Technical Memorandum

Date:	Monday, February 01, 2016
Project:	Stormwater Master Plan Update
To:	City of Cedar Rapids
From:	William Bogert/Anderson Bogert, Terry Tiedemann/Anderson-Bogert
Subject:	TM 6.0 Policy Considerations

This Technical Memorandum presents the following;

- Brief history and summaries of existing federal, state, and local regulatory programs pertaining to the City's stormwater management system,
- Overview of Floodplain Management programs,
- Overview of other regional/local stormwater programs,
- Present green stormwater infrastructure practices, policies, and incentives
- List of stormwater related issues in need of strengthened policy and/or standards.

The intent of this Technical Memorandum is to provide a brief synopsis of the existing Federal, State, and Local stormwater regulatory policies and City programs that have guided the City's stormwater management program, and to provide recommendations with respect to additional policy needs.

It is organized as follows.

- Objective
- Summary
- Federal Regulatory Programs
- Floodplain Policy
- Regional/Local Stormwater Programs
- Green Infrastructure
- Local Policy Recommendations

Objective

The objective of this Technical Memorandum is to inform the reader of existing stormwater regulations and to present stormwater related issues within the City of Cedar Rapids where existing policy could be strengthened or new policy enacted to improve the City's stormwater management system.

Summary

In the past, existing regulatory standards and policies have focused upon utilizing gray infrastructure construction (concrete basins, inlets, piping, etc.) to meet water quality requirements and to control and convey runoff. As development continues to create more

impervious surfaces, coupled with changing weather patterns and higher rainfall intensities; many communities are discovering their existing stormwater systems are unable to manage the increased runoff intensities. Rather than continuing to construct gray infrastructure, communities are incorporating “green infrastructure” into their existing stormwater management policies.

By incorporating green infrastructure into their existing stormwater management policies, communities have discovered economic, environmental, and community benefits not provided by the traditional approaches. The incorporation of green infrastructure provides a holistic stormwater management approach that mimics aspects of the natural hydrological cycle, including but not limited to: retention, infiltration, and evapotranspiration. This technical memo contains a brief description of green infrastructure practices, policies, and incentives used by other communities to develop a sustainable system.

In addition to the promotion of green infrastructure within the City’s stormwater management plan, this memo also includes stormwater related issues that are not adequately addressed within the City’s existing policies. These other policy issues typically originate as citizen requests and are investigated by public works staff. Therefore, it was determined the safety and welfare of residents could be improved by investigating potential actions to strengthen existing stormwater policies to address these requests.

Water Quality Regulatory Programs

The basis of stormwater discharge requirements come from Federal Laws that are then enforced by the Federal Environmental Protection Agency (EPA). The purpose is to prohibit unpermitted discharge of pollutants through point sources into waters of the United States.

Federal Program - Clean Water Act

The Clean Water Act (CWA), or Federal Water Pollution Control Act, is the principal law governing pollution of surface waters in the United States. Originally enacted in 1948, it was totally revised by amendments in 1972 that gave the act its current shape. The 1972 legislation marked a distinct change in the philosophy of water pollution control in the United States. The Amendments contained requirements for water quality-based controls, with an emphasis on technology-based, or end-of-pipe, control strategies that have since been expanded and are still being implemented by industries and municipalities.

The Act's principle intent is to ". . .restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101). To accomplish that objective, the act aims to attain a level of water quality that "provides for the protection and propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water". [1]

Clean Water Act and Major Amendments (codified generally at 33 U.S.C. 1251-1387)		
Year	**Act**	**Public Law Number**
1948	Federal Water Pollution Control Act	P.L. 80-845 (Act of June 30, 1948)
1956	Water Pollution Control Act of 1956	P.L. 84-660 (Act of July 9, 1956)
1961	Federal Water Pollution Control Act Amendments	P.L. 87-88
1965	Water Quality Act of 1965	P.L. 89-234
1966	Clean Water Restoration Act	P.L. 89-753
1970	Water Quality Improvement Act of 1970	P.L. 91-224, Part I
1972	Federal Water Pollution Control Act Amendments	P.L. 92-500
1977	Clean Water Act of 1977	P.L. 95-217
1981	Municipal Wastewater Treatment Construction Grants Amendments	P.L. 97-117
1987	Water Quality Act of 1987	P.L. 100-4

Federal Program - National Pollutant Discharge Elimination System (NPDES)
The intent of the federal stormwater regulations is to improve water quality by reducing or eliminating contaminants. To achieve its objectives, the Clean Water Act embodies the concept that all discharges into the nation's waters are unlawful, unless specifically authorized by a permit. Thus, industrial and municipal dischargers must obtain permits from the Environmental Protection Agency (EPA) (or qualified states) under the act's National Pollutant Discharge Elimination System (NPDES) program (authorized in Section 402 of the act). An NPDES permit requires the discharger (source) to attain best management practices based effluent limits. Permits specify the control technology applicable to each pollutant, the effluent limitations a discharger must meet, and the deadline for compliance. Sources are required to maintain records and to carry out effluent monitoring activities. Permits are issued for five-year periods and must be renewed thereafter to allow continued discharge. [1]

In 1990, the EPA promulgated Phase I of the stormwater rules of the NPDES. This required municipal separate storm sewer systems (MS4s) in areas with 100,000 or more people to regulate the quality of stormwater discharges to waters of the United States. In Iowa, Cedar Rapids is one of only two communities that meet this population. The parts of the MS4 Permit include:

- Public Education and Outreach on Stormwater Impacts,
- Public Involvement and Participation,
- Illicit Discharges,
- Construction Site Stormwater Runoff Control,
- Post- Construction Stormwater Management, and
- Pollution Prevention / Good Housekeeping, and
- Monitoring Industrial and High Risk Run-Off.

State Program; NPDES- Phase I

In 1992, the Iowa Department of Natural Resources (IDNR) received authorization from EPA to issue general permits. IDNR continues to issue NPDES permits to all stormwater discharges subject to the federal NPDES permit requirements within the State of Iowa.

