FINAL REPORT

Airport Drainage Master Plan

ERIE INTERNATIONAL AIRPORT
TOM RIDGE FIELD

C&S COMPANIES
ENGINEERS
DESIGN BUILD
TECHNICAL RESOURCES
OPERATIONS

July 2002

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ERIE INTERNATIONAL AIRPORT DRAINAGE MASTER PLAN SUMMARY

This report contains a drainage master plan for the Erie International Airport – Tom Ridge Field. This plan is based on recommended developments from the Airport Master Plan Draft Final Report dated January 2002 prepared by C&S Companies. These proposed developments consist of the improvement of the Fenestra area, the relocation of the general aviation facilities to an area north of Runway 6-24, and the eastern extension of Runway 24. In addition to the stormwater management plan for these future projects, this report contains an analysis of the floods that commonly occur in the area of the Asbury Road railroad underpass near the southwest corner of airport property.

In designing this drainage master plan, hydrologic computer models were constructed for the airport property and its surrounding areas. These models were created to insure that stormwater management practices would be effective in controlling post-development peak stormwater discharges. These models were run for various rainfall events to evaluate compliance with local ordinances across a range of conditions. A model was also created to review the extent of the flooding at the Asbury Road underpass.

The Asbury Road underpass floods when stormwater discharge from south of the railroad backs up at the culvert under the tracks. Stormwater discharge reaches this culvert faster than the culvert is able to convey it into the airport storm sewer system. As a result, stormwater is ‘informally’ detained in this area. When this stored stormwater reaches a certain elevation, it spills freely into the Asbury Road underpass. According to hydrologic models, this overflow takes place more often than the occurrence of the 2-year storm event. Under existing conditions, the flooding of the Asbury Road underpass is caused by the magnitudes of the stormwater discharges unable to enter the culvert under the railroad.

Stormwater models of the Fenestra area show that a very slight increase in peak discharges would result from the proposed alteration of the facilities there. This is primarily due to the minimal proposed change in impervious area at the site. The Fenestra area contains two drainage sub-areas. The eastern drainage area lies adjacent to the major drainage divide of the airport. This allows for the possibility of directing eastern Fenestra stormwater runoff to the east. Stormwater models of the proposed general aviation relocation area show a significant increase in peak discharges. This is primarily a result of the transformation of a large area of grass-covered soils to impervious surfaces. The proposed general aviation relocation area and the Fenestra area are located within a common drainage boundary on the airport’s property. This allows for the possibility of a common stormwater management plan for development in both areas. Stormwater models of the proposed Runway 24 extension area show that peak discharges will increase as a result of the changes in land-use associated with this project. These models also show that the existing Millcreek Township detention facility contains a significant storage volume that is currently unused.

Several stormwater management scenarios were modeled for the three proposed airport developments. These scenarios included various combinations of stormwater routing, stormwater detention facility designs, and stormwater conveyance improvements. A single drainage master plan was designed to manage the stormwater discharge from the three developments proposed in the Airport Master Plan. The stormwater management plan is illustrated in the large fold out Figure 29 included with this report.

The recommended stormwater management alternative consists of:

- directing stormwater runoff from the eastern Fenestra drainage sub-area to the east,
- changing the existing Millcreek Township detention facility outlet structure from a 36 inch orifice to a 15 inch orifice
- adding a parallel 48 inch culvert under the Norfolk Southern railroad tracks upstream of the existing Millcreek Township detention facility
- constructing a new stormwater detention facility in the area of Marshall Drive,

Directing the eastern Fenestra drainage sub-area's runoff to the east would decrease the airport's peak stormwater discharges to the west into Wilkins Run from existing conditions. The increased runoff to the east would be accommodated through the remaining stormwater management recommendations. This direction of the eastern Fenestra runoff would also satisfy the stormwater management requirements for both the proposed development in the Fenestra area and the proposed relocation of the general aviation facilities.

Changing the existing Millcreek Township detention facility outlet structure to a 15 inch orifice will better utilize the available storage volume in this basin. Even with this significant reduction in outflow, the town detention facility is capable of storing the volume associated with the 100-year storm event.

Adding a parallel 48 inch culvert under the Norfolk Southern railroad tracks will reduce water surface elevations by up to 7 inches and will reduce the volume of stormwater overflow to the east by up to 8.14 acre-feet (2,600,000 gallons). Currently, stormwater runoff reaches the existing single 48 inch culvert faster than it is able to be conveyed under the railroad. As a result, stormwater is 'informally' detained in this area until conditions allow it to pass. As this detained stormwater reaches a certain elevation, it overflows to the east along the tracks. The addition of this parallel culvert will allow more stormwater to pass under the railroad, benefiting the immediate upstream area, as well as those areas to the east.

Constructing a new detention facility in the area of Marshall Drive would dramatically reduce peak stormwater discharges to the existing storm sewer. The existing conditions peak stormwater discharge to the existing storm sewer from the 100-year storm event is 175 cfs (cubic feet per second). The existing storm sewer has a capacity of approximately 15 to 20 cfs. The recommended detention facility would have a peak stormwater discharge from the 100-year storm event of 10 cfs. This reduction in peak stormwater discharge would allow the existing storm sewer in that area to convey the 100-year discharge, and alleviate the flooding in this area for up to the 100-year storm event.

The recommended stormwater management plan benefits those on all sides of the airport and better utilizes existing facilities. With this plan in place, less stormwater will be stored south of the railroad tracks, less stormwater will be forced to the east along the tracks, and peak stormwater discharges will decrease from airport property to both Wilkins Run and Marshall Run. All areas that could be affected by the airport's development will see drainage improvements from current conditions.

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CHAPTER 1 - STUDY BACKGROUND

1.01 Introduction

This report describes a study of the affect of planned development on stormwater discharges from the Erie International Airport – Tom Ridge Field. The main objective of this study is to develop a stormwater control system to allow the airport to operate in accordance with Millcreek Township stormwater ordinances. This future development has been outlined in the Draft Final Report Airport Master Plan dated January 2002, prepared by C&S Companies. In addition, the frequent flooding of the Asbury Road underpass at the southwest corner of the airport will be analyzed to determine whether the airport facilities contribute to this problem.

1.02 Airport Overview

Erie International Airport – Tom Ridge Field is located in Erie County in northwestern Pennsylvania near two major interstates: the east-west I-90 and the north-south I-79. Cleveland Hopkins International Airport is approximately 110 miles to the west, Buffalo International Airport is approximately 105 miles to the east, and Pittsburgh International Airport is approximately 125 miles to the south. The airport serves the northwestern Pennsylvania, western New York, and eastern Ohio regions. These regions consist of nine counties: Crawford, Erie, Forest, Mercer, Venango, and Warren in Pennsylvania; Ashtabula and Trumbull in Ohio; and Chautauqua in New York.

1.03 Study Area and Scope

The following is the scope of the drainage study as authorized:

SCOPE OF WORK

Project Title: Airport Drainage Study
Airport Name: Erie International Airport – Tom Ridge Field
Services Provided: Planning Services

Project Description:

1. Review and quantify existing conditions of areas draining into airport, within the airport property (453 acres), and discharges from the Study Area. The Study Area shall be the airport property boundary and will consider up to 3,000 feet downstream.

   a) Site visit to look over existing drainage system, measure and characterize existing facilities, review and characterize downstream facilities and upstream areas, and list topographic information required.

b) Review system with airport personnel and obtain information on existing problem locations.
c) Determine land use characteristics, drainage areas, soil characteristics, ground covers involved.
d) Meet with local officials involved with drainage issues – assume up to three such meetings.
e) Obtain topographic information.
f) Calculate flow rates at points of interest throughout airport and off-site for a range of storm intensities using HY8, TR20, HEC-2 computer models as appropriate.
g) Prepare map(s) of airport showing existing hydrologic characteristics and existing major drainage facilities. (We would not propose to analyze individual catch basins and storm sewers – focus will be on open channels and culverts.)

2. Based on Master Plan for airport, quantify increases and decreases in flow within and downstream of airport for a range of storm intensities due to proposed airport development including the proposed runway extension.

3. Meet with airport officials to review a number of options for dealing with existing and potential future drainage issues. These would consist of drainage channel improvements or changes and stormwater detention options. Purpose of meeting would be to gauge support or lack of support for various alternatives.

4. Prepare a Drainage Master Plan for Erie International Airport – Tom Ridge Field including: mapping of existing facilities, drainage areas, hydrologic data utilized, computer models developed, tables of existing and proposed flows, and a Master Plan map showing all proposed improvements. Our scope and fee does not include a review and documentation of existing storm sewer conditions, capacities, and exact locations on airport property since they will not have an impact on downstream drainage.

5. Present results of drainage effort at two public meetings assuming maps and illustrations will be necessary.

1.04 Airport Development Plans and Drainage Concerns

This study was undertaken to investigate the state of the airport's drainage patterns and to plan for proposed airport growth outlined in the Draft Final Report Airport Master Plan dated January 2002, prepared by C&S Companies. The proposed development plans that are examined here are the preferred alternatives from the master plan. This report includes an analysis of one drainage concern and plans for three general development proposals:

- the addition of structures and/or aircraft parking aprons in the Fenestra area
- the relocation and expansion of the general aviation facilities
- the extension of Runway 24

1.04-1 Asbury Road Underpass Flooding

Asbury Road runs north and south immediately west of the airport. At the southwest corner of airport property, Asbury Road passes under 3 sets of railroad tracks. At this underpass, the road's surface is 10 to 15 feet lower than the surrounding land. This low area is reportedly flooded on a regular basis. Asbury Road is a major north-south route that all too often becomes blocked by this inundation. The Asbury Road underpass is located in the southern portion of the drainage area labeled 'Underpass' in Figure 4.

1.04-2 Fenestra Area Development

The 'Fenestra' building is located to the south of Runway 24. This building, along with others, encroaches on the Runway Safety Area under the new requirements outlined in the Airport Master Plan. As a result, these facilities will have to be modified to bring them into compliance. The proposed alterations to the Fenestra area could require the design and implementation of a stormwater management plan. Figure 2 shows the proposed changes to the Fenestra area.

1.04-3 General Aviation Relocation/Expansion

Section 6.08 of the Airport Master Plan proposes the relocation of all general aviation facilities, FBO development and corporate hangars to an area east of Taxiway C fronting on Taxiway A. This relocation will require the construction of large new impervious areas. A stormwater management plan will be required to maintain existing peak discharges from the airport's property. Figure 3 shows the proposed relocation and expansion of the terminal facilities.

1.04-4 Runway 24 Extension

The eastern end of Runway 24 is proposed to be extended approximately 1900 feet in order to accommodate larger aircraft. The end of the new runway will be near the existing intersection of West 17th St. and Linden Ave. This area will require approximately 10-15 feet of fill. In addition, FAA regulations require strict 'safety areas' surrounding runways. Inside these safety areas, land slopes must be maintained below stated maxima. As a result, the footprint of the new runway will cover approximately 50 acres. The runway extension will require the fee acquisition and/or sound attenuation improvements of properties in the area. The re-routing of current watercourses will also be required. Figure 1 is a representation of the proposed extension of Runway 24.

Proposed Runway Extension

FIGURE 1

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LEGEND

Proposed Runway Ext.

