

SECTION 7 – BMP SITE INVENTORY

7.1. Introduction

From the conclusions of SECTION 6 - POLLUTION SOURCES AND CONTROL STRATEGIES, both non-structural and structural BMPs are recommended in order to work towards the goal of reducing *E. coli* loading to Antelope Creek. Non-structural controls, detailed in SECTION 8 - MANAGEMENT PRACTICES–RECOMMENDED PROJECTS/PROGRAMS, are focused on controlling the pollutant at the source (and are sometimes referred to as source controls). Non-structural controls can be effective for reducing pollutant loads and tend to be less costly than structural practices. Also, the project team has identified several structural BMPs, most of which include a combination of BMPs and are also detailed in Section 8 - Management Practices–Recommended Projects/Programs.

Non-structural controls can be effective for reducing pollutant loads and tend to be less costly than structural practices

These are the initial demonstration projects, with monitoring, modifications may be necessary when applied over wider areas. The efforts, while significant, do not treat all of the stormwater in the watershed to the high level needed, but are targeting the areas that are expected to have the greatest unit area discharges that can be controlled at the least cost. With this experience, more widespread application of stormwater controls can be planned for the whole area (such as long-term implementation at the time of scheduled road reconstruction/repairs).

This section provides the general methodology for water quality structural BMP site selection within the Antelope Creek Basin. These same selection criteria can be applied to other watersheds within the City of Lincoln or throughout the country. Following the general methodology discussion is a detailed description of the site specific process that was used to identify, screen, and select water quality BMP project sites within the Antelope Creek watershed as part of this Basin Plan. This methodology is essential to filtering the potentially hundreds of BMP sites down to a manageable number to be developed into potential projects.

7.2. General Potential BMP Site Selection

The methodology of BMP site selection has four general steps:

1. Field Screening of potential sites for water quality BMPs
2. Desktop review of potential sites for water quality BMPs
3. Development of watershed specific selection criteria
4. Ranking and selecting sites

7.2.1 Field Screening Potential Sites

The first step in the site selection process is to conduct a field screening of the watershed to identify as many potential sites for water quality BMPs as practical; serving as the basis for the potential final site list. This hands-on activity generally involves a map review, understanding watershed characteristics, and ultimately surveying the watershed to observe site conditions. The list is narrowed down throughout the site selection process. It is important to understand that each watershed and its respective water quality goals are different. Field notes detailing the information gathered at each potential site, as-well-as site photographs, should be kept for use in future steps of the site selection process. Public acceptance was an important criteria involved in all aspects of field screening.

7.2.2 Desktop Review of Potential Sites

The second step in the site selection process consists of conducting a desktop review of each of the potential sites for water quality BMPs identified during the field screening. This step in the selection process allows an “apples to apples” comparison of the sites. A one to two page information sheet of each potential site should be developed at this stage. The information sheets should be used to screen potential sites for water quality BMPs for further consideration. As an example, if the site had utilities buried in potential BMP locations, the site may be removed from further consideration due to constructability concerns. Upon completion of the desktop review of potential sites for water quality BMPs, the larger list of potential sites should be narrowed down to the potential sites that have met all of the screening requirements.

7.2.3 Develop Watershed Specific Selection Criteria

The next step in the site selection process is to develop a specific list of selection criteria and rank them in order of importance to achieve the watershed goals. The selection criteria might include any important aspect of the watershed plans, such as public input, regulatory goals, etc.

7.2.4 Rank and Select Potential Project Sites

Using the information gathered from the field screenings and the desktop review, the full list of potential BMP sites identified for potential projects can now be ranked against each other using the criteria list that was developed. Each site should be scored on a scale against each of the selection criteria. The selection criteria can be ranked and weighted to increase the multiplier for the most important selection criteria. For example, if the treatable area was the most important selection criteria out of five choices, a potential site would receive an x5 multiple of the score it received in that category (conversely the least important criteria would receive an x1 multiple). The top scoring sites should be selected and moved onto the next step of the process, conceptual project layouts, described in SECTION 8 - MANAGEMENT PRACTICES—RECOMMENDED PROJECTS/PROGRAMS.

7.3. Antelope Creek Potential BMP Site Selection

This section details the site specific methods and criteria used to select potential BMP sites within the Antelope Creek watershed as part of this Basin Plan.

