Beaverdam Branch Watershed
Blair County

Phase 1
Storm Water Management Plan
Scope of Study

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BEAVERDAM BRANCH WATERSHED
BLAIR COUNTY, PENNSYLVANIA
PHASE I STORM WATER MANAGEMENT PLAN
SCOPE OF STUDY

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I. INTRODUCTION

Storm Water Runoff - Its Problem and Its Solutions

The water that runs off the land into surface waters during and immediately following a rainfall event is referred to as storm water. In a watershed undergoing urban expansion, the volume of storm water resulting from a particular rainfall event increases because of the reduction in pervious land area (i.e. natural land being covered by pavement, concrete, or buildings). That is, the alteration of natural land cover and land contours to residential, commercial, industrial and even crop land uses results in decreased infiltration of rainfall and an increased rate and volume of runoff.

As development has increased, so has the problem of dealing with the increased quantity of stormwater runoff. Failure to properly manage this runoff has resulted in greater flooding, stream channel erosion and siltation, as well as reduced groundwater recharge. This process occurs every time the land development process causes changes in land surface conditions.

History has shown that individual land development projects are often viewed as separate incidents, and not necessarily a part of a "a bigger picture." This has also been the case when the individual land development projects are scattered throughout a watershed (and in many different municipalities). However, it is now being observed and verified that this cumulative nature of individual land surface changes dramatically effects flooding conditions. This cumulative effect of development in some areas has resulted in flooding of both small and large streams with property damages running into the millions of dollars and even causing loss of life. Therefore, given the distributed and cumulative nature of the land alteration process, a comprehensive (i.e., watershed-level) approach must be taken if a reasonable and practical management and implementation approach and/or strategy is to be successful.

Pennsylvania Storm Water Management Act (Act 167)

Recognizing the need to deal with this serious and growing problem, the Pennsylvania General Assembly enacted Act 167. The statement of legislative findings at the beginning of the Pennsylvania Storm Water Management Act (Act 167), sums up the critical interrelationship between land development, accelerated runoff, and floodplain management. Specifically, this statement of legislative findings points out that:

1. Inadequate management of accelerated runoff of storm water resulting from development throughout a watershed increases flood flows and velocity, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and storm sewers, greatly increases the cost of public facilities to carry and control storm water, undermines floodplain management and floodplain control efforts in downstream communities, reduces groundwater recharge, and threatens public health and safety.

2. A comprehensive program of storm water management, including reasonable regulation of development and activities causing accelerated runoff, is fundamental to the public health, safety and welfare and the protection of the people of the Commonwealth, their resources and their environment.

Before the enactment of Act 167, storm water management had been oriented primarily towards addressing the increase in peak runoff rates discharging from individual land development sites to protect property immediately downstream. Minimal attention was given to the effects on locations further downstream (frequently because they were located in another municipality), or to designing storm water controls within the context of the entire watershed. Management of storm water also was typically regulated on a municipal level, with little or no designed consistency between adjoining municipalities in the same watershed concerning the types, or degree, of storm runoff control to be practiced.

Act 167 changed this approach by instituting a comprehensive program of storm water planning and management -- on a watershed level. The Act requires Pennsylvania counties to prepare and adopt storm water management plans for each watershed located in the county, as designated by the Pennsylvania Department of Environmental Resources (DEPARTMENT). Most importantly, these plans are to be prepared in consultation with municipalities located in the watershed, working through a Watershed Plan Advisory Committee (WPAC). The plans are to provide for uniform technical standards and criteria throughout a watershed for the management of storm water runoff from new land developing sites.

The types and degree of controls that are prescribed in the watershed plan need to be based on the expected development pattern and hydrologic characteristics of each individual watershed. The management plan, specifically the standards and criteria, are to be developed from the technical evaluations performed in the planning process, in order to respond to the "cause and effect" nature of existing and potential storm runoff impacts in the watershed. The final product of the Act 167 watershed planning process is to be a comprehensive and practical implementation plan, developed with a firm sensitivity to the overall needs (e.g., financial, legal, political, technical, etc.) of the municipalities of the watershed, so that a common goal of area wide flood impacts management can be achieved.

II. BEAVERDAM BRANCH WATERSHED CHARACTERISTICS

General Information

The Beaverdam Branch Watershed encompasses approximately 87 square miles. As is illustrated in Figure 1, the vast majority of the watershed is located in west-central Blair County. Approximately one square mile, or roughly one percent of the drainage area lies in Gallitzin Township, Cambria County. The watershed is contained within ten municipalities, nine of which are located in Blair County.

The watershed encompasses that area of land contributing runoff to the Beaverdam Creek from its origins to a point where the creek flows into the Frankstown Branch of the Juniata River. The following are the major tributaries to Beaverdam Branch:

Blair Gap Run	Gillans Run	Spencer Run
Brush Run	Mill Run	Sugar Run
Burgoon Run		

B L A I R C O U N T Y

DESIGNATED WATERSHED NO. 1

WATERSHED OF THE BEAVERDAM BRANCH [OF THE FRANKSTOWN BRANCH] OF THE JUNIATA RIVER

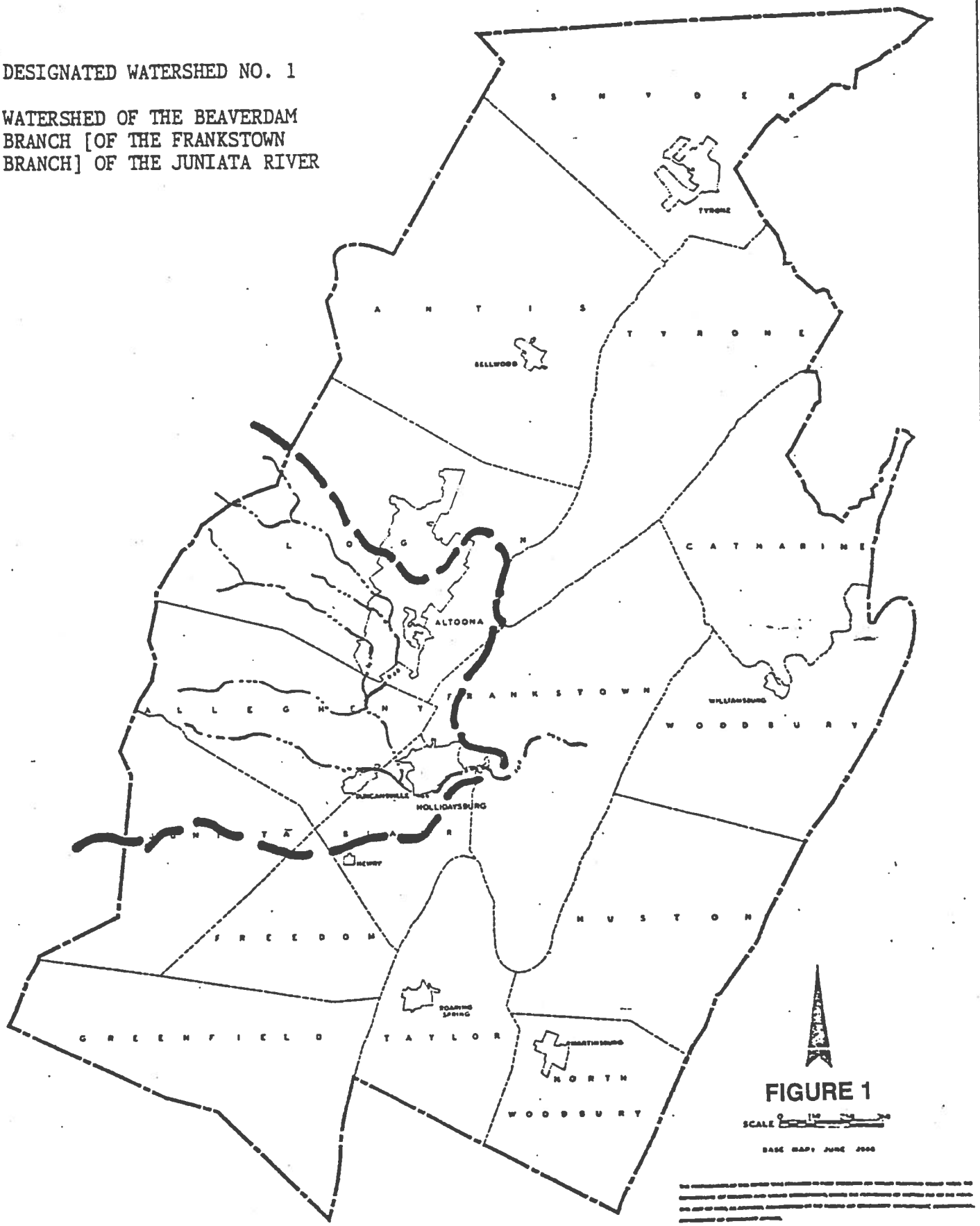


FIGURE 1

SCALE

BASE MAP: JUNE 2000

BLAIR COUNTY - PLANNING COMMISSION

Statistics relative to the municipalities lying within the watershed are provided in Table 1 below:

TABLE 1
GENERAL MUNICIPAL STATISTICS

Municipality	Watershed (acres)	Percent Watershed Area in Municipality (%)
Allegheny Township	18,500	33.1
Altoona City	4,084	7.3
Blair Township	2,570	4.6
Duncansville Borough	250	0.5
Frankstown Township	1,914	3.4
Freedom Township	135	0.2
Hollidaysburg Borough	1,217	2.2
Gallitzin Twp. (Cambria Cty.)	744	1.3
Juniata Township	10,016	17.9
Logan Township	16,534	29.5

Basic Data Sources

There are no continuous record stream flow gauging stations in the watershed. A miscellaneous United States Geologic Survey (USGS) stream gauging site is located 2.2 miles upstream from the mouth of the watershed where the tributary area approximates 83 square miles. "Miscellaneous" sites are defined as locations at which occasional discharge measurements are made, usually when water quality samples are collected.

Two partial record USGS coal-hydrology network stream gauge sites are also located in the watershed. These sites measure flows in Sugar Creek in Altoona, and Blair Gap Run near Foot of Ten. This network was discontinued in 1981. A "partial record" station is a site where limited stream flow data are collected systematically over a period of years for use in hydrologic analyses. Unlike a continuous type water-stage recorder, a partial record station has a crest-stage gauge which records the peak stage (discharge) occurring between inspections of the gauge. Thus, if required, data from this station can be used to compare the flood peaks of the modeled hydrographs produced during Phase II to reported peaks as a calibration method. However, these gauges cannot be used to calibrate the time distribution of modeled hydrographs. Information describing the USGS gauges is presented Table 2.

An investigation of the impact of combined sewer overflows in the Little Juniata River and the Frankstown Branch of the Juniata River was completed by the Altoona City Authority in 1983. The Beaverdam Branch was included in this investigation. Data which appears to be available as a consequence of that effort include water quality measurements, stream flow velocity information, stream flow information and simultaneous precipitation data for several locations within the watershed. This information may be useful in model calibration.

TABLE 2
USGS STREAM GAUGES IN THE WATERSHED

GAUGE NAME	USGS ID NUMBER	DRAINAGE AREA (SQ MI)	RECORD PERIOD
MISCELLANEOUS SITE			
Beaverdam Branch at Hollidaysburg	01555858	83.0	1982 & 1989
PARTIAL-RECORD SITES			
Sugar Run near Altoona	01555849	N/A	Through 1981
Blair Gap Run near Foot of Ten	01555855	N/A	Through 1981

There is a National Oceanographic and Atmospheric Administration (NOAA) precipitation gauging station located near the mouth of the watershed in Hollidaysburg. This is the only station capable of providing long term precipitation data for the watershed. These data are available from the National Climatic Data Center in digital form and will be useful for model calibration and historic rainfall distribution analysis purposes.

In addition, the previously referenced combined sewer overflow investigation included the collection of short term precipitation data at several locations in the vicinity of the watershed. These data may be a useful supplement to the long term NOAA data.

An excellent source of general watershed information and a detailed inventory of stream obstructions is contained in a report titled the *Beaverdam Drainage Basin Study* prepared by the Blair County Planning Commission in 1973. This document promises to be a valuable source of information (pending verification) of stream obstruction geometry and general watershed characteristics information. Additional hydrologic information concerning the watershed is available in several reconnaissance / feasibility studies performed in regard to flooding problems in the Lower Frankstown area.

Soils information for the Beaverdam Branch Watershed can be obtained from the county soil survey published by the U.S. Soil Conservation Service. No digital soil survey data is currently available.

Topography

The topography of the watershed is properly described as mountainous. The western portion of the watershed is comprised of a long precipitous ridge of soil and rock known as the Allegheny Front. In the east, the watershed is confined by the

southern extremities of Brush Mountain. The southern boundary is composed of Catfish Ridge, a series of hills extending from Hollidaysburg Borough westward until they merge with the Allegheny Front. Contained within these boundaries is a portion of the Logan Valley which extends into the northern areas of Blair County.

Hydrology

The Beaverdam Branch watershed is drained by the Beaverdam Branch of the Juniata River and its seven major tributaries. Blair Gap Run, which is fed by Dry Run, Blair Run and Adams Run originates in the heavily forested regions of the Allegheny Front. As the stream approaches its junction with the Beaverdam Branch, it receives runoff from agricultural areas and the urbanized area of Duncansville.

Gillans Run also originates in the dense forests of the Allegheny Front, above the Duncansville Reservoir. As Gillans Run flows toward the Beaverdam Branch, it drains the principally urbanized Maple Hollow area. Agricultural land use predominates as the stream merges with Blair Gap Run near Duncansville.

Spencer Run begins in and drains the sparsely populated upland portions of the Carson Valley in the Allegheny Front.

Sugar Run originates in the eastern slopes of the Allegheny Mountains near Gallitzin in Cambria County. Little development has taken place in this watershed and dense forests are the predominant land cover.

Burgoon Run, with its Glenwhite Run, Kittanning Run and Scotch Gap Run tributaries, provide a portion of the water supply for the City of Altoona and its suburbs via three reservoirs situated in the upper reaches of the watershed. It flows eastward from the Allegheny Mountains, through Logan Township and into the City of Altoona. Land cover within the area drained by Burgoon Run ranges from virgin forests to dense urban land use. The upper reaches of the Burgoon Run are affected by surface mining activities.

Mill Run also flows in a easterly direction into Altoona. Water from Mill Run is impounded in two reservoirs used for water supply and flood control purposes. Runoff from the heavily urbanized areas of Calvert Hills, Westmont and South Altoona contribute water to Mill Run. It is relevant to this study that combined sewers capture portions of the runoff from the urbanized area for transport to the Altoona wastewater treatment facilities.

Brush Run begins in the area of Altoona's East End. As the stream flows southward to its junction with the Beaverdam Branch, it receives runoff from the wooded western slopes of Brush Mountain and the suburban areas of Lakemont, Sylvan Hills and Hollidaysburg.

These major tributaries combine at various points in the watershed to produce the Beaverdam Branch which then flows to its mouth on the Frankstown Branch of the Juniata River.

There are a number of dams / reservoirs within the watershed which may have an impact upon wet weather stream flows and, consequently, watershed storm water management standards and criteria. The Pennsylvania Department of Environmental Resources' Bulletin No. 5 *Dams, Reservoirs and Natural Lakes* lists the following dams / reservoirs within the watershed:

- Blair Gap Dam, located on Blair Gap Run, with a drainage area of 3 square miles.
- Plain Nine Dam, located on Blair Gap Run, with a drainage area of 12.5 square miles.
- Lake Altoona Dam, located on Burgoon Run, with a drainage area of 11.2 square miles.
- Kittanning Point Dam, located on Burgoon Run, with a drainage area of 8.5 square miles.
- Lower Dam, located on Burgoon Run, with a drainage area of 9 square miles.
- Lakemont Park Dam, located on Brush Run, with a drainage area of 4.8 square miles.
- Storage Dam, located on Mill Run, with a drainage area of 7 square miles.
- Unnamed Dam, located on Gillans Run, with a drainage area of 1.4 square miles.
- Unnamed Dam, located on Baker Run, with a drainage area of 0.5 square miles.
- Blair Run Dam, located on Blair Run, with a drainage area of 7.3 square miles.
- Unnamed Dam, located on Kittanning Run, with a drainage area of 0.4 square miles.

Of these reservoirs, the large reservoirs on Burgoon Run, Mill Run, Blair Run, Blair Gap Run and Brush Run appear to have the capacity to significantly affect stream flows.

III. ACT 167 PLANNING FOR THE BEAVERDAM BRANCH WATERSHED

Given the above watershed characteristics, the watershed planning process for this study area must befitted to the watershed characteristics, as well as the resources (technical, political and economic) of this area. This section of the Phase I - Scope of Study presents the concept and approach that has been developed to fully meet these requirements, as well as the specific requirements of Act 167, for this watershed storm water management project.

Benefits of the Plan

The purpose and benefit of the study and implementation plan is to provide all of the municipalities in the watershed (in compliance with the requirements of Pennsylvania Act 167) with an accurate and consistent implementation strategy and procedures for comprehensive storm water management. Currently, not all of the watershed municipalities enforce storm water management regulations and, for those that do, actual enforcement criteria vary. Given the nature of storm runoff and its impacts, as described earlier in this document, a critical objective of sound storm water management planning is to provide for consistency of implementation requirements throughout the watershed. Therefore, the primary objective of the technical study and planning process is to develop a technical and institutional support document to encourage and/or support the consistency of regulations for implementation based on watershed-wide consideration.

The currently accepted watershed planning approach (technical and institutional) recommended by the DEPARTMENT also provides the municipalities of a watershed (in addition to the county) with a considerable amount of usable technical information, such as a detailed watershed runoff simulation model, that can be used for numerous other associated purposes for participating municipalities. Therefore, as a result of developing the primary product of the watershed planning effort (i.e. the implementation plan for local regulation of storm water runoff impacts), the participating municipalities, as well as the county, will realize benefits and/or products that are usable for other planning and engineering purposes.

For example, land use updates and environmental data management are functions that are necessary for effective planning in a watershed. The technical approach being proposed for the Beaverdam Branch Watershed Act 167 planning project will provide unique environmental database management benefits for not only the county, but also for municipal use. Another example of the associated benefits of an Act 167 watershed plan relates to basic public works and/or engineering functions, primarily at the municipal level.

In addition, technical support information, provided as a part of the watershed modeling effort, can be used by public works officials for bridge replacement and floodplain management analysis, design and regulatory permitting efforts. Further, the stream encroachment permit process, which involves the need to supply detailed stream flow data as a part of the application process, can be more efficiently and cost-effectively developed using the calibrated watershed model. Therefore, the benefits of the watershed planning process are wide-ranging, even beyond the important function of developing comprehensive storm water management strategies and ordinance provisions.

Approach for the Development of the Beaverdam Branch Watershed Plan

In order to implement watershed-wide comprehensive planning for and management of storm water runoff, it was necessary to take a very close look at all portions of the watershed for this Phase I study. Since the Act itself is very dependent on municipal coordination to provide for the total planning and management storm water throughout the watershed, it is necessary to get each municipality in the watershed involved in the planning process.

In order to identify the storm water problem areas and to initiate municipal level involvement in the overall development of the PLAN, a Watershed Plan Advisory

Committee and a questionnaire strategy is incorporated into the Phase I work approach for the watershed. The Watershed Plan Advisory Committee (WPAC) was formed by the COUNTY and consists of the required municipal and interested group representatives. The county held a WPAC meeting at the beginning of the Phase I planning process. A follow-up meeting at the end of Phase I is also scheduled. The following is the WPAC membership list.

AFFILIATION	WPAC MEMBER
Allegheny Township	Robert E. Koelle
Altoona City	Robert F. Hagemann, III
Blair Township	Richard P. Imler
Duncansville Borough	Helen M. Dell
Frankstown Township	Joseph A. Robeson
Freedom Township	John M. Harker
Hollidaysburg Borough	Thomas J. Fountaine, II
Juniata Township	Jack E. Walker, Sr.
Logan Township	Frank L. Noye
Concerned Citizens of Lakemont	Donald G. Lynn
Lower Frankstown Civic Association	Timothy Forr
Blair County Planning Commission	Cloyd F. Forsht
Soil Conservation Service	Larry C. Parvin
Blair Conservation District	Donna J. Fisher

The questionnaire is designed to solicit input from each municipality, relative to very specific problems in the watershed, as well as for the needs they may see for storm water management in their particular area. The questionnaire will be distributed, along with a summary of the purpose of Act 167 which includes an emphasis on Act 167 goals as they relate to this watershed (an example of the questionnaire package is included as Appendix A of this document).

Because the most important part of the Act 167 planning process is the actual implementation of the plan, another consideration in utilizing this questionnaire strategy for the Beaverdam Branch Watershed is the interest by the responding municipalities for the need and the desire to actively implement stormwater management measures within their community. A summary of the stormwater related problems and the identification of properties affected by flooding incidences in each municipality is an important product of the Phase I study.

A summary of problems reported in the questionnaires is provided in Table 3.

