Appendix A. Piedmont-Triad Airport Expansion Cumulative Impacts

1.0 Introduction

This section of the Environmental Analysis addresses the issue of cumulative impacts from the result of the proposed expansion at Piedmont-Triad International Airport (PTIA). The White House Council on Environmental Quality (CEQ) report "Considering Cumulative Effects Under the National Environmental Policy Act"[1] provides the framework for this section of the environmental impact analysis by addressing cumulative effects in the environmental assessment (EA). The process of analyzing cumulative effects follows the following procedure: (1) scoping, (2) describing the affected environment, and (3) determining the environmental consequences. In many ways, scoping is the key to analyzing cumulative effects; it provides the best opportunity for identifying important cumulative effects issues, setting appropriate boundaries for analysis, and identifying relevant past, present, and future actions. The environmental baseline and thresholds of environmental change are important for analyzing cumulative effects. Indicators of watershed and wetland integrity and landscape condition are identified and used as benchmarks of accumulated change over time. In addition, remote sensing and geographic information systems (GIS) technologies provide improved means to analyze historical change in indicators of the condition of resources, ecosystems, and human communities, as well as the relevant stress factors.

1.1 Definitions Used

NEPA Sec. 1508.7 Cumulative impact.

"Cumulative impact" is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

NEPA Sec. 1508.8 Effects.

"Effects" include:

(a) Direct effects, which are caused by the action and occur at the same time and place.

(b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

1.2 Techniques Used to Conduct Analysis

The primary tool used for the analysis was the "Arc-GIS" (use of brand name does not constitute government endorsement) geographic information system (GIS). This is a tool developed for geographic analysis that enables the import, use, management, manipulation and display of geographic data in a variety of formats, including image and map files and textual or numeric databases. A literature search also yielded some background information on the general issues and impacts on wetlands and waters in the North Carolina Piedmont physiographic region.

GIS technology enabled the analysis. Digital maps of drainage units distributed by NC Center for Geographic Information and Analysis (CGIA) were used to identify the baseline geographic scope. Additional data produced by North Carolina Department of Transportation (NCDOT) served as a reference for the existing airport footprint and current roadway configurations. Federal data on wetlands and soils provided the wetland indicator data. The Corps of Engineers (Corps) in-house data base management system was the source of the regulatory data.

2.0 Scoping

This section describes the spatial and temporal bounds to the analysis.

2.1 Geographic Scope

The Piedmont-Triad International Airport expansion proposal is in the Cape Fear River Basin, with drainage located within the Reedy Fork and Buffalo Creeks Sub basin (designated by North Carolina Division of Water Quality (NCDWQ) as sub basin 03-05-02). Both Brush and Horsepen Creeks, impacted by the proposed project and associated mitigation, flow to water supply reservoirs downstream along Reedy Fork. The Brush Creek /Horsepen Creek area is a headwaters and therefore is not impacted by upstream activity. The smallest atomic unit used for "watershed" analysis is the 14-digit Hydrological Unit Code (HUC). The Reedy Fork / Buffalo Creeks sub basin is a larger drainage unit than the 14-digit HUC, containing sixteen 14-digit HUCS. Therefore, the analysis focuses on the 14-digit HUC since this will be the drainage unit most impacted by the proposed activity. The 14-digit HUC is referenced by its numeric identification, 03030002020010. (An explanation of the hierarchical systems of classifying drainage units is provided in the data section.)

2.2 Temporal Scope

The cumulative analysis addresses impacts to wetlands and ultimately the health and function of the area's surface waters. A timeframe is needed to identify the baseline status of the wetlands that will serve as the study reference. Since there is no directly monitored data for a baseline, locations of "Type A and B" hydric soils serve as a surrogate for baseline wetland status. (As per the US Dept. of Agriculture-Natural Resources Conservation Service (NRCS) definition: Hydric soil Type A are map units that are all hydric soils or have hydric soils as a major component, and Hydric soil Type B are map units with inclusions of hydric soils or have wet spots.) For a time baseline, this serves as the closest approximation to the recent (geological) environment in its least disturbed state. A second time slice can be inferred from ecological data compiled from aerial photographs taken in the mid-1980s for use by the National Wetlands Inventory. The contemporary timeframe wetlands status is inferred from a combination of air photos taken in 1998-1999 and regulatory data obtained through August 2003.

