Fort Washington Area Flooding and Transportation Improvement Study

Final Report

Prepared by

Center for Sustainable Communities, Temple University

Edited by Lynn Mandarano, PE, PhD

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1 INTRODUCTION

The project team led by the Center for Sustainable Communities, Temple University (CSC Project Team) was awarded a contract through a competitive proposal process to undertake this transportation and stormwater improvement study of the Fort Washington Office Park. This was a 2-year study that began in 2006 and concluded with the publication of this report. The study was funded by Upper Dublin Township through a $420,000 federal grant. In addition, the CSC was contracted by the Federal Emergency Management Agency (FEMA) and Abington Township to update the flood maps for the Sandy Run Creek Watershed for which FEMA provided $200,000 and Abington Township $30,000.

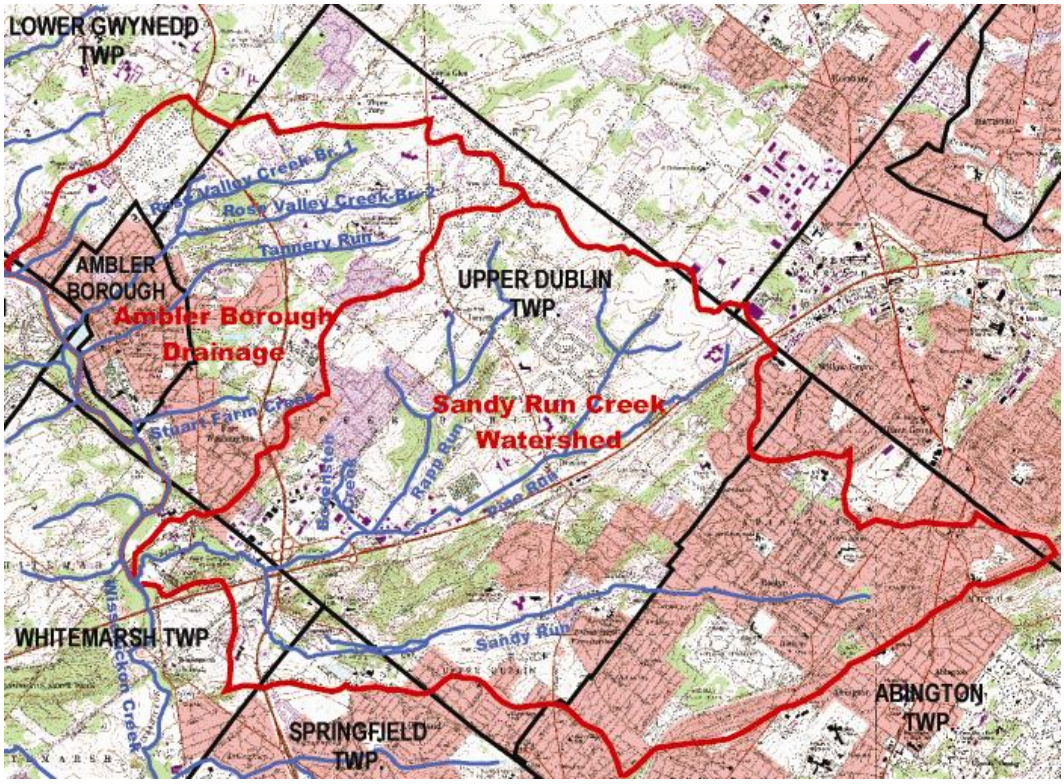
Context of the Study

The Fort Washington Office Park (Office Park) is a major employment center located in Upper Dublin Township, Montgomery County (see Figure 1); however, the success of this facility as an economic growth and development center is hindered by flooding and a poorly organized transportation system. While correcting severe flooding problems is paramount to the future success of the Office Park, this problem could not be corrected by evaluating the Office Park alone. A stormwater analysis of the entire Sandy Run Creek watershed was necessary to understand stormwater flows within the entire watershed and to identify potential stormwater management opportunities within the upper watershed and the Office Park. Similarly, the approach to improving the Office Park's current transportation system required an extensive evaluation of external conditions (e.g., connectivity to local streets, highway and mass transit) as well as internal conditions.

Figure 1 - Fort Washington Office Park Aerial View

The Sandy Run Creek watershed (see Figure 2) is 13.84 square miles and drains portions of Abington, Upper Dublin, Springfield, and Whitemarsh Townships in the eastern portion of Montgomery County, Pennsylvania. The watershed consists of two major tributaries. The first is the main stem of the Sandy Run Creek, which begins in Abington Township and flows through Upper Dublin and Springfield Townships before entering the Wissahickon Creek in Whitemarsh Township. The second tributary, Pine Run, consists of two major branches that converge within the Office Park before draining into the Sandy Run Creek west of the Pennsylvania Turnpike interchange. The first major stream is the Pine Run main stem, which has its headwaters in Upper Dublin Township and flows through the Office Park for much of its length. The second major branch is the Rapp Run, which flows exclusively through residential areas and parkland within Upper Dublin Township before joining the Pine Run main stem. Bodenstein Creek enters the Sandy Run Creek just below its confluence with Pine Run.

Figure 2 - Sandy Run Creek Watershed



Pine Run, Rapp Run and Bodenstien Creek, tributaries to Sandy Run and the larger Wissahickon Creek watershed, transverse the Office Park's landscape. In fact, a large percentage of the Office Park lies within the waterways' floodways and 100-year floodplains. Moreover, Virginia Drive was constructed within the Pine Run floodway. Consequently, 15-20 buildings and Virginia

Drive, the Office Park's primary thoroughfare, are prone to extreme flooding. Flooding has resulted in the loss of life and millions of dollars in property damage. Over time, this had lead to high vacancy rates and damage to paved surfaces within the flood prone areas, which detracts from the Office Park's image and its prime regional location, and contributes to a sense of aging and disinvestment.

With respect to the transportation network, the Office Park evolved over five decades without much planning. Lack of planning and competing interests have resulted in streets that were built without regard to environmental conditions or travel efficiency. Not only is Virginia Drive notorious for serious flooding even from moderate rain events but also for its 90-degree turns, which are unsafe even at the posted speed limits. A slip ramp constructed to facilitate traffic exiting from the Turnpike into the Office Park has adversely impacted local traffic within the Office Park. Although the Office Park is a primary destination for many travelers and even an origin for some trips on PA 309, a significant number of vehicles pass through the Office Park en route to and from PA 309. For such pass through vehicles, the drivers' interest is in a quick and direct through-route. Lastly adjacent residential communities' desire to bar Office Park traffic from their neighborhoods has restricted connectivity and travel efficiency. The four-way stop, with no turns allowed at Virginia Drive and Camp Hill Road, installed to placate these residential communities is a classic case in point.

Finally, there is little in the Office Park that encourages travel by any mode other than private car. At present, sidewalks are intermittent and in generally poor condition and there are no dedicated bicycle facilities. The R5 Fort Washington SEPTA station, which was recently renovated, is within a 5-minute pedestrian shed for part of the Office Park but there is no walkway between the Office Park and the station. The cut-through path used by some is very unsafe. SEPTA bus stops within the Office Park are few and far between and are hardly inviting to transit users, as only one is sheltered. The Office Park's present layout is not conducive to efficient bus service and the expansive building setbacks common to many properties within the Office Park make for long walks to and from any bus stop.

Scope of Study

The study was undertaken using an integrated analytical approach that also incorporated sustainable development principles. The first and most important component of the integrated approach was the analysis of the Sandy Run Creek watershed, which identified the environmental

constraints and opportunities for the remainder of the study's activities. Sustainable development principles in addition to the results of the watershed analysis guided the creation of recommendations to reduce the adverse impacts within Office Park. The study consisted of the following major tasks all of which influenced the recommendations included in this report and redevelopment plan:

- Watershed Flood Mapping and Stormwater Improvement Analysis
- GIS Mapping and Analysis
- Transportation System Analysis
- Office Park Market Analysis
- Public Participation (Design Charrette Workshops)
- Case Study Analysis of Office Park Redevelopment

Project Team

The members of the CSC Project Team who participated in this study are highlighted below including professional consultants.

Center for Sustainable Communities, Temple University

Director
Jeffrey Featherstone, Ph.D., Director

Staff
Md Mahbubur R Meenar, M.U.P., GIS Specialist

Research Fellows
Bradley Flamm, Ph.D., Assistant Professor, Department of Community and Regional Planning, Temple University
Richard Fromuth, M.C.R.P., P.E.,
Lynn Mandarano, Ph.D. P.E., Assistant Professor, Department of Community and Regional Planning, Temple University
Richard Nalbandian, M.R.P., M.S., P.G., Associate Research Professor, Department of Community and Regional Planning, Temple University

Associated Faculty
Michel Boufadel, Ph.D., Graduate Director, Department of Civil and Environmental Engineering, Temple University
Mary Myers, Ph.D., Chair, Department of Landscape Architecture and Horticulture

Graduate Research Assistants
Andreea Ambrus
Hareesh Daguppati
Dennis Dalbey
Ibrahim Ibrahim
Straso Jovanovski

Sujin Park
Alice Walters

Professional Consultants

Aero 2, Inc.: David Betzner, President
Orth-Rodgers & Associates, Inc.: Adrienne Eiss, Senior Project Manager
Coleshill Associates LLC: Shirley Loveless, Ph.D., President
Engineering and Design Institute, Philadelphia University: Robert Fleming, Co-Director
Jacques Whitford Company, Derron LaBrake, Group Leader

2 SANDY RUN CREEK WATERSHED ANALYSIS

Introduction

As noted earlier, concurrent with this study commissioned by Upper Dublin Township, the CSC was under contract with Federal Emergency Management Agency (FEMA) to conduct the flood map modernization process for the Sandy Run Creek Watershed. For more information of FEMA's map modernization program initiated in 2007 visit http://www.fema.gov. The existing Flood Insurance Rate Maps (FIRMs) for the Sandy Run Creek Watershed were developed in the 1970s and hence, do not reflect development that occurred since that earlier watershed analysis. Developing new FIRMs was a critical first step to establish up-to-date knowledge on stormwater flows and flood risks within the Office Park.

Need for Updated Floodplain Maps

According to FEMA, "new maps can take advantage of revised data and improved technologies for identifying flood hazards. Up-to-date maps support a flood insurance program that is more closely aligned with actual risk, encouraging wise floodplain management, and increase the public's flood hazard awareness." Such improvements include revised precipitation data and advances in GIS technology, which can lead to more accurate and detailed flood hazard analysis.

Research has indicated that the precipitation values (from the U.S. Weather Bureau's Technical Paper-40, or TP-40, which was published in 1961) widely used in previous studies to develop FIRMs are no longer valid because they systematically underestimated the extreme precipitation events. These values were used in the creation of existing Sandy Run Creek FIRMs as well. The National Oceanic and Atmospheric Administration (NOAA) started to publish updated precipitation atlases for the US in 2003, Atlas 14, which can be accessed at: http://hdsc.nws.noaa.gov/. The CSC Project Team requested and received permission from FEMA to use this more recent data for this study. This makes a very significant difference in the inputs to the hydrologic and hydraulic models employed in the delineation of the floodplains in the watershed. For instance, according to TP-40, the precipitation from the 100-year, 24-hour storm in our study area was expected to be 7.2 inches, and this number has been codified in virtually all local stormwater management ordinances. The more recent data indicates that at the 90% confidence interval, the 100-year, 24-hour event is 8.32 inches, a difference of more than 15.6%.

Topography plays a vital role in the distribution and flux of water and energy in a watershed. The United States Geological Survey (USGS) has prepared 7½° quadrangle topographic maps at a scale of 1:24,000 for most of the country and used a common contour interval of 10 ft. This scale was generally considered the minimum scale in hydrologic modeling. However, with the advances in digital photogrammetry and GIS mapping technology a tighter interval of 2 ft. is achievable and now is the preferred contour interval for watershed studies. Although GIS has been used since the 1970s, the extensive application of GIS to hydraulic and hydrologic modeling and floodplain mapping and management did not begin until the early 1990s. Now GIS is commonly used for watershed delineation, runoff estimation, hydrologic modeling, and floodplain mapping. For example, the U.S. Army Corps of Engineers (ACOE) software HEC-RAS can import GIS-generated stream networks and cross sections, analyze the data in 3-D perspectives, and export the outputs including floodplain boundaries as a set of polygons.

Creation of GIS-Based Data Inventory

The CSC Project Team developed a GIS-based data inventory for the study area. The key focus of the GIS-based data inventory was to create higher quality or higher resolution Digital Elevation Model (DEM) data, which allows more detailed terrain representation and analysis. Newly created GIS datasets include 2005 digital ortho-photographs (1 ft pixel resolution), 2 ft resolution elevation data such as DEM, Triangulated Irregular Network (TIN), and contour intervals, updated stream networks, flow-paths, bridges and culverts, dams, and building foot prints. The CSC Project Team has collected and edited a number of GIS data layers from different sources that include political and hydrologic boundaries, soil, geology, base flow, land cover, streets, transportation facilities, parcels, land use, trails, and parks and open space.

The consultant Aero2 Inc. created the digital ortho-photography and high resolution elevation data. The aerial mapping was done in non-growing season, when foliage was off the trees. Aero 2 has undertaken the following steps:

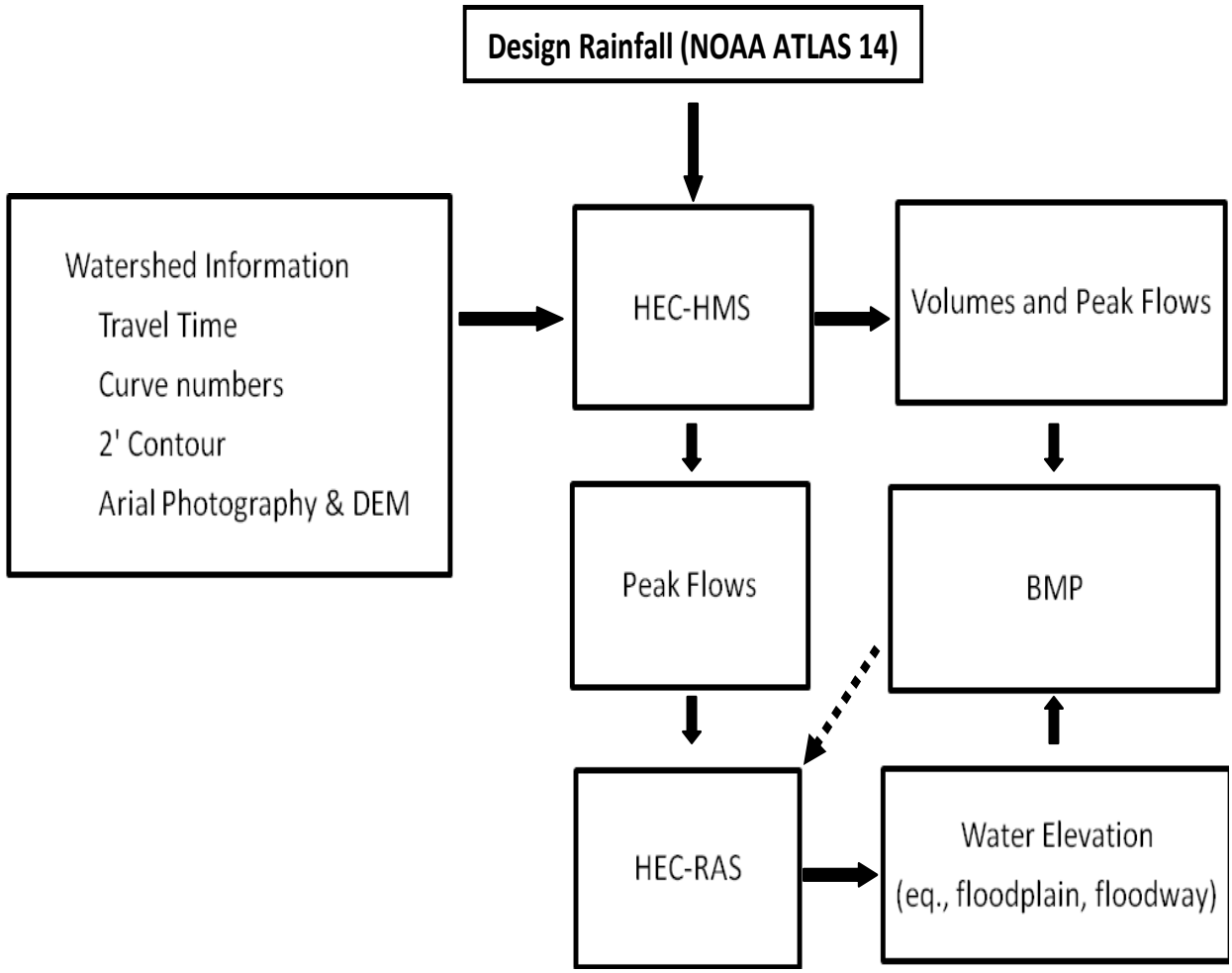
- Aerial Photography at 1"=660' negative scale using Airborne GPS technology flight;
- Ground Control Survey, performed by licensed land surveyor;
- Analytical Aerotriangulation, which performs image measurements to achieve interior and exterior image parameters; and
- Stereo compilation and creation of new data

The Hydrologic Modeling

The goal of hydrologic modeling was to delineate new floodway and floodplains in the Sandy Run Creek Watershed that result from 100- and 500-year hypothetical design storms. It was also used to conduct a re-engineering analysis of the watershed to assess the impacts of proposed stormwater management improvements, thereby simulating reduced runoff volumes attributable to the stormwater improvements identified as part of this study.