Construction Activities. Federal Clean Water Act regulations require that stormwater discharges from certain construction activities be covered under a NPDES permit. Any stormwater runoff generated from construction activities such as clearing, grading, or excavation, that disturb one or more acres and/or are part of a larger development are required to be covered by a NPDES permit. The NPDES permit, a federal stormwater discharge permit, is required for stormwater or snow melt runoff that drains from areas where construction activities occur. These requirements became effective on March 10, 2003.

Iowa's General Permit No. 2 (GP2) covers stormwater discharges from construction activities including land disturbances. This permit is general, in that it can cover most construction land disturbing activities. The general permit contains the terms and conditions of the NPDES permit, but the permit is not applicable to any stormwater discharge until a completed Notice of Intent (NOI) is submitted to the IDNR. The NOI ties a construction activity to the general permit. When a completed NOI is submitted to the IDNR, stormwater discharge is assumed to be covered under the terms and conditions of the general permit, unless the applicant is notified otherwise by the IDNR.

Before construction can begin on a site, the following steps must be taken to be in compliance with the IDNR GP2:

- A Stormwater Pollution Prevention Plan (SWPPP) must be created for the site
- A Notice of Intent (NOI) must be completed by the Operator of the construction site, and this document, along with public notices must be submitted to the IDNR.
- A Letter of Authorization is provided to the Operator of the construction approval of the NOI by IDNR
- SWPPP review and approval is required by MS4 cities prior to construction
- Necessary best management practices should be in place prior to construction
- Construction can then begin

(Iowa Dept. of Natural Resources website)

State Program; NPDES - MS4

This permit includes all areas within the City of Cedar Rapids which is drained by the City's Municipal Separate Storm Sewer System (MS4). This permit allows the MS4 to discharge all existing or new NPDES stormwater permitted point source discharges to waters of the State.

The first General Permit for NPDES for Cedar Rapids was issued in June 1999. Cedar Rapids and Des Moines were the original MS4 permit holders in Iowa. Des Moines's permit is renewed

one year prior to Cedar Rapids and as such, provides Cedar Rapids with one years' notice of upcoming changes. As of 2015, there are currently 47 municipalities or universities that have MS4 permits within the State of Iowa.

Starting with calendar year 2001, the former Engineering Department started submittals of annual reports to the IDNR. The responsibility transferred to Public Works upon an organizational reorganization in July 2007.

The requirements for the program were generally the same with the 1999 and 2005 permits. The 2011 permit changed a number of items which included:

- Added requirement to educate private stormwater basin owners on best practices
- Added requirement to inspect GP2 permit sites quarterly
- Added requirement to inspect all City owned stormwater structures on a 10 year basis
- Added requirement to have a stormwater advisory board or commission
- Added a requirement for the City to develop and maintain a post-construction site runoff policy ordinance
- Deleted the stream monitoring

Per the MS4 Permit for Cedar Rapids, all GP2 sites are inspected on a quarterly basis. Any non-compliant item will be documented, the operator will be notified and the issue will be resolved. The City averages over 150 GP2 locations each year that meet this requirement.

City Program

In compliance with the City's MS4 permit, the City Council adopted, *"Chapter 71 – Erosion and Sediment Control for Construction Sites".* Chapter 71 requires a "Major Erosion Control Permit", if construction activity results in an acre of more of land disturbance, and a "Minor Erosion Control Permit", if construction activity results in a land disturbance of more than a quarter of an acre but less than an acre.

In general, the Major Erosion Control Permit requires: a completed application form, an approved NPDES GP2, an approved Stormwater Pollution Prevention Plan (SWPPP), and proper IDNR stormwater documentation. Minor Erosion Control Permits require a completed application form. Application forms for both permits contain language regarding topsoil restoration requirements.

Future Changes

The IDNR has not stated any specific requirements that may be added to the MS4 for its renewal in 2016. Items that may be added include:

- Specific limits for well permit discharges
- Requirements that specify a longer detention basin for the duration time of release or size of a storm event that must be mitigated.
- Requirements that specify limits for phosphates or nitrogen.
- Reestablishing the requirement for stream monitoring.

- Modification of the new 4 inch soil requirements for developers.
- Higher water quality requirements.

Floodplain Policy

National Flood Insurance Program
Prior to 1960's, the primary way of reducing flood losses was to construct flood control structures such as dams, levees, and floodways. Policy at the time consisted of a single solution: reduce flood losses by controlling flood waters. As disaster relief expenses continued to increase in spite of the flood control structures, the effectiveness of the policy was questioned. In 1968 the National Flood Insurance Program (NFIP) was created. The NFIP:

- Established an insurance program as an alternative to disaster relief,
- Distributed responsibility for floodplain management to all levels of government and to the private sector,
- Set a national standard for regulating new development in floodplains, and
- Began a comprehensive floodplain mapping program.

The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program managed by FEMA that recognizes and encourages communities to enact regulatory standards that exceed NFIP minimums and that are more appropriate for local conditions. In general, the CRS provides a reduction in flood insurance premium rates of up to 45 percent for communities that implement activities above the minimum NFIP requirements.

As a result, flood insurance premium rates are discounted to reflect the reduced flood risk resulting from the community actions meeting the three goals of the CRS; which are:

1. Reduce flood damage to insurable property;
2. Strengthen and support the insurance aspects of the NFIP, and
3. Encourage a comprehensive approach to floodplain management

To receive a CRS flood insurance premium reduction, communities apply to their Regional FEMA Office and submit documentation demonstrating activities taken by the community which exceed NFIP minimum requirements. These premium reductions are the result of credits awarded for engaging in any of nineteen CRS floodplain management activities. These activities are organized into four categories, and are as follows:

1. Public Information Activities (300 Series),
2. Mapping and Regulations (400 Series),
3. Flood Damage Reduction Activities (500 Series), and
4. Warning and Response (600 Series).

Based upon the overall CRS rating, flood insurance premium rates are discounted in increments of 5% (i.e., a Class 1 community would receive a 45% premium discount for those in the Special Flood Hazard Area, while a Class 9 community would receive a 5% discount; a Class 10 is not participating in the CRS and receives no discount).

