TOWN OF NEDERLAND
BOARD OF TRUSTEES / DOWNTOWN DEVELOPMENT AUTHORITY
JOINT WORK SESSION

AGENDA

Nederland Community Center
Nederland, CO 80466

November 27, 2012, 7:00-8:30

A. Review of Route Selection Memo

Decisions to date of utilizing 2nd St for the DRCOG grant route will be summarized and discussed

B. Goal setting and Owner's Project Requirements (OPR) Review/Exercise

Draft OPR will be reviewed and the boards will be asked to provide direct feedback on what the ultimate goals of the project will be.

C. Design Concepts Review

Initial design concepts for the walkway surfaces, different types of bioswales, and water quality features, and others as time allows

D. Adjournment

Attachments

1. **Route Selection Memo**
2. **Owner's Project Requirements**
3. **Permeable Paving Summary**
4. **Biofeatures Options**
5. **DAT Report (for reference only)**
6. **Current Schematic Design plans (for reference only)**

11/21/2012

MEMORANDUM

TO: DDA/BOT Members

FROM: Conor Merrigan, Project Manager and Sustainability Specialist

RE: Route Selection of NedPed Project

Background

At the first meeting of the Design Advisory Team, the question of the choice of 2nd St as the desired route for the NedPed project was discussed. It was the suggestion of one member of the team that a need statement for the use of 2nd St as the route be developed. That need statement is included as Appendix A to the Owner's Project Requirements (OPR). The grant from DRCOG which has been accepted requires an eight foot wide multi-modal pathway that connects the regional bus stop and Library to the Post Office. The decision to utilize 2nd St as the preferred alternative has been the basis of the designs to date and is the current plan moving forward.

Alternatives

The 4 compliant alternatives that have been suggested are:

1) Library to Jefferson St to 1st St to East St to Post Office
2) E 3rd St from Snyder the Post Office (did not say how to connect to the Library)
3) SH119 from the Library to the circle to the Post Office (basically the route of the old Phase 2 Sidewalk)
4) Library to the circle to 2nd St to East St to the Post Office

Analysis

All of these routes serve the essential function of connection and any could fulfill the criteria of the grant. The question of whether to proceed with a path in the first place from a sustainability perspective is a complex one, but ultimately if it serves the needs of the community in a manner that is aligned with sustainability goals it will make sense.

The choice of 2nd St was deemed the one that would satisfy the highest number of stakeholders while best addressing the primary need of a more user-friendly connection and the secondary need of accommodating the flood events that occur primarily on that street. Since 2nd St experiences the greatest flooding and becomes the least safe, this grant provides an opportunity to rectify that situation in particular while also taking a larger look at the causes and consequences of flooding in the region. Further, the mixed character of the street including both commercial and residential development, seems to be the most conducive to having an improved pathway that will accomplish the goals of traffic calming, public space enhancement, and increased usage of alternate modes of transportation.

There are and were a number of pros and cons for each of the alternatives, some of which are presented below. These are not meant to be comprehensive at all, but rather the first impressions of an individual new to the project (myself). They are intentionally simplistic, but do convey what I have heard and observed as major reasons for or against each alternative.

Alternative	*Pros*	*Cons*
1. 1st St	Existing Main Street Continuous Street (1st) Existing Infrastructure Wider ROW	No flooding to mitigate Indirect connection to Post Office
2. 3rd St	Wide ROW Close to RTD Bus Stops	No flooding to mitigate Hill on North side Most undeveloped road
3. 119	Best route for RTD bus stops Existing Pavement Best grade	No flooding to mitigate Unpleasant to walk Declined by BOT
4. 2nd St	Flooding to mitigate Pleasant to walk Straight path towards res. Includes 2nd St School Bus Stop	Creek can still flood ROW narrow/ utilized One way req'd

In any public decision there will invariably be winners and losers. This particular route for the project seems to have been decided upon with due regards to weighing competing interests with public benefit. While I cannot comment on the depth of the public process, it is my understanding that there have been opportunities presented for discussion and comment and that this route has emerged as the best option.

Conclusion

In order to best mitigate flooding events and create the multimodal pathway serving the highest and best use of town residents, 2nd St is the best route to connect the Library to the Post Office. The utilization of sustainability principles expressed in town resolutions, best practices, and finalized in concert with town decision making bodies and residents will ensure the project continues to serve the town and the greater environment to create lasting value. From a sustainability perspective, there are a myriad of factors that could have influenced this decision, but they are less important than that they be considered moving forward. The route selection is logical; the impact can be a positive one for the entire community that will help restore healthy ecological functions, allow for more options to traverse downtown without a car, and help enhance Nederland's existing character. All of these are positive impacts, for which a concurrent price will be paid in terms of energy, development, and disturbance. The balancing act of finding the least intrusive and most beneficial solution is the challenge ahead. With the help and participation of town boards, residents, and design professionals, this project will meet that challenge.

TOWN OF NEDERLAND

OWNER'S PROJECT REQUIREMENTS

Nederland Pedestrian Enhancement Design (NedPeds) and Nederland Pedestrian Transportation and Storm Water Management Improvement Project

Nederland, Colorado

September 7, 2012

Revised October 4, 2012

Introduction:

The goal of the Owner’s Project Requirements (OPR) is to understand the project goals for the Owner as it relates to sustainable, high performance design. The OPR also helps to influence decisions made during the design process by conveying the desires and interests of the Owner to the design team. This will be achieved through an outline of specific questions and general questions about community needs and sustainability goals and practices.

This document should be completed in the Pre-Design Phase of a project. After completion, the document should be distributed throughout the design team to increase understanding of the Owner's goals and interests.

The OPR is considered a “living document” and should be updated to include any changes to the Owner’s project goals at the end of design and construction.

Location:

Nederland, Colorado

Construction:

The project is to be a 'Design-Bid-Build' construction process.

LEED Goals:

Meet the basic tenets of LEED per Town Resolution 2011-21 “*to insure that all projects developed in the Town of Nederland will comply with applicable sections of the LEED Rating System, and or other similar systems*”. The project consultants should reference the “LEED Neighborhood Development Rating System” and the “Sustainable Sites Initiative Guidelines and Performance Benchmarks” to identify clear and measurable goals to increase the project’s sustainability. They should also document which of these objectives could be addressed in this project and how they could be achieved.

Project Description:

The Town of Nederland has come to recognize that healthy ecosystems provide essential services that sustain life and therefore understands the importance of placing the preservation, protection, or enhancement of ecosystem services at the top of the community’s priority list.

Additionally, the Town of Nederland recognizes the impact land development and management practices can have on ecosystem services.

Following is a list of ecosystem services that can be preserved, protected or enhanced through the use of sustainable land development and management practices:

1. Air and water cleansing:
    - Removing and reducing pollutants in air and water

- Habitat functions
- Providing refuge and reproduction habitat to plants and animals, thereby contributing to conservation of biological and genetic diversity and evolutionary process

2. Water supply and regulation:
    - Storing and providing water within watersheds and aquifers
    - Waste decomposition and treatment
    - Breaking down wastes and recycling nutrients

3. Erosion and sediment control:
    - Retaining soil within an ecosystem, preventing damage from erosion and siltation

4. Human health and well-being benefits:
    - Enhancing physical, mental and social well-being as a result of interaction with nature

5. Hazard mitigation:
    - Reducing vulnerability to damage from flooding, storm surge, wildfire and drought
    - Food and renewable non-food products
    - Producing food, fuel, energy, medicine or other products for human use

6. Pollination:
    - Providing pollinator species for reproduction of crops and other plants

7. Cultural benefits:
    - Enhancing cultural, educational, aesthetics and spiritual experiences as a result of interaction with nature

The importance of ecosystem services were not considered in traditional land use development and management practices within the Town of Nederland. This has resulted in a loss of ecosystem functionality including storm water management, erosion and sedimentation control.

Additionally, the Town has also come to recognize the ecological benefits of increasing the use of non-motorized transportation in Town and throughout our region.

The Town of Nederland has committed to becoming a sustainable community and has committed to move forward in a sustainable manner.

Background

A need for safe pedestrian/biking trails that would allow residents and visitors to safely and easily walk or bike between from the east to the west end of town was established by PROSAB and SAB.

The central and south portions of town have been connected by a sidewalk built in 2009. The east to west connectivity is hampered by a lack of defined, non-motorized paths and increased traffic.

Several thunderstorms last summer also showed that there has been a dramatic increase in the velocity/volume of water in North Beaver Creek that caused damage to property adjacent to the creek. The eastern portion of 2nd Street is dirt, while the upper section to the west is paved. Open drainage ditches on each side of the street make crossing the street impractical for some residents and walking down the street is equally impractical due to many large pot holes that reappear after each large rain event. Children and young people going to the Family and Teen Center from other areas of town must use the center of the street for walking due to large drainage ditches on either side of the road, forcing them to walk in the middle of the street with and between cars. The need for safe pedestrian and bicycle paths is becoming more acute as development of vacant land brings more traffic and parked cars.

The Need for the Project:

Using 2nd Street to connect the Post Office to the Library will allow people living on 2nd Street to have safe, non-motorized access to both locations. Many children and families live on 2nd Street and the street has become hazardous with increased vehicular traffic, as well as from the deteriorating conditions of the road surface. The conditions of the road are unsustainable for the future due to erosion, instability, and continued maintenance.

In promoting a healthy community, Nederland strives to encourage alternative modes of transportation. The need for this is to encourage a healthier lifestyle, while also helping to decrease obesity which is a problem nationwide. Colorado’s obesity rate is the lowest in the country for adults, but the obesity rate for children is rising. This is due in part to a decrease in physical activity and more passive indoor activities. In order to help lower this rate, healthy cities have adopted multi-modal forms of transportation. The proposed east/west pedestrian/biking path will help to achieve this purpose.

The need for controlling storm water in the mountains is a concern due to the severity of the storms and the spring runoff. The water from high elevations needs to be safely directed to collection points for use by cities in other parts of the state. Debris and hazardous materials need to be filtered along the riparian corridors to insure clean and healthy drinking water downstream.

This project will address two major issues for the Nederland community in its quest to becoming sustainable:

1. **Improved non-motorized circulation:**
   Reducing our dependence on traditional non-renewable forms of transportation is a small but important step in becoming a sustainable community. Developing a non-motorized circulation system that allow community members to walk or bike to local destinations and to region transportation portals will result in cleaner air, healthier community members, and a greater sense of community.

In order to improve non-motorized transportation, we must first understand how well our existing non-motorized transportation system functions, then determine where and how improvements should be made in order to be successful.

