

Scope of Services

Deerfield Township Stormwater System Evaluation and Management Planning Study

Executive Summary

This scope of services was developed in response to a request by the Deerfield Regional Storm Water District for a stormwater system evaluation for Deerfield Township. The overall goals of the stormwater system evaluation and management plan are to provide the Township with stormwater management policies, watershed-specific detention rules, conceptual design information, and budget level costs for solutions to critical drainage problems along the primary and select portions of the secondary drainage systems within Deerfield Township. Portions of Deerfield Township within the following five watersheds were identified for consideration in the storm water system evaluation:

- Simpson Creek,
- Polk Run,
- Union Creek,
- Little Miami River Tributaries, and
- Muddy / Little Muddy Creek.

The goals of the storm water system evaluation will be accomplished in the following three phases:

- **Phase I:** Develop a model of the primary drainage system within Deerfield Township, identify existing and projected future water surface elevations and flow velocities within that system, and develop floodplain management and watershed-specific detention rules that prevent increases in existing water surface elevations.
- **Phase II:** Extend the model into and conduct a hydrologic / hydraulic evaluation of select portions of the secondary drainage system with reports of existing drainage problems, quantifying the location, severity, and frequency of known and model-projected flooding and erosion problems.
- **Phase III:** Develop conceptual designs for capital improvements to resolve existing drainage problems and/or prevent future drainage problems.

This complete phased approach may be performed for all five watersheds as a single project. Alternatively, individual phases may be performed as separate projects for all watersheds or as individual projects for one or more watersheds. This approach offers

the DRSWD a great deal of flexibility in the pace at which the evaluation of the Township's stormwater drainage system is performed. While the phased approach affords flexibility for execution of individual components of the scope at different times, there are economies of scale associated with performing all phases at once for one or more watersheds, or for performance of a single phase for all watersheds as a single project. These economies of scale arise from factors such as the coordinated performance of data collection and project reporting for multiple watersheds.

Phase I of the stormwater system evaluation will result in the development of a model of the primary drainage system (representing subwatersheds with drainage areas of 100-300 acres in developed areas and 500-1,000 acres in rural areas) within the Township. The model will be tested by comparing known high water elevations along the primary drainage system with simulated peak water surface elevations for existing land use in the watershed(s). The model will be used to evaluate selected stormwater problem areas within the Township. The model will also be used to develop watershed-specific stormwater detention rules for new development within the Township. A Phase I report will be prepared to summarize the procedures, results, and recommendations associated with each task.

Phase II of the stormwater system evaluation will result in the modification of the model developed in Phase I to incorporate approximately 10 percent of the secondary drainage system corresponding to known drainage problems. The secondary drainage system represents additional subwatersheds within these problem areas with drainage areas of no less than 10 acres. CDM will utilize the Phase II stormwater model to project flows and stages under existing and future development conditions over a range of design storms (e.g., 10-year, 25-year, 100-year). The modeling results will be used to identify the location and severity of predicted street and structural flooding within the Township. A Phase II report will be prepared to summarize the procedures, results, and recommendations associated with each task.

Phase III of the evaluation involves the definition of stormwater management performance standards for the Township (e.g., degree of erosion and flood control). Phase III will include the development and evaluation of alternatives for capital improvements to address the stormwater management needs within the Township that were identified during Phase II. A Phase III Stormwater System Evaluation and Management Plan will be prepared to describe recommended capital improvements, conceptual design parameters and construction cost estimates for the improvements, and an implementation strategy.

The following table summarizes approximate budgetary costs for completing the scope of services. A more detailed breakdown of task-specific costs is presented at the end of this scope of services.

Deerfield Township Stormwater System Evaluation and Management Plan Budgetary Cost Estimates

Task	Watershed					Total	
	Simpson Creek	Polk Run	Union Creek	Little Miami R.	Muddy / Little Muddy Creek	Conducted Separately	Conducted as One Project
Phase I - Develop Policies and Detention Rules							
Subtotal	\$58,800	\$52,900	\$29,400	\$58,800	\$70,500	\$270,400	\$216,300
Phase II -- Evaluate Flooding and Erosion Problems							
Subtotal	\$57,400	\$51,600	\$28,700	\$57,400	\$68,900	\$264,000	\$211,200
Phase III -- Develop Capital Improvement Plan							
Subtotal	\$47,300	\$42,500	\$23,600	\$47,300	\$56,700	\$217,400	\$173,900
Total (Conducted Separately)	\$163,500	\$147,000	\$81,700	\$163,500	\$196,100	\$751,800	\$601,400
Total Conducted as One Project	\$130,800	\$117,600	\$65,400	\$130,800	\$156,900	\$601,400	

Scope of Services Overview

This scope of services was developed in response to a request by the Deerfield Regional Storm Water District for a stormwater system evaluation for Deerfield Township, which is approximately 10,600 acres. The purpose of this stormwater system evaluation and management plan is to provide the Township with stormwater management policies, watershed-specific detention rules, conceptual design information, and budget level costs for solutions to critical drainage problems along the primary and select portions of the secondary drainage systems within Deerfield Township. The scope of services begins with a 3-phase technical approach, followed by assumptions for the phase-specific level of effort and budget for each task and subtask on a watershed basis. **Figure 1** shows the portions of Deerfield Township within the following five watersheds that were identified for storm water system evaluation:

- Simpson Creek,
- Polk Run,
- Union Creek,
- Little Miami River Tributaries, and
- Muddy / Little Muddy Creek.