7.3.1 Field Screening

During September and October of 2011 the project team completed a field screening of potential BMP sites within the Antelope Creek watershed. The following list of general field screening criteria was used by EA personnel to develop the preliminary list of potential BMP sites shown in Table 7-1.

Land Ownership/Location – Publically owned property was given a high priority when selecting potential BMP sites. A large amount of land adjacent to Antelope Creek, used for recreation and open space, is owned by the City of Lincoln, and could be available for implementation of structural BMPs.

Projects implemented in these public areas also increase opportunities for outreach, public education and information, and placement of interpretive signage. During field surveys, potential sites for water quality BMPs were identified on both private and public properties but were mostly aimed toward publicly owned properties. Projects on private property are recommendations for the land owner to pursue. City or other agencies may be available for partnership or funding assistance.

Land Use – Land use has a direct impact on the quantity and quality of stormwater and is an important factor in the selection of potential BMP sites. As mentioned above, site selection of structural source water controls was prioritized towards public, quasi-public, open space, transportation, and recreational land uses. Commercial and industrial land uses typically have a greater amount of impervious surface, and thus have greater amounts of surface runoff and may be more suitable for BMP siting. However, these land uses make it more difficult for site specific projects due to increased land purchase costs, limited space to implement potential projects, and potential lack of interest from property owners.

Topography – Topography can play a major role in BMP site selection. If a site is hilly and does not have a well-defined stormwater flow path, it can be difficult to design a BMP that is cost effective due to the limited treatable area. More attention was focused on identifying potential sites for water quality BMPs in flat areas with defined stormwater flow paths.

Drainage Patterns – Drainage patterns relate closely with site topography. Two main types of drainage patterns were noted. The first was overland or open channel flow, and the second was closed conduit or storm drain flows. Drainage pattern characteristics were identified, including direction and size of the drainage pattern, make-up of the drainage system, and the condition of the material in the open channel drainage ways (*i.e.*, concrete liner, soil, amount of vegetation, etc.).



Picture 14: The parking lot at Auld Pavilion was screened as a potential disconnect project

Existing Landscaping – The project team took notes and photos of the existing landscaping. The ability to fit water quality BMPs within existing landscaping, or the possibility of designing them to be similar to existing landscaping, can be a major factor in the public acceptance process of BMPs.

Nearby Pollutant Sources – Because a TMDL for *E. coli* was established for Antelope Creek, potential pollutant sources for bacteria were targeted during the field screening. However, since many structural BMPs are effective at removing multiple pollutants from stormwater runoff, the project team recognized other potential pollution sources readily identifiable near the potential site locations. For example, sediment was targeted during site selection in areas such as large parking lots and gravel/sand from roadways.

Maintenance Access – Operation and maintenance costs occur periodically throughout the life of a stormwater control device or practice. Therefore, the project team took into consideration the availability of maintenance staff onsite when siting projects. For example, an institutional land use, such as a school or hospital, could have staff available to ensure vegetation is established and regular maintenance continues. On the other hand, the success of a newly established rain garden in a residential area may be dependent upon local residents desire to provide maintenance.

Spatial Constraints – Due to the highly urbanized nature of the Basin Plan area, land availability was a limiting factor. Most of the control options examined by the project team (and modeled by WinSLAMM) are intended for retrofitting existing structures. Land availability was another reason the project team targeted City owned property or privately owned properties that drained to well defined City owned areas, such as parks and open spaces along Antelope Creek. Privately owned property can present a number of significant challenges including limited accessibility, increased project costs, maintenance issues, and acceptance.

Utilities – Utilities can create major issues during the design, construction, and operation of BMPs. During the field screening, the project team noted visible evidence of utilities, such as gas meters, cable boxes, or electric lines.

7.3.2 Antelope Creek Desktop Review

Upon completion of the field screening activities, the project team completed a desktop review of the identified potential BMP sites. The following details the additional information that was gathered for each potential site. The final screening of the potential sites for water quality BMPs was based upon the gathered information.

Treatable Area – The overall size of each potential site's drainage areas was determined using City drainage maps, and elevation information from available LiDAR, and GIS. Knowing the total drainage area allowed the project team to determine the total area that could be treated by locating BMPs at the potential pollutant sites.

