CITY OF WEST BRANCH

Stormwater Best Management Practices

FINAL REPORT

November, 2015

UTILITY INFRASTRUCTURE SOLUTIONS

hbk ENGINEERING

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Project Background

History:

The City of West Branch has commissioned the following report in order to further their efforts in applying Best Management Practices to stormwater and flooding issues in their town. This document is intended to complement both the approved 2016 to 2020 Capital Improvements Plan (CIP), and the 2014 Comprehensive Parks Plan, showing where stormwater improvements can be made in conjunction with CIP and Parks projects. Projects that are not related to the Capital and Parks improvements are also included in this document under the umbrella category of Good Housekeeping. The West Branch City Council acknowledges the importance of including BMPs with their plans for future projects. This report is intended to ensure that every project receives consideration for how to decrease runoff excesses and pollution, and decreases the likelihood of needing to retrofit existing structures to accommodate BMPs, which is typically a more costly undertaking. Samples of policy regarding Stream Buffers, and summary descriptions of the recommended BMPs have been included for reference in the Appendices section of this report.

Introduction:

Stormwater Best Management Practices (BMPs) differ from traditional stormwater management in several ways. When new development takes place and impervious surfaces are increased through paving, building, and soil degradation, the quantity of water that runs overland to streams and rivers increases, while the quality of that water tends to decrease. In traditional stormwater practices the focus is primarily on quantity issues, that result in practices that move water efficiently into pipe networks and detention basins, while water quality is often neglected. With Stormwater BMPs, a stronger emphasis is placed on dealing with both quantity and quality, largely by allowing soil to filter out contaminants in stormwater runoff before allowing it to enter a nearby water body. This has the dual benefit of decreasing the need for large detention basins, as more water is allowed to infiltrate back into the ground, while also increasing the health of rivers and streams by preventing water contaminated by oil, grease, chemicals, or other debris from entering through storm sewer outlets.

The majority of stormwater BMPs are designed to intercept and treat runoff from 90% of storms in an average year. In our part of the state, this applies to all storms with an approximate rainfall depth of 1.25 inches or less. The less frequent, larger storm events are beyond the capacity of these practices; and thus, most BMPs will not be able to prevent flooding from larger rains, or treat water that enters during larger storm events. Therefore, even with the use of BMPs, streams and rivers are still vulnerable to erosion and degradation from flooding and high flow events, and may need to be amended to preserve stability and ecologic health. For this reason, several Stream Stabilization BMPs have been outlined in the Appendices section of this report, along with the Stormwater BMPs that have been identified for implementation in West Branch.

Methods:

In choosing sites that are suitable for stormwater BMPs, there are several factors that must be evaluated. These factors broadly include soil type and infiltration rates, topographic slopes, and proximity to flood plains and water bodies and ability to maintain. Depending on the BMP in question, these features may impact the suitability of a given site. In order to formulate our recommendations, the following methods were used.

Meetings with Stake Holders and Site visits

This included five meetings with city council members, the city administrator and other city staff. These meetings were critical in getting a sense of priority areas, which practices may be best received by citizens and maintenance staff, and where plans are currently in place for new development or construction work.

South of Public Work Building, West Branch

Mapping

Organizing the various pieces of information for this report geographically assisted in a clearer overall understanding of project locations, proximity to other features, and their topographic and geologic settings. General soil information was gathered from the USDA Web Soil Survey, while county contours, aerial photos, flood maps, and other points of interest were compiled using GIS data.

Soil Testing

Eight soil testing sites were selected to augment the online soil data. Bore holes were dug to a depth of three feet in these areas. Soils were examined and an infiltration test was performed to determine infiltration rates at the various sites. These tests were considered to be necessary due to the fact that the USDA Soil Survey information is typically less accurate in urban areas where soils have been highly altered during construction and other uses.

Soil tests were preformed using the procedure described in pages 4 through 6 of Iowa's Rain Garden Design and Installation Manual.

Soil Testing, HBK Staff

Soil Mapping Results

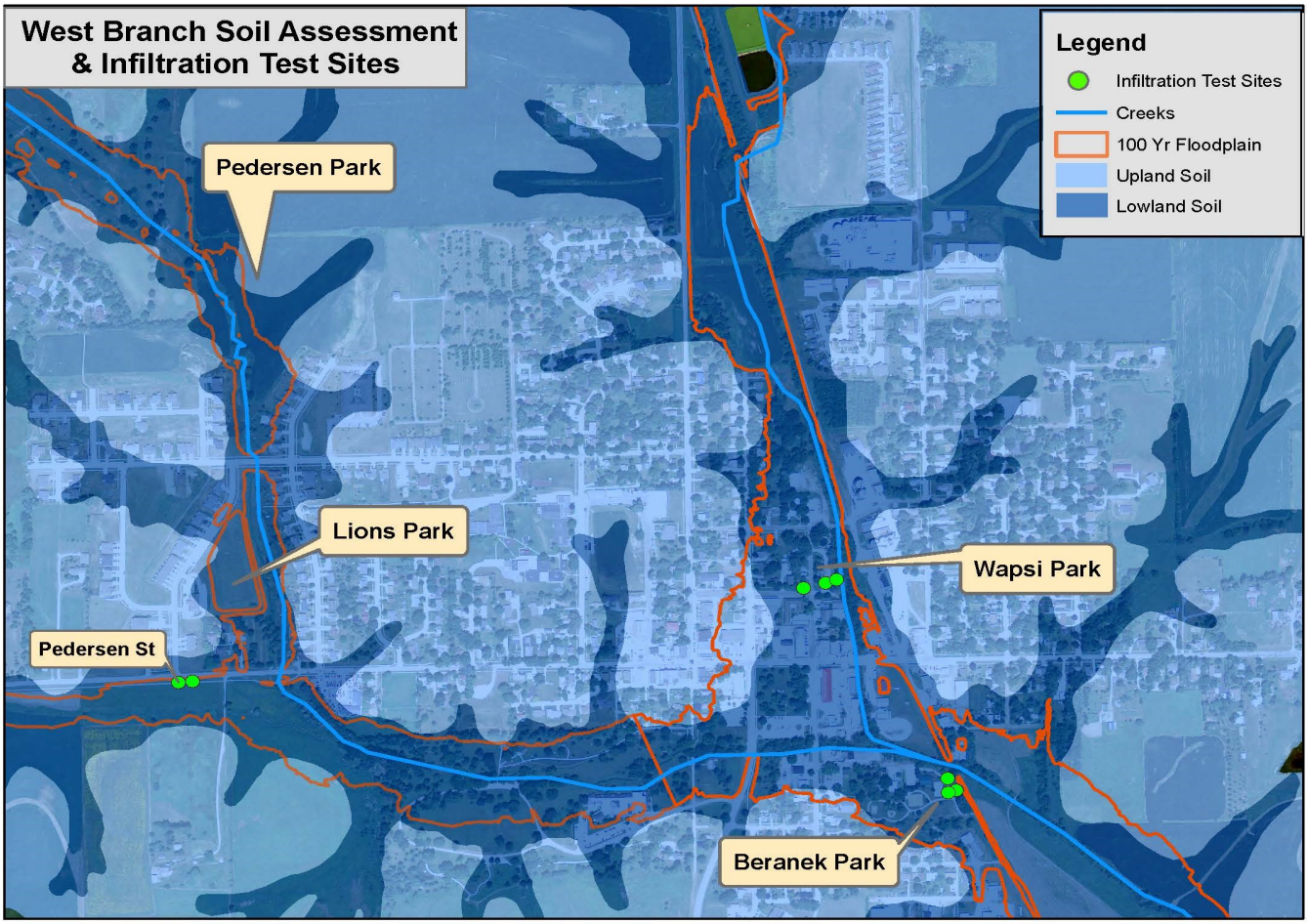


Figure 1. Soil Map

Soil data downloaded from the USDA Web Soil Survey was imported into GIS to create the above map. Although many soil types exist in West Branch, they have been consolidated into two major groups for the purposes of this report. The light blue group noted in the legend as "Upland Soil" includes Tama Silt Loam, Downs Silt Loam, and Lindley Loam. The "Lowland Soil" includes Ely Silty Clay Loam, Colo-Ely Complex, and Colo Silt Loam. As can be noted from the contour lines, the lighter colored soils are mostly found on slopes and along ridges, while the darker soils are located in low-lying areas and major drainage routes for the Hoover and Wapsinonoc Creeks.

Broadly speaking, the Upland Soils tend to be well drained, while the Lowland Soils are more prone to flooding. However, some lowland soils can still drain well if they have good structure (i.e. have not been compacted). It is for this reason that the infiltration test sites focus on areas in the Lowland Soil groups, because these soils tend to have slower infiltration rates.

It should also be noted that in urban areas Soil Survey Data can be inaccurate. Construction practices heavily alter, and in some cases remove top soil. This map provides a broad outline of the type of soil that may be found in these areas, but it should not be the sole source of information for determining stormwater management practices.

Soil Testing Results and Discussion

The sites listed in the table below were selected for soil testing because they are all areas where future improvement projects would potentially be taking place, and, according to the soil map, all are in marginal areas for infiltration. The locations of each site can be noted on the above map. By examining these soils in the field, it was possible to determine whether or not it is advisable to pursue plans for implementing infiltration BMPs in these areas.

Bore #	Infiltration Rate (in/hr)	Location	Soil unit on map	Suitability
1	6.00	Beranek 1	133+	Suitable
2	8.00	Beranek 2	133+	Suitable
3	0.40	Beranek 3	133+	Not Suitable
4	2.77	Wapsi 1	133+	Suitable
5	9.80	Wapsi Parking	911B	Suitable
6	10.00	Wapsi 2	133+	Suitable
7	0.40	Pedersen and Main 1	911B	Not Suitable
8	0.80	Pedersen and Main2	911B	Suitable

Table 1. Infiltration Testing Results

The above summary table shows the most representative infiltration rates determined from the tested sites. General guidelines state that any infiltration rates of less than 0.5 inches per hour are unsuitable for practices like rain gardens that rely solely on infiltration and do not incorporate an underground drain. As shown in the table, the majority of the sites tested were well above this threshold; however, two sites were not and another was only 0.8 inches per hour. Additional results and notes from the soil tests can be found in Appendix F.

The bore sites that drained well in Beranek and Wapsi parks exceeded expectations. Both of these parks are located in the Wapsipinonoc 100-year floodplain and are in a soil mapping unit that is often associated with poor drainage. On the other hand, one site tested in Beranek had a significantly slower infiltration rate than the other two, meaning that there may be other places in both parks where infiltration rates are less.

At the Pedersen and Main Street Crossing, two holes were dug south of Main Street. In both cases a dense clay layer was found roughly two feet below the surface. This layer seems to have severely impeded infiltration at these sites.

Overall, the findings of the infiltration tests demonstrate the fact that soil maps do not always give the full picture of actual soil properties. This is especially true in urban areas where soils have been significantly altered by construction and other practices. For this reason it is important that more soil tests be conducted before any BMP designs are finalized.

Plan of Action

Preliminary Steps to Consider

Before embarking on the specific projects suggested in the Plan of Action, the following topics should be reviewed:

- Maintenance Practices and Plans
- Stream and Soil Assessments
- Costs, Grants, and Funding

Maintenance Practices and Plans

Like all infrastructure, Stormwater BMPs need to be maintained. Even well-designed projects will fail on a fairly short time scale if vegetation is not properly established, native plantings are left untended, or citizens are not informed of the design needs. For instance, permeable paver systems that are not routinely vacuumed will gather debris in their porous chambers and will not allow stormwater to infiltrate as designed.

Permeable Paver Maintenance

Although the need may vary based on the type of paver and the specific site where pavers are laid, a general recommendation for maintaining functional infiltration rates over permeable pavers is to vacuum the surfaces twice per year (fall and spring) to unclog porous spaces. In some cases, where pavers are not exposed to sand, gravel, or sediment, several years may pass before maintenance is needed. Allowing too much time to pass, however, may result in more work when the pavers are cleaned. Serious clogs may require vacuuming out aggregates and replacing with new, clean rock.

Regenerative Air Vacuum Truck, Dubuque, IA

Vacuuming can be a stumbling block for small communities that do not own a vacuum truck or the necessary attachments to remove debris. HBK has investigated this issue locally with results supplied on the following page.

Plan of Action

Permeable Paver Maintenance

Equipment	Use	Local Sources
Pure Vacuum or Regenerative Air Vacuum Truck	General Maintenance for wetting, sweeping and vacuuming debris	Cities of Marion, West Liberty, Davenport and Dubuque own these trucks
General Vacuum truck (for sewer cleanouts)	General to heavy maintenance. Can be used with an attachment or as a power washing and vacuum combination	Cities listed above have these, and West Branch has used one previously for sewer cleanouts
Attachments that can hook onto truck vacuum hoses	Power washing and vacuum attachments such as the Quick Supply model shown in the photo on this page	Some cities may have purchased these recently , however a majority are rented from the contractors who make them or install pavers
Contract Maintenance	It may be possible to arrange maintenance agreements with contractors who sell/ install paver systems.	Some of the local permeable paver and vacuum maintenance contractors include: Hardscape Solutions– Marion Culver Landscaping– Marion City Sewer Service– Iowa City Quick Supply Landscaping-Des Moines

Quick Supply vacuum attachment designed for Pavedrain pavers. Used here on Willow Creek pavers, Dubuque, IA.

Power washing pavers to force debris out in clogged areas, Dubuque, IA

Plan of Action

Native Vegetation Maintenance

As a common component of bio-retention cells, bio-swales, and rain gardens, establishing and maintaining native vegetation is critical to a successful system. Unlike most landscaping, native plants establish over a period of several years. During the establishment period, natives will need frequent maintenance and will not appear overtly attractive. This is often a stumbling block with residents who are not familiar with native plantings and will likely be concerned that the plants are failing. Education is critical both to inform the public with "Prairie in Progress" signs, and also in educating maintenance staff and volunteers in how to identify weeds and tend the beds. Setting regular watering, weeding, and burning schedules for the introduced plant material allows their root systems to hold the soil in place and prevent erosion.

Native Plant Bed, North Liberty Penn Meadows Park

Tallgrass Prairie in front of the State Hygienic Laboratory, Coralville

Fortunately, after plants have established, the maintenance workload decreases significantly, typically consisting of burning once every few years. Re-seeding or inter-seeding may be necessary to increase plant diversity on occasion as well.

Burning native plants is advisable when possible because it quickly removes thatch, weeds, and woody vegetation and introduces additional nutrients to the soil. The native plants, which are highly tolerant of these fires, are then able to return in full force. Prairie burns should always be done in cooperation with local fire departments and experienced persons. If burning is not possible for a given area, other methods such as mowing and spraying may be used to control weeds and improve plant diversity.

Plan of Action

Stream and Soil Assessments

Several projects in this report recommend stream bank stabilizations and channel improvements. Before specific locations for these practices can be chosen, however, HBK would recommend that an assessment of the waterways in West Branch be performed. Data from this assessment should show areas where banks are destabilized due to erosion and undercutting, as well as data on bed materials, soil changes, and biologic activity if possible. This information will give a baseline for the current condition of streams. Recommended timing for this activity is in fall or spring when vegetation is not so thick as to hide channel features.

