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Chapter 4

Prentiss Creek Watershed

1. Introduction and Background

In 2006, the Village of Downers Grove updated its Stormwater Master Plan to provide a comprehensive plan for improving the Village's stormwater management capabilities. This plan focused on the three main watersheds in the Village: Lacey Creek Watershed on the north, St. Joseph's Creek Watershed in the center and Prentiss Creek Watershed on the south end of the Village. The plan identified major flooding sources as well as other stormwater infrastructure inadequacies.

Due to a significant storm event that occurred on October 2, 2006 (3.77 inches of rainfall in an hour) as well as the knowledge of historical flooding, the Village decided to develop a Stormwater Infrastructure Improvement Plan to identify the problem areas, assess the causes of the problems, and prepare watershed-specific Capital Improvement Programs (CIPs) to address improvement alternatives and implementation procedures to mitigate flooding problems.

This Improvement Plan focuses on the Prentiss Creek Watershed, a 5 square mile area located on the southern end on the Village of Downers Grove (see Figure 1-1). This document focuses on the eight delineated subwatersheds and the identified Problem Areas within each subwatershed. This document also includes an assessment of each Problem Area with recommended solutions and implementation schedules.

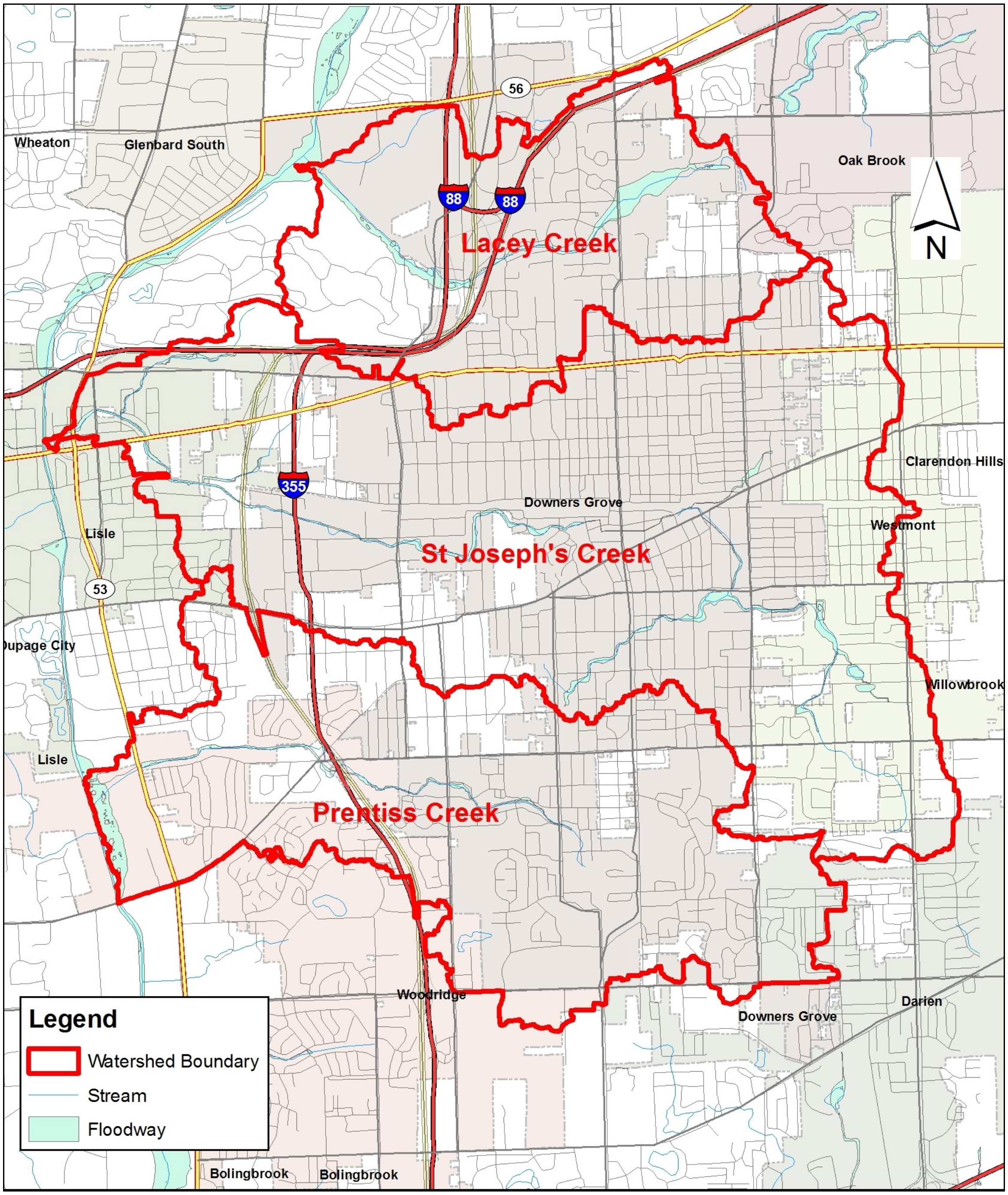


Figure 1-1
Village of Downers Grove Watershed Map

2. Problem Area Identification

2.1. Problem Area Identification Methodology

In order to adequately identify problem areas, existing data were collected from the Village of Downers Grove as well as other entities, and this information was sorted and evaluated to determine the problem areas to be further studied. This section identifies the steps taken towards problem area identification.

2.1.1. List of Data Sources Reviewed

Following is a compilation of the information gathered and reviewed.

Prior Reports
- Village of Downers Grove Stormwater Master Plan Update, October 2006
- Downers Grove Sanitary District, Flow Monitoring Report, August 2006

Plan Sets
- 2201 63rd Street (Meadowbrook Subdivision)
- 6330 Belmont (Meadowbrook Subdivision)
- Berrywood Estates North
- Berrywood Estates West
- Birchwood Meadows
- Bob's Subdivision
- Concord Square Unit I
- Dunham Crossing II
- Dunham Place Unit I
- Dunham Place Unit II
- Dunham Place Unit IV
- Dunham Place Unit V
- Fairview Fines
- Fairview Pointe
- Fox Ridge
- Hidden Pine Estates
- Hillcrest Estates
- Hillcrest Hollow
- Keim's Spring Green
- Kennsington Place
- Kennsington Place II
- Milne's Farm Subdivision
- Nagella's Subdivision
- O'Brien Park
- O'Driscoll Subdivision
- Plymouth Place
- Plymouth Place II
- Prentiss Brook Terrace Subdivision
- Prentiss Creek Subdivision
- Regency Grove Estates East
- Spring Green Crossing

- Spring Green South
- Spring Green Village
- Spring Green Woods
- Spring Park Estates
- Victoria Ridge
- Wallen Estates
- West Lawn Commons

Mapping Products
- Village Drainage Control Map
- DuPage County 2-Foot Topographic Contours (AutoCAD format)
- ArcMap GIS Layers (listed in the table below):

