Charlevoix

Green Stormwater Infrastructure

VISIONING REPORT

SUBMITTED TO

The City of Charlevoix
Charlevoix, MI 49720

December 23, 2020

DRUMMOND CARPENTER
engineering + research

TIP OF THE MITT Watershed Council

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Project Introduction

This report summarizes the conceptual green stormwater infrastructure (GSI) visioning, community engagement, and modeling portions of the **Lake Charlevoix Communities: Increasing Capacity for Coastal Resilience** project. This project was grant funded, with funding provided by the Charlevoix County Community Foundation, and the Coastal Management Program, Water Resources Division, Michigan Department of Environment, Great Lakes, and Energy and the National Oceanic and Atmospheric Administration. The project is a collaboration between the Tip of the Mitt Watershed Council (TOMWC), Drummond Carpenter, and three municipalities within the Lake Charlevoix watershed. This project examined existing stormwater infrastructure in each of the three cities and highlighted opportunities to adopt new GSI practices. The project team selected areas for GSI consideration based on stormwater outlets to Lake Charlevoix, conditions of existing infrastructure, future planned improvements, and meetings with city officials. Locations of recommended GSI practices were then photographed and artistically rendered to show what a GSI practice could look like in that location. These graphics were used to help the public visualize different treatment options in context. They are not a guide to plant selection or the only configuration of a practice. Virtual public engagement during the project provided GSI educational material to the public and then surveyed the public regarding the rendered GSI concepts. The public surveys provide feedback regarding which applications each community favored as well as other comments and concerns.

Timeline

Charlevoix, Boyne City, and East Jordan all participated in initial site selection, virtual interim meetings, and a public visioning processes that followed a similar timeline (Figure 1). Drummond Carpenter and TOMWC representatives participated in three meetings per community partner to refine the conceptual plans and make sure the vision met municipal goals. All meetings after March 2020 were transitioned from in-person meetings to virtual meetings, including the public engagement process.

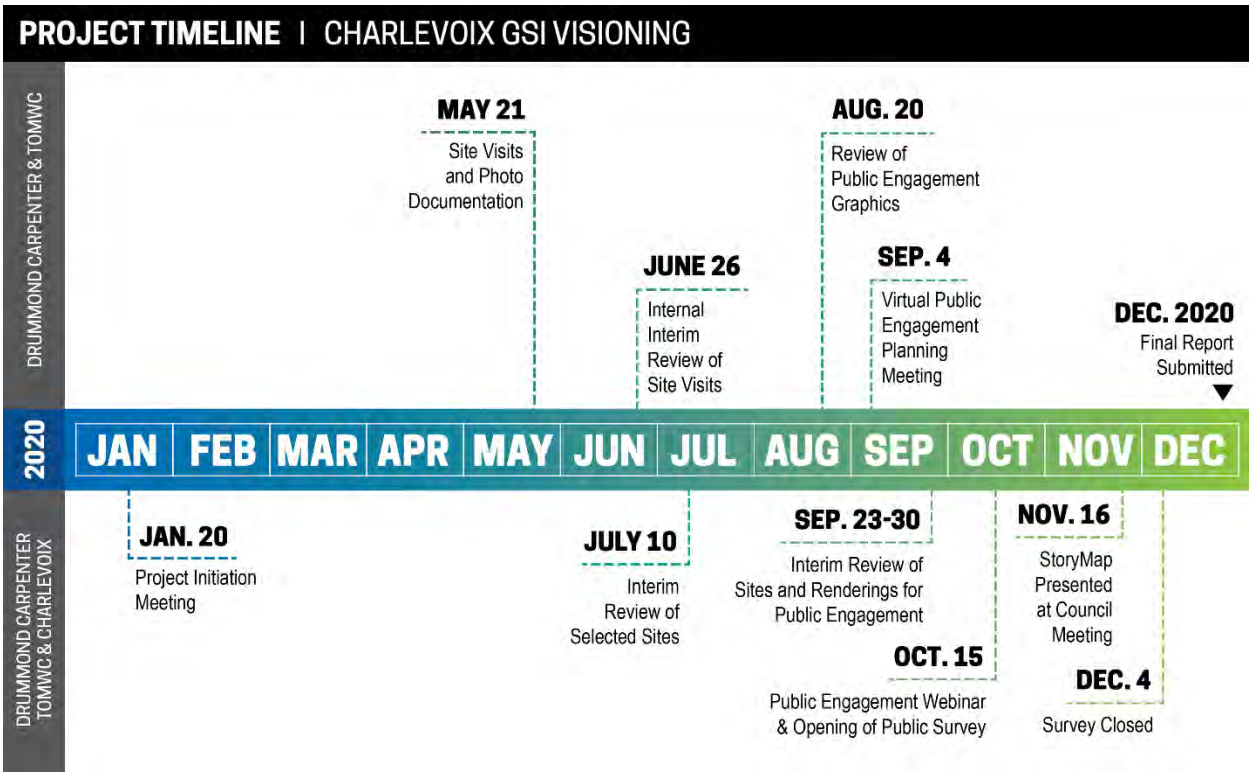

Figure 1 – Project Timeline

Green Stormwater Infrastructure

Green Stormwater Infrastructure (GSI) manages stormwater by mimicking natural processes such as infiltration and evapotranspiration and can help keep water resources clean and protect public health. These practices can prolong the life of existing stormwater infrastructure and enhance stormwater treatment prior to release into Lake Charlevoix.

GSI offers several advantages over traditional, engineered stormwater drainage approaches, including:

- **Addresses stormwater at its source** - GSI practices seek to manage rainfall where it falls, reducing or eliminating the need for detention ponds and flood controls.
- **Promotes groundwater recharge** - Many GSI techniques allow stormwater to infiltrate the earth, recharging groundwater aquifers.
- **Allows for more flexible site layouts** - Designs can incorporate stormwater management in a variety of open spaces and smaller landscaped areas.
- **Preserves streams and watersheds** - GSI practices reduce both pollutant loads and streambank erosion associated with peak flows because of greater infiltration.
- **Enhances aesthetics and public access/use** - Well-designed vegetated practices, such as rain gardens, should be visually appealing as well as functional.
- **Reduces costs** - GSI reduces the need for pipes, asphalt, detention basins, or other infrastructure traditionally needed to handle runoff. It can also reduce energy costs and increase potential developable land area.

Common GSI practices with definitions and photographic examples are in Appendix A.

Existing Conditions Assessment

Potential sites shown in Figure 2 were discussed at the Project Initiation meeting with Charlevoix. These sites were visited on May 21 to evaluate potential for GSI practices and to photo document site conditions (see Appendix B for site visit notes). Sites were evaluated based on field observations of existing drainage patterns, existing infrastructure, signs of ponded water, and planned use. Water quality monitoring data from Lake Charlevoix stormwater outfalls was used to further inform focus areas within the community. Finally, the city of Charlevoix provided infrastructure and planning documents related to these sites.

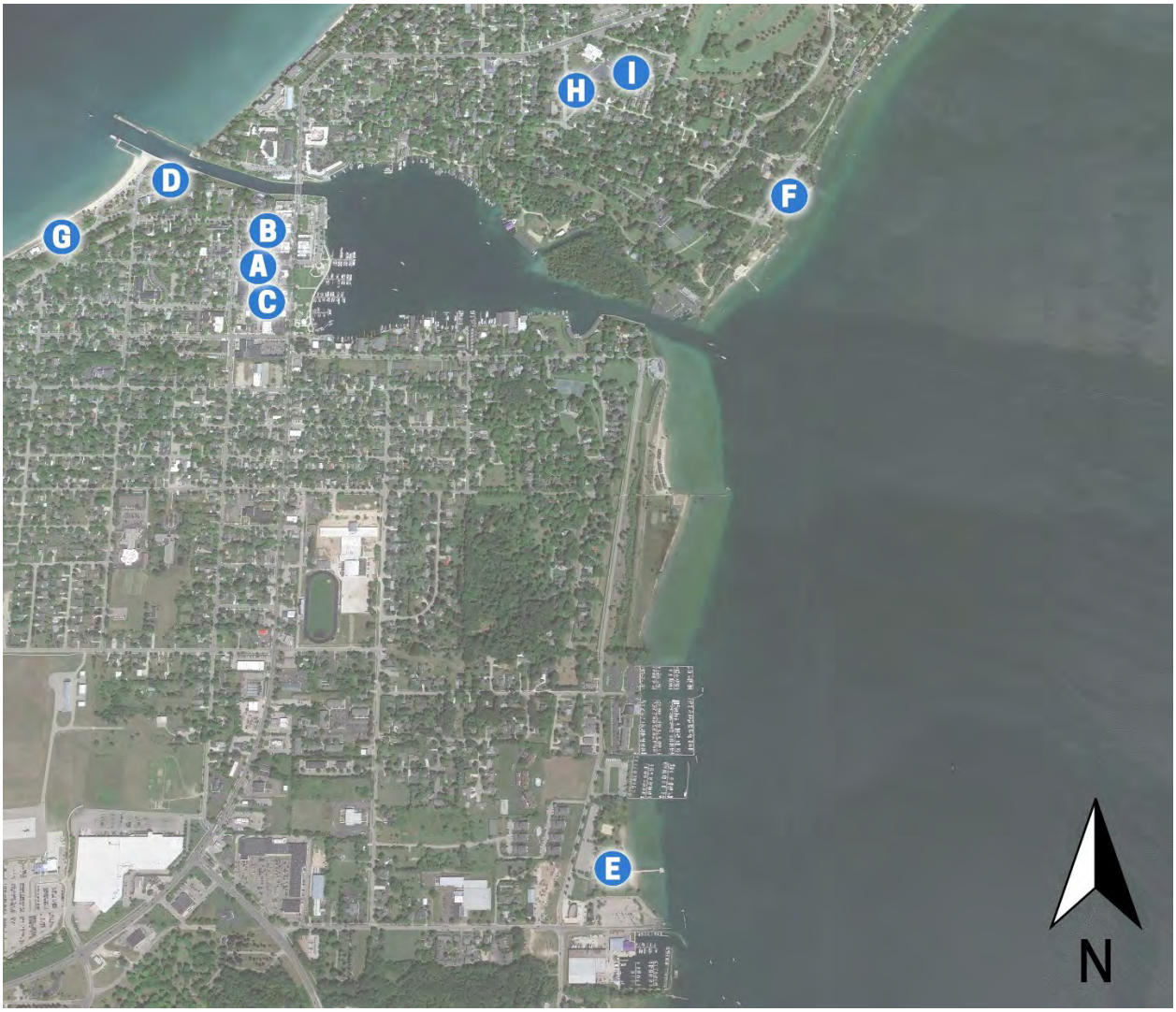

Figure 2 – Evaluated Site Locations

The files provided by Charlevoix used for evaluating potential GSI sites included:

- **GIS Files** (File Folder)
- **Streetscape and Walkability** (Coversheet.pdf) – *July 20, 2020*
- **Charlevoix Downtown Alley Corridor Vision** (CVX_Downtown_Alley_Corridor_Vision_rpt.pdf) – *January 2018*
- **The City of Charlevoix Palmer Street Park** (PALMER LOT BID SET 7-20-2020.pdf) – *July 20, 2020*
- **Charlevoix County Parks and Recreation Plan DRAFT** (Parks & Recreation Plan Draft 01-16-20 LR.pdf) -
- **City of Charlevoix Recreation Master Plan** (Recreation Master Plan.pdf) – *February 20, 2017*

GSI Visioning

Feasibility of each proposed GSI location and practice type was evaluated using available information. Potential locations of GSI practices were discussed with city officials to determine which GSI retrofit opportunities should progress to further visioning and public surveys (Appendix B). A representative number of practices were artistically rendered to help the public visualize different treatment options in context of each site. Plants depicted in the renderings are listed in the *Lake Charlevoix Watershed Homeowner's Guide*[1]; however the renderings only show example plant pallets. It should be noted that not every viable or desired GSI practice was included in the visioning process and that other locations described in Appendix B are well suited for GSI implementation.

Public Engagement

An ESRI StoryMap, a website based immersive story platform, was created for the overall project[2] and each of the three communities involved. The overall project StoryMap was setup with background information on the project, links to the individual community StoryMaps, video recording of the public engagement webinar, Lake Charlevoix watershed background, and information on stormwater pollution and green stormwater infrastructure. StoryMaps for each community contained details for each site including maps, existing and artistically rendered images, and a brief description.

From October 15 to December 4, 2020, a public survey was hosted on the StoryMap for each community to gather input on public perception of GSI techniques and locations. Questions gauged the respondent's reaction to GSI practice locations, aesthetics, and overall concept as well as prioritization of practices. Appendix C contains a list of the questions, results, and all comments received through the survey. Fourty-five (45) participants submitted surveys for Charlevoix.

Stormwater Modeling & Cost Estimating

Stormwater modeling and a general cost estimate was performed for each of the rendered GSI practices. These analyses provide estimates of potential stormwater reductions each practice could achieve based on its contributing drainage area and size. The runoff reduction modeling and conceptual cost estimates are provided as a tool for stakeholders and municipal leadership to prioritize implementation.

Runoff Volume Calculations (Existing and Proposed)

Runoff volumes were calculated using the SCS Curve Number Method[3] for existing and proposed conditions. A 2-year 24-hour storm (approximately 2.16 inches of rainfall[4]) was used for the calculations. The 2-year 24-hour storm was selected because it is a common design storm used for green infrastructure design and represents about 99% of all rainfall events. Calculations were performed in an excel spreadsheet, *CVX_Runoff Calculations_CN.xlsx*. The *CVX_Runoff Calculations_CN.xlsx* spreadsheet could be manipulated for larger storm events by changing the precipitation value, but this should be

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[1] *Lake Charlevoix Watershed Homeowner's Guide* (Oct. 2016) pages 12-13 - Tip of the Mitt Watershed Council

[2] Lake Charlevoix GSI Visioning – ArcGIS StoryMaps (Dec 2020 Web Link: ***arcg.is/0iWbz5***)

[3] USDA SCS (Soil Conservation Service). (1986). "Urban Hydrology for Small Watersheds." SCS Technical Release No. 55. Washington, DC.

[4] NOAA (National Oceanic and Atmospheric Administration). (2013). "Precipitation-Frequency Atlas of the United States." Volume 8 Version 2.0. Silver Spring, MD.

done with caution since many design choices (such as bioretention size and curve number values) were based specifically on a 2-year 24-hour storm. Further detail and SCS curve number calculation details are included within the *CVX_Runoff Calculations_CN.xlsx* spreadsheet.

Calculation Process:

- Drainage Areas
  Each site is broken into sub-drainage areas determined by common outlet points. The areas were determined through data provided by the municipalities, site visits, and google earth elevations. A GIS site plan of existing conditions was created in AutoCAD and used to determine the areas for calculations.

- Cover Type
  Cover type was determined from site visits and Google Earth aerial images[5].

- Soil Type
  Soil type was determined from USDA Web Soil Survey[6] for each sub-area. Each area's soil type is listed at the top of the *CVX_Runoff Calculations_CN.xlsx* spreadsheet.

- CN Values
  The CN values were selected after determining the cover type and soil type. All CN values, excluding green infrastructure, are taken from SCS Method. CN values used in runoff calculations are listed in *Table 1 – CN Values*. Green infrastructure is assigned a CN Value of 100 because all water that lands on that area is accounted for in retention and subtracted at the end.

Table 1 – CN Values

Cover Type	CN Value
Impervious Surfaces	98
Soil – HSG D – Lawn	80
Soil – HSG A – Lawn	39
Green Infrastructure	100

Since each sub-area has multiple cover types, a composite CN value was determined for the sub-area:

$$CN=\Sigma(A_i*CN_i)/A$$

A_i=Surface Area of cover type (acres)
A=Surface Area Total (acres)
CN_i=Curve Number for Cover Type
CN=Composite Curve Number

[5] Google Earth 2020
[6] NRCS (Natural Resources Conservation Service). (2017). "Hydrologic Soils Map." Web Soil Survey, <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm> (23 JUN. 2017).

- Volume of Runoff

  Total areas and composite CN values for each sub-area were used to calculate the runoff with the SCS Method. The equation details are in *CVX_Runoff Calculations_CN.xlsx* spreadsheet. The SCS Method generates runoff values which were multiplied by the sub-area's total area to obtain runoff volumes.

