CHAPTER 5: AGRICULTURAL AND NATURAL RESOURCES

Revisions approved by Council on 6/14/2016 via Ordinance #2568

INTRODUCTION

This element presents an inventory and analysis of the agricultural and natural resource base in New Berlin. Included is information regarding soils and agricultural lands, groundwater resources, surface water resources, wetlands, woodlands, natural areas and critical species habitat sites, and environmental corridors. Also included is a discussion of the Natural Resources Plan for New Berlin, which focuses on the Conservation Framework.

Agricultural and natural resources in New Berlin are critical factors to consider when assessing development potential and preservation priorities throughout the city. These resources provide economic, aesthetic, and recreational value, which contribute to New Berlin's status as an attractive location for potential residents and business owners. Development in New Berlin over the next ten years should be carefully configured to prevent destruction of the resource base. Planning efforts must acknowledge that natural resources are limited, and that development should complement the natural resource base in such a way to avoid environmental problems.

AGRICULTURAL RESOURCES

Soils

The Natural Resources Conservation Service (NRCS) has established a nationwide soil classification system to lend uniformity to the identification of productive farmlands. Soils are categorized relative to their agricultural productivity, with the two most highly productive soils being either national prime farmland or farmland of statewide significance. National prime farmlands are well suited for the production of food, feed, forage, fiber, and oilseed crops. These farmlands provide the soil quality, growing season, and moisture needed to produce economically sustained high crop yields. Farmland of statewide importance includes land aside from national prime farmland which is considered to be of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Figure 5.1 illustrates the soils in New Berlin that are classified as both national prime farmland and statewide importance as of 2005.

Agriculture and Other Land Owners Survey

In March of 2008, the "Agriculture and Other Open Land Owners' Survey" was mailed to 123 people who owned 155 agricultural or vacant properties in the City.. The survey (which was previously conducted in 1999) asked a series of 18 questions about current and future land use. In total, 57 surveys were returned, although not all respondents answered every question.

Properties were selected for the farmland survey based on the following criteria:

- Over 15 acres in size
- Agriculture land use code
- Vacant or undeveloped land over 15 acres, land use code other than agriculture

Certain institutional properties were excluded from the survey due to the existing use or planned use. Properties owned by the City of New Berlin and the City of New Berlin School District were also excluded from the survey. For individuals that owned more than one parcel meeting the survey criteria, only one survey was sent. The survey allowed participants to list all the parcels they owned.

The results were recorded and analyzed, then compared to results of the 1999 survey. Below are selected highlights of the results. The complete survey results are included in Appendix F.

Summary of Survey Results

One of the goals of the survey was to gain an understanding of how people will use their land in the future. The survey asked landowners to "look ahead 10 years and think about all of the agricultural/open land you own in New Berlin and how the land will be used then and approximately what percent of the land will be used?" Seventeen respondents said they would continue to operate the land themselves, with 15 respondents saying that they would operate 100% of the land themselves. Results from the 1999 survey were similar, with most respondents also indicating that they would continue to operate the land

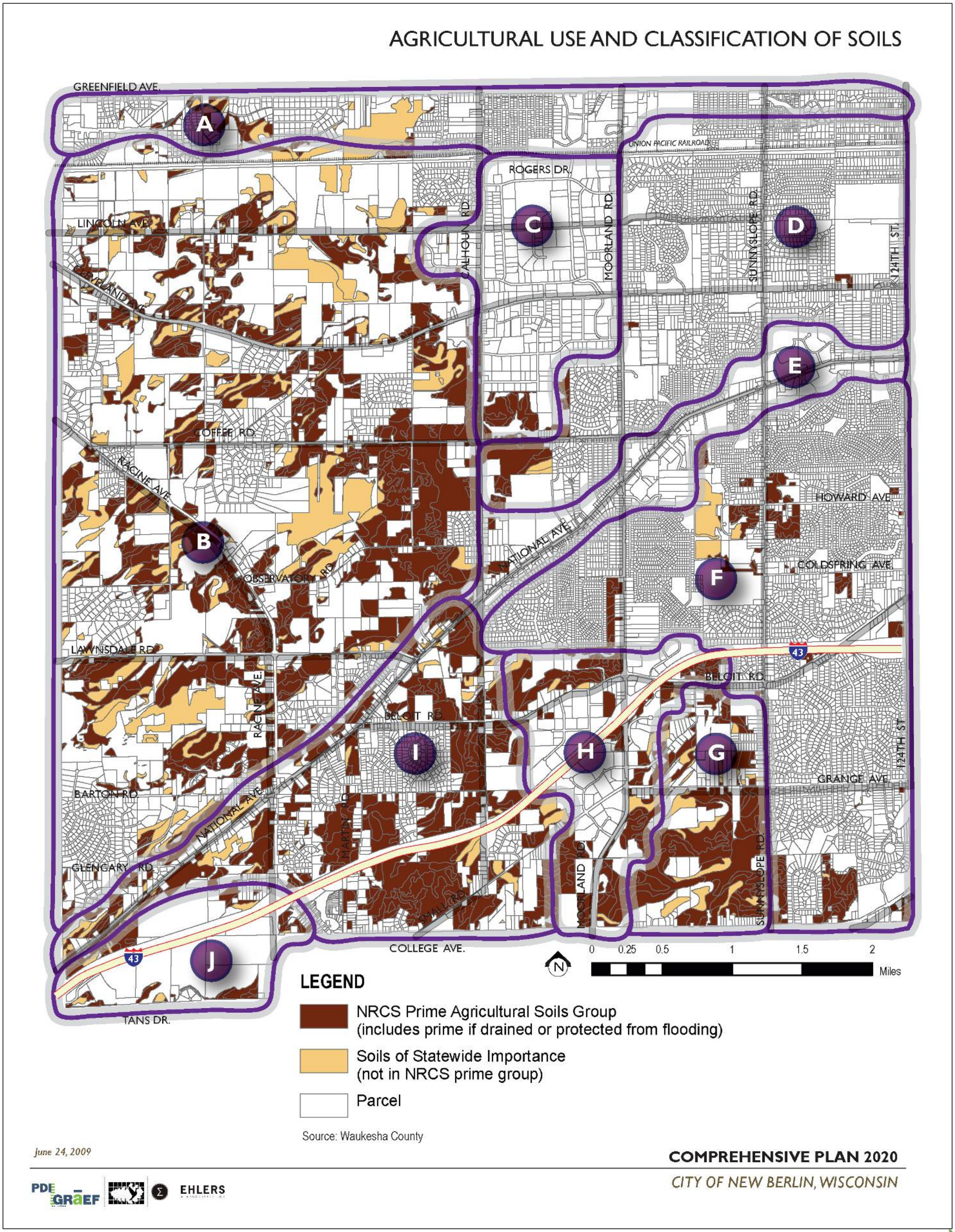


Figure 5.1. Agricultural Use and Soil Classification Map. Source: NRCS, SEWRPC, and Waukesha County.

themselves. Additionally, 17 respondents to the 2008 survey indicated that their land would be developed for residential, industrial and commercial uses. Moreover, 2 respondents said that 80% of their land would be developed, and 9 respondents said that 100% of their land would be developed. In 1999, results were similar with 22 people saying that their land would be developed and 17 people saying that 80% or more of their land would be used for this reason.

Another purpose of this survey was to gain a better understanding of the current and future role of farming in New Berlin. Participants were asked: “Do you consider farming your main occupation?” There were 54 responses to this question, with 9% saying “yes” and 91% answering “no.” Percentages were similar in 1999, with 5% answering “yes” to this question and 95% answering “no.” Furthermore, the survey asked participants “what percentage of your household income do you derive from farming?” There were 45 responses to this question, with 69% indicating that they earn no money from farming and an additional 20% of respondents saying that they derived 10% or less of their income from farming. Results in 1999 were similar, 64% percent answering that they earn no money from farming and an additional 24% indicating that they derive 10% or less of their income from farming.

The survey also asked questions to help gauge the interest of landowners in preserving open land. In this portion of the survey, participants were asked to respond to statements with a choice of very likely, likely, neutral, unlikely or very unlikely. There were 44 responses to the statement, “I would like to see my land used for public use (parks, natural areas).” Of these responses, 66% were either unlikely or very unlikely to use their land for this reason. In 1999, 59% of respondents said they would be unlikely or very unlikely to use their land for this reason. Moreover, there were 41 responses to the statement, “I would consider selling the development rights to my land so that agriculture (present use) can continue.” Of these responses, 71% were either unlikely or very unlikely. In 1999, 60% of respondents indicated that they would be either unlikely or very unlikely to consider this. The 2008 survey also included 41 responses to the statement, “I would consider donating my land for conservation/recreation purposes.” Of these responses, 93% indicated that they would be unlikely or very unlikely to donate their land. In 1999, there were 51 responses, with 77% saying that they would be unlikely or very unlikely to donate their land.

Finally, the survey asked participants "who is farming the land?" There were 39 responses to this question and 59% of respondents indicated that they rent the land to others for farming while an additional 31% indicated that their land is not being farmed. This differs greatly from the 1999 results, in which there were 10 answers to this question and 100% of respondents indicated that they farmed the land themselves.

Summary of Focus Group

As part of the City's comprehensive planning efforts, and to proactively work towards understanding the needs and interests of these landowners, survey participants were asked if they would be interested in taking part in a focus group in order to elaborate on the issues raised in the survey. After the surveys were collected and the results were analyzed, those respondents who had expressed interest were invited to participate in a special focus group, held on July 9, 2008 at the New Berlin Community Center. Respondents to the survey were invited to participate in the discussion, while other members of the community were encouraged to attend in the audience. This activity aimed to share the survey results and to strengthen the communication and level of understanding between the City of New Berlin and the landowners.


Figure 5.2. Tour of Growing Power.

Overall, there were 22 participants and approximately 11 audience members. A copy of the survey (with survey results), summary of the focus group discussion, a list of meeting attendees and focus group PowerPoint presentation can be found in Appendix F of this plan.


Figure 5.3. Tour of Growing Power.

Future Opportunities

On July 1, 2008 Staff toured Milwaukee-based Growing Power located at 5500 W. Silver Spring Road (Figures 5.2 and 5.3). Their website states they are, "a national nonprofit organization and land trust supporting people from diverse backgrounds, and the environments in which they live, by helping to provide equal access to healthy, high-quality, safe and affordable food for people in all communities. Growing Power implements this mission by providing hands-on training, on-the-ground demonstration, outreach and technical assistance through the development of Community Food Systems that help people grow, process, market and distribute food in a sustainable manner." Staff learned a great deal by touring this development and meeting with Will Allen the CEO. Staff gathered information on how to remove barriers in the current City Ordinances that might not allow for something like this in New Berlin. This type of agricultural / food systems entity is going to

Figure 5.4. Tour of Eco-Community - Fields – Unique Storm water Best Management Practices in use.

Figure 5.5. Tour of Eco-Community The Fields – Sample rain gardens. Solar panels are also located on some buildings.

Figure 5.6. Tour of Eco-Community - Fields – Green Roof.

be critical in meeting future food demands of this country especially as transportation costs rise. Having food producers in close proximity to population centers with efficient transportation infrastructure will aid this need. More information is available on their website: http://www.growingpower.org/.

On August 15, 2008, Staff toured Fields - East Troy Eco-Community to learn more about sustainable living communities (Figures 5.4 to 5.7). Their website states that, “this development combines sustainable living with a strong sense of community atmosphere that respects the natural environment. This particular development offers a range of clustered condominiums that integrate the latest green building technologies. The development integrated rooftop gardens, minimal impact on site topography modifications, consolidated utilities, and preservation and protection of sensitive areas.” Staff saw some of the unique Best Management Practices (BMPs) in place throughout the development. They gained a better idea of how BMPs work, and how they should look once they are completed. More information is available on their website at http://www.fieldsneighborhood.org. These types of approaches to development are crucial in supporting the City’s three-dimensional water resource management approach as it relates to managing water quality and quantity. These types of BMPs should become more prominent in all types of development projects whether they be infill / redevelopment, new development projects, or city-led public infrastructure projects.

NATURAL RESOURCES

Groundwater[1]

The following is from the Waukesha County Comprehensive Plan and refers to the County as a whole. Groundwater is recognized as an important resource, as it sustains lake levels and wetlands, provides the perennial base flow of streams, and is a water supply source for all areas of the County. Groundwater recharge is defined as water that crosses the water table and is added to the groundwater system. Recharge is thus the ultimate source of all groundwater. Understanding recharge and its distribution is important to making informed land use decisions. The amount of groundwater recharge which occurs in a given area is primarily a function of climate, land use, topography, and soil characteristics, including the soil water storage characteristics.

Figure 5.7. Tour of Eco-Community; The Fields – Native Plants are used to manage stormwater.

In New Berlin, the low-intensity development standards for the western portion of the city allow for groundwater recharge. The amount, recharge, movement, and discharge of groundwater are controlled by several factors, including:

- Drainage
- Land use
- Lithology and water-bearing properties
- Precipitation
- Soil
- Topography

Groundwater flow follows basic principles: water flows from high points to low points, and moves through a system's regional and local recharge and discharge areas (Figure 5.8).

[1] Groundwater information derived from the Waukesha County Comprehensive Plan, adopted 2009.

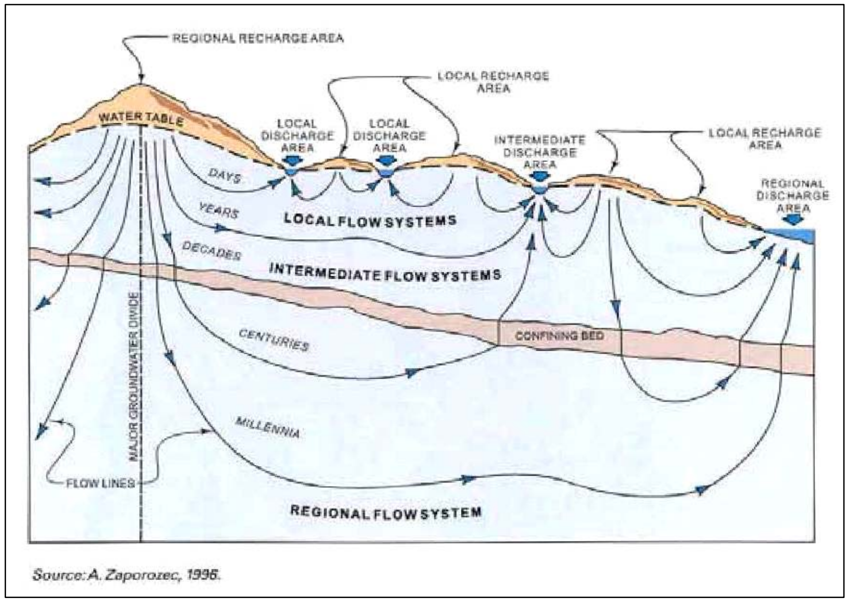


Figure 5.8. Idealized Groundwater Flow Systems Under Steady-State Conditions.