The evaluation will be performed in three phases:

- **Phase I:** Develop a model of the primary drainage system within Deerfield Township, identify existing and projected future water surface elevations and flow velocities within that system, and develop floodplain management and watershed-specific detention rules that prevent increases in existing water surface elevations.
- **Phase II:** Extend the model into and conduct a hydrologic / hydraulic evaluation of select portions of the secondary drainage system with reports of existing drainage problems, quantifying the location, severity, and frequency of known and model-projected flooding and erosion problems.
- **Phase III:** Develop conceptual designs for capital improvements to resolve existing drainage problems and/or prevent future drainage problems.

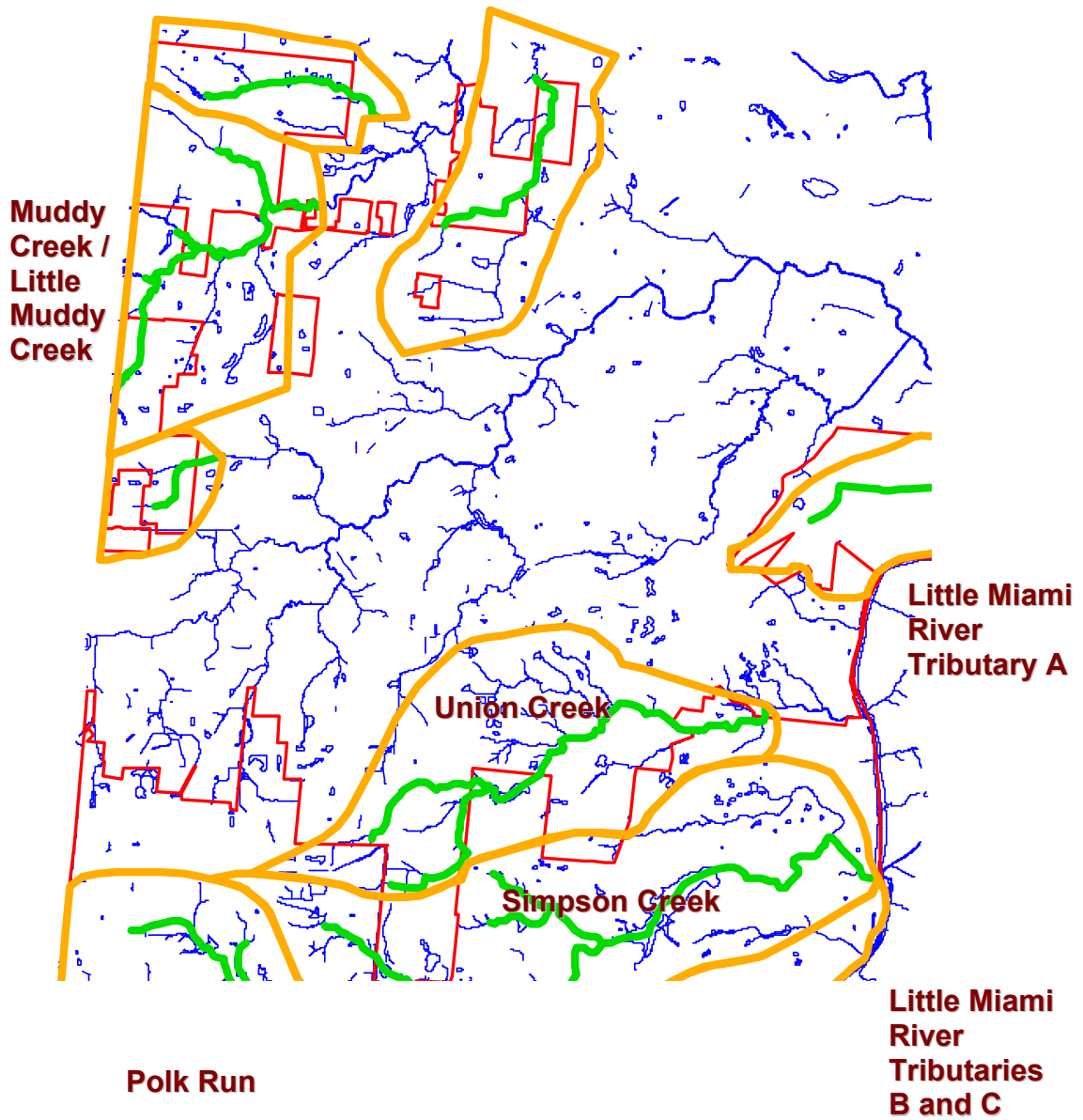


Figure 1. Study watersheds and primary drainage system to be addressed as part of the Drainage System Evaluation

Phase I: Develop Policies and Detention Rules

Under Phase I, CDM will develop a hydrologic / hydraulic model of the primary drainage system within Deerfield Township and use this model to develop stormwater management policies and detention rules for new development and redevelopment in the Township. The following five tasks summarize our approach to this work.

Task 1 Data Collection and Field Work

The stormwater model is the major impact assessment tool for the Stormwater System Evaluation and Management Planning Study. It can be used to compare the peak flow and velocity impacts of different land use patterns and drainage improvements at different locations in the watershed. This task covers the collection and analysis of data for the stormwater model for Deerfield Township.

In general, the data collection effort described in the following subtask will make maximum use of the following existing databases:

- FEMA flood insurance studies of major streams within Deerfield Township.
- Subdivision plans
- As-built drawings
- Township land use plan (circa 1997, and any updates available at the time of modeling)
- SCS Soil Survey
- Topographic maps and ortho-photographs from Warren County's GIS
- Map of known recent stormwater problems

Subtask 1.A Identify Existing Drainage Problems

Update CDM's existing list of drainage problems within Deerfield Township based on information provided by the Township and interviews with Township officials. CDM will update the "measles" map, initially developed during CDM's storm water service fee study (CDM 2005), showing the location of each known drainage problem with a database containing available information characterizing each problem.

