PLATTEVILLE INFRASTRUCTURE IMPROVEMENTS

ZHERDD Consulting

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A report submitted to the University of Colorado Denver, Civil Engineering Department in partial fulfillment of the Senior Design course.

Fall 2020
Submitted December 8, 2020

December 8, 2020

Mr. Bradley A. Curtis P.E.
Northern Engineering Services,
820 8th Street
Greeley, CO 80631

Re:
Final Report and Recommendations
Platteville Infrastructure Improvements
Platteville, CO 80651

Dear Mr. Curtis,

Team ZHERDD Consulting would like to thank you for the privilege of analyzing the Platteville Infrastructure Improvements as part of Senior Design project. It is our understanding that Northern Engineering would like us to focus on the site's planning problems and to present feasible solutions that serve the community of Platteville. The purpose of our involvement was to identify the current issues along the Main Street to match the ADA Accessibility Guidelines and recommend possible solutions. As part of our investigation, we performed a site visit on August 27th and met with you to obtain the background information regarding the selected project area. This report contains our findings, conclusions, and recommendations.

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1. Project Background

1.1 Historical Review

Platteville is a small town located in Weld County, Colorado, United States. It is adjacent to Fort Vasquez on U.S. Highway 85. According to the 2010 census, the population was roughly 2,500 people. Platteville was founded in 1871 and finally incorporated in January 1887. It was named Platteville due to its location on the Platte River. The Platte River's fertile valley was known for its livestock and poultry, with over 200 farms now located in the surrounding area. The total area of Platteville is 2.527 square miles.

This project is for the residents of Platteville, Colorado; the beneficiaries will be the town's people as well as the neighboring towns.

The stakeholders of this project are:

- Residential people of the town
- Commercial and retail shopping Center
- Government Institutions
- Private Institution and offices
- Educational Institutions
- Parks and visiting areas
- Industrial Areas

2. Purpose

The Town of Platteville Comprehensive Plan is considered necessary for accomplishing a coordinated, adjusted, and harmonious development. The Colorado Department of Local Affairs compiled the following list of potential uses for an adopted comprehensive plan:

1. A basis for regulatory actions: The plan provides foundation and guides of provisions and zoning regulations, subdivision regulations, official map, flood hazard regulations, annexation decisions, and various decisions that are made under the regulations.
2. The basis for community programs and decision-making: The plan helps to be the guide and resource for the recommendations. Contained in a capital budget and schedule for a community development program, direction, and content of other local initiatives. Such as for water protection, recreation, land acquisition, and housing.
3. A source for planning studies: plans can address every issue in sufficient detail. Therefore, many projects will recommend further studies to develop courses of action on a specific need.
4. A standard for review at the County and State level: Other regulatory processes identify the municipal plan as a standard for considering applications. Master plans are essential to developing regional plans or inter-municipal programs, i.e., a regional trail network or valley-wide transit program.
5. A source of information: Plans are valuable sources of information for local boards, commissions, organizations, citizens, and businesses.
6. A long-term guide: Plans are a long-term guide to measure and evaluate public and private proposals that affect the community's physical, social, economic, and environmental development.

3. Jurisdictions Having Authority

The National Electrical Code (NEC) defines Authority Having Jurisdiction as an organization office, or it is an individual responsible for applying all code and standards requirements. It is also the responsibility of approving the types of equipment, materials, and installations used.

Design, construction, repair, augmentation, and up-gradation of infrastructure must adhere to standards and codes by the Colorado Department of Transportation (CDOT), which holds the primary jurisdiction for the town of Platteville.
The Town of Platteville Public Works Department is responsible for maintaining streets and sidewalks, water and sewer systems, parks, Mizpah Cemetery, and issuance of permits related to vehicles.

The Government of Platteville Finance Department, issues license and permits to all businesses including contractors, and individual businesses whether they collect sales tax or not. It is also responsible for grant management and investments in Platteville.
The Planning and Zoning applications lie under the jurisdiction of Ms. Melissa Kendrick, who provides contracted services to Platteville.

The Central Weld County Water District, along with the town of Platteville Public Works Department has jurisdictions over providing the supply of drinking water to the town and the people of Platteville.

4. Applicable Building Codes

ADA stands for the Americans with Disabilities, and the Department of Justice published it. Main Street in the town of Platteville, where the project is located needs some essential modifications to comply with the ADA guidelines. The four-block segment between Cherry Avenue and Grand Avenue has design flaws that need to be addressed. The location has many design deficiencies that can be a danger to the life of disabled people. To accomplish safety, modifications and changes need to be on the streets. The project needs to meet the minimum mandatory ADA guidelines. ADA's compliance is highly beneficial, as it provides better and easier accessibility choices for disabled people. With ADA guidelines, the town and the streets will be a safe environment for everyone to travel, as disabled people will have their needs met, and they will have their right to travel and transport legally. ADA Compliance is a complicated topic, and it can be the reason behind high profile lawsuits. Any building or project started on or after March 15, 2012, is required to use the 2010 Standards. Modifications to existing structures and streets can be expensive, but the violation of ADA can also be a very steep penalty. The Platteville project on Main Street needs creative solutions that comply with the ADA guidelines, and the town’s needs for the design of the parking, pedestrian access, intersections, crosswalks, bike lanes, and business access.

4.1 Parking

According to the ADA guidelines, every parking facility is required to have accessible parking spaces on the site. Parking spaces should have accessible spaces that accommodate vans. Every six accessible parking spaces should have at least one parking space that is sized to fit vans. Each building is required to provide easy access to the parking spaces. It will be a challenge in some cases, as the existing streets, curbs, and sidewalks might be in the way. Therefore, the facility is encouraged to request the proper modifications from the responsible public entity.

4.2 Pedestrian access

The streets and the sidewalks of public facilities should be compliant with the ADA guidelines. The pedestrian travel routes should be accessible and have enough room for transportation for people who use wheelchairs and other mobility devices. The ADA sidewalk rules require every ramp's rise to be limited to 30 inches and for the precise landing length to be at least 60 inches. If there is a change in the ramp's direction, then the landing length should be at least 60 x 60 inches. The handrails of the ramp run should be at least 36 inches. The cross slope of the ADA sidewalk cannot be more than ½ inch. There is an exception for where the vehicles are boarded from street levels, where the platform should be less than 8 inches.