Cedar Rapids Public Works Department is the administrator for this program in the City to help reduce the rates for the residents and to track the significant work done by the City. Cedar Rapids received a CRS Class 6 rating on May 1, 2014 with a score of 2,311 points (189 points shy of receiving a Class 5 rating). This new rating resulted in a two class improvement from a CRS Class 8 to a CRS Class 6. The Class 6 rating provides a 20% reduction in NFIP flood insurance premiums for properties within the Special Flood Hazard Area (SFHA); a Class 5 rating would provide a 25% reduction. The 5-yearly cycle for renewal is due in 2018.

Cedar Rapids Code

As granted by Iowa Administrative Code Chapter 364, Cedar Rapids City Code CHAPTER 32B - FLOODPLAIN MANAGEMENT ORDINANCE defines the legal requirements and actions of the City in areas that have higher levels of risk. In general, the ordinance limits construction in the SFHA (a flood having a one percent chance of being equaled or exceeded in any given year). The code chapter includes:

- Legal authority, finding of fact, and purpose
- Definitions
- General provisions
- Floodway, floodplain, and flood-prone area requirements
- Structures in flood plain
- Exceptions
- Administration
- Variances
- Appeal process
- Enforcement
- Non-conforming uses

Potential Changes

As the rate and magnitude of river crests have increased over the last decade, some communities such as Cedar Falls, Iowa now regulate the 500 year event (a flood having a 0.2 percent chance of being equaled or exceeded in any given year) standard for construction restrictions instead of the NFIP standard of the 100 year event (a flood having a 1 percent change of being equaled or exceeding in any given year). Concerns over property damage by flooding is offset by the economic desire to develop by a river in where real estate is more valuable such as the New-Bo or Downtown areas, which will be protected in the future by permanent flood control systems. Currently the City of Cedar Rapids requires all new or substantially improved residential and non-residential structures to have their lowest floor elevated to a minimum of one foot above the Base Flood Elevation (also known as the100-year flood elevation).

The proposed Cedar Rapids Flood Control System is currently being designed to protect the east and west sides of the Cedar River. The proposed system elevation is being designed to convey the volume of the 2008 flood event, with minimal freeboard. This height is approximately equal to the 500-year flood event plus three feet at most points along the alignment. The area protected by the Flood Control System and currently located within the

100-year floodplain is planned to be removed from the regulatory Special Flood Hazard Area hence why development is currently permitted within these previously restricted areas.

Regional/Local Stormwater Programs

Rivers and creeks flow through many jurisdictional boundaries. Therefore, the Cedar River and its tributaries impact areas larger than the Cedar Rapids municipal boundaries. These larger areas are known as watersheds. Cedar Rapids, as one member of these watersheds, participates across political boundaries to discuss and resolve stormwater issues. These efforts are discussed in the following paragraphs.

Indian Creek Watershed Management Authority

The Indian Creek Watershed Management Authority (ICWMA) is a cooperative agreement among the jurisdictions within the Indian Creek watershed to provide a framework for watershed level planning and management. Watershed Management Authorities have the ability to conduct watershed assessments, implement watershed improvement projects, and educate communities about flood risk and water quality concerns. The goal is to increase communication and coordination within the Indian Creek Watershed to reduce flood risk and improve water quality. The authority is organized by a 28E agreement between the jurisdictions of Cedar Rapids, Hiawatha, Linn County, Linn County Soil and Water Conservation District, Marion, and Robins.

The ICWMA, through the City of Marion, received one of three grant awards from the state to develop a comprehensive watershed management plan (http://indiancreekwatershed.weebly.com/). The plan includes an in-depth physical assessment of the Indian Creek Watershed identifying priority projects and a community engagement process to develop local solutions for the watershed. ICWMA has conducted modeling of the watershed, educational outreach, and watershed assessment.

Middle Cedar River Watershed Management Authority

In October 2015 the City of Cedar Rapids Infrastructure Committee voted to support formation of the Middle Cedar River Watershed Management Authority (MCRWMA). The MCRWMA drains approximately 1.5 million acres, includes the cities of Cedar Rapids, Cedar Falls and Waterloo, and all or portions of ten counties (Benton, Blackhawk, Buchanan, Butler, Franklin, Grundy, Hardin, Linn, Marshall, and Tama). “Establishment of the MCRWMA would provide an opportunity to seek grants from a variety of sources, including the National Disaster Resiliency Competition (through U.S. Dept. of Housing & Urban Development), and IDNR – Watershed Management Authorities Comprehensive Planning Grants.” [2]

Coalitions

Representatives of the City of Cedar Rapids participate in forums and groups in the region that support improved water quality and flood management practices. Two such forums include the Cedar River Watershed Coalition and Regional Conservation Partnership Project (RCPP).

The purpose of the Cedar River Watershed Coalition is to facilitate cooperation within the watershed and to organize and advocate for land practices and policies (federal, state, and local) that will reduce future flood damage and improve water quality. The coalition includes

legislators, city officials, county officials, soil and water conservation district commissioners, farmers, business people, environmentalists, and other concerned citizens. The Coalition was founded on February 5, 2010, at a meeting at the Center for Energy and Environmental Education at the University of Northern Iowa, in the aftermath of the Floods of 2008, to say "never again" to the level of flood damage that was sustained during that flood.

Project partners through their financial and technical assistance commitments will work to facilitate adoption of runoff nutrient reduction and water retention practices by producers and landowners in the Middle Cedar watershed over the next five years. Practices will include cover crops, nutrient management, bioreactors, saturated buffers, and wetland creation.

Led by the City of Cedar Rapids, the Regional Conservation Partnership Project (RCPP) will focus on working with local conservation partners, farmers, and landowners to install best management practices to help improve the Cedar River Watershed.