3.0 Methodology and Limitations to the Analysis

This study of cumulative and indirect impacts to the wetlands and waters from the proposed Piedmont-Triad airport expansion uses the best available data and the current state of the art in conducting spatial ecological analysis. However, it is difficult to make exact determinations of wetlands status and trends for a variety of reasons. First, the state of the science supports only indirect observation of factors that can infer prehistoric or least disturbed wetlands baseline. Secondly, the collection of data, via the U.S. Fish & Wildlife Service (USF&WS) National Wetlands Inventory (NWI), the NRCS Natural Resources Inventory (NRI), or other national ecological monitoring efforts define wetland areas slightly differently and encompass ecological landscapes beyond the scope of the jurisdictional regulatory program under Section 404 of the Clean Water Act. However, although the definitional scope is larger in these mapping programs, the unit of generalization is also larger, hence smaller wetlands are omitted when they do not meet the size threshold of 1:24,000 scale mapping standards. Therefore, when compared to the wetlands and waters within 404 jurisdiction, both NWI and NRI maps contain both systematic omissions due to map accuracy standards and commissions due to definitional differences. So even assuming 100% accuracy in all data sets (which is highly unlikely and beyond all map accuracy standards), issues of definition and scale will adversely affect the representation of physical reality.

3.1 Environmental Indicators

An important part of the analysis involved identifying and using appropriate indicators of environmental conditions. An indicator quantifies and simplifies phenomena and helps us understand complex realities. For example, there are Financial Indicators that describe changes in the state of individual, local or national economies; there are Poverty Indicators and Health Indicators, and Environmental Indicators. Whether an indicator is useful or not is dependent on a particular context. Some wetlands or water models are very appropriate for one area but are not valid or relevant for other areas. Some environmental indicators provide no useful information on the state of the hydrology within a watershed although they may provide useful information on other environmental phenomena. The selection of appropriate indicators to analyze the environmental conditions is critical to useful cumulative effects analysis. A careful selection process is needed to determine which indicators may be relevant in a given context. Similarly, indicators need to be used appropriately in assessment. Indicators are selected to provide information about the functioning of a specific system, for a specific purpose - to support decision-making and management. An indicator quantifies and aggregates data that can be measured and monitored to determine whether change is taking place. But in order to understand the process of change, the indicator needs to help decision makers understand why change is taking place.

There are also several important points to bear in mind when using indicators:

- Without good data, based on monitoring or observation, it is not possible to develop quantitative indicators.
- Sets of indicators are seldom, if ever, complete.
- Measurement of indicators tends to reduce uncertainty, but does not eliminate it.

With regard to the data used in the project, wherever possible, indicators were used to analyze the cumulative effects of activities for the area. Given the available data, the following indicators were used:

- Land use patterns (current, trends and forecast) based on aerial photography and from economic and demographic reports from the state and the municipality;
- Wetland types and extent as derived from National Wetland Inventory maps;
- Baseline wetlands as derived by hydric soils from county level soil surveys.
- Impervious surface areas, estimated from recent aerial photography
- Riparian corridors and stream buffers, from project proposal and from recent aerial photography.
- Hydrological alterations, derived from geographic data set on dams and impoundments.
- Wetland impact trends, as derived from recent 404 permitting activities.
- Water quality trends as derived from state 305(b) monitoring and designations and state proposed 303(d) listings.

4.0 Data Elements Used

This section discusses the source data for the cumulative analysis. The methodology section will describe any techniques used for developing surrogate data or making approximations, where actual data is not available or is limited.

4.1 Hydric Soils

A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. Even if current wetland conditions do not exist, hydric soils are indicators of Holocene (including recent) wetland conditions. The NRCS 1998 revised edition of the digital (SSURGO) Guilford County detailed soil survey was used to compute baseline wetland values. (See Map 2). "Type A" hydric soils and "Type B" (hydric soil type B are map units with inclusions of hydric soils or have wet spots) were selected in the baseline, since the hydric soils are not mapped under areas permanently inundated from impoundment and using Type A soils alone in this area may significantly underestimate the baseline wetlands.

4.2 National Wetlands Inventory

The NWI of the USF&WS produces information on the characteristics, extent, and status of the Nation's wetlands and deepwater habitats. NWI are distributed as 7.5' quad maps compiled at 1:24,000 scale from soils maps, air photos, ground studies and field checks. The structure of the

NWI classification is hierarchical, progressing from Systems and Subsystems, at the most general levels, to Classes, Subclasses, and Dominance Types. Modifiers for water regime, water chemistry, and soils are applied to Classes, Subclasses, and Dominance Types. Special modifiers describe wetlands and deepwater habitats that have been either created or highly modified by man or beavers.