Benchmarks	County Wetland Inventory
Dry Bottom Detention	DuPage County 2-Foot Contours
Flood 20061002 - Points	Flood 20061002 – Streets No Power
100-year Floodplain	500-Year Floodplain
Floodway	Forest Preserve
Hydro Lines	Landuse
LPDA	Parcels
Parking Lot Retention	Right of Way
Storm Survey (MH Locations)	Streets
Subdivision	Topo – Spot Elevations
Village Boundary	Watersheds
Zoning	

- DuPage County Geodetic Control Stations
- Storm Sewer Atlas (hand drawn on Village Plat Maps)
- Storm Sewer Survey, Clark Dietz, Inc., March 2007
- Village of Downers Grove Aerial Photography
- Soil Survey, NRCS/USDA Web Soil Survey (WSS)

Flood Event Data
- 15-Minute Rainfall Data, October 2-3, 2006
- List of Flood Complaints, July 19, 1996 (internal memo)
- 1996 Event – Resident Flood Calls
- Department of Public Works, 2007 Capital Improvement Projects Schedule
- Department of Public Works, Drainage Problem Master List
- Department of Public Works, In-House Projects – Future Improvements
- Department of Public Works, In-House Projects – Maintenance Crew
- LPDA Fact Sheets
- LPDA Study Methodology
- 4/4/2007 Neighborhood Meeting Comment Forms
- Community Drainage Flooding Survey Results (Microsoft Access format)

2.1.2. Problem Area Identification

In order to successfully evaluate the drainage issues throughout the Prentiss Creek Watershed, it was necessary to first identify the general problem areas. To do so, the

Watershed was divided into eight subwatersheds with designations PR-A through PR-H. Only flooding issues within Village boundaries were further evaluated; thus, PR-G, covering primarily unincorporated DuPage County, and PR-H, covering primarily land in Westmont, were not evaluated.

Once the subwatersheds were identified, flood complaint information was converted into GIS format and plotted on a watershed map. Areas with high concentrations of flood complaints were grouped together as a "Problem Area". Seventeen problem areas were identified throughout the Prentiss Creek Watershed.

2.2. Problem Areas in Prentiss Creek Watershed

Information was compiled to assess the basic features of the Prentiss Creek watershed and to identify the source of existing drainage problems. A description of the watershed's physical properties is included in this section.

2.2.1. Description of Prentiss Creek Watershed

The Prentiss Creek Watershed is located on the south side of Downers Grove, predominantly south of 61st Street and north of 75th Street (see Figure 2-1). The total watershed area tributary to the point where the creek crosses I-355 is 3,184 acres (5.0 square miles). The watershed contains eight subwatersheds, shown in Figure 2-1 as PR-A through PR-H.

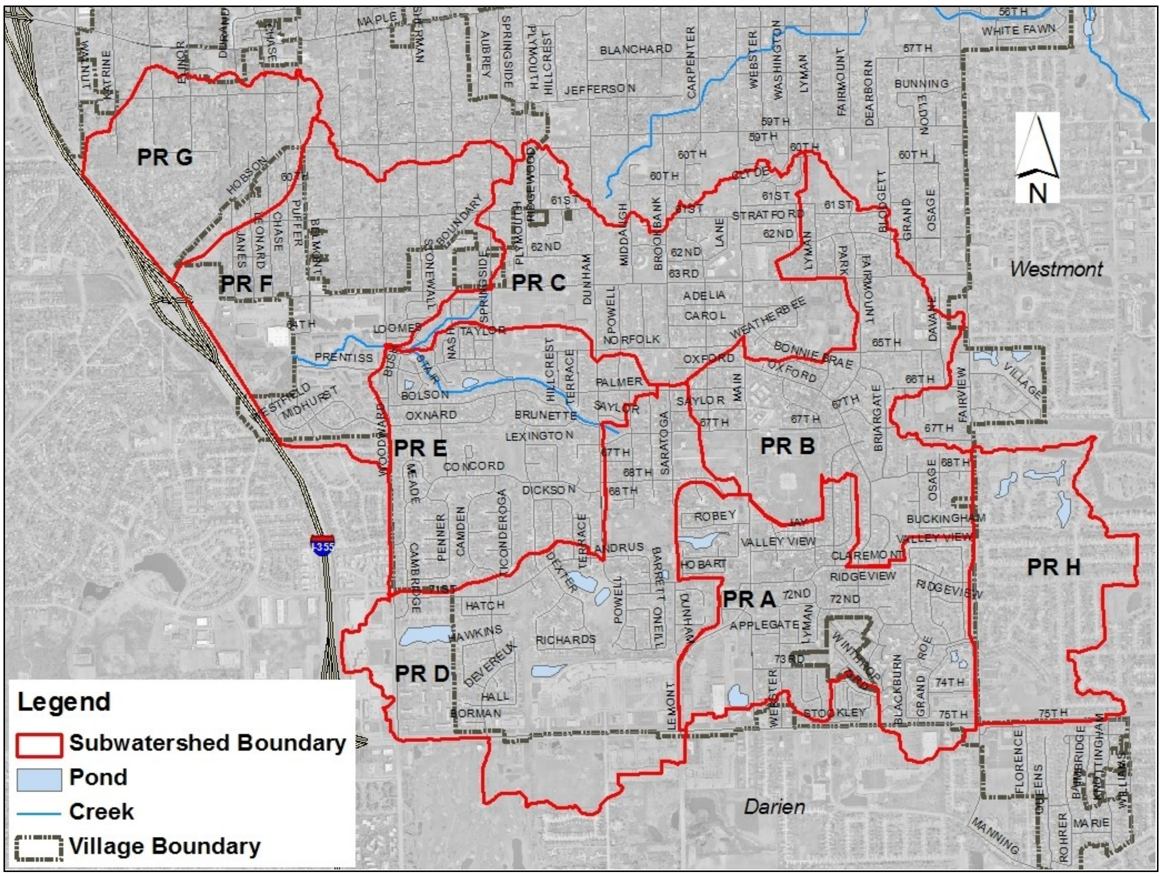


Figure 2-1
Prentiss Creek Subwatershed Map

Soil Properties

Soils in the area are mostly Hydrologic Soil Group Type C, which is typical in an urban area (where compacted soils prevent significant infiltration). Predominant soil types are:

- Orthents: clayey, undulating
- Markham-Ashkum-Beecher complex: 1 to 6 percent slopes
- Markham silt loam: 2 to 4 percent slopes
- Ashkum silty clay loam: 0 to 2 percent slopes

These soil types pose limitations when development occurs; in particular, they are rated "very limited" for dwellings with basements because of the depth to saturated zone, and "very limited" for construction of local roads, because of the depth to saturated zone, frost action, low strength, shrink-swell potential, and ponding. Soils near the creek, particularly in areas with Ashkum silty clay loam, are susceptible to ponding. Figure 2-2 depicts the hydrologic soil group distribution throughout the watershed.