Partners in the project include:

1. The City of Cedar Rapids (Lead)
2. Benton Soil and Water Conservation District (BSWCD)
3. Tama Soil and Water Conservation District (TSWCD)
4. Black Hawk Soil and Water Conservation District (BHSWCD)
5. Natural Resources Conservation Service (NRCS)
6. Iowa Department of Agriculture and Land Stewardship (IDALS)
7. Iowa Department of Natural Resources (IDNR)
8. Iowa State University Extension Service (ISUES)
9. DuPont-Pioneer (DP)
10. Sand County Foundation (SCF)
11. The Nature Conservancy (TNC)
12. Iowa Farm Bureau (IFB)
13. Iowa Soybean Association (ISA)
14. Iowa Pork Producers Association (IPPA)
15. Iowa Corn Growers Association (ICGA)
16. Benton/Tama Counties and Miller Creek Watershed Quality Initiative projects

Partners are contributing $2.3M in financial and technical assistance and Regional Conservation Partnership Program (RCPP) has awarded $2.0M for a total project commitment of $4.3M over 5 years. The City of Cedar Rapids, through the Water Division is contributing $125,000 in financial assistance and $191,000 of “in-kind” technical assistance for project administration and monitoring (total of $316,000 for financial and technical assistance over 5 years).

The Middle Cedar project target area includes several USGS watersheds generally located between Vinton and Waterloo (Miller Creek, Pratt Creek, Wolf Creek, and Rock Creek). These watershed boundaries have been recently delineated using the new Watershed Boundary Dataset (WBD). The WBD is a nationally consistent watershed dataset that is subdivided into six levels. The WBD contains the most current, the highest resolution and the most detailed delineation of the watershed boundaries.

Project partners will provide outreach to producers and landowners to enhance the adoption of conservation practices on 13,400 acres, including planting of cover crops, nutrient management, bioreactors, saturated buffers, wetland creation, and wetland easements. A primary focus of the project is producer education on the benefits of less widely adopted conservation practices that hold promise for improved soil health and nutrient reduction.

Stormwater Commission
Per the NPDES MS4 permit, the City was required to organize a stormwater advisory commission. This group is to "hold public meetings with an informal stormwater stakeholders group to receive public input, hold public hearings, and work with volunteer groups, as appropriate."

The Stormwater Commission was an advisory group established by the Cedar Rapids City Council in December 2008 (Ordinance No. 041-08) to review current stormwater policies and recommend improvements to the policies, as needed. Its mission is to provide a timely and informed exchange between the public and City on flooding, water quality, and stormwater drainage issues within the City of Cedar Rapids.

The Stormwater Commission has general oversight of drainage issues. Duties include but are not limited to:

- Develops and recommends stormwater policies, such as water quality and watershed-based approaches.
- Reviews public input regarding stormwater drainage or erosion and sediment control.
- Recommends corrective actions.
- Advises the City Council in regards to stormwater capital improvements projects.
- Provides property owners with additional resources to resolve private drainage problems.

Stormwater Design

The City of Cedar Rapids stormwater management system design is based upon two distinct drainage systems: a minor system and a major system. The minor system corresponds to a rainfall event recurring not less than 5 years; while the major system generally corresponds to infrastructure required for the 100-year storm event.

According to Chapter 2 of the City's Design Standards, *'the minor storm drainage system should be designed to protect against regularly recurring damage, reduce street maintenance costs, provide an orderly urban drainage system, and provide public convenience'*. The storm sewer system designed to convey the minor storm event (5-year storm peak runoff) consists of underground piping, natural drainage ways, and other required conveyance (retention/detention facilities) for controlling the minor stormwater event within the existing right-of-way.

'The major storm drainage system should be designed to prevent major property damage or loss of life from storm runoff expected from the major storm.' Stormwater detention facilities are

designed to limit runoff leaving developed sites to the 5-year pre-developed peak runoff of the same duration (unless limited by downstream conveyance).

Design policies for stormwater management have been based around Federal and State regulations requiring runoff mitigation and sediment control (water quality) based upon specific design rainfall events. Limiting runoff and providing water quality has chiefly been accomplished through the use of conveyance piping and stormwater detention facilities based upon water volumes associated with these specific design rainfall events. Based upon data provided by the National Oceanic and Atmospheric Administration (NOAA), "in recent years, a higher percentage of precipitation in the United States has come in the form of intense single-day events" [3], and "the amount of rain falling on the heaviest rain days has also increased over the past few decades" [4]. If these stormwater precipitation trends become the new 'normal' or if they continue to increase, the City's previously designed and constructed stormwater detention facilities may require expansion to provide adequate levels of storage volumes and downstream protection.

Modernizing existing stormwater infrastructure simply by upsizing existing gray infrastructure and enlarging existing detention basins to handle increased rainfall events is extraordinarily expensive. Many communities are in various stages of developing and implementing stormwater policies based upon green infrastructure to promote infiltration and preserve natural open space, thereby preventing additional runoff. With many areas within the City's stormwater system identified as 'problematic' during rainfall events, green infrastructure policies implemented by the City can reduce runoff rates and prevent exasperating existing problems.

Green Infrastructure

In Cedar Rapids green infrastructure represents a new approach to stormwater management that has been shown in other communities to be sustainable, environmentally friendly, and cost effective when compared to upsizing gray infrastructure. As impervious development continues to increase and more intense, heavier rainfall events have become more frequent, many municipalities are turning to green infrastructure to complement existing stormwater management systems. This use of green infrastructure can be characterized in terms of the often quoted Benjamin Franklin, "an ounce of prevention is worth a pound of cure". By preventing the water from running off in large volumes after development the City can save the money that would have been necessary to upsize the entire system.

Green infrastructure requires a holistic approach by the use of natural and constructed systems at the site level, the neighborhood level, and at the regional level. The following paragraphs identify and discuss various green infrastructure systems for each level.

Site Level Green Infrastructure. At the site level, "green infrastructure mimics natural systems by absorbing stormwater back into the ground (infiltration, using trees and other natural vegetation to convert it to water vapor (evapotranspiration) and using rain barrels or cisterns to capture and reuse stormwater." [5] The goal of site level green infrastructure is to eliminate runoff for smaller storm events and to reduce runoff peaks and volumes from larger storm events. The advantage of site level green infrastructure is they capture the stormwater at the source reducing offsite runoff which can lead to erosion, sedimentation, and scour of

downstream waterbodies. Many of these site level practices can be incorporated into previously developed sites. Examples of site level green infrastructure include:

- Downspout Disconnection. This practice reroutes stormwater from roof drains and sump pumps from storm or sanitary sewer systems and redirects the flow to rain barrels, cisterns, or redirects the flow to permeable areas to promote infiltration.
    - Advantages: Removal of illegal connections returns existing system to original design capacity.
    - Disadvantages: Issues with discharging onto or towards adjacent properties. City will be contacted to settle conflicts arising between neighbors.
    - Policy Issues: Discharges should be required to be controlled on-site.