Delineating new floodplain boundaries depends on the accurate prediction of stormwater runoff and stream flows, which require three essential parameters: drainage area, times of concentration, and an infiltration/runoff parameter typically based upon soil and land use. The drainage area or sub-basin of a watershed is an area from which the runoff contributes to a "point of interest," such as the outlet of the stream or a stream gage.

Figure 3 - Hydrologic Modeling Flow Diagram



The hydrologic modeling process (see Figure 3) entails developing an actual or hypothetical design storm and then calculating the runoff and peak discharge for the selected event. The calibration entailed using the Delaware Valley Regional Planning Commission's latest land use data, which was based on year 2000 aerial imagery. Soil type data obtained from the Pennsylvania Spatial Data Access, PASDA, (http://www.pasda.psu.edu) at the resolution 1/24,000, which is the highest available from the National Resources Conservation Center.

The CSC Project Team conducted field observations (described in Chapter 3) and provided field data on constrictions in the watershed to support the hydrologic modeling. As constrictions can significantly divert flood flows locally, this step was necessary to fine tune the modeling and floodplain maps. The field observations also identified numerous potential stormwater improvements.

As mentioned previously, in predicting the runoff resulting from the hypothetical design storms, the depth of rainfall estimated by the NOAA Atlas 14 was used instead of the older TP-40 study. This greater rainfall depth along with the new land use data resulted in runoff peak values and volumes that are larger than those predicted in prior studies in the Sandy Run Creek Watershed.

Delineation of the floodplains for the study area was conducted using the (new) two-feet resolution topographic data prepared for the study area. In comparison with prior studies, new floodplains emerged due to the high accuracy of topography used in this study. In addition, the aerial extent of previously mapped floodplains often changed. . However, there was no systematic difference and the extent of the new floodplains was not always larger or smaller than prior studies. It is worth mentioning that the difference was sometimes as large as 900 feet. Overall, the modeling delineates 1.5 square miles of 100-year floodplain areas, compared to 1.2 square miles in the existing maps. The detailed methodology of hydrologic modeling has been included as Appendix A.

Updated FIRMs

The CSC Project Team has created the draft updated FIRMs based upon the data outputs obtained from the hydraulic and hydrologic modeling. The FIRMS were submitted to FEMA in May 2008. After the floodway and 100-year and 500-year floodplains were generated, the team created an overlay of the building footprints of all the structures within the floodplain boundaries based on the 2005 ortho-photographs. Following a spatial GIS query, the number of buildings intersected by floodplains was calculated. Table 1 shows the number of such buildings in each municipality of the Sandy Run Watershed.

Table 1: Buildings intersected by floodplains

By Municipality	FEMA floodway	CSC floodway	FEMA 100-year floodplain	CSC 100-year floodplain	FEMA 500-year floodplain	CSC 500-year floodplain
Abington Township	88	83	327	294	374	352
Springfield Township	1	2	6	6	6	11
Upper Dublin Township	31	39	103	145	141	178
Whitemarsh Township	8	19	33	31	37	39
Total	128	143	469	476	558	580

The new floodway and 100- and 500-year floodplains are displayed in Figures 4-7 (4 map quadrants). Appendix B provides maps highlighting the differences between the old and new floodway, and 100-and 500- floodplains.

Figure 4 - New Floodplain Map, Quad 1

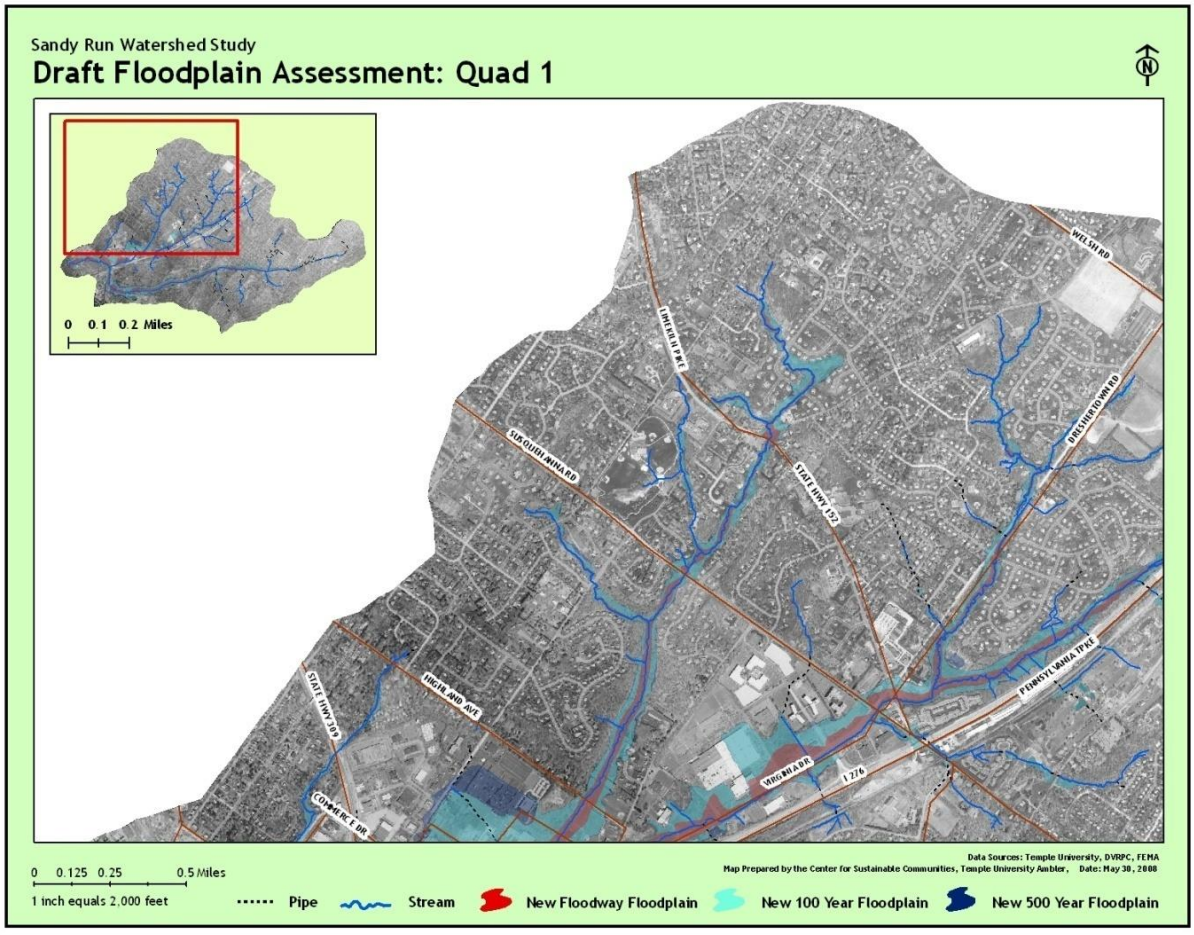


Figure 5 - New Floodplain Map, Quad 2

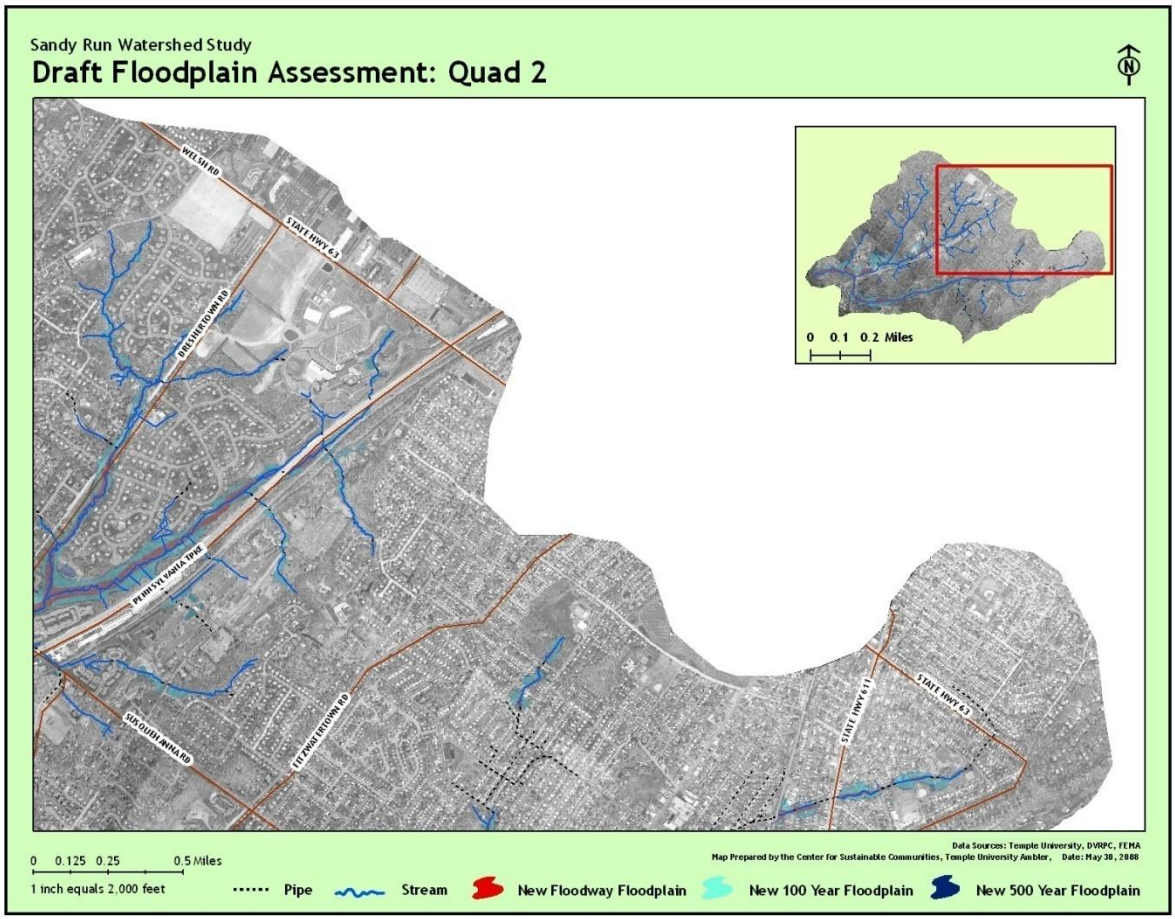


Figure 6 - New Floodplain Map, Quad 3

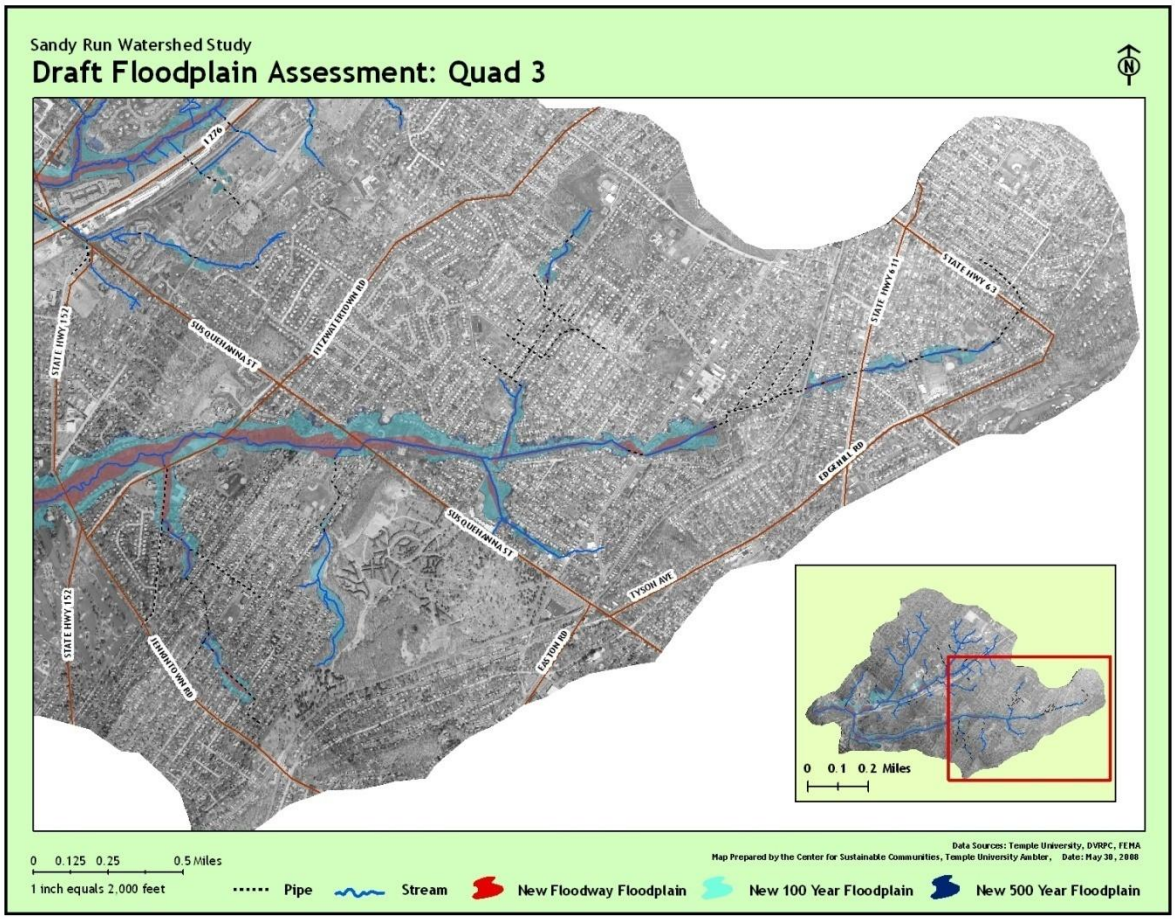
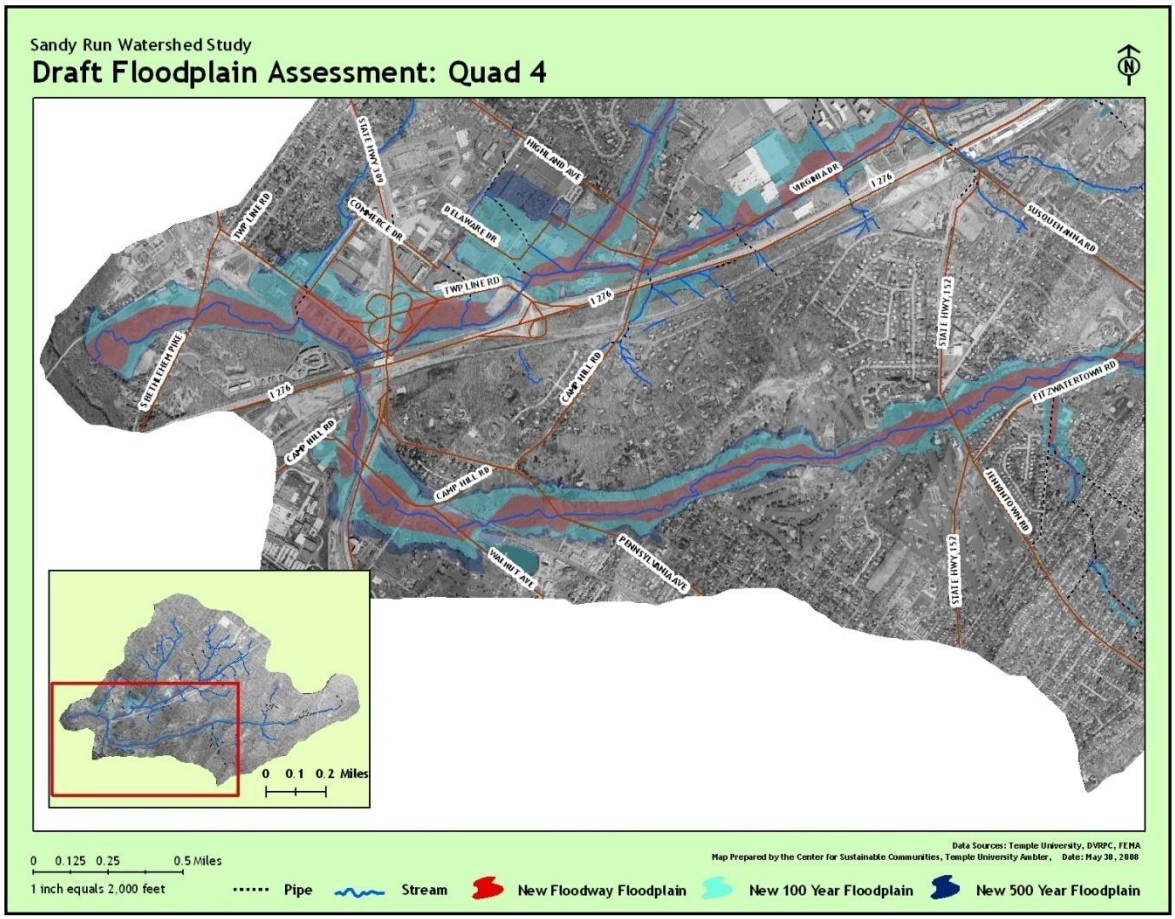


