

MANISTEE CITY PLANNING COMMISSION
Meeting of Thursday, February 5, 2015
7:00 p.m. - Council Chambers, City Hall, 70 Maple Street,
Manistee, Michigan

AGENDA

I Call to Order

II Roll Call

III Approval of Agenda

At this time the Planning Commission can take action to approve the February 5, 2015 Agenda.

IV Approval of Minutes

At this time Planning Commission can take action to approve the January 8, 2015 meeting Minutes.

V Public Hearing

VI Public Comment on Agenda Related items

VII New Business

VIII Old Business

IX Public Comments and Communications

At this time the Chair will ask if there are any public comments.

X Correspondence

At this time the Chair will ask if any correspondence has been received to be read into the record.

XI Staff/Sub-Committee Reports

At this time the Chair will ask Staff for their report.

At this time the Chair will ask if any of the Sub-Committees have anything to report.

XII Members Discussion

At this time the Chair will ask members of the Planning Commission if they have any items they want to discuss.

XIII Worksession

Green Infrastructure – The Planning Commission will begin discussion on developing an Ordinance Amendment addressing green infrastructure.

Redevelopment Sites – The Planning Commission will review potential Redevelopment Sites.

Misc.

XIV Adjournment

Memorandum



TO: Planning Commissioners

FROM: Denise Blakeslee
Planning & Zoning Administrator

DATE: January 28, 2015

RE: February 5, 2015 Meeting

Denise Blakeslee
Planning & Zoning
Administrator
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Commissioners, the Planning Commission will hold a meeting on Thursday, February 5, 2015. We have not received any requests for the Commission to take action on.

This gave us the opportunity to schedule a worksession so that we can begin discussion on the following:

Green Infrastructure

Redevelopment Sites

Misc.

If you are unable to attend the meeting, please call me at 398.2805.

CITY OF MANISTEE PLANNING COMMISSION

70 Maple Street
Manistee, MI 49660

MEETING MINUTES

January 8, 2015

A meeting of the Manistee City Planning Commission was held on Thursday, January 8, 2015 at 7pm in the Council Chambers, City Hall, 70 Maple Street, Manistee, Michigan.

Meeting was called to order at 7:02 pm by Chair Yoder

Roll Call:

Members Present: Maureen Barry, Judd Brown, Ray Fortier, Mark Wittlieff, Roger Yoder

Members Absent: Bill Dean (excused), Marlene McBride (excused)

Others: Mitch Deisch (City Manager), Ed Seng (200 River Street), and Denise Blakeslee (Planning & Zoning Administrator)

APPROVAL OF AGENDA

Motion by Ray Fortier, seconded by Judd Brown that the agenda be approved as prepared.

With a Roll Call vote this motion passed 5 to 0.

Yes: Barry, Brown, Fortier, Wittlieff, Yoder

No: None

APPROVAL OF MINUTES

Motion by Ray Fortier, seconded by Judd Brown that the minutes of the December 4, 2014 Planning Commission Meeting be approved as prepared.

With a Roll Call vote this motion passed 5 to 0.

Yes: Fortier, Barry, Brown, Wittlieff, Yoder

No: None

PUBLIC HEARING

None

PUBLIC COMMENT ON AGENDA RELATED ITEMS

None

NEW BUSINESS

Sub-Committee Appointments

According to the By-Laws of the City of Manistee Planning Commission the Chair will appoint members of the Planning Commission to serve on Sub-Committees of the Planning Commission and one member who shall serve on the Zoning Board of Appeals.

Executive Committee (Chair, Vice Chair, Secretary)/ Ordinance Re-Write Committee - Members of this committee will assist in reviewing the Zoning Ordinance for areas that need to be changed and/or updated and if needed review Zoning Ordinance Amendments with the City Council Ordinance Review Committee. *Meet as needed*

Chair Yoder appointed: **Ray Fortier - Vice Chair, Marlene McBride – Secretary, Roger Yoder - Chair**

Master Plan Review Committee/Green Initiative - Ad Hoc Committee - Members of this committee will be responsible to keep current with new trends/changes that are going on in the community that could impact the Master Plan and will review Green Initiative programs for the City of Manistee. These programs could include wind, solar and alternative energy programs that would benefit the community. *Meet as needed*

Chair Yoder appointed: **Bill Dean, Marlene McBride, and Judd Brown**

Site Plan Review/ Subdivision Committee - Site Plan Review Committee – Needed for Medium Site Plans for new construction; the Zoning Administrator has the option to forward requests to the Committee. Committee Review required for Planned Unit Developments. Subdivision Committee - This committee is required under section 1242.03 of the Code of Ordinances. *Meet as needed*

Chair Yoder appointed: **Bill Dean, Mark Wittlieff, and Roger Yoder**

Chair Yoder appointed 2 Alternates: **Maureen Barry and Judd Brown**

Zoning Board of Appeals - One member of the Planning Commission will be appointed as the **Planning Commission Representative on the Zoning Board of Appeals.**

Chair Yoder appointed **Ray Fortier**

County Wide Park & Recreation Plan Leadership Team - Manistee County and the Alliance for Economic Success have requested that one member of the City of Manistee Planning Commission serve on the County Wide Park & Recreation Plan Leadership Team.

Chair Yoder appointed **Maureen Barry and Judd Brown**

By Law Review

According to the By-Laws of the City of Manistee Planning Commission the commission shall annually review their By-Laws at the regularly scheduled meeting in January.

No Changes were made to the By-Laws.

Master Plan Review

Under Section 125.3845, Sec. 45 (2) "At least every 5 years after adoption of a master plan, a planning commission shall review the master plan and determine whether to commence the procedure to amend the master plan or adopt a new master plan. The review and its findings shall be recorded in the minutes of the relevant meeting or meetings of the planning commission."

Motion by Mark Wittlieff, seconded by Maureen Barry that the Planning Commission will continue their work on rewriting the City of Manistee Master Plan

With a Roll Call vote this motion passed 5 to 0.

Yes: Wittlieff, Fortier, Barry, Brown, Yoder

No: None

Michigan Right to Farm Act/GAAMP

Due to the severe weather the commission will add this item to the January Worksession.

Manistee County Regional Parks, Recreation and Trail Development Plan Initiative

Due to the severe weather the commission will add this item to the January Worksession.

OLD BUSINESS

Zoning Review P-D Peninsula District

City Council has requested the Planning Commission review the current Zoning of the Peninsula District and review the zoning ordinance for specific uses that need to be addressed. A final draft of Findings of Facts was sent to the Commission to review and approve.

MOTION by Maureen Barry, seconded by Judd Brown that the Planning Commission has completed their review of the P-D Peninsula District as requested by City Council, prepared a Finding of Facts (attached) that will be certified by the Secretary of the Planning Commission than forwarded to City Council.

With a Roll Call vote this motion passed 4 to 1.

Yes: Barry, Brown, Wittlieff, Yoder
No: Fortier

PUBLIC COMMENTS AND COMMUNICATIONS

None

CORRESPONDENCE

None

STAFF/SUB-COMMITTEE REPORTS

Denise Blakeslee, Planning & Zoning Administrator – Spoke to the Commission about inquiries to provide for Transient Housing/Homeless Shelter, this will be added to the January Worksession Agenda for discussion along with discussion about City owned property.

Mitch Deisch, City Manager – Spoke to the Commission about the remaining privately owned parcel on Man Made Lake.

MEMBERS DISCUSSION

None

The Planning Commission will hold a Worksession on January 22, 2015

The next regular meeting of the Planning Commission will be held on Thursday, February 5, 2015

ADJOURNMENT

Motion by Ray Fortier, seconded by Judd Brown that the meeting be adjourned. MOTION PASSED UNANIMOUSLY.

Meeting adjourned at 7:35 pm

MANISTEE PLANNING COMMISSION

Denise J. Blakeslee, Recording Secretary

Report of Findings



TO: City Council
FROM: City of Manistee Planning Commission
DATE: January 8, 2015
RE: P-D Peninsula District Review

The Planning Commission has completed the review of the P-D Peninsula as requested by City Council. Each parcel was reviewed for dimensional standards, use and if it were a legal non-conformity (grandfathered). This discussion began at the August 7, 2014 Meeting where the Commission began to review the parcels and existing land uses for each parcel in the District. Staff sent out an invitation to the property owners and occupants in the district that invited them to the September 4, 2014 meeting asking them for their input on the zoning uses in the P-D Peninsula District. The Commission received public input where 12 people spoke and five letters were received.

At the September Worksession the Commission continued their review of P-D Peninsula District. The Commission reviewed the Old Zoning Districts and discussed concerns by residents in the area of Smith Street and Webster Court wanting to be in a Residential District instead of the Peninsula District. Staff reviewed the table of uses for the P-D Peninsula District Zoning and the uses allowed under the old ordinance (prior to March 27, 2006) and dimensional standards.

At the October meeting Staff prepared a review of the Parcels in the PD Peninsula and the adjoining R-3 High Density Residential District. This was done to determine how many parcels met the dimensional standards of the Zoning District and how many non-conforming parcels there are. The uses of the parcels were compared to determine how many conformed to the district standards and how many were non-conforming. Review of the Table of Uses at the October Worksession included suggested changes and Items to further discuss included:

| | |
|-----------------------------------|----------------------------------|
| Animal Grooming | Consider adding as a Special Use |
| Contractors Facilities | Further Discussion |
| Day Care, Group | Consider adding as a Special Use |
| Eating and Drinking Establishment | Change to Use by Right |
| Financial Institution | Further Discussion |
| Greenhouse & Nursery | Consider adding as Special Use |
| Shipping Facility | Further Discussion |

The Commission also discussed parking requirements.

The Commission continued their review of the P-D Peninsula District at the November meeting. Outstanding items include:

- What is the Commission's vision for the Peninsula?
- Does the Peninsula Redevelopment Plan still apply?
- Should changes be made to the Dimensional Standards in the Peninsula?
- What changes should be made to the Uses in the Peninsula?
- Should there be changes to the Parking Requirements?

There are two properties in the P-D Peninsula District that were designated by the Michigan Legislature as Renaissance Zones. The Renaissance Zone expires on December 31, 2014. The Report of Findings should include a recommendation for a Zoning Amendment that would delete Section 605 Peninsula District Renaissance Zone Standards.

Staff prepared a Parcel Area Comparison Table of Commercial/Industrial District for review. A table of Uses with the discussion from the October 16, 2014 Worksession noted and a copy of Section 514 Parking Standards for further discussion. The Commission discussed the Purpose and Intent of the District to see if any changes should be considered.

On November 20, 2014 the Commission began to draft their Report of Findings that was finalized at their January 8, 2015 meeting. After six meetings and three worksession the findings of the Commission are as follows:

Section 600 Purpose and Intent

A Zoning Amendment should be considered that would amend Section 600 Purpose and Intent in the P-D Peninsula District as follows:

It is the intent of this District to establish a mixed-use district incorporating a variety of recreational, residential, business or service uses on or near the Waterfront. This district is intended to encourage and promote sustainable, environmentally and aesthetically compatible developments that use or compliment the shoreline while promoting expanded use of the shoreline by the public. The District is intended to host a variety of land uses including, but not limited to, residential, commercial, entertainment, recreational, service, and **mixed use**.

Section 601 Uses Permitted by Right

After a detailed review of the Table of Uses the findings of the Commission are as follows:

A Zoning Amendment should be considered that would amend Section 601 Uses Permitted by Right in the P-D Peninsula District as follows:

1. **ADD Contractors Facility**
2. **ADD Eating and Drinking Establishments** – change from a Special Use
3. **ADD Mixed Use** – change from a Special Use

Section 602 Uses Permitted by Special Land Use

After a detailed review of the Table of Uses the findings of the Commission are as follows:

A Zoning Amendment should be considered that would amend Section 602 Uses Permitted by Special Land Use in the P-D Peninsula District as follows:

1. **ADD Animal Grooming**
2. **DELETE Eating and Drinking Establishment** – Changing to a Use by Right
3. **ADD Financial Institution** – Change from a Special Use Requiring Key Street Frontage
4. **ADD Greenhouse & Nursery**
5. **DELETE Mixed Use** – Changing to a Use by Right

6. **Shipping Facility** - The Planning Commission would consider allowing a Shipping Facility as a Special Use in the P-D if language could be developed that the Commission is comfortable with.

DELETE Section 603 Uses Permitted by Special Land Use Permit, Requires Frontage on a Key Street Segment

There are only three parcels with Key Street Frontage (US 31/Cypress Street) in the P-D Peninsula District. The findings of the Commission are as follows:

1. DELETE - **Financial Institution** – Changing to a Special Use
2. DELETE - **Motel**
3. DELETE - **Places of Public Assembly, Large**
4. DELETE - **Theater**

Section 604 Dimensional Standards

The Commission reviewed each of the 74 Parcels/67 Zoning Parcels (7 Zoning Lots) in the P-D District.

- 22 Legal Non-Conforming Parcels that do not meet the Minimum Lot Dimensional requirements
- 21 Parcels meet the Minimum Lot Dimensional Requirement for a Single Unit
 - 7 Legal Non-Conforming Uses (Commercial/Multi Family – parcels too small)
- 24 Parcels meet the Minimum Lot Dimensional Requirements for a Duplex or Commercial Use
 - 7 Legal-Non-Conforming Uses (Uses not permitted in the P-D Peninsula District)
 - Accessory Structure – No primary structure on parcel
 - Processing & Manufacturing
 - Contractor’s Facility
 - Warehouse’s (4 parcels)

The findings of the Commission are as follows:

A Zoning Amendment should be considered that would amend the Dimensional Requirements in the P-D Peninsula District as follows:

| District | Minimum Lot Dimensions | | Maximum Lot Coverage | Minimum Yard Requirements (feet) | | | Maximum Density | Maximum Height | Minimum Floor Area Per Dwelling and Width |
|---------------------------------|---------------------------------|---------------|--------------------------------------|----------------------------------|------|--------------------------------|-----------------|------------------------------|---|
| | Area (sq. ft.) | Width (feet) | (%) of gross lot area ^(b) | Front ^(a) | Side | Rear/Waterfront ^(f) | DU/Acre | Feet/stories (Principal Bld) | (Sq.Ft. & Ft) |
| P-D | | | | | | | | | |
| Single-Unit | 6,000 | 60 | | | | | | | |
| Duplex or Commercial | 10,000 | 80 | 60% | 15 | 10 | 10/20 | 17 | 35/2½ | 550/20 |
| Multi-Unit | 10,000^(c) | 80 | | | | | | | |

DELETING the standards for requiring larger parcel area and width for Duplex, Commercial and Multi Unit Dwellings in Section 604 and in the Table of Uses.

DELETE Section 605 Peninsula District Renaissance Zone Standards

There are two properties in the P-D Peninsula District that were designated by the Michigan Legislature as Renaissance Zones. The Renaissance Zone expired on December 31, 2014. The findings of the Commission are as follows:

A Zoning Amendment should be considered that would **DELETE** Section 605 Peninsula District Renaissance Zone Standards.

Section 514 Vehicular Parking Space, Access, Bike Parking and Sidewalks

The Commission reviewed the parking and felt that parking in the P-D Peninsula District should be less restrictive. The new streetscape including curb and gutter and sidewalks in the district allows for safe pedestrian movement with on street parking similar to the downtown. The findings of the Commission are as follows:

A Zoning Amendment should be considered that would amend Section 514 Vehicular Parking Space, Access, Bike Parking and Sidewalks as follows:

ADD new item that reads:

For all permitted uses and special uses in the P-D District the parking provisions of this section shall not apply, except hotels, marinas, and places of public assembly.

AMEND item H. by adding P-D as follows:

- H. Within the C-1, C-2, C-3 and **P-D** Districts, the Planning Commission may approve shared parking arrangements among various uses when it can be demonstrated that parking in sufficient quantities for all such uses as set forth in this Section shall be available at all times.

The City of Manistee Planning Commission directs staff to begin the necessary paperwork to draft language for a Zoning Ordinance Amendment.

CITY OF MANISTEE PLANNING COMMISSION:

AYES: Barry, Brown, Wittlieff, Yoder

ABSTAINING: None

NAYS: Fortier

ABSENT: Dean, McBride

MOTION: CARRIED

CERTIFICATION:

I, Marlene McBride, Secretary of the City of Manistee Planning Commission certify that the foregoing is a true and complete record of action taken by the Planning Commission at their regular meeting of January 8, 2015.

Marlene McBride, Secretary

CITY OF MANISTEE PLANNING COMMISSION WORKSESSION

70 Maple Street, Manistee, MI 49660

January 22, 2015

NOTES

A Worksession of the Manistee City Planning Commission was held on Thursday, January 22, 2015 at 7 pm in the Council Chambers, City Hall, 70 Maple Street, Manistee, Michigan.

Meeting was called to order at 7 pm by Vice Chair Fortier

Roll Call:

Members Present: Maureen Barry, Judd Brown, Bill Dean, Ray Fortier, Marlene McBride

Members Absent: Mark Wittlieff (excused), Roger Yoder (excused)

Others: Denise Blakeslee (Planning & Zoning Administrator)

ITEM

Michigan Right to Farm Act/GAAMP - The Planning Commission discussed the Michigan Right to Farm Act and changes in Generally Accepted Agricultural and Management Practice (GAAMP). The Commission discussed if chickens, ducks and pet pigs should be allowed in the City and if allowed, what Zoning District would be most appropriate?

Manistee County Regional Parks, Recreation and Trail Development Plan Initiative – Commissioner Brown attended the meeting and reported back to the Commission. The City DPW Director discussed that the City form an Ad Hoc Committee with a member from the Planning Commission, Non-Motorized Transportation, and Parks Commission. Mr. Mikula is the City DPW Director and also is representing Manistee Township on the Initiative. The group is working towards developing a County Recreation Plan.

Transient Housing/Homeless Shelters – Staff has received inquiries about the need to provide for Transient Housing and/or Homeless Shelters. Discussion included the difference between a Homeless Shelter, an Adult Rehabilitation Facility and a facility for people who have been released from a Correctional Facility. This discussion was prompted from inquiries from Stonehouse and the United Way.

City Property – The Planning Commission reviewed vacant property that the City owns in the City of Manistee.

ADJOURNMENT - The Worksession adjourned at 7:55 pm

MANISTEE PLANNING COMMISSION

Denise J. Blakeslee, Recording Secretary

Memorandum



TO: Planning Commissioners

FROM: Denise Blakeslee
Planning & Zoning Administrator

DATE: January 27, 2015

RE: Redevelopment Ready Communities Program

Denise Blakeslee
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Commissioners, there are two components that we need to work on for Certification in the Redevelopment Ready Community Programs. The first is developing Green Infrastructure Language for the Zoning Ordinance. Included in your packets are copies of **Chapter 10 Michigan LID Case Studies** from the Southeast Michigan Council of Governments (SEMCOG) manual *Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers 2008*. You will also find a copy of the *Landscaping for Water Quality Guide* produced by the Center for Environmental Study.

This is a starting place to being drafting an ordinance amendment that will include standards for porous paving, rain gardens, swales and a vegetated roof. Staff has compiled sample ordinance language from the City of Ypsilanti and Sections from our Ordinance as a starting point for our discussion.

The second item that we will be discussing is identifying Sites for Redevelopment. Staff has been working on a PowerPoint presentation that we will work from at the meeting.

GREEN INFRASTRUCTURE

DEFINITIONS (Ypsilanti):

POROUS PAVING: Systems that allow water to pass freely through interstitial space ingrained throughout the paving matrix, thereby transforming traditionally impervious surfaces such as pervious concrete and asphalt interlocking pavers, reinforced gravel and grass paving.

RAIN GARDENS: Landscaped depressions that can be built to any size or shape. Also known as 'bio-retention cells', they are designed to allow water to settle and infiltrate into the soil.

SWALE VEGETATED ROCK: A densely vegetated or rock lined drainage ways with low-pitched side slopes that detain, evaporate, and/or infiltrate the runoff associated with a storm event.

SWALE BIOFILTRATION: A shallow drainage way that employ landscaping to stabilize the soil while providing water quality treatment, designed to remove silt and sediment-associated pollutants before discharging to storm sewers and to reduce volume if soils allow for infiltration.

VEGETATED ROOF: The roof of a building that is partially or completely covered with vegetation, including for food production, and a growing medium, planted over a waterproofing membrane.

SECTION 503 PERFORMANCE STANDARDS

- A. No parcel, building or structure in any Zoning District shall be used or occupied in any manner so as to create any dangerous, injurious, noxious or otherwise objectionable element or condition so as to adversely affect the surrounding area or adjoining premises provided any use permitted by this Ordinance may be undertaken and maintained if acceptable measures and safeguards are employed to limit dangerous and objectionable elements to acceptable limits as established by the following performance requirements:
1. No vibration shall be permitted in excess of the applicable City noise regulations (City Code Part Six, Chapter 662: Peace Disturbances) or regulations promulgated by rule thereunder.
 2. No audible noise shall be permitted in excess of City noise regulations (City Code Part Six, Chapter 662: Peace Disturbances) or regulations promulgated by rule there under.
 3. No storm water runoff, which is a result of development site design, or other manmade features, shall be allowed to collect which results in water standing on the surface, unless the standing water is a part of a properly managed and maintained storm water retention system, sediment pond; or the standing water is in a naturally occurring wetland or water body. **DISCUSS ADDING LANGUAGE THAT REFERENCES/INCLUDES STORMWATER CONTROL FEATURES.**

As an alternative, if in the opinion of the City's consulting engineer, the soils are of a type which will allow for efficient drainage, the use of drywells, infiltration trenches, swales, bio-retention or other best management practices for controlling urban runoff quality are permitted. – Example Ypsilanti

- B. The Administrator shall enforce this Section and **Section 504** by cooperating with and reporting suspected violations to the respective enforcement agency(s) responsible for administration of the statutes, rules or ordinances cited above.