Groundwater is present within three major aquifers that underlie all of Waukesha County. From the surface of the land downward, they are:

1. Sand and gravel deposits in the glacial drift;
2. Shallow dolomite strata in the underlying bedrock; and
3. Deeper sandstone, dolomite, siltstone, and shale strata.

The first two aquifers are commonly referred to collectively as the "shallow aquifer," because of proximity to the land's surface and hydraulic interconnection. The latter is referred to as the deep aquifer. The shallow and deep aquifers are mostly separated by Maquoketa shale, which forms a relatively impermeable barrier between the two. Figure 5.9 illustrates the general hydrogeology in Southeastern Wisconsin, while Figure 5.10 depicts typical well depths in relation to the groundwater aquifers.

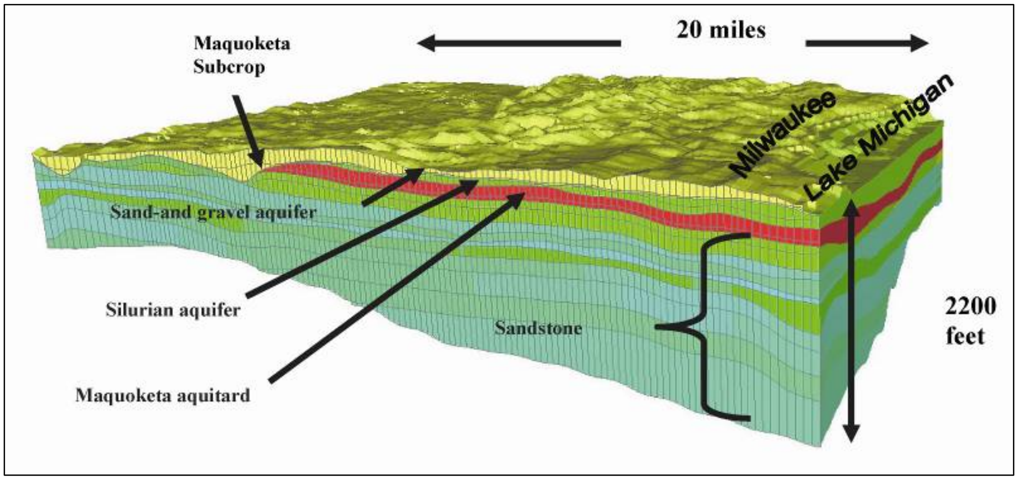


Figure 5.9. General Hydrogeology of Southeastern Wisconsin.
Source: Waukesha County Comprehensive Plan.

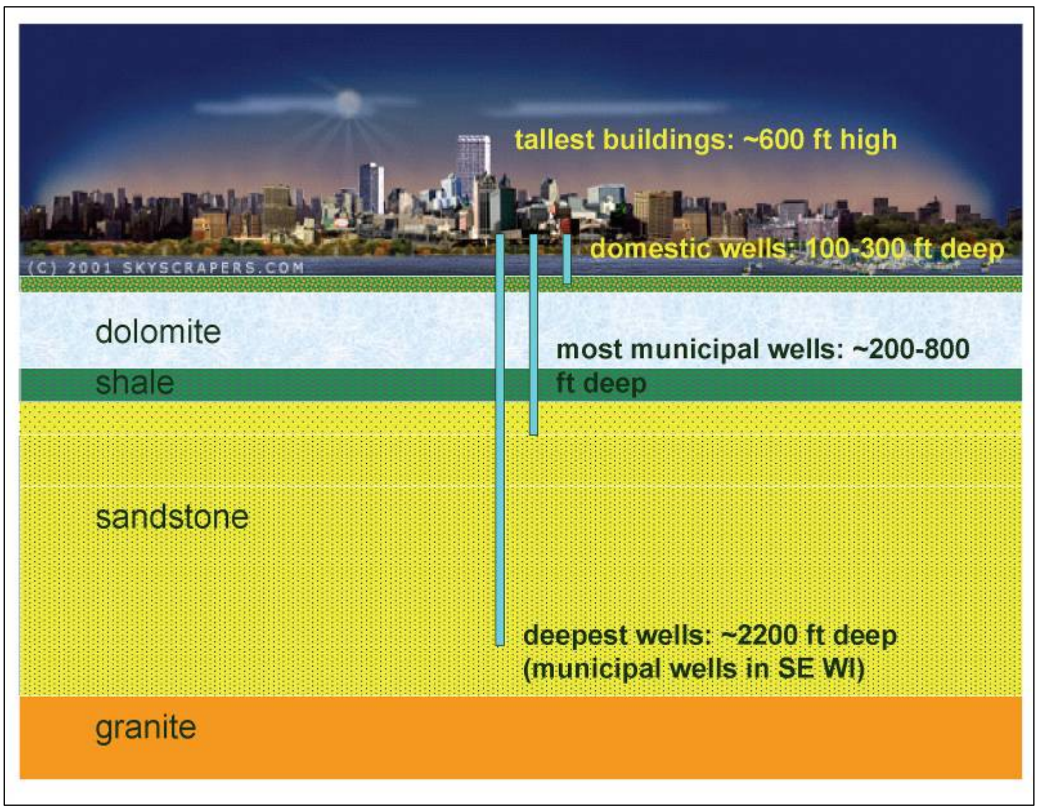


Figure 5.10. Typical Well Depths in Relation to Groundwater Aquifers.
Source: Southeastern Wisconsin Regional Planning Commission.

According to the U.S. Geological Survey, water users in Southeastern Wisconsin are estimated to have used about 291.45 million gallons of water per day (mgd) from surface and groundwater sources in 2005 (Figure 5.11). Approximately 196 mgd, or 67%, was withdrawn from surface water sources, primarily Lake Michigan, while 96 mgd, or about

33%, was withdrawn from groundwater. Figure 5.12 illustrates daily usage in Southeastern Wisconsin over time. In Waukesha County, nearly all of the water supply has historically been obtained from groundwater. This reliance has changed with the conversion of the eastern portion of the Village of Menomonee Falls, the Village of Butler, and the eastern two-thirds of the City of New Berlin to Lake Michigan water.

USGS 2005 AWUDS export processed on 11.13.2007
compiled by C. Buchwald

Note: Data are preliminary and subject to revision

2005 DATA BY WATER SOURCE

County	Surface water; MGD	Groundwater; MGD	Total; MGD
Kenosha	17.43	3.87	21.30
Milwaukee	143.92	6.81	150.73
Ozaukee	1.40	9.27	10.67
Racine	27.01	13.47	40.48
Walworth	0.53	14.81	15.34
Washington	0.19	13.09	13.28
Waukesha	5.59	34.06	39.65
Total:	196.07	95.38	291.45

2005 DATA BY CATEGORY

County	Domestic	Agriculture	Irrigation	Industrial	Commercial	Public Use/Loss	Total
Kenosha	9.63	0.39	0.73	4.21	4.36	1.98	21.30
Milwaukee	61.94	0.08	0.43	31.11	29.88	27.29	150.73
Ozaukee	5.36	0.58	0.64	2.18	0.89	1.02	10.67
Racine	11.89	1.43	5.34	11.97	3.85	6.00	40.48
Walworth	4.10	1.52	2.36	2.04	2.18	3.14	15.34
Washington	7.07	0.79	1.09	1.03	1.64	1.66	13.28
Waukesha	21.59	0.26	1.87	3.73	8.15	4.05	39.65
Total	121.58	5.05	12.46	56.27	50.95	45.14	291.45

Figure 5.11. Estimated Use of Water Within Southeastern Wisconsin: 2005 (in million gallons per day)

TRENDS IN TOTAL WATER USE IN THE SOUTHEASTERN WISCONSIN REGION BY COUNTY: 1979-2005
(IN MILLION GALLONS PER DAY[a])

County	1979			1985			1990			2000			2005		
	Surface Water	Groundwater	Total	Surface Water	Groundwater	Total	Surface Water	Groundwater	Total	Surface Water	Groundwater	Total	Surface Water	Groundwater	Total
Kenosha	17.81	3.42	21.23	17.87	2.54	20.41	20.41	2.56	22.97	16.04	2.69	18.73	17.43	3.87	21.30
Milwaukee	172.47	10.18	182.65	213.26	9.91	223.17	184.96	6.17	191.13	183.22	6.32	189.54	143.92	6.81	150.73
Ozaukee	1.19	6.66	7.85	1.15	6.33	7.48	1.43	6.66	8.09	1.52	7.80	9.32	1.40	9.27	10.67
Racine	22.55	7.69	30.24	22.55	7.28	29.83	29.32	8.85	38.17	26.24	13.63	39.87	27.01	13.47	40.48
Walworth	0.14	9.89	10.03	1.16	9.14	10.30	0.08	16.07	16.15	0.07	14.95	15.02	0.53	14.81	15.34
Washington	0.15	10.11	10.26	0.06	9.37	9.43	0.08	9.76	9.84	0.08	13.30	13.38	0.19	13.09	13.28
Waukesha	0.02	33.37	33.39	0.12	27.84	27.96	0.04	30.78	30.82	0.35	37.56	37.91	5.59	34.06	39.65
Total	214.33	81.32	295.65	256.17	72.41	328.58	236.32	80.85	317.17	227.52	96.25	323.77	196.07	95.38	291.45

[a] *Includes all water uses within each county, except water use for thermoelectric-power generation.*

Source: U.S. Geological Survey.

Figure 5.12.

Overall water use in Waukesha County dropped between 1979 and 1985, but rose steadily between 1985 and 2000. In 2003, the Wisconsin Legislature passed the Groundwater Protection Act, which set new standards for approval of high capacity wells by the Wisconsin Department of Natural Resources (DNR), and set other requirements for the management of the use of groundwater. Under this Act, groundwater management areas were established for Waukesha County.

Groundwater recharge is derived almost entirely from precipitation. Much of the groundwater in shallow aquifers originates from precipitation that has fallen and infiltrated within a radius of about 20 or more miles from where it is found. The deeper sandstone aquifers are recharged by downward leakage of water from the shallow aquifer through the Maquoketa shale, or by infiltration of precipitation in western Waukesha County where the sandstone aquifer is not overlain by the shale. On the average, precipitation annually brings about 32 inches of water to the surface of Waukesha County. Approximately 80% of that total is lost by evapotranspiration. The remaining water either runs to streams or becomes groundwater. On average, annual groundwater recharge to shallow aquifers is approximately 10 to 15% of annual precipitation.

With the above estimate, the average groundwater recharge in Waukesha County would be about 32 billion gallons annually, or about 88 million gallons per day (mgd). As previously shown in Figure 5.11, the estimated daily use of groundwater in 2005 was about 34 mgd. This calculation would indicate that there is an adequate annual groundwater recharge to satisfy consumptive water demands on the shallow aquifer system on a countywide basis. However, withdrawals of groundwater in the deep aquifers cause an imbalance in the supply and demand in areas of concentrated groundwater use. Other estimates from 1999 concluded that the demand on groundwater from the deep sandstone aquifer in Waukesha County is greater than the available supply (Figure 5.13).

Aquifer	Recharge Area (square miles)	Estimated Recharge Rate (inches per year)	Average Daily Recharge (mgd)	Average Daily Demand (mgd)
Shallow	400	3.1	59	3.5
Deep	100	3.1	14.8	31.5

Source: D.S. Cherkauer, 1999

Figure 5.13. Estimates of Available Groundwater in Waukesha County: 1999.

Certain formations within area sandstones are known to produce relatively high concentrations of naturally occurring radium, a radioactive metallic element. This naturally occurring radium has been found to exceed U. S. Environmental Protection Agency (EPA) standards in approximately 50 of the 1,300 municipal water supplies in Wisconsin. Most of the water supplies which exceed the radium standard draw water from the deep sandstone aquifer and lie in a narrow band from Kenosha County through Racine and Waukesha Counties. Evaluations are being undertaken to consider means of reducing the radium level in these wells.

Groundwater quality can be negatively impacted by such sources of surface pollution as infiltration of storm water runoff and runoff from landfills, agricultural fertilizer, pesticides, manure storage and application sites, chemical spills, leaking surface or underground storage tanks, and onsite sewage disposal systems. The potential for groundwater pollution in the shallow aquifer is dependent upon the following:

- Depth to groundwater;
- Depth and type of soils through which precipitation must percolate;
- Location of groundwater recharge areas;
- Subsurface geology.

New Berlin is divided among areas of low, moderate, and high potential for groundwater contamination (Figure 5.14). Areas most vulnerable to groundwater contamination are where both Niagara dolomite and the water table are near the surface.

Technical Report 37: Groundwater Resources of Southeastern Wisconsin, published by the Southeastern Wisconsin Regional Planning Commission (SEWRPC) in 2002, provides additional information regarding groundwater availability and use in Southeastern Wisconsin.

As part of the regional water supply planning program, SEWRPC and the Wisconsin Geological and Natural History Survey prepared analyses and supporting GIS-based mapping of the groundwater recharge characteristics of the Southeastern Wisconsin Region. That work is documented in SEWRPC Technical Report No. 47, Groundwater Recharge in Southeastern Wisconsin Estimated By a GIS-Based Water-Balance Model, July 2008. The results of the groundwater recharge analyses for the City of New Berlin are shown on Figure 5.15 About 5.6 square miles of land within the City is characterized as having high or very high contamination potential. These areas are generally located in the western portion of the City.

Metallic / Non-Metallic Mineral Resources

In 2000, extractive land use in Waukesha County totaled about 4,000 acres, of which New Berlin had approximately 740 acres (Figure 5.16). These land uses in New Berlin consist primarily of sand and gravel extraction.

Extractive uses throughout Waukesha County have increased in acreage over the past three decades. Land with the potential for future commercially viable mining operations was provided by the Aggregate Producers of Waukesha County, and constitutes a general inventory of mineral resources.