4.3 Intersections

Altered streets or newly built ones are required to have curb ramps. The curb ramp should have a width of 36 inches and its steepness should be 1:12 max. The adjacent counters should have slopes that are not steeper than 1:20. The bottom of the diagonal curb ramps should have 48 inches of space within crossing markings. The boarding edge should be at least 24 inches wide, and it should be along the full path of public use.

4.4 Crosswalks

Pedestrian crosswalks should be clearly marked on the pavement to guide the pedestrians into the right path to walk and to alert the vehicles where to expect pedestrians. The ADA requires the crosswalk pavement markings to be smooth and resistant to slip. The texture of the crosswalk can be different from the rest of the road, so people with vision disabilities can recognize their path and differences between the two roads. The alignment of the crosswalk is very important, as it should be perpendicular to the opposite way. It is important to choose the crosswalk to be the shortest convenient way for pedestrians.

4.5 Bike lane

Shared use paths enable a variety of users to travel the road. It is a transportation system that is regulated by the ADA that allows bicyclists and pedestrians using mobility services to travel safely. It is advised to place the bikeway on the left side of the street. The purpose of placing them on the left is to reduce the conflict with transit stops and the accessible loading zones. The bikeway is separated from the vehicle's side of the road by an open space or a barrier.

4.6 Business access

60% is the minimum percentage required for public entrances in new buildings to be accessible. These public entrances include pedestrian tunnels, serving tenancies, and parking facilities. ADA requires the entrances of the facilities to be easily accessed for people in wheelchairs. They should be able to approach the door, reach the door hardware, be able to open the door while still outside the swing of the door, and close the door behind them. There should be enough door clearance for people using wheelchairs to maneuver through doorways. The Threshold should be ½ inch max at the access doors. It is recommended to locate the door swing outside the ramp landing to achieve better safety.

4.7 Wheelchair Accessibility

Wheelchair accessibilities on all intersections can be solved by curb ramps which were usually present at all intersections, only a small proportion of them met all the accessibility criteria evaluated, this helps us in finding the importance for those who are responsible for preparing and maintaining curb ramps and suggests that wheelchairs user and can use their caregivers should also learn the wheelchairs skills needed to overcome such barriers.

4.8 Possible solutions for the ADA, Parking problems

Solution parking on Marion Avenue can be of many categories

- private parking areas
- Parking in disabled persons parking areas (without displaying a permit)
- Disabled parking permits
- No parking
- Public parking

For preparing parking on Marion Avenue we must check all these parking areas which we need to build and check for the perfect parking on Marion Avenue parking any vehicle too close to an intersection we can endanger pedestrians and different cabs drivers by blocking their view of the traffic and restricting proper turning space levels of parking include a driver must not stop on a road within 65 feet of the nearest point of an intersecting road at any given intersection with traffic lights, and we can say a driver must not stop on a road within 10 feet from the nearest point without the intersection of traffic lights apparatus we used for solving this problem is proper design and estimate analysis of the problem which we can lead to proper parking space and all vehicles will be arranged in a proper space.

5. Surveying

A preliminary survey of the site was conducted by the ZHERDD team with the client to see the scope of work. The client provided a tour of the site and showed the ZHERDD team the problem areas and the areas that the team needs to focus on. The survey started from Goodrich street and headed north along Main Street and terminated by Elizabeth Street.

A second site visit was conducted by the ZHERDD team. The purpose of this visit was to survey and investigate the existing infrastructure to help determine factors to consider in the design of this project. Measurements and pictures were taken during this visit and are contained in this report. The team's findings are as follows.

There is a concrete drainage pan (Dip) on Goodrich, and it measures 94 inches wide and spans the entire width of Main Street. This dip provides drainage across Main Street. There is a road sign to warn drivers of this dip, but this sign is not easily visible because of its location. Due to this, drivers speed through this dip and bump into it frequently. There is a culvert located across Marion Street at the intersection with Main Street. This is a concrete culvert with corrugated pipe extensions on either side of the road. The observation made was that the water flow through this culvert is inadequate due to its size and blockage. The crosswalk at the intersection on Main Street with Marion Street is a safety concern for residents according to the client. This is because Main Street is a through traffic and there is a crosswalk but there are no road signs to cater for the safety of pedestrians crossing Main Street.

The parking space on Marion Street has its markings worn out. The intersections of Marion, Goodrich with Main Street have wheelchair accessible ramps. These ramps do not conform to the American Disabilities Act Accessibility Guidelines (ADAAG). The sidewalks along Main Street are not ADA compliance. There are no turning spaces for wheelchairs along the sidewalks. The only turning spaces on sidewalks are provided at the road intersections with Main street and are not designed per ADA standards.

There are significant differences in the road width along Main Street. This led to curbs not being aligned along the street. The road center line has also shifted moving the crown to one side of the road. Utilities have been located on this section of the road. The utilities are mainly water lines buried under the road. Some utilities are found on the outside edge of the sidewalk. See exhibits for photographs.

6. Stormwater

The stormwater analysis for this project consists of determining whether there needs to be a drainage system built underneath the street or if other alternatives can be used. Alternatives considered are an open channel with culvert or street planters. The best option shall suffice in removing precipitation that accumulates on the main street as well as keeping the budget reasonable.

6.1 General Site Description

6.1.1 Topography, Soil Data, Existing Vegetation

The topography of the project site is nearly flat, according to the United States Geological Survey (USGS) topographical map the project site's elevation is 4,820 feet. The average elevation of the town of Platteville is 4,813 feet. The watershed affected area indicates that the Platteville project site is estimated to be roughly 40% sod lawn, grass, and landscape vegetation with the soil type of the project site mostly being ‘Sandy Loam’. The other 60% is considered impervious, due to the roofs, sidewalks, parking

lots, and roads. Refer to Exhibit 3 for aerial photographs from the EPA's National Stormwater Calculator.

