lawns. For every cubic foot of rain garden, about 7.5 gallons of runoff can captured and infiltrated from each 1.25 inch storm event

IOWATER monitoring of the Little Pony Creek began in October 2006. Throughout the grant period monitoring was completed by the staff and students of Iowa School for the Deaf. Testing parameters included PH, nitrate, nitrite, chloride, potassium, dissolved oxygen and water temperature. Testing results are posted to the IOWATER web page. In year two of the project the district was awarded an IOWATER mini-grant for $1,000.00. The funds were used to purchase rubber boots, chest waders, microscopes and reference materials to identify and study macrinvertebrates collected at the testing site. Identifying aquatic life present and species that are absent from the creek as pollutant tolerant or intolerant is just one of the things being done to determine the health of the water body.

Staff from the Council Bluffs field office, ISD and USGS, hosted students from ISD and Lewis Central to take part in the World Water Monitoring Day (WWMD) events in 2007 and 2008. WWMD is a snap shop sampling event hosted in countries around the world. Students and volunteers test their local water bodies and submit the findings to the WWMD web site. In addition to submitting data from Little Pony Creek the group tested the waters at Lake Manawa and the Missouri River. The following story about the Council Bluffs event was

submitted and is posted at the WWMD website and the IOWATER Spring 2009 newsletter. (See Appendix Two: Story)

In addition to the IOWATER monitoring, a USGS Monitoring Station was installed to sample the creek and the wetlands. The USGS monitor samples and records data from the site every fifteen minutes and uploads it to the USGS Website in real time. Testing parameters include pond, deep and shallow gauge heights, water and air temperature and precipitation. http://www.usgs.gov/



Develop and approve a master storm water plan for Little Pony Creek.

The original goal started out with West Pottawattamie SWCD, City of Council Bluffs Engineering Office, and Council Bluffs Development office, Golden Hills RC&D, NRCS and IDALS working together to develop a storm water plan for Little Pony Creek Watershed in hopes it would become the template for all future land use changes in the City of Council Bluffs and within its two mile territorial jurisdiction.

At the initial meeting it was determined that a broader approach was needed to address stormwater issues throughout the Loess Hills corridor. The goal was expanded to create Model Low Impact Development Ordinances and a Best Management Practice Guide specific to the Loess soils. Funds for this part of the project came from the partnership of the Little Pony Creek Project - WIRB Grant and the West Pottawattamie SWCD, Pottawattamie County Board of Supervisors, Mills County SWCD, Golden Hills RC&D, The Loess Hills Alliance and Iowa Farm Bureau.

The creation of these two documents provides a tool that can be used by all counties and municipalities along the Loess Hills corridor to address stormwater runoff, water quality and improve the process of NPDS and MS4 Community Permits. The Model Stormwater Management Ordinances are based on the Post-Construction Model Ordinance prepared by the Center for Watershed Protection Inc., July 29, 2008. The ordinance provides code

language to be used to craft or update stormwater ordinances. The ordinance is written so that individual sections may be taken out and modified to suit individual program needs. The Loess Hills Stormwater BMP manual is designed to be used as a supplement to the Iowa Statewide Urban Design and Specifications (SUDAS) Design Model 2008. The documents BMP design and specifications distinctive to Loess soils provides valuable training and reference for engineers, developers, landscapers and builders working in the urban development of the Loess Hills. (See Appendix Six: *Loess Hills Stormwater Best Management Practices Guidance Manual* AND *Model Stormwater Management Ordinance*)

Information and education for the community:

The first of many urban conservation training sessions, presentations and seminars was held on September 19, 2006. A presentation was given to the Council Bluffs Building Trades Association. At the request of University of Nebraska Lincoln, Douglas and Sarpy County Extension offices a presentation was given to 15 attendees on February 2, 2007 at the Qwest Center Omaha Home & Garden Show. The "Garden Theater" hosted speakers throughout the weekend long home show.

On February 14, 2007 a half day rain garden training session was held at the ISU Extension Careers Building in Council Bluffs. The training session was hosted by the West Pottawattamie SWCD and Iowa State Extension Service. Although only15 people were invited 34 attended, mostly through word of mouth including visitors from Nebraska who had seen our presentation at the Omaha Home Show. All attendees were emailed a questionnaire and comment request following the event. The response was overwhelmingly positive and following its success everyone agreed more Low Impact Development training sessions should be held. From this a Low Impact Development committee was formed it included Cathie Graves and Rich Maaske from IDALS, Dale Duval, Tracy Bruun, Kevin Seevers and Danelle Schmielau from the West Pottawattamie Field office, Greg Mathis and Maria Seick from the East Pottawattamie office, Belinda Greene, David Carter, Marvin Freed and Joni Sell from the Mills County Office, Angela Biggs from the Shelby County office and Shirley Frederickson with Golden Hills RC&D. It was decided 2 additional half day seminars and one full day conference would be held featuring James Patchett and the team from Conservation Design Forum Inc. (CDF, Inc.). Information on CDF, Inc can be found at www.cdfinc.com. The cost of getting Mr. Patchett and the team from Chicago for the full day conference was $15,000. Through the efforts of the committee grant funds for the sessions were attained from the West and East Pottawattamie Soil and Water Conservation Districts, Mills and Shelby County Soil & Water Conservation Districts, Pottawattamie County Board of supervisors, Loess Hills Economic Development Committee, Iowa Department of Natural Resources, Mills County Farm Bureau with additional support from the Loess Hills Conservation Subdivision Project, Iowa Division of Soil Conservation and Natural Resources Conservation Service.

The second half day seminar was held on May 17th, 2007 and attended by 45 people plus the LID Committee members. Speakers included Holly Vandemark, Environmental Specialist, Senior – Iowa Department of Natural Resources, Brian Williams, CPESC, ASP Enterprises, Steven Anderson, Environmental Specialist, Spirit Lake Clean Water Alliance

Coordinator and Tony Toigo, Program Planner, Iowa Division of Soil Conservation, the seminar was followed by a bus tour of Little Pony Creek BMP's. The third half day seminar was held August 2, 2007 and featured speakers John Cambridge, PE, HGM and Associates, Brian Leaders, Landscape Architect/Land Planner, Schemmer and Associates and Wayne Peterson, Urban Conservationist, NRCS. The seminar was followed by a bus tour of the Loess hills Conservation Subdivision. The full day conference was held on October 24th, 2007 and featured James Patchett, RLA, ASLA, LEED AP and his team Tom Price, PE and Jason Navota, Landscape Architect/Land Planner. The seminars and conference were all held at Iowa Western Community College and Continuing Education Credits were offered through the college. IWCC donated the use of their auditorium and equipment at no cost for the seminars.

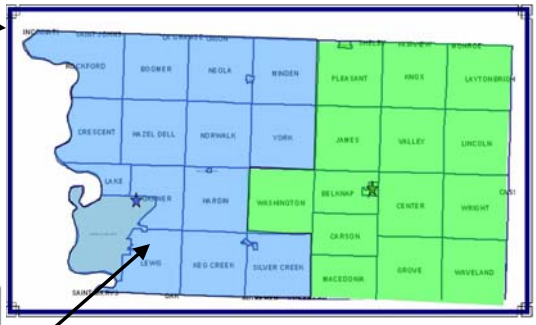
Throughout the grant period many power point presentations were developed and presentations were made to various groups including at the West Pottawattamie Master Gardeners Annual Conference for three consecutive years. This event is well attended each year with an average of 200 plus participants from all over southwest Iowa and eastern Nebraska. Presentations were also made at the USDA Field Office rain garden installation and demonstration, SWCD Contractors Meeting, Iowa Stormwater Conference, Iowa County Board of Supervisors Conference, CDI Spring Regional, Nebraska Extension Papio Urban Conference, ASP Clean and Green Expo and the Professional Developers of Iowa Conference. Presentations were also made for several local garden clubs, the Carter Lake Preservation Society, Iowa Western Community College Horticulture and Landscaping classes and Habitat for Humanity. These presentations were given by West Pottawattamie Field Office Staff; Danelle Schmielau – Project Coordinator, Rich Maaske – IDALS Urban Conservationist, Dale Duval – NRCS District Conservationist and Kevin Seevers – County Resource Planner and Brian Leaders LA – SWCD Commissioner.

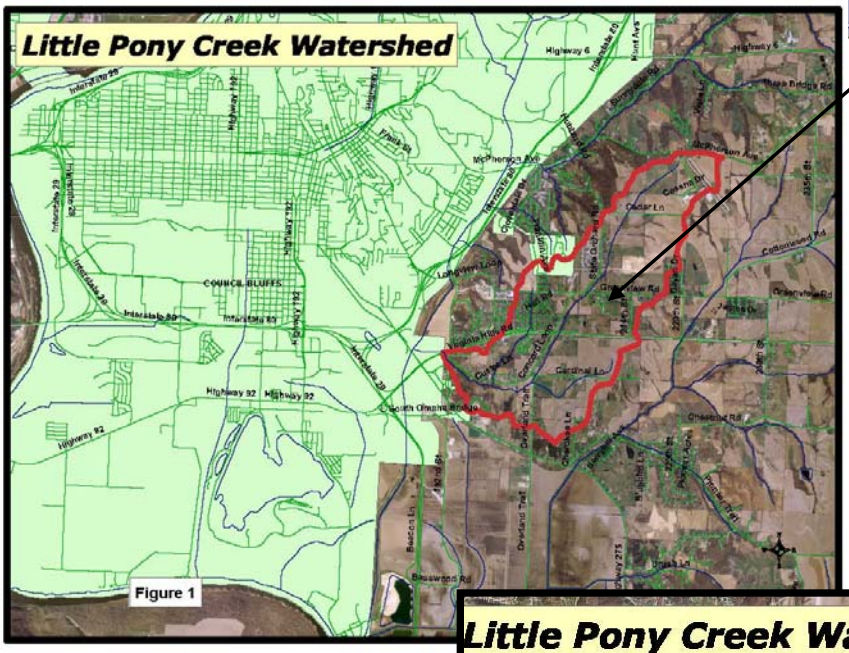
Field days, tours and training sessions were held through out the grant period. Events included demonstration installations and training sessions at the Field Office and Habitat for Humanity project site, a conservation bazaar, a visit and tour with Iowa Secretary of Ag Bill Northey, bus tours and a winter virtual tour of the watershed and BMP's. Brochures were created and printed detailing the watershed project and one on the basics of rain gardens "Rain Gardens - Gardening with a Purpose". Booths were rented at the Annual Council Bluffs Home Show in 2007, 2008 and 2009. Booths were also set up at the West Pottawattamie County Fair and Master Gardeners Conferences, the East Pottawattamie Conservation Bazaar, and the 2008 Post Construction Stormwater Management Workshop. (See Appendix three: Links).

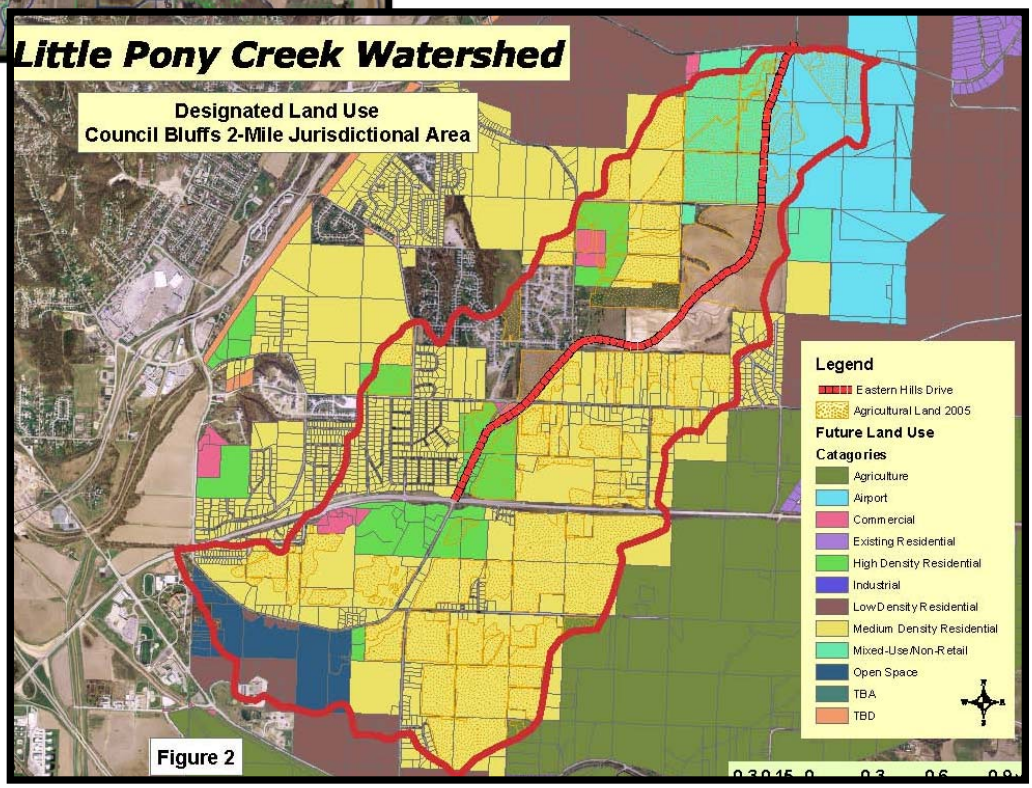
Rehabilitation of Iowa School for the Deaf Wetland

One of the priority areas in the watershed was the rehabilitation of the 1.5 acre Iowa School for the Deaf Wetland. The wetland now collects and filters runoff from the 53 acre campus, reducing the quantity of runoff into Little Pony Creek and improves water quality. NRCS District Conservationist Dale DuVal and Steve Van Riper, US Fish and Wildlife Service worked with Iowa School for the Deaf to ensure the wetland was rehabilitated to NRCS standards and specifications. This is a very visible site along US Highway 92. The project worked with students from Iowa School for the Deaf in rehabilitating the wetland. (See Appendix Four: pictures)

Appendix One: Maps







Appendix Two:

More to Lakes than Water and Fish:
Iowa School for the Deaf Coordinates Local Monitoring Project

Article by Danelle Schmielau and photo by Tracy Bruun

Staff and students at Iowa School for the Deaf (ISD) have been involved with their own local watershed improvement project for several years. In 2006 they began IOWATER monitoring on Little Pony Creek and the rehabilitated wetlands on their Council Bluffs, Iowa campus.

In 2007, they participated in their first World Water Monitoring Day (WWMD).

On September 25, 2008, the students from ISD, their instructor Kris Newton, and a visiting student from neighboring Lewis Central Middle School met at Lake Manawa State Park to enjoy a WWMD Field Day. The group met with staff from the U.S. Geological Survey (USGS), Iowa Department of Agriculture & Land Stewardship (IDALS), Pottawattamie County Resource Planner Kevin Seevers, and staff photographer Josh White from The Council Bluffs Nonpareil. The WWMD Field Day started at Longs Landing, the Missouri River access site in the park. The students were shown the boat, probes, and sampling equipment that the USGS uses to monitor the river. They learned that the USGS tests for the same parameters they test for and how the USGS uses these data. The WWMD Field Day group also monitored at Boy Scout Island, a public area on Lake Manawa. Lake Manawa is a large recreational lake that is on the Iowa Department of Natural Resources 303(d) list of impaired waters. There the students collected water samples for testing using IOWATER techniques. Tests were done for pH, dissolved oxygen, chloride, phosphate, nitrate, and nitrite. Water and air temperatures were also recorded. The kids' favorite part of the day was wearing hip and chest waders as they waded into the lake to collect macro-invertebrates for identification. They learned the importance of caring for their watershed and of using conservation practices to improve water quality. They also enjoyed seeing their story in the newspaper the next day.

As part of the ongoing ISD Council Bluffs, Iowa campus water monitoring project, USGS has partnered with ISD and the West Pottawattamie Soil & Water Conservation District to install a real time monitoring station on the school grounds. The monitoring station collects data from both the wetlands and creek every 15 minutes and uploads the data to the USGS website. Students can monitor the gage height, precipitation, and the air and water temperature from their computers anytime. These data can be found at http://waterdata.usgs.gov.

Appendix Three:

Links to news stories about projects in the county:

http://www.ia.nrcs.usda.gov/features/PCraingardens.html

http://www.ia.nrcs.usda.gov/features/CBraingardens.html

ftp://ftp-fc.sc.egov.usda.gov/IA/news/ISD.pdf

http://www.extension.iastate.edu/RAGBRAIRideAlong.htm.

http://www.ia.nrcs.usda.gov/intranet/currentdevelopments.html

Appendix Four:

ISD Bioswale & Wetland during construction and after rehabilitation.

Council Bluffs Airport Bioswale and 638 Structure after installation and during a rain storm a few days later.

Compost Seeding Comparison Project
Duggan Greater Homes
5351 / 5353 Lynch Circle
Hills of Cedar Creek

Appendix five: Financials

Total Funds Expended by Source

Funding Source	03/01 - 07/31/06	08/01 - 02/28/07	03/01 - 7/31/07	08/01 - 02/29/08	03/01 - 7/31/08	08/01 - 05/28/09	Totals	% of Total
WIRB	4,874.76	24,916.00	28,067.76	19,253.76	16,879.19	69,106.78	163,098.25	52.50%
WPSWCD	5,179.53	24.65	1,102.99	1,000.00	17.47	10.08	7,334.72	2.36%
City of Co. Bluffs	-	-	-	-	-	-	-	0.00%
Pott. County	-	7,381.25	3,768.82	-	2,355.65	7,964.43	21,470.15	6.91%
Landowner	-	11,450.42	3,768.83	-	2,355.66	15,075.44	31,742.85	10.22%
In-Kind	7,186.75	35,971.20	5,065.00	9,488.39	18,179.00	8,122.00	84,012.34	27.04%
LHA Ed. Comm.	-	-	-	-	-	-	-	0.00%
Other (1)	-	3,000.00	-	-	-	-	3,000.00	0.97%
Totals	17,241.04	82,743.52	41,773.40	29,742.15	39,786.97	100,278.73	310,658.31	100.00%

Total Funds Expended by Line Item Category

Line Item	03/01 - 07/31/06	08/01 - 02/28/07	03/01 - 7/31/07	08/01 - 02/29/08	03/01 - 7/31/08	08/01 - 05/28/09	Totals	% of Total
Monitoring Equipment: USGS	-	29,400.00	-	-	-	-	29,400.00	9.46%
Monitoring Equipment	-	-	11,333.34	7,166.67	3,000.00	7,500.00	29,000.01	9.34%
Supplies: WPSWCD	1,779.53	24.65	1,102.99	1,000.00	17.47	10.08	3,934.72	1.27%
Storm Water Plan	-	-	-	-	-	27,000.00	27,000.00	8.69%
Personnel (salary / benefits)	4,616.02	9,633.50	8,696.75	11,580.67	9,167.88	16,894.91	60,589.73	19.50%
Information / Education	258.74	520.00	500.00	506.42	-	1,783.00	3,568.16	1.15%
Bio-Swales: WIRB	-	-	5,445.00	-	-	7,401.07	12,846.07	4.14%
Porour Paving: WIRB	-	-	-	-	-	1,650.00	1,650.00	0.53%
WASCB (638): WIRB	-	-	-	-	-	4,332.00	4,332.00	1.39%
Rain Gardens: WIRB	-	1,750.00	2,092.67	-	3,061.31	2,545.80	9,449.78	3.04%
Compost: WIRB	-	13,012.50	-	-	1,650.00	-	14,662.50	4.72%
Bio-Swales: Landowner	-	3,000.00	2,722.50	-	-	4,749.74	9,564.74	3.08%
Bio-Swales: Pott Cnty	-	-	2,722.50	-	-	3,700.53	6,423.03	2.07%
Bio-Swales: USFW & NRCS	-	3,000.00	-	-	-	-	3,000.00	0.97%
Porous Paving: Pott Cnty	-	-	-	-	-	825.00	825.00	0.27%
Porous Paving: Landowner	-	-	-	-	-	1,705.00	1,705.00	0.55%
WASCB (638): Pott Cnty	-	-	-	-	-	2,166.00	2,166.00	0.70%
WASCB (638): Landowner	-	-	-	-	-	6,803.34	6,803.34	2.19%
Compost:Pott Cnty	-	6,506.25	-	-	825.00	-	7,331.25	2.36%
Compost: Landowner	-	6,506.25	-	-	825.00	-	7,331.25	2.36%
Rain Gardens: Pott Cnty	-	875.00	1,046.32	-	1,530.65	1,272.90	4,724.87	1.52%
Rain Gardens: Landowner	-	1,944.17	1,046.33	-	1,530.66	1,817.36	6,338.52	2.04%
Rain Gardens: WPSWCD	3,400.00	-	-	-	-	-	3,400.00	1.09%
Grade Stabilization Structure	-	-	-	-	-	-	-	0.00%
Partners	7,186.75	6,571.20	5,065.00	9,488.39	18,179.00	8,122.00	54,612.34	17.58%
Totals	17,241.04	82,743.52	41,773.40	29,742.15	39,786.97	100,278.73	310,658.31	100.00%

Appendix Six:
Loess Hills Stormwater Best Management Practices Guidance Manual
Model Stormwater Management Ordinance

Loess Hills Stormwater Best Management Practices Guidance Manual

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Cover Photo credit: Golden Hills RC&D

Purpose of the Loess Hills Stormwater BMP Guidance Manual

This document is designed to be used as supplemental guidance for the design and use of low impact development best management practices in the Loess Hills area of Iowa. It is not a replacement of the Iowa Statewide Urban Design And Specifications (SUDAS) Iowa Statewide Urban Design Standards Manual. This document presents specific design recommendations and investigations of loess soil characteristics for the use of low impact development best management practices.