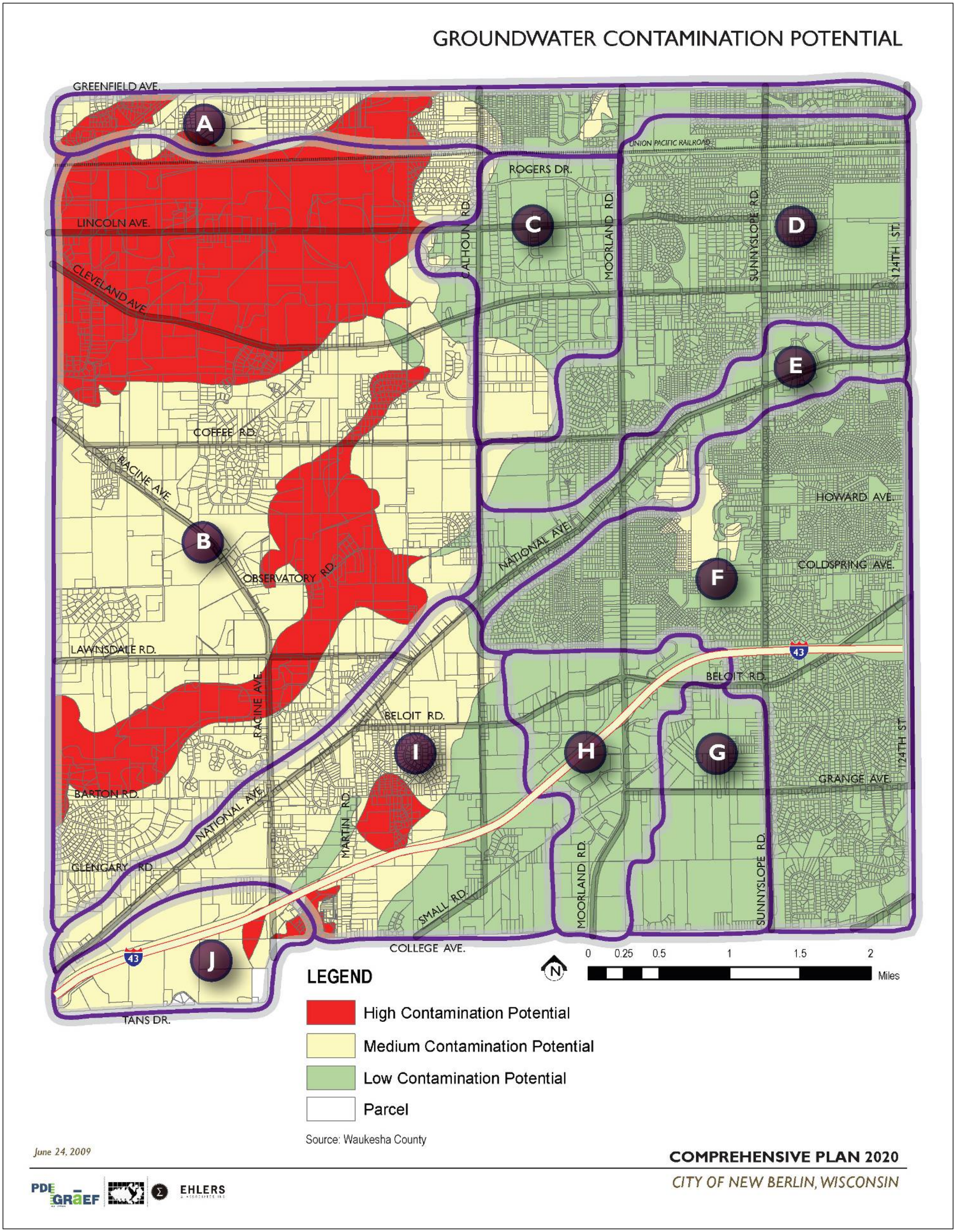


Figure 5.14. Groundwater Contamination Potential.

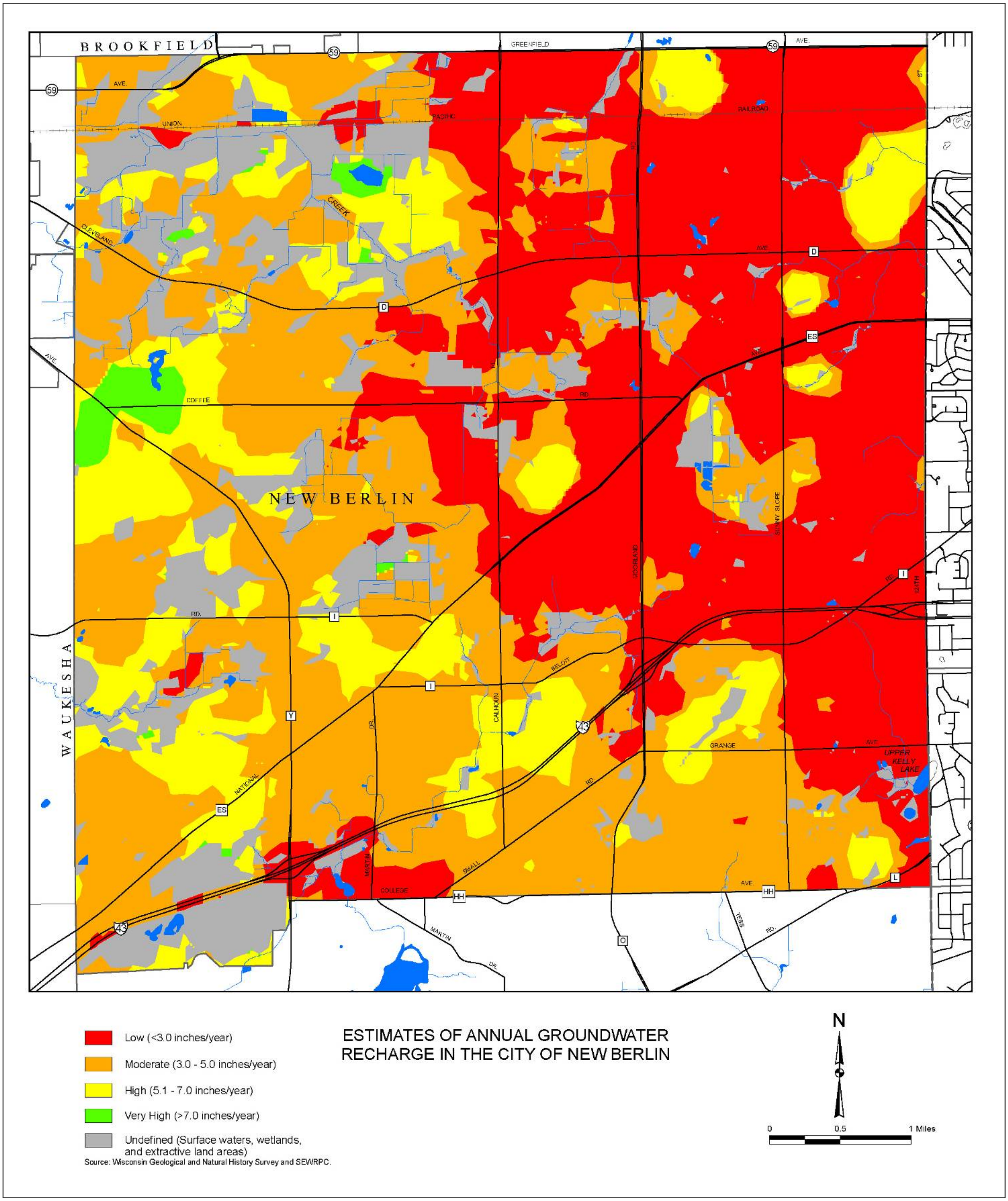


Figure 5.15. Estimated Annual Groundwater Recharge in the City of New Berlin.

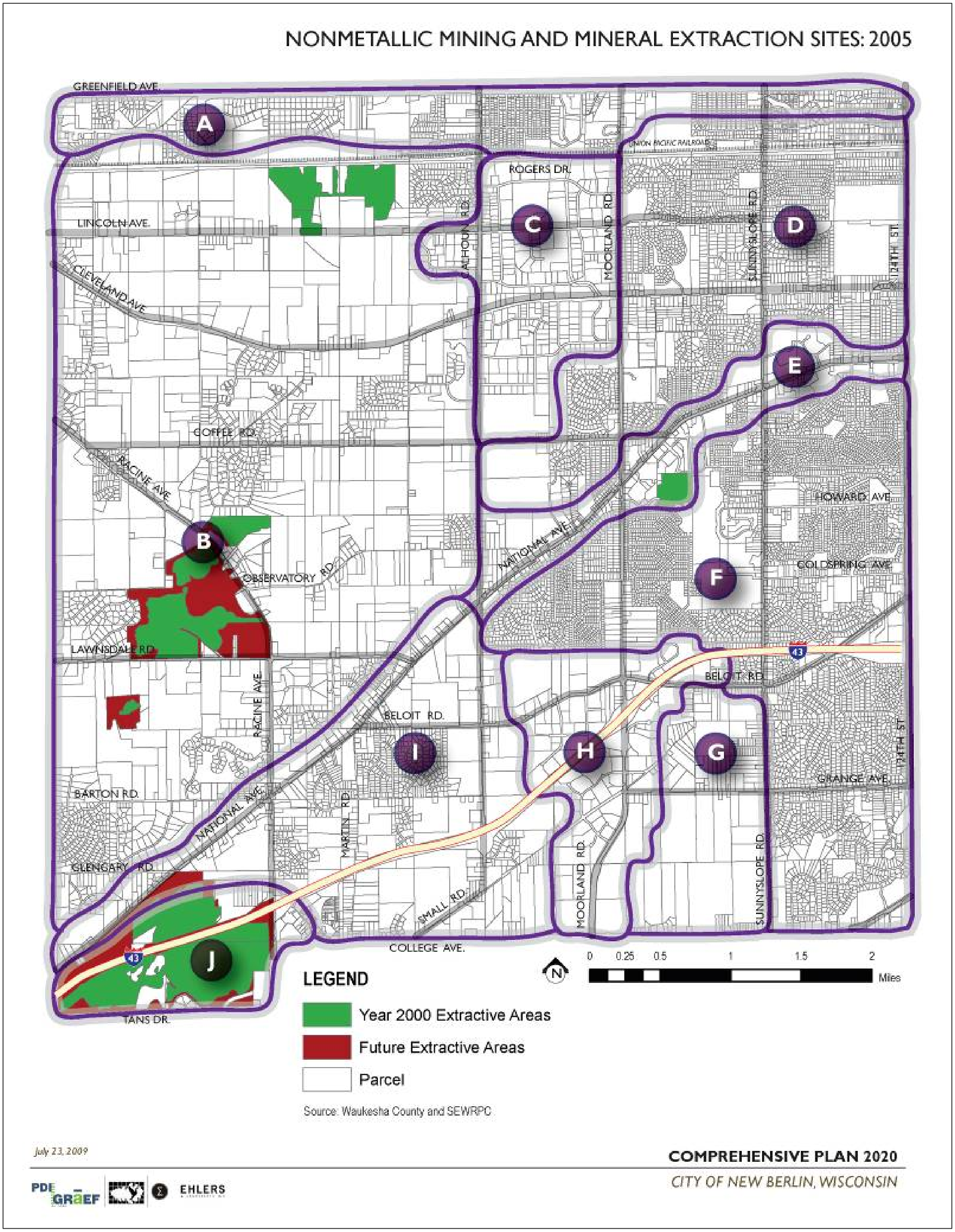


Figure 5.16. Non Metallic Mineral Extraction Sites: 2005.

NATURAL RESOURCES PLAN

Conservation Framework

The Conservation Framework addresses future land uses and establishes policy designed to achieve storm water quality and quantity management, preserve natural resources, and improve wildlife habitat (Figure 5.17). The framework stresses the importance of preserving natural areas for aesthetic and economic reasons in order to enrich the quality of life for New Berlin citizens. As open space continues to shrink due to development, it is vital to identify and protect existing natural areas and to wisely manage remaining open spaces.

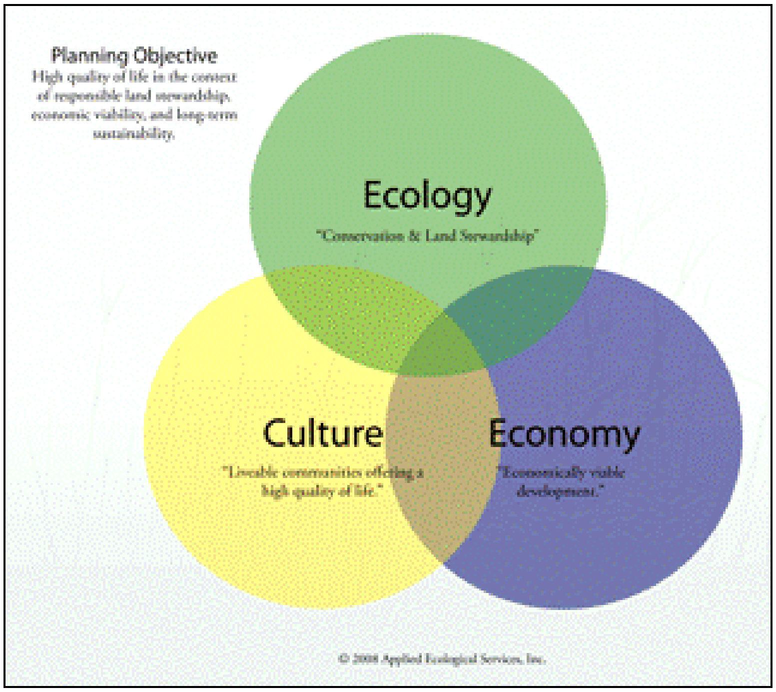


Figure 5.17. The Conservation Framework.
Source: Applied Ecological Services, Inc.

The steps necessary to achieve storm water quality and quantity management, preserve natural resources, and improve wildlife habitat are as follows:

1. Involve the citizens, organizations, and agencies of the region in efforts to conserve biodiversity.
2. Improve the scientific basis of ecological management.
3. Protect globally and regionally important natural communities.
4. Restore natural communities to ecological health.
5. Manage natural communities to sustain native biodiversity.
6. Develop citizen awareness and understanding of local biodiversity to ensure support and participation.

7. Foster a sustainable relationship between society and nature in the region.
8. Enrich the quality of the lives of the region's citizens.

The Conservation Framework recommends that local government implement policy and encourage citizens to protect and restore natural communities. This includes the creation of a comprehensive plan that identifies land with high conservation value and provides restoration and management alternatives; the implementation of programs to encourage the use of best management practices in sewage treatment and storm water management; the revision of zoning ordinances and subdivision regulations to encourage the protection of natural resources; and the revision of the municipal code to allow and encourage the use of natural landscaping.