SECTION 511 DRIVEWAYS AND CURB CUTS

- A. In the P-D, R-4, C-1, C-2, W-F, L-I and G-I Districts, driveway entrances and exits to a property shall comply with the following standards unless superseded by State or Federal statute or rule. [Annotation: PD was added by amendment Z12-08, effective 10/27/12]
 - 1. The location of a driveway curb cut to any street shall be a minimum of fifty (50) feet from an intersection of any two streets, measured from the edge of the respective rights-of-way. Provided that, parcels greater than one hundred (100) feet in width, which shall have driveways curb cuts at least sixty (60) feet from an intersection measured at the edge of the public right-of-way.
 - 2. Driveway curb cuts shall be aligned with driveways on the opposite side of the street or offset a minimum distance of thirty (30) feet, measured from centerline to centerline.
 - 3. Driveways on the same side of a local street shall be separated by at least thirty (30) feet, measured from centerline to centerline. Provided, that common or shared drives shall have zero distance between them but shall comply with required distances from intersections and other driveways as set forth in this section.
 - 4. Exit-only or entrance-only driveways and driveways for dwellings and duplexes, shall be a minimum of ten (10) feet, and no more than twenty (20) feet in width. All other driveways shall be a minimum of twenty (20) feet but no more than thirty five (35) feet in width.
- B. In the **G-C**, R-1, R-2 and R-3 districts, driveway curb cuts shall be placed at least thirty (30) feet from an intersection.
- C. All driveways in every district shall be located at least three (3) feet from a side yard property line.
- D. A driveway curb cut shall not be constructed unto a city-owned street unless a driveway is also being constructed.
- E. In those areas without curbs and gutters, the requirements of this section shall apply and be administered as if the curb and gutters were present.
- F. All driveways shall be paved with asphalt or concrete and connect to the public right-of-way. DISCUSS ADDING LANGUAGE FOR POROUS PAVING
- G. Upon the recommendation of the Zoning Administrator, the Commission may approve a site plan that does not comply the requirements of this section where local conditions make full compliance impossible, providing the distances between the new driveway from street intersections and other driveways is the greatest possible.

SECTION 514 VEHICULAR PARKING SPACE, ACCESS, BIKE PARKING AND SIDEWALKS

- A. For each principal building or establishment hereafter erected or altered and located in any Zoning District, including buildings and structures used principally as places of public assembly, there shall be provided and maintained suitable space off the public right-of-way

which is adequate for the parking or loading of motor vehicles in the proportions shown below. The parking spaces called for hereunder shall be considered minimum requirements under this Ordinance. Where more than one use exists or is proposed on a parcel, the minimum shall be the sum of the required parking for each use, except where it is demonstrated to the Commission that such provisions would be excessive, in which case shared parking may be permitted. All parking areas except for Dwelling Units for Single Family, duplex units and mobile homes; the maximum number of parking spaces shall not exceed 1.5 times the minimum number of required parking spaces

| Use | Number of Parking Spaces Per Unit of Measure |
|---|---|
| Dwellings | Two (2) spaces per Dwelling Unit for Single Family, duplex units and mobile homes. One and a half (1.5) spaces for Multi-Family. |
| Hotels, Motels, Inns and Transient Lodging Places | One (1) space for each rentable room. |
| Hospitals, Nursing and Personal Care Facilities | One (1) space for each four beds, and one (1) space for each employee during the time the largest number of employees are present. |
| Places of public assembly | One (1) space for each four seats of legal capacity. |
| Medical clinics and medical and dental offices | One (1) space for each 50 square feet of usable floor area in waiting rooms, one (1) space for each examining room, dental chair and similar use area, and (1) space for each employee during the time the largest number of employees are present. |
| Offices, other than medical or dental clinics | One (1) space for each 250 square feet of office space. |
| Eating and drinking establishments | One (1) space for each three seats of legal seating capacity. |
| Retail establishments | One (1) space for each 450 square feet of floor area dedicated to retail activity, exclusive of storage areas. |
| Industrial and warehouse uses | One (1) space for each employee during the time the largest number of employees are present plus five (5) spaces for visitors. |

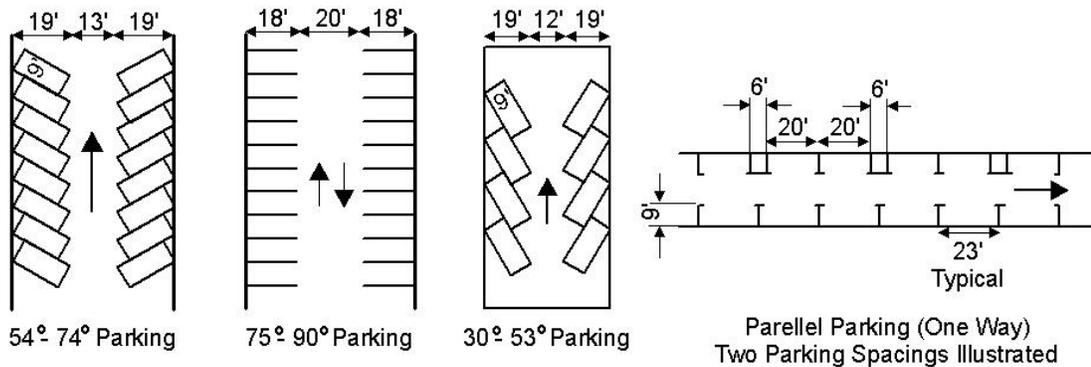
[Annotation: Section Title was changed from Vehicular Parking Space, Access and Lighting to Vehicular Parking Space, Access, Bike Parking and Sidewalks and Section A was amended by Amendment Z12-04; effective 10/27/12]

- B. In the case of uses or businesses not addressed in paragraph A hereof the required parking shall be determined by the Zoning Administrator, subject to Planning Commission concurrence. The latest edition of the Institute of Traffic Engineers *Parking Generation* shall be consulted in determining a parking requirement for any such use or business.
- C. The minimum dimensional standards for parking spaces and aisles shall be as follows.

| Minimum Parking Space and Maneuvering Lane Standards | | | | | | |
|--|--------------|--------------|---------------------------|----------------------------|------------------------------------|--------------|
| Parking Pattern | Lane Width | | Parking Space | | Total Width of Two Tiers Plus Lane | |
| | One-way (ft) | Two-way (ft) | Width ⁽¹⁾ (ft) | Length ⁽²⁾ (ft) | One-way (ft) | Two-way (ft) |
| Parallel | 11 | 18 | 9 | 23 | 40 | 36 |
| 30°-53° | 12 | 18 | 9 | 19 | 50 | 56 |
| 54°-74° | 13 | 19 | 9 | 19 | 51 | 57 |
| 75°-90° | 15 | 20 | 9 | 18 | 51 | 56 |

- (1) Measured Perpendicular to the space centerline.
(2) Measured along the space centerline.

Figure 514



Parking Area Dimensions (for standard-size vehicles)

- D. The approval of the City Engineer shall be obtained for the location of exits and entrances to parking areas and for the design and construction thereof.
- E. Off-street parking areas for all uses requiring City approval shall be paved with concrete or bituminous material with approved curbing and painted parking lines. DISCUSS ADDING LANGUAGE FOR RAIN GARDENS AND POROUS PAVING.

Surfacing. Parking areas and driveways shall be surfaced with crushed limestone or similar gravel material, or shall be hard surfaced with asphalt, concrete, or similar bonded material. Porous paving is also allowed. However, parking areas which are designed for five or more spaces must meet the requirements of subsection 122-835(5). That portion of the driveway between the lot line and the public way, shall be paved with concrete a minimum of six inches thick for residential occupancies and eight inches thick for commercial occupancies. Curb cuts along state trunk lines shall comply with the requirements of the state department of transportation. All other curb cuts shall comply with adopted standards of the Department of Public Works – Example Ypsilanti

Parking areas with ten (10) or more spaces shall include designated pedestrian walkways through the parking lot in addition to landscaped planting islands and perimeter buffers in

accordance with [Section 531](#), in all instances where sufficient space is available. [Annotation: Item E was amended by Amendment Z12-04, effective 10/27/12] *Consider Making this its own item*

Landscape islands must meet the following size requirements:

- (a) Landscape islands containing a tree shall be a minimum of 160 square feet and a minimum of nine (9) feet wide.*
- (b) Landscape islands containing a pedestrian pathway shall be a minimum of eleven (11) feet wide, with a pathway of a minimum width of five (5) feet and minimum three (3) feet wide landscape area on both sides.*
- (c) If landscaped islands are not used for storm water infiltration, the islands must be raised and curbed. – Example Ypsilanti*

- F. For all permitted uses and special uses in the C-3 District the parking provisions of this section shall not apply, except to hotels, motels, and residential use condominiums. [Annotation: Item F was amended by Amendment Z10-03, effective 10/30/10]
- H. Parking areas required under this Section, and city-owned parking lots, shall not be used for the storage of, camping within, or continuous parking or storage of recreational vehicles, trailers, motor vehicles and junk for more than a twenty-four (24) hour period.
- I. Within the C-1, C-2, and C-3 Districts, the Planning Commission may approve shared parking arrangements among various uses when it can be demonstrated that parking in sufficient quantities for all such uses as set forth in this Section shall be available at all times.
- J. No parking area designed for more than 4 vehicles shall be located closer than five (5) feet from the front property line. [Annotation: Item I was added by Amendment Z12-04, effective 10/27/12]
- K. Bike Parking and the installation of a Bike Rack is required for all uses that require Medium Site Plan Review, unless waived in writing by the Zoning Administrator. Bike Parking and the installation of a Bike Rack is required for all uses that require Detailed Site Plan Review unless waived by the Planning Commission. [Annotation: Item J was added by Amendment Z12-04, effective 10/27/12]
- L. In all Districts except the L-I and G-I, sidewalks are required and shall be constructed in accordance with the City of Manistee Sidewalk Standards except as follows:
 - 1. Dwelling, Single Family,
 - 2. Duplex's if waived by the Planning Commission during the Special Use Permit process,
 - 3. Accessory Structures, or
 - 4. Additions or Alterations to existing structures that do not require a Special Use Permit.

SECTION 531 LANDSCAPING AND SCREENING

Whenever a greenbelt, buffer area or vegetation belt is required under the terms of this ordinance, it shall be established in accord with the terms of this Section within six (6) months from the date of issuance of a certificate of occupancy, unless the Planning Commission in any conditions of approval provide for another timeframe for completion.

- A. A landscape plan required under the terms of this ordinance shall be prepared and submitted in conjunction with a site plan. Such landscape plan shall be prepared by a Registered Landscape Architect, professional engineer or by a qualified landscape designer.

Such landscape plan shall provide, to the greatest extent possible, for the preservation and protection of existing natural features on the site.

- B. The landscape plan shall include an inventory of existing trees, wood lots, streams, lakes, wetlands, view sheds and other natural features of the site and detail on the measures proposed to preserve and protect such features. All existing trees having five (5) inches or greater diameter at breast height shall be identified by common or botanical name. Trees proposed to remain, to be transplanted or to be removed shall be so designated. A cluster of trees standing in close proximity (5 feet or closer) may be designated as a "stand" of trees, and the predominant species, estimated number, and average size shall be indicated.
- C. All proposed planting areas for grass, trees, shrubbery and other green space shall be illustrated in the landscape plan. Such illustration shall include the species proposed, the number of plantings, the size of such plantings including the caliber and height, irrigation measures proposed and related information.
- D. The location and nature of lighting, signs, utility fixtures, earth changes, streetscape and any other matter that may affect the appearance of the site shall be illustrated on the landscape plan or site plan.
- E. Not less than thirty percent (30%) of the proposed landscaped area shall consist of woody vegetation, including trees and shrubbery. Landscaped open space shall not include driveways and parking areas. To the greatest extent possible, existing trees over five inches (5") diameter at breast height, shall be retained and protected. Areas of a site plan intended for stormwater detention or retention shall only be included in such required minimum landscaped area if formally landscaped with shrubbery and turf and contoured such that no fencing shall be required.
- F. The area between the edge of the street pavement and property line, with the exception of paved driveways and parking areas permitted by this ordinance, shall be used exclusively for the planting and growing of trees, shrubs, lawns, and other landscaping designed, planted and maintained to serve as a healthy and attractive amenity on the site.
- G. In the event a proposed development includes uses more intense in terms of noise, lighting, traffic, residential density or similar impacts than an existing adjoining use, the Planning Commission may require provision for plantings or other aesthetic screening to mitigate and lessen the potential impact on such adjoining land use.
- H. The applicant shall replace any trees, shrubbery or other plantings that fail to become established and remain viable for a period of two (2) years following completion of all construction on the site. In accordance with [Section 2204, H](#), the City shall require an irrevocable bank letter of credit, certified check or cash in an amount as determined by the City which shall be sufficient to assure the establishment of a viable landscaped area. In the event any of the landscaped materials do not become established and the applicant shall fail to provide a viable replacement, the City shall utilize such bond, irrevocable bank letter of credit or cash to install replacement landscaping materials. After two years of demonstrated viability of all landscape materials, the remaining balance, if any, of such bond, irrevocable bank letter of credit or cash shall be returned to the applicant.

- I. All landscaped areas required pursuant to this section shall be equipped with a watering system capable of providing sufficient water to maintain plants in a healthy condition. Irrigation systems shall be maintained in good working order.

DISCUSS ADDING LANGUAGE THAT REFERENCES/INCLUDES STORMWATER CONTROL FEATURES.

EXAMPLE OF ZONING LANGUAGE CITY OF YPSILANTI

Sec. 122-789. Attached or detached accessory stormwater control features

- (1) Swales: both biofiltration and vegetated/rock swales as defined in 122-3 are permitted in all districts.*
- (2) Pervious paving: permitted in all districts subject to 122- (site plan review), where required, and 122 – (parking lot design).*
- (3) Rain Gardens: as defined in 122-3, rain gardens are permitted in all districts subject to 122-(site plan review), where required. Rain gardens installed accessory to one- or two-family uses in the R-1 district or the Townhouse, Cottage, or House building types in the CN, CN-Mid, CN-SF districts do not require engineering review.*
- (4) Rain Barrels or Cisterns: permitted in all districts subject to 122-(site plan review), where required.*
 - a. Underground cisterns or rain barrels are subject to engineering review and constructed in accordance with the State Building Code.*
 - b. Aboveground rain barrel or cistern systems in excess of 250 gallons accessory to the Mansion, Estate, Apartment House, Courtyard Apartment, Apartment Building, Commercial/Mixed-Use Small, Commercial/Mixed-Use Medium, Commercial/Mixed-Use Large, Single-story Commercial Building, Large Footprint Single Story Commercial Building, Multiple Story, or Institutional building types; or in excess of 250 gallons and located in the R-1 district not accessory to a single-family use; or in excess of 250 gallons and located in the MD or PMD districts, must conform to the accessory building standards in place for those building types and be subject to engineering review and constructed in accordance with the State Building Code.*
- (5) Vegetated roofs: vegetated roof systems are permitted in all districts in accordance with the State Building Code.*
- (6) Other methods: Other methods of onsite stormwater control may be submitted to the City Planner and, at their discretion, may be approved, approved subject to another City department(s) review, approved subject to Planning Commission review, or denied.*

Michigan LID Case Studies

This chapter highlights several developments that have incorporated numerous LID best management practices into their designs. These best management practices help communities meet their land use planning goals of protecting public health, safety, and welfare, as well as preserving community character, and making desirable places for people to live and work.

The following case studies showcase the implementation of numerous best management practices working together through integrated systems. Almost all components of the urban environment have the potential to serve as elements of an integrated stormwater management system. This includes using open space, as well as rooftops, streetscapes, parking lots, sidewalks, and medians.

In addition, these case studies represent various size developments as well as a diverse range of land use types and property ownership. LID is a versatile approach that can be applied equally well to new development, urban redevelopment, and in limited space applications such as along transportation corridors.

Pokagonek Edawat Housing Development

The Pokagonek Edawat Housing Development is located in Dowagiac, MI in Cass County. The Dowagiac River Watershed Management Plan was used as the basis for the design principles in this project, which led to integrating LID techniques into the development.

The Pokagon Band of Potawatomi Indians Tribal Development used nine LID BMPs to arrive at an overall strategy that protects and uses natural flow pathways and preserves natural features in overall stormwater planning and design. This development also maximized stormwater infiltration to ground water through:

- Rain gardens and bioswales,
- Sensitive area preservation,
- Cluster development, and
- Porous pavers.

Rain gardens and bioswales

The first phase, or neighborhood, of the development includes 17 homes. Each home has at least one rain garden that accepts roof-top drainage. During the design process, the native topography of the site was retained as much as possible to preserve the natural drainage. Any stormwater runoff generated from the neighborhood is managed by the depressions where infiltration capacities have been augmented by native vegetation to create bioswales.



Bioswale

Source: Pokagon Band of Potawatomi Indians

The rain gardens and bioswales required approximately two growing seasons to become established. The General Land Office survey notes indicate that the development location was a Mixed Oak Savanna circa 1800s. Thus, plant species associated with savanna and prairie settings were selected. Initial maintenance largely included watering and weeding, and infill planting, as needed. Currently, periodic weeding is the main maintenance activity related to this BMP.

For the bioswales, a combination of plug placement and seeding with a warm season grass drill was used, along with an initial fertilizer application. A mixture of warm season grasses and forbs were selected for the bioswale vegetation. Initial maintenance largely included watering and weeding. Weed management during the first year included mowing. Current maintenance activities include prescribed burns and selective mowing. All maintenance is performed by the Pokagon Band Hous-

ing Department. Most maintenance costs involve the care of limited turf grass that surrounds each home. Watering of the rain gardens is conducted as needed during prolonged dry spells.

Natural flow path and sensitive area preservation

The site was formerly agricultural fields mixed with woodlots. The woodlots and native topography of the site was retained as much as possible to preserve the natural drainage, and the lots and streets were designed around these depressions. Land between these depressions that is not included as a lot and spared via clustered design is scheduled to remain as open space.

Plant species associated with savanna and prairie settings were selected to mimic the presettlement ecosystem. Native vegetation was established by seeding the open space areas with a warm season grass and forb mixture. This was enhanced with selective placement of plugs.

Turf grass was established in small, select locales within the open space to create social gathering areas. Additionally, groomed walking trails were designed into the open spaces and woodlots. Walking trails will connect to subsequent phases of development to create a walkable community.

Annual maintenance costs are chiefly associated with prescribed burns, followed by lesser costs to maintain the limited areas of turf grass. However, the frequency of prescribed burns may be reduced in the future as the landscape matures.

Cluster development

The housing units have been clustered in loops following the site topography with 17 units in the first phase and 16 units scheduled for the second phase. Clustering reduced development costs by shortening roads and utility runs. Smaller lots have reduced lawn and yard maintenance. Clustering also allows for shared bioswales to be established among the buildings, helping to manage runoff. The footprints of the homes were minimized, through smaller hallway space and eliminating foyers, while still providing for maximum usable space.

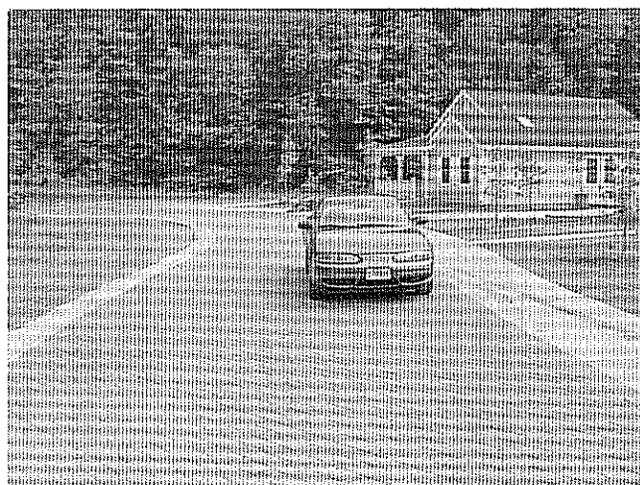
Porous pavers

The street design for the first phase of the development is 1,800 linear feet long with approximately 25,000 square feet of interlocking pavers for the primary driv-



Clustering homes

Source: Pokagon Band of Potawatomi Indians



Reduced imperviousness

Source: Pokagon Band of Potawatomi Indians

ing surface. The street's three-foot depth subbase is composed of a bottom layer of road-grade gravel and crushed concrete overlain by coarse grained sand to help facilitate stormwater infiltration. The earth at the bottom of the subbase is graded with a slight slope toward the central bioswale to assist with drainage during very heavy precipitation events.

Additionally, the sidewalk was constructed using six inches of reinforced concrete and is actually part of the roadway. It is designed to accommodate the weight of heavier emergency vehicles and allow passage in the presence of street traffic and parked vehicles, if needed. This approach also limits impermeable surfaces through the use of pavers and a narrower streetscape, encourag-

ing slower traffic flow while promoting the walkability of the neighborhood.

Curb and gutters were not used in the street design, since the permeable nature of the pavers and subbase made it unnecessary to collect and divert stormwater. However, a concrete border was constructed to anchor the interlocking pavers into place at the outer edges of the street.

The tribal maintenance department is responsible for maintaining the streets. Placing sand between the pavers is conducted as needed, along with periodic weeding.

Additional information

The pre-existing use of the land was agricultural and covered with large areas of wooded open space. Woodlots were maintained and treated with a tree management plan to open the canopy as well as to remove invasive tree species. Invasive underbrush was removed to assist propagation of remnant native vegetation. Half of the Phase I development was integrated into a wooded portion of the parcel for aesthetics and variation. Soil types within the property range from sandy loams to gravelly sands.

Additionally, the wooded areas have been identified as potential conservation areas in a study conducted by the Michigan Natural Features Inventory for a regional green infrastructure project within Cass, Van Buren, and Berrien Counties. The restoration-based concept for the Pokagonek Edawat development demonstrates that conservation and development can be compatible.