Figure 7 - New Floodplain Map, Quad 4



3 SANDY RUN CREEK WATERSHED STORMWATER MANAGEMENT IMPROVEMENTS

Field Observations

The updated hydrologic and hydraulic modeling and floodplain mapping for the Sandy Run Creek watershed illustrates the continuing potential for flood damage in the Office Park from high flows in Pine and Rapp Runs. The CSC Project Team conducted extensive field observations in these watersheds to identify sites where new or improved stormwater management facilities could potentially be used to infiltrate or detain additional runoff as a means of lowering downstream flood crests. Culverts or other structures in need of repair or locations where potential erosion damage control is recommended also were identified. The tables provided in Appendix C list the sites inventoried throughout the Sandy Run Creek watershed.

More than 300 sites were identified and inspected in the field, with over 200 of these sites in the Pine Run and Rapp Run watersheds, where there is the greatest potential for measures to reduce flooding in the Office Park area. An identification code for mapping and evaluation was assigned to each of the sites, and an inventory of several hundred photographs was compiled to document inlet and outlet structures and general conditions at existing detention facilities, as well as other observations related to channel conditions or stream bank erosion. Areas for potential new development and opportunities at existing open space and parking areas for improved stormwater management were also identified. Field observations of site conditions that would promote or limit detention/infiltration, such as adjacent wetlands, potential for increasing berm heights, or high water table were documented. In addition, field observations were used to verify stream pathways where streams were piped or channels were altered by previous development. The field observations and documentation provided a basis for subsequent GIS mapping of the sites, preliminary estimates of potential new detention/infiltration volumes, facility cost estimates, and modeling of potential flood crest reductions provided by new stormwater detention.

Opportunities for Stormwater Management Improvements

Knowledge and documentation of site conditions developed from the field observations, ortho-photographs, topographic data, and updated floodplains, were used to identify opportunities for stormwater management improvements. Since a major objective of this study was to identify means to reduce flood damage potential within the Office Park, priority sites were selected and

evaluated based on the potential to provide additional detention/infiltration storage for the watershed. These sites are highlighted in the tables and corresponding maps in Appendix C. The identification codes shown on the maps correspond to the codes in the tables. In general, sites that were identified for improvement or for repair of existing facilities, but which would not represent new detention storage, are not included as priority sites in the recommendations. Although not included as priority sites, addressing the deficiencies noted would continue the existing level of protection.

Four classes of storage related improvements, listed below, were identified in evaluating the potential for additional detention/infiltration storage. Appendix C identifies the estimated new detention storage for each facility. In addition, for several locations where proposed dams would offer significant storage potential Appendix C includes storage estimates for check dams limited to 3 feet in height as well as for the detention dams higher than 3 feet. The latter were conceptually designed by Temple University's Civil Engineering Department.

Existing Tracts of Open Space Suitable for Development, and Parking Lot Improvements

New detention/infiltration facilities that would completely contain the 10 year rainfall event (5.2 inches) onsite.

New detention/infiltration facilities or existing facilities where improvements would increase available storage

The estimated surface area of the facility, field observations regarding potential berm/overflow height, and installation of infiltration galleries where feasible were considered to determine the potential increase in storage volume.

Stream reaches suitable for installation of low head (3 ft. maximum height) dams to provide initial detention volume on ephemeral and perennial streams.

The storage volume available from these structures is limited in most areas by topography, stream slope, and existing development. Topographic maps were used to locate dams in series and estimate pool areas. The assumed average depth of the pool was one foot during maximum storage conditions. The dams would be installed to allow complete passage of average and low flows without ponding.

Stream reaches for potential location of dams higher than 3 feet

Several stream reaches, particularly along the lower portions of Pine and Rapp Runs, offer topography and open space that would allow for the construction of larger detention facilities. These were further analyzed by Temple's Civil Engineering Department for storage suitability and determination of economic dam height. (These would not entail permanent ponds and would allow the passage of average and low flows.)

Modeling of Potential Stormwater Improvements

In order to evaluate the impact of the potential stormwater improvement projects on reducing flood levels, HEC-HMS and HEC_RAS model runs were completed for the 2-Year, 10-

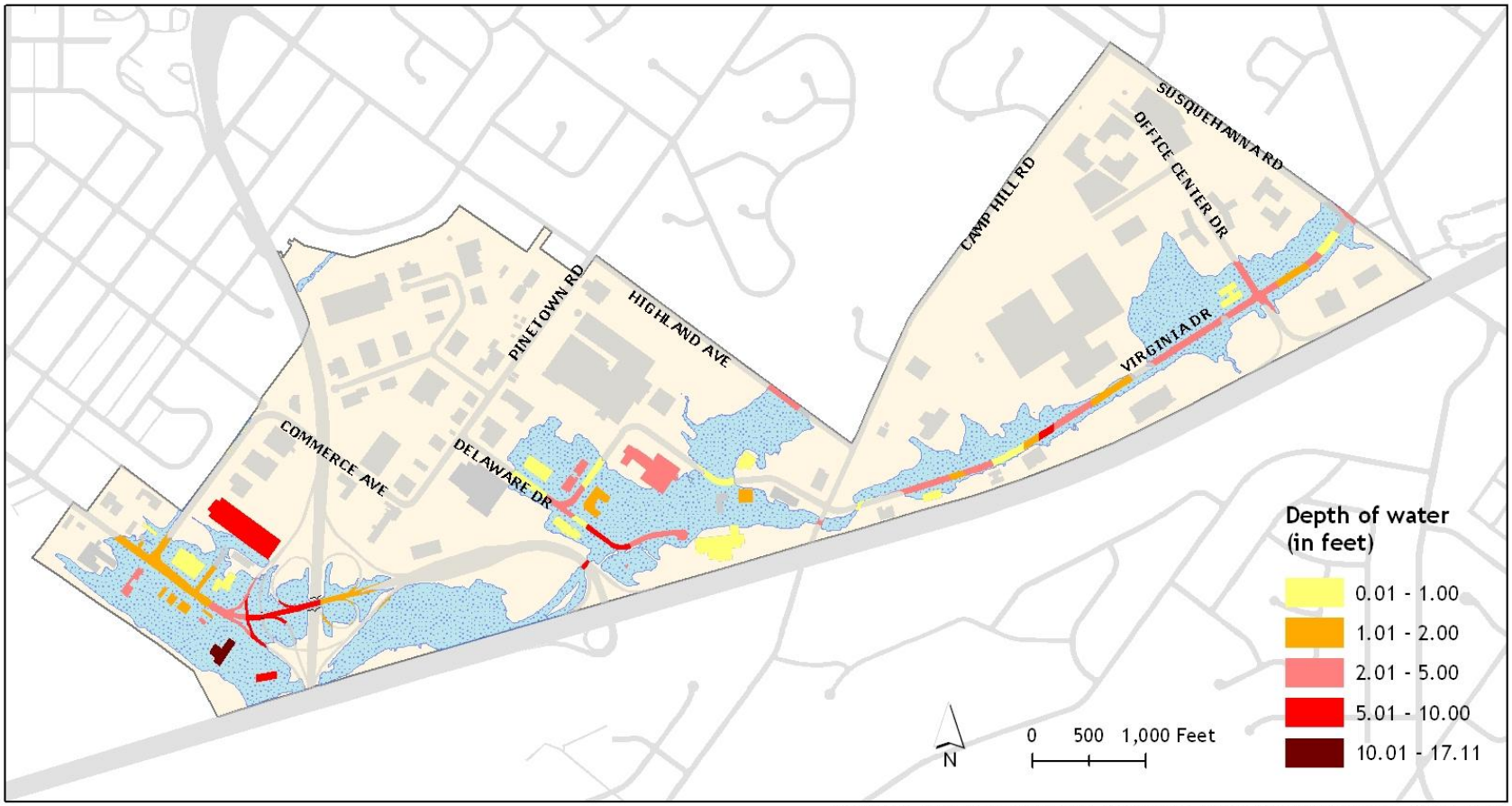
Year, and 100-Year storms, for both pre- and post-improvement conditions. For the post-improvement scenario, additional potential storage that could be provided by small facilities was aggregated by HEC-HMS sub-basin and entered in the model as increased initial abstraction over and above the existing condition. For the larger detention facilities where preliminary dam sizes were calculated as described in Appendix C (see discussion under the subheading 'Sandy Run Watershed – Detention Dam Analysis'), storage vs. discharge relationships were developed and entered into the HEC-HMS model for the respective reaches. The HEC-HMS model was then used to generate the post-improvement discharges, which were subsequently input to HEC-RAS to generate post-improvement flood elevations and flood maps of the 2-Year storm and flood elevations, corrected for backwater, for the 2-, 10-, and 100-Year storms for comparison to the pre-improvement flooding conditions.

The modeling results indicate that the combined detention volume of the improvements will reduce significantly flood elevations for the 2-Year storm (50 percent chance in any year) but not for 10-Year storm (10 percent chance in any year) and larger storms. For the 2-Year storm the improvements offer significant flood crest reduction, particularly along Pine Run, where the reduction exceeds 2 feet in several locations along Virginia Drive. Figures 8 and 9 were developed by the CSC Project Team to demonstrate the impacts of the stormwater improvements on shrinking the extent of the floodplain and depth of flood within the Office Park boundaries, only. HEC-HMS results indicate that peak flows in this reach are reduced by as much as 40 percent (700 cubic feet per second) during the 2-Year storm.

The CSC Project Team also generated cross-section plots to demonstrate the flood crest reductions offered by the improvements. Figure 10, a sample of a cross-section along Pine Run, demonstrates how the improvements offer significant flood crest reductions during the 2-year storm, but not for 10- or 100-Year storm. Reductions in water surface elevation at all of the HEC-RAS modeled cross-sections along Pine, Rapp, and Sandy Runs in the Office Park are shown in Appendix C Table 1. For the 2-Year, 10-Year, and 100-Year storms, the mean stage reduction at these cross sections are 1.39 ft, 0.78 ft., and 0.53 ft., respectively with reductions as high as 3.75 ft during the 2-Yr storm. The elevation reductions for the 10- and 100-Year storm are significantly less than for the 2-Year storm because of the increased flow volume for the larger events. It is important to note that the proposed stormwater improvements do not offer significant flood crest reductions because the improvements do not provide enough storage volume to accommodate larger storm events. As a result, reaches of Pine Run and Rapp Run in the Office Park vicinity would

continue to be severely flooded by 10-Year with inundation depths continuing to exceed 5 feet in many sections along Virginia Drive, Delaware Drive, and at the Pennsylvania Turnpike Interchange during the 100-Year storm (see Figure 12 in Section 4).