- Runoff Reductions
  Separate tabs are setup within the *CVX_Runoff Calculations_CN.xlsx* spreadsheet for existing and proposed (*New*) conditions. The differences between the New tab and Existing tab are that cover types are changed for the green infrastructure and storage volumes added. Storage volumes for green infrastructure are quantified in *CVX_Runoff Calculations_CN.xlsx* and listed in the Storage column. Areas that are retained for a 2-year 24-hour storm, like rain barrels or bioretention areas, are accounted for as reductions after the runoff from that drainage area is calculated (see *CVX_Runoff Calculations_CN.xlsx* spreadsheet). The *New* tab also has a summary of before and after runoff amounts and the reductions in each sub-area.

Reduction Percentages for Individual BMPs

Reductions and sizing for each green infrastructure treatment are calculated in the *CVX_ReductionPercentages.xlsx* spreadsheet. Calculations use the runoff values for each drainage area that were calculated in the *CVX_RunoffCalculations.xlsx* spreadsheet. The spreadsheet is divided into a tab for each GSI treatment type. If adequate space was available, the GSI practice was sized for a 2-year 24-hour storm. In some cases, a larger storm volume could be contained (i.e. more than 100% capture of a 2-year 24-hour storm) but capture percentage was set at 100%.

Conceptual Cost Estimate

A conceptual cost estimate was determined based on GSI projects in Michigan. Estimates for this project are based on an average cost per square foot of treatment surface of the envisioned design. For some practice types, like bioretention and permeable pavers, the practice type can have a wide range of costs dependent on infrastructure and aesthetic requirements. For these practice types high and low complexity costs are listed. Each practice was assigned either a low or high complexity cost based on the location and anticipated difficulty of installation and design. Surveyed drainage areas, design complexity, and further site details will influence the engineered design and result in lower or higher project costs.

Appendix A – Green Stormwater Infrastructure Practices

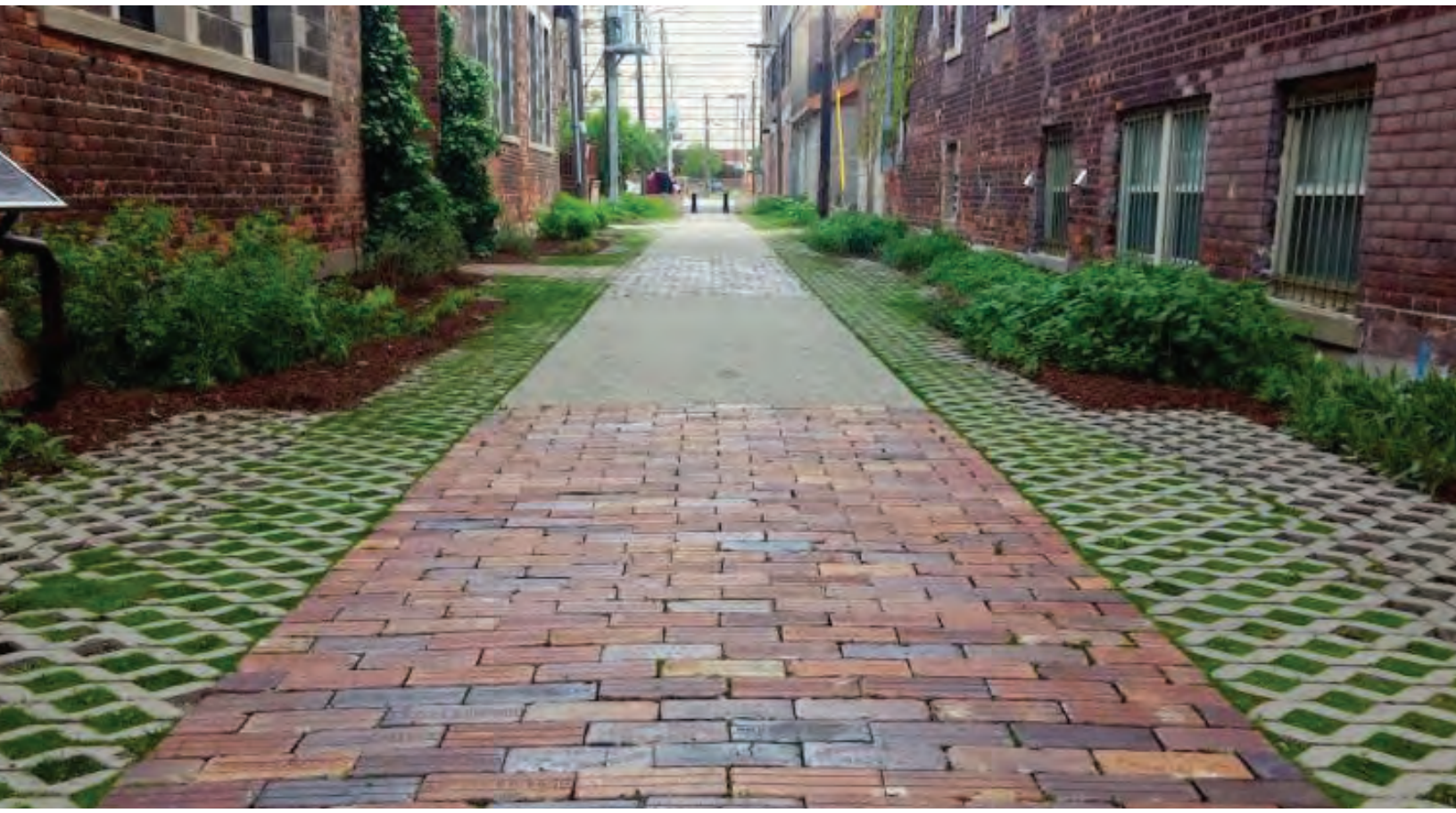
RAIN GARDEN / BIORETENTION

A Rain Garden or **Bioretention Cell** is a shallow depression area in the landscape that captures and treats stormwater runoff in an amended planting soil mix. The depression (or ponding area) allows water to pool for a short time (less than 24 hours) after a rainfall and then slowly absorb into the soil and vegetation.

Native plants are typically used because of their deep roots, hardiness, and ability to provide habitat for native species.

GREEN ALLEYS

Green Alleys and low traffic roads incorporate permeable pavers and underground stormwater storage to help intercept, filter and infiltrate stormwater before it drains into stormwater catch basins. Pedestrian alleys can also feature stormwater planter boxes, which are similar to raised bioretention beds.



POROUS PAVEMENT

Porous Pavement is a stormwater management technique that combines storage and infiltration with a structural pavement.

Porous pavement can consist of permeable asphalt, porous concrete or interconnected concreate paver blocks that are underlain by a storage reservoir.

NATIVE LANDSCAPING

Native Landscaping uses native plants instead of turf grass or other higher maintenance non-native landscaping features.

Native landscaping performs similar to a rain garden but without the ponding and enhanced underground storage areas.

BIOSWALE

A **Bioswale** (or bioretention swale) is a a naturalized swale that has the additional component of bioretention planting mix and/ or a stone sub-basin to promote additional storage and infiltration.

Bioswales reduce runoff volume and increase water quality, while also providing conveyance of excess runoff. The use of pretreatment control measures such as filter strips or other sediment capturing devices can reduce sediment accumulation in the swale.

NATIVE PRAIRIE

A **Native Prairie** is a large scale naturalized grassland area that utilizes deep fertile soil, a cover of tall coarse grasses, flowers and other native prairie plants to absorb stormwater runoff from the surrounding areas.

Native prairie also provides habitat for native species.

NATIVE SHORELINES

Native Shorelines, also known as a riparian buffer, consist of a mix of native trees, shrubs, and herbaceous plants along a lake or river shoreline. Riparian buffers provide many benefits to the lake ecosystem, including shoreline stabilization and erosion control, habitat for shoreline-dependent species, infiltration of runoff, and filtration of pollutants such as sediments, nutrients, and chemicals.

Native shorelines can be divided into different zones that include varying vegetation to enhance the quality of the body of water they are adjacent to. It is important to note turf grass does not provide the same benefits that a mix of native vegetation does and is not considered an adequate buffer.

TREE BOX FILTERS

Tree Box Filters Tree box filters help to effectively manage stormwater by providing areas where water can collect, undergo filtration, and either naturally seep into the ground, be absorbed by the tree, or be transferred to storm drains. They are typically pre-cast or cast-in-place concrete structures that can be set adjacent to structural pavements. The boxes are then filled with loose, filtering soils, which allow urban trees to thrive by providing space for an extensive root system.

STREET TREES

Street Trees play a significant role in the urban hydrologic cycle through tree canopy interception of precipitation, promoting increased infiltration along root paths, removal of water from the soil by roots, and release of water back into the atmosphere through evaporation and transpiration.

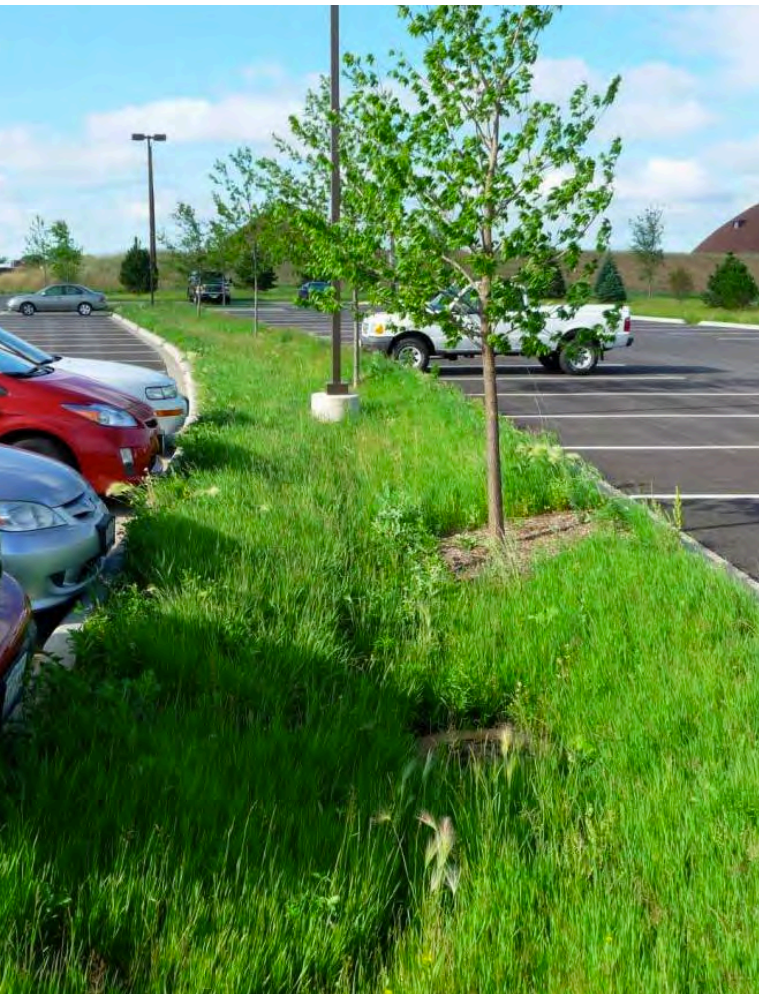
Mature street trees are an extremely valuable resource when it comes to stormwater management and should be designated to remain on site and protected during all construction activities whenever possible.

STORMWATER TREATMENT WETLANDS

Stormwater Treatment Wetlands are engineered, shallow-water ecosystems designed to treat stormwater runoff. Commonly implemented in low-lying areas, stormwater wetlands are well suited to areas along river corridors where water tables are already higher.

Stormwater treatment wetlands provide flood and nutrient control benefits by storing nutrients and slowly releasing water over several days. They also provide excellent plant and wildlife habitat and can be designed as public amenities with trails or platforms for wildlife viewing.

NATURALIZED SWALE



A **Naturalized Swale** is a stormwater drainage swale or "ditch" that incorporates native landscaping instead of mowed turf grass.

The swale can be vegetated with a combination of grasses, shrubs, and/or trees designed to slow, filter, and possibly store or infiltrate stormwater runoff.

CISTERN

Cisterns are structures designed to intercept and store stormwater runoff from rooftops.

Stormwater is typically reused for irrigation or other water needs thereby reducing potable water consumption.

VEGETATED ROOF

Vegetated roofs, or green roofs, are conventional rooftops that include a thin covering of vegetation allowing the roof to function more like a vegetated surface that provides both filtration and infiltration of runoff, but also provides other co-benefits including increased biodiversity and environmental cooling.

The overall thickness of the vegetated roof may range from 2 to 6 inches, typically containing multiple layers consisting of waterproofing, synthetic insulation, non-soil engineered growth media, fabrics, synthetic components, and foliage.

Appendix B – Meeting Minutes (Project Initiation and Site Visits)

Project Initiation Meeting – January 20, 2020

Drummond Carpenter, PLLC
Traverse City, MI
Tel 920.362.4265
RPieschek@DrummondCarpenter.com

28 January 2020

General Meeting Agenda for Tip of the Mitt Watershed Council GSI Visioning 2020 Project

Meeting:
Monday, January 20, 2020
9 am to 10:30 am – Charlevoix

Attendees: Jennifer Buchanan (Tip of the Mitt), Ashley Soltysiak (Tip of the Mitt), Don Carpenter (Drummond Carpenter, Rachel Pieschek (Drummond Carpenter), Mark Heydlauff (City of Charlevoix)

Meeting Minutes:

- Overview of Green Stormwater Infrastructure (GSI) visioning process
    - Drummond Carpenter's past visioning projects with the Clinton River Watershed Council WaterTowns program and Elk Rapids (example work products provided separately).
    - Deliverables & Timeline
        - Community engagement meeting
            - Target timeframe will be sometime in the last two weeks of August
            - Monday, Tuesday, or Thursday nights would be best for community engagement
            - Location – Public Library
        - Initial site visits in May or June (when snow is cleared)

- Discussion of potential locations for GSI visioning – numbers are labeled on pdf map (1,2,5 &6 on Zoomed map as well)
    - (1) Downtown public parking
        - Lots between Antrim and Clinton streets, and State and Bridge

      1(b) Public pedestrian alleys in this area that should be evaluated
    - (2) Gravel Lot Near Channel
        - Currently a grant application out for this location to add a green barrier between the sidewalk and the lot/drive
        - Grant is with the Health Department
    - (3) Boat launch and park
        - OSU project is in this area – will consider areas adjacent to their plans and include any green infrastructure from their project in our conceptual analysis
    - (4) Depot Beach
    - (5) Park Ave
        - Between road and beach the edge of road is used for parking and is in poor shape
    - (6) East Park
        - There may be little opportunity here – the park is already highly designed
        - This would be a lower priority site since it is already very established
    - (7) Elementary School
        - Recently remodeled so aerial imagery may not be accurate
    - (8) Road Triangles