Runway Safety Area

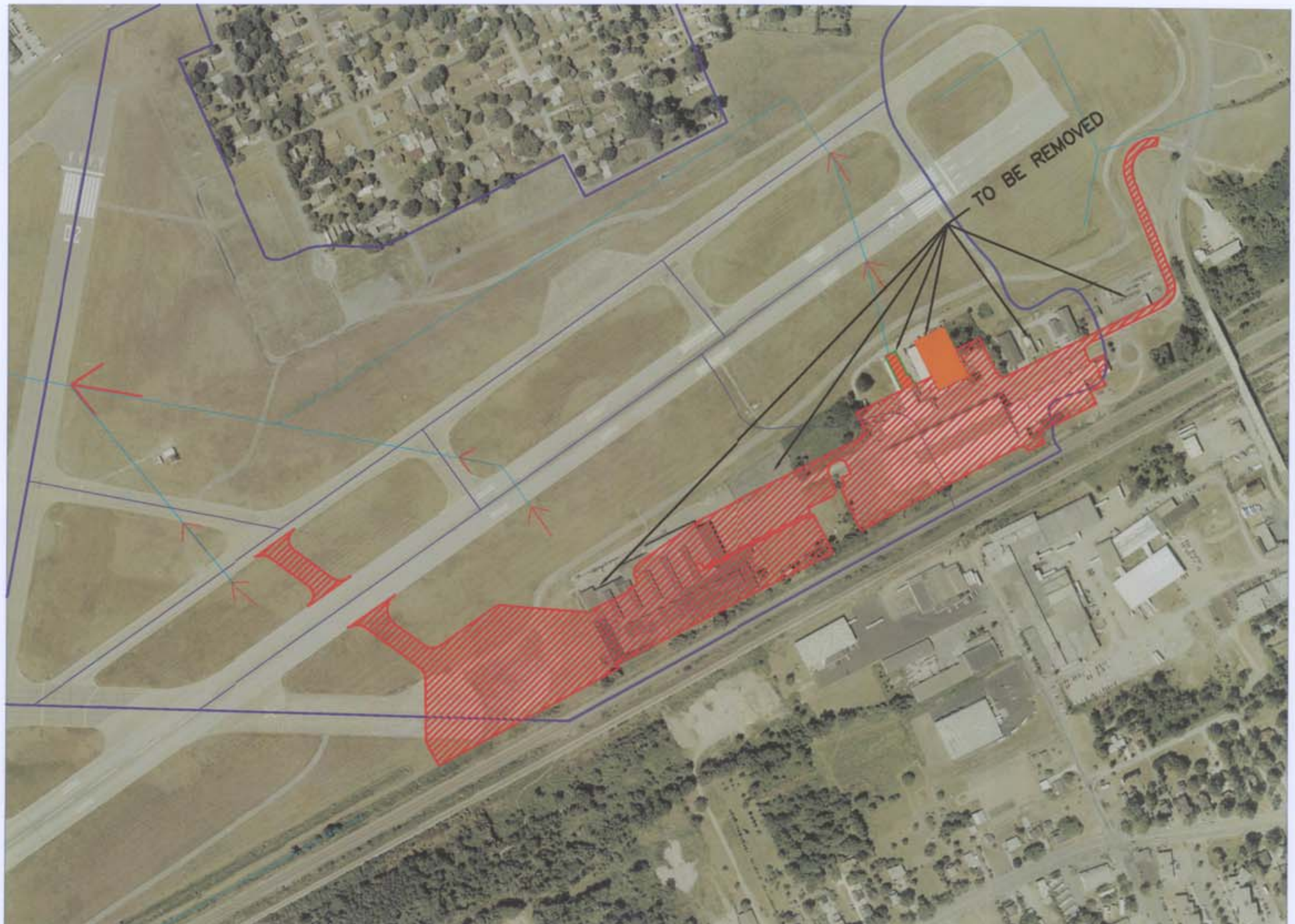
N

1in = 400ft

200 0 200 400

FIGURE 2

Fenestra Area - Proposed Development



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LEGEND

- Drainage Boundary
- Drainage Sub-Boundary
- Proposed Impervious Area
- Ex. Storm Sewer

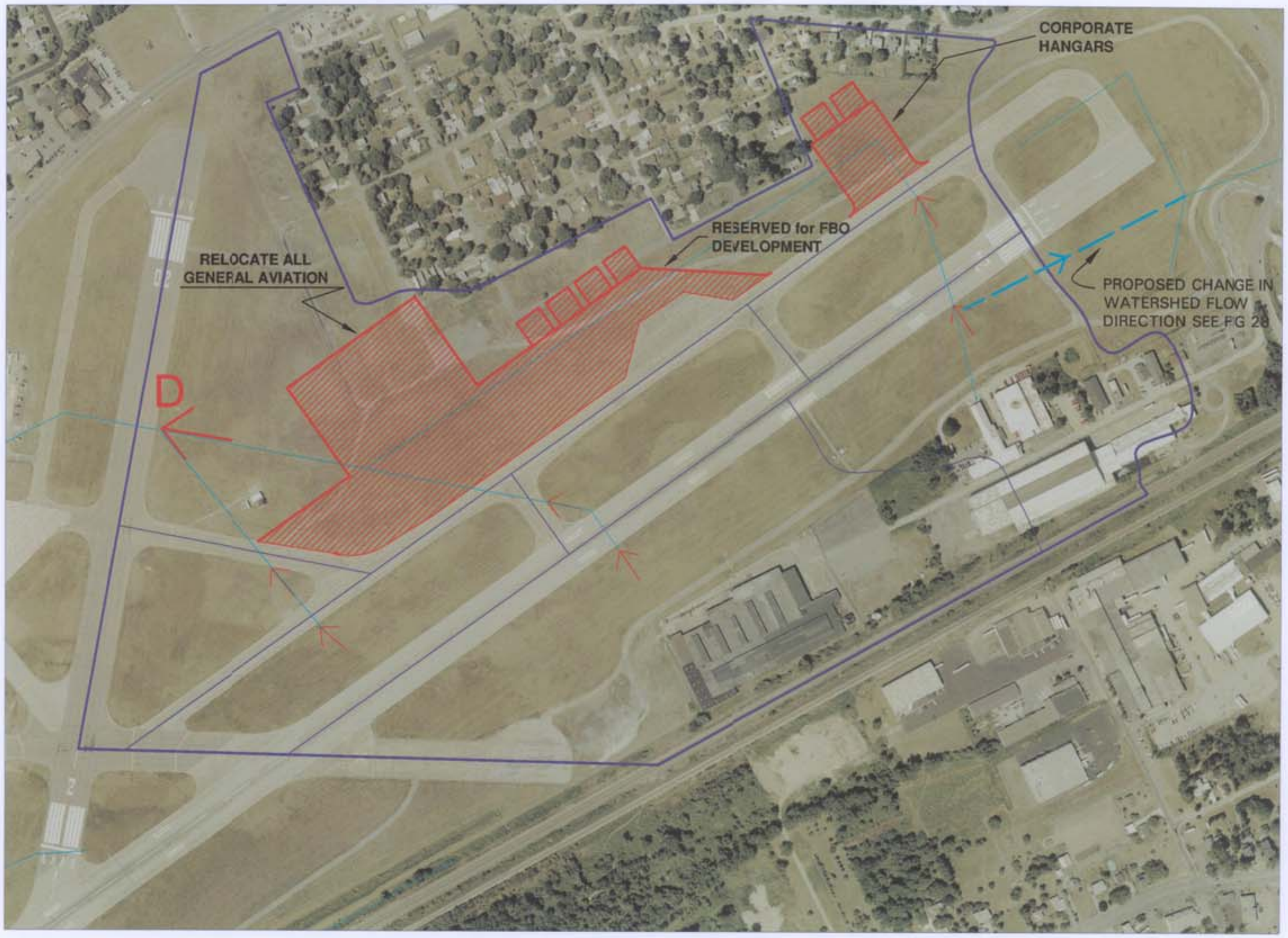
N

1in = 400ft

200 0 200 400

General Aviation - Proposed Relocation

FIGURE 3



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LEGEND

- Drainage Boundary
- Drainage Sub-Boundary
- Proposed Impervious Area
- Ex. Storm Sewer

N

1in = 400ft

200 0 200 400

Study Area Overview

FIGURE 4

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LEGEND

Drainage Boundary

Drainage Discharge Point

N

1in = 2000ft

1000 0 1000 2000

1.04-5 Additional Airport Drainage Concerns

There are several additional drainage concerns in the areas proximate to the Erie International Airport – Tom Ridge Field, some of which could be directly affected by the proposed developments. Riviera Estates, a mobile home park located east of the airport, floods noticeably even during small precipitation events. Hydrologic models show that within this area, stream banks and roads will be overtopped during the 2-year storm event. This area is directly downslope from the planned runway extension, and would be severely affected in the absence of a stormwater management plan. Millcreek Township has recently constructed a stormwater detention facility upstream of Riviera Estates in an attempt to mitigate the frequent flooding events in the area. Riviera Estates is located to the south of the drainage discharge point of the 'East of Airport' drainage area in Figure 4.

There are other flood-prone areas in the Millcreek Township that the airport does not directly impact. Two parallel railroad embankments run east and west through the area. These embankments are located directly south of the airport's property. The predominate drainage direction in the area is to the north toward Lake Erie. As this drainage reaches the railroad embankments from the south, the stormwater is impounded. There are 7 culverts in the vicinity of the airport that convey stormwater through these embankments. Stormwater is impounded upstream of these culverts during even moderate precipitation events. These culverts do not appear to be large enough to handle tributary drainage for the largely developed upstream drainage areas.

The airport's property drains to two watercourses. As each of these watercourses nears their discharge point at Lake Erie, their channels become deep. As these watercourses cut deeper into soil and evolve towards steeper slopes, their banks are naturally prone to erosion. Increases in stormwater flow would likely result in increases in erosion rates. In accordance with local stormwater ordinances, the post-development peak runoff rates from the airport's property will not be greater than pre-development peak runoff rates.

1.05 Additional Issues

There are several existing drainage problems in Millcreek Township. For the most part, these problems are a result of shallow slopes in low-lying areas. Prior to the implementation of stormwater regulations and ordinances, land development tended to aggravate drainage issues such as these. With the increased consideration and use of stormwater control and management techniques, it has been realized that new developments can be designed to alleviate these drainage issues. While the responsibility of the developer is to maintain pre-development runoff rates, cooperation or incentive programs can be utilized to go one step further and lessen these existing problems. It appears that the Millcreek Township is hoping that new developments in this flood-prone area can be planned with the mitigation of drainage issues in mind.

Currently, there are several vacant properties on West 12th St. across from the main terminal area of the airport. These properties are unable to be developed due to the unavailability of stormwater conveyances in the area. One property owner has expressed interest in directing the property's stormwater runoff into the airport's storm sewer system. Under the current stormwater ordinances, the airport will always be responsible for maintaining current stormwater discharges from its property. If the airport chose to accept this additional stormwater, the airport would be required to impound the water and release it during times of lower-flows. This effort would require the construction of a sizeable detention basin within the airport property.

CHAPTER 2 - HYDROLOGIC BACKGROUND

An overview of the drainage boundaries in the airport's vicinity is shown in Figure 4. The airport property is divided between two drainage areas. Stormwater runoff from the western portion of the airport eventually drains into Wilkins Run. Stormwater runoff from the eastern portion of the airport eventually drains into Marshall Run. A diagram of the airport property's general drainage patterns is found in Figure 5. Both Wilkins Run and Marshall Run drain north into Lake Erie. As can be seen in Figure 4, the Wilkins Run drainage area is broken into 6 drainage sub-areas. Originating in the south, runoff from the McKee and Asbury drainage areas enters the airport property where they combine with runoff from the western airport before entering the Underpass drainage area. The characteristics of the Underpass drainage area are diagrammed in Figures 6 and 7. A map of soil groups in the McKee drainage area is shown in Figure 8. McKee's land-use classifications are shown in Figure 9. The soil groups in the Asbury drainage area are mapped in Figure 10. Asbury's land-uses are classified in Figure 11.