Lawrence Technological University - A. Alfred Taubman Student Services Center

The 42,000 square-foot A. Alfred Taubman Student Services Center, located on the Lawrence Technological University Campus in Southfield, MI, in Oakland County not only meets the requirements of the important student services functions it is designed to house, but is also a “living laboratory” of sustainable design and engineering. Built to U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) specifications, the Taubman Student Services Center addresses the criteria of sustainable site development and construction, recycled materials selection, indoor environmental quality, and water and energy efficiency. Specifically related to stormwater manage-

ment, the Taubman Student Services Center uses the following best management practices:

- Vegetated roof,
- Bioswale, and
- Soil restoration.

Vegetated roof

The building’s 10,000 square-foot living vegetated roof is created with layers of insulation, roof membrane, drainage fabric, and a four-inch granular composition that supports nine different species of sedum ground cover. About nine inches thick, the roof offers more effective insulation than traditional roofs and expands and contracts with seasonal changes. It is expected to last about 40 years, more than twice the lifespan of traditional materials.

The vegetated roof also controls and reduces stormwater runoff. With normal rainfall, about 60 percent of the water will be absorbed by the roof while the remainder drains into a 10,000-gallon underground cistern to be used as “gray” water for flushing toilets and for irrigating the campus quadrangle. The weight of the roof is estimated to be 10 to 12 pounds per square foot with a saturated weight of 15 pounds per square foot.



Vegetated Roof at Lawrence Technological University

Source: Lawrence Technological University

The Hydrotech Garden Roof Assembly is an extensive roof that includes the following vegetation:

- *Dianthus plumarius*
- *Koeleria glauca*
- Seven varieties of *Sedum*:
 - *Sedum album*
 - *Sedum floriferum* "Weihenstephaner Gold"
 - *Sedum kamschatcicum*
 - *Sedum spurium*
 - *Sedum spurium* "Fuldaglut"
 - *Sedum spurium* "Summer Glory"
 - *Sedum middendorffianum* "Diffusum"

Maintenance activities included a minor amount of watering (permitted by LEED) in the first two years to develop the roots of the sedum plugs. After the two-year establishment period, watering was cut off. Additionally, the first two years required several weedings due to the spacing between the plugs. Now that the roof has fully filled in, the weeding effort is reduced to almost nothing. These intermittent maintenance activities are performed by the Campus Facilities Department.

Bioswale

A circular bioswale, approximately 725 linear feet was installed around the campus quadrangle. The width of the bioswale varies from eight to 15 feet. The pre-existing soil consisted of clay with minimal topsoil. A system of weirs, tile fields (composed of material made of volcanic ash), and long-rooted grasses and trees will prevent 60 percent of the rainwater that falls on the adjacent campus quadrangle from running into the Rouge River as part of a regional effort to control stormwater drainage and improve the water quality and biodiversity of this portion of the Rouge watershed. This bioswale of vegetation will naturally purify the water by filtering out pollutants commonly found in snow and rain.

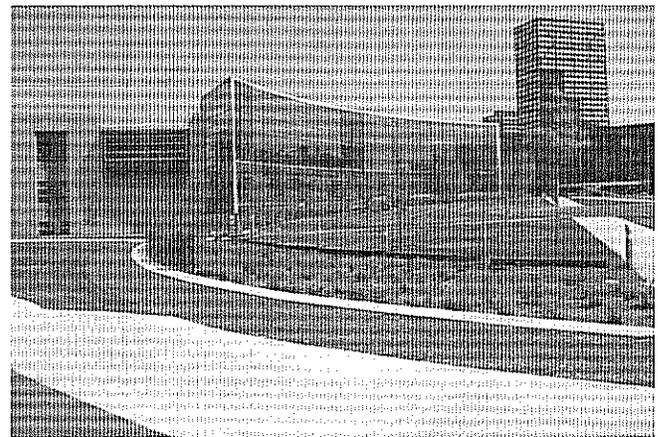
The capacity for the bioswale to capture stormwater runoff was designed for the 10+-year storm event — designed to flood with holding capacity exceeding 10-year event by backing up into the bioswale — essentially a long detention pond. Plants evapotranspiring coupled with free draining soils drain off surface water within 24 to 36 hours. Check dams positioned approximately 30 feet on center through more sloping zones

create additional stormwater holding capacity.

Maintenance activities are conducted by the Lawrence Technological University's Campus Facilities Department. Grasses are cut down in the spring to encourage new growth, along with periodic weeding.

Soil restoration

The upper 18 inches of soil within the bioswale is loamy sand amended with sphagnum peat moss for organic content and pH, covered with shredded hardwood bark mulch. All site subgrade soils were decompacted to a depth of 24 inches following construction operations, including in the bioswale, and prior to finishing landscape soil placement. The operation was performed in order to maximize porosity of subsoils for stormwater infiltration and to foster plant and tree health in the bioswale and all general landscape areas.



Bioswale at Taubman Center, LTU Campus
Source: LTU

Mid Towne Village

Mid Towne Village is a mixed-use urban redevelopment project located in Grand Rapids, MI in Kent County, designed to provide a unique setting that contains a walkable community of residential, retail, and office uses (182,000 sq ft.).

The site was previously an older residential neighborhood consisting of 40 homes. Mid Towne Village is unprecedented in the City of Grand Rapids as it is the first project approved under the new Planned Redevelopment District zoning law passed in the fall of 2003 and uses the following LID BMPs:

- Reduce imperviousness,
- Subsurface infiltration, and
- Capture and reuse using a cistern.

Reduce imperviousness

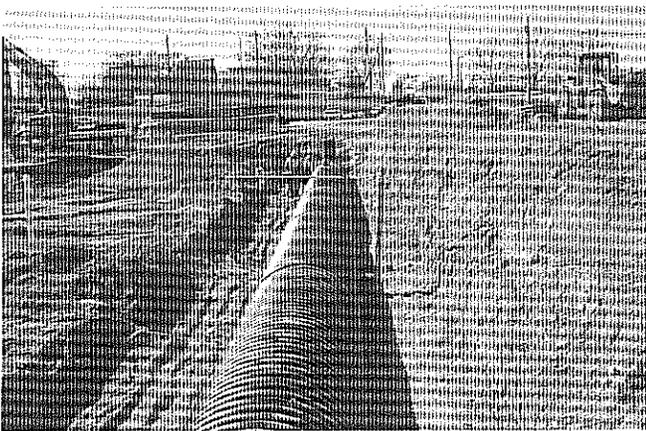
In creating Mid Towne Village, the existing roads and utilities were reconstructed, and an environmentally friendly layout added additional height to the buildings to allow for parking underneath the buildings, construction of subsurface stormwater storage and infiltration, and construction of a cistern to store roof rainwater and reuse it for onsite irrigation purposes.

The Mid Towne Village buildings were built taller to allow for more parking. By incorporating two floors of parking (35,090 sq feet each) into the lower level of the property, exterior impervious surface was reduced resulting in better use of the property.

Cistern and infiltration system

The cistern is located in a park in the middle of the village. The cistern is sized to store 20,000 gallons of roof water from three nearby buildings. The irrigation system of the park area between Union, Dudley, Mid Towne, and Calder streets draws its water from the cistern.

The subsurface infiltration system is sized for the 25-year rain event. The area beneath the park will store 8,950 cubic feet of stormwater; the area along the east side of the site will store 6,774 cubic feet of stormwater. The subsurface stormwater system used the sandy soils and allowed for groundwater recharge, filtration of the stormwater, and eliminated the stormwater connection to the city's storm sewer system. The local rainfall information was reviewed and analyzed to determine the amount of storage necessary to collect adequate supply of rainwater for irrigating the development park area onsite. Using this system, the irrigation system for the development park area was not required to have a separate connection to the city's water system.



Subsurface infiltration system

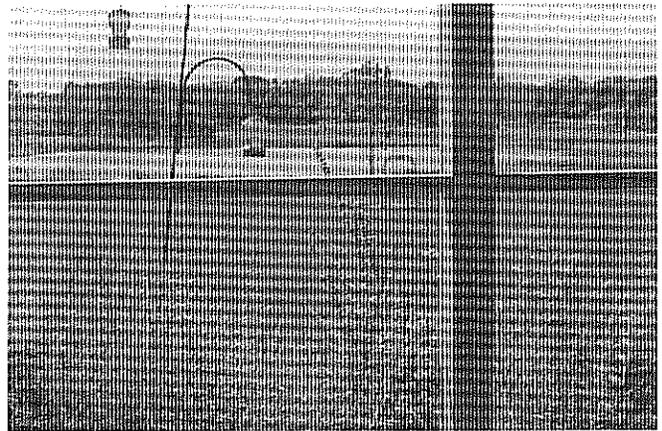
Source: Dreisinger Associates

Maintenance

An annual budget has been prepared for these systems to be privately maintained. This includes activities such as street sweeping, inspecting and cleaning of sewer sumps, inspecting and cleaning of subsurface storage systems, and inspecting and cleaning of the cistern system.

Longmeadow Development

Longmeadow is 400 acres of rolling land divided by ponds, meadows, clusters of trees, wetlands, and horse paddocks in Niles, MI in Berrien County. The design was dictated by the land topography, resulting in separate areas for a variety of housing types and lot sizes. It preserved 50 acres of open space, providing opportunities for fishing, community gardens, walking trails, and private roads for biking and hiking. The design takes into account the need to preserve habitat for wildlife. This includes eliminating street lighting and maintaining animal corridors.



View of wetland

Source: Longmeadow Development, Owner: Jane Tenney

Sensitive areas — existing wetlands and very hilly areas — were preserved. Hilly areas include a change in topography of 20 feet over the 400-acre site. Existing wetlands are maintained by a buffer of greater than 75 feet of vegetation that is not mowed. This vegetated buffer reduces erosion in these areas by providing infiltration for stormwater runoff.

In addition, the site design incorporated the existing long vistas of seeded upland prairie meadows. Most of the trees onsite were preserved, including a very old, large oak tree at the entrance to Longmeadow development. Existing fence rows of trees were also preserved, providing a natural visual separation between housing types.

Bioswales provide infiltration of stormwater runoff from the 24-foot-wide roads and, in some cases, between homes. In a higher density area of homes, flat curbs were installed to maintain road edges, while bioswales direct some stormwater to storm drains surrounded by vegetation. In addition, the fire lanes were constructed with permeable surfaces.

Open space common areas are maintained by the development's homeowners association. Longmeadow was picked by The Conservation Fund as a demonstration project in the State of Michigan for watershed protection.

Quarton Lake Remediation

The Quarton Lake restoration project began in November 2002 in Birmingham, MI in Oakland County. The project included shoreline stabilization using bioengineering techniques, creating fish habitat, an assessment of the tributary stream corridor, and dredging of sediment which accumulated in Quarton Lake during the past 30 years. The stream assessment included a streambank erosion inventory and severity index based on Michigan Department of Environmental Quality procedures to identify areas of erosion and sediment sources.



Aerial view of Quarton Lake

Source: Hubbell Roth & Clark, Inc.

Due to this project's location in a highly urban area, committee meetings were held throughout the design phase soliciting public input and addressing resident concerns. In addition, the project consultant helped the city develop flyers for area residents and articles for neighborhood association newsletters to report project progress throughout construction. This project contains the following LID BMPs:

- Riparian buffer restoration, and
- Native revegetation.

The stabilized buffer area surrounding Quarton Lake has a width of 10 to 50 feet. Invasive plants, including common buckthorn and Japanese barberry were removed from this area for one year. Stabilization activities included installing coir logs on the east and west shorelines and stone terraces on the east and west sides of the lake. A total of 3,500 native plant plugs and 2,000 square yards of fescue and ryegrass seed mix were installed in this area. The native plants included serviceberry, viburnum, common arrowhead, common rush, sedges, and irises.

Quarton Lake initially consisted of over 90 percent carp by weight, creating a monoculture of fish species. To increase fish diversity in the lake, over 700 carp were removed. Gravel substrate was added, along with brush piles, a spawning bay, and a luncker (a man-made fish habitat structure). The lake was stocked with the following fish species: Largemouth bass, Channel catfish, Black crappie, and Flathead minnows.

Dredging of 30,000 cubic yards of soil was performed which was dried in sediment bags and sent to a Type II landfill. In order to gauge the impacts of the dredging, a lake assessment (including monitoring of fish species, fish habitat, dissolved oxygen, and nutrient levels) was performed prior to dredging. The purpose of the dredging was to increase dissolved oxygen levels and improve phosphorus levels found in the lake sediment prior to dredging. Since the lake has been dredged, nutrient levels and dissolved oxygen levels have improved.

The project consultant developed a maintenance plan for the city in 2006, including recommendations for future efforts in Quarton Lake. Dissolved oxygen and temperature levels were monitored in August 2005. Data still showed low dissolved oxygen levels near the stream bed. Temperature levels remain fairly constant from stream bed to the surface. Additional water quality monitoring is recommended for future years. The

city maintains the plantings along the lake's 25-foot no-mow buffer. The city participates in an annual goose round-up, to help prevent goose droppings high in phosphorous from entering the lake. To further assist in water quality efforts, the city maintains a stringent street sweeping and catch basin cleaning program to keep sediment out of the lake. To date, there have been no additional costs incurred for maintenance practices, aside from DPW staff labor costs.



Native vegetation for streambank stabilization and runoff infiltration

Source: Hubbell Roth & Clark, Inc.

Riparian education

A workshop to educate the public about the importance of riparian protection was held. It informed riparian homeowners about the purpose and scope of the Quarton Lake project, and educated them on the importance of riparian buffers, restricted activities in the riparian zones (fertilizer use, feeding waterfowl/wildlife, dumping yard wastes, etc.), shoreline stabilization techniques, permitting, and contractor issues and costs.

Towar Rain Garden Drains

The Towar Rain Garden Drains used LID to completely retrofit a rain garden stormwater system in a neighborhood setting. Located in Meridan Township and the City of East Lansing in Ingham County, MI., the system consists of two concurrent drain projects (Towar Snell Drain & Towar Gardens and Branches Drain) that were installed in the Towar Gardens neighborhood in 2006 and 2007. These projects encompass approximately 200 acres and impact over 400 homes.

The Towar neighborhood experienced flooding of yards, roads, and basements for over 80 years prior to

this project. The neighborhood is very flat, with only six feet of elevation from the lowest rear yard to the outlet more than a half-mile away. The project used rain gardens and installed them in areas where flooding historically occurred.

All the work was performed under the Michigan Drain Code, with more than 100 easements gathered to install over 5.5-acres of rain gardens along streets and in rear yards. The rain gardens were planted using native species and were constructed with new soil media. More than 110 pounds of native wildflower seed was used to construct the rain gardens and nearly 52,000 plugs were planted. More than eight miles of county drains were constructed during the project.

More than 150 individual rain gardens were constructed throughout the project, ranging from 100 square-feet, to areas larger than 2/3 acre. The main conveyance system consisted of small concrete pipes in the roadways that accepted the stormwater from the ditches and rear yards. This project is believed to be the largest urban retrofit of a stormwater system ever performed in the United States and the largest using rain gardens as the primary function to manage stormwater. It is the largest LID project ever performed under the Drain Code in Michigan. Maintenance costs are variable, since activities will be more intense in the initial years after construction is complete and until native species are fully established. Once established, costs are expected to decrease substantially.



Towar Drain neighborhood

Source: Fitzgerald Henne and Associates, Inc.

The Ingham County Drain Commissioner is responsible for all maintenance activities under the laws of the Drain Code of 1956. Maintenance activities include removing invasive and weed species from the rain gardens, cleaning the perforated pipes from tree roots, and continuing education of the community regarding avoiding mowing and applying herbicide to the native plants.



Rain garden one year after establishment

Source: Fitzgerald Henne and Associates, Inc.

Kresge Foundation Headquarters

The site for Kresge Headquarters is an historic farmstead set within the context of a completely altered landscape on a commercial business site in Troy, MI (Oakland County). The 2.76-acre site is a small oasis within a larger suburban-scale, corporate landscape.



Porous pavers

Source: Conservation Design Forum, Inc.

Site goals

The Kresge site attempts to recreate historical hydrology as an essential component of overall ecological performance, which is a key LID principle. In addition, the site provides habitat for the widest range of plant and animal life given its confined context and location. The site receives all of the rainwater that falls in its 2.76 acres and uses much of it to support a diverse water-based landscape. Any stormwater that is not infiltrated into the existing LID practices is treated onsite in the bioswale system before being released into the city storm drain.

The project objective was to create a workplace that promotes the well-being and productivity of staff and visitors. Because the Kresge Foundation invests in the sustainable development of hundreds of nonprofit facilities each year, sustainable planning of their own construction project was a main goal. As part of this green approach, the overall landscape goals for the Kresge Foundation Headquarters were twofold:

1. To maintain rainwater onsite while using it as a resource, promoting infiltration of surplus stormwater, and
2. To create a healthy, vibrant landscape that could be installed and maintained without use of chemicals, large amounts of supplemental water from municipal sources, and other intensive measures.

The strategy for site ecology was to incorporate LID practices into practically every portion of the site. This project includes the following LID BMPs:

- Minimize total disturbed area,
- Vegetated roof,
- Pervious pavement,
- Native landscaping,
- Bioswales,
- Constructed wetland, and
- Water collection and reuse.

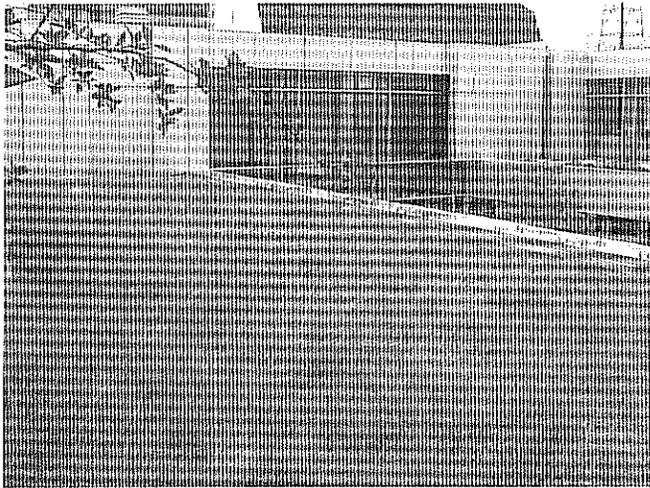
Minimize total disturbed area

The historic farmhouse remains as the cornerstone for the new building. Other historic outbuildings were rearranged to maximize the efficiency of the site. The new building is stacked on two levels and set into the site. The parking lot is tucked on the eastern edge of the site, and has a minimal number of parking spaces. A portion of the building has a vegetated green roof system. The green, or planted, portion of the site is 1.76 acres, or

approximately 63.4 percent of the total site area (2.76 acres). More than 63 percent of the site was restored as landscape area and open space.

Vegetated roof

The portion of the roof surface that is at-grade (3,213 square feet) is established with a green roof using a mid-range grass planting mix. Rainwater from the upper portions of the roof is directed into the green roof, where it is cooled and used. Overflow water is then directed to the lower constructed wetland/pond (see below). Surplus rainwater is stored and reused to irrigate the green roof during periods of drought.



Vegetated roof with meadow grass

Source: Conservation Design Forum, Inc.

Pervious pavement

The parking lot is constructed with interlocking concrete pavers that have gaps filled with crushed stone and underlain with open-graded gravel. This porous paving system allows the water falling on its surface to be cooled, filtered, and infiltrated into the ground. Overflow water is directed to the bioswale systems.

Native landscaping

The entire site was planted with a range of native and adapted grasses and flowering perennials (primarily prairie species) that thrive without supplemental water once established. The landscape was organized into ornamental edges, panels, and zones to address views, programming, and the suburban and historic context of the site. The landscape is managed as a natural system and, where feasible, existing trees were retained. Since controlled burning is not permitted in this area, the landscape was designed with a hybrid native/adapted plant mix that will thrive with minimal input once fully estab-

lished. Invasive species removal and annual removal of the dormant material through mowing are the primary stewardship activities. As the root systems of the native plants, especially the grasses, become fully established, invasive species will be crowded out and be less of an issue. More importantly, the landscape will become progressively better at receiving rainwater sustainably, and returning it to the ground without any runoff.



Native landscaping prairie mix

Source: Conservation Design Forum, Inc.

Bioswales

Surplus rainwater is directed to a bioswale system. The bioswale is constructed with amended topsoil, underlain with stone, and planted with deep-rooted grasses. The bioswale slows and further cleanses and cools the rainwater, allowing more of it to return to the atmosphere in the form of evapotranspiration. The bioswale system then overflows into the city storm drain only in the heaviest rain events and when the ground is saturated.

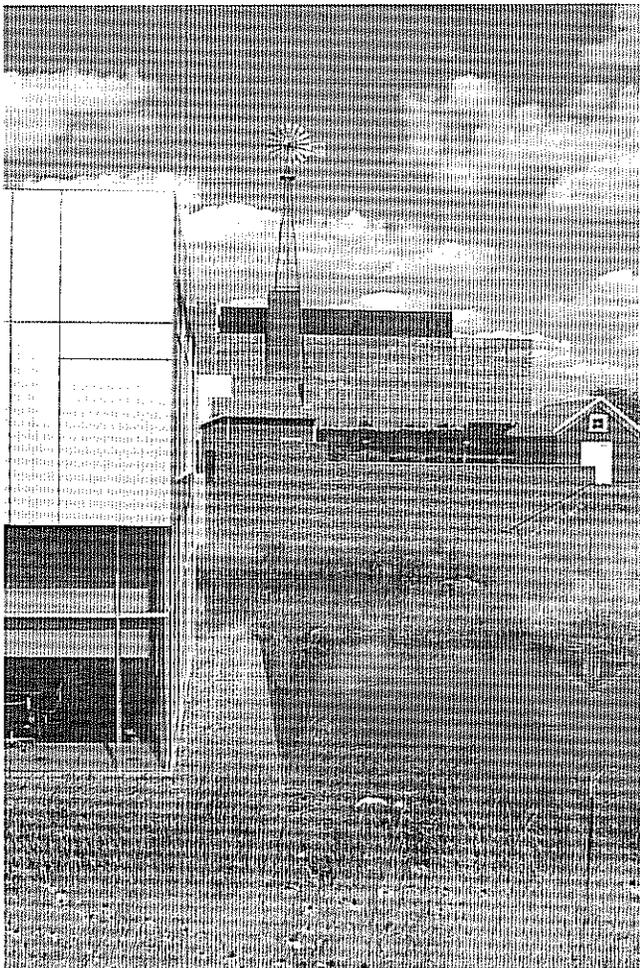


Bioswale along parking lot

Source: Conservation Design Forum, Inc.