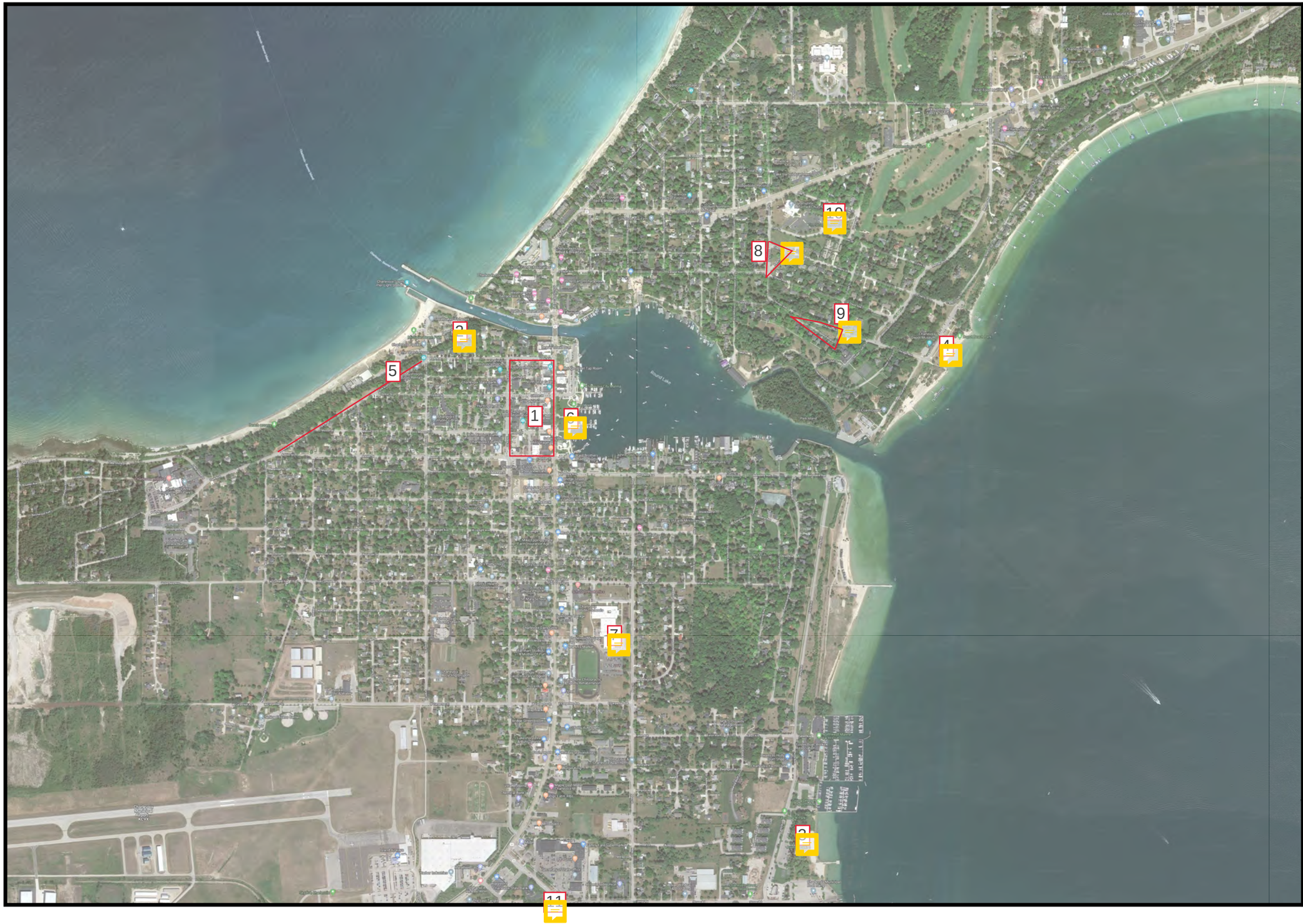
        - Triangle formed by ROW is unused and could be a GI practice location
    - (9) Road Triangles
        - Triangle formed by ROW is unused and could be a GI practice location
    - (10) Tennis Courts
        - Current drainage problem in west corner of parking lot
    - (11) Cemetery
        - Stream is flashy in this area; not necessarily a candidate for GSI but could be revisited.

Charlevoix GIS Data Request

- Underground infrastructure GIS layers – specifically stormwater (storm sewers, inlets, catch basins, manholes, drainage districts, etc) but other infrastructure (water and sanitary sewer) that would influence design would be helpful.
- Roads
- Publicly owned parcel maps
- Locations of existing stormwater treatment (Green infrastructure, vortex chambers, etc).

Other Documentation:

- Information regarding the Sustainable Built Environment Analysis for Charlevoix
- Existing Health Department grant submittal for green space by gravel lot along the Channel (#2 on map)
- Available topography or site plans for the properties listed on the attached map



Tip of the Mitt Watershed Council

GSI Visioning 2020
Charlevoix

Legend:

Notes:

N

0 1000 2000 ft

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GSI Visioning 2020
Charlevoix

Legend:

Notes:

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0 100 200 300 ft

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Appendix B – Meeting Minutes (Project Initiation and Site Visits)

Site Visit Notes

Drummond Carpenter, PLLC
Traverse City, MI
Tel 920.362.4265
RPieschek@DrummondCarpenter.com

15 June 2020

Charlevoix Site Visit Notes

On 22 May 2020, Don Carpenter and Rachel Pieschek conducted a field visit of the sites discussed in the 20 January 2020 Lake Charlevoix GSI Visioning Project meeting. This document is a status update on the visioning process and contains questions (**Bolded in Blue**) for the municipality.

Site Notes:

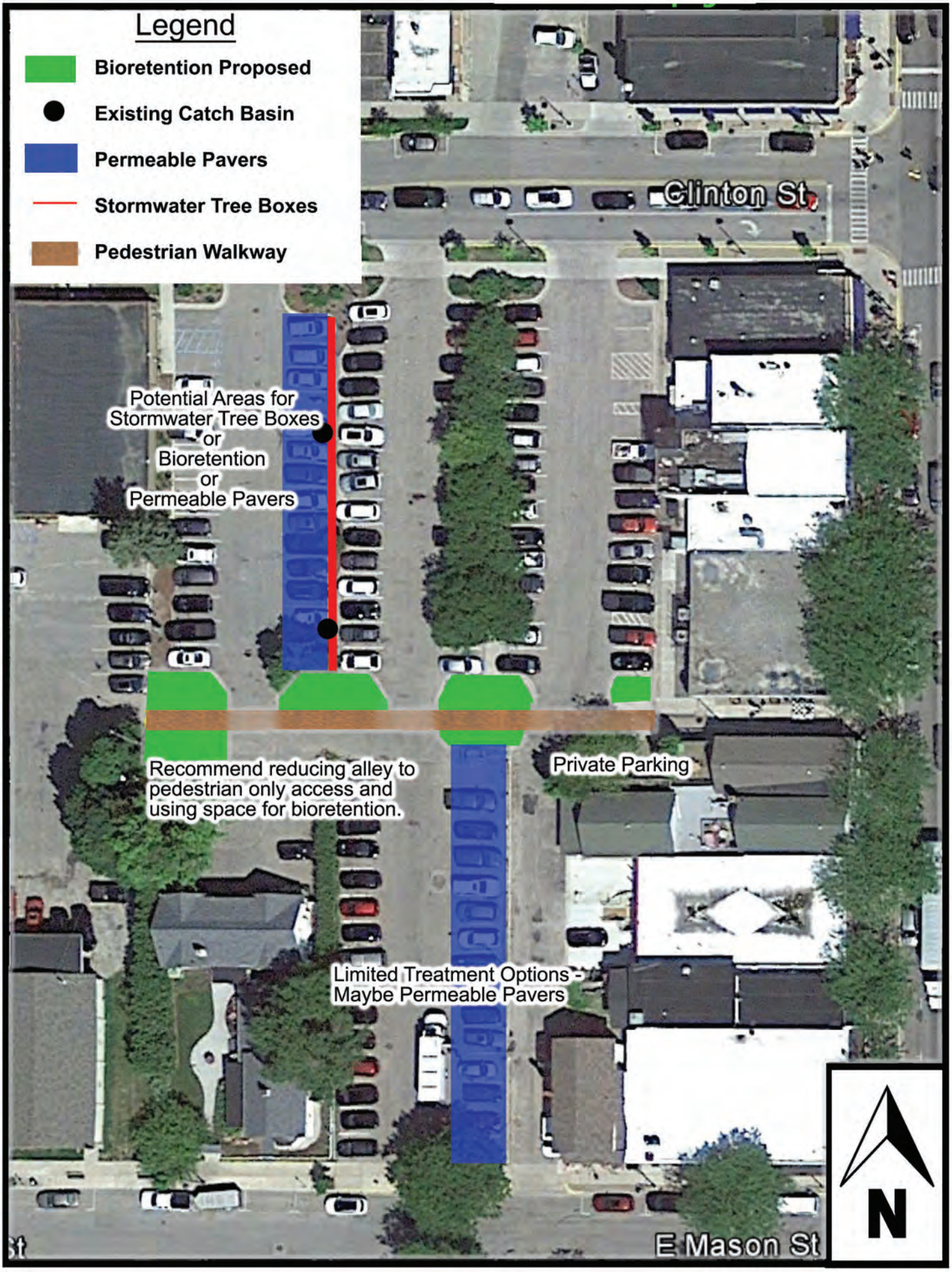
1. Downtown public parking
    a. Alley by Murdick's Fudge and City Hall/Fire Station
        i. Driveway between parking lots could be limited so only pedestrians can go east to west, not cars. Keep the north/south lanes open to get between lots. Limiting traffic would make a safer walkway from parking lot and give potential space for bioretention treatment/greenspace. **Would this idea conflict with access to the fire station?**
        ii. Some areas of this alley are used for resident parking. We are not currently proposing a change to that. **Is removing car access in that alley something we can consider based on property ownership and access requirements?**
    b. Parking Lots between Clinton St and Mason St
        i. NW Lot – has curb catch basins. GSI options include replacing a few parking spaces with bioretention, adding permeable paver row, or tree box infiltration trench. This section of the parking lot does not currently have trees unlike adjacent public parking lots.
        ii. NE Lot – this area could potentially be treated by alley bump outs (Figure 1a). Existing tree area and adjacent parking is not a good place for treatment due to multiple water lines and electrical running through it. Would be difficult to retrofit.
        iii. South Lot – Not clear how this part of the lot drains. It may sheetflow into the adjacent alley. A row of permeable pavers could treat runoff, but there is not room for much else.
    c. Public Parking on Park Ave
        i. Parking lot is tight with angled parking and stormwater structures in drive lanes. It would be difficult to retrofit.
        ii. Alley has opportunities for stormwater management.
            1. Some downspouts are external and could be disconnected into stormwater planter boxes. There are shop entrances and restaurants in this alley as well as residential access to upper levels.
            2. East-West portion of the alley could be turned into pedestrian only and some of the area used for stormwater treatment.
    d. Mason Street could be a feasible location for stormwater tree box filters.
    e. Catch basins are near building. Lined bioretention or permeable pavement in parking stalls option could be used for stormwater treatment.
2. Gravel Lot Near Channel
    a. Currently a Health Department grant application out for this location to add a green barrier between the sidewalk and the lot/drive. **Information on the grant application and status is required if the City wants to include this area in the visioning process. Are there elements of the design we should include in our visioning?**

   b. Catch basin near channel that could be retrofit with bioretention or pretreatment to reduce sediment and pollution from parking lot.
      i. **There was a lot of dry weather flow going through the stormwater pipe. We recommend investigating the source of flow.**
   c. Another CB in corner of lot that was not observed during site visit – it is labeled in the system as "No pipes/perforated" so a portion parking lot is treated via infiltration.
3. Ferry Avenue Park
   a. Ohio State University was contacted to determine the location of their proposed green infrastructure project. Their design converts two parking lot islands on the east side of the boat launch parking to bioretention cells.
   b. North end of park has a healthy wetland area.
   c. South end of park is very wet and mowed. Since this area is not usable due to high water levels, it could be naturalized as a wetland or native plant area similar to other areas of the park.
   d. Parking lot runoff can be treated with bioretention with either curb cuts or replacing a couple parking spaces for stormwater treatment. Stormwater currently is piped to the lake.
   e. Near the boat ramp a larger buffer of non-mowed area adjacent to the water is recommended.
4. Depot Beach
   a. Multiple opportunities to curb cut parking lot into bioretention.
   b. Potential treatment of road runoff in corner of the park with a stormwater treatment wetland and sediment basin around outlet pipe.
   c. The outfall at this site is a water quality monitoring location for the project. Initial results show water quality at this site is in need of improvement.
5. Park Ave
   a. The edge of the road is used for parking and is in poor shape. This area does not have any structures and sheet flows into the woods. Stormwater is already being treated and improvements would mostly be for aesthetics. **Do we still want to include this site?**
   b. Possibilities of reinforced turf grass (for parking) or interconnected concrete pavers. In wider areas a swale would also create a buffer and treat stormwater prior to running into the woods.
6. East Park
   a. There are few, if any, opportunities for green infrastructure retrofits in this park due to its limited space and high use.
7. Elementary School
   a. Recently remodeled and still under construction so this area was not evaluated in-depth. There appears to be opportunities for swales along the roadway and maybe treatment of roof runoff in a few locations. **Does the city still want us to vision this area even though the parking lots have been redone?**
8. Road Triangle
   a. Triangle formed by ROW is unused and could be a GI practice location
      i. We checked parcel maps and this location is private, so it was not evaluated.
9. Road Triangle
   a. Triangle formed by ROW is unused and could be a GI practice location
      i. Opportunity to use this area for bioretention practices. However, there are logistical concerns about routing stormwater runoff to site and potential conflict with utilities.
10. Tennis Courts

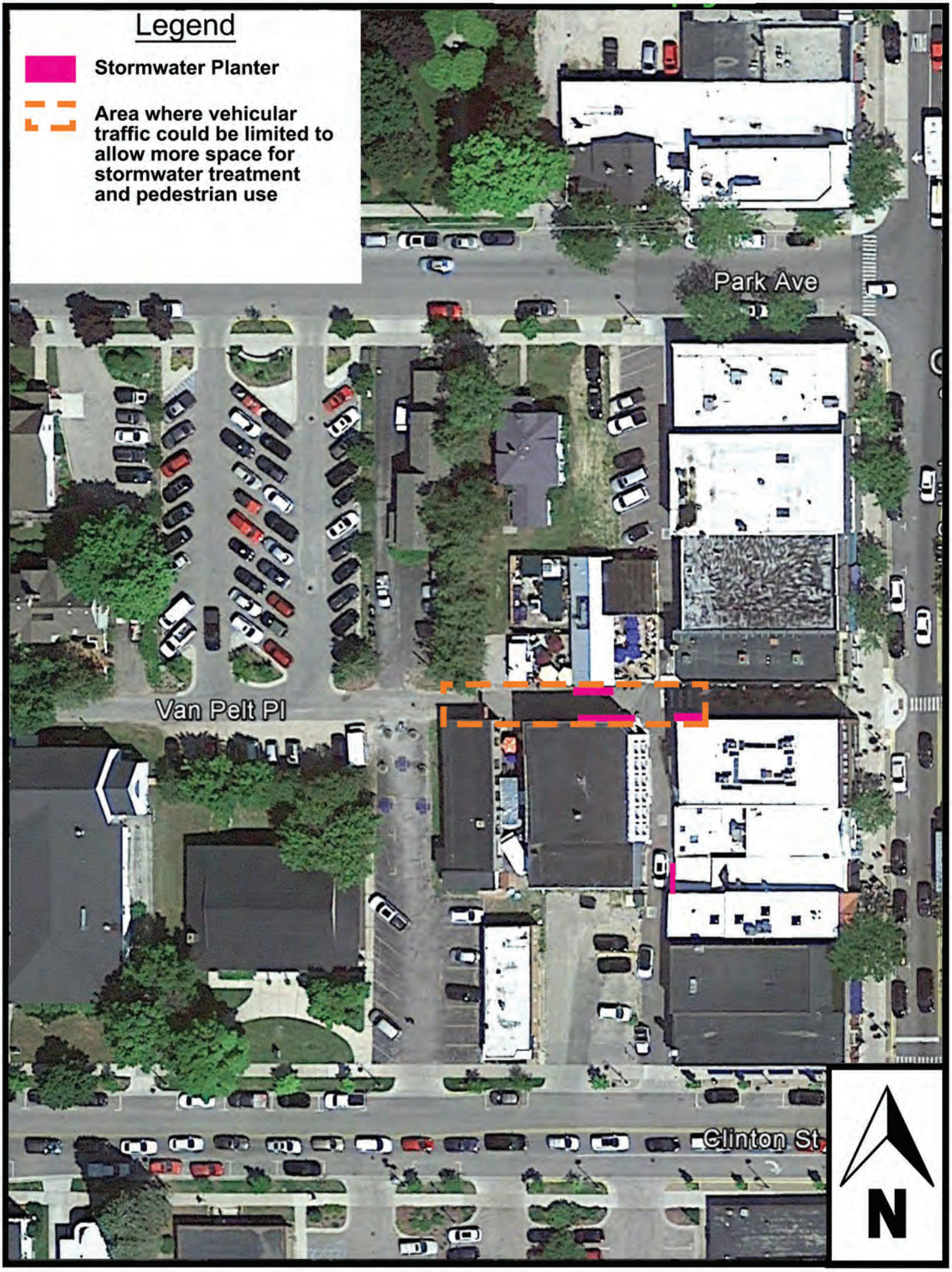
a. Current drainage problem in west corner of parking lot. Sediment buildup is preventing water from draining into the retention area. The adjacent church parking utilizes swales for treating most of its stormwater. The swale entrance needs maintenance to allow stormwater flow into the swale.
b. Along the road there is a manhole that could be retrofitted with a rain garden to treat road runoff and enhance drainage in this area.