Methodology

Ecological communities are typically divided into five general categories:

- *Wetlands* – those areas that have saturated soils or standing water for some part of the year and that are characterized by vegetation adapted to such conditions. Wetlands generally include marshes, sedge meadows, scrub shrub communities and similar areas.
- *Forested Communities* – areas dominated by mature trees, with varying degrees of canopy openness and understory vegetation. Forested communities include mesic upland forest, bottomland forest, and woodland/savanna.
- *Open Water* – includes lakes, ponds, streams, and detention ponds.
- *Parkland* – open, treeless areas dominated by grasses and/or herbaceous vegetation. This includes old fields, prairie remnants/restorations, and areas covered by turf grass.
- *Developed* – those areas that are covered by surfaces impervious to water, such as roads, parking lots, driveways, and buildings.

These categories can be further divided as follows:

Wetlands

- *Emergent* – permanently wet areas characterized by erect, rooted herbaceous wetland vegetation, such as cattail and bulrush.

- *Wet meadow* – areas with wet soils where standing water is only intermittently present, dominated by sedges, forbs, and grasses.
- *Scrub shrub* – wetlands characterized by shrubby woody vegetation, usually found in the transition zone between emergent wetlands and upland.

Wetland areas in the City of New Berlin, as identified in the 2005 Wisconsin Wetland Inventory (WWI), are shown in Figure 5.18.

Open Water

- *Lake* – large body of water deep enough that rooted plants grow only along the shore.
- *Pond* – shallow body of water with rooted plants growing throughout.
- *Stream* – running water environment that may flow intermittently or permanently.
- *Detention* – man-made basin designed to store storm water that may have permanently standing water.

Open waters in the City of New Berlin, as collected in the 2005 WWI, are shown in Figure 5.18.

Forested Communities

- *Mesic upland* – fire-sensitive community with a closed canopy and sparse ground layer.
- *Bottomland* – seasonally flooded community of wetland trees.
- *Woodland/savanna* – fire-maintained communities with a grassy understory.

Parkland

- *Turf* – mowed grass.
- *Old field/fill* – former agricultural fields or fields disturbed by land development, characterized by non-native grasses and forbs.
- *Prairie remnant/restoration* – grasslands supporting a diversity of native grasses and wildflowers, maintained by fire.
- *Agricultural* – land planted in crops, or used for grazing livestock or similar agricultural activities.

Parkland areas in the City of New Berlin are further described in the New Berlin Park and Open Space Plan.

Ecological communities should be evaluated with regard to each of the five general categories and how they reflect the following cultural and natural attributes:

- Presence of remnant natural areas: Remnant natural areas are defined as pockets of relatively high quality native plant communities that persist from pre-European settlement. These would include prairie or oak-hickory woodland remnants.
- Restoration potential: The restoration potential considers the degree of difficulty and likelihood of success of converting an existing resource to an indigenous natural community.
- Existing restoration efforts: Existing restoration efforts include any prior work that has been completed to enhance or restore an existing resource to a healthier indigenous community.
- Proximity to other natural areas (i.e. connectivity): Connectivity weights the relative value of an existing open space site when taken in context with all open space parcels within the city. Sites that are small and isolated arerweighted as less important than sites that would expand an existing open space.
- Potential water quality benefits (i.e. detention ponds discharging into creeks, riparian buffers, floodplain): This category weights a site based on its importance for improving water quality. Riparian buffers are valued as very important for water quality.
- Threat from development: Sites already protected from development are ranked low. Sites under threat of development are ranked high.
- Ease of protection (i.e. ownership): This category weights a site according to the number of owners and the type of owner. The purpose of this category is to get a feel for how difficult it would be to protect an open space site. Large sites with large tracts of public ownership are weighted highly because public agencies might be more inclined to protect their sites for purposes of biodiversity than private owners. Sites with multiple private owners are ranked the lowest. Often, it is more difficult to negotiate protection measures with multiple private landowners than it is to negotiate protection of a large publicly owned parcel.

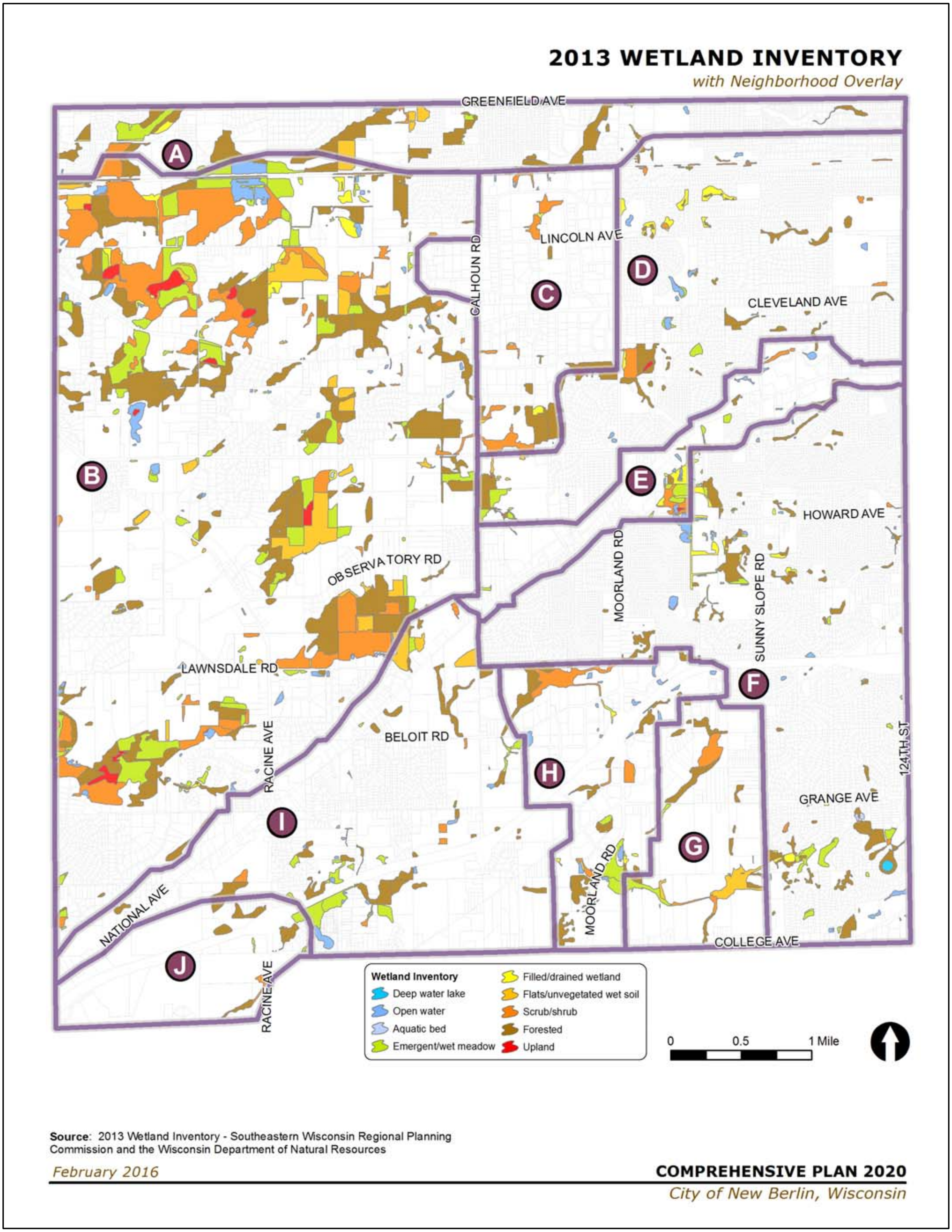


Figure 5.18. Wetland Inventory Map

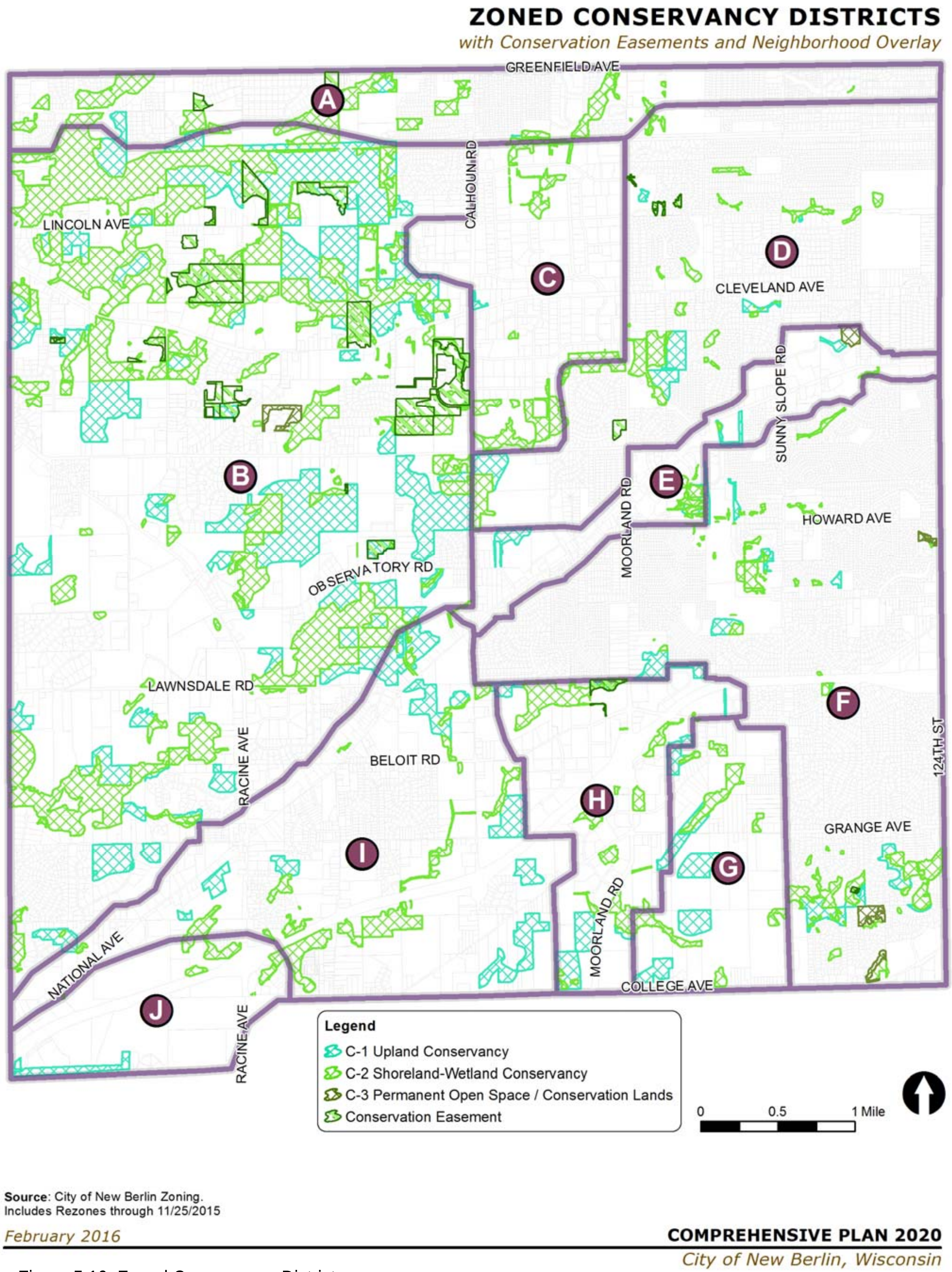


Figure 5.19. Zoned Conservancy Districts.

CONSERVATION DESIGN STRATEGY

In urban and suburban areas, the preservation of natural open space enhances the quality of our lives by making our communities more enjoyable places to live, work and play. Ecologically healthy open spaces are also critical to improving biodiversity in urbanizing areas by providing substantial wildlife habitat and water quality benefits.

Over the past half-century, conventional development practices have transformed undeveloped open spaces into large parcels of predominantly impervious surfaces. Within these developments, roads, driveways, housing units and turf grass lawns dominate. Open space, "natural area" open space in particular, is rare. Frequently referred to as urban sprawl, these conventional developments reduce and fragment the acreage of natural areas in close proximity to our communities. They vastly increase the volume of storm water runoff, and they funnel untreated storm water runoff into engineered systems that lead directly to downstream water resources.

The cumulative effect of this design strategy has been that native plant communities have been replaced with monocultures of invasive, non-native plants. Wildlife populations that depend on contiguous, healthy ecological habitats have declined in both number and species diversity. Aquatic ecosystems have been degraded to the point that many native fish and aquatic organisms have disappeared from river systems, as well as bird, mammal and amphibian species that inhabit river corridors.

In the past few years, many communities in the Midwest have become acutely aware that development practices have contributed measurably to loss of biodiversity, degraded water quality, flood damages and associated environmental concerns. Communities are now beginning to explore alternative development practices designed to address the problems common in urban environments. Integral to these development strategies is the incorporation of ecological systems and ecologically restored open spaces within the built environment. This approach has come to be known as "Conservation Development." The City of New Berlin has implemented Conservation Developments as an encouraged form of residential subdivisions throughout the city.

One key objective in designing Conservation Developments is to create opportunities to infiltrate storm water into the ground before it becomes contaminated surface runoff that damages water resources and contributes to flooding. Since the most efficient infiltration and storm water treatment systems are created by native vegetation communities – prairies and wetlands in particular – these natural communities are highly prized from a biodiversity perspective.

Natural communities of prairie and wetland vegetation feature deep root systems that help direct storm water to groundwater resources. They also provide food and shelter for many wildlife species, some of which are entirely dependent on individual native plant species. Healthy wetlands are among the most bio-diverse ecological communities on earth. Healthy prairie systems feature several hundred plant species with associated beneficial insects, birds, mammals and other organisms that comprise the web of life.

Ecology aside, the realization that native vegetation communities provide economically valuable services has contributed to a heightened interest in the establishment of Conservation Developments. This concept favors alternative design strategies and ecologically restored open spaces that intertwine with the "built" environment to offer a multitude of benefits and win-win opportunities for all stakeholders. Benefits include much-appreciated aesthetic open spaces (and attendant increases in property values), improved wildlife habitat and increased biodiversity, and reduced costs of initial construction as well as long-term, low-cost storm water management.

When planned and implemented from a land ethic perspective, Conservation Developments offer a seamless transition from the built environment to the natural one. Human needs are met while healthy ecological systems are sustained.

Critical features of a Conservation Development include the following:

- In residential developments, lot sizes are reduced and housing units are clustered to allow for large expanses of preserved or restored ecological open spaces. Using this design concept, residential lots are juxtaposed adjacent to open spaces – offering views and access to natural areas that add value to personal properties.

- Impervious surfaces are minimized to allow for expanded open spaces and preserved, or restored, ecological systems that provide natural storm water management functions.