Loess soils are not necessarily unique, as they cover tens of thousands of square miles across the Midwest. The loess soils are composed of wind deposited silts with high quartz content from Pleistocene era river valleys. In western Iowa, there existed just the right combination of climate, abundant outwash material, and valley width for unusually thick deposits to accumulate (source: Geology of the Loess Hills, Proceedings of the Iowa Academy of Science, 1986, Bettis, etal). The exceptional thickness, uniform grain size, permeability, easy erodibility, and propensity to stand in near-vertical faces explains much about the striking topography and the interest it holds for geologists, engineers, and past as well as present inhabitants (source: ibid). Striking topography as long created a desire for people to live among the loess hills, as documented prehistoric dwelling sites are common.

Loess soil does have unique characteristics requiring special attention be given during planning, design and construction of developments to avoid undesirable outcomes. These characteristics must be identified and addressed by thorough geotechnical investigation, soils analysis and foundation design. Failure to adequately investigate and obtain proper design recommendations could result in loess soil failures resulting from low strength, settlement, and/or excessive erosion. See the photographs on the following page.

The loess hills also provide unique habitat for vegetation, it is the western most range of the eastern deciduous species, and the eastern most range of the western plains species, making this an area of significant biological crossroads. This area harbors over 20,000 acres of remnant prairie representing about 75% of Iowa's remaining prairie heritage, of which 99.9% is already lost (source: Golden Hills RC&D Website).

Communities will continue to feel the pressure to grow and developers and their planners, engineers, and contractors need tools to properly plan, design, and build subdivisions to meet the demand for more housing. Low Impact Development (LID) is an ideal approach for the inevitable urbanization that is occurring (and will continue to occur) in the loess hills.

As the land use changes from undeveloped or agricultural to developed, impervious surfaces create increased amounts of stormwater runoff during rainfall events, disrupting the natural hydrologic cycle. Without stormwater management, these conditions erode stream channels and prevent groundwater recharge. Parking lots, roadways, rooftops, and other impervious surfaces increase the pollution levels and temperature of stormwater that is transported to streams, rivers, and groundwater resources.

Photo 1. Storm Drain Conduits Need Restrained Joints

Photo 2. Outlets require erosion protection

Photo 3. Uncontrolled Overland Flow

Photo 4. Uncontrolled Overland Flow

LID concepts include; identification of areas that should not be disturbed such as wetlands, steep slopes, and prairie areas; clustering development to reduce the footprint and infrastructure needs; minimizing impervious area; and building stormwater best management practices to compensate for the remaining impervious area.

Implementing the requirements in this manual will help protect the Loess Hills water resources, which in turn will provide great benefit to human health, fish and wildlife habitat, recreational resources, and drinking water.

Stormwater management is also critical in terms of protecting the Loess Hills sanitary and stormwater infrastructure. Increased runoff contributes to combined sewer overflows (CSOs) and basement sewer backups. Implementing onsite infiltration and flow control measures will conserve the existing and future conveyance capacity of storm sewers and combined sewers. Increased flow concentration will result in higher erosive forces on previously stable drainage structures.

Strategies for meeting the requirements in this manual depend on a number of site factors, including infiltration capacity, available infrastructure, proposed development plans, and the drainage basin the proposed development is in. The applicant's ability to effectively use the design standards in this manual depends on a demonstrated understanding of the development site's ecology and of the potential upstream, downstream, groundwater impacts resulting from stormwater management improvements. The guidance provided in this manual are intended to supplement the criteria provided in the ISWMM for the planning, design, construction, operation and maintenance of stormwater best management practices on loess soils in western Iowa, to make site-specific improvements to properties across the Loess Hills and to comprehensively manage stormwater by watershed.

Stormwater management is critical to maintaining and enhancing the community's livability and improving watershed health. The *Loess Hills Stormwater BMP Guidance Manual* allows the communities to protect both watershed resources and infrastructure investments with every land improvement. As each development and redevelopment project meets the requirements of this manual, it will contribute to achieving these important area-wide goals

A discussion of loess soils and stormwater infiltration practices

Most of the stormwater infiltration BMP's work in very similar manner. Each requires that the soil accept water by percolation. However, water must first pass into the soil by infiltration. It is noted that runoff water is not clean, containing silty soil particles and organic materials. The application of runoff water to a surface causes the non-water materials to be left on the soil interface and these soil and organic materials will quickly form a natural barrier to infiltration. This natural liner affect allows area lakes to hold water as the groundwater level or an area river level drops below the base of the impoundment and has been studied on area lakes, in particular Carter Lake in Iowa. Maintenance of each of these BMP's will need to include cleaning of the natural liner materials from the soil surface to optimize infiltration and absorption. Without ground surface maintenance an infiltration bed becomes an evaporation pond.

Absorption of water into soil changes with time and season. Percolation tests allow a physical measure of the ability of soil to absorb water at a certain time and at the insitu water content at the time of the test. Weather trends at the time of the test will affect the percolation rate even though an attempt to saturate a small area around the test holes is attempted by standard percolation test methods. These BMP's will be taxed during wet weather cycles as the soil achieves a higher degree of saturation in the area of the infiltration BMP and the area soils also achieve a higher degree of saturation through natural absorption. These BMP's will be expected to allow absorption of the greatest amounts of water during wet weather periods, at times when the soil water content and degree of saturation are greatest.

Immediately after periods of drought, there may be a short time period when the soil will not accept water absorption due to a "vapor lock" affect. This is similar to the affect sometimes found on a hot engine with a carburetor fuel delivery system. A vapor lock impedes water infiltration until the excess air is expelled and capillary water conduits are reestablished.

Surface Infiltration Beds, Subsurface Infiltration Beds, Infiltration Trenches, Pervious Pavement, etc. require the area soils accept water from the surface of a shallow impoundment. Overflow runoff will occur for some events.

Percolation tests should be performed along with undisturbed soil sampling to allow determination of things like location of groundwater level, loessial collapse potential and degree of saturation prior to the percolation test. Percolation tests holes should be completed in sets of three holes, since some edge affects might be evaluated with the center test hole. A normal percolation test is conducted at a depth of about 3 feet, within the oxygenated surface soils, to determine absorption of water at the depth of leach field delivery of septic water. Other test depths may be applicable to infiltration beds. Loessial soils generally vary in a predictable manner. A suitable test frequency would appear to be one test set per every 40,000 square feet (per every 200 by 200-foot area). If disturbed soils are present due to fill placement, the percolation rate will be greatly reduced. Percolation tests must be performed in the layers below the base of the proposed BMP. It is noted that construction methods may affect the soil and backhoe excavation is preferred instead of front-end loader excavation.

Undisturbed soil samples can be obtained at the time of percolation test-hole advancement. Additional holes of greater depth can be advanced in areas of slopes or streams to analyze

geotechnical soil parameters such as slope stability, loessial collapse potential, weak soil conditions that may affect constructability and long-term viability of the infiltration system. A visual review of the site is recommended prior to percolation testing to determine what potential soil issues may exist. The geotechnical analyses may show that a slope will not be stable when additional water is added to the soils.

The percolation test and undisturbed soil testing will be used to assess the soil's ability to accept water and the potential rate of water acceptance. Locations of old fill soils and low permeability interbedded seams in the soil may also be found.

An overflow will be necessary for all infiltration beds, since it is usually uneconomical to design for "the big" rainfall events. Vegetative erosion protection with native grasses maintained by annual mowing is preferred. Blade grasses that mat down flat as water rushes over the surface should be used, such as brome or other similar range grasses. The mowed grass debris is one of the most effective erosion control agents. Therefore, harvesting of the grass from any drainage swale should be studied prior to harvesting being allowed. Alfalfa and other stem grasses may be used as a quick cover but not as a final vegetative surface. Crown vetch is not a suitable protective vegetation material.

Concrete lined swales should be avoided in loess unless the combination of slope and flow rate is too great to allow grass to remain. Loess is quickly eroded below surfaces at discontinuities in the soil such as a fill interface and at the interface with concrete or other materials. Root penetration on vegetated surfaces appears to reduce subsurface erosion in some cases. Reinforced turf mats are recommended and porous plastic mats are recommended in areas of higher surface erosion forces. If an open stream or creek bed exists, these BMP's are not suitable.

If it is necessary for the water to be conveyed by a concrete lined system, the use of enclosed pipes with seepage collars and sealed joints is recommended. Water will always tend to flow along the edges of a concrete swale, eventually causing erosion from the base of the concrete in moist soil types. The erosion of soil below concrete swales in loess is noticed earlier because loess soil structure is easier for water to erode. Closed pipes with seepage collars provide a closed system to contain the water flow without erosion around the edges of the conveyance system.

Numerous pipe failures have been linked to leaking joints in loess and in other geologic settings. Retained pipe joints should be recommended in any location where water hammer or pressure forces could displace the pipe; and especially on steep slopes where piping around the pipe can occur.

It is noted that with any erosion behavior in soils, the eroded soil must go somewhere. Erosion around pipes and below concrete lined flumes is a progressive and hidden affect. The soil is first dislodged at the water outlet. The erosion then extends back in the system to all progressive locations where soil can be dislodged at a resulting soil surface until large holes develop.

These notes area made, based on observations and testing of loessial soils for engineering and agricultural purposes.

Definitions

Applicant: Any person, company, or agency that applies for a permit through the *insert local government name here.* Includes all parties represented by the applicant.
Approved Receiving System (Discharge Point): Any system approved by a Jurisdictional Authority to receive stormwater runoff or other discharges. Receiving systems include, but are not limited to, groundwater; onsite, offsite, or public stormwater, sanitary, or combined sewers; and waters of the state.
Bioretention Facility: A facility that uses soils and both woody and herbaceous plants to remove pollutants from stormwater runoff. Examples of bioretention facilities in this manual include vegetated swales, flow-through and infiltration planters, vegetated filters, and vegetated infiltration basins.
Capacity: The flow volume or rate that a facility (e.g., pipe, pond, vault, swale, ditch, drywell, etc.) is designed to safely contain, receive, convey, reduce pollutants from, or infiltrate to meet a specific performance standard. Performance standards for pollution reduction, flow control, conveyance, and infiltration/discharge vary by facility, depending on location.
Catch Basin: A structural facility located just below the ground surface, used to collect stormwater runoff for conveyance purposes. Generally located in streets and parking lots, catch basins have grated lids, allowing stormwater from the surface to pass through for collection. Catch basins also include a sumped bottom and submerged outlet pipe (downturned 90 degree elbow, hood, or baffle board) to trap coarse sediment and oils.
Collapse Susceptible Loess: Only low water content loess is susceptible to collapse. Only low unit weight loess is susceptible to collapse. The loess needs to have both a low water content and low unit weight due to clay bridge structure in order for it to collapse. In the Midwestern United States, engineering practice in western Iowa since the 1950's has found that loess with a water content of less than 10% and a dry unit weight of less than 80 pound has a high potential for loessial collapse. Loess with a water content of greater than 16% and a low in-place unit weight is already soft and compressible, but is not subject to significant collapse potential when new weight is added above it. Loess with a dry unit weight greater than 80 pcf does not generally have sufficient amount of bridge structure to allow collapse to occur.
Combined (or Combination) Sewers: Pipes that convey both sanitary sewage and stormwater.
Connection: Connecting a private sanitary sewage or drainage facility to the public sanitary sewer or drainage system.
***Containerized*:** The storage of any product, byproduct, or waste that is completely held or included on all sides, within a discrete volume or area.
***Containment*:** The temporary storage of potentially contaminated stormwater or process wastewater when a *Insert local government name here* sanitary sewer is not available for appropriate discharge.
Control Structure: A device used to hold back or direct a calculated amount of stormwater to or from a stormwater management facility. Typical control structures include vaults or manholes fitted with baffles, weirs, or orifices.
Conveyance: The transport of stormwater or wastewater from one point to another.
CSO (Combined Sewer Overflow): A discharge of a mixture of sanitary sewage and stormwater at a point in the combination sewer system designed to relieve surcharging flows.
Design Storm: Design criteria used for sizing stormwater management facilities and their conveyance. Design storms are a combination of the design storm return period (which refers to

the frequency) and the storm duration (which defines the rainfall depth or intensity). A prescribed hyetograph and total precipitation amount (for a specific duration recurrence frequency) are used to estimate runoff for a hypothetical storm for the purposes of analyzing existing drainage, designing new drainage facilities, or assessing other impacts of a proposed project on the flow of surface water. The minimum design storms are selected by the permit authority to reflect required levels of protection, the local climate, and catchment conditions.

Design Water Surface Elevation: The elevation at the upper limit of the maximum depth and the lower limit of the freeboard, which corresponds to the overflow elevation. It can be considered the initial outlet elevation or over-topping elevation of the facility where an outlet is not included. The design water surface elevation is the upper limit of the capacity of the stormwater facility. Each cell of the facility may have a different design water surface elevation. The design water surface elevation can be relative to the final discharge point, a known actual elevation onsite, or can be set to zero.

Detention Facility: A facility designed to receive and hold stormwater and release it at a slower rate, usually over a number of hours. The entire volume of stormwater that enters the facility is eventually released.

Detention Tank, Vault, or Oversized Pipe: A structural subsurface facility used to provide flow control for a particular drainage basin.

Development: Any human-induced change to improved or unimproved real estate, whether public or private, for which a permit is required, including but not limited to construction, installation, or expansion of a building or other structure; land division; street construction; drilling; and site alteration such as dredging, grading, paving, parking or storage facilities, excavation, filling, or clearing. Development encompasses both new development and redevelopment.

Development Footprint: The new or redeveloped area covered by buildings or other roof structures and other impervious surface areas, such as roads, parking lots, and sidewalks.

Discharge Point: The ultimate destination for the stormwater leaving a particular site, also known as the stormwater disposal point. Discharge can be through: 1. onsite infiltration (surface infiltration facilities, drywells, sumps, and soakage trenches) or 2. offsite flow to ditches, drainageways, streams, public or private separate stormwater piped systems, or combination sewers.

Discharge Rate: The rate of flow expressed in cubic feet per second (cfs).

Disposal: See definition of *Discharge Point*.

Drainage Basin: A specific area that contributes stormwater runoff to a particular point of interest, such as a stormwater management facility, drainageway, wetland, river, or pipe.

Drainageway: An open linear depression, whether constructed or natural, that functions for the collection and drainage of surface water. It may be permanently or temporarily inundated.

***Driveway*:** The area that provides vehicular access to a site. A driveway begins at the property line and extends into the site. In parking areas, the driveway does not include vehicular parking, maneuvering, or circulation areas.

Drywell: A structural subsurface cylinder or vault with perforated sides and/or bottom, used to infiltrate stormwater into the ground.

Ecoroof: A lightweight low-maintenance vegetated roof system consisting of waterproofing material, growing medium, and vegetation; used in place of or over the top of a conventional roof. Ecoroofs provide stormwater management by capturing, filtering, and evaporating rainfall. Ecoroofs are also called extensive green roofs.

Extended Wet Detention Pond: A surface vegetated basin with a permanent pool of water and additional storage volume, used to provide pollution reduction and flow control for a particular

drainage basin. The permanent pool of water provides a storage volume for pollutants to settle out. During large storm events, stormwater temporarily fills the additional storage volume and is slowly released over a number of hours, reducing peak flow rates.

Filter Fabric: A woven or non-woven water-permeable material, generally made of synthetic products such as polypropylene, used in stormwater management and erosion and sediment control applications to trap sediment or to prevent fine soil particles from clogging the aggregates.

Flow Control: The practice of limiting the release of peak flow rates and volumes from a site. Flow control is intended to protect downstream properties, infrastructure, and natural resources from the increased stormwater runoff peak flow rates and volumes resulting from development.

Flow Control Facility: Any structure or drainage device that is designed, constructed, and maintained to collect, retain, infiltrate, or detain surface water runoff during and after a storm event for the purpose of controlling post-development quantity leaving the site.

Flow-through Planter: A structural facility filled with topsoil and gravel and planted with vegetation. The planter is completely lined and sealed, with a perforated collection pipe placed under the soil and gravel. The planter has an overflow that must be directed to an acceptable discharge point. The stormwater planter receives runoff from impervious surfaces, which is filtered and retained for a period of time.

Freeboard: The vertical distance between the design water surface elevation (overflow elevation) and the elevation at which overtopping of the structure or facility that contains the water would occur.

Geotechnical Report: A report of subsoil conditions authored by a registered engineer with experience in the field of geotechnical engineering to determine soil conditions and soil properties applicable to a proposed site use and providing engineering recommendations to accomplish the proposed site use. Site soil data is usually determined by samples borings or other subsurface exploration means with laboratory testing of soil properties. Recommendations are based on the soil test results with regard to engineering experience to arrive at a set of recommendations that are tailored for a specific set of project requirements.

***Greenstreets*:** Public stormwater facilities that accept runoff from the right-of-way. See definition of *Street Swale*.

Groundwater: Subsurface water that occurs in soils and geological formations that are fully saturated. Groundwater fluctuates seasonally and includes perched groundwater. Groundwater related discharges include, but are not limited to, subsurface water from site remediation and investigations, well development, Brownfield redevelopment, discharges from footing and foundation drains, rainwater infiltration into excavations, and subsurface water associated with construction or property management dewatering activities.

Groundwater Level: The level at which the surface of the water in the soil is at equilibrium with the current air pressure. Note: Groundwater levels vary significantly with barometric pressure even when no change in water condition occurs. Saturated soils generally extend above the groundwater level due to capillary rise in fine-grained soils.

Growing Medium: Non-native soil mixture made up of sand, loam, and compost; used on the surface of stormwater facilities.