Constructed wetland

The lowest portion of the site was developed as a constructed wetland pond. It is a lined basin meant to have a permanent water surface, with a planted wetland fringe mimicking a native system. Rainwater that overflows from the roof and portions of the site are directed to this pond. If the water level rises more than six inches, surplus water is drawn into the cistern for future reuse. If the water level draws down during dry periods by more than six inches, water from the cistern is allowed to flow back in. This keeps a fairly constant water level to maintain a high quality wetland habitat and also allows the pond to be part of the stormwater management system.



Wetland along building

Source: Conservation Design Forum, Inc.

Water collection and reuse

The entire landscape thrives without the use of potable water. Rainwater is harvested, treated, and stored in a cistern to provide water for the constructed wetland and supplemental water for the green roof system. In order to optimize this system, a water budget was developed and used as a design tool. The amount of water potentially generated from rainwater (supply) was compared with water needs (demand). An analysis of the water budget throughout the year led to refinement of the design and sizing of the water landscapes and storage elements.

The green roof systems contain a permanent irrigation system and the created wetland on the south side of the building is topped off when the water level drops below a prescribed depth. Water for green roof irrigation and refilling of the pond is supplied by collected rainwater from the new building roofs, the barn, the utility corridor, the landscape, and water that falls within the courtyard and the created wetland. The runoff water drains by gravity to the aquatic wetland and is then pumped to the 18,000 gallon cistern for later reuse. The water is reused on the four intensive green roofs that are vegetated with a native grass mix, and also to replace evaporated water from the created wetland. The average monthly volume of collected rainwater exceeds the average monthly demand by more than 50 percent. The cistern is of sufficient size to provide more than three weeks of water demand to average out monthly variability and extended periods without rain.

Irrigation water is applied to the green roof drainage layer using a trickle system. Irrigation water is held with the drainage layer using “ridges” two inches in height, at sufficient spacing to cause an average ponding depth of 1.25 inches, which equates to an irrigation volume of 0.5 inches over the roof area (40 percent pore space within the drainage layer media). If the lowest irrigation ridge is not full at the sensor, it will call for the pump to operate and for the drip box water supply valve to open. When the sensor indicates that the system is full of water at that bottom edge of the roof, it signals the valve to shut. Once all the systems are full of water, the pump shuts off. When the cistern is empty, the system does not operate. The maximum irrigation interval is once every other week. The water discharge module consists of drip box, water discharge with shut-off and flow control valves, and a distribution pipe. The discharge module discharges irrigation water consistently along the top roof edge.

When the water level in the created wetland drops two inches below normal water level, the pond is refilled to the normal water level using water in the cistern. The required volume to refill the two-inch drawdown is approximately 6,600 gallons. The 18,000 gallon cistern has sufficient volume to refill the drawdown more than 2.5 times. The average monthly water supply exceeds the average monthly water demand by more than 50 percent. The cistern has sufficient volume to supply more than three weeks of irrigation and refill the created wetland water feature.

Decentralized stormwater management

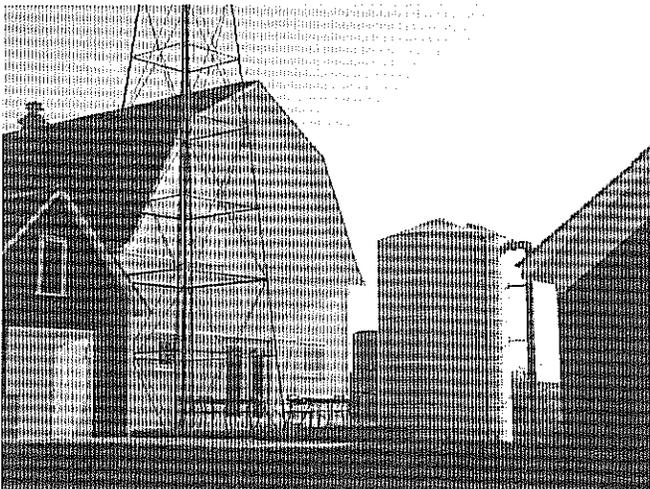
The integrated stormwater management design treats water as a resource, and allows water to flow over land, thus allowing ample opportunity to infiltrate back into the ground. Water is also collected and conveyed underground in the bioswale zones. The stormwater harvesting cistern is above ground, and serves as an icon and part of the Kresge Foundation image. The 18,000-gallon cistern is reminiscent of the “historic farm aesthetic,” and is visible from Big Beaver Road, making a dramatic statement about Kresge’s commitment to water conservation and natural resource preservation. The green roof landscape systems are permanently irrigated by a cistern system that collects and reuses rainwater in a drip fashion. A typical Midwestern office campus with turf vegetation would require irrigation at a rate of one inch per week (Source: Purdue University, State of Indiana and U.S. Department of Agriculture Cooperative). The native landscape established at the Kresge Foundation Headquarters requires no irrigation.

Lessons learned

The City of Troy was interested in having BMPs and LID tools implemented within their city. They were a very helpful partner in bringing innovation to this project, approving the design, and were involved from the early stages reviewing design documents and providing feedback.

It is critical to work closely with the contractor, and for the designer to be onsite regularly overseeing construction and stewardship. It was also advantageous to have well written specifications that require submittals and approvals for various products. This kept the landscape architect in the conversation, and required review of issues before they were installed. While onsite during one field visit, the porous paver parking lot was being constructed using a sand setting bed, rather than the aggregate material from the detail. The construction was halted immediately, and testing was completed to document the infiltration capacity. The owner agreed to a warranty period extension, allowing the rest of the parking lot to be constructed using the specified material. To date, there has been no sign of a lack of infiltration.

It is important to communicate the establishment process and aesthetic considerations very clearly to the client (and all occupants of a particular project), so that all expectations are clear and resolved. Construction schedule impacts also need to be clearly understood throughout the implementation process.



Cistern at Kresge Foundation

Source: Conservation Design Forum, Inc.

LANDSCAPING
FOR
WATER QUALITY



*Concepts and Garden Designs
for
Homeowners*

Landscaping for Water Quality

A guide and resource booklet for
understanding the concepts and applying
garden designs for improving Michigan's
water quality through landscaping practices.

Second Edition

Edited by

Jane C. Secord



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Section 1:

AN OVERVIEW

Landscaping For Water Quality in Michigan – An Overview



The purpose of this booklet is to provide readers with the information needed to incorporate methods that enhance water quality when landscaping their property.

Residents of Michigan enjoy a unique environment. Carved out by retreating glaciers many thousands of years ago, the Great Lakes, along with the thousands of smaller lakes, rivers and streams, were formed. Water is an important resource for our health, economy, and ecosystem. Landscaping practices can impact the quality of our water systems. We need to keep water quality in mind when planning or maintaining our landscape.

Traditionally, a lush green carpet of turf grass from one edge of your property to the other is the ultimate goal. But have you considered it carefully? We precisely sow a tight field of grass that is difficult to coax into growing, ply it with fertilizer, spray it with pesticides, water it till it finally takes hold and grows. Then, just as the plants are healthy and happy, we cut off the top third and it has to struggle all over again! This process is expensive to maintain in both dollars and time, and it is very costly to the environment. Installing landscaping that doesn't require fertilizing, watering or mowing – now that's an idea worth exploring!

Landscaping for water quality is a method that invites nature back into our lives and yards. In addition to being attractive, grasses, sedges (grass-like plants that grow in wet conditions) and wildflowers require less fertilizer and water to thrive. You are in control of the impact from your property. From a simple buffer zone (an area that helps absorb rainwater and filter pollutants) to a radical yard change, the possibilities are endless.

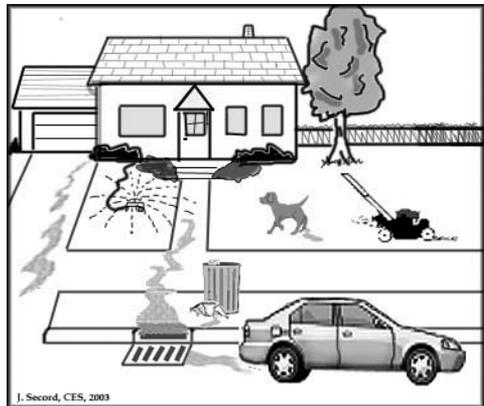
A common misconception about emulating nature in our gardens is that they are unkempt and weedy. In reality, incorporating water quality into your plans for landscaping is not at all limiting. You can produce a finely sculptured, manicured look or that countryside cottage appeal. It is all up to you. Following the basic concepts here, you will get to know your property, so that you can end up with a design specifically for you.

This first section will give an overview of the “why” and “what” of Landscaping for Water Quality. The second section, *Designing Your Garden*, concentrates on the “how”, while the third, *Plant List*, gets specific about what plants to use and “where” to find them.

Why Landscape For Water Quality?

To Protect Water Quality

In nature, rainwater infiltrates into the soil almost completely. Many contaminants are filtered out before the water enters the surface or ground waters. Where development adds homes, driveways, roads, turf grass and compacted soils (impervious surfaces), infiltration is nearly eliminated. As seen in the graphic below, the water running off of these impervious surfaces washes soil, fertilizer, grass clippings and other contaminants into the drains. If we use landscaping for water quality practices, any water that does leave our property will be cleaner and reduced in volume.



To Capture Rainwater

The water that falls in the form of rain or snow and water you use to sprinkle, wash cars etc. is a valuable resource. Consider that in a 1” rainstorm, 13,000 gallons of water falls on a typical 1/2 acre residential lot. That’s enough to fill three average above ground swimming pools! Normally about 2/3rd of this amount runs off your property – meaning you lose about 8,500 gallons down the storm drain (*Schueler, 1994*). By designing your gardens to ‘capture’ this water, you retain a treasure for your own use.

To Increase Infiltration Rates

Decreasing the amount of impervious surface is an important component of any landscaping plan. Carefully decide where you need to use walkways or patios and then choose pervious or permeable products. This beautiful alternative will enhance the look of your landscape while reducing the amount of water running off your property.

To Reduce Flooding.

Even if you live on a curb and gutter system, rainwater eventually drains to a lake or stream. This can contribute to water quality and quantity problems. By capturing large amounts of water on your property, storm drain limits are not exceeded and the extent of flooding within the streams and rivers is reduced. When flooding does occur upstream, plants on the stream banks intercept the floodwaters, slowing it down and reducing the extent of flooding downstream.

To Ease Soil Erosion.

The loss of topsoil from stream banks, construction sites and sloped yards is significant. The problem is twofold. One, your physical property is literally washing down the drain. Two, the impact upon both surface and sub-surface waters by the resulting siltation in the waterways chokes aquatic habitat and pollutes drinking water.

While better than bare ground, the roots of turf grass are too shallow to effectively restrict soil loss from flowing water. Maintaining buffer zones of water quality garden vegetation can abate the force of water that sweeps the topsoil off of your property. The roots of the plants hold the soil in place, absorb some of the excess water and encourage infiltration. The deeper the roots, the more effectively slopes are stabilized.

Prairie plants and flowers have roots that grow from one to several feet deep. These deep roots not only draw up and store water, but form channels in the earth and they die back each winter and reform in the spring. This naturally aerates the soil, maintaining the health of the plants. Stabilizing the soil on slopes and resisting compaction in flat areas helps prevent soil erosion.

To Increase Infiltration and Reduce Pollution through Buffer Strips

A carpet of turf grass typically has a root structure that resembles a three-inch thick dense mat (picture a welcome mat 3" thick). This mat of material restricts water flow into the ground and can actually become nearly as impervious as your paved surfaces (this is why aerating your lawn is periodically necessary). During and after a rainstorm, water rushes off paved and turf grass surfaces.

Buffer strips or zones are effective tools to capture the water running off your property.

The plants in the buffer zone act to slow down the water and increase infiltration. This, in turn, allows filtration of any contaminants, including chemicals, nutrients, soil, pet waste, oil, and salt.



The end result is less water entering the storm drain system and eventually ending up in the nearest waterway. Remember, no matter where your home is located, the water (and the contamination) leaving your property ends up in the nearest body of water. **You could say that every house is on waterfront property!**

To Gain Advantages of Reducing Turf Grass.

With few exceptions, using plants other than turf grass in your landscape: contributes to cleaner air, reduces the amount of yard waste, reduces fertilizer use and subsequent contamination of waterways, reduces mechanical watering needs, and increases habitat for pest predators.

In addition, the turf that you do keep will be easier to maintain due to an increase in moisture retained on your property.

To Provide Wildlife Habitat.

The USDA defines habitat as an environment providing the food and shelter required for an animal to make its home. Therefore, providing “natural” shelter and food would indeed improve habitat. The diversity of the plants used encourages a variety of wildlife to call the gardens home.

Because wildlife provides natural pest management, the use of pesticides is greatly reduced or eliminated. (It should be noted that pesticides pose a threat to the beneficial wildlife.)

To Enhance Property Values.

Landscaping enhancement is a proven method of increasing the value of your property. Using landscaping specifically designed for water quality results in this same value increase. Incorporating ornamental pervious paving stones for your drive or patio adds to the value even more.

Water quality gardens also save homeowners money because of the lower costs of maintaining native gardens, buffer zones, shrubs and trees. An average savings of \$500/year (*U.S. EPA*) can be realized through reduced water, fertilizer, herbicide and pesticide usage, along with freedom from weekly mowing. Therefore, having a water quality landscape plan can result in yearly maintenance savings along with higher property values.

A Recap of the Reasons for Landscaping for Water Quality:

- Protects water quality.
- Captures rainwater for personal use.
- Increases infiltration.
- Reduces flooding.
- Reduces soil erosion.
- Filters contaminants from rain water.
- Benefits gained from reduction of turf grass
- Provides beneficial wildlife habitat and biodiversity.
- Increases property values.



Before you Start your Design:

The first step is to evaluate your property based on the categories below. Understanding the different components will simplify the process when choosing your plants. Make a sketch of your property to guide your decisions and to show your landscape designer (if you choose to use one).

Suitable Areas to Consider

Do you have an eroding bank? A washout area? A low area in which water pools after a storm? A gently sloping yard that dumps all of the rain

water right into the storm drain? An area that is too dry? Is your property on a lake, stream or wetland where the lawn is mowed to the edge? Are beneficial shade trees present? Do you want to redirect rainwater to a specific spot? Do you want to change the topography? (add a berm?)

Keep your chosen area in mind and set a goal that you want to achieve. By utilizing ideas in this booklet you will be able to achieve your goal and improve water quality.

Existing Plants

Is the area turf grass?

Are there existing perennials or trees that you wish to utilize?

Do you have an existing garden where you can incorporate the concepts?

Are there existing plants or trees that you wish to remove?

Sun Exposure

You need to take note of where the landscape is exposed to sun and for how much of the day. Buildings and existing trees may provide shade for part of the day. Keep in mind that the standard for plants requiring full sun is a minimum of 6 hours per day.

Soil Conditions

Plants have preferences to certain soils based on the soil's attributes. These attributes include soil moisture, soil pH, soil type, and soil nutrient availability. Some plants prefer steady moisture, while others are drought tolerant. Knowing if your area is moist or dry is important before choosing your plants.

Soils can be alkaline, neutral or acidic. Knowing your soil's pH will help you choose the appropriate plants. You can pick up a pH testing kit at your local home improvement store or nursery.

Soils are made up of three components – sand, silt, and clay. Combinations of these components are referred to as a loam. You may hear them referred to as a clay-loam; this is a combination of the three components, with clay dominating the mix. A sandy-loam would have sand as the dominant component. Many plants have adapted to these different soil types. When planting in a sandy, or clay loam, seek out plants that prefer these areas.

Regular use of fertilizers is common for those of us who want a beautiful lawn and garden. This practice is usually not necessary and can be harmful from a water quality point of view. **Even if you opt to change nothing in your landscape, it is important to test your soil before adding fertilizers.** The nutrients that fertilizers offer are nitrogen, phosphorous, and potassium, listed as the N: P: K ratio on your fertilizer bag. Most of Michigan has plenty of phosphorous occurring naturally in the soil. By eliminating phosphorous in your fertilizer application, you will make a major positive impact on the local stream quality. Your local MSU Extension office will test the soil for a nominal fee (less than \$15) and provide interpretation of the results. (Ask for Bulletin #E-498 for directions about collecting the soil sample.) The scope of this section is not broad enough to give details here, but you can discuss your specific soil concerns with your local county MSU Extension office.

What if the plants I choose don't fit with my soil conditions? You can either replace your choices with appropriate plants or you can amend your soil. Amending your soil will create more work during installation, however, the long-term gains may make this the best choice for your project. Contact MSU Extension office for advice if you choose to amend your soil.

The second section will take you through a more detailed explanation of preparing your garden site.

Change a Little or a Lot?

Are you happy with the basic look of your landscape? Then you probably want to just plan a few changes, such as adding berm water bars to hold the water near your existing gardens. How about going for the max? This is easy with new construction, but an existing property may need several smaller projects over time. Work with your existing shrubs and trees to reach your goal.

Plant Hardiness Zone

When planning your garden you need to take planting zones and frost dates into consideration. "Plant Hardiness Zones" divide the United States into 11 planting zones based on a 10 degree Fahrenheit difference in the average annual minimum temperatures. There are also different climates and frost dates within planting zones in a region due to the topography, lakes and

rivers, gulleys or hills. These can cause altered airflow, which can raise or lower the temperature, changing the zone in your area. The chemical balance and texture of the soil, exposure, altitude, rainfall, humidity, sun light levels, wind, and wind chill factors can also alter the effects of plant hardiness zones. (USDA)

The plants included in the third section are hardy for most of the State of Michigan (zones 4, 5 & 6). If you are uncertain about the suitability of a plant for your locale, check with a local nursery.

What's Next?

Now that you have a basic understanding of the merit of planting with water quality in mind, planning and designing your new landscape is the next step. It will involve taking the information you just gathered and having fun. The next section will give you some concrete ways to design your own water quality garden.



Section 2:

DESIGNING YOUR GARDEN
&
SAMPLE DESIGNS



Landscaping For Water Quality in Michigan – Designing Your Garden & Sample Designs

This section is designed to help you plan a simple, yet effective, water quality garden or incorporating the concepts into an already existing garden area. Utilizing more than one garden in your yard, adding trees, and reducing turf grass area will all help improve water quality.

You will be walked through the steps for design and basic installation of gardens in your landscape to improve water quality and reduce the amount of water leaving your property. By considering function when designing an aesthetic garden you can add beauty to your landscape, minimize topsoil loss and lower the cost of maintenance, all while capturing valuable rainwater.

When you plan your design, remember that your landscaping is more than plantings, it is an overall concept of improving infiltration, absorption and filtration. More specifically, landscaping for water quality is:

- Removing turf grass wherever possible
- Changing impervious surfaces to pervious
- Optimizing on-site infiltration and absorption through plant selection
- Selecting plant species suitable for your soil conditions to keep maintenance at a minimum
- Using a mixture of plant species to provide diversity, increase survival rates, and add aesthetic qualities spring through fall
- Designing dry areas surrounding all wet areas to help reduce soil and nutrient loss

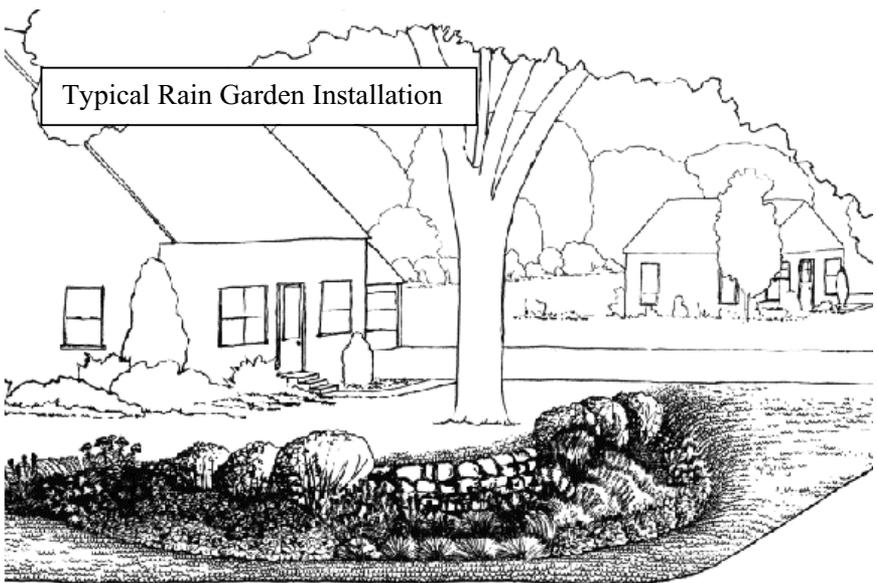
Planning Your Garden

A few simple concepts are central to all water quality gardens. Any planned areas should actively encourage filtration, storage or infiltration of water into the ground. They can include prairie areas, as well as very wet areas, rock gardens, or patios paved with pervious materials. Existing cultivated garden beds can be transformed, at least minimally, into simple water quality gardens by incorporating slight depressions into the plans. Whether you are starting from scratch with new construction or have an established lot, water quality gardens are wise additions. Because the gardens are created to optimize on-site infiltration, planning the placement

of more than one garden on your property will ensure the capture and filtration of as much water as possible.

A water quality garden can be placed on any property. Replacing turf grass with appropriate groundcovers, adding trees to lower the temperature and utilize water on site, and adding specialized “rain gardens” positioned to collect rainwater runoff are all possibilities.

