A Study of

Stormwater Management and Stream Setback Ordinances

within the

Village of New Albany, Ohio

Part Three in a Series of Independent Studies
Submitted as Partial Fulfillment of the Requirements for the Degree of Master of Landscape Architecture (Watershed Stewardship Option)

Timothy S. McSheffery

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Village of New Albany Riparian Setbacks and Stormwater Guidelines

The Village of New Albany, Ohio (VNA) has grown significantly in the last fifteen years. The associated land development has done significant damage to area streams and stormwater drainage infrastructure. Although stormwater management practices have been improving, the Village must still contend with bettering the quality of its streams. Currently the Village is faced with compliance dates for their National Pollution Discharge Elimination System, Phase II permit requirements. In addition, concerns about local flooding (Figures 1 and 2) and questions regarding stream protection setbacks have recently surfaced. If it is to meet federal and state guidelines, improve stream quality and address flooding concerns, the Village of New Albany is in need of a Comprehensive Stormwater Management Plan.

This study will review the current state of stormwater management in the Village; addressing issues of concern regarding current management practices, reviewing and commenting on the effectiveness of current VNA stormwater regulations and critiquing portions of the NPDES Phase II stormwater permit application submitted by the Village in 2003. Examples of regulations, methods, practices and technologies that could help the Village meet its stormwater needs will then be presented. One of above mentioned methods will then be applied via sub-watershed case studies, providing recommendations for establishing riparian buffers. Finally, suggestions will be made as to goals that could be included as part of a adopting a comprehensive stormwater management ordinance.

General Issues of Concern

The following issues of concern relate to general weaknesses or flaws in current practices of stormwater management, stream protection and land development. Although not an exhaustive list, it serves to show a sample of practices that impede sound stormwater policy.

VNA stream setbacks are currently fifty feet, split by the centerline of the stream. This appears to be an arbitrary number that is applied to all situations. In addition, setbacks only apply to “blue line” streams (from USGS quads). This ignores many intermittent streams, focused surface flows, farm ditches, site specific flood plain criteria and the stream cross section.
FEMA flood insurance rate map 100 year flood elevations are usually not applicable to the current landscape conditions. Maps and flood elevations have not been accurately updated to reflect the current drainage conditions. Preliminary planning for development is often based on the 100 year flood lines transposed from FEMA maps. Once preliminary plans are approved, adjusting to the calculated flood elevation is often presented as a “hardship” for the developer.

Farm ditches are not designed for intensive land development volumes or flows and they are not well regulated. For any land use more intensive than agriculture, man made ditches are inadequate. They are often badly eroded and stormwater flows transport heavy sediment loads downstream.

Floodplain protection on minor streams is often based on symmetrical offset stream setbacks that ignore the limits of the functional flood plain, allowing flood plain areas to be filled, paved or otherwise damaged. Any loss of functional flood plain creates or exacerbates stream degradation and flooding problems down stream.

It often happens that mitigation for flood plains and wetlands takes place out of the local watershed. Although the ecological functions of the mitigated area are to be reproduced elsewhere (such as a wetland bank), the stormwater management functions are lost within the local sub-watershed.

Streams are regulated under section 404 of the Clean Water Act (CWA). There are few methods by which streams can be evaluated and protected at the local level. The definition of “waters of the U.S.” in the CWA defines those waters that are protected by federal and state law. Local legislation to protect streams and surface conveyance would provide better long term resource protection and would not be impacted by changes to federal or state statute.

In Ohio, property lines are often at the centerline of the stream channel. Stream migration shifts the stream from one property to the other over time. Removing the centerline as the controlling factor allows streams setbacks to be located in such a way as to reduce stream degradation and the loss of personal property due to erosion or stream migration.

Land use and zoning regulations are based on parcel ownership lines and often ignores subtle features of the landscape. Land use should also be based on a parcels position in the watershed or sub-watershed. This allows for intensive or highly impervious land uses to be located in a position in the watershed which will be less harmful to the natural drainage systems.

Review of Current VNA Stormwater Regulations

There are many sections within the current VNA ordinances that effect streams and stormwater management. The following excerpts are from the municipal planning and zoning code. Review comments will follow each excerpt.

1181.06 STORMWATER RUNOFF CONTROL CRITERIA.

(a) Stormwater runoff control shall address both peak rate and total volume of runoff. The peak rate of the runoff from an area after development shall not exceed the peak rate of runoff from the same area before development for all storms from one year up to a 100-year frequency, twenty-four-hour storm.
In addition, if it is found a proposed development shall increase the volume of runoff from an area, the peak rate of runoff from certain more frequent storms shall be controlled further. There are two reasons why increases in volume of runoff require a control standard more restrictive than controlling to the predevelopment condition.