As noted in the Soil Testing Discussion, additional infiltration tests and soil samples should be evaluated before final design of any infiltration-based stormwater BMP.

Hoover Creek at Lion's Field

Wapsinonoc Creek at Wapsi Park

Plan of Action

Costs, Grants, and Funding

Costs

Although it is outside the scope of this project to provide cost estimates for specific projects, it is possible to give a rough range of prices based on our experience of past projects. Such a range may prove useful for initial planning purposes, although a more detailed investigation of sizes and quantities would be necessary to get a better picture of project costs. For the purposes of the report, we recommend the following:

Stormwater BMPs: Includes raingardens, bio-retention cells and swales, permeable pavers etc.	$20 per square foot of disturbance
Stream Stabilization Practices: Includes riffles, bank stabilization etc.	$100-$150 per linear foot of stream reach

Grants and Funding

There are many options and sources for funding stormwater projects. These include municipal stormwater utility fees, state and federal grants, loan programs etc. Many projects are paid with by a variety of different sources. A comprehensive list of programs that can be investigated or applied for is found in Appendix C.

Plan of Action

The remainder of this section gives the findings of our investigations, specifying suggested practices for specific locations throughout West Branch. These recommendations are broken into three categories:

1) Projects that can be done in conjunction with the Capital Improvements Plan (CIP)

2) Projects related to Parks Improvements

3) Good Housekeeping Projects

Some projects from each of these categories have been identified as "High Priority" by City Council members. Such projects are generally explained in more detail, while projects that were not on the "High Priority" list are explained more briefly under the title "Additional Projects".

Category 1: BMPs Related to CIP Projects

This category contains the largest number of projects, five of which have been identified as high priority by the City council . Suggestions for the priority projects will be described in detail on pages 10-11, while the remaining projects are listed in Table 2 on page 12. See Appendix B for more details on each project regarding their project year of construction, budget, average slopes, soil types, location in the floodplain etc.

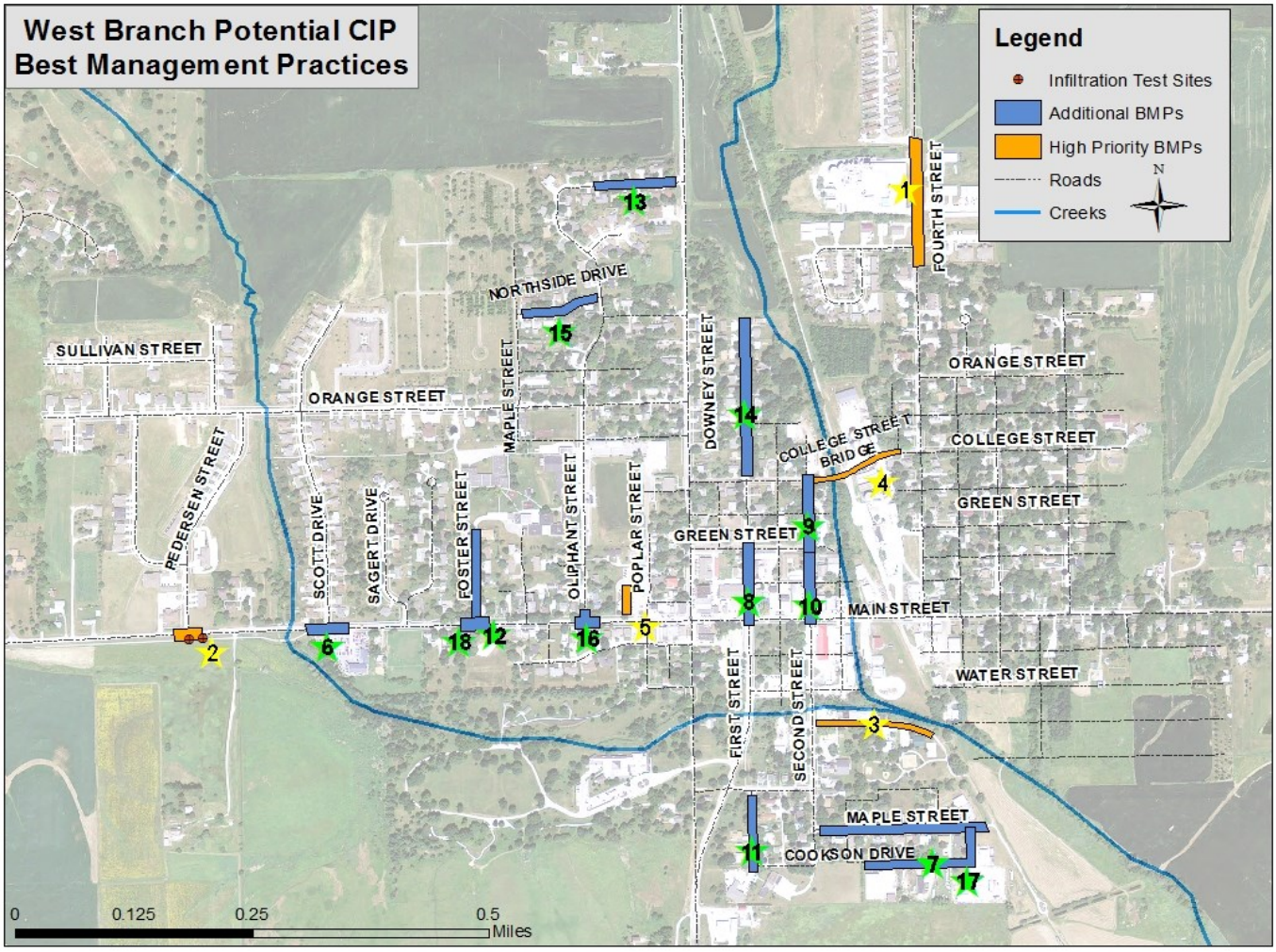


Figure 2. CIP Map

Map Key

1	4th Street Improvements
2	Pedersen and Main Street Crossing
3	Beranek Drive Park Entrance
4	College Street Bridge Replacement
5	Town Hall Renovation
6	Scott and Main Street Crossing
7	Maple Street Asphalt Overlay
8	N First Street Improvements
9	Second St. from Green to College
10	Second St. from Main to Green
11	S First St. from Cookson to Cedar
12	Foster St. from Main to End
13	Oliphant St. to Downey
14	N First St. from College to End
15	Northside Dr. from Oliphant to Maple
16	Oliphant and Main Street Crossing
17	Cookson Dr. from Maple to End
18	Foster and Main Street Crossing

Category 1: BMPs Related to CIP Projects

Priority Projects:

Bio-swale Included in 4th Street Improvements

Current Construction Plan per CIP	Install sidewalk on the West side of the street and make street improvements.
Suggested BMP Component	Bio-swale collecting water from roadway. Swale would run between new sidewalk and the road. Average slope of approximately 4 percent.

Bio-Swale Example, North Liberty

Bio-Swale Example in Seattle, EPA Website

Bio-swale at Pedersen and Main Street Crossing

Current Construction Plan per CIP	Create ADA accessible crossing by raising the existing pedestrian trail to the level of the roadway. Known flooding issues also exist in this area between intersection and creek to the south east.
Suggested BMP Component	Direct excess water from intersection to a bio-swale running south of the roadway. Average slope of approximately 1 percent. Underground perforated drainage pipe could then carry filtered water to the Wapsinonoc Creek, and during high flow events the swale would be designed to convey water overland to the creek as well.
Additional Note	Two infiltration tests were performed near this site. Both yielded sub-optimal drainage rates due to a heavy clay layer found at a depth of approximately two feet (see soil testing data). Special care must therefore be taken in designing the capacity of the underground drainage for this feature and some type of soil remediation may be advisable.

Category 1: BMPs Related to CIP Projects

Bio-retention Cells on Beranek Drive

Current Construction Plan per CIP	Install sidewalk and widen parking lot as well as general improvements to the street and the park entrance aesthetics.
Suggested BMP Component	Direct water from roadway and parking to bio-retention cells. Drainage in this area may be poor based on soil testing and type; therefore these cells should be planted with water tolerant plants. Underground drainage can take filtered water to Wapsinonoc Creek.

Stream stabilization near College Street bridge replacement

Current Construction Plan per CIP	Replace Bridge
Suggested BMP Component	Include stream stabilization practices such as reshaping cut banks, adding rip rap and native vegetation, engineered rocked riffles.

Town Hall Renovation

Current Construction Plan per CIP	Overall improvements to Town Hall building
Suggested BMP Component	Consider the inclusion of bio-cells and/or rainwater harvesting in any landscaping plan. These could collect water from the Town Hall roof drains. Soil type and location within the 100 year flood plain suggest that the site will need some type of underdrain.

College Street Bridge

Example of rain garden at Town Hall in Somers, Wisconsin

Category 1: BMPs Related to CIP Projects

Table 2: Additional Projects

CIP	RAIN GARDEN	BIO-CELL	BIO-SWALE	PERVIOUS PAVING
OLIPHANT AND MAIN ST CROSSINGS/ IMPROVEMENTS	X	X	X	X
FOSTER AND MAIN ST CROSSINGS/ IMPROVEMENTS	X	X	X	X
S. MAPLE 2ND TO 4TH		X	X	
N. 1ST ST GREEN TO MAIN	X	X	X	
2ND ST GREEN TO COLLEGE		X	X	
2ND ST MAIN TO GREEN		X	X	
S. 1ST ST COOKSON TO CEDAR	X	X		
COOKSON DR MAPLE TO END	X	X	X	X
FOSTER ST MAIN TO SCHOOL	X	X	X	X
OLIPHANT ST DOWNEY TO 551 N		X		X
N. 1ST ST COLLEGE TO END		X	X	
NORTHSIDE DR OLIPHANT TO MAPLE		X	X	X
W. MAIN ST OVERLAY		X	X	X
E. MAIN ST OVERLAY		X	X	X
	NO IN DRAINAGE SOILS		NO OVER 6%	NO IN FLOOD-PLAIN
				NO OVER 6%

An "X" indicates that given the current available information, this practice could be applicable at this location. Soil testing should still be performed at any specific site before a design is finalized. Multiple practices can be used together on the same site in order to act as a treatment train.

Category 2: BMPs Related to Parks Improvements

This category is intended to include any projects that could be included with the West Branch Parks Improvements. As mentioned in the previous Comprehensive Parks Report, HBK feels that stormwater quality is a high priority with all development, and even more so in publicly owned, operated, and often visited settings such as parks. Three of these projects were listed as high priority by City Council, while the additional projects were identified as feasible improvements by HBK staff.

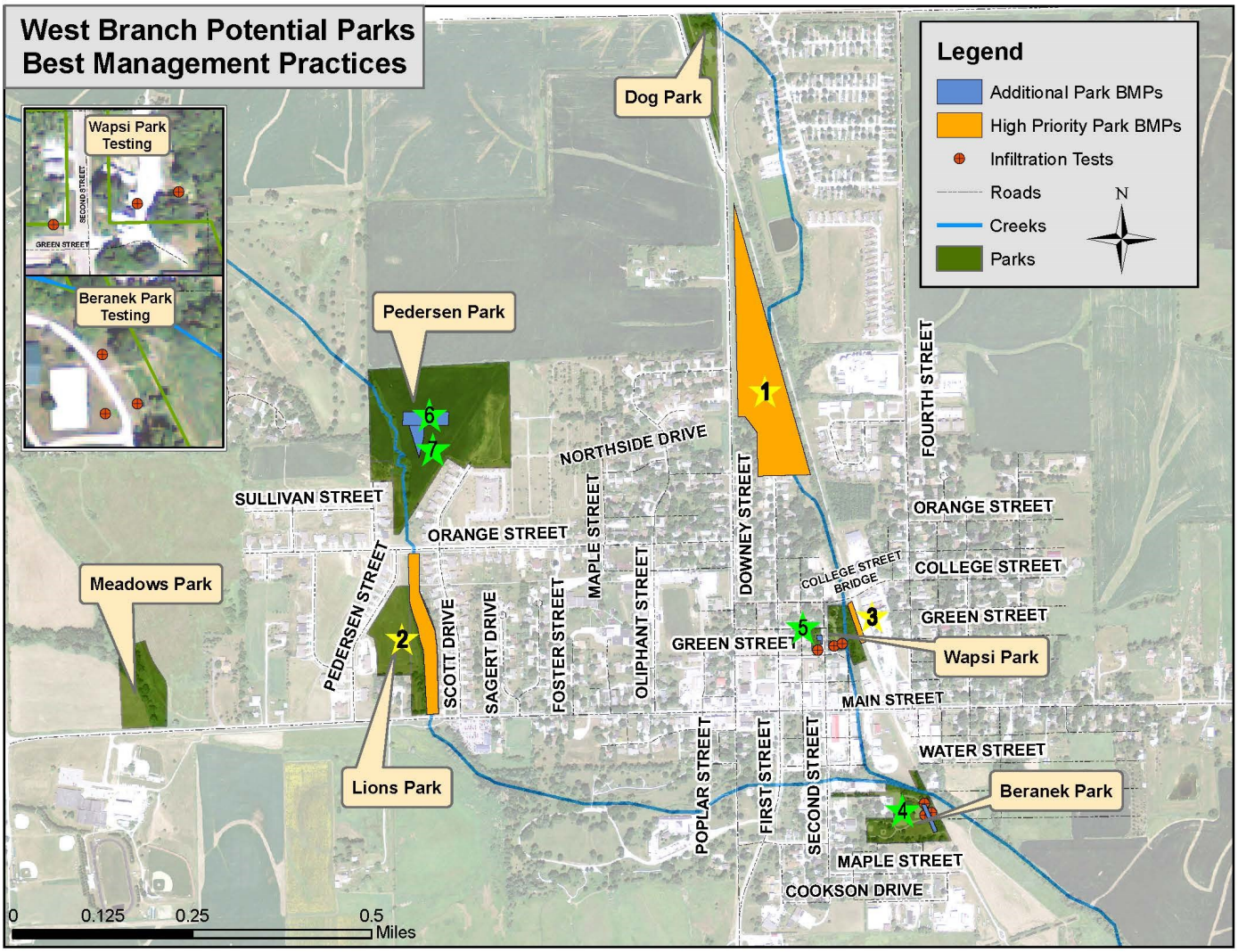


Figure 3. Parks Map

Map Key

1 Downey Street Wetland
2 Lion Park Stream Improvement
3 Wapsi Park Stream Improvements
4 Beranek Park Bio-Retention
5 Wapsi Park Permeable Parking
6 Pedersen Park Permeable Parking
7 Pedersen Park Bio-Retention

Category 2: BMPs Related to Parks Improvements

Priority Projects:

Lions Field Creek Buffer

There is a current need for a defined buffer around Hoover Creek running through Lions Field. Landowners are currently maintaining this buffer area by mowing, which in turn contributes to erosion.