The overall evaluation of the questionnaire illustrates a very significant point. The results indicate that flooding is a significant problem in the Lower Frankstown area and that there are localized storm water problems at various locations throughout the watershed. Moreover, anticipated development is likely to threaten to increase the incidence, frequency and magnitude of flooding. Therefore, this watershed will realize significant benefits during the planning period because of the Act 167 Plan. Because there is so much room for growth and development in the Beaverdam Branch Watershed (and because this growth is being projected with some degree of confidence) the Act 167 Watershed Storm Water Management Plan for this area

may be the best example of a storm water impact "prevention" plan -- as is the true intent of Act 167.

TABLE 3
SUMMARY OF REPORTED STORMWATER PROBLEMS

Municipality	Number of Reported Problems	Number of Properties Affected	General Nature or Character of Problems
Allegheny Township	4	29	Obstructions and lack of effective maintenance of drainage ways.
Altoona City	8	9+	Undersized drainage systems, obstructions, lack of maintenance and excessive runoff.
Blair Township	0	0	No problems reported.
Duncansville Borough	0	0	No problems reported.
Frankstown Township	8*	150 -200	Excessive runoff, undersized drainage systems, obstructions and inadequate maintenance.
Freedom Township	0	0	No problems reported.
Hollidaysburg Borough	5	190	Most problems related to surcharging combined and sanitary sewers.
Juniata Township	0	0	No problems reported.
Logan Township	3	110	Excessive runoff, undersized drainage system, obstructions and lack of maintenance of drainage ways.

* Problems reported for Frankstown Township lie adjacent to the Frankstown Branch

As additional areas of the watershed will experience growth, the technical support basis for the standards and criteria developed in this initial planning project can be easily modified without invalidating the overall plan. The detailed description of the technical modeling activities, presented in the work step descriptions in the next section of this document, will provide more insight into the specific modeling approach to be used to accomplish this objective.

IV. PLAN PREPARATION STRATEGY

The PLAN will contain, at a minimum, the following items:

1. a survey of existing runoff characteristics in small as well as large storms, including the impact of soils, slopes, vegetation and existing development;

2. a survey of existing significant obstructions and their capacities;

3. an assessment of projected and alternative land development patterns in the watershed, and the potential impact of runoff quantity, velocity and quality;

4. an analysis of present and projected development in flood hazard areas, and its sensitivity to damages from future flooding or increased runoff;

5. a survey of existing drainage problems and proposed solutions;

6. a review of existing and proposed storm water collection systems and their impacts;

7. an assessment of alternative runoff control techniques and their efficiency in the particular watershed;

8. an identification of existing and proposed State, Federal and local flood control projects located in the watershed and their design capacities;

9. a designation of those areas to be served by storm water collection and control facilities within a ten year period, an estimate of the design capacity and costs of such facilities, a schedule and proposed methods of financing the development, construction and operation of such facilities, and an identification of the existing or proposed institutional arrangements to implement and operate the facilities;

10. an identification of flood plains within the watershed;

11. criteria and standards for the control of storm water runoff from existing and new development which are necessary to minimize dangers to property and life and carry out the purposes of this act;

12. priorities for implementation of action within each plan;

13. provisions for periodically reviewing, revising and updating the plan;

14. provisions as are reasonably necessary to manage storm water such that development or activities in each municipality within the watershed do not adversely affect health, safety and property in other municipalities within the watershed and in basins to which the watershed is tributary; and

15. consideration for consistency with other existing municipal, county, regional and State environmental and land use plans.

The concept and approach presented in the previous discussions has been organized into a set of following detailed tasks. These tasks include the above indicated 15 elements of the plan.

Task 1 - Project Initiation

This task covers the administrative work required to initiate the Agreement between the Department of Environmental Resources (DEPARTMENT) and the County, and to initiate selection of a Consultant and, upon selection, to initiate contracts between the County and the Consultant and to lay out a framework for the critical coordination aspect with the municipalities. Activities include defining the framework for accomplishing various elements of the PLAN as described in the

tasks 2 to 11, scheduling of time and defining the budget, progress reporting procedures and formats, and finalizing the work schedule. It will also include the preparation for and holding to the Phase II start-up meeting between DEPARTMENT, the Blair County Planning Commission and the selected consultant.

Project Team Responsibilities

-- Blair County Planning Commission -- responsible for overall administration of this task, including the finalizing of the Phase II Agreement with the DEPARTMENT and negotiating a contract with a consultant, the establishment of the project coordination roles and procedures, project scheduling and budget finalization, and the development of progress reporting procedures and formats.

-- Consultant -- will perform a support role to the COUNTY and will attend all necessary project initiation and planning meetings. Consultant shall also finalize a detailed budget and schedule for technical and institutional planning.

Anticipated Task Product

The anticipated product of this task will be a written summary of the notes and/or minutes of project initiation meetings. In addition, the finalized project work program, along with the associated budget and schedule, will be documented for review by the DEPARTMENT and for use as a project management guide. A project correspondence file will also be developed and organized and will be maintained throughout the total project duration.

Task 2 - Project Coordination/Public Participation Thru Watershed Plan Advisory Committee

Coordination efforts and/or activities will continue throughout the duration of the project and will be organized to include the necessary meetings with the County and consultant (anticipated to consist of one telephone progress and/or coordination meeting between the county and consultant per month and one onsite meeting between the county and consultant per quarter for the duration of the project.) A WPAC was established in accordance with Section 6 of the Act. The details of the WPAC including membership is included as Appendix D. Coordination efforts will also involve the reactivation of the Watershed Plan Advisory Committee (WPAC), notification to the members of the WPAC concerning meeting, preparation of Agenda and attendance record at the WPAC meetings. The WPAC membership list will consist of previously designated members. The purpose of the WPAC meetings will be to initiate the important and necessary municipal education process and data gathering efforts, including the preparation and distribution of the questionnaire for technical and institutional data. Additionally, the advisory role of the committee during the development of the plan is vital to the ultimate adoption and implementation processes. These meetings, being held at reasonable time intervals during Phase II, will promote the necessary involvement of the advisory group by contributing to the successful completion of this Act 167 effort in terms of the municipalities support and assistance in the adoption/complementation efforts. Included within the overall public participation program for the project will be the various education and training meetings for the WPAC to maintain critical municipal involvement and understanding of the project. The following describes

proposed WPAC and municipal training meetings and public hearing schedules including the purpose of each meeting.

WPAC Meeting Number	Purpose of Meeting	Meeting Schedule
1	Phase II Start-up Meeting - Introduce the municipalities to the Phase II planning process and establish the degree of critical municipal involvement needed throughout the study. Present the data collection questionnaire and request assistance in gathering the required information.	Beginning of the Project
2	To review the project status, the data questionnaire results and to solicit any additional comments/concerns from municipalities with respect to watershed data items.	Subsequent to Task 3 (Data Collection)
3	Institutional data review and analysis meeting - to review final ordinance matrix and introduce methods to incorporate plan provisions into existing ordinances. Also provide and discuss the basic DEPARTMENT model ordinance to begin to illustrate the kinds of changes the municipalities may have to make as a result of the Act 167 plan.	Subsequent to Task 4 (Institutional Data Preparation)
4	Present technical modeling results and identify/describe the storm runoff problems in the watershed, as well as the "cause and effect" analysis.	Subsequent to Task 7 (Model Runs)
	Present technical standards and criteria for the overall watershed and preliminary ordinance provisions for the municipalities (general and overall).	Subsequent to Task 8 (Development of Standards and Criteria)

WPAC Meeting Number	Purpose of Meeting	Meeting Schedule
5		
Individual Municipal Follow-up Meetings	Individual municipal meetings (with manager and engineer) to discuss specific application of the standards and criteria as well as recommended municipal ordinance provisions. Intensive question and answer session anticipated.	Following Plan Adoption
Public Hearing	Conduct the hearing required by Act 167 to present the final PLAN to the public.	
Training Session	Present a day-long discussion of standards and criteria implementation, discuss municipal actions necessary to comply with the plan, present municipal engineer procedures recommended by the plan.	Subsequent to Task 10 (Final Preparation)

Project Team Responsibilities

-- County will be responsible for the development of the coordination strategy for the overall project team (including documentation/reporting responsibilities for the WPAC and DEPARTMENT). Also will be responsible for identifying and finalizing the WPAC members, as well as for the necessary arrangements to hold the WPAC meetings, and reproducing necessary material.

-- Consultant - responsible for supporting the County in developing project coordination procedures and for providing guidance and input in the formation of the WPAC. Responsible for the preparation of WPAC meeting agendas and technical presentations (including graphics).

Anticipated Task Product

The product of this task will include correspondence and meeting notes/minutes from the WPAC meetings. In addition, the presentation materials prepared for the WPAC meetings will also constitute a defined product of this project.

Task 3 - Data Collection/Review/Analysis

This task will involve the necessary efforts to gather, review and analyze the required data to complete the technical and institutional planning steps for the Beaverdam Branch Creek Act 167 Watershed Storm Water Management Plan. The consultant and the Blair County Planning Commission will work jointly to collect data from county offices, municipalities, and local, state, and federal agencies that will aid in preparation of the PLAN. The data will consist of information concerning existing and future conditions in the watershed. All data collection activities will be limited to the gathering of available information from either the agencies that will be contacted or, more importantly, on the basis of the data collection questionnaire that will be provided to the municipalities (as well as selected agencies and organizations).

Data to be collected will include, but may not be limited to (and will be based on available information and/or questionnaire results):

- Comprehensive land use plans
- Existing Municipal ordinances
- Storm water related problems and proposed solutions
- Existing and proposed flood control projects
- Existing and proposed storm water control facilities
- Existing and proposed storm water collection and control facilities, including a designation of those areas to be served by storm water collection and control facilities within a 10-year period, an estimate of the design capacity and costs of such facilities, a schedule and proposed methods of financing the development, construction, and operation of such facilities and identification of the existing or proposed institutional arrangements to implement and operate the facilities, where this information is readily available.
- Soils
- Geology
- Flow obstructions
- Topographic mapping
- High Altitude Aerial photographs

-- Engineering and planning studies

-- Streamflow data

-- Floodplain information

-- Water quality data

It is anticipated that most of the information will describing the dimensions of stream obstructions will be extracted from the previously referenced *Beaverdam Drainage Basin Study*. Local governments will be consulted identify those obstructions which have been modified, eliminated and or added since the basin study was completed. The field survey will be limited those obstruction identified as having changed since the preparation of the reference report. The necessary field investigations will be accomplished to gather an/or confirm the data.

This task effort will also coordinate closely with the start-up WPAC meeting, which will involve the distribution of data questionnaires to the municipalities. In addition, a discussion of procedures to be followed in the completion of the questionnaires will be provided at the initial WPAC meeting.

This task also involves the review and preliminary analysis of the technical data that has been obtained for consistency and usability in the development of the final product -- i.e., the development of technical standards and criteria for storm water management. It also includes the review of the institutional data collected through the municipal data questionnaire process for consistency and usability in the final implementation plan. The analysis will, however, involve the identification of initially missing data and verify the availability to gather the missing items. Floodplain information will be gathered for areas where detailed Flood Insurance Studies (F.I.S.) are available, with alternate sources being explored for stream sections that do not have detailed F.I.S.'s. Municipalities which have detailed control engineering plans for proposed remedial measures are available from municipality, county or private agencies. A summary analysis and evaluation of those plans will be included in the storm water management plan. Where detailed plans are not available, preliminary recommendations relating to such measures will be provided.

<u>Project Team Responsibility</u>

-- COUNTY - responsible for the distribution and initial training associated with the municipal data questionnaire.

-- Consultant - responsible for assisting COUNTY with the preparation of municipal data questionnaires. Shall provide support for the actual data gathering and organizing efforts, as well as the preliminary review for consistency and content. Responsible for the review of gathered and organized data and the acceptability of the data, as well as for the preparation of a missing data list. Final responsibilities also include the final determination of data usability for the completion of the necessary technical and institutional planning efforts, as well as

for providing input and/or alternatives for the collection of missing data.

Anticipated Task Product

The product of this task will essentially include the information listed above, gathered and organized in such a way as to be usable for both short- and long-term watershed planning (including updates). A final data summary will be prepared that will identify and/or catalogue the collected data.

Task 4 - Institutional Data Preparation

This task involves the detailed evaluation of the municipal ordinances (gathered during the Task 3 data collection efforts) in order to prepare a municipal ordinance comparison matrix. This matrix is intended to display, for both the actual preparation of the implementation plan and also for the municipal education process, the current storm water management provisions in the various municipal ordinances for all watershed municipalities. The objective of the matrix is to easily and effectively see the similarities and differences, as well as the consistency/inconsistency, between the various municipal ordinances in the watershed. The matrix will be used, in the institutional analysis task (Task 9) to develop ordinance provision recommendations for the various municipalities that are based on the storm water management standards and criteria (identified in the technical plan) for the watershed. This matrix then serves the long-term implementation efforts by providing a convenient reference for the COUNTY to evaluate the individual changes to the various municipal ordinances that will be required as a part of the Act 167 watershed plan adoption process. Appendix B shows an example of a municipal ordinance matrix.

Project Team Responsibilities

-- COUNTY - responsible for providing insight and guidance to the consultant in the preparation of the municipal ordinance matrix.

-- Consultant - responsible for the preparation of the municipal ordinance provision matrix. Also responsible for the review of the completed municipal ordinance provisions matrix for consistency with the needs of the Task 9 institutional analysis and implementation plan development efforts.

Anticipated Task Product

The product of this task will be a completed matrix of storm water management ordinance provisions for the watershed municipalities which identify the current status of ordinance provisions as they relate to storm water management.

Task 5 - Data preparation for Technical Analysis

This task involves the engineering work necessary to transform the raw information collected in Task 3 into a form/format that can be directly used

for the later technical tasks in the overall planning program. A primary effort to be conducted as a part of this task is the preparation of the "land characteristics" information for modeling purposes. That is, this task effort includes the necessary map preparation efforts to develop land use, soils, and slope maps for modeling.

This map preparation effort involves the following:

-- Land Use/Land Cover Information - land use/land cover information will be derived from Landsat Thematic Mapper, National High Altitude Program (NHAP) imagery. Land use/land cover throughout the watershed will be classified into categories corresponding to those for which the U. S. Soil Conservation Service has developed rainfall/runoff relationships. The classified data will be processed using Arc/INFOtm and ERDAS tm Geographic Information Systems (GIS) analysis packages. The various land use/land cover types existing throughout the watershed will be presented on a basemap.

-- Future Land Use Conditions - the existing land development conditions (classified imagery) will be updated to also separately illustrate those areas that are projected for development within a 10-year planning period. These future land development areas will be separately and individually indicated on the base map for the purposes of future conditions modeling and planning.

-- Soils Information - the County Soils Survey maps will be modified and/or prepared to illustrate SCS hydrologic soils groups instead of individual soil types. These data will be digitized and incorporated into the GIS database to facilitate the cross referencing of land cover/soil group intersections required to determine rainfall/runoff relationships based upon U. S. Soil Conservation procedures.

-- Slope Information - U. S. Geological Survey Digital Elevation Models (DEM) for the Lewisburg 7.5 minute quadrangle will be obtained and incorporated into the Beaverdam Branch GIS database. This data will be used to assign slope category information to subareas for which detailed modeling will be completed.

Delineation of Subwatersheds

The watershed and subwatersheds will be delineated by the consultant on a base map at a scale of 1 inch equals 2,000 feet. Subwatersheds will be established based on the office data and results of the field reconnaissance task. This breakdown of the watershed by major tributary drainage courses and points-of-interest will be the basis for the hydrologic and hydraulic analysis.

The subwatersheds will be further delineated to subareas based on the following:

-- the location of existing problems, as identified by local officials in the municipal survey, during the field reconnaissance, or from data previously compiled in any previous studies such as water quality monitoring programs,

-- the location of major obstructions (primarily bridges), highway culverts, or storm water control facilities,

-- confluence points of tributaries, as deemed appropriate based on engineering judgement and good modeling practice, and

-- other points of interest, such as stream gaging or water quality monitoring stations, locations of water quality concerns, or outfall sections downstream of existing developments or where development could be anticipated to occur.

This task will also include the mapping of relevant watershed planning information onto a final watershed map. This mapped information will be selected from the data identified and collected in the Task 3 effort, including:

-- floodplain areas - which will involve the indication on the mapping of those areas for which detailed flood insurance studies are available, as well as an indication of those areas and/or sections of streams for which such detailed information is not currently available.

-- significant obstructions and their capacities - where "significant" obstructions will be those that are identified in the municipal data questionnaires and which are confirmed by the consultant as being areas where insufficient capacity exists for the necessary storm flows.

-- storm sewer systems - for significant system components: areas where storm sewering exists will be indicated generally on the final watershed base map.

-- existing state, federal and local flood protection and storm water management facilities.

-- proposed storm water facilities within the 10-year planning period - where known and confirmed by the municipalities through the municipal data questionnaire process.

-- storm water related "problems" - where indicated in the municipal data questionnaire and where confirmed by technical modeling/analysis (for example, water quality problems in the Beaverdam Branch Watershed).

Project Team Responsibilities

-- COUNTY - responsible for final review of technical mapping information prepared by the consultant and input into the delineation of future development areas.

-- Consultant - responsible for review, analysis, and preparation of the catalogued municipal data questionnaire information to help identify the data, as described above, that will be included on the various maps. Also responsible for actual map and GIS

preparation work described above and the development of watershed base maps for use in both the technical planning process as well as final plan presentation.

Anticipated Task Product

The product of this task will be the completed watershed maps for the information presented above. The maps completed for this task will, however, be preliminary mapping that can and/or will be modified and finalized as a part of the final plan preparation efforts.

Task 6 - Model Selection and Model Set Up

This task involves the selection and preparation of a hydrologic model appropriate for the analysis of the existing and projected land characteristics of the watershed. Technical input data required to run the model (in addition to land characteristics) will also be prepared such as rainfall information, drainage system layouts and capacities, travel times of subareas and information on man-made impoundments.

Hydrologic models currently in use include, but are not limited to, the Penn State Runoff Model PSRM, HEC-1 (Corps of Engineers), TR-20 (SCS) and SWMM.

The selected model will be applicable to the size, land use and geological characteristics of the watershed and will be able to accurately and reliably simulate the runoff characteristics for design storms of various frequencies and durations to produce routable hydrographs that can easily be combined.

Project Team Responsibilities

-- COUNTY - responsible for general support of consultant's efforts in the model selection and development of the necessary model input data.

-- Consultant - primary responsibility for the model selection and development and/or preparation of the model input data.

Anticipated Task Product

The product of this task will be a selected model along with the required hydrologic and hydraulic parameters for the Beaverdam Branch Watershed.

Task 7 - Model Runs

Model Calibration, Runs for Selected Frequency Storms and Interpretation of Results

This task utilizes the material prepared in Task 5 and organized in Task 6, in order to actually run the model and develop watershed-level storm runoff characteristics for six selected frequency design storms (i.e., the mean annual, 5-, 10-, 25-, 50-, and 100-year storm events with various durations) and two land use scenarios (existing and future conditions). This task also includes the

necessary efforts to calibrate and verify the model for the Beaverdam Branch Watershed. This calibration effort will utilize any available prior watershed hydrologic results (for example, completed by the U.S. Army Corps of Engineers) to verify the predicted response to rainfall events.

It is anticipated that watershed specific concurrent rainfall and streamflow records will be available for the Beaverdam Branch Watershed. These data will be used to "test" the accuracy of the model by making model runs. In the event that these data prove to be unusable or unavailable, data from neighboring similar watershed will be used to assess the calibration of the Beaverdam Branch model. If for some reason neither of these approaches proves to be feasible, a regression type approach (such as using PennDOT's PSU IV method) will be used to generally corroborate the model for the watershed. The calibration effort will result in the fine tuning of the watershed modeling input data parameters so that the required design storm modeling efforts can be initiated with confidence.

Subsequent to calibration of the model, the consultant will run the model for the mean annual, as well as the 5-, 10-, 25-, 50- and 100-year storm events with various duration (which depend on time of concentrations). The anticipated evaluation of the results will consider the peak flow rates, as well as flood conditions in the stream for the various storms. This evaluation will be judgmental based on detailed HEC-II analysis of the creek and tributaries if available. If HEC-II results are not available, no effort will be made to perform a HEC-II analysis and the required evaluation will be solely judgmental. Existing capacities of the obstructions on the stream and other downstream locations will also be used to identify storm runoff problem areas for use in developing the technical standards and criteria for storm water management in Task 8.

This analysis will also involve determination of the required design storm. The selection of a watershed design storm, for use in the standards and criteria, will be based on an evaluation of the watershed hydrologic response for the six design storms to be evaluated. Downstream impacts for the various design storms will be evaluated to determine what level of control (e.g., 100-year versus 10-year) will provide cost-effective management of projected downstream areas. For example, it would not be reasonable to select the 100-year storm for the standards and criteria if current (or anticipated) floodplain management and/or zoning requirements in the municipalities would address 100-year runoff impacts in floodplain areas. The selected design storm will also consider the results of the institutional analysis of current procedures in the municipalities.