First, increases in volume mean runoff shall be flowing for a longer period of time. When routed through a watershed, these longer flows may join at some point or points downstream thereby creating new peak flows and the problems associated with peak flow such as flooding. This is known as the “routing problem.” Second, longer flow periods of large runoff quantities place a highly erosive stress on natural channels. This stress can be minimized by reducing the rate of discharge. The permissible peak rate shall be determined as follows:

1. Determine the total volume of runoff from a one-year frequency twenty-four-hour storm, occurring over the area before and after development; and

2. Determine the percentage of increase in volume due to development and using this percentage, pick the critical storm from the following table:

(RUNOFF VOLUME INCREASE CHART)

(b) The peak rate of runoff from the critical storm occurring over the development shall not exceed the peak rate of runoff from a one-year frequency storm occurring over the same area under predevelopment conditions. Storms of less frequent occurrence (longer return period) than the critical storm, shall have a peak rate runoff not greater than for the same storm under predevelopment conditions. As an example, if the total volume is to be increased by thirty-five percent (35%), the critical storm is a five-year storm. The peak rate of runoff for all storms up to this intensity shall be controlled so as not to exceed the peak rate of runoff from a one-year frequency storm under predevelopment conditions in the area. The runoff from a more intense storm up to a 100-year storm need only be controlled so as not to exceed the predevelopment peak rate from the same frequency of storm.

The key concept in this section is that it is both stormwater rate and volume that need to be addressed. While developments that exceed a certain percentage of runoff volume increase must control their post development runoff rate based on a less frequent storm event to compensate, they are not required to incorporate methods to improve on-site infiltration. Although storage via detention/retention basins has traditionally been the most common method of runoff control, infiltration methods and zones should be added to the regulatory language as a means of runoff rate and volume control.

Section 1183.04, Sediment and Erosion Control Standards and Criteria
Section 1183.04, (k), Preservation of Natural Watercourses.

Existing streams and channels shall not be altered or channeled without express permission from the Municipality of New Albany, and shall be preserved with their natural tree or vegetation canopy intact as a means to prevent their pollution from runoff containing sediment. The buffer area necessary to protect such watercourses shall be determined by the Municipal Engineer.

The Engineer may rely, as a guide for determining appropriate buffer area, on The Ohio Department of Natural Resources Natural Areas Guideline for Streams and Watercourses.

When the Municipality of New Albany Engineer determines that in his opinion prohibiting channelization of an existing natural watercourse would cause an undue hardship for the development of property subject to
these regulations, he may permit such alteration after reviewing plans outlining the extent and nature of the channelization or alteration.

Additionally, whenever such watercourse is being considered for alteration, the agency seeking permission to alter the watercourse shall provide the names of the owners of the three next lower riparian properties under wholly different ownership, and such property owners shall be notified in writing of the intended watercourse alteration.

While the critical concept of stream and buffer protection is mentioned, more detail is needed. Leaving the size and make up of the buffer completely open ended allows for more challenges to the code and to the decisions made by village officials. Given the condition of the streams in the village, overstating the willingness of officials allow stream modification is not to the best interest of the village.

The section also mentions that streams shall be preserved with their natural tree or vegetation canopy intact. Groundcover and under story shrubs and trees should be mentioned as well. Property owners often clear all of the low growing vegetation to better their view or access to the stream.

1187.14 SUBDIVISION STANDARDS, DRAINAGE.

(a) General. The Planning Commission shall not approve any subdivision having inadequate storm drainage or other physical drainage impairment, as determined by the Municipal Engineer. In areas known to be subject to periodic floods, such drainage improvements must be made as to satisfy the aforementioned public officers in order that the safety, health and welfare of the people will be protected. Storm water management principles as contained in the most current Municipal ordinance for the management and control of stormwater run off, shall be followed.

(b) Protection of Drainage Courses. No natural drainage course shall be altered and no fill, buildings or structures shall be placed in it unless provisions are made for the flow of water in a manner satisfactory to the Municipal Engineer. An easement shall be provided on both sides of any existing important surface drainage course adequate for the purpose of protecting, widening, deepening, enclosing or otherwise improving such stream for drainage purposes.

(c) Lot Drainage. A master grading plan shall be prepared for all subdivisions and shall be presented for review and approval by the Municipal Engineer. The grading plan shall show the existing topography, the proposed street grades and the proposed storm sewers with pipe sizes and proposed finish grades at the house, and shall delineate the method of rear and side yard drainage by showing proposed swales and direction of surface slope by arrows. The grading plan shall follow the standards as established for such grading by the Federal Housing Administration, except three percent (3%) grade in swales is acceptable.

Wherever possible, with exceptions being made where the topography of an area does not permit such grading practice, lots shall be graded from the rear lot line to the street. Where a lot abuts directly on two streets, the grade shall be from the corner of the lot which is diagonally opposed to the corner of the two streets on which the lot abuts. This regulation is included in a desire to reduce the amount of water standing in yards to a minimum.