Subtask 1.B Delineation of Subwatersheds

The stormwater model developed during Phase I will represent the primary drainage system within Deerfield Township, defined as the portion of the drainage system draining approximately 100 to 300 acres in areas of existing development and 500 to 1,000 acres in undeveloped or rural areas. The primary drainage system (Figure 1) will be defined as a series of subwatersheds linked by pipes and/or open channels.

Each subwatershed should typically drain into a major tributary drainageway and exhibit relatively homogeneous characteristics (e.g., slope).

Within Deerfield Township, CDM will divide the watershed into subwatersheds of 100 to 300 acres in areas of existing development, and subwatersheds of 500 to 1,000 acres in undeveloped or rural areas. For each subwatershed, CDM will use available data to define the following parameters:

- Drainage area
- Average overland flow slope
- Characteristics of the "equivalent" channel or pipe draining the subwatershed
- Average roughness factor (Manning's n) for overland flow

CDM will delineate subwatersheds of 500 to 1,000 acres in areas tributary to but outside of Deerfield Township.

Subtask 1.C Data on Existing Drainage Network

CDM will collect data on the primary drainage system (generally open channels with drainage areas greater than 100 to 300 acres within developed portions of Deerfield Township) to evaluate regional stormwater management needs. The data will consist of the following information:

- Storm drain data: pipe dimensions, length, slope, material
- Stream channel: cross-sections, (incised channel and floodplains), and slopes of major channel reaches measured from topographic maps with 2-ft. contours available from the Warren County Engineer, and roughness coefficients determined during field reconnaissance. For planning studies, data on channel cross-section geometry will typically be required at a frequency of about 3 to 5 transects per stream mile.
- Detention Basins: Stage-surface area, outlet structure dimensions
- Elevations/locations for master planning: determine approximate horizontal locations (± 20 ft) based on Warren County topographic maps and field reconnaissance conducted under Subtask 1G; determine top-of-roadway elevations from topographic maps; and relate elevations of drainage structures to top-of-roadway elevations during field reconnaissance.

Primary data sources will include the following:

- an approximate inventory of storm drainage facilities as originally developed during CDM's storm water service fee study for the Deerfield Regional Storm Water District:
- Warren County topographic maps with 2 foot contour intervals and spot elevations;
- available data from flood insurance studies;
- field reconnaissance surveys conducted under Subtask 1G; and
- construction plans/as-built drawings.

Subtask 1.D Land Use Data

Existing and buildout land use data will be compiled by CDM for each subwatershed for input to the stormwater model. Land use data will be obtained from the Township's most recent land use plan (circa 1997), and any updates available at the time of project initiation. CDM will also utilize recent aerial photos, a limited windshield survey as necessary to verify information in the land use plan, as well as Warren County Auditor's parcel data and the impervious area database developed by CDM during the storm water service fee (CDM 2005). Township land use categories with hydrologically similar properties will be merged to form up to 10 land use categories for modeling. Where buildout land uses have not been defined a medium density land use will be assumed.

Subtask 1.E Impervious Cover Factors

CDM will assign imperviousness factors to each defined land use category. Subwatershed imperviousness will be calculated using the County Auditor's parcel land use data, and the CDM impervious area database.

Subtask 1.F Soil Characteristics/Groundwater Levels

CDM will perform the following services for this subtask:

- Review information on soils in the watershed (SCS soils classification and evaluation survey).
- Determine hydrologic soil group, other pertinent soil infiltration parameters for each soil category.
- Delineate soil categories within each subwatershed.
- Define areas where high groundwater levels may reduce infiltration potential.

Subtask 1.G Field Reconnaissance Survey of Primary Drainage System

To complete the database compiled under Subtasks 1.A through 1.E, CDM will conduct a field reconnaissance survey of the primary drainage system. This survey will focus on the following items:

- Provide descriptions and photographs of existing stream conditions, stream crossings.
- Assess known problem areas (flooding, streambank erosion, obstructions).
- Assist with determination of idealized channel characteristics.
- Identify major stormwater detention facilities.

We assume that the field reconnaissance survey notebooks containing the collected data will cross-reference information to the appropriate drainage element in the stormwater model.

Subtask 1.H Rainfall Data

The purpose of this subtask is to develop design storms for master planning evaluations. CDM will collect the rainfall data for the following design storms:

- 1-year and 2-year design storms: design events typically recommended in the literature for streambank erosion controls.
 - 1-year to 2-year storms produce bankfull flow conditions, the most erosive condition for channel lining.
- 10-year design storm: Typical design event to establish full-flow conditions within the secondary drainage system.
 - Storm sewer designs
 - Typical design storm for secondary road stream crossings
- 25-year design storm: Typical upper limit for drainage improvement designs.
 - Typical upper limit for master plans
 - Incremental flood damages decline significantly beyond the 25-year level (based on Corps of Engineers' studies).
 - Typical design storm for primary road stream crossings.
- 100-year design storm: use for floodplain management, detention pond sizing and final screening of drainage improvement plan.