NC CGIA, the repository for geographic data for the state of North Carolina, joined all of the NWI maps for the state into a single, seamless coverage. This is how the Corps typically uses this data set. Unfortunately, upon inspection, the copy of the Corps' seamless coverage for North Carolina contained suspect data within the watershed unit of concern, in that three of the source quad sheets contained invalid attribute descriptions of wetland types. When contacted, the Fish and Wildlife Service National Wetlands Inventory Center in St. Petersburg, Florida checked and validated their data, indicated the problem existed in the seamless coverage, and provided the Corps with uncorrupted digital maps. These revised maps had to be merged together, as they are distributed by specific quad sheet. The three corrected quad sheets were merged with the rest of the coverage and clipped to the watershed boundary to provide a seamless NWI data set for the drainage unit. This was done using the "geoprocessing" functions (merge, clip, spatial join) within ArcGIS. (See Map 6).

4.3 Surface Hydrography

The surface waters databases used were compiled by NC using U.S. Geological Survey (USGS) specifications and adding NCDWQ use and attainment information. The major hydrography data base delineates surface waters include oceans, sounds, estuaries, rivers, streams, lakes, ponds, wetlands, reservoirs, and other miscellaneous hydrographic features. It is based on 1:24,000 and 1:100,000 scale data, with features coded with the NCDWQ's Use Support and stream classification codes. The Corps uses a statewide coverage, clipped to the area of analysis. Additionally, a skeletal database containing graphics without any attributes, showing unnamed tributaries, was used. The attributes include the assigned USGS Digital Line Graph hydrographic numeric codes; stream and river basin name; NCDWQ index, class, date; use rating, basis, date, causes, sources and sub-sources; reach description, length; and comments. The time period of content reflects a statewide update on April 19, 2001. The NCDWQ use and attainment is current to the 2000 305(b) report and the 2002-303(d) listing. (See Map 5.)

4.4 Hydrological Units

Hydrologic Units are maps that hierarchically classify drainage areas. They are based on the Hydrologic Unit Maps published by the USGS Office of Water Data Coordination, together with the list descriptions and name of region, sub region, accounting units, and subunits. Initially, the maps were complied by USGS at the 8-digit level. However, the usefulness of this scale of analysis for state and local uses is limited. This system divides the country into 21 regions, 222 sub regions, 352 accounting units, and 2,149 cataloging units, based on surface hydrologic features. A hierarchical code consists of two digits for each of the above four levels combine to form an eight-digit hydrologic unit.

The hydrologic unit system is used to identify any hydrologic area of interest. An eight-digit hydrologic unit generally covers 700 or more square miles. In 1978, the USDA-NRCS issued a policy that all resource inventories and surveys were to be coded with and capable of being retrieved by hydrologic unit codes (HUCs). At about the same time, NRCS initiated a national program to further subdivide HUCs into watershed-sized areas (nominally 250,000 acres, or 390 square miles) for use in water resource planning. In North Carolina, the NRCS further subdivided the 8-digit HUCs into 11 and 14 digit units. Using the 14-digit hydrologic unit code, the regional, sub regional, accounting, cataloging, NRCS sub-unit, and NRCS reporting unit boundaries ID's are recorded. These fourteen-digit hydrologic units of approximately 4,000 acres (6 square miles) to 50,000 acres (78 square miles) are small enough in size to be useful as a planning and reporting tool for the USDA-NRCS and other government and state agencies.

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14-digit number breakdown:
Assigned by US Water      Subunit      Reporting Unit (established
Resource Council        (1978 NRCS)    during this study)
|---------------------|----------|--------|
0  3  0  6  0  1  0  1  0  1  0    0  1  0
|----|----|-----|-----|
|    |    |     |
|    |    |      Cataloging Unit Boundary
|    |     Accounting Unit Boundary
|     Sub regional Boundary
Regional Boundary
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These maps are useful in conducting "watershed" based analysis, however the term "watershed" is generic and does not discuss the level of hierarchy used in the analysis; therefore the term "drainage unit" is used in this report rather than watershed.

Also used in North Carolina, for purposes of water quality assessments and reporting, is a Sub basin drainage hierarchy. This system uses a 6-digit code (SUBBASIN#) and was developed independently from the hydrologic unit codes, from an entirely different numbering system. (Example of code: 03-03-01.) The first two numbers identify the river basin designations adopted by the Environmental Protection Agency. Sub basin boundaries were added within individual river basin boundaries (by the office that is now known as the NCDWQ, Water Quality Planning Section). Sequential numbers (example -01) were added by NCDWQ to the first four-digit EPA code to give each sub basin a unique six-digit identifier. (Each sub basin incorporates three or more hydrologic units. The sub basin boundaries have been modified to be coincident with the hydrologic unit boundaries.) (See Map 4).