In the southwest corner of Figure 4, runoff from the Swanville drainage area passes under the railroad into the Wilkins drainage area where it is joined by the flows from the Underpass drainage area described above. Upstream of this combination point, land slopes are generally flat. It is in this area of latitude south of Lake Erie that Millcreek Township's drainage issues are generally located. Downstream of this combination point, the gradient of Wilkin's Run increases and allows for an adequate conveyance to Lake Erie. Swanville's soil and land-use types are shown in Figures 12 and 13 respectively. The Wilkins drainage area's information is in Figures 14 and 15.

As can be seen in Figure 4, the Marshall Run drainage area is divided into 4 drainage sub-areas. In a similar pattern to that described above, the Yoder and the Yoder36 drainage areas pass under the railroad before combining inside the Marshall drainage area. Stormwater runoff from the Caughey drainage area passes under the railroad and into the Marshall drainage area. Stormwater reaches the railroad through the Yoder, Yoder36, and the Caughey drainage areas more quickly than it can pass under the railroad through its respective culverts. As a result, this stormwater is detained in 'informal' stormwater detention areas south of the tracks. A significant volume of stormwater is detained during small rain events. If this detained water reaches a certain elevation, it will overflow from one 'informal' detention area into another. The Caughey culvert has the highest elevation of these three railroad culverts and the land-surface generally slopes to the east. Using this information and available topography, it was determined that this 'informal' detention overflow will typically occur from the Caughey detention area into the Yoder/Yoder36 'informal' detention area. Based on available topographic information, any overflow from the Yoder/Yoder36 informal detention area will flow to the east toward the Peninsula Drive overpass. As a result, any over flow leaving the Caughey detention area was considered to have left the study area, unable to return.

FIGURE 5

Airport General Drainage Patterns

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LEGEND

Drainage Boundary

Drainage Discharge Point

Ex. Storm Sewer

N

1in = 750ft

375 0 375 750

LEGEND

Drainage Boundary
B Type Soils
C Type Soils
D Type Soils

'Underpass' Drainage Area Hydrologic Soil Types

FIGURE 6

N

1in = 1000ft

500 0 500 1000

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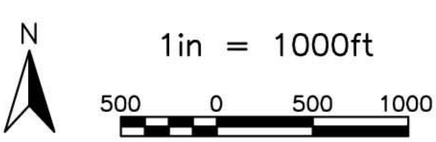
FIGURE 7

'Underpass' Drainage Area
Land Use



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LEGEND

Drainage Boundary
B Type Soils
C Type Soils
D Type Soils

'McKee' Drainage Area
Hydrologic Soil Types

FIGURE 8

N

1in = 1000ft

500 0 500 1000

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'McKee' Drainage Area

Land Use

FIGURE 9

N

1in = 1000ft

500 0 500 1000

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LEGEND

Drainage Boundary

B Type Soils

C Type Soils

D Type Soils

'Asbury' Drainage Area
Hydrologic Soil Types

FIGURE 10

N

1in = 1000ft

500 0 500 1000

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'Asbury' Drainage Area
Land Use

FIGURE 11

N

1in = 1000ft

500 0 500 1000

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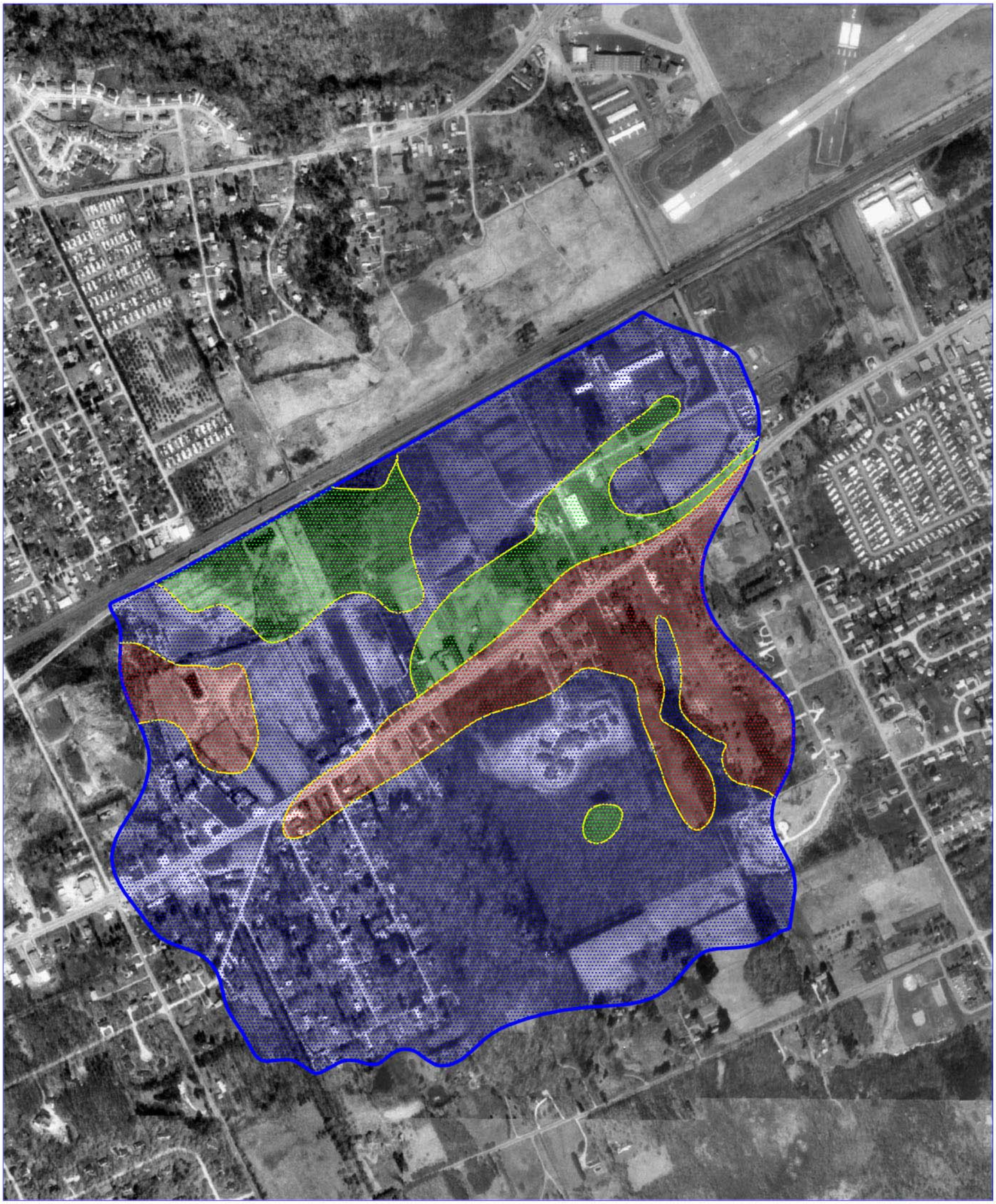
'Swanville' Drainage Area
Hydrologic Soil Types

FIGURE 12

LEGEND
- Drainage Boundary
- B Type Soils
- C Type Soils
- D Type Soils



N

1in = 1000ft

500 0 500 1000

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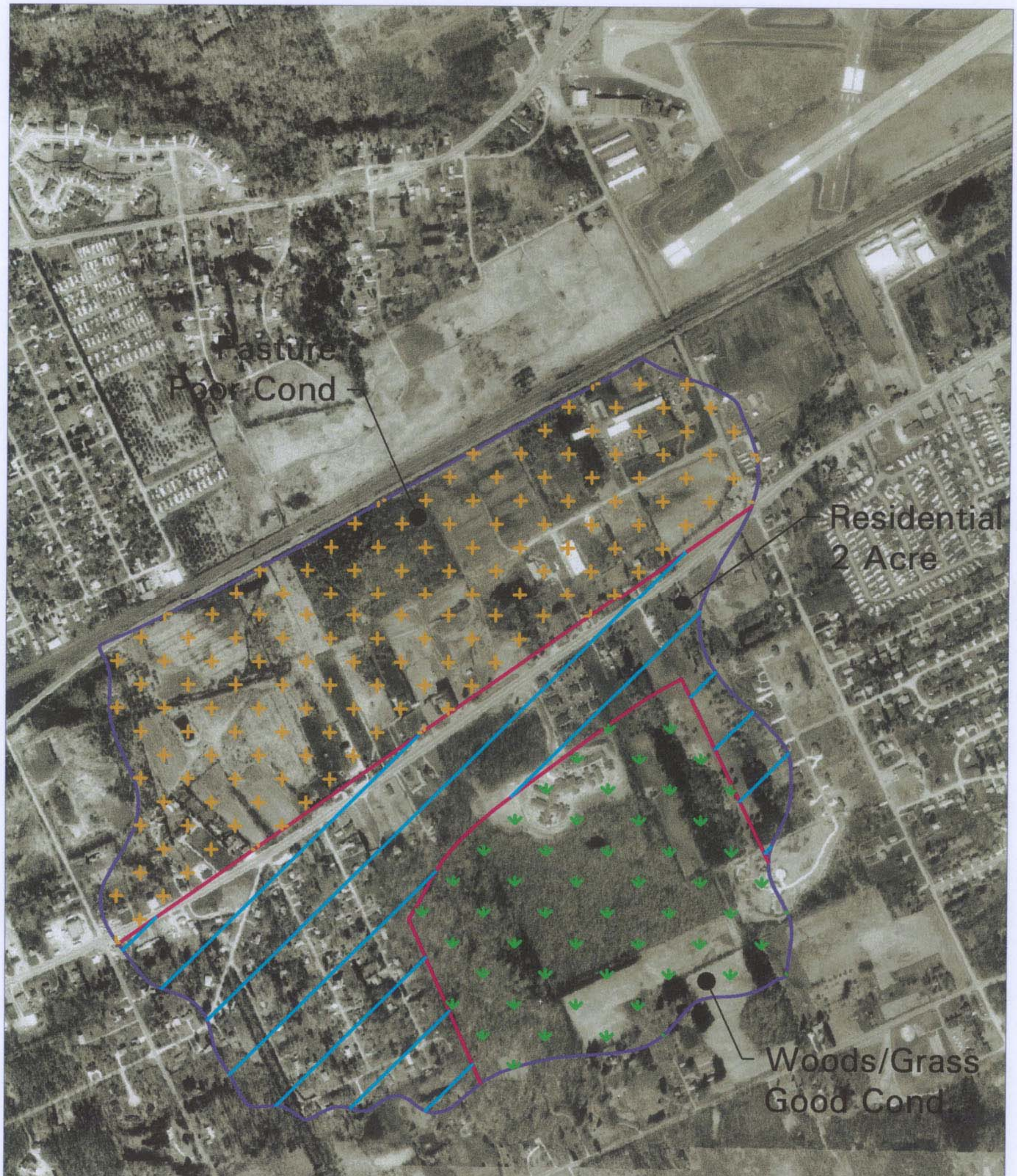
FIGURE 13