In addition, CDM will collect available historical rainfall data within or near Deerfield Township for up to five major rainfall events where information about flooding is available through Subtask 1A. We will also gather available rain gage information during the project from the National Climatic Center, Warren County, Hamilton County, or other entity that collects rainfall gauging information in or near Deerfield Township. As an option, CDM will purchase three rainfall gages, install them at appropriate locations within Deerfield Township, collect available rainfall information for the duration of the project, and obtain radar-rainfall information characterizing the intensity and duration of up to five rainfall events that occur during the project.

Task 2 Hydrologic/Hydraulic Analysis

Subtask 2.A Stormwater Model Setup

CDM will use the U.S. EPA Stormwater Management Model (SWMM) to prepare the Stormwater Management Plan for Deerfield Township. SWMM is one of the most widely-used models for simulating both open and closed drainage systems under a variety of hydraulic conditions (backwater, surcharge, tidal boundaries, time histories of flow and water surface elevation). SWMM has been applied successfully in hundreds of rural, urban, and developing watersheds. SWMM will be applied in Deerfield Township in the following manner:

- Hydrologic Model: SWMM/RUNOFF
 - Overland flow projections
 - Initial abstraction
 - Time-varying soil infiltration
 - Surface flow routing
 - Hydrologic channel/pond routing representing flows discharging from modeled sub-watersheds.
 - Resize channels/pipes for quick evaluation of alternatives
 - Simplified pond routing helps screen detention alternatives
- Dynamic Hydraulic Model: SWMM/EXTRAN
 - Principal hydraulic model for major open channel systems
 - Handles surcharged pipes and backwater effects

- Dynamic flow routing: watershed-wide hydrographs, peak flows, velocities, and water surface profiles (i.e., routes entire streamflow hydrograph at each location)
- Detention basin outlet structures (multi-stage)
- Watershed-wide evaluations of facility plan alternatives
- SWMM/EXTRAN is widely used throughout the U.S.

CDM will deliver SWMM model input and output data sets to the Township in a digital format at the completion of this Phase.

Subtask 2.B Model Testing

To test the ability of the SWMM model to represent drainage within Deerfield Township, CDM will perform the following services:

- Screen Deerfield Township files and other information (staff interviews) on drainage complaints to identify existing problem areas.
- Collect high water mark data at selected locations along the primary drainage system following up to three storm event occurring during the project. High water marks will be obtained by applying chalk to stream crossing structures prior to storm events, and measuring the peak water surface elevation that occurred during the storm event based upon the height of the chalk that was washed off the structure.
- For selected historical storms, compare known high water elevations along the primary drainage system with simulated peak water surface elevations for existing land use pattern in watershed.
- Verify that model approximates recorded flooding complaints and eyewitness accounts.
- Compare peak "cfs/acre" measurements from regional regression equations with model results.

Subtask 2.C Evaluate Existing and Future Stormwater Runoff Problems

CDM will apply the stormwater model of existing and projected buildout land use patterns within the watershed to identify existing and future stormwater problem areas and to identify the sources of these problems. The following services will be performed:

1. ***Identify Flooding Problems***
 - Calculate peak flows in the primary storm drainage system for the 10-year, 25-year, and 100-year design storms.

- Calculate water surface elevations along the primary storm drainage system for the 10-year, 25-year, and 100-year design storms.
- Along the primary storm drainage system, identify approximate zones of inundation, structures within these zones, and roadway overtopping for 10-year, 25-year, and 100-year design storms.

2. ***Identify Erosion/Sediment Control Problems***

CDM will apply the stormwater model of existing and projected buildout land use patterns to evaluate simulated peak flows and velocities for 2-year design storm. The 2-year storm produces bankfull flow conditions, the most critical for streambank erosion control. The methodology CDM will use is outlined below:

- In areas of existing development, streambank erosion impacts will be determined through visual observations and by comparing flow velocities during bankfull conditions with published velocities known to cause erosion of the soils that make up the streambank.
- In areas of future development, streambank erosion impacts will be determined by making use of relationships which represent changes in the channel width caused by changes in the 2-year peak flow (Q) which corresponds to bankfull conditions:

$$\text{Width} \propto Q^n$$

- The exponent "n" varies from stream to stream with values in the range of 0.3 to 0.5 appropriate for Deerfield Township. The relationship given above can be used as a guideline for assessing the impacts of urbanization on streambank erosion.
- Assuming that channel slope, depth, and friction remain constant, the width after development (W2) can be assessed based on the 2-year post-development peak flow (Q2), and the width (W1) and 2-year peak flow (Q1) associated with pre-development conditions:

$$W2 = (Q2^n/Q1^n)(W1)$$

The ratio " $Q2^n/Q1^n$ " is referred to as the "erosion ratio."

- Erosion ratios greater than about 1.5 will be considered excessive since they indicate the existing channel width may increase by 50 percent or more as a result of post-development increases in peak flow. Erosion ratios in the range of 1.25 to 1.50 may be indicative of a moderate problem, while ratios greater than 1.0 but less than 1.25 indicate minimal increases in stream channel erosion potential.

3. ***Compare Existing and Future Impacts Assuming No Controls***

CDM will prepare schematic maps of "problem areas" in the watershed and peak water surface elevation profile plots along major streams represented by the stormwater model.