4.5 Dams and Impoundments

The dam database complies with the specification for the National Inventory of Dams. It contains all state registered dams and impoundments in North Carolina. This data set was used when it became apparent that the most significant impacts to baseline wetlands and waters in the area were due to alteration of hydrology via impounding and creation of reservoirs and ponds. The National Inventory of Dams database contains information on over 76,000 dams throughout the United States and its territories. These data were queried for the State of North Carolina and then clipped to 14-digit HUC 03030002020010. They were used in conjunction with the NWI and the streams and rivers data to provide information on hydrological modifications in the drainage area. (See Map 5).

4.6 RAMS2 Regulatory Actions Data Base

The Regulatory program of the Corps implemented a database management system in the Wilmington District to track regulatory actions, including permits, jurisdictional determinations and enforcement actions. This system, Regulatory Action Management System (RAMS2), is based on the Oracle relational database management system. RAMS2 data are used to record and maintain information such as permit locations, applicant name, permit status, type of activity, area of impact, etc. There are approximately 200 data fields in RAMS2 that can be used to record information about regulatory permits. A report writer was used to create two RAMS2 reports in tabular form (dBase format). The report writer was used to obtain all final actions within a particular county.

Since both western Guilford and the easternmost edge of Forsyth counties fell within the drainage area, RAMS2 data was retrieved for both counties. The 14-digit HUC boundary was used a clip template to retrieve permit information within the area. Since there may be some data that have incorrect coordinate information, a second query, as a quality check, was performed on the proximate waterway field, based on waterbody name, including Beaver Creek, Reedy Creek, Reedy Fork, Brush Creek, Horsepen Creek, Lake Brandt, and Lake Townsend. No additional data records needed to be added. Those records containing any locational records appeared to have good coordinate information. However, it should be noted that some older data records (pre-1997) may be omitted if they contain no locational references. Furthermore, a check of RAMS2 records against actual files was conducted as a quality check for the six Nationwide 39 permits issued within the watershed. In 4 out of the 6 records in RAMS2, the reported numbers of linear feet of impacts exceeded the actual file records of linear feet verified. In these cases, the data base records were corrected to reflect the official files. (See Maps 8 and 9).

4.7 Digital Aerial Orthophotography

The entire state of NC was flown using color infrared film in the spring of 1998 through the winter of 1999. This is a jointly funded project with the USGS. The central one-third of the state was re-flown in the spring of 1999. Also a few small areas were re-flown in 1999. The product is a digital image of an aerial photograph in which displacements caused by the camera and the terrain has been removed. Each image represents 1/4 of a standard USGS 7.5 minute quadrangle map extent. The color infrared images have no attributes. Each scene is available by USGS 3.75 Minute, Quarter Quadrangle (quarter-quad) at 1-meter ground resolution. These data sets are extremely useful in determining land use status circa 1998-1999 and to determine landscape indicators for the area. Of particular interest is the ability to view and analyze the presence or absence of vegetative buffers around streams within the drainage unit. (See Map 1).

4.8 Collateral Data

To supplement the geographic data available, a variety of reports and papers were obtained on specific issues relevant to the proposed expansion at Piedmont-Triad airport. These included newspaper articles, environmental reports, and the applicant package. When specific sources were used, the citations are listed in the endnotes.

5. Results

The section outlines the results of the cumulative impact analysis, using the geographic data and other available sources to review the state of the environment in the scoped area, its pressures, including the proposed activity and impacts on Brush and Horsepen Creeks and Drainage Unit 03030002020010 and environmental responses to the pressures, including the mitigation plans submitted by the applicant.

5.1 Land Use Impacts on Wetlands and Waters – Results of Aerial Photointerpretion

From the data available, the most significant pressures to wetlands and waters in the HUC will be from the proposed impacts from the airport expansion and associated activities. However, the aerial photographs show significant impacts to waters and wetlands already. (See Maps 1, 10, 11, 12, and 13). The drainage area is already experiencing pressures from suburban development and associated transportation infrastructure improvements. Beginning in the first half of the 20th century, Reedy Fork, the major stream draining the area, was impounded for water supply, flooding the confluences of Reedy Fork and Brush and Horsepen Creeks, forming the Lake Brandt and Lake Higgins reservoirs. Recent pressures are from the suburban expansion of Greensboro.

This pressure involves conversion of forested areas to developed areas. With this development, impacts to streams and wetlands have resulted from road construction, removal of surface vegetation, increase in impervious surfaces from buildings and paved areas, increased load of sediment and of pesticides and herbicides resulting from the development, and alteration of natural stream flow from impoundments.