2. **Improved watershed functionality through focused improvements in storm water management systems:**

   It is important for the town to develop and maintain a high functioning storm water management system which allows for safe transportation and protects property from damage, while also helping to retain and restore the watersheds natural ecosystem functionality. Preserving, protecting, enhancing and learning from healthy ecosystems are an essential part of becoming a sustainable community.

   In order to effectively address storm water in our developed areas, the Town would like to understand how the watershed reacts naturally to storm water, then to develop solutions for managing storm water that work with the natural systems.

   Therefore, tasks related to the inherent synergies of addressing non-motorized transportation and storm water management are:

   - Development of a Need Statement (see Exhibit A attached) regarding non-motorized transportation and storm water management, including an explanation of the inherent synergies benefited by the chosen pathway route, with respect to existing traffic issues, and existing storm water management issues along the same corridor.
   - Participation by consultants in an EPA-sponsored biomimicry workshop to determine focus of design objectives.
   - Assessment of existing conditions regarding non-motorized transportation and storm water management.
   - Voluntary compliance with EPA Municipal Separate Storm Sewer (MS 4) Standards.
   - Development of measurable parameters that help our community determine functionality of our non-motorized transportation and storm water management systems.
   - Development of design documents that result in improved non-motorized transportation and storm water management.

Funding Related Requirements:

The Town currently has funding available through the Denver Regional Council of Governments (DRCOG) that requires the following requirements which were listed in the original application for Phase II Sidewalks submitted in October 2010:

1. The project will provide an 8 ft. wide multi-use path for use by pedestrians and bicycles from East Street to Jackson Street connecting the Post Office with the Nederland Public Library and the RTD Park n Ride.
2. The path will connect to existing sidewalks and grade separation of North Beaver Creek.

3. The project will also include 20 bicycle racks (10 will be covered parking) and improved bus stops.
4. The bus stops will be improved by adding paving (currently the bus stops are dirt areas) and by providing a covered area at one stop.
5. The project will also include curb and gutter, curb ramps and crosswalk markings.

The Town intends to utilize this funding to focus on areas that offer the greatest potential for improvement to our non-motorized transportation system while at the same time addressing issues in our storm water management system.

Community Related Requirements:

- Coordination of several open community workshops geared toward better understanding of non-motorized transportation and storm water management. These workshops should be designed to encourage and improve our community's social interactions
- Protection of the town's rural and rustic character
- Protection of the environment through improved habitat and ecosystem functionality
- Utilization of local resources and labor while identifying opportunities for development of a localized economy
- Identification of opportunities for this project to further improve our communities social interactions
- Incorporating educational opportunities throughout the project
- Critical assessment of each decision for opportunities to achieve the following:
  - Reduce and eventually eliminate our dependence on fossil fuels and heavy metals
  - Reduce and eventually eliminate our dependence on man-made chemicals that persist in nature.
  - Reduce and eventually eliminate the destruction of nature.

Project Schedule and Budget (Owner):

The expected completion of this project is fall of 2013.

The total construction budget for the project is ($)______________.

Future expansion goals: ____

Flexibility needs: ____

Schedule of operation: ____

Sustainability Goals and Objectives (Design Team):

Top 5 goals for sustainability and energy efficiency (energy, water, materials, etc.):

Energy goals: ____

Water goals: ____

Material goals: ____

Other: ____

Other: ____

Green Technologies and Systems (Design Team):

Top 3 green system or technologies that should be considered for this project:

1. ____
2. ____
3. ____

Other Requirements (Owner):

Community requirements: ____

Aesthetic requirements: ____

Security requirements: ____

Accessibility requirements: ____

Communication requirements: ____

Constructability requirements: ____

Health and hygiene requirements: ____

Capacity requirements: ____

Efficiency and Sustainability Goals and Practices:

Warranty Requirements:

Measure of Success in terms of Sustainability (Owner):

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

Exhibit A

Need Statement

created June 2012 by the Design Advisory Team
of the Nederland Downtown Development Authority

The Town of Nederland has come to recognize that healthy ecosystems provide essential services that sustain life and therefore understands the importance of placing the preservation, protection or enhancement of ecosystem services at the top of the community's priority list.

Additionally, the Town of Nederland recognizes the impact land development and management practices can have on ecosystem services.

Following is a list of ecosystem services that can be preserved, protected or enhanced through the use of sustainable land development and management practices.

Air and water cleansing
Removing and reducing pollutants in air and water.

Water supply and regulation
Storing and providing water within watersheds and aquifers

Erosion and sediment control
Retaining soil within an ecosystem, preventing damage from erosion and siltation

Hazard mitigation
Reducing vulnerability to damage from flooding, storm surge, wildfire and drought

Pollination
Providing pollinator species for reproduction of crops and other plants

Habitat functions
Providing refuge and reproduction habitat to plants and animals, thereby contributing to conservation of biological and genetic diversity and evolutionary process

Waste decomposition and treatment
Breaking down wastes and recycling nutrients

Human health and well-being benefits
Enhancing physical, mental and social well-being as a result of interaction with nature

Food and renewable non-food products
Producing food, fuel, energy, medicine or other products for human use

Cultural benefits
Enhancing cultural, educational, aesthetics and spiritual experiences as a result of interaction with nature

The importance of ecosystem services were not considered in traditional land use development and management practices within the Town of Nederland. This has resulted in a loss of ecosystem functionality including stormwater management, erosion and sedimentation control.

Additionally, the Town has also come to recognize the ecological benefits of increasing the use of non-motorized transportation in Town and throughout our region.

The Town of Nederland has committed to becoming a sustainable community and has committed to move forward in a sustainable manner.

Sustainable development is development that meets the needs of the present without compromising the ability of future generations or other communities from meeting their needs.

This project will address two major issues for the entire community of Nederland in it's quest to becoming a sustainable community.

1. Improved non-motorized circulation

   Reducing our dependence on traditional non-renewable forms of transportation is a small but important step in becoming a sustainable community. Developing a non-motorized circulation system that allow community members to walk or bike to local destinations and to region transportation portals results in cleaner air, healthier community members and a greater sense of community.

2. Improved watershed functionality through focused improvements in stormwater management systems.

   Developing and maintaining a high functioning stormwater management system not only protects private property from damage but also helps retain and restore the watersheds natural ecosystem functionality. Preserving, protecting, enhancing and learning from healthy ecosystems are an essential part of becoming a sustainable community.

Non-motorized Circulation

In order to improve non-motorized transportation, we must first understand how to measure how well our existing non-motorized transportation system functions.

Once we understand the functionality of the existing non-motorized circulation system, we can then determine where and how improvements should be made in order for improvements to be successful.

Stormwater Management

In order to effectively address stormwater in our developed areas we must first understand how the water shed reacts naturally to stormwater.

Once we understand how our watershed reacts naturally to stormwater we can then develop solutions for managing stormwater that work with the natural systems as opposed to the traditional methods of working against the natural systems.

Background

A need for safe pedestrian/biking trails was established by PROSAB and SAB that would allow the habitants to safely and easily walk/bike between from the East to the west end of town.

The North and South ends of Town have been connected by a sidewalk built in 2009. The East to West connectivity is hampered by lack of defined non-motorized paths and increasing traffic due to development.

Several storms last summer also showed that since recent development on the North Beaver Creek meadow there had been a dramatic increase in the velocity of the water in North Beaver Creek causing damage to property further downstream. The lower portion of 2nd Street to the East is dirt while the upper section to the West that contains the Library is paved. The impact of nonpervious surfaces on watersheds is well documented and the Town of Nederland is a living example of these negative impacts.

Further development projects on 2nd Street have been unable to obtain accurate elevations for connecting sidewalks and handicap ramps, making some of them unusable. Open drainage ditches on each side of the street make crossing the street impractical for some residences and walking down the street is equally impractical for some residences due to many large pot holes that reappear after each large rain event. Children and young people going to the Family and Teen Center from other areas of Town must use the center of the street for walking due to large drainage ditches on either side of the road, forcing them to walk in the middle of the street with and between cars. The need for safe pedestrian and bicycling paths is becoming more acute as some of the vacant land in the area is developed bring more traffic and more parked cars.

The need for connectivity:

Using 2nd Street to connect the Post Office to library allows people living on second street non-motorized access to both locations safely. Many children and families live on 2nd Street and the street has become hazardous with increased vehicle traffic from the mixed use and commercial sections, as well as from the deteriorating conditions of the road surface.

Nederland has adoptive a sustainability Resolution that will direct the community going forward. The deteriorating conditions of the road are unsustainable for the future, not only from a cost stand point, but also from erosion and instability. Mountain communities have vanished over past decades due to wind and soil erosion, such as Caribou and others.

In promoting a healthy community, Nederland strives to encourage alternative modes of transportation. The need for this is to encourage a healthier lifestyle decreasing obesity which is a problem nationwide. Colorado’s obesity rate is the lowest in the country for adults, but the obesity in children is rising rapidly from 3rd in the country to 23rd in 2011. This is due in part to a decrease in physical activity and more passive indoor activities. In order to lower this rate further, healthy cities have adopted multi-model forms of transportation. The proposed east/west pedestrian/biking path will fulfilled this purpose.

The need for controlling storm water in the mountains is greater than in lower elevations due to the severity of the storms and the spring runoff. The water from even higher elevations needs to be safely directed to collection points for use by cities in other parts of the state. Debris and hazardous materials need to be filtered along the run off corridors to ensure clean and healthy drinking water downstream.

With this project we will be able to address two major issues for the entire community of Nederland. A walkable community, as well as a reduction in flooding from storm water runoff.

Permeable Paving Options Summary

This summary of permeable pavement options was forwarded by Brian McClaren, Huitt-Zollars. Additional supporting documents are stored that demonstrate research on issues such as freeze-thaw, durability, etc. available upon request.

Permeable Pavements (Pavers, Concrete):

Benefits

♣ Permeable pavement systems provide water quality treatment in an area that serves more than one purpose. The depth of the pavement system can also be increased to provide flood control.
♣ Permeable pavements can be used to reduce effective imperviousness or alleviate nuisance drainage problems.
♣ Permeable pavements benefit tree health by providing extra air/water to nearby roots.
♣ Permeable pavements are less likely to form ice on the surface than typical pavements.
♣ Some permeable pavements can be used to achieve LEED credits.

Limitations

♣ Additional design and construction steps are required for placement of any ponding or infiltration area near or upgradient from a building foundation, particularly when potentially expansive soils exist. This is discussed in the design procedure section.
♣ In developing or otherwise erosive watersheds, high sediment loads can clog the facility.