Drainage Area Land Use – After sizing the potential site drainage area, the project team estimated the land use percentages within the drainage areas to determine the major pollutant sources and loading.

Spatial Constraints – Although the potential treatable watershed may be large, the area available to treat the watershed might be small. Sites that fall under this consideration would include large parking lots with only the grassed right-of-way for treatment. These sites could be limited to removing sand and sediment from runoff.

Public Education – Educational opportunities were considered during the desktop review of potential sites for water quality BMPs. Locations in the watershed that are more visible to the public or large groups were targeted for site selection. These areas include the Lincoln Children's Zoo, Union Plaza, parks, schools, trails, and others. In addition, sites located near schools also have the potential to be used for outdoor classrooms.

Utility Conflicts – Although utilities were noted during the field screening, City utility maps were reviewed to identify any additional potential utility conflicts that might not have been noted during the field screening.

Once the project team had gathered the information above for each potential site identified during the field screening effort, the data was used to screen the potential sites for water quality BMPs to develop a final list of potential BMP site locations that present the greatest potential for water quality BMP projects. Table 7-1 provides



Picture 15: Cable box in an area which would have otherwise been suitable for stream enhancement.

general information about the potential sites screened and reasons for dismissal or approval of the potential site. Dismissed sites are shown in red. Figure 7-1 shows the approximate locations of each potential site screened.