Task 3 Develop Detention Rules

CDM will apply the model of the primary drainage system in Deerfield Township to develop watershed-specific detention rules that prevent runoff from future development from increasing water surface elevations and velocities within the watershed. CDM will take the following approach to develop these detention rules:

- Determine water quality volume and release rate necessary to comply with the Ohio EPA General Permit for Stormwater Discharges from Construction Activities within each subwatershed. For watersheds that are partially developed, divide this volume between that necessary for future development and that necessary for existing development.
- Determine stormwater quantity control detention volumes and release rates for each subwatershed using the critical storm method. Represent the stormwater quantity / quality control volumes in the stormwater model for a series of design storms (i.e., 1-year, 2-year, 10-year, 25-year, and 100-year) and identify the projected change in water surface elevation along the primary drainage system. Also determine any changes to the magnitude and duration of erosive velocities within the primary drainage system during the 1-year and 2-year design storms.
- Decrease release rates from each subwatershed as necessary to prevent projected water surface elevations and/or velocities from increasing within the watershed and determine approximate water quantity detention volumes that should be provided within each subwatershed to achieve these release rates.

Task 4 Prepare Phase I Stormwater System Evaluation and Management Plan

The Phase I Stormwater System Evaluation and Management Plan will summarize the procedures, results, and recommendations of each task, including the following:

- Description of the watersheds and primary drainage systems within Deerfield Township;
- Description of the stormwater model and model testing activities;
- Description of existing/potential future flooding problems along the primary drainage system
- Definition of sizing criteria and design standards for on-site stormwater management facilities, including:

- Level of service (performance standards) for structure, roadway, and property flooding.
- Subwatersheds where on-site detention is required.
- Allowable release rates (cfs/acre, duration) and unit detention storage (acre-ft./acre) for each design storm to prevent downstream flooding and erosion and address Ohio EPA requirements for stormwater pollution control
- Hydraulic and hydrologic parameters, methods for computing runoff and facility sizes, design features, easement requirements, and other criteria for designing drainage facilities.
- Criteria for development within floodways/floodplains.
- Site plan requirements (e.g., mapping, soil investigations, design details, calculations).
- Technical requirements of a stormwater detention ordinance that implements these rules.

Five (5) copies of the draft Phase I Stormwater System Evaluation and Management Plan will be submitted to the Township for review and comment. CDM will meet with the Township to discuss the Township's comments to the draft report. Following revisions, CDM will provide the Township with fifteen (15) copies of the final master plan report plus 1 unbound copy for the Township's future use.

Task 5 Progress Reporting

CDM will conduct progress meetings with the Township at key milestones. We anticipate three such meetings, which will be used to obtain data, review findings of the hydrologic/hydraulic analysis, review proposed detention rules and development policies, and review the draft version of the Phase I Stormwater System Evaluation and Management Plan report. The monthly invoices will indicate the actual hours and costs incurred by CDM under each task, supported by specific deliverables identified in the Scope of Services and/or materials presented at project meetings.

Phase I Deliverables

- A model of the primary drainage system will be developed to represent subwatersheds with drainage areas of 100-300 acres in developed areas and 500-1,000 acres in rural areas within the Township
- Selected stormwater problem areas within the Township will be evaluated using the model.
- Watershed-specific stormwater detention rules will be developed for new development and re-development in the Township.

- A Phase I report will be prepared to summarize the procedures, results, and recommendations associated with each task.

Schedule

CDM will complete the Phase I Stormwater System Evaluation and Management Plan for Deerfield Township in 4 months from the effective date of this agreement, pending collection of suitable rainfall and high water mark information to support model testing during the first 2 months of the study. This schedule includes a two-week review period by the Township of the draft Phase I Stormwater System Evaluation and Management Plan.

Phase II: Evaluate Flooding and Erosion Problems

Task 6: Problem Characterization

Often, the best information about storm water issues is available from the residents experiencing the problem. Therefore, CDM advocates field reconnaissance surveys and resident interviews to supplement existing complaint record information compiled under Subtask 1A. Feedback from the affected parties enables CDM to better comprehend the type and magnitude of the storm water problems in the study area, accurately represent the storm water problems, and support preliminary alternatives that are acceptable to both the Township and the public. Additionally, the interviews demonstrate to the affected parties that the Township is concerned about their problem, and thus aids in developing community support for the overall project.

Under this task, CDM will work with the Township to develop a list of up to 10 residents to be interviewed. Next, CDM will send each resident a questionnaire form, accompanied by a cover letter from the Township. CDM then will contact each resident by telephone and attempt to schedule a personal interview or telephone interview, if necessary. After completing each interview, CDM will prepare written summaries, including photographs of problem areas.

Task 7: Hydrologic / Hydraulic Analysis

Flooding problems and their solution may vary significantly in complexity. Using a hydrologic / hydraulic analysis method appropriate for the complexity of the problem will produce technically correct solutions cost-effectively. Analysis may vary from a modification in the current storm water maintenance practices to a hydrologic/hydraulic model representing the hydrologic characteristics of the drainage area and hydraulic characteristics of the drainage system for a variety of scenarios.

Task 7.A: Model Development

CDM will expand the stormwater model developed in Task 2 to a level of detail necessary to evaluate existing drainage problems in the primary and secondary drainage systems of Deerfield Township. This will be accomplished in the following manner:

- Extend the model up to the location within the secondary drainage system where existing drainage problems identified by the Township in Subtask 1A occur.
- Divide the subwatersheds delineated in Subtask 1B into smaller subwatersheds (10 acres minimum) as necessary to evaluate localized drainage problems in up to 10 percent of the Township, and define the hydrologic parameters listed in Subtask 1B, 1D, 1E, and 1F for each subwatershed.
- Gather data on the secondary drainage system incorporated into the model as defined in Subtasks 1C and 1G.

- Test the model using the approach defined under Subtask 2B, utilizing data about primary and secondary drainage system problems compiled under Subtasks 1A and 6.
- Document the expanded model of Deerfield Township drainage and rationale for the hydrologic and hydraulic parameters used to represent the drainage system.