6.1.2 Existing Conditions

From the preliminary walk through of the project site it was noted that there is no underground stormwater transportation system. One of the main challenges of this project will be determining where to lead the precipitation that accumulates around pedestrian walkways and at the street intersections. Currently, the water that accumulates on Main street flows towards local roads that intersect it. The water flows following the curbs on the road and into the neighborhood. One area of water accumulation that needs improvement is at the intersection of Marion Avenue and Main Street, where snow accumulation is highest according to the locals. At this specific location there is a concrete culvert that connects water flows north from Goodrich Avenue to Marion Avenue. During the site visits in August and September, it was evident water that had been sitting in the culvert. Knowing that during the winter month there is more precipitation and low evaporation, that area would be difficult to navigate around as a pedestrian. Another problem location that was considered is the dip located at the intersection of Main St and Goodrich Avenue.

6.2 Analysis - Rational Method

This section of the report will identify the basic information used to calculate the peak flow and runoff analysis. The Ration Method is used to determine the peak flow discharge as well as the minimum required pipe sizing for drainage areas. The following formula is used:

$$Q = CIA$$

where:

Q = Peak discharge (cubic feet per second)

C = Runoff coefficient

I = Rainfall intensity (inches per hour)

A = Drainage area (acres)

6.2.1 Rainfall Intensity

The amount of precipitation that occurs within a time frame determines the rainfall intensity. Using the formula below the rainfall intensity shall be calculated,

$I = 28.5P1{-}hr\ Tr\ (10{+}\ Td)\ 0.789$

where:

I = rainfall intensity in (inches/hour)

P1 = one-hour rainfall depth (inches)

Td = rainfall duration in (minutes)

Below are tables showing the Intensity, Frequency and Duration of a storm event from the Urban Drainage and Flood Control District (UDFCD).

DURATION	5 MIN 0.29	10 MIN 0.45	15 MIN 0.57	30 MIN 0.79	60 MIN 1.00	120 MIN	180 MIN
2-YEAR							
1-HR DEPTH (IN)	0.95	0.95	0.95	0.95	0.95		
DEPTH AT DURATION (IN)	0.28	0.43	0.54	0.75	0.95	1.10	1.22
INTENSITY (IN/HR)	3.31	2.57	2.17	1.50	0.95	0.55	0.41
5-YEAR							
1-HR DEPTH (IN)	1.35	1.35	1.35	1.35	1.35		
DEPTH AT DURATION (IN)	0.39	0.61	0.77	1.07	1.35	1.56	1.71
INTENSITY (IN/HR)	4.70	3.65	3.08	2.13	1.35	0.78	0.57
10-YEAR							
1-HR DEPTH (IN)	1.60	1.60	1.60	1.60	1.60		
DEPTH AT DURATION (IN)	0.46	0.72	0.91	1.26	1.60	1.82	1.99
INTENSITY (IN/HR)	5.57	4.32	3.65	2.53	1.60	0.91	0.66
50-YEAR							
1-HR DEPTH (IN)	2.30	2.30	2.30	2.30	2.30		
DEPTH AT DURATION (IN)	0.67	1.04	1.31	1.82	2.30	2.59	2.80
INTENSITY (IN/HR)	8.00	6.21	5.24	3.63	2.30	1.30	0.93
100-YEAR							
1-HR DEPTH (IN)	2.65	2.65	2.65	2.65	2.65		
DEPTH AT DURATION (IN)	0.77	1.19	1.51	2.09	2.65	2.94	3.15
INTENSITY (IN/HR)	9.22	7.16	6.04	4.19	2.65	1.47	1.05

Table 4: Intensity, Frequency and Duration from Urban Storm Drainage Criteria Manual

STORM DURATION (MIN)	STORM FREQUENCY				
	2-YEAR (IN/HR)	5-YEAR (IN/HR)	10-YEAR (IN/HR)	50-YEAR (IN/HR)	100-YEAR (IN/HR)
5	3.31	4.70	5.57	8.00	9.22
10	2.57	3.65	4.32	6.21	7.16
15	2.17	3.08	3.65	5.24	6.04
20	1.92	2.71	3.21	4.58	5.27
25	1.70	2.40	2.84	4.06	4.67
30	1.50	2.13	2.53	3.63	4.19
40	1.21	1.73	2.06	2.99	3.46
50	1.02	1.47	1.76	2.56	2.97
60 (1 HR)	0.95	1.35	1.60	2.30	2.65
80	0.79	1.12	1.32	1.90	2.17
100	0.65	0.93	1.10	1.56	1.78
120 (2 HR)	0.55	0.78	0.91	1.30	1.47
150	0.45	0.63	0.73	1.04	1.17
180 (3 HR)	0.41	0.57	0.66	0.93	1.05

Table 5: Storm Duration and Intensity in inches/hr.

6.2.2 Runoff Coefficient

The runoff coefficient, a dimensionless ratio, is used to determine the amount of runoff generated given the watershed area and the depth of precipitation,

C = R/P

where:

R = Total depth of runoff

P = Total depth of precipitation

For this project location,

40% single family residential area C=0.35

60% impervious business are C=0.90

6.2.3 EPA Data

Below are tables collected from the Environmental Protection Agency (EPA) regarding the 11 acres surrounding the project site.

Precipitation and Evaporation	Longmont 2 ESE	Greeley UNC	Brighton 3 SE
Annual Rainfall	14.04	13.37	14.21
Evaporation Rate	0.27	0.29	0.22

Table 6 shows the data collected from EPA National Stormwater Calculator for the three locations around Platteville where precipitation and evaporation were recorded.

Average Annual Rainfall (inches)	12.83
Average Annual Runoff (inches)	5.09
Days per Year with Rainfall	27.63
Days per Year with Runoff	14.19
Percent of Wet Days Retained	48.64
Smallest Rainfall w/ Runoff (inches)	0.2
Largest Rainfall w/0 Runoff (inches)	0.3
Max Rainfall Retained (inches)	1.13

Table 7: Estimated Annual Rainfall for Main Street

6.3 Stormwater Design

Below you will find the design options for the stormwater management systems. These solutions have considered the cost, ease, design, and sustainability of the town of Platteville.

