Volunteer Creek Watershed

Watershed Improvement Review Board Grant No. 7024-009

Final Project Report

December 31, 2011

Project History

In 2006, the City of Carlisle (City) received a grant from Growing Green Communities to assist with the costs of performing an assessment of impairments of the Volunteer Creek Watershed (Watershed). The City retained the services of Barker Lemar Engineering Consultants (Barker Lemar) to assess the physical attributes of the Watershed and to perform conceptual storm water flow modeling. The assessment indicated that a constructed detention basin, previously attempted erosion control measures, undersized culverts, and storm water run-off from un-developed agricultural areas in the upper portion of the Watershed cause severe erosion and downstream sediment loading within the Watershed. Additional physical changes (i.e. development) to the Watershed were predicted to increase erosion, storm water runoff, and sediment loading if not properly planned, developed, and controlled.

The City received a grant from the Watershed Improvement Review Board (WIRB) in 2008 to construct a storm water (and sediment) detention basin, a vegetative buffer, and a bioswale. These constructed features would help reduce erosion, sediment transport (the Watershed drains into Lake Red Rock Flood Pool), and reduce the severity of flooding within the Watershed (See Attachment A for project site maps). The City also wanted to develop a unique storm water management ordinance specific to the Watershed to require developers to implement best management practices for storm water management within the Watershed.

Photo A - Eroded Bank in Volunteer Creek

2.0 Financial Ledger

The Financial Ledger for this project has been submitted electronically separate from this report.

3.0 Financial Accountability

Services for the construction of Watershed features were selected through a competitive bid process and awarded to the lowest responsible and responsive bidder. The City constructed a 4.9-acre storm water detention basin, installed 1.25 acres of vegetative buffer, and a 0.04 acre bioswale.

Table 1 shows the WIRB funds approved for the construction of the Watershed features, the total WIRB funds expended to date, and the remaining/available WIRB funds.

Table 1 – Watershed Improvement Funds Allocated to Project

Grant Agreement Budget Line Item	Total WIRB Funds Approved	Total WIRB Funds Expended	Available WIRB Funds
Bioswale	$7,500	$7,500	$ -0-
Storm Water Detention Pond	$350,000	$353,790	($3,790)
Vegetative Buffer	$10,000	$6,210	$3,790
TOTAL	$367,500	$367,500	$ -0-
DIFFERENCE		$0	

Table 2 below shows the funding and expended funds for entire project.

Table 2 – Total Project Funding

Funding Source	Cash		In-Kind Contributions		Total	
	Approved Application Budget	Actual	Approved Application Budget	Actual	Approved Application Budget	Actual
WIRB	$367,500	$367,500.00	$0	$ -0-	$367,500	$367,500.00
City	$91,000	$95,843.25	$13,500	$28,307.07	$104,500	$124,150.32
TOTALS	$458,500	$463,343.25	$13,500	$28,307.07	$472,000	$491,650.32

Watershed Improvement Fund Contribution: Approved Application Budget: 78%

Actual: 75%

4.0 Environmental Accountability

The project objectives included designing and constructing features within the Watershed to reduce erosion, sediment transport, and flooding within the Watershed. The construction of these features has been completed. Since the vegetation has not had time to mature and become established, additional time will be needed to continue to collect and analyze additional water samples to measure the impact these features have had on accomplishing project objectives.

The following subsections provide a summary of the individual activities performed for this project and their overall impact.

4.1 Water Quality Monitoring

Water samples were collected upstream and downstream from the project location in March 2011, and one additional sample was taken in 2011. Sample locations had little to no flow for most of 2011, therefore only two samples were collected. The samples were analyzed for turbidity, total suspended solids, flow rate, and the depth/width of each sample location was measured.

The City will continue water sampling/monitoring for this project. With the completion of the project features, sampling/monitoring will be of increased importance to identify and measure water quality improvements as the vegetation becomes established and mature.