The most obvious land use pattern discerned from the air photos is the current footprint of the Piedmont-Triad airport surrounded by suburban developments upstream of the airport and the municipal water supply major reservoirs of Lake Higgins (from the impoundment of Brush Creek) and Lake Brandt (from the impoundment of Horsepen Creek and Reedy Fork). (See Maps 1 and 7).

Roads cross Horsepen Creek (upstream from the airport) in several places via bridges or culverts before the creek flows to Lake Brandt. There is a golf course adjacent to the airport that is bisected by Horsepen Creek. From aerial photography, there appears to be no riparian vegetation left as a buffer in this stream reach. This is one of the areas proposed for on-site mitigation. From an aerial photointerpretation perspective, this appears to be a good location to re-establish wetlands and improve the stream physical integrity. As Horsepen Creek flows north of the airport, downstream from the golf course it traverses an area of new residential development. (See maps 12 and 13). At the time of the air photo collection in 1998, there appeared to be forested and vegetated space left adjacent to the stream; however, the N WI from mid 1980s photography classified the wetland type as streambed (nonvegetated) and the adjacent area as upland. This suggests that the entire length of Horsepen Creek may have experienced significant wetland losses due to hydrological alteration and development. It also suggests a vulnerability of the stream to non-point source runoff and erosion. North of Joseph Bryan Boulevard, some pockets of wetlands appear to be intact from air photo inspection, and the physical integrity of Horsepen Creek appears to be more intact as it flows to Lake Higgins. (See Map 13).

Brush Creek, from air photo-inspection, appears to be more vulnerable to water quality challenges. The NWI maps show areas of emergent, scrub-shrub and forested wetlands immediately adjacent to the airport and within the footprint of the proposed expansion. (See Maps 10 and 11). This area is slated for a variety of on-site restoration, creation and preservation plans to mitigate the impacts proposed in conjunction with the expansion of the airport and facilities. Downstream of the proposed on-site mitigation area around Brush Creek and feeder tributaries, is an area of densely developed single-family residential neighborhoods. (See Map 10). A golf course is the visual centerpiece of these neighborhoods. It straddles Brush Creek. From the aerial photography, there appears to be little or no vegetative buffer around the creek until above the north end of the golf course just below Fleming Road. From this point northward until the Creek flows to Lake Brandt, there appears to be intact and presumably normal functioning wetland and stream environment. (See Map 11). However, from visual photo-inspection, in conjunction with existing mapped wetlands data, the stream reach of Brush Creek from the northernmost edge of the proposed airport mitigation site to the northernmost edge of the golf course (about one stream-mile) appears to have no functioning wetlands or stream buffer. Given the roads and rooftops of this dense development, this appears to be a vulnerable hydrological environment, especially given the large areas of impervious surfaces immediately proximate to the reach.

5.2 Baseline Waters and Wetlands – Results of GIS Analysis

Baseline wetlands status is difficult to determine in regions that have undergone extensive hydrological alterations (most significantly with major impoundments on streams to produce municipal water supply as early as the 1920s). In lieu of having precise baseline status information, this analysis uses hydric soils as a surrogate indicator of baseline wetland state. This approximation technique is similar to the technique[2] used by the US Department of Agriculture in their economic modeling and agricultural statistics and the technique used by the Fish and Wildlife Service National Wetland Inventory in preparing pre-1980s national and regional Status and Trends reports. The baseline estimate came from the Guilford County soil survey, even though a small portion of the drainage area falls outside this survey into the Forsyth County survey. Also, the soil survey was not conducted for the bottoms of Lake Brandt and Higgins, and one can presume these were hydric prior to inundation from impoundment. Type A and Type B hydric soils constitute about 6.25% of the land surface of the portion of the drainage area within Guilford County not under reservoir waters. Therefore, accounting for areas under Lake Brandt and Lake Higgins and the (very small) headwaters areas within Forsyth County, approximately 8% of the land area may have been wetlands prior to human land alterations. This estimate is consistent with estimate of similar land types in stream-cut areas of the mid-Atlantic and south Atlantic Piedmont physiographic province. (See Map 6).

5.3 Wetland and Stream Changes to the Mid 1980s – Results of GIS Analysis

The NWI wetlands maps were used for the entire drainage area, including areas inundated by Lake Higgins and Lake Brandt and the area within Forsyth County. NWI mapped wetlands can serve as an indicator of approximate status of wetlands for the timeframe in which the map was compiled. In this drainage area, the NWI was compiled from aerial photography collected circa mid-1980s.