11. Cemetery
    a. Stream is flashy in this area; not necessarily a candidate for GSI but it was visited. Stormwater reductions would happen upstream of this area to reduce flashiness. A large-scale stream stabilization project is feasible but logistically difficult due to site constraints.

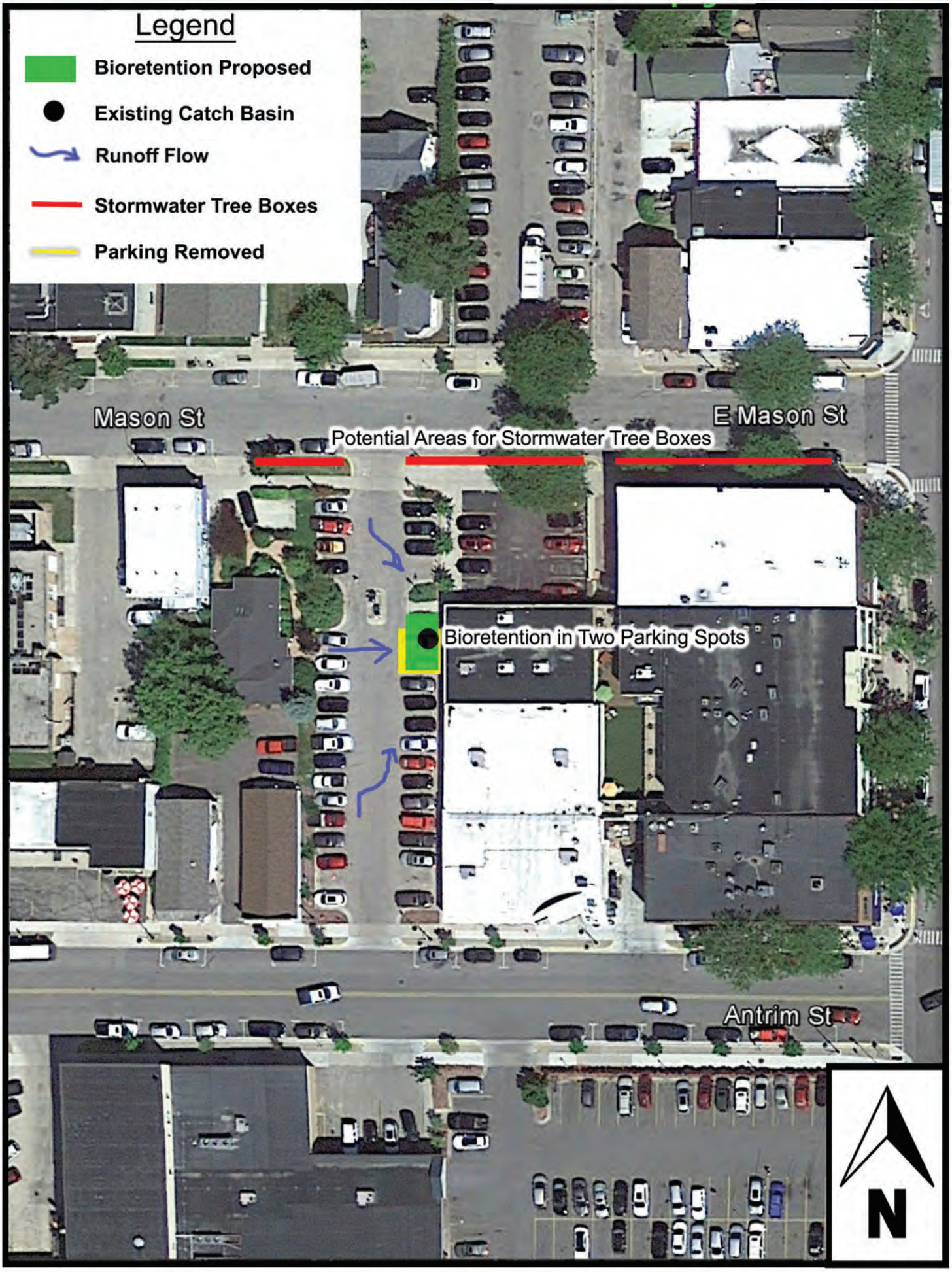
1A AND 1B - CHARLEVOIX DOWNTOWN PARKING BETWEEN PARK AND CLINTON



1C - CHARLEVOIX DOWNTOWN PARKING BETWEEN PARK AND CLINTON

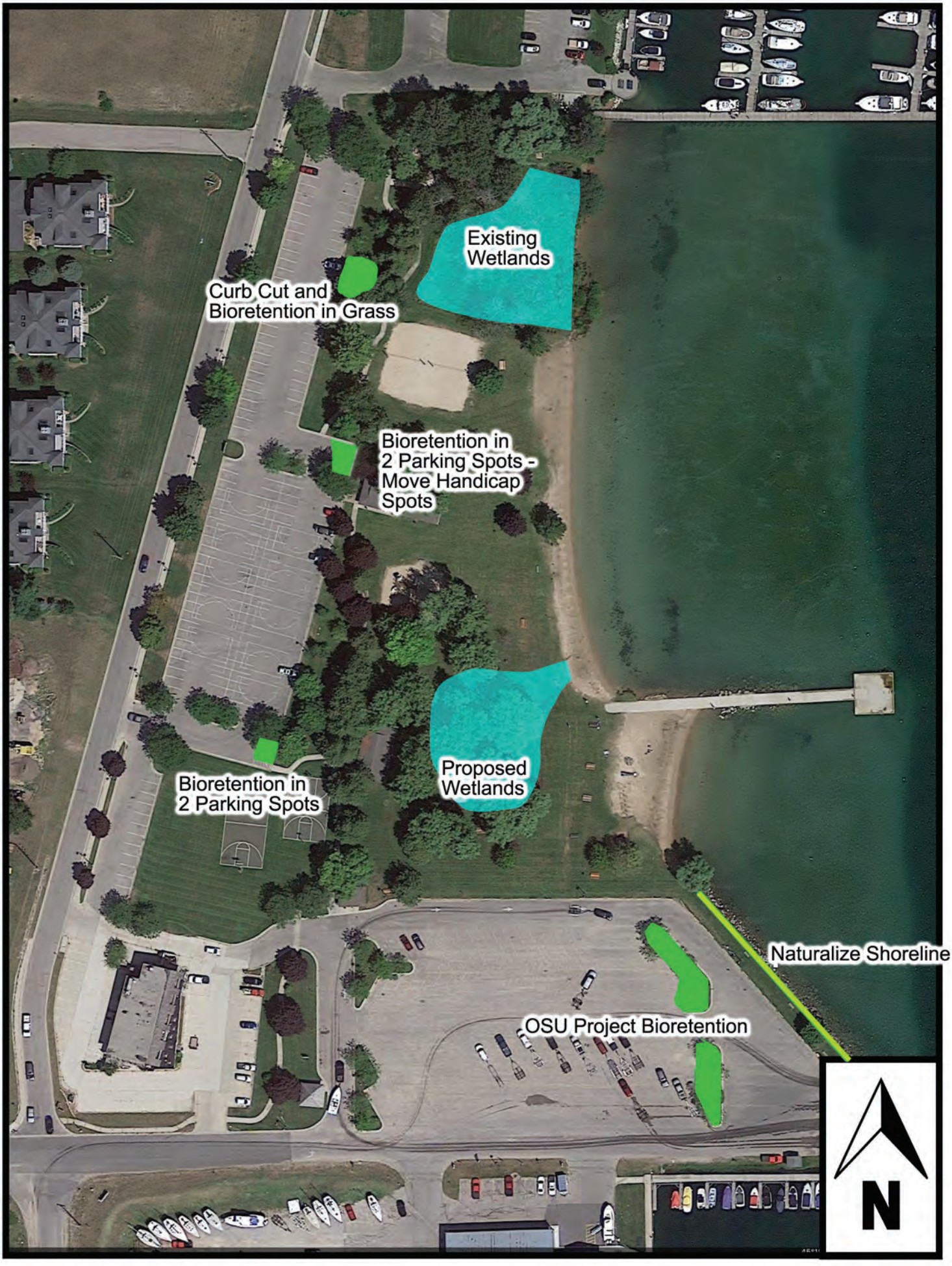


1D AND 1E - CHARLEVOIX DOWNTOWN PARKING BETWEEN MASON AND ANTRIM



CHARLEVOIX 2 - GRAVEL LOT NEAR CHANNEL

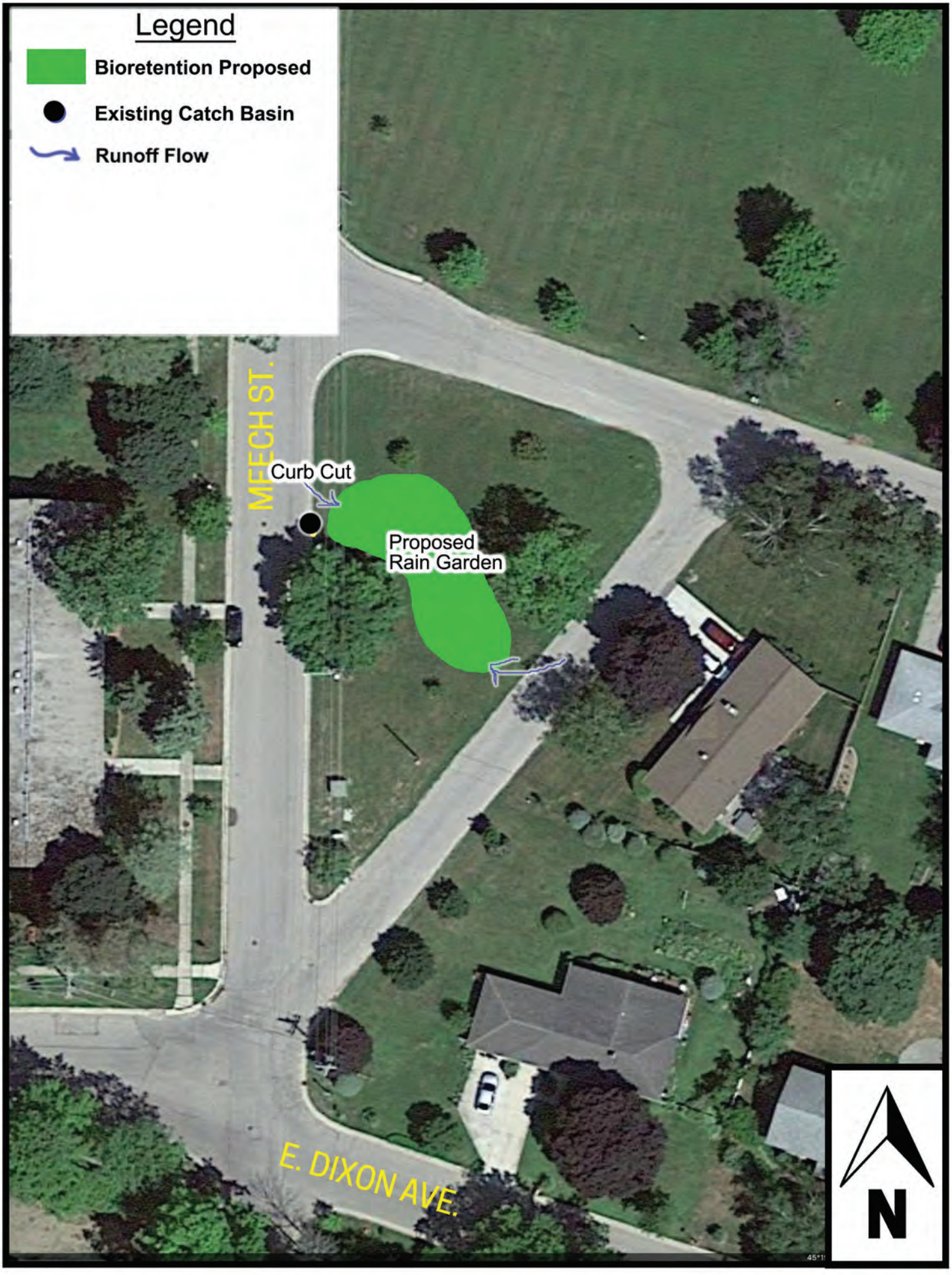
CHARLEVOIX 3 - BOAT LAUNCH & PARK



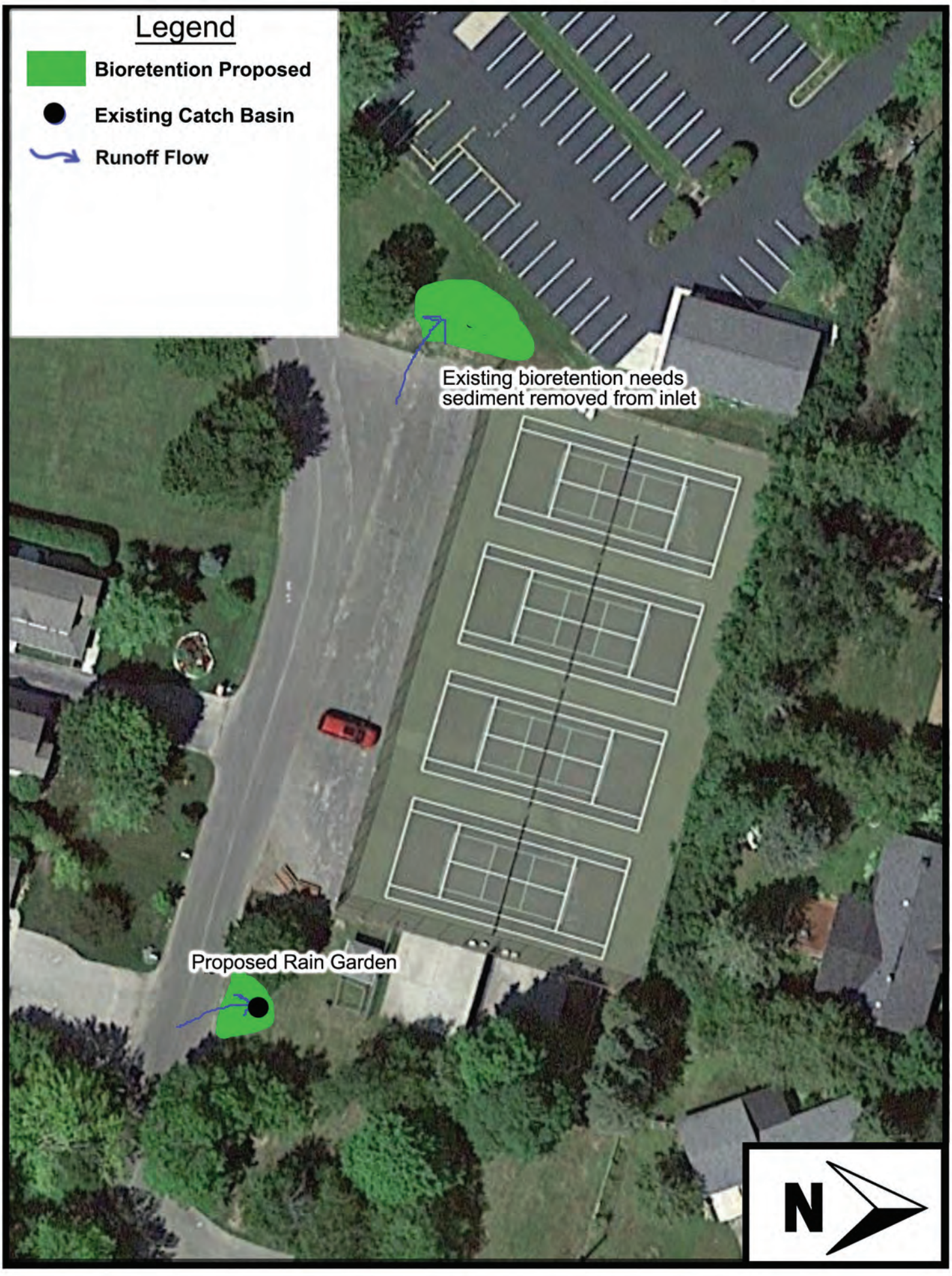
CHARLEVOIX 4 - DEPOT BEACH

CHARLEVOIX 5 - PARK AVE. 1

CHARLEVOIX 8 - ROAD TRIANGLE



CHARLEVOIX 10 - TENNIS COURTS



Appendix B – Meeting Minutes (Project Initiation and Site Visits)

City Responses to Site Visit Notes – July 10, 2020

At the interim meeting on July 10, 2020 the questions generated during site evaluations were answered. The questions are copied from the site visit notes and their responses listed below each question. Context for these answers are listed in the previous section.