- Rainwater Harvesting. Rainwater harvesting systems collect rainwater from impervious areas such as downspouts and driveways and direct it to rain barrels or cisterns for later use such as gardening or landscaping.
    - Advantages: Small reduction in runoff if collected rainwater is utilized.
    - Disadvantages: Habitat for insect breeding if not properly maintained. Water collected must be used to provide volume for additional storms.
    - Policy issues: Overflow discharges should be required to be controlled on-site.

- Rain Gardens. Also known as bio-retention cells or bio-infiltration cells, these are vegetative basins (commonly planted with natural grasses) constructed to mimic natural processes such as infiltration, evaporation, and evapotranspiration of stormwater.
    - Advantages: Retention and infiltration. Provide low maintenance landscaping if correct plants are incorporated into design.
    - Disadvantages: Periodic maintenance required by homeowner.
    - Policy Issues: City inspections required if incentive is based on reduction in fee.

- Planter Boxes. Planter boxes are urban rain gardens with vertical walls (usually concrete), an underdrain discharge system, and soil media planted with vegetative material and trees.
    - Advantages: Retention, infiltration, sediment capture and chemical adsorption. Provide thermal cooling for sensitive receiving waters. Ideal for tight spaces; located within ROW. Curb cut-outs direct stormwater runoff into system.
    - Disadvantages: Maintenance required to remove sediment and debris from distribution boxes. Maintenance also required for vegetation. Mulch may be displaced during large rain events.
    - Policy Issues: Since these structures are located within city ROW, recommend design standards and specifications be adopted.

- Bio-swales. Bio-swales are vegetative swales composed of soil media, vegetation, and mulch and provide infiltration and retention as water moves linearly through the system.
    - Advantages: Retention and infiltration.

    - Disadvantages: Maintenance required to remove sediment and debris from distribution boxes. Maintenance also required for vegetation. Mulch may be displaced during large rain events.
    - Policy Issues: Since these structures are located within city ROW, recommend design standards and specifications be adopted.

- Permeable Pavements. Permeable pavements infiltrate, treat, and store rainfall where it falls. Permeable pavements and sidewalks may be made of concrete, asphalt, or interlocking pavers. Early freeze/thaw concerns of destroying pavements remain relatively unfounded; however, designs should be cognizant of ground water tables and freezing issues.
    - Advantages: Infiltration and chemical adsorption. Significant reduction in site runoff achieved.
    - Disadvantages: Plugging or blinding of permeable pavement, if area is subject to receiving sand during winter months or sediment from nearby construction activities. Maintenance such as vacuuming may be periodically required to restore permeability (may require additional capital outlay to purchase vac-truck(s) and provide personnel with proper training). Salting pavements for deicing should be avoided.
    - Policy Issues: Develop new standards and policies offering incentives to increase the use of permeable pavements.

- Green Streets and Alleys. Green streets and alleys are created by integrating multiple green infrastructure practices described above to promote infiltration, retention, and water quality along a street or alley. Other traffic control design items such as, traffic calming, decreased roadway widths, bike lanes, etc. can also be incorporated into green street design. The City of Dubuque Iowa has a Green Alley Program, their goal was to convert approximately 240 alleys to green alleys. They have replaced 23 alleys in 2014, 28 in 2015, and are planning on replacing another 30 in 2016.
    - Advantages: Retention, infiltration, sediment capture and chemical adsorption.
    - Disadvantages: Require alternative maintenance requirements/standard for these streets and alleys. Increase infiltration near older foundations and basements may lead to interior water related issues. Based upon bid tabulations for green alleys in Dubuque the cost ranges 2-3 times more than a reconstructed alley using conventional construction practices. Substantially increased project costs may be difficult to obtain buy-in from elected City officials.
    - Policy Issues: Develop standards and policies for construction and maintenance.

- Green Parking. Green parking involves the use of permeable pavements and bio-swales or rain gardens to promote infiltration and visually aesthetic vegetation.
    - Advantages: Promotes infiltration, runoff reduction, and provides thermal cooling for environmentally sensitive receiving water bodies. Aesthetically pleasing.
    - Disadvantages: Require alternative maintenance requirements/standards. Periodic maintenance required for vegetative materials.

    - Policy Issues: Develop new standards and policies offering incentives to increase the use of permeable pavements.

- Green Roofs. This practice involves covering rooftops with growing media and vegetation to promote storage and evapotranspiration. This practice is more common to dense urban areas where land values and stormwater management costs are high. Since retrofitting existing structures is usually cost prohibitive and Cedar Rapids has open spaces, this technique would be limited in use.
    - Advantages: Runoff reduction.
    - Disadvantages: Costly for new structures and cost prohibitive for existing structures.
    - Policy Issues: Incentives required to offset construction costs does not outweigh stormwater management costs.

- Urban Tree Canopy. Leaves and branches intercept falling rain causing retention of precipitation. Trees are also a significant source of evapotranspiration.
    - Advantages: Reduction and retention of runoff. Increase property values. May result in lower utility usage.
    - Disadvantages: Maintenance program required for leaf collection.
    - Policy Issues: Current policy seems to be conflicting; iGreenCR states the City values trees greater than 5-inch in diameter, but removal of a 24-inch oak only requires replacement with a small sapling. Consider increasing 'penalties' for tree removals based upon size and condition to existing tree.

- Vegetative Buffer Strips. Vegetative buffer strips consisting of grasses, native deep rooted grasses or prairie grasses along stream banks, parking lots, bio-swales, etc. Native and prairie grasses have root depths between 4 to six feet in depth. Rain gardens vegetated with native grasses have been shown to have infiltration rates 2 to 4 times greater than those vegetated with turf grasses.
    - Advantages: Increased infiltration rates. Decreased erosion. Sediment captured prior to entering other green infrastructure practices such as bio-swales or rain gardens.
    - Disadvantages: Native grasses or prairie grasses can take up to 3 or 4 years before they are fully established. Maintenance is required over this period to prevent existing grasses from crowding out newer planted native grasses. Most native and prairie grasses require burning of old growth to promote new growth.
    - Policy Issues: City inspections required if incentive is based on reduction in fee.