The two land use scenarios to be evaluated for this Act 167 watershed plan include: (1) existing land use, as identified from the most current mapping for the watershed with modifications based upon municipal input concerning recent land development projects; and (2) future land use that will be projected to occur within an approximate planning time frame of ten years.

The particular methodology to be used is based on commonly accepted procedures for storm water pollution (on "Nonpoint Source" pollution) analysis. These procedures are based on the identification of "pollution wash off potential" for the watershed given the types and extent of land use characteristics. That is, given the land cover conditions are necessary data for

modeling, these data can also be used to identify the pollution wash off potential for the watershed. It is anticipated the information developed by the Altoona City Authority describing the effects of their combined sewer overflows will be referenced in this investigation.

"Best Management Practices" or BMP's will be recommended based on the results of this preliminary assessment for those areas found to be of significant impact potential. These recommendations will be included as part of the final plan contents.

These recommendations will include storm water quality management components for the technical Standards and Criteria. These water quality provisions will then also be included in the ultimate municipal ordinance provisions for implementation.

Project Team Responsibilities

-- COUNTY - responsible for support of consultant in the technical activities.

-- Consultant - responsible for the actual modeling and analysis/interpretation efforts to be conducted as a part of this task.

Anticipated Task Product

The product of this task will be the charts, tables and graphs developed to present the modeling results, and the technical interpretation of the modeling results.

Task 8 - Develop Technical Standards and Criteria

This task will involve the detailed evaluation of modeling results to perform a problem identification analysis (i.e., a "cause and effect" analysis). This analysis will concentrate on identifying the downstream storm runoff impacts of projected future land development projects. This evaluation will obviously consider both the increase in current downstream storm runoff problems, as well as new downstream runoff problems.

This work step also consists of performing a technical evaluation of the hydrologic analysis for existing and ultimate land use conditions and recommending standards and criteria to regulate development activity which impacts storm water runoff. This task also involves performing a release rate (or other similar) analysis and a preliminary distributed storage analysis, and developing criteria and standards for proposer control for storm water for new developments. Recommended standards and criteria will accommodate each land development activity, which may range from small lot sizes such as single family dwellings to large commercial or institutional complexes such as shopping malls, schools, hospitals, industrial parks, landfills, etc. The standards and criteria will provide for the application of management practices for the implementation of storm water control measures.

The standards and criteria will address the following:

a. identification of all areas within the watershed where different criteria apply;

b. identification of areas served by combined sewers for which the effects of the operation of the combined sewers should be considered in the development of standards.

c. recommended release rate percentages (if applicable) or other levels of control to accelerated runoff from the subareas identified in item a;

d. recommended design flood frequencies and computational methodologies for storm water management measures;

e. a list of recommended alternate storm water collection and control measures;

f. specifications for construction and maintenance of storm water systems (if applicable);

g. safety requirements for storm water systems during and after construction;

h. water quality management steps and/or actions which are applicable to this watershed. An evaluation will be completed which will project potential storm runoff quality impacts and recommendations will be identified for proper management of these potential storm quality impacts.

The recommendations will be presented in layman's language, keeping in mind that they are directed toward the local municipalities and are to address solutions to storm water management needs and will be read and interpreted by technical as well as non-technical people. The technical standards and criteria developed as a part of this task will be based on watershed-wide considerations in their interpretation and/or application.

Project Team Responsibilities

-- COUNTY - responsible for support in preparation of the technical standards and criteria. Also responsible for the detailed review of the standards and criteria project memorandum, and the submission to the consultant of questions and concerns for resolution prior to the completion of the final Act 167 plan (Task 11).

-- Consultant - responsible for the actual technical evaluation/analysis to be completed for the development of technical standards and criteria as a part of this task.

Anticipated Task Product

The product of this task will be the definition of the technical standards and criteria used in the PLAN.

Task 9 - Institutional Analysis

This task involves the detailed review of ordinances for each individual municipality in the watershed and the county-wide ordinances using the ordinance provisions matrix completed as a part of Task 4. The evaluation of the municipal ordinance matrix will be conducted using the results of Task 8 (i.e. the development of the technical standards and criteria). Essentially, this task effort will involve the identification of the necessary ordinance provisions for each watershed municipality that will be required to be instituted in order to effectively comply with the technical standards and criteria developed in Task 8.

In addition, this review and analysis will include the identification of appropriate legal and/or financial alternatives that can be used, under the proposed PLAN, for storm water management. Also included as a part of this task will be the evaluation of intermunicipal arrangements for watershed level storm water management, including those that would be necessary to implement a regional storm water management concept (e.g. the distributed storage concept).

The evaluation for this task will include the preparation of ordinance provisions for single or multi-purpose ordinances, as selected by the County with appropriate municipal involvement, in order to again effectively implement the technical standards and criteria for storm water management in this watershed.

Project Team Responsibilities

-- COUNTY - responsible for support of the consultant in the development and evaluation of institutional, legal and fiscal alternatives. An important role will be in the description of local institutional capabilities and the delineation of future roles in storm water management activities. The county will have final responsibility for the approval of model ordinance provisions for each municipality to be included in the final implementation plan for the watershed.

-- Consultant - responsible for the completion of the ordinance review activities as part of this task. Also responsible for the development of the legal and financial alternatives for storm water management. Additional responsibilities exist for the evaluation and identification of intermunicipal arrangements for watershed level stormwater management in the watershed. The consultant will also be responsible for providing the necessary coordination between selected ordinance provisions and the technical standards and criteria developed in Task 9.

Anticipated Task Product

The product of this task will be the identification of necessary recommended municipal ordinance provisions.

Task 10 - Plan Report Preparation

The consultant with COUNTY support will compile various components of the PLAN. Each component of each previous task will be directly included, or at least referred to in the plan. In this way the plan shall contain such provisions as are reasonably necessary to manage storm water such that storm runoff from development or activities in each municipality within the watershed shall not adversely affect health, safety and property in other municipalities within the watershed and in basins to which the watershed is tributary. In addition, the plan shall consider and be consistent with other existing municipal, county, regional and state environmental and land use plans. The PLAN shall include the following:

-- A description of the hydrologic characteristics of the watershed, the present and future land uses and their impacts on runoff, storm water collection systems and their impacts on runoff, the available runoff control techniques and their efficiencies in the watershed, a list of signification obstructions and a justification of their classification and available floodplain information. The available floodplain information will either be included in the plan or their sources referenced;

-- Based upon the results of the watershed modeling, the technical evaluation resulting in the criteria and standards governing the use of storm water management controls throughout the watershed. An important aspect of the technical components of the plan will be the delineation of areas which should (and areas that should not) use storm water detention to reduce peak flows. This determination will be made based upon an evaluation of subarea contributions to peak flows at the identified critical drainage points throughout the entire watershed. Each of the storm water management alternatives as discussed earlier will be incorporated in the plan as appropriate, based upon the modeling results. Peak discharge tables will be compiled for the critical drainage points from the computer runs involved in the modeling effort;

-- The tables for the rainfall depths for various frequency durations which are computed as part of the hydrologic modeling;

-- Recommendations for solutions to the existing drainage problems (since the Act 167 is not intended to solve existing problems, but to prevent their aggravation and also prevent other future problems, these recommendations for solutions to existing problems that are found to be relevant to the PLAN will only be conceptual in nature indicating the type of approach needed and intermunicipal cooperation issues);

-- Recommendations for new drainage facilities to prevent future problems due to new development, and a discussion regarding intermunicipal arrangements for funding the projects will also be discussed.

-- A model storm water management ordinance, a list of priorities for implementation and a list of recommendations. Recommended actions will be listed according to the agency, municipality or individual responsible for each action. Priority for actions will be based upon

chronological order, importance, hydrologic significance or other appropriate factors. Also included will be a formal process of reviewing the storm drainage elements of subdivision plans against the performance standards of the PLAN, and the procedures for updating the PLAN at least every five years.

The preliminary outline for the PLAN is as follows:

Section I	Introduction
Section II	Act 167 Watershed Level Storm Water Management Planning and Implementation
Section III	Watershed Characteristics -- Present Land Use -- Projected Land Developments -- Significant Obstructions -- Floodplain and Drainage Problems -- Storm Water and Flood Management Systems
Section IV	Watershed Technical Analysis - Modeling -- Land Development Impacts on Storm Runoff
Section V	Technical Standards and Criteria for Control of Storm Water Runoff Modeling Results Interpretation
Section VI	Runoff Control Techniques and Their Efficiencies
Section VII	Existing Municipal Ordinance Information
Section VIII	Institutional Plan - Development of Model Storm Water Ordinance Provisions
Section IX	Priorities for Implementation of Technical Standards and Criteria
Section X	Plan Review Adoption and Updating Procedures

<u>PLATES</u>:

-- a base map showing the watershed delineation and political subdivisions, roadway network and the location as referenced to the county

-- watershed subareas used for hydrologic analysis (including release rate percentage table, if applicable)

-- stream obstructions, flooding and drainage problem areas, and streams for which 100-year floodplain information is available.

-- areas where storm sewer networks exist (if available)

-- additional information as determined by the county

TABLES:

-- runoff characteristics of the watershed

-- rainfall values for various frequency durations

-- peak flow values at points of interest for mean annual, 5-, 10-, 25-, 50- and 100-year storm events for various durations, and for present and future conditions

-- results of the flood damage analysis (if available)

-- subareas and corresponding release rate percent, if applicable

APPENDICES:

-- a list (or table) of all obstructions including their locations, sizes, calculated capacities and any particular information which may seem helpful to the use of the plan

-- recommended design storm

-- any special information concerning detention/retention basins

All backup material including hydrologic and hydraulic analyses of the watershed will be retained at the COUNTY office for future use during the future plan update or any other reference.

Project Team Responsibilities

-- COUNTY -- to provide a support role for the preparation of text material associated with those sections, or aspects of the work program (i.e., Tasks 1 through 9) for which the consultant had primary responsibility. Finally, responsible for the overall review and approval of the preparation of the PLAN document, with the identification of revisions and modifications to be reviewed and addressed by the Consultant.

-- Consultant -- responsible for the coordination and preparation of the overall report for the Phase II project. Also responsible for the preparation of project maps and the technical results tables and charts for presentation in the final PLAN document.

Anticipated Task Product

The product of this task will be final Beaverdam Branch Watershed PLAN. The final PLAN will be prepared in two parts a Volume I -- Executive Summary and a Volume II -- a document containing the full text and descriptions of the various PLAN contents as described above.

Task 11 - Priorities for Implementation, PLAN Update, PLAN Adoption

Priorities for Implementation

The consultant will summarize the conclusions and recommendations of the PLAN. Recommended actions will be listed according to agency, municipality or individual responsible for each action. Priority of recommended actions will be based on chronological order, importance, hydrologic significance or other factors as may be appropriate.

Plan Update

As a part of the implementation strategy for the PLAN, specific steps and/or procedures will be established for pursuing and completing the necessary updates of the PLAN as required by Act 167. Specific circumstances will be identified and described in the PLAN document that will "trigger" a decision to update the plan, and this will certainly be the case for the required 5-year update. For example, land development circumstances (such as major changes in the type and/or amount of proposed land development, and certainly in excess of that which was assumed for the preparation of the original PLAN) will be identified as reasons for pursuing an update of the PLAN prior to the required 5-year time frame identified in Act 167.

Plan Adoption

The COUNTY will transmit the completed PLAN to the official planning agency and governing body of each involved municipality, each member of the WPAC and the DEPARTMENT by official correspondence. The involved municipalities, WPAC and DEPARTMENT will then review the PLAN. Their review will include an evaluation of the PLAN'S consistency with other plans and programs affecting the watershed. The review and comments will be submitted to the COUNTY by official correspondence. The review comments will be received, tabulated, and responded appropriately and the PLAN will be revised accordingly.

Prior to PLAN adoption, a final meeting will be held with municipalities; to identify specific ordinance changes and method(s) of incorporation of the standards and criteria into municipalities' existing ordinance framework. In addition, the meeting(s) can also serve to provide clarification of any remaining questions or concerns that municipalities may have concerning the implementation of the PLAN for any municipality.

The COUNTY will hold a public hearing concerning the PLAN. A notice for the public hearing will be published at least two weeks before the hearing date. The public hearing notice will contain a brief summary of the principal provisions of the PLAN and a reference to the places within each affected municipality where copies of the PLAN may be examined or purchased at cost. The comments received at the public hearing will be reviewed by the COUNTY and appropriate modifications in the PLAN will be made if applicable.

The PLAN will be voted as a resolution by the Blair County Commissioners body for the purpose of adoption. The resolution will have to be carried by an affirmative vote of at least a majority of the members of the governing body,

and should refer expressly to the maps, charts, textual matter and other materials intended to comprise the PLAN. This action will then be recorded on the adopted PLAN.

The County PLAN will then submit to the DEPARTMENT a letter of transmittal, and three copies each of the adopted PLAN, the review by the official planning agency and governing body of each municipality, County Planning Commission regional planning agencies (Section 6 (c) of Act 167), public hearing notice and minutes (Section 8 (a) of Act 167), and the resolution of adoption of the PLAN by the COUNTY (Section 8 (b) of Act 167). The letter of transmittal will state that the COUNTY had complied with all procedures outlined in Act 167 and will request the DEPARTMENT to approve the adopted PLAN.

Project Team Responsibilities

-- COUNTY -- primary responsibility for the adoption activities described above, and will also assist the consultant concerning establishment of priorities for implementation of actions identified in the PLAN and update schedule.

-- Consultant -- responsible for providing support and guidance to COUNTY during PLAN adoption process and will establish priorities for implementation of actions identified in the PLAN and set update schedule with the help of COUNTY.

Anticipated Task Product

The product of this task will include the official documentation regarding PLAN adoption and implementation process, including the necessary documentation from the COUNTY certifying the adoption of the PLAN, and adopted PLAN and priorities schedule as well as update schedule.

V. LEVEL OF EFFORT AND COST ESTIMATE

The previous eleven (11) work steps were further broken down into subtasks to analyze the required level of effort, both by the county and the consultant to complete each work step. The estimated staff time for each project team member for each subtask are presented in this section. The cost estimates presented in Table 4 reflect the specific work step descriptions presented in Section IV, including the use of the particular procedures and methodologies that are presented. A summary of the estimated cost to complete the Beaverdam Branch Storm Water Management Plan is as follows:

PARTICIPANT	NUMBER HOURS	LABOR COST	DIRECT COST	TOTAL COST
County	767	$ 23,152	$ 455	$ 23,607
Consultant	3,173	$ 165,357	$ 8,640	$ 173,997
TOTAL	4,940	$ 188,509	$ 9,095	$ 197,604

SUMMARY
BEAVERDAM BRANCH WATERSHED

TABLE 4
BEAVERDAM BRANCH WATERSHED PHASE II COST ESTIMATE

TASK DESCRIPTIONS	CONSULTANT																			
	TECHNICAL MANAGER $75.00 /HOUR		PROJECT ENGINEER $57.00 /HOUR		ENGINEER $43.00 /HOUR		ENGINEERING TECHNICIAN $38.00 /HOUR		SECRETARY $26.00 /HOUR		FIELD TECHNICIAN $25.00 /HOUR		GIS PROJECT MANAGER $75.00 /HOUR		GIS TECHNICIANS $38.00 /HOUR		COST SUMMARY TOTAL LABOR			
# DESCRIPTION	HRS	COST	HRS	COST	HRS	COST	HRS	COST	HRS	COST	HRS	COST	HRS	COST	HRS	COST	HRS	COST	EXPENSES	TOTAL COST
1 PROJECT INITIATION	19	1,425	2	114	0	0	0	0	4	104	0	0	0	0	0	0	25	1,643	100	1,743
2 PROJECT COORDINATION/PUBLIC PARTICIPATION	130	9,750	250	14,250	60	2,580	64	2,432	113	2,938	0	0	0	0	0	0	617	31,950	850	32,800
3 DATA COLLECTION/REVIEW/ANALYSIS	14	1,050	255	14,335	84	3,612	24	912	18	468	240	6,000	36	2,700	70	2,660	741	31,937	3,500	35,437
4 INSTITUTIONAL DATA PREPARATION	8	600	30	1,710	0	0	0	0	8	208	0	0	0	0	0	0	46	2,518	25	2,543
5 DATA PREPARATION FOR TECHNICAL ANALYSIS	32	2,400	200	11,400	0	0	64	2,432	0	0	0	0	100	7,500	140	5,320	536	29,052	345	29,397
6 MODEL SELECTION AND SET UP	40	3,000	168	9,576	0	0	0	0	0	0	0	0	40	3,000	65	2,470	313	18,046	10	18,056
7 MODEL RUNS	32	2,400	240	13,680	0	0	0	0	0	0	0	0	0	0	0	0	272	16,080	105	16,185
8 DEVELOP TECHNICAL STANDARDS AND CRITERIA	16	1,200	80	4,560	0	0	0	0	16	416	0	0	0	0	0	0	112	6,176	150	6,326
9 INSTITUTIONAL ANALYSIS	16	1,200	40	2,280	0	0	0	0	0	0	0	0	0	0	0	0	56	3,480	30	3,510
10 PLAN REPORT PREPARATION	56	4,200	265	15,105	0	0	48	1,824	56	1,456	0	0	0	0	0	0	425	22,585	3,500	26,085
11 PRIORITIES FOR IMPLEMENTATION	10	750	20	1,140	0	0	0	0	0	0	0	0	0	0	0	0	30	1,890	25	1,915
GRAND TOTALS	373	27,975	1,550	88,350	144	6,192	200	7,600	215	5,590	240	6,000	176	13,200	275	10,450	3,173	165,357	8,640	173,997

SUMMARY
BEAVERDAM BRANCH WATERSHED

TABLE 4
BEAVERDAM BRANCH WATERSHED PHASE II COST ESTIMATE
(CONTINUED)

TASK DESCRIPTIONS	COUNTY														GRAND TOTALS			
	PLANNING DIRECTOR $47.00 /HOUR		PLANNER III $26.00 /HOUR		CONSERVATION DISTRICT STAFF $11.30 /HOUR		SECRETARY III $14.50 /HOUR		OTHER /HOUR		COST SUMMARY TOTAL LABOR				LABOR			
# DESCRIPTION	HRS	COST	HRS	COST	HRS	COST	HRS	COST	HRS	COST	HRS	COST	EXPENSES	TOTAL COST	HRS	COST	TOTAL EXPENSES	TOTAL COST
1 PROJECT INITIATION	48	2,256	24	624	0	0	13	189	0	0	85	3,069	100	3,169	110	4,712	200	4,912
2 PROJECT COORDINATION/PUBLIC PARTICIPATION	144	6,768	52	1,352	0	0	104	1,508	0	0	300	9,628	65	9,693	917	41,578	915	42,493
3 DATA COLLECTION/REVIEW/ANALYSIS	4	188	8	208	8	90	0	0	0	0	20	486	10	496	761	32,423	3,510	35,933
4 INSTITUTIONAL DATA PREPARATION	10	470	16	416	8	90	2	29	0	0	36	1,005	20	1,025	82	3,523	45	3,568
5 DATA PREPARATION FOR TECHNICAL ANALYSIS	24	1,128	16	416	64	723	0	0	0	0	104	2,267	10	2,277	640	31,319	355	31,674
6 MODEL SELECTION AND SET UP	0	0	0	0	0	0	0	0	0	0	0	0	10	10	313	18,046	20	18,066
7 MODEL RUNS	0	0	0	0	0	0	0	0	0	0	0	0	10	10	272	16,080	115	16,195
8 DEVELOP TECHNICAL STANDARDS AND CRITERIA	0	0	0	0	0	0	0	0	0	0	0	0	10	10	112	6,176	160	6,336
9 INSTITUTIONAL ANALYSIS	40	1,880	40	1,040	18	203	8	116	0	0	106	3,239	20	3,259	162	6,719	50	6,769
10 PLAN REPORT PREPARATION	16	752	24	624	24	271	0	0	0	0	64	1,647	100	1,747	489	24,232	3,600	27,832
11 PRIORITIES FOR IMPLEMENTATION	24	1,128	24	624	0	0	4	58	0	0	52	1,810	100	1,910	82	3,700	125	3,825
GRAND TOTALS	310	14,570	204	5,304	122	1,379	131	1,900	0	0	767	23,152	455	23,607	3,940	188,509	9,095	197,604

The consultant will provide services and guidance to the county for all the work tasks at a level of staff involvement consistent with Table 4. Table 4 lists the breakdown of the estimated level of effort for the work program described herein, based on and including the items identified in the task descriptions.

VI. PROPOSED PLAN DEVELOPMENT SCHEDULE

A schedule has been developed for completing the work program described herein. It is felt that the developed time frame for this project is sufficient for all the necessary contacts and follow-up correspondence, for each of the municipalities and for the applicable tasks.

The proposed work schedule follows in Figure 2.

VII. CONSULTANT CAPABILITIES

The consultant who assisted with the preparation of this ACT 167 Phase I plan was The Chester Engineers.