1. a. i. Would this idea conflict with access to the fire station?

   Do not impede access between fire station and parking.

   a. ii. Is removing car access in that alley something we can consider based on property ownership and access requirements?

   Adjacent apartments would still need access to parking spaces, so pedestrian only access and GSI may impede.

2. a. Information on the grant application and status is required if the City wants to include this area in the visioning process. Are there elements of the design we should include in our visioning?

   The grant information was provided. Since GSI was already being incorporated visioning at this site was not continued.

5. a. Do we still want to include this site?

   Focus efforts on other sites where there would be more impact on water quality.

7. Does the city still want us to vision this area even though the parking lots have been redone?

   Focus efforts on other sites since this site is under construction.

Appendix C – Survey Results

Residents of Charlevoix were invited to participate in a Green Stormwater Infrastructure (GSI) visioning process. The survey was available online from October 15 to December 4, 2020. Participants viewed a brief description, photo, and artistic renderings of the design as it would appear in that location. After scrolling through green infrastructure locations, participants completed a survey designed to gather community input regarding green stormwater infrastructure and the potential designs.

Fourty-Five (45) people participated in the Charlevoix GSI survey and the date of survey participation is shown in Figure C-1.

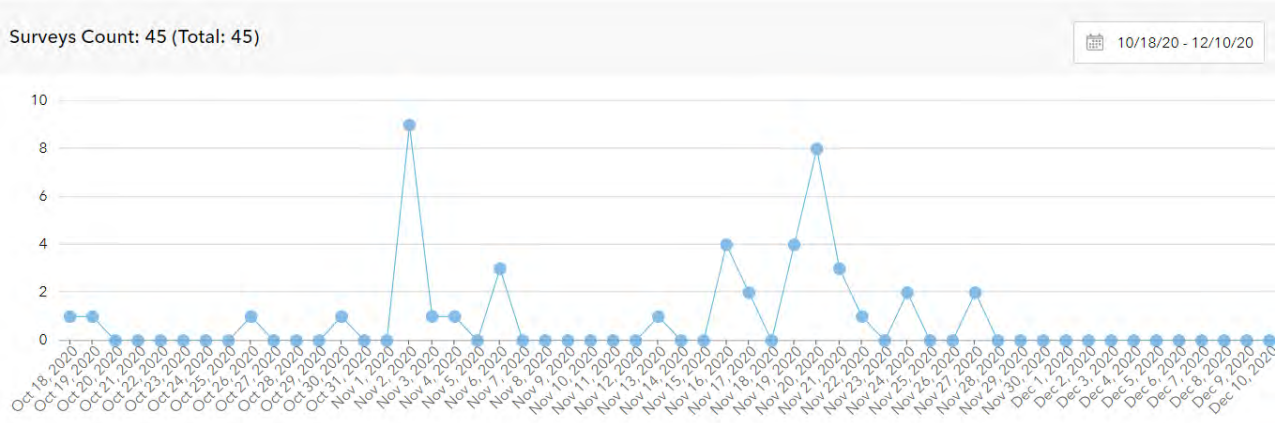


Figure C - 1: Survey Participation by Date

Question 1: What best describes your connection to Charlevoix?

The first survey question helped determine how participants were connected to Charlevoix. The question was a drop-down list including the responses:

- I live or work in Charlevoix.
- I live in a nearby community and visit.
- I vacation in Charlevoix.
- Other – Fill in a text response.

Results are shown in Figure C-2. The one respondent who selected "Other" as an answer wrote: "Summer resident".

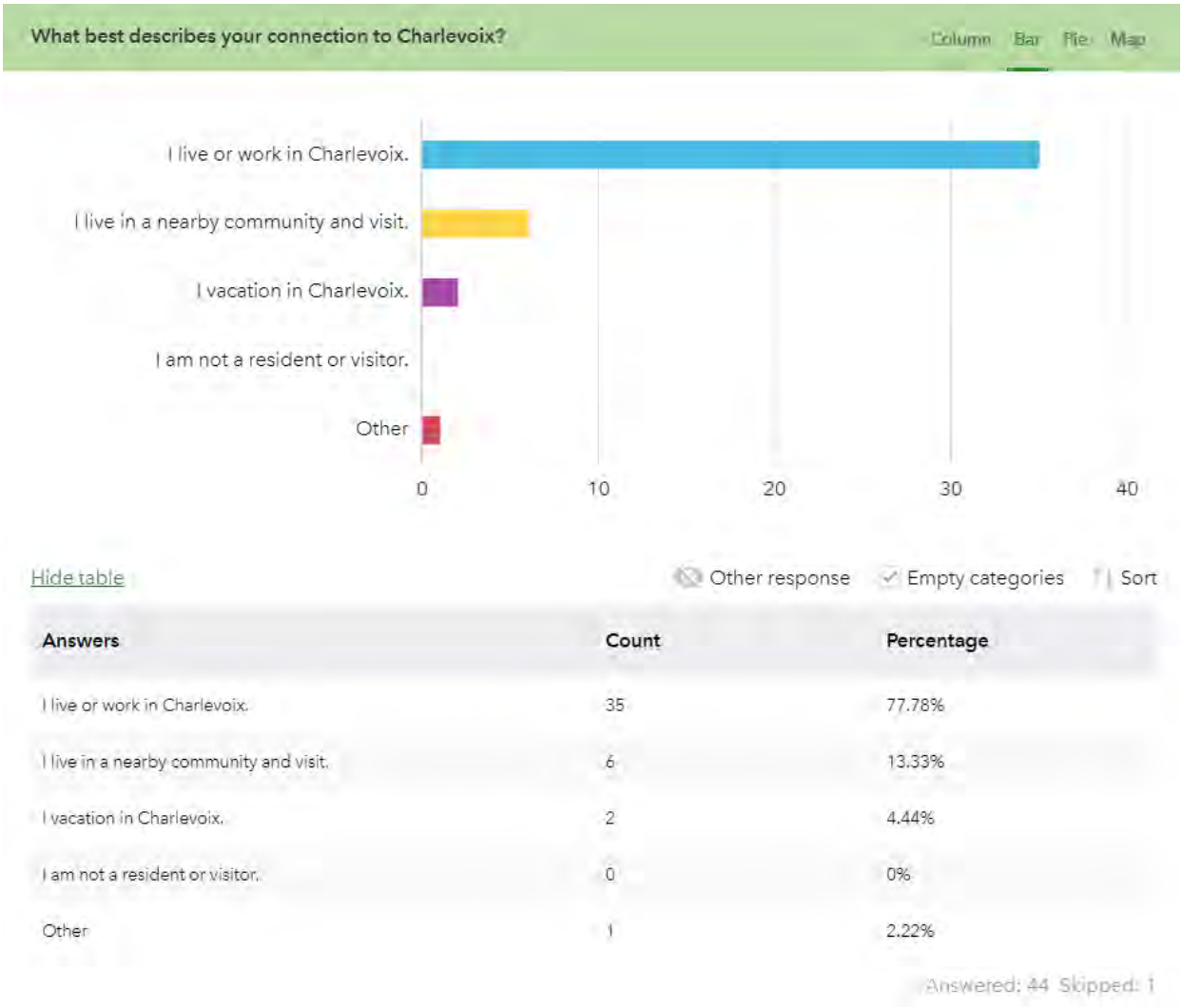


Figure C - 2: Survey Responses to Question 1

Questions 2 through 10: Rate the GSI Concepts

Survey respondents were asked to "Please rate the GSI concepts to help us understand public preferences" for the nine concepts (Figure C-3) proposed for Charlevoix. The survey included Figure C-3 embedded and followed by the questions were respondents were asked to indicate the answer that best expressed their opinion of each proposed practice:

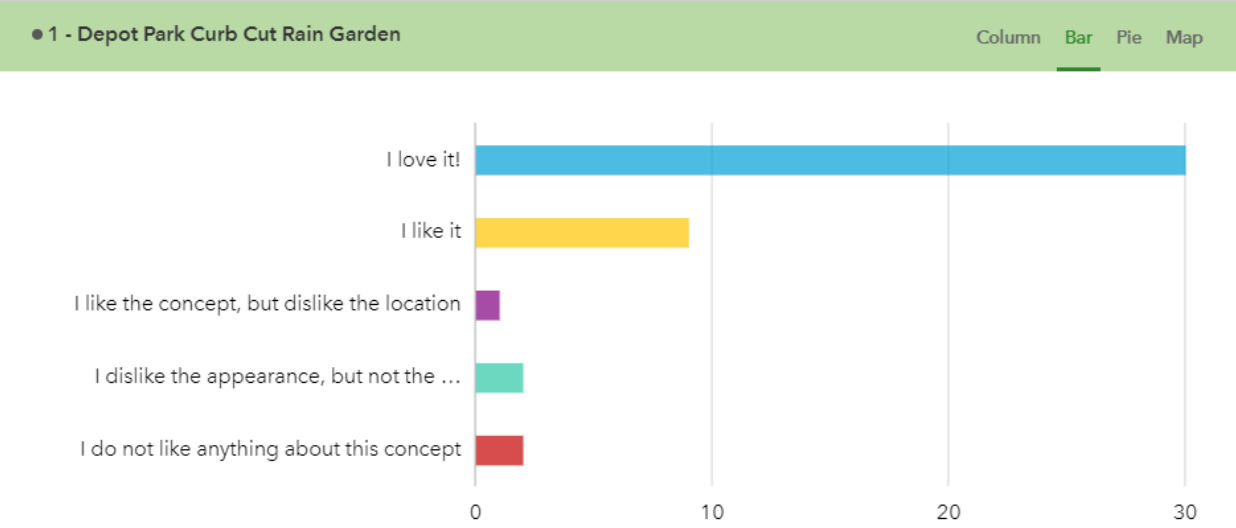
- I love it!
- I like it.
- I like the concept, but dislike the location.
- I dislike the appearance, but not the concept.
- I do not like anything about this concept.

Responses for each concept are shared in Figures C-4 to C-12.

Figure C - 3: Figure from Survey for Questions 2 through 10

Question 2: Practice 1 – Depot Park Rain Garden

Respondent instructions for this question were, "Please rate the GSI concepts to help us understand public preferences". Responses are shown in Figure C-4.



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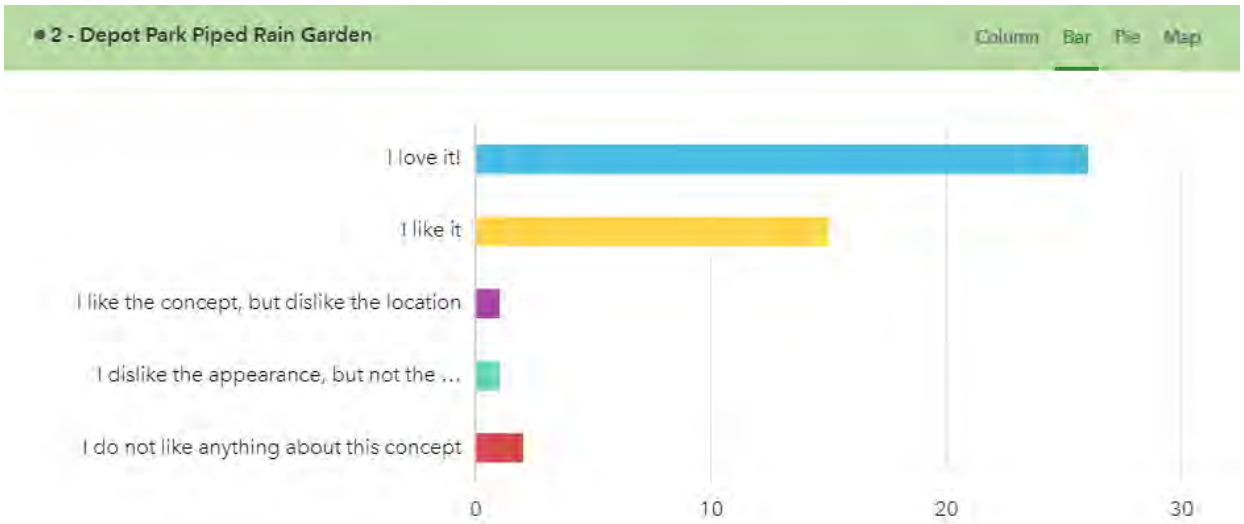
Answers	Count	Percentage
I love it!	30	66.67%
I like it	9	20%
I like the concept, but dislike the location	1	2.22%
I dislike the appearance, but not the concept	2	4.44%
I do not like anything about this concept	2	4.44%

Answered: 44 Skipped: 1

Figure C - 4: Survey Responses to Question 2

Question 3: Practice 2 – Depot Park Pipe Rain Garden

Respondent instructions for this question were, "Please rate the GSI concepts to help us understand public preferences". Responses are shown in Figure C-5.



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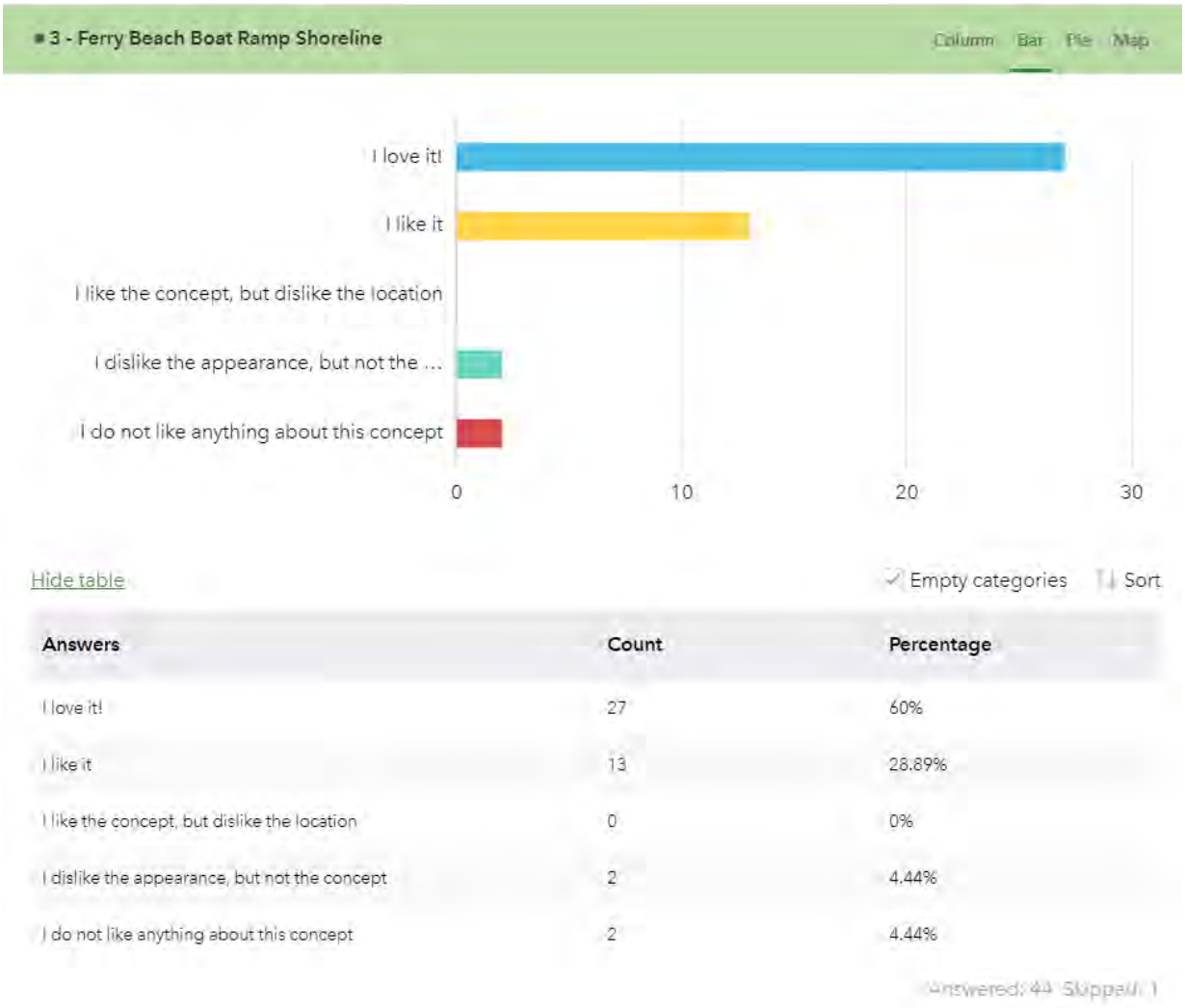
Answers	Count	Percentage
I love it!	26	57.78%
I like it	15	33.33%
I like the concept, but dislike the location	1	2.22%
I dislike the appearance, but not the concept	1	2.22%
I do not like anything about this concept	2	4.44%

Answered: 45 Skipped: 0

Figure C - 5: Survey Responses to Question 3

Question 4: Practice 3 – Ferry Beach Boat Ramp Shoreline

Respondent instructions for this question were, "Please rate the GSI concepts to help us understand public preferences". Responses are shown in Figure C-6.