Table 7-1. Potential BMP Sites

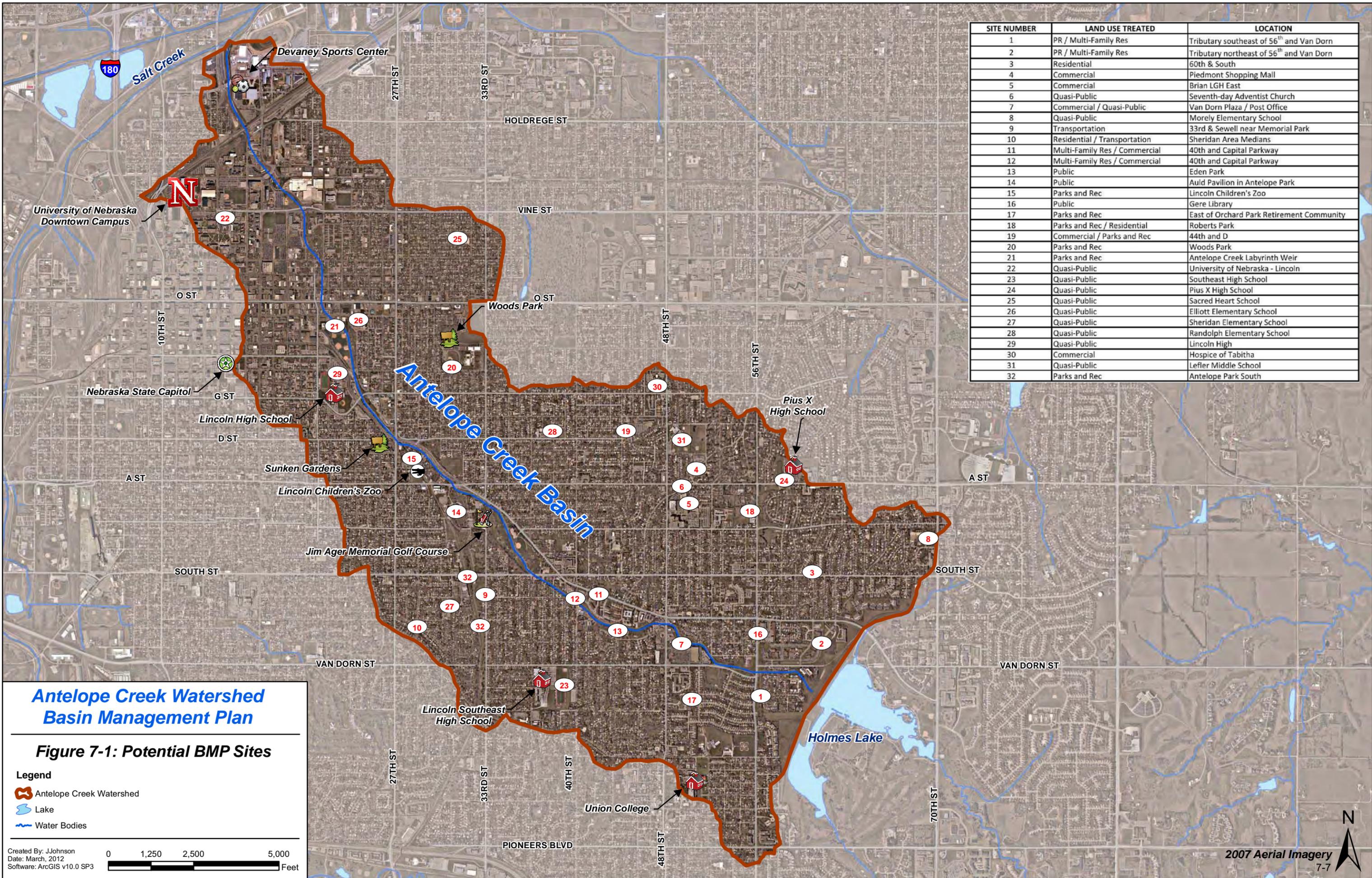
SITE NUMBER	LAND USE TREATED	LOCATION	APPROVED /DISMISSED	REASON
1	PR/Multi-Family Res	Tributary southeast of 56 th and Van Dorn	Approved	Large treatable watershed, high pollutant load, available land for BMP installation
2	PR/Multi-Family Res	Tributary northeast of 56 th and Van Dorn	Approved	Large treatable watershed, high pollutant load, available land for BMP installation
3	Residential	60th & South	Approved	Ease of retrofit, high pollutant load, available land for BMP installation
4	Commercial	Piedmont Shopping Mall	Approved	Publicly owned land nearby, high pollutant load, easy access
5	Commercial	Brian LGH East	Dismissed	Little publicly owned land nearby, small treatable watershed
6	Quasi-Public	Seventh-day Adventist Church	Dismissed	Little publicly owned land nearby, small treatable watershed
7	Commercial/Quasi public	Van Dorn Plaza/Post Office	Approved	Publicly owned land nearby, high pollutant load, easy access
8	Quasi-Public	Morley Elementary School	Dismissed	Low pollutant load, topography, small treatable watershed
9	Transportation	33rd & Sewell near Memorial Park	Dismissed	Small watershed, low pollutant load
10	Residential/Transportation	Sheridan Area Medians	Dismissed	Little publicly owned land nearby, difficult topography, low pollutant load
11	Multi-Family Res /Commercial	40th and Capital Parkway	Approved	Available land for BMP installation, high pollutant load, easy access
12	Multi-Family Res /Commercial	40th and Capital Parkway	Dismissed	Combined with Site 11
13	Public	Eden Park	Approved	Publicly owned, ease of retrofit, topography
14	Public	Auld Pavilion in Antelope Park	Dismissed	BMPs for this site (pervious pavement) make this project cost prohibitive, minimal impact on <i>E. coli</i>
15	Parks and Rec	Lincoln Children's Zoo	Approved	Public education, available land for BMP installation, high pollutant load
16	Public	Gere Library	Approved	Public education, available land for BMP installation, high pollutant load
17	Parks and Rec	East of Orchard Park Retirement Community	Dismissed	Little publicly owned land nearby, maintenance access
18	Parks and Rec/Residential	Roberts Park	Approved	Publicly owned, available land for BMP installation, large treatable watershed