Permeable Asphalt (not yet recommended by Urban Drainage):

http://www.udfcd.org/downloads/pdf/tech_papers/2008-2010%20DWW%20PA%20final.pdf (page 50 suggests that this method is not recommended at this time).

Critical Issues for Crusher Fine Trails:

Water, drainage, existing soil types, and the types of usage are the primary considerations for designing and constructing crusher fine trails. Crusher fines are highly susceptible to washouts from running water, particularly if fines become saturated such as during spring snowmelt.

Goals for Drainage

1. Keep crusher fines from becoming saturated with water.
2. Prevent concentrated flows of runoff from reaching crusher fine surfaces.

Every few years you will have to add some material in spots where compaction, erosion takes place. However, this can be done with a minimum of equipment and skill level. In the long run this regular surface maintenance may still be less compared to the higher initial costs of pavement and its maintenance.

Crusher fines being a “softer surface” do not work well with horses and road bikes, if you want to have an accessible firm and stable surface without much maintenance.

The attached pages illustrate some examples of bioswales, bioretention ponds and pervious pavers and provide an overview of their utilization (courtesy of Brian McClaren, Huitt-Zollars)

Bioswale/bioretention pond benefits include:

- Reduced runoff: In a typical road, a 4-meter swale can reduce approximately 25 percent of total rainfall runoff.
- Reduced pollutants: Bioswales/bioretention ponds remove pollutants by filtering stormwater runoff through natural vegetation and soil-based systems.
- Recharged groundwater: Instead of releasing stormwater into the drainage system, stormwater can be filtered and may provide some groundwater recharge.
- Improved energy efficiency: Sustainable, decentralized stormwater management systems may be more cost effective than centralized stormwater systems. At the minimum, these natural technologies reduce pressure on existing systems and the maintenance costs associated with centralized stormwater management systems.

8.4 BIORETENTION

Source: City of Lenexa, Kansas.

Targeted Constituents

Sediment	◐
Nutrients	●
Trash	●
Metals	●
Bacteria	●
Oil and Grease	●
Organics	●

Legend (Removal Effectiveness)

High	Medium	Low
●	◐	○

Source: California Stormwater Quality Association, 2003.

8.4.1 Description

Bioretention is a best management practice (BMP) that filters, uptakes, and infiltrates stormwater runoff by way of the natural chemical, biological, and physical properties of plants, microbes, and soils (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002) (CDM, 1989, 2001). The practice gets its name from the ability of the biomass within a small landscaped basin to retain the water quality volume (WQv) and remove nutrients and other pollutants from stormwater runoff (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002). The runoff's velocity is reduced by passing the runoff over or through a pretreatment device and subsequently distributing it evenly along a ponding area (Urban Drainage and Flood Control District - Denver, Colorado, 2005). The WQv is allowed to infiltrate into the surrounding soil naturally or be collected by an underdrain system that discharges to the storm sewer system or directly to receiving water. Runoff in excess of the water quality storm is passed through or around the facility via an overflow structure.

Bioretention controls runoff close to the source. Unlike end-of-pipe BMPs, bioretention facilities are typically shallow depressions located in upland areas. The strategic, uniform distribution of bioretention facilities across a development site results in smaller, more manageable subwatersheds, and thus, will help in controlling runoff close to the source where it is generated to promote recharge. This is beneficial in that it reduces the amount of runoff that must be managed further downstream, thus reducing the cost and land area required for large regional BMPs (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).

8.4.2 General Application

Bioretention typically treats stormwater that has run over impervious surfaces at commercial, residential, and industrial areas (Urban Drainage and Flood Control District - Denver, Colorado, 2005). For example, bioretention is an ideal BMP to be used in median strips, parking lot islands, and landscaped swales. These areas can be designed or modified so that runoff is either diverted directly into the bioretention area or conveyed into the bioretention area by a curb and gutter collection system (Urban Drainage and Flood Control District - Denver, Colorado, 2005) (Office of Water, EPA, 1999).

Bioretention is usually most effective when used upland from inlets that receive sheet flow from graded areas. Bioretention can also be applied effectively where runoff is collected from impervious areas and discharged to a bioretention cell. To maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized tributary areas (Urban Drainage and Flood Control District - Denver, Colorado, 2005) (Office of Water, EPA, 1999).

8.4.3 Advantages

- Bioretention facilities use minimal land area (1 to 15 percent of total tributary area) and can therefore be sited in locations that are unsuitable for other BMPs.
- Bioretention is easily incorporated in a BMP treatment train.
- Bioretention reduces peak runoff rate and volume from a site for small frequent storms and may reduce the total volume that must be managed further downstream (depending on the amount of retention).
- Bioretention has one of the highest nutrient and pollutant removal efficiencies of any BMP.
- Properly designed and maintained bioretention provides aesthetic enhancement. When aesthetic features are incorporated into bioretention designs, they encourage environmental stewardship and community pride. (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).
- When constructed in areas with porous native soil, bioretention facilities can contribute to groundwater recharge.
- By intercepting runoff in bioretention areas near the source, the amount of the stormwater management infrastructure may be reduced, resulting in significant cost savings in site work (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002) (CDM, 2001).Bioretention facilities reduce the temperature of water discharged from the overall system (CDM, 2001).

8.4.4 Disadvantages

- Bioretention should not be installed until the entire tributary area has been stabilized; otherwise, silt from unstabilized areas can clog the bioretention facility.
- Bioretention is not a suitable BMP at locations where the wet season water table is within 1 to 2 feet of the ground surface and where the surrounding soil stratum is unstable. Too shallow of a water table can prevent runoff from draining completely through the bioretention soil mixture (CDM, 1989, 2001).
- Bioretention is not recommended for upland areas with slopes greater than 20 percent; otherwise, clogging may be a problem, particularly if the area receives runoff with high sediment loads. If clogging occurs, unclogging can be difficult (Office of Water, EPA, 1999).
- Bioretention is not recommended for areas where mature tree removal would be required (Office of Water, EPA, 1999). Existing trees should be incorporated into the bioretention facility where applicable.
- Flood control features are not easily incorporated into bioretention.
- Bioretention is most effective for tributary areas of less than 4 acres.
- Bioretention requires a specific soil matrix to provide a minimum saturated vertical hydraulic conductivity (See Appendix A for specification).
- Bioretention may not effectively remove pollutants immediately after construction. Pollutant removal efficiency increases as vegetation becomes established.

8.4.5 Design Requirements and Considerations

Design specifications for bioretention facilities are given in Appendix A.

One of the unique qualities of bioretention is the flexibility of design themes that a designer may employ when integrating into the site. Making multi-functional use of existing site constraints, bioretention can blend nicely with buffers, landscape berms, and environmental setback areas (Programs & Planning Division, Department of Environmental Resources, Prince George’s County, MD, Revised 2002). Additionally, the layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and runoff are considered (Office of Water, EPA, 1999) (Programs & Planning Division, Department of Environmental Resources, Prince George’s County, MD, Revised 2002). Figure 23 illustrates the composition of a sample bioretention facility. The following guidelines are to be considered when designing bioretention facilities:

- Bioretention facilities shall not be constructed within stream buffers or in areas adjacent to streams where sediment may be deposited during flood events.
- Bioretention facilities shall not be constructed until all tributary areas are permanently stabilized against erosion and sedimentation. Any discharge of sediment to the cell will require reconstruction of the cell to restore its defined performance.
- The bioretention facility shall be designed to capture the WQv. The WQv should filter through the facility’s planting soil bed in 1 to 3 days.
- Recommended minimum dimensions are 15 feet wide by 40 feet long, although the preferred dimensions are 25 feet wide by 50 feet long, allowing enough space for a dense, randomly dis-

tributed area of plants and shrubs to become established while decreasing the chances of concentrated flow. Essentially, any facilities wider than 20 feet shall be twice as long as they are wide (Urban Drainage and Flood Control District - Denver, Colorado, 2005).
- The tributary area for a bioretention area shall be less than 4 acres. Multiple bioretention areas may be required for larger tributary areas (Office of Water, EPA, 1999). Inflow velocities to bioretention facilities shall be reduced to below erosive levels (generally 3 feet per second) upstream of the facility.

8.4.5.1 Excavation

- The bioretention facility can be excavated before final stabilization of the tributary area; however, the bioretention soil mixture and underdrain system shall not be placed until the entire tributary area has been stabilized. Any sediment from construction operations deposited in the bioretention facility shall be completely removed from the facility after all vegetation, including landscaping within the tributary area to the bioretention facility, has been established. The excavation limits shall then be final graded to the dimensions, side slopes, and final elevations as specified in the construction.
- Low ground-contact pressure equipment, such as excavators and backhoes, is preferred on bioretention facilities to minimize disturbance to established areas around the perimeter of the cell. No heavy equipment shall operate within the perimeter of a bioretention facility during underdrain placement, backfilling, planting, or mulching of the facility.
- Bioretention facility side slopes shall be excavated at 4:1 or flatter.

8.4.5.2 Underdrain or Outlet

The underdrain increases the ability of the soil to drain quickly and in so doing keeps the soil at an adequate aerobic state, allowing plants to flourish. The use of an underdrain system to provide a discharge point precludes the need for extensive geotechnical investigation. Underdrains are configured in many different ways and typically include a gravel/stone "blanket" encompassing a horizontal, perforated discharge pipe. An aggregate can be used to protect the underdrain from clogging (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).

- Design the underdrain system with the following components: a 4-inch minimum perforated pipe system with an 8-inch gravel bed. Filter fabric shall be placed over the gravel bed to separate it from the planting soil bed. The pipe shall have perforations between 0.25 and 0.375 inches diameter, spaced at 6-inch centers, with a minimum of 4 holes per row. Space the pipe at a maximum of 10-foot on-center, and maintain a minimum grade of 0.5 percent. See specification in Appendix A for additional underdrain system design criteria.
- Provide at least one cleanout per run and every 50 feet or less.
- Connect the underdrain system to the conventional stormwater management system, or daylight it to a suitable nonerosive outfall.
- A valve or cap at the end of the underdrain system may be provided to allow for the possibility of closing off the underdrain. This will enable longer retention times, which will allow plants more opportunity for nutrient uptake and more groundwater recharge.

After placing the underdrain and aggregate and before placing the bioretention soil mixture (BSM), the bottom of the excavation shall be rototilled to a minimum depth of 6 inches to alleviate any compaction of the facility bottom. Any ponded water shall be removed from the bottom of the facility, and the soil shall be friable before rototilling. The rototilling shall not be done where the soil supports the aggregate bed underneath the underdrain.