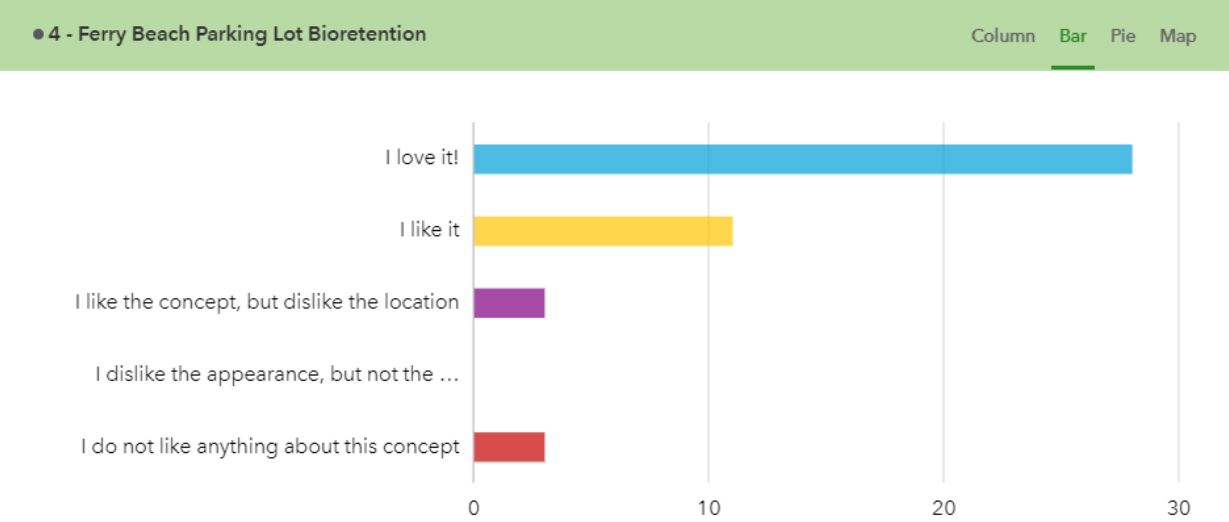
Answers	Count	Percentage
I love it!	27	60%
I like it	13	28.89%
I like the concept, but dislike the location	0	0%
I dislike the appearance, but not the concept	2	4.44%
I do not like anything about this concept	2	4.44%

Answered: 44 Skipped: 1

Figure C - 6: Survey Responses to Question 4

Question 5: Practice 4 – Ferry Beach Parking Lot Bioretention

Respondent instructions for this question were, "Please rate the GSI concepts to help us understand public preferences". Responses are shown in Figure C-7.



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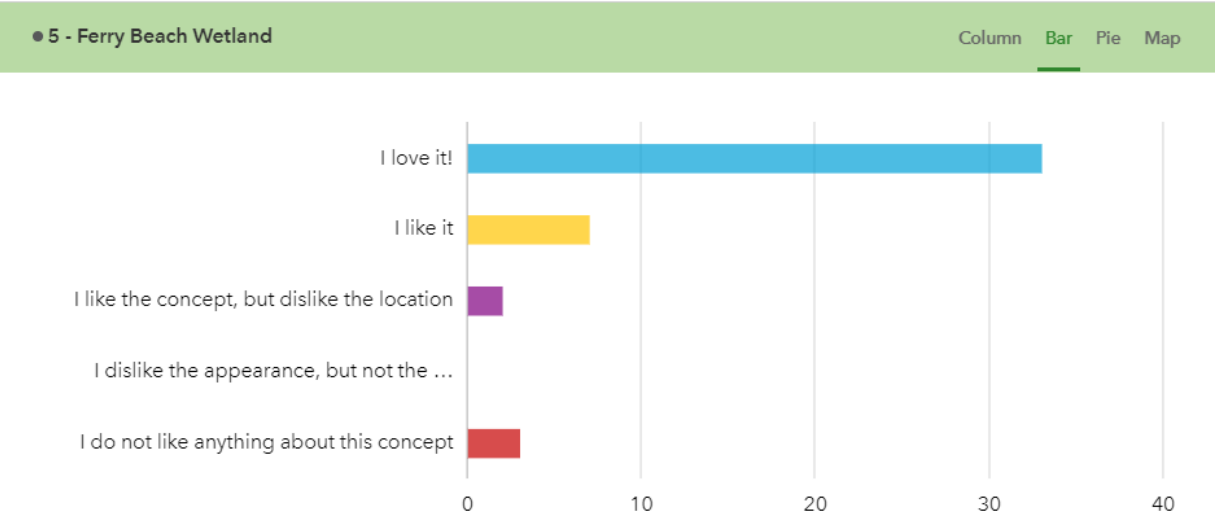
Answers	Count	Percentage
I love it!	28	62.22%
I like it	11	24.44%
I like the concept, but dislike the location	3	6.67%
I dislike the appearance, but not the concept	0	0%
I do not like anything about this concept	3	6.67%

Answered: 45 Skipped: 0

Figure C - 7: Survey Responses to Question 5

Question 6: Practice 5 – Ferry Beach Wetland

Respondent instructions for this question were, "Please rate the GSI concepts to help us understand public preferences". Responses are shown in Figure C-8.



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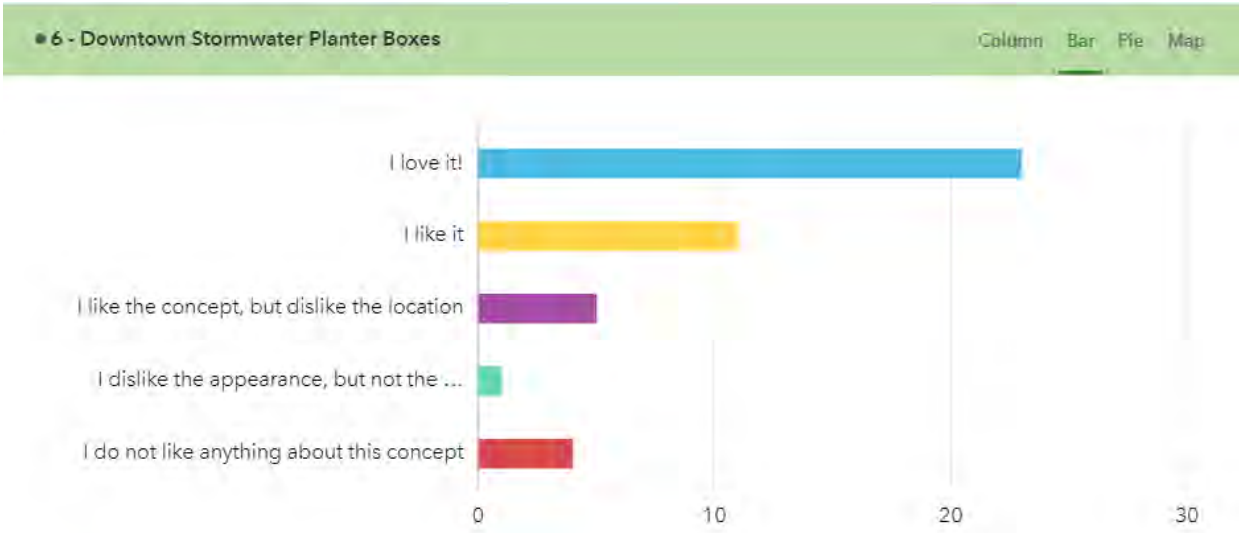
Answers	Count	Percentage
I love it!	33	73.33%
I like it	7	15.56%
I like the concept, but dislike the location	2	4.44%
I dislike the appearance, but not the concept	0	0%
I do not like anything about this concept	3	6.67%

Answered: 45 Skipped: 0

Figure C - 8: Survey Responses to Question 6

Question 7: Practice 6 – Downtown Stormwater Planter Boxes

Respondent instructions for this question were, "Please rate the GSI concepts to help us understand public preferences". Responses are shown in Figure C-9.



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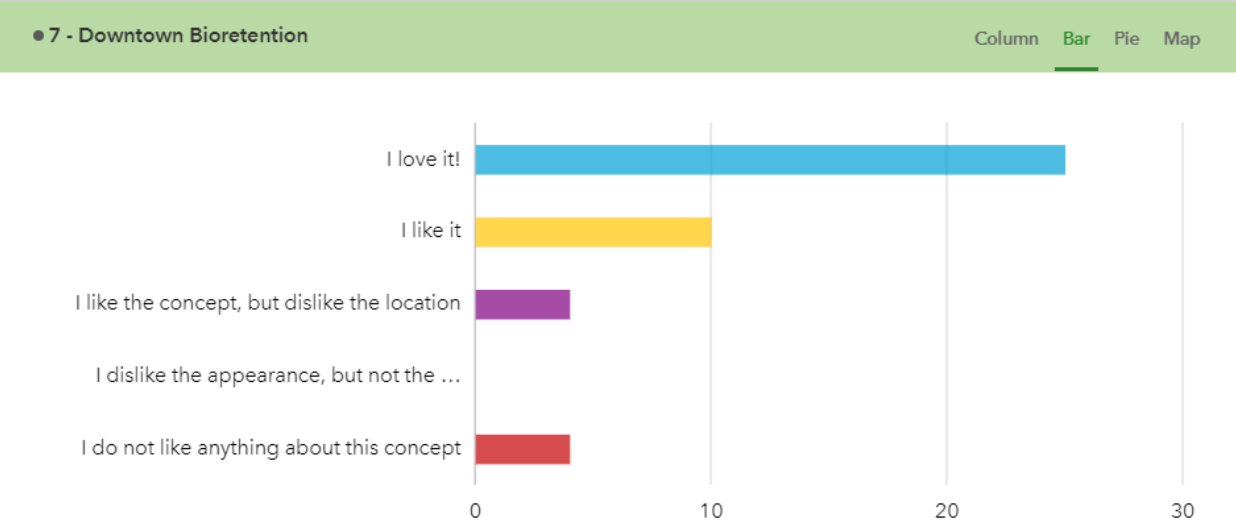
Answers	Count	Percentage
I love it!	23	51.11%
I like it	11	24.44%
I like the concept, but dislike the location	5	11.11%
I dislike the appearance, but not the concept	1	2.22%
I do not like anything about this concept	4	8.89%

Answered: 44 Skipped: 1

Figure C - 9: Survey Responses to Question 7

Question 8: Practice 7 – Downtown Bioretention

Respondent instructions for this question were, "Please rate the GSI concepts to help us understand public preferences". Responses are shown in Figure C-10.



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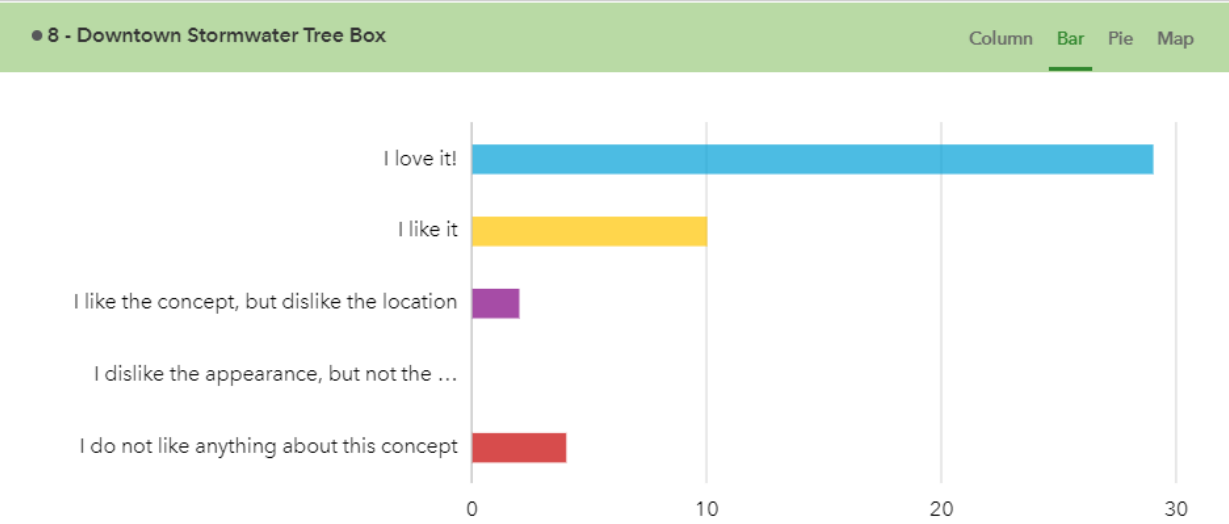
Answers	Count	Percentage
I love it!	25	55.56%
I like it	10	22.22%
I like the concept, but dislike the location	4	8.89%
I dislike the appearance, but not the concept	0	0%
I do not like anything about this concept	4	8.89%

Answered: 43 Skipped: 2

Figure C - 10: Survey Responses to Question 8

Question 9: Practice 8 – Downtown Stormwater Tree Box

Respondent instructions for this question were, "Please rate the GSI concepts to help us understand public preferences". Responses are shown in Figure C-11.



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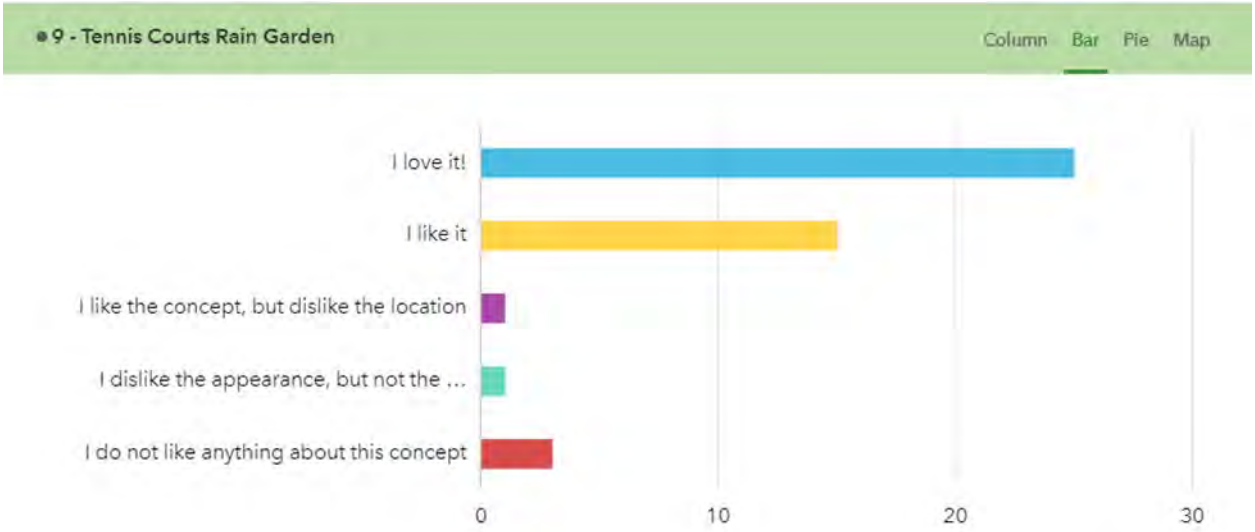
Answers	Count	Percentage
I love it!	29	64.44%
I like it	10	22.22%
I like the concept, but dislike the location	2	4.44%
I dislike the appearance, but not the concept	0	0%
I do not like anything about this concept	4	8.89%

Answered: 45 Skipped: 0

Figure C - 11: Survey Responses to Question 9

Question 10: Practice 9 – Downtown Stormwater Tree Box

Respondent instructions for this question were, "Please rate the GSI concepts to help us understand public preferences". Responses are shown in Figure C-12.