***Hazardous Material*:** Any material or combination of materials that, because of the quantity, concentration, or physical, chemical, or infectious characteristics, may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or that may pose a present or potential hazard to human health, safety, or welfare, or to animal or aquatic life or the environment when improperly used, stored, transported

or disposed of, or otherwise managed. For purposes of chemical regulation by this manual, moderate to high toxicity and confirmed human carcinogenicity are the criteria used to identify hazardous substances. (Note: This manual does not use the Resource Conservation and Recovery Act [RCRA] definition of hazardous. For the purpose of this manual, hazardous material is intended to include hazardous, toxic, and other harmful substances.)

Impervious Surface/Area: Any surface that has a runoff coefficient greater than 0.8 (as defined in SUDAS). Types of impervious surface include rooftops, traditional asphalt and concrete parking lots, driveways, roads, sidewalks, and pedestrian plazas. *Note:* Slatted decks are considered pervious. Gravel surfaces are considered pervious unless they cover impervious surfaces or are compacted to a degree that causes their runoff coefficient to exceed 0.8.

Infiltration: The percolation of water into the ground. Infiltration is often expressed as a rate (inches per hour), which is determined through an infiltration test.

Infiltration Planter: A structural facility filled with topsoil and gravel and planted with vegetation. The planter has on open bottom, allowing water to infiltrate into the ground. Stormwater runoff from impervious surfaces is directed into the planter, where it is filtered and infiltrated into the surrounding soil.

Infiltration Test: Infiltration tests are conducted to determine the feasibility of onsite stormwater percolation for every new development. Three methods are described in the manual: the falling head test, the double-ring infiltrometer test, and the pit test.

Infiltration Trench: A linear excavation backfilled with drain rock, used to filter pollutants and infiltrate stormwater.

Inlet: 1) A structure located just below the ground surface, used to collect stormwater runoff. Generally located in streets and parking lots, inlets have grated lids, allowing stormwater from the surface to pass through for collection. 2) The initial entry into an overflow from a stormwater facility. 3) The point at which stormwater from impervious surfaces or conveyance piping enters a stormwater management facility.

Landscaping: See definition of *Stormwater Facility Landscaping*.

Loessial Soils: Loessial soils: A geologic formation characterized by eolian soils. In the Midwestern United States, the main source of loess is glacial outwash streams. Therefore, all significant deposits of loess are associated with a nearby period of glacial activity.

Long-term Dewatering: When groundwater is drained or pumped from a subsurface or surface system. For site development, long-term is defined as dewatering that occurs during the longevity of the constructed subsurface system. Other permanent dewatering activities are defined as greater than three (3) years. Long-term dewatering includes, but is not limited to, groundwater remediation systems and development/construction sites.

Manufactured Stormwater Treatment Technology: A proprietary structural facility or device used to remove pollutants from stormwater.

Maximum Depth: The greatest vertical distance between the design water surface elevation (overflow elevation) and the top of the growing medium of a surface facility or the base of a subsurface facility, which creates a reservoir capable of providing safe storage capacity of stormwater. Also referred to as the storage depth.

Offsite Stormwater Facility: Any stormwater management facility located outside the property boundaries of a specific development but designed to provide stormwater management benefits for that development.

Onsite Stormwater Facility: Any stormwater management facility located within the property boundaries of a specific development and designed to provide stormwater management benefits for that development.

Open Channel: A fluid passageway that allows part of the fluid to be exposed to the atmosphere.
Operations and Maintenance (O&M): The continuing activities required to keep stormwater management facilities and their components functioning in accordance with design objectives.
Outfall: A location where collected and concentrated water is discharged. Outfalls can include discharge from stormwater management facilities, drainage pipe systems, and constructed open channels.
Overflow Elevation*:* See definition for ***Design Water Surface Elevation*****.**
Partial Infiltration: When the total infiltration design storm (or another specified design storm as required) is unable to be completely percolated into the ground, a portion of the storm must be percolated for fulfillment of partial infiltration.
Parking Area**:** The area of a site devoted to the temporary or permanent storage, maneuvering, or circulation of motor vehicles. Parking areas do not include driveways or areas devoted exclusively to non-passenger loading.
Perched Groundwater: Groundwater held above the regional or main (permanent) water table by a less permeable underlying earth or rock material.
Permeable Pavement: See definition of *Pervious Pavement*.
Pervious: Any surface determined to have a runoff coefficient less than 0.8; a surface modified in a way to encourage infiltration of water (as defined in SUDAS).
Pervious Pavement: The numerous types of alternative pavement systems that allow stormwater to percolate through them and into subsurface drainage systems or the ground (e.g., permeable pavers, pervious asphalt, and pervious concrete).
Pollutant: An elemental or physical material that can be mobilized or dissolved by water or air and creates a negative impact to human health and/or the environment. Pollutants include suspended solids (sediment), heavy metals (such as lead, copper, zinc, and cadmium), nutrients (such as nitrogen and phosphorus), bacteria and viruses, organics (such as oil, grease, hydrocarbons, pesticides, and fertilizers), floatable debris, and increased temperature.
Pollution Reduction Facility: A structure, landscape, or drainage device that is designed, constructed, and maintained to collect and filter, retain, or detain surface water runoff during and after a storm event for the purpose of maintaining or improving surface and/or groundwater quality.
Pollutants of Concern: Watershed-specific parameters identified by the Iowa Department of Environmental Quality (DEQ) as having a negative impact on the receiving water body. Pollutants of concern can include suspended solids, heavy metals, nutrients, bacteria and viruses, organics, volatiles, semi-volatiles, floatable debris, and increased temperature.
Porous Pavement: See definition of *Permeable Pavement*.
Post-Construction Subsurface Drainage**:** Foundation, footing, or perimeter piping and drainage systems installed to collect subsurface water and convey it to a point of use or disposal. Subsurface water is defined as groundwater. See definition of G*roundwater*.
Post-Construction Surface Drainage: Piped storm drainage systems and stormwater facilities used to convey stormwater runoff to a point of use or disposal when construction is complete.
Post-Developed Condition: As related to new or redevelopment: A site's ground cover and grading after development.
Practicable: Available and capable of being done, as determined by the BES Director, after taking into consideration cost, resources, existing technology, and logistics in light of overall project purpose.

Pre-Developed Condition: As related to new development: A site's ground cover and grading prior to development. As related to redevelopment: A site's ground cover and grading prior to any development taking place.
Public Facility: A street, right-of-way, sewer, drainage, stormwater management, or other facility that is either currently owned by the ***Insert local government name here*** or will be conveyed to the ***Insert local government name here*** for maintenance responsibility after construction. A new stormwater management facility that receives direct stormwater runoff from a public right-of-way becomes a public (***Insert local government name here***-maintained) facility unless the right-of-way is not part of the ***Insert local government name here***'s road maintenance system.
Public Works Project: Any development conducted or financed by a local, state, or federal governmental body, including local improvements and public improvements.
Raingarden: See definition of *Vegetated Infiltration Basin.*
Rainwater Harvesting: The practice of collecting and using stormwater for purposes such as irrigation and toilet flushing. For the purpose of this manual, harvesting is a stormwater facility only if the system is used for water quality or flow control, as determined by BES. When harvesting is proposed as a stormwater facility, the Performance Approach must be used to show how Chapter 1 requirements of the manual are met.
Rational Method: The method used to estimate the peak rate of runoff from a drainage basin, using the formula: Q=CiA. Q is the peak discharge, cubic feet per second; "C" is the runoff coefficient; "*i*" is the rainfall intensity, inches per hour; and "A" is the drainage area, acres (as defined in SUDAS).
Redevelopment: Any development that requires demolition or complete removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces. Maintenance activities such as top-layer grinding, repaving (where all pavement is not removed), and reroofing are not considered to be redevelopment. Interior remodeling projects and tenant improvements are also not considered to be redevelopment. Utility trenches in streets are not considered to be redevelopment unless more than 50 percent of the street width is removed and repaved.
Regrading: Applies to areas that are excavated to a depth at or below the top of the subgrade and replaced with new pavement. The subgrade is taken to be the crushed surfacing directly below the pavement layer (asphalt concrete pavement, Portland cement concrete pavement, or bituminous surface treatment). If the removal and replacement of existing pavement goes below the pavement layer, the new surfacing is considered to be regrading.
Repaving: Applies to areas that are not excavated to a depth at or below the top of the subgrade (pavement repair work included) and are replaced in kind. The subgrade is taken to be the crushed surfacing directly below the pavement layer (asphalt concrete pavement, Portland cement concrete pavement, or bituminous surface treatment). If the removal and replacement of existing pavement does not go below the pavement layer, as with typical portland cement concrete pavement grinding or asphaltic concrete pavement planing, the new surfacing is considered to be repaving.
Reservoir: The volume available for holding runoff prior to overflow. For vegetated surface facilities it is defined as the volume between the top of the growing medium, the design water surface elevation (overflow elevation), and the edges of the facility (whether sloped or vertical).
Retention Facility: A facility designed to receive and hold stormwater runoff. Rather than storing and releasing the entire runoff volume, retention facilities permanently retain a portion of the water onsite, where it infiltrates, evaporates, or is absorbed by surrounding vegetation. In this way, the full volume of stormwater that enters the facility is not released offsite.

Retrofit: Installation of a new stormwater facility to treat stormwater from existing impervious area, including, but not limited to, roofs, patios, walkways, and driving or parking surfaces.
***Roadway*:** Any paved surface used to carry vehicular traffic (cars/trucks, forklifts, farm machinery, or any other large machinery).
Roof Garden: A heavyweight roof system of waterproofing material with a thick soil and vegetation cover. Roof gardens can provide stormwater management by capturing, filtering, and evaporating rainfall.
Runoff Coefficient: A unitless number between zero and one that relates the average rate of rainfall over a homogenous area to the maximum rate of runoff, as defined in SUDAS, Iowa Statewide Urban Design Standards Manual.
Safety Factor: A safety factor is based on a risk/value assessment that evaluates the specific conditions anticipated in an application, the failure mode of the construction material, unexpected construction deficiencies, and potential cost of system failure. The safety factor is applied to the maximum performance limit to calculate a lower value, which is then used as a design value. A safety factor must be used to provide reasonable assurance of acceptable long-term system performance.
Sand Filter: A structural facility with a layer of sand, used to filter pollutants from stormwater.
Seasonally High Groundwater Level: The highest level that the permanent groundwater table or perched groundwater may reach on a seasonal basis.
Solid Waste Containers: Compactors, dumpsters, compost bins, grease bins, and garbage cans.
Stormwater: Water runoff that originates as precipitation on a particular site, basin, or watershed. Also referred to as runoff.
Stormwater Facility Landscaping: The vegetation (plantings), topsoil, rocks, and other surface elements associated with stormwater management facility design.
Stormwater Management: The overall culmination of techniques used to reduce pollutants from, detain, retain, or provide a discharge point for stormwater to best preserve or mimic the natural hydrologic cycle, to accomplish goals of reducing combined sewer overflows or basement sewer backups, or to fit within the capacity of existing infrastructure.
Stormwater Management Facility: A technique used to reduce pollutants from, detain and/or retain, or provide a discharge point for stormwater to best preserve or mimic the natural hydrologic cycle, to accomplish goals of reducing combined sewer overflows or basement sewer backups, and/or to fit within or improve the capacity of existing infrastructure.
Stormwater Reuse: See definition of *Rainwater Harvesting*.
Street Swale: A vegetated swale located next to a public or private street for the purpose of managing stormwater.
Sump: A reference to any volume of a facility below the point of outlet, in which water can accumulate.
Surcharge: A flow condition, i.e. pressure flow, resulting when the downstream hydraulic capacity is less than the upstream inflow causing water to accumulate and rise above the inside crown of a pipe or facility. It also refers to the greatest measured distance from the water surface above the pipe to the pipe crown.
Surface Conveyance: The transport of stormwater on the ground surface from one point to another.
Surface Infiltration Facility: A vegetated facility designed to receive and infiltrate stormwater runoff at the ground surface to meet stormwater infiltration/discharge requirements. Pollution reduction and flow control requirements can also be met with surface infiltration facilities.

Temporary Structure: A structure shall be deemed temporary if it is a separate and distinct entity from all other structures and it is created and removed in its entirety, including impervious area associated with the structure, within a continuous period of three years or less. Paved areas such as parking lots that are developed alongside structures are not considered temporary for the purpose of this manual.
Time of Concentration (T of C or TOC): The amount of time it takes stormwater runoff to travel from the most distant point (measured by travel time) on a particular site or drainage basin to a particular point of interest.
Total Infiltration: When the entire designated design storm is able to be completely percolated into the ground.
Total Suspended Solids (TSS): Matter suspended in stormwater, excluding litter, debris, and other gross solids exceeding 1 millimeter in diameter.
Vegetated Facilities: Stormwater management facilities that rely on plantings as an integral component of their functionality. Plantings can provide wildlife habitat and enhance many facility functions, including infiltration, pollutant removal, water cooling, flow calming, and erosion prevention.
Vegetated Filter: A gently sloping, densely vegetated area used to filter, slow, and infiltrate sheetflow stormwater.
Vegetated Infiltration Basin: A vegetated facility that temporarily holds and infiltrates stormwater into the ground.
Vegetated Swale: A long and narrow, trapezoidal or semicircular channel, planted with a variety of trees, shrubs, and grasses. Stormwater runoff from impervious surfaces is directed through the swale, where it is slowed and in some cases infiltrated, allowing pollutants to settle out. Check dams are used to create small ponded areas to facilitate infiltration.
Water Body: Water bodies include coastal waters, rivers, sloughs, continuous and intermittent streams and seeps, ponds, lakes, aquifers, and wetlands.
Water Course: A channel in which a flow of water occurs, either continuously or intermittently, with some degree of regularity. Water courses may be either natural or artificial.
Water Table: The upper surface of an unconfined water body, the surface of which is at atmospheric pressure and fluctuates seasonally. The water table is defined by the levels at which water stands in wells that penetrate the water body.
Wet Pond: A vegetated basin with a permanent pool of water, used to provide pollution reduction for a particular drainage basin. The permanent pool of water provides a storage volume for pollutants to settle out.
Wetland: An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, and similar areas, except those constructed as pollution reduction or flow control facilities. Specific wetland designations are made by the U.S. Army Corps of Engineers.

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Stormwater Best Management Practices

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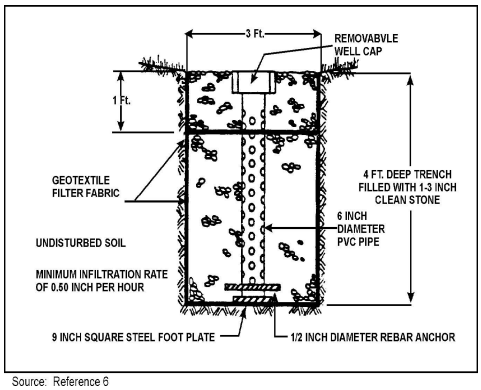
BMP Reference 2E-2 Infiltration Trenches or Dry Well Seepage Pits



Source: Reference 6

Source: EPA Stormwater Fact Sheet – Infiltration Trench

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2E-2 Infiltration Trench for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

- Geotechnical
  - Perform percolation tests, soils analysis to determine allowable shear stress, soil profiles, groundwater elevation, collapsible soils, and bedrock.
  - Upland slopes.
- Hydrology
  - Be mindful of stormwater source to infiltration trench
  - Size basins so that the water quality volume is infiltrated within 48-72 hours
- BMP Placement
  - Place downstream of collection and treatment facilities
  - Avoid placement near structures with basements
  - Avoid high sediment loading potential with upstream practices.
  - Phase construction of this BMP after upstream stormwater quality treatment devices are in place to avoid fouling the trench or pit.
  - Ideally suited for roof runoff.
  - Avoid placement on fill soils – soil compaction reduces infiltration capacity.
  - Avoid placement on slopes greater than 12 percent.
  - Avoid placement near septic systems, adsorption fields or other on-site wastewater facilities.
  - Avoid placement where potential is high for anthropogenic (man-made) spills.

Design Criteria for use in loess soils

- Determine Existing and High Groundwater Elevations.
- Identify Bedrock Elevation
- Specify geotextile based on in-situ soil characteristics
- Portion of trench or pit should be below frost line so that the practice will function in cold weather.

Maintenance Requirements for use in loess soils

- Maintenance items identified in ISWMM
- Inspect and maintain stormwater treatment devices upstream of infiltration trenches

BMP Reference 2E-3 Infiltration Basin

Photo: Bob Elbert Iowa State University

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2E-3 Infiltration Basin for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform percolation tests, soils analysis to determine allowable shear stress, soil profiles, groundwater elevation, collapsible soils, and bedrock.
  - Verify existing slopes.
- Hydrology
  - Be mindful of stormwater source to infiltration basin
  - Size basins so that the water quality volume is infiltrated within 48-72 hours
- BMP Placement
  - Place downstream of collection facilities.
  - Avoid placement near structures with basements.
  - Avoid placement on fill soils
  - Avoid placement on slopes greater than 20 percent.

Design Criteria for use in loess soils

- Determine Existing and High Groundwater Elevations.
- Identify Bedrock Elevation
- Perform shear stress evaluation at outlet for energy dissipator design
- Establish vegetation as soon as feasible on basin floor and slopes.

Maintenance Requirements for use in loess soils

- Maintenance items identified in ISWMM
- Inspect and maintain stormwater treatment devices upstream of infiltration trenches
- Avoid excessive compaction and sediment loading during construction

BMP Reference 2E-4 Bioretention Systems

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2E-4 Bioretention Systems for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform percolation tests, soils analysis, soil profiles, groundwater elevation, collapsible soils, and bedrock.
  - Verify existing slopes.
- Hydrology
  - Be mindful of stormwater source to bioretention basin. High sediment loading will cause failure of the system.
  - Size basins so that the water quality volume is infiltrated within 4-12 hours.
- BMP Placement
  - Place downstream of collection facilities.
  - Ideally suited for pavement runoff or roof runoff.
  - Avoid high sediment loading potential with upstream practice of filter strip or grassed swale.
  - Avoid concentrated inflows.
  - Avoid placement on fill soils
  - Avoid placement on slopes greater than 15 percent.

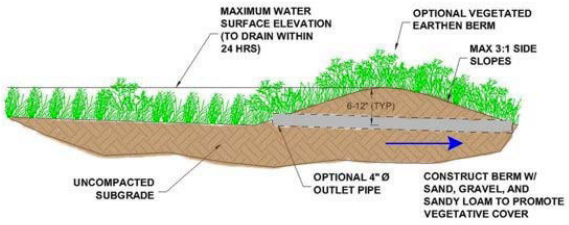
Design Criteria for use in loess soils

- Determine Existing and Seasonal High Groundwater Elevations.
- Identify Bedrock Elevation.
- Design inlet to bioretention overflow system to prevent scouring.
- Design of bioretention overflow spillway to prevent scouring of spillway.
- Establish vegetation as soon as feasible on basin floor and slopes.
- Careful selection of native plants required.
- Modify soil composition to support native plants and retain moisture for use by native plants.

Maintenance Requirements for use in loess soils

- Routine Maintenance items identified in Iowa Stormwater Management Manual
- Inspect and maintain stormwater treatment devices upstream of bioretention systems.
- Avoid excessive compaction and sediment loading during construction.

BMP Reference 2E-X Retentive Grading and Infiltration Berms



Source: Pennsylvania Stormwater BMP Manual

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

This BMP is not described in the ISWWM

The following items are recommended guidelines:

Required Site Investigations

- Geotechnical
  - Perform percolation tests, soils analysis, slope stability analysis, identify soil profiles, groundwater elevation, collapsible soils, and bedrock.
  - Verify existing slopes.
- Hydrology
  - Be mindful of stormwater source to this BMP. High sediment loading will cause failure of the system.
  - Size basins so that the water quality volume is infiltrated within 18-24 hours.
- BMP Placement
  - Suited for pavement or roof runoff.
  - Avoid high sediment loading potential with upstream practice
  - Avoid placement on fill soils.
  - Place infiltration berms along the same contour
  - Avoid placement on slopes greater than 20 percent.
  - Avoid placement near septic systems, adsorption fields or other on-site wastewater facilities.