Figure 8 - 2-year Floodplain and Flood Depths before Improvements



Map Prepared by Center for Sustainable Communities, Temple University Ambler, PA, July 31, 2008

Figure 9 - 2-year Floodplain and Flood Depths after Improvements

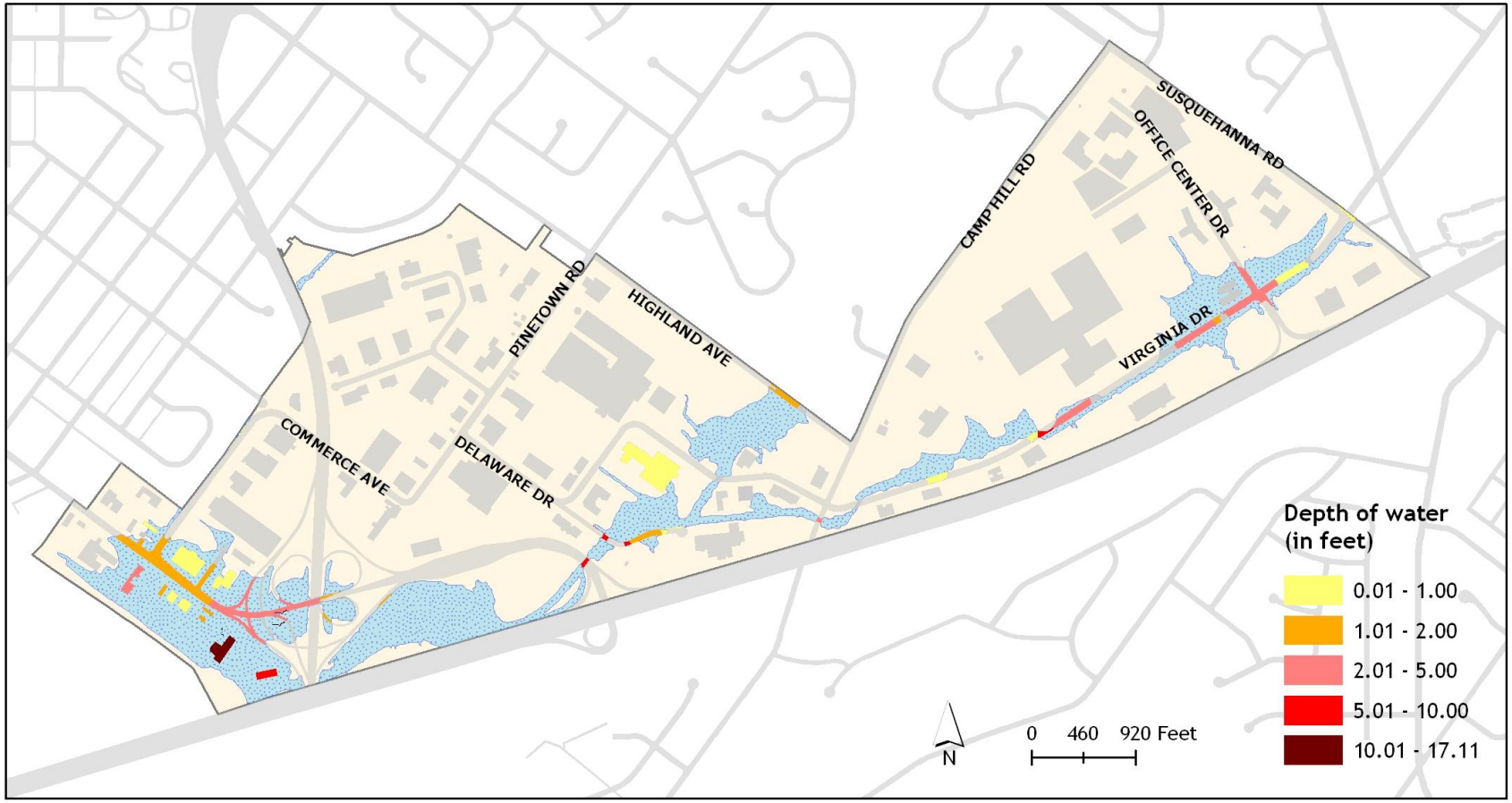
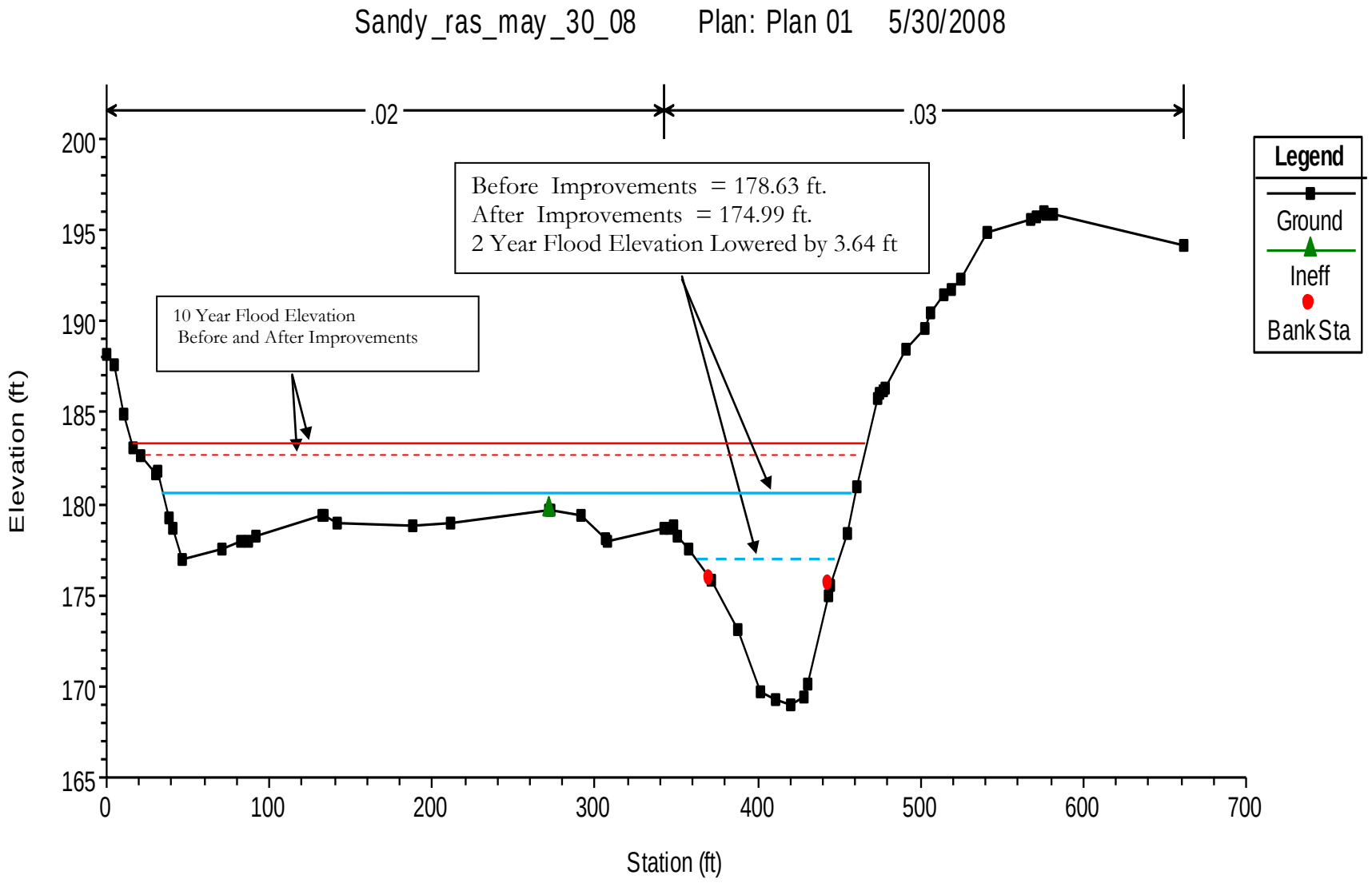


Figure 10 - Sample Cross Section of Flood Crests



Recommendations and Costs

The estimated new detention storage for each recommended stormwater facility is included in Appendix C Tables 2 - 3. For reaches identified for potential location of dams higher than 3 feet, storage estimates and costs assuming both a 3 ft. dam height, and a conceptually designed larger facility are listed in the tables. The results of the engineering analysis for larger structures are discussed in Appendix C under the subheading 'Sandy Run Watershed – Detention Dam Analysis '. With the larger structures in place, the total combined additional storage provided by all facilities during the 2-Year storm would be approximately 260 acre-ft in the Pine Run and Rapp Run watersheds, with about 170 acre-ft of this total provided by the six detention facilities.

Costs of the potential stormwater improvement facilities in Pine Run and Rapp Run watersheds were estimated and included in Tables 2 and 3. The total cost of the highlighted improvements in Tables 2 and 3 for Rapp and Pine Runs is estimated at $28,159,800. This figure includes six large detention dams that were conceptually designed in lieu of small check dams where significant storage could be provided by the larger structures. If these six dams were replaced by the smaller check dams, the total cost would be reduced to $17,362,200. However, this would significantly reduce the additional available storage and the reduce potential reduction in the aerial extent and elevation of flooding during the 2-Year flood and smaller events. If the six larger detention facilities are included in the total project, two thirds of the costs ($18,794,000) are targeted towards the Pine Run sub-watershed. The balance of the costs ($9,365,800) is directed toward the Rapp Run sub-watershed. While there are improvements that can and should be implemented in the Sandy Run and Bodenstein Creek sub-watersheds, such improvements are not highlighted in this report because their effectiveness would be negligible for addressing the flood problems in the Office Park.

4 OFFICE PARK REDEVELOPMENT PLAN

Introduction to the Redevelopment Plan

The CSC Project Team's approach to deriving recommendations for redeveloping the Office Park, first and foremost was guided by the constraints and opportunities revealed by the new floodway and floodplain maps as well as the estimated reductions in flood hazard areas stemming from proposed stormwater improvements. The study also included an office space market study (Appendix D) to identify important national and regional trends to guide the Office Park's future. The CSC Project Team then analyzed the redevelopment opportunities within the Office Park guided by a set of principles (listed below), which were derived from the Charrette Workshops that the CSC Project Team conducted in November 2006 (see Appendix E), drawn from the literature on sustainable development and low impact development, and gleaned from a case study analysis of sustainable office park redevelopment (see Appendix F).

- to reduce flooding risks to persons and properties
- to improve connectivity within Office Park and with community
- to restore the ecological functions of the natural environment while providing for public amenities
- to enrich the sense of place

Flooding Risks within the Office Park

As noted earlier, the CSC Project Team developed new floodway and 100-year floodplain maps for the Sandy Run Creek Watershed. Figure 11 on the following page presents a view of these within the Fort Washington Area. Following this is Figure 12, which shows the depth of flood for the 100-year storm. A map showing the depth of flood after stormwater improvements was not developed for the study because the reductions in flood depth were marginal for the 100-year storm, see discussion in Appendix C. These figures demonstrate the stormwater improvement analyses' conclusion: during heavy storms large expanses of Virginia Drive would be submerged under several feet of water as well as buildings within the 100-year floodplain. The CSC Project Team also took into consideration the growing evidence[1] linking increases in global climate trends (recent and projected) with increases in heavy and very heavy storm events in the northeast and in other

[1] Recent scientific studies documenting the link between global climate change increases in the intensity of precipitation events include: Global Climate Change Impacts in the United States a report prepared by the National Oceanic and Atmospheric Administration, July 17, 2008; Climate Change 2007: Fourth Assessment Report of the IPCC, prepared by the International Panel on Climate Change, 2007; and 'Atmospheric Warming and the Amplification of Precipitation Extremes' by R.P Allan and B.J. Soden in *Science Express*, August 7, 2008.

geographic regions across the globe. Therefore, to reduce the risk of flooding to persons and properties within the Office Park, the CSC Project Team recommends implementing all of the stormwater improvements identified in Appendix C and decommissioning development (buildings and major roadways) sited within the 100-year floodplain.

Figure 11 - New Floodplain Map - Fort Washington Office Park Area

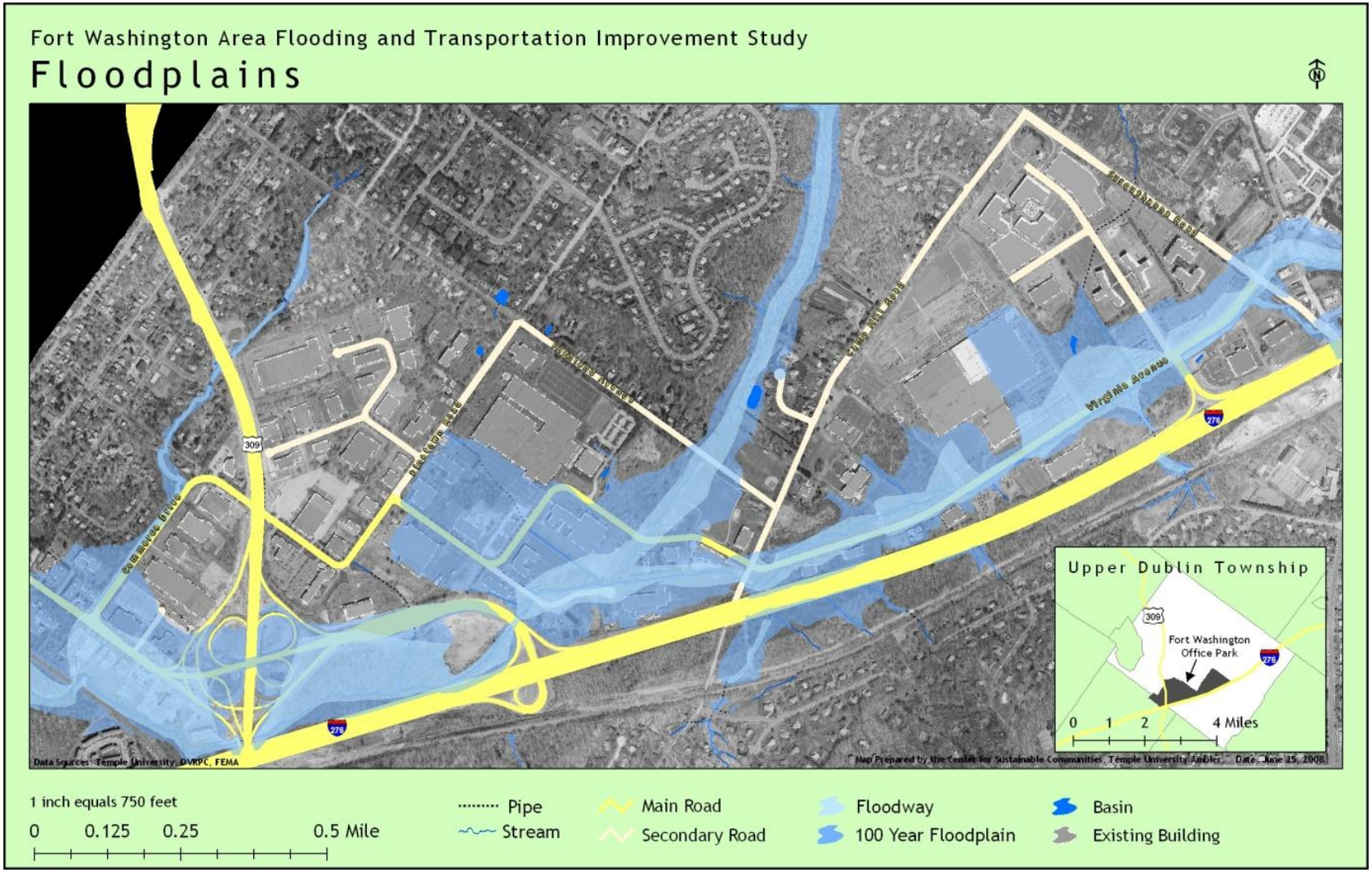
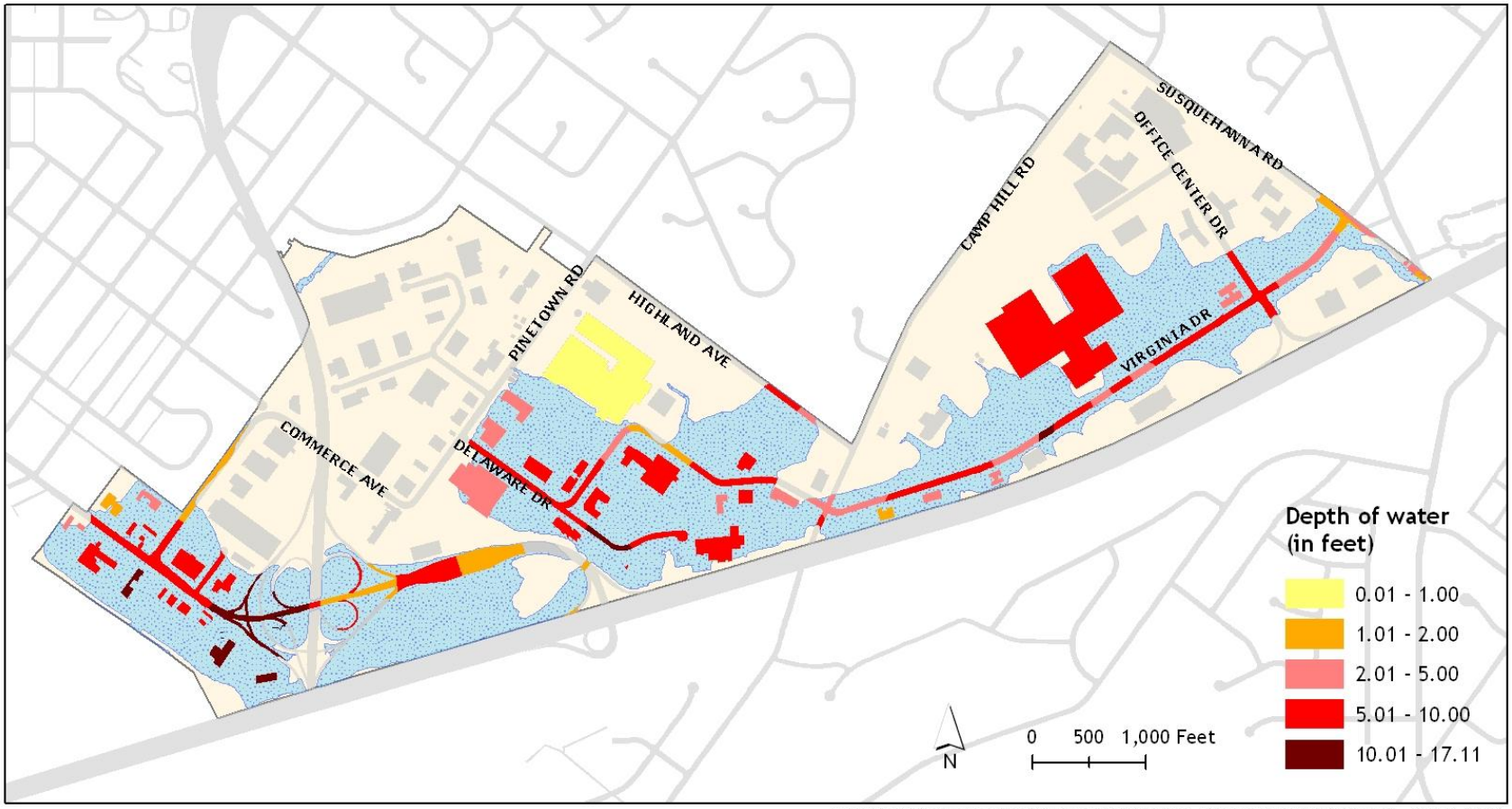


Figure 12 - 100-year Floodplain and Flood Depth within Office Park



Map Prepared by Center for Sustainable Communities, Temple University Ambler, PA, July 31, 2008

Market Study

The following summarizes the key findings of the office market study (see Appendix D), which assessed the Office Park's current conditions, the current regional market, the Office Park's position in the regional market and office space development trends as well as identified recommendations for improving the Office Park's position in the regional market.