Suggested BMP Component: Vegetated filter strips and other landscaping components should be installed to create a visible barrier between private and public property. Stream stabilization methods may be needed in this area as well, pending the results from a stream assessment.

Additional Note: First step of this process should likely be a public awareness campaign. Staking or flagging the correct property lines and distributing information to the adjacent land owners about the benefits of filtered buffer strips.

Illustration of proposed Lion's Field Creek Buffer

Wapsi Creek Buffer

Suggested BMP: Establish a vegetated filter strip along both sides of the Wapsinonoc Creek at Wapsi Park. This will help to protect the creek from erosion and pollution from the nearby cement plant.

Potential Wetland at Downy and Oliphant

Purchase of this field currently being used as cropland, and converting it into a wetland could help to mitigate flooding problems downstream. This area would also serve as an important wildlife habitat and could be an interesting park feature.

Urban Wetland in Ankeny, IA. NRCS

Category 2: BMPs Related to Parks Improvements

Additional Projects

Parking areas at Pedersen and Wapsi Parks

Suggested BMP Component: Incorporate bio-retention cells, bio-swales, tree planting, and permeable pavers where applicable on these areas. Although soil testing near the Wapsi parking area showed fairly high infiltration rates, the park is located within the 100 year flood plain which may be a further consideration in installing permeable pavers. Flooded pavers would require more maintenance to remove silt from the permeable spaces. See Additional Information on Permeable Pavers in the earlier Preliminary Steps section.

Bio-Retention in Parking Area, EPA

Stormwater Improvements: Pedersen, Wapsi, and Beranek Parks

Pedersen- As mentioned in the previous parks report, the Pedersen Valley Recreation Complex provides many opportunities to introduce infiltration practices to the public by way of pervious pavement, bio-retention cells, bio-swales, and even rainwater harvesting for use of irrigation to the ball fields.

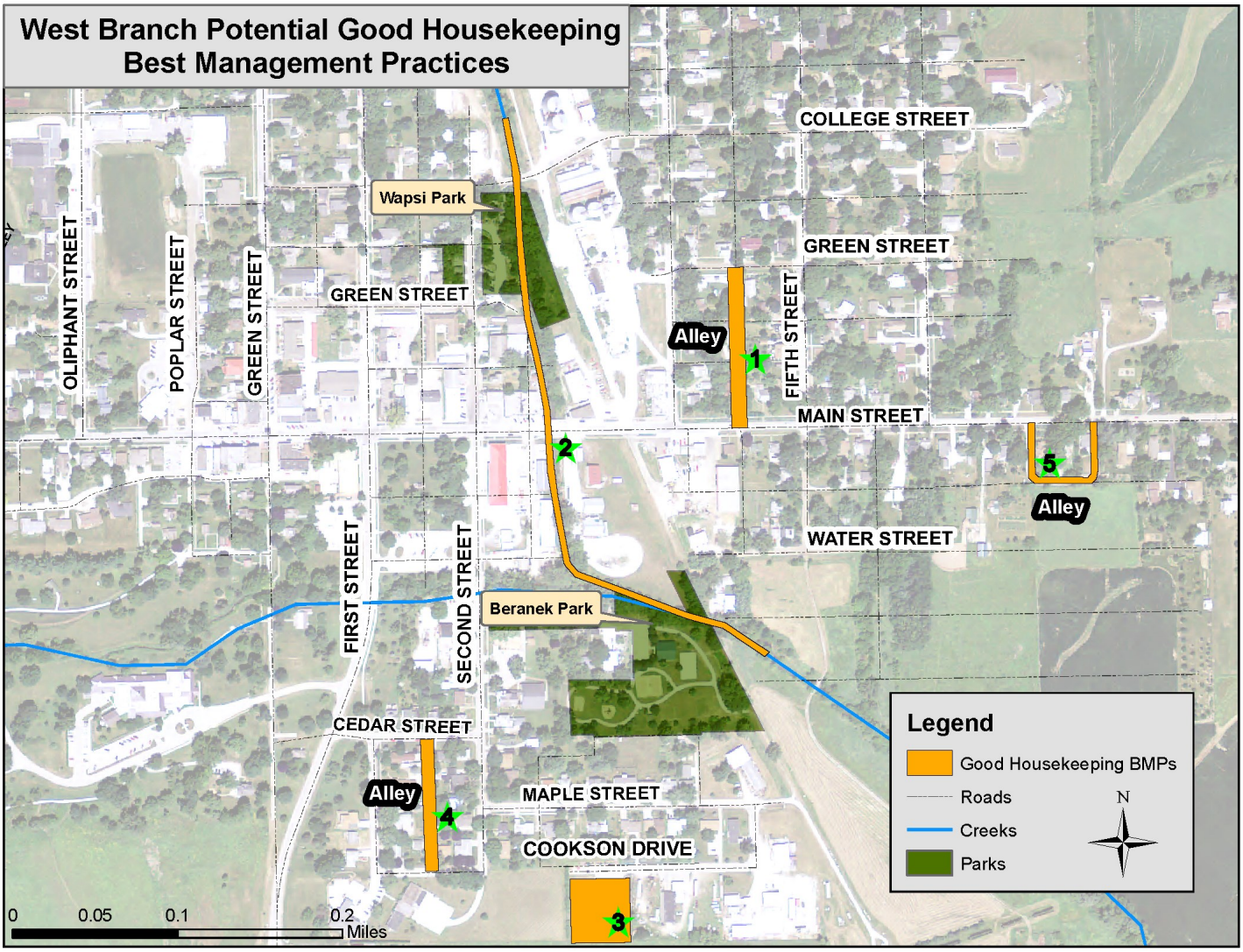
Wapsi- Wapsi Park is in a low-lying area near the creek, and may thus be prone to frequent flooding. During soil testing, however, the tested sites showed encouragingly high infiltration rates. This suggests that flooding from minor storm events may be reduced through infiltration practices such as bio-retention cells or rain gardens. A current stormwater intake with very large spaced grate openings could be replaced with a bio-retention cell and a smaller intake.

Permeable Paving, Coralville

Beranek - Similar to Wapsi, Beranek Park is also located near the stream and is fairly flood-prone. One possible improvement could be to convert the existing drainage ditch that runs between the road and the eastern side of the park to a bio-swale. This would accept water both from the east and west, with an underground drainage tile carrying excess water to the creek. A small pipe network could also be installed in strategic locations of the park to better drain large puddle areas and carry that water to the swale, decreasing flooding during small storm events.

Category 3: Good Housekeeping

The Good Housekeeping category is intended to include any projects that are not specifically referenced in the CIP or associated with parks improvements. These projects are considered items that are important to address in order to mitigate flooding and improve stormwater quality for the City of West Branch.



Map Key

1, 4 and 5	Green Alleys
2	Flood Mitigation along Wapsi Creek
3	Public Works Yard

Category 3: Good Housekeeping

Public Works Building

North Side of Public Works Salt Shed

Current Situation: There has been a recent increase in the amount of runoff collecting in the area behind the Public Works buildings located off of East Cookson Drive. During medium to large storm events, runoff may be contaminated by the salt storage shed that is at the south east corner of the Public Works yard. The contaminated water then flows through a ditch at the eastern side of the property but has no designed outlet.

Suggested Solutions:

Contoured Buffer Strips- It has been suggested that the reason for the increase in runoff is due to the recent re-occurrence of farming in the field to the south of the area. Slopes on this former hayfield are fairly steep, and it is possible that a loss of vegetation there would cause increased erosion and stormwater runoff. If the landowner is amenable to implementing conservation features such as contoured buffer strips on his or her land, this could greatly improve the situation. HBK would suggest that this course be attempted, especially as the benefits would extend to all parties, with the landowner being likely to be able to receive payment for the buffer strips either through government or Iowa State Extension programs.

West Branch Salt Shed, South Wall

Bio-Swale- Installation of a bio-swale behind the Public Works building could also help to slow and infiltrate flows before reaching the salt shed and adjacent properties. Average slope for this feature would be approximately two percent.

Improve Salt Storage- Current storage practices for the salt can be updated to make it more difficult for water to mix with the salt. Walls of the salt storage shed have large gaps that allow water to enter easily. A new or improved salt storage facility is recommended.

Category 3: Good Housekeeping

Suggested Solutions: continued

Use of Alternative De-Icer- City of West Branch can also investigate altering the current practices for de-icing. Various additives such as beet juice can reduce the amount of salt needed in de-icing solutions. Reducing the amount of salt that would need to be stored, and decreasing additional salt pollution due to winter road applications. Additionally, it is recommended that information be made available to residents about salt application rates and their impacts on surrounding water bodies, as well as a review of current municipal application practices and Staff training on this issue.

Flood Mitigation

Flooding continues to be a concern in a large area of West Branch where buildings are within the 100 year flood plain. One way to decrease the severity of flooding is to make sure that the Wapsinonoc Creek is maintained to maximize the channel's capacity. To accomplish this goal, debris should not be allowed to accumulate in the channel and should be regularly removed. Another way to improve flow capacity of the creek may be re-shaping the channel to create a 2-stage bank. Two stage banks have the advantage of increasing flow capacity and ecologic health, without necessarily widening the size of the channel. This is particularly applicable in situations where there is no available space on either side of the creek for decreasing bank slopes, such as in town.

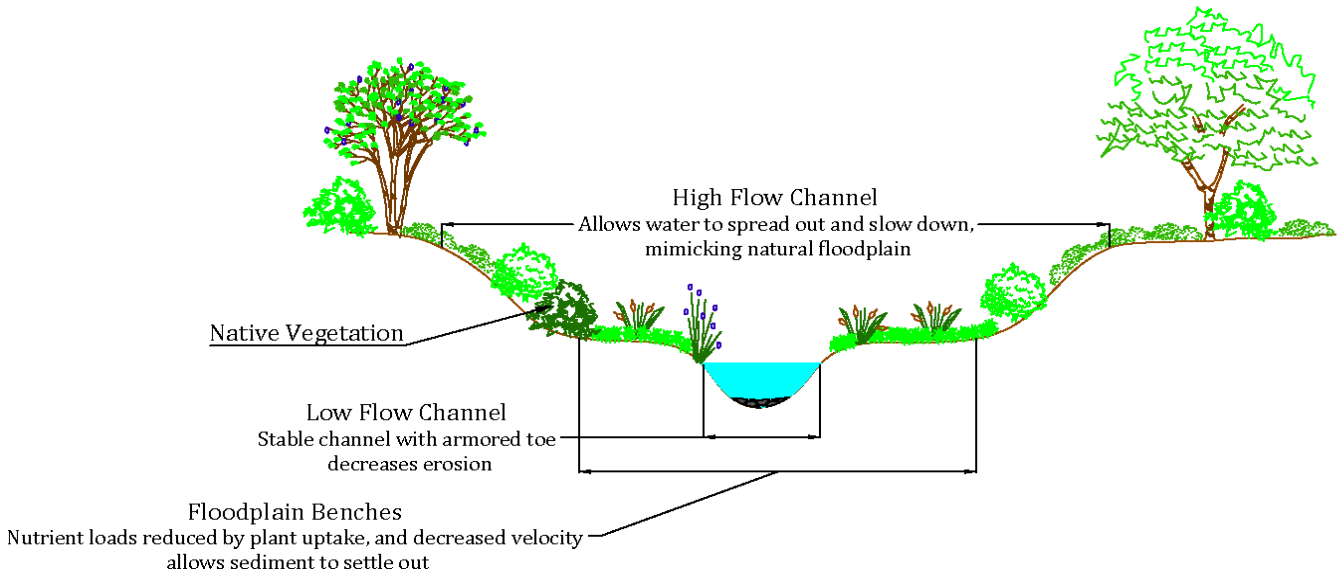


Figure 5. Two-Stage Bank Diagram

Category 3: Good Housekeeping

Permeable Paver Alleys

Three alleys have been pointed out by the City Staff and Council members as areas in need of paving. All three of these are currently gravel surfaces that often wash out during rain events, causing safety concerns to the travelling public as well as plugging and inundating storm sewer intakes and pipes.

Other Midwestern towns such as Dubuque and Chicago have adopted the use of permeable pavers in many of their alleyways. These towns have found this to be a convenient approach that prevents potholing and other maintenance problems common among alleyways, without requiring the installation of storm sewers.

If not properly designed, permeable pavers on steep slopes can cause problems with ponding at the base of the inclines. Designing for the steeper sections of the three West Branch alleys will likely require that granular subgrades be stepped down to provide adequate storage and offset steep slopes. Additional perched drain tile may also need to be added and tied into existing storm sewers in order to carry any excess flow.

Permeable Paver Alley, Dubuque

Permeable Pavedrain Pavers , Davenport

Terror Trail alley is located within the 100-year flood plain, which increases the likelihood that any permeable pavers installed there would need additional maintenance to remove sediment after flood events.

Dubuque Green Alleys Program Presentation Slide

Summary

Based on our research and input from City Council and Staff, HBK can confidently state that there are many opportunities for implementing Stormwater Best Management Practices in West Branch. The commission of this report clearly demonstrates the City's commitment to incorporating best management strategies into their future projects and developments and we are pleased to find that a large majority of the projects investigated are amenable to the implementation of one or several BMPs. HBK sincerely hopes that this report and the following appendices will assist the City in planning sustainable growth and improvements in their community.

Appendices

A. Stormwater Best Management Practices

B. Stream Stabilization Practices

C. Funding Sources

D. Additional CIP Project Data

E. Additional Soil Testing Results

F. Stream Buffer Code

Appendix A:

Stormwater Best Management Practices

This section provides detailed information on the Stormwater BMPs that have been identified as the most suitable for the given project areas. The information is sourced from the Iowa Stormwater Management Manual, which gives information on these and other stormwater practices. The entire manual can be downloaded for free on the Iowa DNR website.