8.4.5.3 Overflow

The overflow component of the bioretention system consists of the gravel underdrain system, an aggregate overflow curtain drain, and a high-flow overflow structure (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002). In a residential setting, overflow usually does not present a problem for two reasons: (1) the tributary area and facility capacity are relatively small, and (2) the system is located within grassy areas that provide a safe, nonerosive surface for any overflow conditions that may arise. Additionally, residential bioretention facilities are typically designed off line and already incorporate a safe overland flow path. In commercial or industrial settings, design for overflow is more critical. Often, facilities in commercial settings are incorporated into the parking lot landscape islands. The paved surfaces flowing to the facilities can generate large quantities of runoff. Designers are required to provide a safe discharge point (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).

- Bioretention can be designed to be off line or on line of the existing stormwater management system (Office of Water, EPA, 1999). If the system is off line, design the overflow to convey peak discharge of the WQv and set it above the shallow ponding limit. If the facility is on line, design the high flow overflow as a conventional stormwater control structure or channel. Connect the overflow structure to the site stormwater management system, or outfall to a suitable nonerosive location.
- The high flow overflow system is usually a yard drain catch basin, but any number of conventional management practices may be used, including an open vegetated or stabilized channel.
- Bioretention facilities shall be designed so that runoff flows from storm events greater than the water quality event, up to and including the 1 percent event, safely pass through or around the facility. If the 1 percent event is to pass through the facility, the maximum velocity shall be kept below 3 feet per second to avoid erosion of the soil matrix. If facilities are designed with a bypass, it shall be designed to safely pass runoff flows from events up to and including the 1 percent event. At a minimum, all facility embankments shall be protected from failure during the 1 percent event.

8.4.5.4 Aggregate

An aggregate, which provides a greater porosity and is less likely to clog, is preferred (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).

It is recommended to have an aggregate layer around the perforated pipe to facilitate drainage. Refer to the specification in Appendix A.

8.4.5.6 Sand Bed

The sand bed is an optional feature that underlies the planting soil bed and allows water to drain from the planting soil bed into the surrounding soil. It provides additional filtration and allows aeration of the planting soil bed (Office of Water, EPA, 1999).

8.4.5.7 Planting Soil Bed

The soil characteristics are critical for the proper operation of the bioretention facility. The planting soil, called the BSM, provides the water and nutrients for the plants to sustain growth (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002). The BSM is a mixture of organic mulch, planting soil, and sand. To enhance nutrient uptake, the soil must have a combination of chemical and physical properties to support a diverse microbial community.

- The planting soil shall have a minimum depth of approximately 2.5 feet to provide adequate moisture capacity and to create space for the root system of the plants. Root balls of many trees will require additional depths (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002). Planting soil shall be 4 inches deeper than the bottom of the largest root ball and a maximum of 4 feet altogether. Planting soil depths greater than 4 feet may require additional construction practices, such as shoring measures (Urban Drainage and Flood Control District - Denver, Colorado, 2005) (Office of Water, EPA, 1999).
- The BSM shall be free of stones, stumps, roots, or other weedy material over 1 inch in diameter, excluding the mulch. Brush or seeds from noxious weeds shall not be present in the solids. Refer to the specification in Appendix A.

8.4.5.8 Organic or Mulch Layer

The organic layer (mulch) protects the soil bed from erosion, retains moisture in the plant zone, provides a medium for biological growth and decomposition of organic matter, and filters pollutants (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).

- Following placement of any trees and shrubs, the ground cover and/or mulch shall be established at an appropriate depth during the establishment period. Ground cover such as grasses or legumes can be planted at the beginning of the growing season (Urban Drainage and Flood Control District - Denver, Colorado, 2005). Mulching shall be complete within 24 hours after the trees and shrubs are planted to reduce the potential of silt accumulation on the surface (Urban Drainage and Flood Control District - Denver, Colorado, 2005).
- Pine mulch and wood chips are not acceptable in the mulch layer because they are displaced during storm events (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002). Grass clippings are not allowed in the mulch layer. Refer to the specification in Appendix A.

8.4.5.9 Plant Materials

The role of plant species in the bioretention concept is to bind nutrients and other pollutants by plant uptake, to remove water through evapotranspiration, and to create pathways for infiltration through root development and plant growth. Root growth provides a media that fosters bacteriologic growth, which in turn develops a healthy soil structure. Proper selection and installation of plant material is key to the success of the bioretention system.

- The designer should assess aesthetics, site layout, natural function, and maintenance requirements when selecting and placing plant species (Office of Water, EPA, 1999).
- Native grasses and other various local ground covers (i.e., ivy and prairie grass) can be incorporated into a bioretention planting scheme. Trees and shrubs are also beneficial in wider facilities (minimum of 15 to 20 feet) because they create shade. Shade helps reduce runoff temperature and can be seen as an amenity in applications such as parking lots.
- See specification in Appendix A for appropriate plant materials.

8.4.5.10 Ponding Area

The ponding area provides temporary surface storage of stormwater runoff before it filters through the soil bed and facilitates the evaporation of a portion of the runoff (Office of Water, EPA, 1999) (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002). Settling of the particulates occurs in the ponding area and provides an element of pretreatment. Ponding design depths shall be kept to a minimum to reduce hydraulic overload of in situ soils/soil medium and to maximize the surface area to facility depth ratio (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002). The ponding area shall have a maximum depth of 6 inches. However, a depth of 3 to 4 inches is preferable (Urban Drainage and Flood Control District - Denver, Colorado, 2005) (Office of Water, EPA, 1999) (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).

8.4.5.11 Pretreatment

Flow Entrance. The best method of capturing and treating runoff is to allow the water to sheetflow into the facility over grassed areas (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002). When site constraints or space limitations impede sheetflow, flow entrances shall be created that reduce the velocity of the water. In the case of parking lot landscape islands, curb cuts protected with energy dissipaters such as landscape stone or surge stone can be used. It is important to note that entrances of this type will tend to become obstructed with sediment and trash that settles out at lower velocities. This is not a problem as long as routine parking lot maintenance is performed (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).

Baffle boxes or other pretreatment devices can be used as a pretreatment to flow entering a bioretention facility from a piped system. This form of pretreatment serves to settle out solids and slow the velocity of flow. Cisterns placed at the bottoms of roof downspouts can be used to slow the velocity of runoff coming from rooftops and direct it to landscaped swale.

8.4.5.12 Vegetative Pretreatment

A pretreatment component is necessary to reduce inflow velocity and to reduce the load of coarse sediment entering the bioretention area (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002). A vegetated filter strip or vegetated channel is the primary pretreatment unit for bioretention facilities.

Vegetated Filter Strip. Runoff enters the bioretention area as sheet flow through the vegetated filter strip, which can be planted with native grass or turf-forming grass. The filter strip reduces incoming runoff velocity and filters particulates from the runoff (Office of Water, EPA, 1999). Several factors determine the length of the vegetated filter strip, including size and imperviousness of the tributary area and filter strip slope. If a vegetated filter strip is used, its length shall be 10 feet at a minimum. See Table 13 for filter strip sizing guidelines.

Vegetated Channel. For sites where concentrated or channelized runoff enters the bioretention system, such as through a slotted curb opening, a vegetated channel with an aggregate is the preferred pretreatment method. This channel can also be planted with native grass or turf-forming grass. The length of the vegetated channel depends on the tributary area, land use, and channel slope. When a vegetated channel is used, the minimum length shall be 25 feet. See Table 14 for vegetated channel sizing guidelines.

8.4.6 Maintenance and Inspections

By design, bioretention does not require intense maintenance efforts. Proper maintenance will increase the expected life span of the facility and will improve aesthetics (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aid in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance (Urban Drainage and Flood Control District - Denver, Colorado, 2005).

Routine inspections for areas of standing water and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention areas are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained (Urban Drainage and Flood Control District - Denver, Colorado, 2005).

Bioretention maintenance resembles that of any maintained landscaping area. Following is a partial list of maintenance actions to upkeep bioretention:

- Inspect biannually for erosion of pretreatment and bioretention areas.
- Mulch as needed to cover bare soil. Spot mulching may be adequate when there are random void areas (Urban Drainage and Flood Control District - Denver, Colorado, 2005) (Office of Water, EPA, 1999). The old mulch shall be removed before the new mulch is distributed. Old mulch shall be disposed of properly (Office of Water, EPA, 1999).
- Annually inspect vegetation to evaluate its health and remove any dead or severely diseased vegetation (Office of Water, EPA, 1999).
- If stressed vegetation is present, further soil investigation is needed. If soil is contaminated, full or partial soil replacement in the planting zone is required.
- Diseased vegetation shall be treated as necessary using preventative and low-toxic measures to the extent possible (Office of Water, EPA, 1999).
- Annually inspect overflow devices.
- Remove trash and sediment as necessary (Programs & Planning Division, Department of Environmental Resources, Prince George's County, MD, Revised 2002).
- Aerate periodically.

8.9 BIOSWALES

Source: Georgia Stormwater Manual

Targeted Constituents

Sediment	●
Nutrients	◐
Trash	○
Metals	◐
Bacteria	◐
Oil and Grease	◐
Organics	◐

Legend *(Removal Effectiveness)*

High	Medium	Low
●	◐	○

8.9.1 Description

Bio-Swales are broad, shallow, natural, or constructed channels with a dense stand of vegetation covering the side slopes and channel bottom. They slowly convey stormwater runoff, and in the process promote infiltration, reduce flow velocities, and pretreat stormwater. Bio-Swales can have either parabolic or trapezoidal cross sections. Bio-Swales include an engineered soil matrix and an under-drain system for drainage.

8.9.2 General Application

Rather than routing stormwater runoff into a lined channel or into a curb-gutter system, consider using a natural conveyance channel. Bio-Swales promote infiltration, filter pollutants through an engineered media and through plant biological uptake. Do not use channels as a BMP component to convey deep concentrated flow; channels are only effective conveying shallow concentrated flow. Take care to identify the proper location for a Bio-Swale. Minimizing disturbance to the area (for example, avoiding application of pesticides and herbicides) maintains the channel's ability to remove contaminants. Select grass and plant species that tolerate low maintenance and can survive without significant human influence (see Appendix A).

8.9.3 Advantages

- Constructed less expensively and maintained more easily than underground pipes
- Underdrain system allows swale to remain dry most of the time and are desirable in residential settings.

- Improve water quality primarily by filtration through an engineered media. Pollutants are also removed through biological uptake.
- Reduce total volume of excess urban runoff to surrounding streams and rivers
- Minimize stream erosion by slowing the conveyance of water
- Enhance biological diversity and create beneficial habitat between upland and surface waters.