Current Position within the Regional Market

Although the Office Park is situated at an advantageous location -- at the crossroads of PA 309 and the Pennsylvania Turnpike, it ranks at the bottom of suburban Philadelphia submarkets for Class A office space. In spite of the improvements made in recent years by Liberty Property Trust and Brandywine Realty Trust, two of the major developers in this region, the Office Park is simply not competitive with other more attractive suburban office centers that also have prime location advantages such as along the US 202 Corridor, within close proximity to the PA Turnpike, or near adjacent to the PA76 and PA476 interchange. These suburban office parks usually have much better amenity packages to offer and they don't have the well-known flooding problems that beset the Office Park.

Office Market Development Trends

There are several important regional and national trends shaping the future of office park development. The most important of these trends is mixed-used development, which provides a range of benefits. The three most common uses in mixed use developments are office, retail and residential. According to a study prepared by the Urban Land Institute, rental rates in mixed-use developments are as much as 25% higher than in traditional office space developments. Other benefits of mixed-use development include more efficient use of land and infrastructure, attractiveness to investors, enhanced connectivity with community and reduction in auto dependency.

Other important trends in office market development are "green design" and flexible design and space. The trend toward "green design" is catching on widely now, not just because of concern for the environment but also because with rising energy costs. As reported in the June 2008 issue of *Urban Land*, green builders and financial investors consider building green a must when building Class A office space today (see Appendix D). Building designs that maximize savings make "bottom line" sense. As high-tech energy-efficient buildings become a larger share of the inventory of office space, customers will seek them in order to reduce their operating cost. Because technology and

business practices are changing rapidly, long-term investment in a property is most attractive when adapting it to new needs is relatively easy and inexpensive. As a result, flexibility in design is an important aspect of a building's marketability. Businesses locating to an office park are seeking the ability to expand or decrease office space or otherwise modify an existing location to accommodate changes as their business model changes. Zoning codes that encourage such flexibility in land uses and densities can facilitate accommodating these business needs. Finally, the most recent trend impacting office space development in the region is increasing demand for centrally located office space. The Philadelphia Central Business District is showing somewhat surprising strength in a weakening economy. The proximity of a wide mix of uses and a dense transit network already in place to serve commuters to Philadelphia's Center City have already encouraged some businesses to shift back into the city.

Recommendations

The necessary starting point to successfully improve the market value of the Office Park is to develop a new vision. The vision should identify the desired mix of uses and locations to enhance not only the economics of the Office Park but also its connection to the broader community. The Office Park already has a number of the types of uses found in successful office/mixed-use developments, such as LA Fitness, three academic institutions, and a daycare facility; however, these mixed uses were located without a guiding framework and may be sited at less than optimal locations. In addition, the auto-oriented scale of development within the Office Park is becoming more of a drawback due to the benefits of mixed use development and current increases in transportation costs. Therefore the vision should also encourage pedestrian-oriented and pedestrian-scaled development, good sidewalk systems and enhanced transit service. The Office Park could capitalize on the most recent market response to increasing motor vehicle transportation costs by improving its connections to the SEPTA regional rail station and bus routes thereby making it more attractive to developers and businesses locating within the region. Finally, the vision should seek to capitalize on the growing commitment to build green. The market is already placing a premium on "green office" buildings. As energy costs continue their inexorable rise, more prospective tenants and building owners will demand energy-efficient buildings. Redevelopment of the Office Park presents the opportunity to renovate some existing properties and to construct new buildings incorporating new "green" technology.

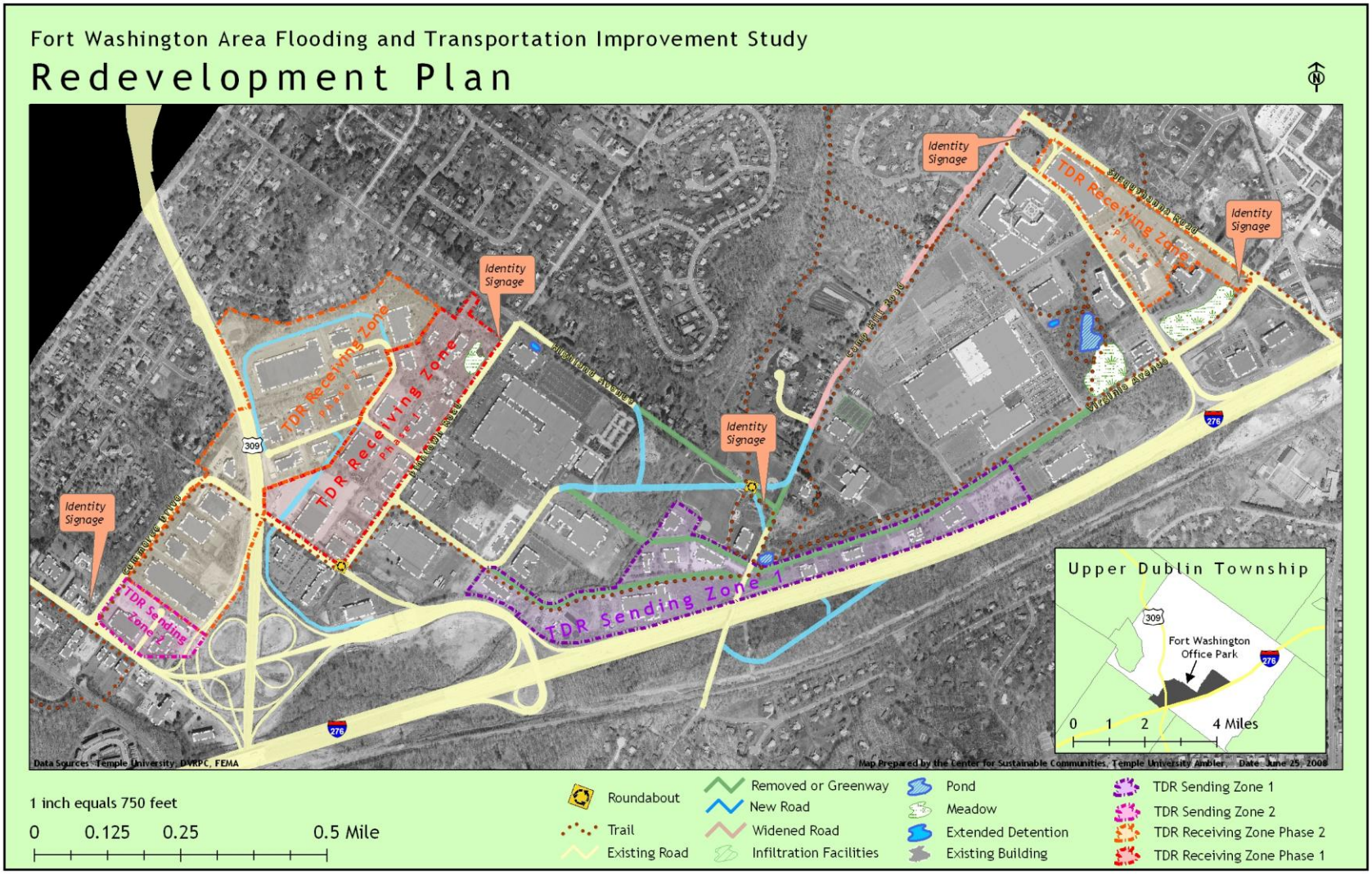
The Redevelopment Plan

The redevelopment master plan shown in Figure 13, see next page, was developed first and foremost with the goal of reducing flooding risks to persons and properties. As shown earlier in this report, significant investment in stormwater management improvements will have a real impact on reducing the flood risk within the boundaries of the Office Park during a 2-year storm event; however, they will have a modest impact during more extreme storms. Because the upstream improvements did not result in a significant reduction in the risk of flooding during large storms, the focus of the redevelopment plan emphasizes reducing flooding risks by reducing the location of persons and development (properties and roadways) in areas having a high risk of severe flooding. The recommended redevelopment plan is based on this premise and thus incorporates decommissioning parcels and segments of roadways that were identified through the stormwater analyses as having a high risk of severe flooding.

The remainder of this chapter highlights the proposed recommendations on how to achieve this lofty goal while improving the long-term economic viability of the Office Park, its connectivity with the community as well as internally. The recommendations are comprised of six key components in addition to the stormwater management recommendations stated above:

- Transportation Improvements
- Transfer of Development Rights
- Mixed Use Development
- Open Space Improvements
- Additional Recommendations

Figure 13 - Fort Washington Office Park Redevelopment Plan



Transportation Improvements

As noted earlier, the transportation analysis was based on an integrated approach that was based on the outcomes of the floodplain remapping and stormwater improvement analysis as well as on evaluations of internal and external roadways conditions and connectivity. The recommendations presented herein summarize the recommendations of a Transportation Study (see Appendix G) that was conducted as part of this study. Appendix G also includes a discussion of all alternatives evaluated such as elevating Virginia Drive to reduce flooding risks.

Internal Roadways Improvements

The analysis of improvements to internal roadways evaluated improvements to Virginia Drive – a roadway known for flooding, Camp Hill Road, and circulation improvements to New York and Maryland Avenues to support the proposed mixed use development in the transfer of development rights receiving zone.

- **Virginia Drive**

The primary transportation improvement involves decommissioning Virginia Drive from its eastern extent at approximately the entrance road to the GMAC complex as far west as the vicinity of 500 Virginia Drive. As noted earlier, this recommendation is based on results from the stormwater analysis that show Virginia Drive as having a high risk of frequent flooding in excess of several feet.

Decommissioning Virginia Drive would involve relocating the major circulation route to a higher elevation – Camp Hill Road. To achieve this, we propose widening and reconfiguring Camp Hill Road as a four lane roadway. A landscaped median is recommended to provide an attractive boulevard for safety of pedestrian crossings. This new roadway is highlighted in yellow on Figure 13.

In the western portion of the Office Park, Virginia Drive will be realigned to improve the flow of traffic by reducing the number of 90 degree turns and to create a smooth transition to the proposed realigned Camp Hill Road. A portion of the realigned Virginia Drive near Rapp Run would be elevated on pilings to avoid flooding. Highland Avenue would be relocated to intersect Virginia Drive at a 'T' intersection, improving the connectivity to the Office Park and avoiding its crossing of Rapp Run, which is subject to flooding.

The decommissioned roadways would be turned into Upper Dublin Township park space providing a greenway for the Cross-County Trail and other recreational uses supporting the ecological functions of the floodway.

- **Camp Hill Road Bridge**

A bridge is proposed for Camp Hill Road to improve the safety of this roadway during flood events. The bridge would serve to elevate Camp Hill Road above floodwaters in the vicinity of the floodway and floodplains at the road's current intersection with Virginia Drive. It would ensure continuity of local circulation during flood conditions.

- **New York and Maryland Avenue**

Improving circulation in the area of the Office Park served by Maryland Avenue, New York Avenue and New Jersey Drive is essential to the success of the mixed-use development proposed to be located in these environs. Currently, this portion of the Office Park is isolated and remote because there are many dead-end roads. The proposed improvements involve extending New York/Maryland Drive south to intersect with Commerce Drive east of the Route 309 overpass. This intersection would be signalized. This intersection would be signalized. It also would involve extending this roadway northward to intersect with Highland Avenue. A signal would not be required at this new intersection.

External Roadway Improvements: Slip Ramps to/from the PA Turnpike

New slip ramps to and from the PA Turnpike are recommended to improve connectivity to external roadways. A slip ramp after the Fort Washington Interchange Toll Booth serving both east and west bound traffic is proposed to provide direct access to the proposed mixed use development area, which will become the core of the western portion of the Office Park. In addition, an on/off EZ Pass only slip ramp is proposed for eastbound Turnpike users at Camp Hill Road to improve access to the central and eastern portions of the Office Park. The following provides brief descriptions of these transportation improvements and Appendix G offers more detailed analyses.

- **Slip Ramp at the Turnpike's Fort Washington Interchange**

Adding access to the Office Park from the Fort Washington interchange will provide more convenient access to the Office Park. The recommended new road alignment would allow vehicles exiting the Turnpike from both directions direct access to the Office Park. The new entrance would follow the Route 309 entrance ramp but would branch off to intersect Commerce Drive directly across from the new intersection proposed for New York and Maryland Avenues at Commerce Drive.

- **Slip Ramps at Camp Hill Road**

Eastbound EZ Pass slip ramps to Camp Hill Road would improve access to the central and eastern portion of Office Park. The most feasible design would be a two-way ramp from Camp Hill Road meeting the Turnpike to the east. The ramp intersection with Camp Hill Road would be designed to allow entry from and exit to the north only (direction of Office Park). The on ramp would intersect Camp Hill Road at the same location; southbound traffic on Camp Hill Road would turn left onto the on-ramp. The road configuration and circulation recommendations are intended to minimize the traffic impact on the residential portions of Camp Hill Road.

Transfer of Development Rights

The recommendations of this study are designed to contribute to a stronger, more ecologically and economically viable Office Park. But buildings and roadways within the remapped floodway and 100- and 500-year floodplains creates a significant challenge, because eighteen existing office park parcels are wholly or partially located within the floodway where mitigation efforts will have a marginal affect in reducing the risk of serious flooding and property damage and another ten

parcels lie within the 100-year floodplain and are also at high risk of repeated flooding. The most appropriate strategy for minimizing those risks is to set aside properties at greatest risk for repeated, serious flooding for uses such as passive recreation where flooding, when it occurs, will not put property or lives at risk. Property owners have made substantial investments in these parcels, however, based on prior assessments of risk that are no longer applicable. They have a legitimate interest in obtaining compensation for the value of their property and investments at the same time the municipality and other office park property owners have an interest in converting those areas from office and light industrial uses to uses appropriate for a floodway.