Rain gardens are special water quality gardens that are expressly designed for areas where water habitually pools or where rainwater is deliberately channeled. These water quality gardens may require soil replacement and more complicated preparation than the simple gardens discussed here. If you are interested in more information about rain gardens, please contact Rain Gardens of West Michigan (see resource list on back cover).



Source: Adapted from Nassauer et al., 1997.

Incorporating Water Quality Benefits into Existing Landscape

The first step is simply observing your landscape. Look at your existing turf grass, beds, trees, and slopes for opportunities.

What percentage of the area is landscaped in turf grass?

This is one instance where “less” is definitely “more”. Turf grass has a very short and matted root system that hinders water infiltration. By replacing turf grass with gardens, groundcovers or ornamental grasses that have deep root systems, infiltration is greatly enhanced.

Does water pool in a specific area and you just don’t want to add a garden?

Consider planting a groundcover that will help manage the water. Although groundcovers do not have deep root systems, the tunnels formed by rhizomes along with beneficial foliage encourages infiltration and storage significantly more than turf grass. Native groundcover choices include the following:

- Aromatic and rapidly spreading wild ginger is ideal for shady and moist spots. It features big, shiny green leaves and unique brownish-purple flowers.
- Pest-free horsetail is suitable for boggy and shady sites. This non-native plant’s cylindrical leaf stalks feature black bands and inch-long cones which add interest.
- Ferns look lovely beneath mature trees. The only pruning is to remove injured or old fronds periodically.
- Wild strawberry needs only filtered shade to show off its thick mat of glossy green leaves, white flowers in spring and red fruits in summer.
- Sun-loving marsh marigold features bright yellow flowers that attract butterflies. It prefers moist to wet soils and full sun.
- Yarrows, with their fernlike foliage, do well in poor soils in sunny sites.
- Common Blue Violet is sun loving and will spread quickly and evenly.

If you want to retain your turf grass, consider altering the topography, adding earth-berm water bars. These mild undulations in the turf are specifically placed at planned angles, channeling the water run-off to desired areas.

Are there areas that “washout” frequently?

Even a very slight slope can have areas that washout during rain or when sprinkling. Adding plants and strategically placed rocks to help stabilize the slope can be a beautiful solution.

Examples of plants for use on a gentle slope are the groundcovers mentioned above or if you prefer a taller plant to fit in with the bed try Cord Grass (*Spartina pecinata*) or Bee Balm (*Monarda fistula*) which spread quickly. Both of these species would need shorter support plants around them. A steep slope will require more careful planning. You may wish to incorporate a terrace design in conjunction with plants to help stabilize the slope. Plants suitable for steep slopes are: Eastern Ninebark, an ornamental shrub, or Canada Wild Rye, an ornamental grass. Adding shredded bark around the Ninebark and Wild Rye would aid in both soil and water retention.

Are there large trees in your landscape?

You may have trees that are flush with your turf grass or areas where they were planned to be raised on berms. In either case, creating small depressions (3-4 inch wide and deep) two to three feet from the trunks of the trees in your landscape (resembling a moat around the tree) will encourage rain and sprinkler water to be used by the trees more effectively. The depressions can be made in the turf grass (by lifting the turf and removing 2 – 3 inches of the subsoil) or by mulching around the base of the tree and forming the depression in the mulch. If you have a large bermed area containing many trees, a depression following the outline of the edge of the berm will keep the water in the area. Adding bright perennials in and on the outer edge of this depression will complete the transformation.

Does the terrain slope toward the edges of your property?

Building codes all require that the terrain slope away from the home to prevent wet basements etc. If that slope continues all the way to the street, water runs off, contributing to water quality problems and losing a valuable resource for your use.

As mentioned earlier, creating a rolling terrain through the use of earth-berm water bars and depressions can help keep rain water runoff on your own property for use in your water quality gardens. Border gardens and tree berms provide additional benefit to your plan.

Designing Your Garden

Concepts to Keep in Mind

It can be fun to design your own water quality garden. The style of garden is up to you. Remember that the more formal the style, more maintenance is required. The garden should have a lowland zone (wet zone) and an upland zone (dry zone). The dry zone should surround the wet zone to help buffer, trap nutrients, retard erosion and stabilize the slopes. Selection of water tolerant plants for the wet zone is essential. The dry zone can be planted with plants adapted to moderate and dry areas.

Although many will call any area where there is a garden planted in a depression a rain-garden, a true rain-garden is well thought out and planned. If you wish to incorporate a true rain-garden, you will need to excavate at least a few feet from the area, creating a large swale. A bed of pea gravel to help store water is covered by a sandy loam (soil augmented with sand) to encourage infiltration. A final layer of topsoil completes the preparation. It is a must that small swales throughout the yard are created to channel water to the rain-garden.

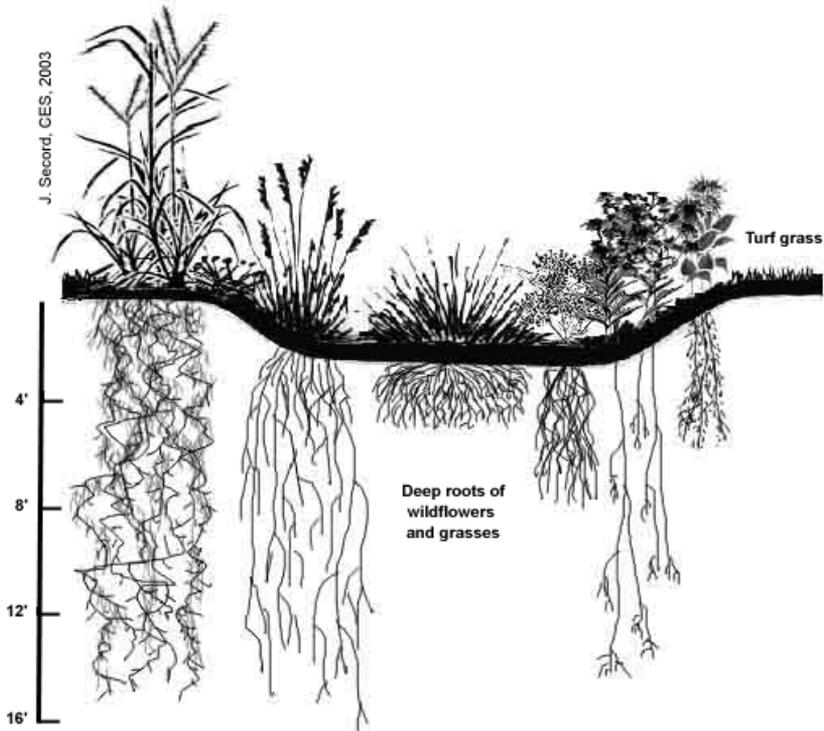
Remember that one goal of your plan is to reduce or eliminate fertilizer use. So, resist the urge to feed your garden. Adding unneeded fertilizer will only serve to encourage weed growth.

Selecting appropriate plants will maximize the benefit of your water quality garden. As discussed in the first section, it is important to understand your existing soil conditions to be able to select the plants that will do well for you. While larger gardens will be able to absorb and process more water, almost any size garden is possible.

Be flexible when choosing your plants, choosing two or three species that will work for each area of the garden. This will make your trip to the nursery much more rewarding. The third section in this booklet lists several plants and cites the size, moisture needs, sun needs and other details for each.

Incorporation of grasses, sedges (grass-like plants that grow in wet conditions) and ferns will aid in your water quality impact. Ornamental grasses such as *Big Blue Stem*, *Switch Grass*, or *Bottle Brush Grass* add color and interest in the winter. Grasses knit the garden into a pleasing

composition, adding movement and sound to the landscape. In addition, grasses serve as a support structure for some of the wildflowers. By incorporating these plant types you are enhancing your garden's infiltration rate. Most grasses and sedges have deep roots that tunnel through the soil creating paths for water to follow. In the winter the roots die back and create new channels in the next season. The old tunnels become storage areas for excess water.



Other hints:

- Use pervious paving stones when planning patios and pathways.
- Modify your existing landscape by incorporating depressions or adding borders designed to capture water runoff.
- Consider a substantial reduction in the square footage of your turf grass. Using ground cover can add visual appeal as well as improve your impact on water quality.

- Neat edges and fences help instill a look of care to a natural garden.
- Use multiple species to keep the color alive and the maintenance down.
- Avoid single species beds. These are vulnerable to pest infestations and are significantly more work to maintain.
- Use a blend of plant heights. Variation will add interest year round as well as serve to trap water as it enters the garden.

Your garden will mature more quickly if you use seedling plants rather than seeds. Although using seeds may be more economical initially, the long term cost will be greater because of increased maintenance needs, the time needed to establish the garden, and delay in realization of the benefits desired. You may initially wish to plant the seedlings a little closer together than would be expected. This will speed the establishment of the garden and the plants can later be thinned to be used in another location. Once established, the garden reduces maintenance issues while aesthetic, economic and water quality benefits are appreciated.

Starting with the Basics

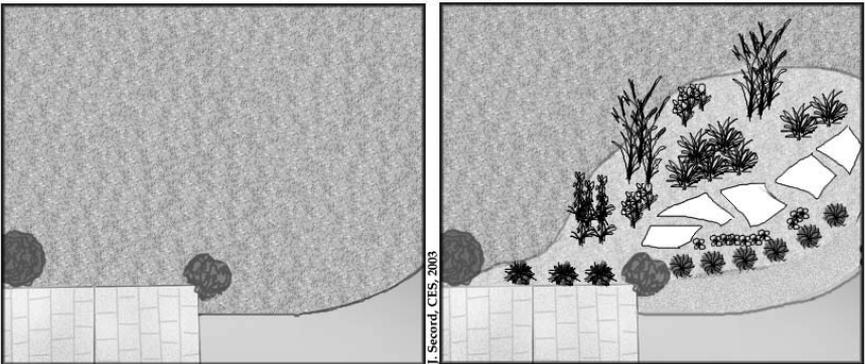
It is important to know the measurements, soil types, moisture, sun exposure and terrain of your property before you begin the actual design. Tips are given in the first section of this booklet on how to gather this information.

Although this booklet does not cover selection or installation of trees and bushes, they are an important component of your landscape and can significantly impact water quality. We strongly suggest that you consider adding both to your overall plan. If you decide to incorporate them into your design, please consult with your local nursery for instructions on installation. Remember to incorporate depressions around your trees as discussed earlier.

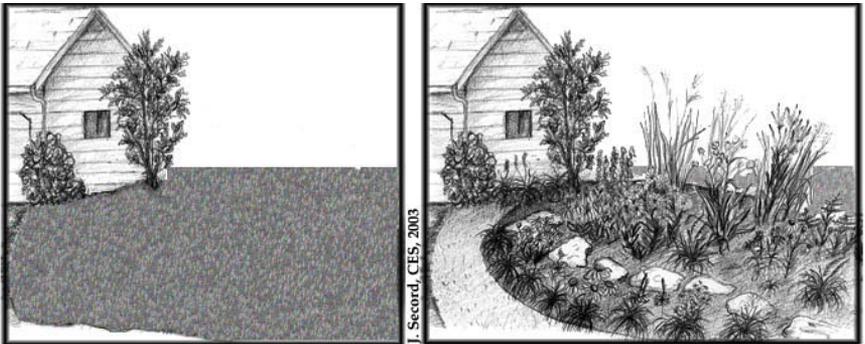
Using the information you gathered, make a rough drawing of the various areas in your yard that you are considering for change. Show existing beds, your house, trees, areas of sun and shade, areas that currently shed water, and areas where water pools. Take a walk around your property to view it from several angles when making your drawing to make sure you haven't missed anything.

Now make a new drawing to encompass the changes you wish to make by installing water quality gardens, berms, swales and pervious surfaces. The following drawings gives examples of the before and after overhead drawings, as well as street view perspectives.

Overhead view...



Street view....



Before you begin any digging, it is important to make sure there are no underground utilities in the areas affected. “Miss Dig” is a free service that will flag where any underground cables, lines or pipes are found. Please call at least three full working days before you dig. The toll-free number is 1-800-482-7171.

Installing Your Garden

Preparation

Garden preparation is similar to preparing for any type of garden. As with anything, the better the preparation, the better the final results.

- Remove any existing sod from the area you've chosen to plant.
- Gently contour your garden, making sure it has a depression of at least 4-5 inches deep in the center area. Variation and undulation can add to the beauty of your garden. To minimize erosion, keep slopes gentle.
- Use the soil you remove from one area to create interesting topography in another. For example, you could create a berm on one side of the garden. Just remember to plan ahead – you want the water to stay in the garden, not flow away from it and off your property.
- No matter what your soil type, you will need to till the subsoil layer. Doing so will help your plants establish and take root. After they are mature, they will do well, even in adverse soil conditions.
- If your soil is rich in clay, you may wish to amend it to help the plants establish. To do so, till weed-free compost into the top 6"- 8" of the bed prior to adding the topsoil.
- Add a layer of topsoil over your prepared garden about 5-6" thick.

Planting

- You can plant a garden at anytime of the growing season, spring through fall, although you will have best success in the spring. Also take note that frequent watering will be necessary if you plant during the heat of summer.
- Although this step is not required, it is good to know what the filtration rate is before you plant. To test this, turn the sprinkler on in the garden area for 60 minutes. Make a visual note of the depth of the water in the garden. Make a check every 15 minutes for an hour. If the water is completely absorbed within 45 minutes, you are good to go. If it takes an hour or longer, you may want to amend your topsoil by adding weed-free compost to the top 4"-5". Once plants are mature, infiltration will be much quicker. Be sure to let the garden dry out before planting.
- If there will be a delay before you can plant your garden, (more than 7 days) mulch it lightly with fibrous shredded wood chips. You will not have to remove the mulch when you do plant. Just gently brush it aside and replace it around the newly planted seedlings.

- You will need to mulch around all of the new seedlings. This mulch layer should be about 4 inches thick. It helps retain moisture and discourage weeds.
- Not all mulches work in water quality gardens. The preferred mulch is a coarse, fibrous shredded wood chip mulch. After the garden has established, varying the wood type from year to year is a good practice to guard against algae or mold growth on the mulch.

Maintenance

Maintenance for these garden beds is minimal. The plants suggested are hardy in our region and require little work once established. As with any young plants, they need to be nurtured for several weeks after planting. Regular watering, watching for and pulling weeds, and maintaining 3-5 inches of mulch around them is all it takes.

After the first few weeks, a once a week soaking through rainfall or sprinkling should be enough. Do not add fertilizer to these gardens, they don't need it!

Before the next growing season, cut the plants back to about 6 inches tall and remove any dead foliage. While this can be done in the fall, you may want to wait until spring as the plants will add interest to your landscape all winter long. Add or replace the mulch, which acts as your weed control, and that's it. You are encouraged to split clumps of growth after several years and use them to create new gardens.

If you choose to incorporate a majority of your property in an extensive native landscape design, every second or third year burning or mowing with a brush hog may be necessary for prairie plants and other maintenance issues may arise. You may wish to seek an experts opinion on a maintenance plan.

Sample Garden Designs

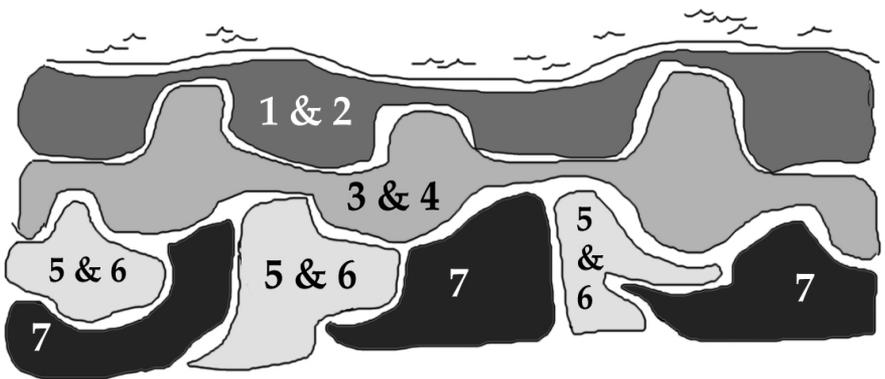
The following are sample garden designs to give you a jump-start at using the concepts of Landscaping for Water Quality. These are examples only - you will have to keep in mind the attributes of your property when considering what plants to choose for your unique gardens. Vary the shapes of the gardens to fit your individual needs. The drawing you made of your property earlier will help you decide on garden type, size and shape.

To determine how many plants your garden will need – calculate your square footage and then figure on one to two plants for every square foot. This will give you an estimate from which to work. Because individual plant requirements differ, ask your nursery for spacing and planting specifics.



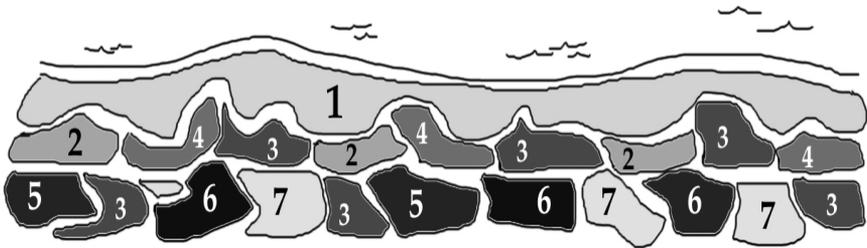
In the first two examples, riparian layouts, the lowland (wet zone) plants are placed closest to the water’s edge, while the drier plants are planted farther away from the water’s edge. (Riparian refers to the land found at the edges of a river or lake.) It is essential that contaminated water runoff is prevented from entering the water bodies. A riparian garden is a beautiful option to meet that need.

A Riparian Garden Layout



1. Switchgrass (*Panicum vigatum*)
2. Cardinal Flower (*Lobelia cardinalis*)
& Great Blue Lobelia (*Lobelia siphilitica*)
3. Culver’s Root (*Veronicastrum virginicum*)
4. Dense Blazing Star (*Liatris spicata*)
5. Little Blue Stem (*Schizachyrium scoparium*)
6. Tall Bellflower (*Campanula americana*)
& Black Eyed Susan (*Rudbeckia hirta*)
7. Harebell (*Campanula rotundifolia*)

A Second Riparian Layout



1. Tussock Sedge (*Carex stricta*)
2. Marsh Milkweed (*Asclepias incarnata*)
3. Bottle Gentian (*Gentiana andrewsii*)
4. Dense Blazing Star (*Liatris spicata*)
5. Blue-eyed Grass (*Sisyrinchium angustifolium*)
6. Early Meadow Rue (*Thalictrum dioicum*)
7. Harebell (*Campanula rotundifolia*)

The first layout functions as a water body buffer zone and utilizes taller species, up to six feet in height. The tall foliage is useful as a privacy screen as well as providing excellent butterfly, bird and other wildlife habitat. The various plant varieties will migrate into each other over time.

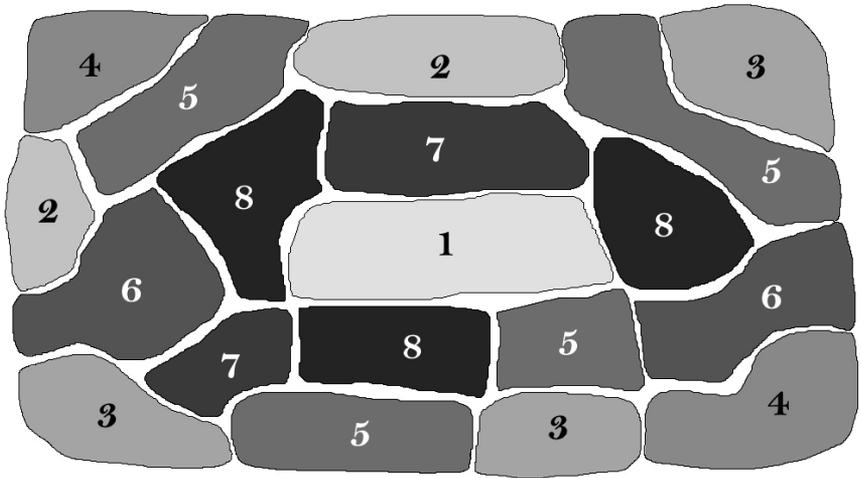
The second layout is another buffer zone example that utilizes shorter species of plants. The roots encourage filtration and the dense foliage acts as an effective barrier to storm water runoff.

It is suggested that you make your buffer at least four to six feet wide. As a rule of thumb, the steeper the slope the wider your buffer zone should be. On a very steep slope, the entire slope should be used as a buffer zone.



In the remaining garden design examples, the lowland (wet zone) plants are placed in the center of the garden design. The ground gradually slopes from the upland (dry zone) areas on the outer edges down to the center. Storm water runoff is encouraged to enter and stay in the garden where it will be filtered and absorbed into the ground.

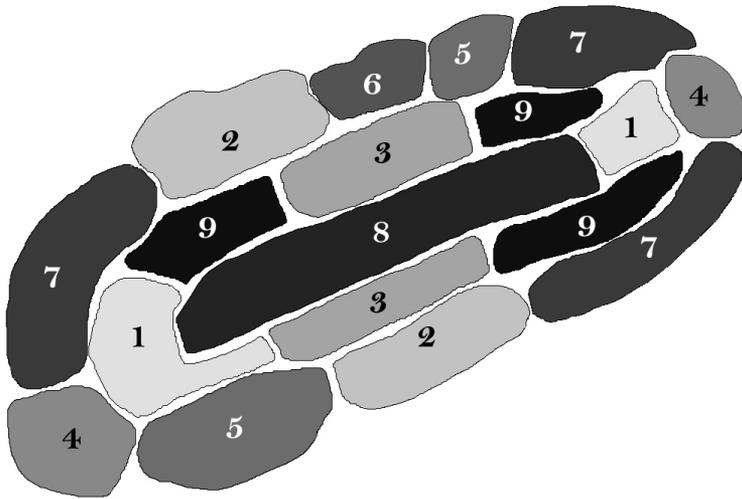
Prairie Garden Layout



1. Switch Grass (*Panicum virgatum*)
 2. Yarrow (*Achillea millefolium*)
 3. Black-Eyed Susan (*Rudbeckia hirta*)
 4. Little Bluestem (*Schizachyrium scoparium*)
 5. Blazing Star (*Liatris spicata*)
 6. Purple Coneflower (*Echinacea purpurea*)*
 7. Missouri Ironweed (*Vernonia missurica*)
 8. Blue Flag Iris (*Iris versicolor*)
- (* denotes not native in Michigan)

Prairie gardens offer extensive water quality benefits to any landscape. Deep roots encourage water infiltration, water storage and soil stabilization, while interesting foliage provides windbreaks. This style of garden is very natural looking and is a low maintenance garden choice. As the name “prairie” implies, this garden does best in full or partial sun. These plants also tolerate drought conditions well, reducing or eliminating the need for “sprinkling”, even during a dry spell.