Task 7.B: Existing System Understanding and Evaluation

An appropriate level of hydrologic and hydraulic analysis provides a clear understanding of the storm water problems and why they occur. This knowledge allows a performance evaluation of identified deficiencies in the study area. The various deficiencies are grouped in such categories as structure flooding, roadway flooding, floodplain concerns, and others. The severity of the problems is quantified using a scoring system that is presented to and agreed upon by the Township. Typical criteria that can be used to gauge the severity of flooding problems include:

- number of structures flooded,
- aerial extent of property flooding,
- length and width of roadway flooding,
- frequency of flooding,
- length of surcharged storm sewers, and
- depth and duration of flooding.

CDM will utilize the stormwater model of the primary and secondary drainage system developed under Subtask 7.A to project flows and stages under existing and future development conditions over a range of design storms (e.g., 10-year, 25-year, 100-year) and prepare summary tables and thematic maps identifying the location and severity of predicted street and structural flooding occurrences within Deerfield Township.

Task 8 Prepare Phase II Stormwater System Evaluation and Management Plan

The Phase II Stormwater System Evaluation and Management Plan will summarize the procedures, results, and recommendations of each task. It will revise the Phase I Stormwater System Evaluation and Management Plan as necessary to define the Phase II work activities, findings and recommendation, including the following information:

- Description of the watersheds, primary drainage systems, and secondary drainage systems within Deerfield Township;

- Description of the stormwater model and model testing activities;
- Description of existing/potential future flooding problems.

Five (5) copies of the draft Phase II Stormwater System Evaluation and Management Plan will be submitted to the Township for review and comment. CDM will meet with the Township to discuss the Township's comments to the draft report. Following revisions, CDM will provide the Township with fifteen (15) copies of the final master plan report plus 1 unbound copy for the Township's future use.

Task 9 Progress Reporting

CDM will conduct progress meetings with the Township at key milestones. We anticipate two such meetings, which will be used to identify stormwater problems, review findings of the hydrologic/hydraulic analysis, and review the draft version of the Phase II Stormwater System Evaluation and Management Plan report. The monthly invoices will indicate the actual hours and costs incurred by CDM under each task, supported by specific deliverables identified in the Scope of Services and/or materials presented at project meetings.

Phase II Deliverables

- The model developed in Phase I will be extended into and a hydrologic / hydraulic evaluation of select portions of the secondary drainage system with reports of existing drainage problems, quantifying the location, severity, and frequency of known and model-projected flooding and erosion problems.
- A Phase II report will be prepared to summarize the procedures, results, and recommendations associated with each task.

Schedule

CDM will complete the Phase II Stormwater System Evaluation and Management Plan for Deerfield Township in 4 months from the completion of Phase I. This schedule includes a two-week review period by the Township of the draft Phase II Stormwater System Evaluation and Management Plan.

Phase III: Develop Capital Improvement Plan

Task 10 Define Performance Standards for Stormwater Management

CDM will meet with the Township to develop performance standards for flood control facilities to be recommended under this plan. The performance standards will:

- Identify stormwater management needs for the Township (flooding, erosion).
- Define acceptable flood elevations in existing problem areas.
- Determine appropriate level-of-service (e.g., recurrence interval, acceptable level of flood protection) for different portions of the Township.

Task 11 Develop and Evaluate Alternative Improvement Options

Alternative measures designed to control erosion and flooding problems will be evaluated for each problem site. These measures included stream crossing improvements, channel improvements, berms, diversions and flood proofing of individual structures. The stormwater management model will be used to simulate the individual site and watershed-wide hydraulic response to the control measures selected: (1) to determine the most beneficial combination of alternative measures for the entire watershed; and (2) to ensure that a structural measure designed to solve a particular upstream flooding problem would not cause an adverse impact in the downstream area, and vice versa.

The evaluation of control measures for flooding problems will proceed in the following order:

- Floodplain Management. Define areas along the primary drainage system that should be preserved as floodplains through zoning ordinances, property acquisition, incorporation into stream valley parks, and/or wetland preservation policies. Investigate creating “major storm detention areas” where site size and grading are favorable for increasing existing floodplain storage.
- Stream crossing improvements (e.g., enlarged culverts). Waterway openings will be designed to pass the appropriate design storm peak runoff for future land use conditions with the detention rules developed in Task 3 in effect. After the stream crossing is redesigned to handle future runoff flows, the stormwater model will be applied to check the cumulative impacts throughout the watershed. If downstream flooding problems result from the removal of upstream "bottlenecks" at stream crossings, the critical crossings will be flagged for evaluation of alternate control plans (e.g., additional on-site detention, regional detention basins, downstream channel improvements).