Our recommendation to address these conflicting goals is to use a program for transferring the development that has occurred on parcels at greatest risk of repeated, serious flooding to other parcels within the office park that are located on higher ground. Such a program could help remove structures and development from the areas at highest risk of flooding while compensating property owners for part of their investments. This recommendation builds on traditional "Transfer of Development Rights" (TDR) programs that have used market transactions between willing sellers and buyers of development rights (also referred to as development credits) to preserve open and agricultural spaces in 32 states. Two notably successful programs are located nearby, in the Pinelands of New Jersey and in suburban Washington D.C.'s Montgomery County (see Appendix H). A traditional TDR program is based upon a transparent public process that designates *sending zones*—where preservation of important natural, agricultural, or historical resources is desired and development rights or credits are *sold* for use elsewhere—and *receiving zones*, areas that can absorb more residential, commercial, or industrial development than is normally permitted by zoning regulations via the *purchase* of development rights. A municipal or public-private institution acts either as a facilitator of the buying and selling of development credits or as a development credits bank, purchasing them up-front and holding them until such time as willing buyers step forward.

The TDR program proposed for the Fort Washington Office Park would differ from traditional TDR programs in two important ways. Because the development rights in most cases have *already* been exercised—that is, buildings have been constructed and used as places of business—the transfer of development rights associated with parcels in the floodway is more complicated than in a traditional TDR program. Selling the development credits in these circumstances would only be a first step that must subsequently be followed by the demolition of existing buildings and infrastructure and the conversion of the parcels into passive recreational uses.

This program would also differ in that the development credits to be transferred would undergo a conversion from square feet of development tied to existing zoning regulations to square feet of development transferrable to the receiving zone with a new set of zoning regulations facilitating mixed-use development. The land uses predominant in the sending zones (primarily office space, with a small amount of municipal and light industrial), therefore, would be converted to development credits that could be used in the receiving zone to develop a variety of land uses—office space, hotel/convention space, small commercial establishments, restaurants, and light industrial—without being directly tied to the previous use in the sending zone.

To get started, we recommend that Upper Dublin Township and the Fort Washington Office Park community create a TDR program by establishing a working group of township representatives, office park property owners, and local residents to define the procedures of the program. The working group should select, and work in collaboration with, real estate and legal experts knowledgeable about local business conditions and TDR requirements. Tasks will include defining the specific objectives of the TDR program as one element of the redevelopment of the Fort Washington Office park, establishing precise boundaries of TDR sending and receiving zones within the office park, and creating a development rights bank, managed by the township, the Fort Washington Office Park Business Alliance, or both working together, to facilitate the transfer of development rights between office park property owners.

- **Sending Zones**:

We recommend that the sending zones be designated in the areas marked Sending Zone #1 and Sending Zone #2 in Figure 9. Both sending zones are made up of parcels that are largely located within the floodway, have experienced repeated, serious flooding incidents in the past 50 years, and remain at significant risk of major flooding events in the future. Parcels in Sending Zone #2 are exposed to additional risk because they are completely inaccessible when Virginia Avenue is flooded. Approximately 500,000 square feet of building space are currently located in these zones (approximately 140,000 in sending zone #1 and 360,000 in sending zone #2). Because mitigation strategies cannot significantly reduce the risk of serious flooding in a floodway, these parcels are best redeveloped for passive recreational uses as part of the 17.5-mile Cross-County Trail, currently under development by the Montgomery County Planning Commission working in collaboration with Upper Dublin and other county municipalities.

Eight parcels located along the south side of Pennsylvania Avenue between Commerce Drive and Route 309 are within neighboring Whitemarsh Township's jurisdiction, not Upper Dublin's. Though it would make management of the TDR program more complicated to include parcels from two separate municipalities, it makes sense ecologically and economically to include these Whitemarsh Township parcels within the TDR program.

- **Receiving Zones**:

Receiving zones should be designated for development in two phases. The Phase I Receiving Zone (see Figure 10) should fully absorb the half-million square feet of existing building space currently located in the two sending zones. At present, approximately 500,000 square feet of office, light industrial and retail space are located within the Phase I Receiving Zone, but at full buildout as proposed in the Mixed Use Development Conceptual Plan, described below, more than 2 million square feet could be constructed.

We are also recommending the designation of a Phase II Receiving Zone for this TDR program. The feasibility of implementing a second phase would depend on the successful implementation of Phase I and residual demand for mixed use development within the Office Park. There are two areas included in the Phase II Receiving Zone. The first of these areas (see Figure 9) includes properties contiguous to the Phase I Receiving Zone. Successful build-out in the first phase might warrant nearby expansion of higher intensity, mixed-use development on properties where current zoning regulations would not permit building footprints larger than 11,000 square feet per acre and building heights above four stories.

The second area designated in the Phase II Receiving Zone is located at the opposite end of the office park, along Susquehanna Road between Camphill Road and Virginia Avenue. This area is already largely built out with building footprints and heights at allowable maximums. As the office park redevelopment process evolves, there may be sufficient interest in redeveloping existing parking lots, parking decks and buildings into a variety of land uses at higher heights, coverages, and densities to support the purchase of additional development credits.

In the Phase II Receiving Zone, development above currently allowable limits (parcel coverage and buildings heights) would be tied to the purchase of development credits valued at a similar level to those purchased for development during Phase I. They would not, however, be directly based on the half million square feet of developed property in Sending Zones #1 and #2 (which ideally would be exhausted in Phase I). The proceeds of sales of Phase II development credits would be banked by the municipality to establish funds for use in demolition of obsolete buildings and infrastructure and construction of the Cross-County Trail segment within the Fort Washington Office Park.

- **Valuation and Management of Development Rights**:

In this TDR program, we suggest valuing and transferring development rights in units of 1,000 square feet of non-residential use. There are currently about 500,000 square feet of existing non-residential structures in Sending Zones #1 and #2 which would convert to 500 units of development credits. As a first step, the valuation process would focus on establishing the value of units of development credits to be transferred from the two sending zones to the Phase I Receiving Zone. The established value would remain the same for Phase II; however, the number of units made available would need to be based on current market conditions regarding demand for additional mixed use development as well as costs to convert the properties in the sending zones into passive recreational uses. Valuation of each unit of development credits and establishment of the legal procedures and management of the development rights bank will require review by real estate and legal experts who will be able to establish appropriate rates per development credit and effective management procedures for selling and buying development credits.

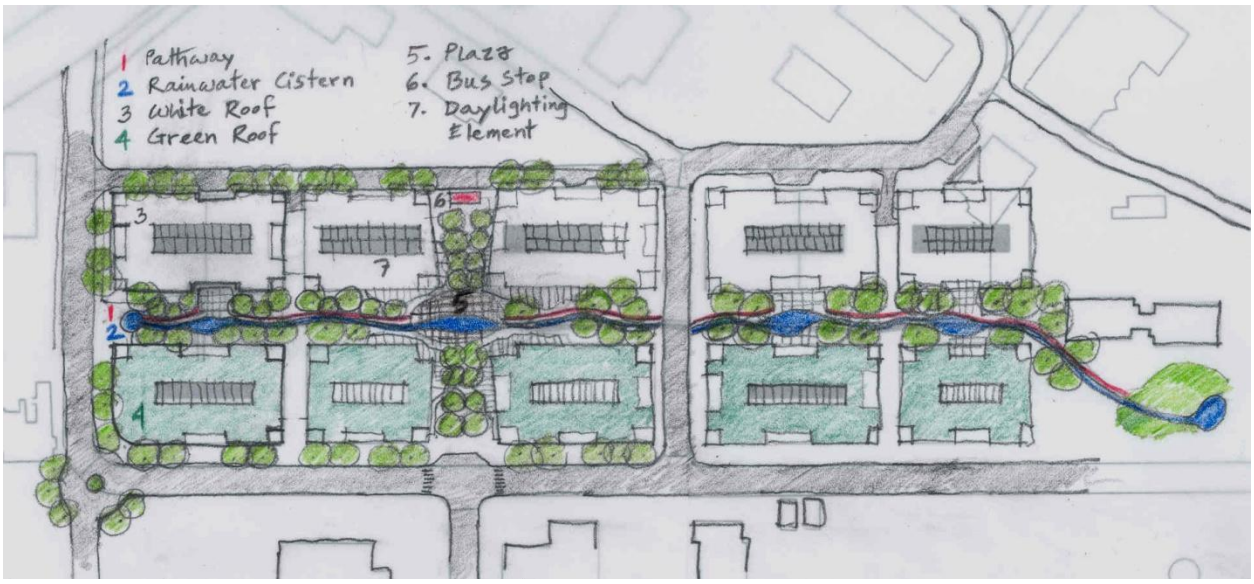
The sale of Phase I development credits would compensate Sending Zone area property owners for the development value of their parcels. Funds for demolition of existing buildings and infrastructure, and costs associated with the redevelopment of properties in the floodway could be funded through proceeds from a Phase II sale of development credits as described above as well as a variety of other sources: municipal and county resources, and federal grants for floodplain management.

Mixed Use Development Conceptual Design for Receiving Zone 1

The goal of incorporating mixed use development within the Office Park in the TDR Phase I Receiving Zone is to create an aesthetically natural, walkable, public-transit oriented place to work with minimal flood risk through innovative land-use and green design principals. A conceptual plan of a mixed used development for the Phase I Receiving Zone is provided in Figure 14 on the following page. A secondary goal is to increase the density, height and uses of buildings while maintaining the existing character of the Office Park. This was a goal expressed during the Charrette Workshops conducted as part of this study. It is important to note that incorporating mixed use development in the Office Park is consistent with intent of the Upper Dublin Zoning Code, Employment Center District Article XVI EC (§ 255-101).

The proposed conceptual plan for mixed use development in the Phase I Receiving Zone provides for increased building density along Pinetown Road/Commerce Drive by constructing new buildings and adding additions to small buildings and infilling between existing buildings. New construction would unify the architectural character along the road, while maintaining the established distance from the road. The number of floors in buildings along the Pinetown Road/Commerce Drive corridor would vary from two to four stories. The sidewalks would be widened and featured with benches, trees, plants, and other street furniture. No parking lots or structures would be permitted in this space.

Figure 14 - Mixed Use Development Conceptual Plan



Taller (up to six stories) and larger buildings would be located along the next row of buildings behind the Pinetown Road/Commerce Drive buildings allowing for more square footage, integrated parking, and access to daylight. Additional daylighting within the taller buildings would be provided by incorporating an atrium in each building core. The taller buildings would incorporate a variety of uses in addition to office space on the ground floor. For example, the ULI study discussed in Appendix D, found that hotel and retail/entertainment space (including restaurants) respectively had very strong and strong synergy with office space. Parking should not detract from the density of mixed uses at the pedestrian level and therefore would be located on the next two building levels followed by two or three levels of office space. The main density of mixed uses is proposed at the near-center of the zone in the square shaped space (plaza).

The linear open space in between the two rows of buildings is intended to remain mostly natural and would include extended space for café's, shops, and other commercial services. This semi-natural and semi-paved space would be comprised of interconnected cisterns for water collection, trees, and plants to reduce the heat island effect and smaller hardscape areas with shade cover all served by ground floor areas of buildings that open themselves to the space via large expanses of glass walls/doors. The space would act as a pedestrian belt or corridor throughout the zone. This corridor would be well connected to the proposed bike path network and trail system discussed below.

A new road is proposed to run behind this second row of buildings to allow access to parking and reduce some of the impact of traffic on Pinetown Road/Commerce Drive. Ideally, the SEPTA bus service should have additional stops throughout this zone.

In order to develop this mixed use zone, the CSC Project Team proposes the following changes in building requirements listed in (§ 255-115):

- Reduce required minimum lot size to at least 0.5 acres, which would encourage smaller builders to do infill development and which would also require a creation of a zoning provision to allow owners to divide individual parcels into smaller lots for sale.
- In addition, reduce minimum setback, front, rear and side yard requirements.
- Reduce impervious surface coverage maximum to less than 30% to encourage building owners and new builders to incorporate in the design or retrofit; open space, impervious pavement and green parking and building design suggestions.
- Increase height restriction to six stories to create more buildable space in TDR Receiving Zone. Change 35ft height limit to 50 feet height limit for all other uses.
- Reduce gross floor area (6,000 sq ft per acre) to encourage builders to build up, instead of out, which would potentially reduce the number of 1 story box office spaces.

Open Space Improvements

The open space system envisioned for Office Park is a carefully designed space which serves as an amenity to owners, tenants and employees; as an asset to the community through greenway connections; and as a living system to infiltrate and trans-evaporate stormwater. Although, the Office Park has had a complicated relationship with stormwater – it has been a potent, dangerous and formidable force in times of excessive precipitation, this plan calls for a positive relationship with stormwater as demonstrated in the office parks reviewed in Appendix F. This plan emphasizes revegetating the site wherever possible to restore healthy functioning of the hydrologic cycle. Additionally, it calls for creating wet storage ponds and wet meadows as places to store and evaporate water back into the atmosphere. These ecosystems, with their associated plant and animal communities are interesting places for the business community as well as the residential community to experience and to explore. In built areas, such as shown in the proposed Mixed Use Development Conceptual Plan, the linear park/plaza incorporates stormwater in a more architectural way through fountains and sculptural treatments.

The designs for the open space improvements were guided by the following principles, which are reflected in each element of the proposed open space system.

- Recognizing stormwater as a resource through various aesthetic/functional treatments
- Restoring a semblance of ecological balance and diversity through replacing buildings and parking in the floodplain areas with native plant communities

- Establishing better connections with surroundings through paths and greenways emphasizing the separation of traffic wherever possible

The two key and distinct elements of the open space system include the Linear Park/Plaza as shown previously in Figure 14 - Mixed-Use Development Conceptual Plan and the Greenway, which will replace the decommissioned properties shown as TDR Sending Zone 1 and decommissioned sections of Virginia Drive (see Figure 13 – Fort Washington Office Park Development Plan). Other elements of the open space system such as the proposed Pedestrian Pathway System are not location specific but are recommended to be implemented throughout the Office Park.

- **Linear Park/Plaza**

The new linear park, shown conceptually in Figure 14, will be contained and framed by its architectural setting and must work in concert with it. The linear park is an ideal place for custom designed cisterns, rain chains, holding pools, reed beds, linear water features and other stormwater associated elements. There should also be a re-circulating fountain (operated with solar powered pumps) as a focal point for a plaza or outdoor dining area. Creative effects could include acoustical chimes activated by rain drops or sculptural downspouts cascading into small holding pools.

Figure 15 – Pedestrian Walkway with Cascading and Linear Pool, Nikko Japan

Photo by Daryl Carrington

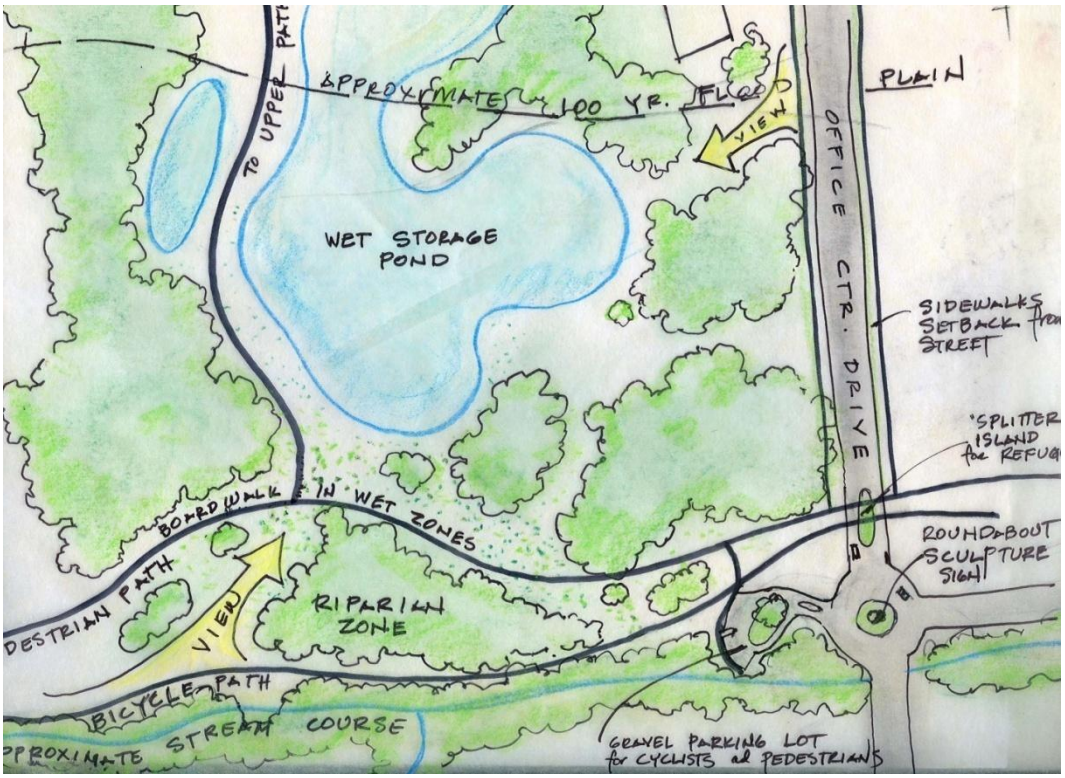
The pedestrian walkway in Nikko Japan, shown in Figure 15, is an example of how water can be incorporated into the plaza design providing an appealing amenity and an innovative approach to stormwater management. Appendix F provides additional information on how contemporary office parks treat stormwater in creative ways.