Therefore, where it is not possible to grade a lot in the prescribed manner, the owner or developer shall provide for the adequate drainage of any and all low areas, and tie such drainage into and make it a part of the storm sewer system of the development and the Municipality, as directed by the Municipal Engineer with approval of such drainage subject to inspection by the Engineer, along with the inspection of other storm sewer installations.
As mentioned in the previous comments, leaving the size and make up of the buffer completely open ended allows for more challenges to the code and to the decisions made by village officials. Although it may be beneficial to have easements in place, a clear definition of different types of easements, and their explicit purpose should be included. The description of an easement that allows for surface water to be “enclosed” has a very different purpose than an easement intended to protect a riparian corridor.

Requiring that residential building lots drain from back to front does not allow for the implementation of stormwater management practices that promote the following of natural site drainage or increased infiltration. Additionally, forcing stormwater to the street and storm sewer increases pollution and concentrated runoff.

Chapter 1155 – FP Flood Plain Overlay District

1155.01 PURPOSE.

It is the purpose of this chapter to promote the public health, safety and general welfare and to minimize losses resulting from periodic inundation of flood waters in the Municipality of New Albany by:

(a) Restricting or prohibiting uses which are dangerous to health, safety or property in times of flooding, or cause excessive increases in flood heights or velocities;
(b) Requiring that uses vulnerable to floods be protected from flood damage at time of initial construction;
(c) Controlling the filling, grading, dredging and other development which may increase flood damage; and
(d) Controlling the alteration of nature/flood plains, stream channels, and natural protective barriers which are involved in the accumulation of flood waters.

Although the primary purpose of this section of the code is to protect public health, safety and welfare, by the nature of its requirements it also has many benefits to the health of streams and riparian corridors. Perhaps this section could be used as the starting point for a specific section of the code governing riparian buffers.

There are a variety of code sections that address stormwater and stream protection in some capacity. It would be beneficial to collect these references and additional concepts into a unified code section that specifically addresses stormwater management.

Village of New Albany NPDES Phase II Permit

The Village of New Albany has agreed to address specific stormwater issues in its NPDES Phase II permit application. The instruments by which these issues will be addressed must be implemented in 2004 or by 2005. Although the majority of the permit sections address water quality and erosion control, practices required to meet the spirit of the permit will have a profound effect on protecting natural drainage courses. A review of specific permit items and the VNA compliance response to these items follows:

Section 3.2.5.2.1 Your program to address stormwater runoff from new development and redevelopment projects. Include in this description any specific priority areas for this program.

The Village response states that it will enforce specific chapters of its codified ordinance (1181 Stormwater Management and Runoff control) (1187 Subdivision Regulations). It is stated that they will employ Best
Management Practices (BMP’s) and Best Available Technologies (BAT’s) that are incorporated in the Village ordinance. Creation of buffer zones around drainage courses to reduce runoff volume and velocity is proposed, but no details of implementation are given. In addition, no specific details of the buffer concepts are apparent in the referenced code chapters.

Section 3.2.5.2.3.1 Policies and ordinances that provide requirements and standards to direct growth to identify areas, protect sensitive areas such as wetlands and riparian areas, maintain, and or increase open space (including a dedicated funding source for open space acquisition), provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize the disturbance of soils and vegetation.

The Village states that it will adopt an ordinance to address stormwater management for new development and redevelopment that would regulate areas of one acre or more as allowable by state and local law. This ordinance is to be completed by 2005. Creation of a comprehensive watershed based stormwater management plan / ordinance that included riparian buffer criteria, stream protection methodology, and infiltration / recharge requirements would go a long way towards satisfying this section of the permit.

In response to further sections of the permit application the Village states again that it will implement BMP’s and BAT’s when feasible. Fact sheets from the Ohio State University Extension (NEMO) are referenced as well. NEMO is a major proponent of progressive stormwater management strategies in Ohio and can provide the Village with extensive resources.

Sample Regulations, Practices and Technologies (and associated benefits)

The following are examples of regulations, practices and technologies that are available to aid the Village in meeting the goals it has set for itself in its NPDES Phase II permit application. Many of the examples address a specific topic within watershed and stormwater management but are intended to be implemented as one part of a comprehensive management plan.

Stream and Flood Plain Restoration

There are many stream segments within the Village that have been channelized and many historical flood plains that have been filled. Prior to significant land development in the Village periodic flooding was a nuisance. As the Village has developed there are new concerns regarding flooding and stream degradation. The idea of restoring segments of stream and flood plain was incorporated in the Rose Run Greenway Enhancement Plan (MSI, 2003). It would be to the best interest of the Village to use this reach of Rose Run as a demonstration project contributing to a watershed based stormwater management strategy.