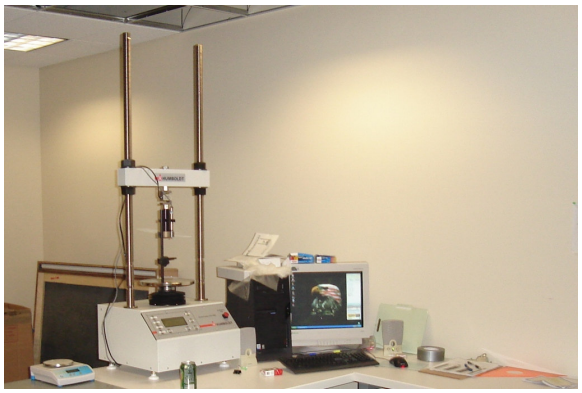
Design Criteria for use in loess soils

- Determine Existing and Seasonal High Groundwater Elevations.
- Identify Bedrock Elevation.
- Maximum berm height of 18 inches.
- Maximum of 4:1 (H:V) slopes.
- Establish vegetation as soon as feasible on berm and slopes.
- Use native grasses or turf grasses as cover vegetation.

Maintenance Requirements for use in loess soils

- Routine Maintenance: mowing, removal of invasive plants, trash and debris, regular inspection for rill erosion or other failures.
- Inspect and maintain stormwater treatment devices upstream of this practice
- Avoid excessive compaction and sediment loading during construction.

BMP Reference 2E-7 Soils Testing Requirements for Infiltration Practices



BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2E-7 Soils Testing Requirements for Infiltration Practices.

In addition to the requirements in the ISWMM the following items are required for practices on loess soils:

Required Site Investigations

- Geotechnical
- Soil Testing:
  - Borings should be done in areas of new BMP's to determine the suitability of the BMP to the site. Infiltration practices should not be placed over deposits of collapse susceptible loess. Borings should extend through the loess to the very moist soils usually found at the base of loess from each glacial period. Normal water seepage will generally form a perched water condition at the base of each loess deposit from any one glacial period. The lower 5 to 10 feet of most loess deposits will generally be very moist to wet. By definition, very moist loess is not susceptible to loessial collapse, since any collapse has already occurred when the loess was wetted eons ago.
  - Extract undisturbed thin-walled tube (Shelby) samples at 5-foot depth intervals to the base of the loess deposit. Keep an accurate field log of the boring and sampling activities. Place undisturbed samples in sealed plastic bags supported in support sleeves for transport to the laboratory.
  - In the laboratory conduct tests of
    - In-place water content on individual samples
    - In-place dry unit weight on individual samples
    - And Atterberg limits on composite groups of samples with similar properties.

Required Site Investigations continued

- Analyses:
  - Compare the in-place water content to the Atterberg limits to determine the in-place soil phase; solid, plastic, or liquid.
  - Compare the in-place water content and dry unit weight to the 10% water content and 80 pcf dry unit weight.

  Use these comparisons to determine potential for loessial collapse.

  If loessial collapse potential is high, water content less than 10% and dry unit weight less than 80 pcf, do not allow infiltration beds.

  If loessial collapse is moderate potential, dry unit weight of less than 80 pcf and water content between 10 and 16%, then look at soil in-place phase as determined by comparison of in-place water content to Atterberg limits. If the soil exists in the solid phase, do not allow infiltration beds. If the soil already exists in the plastic phase, allow infiltration beds. If the soil exists in the liquid phase, it is generally already too wet to allow additional infiltration.
  Percolation rate will further determine the ability of a soil that has a low potential for loessial collapse to accept infiltration water.

  Near steep slopes and other slopes with a history of failures, conduct additional test of:
  - soil strength, shear strength and angle of internal friction with triaxial tests.

  Determine stability of slope as it exists. Determine stability of slope with new fill or with infiltration-related affects on the soil. Soil does not need to collapse in order for increased water content to affect it. The added effective weigh of the soil due to water content increase may initiate a failure with no change in soil strength occurring.

BMP Reference 2E-7 Soils Testing Requirements for Soil Fill Embankment Construction

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2E-7 Soils Testing Requirements for Infiltration Practices.

In addition to the requirements in the ISWMM the following items are required for soil fill embankment on loess soils:

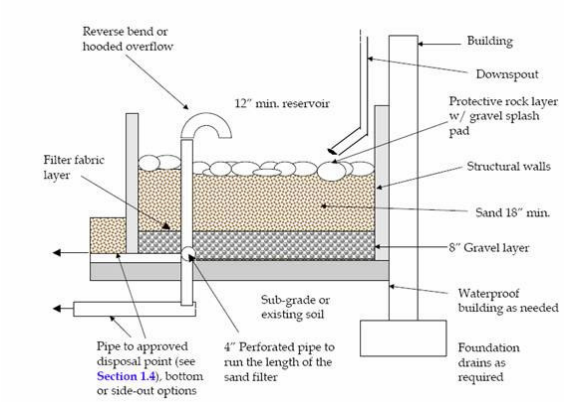
Required Site Investigations

Soil fill Embankment Construction

Soils fills will be placed in order to develop steeply sloping lands. Fill thickness is expected to vary, but every effort should be made to keep fill thickness no greater than 10 feet. Compact all loessial fill to at least 95% of the maximum dry density determined by Standard Proctor Test (ASTM D698-07e1), with a water content within 3 percentage points of the optimum water content also determined by Standard Proctor Test. The entire fill mass should be compacted to this standard, including slopes. Slopes are always associated with fills in loessial hills. Slopes are structural entities and need proper compaction. Bench all new fills into adjoining slopes where ever existing slopes occur.

It is important that groundwater seepage be maintained below embankment fills. Fill embankments can become an inadvertent dam to natural groundwater flow up gradient of the fill section. Unwanted water content increase can be inadvertently caused by innocent placement of fill embankments in loessial hills. Where natural seepage is noted, place a French drain in natural seepage areas prior to fill placement. A French drain shall consist of a 1-foot wide by 1-foot deep trench into natural soils before fill is placed. Line the sides and base of the trench with a separation geotextile, Mirafi 140N or approved equivalent, leaving sufficient geotextile at the top of the trench to allow folding the material over the trench when completed. Fill the trench with washed ¾-inch limestone or washed river gravel. Crushed concrete is not an acceptable substitute. Fold the edges of the geotextile over the top of the trench. Fold the edges of the geotextile over the upstream end of the trench, cut the geotextile open at the downstream outlet of the trench to allow unimpeded flow of water from the crushed stone. Fill soils will not allow significant infiltration. Infiltration beds must be excavated with backhoes and equipment traffic must be kept off of infiltration beds.

BMP Reference 2F-2 Surface and Perimeter Sand Filters



Flow-through Sand Filter Detail. Source: City of Portland 2004 Stormwater Management Manual.

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2F-2 Surface and Perimeter Sand Drain Filters for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations for Earthen Structures

- Geotechnical
  - Perform percolation tests and soils analysis to determine, infiltration rate, allowable shear stress, soil profiles, groundwater elevation, and depth to bedrock.
- Hydrology
  - Evaluate erosion potential of by-passed flows.
  - Use poly-liner or impermeable membrane to seal bottom of earthen structure.

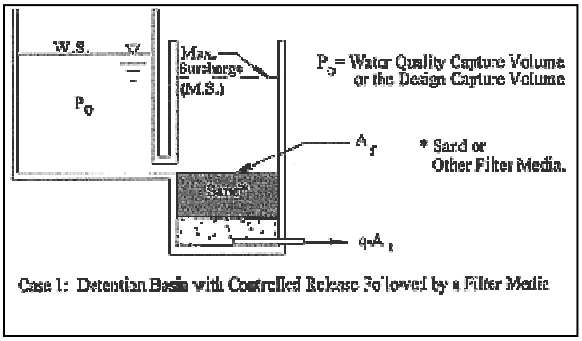
Design Criteria

- Perform shear stress evaluation at outlet for energy dissipator design if not discharging into a conduit conveyance system.

Operation and Maintenance Activities

- Test for water tightness of membrane prior to placing filter media.
- Monitor vegetation establishment in the overflow facilities.

BMP Reference 2F-3 Underground Sand Filter



Case 1: Detention Basin with Controlled Release Followed by a Filter Media

Source Ben Urbonas at UDFCD

BMP Suitability for Loess Soils	
Residential	No
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2F-3 Underground Sand Filters for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations for Earthen Structures

- Geotechnical
  - Perform soils analysis to determine, soil profiles, groundwater elevation, and depth to bedrock.
- Hydrology
  - Evaluate erosion potential of by-passed flows.

Design Criteria

- Perform shear stress evaluation at outlet for energy dissipator design if not discharging into a conduit conveyance system.

Operation and Maintenance Activities

- Not recommended for residential developments due to high maintenance costs.
- Test for water tightness of structure prior to placing filter media.
- Monitor vegetation establishment in the overflow facilities.

BMP Reference 2G-2 Dry Detention

Source USGS File Photo Dry-detention

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2G-2 Dry Detention for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform slope stability on embankment regardless of berm height.
  - Perform percolation tests, soils analysis to determine allowable shear stress, soil profiles, groundwater elevation, and bedrock.
  - Upland slopes.
- Hydrology.
  - Size basins so that the temporary runoff water volume is discharged within 24 - 48 hours.
- Placement downstream of collection and treatment facilities.
  -

Design Criteria

- Cast-in-place concrete pilot or low-flow channels are not allowed.
- Perform shear stress evaluation at outlet for energy dissipator design.
- Provide seepage protection around conduits in the form of collars or filters.
- Evaluate erosive forces acting on the auxiliary spillway channel to determine level of protection required.

BMP Reference 2G-3 Wet Detention

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2G-3 Wet Detention for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform slope stability analysis on embankment regardless of berm height.
  - Perform percolation tests and soils analysis to determine, infiltration rate, allowable shear stress, soil profiles, groundwater elevation, and depth to bedrock.
  - Evaluate stability of upland slopes.
- Hydrology
  - Size basins so that the temporary runoff water volume is discharged within 24 - 48 hours.
  - Evaluate potential for shoreline erosion.

Design Criteria

- Cast-in-place concrete pilot or low-flow channels are not allowed.
- Perform shear stress evaluation at outlet for energy dissipator design.
- Provide seepage protection around conduits in the form of collars or filters.
- Evaluate erosive forces acting on the auxiliary spillway channel to determine level of protection required.

Operation and Maintenance Activities

- Monitor vegetation establishment in the overflow facilities.

BMP Reference 2H-2 Constructed Wetlands

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2H-2 Constructed Wetlands for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform slope stability analysis on embankment regardless of berm height.
  - Perform percolation tests and soils analysis to determine, infiltration rate, allowable shear stress, soil profiles, groundwater elevation, and depth to bedrock.
  - Evaluate stability of upland slopes.
- Hydrology
  - Size basins so that the temporary runoff water volume is discharged within 24 - 48 hours.
  - Evaluate potential for shoreline erosion if open water is anticipated.

Design Criteria

- Perform shear stress evaluation at outlet for energy dissipator design.
- Provide seepage protection around conduits in the form of collars or filters.
- Evaluate erosive forces acting on the auxiliary spillway channel to determine level of protection required.

Operation and Maintenance Activities

- Monitor vegetation establishment in the overflow facilities

BMP Reference 2I-2 Grassed Swales

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2I-2 Grassed Swales for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform soils analysis to determine, soil profiles, groundwater elevation, and depth to bedrock.
- Hydrology
  - Evaluate erosion potential.
  - Consider temporary by-pass during establishment of vegetation.

Design Criteria

- Perform shear stress evaluation limit velocities to non erosive values.
- Protect swale on downstream edge of check dams from erosion.
- Maximum velocity for Qwq = 1.0 fps.
- Maximum velocity for 2-year and 10-year storms based on allowable shear stress.

Operation and Maintenance Activities

- Observe the facility monthly to monitor erosion and vegetation establishment during first year of operation.

BMP Reference 2I-3 Dry and Wet Swales

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2I-3 Dry and Wet Swales for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform soils analysis to determine, soil profiles, groundwater elevation, and depth to bedrock.
  - Wet swales evaluate potential for bank erosion.
- Hydrology
  - Evaluate erosion potential.
  - Consider temporary by-pass during establishment of vegetation.

Design Criteria

- Perform shear stress evaluation limit velocities to non-erosive values to reduce resuspension of accumulated materials.
- Protect swale on downstream edge of check dams from erosion.
- Maximum velocity for Qwq = 1.0 fps.
- Maximum velocity for 2-year and 10-year storms based on allowable shear stress.

Operation and Maintenance Activities

- Observe the facility monthly to monitor erosion and vegetation establishment during first year of operation.

BMP Reference 2I-4 Grassed Vegetated Filter Strips

From City of Portland 2004 Stormwater Management Manual

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2I-4 Grassed Vegetated Filter Strips for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform soils analysis to determine, soil profiles, groundwater elevation, and depth to bedrock.
- Hydrology
  - Evaluate erosion potential.
  - Consider temporary by-pass during establishment of vegetation.

Design Criteria

- Perform shear stress evaluation limit velocities to non erosive values.
-

Operation and Maintenance Activities

- Observe the facility monthly to monitor erosion and vegetation establishment during first year of operation.

BMP Reference 2J-4 Pervious Pavement

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

This BMP is under development in the ISWWM.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform percolation tests, soils analysis, bearing capacities, slope stability analysis, identify soil profiles, groundwater elevation, collapsible soils, and bedrock.
  - Verify existing slopes.
- Hydrology
  - Be mindful of stormwater source to this BMP. High sediment loading will cause failure of the system.
  - Size basins so that the water quality volume is infiltrated within 18-24 hours.
- BMP Placement
  - Avoid high sediment loading potential.
  - Restrict to sidewalks, parking magazines, alleys, drives and private roads.
  - Avoid areas with a high potential for anthropogenic (man-made) spills.
  - Use with Subsurface Infiltration beds, bioretention systems or vegetated swales as secondary treatment and conveyance methods.
  - Slopes should be less than 5 to 10 percent

Design Criteria for use in loess soils

- Pavement must allow runoff to infiltrate into a permeable media below the pavement section.
- Provide distributed infiltration area (5:1 ratio of impervious area to infiltration area - maximum),
- Underdrain system will be required where existing soil conditions are not suited to infiltration or soils are classified as collapsible.

BMP Reference 2J-4 Pervious Pavement (continued)

- Infiltration Bed shall be wrapped in nonwoven geotextile.
- Level or nearly level bed bottoms
- Protect from sedimentation during construction
- Provide perforated pipe network along bed bottom for distribution and conveyance as necessary

Maintenance Requirements for use in loess soils

- Inspect catch basins and inlets every three months following installation and after significant runoff events (>10-year) for the first two years. Semi-annual inspections after two years. Remove accumulated sediment, trash or debris as necessary.
- Avoid excessive compaction and sediment loading during construction.

More Pervious Pavement

Pervious Pavers

BMP Reference 2K-1Mechanical System

No Photo

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

This BMP is under development in the ISWWM.

This BMP is under development and is not included in the ISWWM so no additional guidance is provided at this time.

BMP Reference 2L-1Chemical Treatment for Turbidity Removal

No Photo

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

This BMP is under development in the ISWWM.

This BMP is under development and is not included in the ISWWM so no additional guidance is provided at this time.

BMP Reference 2M-1 General Information for Storm Sewer Design

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2M-1 General Information for Storm Sewer Design for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

Numerous pipe failures have been linked to leaking pipe joints in loess and other geologic settings.

- Geotechnical
  - Perform slope stability analysis on embankment regardless of berm height.
  - Perform percolation tests and soils analysis to determine, infiltration rate, allowable shear stress, soil profiles, groundwater elevation, and depth to bedrock.
- Hydrology
  - Evaluate potential for entrance and exit erosion.

Design Criteria

- Require sealed joints on storm drain conduits.
- Require restrained joints on steep slopes or other areas where water hammer or pressure could displace the pipe.
- Perform shear stress evaluation at outlet for energy dissipator design.
- Provide seepage protection around conduits in the form of collars or filters for structures with a permanent upstream water surface.
- Refer to the addendum to Table 3 Section 2O-2 Open Channel Flow for permissible open channel velocities when sizing energy dissipators, shown below.

BMP Reference 2M-1 General Information for Storm Sewer Design (continued)

Required Site Investigations continued

Table 3: Permissible Velocities for Channels with Erodible Linings, Based on Uniform Flow in Continuously Wet, Aged Channels

	Maximum permissible velocities for --		
Soil type or lining	Clear Water	Water carrying fine silts	Water carrying sand and gravel
	fps	fps	fps
Loess			
- Mulch	2.0	3.0	2.0
- Established Vegetation	4.0	5.0	4.0
- Erosion Resistant Matting	7.0	7.0	7.0

Operation and Maintenance Activities

- Perform leak testing of storm drain conduit systems.
- Perform periodic observation of low flows in storm drain conduits to detect leaking joints.
- Monitor vegetation establishment in the overflow facilities
- Monitor energy dissipator performance.

BMP Reference 2N-1 General Information for Design of Culverts


Source Nebraska Department of Roads

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2N-1 General Information for Design of Culverts for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform slope stability analysis on embankment regardless of berm height.
  - Perform percolation tests and soils analysis to determine, infiltration rate, allowable shear stress, soil profiles, groundwater elevation, water content, unit weight, Atterburg limits, and depth to bedrock.
- Hydrology
  - Evaluate potential for entrance and exit erosion.

Design Criteria

- Perform shear stress evaluation at outlet for energy dissipator design.
- Provide seepage protection around conduits in the form of collars or filters for structures with a permanent upstream water surface.
- Refer to the addendum to Table 3 Section 2O-2 Open Channel Flow for permissible open channel velocities when sizing energy dissipators, shown below.

Table 3: Permissible Velocities for Channels with Erodible Linings, Based on Uniform Flow in Continuously Wet, Aged Channels

	Maximum permissible velocities for --		
Soil type or lining	Clear Water	Water carrying fine silts	Water carrying sand and gravel
	fps	fps	fps
Loess			
- Mulch	2.0	3.0	2.0
- Established Vegetation	4.0	5.0	4.0
- Erosion Resistant Matting	7.0	7.0	7.0

Operation and Maintenance Activities

- Monitor vegetation establishment in the overflow facilities.
- Monitor energy dissipator performance.

BMP Reference 2O-1 Open Channel Flow

Open Channel with grade checks

BMP Suitability for Loess Soils	
Residential	Yes
Commercial	Yes
Industrial	Yes
Retrofit	Yes

Please refer to *Iowa Stormwater Management Manual* – Best Management Practice 2O-1 Open channel Flow for specifics on use and design of this BMP.

The following items are recommendations in addition to the ISWMM design guidelines:

Required Site Investigations

- Geotechnical
  - Perform soils analysis to determine, soil profiles, groundwater elevation, and depth to bedrock.
- Hydrology
  - Evaluate erosion potential.
  - Consider temporary by-pass during establishment of vegetation.

Design Criteria

- Perform shear stress evaluation limit velocities to non-erosive values to reduce resuspension of accumulated materials.
- Maximum velocity for 2-year and 10-year storms based on allowable shear stress.
- Locate channel checks at intervals determined by design (maximum 100-foot horizontal interval or maximum 6-foot vertical interval).
- Submit channel design calculations
- Refer to the addendum to Table 3 Section 2O-2 Open Channel Flow for permissible open channel velocities, shown below. Velocities are based on proper installation and maintenance.