8.9.4 Disadvantages

- May not be feasible to implement after development has occurred
- Area requirements can be excessive for high-density development sites
- Not designed to be the fastest conveyance method and, therefore, require exact placement and design to minimize risk of flooding

8.9.5 Design Requirements and Considerations

To maximize pollutant removal efficiency, the time runoff is in contact with the vegetated swale should be maximized, and channelization of high flows should be avoided. This methodology is designed to treat the WQv through a volume-based design (see Table 1). If the wetland Swale is intended to convey flood flows in excess of the WQv, consult local ordinances for design criteria and freeboard requirements.

8.9.5.1 Shape and Slope

- The swales should generally be trapezoidal in shape, although a parabolic shape is also acceptable (provided the width is equal to or greater than the design bottom width for a trapezoidal cross section). The criteria presented in this section assume a trapezoidal cross section. Figure 23 below illustrates a typical Bio-Swale section.
- For the trapezoidal cross section, size the bottom width between 2 and 8 feet. The 2-foot minimum allows for construction considerations and ensures a minimum filtering surface for water quality treatment. The 8-foot maximum reduces the likelihood of flow channelization within a portion of the swale.
- The side slopes of the channel should be no steeper than 3:1 for maintenance and safety considerations. Flatter slopes are encouraged where adequate space is available to aid in providing pretreatment for lateral flows.

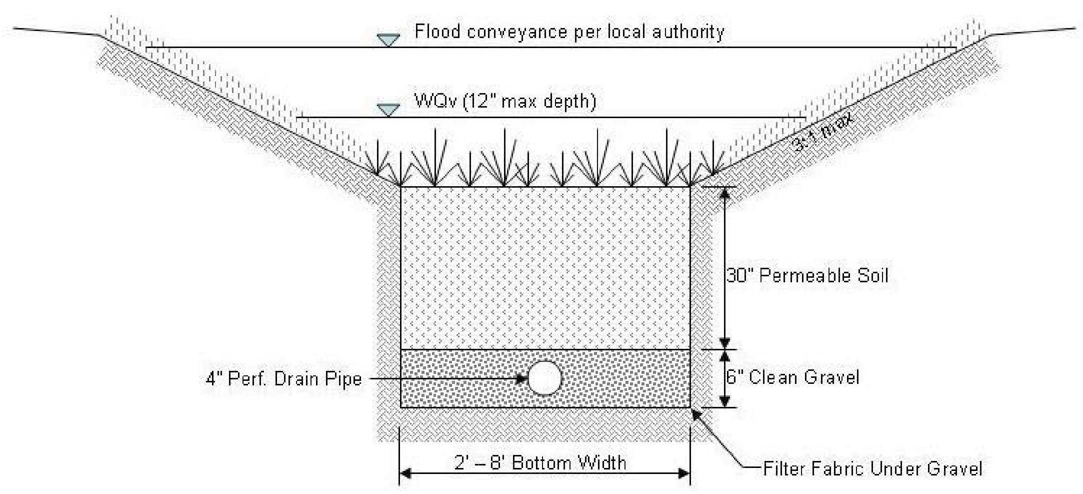

Figure 35 : Typical Bioswale Section

- Longitudinal slope between 1%-4% is recommended. When natural topography necessitates, steeper slopes may be acceptable if rock check dams (vertical drops of 6 to 12 inches) are used. These structures will require additional energy dissipating measures and should be placed no closer than 50 to 100 foot interval.

TABLE 18:
Design Summary for Bio Swales

Parameter	***Swale Design Criteria***
Energy Dissipation	Required if piped inflow to swale
Pretreatment	Use forebay if high sediment load expected
Bottom Width	2 feet minimum, 8 feet maximum
Side Slopes	3:1 or flatter preferred
Longitudinal Slope	Up to 4% without check dams
Underlying soil bed	6” gravel with perforated underdrain pipe under 30” permeable soil
Sizing Criteria	Bio-Swales shall be sized to store and infiltrate the entire water quality volume (WQv) with less than 12” of ponding at any point in the swale with a maximum ponding time of 40 hours. Additional conveyance capacity and freeboard provided per local authority.
Erosion Protection	Width and slope shall be designed to ensure velocity of less than 5 fps in the 50% (2-year) discharge.

8.9.5.2 Design Procedure

- Compute the water quality runoff volume (WQv) and applicable flood conveyance discharges, as applicable per local criteria.
- Determine pretreatment volume. The forebay should be sized to contain 20% of the contributing WQv. The forebay storage volume counts toward the total WQv requirement and should be subtracted from the WQv for subsequent calculations.
- Determine Bio-Swale dimensions. Design swale to store and infiltrate the WQv with a maximum ponding depth of 12 inches and maximum ponding time of 40 hours. Design the bed of the swale to contain a permeable soil layer of at least 30 inches in depth, above a 4-inch diameter perforated PVC pipe (AASHTO M 252) longitudinal underdrain in a 6-inch gravel layer. The soil media should have an infiltration rate of at least 1 foot per day (1.5 feet per day maximum) and contain a high level of organic material to facilitate pollutant removal.
- Determine number of rock check dams necessary to store the WQv.
- Calculate the velocity and depth of flow through the swale using the 50% flow rate; maximum flow velocity shall not exceed 5.0 ft/s for erosion prevention. If these conditions are not attained, modify swale geometry, each time altering the depth, bottom width or longitudinal slopes until these criteria are satisfied.
- Provide bypass for high flows if the swale cannot be stable during the 10% or greater storm event.
- Check local criteria for flood conveyance and freeboard requirements.
- Use outlet protection at any discharge point from wetland swales to prevent scour at the outlet.
- The underdrain system should discharge to the storm drainage infrastructure or a stable outfall.

8.9.5.3 Vegetative Cover

- Species selection will depend upon the duration of water inundation, soil type, and amount of light. Desirable vegetative characteristics include species that form dense sod with vigorous, upright growth.
- Specify plant species resistant to periodic inundation and periodic drought. Specify vegetation required to meet design condition (see appendix A).
- Appropriate soil stabilization methods, such as mulch, blankets or mats should be used before the establishment of vegetation. Seeding, sodding, and other items related to establishing vegetation should be in accordance with accepted erosion-control and planning practices.

8.9.5.4 Maintenance and Inspections

The following is a partial list of actions to upkeep Bio-Swales:

- Inspect swale several times the first few months to ensure plant species are establishing well. If not, reseed or plant an alternative species. Also, inspect the channel for erosion after every rainfall event and repair as necessary.
- If a forebay is used, inspect and remove excessive sediment, trash, and debris and dispose of in an appropriate location.
- Control vegetation by mowing or grubbing techniques (not by chemicals).
- If heavy sediment loading occurs, clean the channel to remove excess material.

8.5 POROUS PAVEMENT

Source: Concrete Promotions Demo

Targeted Constituents

Sediment	●
Nutrients	●
Trash	●
Metals	●
Bacteria	○
Oil and Grease	◐
Organics	●

Legend *(Removal Effectiveness)*

High	Medium	Low
●	◐	○

8.5.1 Description

Porous pavement infiltrates stormwater runoff into the ground through a permeable layer of pavement or other stabilized permeable surface. These systems can include porous asphalt, pervious concrete, cobble pavers with porous joints or gaps, or reinforced turf (Choi and Engel). However, modular perforated concrete or equivalent surfacing that provides large voids with sufficient volume for establishing vegetation may be used.

8.5.2 General Application

Porous pavement is used in parking lots, roads, and other paved areas can greatly reduce runoff and associated pollutants leaving the area—especially when vegetated. Porous pavement may be suitable for applications in areas not exposed to high volumes of traffic or heavy equipment. It is particularly useful for driveways, streets, residential areas, and overflow parking areas. Porous pavement has been used across the U.S. in a variety of applications. Care should be taken to assure that, whatever method of porous pavement used; it is designed correctly and constructed using appropriate methods. Porous pavement is not effective in areas that receive runoff with high amounts of sediment because the pores clog (Urban Drainage and Flood Control District, Denver, Colorado, 1999).

Several systems may be used as porous pavement:

- Precast Concrete Grids: Concrete paving units incorporating void areas, usually precast at a concrete products plant and trucked to a job site for placement. These units have a higher percentage of permeable surfaces such as grass.
- Modular Unit Pavers: Smaller pavers that may be clay bricks, granite sets, or precast concrete of various shapes. These are monolithic units that do not have void areas incorporated in the blocks. They are installed on the base layer with pervious material placed in the gaps between the units.
- Geowebs: Primarily designed for soil reinforcement, but they may serve as permeable pavement.
- Pervious concrete and porous asphalt: See www.perviouspavement.org and http://www.pavegreen.com/water_quality.asp for design and maintenance information.

8.5.3 Advantages

- Can reduce flooding potential by infiltrating or slowing down runoff
- Can remove particles
- Can furnish functional and aesthetic advantages via modular block patterns, colors, and materials

8.5.4 Disadvantages

- Can cost more than traditional paving
- Can present uneven driving surface and potential traps for high heels of shoes
- Can require high cost for restorative maintenance when the system seals with sediment and no longer functions as pervious pavement

8.5.5 Design Requirements and Considerations

- Design pervious pavement to infiltrate the water quality storm; provide for runoff from larger storms.
- The base course should contain an appropriate coarse aggregate with all fractured surfaces. Assume a 30-percent open pore space.
- The design area ratio (contributing impervious area divided by pervious pavement area) should not exceed 3:1.
- Provide a storage volume (design volume) equal to the water quality volume (WQv) (watershed inches of runoff) assuming a 12-hour drain time. To calculate the design volume in cubic feet, first determine the required WQv, assuming a 12-hour drain time and imperviousness of 100 percent for the area; then apply the formula:

  Design Volume = (WQv/12)* Area

  Where

  Area (square feet) = The watershed area tributary to the pervious pavement

Calculate minimum required surface area as follows:

Minimum surface area (square feet) = Design Volume (cubic feet)/0.17 feet

If expansive soils are a concern or the tributary catchment has chemical petroleum products handled or stored, install an impermeable membrane and place the base course on top of the membrane. Otherwise, install a nonwoven geotextile membrane to encourage infiltration.

If the pavement is in low permeability soils such as clayey silt, sandy clays, clays or others, design a subdrain with a permanent restrictor outlet to drain the available pore space volume in the base course within 12 hours.

8.5.6 Maintenance and Inspections

- Maintain the turf included in these installations as the permeable surface medium. Limit fertilizers and deicing chemicals since they adversely affect concrete products.
- Cast-in-place installations can be snowplowed, provided the blade is set high enough to prevent damage to grass cover. Additional care is needed when plowing paving blocks or grids.