'Swanville' Drainage Area
Land Use



N

1in = 1000ft

500 0 500 1000

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LEGEND

Drainage Boundary
B Type Soils
C Type Soils
D Type Soils

'Wilkins Run' Drainage Area
Hydrologic Soil Types

FIGURE 14

N

1in – 1000ft

500 0 500 1000

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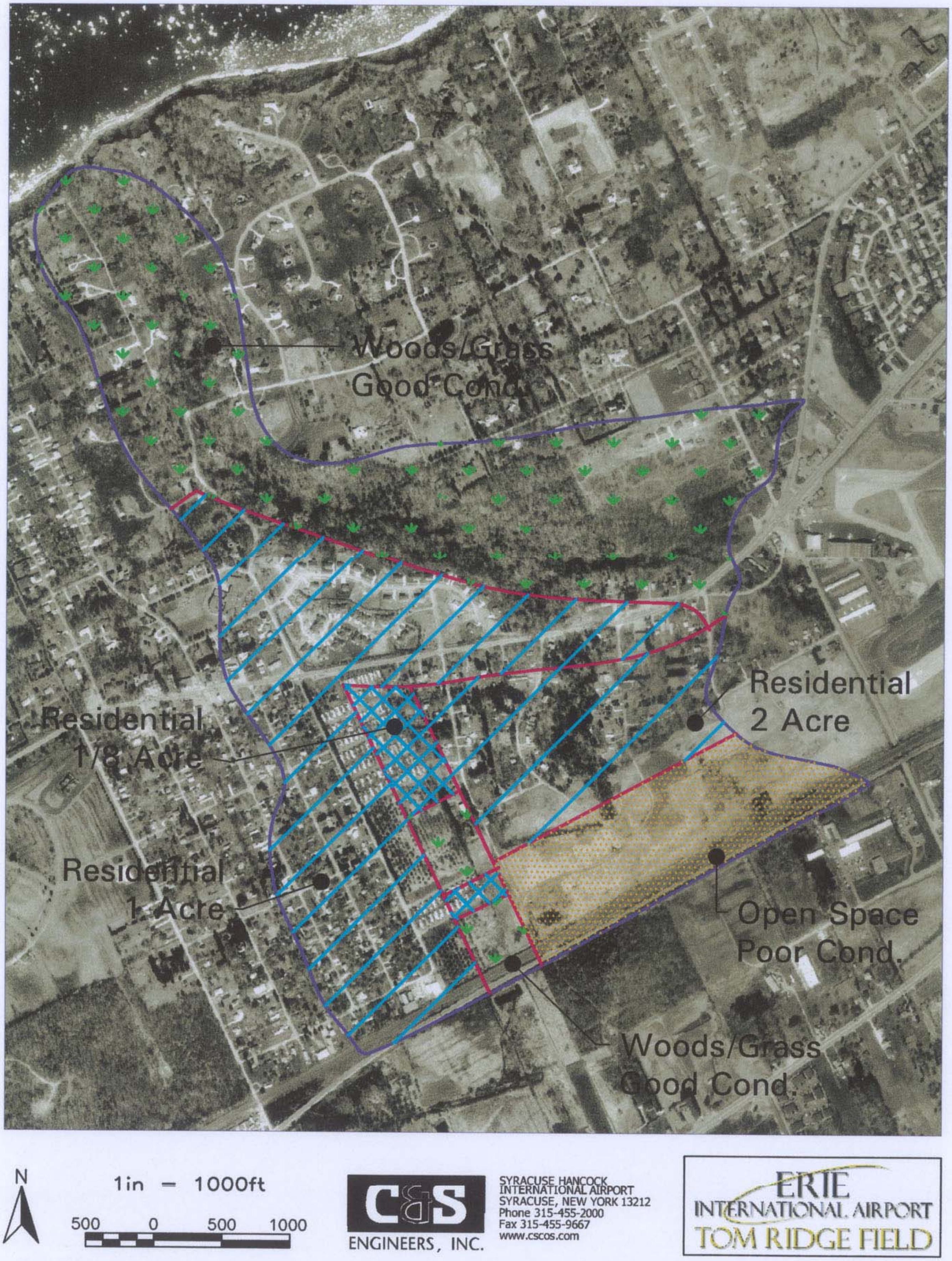
FIGURE 15

'Wilkins Run' Drainage Area
Land Use



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Stormwater runoff draining across the railroad from the 'informal' Caughey detention area enters the existing town detention area directly north of the railroad. Stormwater runoff from the eastern airport combines with the outflow from the town basin before flowing into the Marshall drainage area. Once inside the Marshall drainage area, this flow combines with the flow from the Yoder drainage areas before proceeding to Lake Erie through Marshall Run. Similar to the Wilkins' Run drainage area, the Marshall Run drainage area is predominantly flat in its upstream portion. Marshall Run, however, contains a greater percentage of these flat areas than Wilkins Run. This results in more common and generally more severe drainage problems. In addition, the Marshall Run drainage area contains a more dramatic transition from the flat area into the 'run' itself. This transition occurs near West Lake Rd. This translates into higher velocity stream flows that tend to result in greater rates of erosion. Erosion problems are evident in sections of Marshall Run immediately upstream of the lake. The soil and land-use types in the Caughey drainage area are shown in Figures 16 and 17, respectively. The soil and land-use types for the Yoder and Yoder36 drainage areas are shown in Figures 18 through 21. The Marshall drainage area's soil and land-use types are shown in Figures 22 and 23.

The Erie International Airport – Tom Ridge Field has a drainage area of approximately 453 acres. The western portion drains to the western end of the airport and then to Lake Erie via Wilkins Run, while the extreme eastern portion drains to the east and then to Lake Erie via Marshall Run. The airport drainage divide is located along Taxiway A1 on Runway 24. The airport's general drainage patterns are diagrammed in Figure 5. The airport drainage areas contain a mix of soils from three of the four hydrologic soil groups. The soils are classified as types B, C, and D, the three poorer draining categories of the existing four groups. A map of the western portion of the airport property's soil types is shown in Figure 24. The land-use for runways and terminal areas is assumed 'impervious' while all other areas are assumed to be 'pasture-fair condition'. These land-use categories are depicted in Figure 25. The soil types for the eastern portion of the airport, or 'East of Airport', are shown in Figure 26. The assumed land-uses for the same area are depicted in Figure 27.

The southern boundary of both airport drainage areas is formed by the railroad embankment that runs east and west through the township. Each airport drainage area receives inflow through this embankment. The inflow to the eastern airport drainage area is shown as point 'A' on Figure 4. There are two inflows to the western airport drainage area, one to the south of the unused runway at the southern end of taxiway 'D', and one to the south of the end of Runway 2. These inflow points are shown as 'B' and 'C', respectively, in Figure 4. These inflows to the western airport drainage area combine and then continue through airport property in an underground storm sewer system. The drainage boundaries for the western and eastern limits of the airport's property are defined by the local storm sewer system. The northern drainage boundary is West 12th St. A diagram of the airport's drainage areas is found in Figure 5.

LEGEND

- Drainage Boundary
- B Type Soils
- C Type Soils
- D Type Soils

'Caughey' Drainage Area
Hydrologic Soil Types

FIGURE 16

N

1in = 1000ft

500 0 500 1000

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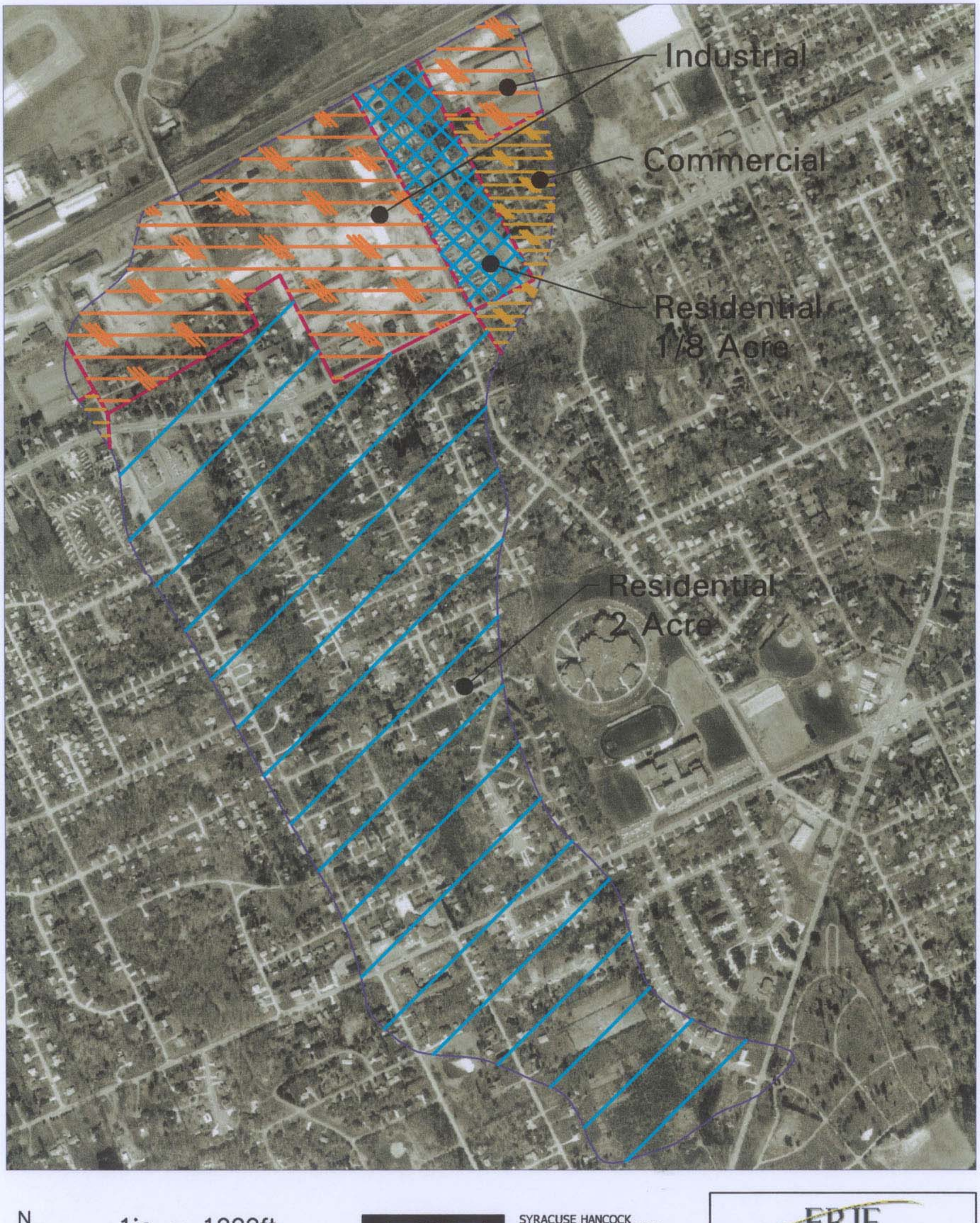
'Caughey' Drainage Area
Land Use