- Traditional storm sewer systems, including curb and gutter and deep detention basins, are avoided where possible. Alternatively, storm water is managed using natural drainage and infiltration areas such as swales or filter strips planted with native vegetation that are designed to function in series as a Stormwater Treatment Train™ (see Figure 5.20).

- Native plant communities are enhanced (if existing) or restored/created (if not existing) to provide infiltration functions offered by their deep root systems and evapotranspiration functions offered by above ground plant structures.

- During construction, soil disturbance (grading) is minimized and Best Management Practices (BMPs) are followed to maximize erosion/sediment control and to facilitate the establishment of natural vegetation systems.

Additional attractive features can be designed into these types of residential housing projects, such as trail systems in natural areas and traditional neighborhood design features that incorporate pedestrian-friendly site layouts, such as front-porch housing designs, sidewalks, and rear-loaded garages. Watershed-sensitive commercial or corporate development projects can also integrate trail systems, passive recreation opportunities and volunteer interaction/education with the ecological areas to maximize the potential of sites designed for biodiversity and water quality enhancement.

Cultural Planning Policies

The following ideals are employed in the continued success of cultural development within the community:

1. Environmental Protection and Enhancement – Protect, preserve, enhance and restore ecological systems. Responsible stewardship provides the fundamental underpinning for all conservation developments.
2. Nurture a Healthy Lifestyle - Create a living environment that provides for human needs and values, ranging from interpersonal social connections to human connections with the natural environment.

3. Create a Sense of Place - Create opportunities for the community to develop a positive and memorable sense of place and time.
4. Create a Sense of Community - Foster good citizenship and a commitment to the common good.
5. Foster Economic and Cultural Diversity – Encourage economic diversity by providing a complementary mix of housing options. Foster cultural diversity by welcoming and celebrating cultural differences.
6. Construct a Convenient and Efficient Inter-Modal Transportation System - Seek to enhance transit options that offer alternatives to personal automobiles. Options to consider range from convenient mass transit to interconnected walkways and bicycle paths.
7. Encourage Energy and Resource Conservation - Seek to enhance energy efficiency in homes through energy-efficient designs. Reduce dependence on resources through efficient planning layouts (e.g., roads), use of recycled building materials, and by relying more on natural systems rather than built systems (e.g., storm sewers). Develop a city-wide energy audit and renewable energy strategy.
8. Promote Lifelong Learning and Education - Promote continuous learning by incorporating social spaces and interpretive areas into development plans.
9. Advocate Aesthetic Design and High Quality Construction - Promote design and construction standards that result in structures that enhance and reflect the community.
10. Economic Viability – Encourage economic opportunities, such as an organic farm, that reflect and support the community's vision.

Land Planning Policies

In addition to the principles of Conservation Development described above, specific ecological principles should also be incorporated into the design of any Conservation Development:

1. Preserve the Integrity, Vitality, and Sustainability of Ecological Systems
    a. Ecological systems serve as the basic underpinning for all development strategies. Preservation of existing systems begins with an inventory and assessment of natural resources, conducted by a qualified ecologist.

2. Integrate Natural Resources with Development
    a. Minimize grading and landform changes to protect natural features.
    b. Integrate natural resources within the "built" environment as aesthetic and functional elements of the development.
    c. Enhance quality of life by providing human access and trail connections to the natural areas.
    d. Provide a seamless integration of natural resource areas with parks and greenways.

3. Maximize Environmental Engineering Opportunities
    a. Apply environmentally sensitive storm water management and water quality approaches to reduce a reliance on conventional built structures and man-made systems such as storm sewers.
    b. Emphasize water quality strategies and control storm water runoff through the use of Best Management Practices (BMPs) such as open channels, bio-retention areas, filter strips, and Stormwater Treatment Train™ concepts (Figure 5.20).
    c. Minimize soil disturbance and erosion during construction by employing BMPs for erosion and sedimentation control.

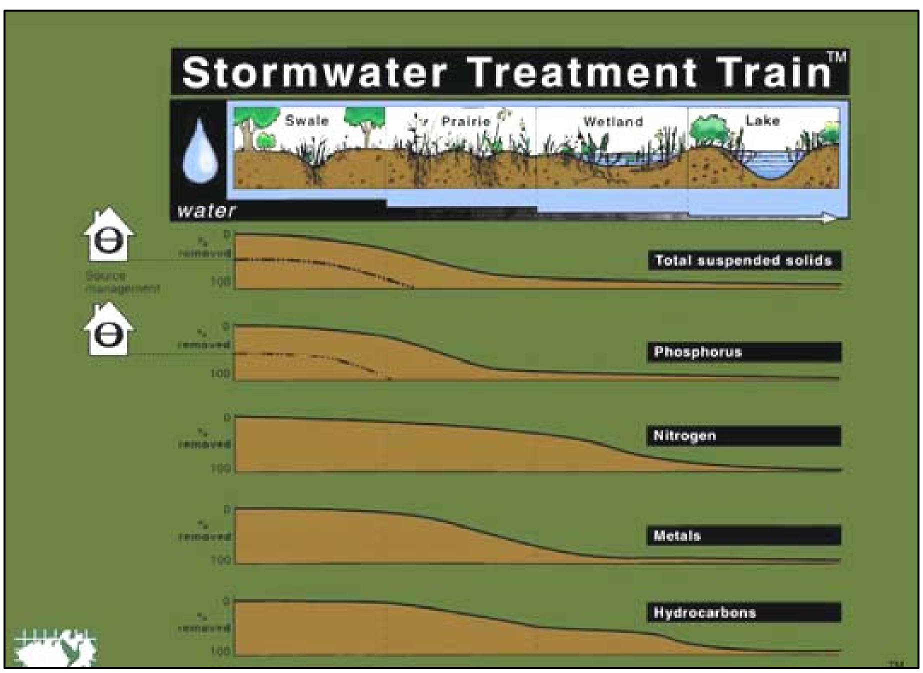


Figure 5.20. Stormwater Treatment Train™ Concepts.

4. Restore Disturbed Ecological Systems and Connect Natural Communities
   a. Restore degraded ecological systems and integrate them into the overall ecological plan.
   b. Reconnect natural resource remnants with restored natural communities.
   c. Develop a city-wide ecology plan to properly guide restoration efforts.

5. Provide Buffering
   a. Provide adequate buffers between the built environment and sensitive ecological systems.

6. Ensure Ecological Management and Monitoring
   a. Prepare and implement restoration, management, monitoring, and protection plans as part of the development planning process. These plans should be an integral part of the community's planning process.
   b. Clearly define responsibilities for implementation and monitoring of plans.
   c. Prepare covenants for homeowners and homeowner associations, including a handbook of Best Management Practices for Homeowners and legal restrictions that govern the management of common open spaces. Require homeowners to preserve the natural environment, and prohibit homeowners from degrading the environment (e.g., dumping yard debris and contaminants on public open space, encroaching yards and structures into ecologically-sensitive areas, etc.).

7. Enhance Ecological Education
   a. Develop an ecological education plan and make it available to the community.
   b. Clearly define the role of community members in preserving the natural environment, and provide education to facilitate their roles.

8. Encourage the Use of Native Landscaping
   a. Encourage landscaping with locally native plant material around homes, businesses, and corporate campuses to foster a stronger relationship with nature.

b. Encourage employment of “energyscaping” techniques using native vegetation to promote energy efficient practices. For example, deciduous trees and shrubs can be planted on the south side of a building to provide shade in summer, while evergreens planted on the north side act as a wind break in winter.

ENVIRONMENTAL CORRIDORS AND WILDLIFE HABITAT

Though the term “greenway” is relatively new, the concept has been in existence in the United States since the mid-1880s when greenways were used strictly for recreation. Regionally, greenways are commonly referred to as “environmental corridors.” These corridors are further divided into primary environmental corridors, secondary environmental corridors, and isolated natural resource areas:

- Primary environmental corridors contain concentrations of the most significant natural resources. They are at least 400 acres in size, at least two miles long and at least 200 feet wide.
- Secondary environmental corridors contain significant but smaller concentrations of natural resources. They are at least 100 acres in size and at least one mile long, unless serving to link primary corridors.
- Isolated natural resource areas contain significant remaining resources apart from environmental corridors. They are at least five acres in size and at least 200 feet wide.

Figure 5.21 illustrates the primary/secondary environmental corridors and isolated natural resource areas in New Berlin. In recent decades, environmental corridors have taken on a larger definition as a component of a multifunctional green infrastructure that can mesh with storm water, road, recreation, and utility needs that pervade in any community. Green infrastructure implies natural communities, such as wetlands, stream corridors, prairie remnants, and forest areas, facilitating municipal needs while greatly enhancing the quality of life within the community. Stream corridors can be employed as storm water and flood management while providing scenic bike trails. Unused rail tracks can be converted into corridors for utilities while providing nature trails, space for recreation and habitat for wildlife.

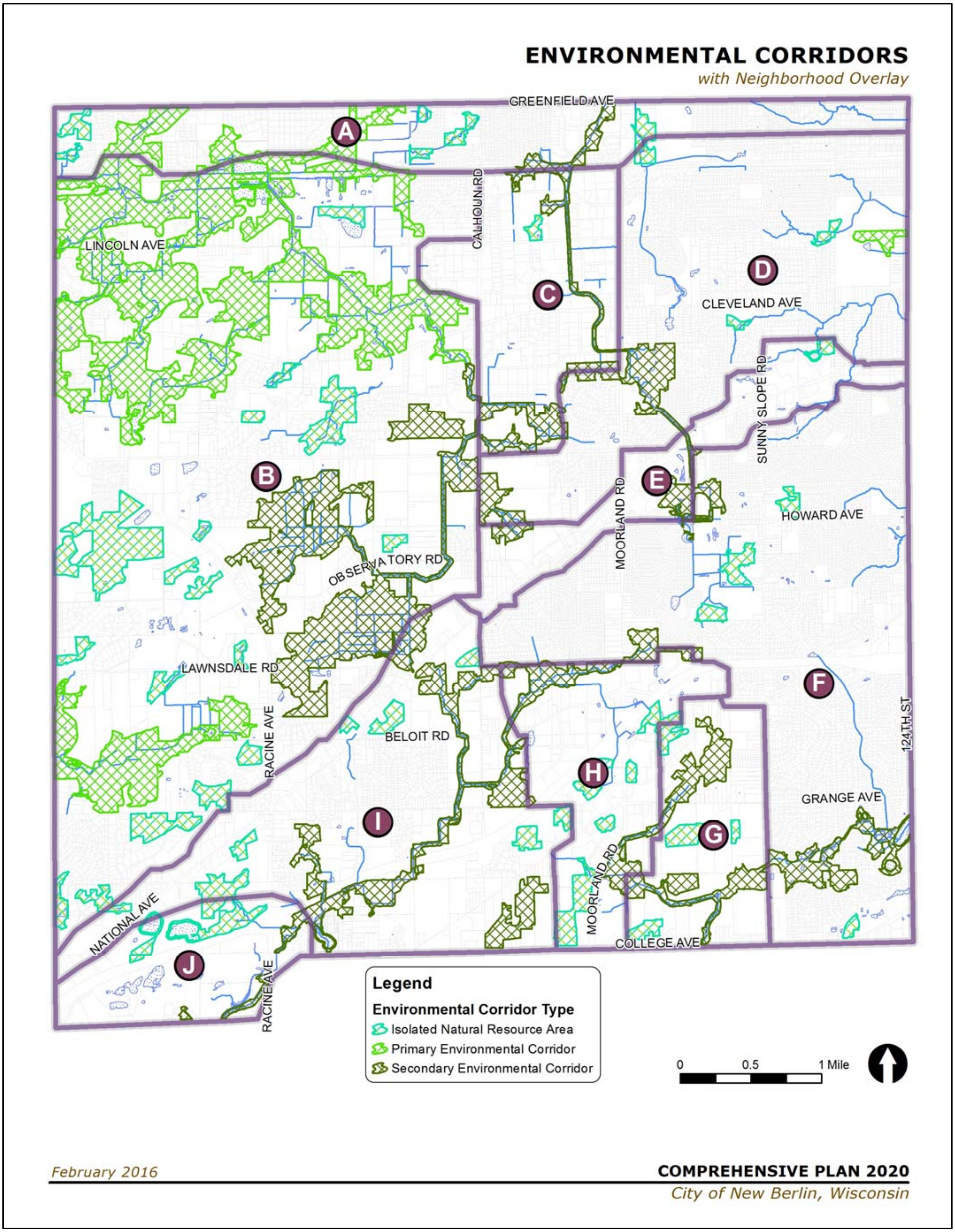


Figure 5.21. Environmental Corridors in New Berlin

Environmental corridors are linear tracts of land that are composed of natural vegetation. They typically follow natural corridors such as stream and river ways, remnant prairie areas, forested lands, and wetlands. Environmental corridors inherently connect a variety of habitats and land uses, flowing from farm field to suburban stream.

From an ecological viewpoint, environmental corridors are vital to biotic communities and their survival. Ecologists think in terms of systems, energy flow, and species interactions. They study the impacts of water cycles, hydrologic and hydraulic conditions, climate, and successional regimes.

Ecologists research historic conditions, locally adapted species, the potential for intrusion of non-native species, and impacts resulting from human activities. They consider water quality and habitat characteristics, including size (width and length) of required habitat for target species. They think about the composition and quality of riparian forest communities, associated avian, insect and aquatic communities, human impacts, and other factors. In urban systems, ecologists think in terms of environmental corridors. These corridors are imperative for connectivity within the web of life in urban areas, as they physically link the dots of fragmented nature.

Nearly without exception, the more land available for environmental corridors, the better they will function and the better will be their ecological health. Larger parcels, particularly when connected to other large parcels, display a greater richness in species diversity and have greater potential to sustain rare species that have very specific ecological requirements.

In urban areas, however, even where greenway development and expansion is desired by both wildlife and humans, bigger may not always be possible. Where corridors are constricted by existing development, it may not be feasible in some areas to widen the environmental corridor. It is sometimes possible to make it *longer*. River corridors are obvious passageways for many wildlife species. Providing connections between disjointed reaches of stream corridor or patches of natural areas will enable many species to travel more freely. Connecting corridors not only helps provide additional food sources and shelter for species, it also helps broaden the gene pool, improving disease resistance and survivability.

So, how narrow is too narrow? It depends on a) what is possible, physically and structurally, within confined suburban areas, b) the ecological *possibilities*, given specific site constraints, c) the *goals* of the corridor preservation and restoration program, d) the restoration potential of degraded water and land resources (and the cost/benefit ratio thereof), e) adjacent human development impacts, f) recreational priorities, and more.