8.5.7 Design Example

To be completed at a later date.

Town Of Nederland
NEDERLAND DOWNTOWN DEVELOPMENT AUTHORITY
Report from
The Design Advisory Team (DAT) for
Nederland Pedestrian Enhancement and Stormwater Management Project.

by

Pat Everson

November 28, 2012

The DAT has been exceptionally busy during the months of October and November. The 2nd DAT meeting with the property owners, business owners and renters along 2nd St and SH 119 met on Oct. 18 at the Library to discuss concerns and ideas of the stakeholders. This meeting was well attended and there was much constructive and positive input for the design team from Huitt-Zollars led by Brian McLaren and Sarah Lawrence. I have attached the minutes from that meeting for your information.

During October, a selection committe of Mayor Pro-tem Kevin Mueller, Town Administrator Alisha Reis, NDDA Project Coordinator Paul Turnburke, and NDDA Vice Chairman Pat Everson went through the process of selecting a Project Manager/Sustainability Consultant for the NedPed project. After a lengthy process of review of applications and personal meetings they selected C2Sustainability from Denver, with Conor Merrigan representating that company as the Project Manager.

A Biominicry workshop was held for the professional team on November 7, 2012 in Denver. This workshop was lead by Marie Zanowick and attended by the team from Huitt-Zollars as well as our new project manager Conor Merrigan. They were assigned homework pertaining to applying the principals of Biominicry to the NedPed project. Their next meeting will be January 15, 2013 to review the plans for the design. Please refer to the summary of the workshop, prepared by Brian McLaren.

The 3rd DAT meeting was held on November 8th at the Library. It also was well attended. At this time a preliminary schematic design was presented. There was much discussion of various concerns for placing it on the northside of 2nd St. Brian McLaren conducted the meeting and placed all concerns and objections of the rough plans for consideration by the team when they returned to Denver. Please refer to the attached minutes from that meeting.

The first roll out of the 30% schmatic design was at the PROSAB meeting on November 15. This presentation was done by Sarah Lawrence from Huitt-Zollars. This was the first opportunity that the DAT team had to see the plans. I had extended an invitation to the members of the DAT and 2nd St to attend and many attended including the Mayor, Joe Gierlach. This was the start of the Nederland Public Process (NPP), but due to time constraints we were not able to get the public notified of the meeting. The PROSAB board was allowed to comment on the plans as well as the public. There was lively discussion. Then the PROSAB board answered a questionaire prepared by the board for projects in Town. On most of the items the plans scored very well, with a lot of positive input from

the PROSAB board members. The notes of this meeting were prepared by Conor Merrigan and are attached.
On Friday, November 16, the Technical Review Committee composed of Jason Morrison, Public Works, Alisha Ries, Town Administrator, Paul Turnburke, NDDA Project Coordinator, Brian McLaren, Huitt-Zollars, Inc, Conor Merrigan, NedPed Project manager/sustainability coordinator. They walked the route and discussed various problems that might occur during construction and later with maintenance. These minutes were not available at the writing of this report.

Upcoming meetings are planned as follows:

November 27th @ 7:00 to 8:30 a joint NDDA/BoT meeting. The agenda for this meeting will cover the Owner's Project Requirements (OPR) as well as set goals for the project during the next year.

November 28th, @ 7:30 a NPP presentation to the Planning Commission after the NDDA meeting. This meeting will be in the multi-purpose room of the community center.
The presentation will be by Brian McLaren and Conor Merrigan. This is the first opportunity for the entire NDDA board to view the proposed schematic design and will include input from the Planning Commission.

December 4 @ 5:30-6:30 presentation of the schmatic design to the BoT in a joint BoT/NDDA workshop. This meeting will include the input from the other advisory boards.

Submission of the 30% schematic design to CDOT is estimated for December 21st. It will take approximated 2 - 3 weeks to obtain approval of the design before we can move forward with the 90% construction documents. The design development documents will then be presented the the NDDA, DAT and proceed through another round of NPP process to all boards.

The following meetings are tentatively planned for January:

1.January 15, 2013 Part Two of the biominicry workshop for the professionals.

2. January 16, 2013 - The 4th DAT meeting. It is tentatively planned that this meeting should be opened for all public input. More details are being worked out with Conor, Paul and Brian.

Attachments:

1. Summary of Biomicry Workshop
2. Minutes of DAT Meeting #2
3. Minutes of DAT Meeting #3
4. Notes on meeting with PROSAB

Summary Biomimicry Workshop for Nedped Project held on Nov. 7, 2012

Prepared by
Brian McLaren

The purpose of this workshop with the United States (US) Environmental Protection Agency (EPA) and the consultant team was to present and discuss the City's problem with flooding and identify potential nature-based implementations to be considered with the initial schematic design concepts for the Nederland Pedestrian Enhancements (NedPeds) project.

The EPA presented the Life's Principles basis for biomimicry. In discussions during the workshop, the non-controlled development in the valley was suggested as a contributing factor for the Town's problem with flooding. However, it was acknowledged that the scope of this project would have a limited impact of the larger flooding problem. The following functions were identified for this project:

Transit
Water Quality
Animal Movement
Water Conveyance
Flood Control
Recreation

Nature-Based strategies were discussed and the following goals identified for this specific project:

Pedestrian Transit
Storm water Quality

To address the larger problem of flooding in the town, the following Nature-Based strategies were also identified:

Master Planning
Major Functions, applying life's principles, sustainability (with cost parameters)

In discussions during the workshop, the non-controlled development in the valley was suggested as a contributing factor for the Town's problem with flooding.

HUITT-ZOLLARS, INC.

Brian D. McLaren, P.E.

HUITT-ZOLLARS

HUITT-ZOLLARS, INC. • 4582 South Ulster St. • Suite 240 • Denver, CO 80237-2639 • 303.740.7325 phone • 303.224.9997 fax • huitt-zollars.com

Meeting Minutes

PROJECT: Nederland Ped. Enhancements

LOCATION: Nederland Public Library

PROJECT NO.: 16-0312-01

DATE: Oct. 18, 2012

OWNER: Town of Nederland

TIME: 7:00 PM

PURPOSE: Design Advisory Team (DAT) Meeting No.1

ATTENDEES:

See Attached

DECISIONS, CONCLUSIONS, ETC.:

The purpose of this first meeting with the Design Advisory Team (DAT) and the consultant team was to discuss with the DAT the project scope, goals, and schedule for Nederland Pedestrian Enhancement Project (NedPeds); the positive and negative aspects of the Sidewalks Phase 1 project; and the communities expectations and concerns regarding the current project.

Project Overview

Brian McLaren (Consultant Project Manager) described the scope of the NedPeds project, which is to provide a multi-use path for use by pedestrians and bicycles that will connect the RTD park-n-Ride with the Youth & Family Center along 2nd Street, and with the Post Office along East Street. “Spur” connections are planned along Jackson St. between 1st & 2nd, along 3rd St. between the Library and Bridge St., and Snyder St. between 1st & 3rd. The project will also address storm water management issues in the project area.

The project goals were described in the Project’s Needs Statement and are:

1. **Improve non-motorized circulation:** Reducing our dependence on traditional non-renewable forms of transportation is a small but important step in becoming a sustainable community. Developing a non-motorized circulation system that allows community members to walk or bike to local destinations and to region transportation portals will result in cleaner air, healthier community members, and a greater sense of community.
   In order to improve non-motorized transportation, we must first understand how well our existing non-motorized transportation system functions, then determine where and how improvements should be made in order to be successful.

2. **Improved watershed functionality through focused improvements in storm water management systems:** It is important for the town to develop and maintain a high functioning storm water management system which allows for safe transportation and protects property from damage, while also helping to retain and restore the watersheds natural ecosystem functionality. Preserving, protecting, enhancing and learning from healthy ecosystems are an essential part of becoming a sustainable community.

> In order to effectively address storm water in our developed areas, the Town would like to understand how the watershed reacts naturally to storm water, and then develop solutions for managing storm water that work with the natural systems.

The anticipated project schedule will be to complete the design work this fall and winter, and then be able to bid the project in late winter/early spring, and begin construction in the summer.

Sidewalks Phase 1 Feedback

The design team asked for feedback from the community as to what was liked about the Phase 1 project, as well as what wasn't liked.

A comment was made that the Town has "sidewalk people" and "no sidewalk" people, and that the design process needs to make people feel included.

It was noted that at one location (Lakeview Drive & SH119), the roadway width went from 2 lanes to one lane resulting in right-turning traffic having to wait on left turns exiting the B & F Foods area.

Prominent features need to fit in like you wouldn't notice it (rustic & natural).

A major issue that has arisen from the Phase 1 project is maintenance. During large snow events, the Phase 1 pathway requires special maintenance equipment to clear the snow that is not needed anywhere else in town. This results in additional funds needed in the budget to account for the new pathways. Different materials were suggested for this phase including crushed gravel and different colored/textured concrete (pathway would be flush with the road). It was noted that the current gravel road gets washed out and needs constant maintenance. The crushed gravel pathway would require the same maintenance. The colored/textured concrete could be easily maintained because during a snow event, it can be cleared using the towns existing equipment.

NedPeds Project Expectations and Concerns

The question of why the pedestrian improvements and the drainage portion of the project needed to be combined (i.e., both projects along 2nd Street) was raised. It was explained that 2nd Street was chosen as the pedestrian route because combining the multi-modal pathway and the drainage project along 2nd Street would allow for maximum utilization of the funds in a dual purpose. Improvements along 2nd Street would address the flooding issues for that area as well as tie together the various amenities in the town.

Currently, 2nd Street is a one-way street. The west end of the street is zoned as commercial while the east end of the street is designated as commercial/residential. Several options were discussed regarding the designation of the street (one-way vs. two-way). The first suggestion was that it is beneficial to the commercial area on the west end of the street to be two-way through the residential/commercial section, then have a traffic calming object (such as a planter) and a sign stating that only local traffic is permitted. This would limit the amount of commercial trucks entering into a residential area where children might be playing. The second suggestion was that 2nd Street would remain a one-way street. Traffic would enter on the west end of the street and exit on the east end. It was stated that currently, vehicles turn around and go the wrong way on the one-way to exit or back up on the one-way to exit. A third suggestion was to make the length of 2nd Street a two-way street (with no traffic calming object). The two-way in the commercial section would keep the non-local traffic out of the residential area.