FIGURE 17



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LEGEND

Drainage Boundary
C Type Soils
B Type Soils
D Type Soils

'Yoder' Drainage Area Hydrologic Soil Types

FIGURE 18

N

1in = 1000ft

500 0 500 1000

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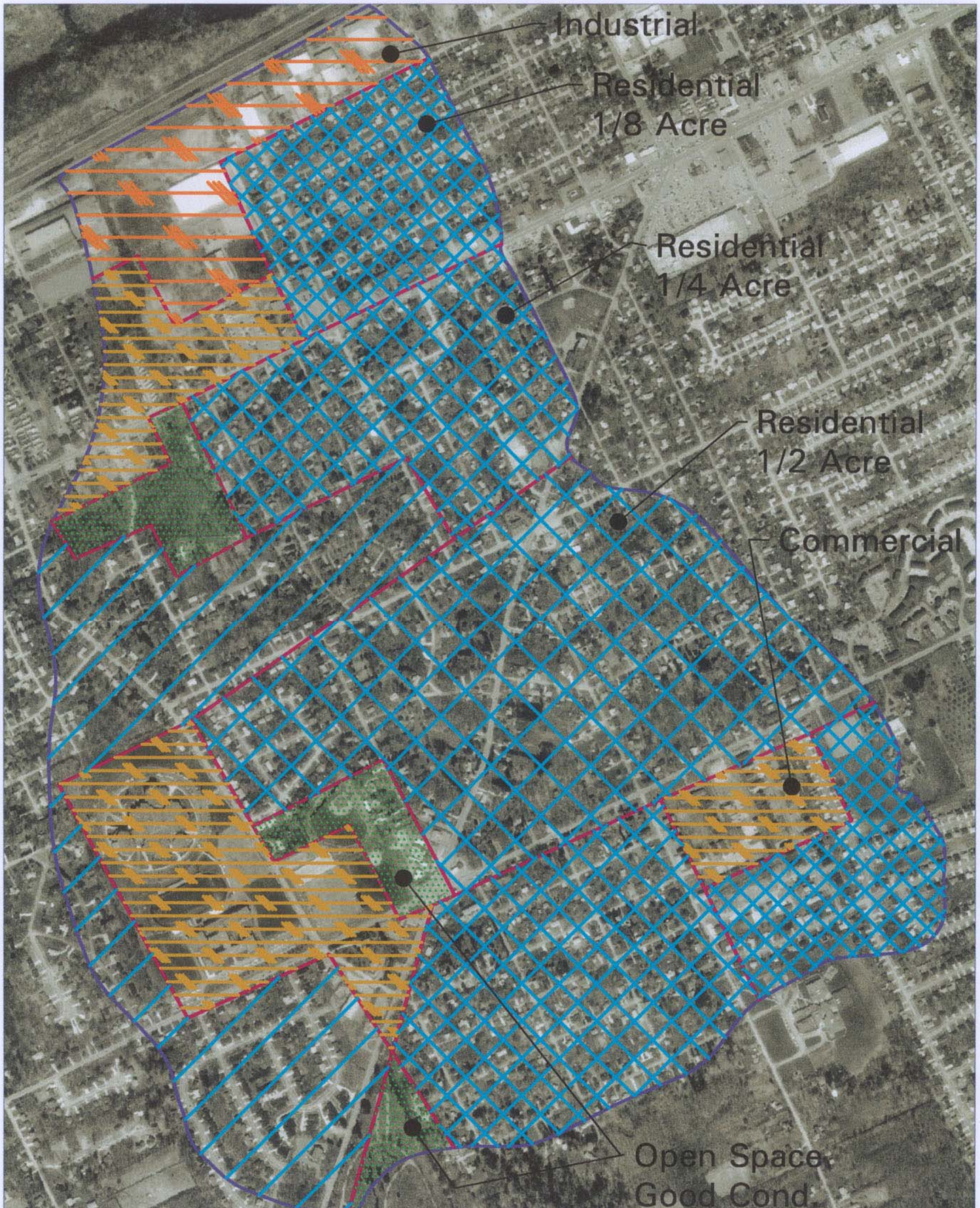
FIGURE 19

'Yoder' Drainage Area - Land Use



N

1in = 1000ft

500 0 500 1000

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LEGEND

Drainage Boundary
B Type Soils
C Type Soils
D Type Soils

'Yoder 36' Drainage Area Hydrologic Soil Types

FIGURE 20

N

1in = 1000ft

500 0 500 1000

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'Yoder 36' Drainage Area
Land Use

FIGURE 21

N

1in = 1000ft

500 0 500 1000

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LEGEND

- Drainage Boundary
- B Type Soils
- C Type Soils
- D Type Soils

'Marshall Run' Drainage Area
Hydrologic Soil Types

FIGURE 22

N

1in — 1000ft

500 0 500 1000

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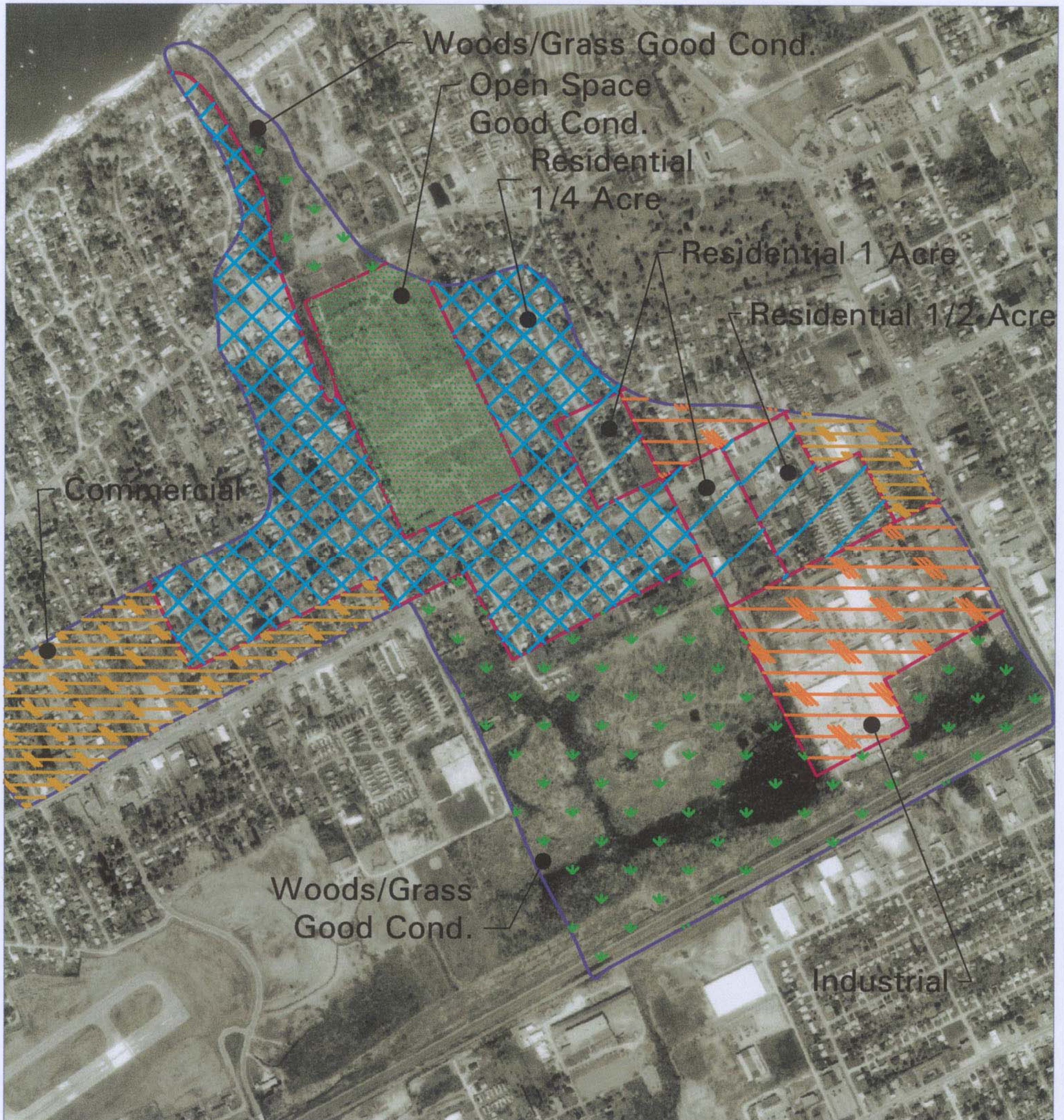
FIGURE 23

'Marshall Run' Drainage Area
Land Use



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LEGEND

- Drainage Boundary
- B Type Soils
- C Type Soils
- D Type Soils

'Western Airport' Drainage Area
Hydrologic Soil Types

FIGURE 24

N

1in — 1000ft

500 0 500 1000

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'Western Airport' Drainage Area
Land Use - Existing Conditions

FIGURE 25

N

1in = 1000ft

500 0 500 1000

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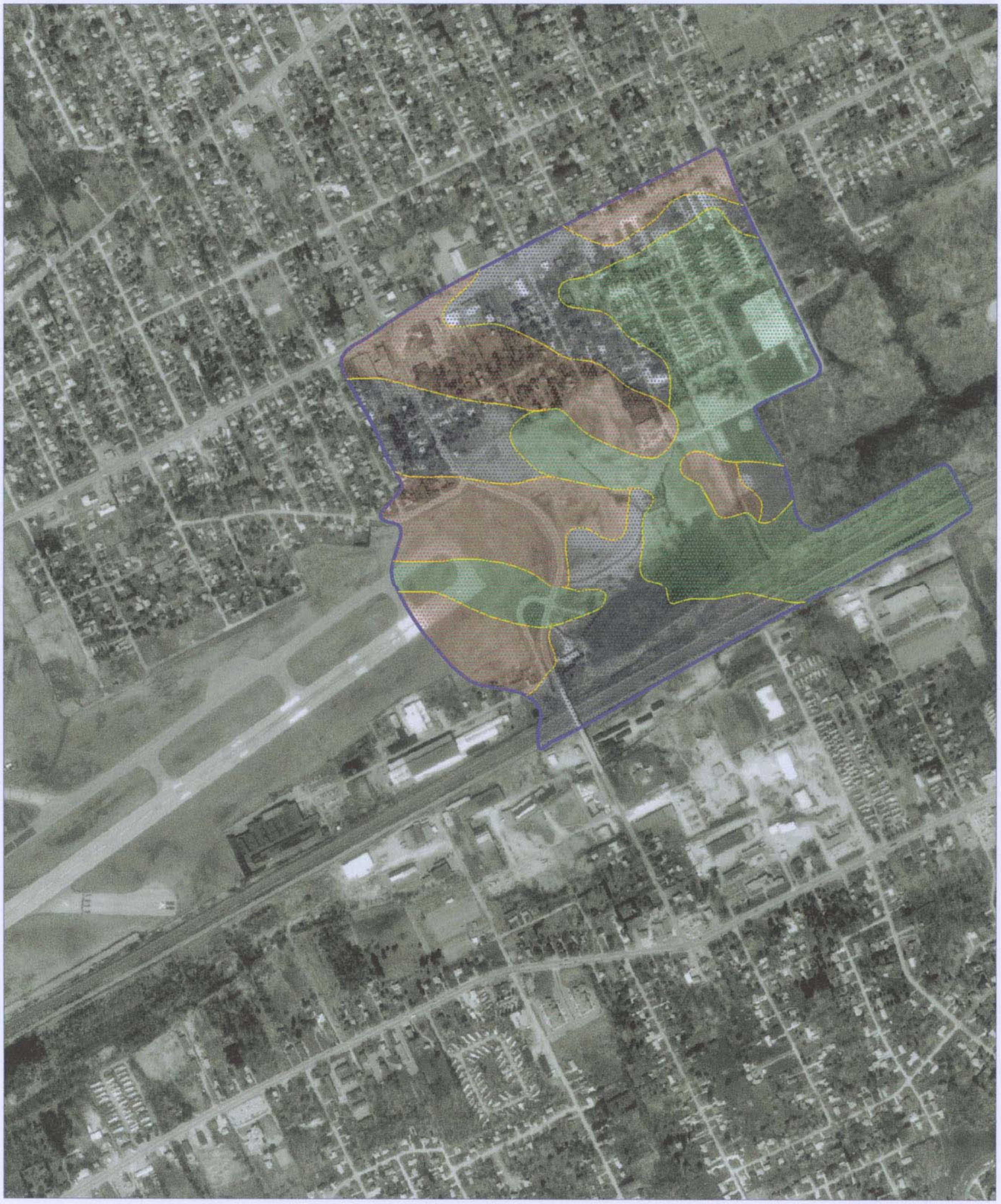
LEGEND

Drainage Boundary
B Type Soils
C Type Soils
D Type Soils

'East of Airport' Drainage Area
Hydrologic Soil Types

FIGURE 26



N

1in = 1000ft

500 0 500 1000

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FIGURE 27

'East of Airport' Drainage Area
Existing Conditions Land Use

N

1in — 1000ft

500 0 500 1000

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CHAPTER 3 - HYDROLOGIC ANALYSIS AND DESIGN

The following section outlines the methods used in the quantitative hydrologic analysis of the study area.