Figure 3, Channel Morphology Criteria (Rosgen, 1994)
**Reference reach** classification is used to develop a natural channel design criteria based on measured morphological relation associated with the bankfull stage for a specific stable stream type (Rosgen, 1994) (Figure 3). Simply put, if you want to restore a stream, it is beneficial to model your design on a local stream that has more natural and undisturbed characteristics. Sadly, it is very difficult to find unmodified stream reaches in the New Albany area.

Stream restoration can also be employed as a means to protect existing municipal infrastructure. Dr. Peggy Johnson from the Pennsylvania State University Department of Civil and Environmental Engineering has been studying methods of restoring stream channels upstream from bridges and culverts to reduce scour and the resulting structural damage (Figure 4). A stable stream will carry less erosive sediment and moves at a slower velocity, thus doing less damage to the channel and existing infrastructure. In addition to all of the ecological benefits, a stable stream can save the Village money in the long term by reducing the frequency of infrastructure repair and replacement.

**Farm Ditch Reconstruction**

Farm ditches were most often constructed to receive the water from drain tiles used to dry out fields cleared for agriculture. However, these ditches are not able to manage stormwater runoff rates and volumes that are created when agricultural land is developed to a more intense land use. It is feasible then that if development is proposed on previously agricultural land, the ditch, as part of the stormwater infrastructure, should be upgraded in some way prior to development occurring. One alternative would be to reconstruct the ditch as “natural” stream channel capable of handling the stormwater stresses created by intensive land development.

**Infiltration (Recharge) Zone Protection**

One of the biggest impacts on stormwater runoff and the streams that receive the runoff is the increase in impervious surfaces that accompanies land development. When the amount of impervious surface area in an undeveloped watershed exceeds 10% coverage, degradation and loss of stream stability begins (Schueler, 1995). With this in mind it is critical that areas of high groundwater recharge be protected within the watershed. The Stormwater Management Ordinance from Halfmoon Township Pennsylvania has a specific section (1515, C) that addresses recharge volumes (Halfmoon Township, 2004). This section requires that “recharge mitigation shall be provided for all proposed impervious areas”. A proposed development plan is reviewed in detail by the municipality to find natural infiltration areas and proposed impervious areas that may qualify for infiltration credit. For example; rooftop drainage can be removed from the impervious area calculation for the development if it is sumped into a dry well that meets specific infiltration and storage criteria.
Watershed Based Zoning

The underlying premise of watershed based zoning is that impervious cover, rather than population density is a superior measure of growth impact (Schueler, 1995). Following the landscape characteristics within the watershed is a better guide to land use locations than property boundaries or parcel lines. There are several watershed management units that represent different scales of planning (Figure 5) (Table 1). The smallest planning unit, the catchment, is the most highly influenced by impervious cover and is the best location for site level BMP’s. A process to institute watershed based zoning is detailed in Figure 6 and Table 2 provides stream protection strategies within a watershed zoning framework.

![Relationship of Watershed Management Units](image)

**Characteristics of Five Watershed Management Units**

<table>
<thead>
<tr>
<th>Watershed Management Unit</th>
<th>Typical Area (sq miles)</th>
<th>Influence of Impervious Cover</th>
<th>Primary Planning Authority</th>
<th>Management Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catchment</td>
<td>0.05 to 0.50</td>
<td>very strong</td>
<td>Property owner local</td>
<td>BMP and site design</td>
</tr>
<tr>
<td>Subwatershed</td>
<td>1 to 10</td>
<td>strong</td>
<td>Local government</td>
<td>Stream classification &amp; management</td>
</tr>
<tr>
<td>Watershed</td>
<td>10 to 100</td>
<td>moderate</td>
<td>Local or multi-local</td>
<td>Watershed-Based Zoning</td>
</tr>
<tr>
<td>Subbasin</td>
<td>100 to 1,000</td>
<td>weak</td>
<td>Local, regional and state</td>
<td>Basin Planning</td>
</tr>
<tr>
<td>Basin</td>
<td>1,000 to 10,000</td>
<td>very weak</td>
<td>State, multi-state, federal</td>
<td>Basin Planning</td>
</tr>
</tbody>
</table>