4.2 Project Practices Developed/Constructed

The main objectives of this project were to design and construct features to reduce erosion, sediment transport, and severity of flooding, and to develop a unique, watershed-based, storm water ordinance.

4.2.1 Watershed Based Storm water Management Ordinance

Previous storm water modeling indicated that existing flooding issues within the Watershed would increase in severity as the upstream portions of the Watershed were developed. The City knew that their existing city-wide storm water management ordinance would not improve the situation. Therefore, as part of the WIRB project, the City developed a watershed-based storm water management ordinance. This approach allowed the City to develop a storm water management ordinance specific to the needs of a specific watershed (versus a general city-wide ordinance).

Photo B - Flooding

The adopted ordinance was designed to require developers within the Watershed to have an increased role/responsibility for storm water management on their property.

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The initial storm water management ordinance developed was considered by the City to be too restrictive and cumbersome to developers interested in developing within the Watershed. Modifications were made to the ordinance to allow the City and developers flexibility in determining the implementation strategies required to meet storm water management objectives.

The developed storm water management ordinance accounts for the features constructed within the Watershed. The ordinance also requires developers to implement storm water management strategies such as rain gardens, permeable pavement, and vegetative buffers to help reduce the quantity and flow rates of storm water from their developed property.

The final ordinance has been adopted by the City and is included in Attachment B of this report. The ordinance can also be accessed here: http://carlisleiowa.org/your-city-government/city-ordinances/post-construction-storm-water-management-chapter-158/.

4.2.2 Constructed Project Features

Barker Lemar worked with the City, neighborhood associations, the public, the Army Corps of Engineers (ACOE), and other interested parties in the design of features to improve the water quality within the Watershed. Barker Lemar attended several City Council meetings, hosted project site tours/discussions, and met with residents one-on-one to discuss the project objectives, answer questions, and to receive feedback concerning feature designs.

Barker Lemar modified the design of the features to accommodate feedback from Watershed residents and as directed by the City. Design modifications included considering two detention basins (versus the originally proposed one pond), and the movement of the location of the bioswale and vegetative buffer areas. Most of the design modifications were made to respond to property owner's desires to reduce the project's footprint and to preserve existing vegetation and scenic views.

All construction activities directly associated with this project have been completed.

Storm water Detention Basin

Barker Lemar worked with the City, public and private parties, and the ACOE to design a storm water detention basin within the Watershed to reduce erosion, sediment transport, and flooding downstream. At the direction of the City, Barker Lemar developed several design options to accommodate a variety of specific requests received by different parties. The detention basin will manage the storm water and sediment flow from upstream areas within the Watershed during 100-year/24-hour storm events. Approximately 3 acres of private property was purchased by the City to construct the 4.9 acre storm water detention basin.

Photo C - Outlet of Storm Water Detention Basin

Photo D - Storm Water Detention Basin & Vegetative Buffer

Vegetative Buffer

The vegetative buffer was designed to help slow the flow rate of water into the storm water detention pond, reduce erosion around the edges of the pond, and to capture sediment being transported by surface water flows. The vegetative buffer was designed to be expanded as land is developed upstream from the storm water detention pond. Native grass species were selected that were suitable for the specific conditions within the Watershed. The native grasses should help reduce the need for maintenance.

Vegetative buffer strips are designed to manage sheet flow at depths no deeper than 1 to 2 inches. The project's vegetative buffer strips have a capacity to manage sheet flows of approximately 1 inch in depth.

Bioswale

The project constructed a bioswale downstream of the storm water detention basin. The bioswale was designed and constructed to minimize sediment loading and to reduce the amount and velocity of storm water flow by absorbing water through the root system. The bioswale consists of an excavated area of approximately 0.04 acres with deep rooted native vegetation. Due to unanticipated property ownership issues, the bioswale was constructed smaller than originally planned. However, the modified design is believed to be less intrusive to surrounding property owners.

Photo E - Bioswale

Bioswales are designed to capture and treat runoff from 90 percent of the average annual rainfall events, which equates to 1.25 inches for most of Iowa. As a result, the project's bioswale has a required treatment volume of 170 gallons. The actual volume available in the constructed bioswale is estimated to be approximately 5 times the required amount or 850 gallons.