<u>Neighborhood Level Green Infrastructure.</u> Neighborhood level green infrastructure incorporates modifications in existing comprehensive planning policies to require the use of green infrastructure stormwater management techniques for public retrofit projects. Open green spaces such as parks and golf courses contribute little to runoff; however, they can provide large areas to infiltrate and treat stormwater.

- Infiltration Basins and Trenches. Infiltration basins and trenches are used to hold runoff until infiltration occurs. It is recommended that a sedimentation basin such as a wet pond located upstream of the infiltration basin be utilized to prevent blinding of the infiltration media.
- Reduction in Impervious Areas. Updating comprehensive planning documents to utilize narrower street widths in appropriate locations.
- Transportation/Pedestrian Green Improvements. Reducing pavement widths not only reduces impervious areas, but also creates opportunities for sidewalk planter boxes, rain gardens and bio-swales. Pedestrian bump-outs can also be utilized for green infrastructure.
- Reduce Mandatory Parking Space Requirements.
- Create Mixed Use Development Areas with Decreased Parking.
- Redevelopment of Brownfields.
- Increase Buffer Protection Requirements along Existing Streams and Waterways.

Regional Level Green Infrastructure. At the regional level green infrastructure consists of protecting and preserving existing natural areas. These areas can be located adjacent to or located within the City limits and may include wetlands, forested areas, steep hill sides and buffer areas between uplands and rivers or streams. Protecting and preserving existing natural areas can be accomplished using the following:

- Land Conservation.
- Habitat Corridors.
- Water Resource Protections.

Green Infrastructure – Policies

EPA is now developing guidance for state permit writers that will expand the requirements for using green infrastructure to meet MS4 permit requirements. [6] While new stormwater regulations are the driving factor, they cannot alone address development practices and larger land use patterns. Modifying land-use planning policies will also be required to fully protect natural waterways and sensitive lands. Many communities that have enacted green infrastructure initiatives have conducted a comprehensive review process which included a thorough review of development codes, local ordinances, stormwater regulations, landscaping requirements, street, sidewalk, and parking design requirements to ensure coordination and cooperation between departments. Surface transportation systems are likely the greatest contributor to total impervious area. The City is currently funding many large scale construction projects through the City's Paving for Progress program. Therefore, the City should review large scale street reconstruction projects to determine the viability of incorporating green infrastructure. These large projects may play a vital role in enacting green infrastructure policies adopted by the City.

The City of Cedar Rapids should not see the enactment of green infrastructure policies as a mechanism to downsize existing gray infrastructure, but as an asset management tool to extend the life and capacity of existing gray infrastructure. By actively promoting stormwater infiltration

and runoff reduction techniques throughout existing drainage basins, costly roadway and storm sewer projects may be indefinitely postponed or delayed until funding becomes available.

Developing an integrated municipal green infrastructure program is not possible through a single policy. Municipalities have found green infrastructure practices, like the problems they are meant to correct, must be evaluated case-by-case. Some practices are relatively well-understood and cost-effective; others may be less well known or have unexpected barriers, including:

- Funding,
- Lack of political support/leadership,
- Resistance to change,
- Coordination of multiple stakeholders and partners,
- Legislative action,
- Conflicting regulations and policies,
- Need for technical information and training,
- Small or developing markets,
- Misunderstanding about land use issues, and
- Cost Concerns. [7]

Upon reviewing twelve municipal green infrastructure programs across the country, the EPA assembled a three step approach to guide municipalities from policy implementation to successful practices. The first step includes: developing a funding source, creating improved stormwater ordinances, and code review to eliminate codes that conflict with green practices. The second step includes: development of demonstration/pilot projects, provide education and outreach programs, and establish incentives. Finally, the third step includes: utilizing green infrastructure on high profile projects and provide fee discounts to achieve high participation rates.

Retrofit Policies in Developed Areas. Several green infrastructure practices can be utilized in areas previously developed with little or no modifications to the City's infrastructure; this includes: disconnection of drain spouts, rain harvesting, tree planting and rain gardens. Other green infrastructure practices such as; planter boxes, bio-swales, permeable pavements, green parking, and green streets and alleys lend themselves to be incorporated into roadway/utility reconstruction and/or maintenance projects. Practices such as retrofitting structures with green roofs or land acquisition within developed areas are often cost prohibitive.

New Development Policies.

- New or Redevelopment Projects.
    - Require developers to manage a specific volume of stormwater created by impervious surfaces on-site using "green" infrastructure.
    - Require minimal site disturbances and/or reduction of impervious surfaces by incorporating incentives to the developer/property owner.
- Establish policies to direct developers away from sensitive lands and buffer areas.

Policies for City Infrastructure. Many communities have chosen to "lead by example" and have begun using green infrastructure at its own facilities and lands owned by the municipality. For example, the City of Chicago responded to flooded alleys by developing "Chicago's Green Alley Program".

The City of Cedar Rapids City Services Center utilized bio-swales in its parking area and has initiated a "Stormwater Best Management Practices Cost Share Program", which provides financial assistance to private property owners for constructing rain gardens and bio-retention cells. While the program is in its infancy, it appears to lack public interest. Increased public interest may be gained with development of green infrastructure policies, development of an education and outreach program, and construction of high profile small-scale demonstration and pilot projects within the City utilizing green infrastructure.

- As a pilot program, incorporate green infrastructure practices within the City's Paving for Progress Program to control a percentage of impervious area using green infrastructure.
- Institute an internal committee to review City owned lands such as: parks, golf courses, vacant lots, street right-of-ways, and water front properties and their ability to support green infrastructure.
- Establish Land Acquisition Programs. Land acquisition programs have been developed in Charlotte-Mecklenburg County and Portland Oregon to purchase and protect land in floodplains to provide flood mitigation, stream protection, water quality improvements and recreational amenities.