6.3.1 Stormwater Planters

Stormwater planters also known as sidewalk planters are a rather new way of managing stormwater. This design is sophisticated and eye catching. It has not been utilized as much as other stormwater management plans around the state of Colorado. Given the sidewalk space Platteville has and its need to reduce pedestrian crossing length, it was chosen as the best option.

6.3.1.1 Design

Stormwater planters are designed to capture runoff from streets and release it back into the ground. The water that is released will have been filtered out by the soil and aggregate located inside of these planters. Below are figures explaining what exactly these planters look like,

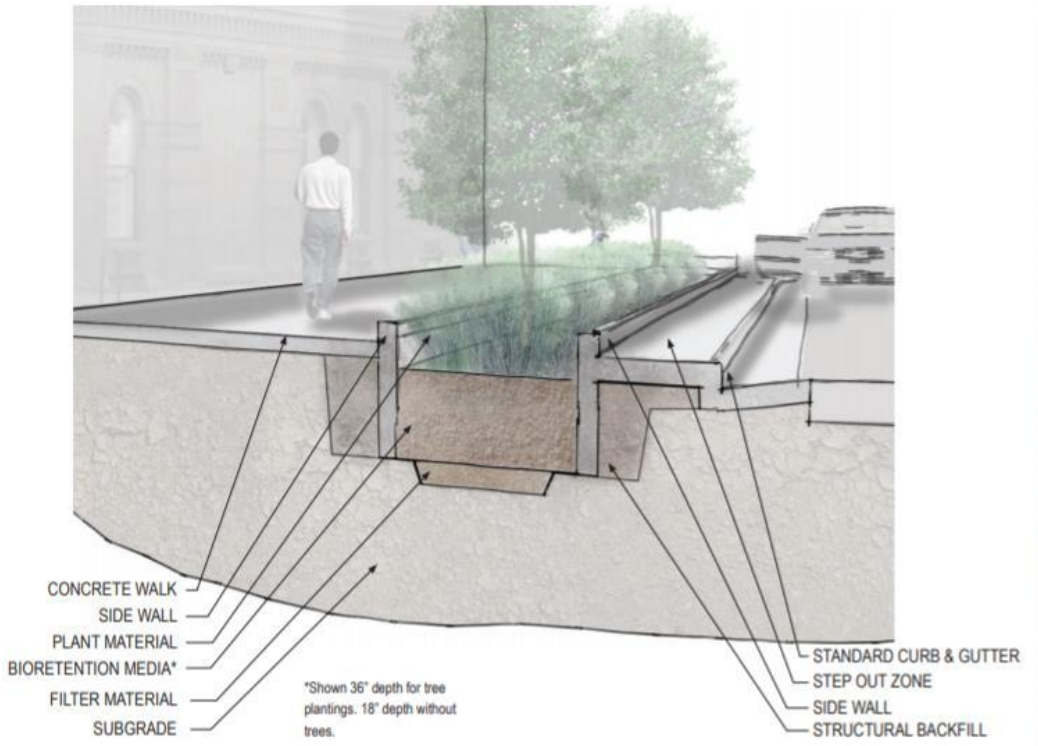

Figure 6.1: Section cut of stormwater planters (source: Ultra-Urban Green Infrastructure Guideline.)

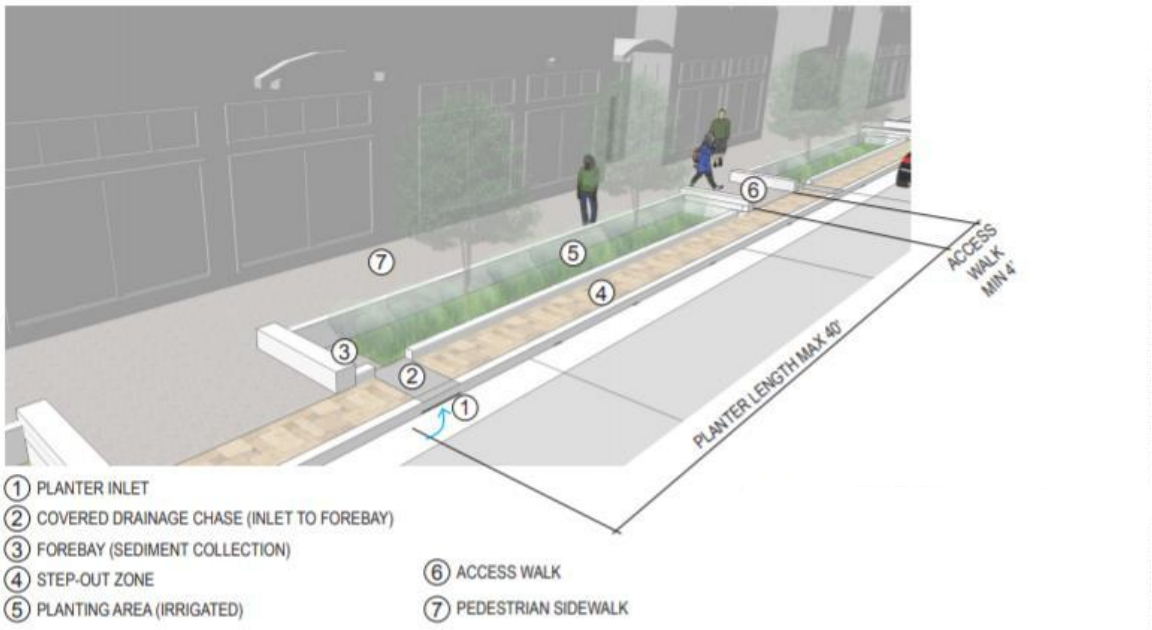

Figure 6.2: Isometric Diagram of stormwater planters (source: Ultra-Urban Green Infrastructure Guideline)