- Existing structure flooding. Recommended control measures (e.g., berms, raising building, channelization, associated benefits from crossing improvements) will be designed to provide flood protection up to the 25-year level associated with the future land use plan.
- Regional detention basin system. The most suitable regional facility sites will be identified. The primary objectives of the regional detention basin system are to: (a) contribute to meeting the performance standards for erosion control, flood control, and water quality management under future land use conditions, and (b) minimize the number of small onsite detention facilities required to meet the performance standards for future conditions. If the regional facility(ies) are located upstream of proposed stream crossing improvements or other flood control measures we will consider the cost-effectiveness of enlarging the regional facility in lieu of the downstream improvement. Feasible regional detention basins may include additional storage capacity to compensate for other areas in the watershed where suitable sites for regional facilities are not available.
- Onsite Detention Zones. Regional detention basin system requirements will be compared with the on-site detention rules developed under Task 3 and regional detention basins capable of providing "in-lieu of" on-site detention will be identified. Cost-sharing formulae will be developed to either have a developer compensated for providing a regional detention basin at a strategic location and/or have a developer pay an "in-lieu-of" fee for a regional detention basin provided by the Township.
- Stream Channel Improvements. Residual erosion and flooding problems will be addressed with stream channel improvements. Existing channel erosion problems will receive the highest priority. Since channel improvements for mainstream and major tributary channels can degrade the natural stream environment and impact wetland areas (wetland regulations are getting more restrictive), it is appropriate that these control measures be considered last and only to address residual problems.
- Cumulative Problems. The master plan will be screened with the stormwater model to ensure that the cumulative impacts of the major improvements (road crossings, flood control improvements, regional detention basins, stream channel improvements) do not increase the existing 100-year flood levels.
- Water Quality Considerations. Following the formulation and testing of a management plan for the control of runoff "quantity," CDM will describe the potential benefits of runoff "quality" controls which could be achieved through a multipurpose design of the recommended regional and on-site detention basins.
- "Level of Service" Considerations. We will use a "level of service" approach to evaluate drainage systems where structural or nonstructural controls identified under Steps 1 through 8 do not appear to be cost-effective. The level of service

approach identifies the acceptable depth and frequency of flooding of roadways and property that will occur during a storm of design proportions. Since it is not feasible to completely contain, within natural stream channels, the runoff from all storms of any duration and volume, it is implicit that some amount of out-of-bank flooding is permissible in certain areas under certain design storm conditions.

- Evaluate Alternatives. The stormwater management alternatives will be evaluated using the following criteria:
 - Costs (capital, O&M, land acquisition)
 - Flood control benefits (number of structures, roadway crossings, commercial acreage)
 - Water quality benefits (typical pollutants and loading reductions)
 - Multi-use benefits
 - Community impacts, including
 - Relocations
 - Encroachments
 - Tax base impacts
 - Relationship to other Township plans and policies
 - Environmental impacts (type, size, location), including:
 - Comparison of facility "needs" and "impacts"
 - Mitigation measures
 - Wetlands impacts (e.g., Federal 404 permit requirements)
 - Implementability, including:
 - Regulatory review (State, federal)
 - Uncertainty/risk
 - Overall feasibility

Task 12 Recommend Stormwater Improvements

CDM will provide conceptual design information for recommended regional stormwater facilities based on the findings of Task 11. The following conceptual design data will be prepared for each type of facility:

- Regional Detention Basins
 - Pool elevations
 - Storage required
 - Surface area
 - Dam height and length
 - Spillway capacity and dimensions
 - Access Roads
 - Stream Crossings
 - Dimensions
 - Invert Elevation
 - Roadway Elevation
 - Entrance/Exit Configuration
- Channel Improvements
 - Cross-Section
 - Material
 - Length

CDM will develop cost estimates for recommended regional facilities, including:

- Construction cost estimates suitable for budgetary planning based upon unit cost factors and recent bid documents representative of Deerfield Township.
- Annual O&M cost estimates with and without water quality control features.

CDM will determine pipe diameters and ditch/swale width/depth for recommended improvements to resolve the localized problems evaluated in the secondary drainage system.

Task 13 Prepare Phase III Stormwater System Evaluation and Management Plan

The Phase III Stormwater System Evaluation and Management Plan will summarize the procedures, results, and recommendations of each task. It will revise the Phase II Stormwater System Evaluation and Management Plan as necessary to define the Phase III work activities, findings and recommendation, including the following information:

- Description of existing/ potential future flooding problems and recommended conceptual improvements plan;
- Description of conceptual improvements plan to manage water quality impacts of stormwater;
- Evaluation of specific structural/nonstructural measures which achieve the objectives of the conceptual improvements plan;
- Conceptual design parameters and construction cost estimates for specific capital improvements required to implement the conceptual improvements plan;
- Overview of implementation strategy.

Five (5) copies of the draft Phase III Stormwater System Evaluation and Management Plan will be submitted to the Township for review and comment. CDM will meet with the Township to discuss the Township's comments to the draft report. Following revisions, CDM will provide the Township with fifteen (15) copies of the final report plus 1 unbound copy for the Township's future use.

Task 14 Progress Reporting

CDM will conduct progress meetings with the Township at key milestones. We anticipate three such meetings, which will be used to identify and evaluate alternative drainage improvements, review the recommended stormwater management plan, and review the draft version of the Phase III master plan report. The monthly invoices will indicate the actual hours and costs incurred by CDM under each task, supported by specific deliverables identified in the Scope of Services and/or materials presented at project meetings.

Phase III Deliverables

- Stormwater management performance standards will be defined for the Township (e.g., degree of erosion and flood control).
- Alternatives for capital improvements will be developed and evaluated to address the stormwater management needs within the Township identified during Phase II.

- A Phase III Stormwater System Evaluation and Management Plan will be prepared to describe recommended capital improvements, conceptual design parameters and construction cost estimates for the improvements, and an implementation strategy.

Schedule

CDM will complete the Phase III Stormwater System Evaluation and Management Plan for Deerfield Township in 4 months from the completion of Phase II. This schedule includes a two-week review period by the Township of the draft Phase III Stormwater System Evaluation and Management Plan.

Assumptions / Level of Effort Details

The level of effort associated with each task and subtask was based on specific characteristics of each individual watershed or catchment. The watershed characteristics used in estimating levels of effort are summarized in the table below.