A summary of specific experience related to watershed storm water management modeling and planning is presented below. A statement of qualifications and experience is provided in the Appendix.

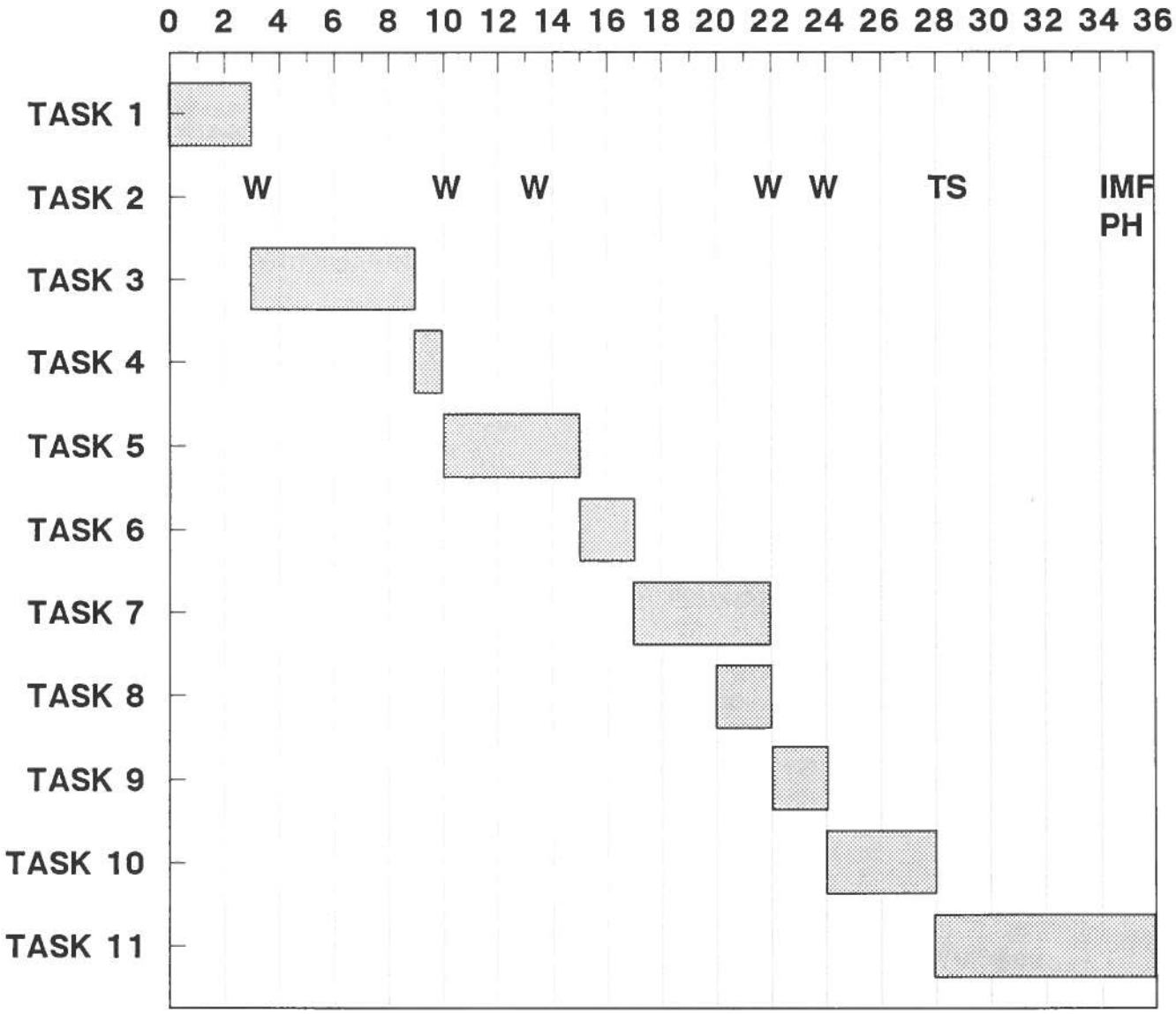
Hydrologic Modeling

- Hydrologic modeling of the Glade Run watershed in Armstrong County performed in conjunction with the preparation of the Glade Run Act 167 Storm Water Management Plan.
- Hydrologic modeling of the Turtle Creek watershed in Allegheny and Westmoreland counties performed in conjunction with the preparation of the Turtle Creek Storm Water Management Plan.
- Hydrologic modeling of the Fox Hollow watershed in Williamsport, Pennsylvania.
- Hydrologic modeling of the Broadway Interceptor Drainage Area in Allegheny County.
- HEC 2 modeling of improvements to Spring Creek in support of the design of the Harrisburg Sewerage Authority's Spring Creek interceptor improvements.
- Modeling of tributaries to the Monongahela River in Allegheny County in support of the Monongahela River Watershed Act 167 Storm Water Management Plan (in progress).
- Modeling of the Conneaut Outlet watershed in Crawford County in support of the Conneaut Outlet Watershed Act 167 Storm Water Management Plan (in progress).

FIGURE 2

BEAVERDAM BRANCH WATERSHED STORMWATER MANAGEMENT PLAN

PHASE II WORK SCHEDULE



W = Watershed Plan Advisory Committee Meeting

TS = Training Session

IMF = Individual Municipal Follow-up Meetings

PH = Public Meeting

Storm Water Management Planning

--- Act 167 Phase I Storm Water Management Plan for the Glade Run watershed in Armstrong County, Pennsylvania.

--- Act 167 Phase I Storm Water Management Plan for the Turtle Creek watershed in Allegheny and Westmoreland counties, Pennsylvania.

--- Act 167 Phase I Storm Water Management Plan for the Conneaut Outlet watershed in Crawford County, Pennsylvania.

--- Act 167 Phase I Storm Water Management Plan for the Breakneck Creek watershed in Butler and Allegheny counties, Pennsylvania.

--- Act 167 Phase I Storm Water Management Plan for the Monongahela River watershed in Allegheny County, Pennsylvania.

--- Act 167 Phase II Storm Water Management Plan for the Glade Run watershed in Armstrong County, Pennsylvania.

--- Act 167 Phase II Storm Water Management Plan for the Glade Run watershed in Armstrong County, Pennsylvania.

--- Act 167 Phase II Storm Water Management Plan for the Turtle Creek watershed in Allegheny and Westmoreland counties, Pennsylvania.

--- Storm water control plan review services for the Allegheny County Department of Planning

--- Storm Water Management Plan for the Broadway Interceptor Area, Allegheny County, Pennsylvania

--- Assessment of Storm Water Master Plan, City of Huntington, West Virginia

--- Design of storm water control facilities for McIntyre Hospital Site, Ross Township, Pennsylvania

--- Design of storm water detention facilities for McDonald's Corporation, Shaler Township, Pennsylvania

Consultant resumes are provided in the Statement of Qualification and Experience attached as Appendix E.

APPENDIX A

BEAVERDAM BRANCH WATERSHED
ACT 167 - PHASE I
STORMWATER MANAGEMENT PLAN

MUNICIPALITIES QUESTIONNAIRE

Please complete the following questionnaire. If you have any questions or comments please contact the Blair County Planning Commission at 695-5541.

GENERAL INFORMATION	
Municipal Contact Person:	Name: _____ Address: _____ _____ _____ Phone: _____
Person completing this form:	Name: _____ Address: _____ _____ _____ Phone: _____
Watershed Advisory Committee Designee:	Name: _____ Address: _____ _____ _____ Phone: _____

BEAVERDAM BRANCH WATERSHED
ACT 167 - PHASE I STORMWATER MANAGEMENT PLAN
MUNICIPALITIES QUESTIONNAIRE

Please indicate the location of existing stormwater problem areas within your municipality on a map of your municipality. Identify each problem area by number and complete the following form to the best of your knowledge.

	AREA			
	1	2	3	4
CAUSES Please check off what you feel are the causes of each identified stormwater problem.				
▪ Too large an increase in uncontrolled runoff.				
▪ Uncontrolled runoff into your municipality from upstream municipalities.				
▪ Drainage system is too small and corrections need to be made.				
▪ Obstructions in system that need to be removed.				
▪ Lack of maintenance of drainage ways.				
▪ Other (explain).				
OCCURRENCES How often does the stormwater problem occur in each identified area?				
▪ Every rain.				
▪ Between one and ten times per year.				
▪ Only during major flood events.				
DAMAGES What type of damages are experienced as a result of this problem?				
▪ Loss of life.				
▪ Loss of vital services.				
▪ Property damage.				
▪ Type(s) of property damaged:				
private				
public				
other (specify)				
▪ Approximate number of properties affected.				
PLEASE PROVIDE SPECIFIC COMMENTS REGARDING ANY OF THE STORMWATER PROBLEMS WHICH YOU HAVE IDENTIFIED IN THIS QUESTIONNAIRE.				

BEAVERDAM BRANCH WATERSHED
ACT 167 - PHASE I STORMWATER MANAGEMENT PLAN
MUNICIPALITIES QUESTIONNAIRE

Please indicate the location of existing stormwater problem areas within your municipality on a map of your municipality. Identify each problem area by number and complete the following form to the best of your knowledge.

	AREA			
	5	6	7	8
CAUSES Please check off what you feel are the causes of each identified stormwater problem.				
▪ Too large an increase in uncontrolled runoff.				
▪ Uncontrolled runoff into your municipality from upstream municipalities.				
▪ Drainage system is too small and corrections need to be made.				
▪ Obstructions in system that need to be removed.				
▪ Lack of maintenance of drainage ways.				
▪ Other (explain).				
OCCURRENCES How often does the stormwater problem occur in each identified area?				
▪ Every rain.				
▪ Between one and ten times per year.				
▪ Only during major flood events.				
DAMAGES What type of damages are experienced as a result of this problem?				
▪ Loss of life.				
▪ Loss of vital services.				
▪ Property damage.				
▪ Type(s) of property damaged:				
private				
public				
other (specify)				
▪ Approximate number of properties affected.				
PLEASE PROVIDE SPECIFIC COMMENTS REGARDING ANY OF THE STORMWATER PROBLEMS WHICH YOU HAVE IDENTIFIED IN THIS QUESTIONNAIRE.				

BEAVERDAM BRANCH WATERSHED
ACT 167 - PHASE I
STORMWATER MANAGEMENT PLAN

MUNICIPALITIES QUESTIONNAIRE

GENERAL STORMWATER MANAGEMENT INFORMATION

- These are the types of storm water related problems that may occur in your community. Please indicate the degree of severity of each of these types of problems.

  STREAM FLOODING
  ☐ Critical ☐ Moderate ☐ No Problem ☐ Don't Know

  STREET FLOODING
  ☐ Critical ☐ Moderate ☐ No Problem ☐ Don't Know

  SOIL WASHOFF
  ☐ Critical ☐ Moderate ☐ No Problem ☐ Don't Know

  STORM WATER POLLUTION
  ☐ Critical ☐ Moderate ☐ No Problem ☐ Don't Know

  OTHER (PLEASE SPECIFY)
  ☐ Critical ☐ Moderate ☐ No Problem ☐ Don't Know

- Do you have ordinances or regulations which address the following:

  Stormwater Management? ☐ Yes ☐ No
  Drainage? ☐ Yes ☐ No
  Erosion and Sediment Control? ☐ Yes ☐ No

- Where are the above regulations contained?
  ☐ Separate Ordinances
  ☐ Subdivision/Land Development Ordinance
  ☐ Building Code

- Would you provide involvement and support to the development of a stormwater management plan, including the Watershed Advisory Committee by attending scheduled meetings to be held in convenient locations?
  ☐ Yes ☐ No

APPENDIX B

Table VII-2
Existing Municipal Ordinance Matrix

Existing Regulatory Controls	Municipality North Huntingdon Township
Land use planning standards	Zoning (Ord #542): allows mineral removal as conditional use in several districts; agriculture permitted use in residential districts; designates conservation & recreation disticts on zoning map PRD (#490): promotes preservation of sttep slopes, trees, watercourses, etc.; limits removal of vegetative cover on steep slopes; limits building coverage to 25% in PRD
Stormwater control provisions	#542: requires stormwater mgmt. plan as requirement for topsoil and mineral removal including runoff calculations. S/D (#81): includes standards for stormwater drainage systems for streets; #490: requires PRD to protect watercourses, prevent erosion & flooding, requires adequate stormwater drainage for streets, protect adjacent properties, etc. and safe deposition of runoff
Rate of runoff standard	None
Specific calculation method	None
Design standards for storm water controls	S/D: minimum standard for street drainage no construction specifications
Erosion and sedimentation controls	#490: submit E/S plan for PRD, general performance requirements and standard language to prevent erosion, etc.; #542: E/S controls required for topsoil or mineral removal
Plan review process	PRD & S/LD: final plan approved by township commissioners
Fees	Not mentioned
Inspection schedule	None
Maintenance provisions	S/D: maintenance bond for dedicated facilities

APPENDIX C

TABLE C-1
BREAKDOWN OF EXPENSES IN TABLE 4
BEAVERDAM BRANCH WATERSHED

PLAN COPIES

Number of Copies of Reports to Be Distributed

10 Municipalities: 2 Each
County Commissioners and Departments: 10
Soil Conservation Service: 1
Stormwater Consultant: 3
Federal / State Officials / Agencies: 6
Others / Public Distribution: 20

PLAN REPRODUCTION / DISTRIBUTION

Copies

25 Draft Plans @ $25.00/copy =	$625
60 Final Plans @ $25.00/copy =	$1,500
25 Draft Summaries @ $10.00/copy =	$250
60 Final Summaries @ $10.00/copy =	$600
TOTAL =	$2,975

Postage

50 Plans @ $3.00/copy =	$150
50 Summaries @ $1.50 =	$150
TOTAL =	$300

GENERAL ADIMINSTRATION

Progress Reports (1/month) =	144 hours *
Invoices (1/month) =	144 hours *
WPAC meetings =	195 hours *
Travel =	$50
Advertising =	$250

* Labor hours included in estimate in Table 4

TABLE C–1
BREAKDOWN OF EXPENSES IN TABLE 4
BEAVERDAM BRANCH WATERSHED
(CONTINUED)

TASK COST BREAKDOWN

Task No. 1	Project Initiation	$4,712
Task No. 2	Project Coordination	$41,578
Task No. 3	Data Collection/Review/Analysis	$32,423
Task No. 4	Institutional Data Preparation	$3,523
Task No. 5	Data Preparation for Technical Analysis	$31,319
Task No. 6	Model Selection and Set Up	$18,047
Task No. 7	Basic Model Runs	$16,080
Task No. 8	Develop Technical Standards & Criteria	$6,176
Task No. 9	Institutional Analysis	$6,719
Task No. 10	PLAN Report Preparation	$24,232
Task No. 11	Priorities for Implementation, Update & Adoption	$3,700
Project Direct Cost (including travel, maps, charts, data, paper supplies, printing and reproduction, telephone charges, meeting room rentals, equipment rentals, computer connect time, postage and other miscellaneous expenses).		$9,095
	GRAND TOTAL	$197,604
Maximum Department Share (75%)		$148,203
Maximum County Share (25%)		$49,401

	TOTAL	DEPART. SHARE	COUNTY SHARE
FY 92 *	$21,956.00	$16,467.00	$5,489.00
FY 93	$65,868.00	$49,401.00	$16,467.00
FY 94	$65,868.00	$49,401.00	$16,467.00
FY 95 **	$43,912.00	$32,934.00	$10,978.00
TOTAL	$197,604	$148,203.00	$49,401.00

* Four (4) months
* Eight (8) months

APPENDIX D

J. EDWARD BIDDLE
VICE-CHAIRMAN
WILLIAM R. HALL
SECRETARY-TREASURER
GLENN C. BISTLINE
ROBERT A. DiVENTURA
CLOYD F. FORSHEE
ROBERT E. KOELLE
RANDALL L. MANNING
MERLE K. LAYS
SOLICITOR

BLAIR COUNTY PLANNING COMMISSION

HIGHLAND HALL ANNEX
P.O. BOX 365
HOLLIDAYSBURG, PA [illegible]
RICHARD E. HAINES, AICP
EXECUTIVE DIRECTOR

TELEPHONE
814-695-5541
814-224-2166
814-793-3737
814-943-9946
extension 360 all numbers

May 22, 1991

Dear :

ANNOUNCEMENT OF INITIATION OF ACT 167 STORM WATER MANAGEMENT PLAN DEVELOPMENT FOR THE BEAVERDAM BRANCH WATERSHED

This letter is to inform you that the Blair County Planning Commission is proceeding with the first phase of the preparation of a storm water management plan for the Beaverdam Branch watershed. A map depicting the approximate boundaries of the watershed is attached. Since all or portions of your municipality are located in the watershed, your municipality will be involved in this planning effort.

Act 167 requires that counties prepare and adopt Storm Water Management Plans for all designated watersheds within their jurisdictions. The basic purpose of the Act is to encourage the management of storm water runoff throughout the Commonwealth in a manner consistent with sound water and land use practices. In general, this will be accomplished by instituting storm water management control requirements designed to adequately control accelerated runoff resulting from new land development.

The current effort consists of the preparation of the Phase I - Scope of Study. This Scope of Study, once completed, will outline the procedures and methods to be followed and the costs associated with completing the second phase of the process - the actual storm water management plan.

Act 167 requires that municipalities adopt or amend and implement ordinances and regulations necessary to manage storm water as outlined in the plan. Consequently, early and continuing involvement in the planning process by the affected municipalities will be valuable to all concerned. This involvement will enable the plan to accurately reflect local conditions and concerns and produce recommendations that can be implemented by local governments.

Since all or portions of you municipality is situated within the Beaverdam Branch watershed, we are asking that you complete and return the enclosed questionnaire at your earliest convenience.

The purpose of this questionnaire is to permit our consultant to develop a broad assessment of the general storm water management issues as they currently exist in the watershed. A more detailed questionnaire form will be completed during the second phase of the project. As a result, it is the intent that this questionnaire be completed by an individual; who is generally familiar with storm water issues in your municipality. The form should be completed using the general knowledge of such an individual. We do not expect you to conduct an exhaustive study of conditions in you municipality. Information readily available to a knowledgeable individual such as you, the municipality's manager, or the municipal engineer will suffice.

The information you provide on the completed questionnaire is necessary for us to preliminary assess storm water runoff conditions within your municipality in particular and throughout the watershed in general. This information will be used to develop a scope of study which will guide the preparation of a detailed storm water management plan.

We consider the information you can provide by completing this form to be important to our efforts and encourage you to complete the form to the best of your ability. Please keep in mind that you need only address problems which occur in the portions of your municipality which lie within the Beaverdam Branch watershed.

Should you have any questions, please contact the undersigned of John Maslanik of The Chester Engineers at (412) 269-5828.

We are confident that with your cooperation, we will produce a plan which will assist the County of Blair and your municipality in discharging our Act 167 storm water management responsibilities. Please feel free to contact us should you have any questions concerning this matter.