Sunny Garden Layout

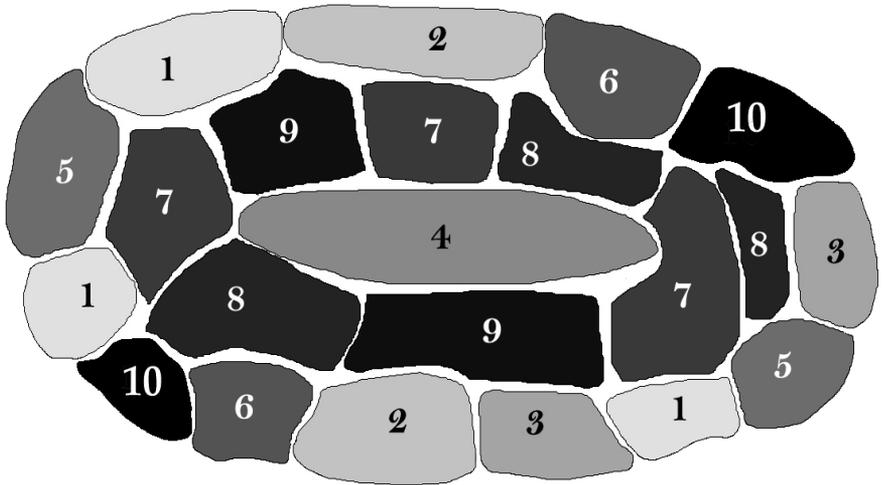


1. Bee Balm (*Monarda fistulosa*)
 2. Blue-Eyed Grass (*Sisyrinchium angustifolium*)
 3. Oxeye Sunflower (*Heliopsis helianthoides*)
 4. Hoary Vervain (*Verbena stricta*)
 5. Spiderwort (*Tradescantia ohioensis*)
 6. Black-Eyed Susan (*Rudbeckia hirta*)
 7. Blackberry Lily (*Belamcanda chinensis*)*
 8. Queen of the Prairie (*Filipendula rubra*)
 9. New England Aster (*Aster novae-Angliae*)
- (* denotes not native in Michigan)

This garden is for sunny areas – places receiving more than six hours of direct sunlight per day. The plants used encourage water infiltration while providing vibrant colors.

There are numerous species of sun loving plants that can have a positive impact on water quality. If the nursery near you does not carry a specific plant in your plan, substitute a similar one.

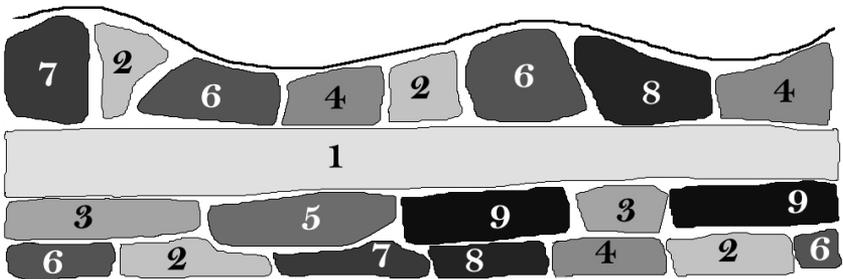
Butterfly Garden Layout



1. May Night Salvia (*Salvia X superba*)*
 2. Butterfly Weed (*Asclepias tuberosa*)
 3. Smooth Aster (*Aster laevis*)
 4. Fireweed (*Epilobium angustifolium*)
 5. Black-eyed Susan (*Rudbeckia hirta*)
 6. Blazing Star (*Liatris spicata*)
 7. Joe Pye Weed (*Eupatorium maculatum*)
 8. Blue Vervain (*Verbena hastata*)
 9. Missouri Ironweed (*Vernonia missurica*)
 10. Autumn Joy Sedum (*Sedum 'Autumn Joy'*)*
- (* denotes not native in Michigan)

Designed for a fairly steep slope, the plants in this garden not only provide water quality benefits, but are also attractive to butterflies and birds. The plants were selected to provide a long colorful blooming season with fragrant blossoms. Wildflowers are a great choice when your goal is to ensure water quality and storm water management.

Sunny Border Garden Layout

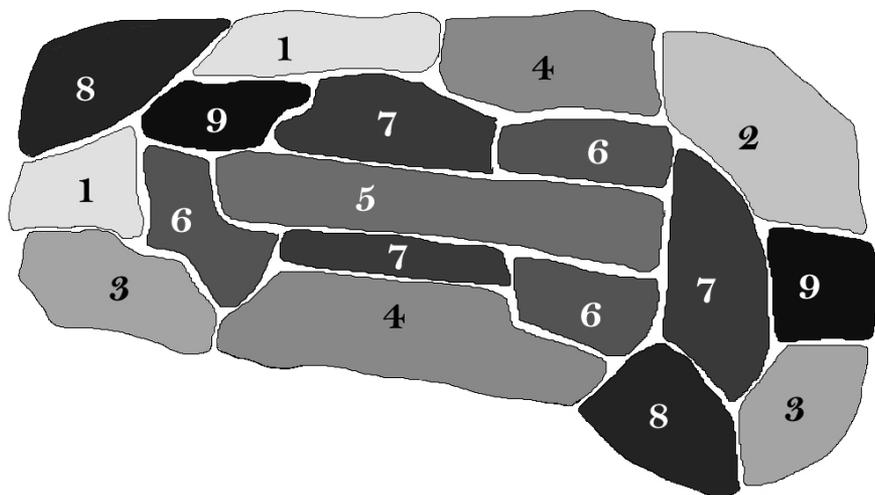


1. Blue Flag Iris (*Iris versicolor*)
& Golden Alexanders (*Zizia aurea*)
 2. Blue-Eyed Grass (*Sisyrinchium angustifolium*)
 3. White Coneflower (*Echinacea purpurea alba*)*
 4. Purple Leaf Sedum (*Sedum X 'Vera Jameson'*)*
 5. Tall Bellflower (*Campanula americana*)
 6. Moonbeam Coreopsis (*Coreopsis verticallata 'Moonbeam'*)*
 7. Hairy Beard Tongue (*Penstemon hirsutus*)
 8. Lambs Ears (*Stachys lanata*)*
 9. Missouri Ironweed (*Vernonia missurica*)
- (* denotes not native in Michigan)

This garden is designed as a running border at the edge of your property or wherever you wish to have a border of color. The flowers and seeds are attractive to birds and butterflies while providing an interesting mix of foliage and textures.

The lowland (wet zone) is planted with Blue Flag Iris, which does very well in shallow water, interspersed with Golden Alexander for variety. You may wish to add a second or third species in the lowland area to add diversity, such as Bottle Gentian or Monkey Flower.

The Shady Garden Layout

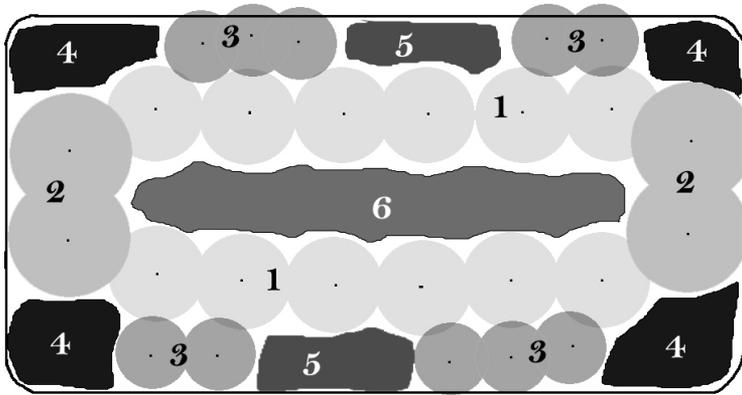


1. Jack-in-the-Pulpit (*Arisaema triphyllum*)
 2. August Lily Hosta (*Hosta plantaginea*)*
 3. Golden-Edged Hosta (*Hosta fortunei*)*
 4. Pink Astilbe (*Astilbe Arendsii* 'Rheinland')
 5. Great Blue Lobelia (*Lobelia siphilitica*)
mixed with Riverbank Wild Rye (*Elymus riparius*)
 6. Culver's Root (*Veronicastrum virginicum*)
 7. Ostrich Fern (*Mateuccia pennsylvanica*)
 8. Lady's Mantle (*Achelmilla mollis*)
 9. Black-Eyed Susan (*Rudbeckia hirta*)
- (* denotes not native in Michigan)

This garden is for shady or partly shaded areas – places receiving less than six hours of direct sunlight per day. The blooming season is long, giving three-season color. Shade plants help hold moisture in the soil, which is beneficial to the trees providing the shade.

To replace turf grass that is often difficult to grow in the shade, you may want to try areas of groundcover such as Round-lobed Hepatica or Lady's Mantle. Although groundcovers offer less than optimum water quality benefits, they can make a large impact over time.

Inviting Shrub Garden



1. Large Cranberrybush (*Vaccinium macrocarpon*)
 2. Annabelle Hydrangea (*Hydrangea arborescens* 'Annabelle')*
 3. Maple Leaf Viburnum (*Viburnum acerifolium*)
 4. Happy Returns Daylily (*Hemerocallis* 'Happy Returns')*
 5. Horsemint (*Monarda punctata*)
 6. Tall Bellflower (*Campanula americana*)
- (* denotes not native in Michigan)

Plants for this garden are mostly shrubs and were selected to provide water uptake and storage. The fabulous blue & white colors may attract hummingbirds.

Planning your landscape can bring out both the engineer and artist in you. Imagine having a landscape that is awash with color year-round, requires little maintenance and helps insure water quality for years and years to come! Share the ideas with your neighbors and friends. We all could make a tremendous impact.



The next section contains specific plant attributes to help you choose what plant is right for your garden. Also included in that section is a reference to find the right nursery in your area to obtain the native plants you may want.

Section 3:

PLANT LIST



Landscaping For Water Quality in Michigan – Plant Lists

Before utilizing this third section, it is suggested that you read about the concepts in, *An Overview*, and plan your design using one or more of the ideas in the second section, *Designing Your Garden and Sample Designs*.

What Plants do I use for MY Garden?

The specific plants you choose to use is entirely a personal choice. In this booklet we offer a variety of plants from which to choose. The plants listed are by no means the complete list of plants you can consider. You will see that the majority of the species listed are native to Michigan, defined here as: “Plants that were found in this region prior to European settlement”.

Native species are well suited to the local quirks of nature and many provide the functions desired to have a successful water quality garden. Use of native species also provides food and habitat for native animals and can cultivate a better appreciation for Michigan’s past. Some will argue that the use of genetically pure native species is the preferred choice. However, it can also be argued that many species of plants that are not native to Michigan also provide excellent water quality benefits. The specific functions to look for in a plant species is ultimately more important than whether or not the plant is native to Michigan.

Those with deep root systems, ability to filter or absorb pollutants, have little or no need for fertilization or sprinkling and are nearly maintenance free are the ones to choose.



Be flexible when choosing your plants. You will probably design your landscape with a few specific plants in mind, but when you go to the nursery to buy them, you may have to substitute. Work with the nursery to reach a solution that will give you the effect you desire.

As a note of caution, when selecting any species ask questions of your nursery to ensure your choices are not invasive species that could spread

beyond your garden and cause environmental damage. In addition, some species may be on endangered or threatened species lists. Please verify that your choices are appropriate for the intended use.

The plants in this booklet are divided into several categories. Each species will have specific characteristics listed, and in addition, short comments to help you make your decisions. This listing is in no way comprehensive. There are many other species that are suitable for water quality gardens that were not included in this list. You can consult with your local native plant nursery for more native suggestions, discuss your needs with your nursery or explore the resource list suggested at the end of this booklet.



A quick note about the categories:

Plant Names

Because there is no standardization of common names of plants, look for the plant tags at the time of purchase. The tags will list the scientific name and the plant characteristics. This is helpful in both securing the exact plant you seek as well to identify good substitutions, if necessary.

Plant Height

Influences such as water availability, sun exposure and proximity to other plants can affect plant height. In addition, you can physically limit plant height through pruning. Many of the shrubs can be utilized as trees if desired.

Exposure (Sun)

The symbols used are: ○ = full sun, ◐ = partial sun, ● = shade.

Native ()*

A star (*) in this column indicates that the species is native to Michigan.



Wildflowers

| PLANT NAMES | | Height (ft) | Bloom Time |
|---------------------------------|---------------------------|-------------|------------|
| Botanical | Common | | |
| <i>Achillea filipendula</i> | Moonshine Yarrow | 2-4 | June-Sept |
| <i>Achillea millefolium</i> | Yarrow | 1-4 | June-Sept |
| <i>Acorus calamus</i> | Sweet Flag | 2-5 | May-Jul |
| <i>Actaea pachypoda</i> | Baneberry | 1-3 | May-Jun |
| <i>Alchemilla mollis</i> | Lady's Mantle | 1-2 | May-Aug |
| <i>Alisma subcordatum</i> | Water Plantain | 2-3 | June-Sept |
| <i>Allium cernuum</i> | Nodding Onion | 1-2 | May-Aug |
| <i>Amorpha canescens</i> | Lead Plant | 2-3 | May-Aug |
| <i>Anemone canadensis</i> | Canada Anemone | 1-2 | May-July |
| <i>Anemonella thalictroides</i> | Rue Anemone | 0.5-1 | April-June |
| <i>Aquilegia canadensis</i> | Columbine | 2-3 | May-Jul |
| <i>Arisaema triphyllum</i> | Jack-in-the-Pulpit | 1-2 | April-June |
| <i>Asarum canadense</i> | Wild Ginger | 0.5-1 | April-May |
| <i>Asclepias incarnata</i> | Marsh Milkweed | 1-2 | Jun-Sept |
| <i>Asclepias syriaca</i> | Common Milkweed | 1-6 | May-Aug |
| <i>Asclpias tuberosa</i> | Butterfly Weed | 1-3 | Jun-Aug |
| <i>Aster laevis</i> | Smooth Aster | 2-4 | Aug-Oct |
| <i>Aster novae-angliae</i> | New England Aster | 3-6 | Aug-Oct |
| <i>Aster umbellatus</i> | Tall Flat Top White Aster | 3-7 | Aug- Sept |
| <i>Astilbe arendsii</i> | Pink Astilbe | 3-5 | June-July |
| <i>Belamcanda chinensis</i> | Blackberry Lily | 1-2 | Aug-Sept |
| <i>Calla palustris</i> | Wild Calla | 0.5-2 | June-July |
| <i>Caltha palustris</i> | Marsh Marigold (Cowslip) | 0.5-2 | March-May |
| <i>Campanula americana</i> | Tall Bellflower | 2-6 | Jul-Oct |

| Flower Color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|---|
| Yellow | Med | ○ | | Resistant to deer; aromatic leaves; use in dried flower arrangements. |
| White | Med-Dry | ○ | * | Can be aggressive; drought tolerant. |
| Yellow | Wet | ○ | * | Wildlife benefits; medicinal uses. |
| White | Med | ●● | * | Flowers followed by white berries; attractive shade plant. |
| Yellow | Med | ○● | | Interesting as a groundcover; dried flower arrangement use; clump-forming. |
| White | Wet | ○ | | Must be kept in moist to flooded areas; waterfowl food source; fast grower. |
| Pink | Med-Dry | ○● | * | Best in sandy soils; clump-forming; attractive garden plant. |
| Purple | Med-Dry | ○● | * | Attracts butterflies; spike flowers; drought tolerant; longlived. |
| White | Med-Wet | ○● | * | Spreads aggressively; delicate 1-2" flower, deep green leaves. |
| White | Med | ●● | * | Long-lasting spring blooms; MI native in southern-lower peninsula; groundcover. |
| Red | Med | ○●● | * | Deer deterrent; attracts hummingbirds; best in partial shade gardens. |
| Purple | Med-Wet | ●● | * | Interesting shade plant; bright red fall fruit; easily grown from seed. |
| Red | Med-Wet | ●● | * | Medicinal uses; satiny, deep-green, heartshaped leaves; groundcover. |
| Pink | Med-Wet | ○ | * | Deep root; clump-forming; attract butterflies; attractive garden plant. |
| Pink | Med-Dry | ○● | * | Medicinal purposes; attract butterflies; poisonous when ingested; sandy areas. |
| Orange | Med-Dry | ○● | * | Gorgeous bed plant; attracts butterflies; medicinal uses; poisonous if ingested; can be aggressive. |
| Variety | Med-Dry | ○ | * | Grows well in sand; blooms late; attracts butterflies. |
| Purple | Med | ○● | * | Medicinal uses; attracts butterflies; rabbit deterrent; prefers sand. |
| White | Med-Wet | ○● | * | Attracts butterflies and birds; wonderful garden plant. |
| Pink | Med-Wet | ●● | | Gorgeous floral spike; dark green foliage; great addition to shade beds. |
| Orange | Med | ○ | | Delicate flowers followed by black berry seeds; drought tolerant. |
| White | Wet | ○ | * | Best in calm water; beautiful for water gardens. |
| Yellow | Wet | ○● | * | Attracts butterflies; soft, spongy roots - best along stream banks; early flower. |
| Blue | Med | ○●● | * | Fabulous star shaped flowers; easily grown. |

Wildflowers - continued

| PLANT NAMES | | Height (ft) | Bloom Time |
|--------------------------------|--|-------------|------------|
| Botanical | Common | | |
| <i>Campanula rotundifolia</i> | Harebell | 1-1.5 | July-Sept |
| <i>Cassia hebecarpa</i> | Wild Senna | 4-6 | Jul-Aug |
| <i>Chelone glabra</i> | Turtlehead | 1-3 | July-Oct |
| <i>Claytonia virginica</i> | Spring Beauty | 0.5 | March-May |
| <i>Coreopsis tripteris</i> | Tall Coreopsis | 3-6 | July-Sept |
| <i>Coreopsis verticillata</i> | Moonbeam Coreopsis | 1-3 | June-Sept |
| <i>Dalea purpurea</i> | Monkeyflower; Purple Prairie Clover | 1-3 | May-Sept |
| <i>Echinacea purpurea</i> | Purple Coneflower | 1-3 | June-Aug |
| <i>Epilobium angustifolium</i> | Fireweed | 2-6 | Jun-Aug |
| <i>Eryngium yuccifolium</i> | Rattlesnake Master | 2-6 | June-Sept |
| <i>Eupatorium maculatum</i> | Joe-Pye Weed | 4-6 | Jul-Sept |
| <i>Eupatorium perfoliatum</i> | Boneset | 4-6 | Aug-Oct |
| <i>Eupatorium purpureum</i> | Purple Joe-Pye Weed | 5-7 | Aug-Sept |
| <i>Eupatorium rugosum</i> | White Snakeroot | 1-5 | July-Oct |
| <i>Filipendula rubra</i> | Queen of the Prairie | 6-8 | Jul-Aug |
| <i>Fragaria virginiana</i> | Wild Strawberry | 0.5 | April-June |
| <i>Gentiana andrewsii</i> | Bottle Gentian | 1-2 | Aug - Oct |
| <i>Gaillardia pulchella</i> | Blanket Flower | 1-2.5 | May-Sept |
| <i>Geranium himalayense</i> | Johnson's Blue Geranium | 1-2 | May-June |
| <i>Geranium maculatum</i> | Wild Geranium | 1-2 | April-May |
| <i>Helenium autumnale</i> | Sneezeweed | 2-5 | July-Oct |

| Flower Color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|---|
| Blue | Med-Dry | ☉☿ | * | Attracts butterflies; fond of sandy soil; gorgeous garden plant. |
| Yellow | Med-Wet | ☉ | * | Attracts birds; clay-loving; brilliant color addition to any native garden. |
| Variety | Med-Wet | ☉☿ | * | Unique flower; prefers a compost mulch. |
| Pink | Med | ☉☿ | * | Clump forming spring ground cover dies back completely in summer); can be aggressive; early bloom. |
| Yellow | Med-Dry | ☉ | * | Tolerant to heat, humidity and drought; a colorful addition to a bed. |
| Yellow | Med-Dry | ☉ | | Delicate foliage; low maintenance; drought tolerant; tolerates poor soils. |
| Purple | Med | ☉ | | Extripated in Michigan - only grandfathered stock or non-native specimens are available; Wildlife benefits; medicinal uses; very attractive. |
| Purple | Med-Dry | ☉☿ | | Extripated in Michigan - only only grandfathered stock or non-native specimens are available are available; Medicinal uses; popular flower garden plant; easy to grow. Also available in "alba" or white variety. |
| Pink | Med-Wet | ☉☿ | * | Attracts butterflies; striking flower; medicinal uses; aggressive in wet areas; prefers disturbed ground. |
| White | Wet-Dry | ☉ | | Threatened species in Michigan - requires MDNR permit or grandfathered stock to sell/trade; attractive plant; used in prairie restoration; beneficial to wildlife. |
| Pale Pink | Med-Wet | ☉ | * | Flower clusters up to 6" across; attracts butterflies. |
| White | Med-Wet | ☉☿ | * | Tolerant of sandy and clay soils; clump-forming; fuzzy cluster blossoms. |
| Pink | Med | ☉ | * | Clump-forming; fragrant; attract butterflies; attractive addition for a garden. |
| White | Dry | ☉☿☿ | * | Beautiful cut flower; poisonous if ingested. |
| Pink | Med-Wet | ☉☿ | * | Threatened species in Michigan - requires MDNR permit or grandfathered stock to sell/trade; striking addition to the garden; use in clay soils; fragrant. |
| White | Med-Dry | ☉☿ | * | Ground cover; beneficial to wildlife; edible fruit. |
| Purple | Med-Wet | ☉☿ | * | Blooms never fully open, hence bottle-like appearance. |
| Red & Yellow | Med-Dry | ☉☿ | | Daisy-like red blossoms with yellow rims; forms dense colonies. Very easily grown from seed. |
| Blue | Med | ☉☿ | | Easily grown; also called Cranesbill; clump-forming. |
| Pink | Med | ☉☿☿ | * | Clump-forming; great addition to shade beds. |
| Yellow | Med-Wet | ☉☿ | * | Avoid fertilizer; bright yellow daisy-like flowers. |