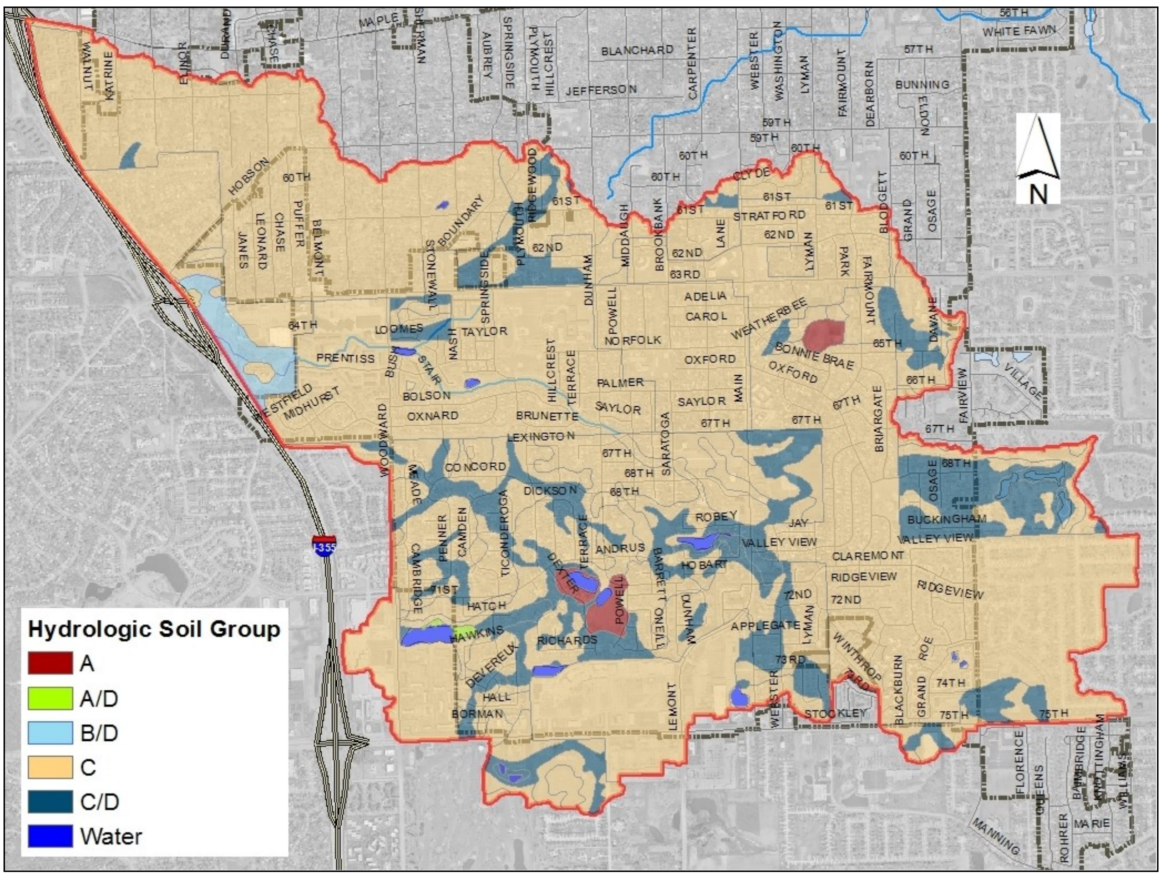


Figure 2-2
Prentiss Creek Soil Map

Land Use

Land use in the Prentiss Creek watershed is predominantly residential (0-6 dwelling units per acre), with a smaller percentage of higher-density residential, as well as commercial and open space. The residential developments in this watershed are relatively new (compared to the central portion of the Village) and consist primarily of post-1970 construction. Many of the residential subdivisions have stormwater detention or retention areas. Figure 2-3 illustrates the land use in the watershed.

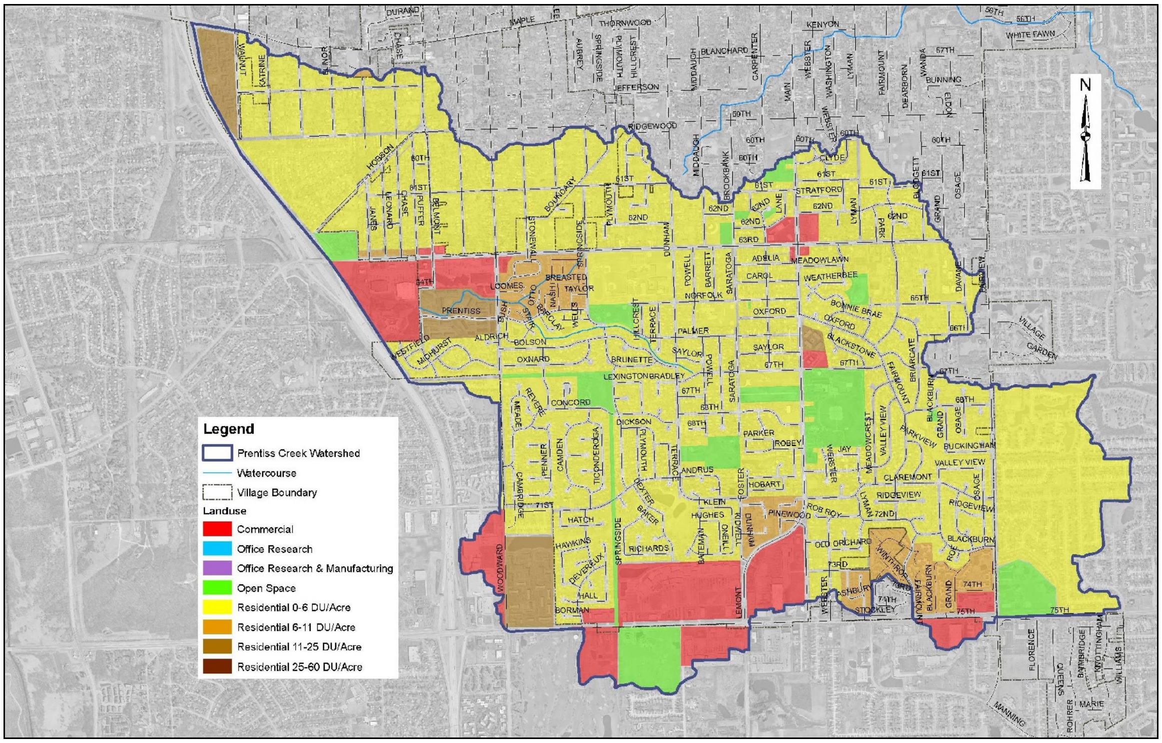


Figure 2-3
Prentiss Creek Land Use Map

Topographic and Hydrologic Features

Land in the Prentiss Creek watershed is relatively steep, with slopes between 1 to 5 percent near the creek and 0.5 to 2 percent in the upstream reaches. The topography has many depressional areas which promote ponding during wet weather events. Several large detention basins have been constructed in the watershed, including the O'Brien Park pond, Dunham Place Park ponds, and the ponds east of Fairview and 68th. These detention ponds, along with other, smaller, detention and retention ponds built throughout the watershed, attenuate stormwater flows during peak storm events and lessen the impact on the receiving stream. Figure 2-4 shows the topography of the Prentiss Creek basin, flow direction, and major detention ponds.