Sincerely,
BLAIR COUNTY PLANNING COMMISSION

Richard T. Haines

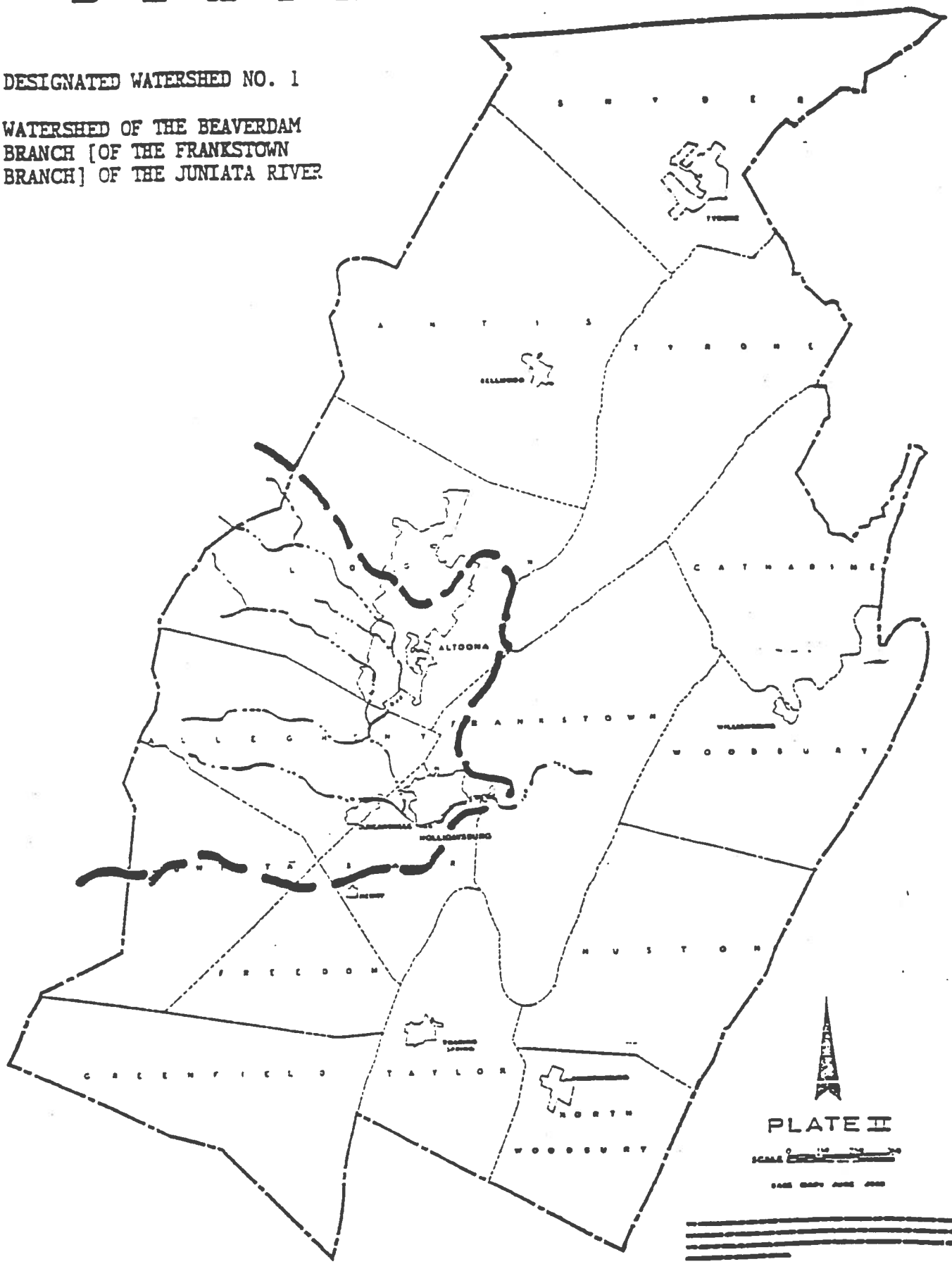
Richard T. Haines, AICP
Planning Director

Copies: Board of Commissioners of Blair County
24-Member Government Advisory Committee
Blair County Planning Commission
The Chester Engineers

B L A I R C O U N T Y

DESIGNATED WATERSHED NO. 1

WATERSHED OF THE BEAVERDAM BRANCH [OF THE FRANKSTOWN BRANCH] OF THE JUNIATA RIVER



BLAIR COUNTY - PLANNING COMMISSION

BLAIR COUNTY PLANNING COMMISSION

HIGHLAND HALL ANNEX
P.O. BOX 405
HOLLIDAYSBURG, PA 16648-0405
RICHARD T. HAINES, AICP
DIRECTOR

TELEPHONE
814-695-5541
814-224-2166
814-793-3737
814-943-9946
extension 360 all numbers

TO: Watershed Plan Advisory Committee for the Storm Water Management Plan for the Beaverdam Branch (Act 167 of 1978)

Helen M Dell
Donna J. Fisher
Timothy Forr
Cloyd F. Forsht
Thomas J. Fountaine, II
Robert F Hagemann, III
John M. Harker
Richard P. Imler
Robert E. Koelle
Donald G. Lynn
Frank L. Noye
Larry C. Parvin
Joseph A. Robeson
Jack E. Walker, Sr.

RZH

FROM: Richard T. Haines, AICP
Planning Director

DATE: May 22, 1991

SUBJECT: Meeting Notice and Agenda

We have schedule the first meeting of the Watershed Plan Advisory Committee for the Storm Water Management Plan for the Beaverdam Branch (Act 167 of 1978) with the particulars as follows:

DATE: Thursday, June 6, 1991
TIME: 1:30 PM
PLACE: Conference Room
Emergency Management Center
Blair County Courthouse
Hollidaysburg, Pennsylvania

The proposed agenda for the meeting is as follows:

AGENDA

ITEM

1. Opening Remarks

2. Review of the Storm Water Management Act (Act 167 of 1978)

3. Review of the Role of the Watershed Plan Advisory Committee

4. Review of Municipalities Questionnaire

5. Questions and Answers

6. Adjournment

For your information, we have prepared and enclosed a copy of the following:

- Request for Qualifications (RFQ), Phase I - Scope of Study Storm Water Management Plan for the Beaverdam Branch (Act 167 of 1978)

- Memorandum of May 17, 1991: Evaluation of Statement of Qualifications with a Recommendation for the Selection of a Consulting Firm to Prepare Phase I - Scope of Study of the Storm Water Management Plan for the Beaverdam Branch (Act 167 of 1978)

- **Municipalities Questionnaire** with cover letter of May 22, 1991

In preparation for the upcoming meeting, please review and complete the Municipalities Questionnaire to the best of your ability. (If you need a blank map of your municipality, please call me at 695-5541 Ext. 366 and we will furnish you one).

We look forward to seeing you at the upcoming meeting.

If you have any questions, please call.

Copies: Board of Commissioners of Blair County
24-Member Government Advisory Committee
Blair County Planning Commission

APPENDIX E

Statement of Qualifications and Experience Relative to Stormwater Management

March 1991

Prepared by

The Chester Engineers

A ***CHESTER*** Environmental Company

P.O. Box 15851

Pittsburgh, Pennsylvania 15244

412 269-5700

Corporate Office

TABLE OF CONTENTS

Page No.

SECTION I

Company Profile

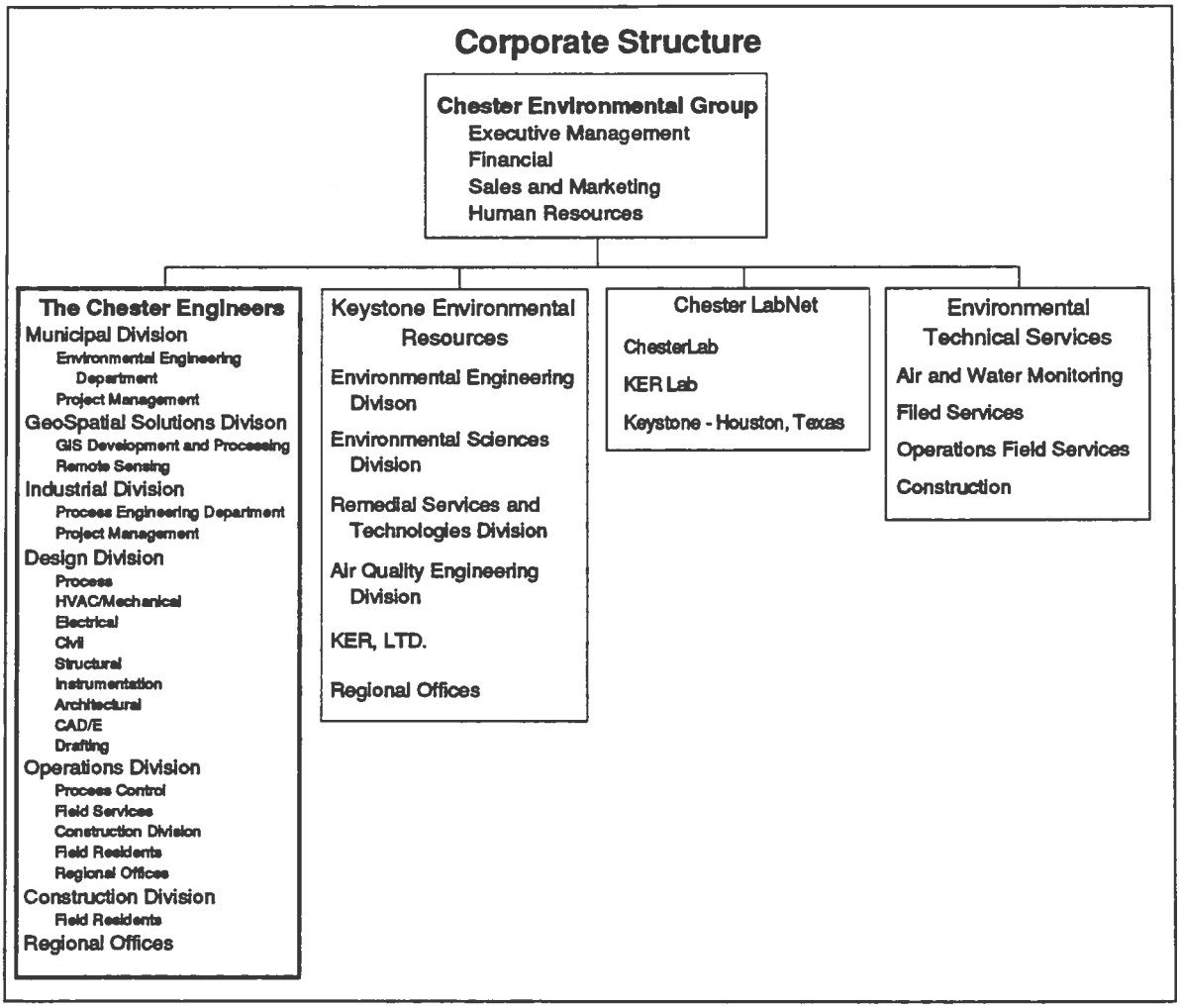
SECTION I
COMPANY PROFILE

INTRODUCTION

Chester Environmental Group (CHESTER), our new name effective January 1, 1990, communicates a unique history and experience in serving the needs of municipalities, industries and government regulatory agencies.

Chester Environmental Group is now organized with a Corporate Staff and four operating units that employ over 550 employees.

The units are:
- The Chester Engineers
- Chester LabNet
- Keystone Environmental Resources
- Environmental Technical Services, Inc.



Founded in 1910 CHESTER is rated by the Engineering News-Record as one of the top 20 firms in the country with more than fifty years of continuous experience in environmental engineering projects. The firm currently ranks 109 in the Engineering News-Record's top 500 design firms nationwide.

The Chester Engineers is experienced in all aspects of wastewater collection, treatment and reuse; water supply, treatment, storage and distribution; hazardous and nonhazardous solid waste management; hydrogeologic investigations; environmental impact and assessment studies; water quality modeling and water resources planning; air pollution control and abatement; and facilities design. The firm has the engineering and technological capability to develop programs from the earliest planning stage through design, management of construction, and supervision of operation.

Chester Engineers' activities concentrate on meeting the environmental engineering-related needs of government and industry. As a result, Chester Engineers' long experience, extensive resources, and broad scientific and professional engineering staff capabilities are focused on the specialized environmental engineering needs of our clients.

Chester Environmental Group Office Locations 5/90

OFFICE LOCATIONS

CHESTER maintains offices in the following cities:

Corporate Office:	Pittsburgh, Pennsylvania
Regional Offices:	Ann Arbor, Michigan Atlanta, Georgia Baltimore, Maryland Boulder, Colorado Cleveland, Ohio Gary, Indiana Houston, Texas Huntington, West Virginia Nashville, Tennessee Philadelphia, Pennsylvania Toronto, Ontario Vancouver, British Columbia Washington, D.C.

TABLE I-1

	CHESTER Environmental Group Staff	Bachelor Degree	Graduate Degree (PhD)	Total Staff*	Registered[1]
Engineering Disciplines	Air Quality	4	2 (1)	9	1 PE
	Architects	2	1	3	3 RA
	Chemical	29	9 (2)	38	13 PE
	Civil	31	14 (1)	46	23 PE
	Construction	11		24	1 PE
	Electrical	5		6	2 PE
	Environmental	11	5 (2)	16	4 PE
	Estimating/Scheduling			4	
	Geotechnical		2 (1)	2	1 PE
	Industrial Technology	4		4	
	Management Systems	1	1	2	
	Mechanical	10		14	3 PE
	Petroleum	2	1	3	
	Plant Operations	2	4	14	
	Sanitary		4	4	4 PE
	Structural	3		3	2 PE
	Surveyors			1	1 PLS
	Treatability Specialists	1		3	3
	Subtotal	**116**	**43 (7)**	**196**	**58**
Scientific Disciplines	Biology	33	2	36	
	Chemistry	73	17 (4)	97	1 PE/CP
	Data Processing	3		6	
	Ecology	2	1 (1)	3	
	Economics	3		3	
	Environmental	10	1	11	
	Forestry	2	2	4	
	Geography	1		1	
	Geology	12	4	14	1 CPG
	Health and Safety	5		6	1 CIH
	Hydrogeology	10	6	16	3 CPG
	Mathematics	2	1	3	
	Meteorology	1		1	
	Microbiology	2		2	
	Regulatory Specialists	3		6	
	Toxicology	1	2 (2)	6	
	Subtotal	**163**	**5 (7)**	**215**	**6**
Technical and Others	Administrative	13	2	35	2 PE
	Designers	3	1	15	
	Drafting and CAD/E Operators	3		20	
	Technicians	5	1	76	
	Laboratory Technicians	1		28	
	Secretarial	2		52	
	Subtotal	**27**	**4 (7)**	**226**	**2**
	Totals Full Time	**306**	**88 (14)**	**637**	**66**
	Part Time Not Classified			**35**	
	GRAND TOTAL	**306**	**88 (14)**	**672**	**66**

[1] CPC = Certified Professional Chemists; CPG = Certified Professional Geologists; PE = Professional Engineer; PLS = Professional Land Surveyor; RA = Registered Architect; CIH = Certified Industrial Hygienist

* Includes Technical/Associate Degrees and Non-Degreed Staff.

pm4\cegchart 5/91

PERSONNEL

CHESTER's commitment to excellence is reflected in the firm's large, diverse and trained staff of engineers, scientists, and technicians profiled in the chart below. This staff currently numbers 535 individuals including engineers, surveyors, field engineers and technicians, architects, chemists, biologists, computer scientists, geologists, hydrologists, draftsmen, and CAD/E technicians. Fifty-seven of CHESTER's engineers are registered professional engineers in one or more states.

COMPANY ORGANIZATION AND SERVICE APPROACH - THE CHESTER ENGINEERS

Briefly stated, The Chester Engineers' general approach to all engineering assignments is to furnish comprehensive scientific, engineering and architectural services provided by an experienced staff. These experts use state of the art equipment and technologies and are efficiently managed in a framework specifically structured to maximize technical competence.

The Chester Engineers is organized in a manner designed to use the best level of expertise applied to the specific needs of each of our clients in the most efficient way possible. Each department within The Chester Engineers organization is formed to satisfy specific client needs and/or provide critical support services. Staff members working in each department develop, through formal training and experience, the ability to efficiently and confidently respond to specific client needs. In this manner, Chester Engineers is able to maintain a depth of skills, training and experience across a broad range of environmental engineering services. This organizational structure also permits Chester Engineers to offer our clients the significant advantages associated with sole source procurement of engineering, geotechnical and laboratory services.

The resources of Chester Engineers are managed to meet the particular client's needs under the direction of an assigned project manager who employs a management organization system and a set of established internal procedures to organize and control each assignment. This system provides the appropriate combination of expertise from each department as necessary to complete assignments on time, within budget and to a high level of quality. It also provides our clients with a single contact professional who develops an intimate familiarity with the client's facilities, a comfortable working relationship with the client's management and staff, and a thorough understanding of the client's goals and special needs. In essence, our project managers function to focus the broad capabilities of Chester Engineers to meet the specific needs of our clients, direct the activities required to meet these needs and assure that our efforts accurately and fully respond to the client's wishes.

FACILITIES AND EQUIPMENT

The efforts of Chester Engineers' staff are supported and enhanced by the availability of a range of state of the art facilities and equipment. The capabilities provided by these facilities increase Chester Engineers' ability to respond fully to the needs of our clients while maximizing the efficiency and accuracy of our efforts.

Computer Facilities

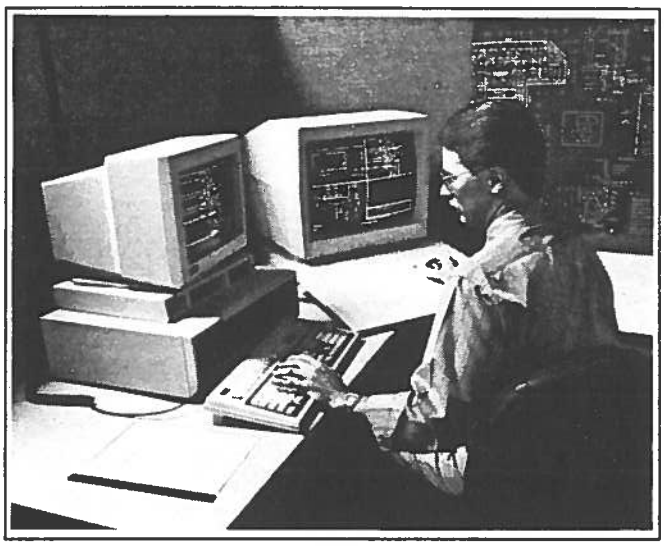
Chester Engineers' computer capabilities include data analysis, system modeling and design applications. Computer facilities consist of a Hewlett-Packard HP-3000 Series central computer and numerous peripheral and stand alone microcomputer work stations. High speed and high resolution multicolor plotting facilities are capable of producing engineering flow diagrams, isopleth maps of surface and subsurface data, graphic statistical displays and a wide range of two dimensional and perspective graphics.

An extensive library of scientific, engineering, graphics and statistical software has been amassed through in-house development efforts and third party software purchases. Specific software application packages used by Chester Engineers' staff include pipe network analyses, surveying and property plotting, hydraulic and hydrological modeling and engineering analyses, and slope stability evaluations.

The extensive utilization of computer assisted data management, engineering analysis, and graphics and document production techniques by our personnel translates into a number of advantages to our clients. Our ability to analyze data is increased, the evaluation of larger numbers of options and what-if scenarios is facilitated and the visual effectiveness of our presentations enhanced, all with the added benefits of increased accuracy and efficiency.

Computer Aided Design/Engineering (CAD/E)

The application of and benefits offered by the utilization of digital computer technologies extend beyond data management and analysis and information processing. Computer Aided Drafting and Design (CADD) capabilities have revolutionized facilities design and Chester Engineers is a leader in the application of these capabilities to the design of water and wastewater treatment and piping facilities.



Chester's CAD/E facilities consist of an Intergraph Microstation System, HP Series 48 central computer, Intergraph software, IBM and Hewlett Packard micro-computers, multicolor plotting facilities, interactive graphic terminals and a digitizing table. Through the use of Inroads CADD software, Chester Engineers has the capability to develop landfill designs as well as other applications. These facilities are programmed, operated and maintained by our data processing experts and computer programmers who are trained and experienced in the use of computers for solving design problems.

In CAD/E, engineering drawings are constructed as closely as possible to the normal construction sequence and are generated on one integral plane encompassing the entire limits of the work. This assures continuity between drawings because each discipline works within the same limits. Overlays which depict each of the functional disciplines, e.g. architectural, electrical, mechanical, structural, etc., can be viewed separately, together, or in any combination in order to prevent interferences. All drawing dimensions on CAD/E are entered at full scale and the computer maintains the relationship between lines for the drawing scale that is required. This reduces the need for repetitive checking, makes dimensional calculations unnecessary and assures that drawings are always to scale.

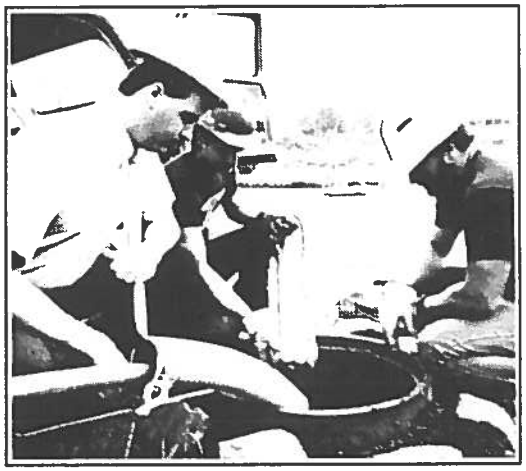
Material and quantity take-offs and schedules can be compiled and printed parallel to the production of drawings. The CAD/E system assures that drawings are consistent in form and notation. If desired, sections or whole drawings can be

enlarged for study or reduced for convenience. Experience has proven that the production of readily understandable, accurate, and reliable drawings serves to increase contractor confidence and reduce contingency allowances normally associated with estimates.

With CAD/E, drawing changes during the construction phase are easily accomplished. Field change orders can be accurately recorded on the drawings and the effect that they have on all aspects of the facility can be evaluated to determine if any interferences will result.

In summary, the CAD/E system provides our engineers, architects and designers with the capability to create, draft, analyze and control a project from the initial process selection or preliminary design phase through the final design, construction and operation phases. CAD/E has added precision, speed and flexibility to our drafting and design efforts which translate to improved designs and reduced costs during both the design and construction phases of projects.

Sewer System Inspection and Monitoring Equipment



Chester Environmental Group, through its wholly owned subsidiary Environmental Technical Services, Inc. (ETS), operates a fleet of sewer system inspection, maintenance and repair equipment and a complete inventory of sewer system flow monitoring equipment. This equipment is available for use as elements of sewer system, monitoring and evaluation programs conducted by Chester Engineers and provides us with ready and direct access to the sophisticated tools necessary to assess the condition of existing sewer systems and define appropriate remedial actions as warranted.