Table 3: Permissible Velocities for Channels with Erodible Linings, Based on Uniform Flow in Continuously Wet, Aged Channels

	Maximum permissible velocities for --		
Soil type or lining	Clear Water	Water carrying fine silts	Water carrying sand and gravel
	fps	fps	fps
Loess			
- Mulch	2.0	3.0	2.0
- Established Vegetation	4.0	5.0	4.0
- Erosion Resistant Matting	7.0	7.0	7.0

BMP Reference 2O-1 Open Channel Flow (continued)

Operation and Maintenance Activities

- Observe the facility monthly to monitor erosion and vegetation establishment during first year of operation.
- If mown, leave clippings on the ground.

References

Statewide Urban Design and Specifications (SUDAS) Design Manual, 2008, Iowa SUDAS Corporation.

Iowa Storm Water Management Manual (ISWMM), February 2007, Center for Transportation Research and Education.

Storm Water Technology Fact Sheet - Infiltration Trench, EPA 832-F-99-019 September 1999, www.epa.gov-npdes-pubs-infltrenc.pdf, US Environmental Protection Agency.

Portland Stormwater Management Manual Adopted July 1, 10999; revised September 1, 2004, City of Portland, Oregon.

Pennsylvania Stormwater Best Management Practices Manual, December 30, 2006, Pennsylvania Department of Environmental Protection, Bureau of Watershed Management.

Hydraulic Design of Sand Filters for Stormwater Quality by Ben R. Urbonas, Chief, Master Planning Program, Denver, Colorado, Urban Drainage and Flood Control District

Photography Credits

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Model Stormwater Management Ordinance

This Model Stormwater Management Ordinance is based on the Post-Construction Model Ordinance prepared by the Center for Watershed Protection, Inc., July 29, 2008. It was adapted based on the comments from the Golden Hills Low Impact Development Model Ordinance Steering Committee.

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Introduction

This Model Stormwater Management Ordinance provides a MENU of code language for stormwater programs to use to craft or update their ordinances. The ordinance is written so that individual sections can be lifted out and modified to suit individual program needs.

Guidance for using the Model Ordinance is provided below:

1. The Ordinance is designed to complement the Post-Construction Program Self-Assessment. Completing the Self-Assessment will assist a stormwater manager in determining which sections of the Model Ordinance to include in his or her new or revised post-construction code.
2. The text in the Model Ordinance has different styles applied to it based on each section's relevance to programs that are at different stages or levels of sophistication. This system parallels the Post-Construction Program Self-

Assessment, where the columns represent actions taken by local programs as they evolve and develop. The text styles in the Model Ordinance reflect the following:

a. Standard text represents fundamental language that all programs should strive to include in some form as part of a "basic" program (generally corresponding to "Group A" in the Self-Assessment). Programs that creating an ordinance from scratch (e.g., no pre-existing stormwater code) should begin with this language. Other programs should confirm that, at a minimum, these elements are addressed in the existing code.
b. Text in *italics* represents program enhancements that most programs should strive to incorporate within the near future (for example, by the second permit cycle for programs subject to MS4 requirements). These program elements allow for more flexibility in compliance and also incorporate enhanced criteria to protect water resources.
c. Text that is <u>underlined</u> represents advanced or alternative program elements that either require a fairly high degree of program sophistication and watershed information OR support alternative program elements that can save time and money for local programs (such as the use of certified private inspectors). In general, these elements also provide more flexibility for both applicants and reviewers and promote a watershed-based approach to stormwater, rather than relying solely on site-by-site compliance.

3. While these text styles provide some guidance, it should be considered fluid. Each program is unique, and may incorporate elements from all three types of text.
4. The Model Ordinance contains language in brackets to indicate where a local program should insert its particular information. An example is the **[County of Pottawattamie, Iowa]**, which, at the local level, is the department charged with operating the stormwater program. Other terms, are in bold because a locality may wish to substitute another term or reference.
5. Many model ordinances are currently available from local, regional, and state agencies and organizations. A local program should consult any models that are "close to home" and then compare sections with this Model Ordinance to see if other elements should be added.
6. Text boxes are provided throughout the ordinance to provide clarification or to present various options for developing code language. **These boxes should be removed when developing an actual code document.**

Table 1 lists some critical decisions to make while developing a post-construction ordinance. Chapter 5 of the Post-Construction Guidance provides more information on many of the topics to consider when crafting an ordinance.

TABLE 1: POST-CONSTRUCTION ORDINANCE DECISIONS	
Decision	**Rationale**
Should post-construction ordinance be combined with erosion and sediment control (construction stormwater) and/or illicit discharge detection and elimination ordinances	Creates a comprehensive code, but can end up being a massive overwhelming document
Develop a separate Stormwater Management Manual to keep technical details and specifications out of the ordinance	Having a separate manual is the recommended approach, and there are likely state and local manuals to reference
Include credits for Low-Impact Development, non-structural measures, and Smart Growth techniques	These are recommended program tools. The program should develop the technical and program capabilities to include these as the program matures.
Include special stormwater criteria for important resources, such as drinking water supplies, coastal areas, wetlands, cold-water fisheries, impaired streams	Special criteria can provide extra protection for locally-important resources. The technical criteria for meeting the standards should be in the Design Manual.
Determine the number and types of sites that will be subject to stormwater requirements, plan review, and site inspections	The ordinance can apply to nearly all development and redevelopment sites, or only those of a certain size, disturbed area, or impervious threshold. Applicability is a critical program decision

Model Stormwater Management Ordinance

Contents

Section 1. General Provisions

1.1. Findings of Fact

It is hereby determined that:

(1) Land development activities and associated increases in site Impervious Surface/Area often alter the hydrologic response of local watersheds and increase stormwater runoff rates and volumes, flooding, stream channel erosion, or sediment transport and deposition;

(2) This stormwater runoff contributes to increased quantities of water-borne pollutants, including siltation of aquatic habitat for fish and other desirable species;

(3) Loess soils are composed of wind deposited silts with high quartz content from Pleistocene era river valleys and cover tens of thousands of square miles across the mid-west. In western Iowa, there existed just the right combination of climate, abundant outwash material, and valley width for unusually thick deposits to accumulate (source: Geology of the Loess Hills, Proceedings of the Iowa Academy of Science, 1986, Bettis, etal).

(4) The loess hills provide unique habitat for vegetation, are the western most range of the eastern deciduous species, and the eastern most range of the western plains species, making this an area of significant biological crossroads. This area harbors over 20,000 acres of remnant prairie representing about 75% of Iowa's remaining prairie heritage, of which 99.9% is already lost (source: Golden Hills RC&D Website);

(5) Loess soil has unique characteristics requiring special attention be given during planning, design and construction of developments to avoid undesirable outcomes. These characteristics must be identified and addressed by thorough geotechnical investigation, soils analysis and foundation design. Failure to adequately investigate and obtain proper design recommendations could result in loess soil failures resulting from low strength, settlement, and/or excessive erosion.

(6) Improper design and construction of stormwater best management practices (BMPs) can increase the velocity of stormwater runoff thereby increasing stream bank erosion and sedimentation;

(7) Impervious surfaces allow less water to percolate into the soil, thereby decreasing groundwater recharge and stream baseflow;

(8) Substantial economic losses can result from these adverse impacts on the waters of the municipality;

(9) Stormwater runoff, soil erosion and nonpoint source pollution can be controlled and minimized through the regulation of stormwater runoff from land development activities;

(10) The regulation of stormwater runoff discharges from land development activities in order to control and minimize increases in stormwater runoff rates and volumes, stream channel erosion, and nonpoint source pollution associated with stormwater runoff is in the public interest and will minimize threats to public health and safety.

(11) Regulation of land development activities by means of performance standards governing stormwater management and site design will produce development compatible with the natural functions of a particular site or an entire watershed and thereby mitigate the adverse effects of stormwater runoff from development.

(12) Clearing and grading during construction tends to increase soil erosion and add to the loss of native vegetation necessary for terrestrial and aquatic habitat;

(13) Illicit and non-stormwater discharges to the storm drain system can contribute a wide variety of pollutants to waterways, and the control of these discharges is necessary to protect public health and safety and water quality.

1.2. Purpose

Purpose

- Most local codes do have a purposes section that establishes the reasons that the locality is regulating stormwater.
- The Purpose section is usually tied to protection of public health and safety and may also refer to regulatory requirements (e.g., MS4 requirements).
- If the ordinance addresses construction stormwater and/or illicit discharge detection & elimination, then the "Purpose" section should include references to these activities.
- Optional "add-ons" to the section are indicated in italics at the end of the section.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

The purpose of this ordinance is to establish minimum stormwater management requirements and controls to protect and safeguard the general health, safety, and welfare of the public residing in watersheds within the **JURISDICTION**. This ordinance seeks to meet that purpose through the following objectives:

(1) To inhibit the deterioration of water resources resulting from development.
(2) To protect the Loess Hills soil and water resources, which in turn will provide great benefit to human health, fish and wildlife habitat, recreational resources, and drinking water.

(3) To protect the safety and welfare of citizens, property owners, and businesses by minimizing the negative impacts of increased stormwater discharges from new land development and redevelopment.
(4) To control the rate, quality and volume of stormwater originating from development and redevelopment sites so that surface water and groundwater are protected and flooding and erosion potential are not increased.
(5) To control nonpoint source pollution and stream channel erosion.
(6) To maintain the integrity of stream channels and networks for their biological functions, drainage, and natural recharge of groundwater.
(7) To protect the condition of state (and U.S.) waters for all reasonable public uses and ecological functions.
(8) To provide long-term responsibility for operation and maintenance of stormwater BMPs.
(9) To facilitate the integration of stormwater management and pollution control with other ordinances, programs, policies, and the comprehensive plan of the **JURISDICTION**.
(10) To establish legal authority to carry out all the inspection and monitoring procedures necessary to ensure compliance with this ordinance.
(11) To facilitate compliance with state and federal standards and permits by owners of construction sites, developments, and permanent stormwater BMPs with the **JURISDICTION.**
(12) To preserve the natural infiltration of groundwater to maintain the quantity and quality of groundwater resources.
(13) To protect against and minimize the pollution of public drinking water supplies resulting from development and redevelopment.

1.3. Applicability

Applicability

- The Applicability section establishes the "mesh size" for the post-construction ordinance; that is, the site size or site characteristics that trigger application of the post-construction standards.
- Applicability can be based on site impervious cover, a land disturbance threshold, overall site size, number of lots, and/or the type of development (e.g., hotspots).
- The most common threshold is 1-acre disturbed. The advantage of this threshold is that it is consistent with the NPDES threshold for construction sites. However, impervious cover may be a more precise trigger for a post-construction ordinance.
- The following table outlines choices for the applicability section based on program sophistication. **Choices should be substituted for the area size in brackets in the ordinance language.**

Table 1. Applicability Choices Based on Program Sophistication

Increasing Program Sophistication →		
1 acre or more of land disturbance OR 5000 square feet of land disturbance activity in the loess hills	• 5,000 square feet or more of new impervious cover • 5,000 square feet or more of impervious cover created, added or replaced for redevelopment AND • Any new development or redevelopment, regardless of size, that is identified by **Pottawattamie County, Iowa** to be an area where the land use has the potential to generate highly contaminated runoff	• 2,500 square feet of new impervious cover • Any redevelopment OR • All land development and redevelopment activities

- Some local ordinances will have a variable trigger for new development versus redevelopment, especially if redevelopment is a critical component to an overall land use policy that encourages infill.
- The "Applicability" section must be clear in its terminology. It is important to define and be consistent with terms such as "land disturbing activity," "development," "land development," or "agricultural land uses." These terms should be provided in the definitions section and should also be used consistently with applicable state regulations.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

This ordinance shall be applicable to all land development, including, but not limited to, site plan applications, subdivision applications, and grading applications, unless exempt pursuant to Section 1.4. These provisions apply to any new development or redevelopment site within The JURISDICTION that meets one or more of the following criteria:

(1) Land disturbance activity that creates [**FIVE-THOUSAND (5,000) SQUARE FEET OR MORE**] of Impervious Surface/Area.

(2) Redevelopment that creates, adds, or replaces **[FIVE-THOUSAND (5,000) SQUARE FEET OR MORE]** of Impervious Surface/Area.

(3) Land disturbance activities that are smaller than the minimum applicability criteria set forth above if such activities are part of a larger common plan of development, even though multiple, separate and distinct land development activities may take place at different times on different schedules.

1.4. Exemptions

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

Exemptions

- The most important consideration in the Exemptions section is to catch land uses activities that should be regulated. Exemptions can easily turn into loopholes if the ordinance language is not precise.
- There is some debate about some exemptions, such as state and federal projects (that may also be subject to other regulatory requirements) and temporary projects, such as road and utility maintenance.
- Exemption 3b is provided as an incentive for conservation plans.

The following activities are exempt from this ordinance:

(1) Individual single-family or duplex residential lots that are not part of a subdivision or phased development project that is otherwise subject to this ordinance.

(2) Additions or modifications to existing single-family or duplex residential structures.

(3a) Projects that are exclusively for agricultural and silvicultural uses. Agricultural or silvicultural roads that are used to access other land uses subject to this ordinance are not exempt. Agricultural structures that are also used for other uses subject to this ordinance are not exempt.

OR

*(3b) Any agricultural or silvicultural activity that is conducted according to an approved farm conservation plan or timber management plan prepared or approved by **[APPROPRIATE STATE AGENCIES: e.g., NRCS or the Iowa Department of Agriculture]**.*

(4) Maintenance and repair to any stormwater BMP deemed necessary by the **JURISDICTION.**

(5) Any emergency project that is immediately necessary for the protection of life, property, or natural resources.

(6) Linear construction projects, such as pipeline or utility line installation, that do not result in the installation of any Impervious Surface/Area and the secondary roads of the county, state, or federal system, as determined by the JURISDICTION. Such projects must be designed to minimize the number of stream crossings and width of disturbance, and are subject to **[State of Iowa NPDES and the JURISDICTION construction stormwater or erosion & sediment control ordinance].**

(7) Any part of a land development that was approved by **the JURISDICTION** prior to the effective date of this ordinance.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

Legal Authority, Compatibility, Severability, Liability, Designation of Stormwater Authority Sections

- These Administrative sections appear in some, but not all, ordinances for various legal reasons.
- Check with legal staff to determine the applicability of these sections to your situation.

1.5. Legal Authority

This ordinance is adopted pursuant to authority conferred by and in accordance with **[APPLICABLE STATE AND/OR FEDERAL REGULATIONS].**

1.6. Compatibility with Other Permit and Ordinance Requirements

This ordinance is not intended to interfere with, abrogate, or annul any other ordinance, rule or regulation, stature, or other provision of law. The requirements of this ordinance should be considered minimum requirements, and where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule or regulation, or other provision of law, whichever provisions are more restrictive or impose higher protective standards for human health or the environment shall be considered to take precedence.

1.7. Severability

If the provisions of any article, section, subsection, paragraph, subdivision or clause of this ordinance shall be judged invalid by a court of competent JURISDICTION, such

order of judgment shall not affect or invalidate the remainder of any article, section, subsection, paragraph, subdivision or clause of this ordinance.

1.8. Liability

Any person who undertakes or causes to be undertaken any land development shall ensure that soil erosion, sedimentation, increased pollutant loads and changed water flow characteristics resulting from the activity are controlled so as to minimize pollution of receiving waters. The requirements of this ordinance are minimum standards and a person's compliance with the same shall not relieve such person from the duty of enacting all measures necessary to minimize pollution of receiving waters.

By approving a plan under this regulation, The **JURISDICTION** does not accept responsibility for the design, installation, and operation and maintenance of stormwater BMPs.

1.9. Designation of Stormwater Authority: Powers and Duties

The JURISDICTION shall administer and enforce this ordinance, and may furnish additional policy, criteria and information including specifications and standards, for the proper implementation of the requirements of this ordinance and may provide such information in the form of a Stormwater Management Manual.

The Stormwater Management Manual may be updated and expanded from time to time, at the discretion of the State of Iowa, based on improvements in engineering, science, monitoring and local maintenance experience.

Representatives of the JURISDICTION shall have the right to enter upon any land for the purposes of making an inspection or acquiring information to determine whether or not the property conforms to the requirements of this ordinance.

Section 2. Definitions

Definitions
Ensure that terms are defined consistently across other related guidance and regulatory documents.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

"Applicant" means a property owner or agent of a property owner who has filed an application for a [stormwater management, development, subdivision, etc] permit through the **JURISDICTION**.

"Approved Receiving System (Discharge Point)": Any system approved by a JURISDICTIONAL Authority to receive stormwater runoff or other discharges. Receiving systems include, but are not limited to, groundwater; onsite, offsite, or public stormwater, sanitary, or combined sewers; and waters of the state.

"Building" means any structure, either temporary or permanent, having walls and a roof, designed for the shelter of any person, animal, or property, and occupying more than 100 square feet of area.

"Bioretention Facility" means any facility that uses soils and both woody and herbaceous plants to remove pollutants from stormwater runoff. Examples of bioretention facilities include vegetated swales, flow-through and infiltration planters, vegetated filters, and vegetated infiltration basins.

"Capacity" means the flow volume or rate that a facility (e.g., pipe, pond, vault, swale, ditch, drywell, etc.) is designed to safely contain, receive, convey, reduce pollutants from, or infiltrate to meet a specific performance standard. Performance standards for pollution reduction, flow control, conveyance, and infiltration/discharge vary by facility, depending on location.

"Catch Basin" means a structural facility located just below the ground surface, used to collect stormwater runoff for conveyance purposes. Generally located in streets and parking lots, catch basins have grated lids, allowing stormwater from the surface to pass through for collection. Catch basins also include a sumped bottom and submerged outlet pipe (downturned 90 degree elbow, hood, or baffle board) to trap coarse sediment and oils.

"Channel" means a natural or artificial watercourse with a definite bed and banks that conducts continuously or periodically flowing water.

"Control Structure" means a device used to hold back or direct a calculated amount of stormwater to or from a stormwater management facility. Typical control structures include vaults or manholes fitted with baffles, weirs, or orifices.

"Dedication" means the deliberate appropriation of property by its owner for general public use.

"Easement" means a legal right granted by a landowner to a grantee allowing the use of private land for conveyance or treatment of stormwater runoff and access to stormwater practices.

"Erosion and Sediment Control Plan" means a plan that is designed to minimize the accelerated erosion and sediment runoff at a site during construction activities.

"Fee-in-Lieu Contribution" means a payment of money in place of meeting all or part of the stormwater performance standards required by this ordinance.

“Groundwater Management Area” means a geographically defined area that may be particularly sensitive in terms of groundwater quantity and/or quality by nature of the use or movement of groundwater, or the relationship between groundwater and surface water, and where special management measures are deemed necessary to protect groundwater and surface water resources.

“Groundwater Recharge Volume (Rev)” – means the portion of the water quality volume (WQv) used to maintain groundwater recharge rates at development sites.

“Impaired Waters” means those streams, rivers and lakes that currently do not meet their designated use classification and associated water quality standards under the Clean Water Act.

"Industrial Stormwater Permit" means a National Pollutant Discharge Elimination System permit issued to a commercial industry or group of industries that regulates the pollutant levels associated with industrial stormwater discharges or specifies on-site pollution control strategies.

“Infill Development” means land development that occurs within designated areas based on local land use, watershed, and/or utility plans where the surrounding area is generally developed, and where the site or area is either vacant or has previously been used for another purpose.

"Infiltration Facility" means any structure or device designed to infiltrate retained water to the subsurface. These facilities may be above grade or below grade.

"JURISDICTIONAL Wetland" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

“Land Development” means a human-made change to, or construction on, the land surface that changes its runoff characteristics.