Rainscaping Iowa

2E-2 Infiltration Trenches

Source: California Stormwater Manual

Pollutant Removal Low = <30% Medium = 30-65% High = 65-100%			
	Low	Med	High
Suspended Solids			■
Nitrogen		■	■
Phosphorous		■	
Metals			■
Bacteriological			■
Hydrocarbons		■	

Description: An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. Runoff is stored in the void space between the stone aggregate and infiltrates through the bottom and into the soil matrix. Infiltration trenches can range from 3-12 feet deep, are backfilled with stone aggregate, and are lined with filter fabric. Underground trenches receive runoff through pipes or channels, whereas surface trenches collect sheet flow from the drainage area. Trenches should be designed to drain completely within 6-48 hours. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Pre-treatment using buffer strips, swales, or detention basins is important for limiting amounts of coarse sediment entering the trench, which can clog and render the trench ineffective.
Typical uses: Residential subdivisions, high-density residential, ultra-urban areas, and parking lots.
Advantages:

- Appropriate for small sites with porous soils
- Infiltration trenches reduce runoff volume and filter pollutants
- Provide stream baseflow and recharge groundwater.
- As an underground BMP, trenches are unobtrusive and have little impact on site aesthetics

Limitations:

- Use should be restricted to small drainage areas – generally less than 5 acres
- Suitable for NRCS HSG-A/B soils; limited application in HSG-C soils; not recommended in HSG-D soils. Do not use with soil infiltration rates < 0.5 inches/hour
- Seasonal high water table should be 4 feet below bottom of trench
- Susceptible to clogging by sediment – use upstream BMPs for sediment removal
- Restricted in karst areas
- Placement under paved surfaces or in industrial or commercial settings not recommended

Maintenance requirements:

- Remove sediment accumulation to ensure proper functioning
- Inspect for clogging – install an integrated observation well/peizometer to check water level
- Remove sediment from pre-treatment areas

2E-4 Bioretention Systems

BENEFITS Low = <30% Medium = 30-65% High = 65-100%			
	Low	Med	High
Suspended Solids		■	
Nitrogen		■	
Phosphorous	■		
Metals		■	■
Bacteriological			■
Hydrocarbons			■

Description: Bioretention systems incorporate shallow landscaped level depressions that temporarily store and readily infiltrate runoff. They include both rain gardens and bioretention cells. A rain garden relies solely on soils with good percolation rates. Bioretention cells typically include a rock chamber, subdrain, and modified soil mix. In bioretention cells, stormwater runoff collected in the upper layer of the system is filtered through the surface vegetation, mulch layer, pervious soil layer, and then stored temporarily in a stone aggregate base layer. The Water Quality Volume (WQv) is drained from the aggregate base by infiltration into the underlying soils and/or to an outlet through a perforated pipe subdrain. Systems can operate either off-line or online. They are designed with a combination of plants that may include grasses, flowering perennials, shrubs, or trees. Integrated upstream treatment is provided by a perimeter grass filter strip or grass swale for initial capture of sediment.

Typical uses:

- Manages water quality runoff volume from residential, commercial, and institutional sites.
- Drainage area for each cell is typically 0.5 to 2.0 acres. Larger drainage areas should be divided into smaller sub-areas with individual bioretention cells distributed throughout the site.
- Suitable for landscaped depressional areas such as parking lot islands, road medians, and street right-of-ways.

Advantages/benefits:

- Reduce runoff rate and volume from impervious areas; provide opportunity for infiltration and filtration processes. Good for highly-impervious areas, such as parking lots.
- Removes fine sediments, heavy metals, nutrients, bacteria, and organics. Reduces thermal pollution from runoff across pavement surfaces.
- Flexible design options for varying site conditions; subdrain system allows use on sites with limiting soils. Good retrofit opportunities.
- Flexible landscaping options can provide an aesthetic feature.

Disadvantages/limitations:

- High entrance velocities and concentrated flows may need special design considerations.
- High sediment loads can cause premature failure; upstream practice is needed.
- High water table may require special design considerations.

Maintenance requirements:

- Routine landscape maintenance - removal of undesirable and dead vegetation.
- Replenish mulch layer.
- Removal of accumulated sediment in pretreatment areas.

2E-5 Bioswales

BENEFITS Low = <30% Medium = 30-65% High = 65-100%	Low	Med	High
Suspended Solids			■
Nitrogen	■	■	
Phosphorous	■		
Metals			■
Bacteriological	*	*	*
Hydrocarbons	*	*	*

* Insufficient Data

Description: Bioswales are essentially bioretention cells designed with positive grade, passing flows from small frequent storms at slow velocities to promote filtration through vegetation and infiltration into constructed soil media layers. A bioswale system consists of an open conveyance channel with a filter bed of permeable soil overlaying a perforated pipe underdrain system. Flow passes into and is detained in the main portion of the channel, where it is filtered through the soil bed. Infiltrated runoff is collected and conveyed by a perforated pipe and gravel underdrain system to the outlet. Bioswales can also be designed to effectively convey flow from larger storms at moderate velocities (to prevent erosion and re-suspension of captured pollutants).

Runoff from the WQv event is temporarily retained in a pool or series of pools created by permanent check dams. The holding time provides an opportunity for sedimentation of particulates and facilitates infiltration of runoff.

Typical uses:

- Manage runoff from residential sites, parking areas, and along perimeter of paved roadways.
- Located in a drainage easement at the rear or side of residential parcels.
- Road shoulder rights-of-way; used adjacent to paved roadways in place of curb and gutter, or used as a conveyance channel on the back side of curb-cut openings.

Advantages/benefits:

- Cost saving alternative to underground pipe systems.
- Mitigate runoff from impervious surfaces.
- Remove sediment and pollutants to improve water quality.
- Reduce runoff rate and volume in highly impervious areas; reduce runoff velocity.
- Provide for groundwater recharge if design and site soils provide sufficient infiltration.
- Good option for small area retrofits – replacing existing drainage ditches.
- Good retrofit opportunities for residential or institutional areas of low to moderate density.
- Linear configuration works well with highway or residential street applications.

Disadvantages/limitations:

- Sediment/pollutant removal sensitive to proper design of slope and vegetation density.
- Caution should be used when a high water table is present; an evaluation should be made for potential groundwater contamination.
- Difficult for use on steep slopes (>6%).
- Higher surface maintenance than curb and gutter systems.

Maintenance requirements:

- Need routine landscape maintenance; maintain grass height of approximately 4 to 6 inches.
- Inspect annually for erosion problems; remove accumulated trash and debris.
- Remove sediment from forebay and channel (if necessary).

2J-4 Permeable Pavers

Pollutant Removal Low = <30% Medium = 30-65% High = 65-100%	Low	Med	High
Suspended Solids			■
Nitrogen		■	■
Phosphorous		■	
Metals			■
Bacteriological			■
Hydrocarbons		■	

Description: Two types of permeable pavers are included in this section. The first type is monolithic units that do not have void areas incorporated in the pavers. The second type includes manufactured modular paving units with incorporated void areas that are filled with pervious materials such as gravel or grass turf. Permeable pavers are installed over a gravel base course that provides storage as runoff infiltrates through the permeable paver system into underlying permeable soils.

Typical Uses: Intended for low traffic areas, or for residential or overflow parking applications in higher density residential areas, high-density ultra urban areas, commercial areas.

Advantages:

- High level of pollutant removal
- Provides reduction in runoff volume
- Suitable for cold climates
- Available from commercial vendors

Limitations:

- Soil infiltration rate of 0.5 inches per hour or greater required
- High cost compared to conventional pavements
- High maintenance requirements
- Potential for high failure rate if not adequately maintained or used in unstabilized areas
- Potential for groundwater contamination

Maintenance Requirements:

- Prevent run-on of sediment in runoff from adjoining areas
- Sweep/vacuum one to two times per year
- Avoid ("prevent") application of sand in winter

2J-3 Porous Asphalt Pavement

Porous Asphalt Parking (Lot 121 – Iowa State University)

Pollutant Removal Low = <30% Medium = 30-65% High = 65-100%			
	Low	Med	High
Suspended Solids		■	
Nitrogen		■	■
Phosphorous		■	
Metals			■
Bacteriological		■	
Hydrocarbons		■	■

Description: Porous asphalt concrete is the term for a mixture of coarse aggregate and asphalt binder materials. An aggregate subbase reservoir provides temporary storage as runoff infiltrates into underlying permeable soils and/or out through an underdrain system. Provide water quality capture volume (WQv) and some stormwater quantity management for smaller storms (channel protection volume, CPv).

Typical Uses: Intended for low traffic areas, recreational trails, pedestrian paths, or for residential or overflow parking applications in higher density residential areas, high-density ultra urban areas, and commercial areas. Good general application for parking areas to reduce impervious area. Aggregate layer can accept roof runoff from adjoining buildings.

Advantages:

- High level of pollutant removal.
- Provides reduction in runoff volume and some peak rate control (CPv).
- Suitable for cold climates with modified pervious mix.
- Fewer problems with icing in the winter.

Limitations:

- Soil infiltration rate of 0.5 inches per hour or greater required
- Higher cost compared to conventional pavements
- Increased maintenance requirements over standard PCC.
- Potential for high failure rate if not adequately maintained or used in unstabilized areas
- Potential for groundwater contamination

Maintenance Requirements:

- Prevent run-on of sediment in runoff from adjoining areas.
- Sweep/vacuum one to two times per year.
- Avoid ("prevent") application of sand in winter.

2J-2 Pervious Concrete Pavement

(Iowa State University Parking Lot, 2006)

Pollutant Removal Low = <30% Medium = 30-65% High = 65-100%	Low	Med	High
Suspended Solids		■	
Nitrogen		■	■
Phosphorous		■	
Metals			■
Bacteriological		■	
Hydrocarbons		■	■

Description: Pervious concrete is the term for a mixture of coarse aggregate, cementitious materials, admixtures, and water that allow for rapid infiltration of stormwater and overlays a stone aggregate reservoir. A small amount of fine aggregate is added to increase strength and freeze-thaw durability in colder climates. The aggregate reservoir provides temporary storage as runoff infiltrates into underlying permeable soils and/or out through an underdrain system. The pavement system provides water quality capture volume (WQv) and some stormwater quantity management for smaller storms (Channel Protection volume, CPv).

Typical Uses: Intended for low traffic areas, recreational trails, pedestrian paths, or for residential or overflow parking applications in higher density residential areas, high-density ultra urban areas, and commercial areas. Good general application for parking areas to reduce impervious area. Aggregate layer can accept roof runoff from adjoining buildings.

Advantages:

- High level of pollutant removal
- Provides reduction in runoff volume and some peak rate control (CPv)
- Suitable for cold climates with modified pervious mix
- Fewer problems with icing in the winter

Limitations:

- Soil infiltration rate of 0.5 inches per hour or greater desired
- Underdrain system needed for low-permeability soils (f < 0.5 inches/hour)
- Higher cost compared to conventional pavements
- Increased maintenance requirements over standard PCC
- Potential for high failure rate if not adequately maintained or used in unstabilized areas
- Potential for groundwater contamination

Maintenance Requirements:

- Prevent run-on of sediment in runoff from adjoining areas
- Sweep/vacuum one to two times per year
- Avoid ("prevent") application of sand in winter

2I-4 Vegetated Filter Strips

Source: UDFCD, 1999

BENEFITS Low <30% Medium=30-65% High=65-100%			
	Low	Med	High
Suspended Solids			■
Nitrogen	■	■	
Phosphorous	■		
Metals			■
Bacteriological	*	*	*
Hydrocarbons	*	*	*

* Insufficient data

Description: Vegetated filter strips (VFS) are zones of vegetation through which sediment and pollutant-laden flow are directed before being discharged to a concentrated flow channel. They may closely resemble many natural ecological communities such as grassy meadows or riparian forests. Dense vegetative cover facilitates sediment attenuation and pollutant removal. VFS provide little treatment for concentrated flows. Grading and level spreaders are often used to create a uniformly sloping area to distribute the runoff evenly across the filter strip.

Typical uses:

- Manage runoff from residential sites, parking areas, and along perimeter of paved roadways.
- Located in a drainage easement at the rear of side of residential parcels.
- Road shoulder rights-of-way; used adjacent to paved roadways in place of curb and gutter, or used as a conveyance channel on the back-side of curb-cut openings.

Advantages/benefits:

- Mitigates runoff from impervious surfaces.
- Remove sediment and pollutants to improve water quality.
- Reduce runoff rate and volume in highly impervious areas; reduce runoff velocity.
- Provide for groundwater recharge if design and site soils provide sufficient infiltration.
- Good retrofit opportunities for residential or institutional areas of low to moderate density.
- Linear configuration works well with highway or residential street applications.

Disadvantages/limitations:

- Sediment and pollutant removal sensitive to proper design of slope and maintaining sufficient vegetation density.
- Limited to small areas (<5 acres); cannot be used on steep slopes (>6%).
- Possible re-suspension of sediment.

Maintenance requirements:

- Needs routine landscape maintenance; maintain grass height of approximately 2-4 inches.
- Inspect annually for erosion problems; seed or sod bare areas.

2I-3 Dry and Wet Swales

Source: Georgia Stormwater Manual

BENEFITS Low = <30% Medium = 30-65% High = 65-100%			
	Low	Med	High
Suspended Solids			■
Nitrogen	■	■	
Phosphorous	■		
Metals			■
Bacteriological	*	*	*
Hydrocarbons	*	*	*

* Insufficient Data

Description: Dry swales (also called bio-swales) are a type of open vegetated channel used to treat and attenuate the WQv of stormwater runoff. The swale also serves as a conveyance to move excess stormwater to a downstream discharge point. In dry swales, the entire WQv is temporarily retained in a pool or series of pools created by permanent check dams. The holding time provides an opportunity for sedimentation of particulates and facilitates infiltration of runoff. The wet swale is a vegetated channel designed to retain water or marshy conditions that support wetland vegetation. A high water table or poorly-drained soil is necessary to retain water.

Typical uses:

- Manage runoff from residential sites, parking areas, and along perimeter of paved roadways.
- Located in a drainage easement at the rear of side of residential parcels.
- Road shoulder rights-of-way; used adjacent to paved roadways in place of curb and gutter, or used as a conveyance channel on the back side of curb-cut openings.

Advantages/benefits:

- Mitigate runoff from impervious surfaces.
- Remove sediment and pollutants to improve water quality.
- Reduce runoff rate and volume in highly impervious areas; reduce runoff velocity.
- Provide for groundwater recharge if design and site soils provide sufficient infiltration.
- Good option for small area retrofits – replacing existing drainage ditches.
- Good retrofit opportunities for residential or institutional areas of low to moderate density.
- Linear configuration works well with highway or residential street applications.

Disadvantages/limitations:

- Sediment/pollutant removal sensitive to proper design of slope and maintaining sufficient vegetation density.
- Limited to small areas (<5 acres); cannot be used on steep slopes (>6%).
- Higher maintenance than curb and gutter systems.
- Possible re-suspension of sediment.

Maintenance requirements:

- Need routine landscape maintenance; maintain grass height of approximately 4-6 inches.
- Inspect annually for erosion problems; remove accumulated trash and debris.
- Remove sediment from forebay and channel (if necessary).

2H-1 General Information for Stormwater Wetlands

BENEFITS Low = <30% Medium = 30-65% High = 65-100%	Low	Med	High
Suspended Solids			■
Nitrogen		■	
Phosphorous	■	■	
Metals		■	■
Bacteriological		■	■
Hydrocarbons			■

Description: Stormwater wetlands are constructed wetland systems explicitly designed to incorporate the functions of natural wetlands to aid in pollutant removal from stormwater. Constructed wetlands can also provide for quantity control of stormwater by providing a significant volume of temporary water storage above the permanent pool elevation. As stormwater runoff flows through the wetland, pollutant removal is achieved by settling and biological uptake within the practice. Wetlands are among the most effective stormwater practices in terms of pollutant removal, and also offer aesthetic value. A sediment forebay is provided for removal of course sediments that could degrade performance.

Typical uses:

- Larger residential developments and medium-density suburban commercial areas. Not suited for high-density/ultra urban areas due to space constraints.