Specialized sewer cleaning, inspection and repair equipment directly available to Chester Engineers through ETS include complete internal closed circuit television inspection units with internal grouting capabilities; sewer jets, cleaners, rodders and vactors; associated support vehicles; and related safety equipment. Monitoring of sewage flows is accomplished through the use of an inventory of flow measuring and recording equipment including Steven's and Manning depth recorders, flow velocity probes, and Marsh-McBirney flow depth and velocity measurement and recording

devices. Automated, timed and flow proportioned and/or composite sewage sampling can be accomplished using our inventory of ISCO automatic samplers. Rainfall data, which is important in the evaluation of wastewater flow rate data, is routinely obtained on-site using continuously recording Belford rain gages.

The complete range of sewer system monitoring and inspection equipment available to Chester Engineers allows our engineers to design and implement large scale and effective field investigations of separate and combined sewer system. The fact that our engineers routinely work closely with the same team of field supervisors and technicians increases our confidence in the reliability of the data obtained.

Word Processing Center

Chester Engineers' Word Processing Center is staffed by full-time operators and supervisors. The benefits of word processing include high quality output, simplified formatting, automation of repetitive documents, revision and update of documents quickly and input to the system via a variety of methods. Our internal communication network links the word processing center with our computer facilities, all departments at the corporate office and our branch offices. The center assists the technical staff in the production of reports, specifications, and operation and maintenance manuals, as well as the maintenance of our construction cost data base.

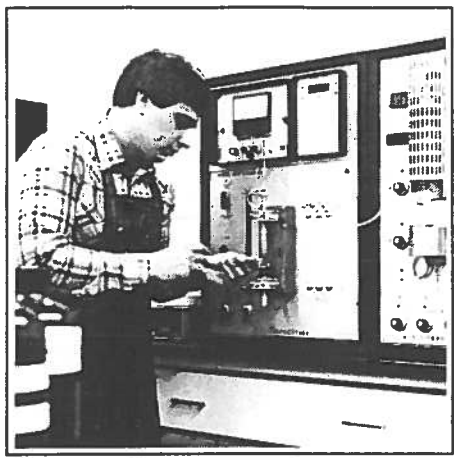
This capability permits us to respond rapidly to the word processing and document production needs of our clients while enhancing the quality and general appearance of the documents we produce on their behalf.

Chester LabNet

Chester Environmental Group's (CHESTER) laboratories provide a full range of analytical laboratory services, including: 1) inorganic, organic and microbiological analyses; 2) physical-chemical determinations; 3) bench scale treatability studies; 4) priority pollutant analyses for NPDES permits; and 5) RCRA EP toxicity tests.

The laboratories are fully equipped and include the following major items of equipment:

- Gas chromatograph/mass spectrometers equipped with Tekmar liquid sample concentrator, data system, libraries and tape storage
- Gas chromatographs equipped with flame, electron capture, electrolytic conductivity, and photo ionization detectors
- Organic carbon analyzer equipped with direct injection and ampule capabilities
- Atomic absorption units equipped with hydride generation, cold vapor and carbon rod
- ICP spectrometer for metal analysis
- Liquid chromatograph for organic analysis
- Zero head-space extractor



CHESTER's laboratories provide our clients with direct and easy access to laboratory services and confidence that Chester LabNet's trained laboratory technicians and computer assisted quality assurance/quality control program will produce accurate analytical results.

SERVICES OFFERED

The broad range of expertise offered by our staff and the variety and sophistication of the facilities at our disposal permits Chester Engineers to offer a complete range of environmental engineering, and related planning and architectural services. A listing of the services typically performed for our clients is presented in Table I-2.

Table I-2
The Chester Engineers
Catalog of Services Offered

- Planning, concept and final design, technical construction observation and operation services:
  - Stormwater management
  - Water supply, treatment, distribution and storage facilities
  - Wastewater collection, conveyance treatment and reuse facilities
  - Solid and hazardous waste handling, treatment and disposal faciities
- General facilities design
- Architectural studies and final design
- Sewer system evaluation and monitoring services
- Analytical laboratory services including GC/MS capabilities and the analysesrequired by the RCRA regulations
- Operations assistance: start-up, operator training, troubleshooting, monitoring, inspection, and the preparation of O&M Manuals
- Wastewater management reports
- Preparation of reports, permit applications and modules to meet state and EPA requirements
- Funding coordination and grants administration
- Financing and Rate Studies
- Water quality surveys and modeling studies
- Environmental assessments and impact statements
- Community and regional planning
- Water leak detection and hydraulic modeling

As is indicated by the list of services, Chester Engineers can function as a sole source supplier of all of the consulting environmental engineering services typically required by public and private sector clients. This broad capability allows us to fully respond to our clients' needs, maximize efficiency and assure consistency and quality control of the engineering services provided.

CLIENT PROFILE

The quality and breadth of the services offered have enabled Chester Engineers to serve a broad range and wide variety of public and private sector clients across the country. Chester Engineers has provided consulting engineering services to hundreds of public sector clients across the country. Our public sector clients typically include authorities, cities, boroughs, townships, counties and state and federal government agencies.

Our active public sector clients range in size from authorities serving as few as 100 customers to metropolitan areas such as the City of Pittsburgh Water and Sewer Authority, Allegheny County Sanitary Authority and the Metropolitan Government of Nashville and Davidson County. Chester Engineers' client base also includes more moderately sized cities such as Huntington, West Virginia, and the cities of Erie, Harrisburg and Uniontown, Pennsylvania. We have provided Act 167 stormwater management consulting services to the following Pennsylvania counties:

- Allegheny
- Armstrong
- Butler
- Crawford
- Erie
- Fayette
- Indiana
- Mercer
- Union
- Westmoreland

In addition, we have provided consulting engineering services to government agencies such as the Pennsylvania Public Utility Commission, Pennsylvania Department of General Services, the U.S. Naval Facilities Engineering Command, the U.S. Army Corps of Engineers, and the U.S. Department of Energy.

Private sector industrial clients include such major and diversified firms as Ashland Oil, Chrysler, IBM Corporation, General Electric Company, General Motors Corporation, Georgia-Kraft Company, Lockheed Corporation, McDonnell Douglas, U.S. Steel Corporation, Waste Management of North America and Weirton Steel.

SUMMARY

During the 80 years that Chester Engineers has been a leader in the consulting profession, we have earned a reputation for engineering excellence, cost effective performance and client satisfaction. This is evidenced by a high volume of repeat business.

Our clients reap the benefits of our experience because we communicate with them to fully understand and respond to their project needs. This interaction is done through the efforts of our diversified, highly qualified personnel using 90's technology and equipment.

Chester Environmental Group is committed to providing excellent service to small, large, new and "old" clients for projects requiring either conventional or sophisticated engineering technology and management procedures.

SECTION II

Demonstrated Commitment to Stormwater Management Planning

SECTION II
DEMONSTRATED COMMITMENT TO STORMWATER MANAGEMENT PLANNING

GENERAL

The Chester Engineers has over 80 years of experience in civil, sanitary and environmental engineering and planning. Much of this experience has been achieved in the area of stormwater management, including the following:

- Pennsylvania Act 167 Watershed Stormwater Management Plans
- Ongoing Act 167 Stormwater Management Plan administration assistance
- Special purpose stormwater management studies
- Storm sewer master planning
- Storm sewer design
- Watershed studies
- Non-point source pollution assessments
- Identification of best management practices for the control of non-point source pollutants
- Combined sewer overflow studies
- Runoff control facilities design

As a result of our long and diverse experience in stormwater management, Chester Engineers has developed extensive staff, facilities and equipment qualifications. Equally important, we have developed and demonstrated the ability to apply state-of-the-art technologies to achieve the completion of all aspects of stormwater management planning.

STAFF COMMITMENT TO PLANNING, RESEARCH AND DEVELOPMENT

The Chester Engineers' Planning and Studies Department and GeoSpatial Solutions Division include a staff of engineers and scientists whose primary responsibility includes the completion of stormwater analysis, modeling and planning projects. Resumes of individuals who serve as our lead stormwater consultants were provided in Section 7 of this qualifications statement. As indicated by the information provided in the resumes, Chester Engineers stormwater management consultants provide a broad range of academic training and experience.

One aspect of Chester Engineers' commitment to providing our clients with state-of-the-art stormwater management consulting service is our ongoing program of continuing staff education and participation in technology transfer. As is indicated in our staff resumes, personnel who participate in our stormwater management projects hold advanced degrees in related disciplines and/or have received ongoing training in stormwater management techniques. The technological strength of our staff is further evidenced by the number of professional papers which our staff members have participated in developing. Published papers include the following:

"An Application of Kriging to Rainfall Network Design." *Nordic Hydrology*. Denmark. 1988.

"Application of Remote Sensing and Geographic Information Systems in Assessment of a Storm Sewer Master Plan." Landuse Management Conference. Blacksburg, Virginia. 1990.

"Effect of Storm Distribution on Watershed Stormwater Management." Accepted for presentation at ASCE National Conference on Water Resources Planning and Management. New Orleans, Louisiana. 1991.

"Geographic Information System Application for Operational Modeling of Stormwater Runoff." Floodplain Stormwater Management Symposium. State College, Pennsylvania. 1988.

"Kriging in Spatial Analysis of Hydrologic Data." Masters Thesis. Asian Institute of Technology. Bangkok, Thailand. 1984.

"Optimal Interpolation of Rainfall Data by Kriging." *Journal of the Institution of Engineers*. India. 1986.

"Stormwater Management in Urban Collector Streams." University of North Carolina Water Resources Institute. Chapel Hill, North Carolina. 1986.

"The Use of Geographic Information Systems and Terrain Modeling in the Development of a Pennsylvania Stormwater Management Plan." 10th Annual American Geophysical Union Hydrology Days. Fort Collins, Colorado. 1990.

"The Use of Merged Imagery in GIS Database Development." Presented at 1989 ARC/INFO Users Group Meeting. Denver, Colorado.

"Use of Watershed Hydrologic Response in 208 Non-Point Source Planning." 14th American Water Resources Conference. Lake Buena Vista, Florida. 1978.

"Watershed Mapping Using Merged Thematic Mapper and SPOT Panchromatic Imagery." Geoscientific Information Systems Applied to Exploration and Research. *Denver GeoTech '89*. pp. 69-74.

CORPORATE COMMITMENT EVIDENCED BY FACILITIES AND EQUIPMENT PROVIDED

The facilities and equipment provided to our staff in support of their stormwater management activities is evidence of our corporate commitment to excellence in this field. Each of our staff members involved in stormwater management is personally equipped with an IBM PS/2 personal computer which is fully networked to all other members of the department. This computer equipment is used for the data processing, modeling, word processing and graphics production activities involved in the completion of stormwater management assignments.

In addition, Chester Engineers' Computer Aided Design/Engineering (CAD/E) capabilities are available to support our stormwater management efforts by providing digitization, map production and design assistance services. Available CAD/E equipment consists of an Intergraph microstation system, HP Series 48 central computer, Intergraph software, IBM and Hewlett Packard microcomputers, multicolor plotting facilities, interactive graphic terminals and a digitizing table.

Presentation graphics preparation services are provided by Chester Engineers' Visual Resources Department. Equipment employed includes two IBM PS/2 graphics work stations, ITEK graphics camera, QMS 300 DPI laser printer, Compugraphics typesetter and HP optical scanner. This equipment is used to produce high quality documents and graphics in support of our stormwater management planning efforts.

Chester Engineers, through our sister firm Environmental Technical Services (ETS), has access to a full range of stream and open channel flow measuring, rainfall gaging and water sampling equipment and the manpower necessary to use that equipment. The inventory of equipment operated by ETS includes Gurley open channel flow velocity meters, a full range of liquid level and flow measuring and recording equipment, automatic samplers and continuously recording precipitation gages.

COMMITMENT EVIDENCED THROUGH THE USE OF ADVANCED TECHNOLOGIES

Computerized Computation and Modeling

A key component of Chester Engineers' approach to our stormwater investigations and planning studies consists of maintaining and using a full compliment of computerized computational and modeling software. Due to the nature of the computations involved in estimating runoff and sizing stormwater management and control facilities, a wide variety of computer software has been developed. In order to be fully responsive to the various needs of our clients, Chester Engineers maintains a library of and working familiarity with a wide range of computational and modeling software. When circumstances warrant, we have developed new and/or customized existing software in-house to meet special needs and enhance effectiveness. This proprietary software is added to our library for use on future projects. A partial listing of the software maintained for use in conjunction with our stormwater activities follows:

- U. S. Corps of Engineers Flood Hydrograph Package (HEC 1)
- U. S. Corps of Engineers Generalized Computer Program for Water Surface Profiles (HEC 2)
- U. S. EPA Stormwater Management Model (SWMM)
- U. S. Soil Conservation Service Project Formulation - Hydrology (TR-20)
- U. S. Soil Conservation Service Urban Hydrology for Small Watersheds (TR-55)
- Penn State Runoff Model (PSRM)
- Chester Engineers Modified Penn State Runoff Model (CPSRM)
- Chester Engineers Rainfall Analysis Program (RAP)
- Multi-Stage Outlet Design and Routing Model (MSRM)
- Small Watershed Interactive Runoff Management Model (SWIRM)
- Penn State Urban Hydrology Model (PSUHM)
- Intergraph InRoads and InFlow storm drainage modeling and design software

Remote Sensing System Data Acquisition

An important parameter in stormwater modeling is land cover / land use. The accurate description of existing land cover / land use is a prerequisite for accurate stormwater modeling. The Chester Engineers has used remotely sensed data available from a the complete range of platforms to derive the land cover / land use information necessary for stormwater modeling, including the following:

- Traditional low level aerial photographs
- Color infrared high altitude aerial photographs acquired as part of the National Aeronautic and Space Administration's (NASA) National High Altitude Photography Program (NHAP)
- Landsat 5 Thematic Mapper (TM) multi-spectral satellite imagery providing a 30 meter ground resolution
- Specially ordered French SPOT Image Corporation SPOT1 panchromatic satellite images providing a 10 meter ground resolution

Remotely sensed data from these sources are preprocessed, enhanced and manually and/or digitally classified into land cover / land use categories. Expert system rule based queries have been used to extract additional information necessary to delineate industrial areas within urban areas, vegetation within urban areas and recent land cover changes.

Digital Data Acquisition

Since stormwater investigations by nature lend themselves to computer analysis, efficiency is enhanced when the basic data can be acquired in or economically transformed into digital form. The Chester Engineers has considerable experience in the use of such data. The Chester Engineers routinely uses ground slope and aspect information derived from United States Geologic Survey Digital Elevation Models (U.S.G.S. DEMs) and Defense Mapping Agency Digital Elevation Models (DMA DEMs); road, stream and municipal boundary information obtained from U.S.G.S. Digital Line Graphs (DLGs); and land cover information derived from the previously referenced satellite acquired data. These data are acquired in digital form, and as such can be readily incorporated into many computerized analysis applications.

Some important information is not available in digital form and must be digitized prior to use. We have experience in using information which has been digitized by both hand and scan digitization methods. Digitized themes frequently used by Chester Engineers in our stormwater modeling activities include watershed boundaries, soils information and wet-lands locations.

Geographic Information Systems Applications

Geographic Information Systems (GIS) are digital computer systems for capturing, processing, managing, displaying, modeling and analyzing geographically referenced spatial data. Since all of the basic data required for stormwater modeling are geographically referenced, GIS technologies are boon to stormwater management efforts. We make extensive use of GIS technologies in order to capture, organize and process the many layers of information necessary to complete stormwater modeling on any scale. The GeoSpatial Solutions division of Chester Engineers uses ERDAS™ and ARC/INFO™ GIS software to compile and process information and provide data to our specifications for direct input into our stormwater models. We have used this approach on a number of our projects to date. In every instance, the use of this technology has served to increase the amount and accuracy of the data provided while minimizing the cost of data processing.

SECTION III

Stormwater Management
Project Experience

SECTION III
STORMWATER MANAGEMENT PROJECT EXPERIENCE

PENNSYLVANIA ACT 167 STORMWATER MANAGEMENT PLANNING: PHASE I

Watershed stormwater management planning under Pennsylvania's Stormwater Management Act (Act 167) is a two phase process. The first phase consists of the preparation of a *Scope of Study*. The purposes of the *Scope of Study* is to establish plan outcomes that will meet the objectives of Act 167; determine the cost-effectiveness of study procedures; provide consistency between county planning efforts; and eliminate duplication of effort. The completed *Scope of Study* includes Phase II task descriptions; a time schedule for the completion of Phase II; descriptions of the level of effort required to complete major tasks; and cost estimates for the completion of Phase II. As such, the *Scope of Study* is an integral part of the plan, providing detailed guidance for plan development.

The value of consultant experience is at a premium in preparing the Phase I *Scope of Study*. To a large extent, decisions relative to plan approach and estimates of required levels of effort, time requirements and costs must be based upon the consultant's judgement guided by relevant experience. The Chester Engineers is pleased to have participated in the development of the following *Act 167 Scopes of Study*.

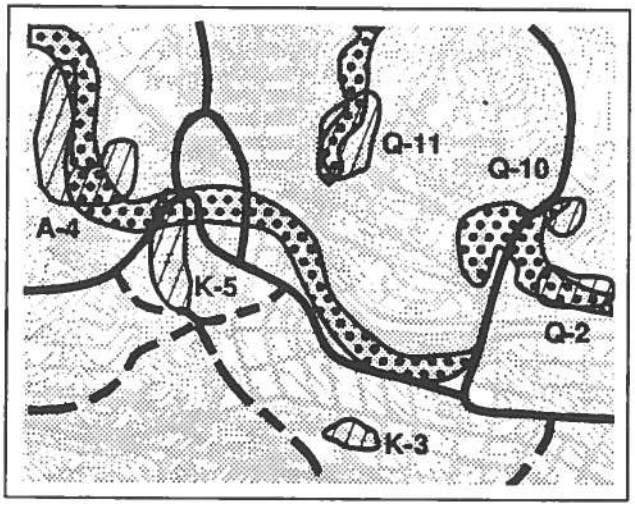
Glade Run Phase I Scope of Study

The Glade Run watershed is approximately 25 square miles in size. It is located in Armstrong County, Pennsylvania and encompasses land which is primarily rural in nature. The far northern portion of the watershed has been heavily stripped for coal, but the majority of the watershed remains forested or is used for agricultural purposes. Municipalities in the watershed report increasing interest in residential development. Recent construction of an industrial park in the area appears to signal the beginning of an increase in both commercial and residential development in the area. These conditions pointed to the advisability of completing Act 167 watershed stormwater management planning and placing recommended stormwater management controls into place prior to the advent of extensive development.

In 1986, The Chester Engineers, in cooperation with the Armstrong County Department of Planning, prepared the *Phase I Scope of Study for the Glade Run Stormwater Management Plan*. As required, the *Scope of Study* outlined the approach and procedures to be followed during the preparation of the Phase II Plan and developed associated cost estimates and anticipated completion schedules. The *Phase I Scope of Study* received the approval of Armstrong County and the Pennsylvania Department of Environmental Resources.

Turtle Creek Phase I Scope of Study

The Turtle Creek watershed is situated within Allegheny and Westmoreland counties in southwestern Pennsylvania. It encompasses approximately 150 square miles and includes all or portions of 30 municipalities. The Allegheny County portion of the watershed (roughly 1/3) is extensively developed into urban, commercial, industrial and residential land uses. The upstream, Westmoreland County portion of the watershed contains some urban concentrations, but also large tracts of undeveloped land. Flooding in areas of the Turtle Creek watershed has long been a problem. Act 167 planning was initiated to place necessary controls into place before anticipated future development exacerbates existing flooding problems.



The *Phase I Scope of Study for the Turtle Creek Watershed Stormwater Management Plan* was completed by Chester Engineers in 1987 in cooperation with the Allegheny County Planning Department and the Westmoreland County Conservation District. Due to the large size of the watershed and the diverse nature of land cover within the area, the Phase I investigations produced a work plan calling for the use of sophisticated remote sensing, image analysis and geographic information system technologies during Phase II. The *Phase I Scope of Study* was approved by Allegheny and Westmoreland counties and the Pennsylvania Department of Environmental Resources.

Conneaut Outlet Phase I Scope of Study

The Conneaut Outlet watershed is located in Crawford County, northwestern Pennsylvania. A total of nine municipalities are situated within the watershed which encompasses a drainage area of approximately 90 square miles. Factors of particular interest in this project are that a major lake (Conneaut Lake) is situated in the upper reaches of the watershed and a large swamp (Conneaut Marsh) occupies much of the lower area of the basin. The *Phase I Scope of Study* addressed the existence of these major hydrologic features by incorporating supplemental stream flow gaging and analysis activities designed to characterize the effects of these features on runoff and stream flow.

The *Conneaut Outlet Phase I Scope of Study* was completed in 1989 with the cooperation of the Crawford Planning Commission. The document has been approved by Crawford County and the Pennsylvania Department of Environmental Resources.