Watershed Name	Area (Acres)	Assumptions for Phase I - Primary Drainage System Evaluation			Assumptions for Phase II - Secondary Drainage System Evaluation		
		Approx. No. of Sub-watersheds	Primary Drainage System Length (ft)	Approx. No. of Cross-Sections	Approx. No. of Additional Sub-watersheds	Secondary Drainage System Length (ft)	Approx. No. of Model Links
Muddy / Little Muddy Creek	3,422	24	36,228	22	35	10,319	70
Union Run	1,931	14	24,663	15	20	5,821	40
Simpson Creek	2,787	20	33,006	20	29	8,405	57
Little Miami River Tribs	2,629	19	28,909	17	27	7,928	54
Polk Run	2,430	17	33,611	20	25	7,328	50
Total	13,199	95	156,417	96	139	39,800	272

Budget

The following table summarizes budgetary estimates for each phase-specific task. Cost totals are presented for each watershed, as well as for a total project including all watersheds. The budgetary estimates are presented in the context of the three-phase approach. Depending on the results of each phase, the costs associated with subsequent phases are subject to change.

Deerfield Township Stormwater System Evaluation and Management Plan Budgetary Cost Estimates

Task	Watershed					Total		
	Simpson Creek	Polk Run	Union Creek	Little Miami R.	Muddy / Little Muddy Creek	Conducted Separately	Conducted as One Project	
Phase I - Develop Policies and Detention Rules								
1	Data Collection and Field Work							
A	Identify Existing Drainage Problems	\$1,500	\$1,400	\$800	\$1,500	\$1,900	\$7,100	\$5,700
B	Delineation of	\$1,500	\$1,300	\$700	\$1,500	\$1,700	\$6,700	\$5,400
C	Data on Existing Drainage Network	\$2,200	\$2,000	\$1,100	\$2,200	\$2,600	\$10,100	\$8,100
D	Land Use Data	\$1,100	\$900	\$500	\$1,100	\$1,300	\$4,900	\$3,900
E	Impervious Cover Factors	\$2,200	\$2,000	\$1,100	\$2,200	\$2,700	\$10,200	\$8,200
F	Soil Characteristics/Groundwater Levels	\$1,300	\$1,200	\$600	\$1,300	\$1,500	\$5,900	\$4,700
G	Field Reconnaissance	\$4,000	\$3,600	\$2,000	\$4,000	\$4,800	\$18,400	\$14,700
H	Rainfall Data	\$2,300	\$2,100	\$1,200	\$2,300	\$2,800	\$10,700	\$8,600
2	Hydrologic/Hydraulic							
A	Stormwater Model Setup	\$6,700	\$6,000	\$3,400	\$6,700	\$8,100	\$30,900	\$24,700
B	Model Testing	\$7,800	\$7,000	\$3,900	\$7,800	\$9,400	\$35,900	\$28,700
C	Evaluate Existing and Future Problems	\$7,200	\$6,500	\$3,600	\$7,200	\$8,700	\$33,200	\$26,600
3	Develop Detention Rules	\$9,700	\$8,700	\$4,800	\$9,700	\$11,600	\$44,500	\$35,600
4	Prepare Phase I Plan	\$7,700	\$6,900	\$3,900	\$7,700	\$9,300	\$35,500	\$28,400
5	Progress Reporting	\$3,600	\$3,200	\$1,800	\$3,600	\$4,300	\$16,500	\$13,200
	Subtotal	\$58,800	\$52,900	\$29,400	\$58,800	\$70,500	\$270,400	\$216,300
Phase II -- Evaluate Flooding and Erosion Problems								
6	Problem Characterization	\$3,200	\$2,900	\$1,600	\$3,200	\$3,900	\$14,800	\$11,800
7	Hydrologic / Hydraulic Analysis							
A	Model Development	\$29,100	\$26,100	\$14,500	\$29,100	\$34,900	\$133,700	\$107,000
B	Existing System	\$7,200	\$6,500	\$3,600	\$7,200	\$8,700	\$33,200	\$26,600
8	Prepare Phase II Plan	\$9,700	\$8,700	\$4,800	\$9,700	\$11,600	\$44,500	\$35,600
9	Progress Reporting	\$8,200	\$7,400	\$4,100	\$8,200	\$9,800	\$37,700	\$30,200
	Subtotal	\$57,400	\$51,600	\$28,700	\$57,400	\$68,900	\$264,000	\$211,200
Phase III -- Develop Capital Improvement Plan								
10	Define Performance	\$2,300	\$2,100	\$1,200	\$2,300	\$2,800	\$10,700	\$8,600
11	Develop and Evaluate Alternatives	\$22,400	\$20,200	\$11,200	\$22,400	\$26,900	\$103,100	\$82,500
12	Recommend Stormwater Improvements	\$11,200	\$10,100	\$5,600	\$11,200	\$13,500	\$51,600	\$41,300
13	Prepare Phase III Plan	\$7,700	\$6,900	\$3,900	\$7,700	\$9,300	\$35,500	\$28,400
14	Progress Reporting	\$3,600	\$3,200	\$1,800	\$3,600	\$4,300	\$16,500	\$13,200
	Subtotal	\$47,300	\$42,500	\$23,600	\$47,300	\$56,700	\$217,400	\$173,900
	Conducted Separately	\$163,500	\$147,000	\$81,700	\$163,500	\$196,100	\$751,800	\$601,400
Total	Conducted as One Project	\$130,800	\$117,600	\$65,400	\$130,800	\$156,900	\$601,400	