Various types of porous pavement could be incorporated, including zones of sturdy porous concrete or asphalt for heavily trafficked plazas. Colored patterns could be incorporated into this type of pavement. Where there is less traffic, decomposed granite or other fine crushed stone will provide a soft, resilient surface for walking that is also permeable.

In addition, careful attention to detailing will be necessary in the design of the linear park/plaza to ensure that the space will fulfill its potential as a richly textured, appealing plaza. Trellises or deciduous trees should be incorporated for shade on hot summer days and for their ability to reduce air conditioning costs of adjacent buildings. Lighting should be incorporated to extend the use of the plaza/park beyond daylight. Light fixtures should be integrated with other design elements, such as within walls, steps, paving or ramps so as not to stand out as independent objects in the landscape. Fiber-optic cable or neon cable could be incorporated for special effects. Ideally, furnishings such as tables, chairs and benches should be moveable rather than anchored providing flexibility and giving individuals autonomy over the setting.

- **Greenway**

Figure 16 – Greenway Conceptual Design



As noted earlier in this report, the CSC Project Team is recommending de-accessing a section of Virginia Drive and corresponding properties within the 100-year floodplain and restoring the 100-year floodplain with an vegetated greenway. Figure 16 presents a conceptual design of a portion of the greenway at its eastern most extension and Figure 17 highlights how the greenway would be designed to include separate pedestrian and bicycle paths. The previously developed landscape will be restored to its natural state: a riparian woodlands. This will include the restoration of natural features such as a wet meadow adjacent to a wet storage pond. Both will provide ecological functions as well as serve as a visual amenity to the office park. The storage pond(s) will be included to capture stormwater from parking and driving surfaces, allowing settling out of some pollutants and their absorption by plant roots in the new wet meadow area prior to flowing to Pine Run. Pavement within the greenway zone should accommodate flooding. For example, boardwalk made of recycled plastic could be used for the pedestrian path where it passes through the riparian wet meadow zone south of the proposed wet storage pond area. Parking for recreational cyclists, walkers and others using the greenway is provided as a gravel parking lot just west of the new traffic circle terminating Virginia Drive. The new circle is envisioned to be an identifying feature for the office park, with sculpture and sign or icon at its center. Also shown in the conceptual plan is a secondary path connecting the greenway to the existing greenway along Camp Hill Road. This greenway should be designed to connect with the proposed Cross County Greenway as well as with the linear park/plaza envisioned in the Mixed Use Development Conceptual Plan.

Figure 17 – Sketch of Greenway and Paths

- **Pedestrian Pathway System**

A pedestrian path system is envisioned as a potentially vital link in this vast, fragmented landscape. It appears that portions of such a path have already been built. For example, a wide concrete path occurs along Virginia Drive in front of the GMAC building and an asphalt path has been built along Camp Hill Road. Narrower sidewalks also occur in various stretches of the major roads within the Office Park; however sidewalks are intermittent and do not add up to a well connected pedestrian pathway. A complete path system should be built which has a coherent scale and design that would be immediately perceived by drivers, bicyclists and pedestrians within the office park. Coherence and visibility ensure greater safety for pedestrians because they provide strong visual cues to drivers and bicyclists. The path system can be used for pedestrian mobility within the Office Park as well as for recreational uses such as exercise during the lunch hour.

The path should offer a variety of landscape experiences and views yet have a consistent language of furniture (benches, signs and lights) to characterize the path as it moves through varied parts of the landscape. For example, it could take on the form of a boardwalk or mowed walkway through a wet meadow dotted with trees. In areas where it may link buildings, or of necessity intersect with parking lots, the walkway ought to be bordered with rows of tall shade trees whose trunks provide a feeling of separation and buffer from the cars, as well as, overhead canopy. In upland zones, a woodland character could be established such as the existing path adjacent to Camp Hill Road. The path within the greenway should include educational signs to provide some information on the natural qualities of the area, how it has changed over time and features of the new design which will restore ecological function (such as using native plants communities, infiltrating stormwater in ponds, swales and rain gardens). The path ought to be a porous material, preferably crushed aggregate or decomposed granite in drier zones, for resiliency and shock absorptive qualities as well as, porosity.

Pedestrian pathways should be set well back from streets. The set back can vary depending upon the use. Major thoroughfares typically require greater setbacks, for example, fifteen to eighteen feet is needed for pedestrians to feel safe and at ease along a four lane thoroughfare. (A sidewalk with a generous setback has already been built along Virginia Drive in front of the GMAC building. This sidewalk will remain as a pedestrian way.) A minimum of six feet is needed for adequate buffer along other streets. Shade trees should be planted between the automobile way and pedestrian or bicycle paths. These will provide shade to both the street and walkway and act as barriers shielding the pedestrians from traffic.

Where possible, the path ought to connect to surrounding neighborhoods and amenities. For example, safe pedestrian crossing to the Fort Washington Train Station should be created with pedestrian activated crossing lights, "no right turn on red" signs, bump – outs or islands to increase pedestrian refuge zones, pigmented and textured concrete, or other features serving as visual cues to both drivers and pedestrians. Additional consideration ought to be given to crossing Susquehanna Road to access shops, such as Starbucks, on the opposite side.

- **Separation of Traffic**

Different modes of transportation need to be separated for safety and ease of use. Pedestrians, bicyclists and autos should each have their own route with clearly marked and safe points of intersection with other modes. Bicycle (and other pedestrian "wheel" paths

should be designed where possible to separate individuals traveling in opposing directions. Each lane should be a minimum of 6 feet wide. The lanes can be separated by landscaped islands, or where necessary, by a narrow strip of landscape or simply a painted line. Wider separation is always safest. In "tight" areas a narrow, curbed island could be used to separate cyclists, roller bladders and skateboarders from pedestrians (see Figure 18).

Figure 18 – Separation of Pathways, Vancouver, British Columbia

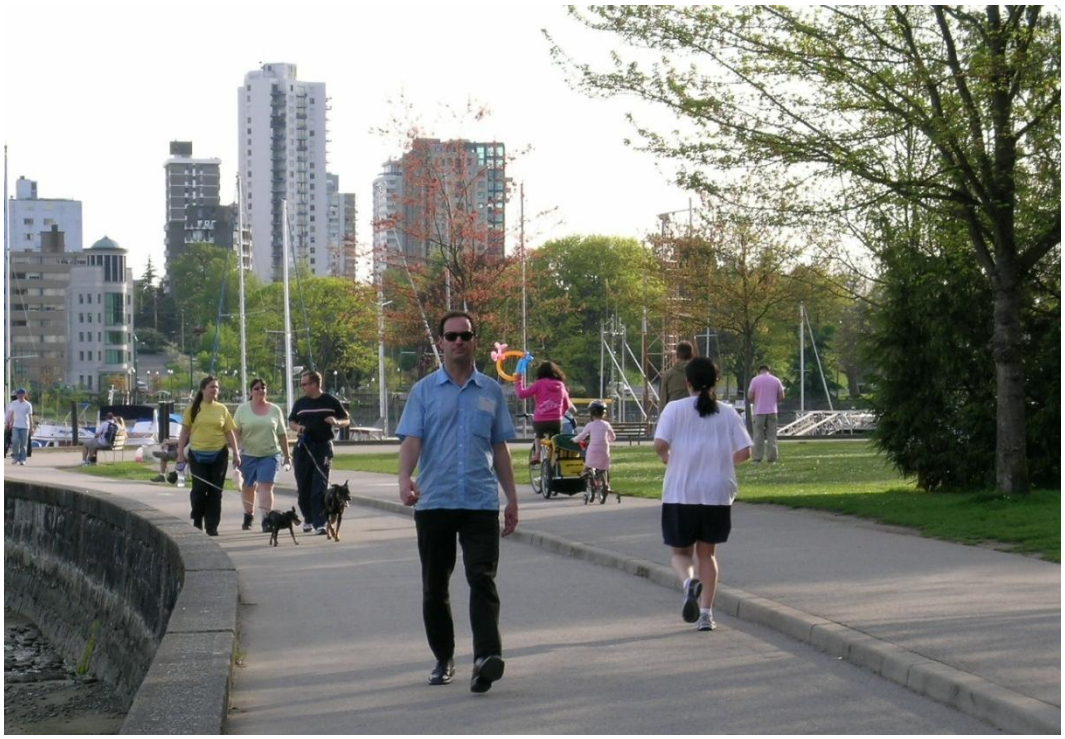


Photo by Daryl Carrington

- **Additional Open Space**

The GMAC building tiered parking lots present another opportunity to create an open space feature within the Office Park. The three tiers of parking lots all impervious surfaces contribute a large volume of stormwater runoff within the Office Park. The third tier of the parking lot does not appear to be used at all and could be transformed into a native woodland community which would be its natural evolutionary state. The second tier does not appear to be highly used and could either be reduced in size, portions replaced with vegetation or bio-infiltration beds added to better manage stormwater.

Additional Recommendations

The following are additional recommendations developed by the CSC Project Team for consideration in implementing the Redevelopment Plan. The recommendations provide sustainable development guidance for mixed use development in the TDR Receiving Zones. Other improvements addressed in this discussion include 'green streets', surface parking and a flood warning system.

The green or sustainable building movement is now ten years old and growing stronger every day. In order for the Office Park's redevelopment to be financially sustainable, it must be environmentally sustainable. Building tenants who rent space are increasingly looking for green office space and are willing to pay more for such space. The Co Star Group study (discussed in Appendix D) found that LEED buildings command premiums of $11.33/SF and $171/SF for rental and selling prices respectively. Since this is a long term plan for the Office Park, it is necessary to project five to ten years ahead. In ten years, sustainable design and construction will be the norm. The benefits of sustainable buildings are well documented: higher worker productivity, energy savings and increased lease rates, reduced insurance rates, and longer tenant occupancy than standard office space (Heschong-Mahone, Smartmarket report, USGBC).

The Leadership in Energy and Environment Design (LEED) is a rating system administered by the United States Green Building Council. While there are other systems out there such as Green Globes, the LEED rating system has quickly become the standard. This is evidenced by Montgomery County's recent GreenPrints (http://greenprint.montcopa.org/) plan that recommends that all county buildings meet LEED silver or higher standards. Other municipalities and government organizations are quickly adopting LEED as the barometer of green construction. LEED is helpful because it captures the holistic nature of sustainable building and frames the different sustainable strategies in a way that is easy to understand. From a marketing point of view, advertising LEED rated construction will help to bring more possible tenants. This has been the case at the Philadelphia Navy Yard, where one LEED platinum building (highest) rating has already been constructed and more are on the way. While there is a constant need to understand the additional costs of LEED certification such as commissioning, building simulation and registration fees, owners can rest assured that the return on that investment can come as quickly as three years or less.

Whether using a LEED or other rating system, the goals of sustainable building can be organized by 5 major themes: Sustainable sites; (which include stormwater management and control), water efficiency, energy efficiency; sustainable materials and construction practices; and indoor environmental quality. These categories are meant to be understood in a holistic context, where the achievement of one category may come at the expense of another. Cost is always a factor. Therefore, more work needs to be done to clearly set priorities for the sustainable characteristics for

this project. However, given this project's location and the amount of proposed hard surface, and the past history of flooding, stormwater management best practices should take the highest priority.

- Water

For this project, stormwater management and water efficiency can work together to mitigate the impact of run-off from buildings and impervious surfaces. It is necessary to note that the speed at which water leaves the building site is as important as controlling the quantity of water. The following should be considered as best practices for this project: 1) install vegetated roofs (30% of rain water evaporates back to the atmosphere), with the rest leaving the building site at a much slower rate. Vegetated roofs require minimal maintenance – weeding twice per year and watering during the first three months of installation. Some roofs come in tray form, which allows access to roof areas that may require access. Such roofs have been shown to increase the life span of typical rubber roofs by blocking unwanted UV light. Care should be given when proposing *extensive* (non-walkable) vegetated roofs on existing buildings due to a slight increase in structural capacity to receive the weight of the soil. Large cisterns should be installed below ground to collect and store remaining run-off from buildings to be used for irrigation purposes and toilet flushing for buildings. Pervious or porous paving and rain gardens are not recommended for the Office Park due to high water tables and saturated water conditions during storm events on nearby sites. Bioswales should be used to divert and mitigate run-off from pervious parking surfaces. This is covered in other sections of the report.

- Energy

As indicated earlier in the report, the larger buildings will be located behind a row of smaller buildings that front Pinetown road. The purpose of this layout is to insure adequate solar access for the office floors. These buildings should be designed to maximize daylighting while minimizing heat gain and glare in the summer months. The shapes of the buildings should be as thin as possible to allow daylight from the south to penetrate deep into the buildings, thereby allowing maximum daylight potential. In addition building roofs should be used for Photovoltaic and solar hot water where possible, although top priority should be given to vegetated roofs. Medium term energy efficiency goals for this project should seek at minimum a 14% better performance than standard code compliant buildings (LEED Silver rating requirement). Long term goals for Energy should move towards carbon neutral buildings that have net zero energy performance.

- Materials and Construction

There is increasing awareness that materials selection and construction quality have large impacts on the total carbon foot print of constructing a building. Selecting local materials will reduce the embodied energy consumption associated with travel and help to stimulate the local economy. Local builders should have demonstrated knowledge of sustainable construction via direct experience on sustainable projects or via certifications such as Green Advantage (www.greenadvantage.com) and LEED accredited professionals.

- Indoor Air Quality

Part of future marketing of the Mixed Use Zone will look at quality of life of the employees who will eventually occupy the buildings. Indoor air quality issues play a huge role in defining a sustainable project. Office workers will want access to increased amounts of fresh air via operable windows or increased air changes per hour. View to the outdoors and access to natural light are large drivers of sustainable architecture, leading to thinner floor

platforms, higher floor to ceiling heights and rearrangement of floor plans to eliminate perimeter offices that typically block daylight from entering deeper into the building.

Green Streets and Parking

The concepts of "Green Streets" and "Road Ecology" have gained momentum in environmental and transportation planning. Both are built on solid scientific studies that have documented the impacts of roads and other impervious surfaces on their surroundings and the effects in turn of the environment on them. The mutual effects involving water flows and impervious surfaces are particularly pertinent to the conditions that exist in the Fort Washington Office Park. The techniques developed by the proponents of "Green Streets" and "Road Ecology" to minimize the undesirable impacts of impermeable surfaces in a watershed and the damaging effects of stormwater on roadways, development, and natural features have been tried and tested. Many of these have been described in Appendix I. These are now considered "best practices" for the planning of transportation infrastructure, including parking facilities.