Advantages/benefits:

- Very good removal of suspended and particulate pollutants.
- Biological uptake of nutrients by wetland plants.
- Reduction of peak flows and flood attenuation.
- Enhancement of vegetation diversity and wildlife habitat in urban areas.
- Relatively low maintenance costs

Disadvantages/limitations:

- Needs continuous baseflow for viable wetland vegetation – a critical design factor for smaller areas (<20 acres).
- Usually some release of nutrients in the fall and winter months.
- May act as a heat sink with discharge of warmer water to downstream reaches.
- May attract year-round population of wild geese if natural buffers not included in the wetland design.
- Relatively higher land requirements and construction costs than most other BMPs.

Maintenance requirements:

- Replacement of wetland vegetation to maintain at least 50% surface area coverage.
- Remove invasive vegetation.
- Monitor sediment accumulation and remove periodically.

2E-7 Native Landscaping

BENEFITS Low = <30% Medium = 30-65% High = 65-100%	Low	Med	High
Suspended Solids	■	■	■
Nitrogen	■	■	■
Phosphorous	■	■	■
Metals	■	■	■
Bacteriological	■	■	■
Hydrocarbons	■	■	■

Description: Native plants are those that grew naturally in Iowa before European settlement, and therefore are well-adapted to this environment. The tallgrass prairie ecosystem developed in Iowa over 10,000 years ago. It was an extremely diverse habitat that consisted of grasses, forbs (flowering plants), insects, and other animals. It adapted to survive conditions that ranged from hot and dry to moist and boggy in any given year; in addition to severe winters, frequent high winds, grazing by buffalo, and routine fire. The response to this ever-changing environment was the development of deep, fibrous root systems commonly reaching 6-12 inches deep. These root systems led to the development of Iowa's fertile soils, and can still contribute significantly to soil quality enhancement. Carefully chosen native plants can be used in a wide variety of infiltration and filtration practices to increase water quality. Landscaping with native plants provides color and habitat, and is an important component for engineered practices to capture and treat the water quality volume and the first flush of runoff from larger storms.

Typical uses:

- Used in conjunction with engineered water management practices.
- Used for runoff management from residential, commercial, and institutional sites.
- Used in rain gardens, bioretention areas, vegetated swales, and basins.

Advantages/benefits:

- Reduces runoff rate and volume from impervious areas in infiltration practices.
- Removes sediment and pollutants to improve water quality.
- Plants are beautiful, hardy, drought-resistant, and low-maintenance.
- Provides aesthetic value and habitat for beneficial insects and animals.
- Reduces the need for inputs from fertilizers, pesticides, water, and mowing.

Disadvantages/limitations:

- Maintenance techniques are not as widely-known as for turf grass.
- Establishment takes longer than turf grass, especially with seeded areas.

Maintenance requirements:

- Annual removal of vegetation growth through burning, or mowing and baling/raking.
- Plantings need to be watered and weeded regularly during establishment.
- Maintenance goes down after establishment (2-3 years).

2E-6 Soil Quality Restoration

BENEFITS Low = <30% Medium = 30-65% High = 65-100%			
	Low	Med	High
Suspended Solids	■	■	■
Nitrogen	■	■	■
Phosphorous	■	■	■
Metals	■	■	■
Bacteriological	■	■	■
Hydrocarbons	■	■	■

Description: Healthy soils have tremendous capacity for infiltrating and storing water. Healthy soils also have active microbial life that will breakdown and utilize many pollutants moving in urban non-point runoff. Soil quality restoration helps urban landscapes absorb, infiltrate and purify runoff. Directing stormwater flows onto landscapes with good soil quality reduces the volume of runoff that is generated. Soil quality restoration involves a combination of steps. Reducing compaction, increasing pore space, improving organic matter content, and re-establishment of soil dwelling populations (microbes, worms, insects, etc) are the main components of soil quality restoration. Soil quality restoration is most beneficial to soils that have been altered and compacted through recent land-disturbing activities on construction sites, but almost any urban landscape can benefit from soil quality restoration techniques.

Typical uses:

- Included in the final grading and stabilization of construction sites.
- Incorporated into lawn care management practices on established landscapes.

Advantages/benefits:

- Reduces stormwater runoff volume.
- Protects water quality by infiltrating and processing pollutants moving in stormwater runoff.
- Reduces the need for irrigation by increasing water holding capacity and water availability.
- Usually reduces the need for fertilizers and pesticides.

Disadvantages/limitations:

- Access to soil restoration services may be limited.
- Access to compost may be limited.
- May increase landscaping costs initially.

Maintenance requirements:

- After restoration practices, the key need is to maintain and increase organic matter content.
- Annual applications of compost amendments is recommended (but not required).
- Do not remove lawn clippings; leave to decompose and maintain organic matter content.
- Minimize pesticide use to maintain healthy populations of earthworms, soil dwelling insects, and soil microbes.
- Native landscaping will maintain and enhance soil quality restoration over time.

THE SILVA CELL®

INTEGRATING TREES, SOIL AND STORMWATER FOR SUSTAINABLE DEVELOPMENT

SOIL IS CRITICAL TO THE LONG TERM SUSTAINABILITY OF DEVELOPMENT SITES.

Provide the basis for healthy vegetation, treat stormwater as a resource, and restore ecosystem services with the Silva Cell.

The Silva Cell is a modular building block for containing unlimited amounts of healthy soil beneath paving while supporting traffic loads and accommodating surrounding utilities. The Silva Cell is filled with high-quality, uncompacted soil to grow trees and manage the rate, quality and volume of stormwater. The modular system can be easily sized to accommodate the needs of any site without compromising effectiveness or site design.

By combining on-site stormwater management with expanded rooting volumes for healthy tree growth, Silva Cells create an unparalleled ability to restore ecological function to developed areas.

SOIL, TREES AND STORMWATER

Increasing attention is being paid to soil, and the conclusion is inescapable – soil matters. A Report by the National Research Council commissioned by the United States Environmental Protection Agency concludes:

> *"Nearly all of the associated problems [of urbanized watersheds] result from one underlying cause: loss of the water-retaining and evapotranspirating functions of the soil and vegetation in the urban landscape."* [1]

The report goes on to state:

> *"Stormwater Control Measures that harvest, infiltrate, and evapotranspirate stormwater are critical to reducing the volume and pollutant loading of small storms."* [2]

The more healthy soil is available to trees, the bigger they can grow – and the bigger a tree grows, the more significant environmental and social benefit it provides. USDA Forest Service research shows that a tree with a 30-inch diameter removes 70 times the pollution of a tree with just a 3-inch diameter[3]. Typically, urban tree growth is stunted by limited access to soil and poor soil quality. Buckling sidewalks from roots are hazardous and a major cost to repair. The Silva Cell overcomes these challenges by providing unlimited soil volumes without compromising above ground surface area.

The Silva Cell integrates trees and soil with stormwater management, utilizing the proven capacity of soils to act as an underground bioretention system. When rainfall moves across impermeable paving, it picks up pollutants. As it is channeled off-site, it deposits these pollutants in oceans, lakes, rivers and wetlands. This non-point source runoff, a leading cause of urban pollution, is significantly mitigated by use of the Silva Cell. Through soil filtration, bioremediation and evapotranspiration, the Silva Cell treats stormwater directly on-site, restoring ecosystem services and saving money while protecting one of our most valuable resources.

1. Urban Stormwater Management in the United States (a report by the National Research Council. National Academies Press, 2008)
2. Ibid. 6.
3. David Nowak; "Trees Pollute? A "TREE" Explains It All." (Proceedings of the 7th National Urban Forest Conference, Washington, D.C., USA, 1995)

APPLICATIONS

The Silva Cell can be used in a wide variety of applications. Some of the most common are:

- **STREETSCAPES AND PLAZAS**
- **BREAK-OUT ZONES**
- **PARKING LOTS**
- **GREEN ROOFS/ON-STRUCTURE**
- **GREEN WALLS**

Each of these applications can be designed to optimize tree growth and stormwater management.

For more information on different types of Silva Cell applications see pages 7-8, or contact us at info@deeproot.com or (415) 781-9700.

*The Silva Cell is only one brand of modular paving and soil systems. Alternative manufacturers of similar products exist.

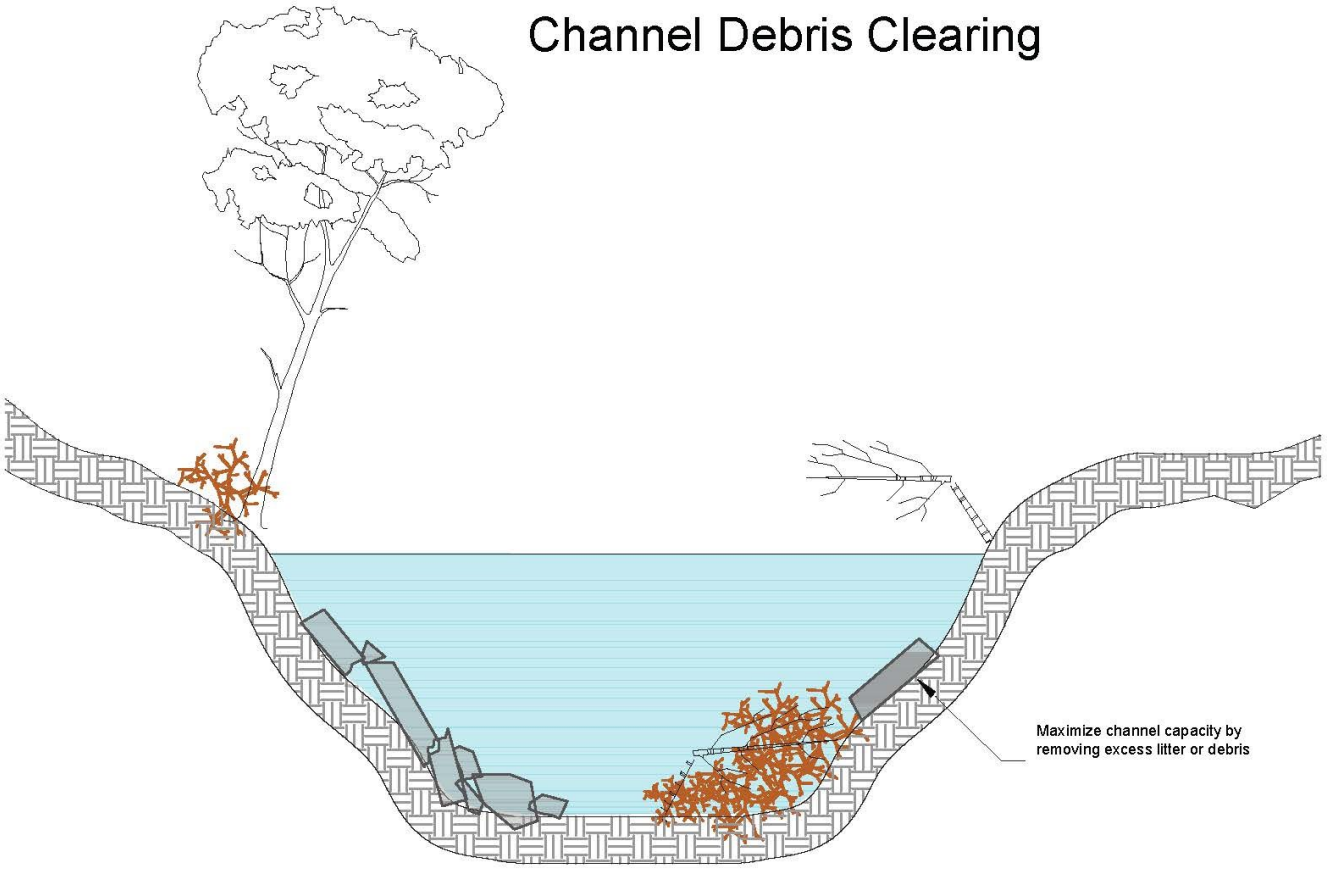
Appendix B:

Stream Stabilization Best Management Practices

Due to the fact that a large proportion of stormwater eventually finds it's way to a channel or stream, managing these waterways is an important aspect of Stormwater BMPs. If stream banks are found to be eroding, or experience frequent flooding, the cause may be a change in the watershed. Increases in impervious or semi-pervious areas such as pavement, roofs, or cultivated land can result in greater volumes of storm runoff entering streams and rivers. One of the goals of Bio-retention cells, rain gardens, and other practices proposed in this report is their ability to prevent streams from becoming over-burdened by slowing runoff down and allowing it to infiltrate before it can reach a stream. In many urban areas, however, streams may still need help to function properly. The following diagrams show how keeping channels free of litter and debris, maintaining good vegetation on banks, and installing engineered practices such as riffles, two stage banks, and armored-toe rip rap can help to keep streams in good biologic and hydrologic health.