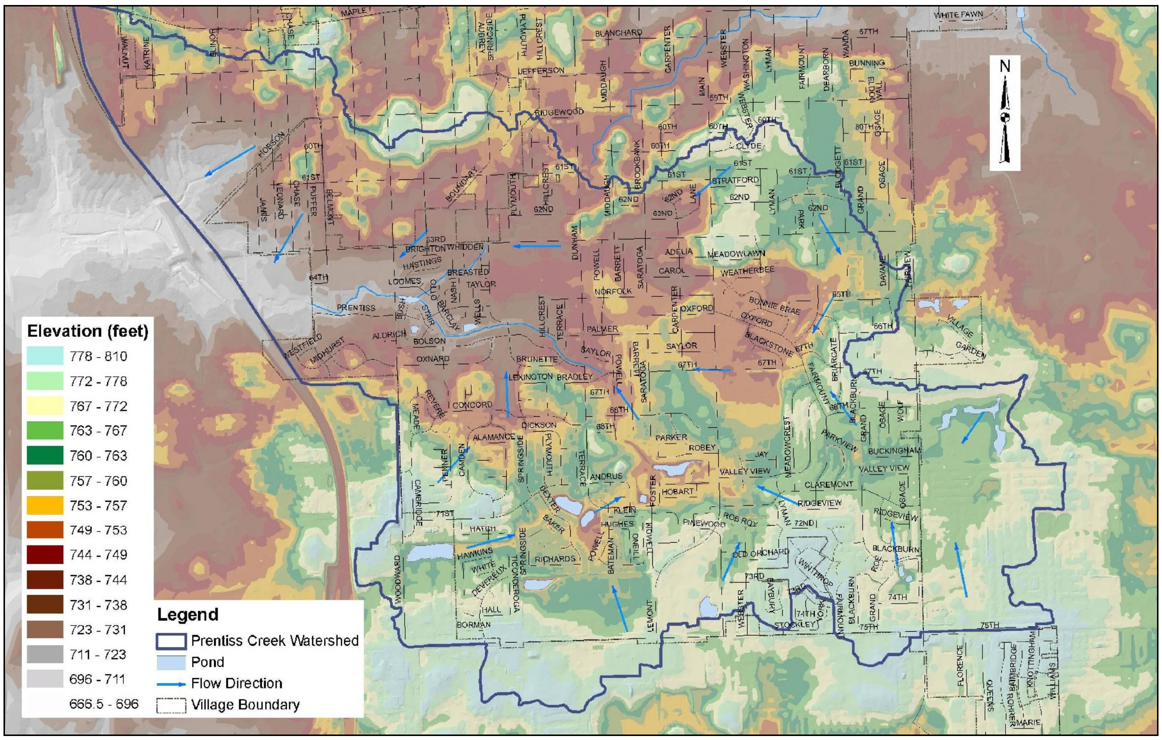


Figure 2-4
Prentiss Creek Topographic Map

2.2.2. Typical Drainage Issues

The severity of stormwater drainage problems in the Prentiss Creek watershed ranges from low to moderate. Frequent complaints include ponding in backyards, moderate street flooding, detention basin concerns, and clogged catch basins.

Although several residents were concerned about yard flooding in areas that are in the 100-year floodplain, this report does not directly address these areas, since these areas are expected to be inundated during intense rainfall events. This report was intended to focus on drainage concerns caused by inadequate infrastructure upstream of the main drainage channel; however, if the extents of the floodplain had an effect on flooding of roadways or other public infrastructure, those areas were be addressed. Additionally, a frequent concern of residents throughout the Prentiss Creek watershed is basement flooding due to sump pump failure. The Prentiss Creek Watershed has had numerous power outages which last for many hours; thus, residents with electric sump pumps experienced flooding due to inactive sump pumps, and even those with battery backups experienced flooding when the power outages lasted for extended time periods (as the battery backups are not designed for prolonged use). Since these flooding issues are related to power outages and not directly to stormwater infrastructure, they were not considered in the problem area identification.

3. Hydrologic and Hydraulic Analysis

The Prentiss Creek Watershed was subdivided into eight subwatersheds to quantify the stormwater runoff contribution from individual portions of the watershed. Subwatershed delineation was performed using 2-foot contours (2005) provided by DuPage County and by determining the locations of storm sewers using field survey and the Village storm sewer map. Storm sewers which were upstream of or bypassed the trunk storm sewers were not evaluated or modeled as part of this study, but were assumed to be appropriately sized to adequately convey stormwater runoff. For the purposes of this study, a trunk storm sewer was defined as the primary storm sewer segment draining a particular subwatershed.

Only subwatersheds served by a major trunk sewer were modeled. Other subwatersheds, not served by a major sewer network, were analyzed on a more qualitative basis. Table 3-1 outlines each of the eight subwatersheds, the type of drainage system, and the analysis method used.

Subwatershed	Drainage System	Analysis Method
PR-A	Main Storm Sewer Network	XP-SWMM
PR-B	Main Storm Sewer Network	XP-SWMM
PR-C	Main Storm Sewer Network	XP-SWMM
PR-D	Main Storm Sewer Network	XP-SWMM (downstream portion only)
PR-E	Local Storm Sewer Systems	Qualitative Analysis
PR-F	Ditch Drainage or Local Storm Sewer Systems	Qualitative Analysis
PR-G	Ditch Drainage	N/A – Unincorporated Area
PR-H	Storm Sewer Network	N/A – Village of Westmont

3.1. Hydrologic and Hydraulic Methods – Storm Sewer Modeling

In subwatersheds served by a major trunk sewer system (PR-A through PR-D), the system was surveyed and modeled using hydrologic and hydraulic software. The modeling program XP-SWMM, version 9.5, was used to estimate peak flow rates and determine the hydraulic capacity of the existing trunk sewers and key detention ponds within the watershed. XP-SWMM is a physically-based storm event simulation program capable of simulating runoff from various land uses and soil types, combining subbasin hydrographs, and routing flow through storage (detention ponds) and conveyance elements (channels or sewers).

Within each subwatershed, stormwater runoff from individual subbasins was computed using the Natural Resources Conservation Service (NRCS) unit hydrograph method available in XP-SWMM. Required parameters include subbasin area, curve number, and time of concentration. Curve numbers were based on typical values for corresponding land uses, assuming Antecedent Moisture Content 2 (AMC II). The time of concentration for each subbasin was estimated using the NRCS velocity (TR-55) method.

Peak flow rates were calculated for 5-year, 10-year and 100-year recurrence interval events with 1, 2, and 3-hour durations. A 24-hour duration rainfall was also used for the 100-year recurrence interval event. The Huff 1st Quartile rainfall distribution was used for the critical duration analysis (1-hour, 2-hour, 3-hour durations) and the Huff 3rd Quartile rainfall distribution was used for the 24-hour duration.

XP-SWMM integrates the hydrologic analysis with the hydraulic analysis, so any stormwater storage resulting from detention ponds or surface flooding is calculated and peak flows are adjusted accordingly. Flow data used for the hydraulic analysis consisted of unsteady flow data computed using the hydrologic analysis component of XP-SWMM. Storm sewers were analyzed, with boundary conditions assumed to be the 100-year flood elevation in the receiving open channel (Prentiss Creek), as listed in the corresponding FEMA Flood Insurance Rate Map and Flood Insurance Study. As part of this modeling effort, it was assumed that sewer inlets can deliver surface runoff to the sewer system. Peak flows from the hydrologic analysis were used to compute a hydraulic grade line (HGL) for each section of sewer pipe and open drainage channel.