Figure 5, Table 1, Watershed Management Units and their Characteristics (Schueler, 1995)
<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Conduct comprehensive stream inventory</td>
</tr>
<tr>
<td>2.</td>
<td>Refine/verify impervious cover/stream quality relationships</td>
</tr>
<tr>
<td>3.</td>
<td>Map existing and future impervious cover at subwatershed level</td>
</tr>
<tr>
<td>4.</td>
<td>Designate subwatersheds into stream quality categories, based on growth patterns and attainable stream quality</td>
</tr>
<tr>
<td>5.</td>
<td>Modify existing master plan to meet subwatershed targets</td>
</tr>
<tr>
<td>6.</td>
<td>Incorporate any management priorities derived from larger watershed planning efforts (i.e., watershed, sub-basin or basin plans)</td>
</tr>
<tr>
<td>7.</td>
<td>Adopt specific stream protection strategies for each subwatershed</td>
</tr>
<tr>
<td>8.</td>
<td>Implement long-term monitoring and enforcement program to provide management feedback</td>
</tr>
</tbody>
</table>

Figure 6, General Process to Institute Watershed Based Zoning (Schueler, 1995)
<table>
<thead>
<tr>
<th>Urban Stream Classification</th>
<th>Sensitive 0-10% Imperv.</th>
<th>Degrading 11-25% Imperv.</th>
<th>Non-Supporting 26+ % Imperv.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stream Quality Goal</strong></td>
<td>Preserve biodiversity and channel stability at predevelopment level</td>
<td>Limit degradation to stream quality</td>
<td>Minimize pollutant loads delivered to downstream waters</td>
</tr>
<tr>
<td><strong>Land Use Controls</strong></td>
<td>Watershed-wide limits on imperv. cover, restrictions on site imperv. cover.</td>
<td>Upper limit on watershed impervious cover.</td>
<td>No watershed imperv. limits.</td>
</tr>
<tr>
<td><strong>BMP Selection Criteria</strong></td>
<td>Maintain pre-dev. hydrology (ED or I), Minimize stream warming and sedimentation, Only off-stream ponds Preference for filtering systems</td>
<td>Maintain pre-dev. hydrology (ED), Maximize pollutant removal, Ponds/wetlands OK with some restrictions</td>
<td>Maximize pollutant removal and quantity control, Remove N,P and metals, toxics, No restrictions on ponds and wetlands</td>
</tr>
<tr>
<td><strong>Streamside Management</strong></td>
<td>Stream valley buffers, few uses allowed</td>
<td>Stream buffers</td>
<td>Greenways</td>
</tr>
<tr>
<td><strong>Monitoring</strong></td>
<td>Biological indicators, including single-species (e.g. trout)</td>
<td>Biological and physical indicators</td>
<td>Water quality trends, BMP performance</td>
</tr>
<tr>
<td><strong>Enforcement</strong></td>
<td>GIS tracking of impervious cover</td>
<td>GIS, biomonitoring trends, BMP surveys</td>
<td>Simulation model, WQS standards</td>
</tr>
<tr>
<td><strong>Development Rights</strong></td>
<td>Transferred out</td>
<td>No transfers</td>
<td>Transferred in</td>
</tr>
<tr>
<td><strong>Other Tools</strong></td>
<td>Land acquisition, extraordinary E&amp;S control, special review</td>
<td>Regional BMPs</td>
<td>Pollution prevention, Stormwater retrofits, illicit connections, restoration inventory</td>
</tr>
</tbody>
</table>

*The precise impervious cover ranges shown in this example are illustrative and may shift slightly due to regional and climatic conditions or historical management of the stream channel (e.g., ditching).*

Table 2, Stream Protection Strategies under Watershed Based Zoning Framework (Schueler, 1995)
Stream Setbacks and Buffers

A method of establishing stream setbacks will be published in the 2004 update of Rainwater and Land Development (Ohio’s Standards for Stormwater Management, land Development and Urban Stream Protection). This method is best applied to drainage areas less than ten square miles. As the tributary area to a stream increases, the size of the buffer increases correspondingly. The background of the equation used to establish the stream setbacks is as follows:

Empirical equations have been developed to describe channel geometry. Williams (1986) related the meander belt width ($B$) and the bankfull width ($W$) of streams based on 153 data points.

(1) \[ B = 3.7 W^{1.12} \text{ (feet)} \] (or $B = 4.3 W^{1.12}$ meters)

The above equation (1) represents the mean, yet there is significant variability in stream channels. The mean belt width would under predict the pattern of many streams in Ohio that have been allowed sufficient room to maintain a sinuous character. Therefore the following equation (2) incorporates the addition of the average deviation beyond (positively) equation (1) of stream channels measured. While there will be stream channels that do develop greater meander patterns, this represents the area that should contain most streams and their associated pattern.

(2) \[ B = 6.4 W^{1.12} \text{ (feet)} \]

An equation for the relationship between bankfull channel width and drainage area (DA, square miles) for rivers in the eastern USA (Dunne, 1978) gives the equation (3):

(3) \[ W = 14.7 D.A^{0.38} \text{ (feet)} \]

Substituting this last equation (3) for bankfull width ($W$) in equation (2) (the standard deviation of positive values) yields the following equation and is the stream setback area proposed in this practice.