3.01 Stormwater Regulations and Policies

In general terms, the Milllcreek Township Stormwater Ordinance 97-4 states that a property's post-development peak discharges that result from a certain magnitude rainfall event must not exceed the property's pre-development peak discharges that result from the same rainfall event. These peak flows can be determined using a number of computational methods. Those used in this study are described in section 3.02.

3.02 Stormwater Quantification Methods

The analysis of stormwater runoff was undertaken using methods described in the United States Soil Conservation Service Technical Release Number 55 Urban Hydrology for Small Watersheds (TR55), and Technical Release Number 20 (TR20). TR20 is a computer program that routes stormwater discharges from watersheds that have been modeled using TR55.

Input data for TR55 includes a number of hydrologic factors:

- Drainage Areas
- Runoff Curve Numbers (CN's)
- Times of Concentration (T_C's)
- Precipitation Information
- Soils and Land Use Information

The size of the drainage area influences peak discharge rates. A larger drainage area will contribute more flow while a smaller drainage area contributes less flow to a concentration point or outlet.

The runoff Curve Number (CN) is a composite number assigned to a combination of soil types and land uses. The CN is affected by the infiltration rate of the soil, vegetation, and the amount of impervious area located within the drainage area. High CN's, typical of a commercial setting, model high rates of runoff while low CN's, typical of wooded, well-drained soils model low rates of runoff. The runoff curve numbers used in computer models reflect conditions as determined using United States Geologic Survey (USGS) Topographic Quadrangle maps, aerial photographs, and field investigation.

Before runoff can reach the concentration point or outlet, it may follow a flow path through a variety of media, possibly including roofs, lawns, pavements/roads, culverts, and open channels. The Time of Concentration (T_C) is the travel time of stormwater from the hydrologically most distant point of the watershed to its outlet. The T_C is determined by the slope, length, and surface roughness of the flow path. The T_C has a significant effect on peak flows. Reducing the T_C increases peak discharge rates. The T_C for a wooded area will be longer than that of a commercial development for equal travel distances and slopes.

Of the factors that affect surface stormwater runoff, the depth of rainfall on a specific watershed does not change as a result of development. Peak rates of flow *are* affected by the antecedent moisture condition (AMC) of the soil and by the distribution of rainfall within a given storm. The Type II rainfall distribution was used in these analyses. This distribution is characteristic of rainfall typical to the northeastern Pennsylvania region. The antecedent moisture condition of soil is broken down into three categories referred to as 1, 2 and 3. AMC 1 is characteristic of soil in a growing season that has received less than 1.4 inches of rainfall within the previous five-day period. AMC 2 is characteristic of soils that have received between 1.4 and 2.1 inches of rainfall, and AMC 3 is characteristic of soils that have received more than 2.1 inches of rainfall within the previous five-day period. AMC 2 was used in all of the analyses undertaken in this study.

Soils are classified into hydrological soil groups according to their infiltration rates and runoff potential for bare soil after prolonged wetting. The hydrologic soil groups are:

A. Low runoff potential
B. Moderately low runoff potential
C. Moderately high runoff potential
D. High runoff potential

The infiltration rate is the rate at which water enters the soil at the soil surface. Generally, development reduces infiltration and decreases the Time of Concentration, which results in higher peak rates of stormwater runoff. The volume of runoff is determined by the depth of precipitation, the soil infiltration characteristics, the type of vegetal cover (lawns, meadow, woods, etc.), the extent of impervious areas (roads, roofs, etc.), and the occurrence of surface water retention. Development will generally result in less pervious area and thus increase the surface water component and decrease the ground water component of stormwater runoff.

3.03 Basis of Design

According to Millcreek Township Stormwater Ordinance 97-4, following development, a site may release no more than 100% of its pre-development peak discharges for the 2, 5, 10, 25, and 100-year storm events. All stormwater management facilities will be designed according to this regulation. In addition, consideration will be given to areas upstream of the study area. Because the study area is relatively flat, there exists the potential for stormwater controls to create 'backwater' conditions that could adversely affect upstream areas. As a result, no stormwater management plan presented in this report will have a detrimental effect on upstream conditions.

These potential backwater conditions were modeled using 'Pond Pack'. Pond Pack is a platform used to run TR20 and TR55. The Pond Pack software runs TR20 while considering downstream conditions. If TR20 routes stormwater into a series of ponds or detention basins, Pond Pack will recognize this condition and re-calculate the inflow rates based on the water surface elevations encountered. These calculations are performed in a series of iterations, or repetitions, until the correct balance of upstream and downstream elevations is achieved. This method is necessary when flows are moving through a series of ponds. An example of this situation is the town detention facility and the ponding, or flooding that occurs upstream of the railroad in that location. Pond Pack is capable of analyzing these situations effectively to ensure that proposed changes to the town detention facility will benefit downstream properties and at the same time not adversely impact upstream conditions.

3.04 Points of Design

The following section includes discussions about each of the different areas examined as a part of this study.

3.04-1 Asbury Road Underpass Flooding

In addition to the mitigation of the effects of development on peak stormwater discharges, this study includes an analysis of the frequent flooding of the Asbury Road underpass. Asbury Road is adjacent to the west end of the airport's property. At the airport's southwest corner, Asbury Road passes under the railroad lines that border the airport to the south. Considerable flooding reportedly occurs here on the order of every two years.

In order to identify and quantify the processes that lead to this flooding, a hydrologic model of this drainage system was created using TR20. Due to a lack of high-resolution topographic data, a few assumptions had to be made in the creation of the hydrologic model. First, all surface land slopes were assumed to be 0.01. Second, all open channel flows were assumed to travel with a velocity of 3.5 feet per second. Third, the storage volumes south of the railroad embankment in the McKee drainage watershed were assumed. These assumptions were based upon available data and overall site characteristics. The main focus of this section of the drainage study was to determine the airport's facilities' role, if any, in the flooding of the Asbury Road underpass.

For example, if the stormwater flows from the Asbury drainage area were too large for the airport's facilities to pass, it would be possible for stormwater to back up into the 'natural' storage basin south of the railroad beds. If this water surface elevation became too high, the impounded water would spill over the western embankment and into the Asbury Road underpass area. In this situation, the airport's facilities would be contributing to the flooding in the underpass. However, if the conduit through the railroad embankments is too small to pass the stormwater discharges from the Asbury drainage area, a similarly rising water surface elevation would occur, again contributing to the flooding in the underpass. In this situation, the airport's facilities would not necessarily contribute to this flooding.

This drainage sub-system was examined from the downstream end, moving upstream. This system leaves the airport property in an 8 ft. by 10 ft. concrete box under Asbury Road approximately 1000 ft. north of the underpass. This drainage sub-system is diagramed in Figure 28.

Asbury Road Flooding Analysis

FIGURE 28

The full-flow capacity of this 8 ft. by 10 ft. box is approximately 660 cubic feet per second (cfs). The 100-year storm will produce a peak discharge of approximately 370 to 380 cfs. The outlet of this drainage sub-system is capable of conveying the 100-year storm. Moving upstream, the major storm sewer pipe is 5 ft. in diameter. The capacity of this pipe is approximately 135 cfs. This capacity is exceeded between the occurrences of the 10-year and 25-year storms. This return period will cause peak discharges to 'back up' in the airport's storm sewer system. However, the flooding in the Asbury Road underpass reportedly occurs much more often than this, indicating that this point in the airport's facilities may not be the major problem. Moving farther upstream, the peak discharges in the 5 ft. pipe decrease. At the point of entry into the airport's property from the south, a 4 ft. pipe passes through the railroad embankment. This pipe has a capacity of 90 cfs. The peak discharge to this point from the 2-year storm is approximately 150 cfs. This pipe is overwhelmed more often than the occurrence of the 2-year storm. When this occurs, stormwater is impounded south of the railroad embankment. When the surface elevation of this water exceeds approximately 732.5 ft., water begins to spill into the area of the Asbury Road underpass. Here, the 2-year storm produces a peak water surface elevation of approximately 732.7 ft., resulting in a peak discharge of 15-20 cfs over the embankment into the Asbury Road underpass. This appears to be the cause of the frequent Asbury Road underpass flooding.

3.04-2 Fenestra Development

The 'Fenestra' area of the airport' property is located south of Runway 6-24 near taxiway A2. This area has recently been purchased by the airport and is to be the site of air cargo operations. The proposed development, as planned by Weber Murphy Fox, is illustrated in Figure 2. The shaded area in Figure 2 represents the extent of the proposed impervious surface. Hydrologic models of this area were developed in order to quantify the effects of the development on stormwater discharge. The results are shown in Table 1.

Table 1 – **Fenestra Area Peak Discharges – Existing and Proposed Conditions**

Storm	**Fenestra West**		**Fenestra East**	
	Existing Cond. (cfs)	Proposed Cond. (cfs)	Existing Cond. (cfs)	Proposed Cond. (cfs)
2-year	40	42	21	20
5-year	54	57	30	30
10-year	68	71	40	39
25-year	91	93	55	54
100-year	132	134	83	82

Due to the implementation of the new structures within the old structures' footprints and the return of certain areas from pavement to vegetative cover, the post-development stormwater peaks will be slightly smaller than the pre-development peaks in the 'Fenestra East' sub-basin. As a result, no stormwater management plan is required other than the continued maintenance of existing facilities. For the 'Fenestra West' sub-basin, a slight increase in peak discharges will follow development. This increase will be accounted in the stormwater management plan for the general aviation relocation/expansion discussed in the following section.

3.04-3 General Aviation Relocation/Expansion

The third proposal analyzed in this report is the relocation of all general aviation, conventional/corporate hangars, and FBO activity to the area east of Taxiway C with an apron fronting on Taxiway A. This potential development is referred to in section 6.08 of the current Airport Master Plan. Figure 3 contains a diagram of the proposed facilities. The area was modeled at the hydrologic concentration in the existing airport storm sewer immediately east of Runway 20 and north of Taxiway C, identified as point ‘D’ on Figure 3. This point defines a drainage sub-basin that contains the entire development. Figure 3 is a diagram of the drainage basins included in the hydrologic model. As shown if Figure 3, the drainage areas involved include the Fenestra area because of the existing storm sewer layout. This development would require the addition of a substantial impervious surface. It was assumed that the land formerly occupied by these facilities would remain in its current, impervious state. This development would result in a significant increase in stormwater runoff from the airport property. Table 2 contains the results of the pre and post-development land without any consideration given to stormwater management.