SITE NUMBER	LAND USE TREATED	LOCATION	APPROVED /DISMISSED	REASON
19	Commercial/ Parks and Rec	44th and D	Approved	Large treatable watershed, available land for BMP installation, high pollutant load
20	Parks and Rec	Woods Park	Approved	Publicly owned, available land for BMP installation, high pollutant load
21	Parks and Rec	Antelope Creek Labyrinth Weir	Approved	Publicly owned, large treatable watershed, high pollutant load
22	Quasi-Public	University of Nebraska–Lincoln	Dismissed	UNL would be better utilized as a program-based partnership for multiple projects.
23	Quasi-Public	Southeast High School	Dismissed	BMPs already in place
24	Quasi-Public	Pius X High School	Approved	High pollutant load, topography, public education
25	Quasi-Public	Sacred Heart School	Dismissed	Little publicly owned land nearby, low pollutant load, small treatable watershed
26	Quasi-Public	Elliott Elementary School	Dismissed	Low pollutant load, small treatable watershed
27	Quasi-Public	Sheridan Elementary School	Dismissed	Low pollutant load, topography, small treatable watershed
28	Quasi-Public	Randolph Elementary School	Dismissed	Little publicly owned land nearby, low pollutant load
29	Quasi-Public	Lincoln High	Approved	Publicly owned, education, high pollutant load
30	Commercial	Hospice of Tabitha	Approved	Topography, drainage patterns, high pollutant load
31	Quasi-Public	Lefler Middle School	Approved	Public owned, education, topography
32	Parks and Rec	Antelope Park	Approved	Public owned, large treatable watershed, high pollutant load, education

Source: EA Field Survey 2011

Note: Sites shown in red were dismissed

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SITE NUMBER	LAND USE TREATED	LOCATION
1	PR / Multi-Family Res	Tributary southeast of 56 th and Van Dorn
2	PR / Multi-Family Res	Tributary northeast of 56 th and Van Dorn
3	Residential	60th & South
4	Commercial	Piedmont Shopping Mall
5	Commercial	Brian LGH East
6	Quasi-Public	Seventh-day Adventist Church
7	Commercial / Quasi-Public	Van Dorn Plaza / Post Office
8	Quasi-Public	Morely Elementary School
9	Transportation	33rd & Sewell near Memorial Park
10	Residential / Transportation	Sheridan Area Medians
11	Multi-Family Res / Commercial	40th and Capital Parkway
12	Multi-Family Res / Commercial	40th and Capital Parkway
13	Public	Eden Park
14	Public	Auld Pavilion in Antelope Park
15	Parks and Rec	Lincoln Children's Zoo
16	Public	Gere Library
17	Parks and Rec	East of Orchard Park Retirement Community
18	Parks and Rec / Residential	Roberts Park
19	Commercial / Parks and Rec	44th and D
20	Parks and Rec	Woods Park
21	Parks and Rec	Antelope Creek Labyrinth Weir
22	Quasi-Public	University of Nebraska - Lincoln
23	Quasi-Public	Southeast High School
24	Quasi-Public	Pius X High School
25	Quasi-Public	Sacred Heart School
26	Quasi-Public	Elliott Elementary School
27	Quasi-Public	Sheridan Elementary School
28	Quasi-Public	Randolph Elementary School
29	Quasi-Public	Lincoln High
30	Commercial	Hospice of Tabitha
31	Quasi-Public	Lefler Middle School
32	Parks and Rec	Antelope Park South

Antelope Creek Watershed Basin Management Plan

Figure 7-1: Potential BMP Sites

- Legend**
- Antelope Creek Watershed
 - Lake
 - Water Bodies

Created By: JJohnson
 Date: March, 2012
 Software: ArcGIS v10.0 SP3

0 1,250 2,500 5,000 Feet

7.3.3 Antelope Creek Site Selection Key Criteria List

Upon completion of the initial screening process, the project team selected five key criteria from the general field screening and desktop review activities. These five key criteria were ranked as shown below according to importance to achieving the water quality goals of the Basin, and were used as the Selection Criteria for the BMP Site Selection:

1. **Land Ownership/Location (5x)** – Publically owned property was a high priority for site selection based upon input from the City and LPSNRD. Additional consideration was given to locations where a series of projects could be located in one sub-basin. Scores were given in the following order from highest to lowest due to ease of installation and maintenance of BMPs; publicly owned land, quasi-public, commercial, residential.
2. **Public Education (3x)** – The City and LPSNRD intend to use BMP sites for use as demonstration sites for the public to increase understanding of the purpose of BMPs and the importance of similar practices being implemented City-wide.
3. **Spatial Constraints (2x)** – Higher scores were given to sites with adequate open space to construct BMPs that are appropriately sized to meet treatment goals.
4. **Pollutant Loading (2x)** – Higher scores were given to sites with the greatest potential for removal of bacteria, TSS, nutrients.
5. **Treated Area (1x)** – Higher scores were given to larger sites because they present higher potential for pollutant removal.