(4) \[ B = 129 D.A^{0.43} \text{ (feet)} \]

When using the formula it is important to know that this is just a method of establishing stream setback areas. Once a buffer area for a specific stream reach is determined it must be applied to the site according to topography and adjust to changes in stream and valley direction (Mecklenberg, 2004). The calculated buffer width should not be centered on the stream channel as the channel is rarely the center of the functional floodplain (Figure 7).

Figure 7, Sample Stream and Floodplain Relationship (Rosen, 2004)
Sub-watershed Case Studies

The two sub-watershed case study areas, A and B, were selected primarily because of their location upstream from the Village Center, both areas being tributary to Rose Run (Figure 8). With increased financial investment in the Village Center there are concerns about flooding, as happened in May of 2003. Area A and B are currently both primarily undeveloped agricultural land. The stream system is so degraded downstream from the Village Center that slight increases in runoff rate and volume in upstream sub-watersheds could cause more frequent and possibly more severe flooding. The majority of the land in area A and B is currently zoned PUD (Figure 9). The purpose and intent of the PUD zoning district is described in the Village of New Albany Codified Ordinances:

*PUD Zoning - 1159.02 PURPOSE AND INTENT.*

The application of flexible and creative land use regulations to the development of land is often difficult or impossible within traditional zoning district standards. In order to permit the use of more flexible land use regulations and to facilitate use of the most advantageous techniques of land development, it is often necessary to establish a Planned Development District designation in which development is in harmony with the general purpose and intent of this Code, and the Strategic Plan. The objective of a Planned Development District is to encourage ingenuity, imagination and design efforts on the part of builders, architects, site planners and developers, to produce development that is in keeping with overall land use intensity and open space objectives of this Code and the Strategic Plan, while departing from the strict application of the dimensional standards of the traditional Districts.

The flexibility of the PUD zoning district, allowing for the thoughtful incorporation of stormwater management design, and the future institution of a stream buffer policy by the Village could lead to less stream degradation, higher stormwater infiltration rates and reduced incidence of local flooding.
Figure 8, Photo of Study Areas A and B
Both case study areas and sub-areas tributary to Rose Run were calculated. From these calculations and incorporating the stream setback formula detailed above (\(B = 129 \text{ D.A.}^{0.43} \text{ (feet)}\)), stream buffer widths for specific stream segments were derived (Figures 10 thru 13).
Sub-Area A-1
0.12 Square Miles
52 Foot Buffer

Figure 10, Sub-Waterhed Area A-1, Calculated Stream Buffer for Reach Highlighted in Green
Figure 11, Sub-Waterhed Areas A-1 and A-2, Calculated Stream Buffer for Reach Highlighted in Green
Sub-Area B-4
0.17 Square Miles
0.56 Sq. Mi. Tributary
100 Foot Buffer

Figure 12, Sub-Waterhed Areas B-1 thru B-4, Calculated Stream Buffer for Reach Highlighted in Green
Figure 13, Sub-Waterhed Areas B-1 thru B-5, Calculated Stream Buffer for Reach Highlighted in Green

Sub-Areas B-1 Thru B-4
0.72 Square Miles

Sub-Area B-5
0.46-Square Miles
1.18 Square Miles Tributary
138 Foot Buffer
VNA Stormwater Ordinance Opportunities

The Village of New Albany has many good opportunities to improve the management of stormwater and protect streams. In addition to meeting the requirements of the NPDES Phase II permit application, there is momentum within the village administration to address stream and stormwater issues that will affect the long term prosperity of the Village.

Some goals of a comprehensive ordinance, as has been discussed herein, would be as follows:

- Incorporation of all surface water conveyances and stormwater infiltration zones as sensitive areas that must be protected.
  - Utilize the currently updated stream, drainage and stormwater outfall (GIS) mapping generated by the Franklin Soil and Water Conservation District as a base to begin more detailed mapping of floodplains and other visible recharge areas as critical and sensitive resources.
  - Add language to the ordinance regulating types and proximity of specific land uses as a means of protection.

- Strive for the lowest net increase of stormwater runoff RATE and VOLUME leaving any sub-watershed between pre and post-development conditions.
  - Accurately map sub-watersheds within and adjacent to the Village, including land use, impervious surface cover, areas and types of vegetative cover, current soils information and estimated runoff rate and volume for a range of design storms. This will provide information as to what areas are in need of stricter regulation.
  - Require developers to provide accurate information for pre and post-development runoff rates and volumes as well as their proposed methods of on site management of any increases of rate and volume.
  - Become familiar with preferred management practices, utilizing organizations such as O.D.N.R and Ohio State NEMO as resources.