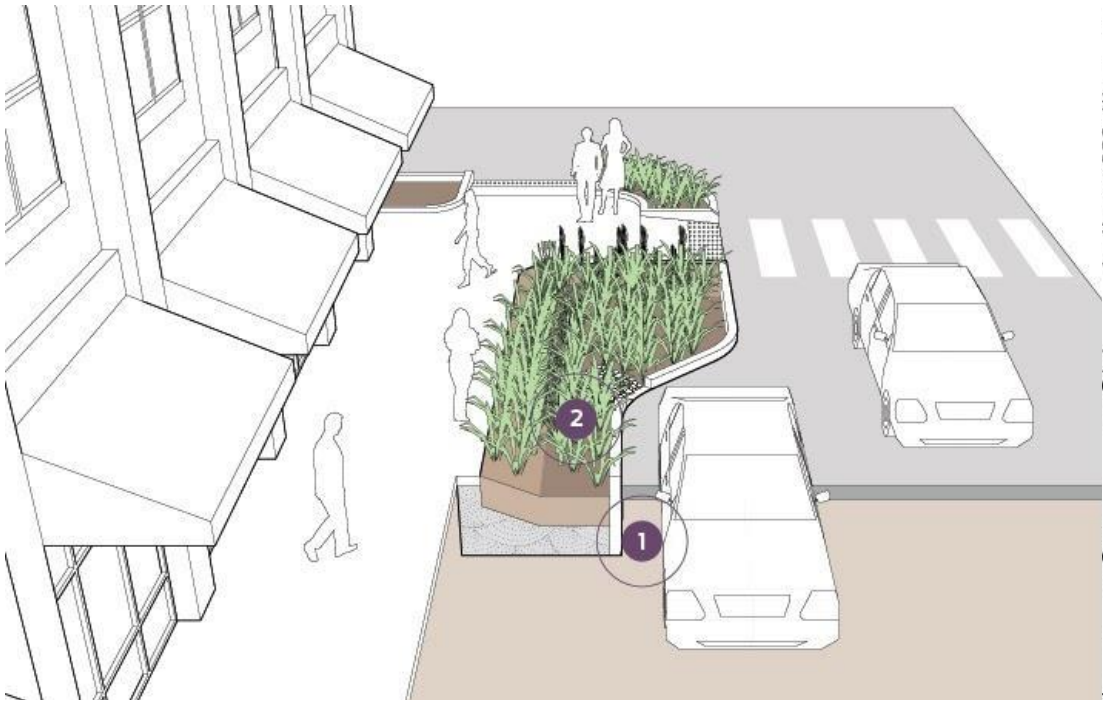

Figure 6.3: Pedestrian cross walk reduction. "1" represents possible parking design. "2" represents vegetation area.

Figure 6.4: Stormwater planters, infiltration system. Image shows water traveling following the slopes of street and sidewalk.

6.3.1.2 Locations

Suggested locations for the planters are shown in the map below. The locations are picked to reduce the amount of runoff. Locations in green will eliminate the need for a culvert at the intersection of Marion Avenue and Main street. Locations in blue will reduce runoff that traveled across the intersection of Goodrich Avenue and Main street. This will also help eliminate the need for a culvert at the dip.

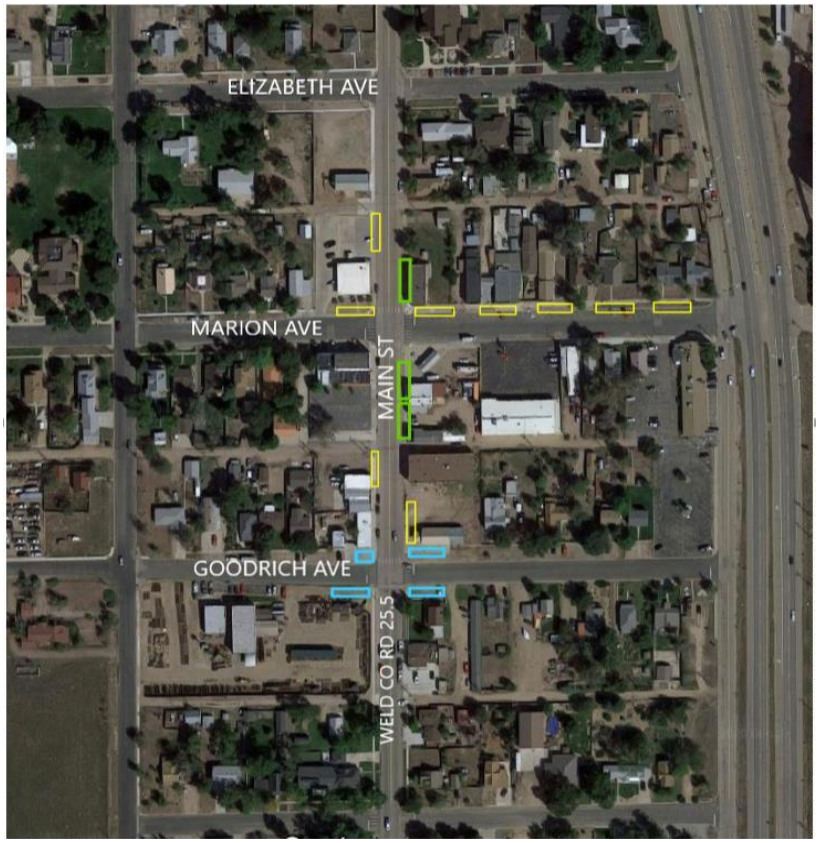

Figure 6.5: Possible locations for stormwater planters

6.3.1.3 Options

ZHERDD consulting believes people of Platteville should have a choice on what kind of vegetation they would like to see as they pass by the stormwater planters. Below are options of acceptable vegetation that is most likely to thrive in the climate. This was taken from denvergov.org.