Green Infrastructure – Incentives

Incentives are a mechanism utilized by municipalities to achieve desirable results outside the limits of their regulatory authority. In the case of green infrastructure implementation, incentives are used to encourage property owners to construct green infrastructure on private property which were developed prior to (and are not governed by) the updated stormwater management policies. The primary types of green infrastructure incentives include:

- Stormwater Fee Discount. Usually this incentive requires the fee to be based upon impervious area. If the impervious area is reduced then the fee is also reduced. A discounted fee would require the City to hire additional personnel to provide continual inspection/verification services.
- Development Incentives. This incentive goes to developers that use more sustainable site design such as: infill development, native grasses, permeable pavements, green roof, rain gardens, etc. Incentives could be reduced permit times or lower permit fees.
- Grants. Grants are providing direct funding to property owners or community groups for the construction of green infrastructure projects.
- Rebates and Installation Financing. This mechanism provides financial incentives to property owners who install specific green infrastructure practices.
- Awards and Recognition Programs. Awards provide recognition to individuals who are responsible for implementing green infrastructure practices. Awards also increase public awareness. Awards are quite often one of more of the following; monetary, public presentations, and/or signs placed at the site.

Local Policy Recommendations

Near term policies that will need to be considered and presented to City Council deal with drainage, financing, maintenance, and changes in how to handle private related issues. The outcomes of the policy choices will affect services and charges for them.

Develop Framework for a Green Infrastructure Program

An integrated municipal green infrastructure program cannot be created without coordination and cooperation at all levels of decision makers, across all departments and eventually buy-in from the public. Even the creation of a single policy, without adequate public awareness and/or high profile projects, can delay implementation of a green infrastructure program. Successful development, implementation, and wide-spread community involvement often is the result of "leading by example".

Review all existing policies and remove policies conflicting with the development of a green infrastructure program. For instance, the Complete Streets Policy requires sidewalks in new developments and in areas where significant roadway improvements occur. Not only do sidewalks increase impervious surface, but their initial construction often requires tree removal, which is in conflict with the iGreenCR initiative. Communities that have been successful in creating sustainable green programs have reviewed and revised local codes and ordinances to complement newly created strong stormwater standards.

Private Cross Connects

The City of Cedar Rapids is currently developing a Private Service Lateral (PSL) Program aimed at reducing the amount of inflow and infiltration into the existing sanitary sewer system from private sources. These private sources are commonly referred to as "cross connects" and are sump pumps, foundation drains, downspouts and outdoor area drains which discharge into the City's sanitary sewer system through the private service lateral. While it is currently illegal to connect and discharge uncontaminated storm, surface, and ground waters into the City's system; this was common practice well into the 1960's.

The proposed PSL Program mentions the need to develop city-wide specifications for sanitary sewer lateral rehabilitation and reconstruction including redirecting sump pump, roof drain and foundation drains. Relocating discharge locations for sump pumps and cross-connection issues will require a holistic approach to ensure the removal of stormwater from the sanitary system does not cause unintended consequences within the ROW or on adjacent properties. Furthermore, the use of green infrastructure and/or storm sewer systems in the ROW will need to be better formalized as there are some areas in the City without any storm sewers.

Issues requiring formalization include;

- Discharges too close to public sidewalks may lead to icing conditions during winter months and moss growth during the summer months.
- Utilizing existing storm sewer piping will reduce the capacity of the existing stormwater system to convey the design storm runoff volumes.
- Behind the curb storm drainage systems drain subgrade water from streets, which increase the street service life, commonly known as drain tiles or French drains were

not designed or sized to carry the volume or pressure of flow delivered from sump pump discharges. Most of the existing drain tiles are constructed from single walled (perforated) HDPE insufficient of providing long-term performance.

- Introduction of sump pumps or increased flows can result in a surcharged system which could backflow into foundation drains or sump pump pits. Sump pumps usually are equipped with backflow prevention devices; however, foundation drains are not. Inundating a foundation drain could easily overwhelm a sump pump's capacity, resulting in flooding. The issue of backflow prevention will need to be addressed, including cost, ownership, maintenance, and location.

Grading and Runoff

As of the end of 2014, the City did not have an enforceable ordinance for property grading and post-construction compliance with design specifications. Requirements should be implemented for a post-construction grading survey to prevent long term nuance difficulties of water runoff and erosion.

The following language appears within the Subdivision Design Standards for the City of Waterloo, Iowa (Title 11, Chapter 5, Article 2) and should be considered for Cedar Rapids.

> 11-5-2: LOT IMPROVEMENTS
>
> D. Soil Preservation, Grading and Seeding:
>
> 1. Soil Preservation and Final Grading: In grading platted lots at least six inches (6") of topsoil shall be maintained on the lots.
> 2. Lot Drainage: Lots shall be laid out so as to provide positive drainage away from all buildings, and individual lot drainage shall be coordinated with the general storm drainage pattern for the area. Drainage shall be designed so as to avoid concentration of storm drainage water from each lot to adjacent lots.

Chapter 4 of FEMA Manual 511, dated June 2005, entitled "Reducing Damage from Localized Flooding – A Guide for Communities" provides a number of regulatory options designed to protect new buildings from flooding and prevent new developments from creating new or worsening existing flooding issues.

On April 22, 2014 the City of Coralville City Council passed a post-construction stormwater ordinance (Chapter 159 Post Construction Stormwater Control) aimed at regulating stormwater runoff from land development and other construction activities to control and minimize runoff rates, runoff volumes and soil erosion. Several of the standards incorporated into the ordinance include:

- "Site shall be designed using the 'Better Site Design' process." The Better Site Design process requires the site designer to address key issues such as; "open space protection, impervious cover minimization, and runoff distribution and minimization".
- "Existing topsoil must be preserved and reapplied on the site in a uniform uncompacted manner."

- "The site shall be designed to manage the water quality volume of 1.25 inches by infiltration processes according to the Iowa Stormwater Management Manual."
- "The site shall be designed to provide vegetated buffers for water quality protection adjacent to receiving channels and waters."