7.3.4 Antelope Creek Selected Sites

Using the information gathered from the field screenings and the desktop review, the full list of sites selected for potential projects (19) was ranked against each other using the criteria listed in Section 7.3.3. This was completed using the evaluation matrix shown below in Table 7-2. Each site was scored on the basis of the selection criteria list from a range of 1 to 5, with the highest score showing the ideal site based upon the selection criteria. The top sites were selected and put forth to conceptual design and prioritized as Capital Improvement Program (CIP) projects in SECTION 8 - MANAGEMENT PRACTICES–RECOMMENDED PROJECTS/PROGRAMS.

Table 7-2. Potential BMP Site Selection Matrix

Ranking No.	Site Number	Site Location	Site Selection Criteria					Total Score	Total Weighted Score
			Land Ownership/Location (5x)	Public Education (3x)	Spatial Constraints (2x)	Pollutant Loading (2x)	Treated Area (1x)		
1	32	Antelope Park	5	5	5	5	5	25	65
2	18	Roberts Park	5	4	5	5	5	24	62
3	15	Lincoln Children's Zoo	5	5	3	5	3	21	59
4	20	Woods Park	5	4	4	4	4	21	57
5	16	Gere Library	5	5	3	4	1	18	55
6	13	Eden Park	5	4	5	3	1	18	54
7	21	Antelope Creek Weir	3	4	4	5	5	21	50
8	7	Van Dorn Plaza/Post Office	4	3	3	4	1	15	44
9	11	40th and Capital Parkway	3	3	5	3	1	15	41
10	3	60th & South	3	1	5	5	2	16	40
11	29	Lincoln High	3	5	1	3	1	13	39

Ranking No.	Site Number	Site Location	Site Selection Criteria					Total Score	Total Weighted Score
			Land Ownership/ Location (5x)	Public Education (3x)	Spatial Constraints (2x)	Pollutant Loading (2x)	Treated Area (1x)		
		School							
12	1	Tributary southeast of 56th and Van Dorn	2	1	5	5	5	18	38
13	2	Tributary northeast of 56th and Van Dorn	2	1	5	5	5	18	38
14	31	Lefler Middle School	3	5	1	1	2	12	36
15	19	44th and D	2	2	4	3	3	14	33
16	24	Pius X High School	1	5	1	3	2	12	30
17	4	Piedmont Shopping Mall	1	1	2	3	1	8	19
18	30	Hospice of Tabitha	1	1	1	3	2	8	18

7.4. Non-Structural Sites

Several small scale non-structural stormwater controls, such as roof-top disconnections and bridge retrofits for bird control, were sited throughout the watershed but are too widespread to include as single projects. In some cases, disconnections could be recommended as a component of a larger structural project. Non-structural and program recommendations are discussed in SECTION 8 - MANAGEMENT PRACTICES–RECOMMENDED PROJECTS/PROGRAMS.

7.5. Conclusion

The potential project site list developed by the field screening resulted in 32 potential water quality BMP sites. After the desktop review and the selection criteria screening, 18 potential water quality BMP sites remained. These 18 sites were ranked based on the site selection matrix. Although all of the sites were viable, the sites with a score of 40 points or higher were selected and developed as project sites. These sites are shown in Table 7-3 in order of highest potential sites first. Due to the potential for unforeseen opportunities, additional sites may be considered as conditions change in the watershed.

Antelope Park ranked as the highest potential site and also has several opportunities for enhancement of existing wetlands and waterways in order to increase water quality benefits. The Antelope Park sub-watershed receives stormwater from mostly residential land uses, is highly visible, and has potential for several structural BMPs.



Picture 16: Antelope Park had several high ranking projects after the screening process was completed

Table 7-3. Selected BMP Sites

Ranking No.	Site Number	Site Location	Total Weighted Score
1	32	Antelope Park	65
2	18	Roberts Park	62
3	15	Lincoln Children's Zoo	59
4	20	Woods Park	57
5	16	Gere Library	55
6	13	Eden Park	54
7	21	Antelope Creek Weir	50
8	7	Van Dorn Plaza/Post Office	44
9	11	40th and Capital Parkway	41
10	3	60th & South	40

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