4.3 Education Activities

Public Meetings and Workshops

The City and Barker Lemar hosted several public meetings/workshops to discuss the objectives of the project and to involve the community in actions to improve the water quality of the Watershed. These events informed residents of storm water management issues (i.e. erosion, sediment transport, flow rates, etc.) that were negatively impacting the Watershed. These events also encouraged residents to implement storm water best management practices for their properties (i.e. rain gardens, rain barrels, pollution prevention, etc.).

Photo F - Project Sign

Tri-Fold Educational Brochure

Barker Lemar worked with the City to develop a tri-fold educational brochure that promoted the project and encouraged residents to implement storm water best management practices for their properties. The tri-fold brochure is available at City Hall and other public places, is being distributed to homeowners within the Watershed, and is available in a digital file to interested parties.

Photo G - Watershed Committee Workshop Session

Project Presentations

The City and Barker Lemar have developed a presentation that examines the project's objectives and outcomes, and discusses environmental/storm water management issues. The presentation also includes lessons learned from the development and implementation of this project. The City has requested permission from the following groups/associations to perform the presentation.

- American Public Works – Iowa Chapter
- Iowa League of Cities

Unfortunately, these groups/associations were unable to accommodate the City's request for 2011. However, they have agreed to evaluate the request to present at future events.

Watershed Based Management Tool-kit

The project includes the development of a tool-kit to summarize the project's activities and lessons learned in order to assist interested watershed management groups implement similar storm water management strategies in their watershed. This tool-kit includes methods used to perform storm water modeling, the developed storm water management ordinance, explanation of the designed/constructed features and their combined roles in improving water quality within the Watershed, and a discussion of general lessons learned throughout the project.

Table 3 shows the practices and activities performed for this project.

Table 3 – Practices and Activities

Practice/Activity	Unit	Approved Application Goal	Accomplishments	Percent of Goal Completed
Construct Storm water Detention Basin	Number	1 (5.0 acres)	1 (4.9 acres)	100%
Install Vegetative Buffer	Acres	2.0	1.25	63%
Construct a Bioswale	Number	1	1	100%
Design Conservation Sensitive Design Strategies	Number	1	1	100%
Perform Additional Storm water Flow Modeling	Models	2	2	100%
Collect and Analyze Storm water Samples	Number of Samples	24	2	8%
Tri-Fold Educational Brochure	Brochures Developed	1	1	100%
Educational Sessions	No. Sessions	3	3	100%
Workgroup Session	No. Sessions	2	2	100%
Project Signage	N/A	1	1	100%
Trade Show Presentations	No. Presentations	2	0	0%

4.4 Pollutant Reductions

The existing rural and urban combination of this watershed makes it difficult to apply traditional rural erosion control modeling. According to Adam Kiel of the Iowa Department of Natural Resources, the Sediment Delivery Calculator software "does not work well with urban BMPs." Similar issues arise for applying a purely urban approach. Therefore, the following approach was used in an attempt to measure potential pollutant reductions.

The primary sediment of concern in the watershed is topsoil from the farmland. Data from the 2007 National Resources Inventory shows Iowa's average erosion rate was 5.2 tons per acre per year, which equates to over 1,500 tons per year for the entire Watershed. Due to the existing development in a portion of the watershed, this amount is likely closer to 1,200 tons per year for the Watershed. As storm water carries the sediment, the sediment will typically begin to settle out as the velocity of the flow falls below 2 feet per second, which does not occur at most locations in the Watershed until it enters the Red Rock flood plain/pool.

However, as the incoming stream flow transitions to the pool in the new storm water detention basin, the velocity of flow decreases and sediment begins to drop out. Based on this natural ability for topsoil to rapidly settle out of water, the sediment removal efficiency is expected to be very high.