To consider the ecology of biotic communities in environmental corridors without considering the impact of the human community is to ignore a critical, undeniable component of the ecology of these corridors, because the human and natural communities are intertwined.

On the landscape, human and natural communities come together in a wide variety of specific points of contact. One point of contact is with our feet, or trail systems. Another is the point of contact with our lifestyles – homeowner practices, development, and engineering practices – especially on adjacent lands but even on further distant upland areas within a watershed.

Significant Natural Areas and Endangered Species

In 1997, SEWRPC conducted a comprehensive inventory of natural areas within Waukesha County as part of the Natural Areas and Critical Species Habitat Protection and Management Plan. The inventory systematically identified all remaining high-quality natural areas and critical species habitat. The natural area classification system was developed by the Wisconsin DNR, and includes the following three categories: NA-1, natural areas of statewide or greater significance, which contain nearly complete and relatively undisturbed plant and animal communities believed to resemble closely those of pre-settlement times; NA-2, natural areas of countywide or regional significance, which contain native biotic communities judged to be lower than NA-1 either because of evidence of a limited amount of human disturbance or because of limited size; and NA-3, natural areas of local significance, which have been substantially altered by human activities, but which provide refuge for native plant and animal species that no longer exist in the surrounding area because of land uses and associated activities.

Since the preparation of Planning Report No. 42, SEWRPC has identified additional sites across the region, including 44 additional natural area sites (six NA-2 sites and 38 NA-3 sites) and 133 additional critical species habitat area sites. One new geological area of local significance (GA-3) has also been identified. These sites have all been added to the regional inventory and are documented in the updated plan to be adopted by SEWRPC.

New Berlin had one natural area of local significance (NA-3) and two critical species habitat sites, as identified in the adopted plan. Four critical species habitat sites are proposed to be added under the recommended plan amendment (Figure 5.22).

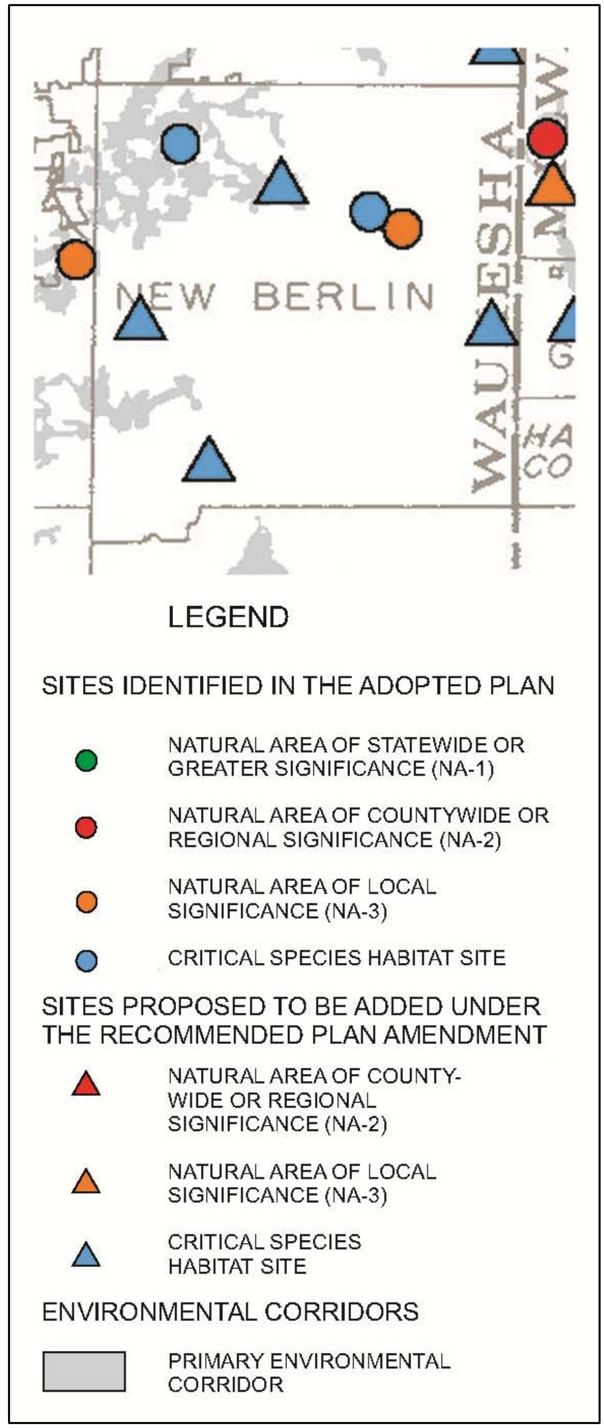


Figure 5.22. Natural Areas And Critical Species Habitat Sites Identified In The Adopted Natural Areas And Critical Species Habitat Protection And Management Plan And Sites Proposed To Be Added Under The Plan Amendment: New Berlin.

Aquatic Habitat

Increased impervious cover negatively impacts stream habitat and its associated biological communities. When a stream receives more severe and frequent runoff volumes compared to historical conditions, channel dimensions often respond through the process of erosion by widening, down-cutting, or both, thereby enlarging the channel to handle the increased flow. Channel instability leads to a cycle of stream bank erosion and sedimentation resulting in physical habitat degradation. Stream bank erosion is one of the leading causes of sediment suspension and deposition in streams. Sediment suspension causes turbid conditions that may result in undesirable changes to aquatic life. Sediment deposition alters habitat for aquatic plants and animals by filling spaces in substrates important to macro invertebrates and certain fish species. Physical habitat degradation also occurs when high and frequent flows decrease riffle-pools, overhead cover, and in-stream structures.

Stream substrate, in-stream fish cover, and water quality indicators reflect the quality of aquatic habitat. Habitats with silt free substrates, good water quality indicators, and in-stream cover are important to macro invertebrates and fish.

Water quality can be assessed by visually inspecting and documenting turbidity, grease/oil in the water, and presence of filamentous algae. Carp populations can cause turbidity. Grease and oil can be caused by residential and commercial/industrial land uses draining directly by storm sewer pipes to streams. Filtering of these substances needs to occur prior to water entering the stream system via vegetated swales and naturalized detention areas. Algae can become a significant problem within streams due to fertilizers with high phosphorous content typically used on golf courses, and on lawns in residential neighborhoods and other urban areas (Figure 5.24).

Figure 5.24. An example of poor water quality and algal growth along a stream reach.

Major inland lakes in the region are defined by the DNR and SEWRPC as those with a surface area of 50 acres or larger, a size capable of supporting reasonable recreational use with minimal degradation of the resource. The following are recognized lakes in the City of New Berlin, none of which are classified as major lakes:

- Linnie Lac
- Lower Kelly Lake
- Upper Kelly Lake

Lake water quality is significantly affected by surrounding land uses. Both development and agricultural activity has led to a decline in water quality of many Waukesha County lakes. Water quality can change as a result of increasing nutrient levels, i.e. nitrogen and phosphorus, which enter a lake. Eutrophication is a condition in lakes created when the accumulation of nutrients produces increasing amounts of aquatic plants. As the resulting lush aquatic plant growth dies each year, organic deposits fill in the lake. This natural process can be greatly accelerated by additional nutrients from inadequate or failing onsite sewage disposal systems, lawn fertilizers, agricultural and construction runoff, and street debris.

Major streams are defined regionally as perennial streams, which maintain, at a minimum, a small contiguous flow throughout the year except under unusual drought conditions. The City of New Berlin includes the following streams, none of which are classified as major streams:

- Deer Creek
- Hales Corners Creek
- Poplar Creek
- Root River, West Branch
- Tess Corners Creek
- Underwood Creek, South Branch

Trail Systems

Ecologically speaking, trail systems are carriers of species, both plant and animal. They are our pathways to explore and reconnect with the natural world, especially in urban areas.

Trails both benefit and harm natural systems. Harm comes not only because trails introduce the human element where it can negatively impact sensitive species, but also from the potential that trails open pathways for exotic invasive species to invade into new areas. Benefit comes from the way a well-designed trail system keeps people "on the road" rather than going off-trail through sensitive vegetation communities. Benefit also comes from the trail usage by wildlife and the ability for trails to facilitate important movements of a wide variety of wildlife species.

Recreation Opportunities

Recreation opportunities are a direct result of Conservation Development and ecologically based systems. Improved wildlife habitat provides the diversity and ecosystem necessary for high quality fishing and bird watching. Environmental corridors present opportunities for trail systems for biking and hiking, bringing society and wildlife together.

BEST MANAGEMENT PRACTICES

Through urbanization and agricultural drainage, we have dramatically altered the way our landscape manages runoff. Agricultural drainage with tiles and ditches contribute immense amounts of fertilizer, pesticide, and sediment-laden water to our stream and river systems. In urban areas, engineered systems designed to funnel water downstream, detain it, or retain it, have not been able to prevent flooding problems effectively, nor have they benefited downstream water quality. It is clear that farmland drainage and traditional urban storm water systems have contributed greatly to our muddied, eroded streams, poor water quality in nutrient-rich lakes, and the degraded fish and wildlife habitats that typically exist in our riparian corridors.

Whether on a watershed scale or on a specific site, alternative storm water management systems can be designed using natural systems (such as prairies and wetlands) to clean the water in our waterways, mitigate flooding impacts, and provide healthy fish and wildlife habitat. In short, alternative storm water management uses healthy natural landscapes to provide a higher quality of life in our communities, and this approach is central to the design process in Conservation Development. Alternative storm water management systems often utilize native vegetated swales, prairies, wetlands, and ponds to:

1. Reduce the rate and volume of runoff from the site
2. Improve on-site and downstream water quality
3. Enhance infiltration and groundwater recharge
4. Decrease infrastructure development costs by minimizing to the extent possible curb, gutter, and storm sewer systems, and by minimizing impervious surfaces by narrowing road widths.

Basic principles of alternative storm water management:

1. You cannot control where the rain falls, but you can often control what it hits, where it goes, and how fast.
2. There are alternatives to curbs, gutters, detention ponds, and other conventional techniques. These techniques can decrease the rate and volume of storm water runoff while increasing water quality.
3. Storm water is easier to manage close to where it falls or originates.

4. A reduction in impervious surfaces increases infiltration and evapotranspiration.

On a watershed scale, alternative storm water management principles provide opportunities to restore degraded wetlands with a host of downstream benefits. They also offer opportunities to stabilize our stream systems, increasing and improving habitat for fish, birds and other wildlife.

Innovative hydrologic studies, sound ecological planning, and active involvement of local communities are the hallmarks of successful projects with goals for environmentally sensitive storm water management.

Alternative Storm Water Applications and Techniques

Alternative storm water management can take many forms and can be applied in many settings: natural, rural, suburban, or urban. Sometimes, particularly when space is very limited, these alternative approaches are combined with conventionally engineered storm water management techniques. The following lists provide some alternative storm water management techniques that have proven effective in various settings.

Large-scale Techniques

- Bioretention/biofilter wetlands/ponds, forebays (where the larger solids and course organic material settle out before entering the wetland)
- Wetland restoration/creation
- Permeable pavement systems and materials

Small-scale Techniques

- Native landscaping
- Rain gardens
- Rain barrels
- Downspout disconnection, where permitted
- Weep walls (infiltration systems along retaining walls)
- Vegetated swales (infiltration and/or bioretention)
- Dry wells/infiltration cells/trenches
- Sunken parking lot islands and tree boxes
- Removal of curb & gutter
- Green (vegetated) roofs
- Permeable pavement systems and materials
- Breaking up unnecessary impervious areas
- Deep aeration

Ordinances can require or provide incentives for implementation of alternative storm water management techniques. They can be developed to target existing problem areas (e.g., portions of the community that are subject to flooding), new development projects, or redevelopment projects. The overall objective is for properties to manage on-site all storm water generated on the property whenever and wherever possible.

Choosing BMP Locations

BMP locations are site specific in nature. This chapter provides a general description of BMPs; specific recommendations are found in the individual neighborhood chapters. A general comprehensive plan can depict highly probable locations based on existing and future land uses, overall site topography, location of natural resources, watershed delineation, and watercourse locations, to name a few. A comprehensive plan offers an inventory of BMPs which is useful for recognizing target areas that could potentially be deficient in water quality treatment. The deficiencies can then be addressed by enforcing site constraints, such as lower density, for future development. Off-site areas can be designated for higher level water quality treatment in an effort to offset deficient sites that are already developed.

When determining the BMP locations for New Berlin, a variety of information and data was used to determine the BMP locations. These included: the 2000 Storm Water Management Plan, the 2001 future land use map, environmental maps for the City, and consultant experience with specific BMPs.

Section 6 of the 2000 New Berlin Storm Water Management Plan identifies sediment, phosphorous, copper, lead, and zinc as urban pollutants in the area. The pollutant levels were studied to determine their impact on future development. Pollutant loadings were identified by land use as well as by drainage area. Section 9 of the 2000 New Berlin Storm Water Management Plan identifies specific problem areas throughout the City and provides recommendations for addressing flooding and storm water quality concerns. Recommended locations for regional detention areas are listed by their general location in each section of the City. These areas were incorporated into the BMP comprehensive recommendations and locations for the specific BMPs.

The Future Land Use Map was used to determine locations for future development. An understanding of possible land use reveals the limitations for BMPs in an area and the likelihood of their implementation. Business Parks/Industrial areas, for example, have parking lots and limited grassy areas. They will be more conducive for recessed parking islands and vegetated swales. Many times these developments also have regional detention basins in order to maximize building space. The buildings in an industrial site may be perfect opportunities for implementing the use of cisterns or greywater re-use. Residential neighborhoods, on the other hand, tend to offer the opportunity for green corridors that can incorporate a multitude of BMPs. Vegetated filter strips can be implemented along creeks and streams as well as detention basin buffers. Existing neighborhoods can be retrofitted with BMPs or existing detention basins outfitted with natural water quality treatment features. Native vegetation can be implemented along basin side slopes and to stabilize the toe of slopes around the water's edge.

The Natural Features maps provided in each neighborhood chapter show locations of existing watercourses, environmental corridors, and flood fringe areas superimposed on aerial photographs that depict existing buildings and open space. BMP locations are chosen based upon these locations. Regional detention basins, constructed wetlands, and sediment forebays will more than likely be located adjacent to streams and flood fringe areas. Existing upland open space has the highest potential for preservation as prairies.

Implementation of the recommended BMPs will support other City efforts toward achieving the overall goal of reducing suspended solids and contaminants in the City's waterways. USEPA estimated percent pollutant removal efficiencies for various BMPs (Figure 5.26) along with an ongoing inventory of BMPs and their drainage areas are necessary planning tools for achieving the Wisconsin Department of Natural Resources' goal of 40% removal of total suspended solids by 2013.