Although NWI does not correspond directly in scale or definition to jurisdictional wetlands, these data can provide useful information about the type and extent of wetlands in the area in the mid-1980s. The total land area of this drainage unit is 44,806 acres. The total NWI wetlands mapped are 2,438 acres (not including linear wetland features handled separately). This is approximately 5.4% of the total land area. It is notable that NWI classifies 1,392.8 acres within this drainage unit as lake or pond environments, or 57% of all mapped wetlands. This indicator suggests that stream and other waterbody impoundments in this area have profoundly altered the wetland type and may have altered (either increased or decreased) total wetland extent.

Class	Count_Class	Average_Acres	Sum_Acres
L1U	1	92856	928.56
PEM	8	1521	121.71
PFO	5	13660	682.98
PSS	5	4437	221.86
PUB	3	15475	464.24
PUS	3	630	18.91

Chart class codes are from Cowardin et al. Classification of Wetlands and Deepwater Habitats "L1U" is Lucustrine unconsolidated bottom sediment, (lacustrine systems are associated with freshwater lakes or deepwater habitats greater than 20 acres in size. "PEM" is palustrine emergent (palustrine are also freshwater systems but differ from lacustrine systems on the basis of water depth and size. Palustrine systems are wetland systems such as marshes, swamps, and bogs. Palustrine wetlands and water bodies are less than 2 meters deep at low water, and smaller than 20 acres in size. Emergent vegetation describes any of various plants, such as a cattail, rooted in shallow water and having most of the vegetative growth above the water.) "PFO" is palustrine forested, "PSS" is palustrine scrub-shrub, "PUB" is palustrine unconsolidated bottom (sediment under shallow ponds), "PUB" is palustrine unconsolidated shoreline.

The hydric soils to NWI rough indicator of trends for this drainage area shows a significant decline in wetlands since first human alteration. Perhaps about a half of the baseline wetlands have changed or been removed due to hydrological alterations. This provides an historical context of the hydrological impacts within this drainage area.

5.4 Recent Changes in Wetland Status – Results of GIS Analysis

From the mid-1980s to the recent time, aerial photographs and records of regulatory actions serve as the change indicator for wetland status. This analysis was based on a data base search of all Final Actions in RAMS2 for Guilford and Forsyth Counties. The search was further refined by geographic selection within the Hydrographic Unit. A quality check was conducted by a data base query based on waterbody name, including Beaver Creek, Reedy Creek, Reedy Fork, Brush Creek, Horsepen Creek, Lake Brandt, and Lake Townsend. Some older data records may have been omitted if the locational information cannot be determined. (See Maps 8 and 9).

The chart below summarizes the state of the wetlands for Regulatory Actions (404 Permits Issued) within hydrologic unit 030002020010.

TYPE	Count	Sum IMPACTACRE	Sum IMPACTLINF
198200031	1	0	0
IP	1	1.87	0
NW03	3	0.266	30
NW12	12	0.441	10
NW14	7	0.33	151
NW18	3	0.144	0
NW23	3	1.07	0
NW26	24	5.802	0
NW27	1	0.33	0
NW33	1	0	100
NW39	6	0.01	794

Total Impacts from 404 Permits To Date: 10.26 acres and 1085 linear feet.
Proposed additional impacts from Airport Expansion and related projects: 22.68 acres of jurisdictional wetlands and 1279 linear feet of streambed or channel. Since reliable locational data has been stored in digital database form for the regulatory actions, the numbers of permits issued in the area have not shown a steady increase over time. Although no trend can be definitely determined, in 1996 there were 6 permits issued for impacts, with four of these to make infrastructure improvements and two were for new developments. In 1997, 11 § 404 permits were issued, including 7 for activities related to construction of new developments. In 1998, 9 § 404-permits were issued. All of these actions were resulting from new construction for developments in this drainage area. Similarly in 1999, all 9 § 404 permits issued within the drainage area related to development activities. In 2000, the 9 § 404 permits related roughly half and half for new development and half for infrastructure and municipal improvements. In 2001, 5 of the 7 § 404 permits issued were for municipal or infrastructure improvements. In 2002, all 4 of the § 404 permits issued were related to development activities. So far, in 2003, 7 § 404 permits have been issued. Of these, the one individual permit for transportation improvements was issued, two permits for activities relating to municipal, public works improvements, and the remaining for new development activities. These actions are reflective of a growing area, mostly residential, with considerable activity in transportation and other infrastructure expansion. (See Map 8).