Table 2 – **General Aviation Area Pre-Management Peak Discharges**

Storm Event	Existing Conditions (cfs)	Proposed Conditions No Stormwater Management (cfs)
2-year	118	135
5-year	164	184
10-year	210	233
25-year	283	311
100-year	421	453

It would likely be possible to detain the additional stormwater on the airport property downstream of this development. However, drainage improvements being considered surrounding the runway extension can more cost effectively be modified to accommodate the increased stormwater runoff. To utilize this approach, drainage from the Fenestra East sub-area is proposed to be diverted east as illustrated in the fold-out Figure 29. This will reduce the discharges through the proposed general aviation area and allow the proposed development to proceed. Table 3 contains the existing conditions and proposed conditions peak discharges.

Table 3 – **General Aviation Area Post-Management Peak Discharges**

Storm Event	Existing Conditions (cfs)	Proposed Conditions Re-Routed Fenestra East (cfs)
2-year	118	118
5-year	164	159
10-year	210	200
25-year	283	263
100-year	421	380

3.04-4 Runway 24 Extension

The major development project analyzed as a part of this study is that of the eastern extension of Runway 24. The runway extension will necessitate the alteration of much of the land-use in the immediate vicinity. This extension will require extensive re-grading of a significant area of land and the importation of a large volume of fill. The entire Riviera Estates mobile home park will be acquired and dismantled by the airport. The addition of the runway itself will increase the impervious area within the drainage boundaries. The combination of these factors will cause a change in the drainage characteristics of the area. A point just south of the intersection of West 12th St. and Marshall Drive was selected as the hydrologic design point for the analysis of the extension of Runway 24. All of the areas that would be modified as a result of this project drain to this point. The drainage area involved is named 'East of Airport' and is shown in Figures 26 and 27.

The proposed eastern extension of Runway 24 would be parallel to and very close to the north edge of the existing town detention basin. At this location, the runway will be elevated 10 to 15 feet above existing grade. The slope of the proposed runway extension fill will meet the embankment of the existing town detention basin, effectively creating a new detention area to the west. This area has been called the 'Wet Area' and is illustrated in Figure 29. The Wet Area currently contains areas of standing water. According to the Pennsylvania Department of Environmental Protection, water surface elevation in these areas of standing water may mot be raised from existing conditions by more than a foot for a period longer than 24 hours. Based on available topographic information, the existing water surface elevation in the Wet Area is approximately 145.6 feet (Millcreek vertical datum).

The hydrologic modeling system 'TR20' was used on the 'Pond Pack' platform to predict peak discharges for both pre and post-development conditions. The discharges at the hydrologic design point for various rainfall events can be found in Table 4. In the absence of a stormwater management plan, the proposed extension of Runway 24 will increase peak discharges over a range from 6% to 33%, depending on the magnitude of the storm. This peak discharge increase is primarily a result of changing land-use to types that are likely to produce higher peak discharges. These discharge peaks can be reduced using a number of different methods. One common method is the construction of stormwater detention facilities. These facilities are reservoirs that trap stormwater and detain it on site, slowly releasing it in order to keep peak discharge rates below their pre-development levels.

For this runway extension, there are three general stormwater management scenarios:

1. **Construction of a detention basin near the hydrologic concentration point of West 12th St. and Marshall Drive.** A diagram of this potential detention basin is presented in Figure 29. Constructing a detention basin near the hydrologic concentration is a common practice due to the fact that the entirety of the stormwater is already headed to that point, so re-routing water is not usually required. In addition, the hydrologic concentration is typically the point of lowest elevation, offering the greatest potential depth of storage for an area. This alternative was fully explored in this study.

This potential detention facility will be referred to as the 'trailer park' basin (see note 1 following this chapter).

2. **Modification of the outlet structure of the existing Millcreek Township stormwater detention basin.** In this scenario, the outlet capacity of the existing Millcreek township detention facility would be reduced to better utilize its available storage volume. Following its passage through the existing detention basin, stormwater is joined by the runoff from the eastern side of the airport prior to exiting the drainage area at the previously described point near West 12^{th} St. and Marshall Drive. In this second scenario, the construction of a new detention facility was not considered, although the existing course of the town detention outflow channel would have to be modified slightly to adhere to runway safety requirements.

3. **Utilization of the Wet Area drainage area for stormwater detention.** In this scenario, runoff from the area of the runway expansion was routed to the Wet Area. Following its impoundment there, the stormwater would combine with the outflow from the existing Millcreek township stormwater detention facility before proceeding to the design point. As was the case with the second scenario, the natural course of the town detention outflow would have to be modified slightly to adhere to runway safety requirements.

In addition to these three general stormwater management scenarios, a number of combinations of the three above scenarios were considered. For example, one alternative involved the construction of the 'trailer park' stormwater detention facility in conjunction with the constriction of the Millcreek Township stormwater detention facility's outlet structure to an 18-inch diameter pipe. The results of the better alternatives tested are located in Table 4. The stormwater routing paths for these alternatives are illustrated in Figure 29.

Table 4 – **Stormwater Management Alternatives - Peak Discharges**

Storm	Existing Cond. (cfs)	Alternative 1 (cfs)	Alternative 2 (cfs)	Alternative 3 (cfs)	Alternative 4 (cfs)	Alternative 5 (cfs)
2-year	50	26	29	9	17	9
5-year	59	48	35	9	21	9
10-year	65	71	38	10	23	10
25-year	100	109	41	10	24	10
100-year	175	182	44	10	28	10

All alternatives shown are viable except for Alternative 1. Alternative 1 can be thought of as a 'do nothing' case. Here, the runway is extended without the presence of a stormwater management plan other than routing stormwater runoff from the new pavement into the Wet Area. This alternative is shown to provide a basis for comparison. For the 2-year and 5-year rainfall events, the peak discharges from the entire system are actually less for Alternative 1 than under existing conditions. This is a result of the utilization of the Wet Area for detention under proposed conditions in the East of Airport drainage area. This reduces the peak discharges from the study area to the design point. Peak discharges increase for more severe, 10-year through 100-year storms. The Pond Pack model output and supporting information can also be found in Appendix A.

Each of the remaining alternatives (2 through 5) include the modification of the outlet structure of the existing Millcreek Township detention basin. In addition, these alternatives divide the East of Airport drainage area into drainage sub-areas. These sub-areas would be routed into the Wet Area using culverts. These drainage sub-areas and culverts are shown in the large fold-out Figure 29. From this diagram, it can be seen that a culvert could be installed from the existing structure north of the Fenestra area. This 60-inch by 38-inch elliptical concrete culvert could convey the stormwater runoff from the Fenestra East sub-area to the Wet Area. Figure 29 also shows a proposed 34-inch by 22-inch elliptical concrete culvert from the Infield West sub-area into the Wet Area. A 36-inch diameter concrete culvert could convey stormwater from the Infield East sub-area to the Wet Area. The North of Taxiway sub-area could be drained to the Wet Area with a 49-inch by 32-inch elliptical concrete culvert. All of these proposed culvert sizes are preliminary. Under existing conditions, the Wet Area drains from the northwest corner of the existing town detention basin north toward the storm sewer system. Under the proposed conditions, the Wet Area would be drained through a 12-inch culvert with an inlet placed in the invert of the existing ditch, maintaining existing Wet Area conditions as much as possible. This culvert would join the outflow from the existing Millcreek township stormwater detention basin just downstream of its outlet structure.

Alternative 2 consists of replacing the existing 36-inch town detention outlet orifice with a 24-inch orifice. As discussed previously, Alternative 2 also re-routes stormwater runoff from runway extension drainage sub-areas to the Wet Area. A diagram of these drainage sub-areas and their routing for Alternative 2 is located in the large fold-out Figure 29.

The Pond-Pack model output and its supporting information can be found in the Appendix B. It appears that Alternative 2 would be adequate to satisfy the requirements of the runway extension's stormwater management plan. However, based on the assumption that the storm sewer slope is the same as the existing land slope, the 24-inch storm sewer at the drainage discharge point will have a capacity of approximately 15 to 20 cfs. Under the proposed conditions of Alternative 2, this capacity will be surpassed more often than the 2-year storm event. During stormflow events that exceed 15 to 20 cfs, water will be detained at the inlet to the storm sewer, much like existing conditions. Alternative 2 will result in less flooding than occurs currently, but will still flood more often than every 2 years.

Alternative 3 incorporates the proposed improvements of Alternative 2 with the addition of a new stormwater detention facility near the drainage outlet at West 12th St. and Marshall Drive. Figure 29 depicts this new stormwater detention facility. This new facility would have a volume of approximately 46.5 acre-feet and would fill to a depth of approximately 8 to 9 feet during the 100-year storm event. This new stormwater detention facility would have a 12-inch orifice for an outlet structure. In Alternative 3, the existing town detention basin would have a 15-inch outlet orifice. Alternative 3 results in peak discharges considerably less than those of Alternative 2. Alternative 3's peak discharges are within the capacity of the receiving storm sewer system for all storms analyzed.

The Pond-Pack model output for Alternative 3 and its supporting information can be found in the Appendix C. Alternative 3 results in very manageable outflows from the trailer park detention facility into the existing storm sewer system. Table 5 shows the water surface elevations and storage volume for Alternative 3 for various storm events. Alternative 3 also maintains water surface elevations in the informal detention area south of the railroad.

Table 5 – **Alternative 3 (& 5) Trailer Park Detention Elevations and Volumes**

Storm Event	Trailer Park Detention Fac. Water Surface Elevation (ft above Millcreek datum)	Trailer Park Detention Fac. Storage Volume (acre-feet)
2-year	139.10	16.00
5-year	139.72	19.87
10-year	140.06	22.37
25-year	140.34	25.85
100-year	140.97	33.70

Alternative 4 consists of Alternative 2 plus the installation of an additional 48-inch culvert under the southern-most railroad tracks. This new culvert would be placed in parallel to the existing 48-inch culvert and would allow water to be conveyed under the railroad more quickly. This will lower the water surface elevation of the 'informally' detained stormwater south of the tracks. Alternative 4 uses the same stormwater routing described previously and shown in the large fold-out Figure 29.

The Pond-Pack model output and its supporting information can be found in the Appendix D. Similarly to Alternative 2, Alternative 4 would reduce peak discharges at the outflow from the study area well below exiting conditions. However, these peak discharges, shown in Table 4, would still be beyond the capacity of the existing storm sewer. The benefit of the additional railroad culvert can be seen in comparisons of water surface elevations and overflow volumes between Alternative 4 and the previous alternatives. These comparisons are shown in Tables 6 and 7.

Alternative 5 consists of the conditions of Alternative 4 with the addition of a new detention facility in the trailer park area. This detention facility is the same facility implemented in Alternative 3. The Pond-Pack model output and its supporting information can be found in the Appendix E. As can be seen in Table 4, Alternative 5 results in similar outflows as Alternative 3. These outflows are significantly less than existing conditions and would be within the capacity of the receiving storm sewer. Alternative 5 results in similar south of rail flood reduction benefits as Alternative 4.