Breakneck Creek Phase I Scope of Study

The Breakneck Creek watershed is situated primarily within Butler County in western Pennsylvania. A small portion of the upper reaches of the watershed is in Allegheny County. A total of eleven municipalities lie in the watershed which encompasses approximately 43 square miles. This area is expected to develop at a rapid rate within the next five to ten years with large developments currently in the preliminary planning stages. This impending development was the major impetus for initiating the Act 167 planning process and was identified as a major concern to be addressed in the Phase II effort.

The *Breakneck Creek Watershed Phase I Scope of Study* was completed by Chester Engineers in cooperation with the Butler County Planning Commission in 1989. The report was approved by Butler County and accepted by the Pennsylvania Department of Environmental Resources.

Bull Run Phase I Scope of Study

The Bull Run watershed is located in southeastern Union County, Pennsylvania. The Bull Run watershed is contained in three municipalities and covers an approximately 7.5 square mile area. The predominant land use in the watershed is agriculture, which is mainly located in the central and western portions of the watershed. Residential, commercial and industrial land use is concentrated in the vicinity or Lewisburg, which occupies the eastern portion of the basin.

Chester Engineers, together with the Union County Department of Planning completed the *Bull Run Watershed Phase I Scope of Study* in 1990. The document was approved by Union County and the Pennsylvania Department of Environmental Resources.

Monongahela River Phase I Scope of Study

In 1990, Chester Engineers, in cooperation with the Allegheny County Planning Department completed the *Monongahela River Phase I Scope of Study* for the designated Monongahela River watershed in Allegheny County, Pennsylvania. The watershed encompasses approximately 106 square miles and all or portions of 34 municipalities. Much of the northern portion of the watershed is very highly urbanized. This includes the downtown, Golden Triangle and Oakland areas of the City of Pittsburgh and several extensively developed suburbs. Because development in these highly urbanized areas has essentially reached the saturation point, there is little need for hydrologic modeling for the purpose of developing standards and criteria for new development in such areas. The southern areas of the watershed, on the other hand, are much less densely developed and include large expanses of rural areas. In this portion of the watershed, the future development potential is high and the need for modeling is clear.

Based upon these considerations, the *Phase I Scope of Study* outlined a procedure for delineating those areas requiring differing levels of modeling and described the differing levels of effort and direction of emphasis to be followed in the urban (north) and suburban (south) portions of the watershed.

The *Monongahela River Phase I Scope of Study* was accepted by Allegheny County and approved by the Pennsylvania Department of Environmental Resources.

Redstone Creek Phase I Scope of Study

The Redstone Creek watershed is located in Fayette County in southwestern Pennsylvania. All or portions of eleven municipalities lie within the watershed which drains northward from the Uniontown area to the Monongahela River. Preparation of this *Phase I Scope of Study* is currently underway.

Shenango River Phase I Scope of Study

The Shenango River watershed lies in Crawford, Lawrence and Mercer counties in western Pennsylvania and portions of eastern Ohio. Portions of a total of 46 Pennsylvania municipalities lie within the basin. A notable feature of the Shenango River watershed is the fact that it contains several sizable flood control / recreational lakes. Outlining the procedures for accounting for the effects of these water bodies on stormwater runoff will be a major aspect of the *Phase I Scope of Study* which is currently under development.

PENNSYLVANIA ACT 167 STORMWATER MANAGEMENT PLANNING: PHASE II

Phase II is the final and major component of the watershed stormwater management planning process under Pennsylvania's Stormwater Management Act. The *Phase II Stormwater Management Plan* is the basis for the entire management system and ongoing stormwater management activities. The key elements of the *Phase II Stormwater Management Plan* include the following:

- Hydrologic and hydraulic modeling of the watershed to permit the rational development of stormwater management performance criteria reflecting local conditions.

- Development and definition of specific criteria and standards to be used in the management of stormwater with the watershed.

- Identification of the optimal institutional arrangement and procedure for implementing the plan on a watershed basis.

- Recommendation of specific activities which must be undertaken by each municipality in order to implement the plan on the local level. This includes the identification of key elements of required local ordinances and regulations.

The production of a technically sound *Phase II Stormwater Management Plan* requires that the consultant be expert the technical elements associated with hydrologic modeling and stormwater control. For the final plan to be capable of being implemented and workable, the consultant must also be experienced in working with local government officials and developing practical model ordinance provisions. We point to the following Act 167 *Phase II Stormwater Management Plans* as evidence of our expertise and experience in these fields.

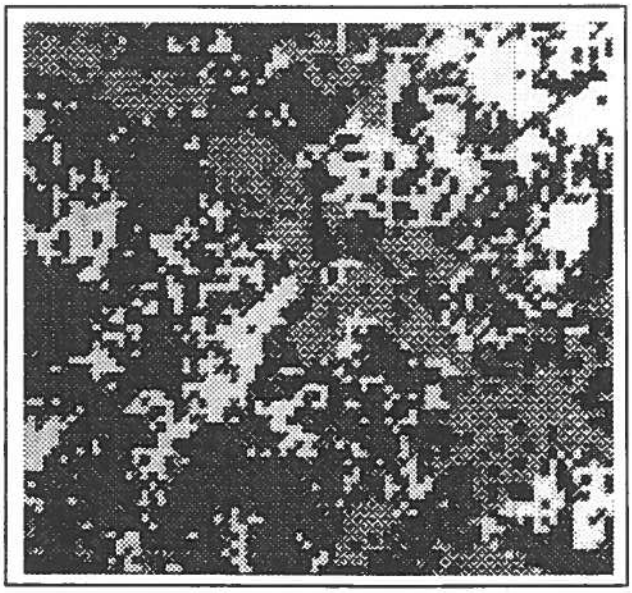
Glade Run Phase II Stormwater Management Plan

The *Glade Run Phase II Stormwater Management Plan* was completed and approved by the Pennsylvania Department of Environmental Resources in 1990. Data describing topography, soil types, land use patterns, stream characteristics, stream restrictions and flood prone areas were input to the Penn State Runoff Model to determine watershed hydrologic characteristics. Landsat Thematic Mapper (TM) and NASA High Altitude Photograph (NHAP) images were obtained and classified to identify land cover characteristics. This information was combined with digitized Soil Conservation Service soil maps using the ERDAS™ and ARC/INFO™ image processing and GIS systems to assign runoff curve numbers. This data was combined in the GIS with USGS digital elevation models to produce the data set required by the Penn State Runoff Model. Once calibrated the model, was used to develop watershed wide stormwater control standards and specific performance criteria applicable in 90 individual subbasins delineated throughout the watershed.

The Plan presents recommendations relative to the institutional measures to be taken to codify the identified standards and criteria defined by the technical elements of the Plan. None of the municipalities in the watershed had a subdivision/land development ordinance. Instead, the municipalities relied upon a county level subdivision/land development ordinance administered by the Armstrong County Department of Planning. In view of this situation, Chester Engineers recommended that the stormwater management requirements be incorporated into the county subdivision/land development ordinance and that reviews and approvals relative to developers' stormwater controls be performed on the county level. Specific language to be contained in the amended county ordinance was identified in the Plan.

Turtle Creek Phase II Stormwater Management Plan

The *Draft Turtle Creek Phase II Stormwater Management Plan* was completed in 1990. Digital satellite imagery obtained from the Landsat Thematic Mapper (TM) and SPOT1 satellite and infrared photos from the NASA National High Altitude Photography (NHAP) were used to delineate land cover classes in the watershed. This information was combined with digital terrain information, digitized watershed boundaries and soil group locations in the ERDAS™ and ARC/INFO™ geo-



graphic information systems to produce the data set necessary to perform the required hydrologic modeling using the Penn State Runoff Model.

The large size of the watershed and the desire to as closely as possible retain and reflect the actual stream topology in the construction of the model produced a large number of subbasins to be modeled (in excess of 500). In response, Chester Engineers modified the Penn State Runoff Model and used the modified version to speed data input, facilitate analysis of model output and permit simultaneous modeling of over 160 subbasins.

Watershed wide stormwater standards recommended and specific control standards were developed for each of the over 500 subbasins comprising the Turtle Creek watershed. A review of the current status of applicable ordinances revealed that the majority of the municipalities within the watershed operate under their own subdivision/land development ordinances. However, most of the existing ordinances are deficient in specific stormwater management provisions. In order to retain the current institutional structure, the Plan recommended that implementation be achieved through local municipal ordinances. The Plan presented model local ordinance provisions to be used by each municipality to bring existing ordinances into compliance. In order to encourage consistent application of the stormwater management system across municipal and county boundaries, the Plan recommended that the Allegheny County Department of Planning and the Westmoreland Conservation District perform an ongoing review and comment function during plan implementation and administration.

Conneaut Outlet Phase II Stormwater Management Plan

The *Conneaut Outlet Phase II Stormwater Management Plan* is currently under development.

Monongahela River Phase II Stormwater Management Plan

The *Monongahela River Phase II Stormwater Management Plan* is currently under development.

Bull Run Phase II Stormwater Management Plan

The *Bull Run Phase II Stormwater Management Plan* is currently under development.

MISCELLANEOUS STORMWATER INVESTIGATIONS

The Chester Engineers has been involved in a number of stormwater investigations apart from our Act 167 stormwater management activities. These investigations include watershed wide studies roughly paralleling Act 167 plans; investigations into site specific problems; and investigations preparatory to the design of drainage facilities.

Broadway Interceptor Area Stormwater Management Plan

Under contract to the Char-West Council of Governments, Chester Engineers developed a stormwater management plan for the Broadway Interceptor drainage area in the McKees Rocks Borough, and Stowe and Kennedy township areas in southwestern Pennsylvania. This project incorporated most of the elements of an Act 167 stormwater management plan. It included the analysis of existing conditions, use of the Penn State Runoff Model for peak flow computations, the development of engineering alternatives and the establishment of the necessary institutional structure necessary for plan implementation.

Lewis Run Hydraulic and Mapping Study

The Chester Engineers completed a hydraulic and mapping study of the Lewis Run watershed in southwestern Pennsylvania in order to develop the database required for further stormwater management planning. A significant portion of this investigation involved the development of a stormwater drainage map of the entire watershed. A detailed stream survey was conducted to identify existing problem areas and to determine the hydraulic capacities of major stream crossings.

Franklin Park Borough Runoff Control Study

This study consisted of the inspection and analysis of all existing stream obstructions within the Rippling Run and Lowries Run watersheds in the Borough of Franklin Park, Pennsylvania. Baseline and future runoff conditions were established using aerial photography, USGS topographical maps and the Penn State Runoff Model. Existing problem areas and potential future problems were identified using the model. A ten year implementation plan consisting of recommended improvements to the stormwater system was developed. A stormwater management ordinance and related regulations and standards to implement stormwater control for future development were also developed as part of the study.

Fox Hollow Stormwater Management Plan

Fox Hollow is a 2+ square mile watershed in Williamsport, Pennsylvania which is divided into three main land use types. The steeply sloped headwater area is suburbanizing, with increasing peak flows causing channel erosion. The central portion is an older, residential area with undersized stream culverts. The lowest portion is a very flat, prime industrial area that experiences frequent flooding. For water to exit the area, it first must pass through inadequate highway culverts and the Susquehanna River Flood Level System. A comprehensive stormwater management plan that addresses existing and projected future stormwater handling requirements was developed.

The hydrologic design was based on computer simulations using the Penn State Runoff Model. The structural alternatives evaluated included diversions, flood water detention basins, flood pumping stations, and conventional interior storm drainage facilities. The project also addressed the need for on-site runoff controls for both existing and new development. The recommended implementation plan included preliminary construction cost estimates and a prioritized implementation sequence.

Town of McCandless Stormwater Master Plan

The Town of McCandless is a rapidly growing community near the City of Pittsburgh, Pennsylvania. The Town encompasses approximately 20 square miles and contains four separate watersheds. The Chester Engineers, under contract to the Town, developed a master plan providing direction and guidance to managing runoff from the rapidly developing areas of the municipality.

The scope of services included an investigation of rainfall intensity, development of existing and projected land uses, calculation of the resulting quantity of stormwater runoff and subsequent implementation of the plan. The plan, which was developed for each watershed, provides the municipality with the recommended measures to be taken to control urban stormwater runoff.

Port Allegany Stormwater Master Plan

The Borough of Port Allegany has only a rudimentary stormwater drainage system. Most surface water drainage is through open ditches. The portion of the piped drainage system that does exist has capacity restrictions where it passes under buildings and railroad tracks. The Master Plan developed by Chester Engineers provided a conceptual design of a completely new storm sewer system for the entire Borough. The design objective was to divert as much water as possible away from the business and industrial areas that were experiencing flooding. Since the site evaluation indicated virtually no opportunities for on-site stormwater management techniques, the project was conducted in a traditional storm sewer planning framework. The project report presented line capacities, sizes and grades as well as cost estimates and implementation priorities.

Assessment of Huntington Storm Sewer Master Plan

The Chester Engineers has been privileged to have served the City of Huntington, West Virginia for many decades. In 1947, Chester Engineers prepared a *Master Plan for Storm Sewers* for the City. Available funds has limited the extent to which of the recommended storm sewer system has been constructed. However, recent efforts are being made to proceed with the construction of needed storm sewer facilities. Upon our recommendation, Chester Engineers conducted a review of the procedures employed and land cover and rainfall data used during the preparation of the 1947 Plan to determine whether duplication of the detailed and expensive investigations could be avoided. The original sewer design was based upon the Rational Method which computes stormwater runoff from land cover and design storm precipitation characteristics. Therefore, our assessment of the continued validity of the Plan was based upon our assessment of the validity of the rainfall data and land cover statistics employed in 1947.

The rainfall intensity-duration curves used in 1947 were compared to current design standards and were found to reasonably conform. An analysis of current land cover and land use was carried out to determine the current percent impervious statistics for comparison to the 1947 estimates. This analysis was performed using a combination of digital and analog methods of analysis combined in a rule based expert system query. The basic information used to classify land use was obtained from a SPOT panchromatic scene and NASA National High Altitude Photography (NHAP) program photographs. In was determined that the estimates used in the 1947 analysis were sufficiently accurate to validate their continued validity for 37 of the 48 sewer districts in the City. The report concluded that there is no need to duplicate the calculations in the 37 sewer districts, which permits rapid and economical progress to the design phase for those areas of the City.

HEC 2 Analysis of Spring Creek Channel Relocation

The relocation of a portion of the Spring Creek channel is an aspect of an interceptor sewer construction project designed by Chester Engineers for the Harrisburg, Pennsylvania Authority. In support of the acquisition of necessary permits, Chester Engineers conducted an analysis of the effects of the channel relocation upon water surface profiles and 10, 50, 100 and 500 year floodways. This was accomplished by obtaining the HEC 2 models used in the development of the Flood Insurance Study for the area. The models were modified to reflect the proposed channel alterations and run to determine changes to water surface profiles. This analysis determined that the proposed channel relocation will not adversely affect water surface profiles nor expand the floodway.

Chartiers Creek Interceptor Capacity Study

The Allegheny County Sanitary Authority's Chartiers Creek Interceptor conveys wastewater collected in 22 municipalities in Allegheny County, Pennsylvania. Wastewater conveyed by this interceptor is collected by a combination of separate sanitary and combined sewer systems. The Chester Engineers is in the process of completing an assessment of the capacity of this interceptor in order to define options available relative to expansion of the current service area and the reduction of combined sewer overflows through the acceptance of additional stormwater runoff. We are using the U. S. Environmental Protection Agency's Stormwater Management Model (SWMM) to simulate existing and future dry and wet weather flows from the current tributary area, model the performance of the interceptor and assess the reserve capacity of the facilities.

Assembly of the hydrologic characteristics database is being accomplished using the remote sensing, image analysis and GIS techniques we employ as standard procedure during our Act 167 stormwater management planning activities. The database will be expanded to include demographic information necessary to estimate dry weather wastewater flows under SWMM. This will be accomplished by digitizing U.S. Census Tract boundaries and overlaying the associated demographic statistics over identified sewer system boundaries in the GIS environment.

STORMWATER CONTROL PLAN REVIEW SERVICES

A key element of stormwater management plans is the ongoing review of developers' proposed stormwater control facilities at the local and county levels of government. It is important to the success of the overall stormwater management plan that the control facilities actually constructed are designed in conformance with the plan's standards and criteria. The Chester Engineers provides consulting services in support of such review activities as illustrated by the following examples.

Allegheny County Plan Review Services

The Chester Engineers provides stormwater control plan review services to the Allegheny County Department of Planning. These services include the review of stormwater control plans submitted by land developers under the requirements of existing stormwater management plans in the County. Our assessment of compliance with the plan requirements is used by the County as the basis for recommending approval or disapproval of the developers' submittals. This ongoing service provides Chester Engineers with an awareness of current stormwater management practices. In addition, it provides us with valuable experience with the interpretation and application of stormwater management criteria, standards and ordinances.

Martinsburg Plan Review Services

As the City of Martinsburg, West Virginia's consulting engineer, Chester Engineers conducts detailed engineering reviews of all site development plans to ensure that proposed facilities will meet the standards established by the City's stormwater management ordinance.

STORMWATER CONTROL FACILITIES DESIGN

Stormwater control facilities constructed in support of land development are the bottom line in stormwater management. These facilities perform the function of implementing the runoff control standards and criteria developed by stormwater management plans and codified in stormwater management ordinances and regulations. The following are examples of Chester Engineers experience in the design of such facilities.

McIntyre Hospital Stormwater Control Facilities

The objective of this project was the development of an overall stormwater control system for the project site which would meet the stormwater management principle of no increase in peak runoff following development. This was accomplished through a system of swale drainage ditches and conventional storm sewers which terminate in a large underground storage culvert. The facility was designed as an off-line structure to permit low flows to bypass the primary structure to reduce sedimentation and corrosion from winter road treatment chemicals. The outlet was designed with multiple releases to permit only the predevelopment peak flow rate for all storms up to the specified design storm. Storm flow in excess of the outflow rate is stored and released gradually as inflow decreases. The Chester Engineers worked closely with the landscape architect so that the stormwater control facilities were integrated with the overall site grading plan for maximum aesthetic benefit.

McDonald's Corporation Stormwater Detention Facilities

The Chester Engineers was responsible for the design of a stormwater management facility to limit post-development peak discharges to predevelopment levels. This was achieved through the use of oversized pipe with reduced outlet capacity. This represents a simple but effective means of achieving the detention storage capacity necessary to reduce peak discharge rates within the framework of a conventional storm sewer system for a single lot development.

Cerro Copper Products Company Stormwater Facilities

This project consisted of the design of facilities to collect stormwater and process water generated on an industrial site, store it as necessary to minimize peak discharge rates and pump it to an existing municipal sewer system. The final design provides underground storage of approximately one million gallons and a pump station capable of discharging 9,000 gallons per minute of wastewater to the municipal system. Approximately 1,600 linear feet of box culvert provides approximately 60% of the storage volume. This system will prevent surcharge from the system back into the collection system for storms up to the ten year return frequency. Longer return frequency storms will require the use of temporary additional pumping capacity or collection system surcharge.

STORM SEWER DESIGN PROJECTS

The Chester Engineers has a long history of successfully designing traditional storm sewer system. The following are descriptions of representative municipal storm sewer design projects.

Forty-Fort Borough Storm Sewer Facilities

This Federal Department of Housing and Urban Development project located in northern Pennsylvania included the design of approximately 35,000 feet of 17 inch to 84 inch storm sewers and appurtenances. The scope of work also included surface restoration and reconstruction of streets, curbs, trees, lawns and sidewalks. Engineering services provided by Chester Engineers included preliminary survey and design, final design and plans, general project services during construction and resident inspection.

City of Huntington Storm Sewer Facilities

The Chester Engineers was responsible for the design of this stormwater collection system project for the City of Huntington, West Virginia. This project consisted of:

- Construction of 72 inch main outfall sewers, including headwalls, sluice gates, sluice gate chambers, bridges, piers, other appurtenances and all work required for the removal and restoration of a concrete flood wall.

- Construction of all storm sewers, junction chambers, manholes, catch basins and other appurtenances located along Second Street.

- Construction of the main storm sewer and appurtenances located along Ninth Street, Eleventh Street and all tributary lines.

- All sewers and appurtenances located west of Eighth Street and south of relocated Second Avenue and a 54 inch storm sewer in Second Avenue.

City of Williamsport Storm Sewer Facilities

This project consisted of the construction of approximately 30,000 feet of storm and sanitary sewers. The storm sewers consisted of reinforced concrete (18 inches to 66 inches in diameter), and horizontal elliptical (34 inches by 53 inches to 68 inches by 106 inches in size) pipe. Street reconstruction and surface restoration was also performed. Engineering services included master plan preparation, design and general project services and resident project services during construction.

SUMMARY

The Chester Engineers has a long history and extensive experience in all aspects of stormwater management planning and facilities design. This, coupled with our commitment to remaining at the forefront of the application of developing technologies, uniquely qualifies Chester Engineers to provide state, county and local governments with quality stormwater management consulting services.