With all of the activities permitted since 1996, it is notable that total cumulative impacts to wetlands prior to the proposed PTIA expansion equals about 10.26 acres. The amount of wetlands estimated to have unavoidable impacts in the PTIA proposal is more than double that which has already been impacted under the 404 program to date throughout the drainage area. The PTIA proposed expansion could cause slightly more impacts to streams, as what cumulatively to date has been permitted.

This analysis looks primarily at the wetlands and streams status and trends, and not the water quality consequences of the proposed PTIA expansion on waterbodies (water quality issues were addressed in the NCDWQ study). However, it is notable that the project would increase the amount of imperious surfaces in this drainage area. Although no set definitive threshold exists, with impervious cover ranging from 10 percent to 20 percent, notable declines in biological integrity and habitat quality are observable in watersheds[3]. These observations include: shifts in populations of environmentally sensitive organisms to organisms more tolerant of degraded conditions; less riparian vegetation, and therefore reduced shading and entry of leaf litter; reduced macroinvertebrate, fish, and amphibian diversity; lower plant and amphibian density; increased rates of water and sediment delivery; less wood (snags) in channels to dissipate stream energy; and channel instability[4]. As the imperviousness of watersheds increases, so does stream degradation and habitat loss. It is also important to note that some species show signs of stress and population decline before the 10 percent impervious cover threshold is reached.

5.5 A Discussion of Proposed Compensatory Mitigation Effects on Cumulative Impact Assessment Results.

The PTIA proposed expansion includes a proposal for mitigation for the unavoidable impacts to wetlands and waters. For the purpose of assessing impacts to drainage area HUC 03030002020010, only those activities proposed within the HUC are considered. The approximate footprint of the area was digitized from the maps included in the Public Notice. No measurements were made from the digitized boundary due to the imprecise manner in which the boundary was digitized. The boundary file was created to enable visual inspection over aerial photography of the proposed on-site activities. All measurements used in the analysis were based on the acreage and linear feet projections included in the Public Notice.

The revised plans provided with the proposed project mitigation plan dated December 28, 2002, show that the proposed construction of the new runway 5L/23R, a new overnight express air cargo sorting and distribution facility, and associated development at PTIA will impact approximately 22.68 acres of jurisdictional wetlands and 12,719 linear feet of jurisdictional stream channel (total of 23.93 acres of the jurisdictional waters of Brush Creek). These proposed unavoidable impacts are associated with approximately 11.86 acres of fill within jurisdictional waters resulting from the proposed new runway and taxiway construction, approximately 4.61 acres of fill within jurisdictional waters resulting from the proposed air cargo sorting/distribution hub facility construction, and approximately 7.46 acres of fill within jurisdictional waters resulting from the proposed roadway improvements to Bryan Boulevard, North Triad Boulevard, and Old Oak Ridge Road.

Piedmont Triad Airport authority (PTAA) proposes to provide compensatory mitigation for unavoidable impacts to jurisdictional waters of the U.S., including wetlands associated with the proposed airport expansion project, by restoring, creating, and preserving approximately 101.2

acres of wetlands (96% of total acres is onsite mitigation) and restoring, enhancing, and preserving approximately 26,727 linear feet of stream channels (78% of total linear feet of stream channel is onsite mitigation). The proposed mitigation is divided into two major components (on-site and off-site):

- **ON-SITE** restoration of Horsepen Creek, a perennial/permanent stream that flows through Longview Golf Course southeast of the airport which will include the restoration and creation of floodplain wetlands (2.0 acres of restoration and 12.6 acres of creation) and stream channel restoration (6,107 linear feet of restoration). (14% of wetland total and 23% of stream channel total.)
  ON-SITE preservation of the Brush Creek stream channel and bottomland hardwoods wetlands located on the north side of the airport property which will include the preservation, restoration, and creation of floodplain wetlands (69.9 acres of preservation, 7.4 acres of restoration, and 5.3 acres of creation) and stream channel preservation and restoration (14,510 linear feet of preservation and 200 linear feet of restoration). (82% of wetland total and 55% of stream channel total.)

Notable, but not affecting the cumulative impacts analysis is the proposed off-site mitigation:

- **OFF-SITE** stream channel restoration (2510 linear feet of restoration) within the Haw River Basin, which includes sections of Staley Creek in North Park and Robinson Park and a tributary to Little Alamance Creek in Willowbrook Park located in Alamance County under the control of the City of Burlington Parks and Recreation Department. (9% of stream channel total.)
  OFF-SITE restoration of North Prong of Stinking Creek, a perennial/permanent stream that flows through the Causey Farm property located in southeast Guilford County which will include restoration of floodplain wetlands (4.0 acres of restoration) and stream channel restoration (3,400 linear feet of restoration). (4% of wetland total and 13% of stream channel total.)