As the Watershed becomes developed, the amount of topsoil sediment will decrease and will transition to a combination of topsoil plus sand-sized particles used on the roadways for snow and ice control. Further, the Watershed management concept is to use a storm water train where the upstream storm water controls required by the storm water ordinance will manage much of the sand-sized particles, and those that get transported downstream will be managed by the storm water detention basin. Since the sand particles are generally larger than topsoil particles, the settlement time is less than that for topsoil. It is estimated that the average sand particle will settle from the water column in under 1 minute. As a result, the sediment removal capability of the storm water detention basin will "improve" as the development of the watershed continues.

In addition, the construction of the storm water/sediment basin reduces peak flows. These reduced flows also reduce stream bank erosion, which was noted throughout the Watershed during the study phase of the project. It should be noted that the storm water detention basin was not designed to manage small silt or clay particles, which typically require hours if not weeks to properly settle out the particles. In fact, wind and thermal effects can keep some these smaller particles suspended indefinitely. Instead, these particles are required by law to be managed on the construction site from which they originate.

Vegetative Buffer Strip

According to information in the Iowa Storm Water Management Manual, buffer strips when sized, designed, constructed, and maintained in accordance with recommended practices have the following average pollutant reduction percentages.

- Total suspended solids: 50%
- Total phosphorus: 20%
- Total nitrogen: 20%
- Heavy metals: 40%

Bioswale

According to information in the Iowa Storm Water Management Manual, bioswales when sized, designed, constructed, and maintained in accordance with recommended practices have the following average pollutant reduction percentages.

- Total suspended solids: 80%
- Total phosphorus: 50%
- Total nitrogen: 50%
- Heavy metals: 40%

Continued water sampling will need to be performed after the first growing season is complete to help determine the impact the constructed features have had on water quality within the Watershed. It is anticipated that the constructed

features (and adopted storm water management ordinance once land is developed) will reduce erosion, sediment transport, flow rates, and reduce flooding within the Watershed.

5.0 Program Accountability

The project has accomplished the main objectives of constructing the Watershed features and developing a unique watershed-based storm water management ordinance. The project has also accomplished objectives related to increasing storm water management/Watershed awareness/education throughout the Watershed as well as throughout the greater community.

5.1 Expand Impact of Project

As a result of the public meetings and workshops hosted by the City and Barker Lemar, residents of the Watershed received information about strategies to improve the management of storm water within their Watershed. Residents were involved and engaged during the concept and design phase of the proposed Watershed features. This engagement from residents has increased their interest and understanding of the impacts development, land use, and storm water management issues have not only on their Watershed, but those watersheds downstream (Lake Red Rock Flood Pool).

5.2 Challenges and Lessons

Due to the uniqueness of the project design and concept, the project was challenged with communicating the purposed activities with the ACOE. To complicate communications, several ACOE staff was involved in the review of the design/concept at various stages of the project. Several meetings were held with ACOE staff (including a site visit to the project area) in order to educate the ACOE concerning the benefits the constructed features would have for the Watershed as well as the Lake Red Rock Flood Pool. This process took longer than anticipated and ultimately delayed the progress of the project. Once the various staff members with the ACOE fully understood the project objectives, the project was allowed to proceed.

5.3 Recommendations

The City will continue to collect and analyze water samples to measure/monitor water quality improvements due to the constructed features.

The City will continue to pursue opportunities to present the project at two conferences or seminars.