SECTION IV

Description of Remote Sensing and Geographic Information System Capabilities

SECTION IV
DESCRIPTION OF REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM CAPABILITIES

GENERAL

The Chester Engineers, through its GeoSpatial Solutions Division offers full service remote sensing, geographic information and image processing services ranging from software development, system design and final data processing. Chester Engineers' GeoSpatial Solutions Division translates our clients' needs into the optimum solution by considering all aspects of information requirements, available data, state-of-the art software, equipment and analysis alternatives. Because of GeoSpatial Solutions' demonstrated expertise in remote sensing technologies and custom software development we are much more than a "computer mapping" company. We offer our clients the complete package of remote sensing, data acquisition, image analysis and geographic information system (GIS) processing capabilities necessary to efficiently bring these technologies to bear on the solution of immediate and real problems.

GeoSpatial Solutions uses a variety of computing tools to solve the problems presented in natural resource management, terrain analysis, planning and impact assessment projects. Services offered include acquisition and analysis of Landsat, SPOT, AVHRR, Seasat, SAR, DMSP, and passive microwave imagery. GIS processing is accomplished using ARC/INFO, MOSS, MAPS, GRASS, IDRISI and EPPL7 software packages. Image analysis is carried out using ERDAS and ELAS. Data are entered into these software systems using both manual and automated digitizing techniques. GIS and image processing packages are supplemented with software developed by GeoSpatial Solutions to translate data and provide additional procedures unavailable in commercial packages.

In addition to the application and development of state-of-the-art GIS and remote sensing techniques, GeoSpatial Solutions provides system development and support. Our staff has extensive experience in all aspects of specification, development and maintenance of GIS and image processing software and hardware.

REPRESENTATIVE PROJECTS

The following are brief descriptions of recent projects conducted by the GeoSpatial Solutions Division of Chester Engineers.

Mapping and GIS Analysis for Planning and Stormwater Management

Our recently completed and on-going Act 167 Stormwater Management Planning efforts are supported by GeoSpatial Solutions' development of digital geographic databases for land use planning and input into the hydrologic models employed. These efforts include acquisition and processing of aircraft and satellite imagery (National High Altitude Program photographs, digital SPOT imagery and multispectral Thematic Mapper data) and digital elevation data to provide terrain and land cover information for subbasins within the watersheds under study. Digital image enhancement, multispectral classification and GIS techniques are used to combine the various types of data and to extract the information needed to define hydrologic conditions within the watersheds. Other classes of information such as hydrologic soils groups, transportation networks and administrative boundaries are captured using a combination of scan- and manual digitizing techniques. The resulting vector data are converted to raster form and included in the digital database. Image processing and GIS analysis activities are performed using the ERDAS and ARC/INFO systems.

Satellite images and aerial photographs are used to provide land cover information. Soil units digitized from Soil Conservation Service (SCS) soils plats and terrain calculated from USGS digital elevation models are combined to yield estimates of representative slopes, overland flow lengths, tributary areas, percent impervious surface coverage and SCS runoff curve numbers. Other information provided in the databases includes roads, hydrography and political boundaries.

Data acquisition and GIS analysis activities were furnished in support of the completed Phase II Act 167 Stormwater Management Plans for the 150 square mile Turtle Creek Watershed and the 25 square mile Glade Run Watershed. Similar activities are in progress in support of our on-going Phase II Act 167 Stormwater Plans for the 90 square mile Conneaut Outlet Watershed, 7.5 square mile Bull Run Watershed and 106 square mile Monongahela River Watershed.

Remote sensing and GIS techniques have also been used in the preparation of an update and assessment of a Storm Sewer Master Plan for the City of Huntington, West Virginia, the development of a Master Water Plan for West Deer Township, Pennsylvania and the evaluation of the capacity of the Allegheny County Sanitary Authority's Chartiers Creek interceptor. In each of these cases, the attributes of a variety of data sources and the capabilities of remote sensing and GIS technologies were melded in applications supporting classical civil/environmental engineering and planning projects.

Large-Area Database Development

GeoSpatial Solutions' staff have been responsible for the creation of geographic databases for areas covering as much as 2,000,000 acres in the western U.S. These databases typically included contiguous digital elevation data sets created from mosaicked digital elevation models, land cover information derived from Landsat multispectral classifications, and other information collected by digitizing and rasterizing hydrographic, transportation, soils, and administrative themes.

GIS Terminal Configuration for the United States Bureau of Indian Affairs

GeoSpatial Solutions was responsible for configuring three high-performance workstations for use as Geographic Information Systems Graphics Terminals by local offices of the U.S. Department of the Interior Bureau of Indian Affairs. This work integrates with the Map Overlay and Statistical (MOSS)/Map Analysis Package (MAP) family of software. The principal use of these GIS terminals is for use with MOSS/MAP and associated GIS software but they also provide for local office automation processing such as word processing, database management, spreadsheet and project management. In this way, the microcomputers can be put to maximum use for both office and technical work. The terminals are also integrated with graphics devices such as laser printers and pen plotters.

Alaska Initial Attack Management System

GeoSpatial Solutions developed and implemented an operational initial Attack Management System for the U.S. Department of the Interior Bureau of Land Management (BLM) Alaska Fire Service. This system was required to interface with the Department of the Interior's Map Overlay and Statistical (MOSS)/Map Analysis Package (MAP).

The project involved the development of a new, special purpose geographic information system (GIS) to augment the capabilities of MOSS/MAP. The system required the integration of data from a wide variety of disparate data sources into a comprehensive GIS. Data from Automated Lightning Detection System (ALDS) and Remote Automated Weather Stations (RAWS) as well as digital terrain data, wildfire fuel types and fire suppression status can be integrated using this system. The system interfaces with the U.S. Forest Service fire modeling program BEHAVE. Compatibility with MOSS/MAP is maintained throughout the system. The system integrates a wide variety of functionality via extensive use of macros to assist applications processing. The final product is a comprehensive Initial Attack Management System to address the specific information needs of BLM's fire suppression activities in Alaska.

Quick Response Atlas and Terrain Mapping for Fire Departments

Fire departments require accurate and up-to-date information on residences in their districts. In addition, fire departments with the responsibility for controlling wildfires and fires in the wildland/urban interface can benefit from terrain and fire fuels information. Using the ARC/INFO GIS system and digital data from a variety of sources including local planning agencies, United States Geological Survey (U.S.G.S.) Digital Line Graph (DLG) files, U.S. Census TIGER files, digital terrain models and aerial photographs, GeoSpatial Solutions has developed maps and a digital data base for the Cherryvale Fire Protection District in Boulder, Colorado. The resulting digital information is easily updated and can be used to provide a variety of data and map types.

I2S WS Function for Workshop Processing of Classified Images

GeoSpatial Solutions developed a new image processing capability for the U.S. Department of the Interior Bureau of Land Management (BLM) at their Denver Service Center. Using the local hardware processing capabilities of the International Imaging Systems (I2S) Model 70 Image Display, we developed a capability for interactively roaming, zooming and pseudocoloring a classified image. This capability did not previously exist and was required for rapid assessment of classified imagery by field personnel in land cover mapping.

The importance of image classification workshops for field office personnel cannot be overemphasized. Any capabilities of the image processing system which will improve the flow of classification and evaluation process is a great asset in the mapping process. Through effective software development techniques and an in-depth understanding of the information requirements of field personnel, this software development effort significantly improved the BLM's workshop display capabilities.

BLM Wyoming Coal Verification Work

GeoSpatial Solutions recently conducted a project for the U.S. Department of the Interior in Wyoming to develop and implement a Coal Production Verification System. This system integrates a dBase III+ application developed on an IBM PC with the MOSS/MAP software to provide true relational database management capabilities integrated with GIS capabilities. The system also interfaces with a digital photogrammetric system for the verification of volumes removed from coal mines. Other software required by geologists and mining engineers is also available as part of this system. The system is unique in that it integrates a wide variety of public domain and commercial software to address the problem of coal production verification in a comprehensive manner.

MOSS Symbols Software

GeoSpatial Solutions recently completed major revisions to the Department of the Interior Bureau of Land Management's MOSS software for mapping symbol generation and management. This work involved the development and implementation of new mapping symbols and re-writing of the software to permit more user flexibility in managing MOSS mapping symbols.

The software has provided a MOSS/MAP capability previously unavailable to users. It combines several FORTRAN 77 routines with a macro driver to facilitate easy use. The software integrates a wider selection of mapping symbols including oil and gas symbols with a convenient method for the management and addition of mapping symbols by the MOSS/ MAP user. The result is an easy to use facility for the creation of maps of superior readability.

MOSS/MAPS Slope, Aspect Enhancement

GeoSpatial Solutions performed a number of software enhancements to the MOSS/MAP software and used extensively by the U.S. Department of the Interior. These enhancements were requested of GeoSpatial Solutions by the Department of the Interior Bureau of Land Management because of GeoSpatial Solutions' extensive experience with this software and a proven record of transforming resource information requirements to effective information systems capabilities. One such enhancement includes modification of the MOSS/MAPS slope/aspect function to provide several options for masking or interpolating missing or invalid data.

DEM Arc-Second Import Command for MOSS/MAPS

GeoSpatial Solutions developed a command for the MOSS/MAPS package to permit transfer and reformatting of 1:250,000-scale digital elevation models (arc-second Defense Mapping Agency data) as supplied by the U.S. Geological Survey. The import command extracts header information and converts the DEM-format data into standard MAPS cell files.

Projection-Change and Resampling Command for MOSS/MAPS

GeoSpatial Solutions built a MAPS command to allow conversion of MAPS cell files between a variety of different map projections. Second-order transformations are created to predict grid positions between input and output maps and one of several available resampling techniques are used to fill the output map.

MOSS Point to Polygon Distance Determination

GeoSpatial Solutions recently completed the development of a new MOSS software capability to permit the calculation of distances between point locations and polygonal areas. This capability was previously unavailable to Department of the Interior agencies and was required for a number of geological analyses.

PC/MOSS

GeoSpatial Solutions recently completed the conversion of elements of the MOSS software system from the minicomputer environment to the Personal Computer environment for the U.S. Department of the Interior. This new software development, in combination with increased cost effectiveness of Personal Computer hardware for technical data processing, will permit the use of Geographic Information Systems (GIS) technology by organizations which previously could not afford such an approach to mapping needs.

Cartographic Output Systems Survey

GeoSpatial Solutions recently completed a comprehensive survey of computerized cartographic output systems for the U.S. Department of the Interior Bureau of Land Management. This survey investigated the software systems available and reported technical details of the relative merits of the various systems to suit the needs of the Bureau. This effort provides further evidence of GeoSpatial Solutions' leadership position in computer applications to the mapping sciences. The performance of efforts proves beneficial to GeoSpatial Solutions' goal of remaining well informed of the state-of-the-art.

Bureau of Indian Affairs On-Site Support

For several years, GeoSpatial Solutions provided full time on-site technical support to the U.S. Department of the Interior Bureau of Indian Affairs *Geographic Information Systems and Remote Sensing Program.* This program provides computerized mapping services nation-wide to assist in the effective collection, assimilation, analyses, interpretation and reporting of land use information. The role of GeoSpatial Solutions in this program ranged from computerized mapping systems hardware and software support to specialized applications projects requiring a comprehensive understanding of a wide range of spatial data handling techniques.

Bureau of Indian Affairs ERDAS™, ELAS, ARC/INFO™, MOSS On-Site Support

GeoSpatial Solutions was responsible for acquiring, installing and supporting the remote sensing and GIS systems (ERDAS, ELAS and ARC/INFO) currently installed for the U.S. Department of the Interior Bureau of Indian Affairs GIS activities. GeoSpatial Solutions staff have attended ERDAS and ARC/INFO training and information sessions and fully understand the operation, file structures and data transfer requirements of each system.

Custom GIS and Data Analysis Services for Arctic Sea-Ice Information

Unique applications often yield data sets that require specialized processing and services. GeoSpatial Solutions has provided such services to Arctic Analysts, Inc. to analyze satellite derived information on sea-ice in the Arctic. Tasks include specialized software to convert data to ARC/INFO format and analysis in combination with satellite imagery.

University of Colorado GIS Class Instruction

GeoSpatial Solutions personnel have participated in lectures for the benefit of a University of Colorado course in GIS and Computerized Cartography. GeoSpatial Solutions staff provides expert training in such work and their insights and experiences prove useful to those anticipating the use of these technologies. GeoSpatial Solutions personnel have instructed the GIS and Computerized Cartography classes offered to seniors an graduate students in Geography at the University of Colorado. The nature of this training is much like that needed by many other organizations considering involvement in GIS work. GeoSpatial Solutions has provided this and similar training to other organizations as part of the technology transfer often associated with major projects.

Bureau of Land Management GIS and Remote Sensing Training

GeoSpatial Solutions has given training to U.S. Department of the Interior Bureau of Land Management personnel in the areas of geographic information systems and remote sensing. In particular, this training addressed the application of Department of the Interior systems to natural resource management information needs. Topics covered included the use and management of GIS and digital image processing systems, digital image processing techniques, and GIS techniques.

On-Going Research and Development

GeoSpatial Solutions typically maintains a variety of research and development activities designed to improve project performance, expand capabilities and maintain the professional development of staff members. Current work includes investigation of geo-rectification of vector data using least-squares transformations, application of point-spread functions to the reconstruction of resampled satellite imagery, integration of GIS capabilities with existing runoff models, improved methods of constructing topological information from scan-digitized data and investigation of combining multispectral, multi-sensor imagery to provide data across a broad range of the energy spectrum. The following is a listing of technical papers published by GeoSpatial Solutions personnel.

"An Assessment of SPOT Simulator Data for Rangeland Resource Mapping" *SPOT Simulations Handbook.* SPOT-Image Corporation. 1984.

"Application of Remote Sensing and GIS in Assessment of Storm Sewer Master Plan." International Conference on the Application of GIS and Knowledge Based Systems for Landuse Management. Virginia Polytechnic Institute and State University. Blacksburg, Virginia. 1990.

"Arctic Sea Ice Characteristics and Associated Atmosphere-ice Interactions." *Geojournal.* 1989.

"Cloud Classification from Satellite Data Using a Fuzzy Sets Algorithm: A Polar Example." *International Journal of Remote Sensing.* 1988.

"Cloud Classification of Merged AVHRR and SMMR Arctic Data with Neural Networks." *Photogram. Eng. Rem. Sens.* 1989.

"Comparison of Nimbus 7 Scanning Multichannel Microwave Radiometer Radiance and Derived Sea Ice Concentrations with Landsat Imagery for the North Water Area of Baffin Bay." *J. Geophys. Res.* 1988.

"Digital and Manual Analysis of Seasat-A Synthetic Aperture Radar Data" Report 120/OR. Office for Remote Sensing of Earth Resources. Pennsylvania State University. University Park, Pennsylvania. 1981.

"Geographic Information System Application for Operational Modeling of Stormwater Runoff." Floodplain/Stormwater Management Symposium. University Park, Pennsylvania. 1988.

"Impacts of High Resolution Data on an Operational Remote Sensing Program." 10th Symposium on the Remote Sensing of the Environment. LARS. Purdue University. 1983.

"Import of Scan Digitized Data into PC-MOSS: A Case Study." 4th MOSS Users Workshop. Denver, Colorado. 1987.

"Interannual Variability of Short-period Changes in Sea Ice and Atmospheric Conditions in the Canada Basin." Second Conference on Polar Meteorology and Oceanography. Madison, Wisconsin. 1988.

"Merging AVHRR and SMMR Data for Remote Sensing of Ice and Cloud in Polar Regions." *International Journal of Remote Sensing*. 1989.

"Problems of Cloud Cover Analysis in Polar Regions." Abstract in Clouds in Climate II Workshop. World Climate Program. Columbia, Maryland. 1987.

"Remote Sensing in Antarctica and the Southern Ocean: Applications and Developments." In Press, *Antarctic Science*.

"Short-term Interactions Between Atmospheric Synoptic Conditions and Sea Ice Behavior in the Canadian Basin." *Annals of Glaciology*. 1989.

"The Use of GIS and Terrain Modeling in the Development of a Pennsylvania Stormwater Management Plan." 10th Annual American Geophysical Union Hydrology Days. Fort Collins, Colorado. 1990.

"The Use of Merged Imagery in GIS Database Development." ARC/INFO Users' Group Meeting. Denver, Colorado. 1989.

"Watershed Mapping Using Merged Thematic Mapper and SPOT Panchromatic Imagery." Geoscientific Information Systems Applied to Exploration and Research. *Denver GeoTech '89*.

SECTION V

Key Personnel

SECTION V
KEY PERSONNEL

The following pages contain resumes of Chester Engineers' staff members who will be available for assignment to stormwater management planning projects.

JOHN M. MASLANIK

Senior Engineer

Education

B.S. in Civil Engineering, 1974, University of Pittsburgh

Short Course and Symposium, Computational Methods in Stormwater Management, 1986, The Pennsylvania State University

Responsibilities

Mr. Maslanik is a member of the Planning and Studies Department with primary responsibility for the preparation of stormwater management and drinking water distribution system modeling assignments.

Experience

Mr. Maslanik served as Project Manager during the completion of *Phase I Act 167 Stormwater Management Plan Scopes of Study* for six watersheds in Pennsylvania: 1) Glade Run watershed; 2) Turtle Creek watershed; 3) Conneaut Outlet watershed; 4) Breakneck Creek watershed; 5) Monongahela River watershed; and 6) Bull Run watershed. His activities in conjunction with the preparation of these documents included the evaluation of current condition, design of appropriate planning approaches and estimation of scheduling, staffing and cost requirements. He also served as project manager during the completion of the *Phase II Act 167 Stormwater Management Plan for the Turtle Creek Watershed.* This Plan encompasses an nearly 150 square mile watershed located in Allegheny and Westmoreland counties, Pennsylvania. During this project, Mr. Maslanik directed the development of modifications to the Penn State Runoff Model and the application of remote sensing and geographic information system technologies for the acquisition, management and analysis of the data necessary to conduct comprehensive modeling of the entire watershed. He was directly responsible for the assembly, use and interpretation of results of the Penn State Runoff Model for the Turtle Creek watershed.

Previously, Mr. Maslanik served as Project Engineer during the preparation of a 1977 *Master Water Plan* and 1986 *Master Water Plan Update* for the Metropolitan Government of Nashville and Davidson County, Tennessee. These plans recommended phased, twenty-five year programs of system improvements and extensions including over 200 miles of water mains and in excess of 20 million gallons of storage capacity. He recently completed a Pennsylvania Public Utility Commission (PUC) sponsored investigation of reported water quality problems with a major Pennsylvania privately owned water utility serving over 420,000 persons. This investigation included analyses of water quality complaints, water quality parameters and current treatment and distribution system operating procedures. This study presented recommendations for enhanced treatment and improved operating procedures which served as the basis fro subsequent PUC directives.

(continued)

"Computerized Evaluation of Water-Supply Reliability", 1990, *IEEE Transactions on Reliability*, Vol. 39, No. 1.

"Application of Remote Sensing and GIS in Assessment of Storm Sewer Master Plan", 1990, Conference on Application of Geographic Information Systems and Knowledge Based Systems for Landuse Management, Virginia Polytechnic Institute and State University (Co-author with John M. Maslanik).

Professional Affiliations

American Society of Civil Engineers

SARA E. WOLD

GIS GENERAL MANAGER

Education

B.S. in Geography, 1982, California State University at Chico

M.A. in Geography (GIS/Remote Sensing), 1989, University of Colorado

Responsibilities

Ms. Wold is GIS projects Project Manager in the GeoSpatial Solutions Division of Chester Engineers. In this capacity she implements remote sensing and GIS operations meeting data requirements and specifications produced by Chester Engineers and our clients. Her responsibilities include PC computer systems management, software development and geographic applications.

Experience

Ms. Wold was responsible for the assembly of the GIS databases produced in support of Chester Engineers' *Phase II Stormwater Management Plan for the Glade Run Watershed* and *Phase II Stormwater Management Plan for the Turtle Creek Watershed*. She also has provided remote sensing and GIS applications services in support of several other stormwater management and water supply planning projects, including the *Assessment of the Storm Sewer Master Plan* for Huntington, West Virginia and *West Deer Township Master Water Plan*. She is currently involved in assembling the geographic databases for our ongoing *Act 167 Phase II Stormwater Management Plans*.

Publications

"The Use of Merged Imagery in GIS Database Development", 1989, ARC/INFO Users' Group Meeting, Denver, Colorado.

"Watershed Mapping Using Merged Thematic Mapper and SPOT Panchromatic Imagery", 1989, *Geoscientific Information Systems Applied to Exploration and Research*, Denver GeoTech '89.

"The Use of GIS and Terrain Modeling in the Development of a Pennsylvania Stormwater Management Plan", 10th Annual American Geophysical Union Hydrology Days, Fort Collins, Colorado (Co-author with J.M. Maslanik).

"Application of Remote Sensing and GIS in Assessment of Storm Sewer Master Plan", 1990, International Conference on the Application of GIS and Knowledge Based Systems for Landuse Management, Virginia Polytechnic Institute and State University, Blacksburg, Virginia (Co-author with U.M. Shamsi, et.al.).