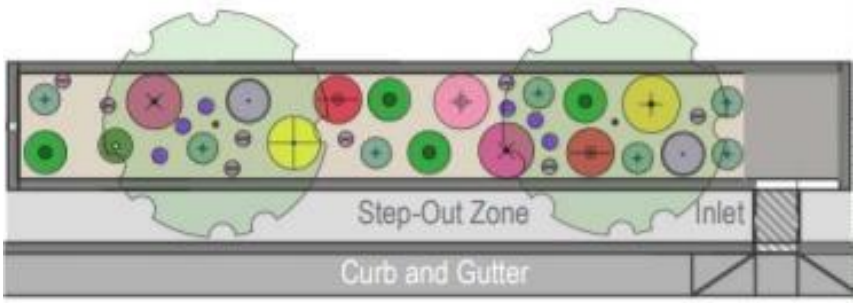

FIGURE 12. Western Prairie Planting Plan (Source: Stream Design. 2015.)
Scale: 1" = 10'

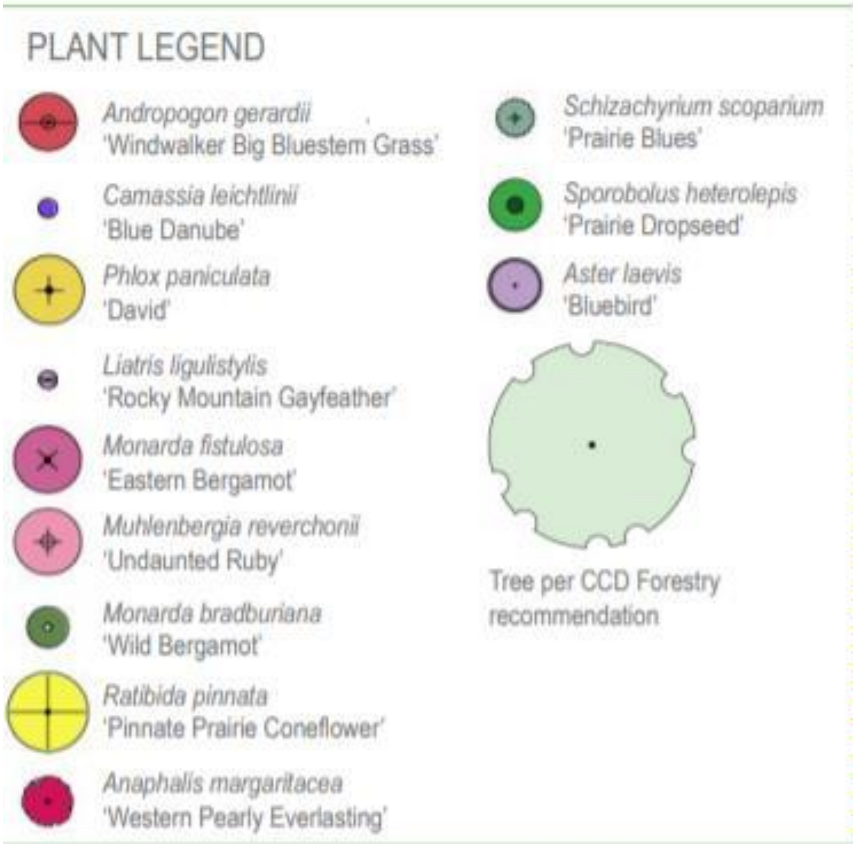

Figure 6.6: The Western Prairie, a "natural" prairie that allows plants to grow and blossom at different times of the season.

Figure 6.7: The Modern Matrix, requires more maintenance than Wester Prairie. Uses Native plants to create a more organic, urban garden.

6.3.2 Storm Sewer

Exhibit 3, Shows the topography of the project area according to EPA.net. The area is mostly flat with a maximum of 2% slope. Given the data above and the observations during the preliminary site visit, the high and low points of the area were determined. Another thing that was noted was the fact that there is no existing storm sewer in the project area. This option will require excavation of the project site as well as 3 blocks west of the intersection at Goodrich Avenue and Main Street to connect the new storm sewer to the existing sewer located at the end of Goodrich Avenue. Below is a plan view of the proposed design.

Figure 6.6: Storm sewer overall design.

6.3.2.1 Storm sewers sizing

The rational method helped in the determination for the sizing of the pipe to use for the stormwater sewer. Calculation section has a more detailed calculation that identifies the sizing. The min this storm sewer dimensions must be 14 inches.

6.3.2.2 Storm Inlets -Type, Design, and Location

The design has a possible of 14 inlet locations throughout the project site. Stormwater access chambers are spaced at 400 feet on center. Below is a map identifying possible locations for inlets and stormwater access points.

Figure 6.7: Possible locations of stormwater system access points (red) and inlet locations (dark green)

7. Proposed Roadway Design

As a proposed design for this project, we recommend a reconstruction of Main Street, Marion Avenue and Goodrich Avenue to fulfill American Disability Act (ADA) requirements and standard roadway requirements. This should include providing pedestrian access routes and making the road safe for all users. Main Street reconstructed to serve a multimodal purpose by incorporating bike lanes. A 2.0 percent cross slope for all the roads is required.

7.1 Main Street

- A two-lane highway with one lane in either direction.
- A bike lane on the east and west sides of the vehicle travel lane
- A standard lane width of 12.0 feet

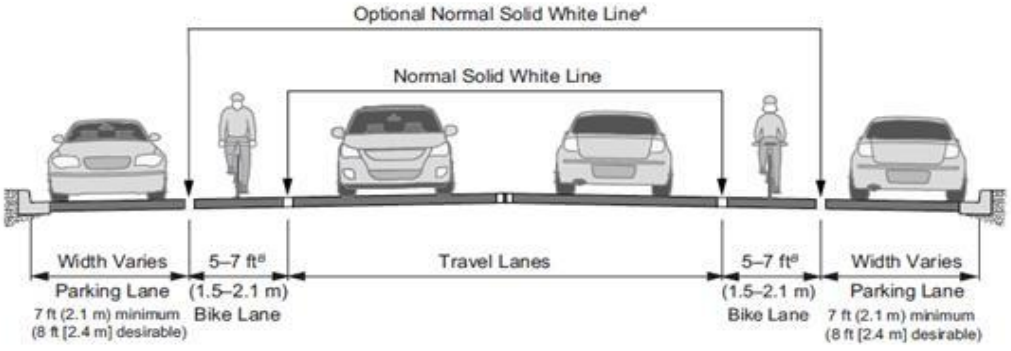

Figure 8.1. On-Street Parking, Travel lane and Bike lane illustration for Main Street

7.2 On - Street Parking

Where perpendicular or angled parking exists, an access aisle of 8.0 feet wide minimum must be provided. The access aisle shall be provided at street level the full length of the parking space and it shall connect to a pedestrian access route

7.2.1 Main Street

- Parallel parking lanes on the east and west sides along the road
- Pedestrian access route at intersections

7.2.2 Marion Avenue

- Angled Parking on the north side of the road
- Parallel parking on the East side of road
- Access aisle and pedestrian access route at Angled parking area

7.3 Bicycle Lane Markings

The bike lane should be marked with standard bike lane markings to inform bicyclist and motorists of the restricted nature of the bike lane. Markings should be placed after each intersection or signalized driveway and in any visible location in a bike lane on the intersection approach before the crosswalk.