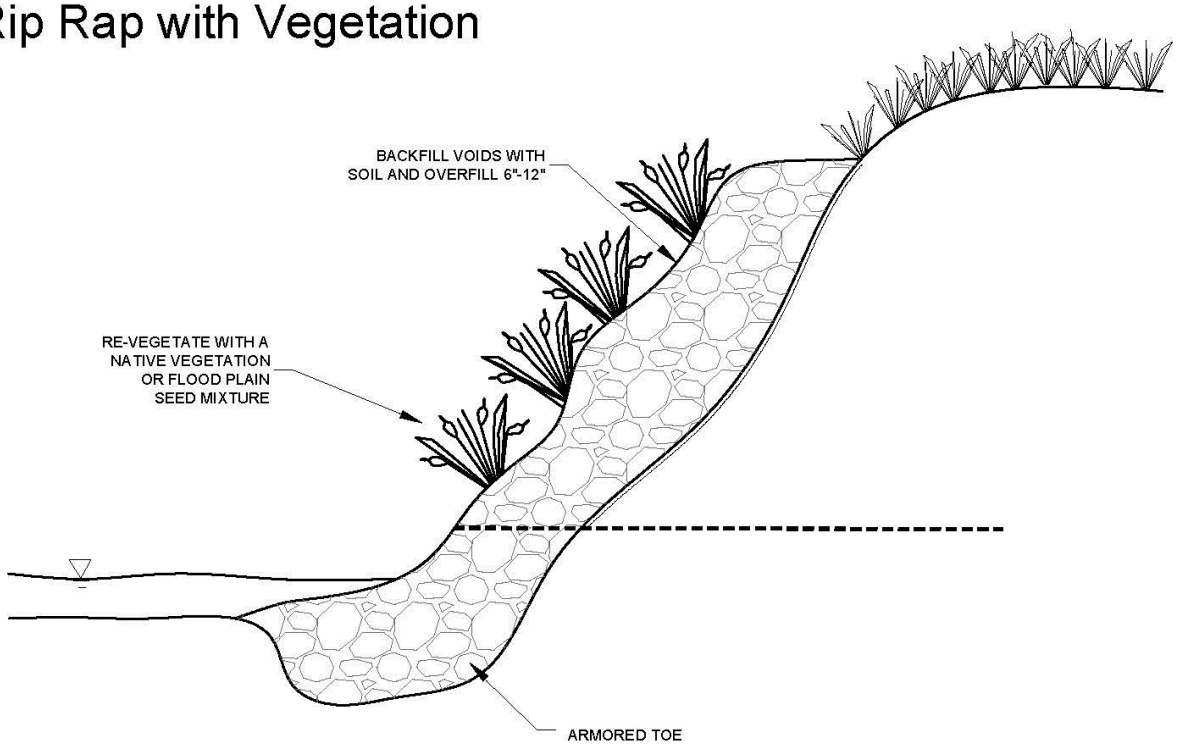
Wapsi Park, West Branch

Stream Stabilization BMPs

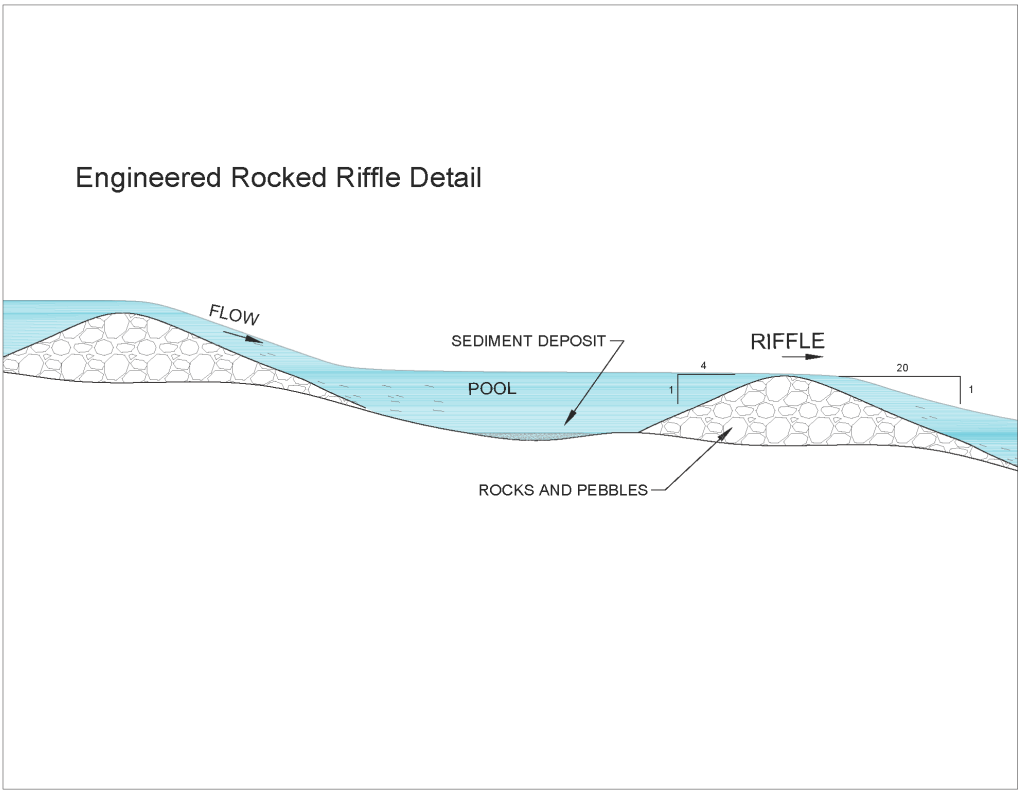


Stream Stabilization BMPs

Rip Rap with Vegetation

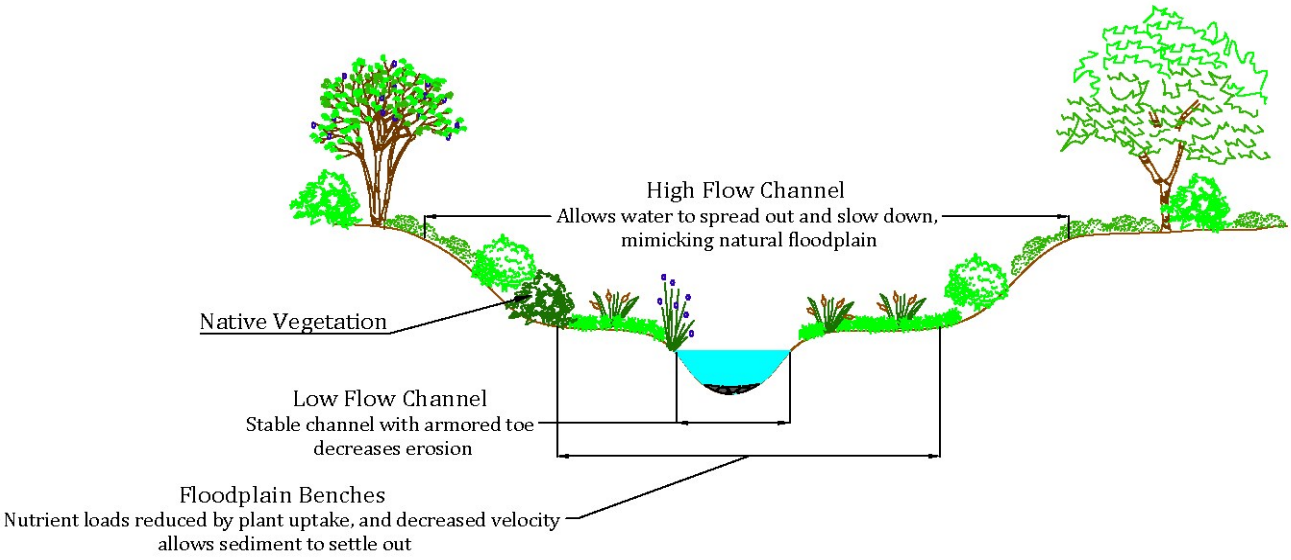


Stream Stabilization BMPs



Example Photo from Dave Derrick Presentation, USACE

Channel with Two-Stage Banks



Example photo from The Nature Conservancy

Watershed Improvement Funding Sources

Revised February 2015

Iowa Department of Agriculture and Land Stewardship - Division of Soil Conservation

* Dates are approximate. Check with funding agency to determine exact due date.

Programs	Web address (some may break on to two lines)	Program Description	Application Due*
Iowa Financial Incentives Program (IFIP)	http://www.iowaagriculture.gov/FieldServices/financialAssistance.asp	50 percent cost-share available to landowners through 100 SWCDs for permanent soil conservation practices.	continuous
No-Interest Loans	http://www.iowaagriculture.gov/FieldServices/noInterestLoans.asp	State administered loans to landowners for permanent soil conservation practices.	Feb. 1
Water Quality Initiative (Nutrient Reduction Strategy)	http://www.iowaagriculture.gov/requestForApplications.asp	Focuses on adoption of practices outline in the science assessment that have the highest potential to provide nutrient load reductions to Iowa's water resources.	varies, TBD
Watershed Improvement Review Board (WIRB)	http://www.iowaagriculture.gov/IWIRB.asp	Funds to support projects that will improve water quality or prevent flooding as part of a watershed effort. New in 2013, a portion of the funds will be directed to support for projects associated with the Water Quality Initiative.	Varies; typically Fall
District Buffer Initiatives	http://www.iowaagriculture.gov/FieldServices/districtInitiatives.asp	Funds for SWCDs to initiate, stimulate and incentivize signup of USDA programs, specifically buffers.	continuous
Mining Reclamation	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	$2 million state and federal program (16:1 match) to reclaim abandoned surface coal mines at no cost to landowner.	varies
Public Owned Lakes (POL)	http://www.iowaagriculture.gov/FieldServices/financialAssistance.asp	Provides up to 75 percent cost-share to landowners for permanent (primarily structural) practices about public lakes.	April 1
Watershed Protection Fund Program (WSPF)	http://www.iowaagriculture.gov/waterResources/projectApplicationRequest.asp	Funds to support projects in SWCDs to provide water quality protection, flood control, and soil erosion protection in priority watersheds; 50-75 percent cost-share; May be used in conjunction with other funding sources such as Section 319, WIRB, IFIP, etc.	TBD; typically Spring
Conservation Reserve Enhancement Program (CREP)	http://www.iowaagriculture.gov/waterResources/CREP.asp	Levering USDA funds (4:1) to establish nitrate removal wetlands in 37 north-central Iowa counties with no cost to landowner	Ongoing
Soil and Water Enhancement Account – REAP Water Quality Improvement Projects	www.iowaagriculture.gov/FieldServices/waterQualityProtectionProjects.asp	Funds to support projects in SWCDs to provide water quality protection and improvement; 50-75 percent cost-share; May be used in conjunction with other funding sources such as Section 319, WIRB, IFIP, etc.	TBD
Soil and Water Enhancement Account – REAP Water Quality Improvement Practices	www.iowaagriculture.gov/FieldServices/waterQualityProtectionPractices.asp	50-75 cost-share available to landowners through SWCDs for the implementation of water quality improvement, urban storm water, and forestry/native grasses practices.	continuous
Watershed Development and Planning Assistance Grant (Development Grant)	http://www.iowaagriculture.gov/requestForApplications.asp	To assist soil and water conservation districts develop effective watershed project applications for soil protection, water quality, and flood control projects.	November-January
State Revolving Loans (SRF)	http://www.iowaagriculture.gov/FieldServices/waterQualityLoanFund.asp	Low interest loans provided by SWCDs to landowners for permanent water quality improvement practices; subset of DNR program	continuous

State Soil Conservation Committee Research and Demonstration Program	http://www.iowaagriculture.gov/requestForApplications.asp	Provides funds to collaborative teams of scientists, farmers, institutions, organizations, and educators who are exploring sustainable ag and nonpoint pollution projects or education/demonstration projects.	varies, May
Agricultural Drainage Well Closure Assistance Fund	http://www.iowaagriculture.gov/waterResources/agDrainageWellClosure.asp	Provides 75 percent cost-share to landowners for alternative drainage in order to close ag drainage wells and protect groundwater quality.	Ongoing

Iowa Department of Natural Resources

Programs	Web address	Program Description	Application Due*
Lake Restoration Fund	http://www.iowadnr.gov/Environment/WaterQuality/LakeRestoration.aspx	Provides funding for restoration of Iowa's publicly owned lakes, in combination with watershed improvement to improve water quality.	Ongoing
Resource Enhancement and Protection Program (REAP) - City Parks & Open Space	http://www.iowadnr.gov/Environment/REAP/REAPFundingatWork/CityParksOpenSpaces.aspx	This money is available to cities through competitive grants. Parkland expansion and multi-purpose recreation developments are typical projects funded under this REAP program. The DNR administers the city grant program. Eligibility: This money is available to cities through competitive grants.	15-Aug
Resource Enhancement and Protection Program (REAP) - County Conservation	http://www.iowadnr.gov/Environment/REAP/REAPFundingatWork/CountyConservation.aspx	This money is available land easements or acquisition, capital improvements, stabilization and protection of resources, and environmental education, etc. The DNR administers the county conservation grant program. Competition for these grants is extremely keen. Eligibility: This money is available to counties, only if they are dedicating at least 22¢ per $1,000 of the assessed value of taxable property in the county for county conservation purposes, through competitive grants.	15-Aug
Resource Enhancement and Protection Program (REAP) - Conservation Education	http://www.iowadnr.gov/Environment/REAP/REAPFundingatWork/ConservationEducation.aspx	This money is available to grantees for programs that teach people of all ages about their environment and how to make intelligent, informed decisions about its well-being. $350,000 is available for this program. The DNR administers the conservation education program.	15-May
Iowa DNR - Wildlife Diversity Program	http://www.iowadnr.gov/Environment/WildlifeStewardship/NonGameWildlife/InsideWildlifeDiversity/GrantsAvailableFunding.aspx	The Iowa DNR's Wildlife Diversity program has three separate grant programs: 1) Habitat Management Grants, 2) Small Grants, and 3) State Wildlife Grants. Please read below for information about each program and instructions for submitting applications.	varies
Land & Water Conservation Fund	http://www.iowadnr.gov/InsideDNR/GrantsOtherFunding/LandWaterConservationFund.aspx	This federally-funded grant program provides match funds of 50% for outdoor recreation area development and acquisition. Competition for LWCF funds is intense, but this program provides an excellent opportunity to develop a wide range of outdoor recreational projects that are in high demand. Popular projects in recent years have included skate parks, playgrounds, new and renovated swimming pools, sport complexes, campgrounds, and multipurpose trails.	15-Mar

Section 319 Clean Water Act	http://www.iowadnr.gov/Environment/WaterQuality/WatershedImprovement/ResourcesforLocalGroups/ImplementationGrants.aspx	Watershed Implementation funds help local groups and organizations put watershed management plans into action. Must have a DNR-approved Watershed Management Plan. Eligibility: Local or regional public and private organizations or agencies; must address a watershed of 50,000 acres or smaller that drains directly or indirectly to a waterbody on the state's impaired waters list.	varies
Water Quality Cooperative Agreements [Section 104(b)(3)]	www.epa.gov/owm/cwfinance/waterquality.htm	Developing, implement, and demonstrate innovative approaches relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution	varies
State Revolving Fund (SRF)	http://www.iowasrf.com/about_srf/srf-resources/	Provides low interest loans to municipalities for waste water and water supply; expanding to private septics, livestock, stormwater, and NPS pollutants	continuous
SRF Water Resource Restoration Sponsored Projects	http://www.iowasrf.com/about_srf/sponsored-projects-home-page/	During the 2009 Iowa General Assembly session, legislation was passed to allow a new method for funding water quality protection. SF 339 amended the Iowa Code to add a new category of projects that can be financed with sewer revenues. This new category, called "water resource restoration sponsored projects," includes locally directed, watershed-based projects to address water quality problems. Eligibility: Wastewater utilities may apply, in collaboration with watershed groups or other watershed partners.	March, September
Dam Mitigation Grant	http://www.iowadnr.gov/Recreation/CanoeingKayaking/WaterTrailDevelopmentTools/RiverGrantsTools.aspx	The Iowa Legislature appropriated funds for fiscal year 2015 for the development of dam mitigation and water trail projects. A portion the funds are available competitively for dam mitigation cost-share grants. Dam owners and other eligible entities are encouraged to apply for cost-share assistance for projects that reduce recreational hazards and enhance	varies
Environment Management Systems/Comprehensive Planning	http://www.iowadnr.gov/Environment/LandStewardship/WasteManagement/FABA/CurrentFABABulletin.aspx#story3	The Solid Waste Environmental management System (EMS) is a voluntary alternative to the traditional Comprehensive Planning system for Iowa. The program participants set program objectives (goals) and report annually on the steps and methods used to accomplish those goals.	February
Fish Habitat Program	http://www.iowadnr.gov/InsideDNR/GrantsOtherFunding/FishHabitatProgram.aspx	Funding assistance is available to County Conservation Boards for land acquisition and development of fish habitat.	November
OnSite Waste Water Assistance Program	http://www.iowasrf.com/program/other_water_quality_programs/onsite_waste_water_assistance_program.cfm	The On-site Wastewater Assistance Program (OSWAP) offers low-interest loans through participating lenders to rural homeowners for the replacement of inadequate or failing septic systems.	Ongoing
Section 604 (b)	http://www.iowadnr.gov/Environment/WaterQuality/WatershedManagementAuthorities.aspx	A maximum of 40% of the state's federal fiscal year allocation of 604(b) funding may be passed through the regional planning agencies (RPAs) to support water quality planning activities to be conducted by such agencies. Eligibility: Regional Planning Agencies may apply (COGs, MPOs, Watershed Management Authorities)	varies