BMP Efficiency at Water Quality Improvement (Pollutant Load Reduction)

BMPs play an integral part in reducing pollutants. The following are estimates of their efficiency in pollutant removal.

	TSS	TDS	BOD	COD	TN	TKN	DP	TP	Cd (Cadmium)	Pb (Lead)	Cu (Copper)	Zn (Zinc)
Vegetated Filter Strips	73%	*	50.5%	40%	40%	*	*	45%	*	45%	*	60%
Grass Swales	65%	*	30%	25%	10%	*	*	25%	50%	70%	50%	60%
Infiltration Devises	94%	*	83%	*	*	*	*	83%	*		*	*
Extended Wet Detention	86%	*	72%	*	55%	*	*	68.5%	*	40%	*	20%
Wetland Detention	77.5%	*	63%	50%	20%	*	*	44%	*	65%	*	35%
Dry Detention	57.5%	*	27%	20%	30%	*	*	26%	*	50%	*	20%
Settling Basin	81.5%	*	56%	*	*	*	*	51.5%	*		*	*
Sand Filters	82.5%	*	40%	*	*	*	*	37.5%	*		*	*
Water Quality Inlets	37%	*	13%	5%	20%	*	*	9%	*	15%	*	5%
Weekly Street Sweeping	16%	*	6%	*	*	*	*	6%	*		*	*
Infiltration Basin	75%	*	*	65%	60%	*	*	65%	*	65%	*	65%
Infiltration Trench	75%	*	*	65%	55%	*	*	60%	*	65%	*	65%
Porous Pavement	90%	*	*	80%	85%	*	*	65%	*	1%	*	1%
Concrete Grid Pavement	90%	*	*	90%	90%	*	*	90%	*	90%	*	90%
Sand Filter/Infiltration Basin	80%	*	*	55%	35%	*	*	50%	*	60%	*	65%
WQ Inlet w/ Sand Filter	80%	*	*	55%	35%	*	*		*	80%	*	65%
Oil/Grit Separator	15%	*	*	5%	5%	*	*	5%	*	15%	*	5%
Wet Pond	60%	*	*	40%	35%	*	*	45%	*	75%	*	60%
Agriculture Filter Strip	*	*	*	*	53%	*	*	61%	*		*	*
Stream bank and Lake Shoreline Stabilization	Stream bank and lake shoreline stabilization pollutant removal efficiencies vary depending on bank height and lateral recession rates. The USEPA only estimates the removal of sediment, phosphorous and nitrogen for stream bank and shoreline stabilization.											

Figure 5.26. USEPA BMP Estimated Percent Pollutant Removal Efficiencies
Source: Illinois EPA; * No available data

NATIVE LANDSCAPING

In the United States, millions of acres have been converted from a pre-settlement natural condition to turf grass lawns. Lawns typically are not considered ecological systems since they are dominated by non-native plant and animal species. A lawn may feature 10-15 actual plant species; a native prairie features hundreds. Biodiversity suffers when property owners follow the conventional lawn paradigm of yard landscaping.

In contrast to biologically barren and high maintenance lawns, native plant communities, such as wetlands, prairie, or savanna, are immensely diverse, productive systems. These native landscapes are seasonally dynamic, and provide year-round food and cover for a variety of wildlife. While the biodiversity of these systems is not easily recreated in a backyard, landscaping properties with native plants can provide a worthwhile contribution.

Below are some items for consideration regarding native landscaping:

- Traditional planning, landscaping and development resulted in the replacement of native with non-native plant species, loss of habitat, habitat fragmentation, habitat degradation, and/or habitat destruction. Most threatened, endangered, and rare species have become so because of this loss of habitat.
- Healthy native ecosystems perform many functions necessary for sustainable living. In addition to providing wildlife habitat, these ecosystems act as ecological filters and sponges, clean water and air, reduce and store storm water, stabilize soils, protect shorelines, recharge groundwater aquifers, insulate roots of trees and other perennial plants, etc.
- Native ecosystems also provide many less tangible values to human quality of life (e.g., beautiful aesthetics, connection to nature, passive recreation, etc.).
- Native landscape projects need not be large to have a positive impact. Even a small backyard butterfly garden can provide a beautiful amenity and much-needed native habitat.
- Rain gardens offer a wonderful opportunity to bring beautiful native plants into a landscape while also benefiting storm water management.
- Native landscapes are not “no maintenance”; they are, however, low maintenance. Careful initial planning followed by weed

management the first few years of establishment is critical to a successful project.

The following are some basic guidelines for creating a beautiful, functional, and successful native landscape. Appendix G of this Plan: Native Plants: Design Rules and Maintenance Techniques, provides a supplement to the list below.

1. Define target communities (e.g., dry, mesic, or wet prairie; emergent wetland; savanna, etc.), evaluate existing site conditions (e.g., light, moisture, soils, etc.), and consider what needs to be achieved.
2. Develop a seeding/planting plan using planting zones, species lists, etc. Choose native plant species appropriate for the anticipated site conditions, keeping in mind height, time of flowering, color, texture, wildlife value, etc. This plan can be tailored to best utilize available funds. Seeding is much less expensive than installing live plants, but seeding requires more patience. For many projects, a combination of seed and live plants are used.
3. Conduct appropriate site preparation. This may require herbiciding of weeds, especially exotic/invasive species, tillage, or a combination of these measures. Inadequate site preparation may result in erosion/sedimentation, abundant/persistent weeds, and a less successful project overall.
4. Implement the plan, and adjust activities as necessary if field conditions warrant a deviation from the plan.
5. Conduct weeding diligently for the first 2 to 3 years. Native plants direct most of their energy into root growth in the first year or two. Thus, weeding helps to reduce competition for sunlight by the above-ground plant parts of weedy species.
6. Water new plantings initially to ensure healthy establishment. Native plants generally do not require watering after the first few months.
7. Do not fertilize. Native plants generally do not require fertilizer; in fact, applying fertilizer can actually encourage the growth of weeds.
8. Monitor, manage, adapt, and enjoy!

Retrofitting Existing Developments

All of the native landscaping and alternative storm water management guidelines described above can be applied to redesign or retrofit existing residential and commercial developments in order to make them more ecologically friendly. However, existing developments typically present more constraints and limitations that affect the extent to which Conservation Development principles can be achieved.

Conservation Development Principles

General Guidelines for Applying Conservation Development Principles to Existing Developments

1. Reduce and/or break-up impervious surfaces by converting unnecessary or excess areas to vegetation (e.g., parking spaces, asphalt, etc.).
2. Reduce amount of turf area by converting excess areas to native vegetation.
3. Increase amount of native plant species, including boulevard trees, gardens, and ornamental plantings.
4. Remove problematic plant species and replace with native species.
5. Restore degraded habitats.
6. Provide native buffers around all water bodies at a minimum width of 25 feet.
7. Employ alternative storm water management techniques where possible by increasing vegetated conveyance swales and enhancing infiltration capacity where possible.
8. Provide education and information to the people who live or work in the development regarding the changes and improvements implemented.

Retrofitting Landscaping

Landscaping on existing developments can be converted to a more natural state by using native vegetation. Areas to consider converting include excess areas of turf lawn, exotic species-dominated gardens, and exotic ornamental plantings.

Turf grass can be replaced with prairie grasses and wildflowers. Parking lot islands – often costly to maintain – can be converted to low maintenance native plantings of prairie and savanna vegetation. Short, low-growing prairie grasses provide a lush native cover and can be used in parking lot islands. Gardens can be converted from exotic species to locally native plants. Native trees and shrubs can be added to, or replace, exotic ornamental plantings. The addition of wooded groves to former lawn areas provides structural diversity and enhanced habitat for birds and other wildlife. Diverse native trees, shrubs, grasses, and wildflowers bring beauty to these areas and enhance people's connection with nature.

Retrofitting Ponds

A native upland buffer can usually be established around existing storm water ponds. However, establishing healthy native vegetation along the shorelines of existing storm water ponds may provide particular challenges in some developments. In many cases, the existing hydrologic condition of the pond creates conditions unfavorable to the establishment of a diverse, healthy, native shoreline. Ultimately, however, all water bodies should have at least some adjacent vegetation that is not mowed or chemically treated in order to reduce erosion, sedimentation, and contaminant loading, and provide wildlife habitat and goose control.

General Guidelines for Retrofitting Storm water Ponds

1. Determine existing hydrologic conditions of the pond (characteristics of contributing watershed, water quality, and amount of water level fluctuation associated with storm events, etc.).
2. If existing conditions can support a diverse, native shoreline, install.
3. Regardless of whether or not existing conditions can support diverse, native shoreline community, investigate opportunities to make the pond more ecologically "healthy" and its hydrologic regime more "natural" by implementing alternative storm water management techniques in the contributing watershed (e.g., enhancing filtration and infiltration opportunities, constructing forebay wetlands for holding and filtering storm water, etc.).

WATER QUALITY

Water pollution has been described and interpreted in many ways. The Clean Water Act defines pollution as the human-made or human-induced alteration of chemical, physical, biological, and radiological integrity of water. Regardless of its definition, chemical pollution is a threat to streams and lakes.

Limnologists evaluate the ecological health of a water body and probability of biological productivity by measuring a variety of water quality parameters. The overall objective of water quality sampling and monitoring is to assess existing conditions in an attempt to restore or maintain the chemical, physical, and biological integrity of a stream or lake.

Typical physical and chemical monitoring parameters:

- Temperature
- pH
- Dissolved Oxygen (DO)
- Total Suspended Solids (TSS)/Turbidity
- Total Dissolved Solids (TDS)
- Metals (Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Silver, Zinc)
- Nitrogen (N)
- Total Phosphorus (TP)
- Fecal Coliform (*E. coli*)
- Water Clarity/Light Penetration
- Conductivity

Potential Causes and Sources of Pollution

It is difficult to determine precise causes and sources of non-point pollution. By definition, these pollutants come from a variety of areas and sources within the contributing watershed (Figure 5.27):

Pollutant	Potential Causes and Sources of Pollution	Designated Use Impairment
E. coli	Causes: Animal and human waste Sources: Public parks, Streets, lawns, driveways, parking lots, etc.	Primary and Secondary Contact
Salt	Causes: Excess dilution in stormwater runoff Sources: Deicing operations on streets, driveways, parking lots, and other impervious surfaces.	
Total Suspended Solids (TSS)	Causes: Eroded soils and other loose debris Sources: Streets, lawns, driveways, parking lots, soil erosion: elevated and highly varied stream flows, improper construction site management of sediment, agricultural practices, increasing land development without proper stormwater management practices	Aquatic life, water supply, primary contact
Total Dissolved Solids (TDS)	Cause: Dilution of substances in stormwater Sources: Streets, lawns, driveways, parking lots, construction activities, channel erosion	Aquatic life, water supply, primary contact,
Biological Oxygen Demand (BOD)	Cause: Organics Sources: Poorly treated wastewater, blooms caused by high nutrient loads	Aquatic life
Chemical Oxygen Demand (COD)	Cause: Organics Sources: Poorly treated wastewater and stormwater, algae blooms caused by high nutrient loads	Aquatic life
Total Nitrogen (TN)	Causes: Excessive dilution in stormwater Sources: Applications of fertilizer, failing septic systems, sewage treatment plant discharges, livestock, nuisance geese	Aquatic life, primary contact, water supply
Total Kjeldahl Nitrogen (TKN)	Causes: Excess dilution in stormwater Sources: Plant and animal decay	Aquatic life, primary contact, water supply
Dissolved Phosphorus (DP)	Causes: Excess dilution in stormwater Sources: Streets, residential lawns (lawn fertilizers, grass clippings), driveways, agricultural fertilizers, soil erosion, runoff from animal raising operations, untreated stormwater and wastewater, detergents, inadequate or failing septic systems, lake sediments, nuisance geese	Aquatic life, primary contact, water supply
Total Phosphorous (TP)	Causes: Excess dilution in stormwater Sources: Streets, residential lawns (lawn fertilizers, grass clippings), driveways, agricultural fertilizers, soil erosion, runoff from animal raising operations, untreated stormwater and wastewater, detergents, inadequate or failing septic systems, lake sediments, nuisance geese	Aquatic life, primary contact, water supply
Cadmium (Cd)	Causes: Constituent of alloys, pigments, batteries, metal coatings; for example protective coatings on steel, plastics, smelting of lead, zinc and copper as these occur in mixed ores with cadmium, underground pipes Sources: street, industrial parking, industrial wastewater, tire wear, insecticide application	Aquatic life, primary contact, water supply, fish consumption
Lead (Pb)	Causes: Point source discharges such as industrial, waste water treatment plant discharges, atmospheric deposition, urban stormwater runoff, underground pipes Sources: street, industrial parking (presume it comes from lead pipes in waste waters)	Aquatic life, primary contact, water supply, fish consumption
Copper (Cu)	Causes: Point source discharges such as industrial, waste water treatment plant discharges, atmospheric deposition, urban stormwater runoff, underground pipes Sources: street, industrial parking Metal plating, bearing and bushing wear, moving engine parts, brake lining wear, fungicides and insecticides	Aquatic life, primary contact, water supply, fish consumption
Zinc (Zn)	Causes: Point source discharges such as industrial, waste water treatment plant discharges, atmospheric deposition, urban stormwater runoff, underground pipes Sources: Industrial, commercial and residential roofs, streets, driveways, parking lots, tire wear, motor oil	Aquatic life, primary contact, water supply, fish consumption

Figure 5.27. Potential Causes and Sources of Pollution.
Source: Applied Ecological Services.

FLOODING AND DEPRESSIONAL STORAGE

Flooding is an obvious consequence of increased flows resulting from high impervious cover. Increased impervious cover leads to higher water levels, greater runoff volumes, and higher floodplain elevations. Higher floodplain elevations usually result in more flood problem areas. Furthermore, as development increases, wetlands and other open space decreases. A loss of these areas increases flows because wetlands and open space typically capture rainfall and release it slowly to streams and lakes. Detention basins can and do minimize flooding in highly impervious areas by regulating the discharge rate of storm water runoff, but detention basins do not reduce the overall increase in runoff volume.

Increased occurrence of the 100-year storm with high intensities has caused more regional flooding problems over the last ten years. Although New Berlin has completed, with great success, several projects to alleviate flooding, more work needs to be done. The updated storm water management plan provides locations of regional flooding concerns.