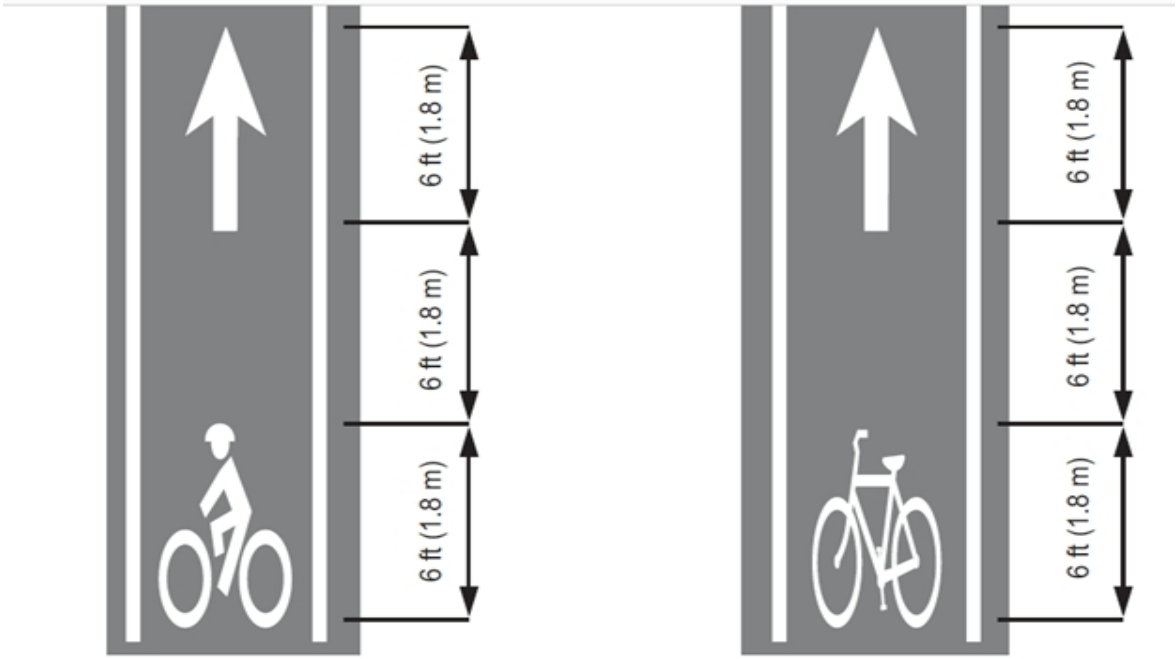

Figure 8.2: Typical Bike Lane Marking

7.4 Design Criteria for Main Street

Design Feature	Proposed Dimension
Lane Width	12.0 feet
Sidewalk Width	5.0 feet
Curb and Gutter	2.0 feet
Pipe Culvert	14.0 inches (diameter)
Parking Lane	7.0 feet
Bike Lane	5.0 feet

Table 7: Design Criteria for Main Street

7.5 Design Criteria for Marion Avenue

Design Feature	Proposed Dimension
Lane Width	12.0 feet
Sidewalk width	5.0 feet
Curb and Gutter	2.0 feet
Pipe Culvert	14.0 inches (diameter)
Cross slope	2.00%

Table 8: Proposed Criteria for Marion Avenue

7.6 Design Criteria for Goodrich Avenue

Design Feature	Proposed Dimension
Lane width	12.0 feet
Sidewalk	4.0 feet
Curb and Gutter	2.0 feet
Cross slope	2.00%

Table 9: Design Criteria for Goodrich Avenue

8. Recommendation

ZHERDD Consulting recommends reconstruction of Main Street, Marion Avenue and Goodrich Avenue. The Sidewalks, curb ramps should be removed and replaced by new ones to comply with ADA design requirements. Adequate road signs should also be provided for safety.

We also recommend using the stormwater planters instead of the sewer system because it is more cost efficient. In addition to that, planters are designed to sustain a 25-year design storm under gravity flow conditions. Using the stormwater planters instead of the sewer system, both the problems of the culvert and the dip will be eliminated. The following sections provide our proposed designs and calculations for the infrastructure improvements and stormwater management system.

9. Cost Estimates

9.1 Cost Estimation Analysis of the two options

For the cost, there were two cost estimations completed. The first one is the total construction cost with design costs. In addition to that, the stormwater system consists of only storm planters. While the second cost estimation contains the same constructional cost but instead of the storm planters, storm sewer water system was considered.

There will be a need to temporarily control traffic at each intersection. This is because constant disruptions by traffic at whatever stage of the project will lead to time wastage and can also interfere with the concentration of the workers on site. There are two intersections, but the cost will be quite high at $34,000. Nonetheless, this expenditure is highly justifiable as it will partly determine the pace and quality of work performance. The sidewalk, asphalt pavement, curb, and gutter, as well as the ramp will also need to be removed. Here, the highest cost is that of removing the sidewalk ($88,333.33), even though the cost of the removal of the pavement and the curb and gutter will also be considerably high. Despite this high cost, these activities will take place early in the project hence the need to ensure that the funds are provided on time. Any delays will cause delays in other stages of the project and all these may add onto the overall cost of the project. The removal of the ramp will cost a much lower amount, but the work is equally important.