"Land Disturbing Activity" means any activity that changes the volume or peak flow discharge rate of rainfall runoff from the land surface. This may include the grading, digging, cutting, scraping, or excavating of soil, installation of septic systems, wells, placement of fill materials, paving, construction, substantial removal of vegetation, or any activity that bares soil or rock or involves the diversion or piping of any natural or man-made watercourse.

"Landowner" means the legal or beneficial owner of land, including those holding the right to purchase or lease the land, or any other person holding proprietary rights in the land.

"Maintenance Agreement" means a legally recorded document that acts as a property deed restriction, and that provides for long-term maintenance of stormwater BMPs.
"Municipal Separate Storm Sewer System (MS4)" means publicly-owned facilities by which stormwater is collected and/or conveyed, including but not limited to any roads with drainage systems, municipal streets, gutters, curbs, catch basins, inlets, piped storm drains, pumping facilities, retention and detention basins, natural and human-made or altered drainage ditches/channels, reservoirs, and other drainage structures.

"Municipal Separate Storm Sewer System (MS4)" means publicly-owned facilities by which stormwater is collected and/or conveyed, including but not limited to any roads with drainage systems, municipal streets, gutters, curbs, catch basins, inlets, piped storm drains, pumping facilities, retention and detention basins, natural and human-made or altered drainage ditches/channels, reservoirs, and other drainage structures.

"National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit" means a permit issued by the EPA, or by a State under authority delegated pursuant to 33 USC § 1342(b), that authorizes the discharge of pollutants to waters of the State, whether the permit is applicable on an individual, group, or general area-wide basis.

"Non-Stormwater Discharge" means any discharge to the storm drain system that is not composed entirely of stormwater.

"Non-Structural Measure" means a stormwater control and treatment technique that uses natural processes, restoration or enhancement of natural systems, or design approaches to control runoff and/or reduce pollutant levels. Such measures are used in lieu of or to supplement structural practices on a land development site. Non-structural measures include, but are not limited to: minimization and/or disconnection of impervious surfaces; development design that reduces the rate and volume of runoff; restoration or enhancement of natural areas such as riparian areas, wetlands, and forests; and on-lot practices such as rain barrels, cisterns, and vegetated areas that intercept roof and driveway runoff.

"Nonpoint Source Pollution" means pollution from any source other than from any discernible, confined, and discrete conveyances, and shall include, but not be limited to, pollutants from agricultural, silvicultural, mining, construction, subsurface disposal and urban runoff sources.

"Owner" means the owner or owners of the freehold of the premises or lesser estate therein, a mortgagee or vendee in possession, assignee of rents, receiver, executor, trustee, lessee or other person, firm or corporation in control of a piece of land. As used herein, owner also refers to, in the appropriate context: (i) any other person authorized to act as the agent for the owner; (ii) any person who submits a stormwater management concept or design plan for approval or requests issuance of a permit, when required, authorizing land development to commence; and (iii) any person responsible for complying with an approved stormwater management design plan.

“Permanent Stormwater BMP” means a stormwater best management practice (BMP) that will be operational after the construction phase of a project and that is designed to become a permanent part of the site for the purposes of managing stormwater runoff. “Private Inspector” means an independent agency or private entity that is retained by the applicant to conduct inspections and submit documentation to the JURISDICTION in accordance with this ordinance, and that is certified by the JURISDICTION to conduct such inspections.

“Private Inspector” means an independent agency or private entity that is retained by the applicant to conduct inspections and submit documentation to the JURISDICTION in accordance with this ordinance, and that is certified by the JURISDICTION to conduct such inspections.

“Pro-Rata Share” means the proportional amount to be paid by an applicant to contribute to the construction of a regional stormwater BMP, as determined by the JURISDICTION.

“Receiving Stream or Channel” means the body of water or conveyance into which stormwater runoff is discharged.

"Recharge" means the replenishment of underground water reserves.

"Redevelopment" means a change to previously existing, improved property, including but not limited to the demolition or building of structures, filling, grading, paving, or excavating, but excluding ordinary maintenance activities, remodeling of buildings on the existing footprint, resurfacing of paved areas, and exterior changes or improvements that do not materially increase or concentrate stormwater runoff or cause additional nonpoint source pollution.

“Regional Stormwater” means stormwater BMPs designed to control stormwater runoff from multiple properties or a particular land use district, and where the owners or developers of the individual properties may participate in the provision of land, financing, design, construction, and/or maintenance of the facility.

“Responsible Party” means any individual, partnership, co-partnership, firm, company, corporation, association, joint stock company, trust, estate, governmental entity, or any other legal entity; or their legal representatives, agents, or assigns that is named on a stormwater maintenance agreement as responsible for long-term operation and maintenance of one or more stormwater BMPs.

"Stop Work Order" means an order issued that requires that all construction activity on a site be stopped.

“Stormwater Authority” means the department or agency, and its authorized agents, which is responsible for coordinating the review, approval, and permit process as defined by this ordinance.

"Stormwater Best Management Practice (BMP)" means a measure, either structural or nonstructural, that is determined to be the most effective, practical means of preventing or reducing point source or nonpoint source pollution inputs to stormwater runoff and water bodies.

“Stormwater Design Manual” means an engineering and/or project review document maintained by the **JURISDICTION** such as the **Iowa Stormwater Management Manual (ISWMM), Statewide Urban Design and Specifications Design Standards Manual (SUDAS), and the Loess Hills Stormwater BMP Guidance Manual** containing technical standards and specifications, policies, procedures, and other materials deemed appropriate by JURISDICTION to assist with compliance with the provisions of this ordinance.

"Stormwater Hotspot" means an area where land use or activities generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater.

“Stormwater Pollution Prevention Plan” means a plan, usually required by a permit, to manage stormwater associated with industrial, commercial, institutional, or other land use activities, including construction. The Plan commonly describes and ensures the implementation of practices that are to be used to reduce pollutants in stormwater and non-stormwater discharges.

"Stormwater Retrofit" means a stormwater BMP designed for an existing development site that previously had either no stormwater BMP in place or a practice inadequate to meet the stormwater management requirements of the site.

"Stormwater Runoff" means flow on the surface of the ground, resulting from precipitation.

“Stream Buffer” means an area of land at or near a streambank, wetland, or waterbody that has intrinsic water quality value due to the ecological and biological processes it performs or is otherwise sensitive to changes which may result in significant degradation to water quality.

"Water Quality Volume (WQv)" means the storage needed to capture and treat 90% of the average annual stormwater runoff volume. Numerically (WQv) will vary as a function of long term rainfall statistical data.

"Watercourse" means a permanent or intermittent stream or other body of water, either natural or man-made, which gathers or carries surface water.

"Watershed or Subwatershed Management Plan" means a document, usually developed cooperatively by government agencies and other stakeholders, to protect, restore, and/or otherwise manage the water resources within a particular watershed or subwatershed. The plan commonly identifies threats, sources of impairment, institutional issues, and technical and programmatic solutions or projects to protect and/or restore water resources.

"Wetland Hydroperiod" means the pattern of fluctuating water levels within a wetland caused by the complex interaction of flow, topography, soils, geology, and groundwater conditions in the wetland.

Section 3. Permit Procedures and Requirements

Permit Procedures & Requirements

- This section outlines the requirements for plans to be submitted, the schedule for review, and general conditions for approval.
- Plan approval can be a locality's last chance to influence several important issues, such as ensuring long-term access to stormwater BMPs and assigning maintenance responsibility.
- The ordinance should establish the plan approval process as a mechanism to secure needed documents for the long-term viability of a site's stormwater BMPs.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

3.1. Stormwater Management Concept Plan and Consultation Meeting

Each owner subject to this ordinance shall submit to the JURISDICTION for review and approval a stormwater management concept plan as provided herein:

(1) ***Stormwater Management Concept Plan:*** *All preliminary plans of subdivision and site plans shall provide a stormwater management concept plan describing, in general, how stormwater runoff through and from the development will be treated and conveyed. The concept plan shall also identify important natural features identified though a Natural Resources Inventory conducted in accordance with Section 4.1(17). All other land development projects subject to this ordinance shall submit a stormwater management concept plan prior to preparation of the stormwater management design plan.*

(2) ***Application Requirements:*** *The stormwater management concept plan submittal shall contain a completed application form provided by the JURISDICTION, the fee required by Section 3.10, and a stormwater management concept plan that satisfies the requirements of this section and the Stormwater Management Manual.*

(3) ***Concept Plan Prior to Design Plan****: The stormwater management concept plan must be approved prior to submission of a stormwater management design plan (as part of the construction or final site plan) for the entire development, or portions thereof.*

(4) ***Meetings with JURISDICTION:*** *All applicants are encouraged to hold a pre-submittal consultation meeting with the JURISDICTION to discuss potential approaches for stormwater design and opportunities to use design techniques to reduce runoff rates, volumes, and pollutant loads. In addition, the applicant or his representative shall meet on-site with a designee of the JURISDICTION prior to approval of the stormwater management concept plan for the purposes of verifying the conditions of the site and all receiving channels.*

(5) ***Maximize Use of Stormwater BMPs to Reduce Runoff by Design:*** *The stormwater management concept plan shall utilize to the maximum extent practicable site planning and design technique that reduce runoff rates, volumes, and pollutant loads. Such techniques include, but are not limited to, minimization and/or disconnection of impervious surfaces; development design that reduces the rate and volume of runoff; restoration or enhancement of natural areas such as riparian areas, wetlands, and forests; and distributed practices that intercept and treat runoff from developed areas.*

3.2. Stormwater Management Design Plan

Each owner subject to this ordinance shall submit to the JURISDICTION for review and approval a stormwater management design plan as provided herein:

Stormwater Management Design Plan: A stormwater management design plan containing all appropriate information as specified in this Ordinance shall be submitted to the JURISDICTION in conjunction with the final subdivision plat, final site plan, construction plan, or any other land development plan subject to this ordinance.

Application Requirements: The stormwater management design plan submittal shall contain a completed application form provided by the JURISDICTION, the fee required by Section 3.10, a stormwater management design plan that satisfies the requirements of this section and the Stormwater Management Manual, a stormwater maintenance plan, and a certification stating that all requirements of the approved plan will be complied with. Failure of the owner to demonstrate that the project meets these requirements, as determined by the JURISDICTION, shall be reason to deny approval of the plan.

Consistency between Concept & Design Plans: A copy of the approved stormwater management concept plan shall be submitted with the stormwater management design plan. The JURISDICTION shall check the design plan for consistency with the concept plan and may require a revised stormwater management concept plan if changes in the site development proposal have been made.

Stormwater Management Design Plan Content: The stormwater management design plan shall contain maps, charts, graphs, tables, photographs, narrative descriptions, explanations, citations to supporting references, a record of all major permit decisions, and other information as may be necessary for a complete review of the plan, and as specified in the latest version of the Stormwater Management Manual.

3.3. Stormwater Management Design Plan: Review Procedures

Preliminary Review for Completeness of Plan: The JURISDICTION shall have a maximum of ten (10) calendar days from the receipt of an application for preliminary review to determine if the application is complete. During this period, the application will be accepted for review, which will begin the thirty (30) day review period, or rejected for incompleteness. The applicant will be informed in writing of the information necessary to complete the application.

Review Period: The **[thirty (30), forty-five (45), ninety (90)]** day review period begins on the day the complete stormwater management design plan is accepted for review by the JURISDICTION. During the **[thirty (30), forty-five (45), ninety (90)]** day review period, the JURISDICTION shall either approve or disapprove the plan and communicate the decision to the applicant in writing. Approval or denial shall be based on the plan's compliance with this Ordinance and the Stormwater Management Manual.

Modifications Needed for Approval: In cases where modifications are required to approve the plan, the JURISDICTION shall have an additional thirty (30) days to review the revised plan from the initial and any subsequent resubmission dates. If the plan is approved, one copy bearing certification of such approval shall be returned to the applicant. If the plan is disapproved, the applicant shall be notified in writing of the reasons.

Appeal Decisions of JURISDICTION: The applicant or any aggrieved party authorized by law may appeal the [**STORMWATER AUTHORITY'S**] decision of approval or disapproval of a stormwater management design plan. The appeal shall be made to the [**GOVERNING BOARD OF JURISDICTION**], must be in writing, and must be submitted within thirty (30) days after the JURISDICTION renders its decision to approve or disapprove the plan.

Substantive Changes to Plan: No substantive changes shall be made to an approved plan without review and written approval by the JURISDICTION. The JURISDICTION may request additional data with a plan amendment as may be necessary for a complete review of the plan and to ensure that changes to the plan will comply with the requirements of this ordinance.

Expiration of Plan Approval: The stormwater management design plan's approval expires in one year from the date of approval unless a final plat is recorded or unless work has actually begun on the site. The recordation of a final plat for a section of a subdivision (or initiation of construction in a section) does not vest the approval of the stormwater management design plan for the remainder of the subdivision. If the stormwater management design plan expires, the applicant shall file with the JURISDICTION for reapproval of the stormwater management design plan.

3.4. Plan Preparation and Certification

(1) **Certification by Plan Preparer:** The stormwater management design plan shall be prepared by a certified professional in erosion and sediment control, licensed landscape architect, certified professional surveyor, or professional engineer and must be signed by the professional preparing the plan, who shall certify that the design of all stormwater BMPs meet the requirements in this local law.

(2) **Certification by Owner:** The owner shall certify that all land clearing, construction, land development and drainage will be done according to the approved plan.

3.5. Coordination with Other Approvals and Permits

*(1) **Approval of Other Permits:** No grading or building permit shall be issued for land development without approval of a stormwater management design plan.*

*(2) **Coordination with Other Plans:** Approval of the stormwater management design plan shall be coordinated by the JURISDICTION with approval of an erosion and sediment control or construction stormwater plan with regard to the location, schedule, and/or phasing for temporary and permanent stormwater management measures. If natural drainage features or other natural areas are to be preserved, then these areas must be shown and measures provided for their protection on both the erosion and sediment control plan and the stormwater management design plan. If other elements of the stormwater management design plan utilize soils, vegetation, or other natural features for infiltration or treatment, then these areas must be shown on the erosion and sediment control plan and measures provided for their protection during construction*

*(3) **Other Permits or Approvals May Be Needed:** Approvals issued in accordance with this ordinance do not relieve the applicant of responsibility for obtaining all other necessary permits and/or approvals from other federal, state, and/or local agencies. If requirements vary, the most restrictive shall prevail. These permits may include, but are not limited to: construction stormwater discharge permits, applicable state and federal permits for stream and wetland impacts, and applicable dam safety permits. Applicants are required to show proof of compliance with these regulations before the [**COUNTY'S PLAN APPROVING AUTHORITY**] will issue a grading, building, or zoning permit.*

*(4) **Stormwater Measures within Flood Plain:** Construction of stormwater measures or facilities within a Federal Emergency Management Agency (FEMA) designated floodplain shall be avoided to the extent possible. When this is unavoidable, all stormwater BMP construction shall be in compliance with all applicable requirements of the [**COUNTY'S FLOOD PLAIN CODE**].*

3.6. Maintenance Agreement and Plan

Maintenance Agreement and Plan
This section is intended to ensure long-term maintenance. The approval and review procedures should include the following:

- Ensure maintenance agreements are recorded.
- Ensure the easements for maintenance and access are platted.
- Establish maintenance inspection and reporting requirements.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

Prior to approval by the JURISDICTION of a stormwater management design plan, each owner shall submit a maintenance agreement and maintenance plan in accordance with the following:

(1) **Responsible Party:** The owner shall be responsible for the operation and maintenance of such measures and shall pass such responsibility to any successor owner, unless such responsibility is transferred to The JURISDICTION or to another governmental entity in accordance with Section 3.12.

(2) **Requirement for Maintenance Agreement & Plan:** If a stormwater management design plan requires structural or nonstructural measures, the owner shall execute a stormwater maintenance agreement prior to the JURISDICTION granting final approval for the plan, or any plan of development or other development for which a permit is required under this Ordinance. The agreement shall be recorded in the office of the clerk of the circuit court for The JURISDICTION and shall run with the land.

(3) **Required Elements for Maintenance Agreement & Plan:** The stormwater maintenance agreement shall be in a form approved by The JURISDICTION, and shall, at a minimum:

(a) **Designate Responsible Party:** Designate for the land development the owner, governmental agency, or other legally established entity (responsible party) which shall be permanently responsible for maintenance of the structural or non-structural measures required by the plan.

(b) **Pass Responsibility to Successors:** Pass the responsibility for such maintenance to successors in title.

(c) **Right of Entry for Stormwater Authority**: Grant the JURISDICTION and its representatives the right of entry for the purposes of inspecting all stormwater BMPs at reasonable times and in a reasonable manner. This includes the right to enter a property when the JURISDICTION has a reasonable basis to believe that a violation of this Ordinance is occurring or has occurred and to enter when

necessary for abatement of a public nuisance or correction of a violation of this Ordinance.

(d) **Maintenance Plan:** Ensure the continued performance of the maintenance obligations required by the plan and this ordinance through a maintenance plan (which may be an attachment to the actual maintenance agreement). The plan shall include a list of inspection and maintenance tasks, a schedule for routine inspection and maintenance, actions to be taken when maintenance is required, and other items listed in the Stormwater Management Manual.

3.7. Easements

Storm drainage easements shall be required where the conveyance, storage, or treatment of stormwater is identified on the stormwater management design plan, or where access is needed to structural or non-structural stormwater measures.

The following conditions shall apply to all easements:

(1) Dimensions: Easements shall be of a width and location specified in the SUDAS Manual.

(2) Easements Approved Before Plat Approval: Easements shall be approved by the [COUNTY'S PLAN APPROVING AUTHORITY] prior to approval of a final plat and shall be recorded with the JURISDICTION and on all property deeds.

(3) Deeds of Easement: A deed of easement shall be recorded along with the final plat specifying the rights and responsibilities of each party to the easement.

3.8. Performance Bond or Guarantee

(1) ***Performance Bond or Guarantee Required:*** *No permits shall be issued unless the applicant furnishes a performance bond or guarantee. This is to ensure that action can be taken by The JURISDICTION, at the applicant's expense, should the applicant fail to initiate or maintain those measures identified in the approved stormwater management design plan (after being given proper notice and within the time specified by the JURISDICTION). If The JURISDICTION takes such action upon such failure by the applicant, The JURISDICTION shall collect from the applicant the difference should the amount of reasonable cost of such action exceed the amount of the security held.*

(2) ***Term of Performance Bond or Guarantee:*** *The performance bond or guarantee furnished pursuant to this section, or the unexpended or unobligated portion thereof, shall be returned to the applicant within sixty (60) days of issuance by the JURISDICTION of a Stormwater Certificate of Completion in accordance with Section 5, OR the final acceptance of the permanent stormwater BMP by the JURISDICTION.*

(3) ***Term Extended for Initial Maintenance****: At the discretion of the JURISDICTION, the performance bond or guarantee may be extended beyond the time period specified above to cover a reasonable period of time for testing the practices during storm events and for initial maintenance activities. For the purposes of this section, the time shall not exceed 2 years.*

(4) ***Partial Release of Bond:*** *The JURISDICTION shall have the discretion to adopt provisions for a partial pro-rata release of the performance bond or guarantee on the completion of various stages or phases of development.*

3.9. As-Built Plans

All applicants are required to submit as-built plans for any permanent stormwater management facilities located on-site after final construction is completed. The plan must show the final design specifications for all stormwater management facilities, meet the criteria for as-built plans in the Stormwater Management Manual, in addition they must include a photographic record of key components that can not be readily observed after installation, and be sealed by a registered professional engineer. A final inspection by the JURISDICTION is required before any performance bond or guarantee will be released.

3.10. Fees

Fees
- The jurisdiction should insert the applicable fee schedule in **Section 3.10**.
- If a local program does not currently charge fees for plan review, waivers, and inspections, then it should consider fees as a possible revenue source for the program.