An *Existing Conditions* SWMM model was developed to simulate the watershed under existing land use conditions. Once the output of the *Existing Conditions* SWMM model was evaluated and adjusted to match observed conditions, a *Proposed Conditions* SWMM model was developed to simulate the impact of proposed improvements.

3.2. Hydrologic and Hydraulic Methods – Qualitative Analysis

In two of the studied subwatersheds, it was not practical to model the storm sewer system, as it was not part of the larger network of trunk storm sewers, or no storm sewers were present. In these areas, the problems were not sewer-related but were defined by overland flow, so hydraulic modeling would not have been productive. In these cases, a more qualitative analysis was completed, which involved compiling information from resident complaints, topographic data, and site visits to determine the potential cause(s) of flooding and develop recommendations.

In some cases, the recommendations may identify the need for a more in-depth analysis of the area. Because of time and budget constraints, detailed information, such as a site-specific topographic survey, could not be obtained. In these identified areas, the Village may wish to obtain the additional information necessary to gain more detail for this report's broader recommendations.

4. Problem Area Analysis

4.1. Prentiss Creek Problem Area Overview

Figure 4-1 depicts the eight subwatersheds in the Prentiss Creek watershed, along with the areas within the Village where there were relatively high concentrations of drainage complaints.

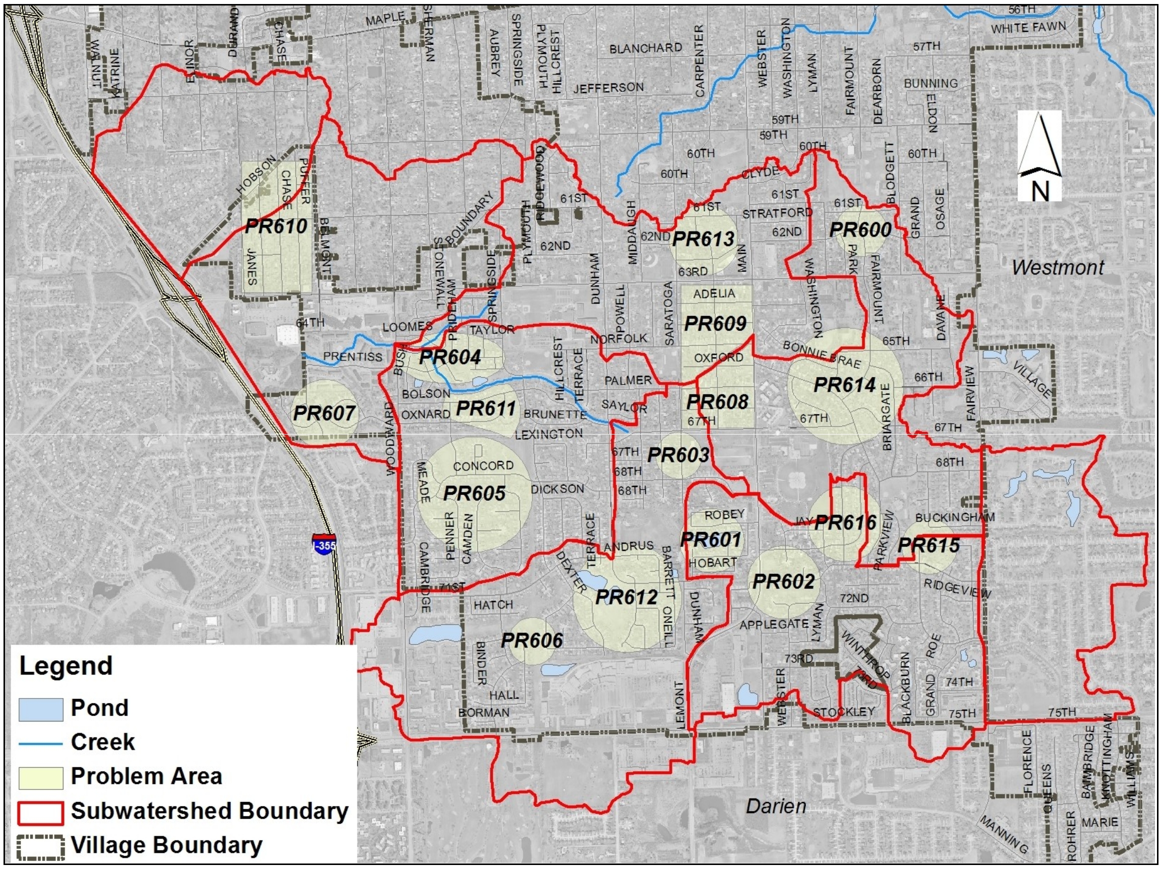


Figure 4-1
Prentiss Creek Problem Area Map

The 17 Prentiss Creek problem areas (PR600 through PR617) are listed in Table 4-1, sorted by subwatershed. Section 4.2 includes an exhibit for each Problem Area, detailing the concerns in the area, recommendations, cost and priority.

Table 4-1
Problem Area Summary, Prentiss Creek Watershed

Subwatershed	Problem Area	Description of Problem
PR-A	PR 601	Water quality issues in O'Brien Park Pond.
	PR 602	Street and yard flooding in area.
	PR 615	Ponding occurs in depressional area in street.
	PR 616	Recurring street and yard flooding.
PR-B	PR 600	Street and yard flooding in area.
	PR 608	Poor drainage due to lack of proper stormwater conveyance system.
	PR 614	Storm sewer surcharging, street flooding.
PR-C	PR 609	Poor drainage due to lack of proper stormwater conveyance system.
	PR 613	Street and yard flooding in area.
PR-D	PR 603	Excessive rates of overland flow in area.
	PR 606	Flooding of electrical boxes in back right-of-way.
	PR 612	Street and yard flooding in area.
PR-E	PR 604	Water quality issues in detention ponds.
	PR 605	Street and yard flooding in area, including severe property damage.
	PR 611	Street and yard flooding in area.
PR-F	PR 607	Excessive rates of overland flow in area.
	PR 610	Poor drainage due to lack of proper stormwater conveyance system.
PR-G	N/A	Unincorporated Area – problem areas not identified
PR-H	N/A	Village of Westmont – problem areas not identified

4.2. Prentiss Creek Subwatershed Overview Maps

The following exhibits depict an overview of each Prentiss Creek subwatershed, along with the recommended improvements, an estimate of cost, and a timeline for completion of all the projects in the subwatershed.

A scoping report for each problem area is included in Appendix A. Each scoping report consists of a description of the problem, results of the investigation and analysis, recommendations for improvements, priority (high, medium or low), an engineer's estimate of probable cost, and an implementation schedule for planning purposes.

5. Additional issues

5.1. Roadway Cross Section Options

The Village has several options when determining what type of roadway cross section to use when reconstruction of a road will take place. Currently, the Village uses either an urban roadway cross section or a rural roadway cross section. However, other options are available and may be beneficial depending on the specifics of the site where the reconstruction will occur.