Some of these "best practices" are not likely candidates for general implementation in the Office Park. Because of the underlying flooding situation, high water tables and easily saturated soils these measures would yield little or no stormwater management benefits. For example, replacing impervious parking surfaces with permeable materials will not work in an area with a water table near the ground surface. The accumulated water would simply pond on the surface or percolate up. However, there are some areas within the Office Park where this strategy could make an important contribution to runoff control. Simply removing some of the over-supply of parking and narrowing the width of streets throughout the Office Park would likely yield noticeable improvements and at relatively little cost.

Other strategies such as planting street trees in tree wells at appropriate intervals along the streets within the Office Park might not make big differences in isolation, but, as part of a total stormwater management package, they could be helpful. Moreover, street trees would be a huge improvement to the Office Park in many other ways. Reduced heat effect is one benefit that could translate into lower air conditioning costs for Office Park tenants. In addition, the aesthetic improvement associate with "green streets" landscaping would help improve the Office Park's position in a highly-competitive regional office market.

The path toward a more diversified and compact Office Park is the most promising one for its revitalization and the one that offers the best opportunities for reducing the flooding. The following are strategies we recommend:

- Reduce paved surfaces of all large parking lots by 20 percent
- Redesign lots to include bio-retention basins within the islands between parking rows.
- Redesign drainage systems of lots to include more drains and/or direct runoff into on-site retention facilities.
- Convert all parking lots not in the floodplain or with known water table problems to permeable pavement.
- Reduce street widths to minimums necessary to handle existing traffic levels. (More through traffic in the Office Park should be discouraged. Where it is likely to increase because of outside connections, e.g., the PA Turnpike E-Z Pass slip ramps, consideration should be given to reducing the impacts of traffic and stormwater on the character of the Office Park).
- Insert linear detention basins in center islands on all streets wide enough to accommodate this measure.
- Insert street trees with tree wells at recommended intervals on all streets.
- Regrade slopes to direct runoff away from streets and parking lots (unless existing street and parking lot drains have proven adequate capacity) and/or construct swales and infiltration trenches to intercept some stormwater before it reaches roads and parking lots.

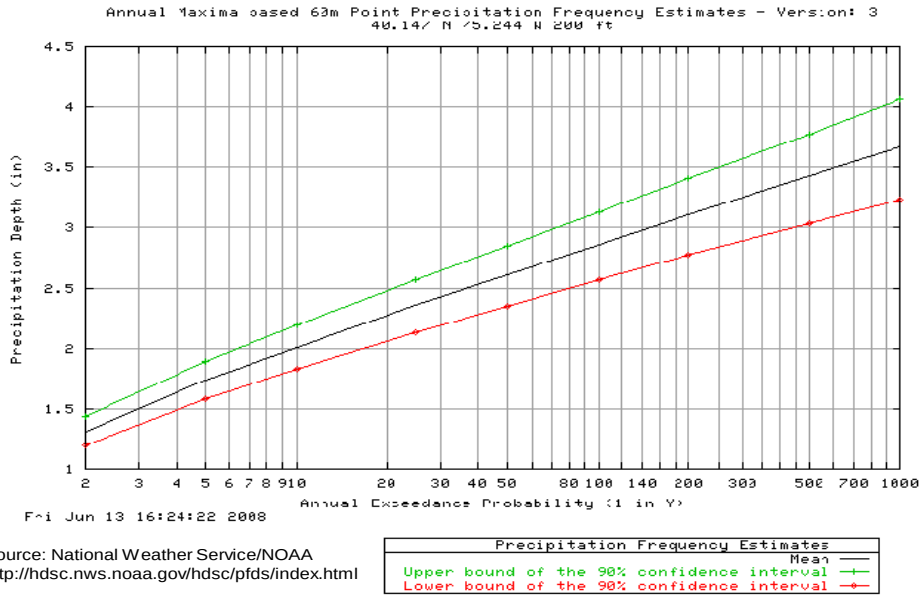
Flood Warning System

As a result of repeated flooding of the Office Park and subsequent flood emergency responses, Upper Dublin Township officials are familiar with and utilize the on-line flash flood warning products provided by the National Weather Service (NWS). Based on experience with past events, a rainfall intensity of two inches per hour has been cited by the township as sufficient to generate flooding conditions. Flooding can also occur under other circumstances depending on antecedent moisture conditions and season of the year, but rainfall intensity of two inches per hour would cause flooding at any time of year. This precipitation intensity can occur in all or part of the Sandy Run Creek watershed during local thunderstorms or during the passage of larger tropical systems. But it is a particular problem in the Office Park vicinity due to the traffic density and flooded roadway conditions. Based on information presented in NOAA Atlas 14 and shown in Figure 15, the chance for experiencing an event of this intensity is 16 percent in any given year (based on the upper bound of the 90 percent statistical confidence limit). To put this risk in perspective, the Office Park would have a 58 percent chance of experiencing such an event over the course of a five year period, and an 83 percent chance over a 10 year period, with multiple events possible. During flooding conditions, driving into submerged roadways presents the biggest single threat to the safety of drivers, passengers, and rescue workers. Upper Dublin Township has made numerous rescues of stranded vehicles and passengers during past flood events and has purchased special towing equipment for hauling vehicles out of floodwaters. Lack of compliance with

emergency traffic measures and the general lack of public knowledge concerning water depth and the susceptibility of vehicles to flotation continue to be problems.

In addition to the work by Upper Dublin Township to keep alerted of potential flood conditions, Montgomery County has been recognized as a StormReady community by the NWS. A StormReady community must establish an infrastructure for the rapid exchange of information between the NWS and the general public, and an on-going public information campaign must be conducted within the county or community to ensure that people know what action to take when a warning is issued by the NWS. (For additional information visit the National Weather Service Website: http://www.erh.noaa.gov/er/phi/stormready/). Local townships and boroughs are also eligible to participate in the StormReady program.

Figure 19 - NOAA Atlas 14 Exceedence Probability for 60 Minute Rainfall Events



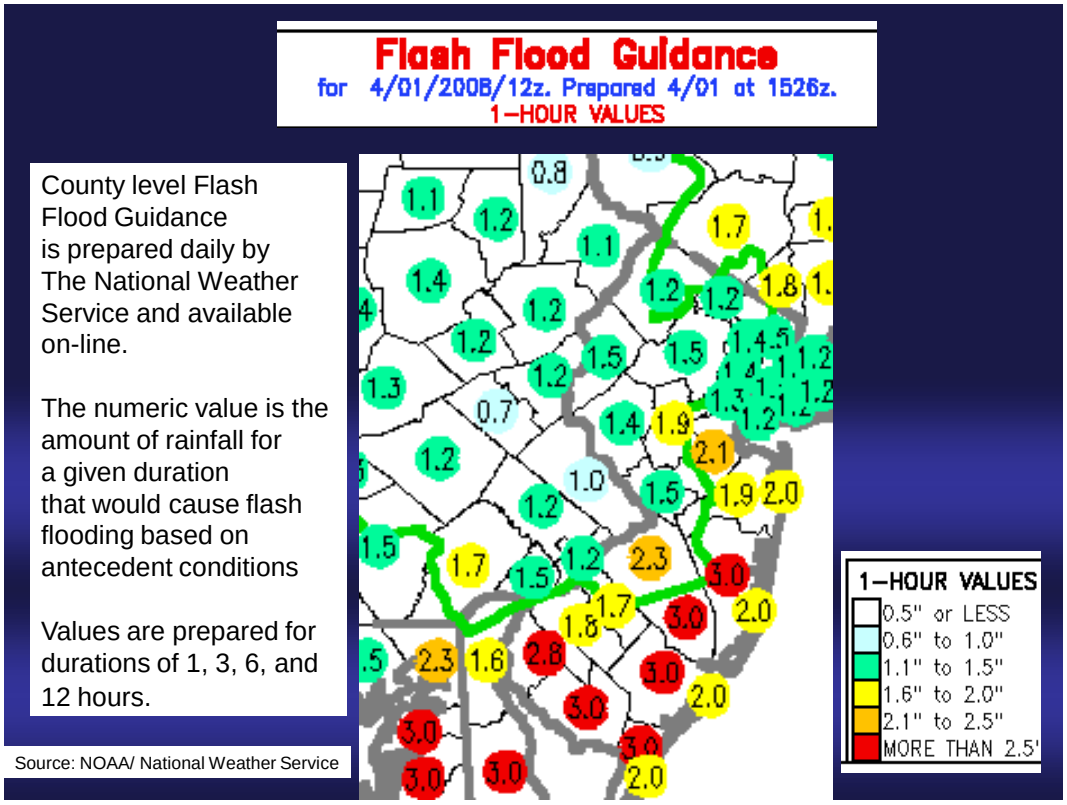
Source: National Weather Service/NOAA
http://hdsc.nws.noaa.gov/hdsc/pfds/index.html

The NWS has developed flash flood guidance products at the county level which are updated daily and available on-line at: http://www.erh.noaa.gov/marfc/Water/index.shtml#ffg. An example of a graphical product is shown in Figure 16. Using current information on hydrologic conditions at the County scale, the NWS calculates the quantity of rainfall that would be expected to cause flash flood conditions for rainfall durations of 1, 3, 6, and 12 hours. The NWS then tracks the accumulated rainfall using Doppler Radar (NEXRAD) and surface observations, and issues flash flood warnings if the guidance is exceeded by the actual precipitation. At the small watershed level, tracking of accumulated rainfall totals using on-line NEXRAD data or local rainfall gage data would

complement the NWS products. Software is available that smoothes NEXRAD images to easier interpretation of local accumulated rainfall.

Small urbanized watersheds such as Rapp Run, Pine Run, and Sandy Run Creek can flood quickly in response to heavy rainfall, and flood conditions near the Office Park may occur within a few hours of the start of an event. Accordingly, flood warning keyed to both precipitation and observed stream levels, coupled with an effective means of communicating emergency procedures and transportation route information is critical to public safety.

Figure 20 - Example of National Weather Service Flash Flood Guidance



The flood warning and response recommendations for the Office Park focus on Flood Warning Enhancement, and Public Communication. These are intended to improve flood warning lead time and support the appropriate response to flood events by the affected public. The public communication recommendations could be implemented regardless of the degree to which the flood warning enhancements are pursued. These recommendations include:

Flood Warning Enhancement Recommendations:

- Continue to track NEXRAD rainfall estimates against National Weather Service flash flood guidance products at the county and local level.

- To complement NEXRAD rainfall data, consider installing a total of three automated precipitation gages - one each in the upper portions of the Rapp Run, Pine Run, and Sandy Run Creek watersheds. The gages should meet National Weather Service specifications for equipment and telemetry so they can be used in the Weather Service gage network.
- At the automated rain gage sites, consider the co-installation of stream level alarms – one each in Rapp Run, Pine Run, and Sandy Run Creek, in order to verify flood conditions. The alarm receivers could be located at county and local emergency centers and Office Park floodplain buildings.
- Evaluate the feasibility of adopting the HEC-HMS model developed for Sandy Run Creek as a flood warning tool. Use of the model for this purpose would require calibration using observed precipitation and flood levels and installation of stream gages for calibration purposes in each of the three watersheds. Also required would be a designation of responsibility for maintaining and running the model as an emergency operations function.

Public Communications

- Establish an Office Park Emergency Information web site as a location for posting instructions related to flood watches, flood warnings, and emergency instructions during flood events, and for posting maps showing evacuation routes and routes typically closed during flooding. General information on flood warning products and vehicle safety could also be included.
- Establish an e-mail early warning notification network, activated at the county or local emergency operations centers, for announcing flood warnings or observed flooding conditions. E-mails could direct recipients to the emergency web site for detailed information.
- Evaluate use of the PA Turnpike Radio system as a means of warning turnpike travelers of flood conditions in the Fort Washington area.
- Use local cable television and news radio as an additional means of distributing flooding and road closure information.

Additional Considerations Relating of Flood Loss

- **Floodproofing Requirements for Non-residential Structures**
  Where proposed new or expanded non-residential structures are located in the 100 year floodplain, design criteria should be consistent with FEMA Technical Bulletin 3-93, "Non-residential Floodproofing – Requirements and Certification". The publication covers the design requirements for hydrodynamic, hydrostatic and impact loads on structures due to flooding.

- **Natural Hazard Mitigation Plans**
  Both Abington and Upper Dublin Townships have adopted Montgomery County's Natural Hazard Mitigation Plan and have received FEMA approval for federal disaster funding eligibility through August 2012. This plan must be reviewed and resubmitted for approval within five years to maintain eligibility for disaster funding under the Disaster Mitigation Act of 2000.

5 IMPLEMENTATION & COSTS

The implementation of the Redevelopment Plan can be achieved through a phased implementation approach. The first phase would concentrate on implementing the stormwater management improvements while additional studies were conducted such as the development of final designs for the transportation improvements, a real-estate assessment to determine a value for the TDR credits, and landscape studies to finalize the designs for the open space improvements. The second phase of the project would entail implementing the TDR program and mixed-use development plan, transportation improvements, open space improvements and remaining recommendations. A phased approach would provide the Upper Dublin Township with flexibility to assess the economic feasibility of the TDR program in light of the current real estate market slump. Please note that the cost estimates provided below are preliminary estimates for the stormwater and transportation improvements only and are subject to change based on the development of detailed design drawings, construction plans and specifications. Some of the transportation improvements require acquisition of right of way, which will result in additional cost beyond the construction cost. Details on the stormwater and transportation improvement costs are provided respectively in Appendices C and G.

Table 1 – Cost Estimate for Redevelopment Plan

Activity	**Cost**
First Phase	
Stormwater Management Improvements	$28,159,800
Second Phase	
Transportation Improvements	$40,540,000

Costs for the remaining phase two activities have not been estimated at this time because they are contingent upon a follow-up studies and other variables. For example, a real estate assessment of the properties within the TDR sending zones is needed to establish the value of TDR credits. Implementation of a mixed-use development scenario in the TDR receiving area could result in marginal costs to Upper Dublin Township if staff develop the zoning changes and oversee its implementation or in larger costs if planning, real estate and legal experts are contracted. Finally, the costs for the open space improvements would vary based on landscape design studies to develop the conceptual designs presented herein into final designs. For example, the cost to design and construct the proposed greenway is dependent upon conducting site investigations after demolition

to determine for example grading requirements and soil conditions. In addition, the greenway cost is highly dependent upon many design variables such as width, extent of riparian restoration, extent of woodland restoration, number of wet ponds, extent of dredging, selection of plantings, etc..

If during the first phase of implementing the Redevelopment Plan it is determined that it is not economically feasible to implement the TDR program and reasonable to delay the corresponding internal roadway improvements (e.g. Virginia Drive, Camp Hill Road Bridge, New York and Maryland Avenue improvements) and external roadway improvements in the immediate future, the CSC Project Team has devised and alternative implementation scenario. Although not the preferred implementation scenario, this approach provides the opportunity to implement the full Redevelopment Plan when market conditions rebound. This alternative would involve reconstructing Virginia Drive in its current location with a commitment to a higher level of maintenance to repair the road from the impacts of frequent and severe flooding. This alternative would require that all properties have access to periphery roads such as Highland Avenue, Pinetown Road and Camp Hill Road so that they could serve as emergency evacuation routes. The cost estimate for this alternative is based on the assumption that Upper Dublin Township would proceed with implementing the recommended stormwater improvements, which would reduce the frequency that Virginia Drive was inundated with floodwaters during routine storm events. Appendix G provides more detail on the Virginia Drive reconstruction and corresponding maintenance costs.

Table 2 - Cost Estimate for Alternative Implementation Scenario

Activity	**Cost**
First Phase	
Stormwater Management Improvements	$28,159,800
Second Phase	
Virginia Drive Reconstruction in-place	$9,664,000