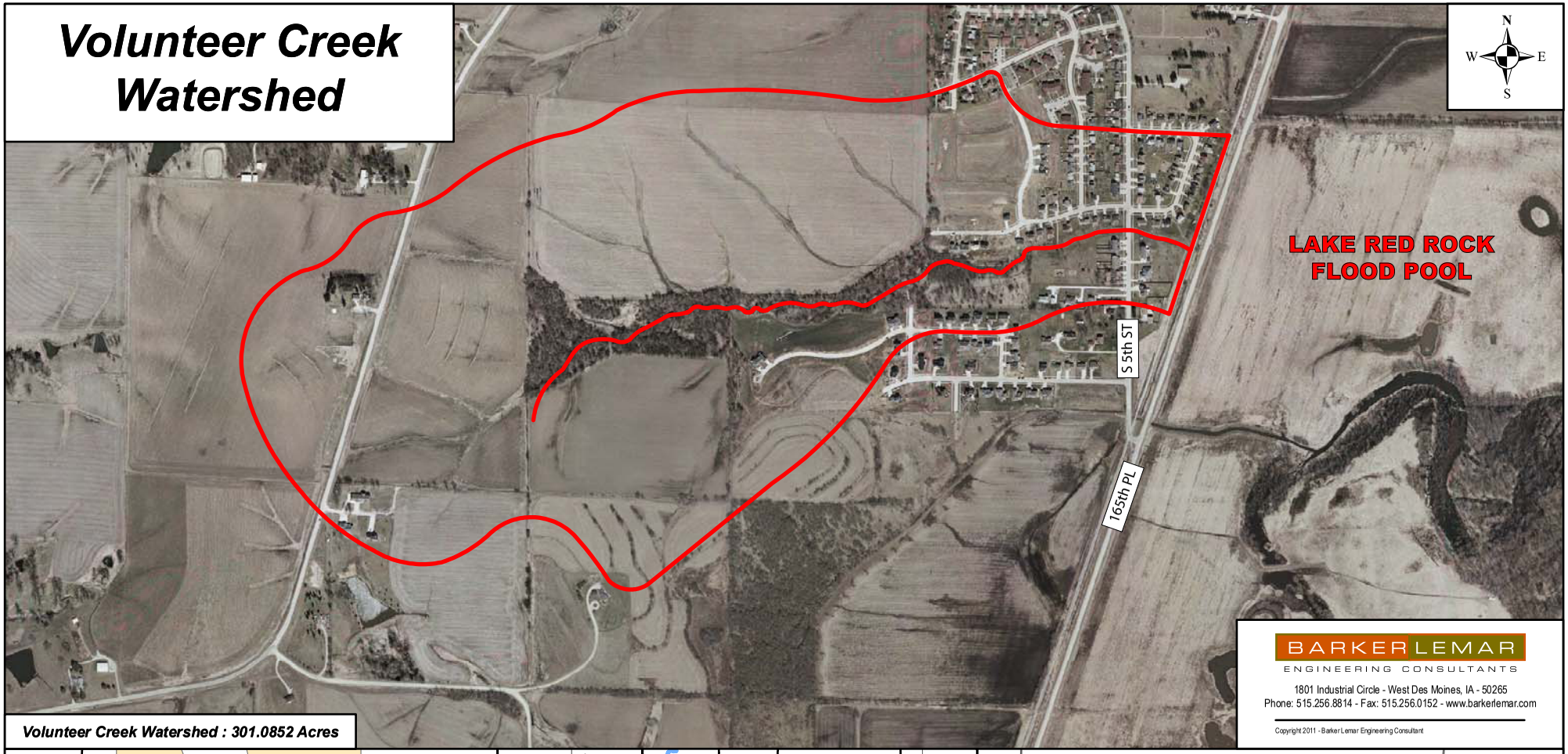
5.4 Limitations for Replication

There are no clear limitations for the replication of a similar project approach for other watershed groups. The watershed groups may need the support of professional engineers to help perform modeling, design features, and coordinate the construction/implementation phase.