Table 6 contains the water surface elevations in the informal stormwater detention area south of the railroad tracks for existing conditions compared to those associated with each of the stormwater management alternatives. The existing conditions water surface elevations would remain unchanged under Alternatives 1, 2, and 3. For Alternatives 4 and 5, the water surface elevations are lower for all modeled storm events. This is a result of the increased stormwater flow capacity through the railroad embankment.

Table 6 – **South of Railroad Water Surface Elevation Comparison**

Storm Event	Existing /Alt's 1,2,3 S. of Rail WS Elev. (ft)	Alternatives 4,5 S. of Rail WS Elev (ft)	Difference (ft)
2-year	150.38	149.96	-0.42
5-year	151.58	150.93	-0.65
10-year	152.15	151.89	-0.26
25-year	152.43	152.34	-0.09
100-year	152.89	152.81	-0.08

In addition to reducing flood levels in the area of the informal detention area, the new culvert in Alternatives 4 and 5 would result in a smaller volume of water that would overflow into the adjacent informal detention areas to the east in the Yoder/Yoder36 drainage areas. Table 7 shows this overflow volume difference for each alternative. In general, this increased capacity under the railroad would better utilize the available storage in the existing town detention basin while decreasing the burden on the informal storage areas south of the railroad.

Table 7 – **South of Railroad Overflow Volume Comparison**

Storm Event	Existing/ Alts 1,2 S. of Rail Overflow Vol. (acre-feet)	Alterative 3 S. of Rail Overflow Vol. (acre-feet)	Alternatives 4,5 S. of Rail Overflow Vol. (acre-feet)
2-year	0	0	0
5-year	0.07	0.07	0
10-year	5.92	5.92	1.68
25-year	19.69	19.69	13.48
100-year	49.95	50.02	41.88

It should be noted that the stormwater management plans presented here reduce the discharge to rates significantly *less* than pre-development levels. Again, according to local ordinances, the airport is responsible for *not increasing* pre-development discharges. These management alternatives that go beyond the legal requirements are presented as opportunities that could lend to the improvement of the town's drainage conditions both upstream and downstream of the railroad.

Note 1:
The stormwater detention facility is proposed to be located in the current Riviera Estates Trailer Park – a mobile home area recommended for acquisition under a Record of Approval (ROA) in 1992 for the Federal Aviation Regulation (FAR) Part 150 Noise Compatibility Program (NCP). (See Noise Compatibility Study/Noise Compatible Program for Erie International Airport, 1990.)

The Riviera Estates is one of 82 properties around the Erie International Airport approved for acquisition because of the following reasons:

- The Riviera Estates is an incompatible land use within the 70 Ldn noise contour. At present, the park is a recipient of noise generated by aircraft operation at the Erie International Airport. The noise level exceeds the allowable limit of less than 65 Ldn for residential living.
- The Riviera Estates is not eligible for FAA's Residential Sound Insulation Program because the structural nature of the mobile homes cannot accommodate sound insulation practice.

The acquisition of the property is presently under review and it is expected that a relocation program, in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1070, (49 CFR 24), will take effect in the near future.

CHAPTER 4 - CONCLUSIONS AND RECOMMENDATIONS

It is recognized that the watercourses downstream of the airport, in particular Wilkins and Marshall Runs, are approaching their capacities. In addition, natural erosion is taking its toll on private properties along their banks. While this condition is not easily curable, it can be managed through strategies to reduce the overall flow rates to these watercourses. This can be contributed to through the utilization of naturally occurring low areas and the conscientious design of stormwater controls associated with new developments.

4.01 Asbury Road Underpass Flooding

From the analysis of current stormwater management facilities and the use of hydrologic computer models, it was determined that the cause of the frequent Asbury Road underpass flooding is the undersized conduit through the railroad embankment. The current airport facilities are adequately designed to convey flows from the railroad embankment conduit for the 25-year return period. The underpass flooding could potentially be alleviated through the re-grading of the areas south of the railroad embankments. If these areas are changed and made capable of effectively detaining larger peak discharges, the underpass flooding could be reduced.

4.02 Fenestra Area Development

Based on available information, the proposed Fenestra development will only slightly increase peak stormwater discharges from its western drainage area while actually decreasing peak stormwater discharges from its eastern area. This is a result of the proposed removal of some of the existing impervious areas. Both of the Fenestra drainage areas currently drain west to Wilkins Run through the airport storm sewer system. The point where this sewer system discharges from airport property is the design point for all proposed developments in the western airport drainage area. Since there are two proposed developments within the western airport drainage area, their stormwater management could be combined into a single plan.

The eastern Fenestra drainage area is located on the boundary of the east/west airport drainage divide shown in Figure 5. As a result, Fenestra East stormwater runoff could be directed east. There could be a significant potential reduction in peak stormwater discharges to Marshall Run as a result of the proposed stormwater management of the Runway 24 extension. As a result, the addition of the Fenestra East stormwater runoff to Marshall Run is feasible. The direction of the Fenestra East stormwater runoff to the east would compensate for the increases in peak discharges from the Fenestra West development as well as the increases in peak discharges from the proposed General Aviation Relocation/Expansion.

4.03 Terminal Relocation/Expansion

As discussed in Section 4.02, it is recommended that discharge from the 'Fenestra East' drainage sub-area be routed to the existing town detention basin to the east. This will reduce the peak discharges to the design point of both the General Aviation Relocation/Expansion and the Fenestra area development.

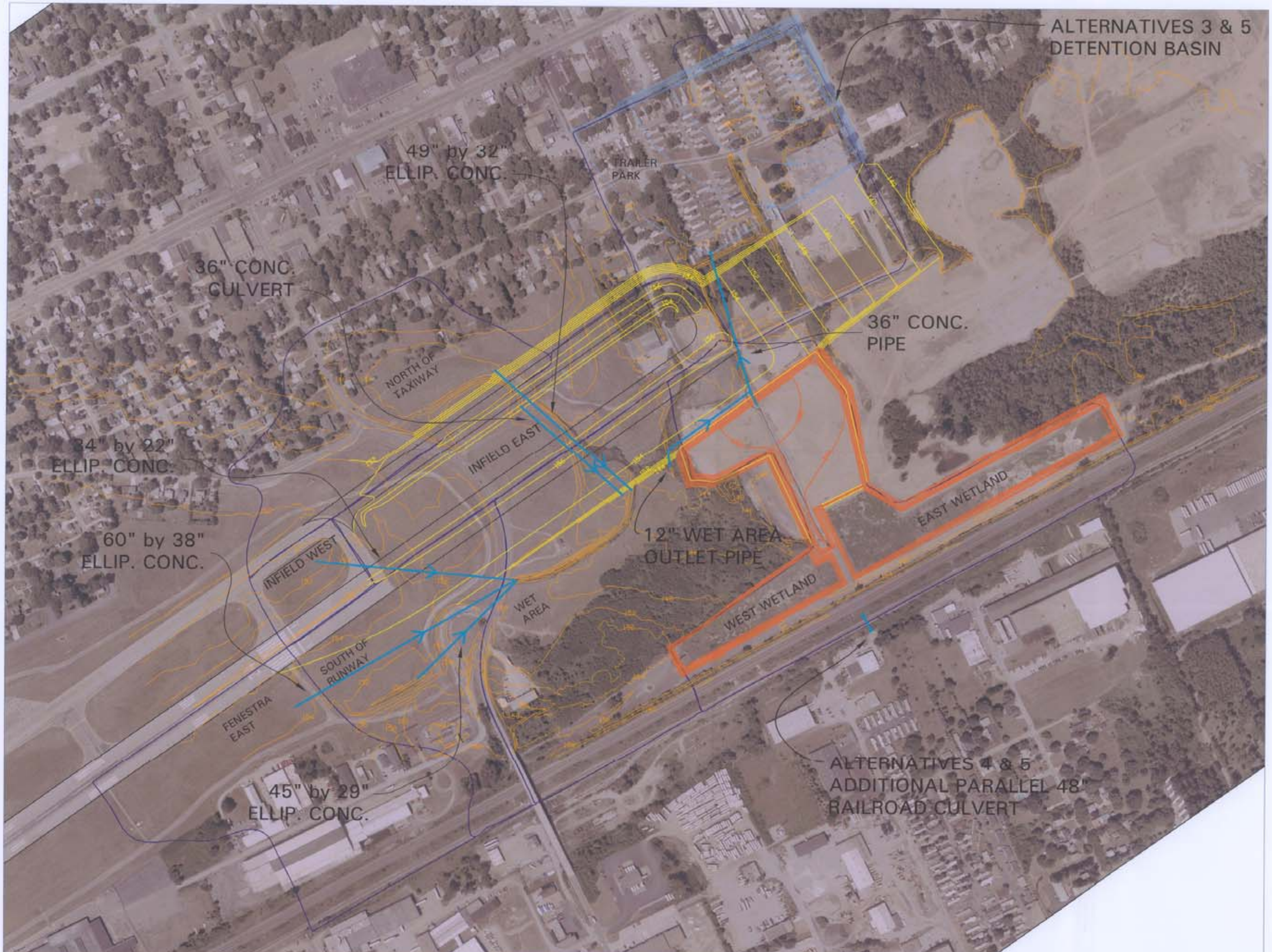
4.04 Runway 24 Extension

There are two areas of concern in the stormwater analysis of the proposed Runway 24 extension. The outflows at the drainage discharge point near Marshall Drive must be maintained at or below existing outflows, and the water surface elevation of the informal detention area south of the railroad must be maintained at or below existing levels. Five stormwater management alternatives were presented for the proposed Runway 24 extension. Alternatives 2 through 5 would all satisfy the requirements of Millcreek Township Ordinance 97-4. However, the peak discharges under Alternatives 2 and 4 would be beyond the capacity of the receiving 24-inch storm sewer under Marshall Drive. The peak stormwater discharges for Alternatives 3 and 5 would be reduced to rates receivable by the existing storm sewer. Alternatives 2 and 3 would maintain water surface elevations and overflow volumes south of the railroad. Alternatives 4 and 5 would result in lower water surface elevations south of the railroad along with decreased overflow volumes. These decreased water surface elevations and overflow volumes would provide a definite benefit to areas south of the railroad and to the east along the overflow path. These decreased overflow volumes would also mean that more stormwater runoff is contained within the management system compared to existing conditions and Alternatives 2 and 3. Even with these added volumes, the system under Alternative 5 is able to reduce peak stormwater discharges to a rate that is receivable by the existing storm sewer under Marshall Drive.

Again, all alternatives shown are viable except for Alternative 1. When the runway extension is complete, stormwater runoff from the new pavement should be directed to the Wet Area and the outlet from the existing Millcreek Township detention basin should be reduced from 36 inches to 15 inches. This will insure compliance with the Millcreek Township Stormwater Ordinance. With these changes in place, however, the historical flooding problem would still remain. When flooding does occur, the new runway extension may inaccurately be perceived to be the cause. For this reason, it is recommended that the trailer park detention basin and the parallel, 48-inch railroad culvert be installed as soon as practicable. These additional improvements provide obvious benefits. Under Alternative 5, areas downstream of the eastern airport drainage area benefit from dramatically reduced peak stormwater discharges and the near elimination of flooding in the area of Riviera Estates. In addition, areas upstream of the eastern airport drainage area benefit from lower water surface elevations and reduced overflows to the east.

Runway Extension Stormwater Routing

FIGURE 29



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SYRACUSE HANCOCK INTERNATIONAL AIRPORT
SYRACUSE, NEW YORK 13212
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N

1in = 300ft

150 0 150 300

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