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Answers	Count	Percentage
I love it!	25	55.56%
I like it	15	33.33%
I like the concept, but dislike the location	1	2.22%
I dislike the appearance, but not the concept	1	2.22%
I do not like anything about this concept	3	6.67%

Answered: 45 Skipped: 0

Figure C - 12: Survey Responses to Question 10

Question 11: Drag and Drop Ranked Choice

Respondents were asked to "drag and drop rank the concepts in order of what you want to see implemented". Figure C-13 shows a screenshot of the survey for question 11. The question may have appeared different depending on what device was used to access the survey.

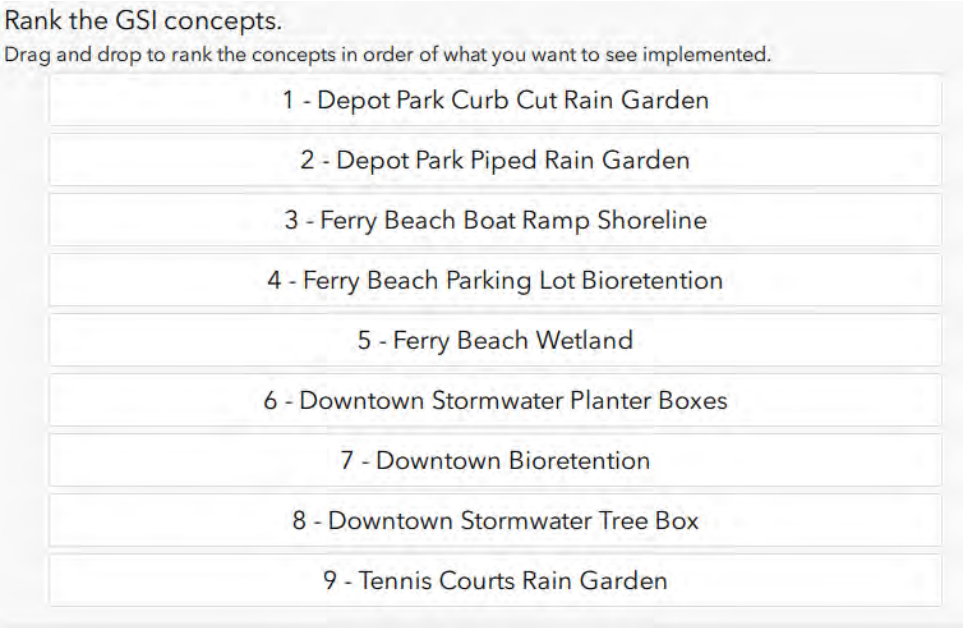


Figure C - 13: Screenshot of Survey Question 11

Due to a user difficulty with the phone-based version of the survey, many users did not answer the question and the resulting order was submitted as "1,2,3,4,5,6,7,8". Due to the known user difficulty, any results that did not modify rank order in the survey were removed before evaluating the data. The ranked choice voting results were weighted based on the number of votes for 1st place, 2nd place, 3rd place, etc. and the resulting ranked order is:

- 1 - Depot Park Curb Cut Rain Garden
- 5 - Ferry Beach Wetland
- 3 - Ferry Beach Boat Ramp Shoreline
- 2 - Depot Park Piped Rain Garden
- 4 - Ferry Beach Parking Lot Bioretention
- 6 - Downtown Stormwater Planter Boxes
- 8 - Downtown Stormwater Tree Box
- 7 - Downtown Bioretention
- 9 - Tennis Courts Rain Garden

The number of times each practice received a 1st, 2nd, 3rd, etc rank is listed in the Table C-1:

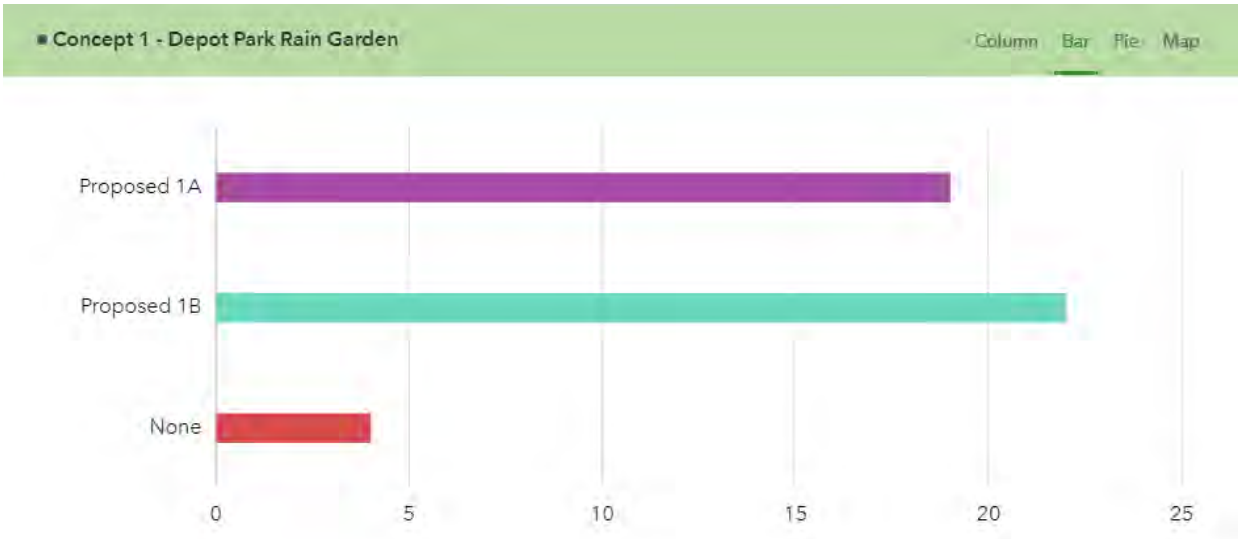
Table C-1 – Number of Results for Each Practice Ranking

	RANK								
GSI CONCEPT	***First***	***Second***	***Third***	***Fourth***	***Fifth***	***Sixth***	***Seventh***	***Eighth***	***Ninth***
1 - Depot Park Curb Cut Rain Garden	8	3	5	8	4	1	3	1	0
2 - Depot Park Piped Rain Garden	1	4	4	7	8	4	2	2	1
3 - Ferry Beach Boat Ramp Shoreline	5	10	3	3	2	3	4	3	0
4 - Ferry Beach Parking Lot Bioretention	1	5	3	6	7	4	1	4	2
5 - Ferry Beach Wetland	12	1	8	2	0	2	3	2	3
6 - Downtown Stormwater Planter Boxes	1	2	5	1	2	15	2	2	3
7 - Downtown Bioretention	1	3	0	3	4	2	14	5	1
8 - Downtown Stormwater Tree Box	3	4	3	3	2	2	1	12	3
9 - Tennis Courts Rain Garden	1	1	2	0	4	0	3	2	20

Question 12: Concept 1 - Aesthetics

Respondents were asked “Which of these proposed versions do you aesthetically prefer?” for Concept 1 (Figure C-14). Figure C-14 was embedded in the survey and shows the practice rendered with two different plant pallets. Version 1B was preferred with 22 votes, but Version 1A was not far behind with 19 votes (Figure C-15).

Figure C - 14: Survey Image for Question 12



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Answers	Count	Percentage
Proposed 1A	19	42.22%
Proposed 1B	22	48.89%
None	4	8.89%

Answered: 45 Skipped: 0

Figure C - 15: Survey Responses to Question 12

Question 13: Concept 1 - Text

Respondents were then asked, “Why did you select that version of Concept 1 as your preference?”. Six respondents did not answer this question. Responses are recorded verbatim below grouped by which version of the practice they chose.

Text responses for Proposed 3A:

- Natural arrangement of plants, trees and woody plants could be added
- It's filled out better. It seems more likely that pedestrians won't go in it, and aesthetically it is more vibrant.
- I vote vote for whatever costs less in original plants as well as continuing maintenance. I would choose whatever plants experts say work best.
- It strikes me as more environmentally beneficial than the more formal proposal.
- I like a more wild and natural look, I think it fits into what surrounds Charlevoix.
- Prefer natural plantings
- More densely planted
- current gardens are not kept up on weeding. the natural look will overall be better
- I feel the natural option will be easier to maintain
- I tend to favor less formal, it tends to look better and need less upkeep.
- More natural looking
- It seems to be lower maintenance.
- less formal, easier to maintain
- Less manicured and more natural for the setting. Less maintenance for the city staff.
- Natural

Text responses for Proposed 3B:

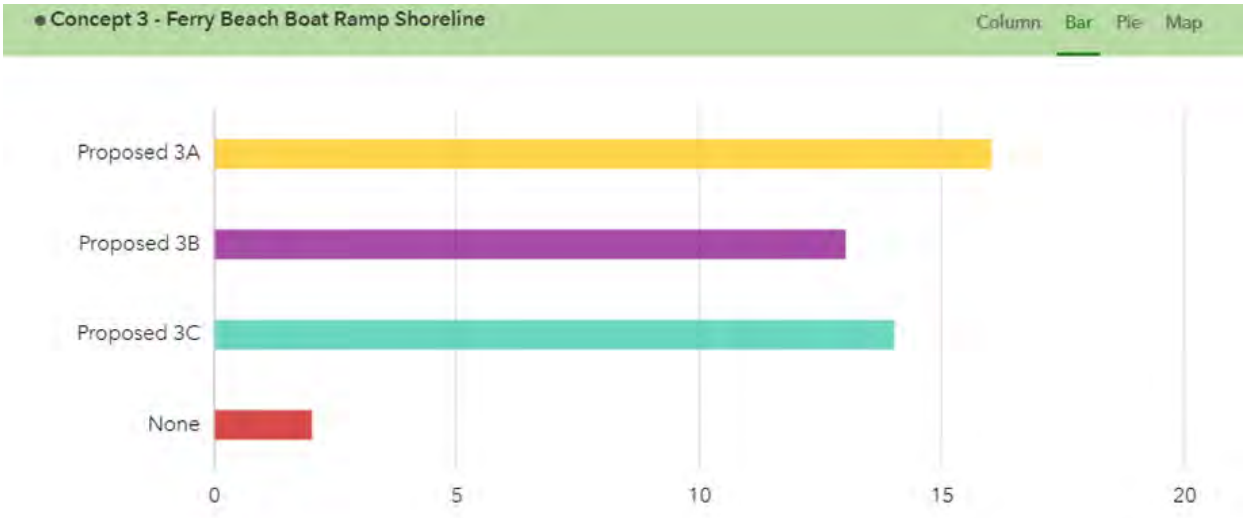
- Color variation of plants
- Has more variety and visually looks better to me.
- Different colors, more manicured looking
- color variation
- Greater contrast in plantings.
- Aesthetically more pleasing, but might be more upkeep.
- The other one looks weedy
- I like a more orderly, manicured space.
- More variety and neater looking
- Color
- It is a “cleaner” look.
- Variety of color
- More colorful
- Variety of color and grasses.
- Colors
- More colorful
- Better color
- Actually either is fine but 1b looks neater.

- I have seen over the years, gardens are put in but not taken care of.

Question 14: Concept 3 - Aesthetics

Respondents were asked “Which of these proposed versions do you aesthetically prefer?” for Concept 3 (Figure C-16). Figure C-16 was embedded in the survey and shows the practice rendered with two different plant pallets. Proposed 3A had the most votes, but the other two versions had a similar number of votes (Figure C-17).

Figure C - 16: Survey Image for Question 14



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Answers	Count	Percentage
Proposed 3A	16	35.56%
Proposed 3B	13	28.89%
Proposed 3C	14	31.11%
None	2	4.44%

Answered: 45 Skipped: 0

Figure C - 17: Survey Responses to Question 14

Question 15: Concept 3 - Text

Respondents were then asked, “Why did you select that version of Concept 3 as your preference?”. Seven respondents did not answer this question. Responses are recorded verbatim below grouped by which version of the practice they chose.

Text responses for Proposed 3A:

- No trees obstructing view, and the flowers look beautiful. 3b doesn't look bad either.
- Prefer natural plantings
- Density & informality of plantings. No obstruction of view. Less loss if water level rises.
- don't put trees then can't see boat activity
- Lower maintenance and more natural
- most natural and likely to endure changing water levels
- I believe these plantings would provide the most protection for the shoreline
- No trees to block view
- I like A and B equally, but do not like C as additional trees block the view.
- Lowest height not to block any views. Many people drive down to this area to watch the lake and sometimes eat lunch. I'm not sure if high water would impact this project. (all views A,B or C)
- Natural looking
- Clean lines. Looks good next to shoreline

Text responses for Proposed 3B:

- Use of different plants with color and no trees to obstruct view
- I love the color scheme and think it would very nice next to the boat ramp.
- The plants are more interesting and varied. I do not like the idea of many trees being planted along the shoreline.
- 3A runs together too much and 3C trees hinder lake view. 3B is colorful and people can see the view still.
- More pleasing to the eye.
- Texture and color of plantings.
- Better color

Text responses for Proposed 3C:

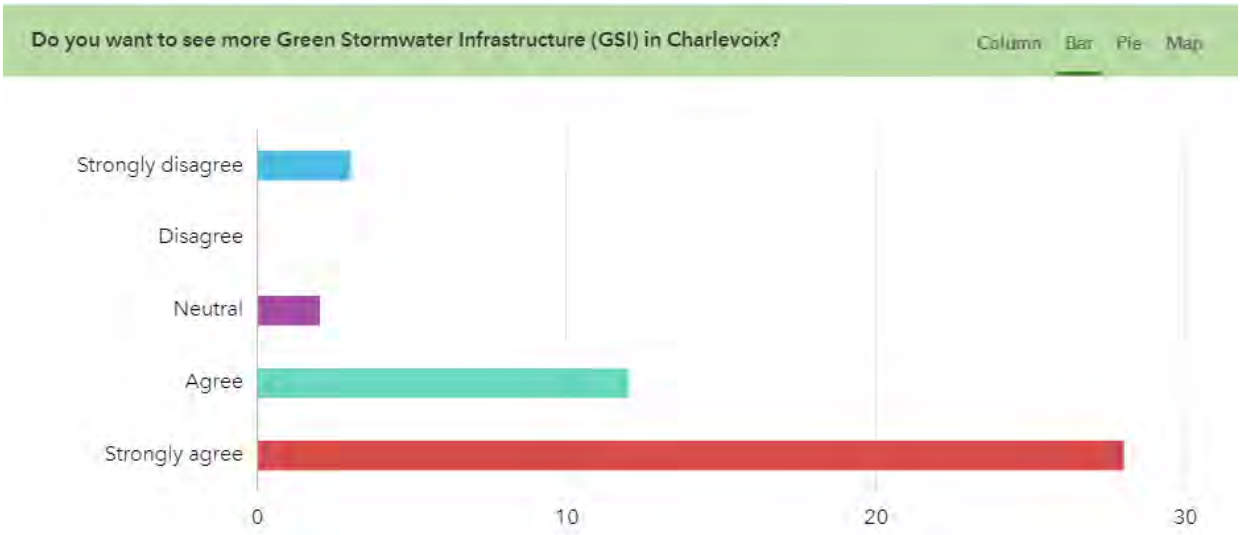
- Combination of trees, woody plants and perrenials. more seating would be better.
- Trees seem nice to vary height. My choices again would be what is most cost effective in original cost and continuing maintenance costs (Weeds?)
- I prefer to see more trees in that area--not so much that they would hinder the view, just enough to "frame" the view and enhance it.
- I think this would allow for the shoreline to be used more by people, e.g. hammocking in trees and rustic benches :)
- Trees offer shade and still allows for people to sit
- I actually like 3A and 3B plantings, but think trees would be a nice addition along the shore
- perfect blending of natural and cultivated - love the trees

- trees! year round
- Easier to maintain. Looks nicest.
- Trees
- I like the trees
- Trees
- I like the addition of trees.

Questions 16-17: Additional GSI Questions

Question 16: Do you want to see more Green Stormwater Infrastructure (GSI) in Charlevoix?