ATTACHMENT A

PROJECT SITE MAPS

Volunteer Creek Watershed



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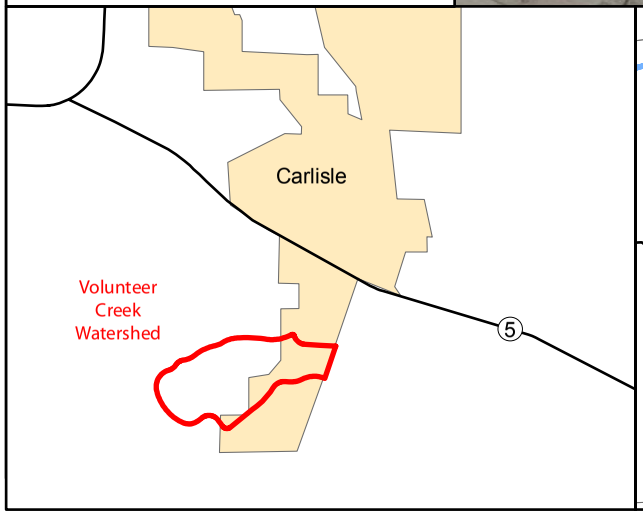
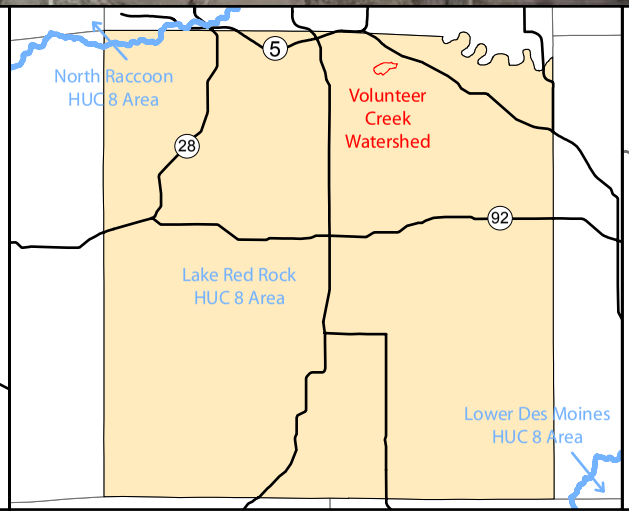
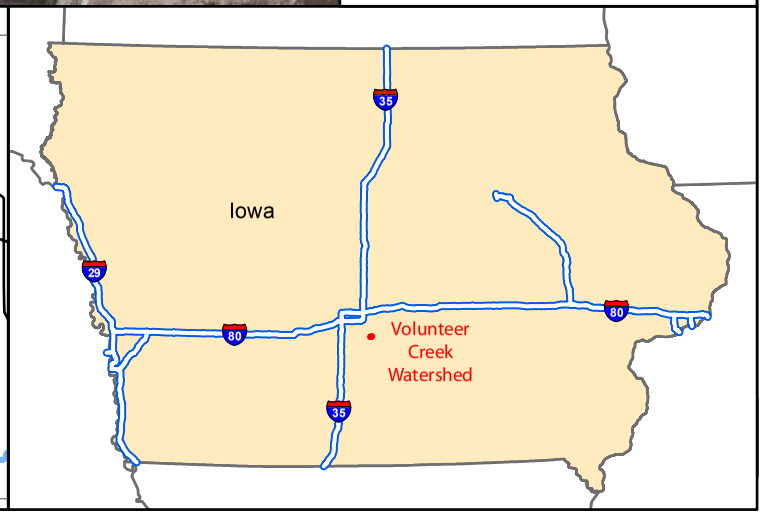
Volunteer Creek Watershed : 301.0852 Acres







SCALE

0 500 FT.

PROJECT SUMMARY PHOTO

VOLUNTEER CREEK IMPROVEMENTS
CYCAR 08000
DRAWING DATE: MAY 2011

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SHEET
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ATTACHMENT B

STORM WATER ORDINANCE

CHAPTER 158

POST-CONSTRUCTION STORM WATER MANAGEMENT

158.01 PURPOSE. The purpose of this chapter is to establish a set of water quality policies to provide reasonable guidance for the regulation of storm water runoff for the purpose of protecting water resources within the Volunteer Creek Watershed from degradation. The regulation of storm water runoff discharges from land development and other construction activities is essential in order to control and minimize runoff rates and volumes, soil erosion, stream channel erosion, and non-point source pollution associated with storm water runoff. These regulations are in the public interest and will prevent threats to public health and safety.