The highest cost relates to the hot mix asphalt, as it stands at $181,749.37. The cost being this high and the work being a critical part of the project, this area of expenditure will need to be considered right from the beginning of the project. This is to ensure that adequate resources are set aside so that no resources-related delays will be encountered. Also, relatively high costs are those of building the concrete sidewalk and the concrete curb and gutter, at $143,541.67 and $126,240.00, respectively. The concrete pavement will also cost relatively high at $80,888.89. The work on the three will need to not only be quality, but also contribute to the aesthetic value of the final product of the project. They will be carefully done without any compromise on the type of materials and the

quality of work, and therefore the resources will also need to be availed in the right amount and on time. The concrete ramp will cost a total of $5,727.27. The amount is not as high compared to the items discussed above, but the ramp is equally important to the overall project implying that it will also need to be done without any compromise. The pavement will need to be marked at a cost of $4,161.85 whereas the pedestrian push button signal will cost $7,759.82. As for the storm planters, they will cost $20,739.

Also, worth noting is the percentage of the construction cost taken by construction-related costs. The constructional labor cost will be the highest as it will take up 40% of the total cost. Human capital will play a huge role in the quality of project outcome. It is thus extremely important that to get the right personnel for the work and in the right numbers, even if this will mean parting with a greater number of financial resources than what was anticipated. The lowest costs are the bond cost and the civil engineering design cost, as they will account for only 1%. The all-important permit will account for 4% of the construction cost and it is crucial that it is obtained early enough. The geotechnical engineering design cost and the total design cost will account for 10% each. While looking at the second option, it was found that replacement of the planters with a whole wastewater system that consist of 12 inlets, 3 access points, PVC sewer pipes, and Earth work. The estimated cost of this system is $115,566.88.

9.1.1 First Design Alternative Cost Estimation

Type of Work or Material	Unit	Estimated Quantity	Unit Price	Amount
Temporary Traffic control	Per Intersection	2.00	$17,000.00	$34,000.00
Asphalt Pavement Removal	SY	7180.22	$7.00	$50,261.56
Removal of Side Walk	SY	2208.33	$40.00	$88,333.33
Removal of Curb and Gutter	LF	3156.00	$10.00	$31,560.00
Removal opf Ramp	SQY	32.73	$50.00	$1,636.36
Hot Mix asphalt	TON	2423.32	$75.00	$181,749.37
Concrete Pavement	SY	622.22	$130.00	$80,888.89
Concrete Sidewalk	SY	2208.33	$65.00	$143,541.67
Concrete Curb and Gutter	LF	3156.00	$40.00	$126,240.00
Comcrete Ramp	SY	32.73	$175.00	$5,727.27
Pavement Marking	LF	1771.00	$2.35	$4,161.85
Pedestrian Push On Signal	Per Signal	2.00	$3,879.91	$7,759.82
Stowmwater Planters	SY	8.00	$2,592.38	$20,739.00
			Estimated Total Constructional Cost	$776,599.12

Construction Related Cost	Percentage of Constructional Cost	Amount
Total Design Cost	10%	$77,659.91
Civil Engineering Design Cost	1%	$7,765.99
Geotechnical Engineering Design Cost	10%	$77,659.91
Constructional Labor Cost	40%	$310,639.65
Permit Cost	4%	$31,063.96
Bond Cost	1%	$7,765.99
	Estimated Total	$512,555.42
	Total	$1,289,154.54

Table 10: Cost Estimation for the first alternative

9.1.2 Cost Estimation of the Second Design Alternative

Below there is a substitution of the planters with a whole wastewater system across Main Street, the rest of the cost will be the same.

Waste Water System Estimation Cost				
Construction Type	Quantity	Unit	Unit Price	Estimated Price
Earth Work	586.13	m	$45.00	$26,375.85
PVC Sewer Pipes	586.13	m	$42.59	$24,963.28
Manholes	3	each	$8,310.00	$24,930.00
inlet protection	12	each	2542.02	30504.24
Manhole slab base	3	each	2317.29	6951.87
Inlet protection	12	each	153.47	1841.64
			Estimated Total	$115,566.88

Table 11: Cost Estimation for second alternative

10. Future Work / Study

This report has a narrow scope of work required for this project, which was conducted as a preliminary investigation and analysis of the stormwater management and urban infrastructure renewal project in Platteville. The study was conducted by students and as a result, ZHEERD Consulting recommends that the town of Platteville seek the services of a licensed professional engineer (P.E) to conduct further studies and analysis for future work. The town could present this report and the design ideas in it if so desired to help with future work study.

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12. Disclaimer

The assumptions, findings, calculations, and conclusions expressed and described in this report and its exhibits were developed by undergraduate civil engineering students who are not licensed professional engineers. This report was prepared as an academic exercise as partial fulfillment of the Civil Engineering Senior Design course. Pursuant to C.R.S §12-25, no part of this report should be used for planning, budgeting, construction, or fiscal related decisions without a complete review and written endorsement from an independent, qualified, and licensed engineer who can assume responsible charge of the project and who is willing and able to become the engineer of record for all aspects of the study, calculations, findings, recommendations, and the project in part and in whole.
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13. Conclusion and Summary

The purpose of this report was to study, analyze and design an infrastructure improvement to a four-block segment (between Elizabeth Avenue and Cherry Avenue) on Main street in the town of Platteville. The study also involves developing and integrating a comprehensive stormwater management plan for this segment. ZHERDD Consulting met the goal of this report by providing alternative solutions and observing codes and standards (with the information that was provided).

The infrastructure improvements provide a design criterion to comply with American with Disabilities Act Accessibility Guidelines (ADAAG) and provide design alternatives for stormwater management. The design also incorporates a guide for the design of bicycle facilities by The American Association of State Highway and Transportation Officials (AASHTO).

A cost estimate of the project was conducted to give the town of Platteville a projected cost to do the improvements to this segment of the town. The total estimated cost of the infrastructure improvement and stormwater management is roughly $1.3 million. ZHERDD Consulting would like to thank the town of Platteville for giving us the opportunity to conduct this study. We would also like to thank Bradley A. Curtis, PE for his assistance, guidance and above all, his patience while working with us throughout the course of this project.

If there are any questions regarding the project report, please feel free to contact any of us.

Sincerely,

Dalia Aljadii	12/8/2020
David Sarjo	12/8/2020
Elshaday Yacob	12/8/2020
Hashem Alhashem	12/8/2020
Rashid AL-Nuami	12/8/2020
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