- Establish stream setback / riparian buffer criteria.
  - Map all streams and other drainage conveyances using the mapping information detailed in the previous goal.
  - Determine a method of assigning minimum buffer placement and dimensioning, such as that shown in the previous case studies.
  - Research and define all critical buffer characteristics in the ordinance. These may include but would not be limited to dimensions, placement, vegetation, habitat, land use and access restrictions.
  - Allow for case by case modification of the minimum buffer criteria based on site specific characteristics.
• Identify functional flood plain zones that are most critical to flood control.
  o Solicit the residents of the Village to report areas of frequent flooding, backwaters and standing water. Add these locations to the sub-watershed mapping as a means of better understanding the stormwater drainage system as a whole.

• Identify areas of potential stream and floodplain restoration and daylighting of enclosed streams through the village’s sub-watersheds.
  o Study the sub-watersheds for signs of historical stream channelization, diversion or impoundment. Historical maps and photographs can often provide clues as to the pre-development condition of the natural drainage system.
  o Interview long time residents to attain their recollections of stream altering activities.

• Create an ordinance that would address defined and intermittent streams, focused surface flows, farm ditches, floodplain criteria, riparian buffers, infiltration and recharge, stormwater storage as well as all of the man made stormwater infrastructure.
  o Review and reference all code sections that govern, regulate or affect any of the above. Verify that stormwater related issues in varying code sections do not conflict with one another in their intent or application.
  o Approach all means of stormwater conveyance, collection, storage, treatment, and infiltration, either man made or natural, as one integrated system.
  o Bring all stormwater related items under one unified code section.

• Watershed Based Planning and Zoning
  o The earlier discussion of watershed based zoning, including Figure 6 (General Process to Institute Watershed Based Zoning), provide basic information and a framework of the steps to meet this goal. All of the previously listed goals are best addressed at the watershed and sub-watershed scale.
References


Clinton, Daniel; Jennings, Greg; Harman, William; Patterson, Jan; Slate, Louise, and Williams, John, 2000: North Carolina Reference Stream Channel Morphology Relationships, North Carolina State University.


Matthews, John, Stormwater Specialist, Ohio Department of Natural Resources, 2004 Personal Interview.

Mecklenburg, Dan, 2004: Rainwater and Land Development, 2004 Update, Ohio Department of Natural Resources, Columbus, Ohio.

Myers Schmalenberger Inc., 2003: Rose Run Greenway Study, Columbus, Ohio.

Pinkham, Richard, 2000: Daylighting, New Life for Buried Streams, Rocky Mountain Institute, Snowmass, Colorado.


VNA - The Village of New Albany, Ohio, 2001: Title Seven, Soil and Stormwater Management, The Village of New Albany, Ohio Codified Ordinances, Chapter 1181 and 1183.


Ward, Andy and Mecklenberg, Dan, 2003: Calculated Methods of Stream Corridor Protection, FAB Engineering, the Ohio State University; Ohio Department of Natural Resources, Columbus, Ohio.
Previous Studies

In the previous year I completed two study projects that were based in the Village of New Albany, Ohio, both of which were focused on the proposed Market Street Residential (MSR) development project. They were both relevant to my current study in that they increased my understanding of site scale stormwater design practices and provided information as to the financial feasibility of new and modified methodologies of land development and construction practices. Better understanding design and construction practices and the associated costs allowed me to make stormwater ordinance recommendations in the final study that are realistic and attainable.

The first project was a detailed hydrologic and stormwater study of the MSR. Calculations were made for stormwater runoff in three conditions, pre-development, post-development (as per owners plan) and post-development.
development per an alternative plan. The goal of the alternative plan was to increase stormwater infiltration, reduce the need for on-site detention and decrease point source discharge into the adjacent stream. An additional focus of the alternative plan was to reduce the impact of the land development to adjacent forested and riparian zones.

**Alternative Plan**

Goals of Alternative Plan:
1. Improve post development stormwater quality (EPA Phase II or better).
2. Remove (or reduce) the need for stormwater detention basins on site.
3. Implement non-traditional methods of stormwater interception, infiltration and flow direction.
4. Meet existing zoning regulations unless they are in direct conflict with stormwater design and quality.
5. Meet the financial requirements of the owner.