158.02 DEFINITIONS. For the purpose of this section certain words or phrases are defined as follows:

1. "Applicant" means a person, firm, or entity applying for a permit or development approval to develop, grade, or construct any improvement within the corporate limits of the City.

2. "Approval" means formal, written consent by the Council or authorized representative of the City.

3. "Best management practices" (BMPs) means schedules of activities, prohibitions of practice, 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 Storm Water Management Manual* and *Iowa Statewide Urban Designs and Specifications* (SUDAS). The BMPs covered are not meant to be a comprehensive list of acceptable BMPs.

4. "Drainage, detention, or overland flowage easement" means a legal right granted by a landowner to a grantee allowing the use of private land for storm water management.

5. "National Pollutant Discharge Elimination System" (NPDES) is the program for issuing, modifying, revoking, terminating, monitoring, and enforcing permits under the Clean Water Act (Sections 301, 318, 402 and 405) and the United States *Code of Federal Regulations* Title 33, Sections 1317, 1328, 1342 and 1345.

6. "Post-Construction Storm Water Management Plan" (PCSWMP) means a set of plans and specifications approved by the Council or authorized representative during the approval of the site plan, construction drawing, and plat that defines the system of BMPs that are to be constructed and maintained on the site.

7. "Property" means land located in the City, whether or not improved with buildings or other structures.

8. "Property owner" means a person who, alone or with another person or other persons, holds legal title to property; however, where property has been sold on contract to a person who has the present right to possess the property and the contract has been filed for record in the office of the County Recorder, the person so purchasing the property, whether alone or with another person or

other persons, is the property owner and the person retaining bare legal title to the property as security for the balance of the purchase price.

9. "Regional detention facility" means a wet or dry detention basin that is designed to accept storm water runoff from two or more sites and complies with all City, State, or Federal permit requirements as they apply to storm water management requirements for those sites.

10. "Storm water" means storm water runoff, snowmelt runoff, and surface runoff and drainage.

11. "Storm Water Pollution Prevention Plan" (SWPPP) is a plan as defined in the Iowa NPDES storm water general permit.

12. "SUDAS" means the current Iowa Statewide Standard Urban Design and Specifications for Public Improvements.

13. "Iowa Storm Water Management Manual" means the current manual for BMPs for storm water management.

158.03 POST-CONSTRUCTION STORM WATER MANAGEMENT PLAN. Every property owner or applicant in the Volunteer Creek Watershed shall design, install, and maintain Post-Construction Storm Water Management Plan (PCSWMP) facilities and/or practices as approved by the Council or authorized representative during the site plan, construction drawing, or platting process. A State-licensed professional engineer or landscape architect shall design PCSWMP facilities in conformance with the current guidelines established in the State *Storm Water Management Manual*, SUDAS, or other documents determined to be applicable to the City. PCSWMP facilities shall be designed with appropriate BMPs, such as grass swales, buffer strips, rain gardens, permeable paving, bio-retention and other similar types of infiltration basins, and riparian areas. The BMPs shall be designed with conservation sensitive design (CSD) strategies to improve water quality, reduce erosion, and reduce sediment loading. The BMPs shall promote continuity with and not negatively affect previously approved PCSWMPs that are upstream or downstream of the property owner's or applicant's property. In order to ensure that the PCSWMP facilities are constructed in accordance with the approved design, the property owner or applicant shall provide to the City an as-built plan detailing dimensions and elevations as well as certification that the approved facilities were installed and are operating properly. The as-built plans shall be completed by a State-licensed professional engineer or landscape architect and submitted to the City prior to the acceptance of any improvements or issuance of any improvements or issuance of any certificate of occupancy. The property owner or applicant may satisfy the peak flow rate requirements of the PCSWMP by ensuring the conveyance of storm water discharge from the property to the regional detention facility.

158.04 MAINTENANCE. It is the property owner's duty to ensure that the site is periodically inspected and maintained in accordance with the approved PCSWMP. Periodic inspections shall be completed as needed and in no case less than one time per year. Inspections shall be documented and shall be retained for at least three years. Copies of the inspection documentation shall be made available to the City upon request.