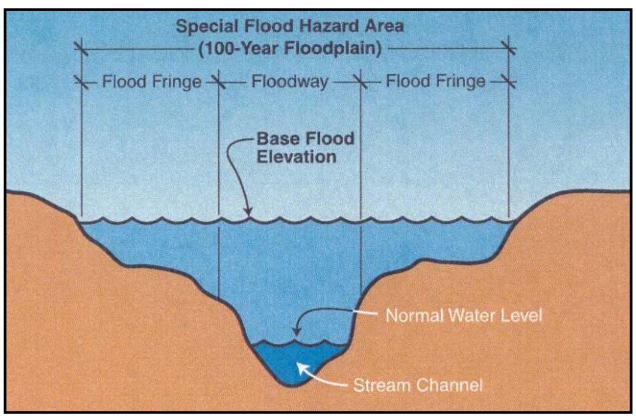


Figure 5.28. The 100-Year Floodplain and Floodway.

Floodplain

Floodplains along stream and river corridors perform a variety of benefits. Some of these benefits include aesthetic value, flood storage, water quality, and plant and wildlife habitat. The most important function however is the capacity of the floodplain to hold water during significant rain events to minimize flooding issues. The 100-year floodplain is defined as the area that would be inundated during a flood event (100-year flood) that has a one percent chance of occurring in any given year. However, 100-year floods can and do occur more frequently. The 100-year flood has become the accepted national standard for floodplain regulatory purposes and was developed in part to guide floodplain development to lessen the damaging effects of floods. The 100-year floodplain also includes the floodway. The floodway is the portion of the stream or river channel that comprises the adjacent land areas that must be reserved to discharge the 100-year flood without increasing the water surface. Figure 5.28 depicts the 100-year floodplain and floodway in relation to the stream channel.

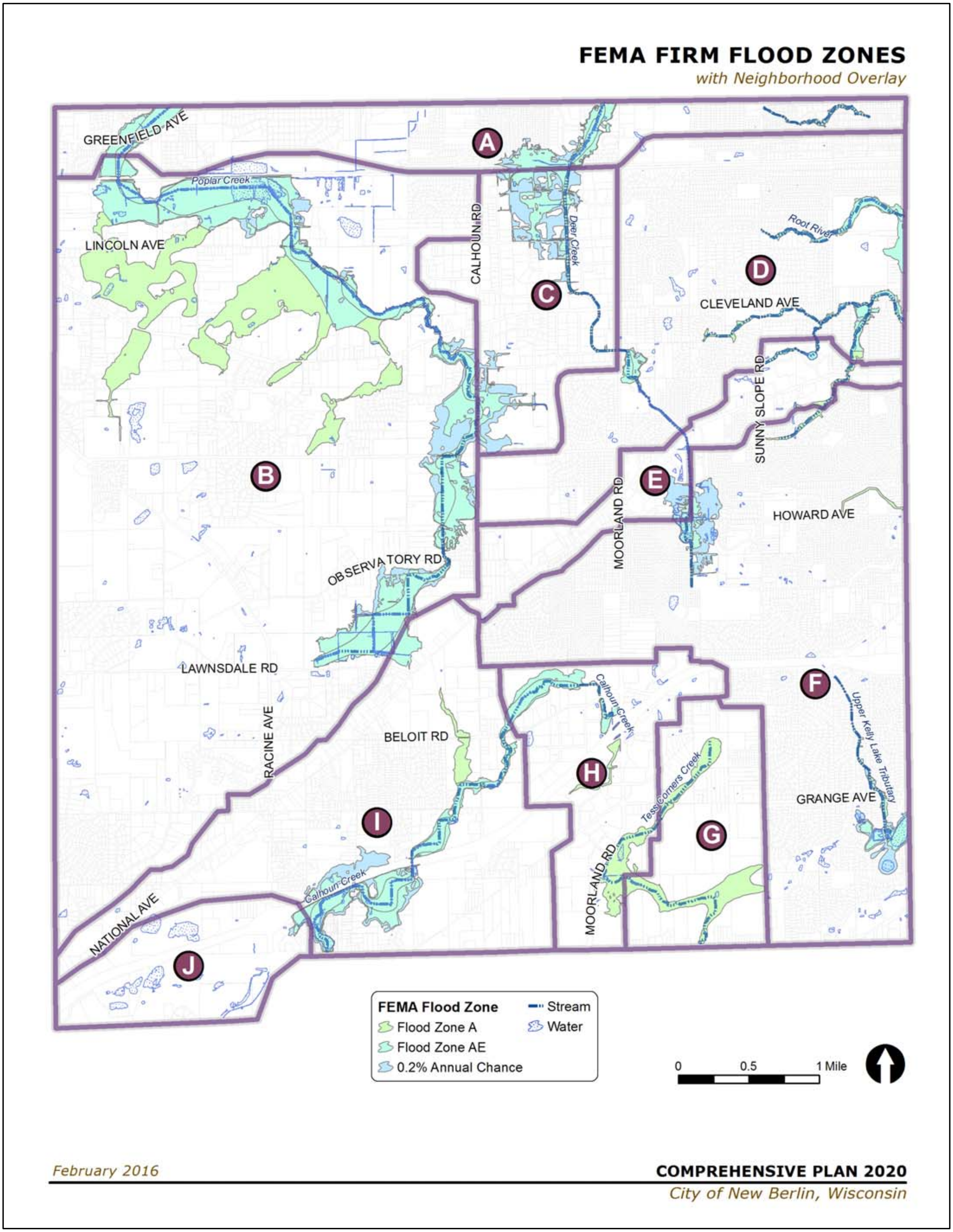


Figure 5.29. FEMA Flood Zones

Studies conducted by the Federal Emergency Management Agency (FEMA) to determine areas that have the highest probability for flooding are called Flood Insurance Studies (FIS). Flood Insurance Rate Maps (FIRM) are produced from the studies and used to determine the level of risk to people and structures in a certain area with respect to the dangers of flooding. FIRM maps are also used to determine the cost and requirements for the purchase of flood insurance. The FIRM map for New Berlin is shown in Figure 5.29. New Flood Insurance Studies and Flood Insurance Rate Maps were issued by FEMA with an effective date of November 5, 2014.

The City participates in the National Flood Insurance Program and Community Rating System (CRS) programs. Property owners receive a fifteen percent discount on floodplain insurance because of the City's participation in the CRS.

Constructed Drainage System

The natural drainage system has experienced changes as residential, commercial, industrial, and transportation land uses have increased. Early urban development was constructed without detention basins with storm water directed to streams and lakes via ditches and storm sewer systems. The goal was to remove runoff from developed areas as quickly as possible. Without detention, storm water originating from increased amounts of impervious surface and extensive storm sewer networks causes streams to rise quickly during a storm event and fall quickly afterward. This causes channel degradation such as down-cutting and channel widening as well as flooding and unstable conditions that are not suitable to most fish and invertebrates. More recently, land planners and engineers have realized the benefits of storing storm water runoff in detention basins that are designed to capture storm water runoff from a surrounding development and release the water slowly over a given amount of time. If designed with native plants and other features, detention basins can also provide wildlife habitat and improve water quality.

Riparian buffers are vital elements of watersheds, primarily due to their protection of surface and ground water quality from impacts related to human land use. These vegetated buffers are complex ecosystems that provide food and habitat for unique plan and animal species, and are essential to the mitigation and control of nonpoint source pollution. In fact the removal of streamside vegetation, primarily for development purposes, has resulted in degraded water resources and diminished value for human consumption, recreation, and industrial use. (Welsch 1991)

Detention Basins

Detention basins are designed in a variety of ways and in various locations relative to a development. Basins are often constructed in low areas relative to a development and contain storm sewer networks that drain to them. These basins are either dry bottom or wet bottom. Most dry bottom basins are typically lined with manicured turf grass. Dry bottom basins hold water for short periods following rain events but quickly drain and dry (Figure 5.30). Short residence time and lack of appropriate vegetation do not improve water quality or promote infiltration. Wet bottom basins typically hold water that is controlled by the elevation of the outlet pipe (Figure 5.31). Many older wet bottom basins are lined with turf grass and in many cases have rip rap near the toe of the slope (where water meets land). These conditions also do not improve water quality but may promote infiltration. Most newly constructed basins are designed to be wet bottom with side slopes and an emergent zone that is planted with native vegetation to help clean storm water, promote infiltration, and improve habitat for wildlife (Figure 5.32). These types of basins are usually referred to as naturalized detention basins.

Figure 5.30: Typical dry bottom basin

Figure 5.31. Typical wet bottom basin

Retrofitting Detention Basins

Detention basin retrofitting improves water quality, wildlife habitat, and decreases flooding. Retrofits include:

- converting dry basins to wet or wetland basins;
- prevent short-circuiting using berms or other measures;
- replace turf grass and rip rap with native vegetation for improved filtration and habitat;
- repair inlets/outlets and remove excess wood debris;
- clean up litter;
- treat excess algae.

Figure 5.32. Naturalized Detention Basin

Regional Detention Basins

Regional detention basins are defined as existing or created depressional areas that are presently storing, or potentially could store, storm water runoff for multiple developments within a watershed. In many cases, potential storage locations coincide with potential wetland restoration sites and could be created to mitigate for wetland losses occurring via development. More importantly, existing and potential storage areas present opportunities to mitigate Flood Problem Areas. When identifying existing and potential storage locations in a watershed, the following criteria should be used:

Existing Storage Areas

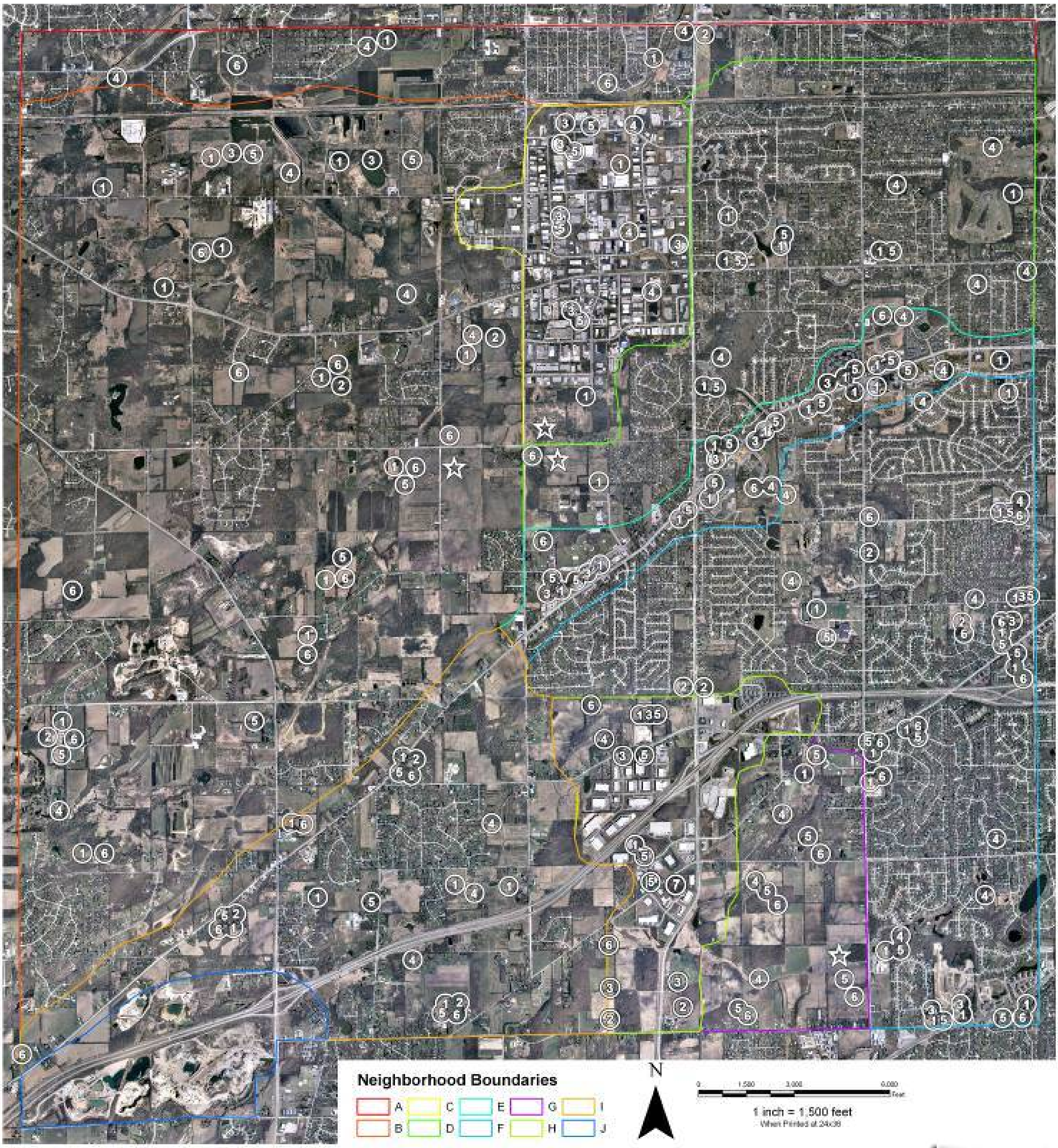
- include all detention basins, 100-year floodplains, open water (streams and lakes), hydric soils, and wetlands;
- exclude parcels less than 1/3 acre, transportation, and building footprints;
- use 2-foot boundary elevation (assumes 2 feet of storage for each location and provides appropriate hemi-marsh wetland creation dimensions and water depths).

Potential Storage Areas

- include all areas with 1% slope or less and merge with hydric soils and 100-year floodplain;
- exclude transportation, building footprints, and existing storage locations;
- only include locations greater than 5 acres and assume 2 feet of storage for each location.

Figure 5.33 illustrates the recommended locations for best management practices in the City of New Berlin.

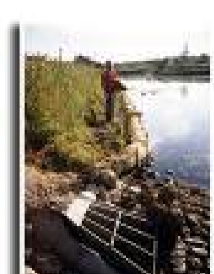
NEW BERLIN BEST MANAGEMENT PRACTICES LOCATION MAP




1. Vegetated Filter Strips and Swales


2. Bio-Filter Infiltration Basin


3. Recessed Parking and Cul-de-Sac Islands


4. Stream Bank Stabilization, Morphology and Improved Wildlife Habitat


5. Rain Barrels, Cisterns and Rain Gardens


6. Prairie


7. Wetland Restoration

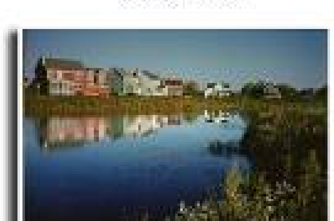

☆ Regional Detention Basin with Constructed Wetland and Sediment

Figure 5.33. Best Management Practices Location Map.
Source: Applied Ecological Services.