Figures 5-1 and 5-2 depict the Village's current standard cross sections for residential roadways. The urban cross section is a typical curb & gutter cross section with a roadway width of 31 feet from back of curb to back of curb. The rural cross section has a 24-foot roadway width with a gravel shoulder; stormwater runoff flows into a ditch parallel to the roadway.

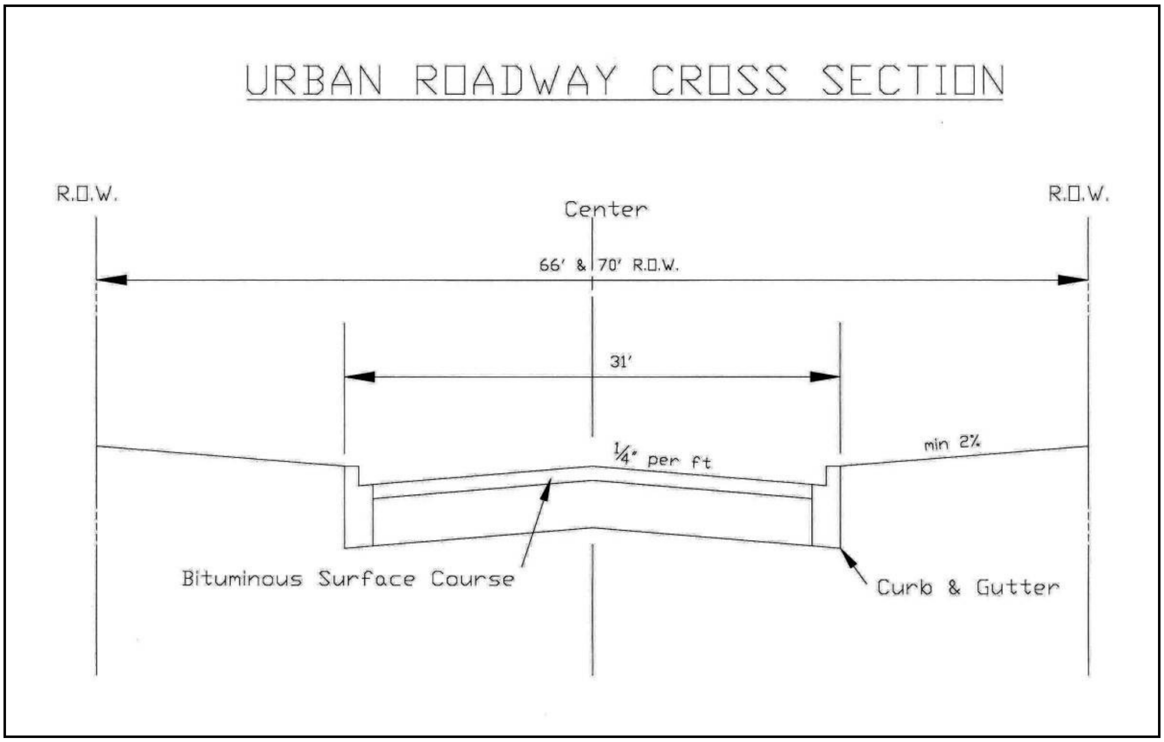


Figure 5-1
Typical Urban Cross Section

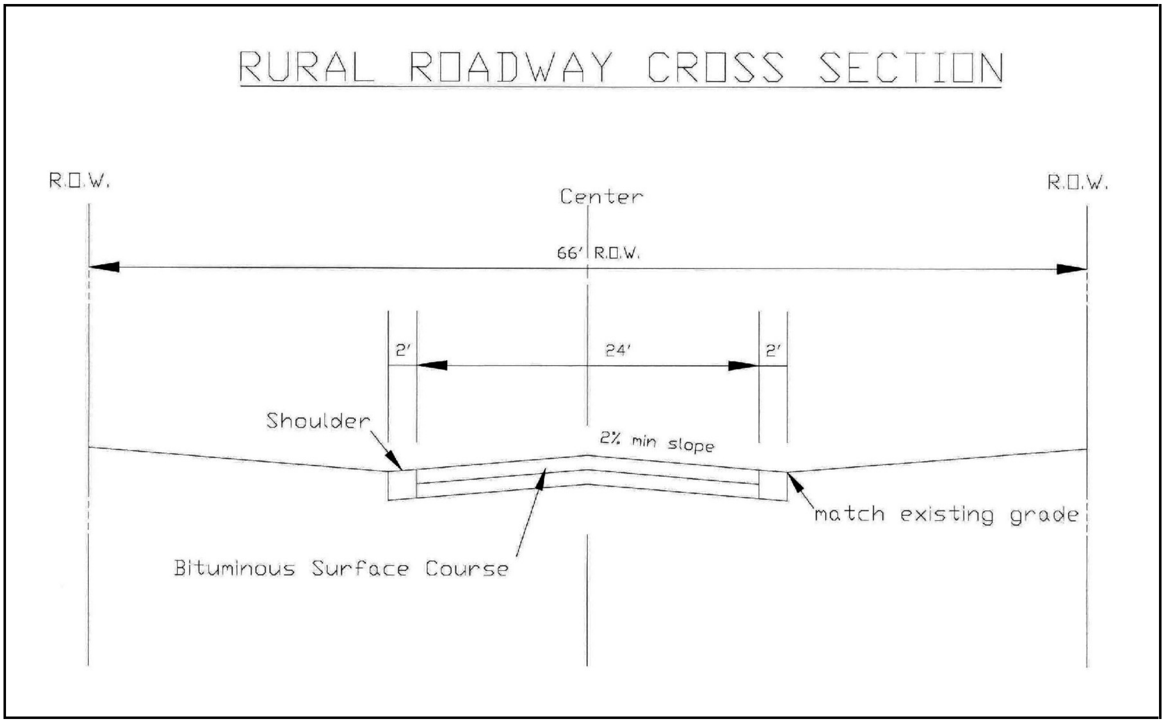


Figure 5-2
Typical Rural Cross Section

When considering the reconstruction of a roadway with a rural cross section, the Village may wish to apply an alternate cross section than those presented above. Two options include (1) a modified rural cross section and (2) a low impact cross section.

Modified Rural Cross Section

The modified rural cross section is similar to the Village's existing standard for a rural cross section, only in includes a storm sewer component. Figure 5-3 illustrates a typical cross section for this alternative.

The modified rural cross section offers advantages over the current rural cross section standard in areas where ditch drainage may be inadequate. In areas where ditch slopes are relatively flat, the ditches become susceptible to siltation and vegetation, which reduces the carrying capacity. Additionally, a wider ditch is needed to convey the full design flow. By adding inlet structures at strategic points along the ditch profile, areas that may otherwise be susceptible to ponding can drain, and a narrower ditch can be used since the peak ditch flow will be decreased because of stormwater being intercepted by upstream inlets.

Disadvantages of the modified rural cross section include cost and maintenance issues. The cost will be higher than the typical rural cross section because additional storm sewer infrastructure needs to be constructed. However, the cost would still be lower than that of the urban, curb and gutter cross section. Additionally, maintenance needs are greater with the modified rural cross section. With the typical rural cross section, maintenance needs to be performed on the ditches, such as mowing and periodic regarding, to keep them functioning properly. With the modified rural cross section, the same ditch maintenance needs to be performed, along with ongoing maintenance of the underground infrastructure.