**Plan Comparison**

<table>
<thead>
<tr>
<th>Traditional Plan</th>
<th>Alternative Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pervious Elements:</strong></td>
<td><strong>Pervious Elements:</strong></td>
</tr>
<tr>
<td>Forested preserve areas (per zoning)</td>
<td>Forested areas</td>
</tr>
<tr>
<td>3.32 Acres</td>
<td>6.70 Acres</td>
</tr>
<tr>
<td>Lawn (compact - variable porosity)</td>
<td>Lawn (low compaction)</td>
</tr>
<tr>
<td>9.89 Acres</td>
<td>6.96 Acres</td>
</tr>
<tr>
<td>Stormwater Detention Basins (2)</td>
<td>Stormwater Infiltration Areas</td>
</tr>
<tr>
<td>+/- 0.50 Acres</td>
<td>+/- 0.25 Acres</td>
</tr>
<tr>
<td><strong>Impervious Elements:</strong></td>
<td><strong>Impervious Elements:</strong></td>
</tr>
<tr>
<td>Streets – curb &amp; gutter with 24&quot; wide porous asphalt pavement</td>
<td>Streets – curb &amp; gutter with 24&quot; wide porous asphalt pavement</td>
</tr>
<tr>
<td>0.96 Acres</td>
<td>1.02 Acres</td>
</tr>
<tr>
<td>Sidewalks – concrete, 5&quot; width</td>
<td>Sidewalks – concrete, 5&quot; width</td>
</tr>
<tr>
<td>0.37 Acres</td>
<td>0.36 Acres</td>
</tr>
<tr>
<td>Asphalt Driveways</td>
<td>Driveways – porous asphalt or bitumen</td>
</tr>
<tr>
<td>0.23 Acres</td>
<td>0.23 Acres</td>
</tr>
<tr>
<td>Roofs</td>
<td>Roofs (reflective materials to wall)</td>
</tr>
<tr>
<td>2.73 Acres</td>
<td>2.73 Acres</td>
</tr>
</tbody>
</table>

The second project focused on the same owner proposed site plan for the MSR as previously mentioned but the primary focus was a cost/benefit analysis of alternative land development and construction techniques. Three cases were studied and compared. The first case was the baseline; having the project being built using current regulations and standard construction techniques. The second and third case presented two development and construction practice alternatives that would increase on-site stormwater infiltration and reduce the amount of stormwater infrastructure. Alternative two was ultimately selected based on its described merits.
Goal: Increase Infiltration Rate of Soil in Yard Areas

(Reference Project Site Will be Used for Analysis)

Baseline: Develop Land per Current Standards.

Alternative One: Regulation Requiring Developer to Amend Soil in Yard Areas After Construction is Complete.

Alternative Two: Require Modified Development and Grading Practices such to Avoid Compacting Yard Areas in the First Place.

Alternative Two - Assumptions

- Machinery is available that can “tread lightly” enough as to not inadvertently compact the existing soils.
- Site construction traffic can be adequately monitored and controlled.
- Infiltration rate of native soils is two to four times higher when not compacted by construction activities.
- Local housing market remains stable or expands.
Alternative Two - Costs

- Additional time and expertise required to design a plan layout that works with existing stormwater drainage patterns, removing the need for mass clearing and grading operations.

- Modify construction sequence such that heavy equipment access is limited throughout site, primarily in future yard areas, to reduce the rate of soil compaction.

Notes:
- change to the standard approach to site design
- would not require new materials or machinery.
- costs incurred because the model for purchase, zoning, design and construction of property is guided by a standardized economic model.

Analysis

Alternative Two - Costs

- Cost to Developer of Changing Site Design Approach (Additional Consultant Fees) = $100,000 to $150,000

- Cost to Developer of Modified Development/construction Procedures (Time and Specialized Knowledge) = $500,000

- Possible Loss of Site Development Density (Number of Homes per Acre) = $50,000 to $300,000

Analysis
Alternative Two - Benefits

• The benefits of Alternative two are much the same as Alternative one.

Additional Benefits

• Reduced costs of site clearing and grading
• Health of adjacent vegetated and forested areas. With less modification of the quality and flow of ground water (via less soil compaction), the existing vegetation will suffer lower stress caused by the adjacent construction.

Analysis

Alternative Two - Benefits

Monetized

• Reduction in grading and clearing operations required throughout project = $600,000
• Reduced excavation of detention basins due to reduced runoff volumes = $189,000
• Reduction in storm sewer pipe size required throughout project = $6000

Non-Monetized

• Tax break for property over a specified time period.
• Improved Health of Adjacent Forested/Undeveloped Areas.
• Long Term Benefits Described for Alternative 1.
Alternative Two – Risks and Uncertainties

• Difficult to Calculate Infiltration Rate in Native Undisturbed Soil
• Difficult to Monitor Site-By-Site Clearing and Construction Operations.
• Availability of Machinery that can “Tread Lightly” Enough as to Not Inadvertently Compact Soils
• Ripple Effect is to Associated Industries and the Reflection of Increased Costs is Unknown.

Recommendation – Alternative Two

• The Two Alternatives Have Many of the Same Benefits.
• Both Alternative One and two Offer the Possibility of Balancing Monetary Costs and Benefits to the Developer. This Reduces the Need to Accurately Monetize Long Term Environmental Benefits via Discounting.
• Alternative Two attempts to improve the problem of increased stormwater runoff created by soil compaction by not creating the problem in the first place.