158.05 INSPECTION. The City shall be permitted to enter and inspect any property subject to regulation as often and as necessary to determine compliance with this chapter. The City may conduct site visits at any time to determine compliance with the approved PCSWMP. Additionally, the City may request that a property owner verify, through the preparation of an as-built plan completed by a State-licensed professional engineer or landscape architect, that the PCSWMP facilities contain appropriate capacities and operational characteristics as originally designed and approved. In the event that a site is found not to be in compliance with the PCSWMP, the City will communicate in writing to the property owner a list of deficiencies that identifies the area or incident of noncompliance. The property owner shall have 14 days

from the date of notice to provide a written response that outlines the steps and implementation timelines for corrective action. The property owner shall have 30 days from the date of notice to complete the corrective action necessary to bring the site back into compliance with the approved PCSWMP. Following the review of the property owner's written response, if extenuating circumstances exist that make implementation of the necessary corrective action difficult to complete within the specified time period, the City may grant, at its sole discretion, a reasonable extension of time to complete the corrective action. Failure to allow access to the property, provide a written response, or undertake corrective action shall constitute a violation of this chapter.

158.06 CORRECTIVE ACTION BY CITY. If the property owner fails to take corrective action in the time period prescribed in the previous section, 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 therefor. Said costs shall include salaries and benefits earned by City employees during such corrective action, a charge for the City machinery used, and such other costs and expenses as the City actually incurred. To the extent allowed by State law, such costs and expenses may be assessed against the property owner and collected in the same manner as property taxes.

158.07 RESPONSIBILITY. The failure of City officials to observe or foresee hazardous or unsightly conditions, or to impose other or additional conditions or requirements, or to deny or revoke permits or approval, or to stop work in violation of this chapter shall not relieve the property owners of the consequences of their actions or inactions or result in the City, its officers, or agents being liable for the same. Notwithstanding any provision of this chapter, every applicant bears final and complete responsibility for compliance with the NPDES General Permit Number 2 and any other requirements of State or Federal law or administrative rule.

158.08 VIOLATIONS. Violation of any provision of this chapter may be enforced by civil action including an action for injunctive relief. In any civil enforcement action, administrative or judicial, the City shall be entitled to recover its attorneys' fees and cost from a person who is determined by a court of competent jurisdiction to have violated this chapter.

158.09 APPEAL. Administrative decisions by City staff and enforcement actions of the enforcement officer may be appealed by the applicant to the board of adjustment pursuant to the following rules:

1. The appeal must be filed in writing with the City Clerk within five business days of the decision or enforcement action.

2. The written appeal shall specify in detail the action appealed from, the errors allegedly made by the enforcement officer giving rise to the appeal, a written summary of all oral and written testimony the applicant intends to introduce at the hearing, including the names and addresses of all witnesses the applicant intends to call, copies of all documents the applicant intends to introduce at the hearing, and the relief requested.

3. The enforcement officer shall specify in writing the reasons for the enforcement action, a written summary of all oral and written testimony the applicant intends to introduce at the hearing, including the names and addresses of all witnesses the enforcement officer intends to call, and copies of all documents the enforcement officer intends to introduce at the hearing.

4. The City shall notify the applicant and the enforcement officer by ordinary mail and shall give public notice in accordance with Iowa Code Annotated (ICA) Chapter 21 of the date, time, and place for the regular meeting of the Board of Adjustment at which the hearing on the appeal shall occur. The hearing shall be scheduled for a date not less than four but not more than 20 days after filing of the appeal. The rules of evidence and procedure, and the standard of proof to be applied, shall be the same as provided by ICA Chapter 17A. The applicant may be represented by

counsel at the applicant's expense. The enforcement officer may be represented by the City Attorney or by an attorney designated by the City at City's expense.

The decision of the Board of Adjustment shall be rendered in writing and may be appealed to the Iowa District Court.