U.S. Department of Agriculture - Farm Services Agency

Programs	Web address	Program Description	Application Due*
General Signup Conservation Reserve Program (CRP)	www.fsa.usda.gov Click on "Conservation Programs."	Encourages farmers to convert highly erodible land or other environmentally sensitive land to vegetative cover; Farmers receive annual rental payments	determined from time-to-time

Continuous Conservation Reserve Program (CCRP)	www.fsa.usda.gov Click on "Conservation Programs."	Encourages farmers to convert highly erodible land or other environmentally ensitive land to vegetative cover, filter strips, or riparian buffers; Farmers receive annual rental payments	continuous
Farmable Wetland Program (FWP)	http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=fwp	Voluntary program to restore farmable wetlands and associated buffers by improving hydrology, vegetation	continuous

U.S. Department of Agriculture - Natural Resources Conservation Service

Programs	Web address	Program Description	Application Due*
Agricultural Conservation Easement Program (ACEP)	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/easements/acep/?cid=stelprdb1242695	The New Farm Bill combined Grassland Reserve Program (GRP), Farm & Ranchland Protection Program (FRPP) and Wetland Reserve Program (WRP) into one program. This establishes two tracks, wetland reserve easements (WRE) and agricultural lands easements (ALE). Provides for easements to protect grasslands and for restoration of wetlands.	continuous
Environmental Quality Incentives Program (EQIP)	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/	Provides technical and financial assistance for natural resource conservation in environmentally beneficial and cost-effective manner; program is generally 50 percent cost-share	continuous
Emergency Watershed Protection Program (EWP)	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/landscape/ewpp/?&cid=nrcs143_008258	Flood plain easements acquired via USDA designated disasters due to flooding. Funds also available for recovery work from flood damage.	determined by need
Mississippi River Basin Healthy Watershed Initiative	www.nrcs.usda.gov/programs/	Conservation partnerships that focus technical and financial resources on conservation priorities in the Mississippi River Basin	To be determined
Conservation Stewardship Program (CSP)	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/csp/?cid=stelprdb1242683	Green payment approach for maintaining and increasing conservation practices	continuous
Regional Conservaction Partnership Program	http://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/	RCCP promotes coordination between NRCS and its partners to deliver conservation assistance to producers and Landowners. Assistance is delivered in accorance with the rules of EQIP,CSP, ACEP and HFRP.	varies
Conservation Innovation Grants (CIG)	http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/	National and state grants for innovative solutions to a variety of environmental challenges	varies

Private Sector

Programs	Web address	Program Description	Application Due*
Fundsnet Services	http://www.fundsnetservices.com/	Since 1996 Fundsnet Services has provided resources information about grants, fundraising, philanthropy, foundations and 501(c)(3) non-profits organizations to those in need of funding and research for their philanthropic efforts and missions	varies
Nation Fish and Wildlife Foundation - Conservation Partners Program	http://www.nfwf.org/conservationpartners/Pages/home.aspx	Grant provides staff and technical assistance to private landowners in regions where some of the nation's most crucial conservation issues can be addressed through Farm Bill programs	April

The McKnight Foundation	https://www.mcknight.org/grant-programs/grantees?program_area=Mississippi+River	Restore and protect floodplains and wetlands in the 10-state Mississippi River corridor.	varies
Walton Foundation	http://www.waltonfamilyfoundation.org/environment/freshwater-conservation	In Mississippi River Basin, our conservation work is focused on promoting key components of a healthy river system. Some grantees include: Environmental Defense Fund, Nation Audubon Society, and Nature Conservancy.	varies
Wells Fargo	https://www.wellsfargo.com/about/charitable/io_guidelines	Wells Fargo will consider requests from organization that work to create strong environmental practices that conserve natural resources, provide environmental education, and support the transition to a sustainable environment.	varies
Coca-Cola	http://www.coca-colacompany.com/our-company/community-requests-guidelines-application	Grant focuses on making a unique and sustainable difference: water stewardship, active healthy living, community recycling, and education.	Opens on January 15th every year.

Other State Regional Entities

Programs	Web address	Program Description	Application Due*
Living Iowa Roadway Trust Fund	http://www.iowalivingroadway.com/GrantApplication.aspx	This annual, competitive grant program provides funding for integrated roadside vegetation management (IRVM) activities, including the preservation, establishment, and maintenance of native vegetation along Iowa's roadsides. Eligibility: LRTF grant applications may be submitted by individuals or private organizations and city, county, or state agencies. Individuals and private organizations must apply under sponsorship of city, county, or state government agencies and, when applicable, must have written support from the agency responsible for maintaining the right-of-way in which the project is proposed. Agency sponsorship may not be necessary for research, demonstration, and education projects, depending on the project's merit and the qualifications of the applicant.	June 15th
Keep Iowa Beautiful	http://www.keepiowabeautiful.com/grants/beautification-grant	Community beautification/enhancement in communities of 5,000 and under for beautification projects and derelict building renovation/removal AWARD AMOUNT: Up to $5,000 for beautification, or $25,000 for derelict building projects.	varies
Vision Iowa - River Enhancement Community Attraction and Tourism	http://www.iowaeconomicdevelopment.com/Community/VisionIowa	The River Enhancement Community Attraction and Tourism (RECAT) Program supports projects that promote and enhance recreational opportunities on and near rivers or lakes within cities.	January 15th
Iowa Resource Conservation and Development	http://iowaleaguercd.org/	Iowa's twelve Resource Conservation & Development (RC&D) councils help rural Iowa communities care for and protect their natural resources in a way that improves the local economy and raises living standards.	Yearly - January

Other Partners

The Nature Conservancy http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/iowa/index.htm
Iowa Natural Heritage Foundation https://www.inhf.org
Center for Watershed Protection http://www.cwp.org/
American Rivers http://www.americanrivers.org/
Pheasants Forever http://iowapf.net/LocalChapterHelp.aspx
Ducks Unlimited http://www.ducks.org/livinglakes

APPENDIX D
ADDITIONAL CIP PROJECT DATA

YR	CIP	AMOUNT	DETAIL	Soil (s)	Slope Ave	FLOODPLAIN	DRAINAGE WAY SOIL
FY15-16	SCOTT AND MAIN ST CROSSING	35,000	ELEVATE PED. TRAIL AT PEDERSEN (LISTED WITH PEDERSEN CROSSING)	911B	4.00%		YES
	OLIPHANT AND MAIN ST CROSSINGS/ IMPROVEMENTS	110,000	CURRENT FLASHING SCHOOL LIGHTS--CREATE MORE ACCESSIBLE CROSSING	120, 911B	1.20%		NO
	FOSTER AND MAIN ST CROSSINGS/ IMPROVEMENTS	150,000	SCHOOL SAFETY CROSSING	120	3.10%		NO
FY 16-17	S. MAPLE 2ND TO 4TH	60,000	ASPHALT OVERLAY	133+, 162	7.5% TO 2.7%	YES	YES
	N. 1ST ST GREEN TO MAPLE* main?	81,000	IMPROVE ST	162	0.00%	YES	NO
	2ND ST GREEN TO COLLEGE	135,000	ASPHALT OVERLAY	911B	0.00%	YES	YES
	2ND ST MAIN TO GREEN	140,000	ASPHALT OVERLAY	911B	0.00%	YES	YES
FY 17-18	S. 1ST ST COOKSON TO CEDAR	102,000	REPLACE ROAD	162	9% TO 6%		NO
FY18-19	COOKSON DR MAPLE TO END	73,000	REPLACE ROAD	120	4.3% TO 0%		NO
	FOSTER ST MAIN TO SCHOOL	158,000	RESURFACE ROAD	120	3.10%		NO
	OLIPHANT ST DOWNEY TO 551 N	130,000	REPLACE ROAD	120, 162, 911B	11% TO 2%		YES
FY 19-20	N. 1ST ST COLLEGE TO END	239,000	REPLACE ROAD	911B, 162	0.00%	YES	YES
	NORTHSIDE DR OLIPHANT TO MAPLE	113,000	REPLACE ROAD	162, 911B	6% TO 0%		YES
	W. MAIN ST OVERLAY	215,000	ASPHALT OVERLAY	120, 162, 911B	6% TO 0%		YES
	E. MAIN ST OVERLAY	205,000	ASPHALT OVERLAY	911B, 120, 162, 133+	6% TO 0%		YES
HIGH PRIORITY PROJECTS							
FY15-16	4TH ST. ANIMAL CLINIC TO REAGAN BLVD.	500,000	INSTALL SIDEWALK ON W. SIDE OF STREET. IMPROVE ST	911B, 162, 65	2% to 6%		YES
FY15-16	PEDERSEN AND MAIN ST CROSSING	35,000	ELEVATE PED. TRAIL AT PEDERSEN	911B	4.00%	YES	YES
FY 16-17	BERANEK ST	400,000	SIDEWALK AND PARKING LOT WIDENING, IMPROVE ST	133+	0.50%	YES	YES
FY 17-18	COLLEGE ST BRIDGE	750,000	REPLACE- TOTAL PROJECT AT 1.5 MILLION	162, 911B, 133+	7% to 10%	YES	YES
FY 18-19	TOWN HALL RENOVATION	400,000	A. ACCESSIBLITY B. RESTROOMS C. CONVERT GARGAGE TO OFFICE/ LOBBY D. RESTRICT BASEMENT ENTRANCE	162, 911B	0%	YES	YES

Appendix E:
Additional Soil Testing Data

8/17/15 Soil Testing West Branch	50% Chance of Rain Materials Needed: Auger, gas, 5 gallon buckets, water source, lathe, tape, GPS, tape measure		
	Location Notes	Ribbon Test	Soil Notes
Beranek			
Location 1	Ditch at east boundary. 48' to location 2	2-inch +	Light clay visible near 3' depth
Location 2	Behind basketball court. 84' to location 3	2-inch	All dark earth
Location 3	Across the road from NE corner of basketball court. 86' from location 1	2-inch -	Very crumbly, mix of light and dark earth
Wapsi			
Location 4	Near entrance sign and former mobile home park road location	1-inch -	Gravel 0" to 4" depth, brown dirt then black dirt near 3'. Crumbly
Location 5	South of proposed parking lot near ditch and Liberty Com. line	1-inch -	Dark/ light mix, slightly more moist than location 4. Crumbly
Location 6	In park nearer creek than Location 4	1-inch -	Dark
Pedersen Crossing			
Location 7	West	2-inch +	Transition to light clay near 2' deep from black top soil
Location 8	East	2-inch +	Transition to light clay near 2' deep from black top soil

Figure 1.
Example of "2-inch +" ribbon of soil at Beranek Park. This field test can give a comparative indication of clay content in soils. Soil that can be formed into a longer ribbon is likely to have higher clay content than soils that crumble or break off when formed into a ribbon. Higher clay content is often linked to lower percolation rates and slower drainage.

Appendix F
Stream Buffer Code Examples

Section 2. Streams

(A) Intent and Purpose

The intent of this Section is to establish regulations and procedures that govern all land uses and related development activities adjacent to streams. The streams covered by this Section are identified on Figure 3.2 and 5.1 from the Polk County 2030 Comprehensive Plan. These regulations shall require undisturbed buffers and impervious surface setbacks adjacent to streams.

The purpose of undisturbed buffers and impervious surface setbacks are:

- to protect, restore and maintain the chemical, physical and biological integrity of streams and their water resources;
- to remove pollutants delivered in urban storm water;
- to protect public water supplies;
- to maintain base flow of streams;
- to minimize erosion and control sedimentation;
- to provide infiltration for storm water runoff;
- to minimize impervious surfaces close to streams; and
- to provide riparian wildlife habitats and promote desirable aquatic habitat.

(B) Definitions

Protection Area. Any and all land and vegetation within the undisturbed buffer and impervious surface setback.

Top of Bank. Intersecting point between the stream channel and the break in the stream bank slope or the highest point of the stream channel.

Undisturbed Buffer. A naturally vegetated strip of land where no improvements shall take place or have been made and which lies adjacent to a stream, river, or lake and provides such functions as protecting water quality, providing wildlife habitat, and storing flood waters.

(C) Protection Criteria

(1) Buffer and Setback Requirements

(a) Streams in all watersheds within unincorporated Polk County shall require a minimum 25-foot undisturbed buffer on each side of the stream, measured from the top of bank. Septic tanks and septic tank drain fields are prohibited within the undisturbed buffer and setback area;

(b) An additional 25-foot setback shall be maintained adjacent to the undisturbed buffer in which all impervious surfaces shall be prohibited. Storm water retention or detention facilities are permitted within this setback but prohibited within the stream channel.

(c) Within these watersheds, new hazardous waste treatment or disposal facilities are prohibited.

(D) Applicability

This article shall apply to all land development activity on property containing a stream or near a stream. The Protection areas as defined above shall be met. These requirements are in addition to, and do not replace or supersede, any other applicable buffer requirements established under State Code.

(E) Exemptions

Exemption of these activities does not constitute an exemption for any other activity proposed on a property:

(1) Any existing use that does not change use, zoning district or size is exempt from the requirements but shall meet the requirements for compliance for any new additions, structures or grading on the property.

(2) A perpendicular stream crossing by a driveway, street, or utility lines;

(3) A street or driveway where buffer intrusion is the only option to provide access to a property;

(4) Paved and unpaved trails and paths for public use;

(5) Public water supply intake or public wastewater outfall structures;

(6) Public access facilities that must be on the water including boat ramps, docks, foot trails leading directly to the river, fishing platforms and overlooks;

(7) Utility lines and easements running parallel with the stream, except that all easements (permanent and construction) and clearing and grading shall recognize the sensitivity of the streams and use Best Management Practices to limit and repair the disturbance within the buffer area. This includes such impervious cover as necessary for the operation and maintenance of the utility, including but not limited to manholes, vents and valve structures.

(8) Land development activities within a dedicated street right-of-way existing as of the effective date of this ordinance.

(9) Forestry activities on land that is zoned for forestry or agricultural uses and are not incidental to other land development activity.

(10) Minor land-disturbing activities for the intent of emergency erosion control and bank stabilization activities (i.e. for the purposes of corrective maintenance; measures for health, safety and welfare; post storm; or other disaster relief)

(F) Variance Procedures

No variance shall be granted to the undisturbed buffer and/or setback requirements contained in this section unless a hardship exists and relief, if granted, meets the general purpose and intent of this article. Variance requests shall only be considered if the public or private project with buffer and/or setback intrusion can demonstrate that the completed project will result in maintained and/or improved water quality downstream; and, yields no increase in storm water runoff.