Wildflowers - continued

| PLANT NAMES | | Height (ft) | Bloom Time |
|-------------------------------------|-----------------------------|-------------|------------|
| Botanical | Common | | |
| <i>Helianthus giganteus</i> | Tall Sunflower | 3-12 | July-Oct |
| <i>Heliopsis helianthoides</i> | Oxeye or False Sunflower | 2-5 | June-Sept |
| <i>Hemerocallis "Happy Returns"</i> | Happy Returns Daylily | 0.5-2 | May-Aug |
| <i>Hepatica americana</i> | Round-Lobed Hepatica | 0.5-1 | April-May |
| <i>Hosta fortunei</i> | Golden-Edged Hosta | 1-2 | June-Aug |
| <i>Hosta plantaginea</i> | August Lily Hosta | 2 | Aug |
| <i>Hydrophyllum virginianum</i> | Virginia Waterleaf | 1-3 | May-Aug |
| <i>Iris versicolor</i> | Blue Flag (Wild Iris) | 2-3 | May-July |
| <i>Liatris aspera</i> | Rough Blazing Star | 2-5 | Aug-Sept |
| <i>Liatris spicata</i> | Dense or Marsh Blazing Star | 1-3 | July-Sept |
| <i>Lobelia cardinalis</i> | Cardinal Flower | 2-6 | July-Oct |
| <i>Lobelia siphilitica</i> | Great Blue Lobelia | 1-4 | July-Sept |
| <i>Lupinus perennis</i> | Lupine | 1-2 | May-June |
| <i>Mimulus ringens</i> | Monkeyflower | 1-3 | June-Sept |
| <i>Mitchella repens</i> | Partridgeberry | <1 | April-July |
| <i>Monarda fistulosa</i> | Wild Bergamot, Bee Balm | 2-4 | June-Sept |
| <i>Monarda punctata</i> | Horsemint | 1-3 | Jul-Sep |
| <i>Nymphaea tuberosa</i> | White Water Lily | 1-5 | Jul-Aug |
| <i>Oenothera biennis</i> | Common Evening Primrose | 2-5 | June-Oct |
| <i>Peltandra virginica</i> | Arrow Arum | 1-2 | May-July |
| <i>Penstemon digitalis</i> | Foxglove Beard Tongue | 3-4 | May-June |
| <i>Penstemon hirsutus</i> | Hairy Beard Tongue | 1-3 | May-July |
| <i>Phlox divaricata</i> | Woodland Phlox | 1-3 | April-June |

| Flower Color | Water Needs | Sun | * | Notes |
|-----------------|-------------|-----|---|--|
| Yellow | Med-Wet | ☉☿ | * | Tall, bright addition to a partial shade garden; 4" wide flower head. |
| Yellow | Med-Dry | ☉☿ | * | Easily grown; native to the Eastern U.S.; grows well in clay. |
| Yellow | Med | ☉☿ | * | Heat tolerant; long flower season; gorgeous addition to any bed. |
| Blue-Pink-White | Med-Dry | ●☿ | * | Delicate 1" star shaped flower; great groundcover in shade beds. |
| Purple | Med | ●☿ | * | Beautiful foliage; great addition to shade gardens; mass for groundcover. |
| White | Med | ●☿ | * | Shiny foliage; fragrant flowers; great planted close together as groundcover. |
| White | Med-Wet | ●☿ | * | Medicinal properties. |
| Blue | Med-Wet | ☉☿ | * | Gorgeous perennial; attracts butterflies; does well in shallow water. |
| Purple | Med-Dry | ☉ | * | Drought tolerant; attracts butterflies; blooms late in season. |
| Purple | Med | ☉☿ | * | Drought tolerant; used in cut flower arrangements; feathery plume attracts butterflies. |
| Red | Med-Wet | ☉☿☿ | * | Gorgeous bright red stalk attracts humming birds and butterflies; prefers part shade. Save seedlings to replant this short-lived perennial |
| Blue | Med-Wet | ☉☿ | * | Easily grown; attracts hummingbirds; grows well in a variety of soils. |
| Variety | Med-Dry | ☉☿☿ | * | Attracts rare Karner Blue butterfly; attractive flower and foliage. |
| Purple | Med-Wet | ☉☿ | * | Great for wet areas; interesting flower shape. |
| Pink | Med-Dry | ● | * | Produces red fruit; medicinal uses; food source for wildlife; groundcover. |
| Pink / lavender | Med-Dry | ☉☿ | * | Aromatic; attractive to butterflies and hummingbirds; medicinal uses; can be aggressive. |
| Yellow | Med-Dry | ☉ | * | Attractive to hummingbirds; likes sandy soil. |
| White | Wet | ☉☿ | * | Beautiful aquatic plant; tuber; floating leaves and flower; beneficial to wildlife. |
| Yellow | Med | ☉ | * | Medium bright flowers, open in evening; used in dried flower arrangements; attracts hummingbirds; can be aggressive. |
| Yellow | Wet | ☉☿☿ | * | Salt tolerant; variable pH tolerant; can grow in water; used in buffer zones; beneficial to wildlife. |
| White | Med-Dry | ☉☿☿ | * | Ornamental; beautiful flower and foliage; attractive to butterflies and hummingbirds. |
| Purple | Med-Dry | ☉☿ | * | Versatile plant; low grower; early summer bloomer; likes sandy soil. |
| Blue | Med | ☉☿☿ | * | Can be aggressive; gorgeous 1 1/2" flower; caution - not <i>Phlox paniculata</i> which is invasive. |

Wildflowers - continued

| PLANT NAMES | | Height (ft) | Bloom Time |
|-----------------------------------|------------------------|-------------|-------------|
| Botanical | Common | | |
| <i>Phlox pilosa</i> | Prairie or Downy Phlox | 1-1.5 | April-June |
| <i>Podophyllum peltatum</i> | May Apple | 1-2 | April-May |
| <i>Polygonatum biflorum</i> | True Solomon Seal | 1-3 | May-June |
| <i>Pontederia cordata</i> | Pickereelweed | 2-4 | May-Oct |
| <i>Potentilla simplex</i> | Common Cinquefoil | 0.5-1.5 | April-June |
| <i>Ratibida pinnata</i> | Yellow Coneflower | 3-5 | Jul-Sep |
| <i>Rudbeckia hirta</i> | Black-Eyed Susan | 1-3 | Jun-Sep |
| <i>Rudbeckia laciniata</i> | Cut-Leaved Coneflower | 3-10 | Aug-Sept |
| <i>Rudbeckia triloba</i> | Three-Lobed Coneflower | 2-5 | July-Oct |
| <i>Sagittaria latifolia</i> | Arrowhead | 1-4 | July-Sept |
| <i>Salvia X superba</i> | May Night Salvia | 1-1.5 | Apr - Jun |
| <i>Sanguinaria canadensis</i> | Bloodroot | 0.5-1 | March-April |
| <i>Saururus cernuus</i> | Lizard's Tail | 1-2 | June-Sept |
| <i>Sedum "Autumn Joy"</i> | Autumn Joy Sedum | 1-2 | September |
| <i>Sedum "Vera Jameson"</i> | Purple Leaf Sedum | 1 | Aug-Sept |
| <i>Silphium integrifolium</i> | Rosinweed | 3-6 | Jul-Sep |
| <i>Silphium laciniatum</i> | Compass Plant | 3-10 | June-Sept |
| <i>Silphium perfoliatum</i> | Cup Plant | 4-8 | Jul-Sep |
| <i>Sisyrinchium angustifolium</i> | Blue-Eyed Grass | 0.5-2 | May-July |
| <i>Sium suave</i> | Water Parsnip | 2-6 | July-Sept |
| <i>Stachys lanata</i> | Lamb's Ear | 0.5-2 | June-July |
| <i>Stylophorum diphyllum</i> | Celandine Poppy | 1-2 | May-June |

| Flower Color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|---|
| Pink | Med-Dry | ○●● | * | Early flowering prairie plant; ornamental plant. |
| White | Med | ●● | * | Medicinal uses; dormant in summer; early bloomer; produces a yellow fruit. |
| White | Med-Wet | ●● | * | Bell-shaped flowers; black berries in fall; beneficial to wildlife. |
| Blue | Wet | ○● | * | Provide wave buffering along shorelines; wildlife benefits; grows in water. |
| Yellow | Dry | ○●● | * | Groundcover; dainty flower; attracts butterflies; early bloomer. |
| Yellow | Med-Dry | ○ | * | Long, drooping petals; Wildlife benefits; strong competitor; long lived; attracts butterflies; prefers sandy or clay soils; tall stem may need support. |
| Yellow | Med-Dry | ○● | * | Erosion control plant; wildlife benefits; biennial; does well in sandy soils. |
| Yellow | Med-Wet | ○● | * | Easily grown; great for wet areas; grows well in a variety of soils; leggy. |
| Yellow | Med | ○● | * | Attracts butterflies; great for cut flower arrangements; long blooming season. |
| White | Wet | ○● | * | Aquatic plant; edible; wildlife food source; great for water gardens. |
| Deep Blue | Med | ○● | | Very showy; wrinkled foliage; best in poor soil. |
| White | Med | ●● | * | Needs rich soil in shade; red sap from roots-poisonous; large striking flower. |
| White | Wet | ○●● | * | Great for water gardens; fragrant; aggressive in optimum conditions. |
| Pink | Med-Dry | ○● | | Also called Stonecrop; succulent; drought tolerant; not tolerant of clay. |
| Pink | Med-Dry | ○ | | Ornamental foliage; succulent; drought resistant; clump-forming. |
| Yellow | Med | ○ | * | Threatened species in Michigan - requires MDNR permit or grandfathered stock to sell/trade; wildlife food source; attract butterflies. |
| Yellow | Med-Dry | ○ | * | Threatened species in Michigan-requires MDNR permit or grandfathered stock to sell/trade; tremendous taproot; grows well in clay. |
| Yellow | Med-Wet | ○● | * | Threatened species in Michigan - requires MDNR permit or grandfathered stock to sell/trade; attracts hummingbirds and butterflies; beneficial to birds. |
| Deep Blue | Med | ○● | * | Low growing; clump-forming; grass-like foliage. |
| White | Wet | ○● | * | Aquatic plant; showy in bloom. |
| Purple | Med-Dry | ○●● | | Furry leaves; drought resistant; can be aggressive; attracts hummingbirds. |
| Yellow | Med-Wet | ●● | * | Requires consistently moist soil; blooms repeatedly. |

Wildflowers - continued

| PLANT NAMES | | Height (ft) | Bloom Time |
|---------------------------------|--------------------|-------------|------------|
| Botanical | Common | | |
| <i>Thalictrum dasycarpum</i> | Purple Meadow Rue | 3-6 | Jun-Jul |
| <i>Thalictrum dioicum</i> | Early Meadow Rue | 1-2 | April-June |
| <i>Tiarella cordifolia</i> | Foamflower | 1-2 | May-June |
| <i>Tradescantia ohiensis</i> | Spiderwort | 2-4 | June-July |
| <i>Trillium grandiflorum</i> | White Trillium | 1-2 | May-June |
| <i>Verbena hastata</i> | Blue Vervain | 3-6 | Jul-Sep |
| <i>Verbena stricta</i> | Hoary Vervain | 2-4 | July-Sept |
| <i>Vernonia missurica</i> | Missouri Ironweed | 3-10 | Aug-Oct |
| <i>Veronicastrum virginicum</i> | Culver's Root | 2-6 | June-Sept |
| <i>Viola papilionacea</i> | Common Blue Violet | <1 | Apr - Jul |
| <i>Zizia aurea</i> | Golden Alexanders | 1-3 | Apr-Jun |

Grasses, Sedges, Rushes

| PLANT NAMES | | Height (ft) | |
|----------------------------|--------------------|-------------|--|
| Botanical | Common | | |
| <i>Andropogon gerardii</i> | Big Blue Stem | 3-8 | |
| <i>Carex comosa</i> | Bristly Sedge | 2-5 | |
| <i>Carex grayi</i> | Gray's Sedge | 2-3 | |
| <i>Carex hystericina</i> | Porcupine Sedge | 1-2 | |
| <i>Carex lacustris</i> | Lake Sedge | 2-5 | |
| <i>Carex stricta</i> | Tussock Sedge | 1-3 | |
| <i>Elymus canadensis</i> | Canada Wild Rye | 2-5 | |
| <i>Elymus riparius</i> | Riverbank Wild Rye | 1-4 | |
| <i>Elymus virginicus</i> | Virginia Wild Rye | 3-5 | |

| Flower Color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|---|
| White | Med-Wet | ○☐ | * | Attractive foliage and flowers; early summer bloom; may need staking. |
| Green | Med | ○●● | * | Early spring blooms, attractive foliage, needs male & female to seed. |
| White | Med | ●● | * | Spike of tiny flowers; attractive foliage turning bronze in autumn. |
| Blue | Med-Dry | ○☐ | * | Aggressive; each tri-petalled blossom lasts one day. |
| White | Med-Dry | ●● | * | Long lived; medicinal uses; white flower turns pink with age. |
| Blue | Med-Wet | ○ | * | Attracts butterflies; wonderful for cut flower arrangements; can be aggressive. |
| Blue | Med-Dry | ○ | * | Attracts butterflies; great for cut flower arrangements; drought resistant. |
| Purple | Med | ○☐ | * | Easily grown; attracts butterflies; aggressive; late summer blooms. |
| Pink | Med | ○●● | * | Small dense flower, on tall spike; great for cut flower arrangements. |
| Deep Blue | Med-Wet | ●● | * | Prefers moist conditions; shade plant. |
| Yellow | Wet | ○☐ | * | Can be aggressive; interesting addition to gardens. |

| | Water Needs | Sun | * | Notes |
|--|-------------|-----|---|--|
| | Med-Dry | ○☐ | * | Erosion control use; preferred by livestock; beneficial to birds. |
| | Med-Wet | ○☐ | * | Waterfowl food source; long-lived. |
| | Med-Wet | ○☐ | * | Ornamental grass; interesting flower form; easily grown. |
| | Wet | ○☐ | * | Long-lived; clump-forming; tufted. |
| | Wet | ○☐ | * | Can grow in shallow standing water; adds color to waters edge. |
| | Wet | ○☐ | * | Forms bluish-green tussocks; attracts butterflies; aquatic grass. |
| | Med-Dry | ○☐ | * | Cool season, clump-forming ornamental grass; wheat/rye like spikes that remain well into winter; excellent ground cover for dry, sunny slopes. |
| | Med-Wet | ○●● | * | Slightly nodding, long, wide, wheat like spikes; beneficial to butterflies. |
| | Med-Wet | ○●● | * | Mixes well with Bottle Brush grass and tall woodland flowers; excellent for wooded openings and forest edges. |

Grasses, Sedges, Rushes - continued

| PLANT NAMES | | Height (ft) |
|--------------------------------|--------------------|-------------|
| Botanical | Common | |
| <i>Equisetum fluviatile</i> | Water Horsetail | 1-3 |
| <i>Hystrix patula</i> | Bottle Brush Grass | 2-3 |
| <i>Juncus effusus</i> | Corkscrew Rush | 1-2 |
| <i>Juncus tenuis</i> | Roadside Rush | 1-2 |
| <i>Juncus torreyi</i> | Torrey's Rush | 1-3 |
| <i>Panicum virgatum</i> | Switchgrass | 3-6 |
| <i>Schizachyrium scoparium</i> | Little Bluestem | 2-4 |
| <i>Scirpus atrovirens</i> | Bulrush | 3-5 |
| <i>Sorghastrum nutans</i> | Indian Grass | 3-4 |
| <i>Spartina pectinata</i> | Prairie Cord Grass | 4-6 |

Ferns

| PLANT NAMES | | Height (ft) |
|------------------------------------|------------------|-------------|
| Botanical | Common | |
| <i>Adiantum pedatum</i> | Maidenhair Fern | 1-2 |
| <i>Athyrium filix-femina</i> | Lady Fern | 1-3 |
| <i>Dryopteris celsa</i> | Log Fern | 3-4 |
| <i>Dryopteris goldiana</i> | Goldie Fern | 3-5 |
| <i>Matteuccia struthiopteris</i> | Ostrich Fern | 3-5 |
| <i>Onoclea sensibilis</i> | Sensitive Fern | 3-4 |
| <i>Osmunda cinnamomea</i> | Cinnamon Fern | 2-3 |
| <i>Osmunda claytoniana</i> | Interrupted Fern | 3-4 |
| <i>Osumunda regalis</i> | Royal Fern | 2-4 |
| <i>Polystrichum acrostichoides</i> | Christmas Fern | 1-2 |
| <i>Thelypteris noveboracensis</i> | New York Fern | 1-2 |

| | Water Needs | Sun | * | Notes |
|--|-------------|-----|---|---|
| | Wet | ☉☉ | | Fast spreading; bank stabilizer; have hollow, jointed stems. |
| | Med-Dry | ☉☉ | * | Ornamental grass; bristly flower heads resemble a bottle brush. |
| | Wet | ☉☉ | * | Easily grown in wet soils, including standing water; corkscrew stems can be cut and used in floral arrangements. |
| | Med | ☉☉ | * | Tolerates droughts; tolerates compacted soil; may be used as a groundcover. |
| | Med-Wet | ☉ | * | Tolerates droughts; has interesting "seed balls" at tips of stems. |
| | Med-Wet | ☉☉ | * | Clump-forming ornamental grass; erosion control; establishes readily from seed. |
| | Med-Dry | ☉ | * | Ornamental grass; distinctive "blue" coloration at the base of the stems; attractive reddish brown fall color. |
| | Wet | ☉ | * | Soil stabilizer; tolerates floods or drought for short periods; can be invasive. |
| | Med-Dry | ☉☉ | * | Showy; clump-forming; often used in wind erosion control; tolerates a moderate amount of salt; may become invasive if not maintained. |
| | Med-Wet | ☉ | * | Aquatic grass that grows well in regular drained soil; good fall yellow color; great plumes; can be aggressive. |

| | Water Needs | Sun | * | Notes |
|--|-------------|-----|---|--|
| | Med-Wet | ●☉ | * | Clump-forming; ornamental fern; good for borders. |
| | Med | ●☉ | * | Attractive in shade beds. |
| | Med-Wet | ●☉ | | Threatened species in Michigan - requires MDNR permit or grandfathered stock to sell/trade; dark green fronds with contrasting dark stripes. |
| | Med | ●☉ | * | Large fern; attractive in shady garden borders. |
| | Med-Wet | ●☉ | * | Excellent landscape fern; large in size. |
| | Med-Wet | ●☉ | * | Aggressive in optimum conditions; bright green color; drought and frost sensitive. |
| | Med-Wet | ●☉ | * | Excellent for wet areas; yellow in autumn. |
| | Med-Wet | ●☉ | * | Easily grown; use in borders and along streams. |
| | Med-Wet | ●☉ | * | Clump-forming; yellow in autumn; needs wet areas. |
| | Med-Dry | ●☉ | * | Grows in fountain-like clumps; utilized for erosion control. |
| | Med | ●☉ | | Hardy; easy to grow; aggressive. |

Vines

| PLANT NAMES | | Height (ft) | Bloom Time |
|------------------------------------|----------------------|-------------|------------|
| Botanical | Common | | |
| <i>Amphicarpa bracteata</i> | Hog Peanut | 2-8 | Aug-Sept |
| <i>Celastrus scandens</i> | American Bittersweet | 1-20 | May-June |
| <i>Clematis virginiana</i> | Virgins' Bower | 10-20 | July-Sept |
| <i>Menispermum canadense</i> | Moonseed | 8-10 | May-July |
| <i>Parthenocissus quinquefolia</i> | Virginia Creeper | 1-60 | May-June |