Stormwater Utility
- It may be possible to establish a stormwater utility to support local plan review, inspection, program administration, and other stormwater management activities. Initial discussion with legal council for the Iowa State Association of Counties indicates Counties are likely not prohibited from establishing stormwater utilities. Check with legal staff before considering action to establish a stormwater utility.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

Fees
- The jurisdiction should insert the applicable fee schedule in **Section 3.10**.
- If a local program does not currently charge fees for plan review, waivers, and inspections, then it should consider fees as a possible revenue source for the program.

The JURISDICTION has the ability to require a fee to support local plan review, inspection and program administration. Each owner seeking approval of a stormwater management concept plan or stormwater management design plan shall pay a fee upon submittal of such plan, and shall pay a fee for each inspection, in amounts according to the schedule set forth below.

(1) Stormwater Management Concept Plan: $
(2) Stormwater Management Design Plan: $
(3) Amendment to a Stormwater Management Concept or Design Plan: $
(4) Request for a Waiver: $
(5) Each Inspection: $

3.11. Fee-In-Lieu Payment

The JURISDICTION may maintain a Fee-In-Lieu and/or Pro-Rata Share program in accordance with an approved watershed or subwatershed plan or stormwater master plan. Such a program shall follow the general conditions of **Section 4.9.**

3.12. Dedication of Stormwater BMPs

The owner of a stormwater practice required by this Ordinance may offer for dedication any such stormwater practice, together with such easements and appurtenances as may be reasonably necessary, as provided herein:

(1) **Preliminary Determination by JURISDICTION** : Upon receipt of such offer of dedication by The JURISDICTION, the JURISDICTION shall make a preliminary determination that the dedication of the practice is appropriate to protect the public health, safety and general welfare, and furthers the goals of [**COUNTY'S**] stormwater management program and/or associated watershed plans. The JURISDICTION shall forward its determination to [**GOVERNING BOARD OF JURISDICTION**]. Prior to making its determination, the JURISDICTION shall inspect the practice to determine whether it has been properly maintained and is in good repair.

(2) **Acceptance by [GOVERNING BOARD]: [GOVERNING BOARD OF JURISDICTION**] may accept the offer of dedication by adoption of a resolution. The document dedicating the stormwater BMP shall be recorded in the office of the clerk of the circuit court for the the JURISDICTION.

(3) **Owner to Provide Documentation**: The owner, at his sole expense, shall provide any document or information requested by the JURISDICTION or the [**GOVERNING BOARD OF JURISDICTION**] in order for a decision to be reached on accepting the practice.

Section 4. Post-Construction Performance Criteria for Stormwater Management

Post-Construction Criteria

- Criteria are the core of the stormwater ordinance. They establish the design objectives for stormwater BMPs, and will influence the types and sizes of these practices.
- Criteria in the ordinance should remain fairly simple, with technical detail relegated to the design manual.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

4.1. General Post-Construction Stormwater Management Criteria

(1) **Stormwater BMP Maintenance:** All stormwater BMPs shall be maintained in accordance with the approved and deeded stormwater maintenance agreement and stormwater maintenance plan. The design of stormwater facilities shall incorporate maintenance accommodation and long-term maintenance reduction features in accordance with the latest version of the Stormwater Management Manual.

(2) **Overland Flood Routes:** Overland flood routing paths shall be used to convey stormwater runoff from the 100-year, 24-hour storm event to an adequate receiving water resource or stormwater BMP such that the runoff is contained within the drainage easement for the flood routing path and does not cause flooding of buildings or related structures. The peak 100-year water surface elevation along flood routing paths shall be at least one foot below the finished grade elevation at the structure. When designing the flood routing paths, the conveyance capacity of the site's storm sewers shall be taken into consideration.

(3) **Velocity Dissipation:** Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall to provide non-erosive flow velocity from the structure to an adequate receiving stream or channel so that the natural physical and biological characteristics and functions of the receiving stream are maintained and protected.

(4) **Discharges to Adjacent Property:** Concentrated discharges from land development, including from stormwater practices, shall not be discharged onto adjacent developed property without adequate conveyance in a natural stream or storm sewer system. The JURISDICTION may require drainage easements where stormwater discharges must cross an adjacent or off-site property before reaching an adequate conveyance.

(5) **Individual Lots Not Separate Land Development:** Residential, commercial or industrial developments shall apply these stormwater management criteria to land development as a whole. Individual residential lots in new subdivisions shall not be

considered separate land development projects, but rather the entire subdivision shall be considered a single land development project.

(6) **Location of Stormwater Facilities on Lots:** Stormwater facilities within residential subdivisions that serve multiple lots and/or a combination of lots and roadways shall be on a lot owned and maintained by an entity of common ownership, unless an alternative arrangement is approved by the JURISDICTION. Stormwater practices located on individual lots shall be maintained by the lot owner or, at the discretion of the JURISDICTION, be placed within an easement and maintained by an entity of common ownership.

(7) **Hydrologic Computation Assumptions:** Hydrologic parameters shall reflect the ultimate land development and shall be used in all engineering calculations. All pre-development calculations shall consider woods and fields to be in good condition, regardless of actual conditions at the time of application.

(8) **Authorization to Discharge to MS4:** If runoff from a land development will flow to a municipal separate storm sewer system (MS4) or other publicly-owned storm sewer system, then the applicant shall obtain authorization from the system's owner to discharge into the system. The JURISDICTION may require the applicant to demonstrate that the system has adequate capacity for any increases in peak flow rates and volumes.

(9) **Compliance with Federal & State Regulations:** All stormwater facilities and conveyance systems shall be designed in compliance with all applicable state and federal laws and regulations, including the Federal Clean Water Act and all applicable erosion and sediment control and flood plain regulations. To the extent practical, stormwater facilities shall not be located in areas determined to be JURISDICTIONAL waters through Section 404 of the Federal Clean Water Act and/or applicable state regulations.

(10) **Protect Public Health, Safety & General Welfare:** The design of stormwater BMPs shall consider public health, safety, and general welfare. These considerations include, but are not limited to: preventing flooding of structures and travelways; preventing standing water in facilities, manholes, inlets, and other structures in a manner that promotes breeding of mosquitoes; preventing attractive nuisance conditions and dangerous conditions due to velocity or depth of water and/or access to orifices and drops; and preventing aesthetic nuisances due to excessive slopes, cuts and fills, and other conditions.

(11) **Adherence to Stormwater Management Manual:** All stormwater BMPs shall be designed to the standards of the most current version of the Stormwater Management Manual, unless the JURISDICTION grants the applicant a waiver or the applicant is exempt from such requirements.

(12) **Treat Entire Land Development:** The stormwater design shall provide for treatment of runoff from the entire land development, to the extent practical.

(13) **Landscape Plan:** The design of stormwater BMPs shall include a landscape plan detailing both the vegetation to be in the practice and how and who will manage and maintain the vegetation. The landscape plan shall be prepared in accordance with the Stormwater Management Manual.

(14) **Pretreatment:** Each stormwater BMP shall have an acceptable form of water quality pretreatment, in accordance with the pretreatment requirements found in the current Stormwater Management Manual.

(15) **Stormwater Authority Discretion:** If hydrologic, geologic, topographic, or land use conditions warrant greater control than that provided by the minimum control requirements, the JURISDICTION may impose additional requirements deemed reasonable and necessary to control the volume, timing, rate and/or quality of runoff. The JURISDICTION may restrict the use of certain stormwater BMPs, require pretreatment above the minimum standards in the Stormwater Management Manual, and/or require a stormwater pollution prevention plan in certain circumstances. These include, but are not limited to: stormwater generated from stormwater hotspots, stormwater discharges that are conveyed with non-stormwater discharges, and stormwater discharged in important groundwater management areas or areas where geologic conditions are conducive to groundwater contamination (e.g., karst).

(16) **Replicating Pre-Development Hydrology:** Stormwater management designs shall preserve the natural hydrologic functions, stream channel characteristics, and groundwater recharge of the pre-developed site, to the extent practical. This shall be accomplished by treating runoff at the source, disconnecting impervious surfaces, preserving or enhancing natural flow paths and vegetative cover, preserving or enhancing natural open spaces and riparian areas, and other measures that replicate pre-development hydrologic conditions. The JURISDICTION shall exercise discretion in the application of this standard, especially in cases of infill development, redevelopment, or other unique circumstances.

(17) **Natural Resources Inventory:** Stormwater management designs shall include an inventory of important natural resources features on the site, and these features shall be shown on the Stormwater Management Concept Plan that may be prepared in accordance with Section 3.1. Protection and/or conservation of the site's natural features may, at the discretion of the JURISDICTION, be used and given credit as "Non-Structural Measures" in accordance with Section 4.8. The natural resources inventory shall include, but not be limited to the following: natural drainage features, riparian buffers, wetlands, steep slopes, soils with high infiltration capacity, significant forest or prairie patches, and significant trees and natural communities.

(18) **Treatment of Off-Site Stormwater:** Off-site stormwater conveyed through a land development shall be placed within an easement and conveyed in a manner that

does not increase upstream or downstream flooding. Off-site stormwater shall be conveyed around on-site stormwater BMPs, unless the facilities are designed to manage the off-site stormwater. The JURISDICTION may allow credits for treating off-site stormwater.

(19) **Stream & Wetland Crossings:** All stream and wetland crossings subject to Section 404 and/or state stream and wetland regulations shall minimize impacts on streams and wetlands, to the extent practical and achievable, by crossing streams and wetlands at a right-angle, reducing the footprint of grading and fill, and utilizing bridges, open bottom arches, spans, or other structures that do not restrict or alter stream or wetland hydrology. If culverts are placed within stream and wetlands, at least one culvert shall be countersunk or otherwise placed to allow the formation of a natural channel or wetland bottom to allow movement of aquatic organisms.

4.2 Runoff Reduction Criteria

Runoff Reduction Criteria

- Runoff Reduction is a relatively recent criterion that seeks to tailor stormwater treatment to meet more specific resource objectives, such as promoting groundwater recharge, enhancing protection for locally-important resources, or providing better overall protection for water quality and downstream channel impacts.
- These criteria can apply jurisdiction-wide or to specifically-designated zones where stormwater management is more critical, such as drinking water source areas, wetlands, cold-water fisheries, impaired waters, and others.
- When using these criteria, programs should stress the use of non-structural measures (see **Section 4.8**) to complement structural practices.
- The Runoff Reduction criteria in the model ordinance give three basic options. The first focuses on groundwater recharge, and is a good choice for programs where recharge is an important objective. The second and third options are for the more generalized goal of reducing post-development runoff volumes. While these three options are provided in the model ordinance, the local program should select the one that best meets local objectives. This will simplify the application of this criterion.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

In order to replicate pre-development hydrologic conditions, and to promote baseflow to streams and wetlands, some portion of the post-development runoff shall be permanently reduced by disconnecting impervious areas, maintaining sheetflow to areas of natural vegetation, infiltration practices, and/or collection and reuse of runoff. The applicant shall use either (1) (2) or (3) below to comply with these criteria:

(1) <u>Groundwater Recharge/Infiltration</u>

Replicate the pre-development recharge volume, based on regional average recharge rates for hydrologic soil groups

- Residential Sites: Post-development recharge = 90% of pre-development recharge
- Non-Residential Sites: Post-development recharge = 60% of pre-development recharge

(2) Overall Runoff Reduction (Option 1)
No increase in the overall runoff volume compared to the pre-development condition for all storms less than or equal to the 2-year, 24-hour storm.

(3) Overall Runoff Reduction (Option 2)
Capture and remove from the site hydrograph the volume of water associated with the 80th percentile storm event (or other storm event deemed appropriate by the STORMWATER AUTHORITY).

(4) This criterion shall be met using practices outlined in the **Iowa Stormwater Management Manual** that provide for the infiltration, evapotranspiration, and/or storage and reuse of runoff.

(5) The volume of water needed for Runoff Reduction shall be considered part of the overall Water Quality Volume (WQv) required in Section 4.3, and shall not be in addition to the Water Quality Volume.

The JURISDICTION may waive some or all of the requirements of this section as specified in (6) and (7) below:

(6) **Risk of Groundwater Contamination:** Stormwater hotspots, contaminated soils, and sites in close proximity to karst or drinking water supply wells may not be subject to groundwater recharge/infiltration requirements, as determined by the JURISDICTION. The JURISDICTION may impose reasonable conditions in granting such a waiver.

(7) **Site Constraints:** Areas characterized by high water table, shallow bedrock, clay soils, contaminated soils, and other constraints may be subject to reduced volume control requirements, as determined by the JURISDICTION . The JURISDICTION may impose reasonable conditions in granting such a waiver.

(8) ***Documentation for Waiver:*** *When seeking a waiver in accordance with either (6) or (7) above, the applicant shall demonstrate that no reasonable alternatives for compliance exist through site and stormwater management design, and that stormwater discharges will not unreasonably increase the extent, frequency, or duration of flooding at downstream properties and structures or have an unreasonable adverse effect on streams, aquatic habitats, and channel stability. In making its determination to allow full or partial waivers, the* **JURISDICTION**

shall consider cumulative impacts and also the land development's adherence to the land use plans and policies of The JURISDICTION, including the promotion of infill and redevelopment in particular areas.

4.3. Water Quality Criteria

Post-development runoff that is not permanently removed through the application of the runoff reduction criterion shall be captured and treated in a water quality BMP to prevent or minimize water quality impacts from land development. The applicant shall use (1) below to comply with this criterion:

(1) **Water Quality Volume Standard:** Structural and non-structural practices shall be designed to capture and treat the Water Quality Volume (WQv). The WQv shall be computed as specified in the **Iowa Stormwater Management Manual**.

(2) This criterion shall be met using practices from the Stormwater Technology in the **Iowa Stormwater Management Manual**. BMPs or combinations of BMPs should be selected that achieve the highest pollutant load reduction for the pollutants of concern.

(3) All runoff removed through the runoff reduction criterion counts towards treating the WQv.

(4) ***Additional Criteria for Stormwater Hotspots:*** *In addition, stormwater discharges from stormwater hotspots may require the use of specific structural, non-structural, and/or pollution prevention practices, including enhanced pre-treatment. Discharges from a stormwater hotspot shall not be infiltrated without enhanced pre-treatment, as approved by the JURISDICTION.*

4.4. Channel Protection Criteria

The stormwater system shall be designed so that post-development discharges will not erode natural channels or steep slopes. This will protect in-stream habitats and reduce in-channel erosion. The applicant shall use Tier 1 or Tier 2 performance standards, as applicable, to meet this criterion.

(1) At each discharge point from the site, if the on-site drainage area is **less** than 10% of the total contributing drainage area to the receiving channel or waterbody, the following Tier 1 performance standards shall apply:

Tier 1 Performance Standards

(a) Wherever practical, maintain sheetflow to riparian buffers or vegetated filter strips. Vegetation in buffers or filter strips must be preserved or restored where existing conditions do not include dense vegetation (or adequately sized rock in arid climates).
(b) Energy dissipaters and level spreaders must be used to spread flow at outfalls.

(c) On-site conveyances must be designed to reduce velocity through a combination of sizing, vegetation, check dams, and filtering media (e.g., sand) in the channel bottom and sides.
(d) If flows cannot be converted to sheetflow, they must be discharged at an elevation that will not cause erosion or require discharge across any constructed slope or natural steep slopes.
(e) Outfall velocities must be non-erosive from the point of discharge to the receiving channel or waterbody where the discharge point is calculated.

(2) At each discharge point from the site, if the on-site drainage area is **greater** than 10% of the total contributing drainage area to the receiving channel or waterbody, then the Tier 1 performance standards in subsection (1) shall apply in addition to the following Tier 2 performance standards:

Tier 2 Performance Standards

(a) Sites greater than 10 acres (or a site size deemed appropriate by the JURISDICTION) must perform a detailed downstream (hydrologic and hydraulic) analysis based on post-development discharges. The downstream analysis shall extend to the point where post-development discharges have no significant impact, and do not create erosive conditions, on receiving channels, waterbodies, or storm sewer systems.
(b) If the downstream analysis confirms that post-development discharges will have an impact on receiving channels, waterbodies, or storm sewer systems, then the site must incorporate some or all of the following to mitigate downstream impacts:
    - Site design techniques that decrease runoff volumes and peak flows.
    - Downstream stream restoration or channel stabilization techniques, as permitted through local, state, and federal agencies.
    - 24-hour detention of the volume from the post-development 1-year, 24-hour storm. The JURISDICTION may give credit for the application of Runoff Reduction (Section 4.2) and WQv measures (Section 4.3) toward meeting storage requirements. Discharges to cold water fisheries should be limited to 12-hour detention.
(c) Sites less than 10 acres (or a site size deemed appropriate by the JURISDICTION shall verify that stormwater measures provide 12- to 24-hour detention of the volume from post-development 1-year, 24-hour storm. The JURISDICTION may give credit for the application of Runoff Reduction (Section 4.2) and WQv measures (Section 4.3) toward meeting storage requirements. A detailed downstream analysis is not required unless the local program identifies existing downstream conditions that warrant such an analysis.

4.5. Flood Control Criteria

Flood Control Criteria
The Flood Control criterion depends on where a property is situated within a watershed and the design storms that typically cause flooding in the community. This criterion can address one or both of the following, depending on community priorities:

- Overbank Flood Protection: Prevent nuisance flooding that damages downstream property and infrastructure.
- Extreme Flood Control: Maintain boundaries of the pre-development 100-year flood plain and reduce risk to life and property from infrequent but extreme storms.

Most local reviewing authorities establish an overbank design storm that is matched with the same design storm used for open channels, culverts, bridges, and storm drain systems. SUDAS requires ditches to convey the 50-year storm within the ditch banks and the 100-year storm to flow within the easement boundary.

Some flood-prone communities require a more rigorous standard to detain the 100-year storm. Even if this standard is not applied, local programs should require that all stormwater structures that impound water can safely pass the 100-year storm without overtopping or creating damaging downstream conditions, as stated in **Section 4.5**.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

Downstream overbank flood and property protection shall be provided by controlling the post-development peak discharge rate to the pre-development rate. This criterion shall be met for the design storm(s) listed in the **Stormwater Management Manual.**

Stormwater BMPs that impound water shall demonstrate that the 100-year storm can safely pass through the structure without overtopping or creating damaging conditions downstream.

The JURISDICTION may waive some or all of the requirements of this section as specified in (1), (2), (3) and (4) below:

(1) **Discharge to Large Waterbody:** The land development discharges directly to a flood plain, ocean, or major river or waterbody, and the JURISDICTION determines that waiving the flooding criteria will not harm public health and safety. The applicant shall secure drainage easements from any downstream property owners across whose property the runoff must flow to reach the flood plain, ocean, or major river or waterbody. The applicant shall also demonstrate that any piped or open-channel system in which the runoff will flow has adequate capacity and stability to receive the project's runoff plus any off-site runoff also passing through the system.

(2) **Insignificant Increases in Peak Flow:** The land development results in insignificant increases in peak flow rates, as determined by the JURISDICTION.

(3) **Alternative Criteria Provided:** The land development is subject to a floodplain study that recommends alternative criteria for flood control.

(4) **Increases in Downstream Peak Flows or Flood Elevations:** The JURISDICTION determines that complying with the requirements of this section will result increases in peak flows or downstream flooding conditions due to coincident peaks from the site and the contributing watershed or another factor.

(5) **Documentation for Waiver:** When seeking a waiver in accordance with either (1), (2), (3) or (4) above, the applicant shall demonstrate that stormwater discharges will not unreasonably increase the extent, frequency, or duration of flooding at downstream properties and structures or have an unreasonable adverse effect on streams, aquatic habitats, and channel stability. In making its determination to allow full or partial waivers, the JURISDICTION shall consider cumulative impacts and also the land development's adherence to the land use plans and policies of The JURISDICTION, including the promotion of infill and redevelopment in particular areas.