(G) Liability

Neither the approval of a plan or issuance of a permit for any regulated activity under the provisions of this ordinance, or compliance with the provisions of this article shall relieve any person from responsibility or liability for:

(1) Any damage to any person, property, tributary or other water body; or

(2) Noncompliance with any other local, State or Federal ordinances, statutes, rules or regulations.

Pleasant Hill Stream Buffer Ordinance

ORDINANCE NO. 753

AN ORDINANCE AMENDING THE CODE OF ORDINANCES OF THE CITY OF PLEASANT HILL, IOWA 1998, BY ESTABLISHIING CHAPTER 104, STREAM BUFFER PROTECTION AND MANAGEMENT

Be it enacted by the City of Pleasant Hill, Iowa, that Chapter 104 of the Code of Ordinances of the City of Pleasant Hill, Iowa be established as follows:

Chapter 104

STREAM BUFFER PROTECTION AND MANAGEMENT

104.01 Purpose
104.02 Definitions
104.03 Applicability
104.04 Stream Buffer Design
104.05 Buffer Management and Maintenance
104.06 Stream Buffer Management Plan
104.07 Enforcement
104.08 Exemptions

104.01 PURPOSE

1. The purpose of this ordinance is to establish minimum requirements for the design of buffers to protect the streams, wetlands, and floodplains of Pleasant Hill; to protect the water quality of watercourses, reservoirs, lakes, and other significant water resources within Pleasant Hill; to protect Pleasant Hill's riparian and aquatic ecosystems; and to provide for the environmentally sound use of Pleasant Hill's land resources.

2. Buffers adjacent to stream systems provide numerous environmental protection and resource management benefits that can include the following:

    A. Restoring and maintaining the chemical, physical, and biological integrity of the water resources

    B. Reducing pollutants delivered from urban stormwater

    C. Reducing erosion and sediment entering the stream

    D. Allow for stabilization of stream banks

    E. Providing infiltration of stormwater runoff

    F. Maintaining base flow of streams

G. Contributing the organic matter that is a source of food and energy for the aquatic ecosystem

H. Providing tree canopy to shade streams and promote desirable aquatic organisms

I. Providing riparian wildlife habitat

J. Furnishing scenic value and recreational opportunity

K. Protecting the public from flooding, property damage and loss

L. Providing sustainable, natural vegetation

3. It is the desire of the City of Pleasant Hill to protect and maintain the native vegetation in riparian and wetland areas by implementing specifications for the establishment and protection of vegetation along all stream systems within our jurisdictional authority.

104.02 DEFINITIONS

1. "Active Channel" is the area of the stream channel that is subject to frequent flows (approximately once per one and a half years) and that includes the portion of the channel below the floodplain.

2. "Best Management Practices (BMP's)" means a schedule of activities, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. Common BMPs are described in the Iowa Stormwater Management Manual and SUDAS. The BMPs covered are not meant to be a comprehensive list of acceptable BMPs.

3. "Buffer" is a vegetative area, including trees, shrubs, and herbaceous vegetation, that exists or is established to protect a stream system, lake, or reservoir area. Alteration of this natural area is strictly limited.

4. "Native Vegetation" refers to vegetation originating naturally in this region of the state. Native vegetation is not to be confused with all existing vegetation.

5. “Streams” are perennial and intermittent watercourses identified through site inspection and United States Geological Survey (USGS) maps and further defined and categorized as follows:

    A. Type I Streams are defined as perennial streams shown as solid blue lines on the United States Geological Survey seven and one-half minutes series topological map and have a drainage area of greater than 50 acres.

    B. Type II Streams are defined as intermittent streams shown as dashed blue lines on the United States Geological Survey seven and one-half minutes series topological map and have a drainage area of greater than 50 acres.

    C. Type III Streams are defined as intermittent streams or natural channels which are not shown on the United States Geological Survey seven and one-half minutes series topological map as either blue or dashed blue lines which have drainage areas of greater than 50 acres.

6. “Stream Bank” is the area between the stream channel and the break in the stream bank slope or the highest point of the stream channel.

7. “Stream Channel” is part of the watercourse either naturally or artificially created that contains an intermittent or perennial base flow of groundwater origin. Base flows of groundwater origin can be distinguished by any of the following physical indicators:

    A. Hydrophytic vegetation, hydric soil, or other hydrologic indicators in the area(s) where groundwater enters the stream channel in the vicinity of the stream headwaters, channel bed, or channel banks

    B. Flowing water not directly related to a storm event

    C. Historical records of a local high groundwater table, such as well and stream gauge records

8. “SUDAS” means the current Standard Urban Design and Specifications Manual, as locally amended, that specifies the stormwater guidelines and stormwater controls deemed by SUDAS to meet the goals of the U.S. Environmental Protection Agencies NPDES permit program administered by the Iowa Department of Natural Resources.

9. “Wetland” is defined as areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

104.03 APPLICABILITY

1. This chapter shall apply to proposed improvements associated with all land development activity requiring a site plan, construction drawings, or subdivision on property containing a stream, near a stream, or drainage swale draining greater than 50 acres. These requirements are in addition to, and do not replace or supersede, any other applicable buffer requirements established by other regulatory avenues.

104.04 STREAM BUFFER DESIGN

1. A stream buffer for a stream system shall consist of a native vegetative strip of land extending along both sides of a stream and its adjacent wetlands, floodplain, or slopes. The stream buffer width shall be adjusted to include contiguous sensitive areas, such as steep slopes or erodible soils, where development or disturbance may adversely affect water quality, streams, wetlands, or other water bodies.

2. The required base width for all buffers shall be determined based on the type of stream being protected, as specified in TABLE I. of this ordinance below:

TABLE I. Required Minimum Stream Buffer Width	
Stream Type	Required Width (each side)
Type I	100 feet
Type II	50 feet
Type III	25 feet

3. Stream buffer width shall be modified if there are steep slopes which are above the ordinary high water mark and within the required stream buffer width and drain into the stream system. In those cases, the buffer width will be adjusted according to the guidance in TABLE II. Below:

TABLE II. Modifications to Stream Buffer Width Based on Slope	
Percent Slope	Additional Width of Buffer
0-14%	No Change
15%-25%	Add 25 feet
Greater than 25%	Add 50 feet

4. The stream buffer width may be relaxed and buffer permitted to become narrower at some points so long as the average width of the stream buffer meets the minimum requirement specified in Table 1 and Table 2. This averaging of the buffer may be used to allow for the presence of an existing structure or to recover a lost lot. The City of Pleasant Hill may consider other buffer design modifications in unique cases of topography or other hardship provided that the project can meet the goals outlined in the purpose and intent of this ordinance.

    A. At no point in the averaged stream buffer width may development activities come within 50 feet of type I streams, 25 feet of type II stream, and 15 feet of type III streams, this distances could be altered due to floodplain and wetland location, slope, and environmentally sensitive areas.

    B. Additional footage for maintenance access outlined in Section 104.04.05 must still be incorporated outside the averaged buffer distances.

5. After the buffer distance has been determined an additional distance shall be provided for maintenance access, this additional distance is outlined in TABLE III. Below:

TABLE III. Maintenance Access Distances		
Stream Type	Additional Width of Buffer	Sides of Buffer
Type I	20 feet	Both
Type II	20 feet	Both
Type III	15-20 feet	One Side

6. The buffer shall begin at the edge of the waterway for type I and at the centerline of the channel for type II and III waterways. The edge of the waterway is the outer wet edge of the channel during base flow or where the edge of vegetation occurs.

7. A stream buffer shall not be required for the portions of a stream that are less than 150 feet in length due to the stream having been previously enclosed within a pipe or box structure.

8. Impervious surfaces, septic systems and all associated equipment are prohibited within the buffer.

9. Dominant vegetation shall consist of existing or seeded/planted native trees, shrubs, perennial grasses and forbs suited to the soil and hydrology of the site and the intended purpose. No single species shall make up more than 50% of the total number of species planted. Turfgrass (lawn) is not permitted.

10. Overland flow through the stream buffer area will be maintained as sheet flow.

104.05 BUFFER MANAGEMENT AND MAINTENANCE

1. The stream buffer, including wetlands and floodplains, shall be managed to enhance and maximize the unique value of these resources. Management includes specific limitations on alteration of the natural conditions of these resources.

2. The City of Pleasant Hill will be responsible for the management and maintenance of the stream buffer, including wetlands and floodplains, of type I & II streams.

3. Type III stream management and maintenance shall be subject to drainage area and development goals. If management and maintenance of the type III stream buffer is private, then a management plan shall be developed by the owner. The requirements for a stream buffer management plan are outlined in Section 104.06

4. A deed to the City shall be given for all required stream buffers as part of the final plat or site plan approval process.

5. Temporary access easements may need to be developed during the site plan or subdivision process, if the buffer is not yet contiguous to another point of access.

6. The following structures, practices, and activities are permitted in the stream buffer, with specific design or maintenance features, subject to the review of the City of Pleasant Hill:

    A. Roads, bridges, paths, and utilities:

        - the right-of-way should be the minimum width needed to allow for maintenance access and installation

        - the angle of the crossing shall be as close to perpendicular as feasible to the stream or buffer in order to minimize clearing requirements

    B. Stream restoration projects, facilities and activities approved by the City of Pleasant Hill are permitted within the buffer.

    C. Water quality monitoring and stream gauging are permitted within the stream buffer, as approved by the City of Pleasant Hill.

7. The following practices and activities are prohibited within the buffer, except with approval by the City of Pleasant Hill:

    A. Clearing of existing vegetation.

    B. Grading, stripping, or other soil disturbing practices.

    C. Filling or dumping.

D. Draining the buffer area by ditching, underdrains, or other systems

E. Use, storage, or application of pesticides, except for the spot spraying of noxious weeds or nonnative species consistent with recommendations of the Polk County Soil and Water Conservation District.

8. All plans prepared for recording and all right-of-way plans shall clearly:

A. Show the extent of any stream buffer on the subject property

B. Label the stream buffer

C. Provide a note to reference any stream buffer stating: “There shall be no clearing, grading, construction or disturbance of vegetation except as permitted by the City of Pleasant Hill.”

9. The dedication of a stream buffer area in any form to the City of Pleasant Hill shall not be interpreted to mean that this automatically conveys to the general public the right of access to this area.

104.06 STREAM BUFFER MANAGEMENT PLAN

1. A plan approved by the City of Pleasant Hill is required for all type III streams where the ownership is private.

2. The plan shall contain an informative, conceptual, and schematic representation of the proposed development activity by means of maps, graphs, charts, or other written or drawn documents so as to enable an informed decision regarding the proposed development activity.

3. The plan shall contain the following specific information:

A. A location or vicinity map to include maximum two feet contour intervals and scale of no greater than one inch equals 100 feet.

B. Field delineated streams, springs, seeps, bodies of water, wetlands, and waterway buffer.

C. A buffer plan shall be submitted in conjunction with the required grading plan for any development, and the buffer should be clearly delineated on the final grading plan.

D. Boundary markers will be installed by the applicant prior to commencing clearing and grading operations. Markers will be placed at the outside edge of the buffer prior to the start of any activity adjacent to the buffer. Markers

shall be clearly visible and shall be spaced at a maximum of 100 feet. The markers may be joined by marking tape or fencing.

4. The plan shall be developed by an Iowa licensed Professional Engineer, Iowa licensed Landscape Architect, or representative from the Polk Soil & Water Conservation District.

5. The plan shall outline the maintenance procedures established by the owner, to ensure the proper management of the stream buffer.

6. If a maintenance procedure consists of a controlled burn, an approved burn plan for the native areas shall also be included in the management plan. The burn plan shall be approved by the City and Polk County Air Quality prior to any burning activities. If, at a later date, the owner of the management plan decides to use controlled burning as a management tool, they may develop a burn plan and seek City approval.

104.07 ENFORCEMENT

1. The Community Development Director or his/her designee is authorized and empowered to enforce the requirements of this ordinance in accordance with the procedures of this section

2. If, upon inspection or investigation, the director or his/her designee is of the opinion that any person has violated any provision of this ordinance, he/she shall with reasonable promptness issue a notice of the violations identified while conducting an inspection or investigation. Each notice shall be in writing and shall describe the nature of the violation, including a reference to the provision within this ordinance that has been violated. In addition, the notice shall set a reasonable time for the abatement and correction of the violation.

3. If the property owner fails to take corrective action, following notice prescribed for the service of civil process by the Iowa Rules of Civil Procedure, the City may do so by its own crews or by persons under its hire and assess against the property owner the City's cost therefore. The cost shall include the salaries and benefits earned by the City employees during such corrective action, a charge for City machinery used and such other costs and expenses as the City actually incurred. To the extent allowed by Iowa law, such costs and expenses may be assessed against the property owner and collected in the same manner as a property tax.

4. Unless another penalty is expressly provided by this chapter for any particular provision or section, any person violating any provision of this chapter or any rule

or regulation adopted herein by reference shall be subject to a civil penalty as set forth in the Schedule of Civil Penalties in Chapter 4 of this Code of Ordinances.

5. Each day that a municipal infraction occurs and/or is permitted to exist constitutes a separate offense.

104.08 EXEMPTIONS

1. Exemption of these activities does not constitute an exemption of any other activity proposed on a property:

   A. Any existing use that does not change use, zoning district or size is exempt from requirements but shall meet the requirements for compliance for any new development requiring a site plan or subdivision.

   B. A perpendicular stream crossing by a driveway, street, or utility lines;

   C. A street or driveway where buffer intrusion is the only option to provide access to a property;

   D. Paved and unpaved trails and paths for public use;

   E. Public water supply intake or public wastewater outfall structures;

   F. Public access facilities that must be on the water including boat ramps, docks, foot trails leading directly to the river, fishing platforms and overlooks;

   G. Utility lines and easements running parallel with the stream, except that all easements (permanent and construction) and clearing and grading shall recognize the sensitivity of the streams and use Best Management Practices to limit and repair the disturbance within the buffer area. This includes such impervious cover necessary for the operation and maintenance of the utility, including but not limited to manholes, vents and valve structures.

   H. Land development activities within a dedicated street right-of-way existing as of the effective date of this ordinance.

   I. Minor land disturbing for the intent of emergency erosion control and bank stabilization activities (i.e. for the purposes of corrective maintenance; measures for health, safety and welfare; post storm; or other disaster relief) if City of Pleasant Hill is notified about the activity and the disturbance area is less than 5,000 square feet.

This Chapter 104 shall become effective following its passage, approval, and publication, as provided by law.

Passed and approved by the Pleasant Hill City Council on the 27th day of August 2012.

_____
Mike Richardson, Mayor

ATTEST:

_____
Susan Lensch Mahannah, City Clerk/Finance Director

I, Susan Lensch Mahannah, City Clerk/Finance Director of said City, hereby certify that at a meeting of the City Council of said City of Pleasant Hill, held on the above date, among other proceedings, the above was adopted, and that the foregoing was published as Ordinance No. 753.

_____
Susan Mahannah, City Clerk/Finance Director