Shrubs

| PLANT NAMES | | Height (ft) | GROWTH RATE |
|----------------------------------|---------------------|-------------|-------------|
| Botanical | Common | | |
| <i>Alnus rugosa</i> | Speckled Alder | 15-25 | Med |
| <i>Amelanchier arborea</i> | Serviceberry | 25 | Med |
| <i>Ceanothus americanus</i> | New Jersey Tea | 3-4 | Slow |
| <i>Celtis occidentalis</i> | Hackberry | 25 | Med |
| <i>Cephalanthus occidentalis</i> | Buttonbush | 5-12 | Med |
| <i>Cornus amomum</i> | Silky Dogwood | 7 | Med |
| <i>Cornus foemina</i> | Gray Dogwood | 6-15 | Med |
| <i>Cornus stolonifera</i> | Red-Osier Dogwood | 6-9 | Med |
| <i>Corylus americana</i> | Hazelnut | 3-13 | Med |
| <i>Hydrangea arborescens</i> | Annabelle Hydrangea | 3-6 | Fast |
| <i>Juniperus horizontalis</i> | Creeping Juniper | 1-2 | Med-Fast |
| <i>Lindera benzoin</i> | Spicebush | 3-16 | Slow |
| <i>Physocarpus opulifolius</i> | Eastern Ninebark | 3-10 | Slow |
| <i>Prunus virginiana</i> | Chokecherry | 20-30 | Fast |

| Flower Color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|--|
| Pink | Med | ●● | * | Pea-like flowers; delicate twining vine. |
| Yellow | Med-Dry | ○ | * | Needs support; attractive fruit; poisonous fruit; aids in erosion control; wildlife food source; aggressive. |
| White | Med | ○● | * | Aggressive; fragrant; needs support. |
| White | Med-Wet | ○● | * | Medicinal uses; poisonous if ingested; form black berries. |
| Green | Med-Dry | ○●● | * | Useful in erosion control and watershed protection; beneficial to wildlife; ornamental vine; salt tolerant. |

| Flower color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|---|
| Brown | Med | ○● | * | Soil stabilizer; acid to neutral conditions; fixes nitrogen. |
| | Med-Dry | ○● | * | Excellent landscape plant with dark green foliage. |
| White | Dry | ○● | * | Taprooted, do not try to transplant; drought tolerant. |
| | Med-Dry | ○● | * | Easily transplanted; can grow in dry soils; withstands grime of cities. |
| White | Med-Wet | ○● | * | Used for wetland restoration; exceptional wildlife benefits; best in wet conditions. |
| White | Wet | ○● | * | Used for field windbreaks and wildlife borders; used for streambank protection; bright red stems fall, winter and spring. |
| White | Med-Wet | ○● | * | Utilized by several birds; not typically stocked in nurseries. |
| White | Wet | ○● | * | Streambank protection; habitat improvement; slope stabilization; plant in masses. |
| Brown | Med-Dry | ○● | * | Beneficial to a variety of wildlife; medicinal uses; ornamental shrub. |
| White | Med | ○● | | Best in partial shade; clump-forming; deciduous shrub; medicinal uses. |
| | Med | ○ | * | Adaptable; withstands hot, dry situations; produces dark blue berries; ornamental evergreen shrub. |
| Yellow | Med-Wet | ○● | * | Beneficial to wildlife; in partial shade leaves turn bright yellow in autumn. |
| White | Med | ○● | * | Ornamental shrub; beneficial to wildlife; used for erosion control on banks. |
| White | Med | ○● | * | Can grow in acidic to alkaline soils; ornamental small tree or shrub. |

Shrubs - continued

| PLANT NAMES | | Height (ft) | GROWTH RATE |
|--|------------------------|-------------|-------------|
| Botanical | Common | | |
| <i>Ptelea trifoliata</i> | Hop Tree | 20 | Slow |
| <i>Ribes americana</i> | Wild Black Currant | 3-5 | Med |
| <i>Rosa carolina</i> | Carolina Rose | 3-6 | Med |
| <i>Rosa palustris</i> | Swamp Rose | 3-7 | Med |
| <i>Salix candida</i> | Sageleaf Willow | 3-6 | Fast |
| <i>Salix interior</i> | Sandbar Willow | 6-20 | Med-Fast |
| <i>Sambucus canadensis</i> | American Elderberry | 6-26 | Fast |
| <i>Sambucus racemosa</i> | Red-Berried Elder | 8-20 | Fast |
| <i>Spiraea alba</i> | Meadowsweet | 2-5 | Med |
| <i>Spiraea bumalda</i> | Anthony Waterer Spirea | 2-3 | Fast |
| <i>Staphylea trifolia</i> | American Bladdernut | 10-15 | Fast |
| <i>Vaccinium macrocarpon</i> | Large Cranberry | 2-6 | Slow |
| <i>Viburnum acerifolium</i> | Maple-Leaf Viburnum | 2-6 | Slow |
| <i>Viburnum dentatum</i> | Arrow Wood | 3-10 | Med |
| <i>Viburnum lentago</i> | Nannyberry | 14-16 | Slow |
| <i>Viburnum prunifolium</i> | Blackhaw | 12-15 | Slow |
| <i>Viburnum opulus (var. americanum)</i> | Highbush Cranberry | 6-10 | Med |

Trees

| PLANT NAMES | | Height ft@ 20 years | GROWTH RATE |
|-----------------------------|-------------------|---------------------|-------------|
| Botanical | Common | | |
| Evergreen Trees | | | |
| <i>Abies balsamea</i> | Balsam Fir | 40-90 | Slow |
| <i>Juniperus virginiana</i> | Eastern Red Cedar | 25 | Slow |
| <i>Picea glauca</i> | White Spruce | 100 | Slow |
| <i>Picea mariana</i> | Black Spruce | 100 | Slow |

| Flower color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|--|
| | Wet | ☉☿ | * | Shade tolerant; seeds and foliage have an unpleasant odor. |
| Yellow | Med-Wet | ☉☿ | * | Can be invasive; wildlife food source; ornamental shrub. |
| Pink | Wet-Dry | ☉ | * | Better resistance to disease than most hybrid roses. |
| Pink | Med-Wet | ☉☿ | * | Attractive throughout the year; food source for wildlife. |
| Green | Wet | ☉☿ | * | Used for erosion control and restoration practices. |
| Brown | Med-Wet | ☉ | * | Short-lived; forms colonies; does well in flooded areas. |
| White | Med-Wet | ☉ | * | Edible fruit; medicinal uses; beneficial to wildlife; blue berry. |
| White | Med-Wet | ☉ | * | Red berries; raw fruits are toxic. |
| White | Wet | ☉☿ | * | Fragrant; good in low spots or boggy areas. |
| White | Med | ☉☿ | | Showy autumn foliage; ornamental value; showy flowers. |
| White | Med-Dry | ☼☼ | * | Easily grown; seed capsules used in dried flower arrangements. |
| Pink | Med-Wet | ☉☿ | * | Grow in acidic soils; leaves become purple in winter. |
| White | Wet-Dry | ☉☼☼ | * | Reddish-purple fall color; black fruit; develops large colonies; beneficial to wildlife; acidic soil tolerant. |
| White | Med | ☉☿ | * | Medicinal uses; bird food source. |
| White | Med | ☉☼☼ | * | Good seasonal displays; food source for wildlife. |
| White | Med-Dry | ☉☿ | * | Special Concern plant in Michigan; Attracts birds; adaptable. |
| White | Med-Wet | ☉☿ | * | Beneficial to wildlife; good windbreak; red fruit; ornamental shrub. |

| Flower color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|--|
| | Med-Wet | ☉☼☼ | * | Readily transplanted; prefers acidic soils; tolerates a wide range of soils. |
| | Dry | ☉☿ | * | Used for windbreaks. |
| | Med | ☉☿ | * | Used for windbreaks; adaptable to a wide range of conditions. |
| | Med-Wet | ☉☼☼ | * | Interesting irregular form; tolerant of nutrient poor soils; prefers acidic soils. |

Trees - continued

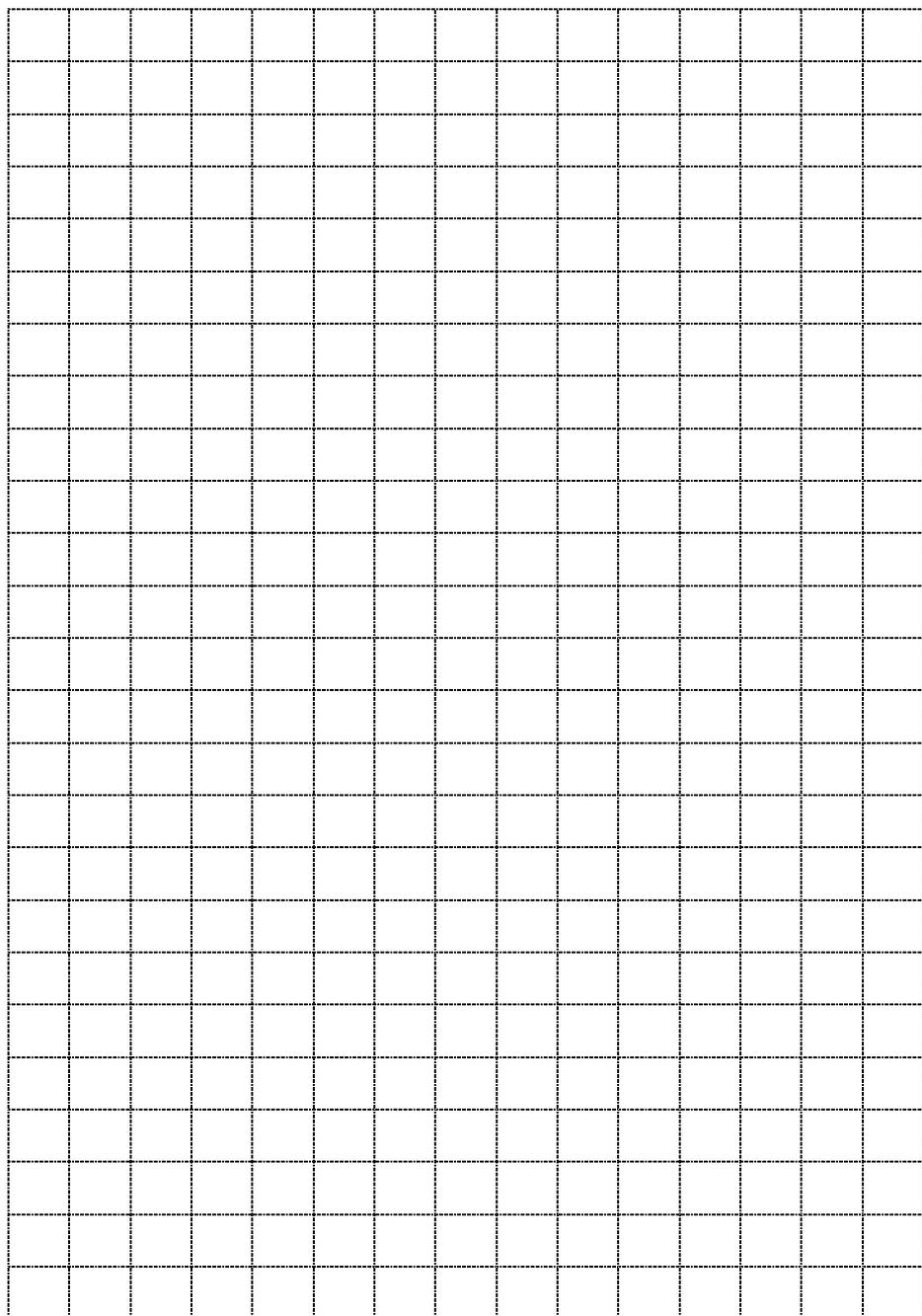
| PLANT NAMES | | Height ft@ 20 years | GROWTH RATE |
|------------------------------|----------------------|---------------------------|----------------|
| Botanical | Common | | |
| Evergreen Trees | | | |
| <i>Pinus resinosa</i> | Red Pine | 50-80 | Fast |
| <i>Pinus strobus</i> | Eastern White Pine | 150 | Fast |
| <i>Thuja occidentalis</i> | Northern White Cedar | 40-50 | Slow |
| <i>Tsuga canadensis</i> | Eastern Hemlock | 75 | Slow |
| Deciduous Trees | | | |
| <i>Acer rubrum</i> | Red Maple | 35 | Med-Fast |
| <i>Acer saccharinum</i> | Silver Maple | 45 | Fast |
| <i>Acer saccharum</i> | Sugar Maple | 100 | Slow |
| <i>Aesculus glabra</i> | Ohio Buckeye | 40 | Med |
| <i>Betula alleghaniensis</i> | Yellow Birch | 25 | Fast |
| <i>Betula nigra</i> | River Birch | 40 | Fast |
| <i>Betula papyrifera</i> | Paper Birch | 40 | Fast |
| <i>Carpinus caroliniana</i> | American Hornbeam | 18 | Slow |
| <i>Carya cordiformis</i> | Bitternut Hickory | 30 | Med-Slow |
| <i>Carya ovata</i> | Shagbark Hickory | 15 | Fast |
| <i>Cercis canadensis</i> | Redbud | 16 | Slow |
| <i>Comus florida</i> | Flowering Dogwood | 30 | Med |
| <i>Crataegus mollis</i> | Downy Hawthorn | 25 | Med |
| <i>Fagus grandifolia</i> | American Beech | 30 | Slow |
| <i>Fraxinus americana</i> | White Ash | 40 | Med |

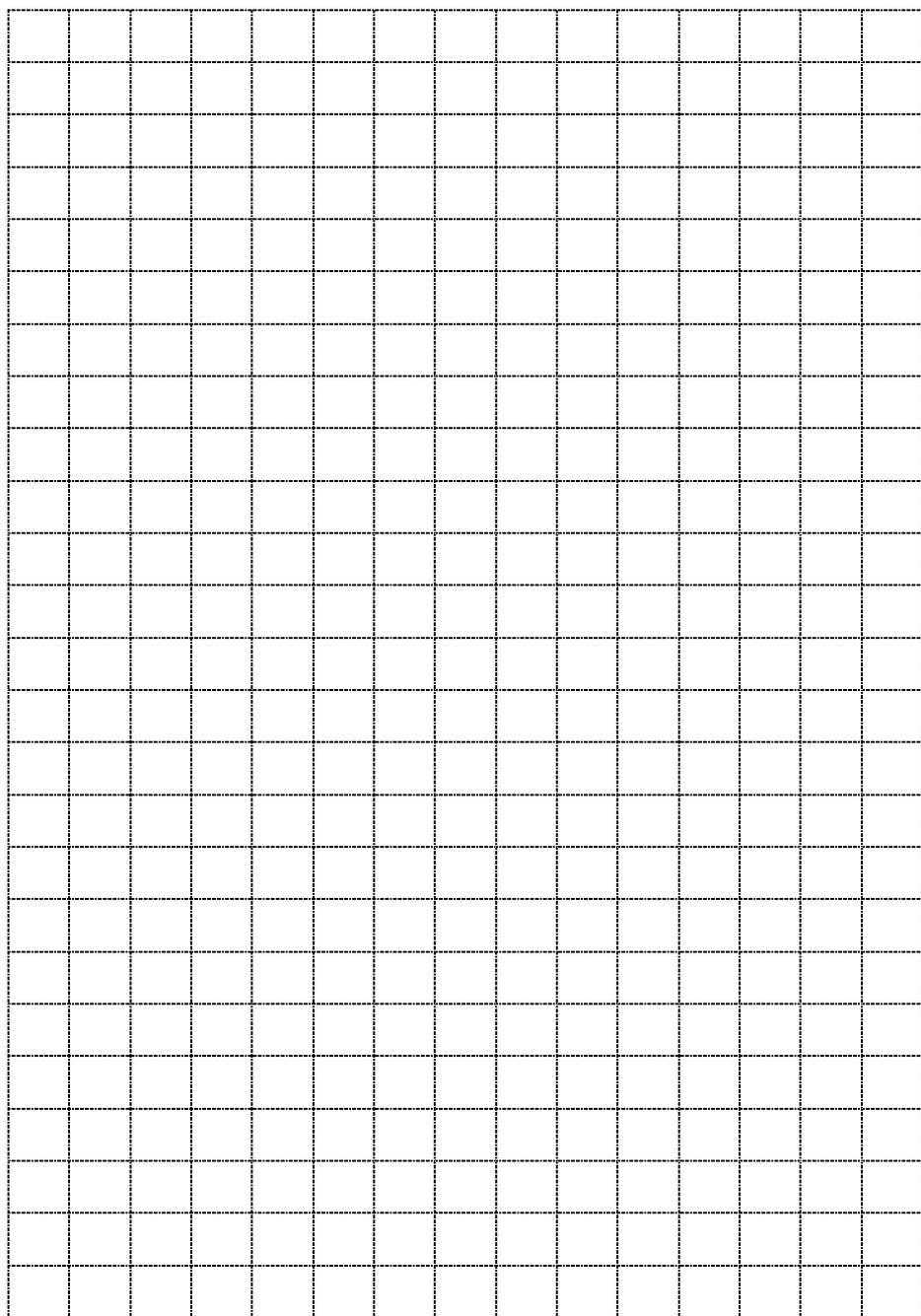
| Flower color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|--|
| | Med-Dry | ○ | * | Prefers dry, sandy, acidic soils; found in low fertility areas; cold tolerant; susceptible to salt damage; used for windbreaks. |
| | Med-Dry | ○◐ | * | Tolerates many soil types; intolerant of air pollutants; used for windbreaks. |
| | Med-Wet | ○◐ | * | Prefers neutral soil; well adapted to find water and nutrients. |
| | Wet | ●◐ | * | Must plant in cool, moist conditions; creates beautiful screen; long-lived. |
| Red | Med | ○◐ | * | Gorgeous red fall color; fragrant blossoms March into April; does not tolerate heavily polluted areas. |
| | Med | ○◐ | * | Easily transplanted; one of the best trees for poor soils. |
| | Med | ●◐ | * | Best in slightly acidic soils; great shade providing tree; not for crowded and polluted conditions; used for maple syrup production. |
| | Med-Wet | ○●◐ | | Leaves shaped like hand; wonderful color spring-fall; attracts hummingbirds. |
| | Med | ○◐ | * | Good lawn tree; providing relatively light shade; showy bark. |
| Yellow | Wet | ○ | * | Very attractive ornamental tree; very good for erosion control. |
| Yellow | Wet | ○◐ | * | Striking coloration with white bark and yellow fall color; good riparian buffer. |
| Green | Med | ○●◐ | * | Beautiful understory tree; difficult to transplant; tolerates periodic flooding; used in landscaping for its unique fruit and vibrant fall colors. |
| | Med-Wet | ○◐ | * | Large tap-root makes transplanting difficult; flowers April-May; used for fruit and unique bark. |
| | Dry-Med | ○◐ | * | Edible fruit; adaptable to a wide range of soils; bark has culinary use. |
| Purple | Dry | ○●◐ | * | Flowers bloom in early spring; will grow taller in shade conditions. |
| White | Dry | ○◐ | * | Excellent ornamental tree; striking display when in full bloom. |
| | Med | ○ | | Small, wide spreading tree; silvery-grey bark, thicket of twigs and thorns; produces copious fruit. |
| | Med | ○●◐ | * | Prefers acidic soils; handsome shade providing tree for large open areas. |
| | Wet | ○ | * | Attractive shade providing tree; pH adaptable; easily transplanted. |

Trees - continued

| PLANT NAMES | | Height ft@ 20 years | GROWTH RATE |
|--------------------------------|-----------------------|---------------------------|----------------|
| Botanical | Common | | |
| Deciduous Trees | | | |
| <i>Fraxinus pennsylvanica</i> | Green Ash | 35 | Fast |
| <i>Liriodendron tulipifera</i> | Tulip Tree | 50 | Fast |
| <i>Malus coronaria</i> | Sweet Crab Apple | 20 | Slow |
| <i>Nyssa sylvatica</i> | Black Gum | 30 | Med |
| <i>Ostrya virginiana</i> | Ironwood | 30 | Med |
| <i>Platanus occidentalis</i> | Sycamore | 65 | Fast |
| <i>Populus tremuloides</i> | Trembling Aspen | 50 | Fast |
| <i>Prunus serotina</i> | Black Cherry | 40 | Fast |
| <i>Quercus alba</i> | White Oak | 25 | Slow |
| <i>Quercus bicolor</i> | Swamp White Oak | 30 | Fast |
| <i>Quercus macrocarpa</i> | Bur Oak | 25 | Slow |
| <i>Quercus rubra</i> | Red Oak | 35 | Med |
| <i>Salix nigra</i> | Black Willow | 50 | Fast |
| <i>Sassafras albidum</i> | Sassafras | 25 | Slow |
| <i>Sorbus americana</i> | American Mountain Ash | 30 | Med |
| <i>Tilia americana</i> | Basswood | 60 | Med |

| Flower color | Water Needs | Sun | * | Notes |
|--------------|-------------|-----|---|---|
| | Med | ☉☿ | * | Widely used as shade providing tree; can be used as windbreak. |
| Yellow | Med | ☉ | * | Great ornamental tree; grows rapidly; pyramidal shaped; insect & disease resistant; unusual flowers; yellow fall color. |
| Pink | Med | ☉☿ | * | Native to lower Michigan only; ornamental tree; edible fruit. |
| | Med | ☉☿☿ | * | Provides erosion control; attractive dense autumn foliage. |
| | Med | ☉☿☿ | * | Shade tolerant; dark green foliage; attractive cluster of nuts. |
| | Wet | ☉☿ | * | Disease resistant; tolerant of air pollution; rehabilitates strip-mined soils. |
| | Med | ☉☿ | * | Beautiful clear-yellow fall color; smooth bark; spreads rapidly. |
| | Med | ☉ | * | Fast growing shade providing tree; leaves may be toxic. |
| | Med | ☉☿ | * | Excellent residential tree; large crown; dense foliage; red fall color. |
| | Wet | ☉☿ | * | Grows well in compacted soils; drought tolerant; tolerates flooding. |
| | Med | ☉☿ | * | Tolerant of air pollution; tolerant of compacted soil, sand, and alkaline soils; common shade providing tree; deep tap root facilitates water infiltration. |
| | Med | ☉☿ | * | Shade tolerant with space available; hardwood for furniture; easily transplanted; tolerant of air pollution and dry, acid soils. |
| | Wet | ☉ | * | Thrives in wet areas; weep branchers; discouraged for landscape use. |
| Yellow | Dry | ☉ | * | Vibrant spring flower; aromatic tree; striking fall color; attracts butterflies. |
| Whitw | Med | ☉☿ | * | Beautiful fall color; grows a stunted form in dry soils. |
| Yellow | Med | ☉☿☿ | * | Shade providing tree; soil-enriching. |





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United States Environmental Protection Agency.
<http://www.epa.gov/>

Watershed Enhancement Team.
<http://www.open.org/~h2oshed/>

The Rouge River Watershed -The Rouge River Project

The Michigan Environmental Protection Agency

Rain Gardens of West Michigan
<http://www.raingardens.org>

Recommended Nurseries:

For a list of reputable nurseries and consultants, you can contact the Michigan Native Plant Producers Association - <http://www.nohlc.org/MNPPA.htm>