The suggestion of paving the east end of 2nd Street was made. This would limit the dust issue that the residences and businesses are dealing with. The paving would also be beneficial to solving the drainage problems along 2nd Street.

The suggestion of a meandering road was proposed. This solution will provided a natural calming effect for traffic in the commercial areas. The gardens along 2nd Street could potentially be used as bio-swales.

It was noted that many residents have fences and gardens that encroach on the right-of-way. Some members of the community feel that the town should do what it can to protect those fences and gardens. Others feel that the right-of-way is owned by the city and the full extent of the right-of way should be used, if needed, for this project.

It was suggested that the project could tie into the existing pathway at The Business Connection. Parking in front of this business is head-in/angle.

It was suggested that a pathway could be placed behind the museum in the county easement.

A suggestion was made to create a separate bike lane.

The question was raised regarding the need for the pathway to be located on both the north and south side of the street. The north side of the street appears to be a good location for the pathway. The area gets plenty of sun (to facilitate snow melt) and has room for a walk because the on-street parking is mainly located on the south side. In addition to the on-street parking on the south side of the street, the snow tends to melt much slower under the shadow of the buildings.

Pat Everson provided the design team with a copy of comments that had been e-mailed to her from folks who weren't able to attend the meeting. A synopsis of those comments follows:

- One idea that has been mentioned is blocking car traffic part way down the block, with designate parking and non-parking sections to allow for space to turn around. A removable obstacle may be better for emergency vehicle access.
- How about a passable feature, like a planter, tree or other such thing that would slow traffic and a sign to indicate "local/pedestrian traffic only".
- Regarding the suggestion of blocking off one end of East Street, although this does seem to be a good idea, and would allow residents only, and pedestrians, to use the street for both driving and walking with safety, without an 8-foot wide sidewalk taking up valuable extra space, there is one consideration: A number of resident do not have driveways, and therefore would have to turn around their cars on the already narrow street each time they need to drive form their home. Visitors would have the same problem. And parking on the street, which is already inevitable, will make this problem worse because the available space for turning cars around would often be absent. Another point: it is true that many persons use Second Street as a path between the downtown and the reservoir area. A safe sidewalk along the Highway would undoubtedly absorb some of this pedestrian traffic. Current pedestrian use density changes when safe alternatives become available.
- I understand that the survey of the Second Street right-of-way has three potential purposes: (1) to determine the feasibility and desirability of adding flood water mitigation to Second Street and Beaver Creek by installing storm sewers; (2) to determine the feasibility and desirability of adding a sidewalk along Second Street, connecting the

downtown with the Post Office; and (3) potentially, to investigate paving Second Street. I have read some comments which suggest that these three possible proposed projects should be linked to reduce effort or expenses. However, I believe they should be considered separately on their separate merits, and that combining the work should only be investigated after that consideration is completed. The idea of linking them should not influence the choice as to whether to do one or more of them. Here are some comments I have on each of the three listed proposals: (1) adding flood water mitigation is long overdue. Nobody wants to have their homes flooded, bridges damaged, or yards covered with gravel, all of which occurred after a flash flood last summer; (2) putting a sidewalk along Second Street is a bad idea for several reasons; (a) Second Street is very narrow and crowded, with a lot of houses close to the street, and with a number of improvements close to the street. A sidewalk would probably require the destruction of some of these improvements. As an example, along our Second Street frontage, we have a garden with trees, native bushes, and other native plants and flowers which has taken us ten years to develop. This garden is appreciated by the community, eliciting daily comments to us from passers-by, even including picture-taking. And the fact that some homes have no driveways (and cars must park on the street) adds to the crowding, which could require some cars to park on the sidewalk because there would be no other room for them; (b) a sidewalk along the highway, which was the original proposal, is the best solution. For one thing, it is currently much more dangerous to walk along the highway than it is to walk on First, Second, or Third Street, because of the amount and speed of the traffic. There is also a lot more room to build a sidewalk along the highway without encroaching on improvements in a crowded neighborhood, and in most places the sidewalk along the highway can have a grassy buffer between it and the speeding traffic. Some claims have been made that people do not walk along the highway. This is simply not true. From our upstairs window, we have a clear view of the highway from East Street past the Post Office toward the west. Nearly every day I see people walking along the highway. Some walk to or from the bus stop at East Street, but others are obviously walking there for other reasons. And on one wither morning, my wife and I were walking along the highway from the roundabout to the Post Office after a fresh nighttime snowfall, and found a lot of fresh human footprints in the snow preceding us. If a sidewalk were built along the highway, certainly more people would use it because it would finally be safe to walk there. I urge the appropriate authorities to re-open the highway route as a possible sidewalk location. In fact, the sidewalk location should be put to a poll or ballot so that effective feedback can be obtained equitably from our entire population instead of from a few vocal individuals who do not represent the people who would use such a sidewalk, and do not represent the town as a whole. Every person I have talked to (with only one exception) has told me that he/she supported the highway sidewalk location, but never got involved with the discussion because they were unaware that the highway location was in jeopardy. (3) the issue of paving Second Street has been talked about less than the other two issues listed above. Currently, there is a lot of dust stirred up by traffic and wind along Second Street, resulting in continuous dust accretion inside our house. Undoubtedly others along Second Street have the same experience. Paving Second Street would obviously help this situation tremendously. But I have heard complaints that paving Second Street would encourage traffic to drive faster. Is that really true? First Street is paved. Has anyone tried to determine whether the First Street residents wish that their street was not paved in order to slow down traffic? Would they prefer instead to have a lot more dust blowing around and into their homes? And if indeed traffic were found to be too fast on a paved Second Street, speed bumps (or speed dents to help the snowplows) could be installed later.

FOLLOW UP: to be done, what, who, when, etc.

Huitt-Zollars will begin the schematic design.

Meetings with the DAT will be held frequently to resolve any issues with the community and to keep the community informed of the project progress.

The OPR and the project scope will be posted on the NDDA website.

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Meeting Agenda

NEDERLAND PEDESTRIAN ENHANCEMENT DESIGN (NedPed) and NEDERLAND PEDESTRIAN & STORMWATER MANAGEMENT IMPROVEMENT PROJECT

Meeting Date:	Oct. 18, 2012	Meeting Time:	7:00 pm
Location	Nederland Community Library Conference Room		
Meeting Purpose:	Design Advisory Team (DAT) Meeting No. 1		

AGENDA

1) Introductions

2) Project Overview

    a. Scope
    b. Goals
    c. Schedule

3) Sidewalks Phase 1 Feedback

    a. What you liked
    b. What you didn’t

4) NedPeds Project

    a. Expectations
    b. OPR (Owner’s Project Report) Sustainability & Green Technology
    c. Concerns
    d. Specific Problem Areas

5) What’s Next

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Meeting Attendance

PROJECT: Nederland Pedestrian Enhancements
LOCATION: Nederland Public Library
PROJECT NO.:
DATE: Oct. 18, 2012
HZ NO.: 16-0321-01
CLIENT: Town of Nederland
TIME: 7:00 PM
PURPOSE: Design Advisory Team (DAT) Meeting No. 1

ATTENDEES:

Name	Address	E-mail Address
Tom Stoeckley	198 East Street	trstoeckley@gmail.com
Donna Kirkpatrick	115 E. 2nd	donnasuek@aol.com
Theresa Bradly	140 E 2nd	whandsinc@yahoo.com
Alisha Reis	Town Hall	
KAYLA EVANS	1250 ELDORA ROAD	ARAPAHOHAWK1447@MSN.COM
Paul Turnburke	9259 Ridge	
Kevin Mueller	140 Lakeview Place	
Bradley Graham	260 East St.	
[illegible]	9590 Sugarloaf	
Alice Lemoine	P.O. Box 1568, Ned	alice@ntndesignco.com
RONALD A. Mitchell	75 East First Street	ronaldamitchell@mail.com
JOE GIERLACH	65 POMO WAY	JOEG@NEDERLANDCO.ORG

HUITT-ZOLLARS

HUITT-ZOLLARS, INC. • 4582 South Ulster St. • Suite 240 • Denver, CO 80237-2639 • 303.740.7325 phone • 303.224.9997 fax • huitt-zollars.com

Meeting Minutes

PROJECT: Nederland Ped. Enhancements
LOCATION: Nederland Public Library
PROJECT NO.: 16-0321-01
DATE: Nov. 08, 2012
OWNER: Town of Nederland
TIME: 6:30 PM
PURPOSE: Design Advisory Team (DAT) Meeting No. 3

ATTENDEES:

See Attached

DECISIONS, CONCLUSIONS, ETC.:

The purpose of this meeting with the Design Advisory Team (DAT) and the consultant team was to present and discuss the initial schematic design concepts for the NedPeds project. The schematic design is intended to be a collaborative process – the design team does some work, listens to the community, refines the concepts, and so on, resulting in a plan that fulfills the project goals and benefits the community as a whole.

Project Overview

Brian McLaren (Consultant Project Manager) summarized the comments presented at the Oct. 18th meeting and reminded everyone of the project goals.

The project goals were described in the Project's Needs Statement and are:

1. **Improve non-motorized circulation:** Reducing our dependence on traditional non-renewable forms of transportation is a small but important step in becoming a sustainable community. Developing a non-motorized circulation system that allows community members to walk or bike to local destinations and to region transportation portals will result in cleaner air, healthier community members, and a greater sense of community.
   In order to improve non-motorized transportation, we must first understand how well our existing non-motorized transportation system functions, then determine where and how improvements should be made in order to be successful.

2. **Improved watershed functionality through focused improvements in storm water management systems:** It is important for the town to develop and maintain a high functioning storm water management system which allows for safe transportation and protects property from damage, while also helping to retain and restore the watersheds natural ecosystem functionality. Preserving, protecting, enhancing and learning from healthy ecosystems are an essential part of becoming a sustainable community.
   In order to effectively address storm water in our developed areas, the Town would like to understand how the watershed reacts naturally to storm water, and then develop solutions for managing storm water that work with the natural systems.

Feedback from the Oct. 18 meeting included:

- Consider using a meandering alignment for both the roadway and pathway to help keep traffic speeds low.
- The north side of the street would be a good location for the pathway to take advantage of sunshine to facilitate snow melt.
- Paving the entire length of 2nd Street between Snyder and East St. would help the dust issue and also prevent erosion of the street.
- The designation of 2nd St. as 2-way vs. 1-way was discussed.
- Snow removal and maintenance of the pathway are concerns.

Schematic Design Concepts

The design team presented their initial design concepts for consideration. The base project area along 2nd Street logically falls into three distinct areas – the stretch from the park-n-Ride to the roundabout; from the roundabout to Snyder St.; and from Snyder St. to East St.