The City currently has draft revisions to Chapter 72 – Stormwater Management Ordinance. The key revision to this policy is the introduction of a "Soil Quality Plan". Similar to the Coralville policy, the Soil Quality Plan requires improvements/developments to retain the existing topsoil onsite and distribute it in a uniform and uncompacted manner in accordance with the Iowa Stormwater Management Manual Section 2E-6 Part F. Developing policies that not only retain existing topsoil onsite, but also require contractors to leave the upper layers of soils in an uncompacted state, not only promotes stormwater infiltration by increasing soil porosity but also enhances vegetative growth which reduces soil erosion.

Incentivize Green Practices

The City currently has a draft ordinance amending Chapter 72 (Stormwater Management). This draft amendment includes a stormwater utility charge based upon impervious surface area and then converted into Equivalent Residential Units (ERU), which has been established as 4,356 square feet of impervious surface area. Property Owners will be billed a stormwater utility charge, which is the total ERU count multiplied by the ERU rate of $0.1702/day. To incentivize the green practices, the draft policy includes a 'Water Quality and Quantity Credit' for the installation of stormwater infiltration practices in accordance with the Iowa Stormwater Manual. Based upon the percentage of impervious area runoff infiltrated this credit reduces the number of ERU's from 10 to 40%.

The City has initiated a "Stormwater Best Management Practices (BMPs) Cost-Share Program" for private property owners. This program provides private property owners financial and technical assistance in implementing stormwater BMPs for improving water quality and reducing stormwater runoff. The BMPs will improve water quality and reduce the amount of runoff by promoting infiltration practices. It is foreseeable that after implementation of the proposed 'Water Quality and Quantity Credit' this BMP cost-share program will be discontinued.

Funding Non-City Stormwater Property Losses

Develop a policy regarding requirements and conditions of when City funds are to be spent addressing stormwater issues on private property.

- For public facilities only or for private losses for certain cases?
- Damages incurred by residents as a result of overtopping/overland flow from public ROW for storm events of less than a certain size (say storm events less than the 100-year event).
- Damages as a result of overland flows created solely on private properties are not the City's responsibility.
- Damages as a result of storm events above a certain storm event are not the City's responsibility.

- Buyouts for business or residential units which have sustained damage (specify %) a certain number of times (4) as a result of a storm event at or below a specified storm event.

Low Level Openings and Lot Corner Grades Required on Site Development Plans
Require "Low Level Opening Elevations" and lot "corner grades" for all residential lots and commercial developments on plats and site plans, based upon a specific size storm event (say 100-year plus one foot). This would ultimately facilitate reduction of the many calls the City receives about final lot grading and home elevation issues causing localized flooding of newly built homes.

In recent years the city has had an issue with a handful of homes being constructed with walk-out basements on lots adjacent to drainage swales. The soils removed to facilitate the walk-out basement is the side slope of the drainage swale; and as a result flooding occurs within the structure during the design storms. By having the Engineer list the lowest opening elevation on the site plan for each lot within the development, the builder and the future homeowner do not need to be familiar with the various designed storm event water levels and flow patterns, but rather with the elevation of the lowest opening as it appears on the approved site plan.

Regional Detention Basins
In an attempt to reduce the number of smaller inaccessible basins currently being 'maintained' by City forces, by developers, or by homeowner associations; the City should consider constructing regional stormwater detention basins to manage storm events, which developers can purchase stormwater volumes within the newly constructed basin. The City could develop a "cost-share" program for these regional basins; initially funding the basin construction with City stormwater funds only to be reimbursed by developers utilizing the basin at a given percentage of the construction costs.

Drainage Easements
The City currently has a policy regarding encroachment within drainage easements for new properties; however, a policy is required for removing previously installed items from drainage easements. These items include, fences, sheds, walls, etc. Items located within these drainage easements (fences, structures) may have been previously permitted by the City; however, many these encroachments have become impediments to surface flows creating localized flooding issues. Mandatory relocation of these items will be met with opposition, likely resulting in a need for an incentive based policy.

Existing drainage easements are identified on legal documents such as plats and abstracts; however, because of the lack of infrastructure, many property owners are often unaware of their existence. Without knowledge of the purpose and/or existence of these drainage easements, property owners construction surface features (fences, garages, sheds, retaining walls, etc.), which lead to stormwater impedance and localized flooding.

- Consider future drainage easements to be owned and maintained by the homeowners' association and not the individual resident. Taking ownership away from individual

property owners might solve the issue of constructing surface features; however, the lack of periodic maintenance could exacerbate stormwater issues.
- Periodic maintenance will be required, if not, long grasses restrict flow, and long cut grasses clog downstream intakes, resulting in localized flooding.
- Provide a point of contact at the City GIS department to update easements throughout the City.

Targeted Buy-outs

Identify targeted buy-out areas located along problematic stormwater channels and/or existing stormwater basins for the purpose of increasing storage volumes and/or maintenance access (also to provide overland flow path for 100-year event).

- Policy may require condemnation, which is not popular with City Council or residents.
- Policy will also be expensive; ten homes at $200,000 is equal to the entire FY CIP budget.

Increase Educational Program Awareness

Increase City efforts to educate residents on existing programs and advantages of runoff reduction measures, such as:

- Flood Insurance Policies.
- Issues associated with restricting flow within drainage easements.
- Rain Garden Construction and Reimbursement Program.
- Prairie Grass Restoration Program (new program). According to “Iowa Rain Garden Design and Installation Manual”, due to the high organic matter in prairie soils, more than 90 percent of rainfall on these grasses would have infiltrated. Provide reduction in stormwater fees for removal of impervious areas / short-rooted turf grasses and revegetation with prairie grasses and wildflowers. The City and the School District could set an example by planting natural grasses at parks, schools, and golf courses. Stormwater Fee discounts would remain in effect as long as prairie grasses are viable and maintained. Initial investment in seed and initial maintenance will be offset by reduction in future maintenance costs.

[1] Encyclopedia Earth – Clean Water Act
[2] City of Cedar Rapids, Infrastructure Committee Meeting Minutes, October 13, 2015.
[3] US EPA (2014). Climate Change Indicators in the United States.
[4] Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014: Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.
[5] US EPA (2010). Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure.
[6] www.epa.gov/npdes/pubs/gi_memo_enforce.pdf
[7] Godwin, D.C., Chan, S.A., Burris, F.A. Barriers and Opportunities for Low Impact Development: Case Studies from Three Oregon Communities.