Most respondents strongly agree that they would like to see more GSI in Charlevoix (28 respondents of 45) and another 12 responded they agree (Figure C-18). Three respondents strongly disagree with wanting to see more GSI in Charlevoix.



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Answers	Count	Percentage
Strongly disagree	3	6.67%
Disagree	0	0%
Neutral	2	4.44%
Agree	12	26.67%
Strongly agree	28	62.22%

Answered: 45 Skipped: 0

Figure C - 18: Survey Responses to Question 16

Question 17: Do you feel Green Stormwater Infrastructure (GSI) is important to improving water quality in Lake Charlevoix?

Three respondents strongly disagreed that GSI is important to improving water quality in Lake Charlevoix. However, 39 people who responded selected Agree or Strongly Agree (Figure C-19).

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Answers	Count	Percentage
Strongly disagree	3	6.67%
Disagree	0	0%
Neutral	3	6.67%
Agree	11	24.44%
Strongly agree	28	62.22%

Answered: 45 Skipped: 0

Figure C - 19: Survey Responses to Question 17

Question 17: Do you have any additional comments you would like to share with us?"

Sixteen participants provided the answers below. Answers are provided verbatim.

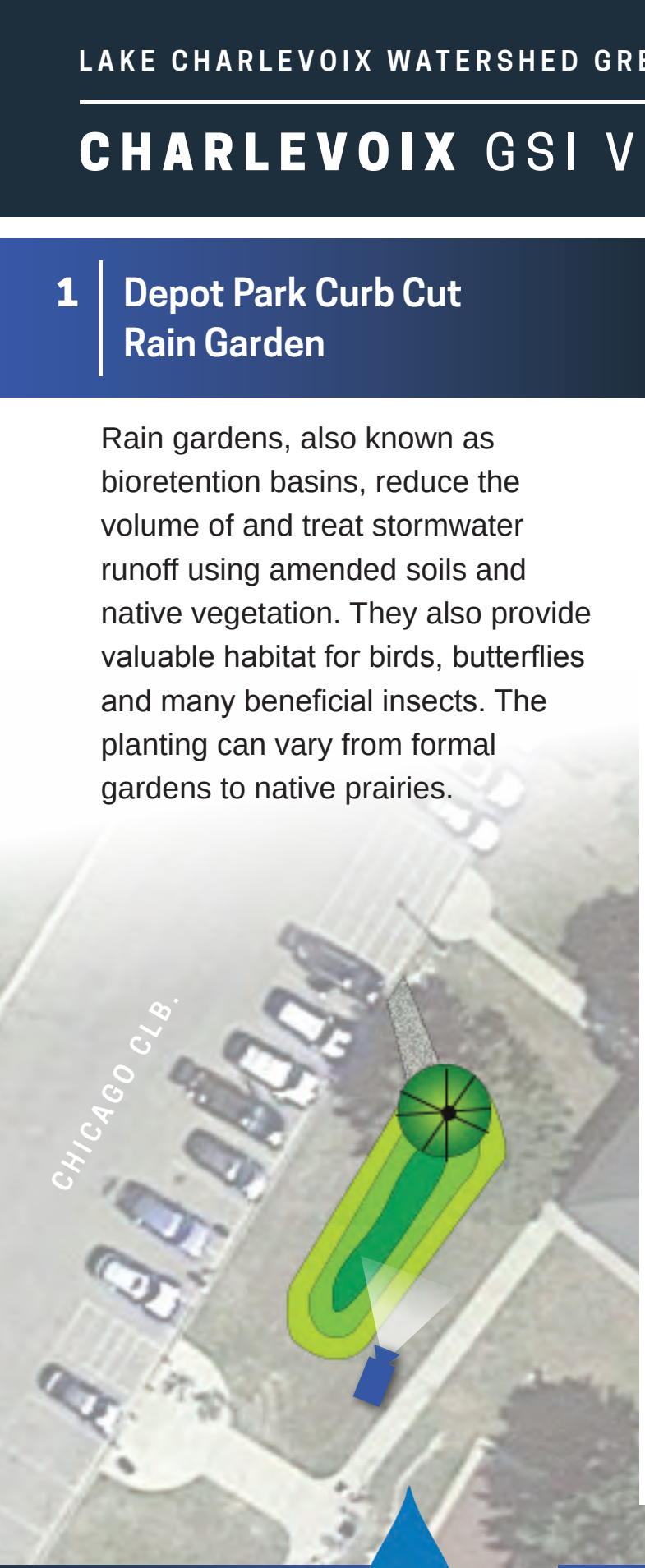
1. A systematic survey of the downtown area's drain inlets in regard to their potential for locating range gardens and tree boxes.
2. Keep up the good work! (and help Camp Seagull's major runoff problems!)
3. If you look at gardens by the band shelter, they have weeds in them. If you put these types of gardens in, what is the budget to maintain them. In Charlevoix township they have taken gardens out.
4. Great idea- whatever we can afford to make the most impact according to experts on the field. I like the look of the alley update, but that is a working alley and trucks must travel down there. Might make too narrow. Bricks strong enough?
5. Thank you for considering all of these options. How about the algae growing at the mouth of storm drains in the City Marina next?
   I like the idea shown at Ferry Beach, but not sure how this would work. Standing water in this park is a big problem.
6. Green grass is my preference in all situations.
7. Good work
8. I hope these projects--with the exception of the Ferry Wetland--can happen ASAP. Hoping Ferry wetland, an area that was an ideal setting for families to gather, spread out, be in the shade on a hot summer day, can return to lawn as water levels recede.
9. I think proposal 6 should include the paving which absorbs runoff as well. I think Ferry Beach would benefit greatly from this as a lot of space is unusable as it is.
10. I think that we need to focus on natural, sustainable, and cost effective stormwater management.
11. Please disregard the raking question on this survey. The drag and drop does not work on mobile devices, thus the order listed does not represent my preferred order. I am not in favor of losing any parking spaces to these projects.
12. Wonderful that you're engaging in this process. More greenery with color and purpose will be a welcome sight! Thanks for your efforts.
13. I love the concepts and ideas shown here. It would be nice to add such things to the city. We really need it.
14. Thank you for keeping Charlevoix Beautiful!
15. I'm concerned about "moving" handicap parking spots for the Ferry Beach parking lot concept. I'd prefer an island be created in the middle of the parking lot.
16. All proposed designs are beautiful, except for trees being placed at launch shoreline. Object to any placement of trees to obstruct views.

Appendix D – Proposed GSI Practices

CHARLEVOIX GSI VISIONING | SITE 1

1 Depot Park Curb Cut Rain Garden

Rain gardens, also known as bioretention basins, reduce the volume of and treat stormwater runoff using amended soils and native vegetation. They also provide valuable habitat for birds, butterflies and many beneficial insects. The planting can vary from formal gardens to native prairies.



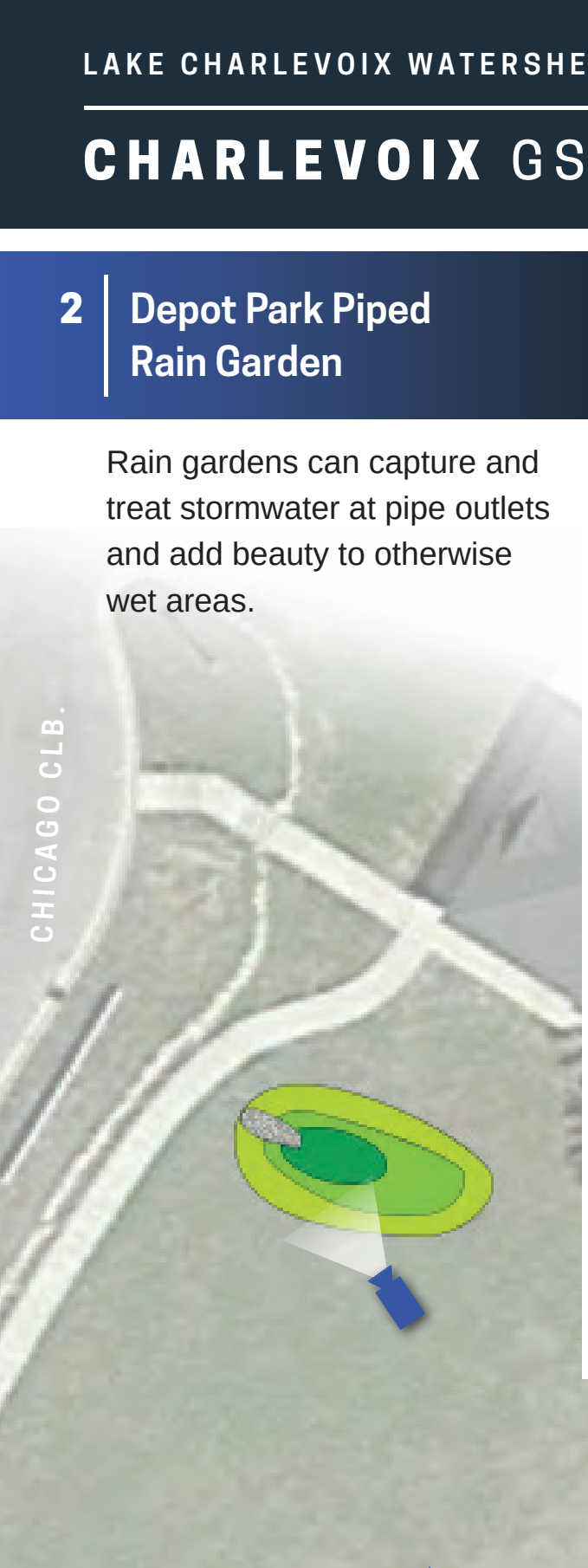
RUNOFF REDUCTION 100%

COST ESTIMATE | $ 19,300

CHARLEVOIX GSI VISIONING | SITE 2

2 Depot Park Piped Rain Garden

Rain gardens can capture and treat stormwater at pipe outlets and add beauty to otherwise wet areas.



RUNOFF REDUCTION 100%

COST ESTIMATE | $ 17,800

CHARLEVOIX GSI VISIONING | SITE 3

3 Ferry Beach Boat Ramp Shoreline

Naturalized shorelines, also called riparian buffers, provide many benefits to the lake ecosystem, including shoreline stabilization and erosion control, habitat for shoreline-dependent species, infiltration of runoff, and filtration of pollutants such as sediments, nutrients, and chemicals. Riparian buffers ideally consist of dense native vegetation, but formal plantings provide more treatment than mowed turf grass.

COST ESTIMATE | $ 5,500

CHARLEVOIX GSI VISIONING | SITE 4

4 Ferry Beach Parking Lot Bioretention

Converting small sections of parking lot to bioretention basins allow stormwater to be captured and cleaned before discharging into the lake. In this scenario, the handicap parking would be moved to adjacent parking stalls.

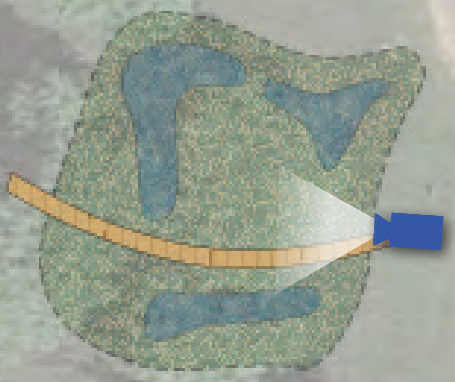
RUNOFF REDUCTION 37%

COST ESTIMATE | $ 49,500

CHARLEVOIX GSI VISIONING | SITE 5

5 | Ferry Beach Wetland

High water levels leave some park areas wet, unused, and difficult to maintain. Creating coastal wetlands in already wet areas can create a unique and inviting space that also helps improve water quality while drying out other areas of the park. This concept is similar to naturalized shoreline.



COST ESTIMATE | $ 270,800*

*Cost estimate does not include placemaking elements

CHARLEVOIX GSI VISIONING | SITE 6

6 Downtown Stormwater Planter Boxes

Stormwater planter boxes work like rain gardens in a box. The planters help manage stormwater by providing areas where water can be collected, filtered, absorbed by the plants, or outflow to storm drains. They can also serve as a key component of a pedestrian green alley.

RUNOFF REDUCTION 100%

COST ESTIMATE | $ 9,500*

*Cost estimate does not include placemaking elements

CHARLEVOIX GSI VISIONING | SITE 7

7 | Downtown Bioretention

Converting small sections of parking lot to bioretention basins allow stormwater to be captured and treated before entering the stormwater pipe network. They can also add beauty to otherwise grey areas. In this scenario, the handicap parking would be moved to adjacent parking stalls.

U.S. HWY 31

RUNOFF REDUCTION 47%

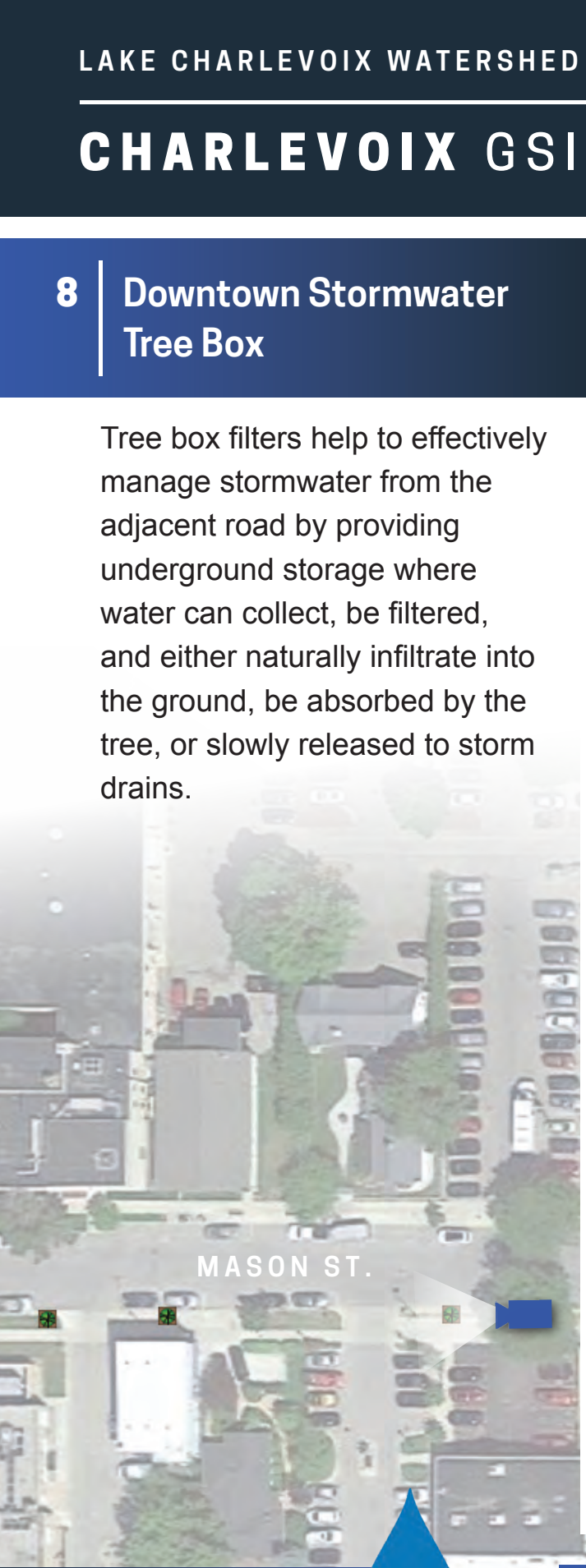
COST ESTIMATE | $ 18,900

ANTRIM ST.

CHARLEVOIX GSI VISIONING | SITE 8

8 Downtown Stormwater Tree Box

Tree box filters help to effectively manage stormwater from the adjacent road by providing underground storage where water can collect, be filtered, and either naturally infiltrate into the ground, be absorbed by the tree, or slowly released to storm drains.



RUNOFF REDUCTION 100%

COST ESTIMATE | $ 62,400

CHARLEVOIX GSI VISIONING | SITE 9

9 Tennis Courts Rain Garden

Turf grass areas that are underutilized or serve no other function are good candidates for conversion to native planting areas and rain gardens. Rain gardens that intercept runoff from streets are particularly beneficial and can beautify park areas. In locations like this, gravel boarders can catch sediment before it clogs the planting beds.

RUNOFF REDUCTION 100%

COST ESTIMATE | $ 7,500