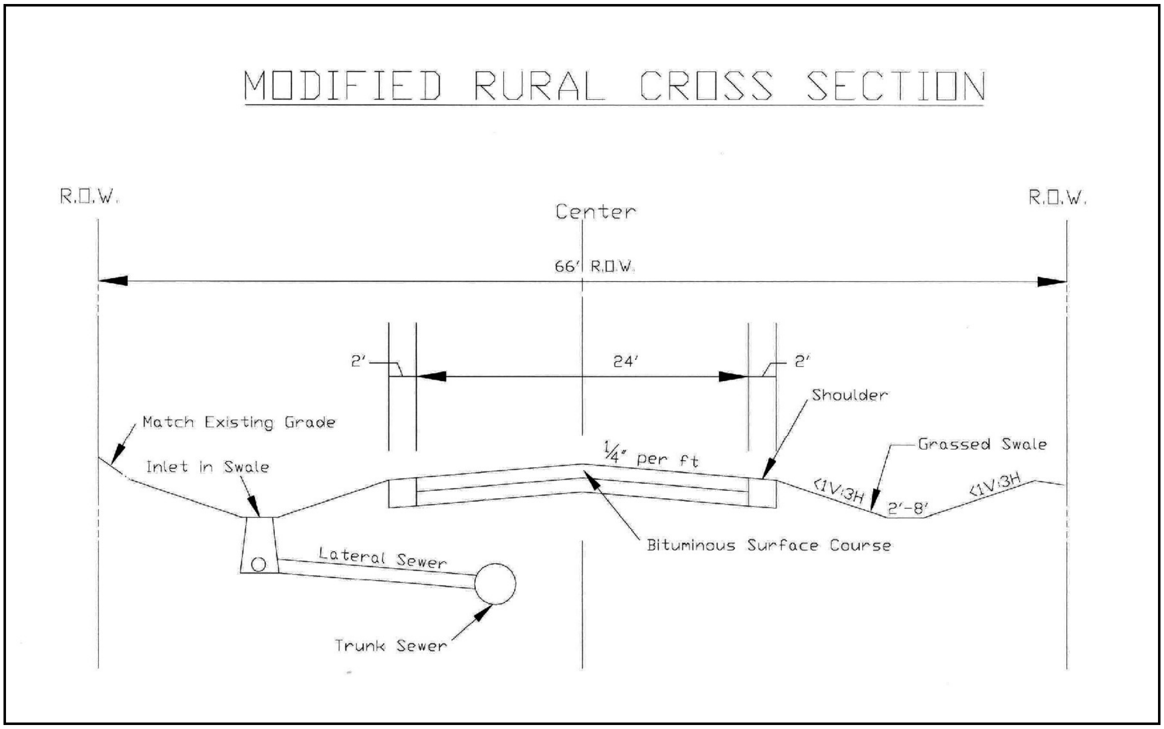


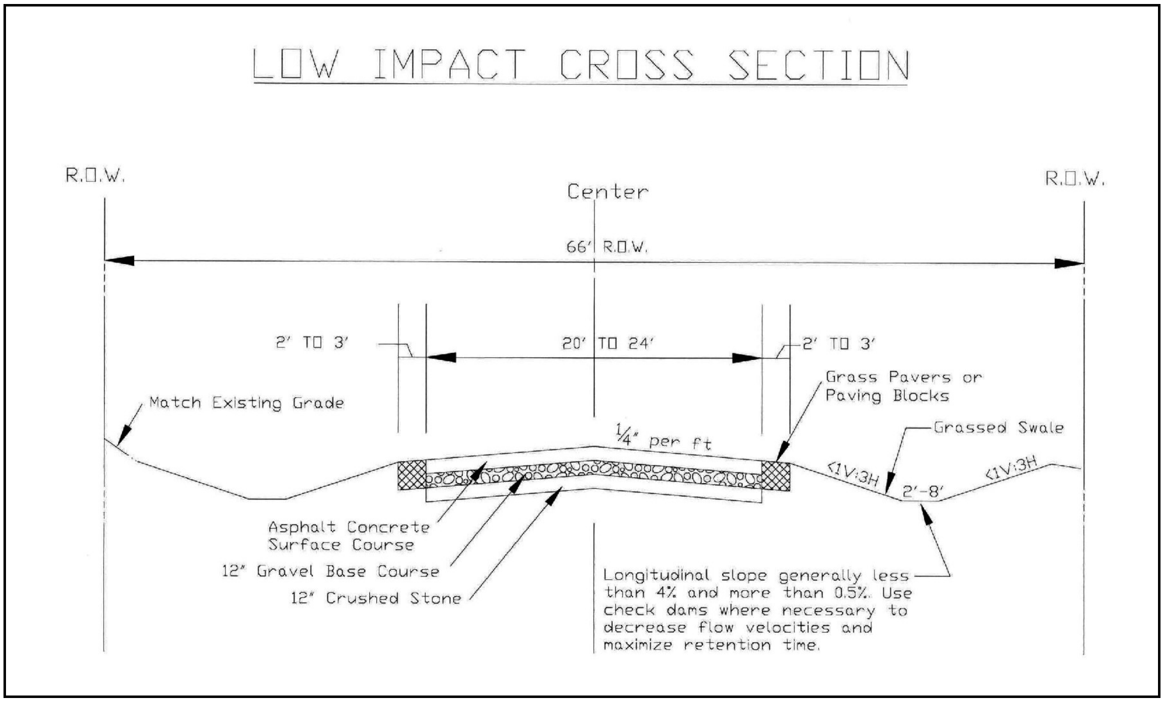
Figure 5-3
Example of a Modified Rural Cross Section

Low Impact Cross Section

The second alternative to the Village's existing typical cross sections is the adoption of the low impact cross section. The goal of this cross section is to reduce the impacts of the roadway's impervious area on stormwater runoff. The goals of this type of design are to reduce the total impervious area, minimize disturbance to the site's natural topography and create opportunities for stormwater treatment and infiltration.

The low impact cross section has a typical roadway width of 20 to 24 feet in residential areas. The purpose of the narrower roadway width is to decrease impervious area when it is not needed; in a typical neighborhood, two, 12-foot lanes are adequate for two-way traffic. The Village's standard width of 24 feet in residential areas conforms to this recommendation.

Since curbs and gutters concentrate stormwater runoff and increase flow rates, these are not used in the low-impact scenario. Instead, an open road cross section, similar to the Village's rural cross section, is used, with stormwater conveyed into filter strips and swales. The use of the filter strips promotes infiltration and slows the flow velocities. If the site-specific conditions require a curb, there are options such as invisible curbs, periodic curb cuts, or perforated curbs which can be used. Figure 5-4 illustrates a low impact cross section, and Figure 5-5 illustrates the various curb options available.