The concept for the stretch from the park-n-Ride to the roundabout consists of utilizing the existing S.H. 72 shoulders for bicycle traffic, and adding pathways adjacent to the existing roadway in those areas where none currently exist.

Comments on the first section of the schematic concept:

- ➢ Show crosswalk markings at the street crossings – particularly near the library.
- ➢ The west end of the pathways should terminate at a logical location. Both the northerly & southerly paths should extend at least to the west entrance to the park-n-Ride, consideration should be given to extending the southern path to accommodate the future park-n-Ride expansion.
- ➢ Cars currently park along the north side of S.H. 72, particularly near the Presbyterian Church on Sundays.
- ➢ The Business Connection would like to maintain their current head-in/angle parking configuration.
- ➢ The roadway should be kept as wide as possible for westbound traffic near the Mining Museum. RTD buses making the left turn from NB to WB need as much width as possible. The pathway should be as close as possible to the museum building.
- ➢ A 20' access easement exists just west of the Mining Museum building. A driveway will need to be provided.
- ➢ Consideration should be given to reconstructing the existing sidewalk along the front of the Mining Museum.
- ➢ Considerable discussion concerned the safety aspects of the existing roundabout. Sight distance problems due to the existing landscaping in the center should be reviewed.

The schematic concept for the second stretch of 2nd Street (roundabout to Snyder) consisted of a more urban type improvement with curb & gutter, an 8' pathway along the north side, and an attached 5' sidewalk along the south side. Comments on the second section of the schematic design included:

- ➢ Curb & gutter is really not needed in this section, consider providing flush pathways similar to the rest of the project.
- ➢ The location of the easterly crosswalk should be reviewed to see if moving it further east would be safer.
- ➢ Provision for a bus shelter at the school bus stop at 2nd & Snyder should be made.
- ➢ Crosswalk markings should be shown.

The schematic concept for the third section of 2nd St. (Snyder to East St.) provided for an 8-ft. pathway along the north side of the street, a single lane of traffic (1-way eastbound), some parallel parking along the south side of the street, and room for bioswales to treat stormwater runoff prior to entering the creek. The existing culvert across 2nd St. for N. Beaver Creek is most likely undersized and will need to be replaced and upgraded. The existing overhead utility line is roughly 5 feet inside the street right-of-way. To avoid costly relocation of this utility line, a meandering roadway alignment is proposed that would avoid the poles. The meandering alignment also provides for a traffic calming effect to keep vehicle speeds down.

Comments on the third section of the schematic design included:

- Parking locations need to be reviewed with respect to current driveway locations.
- The design should consider parking in front of the feed store.
- The design of the spur along Snyder should consider placing the pathway along the west side of Snyder and parking along the east side.
- Considerable discussion concerned traffic flow along this stretch of 2nd St. – delivery vehicles (and others) at the westerly end of the block oftentimes exit 2nd St. to the west by going the wrong way. This has resulted in safety concerns at the 2nd & Snyder intersection because the wrong way drivers don't have a stop sign. Suggestions were made to make the westerly portion of the street two-way to alleviate this problem.
- It was noted that a better solution might be to put the path along the south side of the roadway rather than the north – many of the homes along the north side don't have off-street parking.
- Crosswalks should be shown across East St.
- There is an existing power line crossing 2nd St. that has had vertical clearance problems in the past.

FOLLOW UP: to be done, what, who, when, etc.

Huitt-Zollars will continue to refine the schematic design, considering feedback from the DAT.

The next DAT meeting is planned for mid-January to present the Design Development Documents. Presentations of the evolving schematic design to the Town's Sustainability Advisory Board, Parks, Recreation & Open Space Advisory Board, the Technical Review Committee, the NDDA, and the Board of Trustees will occur in November & December.

Meeting Attendance

PROJECT: Nederland Pedestrian Enhancements
LOCATION: Nederland Public Library
PROJECT NO.:
DATE: Nov. 08, 2012
HZ NO.: 16-0321-01
CLIENT: Town of Nederland
TIME: 6:30 PM
PURPOSE: Design Advisory Team (DAT) Meeting No. 3

ATTENDEES:

Name	Address	E-mail Address
Alice Lemoine	P.O. Box 1568, Ned	alice@mtndesignco.com
PAT EVERSON	P.O. Box 114 Ned	patricia.everson@gmail.com
Paul Turnburke	3259 Ridge	[illegible] info@nedda.org
KAYLA EVANS	1270 ELDORA ROAD	MADAHORAUCH47@MSN.COM
Alisha Reis	PO BOX 396	alishar@nederlandco.org
Frank W Lutz	POB 57	lutzfs@gmail
SALLY GRAHAM	Box 399	sallygrahm@yahoo.com
RON Mitchell	P.O. BOX 1705 Boulder CO 80306	ronaldamitchell@gmail.com
DONNA Kirkpatrick	P.O. Box 146 Ned	donnasuek@aol.com
Theresa Bradley	P.O BOX 777 Ned.	whandsinc@yahoo.com
Vera Schulte	POB 1462/164 E 2nd Ned	vera.schulte@gmail.com
Pam North	POB 157, Rollinsville, CO 80474	snowbear@talisman.org
Barbara Kuiper	PO Box 1654 Ned CO 80466	
JOE GIERLACH	PO Box 361 NED	JOEG@NEDERLANDCO.ORG
Andy Johnson	P.O. 3070 Ned	andyjohnson@nedernet.net

11/21/12

(Unofficial) PROSAB Meeting Notes – 11/15/2012

The following notes were taken to supplement the Official Meeting Minutes and should not be regarded as representing the views of any town board:

- The walkways will not include curb and gutter to preserve rural character, allow for ease of maintenance, lower costs, and address elevation issues (street would have to be lowered or adjacent lots raised in some cases)

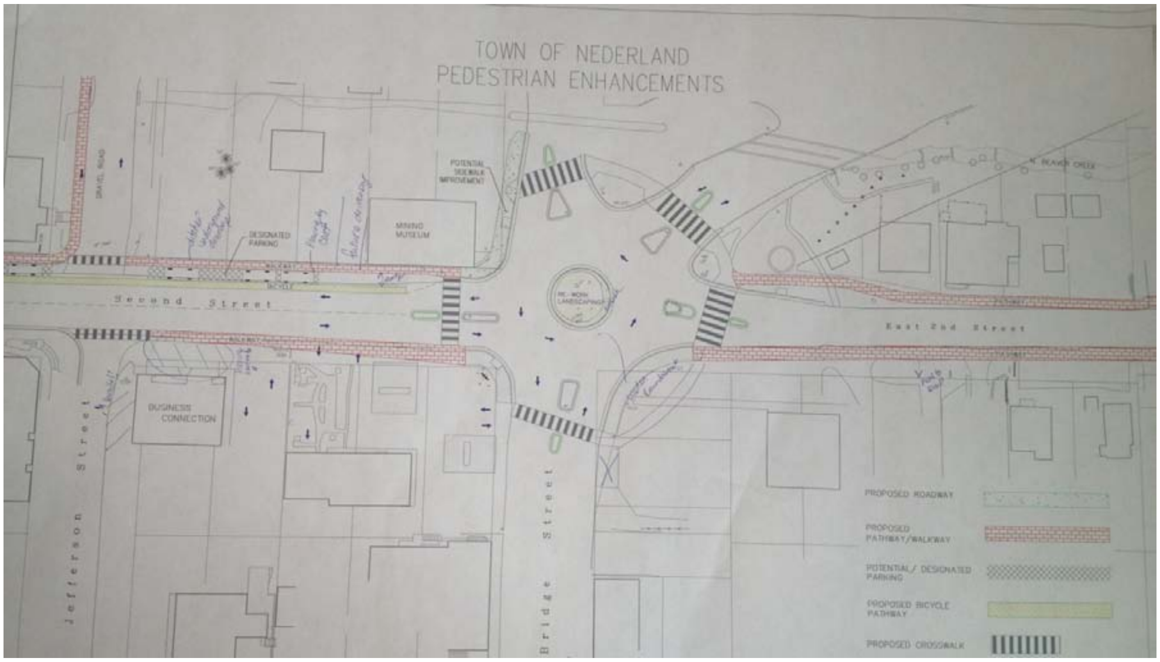
- Boulder County currently owns mining building. Future access is planned for West side of building (potentially across walkway), sidewalk is in need of repair

- Ditches on upper 2nd (Highway 119) could convey water underground in some instances allowing for ease of access to church, etc. in conjunction with construction of walkway

- Intent is to preserve diagonal parking for Business connection, but ultimately CDOT must rule as backing into the highway may be illegal

- Survey issues need to be solved, but currently have two different alignments of ROW where 2nd meets Snyder

- Maintenance and delineation of the pathway throughout the town than can be replicated (without a grant) is a big concern. The town wants to use this project as a model for future projects.
- The signage for the trail system was important to the PROSAB. While there are no standards yet, the committee predicts there will be standards for signage by the January-March timeframe. For now, the signage must match the current signage displayed throughout the town.



Notes: Design suggestions for SE corner of Roundabout provided by Ron, Property Owner. The idea to merge paths on North side to one walkway was supported.

Notes: Moving Path to West side was supported. Attention was drawn to additional water drainage issues from Stinky Gulch and other areas across the Highway.

TOWN OF NEDERLAND
PEDESTRIAN ENHANCEMENTS

SCHEMATIC DESIGN

HUITT-ZOLLARS
4582 S. Ulster St. Ste 240 Denver, CO 80237
Phone (303) 740-7325 Fax (303) 224-9997

1"=20'
SHEET 1
11/20/12

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HUITT-ZOLLARS
4582 S. Ulster St. Ste 240 Denver, CO 80237
Phone (303) 740-7325 Fax (303) 224-9997

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1"=20'
SHEET 2
11/20/12

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SCHEMATIC DESIGN

HUITT-ZOLLARS
4582 S. Ulster St. Ste 240 Denver, CO 80237
Phone (303) 740-7325 Fax (303) 224-9997

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SHEET 3
11/20/12

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SCHEMATIC DESIGN

HUITT-ZOLLARS
4582 S. Ulster St. Ste 240 Denver, CO 80237
Phone (303) 740-7325 Fax (303) 224-9997

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SHEET 4
11/20/12

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PEDESTRIAN ENHANCEMENTS

SCHEMATIC DESIGN

HUITT-ZOLLARS
4582 S. Ulster St. Ste 240 Denver, CO 80237
Phone (303) 740-7325 Fax (303) 224-9997

1"=30'
SHEET 5
11/20/12