4.6. Redevelopment Criteria

Redevelopment Criteria
Redevelopment projects can present unique stormwater challenges due to existing hydrologic impacts, compacted soils, generally small size and intensive use, and other factors.

Local programs should examine flexible standards for redevelopment, so that stormwater requirements do not act as a disincentive for desirable redevelopment projects. This is especially important within designated redevelopment zones, downtown revitalization zones, enterprise zones, brownfield sites, and other areas where infill and redevelopment is promoted through local policies and incentive programs. At the same time, redevelopment offers a unique opportunity to achieve incremental water quality and/or drainage improvements in previously developed areas where stormwater controls might be few or nonexistent. Redevelopment is one of the few chances to address existing impairments.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

Land development that qualifies as redevelopment shall meet one of the following criteria:

(1) ***Reduce Impervious Surface/Area:*** *Reduce existing site Impervious Surface/Area by at least 20%.*

(2) ***Provide Treatment:*** *Provide Runoff Reduction and water quality treatment for at least 30% of the site's pre-development Impervious Surface/Area and any new Impervious Surface/Area through stormwater BMPs designed in accordance with the criteria in* ***Sections 4.2 through 4.3*** *and the* ***Stormwater Management Manual****.*

(3) ***Apply Innovative Approaches:*** *Utilize innovative approaches to reduce stormwater impacts across the site. Examples include green roofs and pervious parking materials. The local program can exercise flexibility with regard to sizing and design standards for sites that are fitting practices into existing drainage infrastructure.*

(4) ***Provide Off-Site Treatment:*** *Provide equivalent stormwater treatment at an off-site facility*

(5) ***Address Downstream Issues:*** *Address downstream channel and flooding issues through channel restoration and/or off-site remedies*

(6) Contribute to Watershed Project: *Contribute to a watershed project in accordance with* ***Section 4.9.***

(7) ***Combination of Measures:*** *Any combination of (1) through (6) above that is acceptable to the JURISDICTION.*

4.7. Sensitive Waters and Wetlands: Enhanced Criteria

Land development that discharges to sensitive waters and wetlands, as designated in the **Stormwater Management Manual**, shall meet enhanced criteria. These may include, but are not limited to:

(1) **Nutrient-Sensitive Waters:** Enhanced control of nutrients and sediment for discharges to drinking water reservoirs, lakes, estuaries, and/or coastal waters.

(2) **Cold-Water Fisheries:** Control of temperature increases for discharges to designated cold-water fisheries.

(3) **Groundwater:** Enhanced recharge and pre-treatment requirements to protect groundwater supply.

(4) **Wetlands**: The control of impacts to wetland hydrology, including limiting fluctuations to the natural or pre-development wetland hydrology.

(5) **Impaired Waters:** Enhanced bacteriological or pollutant controls for discharges to impaired waters, as designated in the most recent 303(d) list produced by EPA or the appropriate State agency.

In these cases, the JURISDICTION may require additional storage, treatment, filtering, infiltration, or other techniques. The use of non-structural practices shall be used to the maximum extent practical to meet enhanced criteria.

In making its determination to apply enhanced criteria, the JURISDICTION shall consider cumulative impacts and also the land development's adherence to the land use plans and policies of The JURISDICTION, including the promotion of infill and redevelopment in particular areas.

4.8. Non-Structural Measures

The use of nonstructural measures is encouraged to reduce sole reliance on structural stormwater management measures. The applicant may, if approved by the JURISDICTION, take credit for the use of nonstructural measures as a means to comply with the criteria in **Sections 4.2 through 4.7**. For each potential credit, there is a minimum set of design criteria that identify the conditions or circumstances under which the credit may be applied. The site design practices that qualify for this credit and the criteria and procedures for applying and calculating the credits shall be included in the **Stormwater Management Manual**.

4.9. Contribution to a Watershed Project: Fee-in-Lieu & Pro-Rata Share

Compliance Through Off-Site or Watershed Projects
A local program may want to dictate the conditions under which an off-site or watershed project can be used to comply with stormwater criteria. Such conditions may include:

- **Site Size**: Small sites (less than ½ acre impervious cover) may not be able to provide as effective or comprehensive on-site treatment compared to larger sites. Off-site or watershed solutions may make sense for small sites, especially in areas designated for infill and redevelopment.
- **Condition of Receiving Stream or Watershed**: If a site discharges to a degraded or impaired stream, even effective on-site treatment will not correct past problems. In these cases, contribution to restoration project may be suitable for partial compliance. The Stormwater Authority must assure, however, that the site development does not make conditions in the receiving stream even worse. In this regard, adherence to on-site channel protection criteria may be advisable.
- **Watershed or Subwatershed Management Plan**: As noted in **Section 4.9**, projects identified in an adopted watershed or stormwater management plan can be implemented through the site development process – either through on-site implementation or contribution to or implementation of off-site projects.

If a jurisdiction opts to collect offset fees, specific provisions relating to the collection and expenditure of the fees should be included in the ordinance. Jurisdictions should verify that the fees collected can fully recover the cost of stormwater management. For example, the Maryland Critical Areas Commission set the offset fee to recover the cost to remove phosphorus from one acre of impervious cover (CWP, 2003).

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

The JURISDICTION shall establish the criteria and conditions by which a project is eligible for a fee-in-lieu payment for off-site and watershed enhancements. The JURISDICTION may allow a fee-in-lieu payment, according to the established criteria and conditions, in lieu of partial or full on-site compliance with the requirements of this Ordinance.

Provided that the JURISDICTION implements a program in accordance with **Section 3.11**, land development projects that are within the target or drainage area of a watershed or subwatershed management plan adopted by the JURISDICTION , The JURISDICTION, and/or another appropriate local, regional, or state agency or program, shall comply with the following:

(1) **On-Site Projects**: If the watershed or subwatershed management plan identifies specific projects on the applicant's property, the JURISDICTION may allow

implementation of some or all of these projects as part of the stormwater management design plan to satisfy, in part or in whole, the criteria in Sections 4.2 through 4.7.

(2) **Fee-in-Lieu Contribution for Off-Site Projects:** The JURISDICTION may allow a fee-in-lieu contribution to off-site watershed project(s) identified in the management plan to satisfy, in part or in whole, the criteria in Sections 4.2 through 4.7. The fee-in-lieu contribution shall be in accordance with the fee schedule adopted by The JURISDICTION and maintained by the JURISDICTION.

(3) **Regional Stormwater Management:** If the land development is within the drainage area of an existing or planned regional stormwater BMP identified in the management plan, the applicant shall pay a pro-rata share of the cost of implementing the practice. The pro-rata share contribution shall be in accordance with the fee schedule adopted by The JURISDICTION and maintained by the JURISDICTION. If a project is eligible for a fee-in-lieu and pro-rata share contribution, then the JURISDICTION shall determine one or the other fee or contribution for the project to pay.

(4) **Other Off-Site Projects:** In certain circumstances dictated by the JURISDICTION, the applicant may propose an off-site watershed solution as a means to comply, in part or in whole, with the criteria in **Sections 4.2 through 4.7**. In these cases, the JURISDICTION shall require submission of a comprehensive watershed study that includes sufficient information to evaluate impacts of the proposed solution on runoff rates, water quality, volumes and velocities, and environmental characteristics of the affected areas. The JURISDICTION may approve the watershed solution as a means to comply with **Sections 4.2 through 4.7**, in part or in whole, if the watershed solution provides better overall protection for water resources than strict application of the on-site criteria. In all cases, land rights, access agreements or easements, and a maintenance agreement and plan shall be provided to ensure long-term maintenance of any off-site watershed project.

Nothing in the subsection shall compel the JURISDICTION to approve a plan that, in its determination, may pose a threat to public health, safety, or the environment. In approving a contribution to a watershed project, the JURISDICTION may apply conditions necessary to protect downstream property and environmental resources.

4.10. Waivers

Every applicant shall provide for stormwater management as required by this Ordinance, unless a written request for a waiver is filed and approved by the JURISDICTION. Prior to applying for a waiver request, the applicant must demonstrate that all reasonable options to comply with Ordinance have been exhausted, including the use of non-structural measures (**Section 4.8**) and/or construction or contribution to a watershed project (**Section 4.9**).

The request for a waiver must be in writing and must include waiver fee specified in **Section 3.10**. The JURISDICTION shall respond in writing by granting or denying the waiver in full, or granting the waiver with any necessary conditions or mitigation

measures to protect public health, safety, and the environment. The applicant shall note any full or partial waivers, and conditions imposed by the JURISDICTION, on the stormwater management design plan.

Section 5. Construction Inspection for Permanent Stormwater BMPs

Construction Inspection for Permanent BMPs

- The inspection section of the ordinance outlines the regulatory requirements for inspecting and reporting on permanent stormwater controls.
- The ordinance should be clear about who is responsible for conduction inspections (the responsible party, a local government department or a combination), and the type and frequency of reporting that must be submitted.

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

5.1. Notice of Construction Commencement

The applicant must notify the JURISDICTION before the commencement of construction. In addition, the applicant must notify the JURISDICTION in advance of construction of critical components of the stormwater practices on the approved stormwater management design plan. The JURISDICTION may, at its discretion, issue verbal or written authorization to proceed with critical construction steps, such as installation of permanent stormwater practices based on stabilization of the drainage area and other factors.

5.2. Construction Inspections by JURISDICTION or its Representatives

The JURISDICTION or its representatives shall conduct periodic inspections of the stormwater practices shown on the approved stormwater management design plan, and especially during critical installation and stabilization steps. All inspections shall be documented in writing. The inspection shall document any variations or discrepancies from the approved plan, and the resolution of such issues. A photographic record of construction or installation of key components must be maintained. Additional information regarding inspections can be found in the **Stormwater Management Manual**. A final inspection by the Stormwater Authority is required before any performance bond or guarantee, or portion thereof, shall be released.

5.3. Inspection by Certified Inspector

At its discretion, the JURISDICTION may authorize the use of private inspectors to conduct and document inspections during construction. Such private inspectors shall submit all inspection documentation in writing to the **JURISDICTION.** All costs and fees associated with the use of private inspectors shall be the responsibility of the applicant.

If the use of private inspectors is authorized, the JURISDICTION shall maintain a training and certification program, or authorize another entity to maintain such a program. All private inspectors shall be certified prior to conducting any inspections or submitting any inspection documentation to the JURISDICTION.

If private inspectors are utilized, then inspections by the JURISDICTION or its representatives, as provided in **Section 6.2**, may be reduced in frequency. However, the JURISDICTION shall remain the responsible entity for ultimate inspection, approval, and acceptance of all stormwater BMPs, and for issuance of the Certificate of Completion in accordance with **Section 5.5**.

5.4. Stormwater Certificate of Completion

Subsequent to final installation and stabilization of all stormwater BMPs shown on the stormwater management design plan, submission of all necessary as-built plans, and final inspection and approval by the JURISDICTION, the JURISDICTION shall issue a Stormwater Certificate of Completion for the project. In issuing such a certificate, the JURISDICTION shall determine that all work has been satisfactorily completed in conformance with this Ordinance.

Section 6. Ongoing Maintenance for Stormwater BMPs

6.1. Maintenance Responsibility

*The responsible party named in the recorded stormwater maintenance agreement (**Section 3.6**) shall maintain in good condition and promptly repair and restore all structural and non-structural stormwater BMPs and all necessary access routes and appurtenances (grade surfaces, walls, drains, dams and structures, vegetation, erosion and sedimentation controls, and other protective devices). Such repairs or restoration and maintenance shall be in accordance with the approved stormwater management design plan, the stormwater maintenance agreement, and the stormwater maintenance plan.*

6.2. Maintenance Inspection by JURISDICTION or its Representatives

The JURISDICTION or its representatives shall conduct periodic inspections for all stormwater practices for which a Stormwater Certificate of Completion has been issued in accordance with Section 5.5. All inspections shall be documented in writing. The inspection shall document any maintenance and repair needs and any discrepancies from the stormwater maintenance agreement and stormwater maintenance plans. A photographic record of the periodic inspections and any operation and maintenance activities must be maintained.

6.3. Maintenance Inspection by Certified Inspector

At its discretion, the JURISDICTION may authorize the use of private inspectors to conduct and document ongoing maintenance inspections. Such private inspectors shall submit all inspection documentation in writing to the JURISDICTION. All costs and fees associated with the use of private inspectors shall be the responsibility of the responsible party.

If the use of private inspectors is authorized, the JURISDICTION shall maintain a training and certification program, or authorize another entity to maintain such a program. All private inspectors shall be certified prior to conducting any inspections or submitting any inspection documentation to the JURISDICTION.

*If private inspectors are utilized, then inspections by the JURISDICTION or its representatives, as provided in **Section 6.2**, may be reduced in frequency. However, the JURISDICTION shall remain the responsible entity for ultimate inspection of stormwater practices and any enforcement actions necessary under **Section 7 of this Ordinance**.*

6.4. Records of Maintenance Activities

The responsible party shall make records of the installation and of all maintenance and repairs, and shall retain the records for at least five (5) years. These records shall be made available to the JURISDICTION during inspection of the practice and at other

reasonable times upon request. An annual report of the previous years inspection and operation and maintenance activities must be submitted to the JURISDICTION.

6.5. Failure to Provide Adequate Maintenance

In the event that the stormwater BMP has not been maintained and/or becomes a danger to public safety or public health, the JURISDICTION shall notify the responsible party by registered or certified mail. The notice shall specify the measures needed to comply with the maintenance agreement and the maintenance plan and shall specify that the responsible party has thirty (30) days or other time frame mutually agreed to between the JURISDICTION and the responsible party, within which such measures shall be completed. If such measures are not completed, then the JURISDICTION shall pursue enforcement procedures pursuant to Section 7 of this Ordinance.

If a responsible person fails or refuses to meet the requirements of an inspection report, maintenance agreement, or maintenance plan the JURISDICTION, after thirty (30) days written notice (except, that in the event the violation constitutes an immediate danger to public health or public safety, 24 hours notice shall be sufficient), may correct a violation of the design standards or maintenance requirements by performing the necessary work to place the practice in proper working condition. The JURISDICTION may assess the responsible party of the practice for the cost of repair work which shall be a lien on the property, or prorated against the beneficial users of the property, and may be placed on the tax bill and collected as ordinary taxes by The JURISDICTION.

Section 7. Violations, Enforcement and Penalties

7.1. Violations

Any action or inaction which violates the provisions of this Ordinance, the requirements of an approved stormwater management design plan or permit, and/or the requirements of a recorded stormwater maintenance agreement may be subject to the enforcement actions outlined in this Section. Any such action or inaction is deemed to be a public nuisance and may be abated by injunctive or other equitable relief. The imposition of any of the penalties described below shall not prevent such equitable relief.

7.2. Notice of Violation

If the JURISDICTION or The JURISDICTION determines that an applicant or other responsible person has failed to comply with the terms and conditions of a permit, an approved stormwater management design plan, a recorded stormwater management maintenance agreement, or the provisions of this ordinance, it shall issue a written notice of violation to such applicant or other responsible person. Where a person is engaged in activity covered by this ordinance without having first secured a permit therefore, the notice of violation shall be served on the owner or the responsible person in charge of the activity being conducted on the site.

The notice of violation shall contain:

(1) The name and address of the owner or the applicant or the responsible person;

(2) The address or other description of the site upon which the violation is occurring;

(3) A statement specifying the nature of the violation;

(4) A description of the remedial measures necessary to bring the action or inaction into compliance with the permit, the stormwater management design plan, the stormwater maintenance agreement, or this ordinance and the date for the completion of such remedial action;

(5) A statement of the penalty or penalties that may be assessed against the person to whom the notice of violation is directed; and,

(6) A statement that the determination of violation may be appealed to **[GOVERNING BOARD OF JURISDICTION]** by filing a written notice of appeal within thirty (30) days after the notice of violation (except, that in the event the violation constitutes an immediate danger to public health or public safety, 24 hours notice shall be sufficient).

7.3. Penalties

Penalties (Civil)

- Most post-construction ordinances do not have a schedule of civil penalties as laid out in **Section 7.3(4).** The advantage of having such a schedule is that it makes administering the civil penalties more predictable and easier for the jurisdiction to apply. For a particular jurisdiction, the specific violations tied to civil penalties and the penalty amounts can be modified.
- **Check with legal staff before including a schedule of civil penalties. State or local codes may specify how these can apply.**

This box contains clarifications or presents options and must be deleted prior to adopting the ordinance.

In the event the remedial measures described in the notice of violation have not been completed by the date set forth for such completion in the notice of violation, any one or more of the following actions or penalties may be taken or assessed against the person to whom the notice of violation was directed.

(1) **Stop Work Order:** The **JURISDICTION** may issue a stop work order which shall be served on the applicant or other responsible person. The stop work order shall remain in effect until the applicant or other responsible person has taken the remedial measures set forth in the notice of violation or has otherwise cured the violation or violations described therein, provided the stop work order may be withdrawn or modified to enable the applicant or other responsible person to take the necessary remedial measures to cure such violation or violations.

(2) **Withhold Certificate of Occupancy:** The **JURISDICTION , [COUNTY'S PERMIT ISSUING AUTHORITY]**, or may refuse to issue a certificate of occupancy for the building or other improvements constructed or being constructed on the site until the applicant or other responsible person has taken the remedial measures set forth in the notice of violation or has otherwise cured the violations described therein.

(3) **Suspension, Revocation or Modification of Permit:** The **JURISDICTION** may suspend, revoke or modify the permit authorizing the land development project. A suspended, revoked or modified permit may be reinstated after the applicant or other responsible person has taken the remedial measures set forth in the notice of violation or has otherwise cured the violations described therein, provided such permit may be reinstated upon such conditions as the **JURISDICTION** may deem necessary to enable the applicant or other responsible person to take the necessary remedial measures to cure such violations.

Check with legal staff before including a schedule of civil penalties. State or local codes may specify how these can apply.

(4) ***Civil Penalties:*** *In the event the applicant or other responsible person fails to take the remedial measures set forth in the notice of violation, the* ***JURISDICTION*** *may impose a penalty not to exceed $1,000 (depending on the severity of the violation) for each day the violation remains unremedied after receipt of the notice of violation. A schedule of civic penalties is outlined in the table below.*

Violation	*Penalty*
Failure to submit and receive approval of a stormwater management design plan prior to construction	***[$ 1,000]***
Failure to submit and receive approval of a stormwater maintenance agreement and plan prior to construction	***[$ 500]***
Failure to install stormwater BMP(s) as indicated on the approved stormwater management design plan	***[$ 750]***
Failure to notify Stormwater Authority before commencement of construction	***[$ 500]***
Failure to maintain stormwater BMP within 30 days of notification (See Section 6.5 for more detail)	***[$ 750]***

- ***JURISDICTIONS SHOULD check with legal staff before including criminal penalties. State or local codes may specify how these can apply.***

(5) ***Criminal Penalties****: For intentional and flagrant violations of this ordinance, the* ***JURISDICTION*** *may issue a citation to the applicant or other responsible person, requiring such person to appear in* ***[APPROPRIATE MUNICIPAL, MAGRISTRATE, OR RECORDERS]*** *court to answer charges for such violation. Upon conviction, such person shall be punished by a fine not to exceed $1,000 or imprisonment for 60 days or both. Each act of violation and each day upon which any violation shall occur shall constitute a separate offense.*

7.4. Appeals

The decisions or orders of the **JURISDICTION** shall be final. Further relief shall be to a court of competent jurisdiction.

7.5. Remedies Not Exclusive

The remedies listed in this Ordinance are not exclusive of any other remedies available under any applicable federal, state or local law.

Approved by: _____ Date _____

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