Also as part of the mitigation plan each of the wetland and stream channel mitigation sites include upland buffers. Many of the historical functions performed by upland forest and wetland forest habitat complexes in the region have been modified by extensive anthropogenic activities, including farming, urban development, and forestry activities. Wetland buffers and wetland/upland ecotones are important in reducing sediment and nutrient inputs into local streams and rivers. Documented studies have shown that sediment removal rates of 80 to 90 percent may be expected from vegetative buffers. High ground soils, because of generally higher cation concentrations, are probably more efficient than wetland soils in removing and retaining phosphorous and nitrogen. Therefore, inclusion of uplands in the buffer matrix may attenuate nutrient inputs and enhance the ability of wetland ecosystems to sequester and assimilate elements, nutrients, and compounds. Vegetative buffers can also moderate in-stream water temperatures and increase available dissolved oxygen in cooler waters. They help create and maintain a diversity of aquatic habitat types that in turn provide for a high diversity and abundance of aquatic organisms. Vegetated upland buffers may also enhance groundwater recharge into adjacent wetlands through increased flood storage capacities and dissipated flood waters by frictional resistance and evapotranspiration to desynchronize runoff into wetland and stream channel corridors. Finally, the buffers also provide important wildlife habitat and corridors. Approximately 49.50 acres of high ground buffers are included with the onsite mitigation properties and approximately 17.7 acres of high ground buffers are included with the offsite mitigation properties.

PTAA's proposed compensatory mitigation plan for unavoidable impacts to jurisdictional waters of the U.S., including wetlands associated with the proposed airport expansion project titled "Wetland and Stream Mitigation Plan" dated December 28, 2001, was received by the Raleigh Regulatory Field Office on January 11, 2002, and put out on public notice by the Raleigh Regulatory Field Office for public and agency review and comment on February 5, 2002.

6. Conclusion

The proposed expansion of PTIA will likely be the largest single impact to waters and wetlands in HUC 03030002020010 since the § 404 permit program was initiated in 1972. This project will impact 23.93 acres of wetlands and waters, more than double the amount of impacts permitted by the § 404 program over the past eight years. It is important to note, however, that of the 2,438 acres of wetlands mapped by NWI in this HUC, the proposed project will impact less than one percent (0.92%) of the existing wetlands in this area. Moreover, the applicant plans to create or restore 26.3 acres of wetlands, and preserve an additional 69.9 acres of high-quality wetlands on PTIA property. Taken together, this 101 acres of mitigation will preserve in perpetuity 4.1% of the wetlands in the HUC, providing a much-needed large tract of habitat for wetland species in this heavily pressured watershed.

It is also important to note that, given the rapid expansion of Greensboro and the increasing suburbanization of Guilford County, it can be expected that many of the wetlands in the HUC, including some impacted by the proposed project, would likely be impacted in the near future by other projects. As such, the wetlands offered as compensatory mitigation by PTIA will be of increasing importance as the watershed continues to experience development pressures. The Corps and other Federal and state resource agencies appreciate the value offered by contiguous tracts of wetland environments, and are pleased that the applicant has offered such tracts in its mitigation plan.

In conclusion, the impacts to the waters of HUC 03030002020010 due to the proposed project will be large in comparison to past projects in the area, but small in relation to the amount of wetlands and waters in the watershed. Given the suburban nature of the watershed, it is likely that many of these waters would have been impacted in the near future. The compensatory mitigation offered by the applicant should offset these impacts, and provide important habitat and water quality functions to the HUC in perpetuity. Therefore, the Corps has determined that the secondary and cumulative impacts associated with the project would not be significant once all Special Conditions, including the Section 401 Water Quality Certification conditions, and implementation of the compensatory mitigation plan are incorporated.

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[1] "Considering Cumulative Effects Under the National Environmental Policy Act" (CEQ) - White House Council on Environmental Quality. (January 1997) Washington DC.

2 Acreage derived by combining existing wetland acreage with drainage data presented by Pavelis, G.A. 1987. Economic survey of farm drainage. In *FARM DRAINAGE IN THE UNITED STATES.* U.S.D.A.:, Economic Research Service. Washington, D.C. pp. 110-136.

3 Barnes; Morgan; and Roberge; "Impervious Surfaces and the Quality of the Natural and Built Environments" Towson University, 2001.

4 Schueler, T. "The Importance of Imperviousness", *Watershed Protection Techniques*, v1n3, 1994