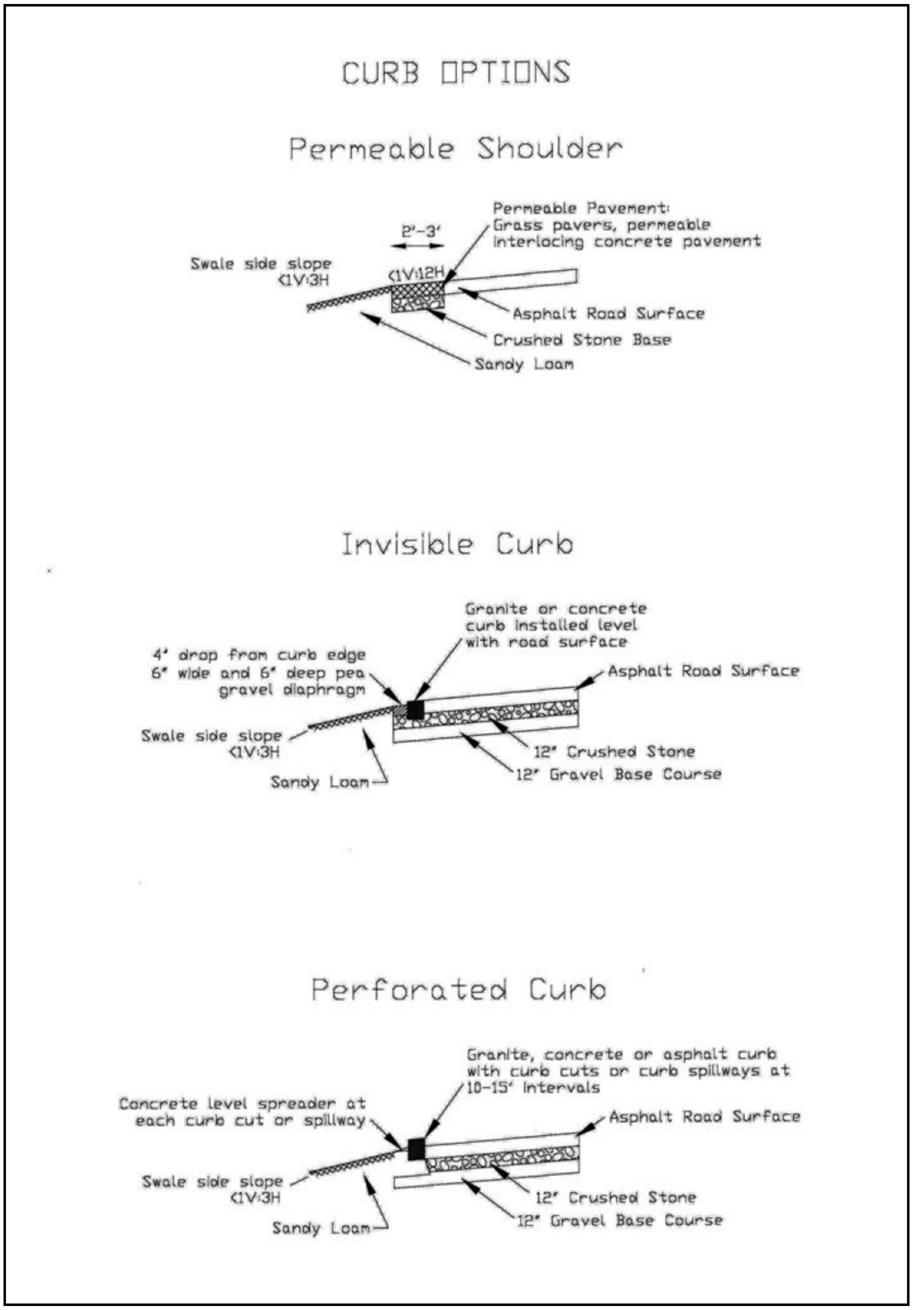
Source: Massachusetts Smart Growth Toolkit

Figure 5-4
Example of a Low Impact Cross Section

There are limitations to the use of a low impact cross section. First, since the design promotes infiltration, the ground has to have an adequate infiltration capacity. Since the Village has a high instance of clay soils and/or high water tables, this option will not be applicable in all areas. Amending the soils may be possible in some areas, but this may lead to flooding problems over time as the soil becomes compacted and as fine particles (from upstream erosion) settle in the ditch bottoms.

The low impact cross section may require a wider cross section than other options. Although, in some areas, it may be no wider than the standard rural cross section, in other areas a wider ditch may be needed to hold the runoff volume to promote infiltration.

A third limitation involves the maintenance of the roadway. Maintenance staff will need to be trained in the maintenance of the filter strips, permeable pavement shoulders, and other unique properties of the roadway. However, as time passes, employee turnover of the maintenance staff will lead to an inevitable decrease in staff with knowledge of proper roadway maintenance for low impact roadways.



Source: Massachusetts Smart Growth Toolkit

Figure 5-5
Examples of a Low Impact Curb Options

The design and construction of low impact roadways will need to be performed by engineers and contractors familiar with the new methods. Roadways designed without the proper knowledge of stormwater infiltration methods and low impact design principles may lead to a roadway which does not provide any more benefits than the typical rural cross section. Contractors should be selected who have worked with atypical roadway designs before; construction of features such as the permeable shoulder cannot be done with standard paving equipment.

Selection of the cross section which is best suited for an individual roadway will depend on site characteristics and the preferences of the Village as well as the residents. Table 5-1 compares the attributes of the four cross sections discussed in this section.

Table 5-1
Cross Section Attribute Comparison

Attribute	**Cross Section Type**			
	Urban	**Modified Rural**	**Rural**	**Low Impact**
Time of Concentration	Shorter time of concentration and higher flow velocities	Moderate	Moderate	Longer time of concentration and lower flow velocities
Flow Volume	Higher flow volumes due to large impervious area with no infiltration	Moderate	Moderate	Lower flow volumes due to infiltration and less impervious area.
Water Quality Benefit	None	Some filtration provided by ditches. Minor reduction in common stormwater pollutants such as heavy metals and nutrients.	Some filtration provided by ditches. Minor reduction in common stormwater pollutants such as heavy metals and nutrients.	Considerable filtration provided by filter strips. Significant reduction in common stormwater pollutants such as heavy metals and nutrients.
Right-of-Way Requirements	Can be built with narrow R.O.W.	Moderate; ditches can be narrower that Rural option because of removal of flow from ditches via storm sewer	Moderate; ditches may need to be wide in some areas	Moderate to High; some areas may require wide ditches to accommodate infiltration practices
Loss of Trees / Vegetation	Low	Moderate, depending on width of ditch	Moderate, depending on width of ditch	Moderate to High, depending on width of ditch, but cross section can be designed to be aesthetically pleasing
Maintenance Requirements	Moderate to High due to number of drainage structures and length of sewer installed	Moderate; less underground infrastructure than Urban, but ditch maintenance also needed	Low; requires periodic cleaning of ditches and culverts	Moderate; must be performed by knowledgeable staff
Pavement Durability	Standard durability	Standard durability	Standard durability	Moderate; shoulders or curbs may not be as durable as other options due to materials used
Cost	High, due to amount of underground infrastructure and construction of curb & gutter	Moderate, due to need to install some underground infrastructure	Low	Moderate; material costs similar to Rural options, but higher engineering and construction costs